



# LMI<sup>®</sup>

*an Accudyne Industries brand*



# **ROYTRONIC EXCEL™**

## **Series AD9 Programming Guide**

## **Electronic Metering Pumps**

### **Instruction Manual**

Manual No : 2032

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## SECTION 1 - INTRODUCTION

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The Series AD9 electronic metering pump offers an extensive range of features, including microprocessor control for accurate and flexible automation in response to instrument signals. The microprocessor design employs a graphical display and tactile response keypad. All external inputs and outputs are opto-isolated from the microprocessor.

This manual is a supplement which describes programming and operation for the AD9 series. For complete details on Installation, Maintenance and Troubleshooting, please refer to the ROYTRONIC EXCEL™ Instruction Manual (P/N 2024).

**⚠ CAUTION** SPECIFIC PRECAUTIONS SHOULD BE TAKEN WHEN WORKING WITH ALL LMI® METERING PUMPS. PLEASE REFER TO THE PRECAUTIONS SECTION, SEC. 1.0, OF THE ROYTRONIC EXCEL™ INSTRUCTION MANUAL (P/N 2024).

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## SECTION 2 - FEATURES

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1. Stroke speed adjustment 1-59 SPH (strokes per hour) to 1-120 SPM (strokes per minute).
2. Operating mode selection.
3. Flexible slope adjustable response to mA input signals.
4. Divide or multiply (batch) incoming pulses (1 to 9999).
5. Batch accumulation option.
6. Timed event mode for internal operation.
7. Percent-of-time operation for internal and external modes.
8. Keypad locking.
9. Low-level warning and empty-level shutoff with alarm output.
10. Programmable flow monitoring with alarm output (with FM-ROY-9 DIGI-PULSE™).
11. Continuous non-volatile memory (EEPROM)-no battery required.
12. Remote ON/OFF control.
13. Remote Internal/External mode control.
14. Pulse (pacing) output.
15. Universal voltage input (95-240V) with automatic line voltage compensation and over voltage protection.
16. Programmable menu for optional features parameters.
17. Theoretical flow display.
18. Single-Point and Two-Point calibration.
19. Fixed-time priming mode.
20. Configurable output alarms.
21. 4-20mA output for remote monitoring of stroke speed.

## SECTION 3 - KEYPAD/DISPLAY: DESCRIPTION AND FUNCTION

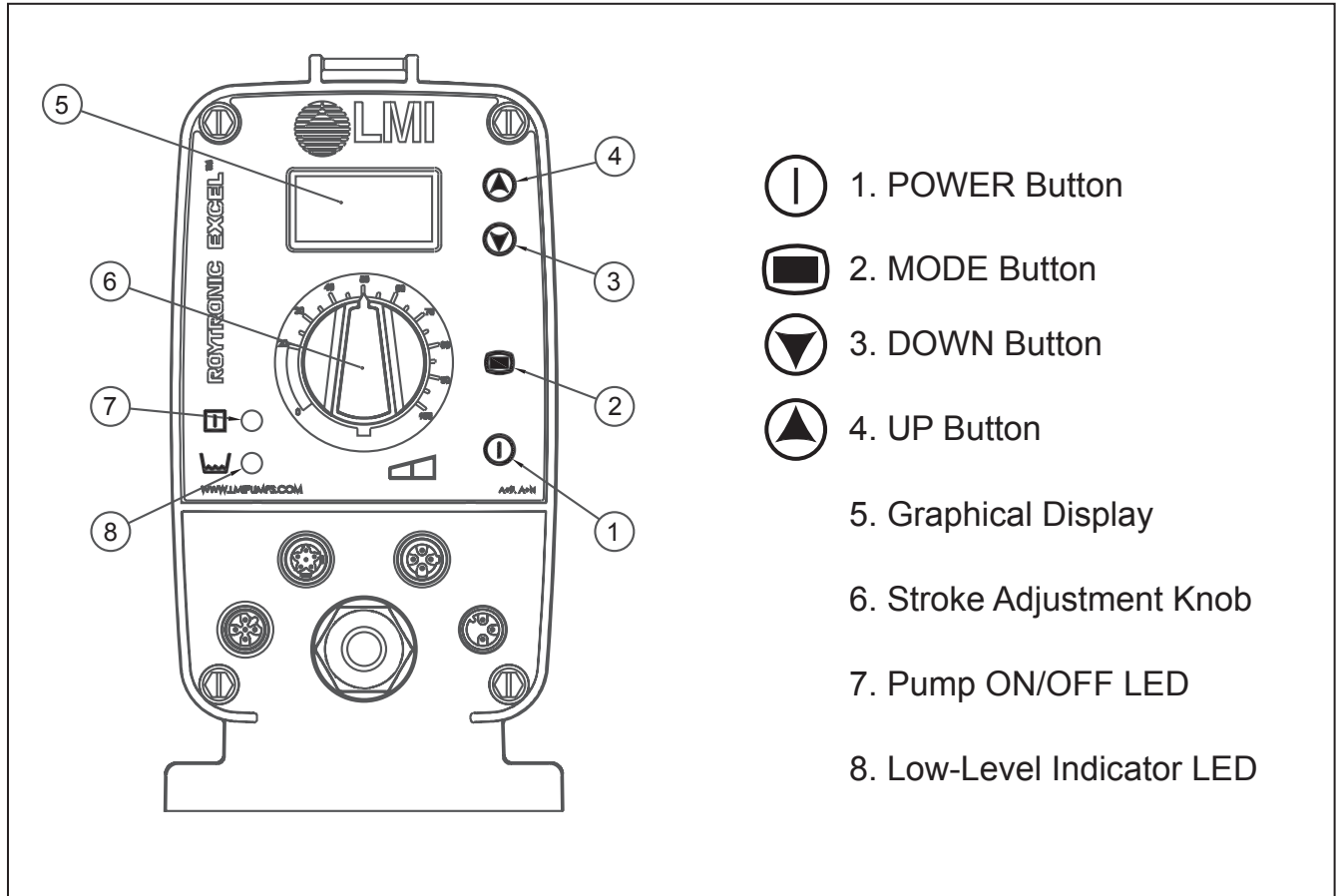


Figure 1. ROYTRONIC EXCEL™ Series AD9 Control Panel

### 3.1 **⏻ POWER BUTTON**

The **⏻** POWER button turns the pump ON or OFF. If the pump is not running, pressing this button will cause the pump to start running. If the pump is running, pressing the **⏻** POWER button will stop the pump. The **⏻** POWER button is also used to prime the pump as described in *Sec. 4.3*. When in a programming screen or a selection menu, the **⏻** POWER button is generally used to enter/select the associated item.

### 3.2 **⏏ MODE SELECTION BUTTON**

The **⏏** MODE button is used to enter the main selection menu. The **⏏** MODE button can also often be used to exit the current programming menu. Details of its use will be covered in greater detail later in this supplement.

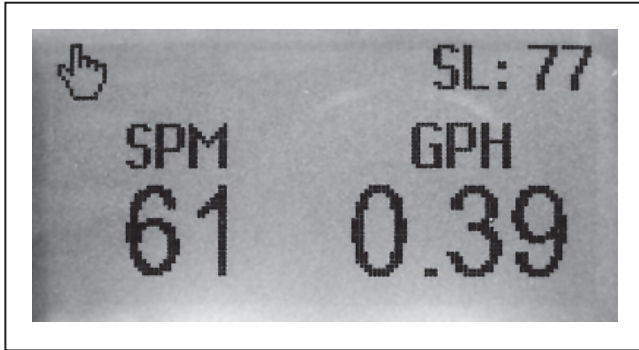
### 3.3 **⬆ UP AND ⬇ DOWN BUTTONS**

The **⬆** UP and **⬇** DOWN buttons are used to change parameters (i.e. stroke frequency) as well as to navigate the selection menus. These functions are covered in greater detail later in this supplement.

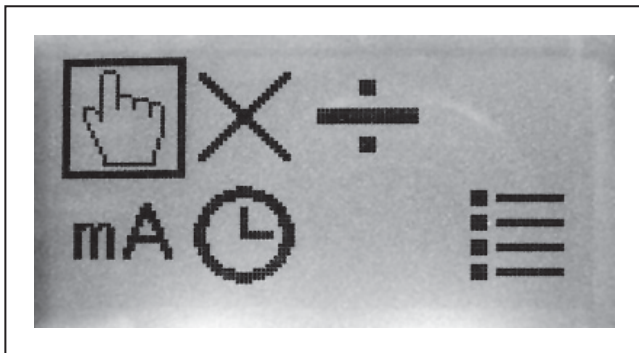
## SECTION 3 - KEYPAD/DISPLAY: DESCRIPTION AND FUNCTION

### 3.4 GRAPHICAL DISPLAY

A graphical display is used to show the current operational state of the pump as well as a variety of specialized programming menus.



Manual Operating Mode Display




Control Mode Selection Display


### 3.5 STROKE ADJUSTMENT KNOB

The Stroke Adjustment Knob is used to adjust the stroke length of the pump. As this knob is adjusted, the stroke length and associated flow will be displayed on the current operating mode display.

### 3.6 PUMP ON/OFF LED

When the pump is started, the  Pump ON/OFF LED will be green when in internal mode and yellow when in an external mode. The LED will also briefly pulse OFF during an actual pump stroke. When the pump is not running, the Pump ON/OFF LED will be OFF.

### 3.7 LOW LEVEL INDICATOR LED

The  Low Level Indicator LED will normally be OFF. However, in the event that an external level sensor is connected to the pump, the LED will turn yellow if a Tank Low input signal is detected or red if a Tank Empty input signal is detected. If both Tank Low and Tank Empty conditions are present, the Tank Empty takes priority. The pump will not stroke when in a Tank Empty condition.



## SECTION 4 - OPERATION OF THE SERIES AD9

This pump features EEPROM nonvolatile memory. The pump will always power up in the last used mode. When shipped from the factory the pump will power up in the Manual mode (see Sec. 5.1), with the pump OFF and a speed setting of 120 SPM.

### NOTE:

*If the power to the pump is cut less than 15 seconds after the last programmed values have been set, the latest changes will NOT be stored in nonvolatile memory. Allow at least 15 seconds before disconnecting from power to ensure that the latest changes are stored.*

### 4.1 PUMP START/STOP

Press the **⏻** POWER button to start or stop the pump. When the pump is OFF, the **⏻** Pump ON/OFF LED will be OFF. When the pump is ON, the **⏻** Pump ON/OFF LED will illuminate. Each time the pump strokes, the **⏻** Pump ON/OFF LED will flash OFF.

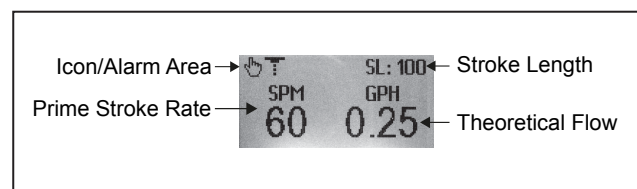
### 4.2 PUMP SPEED

The speed may be changed with the pump ON or OFF. To increase or decrease the speed, press or hold the **⬆** UP or **⬇** DOWN button. The range runs from 0 SPH to 120 SPM. While normally the speed will be set in SPM, if settings of SPH are desired, hold the **⬇** DOWN button until the display reads 1 SPM, then continue to hold it down. The display will then show SPH 59. The speed can be further reduced to 1 SPH with the **⬇** DOWN button.

### 4.3 PRIMING THE PUMP

The priming function allows a fixed-time prime period of 60 seconds and enables priming of the pump in any control mode. To begin priming, hold down the **⏻** POWER button for approximately 5 seconds. The pump will begin operating. Use the **⬆** UP and **⬇** DOWN buttons to vary the stroking speed. To stop priming before the priming cycle is complete, push the **⏻** POWER button. The pump will automatically stop after 60 seconds, and revert to the last used control mode.

### Display Overview:




- 1. Icon/Alarm Area:** The **⏻** icon indicates the pump is in prime mode. Depending on advanced pump configuration options and any alarms alerts detected, other icons may be present as well (see Sec. 4.5).
- 2. Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
- 3. Prime Stroke Rate:** Indicates the stroke speed of the pump while priming (1-120 SPM).
- 4. Theoretical Flow:** The theoretical flow based on stroke speed, stroke length, and calibration settings (see Sec. 6.6 for calibration information).

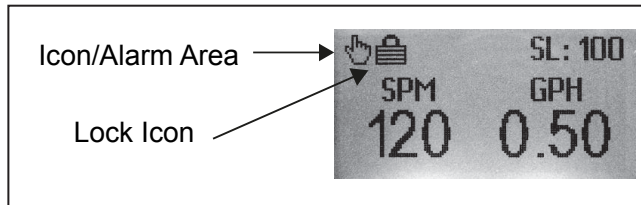
### NOTE:




*The prime stroke rate is independent of the current control mode stroke rate.*




## SECTION 4 - OPERATION OF THE SERIES AD9




### 4.4 LOCKING/UNLOCKING THE PUMP

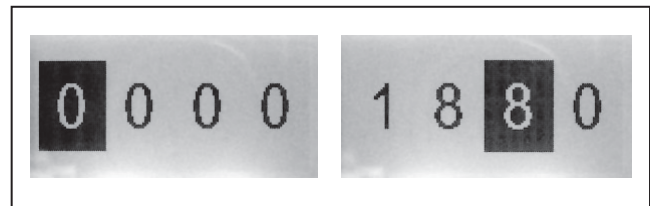
The pump has several lock modes to prevent casual tampering. For a complete description of the lock modes and how to configure them, see Sec. 6.4. A Lock Icon  in the Icon/Alarm Area indicates that the pump has been locked.



To activate the pump lock, depress the  DOWN and  MODE buttons simultaneously for about 1 second until the Lock Icon  appears in the Icon/Alarm area.

To unlock a locked pump, depress the  DOWN and  MODE buttons simultaneously for about 1 second until the Lock Icon  disappears in the Icon/Alarm area or until prompted for the unlock pass code (see below).

To enter the unlock pass code, use the  UP and  DOWN buttons to edit each digit. Use the  POWER button to advance to the next digit. If the pass code is incorrect, the pump will remain locked.




Example of entering an unlock pass code

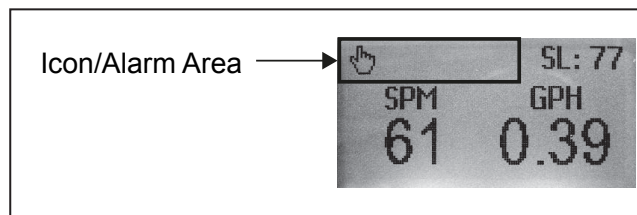
#### NOTE:

*Activating the pump lock is effective immediately. Do not activate unless you have made note of the unlock pass code, which is configured in Sec. 6.4. If the pass code is misplaced while the lock is active, the pump must be returned to the factory in order to be reset.*













*After approximately 2 minutes of inactivity, the unlock pass code display will close and revert back to the current control mode display.*

### 4.5 ALARM/ICON AREA

The upper left portion of every Control Mode Display contains an icon/alarm notification area, which graphically displays operational information. If no alarm conditions exist, the display will only show configuration information. If one or multiple alarm conditions exist, the display will alternate every few seconds between showing configuration information and showing alarm information. Alarm information will always be preceded by the  icon.










#### Configuration Icon Definitions:

ICON	NAME	DESCRIPTION
	Manual Control Mode	Pump is in Manual Control Mode (See Sec. 5.1)
	Pulse Multiply Control Mode	Pump is in Pulse Multiply Control Mode (See Sec. 5.2)
	Pulse Divide Control Mode	Pump is in Pulse Divide Control Mode (See Sec. 5.3)
	Analog Control Mode	Pump is in Analog Control Mode (See Sec. 5.4)
	Timed Event Control Mode	Pump is in Timed Event Control Mode (See Sec. 5.5)
	Prime	The pump is priming (See Sec. 4.3)
	Keypad Locked	The keypad is locked (See Sec. 4.4)
	Digi-Pulse™ Flow Monitoring	Digi-Pulse™ flow switch monitoring is enabled (See Sec. 6.9)
	Percent-of-Time	Percent-of-Time Functionality Enabled (See Sec. 6.10)
	Batch Mode	Batch Mode Enabled (See Sec. 6.2)
	1-Point Calibration	Pump user-calibrated : 1-point (See Sec. 6.6.1)
	2-Point Calibration	Pump user-calibrated : 2-point (See Sec. 6.6.2)

**Table1. Configuration Icon Definitions**

## SECTION 4 - OPERATION OF THE SERIES AD9

### Alarm Icon Definitions:

ICON	NAME	DESCRIPTION
	Stroke length alarm	The pump is user-calibrated and the stroke length is operating outside the allowable range
	Digi-Pulse™ flow switch alarm **	Digi-Pulse™ Flow Monitoring is enabled and the missed strokes threshold has been reached
	Analog input alarm	The 4-20ma input current exceeds 21.5 mA
	Incoming pulse rate alarm	The input pulse rate results in a stroke rate exceeding 120 SPM
	Batch alarm	Pulses are received before current batch action is completed
	Low tank alarm	Corresponds to the external Tank Level Low input
	Empty tank alarm**	Corresponds to the external Tank Empty input

\*\* = *The pump will stop stroking in this condition*

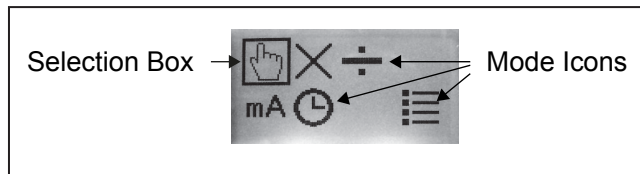
**Table 2. Alarm Icon Definitions**

## SECTION 5 - CONTROL MODE SELECTION MENU

This menu is used to select the control mode or enter into the advanced configuration menu. There are 2 internal control modes and 3 external control modes. In order to operate the pump in an external control mode, a remote device must be connected to the pump through the 5-Pin connector.






With the pump turned OFF, push the **MODE** button to bring up the Control Mode Selection Menu. Use the **UP** and **DOWN** buttons to scroll through the modes. Once the desired mode is selected, use the **POWER** button to enter that mode. Push and hold the **MODE** button for approximately 2 seconds to exit the menu.

### Display Overview:



**Control Mode Selection Menu**

**1. Mode Icons:** Each icon represents a different control mode, as follows:

-  = Manual Mode - Internal (Sec. 5.1).
-  = Pulse Multiply Mode - External (Sec. 5.2).
-  = Pulse Divide Mode - External (Sec. 5.3).
- mA** = Analog mA Mode - External (Sec. 5.4).
-  = Timed Event Mode - Internal (Sec. 5.5).
-  = Advanced Configuration Options (Sec. 6.0).

**2. Selection Box:** Indicates the currently selected item.

### NOTE:

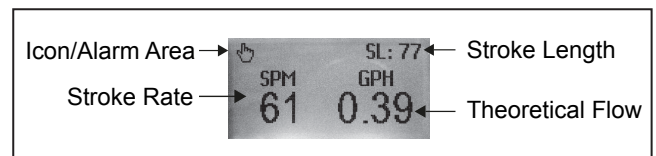
*After approximately 2 minutes of inactivity, the mode selection menu will automatically close and revert back to the prior display.*

*While in this menu, all external outputs will return to their default "OFF" state and all external inputs will be ignored.*


### 5.1 MANUAL MODE (INTERNAL)

This mode is used when external devices are not being used to control the pump. While in manual mode, the stroke speed is varied by using the **UP** and **DOWN** buttons. To turn the pump ON or OFF, push the **POWER** button or toggle the remote ON/OFF. The **Pump ON/OFF LED** will illuminate green when the pump is ON.

### Display Overview:



**Manual Mode Display**

- 1. Icon/Alarm Area:** The  icon indicates the pump is in the manual mode. Depending on advanced pump configuration options and any alarms alerts detected, other icons may be present as well (see Sec. 4.5).
- 2. Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
- 3. Stroke Rate:** Indicates the stroke speed of the pump (1-59SPH or 1-120 SPM).
- 4. Theoretical Flow:** The theoretical flow based on stroke speed, stroke length, and calibration settings (see Sec. 6.6 for calibration information).

# SECTION 5 - CONTROL MODE SELECTION MENU

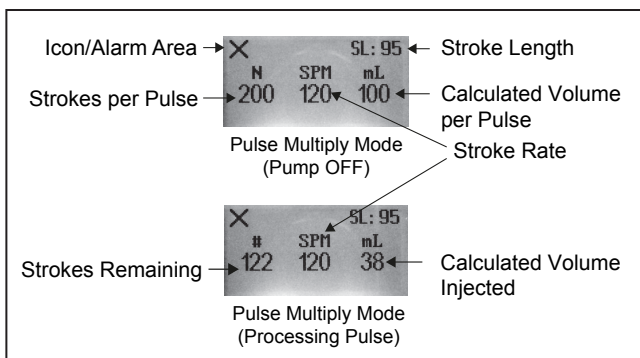
## 5.2 PULSE MULTIPLY MODE (EXTERNAL)

This mode is used to control the pump with an external device connected to the appropriate contacts of the 5-Pin connector. With the pump OFF, use the ▲ UP and ▼ DOWN buttons to vary the strokes-per-pulse parameter. To turn the pump ON or OFF, push the Ⓚ POWER button, or toggle the remote ON/OFF. The □ Pump ON/OFF LED will illuminate yellow when the pump is ON. With the pump turned ON, and a pulse is received, the pump will begin running, with the remaining pulses counting down on the display.

If a pulse is received before the countdown is complete and Batch Mode is OFF (see Sec. 6.2), the 📉 error code (see Sec. 4.5) is displayed and the pump batch count then restarts from the strokes-per-pulse setpoint. The fault will be corrected when the pump completes the current batch OR the pump is stopped.

If a pulse is received before the countdown is complete and Batch Mode is ON (see Sec. 6.2), the pump will accumulate strokes (up to a maximum of 9999), allowing all strokes to be accounted for.

### Display Overview:

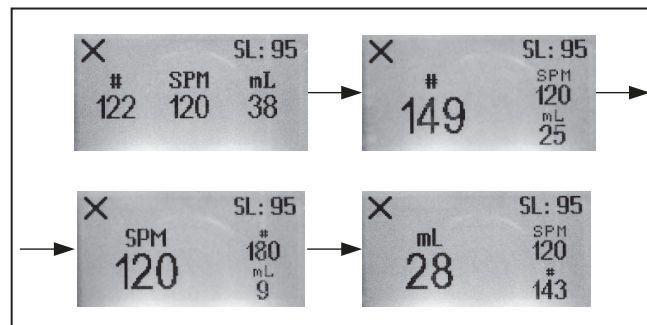


- Icon/Alarm Area:** The ✕ icon indicates the pump is in the pulse multiply mode. Depending on advanced pump configuration options and any alarms/alerts detected, other icons may be present as well (see Sec. 4.5).
- Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
- Stroke Rate:** Indicates the stroke speed of the pump (1-59 SPH or 1-120 SPM). To allow true flow proportioning, this is set in manual mode (see Sec. 5.1).
- Strokes per Pulse (Pump OFF only):** Number of strokes (1-9999) to occur for each valid pulse input. See Sec. 6.3 to define a valid pulse.
- Strokes Remaining (Pump ON only):** Number of strokes remaining for the current batch cycle.
- Calculated Volume per Pulse (Pump OFF only):** The calculated flow based on stroke count, stroke length, and calibration settings (see Sec. 6.6 for calibration information).
- Calculated Volume Injected (Pump ON only):** The calculated flow based on strokes made, stroke length, and calibration settings (see Sec. 6.6 for calibration information).

### NOTE:

The pump will ignore the pulse input while the pump is OFF.

Depressing the ▲ UP and ▼ DOWN buttons simultaneously will cycle through alternate display formats, as shown below:

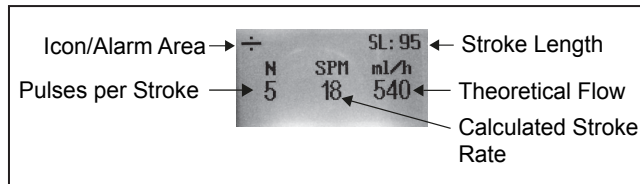


## SECTION 5 - CONTROL MODE SELECTION MENU

### 5.3 PULSE DIVIDE MODE (EXTERNAL)

This mode is used to control the pump with an external device connected to the appropriate contacts of the 5-Pin connector. With the pump OFF, use the  $\blacktriangle$  UP and  $\blacktriangledown$  DOWN buttons to vary the pulses-per-stroke parameter. To turn the pump ON or OFF, push the  $\text{Ⓚ}$  POWER button or toggle the remote ON/OFF. The  $\text{Ⓚ}$  Pump ON/OFF LED will illuminate yellow when the pump is ON. With the pump turned ON, the pump will pulse after the programmed number of pulses has been received.

#### Display Overview:



- 1. Icon/Alarm Area:** The  $\text{Ⓚ}$  icon indicates the pump is in the pulse divide mode. Depending on advanced pump configuration options and any alarms/alerts detected, other icons may be present as well (see Sec. 4.5).
- 2. Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
- 3. Calculated Stroke Rate:** Indicates the calculated stroke rate of the pump (0-120 SPM) based on the rate of incoming pulses and the divide value.

**4. Pulses per Stroke:** Number (1-9999) of valid pulses to detect before performing a pump stroke. See Sec. 6.3 to define a valid pulse.

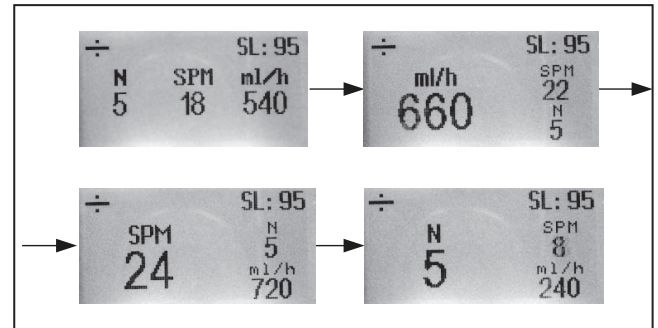
**5. Theoretical Flow:** The theoretical flow based on stroke speed, stroke length, and calibration settings (see Sec. 6.6 for calibration information).

#### NOTE:

The pump will display the calculated stroke rate and theoretical flow with the pump ON and OFF.

A  $\text{>}}]$  fault will be indicated if the calculated stroke rate exceeds 120 SPM (see Sec. 4.5).

Depressing the  $\blacktriangledown$  UP and  $\blacktriangle$  DOWN buttons simultaneously will cycle through alternate display formats, as shown below:

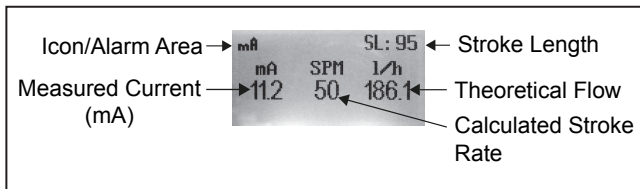


# SECTION 5 - CONTROL MODE SELECTION MENU

## 5.4 ANALOG MODE (EXTERNAL)

This mode is used to control the pump with an external device connected to the appropriate contacts of the 5-Pin connector. With the pump OFF, press the ▲ UP or ▼ DOWN button to change the response curve (see Sec. 5.4.1). To manually turn the pump ON or OFF, push the Ⓚ POWER button or toggle the remote ON/OFF. The □ Pump ON/OFF LED will illuminate yellow when the pump is ON.

### Display Overview:



- 1. Icon/Alarm Area:** The mA icon indicates the pump is in the analog mode. Depending on advanced pump configuration options and any alarms/alerts detected, other icons may be present as well (see Sec. 4.5).
- 2. Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
- 3. Calculated Stroke Rate:** Indicates the calculated stroke speed of the pump (0-59 SPH, 0-120 SPM) based on the analog set points and measured current.

- 4. Measured Current:** Measured current value (0-24.0 mA).
- 5. Theoretical Flow:** The theoretical flow based on calculated stroke speed, stroke length, and calibration settings (see Sec. 6.6 for calibration information).

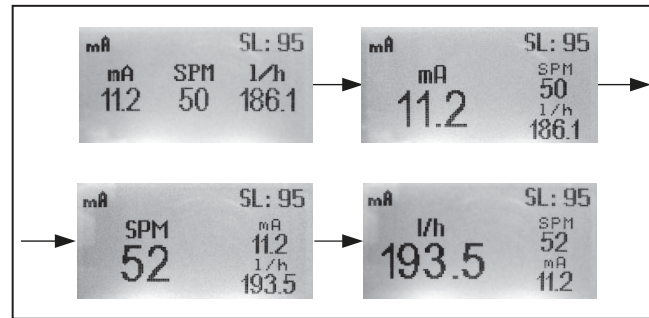
### NOTE:

The pump will display the calculated stroke rate and theoretical flow with the pump ON and OFF.

A >mA fault (see Sec. 4.5) will be indicated if the 4-20mA input exceeds 21.5mA.

The pump will not stroke if the 4-20ma input signal is 0.5mA or less.

Depressing the ▲ UP and ▼ DOWN buttons simultaneously will cycle through alternate display formats, as shown below:





## SECTION 5 - CONTROL MODE SELECTION MENU

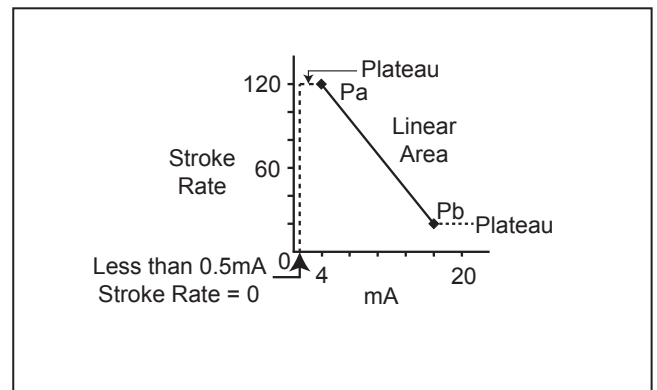
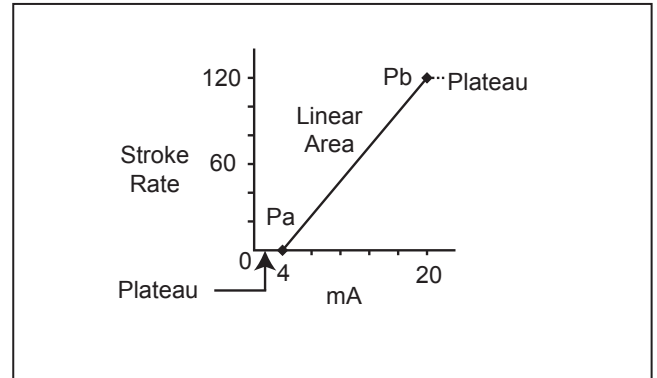
### 5.4.1 Programming the Analog Mode Response Curve

Use the  $\blacktriangle$  UP or  $\blacktriangledown$  DOWN button to move the selection box to the parameter you wish to change. Use the  $\text{Ⓚ}$  POWER button to toggle to the parameter's edit mode - a black background indicates the parameter is in edit mode. While in edit mode, use the  $\blacktriangle$  UP and  $\blacktriangledown$  DOWN buttons to set the value. Use the  $\text{Ⓚ}$  POWER button to exit edit mode and save the setting.

<table border="1"> <thead> <tr> <th></th> <th>mA</th> <th>SPM</th> </tr> </thead> <tbody> <tr> <td>P1</td> <td>4.0</td> <td>0</td> </tr> <tr> <td>P2</td> <td>20.0</td> <td>120</td> </tr> </tbody> </table> <p><b>Parameter Selected</b></p>		mA	SPM	P1	4.0	0	P2	20.0	120	<table border="1"> <thead> <tr> <th></th> <th>mA</th> <th>SPM</th> </tr> </thead> <tbody> <tr> <td>P1</td> <td>4.0</td> <td>0</td> </tr> <tr> <td>P2</td> <td>20.0</td> <td>120</td> </tr> </tbody> </table> <p><b>Placed Into Edit Mode</b></p>		mA	SPM	P1	4.0	0	P2	20.0	120
	mA	SPM																	
P1	4.0	0																	
P2	20.0	120																	
	mA	SPM																	
P1	4.0	0																	
P2	20.0	120																	
<table border="1"> <thead> <tr> <th></th> <th>mA</th> <th>SPM</th> </tr> </thead> <tbody> <tr> <td>P1</td> <td>4.0</td> <td>0</td> </tr> <tr> <td>P2</td> <td>20.0</td> <td>110</td> </tr> </tbody> </table> <p><b>Parameter Modified</b></p>		mA	SPM	P1	4.0	0	P2	20.0	110	<table border="1"> <thead> <tr> <th></th> <th>mA</th> <th>SPM</th> </tr> </thead> <tbody> <tr> <td>P1</td> <td>4.0</td> <td>0</td> </tr> <tr> <td>P2</td> <td>20.0</td> <td>110</td> </tr> </tbody> </table> <p><b>Parameter Saved</b></p>		mA	SPM	P1	4.0	0	P2	20.0	110
	mA	SPM																	
P1	4.0	0																	
P2	20.0	110																	
	mA	SPM																	
P1	4.0	0																	
P2	20.0	110																	

Use either the  $\text{MODE}$  button or navigate using the  $\blacktriangle$  UP or  $\blacktriangledown$  DOWN buttons to exit the programming mode. The valid range for the mA value is 0.0 to 20.0 mA. The valid range for the SPM value is 0 to 120 SPM or 0-59 SPH.

The programming of points P1 and P2 when plotted will result in a graph similar to one of the 2 charts below (Pa = lowest programmed mA value; Pb = highest programmed mA value). The pump will vary its stroke speed linearly between points Pa and Pb based on the mA input signal. If the mA input signal exceeds Pb, the stroke speed will remain (plateau) at the speed corresponding to Pb. If the mA input drops to less than Pa, the stroke speed will remain (plateau) at the speed corresponding to Pa. Regardless of settings, if the mA input drops to 0.5 mA or below, the pump will stop stroking.



### Display Overview:

	Selection Box	mA	SPM
Point 1 (P1) Settings	→ P1	4.0	0
Point 2 (P2) Settings	→ P2	20.0	120

- 1. Selection Box:** indicates the currently selected item.
- 2. Point 1 (P1) Settings:** the settings (mA and stroke rate) corresponding to set point P1.
- 3. Point 2 (P2) Settings:** the settings (mA and stroke rate) corresponding to set point P2.

### NOTE :

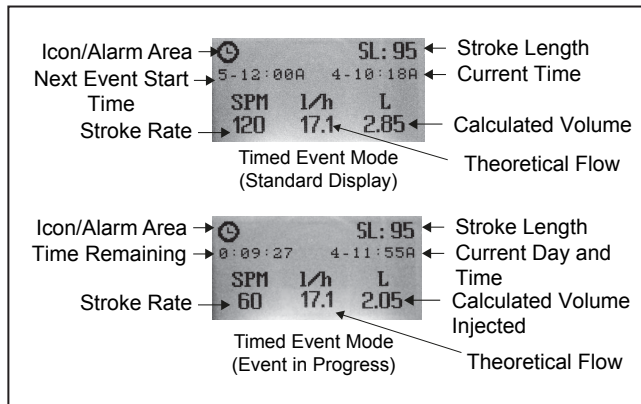
*Parameter changes are saved when editing is complete and go into effect immediately.*

## SECTION 5 - CONTROL MODE SELECTION MENU

### 5.5 TIMED EVENT MODE (INTERNAL)

With the pump OFF, press the  $\uparrow$  UP or  $\downarrow$  DOWN button to view and/or program the timed events (see Section. 5.5.1). To turn the pump ON or OFF, push the  $\text{Ⓚ}$  POWER button or toggle the remote ON/OFF. The  $\text{Ⓚ}$  Pump ON/OFF LED will illuminate green when the pump is ON.

#### Display Overview:



- 1. Icon/Alarm Area:** The  $\text{Ⓚ}$  icon indicates the pump is in the Timed Event mode. Depending on advanced pump configuration options and any alarms/alerts detected, other icons may be present as well (see Sec. 4.5).
- 2. Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
- 3. Next Event Start Day and Time:** The Day and Time of the next timed event. See below for the displayed format. The '\*' character in this field indicates that no events are enabled (see Sec. 5.5.1 for event programming information).

- 4. Current Day and Time:** The current Day and Time (see below for time format description).
- 5. Stroke Rate:** Indicates the stroke speed of the pump (1-59SPH or 1-120 SPM) for the currently running event or the next scheduled event.
- 6. Theoretical Flow:** The theoretical flow based on stroke speed, stroke length, and calibration settings (see Sec. 6.6 for calibration information).
- 7. Calculated Volume:** The calculated volume based on event duration, stroke rate, stroke length, and calibration settings (see Sec. 6.6 for calibration information).
- 8. Time Remaining (Event in Progress Only):** Remaining time of event.
- 9. Calculated Volume Injected (Event in Progress Only):** The calculated volume based on strokes made, stroke length, and calibration settings (see Sec. 6.6 for calibration information).

#### NOTE:

The displayed format for time is: D – H:MMx, where D = Day of Week (1-7), H = Hour (1-12), MM = Minute (0-59), x = A for AM or P for PM.

## SECTION 5 - CONTROL MODE SELECTION MENU

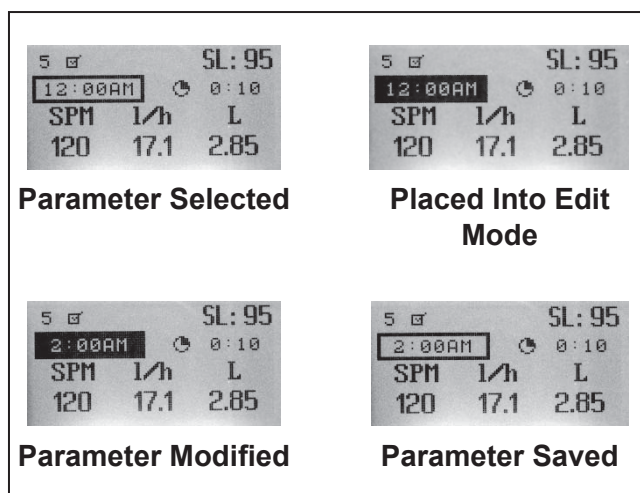
### 5.5.1 Programming Timed Events

One timed event may be programmed to execute for each of 7 days. Each event has a uniquely programmable start time, duration, and stroke rate.

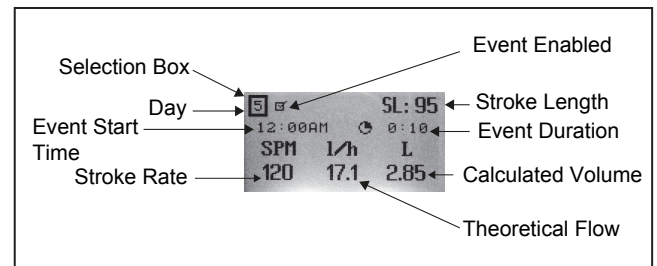
Use the  $\blacktriangle$  UP or  $\blacktriangledown$  DOWN button to move the selection box to the parameter you wish to change. Use the  $\text{Ⓚ}$  POWER button to toggle the parameter's edit mode. A black background indicates the parameter is in edit mode. The Event Enabled parameter will be toggled ON/OFF rather than going into an edit mode.

While in edit mode, use the  $\blacktriangle$  UP and  $\blacktriangledown$  DOWN buttons to set the value. The valid range for the day value is 1-7. As the day value is changed, the start time, duration, and stroke rate will be updated to reflect the programming for the selected day. A checked event enabled box indicates that the currently displayed event is enabled. The valid range for the duration value is 1 minute to 24 hours. The valid range for the SPM value is 0 to 120 SPM or 0-59 SPH.

Use the  $\text{Ⓚ}$  POWER button to exit the edit mode and save the setting. Use the  $\text{Ⓜ}$  MODE button to exit the programming mode.



### Display Overview:



- 1. Selection Box:** Indicates the currently selected item.
- 2. Day:** Day of currently displayed event.
- 3. Event Enabled:** Indicates whether currently displayed event is enabled (checked = enabled).
- 4. Stroke Length:** The numeric stroke length value indicates the current stroke length setting (in percent).
- 5. Event Start Time:** The Day and Time of the next timed event (see Sec. 5.5 for time format).
- 6. Event Duration:** Duration / Run-Time of currently displayed event (format Hours:Minutes).
- 7. Stroke Rate:** Indicates the stroke speed of the pump (1-59SPH or 1-120 SPM) for the currently running event or the next scheduled event.
- 8. Theoretical Flow:** The theoretical flow based on stroke speed, stroke length, and calibration settings (see Sec. 6.6 for calibration information).
- 9. Calculated Volume:** The calculated based on event duration, stroke rate, stroke length, and calibration settings (see Sec. 6.6 for calibration information).

#### NOTE:

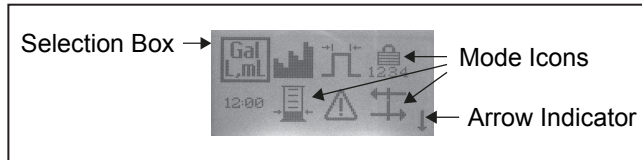
Parameter changes are saved when editing is complete and go into effect immediately.

After approximately 2 minutes of inactivity, the programming menu will automatically close and revert back to the main analog mode display.

# SECTION 6 - ADVANCED CONFIGURATION MENU

Use the  $\blacktriangle$  UP and  $\blacktriangledown$  DOWN buttons to select the desired mode. Push and hold the  $\text{\textcircled{1}}$  POWER button for approximately 1 second to select the desired mode. Push and hold the  $\text{\textcircled{M}}$  MODE button for approximately 2 seconds to exit the menu.

## Display Overview:



**1. Mode Icons:** Each icon represents a different control mode, as follows:

- = Set Units (Sec. 6.1)
- = Set Batch Mode (Sec. 6.2)
- = Set Pulse Width (Sec. 6.3)
- = Set Lock Mode Configuration (Sec. 6.4)
- = Set Clock (Sec. 6.5)
- = Calibrate Pump (Sec. 6.6)
- = Set Alarm / Internal-External Output (Sec. 6.7)
- = Set Remote Internal-External Mode Input (Sec. 6.8)
- = Digi-Pulse™ Setup (Sec. 6.9)
- = Set Percent-of-Time Operation (Sec. 6.10)
- = Load Factory Defaults (Sec. 6.11)
- = View Pump Information (Sec. 6.12)

**2. Selection Box:** Indicates the currently selected item.

**3. Arrow Indicator:** An arrow appearing on the upper or lower right of the display indicates that more icons are available via scrolling.

### NOTE:

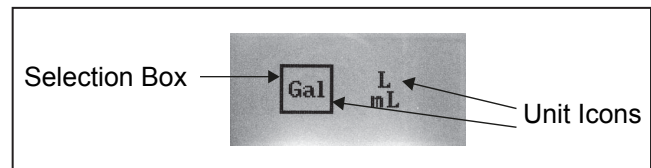
*Parameter changes are saved when editing is complete and go into effect immediately.*

*After approximately 2 minutes of inactivity, the mode selection menu will automatically close and revert back to the most recent control mode display.*

## 6.1 Gal L,mL SET UNITS

Use the  $\blacktriangle$  UP and  $\blacktriangledown$  DOWN buttons to select the desired units. Push the  $\text{\textcircled{1}}$  POWER button to selected the item and return to the advanced configuration menu.

## Display Overview:







**1. Unit Icons:**

- Gal** = English Units  
(i.e. Gallons per hour - GPH).
- L mL** = Metric Units (i.e. Liters, milliliters).

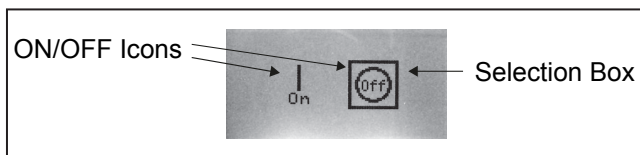
**2. Selection Box:** Indicates the currently selected item.

## SECTION 6 - ADVANCED CONFIGURATION MENU


### 6.2 SET BATCH MODE


Batch mode applies only to the Pulse Multiply Mode (see Section. 5.2). Use the  UP and  DOWN buttons to select On or Off. Push the  POWER button to select the item and return to the advanced configuration menu. Use the  MODE button to return to the advanced configuration menu without saving changes.

#### Display Overview:







#### 1. ON/OFF Icons:

 = Batch Mode ON (Stroke counter will accumulate when pulses are detected during an existing pump cycle)

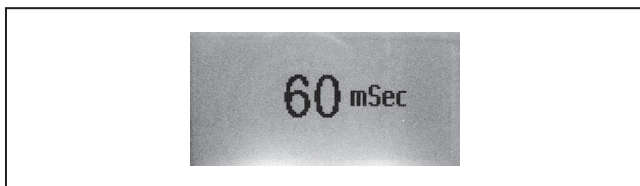
 = Batch Mode OFF (Stroke counter will reset if a pulse is detected during an existing pump cycle)

2. **Selection Box:** Indicates the currently selected item.

### 6.3 SET PULSE WIDTH








Use the  UP and  DOWN arrows to change the value for the pulse width. The valid range is 4 mSec - 60 mSec (in 4 mSec increments). Push the  POWER button to save the value and return to the advanced configuration menu. Use the  MODE button to return to the advanced configuration menu without saving changes.

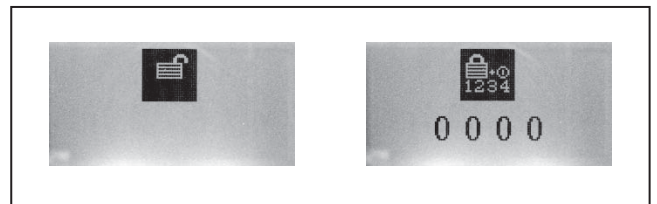
#### Display Overview:



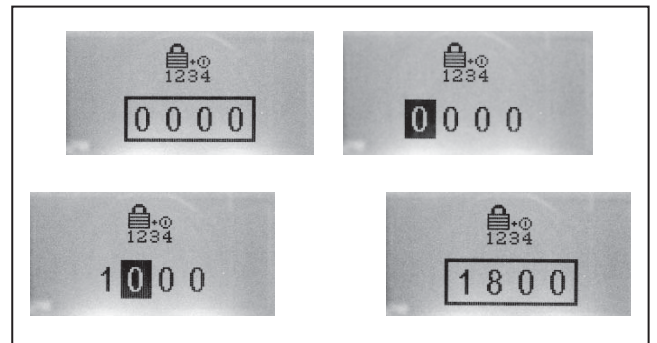
Pulse width (in milliseconds)

### 6.4 SET LOCK MODE CONFIGURATION

This menu is used to select the desired lock mode and to set the pass code; when you exit this menu, the lock is not activated (see Sec. 4.4 to activate the lock). Use the  UP or  DOWN button to select the desired parameter. Use the  POWER button to toggle to parameter's edit mode. A black background indicates the parameter is in edit mode. While in edit mode, use the  UP and  DOWN buttons to set the value. While setting the unlock pass code, use the POWER button to advance to the next digit, and the  MODE button to go back to the prior digit. Use the  MODE button to return to the advanced configuration menu.



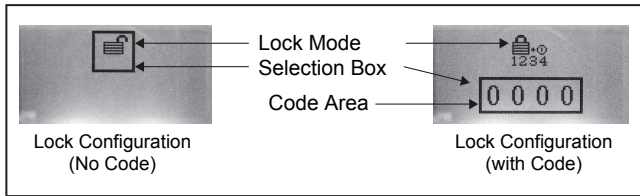
Example: Editing Lock Mode



Example: Editing Unlock Pass Code

# SECTION 6 - ADVANCED CONFIGURATION MENU

## Display Overview:



### 1. Lock Mode:

The icon corresponding to the current lock mode configuration.

- = Always unlocked (default).
- = All buttons locked out except the **POWER** button.
- = All buttons locked out.
- = All buttons locked out except the **POWER** button and an unlock pass code required to unlock pump.
- = All buttons locked out and an unlock pass code required to unlock pump.

**2. Code Area** (on appropriate lock modes only):  
Displays 4-digit unlock pass code.

**3. Selection Box:** Indicates the currently selected item.

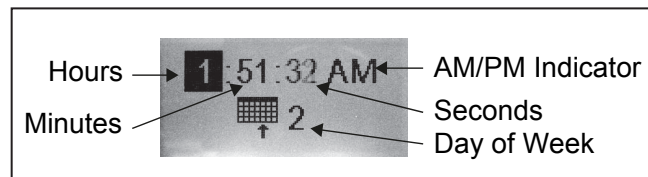
### NOTE:

*Make note of the pass code you have selected. This will be required to unlock the pump. If the pass code is misplaced and the lock is activated, the pump must be returned to the factory in order to be reset (see Section 4.4 to unlock the pump).*

## 6.5 12:00 SET CLOCK

The clock will only be displayed when operating in Timed Event Mode (see Sec. 5.5). Use the **UP** or **DOWN** button to edit the highlighted parameter. Use the **POWER** button to advance to the next parameter. Use the **MODE** button to go back to the prior parameter.

### Display Overview:





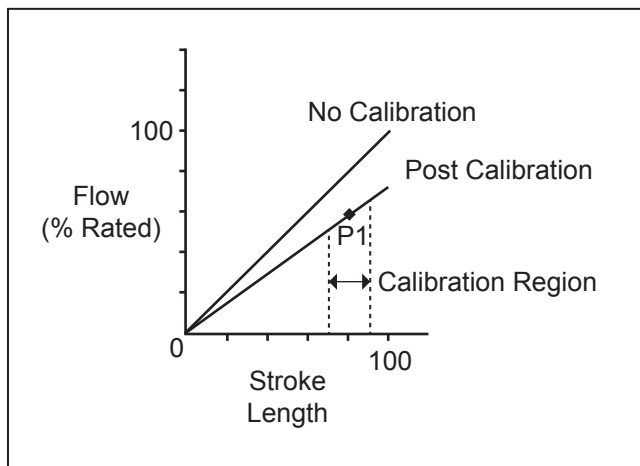
1. Hours (1-12).
2. Minutes (0-59).
3. Seconds (0-59).
4. AM/PM Indicator (AM or PM).
5. Day of Week (1-7).

## 6.6 PUMP CALIBRATION

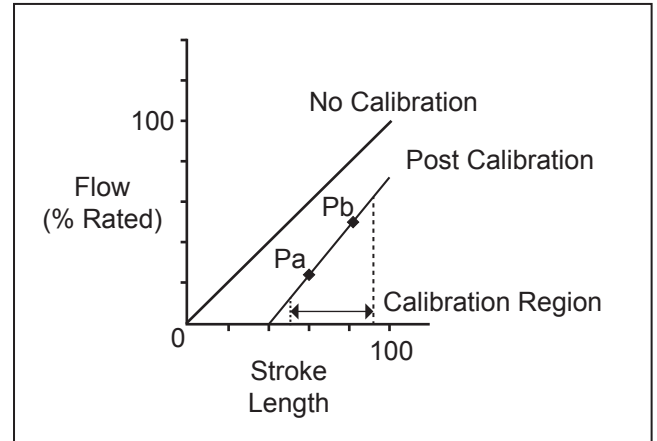
Pump calibration will increase the accuracy of the various displayed flow rates and volumes. In Single-Point Calibration (see *first diagram below*), the pump is calibrated to a specific stroke length and flow rate (P1), changing the slope of the flow line as indicated in the diagram. The “Calibration Region” extends to +/- 10% of the calibrated stroke length. As a result, the Single-Point Calibration should only be used if the stroke-length is to be maintained within 10% of the calibration setting.

In Two-Point Calibration (see *second diagram below*), the pump is calibrated to two specific stroke length and flow rate combinations (Pa and Pb), changing the slope and the offset of the flow line as indicated in the diagram. Pa and Pb stroke lengths must differ by at least 10%. The “Calibration Region” extends from -10% of Pa to +10% of Pb stroke lengths. The Two-Point Calibration will always result in a larger “Calibration Region” than the Single-Point Calibration.





When a pump has been calibrated, the  or  icon is displayed in the Icon/Alarm area of the display (see Sec. 4.5). If the stroke length is adjusted outside the calibration region, the **SL** alarm icon will be displayed in the Icon/Alarm area of the display.



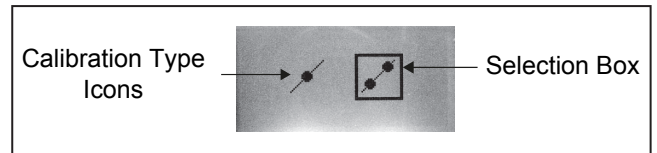
**Figure 2. Single-Point Calibration**



**Figure 3. Two-Point Calibration**

Use the  UP or  DOWN button to select the desired calibration mode. Use the  POWER button to select the mode (see Sec. 6.6.1 for *single-point calibration procedure* or Sec. 6.6.2 for *two-point calibration procedure*). Use the  MODE button to return to the advanced configuration menu without making changes.

### Display Overview:



**1. Calibration Type Icons:** The icons corresponding to the following calibration types:

 = Single-Point Calibration

 = Two-Point Calibration

**2. Selection Box:** Indicates the currently selected item.

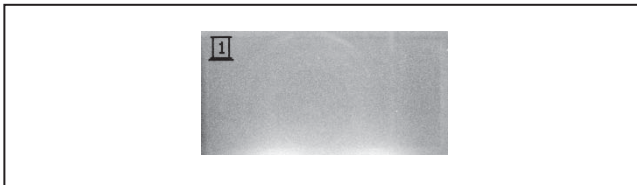
## SECTION 6 - ADVANCED CONFIGURATION MENU

### 6.6.1 Single-Point Calibration Procedure

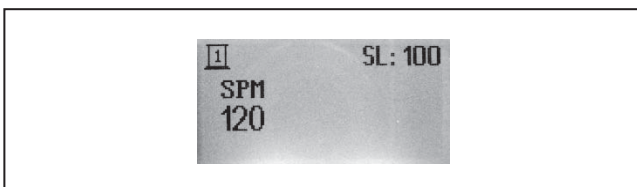
During calibration, accuracy improves as stroke count increases. As a result, a minimum of 100 strokes should be used to calibrate the pump. The maximum number of strokes in the calibration process is 9999. The stroke length cannot be changed during calibration step 3 below. If the stroke length is changed, a **SL** error icon will display, the pump will stop, and the stroke count and pump output will be reset to zero. Stroke speed may only be adjusted in step 2. In general, the **MODE** button may be used to step back in the calibration procedure.

#### Procedure:

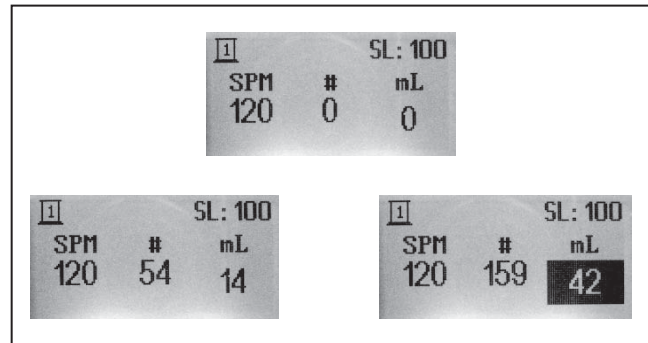
1. Upon selecting single-point calibration, the **1** icon will be displayed indicating that pump is ready to begin calibration.



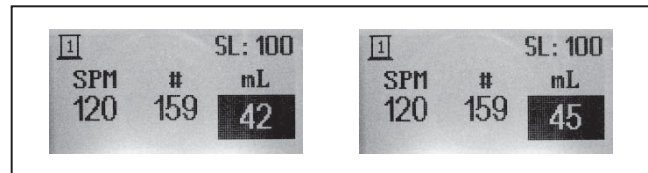
2. Press the **POWER** button. The pump will begin pulsing. Adjust the stroke length knob to the desired setting for calibration. Use the **UP** or **DOWN** buttons to adjust the stroke speed to the desired setting for calibration. Press the **POWER** button when adjustments are complete. The pump will stop pulsing.



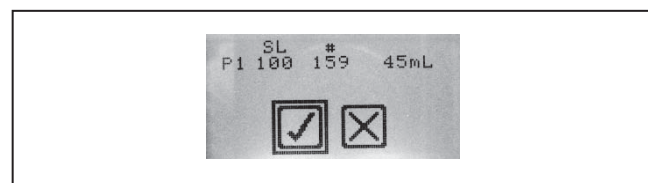
3. Press the **POWER** button to begin calibration of the pump. The pump will start pulsing. The display will begin counting the strokes and displaying the accumulated volume. The volume displayed is based upon the pre-existing settings. Press the **POWER** button when the desired number of strokes has occurred.



4. Use the **UP** or **DOWN** buttons to edit the highlighted volume as necessary. Press the **POWER** button when complete.



5. Use the **UP** or **DOWN** buttons to select whether to  (Save) or  (abandon) the displayed calibration settings. Press the **POWER** button to accept the selection and then return to the main calibration menu.





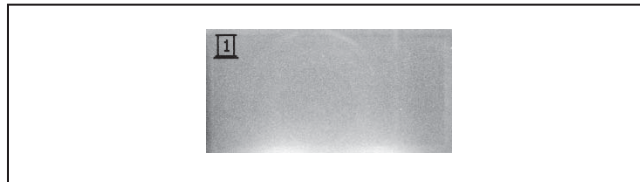
## SECTION 6 - ADVANCED CONFIGURATION MENU

### 6.6.2 Two-Point Calibration Procedure

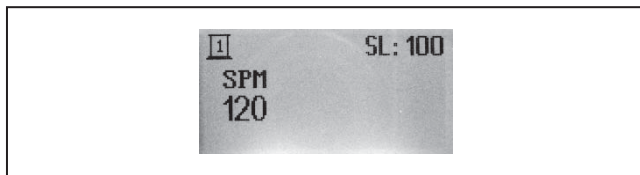
During calibration, accuracy improves as stroke count increases. As a result, a minimum of 100 strokes should be used to calibrate the pump. The maximum number of strokes in the calibration process is 9999. The stroke length cannot be changed during calibration steps 3 and 7. If the stroke length is changed, a **SL** error icon will display, the pump will stop, and the stroke count and pump output will be reset to zero. Stroke speed may only be adjusted in calibration steps 2 and 6. In general, the **MODE** button may be used to move back in the calibration procedure.

#### Procedure:

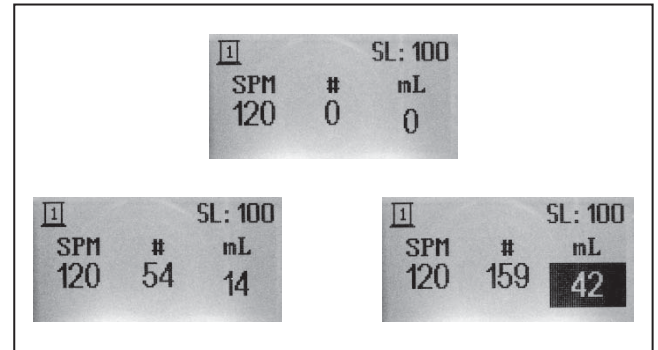
1. Upon selecting two-point calibration, the **1** icon will be displayed indicating that the pump is ready to begin calibration of point one.



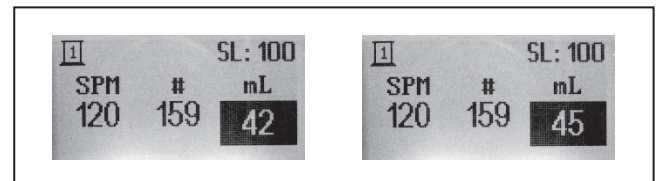
2. Press the **POWER** button. The pump will begin pulsing. Adjust the stroke length knob to the desired setting for calibration of point 1. Use the **UP** or **DOWN** buttons to adjust the stroke speed to the desired setting for calibration of point 1. Press the **POWER** button when adjustments are complete. The pump will stop pulsing.



3. Press the **POWER** button to begin the calibration of point 1. The pump will start pulsing. The display will begin counting the strokes and displaying the accumulated volume. The volume displayed is based upon the pre-existing settings. Press the **POWER** button when the desired number of strokes has occurred.



4. Use the **UP** or **DOWN** buttons to edit the highlighted volume as necessary. Press the **POWER** button when complete.

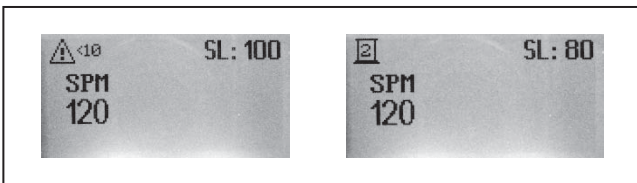


5. The **2** icon will now be displayed, indicating that the pump is ready to begin calibration of point two.

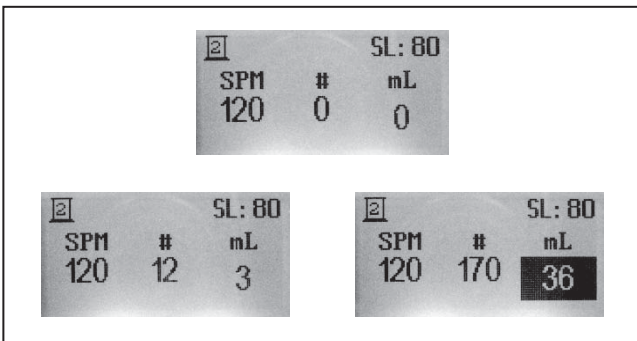


## SECTION 6 - ADVANCED CONFIGURATION MENU

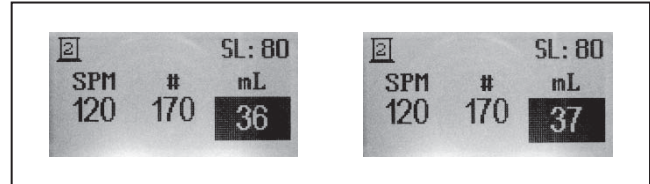
6. Press the **ⓘ** POWER button. The pump will begin pulsing. Adjust the stroke length knob to the desired setting for calibration of point 2. Use the **▲** UP or **▼** DOWN buttons to adjust the stroke speed to the desired setting for calibration of point 2. Press the **ⓘ** POWER button when adjustments are complete. The pump will stop pulsing. The two stroke length settings must be at least 10% apart. If not, a <10 error icon will display.



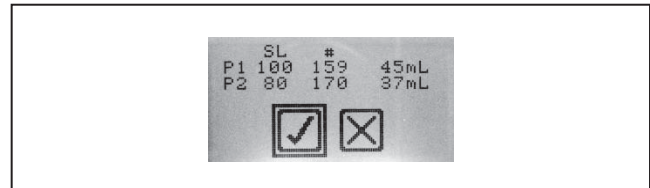
7. Press the **ⓘ** POWER button to begin calibration of point 2. The pump will start pulsing. The display will begin counting the strokes and displaying the accumulated volume. The volume displayed is based upon the pre-existing settings. Press the **ⓘ** POWER button when the desired number of strokes has occurred.



8. Use the **▲** UP or **▼** DOWN buttons to edit the highlighted volume as necessary. Press the **ⓘ** POWER button when complete.







9. Use the **▲** UP or **▼** DOWN buttons to select whether to  (Save) or  (abandon) the displayed calibration settings. Press the **ⓘ** POWER button to accept the selection and then return to the main calibration menu.



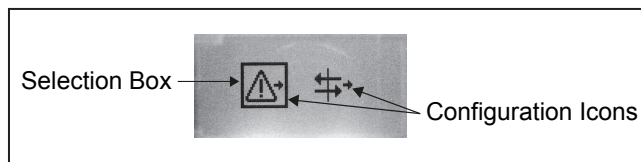
## SECTION 6 - ADVANCED CONFIGURATION MENU

### 6.7 CONFIGURE ALARM OUTPUT


This feature is used to configure the alarm output, which is indicated on the appropriate contacts of the 6-Pin connector. The alarm output can be configured in one of two ways: it can be used to indicate the alarm status or it can be used to indicate whether the pump is in an internal or external control mode. If the alarm output is configured to indicate the alarm status, then open contacts indicate that there is no alarm. When an alarm is active, the contacts will be closed. If the alarm output is configured to indicate the internal external mode status, then open contacts indicates the pump is in an internal mode; closed contacts indicates the pump is in an external mode.


Use the  UP or  DOWN button to select the desired configuration. Use the  POWER button to select the configuration. If alarm output indicates alarm status is selected, the Alarm Output Mask configuration menu will display next (see Sec. 6.7.1). Use the  MODE button to return to the advanced configuration menu without making changes.

#### Display Overview:









#### 1. Configuration Icons:

 = Alarm output indicates alarm status.

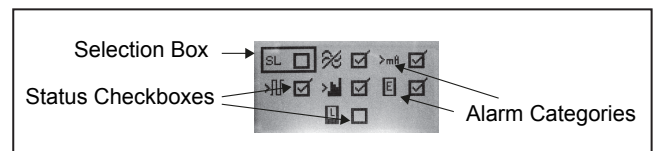
 = Alarm output indicates Internal/External Mode status.

2. **Selection Box:** Indicates the currently selected item

### 6.7.1 Configure Alarm Output Mask

Use the  UP or  DOWN button to select the desired alarm to enable/disable. Use the  POWER button to toggle the associated status check box. Use either the  MODE button or navigate using the  UP or  DOWN buttons to save the data and return to the configure alarm output menu.

#### Display Overview:




1. **Alarm Categories** (see Sec. 4.5 for descriptions of each alarm condition)


**SL** = Stroke length alarm.


 = DIGI-PULSE™ flow switch alarm.

**>mi** = Analog input alarm.

 = Incoming pulse rate alarm.

 = Batch alarm.

 = Empty tank alarm.

 = Low tank alarm.

2. **Status Check boxes:** Indicates if the alarm output will be enabled (checked) or ignored (unchecked) when the associated alarm condition is detected.

3. **Selection Box:** Indicates the currently selected item.





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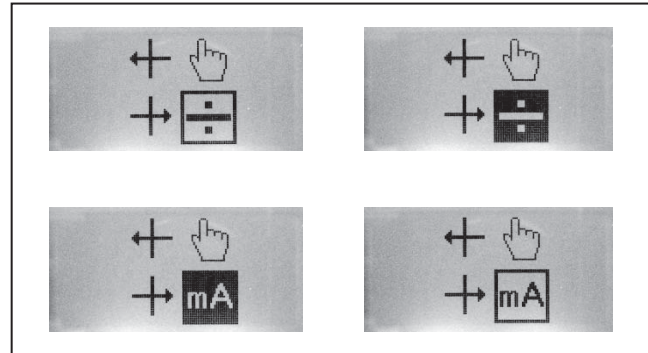
### 6.8 SET REMOTE INTERNAL-EXTERNAL MODE INPUT

This feature is used to switch from an internal control mode to an external control mode remotely by using the appropriate contacts of the 6-Pin connector. There are two internal control modes and 3 external control modes (see Sec. 5.0). The remote internal/external inputs are only monitored when the contacts are switched from open to closed, or vice versa. As a result, the control mode can always be changed from the pump, regardless of the closure status of these contacts.

If the pump is in an internal mode and the contacts on the remote internal/external input are closed, the pump will switch to the programmed external mode. If the pump is in an external mode and the contacts are opened, the pump will switch to the programmed internal mode.

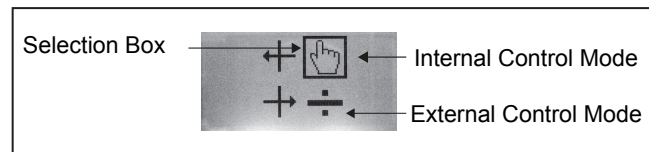
If the pump is in an internal mode and the contacts are opened, no action will be taken—the pump will remain in the pre-existing control mode. In this case, if the pre-existing control mode differs from the programmed control mode, the pre-existing control mode takes priority. Conversely, if the pump is in an external mode and the contacts are closed, no action will be taken.

Use the  POWER button to toggle to parameter's edit mode. A black background indicates the parameter is in edit mode. While in edit mode, use the  UP and  DOWN buttons to set the value. Use the POWER button to exit edit mode and save the setting. Use the  MODE button to return to the advanced configuration menu.




**Example: Editing the External Control Mode Parameter**

#### Display Overview:



**1. Internal Control Mode:** The following are valid internal type control modes:

 = Manual

 = Timed Event

**2. External Control Mode:** The following are valid external type control modes:

 = Pulse Multiply








 = Pulse Divide

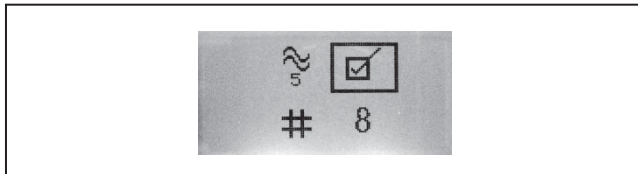
mA = Analog (mA)

**3. Selection Box:** Indicates the currently selected item.

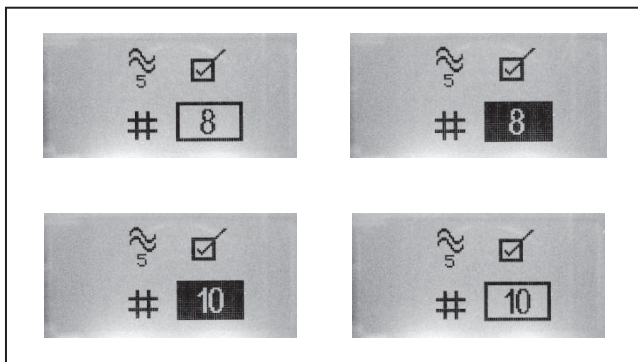
## 6.9 DIGI-PULSE™ FLOW MONITORING SETUP

This feature is used in conjunction with the LMI® Series FM-ROY-9 Digi-Pulse™ Flow Monitor (refer to DIGI-PULSE™ Flow Monitor Instructions P/N 1865). This device is designed to monitor the output flow from a pump. It may be set to deliver a pulse signal output for each successful pump stroke registered. If the flow stops or lessens, the pulse outputs will cease. With the FMROY- 9 connected to the 4-Pin connector, the presence or lack of pulses can be detected.

Use the  UP or  DOWN button to select the icon. Use the  POWER button to toggle the Function Enabled Indicator. Use the  POWER button to toggle the Missing Pulses parameter's edit mode. While in edit mode, use the  UP and  DOWN buttons to set the value. Use the  MODE button to return to the advanced configuration menu.

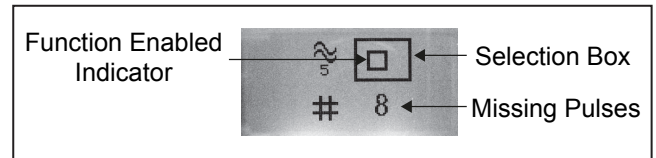


**Example: Enabling the Function**






**Example: Editing the Missing Pulses Parameter**

### Display Overview:



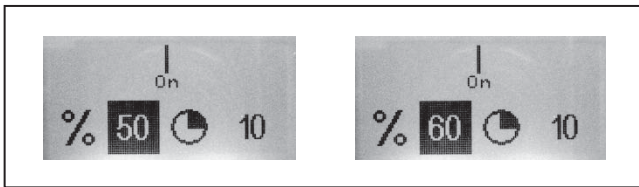
- 1. Function Enabled Indicator:** Check box indicating if DIGI-PULSE™ Flow Monitoring functionality is enabled (checked=enabled).
- 2. Missing Pulses:** Number of missing pulses to detect before issuing pump alarm. The valid range is 0-255. The factory default is 8. A setting of 1 is the most sensitive; a setting of 255 is the least sensitive.
- 3. Selection Box:** Indicates the currently selected item.

When flow monitoring is enabled, the  icon is displayed in the Icon/Alarm area of the display (see Sec. 4.5). If, for example, the Missing Pulses parameter is set to 5 and 5 strokes of the pump occur without any pulse being received from the FM-ROY-9, the  alarm icon will be displayed in the Alarm/Icon area of the display (see Sec. 4.5). The pump will stop and the alarm outputs will be activated, if enabled (see Sec. 6.7). Pressing the  POWER button clears the alarm.

## SECTION 6 - ADVANCED CONFIGURATION MENU

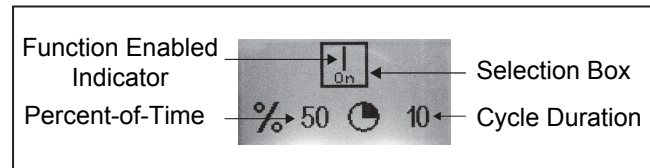
### 6.10 % SET PERCENT-OF-TIME OPERATION

This feature allows time-based cycling of the pump in Manual, Pulse Divide, and Analog Control Modes. The pump cycles on and off based on the configuration parameters. Use the  $\uparrow$  UP or  $\downarrow$  DOWN button to select the % icon. Use the  $\text{P}$  POWER button to toggle the Function Enabled Indicator. Use the  $\text{P}$  POWER button to toggle the parameter's edit mode (Percent of Time and Cycle Duration parameters). While in edit mode, use the  $\uparrow$  UP and  $\downarrow$  DOWN buttons to set the value. Use the  $\text{M}$  MODE button to return to the advanced configuration menu.



**Example: Editing Percent-of-Time Parameter**

#### Display Overview:



**1. Function Enabled Indicator:** Indicates if Percent-of-Time functionality is enabled.

$\text{Off}$  = Function OFF / Disabled.

$\text{On}$  = Function ON / Enabled.

**2. Percent of Time (Function ON only):** Percent of time cycle to enable pump stroking (0-100).

**3. Cycle Duration (Function ON only):** Total cycle time in minutes (1-1440).

**4. Selection Box:** Indicates the currently selected item.

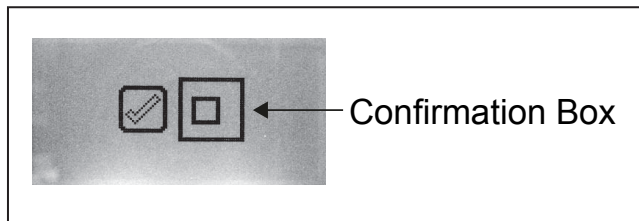
For example, if % = 20 and  $\text{On}$  = 10, then the pump will cycle continuously as follows: run for 2 minutes, stop for 8 minutes. When this feature is enabled, the % icon is displayed in the Icon/Alarm area of the display (see Sec. 4.5).

## SECTION 6 - ADVANCED CONFIGURATION MENU

### 6.11 ↻ LOAD FACTORY DEFAULTS

This feature will return the pump parameters to their factory default settings. Push the **ⓘ** POWER button to highlight the confirmation box. Push the **▲** UP or **▼** DOWN button to check or uncheck the box. Push the **ⓘ** POWER button to load factory defaults and return pump to default state (see Sec. 4.0). Use the **Ⓜ** MODE button to return to the advanced configuration menu without saving changes.

#### Display Overview:

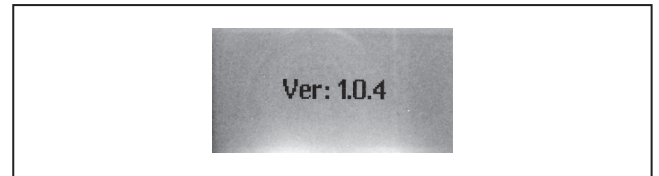


- 1. Confirmation Box:** Check this box to confirm operation

### 6.12 ⓘ VIEW PUMP INFORMATION

This feature displays the pump firmware version. Use the **Ⓜ** MODE button to return to the advanced configuration menu.

#### Display Overview:



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