THE LEGEND PLUS MULTI-PRESET

MODEL LGPM INSTRUCTION MANUAL

INTRODUCTION

The Legend Plus Multi-Preset Unit (LGPM) is another unit in our multi-purpose series of industrial control products that are 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 indication and control requirements.

The Legend Plus, 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 servicing 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.

Table of Contents

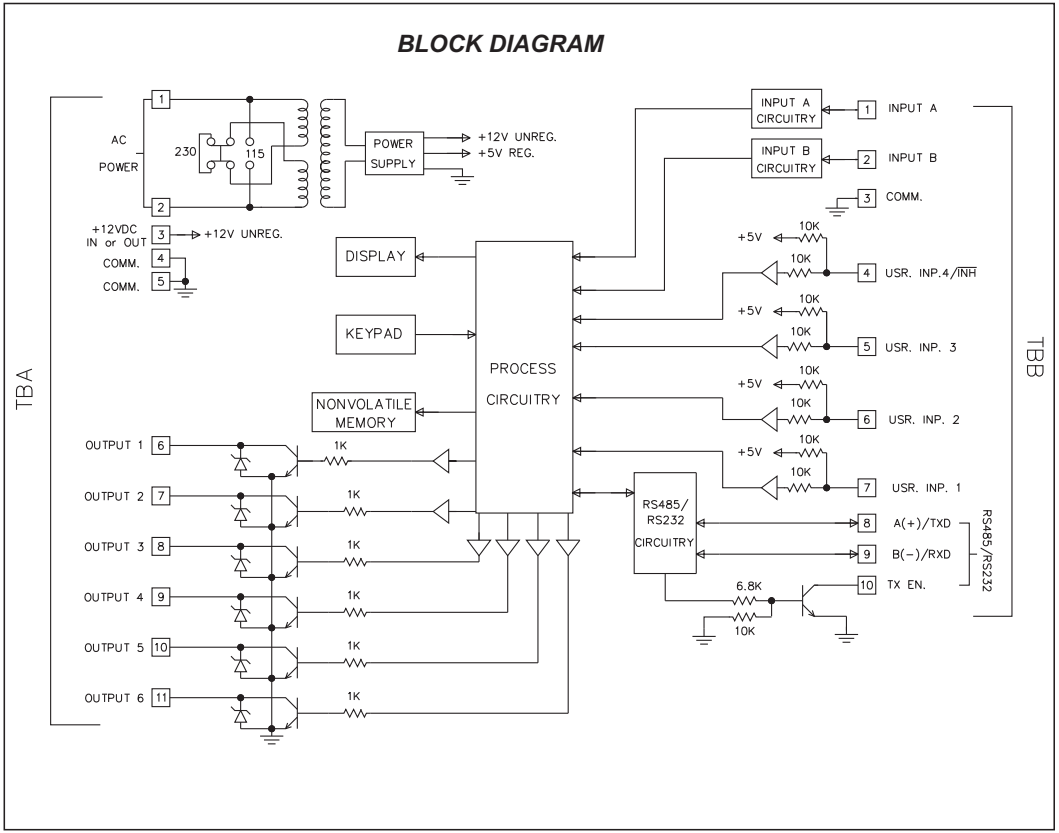
GENERAL DESCRIPTION

The Legend Plus Multi-Preset Counter (LGPM) is a multi-input, counting panel instrument that offers the features and performance of a multi-level preset counter and time interval rate indicator. The LGPM features six presets, which can be assigned to either the rate or count indicator.

The Legend Plus has advanced features that allow the unit to be more closely coupled to the application. The unit features a 2 line by 8 character alphanumeric display, allowing the value mnemonics and programming menus to be easily read. The unit is available in single or dual color display models. The four scroll-through indication displays can be programmed to show various parameters and to automatically scroll. On dual color models, each indication display can be programmed for either color. The mnemonics corresponding to the main display values (RATE, PEAK, VALLEY, COUNT), can be individually programmed and modified as desired. For example, the RATE mnemonic can be reprogrammed to display the word SPEED, so that when the rate mnemonic is to be displayed, the mnemonic SPEED is displayed instead.

Two custom display lines allow the user to specify the number of digits of a value to be displayed on a line, along with any alphanumeric prefix or suffix.

BLOCK DIAGRAM



GENERAL DESCRIPTION (Cont'd)

This capability allows displays such as; '1000 RPM', '99999 Ft', 'PRC 9999', etc.

The Legend Plus also features messaging capabilities that can inform the user of output actions or other events that occur in a system. Up to ten messages can be programmed. Messages can be requested by an output status change, User Input(s), or through serial communications. The messages can be programmed for block or character scroll, to blink, time out, and to alternately flash between message and indication display. On dual color models the message can be programmed to be displayed in either color. This capability is very useful in drawing the operator's attention to particular messages.

The program disable DIP switch, a code value, and an external User Input selected for Program Disable can be utilized to provide multi-level protection against unwanted changes to data values and unit configuration.

The Legend Plus features enhanced serial communications. The Serial port can be configured for connection to RS485 or RS232 devices. It can be used for data retrieval and for programming various data values.

Optional Legend Plus Programming software (SFLGP) for IBM® compatible PCs is available to program all the Legend Configuration parameters, such as, messages, count modes, etc. The software allows unit configurations to be created, uploaded, down-loaded, and saved to a file for rapid programming of the Legend unit.

The six Programmable User Inputs can be configured to provide a variety of functions. Four User Inputs are located on the upper rear terminal block. The other two inputs are front panel function keys.

The User Inputs can be configured to provide functions such as:

Count Inhibit	Reset
Message Request	Counter Load
Message Cancellation	Output Activation
View/Freeze Display	Output Deactivation
Change Display	Skip Presets (outputs)
Program Disable	Print Request

The LGPM offers a choice of seven programmable counting modes for use in applications requiring bidirectional, Anti-coincidence, and Quadrature counting. The count inhibit function can be utilized with all of these input response modes by programming User Input 4 for the Inhibit Count function.

Input A accepts a signal for the Count and Rate displays. Input B accepts a signal for the Count display or direction control. In the Anti-coincidence mode, both inputs are monitored simultaneously, so that no counts are missed, and the final count can be chosen as the sum or difference of the two inputs.

Rate and Count displays have separate scaling and decimal point placement, for readouts in different units. The Counter Load feature enables the operator to modify the count value. This is useful when flawed material has been counted and it is necessary to adjust the count value accordingly.

The rate operates in the time interval method (1/tau) to calculate the rate value. This method insures high resolution at all input rates. Averaging can be accomplished by programming the Minimum and Maximum Update Time for the desired response. Extensive scaling capabilities allow practically any reading at very slow input rates.

The construction of the LGPM unit is a lightweight, high impact plastic case with a clear viewing window. The sealed front panel with the silicone rubber keypad meets NEMA 4X/IP65 specifications for wash-down and/or dusty environments, when properly installed. Plug-in style terminal blocks simplify installation and wiring changes.

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.

BASIC OPERATION

The unit contains a counter that keeps track of the input pulse count. The unit takes the actual number of pulses counted (internal count value) and multiplies them by the Count Scale Factor and Count Scale Multiplier. This results in the desired reading value for the Count display.

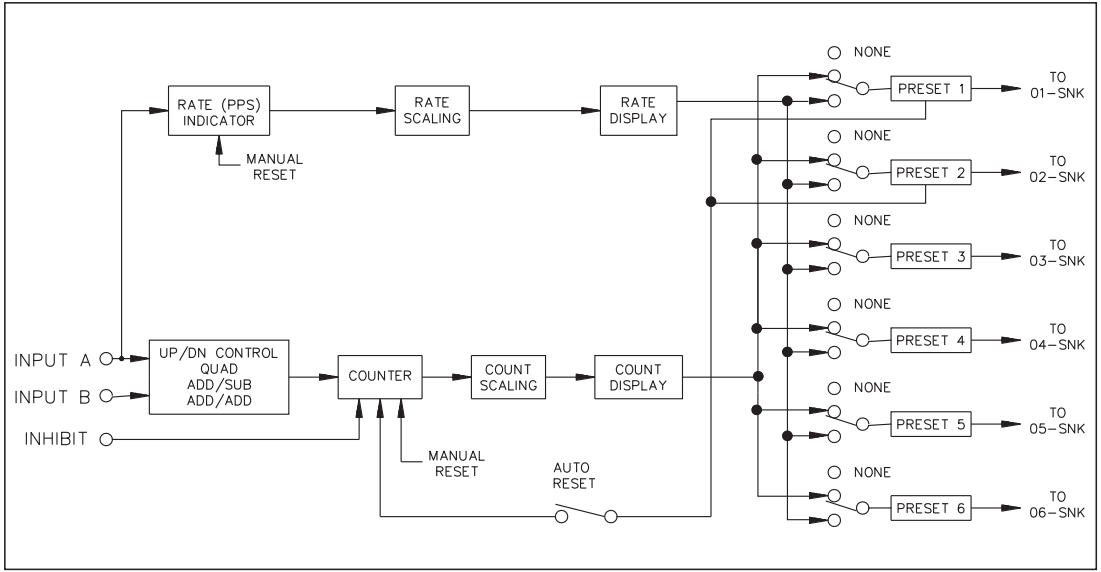
The Counter has three Reset Action modes associated with the display; Reset to Zero (up-count modes), Reset to Preset (down-count modes), or Reset to the Counter Load value. A Reset can be a manual reset, using a programmable User Input, or it can be one of the seven programmable Automatic Reset modes. Both the reset action and automatic reset modes are programmed in the Program Counter Module.

The Counter displays the scaled number of pulses that have been entered. When the count equals a Preset, the appropriate output will activate. The count can be programmed to automatically reset.

During operation of the Legend Plus, after internal scaling is complete, any digits remaining to the right of the least significant digit (LSD) of the display is examined by the unit. If this digit is equal to or greater than 0.5, the LSD of the display is rounded to the next higher digit. Any number less than 0.5 is ignored. During Reset to Preset modes of operation, any remainder greater than 0.5 will cause the display to be rounded up. Due to this rounding action, the output activation may appear to be delayed. In actuality the display may have rounded up or down, but the internal count had not yet reached the preset value or zero.

The signal at Input A is used for the Rate indicator. The rate indicator uses a time interval method (1/tau) to calculate the rate value. The unit counts on the negative edge of the input pulses. After the programmed minimum update time elapses and the next negative edge occurs, the unit saves the number of edges that occurred during the elapsed time. The number of edges is multiplied by the Rate Scale Factor, Rate Scale Multiplier, and the Rate Conversion Factor to calculate the rate value. Averaging can be accomplished by programming the Rate Minimum Update Time for the desired response. Extensive scaling capabilities allow practically any desired reading at very slow count rates.

The following is a Block Diagram overview of the basic operation.



MESSAGES

The Legend Plus features messaging capabilities that can inform the user of output actions or other events that occur in a system. Up to ten messages can be programmed. Messages can be requested by an output status change, User Input(s), or through serial communications.

When a message is requested, the unit checks if there is a message already on the display. If there are no messages on the display, the requested message is displayed. A message on the display is replaced if, the requested message has the same or higher priority. If the unit is not at the main display, the unit stores one message request. If subsequent messages are requested while not at the main display, the unit stores the last message requested, or the highest priority message request. The stored message is redisplayed 2.5 seconds after the user returns to the main display.

If a message is displayed and the user presses the appropriate key to get to the Preset, Scaling or Programming menu display, the displayed message is temporarily suspended. While the message is suspended the message timer, if used, is also halted. The message is redisplayed 2.5 seconds after the user returns to the main displays and the message timer resumes. If the Up or Down arrow key is pressed while in the main display loop, the message is also suspended, and the appropriate programmed display is shown. The message is redisplayed 2.5 seconds after the last key press.

USER INPUT MESSAGE REQUEST OPERATION

Individual User Inputs can be programmed to activate any of the ten messages. The messages can be maintained or momentary. Messages can be assigned a priority from 1 to 8 (1 is highest). This assures that very important messages are displayed first.

BINARY MESSAGE REQUEST OPERATION

Two, three or all four of the User Inputs can be configured to request messages in a binary fashion. Messages 1 through 9 can be requested in this manner. The binary state 0 (all binary inputs inactive) , is used to indicate no message requested. During the scanning of the binary message request inputs, if the Input state is the same as the last requested binary message no change will occur. When an input change occurs, the unit requests the message number corresponding to the state of the inputs. The inputs must be stable for 100 msec (debounce time) for the message to be requested (See Program User Module for more details). Changing the individual binary message request input lines slowly will cause unwanted message requests, if several bits need to be changed. This would be noticeable on the display, if a user were to utilize a thumbwheel switch to change messages.

OUTPUT MESSAGE REQUEST

Each output can be individually programmed to request a specific message when activated. The appropriate message will be requested regardless of the method used to activate the output, i.e. User Input, Count/preset processing, serial command, etc.

Note: The Output must be active for a minimum of 50 msec. for the request to be seen.

MESSAGE CANCELLATION

Messages can be cancelled automatically, or manually. When cancelled, messages programmed for maintained request, will be re-requested if the display is available and the request source is still active. A request for a message of the same or higher priority will cancel the current message on the display. Messages can also be cancelled by a User Input programmed for Cancel Message or via the serial port. The three programmable cancellation options are Latched, Timed, and Til End. (See Program User Message Cancellation for details).

OVERFLOW INDICATION

The unit flashes the word "OVERFLOW" (or assigned mnemonic) in the appropriate display when an overflow condition occurs. An overflow occurs if the capacity of the display (6-digits) is exceeded or if the internal count capacity (9-digits) is exceeded. The use of an extremely small Scale Multiplier and Scale Factor value can cause the internal count capacity to overflow before the displayed value overflows.

For example, if a Scale Factor of 0.0001 and a Scale Multiplier of 0.001 is used, for every 10,000,000 count edges received, the display increments by 1. Before the display reaches 215, the internal counter overflows. When the capacity of the display is exceeded, the count value is maintained and is valid. If the internal count capacity is exceeded, the count value is no longer valid.

Use of a Scale Factor larger than "1" can cause the count display to overflow before 999,999 internal counts are accumulated. The use of a Rate Scale Factor, Scale Multiplier, and Rate Conversion Factor larger than "1" can cause the rate display to be in an overflow condition.

The counters should not be allowed to operate in an overflow condition. As soon as, or before the counters overflow, the information should be recorded and the counters reset.

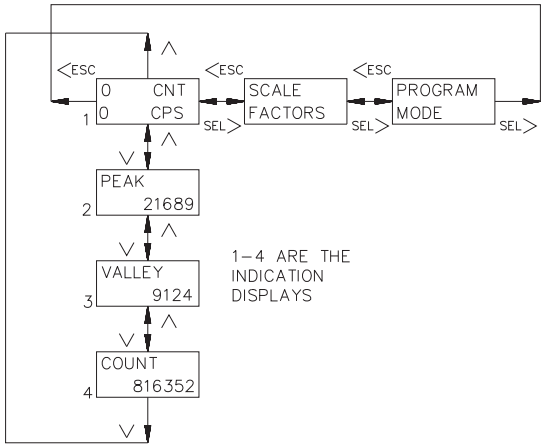
PEAK & VALLEY

The Peak and Valley registers record the lowest (Valley) and the highest (Peak) readings of the rate input signal. These values are viewed in the indication display loop and are updated automatically. A User Input can be programmed to reset the values to the current rate value individually or by sending the proper command via the serial communication port. The Peak and Valley values are NOT retained when power to the unit is removed.

NORMAL OPERATING MODE

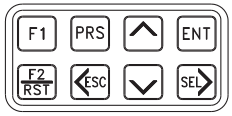
In the normal operating mode, the up, down, left, and right arrow keys are used to scroll through the main display loop. In the main display loop, the four indication displays, scale factors, and program mode modules are viewed, as shown below. In the indication display loop, the up and down arrow keys are used to scroll to each display. The indication displays are referenced as 1 (0 CNT/0 CPS), 2 (PEAK), 3 (VALLEY), and 4 (COUNT), which are the factory default settings. The indication displays can be programmed to show other parameters and automatically scroll (See Program Displays Module). The last indication display that was viewed at power down, is the one viewed on power up.

The Presets and Counter Load values are accessed from any of the indication displays or from the programming loop. The Count and Rate scale factors are accessed from the Scale Factors display or when in the programming loop from the Program Scaling module. In the Program Mode display, the operator enters the programming loop to access all parameters to configure the unit. Shown below is the Main Display Loop.



KEYPAD DESCRIPTION

The keypad has a key array of two rows by four columns. Some keys have a dual function. For a description of key functions during text and mnemonics editing, see Text Editing in the Program Message Module. The following is a description of each key and its function during programming and normal operation:



KEYPAD FUNCTIONS

F1 - Function key F1 is a User Programmable Input. When the key is pressed, the unit performs the appropriate function as programmed in the "Program User Module".

F2/RST - Function key F2/RST is a User Programmable Input. When the key is pressed, the unit performs the appropriate function, as programmed in the "Program User Module". The "RST" printing on this key is used as a quick reference for the operator if the function key is selected for a reset function.

PRS - The PRS key accesses the Preset and Counter Load Module provided these values are not programmed for 'loc'k. If all values are 'loc'ked, pressing the PRS key does nothing. Preset values that are accessible (changeable), can be changed immediately. Pressing the SEL> key is no longer necessary to edit preset values. Within the preset menu, pressing this key saves the value and advances the display to the next available preset. Pressing the PRS key at the end of the module exits the module and returns the user to the main display loop.

<ESC - The Left arrow/escape key scrolls to the left in the main display loop. When programming a numerical value, it selects the digit to the left. In a sub-menu, it exits to the next higher level menu in the loop. It is also used to exit the programming loop. When exiting the programming loop, the unit stores all parameters in non-volatile memory and returns to the last viewed indication display.

KEYPAD FUNCTIONS (Cont'd)

^ - The Up arrow key scrolls through the indication displays. In the programming loop, this key can be used to scroll through the main menus. When programming a numerical value, it increments (decrements, i.e., goes more positive, for negative values) at the selected digit position. If the key is pushed and held, the value will scroll (count up) automatically. After 5 counts, the unit enters fast scroll mode. If the key remains pushed, a digit shift occurs every one hundred counts until the maximum value or zero (for negative presets) is reached. When the digit shift occurs, the previously scrolling digit goes to zero. When zero is reached (for negative values), the display holds at zero. To go positive, the key must be released and pushed again.

V - The Down arrow key scrolls through the indication displays. In the programming loop, it scrolls through the main menus and sub menus. When programming a numerical value, it decrements (increments or goes more negative, for negative values) at the selected digit position. If the key is pushed and held, the value will auto scroll (count down automatically). After 5 counts, the unit enters fast scroll mode. If the key remains pushed, a digit shift occurs every one hundred counts until zero is reached. When the digit shift occurs, the previously scrolling digit goes to zero. When zero is reached, the display holds at zero. To go negative, the key must be released and pushed again.

ENT - The Enter key enters the programming loop, when "Program Mode" is displayed from the main display loop. When "Scale Factors" is displayed, pressing Enter allows access to the scale factors. This key is also used to save changes to data values. If the data value is a preset or counter load value, the value is entered and the preset menu is exited. For all other numeric data values (i.e., Output time, Rate update times, etc.), the value is entered and the value edit mode is exited. The value is still viewed in the display, but with no digits flashing.

SEL> - The Select/Right arrow key scrolls right in the main display loop. When programming a numerical value, it selects the digit to the right. In a sub-menu loop, it is used to go to the next lower level and eventually into an edit menu.

PROGRAM CODE NUMBER (PRO.CODE)

In two of the Program Disable states, it is necessary to enter the PRO.CODE number before gaining access to the programming menus. The default value for the code is "00", but should be programmed differently. This helps prevent inadvertent entry into the unit programming menus (See Program Options Module). The PRO.CODE prompt is viewed when PROGRAM MODE is displayed and the enter key is pressed. At this time, the Code Number must be entered using the arrow keys. If the wrong code number is entered, the operator will NOT be able to enter the programming loop and the unit returns to the main display loop.

FRONT PANEL ACCESSIBLE FUNCTIONS WITH PROGRAM DISABLE

The Legend Plus has several ways to limit the programming of parameters from the front panel keypad. The Operator Access section of the Program Options Module is used with the Program Disable (PGM.DIS.) DIP switch and a User Input selected for PGM.DIS to limit programming. To enter the programming loop, a code number may need to be entered, depending on the Program Disable setting. Only an external User Input can be selected for Program Disable. The following list describes the possible program disabling settings.

PGM.DIS. SWITCH	USER INPUT TERMINAL	PROGRAM CODE NUMBER	ACTION
OFF	INACTIVE or Not Programmed for PGM.DIS	ALL	All programming enabled.
OFF	ACTIVE	0 to 98	Operator Accessible Functions Enabled, Programming Loop Accessible via code number.
OFF	ACTIVE	99	Operator Accessible Functions Enabled, Programming Loop Disabled.
ON	INACTIVE or Not Programmed for PGM.DIS	0 to 98	Operator Accessible Functions Enabled, Programming Loop Accessible via Code number.
ON	INACTIVE or Not Programmed for PGM.DIS	99	Operator Accessible Functions Enabled, Programming Loop Disabled.
ON	ACTIVE	ALL	Operator Accessible Functions Disabled, Programming Loop Disabled.

Note: If the User Input, set for PGM.DIS., is changed to another function, make sure the User Input is not low (active). If the input is low when the function is changed, the program disable function will remain active.

PROGRAMMING GENERAL DESCRIPTION

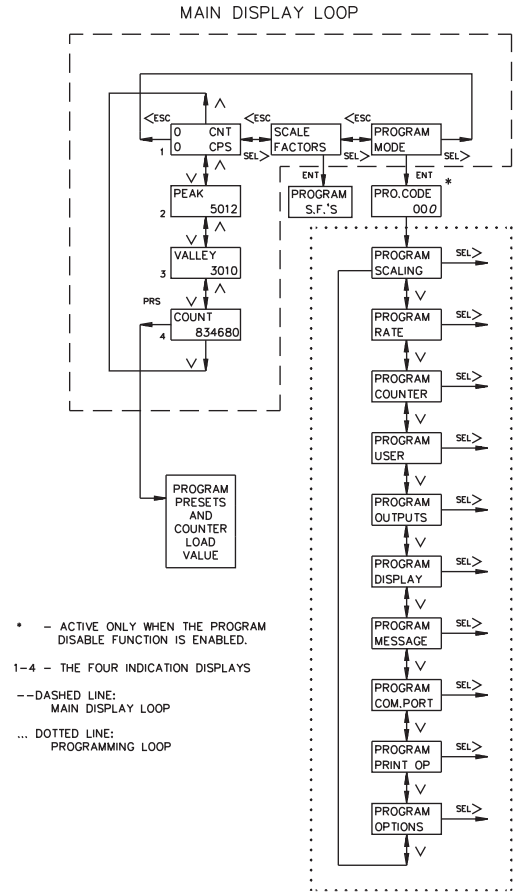
Programming of the Legend Plus is done through the front panel keypad, which allows the user to enter into Main Menus, Sub-Menus, and Edit Menus. English language prompts, flashing parameter values, and the front panel keypad aid the operator during programming.

Although the unit has been programmed at the factory, the parameters generally have to be changed to suit the desired application. The Main Menus are entered by pressing the enter (ENT) key when Program Mode is displayed. From Main Menus, the user can enter a Sub-Menu where parameter values can be viewed. From the Sub-Menu, the operator can advance into an Edit Menu, where a parameter value is changed and entered. There are three types of Edit Menus:

1. A Choice Edit Menu allows the operator to scroll through options by repeatedly pressing the down arrow key until the desired option is viewed. The option is selected by pressing the ENT (enter) key, which returns the operator to the previous sub-menu. The operator can exit the Edit Menu WITHOUT making a selection by pressing the <ESC key, which returns the operator to the previous sub-menu.
2. In a Numerical Value Edit Menu, the operator uses the left or right arrow key to select a digit. The up and down arrow keys change the digit's value. The PRS key toggles the left-most digit between a minus (-) and a zero for plus (+), for that numeric value. When the appropriate numerical value is selected, it is entered by pressing the ENT key, which returns the operator to the previous sub-menu.
3. A Text Edit Menu is where messages are programmed, and changes are made to mnemonics and custom display lines. The up and down arrow keys are used to scroll through characters. The function keys are used with the up and down arrow keys to toggle between upper and lower case letters and to toggle between standard and extended character sets. A complete listing of key functions in a Text Edit menu can be found in the Program Message Module.

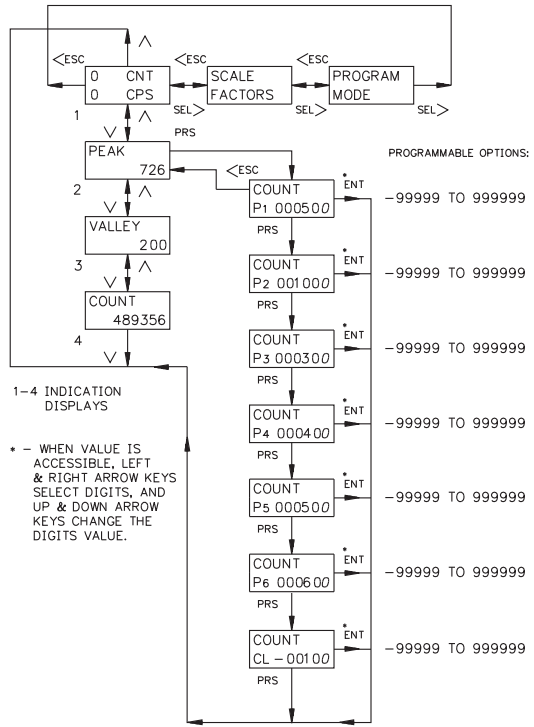
All parameter values changed in the Programming Loop are saved when exiting the loop. The operator can exit the programming loop from any of the main menus by pressing the <ESC key. When the <ESC key is pressed, the display momentarily shows "Please Wait...", while the parameter values are saved in non-volatile memory. The unit returns to the indication display that was last viewed. Shown are the Main Display Loop and the Main Programming menus of the Multi- Preset Legend Plus (LGPM) unit.

All following flow charts have slanted characters to show parameters that are flashing in the unit's display and have programmable options.



PROGRAM PRESETS & COUNTER LOAD MODULE

The Preset and Counter Load values are accessed from any of the indication displays, or from any of the main menus in the programming loop, by pressing the PRS key. The top line indicates which display the preset is assigned to. The bottom line indicates which preset is viewed and the programmed value. The following flowchart shows only the Preset and Counter Load portion:



PRESET VALUES

Preset values P1 through P6 can activate solid state outputs 01-SNK through 06-SNK respectively, when the assigned display equals the preset value. Presets P1 to P6 can be assigned to the count or rate displays. The output action (timed, latched, or boundary) is programmed in the Program Outputs Module. The preset values may range from -99,999 to 999,999.

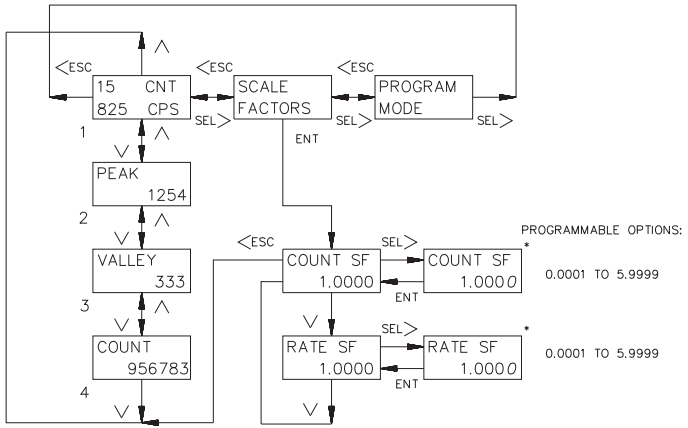
The Count Scale Factor, has a direct effect on the preset value entered, when the output (preset) is assigned to a counter display. For a Scale Factor Value greater than "1", the preset value should be a whole number multiple of the Scale Factor value. If it is not, the unit automatically adjusts the preset value up or down to force it to be evenly divisible by the Scale Factor.

COUNTER LOAD VALUE

The Counter Load (CL) value allows the user to start the count value from a value other than zero or a preset. The reset mode is set in the Program Counter Module. The Counter Load value can be programmed from -99,999 to 999,999.

PROGRAM SCALE FACTORS MODULE

The Scale Factors are accessed from the Scale Factors Module in the main display loop or from the Scaling Module in the programming loop. Since the Scale Factors may need to be changed periodically, this module allows the operator to change a Scale Factor value WITHOUT entering the programming loop. The following flowchart shows only the Scale Factor portion:



* – LEFT & RIGHT ARROW KEYS TO SELECT DIGIT, UP & DOWN KEYS TO CHANGE THE DIGITS VALUE.

1–4 INDICATION DISPLAYS

COUNT SCALE FACTOR

The number of pulses counted (internal count value) is multiplied by the Count Scale Factor value and the Scale Multiplier to obtain the desired Count display value. A Count Scale Factor Value of 1.0000 and a Scale Multiplier of "1" results in the display of the actual number of input pulses that were counted. The Count Scale Factor value is used for converting the number of pulses counted to the required units of measure for the display. This includes conversion from different units of measure (i.e feet to meters, etc.). The Count Scale Factor Value can range from 0.0001 to 5.9999. It is important to note that the precision of a counter application cannot be improved by using a Scale Factor greater than "1". To accomplish greater precision, more pulse information must be generated per measuring unit. For details, refer to Scaling for Count Indication in the Appendix.

RATE SCALE FACTOR

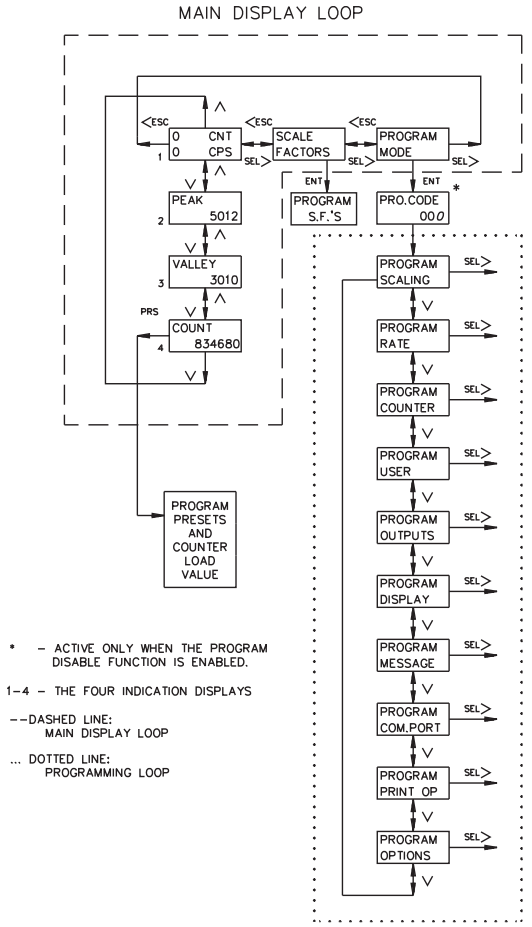
The internal rate value (pulses per second) is multiplied by the Rate Scale Factor, Rate Scale Multiplier, and Rate Conversion Factor values, to obtain the desired rate display value. The Rate Scale Factor value is used for converting the internal rate to the required units of measure for the display. This includes conversion from different units of measure (i.e feet to meters, etc.). The Rate Scale Factor Values range from 0.0001 to 5.9999. Due to the way the rate is calculated, high resolution and accuracy are achieved at all input rates. For details, refer to Scaling for Rate Indication in the Appendix.

PROGRAMMING MENUS

The programming menus are accessed when "Program Mode" is displayed in the main display loop. All parameter values can be accessed from the Main Programming Menus. Accessibility to the programming menus depends on the Program Disable Function setting (See Front Panel Accessible Functions with Program Disable) and could require a Program Code number to enter the programming menus.

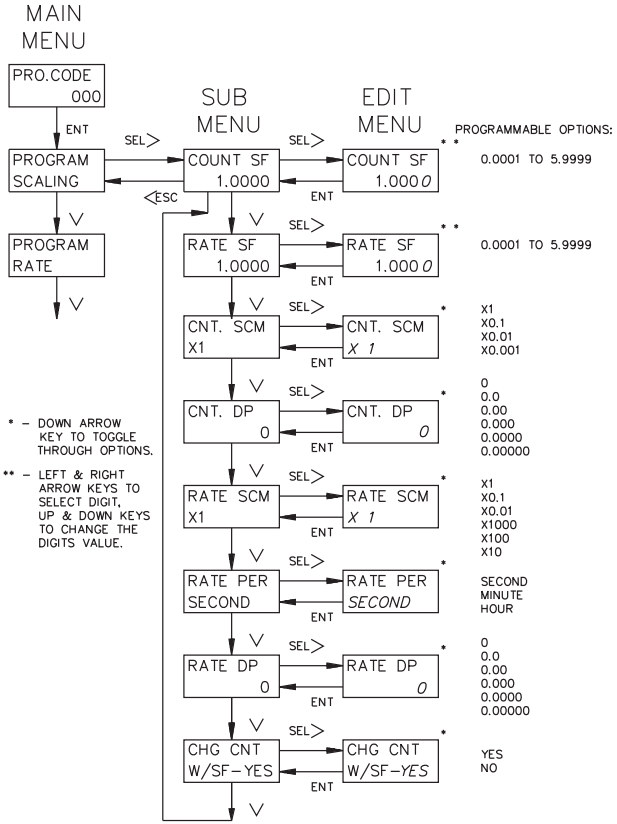
In the programming menus, pressing the up or down arrow key scrolls through the main menus. From the Main Menu, a sub-menu is accessed by pressing the SEL> key. In a sub-menu, the operator can view the parameter values that are currently selected. To change a parameter value, the edit menu is accessed by pressing the SEL> key (See Programming General Description section).

The Preset and Counter Load module can be accessed from any Main Programming Menu by pressing the PRS key. When exiting the preset and counter load module, the unit returns to the last main menu that was viewed. When all parameter changes have been made, the operator can exit the programming loop, from any main menu, by pressing the <ESC key. Exiting saves all parameter values and returns the unit to the last indication display that was viewed. Shown are all of the main programming menus:



PROGRAM SCALING MODULE

In the scaling module, the Count and Rate Scale Factors, scale multipliers, rate conversion factor, and decimal points are accessed. The following flowchart shows only the Scaling portion:



COUNT SCALE FACTOR (COUNT SF)

The Count Scale Factor Value can range from 0.0001 to 5.9999. See PROGRAM SCALE FACTORS MODULE for detailed description.

RATE SCALE FACTOR (RATE SF)

The Rate Scale Factor Value can range from 0.0001 to 5.9999. See PROGRAM SCALE FACTORS MODULE for detailed description.

Note: Since the Count and Rate Scale Factors may need to be changed periodically, they can also be accessed from the Scale Factors Module in the main display loop.

COUNT SCALE MULTIPLIER (CNT.SCM)

There are four Count Scale Multipliers available; X 1, X 0.1, X 0.01, or X 0.001 that change the count display value accordingly. The number of pulses counted (internal count value) is multiplied by the scale multiplier and the scale factor values to obtain the desired Count display.

Note: Use of a small scale multiplier with a small scale factor could cause the internal count value to be exceeded before the 6-digit display value is exceeded.

RATE SCALE MULTIPLIER (RATE SCM)

The Rate Scale Multiplier is used with the rate scale factor and rate conversion factor to scale the rate display value for the proper units of measure. The scale multipliers available are; X 1, X 0.1, X 0.01, X 1000, X 100, or X 10.

RATE CONVERSION FACTOR (RATE PER)

The Rate Conversion Factor is used to display the rate value in the proper time units of measure, per second (X1), per minute (X60), or per hour (X3600) for the Rate display.

DECIMAL POINT (CNT. DP, RATE DP)

There are six Decimal Point locations available for the Rate and Count displays. The decimal point position is programmed individually for each display. The decimal point location programmed for the Rate display is the same for the Peak and Valley displays.

CHANGE COUNT VALUE WITH SCALE FACTOR (CHG CNT W/SF)

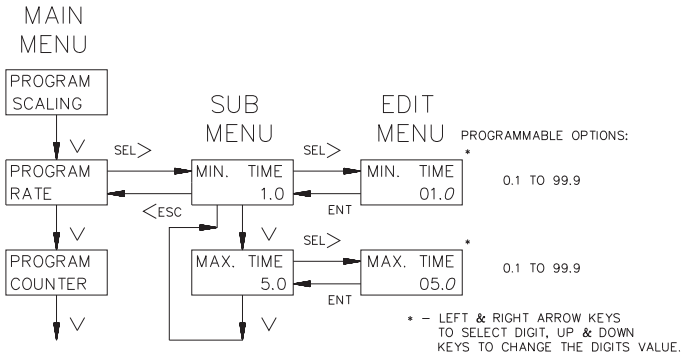
When yes is selected for this option, any changes to the count scale factor adjusts the currently displayed count value to reflect the new scale factor. If this option is set to no, the internal count value is modified so that the count display value is not affected.

Example; The count scale factor of an LGPM with a count value of 36 is changed from 1.000 to 0.500. If the option is set to yes, the new count value would be 18. If the option was selected as no, the count display value would remain at 36.

PROGRAM RATE MODULE

MINIMUM AND MAXIMUM UPDATE TIME

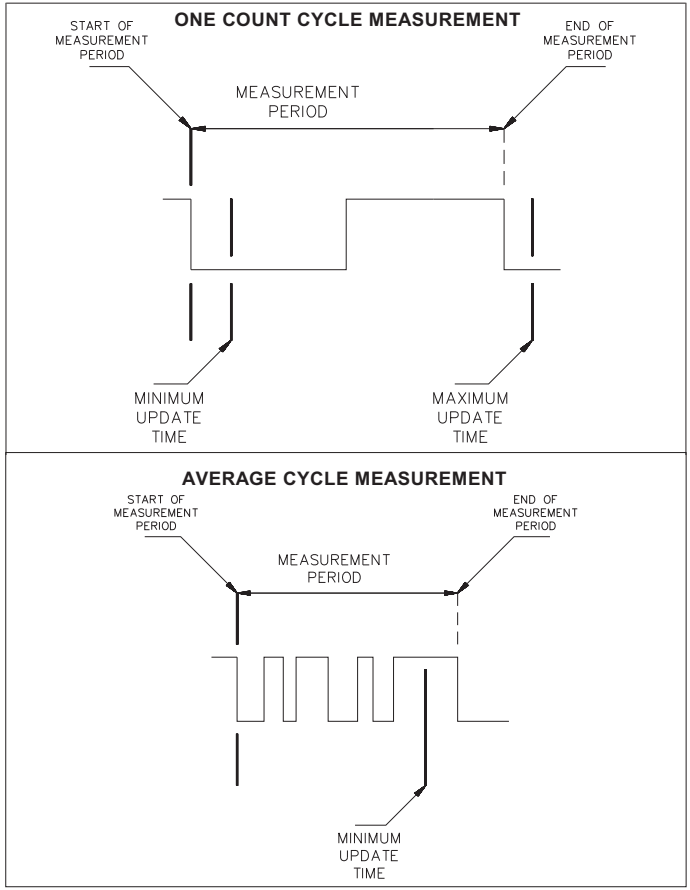
The Minimum and Maximum Update Times are programmed in the Rate module. The update times can range from 0.1 to 99.9 seconds. The following flowchart shows only the Rate portion:



The Rate value is calculated using the time measured between the first and last pulse as the measurement period. The measurement period ends when the minimum update time has expired, and the next negative edge occurs. The number of pulses that occurred during the measurement period are counted and multiplied by the rate scale factor, scale multiplier, and rate conversion factor. The result is divided by the actual measurement period to obtain the rate display value. If the unit does not receive a negative edge within the period between the minimum update time and the maximum update time from the start of the measurement period, the time period ends and the rate display goes to zero. At very slow count rates the measurement period is the actual period of one count cycle, as long as the input rate frequency is not longer than the maximum update time. The rate indicator only uses the falling edge of the Input A signal.

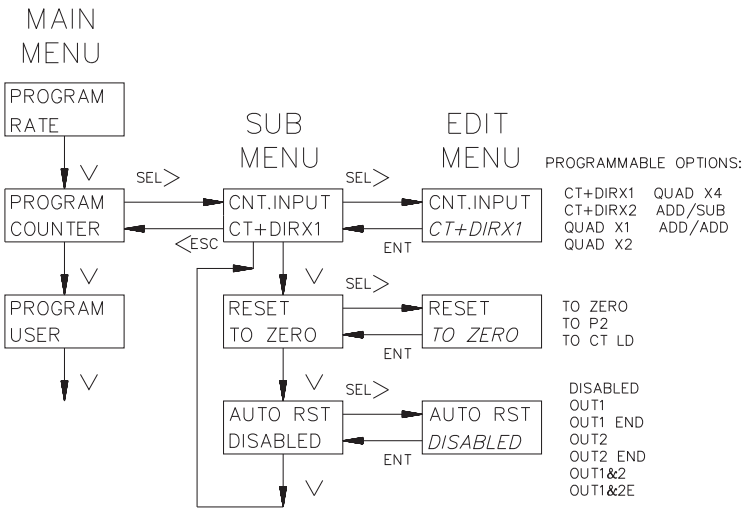
Note: The minimum update time must be equal to or less than 65536 divided by the maximum operating frequency (in Hz) or the internal rate counter will overflow. For example: If the maximum operating frequency is 10 KHz, the minimum update time must be less than 6.5 sec (65,535 ÷ 10,000 = 6.5).

BASIC TIMING DIAGRAMS FOR RATE OPERATION



PROGRAM COUNTER MODULE

In the Counter Module, the count mode, reset action, and automatic reset capability are selected. The following flowchart shows only the Counter portion:



COUNT MODES (CNT.INPUT)

There are seven available count modes. User Input 4 programmed for the count Inhibit function can be used with any count mode. Input A signal is used for the count and rate input. Input B is used in combination with Input A for Count Control Direction, Quadrature counting, Anti-coincidence Add/Subtract or Anti-coincidence Add/Add counting applications.

CT+DIRX1 (X1 COUNTING WITH DIRECTION)

The unit counts one count on every negative edge of the input signal at Input A. The direction of the count is determined by the logic state of Input B. A high level at Input B causes the unit to count in a positive direction. A low level causes the unit to count in a negative direction. The rate display is NOT affected by the logic state of Input B.

CT+DIRX2 (X2 COUNTING WITH DIRECTION)

The unit counts one count on every negative edge of the input signal and one count on every positive edge of the input signal at Input A. In this mode, the input signal is effectively doubled. The direction of the count is determined by the logic state of Input B. A high level at Input B causes the unit to count in a positive direction. A low level causes the unit to count in a negative direction. The rate display is NOT affected by the state of Input B.

QUAD X1 (QUADRATURE X1)

Quadrature counting modes are primarily used in positioning and anti-jitter applications. This mode works due to the manner in which the two incoming pulses are positioned relative to each other. The pulse signal on Input B is shifted 90º away from the pulse signal at Input A. These two signals are processed by the Legend Plus as follows:

Input A serves as the count and rate input, while Input B serves as the quadrature input. For quadrature with single edge counting, the counter counts in a positive direction when Input A is a negative going edge and Input B is at a low level. The counter counts in a negative direction when Input A is a positive going edge and Input B is at a low level. All transitions on Input A are ignored when Input B is at a high level. These logic rules provide the basis for anti-jitter operation which prevents false counts from occurring due to back-lash, vibration, chatter, etc.

QUAD X2 (QUADRATURE X2)

When two edge counting is used, the quadrature mode works the same as with single edge counting when Input B is low. But when Input B is a high level, counts at Input A are no longer ignored. Instead, the logic rules for Input A are complemented, allowing both edges of Input A to be counted. This doubles the effective resolution of the encoded input.

COUNT MODES (CNT.INPUT) (Cont'd)

QUAD X4 (QUADRATURE X4)

This mode takes the quadrature mode, with two edge counting, one step further. In quadrature times 4, both Input A and Input B serve as the count or quadrature input, depending on their state. In one instance, Input A serves as the count input and Input B serves as the quadrature input. In another instance, Input A is the quadrature input and Input B is the count input. This enables each edge, positive and negative going, of both inputs, A and B, to be counted. This results in a resolution four times greater than in the basic quadrature X1 mode. As in the other modes, Input A is also used for the rate input.

ADD/SUB (TWO INPUT ANTI/COINCIDENCE ADD/SUBTRACT)

This mode effectively separates count pulses that may simultaneously appear at the two inputs. The Legend Plus processes the count pulses into a string of time-separated pulses, so the internal counter does not miss any count pulses. Input A serves as the add input (count increments) and Input B serves as the subtract input (count decrements).

ADD/ADD (TWO INPUT ANTI/COINCIDENCE ADD/ADD)

This mode effectively sums count pulses that may simultaneously appear at the two inputs. The Legend Plus processes the count pulses into a string of time-separated pulses so the internal counter does not miss any count pulses. Input A serves as an add input (count increments) and Input B serves as an additional add input (count increments).

COUNTER RESET ACTION

The count display can be reset to Zero, Preset 2, or to the Counter Load value. The display can be reset automatically or by a User Input. A User Input can be programmed for a Maintained or Momentary reset (See Program User Module for details). Automatic reset is covered in the next section.

RESET TO ZERO

The Counter Display value returns to Zero.

TO P2 (PRESET 2)

The Counter Display value returns to the Preset 2 value. Output 2 triggers when the count reaches zero. This is not recommended for Boundary mode.

TO CT LD (COUNTER LOAD)

The Counter Display value returns to the Counter Load value.

COUNTER AUTOMATIC RESET (AUTO RST)

The Automatic reset mode can be enabled or disabled. The Counter display automatically resets to the programmed reset action, when one of the automatic reset modes is selected. A manual reset by a User Input causes the count to reset regardless of the automatic reset mode. The following choices are available:

OUT1 (Reset at Beginning Of Output 1)

The counter resets when the count equals the preset 1 value. Output 1 can be timed or latched.

OUT1END (Reset at End Of Timed Output 1)

The counter resets after output 1 has timed out.

OUT2 (Reset at Beginning Of Output 2)

The counter resets when the count equals the preset 2 value or zero (Reset to P2). Output 2 can be timed or latched.

OUT2END (Reset at End Of Timed Output 2)

The counter resets after output 2 has timed out.

OUT1&2 (Reset at Beginning Of Output 1 or Output 2)

The counter resets when the count equals preset 1, preset 2,or zero (reset to P2). Outputs 1 and 2 can be Timed or Latched.

OUT1&2E (Reset at End Of Timed Output 1 or Output 2)

The counter resets after output 1 or output 2 has timed out.

Notes:

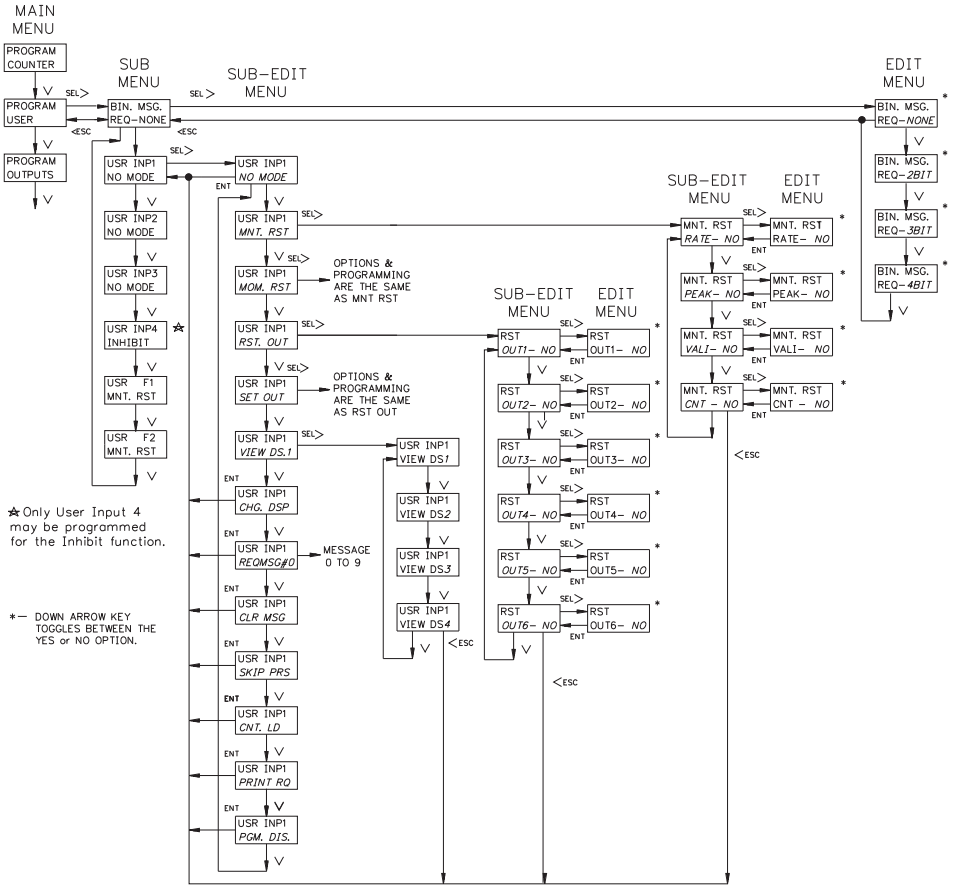
1. *For Auto Reset modes, when operating approximately ½ or greater than ½ of the maximum count rate, all other presets should not be within 1 to 3 counts (positive or negative) of the value to which Auto Reset resets. In Reset to Zero modes this would apply to any presets within 0 to 3 counts (positive or negative) of zero. For Reset to Preset 2 or Counter Load modes, it would apply to presets within 0 to 3 counts (positive or negative) of Preset 2 or Count Load values.*
2. *For Auto Reset modes, no other count presets should be set to the same count value at which Auto Reset occurs (Preset 2 or zero for Reset to Preset or Counter Load mode). If they are, only the auto reset output will activate. If the counter is set to Auto Reset at Out1&2, and other Presets are the same as Preset 2(or zero for Reset to Preset mode), only Output 2 will activate.*

PROGRAM USER MODULE

There are six User Inputs; four external User Inputs, and two front panel Function keys, which have various programmable capabilities. An external User Input is active when tied to common. A front panel function key is active when pressed. The options for each User Input are the same, except as noted below:

1. The two Function keys (F1 & F2/RST) DO NOT have the Program Disable (PGM.DIS.) option.
2. Only User Input 4 has the Inhibit Function.

The operator can select only one option for each User Input. The operator may have to enter a second sub-menu for some options before entering the edit menu. The flowchart at right shows only the User portion:



PROGRAM USER MODULE (Cont'd)

BINARY MESSAGE REQUEST (BIN MSG REQ)

Two, three, or all four of the external User Inputs can be configured as binary message request inputs. When configured as binary message request inputs, the individual user input options are not displayed or available. The inputs are active when pulled low (to common). In order for a message to be requested, the inputs must remain stable for 100 msec minimum. The number of messages that can be requested varies with the mode (# of bits) selected; for 2bit - 3 messages, 3bit - 7 messages, 4bit - 9 messages. Message #0 cannot be requested, since binary state 0 is used to indicate no request.

Example: If the Legend Plus is set up for 2 bit Binary Requests, User Inputs 1 and 2 do not appear in the Program User loop for programming. Activating User Input 1 displays Message 1, and activating User Input 2 displays Message 2. Activating both together displays Message 3.

Changing the individual binary message request inputs slowly may cause unwanted message requests, if several bits need to be changed.

USER INPUT NUMBER (0=INACTIVE, 1=ACTIVE)				MESSAGE REQUESTED
4	3	2	1	
0	0	0	0	NONE
0	0	0	1	MESSAGE #1
0	0	1	0	MESSAGE #2
0	0	1	1	MESSAGE #3
0	1	0	0	MESSAGE #4
0	1	0	1	MESSAGE #5
0	1	1	0	MESSAGE #6
0	1	1	1	MESSAGE #7
1	0	0	0	MESSAGE #8
1	0	0	1	MESSAGE #9

USR.IN 1-4
NO MODE

If a User Input terminal or a Function key is activated, it is ignored.

MAINTAINED RESET (MNT RST)

Maintained reset has four selectable options. Any or all can be selected in the edit menu by selecting YES or NO using the UP and DOWN arrow keys. When using the maintained reset with a small preset value, the Inhibit Count should be used with maintained reset, if the signal is present at the input when the reset is activated.

RATE: Resets the measurement period. The Rate display value is the last reading obtained before the reset. The next reading occurs after the release of the reset and the expiration of the measurement period. The Rate display does not reset to zero.

PEAK: Resets the Peak value to the current rate value.

VALLEY: Resets the Valley value to the current rate value.

COUNT: Resets the count value according to the programmed reset action.

With Maintained reset, the value continuously resets as long as the User Input or Function Key is active. Maintained reset is level sensitive and overrides an automatic reset mode.

MOMENTARY RESET (MOM RST)

Momentary reset has the same four selectable options as Maintained Reset. With Momentary reset, the value resets when the User Input or Function Key is activated. The value starts updating (counting), even if the User Input or Function Key is still active. Momentary reset is negative edge sensitive and overrides an automatic reset mode.

RESET OUTPUT (RST OUT)

The operator can select to have any or all of the Outputs, 1 through 6, reset. If the output is active, it resets to its inactive state when the User Input or Function Key is activated. This is a momentary reset.

Note: The Inactive State of an output can be ON or OFF depending on the Phase programmed in the Program Outputs Module.

SET OUTPUT (SET OUT)

The operator can select to have any or all of the Outputs, 1 through 6, set. If the output is inactive, it goes (sets) to its active state when the User Input or Function Key is activated. If an output is programmed for a time delay, the output does **NOT** latch, but times out after the time delay value expires. This is a momentary reset.

Note: The Active state of an output can be ON or OFF depending on the Phase programmed in the Program Outputs Module.

VIEW/FREEZE DISPLAY (VIEW DS1)

When View Display is activated, the programmed indication display is viewed and the numeric value for that display is held. This is a maintained action. If the operator is in the main display loop, the unit advances to the indication display to be viewed. If more than one User Input is programmed for this option, the input with the highest priority is the only one that holds (freezes) the display and advances from the main display loop. Any other User Input programmed only advances in the indication display loop. The priority order is F2, F1, USR INP4, USR INP3, USR INP2, and USR INP1, with F2 the highest priority. DS1 selects display 1, DS2 display 2, etc. The values that are viewed/frozen on the display are determined by what is selected in the Program Displays Module.

Activation of a User Input programmed for View Display will suspend any displayed message for 2.5 seconds. The User Input has a higher priority in this instance.

CHANGE DISPLAY (CHG DSP)

In the indication display loop, when a User Input is activated, the indication display toggles to the next indication display. The change of display is a momentary action.

Activation of a User Input programmed for Change Display will suspend any displayed message for 2.5 seconds.

REQUEST MESSAGE (REQ MSG#)

The selected message is requested when the User Input is activated. This may be a maintained or momentary request, as selected in the Program Message Module.

CLEAR MESSAGE (CLR MSG)

When the User Input is activated, the displayed message is cancelled. This is a maintained action. While this input is held active, it prevents messages from being requested. Only one User Input should be programmed for the Clear Message function.

SKIP PRESET (SKIP PRS)

Up to 6 Presets can be set to be skipped using one User Input. When the User Input is activated, the output does not activate/deactivate when the count/rate output conditions are met. This includes an Automatic Reset at Preset. The counter continues to count through the preset.

Note: An individual preset may be programmed to be skipped on only <u>one</u> User Input. Other User Inputs may be programmed for skipping presets only if the presets selected are not programmed to be skipped elsewhere.

COUNTER LOAD (CNT LD)

The count value is set to the counter load value, regardless of the reset action programmed in the Program Counter Module. The Counter Load is a maintained action.

PRINT REQUEST (PRINT RQ)

When a User Input is activated, the unit transmits all the information selected in the Print Options Module via the serial port. The print request is a maintained action.

PROGRAM DISABLE (PGM.DIS.)

This option used with the Program Disable DIP switch can limit operator access to programmable parameters (Refer to Operator Accessible Functions With Program Disable section). Only one external User Input can be used for this option. The program disable is a maintained action. If the User Input, set for PGM.DIS., is changed to another function, make sure the User Input is not low (active). If the input is low when the function is changed, the program disable function is still active for the User Input.

INHIBIT COUNT

When active, the Inhibit Count function prevents pulses from being counted on Inputs A & B. The Inhibit Count is a maintained action. The rate input is not affected by the Inhibit function, and continues to indicate the rate of the signal at Input A. This function is only available on User Input 4.

PROGRAM OUTPUTS MODULE

Presets 1 through 6 can activate solid state Outputs 1 through 6 respectively. All outputs can be assigned to the Count or Rate indication display, or None. The preset values are automatically assigned to the appropriate display. Outputs 3 through 6 have the same programmable options as Output 1, except they do not have the Out End Mode option. A manual reset, which requires the use of a User Input, overrides a timed output. If boundary or latched is selected for the output mode the time value does not appear as an option. The following flowchart shows only the Outputs portion:

PHASE

The positive (+) phase of an output indicates that when the display value equals the preset value, the output turns on. When the output is reset it is turned off. The negative (-) phase of an output indicates that when the display value equals the preset value, the output turns off. The reset condition of the output is the on state. When an output phase is changed, it does not take effect until a manual reset or power down is performed.

OUTPUT MODES - TIMED, LATCHED, BOUNDARY OR HI/LO ACTING

TIMED

For timed output operation, when the display value equals the preset value, the output activates for the time selected. After the time value expires, the output returns to its inactive state. The output time can be programmed from 0.01 to 99.99 seconds. An output may appear to be latched if the time delay is longer than the time required for the counter to reach the preset value. When an output is assigned to the rate display, the output may appear to be latched if the output time delay is greater than the minimum update time. The output deactivates when the rate drops below the preset value and the output time expires.

LATCHED

An output selected for the Latched Mode activates when the display value equals the preset value. The output stays active until it is manually reset by a User Input selected for that function. When the unit is reset, the output returns to its inactive state.

BOUNDARY

An output selected for the Boundary mode (Hi Acting) will be active when the display value is greater than or equal to the positive preset value. If the display value is less than the positive preset value, the output will be inactive state. For negative preset values, the output will be active when the count value is less *(more negative)* than the negative preset value. The output will be inactive when the display value is greater *(more positive)* or equal to the negative preset value. If an output is programmed for boundary, the Output End (Reset) Modes will not be applicable and therefore will not appear in the display.

HI/LO ACTING

This mode is used in conjunction with all Rate modes, and also with Boundary count modes. A Lo acting output would perform the Output action when the count/rate is lower than the preset. A Hi acting output would perform the Output action when the count/rate is higher than or equal to the preset.

RATE OUTPUT ON/OFF DELAY

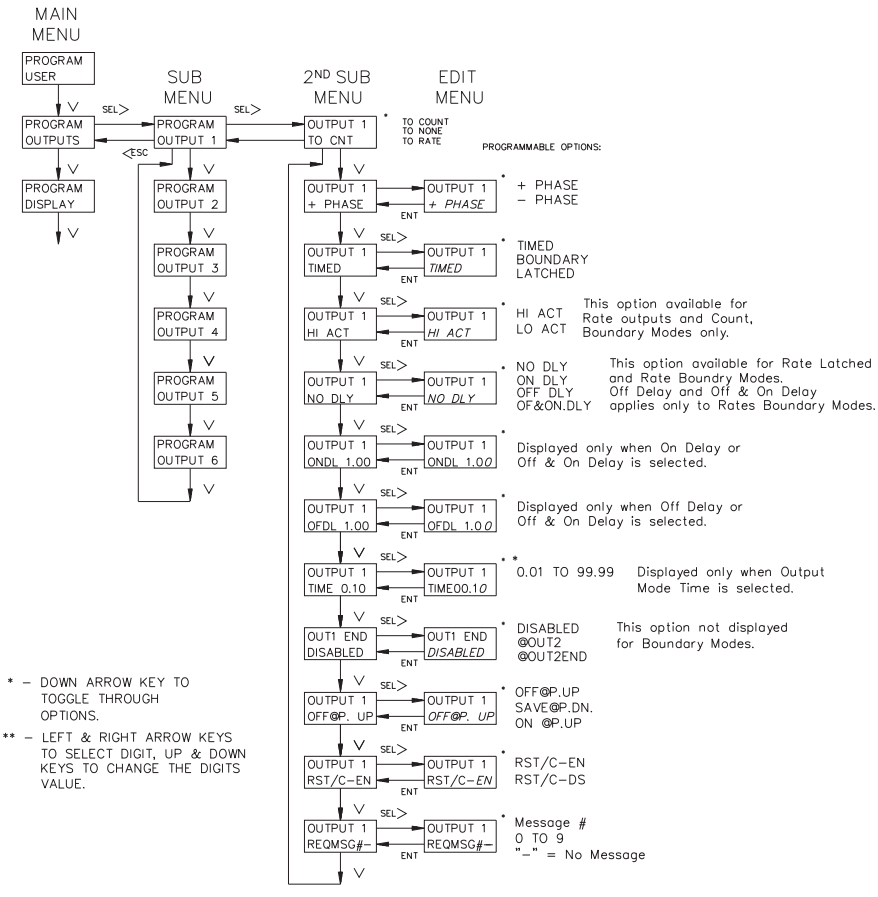
This option is available for the rate indicator and is used to prevent output chatter. The output condition must be satisfied for a period of time longer than the delay period for the output state to change. The minimum on or off delay time allowed is 0.10 seconds. OFF/ON Delay is not available if output is set for TIMED operation. If LATCHED mode is selected, the OFF DLY options are not available.

NO DLY - No delay

ON DLY. - On Delay:
Prevents activation of output(s) for the amount of time programmed.

OFF DLY. - Off Delay:
Prevents deactivation of output(s) for the amount of time programmed.

OF&ON.DLY - Off & On Delay:
This mode prevents output state change for specified delay period when turning on or off.


MAIN MENU
PROGRAM USER
PROGRAM OUTPUTS
PROGRAM DISPLAY
SUB MENU
2ND SUB MENU
EDIT MENU
SEL>
<ESC
PROGRAM OUTPUT 1
PROGRAM OUTPUT 2
PROGRAM OUTPUT 3
PROGRAM OUTPUT 4
PROGRAM OUTPUT 5
PROGRAM OUTPUT 6
OUTPUT 1 TO CNT
TO COUNT
TO NONE
TO RATE
PROGRAMMABLE OPTIONS:
OUTPUT 1 + PHASE
+ PHASE
– PHASE
OUTPUT 1 TIMED
TIMED
BOUNDARY
LATCHED
OUTPUT 1 HI ACT
HI ACT
LO ACT
This option available for Rate outputs and Count, Boundary Modes only.
OUTPUT 1 NO DLY
NO DLY
ON DLY
OFF DLY
OF&ON.DLY
This option available for Rate Latched and Rate Boundry Modes. Off Delay and Off & On Delay applies only to Rates Boundary Modes.
OUTPUT 1 ONDL 1.00
Displayed only when On Delay or Off & On Delay is selected.
OUTPUT 1 OFDL 1.00
Displayed only when Off Delay or Off & On Delay is selected.
OUTPUT 1 TIME 0.10
0.01 TO 99.99
Displayed only when Output Mode Time is selected.
OUT1 END DISABLED
DISABLED
@OUT2
@OUT2END
This option not displayed for Boundary Modes.
OUTPUT 1 OFF@P. UP
OFF@P.UP
SAVE@P.DN.
ON @P.UP
OUTPUT 1 RST/C-EN
RST/C-EN
RST/C-DS
OUTPUT 1 REQMSG#–
Message #
0 TO 9
"–" = No Message
ENT
* – DOWN ARROW KEY TO TOGGLE THROUGH OPTIONS.
** – LEFT & RIGHT ARROW KEYS TO SELECT DIGIT, UP & DOWN KEYS TO CHANGE THE DIGITS VALUE.

PROGRAM OUTPUTS MODULE (Cont'd)

OUTPUT END (RESET) MODES - OUT1 END, OUT2 END

The Output End modes operate with a timed or latched output mode. If either output is selected as boundary, the Output End modes are NOT available. Output End Modes apply only to outputs 1 and 2 when assigned to the Count display. If the output is set for TIMED, the output may deactivate from timing out or when the output end mode is reached, whichever occurs first.

OUT1 END (OUTPUT 1)

@OUT2 (Output 1 End at Output 2 Start)
Output 1 resets to its inactive state when output 2 becomes active. This action occurs when the count equals the preset value or zero (Reset to Preset Modes). This mode does not apply if the output is activated by a User Input programmed for Set Output.

@OUT2END (Output 1 End at Timed Output 2 End)
Output 1 resets to its inactive state when output 2's time delay expires.

OUT2 END (OUTPUT 2)

@ OUT1 (Output 2 End at Output 1 Start)
Output 2 resets to its inactive state when output 1 becomes active. This action occurs when the count equals the preset value or zero (Reset to Preset Modes). This mode does not apply if the output is activated by a User Input programmed for Set Output.

@OUT1END (Output 2 End at Timed Output 1 End)
Output 2 resets to its inactive state when output 1's time delay expires.

OUTPUT POWER UP STATE (OFF@P.UP, SAVE@P.DN OR ON@P.UP)

Each output can be programmed individually to have the state of the output OFF at power up (OFF@P.UP), saved at power down (SAVE@P.DN), or ON at power up (ON@P.UP). The save at power down option restores the state of the output to what it was at power down when power is restored. The save at power down option DOES NOT restore a timed output to the active state if the output was active at power down. The OFF@P.UP and ON@P.UP option refers to the active state of the output, which is determined by the Output Phase.

RESET OUTPUT WITH COUNT (RST/C-EN OR DS)

If Reset with Count is enabled, the output resets with a manual reset of the Count or Rate display. If Reset with Count is Disabled, the output does NOT reset when a manual reset is performed on the value to which the output is assigned.

REQUEST MESSAGE (REQMSG#—)

The selected message is requested when the output is activated. This may be a maintained or momentary request, as selected in the Program Message Module. A dash '-' indicates that no message is to be requested. The output must be active for a minimum of 50 msec for the request to be seen.

PROGRAM DISPLAY MODULE

DISPLAYS 1 TO 4

The four indication displays are programmed individually. Each line of each display can be configured to show a value mnemonic, a numeric value, the output status, a preset value, the counter load value, or a custom display line. Each display can be programmed to be Green or Red on Dual Color models. The full value mnemonics are factory set to:

RATE
PEAK
VALLEY
COUNT

The first character of the full mnemonic is displayed to the left of the appropriate numeric value if the other line is not programmed to display the full mnemonic. For rate peak and rate valley displays, the abbreviated mnemonic is the first character of the full rate mnemonic, followed by the first character of the full peak or valley mnemonic. The following is a list of the single or dual character mnemonics that are displayed for the factory set full mnemonics:

R	-	Indicates the Rate Value.
Rp	-	Indicates the Rate Peak Value.
Rv		Indicates the Rate Valley Value.
C	-	Indicates the Counter Value.
O - 1 2 3 4 5 6	-	Indicates output status: The numeric digits show which outputs are on. When the output is off, the digit is replaced by a small box (■).
P1	-	Indicates Preset 1 Value.
P2	-	Indicates Preset 2 Value.
P3	-	Indicates Preset 3 Value.
P4	-	Indicates Preset 4 Value.
P5	-	Indicates Preset 5 Value.
P6	-	Indicates Preset 6 Value.
CL	-	Indicates Counter Load Value.

SCROLL SPEED (SCRO.SPD)

The indication displays can be set to scroll automatically at a 2.5 or 5 second rate. The displays can be selected not to scroll, in which case the up and down arrow keys are used to scroll through the displays.

DISPLAY INTENSITY (DSP.LEVEL)

The brightness of the backlighting can be adjusted from 1 to 5, with 5 as the brightest. On dual color models, there is a separate adjustment for each color.

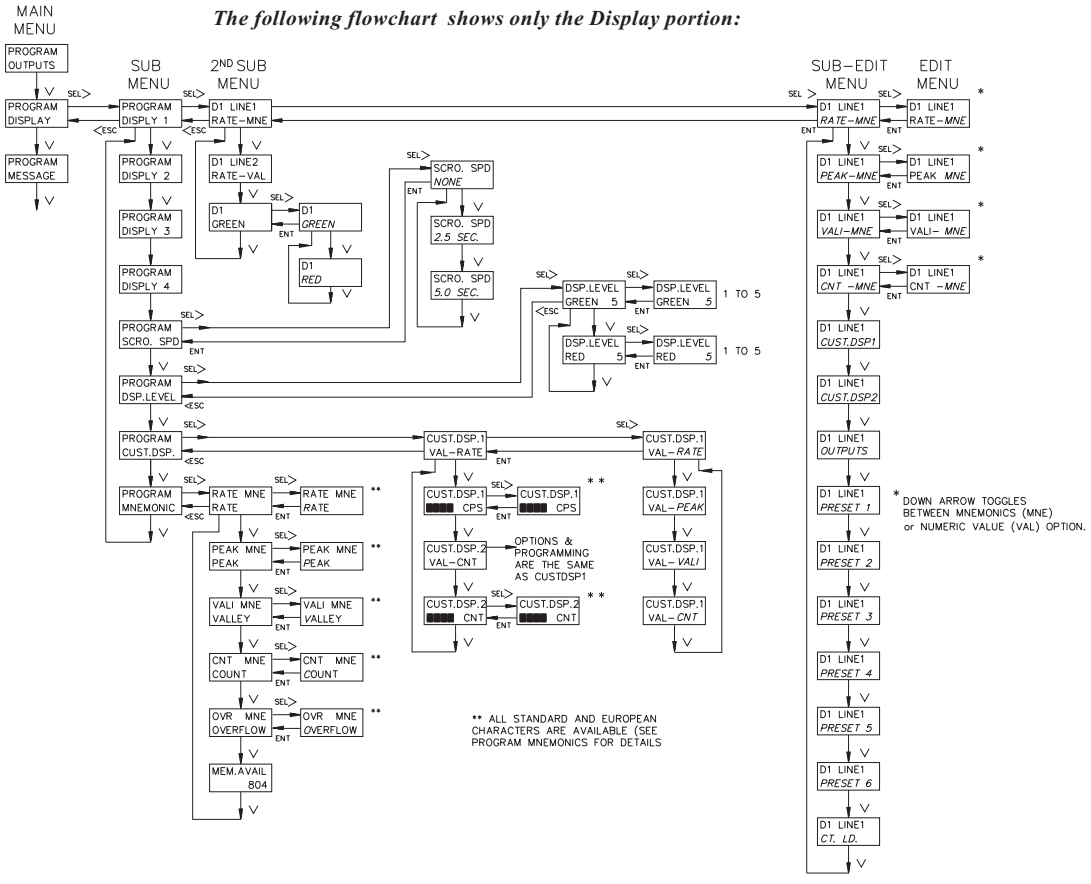
CUSTOM DISPLAY LINES (CUST.DSP.1 / CUST.DSP.2)

The Legend Plus has two Custom Display Lines which allow the user to specify the number of digits of a value to be displayed on the line, along with any alpha-numeric prefix or suffix. This feature has the same available characters as messages and program mnemonics. The numeric digit positions are indicated by pressing F1 and ENT at the desired display position. For a complete list of characters and text editing key functions, see Program Messages Text Editing section.

PROGRAM MNEMONIC

Allows the user to modify main display value mnemonics (RATE, COUNT, etc.) to display the mnemonic of their choice. For example, the value “RATE” can be changed to read “SPEED”. See Program Messages Text Editing section for a complete listing of available characters and text editing commands.

The following flowchart shows only the Display portion:



PROGRAM MESSAGE MODULE

Up to 10 messages can be programmed in the Legend Plus. Messages can be requested by an output status change, User Input(s), or through serial communications. The messages can be programmed for block or character scrolling, to blink, time out, and to alternately flash between message and indication display. On dual color models the message can be programmed to be displayed in the other color. This would by useful in drawing the operator's attention to the message. The following flowchart shows only the Message portion:

MESSAGE TYPE

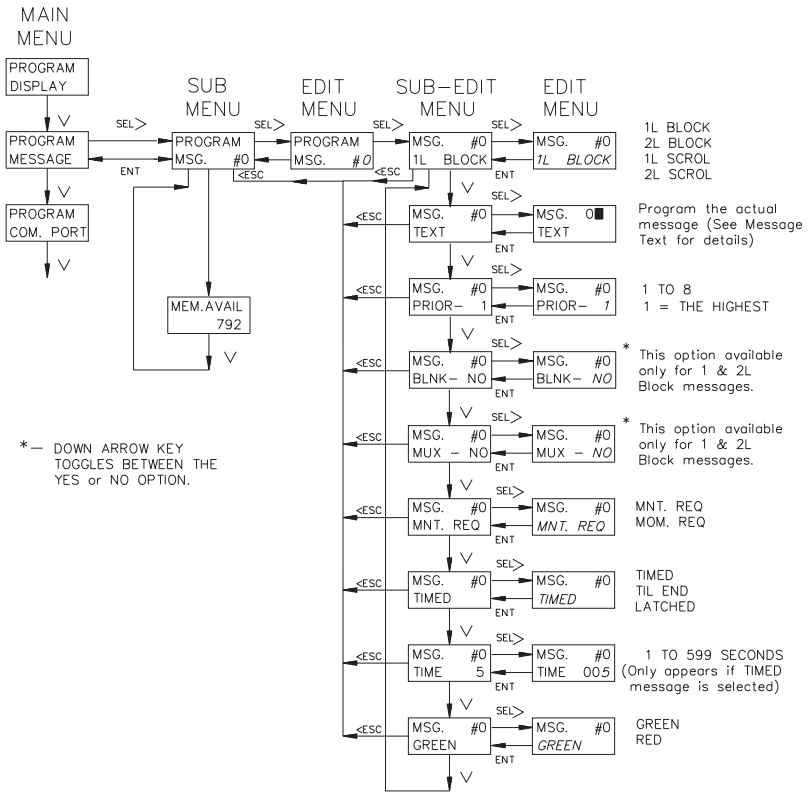
1L Block - A 1 line block message utilizes the top line of the display. The bottom line of the display indicates the information that was viewed before displaying the message. When there are multiple blocks in a message, the message text sequences to the next block every 2 seconds.

2L Block - A 2 line block message uses both lines of the display to display the message. Messages with more than 1 block automatically sequence to the next block every 2 seconds.

1L Scrol - The message text scrolls from left to right on the top line of the display. The bottom line of the display indicates the information that was viewed before displaying the message. The scroll rate is approximately 3 characters per second.

2L Scrol - The message text scrolls from left to right on the top line of the indication display. The bottom line of the display is blanked.

When the message type is changed, the unit automatically replaces End of Block or End of Line Characters with End of Line or space characters if appropriate. The message text may require editing when the message type is changed.



PROGRAM MESSAGE MODULE (Cont'd)

MESSAGE TEXT

A message can contain up to 200 characters. The keypad can be used to perform message editing functions such as; scrolling through message text, inserting and deleting characters, toggling from upper/lower case, toggling from Extended/Standard ASCII characters sets, etc. Refer to table below for text editing key functions. Message Text and other message parameters may also be programmed utilizing the optional Legend Plus Programming Software.

Before entering message text, the message type (1L/2L Block or Scroll) should be configured. This selection will affect the formatting of the message text. When entering block messages, an end of line character and an end of block character can be used to conserve message memory. The End of Line character is displayed as a small open square. It is used only on the top line in 2 line block messages. If there is more than one space at the end of the top line, the End of Line character should be inserted after the last non space character. The End of Block character is displayed as a large open block. It can be inserted after the last character of a message block on either display line. Message blocks that contain only End of Line and/or End of Block characters will be blank when displayed. The End of Line or End of Block are not used in character scrolling messages (1L or 2L Scrol).

The Last character in a message is the End of Message character, which is displayed as a large solid block. The End of Message character cannot be edited.

Text Editing Key Functions:	Keys Pushed
Scroll through characters	∧ or v
Select Character position	> or <
Reset to "A" character	F1 + ∧
Reset to the space character	F1 + v
Insert space Character, push right	F1 + >
Delete character, pull left	F1 + <
Insert End of Line 1 Character	F1 + PRS
Insert End of Block Character or Numeric Field Position (Custom Disp. lines)	F1 + ENT
Upper/Lower Case toggle	F2 + ∧
Toggle between Extended & Standard Character	F2 + v

Special Use Characters

■ - End of Line 1

▯ - End of Block

▌ - End of Message (Non editable)

Note: In message and mnemonic text entry, the F1 & F2 User Input functions are disabled.

ASCII TABLE OF EXTENDED CHARACTERS

HEXA DECIMAL	DECIMAL	LEGEND CHARACTER
80	128	Ç
81	129	ü
82	130	é
83	131	â
84	132	ä
85	133	à
86	134	å
87	135	ç
88	136	ê
89	137	ë
8A	138	è
8B	139	ï
8C	140	î
8D	141	ì
8E	142	Ä
8F	143	Å
90	144	É
91	145	æ
92	146	Æ
93	147	ô
94	148	ö

HEXA DECIMAL	DECIMAL	LEGEND CHARACTER
95	149	ò
96	150	û
97	151	ù
98	152	ÿ
99	153	Ö
9A	154	Ü
9B	155	¢
9C	156	£
9D	157	¥
9E	158	Á
9F	159	Í
A0	160	á
A1	161	í
A2	162	ó
A3	163	ú
A4	164	ñ
A5	165	Ñ
A6	166	Ó
A7	167	Ú
A8	168	¿

ASCII TABLE OF STANDARD CHARACTERS

HEXA DECIMAL	DECIMAL	LEGEND CHARACTER
20	32	
21	33	!
22	34	"
23	35	#
24	36	$
25	37	%
26	38	&
27	39	’
28	40	(
29	41	)
2A	42	*
2B	43	+
2C	44	,
2D	45	-
2E	46	.
2F	47	/
30	48	0
31	49	1
32	50	2
33	51	3
34	52	4
35	53	5
36	54	6
37	55	7

HEXA DECIMAL	DECIMAL	LEGEND CHARACTER
38	56	8
39	57	9
3A	58	:
3B	59	;
3C	60	<
3D	61	=
3E	62	>
3F	63	?
40	64	@
41	65	A
42	66	B
43	67	C
44	68	D
45	69	E
46	70	F
47	71	G
48	72	H
49	73	I
4A	74	J
4B	75	K
4C	76	L
4D	77	M
4E	78	N
4F	79	O

HEXA DECIMAL	DECIMAL	LEGEND CHARACTER
50	80	P
51	81	Q
52	82	R
53	83	S
54	84	T
55	85	U
56	86	V
57	87	W
58	88	X
59	89	Y
5A	90	Z
5B	91	[
5C	92	\
5D	93	]
5E	94	^
5F	95	_
60	96	‘
61	97	a
62	98	b
63	99	c
64	100	d
65	101	e
66	102	f
67	103	g

HEXA DECIMAL	DECIMAL	LEGEND CHARACTER
68	104	h
69	105	I
6A	106	j
6B	107	k
6C	108	l
6D	109	m
6E	110	n
6F	111	o
70	112	p
71	113	q
72	114	r
73	115	s
74	116	t
75	117	u
76	118	v
77	119	w
78	120	x
79	121	y
7A	122	z
7B	123	{
7C	124	|
7D	125	}
7E	126	~

MESSAGE PRIORITY (PRIOR - 1)

Messages can be assigned a priority from 1 to 8 (1 = highest priority). Messages of equal or higher priority will supersede or replace a displayed message of lower or equal priority.

BLINKING MESSAGE (BLNK-YES/NO)

This parameter enables the message to blink at a one second rate when displayed. This mode is only available with 1 or 2 line block messages.

MULTIPLEX (MUX - YES/NO)

Allows a message to be multiplexed with the indication display. The unit displays the requested message then the indication display each for 2 seconds. Message multiplexing is only available with 1 or 2 line block messages.

MAINTAINED/MOMENTARY MESSAGE REQUEST

MNT. REQ (Maintained **Request***)*

Programming a message for maintained request allows the message to be re-requested if the message has been displaced by another message. To be re-requested, the User Input or output requesting the message must be active (maintained) and the interrupting message must have been cancelled.

Maintained messages of the same priority are treated as follows when more than one message requesting input or output is active. A new message of the same or higher priority will always be requested when the request source is activated. When a maintained message is cancelled, the message of the requesting input or output of highest priority is displayed. The priority order, from highest to lowest, for the various request sources are: User Input 1, 2, 3, 4, User F1, User F2, Binary Message Request inputs, and Outputs 1 to 6. User Input 1 (programmed for REQ.MSG) has the highest priority and Output 6 has the lowest.

MOM. REQ (Momentary **Request***)*

Once a momentary message is displayed, if another message is requested and displaces the momentary message, the momentary message is cancelled. It will not be requested again unless the User Input or output is deactivated then activated again. If no other messages are requested while the momentary message is displayed, it remains on the display until cancelled as programmed.

MESSAGE CANCELLATION

Any displayed message is immediately displaced when another message of equal or higher priority is requested. A displayed message can also be cancelled by activating a User Input programmed for the Cancel Message function, or via the serial port. If no other function purposely cancels a message, it is cancelled per the cancellation mode programmed. A message that is programmed for maintained request will be re-requested when the message times out or is cancelled, if the request source (User Input or output) is still active. If several maintained messages' request sources are active, and the last requested message times out or is cancelled, the message associated with the highest priority input will be requested next (See Maintained Request).

LATCHED - Latched messages can only be cancelled by the methods described above.

TIMED - Timed messages automatically cancel at the end of the specified time period as programmed in "MESSAGE TIME". A Character or block scrolling message will scroll to the end before being cancelled. This causes the message to remain on the display longer than specified by the time-out value. A 2 Line Block message will stay on the display for a minimum of 2 sec. (1 block time) before timing out. The message time out value is initially set to 5 seconds when the timed mode is selected.

TIL END - A message programmed for this mode will automatically get cancelled when the output or User Input programmed to request this particular message deactivates. Only one request source should be programmed to request a message set for Til End. A Til End message that is requested by serial communication will be immediately cancelled, if there is an inactive request source set to request that message.

MESSAGE TIME

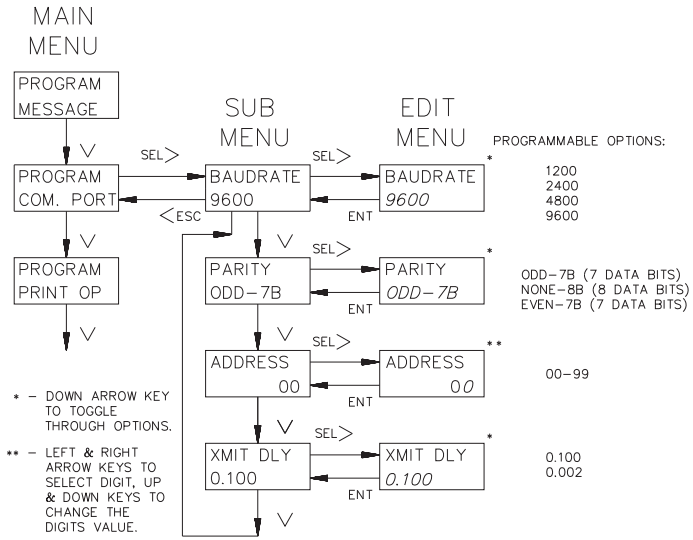
This parameter is available only if the message cancellation mode is set for timed. The message time for a timed message can be programmed from 1 to 599 seconds.

MESSAGE COLOR

Can be programmed for Red or Green on dual color models.

PROGRAM COMMUNICATION PORT MODULE

When communicating to a Legend Plus via the serial port, the data formats of both units must be identical. The Baud Rate and Parity Bit/number of data bits are selected for the data format in this module along with the Unit Address and Serial Transmit Delay. Serial communication is covered in detail in the SERIAL COMMUNICATIONS SECTION. The following flowchart shows only the Communication portion:



BAUD RATE

The Baud Rates available are: 1200, 2400, 4800, and 9600 Baud.

PARITY/ NUMBER OF DATA BITS

The Parity can be ODD-7B (7data bits), EVEN-7B (7 data bits), or No parity-8B (8 data bits). If any of the extended ASCII characters are to be transmitted serially (used in mnemonics or in message #0 when MSG0-YES is configured), the unit must be configured for 8 data bits (NONE-8B).

UNIT ADDRESS

The Unit Address can range from 00 to 99. This allows addressing of multiple units on a single pair of wires and a common (RS485 only), with each unit capable of having a different address. If only one unit is on the line an address of zero can be used, eliminating the need for an address command.

SERIAL TRANSMIT DELAY

The Serial Transmit Delay is the minimum amount of time the Legend Plus unit waits to transmit data to a peripheral unit. The time begins after the Legend Plus receives a command to transmit data or when a print request is received. The delay can be set for 0.002 or 0.100 second. This delay time gives the software controlling an RS485 interface card time to change the RS485 port from transmit to receive mode.

PROGRAM PRINT OPTIONS MODULE

A print operation occurs when a User Input, programmed for the print request function, is activated or when a "P" command is sent via the serial communications port. The unit will transmit the values selected as "YES" in this module.

If a display is in an overflow condition, an asterisk will precede the digits that are printed (ex. positive overflow * 2178, negative overflow * -2178).

Serial transmissions are covered in detail in the serial communications section.

MNEMONICS (MNEM-YES/NO)

When transmitting data, the unit can be programmed to suppress the address number, mnemonics, and some spaces by selecting NO for the MNEM (mnemonics). A selection of NO results in a faster transmission and may be useful when interfacing with a computer. However, when interfacing with a printer, sending mnemonics is usually desirable. Setting MNEM to YES inserts the address, mnemonics and a 400 msec printer delay following each transmitted print option. An example of sending and NOT sending mnemonics are shown below:

6 CNT 123.8<CR><LF>	with mnemonics
123.8<CR><LF>	without mnemonics

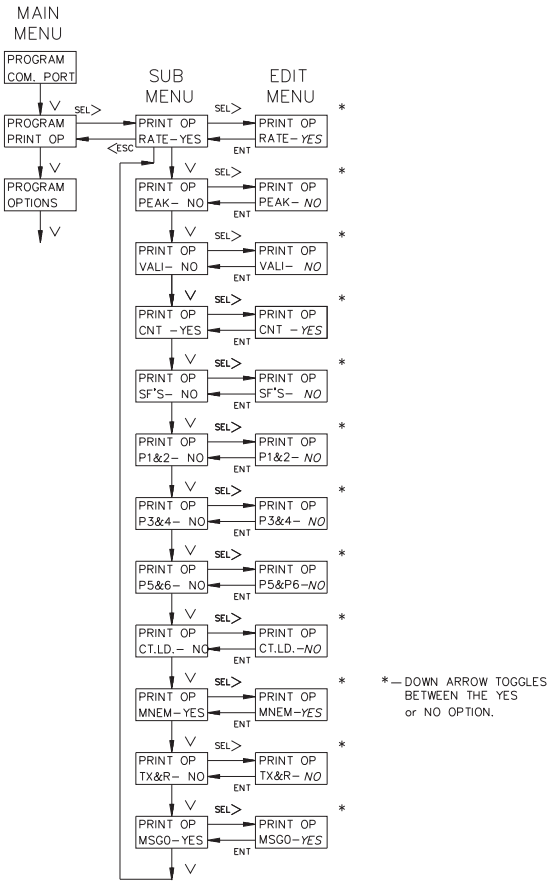
TRANSMIT AND RESET (TX&R-YES/NO)

When programmed to YES each count value selected to be printed is reset after the count value is acquired for serial transmission.

TRANSMIT MESSAGE #0 (MSG0-YES/NO)

Enables the first 60 characters of message #0 to be transmitted as a print header (first item in the print out). For a single line print header, program message #0 as 1L or 2L Scroll. For a multiple line print header, program message #0 as 1L or 2L Block. The End of Line or End of Block character is used to indicate the end of a line on the header. Do not use them in the same fashion as messages to be displayed on the unit. When entering the text for each line, if a word does not fit on a line, allow it to continue on the next line or block. Refer to Program Messages section.

The following flowchart shows only the Print Options portion:



PROGRAM OPTIONS MODULE

The Program Options module is used to program the Operator Accessible functions, Preset Tracking selections, the Programmable Code value, or load the Factory Settings. The flowchart shows only the Options portion.

OPERATOR ACCESS

The Operator Access menu is used with the Program Disable DIP switch and/or an external User Input selected for program disable. Values can be set for YES, NO, or LOC. When a value is selected for NO, the operator can view the value, but CANNOT change it from the front panel keypad (See Front Panel Accessible Functions With Program Disable for details). Values selected for LOC do not appear in the displays outside of the programming loop. The following values can be disabled from front panel access programming:

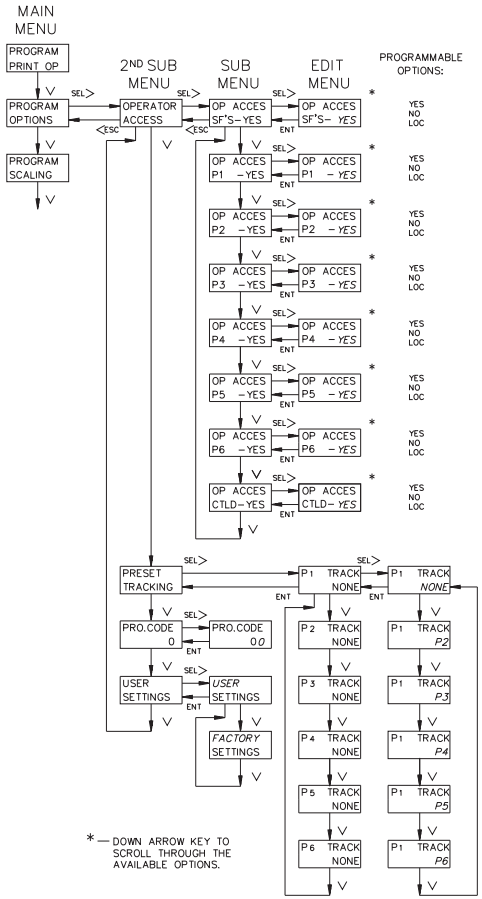
Preset 1	Preset 5
Preset 2	Preset 6
Preset 3	Counter Load value
Preset 4	Scale Factors

PRESET TRACKING

If Preset Tracking is enabled and a preset value is changed, the preset value that is tracking it will also change by the same offset. The amount of offset between presets is changed by changing the preset value doing the tracking first. Example: Preset 1 is tracking Preset 2. If Preset 2 is 100 and it is desired that Preset 1 occurs 20 counts before Preset 2, the Preset 1 value would be set to 80. If Preset 2 is then changed to 200, Preset 1 will automatically change to 180, maintaining the same 20 count Offset. All presets can be set to track a different preset if they are assigned to the same function (rate or count). If only one preset is selected for a particular function then that preset cannot be used for preset tracking.

PROGRAM CODE (PRO.CODE)

The value can be programmed from 0 to 99. This value may be required to be entered before the unit allows access to programming menus, depending on the level of security that has been chosen. Programming a value of 99 disables access to programming menus when PGM.DIS. switch is on. Refer to “Front Panel Accessible Functions with Program Disable.”



USER/FACTORY SETTINGS

This module should only be entered if the operator wants to reset ALL parameters to the factory settings. When the word "FACTORY" is flashing in the display and the ENT key is pressed, all parameters will be set to the factory settings when exiting the programming loop. The operator can exit the factory settings option WITHOUT resetting all parameters by pressing the <ESC key. The following are the settings when shipped from the factory, along with a chart for user settings:

Caution: *If factory settings are selected, all programming by the user will be reset.*

LGPM FACTORY SETTINGS CHART

SCALE FACTORS

COUNT SF	1.0000
RATE SF	1.0000
CNT. SCM	X 1
CNT. D.P.	0
RATE SCM	X 1
RATE PER	SECOND
RATE D.P.	0
CHG. CNT/ WITH SF	YES

RATE

MIN. TIME	1.0
MAX. TIME	5.0

COUNTER

CNT. INPUT	CT+DIRX1
RESET	TO ZERO
AUTO. RST	DISABLED

USER INPUTS

BIN. MSG.REQ.	NONE
USER INP. 1	NO MODE
USER INP. 2	NO MODE
USER INP. 3	NO MODE
USER INP. 4	INHIBIT
USER F1	MNT RST
	RATE-NO
	PEAK-YES
	VALLEY-YES
	COUNT-NO
USER F2	MNT RST
	RATE-NO
	PEAK-NO
	VALLEY-NO
	COUNT-YES

OUTPUTS

OUTPUT 1		OUTPUT 2		OUTPUT 3	
ASSIGNED	TO CNT	ASSIGNED	TO CNT	ASSIGNED	TO CNT
PHASE	+	PHASE	+	PHASE	+
TYPE	TIMED	TYPE	TIMED	TYPE	TIMED
ACT/TIME	0.10	ACT/TIME	0.10	ACT/TIME	0.10
OUTPUT END	DISABLED	OUTPUT END	DISABLED	DLY TYPE	
DLY TYPE		DLY TYPE		ON DL TIME	
ON DL TIME		ON DL TIME		OF DL TIME	
OF DL TIME		OF DL TIME		OFF@P.	UP
OFF@P.	UP	OFF@P.	UP	RST/C	EN
RST/C	EN	RST/C	EN	REQ MSG #	–
REQ MSG #	–	REQ MSG #	–		

OUTPUT 4		OUTPUT 5		OUTPUT 6	
ASSIGNED	TO CNT	ASSIGNED	TO CNT	ASSIGNED	TO CNT
PHASE	+	PHASE	+	PHASE	+
TYPE	TIMED	TYPE	TIMED	TYPE	TIMED
ACT/TIME	0.10	ACT/TIME	0.10	ACT/TIME	0.10
DLY TYPE		DLY TYPE		DLY TYPE	
ON DL TIME		ON DL TIME		ON DL TIME	
OF DL TIME		OF DL TIME		OF DL TIME	
OFF@P.	UP	OFF@P.	UP	OFF@P.	UP
RST/C	EN	RST/C	EN	RST/C	EN
REQ MSG #	–	REQ MSG #	–	REQ MSG #	–

LGPM FACTORY SETTINGS CHART (Cont'd)

DISPLAY

DISPLY 1		DISPLY 2	
D1 LINE 1	CUST.DSP.2	D2 LINE 1	PEAK-MNE
D1 LINE 2	CUST.DSP.1	D2 LINE 2	PEAK-VAL
D1 COLOR	GREEN	D2 COLOR	GREEN
DISPLY 3		**DISPLY 4**	
D3 LINE 1	VALI-MNE	D4 LINE 1	CNT-MNE
D3 LINE 2	VALI-VAL	D4 LINE 2	CNT-VAL
D3 COLOR	GREEN	D4 COLOR	GREEN
SCRO. SPD	NONE	MNEMONIC	
DSP. LEVEL G	5	RATE	RATE
R	5	PEAK	PEAK
		VALI	VALLEY
CUST. DSP.		CNT	COUNT
CUST. DSP.1	VAL-RATE	OVR	OVERFLOW
	■ CPS	MEM AVAIL	804
CUST. DSP.2	VAL-CNT		
	■ CNT		

MESSAGE

MSG. #	0 to 9
TYPE	1L BLOCK
TEXT	*
PRIORITY	1
BLINKING	NO
MULTIPLEX	NO
MOM/MNT REQ	MNT
CANCEL	LATCHED
TIME SEC.	
COLOR	GREEN

* - Message Number (single digit) is entered in message text.

COM. PORT

BAUD RATE	9600
PARITY	ODD-7B
ADDRESS	00
XMIT DLY	0.100

PRINT OP

RATE	YES
PEAK	NO
VALI	NO
CNT	YES
SF'S	NO
P1&2	NO
P3&4	NO
P5&6	NO
CTLD.	NO
MNEM	YES
TX&R	NO
MSG0	NO

OPTIONS

ACCESS	
P1	YES
P2	YES
P3	YES
P4	YES
P5	YES
P6	YES
CTLD.	YES
SF'S	YES

PRESET TRACKING

P1 TRACK	NONE
P2 TRACK	NONE
P3 TRACK	NONE
P4 TRACK	NONE
P5 TRACK	NONE
P6 TRACK	NONE
PRO. CODE	0

PRESETS

P1	500
P2	1000
P3	300
P4	400
P5	500
P6	600
CL	-100

LGPM USER SETTINGS PROGRAMMING SHEET

SCALE FACTORS

COUNT SF _____
RATE SF _____
COUNT SCM _____
CNT. D.P. _____
RATE SCM _____
RATE PER _____
RATE D.P. _____
CHG. CNT/
WITH SF _____

RATE

MIN. TIME _____
MAX. TIME _____

COUNTER

CNT. INPUT _____
RESET
AUTO. RST _____

USER INPUTS

BIN. MSG.REQ.
USER INP. 1 _____
USER INP. 2 _____
USER INP. 3 _____
USER INP. 4 _____
USER F1 _____
USER F2 _____

OUTPUTS

OUTPUT 1		OUTPUT 2		OUTPUT 3	
ASSIGNED	_____	ASSIGNED	_____	ASSIGNED	_____
PHASE	_____	PHASE	_____	PHASE	_____
TYPE	_____	TYPE	_____	TYPE	_____
ACT/TIME	_____	ACT/TIME	_____	ACT/TIME	_____
OUTPUT END	_____	OUTPUT END	_____	DLY TYPE	_____
DLY TYPE	_____	DLY TYPE	_____	ON DL TIME	_____
ON DL TIME	_____	ON DL TIME	_____	OF DL TIME	_____
OF DL TIME	_____	OF DL TIME	_____	____ @P.	_____
____ @P.	_____	____ @P.	_____	RST/C	_____
RST/C	_____	RST/C	_____	REQ MSG #	_____
REQ MSG #	_____	REQ MSG #	_____		

OUTPUT 4		OUTPUT 5		OUTPUT 6	
ASSIGNED	_____	ASSIGNED	_____	ASSIGNED	_____
PHASE	_____	PHASE	_____	PHASE	_____
TYPE	_____	TYPE	_____	TYPE	_____
ACT/TIME	_____	ACT/TIME	_____	ACT/TIME	_____
DLY TYPE	_____	DLY TYPE	_____	DLY TYPE	_____
ON DL TIME	_____	ON DL TIME	_____	ON DL TIME	_____
OF DL TIME	_____	OF DL TIME	_____	OF DL TIME	_____
____ @P.	_____	____ @P.	_____	____ @P.	_____
RST/C	_____	RST/C	_____	RST/C	_____
REQ MSG #	_____	REQ MSG #	_____	REQ MSG #	_____

LGPM USER SETTINGS PROGRAMMING SHEET (Cont'd)

DISPLAY

DISPLY 1
D1 LINE 1 ____________
D1 LINE 2 ____________
D1 COLOR ____________

DISPLY 2
D2 LINE 1 ____________
D2 LINE 2 ____________
D2 COLOR ____________

DISPLY 3
D3 LINE 1 ____________
D3 LINE 2 ____________
D3 COLOR ____________

DISPLY 4
D4 LINE 1 ____________
D4 LINE 2 ____________
D4 COLOR ____________

SCRO. SPD ____________
DSP. LEVEL G ____________
R ____________

MNEMONIC
RATE ____________
PEAK ____________
VALLEY ____________
COUNT ____________
OVERFLOW ____________
MEM AVAIL ____________

CUST. DSP.
CUST. DSP.1 ____________
____
CUST. DSP.2 ____________
____

MESSAGE

MSG. # ____________
TYPE ____________
TEXT ____________
____
PRIORITY ____________
BLINKING ____________
MULTIPLEX ____________
MOM/MNT REQ ____________
TIMED ____________
TIME SEC. ____________
COLOR ____________

MSG. # ____________
TYPE ____________
TEXT ____________
____
PRIORITY ____________
BLINKING ____________
MULTIPLEX ____________
MOM/MNT REQ ____________
TIMED ____________
TIME SEC. ____________
COLOR ____________

MESSAGE

MSG. # ____________
TYPE ____________
TEXT ____________
____
PRIORITY ____________
BLINKING ____________
MULTIPLEX ____________
MOM/MNT REQ ____________
TIMED ____________
TIME SEC. ____________
COLOR ____________

MSG. # ____________
TYPE ____________
TEXT ____________
____
PRIORITY ____________
BLINKING ____________
MULTIPLEX ____________
MOM/MNT REQ ____________
TIMED ____________
TIME SEC. ____________
COLOR ____________

MSG. # ____________
TYPE ____________
TEXT ____________
____
PRIORITY ____________
BLINKING ____________
MULTIPLEX ____________
MOM/MNT REQ ____________
TIMED ____________
TIME SEC. ____________
COLOR ____________

MSG. # ____________
TYPE ____________
TEXT ____________
PRIORITY ____________
BLINKING ____________
MULTIPLEX ____________
MOM/MNT REQ ____________
TIMED ____________
TIME SEC. ____________
COLOR ____________

LGPM USER SETTINGS PROGRAMMING SHEET (Cont'd)

MESSAGE

MSG. #	_____	MSG. #	_____
TYPE	_____	TYPE	_____
TEXT	_____	TEXT	_____
	_____		_____
PRIORITY	_____	PRIORITY	_____
BLINKING	_____	BLINKING	_____
MULTIPLEX	_____	MULTIPLEX	_____
MOM/MNT REQ	_____	MOM/MNT REQ	_____
TIMED	_____	TIMED	_____
TIME SEC.	_____	TIME SEC.	_____
COLOR	_____	COLOR	_____
MSG. #	_____	MSG. #	_____
TYPE	_____	TYPE	_____
TEXT	_____	TEXT	_____
	_____	PRIORITY	_____
PRIORITY	_____	BLINKING	_____
BLINKING	_____	MULTIPLEX	_____
MULTIPLEX	_____	MOM/MNT REQ	_____
MOM/MNT REQ	_____	TIMED	_____
TIMED	_____	TIME SEC.	_____
TIME SEC.	_____	COLOR	_____
COLOR	_____		

COM. PORT

BAUD RATE	_____
PARITY	_____
ADDRESS	_____
XMIT DLY	_____

PRINT OP

RATE	_____
PEAK	_____
VALI	_____
CNT	_____
SF'S	_____
P1&2	_____
P3&4	_____
P5&6	_____
CTLD.	_____
MNEM	_____
TX&R	_____
MSG0	_____

OPTIONS

ACCESS

P1	_____
P2	_____
P3	_____
P4	_____
P5	_____
P6	_____
CTLD.	_____
SF'S	_____

PRESET TRACKING

P1 TRACK	_____
P2 TRACK	_____
P3 TRACK	_____
P4 TRACK	_____
P5 TRACK	_____
P6 TRACK	_____
PRO. CODE	_____

PRESETS

P1	_____
P2	_____
P3	_____
P4	_____
P5	_____
P6	_____
CL	_____

SERIAL COMMUNICATIONS

Serial communications allows for transmitting and receiving of data between the Legend Plus and other devices. This feature can be used for monitoring various values, resetting output(s), and changing values, all from a remote location. Typical devices that are connected to a Legend Plus unit are a printer, a terminal, a programmable controller, or a host computer.

The Legend Plus is jumper selectable between RS485 and RS232 communications. The RS485 differential (balanced) design has good noise immunity and allows for communication distances of up to 4000 feet. Up to 32 units can be connected on a pair of wires and a common. The unit's address can be programmed from 00 to 99. RS232 is useful for connecting a single unit to a printer or to a computer for programming using the optional Legend Plus Programming Software.

PROGRAMMING SOFTWARE

Software for IBM® compatible PCs is available to program all of the Legend configuration parameters such as messages, count modes, etc. The software allows unit configurations to be created, uploaded, downloaded, and saved to a file for rapid programming of the Legend. Before using the programming software, the Legend unit should be powered up and the version number recorded. This information is needed to take full advantage of the programming software capabilities.

Note: While using the Legend Plus Programming Software, the Legend unit should NOT be controlling a process. If the unit is connected while uploading or downloading the configuration files, unit operation will be interrupted and counts will be missed.

Minimum Requirements:

IBM® compatible 286 or better.
Minimum of 450K FREE conventional memory.
MSDOS 3.3 or later.
RS232 or RS485 serial port with ID of COM1 or COM2.
Video TEXT mode of 80 columns x 25 rows.
Mouse supported.

INSTALLING SOFTWARE

A backup copy should be made of the program disk. The program may be run using the floppy drive or, it may be installed to a Hard drive. To install on the hard drive, copy all files from the program disk to the desired directory on the hard drive.

Refer to "SERIAL CONNECTIONS" section of the manual for connecting the Legend Plus to a computer.

USING SOFTWARE

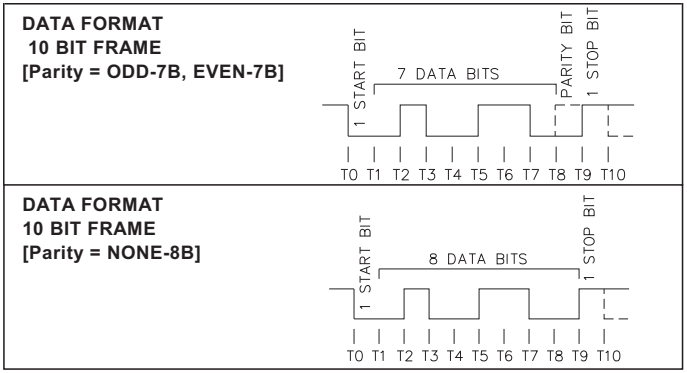
To start the Legend Programming Software (SFLGP) switch to the disk/directory that contains the Software. Type SFLGP and press ENTER. The software will display an opening screen that displays the current version of the Legend Programming Software. Press ENTER to proceed to the main editing screen. The screen is divided into four areas. The top of the screen contains a pull-down menu that allows actions such as uploading and downloading of a file. The bottom of the screen displays an alternate method of accessing the pull-down menu selections by using the F1-F8 keys in combination with the ALT key. The middle section displays the programming parameters of the current file and model of Legend. Below the pull-down menu is the file status information that indicates the current filename, model and available message/mnemonic memory available. Multiple pages are used to display all of the programming parameters. To change the page displayed press PGUP/PGDN or use the mouse to click on the arrows located at the upper and lower right of the screen.

Uploading/Downloading of files from the Legend requires that the Baud Rate and Unit Address of both the Legend and the SFLGP be identical. Prior to performing either an upload or download, a menu of the current PC communications settings will be displayed. These settings may be modified before proceeding with the intended action. Once the action is started, the Legend will display "TX'ING PROGRAM" if uploading or "RX'ING PROGRAM" if downloading. Uploading is file transfer from the LEGEND to the PC and Downloading is file transfer from the PC to the Legend.

COMMUNICATION FORMAT

The half-duplex communication operation sends data by switching voltage levels on the common pair of wires. Data is received by monitoring the levels and interpreting the codes that were transmitted. After the Legend Plus receives a Transmit Command or Print Request, it waits the Serial Transmit Delay time before it begins transmitting data. The serial transmit delay can be programmed for 0.002 or 0.100 second. For data to be interpreted correctly, there must be identical formats and baud rates between the communicating devices. The formats available for the Legend Plus unit are 1 start bit, 7 or 8 data bits, No parity or 1 parity bit (odd or even) and 1 stop bit. The available baud rates are; 1200, 2400, 4800, or 9600 baud. If any extended characters are to be used or transmitted, the Legend Plus communication port should be set-up for Parity of "NONE-8B". This configures the unit to accept and transmit 8 data bits with no parity.

Before serial communication can take place, the unit must be programmed to the same baud rate and parity as the connected equipment. In addition, the loop address number and print options should be known. When used with a terminal or host computer and only one unit is employed, an address of zero (00) may be used to eliminate the requirement for the address command when sending a command. If more than one unit is on the line, assignment of unique non-zero addresses is required.



SENDING COMMANDS AND DATA

When sending commands to the Legend Plus unit, a command string must be constructed. The command string may consist of command codes, value identifiers, and numerical data. Below is a list of commands and value identifiers that are used when communicating with the LGPM unit.

COMMAND	DESCRIPTION
M (4DH)	Request message command; Followed by the message number 0 to 9.
MC (4DH, 43H)	Clear message command.
N (4EH)	Address command; Followed by the address number 1 to 99.
P (50H)	Transmit print options command; Transmits the options selected in the Program Options Module section.
R (52H)	Reset value command; Followed by one Value Identifier (E, I, J, O, or 1 to 6 [for outputs]).
T (54H)	Transmit value command; Followed by one Value Identifier (A-O).
V (56H)	Change value command; Followed by one Value Identifier (A-E, K-O), then the proper numerical data.

SENDING COMMANDS AND DATA (Cont'd)

VALUE IDENTIFIERS	MNEMONIC
A (41H) PRESET 1	P1
B (42H) PRESET 2	P2
C (43H) COUNT SCALE FACTOR	SFC*
D (44H) RATE SCALE FACTOR	SFR*
E (45H) COUNT	CNT*
H (48H) RATE	RAT*
I (49H) PEAK	PEA*
J (4AH) VALLEY	VAL*
K (4BH) PRESET 3	P3
L (4CH) PRESET 4	P4
M (4DH) PRESET 5	P5
N (4EH) PRESET 6	P6
O (4FH) COUNTER LOAD	CLD

* *From Factory Settings, the mnemonic transmitted is based on full mnemonic programmed in Display Module. The print mnemonic is the first three characters of the full mnemonic. The printed mnemonics for the Scale Factors is SF followed by the first character of the full mnemonic for the value associated with the Scale Factor.*

Note: Command identifiers other than those listed should ***NOT*** *be transmitted. Otherwise, undefined or unpredictable operation could result.*

The command string is constructed by using a command, a value identifier, and a data value if required. The Data value need not contain the decimal point since it is fixed within the Legend Plus unit, when programmed at the front panel. The Legend Plus will accept the decimal point, however, it does not interpret them in any way. Leading zeros can be eliminated, but all trailing zeros must be present.

Example: If a Scale Factor of 1.0000 is to be sent, the data value can be transmitted as 1.0000 or 10000. If a "1" is transmitted, the Scale Factor will be changed to 0.0001.

The Address command is used to allow a command to be directed to a specific unit on the Serial Communications Line. When the unit address is zero, transmission of the Address command is not required. This is done for applications that do not require more than one Legend Plus. For applications that require several units, each Legend Plus on the line must be given a non-zero address. If they are given the same address, a command such as the Transmit Value Command, will cause all the units to respond simultaneously, resulting in a communication collision. All Legend Plus units in a multiple unit application should be given an address other than zero. If a unit has an address of zero, it will attempt to process any transmissions from the other Legend Plus units as commands. These transmissions fill up the receive buffer of the unit with an address of zero, which may produce unpredictable results.

The command string is constructed in a specific logical sequence. The Legend Plus does not accept command strings that do not follow this sequence. Only one operation can be performed per command string. Below is the procedure to be used when constructing a command string.

1. The first two or three characters of the command string must consist of the Address Command (N) and the address number of the unit (1 to 99). If the Legend Plus address is zero, the address command and number need NOT be sent.
2. The next characters in the command string is the actual command that the Legend Plus is to perform (M, MC, P, R, T, or V).
3. A Value or command Identifier is next if it pertains to the command. The command P (print) does not require a Value Identifier.
4. The numerical data will be next in the command string if the "Change Value" command is used.

5. All command strings must be terminated with an asterisk* (2AH). This character indicates to the Legend Plus that the command string is complete and begins processing the command Below are some typical examples of properly constructed command strings.

(EX. 1) Change Preset 1 Value to 123.4 on the Legend Plus with an address of 2.

COMMAND STRING: N2VA1234*

(EX. 2) Transmit the Count Value of the Legend Plus unit with an address of 3.

COMMAND STRING: N3TE*

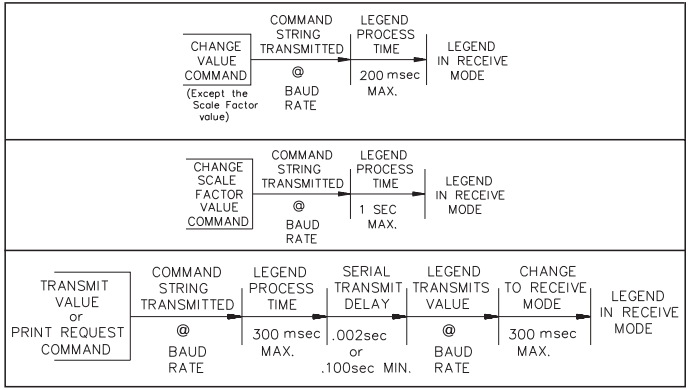
(EX. 3) Reset Output 1 of the Legend Plus unit with an address of 0.

COMMAND STRING: R1*

If illegal commands or characters are sent to the Legend Plus, the unit addressed responds by transmitting an error character “E” (45H) in which case the string must be re-transmitted.

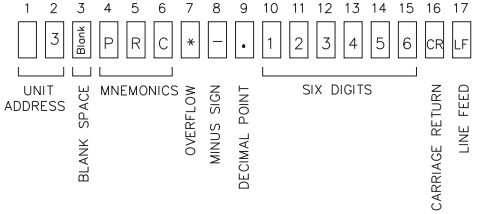
When writing application programs in Basic, the transmission of spaces or carriage return and line feed should be inhibited by using the semicolon delimiter with the “PRINT” statement. The Legend Plus will not accept a carriage return or line feed as valid characters. See “Terminal Emulation Program” section for a listing of an IBM® PC Basic terminal emulation program.

It is recommended that a “Transmit Value” command follow a “Change Value” Command. If this is done, the reception of the data can provide a timing reference for sending another command and ensures that the change has occurred. When a “Change Value or Reset Value” command is sent to the Legend Plus, time is required for the unit to process the command string. The diagrams show the timing considerations that need to be made. The Legend Plus process times shown are for a Legend Plus operating at the maximum count rate. The process times are count rate dependent and will be considerably less when the unit is operating at low count rates.



RECEIVING DATA

Data is transmitted from the Legend Plus when a "T" (Transmit Value) or a "P" (Transmit Print Options) command is sent to the Legend Plus via the serial port or when a User Input, programmed for the Print Request function, is activated. The Legend Plus will wait until the minimum serial transmit delay time (0.100 or 0.002 sec) expires and then begin transmissions. The Legend Plus can also be programmed to transmit Mnemonics. The format for a typical transmission string with mnemonics is shown below:



The first two digits transmitted are the unit address followed by one blank space. If the unit address is 0, the first locations are left blank. The next three characters are the mnemonics followed by one or more blank spaces. The numerical data value is transmitted next. Negative values are indicated by a "-" sign. If the numeric value is in an Overflow condition, an asterisk (*) will precede the most significant digit of the value. The decimal point position "floats" within the data field depending on the actual value it represents. The numeric data is right justified without leading zeros.

When a "T" command or print request is issued, the above character string is sent for each line of a block transmission. An extra <SP><CR><LF> is transmitted following the last line of transmission from a print request, to provide separation between print outs.

If Mnemonics are NOT transmitted (MNEM - NO print option), the Legend only transmits the numeric data. The unit address, extra spaces and 400 msec time delay, is not sent. If the Legend Plus transmits Mnemonics (MNEM - YES), there is a 400 msec built-in time delay after each transmission string. When interfacing to a printer, sending Mnemonics is usually desirable. Examples of transmissions are shown below:

3 PRC -6732.5<CR><LF> (400 msec delay) Mnemonics Sent
-6732.5<CR><LF> NO Mnemonics Sent

The various Print Options are used with a printer or a Computer Terminal. They provide a choice of which Legend Plus data values are to be printed, when either the User Input, programmed for the print request function is activated, or a "P" (Transmit Print Options) command is sent to the Legend Plus via the serial port. The Print Options are programmed in the "Program Print Options" module, the available options are:

A. Print Rate Value.
B. Print Peak Value.
C. Print Valley Value.
D. Print Count Value.
E. Print Scale Factors (Count & Rate) Values.
F. Print Presets 1 & 2 Values.
G. Print Presets 3 & 4 Values.
H. Print Presets 5 & 6 Values.
I. Print Counter Load Value.
J. Print Mnemonics for all Values.
K. Reset selected Count values following print
L. Print Message 0.

A print out from a Legend Plus unit with an address of 1 and all print options selected is shown below. Message #0 is programmed with the text, "MACHINE #1".

MACHINE #1
1 RAT54
1 PEA100
1 VAL0
1 CNT4000
1 SFC1.0000
1 SFR1.0000
1 P1500
1 P21000
1 P3300
1 P4400
1 P5500
1 P6600
1 CLD-100

TERMINAL EMULATION PROGRAM FOR IBM® PC

Utilizing the RS485 Serial communications capability of the Legend Plus requires the use of an RS485 serial card in the computer. If an IBM® PC compatible is used, this card would be installed in an expansion slot on the mother-board. The RS485 card should be configured for "2-wire half-duplex" operation. For this mode of operation, each piece of equipment must be able to switch from receive mode to transmit mode and vice-versa. The Legend Plus is normally in the receive mode. It automatically switches to the transmit mode when a Transmit Value Command is issued or a Print Request is issued. For the computer to switch from receive to transmit mode, the controlling software must be written to perform this task. On most RS485 serial cards the RTS (Request-to-send) signal can be configured to be used as the direction (transmit/receive) control signal. The controlling software must switch the state of the RTS line when the computer is to switch from transmitting to receiving data.

The Serial Transmit delay, "XMIT DLY", of the Legend Plus is used to give the computer time to switch from transmit to receive mode. The delay can be programmed to be either 0.002 or 0.100 second.

If an RS485 card cannot be obtained, and only an RS232 port is available, the Legend Plus unit has the capability of operating directly from RS232 by changing the jumper selection on the back of the unit. When using RS232, only one Legend can be connected to the RS232 port.

Listed below is a basic program that emulates a terminal. It is written using GW Basic. The program may need to be modified if using a different Basic interpreter. Set up the Legend Plus for a baud rate of 9600. When the program is running, commands can be typed in from the keyboard as shown in the previous examples. An asterisk (*) is used to end all commands, Do NOT use the carriage return to end a command. When using this program, the Serial Transmit Delay should be set to 0.100 second.

```
1 REM"FOR THIS PROGRAM TO WORK THE "RS485" CARD SHOULD BE SET-UP AS COM2"
2 REM "ALSO THE CARD SHOULD USE "RTS" FOR HANDSHAKING"
3 REM "THE LEGEND PLUS SHOULD BE SET-UP FOR 9600 BAUD, AND ODD PARITY"
4 TXEMPTY = &H60
5 LSR = &H2FD: REM "COMM2 LINE STATUS REGISTER"
6 MCR = &H2FC: REM "COMM2 MODEM CONTROL REGISTER"
10 CLS : CLOSE :
20 OPEN "COM2:9600,0,7,1" FOR RANDOM AS #1
30 ON TIMER(1) GOSUB 300
40 A$ = INKEY$: IF A$ < > ""THEN GOTO 1000:REM "CHECK FOR KEYBOARD INPUT"
50 IF LOC(1) = 0 THEN 40 ELSE 80: REM "CHECK FOR INPUT"
60 IF LOC(1) = 0 THEN 80: REM "SKIP CLEARING OF BUFFER"
70 B$ = INPUT$(LOC(1), #1): REM "CLEAR BUFFER"
80 F = INP(MCR) AND 253: OUT MCR, F: REM "SET FOR RECEIVE MODE"
90 IF INP(LSR) < > TXEMPTY THEN 90: REM "WAIT UNTIL DONE TRANSMITTING"
100 TIMER ON
110 IF LOC(1) = 0 THEN 110
120 B$ = INPUT$(1, #1)
130 IF B$ = CHR$(10) THEN 160: REM "TO PREVENT DOUBLE SPACING ON PRINT"
140 PRINT B$;
160 IF NOT B$ = "" THEN GOTO 90
170 TIMER OFF
200 GOTO 40
300 TIMER OFF: RETURN 40
1000 D = INP(MCR) OR 2: OUT MCR, D; REM "SET FOR TRANSMIT MODE"
1010 PRINT #1, A$; : PRINT A$; : REM "PRINT KEYSTROKE"
1020 IF A$ = "*" THEN PRINT
1030 IF A$ = "*" THEN IF INP(LSR) < > TXEMPTY THEN 1030 ELSE GOTO 60
1040 A$ = INKEY$: IF A$ < > "" THEN GOTO 1000
1050 GOTO 1010
```

SERIAL CONNECTIONS

When wiring, remove the 10-position terminal block, which is on the top board at the rear of the unit. Refer to the top label and configure the RS485/RS232 jumpers for the desired interface. Then, refer to the numbers listed on the label with the terminal description for installing each wire in its proper location.

For RS485 the data (transceiver) wires connect to the A (+)/TXD and B (-)/RXD terminals. 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. In some applications, a signal ground may be required to establish a ground reference. The signal ground is required if the equipment does not have internal bias resistors connected to the transceiver lines. The signal ground is connected from only one Legend Plus to the equipment. If necessary, the shield can be used as the signal ground.

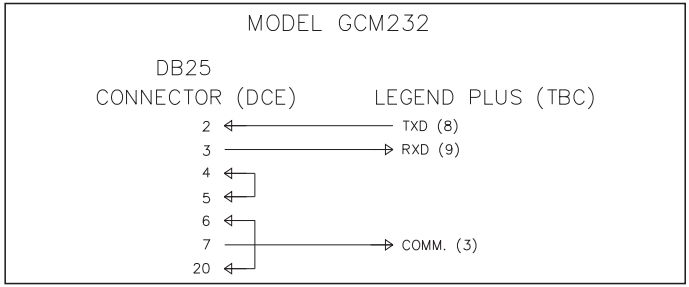
TERMINAL DESCRIPTIONS

COMM. - Common required for some applications.

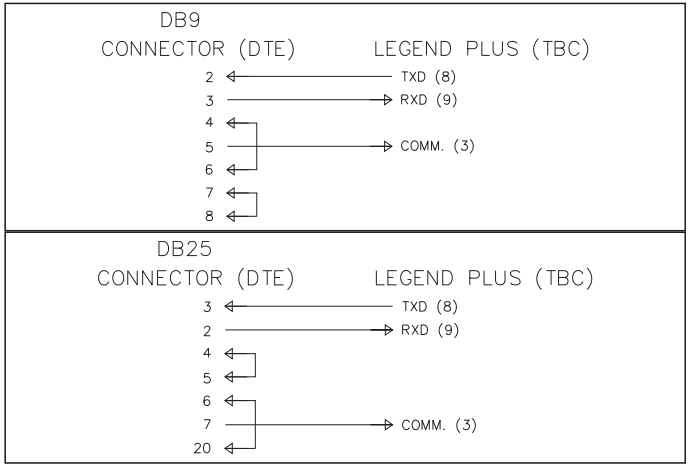
A (+)/TXD & B (-)/RXD - The Legend Plus transmits and receives on these two terminals which are connected to the external device.

TX EN. - Used primarily with a Red Lion Controls (RLC) GCM422 module to interface with an RLC model DMPC printer or connect to a Legend Plus in a 20 mA communication loop with other units.

For connection to an GCM232 Converter Module, refer to diagram below.



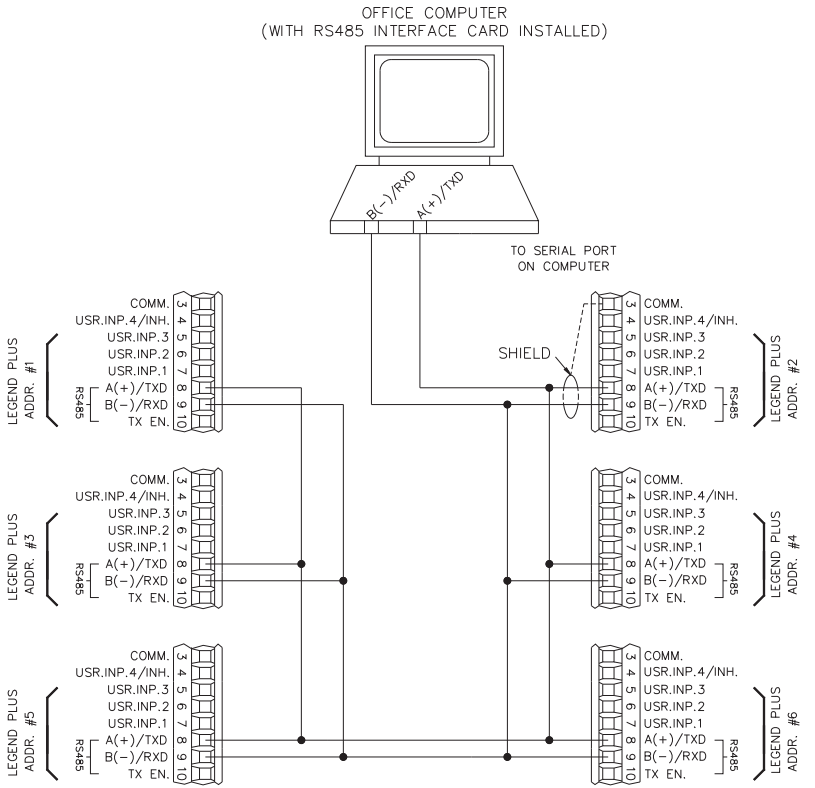
For connection to an RS232 port on a computer, refer to diagrams below.



When all connections are made, replace the terminal block into its proper location.

CONNECTING TO A HOST TERMINAL

Six Legend Plus units are used to monitor and control parts packaging machines in a plant. The Legend Plus 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 Legend Plus is programmed for a different address and are all programmed for the same baud rate and parity as the computer (ex. 9600 baud, parity even). An application program is written to send and receive data from the units using the proper commands.



TROUBLESHOOTING SERIAL COMMUNICATIONS

If problems are encountered when interfacing the Legend Plus(s) and host devices or printers, the following check list can be used to help find a solution.

1. Check all wiring. Refer to the previous application examples and use them as a guide to check your serial communication wiring. Proper polarity of all Legend Plus(s) and other peripherals must be observed.
2. Check RS232/RS485 configuration jumpers for proper interface selection.
3. If the Legend Plus is connected to a "host computer", device or printer, check to make sure that the computer or device is configured with the same communication format as the Legend Plus. The communication format that the Legend Plus will accept is; 1 start bit, 7 or 8 data bits, no parity or 1 parity bit (odd or even), and 1 stop bit.
4. Check the baud rate and parity in the Program Communication Module and make sure all devices on the line have the same baud rate and parity.
5. Check the Legend Plus's unit address. If the Address command is not used when transmitting a command to the Legend Plus, the Legend Plus's address must be set to 0. See "Sending Commands & Data" for command structure.
6. If two-way communications are to be established between the Legend Plus and a computer, have the computer receive transmissions from the Legend Plus first. Activating a User Input, programmed for the print request function, will initiate transmissions from the Legend Plus.
7. When sending commands to the Legend Plus, an asterisk *(2Ah) must terminate the command. NO CARRIAGE RETURNS (0Dh) OR LINE FEED (0Ah) CHARACTERS SHOULD BE SENT TO THE LEGEND PLUS. If they are sent, the Legend Plus will respond by transmitting an "E".
8. In multiple unit configurations, make sure each unit has a different address other than zero. If a transmit value or print request command is issued, an asterisk (*) must be sent before sending another transmission.
9. In some RS485 applications, a twisted pair with a signal ground may be needed to establish a ground reference. The signal ground is required if the equipment does not shave internal bias resistors connected to the transceiver lines. The signal ground is connected from only one Legend Plus to the equipment.

INSTALLATION & CONNECTIONS

Installation Environment

Before installing the Legend Plus into the panel, the user should first become familiar with the unit. Also, it may be desirable to program the unit and set the appropriate DIP switches for the application. When programming is complete, all parameters will be saved in nonvolatile memory. The Program Disable DIP switch used with an external User Input, programmed for the program disable function, provides various levels of security to prevent accidental or unauthorized programming changes. The Legend Plus should be installed in a location that does NOT exceed the maximum operating temperature and provides good air circulation. 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.

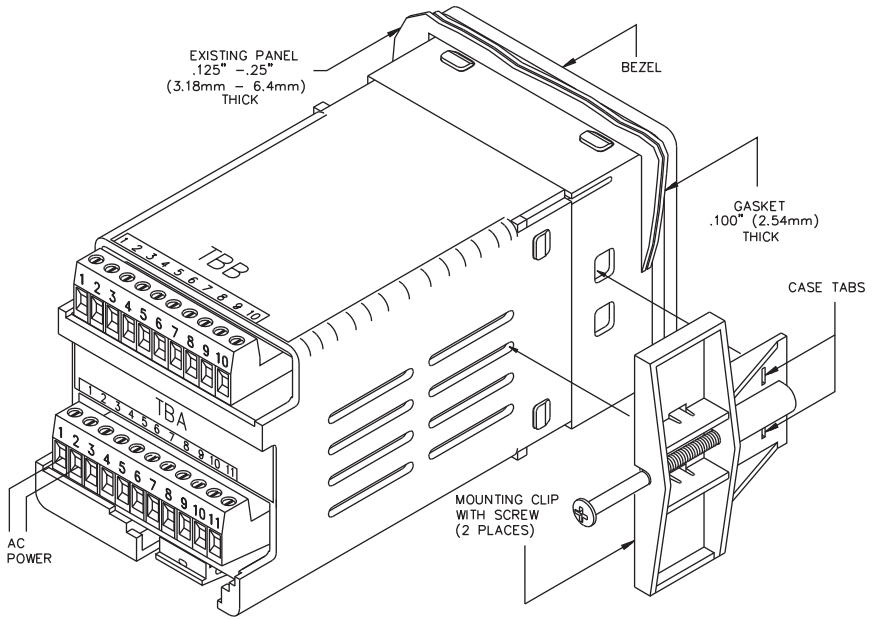
Installation

The unit meets NEMA 4X/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 that is too thin may distort and not provide a water-tight seal, therefore the recommended minimum panel thickness is 1/8" (3.2 mm). The recommended clearance behind the panel for mounting clip installation is 3.0" (6.45 cm) H x 4.0" (10.16 cm) W.

After the panel cut-out is completed and deburred, carefully apply the gasket to the panel. DO NOT APPLY THE ADHESIVE SIDE OF THE GASKET TO THE BEZEL. Insert the unit into the panel as depicted in the drawing. Thread the screws into the clips until the pointed end just protrudes through the other side. Install each mounting clip by inserting the case tabs of the clip into the holes, located on either side of the bezel.

Then snap the rear end of the clip into the case and slide the clip towards the rear of the unit, locking it in place. 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 over tighten screws.*



EMC COMPLIANCE INSTALLATION

This unit complies with the Electromagnetic Compatibility (EMC) standards listed in the specifications. Compliance to the EMC standards was demonstrated by means of a test set-up using the following installation methods:

1. Unit installed in a metal panel mounted to an open aluminum rack connected to earth ground (protective earth).
2. Shielded (screened) cables for Signal and Control inputs, and solid state outputs (01-06 SNK) with shield drain wire connected to earth ground at the mounting panel only.

Multi-conductor Cable	Function Used For
Belden #8451 - 2 conductor, #22 AWG twisted pair w/ foil shield and drain wire	User Input 4/Inhibit
Belden #8771 - 3 conductor, #22 AWG with foil shield and drain wire	Input A, Input B, User Inputs 1,2 & 3, 01-06 SNK (solid state outputs)
Alpha #2404 - 4 conductor, #22 AWG with foil shield and drain wire	RS485/RS232

3. EMI line filter (Corcom #1VB3) placed on the DC power supply when DC powered.
   Test: EN 61000-4-4 EFT and ENV 50141 RF Conducted Immunity.
4. Ground shield or ferrite suppression core (TDK #ZCAT3035-1330A) at device end (opposite end from unit) on serial communication cable eliminates serial transmission garble.
   Test: RF Conducted Immunity per ENV 50141

It should be noted that the methods listed above may not be necessary for every unit installation. For the purpose of EMC testing, every input and output line on the unit was connected with 25 feet (8 m) of cable. 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 troublesome installation.

ADDITIONAL 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 the electrical noise, source or coupling method into the unit may be different for various installations. Listed below are some additional EMC guidelines for successful installation in an industrial environment.

1. Use shielded (screened) cables for all Signal and Control inputs. 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.
2. 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.
3. Signal or Control cables within an enclosure should be routed as far away as possible from contactors, control relays, transformers, and other noisy components.

ADDITIONAL EMC INSTALLATION GUIDELINES (Cont'd)

4. 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 #1VB3
   Corcom #1VR3
   Note: Reference manufacturer's instructions when installing a line filter.
5. Long cable runs are more susceptible to EMI pickup than short cable runs. Therefore, keep cable runs as short as possible.
6. Switching of inductive loads produces high EMI. Use of snubbers across inductive loads suppresses EMI.
   Snubbers:
   RLC #SNUB0000

WIRING CONNECTIONS

The bottom board has a removable terminal block (TBA) where the solid state outputs and the power connections are made. The top board has a removable terminal block (TBB) where the signal inputs, User Inputs, and serial communications connections are made. When wiring the unit, remove the terminal block and use the numbers on the top label to identify the position number with the proper function. 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 (AC or DC) be protected by a fuse or circuit breaker. Strip the wire, leaving approximately ¼" 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 in tightly. Each terminal can accept up to two 18-gage wires. After the terminal block is wired, install it in the proper location at the rear of the unit. Wire each terminal block in this manner.

USER INPUT WIRING

Programmable external user inputs are digital inputs that are active when connected to TBC #3 Common. The use of shielded cable is recommended. Follow the Additional EMC Installation Guidelines for shield connection.

A.C. POWER WIRING

The AC power is connected to the bottom left terminals TBA 1 & 2 marked AC PWR. The voltage selector switch, located at the side of the unit, is used to select the proper voltage. The switch is a slide movement type and can be set by using a small screwdriver. If the switch is toward the front of the unit, it is set for 115 VAC input. If the switch is towards the rear of the unit, it is set for 230 VAC input. The switch is in the 230 VAC position when shipped from the factory.

Note: Before applying power to the unit make sure the A.C. power switch is set for the proper voltage setting.

To reduce the chance of noise spikes entering the AC line and affecting the unit, the AC power should be relatively "clean" and within the specified ±10% variation limit. Connecting power from heavily loaded circuits or circuits that also power loads that cycle on and off, (contactors, relays, motors, etc.) should be avoided.

DC POWER WIRING

The DC power is connected to the bottom left terminals TBA 3 & 4 marked +12 VDC and common. The DC power source must be capable of supplying the unit's rated current (250 mA) and be within the specified ±20% variation limit. It is not necessary to provide battery backup to retain programmable information. The Legend Plus has non-volatile memory and information is stored on power down (Refer to block diagram).

SERIAL COMMUNICATIONS

Refer to the Serial Communications section of the manual, for wiring and operational procedures.

SIGNAL WIRING

INPUTS A & B

Input A and Input B have the same input circuitry and share the same common. Input A and Input B each have separate DIP switches for setting the type of signal input. A Magnetic Pickup or Logic Input signal can be sent to either input. When a MAGNETIC PICKUP is used, the Sink/Source DIP switch, for the appropriate input, must be in the "SRC" position or the unit will not receive the signal. The HI/LO FRQ DIP switch affects the maximum input frequency at that input.

The Input schematic shows the details of Input A and Input B circuitry. Each input has three DIP switches associated with its input. The functions of these switches are as follows:

INPUT A

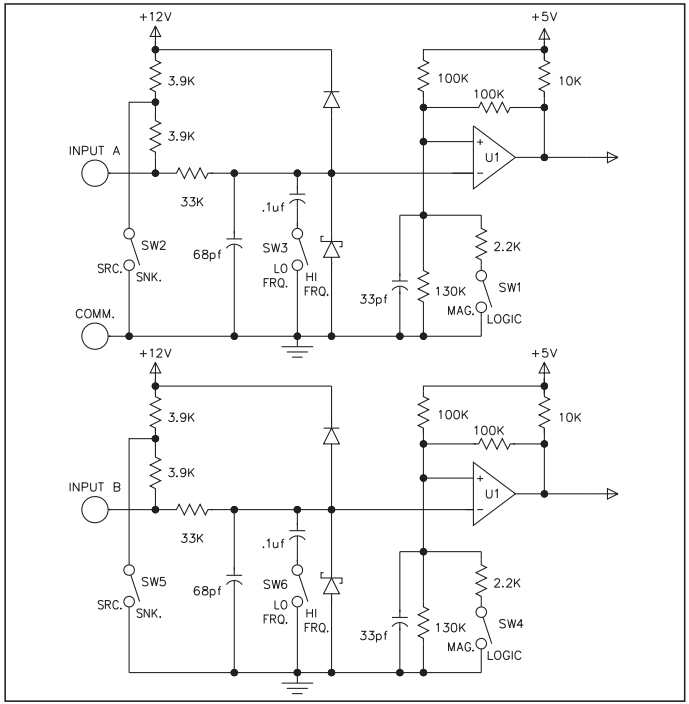
SW1 - MAG: Sets input for a Magnetic Pickup signal.
Sensitivity: 200 mV peak; hysteresis: 100 mV
LOGIC: Sets input for a Logic signal.
Input trigger levels: V_{IL} = 1.5 V max; V_{IH} = 3.75 V max.

Note: SW2 must be in the "SRC" position for a Magnetic Pickup signal.

SW2 - SNK: Provides a 7.8 KΩ internal pull-up resistor for sensors with current sinking outputs.
SRC: Provides a 3.9 KΩ internal pull-down resistor for sensors with current sourcing outputs.

SW3 - HI FRQ: Removes damping capacitor and allows operation up to the max. frequency.
LO FRQ: Connects damping capacitor for switch contact debounce. Limits count speed to 50 cps max. Min. count pulse ON or OFF time is 10 msec.

Note: The HI/LO FRQ selection switch must be set on "LO FRQ" when switch contacts are used to generate count input signals. The "LO FRQ" mode provides very high immunity against electrical noise pickup. It is recommended that this mode also be used, whenever possible, with electronic sensor outputs. The "LO FRQ" mode can be used with any type of sensor output, provided count pulse widths never decrease below 10 msec, and the count rate frequency does not exceed 50 Hz.



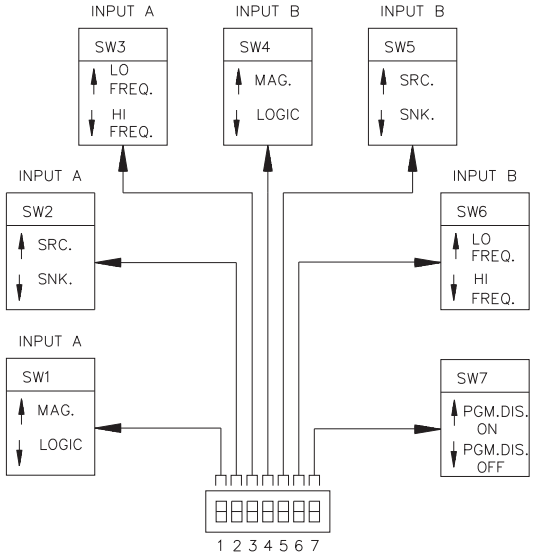
INPUT B

SW4 - Same as SW1
SW5 - Same as SW2
Note: SW5 must be in the "SRC" position for a Magnetic Pickup signal.
SW6 - Same as SW3

Note: A Magnetic Pickup type sensor should not be used unless a large enough signal is provided at all speeds of operation.

DIP SWITCH SET-UP

The DIP switches are accessible through the side of the Legend Plus. The DIP switch positions and their functions are shown below:



NOTES:

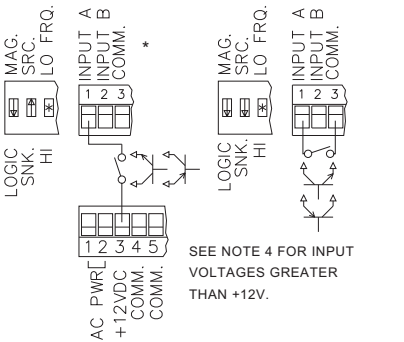
1. SENSOR VOLTAGE AND CURRENT
   The +12 VDC (in/out) terminal can supply voltage to a sensor within a ±25% variation, due to line and internal load variations. All RLC sensors will accommodate this variation.
2. HI/LO FRQ SELECTION
   The HI/LO FRQ selection switch must be set on "LO FRQ" when switch contacts are used to generate count input signals. The "LO FRQ" mode also provides very high immunity against electrical noise pickup. It is recommended that this mode also be used, when possible, with electronic sensor outputs. The "LO FRQ" mode can be used with any type of sensor output, provided count pulse widths never decrease below 10 msec, and the count rate frequency does not exceed 50 cps.
3. When shielded cable is used, the shield should be connected to "COMM." at the unit and left disconnected at the sensor end.
4. Inputs A and B can accept source pulses from other circuits up to +28 V in amplitude. For voltages above +28 V, a limiting resistor and zener diode should be used to limit the voltage at the input.

VARIOUS SENSOR OUTPUT CONNECTIONS *(See Note 1)*

COUNT SWITCH OR ISOLATED TRANSISTOR OUTPUTS

CURRENT SOURCE CONNECTED (COUNT ON OPENING)

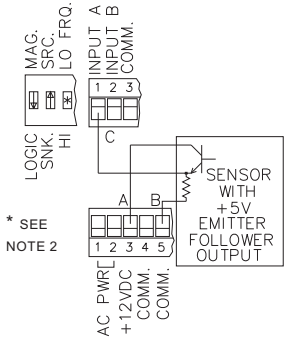
CURRENT SINK CONNECTED (COUNT ON CLOSING)



RLC SENSOR MODELS: PR & RR PHOTO-ELECTRICS

SENSORS WITH -EF OUTPUT-CURRENT SRC CONN.

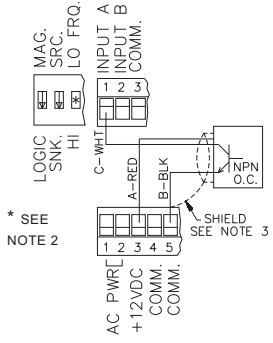
(COUNT ON FALLING EDGE)



RLC SENSOR MODEL: LMP-EC

SENSORS WITH CURRENT SINK OPEN COLLECTOR (NPN O.C.)

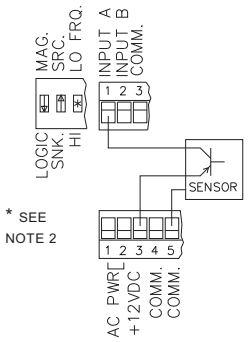
(COUNT ON TURN-ON)



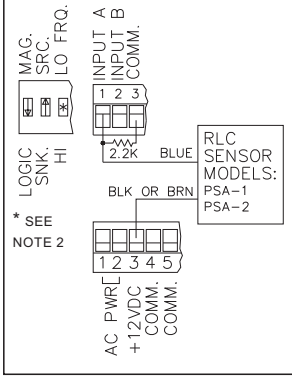
RLC SENSOR MODELS: ASTC, LMPC, LSC, PSAC, RPGB, RPGC, RPGH

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

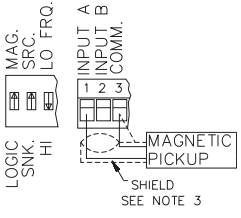
(COUNT ON TURN-OFF)



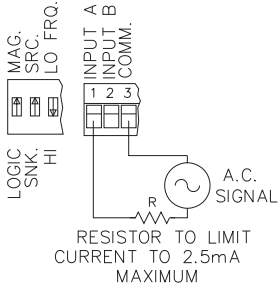
2-WIRE PROXIMITY SENSORS



MAGNETIC PICKUPS

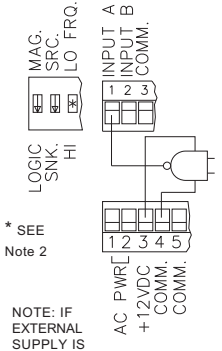


A.C. INPUTS FROM INVERTERS,



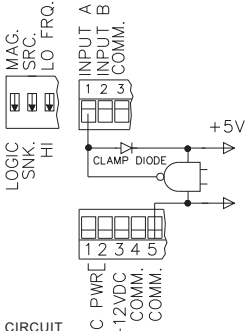
A.C. SIGNALS OVER 50VAC PEAK SHOULD BE ISOLATED BY A STEP DOWN TRANSFORMER.

INTERFACING WITH CMOS



NOTE: IF EXTERNAL SUPPLY IS USED TO POWER CMOS CIRCUIT, THE VOLTAGE MUST BE ≥ DC OUT VOLTAGE

INTERFACING WITH TTL



NOTE: CIRCUIT SHOWN FOR STD TTL OUTPUT. TTL CIRCUITS ARE AVAILABLE W/OPEN COLLECTOR OUTPUTS ELIMINATING THE NEED FOR A DIODE CLAMP.

SPECIFICATIONS & DIMENSIONS

1. **DISPLAY:** 2X8, 0.3" (7mm) high characters, negative image transmissive LCD, with Single (green or red) or Dual Color (green and red) LED backlighting.
2. **POWER:**
   AC Operation: 115/230 VAC ±10%, 50/60 Hz, 10 VA, switch selectable.
   DC Operation: +12 VDC ±20% @ 250 mA. max.
3. **MEMORY:** Non-volatile memory retains all programming information. Count and Preset values are written to non-volatile memory when power is interrupted. All other programming parameters are written to memory when programming mode is exited. If power is removed while in the programming menus, the parameters are restored to previously saved settings.
   Data Retention: 10 years minimum
   Message/Mnemonics Memory: 804 bytes available (with factory settings loaded).
4. **SENSOR POWER:** +12 VDC ±25% @ 100 mA.
5. **INPUTS A and B:** DIP Switch selectable to accept count pulses from a variety of sources including switch contacts, outputs from CMOS or TTL circuits, and all standard RLC sensors.

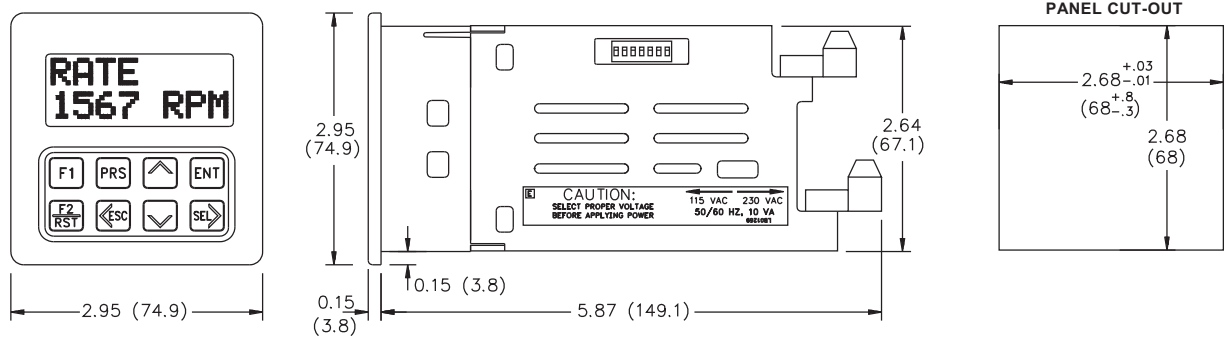
LOGIC: Input trigger levels V_{IL} = 1.5 V_{MAX}; V_{IH} = 3.75 V_{MIN}.
Current sinking: Internal 7.8 KΩ pulled up to +12 VDC , I_{MAX} = 1.9 mA.
Current sourcing: Internal 3.9 KΩ pull-down, 7.3 mA @ 28 VDC_{MAX}.
Debounce: Damping capacitor provided for switch contact bounce. Limits count speed to 50 Hz and input pulse widths to 10 msec minimum.

MAGNETIC PICKUP:
Sensitivity: 200 mV peak.
Hysteresis: 100 mV.
Input impedance: 3.9 KΩ @ 60 Hz.
Maximum input voltage: ±50 Vp
Note: For magnetic pickup input, the sink/source DIP switch must be in the SRC position.

6. **RATE ACCURACY:** +0.01%.
7. **RATE MINIMUM INPUT FREQUENCY:** 0.01 Hz.

DIMENSIONS In inches (mm)

Note: Recommended minimum clearance (behind the panel) for mounting clip installation is 3.0" (76.2)H x 4.0" (101.6)W.



8. **MAXIMUM COUNT RATE IN KHz**:

MODEL	CNT + DIR		QUAD			ADD/ADD	ADD/SUB
	X1	X2	X1	X2	X4	X1*	X1*
LGPM (Multi)	13	6	6	5	2.5	12	6

***Notes**:*

1. Maximum count rates given are for counter set for Auto reset with the auto cycle preset set to an equivalent of 100 count pulses or greater. With auto cycle presets less than 100 counts the maximum count rates may be lower. The actual Preset value for 100 count pulses, with Count SF = 0.5000 and Count Scale Multiplier = X1, would be 50.

2. Maximum count rate given for X2 and X4 count modes are given for 50% duty cycle signals and Quad signals with 90º phase shift.

* - *Inputs A and B count rates summed.*

9. **MAXIMUM COUNT CAPACITY:**
Count: 9 digits internal (non-scaled),
6 digits displayable (scaled).

10. **CONTROL INPUTS:**
Programmable User Inputs (4):
USR INP 1 to 3: Internal 10 KΩ pull-up to +5 VDC, V_{IL} = 1.0 V_{MAX}; V_{IH} = 4.0 V_{MIN}, V_{max} = 30 VDC, response time = 30 msec typical, 100 msec max. (count rate dependent).
USR INP 4/INH: Internal 10 KΩ pull-up to +5 VDC, V_{IL} = 1.5 V_{MAX}; V_{IH} = 3.0 V_{MIN},, V_{max} = 30 VDC, response time = 30 msec typical, 100 msec max. (count rate dependent).
INHIBIT Response time = 50 µsec max.
User Inputs Programmed for Binary Message Request: Debounce = 100 msec. (Binary Message Request Inputs must be stable for 100 msec. before a message is requested).

11. **SERIAL COMMUNICATIONS:**
Type: Jumper selectable RS485 or RS232.
Can connect up to 32 units when using RS485 interface.
Baud Rate: Programmable from 1200 to 9600.
Maximum Addresses: Programmable from 00 to 99. (Actual number on a line is limited by hardware specifications)
Transmit Delay: Programmable for 0.002 or 0.100 second.
Data Format: 10 Bit Frame; 1 start bit, 7 or 8 data bits, 1 or no parity bit, and 1 stop bit. Parity is programmable for either ODD (7 data bits), EVEN (7 data bits), or NO Parity (8 data bits).

12. **OUTPUT(S):**
Solid-State: Current sinking NPN open collector transistor.
V_{CE} = 1.1 V_{SAT} @ 100 mA max. V_{OH} = 30 VDC max. (Internal Zener Diode Protection).
Programmable Timed Output(s): Programmable time ranges from 0.01 to 99.99 seconds, ±0.05% - 11 msec. max.
Output Time Required to Request Message: 50 msec.
Count Boundary Output Response Time: 10 msec. nominal

13. **ENVIRONMENTAL CONDITIONS**:
Operating Temperature: 0 to 50°C
Storage Temperature: -40 to 70°C
Operating and Storage Humidity: 85% max. relative humidity (non-condensing) from 0°C to 50°C.
Vibration According to IEC 68-2-6: Operational 5 to 150 Hz, in X, Y, Z direction for 1.5 hours, 2 g.
Shock According to IEC 68-2-27: Operational 20 g (10 g relay), 11 msec in 3 directions.
Altitude: Up to 2000 meters

14. **CERTIFICATIONS AND COMPLIANCES:**

SAFETY

IEC 61010-1, EN 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1.

IP65 Enclosure rating (Face only), IEC 529

Type 4X Indoor Enclosure rating (Face only), UL50

ELECTROMAGNETIC COMPATIBILITY

Immunity to EN 50082-2

Electrostatic discharge	EN 61000-4-2	Level 2; 4 Kv contact Level 3; 8 Kv air
Electromagnetic RF fields	EN 61000-4-3	Level 3; 10 V/m 80 MHz - 1 GHz
Fast transients (burst)	EN 61000-4-4	Level 4; 2 Kv I/O[1] Level 3; 2 Kv power
RF conducted interference	EN 61000-4-6	Level 3; 10 V/rms[1] 150 KHz - 80 MHz
Power frequency magnetic fields	EN 61000-4-8	Level 4; 30 A/m

Emissions to EN 50081-2

RF interference	EN 55011	Enclosure class A Power mains class A

Note:

1. When the unit is DC powered from terminal TBA pin 5 (common) and terminal TBA pin 3 (DC OUT/IN) a power line filter was installed, RLC #LFIL0000 or equivalent, so as not to impair the function of the unit.

Refer to EMC Compliance Installation for additional information

15. **CONSTRUCTION:** High impact plastic case with clear viewing window. This unit is rated for NEMA 4X/IP65 indoor use. Installation Category II, Pollution Degree 2. Panel gasket and mounting clips included.

16. **WEIGHT:** 1.5 lbs. (0.68 Kg)

TROUBLESHOOTING GUIDE

For further technical assistance, contact technical support at the numbers listed on the back cover of the instruction manual.

PROBLEMS	*POSSIBLE CAUSE*	*REMEDIES*
NO DISPLAY	1. Power off	1. Verify power.
	2. Improperly wired	2. Check wiring.
	3. Voltage selector switch in the wrong position.	3. Check switch position.
	4. Power in a Brown out condition	4. Verify voltage reading.
	5. If powered by +12 VDC source, not enough current to drive Legend Plus.	5. Verify Source current rating.
	6. Blank message requested.	6. Check message, Output message request User Input programming.
	7. Mnemonics/Display not programmed properly.	7. Check Display programming.
CHECKSUM ERROR 1 OR 2 ON DISPLAY	1. Data error detected by processor.	1. Press “ENT” key. a. Check all programming parameters. 2. Check signal lines for possible noise sources.
UNIT DOES NOT COUNT	1. No input signal.	1. Check sensor connections. a. Verify power to sensor.
	2. Type of input signal incorrectly selected.	2. Check DIP switch setting on side of unit.
	3. Count Inhibited.	3. Disable Count Inhibit.
	4. Scale factor and/or multiplier value too small.	4. Check scale factor value and scale multiplier values.
UNIT WILL NOT ACCEPT THE DESIRED PRESET	1. When a count scale factor greater than 1 is used, the preset value must be evenly divisible by the scale factor.	1. Unit automatically adjusts preset to be evenly divisible by the scale factor.
UNIT COUNTS INCORRECTLY	1. Input signal type incorrectly selected.	1. Check DIP switches. Set HI/LO FRQ. switch to LO for a count speed of less than 50 Hz.
	2. Inputs improperly connected.	2. Check sensor input connections.
	3. Electrical noise interference.	3. Check power source for noise. a. Check signal wire routing.
	4. Incorrect counting mode.	4. Verify programming in “Program Cntr Module”.
	5. Scale factor incorrect.	5. Verify scale factor value.

TROUBLESHOOTING GUIDE (Cont'd)

PROBLEMS	*POSSIBLE CAUSE*	*REMEDIES*
COUNT, PEAK, OR VALLEY VALUES WILL NOT RESET WHEN A MANUAL RESET IS PERFORMED	1. User Input NOT properly programmed.	1. Verify programming in "Program User Module".
CAN NOT ENTER INTO PROGRAMMING MENUS	1. Front panel disabled.	1. Check "Front Panel Accessible Functions With Program Disable" section in manual.
PRESETS, COUNTER LOAD, OR SCALE FACTORS CAN BE VIEWED BUT NOT CHANGED	1. Front panel disabled.	1. Verify programming in "Program Options Module" sub-menu Operator Access. 2. Check " Front Panel Accessible Functions With Program Disable" section of manual.
UNIT COUNTS WHILE RESET IS ACTIVATED	1. User Input Reset mode set for Momentary reset.	1. Program User Input to a Maintained reset.
PRESET OR COUNTER LOAD VALUE LOADS SMALLER NUMBER THAN WHAT IS ENTERED	1. Entered number exceeds internal count capacity (Scale multiplier/Scale factor too small).	1. Check scaling. Reduce number of pulses per unit of measure.
OUTPUT WILL NOT RESET	1. Output assigned to wrong display (Count or Rate). 2. Reset with count disabled (Program Outputs Module). 3. User Input NOT properly programmed.	1. Verify programming in "Program Outputs Module". 2. Verify programming in "Program Outputs Module". 3. Verify programming in "Program User Module".

TROUBLESHOOTING GUIDE (Cont'd)

PROBLEMS	*POSSIBLE CAUSE*	*REMEDIES*
NO RATE INDICATION	1. No signal at Input A.	1. Check sensor connections. a. Verify power to sensor.
	2. Type of input signal selected incorrectly.	2. Check DIP switch setting on side of unit.
	3. Rate Scale factor and/or Rate Scale Multiplier too small.	3. Check scale factor value and scale multiplier values.
INCORRECT RATE READING	1. Input signal type incorrectly selected.	1. Check DIP switches. Set HI/LO FRQ. switch to LO for a count speed of less than 50 Hz.
	2. Inputs improperly connected.	2. Check sensor input connections.
	3. Electrical noise interference.	3. Check power source for noise. a. Check signal wire routing.
	4. Scale factor incorrect.	4. Verify scale factor value.
	5. Rate input signal too high of a frequency.	5. Verify input signal.
RATE DISPLAY FLASHING OVERFLOW	1. Rate Scale Factor, Multiplier and/or Conversion Factor values too large.	1. Check values.
	2. Minimum update time set too high for input rate. See Note in "Programming Rate" Section.	

APPENDIX "A" - SCALING FOR COUNT INDICATION

SCALING FOR COUNT INDICATION

The Legend Plus is factory set to provide 1 count on the display for each pulse that is input to the unit. In many applications, there is not a one to one correspondence between input pulses and display units. In these applications it is necessary for the Legend Plus to scale or multiply the input pulses by a scaling factor to achieve the proper display units desired (feet, meters, gallons, etc.). The Count Scale Factor, the Count Scale Multiplier, and the Number of Count Edges are used in scaling the input pulses to the desired reading. The number of count edges is determined in the Program Counter Module. For example, the number of edges for the CNT+DIRX1 mode is one and the QUAD X4 mode is four. All three are factored together to provide the Scaling necessary for the Process display. The Count Scale Factor and Scale Multiplier are programmed in the Program Scaling section.

The first step in scaling requires the Number of Pulses per Display Units to be obtained. This may require a small amount of deductive reasoning.

Example: A 48-tooth gear is mounted to a 2 ft circumference feed roll in a paper processing plant. It is desired to display the footage of paper processed per day. In this example, the display units are in feet. A sensor sensing the gear teeth provides 48 pulses for each revolution of the feed roll. Each revolution equates to a linear distance of 2 feet. The number of Display Units desired is 2. The Number of Pulses per Display Units is 48. When the number of Display Units and the Number of Pulses have been obtained, the Total Scaling can be calculated.

The Total Scaling, denoted as "K_T", is simply the total amount of scaling required for the Process. It is obtained by dividing the Display Units by the Number of Pulses as shown in Formula #1 below.

FORMULA #1: K_T = Display Units ÷ Number of Pulses

WHERE:

K_T = Total Scaling.

Display Units = The number of desired units (revolutions, feet, 10ths of feet, meters, etc.) that would be acquired after the Number of Pulses has occurred.

Number of Pulses = The Number of pulses required to achieve the number of Display Units.

For the preceding example, the Total Scaling, "K_T", is calculated by plugging in 2 and 48 in the formula:

$$K_T = 2 \div 48 = 0.041667$$

As previously stated, the Total Scaling, "K_T", is the combination of the Count Scale Factor, Scale Multiplier, and Number of Count edges. In many applications the Total Scaling, "K_T", can be programmed directly into the Count Scale Factor, "SF", in which case the Scale Multiplier and Number of Count Edges can be left at the factory settings of X1.

In some applications, more display resolution may be required. When the Total Scaling (K_T) is greater than 1.0000 and only one edge per count pulse is used, there may not be enough display resolution.

Example: With a Total Scaling of 2.000, when an input pulse is generated, the display increments by 2. If the display units are in feet, when 3 feet have gone by, the display still reads 2. It will not increment again until 4 feet have been accumulated. With this amount of display resolution it would be impossible to set the Preset and have the output respond at odd feet intervals (1, 3, 5, etc.). To increase resolution, the Number of Count edges must be increased. This can be achieved by selecting the CT+DIRX2 mode (Count plus direction times 2) in the Program Count Module or by selecting the QUAD X4 mode, if quadrature counting is being used. If enough resolution still has not been attained, more input pulses need to be generated per display unit.

The amount of resolution required varies depending on the particular application. In cut-to-length applications, a high amount of resolution is often necessary. However, in totalizing applications, display resolution may not be important. It should be noted that whenever the number of count edges is increased to 2 or 4, the maximum count frequency decreases. (See Specifications for maximum count frequency).

Note: When using 2 or 4 edge counting for length sensor, on/off duty cycle must be 50% to maintain max. accuracy (mag. pickup will not work).

Once the Number of Count Edges (NCE) to be used has been determined, the Remaining Scaling factor required, "K_R", can be calculated. This is the Total Scaling, "K_T", divided by the Number of Count edges used as shown in Formula #2:

FORMULA #2: $K_R = K_T \div NCE$

WHERE:

K_R = Remaining Scaling Factor.
K_T = Total Scaling.
NCE = Number of Count Edges.

In our original example, the Total Scaling, "K_T" was determined to be 0.041667. Since this value is less than one, sufficient pulse information is being generated, i.e., there is enough resolution for the units selected. The Number of Count edges can be left at the factory set value of X1. The Total Scaling, "K_T", therefore equals the Remaining Scaling Factor, "K_R".

$$K_R = 0.041667 \div 1 = 0.041667$$

If the remaining scaling is between 0.6000 and 5.9999, it can be programmed directly into the Count Scale Factor value and the X1 factory setting for the Count Scale Multiplier "SCM", can be used.

COUNT SCALE MULTIPLIER

The general rule for choosing a SCM value is, when the Remaining Scaling Factor, "K_R", is less than 0.6000, a SCM value of 0.1 or 0.01 can be used to get a Count Scale Factor value between 0.6 and 5.9999 or to the point where the maximum number of significant digits is obtained.

FORMULA #3: $SF = K_R \div SCM$

WHERE:

SF = Count Scale Factor.
K_R = Remaining Scaling Factor.
SCM = Count Scale Multiplier.

Following our continuing example, it is easy to see that the Remaining Scaling Factor, "K_R" (0.041667), cannot fit into the Count Scale Factor Value without losing significant digits. Using the Formula above and a Scale Multiplier value of 0.01 allows us to get the maximum number of significant digits possible for the Count Scale Factor value:

$$SF = K_R \div SCM = 0.041667 \div 0.01 = 4.1667$$

COUNTER SCALING EXAMPLE:

EXAMPLE #1:

A flow sensor provides 62 pulses per gallon. Calculate the scaling required to provide a display reading in gallons. The number of "Display Units" displayed after 62 pulses have been counted should be 1.

STEP 1 - Calculate the Total Scaling, "K_T", using Formula #1.

FORMULA #1:

$$K_T = \text{Display Units} \div \text{Number of Pulses} = 1 \div 62 = 0.016129$$

STEP 2 - In this application 62 pulses per gallon provides more than enough resolution, so the Number of Count Edges (Selected in the Program Counter Module) is set to a value of X1. With an "NCE" value of 1, the remaining scaling factor required is still 0.016129.

FORMULA #2

$$K_R = K_T \div NCE = 0.016129 \div 1 = 0.016129$$

STEP 3 - To provide maximum scaling accuracy, a Scale Multiplier value is chosen that will give the maximum amount of significant digits in the Count Scale Factor. A value of 0.01 results in a Count Scale Factor Value of 1.6129.

FORMULA #3

$$SF = K_R \div SCM = 0.016129 \div 0.01 = 1.6129$$

COUNTER SCALING EXAMPLE: (Cont'd)

EXAMPLE #2:

A quadrature Rotary Pulse Generator that provides 100 pulses per revolution is coupled to a feed roll that is 2.5 feet in circumference. It is desired to read in feet with display resolution to the nearest hundredth of feet (0.01).

In this application, the requirement is for the display to read in hundredths of a foot. A 2.5 ft. distance equates to 250 "Display Units" (hundredths). The "Number of Pulses" for 2.5 ft. is 100, as stated.

From the information obtained, the Total Scaling, "K_T", can be calculated, using Formula #1.

$$K_T = \text{Display Units} \div \text{Number of Pulses} = 250 \div 100 = 2.5$$

With a Total Scaling, "K_T", of 2.5, it can easily be seen that for every pulse that is input, the display increments by 2.5 display units (hundredths). The application requires resolution to the nearest hundredth of a foot. To get higher resolution, Quadrature X4 Input Response Mode is selected. This provides four times the resolution. Using Formula #2, and 4 for the "Number of Count Edges", the Remaining Scaling, "K_R", is calculated.

$$K_R = K_T \div \text{Number of Count Edges} = 2.5 \div 4 = 0.625$$

At this point, it can be seen that the Remaining Scaling Factor value of 0.625 fits into the Count Scale Factor value range without losing any significant digits or scaling it any further. Because of this, the Scale Multiplier (SCM) factory set value of X1 is used, and 0.6250 is programmed directly in for the Count Scale Factor, "SF".

$$SF = K_R \div SCM = 0.6250 \div 1 = 0.6250$$

APPENDIX "B" - SCALING FOR RATE INDICATION

The Legend Plus offers a simplified method for scaling the rate portion of the indicator. The method does not require time unit conversions. The desired time format (Rate Per Second, Rate Per Minute, Rate Per Hour) is simply selected as part of the programming procedure. Due to the way the rate is calculated (See "General Description" section), high resolution and accuracy can be realized at all input rates, slow or fast.

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

The Rate Minimum Update Time can be programmed from 0.1 up to 99.9 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 Legend Plus so that input pulses to the unit are 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).

If the rate indicator is to display the rate at which the counter is counting, the rate indicator can be programmed with the same scaling parameters as the counter. The only other requirement is that the desired "Rate Conversion Factor" be selected to provide the rate display in the desired time format, Rate per Second (X1), Rate per Minute (X60), or Rate per Hour (X3600). This automatically scales the rate by X1 (1 pulse per second), X60 (60 pulses per minute), or X3600 (3600 pulses per hour).

Note: The rate uses only the negative edge of the pulse at Input A. The counter uses both edges of the input pulse for a X2 or X4 count mode. The rate can show the same reading as the count, but take into consideration the counter mode selected.

If the rate application is to display a specific Display Unit, then to scale the rate, it is only necessary to know the number of pulses per display unit desired or units (feet, revolutions, etc.).

Example: A 48-tooth gear, which is coupled to a shaft, is being sensed and it is desired to indicate the shaft speed in revolutions, the display units will be in revolutions. It is obvious that 48 pulses will occur in one revolution. To convert the pulse units to revolutions, it is necessary for the Legend Plus to multiply the number of pulses by a scaling factor to convert the pulse units to revolution units. The Legend Plus has a Rate Scale Factor and a Rate Scale Multiplier to scale pulse units to the desired display units. They are programmed in the Program Scaling section. Both are used to attain the Total Scaling, "K_T". To calculate the Total Scaling, "K_T", for the application, the following formula is used.

FORMULA #1: K_T = Display units ÷ Number of pulses

WHERE:

K_T = Total Scaling.

Display Units = The number of desired units (revolutions, feet, 10ths of feet, meters, etc.) that would be acquired after the Number of Pulses has occurred.

Number of Pulses = The Number of pulses required to achieve the number of Display Units.

Using the example previously discussed, the desired display unit would be 1 revolution and the number of pulses per display unit would be 48. Therefore, the Total Scaling would be 0.020833.

K_T = 1 rev ÷ 48 pulses per rev = 0.020833

In many applications the Total Scaling, "K_T", can be programmed directly into the Rate Scale Factor, "SF", in which case the Scale Multiplier "SCM" can be left at the factory setting of X1. However, in some applications, such as the one above, it may be desired to obtain more significant digits in the Scale Factor, "SF".

These situations occur when "K_T" does not calculate to an even number that will fit into the four decimal places available to the Scale Factor. The following formula can be used to calculate the Scale Factor when an SCM value other than X1 is needed.

FORMULA #2: SF = K_T ÷ SCM

WHERE:

SF = Rate Scale Factor.

K_T = Total Scaling.

SCM = Rate Scale Multiplier.

In this formula, the Total Scaling, previously calculated, is divided by the Scale Multiplier Value, "SCM", to obtain the Scale Factor, "SF".

RATE SCALE MULTIPLIER

The general rule for choosing an SCM value is, when the Total Scaling, "K_T", is less than 0.6000, an SCM value of 0.1 or 0.01 can be used to get a Scale Factor value between 0.6 and 5.9999, or to the point where the maximum number of significant digits is obtained. If the Total Scaling, "K_T", is greater than 5.9999, then an SCM value of 10, 100, or 1000 can be used to obtain a Scale Factor Value between 0.6 and 5.9999.

In our initial example, the Total Scaling, "K_T" was determined to be 0.020833. It is easy to see that this number cannot be programmed into the Scale Factor, "SF", without losing significant digits. Using formula #2 and the general rules stated above, a Scale Multiplier Value of 0.01 is chosen and the Scale Factor is calculated as shown below. This will provide the maximum amount of conversion accuracy possible.

$$K_T \div SCM = 0.020833 \div 0.01 = 2.0833$$

In situations where the Total Scaling is already in range of the Scale Factor (0.0001 to 5.9999) and when there are no significant digits that are lost, the Total Scaling, "K_T", can be programmed directly into the Scale Factor Value and a Scale Multiplier value of X1 (the factory set value) can be used.

Example: If the desired display units are in feet and there are 100 pulses per foot, the Total Scaling, "K_T", would be 0.01.

$$K_T = \text{Display units} \div \text{number of pulses} = 1 \div 100 = 0.01$$

Since the Total Scaling, "K_T", is exactly 0.01, it can be programmed into the Scale Factor Value, "SF", and the Scale Multiplier Value, "SCM", can be left at its factory setting of X1. After the Scale Factor and Scale Multiplier values are selected, all that is necessary to complete the scaling is to choose the Rate Conversion Factor. The Rate Conversion Factor (RCF) can be selected to provide indication in Rate per Second (X1), Rate Per Minute (X60), or Rate per Hour (X3600).

There may be situations where there are many more pulses per display unit than needed. In these situations the minimum SCM value (0.01) may not provide enough significant digits in the Scale Factor. To achieve more significant digits, the Rate Conversion Factor should be set to Rate per Second and the following formula be used.

$$SF = K_T \times RCF \div SCM$$

WHERE:

RCF = 60 for display reading in Rate Per Minute or 3600 for display reading in Rate Per Hour

RATE SCALING EXAMPLE:

EXAMPLE #1:

A 60-tooth gear is mounted to a roll that has a circumference of 2 feet. It is desired to have a rate readout with a resolution in 10ths of feet per minute. Calculate the Scale Factor and Scale Multiplier values necessary to provide the desired readout.

In this example one revolution of the web will provide 60 pulses for 2 feet of linear travel. Since the desired display units are to be in tenths of feet, it is necessary to convert 2 feet to tenths ($2 \div .1 = 20$), giving us 20 tenths (display units). The Total Scaling, "K_T", is calculated by simply plugging in the two numbers into Formula #1.

$$K_T = \text{Display Units} \div \text{Number of Pulses} = 20 \div 60 = 0.333333$$

To get the maximum number of significant digits in the Scale Factor we use formula #2 and a Scale Multiplier value of 0.1 as shown below.

$$SF = K_T \div SCM = 0.333333 \div 0.1 = 3.3333$$

To obtain rate indication in Feet Per Minute, the Rate Conversion Factor is programmed for the Rate per Minute mode. A decimal point is programmed to 0.0, which allows the unit to display in 10ths of feet.

EXAMPLE #2:

The shaft of a positive displacement pump has a 14 tooth sprocket that is being sensed by a magnetic pickup. It is known that the unit pumps 810 liters of water per minute, when the shaft is turning 400 RPM. It is desired to have a display readout in liters per minute.

With the Legend Plus, it is not necessary to deal with time unit conversions. From the information given, we know that when the shaft has turned 400 revolutions, 810 liters of water will have been pumped. The first step we need to take is to calculate the number of pulses that occur when 810 liters have been pumped.

Number of Pulses = # of Rev x Pulses per Rev
= 400 Rev x 14 PPR = 5600 pulses.

We now have all the information necessary to scale the rate. The Total Scaling, "K_T", is calculated using Formula #1 as shown below.

K_T = Display Units ÷ Number of Pulses = 810 ÷ 5600 = 0.144643

It is noticed that there are more significant digits in the Total Scaling, "K_T", than there are available for the Scale Factor, "SF". To acquire the maximum amount of significant digits for the Scale Factor, Formula #2 is used and a Scale Multiplier value of 0.1 is selected.

$SF = K_T \div SCM = 0.144643 \div 0.1 = 1.4464$

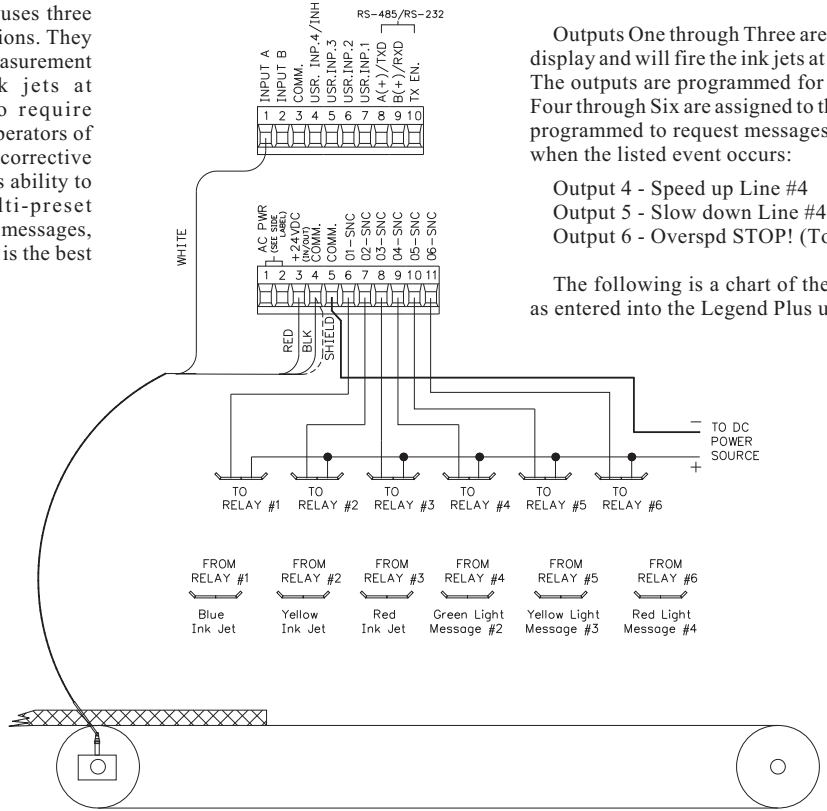
The Scale Factor, "SF", equals 1.4464 (1.44643 rounded to 4 decimal places). This provides the maximum amount of conversion accuracy possible.

The final step is to select a Rate Conversion Factor. The Rate Conversion Factor is chosen to be Rate Per Minute as was required.

APPENDIX "C" - APPLICATION

A textile manufacturing company uses three ink jets to mark cloth at various locations. They need a counter to track the cloth measurement and provide outputs to the ink jets at predetermined points. They also require displayed messages to inform their operators of changing line speed conditions and corrective actions that need to be taken. With its ability to monitor rate, count, provide multi-preset outputs and display user programmed messages, the Legend Plus Multi-preset counter is the best unit for the job.

The cloth moves over a roller with a circumference of 13.20 inches. A 72 tooth gear is mounted on the roller. Due to the size of the gear, the best sensor would be the model HESS. The desired display on the LGPM is tenths of inches. It is also desired to display a rate of tenths of inches per minute. With the Legend Plus, the scaling for the rate is the same as for the counter.



Outputs One through Three are programmed to the count display and will fire the ink jets at the appropriate intervals. The outputs are programmed for a Timed output. Outputs Four through Six are assigned to the rate display and will be programmed to request messages to appear on the display when the listed event occurs:

Output 4 - Speed up Line #4
Output 5 - Slow down Line #4
Output 6 - Overspd STOP! (Top Priority)

The following is a chart of the necessary programming as entered into the Legend Plus unit.

LEGEND PLUS PROGRAM SHEET

SCALE FACTORS

COUNT SF	1.8333
RATE SF	1.8333
CNT. SCM	X1
CNT. D.P.	0.1
RATE SCM	X1
RATE PER	MINUTE
RATE D.P.	0.1
CHG. CNT/ WITH SF	YES

OPTIONS

ACCESS

P1	NO
P2	NO
P3	NO
P4	NO
P5	NO
P6	NO
CTLD.	NO
SF'S	NO

PRESETS

P1	36.0
P2	180.0
P3	360.0
P4	1150.0
P5	1250.0
P6	1300.0
CL	0

RATE

MIN. TIME	1.0
MAX. TIME	5.0

COUNTER

CNT. INPUT	CT+DIRX1
RESET	TO ZERO
AUTO. RST	DISABLED

PRESET TRACKING

P1 TRACK	NONE
P2 TRACK	NONE
P3 TRACK	NONE
P4 TRACK	NONE
P5 TRACK	NONE
P6 TRACK	NONE
PRO. CODE	23

USER INPUTS

BIN. MSG.REQ. **NONE**

USER INP. 1	NO MODE	USER INP. 2	NO MODE
USER INP. 3	NO MODE	USER INP. 4	NO MODE
USER F1	NO MODE	USER F2	NO MODE

OUTPUTS

OUTPUT 1

ASSIGNED	TO CNT
PHASE	+
TYPE	TIMED
ACT/TIME	0.5
OUTPUT END	DISABLED
DLY TYPE	
ON DL TIME	
OF DL TIME	
OFF@P.	UP
RST/C	EN
REQ MSG #	–

OUTPUT 2

ASSIGNED	TO CNT
PHASE	+
TYPE	TIMED
ACT/TIME	0.5
OUTPUT END	DISABLED
DLY TYPE	
ON DL TIME	
OF DL TIME	
OFF @ P.	UP
RST/C	EN
REQ MSG #	–

OUTPUT 3

ASSIGNED	TO CNT
PHASE	+
TYPE	TIMED
ACT/TIME	0.5
DLY TYPE	DISABLED
ON DL TIME	
OF DL TIME	
OFF @ P.	UP
RST/C	EN
REQ MSG #	–

OUTPUT 4

ASSIGNED	TO RATE
PHASE	+
TYPE	BOUNDARY
ACT/TIME	LO ACT
DLY TYPE	NO DLY
ON DL TIME	
OF DL TIME	
OFF @ P.	UP
RST/C	EN
REQ MSG #	2

OUTPUT 5

ASSIGNED	TO RATE
PHASE	+
TYPE	BOUNDARY
ACT/TIME	HI ACT
DLY TYPE	NO DLY
ON DL TIME	
OF DL TIME	
OFF @ P.	UP
RST/C	EN
REQ MSG #	3

OUTPUT 6

ASSIGNED	TO RATE
PHASE	+
TYPE	BOUNDARY
ACT/TIME	HI ACT
DLY TYPE	NO DLY
ON DL TIME	
OF DL TIME	
OFF @ P.	UP
RST/C	EN
REQ MSG #	4

LEGEND PLUS PROGRAM SHEET (Cont'd)

DISPLAY

DISPLY 1

D1 LINE 1	CUST. DSP. 1
D1 LINE 2	CUST. DSP. 2
D1 COLOR	GREEN

DISPLY 3

D3 LINE 1	PEAK-VAL
D3 LINE 2	VALI-VAL
D3 COLOR	GREEN
SCRO. SPD	NONE
DSP. LEVEL G	5
DSP. LEVEL R	5
CUST. DSP.	
CUST. DSP.1	VAL-RATE
	[redacted] IPM
CUST. DSP.2	VAL-CNT
	[redacted] IN.

DISPLY 2

D2 LINE 1	RATE-MNE
D2 LINE 2	CUST.DSP.1
D2 COLOR	GREEN

DISPLY 4

D4 LINE 1	CNT-MNE
D4 LINE 2	CNT-VAL
D4 COLOR	GREEN

MNEMONIC

RATE	SPEED
PEAK	P
VALLEY	V
COUNT	INCHES
OVERFLOW	OVERFLOW

MESSAGE

MSG. #	2
TYPE	2L BLOCK
TEXT	SPEED UP
	LINE #4
PRIORITY	6
BLINKING	YES
MULTIPLEX	YES
MOM/MNT REQ	MNT
CANCEL	TIL END
TIME SEC.	
COLOR	GREEN
MSG. #	3
TYPE	1L BLOCK
TEXT	SLOW DOWN
	LINE #4
PRIORITY	6
BLINKING	NO
MULTIPLEX	YES
MOM/MNT REQ	MNT
CANCEL	TIL END
TIME SEC.	
COLOR	GREEN
MSG. #	4
TYPE	2L BLOCK
TEXT	OVERSPD
	STOP!
PRIORITY	2
BLINKING	YES
MULTIPLEX	NO
MOM/MNT REQ	MNT
CANCEL	TIL END
TIME SEC.	
COLOR	RED

APPENDIX "D" - ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER 115/230VAC & +12VDC
LGPM	Multi Preset (6) Legend Plus w/Grn Backlighting	LGPM0001
	Multi Preset (6) Legend Plus w/Red Backlighting	LGPM0101
	Multi Preset (6) Legend Plus w/Dual Color Bcklghtng	LGPM0201
SFLGP	Legend Plus Programming Software, 3 ½", 1.44 M disk	SFLGP

APPENDIX "E" - FLOWCHART FOLD-OUT (Insert)

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.

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