

McMillan

C•O•M•P•A•N•Y

MANUFACTURERS OF AFFORDABLE
FLOW SENSORS, METERS & CONTROLLERS

OPERATING MANUAL

Model 220 Digital Rate Meter & Totalizer



Literature Request No.:
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! CAUTION !
PLEASE READ INSTRUCTION MANUAL
BEFORE USE OF DISPLAY!

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Section I. UNPACKING YOUR DISPLAY.....

1.a Checking for external damage to shipment

Your Model 220 Display was packed by the manufacturer in such a way that you should receive it with no damage. If external damage is noted upon receipt of the package, please contact the shipping company (*not McMillan Company*) immediately. McMillan Company will not be liable for damage to the meter once it has left the manufacturing premises.

1.b Unpacking the display

After external inspection of the product, proceed to open the package from the top, taking care not to cut too deep. Remove all documentation (if any) resting on top of the packing peanuts. Inspect all products for concealed shipping damage. If damage is noted, please contact the shipping carrier and/or McMillan Company to resolve the problem.

When unpacking the products from the shipment, please take care to remove *all* products from the box. Check thoroughly for extra cables, power adapters, and other options listed on the packing slip, if any.

1.c Cautions against damaging the unit

Any damage inflicted on the display by the customer will not be repaired under warranty by McMillan Company. See Section 6 for more information.

Section II. INSTALLING YOUR MODEL 220.....

2.a Mounting the display

When choosing a place to mount the display, keep these three things in mind:

- The display should not be mounted near a solenoid or other inductive device.
- Enough ventilation should be supplied to keep the totalizer operating within the temperature specifications (see Section 5).
- This display should not be mounted in a heavy vibration area.

The recommended mount for the Model 220 display is panel-mount. The recommended panel cutout for the display is 2.677" wide (68 mm) by 1.299" tall (33 mm).

To install the unit in a panel-mount, first remove the two fasteners located on the side of the unit. These slide tightly in grooves and should slide out without too much trouble. **DO NOT MISPLACE THESE FASTENERS!!!**

With the fasteners removed, the display should slide into the panel cutout. The included gasket should be between the panel and the face of the display. Making sure the gasket is properly aligned and not twisted, slide the display in place. Reinstall the fasteners by sliding them in their grooves until they stop. The screws on the fasteners should be facing towards the back of the display, with the pointed end facing the panel and the head of the screw facing away from the panel.

Tighten the set screws of the fasteners using a flathead screwdriver in a clockwise motion. They should be equally tightened until the display is snug and the gasket is reasonably compressed.

When mounted with the provided fasteners, gasket, and specified rectangular panel cutout, the Model 220 display achieves a NEMA-4X rating.

2.b Electrical connections to the display

The Model 220 is self-powered using an internal lithium battery. There is, then, no need for external power. The typical life of this battery is 5 years.

After connections are made, power the display by removing the temporary insulator on the back of the unit. Simply pull the white tab out — there is no need to open the battery cover.

Pin #1	Pin #2	Pin #3	Pin #4	Pin #5
Signal & Reset Ground	Not Used	Signal In (Pulse Input)	Remote Reset (optional)	Enable Program Mode

Pin #1: This pin should be connected to the ground of the pulse signal. In most cases, this will be the same as the ground of the Flo-Sensor that the Model 220 Display is connected to.

Pin #2: This pin is not used with any McMillan Company products.

Pin #3: This is the pulse signal input. The Model 220 accepts all 100T/101T/102T/105 Series Flo-Sensor pulse outputs. These are 7.5VDC peak square-wave pulses directly proportional to the flow rate.

Pin #4: This pin is used for remote reset. When momentarily connected to ground, this pin will reset the totalizer just like the front panel reset button.

Pin #5: This pin is used to enter program mode. When connected to the ground, the Model 220 enters program mode, described in Section 3.

Pin #6 - Pin #8: These pins are not functional.

See Appendix A for wiring diagrams of connections to various Flo-Sensors and other products.

Section III. PROGRAMMING THE 220.....

The McMillan Company Model 220 Display is a versatile meter that will indicate flow rates and totalize flow in virtually any unit of measurement. To do this, it uses 2 numerical factors (programmed by the user) to customize and match each display with each particular Flo-Sensor.

To successfully program this display, you must first understand how it works and what you are programming into it. Program mode uses six different screens to program rate and total flow. They are used as follows:

TOTALIZER FUNCTION:

Screen #1: The significant digits of the Totalizer Multiplier are entered here. The Model 220 uses these to calculate total flow.

Screen #2: This screen is simply a decimal placer. Since only the significant digits of the Totalizer Multiplier are entered in screen #1, this allows you to make up for the insignificant zeros not entered there.

RATE FUNCTION:

Screen #3: The significant digits of the Rate Multiplier are entered here. The Model 220 uses these to calculate current rate of flow.

Screen #4: This screen is another decimal placer. Since only the significant digits of the Rate Multiplier are entered in screen #3, this allows you to make up for the insignificant zeros not entered there.

MISCELLANEOUS:

Screen #5: This screen should always read "1". It is not used with any McMillan Company Flo-Sensors.

Screen #6: This screen enables/disables the front panel reset button.

To understand the insignificant/significant digit importance, you must understand that many of your Rate and Totalizer Multipliers will be very small, with several zeros in front of them, such as 0.0001234. However, screens 1 and 3, where those numbers are entered, will only allow 6 and 4 digits, respectively. There is, therefore, no room for those preceding zeros. For each zero removed, the decimal place in the following screen shifts one left. This is further described in Section 3.d.

3.a Entering Program Mode

In order to program the factors into the display, it must first be put into program mode (of course, the unit must be powered, see Section 2.b). To do this, simply connect the ground input (pin #1) to the enable program input (pin

#5) with a short wire, jumper, or alligator clip. Make sure the connection will hold well enough for you to program a series of numbers into the unit. When you are finished and wish to exit program mode, simply remove the connection.

Since the Model 220 operates on pulse inputs, the pulse output (frequency) of the Flo-Sensor at 100% flow must be determined. This number is located in one of three places:

1. On a tag attached to a fitting of the Flo-Sensor
 2. On a calibration data sheet, included with the Flo-Sensor
 3. On a label near the connector of the Flo-Sensor
- The label should provide pulse output (PPS) information of that particular Flo-Sensor at the rated 100% flow of the Flo-Sensor. For example, for a Model 101-7 Flo-Sensor, rated from 0.1 to 2.0 L/min, you would need the pulse output data of that Flo-Sensor at 2.0 L/min. (The pulse output is usually given when the voltage output is 5.00 VDC, or 100% flow.)

NOTE: If this tag listed the pulse rate is missing, please contact McMillan Company for pulse output information on that particular Flo-Sensor. Please provide the model number, serial number, and flow range of the Flo-Sensor you are requesting information on. It is also possible to determine the pulse output frequency by using a volt meter and the Model 220 together. Using methods of programming described in Section 3.d, set screen #3 to read "1.000" and screen #4 to read "0000". Hook the volt meter up to the analog voltage output of the Flo-Sensor. Using the voltage output as a guide, provide enough flow through the sensor to where the sensor outputs 5.00 VDC. Place the 220 in rate mode and the number displayed will be the pulse output of the sensor at 100% rated flow.

3.b Figuring the Rate Multiplier

The Rate Multiplier is the number that the Model 220 uses to interpret pulses into rate. To determine this factor, first convert the 100% flow rate of the Flo-Sensor (listed in the manual of the Flo-Sensor) into the units in which you wish the Model 220 to display rate. Use the following formula to figure the Rate Multiplier:

$$\frac{100\% \text{ Rated Flow}}{\text{Time Unit}} \times \frac{\text{New Flow Unit Factor}}{\text{New Time Unit Factor}} \times \frac{1}{\text{Pulse Output (PPS)}}$$

where 100% Rated Flow = 100% flow rate of Flo-Sensor, where pulse output is given (Ex: 2.0 L)

Time Units = time units of 100% Rated Flow (Ex: 1 min.)

Pulse Output = Marked pulse output of sensor at 100% Flow (PPS)

New Flow Unit Factor = see table below

New Time Unit Factor = see table below

TIME UNIT FACTOR

<i>Current Time Unit</i>	<i>Desired Time Unit</i>	<i>Factor</i>
minutes	seconds	60.00
minutes	minutes	1.00
minutes	hours	0.016667
minutes	days	0.0006944
hours	seconds	3600.00
hours	minutes	60.00
hours	hours	1.00
hours	days	0.0416667

FLOW UNIT FACTOR

<i>Current Flow Unit</i>	<i>Desired Flow Unit</i>	<i>Factor</i>
ml (milliliters)	ml	1.0000
ml	L	0.0010
ml	US Gallons	0.00026418
ml	Fluid Ounces	0.033814
L (liters)	ml	1000.0
L	L	1.0000
L	US Gallons	0.26418
L	Fluid Ounces	33.814
US Gallons	ml	3785.4
US Gallons	L	3.7854
US Gallons	US Gallons	1.0000
US Gallons	Fluid Ounces	128.0000

If this all seems confusing, please note the following examples:

EXAMPLE ONE

A certain Model 101-7 Flo-Sensor is rated from 0.1-2.0 L/min. The pulse output of that particular sensor is 274 PPS @ 2.0 L/min (each sensor will vary in pulse output). You want the Model 220 to display rate in mL/min. The formula would look something like this:

$$\frac{2}{1} \times \frac{1}{1} \times \frac{1}{274} = 0.0072993$$

EXAMPLE TWO

A certain Model 102-9 Flo-Sensor is rated from 1.0-10.0 L/min. The pulse output of that particular sensor is 473 PPS @ 10.0 L/min (each sensor will vary in pulse output). However, you want the Model 220 to display rate in Gallons/min. The formula should be used this way:

$$\frac{10}{1} \times \frac{0.26418}{1} \times \frac{1}{473} = 0.005585$$

EXAMPLE THREE

A certain 105-5G Flo-Sensor is rated from 1-10 GPH. The pulse output of that particular sensor is 347 PPS @ 10 GPH (each sensor will vary in pulse output). However, you wish the Model 220 to display rate in mL/second. Use the formula like this:

$$\frac{10}{1} \times \frac{3785.4}{3600} \times \frac{1}{347} = 0.030303$$

When you derive your particular Rate Multiplier using the formula and/or examples above, write it down -- it will be entered into screen #3 of the Model 220 later.

3.c Figuring the Totalizer Multiplier

The Totalizer Multiplier is the number that the Model 220 uses to interpret pulses into total flow accumulated. To determine this factor, first convert the 100% flow rate of the Flo-Sensor (listed in the manual of the Flo-Sensor) into the units in which you wish the Model 220 to display total flow. Use the following formula to figure the Totalizer Multiplier:

$$\frac{100\% \text{ Rated Flow}}{\text{Pulse Output (PPS)}} \times \frac{\text{New Flow Unit Factor}}{\text{Totalizer Time Factor}}$$

where 100% Rated Flow = 100% flow rate of Flo-Sensor, where pulse output is given (Ex: 2.0 L)

Pulse Output = Marked pulse output of sensor at 100% flow (PPS)

New Flow Unit Factor = see table on page 6

Totalizer Time Factor = see table below

TOTALIZER TIME FACTOR

<i>Time Unit Sensor was Calibrated For</i>	<i>Totalizer Time Factor</i>
minutes	60
hours	3600

If this seems complicated, take a look at these examples:

EXAMPLE ONE

A certain Model 101-7 Flo-Sensor is rated from 0.1-2.0 L/min. The pulse output of that particular sensor is 274 PPS @ 2.0 L/min (each sensor will

vary in pulse output). You want the Model 220 to display total flow in mL. The formula would look something like this:

$$\frac{2}{274} \times \frac{1}{60} = 0.0001216545$$

EXAMPLE TWO

A certain Model 102-9 Flo-Sensor is rated from 1.0-10.0 L/min. The pulse output of that particular sensor is 473 PPS @ 10.0 L/min (each sensor will vary in pulse output). However, you want the Model 220 to display total flow in Gallons. The formula should be used this way:

$$\frac{10}{473} \times \frac{0.26418}{60} = 0.0000930867$$

EXAMPLE THREE

A certain Model 105-5G Flo-Sensor is rated from 1-10 GPH. The pulse output of that particular sensor is 347 PPS @ 10 GPH (each sensor will vary in pulse output). However, you wish the Model 220 to display total flow in mL. Use the formula like this:

$$\frac{10}{347} \times \frac{3785.4}{3600} = 0.030303$$

3.d Programming the Rate and Totalizer Multipliers into the Model 220

Once in program mode as described in Section 3.a, the Model 220's display should read a "1" on the far left. On the right, you should see "01.0000" with the far right digit flashing (it may read a different value if it has been previously programmed). You are now on screen #1, where the significant digits of the Totalizer Multiplier are entered.

First, you must determine which digits are significant. As you can see, only 6 digits can be programmed into screen #1. You must choose the 6 most important, or the 6 farthest left that are not zeros. The following chart shows examples of totalizer multipliers and which numbers you would actually enter:

Totalizer Multiplier	Value to Enter in Scrn #1
.0002499	24.9900
.003456789	34.5679
.000098765	98.7650
1.66666667	16.6667

To program your significant digits in, use the RST button to set the flashing digit and the T/R button to select the flashing digit.

When you have completed screen #1, move on to screen #2 by pressing both the T/R button and the RST button simultaneously. The far left digit on the screen should now read "2".

Screen #2 allows you to make up for the decimal places you lost by only entering the significant digits in screen #1. To determine the decimal place for screen #2, divide the exact number you entered in screen #1 by the actual Totalizer Multiplier. For example, if your Totalizer Multiplier is .009567, you should have entered "95.6700" in screen #1. To determine screen #2, divide 95.67 by .009567, which gives you 10000. The result, in this case 10000, determines how many zeros after the decimal point you should have in screen #2. Since 10000 contains 4 zeros, screen #2 should have 4 zeros after the decimal point; screen #2 would read "00.0000". If the result of dividing screen #1 by the actual Totalizer Multiplier equals one, then screen #2 should not have a decimal point.

To select the decimal point, use the RST button. Each press of the button will move the decimal point one to the right. When you have selected the correct decimal position, press both the RST and the T/R button to go on to screen #3. Once you have done this, the far left digit of the screen should read "3".

Screen #3 allows you to enter the significant digits of the Rate Multiplier. It, however, is limited to only 4 digits. Select the significant digits of the Rate Multiplier using the same method as you used for the Totalizer Multiplier, except this time selecting 4 digits instead of 6.

Enter the digits much in the same way as you did for the Totalizer Multiplier. The RST button sets the flashing digit and the T/R button selects the flashing digit. The difference is that screen #3 will also allow you to set the decimal place of the Rate Multiplier. Usually, it is best to move the decimal point on this screen as far to the left as possible (it will only go as far left as X.XXX). For instance, if your Rate Multiplier is 1.234, then that exact value could be entered into this screen. If your Rate Multiplier is something like .0004567, though, then you would want to enter 4.567 in this screen. However, if your Rate Multiplier is more than 9, such as 57.6789, then you would want to enter 57.68 in as your value, not 5.768.

To program this value into the Model 220, use the RST button to set the flashing digit and the T/R button to select the flashing digit. Once you have cycled through the digits once, a "d" appears on the far right of the display. This signifies that the Model 220 is ready to accept the decimal position of this screen. Move the decimal point as far left as possible for your value using the RST button. When this is completed, move on to screen #4 by pressing both

the T/R button and the RST button simultaneously. The far left digit on the screen should now read "4".

Screen #4 makes up for any lost decimal places in screen #3. For this screen, divide the exact number you entered in screen #3 by the actual Rate Multiplier. For example, if your Rate Multiplier is .004321, you should have entered "4.321" in screen #3. To determine screen #4, divide 4.321 by .004321, which gives you 1000. The result, in this case 1000, determines how many zeros after the decimal point you should have in screen #4. Since 1000 contains 3 zeros, screen #4 should have 3 zeros after the decimal point; screen #4 would read "0.000". If the result of dividing screen #3 by the actual Rate Multiplier equals one, then screen #4 should not have a decimal point.

When this is completed, move on to screen #5 by pressing both the T/R button and the RST button simultaneously. The far left digit on the screen should now read "5".

The far right value of screen #5 should be "1". If it reads "10", press the RST button to change it to "1". When this is completed, move on to screen #6 by pressing both the T/R button and the RST button simultaneously. The far left digit on the screen should now read "6".

Screen #6 allows you to disable/enable the front panel reset button. This button resets the totalizer value to zero. If you wish to disable this button, use the RST button to make screen #6 read "no R". If you wish the button to operate, screen #6 should read "R".

NOTE: If the front panel reset button is disabled, the totalizer may still be reset by connecting the rear terminal pin #4 (RST) to pin #1 (GND).

When you are finished programming the Model 220, disconnect the programming jumper (running from pin #1 to pin #5).

3.e Making minor changes in calibration (of the display)

If you notice a small error in the display of either rate or total flow, a small change in the Rate or Totalizer Multiplier may correct the problem. To establish the error, you must provide a constant, steady signal to the Model 220 Display. This usually means putting a steady, constant flow through the Flo-Sensor that the display is connected to. Higher flows (within the flow range of the Flo-Sensor) will allow you to more accurately correct the error.

To recognize the error, the display should be in normal operating mode, not programming mode. With a constant signal, the Model 220 will display a constant rate and will totalize flow steadily. If you are experiencing a minor error in the Rate display, set the display to show rate (see Operating

Instructions). If you are experiencing a minor error in the Total Flow display, then set the display to show total flow.

With the display in the correct mode, measure the amount of flow passing through the Flo-Sensor in exactly one minute. Compare this to what the Model 220 shows. If there is a small error, correct it by dividing the actual flow by the indicated flow. Take that result and multiply it by the factor located in screen #1 or screen #3, the Totalizer Multiplier and Rate Multiplier screens, respectively. If you are correcting a minor error in the Totalizer function, then multiply it by the factor in screen #1. If you are correcting a minor error in the Rate function, then multiply that number by the factor in screen #3. The final result should be programmed into the appropriate screen as outlined in Section 3.d. No decimal points should need to be moved for corrections of minor errors.

As an example, a Model 220 display indicates a flow rate of 5.0 L/min when the flow rate is actually 5.2 L/min. If you divide 5.2 by 5.0, you get approximately 0.962. The Rate Multiplier in screen #3 is currently 1.345. If you multiply 0.962 by 1.345, you arrive at 1.294. This number should then be programmed into screen #3, and the minor error will be corrected.

Section IV. OPERATING INSTRUCTIONS.....

The entire operation of the Model 220 is dependent on the two buttons located on the front panel. The unit will not operate in programming mode. If it is currently in program mode (with a jumper from pin #1 to pin #5), then remove the jumper and the Model 220 will automatically exit program mode and return to normal operation.

Two screens are available on the Model 220. The Totalizer screen displays the accumulated pulse inputs, or total flow. This unit will totalize up to 8 digits, automatically blanking any leading zeros. The Rate screen shows the current process, or flow rate, passing through the Flo-Sensor the display is connecting to. This screen updates every 0.7 seconds. To determine which mode you are currently in, look at the far left of the display. If the letter "R" is displayed there, then the Model 220 is displaying rate. If there is no "R", then the display is showing total flow. To toggle between the two modes, press the T/R button.

If you are currently in Rate mode, the RST button and/or reset terminal have no effect. If you are operating in Totalizer mode, then the RST button will reset the totalizer back to zero. If this button has no effect, it may be disabled (see Programming Instructions). The totalizer may also be reset by momentarily connecting pin #4 (on the rear of the unit, RST) to pin #1 (also on the rear, GND). This function cannot be disabled.

If the totalizer is not reset before all 8 digits read "9", then it will roll over back to zero and continue monitoring total flow.

Section V. SPECIFICATIONS.....

Power:	<i>Internal battery: 3VDC, lithium Typical life expectancy of five years Replacement Part: 220-01-01</i>
Physical:	<i>Operating Temperature: 0-55 °C Operating Humidity: 90% Non-Condensing Weight: 2.2 oz. Net Display Size: 0.43" high Front Panel Rating: NEMA-4X, when mounted as directed Case Material: Cylolac X-17 CE Approval: EN55011, EN50082-1(both under 89/336/EEC)</i>
Totalizer:	<i>Type: 8-digit, Up counting Scaler: 0.0001-100.0000 (0.0000 scales by 100) Decimal Point: 5 positions, programmable</i>
Rate:	<i>Type: 1/Tau, 4-digit Scaler: 0.001-9999 Decimal Point: 5 positions, programmable Accuracy: ±0.2% Update Time: 0.7 seconds Zero Time: 10 seconds</i>
External Reset Input:	<i>Location: Rear of unit, pin #4 (RST) Min. Low Time: 110 msec Min. High Time: 190 msec</i>
Count Input:	<i>Location: Rear of unit, pin #3 (IN A) Speed: 10 kHz @ 50% duty cycle Impedance: 27 kOhm at 3.0 VDC Voltage Thresholds: High -- 1.0VDC (Max) Low -- 0.7VDC (Min)</i>

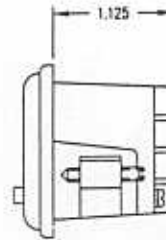
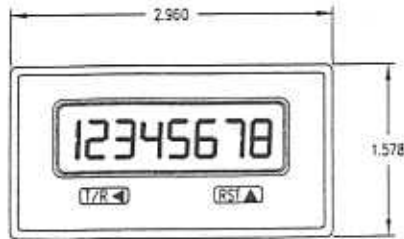
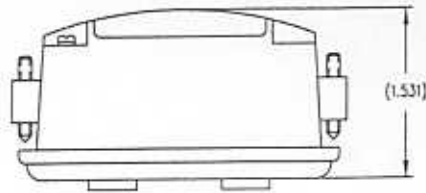
Section VI. GUARANTEES.....

If at any time within one year of shipment, but not thereafter, it is proved that any part of the equipment furnished by us was defective when shipped by us, we will replace the same free of charge, F.O.B. our plant. Notice of this claim must be made to us within one year after delivery. Our liability is limited to replacement of such defective parts or equipment. There are no guarantees or warranty expressed or implied other than those herein specifically mentioned.

McMillan Company shall herein not in any event be liable for any consequential damages, secondary charges, expenses for erection or disconnecting, or losses resulting from any alleged defect in the apparatus.

It is understood that corrosion or erosion of materials is not covered by our guarantee. Batteries are not covered by our guarantee.

Appendix B. DIMENSIONS.....



Appendix C. RETURN INFORMATION.....

If it is necessary to return a McMillan Company product for service or repair, please contact us at:

McMillan Company
Customer Service Department
7075 RR 2338
P.O. Box 1340
Georgetown, Texas 78628 U.S.A.
Phone: (512) 863-0231
Fax: (512) 863-0671

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