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FC220 Flow Monitor

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Congratulations on your purchase of the Global Water FC220 Flow Monitor. This instrument has been quality tested and approved for providing accurate and reliable measurements. We are confident that you will find the monitor to be a valuable asset for your application. Should you require assistance, our technical staff will be happy to help.

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I. FC220 Flow Monitor Description

The Global Water FC220 Flow Monitor is a reliable and accurate instrument for measuring and totalizing water flow in a wide variety of applications. Water level is measured using Global Water's popular WL400 level sensor, WL700 ultrasonic sensor, or almost any other 4-20mA, 0-5V or 0-1V water level sensor. Flow is then calculated by the microprocessor using a variety of different techniques. The backlit LCD display shows real-time flow, water level or total flow in user selectable units; and the 8-button keypad easily guides the user through the versatile setup menus.

The FC220 supports several different types of flow calculation modes. Over 40 preprogrammed flume and weir equations are included. For monitoring in round pipes and open rectangular channels; the Manning's Equation mode allows the user to enter their own parameters for material type, slope and pipe or channel dimensions. Standard flow equations can also be defined; which can calculate flow for almost all flumes and weirs. Another mode lets the user enter parameters for a best fit 3rd order polynomial that is useful for calculating flow based on empirical data and lookup tables. In addition, a factory programmable lookup table can be permanently stored in the processors memory for monitoring in applications where a single equation can't accurately predict flow, such as streambeds and open channels with complicated geometry. A 16-character name can be programmed into the FC220 by the user to identify the installation site or show other information about the configuration.

Water flow is displayed with up to 7 digits which allows for the display of flow in the largest applications. The totalizer records flow volume up to 9 digits with floating point and scientific (engineering) notation supported in non-volatile memory, and is password protected from reset. The maximum recordable total volume is more than one trillion cubic feet. Available volume units are cubic feet, gallons, million gallons, cubic meters and liters; time units include seconds, minutes, hours and days. This allows for the display of flow in 20 different user defined units. Water level is calibrated and displayed in feet, inches, meters or centimeters; and a level offset function allows the measured level to be adjusted to compensate for variations in sensor installation. The engineering units for all display modes and setup parameters are independently programmable, which allows for the greatest possible versatility.

Four independent relay outputs are provided for triggering external devices like water samplers and monitoring devices. These relays can be separately programmed to trigger based on volume per pulse, and threshold settings can be used to limit triggering to flows above preset levels. There is also an accurate and scalable 4-20mA output provided for monitoring flow using data loggers and PLC devices. An internal USB data logger is available as a factory option that allows the historical flow data to be recorded, as well as the exact time of each relay trigger event. Free software is provided for programming the data logger, downloading flow and relay data, and exporting to spreadsheets. Programmable power saving features allow the supply current to be reduced, which is important in remote monitoring applications.

A 16 character by 2 line LCD display can show either the current flow rate, the water level, or the volume in the totalizer. The 8-button keypad allows the selection of the display modes, and the programming of the setup parameters. The DISPLAY button toggles the LCD display between the flow rate, the water level, and the totalizer. This button also allows the quick exit from the setup menus when in any setup mode. Holding the MENU button down for two seconds enters the setup menu. In setup mode, the MENU button moves from one menu selection to another. The BACK button moves the user backward through the various setup options. The SAVE button will save a setup parameter to memory. The UP, DOWN, LEFT and RIGHT arrow buttons are used to select and change setup parameters.

Note:

The FC220 flow monitor requires a level sensor to operate. Two and three wire level sensors with 4-20mA, 0-5 volt and 0-1 volt outputs are supported. A sensor is not supplied with the FC220, contact Global Water for more information on available sensors.

II. FC220 Specifications:

Power Requirements:	12VDC or 18-24VDC Input, +/-10%
Supply Current:	13mA + Sensor Current + Backlight + 4-20mA Output 150mA Maximum Total Current
Backlight Current:	23mA when on
Internal Fuse:	315mA
Power Adaptor:	18VDC Universal Power Supply, 90-220VAC Input
Equation Formats:	Manning's Equation for Round Pipes Manning's Equation for Rectangular Channels Standard Flow Equation: Q=A*(B+Ch)^D 3rd Order Polynomial: Q=A+Bh+Ch^2+Dh^3
Stored Flumes:	H Type: 0.5, 0.75, 1.0, 1.5, 2.0 HS Type: 0.4, 0.6 Parshall: 1", 2", 3", 6", 9", 12", 24", 36", 48", 60", 72" Palmer-Bowlus: 4", 6", 8", 10", 12", 15", 18", 24", 30", 36" Trapezoidal: 60º
Stored Weirs:	Rectangular: 1', 2' 3, V-Notch: 22.5º, 30º, 45º, 60º, 90º, 120º Cipolletti: 1', 1.5', 2', 3', 4'
Lookup Table:	One, Factory Programmable Only
Output Relays:	4 Independent SPDT Relays, Pulse On Time = 1 Second Contact Rating: 8A @ 250VAC, 5A @ 30VDC Resistive
Level Sensor Input:	2-Wire or 3-wire, 4-20mA, 0-5VDC, 0-1VDC
Output:	4-20mA Scalable
Display/Keypad:	16 Character x 2 Line Backlit LCD, 8-Button Tactile Keypad
Flow Capacity:	7 Digit Maximum, Auto-Floating point
Totalizer Capacity:	9 Digit Maximum Auto-Floating Point, Engineering notation supported Max Volume = 1.0995E12 Cubic Feet (1.0995 x 10^12 Ft^3)
Level Capacity:	5 Digit Maximum
Display Resolution:	3 Decimal Places Maximum, Auto-Adjusting
Accuracy:	Sensor Accuracy + Equation/Table Error + 0.1% + 1 Digit
Level Units:	Feet, Inches, Meters, Centimeters
Volume Units:	Cubic Feet, Gallons, Million Gallons, Cubic Meters, Liters
Time Units:	Seconds, Minutes, hours, Days
Flow Units:	20 Combinations of Volume and Time Units Above
Dimensions:	7.1"W x 5.1"H x 1.4D (180mm x 130mm x 35mm)
Weight:	1 lb

III. Flow Calculation Modes

The FC220 determines flow from water level in several different ways. Standard flow equations, Manning's Equation, polynomials or a lookup table can all be used. The following equation formats calculate flow in cubic feet per second based on the measured water level in feet. A conversion is made by the microprocessor so that the display and 4-20mA output work in the user defined flow units.

Flow Equation:
There are standard flow equation parameters for over 40 flumes and weirs stored in the FC220. The user also has the ability to enter their own parameters for the flow equation in the form of:

$Q = A * (B+Ch)^{\wedge}D$

Where:
Q = Flow in Cubic Feet Per Second
A - D = User Programmable Coefficients. If B is not used, enter zero
h = Water Level in Feet

If this mode is selected, the user is prompted to enter the four parameters in the equation, A, B, C and D.

Manning's Equation:
The Manning's Equation is a widely accepted way of calculating the flow in any gravity feed partially full channel of known geometry. Two applications are supported, round pipes and rectangular channels. The equation is in the form of:

$Q = (1.486 / n) * WA * (WA / WP) ^ 0.6667 * (Slope) ^ 0.5$

Where:
Q = Flow in cubic feet per second
n = Roughness Factor
WA = Wetted Area in Feet², cross sectional area of the water at any given depth
WP = Wetted Perimeter in ft, length of bottom and sides that is wet at any given depth
Slope = Slope of channel or pipe, drop in elevation divided by length of drop.

In these modes the user is either prompted to enter the pipe diameter or rectangular channel width, in user programmable units. The WA and WP are automatically calculated based on the diameter or width, and the measured water level.

The roughness factor is determined by the construction material, typical values are:

0.010	Plastic, other smooth surfaces
0.012	Smooth unpainted steel
0.013	Painted steel, coated cast iron
0.013	Clay drainage tile, smooth asphalt
0.013	Finished concrete
0.014	Vitrified clay sewer tile
0.014	Uncoated cast iron
0.017	Unfinished concrete
0.024	Corrugated metal storm drain

Polynomial:
A best fit 3rd order polynomial can also be used to calculate flow. This is useful when you need to find an equation that best fits measured data or a lookup table. The equation is in the form of:

$Q = A + Bh + Ch^2 + Dh^3$

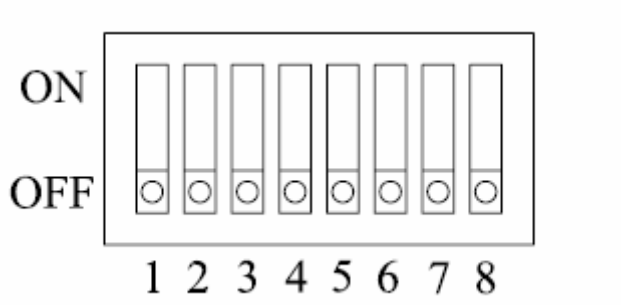
Where:
Q = Flow in cubic feet per second
A - D = User defined coefficients
h = Water level in feet

When selecting this mode, the user is prompted to enter the values for A, B, C and D.

Look-Up Table:
For applications where a single equation does not properly calculate flow, a single look-up table can be programmed into the FC220. This is a factory programmable option only. Data for this table must be provided to Global Water in two columns and no more than 200 lines. The first column is water level in feet and the second column is the flow in cubic feet per second at that water level. Liner interpolation is automatically done when a measured water level is between two data points.

IV. Switch Settings

Inside the FC220 is a bank of 8 switches which are used to select the sensor type and power input. Select the switches as follows:



Select only one of SW1 and SW2, leave the other switch off
SW1: ON, Sensor power is 12 volts
SW2: ON, Sensor power is 18-24 volts depending on the voltage input to the FC220. Note this feature is not available when running from a 12 volt battery

SW3: ON, Sensor power is continuous
SW3: OFF, Sensor power is switched on and off by the microprocessor in power saving mode. If not using power saving mode, set SW3 to ON.

SW4: ON, Sensor type is 4-20mA
SW4: OFF, Sensor type is 0-5 VDC or 0-1 VDC

SW5: ON, Sensor type is 4-20mA or 0-5 VDC
SW5: OFF, Sensor type is 0-1 VDC

SW6: This switch is unused

Select only one of SW7 and SW8, leave the other switch off
SW7: ON, Power input to the FC220 is 18-24 VDC
SW8: ON, Power input to the FC220 is 12 VDC

V. Sensor Input

The FC220 accepts any water level sensor with a 4-20mA, 0-5VDC or 0-1VDC output. Available power for the sensor depends on the power input to the FC220. When powering the FC220 from 12 volts, the sensor power is also 12 volts. If you are running from a power supply of 18-24 volts, the sensor power can be selected from either a regulated 12 volt supply, or directly from the 18-24 volt input. The power can also be connected continuously or it can be set to be turned on and off by the FC220 when using power saving mode. In this mode the sensor is turned on at user defined intervals for a programmable warm-up time, then turned off again to conserve power.

VI. 4-20mA Output

A 4-20mA output is provided that is proportional to water flow. This allows the water flow history to be recorded by an external data logger or PLC, or by the internal data logger option, or both. The output is scalable and allows the user to select the flow rates that are proportional to the 4mA and 20mA output currents.

VII. Relay Operation

Four independently programmable relays are provided for triggering external devices. These outputs are generally intended for triggering water samplers when doing flow proportional sampling, or for recording by an external data logger or PLC. The relays are single pole double throw (SPDT) types with common, normally open and normally closed contacts available at the terminal block inside the FC220. The setup menu allows the user to independently set the volume of water per output pulse, and set a threshold level that inhibits the accumulation of volume when the flow is below a user defined flow rate. The relays are pulsed on for 1 second when the volume of water since the last pulse equals the volume per pulse setting, and the flow rate is above the threshold level. Example: The volume per pulse is set to 100 gallons and the threshold setting is 10 gallons per minute. As long as the flow rate is 10 gallons per minute (GPM) or more, the water volume is counted and one pulse will occur for every 10 gallons. If the flow falls below 10 GPM the counting of water volume will stop until the flow rises above the threshold setting again. If the flow is above 10 GPM long enough to accumulate 5 gallons, then falls below 10GPM, counting stops but the accumulated 5 gallons is retained. When the flow rate rises above 10GPM again, only 5 more gallons is needed to output a relay pulse.

VIII. Power Saving Mode

A power saving mode is provided that allows the operating current to be reduced in remote monitoring applications. One way this is accomplished is to turn off the LCD display backlight, this saves about 20mA of current. Three modes allow the user to turn the backlight on all the time, off all the time, or turn it on for one minute only. In this last mode, the backlight will come on for one minute when any of the buttons on the keypad are pressed, then turn off again. The water level sensor can also be turned on and off periodically to reduce power consumption. The user can program a sample rate of 0-60 minutes, and can set the sensor warm-up time of 0-60 seconds. Example: The sample rate is 30 minutes and the warm-up time is 3 seconds. The sensor will be turned on for 3 seconds every 30 minutes then shut off again. During the time the sensor is off the flow display and 4-20mA output will indicate a flow based on the last level reading. The totalizer will continue to be incremented, and the relays will continue to operate, based on that last reading. After 30 minutes more, a new reading will be taken and the display and 4-20mA output updated again. Note that using the 4-20mA output will increase the current draw by an amount equal to the output current.

IX. Scientific Notation

Scientific notation is generally used for displaying very large or very small numbers. It represents a number as being multiplied by 10 raised to a power, such as 5.67*10^2 being equal to 567 since 10^2 equals 100 ($10^2 = 10^2$). Engineering notation is similar but only uses 10 raised to a power that is a multiple of 3; like 10^3 (one thousand), 10^6 (one million) or 10^9 (one billion). This notation also replaces "*10^" with "E" (Exponent) so that 5.67E2 is equivalent to 5.67*10^2 or 567. The notation E2 is also equivalent to "shift the decimal point to the right two times". This makes the display of large numbers easier to read; 5.67E3 is 5.67 thousand or 5670, 5.67E6 is 5.67 million, etc. In the same way, small numbers less that one can be shown as 10 raised to a negative power, or "shift the decimal point that many times to the left"; such as 5.67E-3 = 0.00567 or 5.67 thousandths, 5.67E-6 = .00000567 or 5.67 millionths.

X. Totalizer

A 9-digit totalizer keeps track of the total volume of water that has accumulated since the last time the totalizer was reset. The totalizer display supports engineering notation and can store volumes up to 1.1E12 cubic feet (1.1 x 10^12 or 1.1 trillion) in any of the

5 selectable volume units. The engineering notation is automatically switched on when the totalizer volume exceeds the capacity of the 9-digit display.

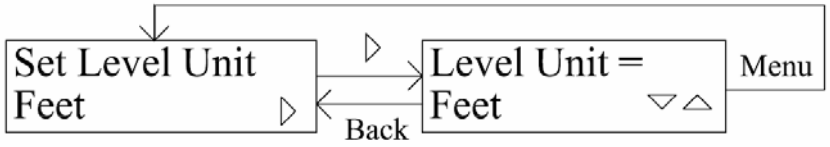
The totalizer reset function is password protected, preventing a user from entering the reset menu. This menu also allows the user to change the password. The password is 4 digits in the range of 0000-9999. When shipped from the factory the default password is 1234. It is recommended that the password be changed before installing the FC220. If the password is lost or forgotten, contact the Technical Support department at Global Water.

XI. Programming Setup Parameters

Press the MENU button for 2 seconds to enter the setup menu. Pressing the MENU button again cycles through the different setup options. Pressing the BACK button moves backward to the previous display. Pressing the DISPLAY button from any menu exits to the normal display mode. Press the RIGHT arrow button to enter any of the setup sub-menus. These sub-menus are Set Level Unit, Set Volume Unit, Set Time Unit, Calibrate Sensor, 4-20mA Output Calibration, Set Site Info, Power Saving, Relay Settings, and Totalizer Reset. Note that while in the setup menus, flow calculations and relay operations will stop. After one minute of inactivity, the FC220 will automatically return to the main display and operation mode.

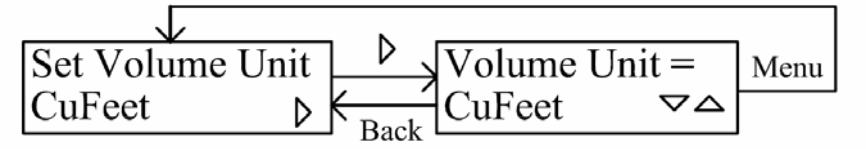
The following three menus set the level, volume and time units used for showing data on the main display. The level unit is used to display the water level. The volume unit is used to display the totalizer, the total volume of flow since last reset. The volume and time units are combined to form the flow units of Volume/Time. Other setup parameters in these menus have independently programmable units. Changing a unit of measure in one menu will not affect the settings in any other menu.

Set Level Unit:



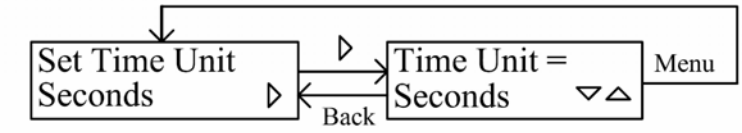
This unit is used to display water level on the main display. The current setting is shown in the Set Level Units menu. Use the RIGHT arrow to change the level units. Use UP and DOWN to select either Feet, Inches, Meters or Centimeters. Press Save to store the new setting.

Set Volume Unit:



This unit is used to display the totalizer volume on the main display. The current setting is shown in the Set Volume Unit menu. Use the RIGHT arrow to change the volume units. Use Up and DOWN to select either Cubic Feet, Gallons, Million Gallons, Cubic Meters, or Liters. Press SAVE to store.

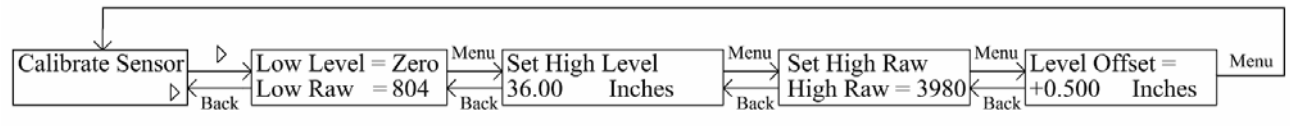
Set Time Unit:



This unit, combined with the volume unit from the previous menu, is used to determine the flow unit on the main display. The current time units are shown in the Set Time Unit menu. Use the RIGHT arrow to change the time units. Use Up and DOWN to select either Seconds, Minutes, Hours or Days. Press SAVE to store.

Example: If the volume unit is set to cubic feet and the time unit is set to seconds, the flow unit is automatically cubic feet per second. There are 20 possible combinations of volume and time units that determine the flow unit.

Calibrate Sensor:

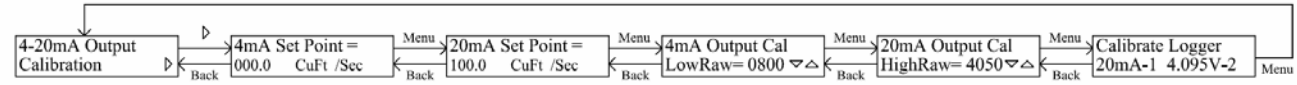


To change or check the sensor calibration press the RIGHT arrow button. To skip the calibration option press the MENU key to move to the next option or press BACK to return to normal display mode.

The low water level is set at zero. Remove the level sensor from the water and press SAVE to store the raw data number for the zero level sensor output. In the case of an ultrasonic sensor, place it at a distance from a target equivalent to the zero water level point. Press MENU to move forward to the High Level option. Place the sensor at a known depth as close to maximum range of the sensor as possible. Use the LEFT and RIGHT arrows to select a digit to modify, then use the UP and DOWN arrows to scroll through digits 0-9 and decimal point. Select just one decimal point if it is needed. In this manner change the High Level numbers to match the depth of the sensor. Use the

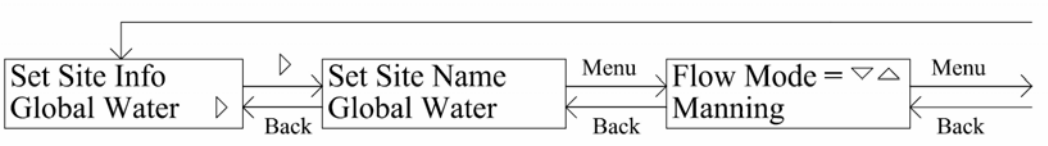
RIGHT arrow to move to the level unit, the units will flash. Use UP and DOWN to select the unit that corresponds to the high level that was just set. Press SAVE to store these settings. Press MENU to move forward. Press the SAVE button to store the raw data value for the high level sensor output. Press MENU to move to the level offset option. The level offset is added to (or subtracted from) the measured water level to correct for errors in installation. For example, if a sensor is installed horizontally in the bottom of a pipe you can add the radius of the sensor housing to make up for the fact that the sensor output will not change until the water level reaches the center. The radius of the WL400 sensor is 0.41" and the radius of the FL400 sensor is 0.50". Use the arrows to set the level offset. Set the first character to either + or – to add or subtract the offset respectively, select the remaining characters from 0-9 and decimal point. Press SAVE to store the offset value.

4-20mA Output Calibration:



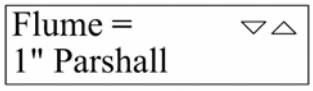
To scale and calibrate the 4-20mA output press the RIGHT arrow key. The 4mA Set Point is the amount of flow that results in an output current of 4mA, generally zero. Use the arrow buttons to change the setting. Use the RIGHT arrow to advance to the volume unit until it flashes. Use UP and DOWN to select the volume unit. Use the RIGHT arrow to advance to the time unit. Use UP and DOWN to select the time unit. Press SAVE to store these settings and MENU to move forward. The 20mA Set Point is the magnitude of flow that causes a 20mA output current. Use the arrow buttons to change the set point value, the units are those selected in the previous menu. Press SAVE to store this setting. Any flow between these two set points will be scaled to the corresponding output current. The next three menus are generally set at the factory and should not need to be changed. The 4mA Output Cal menu allows the 4-20mA output to be set to exactly 4mA. Connect a DC current meter between the 4-20mA output and ground. Use the UP and DOWN arrows to raise and lower the raw data number (and output current) until the current meter reads exactly 4.000mA. Press SAVE and MENU. The 20mA Output Cal menu sets the 20mA output in the same way. Use UP and DOWN to adjust the output until the current meter reads exactly 20.000mA. The Calibrate Logger menu is used to recalibrate the FC220 data logger option only and will be discussed in the section titled Data Logger Option and in the Data Logger Option software manual.

Set Site Info:



The Site Info menu is where the type of flow monitor calculation is defined. A 16 character site name or label can also be added for reference. The current site name is shown in the Set Site Info menu. To change site information press the RIGHT arrow button. Change the site name in the first sub-menu. Use the LEFT and RIGHT arrows to select a character and then scroll through available characters using UP and DOWN. Press SAVE to store and MENU to move forward. The next menu sets the type of flow calculation; use UP and DOWN to choose one of: flume, weir, Manning's Equation (round pipe or rectangular channel), standard flow equation, best fit 3rd order polynomial, or look-up table. Press SAVE to store the flow mode.

Flume:

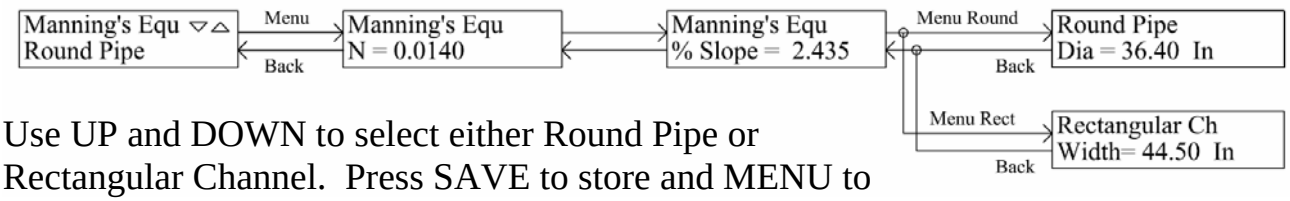


If Flume is selected, the user is prompted to select a flume type from a list of standard flumes. See the specifications section for a list of available flumes. The flow equation parameters are shown in Appendix C. Use UP and DOWN to select the flume type and press SAVE to store the change.

Weir:

If Weir is selected, the user is prompted to select a weir type from a list of standard weirs. See the specifications section for a list of available weirs. The flow equation parameters are shown in Appendix C. Use UP and DOWN to select the weir type and press SAVE to store the change.

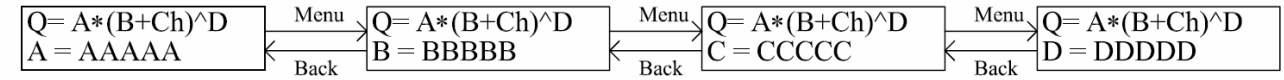
Manning's Equation:



Use UP and DOWN to select either Round Pipe or Rectangular Channel. Press SAVE to store and MENU to advance. To set the roughness index n, use LEFT and RIGHT to select a digit and UP and DOWN to change it. Press SAVE and MENU. In the same manner, enter the slope in percent. Press SAVE and MENU. Enter the diameter of the round pipe or the

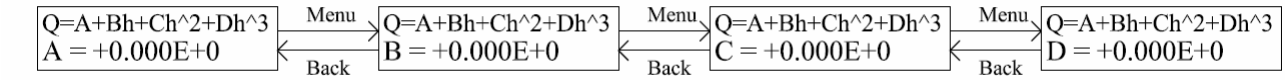
width of the rectangular channel. Use the RIGHT arrow to advance to the units until they flash, use UP and DOWN to select the unit and press SAVE to store the settings.

Standard Flow Equation:



The water flow through most or all flumes and weirs can be described by the equation shown above. Use the MENU, arrow buttons and SAVE to set the parameters A - D. Not all flow equations require all 4 coefficients. If B is not used enter 0.000, if C is not used enter 1.000 as shown above. A and D can also be set to 1.000.

3rd Order Polynomial:

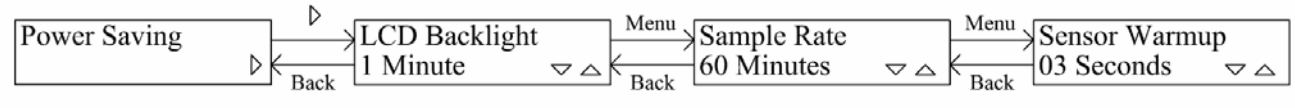


A set of data points such as from a lookup table can be approximated by a polynomial. The 3rd order polynomial shown above can give a very good approximation of flow in many cases. The accuracy of the equation will vary depending on the accuracy and number of the data points. Errors can increase toward the upper and lower ends of the curve. If the normal range of flow is known, the equation coefficients can be adjusted to minimize errors within the measurement range. Near zero flow the approximation can result in negative numbers. While these negative numbers are generally very small, they must be ignored for the purposes of displaying flow and updating the totalizer and 4-20mA output. Any negative number calculated by the polynomial will be considered zero flow. Using the arrow buttons, SAVE and MENU; set the parameters A – D observing the +/- signs. The exponent is one digit in the range of -9 to +9.

Look-Up Table:

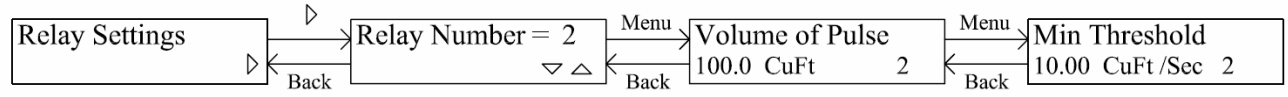
A single lookup table can be selected in cases where an application can't be modeled by an single equation. The lookup table and table name are factory programmable only. A name of up to 16-characters, and lookup table data must be supplied. For more information contact the Technical Support department at Global Water.

Power Saving Mode:



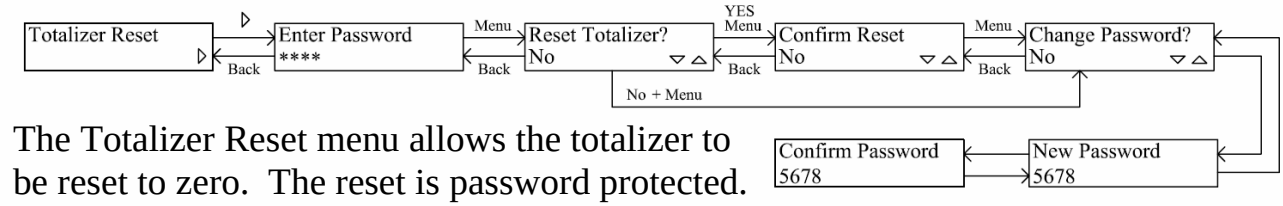
The power saving mode allows the average power consumption to be reduced by controlling the time when the water level sensor and LCD backlight are turned on. To set the power saving parameters, press the RIGHT arrow button. The LCD Backlight has 3 settings, ON turns the backlight on all the time, OFF forces the backlight to be off, and 1 Minute mode will turn the backlight on when any button on the keypad is pressed, then it will turn off again after one minute of inactivity. Use the UP and DOWN arrows and SAVE to set and save the setting. The Sample Rate is the interval between sensor readings (and how often the display and 4-20mA output will be updated). Use LEFT and RIGHT to select a digit and use UP and DOWN to scroll through 0-9, press SAVE to store the setting. The Sensor Warmup time is how long the sensor will be powered on before a reading is taken. Set this parameter in the same manner as the sample rate. In this example the backlight is in 1 minute mode. The sensor will be turned on for 3 seconds every 60 minutes. The display and 4-20mA output will remain on but will continue to indicate the flow that corresponds to the last level measurement. During the time the sensor is off, the totalizer and relays will continue to operate based on the last sensor reading.

Relay Settings:



To modify Relay Settings, press the RIGHT arrow button. Each relay is independent of the others and must be programmed separately. Use the UP and DOWN arrows to select which relay is to be changed, press MENU to move to the next sub-menu. The Volume of Pulse setting is the amount flow needed to generate a relay pulse. The relay number selected is shown at the lower right. If a relay is not used, enter zero and no pulses will be generated. Use LEFT and RIGHT to select a digit, and UP and Down to scroll through the numbers. Use the RIGHT arrow to move to the volume units, select using UP and DOWN. Press SAVE to store the setting. The Minimum Threshold setting inhibits the counting of pulse volume unless the flow rate is above the threshold level. The selected relay number is shown at the lower right. Set the threshold level, volume unit and time unit in the same way, then press SAVE. In the above example, relay 2 will be pulsed for every 100 cubic feet of water as long as the flow rate is over 10 cubic feet per second. Any water flow while the flow rate is below the 10 cubic feet per second threshold will not be counted toward the 100 cubic foot pulse volume.

Totalizer Reset:



The Totalizer Reset menu allows the totalizer to be reset to zero. The reset is password protected. This menu also allows the password to be changed. When shipped from the factory the password is set to 1234. Press the RIGHT arrow to enter the password. Use the LEFT and RIGHT arrows to select each digit, and use UP and DOWN to scroll through the numbers. Press MENU to move forward provided that the password was entered correctly. If the password is lost or forgotten, contact the Global Water Technical Support department. If you want to reset the totalizer counter to zero, use UP or DOWN to select YES, then SAVE. If you do not want to reset the counter, select NO. Press Menu to move forward. If you said YES you must confirm the reset, use UP or DOWN to select yes, then SAVE and MENU. If you want to change the password, use UP or DOWN to select YES, then SAVE and MENU. Use the LEFT and RIGHT arrows to select each digit and use UP and DOWN to scroll through the numbers. Press SAVE and MENU. Confirm the new password by entering it again in the same manner as before.

XII. Data Logger Option

A factory option for the FC220 is an internal data logger which records a historical record of water flow, and records the exact time of each relay pulse. Channel one of the data logger records flow and channel two records relay events. A special software package allows the programming of the logger and the download of recorded flow and relay data. This software differs from other Global Water data logger software in the way it processes the relay data. Software such as Global Logger II will work with the FC220 data logger option but some relay information will not be seen. The data logger is factory calibrated and should not need to be recalibrated again. Should you need to recalibrate the logger, consult the Data Logger Option manual.

XIII. Maintenance and Troubleshooting

a. Global Water recommends verifying the sensor's calibration every 6 months.

b. The screen on the end of the sensor must be periodically checked for clogging from mud, sludge, and other debris. Wash the screen with clean water and/or scrub it gently with a toothbrush. Do not insert objects through the screen, as this may cause damage to the sensor.

c. In battery operated systems it is recommended that the battery be replaced every 3-4 years, more often in harsh environments or when the battery is allowed to be completely discharged.

Trouble Shooting

d. Verify that the power source is supplying correct voltage to the FC220 and to the sensor.
e. Make sure that the vent tube has not been kinked or sealed. The sensor uses this tube to compensate for barometric pressure changes.
f. Check the sensor's calibration.
g. Clean the sensor following the maintenance instructions.

Testing the sensor:

To check the level sensor calibration separate from the flow monitor, you will need:

1 column of water (the closer the depth is to the maximum range of the sensor the better the calibration will be)
1 power supply
1 current meter
Connecting wires as necessary

Unplug the Flow Meter and disconnect the sensor. Connect the sensor to the power supply and current meter in the following way. Attach the black wire to the positive input of the current meter. Connect the ground terminal of the power supply to the ground of the current meter. Attach the red wire to the positive terminal of the power supply.

See Appendix A. **Warning:** Always connect the sensor with the power turned off.

At zero feet (out of water), the sensor should output approximately 4mA. This can be read directly on the current meter or, if using the voltmeter method, the meter should read 0.5 volts across a 125 ohm resistor. At the maximum water depth of the sensor, the sensor should output approximately 20mA or 2.50 volts across the 125 ohm resistor.

Issue: Water in the vent tube

a. If water gets into the vent tube the water level readings can show very large errors and can be erratic. If water gets into the vent tube of the cable place it next to a heater for 24 hours to dry the inside of the cable.

Other issues

a. Call Global Water for tech support: 800-876-1172 or 916-638-3429 (many problems can be solved over the phone). Fax: 916-638-3270 or Email: **globalw@globalw.com.**

   When calling for tech support, please have the following information ready;

   1. Model #.
   2. Unit serial number.
   3. P.O.# the equipment was purchased on.
   4. Our sales number or the invoice number.
   5. Repair instructions and/or specific problems relating to the product.

   Be prepared to describe the problem you are experiencing including specific details of the application, installation, and any additional pertinent information.

b. In the event that the equipment needs to be returned to the factory for any reason, please call to obtain an RMA# (Return Material Authorization). Do not return items without an RMA# displayed on the outside of the package.
   Clean and decontaminate the FC220 if necessary.
   Include a written statement describing the problems.

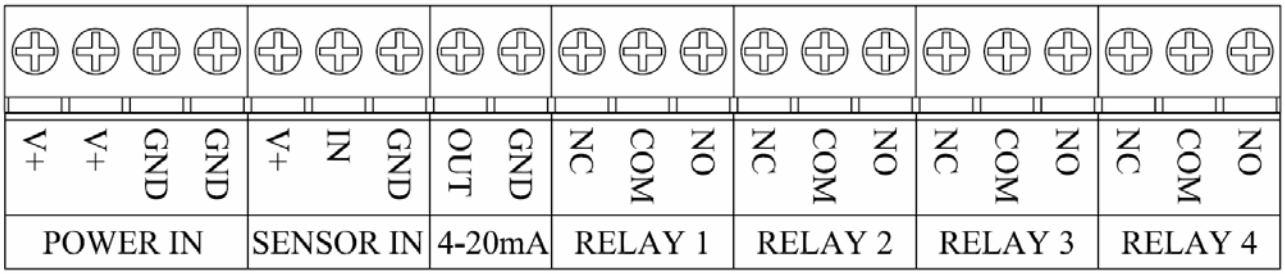
Send the package with shipping prepaid to our factory address. Insure your shipment, Global Water's warranty does not cover damage incurred during transit.

Warranty

a. Global Water Instrumentation, Inc. warrants that its products are free from defects in material and workmanship under normal use and service for a period of one year from date of shipment from factory. Global Water's obligations under this warranty are limited to, at Global Water's option: (I) replacing or (II) repairing; any products determined to be defective. In no case shall Global Water's liability exceed the products original purchase price. This warranty does not apply to any equipment that has been repaired or altered, except by Global Water Instrumentation, Inc., or which has been subject to misuse, negligence or accident. It is expressly agreed that this warranty will be in lieu of all warranties of fitness and in lieu of the warranty of merchantability.

b. The warranty begins on the date of your invoice.

XIV. Appendix A: Terminal Strip Diagram



POWER IN:

V+ 12VDC or 18-24VDC Input

V+ 12VDC or 18-24VDC Input

12VDC Input: SW7 OFF, SW8 ON

18-24VDC Input: SW7 ON, SW8 OFF

GND Power Supply and System Ground

GND Power Supply and System Ground

SENSOR IN:

V+ Sensor Power

12VDC Sensor Power: SW1 ON, SW2 OFF

18-24VDC Sensor Power: SW1 OFF, SW2 ON

(18VDC Power Input Only)

IN Sensor Input

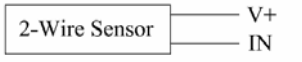
Sensor Power Continuous: SW3 ON

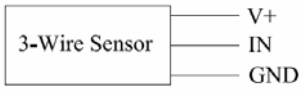
Sensor Power Switched: SW3 OFF (Power Saving Mode)

4-20mA Sensors: SW4 ON, SW5 ON

0-5VDC Sensors: SW4 OFF, SW5 ON

0-1VDC Sensors: SW4 OFF, SW5 OFF



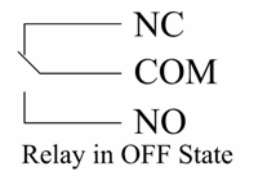


4-20mA:

OUT 4-20mA Output

GND Power Supply and System Ground, 4-20mA return Path

RELAY 1-4:



XV: Appendix B: Flume and Weir Equation Parameters

		EQ Type:	1 = Flow Q=A*(B+Ch)^D Q=A+Bh+Ch^2+Dh^3	2 = Poly	
Flumes	EQ Type	A	B	C	D
0.5 H Flume	1	1.600	0.000000	1	2.200
0.75 H Flume	1	1.770	0.000000	1	2.230
1.0 H Flume	1	1.950	0.000000	1	2.300
1.5 H Flume	1	2.120	0.000000	1	2.300
2.0 H Flume	1	2.370	0.000000	1	2.230
1" Parshall	1	0.338	0.000000	1	1.550
2" Parshall	1	0.676	0.000000	1	1.550
3" Parshall	1	0.992	0.000000	1	1.550
6" Parshall	1	2.060	0.000000	1	1.580
9" Parshall	1	3.070	0.000000	1	1.530
12" Parshall	1	3.950	0.000000	1	1.550
24" Parshall	1	8.000	0.000000	1	1.550
36" Parshall	1	12.000	0.000000	1	1.570
48" Parshall	1	16.000	0.000000	1	1.580
60" Parshall	1	20.000	0.000000	1	1.590
72" Parshall	1	24.000	0.000000	1	1.590
4" Palmer-Bowlus	1	1.730	0.005880	1	1.957
6" Palmer-Bowlus	1	2.071	0.005421	1	1.903
8" Palmer-Bowlus	1	2.537	0.014560	1	1.972
10" Palmer-Bowlus	1	2.843	0.016160	1	1.953
12" Palmer-Bowlus	1	3.142	0.017000	1	1.936
15" Palmer-Bowlus	1	3.574	0.016800	1	1.906
18" Palmer-Bowlus	1	3.988	0.018750	1	1.898
24" Palmer-Bowlus	1	4.574	0.040800	1	1.950
30" Palmer-Bowlus	1	5.022	0.062500	1	1.966
36" Palmer-Bowlus	1	5.462	0.080000	1	1.991
60º Trapezoidal	1	1.550	0.000000	1	2.580
0.4HS	2	-3.48332E-05	2.10389E-03	3.51517E-01	4.39885E-01
0.6HS	2	-7.52381E-05	8.29552E-03	4.01877E-01	3.79339E-01

Weirs	EQ Type	A	B	C	D
1.0' Rectangular	1	3.333	0.000000	1	1.500
2.0' Rectangular	1	6.667	0.000000	1	1.500
3.0' Rectangular	1	10.000	0.000000	1	1.500
22.5º V-Notch	1	0.505	0.000000	1	2.500
30º V-Notch	1	0.676	0.000000	1	2.500
45º V-Notch	1	1.028	0.000000	1	2.500
60º V-Notch	1	1.420	0.000000	1	2.440
90º V-Notch	1	2.490	0.000000	1	2.475
120º V-Notch	1	4.333	0.000000	1	2.500
0.5' Cipolletti	1	1.684	0.000000	1	1.500
1.0' Cipolletti	1	3.367	0.000000	1	1.500
1.5' Cipolletti	1	5.051	0.000000	1	1.500
2.0' Cipolletti	1	6.374	0.000000	1	1.500
3' Cipolletti	1	10.101	0.000000	1	1.500
4' Cipolletti	1	13.468	0.000000	1	1.500