THE APOLLO INTELLIGENT METER SERIES

MODEL IMI INSTRUCTION MANUAL

INTRODUCTION

The Intelligent Meter for Rate Inputs (IMI) is another unit in our multi-purpose series of industrial control products that is field-programmable for solving various applications. This series of products is built around the concept that the end user has the capability to program different personalities and functions into the unit in order to adapt to different indication and control requirements.

The Intelligent Rate Meter, which you have purchased, has the same high quality workmanship and advanced technological capabilities that have made Red Lion Controls the leader in today's industrial market.

Red Lion Controls has a complete line of industrial indication and control equipment, and we look forward to being of service to you now and in the future.

CE

CAUTION: Risk of Danger.
Read complete instructions prior to installation and operation of the unit.

CAUTION: Risk of electric shock.

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GENERAL DESCRIPTION

The Apollo Intelligent Meter for Digital Rate Inputs (IMI) accepts frequencies up to 50 KHz which can be scaled to any desired engineering units. The sensor input is user configurable and allows for a wide selection of compatible sensors. The adjustable low (minimum) and high (maximum) update times provide optimal display response at any input frequency.

The IMI provides two display functions in a single package. The display can indicate the input rate and then be toggled to display either totalization or efficiency. The maximum display for all functions is 999,999. The totalizer features independent scaling and a low signal cut-out to suit a variety of applications. The efficiency will display the input rate in percent. Additionally, nine segments can easily be programmed to linearize transducers with non-linear outputs, such as square law devices.

The indicator features a choice of two different scaling procedures for the rate display, which greatly simplifies initial set-up. English-style display prompts and front panel buttons aid the operator in set-up and operation. A front panel programmable lock-out menu protects set-up data and operation modes from unauthorized personnel. Programmable digital filtering enhances the stability of the reading. Programmable remote inputs “E1-CON” and “E2-CON” can be utilized to control a variety of functions, such as totalizing, alarm control, display hold or triggered input. All set-up data is stored in non volatile memory.

Peak/valley (max/min) indication is included and is easily recalled and controlled by either the front panel buttons or a remote input.

The Peak/valley buffers can be assigned to either the rate or efficiency display and all readings are retained at power-down.

Optional dual relays with parallel solid state outputs are fully programmable to operate in a wide variety of modes to suit many control or alarm applications.

Optional 20 mA loop, half-duplex serial communications provides computer and printer interfacing to extend the capabilities of the indicator. More than one unit can be connected in the loop with other RLC products which have serial communications capabilities.

An optional 4 to 20 mA or 0 to 10 VDC analog output can be scaled by the user to interface with a host of recorders, indicators and controllers. The type of analog output is determined by the model ordered. (See Ordering Information for available models.) The indicator has several built-in diagnostic functions to alert operators of most malfunctions. Extensive testing of noise interference mechanisms and full burn-in make the indicator extremely reliable in industrial environments. The die-cast front bezel meets NEMA 4/IP65 requirements for washdown applications, when properly installed. Plug-in style terminal blocks simplify installation and wiring change-outs.

SAFETY SUMMARY

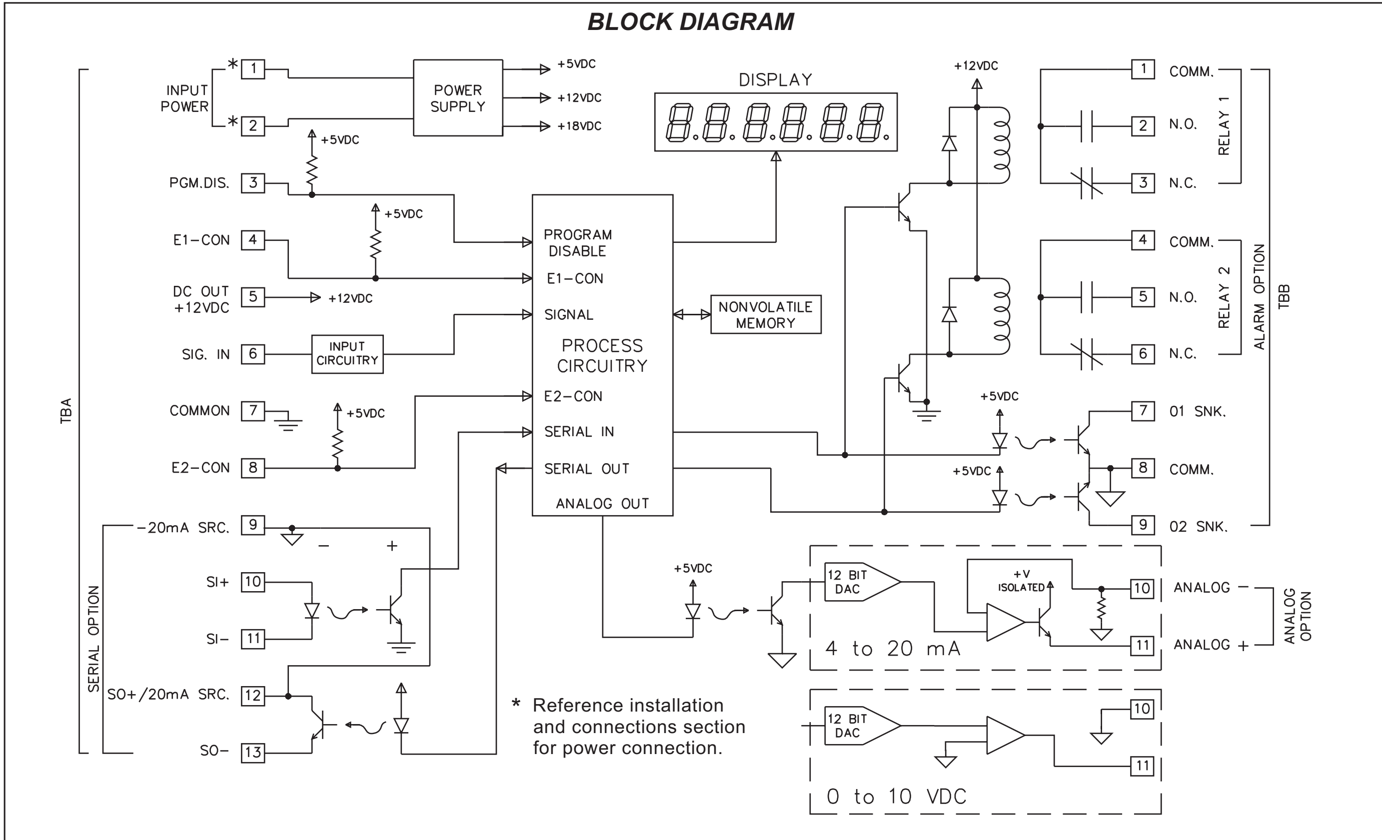
All safety related regulations, local codes and instructions that appear in the manual or on equipment must be observed to ensure personal safety and to prevent damage to either the instrument or equipment connected to it. If equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Do not use this unit to directly command motors, valves, or other actuators not equipped with safeguards. To do so can be potentially harmful to persons or equipment in the event of a fault to the unit.

THEORY OF OPERATION

The IMI employs a microprocessor to perform the rate conversion on the input signal. It scales the signal and displays the result on the 6-digit display. A non-volatile EPROM memory device provides permanent data retention for operating variables. The alarm option employs opto-isolators to isolate the open collector devices from common. Operating in parallel, the relays are type Form-C and are rated at 5-amps. The serial communication option features a built-in 20 mA current source and complete opto-isolation. The analog option features a 12-bit DAC and provides an output signal that is digitally scaled. The analog output is isolated from signal common.

BLOCK DIAGRAM



Note: Alarm common and analog "-" (TBA #10) are separate and isolated from the signal common (TBA #7). The commons should NOT be tied together.

PROGRAMMING AND OPERATING THE IMI

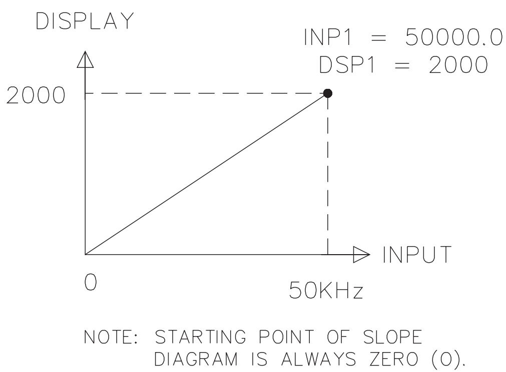
PROGRAMMING THE IMI

Prior to installing and operating the indicator, it may be necessary to change the scaling to suit the display units particular to the application. The unit is scaled from the factory to indicate directly in frequency. Although the unit has been programmed at the factory, the set-ups will generally have to be changed.

The indicator is unique in that two different scaling methods are available. The operator may choose the method that yields the easier and more accurate calibration for the application. The two scaling procedures are similar in that the operator keys-in a display value and either keys-in or applies a rate value that corresponds to the display value (see Slope Diagram below). The location of the scaling point should be near the process end limit for the best possible accuracy. Once these values are programmed (coordinates on a graph), the indicator calculates the slope and intercept of the rate input display automatically. No span/zero interaction occurs, making scaling a one-pass exercise. Scaling is complete after decimal point selection, unit rounding (dummy zeros) and digital filtering level selection. The following graph shows a typical scale for the indicator.

Before trying to program the indicator, it is advised to organize all the data for the programming steps to avoid any possible confusion and to read the programming procedure before proceeding.

Slope Diagram



To set-up the indicator, first select the desired input switch configuration (refer to “Input Configuration and Switch Set-Up”). Connect power and signal wires as outlined in the connections section (Appendix “A”). Remove the jumper wire (if installed) from TBA #3 (PGM.DIS.), this will allow the operator to enter and modify all of the indicator’s parameters. Press the front panel button labeled “P”, momentarily. The display will alternately flash between “Pro” and “0”. This is the indicator’s programming mode. The programming mode is divided into nine modules, numbered 0 through 9, each of which can be individually accessed. The front panel “UP” and “DOWN” arrow buttons are used to select a module number and the “P” button used to enter the selected programming module. In all of the programming modules, the “UP” and “DOWN” buttons are used to either select from a list of choices or change a value. The “P” button is used to save the new value and progress to the next step within a module.

Note: The new value takes effect when “P” is pressed.

Upon completion of a module, the indicator returns to the “Pro” < > “0” stage. Pressing the “P” button at this point causes the unit to display “End” after which the unit returns to the normal display mode. The following table explains the basic function of each step.

Note: < > This indicates that the display will alternate between the English prompt and the actual data.

DISPLAY	RESULT OF “P” BUTTON
“Pro” < > “0” -	The indicator will return to the normal display mode. Any changes to set-up data are permanently stored in the EPROM.
“Pro” < > “1” -	Module #1 allows the user to select the decimal point position, unit rounding, low/high update times and scaling by the method of applying the signal rates to the indicator that correspond to the programmed display values. Use this method when the transducer (signal source) is connected to the process and the process can be brought to known levels (ie. fpm, rps, mph, etc.). Alternately, a frequency generator may be substituted to simulate the transducer. A second method is available in Pro 2.
“Pro” < > “2” -	Module #2 allows the user to select the decimal point position, unit rounding, and low/high update times as in Pro 1. But the method of scaling differs in that the user keys-in signal rates instead of applying signals to the indicator. Use this method when the signal transducer (signal source) is pre-calibrated with known display values at known signal rates. An alternate method is available in Pro 1.
“Pro” < > “3” -	Module #3 allows the user to program what can be accessed from the front panel when the PGM. DIS. (TBA #3) pin is connected to “COMM” (TBA #7). This feature protects critical set-up data from accidental modification while allowing access to setpoints and other functions. The front panel lock-out menu (Quick Programming) includes setpoint modification, totalizer resetting, and peak/valley resetting. *Note: The term “Quick Programming” is used to refer to the ability to change information accessed from the front panel when the “PGM. DIS.” terminal is connected to “COMM” (TBA #7).*
“Pro” < > “4” -	Module #4 programs the digital filtering level and the function of the “E1-CON” (TBA #4), and “E2-CON” (TBA #8) inputs. The function of E1-CON and E2-CON are the same and include display hold, peak/valley modes, totalizer reset, alarm reset, trigger mode or print request.

DISPLAY	RESULT OF “P” BUTTON
“Pro” < > “5” -	Module #5 assigns either the totalizer or efficiency to the second display. It sets the time base, scale factor and low signal disable function for the totalizer or the peak/valley buffer assignment, decimal point and 100% assignment for the efficiency.
“Pro” < > “6” -	Module #6 allows programming for the configuration of the alarm option. The programming includes HI/LO acting, tracking, alarm display, latched or auto-reset, assignment to rate/efficiency/totalizer, on/off/no delay, and alarm and hysteresis values.
“Pro” < > “7” -	Module #7 is the serial communication parameter programming. Baud rate, unit address, print request function and abbreviated prints are all programmable.
“Pro” < > “8” -	Module #8 allows digital scaling of the analog output. The analog output may be programmed to track the rate, efficiency or totalizer. Additionally scaling is accomplished by assigning display values to the 4 mA or 0 VDC and 20 mA or 10 VDC points.
“Pro” < > “9” -	Module #9 is the service operations sequence and is not normally accessed by the user. This step loads the factory settings or performs an analog, alarm, display, or serial self-test. A code number entry step is used to protect from inadvertent entries.

MODULE #1 - SCALE BY SIGNAL RATE METHOD

PROGRAM DECIMAL POINT POSITION

Select the desired decimal point position of the scaled input rate display by pressing either the “Up” or “Down” button.

Note: The decimal point selected will appear in succeeding programming steps. Also, the “P” button must be pressed after each step to enter the desired data and to proceed to the next step.

“dECPNt” < > “0”
“0.0”
“0.00”
“0.000”
“0.0000”

PROGRAM ROUNDING INCREMENT AND RIGHT HAND DUMMY ZEROS

Rounding values other than one cause the scaled number to ‘round’ to the nearest rounding increment selected (i.e. rounding of ‘5’ causes ‘122’ to round to ‘120’ and ‘123’ to round to ‘125’). If the process is inherently jittery, the display value may be rounded to a higher value than one. If the range of the process exceeds the required resolution, (ex. 0-10,000 RPM, but only 10 RPM resolution is required), a rounding increment of 10 will effectively make the display more stable. This programming step is usually used in conjunction with programmable digital filtering (Pro 4) to help stabilize display readings. (If display stability appears to be a problem and the sacrifice in display resolution is unacceptable, program higher levels of digital filtering, increase the low update time or increase the level of process dampening.) Rounding increments of 10, 20, 50, and 100 may also be used to add “dummy zeros” to the scaled readings, as desired.

“round” < > “1”
“2”
“5”
“10”
“20”
“50”
“100”

PROGRAM LOW/HIGH UPDATE TIMES

Select the desired low update time in tenths of seconds. The low update time is the minimum amount of time between display updates for the rate display and also the efficiency display if selected.*

“Lo-udt” < > “0.2 to 100.0”

Select the desired high update time in tenths of seconds. The high update time is the maximum amount of time before the rate display and the efficiency display if selected goes to zero.

“Hi-udt” < > “0.1 to 100.1” plus Lo-udt value

** See RATE section for detailed explanation of update times.*

At this stage a choice of either returning to “Pro 0” or continue with scaling of the display is offered.

“SCALE” < > “yES”
“NO”

If “YES” was selected for the previous step, the scaling procedure by signal rate method is started. In order to scale the indicator, a rate value and a display value that correspond must be known. These two values are used to complete the scaling operation. An example is listed below:

DISPLAY		RATE
1500 RPM	@	975.0 Hz

KEY-IN DISPLAY VALUE FOR SCALING POINT #1

“dSP 1” < > “0 to 999999” (ex. 1500 RPM)

APPLY RATE TO INDICATOR FOR SCALING POINT #1

The meter will indicate the actual frequency of signal being applied to the input. However, the indicator still retains the previously applied value until “P” is pressed, at which time the new value is stored. Pressing either the “UP” or “DOWN” button causes the previous value to remain programmed in the unit.

“rAtE 1” < > “0.0 to 50000.0” (ex. 975.0)

PROGRAM NUMBER OF LINEAR SEGMENTS

This programming step loads in the number of linear segments desired for multi-segment linearization. If only single slope scaling is desired for the input, select "1" for this step. If two segments are desired for the input, select "2", etc. The number of scaling points must equal the number of segments. This step may be used to deactivate previously programmed segments where lower segments would override (ex. changing "SEGt" from 5 to 3 causes slopes 4 & 5 to be replaced by an extension of slope 3).

"SEGt" < > "1 to 9"

If "1" was selected, the indicator will return to "Pro 0" since scaling for the first segment was already completed. At this stage, scaling is complete. The indicator will automatically calculate the slope and offset of the display units. After completing Pro 1, it is recommended that the scaling operation be verified by applying various signal rates and checking the displayed reading.

If a number other than "1" was selected, a choice of either returning to "Pro 0" or commencing with the multi-slope linearization scaling is offered.

"SCALE" < > "yES"
"NO"

KEY-IN DISPLAY VALUE FOR SCALING POINT #2

If "YES" was selected, the display value for the second point is entered. Otherwise, the indicator returns to "Pro 0".

"dSP 2" < > "0 to 999999"

APPLY RATE TO INDICATOR FOR POINT #2

The signal rate value for point 2 is applied.

"rAtE 2" < > "0.0 to 50000.0"

The sequence of entering display and signal values continues with "dSP 3", "rAtE 3", "dSP 4", etc. until the number programmed for "SEGt" is reached. Upon completion, the indicator is scaled to the multiple segments. It is recommended that the scaling be checked by applying signal rate values and verifying for correct display values.

Note: As the "UP" or "DOWN" button is continually held in, the display will progressively increment faster until the most significant digit is changing at a rate of 1 number per second.

MODULE #2 - SCALE BY KEY-IN METHOD

PROGRAM DECIMAL POINT POSITION

Select the desired decimal point position of the scaled input rate display by pressing either the "Up" or "Down" button.

Note: The decimal point selected will appear in succeeding programming steps. Also, the "P" button must be pressed after each step to enter the desired data and to proceed to the next step.

"dECPNt" < > "0"
"0.0"
"0.00"
"0.000"
"0.0000"

PROGRAM ROUNDING INCREMENT AND RIGHT HAND DUMMY ZEROS

Rounding values other than one cause the scaled number to 'round' to the nearest rounding increment selected (ie. rounding of '5' causes '122' to round to '120' and '123' to round to '125'). If the process is inherently jittery, the display value may be rounded to a higher value than one. If the range of the process exceeds the required resolution, (ex. 0-10,000 RPM, but only 10 RPM resolution is required), a rounding increment of 10 will effectively make the display more stable. This programming step is usually used in conjunction with programmable digital filtering (Pro 4) to help stabilize display readings. (If display stability appears to be a problem and the sacrifice in display resolution is unacceptable, program higher levels of digital filtering, increase the low update time or increase the level of process dampening.) Rounding increments of 10, 20, 50, and 100 may also be used to add "dummy zeros" to the scaled readings, as desired.

"round" < > "1"
"2"
"5"
"10"
"20"
"50"
"100"

PROGRAM LOW/HIGH UPDATE TIMES

Select the desired low update time in tenths of seconds. The low update time is the minimum amount of time between display updates for the rate display and also the efficiency display if selected.*

"Lo-udt" < > "0.2 to 100.0"

Select the desired high update time in tenths of seconds. The high update time is the maximum amount of time before the rate display and the efficiency display is selected goes to zero.*

"Hi-udt" < > "0.1 to 100.1" plus Lo-udt value

** See RATE section for detailed explanation of update times.*

At this stage a choice of either returning to "Pro 0" or continue with scaling of the display is offered.

"SCALE" < > "yES"
"NO"

If "YES" was selected for the previous step, the scaling procedure by key-in is started. In order to scale the indicator, a rate value and a display value that correspond must be known. These two values are used to complete the scaling operation. An example is listed below:

DISPLAY		RATE
1500 RPM	@	975.0 Hz

KEY-IN DISPLAY VALUE FOR SCALING POINT #1

"dSP 1" < > "0 to 999999" (ex. 1500 RPM)

KEY-IN RATE VALUE FOR SCALING POINT #1

"rAtE 1" < > "0.0 to 50000.0" (ex. 975.0)

PROGRAM NUMBER OF LINEAR SEGMENTS

This programming step loads in the number of linear segments desired for multi-segment linearization. If only single slope scaling is desired for the input, select "1" for this step. If two segments are desired for the input, select "2", etc. The number of scaling points must equal the number of segments. This step may be used to deactivate previously programmed segments where lower segments would override (ex. changing "SEGt" from 5 to 3 causes slopes 4 & 5 to be replaced by an extension of slope 3).

"SEGt" < > "1 to 9"

If "1" was selected, the indicator will return to "Pro 0" since scaling for the first segment was already completed. At this stage, scaling is complete. The indicator will automatically calculate the slope and offset of the display units. After completing Pro 1, it is recommended that the scaling operation be verified by applying various signal rate and checking the displayed reading.

If a number other than "1" was selected, a choice of either returning to "Pro 0" or commencing with the multi-slope linearization scaling is offered.

"SCALE" < > "yES"
"NO"

KEY-IN DISPLAY VALUE FOR SCALING POINT #2

If "YES" was selected, the display value for the second point is entered. Otherwise, the indicator returns to "Pro 0".

"dSP 2" < > "0 to 999999"

KEY-IN RATE VALUE FOR SCALING POINT #2

"rAtE 2" < > "0.0 to 50000.0"

The sequence of entering display and signal values continues with "dSP 3", "rAtE 3", "dSP 4", etc. until the number programmed for "SEGt" is reached. Upon completion, the indicator is scaled to the multiple segments. It is recommended that the scaling be checked by applying signal rate values and verifying for correct display values.

Note: As the "UP" or "DOWN" button is continually held in, the display will progressively increment faster until the most significant digit is changing at a rate of 1 number per second.

MODULE #3 - FRONT PANEL ACCESSIBLE FUNCTIONS WITH PROGRAM DISABLE

This programming module enables or disables parameters that are accessible through the front panel when the PGM. DIS. input is connected to "COMM" (TBA #7).

Note: The term "Quick Programming" is used to refer to the ability to change the information that can be accessed from the front panel when the "PGM. DIS." (TBA #3) terminal is connected to "COMM." (TBA #7).

DISPLAY ALARM VALUES

If the alarm option is installed, this selects whether the alarm values will or will not be displayed.

"dSP AL" < > "yES or NO"

ENTER ALARM VALUES*

If "YES" was selected for display alarm values, this will select if alarm values may be modified from the front panel. (If "NO" was selected for display alarm values, then this step will default to "NO" and will not be displayed for selection.)

"ENt AL" < > "yES or NO"

DISPLAY HYSTERESIS VALUES

If the alarm option is installed, this selects whether the hysteresis values will or will not be displayed.

"dSPHyS" < > "yES or NO"

ENTER HYSTERESIS VALUES*

If "YES" was selected for display hysteresis values, this selects whether hysteresis values may be modified from the front panel. (If "NO" was selected for display hysteresis values or the alarm is programmed for latch operation, then this step will default to "NO" and will not be displayed for selection.)

"ENtHyS" < > "yES or NO"

RESET LATCHED ALARMS

If the alarm option is installed and if either alarm is programmed to latch, this will allow a latched alarm(s) to be reset from the front panel.

"rSt AL" < > "yES or NO"

DISPLAY PEAK/VALLEY MEMORY BUFFER

Selects whether peak and valley buffers will be displayed.

"dSPbUF" < > "yES or NO"

RESET PEAK/VALLEY MEMORY BUFFER*

If "YES" was selected for the previous step, this selects whether the peak and valley buffers may be reset from the front panel. (If "NO" was selected, then this step defaults to "NO" and will not be displayed for selection.)

"rStbUF" < > "yES or NO"

SELECT DISPLAY**

Selects whether the display can be switched from rate to total/efficiency.

Note: When "NO" is selected, whatever display (rate, efficiency or total) is currently shown, will be the only display accessible.

"SELdSP" < > "yES or NO"

RESET TOTAL*,**

If the totalizer is currently selected as the second display function, this selects whether the total can be reset from the front panel. If efficiency is currently selected as the second display function, then this step is not displayed.

"rSttot" < > "yES or NO"

Depending on functions selected under Pro 3 and Pro 6, alarms, hysteresis, peak, and valley values can be monitored and/or changed when PGM.DIS. (TBA #3) is tied to "COMM" (TBA #7). This provides a "QUICK PROGRAMMING" method for "day to day" process changes. (See QUICK PROGRAMMING SECTION for more details.)

* *Note: This sequence may be locked-out due to other programmed sequences.*
** *Note: This function operates independent of the state of the "PGM.DIS." input.*

MODULE #4 - DIGITAL FILTER AND REMOTE INPUTS

DIGITAL FILTERING

If the displayed process signal is difficult to read due to small process variations or noise, increased levels of filtering will help to stabilize the display. This programming step may be used in conjunction with display rounding programming (Pro 1 & 2) to help minimize this effect.

The digital filter used is an "adaptive" filter. That is, the filter coefficients change dynamically according to the nature of the input signal. This feature simultaneously allows the filter to settle quickly for large input changes while providing a stable display reading for normal process variations. Because of the adaptive nature of the filter, it cannot be characterized in terms of a time constant. The following table lists the maximum settling time for a step input to within 99% of final value.

"FILtEr" < >	Filter Value	Settling Time (99%)
	"0" - no digital filtering	1.5 sec.
	"1" - normal filtering	2 sec.
	"2" - increased filtering	6 sec.
	"3" - maximum filtering	13 sec.

FUNCTION OF REMOTE INPUTS (E1-CON & E2-CON)

The functions of the inputs "E1-CON" (TBA #4) and "E2-CON" (TBA #8) are identical. The inputs are activated when connected to signal common (TBA #7). Regardless of whether the function is edge or level activated, it must be held low for a minimum of 20 msec to be recognized. The inputs can be used simultaneously and with any combination of functions. If both inputs are tied together and activated, the E1-CON function is generally performed first.

"E1-CON" < > "0" - A negative going edge re-starts the measurement time period.

"1" - A negative going edge resets the contents of the totalizer to zero. Totalization commences regardless of the state of the input. If the second display is programmed for efficiency, this function has no effect.

"2" - A negative going edge resets the contents of the totalizer to zero and allows totalization as long as input is low. If the input goes high, totalization is stopped and the contents are saved. This acts as a totalization enable control for gated totalization. If the second display is programmed for efficiency, this function has no effect.

"3" - A low level allows totalization as long as the input is low. If the input goes high, totalization is stopped and the contents are saved. This acts as a totalization enable control for gated totalization. If the second display is programmed for efficiency, this function has no effect.

"4" - A low level holds the displays (display hold). While this input is low, the indicator continues to process the rate signal and drive the alarms, totalizer or efficiency, etc. with the actual rate signal. The contents of the totalizer or efficiency are stored at the same time the rate display is held.

Note: If display hold is activated, and the rate value is requested via serial, the value on the display will be sent instead of the actual rate value at that time.

"5" - A negative going edge resets both peak and valley buffers.

Note: When Peak/Valley is called up, a change will not appear on the display until the next time the Peak/Valley is called up.

"6" - A negative going edge resets only the peak buffer and the indicator enters a peak reading display mode as long as the input is low. If the input goes high, peak detection and indication are stopped and the last peak reading is retained.

"7" - A negative going edge resets only the valley buffer and the indicator enters a valley reading display mode as long as the input is low. If the input goes high, valley detection and indication are stopped and the last valley reading is retained.

"8" - If the alarm option is installed, a negative going edge resets the latched alarm(s).

"9" - If the alarm option is installed, a low level resets a latched or unlatched alarm. This provides manual override of alarms for system start-up and other unusual events such as system testing. An off delay alarm will deactivate after the programmed delay expires.

"10" - A negative going edge toggles the display between "rate" and "total" or "rate" and "efficiency" depending upon which function is programmed for the secondary display. No action is taken on the positive going edge.

"11" - Programs the IMI to function as a triggered rate meter. The Rate display will no longer update automatically. A negative going edge resets and starts the measurement period. When the measurement period is complete the display will update and remain frozen until another negative edge is received and the current measurement period is complete. The totalizer, if programmed, will continue to accumulate counts normally as long as the displayed rate value is greater than or equal to the Lo-cut value. The efficiency, if programmed, is slaved to the rate display and will only update as the rate display updates.

"12"- Print request. Transmits data according to the print options that have been selected in Program Module #7. If the low time exceeds 800 msec, a second print-out may occur.

"E2-CON" < > Has the same programmable functions as E1-CON.

MODULE #5 - SECONDARY DISPLAY (TOTALIZER OR EFFICIENCY)

This programming module selects either the Totalizer or Efficiency function for the second display. For the totalizer, the time base, scale factor and low rate signal disable function are selected. For the efficiency, the peak/valley buffer assignment, decimal point and 100% assignment are selected.

SELECT DISPLAY

Select the desired display function.

"dISP" < > "totAL or EFF"

Note: If "totAL" is selected only those parameters pertaining to total will be viewed. If "EFF" is selected only those parameters pertaining to efficiency will be viewed.

TOTALIZER

Programming for the totalizer consists of four programming steps: decimal point position, time base, scale factor and low rate signal disable. The decimal point position of the totalizer is independent of the decimal point position of the scaled rate display. The totalizer value will roll over and flash when the total exceeds 999999 indicating an overflow condition. For a detailed example of the totalizer set-up, refer to the Totalizer section.

DECIMAL POINT POSITION*

Enter the decimal point position for the totalizer.

"dECPNt" < > "0"
"0.0"
"0.00"
"0.000"
"0.0000"

TOTALIZER TIME BASE*

The time base divides the input signal by 1, 60 or 3600

"tbASE" < > "0" - divide by 1
"1" - divide by 60
"2" - divide by 3600

**Note: This sequence may be locked-out, depending on the display function selected.*

*TOTALIZER SCALE FACTOR**

The scale factor multiplies the input signal by the indicated amount.

"SCLFAC" < > "0.001 to 100.000"

*LOW-END CUTOUT (low rate disable)**

In order to prevent false totalization during system start-up or other low speed situations where totalization is undesirable, a programmable setpoint can be used to disable totalization when the scaled input rate falls below the low-end cutout value.

"Lo-cut" < > "0 to 999999"

EFFICIENCY

Programming for the efficiency consists of three programming steps: peak/valley buffer assignment, decimal point position and 100 percent assignment. The decimal point position of the efficiency display is independent of the decimal point position of the rate input display. The efficiency value is calculated from the rate and as a result updates according to the Hi/Lo update times of the rate (refer to PRO 1, 2).

*PEAK/VALLEY BUFFERS ASSIGNMENT**

The Peak/Valley buffers may be assigned to the rate or efficiency display. Peak/Valley buffer assignment defaults to rate if total was chosen as the second display function.

"ASNbUF" < > "rAtE or EFF"

*DECIMAL POINT POSITION**

Enter the decimal point position for the efficiency.

"dECPNt" < > "0"
"0.0"
"0.00"

*ENTER TARGET VALUE**

The efficiency display indicates the current percentage of the desired target value. It is calculated directly from the rate display and updates when the input "rate" display updates. Zero percent efficiency always corresponds to a "rate" of zero. The 100 Pct or target value is the "rate" display value which corresponds to an efficiency of 100 percent.

Example: 2000 RPM = 100% when the rate display indicates 2000, the efficiency display will indicate 100. If the rate display increases to 2100, the efficiency display will increase to 105.

Enter the "rate" display value which corresponds to 100 percent efficiency.

100 Pct < > "0 to 999999" (Ex. 2000)

**Note: This sequence may be locked-out, depending on the display function selected.*

MODULE #6 - ALARM/SETPOINT

If the alarm option is installed, this module is used to configure the operation of the alarms to a variety of combinations. The programmable options are HI/LO acting, auto/manual reset (latching), on/off/no delay, tracking, assignment to rate, efficiency or totalizer, display alarms, alarm values and hysteresis (deadband) values.

ALARM TRACKING

With alarm tracking, when alarm #2 is changed, alarm #1 will also change so that the offset between alarm #2 and alarm #1 remains the same. This is useful for hierarchical setpoints (pre-alarm and alarm) when one change applies to both alarm values. When programming from the front panel, tracking only occurs when PGM. DIS. is low (during front panel lock-out mode, alarm #1 will not appear). Tracking will always occur if alarm #2 is modified via serial communications independent of PGM. DIS.

"trAc" < > "yES or NO"

DISPLAY ALARMS

If desired, a message will flash on the display every 5-10 secs when an alarm activates. For alarm #1, the message will flash "AL1 on" and alarm #2 will flash "AL2 on", this warns an operator of an alarm condition. The message will stop when the unit is no longer in an alarm condition.

"dISP" < > "yES or NO"

AUTO OR MANUAL RESET FOR ALARM #1

The reset action of alarm #1 may be programmed to reset automatically (unlatched) or require a manual reset (latched), through either a remote input (E1-CON or E2-CON) or the front panel buttons. Latched alarms are typically used when an operator is required to take some action for the alarm condition.

"LAtC-1" < > "yES or NO"

ALARM #1 ASSIGNMENT TO RATE, TOTALIZER OR EFFICIENCY

Alarm #1 may be programmed to activate on the rate, totalizer or the efficiency value.

"ASN-1" < > "rAtE or totAL/EFF"

ALARM #1 VALUE

The range of the alarm value is 0 to 999,999.

"AL-1" < > "0 to 999999"

HYSTERESIS VALUE FOR ALARM #1

(Cannot be programmed if alarm latch is programmed)

The hysteresis (deadband) value for alarm #1 may be programmed from 1 to 999,999. The value is either added to or subtracted from the alarm value depending on whether the alarm is high or low acting. (See alarm section diagram for operation.)

"HyS-1" < > "1 to 999999"

ALARM #1 HIGH OR LOW ACTING

The action of alarm #1 may be programmed to activate either when the signal goes above the alarm value (high acting) or goes below it (low acting).

"Act-1" < > "HI or LO"

ALARM #1 ON DELAY

Alarm 1 may be programmed for an "on" delay action. (See alarm section diagram for operation.)

"ONdEL1" < > "yES or NO"

ALARM #1 OFF DELAY

(Cannot be programmed if "on" delay is programmed)

Alarm 1 may be programmed for an "off" delay action. (See alarm section diagram for operation.)

"OFdEL1" < > "yES or NO"

ALARM #1 DELAY TIME

(Cannot be programmed if both "ONdEL1" and "OFdEL1" are "NO")

The delay time for the on/off delay may be set to a value from 0.2 seconds up to 100.0 seconds.

"dELAy1" < > "0.2 to 100.0"

AUTO OR MANUAL RESET FOR ALARM #2

The reset action of alarm #2 may be programmed to reset automatically (unlatched) or require a manual reset (latched), through either a remote input (E1-CON or E2-CON) or the front panel buttons. Latched alarms are typically used when an operator is required to take some action for the alarm condition.

“LAtC-2” < > “yES or NO”

ALARM #2 ASSIGNMENT TO RATE, TOTALIZER OR EFFICIENCY

Alarm #2 may be programmed to activate on either the rate, totalizer or efficiency value.

“ASN-2” < > “rAtE or totAL/EFF”

ALARM #2 VALUE

The range of the alarm value is 0 to 999,999.

“AL-2” < > “0 to 999999”

HYSTERESIS VALUE FOR ALARM #2

(Cannot be programmed if alarm latch is programmed)

The hysteresis (deadband) value for alarm #2 may be programmed from 1 to 999,999. The value is either added to or subtracted from the alarm value depending on whether the alarm is high or low acting. (See “alarms” section for operation.)

“HyS-2” < > “1 to 999999”

ALARM #2 HIGH OR LOW ACTING

The action of alarm #2 may be programmed to activate either when the signal goes above the alarm value (high acting) or goes below it (low acting).

“Act-2” < > “HI or LO”

ALARM #2 ON DELAY

Alarm 2 may be programmed for an “on” delay action. (See alarm section diagram for operation.)

“ONdEL2” < > “yES or NO”

ALARM #2 OFF DELAY

(Cannot be programmed if “on” delay is programmed)

Alarm 2 may be programmed for an “off” delay action. (See alarm section diagram for operation.)

“OFdEL2” < > “yES or NO”

ALARM #2 DELAY TIME

(Cannot be programmed if both “ONdEL2” and “OFdEL2” are “NO”)

The delay time for the on/off delay may be set to a value from 0.2 seconds up to 100.0 seconds.

“dELAy2” < > “0.2 to 100.0”

Note: Depending on options selected under Pro 3 and Pro 6, alarms, hysteresis, peak, and valley values can be monitored and/or changed when PGM. DIS. is tied to COMM. This provides a “QUICK PROGRAMMING” method for “day to day” process changes. (See QUICK PROGRAMMING SECTION for more details.)

MODULE #7 - SERIAL COMMUNICATIONS

Several programmable parameters must be programmed before serial communication can occur.

BAUD RATE

Select one of the baud rates from the list to match the baud rate of the printer, computer, controller, etc.

“bAud” < >	“300”	-	300 baud
	“600”	-	600 baud
	“1200”	-	1200 baud
	“2400”	-	2400 baud
	“4800”	-	4800 baud
	“9600”	-	9600 baud

UNIT ADDRESS NUMBER

To allow multiple units to communicate via the 20 mA loop, different address numbers must be assigned to each unit. If only one unit is in the loop, an address of “0” may be given, eliminating the need for the address command.

“AddrES” < > “0 to 99”

PRINT REQUEST FUNCTION

A selection of print operations can be programmed. A print operation occurs when a print request is activated via E1-CON (TBA #4), E2-CON (TBA #8), or a “P” command is sent via the serial communications options. If the option to which a particular print code applies is not installed, then that parameter will not be printed.

If the totalizer is overflowed, an asterisk (*) will precede the digits that are printed (ex. *000127 overflow). If the rate or efficiency overflows the display, a “———” is printed.

“Print” < >	“0”	-	rate
	“1”	-	rate, peak, valley
	“2”	-	rate, alarm 1, alarm 2
	“3”	-	rate, alarm 1, alarm 2, hysteresis 1, hysteresis 2, peak, valley
	“4”	-	totalizer/efficiency
	“5”	-	rate, totalizer/efficiency
	“6”	-	rate, totalizer/efficiency, peak, valley
	“7”	-	totalizer/efficiency, alarm 1, alarm 2
	“8”	-	rate, totalizer/efficiency, alarm 1, alarm 2
	“9”	-	rate, totalizer/efficiency, alarm 1, alarm 2, hysteresis 1, hysteresis 2, peak, valley

FULL OR ABBREVIATED TRANSMISSION

When transmitting data, the IMI can be programmed to suppress the address number, mnemonics and some spaces. A selection of “NO” will invoke this feature and result in faster transmission. This may be helpful when interfacing with a computer. When interfacing to a printer, a “YES” response is usually desirable.

“FULL” < > “yES or NO”

An example of full and abbreviated transmission is shown below:

2 RTE 125.75<CR> <LF>	Full transmission
125.75<CR> <LF>	Abbreviated transmission

MODULE #8 - ANALOG OUTPUT

This programming module allows digital scaling of the 4 to 20 mA or 0 to 10 VDC analog output. The type of analog output is determined by the model ordered. (See Ordering Information for available models.) The analog output may be programmed to track the rate, efficiency or totalizer. The “AN-Lo” value is the display value which corresponds to an output of 4 mA or 0 VDC and the “AN-HI” value is the display value which corresponds to an output of 20 mA or 10 VDC. Ex. 20 RPM @ 4 mA and 1050 RPM @ 20 mA. Reverse acting output can be achieved by programming the “high” display value for the “AN-Lo” programming step and the “low” display value for the “AN-HI” step. The analog output updates as the assigned display updates.

Note: DO NOT ADJUST THE ANALOG OUTPUT POTS ON THE BACK OF THE UNIT. Fine offset and span adjustment pots are externally accessible to compensate for small drifts in the output. These pots have been set at the factory and do not normally require adjustment.

ANALOG OUTPUT SOURCE

Program the rate, totalizer or efficiency as the basis for the analog output signal.

“ASIN” < > “rAtE or totAL/EFF”

ANALOG OUTPUT LO DISPLAY VALUE

Program the display value at which the analog output transmits 4 mA or 0 VDC.

“AN-Lo” < > “0 to 999999”

ANALOG OUTPUT HI DISPLAY VALUE

Program the display value at which the analog output transmits 20 mA or 10 VDC.

“AN-HI” < > “0 to 999999”

MODULE #9 - SERVICE OPERATIONS

The indicator has been fully tested at the factory and will only require a scaling operation (Pro 1 or 2) to display the units of the process. If the unit appears to be indicating incorrectly or inaccurately, refer to the troubleshooting section.

ENTER ACCESS CODE

A code number must be keyed-in to enter a self-test or restore factory settings. Access code numbers other than those listed in this section, should not be entered. A code number of 50 will exit Pro 9 and return unit to Pro 0 without any effect.

“CodE” < > “0 to 99”

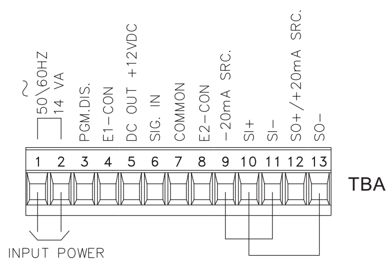
If the code number for the previous step was not recognized, the indicator returns to “Pro 0”, with no action taken. Otherwise, the corresponding operation is entered.

SERIAL HARDWARE (loop-back) DIAGNOSTICS

The internal serial communications hardware in the IMI can be tested to verify proper operation. The procedure consists of connecting the Serial Input (SI), Serial Output (SO), and 20 mA Source into a loop, and then entering access code 39.

Connect the IMI as shown below. Enter “Pro 9”, key-in “Code 39”, and then press “P”. If the serial communication hardware is OK, “PASS” will be displayed. Conversely, if there is an internal problem, “FAIL” will be displayed. After the diagnostic test is complete, press “P” to return to “Pro 0”.

“CodE” < > “39”



DISPLAY, ALARM, AND ANALOG DIAGNOSTIC

The IMI will display 88.8.8.8.8., the most significant decimal point will not illuminate. Pressing the up button for 1 second activates and latches alarm 1 and sets the analog output for the minimum output of 4 mA or 0 VDC. Pressing the down button for 1 second activates and latches alarm 2 and sets the analog output for the maximum output of 20 mA or 10 VDC. If the analog output signal is out of tolerance refer to the Analog Output Calibration section. Pressing the “P” button exits the self-test.

“CodE” < > “52”

Note: The alarms will turn off upon entry of this procedure. The analog output will freeze at the present value unless the up or dn button is pressed.

RESTORING ALL PROGRAMMING PARAMETERS BACK TO FACTORY CONFIGURATION

All of the programming in Modules #1 through #8 can be restored back to the factory parameters by entering access code 66 (Refer to the “Factory Configuration” section for these parameters.) The procedure consists of entering “Pro 9”, keying-in “Code 66”, and then pressing “P”. The IMI responds by displaying “INItAL” for several seconds, and then returns to “Pro 0”.

Note: When this procedure is performed, all of the scaling, presets, etc. that were programmed into the IMI will be reset.

“CodE” < > “66”

OPERATING THE IMI

After completing input configuration and switch set-up, scaling, and all set-up selections, the unit is ready to install and operate. After power is applied, a display test consisting of illuminating all segments for 2 seconds is performed. Afterward, the rate, total or efficiency will appear, depending upon the display mode prior to the last power-down. To switch the display to rate, press "DOWN" (indicated by "arrows" on the front panel) and to switch it to total or efficiency, press "UP". If a decimal point is chosen, one leading and one or more trailing zeros will accompany the decimal point.

QUICK PROGRAMMING

To limit access to the set-up parameters, connect a key-switch or wire from PGM. DIS. (TBA #3) to COMM. (TBA #7). With this pin connected to common, only a predetermined amount of data can be viewed or altered, as determined by Programming Module #3 (Pro 3). If "NO" was programmed for all of the available steps in Pro 3, then pressing "P" will cause the unit to display "Loc". However, if "YES" was programmed in one or more of the steps, then "P" will invoke entry into a series of commonly modified parameters while protecting the crucial set-up information. This is referred to as the "Quick Programming" mode. When "Quick Programming" mode is entered, the alarms and hysteresis values may be modified in the same manner as in the regular programming mode. The new alarm and hysteresis values will take effect when "P" is pressed. The other operations in the "Quick Programming" mode require special sequences of the front panel buttons as follows:

RESET ALARMS

To reset a latched alarm, scroll through steps in "Quick Programming" mode using the "P" button until "LAtCH1" or "LAtCH2" appears in the display. If they do not appear, they are not latched. While "LAtCH1" or "LAtCH2" is displayed, press and hold the "DOWN" button and press the "P" button. Pressing "P" alone causes a step to the next item with no action taken on the alarm.

RESET PEAK/VALLEY BUFFERS

To reset peak and valley buffers, scroll through steps in Quick Programming mode using the "P" button until "PEA" or "VAL" appears in the display. While "PEA" or "VAL" is displayed, press and hold the "DOWN" button and press the "P" button. Pressing "P" alone causes a step to the next item with no action taken on the buffer.

FRONT PANEL BUTTON FUNCTIONS (NORMAL MODE)

The front panel buttons are not only used to input data during the programming and "Quick Programming" mode, but control other functions (if enabled in "Pro 3") as well. In the normal mode, these functions are available:

Switch display to rate: Press "DOWN" button.
Switch display to totalizer/efficiency: Press "UP" button.
Reset totalizer to zero: Press and hold "UP" and press "P".
Enter programming or "Quick Programming": Press "P".

After each operation, a message will appear briefly to acknowledge the action.

FACTORY CONFIGURATION

The following chart lists the programming of the unit when shipped from the factory. Input switch settings are MAG PKUP “OFF”, LOGIC “ON”, and NPN O.C. “OFF”. Code 66 in “Pro 9” will restore the IMI programming to the following values.

“Pro 2”	“dECPNt”	-	“0”
	“round”	-	“1”
	“Lo-udt”	-	“1.0”
	“Hi-udt”	-	“2.0”
	“dSP 1”	-	“10000”
	“rAtE 1”	-	“10000.0”
“Pro 3”	“dSP AL”	-	“yES”
	“ENt AL”	-	“yES”
	“dSPHYS”	-	“yES”
	“ENtHYS”	-	“yES”
	“rSt AL”	-	“yES”
	“dSPbUF”	-	“yES”
	“rStbUF”	-	“yES”
	“SELdSP”	-	“yES”
	“rSttOt”	-	“yES”
“Pro 4”	“FILtEr”	-	“1”
	“E1-CON”	-	“4”
	“E2-CON”	-	“4”
“Pro 5”	“dISP”	-	“totAL”
	“dECPNt”	-	“0”
	“tbASE”	-	“0”
	“SCLFAC”	-	“1.000”
	“Lo-cut”	-	“0”

“Pro 6”	“trAc”	-	“NO”
	“dISP”	-	“NO”
	“LAtC-1”	-	“NO”
	“ASN-1”	-	“rAtE”
	“AL-1”	-	“1000”
	“HYS-1”	-	“1”
	“Act-1”	-	“Hi”
	“ONdEL1”	-	“NO”
	“OFdEL1”	-	“NO”
	“LAtC-2”	-	“NO”
	“ASN-2”	-	“rAtE”
	“AL-2”	-	“1000”
	“HYS-2”	-	“1”
	“Act-2”	-	“Hi”
	“ONdEL2”	-	“NO”
	“OFdEL2”	-	“NO”
“Pro 7”	“bAud”	-	“1200”
	“AddrES”	-	“0”
	“Print”	-	“0”
	“FULL”	-	“yES”
“Pro 8”	“ASIN”	-	“rAtE”
	“AN-Lo”	-	“0”
	“AN-HI”	-	“10000”

PROGRAMMING EXAMPLE

An IMI is used to monitor web speed of a textile machine. A display of the web speed in feet per minute and efficiency is desired. Underspeed and overspeed protection is desired in addition to an analog output to a chart recorder. The optimum speed of the web is 1100 FPM. The absolute maximum speed equals 120% of the optimum speed and the absolute minimum speed equals 70% of the optimum speed. If the web speed exceeds these limits, the appropriate alarm will latch and shut-down the machine. The "on" delay feature is used for both setpoints to allow the textile machine five seconds to reach operating speed during start-up and also allow for temporary over or underspeed situations. The analog output will monitor the efficiency and provide 4 mA @ 0.00% and 20 mA @ 120.00%. A proximity sensor is used to sense a key-way on an idler roll and produces 565 Hz @ 1100 FPM. Reset of the latched alarms and peak/valley buffers is accomplished via a key switch connected to inputs E1-CON and E2-CON.

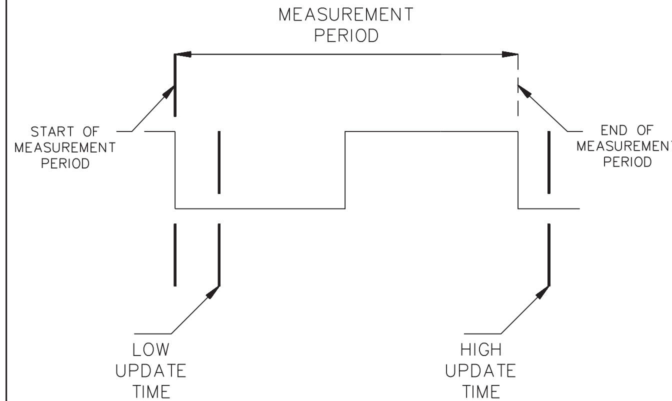
"Pro 2"	"dECPNt"	-	Enter 0.0
	"round"	-	Enter 0.1
	"Lo-udt"	-	Enter 1.0
	"Hi-udt"	-	Enter 2.0
	"dSP 1"	-	Enter 1100.0
	"rAtE 1"	-	Enter 565.0
"Pro 3"	"dSP AL"	-	Enter yES
	"ENt AL"	-	Enter yES
	"dSPHyS"	-	Enter NO
	"ENtHyS"	-	Enter NO
	"rSt AL"	-	Enter NO
	"dSPbUF"	-	Enter yES
	"rStbUF"	-	Enter NO
	"SELdSP"	-	Enter yES
"Pro 4"	"FILtEr"	-	Enter 1
	"E1-CON"	-	Enter 8 (reset latched alarms)
	"E2-CON"	-	Enter 5 (reset peak/valley buffers)
"Pro 5"	"dISP"	-	Enter EFF
	"ASNbUF"	-	Enter EFF
	"dECPNt"	-	Enter 0.00
	"100Pct"	-	Enter 1100.0

"Pro 6"	"trAc"	-	Enter NO
	"dISP"	-	Enter yES
	"LAtC-1"	-	Enter yES
	"ASN-1"	-	Enter EFF
	"AL-1"	-	Enter 70.00
	"HyS-1"	-	Enter 0.01
	"Act-1"	-	Enter LO
	"ONdEL1"	-	Enter yES
	"dELAy1"	-	Enter 5.0
	"LAtC-2"	-	Enter yES
	"ASN-2"	-	Enter EFF
	"AL-2"	-	Enter 120.00
	"HyS-2"	-	Enter 0.01
	"Act-2"	-	Enter HI
	"ONdEL2"	-	Enter yES
	"dELAy2"	-	Enter 5.0
"Pro 8"	"ASIN"	-	Enter EFF
	"AN-Lo"	-	Enter 0.00
	"AN-HI"	-	Enter 120.00

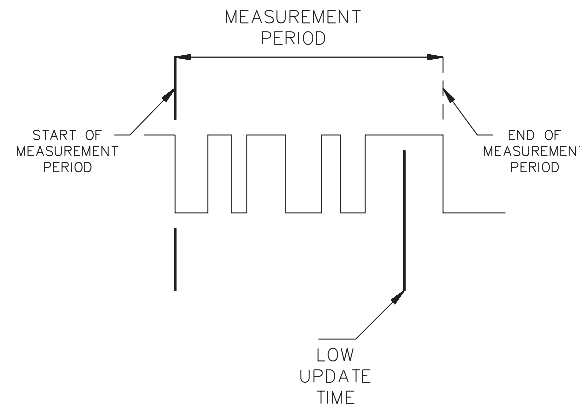
RATE

The rate value calculation uses the method in which the time measured between the first and last pulse is the measurement period. The measurement period begins when a negative going edge is received at the signal input (TBA #6). When the Low Update time has expired, the unit will end the measurement period on the next negative going edge and update the display. The unit will count the number of pulses that occurred during the measurement period and update the display, according to the scaling value, at the end of the measurement period. If the unit does not receive a negative edge within the period between the low update and high update time, the unit will end the measurement period and the input (rate) display will go to zero. At very slow count rates the update time (measurement period) will be the actual period of one count cycle.

ONE COUNT CYCLE MEASUREMENT



AVERAGE CYCLE MEASUREMENT



TOTALIZER

The totalizer adds incoming pulses received through the signal input (TBA #6), modifies the result by the programmed scale factor and time base, and displays the result. The totalizer updates every 0.2 secs maximum, independent of the rate update times. As a result, the input is accumulated in "batches" every 200 msec. Therefore, the totalizer start and stop sequencing, as well as alarm values set to trigger at specific totalizer values, are only accurate to the 200 msec totalizer update rate. The scale factor and time base can be used to modify the total counts received, to display any desired engineering units.

The scale factor has a range of 0.001 to 100.000. The total counts received are multiplied by the scale factor value and then the time base divides the resultant by 1, 60, or 3600.

The scale factor is used for conversion of the pulse per unit to the desired totalizer display units.

$$\text{Scale Factor} = \frac{\text{Desired Display Units}}{\text{Number of Pulses}}$$

The decimal point position of the totalizer is programmable and independent of the rate display. Reset may be accomplished through a remote input, by the front panel or through the serial communications option. The alarms and analog output may be programmed to trigger from the totalizer value. A programmable low signal level disable completes the totalizers features (this will stop totalization when the rate signal drops below this programmed value, "low cut"). At loss of power to the indicator, the contents of the totalizer are saved. This allows totalizing over consecutive shifts, days, etc. The total can accumulate to 999,999.

Note: The totalizer value will roll over and flash when the total exceeds 999999, indicating an overflow condition.

Example: The totalizer display is used to totalize the number of feet used in a process. It is necessary to know the number of pulses for the desired units to be displayed. The decimal point is selected to show the resolution in hundredths.

$$\text{Scale Factor} = \frac{\text{Desired Display Units}}{\text{Number of Pulses}}$$

Known 128 pulses is equal to 100 feet. Display total feet with a one-hundredth resolution.

$$\text{S.F.} = \frac{100}{128}$$

$$\text{S.F.} = 0.781$$

EFFICIENCY

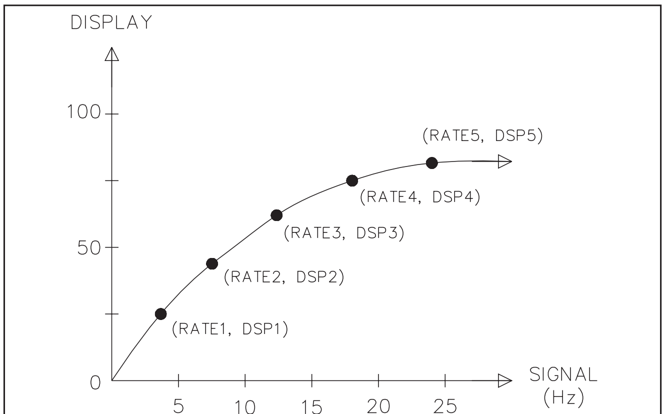
The efficiency display indicates the current efficiency of the rate process being monitored. Zero efficiency corresponds to a process rate of zero. The 100 percent efficiency corresponds to the percentage of the rate display as compared to the target value (100 pct).

Example: 2000 RPM = 100% when the rate display indicates 2000, the efficiency display will indicate 100. If the rate display increases to 2100, the efficiency display will increase to 105.

The efficiency display tracks the rate display and will update as the rate display updates. Alarms may be programmed to trigger from the efficiency. The analog output may also be assigned to track the efficiency. If the efficiency display exceeds 999,999, the display will change to "———". The round and filter functions effect the efficiency in addition to the rate display.

LINEARIZER

The linearizer feature is a series of programmable scaling points that are used to construct linear segments to linearize the input signal. The most common application would be to interface with square law devices (commonly, flow transducers). Correction for non-linearity is accomplished by continuing with scaling points beyond “DSP 1” and “rAtE 1” in “Pro 1” and “Pro 2”, with “DSP 2”, and “rAtE 2”, “DSP 3”, and “rAtE 3”, etc. The unit automatically calculates the linear segments between the programmed coordinates. This process of entering linear segments is also known as “curve fitting.” A maximum of nine segments are available and using nine segments for a square law device would reduce linearity errors to approximately 0.35%. The ordering of the input signal scaling points must be in increasing order. To have one or more points “back-track,” the input/output (signal/display) relationship would not be a function and would be undefined in that area. Additionally, consideration should be given to the location and length of each segment to fully minimize the segment conformity error over the desired range. A typical curve is shown below using five segments (five scaling points). Usually it is desirable to use as many segments as possible to reduce the amount of linearity error.



The computer program in Appendix “C” outputs the display and process (rate) scaling points (the location of each linear segment) as a percentage of the full scale input (i.e. 0-1500 Hz) and full scale display (i.e. 0-46006 GPM). To obtain the actual input and display scaling points, multiply the respective percent of full scale values by the respective full scale range for the input and display. “Pro 2” is then used to enter these values into the IM unit.

PEAK/VALLEY

The IMI will record the lowest reading (valley) and the highest reading (peak) automatically of the input rate or efficiency display depending on the programming in program module #5, for later recall. This information is valuable in monitoring the limits of the process over any length of time since these values are stored at power-down to span over shifts, days, etc. An external input can be programmed to reset or engage the unit into a peak/valley reading indicator. Additionally, the peak and valley can be viewed and reset from the front panel, if so programmed, and from the serial communication option.

Note: The peak/valley measurement is not instantaneous and is based on the assigned display response time.

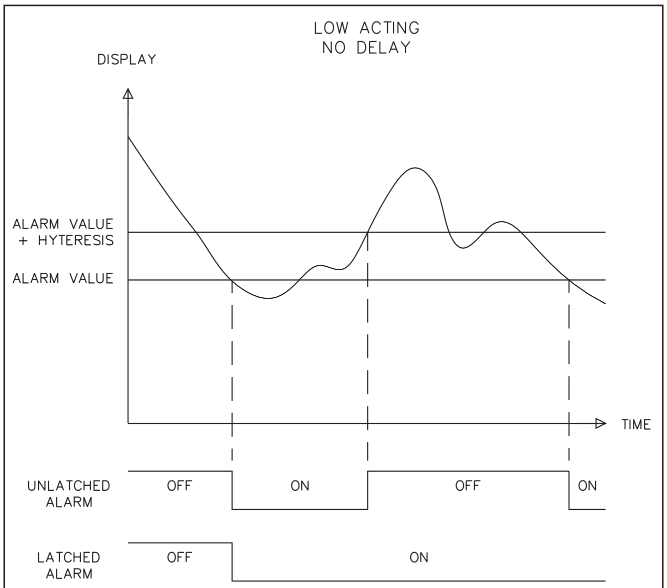
ALARMS (Optional)

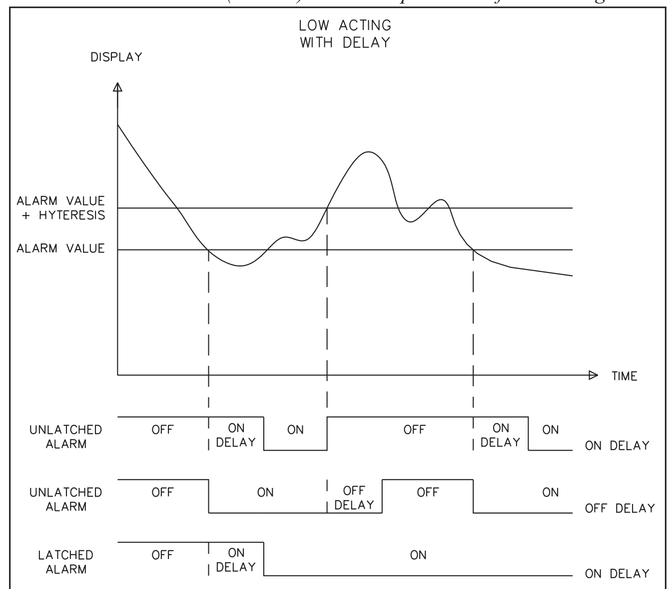
The alarm option consists of an additional printed circuit board with nine terminals. Six of these terminals are the two Form-C relays and the other three are the two open collector transistors, which act in parallel with the relays. The two alarms are completely independent with programmable values, hysteresis (deadband), high or low acting, on/off or no delay, auto or manual reset, triggering from rate, total or efficiency, and tracking one another, if desired. If the alarms are programmed to latch (manual reset), then they will have to be reset either by the front panel buttons or a remote input. The alarms can be connected to activate external alarms, control valves, etc. Additionally, the alarms may be programmed to activate the display with a flashing message to alert operators of the condition.

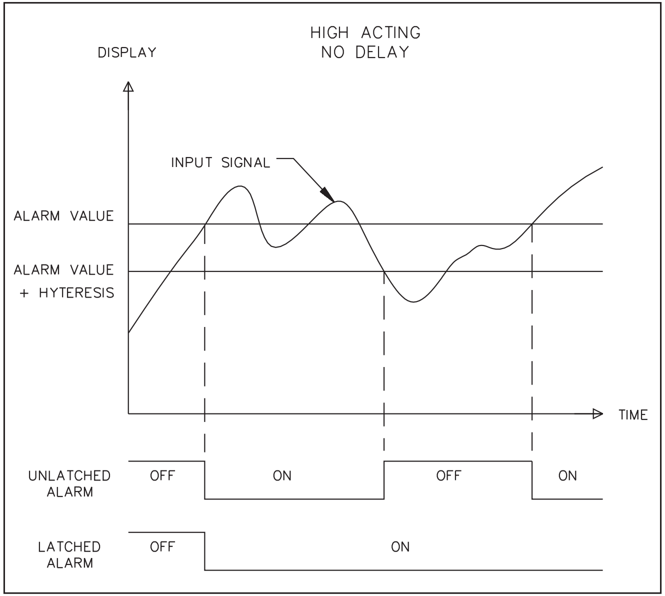
Alarm #1 can be made to track Alarm #2 by enabling alarm tracking. This is useful in alarm set-ups where a pre-warning control activates before a second alarm shuts off the process. Changing the shut-off trip value (Alarm #2) automatically changes Alarm #1 so that the offset between Alarm #2 and Alarm #1 remains the same. Alarm and hysteresis values can be modified through the optional serial communications to provide automatic control. The following diagrams depict how the alarms work with both “HI” and “LO” acting set-ups.

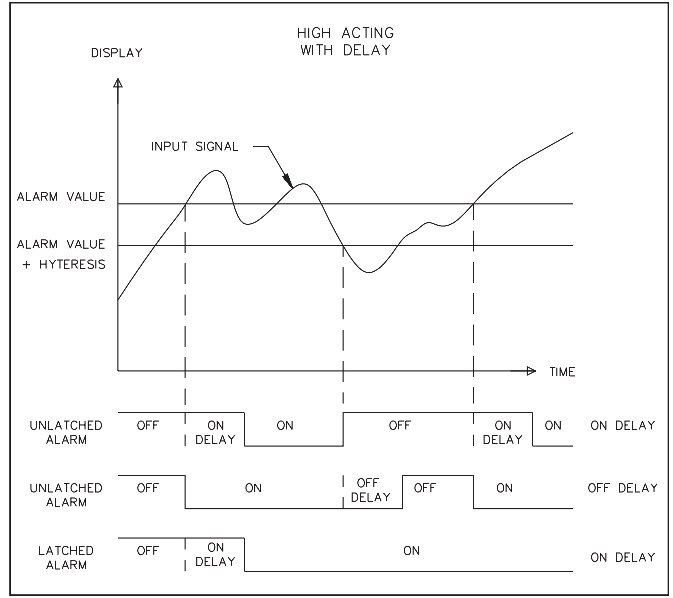
Programming of the alarms can be done in “Pro 6” or when the unit is in the “Quick Programming” mode, if enabled.

Note: Alarm Comm. (TBB #8) must be kept isolated from Analog “-”.









Note: Alarm Comm. (TBB #8) must be kept isolated from Analog "-".

20 mA CURRENT LOOP SERIAL COMMUNICATIONS (Optional)

GENERAL DESCRIPTION

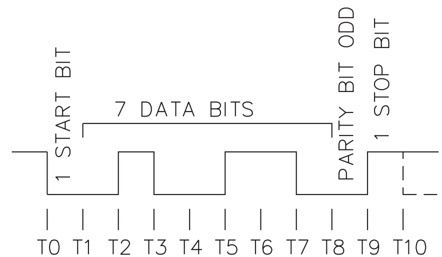
The serial communication option is a half-duplex, two-way, 20 mA loop that can connect to a variety of printers, computers, terminals and controllers to suit many data-polling or automatic operation applications. The indicator responds to a host of commands, including change alarm value, reset totalizer and transmit rate value. Two loops are required for all hook-ups; a transmit (out-going data) loop and a receive (in-coming data) loop. Since the indicator monitors the receive loop for a busy signal (current interrupted) while transmitting, the receive loop must be connected even if the indicator is transmitting only, such as to a printer. The built-in 20 mA source can be used in the transmit loop (only) by connecting the current return wire to -20 mA SRC., instead of SO+. To bypass the built-in current source, make transmit loop connections to SO+ and SO-. Additionally, multiple units and other Red Lion Controls instruments can be serially addressed, up to a maximum of 99 units. (The actual number in a single loop is limited by the serial hardware specifications.) To eliminate problems with ground loops, the serial circuitry is isolated from both signal common and output common. Optional 20 mA to RS232C and 20 mA to RS422 converter modules expand the unit's flexibility.

Note: When operating the unit with a printer, the receive loop of the indicator must have current flowing before transmission can take place.

COMMUNICATION FORMAT

Data is sent by switching current on and off in the loop and is received by monitoring the switching action and interpreting the codes that are transmitted. In order for data to be correctly interpreted, there must be identical formats and baud rates among the communicating equipment. The only format available with this indicator is 1 start bit, 7 data bits, 1 odd parity bit and 1 stop bit. The baud rates are programmable and the choices are: 300, 600, 1200, 2400, 4800 and 9600.

DATA FORMAT-10 BIT FRAME [300, 600, 1200, 2400, 4800, or 9600 Baud]



Before serial communication can take place, the indicator must be programmed to the same baud rate as the connected equipment. In addition, the loop address number, print options and full or abbreviated transmission must be programmed. If only one indicator is to be used, then a loop address number of "0" may by used, to eliminate the requirement for the address specifier when sending a command. If more than one indicator is on the loop, assignment of unique addresses, other than zero, for each indicator is recommended. Valid addresses of 0 to 99 may be assigned, but the built-in current source, if used, is capable of driving up to 7 units. Additional drive capability may be afforded by an external current source with a higher compliance voltage. Refer to programming section "Pro 7" to program the serial option parameters.

SENDING COMMANDS TO THE IMI

When sending commands to the unit, a command string must be constructed. The command string may consist of command codes, value identifiers, and numerical data. Below is a table outlining the codes the indicator will recognize.

COMMAND	FUNCTIONS
T	transmits the requested information specified by the identifier (A-L)
V	change a value specified by the identifier (C-F, K and L)
N	address a particular indicator in a multiple unit loop (0-99)
R	reset a value specified by the identifier (B-D, G, and H)
P	print per programmable print options (A-H)

VALUE	IDENTIFIERS	SERIAL MNEMONICS
A	display value	RTE
B	secondary display	TOT or EFF
C	alarm #1	AL1
D	alarm #2	AL2
E	hysteresis #1	HS1
F	hysteresis #2	HS2
G	peak reading	PEK
H	valley reading	VAL
K	analog low	ANL
L	analog high	ANH

A command string is constructed by using the above commands and identifiers along with any data values that are required. The indicator will accept a "+" in front of the data value. Leading zeros can be eliminated and both lower and upper case characters are accepted. The address command is used to allow a command to be directed to a specific unit on the loop. If the indicator is assigned an address of "0", transmission of the address command is not required. This is done where only one indicator is in the loop.

The command string is constructed in a specific logical sequence. The indicator will reject command strings that do not conform. Only one operation can be performed per command string. The following is a description of how to construct a command string.

1. If the indicator has an address other than zero, the first two characters of the string must consist of the address command (N) followed by the unit address number (0-99). If the indicator has an address of 0, the address command is optional.
2. The next two characters in the string are the actual command the indicator must perform and the identifier on which it operates. The command P - print, has an implied operation and needs no value identifier.
3. If the change value command is being used (V), the next characters in the string after the value identifier, are the numerical data. When sending numerical data, such as change an alarm value, the correct number of digits to the right, must be included. As an example, to change an alarm value from 750.2 to 500.0. Sending 500 would cause the indicator to see 50.0 and change the alarm value accordingly.
4. All commands must be terminated by an asterisk(*). The indicator will not respond to any other code. Carriage return and line feed are not valid terminators and should be suppressed with the character ";", if using a BASIC print statement (ex. Print "N9TA*";).

COMMAND STRING EXAMPLES

Indicator with address 3, transmit rate reading.

N3TA*

Indicator with address 0, change alarm #1 to 1500.

VC1500*

Indicator with address 1, reset totalizer.

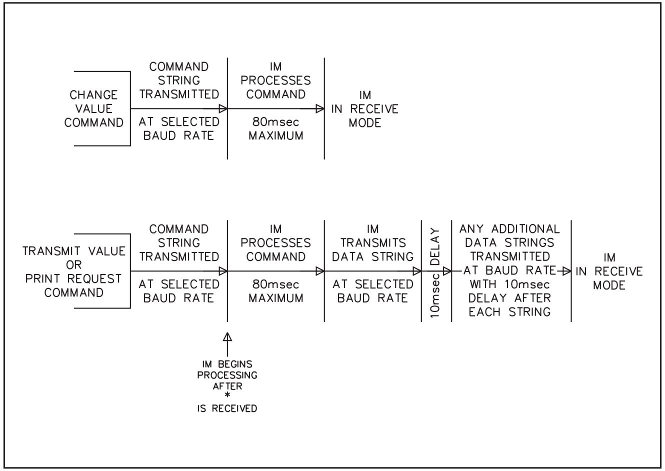
N1RB*

Indicator with address 99, print the print options.

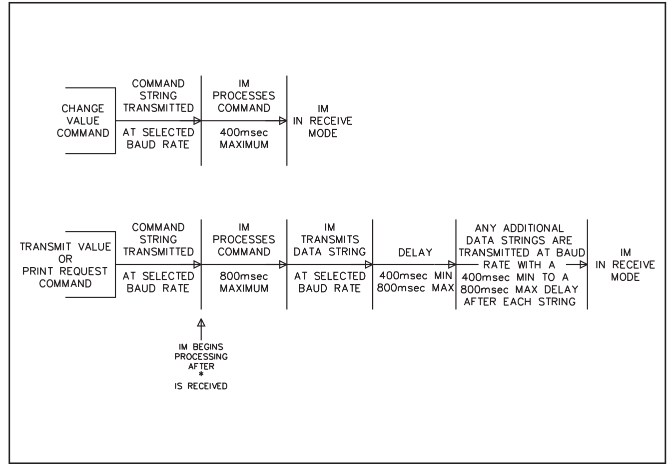
N99P*

If an illegal command or character is sent to the IM, an asterisk (*) must be transmitted to clear the input buffer. The IM will not respond to an illegal or incomplete transmission. The diagrams on the following page show the differences in the timing considerations for either Abbreviated or Full Character Transmission, or if a Reset Command is issued.

TIMING DIAGRAMS (ABBREVIATED TRANSMISSION SELECTED)

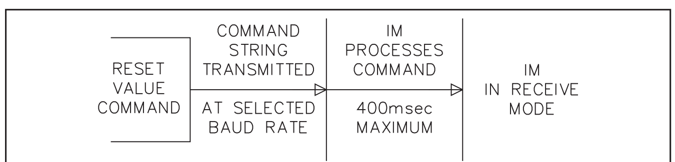


TIMING DIAGRAMS (FULL TRANSMISSION SELECTED)



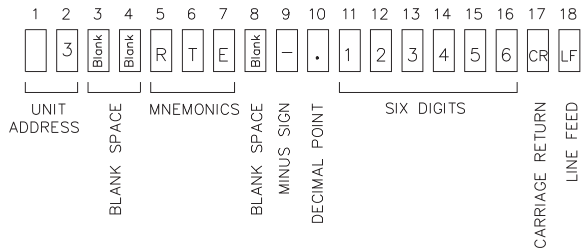
Note: If Full Transmission is selected and the front panel is being accessed at the time of transmission, the IM may take as long as 2 seconds to respond.

RESET COMMAND INDEPENDENT OF TYPE OF TRANSMISSION SELECTED



RECEIVING DATA FROM THE IMI

Data is transmitted from the indicator whenever a “T” or “P” command is received via serial communications or a remote input, E1-CON or E2-CON is programmed for print request, is activated. If the abbreviated transmission was programmed, just data will be transmitted with no built-in delay. (If full transmission is programmed, then there is a 400 msec min. to 800 msec max. delay built-in to the string.) A typical data string transmission is shown below.



The first two characters transmitted are the unit address number, unless it is zero, in which case it is left blank. Then two blank spaces are sent. The next three characters are the abbreviation for the value (mnemonics), which is then followed by a blank. The actual data is transmitted next. The field is right justified with leading zeros. Negative numbers are indicated by a minus sign fixed next to the identifier. A carriage return and a line feed are transmitted next. For various reasons, “extra” characters are added onto the end of the above character string. (These characters could be and are used for control or signaling purposes.) These characters are:

<CR> sent after single line transmissions from IM unit.

<SP><CR><LF> sent after last line of a “block” transmission from IM unit.

For a “T” command or after each line of a “block” transmission, no additional characters are sent. If the abbreviated transmission is selected, the address, mnemonics, and any blank spaces (first eight characters) are not transmitted (the data strings are left justified in this case).

If the transmitted data is overrunning the peripheral’s buffer, the receive channel to the indicator may be used for handshaking purposes. As a consequence of this, even if the indicator is to transmit only (ex. to a printer), current must be flowing in the receive channel to allow transmission. Examples of transmissions are as follows:

2 TOT 125.75 <CR> <LF> (400 msec delay) full transmission

125.75 <CR> <LF> abbreviated transmission

CURRENT LOOP INSTALLATION

WIRING CONNECTIONS

It is recommended that shielded (screened) cable be used for serial communications. This unit meets the EMC specifications using Alpha #2404 cable or equivalent. There are higher grades of shielded cable, such as four conductor twisted pair, that offer an even higher degree of noise immunity.

When wiring the 20 mA current loop, remove the bottom terminal block (TBA), located on the rear of the unit. Refer to the numbers listed with the terminal descriptions below or those located on the label. Install each wire in its proper location on the terminal block. When all connections are made, replace the terminal block into its proper location.

SERIAL TERMINAL DESCRIPTIONS

8. E1 or E2-CON -

   A remote input terminal pulled low activates the unit to transmit data according to the print function selected in Program Module #7 (Reference Programming Module #7 for more details.) In order for a print request function to occur, E1-CON (TBA #4) or E2-CON (TBA #8) must be programmed for print request.

   Note: In order to guarantee a print-out, the programmed E-CON pin must be held low for at least 20 msec. If this time exceeds 800 msec, a second print-out may occur.

9. -20 mA SRC. -

   20 mA current source return path for the transmit loop. Current flows into this pin.

10. SI+ (Serial In+) -

11. SI- (Serial In-) -

    The unit receives commands on the SI terminals. They are connected in series with the transmit or output terminals of the device to be connected.

12. SO+/+20 mA SRC. (Serial Out+) -

    20 mA current source for the transmit loop (internally connected).

13. SO- (Serial Out-) -

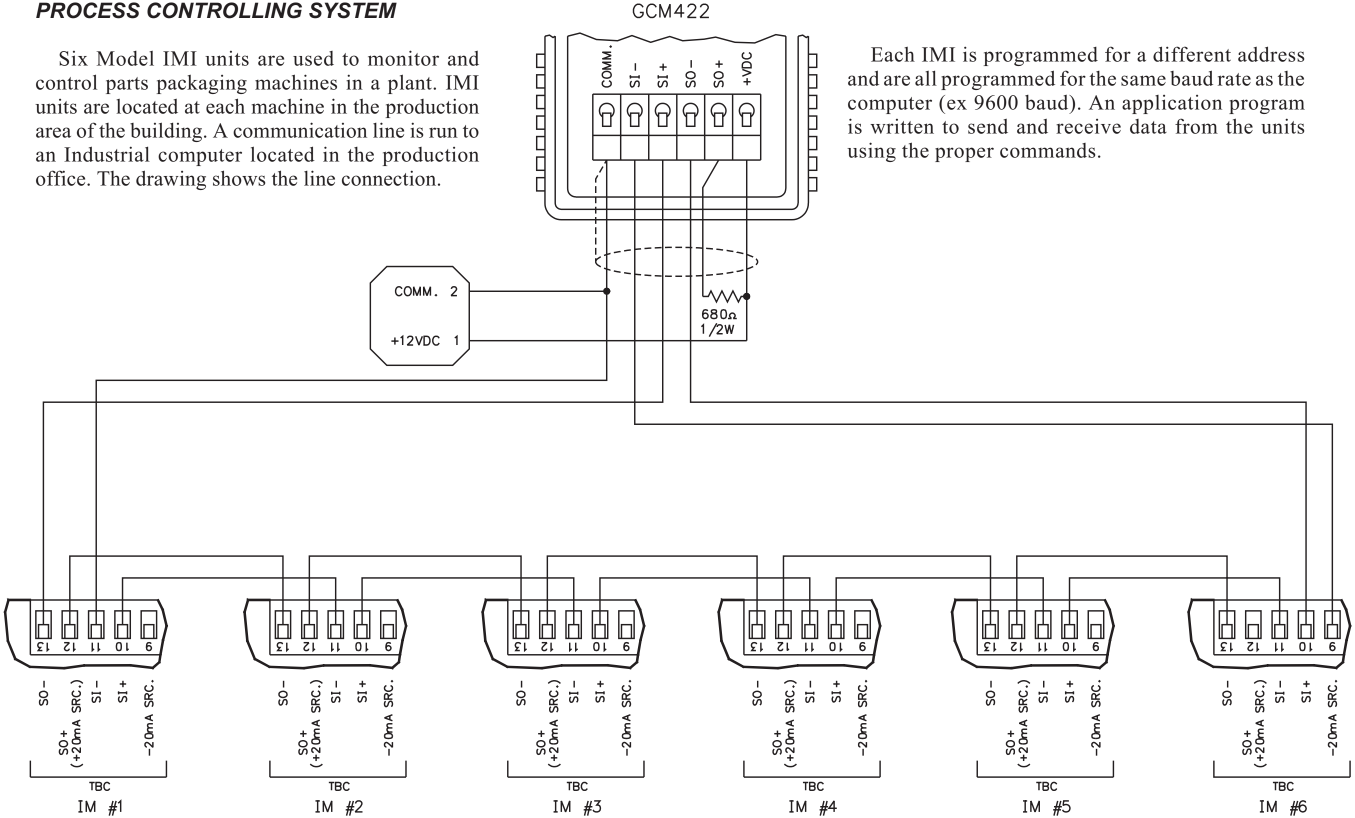
    The unit transmits the requested data on the SO terminals. They are connected in series with the receive input of the device to be connected.

    Note: The Serial Input terminals must be held in the mark condition (current flowing) in order for the unit to respond to a Print Request activation.

PROCESS CONTROLLING SYSTEM

Six Model IMI units are used to monitor and control parts packaging machines in a plant. IMI units are located at each machine in the production area of the building. A communication line is run to an Industrial computer located in the production office. The drawing shows the line connection.

Each IMI is programmed for a different address and are all programmed for the same baud rate as the computer (ex 9600 baud). An application program is written to send and receive data from the units using the proper commands.

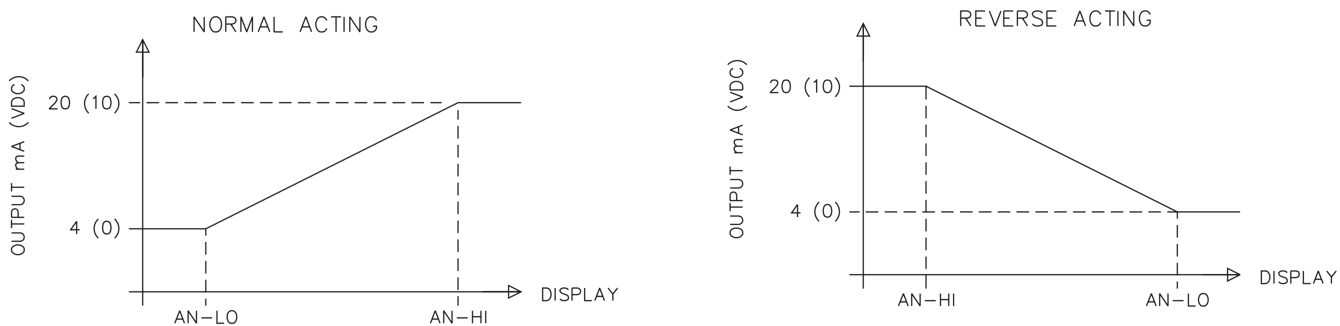


ANALOG OUTPUT (Optional)

The analog output option transmits a digitally scaleable 4 to 20 mA or 0 to 10 VDC signal to drive chart recorders, remote indicators and controllers. The option is contained on the upper PCB and has two outputs, "ANALOG-" (TBB #10) and "ANALOG+" (TBB #11) and is self-powered (active) with a compliance of 10 VDC. The analog "-" output is isolated from the signal input common, eliminating problems from ground loops. Programming the option is performed in "Pro 8". Display values are simply keyed in to provide a 4 mA or 0 VDC output, "AN-LO", and a 20 mA or 10 VDC output, "AN-HI". The analog output then follows the assigned value and as such will update every measurement cycle. Nonstandard current or voltage ranges can be supported by calculating the slope and intercept of the display/output and calculating the required display values at 4 mA or 0 VDC and 20 mA or 10 VDC. Reverse action can be achieved by programming a "high" display value for "AN-LO" and a "low" display value for "AN-HI".

Note: Analog "-" must be kept isolated from alarm comm. (TBB #8).

ANALOG OUTPUT DIAGRAMS

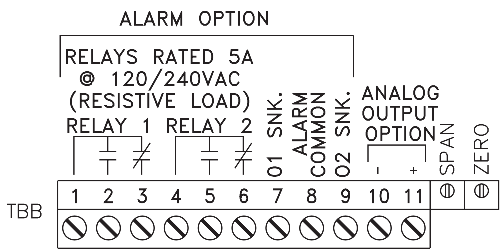


ANALOG OUTPUT CALIBRATION

Although the analog output has been calibrated at the factory, zero and span adjustments are provided to compensate for small offsets and drifts. If excessive drift is noticed, the following calibration procedure may be performed.

4 to 20 mA CALIBRATION

Enter "Pro 9" and code number 52. Press the up button for 1 second and adjust the zero potentiometer (right side) so that exactly 4.00 mA flows, as verified by an accurate ammeter. Press the down button for 1 second and adjust the span potentiometer (left side) so that 20.00 mA is flowing. Repeat the zero and span adjustments until both are accurate. Analog output calibration is complete.



0 to 10 VDC CALIBRATION

Exit the programming mode and apply a (temperature)/(resistance) to the input of the indicator so that the display reading is below that of the value entered for "AN-LO". Adjust the zero potentiometer (right side) so that exactly 0.00 VDC flows, as verified by an accurate voltmeter. Next, apply a (temperature)/(resistance) to the input of the indicator so that the display reading is above that of the value entered for "AN-HI". *(See Appendix "B" for maximum input voltage.)* Adjust the span potentiometer (left side) so that 10.00 VDC is flowing. Repeat the zero and span adjustments until both are accurate. Analog output calibration is complete.

APPENDIX "A" - INSTALLATION & CONNECTIONS

Before installing the IM into the panel, the user should first become familiar with the unit. It may also be desirable to program the unit for the application. When programming is complete, all parameters will be saved in non-volatile memory. The Program Disable (PGM.DIS.) terminal should be connected to COMM. to prevent accidental or unauthorized programming changes.

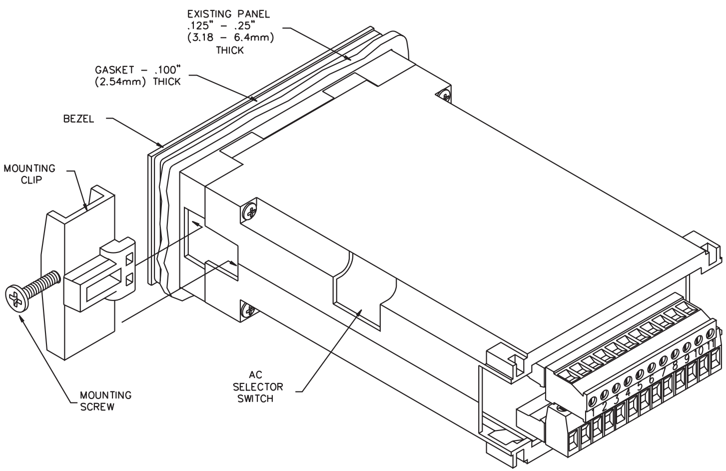
INSTALLATION ENVIRONMENT

The unit should be installed in a location that does not exceed the maximum operating temperature and provides good air circulation. Be sure to keep it away from heat sources (ovens, furnaces, etc.), away from direct contact with caustic vapors, oils, steam, condensation, or any other process by-products in which exposure may affect proper operation. Placing the unit near devices that generate excessive heat should be avoided.

The bezel should be cleaned only with a soft cloth and neutral soap product. Do NOT use solvents.

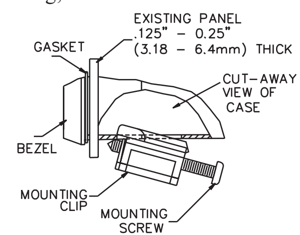
Continuous exposure to direct sunlight may accelerate the aging process of the bezel. Do not use tools of any kind (screwdrivers, pens, pencils, etc.) to operate the keypad of the unit.

PANEL INSTALLATION



The unit meets NEMA 4/IP65 requirements for indoor use, when properly installed. The units are intended to be mounted into an enclosed panel, with a gasket to provide a water-tight seal. Two mounting clips and screws are provided for easy installation. Consideration should be given to the thickness of the panel. A panel which is too thin may distort and not provide a water-tight seal. (Recommended minimum panel thickness is 1/8".)

Cut the panel opening to the specified dimensions. Remove burrs and clean around the panel opening. Slide the panel gasket over the rear of the unit to the back of the bezel. As depicted in the drawing, install the screws into the narrow end of the mounting clips. Thread the screws into the clips until the pointed end just protrudes through the other side. Install each of the mounting clips by inserting the wide lip of the clips into the wide end of the hole, located on either side of the case. Then snap the clip onto the case. Tighten the screws evenly to apply uniform compression, thus providing a water-tight seal.



CAUTION: Only minimum pressure is required to seal panel. Do NOT overtighten screws.

SELECT AC POWER (115/230 VAC)

The AC power to the unit must be selected for either 115 VAC or 230 VAC. The selector switch is located through an access slot on the side of the case. (See figure on previous page or label on case.) The unit is shipped from the factory with the switch in the 230 VAC position.

Caution: Make sure the AC selector switch is set to the appropriate position before applying power to the unit. Damage to the unit may occur if the AC selector switch is set incorrectly.

EMC INSTALLATION GUIDELINES

Although this unit is designed with a high degree of immunity to ElectroMagnetic Interference (EMI), proper installation and wiring methods must be followed to ensure compatibility in each application. The type of electrical noise, source or coupling method into the unit may be different for various installations. In extremely high EMI environments, additional measures may be needed. The unit becomes more immune to EMI with fewer I/O connections. Cable length, routing and shield termination are very important and can mean the difference between a successful or a troublesome installation. Listed below are some EMC guidelines for successful installation in an industrial environment.

1. The unit should be mounted in a metal enclosure, which is properly connected to protective earth.
   a. If the bezel is exposed to high Electro-Static Discharge (ESD) levels, above 4 Kv, it should be connected to protective earth. This can be done by making sure the metal bezel makes proper contact to the panel cut-out or connecting the bezel screw with a spade terminal and wire to protective earth.
2. Use shielded (screened) cables for all Signal and Control inputs, and Solid State Outputs. The shield (screen) pigtail connection should be made as short as possible. The connection point for the shield depends somewhat upon the application.

   Listed below are the recommended methods of connecting the shield, in order of their effectiveness.
   a. Connect the shield only at the panel where the unit is mounted to earth ground (protective earth).
   b. Connect the shield to earth ground at both ends of the cable, usually when the noise source frequency is above 1 MHz.
   c. Connect the shield to common of the unit and leave the other end of the shield unconnected and insulated from earth ground.
3. Never run Signal or Control cables in the same conduit or raceway with AC power lines, conductors feeding motors, solenoids, SCR controls, and heaters, etc. The cables should be run in metal conduit that is properly grounded. This is especially useful in applications where cable runs are long and portable two-way radios are used in close proximity or if the installation is near a commercial radio transmitter.
4. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.
5. In extremely high EMI environments, the use of external EMI suppression devices, such as ferrite suppression cores, is effective. Install them on Signal and Control cables as close to the unit as possible. Loop the cable through the core several times or use multiple cores on each cable for additional protection. Install line filters on the power input cable to the unit to suppress power line interference. Install them near the power entry point of the enclosure. The following EMI suppression devices (or equivalent) are recommended:

   Ferrite Suppression Cores for signal and control cables:
   Fair-Rite # 0443167251 (RLC #FCOR0000)
   TDK # ZCAT3035-1330A
   Steward #28B2029-0A0

   Line Filters for input power cables:
   Schaffner # FN610-1/07 (RLC #LFIL0000)
   Schaffner # FN670-1.8/07
   Corcom #1VR3

   Note: Reference manufacturer's instructions when installing a line filter.
6. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
7. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.

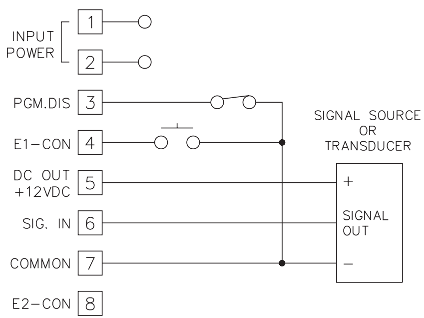
   Snubbers:
   RLC #SNUB0000

WIRING CONNECTIONS

After the unit has been mechanically mounted, it is ready to be wired. All conductors should meet voltage and current ratings for each terminal. Also cabling should conform to appropriate standards of good installation, local codes and regulations. It is recommended that power supplied to the unit be protected by a fuse or circuit breaker. All wiring connections are made on fixed or removable terminal blocks. There is a separate terminal block for the bottom board *(TBA)* and optional top board *(TBB)*. When wiring the unit, remove the terminal block *(where applicable)* and use the numbers on the label to identify the position number with the proper function. Strip the wire, leaving approximately 1/4" bare wire exposed *(stranded wires should be tinned with solder)*. Insert the wire into the terminal and tighten down the screw until the wire is clamped tightly. Each terminal can accept up to one 14-gage, two 18-gage or four 20-gage wire*(s)*. After the terminal block is wired, install it into the proper location on the PC board. Wire each terminal block in this manner.

POWER WIRING (A.C. VERSION)

Primary AC power is connected to TBA #1 and #2 (marked VAC 50/60 Hz, located on the left hand side of the bottom terminal block). To reduce the chance of noise spikes entering the AC line and affecting the indicator, the AC power should be relatively “clean” and within the specified ±10% variation limit. Drawing power from heavily loaded circuits or circuits which also power loads that cycle on and off, (contactors, relays, motors, machinery, etc.) should be avoided.



SIGNAL WIRING

Select the appropriate input switch configuration for the sensor input (refer to “Selecting The Input Configuration and Switch Set-up” section). When connecting the unit using its various options, the different COMM.’s of these options should NOT be connected to one another. The output options and input COMM.’s are all internally isolated from one another. Connecting them would defeat this feature.

Note: The +12 VDC DC OUT terminal (TBA #5) is referenced to “COMM.” (TBA #7). Refer to the diagram which illustrate the connections.

USER INPUT WIRING

User inputs (PGM.DIS., E1-CON, and optional E2-CON) are digital inputs that are active when connected to TBA #5 Common. Any form of mechanical switch, sinking collector logic with less than 0.7 V saturation may be used. The use of shielded cable is recommended. Follow the Additional EMC Installation Guidelines for shield connection.

OUTPUT WIRING

Relay Connections

To prolong contact life and suppress electrical noise interference due to the switching of inductive loads, it is good installation practice to install a snubber across the contactor. Follow the manufacturer’s instructions for installation.

Note: Snubber leakage current can cause some electro-mechanical devices to be held ON.

INPUT CONFIGURATION & SWITCH SET-UP

The input configuration is selected by setting the three position DIP switch, located at the side of the unit. The switches are designated NPN O.C., LOGIC, and MAG. PKUP.

MAG. PKUP. (ON) - Connects a 0.1 µf capacitor from the input to common. This capacitor is used mostly with magnetic pickup sensors and serves to filter out high frequency noise. Also it can be used as a debounce filter for switch contact closures. If excessive contact bounce is encountered, an additional external filter capacitor may be necessary.

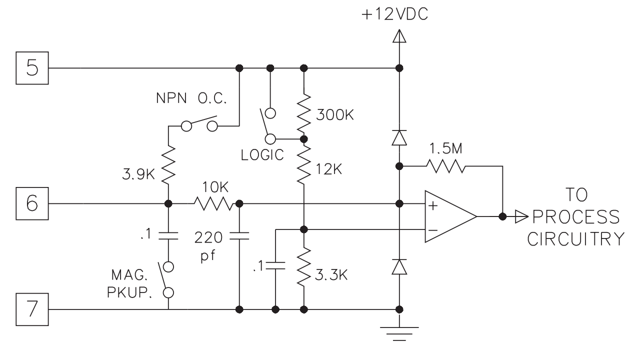
Note: Reed switches, mercury wetted contacts, snap action limit switches, and silver alloy relay contacts with wiping action are usually satisfactory generating an input signal. Motor starter, tungsten, and brush-type contacts should not be used.

LOGIC (ON) - Sets the bias reference voltage to approximately 2.5 VDC with a 30 mV hysteresis.

(OFF) - Sets the bias reference voltage to approximately 0.125 VDC with a 30 mV hysteresis.

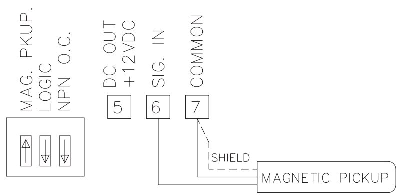
NPN O.C. (ON) - Connects an internal 3.9 K pull-up resistor for sensors or circuits with current sink outputs.

The sensor output must sink 4 mA with a V_{OL} of 1V or less for the OFF state and a V_{OH} of 3 V or higher for an ON state.



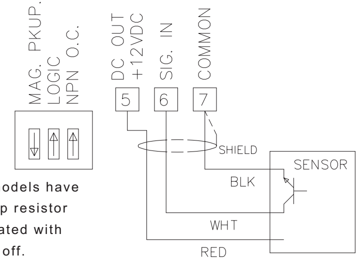
CONNECTIONS & CONFIGURATION SWITCH SET-UP FOR VARIOUS SENSOR OUTPUTS

MAGNETIC PICKUPS



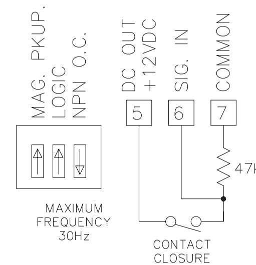
Use 2-wire shielded cable for magnetic pickup signal leads.

SENSORS WITH CURRENT SINK OUTPUT (NPN O.C.)
[Includes ASTC, LMPC, PSAC, RPGC, RPGB, RPGH, and LSC]

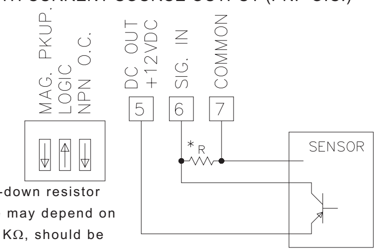


RPGB & RPGH models have an internal pull-up resistor and may be operated with NPN O.C. switch off.

INPUT FROM CONTACT CLOSURES

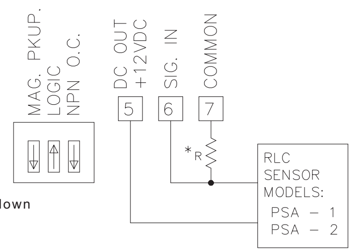


SENSORS WITH CURRENT SOURCE OUTPUT (PNP O.C.)



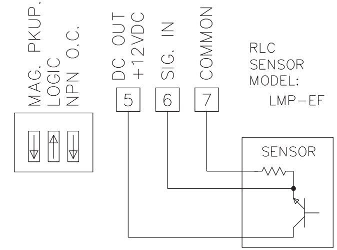
* External pull-down resistor required. Value may depend on sensors but 10 KΩ, should be adequate for most cases.

2-WIRE PROXIMITY SENSORS



* External 1.5 K pull-down resistor required.

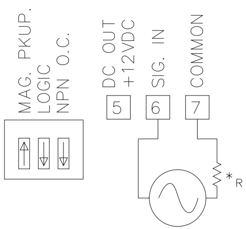
SENSORS WITH -EF OUTPUT



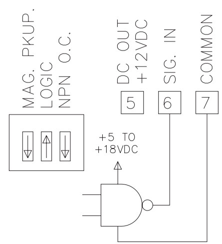
A.C. INPUTS FROM TACH. GENERATORS, INVERTERS,

A.C. power source such as inverters with more than 50 V output, should be coupled with a step-down isolation transformer.

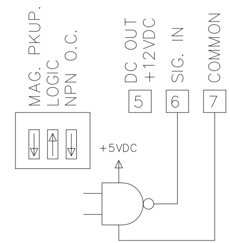
* Resistor to limit input current to 5 mA peak.



INPUT FROM CMOS & OTHER BI-POLAR OUTPUTS



INPUT FROM TTL



APPENDIX "B" - SPECIFICATIONS AND DIMENSIONS

1. **DISPLAY:** 6-digit, 0.56" (14.2 mm) High Red LED, programmable decimal points, maximum display 999,999. Flashing display during totalizer overflow."———" displayed during rate/efficiency display out of range.

2. **POWER REQUIREMENTS:**
   AC POWER: Switch selectable 115/230 VAC, ±10%, 50/60 Hz, 14 VA

3. **CONTROLS:** Three front panel push buttons for modifying alarm values and indicator set-up. Three external inputs; one for disabling the front panel, two for programmable function inputs.

4. **SIGNAL INPUT:** Switch selectable to accept signals from a wide variety of sensors.
   Max. Input Frequency: 50 KHz, 50% duty cycle.
   Max. Input Voltage & Current: With NPN O.C. switch OFF; ±50 V peak, ±5 mA.
   Input Impedance: With MAG. PKUP. & NPN O.C. switches OFF; 1MΩ.
   SWITCHES:
   - **MAG PKUP:** Connects a 0.1 µF input damping capacitor.
     - **Sensitivity:** 125 mV peak (typical @ 12 VDC)
     - **Hysteresis:** 30 mV
     - **Input Impedance:** 26.5 KΩ @ 60 Hz
     - **Maximum Input Voltage:** ±50 V peak
   - **LOGIC:** Sets input trigger level.
     - **Trigger Level:** +2.5 V with 30 mV hysteresis.
   - **NPN O.C.:** Provides internal 3.9 KΩ pull-up resistor to +12 VDC.
     - I_{SNK} = 4 mA M_{AX} @ 12 VDC
     - V_{MAX} IN = 28 VDC

5. **DISPLAY COMBINATIONS:** Rate/Total or Rate/Efficiency.

6. **RATE/EFFICIENCY:**
   Accuracy: 0.01% ±1 digit
   Minimum Input Frequency: 0.01 Hz
   Programmable Update Time Range: 0.2 secs to 100.0 secs

7. **TOTALIZER:** Programmable time-base, scale factor (0.001 to 100.000) and low-end cutout. Max. response time 0.2 secs.

8. **PROGRAM DISABLE (PGM.DIS.):** Used with programmable lockout menus to limit operator entry when active. Connect PGM. DIS. (TBA #3) to common (TBA #7) to activate.

9. **E1-CON & E2-CON:** External remote inputs which allow activation of various functions. (reset total, peak indicator mode, trigger mode, etc). V_{IL} = 0.8 V_{MAX}; V_{IH} = 2.0 V_{MIN}; Response Time = 0.2 sec max.

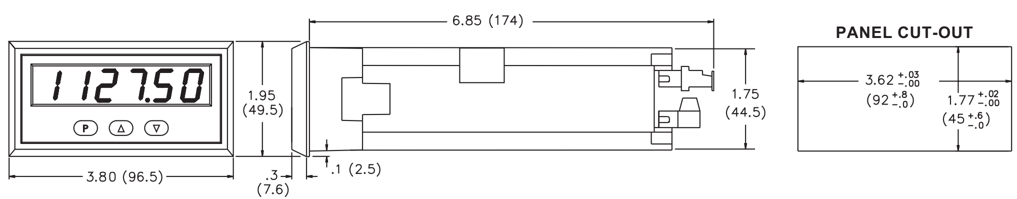
10. **ENVIRONMENTAL CONDITIONS:**
    Operating Temperature: 0 to 50°C
    Storage Temperature: -40 to 80°C
    Operating and Storage Humidity: 85% max. (non-condensing) from 0°C to 50°C.
    Altitude: Up to 2000 meters

11. **DC OUT:** 12 VDC ±25% @ 60 mA max.

12. **SERIAL COMMUNICATIONS (Optional):**
    Type: Half duplex bi-directional 20 mA current loop, 20 mA source provided on transmit loop. (Powers up to 7 units in a loop with internal current source).
    Baud Rate: programmable 300 to 9600
    Maximum Address: 99 (Actual number in a single loop is limited by serial hardware specifications).

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 5.5" (140)W x 2.1" (53.4)H.



Data Format: 10 bit frame, Odd parity (one start bit, 7 data bit, one odd parity bit, and one stop bit).

Serial Hardware Specifications:

SO - Output Transistor Rating: V_{MAX} = 30 VDC, V_{SAT} = 1 V_{MAX} at 20 mA.

Note: This will allow up to 28 units max. in each loop.

SI - Input Diode Rating: V_F = 1.25 V $_{TYP}$; 1.5 V_{MAX}

Note: The compliance voltage rating of the source must be greater than the sum of the voltage drops around the loop. (Typically a 30 VDC powered source would be capable of operating between 18 and 22 units in a loop.)

13. ALARMS (Optional):

Response Time: 0.2 sec max.

Solid State: Two, isolated, sinking open collector NPN transistors acting in parallel with relays.

V_{CE} = 1 V_{MAX} @ 100 mA max.; V_{OH} = 30 VDC max.

Relays:

Type: Form C (2)

Max. Rating: 5 Amps @ 120/240 VAC or 28 VDC (resistive load), 1/8 HP @ 120 VAC (inductive load). The operate time is 5 msec nominal and the release time is 3 msec nominal.

Relay Life Expectancy: 100,000 cycles at Max. load Rating. (As load level decreases, life expectancy increases.)

14. ANALOG OUTPUT (Optional): Digital scaling and offsetting

4 to 20 mA:

Accuracy: ± 30µA

Resolution: 12 bits

Compliance Voltage: 10 VDC *(500Ω max. loop impedance)*

0 to 10 VDC:

Accuracy: 25 mV

Resolution: 12 bits

Min. Load Resistance: 10 KΩ *(1 mA max.)*

15. LINEARIZER/PEAK/VALLEY:

9-segment multiple slope scaling for non-linear inputs. Peak and Valley recording.

16. CERTIFICATIONS AND COMPLIANCES:

SAFETY

EN 61010-1, IEC 61010-1

Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1

ELECTROMAGNETIC COMPATIBILITY

Immunity to EN 50082-2

Electrostatic discharge	EN 61000-4-2	Level 2; 4 Kv contact [1] Level 3; 8 Kv air
Electromagnetic RF fields	EN 61000-4-3	Level 3; 10 V/m [2] 80 Mhz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 Kv I/O Level 3; 2 Kv power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms 150 Khz - 80 MHz
Power frequency magnetic fields	EN 61000-4-8	Level 4; 30 A/m
Simulation of cordless telephones	ENV 50204	Level 3, 10 V/m 900 Mhz ±5 MHz 200 Hz, 50 % duty cycle

Emissions to EN 50081-2

RF interference	EN 55011	Enclosure class A Power mains class A

Notes:

1. Metal bezel of unit connected with ground lead from rear bezel screw to metal mounting panel.

2. Self-recoverable loss of performance during EMI disturbance at 10 V/m:
Analog output signal may deviate during EMI disturbance.
For operation without loss of performance:
Unit is mounted in a metal enclosure (Buckeye SM7013-0 or equivalent)
I/O and power cables are routed in metal conduit connected to earth ground.
Install power line filter, RLC#LFIL0000 or equivalent.

Refer to the EMC Installation Guidelines for additional information.

17. CONSTRUCTION:

Die-cast metal front bezel that meets NEMA 4/IP65 requirements for indoor use when properly installed. Installation Category II, Pollution Degree 2. Case body is black, high impact plastic (panel gasket and mounting clips included).

18. CONNECTION: Removable terminal blocks.

19. WEIGHT: 1.2 lbs (0.5 kg)

APPENDIX “C” - LINEARIZER PROGRAM

The following computer program, written in GWBASIC, calculates two percentage tables required to linearize any non-linear relationship

The program calculates two sets of values. One set represents percent of full scale for the input value and the other represents percent of full scale for the display value. These values are then used to compute the actual input and display scaling points.

To use the program, copy it into any computer with GWBASIC installed. The program uses, in subroutine 10000, the relationship between the measured parameter and the display reading for the non-linear relationship, such as a square law device (ie. pH, flow, etc.) can be substituted into the routine to yield the % of full scale input and the % of full scale display. The program will prompt for % of full scale error relative to display readings. Increasing the conformity error decreases the number of linear slopes required to fit the function. The IMI can accommodate up to nine linear segments and it is generally desired to use all of them to minimize linearity error.

Note: The equation at line 10011 can be substituted with any non-linear function.

```
10 CLS:PRINT “      CURVE FITTING PROGRAM”
15 PRINT “”
30 DIM PA(30)
40 DIM DA(30)
50 INPUT “  - ENTER CURVE FITTING ERROR (%) >> ”;E
60 P = 10000
63 INPUT “  - ENTER THE VALUE FOR CONSTANT K”;K
70 GOSUB 10000
75 CR=D/P
80 ER=D*E*.01
110 CLS
111 SG=SG+1
112 PRINT “      CALCULATING LINEAR SEGMENT ”;SG
115 IF P2>>=10000 THEN A=1:GOTO 1000
117 P2=P2+10<R>
130 P=P1<R>
140 GOSUB 10000<R>
150 D1=D<R>
170 P=P2<R>
180 GOSUB 10000
190 D2=D
210 M=(D2-D1)/(P2-P1)
220 B=D1-(P1*M)
240 PT=P1
245 AD=(P2-P1)/6
250 PT=PT+AD
260 P=PT
270 GOSUB 10000
280 DT=D
290 DT1=(PT*M)+B
310 IF ABS(DT1-DT)>>ER THEN 500
320 IF PT<<P2 THEN GOTO 250
330 GOTO 115
500 P2=P2+10
510 D2=(P2*M)+B
515 P=P2
520 GOSUB 10000
550 IF ABS(D-D2)<< E  THEN 500
1000 PA(SG)=P2/100
1020 DA(SG)=D2/CR/100
1200 P1=P2
1210 D1=D2
1216 IF A << >> 1 THEN GOTO 110
2000 CLS
2010 PRINT “NUMBER OF LINEAR SEGMENTS = ”;SG
2012 PRINT “CURVE FITTING ERROR (%) = ”;E
2015 PRINT “”
2016 PRINT “DISPLAY VALUES     PROCESS VALUES”
2017 PRINT “(% OF RANGE)       ”;"(%) OF RANGE"
2018 PRINT “”
2019 FOR I=0 TO SG
2020 PRINT USING “###.##”;DA(I);
2022 PRINT “              ”;
2025 PRINT USING “###.##”;PA(I)
2030 NEXT I
2040 END
10000 REM TYPICAL EQUATION FOR A SQUARE LAW DEVICE
10010 REM D=DISPLAY(Y), P=PROCESS RATE FREQUENCY(X), K=CONSTANT
10011 D=K(P^2)
10020 RETURN
```

APPENDIX "D" - TROUBLESHOOTING GUIDE

The majority of all problems with the indicator can be traced to improper connections or programming set-ups. Be sure all connections are clean and tight, check the programming setups for correct data.

For further technical assistance, contact technical support at the appropriate company numbers listed.

PROBLEM	POSSIBLE CAUSE	REMEDIES
NO DISPLAY	1. Power off, improperly wired 2. Power in brown-out condition	1a. Verify power. b. Check wiring. 2. Verify power reading.
"PPPPPP" IN DISPLAY	1. Program data error	1. Press "P" and Check data set-ups.
FLASHING DISPLAY	1. Totalizer overflow	1. Reset totalizer.
"......" IN DISPLAY	1. Rate or efficiency display out of range 2. Loss of data set-ups	1a. Check unit scaling. b. Check for electrical disturbances. 2a. Check programming data set-ups. b. Check for electrical disturbances. c. Disconnect and reconnect power.
DISPLAY WANDERS	1. Loss of data set-ups	1a. Check programming data set-ups. b. Check for electrical disturbances. c. Disconnect and reconnect power.
JITTERY DISPLAY	1. Electrical "Noise" in signal lines 2. Process inherently unstable	1a. Increase Low Update time. b. Increase digital filtering. c. Increase display rounding value. d. Re-route signal wires. 2. Dampen process to eliminate oscillations.

APPENDIX "E" - PROGRAMMABLE FUNCTIONS

Programming of the indicator is divided into modular steps. Each module is a short sequence of data entries. The front panel "UP" and "DOWN" buttons (shown as "arrows" on the front panel) are used to change the data and set-ups, while the "P" button is used to save or enter the data. After pressing "P", the user gains entry into the programming mode. The programming modules are identified by the message "Pro" and a module number in the display. "UP" and "DOWN" are used to select the desired programming module and "P" is used to enter it. All of the subsequent programming steps follow the same procedure. The rear terminal labeled "PGM.DIS." must be inactive (ungrounded) to gain access to programming. The following table lists the programming steps.

"Pro 0" - RETURN TO MEASUREMENT MODE

"Pro 1" - SCALE UNIT BY APPLYING SIGNAL

"dECPNt" – Enter decimal point for scaled input display
"round" – Enter rounding factor and trailing zeros for scaled input display
"Lo-udt" – Enter low update time for rate display updates
"Hi-udt" – Enter high update time for rate display updates
"SCALE" – ✧
"dSP 1" – Enter display reading for scaling point #1
"rAtE 1" – Apply rate value for scaling point #1
"SEGt" – ✧

"Pro 2" - SCALE UNIT BY KEY-IN SIGNAL LEVEL

"dECPNt" – Enter decimal point for scaled input display
"round" – Enter rounding factor and trailing zeros for scaled display
"Lo-udt" – Enter low update time for rate display updates
"Hi-udt" – Enter high update time for rate display updates
"SCALE" – ✧
"dSP 1" – Enter display reading for scaling point #1
"rAtE 1" – Enter rate value for scaling point #1
"SEGt" – ✧

✧ - *Entire sequence for this modular step is not shown (see manual for further details).*
✳ - *This sequence may be locked-out due to other programmed sequences.*

"Pro 3" - PROGRAM FUNCTIONS ACCESSIBLE WITH FRONT PANEL LOCKOUT ENGAGED

"dSP AL" – Enable display alarms
"ENt AL" – Enable enter alarms ✳
"dSPHYS" – Enable display hysteresis
"ENtHYS" – Enable enter hysteresis ✳
"rSt AL" – Enable reset latched alarms
"dSPbUF" – Enable display of peak/valley readings
"rStbUF" – Enable reset of peak/valley readings ✳
"SELdSP" – Enable switching display between input and total/efficiency
"rSttOt" – Enable reset total ✳

"Pro 4" - PROGRAM DIGITAL FILTERING AND REMOTE INPUT FUNCTION

"FILtEr" – Enter level of digital filtering
0 – no digital filtering
1 – normal filtering
2 – increased filtering
3 – maximum filtering
"E1-CON" – Enter function of remote input
0 – Re-start measurement period for input
1 – Reset total
2 – Reset and gate totalizer
3 – Gate totalizer
4 – Display hold
5 – Reset peak/valley
6 – Reset peak and start peak indicator
7 – Reset valley and start valley indicator
8 – Reset latched alarms
9 – Reset all alarms
10 – Toggle display between input rate and total or efficiency
11 – Input rate functions as a triggered rate meter
12 – print request
"E2-CON" – Same programmable functions as E1-CON

APPENDIX "E" - PROGRAMMABLE FUNCTIONS (Cont'd)

"Pro 5" - PROGRAM SECONDARY DISPLAY AS TOTALIZER OR EFFICIENCY

"dISP" – Select desired display (Total or Efficiency)

TOTALIZER

"dECPNt" – Enter decimal point for totalizer ✳
"tbASE" – Enter time base
- 0 – Divide by 1 (second)
- 1 – Divide by 60 (minute)
- 2 – Divide by 3600 (hour)

"SCLFAC" – Enter multiplying scale factor ✳
"Lo-cut" – Enter low-signal cut out ✳

EFFICIENCY

"ASNbUF" – Assign peak/valley buffers ✳
"dECPNt" – Enter decimal point for efficiency ✳
"100 Pct" – Enter value for desired 100 percent target value ✳

"Pro 6" - PROGRAM ALARMS

"trAc" – Enable alarm value tracking
"dISP" – Enable display alarm annunciators
"LAtC-1" – Enable alarm #1 latching
"ASN-1" – Enter alarm #1 trigger source (input or total/eff.)
"AL-1" – Enter alarm #1 value
"HyS-1" – Enter hysteresis value for alarm #1
"Act-1" – Enter alarm #1 action (high or low)
"ONdEL1" – Enable delay ON action for alarm #1
"OFdEL1" – Enable delay OFF action for alarm #1 (disabled if delay ON is selected) ✳
"dELAy1" – Enter delay time value
"LAtC-2" – Enable alarm #2 latching
"ASN-2" – Enter alarm #2 trigger source (input or total/eff.)
"AL-2" – Enter alarm #2 value
"HyS-2" – Enter hysteresis value for alarm #2
"Act-2" – Enter alarm #2 action (high or low)
"ONdEL2" – Enable delay ON action for alarm #2
"OFdEL2" – Enable delay OFF action for alarm #2 (disabled if delay ON is selected) ✳
"dELAy2" – Enter delay time value ✳

"Pro 7" - PROGRAM SERIAL COMMUNICATIONS

"bAud" – Enter baud rate
"AddrES" – Enter loop address number (0-99)
"Print" – Enter print function
- 0 – rate
- 1 – rate, peak, valley
- 2 – rate, alarm 1, alarm 2
- 3 – rate, alarm 1, alarm 2, hysteresis 1, hysteresis 2, peak, valley
- 4 – totalizer/efficiency
- 5 – rate, totalizer/efficiency
- 6 – rate, totalizer/efficiency, peak, valley
- 7 – totalizer/efficiency, alarm 1, alarm 2
- 8 – rate, totalizer/efficiency, alarm 1, alarm 2
- 9 – rate, totalizer/efficiency, alarm 1, alarm 2, hysteresis 1, hysteresis 2, peak, valley

"FULL" – Enable/Disable abbreviated printing

"Pro 8" - PROGRAM RE-TRANSMITTED ANALOG OUTPUT

"ASIN" – Select source of analog output (rate or total/eff.)
"AN-Lo" – Enter 4 mA or 0 VDC display value
"AN-HI" – Enter 20 mA or 10 VDC display value

"Pro 9" - FACTORY SERVICE OPERATIONS (Protected by access code)

"Code 39" – Serial hardware (loop-back) test
"Code 52" – Display, alarm, and analog test
"Code 66" – Reset parameters to factory configuration

✳ - *This sequence may be locked-out due to other programmed sequences.*

APPENDIX "F" - SCALING FOR RATE INDICATION

Due to the way the rate is calculated (Refer to Rate Operation section), high resolution and accuracy can be obtained at all input rates, slow or fast.

Note: It is not necessary to increase the pulse information to obtain higher resolution.

The Rate Low Update Time can be programmed from 0.2 up to 100.0 seconds to provide averaging in applications where the input pulse spacing is not stable. The Update Time selected, however, will not affect the scaling in any manner.

Scaling the Rate Channel involves programming the IMI so that input pulses to the unit will be scaled to the desired display units (revolutions, feet, meters, etc.) and in the desired time format (Rate Per Second, Rate per Minute, Rate Per Hour).

Note: Input frequency can be read directly if scaling is equal to "1".

If the rate application is to display a specific Display Unit, then to scale the rate display it is only necessary to know the number of pulses per desired display unit/s (feet, revolutions, etc.). Use the following formula to calculate the rate scaling point:

rAtE 1 (Hz) = dSP1 x (pulses per unit ÷ time)

Where:

rAtE 1 = Rate input frequency (Pulses Per Second)
dSP1 = Desired display in units per hour, minute, or seconds.
time = 1 if dSP1 is to display units per second.
60 if dSP1 is to display units per minute.
3600 if dSP1 is to display units per hour.

Example: Display is to indicate 1500 revolutions per minute (RPM). Input pulses are 39.45 pulses per revolution (PPR).

rAtE 1 (Hz) = 1500 RPM x (39.45 PPR ÷ 60)
rAtE 1 (Hz) = 986.25

Since the rAtE 1 value can only be programmed in tenths, the rAtE 1 value is re-calculated by increasing the dSP1 value by a factor of ten. The dSP1 value is continually increased until one following is reached:

1. The rAtE 1 value's least significant digit is no smaller than a tenth.
2. The dSP1 value exceeds 999999.
3. The rAtE 1 value exceeds 50000 Hz.

Note: For two and three, use the value that was calculated prior to exceeding that value.

rAtE 1 (Hz) = 15000 RPM x (39.45 PPR ÷ 60)
rAtE 1 (Hz) = 9862.5

15000 is entered for dSP 1
9862.5 is entered for rAtE 1

APPENDIX "G" - ORDERING INFORMATION

MODEL NO.	DESCRIPTION	OPTIONS			PART NUMBERS
		DUAL ALARMS	SERIAL COMMUNICATIONS	ANALOG OUTPUT	115/230 VAC
IMI	Intelligent Digital Rate Meter	No	No	No	IMI04160
		No	Yes	No	IMI04161
		Yes	No	No	IMI04162
		No	No	4 to 20 mA	IMI04163
		Yes	Yes	4 to 20 mA	IMI04167
		Yes	Yes	0 to 10 VDC	IMI04169
For information on Pricing, Enclosures, & Panel Mount Kits refer to the RLC catalog or contact your local RLC distributor.					

LIMITED WARRANTY

The Company warrants the products it manufactures against defects in materials and workmanship for a period limited to two years from the date of shipment, provided the products have been stored, handled, installed, and used under proper conditions. The Company's liability under this limited warranty shall extend only to the repair or replacement of a defective product, at The Company's option. The Company disclaims all liability for any affirmation, promise or representation with respect to the products.

The customer agrees to hold Red Lion Controls harmless from, defend, and indemnify RLC against damages, claims, and expenses arising out of subsequent sales of RLC products or products containing components manufactured by RLC and based upon personal injuries, deaths, property damage, lost profits, and other matters which Buyer, its employees, or sub-contractors are or may be to any extent liable, including without limitation penalties imposed by the Consumer Product Safety Act (P.L. 92-573) and liability imposed upon any person pursuant to the Magnuson-Moss Warranty Act (P.L. 93-637), as now in effect or as amended hereafter.

No warranties expressed or implied are created with respect to The Company's products except those expressly contained herein. The Customer acknowledges the disclaimers and limitations contained and relies on no other warranties or affirmations.

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