INFORMER+

Totalizer/Rate Indicator

PT-301

Operation Manual

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PT-301

INFORMER+

Totalizer/Rate Indicator

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Introduction

About This Manual

This instruction manual provides information specific to the PolarTek 2000 PT-301 and Informer+ Flow Totalizers and Rate Indicators. Other peripheral equipment should be supplied with its own instruction manual and that manual should be referred to for proper operation of the peripheral equipment.

It is essential that this manual be read and understood for proper installation and operation of your PT-301/Informer+.

This manual includes:

INTRODUCTION:	Briefly describes the key features of the PT-301/ Informer+.
INSTALLATION:	Detailed description of mounting and connection.
PROGRAMMING:	Describes the method for setting the K-Factor, display options, and other operational parameters.
OPERATION:	Describes the normal operation of the PT-301/ Informer+.
TROUBLESHOOTING:	Describes several quick problem solving techniques.
SPECIFICATIONS:	Describes the physical and operational characteristics.
TECHNICAL REFERENCE:	Provides supplementary technical information.
INFORMER+ MODBUS COMMUNICATIONS:	Provides the necessary information to use the Modbus functions of the Informer+. This section does not apply to the PT-301.

About the PT-301/Informer+

The PT-301/Informer+ is a low cost flow totalizer and rate indicator. The PT-301/Informer+ accepts input pulses from a turbine meter, and uses those pulses to calculate the flow volume and flow rate in a pipeline. The PT-301/Informer+ displays both values at the same time on an adjustable contrast LCD display. In addition to displaying these values, the PT-301/Informer+ can provide: a flow rate proportional 4-20mA output signal; a flow total proportional scaled pulse output signal; and Modbus communications (Informer+ *only*) for remote access. Programming and operation is as easy as a digital watch. The PT-301/Informer+ maintains a 36 day cumulative log of the flow totals for easy access to flow history. For true stand alone operation the PT-301/Informer+ can use a 3.6V lithium battery pack with an average life span of 3 to 5 years with the pulse output signal turned off.

These features combine to make the PT-301/Informer+ a simple solution to your flow measurement needs.

Please refer to the Installation section of this manual for directions on how to connect and set up the PT-301/Informer+.

Main Features

Enclosure:	CSA approved for Class1, Div. 1, Groups BCD, NEMA 4
Input/Output:	Turbine input from 2Hz to 5.0kHz at 25mVp-p minimum at 2Hz. Very high noise rejection at default input sensitivity with an adjustment to increase noise rejection if necessary. Flow total and flow rate are displayed at the same time on an adjustable contrast LCD display. Rate proportional 4-20mA loop power, optically isolated scaled pulse output, and Modbus communications (Informer+ *only*) for remote access.
Reliability:	Built using industrial specified components to ensure long life and high reliability even in harsh conditions.
Programming:	The PT-301/Informer+ is designed to be as easy to program as a digital watch. The programmable features are K-Factor (0000.0001 to 99 999 999 with up to 4 decimal digits), K-Factor units (for internal conversion to displayed units), Flow total decimal position (0 to 4 digits), Flow rate decimal position (0 to 3 digits), displayed flow units (for internal conversion from K-Factor units), Flow rate time base, 10-point linearization parameters, 4-20mA zero and span, scale for the pulse output, Modbus ID (Informer+ *only*), Display contrast level, and Security Lockout Code.
Memory:	All parameters, log entries, and the Security Lockout Code are store in nonvolatile memory to ensure that, even if the unit loses power, no loss of information occurs.
Upgrading:	The PT-301 can be upgraded to allow Modbus communications, making it an Informer+. Please contact your distributor for information.

Installation

Installation must be performed in compliance with local governing regulations by qualified personnel.

Environmental

Choose a mounting location suited to the PT-301/Informer+ enclosure.

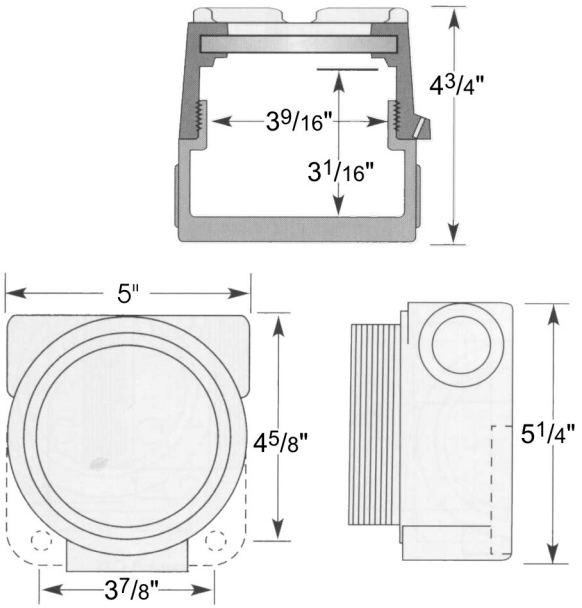
The ideal PT-301/Informer+ mounting location is where the:

1. Turbine pick-up is as close as possible.
2. Mounting surface has minimal vibration.
3. Abient temperature is always within -40°C to +65°C (-40°F to +149°F).
4. Cable lengths are minimal.

Avoid mounting locations where the PT-301/Informer+ is:

- Vibrating.
- Close to high voltage/current runs, contactors, SCR control devices, or frequency inverters.

Outline



Wiring

Electrical connections to the PT-301/Informer+ are made through an 11 pin removable connector on the back of the circuit board. To access this connector the enclosure must be opened and the two screws on the face of the unit must be loosened. The green connector should be unplugged prior to making the connections.

Turbine Meter Connection

The PT-301/Informer+ is supplied with a 12" magnetic pick-up cable already installed. If a different length is required, ensure that it is installed into the same terminals as the exisiting cable.

The PT-301/Informer+ can be connected to the turbine in two different manners. The PT-301/Informer+ comes with a 1" NPT, explosion proof union standard for mounting directly to the turbine. Alternately, the PT-301/Informer+ can be wall mounted using the existing flanges on the enclosure.

Note: If wall mounting the PT-301/Informer+, a proper explosion proof seal must be installed in addition to the supplied union.

When properly installed onto a turbine meter, or CSA type 4 connection the entire PT-301/Informer+ body is rated CSA / NEMA 4, 4X.

Mount the PT-301/Informer+ directly on the turbine as follows:

Step 1: Ensure the turbine's magnetic pick-up is turned in hand tight.

Step 2: Extend the PT-301/Informer+'s pick-up cable far enough out of the unit to allow for easy attachment to the magnetic pick-up. Connect the pick-up cable to the pick-up ensuring that the restraining collar is tightened hand tight.

Step 3: Unscrew the bottom half of the 1" union from the PT-301/Informer+ and attach it securely to the mounting boss on the turbine.

Step 4: Feed the remaining cable into the PT-301/Informer+ and tighten down the upper half of the union.

Note: For important information about specifying and mounting turbine meters, please refer to the Technical Reference at the back of this manual.

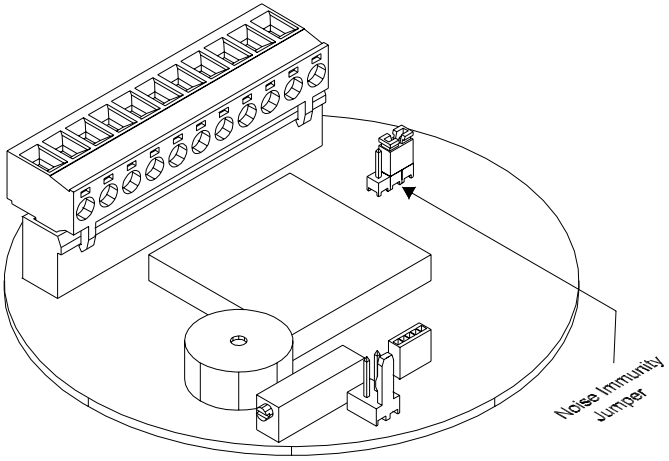
Magnetic Pick-up Noise Immunity Settings

The PT-301/Informer+ has been designed with extremely high noise immunity while maintaining a very sensitive input. The factory default setting for noise immunity will allow the PT-301/Informer+ to correctly read a 3/8" turbine to about 1m^3/day (rated flow for a 3/8" turbine is 1.63m^3/day).

The noise immunity jumper should only be moved in cases where there is extreme electrical interference and *the PT-301/Informer+ shows evidence of being affected by the interference*. For 99% of applications the factory default position will work. Ensure that the conditions in the following chart are met before adjusting the setting.

Setting	Meter Size	Flow Rate	Use
	ALL	ALL	Factory default
	ALL	mimimum 4m^3/day on 3/8" meter	Only with extreme electrical interference

To adjust the jumper, the PT-301/Informer+ case must be opened and the circuit board removed using a robertson head screwdriver. Locate the jumper as shown. Set the jumper to the left hand position.

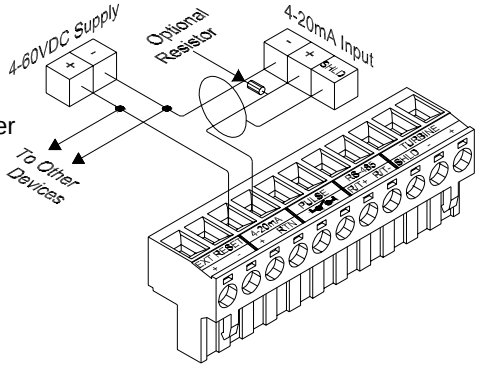


4-20mA Loop Power

The PT-301/Informer+ can be operated as a loop powered device. This allows for simplified wiring, with only two wires power can be supplied to the unit and a signal proportional to the flow rate can be read. When configured for a 4-20mA output the PT-301/Informer+ will adjust the loop current between 4mA and 20mA. The low and high for the 4-20mA signal can be set for any desired flow rate. At or below the low value the signal will be 4.0mA, and at or above the high value the signal wil be 20.0mA, between the two values the signal will be proportional to the flow rate.

When the PT-301/Informer+ is not configured for 4-20mA output, this connection is used for external power. Through this connection, with the 4-20mA signal turned off, the PT-301/Informer+ will draw approximately 700µA. For other power options for the PT-301/Informer+ please refer to the Power Connection section of this manual.

Connect the 4-20mA loop power signal as shown. If the analog input requires a voltage, the optional resistor can be installed. Please refer to the following chart to determine which resistor best suits your needs.



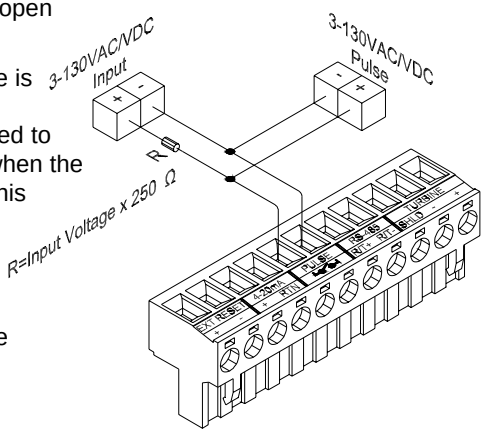
Resistor Value	Low Voltage	High Voltage
165	0.66V	3.30V
250	1.00V	5.00V
600	2.40V	12.00V
1200	4.80V	24.00V

Please refer to the Programming section of this manual for directions on how to configure the 4-20mA output.

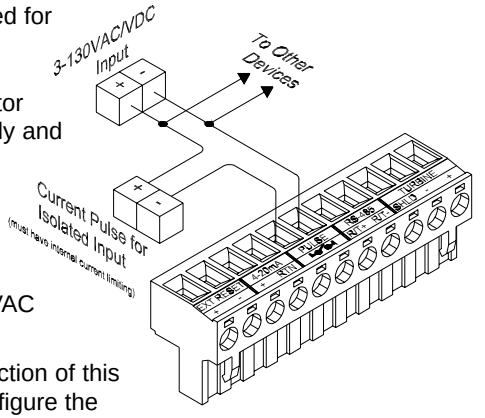
Pulse Output Connection

The PT-301/Informer+ is equipped with an optically isolated, normally open, dry contact pulse output. This output is capable of switching 3-130VAC/VDC at up to 130mA. Because this is a normally open contact output, it has no polarity.

The wiring configuration shown here is a typical connection for the pulse output. The resistor shown is required to allow the input voltage to be seen when the PT-301/Informer+ output is open. This resistor should be sized to prevent the current from exceeding 130mA.The voltage input can be supplied by tying in to the loop power supply or by using a separate supply.



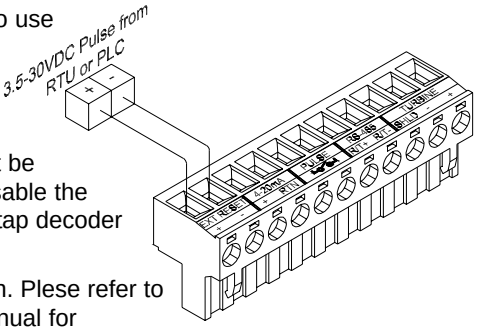
The configuration shown here is used for connection to an optically isolated input. The input must have internal current limiting, if it does not a resistor is required between the power supply and the positive of the isolated input. Consult the documentation for the input device to ensure the wiring is correct. This configuration is also used for connecting to older style RTUs or PLCs which require a 120VAC input signal.



Please refer to the Programming section of this manual for directions on how to configure the pulse output.

External Reset Connection

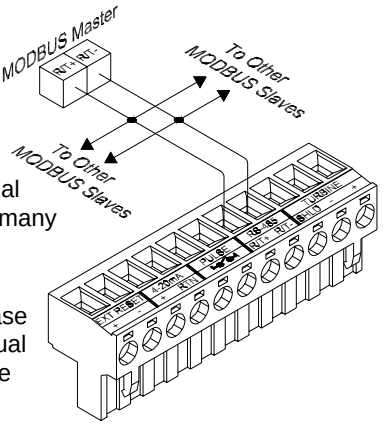
The PT-301/Informer+ is designed to use three differrent configurations to reset the displayed total. One method is to use an externally generated pulse from an RTU or PLC. The external reset option must be enabled in programming and will disable the external button reset as well as the tap decoder reset.



Connect the external reset as shown. Plese refer to the Programming section of this manual for directions on how to configure and use the reset feature of the PT-301/ Informer+.

Communications Connection

This section does not apply to the PT-301. This feature exists on the Informer+ only.

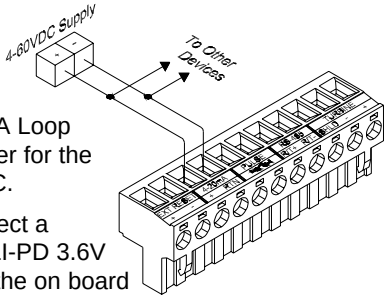


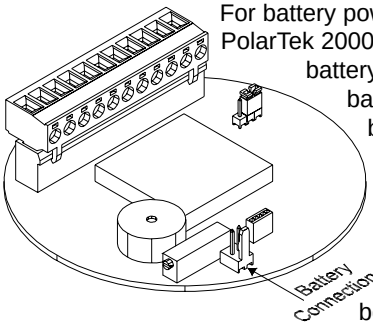
The Informer+ uses an RS-485 connection in order to communicate Modbus with a host system. RS-485 is a two-wire, multipoint, serial communication connection. This means that many devices can be connected to the same communication bus.

Connect the communications as shown. Please refer to the programming section of this manual to set the Slave address for the unit. For more information on RS-485 or Modbus communications, please refer to the Informer+ Modbus Communications section of this manual.

Power Connection

The PT-301/Informer+ can be powered one of three ways: Field Power; Battery Power; Field Power with a Battery Backup. When connected to field power as shown with the 4-20mA signal disabled, the unit will draw approximately 700µA. Field power can also be provided as shown in the 4-20mA Loop Power section of this manual. The input power for the PT-301/Informer+ must be between 4-60VDC.





For battery power, connect a PolarTek 2000 Ltd. PT-LI-PD 3.6V battery pack to the on board battery connection as shown. If using only battery power ensure that the pulse output signal is set to off, otherwise battery life will be reduced from approximately 5 years to approximately 6 months.

To use the PT-301/Informer+ with field power and a battery backup simply connect both sources to the unit in their appropriate locations. The PT-301/Informer+ will draw power from the field supply until that is interrupted, then it will automatically switch over to battery power.

This function works extremely well with legacy data logging devices which only operate analog inputs. To conserve power the PT-301/Informer+ can be operated primarily from the battery and, when a reading is required, the loop power can be turned on and read accurately in about 1 second. After the reading is taken the loop can be powered down. The PT-301/Informer+ will continue to correctly calculate the flow to quickly produce the proper output next time it is required.

For more information on batteries please refer to the following section.

Battery Packs

***Use only PolarTek 2000 Ltd. instrumentation battery pack P/N* PT-LI-PD.**

The following label appears on all PolarTek 2000 Ltd. instrumentation battery packs. If this label does not appear on the pack you are using, please contact your distributor to replace it with the correct pack.

Life Expectancy

In order to extend the battery life, the PT-301/Informer+ has been designed as an ultra low power device. The battery life expectancy is calculated using the battery manufacturer's rated capacity, the PT-301/Informer+ worst case current (with the pulse output signal disabled) +20%, and a derating to 80% of that resulting time.

Average life expectancy for the PT-LI-PD battery pack is:

5 Yrs. minimum at +25°C

2 Yrs. minimum at -40°C

Battery Test

To see the current measured battery voltage press the ↑ key. The battery voltage will appear on the top of the display. The PT-301/Informer+ will return to the main display after about 4 seconds. For more information about the battery test function, please refer to the Operation section of this manual.

Replacing the Battery

During normal operation, the PT-301/Informer+ periodically performs a test on the battery. When the PT-301/Informer+ determines the battery to be at 30% or less the low battery indicator will turn on and remain on until the battery is replaced.

Prior to replacing the battery, press the ENTER key to save the current flow total (see the Operation section of this manual for more information). The configuration is always stored in nonvolatile memory and will not be affected by removing the battery.

To replace the battery follow these steps:

Step 1. Open the enclosure and and remove the circuit board using a robertson head screwdriver.

Step 2. Disconnect the battery from the circuit board.

Step 3. Remove the battery from the hook and loop patch holding it in place in the enclosure. Be sure to dispose of the battery in an appropriate manner.

Step 4. Place the new battery into the enclosure, ensure that the hook and loop fastener engages to prevent the battery from moving around.

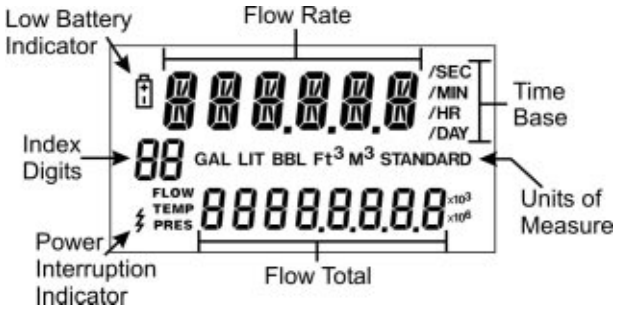
Step 5. Plug the new battery into the circuit board. The plug is polarized and will only fit on the connector one way, *do not* force the connector into place as it will break.

Step 6. Check to ensure that the PT-301/Informer+ has reinitialized and returned to normal operation.

Step 7. Replace the PT-301/Informer+ circuit board and close the enclosure.

Display

Please refer to the following diagram for the locations of the various display components.



Programming Conventions

When programming the PT-301/Informer+, the following conventions apply throughout the process:

- ✓ Flashing segments indicate the current selection.
- ✓ To change the current selection, press [↑].
- ✓ To advance to the next selection, press [←].
- ✓ To exit the menu and save the changes at any time, press [ENTER].
- ✓ To exit the menu without saving the changes, do not press any keys for about 90sec. The Informer+ will return to the main display automatically.

Note: When programming the K-Factor and setting the display units, all conversions are performed internally. Unless the K-Factor is specified in a unit other than those shown on the display, there is no need to convert it from the units specified.

Programming the K-Factor

The K-Factor is a number which denotes the number of pulses that will be put out by a turbine for a known volume. In order for a K-Factor to be accurate, the turbine must be calibrated using known volumes and known flow rates. For most applications, a single average K-Factor provides an acceptable level of accuracy. This is the K-Factor usually found on a tag attached to the mounting boss of the turbine. For those few applications which require greater than about 1% accuracy multi-point K-Factors can be used (see the 10 Point Linearization section of this manual for more information).

When programming the K-Factor into the PT-301/Informer+, it is very important to note that the units the K-Factor is programmed in will be used in the calculation of the flow rate and flow total. Internally the PT-301/Informer+ will perform all necessary conversions on the K-Factor to display the flow data in the desired units. The K-Factor can be entered in any of the following units: GAL, LIT, BBL, Ft^3, or M^3. The PT-301/Informer+ contains all the necessary information to convert any of these units into any other of the units eliminating the need for the operator to perform the conversions.

In order to allow for entry of extremely large K-Factors and eliminate the need to scale or truncate the values while maintaining the highest accuracy possible, the PT-301/Informer+ can accept a full 8-digit K-Factor with up to 4 decimal places. This allows for a range of K-Factors from 0.0001 to 99 999 999. A chart of typical, single point K-Factors can be found in the Technical Reference section of this manual.

Entering a Linear K-Factor

The default setting for the K-Factor on the PT-301/Informer+ is to use a linear (single point) K-Factor. The following procedure outlines the method for setting a single point K-Factor:

Step 1: Press [K-Factor Menu]. The message 'LINEAR K-FACTOR' will scroll across the top of the display. If the message '10-POINT K-FACTOR ENTER SMALLEST FREQUENCY FIRST' appears, please see the Setting Advanced Options section of this manual to set the unit for a Linear K-Factor.

The word FACTOR will remain on the display to indicate that the PT-301/Informer+ is in the K-Factor menu. The display will change to show the current K-Factor and K-Factor units with the units blinking to indicate they are ready for editing.

Step 2: Press [↑] until the desired K-Factor units are selected. This selection should match the units that the turbine meter was calibrated in. The available K-Factor units are GAL, LIT, BBL, Ft^3, and M^3. The units will cycle through each of these selections every time the [↑] key is pressed. Once the desired units are blinking, press [←] to advance to the decimal position selection.

Step 3: Press [↑] to select the position of the decimal. The decimal positions available are: no decimal, 0.0, 0.00, 0.000, and 0.0000. The decimal point will cycle through each of these selections every time the [↑] key is pressed.

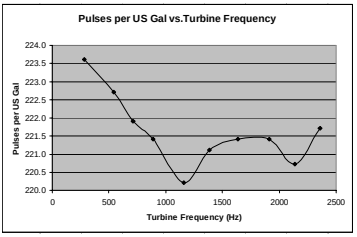
Once the desired decimal location is flashing, press [←] to advance to the K-Factor Digits.

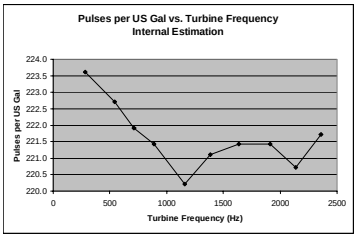
Step 4: Press [↑] to increment the current digit. Holding [↑] for more than 1 second will cause the digit to autoincrement by ones. When the correct value is displayed, press [←] to move to the next digit. Continue this procedure until all K-Factor digits are set.

Step 5: Once all K-Factor digits have been set either press [←] to cycle back to the units, or press [ENTER] to save the new K-Factor information and exit to the main display.

10-Point Linearization

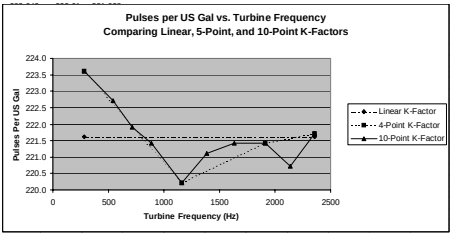
Over its entire rated flow range, a turbine meter does not show linear characteristics. This is caused by the different materials and different construction and moulding techniques used in the construction of a turbine. This is perfectly normal and has effects of less than 2%, on average, over the entire flow range. The chart shown here is an example of the actual readings from a gas turbine meter over its rated flow range. The chart shows the frequency of the output pulses (directly related to the speed at which the turbine is spinning) across the bottom and the pulses measured per US gallon (K-Factor) up the side. Please note that the overall variation in K-Factor is about 1.6% throughout the operating range. The small ticks on the curve indicate the points of measurement used for the 10-Point Linearization.





The PT-301/Informer+ uses these points of measure to mathematically create a straight line version of the turbine's characteristic curve as shown in this chart. This allows the PT-301/ Informer+ to greatly increase the accuracy of its measurements by taking the frequency it is reading and comparing it to this chart to determine the best K-Factor for that frequency.

One of the benefits of 10-Point Linearization is the large increase in accuracy, however the expense of having the turbine meter proved at 10 points is usually too high to justify. A compromise, when greater accuracy is required but the expense of 10 point calibration is too much, is to use 4 or 5 points of calibration. This does not provide the precision of the 10 point calibration, however it does increase greatly from the single point, as shown in this chart which compares the characteristics generated by these three methods.



Before entering a multi point K-Factor, ensure that the turbine meter has an appropriate calibration chart indicating the correct number of frequencies. In addition to a calibration chart for the turbine, the PT-301/Informer+ must be set to accept multi-point K-Factors. Please see the Setting Advanced Options section of this manual for the correct method.

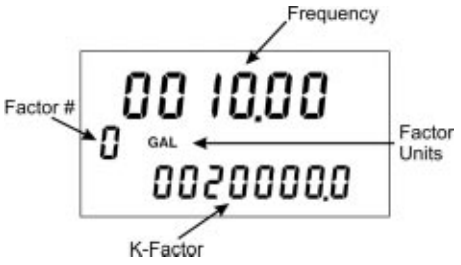
Entering Multiple K-Factors

In order for the 10-Point Linearization feature of the PT-301/Informer+ to function correctly, both the frequency and the K-Factor must be entered for each point. The data points must be entered in ascending order, smallest frequency first, largest frequency last.

If using the multi-point K-Factor feature with less than 10 points, enter the points being used in the first positions available, skipping no positions. After all the desired points have been entered, enter a very large frequency (above the operational range of the turbine is best) such as 9000Hz in the next position, the last K-Factor entered should be repeated to ensure correct operation. The remaining points can be skipped over by repeatedly pressing the ENTER key until the PT-301/Informer+ returns to the main display.

Note: The K-Factor units can be adjusted when entering each point, this will change the units for all of the K-Factors entered. Adjusting the units at any point other than the first will convert all previous K-Factors into those units, e.g. Factor #1 = 1.000 GAL, Factor #2 = 2.000 GAL, Factor #3 = 10.000 LIT, all remaining Factors entered in LIT. When returning to view the K-Factors: Factor #1 = 3.785 LIT, Factor #2 = 7.571, Factor #3 = 10.000LIT, etc.

The display shown here indicates how to view the display for multi-point K-Factors.



The following procedure outlines the method for setting up to 10 K-Factors:

Step 1: Press [K-Factor Menu]. The message '10-POINT K-FACTOR ENTER SMALLEST FREQUENCY FIRST' will scroll across the top of the display. If the message 'LINEAR K-FACTOR' appears please see the Setting Advanced Options section of this manual to set the unit for 10-Point Linearization.

The display will change to show the current K-Factor being entered in the index digits (0 is the first entry, 9 is the last entry), the current point's frequency, and the current point's K-Factor. The lowest digit of the frequency will be flashing.

Step 2: Use the [↑] key to increment the flashing digit. Use the [←] key to select the next digit. The decimal point is not able to be adjusted in the frequency, it is set to 2 decimal positions and this is sufficient for the entire range of measurement for the PT-301/Informer+. When the correct frequency is set, press [ENTER] to begin entering the K-Factor.

Step 3: Press [↑] until the desired K-Factor units are selected. This selection should match the units that the turbine meter was calibrated in. The available K-Factor units are GAL, LIT, BBL, Ft^3, and M^3. The units will cycle through each of these selections every time the [↑] key is pressed. Once the desired units are blinking, press [←] to advance to the decimal position selection for the K-Factor.

Note: The K-Factor units should only be set while editing the first point in a multi-point K-Factor.

Step 4: Press [↑] to select the position of the decimal. The decimal positions available are: no decimal, 0.0, 0.00, 0.000, and 0.0000. The decimal point will cycle through each of these selections every time the [↑] key is pressed. Once the desired decimal location is flashing, press [←] to advance to the K-Factor Digits.

Step 5: Press [↑] to increment the current digit. Holding [↑] for more than 1 second will cause the digit to autoincrement by ones. When the correct value is displayed, press [←] to move to the next digit. Continue this procedure until all K-Factor digits are set.

Step 6: Once all K-Factor digits have been set either press [←] to cycle back to the units, or press [ENTER] to move to the next point in the multi-point K-Factor.

Step 7: Repeat Step 2 to Step 6 until all desired points have been entered. If using less than 10 points, repeat Step 2 to Step 6 to set the frequency to a value above the turbine's operating range, this will cause the PT-301/ Informer+ to ignore all frequencies above this point. The K-Factor should be set to match the last K-Factor entered.

Step 8: Press ENTER repeatedly until the unit returns to the main display. This will save the new K-Factors.

Setting the Display Options

The PT-301/Informer+ has been designed with a highly flexible set of display options including:

- 5 selectable units of measure, GAL, LIT, BBL, Ft^3, M^3.
- 4 selectable time bases, /SEC, /MIN, /HR, /DAY.
- A 6 digit flow rate with up to 3 decimal places allowing for flow rates from 0.001 to 999 999.
- An 8 digit flow total with up to 4 decimal places allowing for flow totals from 0.0001 to 99 999 999.

All of these parameters are user programmable to assist in providing the most accurate information in the most desired way.

In addition to the flexibility of the display options, the PT-301/Informer+ continues to calculate and display the current flow rate and flow total as the display options are being programmed. The unit even converts the values on the fly, as the units of measure or time base are changed the PT-301/Informer+ updates the displayed flow total and flow rate to reflect the new setting even before it has been saved to memory. This allows the user to see the effects of the changes before committing to them.

When setting up the display on the PT-301/Informer+, it is very important to note that the units the K-Factor is programmed in will be used in the calculation of the flow rate and flow total. Internally the PT-301/Informer+ will perform all necessary conversions on the K-Factor to display the flow data in the desired units. The K-Factor and displayed flow data can be set up in any of the following units: GAL, LIT, BBL, Ft^3, or M^3. The PT-301/Informer+ contains all the necessary information to convert any of these units into any other of the units eliminating the need for the operator to perform the conversions.

Display Error Messages

There are two error messages that may appear on the PT-301/ Informer+, 'E-RATE' and 'oVEr run'. These messages are generated when the flow data exceeds the ability for the current settings to display it. The best method for correcting this is to set the units of measure and time base to the desired values and adjust the decimal points until the flow data is displayed correctly. The flow total will continue to accumulate correctly even if the 'oVer run' error is displayed, once the decimal location or the units of measure allow the total to be displayed the total will be correct.

Setting the Display

The following procedure outlines the method for adjusting the display options:

Step 1: Press [Display Menu]. 'DISPLAY MENU' will scroll across the top of the display. A 'P' will appear in the index digits to indicate that the display is in the Display Menu. The units of measure will be blinking.

Step 2: Press [↑] to select the units to display flow in. The flow rate and flow total shown will adjust to the new unit of measure automatically. Press [←] to advance to the time base.

Step 3: Press [↑] to select the time base for the flow display. The flow rate will adjust itself automatically to reflect the new time base. Press [←] to advance to the decimal position for the flow total.

Step 4: Press [↑] to select the position for the flow total decimal point. The flow total will adjust itself automatically to reflect the new decimal position. Press [←] to advance to the decimal position for the flow rate.

Step 5: Press [↑] to select the position for the flow rate decimal point. The flow rate will adjust itself automatically to reflect the new decimal location. Press [←] to return to the units of measure or press [ENTER] to save the changes and exit to the main display.

Setting the Output Options

The PT-301/Informer+ is equipped with two programmable outputs: a 4-20mA output and a scaled pulse output. Both of these outputs are set through the Output Menu.

Configuring the 4-20mA Output

The PT-301/Informer+ has been designed with a 16 bit digital to analog converter to provide a user programmable 4-20mA output signal. This produces a signal with a resolution of about 0.24µA.

This allows a high accuracy, flow rate proportional, analog signal to be produced over a user specified range. This is accomplished by entering the lower and upper flow rates for the signal. The PT-301/Informer+ will adjust the signal between these two points as the flow rate varies. Because this signal is based on the calculated flow rate, it remains accurate even when a full 10 point linearization is used.

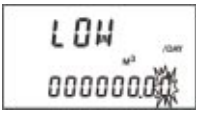
To configure the 4-20mA output, follow these steps:

Step 1: Press [Output Menu]. 'OUTPUT MENU' will scroll across the top of the display. The display will change to the 4-20mA enable screen.

Step 2: Use the arrow key to set the 4-20mA signal to 'OFF' or 'ON'. 'ON' will enable the 4-20mA output, 'OFF' will disable the 4-20mA output. Press [ENTER] to advance. If the 4-20mA signal is 'ON' follow steps 3 through 6 to configure the signal, if the 4-20mA signal is 'OFF' the unit will skip the setup steps and go directly to the Pulse Output setup.

Step 3: The display will show '4-20mA LOW' and the current 4mA setting. The decimal point will be flashing. Use [↑] to select the desired decimal position. Press [←] to advance to setting the digits.

Step 4: Use [↑] to select the desired digit. Press [←] to select the next digit. Continue to use [↑] and [←] to adjust the digits until the desired 4mA flow rate is set. Once the required flow rate is showing, press [ENTER] to move on to setting the 20mA flow rate.



Step 5: The display will show '4-20mA HIgH' and the current 20mA setting. Follow the same procedure as outlined for the 4mA setting to set the 20mA rate.

Step 6: Once the 4-20mA output is configured, press [ENTER] to begin configuring the Pulse Output.

Configuring the Pulse Output

The PT-301/Informer+ can be configured to produce a real-time scaled pulse output.

A traditional pulse output usually has a fixed pulse width with a user programmable output frequency (usually 4, 8, or 10Hz). this causes the pulse output to be produced in bursts which could create the need for a high frequency input card in the RTU or PLC. This could also cause the unit to continue to emit pulses after the flow has stopped.

The PT-301/Informer+ uses both the flow total and the flow rate to produce a real-time pulse output. This output signal will produce a pulse at the desired volume of flow, but will use the current rate to make this pulse width 1/2 that of the total time between pulses. This eleiminates the need for the user to program a fequency and is not limited to a fixed pulse width. The PT-301/Informer+ can produce a pulse output signal up to 100Hz across an isolation barrier.

The pulse output multiplier is based on the far right digit of the displayed flow total regardless of the decimal position. This means that a pulse output multiplier of 1 will produce one pulse for each time the rightmost digit is incremented, a multiplier of 10 will produce one pulse for each 10 times that the rightmost digit

is incremented (or one pulse each time the second from rightmost digit is incremented). The pulse output can be set to OFF, 1, 10, 100, 1000, 10 000, or 100 000. This, along with the programmable flow total decimal location, can produce a pulse output of 1 pulse per 0.0001 flow units up 1 pulse per 100 000 flow units. Use the following examples to assist in setting the desired pulse output multiplier.

Example 1: Units = GAL, Decimal location = 0.00, Multiplier = 10, Pulse output produces 1 pulse per 0.10GAL

Example 2: Units = GAL, Decimal location = 0.0, Multiplier = 10, Pulse output produces 1 pulse per 1.0GAL

Example 3: Units = M^3, Decimal location = 0.00, Multiplier = 1000, Pulse out produces 1 pulse per 10.00M^3

To configure the pulse output, follow these steps:

Step 1: Press [Output Menu] then either configure the 4-20mA output or press [ENTER] until the display shows 'PuLSEout' on the bottom and the current pulse output multiplier on the top.

Step 2: Use [↑] or [←] to set the pulse output multiplier to the desired value.

Step 3: Press [ENTER] to save the current 4-20mA and pulse output settings and exit the output menu.

Setting the Modbus Address (Informer+ Only)

The Informer+ is equipped with Modbus communications. This option is not available on the PT-301. in order to facilitate communications each unit in the Modbus system must have a unique address. For more information on RS-485 or Modbus communications, please refer to the Informer+ Modbus Communications section of this manual.

To set the Informer+ Modbus address, follow these steps:

Step 1: Use the above procedures to navigate the Output Menu. After the pulse output setup is complete the Informer+ will enter the address programming option.

Step 2: Use the [↑] key to set the current digit, use [←] to select the next digit. Continue in this manner until the desired address is shown. The highest address available is 255.

Step 3: Press [ENTER] to save the new address and return to normal operation.

Setting Advanced Options

The PT-301/Informer+ is equipped with several advanced options to allow for better functionality and increased security. These options are:

Through the Advanced K-Factor Menu:

- K-Factor setup (10-Point or Linear).

Through the Advanced Display Menu:

- Audible Beep (on or off)
- Reset Operation
- LCD contrast.
- Lockout code.
- Lockout enable.

Setting The K-Factor Type

The K-Factor in the PT-301/Informer+ can be set in either Linear (single point) or 10-Point. This option sets the type of K-Factor being used.

Press and hold [K-Factor Menu] for about 3 sec. The message 'ADVANCED K-FACTOR MENU' will scroll across the top of the display. The display will stop with 'FACTOR' on the top and either 'LinEAr' or '10 Point' on the bottom. To set the unit for single point K-Factor operation set the unit to 'LinEAr', for multi point K-Factors set the unit to '10 Point'. Use the arrow keys to toggle between the two options. See the Programming the K-Factor section of this manual to set the K-Factor itself. When the preferred K-Factor type is shown on the display, press [ENTER] to return to normal operation.

Entering the Advanced Display Menu

To enter the Advanced Display Menu press and hold the [Display Menu] key for about 3 sec. The message 'ADVANCED DISPLAY MENU' will scroll across the top of the display.

Setting the Audible Beep

The first option under the Advanced Display Menu is the audible beep. This is used to turn on or off the audible beep sound for key presses, unit resets, etc. The unit will show 'bEEP' on the bottom and either 'ON' or 'OFF' on the top. Use the arrow keys to toggle between the two options. When the desired option is set, press [ENTER] to move on to setting up the Reset Operation.

Selecting the Reset Operation

The PT-301/Informer+ is designed with three modes for resetting the totals in addition to using the keypad.

The second setting in the Advanced Display Menu is the Reset Operation. The Dispaly will show ‘rESEt oP’ on the bottom and the current reset operation mode on top. Use the arrow keys to select the desired reset operation. You can select from: ‘TAP’; ‘PULSE’ and; ‘bUTTON’. Once the desired Option is selected, press ENTER to move on to setting the display contrast.

Please refer to the following for information on the three reset operation modes

Tap Reset

The PT-301/Informer+ is equipped with a Tap Decoder as an alternative to an expensive external wake switch. The tap decoder allows a user to reset the totals on the unit without opening the enclosure. A specific series of taps is required in order to prevent the unit from triggering a reset from vibrations or other disturbances.

To reset the totals using the tap decoder:

- ✓ Using moderate strength, tap the top of the PT-301/Informer+ with the handle of a screwdriver 3 times at about 1 second intervals.
- ✓ Wait for about 8 sec. A ‘C’ will appear in the index digits.
- ✓ Tap the unit again 3 times at about 1 second intervals.
- ✓ The unit will clear the totals after about 8 seconds.

The program clears the decoder after about 20 sec. If the above procedure does not work the first time wait about 20 sec. for the decoder to reset and try again.

Pulse Reset

The PT-301/Informer+ is equipped with a pulse input to reset the totals remotely from an RTU or PLC. Please see the wiring section of this manual for proper connection of the pulse input. This reset mode is primarily used in automated systems however it can be used as a less expensive solution in high vibration areas where the tap decoder might be triggered accidentally.

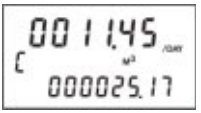
To reset the totals using the pulse input ensure the external reset is connected properly, then send the input a pulse between 3.5 to 30VDC. The pulse should be less than 0.5 sec. in duration. The reset will be triggered on the falling edge of the pulse. The unit will emit a short beep and set the totals to 0.

Button Reset

This is the most expensive, but most reliable method to reset the totals on the PT-301/Informer+. using the button for reset involves having an explosion proof button installed on the unit. In order to maintain CSA approvals this button must be installed at either the PolarTek 2000 factory or at our distributor. If a button is required it should be specified at the time of order.

To reset the totals using the external button:

- ✓ Press the button 3 times at about 1 second intervals.
- ✓ Wait for about 8 sec. A 'C' will appear in the index digits.
- ✓ Press the button again 3 times at about 1 second intervals.
- ✓ The unit will clear the totals after about 8 seconds.



The program clears the decoder after about 20 sec. If the above procedure does not work the first time wait about 20 sec. for the decoder to reset and try again.

Setting the LCD Contrast

The third setting in the Advanced Display Menu is the LCD Contrast. The display will show 'LCD CNTRST' and a bar graph will appear at the bottom of the display. Press ⬆ to make the display darker, press ⬅ to make the display lighter. When the contrast is set to the desired level, press ENTER to move on to setting the Security Lockout Code.

Note: The PT-301/Informer+ is designed to compensate for the ambient temperature with its display contrast. The contrast will change as the unit gets warmer or colder. This is done to ensure good visibility across the temperature range as well as power conservation.

The Security Lockout Code

A security lockout code has been integrated into the PT-301/Informer+ to prevent the settings from being changed or the totals from being cleared. This code is stored in nonvolatile memory onboard the PT-301/Informer+. Once the code has been set *and* enabled no changes can be performed on the unit without entering the code to unlock the unit. If the security lockout code is lost or forgotten the *only* way to unlock the unit is to call your distributor or PolarTek 2000 Ltd. to get a security lockout bypass code.

The functions locked by the security lockout code are:

- K-Factor programming
- Adjusting display options
- Setting advanced options
- Clearing flow data
- Resetting factory defaults

The functions not locked by the security lockout code are:

- Battery and temperature test
- Saving Flow data
- Viewing the 36 day flow log

This feature should only be used with caution. Once the lockout code is enabled the only *way to access the programming features or clear the totals is to enter the lockout code. If the lockout code is lost or forgotten you* must *contact your distributor or PolarTek 2000 Ltd.*

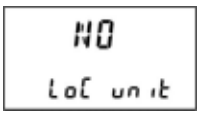
Setting the Security Lockout Code

The unit will display 'Loc CodE' on the bottom and the current 6 digit Security Lockout Code on the top. Setting this code will not, in itself, lock the unit after setting this code the lockout must be enabled in the next step. Use [↑] and [←] to select a 6 digit security code to lock the unit. Ensure that this number is either written down or very easy to remember. Without this number the unit will not be able to be unlocked once the lockout is enabled. Once the Security Lockout Code is set, press [ENTER] to continue to the Lockout Enable option.

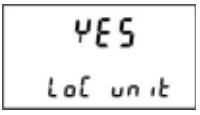
Enabling the Security Lockout

This feature should only be used with caution. Once the lockout code is enabled the only *way to access the programming features or clear the totals is to enter the lockout code. If the lockout code is lost or forgotten you* must *contact your distributor or PolarTek 2000 Ltd.*

The unit will display 'LoC unit' on the bottom and either 'NO' or 'YES' on the top. To



enable the Security Lockout code use [↑] to set the display to 'YES'. To *disable* the Security Lockout Code press [↑] to set the display to 'NO'. Once the Security Lockout



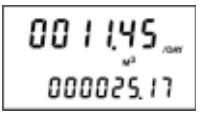
Code enable option is set, press [ENTER] to exit the Advanced Display Menu and return to the main display.

Resetting Factory Defaults

The PT-301/Informer+ configuration can be erased and reset to the factory defaults at any time during normal operation. To do this press and hold ENTER for about 10 sec. The unit will let out a chirping sound and turn on all segments of the display. This last stage is meant as a display test to verify that all segments are functioning. When the display test appears the ENTER key can be released. The PT-301/Informer+ will show 'LOAD dEFAuLts'. At this time the unit will be reset to factory defaults. The flow total will not be erased and the flow rate will continue to be displayed, however the units of measure and time base for the flow data may have been changed. See the Technical Reference section of this manual for a list of the factory defaults.

Note: When the PT-301/Informer+ has been set up for the first time, the total should be cleared to ensure accuracy.

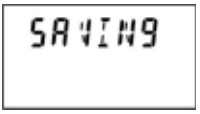
During normal operation the PT-301/Informer+ continually calculates the flow rate and flow total as read from the turbine meter. The PT-301/Informer+ will update the display of this information every 4 seconds. The display is designed to show all the necessary information at all times, the flow rate is shown on the top section of the display and the flow total is shown on the bottom section. The units of measure and time base are also on the display at all times. In addition to the data displayed, the PT-301/Informer+ enters the flow total as displayed in the Flow Log every 24 hrs.



While the unit is functioning normally the following operations can be performed without affecting the calculations being performed:

Saving Flow Data and Unit Identification

The flow total currently displayed on the PT-301/Informer+ can be saved into nonvolatile memory at any time by pressing the ENTER key. The display will show 'SAVING' for about 1 second and change to the unit identification display. This display consists of the firmware version, the unique serial number programmed into the main processor, and an identifier showing whether the unit is functioning as a PT-301 or an Informer+. The index digits will show 'Pt' if the unit is a PT-301, or 'PL' if the unit is an Informer+.



This serial number is recorded and used to track information such as date of manufacture, date of sale, and customer.

Testing the Battery and Unit Temperature

The PT-301/Informer+ has been designed to monitor its battery power and internal temperature. The battery power is monitored in order to allow indication of when the battery needs to be replaced. The internal temperature is monitored to allow for the PT-301/Informer+ to compensate for the effects of temperature on the display and the internal timing circuitry. This temperature is accurate to within 2.0°C.

Press ⬆ to view the current battery status and the unit temperature. The current battery voltage is displayed on the top section of the display. The temperature in °C and °F is displayed on the bottom section of the display.

Viewing the 36 Day Flow Log

Every 24 hrs. the PT-301/Informer+ records the currently displayed flow total in a 36 entry flow log. This allows for 36 days of flow history to be easily viewed. This log is stored in nonvolatile memory to prevent its loss in the event of a power loss to the PT-301/Informer+.

Setting the Log Time (Contract Hour)

The PT-301/Informer+ is equipped with a timer that counts down for 24 hrs. then resets itself and begins counting again. This timer begins counting when power is applied to the unit. Because this is not a clock it can't be set like a normal clock. If a specific time for the data to be logged is required, power must be applied at that time.

Reading the Flow Log

Press [←] to view the first entry in the flow log. The display will show 'DAYLOG' on the top section, the index digits will show '00', and the most recent total will appear on the bottom of the display. This total is the flow total that was on the display at the last log time (i.e. if the log time has been set for 8:00am the total seen in the first entry was the total at 8:00am today).

The index digits show the day currently being viewed (00 to 35). Use the [←] and [↑] keys to navigate backwards and forwards through the days. As the day number gets larger the farther back the total being viewed is. If the log time is 8:00am then 0 = 8:00am today, 1 = 8:00am yesterday, 2 = 8:00am two days ago, 14 = 8:00am two weeks ago.

Because the flow log records the current total at the log time, it is fairly easy to determine the flow on any given day, provided the total was not reset during that day. To determine the total for a specific day, go to that day in the flow log and subtract the total show from the total of the following day (next lower day number). For example: the desired total is for 7 days ago, go to day 7 and record the number e.g. 764M^3, select day 6 and record the number e.g. 815M^3, subtract day 7 from day 6 to determine the total for day 7 e.g. 815M^3 - 764M^3 = 51M^3.

When finished viewing the flow log, press [ENTER] to return to the main display. If no key is pressed for about 90sec. the PT-301/Informer+ will exit the Flow log on its own.

Clearing the Flow Data

During normal operation the flow total can be reset to zero by pressing the [ENTER] and [←] keys at the same time. The display will show 'DATA CLEArEd' and the total will be set to zero. If the PT-301/Informer+ is still reading flow at that time the total will begin accumulating again immediately. This operation will not affect the configuration of the PT-301/Informer+, only the displayed total is affected.

Power Interruption Indicator

The PT-301/Informer+ has the ability to indicate a loss of power by turning on the power interruption indicator. This indicator will turn on if the battery is removed or if the power input drops below 0.9V for more than 1/2 sec. The indicator will remain on until one of the PT-301/Informer+ keys is pressed.

Troubleshooting

This section details a few quick problem solving methods for the PT-301/ Informer+. If this section does not solve a problem, please contact your distributor.

Symptom	Possible Solution
Incorrect flow rate displayed.	Check the K-Factor
Pump is on, no flow rate dispayed.	Possible turbine problem
'E-RATE' appears on the display.	Adjust the decimal position for the flow rate. Adjust the time base for the flow rate. (See the Programming section of this manual)
'oVEr run' appears on the display.	Adjust the decimal position for the flow total. (See the Programming section of this manual) Clear the flow total.
Display is blank.	Ensure power is connected properly. Replace the battery. (See the Installation section of this manual)
4-20mA signal appears to be incorrect.	Verify the 4-20mA settings. (See Setting the Output Options section) If a resistor is used, ensure the value is correct. (See the Installation sectin of this manual)
Pulse output appears to be incorrect.	Verify the pulse output setting. (See Setting the Output Options) Verify that the pulse output is correctly connected. Verify that the resistor used is the correct value. (See the Installation section of this manual)

Specifications

Area Rating:	CSA Class 1, Div 1, Groups B, C, D
Enclosure:	CSA Type 4, with 1" union connection for turbine
Operating Temperature:	-40°C to +65°C (-40°F to +149°F)
Relative Humidity:	0% to 90% non-condensing
Power Source:	PolarTek PT-LI-PD Double Lithium Battery Pack
Life Expectancy:	3yr. min. at -40°C
	5yr. min. at +20°C
Loop Power:	7 to 60VDC at 4-20mA
	≈720µA with 4-20mA signal off
Loop Signal:	16bit resolution (≈0.24µA)
Pulse Output:	Optically isolated, Normally open, Photo-voltaic Relay
	Up to 130VAC/DC @130mA max.
Turbine Input:	
Frequency:	2Hz to 5.0kHz
Amplitude:	25mVp-p @2Hz
Sensitivity:	High: 25mVp-p
	Low: 70mVp-p
Displayed Data:	
Total:	8 digits, 4 Programmable Decimal Positions, 5 Units of Measure
Rate:	6 digits, 3 Programmable Decimal Positions, 4 Time Bases
K-Factor:	8 digits, 4 Programmable Decimal Positions, 5 Units of Measure, Up To 10 Points of Linearization
Reset Options:	Keypad reset, always available
	Tap Decoder
	Optically isolated 3-30VDC pulse input
	External explosion proof switch
Security:	Programmable 6 digit Password
Informer+ Only:	
Modbus:	Modbus RTU format
	Following MODICON standard
	User-programmable address and response delay
RS-485 Port:	9600 baud, 8 data bits, no parity, 1 stop bit
	Half Duplex

Technical Reference

This section is intended to provide supplemental, technical information about the PT-301/Informer+.

Typical K-Factors

The following chart shows typical average K-Factors for a variety of turbine meter sizes.

Flow Meter Size	K-Factor		Flow Range	
	GAL (US)	M^3	GAL / MIN	M^3 / DAY
1"x$^3/_8$" MNPT	22000	5812400	0.3-3	1.63-16.3
1"x$^1/_2$" MNPT	14500	3830900	4.08-40.8	25-250
1"x$^3/_4$" MNPT	2950	77390	10.8-81.8	68-515
1"x1" MNPT	900	237780	5-50	27.3-272.6
1$^1/_2$"x1$^1/_2$"MNPT	325	85870	15-180	81.8-981.1
2" FNPT	55	14530	40-400	218.2-2180
2"x$^7/_8$" Wafer	2350	620870	3-30	16.3-163.4
2"x1" Wafer	900	237780	5-50	27.3-272.6
2"x1$^1/_2$" Wafer	325	85870	15-180	81.8-981.1
2"x2" Wafer	55	14530	40-400	218.0-2180
3"x3" Wafer	57	15060	60-600	327.1-3271
4"x4" Wafer	30	7930	100-1200	545.1-6541
6" Victaulic	7	1850	200-2500	1090-13627
8" Victaulic	3	790	350-3500	1908-19078

Factory Defaults

The following list details the settings as set at the factory:

K-Factor Type: Linear
K-Factor: 20000.0 GAL
Flow Total Decimal: 000000.00
Flow Rate Decimal: 0000.00
Flow Units: M^3 /DAY
Security Lockout Code: 000000
Security Lockout Enabled: No
4-20mA: Off
Pulse Output: Off
Reset Option: Tap
Beep: On
Slave ID (Informer+ Only): 1

Turbine Meter Considerations

The most common cause of incorrect flow measurement or failure is incorrect installation or specification of the turbine flow meter itself. The following guidelines should be followed when specifying and installing turbine flow meters:

- ✓ Ensure the flow rates for the application fall within the range for the turbine meter. If the flow rate is outside the turbine meter's range the accuracy of the meter may be severely affected.
- ✓ Turbine meters are usually calibrated in the horizontal position. A turbine meter will provide a more accurate reading when operated in the same position as calibrated.
- ✓ Ensure that the flow direction marked on the turbine meter matches the flow direction in the pipe.
- ✓ Do not mount the turbine meter in a low spot where solids or particles may settle.
- ✓ Do not mount the turbine meter in a location with heavy mechanical vibration. This can greatly affect the accuracy of the turbine meter
- ✓ Isolate the turbine meter from ambient electrical interference. Mount the turbine meter as far as possible from any electric motor, pump, solenoid, or transformer.
- ✓ Do not submit the turbine meter to more than its rated operating pressure.

Important Piping Requirements

Swirling and turbulent flow can cause inaccuracies in the signal from a turbine flow meter. Proper installation can minimize these effects by providing the straightest possible flow through the turbine meter. The following chart shows the minimum recommended pipe lengths both upstream and downstream from the turbine meter. These lengths are determined by the pipe diameter and the upstream piping components. The lengths are defined in terms of pipe diameters (i.e. on a 2" pipe 10D=20"). Flow straighteners may be used if the physical constraints do not allow for the recommended pipe lengths.

Components Upstream	Recommended Length Upstream	Recommended Length Downstream
Wide Open Valve Sharp Right Angle Bend Straight Run of Pipe	10D	5D
Long Radius Bend Smooth Elbow Two Elbows Partially Open Valve Another Turbine Meter	20D	5D

Special Applications

The PT-301/Informer+ as a Pulse / Frequency Counter

The PT-301/Informer+ is well suited for use on a turbine meter proving bench. The display remains on at all times and it can easily be set to act as a pulse and frequency counter.

To set the PT-301/Informer+ for pulse / frequency counter mode simply press and hold both the K-Factor Menu key and the ENTER key for about 10 seconds. The message 'LOAD dEFAuLtS' will appear on the display. Once this message appears the keys can be released. At this point the PT-301/Informer+ will have changed its K-Factor to 1 GAL,

and its display will measure in GAL /SEC. This allows the flow total section of the display to show the number of pulses counted and the Flow rate section to show the frequency in Hz. The other functionality of the PT-301/Informer+ is not affected.

The PT-301/Informer+ as a Gas Recorder / Totalizer

As with liquid turbines, gas turbines measure the actual volume passing through them. Metering the actual volume of gas only provides useful information when the operating pressure and temperature are known. This is because the amount of mass within a volume of gas (density) is greatly dependant on the temperature and pressure of the gas. When sizing a gas turbine meter it is necessary to determine the flow rate in terms of actual volumes (because turbine meters measure actual volumes) such as Actual Cubic Feet per Minute (ACFM). However, when delivering gas flow data it can be more useful in terms of Standard Cubic Feet per Minute (SCFM) which represents the amount of volume at a standardized operating temperature and pressure.

Measuring Actual Gas Volumes

Gas turbine meters will be provided with K-Factors in standard units such as Pulses per Standard Cubic Foot (PPSCF). The operator can convert the factor to Pulses per Actual Cubic Foot (PPACF) using the the application's pressure and temperature data in the following formula:

$$PPACF = \frac{530 \times PPSCF \times P_a}{14.7 \times T_a}$$

Where:
PPACF = Pulses per Actual Cubic Foot
PPSCF = Pulses per Standard Cubic Foot
P_a = Operating Pressure PSIA = PSIG + 14.7
T_a = Temperature in $^oRankine = {}^oF + 460.67$
$= (1.8 \times {}^oC) + 492.67$

Recorded actual volumes can be converted to standard volumes using:

$$SCF = \frac{ACF \times P_a}{14.7} \times \frac{530}{T_a}$$

Informer+ Modbus Communications

Introduction

Modbus is a communications protocol. This means that Modbus defines the form data takes (layout and contents of message fields) not the method for transmitting this data. The Modbus protocol defines how a controller requests data from another device, how a device or a controller responds to a request for data, and how errors are detected and reported.

Controllers use a master-slave method for communications. In this method a master is the only device which can initiate data transfer, the salves will only respond when polled by the master. A slave is also able to complete an action requested by a master. Unless otherwise specified, all PolarTek instruments which are Modbus enabled will act as slaves. Typical Modbus master devices include host processors and programming panels.

A Modbus slave must have a specific address assigned to it. This allows the master to communicate with each slave independent of the other devices connected to it. When a slave receives a query specifically directed to its address, the slave will return a message to the master. It is also possible for the master to initiate a broadcast to all of the slaves connected to it. The slaves will not send a response to a broadcast query.

To set the slave address on PolarTek Modbus enabled instruments, please see the Setting the Modbus Address section of this manual.

Supported Communications Format

PolarTek instruments which are Modbus enabled are able to communicate using the Modbus protocol over a half duplex, RS485 network. These devices use the Modbus RTU format, which states that each byte in a message will contain two 4-bit hexadecimal characters. Modbus RTU format also defines how the information will be framed (see the following section of this manual for more information on packet framing). Each message from a PolarTek instrument is transmitted in a continuous stream.

All PolarTek instruments with Modbus enabled communicate using serial data at the following settings:

Baud Rate	9600
Start Bits	1
Data Bits	8
Parity	N
Stop Bits	1 or 2

Modbus RTU Framing

Modbus communications uses a series of packets to transmit data. In order for the devices to recognize these packets and verify the accuracy of the information contained in a packet, the packets must be framed in a specific way.

The following is an example of a generic message packet:

Start	Address	Function	Data	CRC	Stop
4 x Character Time	8 Bit	8 Bit	n x 8 Bit	16 Bit	4 x Character Time

The maximum size for a data packet is 200 bytes (100 words).

The parts that make up a data packet are:

Start: This is used to indicate that a packet is about to be sent. The start bits are indicated by having no communications on the bus for 4 character time periods. The character time is defined as the time it takes to send one character at the baud rate that is being used. At 9600 baud this is approximately 416µS.

Address: This is the address of the device being communicated with. This is sent as two hexadecimal characters.

Function: This is the control function which determines what action is to be taken with the data in the packet. This is sent as two hexadecimal characters.

Data: This is the actual data being transmitted. This will be sent in pairs of hexadecimal characters. The length of this part varies, it can contain no data or it can contain up to 196 pairs of hexadecimal characters.

The data part of the packet contains some framing as well. When presetting or reading data in the holding registers, a 16 bit address for the starting register, a 16 bit number of registers to read or preset, or 16 bit byte count must be sent before the data itself.

CRC: This is used for error checking. The CRC is calculated by the transmitting device from the actual characters contained in the packet. This value is then attached to the end of the packet. When the receiving devices gets the packet, it calculates a CRC from the actual data it received and compares this calculated value to the transmitted one. If the values are not the same the receiving unit rejects the packet and waits for it to be sent again. The CRC is 4 hexadecimal characters.

Stop: This is used to indicate the end of a packet. The stop bits are indicated by having no communications on the bus for 4 character time periods. The character time is defined as the time it takes to send one character at the baud rate that is being used. At 9600 baud this is approximately 416µS.

PolarTek instruments transmit all messages in a continuous stream and expect to receive messages in the same manner. Messages must be sent and received with less than 1.5 character times between any two characters.

PolarTek instruments will typically respond with a packet within 6.6ms of receiving a valid packet with its address. This can cause problems with slower RTUs, PLCs or when there is a communication lag within the network (such as with a radio or satellite transceiver). A bus delay can be set within the instrument to accommodate this.

Control Functions

There are only five controls functions for PolarTek instruments. This is possible because all features and information can be controlled or read by presetting and reading the holding registers within the unit.

Holding registers are points of interest (to the Modbus master) within the PolarTek instrument's memory map. They contain such information as configuration settings and flow data. There are two formats for the holding registers: 16 bit integers; and 32 bit floats. The 32 bit float values are in standard IEEE format.

16 bit data register:

Low Byte	High Byte

32 bit float register:

MSB	Data	Data	LSB

Note: Due to the internal structure of the CPU within the Informer+, all of the 16 bit values for the CRC and Data framing are presented high byte first, however the actual 16 bit register values are read back low byte first. The 32 bit float registers are read back MSB first and follow standard formatting. All other instruments read the 16 bit register values high byte first.

The 32 bit registers can be broken into two 16 bit words and the order of these words reversed to accommodate some systems. This can be set within the instrument.

The following is the list of supported function codes:

Function Code		Function Name	Note
DEC	HEX		
03	0x03	Read Multiple Holding Registers	Max of 16 (16 bit) registers per frame
16	0x10	Preset Multiple Holding Registers	Max of 16 (16 bit) registers per frame
17	0x11	Report Slave ID	Device specific Response
85	0x55	Reset Flow Data	Software reset of the flow totals
170	0xAA	Reset Configuration / Device	Hardware reset with factory defaults

Read Multiple Holding Registers (0x03)

This function is used to read the binary contents of the holding registers in the PolarTek instrument. Broadcast is not supported with this function. The maximum number of registers that can be read in one frame is 100 16 bit registers (total 200 bytes).

The query message specifies the starting register and number of registers to read. Please see the holding registers section of this manual for specific holding register descriptions.

The master's query must be framed as shown.

Field Name	Example (HEX)
Slave Address	16
Function Code	03
Starting Address (high byte)	02
Starting Address (low byte)	20
Number of Registers (high byte)	00
Number of Registers (low byte)	06
CRC (high byte)	C6
CRC (low byte)	89

This example queries an instrument at slave address 22 (0x16) for the flow rate, flow total, and ambient temperature. All of this information is adjacent in the register map and starts at the address 0x220. 0x06 registers are requested because the desired values consist of 3 32 bit floats but the registers consist of 16 bit values.

The data in response to this message is packed as two bytes per register. In the float format, the first byte contains the high order bits and the second contains the low order bits.

Note: When reading 16 bit registers in the Informer+ the information is reversed. The low byte comes first.

Data is scanned in the instrument at the rate of 16 registers (32 bytes) per scan. The response in returned when the data is assembled (typically 6ms) and the programmed bus delay is complete.

Here is a sample response to the above query.

This response states that the message contains 0x0C data bytes (12 DEC). The 12 bytes are sent because the master had asked for 3 32 bit floats at 4 bytes each. The particular flow and temperature information transmitted is shown here. The units for the data are determined by the display settings on the instrument.

Field Name	Example (HEX)
Slave Address	16
Function Code	03
Byte Count	0C
Flow Rate MSB (0x0220)	40
Flow Rate (0x0221)	C7
Flow Rate (0x0222)	C6
Flow Rate LSB (0x0223)	A8
Flow Total MSB (0x0224)	43
Flow Total (0x0225)	03
Flow Total (0x0226)	6D
Flow Total LSB (0x0227)	0E
Temperature MSB (0x0228)	41
Temperature (0x0229)	D8
Temperature (0x0230)	80
Temperature LSB (0x0231)	00
CRC (low byte)	BA
CRC (low byte)	4C

Flow Rate	6.243000
Flow Total	131.426000
Temperature	27.062500

Preset Multiple Holding Registers (0x10)

This function is used to write data to the holding registers in the PolarTek instrument. Broadcast is supported by this function. When using broadcast, this function presets the same register references in all attached slaves. The maximum number of parameters is 100 16 bit registers (total 200 bytes).

The query message from the master specifies the register addresses and number of registers to preset. The requested preset values are specified in the query data field. Data is packed as two bytes per register.

The master's query must be framed as shown.

Field Name	Example (HEX)
Slave Address	16
Function Code	10
Starting Address (high byte)	00
Starting Address (low byte)	3E
Number of Registers (high byte)	00
Number of Registers (low byte)	02
Byte Count	04
Data MSB (Float)	4A
Data	91
Data	F4
Data LSB	78
CRC (low byte)	3E
CRC (low byte)	94

This example query writes a 32 bit float to the linear K-Factor register (0x003E). The float within the sample is 4A 91 F4 78 which is equal to 4782652.2. This is a typical factor is pulses/m^3 for a 1" turbine meter.

The normal response returns the slave address, function code, starting address, and number of registers preset. The proper response to the above preset command is shown here.

Field Name	Example (HEX)
Slave Address	16
Function Code	10
Starting Address (high byte)	00
Starting Address (low byte)	3E
Number of Registers (high byte)	00
Number of Registers (low byte)	02
CRC (high byte)	23
CRC (low byte)	23

Report Slave ID (0x11)

This function is used to read the serial number, firmware version, number of channels, and device type at the selected address. Broadcast is not supported with this function.

The query contains only the address and function code. It does not contain any data.

This query must be structure as shown.

Field Name	Example (HEX)
Slave Address	16
Function Code	11
CRC (high byte)	CF
CRC (low byte)	DC

The response to this function is the same frame format for all PolarTek instruments.

From this example response the master can determine that the slave at address 0x16 is an Informer+ with 1 channel, is running firmware version 2.07, and has a serial number of 03072102.

The following table shows the Product ID Codes and the associated product name:

Product ID Code	Product Name
06	Informer+
07	Patriot

Field Name	Example (HEX)
Slave Address	16
Function Code	11
Byte Count	09
Product ID	06
Number of Channels	01
Firmware Version 1 (MSB)	02
Firmware Version 2	00
Firmware Version 3 (LSB)	07
Serial Number 1 (MSB)	03
Serial Number 2	07
Serial Number 3	15
Serial Number 4 (LSB)	02
CRC (high byte)	6F
CRC (low byte)	5E

The firmware version is read as three separate BCD (binary coded decimal) digits that should be read as follows:

[Firmware Version 1] . [Firmware Version 2] [Firmware Version 3]

The unique serial number is read as 4 separate 2 digit Hex numbers. The displayed serial number converts these Hex values to decimal. The serial number is read in the following sequence:

[Serial Number 1] [Serial Number 2] [Serial Number 3] [Serial Number 4]

Clear Flow Data (0x55)

This function clears the flow total register in the instrument. This action is identical to clearing the flow total through the keypad. Broadcast is supported with this function. The connected slaves will not respond to this command, the master will have to query each unit individually to verify the success of this command.

The command packet contains only the address and function code. It does not contain any data.

The query must be structured as shown.

Field Name	Example (HEX)
Slave Address	16
Function Code	55
CRC (high byte)	CF
CRC (low byte)	EF

This command does not affect any of the configuration settings, such as K-Factor, or flow units.

Note: If this command is issued to a device that is reading flow at that time, an immediate check of the total may not read zero. This is because the unit will continue to receive pulses and calculate the flow data even while it clears its flow total.

Reset Configuration / Device (0xAA)

This function causes the addressed unit to clear all of the internal configuration registers and set them to the factory default values (this will include the K-Factor). This function also causes the unit to perform a hardware reset. Broadcast is supported with this function. The connected slaves will not respond to this command, the master will have to query each unit individually to verify the success of this command. Please see the Technical Reference section of the appropriate manual for a listing of the factory defaults for your instrument.

The command packet contains only the address and function code. It does not contain any data.

The query must be structured as shown.

Field Name	Example (HEX)
Slave Address	16
Function Code	AA
CRC (high byte)	8F
CRC (low byte)	AF

Note: This command will not delete the current total on the instrument, it will however change the units of measure to the default and convert the total to the new units. If it is also desired that the total be cleared at this time, a Clear Flow Data (0x55) command must be issued separately.

Holding Registers

The master has read/write access to all of the holding registers in PolarTek instruments. It is strongly recommended that the master strictly follow the tables listed for the appropriate instrument and not to modify any of the unlisted register addresses. When writing the K-Factors or Analog Output Limits (*Any* Float) to the configuration, only a single float can be written in each packet. This is because of an internal float conversion that is required within the configuration space. The data space does not have this limitation.

It is important that the addresses in the following tables are not offset either internally or externally to the device. Most Modbus software will require that 1, 4000, 40000, 4001, or 40001 be added to the actual address of the registers as shown in the tables. These drivers will strip away these extra values when preparing the RTU packet. Ensure that the outgoing packets contain the addresses as shown in the tables.

Informer+ Holding Registers

The following tables show the Modbus holding registers specific to the Informer+.

Informer+ Configuration Holding Registers

Informer+ Configuration Holding Registers				
Address (Hex)	**Name**	**Format**	**Notes**	
0054 (0036)	Lock Code Enable / 4-20mA Enable	16 Bit	First Byte = Lock Code Enable	0 = Off 2 = On
			Second Byte = 4-20mA Signal Enable	1 = Off 9 = On
0056 (0038)	Display Update Frequency / Lock Code	32 Bit	Firs Byte = Display update frequency in seconds	Allowable Values: 4 to 255
			Second Byte = LSB of the 24bit integer Lock Code	The integer value must be < 99999
			Third Byte = second Byte of the Lock Code	
			Fourth Byte = MSB of the Lock Code	
0060 (003C)	K-Factor Algorithm Select	16 Bit	First Byte = K-Factor Decimal Location	Allowable Values: 0 to 4
			Second Byte = K-Factor Algorithm Select	0 = Linear Factor 1 = 10 Point
0062 (003E)	Factor #0 Linear Factor	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format Units set by Reg# 0137	
0066 (0042)	Frequency #0	16 Bit	LSB, MSB Units are Hz / 10	
0069 (0045)	Factor #1	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format Units set by Reg# 0137	
0073 (0049)	Frequency #1	16 Bit	LSB, MSB Units are Hz / 10	
0076 (004C)	Factor #2	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format Units set by Reg# 0137	
0080 (0050)	Frequency #2	16 Bit	LSB, MSB Units are Hz / 10	
0083 (0053)	Factor #3	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format Units set by Reg# 0137	
0087 (0057)	Frequency #3	16 Bit	LSB, MSB Units are Hz / 10	
0090 (005A)	Factor #4	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format Units set by Reg# 0137	
0094 (005E)	Frequency #4	16 Bit	LSB, MSB Units are Hz / 10	
0097 (0061)	Factor #5	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format Units set by Reg# 0137	
0101 (0065)	Frequency #5	16 Bit	LSB, MSB Units are Hz / 10	
0104 (0068)	Factor #6	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format Units set by Reg# 0137	
0108 (006C)	Frequency #6	16 Bit	LSB, MSB Units are Hz / 10	

Informer+ Configuration Holding Registers (Continued)				
Address (Hex)	**Name**	**Format**	**Notes**	
0111 (006F)	Factor #7	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format Units set by Reg# 0137	
0115 (0073)	Frequency #7	16 Bit	LSB, MSB Units are Hz / 10	
0118 (0076)	Factor #8	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format Units set by Reg# 0137	
0122 (007A)	Frequency #8	16 Bit	LSB, MSB Units are Hz / 10	
0125 (007D)	Factor #9	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format Units set by Reg# 0137	
0129 (0081)	Frequency #9	16 Bit	LSB, MSB Units are Hz / 10	
0135 (0087)	Flow Data Units	16 Bit	First Byte = Volumetric Units	0 = No Units 1 = GAL 2 = LIT 3 = BBL 4 = Ft^3 5 = M^3
			Second Byte = Time Scaler	0 = /SEC 1 = /MIN 2 = /HR 3 = /DAY
0137 (0089)	K-Factor Units	16 Bit	First Byte = Flow Rate Decimal Location	Allowable Values: 0 to 3
			Second Byte = K-Factor Units	0 = No Units 1 = p/GAL 2 = p/LIT 3 = p/BBL 4 = p/Ft^3 5 = p/M^3
0143 (008F)	4-20mA Signal Low Flow Rate	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units set by Reg# 0135	
0148 (0094)	4-20mA Signal High Flow Rate	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units set by Reg# 0135	
0153 (0099)	Modbus Settings	16 Bit	First Byte = Slave Address	Allowable Values: 1 to 255
			Second Byte = Bus Delay (in ms)	Allowable Values: 0 to 255
0156 (009C)	Pulse Out Settings	16 Bit	First Byte = Pulse Divider	0 = Pulse Off 1 = 1:1 2 = 1:10 3 = 1:100 4 = 1:1000 5 = 1:10 000 6 = 1:100 000
			Second Byte = Reserved	Allowable Values: 0

Informer+ Data Holding Registers

Informer+ Data Holding Registers			
Address (Hex)	**Name**	**Format**	**Notes**
0544 (0220)	Flow Rate	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units set by Reg# 0135
0548 (0224)	Flow Total	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units set by Reg# 0135
0552 (0228)	Temperature	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units = °C
0556 (022C)	Battery Voltage	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units = VDC
0560 (0230)	Flow Total Log (0) Total at start of current day	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units = US GAL
0564 (0234)	Flow Total Log (1) Total at start of previous day	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units = US GAL
0568 (0238)	Flow Total Log (2) Total at start of 2 days ago	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units = US GAL
0572 (023C)	Flow Total Log (3) Total at start of 3 days ago	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units = US GAL
0576 (0240)	Flow Total Log (4) Total at start of 4 days ago	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units = US GAL
0580 (0244)	Flow Total Log (5) Total at start of 5 days ago	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units = US GAL
* * *	* * *	* * *	* * *
0680 (02A8)	Flow Total Log (30) Total at start of 30 days ago	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units = US GAL
0684 (02AC)	Flow Total Log (31) Total at start of 31 days ago	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units = US GAL
0688 (02B0)	Flow Total Log (32) Total at start of 32 days ago	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units = US GAL
0692 (02B4)	Flow Total Log (33) Total at start of 33 days ago	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units = US GAL
0696 (02B8)	Flow Total Log (34) Total at start of 34 days ago	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units = US GAL
0700 (02BC)	Flow Total Log (35) Total at start of 35 days ago	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units = US GAL
0704 (02C0)	Yesterday Volume Equal to Day (0) - Day (1)	Float	MSB, Byte, Byte, LSB (32 Bit IEEE Float Format) Units = US GAL

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