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# 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.

$C\,\epsilon$

**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
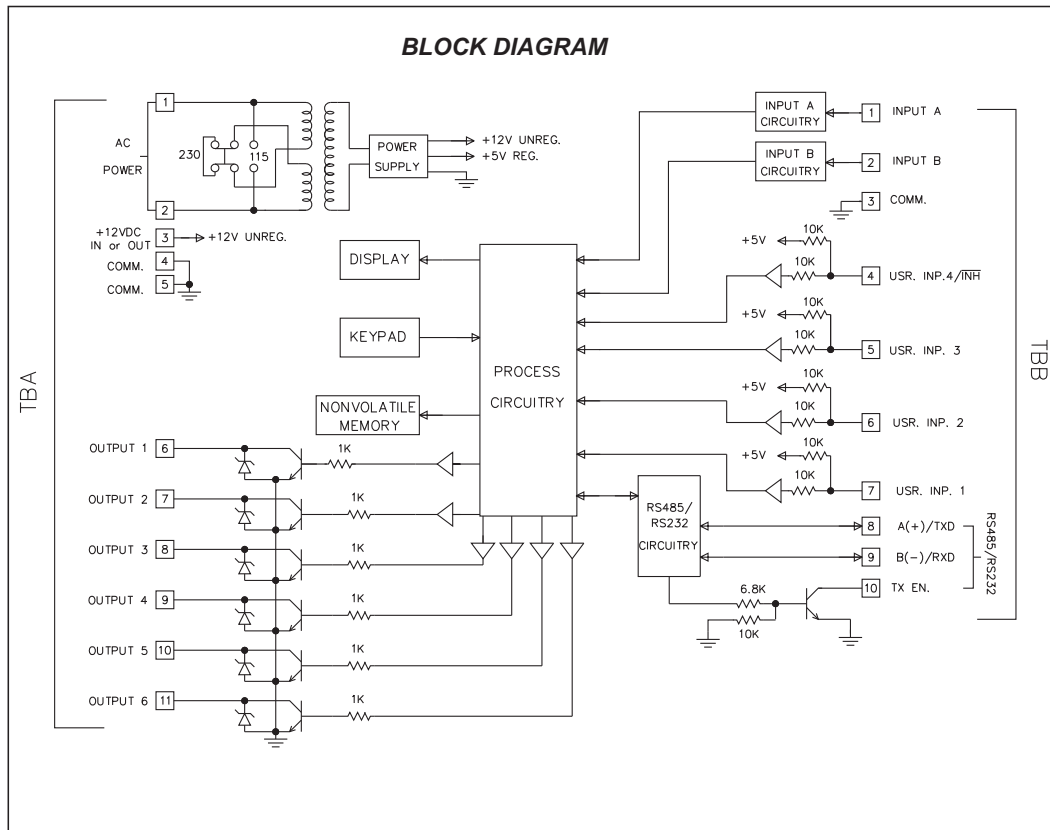
## GENERAL DESCRIPTION (Cont'd)

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.
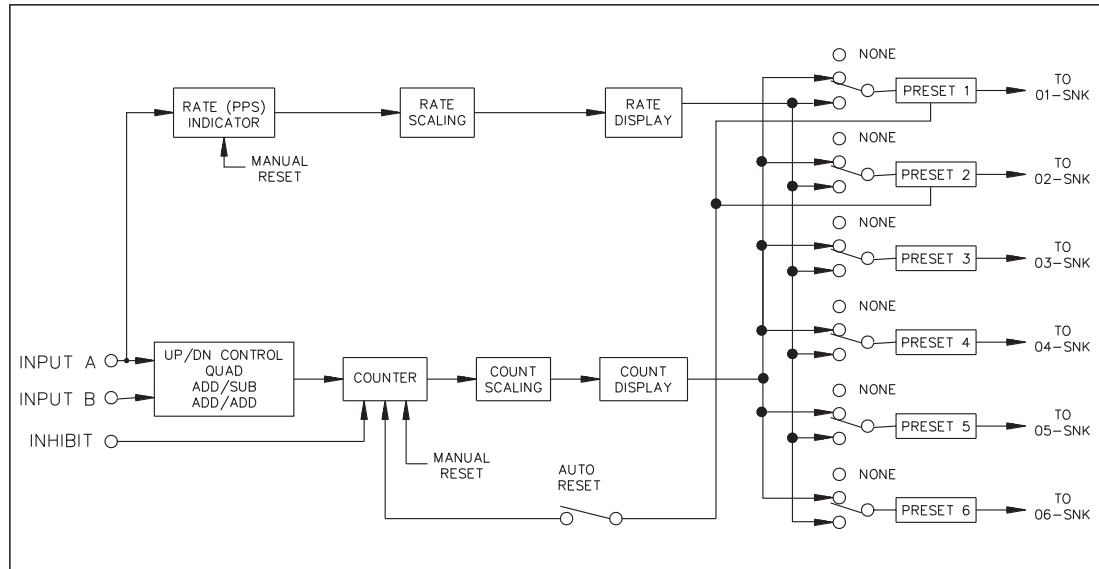
## MESSAGES

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.
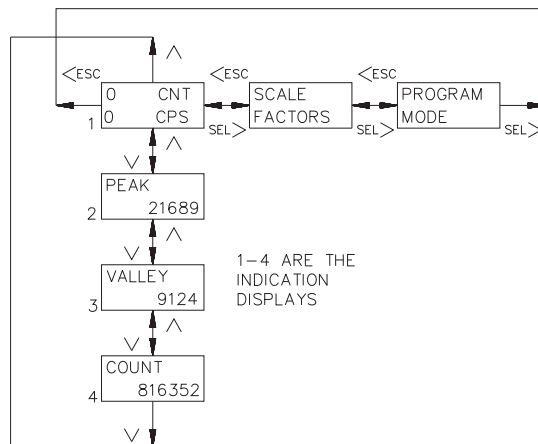
## KEYPAD DESCRIPTION

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:
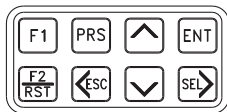
### KEYPAD FUNCTIONS

**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.*
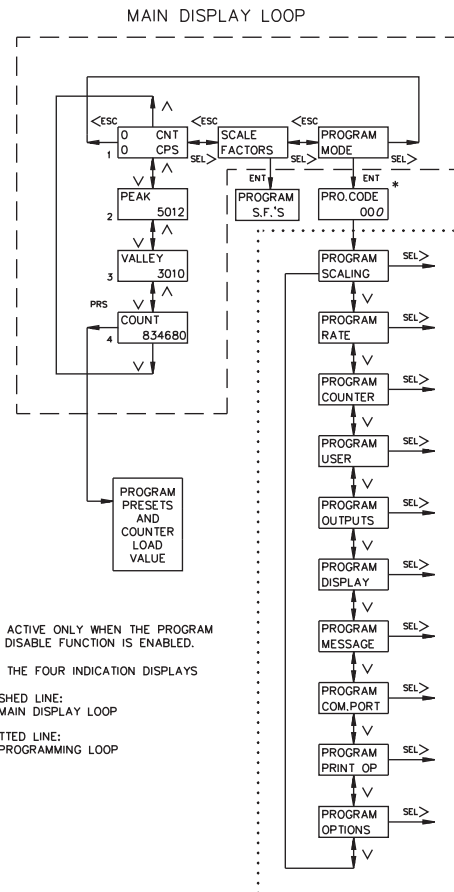
## PROGRAMMING GENERAL DESCRIPTION

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.

MAIN DISPLAY LOOP

| 0 CNT | SCALE | PROGRAM |
| 0 CPS | FACTORS | MODE |

PEAK 5012
VALLEY 3010
COUNT 834680

PROGRAM S.F.'S
PRO.CODE 000 *

PROGRAM PRESETS AND COUNTER LOAD VALUE

PROGRAM SCALING
PROGRAM RATE
PROGRAM COUNTER
PROGRAM USER
PROGRAM OUTPUTS
PROGRAM DISPLAY
PROGRAM MESSAGE
PROGRAM COM.PORT
PROGRAM PRINT OP
PROGRAM OPTIONS

\* – ACTIVE ONLY WHEN THE PROGRAM DISABLE FUNCTION IS ENABLED.

1–4 – THE FOUR INDICATION DISPLAYS

--DASHED LINE: MAIN DISPLAY LOOP

... DOTTED LINE: PROGRAMMING LOOP

## 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:
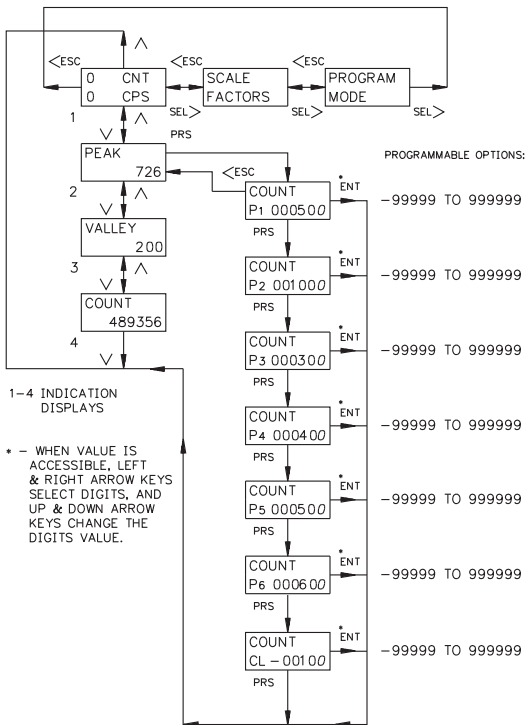


## PRESET VALUES

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:
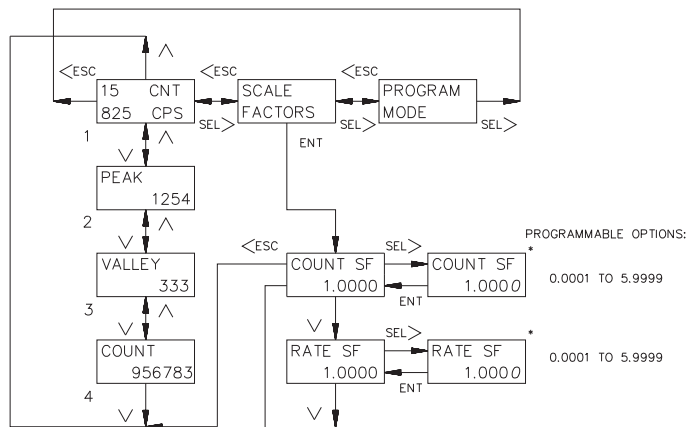


\* – LEFT & RIGHT ARROW KEYS TO
SELECT DIGIT, UP & DOWN KEYS
TO CHANGE THE DIGITS VALUE.

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:



* — ACTIVE ONLY WHEN THE PROGRAM DISABLE FUNCTION IS ENABLED.

1-4 — THE FOUR INDICATION DISPLAYS

--DASHED LINE: MAIN DISPLAY LOOP

... DOTTED LINE: PROGRAMMING LOOP
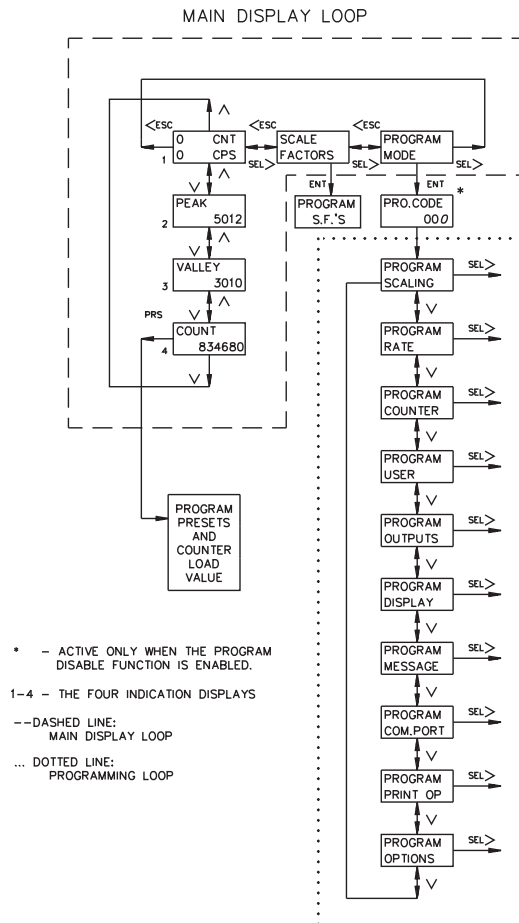
## PROGRAM SCALING MODULE

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:



* – DOWN ARROW KEY TO TOGGLE THROUGH OPTIONS.

** – LEFT & RIGHT ARROW KEYS TO SELECT DIGIT, UP & DOWN KEYS TO CHANGE THE DIGITS VALUE.
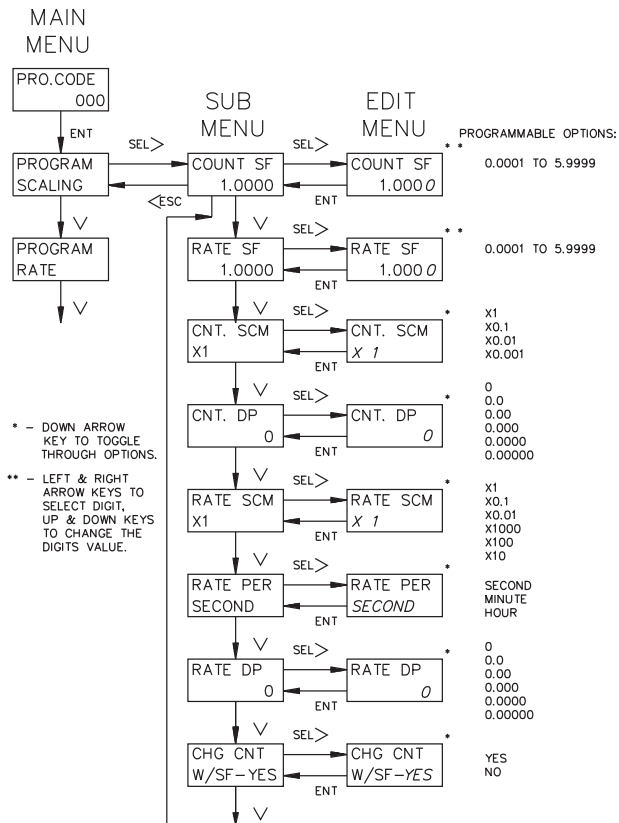
### COUNT SCALE FACTOR (COUNT SF)

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:
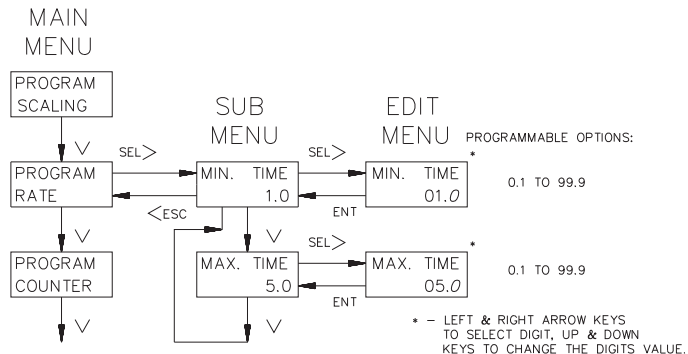


The Rate value is calculated using the time measured between the first and last pulse as the measurement period. The measurement period ends when the minimum update time has expired, and the next negative edge occurs. The number of pulses that occurred during the measurement period are counted and multiplied 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
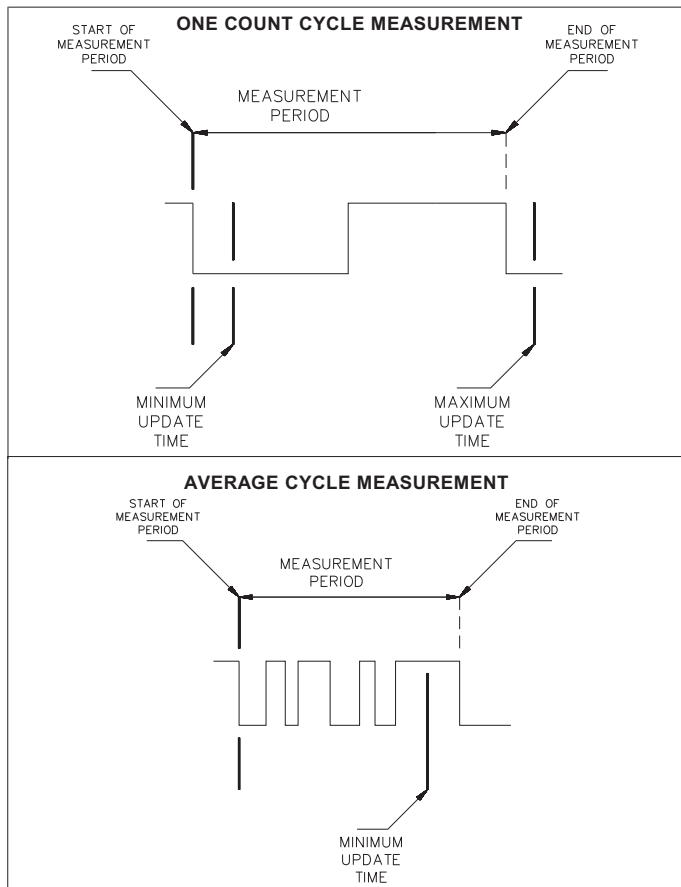
## PROGRAM COUNTER MODULE

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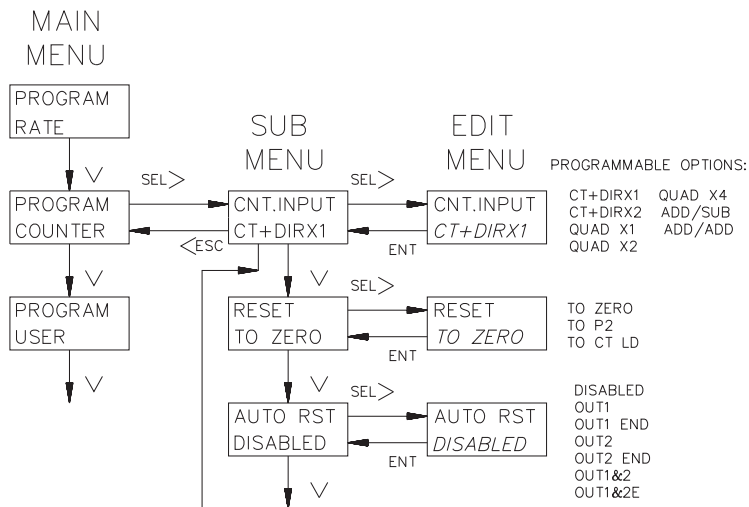


## COUNT MODES (CNT.INPUT)

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:
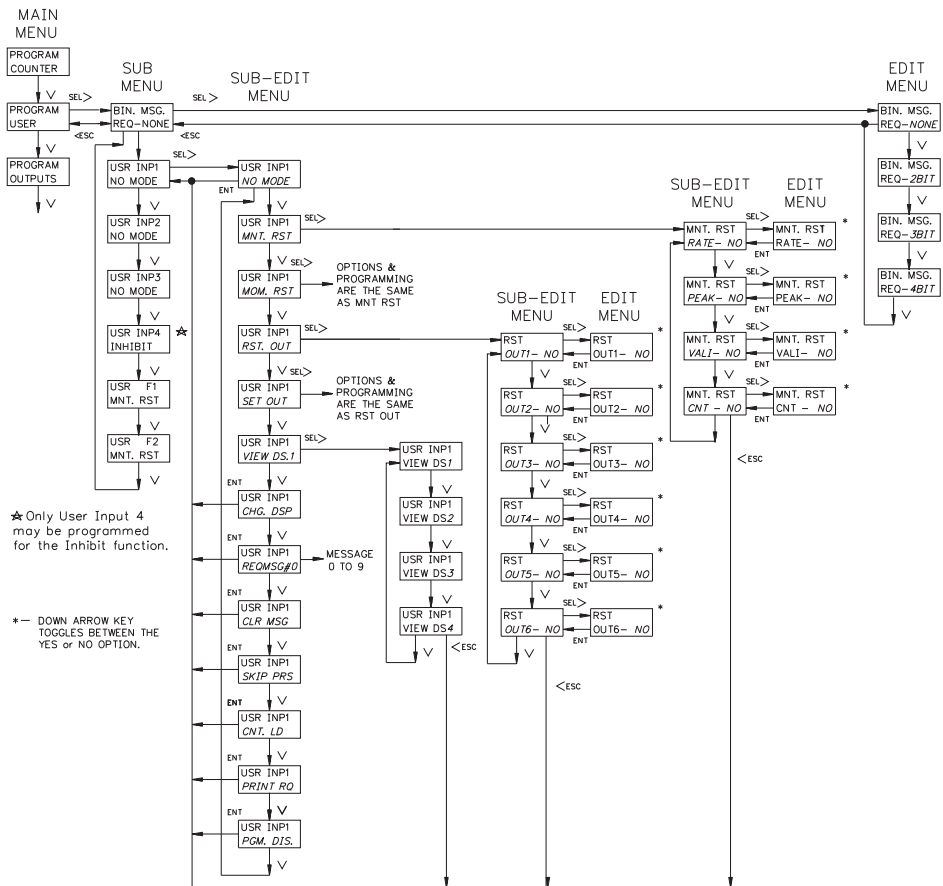
## PROGRAM USER MODULE (Cont'd)
### BINARY MESSAGE REQUEST (BIN MSG REQ)

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 one 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.