med associates inc

instrumentation and software for research

VARIABLE SPEED INFUSION PUMP WITH SERIAL CONTROL

PHM-100VSS

USER'S MANUAL

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Diagrams

CHAPTER 1 | INTRODUCTION

The PHM-100VSS provides infusions from 0.1 to 99.9 seconds in length, at rates ranging from 0.5 to 20 RPM. The pump may be operated using MED-PC® and standard Med connection panel outputs, a TTL signal, a switch closure, or via computer serial control.

The PHM-100VSS requires 110VAC, 60 Hz, while the PHM-100VSSA operates on 220VAC, 50 Hz. The PHM-100VSS also requires a DIG-729 USB High Speed Serial Controller if it is to be used with MED-PC®.

Figure 1-1 - PHM-100VSS Front View
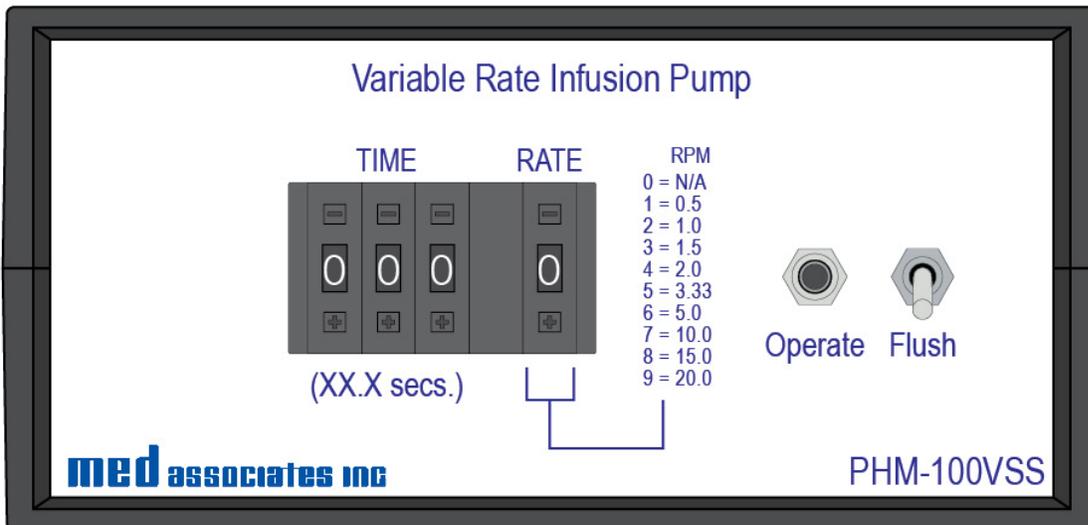
CHAPTER 2 | SYRINGE PLACEMENT

The 4 steps in Figure 2-1 illustrate the proper procedure for loading a syringe into the pump.

1. Squeeze the slide tabs and move the slide to the rear of the pump, towards the motor housing.

2. Lift the syringe clamp cover and place the syringe into the clamp. Load the syringe into the clamp and make sure the hub of the syringe barrel is flush against the syringe clamp. If a gap exists between the hub and the clamp, accurate flow rates cannot be assured, as the entire syringe (the barrel and plunger) may move forward.

3. Squeeze the slide tabs and position the slide against the plunger.

4. Visually check the plunger movement in relation to the barrel by rotating the front knob of the pump.

Figure 2-1 - Loading a Syringe
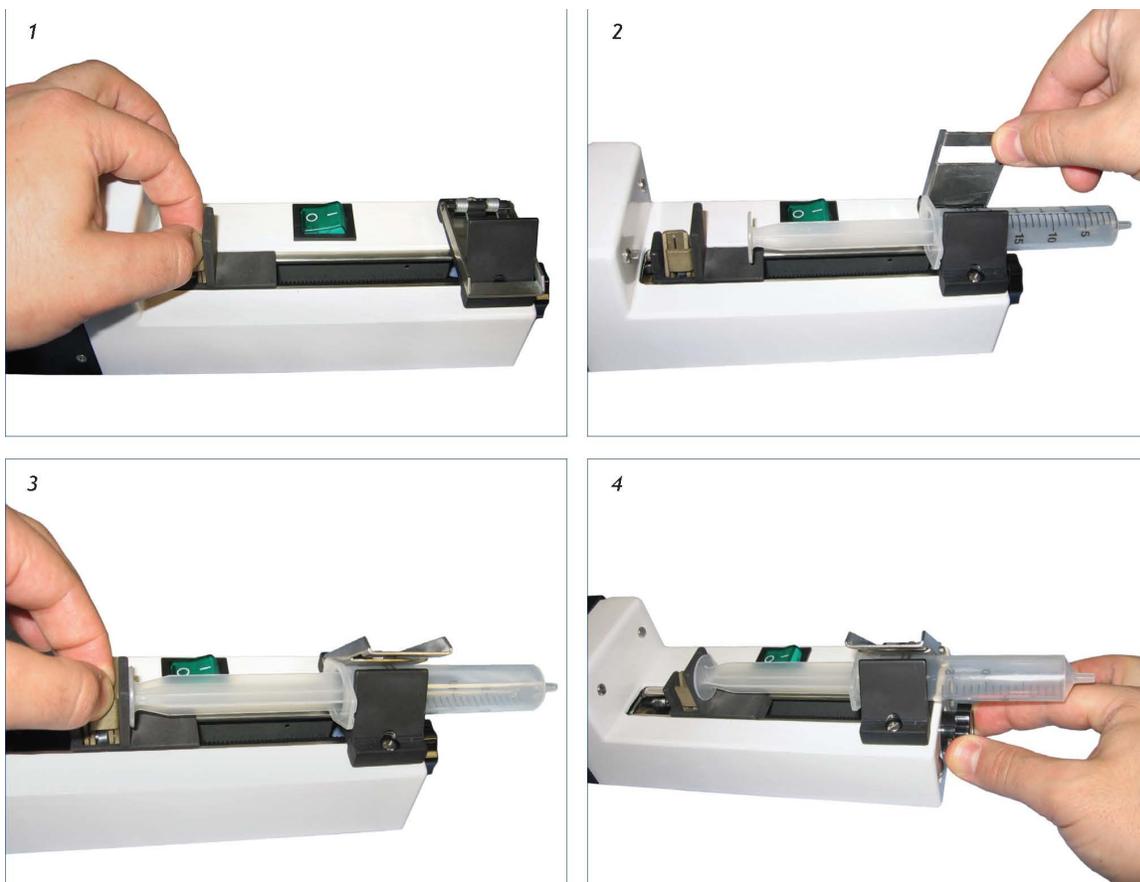
Priming the Line

Once the syringe is installed, the line should be primed until liquid drips out of the syringe or tubing. This ensures that fluid will be infused properly when the pump is activated.

Prime the line by pressing and holding the **Flush** switch (Figure 1-1) in the down position until fluid drips from the syringe tip or tubing. The Flush switch will only operate when a timed infusion is not in progress.   While flushing, the pump will operate at 10 RPM and the **TIME** and **RATE** settings have no effect.

Glass Syringes

Extra caution should be exercised when using glass syringes with a ground glass plunger. These syringes exhibit almost no sliding friction and may cause an uncontrolled infusion if:

1. The weight of the plunger is sufficient to push the fluid out of the syringe when the syringe is positioned with the plunger above the syringe.

2. The weight of the fluid in the tubing is sufficient to siphon the fluid out of the syringe if the catheter infusion site is below the height of the syringe.

To test for either of these conditions, connect the syringe to the tubing and hold the syringe vertically at the height of the pump. If no motion occurs, the syringe may then be placed in the pump.

The following may reduce the risk of an uncontrolled infusion:

1. Lower the relative height of the infusion pump in relation to the infusion site. With the pump below the infusion site, the instrument will pump the fluid to the higher elevation.

2. Use a smaller bore catheter. This will reduce the weight of the fluid in the tubing and increase the friction on the flowing fluid.

3. Position the pump vertically with the plunger below the syringe, thus the weight of the plunger will be acting against the weight of the fluid.

4. Use a syringe with a rubber seal on the plunger, i.e. an O-ring sealed or plastic syringe.

CHAPTER 3 | CONTROLLING THE PUMP IN MANUAL MODE

When the **MODE** switch (Figure 3-1) is in the **Manual** position, the **TIME** and **RATE** push buttons (Figure 3-2) will determine the duration and rate of the infusion. If the end of the syringe is reached during an infusion, the **Automatic Shut-Off Switch** will be activated and the pump will be stopped. See **Chapter 5, Automatic Shut-Off Switch Adjustment** for more information.
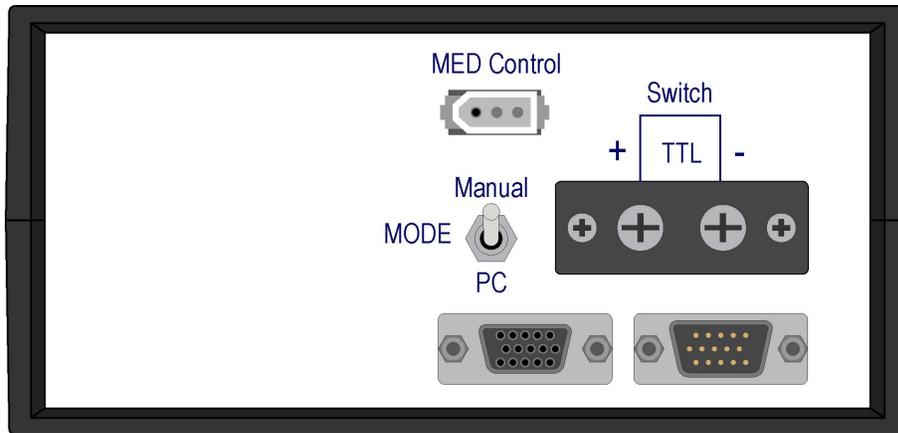
Figure 3-1 - Back Panel of the PHM-100VSS

Figure 3-2 - Front Panel of the PHM-100VSS
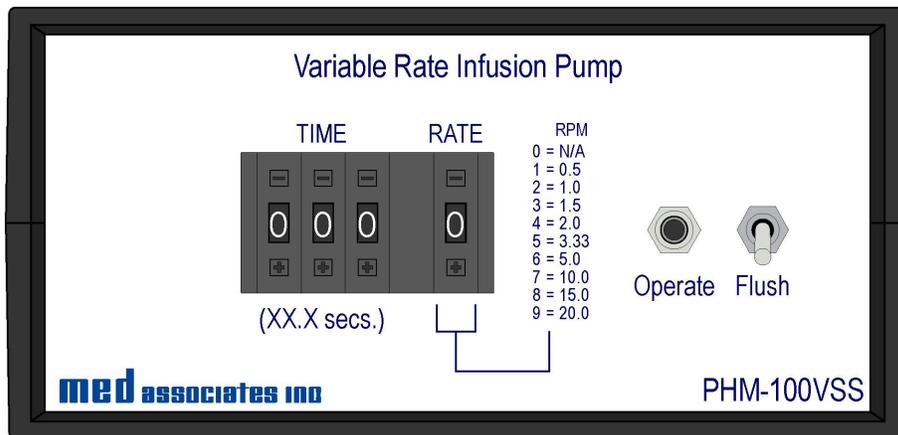
Setting the TIME and RATE Push Buttons

In Manual mode, the duration and speed of the infusion are set using the **TIME** and **RATE** push buttons on the front of the PHM-100VSS. The **TIME** push buttons are used to set infusion time from 0.1 to 99.9 seconds. The **RATE** push button is used to set the pump's RPM. Table 3-1 illustrates the available pump RPM speeds.

For example, in Figure 3-3, the infusion time has been set to 35.0 seconds and the pump RPM is set to 2.0 RPM.

Figure 3-3 - Example Settings

Table 3-1 - RATE Pushbutton Switch Settings

RATE Pushbutton Setting	Corresponding RPMs
0	N/A
1	0.5
2	1.0
3	1.5
4	2.0
5	3.33
6	5.0
7	10.0
8	15.0
9	20.0

Flow Rates and Pump Speeds

Table 3-2 shows the flow rates, in milliliters per minute (mL/min), of several commonly used syringes.

Table 3-2 - Flow Rates of Commonly Used Syringes
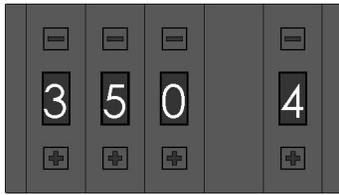
Thumbwheel Setting	Motor RPM	1 mL Multifit	2 mL Multifit	5 mL Multifit	10 mL Plastipak	10 mL Multifit	12 mL Monoject	20 mL Plastipak	20 mL Multifit	20 mL Monoject	30 mL Plastipak	30 mL Multifit	35 mL Monoject	50-60 mL Plastipak Monoject	50 mL Multifit
1	0.50	0.017	0.061	0.106	0.160	0.165	0.193	0.278	0.295	0.323	0.358	0.395	0.437	0.542	0.603
2	1.00	0.034	0.122	0.212	0.320	0.331	0.386	0.557	0.589	0.646	0.715	0.791	0.874	1.084	1.206
3	1.50	0.052	0.184	0.318	0.480	0.496	0.579	0.835	0.884	0.969	1.073	1.186	1.311	1.626	1.809
4	2.00	0.069	0.245	0.424	0.640	0.661	0.773	1.114	1.179	1.292	1.431	1.581	1.748	2.169	2.412
5	3.33	0.115	0.408	0.706	1.066	1.102	1.288	1.856	1.965	2.154	2.385	2.636	2.914	3.614	4.02
6	5.00	0.172	0.612	1.059	1.600	1.653	1.931	2.784	2.947	3.231	3.577	3.954	4.371	5.421	6.031
7	10.00	0.344	1.223	2.118	3.198	3.306	3.863	5.895	5.895	6.462	7.155	7.907	8.741	10.843	12.061
8	15.00	0.516	1.835	3.177	4.798	4.959	5.794	8.353	8.843	9.694	10.732	11.861	13.112	16.264	18.092
9	20.00	0.688	2.446	4.236	6.397	6.612	7.726	11.137	11.789	12.925	14.310	15.814	17.483	21.686	24.122

To calculate the flow rate of a syringe not given above, use the following formula:

Flow Rate (mL/min) = 0.19538 * RPM * syringe cross-sectional area

Med Control

Connect the **Med Control** connector shown in Figure 3-1 to any available output on a standard Med Associates connection panel using a standard Med connection cable. Upon receiving an operate signal, the pump will administer the infusion according to the settings defined by the **TIME** and **RATE** push buttons, and then the pump will stop. The operate signal must be toggled off between infusions. Changes made to the **TIME** and **RATE** push buttons will have no effect until the start of the next infusion.

Figure 3-4 - Med Control Connector Pinout

Molex Pin #	Function
1	Not Used
2	+28 Volts
3	Operate

Numbered Molex Connector
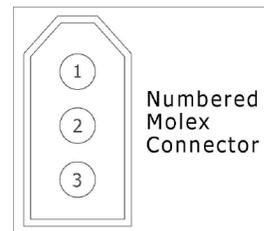
TTL Control (5V)

Connect the TTL ground to the (-) screw terminal and the TTL operate signal to the (+) screw terminal. A TTL high to low transition on the operate line activates the pump.

CAUTION: Voltage levels above 5.2 VDC at the TTL terminals can damage the unit.

Switch Closure Control

Simply connect a switch between the (+) and (-) screw terminals. Closing the switch will operate the pump. The switch must be opened and closed again to activate the pump for another cycle.

CHAPTER 4 | CONTROLLING THE PUMP IN PC MODE

The supplied software allows the pump to be controlled using MED Test or MED-PC® when the **MODE** switch (Figure 3-1) is in the **PC** position. The settings of the **TIME** and **RATE** switches are not recognized when operating in PC mode. If the end of the syringe is reached during an infusion the **Automatic Shut-Off Switch** will be activated and the infusion will be stopped. Refer to **Chapter 5, Automatic Shut-Off Switch Adjustment** for more information.

DIG-729 Installation

Consult the **DIG-729 High Speed Serial Controller**, **DOC-002**, manual for instructions on installing the DIG-729 PCI card or DIG-729 USB High Speed Serial Control Box.

DIG-729 Wiring Instructions

Connect the female DB-15 port on the back panel of the PHM-100VSS to the DIG-729 PCI card in the PC (Figure 4-1) or the DIG-729 USB (Figure 4-2) using the supplied SG-219C cable.

Figure 4-1 – DIG-729 PCI Card Connected to PHM-100VSS

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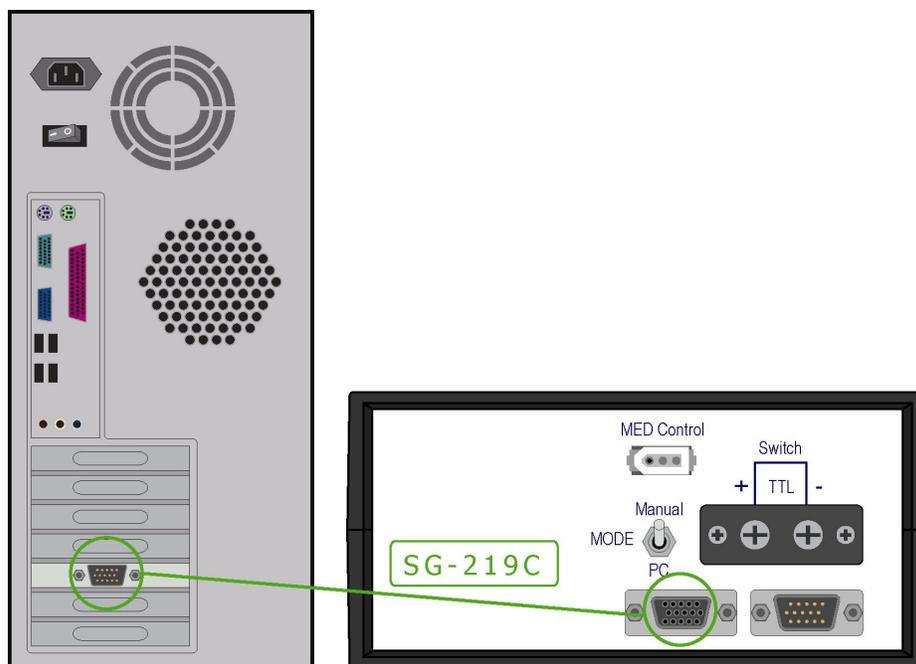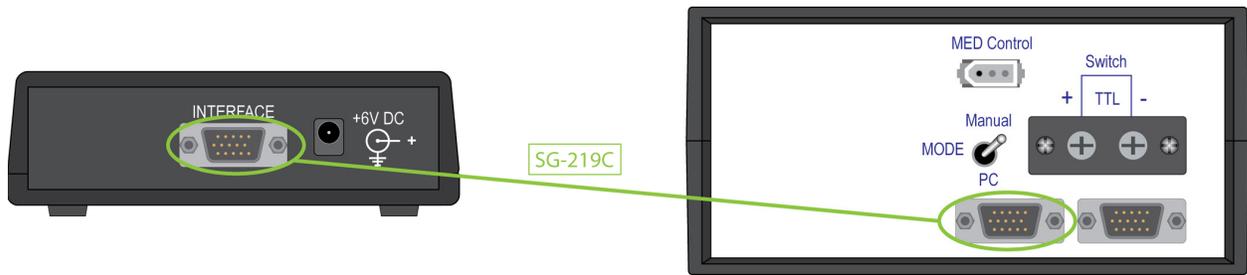Med Associates, Inc.

*Figure 4-2 - DIG-729 USB Connected to PHM-100VSS*

Then connect the PHM-100VSS power cord to a standard wall outlet and use the lighted ON/OFF switch to power on.

Daisy-Chaining Multiple PHM-100VSS Pumps

To control additional PHM-100VSS pumps, connect them in daisy-chain fashion by connecting the male DB-15 port on the first pump to the female DB-15 port on the second pump using an SG-219C cable. Up to 16 pumps may be daisy-chained together in this fashion. The pumps may be daisy-chained in any order as long as the last pump in the series has the highest node number and its terminate switches are ON.

Figure 4-3 – Controlling Additional Pumps
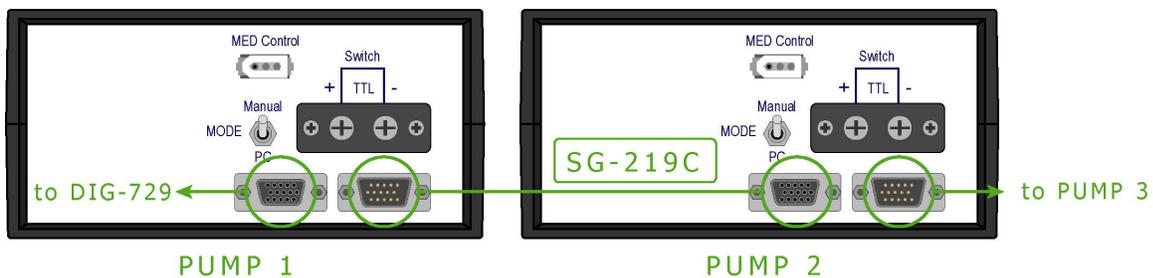
NOTE: The SG-219C cables used to connect the pumps should not exceed 10-feet in length.

PHM-100VSS network address and terminate switches are factory set and are clearly labeled on the pump housing.

In most cases users will not need to adjust these settings. However, if a new PHM-100VSS pump is added to an existing pump network, the network addresses and terminate settings of the PHM-100VSS pumps may need to be adjusted. See **Chapter 6, PHM-100VSS Addressing Scheme** for details on changing network addresses and terminate settings on the PHM-100VSS.

Testing Pumps With MED Test

The MED Test software is installed when MED-PC® is installed. MED Test allows the user to test the PHM-100VSS pumps directly. To test the pumps using MED Test, open MED Test and select **Pumps** > **PHM-100VSS** to open the screen in Figure 4-4.

Figure 4-4 - MED Test Screen

Enter the **Node** number (from the address sticker on the pump), the desired **RPM**, the desired **Infusion Time** in seconds and then click the **Set Pump** button to start the PHM-100VSS pump. After the settings are sent to the pump the pump's status will be displayed in the **Sum Check Sent** and **Sum Check Rec** fields. These fields should match. If a pump is not responding, check that the power is on and all network connections have been properly made. If necessary, contact Med Associates for further assistance.

Once the correct data has been entered and the pump is responding, start the pump by clicking the **Pump On** button. A pump may be operated repeatedly with the same data by repeatedly clicking the **Pump On** button.

Controlling Pumps With MED-PC®

The following MedState® Notation (MSN) commands are available for controlling a PHM-100VSS from within a MED-PC® procedure. See the following **Sample MED-PC® Procedure** for implementation examples.

Using BOX as The Pump Number

The parameter BOX is often used to specify the pump (node) number so that the same program may be used for all boxes. When a program is loaded into a chamber (box) in MED-PC®, the chamber number that the program was loaded into is automatically stored and tracked by MED-PC® in that specific chamber's BOX variable. Therefore, when a program is loaded into chamber 1, chamber 1's BOX variable is assigned the value 1, when a program is loaded into chamber 2, chamber 2's BOX variable is assigned the value 2 etc.

SetPump

Syntax	`~SetPump(MG, P1, P2, P3);~`
Parameters	**MG:** MED-PC® Global Parameter. **P1:** The pump's node value (1 to 16) **P2:** The Rate (0.5 to 20 RPM). **P3:** The infusion time (0.1 to 99.9 seconds).
Comments	Sets the pump's parameters. These parameters are retained until specifically changed or the pump is powered off. **SetPump** must be called before any other commands are issued. Wait 1 clock cycle before calling another command after calling **SetPump**. P1 through P3 may be numbers, constants, special identifiers, or variables. Note: Array elements must be expressed using square brackets P[1].
Example	`~SetPump(MG, BOX, 3.33, 10);~` Uses the value of BOX to specify the pump number. Sets pump (node) number BOX to operate at 3.33 RPM for 10 seconds.

OnPump

Syntax	`~OnPump(MG, P1);~`
Parameters	**MG:** MED-PC® Global Parameter. **P1:** The pump's node value (1 to 16).
Comments	Turns the pump on at the speed, and for the duration set in the **SetPump** command. P1 may be a number, constant, special identifier, or variable. Note: Array elements must be expressed using square brackets P[1].
Example	`~OnPump(MG, BOX);~` Turns on pump (node) number BOX.

LockOnPump

Syntax	`~LockOnPump(MG, P1);~`
Where	**MG:** MED-PC® Global Parameter **P1:** The pump's node value (1 to 16).
Comments	Turns the pump on at the speed set with the **SetPump** command. A **LockOffPump** command must be used to stop the pump. P1 may be a number, constant, special identifier, or variable. Note: Array elements must be expressed using square brackets P[1].
Example	`~LockOnPump(MG, BOX);~` Locks pump number (node) BOX on.

LockOffPump

Syntax	`~LockOffPump(MG, P1);~`
Where	**MG:** MED-PC® Global Parameter **P1:** The pump's node value (1 to 16).
Comments	Overrides **OnPump** and **LockOnPump** commands to immediately stop the pump. P1 may be a number, constant, special identifier, or variable. Note: Array elements must be expressed using square brackets P[1].
Example	`~LockOffPump(MG, BOX);~` Turns pump (node) BOX off.

Sample MED-PC® Procedure

```
\ Copyright (C) 2016 MED Associates, All rights reserved.


\ PHM-100VSS.MPC
\
\ This program demonstrates how to properly call the MED-PC commands that start
\ and stop the PHM-100VSS Pump.
\
\ When the program is loaded it will set up the default values and then wait for
\ the START command.
\
\ When the START command is received the program will send the selected values
\ down to the Stimulator.  The program will now wait for a K-Pulse (K1 - K4).
```

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```
\
\ A K1 pulse will turn on the Pump at the currently set Rate for the set
\ Duration and then increases the Rate by 1.
\
\ A K2 pulse will turn on the Pump at the currently set Rate for the set
\ Duration and then decreases the Rate by 1.
\
\ A K3 pulse will Lock On the Pump at the currently set Rate.
\
\ A K4 pulse will Turn Off the Pump.  The program only looks for a K4 pulse
\ after a K3 pulse has been issued.
\
\ The program records no data and has no end criteria.
\
\ SetPump     - Sets up the pump infusion parameters.
\
\ OnPump      - This command turns on the pump at the specified Rate for the
\               specified Duration.  Allow at least one clock tick between the
\               SetPump command and the OnPump command (i.e. do not place both
\               commands in the same State.)
\
\ LockOnPump  - This command locks on the pump at the specified Rate.
\
\ LockOffPump - This command turns off the pump.  It can even turn off the pump
\               when it was turned on with the PumpOn command.
\
\ MG  - This is the MED-PC Global Pointer.  It allows the PHM-100VSS to pass
\       back information about any errors that might have occured.
\
\ BOX - This parameter specifies which PHM-100VSS the command is for.  When this
\       program is running in Box 1, then the BOX parameter will equal 1 and the
\       PHM-100VSS that is set to Node 1 will receive the command.  When this
\       program is running in Box 2, then the BOX parameter will equal 2 and the
\       PHM-100VSS that is set to Node 2 will receive the command, etc.  This
\       allows the same program to be run in multiple Boxes and control the
\       different Chambers.

\ Inputs
^LeftLever  = 1
^RightLever = 2


\ Outputs
```

```
^LeftLever  = 1
^RightLever = 2
^Pellet     = 3
^Dipper     = 3  \ If both Pellet and Dipper are ordered
                 \ It will be necessary to change one of these
^LeftLight  = 4
^RightLight = 5
^HouseLight = 7
^Pump       = 8


\ A() = Control Variables with Assigned Aliases as Defined
Var_Alias Rate     (0.5 - 20.0 RPM)     = A(0)  \ Default = 5 Revolution Per Minute
Var_Alias Duration (0.1 - 99.9 seconds) = A(1)  \ Default = 10 seconds


^Rate     = 0
^Duration = 1


\ List Working Variables Here
\  H = Infusion Duration in MED Ticks


DIM A = 1


\ K-Pulses Used in this Program
\  K1 = Turn on the Pump at the currently set Rate and then Increase the Rate by 1
\  K2 = Turn on the Pump at the currently set Rate and then Decrease the Rate by 1
\  K3 = Lock on the Pump at the currently set Rate
\  K4 = Turn off the Pump



\***************************************************
\                PHM-100VSS Schedule
\  S1 - Set Default Values
\       Rate            (5 Revolution Per Minute)
\       Duration        (10 seconds)
\***************************************************
S.S.1,
S1,
  0.01": SET A(^Rate) = 5, A(^Duration) = 10 ---> S2


S2,
  #START: ---> S3
  1": SHOW 1,Rate,A(^Rate), 2,Duration,A(^Duration) ---> S2
```

```
S3,     \ Send the values down to the Pump
  0.01": ~SetPump(MG, BOX, A[0], A[1]);~;
         SHOW 1,Rate,A(^Rate), 2,Duration,A(^Duration), 3,Pump Off,0;
         SET H = A(^Duration) * 1" ---> S4


S4,     \ Wait for command to turn the Pump on
  #K1: ~OnPump(MG, BOX);~;
       SET A(^Rate) = A(^Rate) + 1;
       SHOW 3,Pump On,1 ---> S5
  #K2: ~OnPump(MG, BOX);~;
       SET A(^Rate) = A(^Rate) - 1;
       SHOW 3,Pump On,1 ---> S5
  #K3: ~LockOnPump(MG, BOX);~;
       SHOW 3,Pump On,1 ---> S6


S5,     \ Make sure the User can't send another OnPump
        \ command while the Pump is running
  H#T: IF A(^Rate) > 20 [@True, @False]
         @True: SET A(^Rate) = 20 ---> S3
         @False: IF A(^Rate) < 1 [@True, @False]
                   @True: SET A(^Rate) = 1 ---> S3
                   @False: ---> S3


S6,     \ Turn the Pump off
  #K4: ~LockOffPump(MG, BOX);~ ---> S3
```

MED-PC® Log Errors

If a pump parameter is improperly specified or a pump is not responding, MED-PC® will flag the error in the log files. The following list describes the errors and provides possible steps to address them:

| Error	Cause	Correction
[1] Pump is not responding	The pump specified by **SetPump** did not return the proper checksum within the time required.	Check that a pump with that number exists in the system. Verify the pump is powered on. Refer to the **DIG-729 Wiring Instructions** to double check the connections. Test the unit in MED Test program to verify functionality.

[2] Invalid RPM requested	Rate requested is not within the allowable range.	Select a rate within the 0.5 to 20 RPM allowable range.
[3] Invalid duration requested	Duration requested is not within the allowable range.	Select a duration within the 0.1 to 99.9 second allowable range.
[4] Pump halted due to errors	**OnPump** command not allowed due to errors in the **SetPump** command.	Check the log and correct any **SetPump** errors before proceeding.

CHAPTER 5 | AUTOMATIC SHUT-OFF SWITCH ADJUSTMENT

The Automatic Shut-Off Switch is an internal micro-switch that detects when the slide assembly reaches a set point. This point is user adjustable so that the pump can accommodate various sizes and brands of syringes.

To adjust the Automatic Shut-Off Switch, insert an empty syringe with the plunger at the desired shut-off position. Move the slide assembly to the rear of the plunger (Figure 5-1A). With the pump turned on, switch the Flush switch on and rotate the adjustment screw (Figure 5-1B) until the pump stops operating. Turning the screw clockwise will allow the pump to operate longer before the automatic shut-off switch activates while turning the screw counterclockwise will stop the pump sooner. To reset the switch and resume pump operation, move the slider back until the Automatic Shut-Off Switch is disengaged.

*Figure 5-1 – Automatic Shut-Off Switch Adjustment*
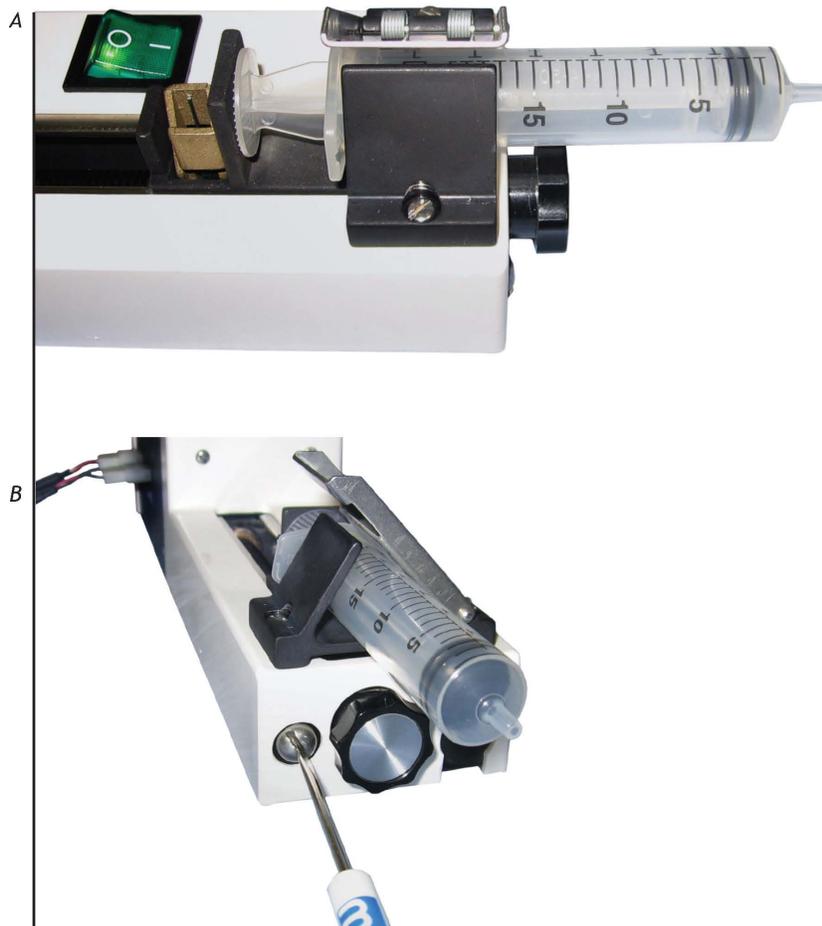
CHAPTER 6 | PHM-100VSS ADDRESSING SCHEME

The addresses (node numbers) and termination on pumps purchased from Med Associates as part of a package or system are set at the factory. These settings should only be modified if a new pump is being added to an existing network.

To change the address or termination of a PHM-100VSS pump, remove the two screws from the bottom panel of the unit, remove the bottom panel and locate the 8 position dipswitch, see Figure 6-1.

Figure 6-1 - PHM-100VSS Dipswitch
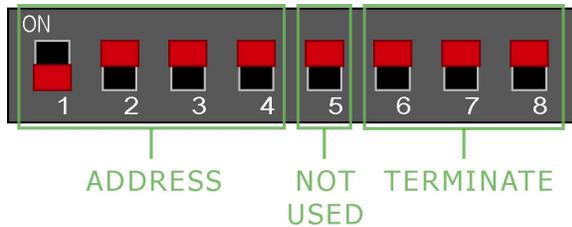
Switches 1 - 4 are used to set a pump's address according to Table 6-1. Switches 6 - 8 are used for line terminations and are preset at the factory. Do not change the termination settings unless additional pumps are being added to the configuration. Only the last pump in the series should have switches 6 - 8 set to ON. Switch 5 is not used.

In Figure 6-1 the pump address is set to 1, and the terminate switches are all ON, indicating it is the last pump in the series.

Table 6-1 - Address Switch Positions

Pump Address	Switch Number			
	1	2	3	4
1	OFF	ON	ON	ON
2	ON	OFF	ON	ON
3	OFF	OFF	ON	ON
4	ON	ON	OFF	ON
5	OFF	ON	OFF	ON
6	ON	OFF	OFF	ON
7	OFF	OFF	OFF	ON
8	ON	ON	ON	OFF
9	OFF	ON	ON	OFF
10	ON	OFF	ON	OFF
11	OFF	OFF	ON	OFF
12	ON	ON	OFF	OFF
13	OFF	ON	OFF	OFF
14	ON	OFF	OFF	OFF
15	OFF	OFF	OFF	OFF
16	ON	ON	ON	ON

CHAPTER 7 | CONTACT INFORMATION

Please contact Med Associates, Inc. for information regarding any of our products.

Visit our website at www.med-associates.com.

For technical questions please call 802-527-2343 or email support@med-associates.com.

For sales questions please call 802-527-2343 or email sales@med-associates.com.