Pump 11 Elite OEM Module Series

USER'S MANUAL

Harvard Apparatus Pump 11 Elite OEM Module Series

Publication 5420–007 Rev B

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phone 508.893.8999 fax 508.429.5732 e-mail bioscience@harvardapparatus.com
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HARVARD APPARATUS

General Information

SAFETY INFORMATION

Please read the following safety precautions to ensure proper use of your syringe pump. If the equipment is used in a manner not specified, the protection provided by the equipment may be impaired.

To Prevent Hazard or Injury:

USE PROPER POWER SUPPLY

The pump is supplied with an approved power supply and line cord. To maintain the safety integrity of the device, use only the following power supplies:

Cui Inc.
Model: 3A – 242DB24
Output: 24V – 1.0A
Input: 100–240V˷50–60 Hz 0.8A

Globtek Inc.
Model: GT–41062–T3
Output: 24V – 0.75A
Input: 100–240V˷50–60 Hz 0.6A

USE PROPER LINE CORD

Use only the specified line cord for this product and make sure line cord is certified for country of use. The operating voltage range for the Pump 11 Elite Series is 12-30 VDC. The universal power supply operating voltage range is 100-240 VAC, 50-60 Hz.

GROUND THE PRODUCT

This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making any connections to the input or output terminals of the product, ensure that the product is properly grounded.

MAKE PROPER CONNECTIONS

Make sure all connections are made properly and securely. Any signal wire connections to the unit must be no longer than 3 meters.

OBSERVE ALL TERMINAL RATINGS

Review the operating manual to learn the ratings on all connections.

AVOID EXPOSED CIRCUITRY

Do not touch any electronic circuitry inside of the product.

AVOID PINCH HAZARD

A pinch hazard may exist between the pusher block and end blocks. Avoid placing fingers between these points while the pump is running.

DO NOT OPERATE WITH SUSPECTED FAILURES

If damage is suspected on or to the product do not operate the product. Contact qualified service personnel to perform inspection.

ORIENT THE EQUIPMENT PROPERLY

Do not orient the equipment so that it is difficult to operate the disconnection device.

PLACE PRODUCT IN PROPER ENVIRONMENT

Review the operating manual for guidelines for proper operating environments.

OBSERVE ALL WARNING LABELS ON PRODUCT

Read all labels on product to ensure proper usage.

⚠ *CAUTION*
Refer to Manual

⏚ *Protective*
Ground Terminal

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WARRANTY AND REPAIR INFORMATION

⚠️ **CAUTION:** REFER TO SAFETY INFORMATION AND SETTING UP THE HARVARD APPARATUS PUMP 11 ELITE SERIES BEFORE PLUGGING IN THE PUMP.

Manual Description

This manual is designed to provide all operational and Method information required to operate and maintain the Pump 11 Elite Syringe Pumps. The functions and features are described in the Technical Specifications section.

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 materials. 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 consumer purchaser.

IN NO EVENT SHALL HARVARD APPARATUS BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES. Some states do not allow the 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 warranty period, promptly contact **Harvard Apparatus, 84 October Hill Road, Holliston, Massachusetts 01746** using out toll free number 1-800-272-2775 or outside the US call 1–508-893-8999. Email address is bioscience@harvardapparatus.com. 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 for non-warranty repairs. Please allow a reasonable period of time for completion of repairs or replacement. 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 a part number obtained from our Technical Support department. If practical, enclose a sample part or sketch. We offer a complete reconditioning service.

Serial Numbers

All inquiries concerning our product should refer to the serial number of the unit, located on the rear panel.
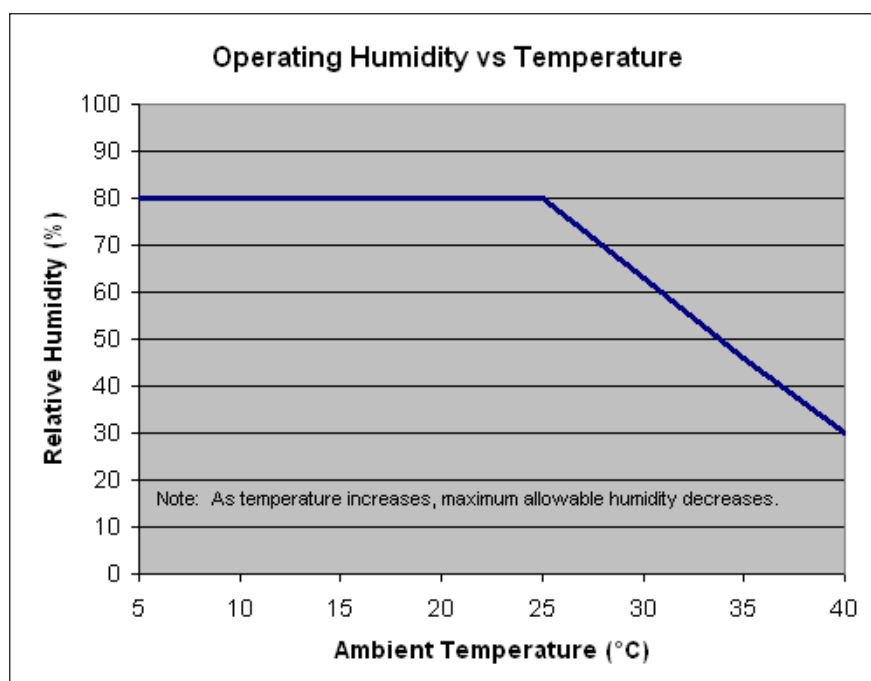
Calibrations

All electrical apparatus are calibrated at rated voltage and frequency. While the flow and volume will stay calibrated, the peak pressure may vary. Harvard Apparatus recommends an annual calibration of the pump.

⚠️ **CAUTION:** FOR RESEARCH USE ONLY. NOT FOR CLINICAL USE ON PATIENTS.

Specifications	Pump 11 Elite OEM	Pico Plus Elite OEM
Accuracy	± 0.5%	± 0.35%
Reproducibility	± 0.05%	± 0.05%
Syringes (Min./Max.)	0.5 µl / 60 ml (10 ml dual)	0.5 µl / 10 ml
Flow Rate:		
Minimum (0.5 µl syringe)	1.26 pl/min	0.54 pl/min
Maximum (10 ml syringe)	26.02 ml/min	11.70 ml/min
Maximum (60 ml syringe)	88.40 ml/min	N/A
Display	None	None
Non-Volatile Memory	Stores all settings	Stores all settings
Connectors:		
RS-485	IEEE-1394, 6 pos	IEEE-1394, 6 pos
USB	Type B	Type B
I/O & TTL	15 pin D-Sub Connector	15 pin D-Sub Connector
Footswitch	Mini phono jack	Mini phono jack
RS-232 (option)	RJ-11	RJ-11
Linear Force (Max)	16 kg (35 lbs) @ 100% Force Selection	16 kg (35 lbs) @ 100% Force Selection
Drive Motor	0.9° Stepper Motor	0.9° Stepper Motor
Motor Drive Control	Microprocessor with 1/16 microstepping	Microprocessor with 1/16 microstepping
Number of Microsteps per one rev. of Lead Screw	15,360	20,480
Step Resolution	0.069 µm/µstep	0.031 µm/µstep
Step Rate:		
Minimum	27.5 sec/µstep	27.5 sec/µstep
Maximum	26 µsec/µstep	26 µsec/µstep
Pusher Travel Rate:		
Minimum	0.15 µm/min	0.068 µm/min
Maximum	159.00 mm/min	71.55 mm/min
Input Power	12-30 VDC (24V recommended)	12-30 VDC (24V recommended)
Input Power Connection	2.5mm ID x 5.5mm OD male plug	2.5mm ID x 5.5mm OD male plug
Power Supply	100-240 VAC, 50-60 Hz, 8 Watts Universal Power Supply, Use Only a Harvard Apparatus Approved Power Supply and Line Cord	100-240 VAC, 50-60 Hz, 8 Watts Universal Power Supply, Use Only a Harvard Apparatus Approved Power Supply and Line Cord
Dimensions	24.13 x 17.15 x 10.67 cm (9.5 x 6.75 x 4.2 in)	24.13 x 17.15 x 10.67 cm (9.5 x 6.75 x 4.2 in)
Weight	2.3 kg (5.08 lbs)	2.3 kg (5.08 lbs)

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Specifications	Pump 11 Elite OEM	Pico Plus Elite OEM
Atmospheric Specifications:		
Operating Temperature	4°C to 40°C (40°F to 104°F)	4°C to 40°C (40°F to 104°F)
Storage Temperature	-10°C to 70°C (14°F to 158°F)	-10°C to 70°C (14°F to 158°F)
Operating Humidity	See Chart Below	See Chart Below
Storage Humidity	20% to 80% RH, non condensing	20% to 80% RH, non condensing
Method of Operation	Continuous	Continuous
Classification	Class I	Class I
Pollution Degree	1	1
Installation Category	II	II
Supplier Name	Harvard Apparatus	Harvard Apparatus
Supplier Address	84 October Hill Rd., Holliston, MA 01746	84 October Hill Rd., Holliston, MA 01746
Supplier Phone Number	(508) 893-8999	(508) 893-8999
Regulatory Certifications	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme
Safety Declarations	ANSI/UL 61010-1 ED. 3 ; CAN/CSA C22.2 No. 61010-1Ed 3 ; IEC 61010-1 Ed 3 ; CENELEC EN 61010-1 ; CB Scheme	ANSI/UL 61010-1 ED. 3 ; CAN/CSA C22.2 No. 61010-1Ed 3 ; IEC 61010-1 Ed 3 ; CENELEC EN 61010-1 ; CB Scheme
EMC Declaration	FCC 47CFR 15B Class A; EN61326-1	FCC 47CFR 15B Class A; EN61326-1

Operating Humidity vs Temperature

Note: As temperature increases, maximum allowable humidity decreases.

Product Overview

The Harvard Apparatus Pump 11 Elite Series is the next generation of syringe pumps.

A green led light on the front panel makes it easy to see if the pump is running.

The pumps are versatile and can be interconnected through the RS-485 interface. Pump 11 Elite Series models can be mixed and matched in the daisy chain offering maximum flexibility. Up to 99 pumps can be linked together through the RS-485 interface provided each pump is assigned its own unique pump address.

Flow performance is optimized with a small step angle stepping motor that drives a precision lead screw and pusher block. The syringe mechanism is easy to use and securely holds the syringes for smooth flow performance.

Advanced microstepping techniques are employed to further reduce the step angle to eliminate flow pulsation. The accuracy is 0.5% (0.35% for Pico Plus Elite). A wide dynamic flow range from 1.26 pl/min to 88.40 ml/min (0.54 pl/min to 11.70 ml/min for the Pico Plus Elite) can be programmed into the pump. Flow rates are selectable with user selected engineering units from ml, µl, nl, pl, and hours, minutes and seconds.

Up to 16 kg (35 lbs) of linear force is available. This force is user adjustable to ensure the right force is applied for the various syringe sizes.

Easy external connections to a computer or other control devices are made through USB interface. Simple ASCII commands make communication with the pump easy. For direct control of the pump, the user can use the I/O interface (15pin Dsub). One trigger output and a trigger input in for external events such as a process parameter are available. The footswitch input will allow the control of the pump through an external device. The unit also has an output for run indication allowing connection to a remote LED.

The 11 Elite OEM Pumps are available with single and dual syringe options. Complete flexibility is offered with the ability to use most manufacturers syringes ranging from 0.5 µl to 60 ml single syringe and 5 µl to 10 ml dual syringe.
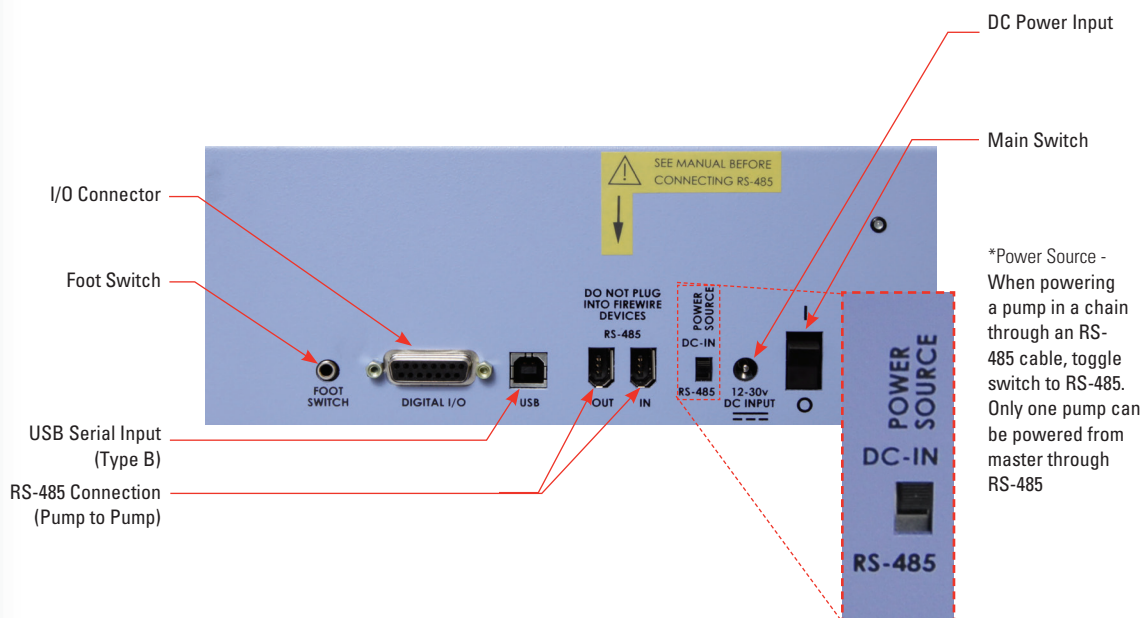
Pump Models

Single Syringe Infuse/Withdraw Programmable

Dual Syringe Infuse/Withdraw Programmable

Pico Plus (dual) Infuse/Withdraw Programmable

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OPERATING INSTRUCTIONS

I/O Connector

Foot Switch

USB Serial Input (Type B)

RS-485 Connection (Pump to Pump)

DC Power Input

Main Switch

*Power Source - When powering a pump in a chain through an RS-485 cable, toggle switch to RS-485. Only one pump can be powered from master through RS-485

POWER CONNECTIONS

1. Plug the power cord in. The Pump 11 Elite Series has a DC power input connector on the rear of the unit. The operating range for the Pump 11 Elite Series series is 12-30 Vdc.

2. Turn on the main power switch.

NOTE *Best performance guaranteed when using 24V power supply.*

CAUTION: DO NOT CONNECT TO FIREWIRE PORTS ON A COMPUTER. DAMAGE MAY OCCUR TO THE PUMP OR COMPUTER.

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SYRINGE LOADING
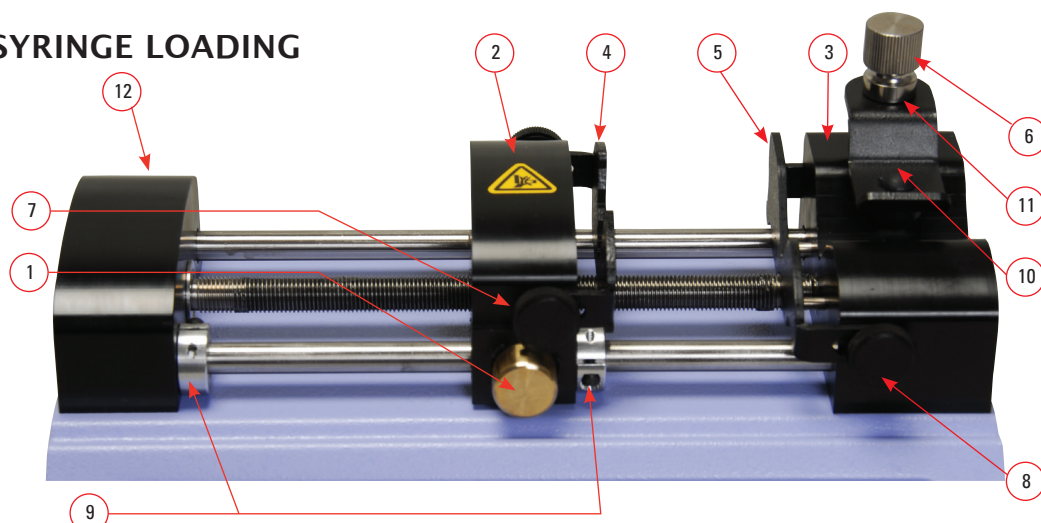
The Pump 11 Elite Series can accommodate up to two syringes. Depending on the mechanism, any type of syringe, glass, plastic or stainless steel can be used. The Pump 11 Elite OEM Module can accommodate from 0.5 µl to 60 ml single syringe and 0.5 µl to 10 ml dual syringe. The syringe barrel clamp should be flipped for syringes larger than 30 ml.

1. Press the release button (1) and move the pusher block (2) to the approximate length of the syringe.

2. Unscrew the bracket clamping knobs (7,8) to loosen the retaining brackets (4,5) on the pusher block (2) and the Syringe holder block (3).

3. Unscrew the syringe barrel clamp by unscrewing the syringe barrel clamp knob (6).

4. Place the syringe on the syringe holder block (3). Ensure the barrel flange is with in the syringe holder's block's retaining bracket (5) and the plunger flange is in the pusher block's retaining bracket.

   The Pico Plus Elite can accomodate from 0.5 µl to 10 ml.

5. Screw down the syringe clamp knob (6)
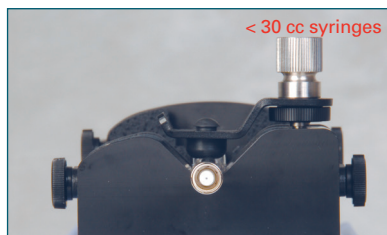
until the syringe barrel clamp (10) is tight against the syringe barrel. Do not overtighten, especially when using glass syringes.

6. Secure the syringe flanges by pushing the retaining brackets (4,5) tightly against the syringe flanges using the bracket clamping knobs (7,8). The syringe plunger should be secured by the pusher block retaining bracket and the flange of the syringe should be secured by the syringe holder block retaining bracket.

7. Tighten the mechanical stop collars (9) using allen wrench (12) to prevent excess travel of the pusher block.

NOTE

The syringe barrel clamp (10) may need to be flipped depending on your syringe size. To do so, completely unscrew and remove the syringe barrel clamp knob from the syringe block. Then remove lock nut (11). Flip the bracket and reassemble.

> 30 cc syringes

< 30 cc syringes
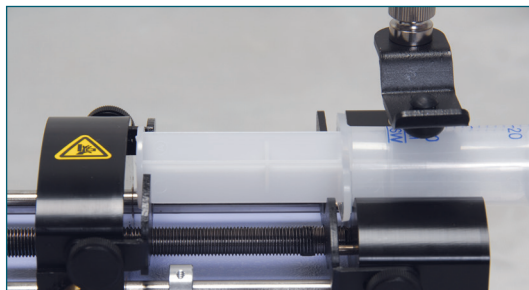
CAUTION: BE SURE MECHANICAL STOP COLLARS ARE POSITIONED PROPERLY TO PREVENT THE PLUNGER FROM BOTTOMING OUT ON GLASS SYRINGES.

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EXTERNAL PUMP CONTROL

This section of the Pump 11 Elite Series manual describes the control of the pump using an external computer device. If communicating via the USB Port, see Appendix C for one time installation instructions of USB Driver.

Setting Up HyperTerminal

HyperTerminal is a Windows application designed to support the external control of devices such as the Pump 11 Elite Series pump through a USB connection. The following instructions describe the configuration of the HyperTerminal application.

1. Select "Start – All Programs – Accessories – Communications – HyperTerminal".

2. Enter a name for a New Connection (i.e Pump_11_Elite), then click OK.

3. Select the Virtual Comm Port from the "Connect using" drop-down list. Click OK. (If the Virtual Comm Port is not known, use Device Manager to find it. Instructions on setting up the Virtual CommPort Driver are supplied in Appendix E.)
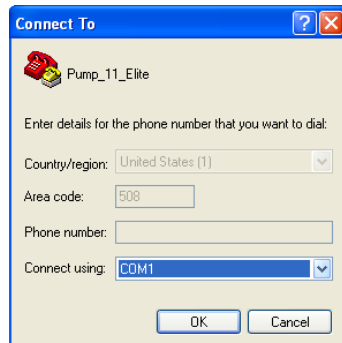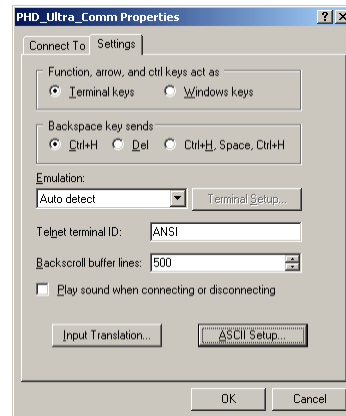

NOTE *To determine the proper comport, in your PCs "Systems Properties" screen, under the "Hardware" tab, select "Device Manger". Expand the "ports (COM & LPT)" section and you should see "Elite". The comport is listed next to this in parenthesis.*
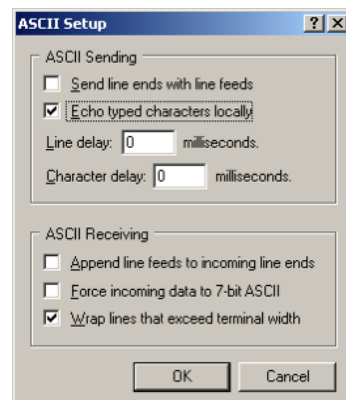
4. Set up the Port Settings as shown below and click OK.
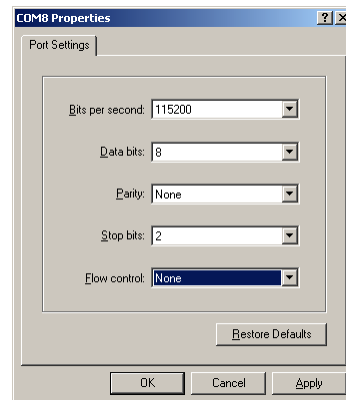
5. Verify the Settings are as shown below.

6. Choose ASCII Setup and select "Echo typed characters locally"then click OK to complete the setup.

NOTE *NOTE: To determine if your pump is connected correctly, in Hyperterminal's main window press 'Enter'; a ':' should appear. If not connected properly, close Hyperterminal, turn off the pump, unplug then re-plug the USB cable, turn on the pump and re-open Hyperterminal.*

PUMP CHAIN COMMANDS

The Pump Chain commands allow all pump control information to be managed from an external computer source. These commands can also be used to control a series of pumps (up to 100) from a single computer interface.

Pump 11 Elite Series commands are communicated to the pump via a USB port interface through a terminal Method such as Harvard Apparatus' Method Manager or HyperTerminal. In using the Pump Chain commands, you will need to assign each pump in the pump chain a unique address, using the Set Pump Address command in the Settings menu. The address range is from 00 to 99. This address value is used to identify which pump is to receive a command and which pump is responding. The first pump in the chain, the one connected to the computer, must use address 0 (zero). Configure each pump with its assigned address and baud rate as described in the Pump Settings section of this guide.

NOTE: *When daisy-chaining using the optional RJ-11 connectors, all pumps must use the same baud rate. Values above 38400 are recommended.*

NOTE: *If you are using the optional RJ-11 connections for daisy-chaining, the connection from the computer must come through either the RJ-11 or RS-232 connectors.*

NOTE: *Once communication is established, if you manipulate the touch screen, you must reestablish communications to the PC (<CR> will do this)*

NOTE: *System commands and start/stop commands can be executed from Method or Method configuration screens. However, for parameter commands (rate, dia, vol, etc) it is necessary to execute from the Quick Start configuration screen.*

NOTE: *To maximize communication speed [as fast as 50 ms rate changes]: (a) prefix commands with the @ symbol to turn off GUI updates (ex: @irate 100 u/m) (b) use the 'NVRAM off' command to turn off writes of rate to memory.*

Using the Pump 11 Elite Series Pump Chain Commands

The following instructions will help you to utilize the Pump Chain commands feature on the Pump 11 Elite Series pump.

Commands may be abbreviated to the first four letters, i.e. address would be abbreviated addr. A space must follow the command if arguments are included.

If the pump address is nonzero, the one or two-digit pump address precedes the command. For example, to set the infuse rate for pump 12, the command would look like "12irat 3.2 u/m".

NOTE *If the USB port is used on a pump with a nonzero address, the pump address does not need to be used.*

Every line of the response from a pump with a nonzero address is prefixed by the two digit pump address (prefixed with a 0 if necessary) followed by a colon. No colon is used to seperate the pump address from the prompt however.

In the command list below, the following convention is used:

{ }	Required parameter
[ ]	Optional parameter
|	Separator between parameter choices
#	Numeric value without preceding zeros
###	Numeric value with preceding zeros
#-#	A range of values
<cr>	Carriage return
<lf>	Line feed
<sp>	Space
[prefix]	Pump address prefix in the format #: if the pump address is not zero
<prompt>	Prompt (see below)

The following prompts are returned after a command is executed:

:	The pump is idle
>	The pump is infusing
<	The pump is withdrawing
*	The pump stalled
T*	The target was reached

If the pump is in poll REMOTE mode, there will be no prompts or carraige returns.

If the pump is in poll ON mode, a XON character is added after the prompt.

If the pump address is nonzero, the pump address is prefixed to the prompt without a colon.

In the following list of commands:

- The pump address is prefixed to every response line followed by a colon.
- <lf>[##]<prompt> is the response unless otherwise noted.

Error Messages

Error messages are displayed if the entered command cannot be executed for some reason. The error message will take up two lines with the first line being the message type and the second line describing the error itself. The second line may be up to 80 characters long.

Command Errors

Command errors are displayed when the command is unrecognized, entered in the wrong mode, or the state of the pump keeps the command from executing (i.e. using the IRUN command if a limit switch is active).

The command error has the following format:

> <lf>[##:]Command error:<cr>
>
> <lf>[##:]<sp><sp><sp>{error message}<cr>
> <lf>[##]<prompt>

Argument Errors

Argument errors are displayed when a command argument is unrecognized or out of range. The argument in question will be displayed except in the case of missing arguments.

The argument error has the following format:

> <lf>[##:]Argument error: [bad argument]<cr>
>
> <lf>[##:]<sp><sp><sp>{error message}<cr>
> <lf>[##:]<prompt>

System commands

ADDRESS

Sets or displays the pump address. Valid range is 0 to 99.

Command format:

> address [0-99]

Query response:

> <lf>[##:]Pump address is #<cr>
>
> <lf>[##]<prompt>

Notes: Pumps with an address of 0 are masters, and pumps with an address between 1 and 99 are slaves.

BAUD

Sets or displays the baud rate. Valid baud rates are 9600, 19200, 38400, 57600, 115200, 128000, 230400, 256000, 460800, and 921600. Note that some computers may not be able to handle baud rates above 115200.

Command format:

> baud [9600 | 19200 | 38400 | 57600 | 115200 | 128000 | 230400 | 256000 | 460800 | 921600]

Query response:

> <lf>[##:]# baud<cr>
>
> <lf>[##]<prompt>

BOOT

Enter the bootloader.

Command format:

> boot

CATALOG

Displays a catalog of Methods stored in the pump.

Command format:

> cat

Query response:

> <lf>[##:]Method name   Size<cr>
>
> <lf>[##:]-------------- ----<cr>
>
> <lf>[##:]{Method name}   #<cr> This line is repeated for each file on the disk
>
> <lf><lf>[##:]# file(s) using # steps<cr>
>
> <lf>[##]<prompt>

Notes: The file size is the number of steps in the Method plus one for the file information header.

The last line shows the number of files and the total number of steps being used on the disk.

DELMETHOD

Deletes a Method stored in the pump.

Command format:

> delMethod {Method}

ECHO

Sets or displays the USB echo state. Valid states are on or off.

Command format:

> echo [on|off]

Query response:

> <lf>[##:] OFF<cr>
>
> <lf>[##]<prompt>

or:

> <lf>[##:] ON<cr>
>
> <lf>[##]<prompt>

FORCE

Sets or displays the infusion force level in percent. Valid range is 1 to 100.

Command format:

> force [1-100]

Query response:

> <lf>[##:]#%<cr>
>
> <lf>[##]<prompt>

FTSWITCH

Sets or displays the footswitch setting. The footswitch may be used in a toggle on or off mode (momentary), a press to run mode (falling), or a release to run mode (rising).

Command format:

> ftswitch [mom l risel fall]

Query response:

> <lf>[##:]Momentary<cr>
>
> <lf>[##]<prompt>
>
> or:
>
> <lf>[##:]Active high<cr>
>
> <lf>[##]<prompt>
>
> or:
>
> <lf>[##:]Active low<cr>
>
> <lf>[##]<prompt>

LOAD

Loads a method.
Command format:

> load
>
> load {method name}
>
> load qs {ilwliwlwi}

Query response:

> <lf>[##:]Quick Start - Infuse Only (qs i)<cr>
>
> <lf>[##]<prompt>
>
> or:
>
> <lf>[##:]Quick Start - Withdraw Only (qs w)<cr>
>
> <lf>[##]<prompt>
>
> or:
>
> <lf>[##:]Quick Start - Infuse/Withdraw (qs iw)<cr>
>
> <lf>[##]<prompt>
>
> or:
>
> <lf>[##:]Quick Start - Withdraw/Infuse (qs wi)<cr>
>
> <lf>[##]<prompt>
>
> or:
>
> <lf>[##:]{method name}<cr>
>
> <lf>[##]<prompt>

METRICS

Displays the pump metrics. The operation of this command is covered in the 11 Elite Configuration document.

Command format:

> metrics

POLL

Sets or displays the polling mode state.

When polling mode is off, prompts are displayed when an event happens, such as a target being reached.

When polling mode is on, prompts are not displayed when an event happens, and a XON character is output when the pump is ready for another command

When polling mode is in remote mode, the following occurs

- Prompts are not displayed
- Carraige returns are not displayed
- The pump address is displayed even if 0
- Echo is forced off and the echo command is illegal
- **Command format:**

  > poll [on l off l remote]

Query response:

> <lf>[##:] OFF<cr>
>
> <lf>[##]<prompt>

or:

> <lf>[##:] ON<cr>
>
> <lf>[##]<prompt><xon>

or:

> [##:] REMOTE<lf>

TIME

Sets or displays the date and time.

Command format:

> time [mm/dd/yy] [hh:mm:ss]*

Query response:

> <lf>[##:]##/##/## ##:##:## #M<cr>
>
> <lf>[##]<prompt>

* 24 hour time format

SYRMANU

Sets or displays the syringe manufacturer. Quick Start mode only. Valide 3-character manufacturer codes are shown in the table below:

air	Air-Tite, HSW Norm-Ject
bdg	Becton Dickinson, Glass (all types)
bdp	Becton Dickinson, Plasti-pak
cad	Cadence Science, Micro-Mate Glass
has	Harvard Stainless Steel
hm1	Hamilton 700, Glass
hm2	Hamilton 1000, Glass
hm3	Hamilton 1700, Glass
hm4	Hamilton 7000, Glass
hos	Hoshi
ils	ILS, Glass
nip	Nipro
sge	SGE (Scientific Glass Engineering)
smp	Sherwood-Monoject, Plastic
tej	Terumo Japan, Plastic
top	Top

Typing 'syrm' with no arguements displays the current syringe setting.

Typing 'syrm ?' displays a list of manufacturers with their associated 3-letter code.

Typing 'syrm {code} ?' shows a list of syringe sizes associated with their specified manufacturer.

Command format:

syrm [? l {3 char code} ? l {volume} ul l ml]

Query response:

<lf>[##:] {manufacturer}, {diameter} mm<cr>

<lf>[##]<prompt>

or:

<lf>[##:] Custom, {diameter} mm<cr>

<lf>[##]<prompt>

or:

<lf>[##:] {code}, {diameter} mm<cr> (this line is repeated for each syringe manufacturer)

<lf>[##]<prompt>

or:

<lf>[##:] {volume}, {unit}<cr> (this line is repeated for each syringe size)

<lf>[##]<prompt>

VER

Displays the short version string.

Command format:

ver

Query response:

<lf>[##:] 11 Elite #.#.#.#<cr>

<lf>[##]<prompt>

VERSION

Displays the full version string.

Command format:

version

Query response:

<lf>[##:]Firmware: v#.#.#.#<cr>

<lf>[##:]Pump address: #<cr>

<lf>[##:]Serial number: C######<cr>

<lf>[##:]Device ID: ########<cr>

<lf>[##]<prompt>

Run commands

IRUN

Runs the pump in the infuse direction. Quick Start mode only.

Command format:

irun

RRUN

Runs the pump in the opposite direction. Quick Start mode only.

Command format:

rrun

RUN

Simulates a key press of the run button located in the lower right corner of the screen.

Command format:

run

STOP / STP

Stops the pump.

Command format:

stop

stp

WRUN

Runs the pump in the withdraw direction. Quick Start mode only.

Command format:

wrun

Rate commands

CRATE

Displays the current rate that the motor is running at. A valid response is returned only in dynamic situations (while the pump is running). Quick Start mode only.

Command format:

crate

Query response:

<lf>[##:]Infusing at # xl/xxx<cr>

<lf>[##]<prompt>

or:

<lf>[##:]Withdrawing at # xl/xxx<cr>

<lf>[##]<prompt>

DIAMETER

Sets or displays the syringe diameter in mm. Quick Start mode only.

Command format:

diameter [{syringe diameter}]

Query response:

<lf>[##:]#.#### mm<cr>

<lf>[##]<prompt>

IRAMP

Sets or displays the infusion rates while ramping. Quick Start mode only.

Command format:

iramp [{start rate} {start units} {end rate} {end units} {ramp time in seconds}]

Query response:

<lf>[##:]Ramp not set up.<cr>

<lf>[##]<prompt>

or:

<lf>[##:]# xl/xxx to # xl/xxx in # seconds<cr>

<lf>[##]<prompt>

IRATE

Sets or displays the infusion rate. Quick Start mode only. The rate argument may be replaced by "max" or "min" to set the maximum or minimum rate, respectively. "lim" may be used to display the range limits.

Command format:

irate [max | min | lim | {rate} {rate units}]

Query response:

<lf>[##:]# xl/xxx<cr>

<lf>[##]<prompt>

or:

<lf>[##:]# xl/xxx to # xl/xxx<cr>

<lf>[##]<prompt>

WRAMP

Sets or displays the withdraw rates while ramping. Quick Start mode only.

Command format:

wramp [{start rate} {start units} {end rate} {end units} {ramp time in seconds}]

Query response:

<lf>[##:]Ramp not set up.<cr>

<lf>[##]<prompt>

or:

<lf>[##:]# xl/xxx to # xl/xxx in # seconds<cr>

<lf>[##]<prompt>

NOTE *To clear a ramp, use CTTIME command.*

WRATE

Sets or displays the withdraw rate. Quick Start mode only. The rate argument may be replaced by "max" or "min" to set the maximum or minimum rate, respectively. "lim" may be used to display the range limits.

Command format:

wrate [max | min | lim | {rate} {rate units}]

Query response:

<lf>[##:]# xl/xxx<cr>

<lf>[##]<prompt>

or:

<lf>[##:]# xl/xxx to # xl/xxx<cr>

<lf>[##]<prompt>

NOTE *For commands requiring rate units, use the following format: m, u, n, p/h, m, s. ex: m/m = milliliter/minutes ex: n/s = nanoliter/second*

Volume commands

CIVOLUME
Clears the infused volume. Quick Start mode only.

Command format:

civolume

CTVOLUME
Clears the target volume. Quick Start mode only.

Command format:

ctvolume

CVOLUME
Clears both the infused and withdrawn volumes. Quick Start mode only.

Command format:

cvolume

CWVOLUME
Clears the withdrawn volume. Quick Start mode only.

Command format:

cwvolume

IVOLUME
Displays the infused volume. Quick Start mode only.

Command format:

ivolume

Query response:

<lf>[##:]# xl<cr>

<lf>[##]<prompt>

SVOLUME
Sets or displays syringe volume. Quick Start mode only.

Command format:

svolume

Query response:

<lf>[##:]#.#### ul<cr>

<lf>[##]<prompt>

or:

<lf>[##:]#.#### ml<cr>

<lf>[##]<prompt>

TVOLUME
Sets or displays the target volume. Quick Start mode only.

Command format:

tvolume [{target volume} {volume units}]

Query response:

<lf>[##:]Target volume not set<cr>

<lf>[##]<prompt>

or:

<lf>[##:] # xl<cr>

<lf>[##]<prompt>

WVOLUME
Displays the withdrawn volume. Quick Start mode only.

Command format:

wvolume

Query response:

<lf>[##:]# xl<cr>

<lf>[##]<prompt>

Time commands

CITIME
Clears the infused time. Quick Start mode only.

Command format:

citime

CTIME
Clears both the infused and withdrawn times. Quick Start mode only.

Command format:

ctime

CTTIME
Clears the target time. Quick Start mode only.

Command format:

cttime

CWTIME
Clears the withdrawn time. Quick Start mode only.

Command format:

cwtime

ITIME
Displays the infused time. Quick Start mode only.

Command format:

itime

Query response:

<lf>[##:]# seconds<cr>

<lf>[##]<prompt>

or:

<lf>[##:]##:##:##<cr>

<lf>[##]<prompt>

TTIME

Sets or displays the target time. Quick Start mode only.

Command format:

ttime [{target time}]

Query response:

<lf>[##:]Target time not set<cr>

<lf>[##]<prompt>

or:

<lf>[##:]# seconds<cr>

<lf>[##]<prompt>

or:

<lf>[##:]##:##:##<cr>

<lf>[##]<prompt>

WTIME

Displays the withdrawn time. Quick Start mode only.

Command format:

wtime

Query response:

<lf>[##:]# seconds<cr>

<lf>[##]<prompt>

or:

<lf>[##:]##:##:##<cr>

<lf>[##]<prompt>

Digital I/O commands

INPUT

Reads and displays the trigger input port status.

Command format:

input

Query response:

<lf>[##:] Low.<cr>

<lf>[##]<prompt>

or:

<lf>[##:] High.<cr>

<lf>[##]<prompt>

OUTPUT

Sets the level on the output port.

Command format:

output {1} {high | low}

Internal commands

STATUS

Displays the raw status for use with a controlling computer.

Command format:

status

Serial Command Notes

The output is in three integer fields and one flag field, all separated by spaces and terminated by a carriage return/linefeed pair. The first integer is the current rate in femtoliters per second. The second integer is the infuse time in milliseconds. The time has a granularity of 1 millisecond. The third integer is the infused volume in femtoliters. All three values are for the current direction.

The flag field consists of six flags.

Flag one is the motor direction and will be "i or I" if the pump is infusing and "w or W" if the pump is withdrawing. If the letter is lower case, the pump motor is idle. If upper case, the pump motor is running.

Flag two is the limit switch status. If the infuse limit switch was hit, "i or I" is displayed. If the withdraw limit switch was hit, "w or W" is displayed. If no limit switch was hit or the pump does not have limit switches, "." is displayed.

NOTE *The Pump 11 Elite OEM Module does not contain limit switches, so "." will be displayed.*

Flag three is the stall status and will be "S" if the pump has stalled. Otherwise it will be ".".

Flag four is the trigger input state and will be "T" if high and "." if low.

Flag five is the direction port state and will be "i or I" for infuse and "w or W" for withdraw.

Flag six is the target reached status. It will be "T" if the target time or volume was reached and "." if not.

Appendices

APPENDIX A: SYRINGE VOLUME/DIAMETER REFERENCE TABLE

Harvard Apparatus Stainless Steel

Size	Diameter
2.5 ml	4.851 mm
8	9.525
20	19.130
50	28.600

Air-Tite HSW Norm-Ject

Size	Diameter
1 ml	4.69 mm
2.5	9.65
5	12.45
10	15.9
20	20.05
30	22.9
50	29.2

Becton Dickinson 'Plasti-pak'

Size	Diameter
1 ml	4.699 mm
3	8.585
5	11.989
10	14.427
20	19.05
30	21.59
50	26.594
60	26.594

Terumo

Size	Diameter
1 ml vc	6.50 mm
1 ml tb	4.70 mm
2.5	9
5	13
10	15.8
20	20.15
30	23.2
60	29.2

SGE Scientific Glass Engineering

Size	Diameter
5 µl	0.343 mm
10	0.485
25	0.728
50	1.03
100	1.457
250	2.303
500	3.257
1 ml	4.606 mm
2.5	7.284
5	10.301
10	14.567
25	23
50	27.5

Hamilton Glass – All Types

Size	Diameter
0.5 µl	0.103 mm
1	0.146
2	0.206
5	0.343
10	0.485
25	0.729
50	1.03
100	1.457
250	2.304
500	3.256
1 ml	4.608 mm
1.25	5.151
2.5	7.285
5	10.3
10	14.567
25	23.033
50	32.573

Cadence Science, Inc. Formerly Popper & Sons MICRO-MATE Glass

Size	Diameter
0.25 ml	3.47 mm
0.5	3.62
1	4.82
2	8.91
3	8.91
5	11.71
10	14.65
20	19.56
30	22.7
50	28.02

Becton Dickinson Glass–All Types

Size	Diameter
0.5 ml	4.64 mm
1	4.64
2.5	8.66
5	11.86
10	14.34
20	19.13
30	22.7
50	28.6

Sherwood–Monoject Plastic

Size	Diameter
1 ml	4.674 mm
3	8.865
6	12.600
12	15.621
20	20.142
35	23.571
60	26.568

Hoshi

Size	Diameter
1 ml	6.50 mm
2	9.10
3	10.00
5	12.60
10	15.10
20	20.45
30	22.50
50	25.60

Top

Size	Diameter
1 ml	6.40 mm
2.5	9.30
5	13.10
10	15.3
20	21.0
30	23.0
50	29.0

NIPRO

Size	Diameter
1 ml short	6.6 mm
1 ml long	4.7
2.5 ml	9.0
5	13.0
10	15.8
20	20.1
30	23.2
50	29.1

ILS Glass

Size	Diameter	
250 ul	2.303	mm
500 ul	3.26	mm
1 ml	4.606	mm
2.5 ml	7.28	mm
5 ml	10.3	mm
10 ml	14.567	mm

Suggested Force Level Settings for Common Syringes

Syringe Type/Material	Capacity	Force Setting	Common Manufacturer(s)
Plastic Syringes	≤5ml	50%	BD plastic, Sherwood, Airtite, Terumo
	>5ml	100%	
Stainless Steel	All	100%	Harvard Apparatus
Glass/Glass	≤20ml	30%	Cadence (Popper)
	>20ml	50%	
Glass/Plastic	≤250µl	30%	Hamilton, SGE
	≤5ml	50%	
	>5ml	100%	

NOTE *The Pump 11 Elite OEM Module can accommodate syringes ranging from 0.5 µl to 60 ml single syringe and 0.5 µl to 10 ml dual syringe.*

NOTE *NOTE: The Pico Plus Elite OEM Module can accommodate syringes ranging from 0.5 µl to 10 ml.*

APPENDIX B: PUMP 11 ELITE OEM MODULE (SINGLE & DUAL) MIN/MAX FLOW RATES

Nominal Minimum/Maximum Flow Rates for Various Syringes. (Actual Limits will vary depending on syringe manufacturer)					
Syringe Size	Syringe ID	Minimum Rate	Units	Maximum Rate	Units
0.5 µl	0.103 mm	1.26	pl/min	1.326	µl/min
1 µl	0.146 mm	2.52	pl/min	2.654	µl/min
2 µl	0.206 mm	5.10	pl/min	5.304	µl/min
5 µl	0.343 mm	14.160	pl/min	14.710	µl/min
10 µl	0.485 mm	28.260	pl/min	29.400	µl/min
25 µl	0.729 mm	63.960	pl/min	66.430	µl/min
50 µl	1.030 mm	127.700	pl/min	132.600	µl/min
100 µl	1.457 mm	255.500	pl/min	265.400	µl/min
250 µl	2.304 mm	638.900	pl/min	663.500	µl/min
500 µl	3.256 mm	1.276	nl/min	1.325	ml/min
1000 µl	4.608 mm	2.556	nl/min	2.654	ml/min
1 ml	4.699 mm	2.658	nl/min	2.760	ml/min
3 ml	8.585 mm	8.871	nl/min	9.213	ml/min
5 ml	11.99 mm	17.300	nl/min	17.970	ml/min
10 ml	14.43 mm	25.050	nl/min	26.020	ml/min
20 ml	19.05 mm	43.680	nl/min	45.360	ml/min
30 ml	21.59 mm	56.110	nl/min	58.270	ml/min
50 ml	26.59 mm	85.130	nl/min	88.400	ml/min
60 ml	26.59 mm	85.130	nl/min	88.400	ml/min

PICO PLUS ELITE OEM MODULE MIN/MAX FLOW RATES

Nominal Minimum/Maximum Flow Rates for Various Syringes. (Actual Limits will vary depending on syringe manufacturer)					
Syringe Size	Syringe ID	Minimum Rate	Units	Maximum Rate	Units
0.5 μl	0.103 mm	0.54	pl/min	596.5	nl/min
1 μl	0.1457 mm	1.14	pl/min	1.194	μl/min
2 μl	0.206 mm	2.28	pl/min	2.386	μl/min
5 μl	0.343 mm	6.36	pl/min	6.615	μl/min
10 μl	0.485 mm	12.72	pl/min	13.230	μl/min
25 μl	0.729 mm	28.74	pl/min	29.880	μl/min
50 μl	1.030 mm	57.42	pl/min	59.650	μl/min
100 μl	1.457 mm	114.9	pl/min	119.4	μl/min
250 μl	2.304 mm	287.4	pl/min	298.5	μl/min
500 μl	3.256 mm	574.0	pl/min	596.1	μl/min
1000 μl	4.608 mm	1.150	nl/min	1.194	ml/min
1 ml	4.699 mm	1.196	nl/min	1.241	ml/min
3 ml	8.585 mm	3.990	nl/min	4.144	ml/min
5 ml	11.989 mm	7.782	nl/min	8.082	ml/min
10 ml	14.430 mm	11.270	nl/min	11.700	ml/min

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phone **508.893.8999** fax **508.429.5732** e-mail bioscience@harvardapparatus.com
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APPENDIX C: EXTERNAL CONNECTIONS

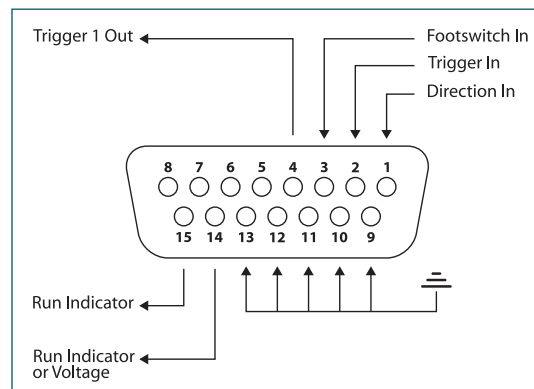### User I/O Connector Specifications

Pin Assignments

1. **Direction control input**

   Rising edge sets pump to infuse

   Falling edge sets pump to refill

2. **Trigger Input**

   Event trigger – falling edge triggers a Method event

3. **Footswitch Input (or Timer)**

   Settable to work as:

   –Momentary switch closure to ground or TTL Logic Low; falling edge toggles between states (run/stop)

   –Starts on rising edge, stops on falling edge

   –Starts on falling edge, stops on rising edge

4. **Trigger 1 Output**

   TTL Logic Output–Default = Low Control thru Method or serial comm

9–13. Signal Return / Ground

14. Run Indicator Voltage

   +5V through a 470 ohm resistor (connect to LED Anode)

15. Run Indicator Output

   TTL Logic Output, active low (low = run) (connect to LED Cathode)

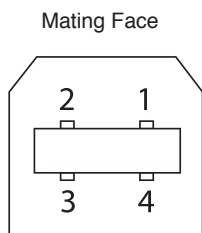#### Electrical Specifications

Inputs: $V_{IH} \geq 2V$ $I_{IH} \leq 20\mu A$
        $V_{IL} \leq 0.4V$ $I_{IL} \leq 0.5mA$

Outputs: $V_{OH} \geq 3.8V$ $I_{OH} \leq 6mA$
         $V_{OL} \leq 0.4V$ $I_{OL} \leq 6mA$

All Inputs are pulled high to +5 Vdc through a 10k resistor All Outputs are at TTL Logic Levels. Pulse duration should be 0.1s minimum.


User I/O Connector Specifications

Utilizing the USB Interface

Mating Face

| 2 | 1 |

| 3 | 4 |

Pin #	Signal
1	+5V
2	- Data
3	+ Data
4	GND

USB VIRTUAL COMMPORT DRIVER INSTALLATION

When you connect the Pump 11 Elite Series pump to a computer via USB for the first time, Windows will seek to install a driver for communication. The following section details the installation of the Virtual CommPort Driver supplied with the Pump 11 Elite Series Pump.
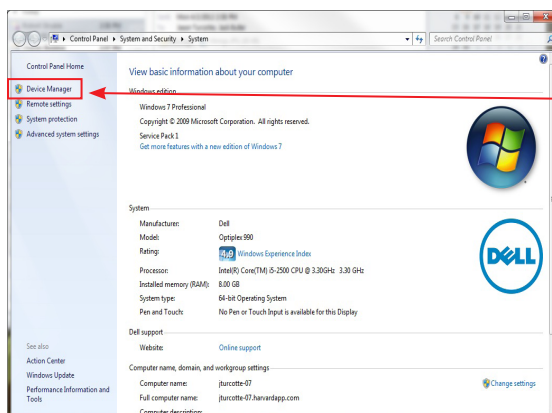

1. Connect the pump to the computer via USB. Open the control panel and select System and Security and then System. Click Device Manager on the left hand menu.
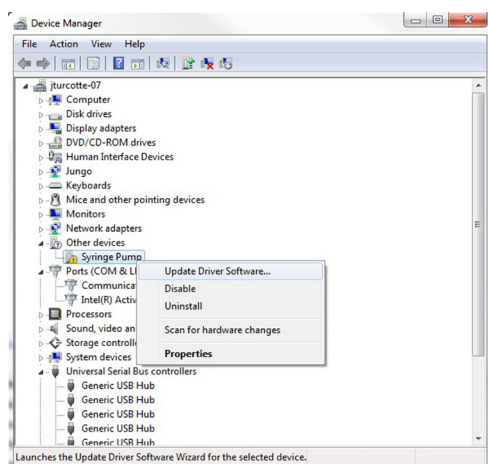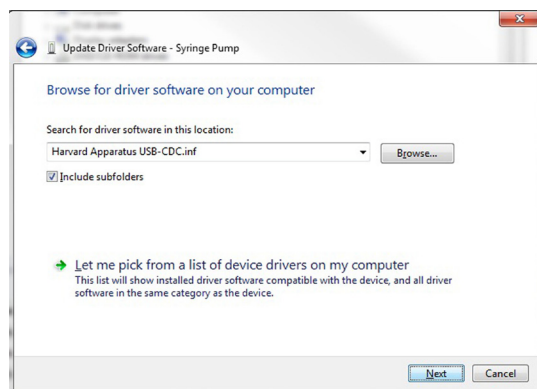

2. Two Flash Update Applications will be displayed in the device manager, under Other Devices. Right click on either of the flash update applications and select Update Driver Software.
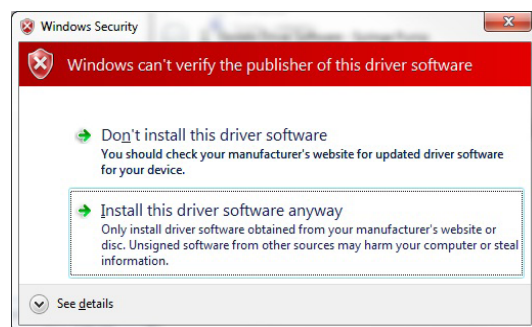
## USB VIRTUAL COMMPORT DRIVER INSTALLATION (CONTINUED)
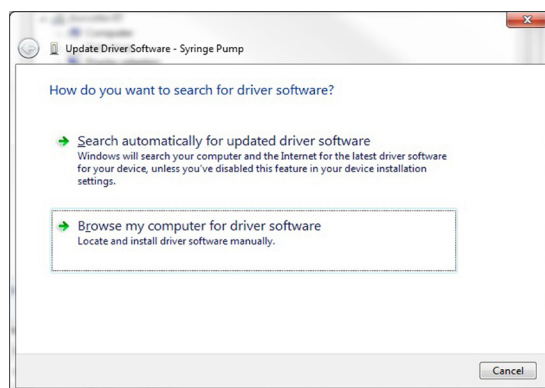
3. Select Browse my computer for driver software.

4. Click Browse and navigate to the pump drivers folder located on the CD supplied with the pump. Select the file Harvard Apparatus USB-CDC.inf. Make sure the Include Subfolders box is checked and then click Next.

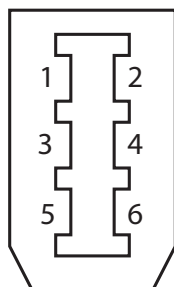5. If a warning message regarding the driver publisher is displayed, choose Install this driver software anyway.
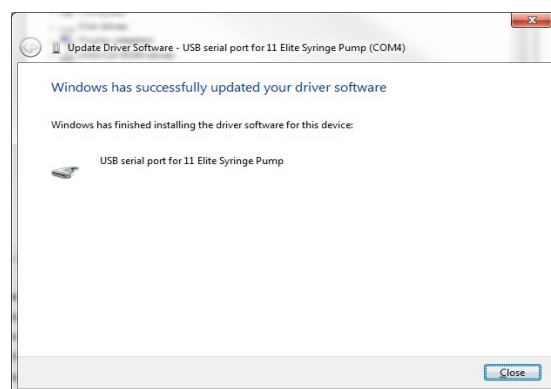
6. Click Close after the software has been successfully installed.

RS–485

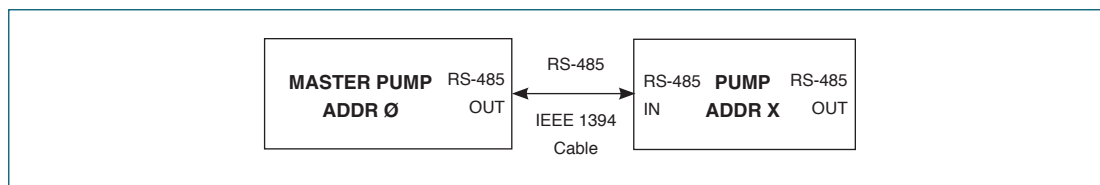⚠️ CAUTION: DO NOT CONNECT TO FIREWIRE PORTS ON A PC. DAMAGE MAY OCCUR TO PUMP AND/OR PC.

Mating Face

Pin #	RS-485 In Signal	RS-485 Out Signal	Notes
1	PWR IN	PWR OUT (+30V)*	* Protected by resettable fuse
2	GND	GND	
3	RS-485 A	TIED TO PIN 4**	** 100 Ω, ½ w to GND termination
4	RS-485 B	TIED TO PIN 3**	
5	TIED TO PIN 6**	RS-485 A	
6	TIED TO PIN 5**	RS-485 B	

RS-485 In/Out - IEEE-1394 Sockets
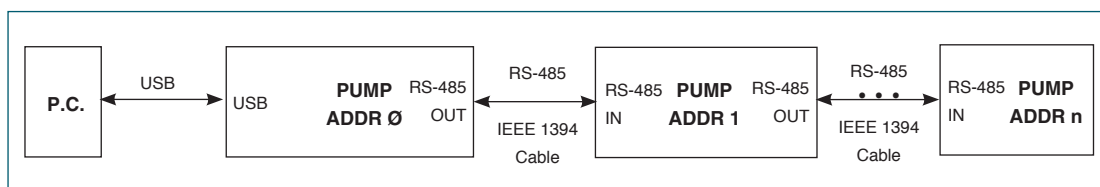
Daisy-Chaining via RS-485

Gradient Connections via RS-485

RS–485 Dasiy Chain Connection Options:

- If all pumps have software versions 2.0.0 or higher, 99 pumps in chain.

- If all pumps have software versions 1.0.6 or lower, 99 pumps in chain.

- If mix of pumps with software version 1.0.6 or lower and 2.0.0 or higher, maximum of 5 pumps in chain and **1** RS-485 adapter (catalog # 70-4025) required.

NOTE *When applying power to pumps in a daisy-chain, apply power to the last group and work backwards.*

NOTE *Power may be removed from any group of pumps, except the first group, without affecting communications "down-stream".*

NOTE *When removing power, be sure to remember that power removed from a stand-alone unit will also cause power to be removed from all RS-485 powered units deriving power from it.*

NOTE *If a larger chain of pumps with mixed software versions is desired, pumps with software versions 1.0.6 or lower can be returned to manufacturer for a hardware update.*

Legacy RJ–11 Option
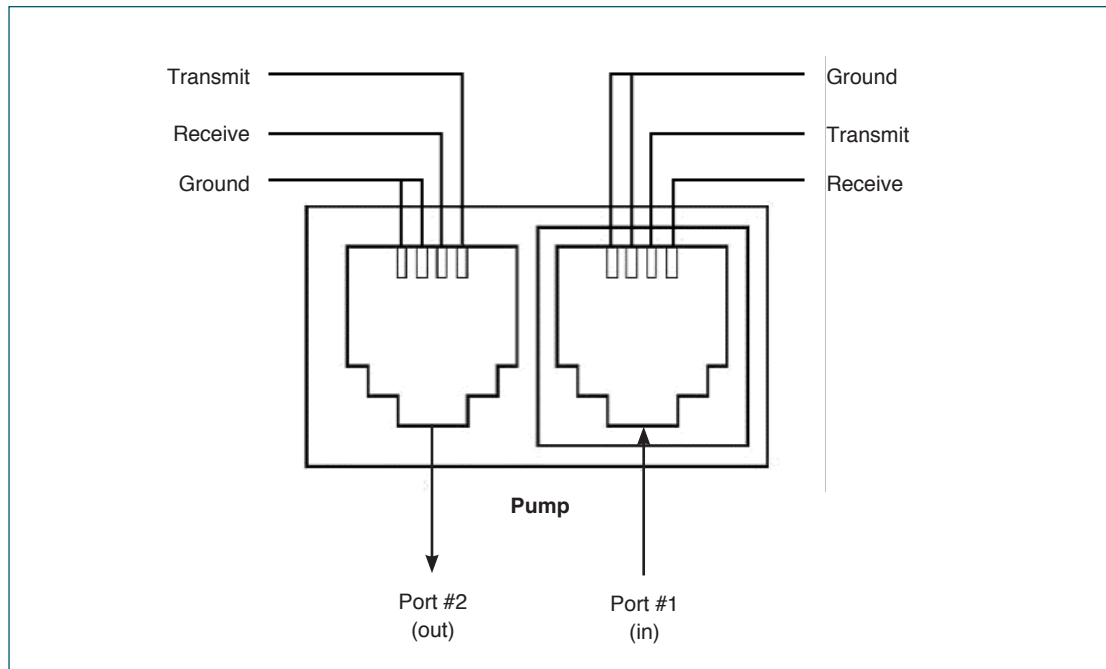
Pumps with Legacy RJ-11 Option

Daisy-Chaining with Legacy RJ-11 Option

NOTE *Pumps 1…n also have RJ-11 telephone jacks.*

APPENDIX D: MAINTENANCE

Maintenance

Pump 11 Elite Series pumps require no special maintenance other than keeping them clean by avoiding accidental spills of pumped material.
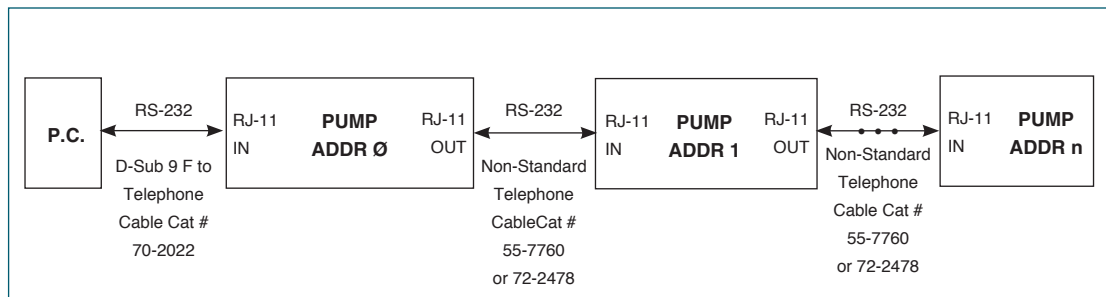
The two guide rods and the lead screw should be sparingly lubricated every 100 hrs. The guide rods and the lead screw should be lubricated with Super Lube Synthetic Grease provided with the pump.

To clean the exterior surfaces, use a lint-free cloth to remove loose dust. For more efficient cleaning, use a soft cloth dampened [not soaked] with water, an aqueous solution of 75% isopropyl alcohol, or a mild detergent.

Pump 11 Elite OEM Module

USER'S MANUAL

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## Upgrading Pump 11 Elite Series Software

NOTE *Prior to upgrading, users will need to install the Pump 11 Elite Series USB driver as well as the bootloader driver file (Pump 11 Elite Series-Bootloader.inf). Reference "USB Virtual Comport Driver Installation".*

1. Upload the latest software version to your desktop (format is filename.srec).
2. Disconnect all I/O devices and then connect the pump to PC using a USB cable.
3. Using Method Manger, send the 'Boot' command to enter "Boot Loader Mode".

NOTE *To exit boot loader mode without upgrading the software, power cycle the pump.*

4. From the CD provided with the pump, open the Pump 11 Elite Series Pump Updater Application.
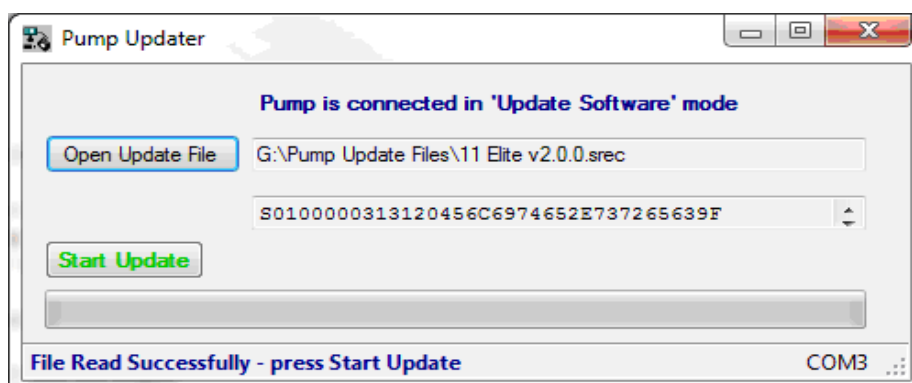
5. Click Open Update File and browse to the file previously saved on your desktop and click Open.
6. Click Start Update.
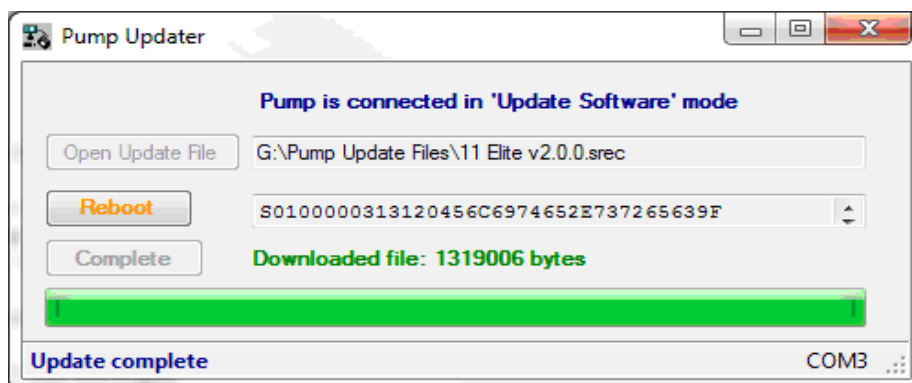
7. After the update is complete, press Reboot to power cycle the pump.

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Pump 11 Elite OEM Module USER'S MANUAL

TROUBLESHOOTING

1. Infusion Accuracy

To ensure infusion accuracy always use new syringe(s) and measure syringe bore diameter and enter actual dimensions in millimeters (mm) using the Custom Syringe entry option. Additionally, make sure that the guide rods and lead screw are properly lubricated.

Pump 11 Elite Series Error Messages

2. Motor Stalled

This indicates that the pusher block travel has been impeded. This may be caused by the syringe plunger hitting bottom, a kink in the tubing (occlusion), syringe plunger binding, incorrect positioning of mechanical stop collars or any situation requiring more force to the head of the syringe than the pump is capable of delivering. To restart the pump, remove the cause of stalling and/or increase the force setting, then press RUN. The pump will continue the interrupted procedure where it stopped.

3. Out of Range

A value was entered or encountered in a pump Method that was beyond the pump's limits.

4. Overload Protection

The Pump 11 Elite OEM Module Series incorporates resettable fuses for overload protection. In the event of an overload, power to the pump may be disconnected. Try to determine and remove the source of the overload, wait a few minutes, and then re-apply power to the pump.

APPENDIX E: ORDERING INFORMATION

Standard Version

Description	Single Syringe	Dual Syringe
Pump 11 Elite OEM ModuleInfusion/Withdrawal	**70–4800**	**70–4801**
Pump 11 Pico Plus Elite Infusion/Withdrawal	—	**70–4802**

Options

Description	Catalog Number
RS-232 RJ-11 Connectors Option	**70–3030**

*If needed, must be ordered at the same time as the Elite pump

Accessories

Description	Catalog Number
RS-485 Cable for Pump-to-Pump Communication, 0.5 m (2 ft)	**70–4000**
RS-485 Cable for Pump-to-Pump Communication, 1 m (3 ft)	**70–4021**
RS-485 Cable for Pump-to-Pump Communication, 2 m (7 ft)	**70–4001**
RS-485 Cable for Pump-to-Pump Communication, 9 m (30 ft)	**70–4020**
USB Cable for PC-to-Pump Communication, 2 m (7 ft)	**70–4002**
USB Cable for PC-to-Pump Communication, 5 m (16 ft)	**70–4003**
Cable Assy, Daisy-chain, Legacy RS-232 RJ-11, 0.5 m (2 ft)	**55–7760**
Cable Assy, Daisy-chain, Legacy RS-232 RJ-11, 2 m (7 ft)	**72–2478**
Line Cord, US (115 v)	**5113–001**
Adapter, D-sub 15 to Term. Blk	**70–4006**
Footswitch (w/ Phono Plug)	**70–2215**
Adapter for 25ml, 50ml Hamilton GasTight™ syringes	**55–8000**
Hex Key, 3/32	**5012–005**
Lubricant, SuperLube, 1cc	**70–4013**
RS-485 Adapter (See Appendix C: External Connections)	**70–4025**

For additional items such as Syringes, Tubing, Syringe Heaters, Spill Sensors, Temperature Controllers, Nano-Fluidic Accessories, and much more please visit our website www.harvardapparatus.com or call (800) 272-2775.

Declaration of Conformity

Manufacturer:

Harvard Apparatus, Inc.
84 October Hill Road
Holliston, Massachusetts 01746-1388, U.S.A.
Phone: (508) 893-8999

We herewith declare that the following product:

Product Name: *Pump 11 Elite OEM Module Syringe Pump Series*
Model No.:   *Pump 11 Elite OEM Module Series- Catalog # 70-4xxx*

To which this declaration relates, is in conformity with the applicable EC Directives, harmonized standards, and other normative requirements:

Application of
Council Directive(s):

2006/95/EC	*Low Voltage Directive*
2004/108/EC	*Electromagnetic Compatibility Directive*
2011/65/EU	*RoHS Directive*

Standard(s) to which
conformity is declared:

Safety: *EN 61010-1:2012 (3rd Edition)*

Emissions/Immunity:
EN 61326:2006/05/01
EN 61000-4-2:1995 + A1:1998+A2:2001
EN 61000-4-3:2002
EN 61000-4-4:2004
EN 61000-4-5:1995+A1:2001
EN 61000-4-6:2007
EN 61000-4-8:1993+A1:2001
EN 61000-4-11:2004
EN 61000-3-2:2000
EN 61000-3-3:1995+A1:2001
CISPR11:2003+A1:2004, Group 1, Class A

EMC and Safety compliance were evaluated by Intertek/ETL Semko

Reference test report
file numbers: *100071222 BOX-002, -004a, -007*

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: *April 02, 2012*

CE

HARVARD
APPARATUS

_____
(Signature)

Beth Bauman
_____
(Full Name)

VP Engineering / Operations
_____
(Position)