

**PHM-104 COMPUTER-CONTROLLED
VARIABLE SPEED
MICROLITER SYRINGE PUMP
USERS MANUAL**

**DOC-144
Rev. 1.0**

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INTRODUCTION

The PHM-104 Computer-Controlled Variable Speed Syringe Pump is designed to be used in the MED-PC environment. It delivers doses ranging from 20 to 80 microliters at rates from 20 to 100 microliters/second using a Hamilton 100 microliter syringe. When a Hamilton 500 microliter syringe is used, the ranges become 25 to 400 microliters at 100 to 500 microliters/second.

INSTALLATION INSTRUCTIONS

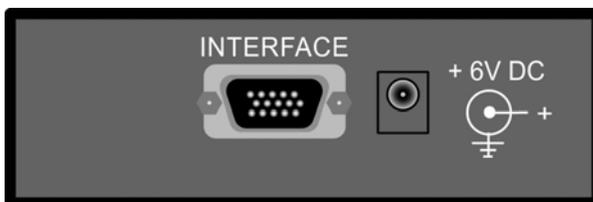
DIG-729 USB Installation

Connect the included A/D power adapter to the port on the back of the DIG-729 USB. Then use the included USB cable to connect the DIG-729 USB to any available USB port on the computer. Follow the steps on the computer to install the necessary drivers. This will only be necessary the first time the DIG-729 USB is connected to the computer USB port.

Figure 1 - DIG-729 USB Front



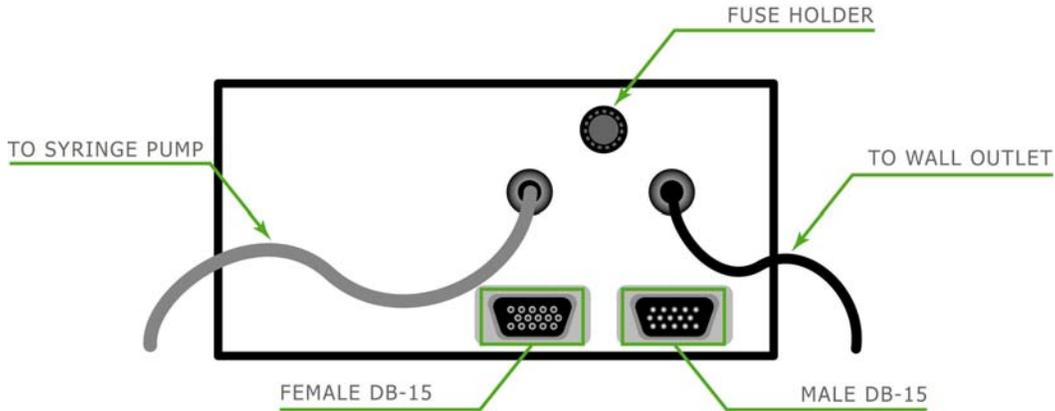
Figure 2 - DIG-729 USB Back



Electrical Connections

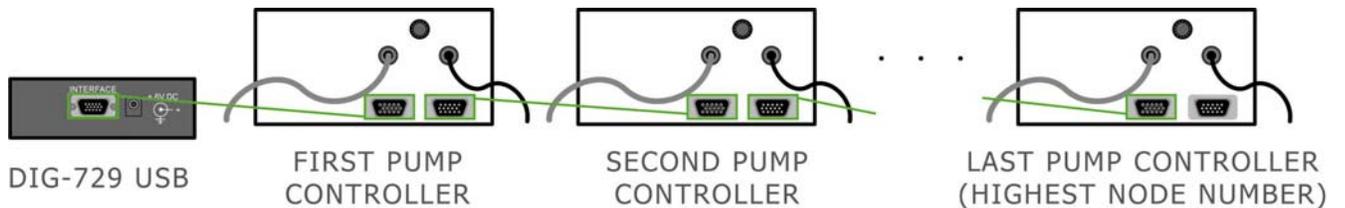
The PHM-104 node numbers are factory set and should be clearly labeled on each pump. Connect the female DB-15 port on Pump 1 controller (Figure 3) to the INTERFACE port of the DIG-729 USB (Figure 2) using the included SG-219C cable.

Figure 3 - Back of the PHM-104 Controller



Control additional pumps using SG-219C cables to connect the male DB-15 port on the Pump 1 controller to the female DB-15 port on the Pump 2 controller, then the male DB-15 port on the Pump 2 controller to the female DB-15 port on the Pump 3 controller, etc. The pumps can be daisy chained together in any order, however the last unit in the series must have the highest node number. Refer to Figure 4.

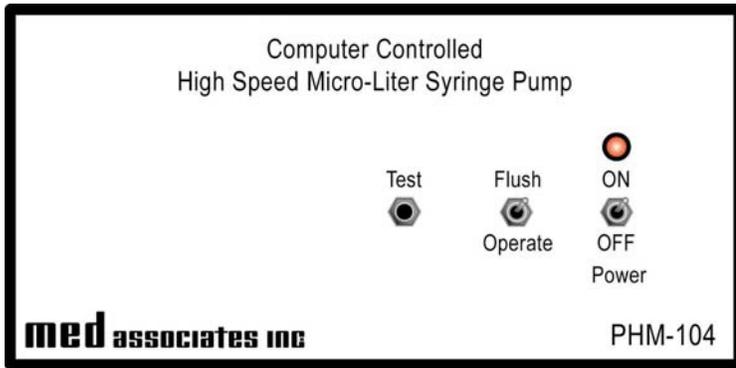
Figure 4 - Daisy Chain Diagram



Next, connect each PHM-104 pump controller to a syringe pump using the 9-pin connectors. Refer to Figure 3. The controllers can now be plugged in to an appropriate AC outlet and quickly tested by turning the power on (Figure 5).

Set the FLUSH/OPERATE switch to **Flush**. The plunger actuator should cycle back and forth until the switch is returned to the **Operate** position. The actuator will stop in a preset position. At this point, pressing the **Test** button will cause the unit to deliver a 50 microliter dose at 100 microliters per second.

Figure 5 - Front of the PHM-104 Controller



OPERATING INSTRUCTIONS

Syringe Loading

A great deal of care should be used when loading syringes to ensure that proper plunger position and alignment are obtained. Proceed as follows:

- Flush the syringe with distilled water or other suitable solution to provide lubrication in order to avoid damage to the plunger seal during the alignment procedure. It is not necessary to keep the syringe filled at all times.
- Cycle the pump from Flush to Operate so that the is in the preset start position (farthest away from the valve).
- With the plunger fully inserted into the syringe, carefully screw the syringe into the valve luer. Tighten securely using caution not to strip the threads.
- Pull the plunger back to the actuator and attach it with the thumbscrew. Do not tighten securely as further fine positioning is required.
- Cycle the actuator by switching the Flush/Operate switch to Flush. Observe the plungers motion into the syringe barrel. The tip of the plunger should travel to about 1 mm of the end of the barrel to ensure proper pumping ability. If it does not, it should be adjusted by loosening the small set screw on the plunger head with the Allen Key provided. Adjust the plunger to the desired position and retighten the set screw. Move in small increments to avoid having the plunger hit the end of the barrel. Cycle again to verify proper position.
- Finally, monitor the movement of the plunger rod for proper alignment while traveling back and forth. If the rod does not move parallel with the barrel, loosen the thumbscrew slightly to allow the plunger head to move in the appropriate direction to allow parallel movement.

Priming the Pump

Connect the fluid supply line to the luer that enters the valve perpendicular to the syringe barrel, next to the valve power supply wire. Connect the output line to the luer opposite the syringe barrel.

Switch the Flush/Operate switch to Flush and cycle the plunger until fluid exits the output line. Check for leaks at the luers and bubbles in the lines. It may be necessary to remove the plunger from the syringe and force fluid from the supply through the back of the syringe to allow bubbles to escape from the barrel. Once the lines are filled and bubble free, the test program can be used to verify proper doses and rates.

Using MED Test

The PHM-104 can be tested using the MED Test software. Open the MED Test application and select PHM-104 from the Misc Modules menu, as shown in Figure 6. The screen shown in Figure 7 will appear.

Figure 6 - MED Test

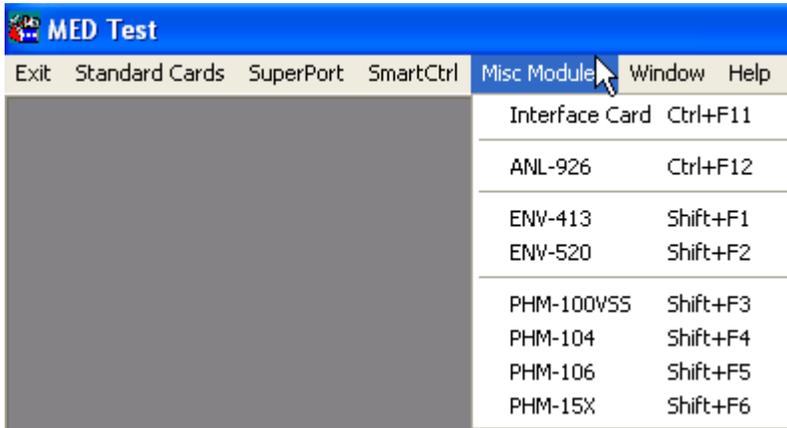
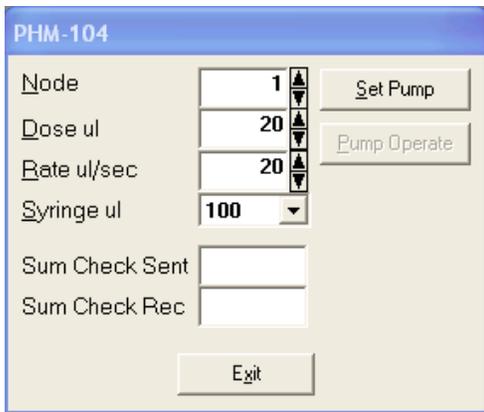


Figure 7 - PHM-104 Test Screen



Select the pump node number (displayed on the pump), the dose in microliters, the rate in microliters per second and the syringe size in microliters. Then select Set Pump to send this data to the pump. The pump's status will be displayed in the Sum Check Sent and Sum Check Rec display windows. If a pump is not responding, verify that power is on and all network connections have been made. If the pump is responding, the Pump Operate button is activated.

Click Pump Operate to run the pump with the entered settings. The pump may be run repeatedly with these settings by clicking Pump Operate again. Click Exit to close the window.

MED-PC Controlled Operation

Please refer to the MED-PC IV User's Manual for a complete guide to installing the MED-PC IV software, building a valid Hardware configuration with the Hardware Configuration utility, and opening and compiling a MSN procedure in the Trans-IV utility.

The MSN procedures utilized by MED-PC IV are found by the application in a folder on the PC's hard drive. The location, by default, is "C:\MED-PC IV\MPC\".

Commands

The PUMPSET command sets up all pump parameters for the specific pump and retains them until they are changed or power is turned off. The PUMPOP command selects the pump node and turns the pump on. It is not necessary to issue a PUMPSET command each time the pump is turned on. Allow at least one clock tick between the PUMPSET command and the PUMPOP command, i.e., do not place both commands in the same State.

PUMPSET

Syntax: ~PUMPSET (P₁, P₂, P₃, P₄);~

Where: P₁ = Pump Node value (1 to 8)

P₂ = Dose (20 to 80 µL – 100 µL syringe, 25 to 400 µL – 500 µL syringe)

P₃ = Rate (20 to 100 µL/sec - 100 µL syringe, 100 to 500 µL/sec – 500 µL syringe)

P₄ = Syringe Size (100 µL or 500 µL)

PUMPOP

Syntax: ~PUMPOP (P₁);~

Where: P₁ = Pump Node value (1 to 8)

Comments: P₁ through P₄ may be numbers, constants, special identifiers or variables. Note, variables must be expressed using square brackets P[1], not the normal parenthesis () used in MEDSTATE NOTATION.

Examples

The following examples are functionally equivalent. Timed injection reward is used as a reinforcer for an FR-10 schedule. 50 microliters are injected at a rate of 100 microliters per second using a 100 microliter syringe.

Example A:

```
S.S.1,
S1,
    0.01":~PUMPSET (BOX,50,100,100);--→S2
S2,
    10#R1:~PUMPOP (BOX);--→S2
```

Example B:

LIST P = 0,50,100,100

S.S.1,
S1,

0.01":Set P(0) = BOX;
~PUMPSET (P[0],P[1],P[2],P[3]);--→S2

S2,

10#R1:~PUMPOP (P[0]);--→S2

MED-PC Journal Errors

If a syringe pump parameter is improperly specified or a pump is not responding, MED-PC will flag the error in the journal. The following list describes the errors and the necessary corrective action.

| Error | Cause | Corrective Action |
|---|--|---|
| [1] Pump is not responding | The pump specified by PUMPSET did not return the proper checksum within the time required. | Verify that a pump with the specified node number exists in the system. Verify that the pump power is on. Check all network cabling. Test the unit using MED Test. Call MED Associates for further assistance if necessary. |
| [2] Dose must be 20-80 µL or Dose must be 25-400 µL | Dose is not set within the range of the syringe specified in the PUMPSET command. | Verify that the proper syringe size and dose are used. Refer to the PUMPSET command description in this manual. |
| [3] Rate must be 20-100 µL/sec or Rate must be 100-500 µL/sec | Rate is not set within the range of the syringe specified in the PUMPSET command. | Verify that the proper syringe size and rate are used. Refer to the PUMSET command description in this manual. |
| [4] Syringe must be 100 or 500 µL | Syringe size is not set to 100 or 500 in the PUMPSET command. | Change to correct size. |
| [5] Pump halted due to errors | PUMPOP command not allowed due to errors in a previous PUMPSET command. | Check the journal for previous errors and refer to the listings above for explanations. |