



**Badger Meter**

## Industrial Flow Computer

FC-5000 Flow Display





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## SCOPE OF THIS MANUAL

This manual describes how to install and program the FC-5000 Flow Display. The electronic version of this manual is available on our website at [www.badgermeter.com](http://www.badgermeter.com).

### IMPORTANT

*Read this manual carefully before attempting any installation or operation.  
Keep the manual in an accessible location for future reference.*

## UNPACKING AND INSPECTION

Upon opening the shipping container, 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.

## SAFETY CONSIDERATIONS

### Terminology and Symbols



Indicates a hazardous situation, which, if not avoided, will result in death or serious personal injury.



Indicates a hazardous situation, which, if not avoided, could result in death or severe personal injury.



Indicates a hazardous situation, which, if not avoided, could result in minor or moderate personal injury or damage to property.



Please consult the user manual in all cases where this symbol is used in order to find out the nature of potential hazards, and any actions which have to be taken to avoid them.



This symbol signifies that the FC-5000 Flow Display may be powered by a DC power supply. Acceptable DC input voltage range is: 10...40V DC.



This symbol signifies that the FC-5000 Flow Display may be powered by an AC power supply. Acceptable AC input voltage range is: 9...28V AC RMS (50...60 Hz).

- Operating temperature is 32...130° F (0...55° C) with a maximum humidity of 85% non-condensing. Always select a mounting location with proper ventilation and environmental protection.
- Maximum operating altitude: 2000 meters (6561 feet)
- Pollution Degree 2: Only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation is to be expected
- Over-Voltage Rating: CAT II

## Safety Instructions

### **WARNING**

- **LIFE SUPPORT APPLICATIONS: THE FC-5000 IS NOT DESIGNED FOR USE IN LIFE SUPPORT APPLIANCES, DEVICES, OR SYSTEMS WHERE MALFUNCTION OF THE PRODUCT CAN REASONABLY BE EXPECTED TO RESULT IN A PERSONAL INJURY. CUSTOMERS USING OR SELLING THESE PRODUCTS FOR USE IN SUCH APPLICATIONS DO SO AT THEIR OWN RISK AND AGREE TO FULLY INDEMNIFY THE MANUFACTURER AND SUPPLIER FOR ANY DAMAGES RESULTING FROM SUCH IMPROPER USE OR SALE.**
- **ELECTROSTATIC DISCHARGE INFLECTS IRREPARABLE DAMAGE TO ELECTRONICS. BEFORE INSTALLING OR OPENING THE UNIT, INSTALLERS MUST DISCHARGE THEMSELVES BY TOUCHING A WELL-GROUNDED OBJECT.**
- **THIS UNIT MUST BE INSTALLED IN ACCORDANCE WITH THE EMC (ELECTROMAGNETIC COMPATIBILITY) GUIDELINES.**

## Safety Rules and Precautionary Measures

The manufacturer accepts no responsibility whatsoever if the following safety rules and precaution instructions and the procedures as described in this manual are not followed.

- Modifications of the Flow Display implemented without preceding written consent from the manufacturer will result in the immediate termination of product liability and warranty period.
- Installation, use, maintenance, and servicing of this equipment must be carried out by authorized technicians.
- Check the mains voltage and information on the manufacturer's nameplate before installing the unit.
- Check all connections, settings and technical specifications of the various peripheral devices with the Flow Display supplied.
- Never open the enclosure.
- Never touch the electronic components (ESD sensitivity).
- Never expose the system to heavier conditions than allowed according to the casing classification (see manufacturer's nameplate).
- If the operator detects errors or dangers, or disagrees with the safety precautions taken, then inform the owner or the principal responsible.
- Adhere to the local labor and safety laws and regulations.

## DESCRIPTION

The FC-5000 Flow Display is a microprocessor-driven device that is designed for flow monitoring. The FC-5000 Flow Display is compatible with the complete line of Badger Meter industrial flow meters, creating a solution to monitor flow rates and totals.

### Functions and Features

This product is designed with a focus on:

- Large display for easy viewing
- Ease-of-use with softkeys and a full numeric keypad
- Ruggedness for its application with a robust enclosure, keypad and mechanical relays
- Info/Sensor Data Screen—view raw and calculated data, both to and from the unit, including flow data and output statuses
- User-friendly installation with quality plug-and-play terminals
- A wide range of outputs and functions for a broad fulfillment in many applications
- User defined relay triggers for flow rates and totals

### Flow Meter Input(s)

Depending on the configuration, one or two sensor inputs are available, allowing a passive or active pulse signal output to be connected. The input circuit supports low and high frequency (0.5...3500 Hz) flow meters. A 12V DC excitation terminal is available for flow meter sensors that require power.

### Digital Inputs

The FC-5000 Flow Display control inputs allow the following functions:

- Unlatch Relays
- Reset Totalizers
- Unlatch Relays and Reset Totalizers

## Relay Control Outputs

The FC-5000 Flow Display has two relay outputs, either a mechanical Form C switch or a solid state Form A switch. The product configuration determines which switches are available. All control functions are always available by dedicated relay outputs. Unneeded outputs may be left disconnected or disabled within the firmware.

Relays can be used for alarm indication or as a totalizing output.

### Form-C

- Can be powered directly from mains circuits rated up to 240V.
- Must be powered through circuits that are insulated from mains by at least basic insulation.
- Connected sources of power need to be limited to 240V AC and fused at 5A or less.
- Not suitable for connection to external circuits that are insulated from mains by at least double insulation (SELV).

### Form A

- Located on TB4 and recommended to use, if configured as a high-rate, totalizing output.
- Relay energizes (contact closes) with a minimum input current of 3 mA through the input LED.
- The relay turns off (contact opens) with an input voltage of 0.8V or less.

## Power Supply

The power supply used must be isolated from mains by double or reinforced insulation (for instance, SELV power supply).

The FC-5000 Flow Display operates on 10...40V DC or 9...28V AC supplied by any suitable source that also meets the requirement listed above. Badger Meter has power supplies available for the FC-5000 Flow Display.

### Power Supply Part Numbers:

- 68334-001: includes wall mount (wall wart) power supply and various adapters
- 68334-002: power module that allows discrete power wiring

A power supply not sourced from the factory must be capable of supplying a minimum of 8 Watts.

## Configuring the Unit

The FC-5000 Flow Display is designed for many types of applications. See *"Advanced Setup" on page 29* for instructions on configuring your FC-5000 Flow Display to your specific requirements.

All information is stored in EEPROM memory and will not be lost in the event of power failure.



## Display Information

The FC-5000 Flow Display has a large transfective LCD with a bright LED backlight that displays symbols and digits for measuring units, status information and keyword messages. See *"Units"* on page 27 for more information on how to configure the units.

## INSTALLING THE FLOW DISPLAY

### CAUTION

**MOUNTING, ELECTRICAL INSTALLATION, STARTUP AND MAINTENANCE OF THIS INSTRUMENT MAY ONLY BE CARRIED OUT BY TRAINED PERSONNEL AUTHORIZED BY THE OPERATOR OF THE FACILITY. PERSONNEL MUST READ AND UNDERSTAND THIS OPERATING MANUAL BEFORE CARRYING OUT ITS INSTRUCTIONS.**

### CAUTION

**THE FC-5000 FLOW DISPLAY MAY ONLY BE OPERATED BY PERSONNEL WHO ARE AUTHORIZED AND TRAINED BY THE OPERATOR OF THE FACILITY. OBSERVE ALL INSTRUCTIONS IN THIS MANUAL.**

### CAUTION

**OBEY ALL SAFETY PRECAUTIONS MENTIONED IN "SAFETY CONSIDERATIONS" ON PAGE 5.**

**NOTE:** For a complete list of parts and accessories, refer to *"Replacement Parts/Accessories"* on page 40.

## Mounting Options

The FC-5000 Flow Display can be mounted on a wall, shelf or instrumentation panel. Wall-mount units are shipped in a NEMA 4X enclosure, ready to mount.

### Panel-Mount Installations

**NOTE:** Mounting clips can accommodate a maximum panel thickness of 1.5 in. (38.1 mm).

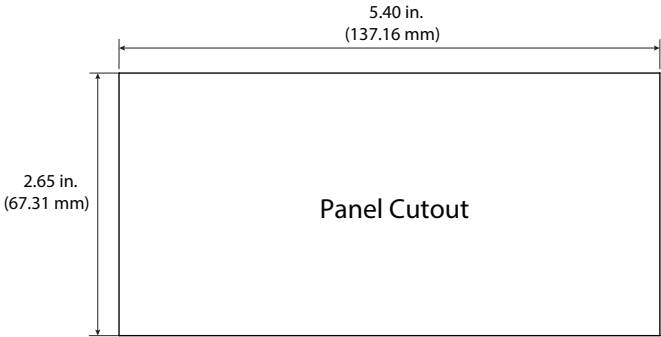


Figure 1: Panel cutout

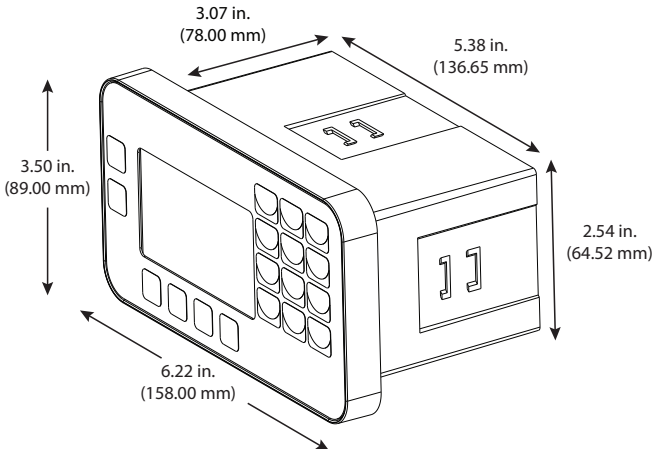


Figure 2: Mounting dimensions

To install:

1. Measure and cut a mounting hole to the dimensions shown in *Figure 1*.
2. Verify that the gasket is secure inside the mounting bezel.
3. Insert the unit through the panel cutout.
4. Secure the unit to the panel with the provided mounting clips.

## Wall-Mount Installations

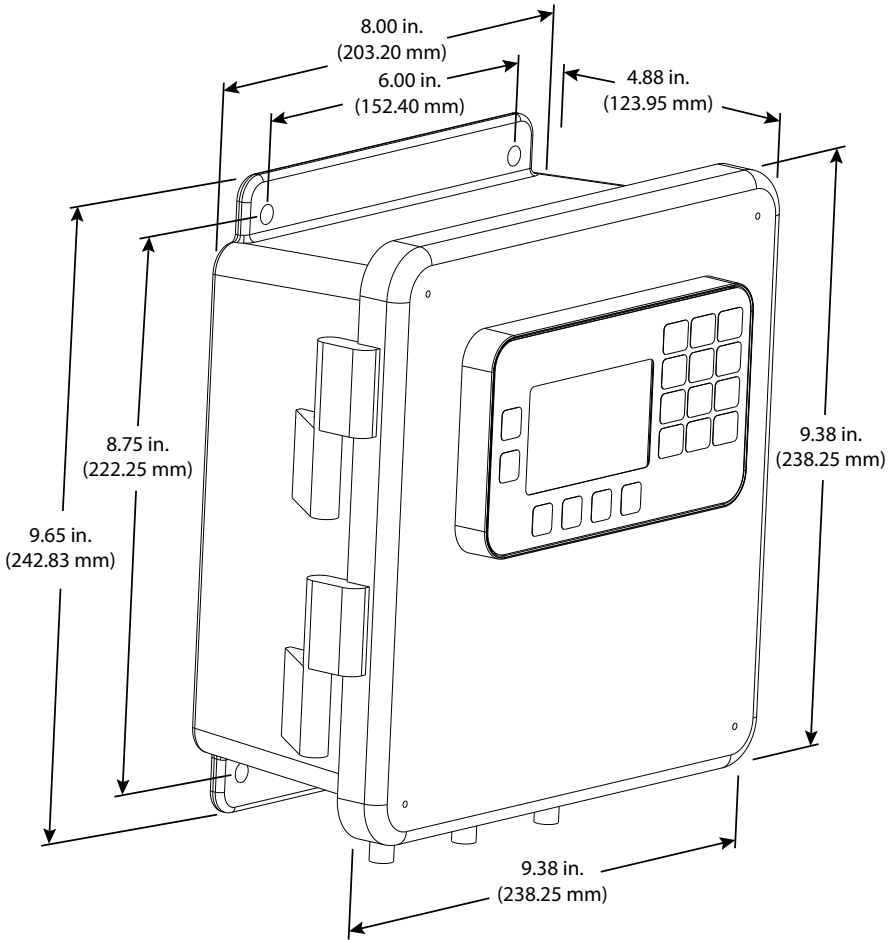


Figure 3: FC-5000 Flow Display in an enclosure

To install the FC-5000 Flow Display on a wall, secure the enclosure to the wall with four mounting screws (customer-supplied).

## Wiring the Flow Display

At installation, be sure to comply with the following requirements:

- Disconnect power to the unit before attempting any connection or service to the unit.
- Avoid using machine power service for AC power. When possible, use a dedicated circuit or a lighting circuit.
- Observe all local electrical codes.
- The unit must be wired with wires and/or cables with a minimum temperature rating of 167° F (75° C).

**⚠ CAUTION** *TO PREVENT ACCIDENTS, DO NOT APPLY POWER UNTIL ALL OTHER CONNECTIONS HAVE BEEN COMPLETED.*

### Terminal Connectors

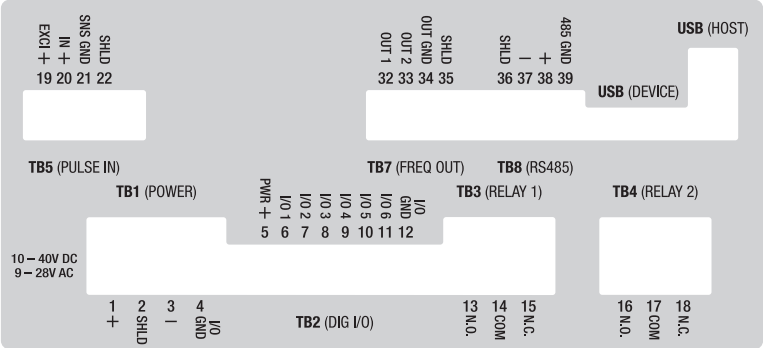


Figure 4: One sensor input, frequency output

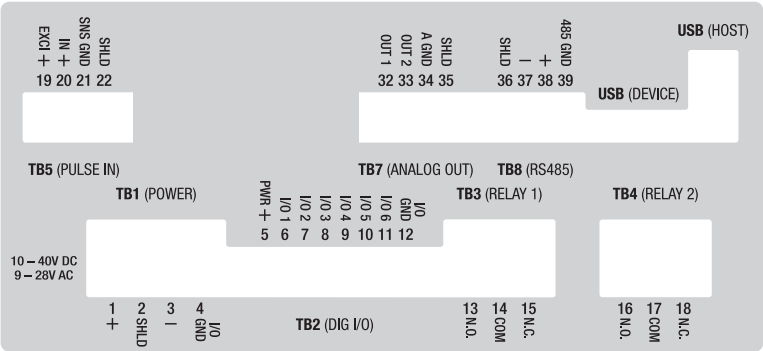
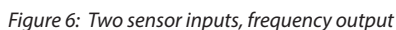


Figure 5: One sensor input, analog out



The FC-5000 Flow Display power input is internally fused and protected from common line noise by a filtering network.

Table 1: Power input

**THE FC-5000 IS MICROPROCESSOR CONTROLLED. IT IS VERY IMPORTANT THAT THE POWER SUPPLY BE FREE OF ELECTRICAL NOISE. AVOID USING POWER LINES THAT FEED HEAVY LOAD ELECTRICAL DEVICES SUCH AS PUMPS AND MOTORS.**

Digital Inputs and Outputs

The FC-5000 Flow Display has six independent channels available for digital input. The channels accept TTL voltage signals in the 0...5V DC range. The control inputs are triggered when the voltage signal on the pin is pulled low (active low). Input range for a logic low signal is 0...1V, logic high is 4...5V.

TB2 (DIG I/O)

| Connector Pin | Function              | Reference Pin |
|---------------|-----------------------|---------------|
| 1             | Excitation or Power   | 5             |
| 2             | Input/Output 1 Signal | 6             |
| 3             | Input/Output 1 Signal | 7             |
| 4             | Input/Output 1 Signal | 8             |
| 5             | Input/Output 1 Signal | 9             |
| 6             | Input/Output 1 Signal | 10            |
| 7             | Input/Output 1 Signal | 11            |
| 8             | Ground or Neutral     | 12            |



Table 2: Digital inputs

Communications

The FC-5000 Flow Display comes with Modbus (RTU or ASCII) and BACnet communication protocols. Signals are transmitted over an EIA-485 (RS-485) physical layer.

TB8 (RS485)

| Connector Pin | Function             | Reference Pin |
|---------------|----------------------|---------------|
| 1             | Shield (Chassis GND) | 36            |
| 2             | Negative (-)         | 37            |
| 3             | Positive (+)         | 38            |
| 4             | Output Ground        | 39            |



Table 3: Communications input

## Scaled Outputs

The FC-5000 Flow Display has two scaled output channels for use in applications requiring remote data collection and/or monitoring. The outputs are firmware configurable, and can be tied to parameters such as rates or total volume.

**TB7 (FREQ OUT) or (ANALOG OUT)**

| Connector Pin | Function             | Reference Pin |
|---------------|----------------------|---------------|
| 1             | Output 1 Signal      | 32            |
| 2             | Output 2 Signal      | 33            |
| 3             | Output Ground        | 34            |
| 4             | Shield (Chassis GND) | 35            |



Table 4: Scaled output channels



**ANALOG OUTPUT CONFIGURATIONS ARE DESIGNED TO PROVIDE A SOURCING OUTPUT SIGNAL. THE RECEIVING DEVICE MUST NOT PROVIDE POWER TO THE LOOP.**

## Relay Output Connectors

The FC-5000 Flow Display has either two Form C relay output terminals or one Form C and one Form A terminal.

### Two Form C

**TB3 (RELAY 1) and TB4 (RELAY 2)**

| Connector Pin | Function               | Reference Pin |         |
|---------------|------------------------|---------------|---------|
|               |                        | Relay 1       | Relay 2 |
| 1             | Normally Open (N.O.)   | 13            | 16      |
| 2             | Signal Common          | 14            | 17      |
| 3             | Normally Closed (N.C.) | 15            | 18      |



Table 5: Relay output connectors, relay option "C"

### One Form C and One Form A

**TB3 (RELAY 1) - Form C**

| Connector Pin | Function               | Reference Pin |
|---------------|------------------------|---------------|
|               |                        | Relay 1       |
| 1             | Normally Open (N.O.)   | 13            |
| 2             | Signal Common          | 14            |
| 3             | Normally Closed (N.C.) | 15            |



Figure 8: Form C Relay Output Connector

**TB4 (RELAY 2) - Form A**

| Connector Pin | Function              | Reference Pin |
|---------------|-----------------------|---------------|
|               |                       | Relay 2       |
| 1             | Connection Point 1    | 16            |
| 2             | Not Used (No Contact) | 17            |
| 3             | Connection Point 2    | 18            |



Figure 9: Form A Relay Output Connector

Flow Sensor Input

The FC-5000 Flow Display is designed to accept pulses from open collector transistors or dry contact closure transmitters.

Before making any connections:

- Always use shielded wire to protect the signal line from external noise (ground shield to terminal #3).
- Make sure the signal lines are not bundled with or touching power lines.

**NOTE:** In the tables below, **RF Pin** refers to RF type pickups/amplifiers.

TB5 - Single Channel Pulse Input Terminal

| Connector Pin | Function                | Reference Pin | RF Pin |
|---------------|-------------------------|---------------|--------|
| 1             | Sensor Excitation (+)   | 19            | A      |
| 2             | Sensor Input (+)        | 20            | C      |
| 3             | Sensor Input/Common (-) | 21            | B      |
| 4             | Shield (Chassis GND)    | 22            | —      |



Table 6: Flow sensor input, single

TB5 - Dual Channel Pulse Input Terminal

| Connector Pin | Function                 | Reference Pin | RF Pin |
|---------------|--------------------------|---------------|--------|
| 1             | Excitation (+12V output) | 19            | A      |
| 2             | Sensor Input CH1         | 20            | C      |
| 3             | Sensor Common (GND)      | 21            | B      |
| 4             | Sensor Input CH2         | 22            | C      |
| 5             | Shield (Earth GND)       | 23            | -      |



Table 7: Flow sensor input, dual

Powering Radio Frequency (RF) Type Pickups

Radio Frequency (RF) type pickups require a power source to generate a radio frequency field. Similar to magnetic pickups, as fluid velocity provides rotational energy on the flow meter rotor, the field generated by the pickup is disturbed, producing output pulses that are proportional to flow rate.

**NOTE:** Maximum current draw from the Excitation pin cannot exceed 200 mA. RF style pickups will require a signal conditioning amplifier.

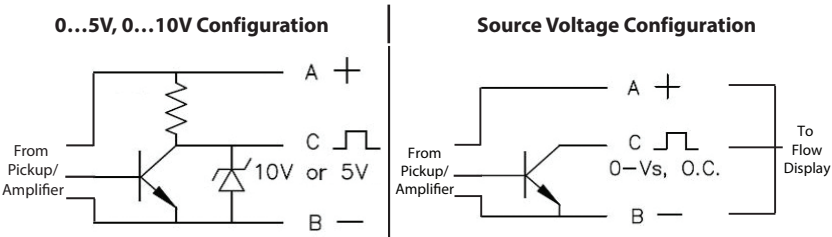


Figure 10: Pickup configurations



# OPERATOR INTERFACE

## Keypad and Soft Keys

The keypad and soft keys are for programming, editing and changing views.

### Scrolling

The screens can display up to four lines at a time. Some menus have more than four items to display. To see the off-screen items, press **UP/DOWN** to scroll through the entire list.

 **CAUTION**

**THE FLOW DISPLAY MAY BE OPERATED ONLY BY PERSONNEL WHO ARE AUTHORIZED AND TRAINED BY THE FACILITY. OBSERVE ALL INSTRUCTIONS IN THIS MANUAL. OBEY ALL SAFETY PRECAUTIONS MENTIONED IN "SAFETY CONSIDERATIONS" ON PAGE 5.**

## Control Panel Keys

**NOTE:** Always press  (ENTER) to save a new value.

|                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                         | The numbered keys are used to enter or change parameter values.                                                                                                                                                                                                                        |
|                                                                                                                                                                                                                                                                         | In editing mode, <b>BACKSPACE</b> deletes the character to the left of the cursor. While navigating, <b>BACKSPACE</b> moves to a previous menu selection.                                                                                                                              |
|                                                                                                                                                                                                                                                                         | Depending on the current screen, <b>ENTER</b> : <ul style="list-style-type: none"><li>• Saves the current value and ends the editing session</li><li>• Advances deeper into the menu structure</li><li>• Toggles enumerations</li></ul>                                                |
| <br>                                                                                                                                                                                | The <b>UP/DOWN</b> keys: <ul style="list-style-type: none"><li>• Toggle the display views on the home screen</li><li>• While editing, use <b>UP/DOWN</b> to advance the cursor to the right or left</li><li>• In the menu structure, scroll through the menus and parameters</li></ul> |
| <br><br><br> | The <b>F1...F4</b> function keys are soft keys that change function to whichever icon is present above them. See "Icon Functionality" on page 18.                                                                                                                                      |

Table 8: Key functions

## Icon Functionality

Depending on the task being performed, one or more of the following icons may appear on the screen. To activate an icon, press the Function key (**F1**, **F2**, **F3** or **F4**) directly under the icon, where applicable.

| Icon                                                                               | Function                                                                                               |
|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
|    | Display the <i>Home</i> screen or cancel an edit (if you activate it without saving first)             |
|    | Display the menu structure                                                                             |
|    | Create a custom label (name) for unit of measure                                                       |
|    | Return to <i>Setup</i> menu                                                                            |
|    | Cycle through alpha characters                                                                         |
|    | Enter a decimal point                                                                                  |
|    | Cycle through special characters                                                                       |
|    | Reveal raw and calculated info/sensor data for the Flow Display                                        |
|    | Clear the selected value or cancel edit (press twice, consecutively)                                   |
|    | Enter conversion factor for custom unit of measure                                                     |
|   | Change selected value to positive ( + ) or negative ( – )                                              |
|  | Set totalizer rollover point                                                                           |
|  | Appears on Home screen for various events. Refer to “ <i>Troubleshooting</i> ” on page 36 for details. |
|  | Enter K-factor in multi-point calibration table                                                        |
|  | Enter frequency-in-hertz calibration data                                                              |
|  | Toggle flow sensor channels                                                                            |

Table 9: Icon functions

## Navigating the Menus

The *Home* screen display shows rates and totals, either separately or simultaneously. Status and alarm messages or alarm icons appear on the display when appropriate.

### Single Input Configurations

Press **UP/DOWN** to toggle between parameter views on the *Home* screen:

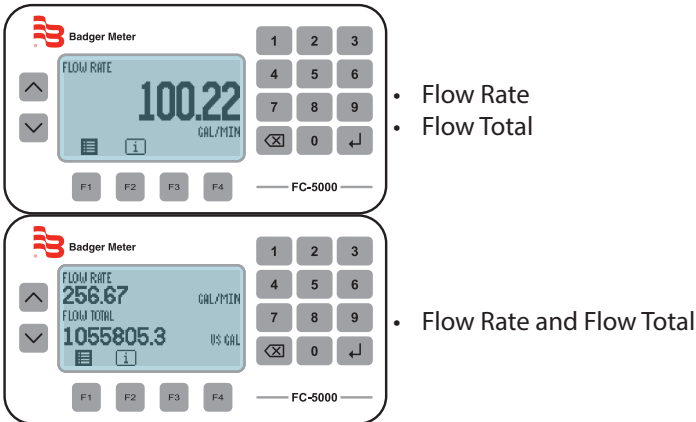


Figure 11: Single input display

### Dual Input Configurations

Press **UP/DOWN** to toggle between parameter views on the *Home* screen. Press **F3** to toggle between flow meters/sensors 1 and 2.

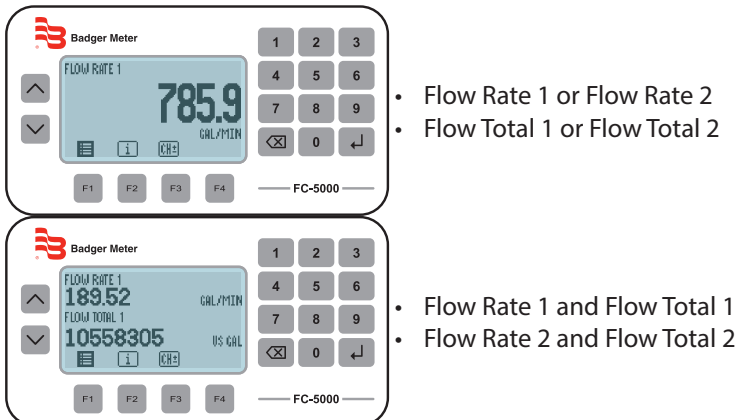


Figure 12: Dual input display

Press **F1** to enter the *Main* menu to access *Setup* and *System Information*, or press **F2** to enter the *INFO/SENSOR DATA* menu.

## Numeric Editing

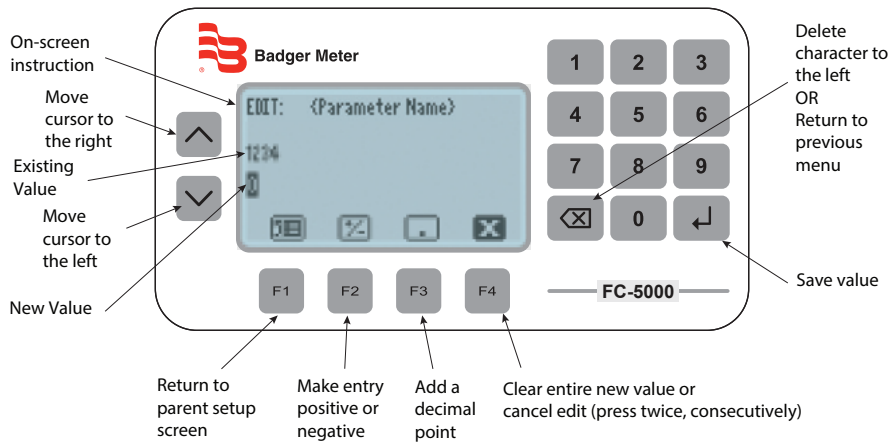


Figure 13: Numeric editing

## Alpha-Numeric Editing

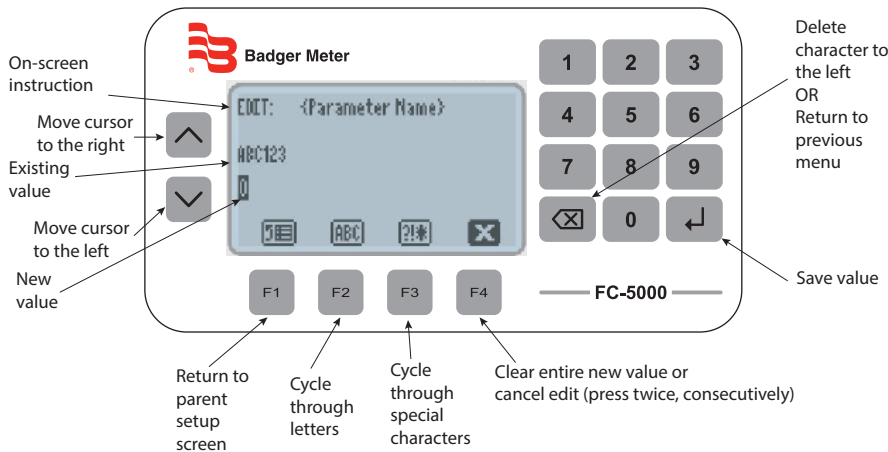


Figure 14: Alpha-numeric editing

### Selection/Enumeration Editing

**NOTE:** Depending on the menu, the selection during an enumeration style edit may appear different.

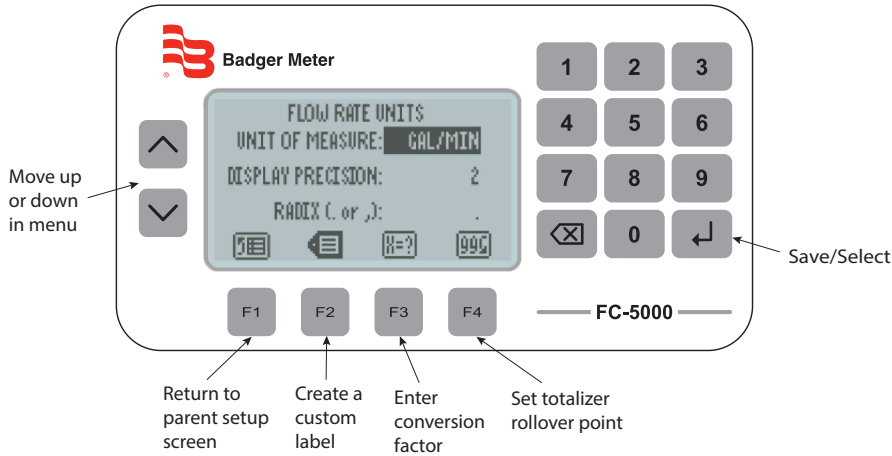


Figure 15: Selection editing

### Confirmation Screen

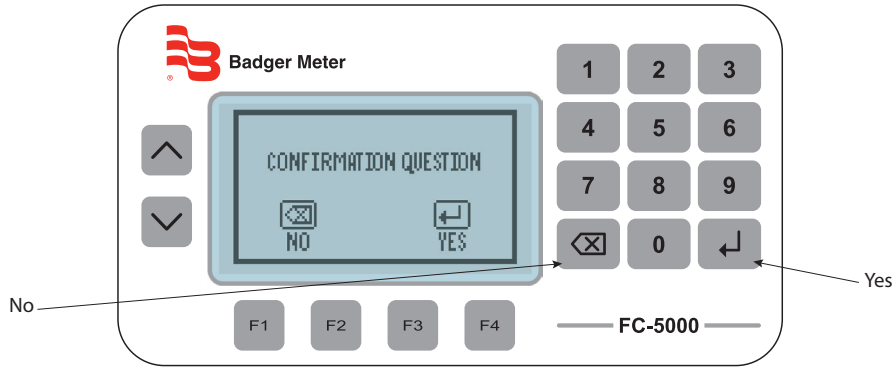


Figure 16: Confirmation screens

## Menu Structure

The available menu items depend on the Flow Display configuration. Each menu item is explained in detail in the following pages.

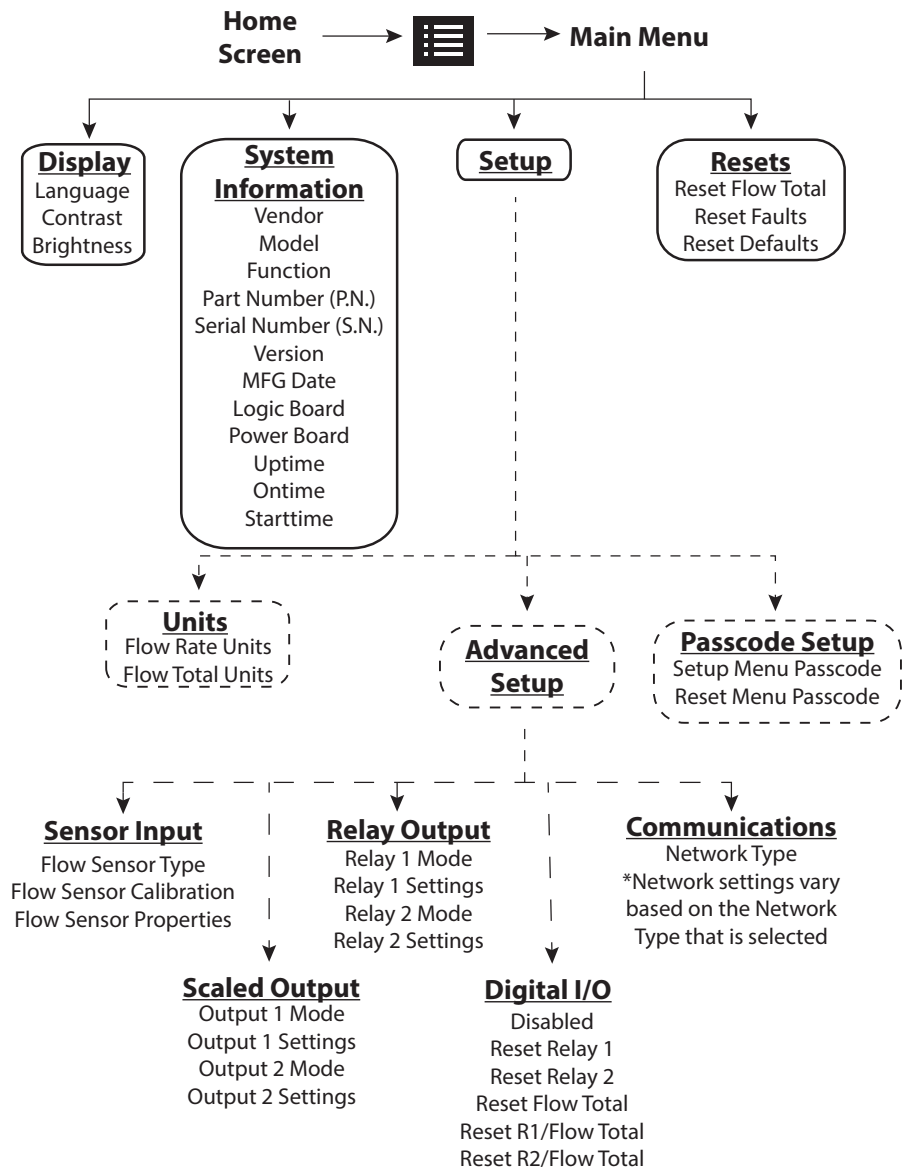


Figure 17: Menu structure

## INFO/SENSOR DATA

The FC-5000 Flow Display features a quick method to view measured data transmitting to and from the device. You can use the data for informational purposes or for troubleshooting. The type of data displayed can include raw input frequency, relay status or calculated data, such as flow rate.

### Info/Sensor Data Table

| Item          | Description                                   |
|---------------|-----------------------------------------------|
| Flow Freq     | Raw frequency of the flow sensor              |
| Flow Count    | Raw pulse count of the flow sensor            |
| Flow Rate     | Calculated flow rate of the flow sensor       |
| Flow Tot      | Calculated flow total of the flow sensor      |
| Flow Freq 1*  | Raw frequency of flow sensor 1                |
| Flow Count 1* | Raw pulse count of flow sensor 1              |
| Flow Rate 1*  | Calculated flow rate of flow sensor 1         |
| Flow Tot 1*   | Calculated flow total of flow sensor 1        |
| Flow Freq 2*  | Raw frequency of flow sensor 2                |
| Flow Count 2* | Raw pulse count of flow sensor 2              |
| Flow Rate 2*  | Calculated flow rate of flow sensor 2         |
| Flow Tot 2*   | Calculated flow total of flow sensor 2        |
| Relay 1       | ENABLED/DISABLED status of relay 1            |
| Relay 2       | ENABLED/DISABLED status of relay 2            |
| D-I/O 1       | ENABLED/DISABLED status of digital I/O port 1 |
| D-I/O 2       | ENABLED/DISABLED status of digital I/O port 2 |
| D-I/O 3       | ENABLED/DISABLED status of digital I/O port 3 |
| D-I/O 4       | ENABLED/DISABLED status of digital I/O port 4 |
| D-I/O 5       | ENABLED/DISABLED status of digital I/O port 5 |
| D-I/O 6       | ENABLED/DISABLED status of digital I/O port 6 |

\*For Dual pulse input configurations, rate and total data appear with a 1 or 2 to indicate which flow meter/sensor its depicting

Table 10: Info/sensor data

To return to the home screen, press **BACKSPACE** or **F1** (home).

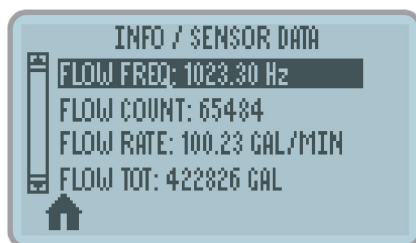


Figure 18: Info/sensor data screen

# SYSTEM INFORMATION

The *System Information* menu contains build information specific to the configuration of the unit.

To view your system information, navigate to *System Information* from the *Main* menu.

| Item      | Description                                         |
|-----------|-----------------------------------------------------|
| Vendor    | Manufacturer of the product                         |
| Model     | Product family/series                               |
| Function  | For factory/diagnostic purposes only                |
| P.N.      | Configured part number                              |
| S.N.      | Serial number                                       |
| Mfg Date  | The original manufacture/build date                 |
| Version   | Loaded firmware version                             |
| Logic Brd | For factory/diagnostic purposes only                |
| Power Brd | For factory/diagnostic purposes only                |
| Uptime    | Time, in seconds, since last power-on session start |
| Ontime    | Total lifetime power-on, in seconds                 |
| Starttime | Ontime at start of power-on session                 |

Table 11: System information menu

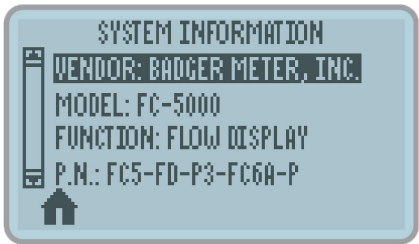


Figure 19: System information screen



## BASIC SETUP

### Display

Use this menu to change the display settings for *Language*, *Contrast* or *Brightness*.

1. Navigate to *Display* from the main menu.
2. Press **UP/DOWN** to scroll through the available display parameters, then press **ENTER**.
3. Scroll through available options, then press **ENTER** to select and save your changes.



Figure 20: Display configuration screen

### Resets

Use this menu to reset *Totalizers*, *Faults*, *Defaults* and *latched relays*:

1. Navigate to *Resets* from the main menu.

**NOTE:** If a passcode was configured, enter the passcode, then press **ENTER** to access this menu.

2. Press **UP/DOWN** to scroll through the available reset options, then press **ENTER**.
3. On the confirmation screen press **ENTER** to confirm the reset.

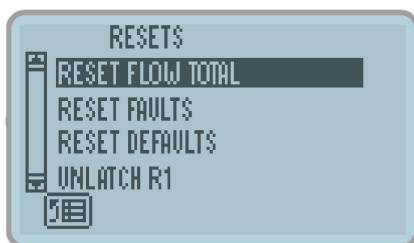


Figure 21: Resets menu

### Clearing a Latched Relay

To clear a relay that latches after a trigger:

1. Navigate to the main menu.
2. Press **UP/DOWN** to scroll to *UNLATCH R1* or *UNLATCH R2*, then press **ENTER**.

### Passcode Setup

#### Enabling Passcodes

FC-5000 units are shipped without passcode protection enabled. You can enable a unique password for the *Setup Menu* and the *Reset Menu*. To enable a passcode:

1. Navigate to *SETUP > PASSCODE SETUP*.
2. Press **UP/DOWN** to scroll to the passcode you want to enable, then press **ENTER**.



Figure 22: Enable passcode screen

3. Enter a numeric passcode from 4 to 8 digits in length, then press **ENTER**.
4. On the confirmation screen, press **ENTER** again to confirm the passcode.

**NOTE:** An asterisk ( \* ) appears next to each passcode if it is enabled.



Figure 23: Asterisk indicates enabled passcode

#### Disabling a Passcode

1. Navigate to *SETUP > PASSCODE SETUP*.
2. Press **UP/DOWN** to scroll to the passcode you want to delete, then press **F4** (clear).
3. On the confirmation screen, press **ENTER** to confirm removal of the passcode.

## Forgotten Passcodes

If you have forgotten your passcode, call Badger Meter customer service and they will be able to assist you in resetting the passcode.

1. Navigate to *System Information* from the main menu.
2. Locate and write down the values shown for "STARTTIME" and "S.N. (Serial Number)".
3. Call Badger Meter customer service. See "*Troubleshooting*" on page 36 for contact information.

## Units

Use the *UNITS* menu to configure units of measure, display precision (resolution) and radix (comma or decimal point). You can configure these settings for each Parameter Unit: Flow (Rate and Total).

1. Navigate to *SETUP > UNITS*.
2. Press **UP/DOWN** to scroll through the available parameter units.
3. Scroll to *Unit of Measure, Display Precision or Radix*, then press **ENTER** to activate the drop-down menu for that setting.

### Unit of Measure

The *Unit of Measure* setting determines the engineering unit and/or time interval for calculated measurements of the selected parameter unit.

Press **UP/DOWN** to scroll through the available units of measure, then press **ENTER** to select and save the new setting.

**NOTE:** For most rate measurements, all options are available in time intervals of seconds (S), minutes (M), hours (H) and days (D).

For any of the *Flow* parameters (*Rate* or *Total*), the available units are:

| Unit            | Description              | Unit           | Description                      |
|-----------------|--------------------------|----------------|----------------------------------|
| US GAL          | US Gallon                | M <sup>3</sup> | Cubic Meters                     |
| IG              | Imperial Gallon          | AC-FT          | Acre Feet                        |
| MG              | US Million Gallons       | BBL            | Oil Barrels [42 US Gallons]      |
| MIG             | Imperial Million Gallons | FBBL           | Liquid Barrels [31.5 US Gallons] |
| L               | Liters                   | US OZ          | US Ounces                        |
| ML              | Million Liters           | I OZ           | Imperial Ounces                  |
| FT <sup>3</sup> | Cubic Feet               | CUST           | Custom                           |

Table 12: Flow units

### **Creating Custom Units for Rate or Total Measurement**

1. Follow the procedure outlined in “Unit of Measure” on page 27 to enter the Unit of Measure menu for a parameter.
2. Press **UP/DOWN** to choose *CUST*, then press **ENTER**.

**NOTE:** The display populates with additional icons that need to be modified for custom units.

3. Press **F2** (custom label). Use the soft keys in conjunction with the numeric keypad and **UP/DOWN** to create a custom label, then press **ENTER**.

**NOTE:** See Table 8 on page 17 and Table 9 on page 18 for button functionality.

4. On the confirmation screen, press **ENTER** to confirm the new custom unit. The new label displays in the selection list.
5. Press **F3** (conversion) to assign a conversion factor for this custom unit. The number entered will be a factor related to the specific parameter.
  - ◇ FLOW RATE: GAL/MIN
  - ◇ FLOW TOTAL: GALLONS (GAL)
6. Press **ENTER** to save the change.
7. On the confirmation screen, press **ENTER** to confirm the change.

**NOTE:** For example, if making a custom unit for Flow Rate and 2 is programmed as a conversion factor, the custom unit is equivalent to 2 GAL/MIN. If 0.5 is entered, the custom unit is equivalent to 0.5 GAL/MIN.

### **Display Precision**

The *Display Precision* setting determines the resolution of a value, indicated by the number of digits after the decimal place, for the selected parameter unit.

1. Press **UP/DOWN** to scroll to *DISPLAY PRECISION*, then press **ENTER**.
2. Scroll through the available options (0...4), then press **ENTER** to select and save the change.

### **Radix**

The *Radix* parameter determines if a period or comma is used to represent a decimal place for the selected parameter unit.

1. Press **UP/DOWN** to scroll to *RADIX*, then press **ENTER**.
2. Scroll through available options (decimal point or comma), then press **ENTER** to select and save the change.

## ADVANCED SETUP

Use the *ADVANCED SETUP* menu to configure flow meters, outputs, relays and communication.

### Configuring a Flow Sensor

#### Flow Sensor Type

See "*Flow Sensor Types*" on page 39 for more details on flow type selection for Badger Meter products. Use this menu to select the flow meter that the device is connected to.

1. Navigate to *SETUP > ADVANCED SETUP > SENSOR INPUTS*.
2. Press **UP/DOWN** to scroll to *FLOW SENSOR TYPE*, then press **ENTER**.
3. Scroll through the available sensor types, then press **ENTER** to select and save the new settings. The flow sensor types are shown in *Table 13*.

| Option                        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| No Sensor/Disabled            | Disables the sensor input in the firmware                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Sine<br>K-Factor              | <ul style="list-style-type: none"> <li>• Frequency input channel <ul style="list-style-type: none"> <li>◊ Examples: Mag pick-offs, Low level signals (~100 mV)</li> </ul> </li> <li>• Single K-Factor entry</li> </ul>                                                                                                                                                                                                                                            |
| Pulse:<br>K-Factor            | <ul style="list-style-type: none"> <li>• Pulse input channel <ul style="list-style-type: none"> <li>◊ Any pulse producing sensor</li> <li>◊ Examples: TTL, RF carriers w/ amplifier</li> </ul> </li> <li>• Single K-Factor entry</li> <li>• Active sensor: No pullup resistor</li> </ul>                                                                                                                                                                          |
| Sine<br>Multi-Point<br>Cal    | <ul style="list-style-type: none"> <li>• Frequency input channel <ul style="list-style-type: none"> <li>◊ Examples: Mag pick-offs, Low level signals (~100 mV)</li> </ul> </li> <li>• Multi-point linearization</li> </ul>                                                                                                                                                                                                                                        |
| Pulse<br>Multi-Point<br>Cal   | <ul style="list-style-type: none"> <li>• Pulse input channel <ul style="list-style-type: none"> <li>◊ Any pulse producing sensor</li> <li>◊ Examples: TTL, RF carriers w/ amplifier</li> </ul> </li> <li>• Multi-point linearization</li> <li>• Active sensor: No pullup resistor</li> </ul>                                                                                                                                                                      |
| Pulse<br>K-Factor<br>Pullup   | <ul style="list-style-type: none"> <li>• Pulse input channel <ul style="list-style-type: none"> <li>◊ Any pulse producing sensor</li> <li>◊ Examples: TTL, RF carriers w/ amplifier</li> </ul> </li> <li>• Single K-Factor entry <ul style="list-style-type: none"> <li>◊ Pulses per unit of volume</li> </ul> </li> <li>• Passive sensor: Pullup resistor to 12V for excitation</li> </ul>                                                                       |
| Pulse<br>Debounce<br>K-Factor | <ul style="list-style-type: none"> <li>• Unique to products with raw reed switches</li> <li>• Pulse input channel <ul style="list-style-type: none"> <li>◊ Any pulse producing sensor coupled with a reed switch</li> <li>◊ Example: Industrial Oval Gear</li> </ul> </li> <li>• Single K-Factor entry <ul style="list-style-type: none"> <li>◊ Pulses per unit of volume</li> </ul> </li> <li>• Passive sensor: Pullup resistor to 12V for excitation</li> </ul> |
| Pulse<br>Dic                  | <ul style="list-style-type: none"> <li>• Unique to the Data Industrial (DIC) product line</li> <li>• Pulse input channel <ul style="list-style-type: none"> <li>◊ Any pulse producing sensor</li> <li>◊ Examples: TTL, RF carriers w/ amplifier</li> </ul> </li> <li>• K and Offset values entered <ul style="list-style-type: none"> <li>◊ K = unit of volume per pulse</li> </ul> </li> <li>• Active sensor: No pullup resistor</li> </ul>                      |

Table 13: Flow sensor types

Flow Sensor Calibration

Use this menu to change the calibration settings (K-factor, offset and low flow cutoff) for the selected Flow Meter Type.

- 1. Navigate to *SETUP > ADVANCED SETUP > SENSOR INPUTS*.
- 2. Press **UP/DOWN** to scroll to *FLOW SENSOR CAL*, then press **ENTER**.
- 3. Scroll to and edit each option, as necessary. The options include:

| Option            | Description                                                                                                                                          |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| K-Factor          | A singular K-factor entry point.                                                                                                                     |
| Offset            | Used to apply an offset to sensor input calibration                                                                                                  |
| Low Flow Cutoff   | The point at which the display reads zero. Represented in configured unit of measure                                                                 |
| Multi-Point Table | Appears when a "Multi-Point Cal" option is picked for a flow sensor type, to replace a single K-Factor. Allows you to program a linearization table. |

Table 14: Flow sensor calibration options

10-Point Linearization

The FC-5000 Flow Display can be set up to linearize the output from an eligible flow meter. The calibration data for a particular flow meter are included when the meter, calibration and FC-5000 unit are ordered from the factory. The calibration data is represented as FREQUENCY (f: Hz) vs K-FACTOR (KFct).To manipulate or enter the linearization parameters:

- 1. Navigate to *SYSTEM SETUP > ADVANCED SETUP > SENSOR INPUT > FLOW SENSOR CAL*.

**NOTE:** For dual pulse input versions, navigate to *FLOW SENSOR 1 CAL* or *FLOW SENSOR 2 CAL*.

- 2. Press **UP/DOWN** to scroll to *MULTI-POINT TABLE*, then press **ENTER**.
- 3. For each calibration point, press **F2** (f:Hz) to enter a frequency value or press **F3** (kFct) to enter or edit the *K-factor* value.
- 4. On the numeric entry screens, enter the value, then press **ENTER** to save the value and return to the previous screen.

**NOTE:** Each entry, 1...10, represents each calibration data point. Any number of points can be entered, up to 10. Leave the fields at 0.000 if no data exists.

Flow Sensor Properties

Use this menu to change flow meter damping. Damping is a smoothing coefficient. As the number increases, averaging becomes greater. As the number decreases, it approaches the raw reading. Valves range from 0...10.

- 1. Navigate to *SETUP > ADVANCED SETUP > SENSOR INPUTS*.
- 2. Press **UP/DOWN** to scroll to *FLOW SENSOR PROP*, then press **ENTER**.
- 3. Press **ENTER** to select the *DAMPING* option and edit it.

**NOTE:** Each time you press **ENTER**, the value (0...10) will increase. If the value is 10, pressing **ENTER** again will restart the list at 0.

## Configuring Outputs

### Scaled Outputs: Output Mode

Use this menu to change the mode of one or both scaled outputs. The mode defines the behavior of the output.

1. Navigate to *SETUP > ADVANCED SETUP > SCALED OUTPUTS*
2. Press **UP/DOWN** to scroll to an output mode, then press **ENTER**.
3. Scroll through the available modes, then press **ENTER** to select and save the setting.

The *Output Mode* options will vary based on device configuration.

| Device Configuration                       | Option             | Description                                         |
|--------------------------------------------|--------------------|-----------------------------------------------------|
| <b>Frequency Output</b><br>FC5-FD-**-F***- | NO OUTPUT/DISABLED | Disables Output                                     |
|                                            | PULSE: TOTAL       | Sends pulse(s)-per-total unit of measure            |
|                                            | PULSE: RATE        | Sends pulse(s)-per-rate unit of measure             |
| <b>Analog Output</b><br>FC5-FD-**-A***-    | NO OUTPUT/DISABLED | Disables Output                                     |
|                                            | ANALOG: 0...5V     | 0...5V output signal, scaled to an output source    |
|                                            | ANALOG: 0...10V    | 0...10V output signal, scaled to an output source   |
|                                            | ANALOG: 4...20 mA  | 4...20 mA output signal, scaled to an output source |

Table 15: Output mode options

### Scaled Outputs: Output Settings

Use this menu to change the output settings for the respective output mode.

1. Navigate to *SETUP > ADVANCED SETUP > SCALED OUTPUTS*.
2. Press **UP/DOWN** to scroll to the applicable output settings, then press **ENTER**.
3. Scroll to and edit each option, as necessary.
  - a. Frequency output options are:

| Output Mode  | Option             | Description                                                               |
|--------------|--------------------|---------------------------------------------------------------------------|
| PULSE: RATE  | OUTPUT SOURCE      | Parameter assignment of the output (such as rate or total)                |
|              | SCALE MINIMUM      | Minimum parameter value associated with output minimum                    |
|              | SCALE MAXIMUM      | Maximum parameter value associated with output maximum                    |
|              | MAXIMUM FREQUENCY  | Maximum frequency output value                                            |
|              | OUTPUT FREQ        | (Read Only) Real-time output frequency                                    |
| PULSE: TOTAL | OUTPUT SOURCE      | Parameter assignment of the output (such as rate or total or temperature) |
|              | SCALING FACTOR     | Units of measure transmitted, per pulse                                   |
|              | SCALED PULSE COUNT | (Read Only) Number of transmitted pulses                                  |

Table 16: Frequency output settings

b. Analog output options are:

| Option            | Description                                                |
|-------------------|------------------------------------------------------------|
| OUTPUT SOURCE     | Parameter assignment of the output (such as rate or total) |
| ANALOG FULL SCALE | Maximum value associated with output maximum               |
| ANALOG LOW SCALE  | Minimum value associated with output minimum               |

Table 17: Analog output settings

**Relay Outputs: Relay Mode**

Use this menu to change the mode of one or both relay outputs. The mode defines the behavior of the output.

- 1. Navigate to *SETUP > ADVANCED SETUP > RELAY OUTPUTS*.
- 2. Press **UP/DOWN** to scroll to an output mode, then press **ENTER**.
- 3. Scroll through the available modes, then press **ENTER** to select and save the setting.

| Option            | Description                                               |
|-------------------|-----------------------------------------------------------|
| NO RELAY/DISABLED | Disables output                                           |
| TOTALIZER         | Totalizer output                                          |
| ALARM: HIGH       | On/Off function, energized at the high set point          |
| ALARM: LOW        | On/Off function, energized at the low set point           |
| ALARM: RANGE      | On/Off function, energized beyond high and low set points |
| MANUAL            | On/Off function of manual operation                       |

Table 18: Relay mode options



## Relay Outputs: Relay Settings

Use this menu to change the relay settings for the respective relay mode.

1. Navigate to *SETUP > ADVANCED SETUP > RELAY OUTPUTS*.
2. Press **UP/DOWN** to scroll to the applicable relay setting, then press **ENTER**.
3. Scroll to and edit each option, as necessary.

**NOTE:** Alarm icons "R1" and "R2" will appear in the upper right section of the Home Screen to provide a local indication when a relay condition has been met and when the relay has been energized.

| Output Mode | Option         | Description                                                                                                                                                                         |
|-------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TOTALIZER   | OUTPUT SOURCE  | Parameter assignment (e.g. Flow Total)                                                                                                                                              |
|             | SCALING FACTOR | Pulse(s) transmitted per unit of measure                                                                                                                                            |
|             | UNITS          | Converts output unit of measure                                                                                                                                                     |
|             | PULSE WIDTH    | Time between the rising and falling edges of a single pulse                                                                                                                         |
| ALARM: HIGH | OUTPUT SOURCE  | Parameter assignment (such as Flow Rate)                                                                                                                                            |
|             | HIGH SETPOINT  | Instructs the device to energize the relay if this value reached/exceeded. This value is linked to the <i>OUTPUT SOURCE</i> and its unit of measure (for example, Flow Rate in GPM) |
|             | HYSTERESIS HI  | Creates a window/zone below the <i>HIGH SETPOINT</i> value where the relay remains in an energized state                                                                            |
|             | SET DELAY      | Time in seconds that will elapse before the relay energizes, if the <i>HIGH SETPOINT</i> value is reached/exceeded                                                                  |
|             | RELEASE DELAY  | Time in seconds that the relay will remain energized, if the <i>HYSTERESIS HI</i> value is reached/exceeded                                                                         |
|             | LATCHING       | Leaves the relay in an energized state until it is manually cleared on the device, either through the keypad interface or through the Digital I/O channels                          |
| ALARM: LOW  | OUTPUT SOURCE  | Parameter assignment (such as Flow Rate)                                                                                                                                            |
|             | LOW SETPOINT   | Instructs the device to energize the relay if this value reached/exceeded. This value is linked to the <i>OUTPUT SOURCE</i> and its unit of measure (for example, Flow Rate in GPM) |
|             | HYSTERESIS LO  | Creates a window/zone above the <i>LOW SETPOINT</i> value where the relay remains in an energized state                                                                             |
|             | SET DELAY      | Time in seconds that will elapse before the relay energizes, if the <i>LOW SETPOINT</i> value is reached/exceeded                                                                   |
|             | RELEASE DELAY  | Time in seconds that the relay will remain energized, if the <i>HYSTERESIS LO</i> value is reached/exceeded                                                                         |
|             | LATCHING       | Leaves relay in an energized state until it is manually cleared on the device, either through the keypad interface or through the Digital I/O channels                              |

| Output Mode     | Option        | Description                                                                                                                                                                          |
|-----------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ALARM:<br>RANGE | OUTPUT SOURCE | Parameter assignment (such as Flow Rate)                                                                                                                                             |
|                 | HIGH SETPOINT | Instructs the device to energize the relay if this value reached/ exceeded. This value is linked to the <i>OUTPUT SOURCE</i> and its unit of measure (for example, Flow Rate in GPM) |
|                 | HYSTERESIS HI | Creates a window/zone below the <i>HIGH SETPOINT</i> value, where the relay remains in an energized state                                                                            |
|                 | LOW SETPOINT  | Instructs the device to energize the relay if this value reached/ exceeded. This value is linked to the <i>OUTPUT SOURCE</i> and its unit of measure (for example, Flow Rate in GPM) |
|                 | HYSTERESIS LO | Creates a window/zone above the <i>LOW SETPOINT</i> value, where the relay remains in an energized state                                                                             |
|                 | SET DELAY     | Time in seconds that will elapse before the relay energizes, if either setpoint value is reached/exceeded                                                                            |
|                 | RELEASE DELAY | Time in seconds that the relay will remain energized, if either hysteresis value is reached/exceeded                                                                                 |
|                 | LATCHING      | Leaves relay in an energized state until it is manually cleared on the device, either through the keypad interface or through the Digital I/O channels                               |
| MANUAL          | OVERRIDE      | Bypasses any programmed triggers to trigger the relay, which will remain triggered until deactivated                                                                                 |

Table 19: Relay settings

## Configuring Digital I/O

The FC-5000 Flow Display has remote reset capabilities for relays and totalizers through any one of six different channels.

All six channels are input-only and can be configured for any combination of the following.

| Option                           | Description                                          |
|----------------------------------|------------------------------------------------------|
| Disabled                         | The I/O channel will have no function                |
| Reset: Relay 1                   | Resets latch on Relay 1                              |
| Reset: Relay 2                   | Resets latch on Relay 2                              |
| Reset: All Relays                | Resets latches on Relays 1 and 2                     |
| Reset: Flow Total                | Resets <i>Flow Total</i>                             |
| Reset: Relay 1 And Flow Total    | Resets latch on Relay 1 and resets <i>Flow Total</i> |
| Reset: Relay 2 And Flow Total    | Resets latch on Relay 2 and resets <i>Flow Total</i> |
| Reset: All Relays And All Totals | Resets Relay 1, Relay 2 and <i>Flow Total</i>        |

Table 20: Channel options

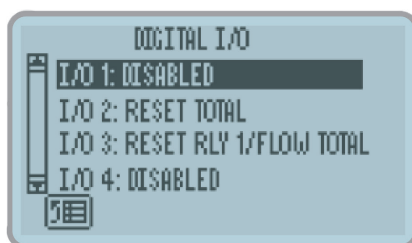


Figure 24: Digital I/O menu

1. Navigate to *SETUP* > *ADVANCED SETUP* > *DIGITAL I/O*.
2. Press **UP/DOWN** to scroll to any of the six input channels.
3. Press **ENTER** repeatedly until the desired function appears. Each time **ENTER** is pressed, the channel toggles through the available functions.

To disable any channel, simply highlight the digital I/O channel, and press **ENTER** until *DISABLED* appears.

## Configuring Communications

The *Communications* menu configures the device to communicate to other systems via Modbus or BACnet.

The available communication settings vary based on Network Type.



Figure 25: Modbus communications menu



Figure 26: BACnet communications menu

1. Navigate to *SETUP* > *ADVANCED SETUP* > *COMMUNICATIONS*.
2. Press **UP/DOWN** to scroll to *NETWORK TYPE*, then press **ENTER**.
3. Scroll through the available options, then press **ENTER** to select save the change.
4. Press **BACKSPACE** to return to the *COMMUNICATIONS* menu.
5. Scroll to and edit each option, as necessary. The options are:

### Modbus RTU and Modbus ASCII

| Settings      | Options                                                                    |
|---------------|----------------------------------------------------------------------------|
| BAUD RATE     | 1200, 2400, 4800, 9600, 14400, 19200, 28800, 34800, 57600, 76800 or 115200 |
| PARITY        | No Parity, Odd Parity or Even Parity                                       |
| STOP BIT      | No Stop Bit, One or Two Stop Bit                                           |
| SLAVE ADDRESS | 1...255                                                                    |

Modbus RTU and Modbus ASCII

| Settings    | Options         |
|-------------|-----------------|
| DEVICE NAME | User-defined ID |

Table 21: Modbus settings

BACnet

| Settings        | Options                                                                    |
|-----------------|----------------------------------------------------------------------------|
| BAUD RATE       | 1200, 2400, 4800, 9600, 14400, 19200, 28800, 34800, 57600, 76800 or 115200 |
| MSTP ADDRESS    | 1...255                                                                    |
| MAX MASTER      |                                                                            |
| DEVICE INSTANCE | 1...4,294,967,295                                                          |
| DEVICE NAME     | User-defined ID                                                            |

Table 22: BACnet settings

TROUBLESHOOTING

This section lists common problems that may be encountered with the Flow Display, the possible causes and the recommended remedies. Most problems are due to improper wiring and/or programming procedures. The problem may also be in the flow meter, valve, pump or other piece of equipment.

Be sure that all other equipment is functioning properly. The FC-5000 Flow Display is extensively tested at the factory before shipment. However, the unit may get damaged during transit or installation. If after all possible remedies have been tried and the problem persists, contact your local representative or Badger Meter.

| Problem                                                  | Possible Causes                                                                                                                                                                                                                                                                                                   | Remedies                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Unit has power but display does not light up.            | Incorrect power wiring.                                                                                                                                                                                                                                                                                           | Re-check power wiring.                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Transmitter is connected but the FC-5000 does not count. | <ol style="list-style-type: none"><li>1. Incorrect transmitter wiring or broken wire.</li><li>2. Transmitter is defective.</li><li>3. No sensory type selected.</li><li>4. Wrong scale factor.</li><li>5. Low frequency input must be on terminal #7.</li><li>6. Meter is defective, rotor not turning.</li></ol> | <ol style="list-style-type: none"><li>1. Check wiring diagrams.</li><li>2. Replace parts or entire unit.</li><li>3. Select a sensor type. See "Flow Sensor Type" on page 29.</li><li>4. Check scale factor calculation. For example, if programmed 0.001 instead of 0.100, unit will wait for 100 pulses before decrementing one count.</li><li>5. Verify connection.</li><li>6. Disassemble meter, check rotor, replace if defective.</li></ol> |
| Valve does not close at setpoints.                       | <ol style="list-style-type: none"><li>1. Relay output is not properly connected.</li><li>2. Relay is defective.</li><li>3. Valve components are defective.</li></ol>                                                                                                                                              | <ol style="list-style-type: none"><li>1. Reconnect relay wiring.</li><li>2. Contact factory for replacement.</li><li>3. Check and replace valve components.</li></ol>                                                                                                                                                                                                                                                                            |

| Problem                                                                           | Possible Causes                                                                                                                                                                          | Remedies                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Counter accumulates too many counts.                                              | <ol style="list-style-type: none"> <li>1. Wrong scale factor.</li> <li>2. Electrical noise causing extra pulses.</li> <li>3. Excessive vibration.</li> </ol>                             | <ol style="list-style-type: none"> <li>1. Check scale factor calculation.</li> <li>2. Check wiring. Make sure power lines are not touching or close to pulse signal line. Always use shielded cable.</li> <li>3. Dampen vibration.</li> </ol>         |
| Some of the keys on the control panel are not operational.                        | <ol style="list-style-type: none"> <li>1. Broken switch behind control panel.</li> <li>2. Function not available on this model.</li> <li>3. Problem with internal components.</li> </ol> | <ol style="list-style-type: none"> <li>1. Replace the Flow Display.</li> <li>2. See <i>"Operator Interface"</i> on page 17.</li> <li>3. Return the Flow Display to the factory for repair.</li> <li>4. Cycle the power to the Flow Display</li> </ol> |
| Display Overrun Error (Shown as "DISPOVR")                                        | There are more digits to display than the maximum quantity.                                                                                                                              | <ol style="list-style-type: none"> <li>1. Check the unit of measure and change to a larger unit if possible (for example, change gallons to mega gallons)</li> <li>2. Check the display precision and reduce it, if possible.</li> </ol>              |
|  | <ol style="list-style-type: none"> <li>1. The rate or total values indicated on the Home Screen are in an overrun condition (value exceeds 8 digits)</li> </ol>                          | <ol style="list-style-type: none"> <li>1. Change the unit of measure associated with the parameter (see <i>"Unit of Measure"</i> on page 27) or reset the totalizer (see <i>"Resets"</i> on page 25).</li> </ol>                                      |
| Alarm notification from the Home screen                                           |                                                                                                                                                                                          |                                                                                                                                                                                                                                                       |
| "R1" and/or "R2" appear on home screen                                            | <ol style="list-style-type: none"> <li>1. Relay 1 and/or Relay 2 are latched</li> <li>2. Relay 1 and/or 2 are energized</li> </ol>                                                       | <ol style="list-style-type: none"> <li>1. See <i>"Clearing a Latched Relay"</i> on page 26</li> <li>2. The programmed alarm conditions are met. Check process or programming</li> </ol>                                                               |
| "DISABLED" displays on home screen                                                | <ol style="list-style-type: none"> <li>1. Flow sensor type setting set to "NO SENSOR/DISABLED"</li> </ol>                                                                                | <ol style="list-style-type: none"> <li>1. Configure a flow sensor. See <i>"Configuring a Flow Sensor"</i> on page 29</li> </ol>                                                                                                                       |

Table 23: Troubleshooting

## CAUTION

**THERE ARE NO FIELD-REPLACEABLE PARTS INSIDE. OPENING THE UNIT WILL VOID ALL WARRANTIES.**

If a repair or evaluation from the factory is required, call your local representative or the factory to obtain a Return Material Approval (RMA).

The shipping address, RMA number and any other required information will be provided to send the unit to an appropriate location.

|                         |                           |
|-------------------------|---------------------------|
| Company Website         | www.badgermeter.com       |
| Customer Service Email  | indorders@badgermeter.com |
| Customer Service Number | (877) 243-1010            |

Table 24: Contact information

# MODBUS INTERFACE

## Modbus Function Code Support

The FC-5000 Flow Display supports access through all four of the Modbus data types. Both single and multiple write-access commands are supported for register and coil data types. For multiple register writes, the command must initiate on a valid parameter address and end on last register of a valid parameter address. Multiple register writes that start in the middle of a multiple register parameter or do not end on the last register of a multiple register parameter are not supported. The table below lists the supported function codes.

| Description                    | Function Code | Subcode |
|--------------------------------|---------------|---------|
| Read Coils                     | 01            | —       |
| Read Discrete Inputs           | 02            | —       |
| Read Holding Registers         | 03            | —       |
| Read Input Registers           | 04            | —       |
| Write Single Coil              | 05            | —       |
| Write Single Register          | 06            | —       |
| Diagnostic – Return Query Data | 08            | 00      |
| Write Multiple Coils           | 15            | —       |
| Write Multiple Registers       | 16            | —       |
| Report Slave ID                | 17            | —       |

Table 25: Supported Modbus function codes

## Modbus Register Map

| Register Name             | Register Address | Coil Addr. | Data Type | Read/Write | Access Type |
|---------------------------|------------------|------------|-----------|------------|-------------|
| <b>Single Pulse Input</b> |                  |            |           |            |             |
| Flow Rate                 | 0x0000           | —          | Float     | Read Only  | Register    |
| Flow Total                | 0x0002           | —          | Float     | Read Only  | Register    |
| Flow Total Precision      | 0x0004           | —          | Double    | Read Only  | Register    |
| <b>Dual Pulse Input</b>   |                  |            |           |            |             |
| Flow Rate 1               | 0x0000           | —          | Float     | Read Only  | Register    |
| Flow Total 1              | 0x0002           | —          | Float     | Read Only  | Register    |
| Flow Total Precision 1    | 0x0004           | —          | Double    | Read Only  | Register    |
| Flow Rate 2               | 0x0008           | —          | Float     | Read Only  | Register    |
| Flow Total 2              | 0x000A           | —          | Float     | Read Only  | Register    |
| Flow Total Precision 2    | 0x000C           | —          | Double    | Read Only  | Register    |
| Flow Rate Quad            | 0x0010           | —          | Float     | Read Only  | Register    |
| Flow Total Quad           | 0x0012           | —          | Float     | Read Only  | Register    |
| Flow Total Precision Quad | 0x0014           | —          | Double    | Read Only  | Register    |

Table 26: Modbus register map

# BACNET INTERFACE

## BACnet Map

| Object Description    | BACnet Object ID | BACnet Object Type |
|-----------------------|------------------|--------------------|
| FLOWRATE CH1          | 2                | Analog Value       |
| FLOWTOTAL CH1         | 3                | Analog Value       |
| FLOWTOTALPREC CH1     | 4                | Large Analog Value |
| FLOWRATE CH2          | 5                | Analog Value       |
| FLOWTOTAL CH2         | 6                | Analog Value       |
| FLOWTOTALPREC CH2     | 7                | Large Analog Value |
| FLOWRATEQUAD          | 8                | Analog Value       |
| FLOWRATETOTALQUAD     | 9                | Analog Value       |
| FLOWRATETOTALPRECQUAD | 10               | Large Analog Value |
| ENERGYRATE            | 11               | Analog Value       |
| ENERGYTOTALPREC       | 12               | Large Analog Value |
| TEMPERATURE CH1       | 13               | Analog Value       |
| TEMPERATURE CH2       | 14               | Analog Value       |
| FLUID DENSITY         | 15               | Analog Value       |
| FLUID SPECIFIC HEAT   | 16               | Analog Value       |

Table 27: BACnet register map

## FLOW SENSOR TYPES

The table below lists the Badger Meter products suitable for use with the FC-5000 Flow Display.

| Meter Technology      | Product Line | Output Type                     | Flow Sensor Input                        |
|-----------------------|--------------|---------------------------------|------------------------------------------|
| Impeller              | Impeller     | Square Wave Frequency           | Pulse: DIC                               |
| Oval Gear             | Oval Gear    | Reed Switch Pulse               | Pulse: Debounce K-Factor                 |
| Positive Displacement | OP Meters    | Unscaled Pulse                  | Pulse: Debounce K-Factor                 |
|                       |              | Scaled Pulse                    | Pulse: Debounce K-Factor                 |
|                       | Recordall    | Unscaled Pulse                  | Pulse: Debounce K-Factor                 |
|                       |              | Scaled Pulse                    | Pulse: Debounce K-Factor                 |
| Turbine               | Blancett     | MAG Pickup                      | Sine: K-Factor<br>Sine Multi-Point Cal   |
|                       |              | MAG Pickup with K-Factor Scaler | Pulse: K-Factor<br>Pulse Multi-Point Cal |
|                       | Cox          | MAG Pickup                      | Sine: K-Factor                           |
|                       |              | MAG Pickup with K-Factor Scaler | Pulse: K-Factor                          |
|                       |              | RF Pickup                       | Pulse: K-Factor                          |
|                       | Turbo        | Unscaled Pulse                  | Pulse: Debounce K-Factor                 |
|                       |              | Scaled Pulse                    | Pulse: Debounce K-Factor                 |
|                       | Flo-tech     | MAG Pickup                      | Sine: K-Factor<br>Sine Multi-Point Cal   |
|                       |              | MAG Pickup with K-Factor Scaler | Pulse: K-Factor<br>Pulse Multi-Point Cal |
|                       | Vision       | Frequency                       | Pulse: K-Factor Pullup                   |

Table 28: Badger Meter flow sensors

PART NUMBERING CONSTRUCTION

FC5

-

FD

-

-

F

6

A

-

Frequency Output

FUNCTION

Flow Display

FD

SENSOR INPUTS

One Pulse

P0

Two Pulse

P3

SCALED OUTPUTS

Two Frequency Outputs

F

RELAY OUTPUTS

One Form C Relay / One Form A Relay

A

Two Form C Relays

C

DIGITAL INPUTS/OUTPUTS

Six Programable Inputs/Outputs

6

COMMUNICATIONS

EIA-485(RS-485); Modbus; BACnet; USB

A

MOUNTING METHOD

Panel Mount

Wall Mount | Includes NEMA 4X (IP67) Rated Enclosure

P

W

FC5

-

FD

-

-

A

6

A

-

Analog Output

FUNCTION

Flow Display

FD

SENSOR INPUTS

One Pulse

P1

Two Pulse

P2

SCALED OUTPUTS

Two Analog Outputs

A

RELAY OUTPUTS

One Form C Relay / One Form A Relay

A

Two Form C Relays

C

DIGITAL INPUTS/OUTPUTS

Six Programable Inputs/Outputs

6

COMMUNICATIONS

EIA-485(RS-485); Modbus; BACnet; USB

A

MOUNTING METHOD

Panel Mount

Wall Mount | Includes NEMA 4X (IP67) Rated Enclosure

P

W

Figure 27: Part numbering construction

Replacement Parts/Accessories

| Part Number | Description                               |
|-------------|-------------------------------------------|
| 68334-001   | P/S Plug; 100-264V AC In; 24V DC out      |
| 68334-002   | P/S Module; 85-264V AC In; 24V DC out     |
| 809041      | Panel mounting clips (2)                  |
| 68788-001   | Wall-mount enclosure kit                  |
| 68231-001   | Terminal connector kit (P2 configuration) |
| 68231-002   | Terminal connector Kit (P1 configuration) |
| 68231-004   | Terminal connector kit (P0 configuration) |
| 68231-005   | Terminal connector kit (P3 configuration) |

Table 29: Replacement parts/accessories



## SPECIFICATIONS

|                         |                                                                                   |                                                                       |
|-------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------|
| <b>Power Supply</b>     | Input range: 10...40V DC and 9...28V AC RMS (50...60 Hz)                          |                                                                       |
|                         | Maximum power consumption: 8 Watts (power supply must provide 8 watts at minimum) |                                                                       |
|                         | Isolated from power ground                                                        |                                                                       |
|                         | Over-voltage, transient and reverse polarity protected                            |                                                                       |
| <b>Flow Meter Input</b> | Input Range: 0.3 Hz...10 kHz                                                      |                                                                       |
|                         | One (1) or two (2) independent channels                                           |                                                                       |
|                         | Configurable as square wave 0...30V pulse with 2.5V threshold                     |                                                                       |
|                         | Configurable as sine wave, zero-centered with 45 mV threshold                     |                                                                       |
|                         | Configurable debounce                                                             |                                                                       |
|                         | <b>Excitation Output</b>                                                          | 12V DC source                                                         |
|                         | <b>Voltage</b>                                                                    | Low: -0.3...1.85V DC                                                  |
|                         |                                                                                   | High: 2.5...25V DC                                                    |
|                         | <b>Impedance</b>                                                                  | Pullup to 12V DC                                                      |
| <b>Scaled Outputs</b>   | Two (2) independent channels                                                      |                                                                       |
|                         | Isolated from power ground                                                        |                                                                       |
|                         | Over-voltage, transient and reverse polarity protected                            |                                                                       |
|                         | Output is multiplexed on the process out pins                                     |                                                                       |
|                         | <b>Analog Output (option A)</b>                                                   | Configurable to 0...5V, 0...10V or 4...20 mA                          |
|                         |                                                                                   | Uncertainty: $\pm 0.1\%$ of reading                                   |
|                         |                                                                                   | 16-bit resolution (0...10V and 4...20 mA), 15-bit resolution (0...5V) |
|                         |                                                                                   | 200 ms, 90-10% step response                                          |
|                         |                                                                                   | Sourcing analog output signal                                         |
|                         | <b>Frequency Output (option F)</b>                                                | TTL, 1...4000 Hz, square wave                                         |
|                         |                                                                                   | Uncertainty: $\pm 0.01\%$ reading                                     |
|                         |                                                                                   | Resolution: 0.01 Hz                                                   |
| <b>Digital I/O</b>      | Six (6) independent channels                                                      |                                                                       |
|                         | Isolated from power ground                                                        |                                                                       |
|                         | Over-voltage, transient and reverse polarity protected                            |                                                                       |
|                         | 0...30V as input                                                                  |                                                                       |
|                         | Debounce                                                                          |                                                                       |
|                         | 0...5V, TTL, 200 ms 90-10% step response, driving $< 0.1 \mu\text{F}$             |                                                                       |

|                        |                                                        |                                                                      |                                                                                         |
|------------------------|--------------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Calculations           | Flow Calculation                                       | ± 0.01% uncertainty                                                  |                                                                                         |
|                        |                                                        | Adjustable FIR/IIR filtering                                         |                                                                                         |
| Relay Outputs          | Configuration Option "C"                               | Two (2) Form C Mechanical Relays                                     |                                                                                         |
|                        | Configuration Option "A"                               | One (1) Form C Mechanical Relay and One (1) Form A Solid State Relay |                                                                                         |
|                        | Isolated coil drivers                                  |                                                                      |                                                                                         |
|                        | Over-voltage, transient and reverse polarity protected |                                                                      |                                                                                         |
|                        | Form C Relay                                           | Load                                                                 | Resistive                                                                               |
|                        |                                                        | Rated Carry Current                                                  | 5 A (N.C. or N.O.)                                                                      |
|                        |                                                        | Maximum Switching Voltage                                            | 250V AC, 30V DC                                                                         |
|                        |                                                        | Minimum Permissible Load                                             | 10 mA at 5V DC                                                                          |
|                        |                                                        | Coil Rating                                                          | 5...24V DC                                                                              |
|                        |                                                        | Life Expectancy                                                      | 5,000,000 operations                                                                    |
|                        | Form A Relay (N.O. SPST)                               | Switching Speed                                                      | On (0.25 ms), Off (0.02 ms)                                                             |
|                        |                                                        | Current Rating (I <sub>O</sub> )                                     | 1 A                                                                                     |
|                        |                                                        | Maximum Output Voltage (V <sub>O</sub> )                             | 60V                                                                                     |
|                        |                                                        | Output On-Resistance (R <sub>ON</sub> )                              | 0.5 Ohms (Ω) @ I <sub>F</sub> = 5 mA, I <sub>O</sub> = 1 A                              |
|                        |                                                        | Output Withstand Voltage (V <sub>O(OFF)</sub> )                      | 60-65V @ V <sub>F</sub> = 0.8V, I <sub>O</sub> = 250 μA, T <sub>A</sub> = 77° F (25° C) |
| Network Communications | Network Types/ Communication Protocols                 | Modbus RTU, Modbus ASCII or BACnet                                   |                                                                                         |
|                        | Physical Layer                                         | EIA-485 (RS-485)                                                     |                                                                                         |
|                        | Baud Rates                                             | 1200...115.2K                                                        |                                                                                         |
|                        | Two-wire (half-duplex)                                 |                                                                      |                                                                                         |
|                        | Over-voltage/ESD Protection                            |                                                                      |                                                                                         |
|                        | Isolated from power ground                             |                                                                      |                                                                                         |
| USB Communications     | USB (HOST)                                             | Type-A Receptacle   Currently not supported                          |                                                                                         |
|                        | USB (DEVICE)                                           | Mini-B Receptacle (used for field updates)                           |                                                                                         |
|                        | Over-voltage/ESD/transient protected                   |                                                                      |                                                                                         |
| Display/User interface | Keypad                                                 | Membrane overlay, domed tactile response keys                        |                                                                                         |
|                        | Display                                                | 128 × 64 pixel LCD graphical display, LED backlit                    |                                                                                         |
|                        | Protected from EMI/RFI                                 |                                                                      |                                                                                         |
|                        | Keypad interface is protected from ESD                 |                                                                      |                                                                                         |

|                       |                                                                            |                                                                                                                                                                                                                     |                        |
|-----------------------|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Environmental Ratings | Pollution Degree                                                           | 2                                                                                                                                                                                                                   |                        |
|                       | Altitude Restriction                                                       | Up to 2000 m (6561 ft)                                                                                                                                                                                              |                        |
|                       | Over-Voltage Rating                                                        | Category II (CAT II)                                                                                                                                                                                                |                        |
|                       | Ambient Temperature Range                                                  | 32...130° F (0...55° C)                                                                                                                                                                                             |                        |
|                       | Storage Temperature Range                                                  | -40...160° F (-40...70° C)                                                                                                                                                                                          |                        |
|                       | Humidity                                                                   | 0...85%, non-condensing                                                                                                                                                                                             |                        |
| Weights (Approx.)     | Panel Mount                                                                | 1.25 lb (0.57 kg)                                                                                                                                                                                                   |                        |
|                       | Wall Mount (Including Unit)                                                | 4.54 lb (2.06 kg)                                                                                                                                                                                                   |                        |
| Operator Functions    | Unlatch Relays, Reset Totalizers, Unlatch Relays and Reset Totalizers      |                                                                                                                                                                                                                     |                        |
| Parameters            | Maximum Displayed Digits                                                   | Rates                                                                                                                                                                                                               | Max 8 (7 with decimal) |
|                       |                                                                            | Totals                                                                                                                                                                                                              | Max 9 (8 with decimal) |
|                       | Resolution/Display Precision                                               | Configurable, 0...4                                                                                                                                                                                                 |                        |
|                       | Volumetric Flow Rate Units<br>Seconds (S), Minute (MIN), Hour (H), Day (D) | US Gallons (US GAL), Imperial Gallons (I GAL), Mega US Gallons (US MGAL), Mega Imperial Gallons (I MGAL), Liters (L), Mega Liters (ML), Cubic Meters (M³), Cubic Feet (FT³), Acre Feet (AC-FT), Oil Barrels (OBBL), |                        |
|                       | Volumetric Flow Total Units                                                | Liquid Barrels (LBBL), US Ounces (US OZ), Imperial Ounces (I OZ), Custom (user-specified)                                                                                                                           |                        |

# STANDARDS AND CERTIFICATIONS

## Agency Approval/Standards

- CE Marked for Low Voltage Directive and RoHS
- CSA Marked per Class C225286 and C225206, Process Control Equipment
- CSA C22.2 No. 61010-1-12, General requirements
- CAN/CSA-C22.2 No. 61010-1-12 Safety requirements for electrical equipment for measurement, control and laboratory use. Part 1: General requirements—Tri-national standard with UL 61010-1 and ANSI/ISA-61010-1 (82.02.01)

## EMI/EMC Compliance

|                                                                   |                                                                           |
|-------------------------------------------------------------------|---------------------------------------------------------------------------|
| Conducted and Radiated Emissions per CISPR11:2009 / EN55011       | Class A, Group 1                                                          |
| IEC 61000-4-2:2008 Electrostatic Discharge                        | 2/4 kV - Contact Discharge, 2/4/8 kV Air Discharge Performance Criteria B |
| IEC 61000-4-3:2006 Radiated RF Immunity                           | Test levels: 80...1000 MHz & 1400...2000 MHz Performance Criteria A       |
| IEC 61000-4-4:2004 EFT Immunity (Signal and Power lines)          | Tested per specification to Performance Criteria B                        |
| IEC 61000-4-5:2005 Surge Protection                               | Tested per specification to Performance Criteria B                        |
| IEC 61000-4-6:2008 Conducted RF Immunity (Signal and Power lines) | Test Levels: 0.15...80 MHz Level 3, Performance Criteria A                |
| IEC 61000-4-11:2004 Voltage Dips, Interruptions, and Dropouts     | Tested per specification to Performance Criteria B & C                    |

Table 30: EMI/EMC compliance

## Enclosure Protection

- IEC/CSA/UL 60529-1: Degrees of protection provided by enclosures (IP65), when installed with all four mounting clips in a similarly rated enclosure, which includes the optional wall mount enclosure.
- Additional Protection (optional): NEMA 4X (wall mount enclosure only).

## Control. Manage. Optimize.

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