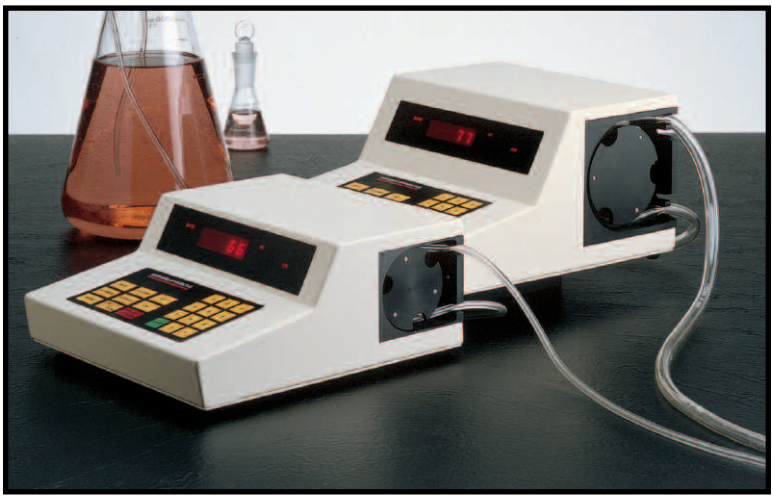
# Model 66 & 77

# Peristaltic Pump Series

# User's Manual

| | |
|---|---|
| *Model 66 Small Peristaltic* | *MA1 55-7766* |
| *Model 77 Large Peristaltic* | *MA1 55-7777* |



HARVARD
APPARATUS

Publication 5387-001-REV-D

# WEEE/RoHS Compliance Statement

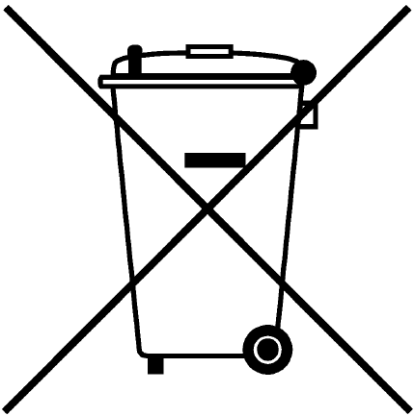
**EU Directives WEEE and RoHS**

To Our Valued Customers:

We are committed to being a good corporate citizen. As part of that commitment, we strive to maintain an environmentally conscious manufacturing operation. The European Union (EU) has enacted two Directives, the first on product recycling (Waste Electrical and Electronic Equipment, WEEE) and the second limiting the use of certain substances (Restriction on the use of Hazardous Substances, RoHS). Over time, these Directives will be implemented in the national laws of each EU Member State.

Once the final national regulations have been put into place, recycling will be offered for our products which are within the scope of the WEEE Directive. Products falling under the scope of the WEEE Directive available for sale after August 13, 2005 will be identified with a "wheelie bin" symbol.

Two Categories of products covered by the WEEE Directive are currently exempt from the RoHS Directive – Category 8, medical devices (with the exception of implanted or infected products) and Category 9, monitoring and control instruments. Most of our products fall into either Category 8 or 9 and are currently exempt from the RoHS Directive. We will continue to monitor the application of the RoHS Directive to its products and will comply with any changes as they apply.



- **Do Not Dispose Product with Municipal Waste**
- **Special Collection/Disposal Required**

# Table of Contents

## Serial Numbers

All inquires concerning our product should refer to the serial number of the unit. Serial numbers are located on the rear of the chassis.

## Calibrations

All electrical apparatus is calibrated at rated voltage and frequency. While the flow will stay calibrated, the peak will vary.

## Warranty

Harvard Apparatus warranties this instrument for a period of two years from date of purchase. At its option, Harvard Apparatus will repair or replace the unit if it is found to be defective as to workmanship or material.

This warranty does not extend to damage resulting from misuse, neglect or abuse, normal wear and tear, or accident.

This warranty extends only to the original customer purchaser.

**IN NO EVENT SHALL HARVARD APPARATUS BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.** Some states do not allow exclusion or limitation of incidental or consequential damages so the above limitation or exclusion may not apply to you. **THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR USE, OR OF ANY OTHER NATURE.** Some states do not allow this limitation on an implied warranty, so the above limitation may not apply to you.

If a defect arises within the two-year warranty period, promptly contact ***Harvard Apparatus, 84 October Hill Road, Building 7, Holliston, Massachusetts 01746-1371*** using our toll free number 1-800-272-2775. Goods will not be accepted for return unless an RMA (returned materials authorization) number has been issued by our customer service department. The customer is responsible for shipping charges. Please allow a reasonable period of time for completion of repairs, replacement and return. If the unit is replaced, the replacement unit is covered only for the remainder of the original warranty period dating from the purchase of the original device.

This warranty gives you specific rights, and you may also have other rights which vary from state to state.

## Repair Facilities and Parts

Harvard Apparatus stocks replacement and repair parts. When ordering, please describe parts as completely as possible, preferably using our part numbers. If practical, enclose a sample or drawing. We offer a complete reconditioning service.

## CAUTION !

This pump is not registered with the FDA and is not for clinical use on human patients.

**CAUTION**
**NOT FOR CLINICAL USE**
**ON HUMAN PATIENTS**

# Models '66/77' Specifications

| | Model '66' | Model '77' |
|---|---|---|
| **Accuracy** | ±1% | ±1% |
| **Reproducibility** | ±1% | ±1% |
| **Volume** | Adjustable from 4 to 100 cc/stroke | Adjustable from 4 to 100 cc/stroke |
| **Size** | 229 x 206 x 89 mm (9 x 8-1/8 x 3-1/2 in) | 241 x 206 x 127 mm (9-1/8 x 8-1/8 x 5 in) |
| **Weight** | 3.6 kg (7.9 lb) | 5.1 kg (11-1/4 lb) |
| **Power** | 115/230 volts, 50-60 Hz, via internal selector switch, 30 W, Fuse 0.5A S.B. | 115/230 volts, 50-60 Hz, via internal selector switch, 30 W, Fuse 0.5A S.B. |
| **Leakage to Ground** | Typically < 20 | Typically < 20 |
| **Ground Resistance** | Typically < 0.5 Ω | Typically < 0.5 Ω |
| **Drive Motor** | Microprocessor controlled stepping motor | Microprocessor controlled stepping motor |
| **Flow Rate:** | | |
| **Minimum** | 0.01 ml/min | 0.01 ml/min (1/8 in ID) |
| **Maximum** | 200 ml/min | 700 ml/min (1/8 in ID) |
| **Step Rate:** | | |
| **Minimum** | 27.3 sec/step | 27.3 sec/step |
| **Maximum** | 416.7 µsec/step | 416.7 µsec/step |
| **Maximum Back Pressure** | 30 psi | 30 psi |
| **Interface** | Bidirectional RS-232C | Bidirectional RS-232C |
| **Selectable Baud Rates** | 300, 600, 1200, 2400 | 300, 600, 1200, 2400 |

# General Description

The Harvard Model 77 and Model 66 are microprocessor controlled stepper motor driven peristaltic pumps.

The volume dispensed is proportional to the pumphead rotation and to the number of steps moved by the stepper motor. The microprocessor maintains count of the number of steps and the motor can be "microstepped" with up to 6400 microsteps per revolution of the pumphead. This fine control permits great dispensing precision both of flowrate and volume dispensed. In addition, to compensate for variations in tubing and flow of different liquids a simple-to-use calibration method is built-in which will automatically recalculate the volume dispensed per revolution, thereby ensuring greater accuracy. Microprocessor control allows many options to be included in the pump such as volume dispense and repetitive batch dispenses.

Via RS-232C the pump can be interfaced with many laboratory devices and up to 100 pumps can be controlled by one PC through a "daisy chain" system included in the pump.

The digital communication interface can be used to connect the pump directly to a weighing scale to establish a feedback loop and dispense by weight.

A TTL input/output is also included.

## *Features:*

**Pump Mode:** Pump runs continuously at set flow rate

**Dispense Mode:** Pump runs at set flow rate to the set volume

**Batch Mode:** Multiple dispenses at set flow rate and set volume. The number of dispenses and the time delay interval between dispenses can be selected

**Calibration Mode:** Used to improve dispense accuracy. Precise measurement of volume (or weight) dispensed per pumphead revolution.

**Endpoint Slowdown:** The pump slows as the setpoint is neared for improved dispense accuracy.

**Anti-drip:** At the completion of a dispense the pump is reversed to prevent any additional unwanted drops.

**RS-232C Interface:** Remote computer control, daisy chain, dispense by weight, interface with other laboratory equipment.

**TTL:** RUN/STOP controls through hand or footswitch or contact closures. 5V signal to activate a relay. TTL signal level input.

**Non-volatile memory:** The last settings are stored in memory.

**Momentary loss of power:** The pump stops and displays flashes to alert the user.

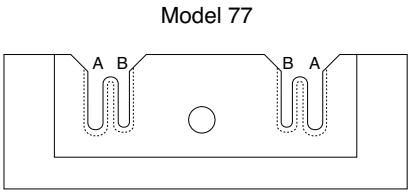
The pump is designed so that the illuminated display will always indicate the status of the pump and the appropriate units associated with the pump operation. For example, when dispensing, the display shows the increasing volume with units of "ml" and "run" illuminated. When the dispense is completed and the pump stops, the "run" is switched off.

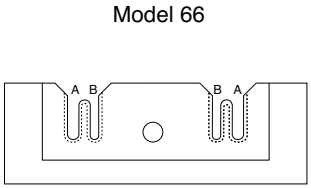
# Initial Set-Up

1) Read the manual.

2) Load tubing in pumphead. Select the correct tubing and locate the tubing in the appropriate size tubing holder machined in the pump block. Feed the tubing around the pumphead by threading the tubing through the round scallop in the pumphead. Manually rotate the pumphead and simultaneously feed the tubing around the moving pumphead through the scallop. Fasten the free tubing into the second tubing holder.

   The tubing should be "snug" around the pumphead but not too tight. Rotate the pumphead manually a few revolutions to ensure free movement.




3) Tubing recommendations:

   Norprene™
   Tygon R-1000™
   C-flex™
   Viton™
   Silicone
   ID 1/16, 1/8, 1/4 inch, wall thickness 1/16 inch

   ™ – Registered trademark Norton Co., Norton Co., Concept Inc., E.I. duPont de Nemours and Co.

4) Turn on the main power switch located on the rear panel above the fuse holder. The display should initially illuminate all LED's followed by 0.0000 flashing to indicate the pump is ready. Press any key to stop the flashing and make ready for entries.

# Initial Set-Up (Contd)



5) Note that U.S. models are set for 115 VAC. Overseas models should have an appropriate plug installed and the voltage selector switch inside the pump will be correctly adjusted. Polarity for international line cord:

   Brown – high
   Blue – neutral
   Green – ground

6) The pump is delivered with a programmed calibration factor corresponding to 1/8 inch ID tubing. For accurate dispenses the pump should be calibrated to match the users conditions.

## Calibration

1) Load the pump with the required tubing and liquid to be pumped. Prime the pump by pressing RUN. The pump is initially configured to run until stopped with the STOP key.
2) Press SET and CAL to select the Calibration mode "ml/rev" will be illuminated and flashing.
3) Enter the approximate calibration factor from the table below using the numerical keypad. When the correct number is displayed press ENTER.
4) Approximate calibration factors:

| Tubing ID (inch) | Pump 77 | Pump 66 |
|---|---|---|
| 1/4 | 5.85 | N/A |
| 1/8 | 1.22 | 0.88 |
| 1/16 | N/A | 0.22 |

Tubing wall thickness is 1/16 inch.

The pump should be run in the 'Calibration' mode for a more accurate calibration factor. The pump can be operated at the preset rate and volume settings or more appropriate RATE and VOLUME settings can be entered after reading "Pump Operation".

5) Press SET and CAL to select 'Calibration' mode.
6) Press RUN. The pump will start, the display will show the increasing volume pumped. The volume displayed is calculated based on the programmed calibration factor and may not be accurate.
7) When the dispense is completed the pump stops automatically. The 'Run' light is shut off and 'ml' is flashing. Measure accurately the dispensed volume.
8) Enter the dispensed volume using the numerical keypad. The display will show the entered numbers. When the correct value is displayed press ENTER. The pump will now automatically recalculate the calibration factor which is displayed with 'ml/rev' illuminated while the CAL key is depressed. The display defaults to 0.0000 when the CAL key is released.
9) To review the new calibration factor press CAL. The new value will be displayed for as long as the CAL key is depressed. When your finger is removed the display will default to volume again.
10) Calibration dispenses should be over 10 ml so that drop size becomes insignificant.

## Auto Calibration

When the pump is connected to a weighing scale and the CAL mode is selected the pump will dispense liquid into the container on the scale and the calibration sequence is fully automatic.

When the RUN key is pressed the scale is tared and the pump displays a set of horizontal dashes (———). After taring the dispense proceeds. The endpoint slowdown and anti-drip features are automatically selected.

When the dispense is completed the dispensed weight registered by the scale is read by the pump and used to automatically recalculate the calibration factor.

The calibration factor is now in units of weight/revolution.

For scale correction see Section 8.2.

The pump must now be set for flow rate, volume and the operational mode selected.

**1) FLOW RATE**

a. Press SET and RATE.
The 'ml/min' LED will flash indicating that the value with these units is ready for updating.

b. The flow rate value in units of ml/minute is entered from the numerical keypad. As the numbers are entered they will be displayed.

c. When the correct value is displayed, press ENTER.

**2) VOLUME SETTING**

a. Press SET and VOLUME. "ml" unit indicator will flash.

b. Enter value of volume to be dispensed.

c. Press ENTER. Display defaults to zero.

**3) SELECT PUMPING MODE**

a. Selection is made by pressing MODE.
The present mode selection is displayed as either "Pump", "Dispense", or "Batch".

b. Press the MODE key until the required mode is displayed.

**4) PUMP MODE**

a. Continuous pumping. Change flow rate if required.

b. Press RUN/STOP to commence. Display shows increasing pumped volume, 'ml' units.

c. To pause, press the RUN/STOP key. Press RUN/STOP key again to restart. The pump continues and displays the accumulated volume.

**5. DISPENSE MODE:** Pump runs at set rate to a set volume and automatically stops.

a. Use SET RATE and SET VOLUME keys for setpoint entries.

**6. BATCH MODE:** This mode is for repetitive dispenses of a set volume. The number of dispenses and time delay interval between dispenses can be set.

**6.1 Number of Dispenses**

a. Press SET and NUMBER. Display shows the last setting.
Use numerical keypad to enter required number of dispenses.

b. When correct number is displayed, press ENTER. Display clears, ready for dispense.

c. Continuous Dispensing. If NUMBER is set to 0 the pump interprets this as an infinite number of dispenses and continues to dispense until manually stopped.

**6.2 Time Interval Between Dispenses**

a. Press Set INTERVAL. Display reads 0:00:00 representing time interval in Hours: Minutes: Seconds. The colons ":" will flash to indicate ready for setting.

b. The interval is entered from the numerical keypad and displayed as entered. These numbers are displayed from the right.

*For example:*
For interval 1 hour, 15 minutes, 23 seconds, enter 11523.
For interval 49 seconds, enter 49.
Minimum time interval is 1 second.

c. When the correct value is displayed press ENTER.

d. Press RUN to start. Display reads volume and automatically stops at the setpoint. The display changes to show the number of completed dispenses. After one second the display changes again to time interval counting up in seconds. When the interval setpoint is reached the pump automatically moves on to the next dispense.

e. If the RUN/STOP key is pressed during the time interval the RUN/STOP does not act as a pause but stops the batch dispense mode and resets the batch number to zero.

**7. RS-232C INTERFACE:** The RS-232C Interface Connectors are telephone jacks mounted on the rear panel and marked IN and OUT. Through the RS-232C Interface the pump can be controlled remotely by a PC or can communicate with other laboratory devices such as a weighing scale. Multiple pumps can be controlled by a single PC through a "daisy chain" inter-connection between pumps.

The IN connector is used to connect the pump directly to a PC or other devices.

The OUT connector is used in the "daisy chain" and is connected to the IN connector of the next pump in the chain.

**8. PRINTER, WEIGHING SCALE OR DAISY CHAIN SELECTION:** After the printer, scale or daisy chained pump connection is made the pump must be configured to communicate to the connected device.

Configuration selection is made by pressing SET and "1". Repeat presses of "1" changes the display through "Print", "Scale", and "Chain". When the appropriate display is recognized, selection is made by pressing the ENTER key.

**8.1 Printer**

a. Press SET and 1. Repeat pressing key 1 until "Print" is displayed. Press ENTER.

b. Printer is connected to the IN connector, then the pump communications interface is set.

c. Printer Configuration.
Baud rate – 2400
Word size – 8
Parity – none
Stop bits – 2

**8.2 Weighing Scale:** The pump is programmed to pump by weight when connected to a weighing scale. A weight feedback loop is established automatically and the dispense which is in units of weight is controlled by the weight measured by the scale. The weight feedback loop provides control, independent of the pump action and guarantees very accurate dispenses.

a. Press SET and "1". Press "1" again until SCALE is displayed, press ENTER.

b. The display should read:

EtLEr – Mettler
OHAUS – OHAUS
SArTr – Sartorius

Repeat presses of "1" changes the display until the appropriate name is displayed. Then press ENTER. The display clears back to zero.

The weighing scale must also be configured:

***METTLER PM Series***
Baud rate – 2400
Parity – even
Pause – 0

***OHAUS GT Series***
Baud rate – 2400
Auto print feature – OFF
Stable data only – OFF
Serial data frame – Fr. 7

***SARTORIUS Basic Series E1200S, E2000D (MP8 - 4 series)***
Code Settings:
211 – External print command without stability
225 – 2400 baud
234 – Even parity
432 – Beeper off
311 – Weight only (models with PLUS performance package)

**8.3 Daisy Chain:** Multiple pumps can be connected through a daisy chain and controlled by a single PC. The PC is connected to the IN connector of the first pump and the OUT of the first pump is connected to the IN of the second pump. Daisy chain is repeated to connect all pumps.

After the connections are made each pump must be given an identifying "address" and the communication baud rate must be selected.

a. Press SET and "1". Repeat pressing "1" until "CHAIN" is displayed, press ENTER.

b. Address: The display now reads "Adr:00". This display represents Address:number. The colons flash to indicate that a setting is required.

The numerical keypad is used to enter the address number from 0 to 99.

Each pump must be given a different address number.

When the correct address number is displayed, press ENTER.

c. Baud Rate: After pressing ENTER display now reads b:2400, that is baud rate 2400 bits/second.

Repeat presses of 1 toggles through the baud rate selection, b:300, b:600, b:1200, b:2400.

When the required baud rate is displayed, press ENTER.

The display clears to zero, ready for dispensing.

**9. ENDPOINT SLOWDOWN:** This feature which slows the pump as the setpoint is approached and can be selected for improved accuracy.

a. Press "SET" and "2". The display reads "E OFF" or "E ON". Each time "2" is pressed the states switch from ON to OFF.

Press ENTE0R when the required state is displayed.

**10. ANTI-DRIP:** This feature reverses the pumphead at the completion of a dispense to prevent any unwanted extra drops falling into the dispense container.

a. Press "SET" and "3".

Display reads "A ON" or "A OFF". Pressing "3" changes from ON to OFF. Press "ENTER" for displayed function.

**11. TTL:** The pump has a nine pin (female) connector for TTL input/outputs (Figure 1).

**11.1 Input**

a. Momentary contact closure – eg: footswitch. Momentary closure between pin 1 (ground) & pin 6 causes the pump to change state,

that is, from RUN to STOP or, from STOP to RUN.

b. Contact ground – eg: timer or relay.
Circuit from pin 7 to ground causes the pump to RUN/STOP.
Rising edge – Pump runs
Falling edge – Pump stops

c. Pins 6, 7, 8, and 9 are software readable.

NOTE: Footswitch and timer are inactive during remote operation.

**11.2 Output**

a. Pin 1 is ground.
Pins 2, 3, 4 are software controlled.
ON = 5 V
OFF = 0 V
Pin 5 = 5 V

**12. RS-232 INTERFACE:** The peristaltic pumps, Models 77 and 66 use an RS-232C interface to communicate with a computer. The same communication system is used by most terminals, modems and many laboratory instruments.

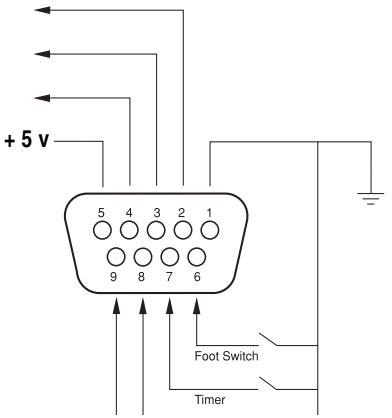



Figure 1. User I/O Connector Specifications

**12.1 Computer to Pump Connection:** Any device with RS-232 communication, such as a PC, has a serial or COM port, usually 25 or 9 pin male connectors. A special cable fitted with a 9 pin female connector is used to connect the serial port to the pump which is equipped with a telephone socket marked "RS-232 IN". The cable wiring diagram is shown below in Figure 2.

To connect the pump:

a. Connect the cable to the computer and pump

b. If appropriate, connect all pumps together in the daisy chain from "OUT" of pump 1 to "IN" of pump 2, etc.

c. Tighten retaining screws

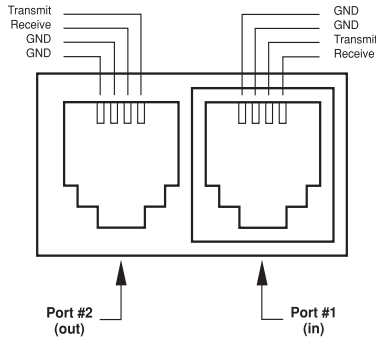



Figure 2. RS-232 Connection

**12.2 Setting the Baud Rate:** The RS-232C interface is bidirectional with data transmitted one bit at a time. The rate of transmission is the baud rate (number of bits per second). The pumps operate at 300, 600, 1200, 2400.

a. Press "SET" and "1". Continue to press "1" until "CHAIN" is displayed. Press "ENTER". The display will now read the pump address "ADr:01".

b. Enter the correct address location and "ENTER". The display will now show the current baud rate setting.

c. Repeat presses of "1" changes the rate, b:300, b:600, b:1200, b:2400. When the required rate is displayed press "ENTER".

This procedure must be followed for every pump connected to the computer.

**12.3 Front Panel Indicator:** After the pump is configured and the RS-232C connection is made the pump is ready for remote control. After receiving the first command to its address, the pump keypad, footswitch, and timer are disabled and the REMOTE light is illuminated. Local control is re-established using the KEY command.

**12.4 Communication**

RS-232C format is : No parity
8 data bits
2 stop bits

**13. INTERFACE QUERY AND COMMAND REFERENCE:** All spaces transmitted are ignored. Transmissions to a pump terminate with CR (Carriage Return).

Format is address [query or command] CR

a. Address is Pump address 0-99. Default is 0.

b. Query format
address = XXX CR XXX = 3 letter
e.g.: 12 VOL CR
Pump 12, what is volume setpoint?

c. Command format
address VOL ****** CR

* can be an integer or decimal point
e.g.: 12 VOL 19.84 CR
Pump 12, set volume setpoint at 19.84 ml.

d. Query – Commands

| | |
|---|---|
| KEY | Return to keyboard |
| RUN | Start pump |
| STP | Stop pump |
| VLA | Query volume accumulator |
| CLA | Clear volume accumulator |
| VER | Query software version |
| RAT [* * * * *] | Set/Query rate |
| VOL [* * * * *] | Set/Query target volume |
| CAL [* * * * *] | Set/Query calibration factor |
| NUM [integer, max 99999] | Set/Query batch limit |
| INT [time] | Set/Query batch wait interval |
| ATD [on:off] | Set/Query anti-drip |
| ENP [on:off] | Set/Query endpoint slowdown |
| MOD [BAT:PMP:DIS] | Set/Query pump mode |
| DIR [CW:CCW:REV] | Set/Query pump direction |
| IN | Read TTL pin |
| OUT d=[ON:OFF] | Output TTL pin d, ON=5V, OFF=OV |

or integer or decimal point

e = X:XX:XX hr:min:sec

**Interface Responses:** The pump responds back to the PC after each query or command.

| | | | |
|---|---|---|---|
| pump output | = | (response) prompt | |
| prompt | = | lf adr : pump stopped | |
| | | lf adr | > pump running (CW) |
| | | lf adr | / pump stopped, interval between dispenses |
| | | lf adr | * pump stalled or paused |
| | | (lf = line feed) | |
| | | adr = address of pump (0-99) | |
| response | = | lf message CR | |
| message | = | bb? | |
| | bb | NA | not available |
| | bb | OOR | out of range |
| | bb | text | |
| | integer | | |
| | float | | |
| | time | | |
| text | = | any string of ASCII characters | |
| integer | = | ddddd, | d=0-9 |
| float | = | fffffff, | f=integer or decimal point |
| time | = | d:dd:dd,hr:min:sec | |
| b | = | blank | |
| lf | = | ASCII 10, line feed | |
| CR | = | ASCII 13, carriage return | |

**14. MAINTENANCE:** No maintenance is required except for general cleaning with water and mild detergent.

**15. RS-232C PUMP CHAIN COMMUNICATION**

**Configuration of Pump Chain**

Each pump in the pump chain needs to be individually configured as a member of the pump chain. To configure a pump, two items of information are needed: baud rate of the host and address of the pump. Allowable baud rates are 300, 600, 1200 or 2400. One baud rate is selected for the entire chain to use. Each pump in the chain is assigned a unique address from 0 to 99.

Enter the configuration into the pump as follows:

- Press keys [SET] [1] and continue to press [1] until display is shown as SCALE.
- Press [ENTER]. Display reads ADR:nn.

- Enter 1 or 2 digit address, then [ENTER]. Display reads "b:baud".
- Press [1] until desired baud rate is shown then [ENTER]. Display now reads 0.0000

**Remote Control**

When a pump is sent a command or a request is made for its prompt, it enters remote mode, indicated by the remote light on the pump's display. During remote mode, the KEYBOARD, FOOTSWITCH AND TIMER ARE DISPLAYED. The keyboard, footswitch and timer can only be re-enabled by either sending a KEY command (see below) or turning the power to the pump OFF and then ON again.

A pump will not accept pump chain communication while it is in a setting mode (entered when user presses the [SET] key), or during calibration. Any settings changed from remote mode will not be stored in the pump's non-volatile memory. When remote mode is exited (via the KEY command) any changes to the settings of the pump will cause all settings, including those changed during remote mode, to be stored in non-volatile memory.

**Prompts**

A prompt is a string of ASCII characters sent by a pump:

l f (line feed), 1 or 2 digit address, prompt character

prompt characters:
: ;pump stopped
> ;pump running
* ;pump paused or stalled
/ ;pump between batches

**Commands**

Each command sent to the pump chain is a string of ASCII characters with the following formats and meanings (all spaces ignored by pump):

a. CR ; Stop all pumps.

b. pump address, CR ; Request for prompt.
The pump with the indicated address responds with its prompt.

c. (Optional) pump address, command, CR ; Send command.
The pump with the indicated address executes the command then responds with its prompt. The optional pump address, if not specified, will default to pump address 0.

The following are the allowable commands and their responses during execution. After each command is executed, the addressed pump sends its prompt. If a command is not recognized by an addressed pump, the pump will respond with the following: lf, space, space, ?, CR

**KEY:** Leaves remote mode, turning remote light off, and re-enabling keyboard, footswitch and timer.

*No response. Prompt character not changed.*

**RUN:** Starts pumping according to the present setting of the pump. If pump is already pumping, command has no effect.

*No response. Prompt character changed to ">"*

**STP:** Stops pump if it was running. If pump is already stopped, command has no effect.

*No response. Prompt character changed as follows:*

If pump was running (prompt ">") new prompt changed to "*" (paused).

If pump was executing a batch interval (prompt "/") new prompt changed to ":" (stopped).

**VLA:** Request for volume accumulator. Response is of the following format:
lf ~~ffffff~~ CR

*Prompt character not changed.*

**CLA:** Request to zero volume accumulator. If the pump was paused, it will return to its stopped state. If pump is running a "Not Applicable" response will be given:
lf, space, space, NA, CR

*No response. Prompt character will be ":"*

**RAT [<float>]:** Request to set or query rate setting.

1. Set rate: RAT rate
   Rate is of format: ~~ffffff~~
   If rate is accepted and valid, rate will become the new rate.

   Rate will not be accepted if the pump is running.
   A "Not Applicable" response will be given:
   lf, space, space, NA, CR.

   If the rate is invalid, an "Out of Range" response will be given: lf, space, space, OOR, CR.

   *Prompt character will be ":"*

2. Query rate: RAT
   Response is of the following format: lf ffffff CR

   *Prompt character will not change.*

**VOL [<float>]:** Request to set or query volume setting.

1. Set volume: VOL volume
   Volume is of format: ffffff

   If volume is accepted and valid, volume will become the new volume.

   Volume will not be accepted if the pump is running.
   A "Not Applicable" response will be given:
   lf, space, space, NA, CR

   If the volume is invalid, an "Out of Range" response will be given:
   lf, space, space, OOR, CR

   *Prompt character will be ":".*

2. Query volume: VOL
   Response is of the following format:
   lf ffffff CR

   *Prompt character will not change.*

**CAL [<float>]:** Request to set or query calibration setting.

1. Set calibration: CAL calibration
   Volume is of format: ffffff

   If calibration is accepted and valid, calibration will become the new calibration.

   Calibration will not be accepted if the pump is running.
   A "Not Applicable" response will be given:
   lf, space, space, NA, CR

   If the calibration is invalid, and "Out of Range" response will be given:
   lf, space, space, OOR, CR

   *Prompt character will be ":"*

2. Query calibration: CAL
   Response is of the following format:
   lf ffffff CR

   *Prompt character will not change.*

**NUM [<integer>]:** Request to set or query batch limit number.

1. Set number: NUM number
   Number is of format:
   ddddd
   If number is accepted and valid, number will become the new number.
   Number will not be accepted if the pump is running.
   A "Not Applicable" response will be given:
   lf, space, space, NA, CR
   *Prompt character will be ":"*
2. Query rate: NUM
   Response is of the following format:
   lf ddddd CR
   Leading zeros will be replaced by spaces.
   *Prompt character will not change.*

**INT [<time>]:** Request to set or query batch interval time.

1. Set Interval: INT interval
   Interval is of format:
   d:dd:dd (hr:min:sec)
   If interval is accepted and valid, interval will become the new interval.
   Interval will not be accepted if the pump is running.
   A "Not Applicable" response will be given:
   lf, space, space, NA, CR.
   If the interval is invalid, an "Out of Range" response will be given:
   lf, space, space, OOR, CR.
   *Prompt character will be ":".*
2. Query Interval: INT
   Response is of the following format:
   lf d:dd:dd CR.
   *Prompt character will not change.*

**ATD [{ON|OFF}]:** Request to set or query anti-drip setting.

1. Set: ATD ON turns anti-drip function ON.
   ATD OFF turns anti-drip function OFF.
   Command will not be accepted if the pump is running.

A "Not Applicable" response will be given:

lf, space, space, NA, CR.

*Prompt character will be ":".*

2. Query: ATD

If anti-drip function is ON, response will be:

lf, space, space, ON, CR.

If anti-drip function is OFF, response will be:

lf, space, space, OFF, CR.

*Prompt character will not change.*

**ENP [{ON|OFF}]:** Request to set or query end point deceleration setting.

1. Set: ENP ON turns end point deceleration function ON.
   ENP OFF turns end point deceleration function OFF.

Command will not be accepted if the pump is running.

A "Not Applicable" response will be given:

lf, space, space, NA, CR.

*Prompt character will be ":".*

2. Query: ENP

If end point deceleration function is on, response will be:

lf, space, space, ON, CR.

If end point deceleration function is off, response will be:

lf, space, space, OFF, CR.

*Prompt character will not change.*

**MOD [{BAT|PMP|DIS}]:** Request to set or query pumping mode set:

MOD BAT puts pump in batch mode.
MOD DIS puts pump in dispensing mode.
MOD PMP puts pump in pumping mode.

Command will not be accepted if the pump is running.

A "Not Applicable" response will be given:

lf, space, space, NA, CR.

*Prompt character will be ":".*

Query: MOD

If pumping mode is batch, response will be:

lf, space, space, BATCH, CR.

If pumping mode is dispense, response will be:
lf, space, space, DISPENSE, CR.

If pumping mode is pump, response will be:

lf, space, space, PUMP, CR.

**DIR [{CW|CCW|REV}]:** Request to set or query pumping direction set:

DIR CW sets pumping direction to clockwise.
DIR CCW sets pumping direction to counter clockwise.
DIR REV reverses direction of current pumping direction.

Command will not be accepted if the pump is running.
A "Not Applicable" response will be given:
lf, space, space, NA, CR.

*Prompt character will be ":".*

Query: MOD
If pump direction is clockwise, response will be:
lf, space, space, CW, CR.

If pump direction is counter clockwise, response will be:
lf, space, space, CCW, CR.

*Prompt character will not change.*

**VER** Request for version of pumps embedded software.

Response for the present version will be:
lf, space, space, 77V1.0, CR.

**IN d** Request to read in the TTL logic value at the specified pin "d" on the external 9 pin D-SUB connector.

Valid pin numbers for input are: 6, 7, 8 and 9.

If the pin specified is valid and if the pin level is high, response will be:
lf, space, space, ON, CR.

If the pin level is low, response will be:
lf, space, space, OFF, CR.

If the pin specified is invalid, an "Out of Range" response will be given:
lf, space, space, OOR, CR.

*Prompt character will not change.*

**OUT d = <ON|OFF>:** Request to set the TTL logic value at the specified pin on the external 9 pin D-SUB connector.

Valid pin numbers for output are: 2, 3 and 4.

If the pin specified is valid, no response is given.

If the pin specified is invalid an "Out of Range" response will be given:
lf, space, space, OOR, CR.

*Prompt character will not change.*

# Table 1: RS-232C Commands

| | | | |
|---|---|---|---|
| **command** | => | [<adr>] [<cmd>] <CR> | |
| **adr** | => | ad | |
| **cmd** | => | KEY | ;return to keyboard |
| | | RUN | ;start pump |
| | | STP | ;stop pump |
| | | VLA | ;query volume accumulator |
| | | CLA | ;clear volume accumulator |
| | | RAT [<float>] | ;set/query rate |
| | | VOL [<float>] | ;set/query target volume |
| | | CAL [<float>] | ;set/query calibration |
| | | NUM [<integer>] | ;set/query batch limit |
| | | INT [<time>] | ;set/query batch wait interval |
| | | ATD [{ON\|OFF}] | ;set/query anti-drip |
| | | ENP [{ON\|OFF}] | ;set/query end point dec |
| | | MOD [{BAT\|PMP\|DIS}] | ;set/query pumping mode |
| | | DIR [{CW\|CCW\|REV}] | ;set/query pumping direction |
| | | VER | ;query software version |
| | | IN d | ;read TTL pin d |
| | | OUT d = <ON\|OFF> | ;output TTL pin d |

# Table 1: RS-232C Commands (Contd)

**All spaces ignored. Maximum 5 digits per integer, float or time.**

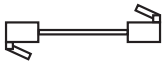
| | | | |
|---|---|---|---|
| **output** | => | [<response>] <prompt> | |
| **response** | => | <response> <response> | |
| | | <lf> <message> <cr> | |
| **prompt** | => | <lf> : | ;stopped |
| | | <lf>...> | ;pumping |
| | | <lf> / | ;between batches |
| | | <lf> * | ;paused or stalled |
| **message** | => | bb ? | ;unrecognized command |
| | | bb NA | ;com not presently applicable |
| | | bb OOR | ;entered value out of range |
| | | bb <text> | |
| | | <integer> | |
| | | <float> | |
| | | <time> | |
| **float** | => | ffffff | |
| **f** | => | dl. | |
| **integer** | => | ddddd | |
| **time** | => | d:dd:dd | |
| **d** | => | 0\|1\|2\|3\|4\|5\|6\|7\|8\|9 | |
| **b** | => | space | |
| **cr** | => | (ascii 13) | ;carriage return |
| **lf** | => | (ascii 10) | ;line feed |
| **text** | => | (any string of ascii characters) | |

| | |
|---|---|
| **legend** | |
| **[ . . . ]** | optional |
| **capital** | terminals |
| **lower case** | non-terminals |
| **\|** | either-or |

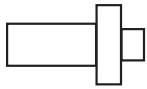
# Appendix A: Pump to PC Connection



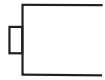

**Pump**



**RJ11 Cable "Straight Thru" Pinning Max Distance: 15M**



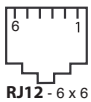
**DB9 Female to 4/6 PIN RJ11/12 such as L-COM P/N RBA098F**



**"Computer"**

**Computer Terminal Port Settings**

| | |
|---|---|
| Baud Rate: | 9600 |
| (or match pump baud rate) | |
| Data Bits: | 8 |
| Stop Bits: | 2 |




**RJ12** - 6 x 6

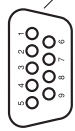

**RJ11 -** 6 x 4

**View of Cable**

**Connection Chart**

| RJ11/RJ12 | - | DB9 | |
|---|---|---|---|
| 5 | - | 3 | REC |
| 4 | - | 2 | XMIT |
| 3 | - | 5 | GND |

**Front View**



**View of Adapter**

**STD DB9**

2 - RD
3 - TD
5 - Sig ground

# Declaration of Conformity

| | |
|---|---|
| Application of Council Directive(s): | *89/336/EEC* |
| Standard(s) to which conformity is declared: | *EN55022:1994 / CISPR22:1993*<br>*IEC 1000-4-3:1995*<br>*IEC 1000-4-2:1995* |
| Manufacturer's Name: | *Harvard Apparatus, Inc.* |
| Manufacturer's Address: | *84 October Hill Road*<br>*Holliston, Massachusetts 01746*<br>*U.S.A.* |
| Type of Equipment: | *Peristaltic Pump* |
| Model No.: | *Model 66 / 77* |

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s).

| | |
|---|---|
| Place: | *United States of America* |
| Date: | *January 25, 1996* |

CE

HARVARD APPARATUS

Beth Bauman
(Signature)

Beth Bauman
(Full Name)

VP Engineering / Operations
(Position)