

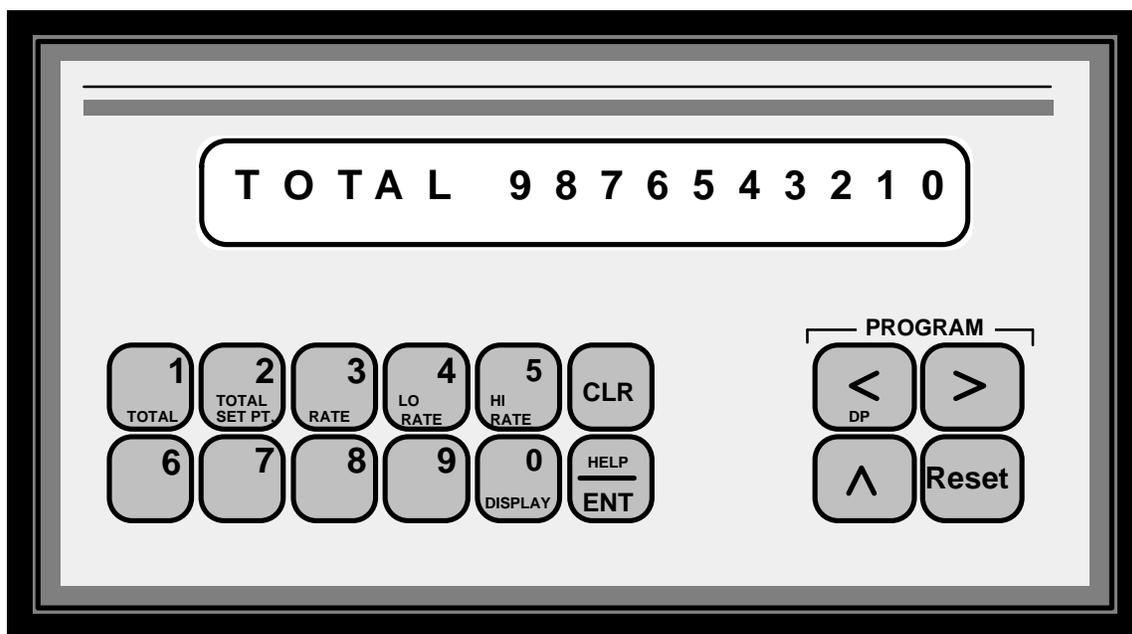


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Operation Manual For Models

EA230-20 and EA230-30

Flow Computers



INTRODUCTION

MODELS

There are two different models of the Flow Rate Totalizer, an EA230-20 and a EA230-30. The -20 does not have a 4 to 20 mA rate output whereas the -30 has this output feature.

FUNCTIONS

The Flow Rate Totalizer performs two basic functions:

- Totalizes all flow
- Displays Flow Rate with high and low alarm outputs

Modes

The flow rate totalizer has two modes of operation, linear or squared. The linear mode accepts a linear 4 to 20 mA signal and can be programmed for up to a 20 point linearization, straight line interpolation between points. The squared mode of operation will accept a linear signal from a 4 to 20mA source, and take and display the square root of the input signal.

TOTALIZER

Operation

The Totalizer is a ten-digit flow totalizer. The Reset key can be programmed to reset the Totalizer count. The Totalizer is unidirectional; it counts up only.

Outputs

Two transistor outputs and two relay outputs are available from the Totalizer. Transistor 1 provides a scaled output pulse for remote totalizing applications. The pulse output duration can be programmed for Fast (125 μ sec), Medium (2 msec.) or Slow (50 msec.). The Totalizer has a buffer capable of storing 255 scaled counts if the Totalizer count rate temporarily exceeds the scaled output rate. If the buffer capacity is exceeded, any Totalizer count attempting to cause the buffer to 256 will be lost from the scaled pulse output, and the message PULSE OVERFLOW will appear on the display. The contents of this buffer are saved if the power is removed from the unit before all of the counts have been put out. This buffer is reset when the totalizer is reset.

Transistor 2 is the Totalizer setpoint output which turns on when the Totalizer count reaches the Totalizer setpoint. The output can be programmed to time out (turn off) from 0.01 to 99.99 seconds after it turns on. Programming the timer to a value of 0.00 disables the time and causes the output to remain on until an input or key board command unlatches it.

Relays K1 and K2 can be programmed to switch on the totalizer setpoint. The output will switch when the Totalizer count reaches the Totalizer setpoint. The output can be programmed to time out (turn off) from 0.01 to 99.99 seconds after it turns on. Programming the timer to a value of 0.00 disables the time and causes the output to remain on until an input or key board command unlatches it.

RATEMETER

Operation

The ratemeter has six-digits of display and calculates flow by converting the analog signal to a pulse and measuring the time interval between input pulses or average time between groups of pulses and then reciprocating the time. The Reset key can be programmed to act on the Ratemeter.

Smoothing

The smoothing function allows the ratemeter to average rate readings from 1.0 seconds to 7.5 seconds in .5 second steps. There is no smoothing when programmed for 0.5 seconds.

High/Low Outputs

The Rate Hi and Low setpoints are used to set Rate values at which the rate output alarms turn on both transistor and relay outputs. The Hi output is turned on if the Rate is greater than the Hi setpoint, the Lo output is turned on if the rate is lower than the Lo setpoint. The outputs can be programmed to follow, time out, or to latch until a keyboard or input signal is received. In the follow mode of operation, the rate is compared to the Hi and Lo setpoints after each rate update. If an output is turned on, it remains on until the next rate update occurs and then the output is either left on or turned off depending on the comparison of the new rate reading with the setpoints. In the time out mode of operation, the outputs can be programmed to turn on for .01 to 99.99 seconds. Programming a value of 0.00 disables the timer and causes the outputs to latch until unlatched by a keyboard or input signal.

Rate at Zero

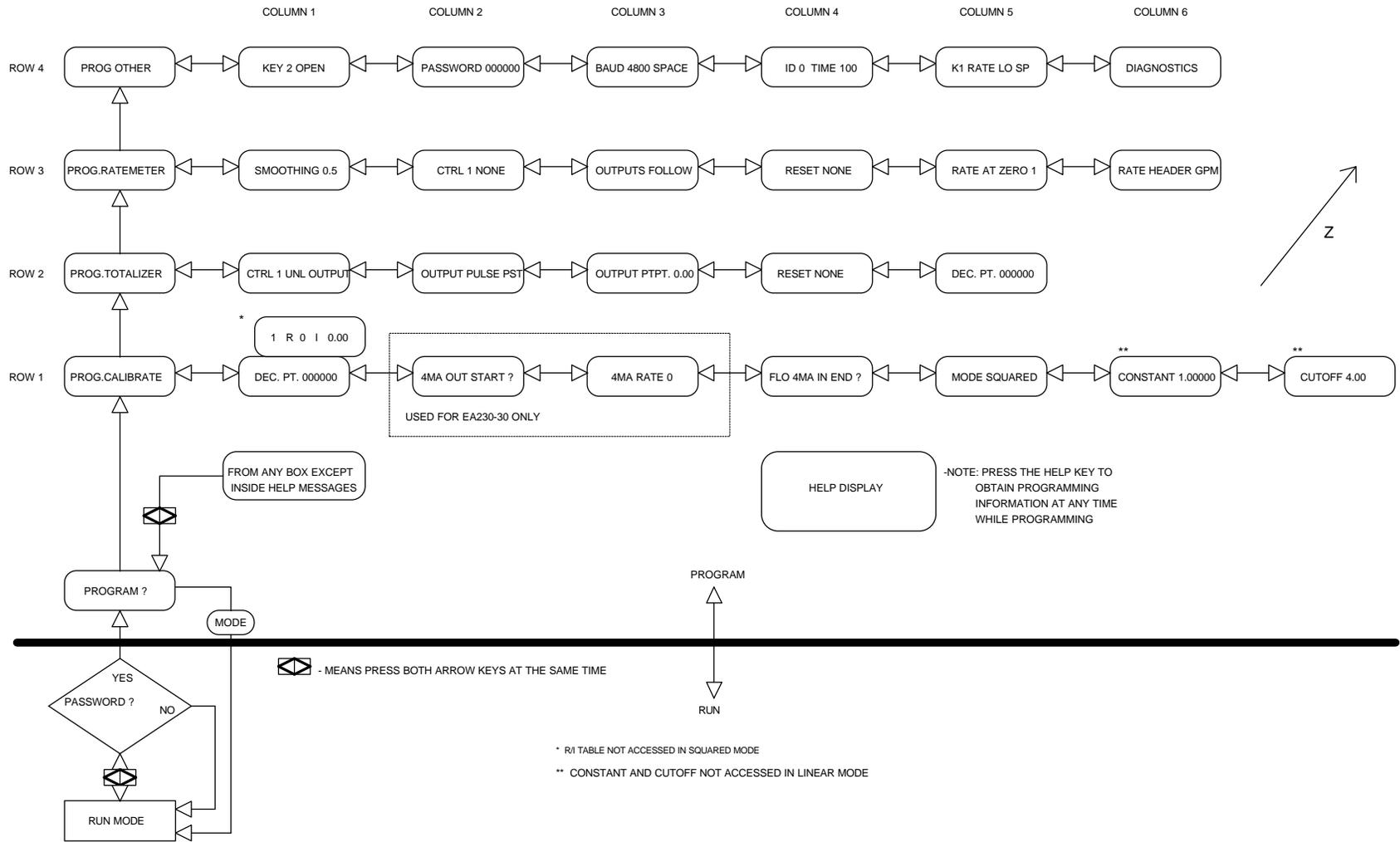
The Ratemeter displays zero rate when the time interval between input pulses exceed the programmed Rate Zero time. The timer can be set from 1 to 15 seconds.

Rate Header

The Rate units of measure (up to three characters) can be programmed into the unit and will be shown along with the rate value and rate setpoints on the display. If the Rate data exceeds four digits, the rate header will be shifted off the display in the split display mode.

Rate 4-20 mA Output (Used for EA230-30 only)

The analog rate output range can be programmed at both the 4 mA and 20 mA points. This permits analog rate indications from 0 to full scale rate or to select a portion of the rate range. The analog output can be digitally calibrated in the program mode. The analog output goes to a value of 4 mA when the unit is being programmed and during power-up diagnostic tests.



PROGRAM MODE

Caution: All count and rate functions are inhibited when in the program mode.

Accessing Programming Mode

Pressing the < and > keys down at the same time causes the display to prompt the user for a PASSWORD. When the correct password is entered, the unit enters into the program mode and displays the message PROGRAM?. The password is not displayed but an underscore is shown for each digit entered. Note: The unit comes from the factory with the Password of 000000. When the password is set to zeros, the unit enters the program mode directly after pressing the < and > keys.

From the program mode entry/exit display, access to submenu items can be obtained in two ways.

PROGRAM ?

1. A. Press the ^ (up) key to scroll through the main menu items (row X).
B. Press the < or > key to scroll through the submenu items (column Y).
2. From the program menu chart, identify the row (x) and column (y) of the submenu desired. Access is gained without scrolling with the arrow keys.

In some cases, submenus are "layered" (Z-axis). Access is gained from the "top" layer of the submenu by pressing the appropriate front panel key. All submenus are mapped out in detail with their definitions in the pages following the Program Menus chart. The HELP key will provide programming information when pressed at any time during programming.

In any submenu of the program mode, pressing the < and > keys at the same time returns the unit to the program mode entry/exit display.

PROGRAM ?

Pressing the Reset key at this time causes the unit to go to the run mode.

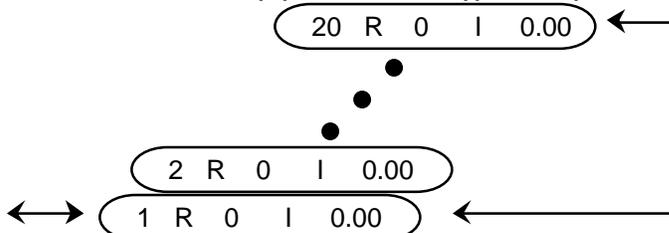
PROG. CALIBRATE

Sub Menu 35 - Ratemeter Decimal Point

←→ DEC. PT. 000000

The ratemeter can have a decimal point set in any of six positions. Use the up arrow key to select the desired decimal point position. The decimal point selected here is shown in the rate display, the rate Hi/Lo setpoint and the rate 4 - 20 mA output setpoints.

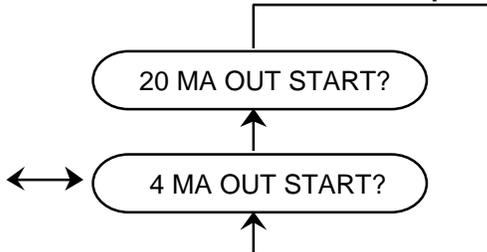
Sub Menu 11- Rate (R) and Current (I) Table (Linear Mode Only)



When linear mode is selected, the linearization table is available for input. Press the ^ key after displaying the DEC PT 00000000 and the linearization table will be displayed. The actual rate (R) and its associated current (I) are entered for up to 20 points. To enter a rate press the > key

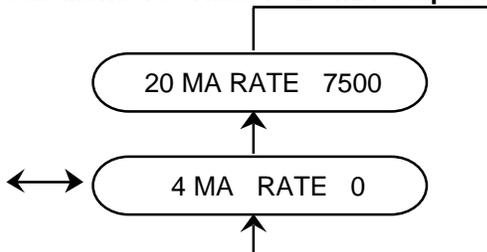
to make the R blink, press the CLR key and then enter the rate, finally press the ENT key to accept the rate. To enter a current press the > key to make the I blink, press the CLR key and then enter the current, finally press the ENT key to accept the current. After entering the first points rate and current press the ^ key to advance to the next point. Repeat the procedure for as many points as are available.

Sub Menu 12 - Rate 4 - 20 mA Output Calibration (Used for EA230-30 only)



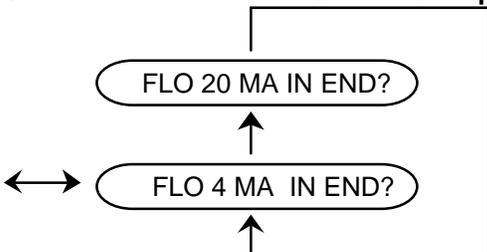
To calibrate the analog output signal, first turn off all power and then connect the analog output "+" terminal and the 24VDC ground terminal to a current meter. Turn power back on and select menu 13. Press the CLR key to start the calibration process and use the left / Right arrow keys to adjust the current to 4 mA, then press the ENT key to enter the 4 mA calibration point. Use the up arrow key to select the 20 mA setpoint. Press the CLR key to start the calibration process and use the Left/Right arrow keys to adjust the current to 20 mA, then press the ENT key to enter the 20 mA calibration point.

Sub Menu 13 - Rate 4 - 20 mA Output Range (Used for EA230-30 only)



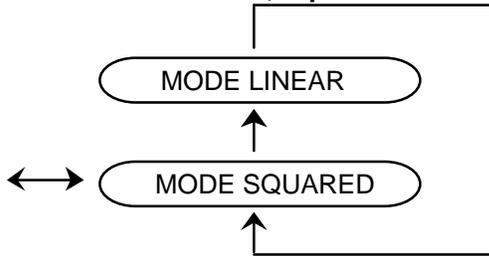
The rate output range is programmed at both the 4 mA and 20 mA points. This permits analog rate indications from 0 to full scale of the digitally displayed Rate or to select a portion of the Rate range. Use the up arrow key to select the 4 mA setpoints and then use the CLR, NUMBER and ENT keys to enter a Rate Value at each setpoint.

Sub Menu 14 - Rate 4 - 20 mA Flow Input Range



The flow input range is programmed at both the 4 mA and 20 mA points. This permit analog flow calibration of the 4.00mA and 20.00mA levels. Use the up arrow key to select the 4 mA flow inputs and then use the CLR, NUMBER and ENT keys to enter a value at each setpoint.

Sub Menu 15 - Mode, Squared and Linear



The linear mode displays the input analog signal in a linear form, the squared mode will take the square root of the signal then display the result. To select the linear or squared modes use the ^ key to toggle between them.

Sub Menu 16 - Constant (Squared Mode)

CONSTANT 1.00000

The squared mode constant is multiplied by the raw analog flow input to scale the display for the desired units. Use the CLR, NUMBER and ENT keys to enter a value for the constant. The constant is calculated by using the following formula:

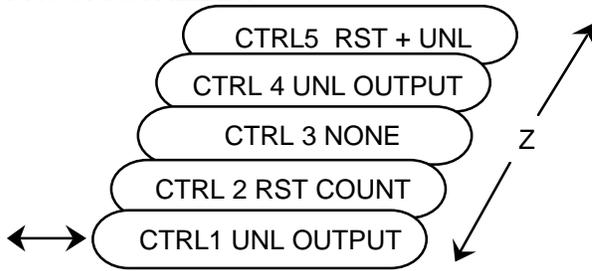
$$CONSTANT = \frac{FULL_SCALE_RATE}{\sqrt{FULL_SCALE_mA - CUTOFF}}$$

Sub Menu 17 - Cutoff (Squared Mode)

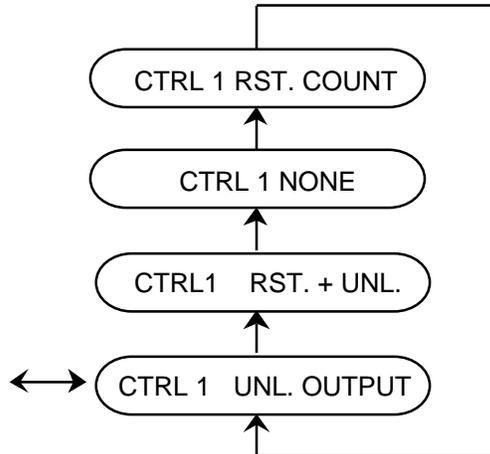
CUTOFF 4.10

The squared mode cutoff current (in mA) can be set to limit the response of the input analog signal. Use the CLR, NUMBER and ENT keys to enter a value for the cutoff.

PROG. TOTALIZER



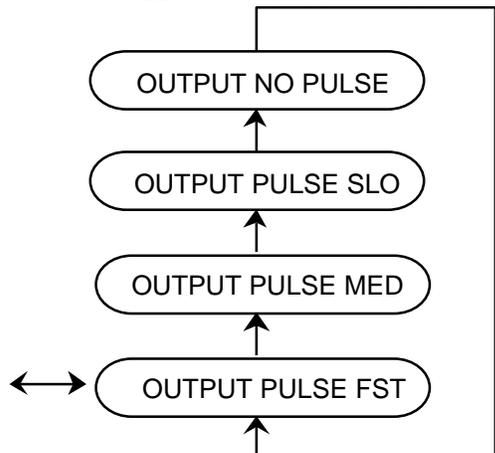
Press 1 through 5 to access control input 1 through control input 5.



Same selections for CTRL 2 through CTRL 5.

Any of the five rear terminal control inputs can be programmed to perform a function on the Totalizing operation of this control. A control input is selected by pressing from panel keys 1, 2, 3, 4 or 5. Key 1 selects control input 1, key 2 selects control input 2, etc. When a control input terminal has been selected, it is shown on the left hand side of the display and its function is shown on the right hand side of the display. The function that a control input terminal performs can be changed by pressing the up arrow key. The functions that can be assigned to an input are: None, Reset Count, Unlatch output, or Reset Count & Unlatch Output. Note: an input assigned to perform a function to the Totalizer can also be assigned to perform additional functions to the Ratemeter in the Ratemeter menu row. A chart is shown on page 15 to provide a convenient means of recording the tasks each control input has been assigned.

Sub Menu 22 - Totalizer Scaled Pulse Output



The totalizer pulse output transistor can be programmed for fast, medium, or slow pulse widths. It can also be programmed to not output pulses.

Frequency Range of Output

Fast - 125 μ sec on, 125 μ sec off, 1500 Hz max. output freq.
Medium - 2 msec on, 2 msec off, 200 Hz max. output freq.
Slow - 50 msec on, 50 msec off, 10 Hz max. output freq.
No pulse - Off Continuously

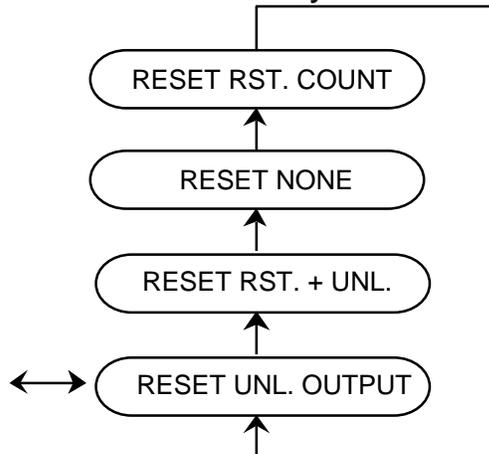
This output has a 255 count buffer. The buffer is saved at power down, and is reset when the Totalizer is reset. Use the up arrow key to select the mode of operation of the scaled pulse output.

Sub Menu 23 - Totalizer Setpoint Timeout

OUTPUT STPT. 0.00 Range 0.01 - 99.99 seconds

The totalizer setpoint output transistor can be programmed to time out in the range of 0.01 to 99.99 seconds. To enter a time value, press the CLR key, enter the time with the 0 through 9 keys, and press the ENT key. The timer can be disabled by setting a time value of 0.00 seconds. When the timer is disabled, the output remains latched until an input or keyboard command unlatches it.

Sub Menu 24 - Reset Key



The reset key can be programmed to perform various functions on the Totalizer operation. The name of the key is shown on the left side of the display and the function it performs is shown on the right hand side of the display. The function can be changed by pressing the up arrow key. Keys assigned to perform a function on the Totalizing operation may also be assigned to perform additional functions to the Ratemeter. A chart is shown on page 15 to provide a convenient means of recording the tasks of the Reset Key.

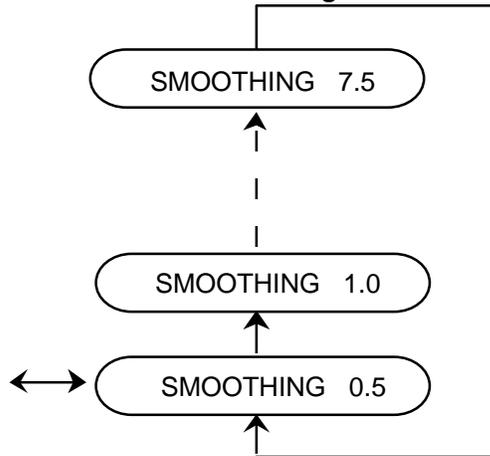
Sub Menu 25- Totalizer Decimal Key

←→ DEC. PT. 0000000000

The totalizer display can have a decimal point programmed in any of six positions. Use the ^ key to select the desired position. The decimal point selected here is shown in the total count and Totalizer setpoint displays.

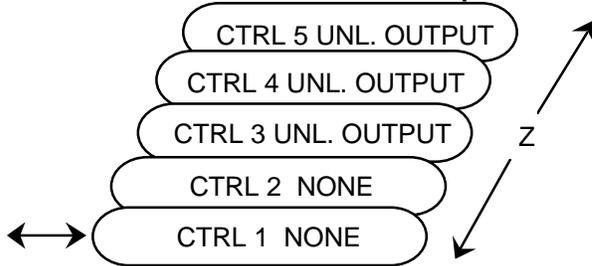
PROG. RATEMETER

Sub Menu 31 - Smoothing

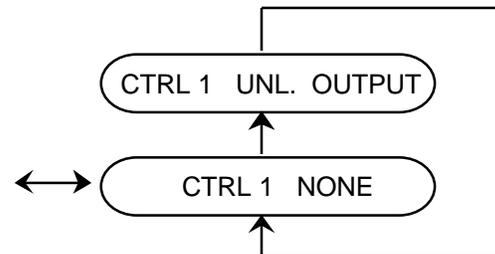


Rate is calculated and the rate display is updated every 0.5 seconds. When rate smoothing is selected to be greater than 0.5 seconds, the most recent rate calculation is averaged with the previous rate calculations that were made in the smoothing period. Use the up arrow key to select the amount of smoothing desired.

Sub Menu 32 - Ratemeter Control Inputs



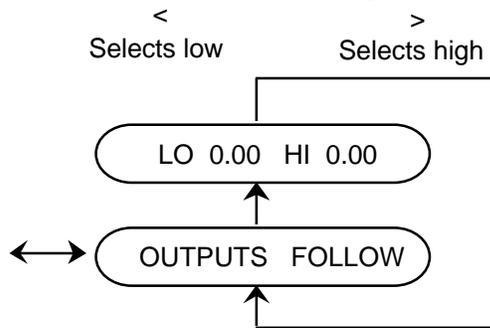
Press 1 through 5 to access control input 1 through control input 5.



Same selections for CTRL 2 through CTRL 5.

Any of the five rear terminal control inputs can be programmed to perform a function on the Ratemeter operation of this control. A control input is selected by pressing front panel keys 1,2,3, 4 or 5. Key 1 selects control input 1, key 2 control input 2 etc. When a control input terminal has been selected, it is shown on the left hand side of the display and its function is shown on the right hand side of the display. The function that a control input terminal performs can be changed by pressing the up arrow key. The functions that can be assigned to an input are: None, Unlatch HI/LO output Alarms. Note: an input assigned to perform a function to the Ratemeter can also be assigned to perform additional functions to the Totalizer in the Totalizer Program menu row. A chart is shown on page 15 to provide a convenient means of recording tasks each control input has been assigned.

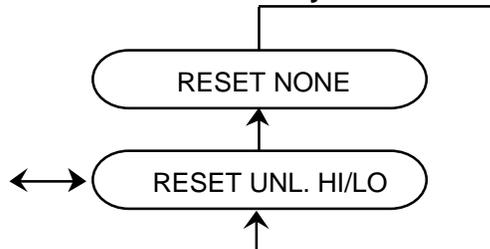
Sub Menu 33 - Ratemeter High and Low Outputs



The Rate Hi and Low setpoints are used to set Rate values at which the rate output alarms turn on. The Hi output is turned on if the Rate is greater than the high setpoint, the Lo output is turned on if the rate is lower than the Lo setpoint. The outputs can be programmed to follow, time out, or to latch until a keyboard or input signal is received. In the follow mode of operation, the rate is compared to the Hi and Lo setpoints after each rate update. If an output is turned on, it remains on until the next rate update occurs and then the output is either left on or turned off depending on the comparison of the new rate reading with the setpoints. In the time out mode of operation, the outputs can be programmed to turn on for .01 to 99.99 seconds. Programming a value of 0.00 disables the timer and causes the outputs to latch until unlatched by the keyboard or input signal. Use the up arrow key to select the output mode of operation. The Lo setpoint can be programmed greater than the Hi setpoint if desired.

Use the < or > key to select the high or low output. The word LO or HI will flash when selected. Use the CLR, NUMBER and ENT keys to enter timer values for both outputs.

Sub Menu 34 - Reset Key



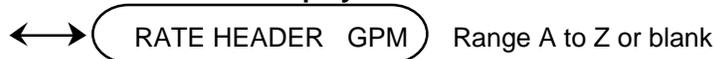
The Reset key can be programmed to unlatch the Ratemeter high and low alarms, or it can be programmed to have no effect on the alarms. Select the function of the reset key on the Ratemeter operation by pressing the up arrow key. The Reset key can be programmed for additional functions on the Totalizer operation. A chart is shown on page 15 to provide a convenient means of recording the tasks of the Reset key.

Sub Menu 36 - Ratemeter Zero Timeout



The Ratemeter displays zero rate when the time interval between input pulses exceed the programmed Rate Zero time. The timer can be set from 1 to 15 seconds. Use the CLR, NUMBER and ENT keys to enter a new timer value.

Sub Menu 37 - Rate Display Header



The Rate units of measure (up to three characters) can be programmed into the unit and will be shown along with the rate value and rate setpoints on the display. If the Rate data exceeds four digits, the rate header will be shifted off the display in the dual display mode of viewing data.

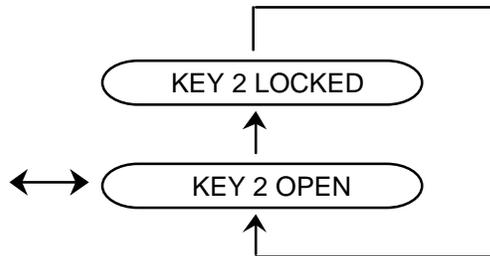
Use the < and > ? keys to cause the selected character to blink. Then use the ^ key to scroll through the alphabet. Blank (no character) is between Z and A.

PROG.OTHER

Sub Menu 41 - Setpoint Lock



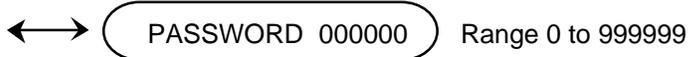
Press 2, 4, 5 to access keys 2, 4, 5.



Same selections for keys 4 and 5.

The Totalizer and Ratemeter Hi/Lo setpoints can be selectively locked to their current value by locking them in the program mode. Use number keys 2, 4 and 5 to select a setpoint. Use the up arrow key to select if the setpoint should be locked to its current value or left open for operator changeability.

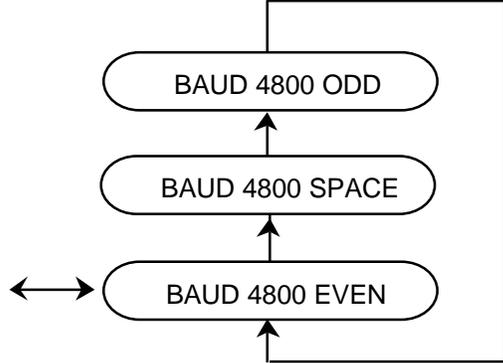
Sub Menu 42 - Password



A password can be programmed into the unit to provide password access to the program mode. The unit as it comes from the factory does not require the entry of a password to gain access to the program mode. This is accomplished by programming all zeros into the password data field. Entering a number from 1 to 6 digits in length into the password data field activates the password access to the program mode.

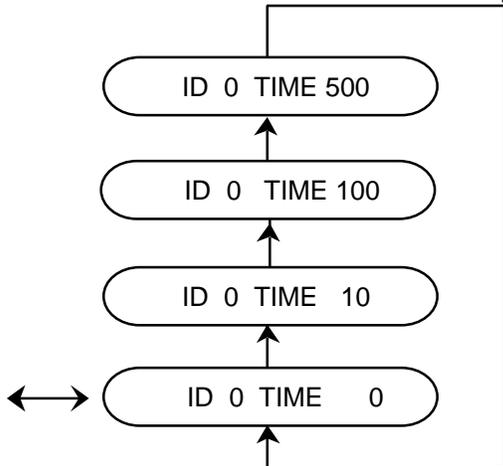
In the run mode of operation, a means of entering into the program mode is provided if the password was lost. When the unit prompts the user for PASSWORD key in 9999999999 ENT.

Sub Menu 43 - Communication Baud Rate and Parity



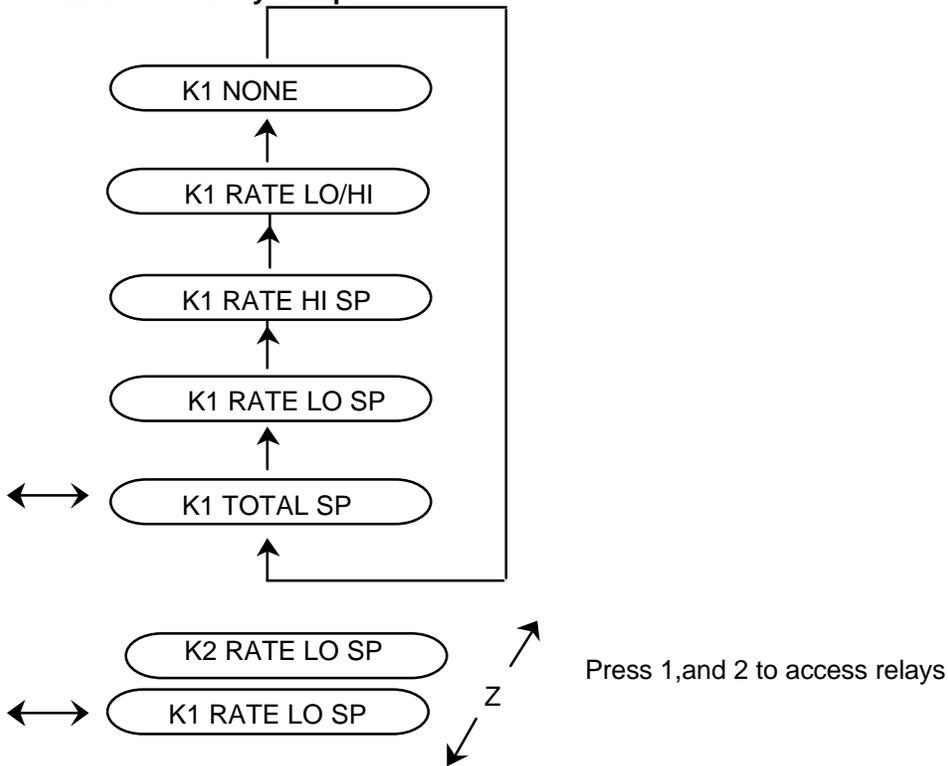
The baud rate and parity are set in this menu. Enter a baud rate of 300, 600, 1200, 2400, 4800, 9600 or 19200 by using the CLR, NUMBER and ENT keys. Enter EVEN, ODD or SPACE parity by using the up arrow key.

Sub Menu 44 - Unit ID number and Response Delay Time



The unit identification number is set in this menu. Each unit on the communication bus must have a unique identifying number, 1 through 255. Enter the units ID by using the CLR, NUMBER and ENT keys. The length of time before the control response to communication requests can set to accommodate various types of computer equipment. Delay times of 0, 10, 100 and 500 milliseconds can be selected by using the up arrow key.

Sub Menu 46 - Relay Setup

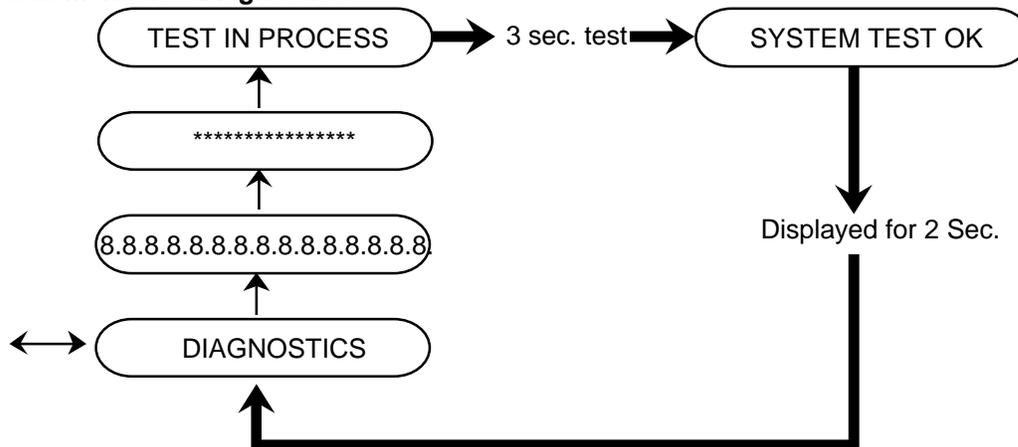


There are two relays, K1 and K2 that have normally open and normally closed connections. Pressing the 1 and 2 keys selects the relay for programming. When a relay input is selected, it is shown on the left hand side of the display and its function is shown on the right hand side of the display. The function that a relay performs can be changed by pressing the up arrow key. The functions that can be assigned to the relays are: rate low setpoint, rate high setpoint, rate low and high setpoint, totalizer set point and relay output disabled. The relay outputs (K1 and K2) are used in conjunction with the total set point, rate low set point, rate high set point and rate LO/HI setpoints. The K1 and K2 relays follow the function of the transistor outputs as shown in the following table.

| Setpoint Mode | Relays | Transistor(s) |
|---------------|-----------------------|---------------|
| NONE | K1, K2 not programmed | - |
| TOTAL SP | K1, K2 ON | # 2 ON |
| RATE LO SP | K1, K2 ON | # 3 ON |
| RATE HI SP | K1, K2 ON | # 4 ON |
| RATE LO/HI | K1, K2 ON | # 3 or 4 ON |

The relay outputs provide additional drive capability (current and voltage) that the transistors do not offer.

Sub Menu 46 - Diagnostics



The diagnostics allow the user to test the control's display and internal memory. Press the up arrow key for display test 1. Each of the display's 16 characters will go to 8 with the decimal point lit. Press the up arrow key for display test 2. Each character will go to *. Press the up arrow key for the internal memory test. The display will read "TEST IN PROCESS" for three seconds while the tests are being run. The display will read "SYSTEM TEST OK" for two seconds, and then go back to "DIAGNOSTICS" if no memory errors were detected. If the unit detects a memory error, the display will hold an error message. The error messages are:

- ROM ERROR
- INTERNAL ERROR
- EXTERNAL ERROR

These errors are non-recoverable. It is possible that electrical noise caused the diagnostic failure, so the power to the unit should be cycled (turned off and then turned back on). The memory tests are always performed at power up. If the same test fails at power up, the unit likely needs repair. If a different test fails, or if the unit powers up normally, it is likely that the unit is experiencing electrical noise problems. Note that the error messages for the power up memory test may be different than the error messages for the program mode diagnostic memory tests. The following table lists each test failure and its associated error message in each test mode.

ERROR MESSAGES

| TEST FAILURE | PROGRAM DIAGNOSTICS | POWERUP DIAGNOSTICS |
|--------------------|---------------------|---------------------|
| ROM checksum error | ROM ERROR | ROM ERROR |
| Int. RAM bit error | INTERNAL ERROR | RAM ERROR |
| Ext. RAM bit error | EXTERNAL ERROR | EXT RAM ERROR |
| EXT. RAM checksum | N/A | STORE ERROR |

Note that the power up diagnostic memory test performs an additional test, the external RAM checksum. If the calculated checksum of the external RAM (the memory which holds the user program) does not match the stored checksum, the user program has been corrupted and the message STORE ERROR appears on the display. This error is recoverable by pressing the Reset key. The message VERIFY PGM DATA then appears on the display for one second to prompt the user to locate and correct program mode item(s) which may have been altered.

Use programming Reference Chart

Reset Key

The reset key is programmable to perform different tasks for the Totalizer and Ratemeter functions of the unit. The Reset key can perform on task under each of the two major control functions shown below. The following table lists the tasks that can be selected.

| KEY | CONTROL FUNCTION | |
|-------|--|--|
| | RATE | TOTAL |
| Reset | <input type="checkbox"/> None <input type="checkbox"/> Unlatch Hi/Lo Alarms | <input type="checkbox"/> None <input type="checkbox"/> Reset Count <input type="checkbox"/> Unlatch Output <input type="checkbox"/> Reset & Unlatch |

Control Inputs

There are 5 control inputs which can be programmed to any of the functions shown in the chart below. An input can be assigned up to two tasks but only one task can be assigned under each of the two control functions shown below. The following table lists the tasks that can be selected.

| CONTROL INPUT | CONTROL FUNCTION | |
|---------------|--|--|
| | RATE | TOTAL |
| 1 | <input type="checkbox"/> None <input type="checkbox"/> Unlatch Output | <input type="checkbox"/> None <input type="checkbox"/> Reset Count <input type="checkbox"/> Unlatch Output <input type="checkbox"/> Reset & Unlatch |
| 2 | <input type="checkbox"/> None <input type="checkbox"/> Unlatch Output | <input type="checkbox"/> None <input type="checkbox"/> Reset Count <input type="checkbox"/> Unlatch Output <input type="checkbox"/> Reset & Unlatch |
| 3 | <input type="checkbox"/> None <input type="checkbox"/> Unlatch Output | <input type="checkbox"/> None <input type="checkbox"/> Reset Count <input type="checkbox"/> Unlatch Output <input type="checkbox"/> Reset & Unlatch |
| 4 | <input type="checkbox"/> None <input type="checkbox"/> Unlatch Output | <input type="checkbox"/> None <input type="checkbox"/> Reset Count <input type="checkbox"/> Unlatch Output <input type="checkbox"/> Reset & Unlatch |
| 5 | <input type="checkbox"/> None <input type="checkbox"/> Unlatch Output | <input type="checkbox"/> None <input type="checkbox"/> Reset Count <input type="checkbox"/> Unlatch Output <input type="checkbox"/> Reset & Unlatch |

RUN MODE

KEYS

Viewing Data

Press the following keys in any order to display the data contained in the control.

| Key Pressed | Shown on Display (example) |
|--------------------------|----------------------------|
| TOTAL | TOTAL 68148 |
| TOTAL SETPOINT | TOT P 1234567890 |
| RATE | RATE 115 GPM |
| LO RATE | LO RATE 100 GPM |
| HI RATE | HI RATE 9600 GPM |
| DISPLAY (SHOWS 2 VALUES) | H 937 115 GPM |

The display key shows two items displayed at the same time. The items are identified with the first letter of the full identifier except for rate, which is identified by the rate header, if programmed. Pressing the DP key momentarily will display the full identifiers for both values being displayed for about 1 second. The items displayed by the display key can be changed by pressing and holding down the DP key until the left side of the display starts to blink. Use the "up arrow" key to scroll through the items that can be displayed stopping at the desired item. Use the > key to select the right data display (blinks) and use the "UP arrow" key to select the data to be displayed. Return to the normal display by pressing the DISPLAY or any numeric key.

Display Hold

Pressing the following keys causes the display to "freeze" the current value for approximately 1 second:

- 0 - dual display
- 1 - totalizer count
- 3 - rate

Counting continues in the background. After the hold time elapses, the display updates to the new current value(s) and continues normal run mode updating thereafter.

Entering Setpoints

Setpoint data can be entered into the following items:

- TOTAL SETPOINT
- LO RATE
- HI RATE

To enter data, select the setpoint to be changed by pressing the desired key. The setpoint label and data should now be shown on the display. Press CLR, 0-9 (key in the new number), and ENT key. The new value for the setpoint is now entered into the control. The setpoints can be locked in the Program Mode such that the value cannot be changed in the Run Mode.

2nd Function Keys

Five different control parameters and the current version of software can be viewed by using the second function key. The selected item is shown for five seconds and then the display is returned to its prior state. To use the second function key, press the "up arrow" key followed by one of the number keys. The number key must be pressed within 3 seconds of pressing the up arrow key.

- 1 - CURRENT FLOW
- 2 - KMF
- 3 - CONSTANT
- 4 - CUTOFF
- 5 - CUTOFF
- 6 - CUTOFF
- 7 - CUTOFF

- 8 - CUTOFF
- 9 - CUTOFF
- 0 - Current Version of Software

Reset Key

The reset key is programmable to perform different tasks for the Totalizer and Ratemeter functions of the unit. The key can be programmed to perform only one task under each of the two major control functions shown below. The following table lists the tasks that can be selected.

| KEY | CONTROL FUNCTION | |
|-------|--|--|
| | RATE | TOTAL |
| Reset | <input type="checkbox"/> None <input type="checkbox"/> Unlatch Hi/Lo Alarms | <input type="checkbox"/> None <input type="checkbox"/> Reset Count <input type="checkbox"/> Unlatch Output <input type="checkbox"/> Reset & Unlatch |

CONTROL INPUTS

There are 5 control inputs which can be programmed to any of the functions shown in the chart below. An input can be assigned up to two tasks but only one task can be assigned under each of the two control functions shown below.

| CONTROL INPUT | CONTROL FUNCTION | |
|---------------|--|--|
| | RATE | TOTAL |
| 1 | <input type="checkbox"/> None <input type="checkbox"/> Unlatch Output | <input type="checkbox"/> None <input type="checkbox"/> Reset Count <input type="checkbox"/> Unlatch Output <input type="checkbox"/> Reset & Unlatch |
| 2 | <input type="checkbox"/> None <input type="checkbox"/> Unlatch Output | <input type="checkbox"/> None <input type="checkbox"/> Reset Count <input type="checkbox"/> Unlatch Output <input type="checkbox"/> Reset & Unlatch |
| 3 | <input type="checkbox"/> None <input type="checkbox"/> Unlatch Output | <input type="checkbox"/> None <input type="checkbox"/> Reset Count <input type="checkbox"/> Unlatch Output <input type="checkbox"/> Reset & Unlatch |
| 4 | <input type="checkbox"/> None <input type="checkbox"/> Unlatch Output | <input type="checkbox"/> None <input type="checkbox"/> Reset Count <input type="checkbox"/> Unlatch Output <input type="checkbox"/> Reset & Unlatch |
| 5 | <input type="checkbox"/> None <input type="checkbox"/> Unlatch Output | <input type="checkbox"/> None <input type="checkbox"/> Reset Count <input type="checkbox"/> Unlatch Output <input type="checkbox"/> Reset & Unlatch |

Program Mode

ALL CTRL INPUTS are disabled in the PROGRAM MODE. The RESET key performs programming functions only.

TRANSISTOR OUTPUTS

- T1 Scaled pulse output transistor. As a scaled pulse output, this transistor provides a count pulse out to a second counter while that totalizer is counting.
- T2 Totalizer setpoint. This transistor turns on when the Totalizer setpoint is reached.
- T3 Rate high alarm output transistor. This transistor turns on at the rate update if the calculated rate is greater than the high rate setpoint.
- T4 Rate low alarm output transistor. This transistor turns on at the rate update if the calculated rate is less than the low rate setpoint.

RELAY OUTPUTS

- K1 Scaled switch output. As a scaled switch output, this relay provides a switch closure or opening as programmed to the total setpoint, rate LO setpoint, rate HI setpoint or rate LO/HI setpoint.
- K2 Scaled switch output. As a scaled switch output, this relay provides a switch closure or opening as programmed to the total setpoint, rate LO setpoint, rate HI setpoint or rate LO/HI setpoint.

The detailed submenu descriptions in the program mode section give the options for turning the transistors off.

MESSAGES

A number of messages are available for display during the run mode or while the unit is entering the run mode from a power up or exit from program mode condition. Diagnostic messages may also be displayed while the unit is running self-test.

Run Mode Messages

INV - Invalid Key

ANA OUTPUT ERROR - The 4 mA output rate is greater than the 20 mA output rate.

OVERFLOW - If the calculated rate is greater than 999999, the word OVERFLOW will appear in the rate display.

SERIAL COMMUNICATIONS

INTRODUCTION TO SERIAL COMMUNICATIONS

PURPOSE

The Flow Rate Totalizer is equipped with an RS-485 serial communication port for the purpose of allowing a computer to:

1. Issue control commands such as reset.
2. Ad..cc (acknowledge with data, d..., and checksum of the data, cc)
3. Nee (not acknowledge with a two digit error code, ee).
4. Query and program all program mode sub menus except numbers 13, 15, 42, 43 & 44.

The serial format follows the Opto 22 Optomux protocol. This consists of a start character (>), a two character unit ID number, a three character command, data for the command, if applicable, a two character checksum and a termination character.

Each character is ten bits. The first bit is the start bit, followed by seven data bits (ASCII code), followed by the parity bit and the tenth bit is the stop bit. If the unit is programmed to space parity, the unit ignores the received parity and transmits space parity. The unit ID number and the checksum are in ASCII hexadecimal and have a range of 00 to FF. The checksum is the two least significant hex digits of the sum of the ASCII values of the unit ID number, the command and the data. All hex characters A through F must be in upper case. All leading zeros in data field must be sent. Decimal points within the data field are indicated by an ASCII comma. Commas within the data fields sent to the control are ignored. The termination character may be an ASCII carriage or an ASCII decimal point.

Responses by the control consist of three possibilities:

1. A(acknowledge)
2. Ad..co(acknowledge with data, d..., and checksum of the data, cc)
3. Nee (not acknowledge with two digit error code, ee)

Example:

Command sent to control - >01RST1B.

Where;

> is the start character,

01 is the unit ID number,

RST is the three character command (reset),

1 is applicable data (reset option - reset only),

8B is the two least significant digits of the hexadecimal checksum,

| | | | | | |
|---|---|---|---|---|---|
| 0 | 1 | R | S | T | 1 |
|---|---|---|---|---|---|

$$30+31+52+53+54+31 = 18B \text{ hexadecimal}$$

Error Codes

ERROR CODES CONSIST OF THE FOLLOWING:

- 01 Invalid Command
- 02 Communication Checksum Error
- 03 Buffer Overrun Error
- 05 Data Format Error
- 08 Parity or Framing Error
- 10 In Run Mode, Command not Allowed
- 12 In Program Mode, Command not Allowed
- 13 Mode Already Active. Command not Allowed
- 21 Data out of Range

CLASSIFICATIONS

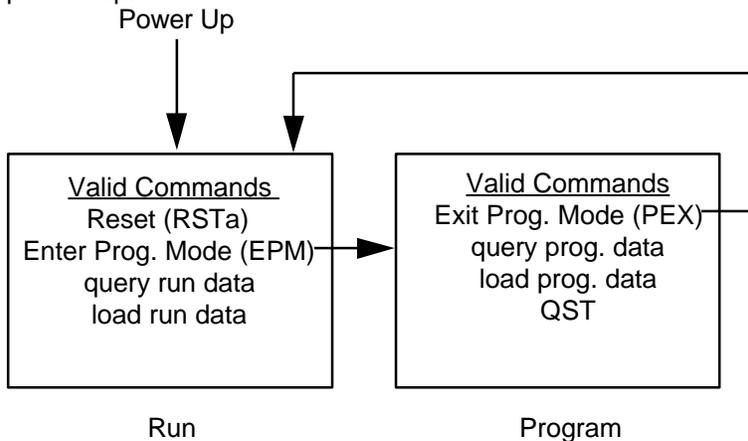
All serial commands fall into one of five classifications. These classifications are:

1. Control Commands
2. Query Run Data
3. Load Run Data
4. Query Program Data
5. Load Program Data

The control has two modes of operation; run mode and program mode. The control will respond to specific commands only if the command is valid for the mode of operation the control is in when the command is received. Command validity is addressed in the following section and all specific commands are described in detail in the following tables.

Control Commands

There are three control commands. Two of them, Enter Program Mode and Exit Program Mode are used to change the control's mode of operation. The following flow chart illustrates the validity and function of each control command and the validity of the other four command classification in each mode of operation. Note that the control goes into the run mode when it powers up.



The third control command, reset, does not change the control's mode of operation, but merely performs a reset and/or unlatch function while leaving the control in the run mode. The Rest control command is suffixed by one digit (a) which allows for secondary functions to occur along

with the Reset function. All secondary functions are listed in the following control command table.

All commands in the following tables are preceded by the start character (>) and unit number and succeeded by the two character checksum and carriage return.

The following control commands are supported by this control:

| Command | Response | Description |
|-----------|----------|--|
| RSTa | A | RESET COMMAND Where "a" determine functions to be performed |
| Digit "a" | 1 | Reset Totalizer |
| | 2 | Unlatch Totalizer |
| | 3 | Reset Totalizer & Unlatch Totalizer Output |
| | 4 | Unlatch Rate Alarms |
| | 5 | Reset Totalizer & Unlatch Rate Alarms |
| | 6 | Unlatch Totalizer Output & Rate Alarms |
| | 7 | Reset Totalizer, and Unlatch Totalizer Output and Rate Alarm |
| EPM | A | ENTER PROGRAM MODE |
| PEX | A | EXIT PROGRAM MODE |

QUERY RUN DATA COMMANDS

This classification of commands allows the computer to read run data information such as status, count, rate, setpoint, etc. These commands are valid in run mode only, except for QST (query status), which is valid in all modes of operation.

The following Query Run Data commands are supported:

| Command | Response | Description |
|---------|----------------|---|
| QST | AST abcde | QUERY STATUS Where a = Current Mode R - Run Mode P - Program Mode b = Totalizer Output Status A - Output On N - Output Off c = Rate High Alarm Status A - Alarm On N - No Alarm d = Rate Low Alarm Status A - Alarm On N - No alarm |
| QRT | ART aaaaaa | Query Rate where aaaaaa = Rate |
| QTC | ATC aaaaaaaaaa | QUERY TOTALIZER COUNT where aaaaaaaaaa + Totalizer Count |
| QRH | ARH aaaaaa | QUERY STATE HI SETPOINT where aaaaaa = Rate Hi Setpoint |

| | | |
|-----|----------------------|--|
| QRL | ARL aaaaaa | QUERY STATE LO SETPOINT where aaaaaa = Rate Lo Setpoint |
| QTS | ATS aaaaaaaaaa | QUERY TOTALIZER SETPOINT where aaaaaaaaaa = Totalizer Stpnt. (totalizer mode) |
| QMD | Aa... | QUERY MENU DATA where a... = Data Specified in Current Menu |
| QAP | Aab c... ab c... ... | QUERY ALL PROGRAM DATA where a = Program Menu Row b = Program Menu Column c = Applicable Data |

LOAD RUN DATA COMMANDS

This classification of commands allows the computer to write setpoints to the control and specify the control's response to the QMD command. These commands are valid only in the run mode.

The following Load Run Data Commands are supported:

| Command | Response | Description |
|--------------------|----------------------------------|---|
| LRHaaaaaa | A | LOAD RATE HI SETPOINT where aaaaaa = Rate Hi Setpoint |
| LRLaaaaaa | A | LOAD RATE LO SETPOINT where aaaaaa = Rate Lo Setpoint |
| LTSaaaaaaaa | A | LOAD TOTALIZER SETPOINT where aaaaaaaaaa = Totalizer Stpnt. (totalizer mode) |
| LCMab | A | LOAD COMMUNICATION MENU where ab determine the information that will be sent by the control when it is issued a QMD command. The following table illustrates the bit assignments for the available data. Setting the appropriate bits will cause that data to be sent. |
| Digit "a" (0-F) | Bit 0 Bit 1 Bit 2 Bit 3 | Status Flow Rate Rate Low Setpoint Rate High Setpoint |
| Digit "b" (0-F) | Bit 0 Bit 1 Bit 2 Bit 3 | Totalizer Count Totalizer Setpoint K Factor Rate Multiplier |

QUERY PROGRAM DATA/LOAD PROGRAM DATA COMMANDS

Query commands allow the computer to read program data from the control and load commands allow the computer to write program data to the control. Each command consists of a L (load) or a Q (query) and the two digit submenu number of the program mode sub menu illustrated on page 5. All program mode sub menus are serially accessible except numbers 13, 15, 42, 43 and 44. These commands are valid only in the program mode.

The following program mode commands are supported by this control. Decimal Points are not required by the command except for those program blocks which allow for a floating decimal point. All other program blocks will insert the decimal point in the correct location.

| | | |
|-------------------|-------------------|---|
| L11 aaaaa | A | Load K Factor where aaaaa = K Factor (D.P. valid) |
| Q11 | A11 aaaaa | Query K Factor where aaaaa = K Factor |
| L12 aaaaaa | A | Load Rate Multiplier where aaaaaa = Multiplier (D.P. valid) |
| Q12 | A12 aaaaaa | Query Rate Multiplier where aaaaaa = Multiplier |
| L14 aaaaaa bbbbbb | A | Load Analog Rate where aaaaaa = 4 mA rate bbbbbb = 20 mA Rate |
| Q14 | A14 aaaaaa bbbbbb | Query Analog Rate where aaaaaa = 4 mA rate bbbbbb = 20 mA rate |
| L21 a b | A | Load Totalizer Control Input where a = Control Input (1-5) b = 0 No Function 1 Reset Totalizer 2 Unlatch Output 3 Reset & Unlatch |
| Q21 | A21 a b ... | Query All Totalizer Control Inputs where A = Control Input B = 0 - No Function 1 - Reset Totalizer 2 - Unlatch Output 3 - Reset and Unlatch |
| L22 a | A | Load Totalizer Pulse Output Speed where a = 0 - No Pulse 1 - Pulse Fast 2 - Pulse Medium 3 - Pulse Slow |
| Q22 | A22 a | Query Totalizer Pulse Output Speed where a = 0 - No Pulse 1 - Pulse Fast 2 - Pulse Medium 3 - Pulse Slow |
| L23 aaaa | A | Load Totalizer Output Time where aaaa = Output Time |
| Q23 | A23 aaaa | Query Totalizer Output Time where aaaa = Output Time |
| L24 a | A | Load Totalizer Reset Key Function where a = Reset Key Function = 1 - Reset Totalizer 2 - Unlatch Output 3 - Reset & Unlatch |

| | | |
|--------------------|-----------------|--|
| Q24 | A24 a | Query Totalizer Reset Key Function where a = Reset Key Function = 0 - No Function 1 - Reset Totalizer 2 - Unlatch Output 3 - Reset and Unlatch |
| L25 a | A | Load Totalizer D.P. Location where a = 0 - No Dec. Pt. 1 - XXXXXXXXXX.X 2 - XXXXXXXXXX.XX 3 - XXXXXXXXXX.XXX 4 - XXXXXXXXXX.XXXX 5 - XXXXXXXXXX.XXXXX |
| Q25 | A25 A | Query Totalizer D.P. Location where a = 0 - No Dec. Pt. 1 - XXXXXXXXXX.X 2 - XXXXXXXXXX.XX 3 - XXXXXXXXXX.XXX 4 - XXXXXXXXXX.XXXX 5 - XXXXXXXXXX.XXXXX |
| L31 aa | A | Load Ratemeter Smoothing where aa = Smoothing Fact. (0.5-7.5) (Must be .5 sec. resolution) |
| Q31 | A31 aa | Query Ratemeter Smoothing where aa = Smoothing Factor |
| I32 a b | A | Load Ratemeter Control Input where a = Control input (1-5) b = 0 - No Function = 1 - Unlatch Alarms |
| L33 a bbbb cccc | A | Load Ratemeter Output Function where a = 0 - Time Outputs bbbb = Low Rate Output time cccc = High Rate Output Time |
| or L33 a Q33 | A33 a bbbb cccc | a = 1 - Outputs Follow Query Ratemeter Output Function where a = 0 - Timed Outputs bbbb = Low Rate Output Time cccc = High Rate Output Time |
| or Q33 L34 a | A33 a A | Where a = 1 - Outputs Follow Load Ratemeter Reset Key Function where a = Reset Key Function 0 - No Function 1 - Unlatch Outputs |

| | | |
|---------|---------|---|
| Q34 | A34 a | Query Ratemeter Reset Key Function where a = Reset Key Function 0 - No Function 1 - Unlatch Outputs |
| L35 a | A | Load Ratemeter D.P. Location where a = 0 - No Dec. Pt. 1 - XXXXX.X 2 - XXXX.XX 3 - XXX.XXX 4 - XX.XXXX 5 - X.XXXXX |
| Q35 | A35 a | Query Ratemeter D.P. Location where a = 0 - No Dec. Pt. 1 - XXXXX.X 2 - XXXX.XX 3 - XXX.XXX 4 - XX.XXXX 5 - X.XXXXX |
| L36 aa | A | Load zero Rate Time where aa = Zero Time (01-15) |
| Q36 | A36 aa | Query Zero Rate Time where aa = Zero Time |
| L37 aaa | A | Load Rate Display Header where aaa = Rate Display Header (Space or Uppercase letters) |
| Q37 | A37 aaa | Query Rate Display Header where aaa = Rate Display Header |
| L41 a b | A | Load Key Lock (Keys 2,4,5) where a = Key Number (2,4,5) b = 0 - Unlocked 1 - Locked |
| Q41 | A41 a b | Query Key Lock (Keys 2,4,5) where a = Key Number (2,4,5) b = 0 - Unlocked = 1 - Locked |
| L45 a | A | Load Count Speed where a = 0 - Low - 40 Hz Max. 1 - Med 400 Hz Max. 2 - High 7500 Hz Max. |
| Q45 | A45 a | Query Count Speed where a = 0 - Low 40 Hz Max. 1 - Med 400 Hz Max. 2 - High 7500 Hz Max. |
| L46 a b | A | Load Programmable Relay K1 or K2 where a = Relay K1 or K2 b = 0 - 4 |

where 0 = NONE (not prog)
1 = TOTAL SP
2 = RATE LO SP
3 = RATE HI SP
4 = RATE LO/HI

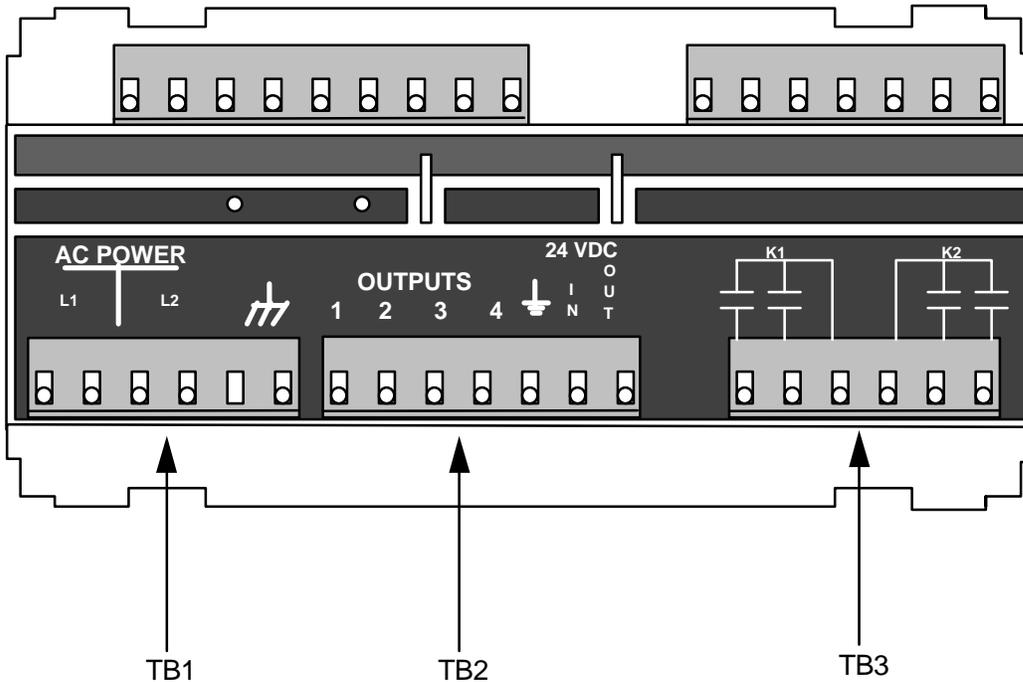
q46

a46 a b a b

Load Programmable Relay
K1 or K2

where a = Relay K1 or K2
b = 0 - 4

I/O TERMINAL DESCRIPTION



TB1 AC POWER INPUT

AC POWER L1 Terminal connection for 120 VAC.

AC POWER L2 Terminal connection for 120 VAC.



Chassis ground. This terminal should be connected to earth ground.

TB2 TRANSISTOR OUTPUTS, 24 and 12 VDC POWER

- OUTPUT 1 Totalizer scaled pulse output.
- OUTPUT 2 Totalizer setpoint output.
- OUTPUT 3 Rate low alarm output.
- OUTPUT 4 Rate high alarm output.

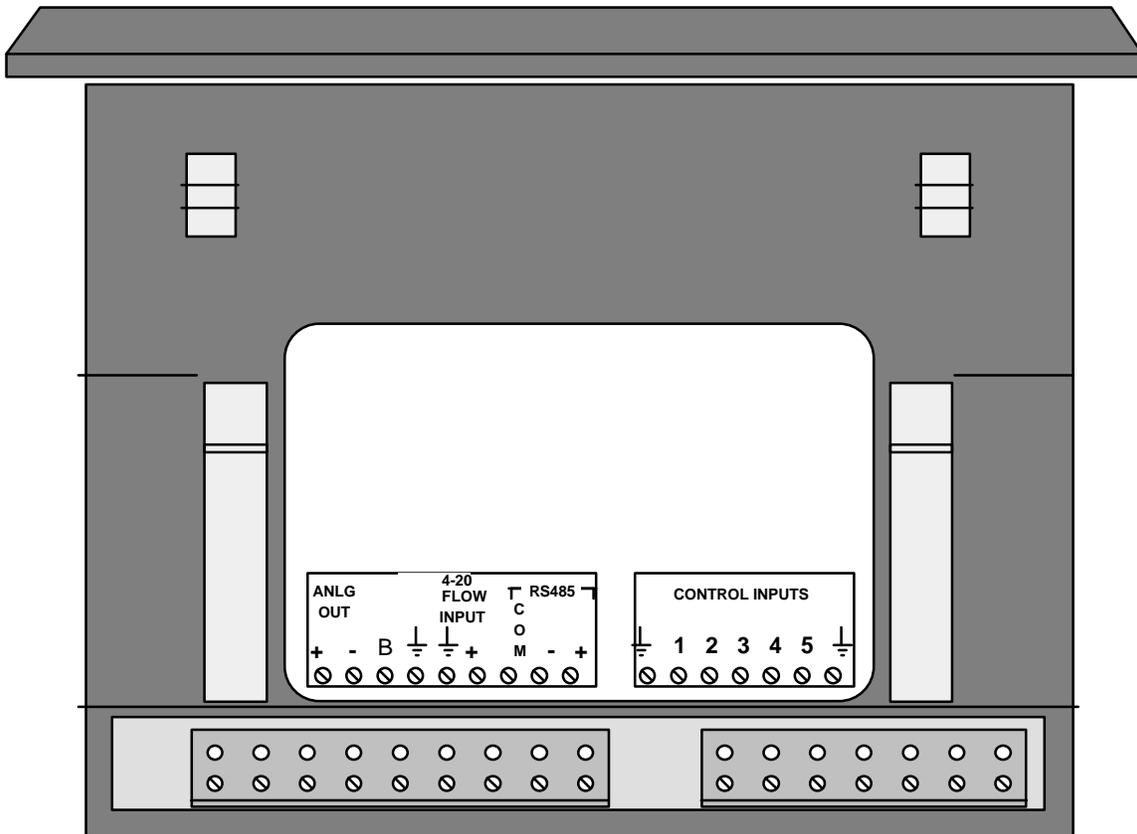
24 VDC  DC common. When unit is powered by DC, connect minus side of 18 - 27 VDC power supply to this terminal. When unit supplies 24 VDC power for accessories, connect accessory DC common to this terminal.

24 VDC IN When unit is powered by DC, connect plus side of 18 - 27 VDC power supply to this terminal.

24 VDC OUT Plus 24 VDC accessory power. Connect this terminal to the accessory plus 24 VDC input. Accessory power is available only if the unit is powered by AC.

RELAY OUTPUTS

- K1 Normally open and closed relay scaled pulse output.
- K2 Normally open and closed relay scaled pulse output.



TB4

TB5

TB4 ANALOG OUTPUT, FLOWMETER INPUT, COMMUNICATIONS OUTPUT

ANLG OUT + The analog output positive terminal is connected to the analog circuit power supply positive or the 24 VDC out terminal on TB2. Maximum voltage applied to ANLG OUT + IS 27 VDC. MINIMUM VOLTAGE IS 12 VDC + LOAD DROP @ 20 mA.

ANLG OUT - The analog output negative terminal is connected to the analog load positive terminal. The 4 - 20 mA signal with respect to common is put out at the ANLG OUT - terminal.

FLOWINPUT B This is the inhibit input.

4-20 FLOWINPUT $\frac{1}{2}$ DC common. DC common is the reference level for the flowmeter and control inputs (input active when connected to DC common) and transistor outputs conduct to DC common when in the "on" state. DC Common is not connected to chassis ground.

4-40 FLOWINPUT This terminal is the 4-20mA input.

RS 485 COM Communications common terminal. Connected to DC common by a 100 Ω internal resistor.

RS 485-/RS 485+ Communications differential signal input/output.

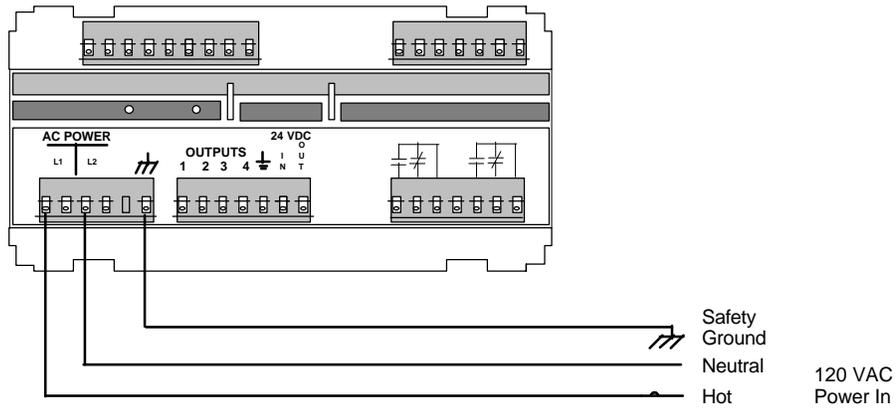
TB5 CONTROL INPUTS

CONTROL INPUTS $\frac{1}{\overline{2}}$ DC Common. Control inputs are active when connected to DC common.

CONTROL INPUTS
1, 2, 3, 4, 5 mode Programmable inputs which may be assigned to various functions as explained in the program mode.

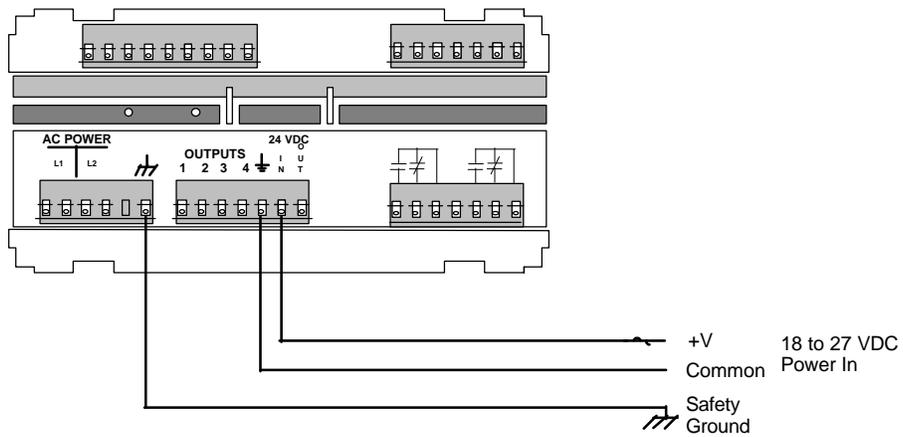
WIRING

AC Power Input



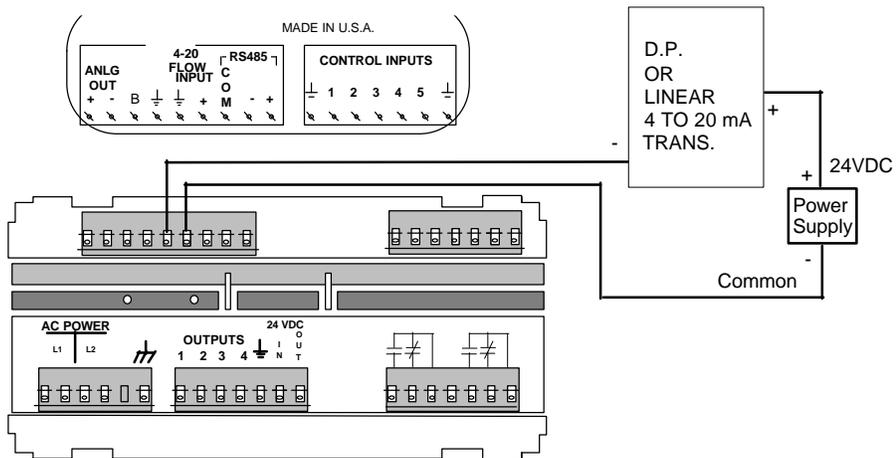
1. Fuse: .2A Slow-Blow
2. The two terminals marked L1 are internally connected together.
3. The two terminals marked L2 are internally connected together.

DC Power Input

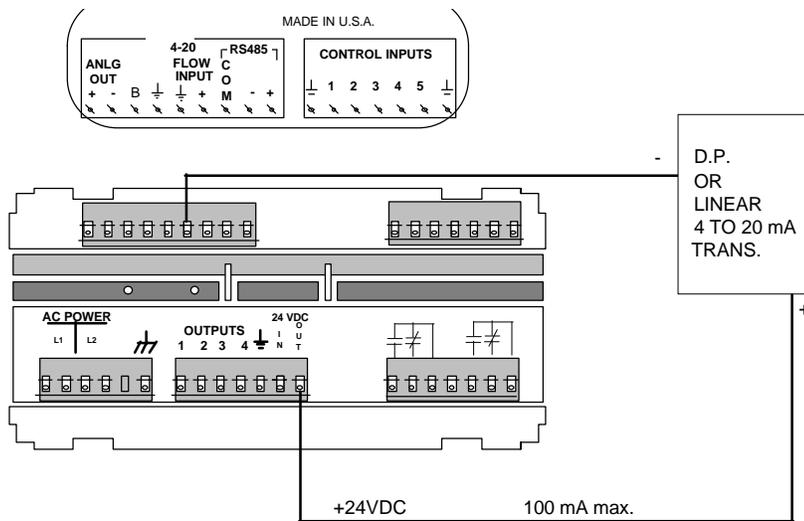


1. Fuse: .5A Slow-Blow
2. Safety ground optional, only required if relays are switching AC Power.

Flow Input Sensor with External Power Supply

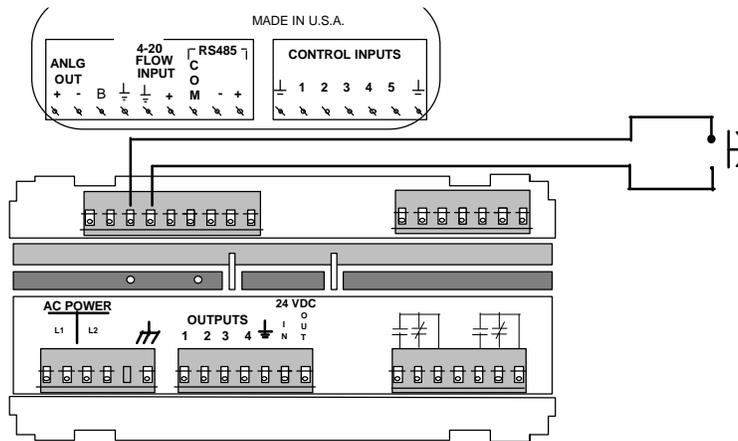


Flow Input Sensor with Control Power Supply



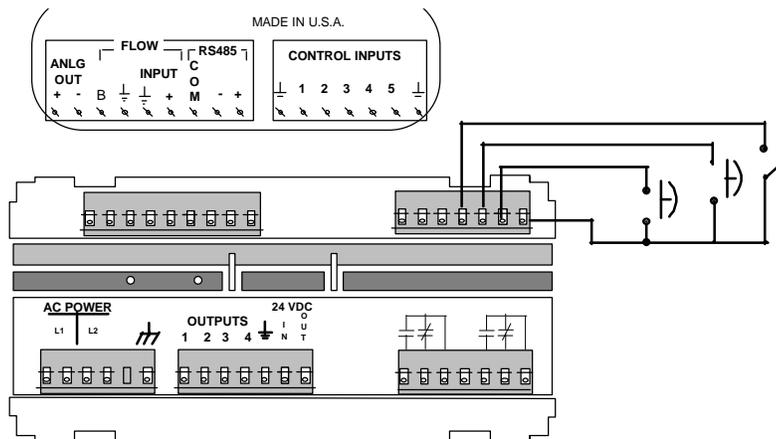
Do not connect the 24VDC out terminal to the sensor if the sensor is powered from another source.

Inhibit Input



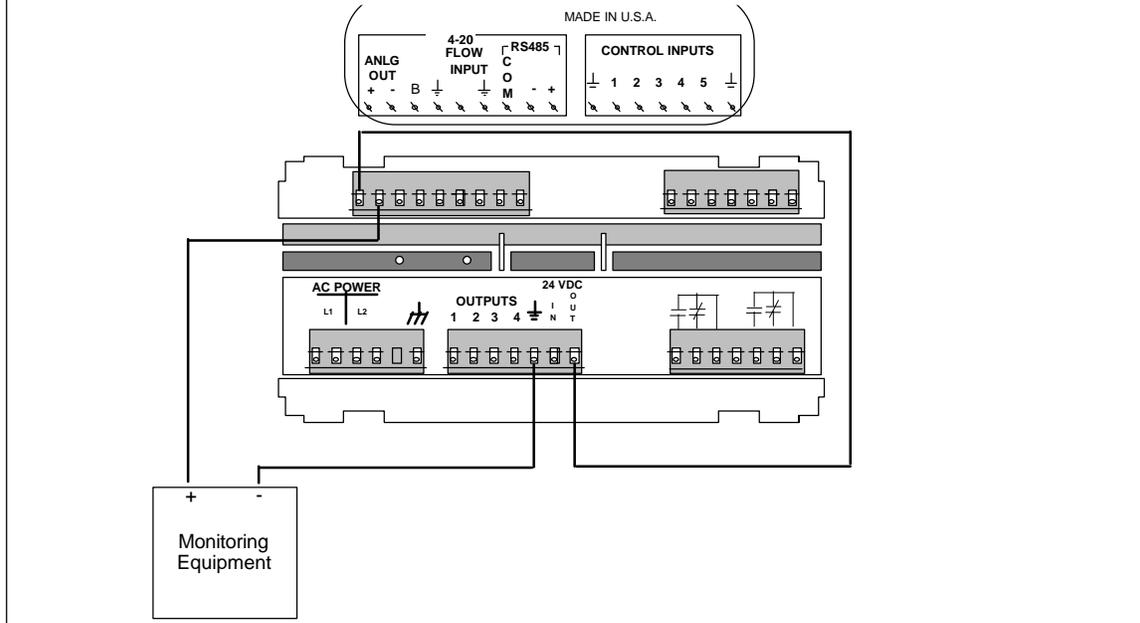
1. Inhibit input device may be a switch or an NPN transistor.

Wiring Control Inputs

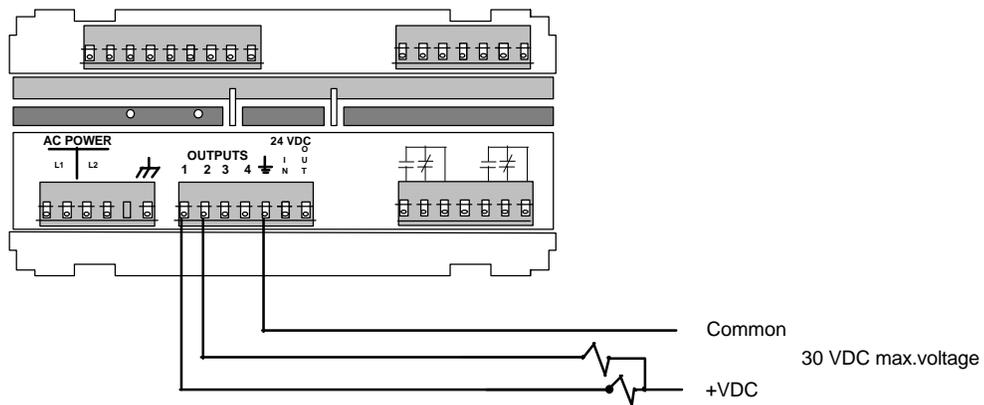


1. Control input device may be a switch or an NPN transistor.
2. Control inputs 1 and 2 wired in a similar manner.

Analog Rate Output (Non-Isolated)



Wiring DC Loads To Transistor Outputs



1. The load must not draw more than 150 mA of current.
2. Outputs 3 and 4 wired in the same manner as outputs 1 and 2.

SPECIFICATIONS

ENVIRONMENTAL

Temp: Operating 0 to 55 C
Storage -40 to 70 C
Humidity: 0 to 85% RH non-condensing
Front Panel: Sealed to Nema 4X

INPUTS

Power: 120 VAC+10%, -15%, 50/60 Hz @ 0.2 amps or 18 to 27 VDC @
.4 amps max. 5 watts max.

Control Inputs:
Number: 5
Type: Requires current sinking device such as contact closure to ground or
NPN transistor to ground.
Impedance: 5.8k to +5 VDC
Voltage: High 3.5 To 24 VDC
Low 0.0 to 1.3 VDC
Response Min Low 30 ms., min. high 30 ms.

Flow Inputs:
Identification: B
Type: Inhibit. Requires current sinking device such as contact
closure to ground or NPN transistor to ground.
Impedance: 5.8 to +5 VDC
Voltage: High 2.8 to 24 VDC
Low 0.0 to 1.3 VDC
Identification: +
Type: 4-20mA, Adj. range 3.75-20.25 mA.
Impedance: 100 Ω
Voltage: 5 Volts max. sustained input voltage
Response 2 Hz
Resolution 11 bits.
Accuracy $\pm 0.1\%$ @ 25° C, $\pm 0.25\%$ over temp.

OUTPUTS

Accessory Power: 24 VDC $\pm 5\%$, 100 mA max.

Totalizer Setpoint
Type: 1 NPN transistor.
Rating: 150 mA maximum, 30 VDC blocking maximum
Operation: Latched or timed from 00..1 to 99.99 seconds

Rate Alarms:
Type: 2 NPN transistors for indicating Rate outside High/Low setpoints.
Rating: 150 mA maximum 30 VDC blocking maximum
Operation: Follows, latched or timed from 00.01 to 99.99 seconds

Scaled Pulse:
Type: 1 NPN transistor for remote totalizing
Rating: 150 mA maximum,, 30 VDC blocking maximum.
Operation: Outputs pulse for every increment of the internal totalizer.
Output pulse width selectable from:
Fast - 125 μ sec. pulse width, 1.5 kHz max. frequency
Med - 2 msec. pulse width 200 Hz max. frequency.
Slow - 50 msec. pulse width, 10 Hz max. frequency.

Flow Rate:
Type: 4-20 mA current loop, optically isolated.
Voltage: Compliance voltage 12 - 27 VDC

Response: 2 Hz.
Accuracy: $\pm 1\%$ @ 25 C, $\pm .25\%$ over temp.
Resolution: 11 bits

RATEMETER

Type: 1/Tau.
Display: 6 digits with 3 character units of measure identifier.
Accuracy: $\pm .05\%$
Rate Multiplier: .00001 to 999999.
Rate Smoothing: .5 to 7.5 sec. in .5 sec steps.

CONSTANT

Range: .0001 to 99999.

COMMUNICATIONS

Type: RS-485 multidrop.
Baud Rate: 300, 600, 1200, 2400, 4800, 9600, 19200.
Parity: Space, Even, Odd
Protocol: Opto-22 compatible.

COMMUNICATIONS

Points: 20
Resolution: Kpv 0.005 to 999999
freq. v 1.10 to 9999
v 0.1 to 800.0
Response: 25 msec
Method: Straight line interpolation between points
Frequency: 1.1 to 5000 Hz

DIMENSIONS

