

Choosing the Right Pump for Your Application & Budget

SYRINGE PUMP QUESTIONS

- What is your application?
- How many syringes will be used simultaneously?
- What size syringe will be used?
- What flow rate(s) will be used? See pump reference pages 102-106
- What is the total volume to be delivered?
- Does the pump need to withdraw (fill the syringe) as well as infuse (dispense)?

Syringe Pump Selection Guide							
	INFUSION ONLY						
MODEL	PUMP 11 ELITE	PUMP 22 **	PHD 22/2000	PHD ULTRA™	PUMP 11 ELITE	PICO PLUS ELITE	
STANDARD PUMP	PC1 70-4500 PC1 70-4501	PC1 55-2222	PC1 70-2000	PC1 70-3005			
PROGRAMMABLE PUMP	—	—	—	—	PC1 70-4504 PC1 70-4505	PC1 70-4506	
NUMBER OF SYRINGES	1 or 2	2 to 10*	2 to 10*	2 to 10*	1 or 2	2	
MINIMUM SYRINGE SIZE	0.5 µl	0.5 µl	0.5 µl	0.5 µl	0.5 µl	0.5 µl	
MAXIMUM SYRINGE SIZE	50/60 ml (single) 10 ml (dual)	140 ml	140 ml	140 ml	50/60 ml (single) 10 ml (dual)	10 ml	
MINIMUM FLOW RATE	1.28 pl/min	0.002 µl/hr	0.0001 µl/hr	1.56 pl/min	1.28 pl/min	0.54 pl/min	
MAXIMUM FLOW RATE	88.28 ml/min (single) 25.99 ml/min (dual)	55.1 ml/min	220.82 ml/min	215.8 ml/min	88.28 ml/min (single) 25.99 ml/min (dual)	11.70 ml/min	
AVERAGE LINEAR FORCE	16 kg (35 lbs) (adjustable)	21 kg (47 lbs)	23 kg (50 lbs) or 30 kg (66 lbs)	34 kg (75 lbs) (adjustable)	16 kg (35 lbs) (adjustable)	16 kg (35 lbs) (adjustable)	
COMPUTER CONTROL	USB	RS-232	RS-232	USB + RS-232	USB	USB	
I/O + TTL CONNECTION	No	Yes	Yes	Yes	Yes	Yes	
DIMENSIONS (H x W x D)	22.6 x 17.78 x 15 cm (9 x 7 x 6 in)	28 x 22.2 x 14 cm (11 x 8.75 x 5.5 in)	15.9 x 22.8 x 27.9 cm (6.3 x 9 x 11 in)	10.16 x 30.5 x 21.6 cm (4 x 12 x 8.5 in)	22.6 x 17.78 x 15 cm (9 x 7 x 6 in)	22.6 x 17.78 x 15 cm (9 x 7 x 6 in)	
PUMP HEAD DIMENSIONS (H x W x D)	—	—	—	—	—	—	
WEIGHT	2.1 kg (4.61 lbs)	4.5 kg (10 lbs)	4.5 kg (10 lbs)	4.5 kg (10 lbs)	2.1 kg (4.6 lbs)	2.1 kg (4.61 lbs)	
PAGE	11	26	29	16	11	14	

Please contact Technical Support for assistance.

* Depends upon the Syringe Rack

4 x 140 Syringe Rack Holds four 60 ml or 140 ml plastic syringes only
 6 x 10 Syringe Rack Holds six 30 to 60 ml syringes or ten 0.5 µl to 20 ml syringes
 Microliter Syringe Rack Holds four 0.5 µl to 10 ml syringes

** Low RFI (Radio Frequency Interference) Pump available

*** Push/Pull pump can hold syringes up to 140 ml if full stroke is not required. Larger syringes will not fully infuse or withdraw. Max of 50 ml syringe if full stroke is required.

SYRINGE PUMPS

Choosing the Right Pump for Your Application & Budget (continued)

SYRINGE PUMP QUESTIONS (CONTINUED)

- What is the viscosity of the liquid you are pumping? See pump reference page 101
- What are the pressure requirements of your experiment? See pump reference pages 101-102
- Does the pump need to continuously infuse over a 24 hour period of time?
- Does the pump need to be programmable?
- Does the pump need to be controlled with a computer?
- Does the pump need to have TTL capabilities (ex. external control of valves, use of footswitch, etc)?

INFUSION/WITHDRAWAL								PUSH/PULL
	PUMP 11 ELITE NANOMITE	PHD ULTRA™ NANOMITE	PUMP 33	PHD 22/2000	PHD ULTRA™	PHD ULTRA™ HPSI	PHD ULTRA™ 4400 HPSI	PHD ULTRA™ PUSH/PULL
			PC1 55-3333	PC1 70-2001	PC1 70-3006	–	–	PC1 70-3008
	PC1 70-4507	PC1 70-3601	–	PC1 70-2002	PC1 70-3007	PC1 70-3111	PC1 70-3010 PC1 70-3111	PC1 70-3009
	1	1	2	2 to 10*	2 to 10*	4	1	4 (2 on each side of pusher block)
	0.5 µl	0.5 µl	0.5 µl	0.5 µl	0.5 µl	20 ml	2.5 ml	0.5 µl
	1 ml	1 ml	140 ml	140 ml	140 ml	200 ml	100 ml	140 ml***
	3.66 pl/min	3.66 pl/min	0.0004 µl/hr	0.0001 µl/hr	1.56 pl/min	49.7 nl/min	3.06 pl/min	1.56 pl/min
	3.818 ml/min	3.818 ml/min	106.6 ml/min	215.8 ml/min	215.8 ml/min	144.1 ml/min	215.8 ml/min	215.8 ml/min
	5 kg (11 lbs) (adjustable)	5 kg (11 lbs) (adjustable)	26 kg (57 lbs)	23 kg (50 lbs) or 30 kg (66 lbs)	34 kg (75 lbs) (adjustable)	197 kg (433 lbs) (adjustable)	91 kg (200 lbs) (adjustable)	34 kg (75 lbs) (adjustable)
	USB	USB	RS-232	RS-232	USB + RS-232	USB + RS-232	USB + RS-232	USB + RS-232
	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	22.6×17.78×9.32 cm (9×7×3.67 in)	30.5×21.6×11.1 cm (12.0×8.5×4.38 in)	15.2×31.1×28.6 cm (6×12.5×11.25 in)	15.9×22.8×27.9 cm (6.3×9×11 in)	10.16×30.5×21.6 cm (4×12×8.5 in)	30.48×21.59×10.8 cm (12×8.5×4.25 in)	30.5×21.6×10.8 cm (12×8.5×4.25 in)	10.16×30.5×21.6 cm (4×12×8.5 in)
	6.35×5.08×19.05 cm (2.5×2.0×7.5 in)	6.35×5.08×19.05 (2.5×2.0×7.5 in)	–	22.9×43.2×30.5 cm (9×17×12 in)	–	40.64×30.5×19.7 cm (16×12×7.75 in)	–	–
	1.96 kg (4.32 lbs)	–	6.8 kg (15 lbs)	4.5 kg (10 lbs)	4.5 kg (10 lbs)	13.7 kg (30.2 lbs)	6.4 kg (14 lbs)	4.5 kg (10 lbs)
	15	23	27	29	16	22	22	16



Our technical support specialists are eager assist you with product selection & questions, call today!
1-800-272-2775 & 508-893-8999

Choosing the Right Pump for Your Application & Budget (continued)

Find your application and go to the pages indicated for more information!

Syringe Pump Application Guide

	STANDARD SYRINGE PUMPS						
	Pump 11 Elite	Pump 11 Pico Plus Elite	Pump 11 Elite Nanomite	Pump 22	Pump 33	PHD 22/2000	
SEE PAGE	11	14	15	26	27	29	
ACCURATE DELIVERY OF COATINGS		X				X	
ANIMAL FEEDING	X			X		X	
BULK FLUID TRANSFER					X		
CELL CULTURES	X				X		
CELLULAR INJECTION		X	X			X	
CONTINUOUS INFUSIONS					X		
DOPING	X			X		X	
DRUG DELIVERY (SAME INFUSION RATES)	X			X		X	
DRUG DELIVERY (DIFFERENT INFUSION RATES)	X			X (RS-232)*	X	X	
DRUG DELIVERY (TIME RELEASED)	X						
DRUG DEVELOPMENT	X			X		X	
ELECTROSPINNING	X					X	
FLUID BLENDING	X			X (RS-232)*	X	X (RS-232)*	
FLUID BLENDING (2 INDEPENDENT CHANNELS)					X		
FLUID SAMPLING	X	X	X	X	X	X	
GRADIENTS	X			X (RS-232)*	X	X (RS-232)*	
HIGH PRESSURE INJECTION		X					
HIGHLY CORROSIVE FLUIDS							
HPLC	X	X			X		
INJECTING INTO HIGH PRESSURE REACTION VESSELS		X					
INJECTION PRESSURE CALCULATIONS	X			X		X	
INSTRUMENT INJECTIONS	X			X		X	
LOW PRESSURE CHROMATOGRAPHY	X						
MASS SPECTROMETRY	X	X		X		X	
MEDICAL COATING DELIVERY							
MICRODIALYSIS	X	X		X			
MICROFLUIDICS	X	X				X	
MRI STUDIES							
MULTIPLE SIMULTANEOUS FEEDING STATIONS	X			X (RS-232)*		X (RS-232)*	
NANOFLUIDICS		X				X	
NUTRITIONAL STUDIES	X			X		X	
OEM MODULES							
OOCYTE APPLICATIONS		X	X				
PATCH CLAMPING							
REMOTE PUMPING OF HAZARDOUS MATERIAL			X			X	
STEREOTAXIC INJECTIONS			X				
TITRATIONS	X			X (RS-232)*	X		
VISCOUS SOLUTIONS		X					

*NOTE: Can be done using RS-232 Computer Control

SYRINGE PUMPS

Choosing the Right Pump for Your Application & Budget (continued)

						OEM SYRINGE PUMP MODULES		
	PHD ULTRA™	PHD ULTRA™ PUSH/PULL	MRI PHD 22/2000	PHD ULTRA™ HPSI	PHD ULTRA™ 4400 HPSI	MICROLITER	MILLILITER	HIGH PRESSURE
	16	16	28	22	22	34	34	34
	X	X						X
	X							
	X	X						
	X	X						
	X					X	X	
		X				X	X	
	X							
	X							
				X (RS-232)*				
	X				X			
	X							
	X							X
	X				X	X	X	
						X	X	
	X					X	X	
	X					X	X	
				X	X			X
				X	X			X
	X	X						
				X	X			X
	X							
	X					X	X	X
	X							
	X							X
	X							
	X							
			X					
	X						X	
	X					X		
	X							
						X	X	X
	X							
	X			X	X	X	X	X
	X					X	X	
	X			X	X			X

Application Selection Guide

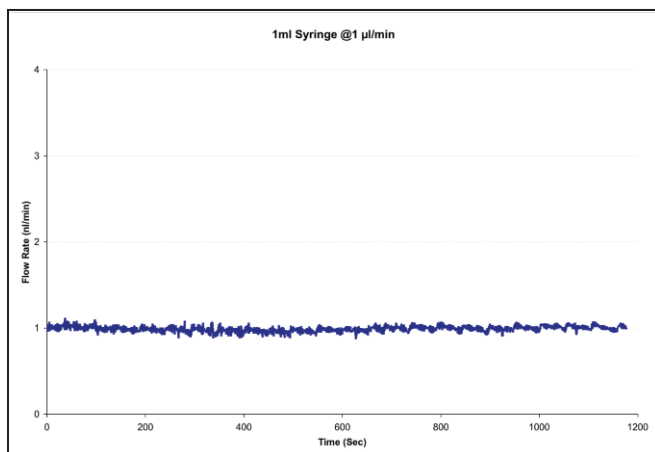
With more than 60 years of experience in the development, manufacture, and support of the highest quality syringe pumps, and 100 years in fluidics, Harvard Apparatus has a wealth of experience to share in recommending the right solution for your application. Following is only a partial guide of some application suggestions. Contact our Technical Support group for their input or with questions for the best pump to meet your need.

If you do not see what you feel is the best solution for your application, give us a call as we often develop or modify standard products for particular applications at little or no extra cost.

Neuroscience

Applications in this area include: microdialysis and site specific microinjection into various brain regions.

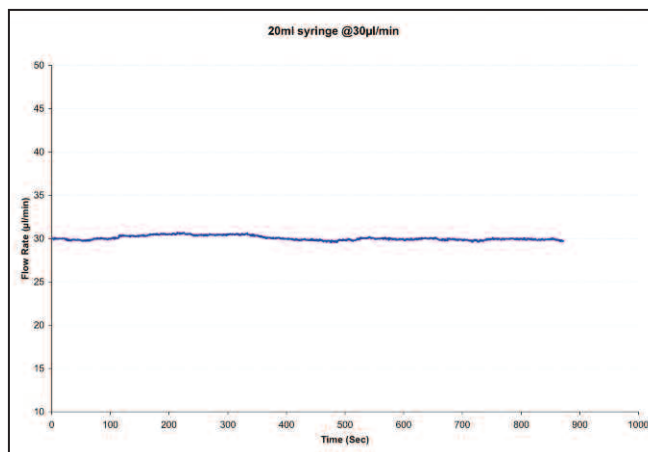
- **For stereotactically guided, single channel microinjection**, see the Pump 11 Elite Nanomite on page 15, or the PHD ULTRA™ Nanomite on page 23.
- **For single or dual probe microdialysis**, see the Pump 11 Elite on page 11 or Pico Plus Elite on page 14.
- **For applications using a liquid switch, or for running multiple experiments simultaneously**, see the PHD ULTRA™ on page 16.



Infusion and Drug Delivery

Delivering accurate volumes and flows is critical to maintaining dosing regimens, interpretation of pharmacokinetics and other data.

- **For single or dual channel infusions**, see the Pump 11 Elite on page 11, or PHD ULTRA™ on page 16.
- **If MRI or PET studies are being conducted**, see the PHD 22/2000 on page 28.
- **To run multiple studies from a single pump**, see the PHD ULTRA™ on page 16.



Neuroscience References

PHARMACOLOGY BIOCHEMISTRY AND BEHAVIOR
Volume 89, Issue 1, March 2008, Pages 17-22
J Appl Physiol 106: 1793-1799, 2009.

EXPERIMENTAL NEUROLOGY
Volume 210, Issue 2, April 2008, Pages 514-520

Infusion and Drug Delivery References

PROC SOC PHOTO OPT INSTRUM ENG. 2008; 6854: 68540H.
doi: 10.1117/12.768798.

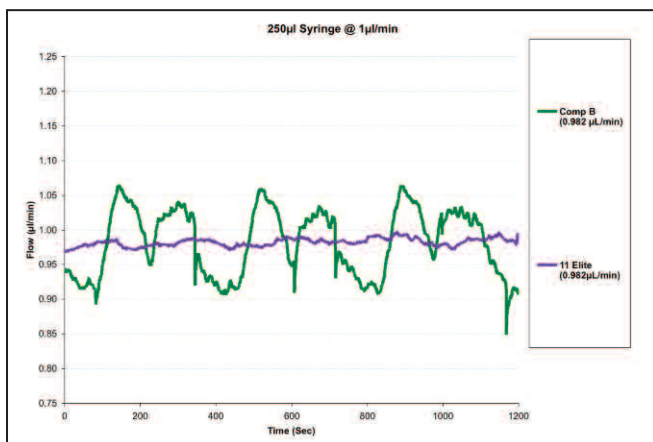
EUROPEAN JOURNAL OF PHARMACOLOGY
Volume 602, Issue 1, 5 January 2009, Pages 112-116

ACTA ANAESTHESIOLOGICA SCANDINAVICA
Volume 52, Issue 2, pages 289-294, February 2008

Cell Biology

Cellular studies typically involve the injection of very small volumes under controlled conditions. Several models offer a foot pedal accessory to start/stop flow on command.

- **For cellular microinjections of plasmids, viruses, and the like**, see either the Pump 11 Pico Plus Elite on page 14, PHD ULTRA™ Nanomite on page 23 or the Pump 11 Elite Nanomite on page 15.



Cell Biology References

ELECTROPHORESIS

Volume 29, Issue 14, pages 2939–2944, No. 14 July 2008
June 6, 2008 The Journal of Biological Chemistry, 283, 15816–15824

MATERIALS SCIENCE AND ENGINEERING: C

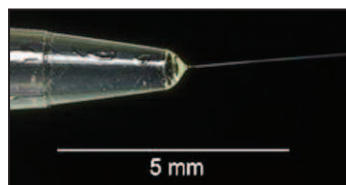
Volume 29, Issue 4, 5 May 2009, Pages 1293–1301

Chemical and Industrial / Electrospinning

Where chemical synthesis, pressurized systems, and other applications demand high performance Harvard Apparatus has the right solution.

- **For high pressure applications**, consider the PHD ULTRA™ HPSI with stainless steel syringes on page 22 or the PHD ULTRA™ 4400 on page 22.

Harvard Apparatus pumps are used in creating Nano and Micro scale polymer fibers in a high voltage field. The stability of flow and flexibility of use, in the PHD ULTRA series pumps, makes it easy to alter the variables relating to



successful electrospinning. Our pumps include a grounded power supply and can be supplied with a grounding strap, which will shunt any high voltage arcs to ground.

Chemical and Industrial/Electrospinning References

Anal. Chem., 2008, 80 (9), pp 3112–3122

Muhammad Miftahul Munir et al 2008 Nanotechnology 19 145603

Journal of Biomechanics Volume 42, Issue 6, Pages 722–730 (16 April 2009)

Mass Spectrometry Calibration and Electrospray Ionization

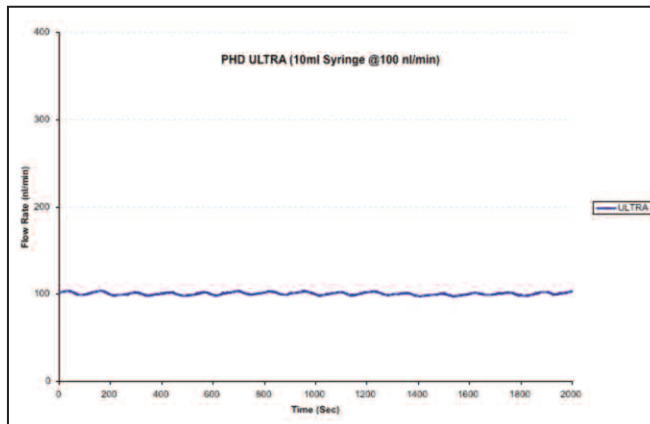
Calibration and Electrospray Ionization

Where precise volume delivery and pulse free flow are required for optimum instrument calibration or solvent elimination, the Pump 11 series has long been the industry standard for manufacturers in OEM configurations and end users. See the Pump 11 Elite on page 11, and Pump 11 Pico Plus Elite systems on page 14.

Additionally, use of the gradient capabilities of the Pump 11 Elite or PHD ULTRA™ Series allows for automated multi-point calibration when performing GLP studies.

MALDI-TOF Matrix Addition

Using the Nanomite with its detachable delivery and electronics allows for easy placement of the syringe over the target to facilitate the dispensing of the appropriate matrix. See the PHD ULTRA™ Nanomite on page 23 or the Pump 11 Elite Nanomite on page 15.



Mass Spectrometry Calibration References

JOURNAL OF THE AMERICAN SOCIETY FOR MASS SPECTROMETRY

Volume 19, Issue 3, March 2008, Pages 332–343

INTERNATIONAL JOURNAL OF MASS SPECTROMETRY

Volume 283, Issues 1–3, 1 June 2009, Pages 161–168

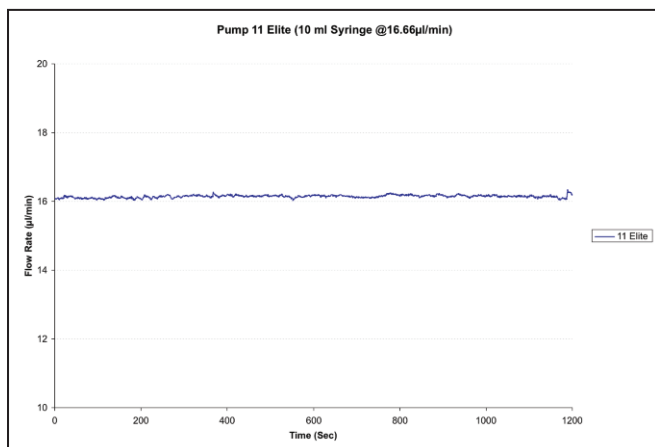
JOURNAL OF MASS SPECTROMETRY

Volume 43, Issue 10, pages 1413–1420, October 2008

Application Selection Guide (continued)

Microfluidics

The PHD ULTRA™ series and Pump 11 Elite series pumps have the performance and flow stability required in micro and nanofluidics. These pumps can be used to mix flow streams and/or create multiple parallel flow streams. Another option is the NanoLeader pressure pump that can push and/or pull fluids using positive or negative air pressure, creating the smoothest flow possible.



Microfluidics References

SENSORS AND ACTUATORS B: CHEMICAL

Volume 140, Issue 1, 18 June 2009, Pages 295-303

PNAS March 4, 2008 vol. 105 no. 9 3191-3196

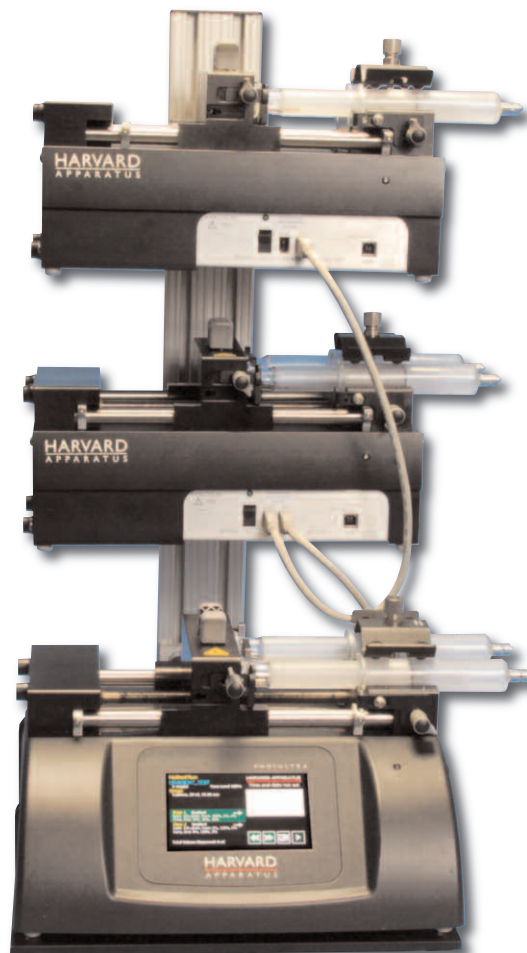
BIOMEDICAL MICRODEVICES

Volume 10, Number 6, 795-805

ANAL. CHEM., 2009, 81 (8), pp 2854-2859

Nano/Micro Liquid Chromatography

The advanced programming capabilities of the PHD ULTRA™ and the Pump 11 Elite Syringe Pumps allow for the easy generation of binary or ternary gradients at flow rates ranging from 100 nL/min to 1.0 mL/min at pressures up to 7,500 PSI. Depending on the number of syringes used, up to one liter of mobile phase may be delivered from each pump used.



NEW Pump 11 Elite



KEY FEATURES

- Easy to use touch screen and icon interface
- Outstanding flow performance
- Easily run simple to complex methods without a PC
- Alphanumeric keypad for easy Method naming and recall
- Adjustable linear force up to 35 lbs
- Upgrade new versions of software remotely
- Legendary reliability – 2 year warranty

APPLICATIONS

- Microfluidics
- Drug/Nutritional Delivery
- Microdialysis
- Emulsification
- Bioreactors
- Electrospinning
- Mass Spectrometry

The Pump 11 Elite Series of syringe pumps expands its capabilities to satisfy your experimental requirements. These compact syringe pumps carry on the tradition as the premier workhorse infusion pump, offering unparalleled ease of use with a high resolution color touch screen with intuitive icon interface. The Pump 11 Elite Series allows you to create, save and run simple to complex methods without a PC.

Superior Performance

These syringe pumps have a new mechanism that includes a tight gripping, more secure syringe clamp for syringes ranging from 0.5ul to 60ml (single syringe) and 0.5ul to 10 ml (dual syringe). The Pump 11 Elite Series offers enhanced flow performance with high accuracy and smooth flow from 1.28 pl/min to 88.28 ml/min (25.99 ml/min for dual syringe rack).

The Pump 11 Elite Series is available in Infusion Only or Infusion/Withdrawal Programmable Models with single or dual syringe racks. All Pump 11 Elite syringe pumps have a footswitch input and USB serial port for computer control. The Infusion/Withdrawal Programmable models also have RS-485 (or optional RJ-11) ports for daisy chaining pumps and Digital I/O for external control via an independent computer or device (see page 13 for more information on connectivity).

Since 1901 Harvard Apparatus has been supporting bioresearch fluidics requirements with a key milestone being the introduction of the first commercial syringe pump for bioresearch in 1956. Since 1956, over 70,000 satisfied syringe pump users around the world have made Harvard Apparatus syringe pumps the worlds #1 choice.

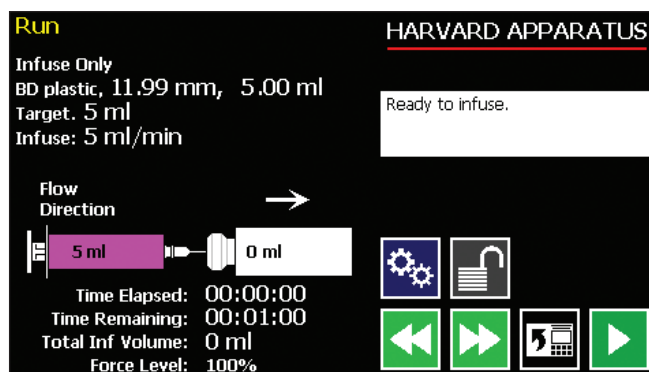
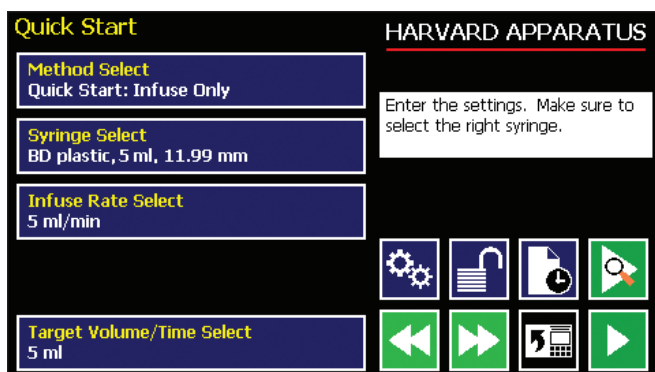
The Pump 11 Elite Series is a family of accurate, low flow syringe pumps designed for use in applications including: mass spec calibration, drug and nutritional studies, reactor dosing, electrospinning and more.

Easy-to-Use Interface

The Pump 11 Elite Syringe Pumps are very easy to use with an LCD color touch screen and icon interface. The Message Area of the touch screen is used to display helpful instructions for the currently displayed screen. It is also used to display error or warning messages to indicate problem conditions in a Method or error conditions during pump operation. The Run Screen shows all of the pump parameters on one screen for easy review.

The software is organized into three main navigational branches, the quick start Methods, user-defined Methods, and system settings. You can control operations directly through the touch screen or remotely from an independent computer or device via the external I/O interface.

NEW Pump 11 Elite (continued)



Pump Models

The Pump 11 Elite Syringe Pumps are available in two configurations designed for different operating environments and varying degrees of operational flexibility.

1. **Infusion Only (single and dual syringe models):** This model supports infusion operations at user-defined flow rates and with selectable target volume or time values to control the total infusion volume. The Infusion Only models do not include programmable, user-defined Methods.
2. **Infusion/Withdrawal Programmable (single and dual syringe models):** This model supports infuse only, withdraw only, infuse/withdraw and withdraw/infuse operations at user-defined flow rates and with selectable target volume or time. This model also allows users to create and store up to two user-defined Methods of 50 steps each on the pump.

Accessories

A full range of accessories are compatible with the Pump 11 Elite including syringe heaters, in-line heaters and coolers, nanofluidic circuits, connectors, tubing, syringes and more.

Program Description

To operate the Pump 11 Elite, the user defines all the required parameters for infusing or withdrawing liquids through a Method. This may be a Quick Start Method, Pre-Programmed or User-Defined Method. The basic operation is a simple 3-step procedure:

1. Select a method
2. Enter operating parameters
3. Preview or Run your method

Quick Start Methods are simple infusions, withdrawals or a combination (depending upon the model). Custom user-defined Methods can be created when more advanced programming is required. The setup for a custom Method is easy using the standard profiles found on all Infusion/Withdrawal Programmable Elite Models. The list of available profiles is:

Constant Rate	Gradient (binary)
Ramp	Autofill

By programming custom (user-defined) Methods into the pump, multi-user errors are reduced. Easily transfer Methods to other pumps and/or download Methods from a PC. Forget having to duplicate Method-development efforts for each new pump added to your system.

Alarms

There are several alarms available on the Model 11 Elite Syringe Pumps:

- End of Run
- Near End of Run
- Power Up
- Stall

Advanced GLP Documentation Features

- Download experimental parameter information to PC
- Alphanumeric keypad for method naming

Adjustable Force

The maximum linear force of the Pump 11 Elite is 16 kg (35 lbs). Depending upon the syringes you are working with and your overall experimental setup you may want to adjust the amount of force applied to the pusher block. You can select a percentage of the total force from 20% to 100%. Refer to the user's manual for suggested force level settings.

CONTROL MULTIPLE PUMPS VIA DAISY CHAIN WITH RS-485

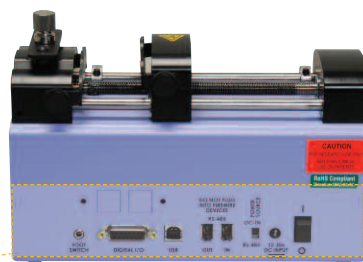


SYRINGE PUMPS

NEW Pump 11 Elite (continued)

Advanced Connectivity

The infusion only Pump Syringe 11 Elite Pumps come standard with a Footswitch input and USB connector. The infusion/withdrawal programmable Pump 11 Elite Syringe Pumps include a Footswitch input, USB, RS-485 and I/O connectors. There is also an option for RJ-11 connectors on the programmable pumps. This option has to be ordered at the time the pump is ordered.



**OPTIONAL
RJ-11
CONNECTORS**
(for pump-to-pump
communication)

**FOOTSWITCH
INPUT**

**USER I/O
CONNECTOR**

**USB SERIAL
INPUT**
(for communication
from PC)

**RS-485
CONNECTORS**
(for pump-to-pump
communication)

**UNIVERSAL
POWER INPUT**

Pump 11 Elite Specifications

TYPE	Microprocessor single or dual syringe, infusion only or infusion/withdrawal programmable
ACCURACY	±0.5%
REPRODUCIBILITY	±0.05%
SYRINGE:	
Type	Plastic or glass
Size (single syringe)	0.5 µl to 50/60 ml
Size (dual syringe)	0.5 µl to 10 ml
FLOW RATE:	
Single Syringe	1.28 pl/min to 88.28 ml/min
Dual Syringe	1.28 pl/min to 25.99 ml/min
DISPLAY	4.3" WQVGA TFT color display with touch screen
CONNECTORS:	
RS-485	IEEE-1394, 6 position
USB	Type B
I/O & TTL	15 pin D-Sub connector
Footswitch	mini phono jack
AVERAGE LINEAR FORCE	16 kg (35 lbs) @ 100% Force Selection
STEP RESOLUTION	0.069 µm/µstep
INPUT POWER	12-30 VDC
INPUT POWER CONNECTION	2.5 mm ID x 5.5 mm 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
DIMENSIONS, H x W x D	22.6 x 17.78 x 15 cm (9 x 7 x 6 in)
WEIGHT	2.1 kg (4.6 lbs)
REGULATORY CERTIFICATIONS	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

FOOTSWITCH INPUT	Start and stop a pump
USB SERIAL INPUT	Control your pump with a computer
RS-485 CONNECTORS	Connect multiple pumps together (daisy chain up to 99 pumps) Connect satellite pumps to the Master pump for binary gradient system (% composition)
RJ-11 CONNECTORS (OPTION)	Connect multiple pumps together (daisy chain)
USER I/O CONNECTOR	
Direction Control Input	Set pump to infuse or withdraw
Trigger Input	Connect an external device to start and stop a pump or Method
Trigger 1 Output	Signal another device to start and stop a pump or Method
Run indicator	Connect an external LED or monitoring device to a pump

Order #	Product
PC1 70-4500	Pump 11 Elite Infusion Only Single Syringe
PC1 70-4501	Pump 11 Elite Infusion Only Dual Syringe
PC1 70-4504	Pump 11 Elite Infusion/Withdrawal Programmable Single Syringe
PC1 70-4505	Pump 11 Elite Infusion/Withdrawal Programmable Dual Syringe

NEW Pump 11 Pico Plus Elite



KEY FEATURES

- Easy to use touch screen and icon interface
- Outstanding flow performance
- Easily run simple to complex methods without a PC
- Alphanumeric keypad for easy Method naming and recall
- Adjustable linear force up to 35 lbs
- Upgrade new versions of software remotely
- Legendary reliability – 2 year warranty

APPLICATIONS

- Microfluidics
- Drug/Nutritional Delivery
- Microdialysis
- HPLC
- Cellular Injections
- Mass Spectrometry

The Pump 11 Pico Plus Elite is the lowest flow, highest accuracy syringe pump. It offers enhanced flow performance with high accuracy and smooth flow from 0.54 pL/min to 11.70 mL/min. This dual syringe pump offers unparalleled ease of use with a high resolution color touch screen with intuitive icon interface. The Pump 11 Pico Plus Elite allows you to create, save and run simple to complex methods without a PC.

The Pump 11 Pico Plus Elite is a dual syringe Infusion/Withdrawal Programmable Model. It has a footswitch input, USB serial port for computer control, RS-485 ports for daisy chaining pumps and Digital I/O for external control via an independent computer or device (see page 13 for more information on connectivity). There is also an option of daisy chaining pumps through the RS-232 (RJ-11) ports. For more information on the Pump 11 Pico Plus Elite including features and programming see the Pump 11 Elite on page 11.

Animal Infusion
Electrospinning
Drug Infusions
Cell Injections
Microfluidics
Dispensing
Emulsion

Pump 11 Pico Plus Elite Specifications

TYPE	Microprocessor dual syringe, infusion/withdrawal programmable
ACCURACY	±0.35%
REPRODUCIBILITY	±0.05%
SYRINGE:	
Type	Plastic or glass
Size Minimum	0.5 µl
Size Maximum	10 ml
FLOW RATE:	
Minimum	0.54 pL/min
Maximum	11.70 mL/min
DISPLAY	4.3" WQVGA TFT color display with touch screen
CONNECTORS:	
RS-485	IEEE-1394, 6 position
USB	Type B
I/O & TTL	15 pin D-Sub connector
Footswitch	Mini phono jack
AVERAGE LINEAR FORCE	16 kg (35 lbs) @ 100% Force Selection
STEP RESOLUTION	0.031 µm/µstep
INPUT POWER	12-30 VDC
INPUT POWER CONNECTION	2.5 mm ID x 5.5 mm 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
DIMENSIONS, H x W x D	22.6 x 17.78 x 15 cm (9 x 7 x 6 in)
WEIGHT	2.1 kg (4.6 lbs)
REGULATORY CERTIFICATIONS	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

Order # Product

PC1 70-4506	Pump 11 Pico Plus Elite Infusion/Withdrawal Programmable Dual Syringe
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NEW Pump 11 Elite Nanomite



KEY FEATURES

- Easy-to-use LCD color touch screen with GUI interface
- Light weight makes it ideal for hand-held or stereotaxic injection
- Easily program simple to complex Methods without a PC
- Create and store up to 2 Methods

APPLICATIONS

- Cellular Injections
- Drug Delivery
- Microinjections
- Hand-Held Automated Delivery
- Stereotaxic Injections
- Regenerative Medicine

The Pump 11 Elite Nanomite is a single syringe infusion/withdrawal programmable syringe pump. This pump allows you to create, save and run simple to complex Methods without a PC. The flow rate range is 3.66 pl/min to 3.818 ml/min with 11 lbs of adjustable force across the entire flow rate range.

The Pump 11 Elite Nanomite has a footswitch input, USB serial port for computer control, RS-485 ports for daisy chaining pumps and Digital I/O for external control via an independent computer or device. There is also an option for daisy chaining pumps through the RS-232 (RJ-11) ports. This option must be ordered at the time the pump is ordered. See page 13 for more information on connectivity.

This pump consists of a control unit, an injection unit, a 6 foot cable to connect the two units and a footswitch. For more information on the Pump 11 Elite Nanomite including features and programming, see the Pump 11 Elite on page 11.

Pump 11 Elite Nanomite Specifications

TYPE	Microprocessor single syringe, infusion/withdrawal programmable
ACCURACY	±0.5%
REPRODUCIBILITY	±0.05%
SYRINGES (MIN./MAX.)	0.5 µl / 1 ml
FLOW RATE:	
Minimum	3.66 pl/min
Maximum	3.818 ml/min
DISPLAY	4.3" WQVGA TFT color display with touch screen
CONNECTORS:	
RS-485	IEEE-1394, 6 position
USB	Type B
I/O & TTL	15 pin D-Sub connector
Footswitch	mini phono jack
AVERAGE LINEAR FORCE	5 kg (11 lbs) @ 100% force selection
STEP RESOLUTION	0.198 µm/µstep
INPUT POWER	12-30 VDC
INPUT POWER CONNECTION	2.5 mm ID x 5.5 mm 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
DIMENSIONS, H x W x D:	
Control Box	22.6 x 17.78 x 9.32 cm (9 x 7 x 3.67 in)
Mechanism	2.5 x 2.0 x 7.5 in (6.35 x 5.08 x 19.05 cm)
WEIGHT	1.96 kg (4.32 lbs)
REGULATORY CERTIFICATIONS	CE, EU RoHS

Order # Product

PC1 70-4507	Pump 11 Elite Nanomite Infusion/Withdrawal Programmable Single Syringe
-------------	--

NEW PHD ULTRA™ Advanced Syringe Pumps



KEY FEATURES

- New patent pending drive mechanism for unmatched smooth flow, accuracy and precision
- For operation at $\mu\text{l}/\text{min}$ to ml/min flow rates
- Easily program simple to complex methods without a PC
- Alphanumeric keypad for easy Method naming and recall
- Real and relative time clocks
- Intuitive touch screen and icon interface
- Vertical or horizontal orientation
- Adjustable linear force to 75 lbs
- Multi-syringe racks for multi-channel operation or large capacity reservoir
- Legendary reliability— 2 year warranty

APPLICATIONS

- Microfluidics
- Drug/Nutritional Delivery
- Electrospraying
- Reaction Chamber Addition
- Mass Spec Calibration
- Feeding Cells
- Low Pressure Chromatography
- Continuous Flow
- Flow Programming
- Gradients
- % Composition Step Changes
- Large Flow Deliveries
- I/O Interactive Experiments



PHD ULTRA™

The PHD ULTRA™ is the solution for your most demanding fluidics applications. This pump represents the latest technology in syringe pumps and was developed utilizing the feedback of the world's largest population of syringe pump users.

The PHD ULTRA™ will change the way you think about syringe pumps. There are three major reasons the PHD ULTRA™ is the new standard for syringe pumps:

1. **NEW Patent pending mechanical drive mechanism and syringe holding mechanics** to achieve the highest performance of any syringe pump.
2. **NEW EZ PRO Software and user interface** allow easy programming of Methods from simple to complex, all without the use of a PC.
 - Preprogrammed Methods for simple to complex operations that allow you to be up and running with the touch of a button.
 - LCD, high resolution color touch screen for powerful functionality, yet very easy to use.
3. **NEW Levels of Versatility**
 - a. Configurations: Standard, push-pull, remote, high pressure, multi-racks.
 - b. Connectivity: For USB or RS-232 computer control; RS-485 or optional RJ-11 for daisy chain (control multiple pumps).
 - c. Orientation: Horizontal or vertical orientation to optimize bench space or to minimize tubing.

Since 1901 Harvard Apparatus has been supporting bioresearch fluidics requirements beginning with the introduction of the first commercial syringe pump for bioresearch in 1956. Since 1956, over 70,000 satisfied syringe pump users around the world have made Harvard Apparatus syringe pumps the world's #1 choice.

The PHD ULTRA™ Syringe Pump series is a family of high-accuracy, easy to use, rugged pumps designed for versatile applications including mass spectrometry calibration, drug and nutritional studies, microdialysis, dispensing, chromatography, LC/HPLC and more.



Highest Accuracy and Precision

The PHD ULTRA™ syringe pump family has a new patent pending fluidics drive mechanism which assures ease of use and high performance, for the smoothest, most accurate flow rates of any syringe pump. Flow rates of 1.56 $\mu\text{l}/\text{min}$ to 215.8 ml/min are accurate within 0.25% and reproducible within 0.05%. A microprocessor-controlled, small step angle stepper motor drives a lead screw and pusher block. Advanced micro-stepping techniques are employed to further reduce the step angle to eliminate flow pulsation.

Maximum Experimental Versatility

This pump can be oriented vertically or horizontally for optimum experimental connectivity. This pump comes standard to hold 2 syringes, but can be purchased with 3 other syringe racks: 6/10 syringe rack, 4 x 140ml syringe rack and 4 x microliter syringe rack. Syringe racks can be ordered separately. Multi-syringe racks provide multi-channel operation or serve as a large capacity reservoir.

- The standard 2-syringe rack holds 2 syringes from 0.5 μl to 140 ml
- The 4 x 140 multi-rack holds four 60 ml or 140 ml plastic syringes only
- 6/10 multi-rack will hold up to 10 syringes from 0.5 μl to 20 ml and up to 6 syringes from 30 ml to 60 ml
- The microliter syringe rack independently holds 4 syringes, from 0.5 μl to 10 ml, enabling syringes of different sizes to run simultaneously.

Easy-to-Use Interface

The PHD ULTRA™ Syringe Pumps are very easy to use with an LCD color touch screen and icon interface. The Message Area of the touch screen is used to display helpful instructions for the currently displayed screen. It is also used to display error or warning messages to indicate problem conditions in a Method or error conditions during pump operation. The Run Screen shows all of the pump parameters on one screen for easy review.

Pump Models

The PHD ULTRA™ Pumps are available in three configurations designed for different operating environments and varying degrees of operational flexibility.

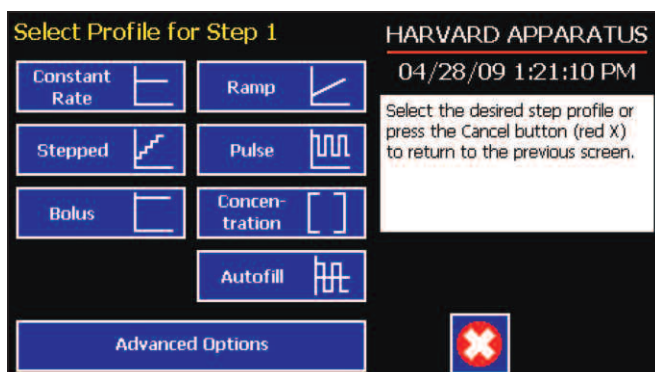
Infusion Only: This model supports infusion operations at user-defined flow rates and with selectable target volume or time values to control the total infusion volume. The Infusion Only models do not include programmable, user-defined Methods.

Infusion/Withdrawal: This model supports infuse only, withdraw only, infuse/withdraw and withdraw/infuse operations at user-defined flow rates and with selectable target volume or time. Users can create and store one Method up to 800 steps.

Infusion/Withdrawal Programmable: This model supports infuse only, withdraw only, infuse/withdraw and withdraw/infuse operations. Users can create and store multiple Methods of up to 800 steps on the pump.



NEW PHD ULTRA™ Advanced Syringe Pumps (continued)



Program Description

To operate the PHD ULTRA™, the user defines all the required parameters for infusing and/or withdrawing liquids through a Method. This may be a Quick Start, Pre-Programmed or User-Defined Method. The basic operation is a simple 3-step procedure:

1. Select a Method
2. Enter operating parameters
3. Preview or Run your Method

Quick Start Methods are for simple infusions, withdrawals or a combination (depending on the pump model). Custom user-defined Methods can be created when a more advanced Method is required. The setup for a custom Method is easy using the standard profiles found on all Infusion/Withdrawal and Infusion/Withdrawal Programmable PHD ULTRA's. The list of available profiles are:

Constant Rate	Bolus	Pulse
Ramp	Concentration	Autofill
Stepped	Gradient	

By programming and saving custom Methods in the pump, multi-user errors are reduced. Easily transfer complex methods to other pumps and/or download methods from a PC. Forget having to duplicate method-development efforts for each new pump added to your system.

In addition to the advanced pumping profiles listed above, the PHD ULTRA™ contains a variety of advanced options allowing the user to repeat steps, link methods, control valves, external triggers etc.

Advanced Programming Features

Flow Programming: Change the flow with time, volume or a triggered event as many times as you like.

Bolus: Inject a large volume of drug (or drugs) at once. The bolus injection can be made in time or volume.

Concentration Delivery: Calibrate flow in concentration units of mg/kg easily so flow is calibrated to concentration of drug and animal weight.

Gradients: EZ PRO software allows you to easily program gradients, continuous or stepped.

% Ratio: Up to three solvents.

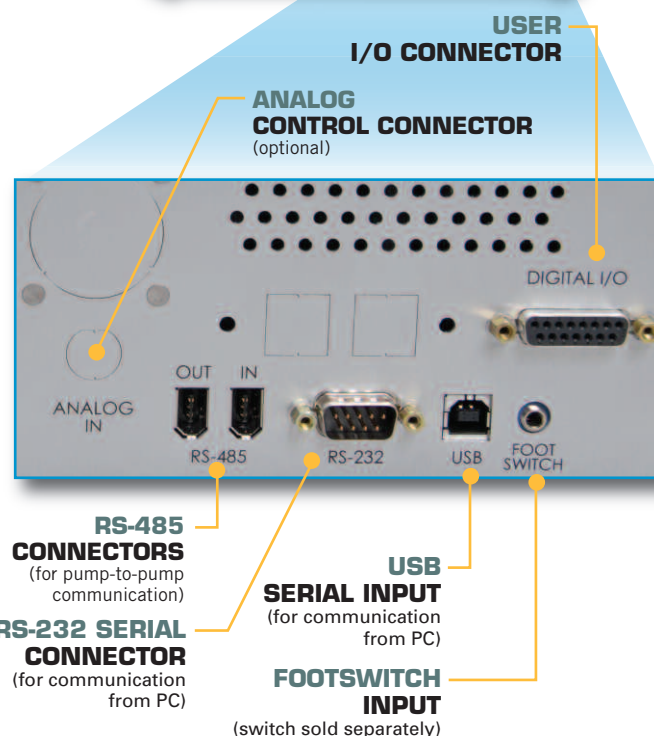
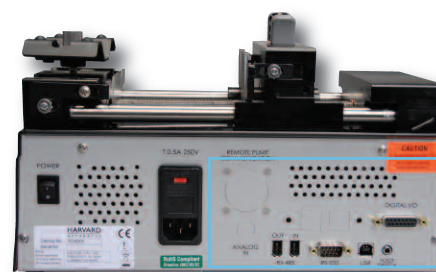
I/O: Dedicated and user defined I/O.

Pulsed Flow: So you can program the pulse easily.

Advanced Connectivity

All PHD ULTRA™ Syringe Pumps come standard with a footswitch, USB, RS-232, RS-485 and I/O connectors. There is also an option for RJ-11 connectors and analog control. These options have to be ordered at the time the pump is ordered.

FOOTSWITCH INPUT	Start and stop a pump
USB AND RS-232 SERIAL INPUTS	Control your pump with a computer
RS-485 CONNECTORS	Connect multiple pumps together (up to 99) Connect remote mechanism Connect satellite pumps to the Master pump for binary or ternary gradient system (% composition)
RJ-11 CONNECTORS (OPTION)	Connect multiple pumps together (daisy chain)
USER I/O CONNECTOR	
Direction Control input	Set pump to infuse or withdraw
Trigger Input	Connect and external device to start or stop a pump or Method
Footswitch Input	Start and stop a pump
Trigger 1 Output	Signal another device to start and stop a pump or Method
Trigger 2 Output	Signal another device to start and stop a pump or Method
Sync Output	Synchronize other devices
Valve Output	External valve control
Run Indicator	Connect an external LED or monitoring device to a pump
ANALOG CONTROL (OPTIONAL)	Analog control of the motor speed (0 to 10 v). This option must be ordered at the same time the pump is ordered.



NEW PHD ULTRA™ Advanced Syringe Pumps (continued)

Alarms

There are several alarms available on the PHD ULTRA™ Syringe Pumps.

End of Run, Near End of Run, Power Up, Stall, Calibration Reminder

You may choose to activate one, activate them all or mute them all.

Advanced GLP Documentation Features

- Download experimental parameters to PC
- Alpha/Numeric capability

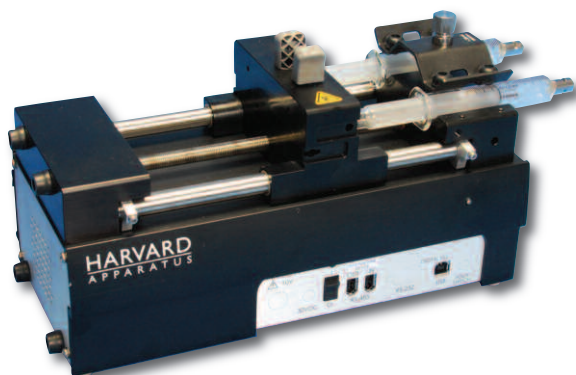
Upgrade

We offer pumps that can be upgraded. If you buy an infusion/withdrawal pump and later decide you want programmability you can upgrade it. You pay a lot less than buying a whole new pump.

Accessories

A full range of accessories are compatible with the PHD ULTRA™ including syringe heaters, in-line heaters and coolers, microfluidic circuits, connectors, tubing, syringes and more.

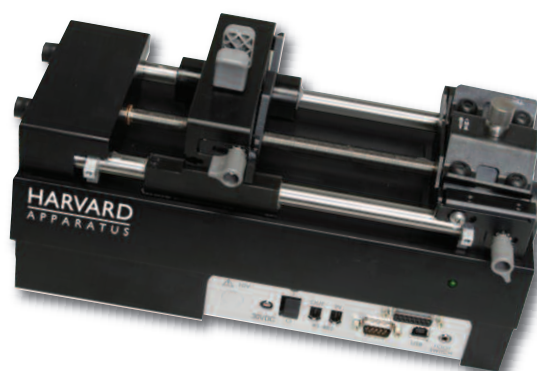
PHD ULTRA™ Satellite Pumps



PHD ULTRA™ Satellite Pumps

The **NEW** PHD ULTRA™ Satellite Pumps are infusion/withdrawal pumps. They are available in three configurations: standard, push/pull and high force. The Satellite Pumps are combined with stand alone PHD ULTRA™ Pumps to create a Gradient System. Satellite Pumps can only be powered from a stand alone PHD ULTRA™ via RS-485. They cannot be controlled with a PC. Satellite Pumps include a footswitch input, USB and RS-485 connectors. See page 20 for part numbers.

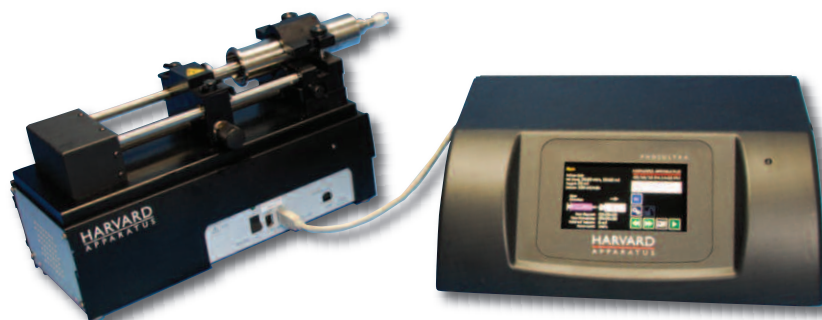
PHD ULTRA™ Syringe Pump Modules



PHD ULTRA™ Syringe Pump Modules

The **NEW** PHD ULTRA™ Syringe Pump Modules are dual syringe infusion/withdrawal pumps. They are available in three configurations: standard, push/pull and high force. These modules include a footswitch input, USB, RS-232, RS-485 and I/O connectors. They can be controlled via PC. You can also start and stop a pump using the 15-pin user I/O connector. See Advanced Connectivity on page 18 for more information. See page 20 for part numbers.

PHD ULTRA™ Remote Pumps



PHD ULTRA™ Remote Pumps

The **NEW** PHD ULTRA™ Remote Pumps consist of a control unit and syringe pumping mechanism all connected via an RS-485 (IEEE-1394) cable. This pump includes a 30 foot RS-485 (IEEE-1394) cable allowing the syringe pumping mechanism and the control box to be separated. Every version of the PHD ULTRA™ is available in a remote model. Use the remote pump in hazardous environments where the researcher is safer when distanced from the material being pumped or for applications where it is necessary to have your pump inside an incubator. See page 20 for part numbers.

NEW PHD ULTRA™ Advanced Syringe Pumps (continued)

PHD ULTRA™ Specifications	
TYPE	Microprocessor multiple syringe, infusion only, infusion/withdrawal or infusion/withdrawal programmable
ACCURACY	±0.25%
REPRODUCIBILITY	±0.05%
SYRINGES:	
Type	Plastic, glass or stainless steel
Size Minimum	0.5 µl
Size Maximum	140 ml
FLOW RATE:	
Minimum	1.56 pl/min
Maximum	215.8 ml/min
DISPLAY	4.3" WQVGA TFT color display with touchscreen
CONNECTORS:	
RS-232	9 pin D-Sub Connector
RS-485	6-position IEEE-1394
USB	Type B
I/O & TTL	15 pin D-Sub connector
Footswitch	Phono jack
LINEAR FORCE	34 kg (75 lbs) @ 100% force selection
STEP RESOLUTION	0.082 µm/step
VOLTAGE RANGE	Universal input 100/240 VAC, 50/60 Hz
DIMENSIONS, H x W x D	10.16 x 30.48 x 21.59 cm (4 x 12 x 8.5 in)
WEIGHT	4.5 kg (10 lbs)
REGULATORY CERTIFICATIONS	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

Product	Order #	Order #	Order #	Order #
PHD ULTRA™ Standard	Stand Alone	Remote	Satellite*	Syringe Pump Module
PHD ULTRA™ Infusion Only	PC1 70-3005	PC1 70-3305	–	–
PHD ULTRA™ Infusion/Withdrawal	PC1 70-3006	PC1 70-3306	PC1 70-3406	PC1 70-3506
PHD ULTRA™ Infusion/Withdrawal Programmable	PC1 70-3007	PC1 70-3307	–	–
PHD ULTRA™ Push/Pull	Stand Alone	Remote	Satellite*	Syringe Pump Module
PHD ULTRA™ Push/Pull Infusion/Withdrawal	PC1 70-3008	PC1 70-3308	PC1 70-3408	PC1 70-3508
PHD ULTRA™ Push/Pull Infusion/Withdrawal Programmable	PC1 70-3009	PC1 70-3309	PC1 70-3410	–
PHD ULTRA™ High Pressure	Stand Alone	Remote	Satellite*	Syringe Pump Module
PHD ULTRA™ 4400 Pump I/W Programmable	PC1 70-3010	PC1 70-3110	PC1 70-3410	PC1 70-3510
PHD ULTRA™ Hpsi Remote Pump I/W Programmable	–	PC1 70-3111	–	–
PHD ULTRA™ Hpsi Remote Pump I/W Programmable with 10 x 140 Rack	–	PC1 70-3112	–	–

*Note: Gradient Systems are available, see page 21 for details.

Order #	Product
PHD ULTRA™ Options	
PC1 70-3030	RS-232 RJ-11 Connectors Option (daisy chain)
PC1 70-3033	Analog Control Input Option (0-10V) ³
PC1 70-3031	Internal Pinch Valve Option ²
PC1 70-3032	Internal 3-Way Isolation Valve Option ²
PC1 70-3034	Internal Fan Option ⁴
PHD ULTRA™ Syringe Rack Kits and Upgrades	
PC1 70-3020	6/10 Multi-Syringe Rack for PHD ULTRA™
PC1 70-3021	4x140 Multi-Syringe Rack for PHD ULTRA™
PC1 70-3022	Microliter Rack, for PHD ULTRA™ holds 4 syringes
PC1 70-3023	Anti-Siphon Kit for PHD ULTRA™
PC1 70-4010	Upgrade Infusion Only to I/W ¹
PC1 70-4011	Upgrade Infusion Only to Programmable ¹
PC1 70-4012	Upgrade I/W to Programmable ¹

¹ Note: Requires Return to Factory

² Note: Only for available for Infusion/Withdrawal or Programmable Models

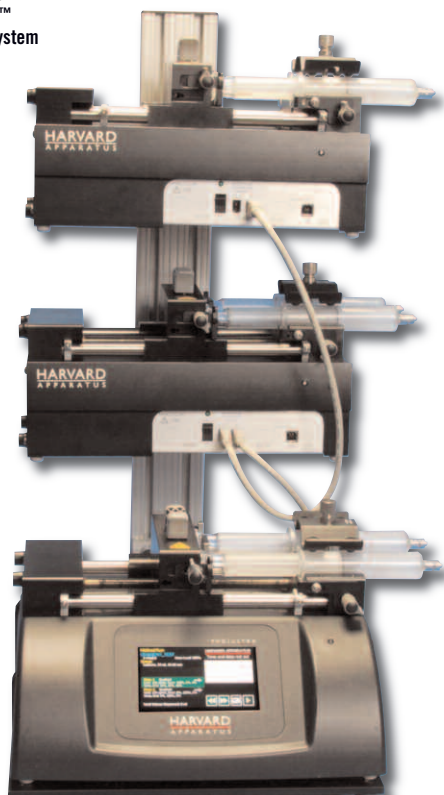
³ Note: Only for Programmable Models. Not available on Satellite Boxes.

⁴ Note: Fan option is required if external operating ambient is expected to be >35°C

Accessories	
PC1 70-4000	RS-485 Cable for Pump-to-Pump Communication, 0.5 m (1.6 ft)
PC1 70-4001	RS-485 Cable for Pump-to-Pump Communication, 2 m (6.6 ft)
PC1 70-4020	RS-485 Extension Cable, 9.1 m (30 ft)
PC1 70-4002	USB Cable for PC-to-Pump Communication, 2 m (6.6 ft)
PC1 70-4003	USB Cable for PC-to-Pump Communication, 5 m (16.4 ft)
PC1 70-4004	RS-232 Cable for PC-to-Pump Communication, 9 pin D-sub, 2 m (6.6 ft)
PC1 70-4005	Adapter, PHD Digital I/O
PC1 70-4006	Adapter, D-sub 15 to Term. Blk
PC1 72-8340	Adapter, USB to Serial
PC1 70-2215	Footswitch (with Phono Plug)
PC1 55-7002	Auto Fill Valve Box, Normal Pressure, 30 psi
PC1 55-7008	Auto Fill Valve Box, High Pressure, 200 psi
PC1 55-7760	Cable Assy, Daisy-chain, Legacy RS-232 RJ-11, 0.6 m (2 ft)
PC1 72-2478	Cable Assy, Daisy-chain, Legacy RS-232 RJ-11, 2.1 m (7 ft)
PC1 55-8000	Adapter for 25 ml, 50 ml, 100 ml Hamilton GasTight™ Syringes

NEW Mixture/Dose Delivery System

PC1 70-4102
PHD ULTRA™
Gradient System
with Stand



KEY FEATURES

- Easily run binary or ternary gradients without a PC
- Combine multiple flow streams into one common output
- No stopping experiment to fill syringes with different mixtures

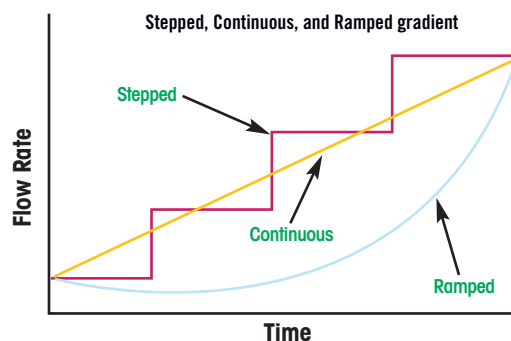
APPLICATIONS

- Serial Dilutions of reaction dosing solutions
- Serial Dilutions for drug infusion experiments
- Serial Dilutions for nutritional infusion experiments
- Serial Dilutions for mixing polymers in electrospinning
- Chromatography
- FIA systems

The PHD ULTRA™ Gradient Systems allows you to quickly and easily run binary or ternary mixtures automatically without a PC. The Method is totally programmed from a master controller pump, so it is easy to program. The intuitive program interface makes simple to complex mixing easy. The Gradient Profile is used to combine multiple flow streams from different pumps into a common output stream. The flow can be smooth and continuous or stepped. No stopping the experiment, mixing different % volume mixtures and placing new syringes into the pumps. Push one button and it all happens automatically.

Binary and ternary gradient systems are available with or without a stand. Individual Satellite units are also available for purchase separately.

For more information on the PHD ULTRA™ Syringe Pumps see page 16. For more information on the PHD ULTRA™ Satellite units see page 19.



Step 1, Gradient

Set Combined Flow Rate 221 ml/min	
Address 00	Set 0 % 25 %
Address 01	Set 25 % 33 %
Address 02	Set 75 % 42 %
Set Time & # Steps 30 second(s) 5 steps	

HARVARD APPARATUS

10/27/09 11:57:15 AM

Enter your total time and number of steps and then press the Enter button (green check mark) to accept or press the Cancel button (red X) to cancel and return to the previous screen.

PHD ULTRA™ Specifications

TYPE	Microprocessor multiple syringe, infusion only, infusion/withdrawal or infusion/withdrawal programmable
ACCURACY	±0.25%
REPRODUCIBILITY	±0.05%
SYRINGES:	
Type	Plastic, glass or stainless steel
Size Minimum	0.5 µl
Size Maximum	140 ml
FLOW RATE:	
Minimum	1.56 pL/min
Maximum	215.8 ml/min
DISPLAY	4.3" WQVGA TFT Color Display with Touchpad
CONNECTORS:	
RS-232	9 pin D-Sub Connector
RS-485	6-position IEEE-1394
USB	Type B
I/O & TTL	15 pin D-Sub Connector
Footswitch	Phono jack
LINEAR FORCE	34 kg (75 lbs) @ 100% force selection
STEP RESOLUTION	0.082 µm/step
VOLTAGE RANGE	Universal input 100/240 VAC, 50/60 Hz
DIMENSIONS, H x W x D	10.16 x 30.48 x 21.59 cm (4 x 12 x 8.5 in)
WEIGHT	4.5 kg (10 lbs)
CERTIFICATIONS	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

Order #	Product
PC1 70-4101	PHD ULTRA™ Gradient System 1 Master/1 Satellite with Stand
PC1 70-4102	PHD ULTRA™ Gradient System 1 Master/2 Satellites with Stand
PC1 70-4106	PHD ULTRA™ Gradient System 1 Master/1 Satellite without Stand
PC1 70-4107	PHD ULTRA™ Gradient System 1 Master/2 Satellites without Stand

SYRINGE PUMPS

NEW PHD ULTRA™ HPSI and PHD ULTRA™ 4400

SYRINGE PUMPS PHD ULTRA™ HPSI and PHD ULTRA™ 4400

PHD ULTRA™ 4400 Stand-Alone



CE

KEY FEATURES

- Delivers >200 lbs (91 kg) linear pumping force across a wide flow rate range
- Accurate and smooth flow
- Ideally suited for stainless steel syringes
- Easy-to-use touch screen and icon interface
- Program simple to complex Methods without a PC
- Legendary reliability – 2 year warranty

PHD ULTRA™ HPSI Remote



CE

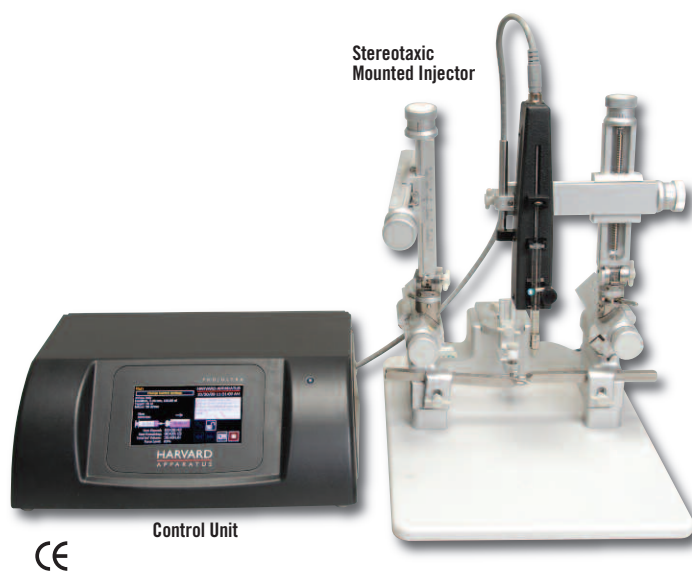
KEY FEATURES

- High capacity – up to 800 ml with four 200 ml syringes
- Ultra high pressure – delivers over 400 lbs of pumping force
- Program simple to complex Methods without a PC
- Built to last – rugged construction for a lifetime of service
- Accepts only Harvard Apparatus' stainless steel syringes
- Legendary reliability – 2 year warranty

Specifications	PHD ULTRA™ 4400 Stand-Alone	PHD ULTRA™ 4400 Remote	PHD ULTRA™ HPSI Remote
TYPE	Microprocessor single syringe infusion/withdrawal programmable	Microprocessor single syringe infusion/withdrawal programmable	Microprocessor multiple syringe infusion/withdrawal programmable
ACCURACY	±0.35%	±0.35%	±0.50%
REPRODUCIBILITY	±0.05%	±0.05%	±0.05%
SYRINGES (MIN./MAX.)	0.5 µl to 140 ml	0.5 µl to 140 ml	20 ml to 200 ml (stainless steel only)
FLOW RATE:			
Minimum	3.06 µl/min	3.06 µl/min	50.70 nl/min
Maximum	215.8 ml/min	215.8 ml/min	144.1 ml/min
CONNECTORS:			
RS-232	9 pin D-Sub Connector	9 pin D-Sub Connector	9 pin D-Sub Connector
RS-485	IEEE-1394, 6 pos	IEEE-1394, 6 pos	IEEE-1394, 6 pos
USB	Type B	Type B	Type B
I/O & TTL	15 pin D-Sub Connector	15 pin D-Sub Connector	15 pin D-Sub Connector
AVERAGE LINEAR FORCE	91 kg (200 lbs) @ 100% Force Selection 1.8° Stepper Motor	91 kg (200 lbs) @ 100% Force Selection 1.8° Stepper Motor	197 kg (433 lbs) @ 100% Force Selection 1.8° Stepper Motor
VOLTAGE RANGE	100-240 VAC: 50/60 Hz, 50 W, 0.5 A fuse	100-240 VAC: 50/60 Hz, 75 W, 0.5 A fuse	100-240 VAC: 50/60 Hz, 75 W, 0.5 A fuse
DIMENSIONS, H x W x D:			
Control Box	30.48 x 21.59 x 18.4 cm (12 x 8.5 x 7.25 in)	30.5 x 21.6 x 10.8 cm (12 x 8.5 x 4.25 in)	30.48 x 21.59 x 10.8 cm (12 x 8.5 x 4.25 in)
Remote Box	N/A	27.9 x 13.5 x 18.4 cm (11.0 x 5.3 x 7.25 in)	40.64 x 30.48 x 19.69 cm (16 x 12 x 7.75 in)
WEIGHT	5.5 kg (12.1 lb)	6.4 kg (14.1 lb)	13.7 kg (30.2 lb)
Order #	PC1 70-3010	PC1 70-3110	PC1 70-3111

SYRINGE PUMPS

NEW PHD ULTRA™ Nanomite



KEY FEATURES

- Light weight makes it ideal for hand-held or stereotaxic injection
- Easy-to-use LCD color touch screen with GUI interface
- Create and store >50 programs for
- High performance in a small package
- 1000 times better than manual syringes

APPLICATIONS

- Cellular Injections
- Drug Delivery
- Microinjections
- Hand-Held Automated Delivery
- Stereotaxic Injections
- Regenerative Medicine

The PHD ULTRA™ Nanomite is a single syringe infusion/withdrawal programmable syringe pump. This pump allows you to create, save and run simple to complex Methods without a PC. The flow rate range is 3.66 pl/min to 3.818 ml/min with 11 lbs of adjustable force across the entire flow rate range.

The PHD ULTRA™ Nanomite has a footswitch input, RS-232 and USB serial ports for computer control, RS-485 ports for daisy chaining pumps and Digital I/O for external control via an independent computer or device. There is also an option for daisy chaining pumps through the RS-232 (RJ-11) ports. This option must be ordered at the time the pump is ordered. See page 18 for more information on connectivity.

This pump consists of a control unit, an injection unit, a 6 foot cable to connect the two units and a footswitch.

For more information on the PHD ULTRA™ Nanomite including features and programming see the PHD ULTRA™ on page 16.

PHD ULTRA™ Nanomite Specifications

TYPE	Microprocessor single syringe Infusion/Withdrawal Programmable
ACCURACY	±0.5%
REPRODUCIBILITY	±0.05%
SYRINGES:	
Type	Glass or plastic
Size Minimum	0.5 µl
Size Maximum	1 ml
FLOW RATE:	
Minimum	3.66 pl/min
Maximum	3.818 ml/min
DISPLAY	4.3" WQVGA TFT color display with touchscreen
CONNECTORS:	
RS-232	9 pin D-Sub connector
RS-485	IEEE-1394, 6 position
USB	Type B
I/O & TTL	15 pin D-Sub connector
Footswitch	Mini phono jack
AVERAGE LINEAR FORCE	5 kg (11 lbs) @ 100% force selection
STEP RESOLUTION	0.198 µm/µstep
VOLTAGE RANGE	100-240 VAC, 50/60 Hz, 75 W, 0.5 A fuse
DIMENSIONS H x W x D:	
Control Box	30.5 x 21.6 x 11.1 cm (12.0 x 8.5 x 4.38 in)
Injector Unit	6.35 x 5.08 x 19.05 cm (2.5 x 2.0 x 7.5 in)
WEIGHT:	
Control Box	2.06 kg (4.55 lbs)
Injector Unit	0.458 kg (1.01 lbs)
REGULATORY CERTIFICATIONS	CE, EU RoHS

Order #	Product
PC1 70-3601	PHD ULTRA™ Nanomite Infusion/Withdrawal Programmable Single Syringe

NEW NanoCool™ Injector



KEY FEATURES

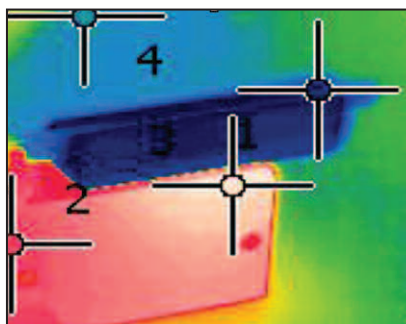
- 18°C for optimal cell viability on any delivery syringe and eppendorf
- 20% Increase in Survivability, 76% Lower O₂ Consumption Rate at 18°C vs. 37°C
- Flow ramping to reduce injection site blowback
- Programmed methods for automatic recall of entire cell delivery system. Up to 100 methods stored for recall
- 2 year warranty
- High accuracy delivery between 367.4 pl/min to 1.906 ml/min
- Preprogrammed bolus injection mode, just specify injection size and time of dispense
- Footswitch activation keeps hands free

NanoCool™ Cell Delivery System

When injecting stem cells viability of cells can be a major issue. The Harvard Apparatus NanoCool is the only cooled cell injection system with optional cooled and oxygenated vortex mixer. The injection system and sample vortex holder are held at 18°C. The cell delivery is totally integrated in its operation through the NanoCool's microprocessor system: power, temperature injection volumes and flow ramping are all controlled by the NanoCool's program. Keeping the cells at 18°C instead of 37°C reduces O₂ consumption of cells by an average of 76%. The chart to the right shows the different organ utilization curves.

Temperature Effect on O₂ Consumption by Organ Cell Type

Organ	Temperature	Oxygen Consumption	Change in O ₂ Consumption	% Change
Kidney	37 to 18	3.7 to 0.9	2.8	75.7
Liver	37 to 18	3.0 to 0.6	2.4	80
Heart	37 to 18	2.4 to 0.7	1.7	70.8
Brain	37 to 18	1.9 to 0.4	1.5	78.9
Muscle	37 to 18	0.8 to 0.2	0.6	75
Skin	37 to 18	0.4 to 0.1	0.3	75



IR Temperature Image
NanoCool at 18°C

NanoCool™ Injector Specifications

ACCURACY	±0.5%
REPRODUCIBILITY	±0.05%
SYRINGES (MIN./MAX.)	50 µl / 500 µl
FLOW RATE:	
Minimum	367.4 pl/min
Maximum	1.906 ml/min
INJECTOR HEAD/ACTUATOR, L x H x W	20.3 x 5.1 x 5.1 cm (8 x 2 x 2 in)

Order #	Product
PC1 70-3040	NanoCool™ Injector

Pump 11 Plus



KEY FEATURES

- Small footprint
- RS-232 option for computer control
- Legendary reliability – 2 year warranty

APPLICATIONS

- Drug/Nutritional Delivery
- Microfluidics/Nanofluidics
- Electrospraying
- Mass Spec Calibration
- Microdialysis

Pump 11 Plus

Harvard Apparatus' Pump 11 Plus is a high performance smooth flow syringe pump at a basic syringe pump price!

Bright Display and Easy-To-Use Interface

A two-line 16 character vacuum fluorescent display and six membrane keypad make this a powerful, easy-to-use syringe pump. Only two entries are required to start pumping; syringe Inside Diameter (mm) and flow rate. The flow rate can be changed while the pump is running.

Two Modes of Operation, Constant Flow Rate & Volume Dispense

The Pump 11 Plus will operate continuously in RATE mode or accurately dispense a specific amount of fluid in VOLUME mode.

Versatile

Select from two different models, Infusion Only or Infusion/Withdrawal. Both models are available with either a single syringe or dual syringe configuration.

Pump 11 Plus Specifications

TYPE	Microprocessor single or dual syringe, infusion only or infusion/withdrawal
ACCURACY	±0.5%
REPRODUCIBILITY	±0.1%
SYRINGE:	
Type	Plastic or glass
Size (single syringe)	0.5 µl to 50/60 ml
Size (dual syringe)	0.5 µl to 10 ml
FLOW RATE:	
Single Syringe	0.0014 µl/hr to 26.56 ml/min
Dual Syringe	0.0014 µl/hr to 7.91 ml/min
CONNECTORS:	
RS-232	Advanced models only
TTL	No
AVERAGE LINEAR FORCE	7.27 kg (16 lbs)
STEP RESOLUTION	0.33 µm/step
VOLTAGE RANGE (POWER SUPPLY)	Universal input 100/240 VAC, 50/60 Hz, 18 watts (Use only Harvard Apparatus approved supply and line cord)
DIMENSIONS, H x W x D	13 x 22.9 x 11.4 cm (5 x 9 x 4.5 in)
WEIGHT	2.1 kg (4.6 lb)

Order #	Product
PC1 70-2208	Pump 11 Plus Infusion Only Single Syringe
PC1 70-2209	Pump 11 Plus Infusion Only Dual Syringe
PC1 70-2211	Pump 11 Plus Advanced Infusion/Withdrawal Single Syringe with Dual RS-232
PC1 70-2212	Pump 11 Plus Advanced Infusion/Withdrawal Dual Syringe with Dual RS-232

References

- Miguéns, M., et al., *Glutamate and aspartate levels in the nucleus accumbens during cocaine self-administration and extinction: a time course microdialysis study*, *Psychopharmacology*, 2008, Vol. 196, 303–313
- Russom, A., et al., *Microfluidic Leukocyte Isolation for Gene Expression Analysis in Critically Ill Hospitalized Patients*, *Clinical Chemistry*, 2008, Vol. 54:5, 891–900
- Choi, S. and Park, J., *Microfluidic system for dielectrophoretic separation based on a trapezoidal electrode array*, *Lab on a Chip*, 2005, Vol. 5, 1161–1167
- Tan, YC., Li Ho, Y., and Phillip, A., *Microfluidic sorting of droplets by size*, *Microfluid Nanofluid*, 2008, Vol. 4, 343–348
- Cucchiaro, G., Chajale, N., and Commons, K.G., *The locus coeruleus nucleus as a site of action of the antinociceptive and behavioral effects of the nicotinic receptor agonist, epibatidine*, *Neuropharmacology*, 2006, Vol. 50, 769–776

Pump 22 and Physio 22 Multiple Syringe Pumps



KEY FEATURES

- Smooth and accurate flow
- Easy to use
- Versatile with wide flow rate range
- Multi-syringe racks for large reservoir capacity
- Legendary reliability – 2 year warranty

APPLICATIONS

- Drug/Nutritional Delivery
- Fluid Sampling
- Mass Spectrometry

Pump 22

The Harvard 22 Syringe Pump is the pump that set the industry standard! It is the world's most popular syringe pump. Harvard Apparatus' long-standing tradition of providing rugged and reliable products is the foundation upon which this pump was built.

- The standard 2-syringe rack holds 2 syringes from 0.5 μ l to 140 ml
- The 4 x 140 multi-rack holds four 60 ml or 140 ml plastic syringes only
- 6/10 multi-rack will hold up to 10 syringes from 0.5 μ l to 20 ml and up to 6 syringes from 30 ml to 60 ml
- The microliter syringe rack independently holds 4 microliter syringes, from 0.5 μ l to 10 ml, enabling syringes of different sizes to run simultaneously.

This pump features an LED display and numeric keypad for easy entry of syringe diameter data and flow rates. Flow rate units can be set in μ l/hr, μ l/min, ml/hr and ml/min. An optical encoder monitors leadscrew rotation to accurately maintain any flow rate. The run LED flashes when syringe plunger movement stops unexpectedly. A complete line of accessories for the Pump 22 are available including a footswitch, audible alarm, reversing switch and serial cables, see page 42.

The Pump 22 can be controlled using RS-232 (serial) commands. Multiple syringe pumps can be interconnected by daisy chaining pumps. Up to 100 pumps can be addressed independently using internal reference addresses from 0 to 99. The default setting is 0. A set of sample programs, using the basic programming language, is included with each pump.

PHYSIO 22

The PHYSIO 22 Pump delivers high accuracy, pulseless flow with no electrical noise to interfere with the sensor signal while performing physiological analyses. This specialty pump is based on our legendary

Syringe Pump 22, but with a special transformer designed for minimum RFI (Radio Frequency Interference). This new transformer cuts electrical noise so that it is almost non-existent. With the PHYSIO 22, even the most sensitive sensors will not show a noise spike.

Pump 22 & Physio 22 Specifications

TYPE	Microprocessor multiple syringe, infusion only or infusion/withdrawal
ACCURACY	$\pm 0.35\%$
REPRODUCIBILITY	$\pm 0.05\%$
SYRINGE:	
Type	Plastic, glass or stainless steel
Size Minimum	0.5 μ l
Size Maximum	140 ml
FLOW RATE:	
Minimum	0.002 μ l/hr
Maximum	55.1 ml/min
CONNECTORS:	
RS-232	25-pin connector
TTL	Shared port with RS-232
AVERAGE LINEAR FORCE	21.36 (47 lbs)
STEP RESOLUTION	0.33 μ m/step
VOLTAGE RANGE	95 to 130 VAC, 60 Hz; 220 to 260 VAC, 50 Hz, selectable
DIMENSIONS, H x W x D	28 x 22.2 x 14 cm (11 x 8.75 x 5.5 in)
WEIGHT	4.5 kg (10 lb)

Order #	Product
PC1 55-2222	Pump 22 Infusion Only with Standard 2-Syringe Rack
PC1 55-2275	Pump 22 Infusion Only with Anti-Siphon Standard 2-Syringe Rack*
PC1 55-5920	Pump 22 Infusion Only with 6/10 Multi-Syringe Rack
PC1 55-2314	Pump 22 Infusion Only with 4 x 140 Multi-Syringe Rack
PC1 55-4150	Pump 22 Infusion Only with Microliter Rack
PC1 55-2226	Pump 22 Infusion/Withdrawal with Standard 2-Syringe Rack
PC1 55-2219	Pump 22 Infusion/Withdrawal with 6/10 Multi-Syringe Rack
PC1 55-2316	Pump 22 Infusion/Withdrawal with 4 x 140 Multi-Syringe Rack
PC1 55-4153	Pump 22 Infusion/Withdrawal with Microliter Rack
PC1 70-2222	PHYSIO 22 Infusion Only with Standard 2-Syringe Rack
PC1 70-2223	PHYSIO 22 Infusion Only with 6/10 Multi-Syringe Rack

* Note: Anti-Siphon syringe holder secures syringe plunger to pusher block to prevent unintended loss of fluid

References

- Svoboda, K., et al., *Conformation and elasticity of the isolated red blood cell membrane skeleton*, Biophys. J., 1992, Vol 63, 784-793.
- Jang, I.K., *Differential Sensitivity of Erythrocyte-Rich and Platelet-Rich Arterial Thrombi to Lysis With Recombinant Tissue-Type Plasminogen Activator: A Possible Explanation for Resistance to Coronary Thrombolysis*, Circulation, 1989, Vol. 79, 920-928.
- Gao, J., et al., *Integrated Microfluidic System Enabling Protein Digestion, Peptide Separation, and Protein Identification*, Anal. Chem., 2001, Vol. 73, 2648-2655
- Jayawickrama, D.A., Wolters, A.M. and Sweedler, J.V., *Mobile phase compensation to improve NMR spectral properties during solvent gradients*, Analyst, 2003, Vol. 128, 421-426
- Hiramatsu, M., et al., *Reversion of muscarinic autoreceptor agonist-induced acetylcholine decrease and learning impairment by dynorphin A (1-13), an endogenous k-opioid receptor agonist*, British Journal of Pharmacology, 1998, Vol. 123, 920-926

SYRINGE PUMPS

Pump 33 Dual Syringe Pump



KEY FEATURES

- Two independent pumping channels
- 2 syringes can run in the same or opposite direction, simultaneously
- Program different flow rates for each syringe
- Legendary reliability – 2 year warranty

BENEFITS

- Bulk Fluid Injections
- Drug Delivery
- Fluid Sampling
- Gradients
- Continuous Infusion

The Harvard 33 Dual Syringe Pump is a breakthrough in pumping technology. The 33 has two independent pumping channels linked through hardware and software. When combined with a valve box (page 42), it provides the continuous delivery of a peristaltic or piston pump with the accuracy, absence of pulsation and low flow rates of a syringe pump.

Several modes of operation are available to accommodate a range of setups and experimental protocols. A unique movable limit switch mechanism is used to change direction or stop operation of the pump depending on the mode of operation.

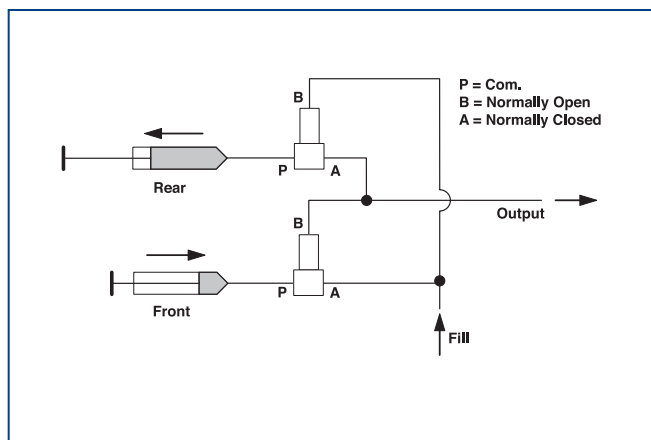
Reciprocal/Parallel Mode - Syringe mechanisms can run in the same or opposite directions (i.e. both infusing or withdrawing at the same time or one infusing and the other withdrawing)

Proportional Mode - Different flow rates and syringe diameters can be set for each syringe mechanism

AutoStop Mode - Pump stops operation when a limit switch is activated.

Continuous Run Mode - When a limit switch is activated each syringe mechanism reverses direction.

This pump has high pressure capability, TTL and RS-232 interface for data acquisition and computer control. The communication ports enable daisy-chaining of up to 100 pumps.



Pump 33 Specifications

TYPE	Microprocessor dual drive, single syringe, infusion/withdrawal
ACCURACY	±0.35%
REPRODUCIBILITY	±0.1%
SYRINGE:	
Type	Plastic, glass or stainless steel
Size Minimum	0.5 µl
Size Maximum	140 ml
FLOW RATE:	
Minimum	0.0004 µl/hr
Maximum	106.6 ml/min
CONNECTORS:	
RS-232	RJ11-4 conductor
TTL	9-pin connector
AVERAGE LINEAR FORCE	57 lbs
STEP RESOLUTION	0.33 µm/step
VOLTAGE RANGE	95 to 130 VAC, 60 Hz; 220 to 260 VAC, 50 Hz, selectable
DIMENSIONS, H x W x D	15.2 x 31.1 x 28.6 cm (6 x 12.5 x 11.25 in)
WEIGHT	6.8 kg (15 lb)

Order # Product

PC1 55-3333 Pump 33 Infusion/Withdrawal Dual Syringe

References

- Chen, D., Wendt, C.H. and Pui, Y.H.D., A novel approach for introducing bio-materials into cells, *Journal of Nanoparticle Research*, 2000, Vol 2, 133–139
- Cabral, P., et al., Oxygen transport by low and normal oxygen affinity hemoglobin vesicles in extreme hemodilution, *Am. J. Physiol. Heart Circ. Physiol.*, 2005, Vol. 288, H1885–H1892.
- Lee, S.H., et al., A polymer lab-on-a-chip for reverse transcription (RT)-PCR based point-of-care clinical diagnostics, *Lab on a Chip*, 2008, Vol. 8, 2121–2127

PHD 22/2000 MRI Compatible Syringe Pump



Control Box

Syringe Holder



KEY FEATURES

- High accuracy and precision
- Can be placed near an imaging magnet
- Holds 0.5 μ l to 140 ml glass or plastic syringes
- Legendary reliability – 2 year warranty

BENEFITS

- Injecting Anesthesia
- Drug Delivery
- Injecting Dyes

The MRI Compatible Pump is based on the design of one of our most tried and trusted syringe pumps. The PHD 22/2000. This pump is made of mostly non-magnetic materials and can be placed near to an imaging magnet when it is in use! **The control box should be positioned at least 5 feet away from the opening of the magnet and not in direct line of the opening.** The exact distance is dependent upon the strength of the magnet. This will now make drug or dye perfusions possible while the magnet is on. This pump is a remote model where the syringe pumping mechanism is separated from the control box by a 30 foot cable. This allows the pump to be started and stopped near the magnet, via a RUN/STOP switch that was added to the syringe holder. If additional space is required between the control box and pumping mechanism, a 60 foot cable is also available. For more details on the PHD 22/2000 Pump Line, see pages 29 to 30.

Program Description

The programming functions of this pump provide powerful capabilities for advanced experiments. While in program mode this pump can perform the following tasks at a predetermined time or when prompted by a signal from an external device:

- Start or stop pumping
- Change pumping direction (infusion/withdrawal)
- Change flow rates
- Pump a precise volume and stop
- Pause operation
- Ramp up or down flow rates

In program mode the above tasks can be linked together into powerful programs to simplify your automation projects.

PHD 22/2000 Specifications

TYPE	Microprocessor dual syringe, infusion/withdrawal or infusion/withdrawal programmable
ACCURACY	$\pm 0.35\%$
REPRODUCIBILITY	$\pm 0.05\%$
SYRINGE:	
Type	Plastic or glass
Size Minimum	0.5 μ l
Size Maximum	140 ml
FLOW RATE:	
Minimum	0.0001 μ l/hr
Maximum	220.82 ml/min
CONNECTORS:	
RS-232	RJ11-4 conductor
TTL	9 pin D-Sub. Connector
AVERAGE LINEAR FORCE	50 lbs
STEP RESOLUTION	0.082 μ m/step
VOLTAGE RANGE	Universal input 100/240 VAC, 50/60 Hz
CABLE LENGTH	9.1 m (30 ft)
DIMENSIONS, H x W x D:	
Control Box	9.5 x 27.9 x 22.9 cm (3.75 x 11 x 9 in)
Syringe Holder	22.9 x 43.2 x 30.5 cm (9 x 17 x 12 in)

Order # Product

PC1 70-2130	PHD 22/2000 MRI Compatible Remote Infusion/Withdrawal Dual Syringe
PC1 70-2131	PHD 22/2000 MRI Compatible Remote Infusion/Withdrawal Programmable Dual Syringe

PHD 22/2000 Advanced Syringe Pumps

PHD 22/2000
Infusion/Withdrawal
with Standard
2-Syringe-Rack



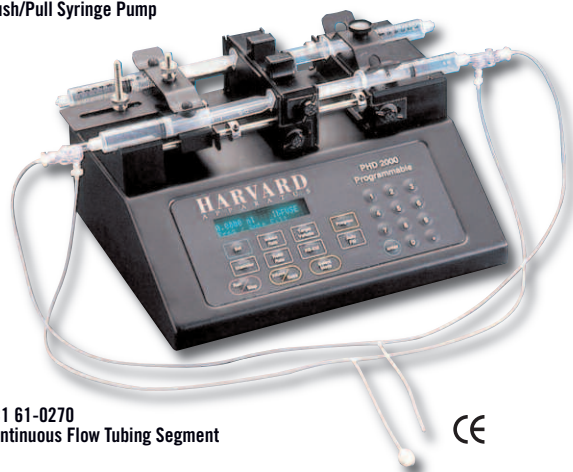
PHD 22/2000
Infusion Only
with Standard
2-Syringe Rack



PHD 22/2000
Infusion/Withdrawal
with 6/10 Multi-Rack



PHD 22/2000
Push/Pull Syringe Pump



PC1 61-0270
Continuous Flow Tubing Segment



KEY FEATURES

- High accuracy and precision
- Multiple configuration available
- Smooth flow over a wide flow rate range
- Multi-syringe racks for large capacity reservoir
- Legendary reliability – 2 year warranty

APPLICATIONS

- Drug/Nutritional Delivery
- Electrospraying
- Microfluidics/Nanofluidics
- Mass Spec Calibration

Over forty years ago Harvard Apparatus perfected the leadscrew principle and created the first syringe pump. Since that time, tens of thousands of Harvard Apparatus pumps have earned a reputation as the most reliable research pumps in every major laboratory in the World. The PHD 22/2000 syringe pump series gives you the lowest flow rates, the highest accuracy, the smoothest flow, advanced programmability from the keypad and yet, is very easy to use. It is also incredibly quiet so it won't disturb your experimental subjects.

Configurations

This pump is available as a **standard, push/pull, remote, high pressure, or with multi-racks.**

Upgrade

We offer pumps that can be upgraded. If you buy an infusion/withdrawal pump and later decide you want programmability you can upgrade it, see page 30.

PHD 22/2000 Specifications

TYPE	Microprocessor, multiple syringe, infusion only, infusion/withdrawal or infusion/withdrawal programmable
ACCURACY	±0.35%
REPRODUCIBILITY	±0.05%
SYRINGE:	
Type	Plastic, glass or stainless steel
Size Minimum	0.5 µl
Size Maximum	140 ml (30 ml for push/pull models)*
FLOW RATE:	
Minimum	0.0001 µl/hr
Maximum	220.82 ml/min
NON VOLATILE MEMORY	Stores all settings
CONNECTORS:	
RS-232	RJ11-4 conductor
TTL	9 pin D-Sub Connector
AVERAGE LINEAR FORCE:	
Standard	50 lbs
High Pressure	66 lbs
POWER	65 W, 0.5 A fuse
VOLTAGE RANGE	Universal input 100/240 VAC; 50/60 Hz
CABLE LENGTH	9.1 m (30 ft) for remote models only
DIMENSIONS, H x W x D	15.9 x 22.8 x 27.9 cm (6.3 x 9 x 11 in)
WEIGHT	4.5 kg (10 lb)

*Push/Pull pump can hold syringes up to 140 ml if full stroke is not required. Larger syringes will not fully infuse or withdraw.

References

- Mazutis, L., et al., *Droplet-Based Microfluidic Systems for High-Throughput Single DNA Molecule Isothermal Amplification and Analysis*, *Anal. Chem.*, 2009, Vol. 81, 4813-4821
- Yeoma, J., et al., *Microfabrication and characterization of a silicon-based millimeter scale, PEM fuel cell operating with hydrogen, methanol, or formic acid*, *Sensors and Actuators*, 2005, Vol. B107, 882-891.
- Guillot, P., et al., *Towards a continuous microfluidic rheometer*, *Microfluid Nanofluid*, 2008, Vol. 5, 619-630.
- Utada, A.S., et al., *Monodisperse Double Emulsions Generated from a Microcapillary Device*, *Science*, 2005, Vol. 308, 537.
- Liu Tsang, V., et al., *Fabrication of 3D hepatic tissues by additive photopatterning of cellular hydrogels*, *FASEB Journal*, 2007, Vol. 21, 790-801.

PHD 22/2000 Advanced Syringe Pumps

(continued)

PHD 22/2000 Syringe Pumps						
	Infusion Only*		Infusion/Withdrawal		Programmable	
SYRINGE PUMP VERSIONS	Standard Force	High Force	Standard Force	High Force	Standard Force	High Force
Standard Syringe Pumps						
STANDARD 2-SYRINGE	PC1 70-2000	PC1 71-2000	PC1 70-2001	PC1 71-2001	PC1 70-2002	PC1 71-2002
6/10 MULTI-RACK	PC1 70-2003	PC1 71-2003	PC1 70-2006	PC1 71-2006	PC1 70-2009	PC1 71-2009
4 X 140 MULTI-RACK	PC1 70-2004	PC1 71-2004	PC1 70-2007	PC1 71-2007	PC1 70-2010	PC1 71-2010
MICROLITER RACK	PC1 70-2005	PC1 71-2005	PC1 70-2008	PC1 71-2008	PC1 70-2011	PC1 71-2011
Remote Syringe Pumps						
STANDARD 2 SYRINGE	PC1 70-2100	PC1 71-2100	PC1 70-2101	PC1 71-2101	PC1 70-2102	PC1 71-2102
6/10 MULTI-RACK	PC1 70-2103	PC1 71-2103	PC1 70-2106	PC1 71-2106	PC1 70-2109	PC1 71-2109
4 X 140 MULTI-RACK	PC1 70-2104	PC1 71-2104	PC1 70-2107	PC1 71-2107	PC1 70-2110	PC1 71-2110
MICROLITER RACK	PC1 70-2105	PC1 71-2105	PC1 70-2108	PC1 71-2108	PC1 70-2111	PC1 71-2111
Push/Pull Syringe Pumps						
STANDARD	–	–	PC1 70-2020	PC1 71-2020	PC1 70-2019	PC1 71-2019
REMOTE	–	–	PC1 70-2120	PC1 71-2120	PC1 70-2119	PC1 71-2119

*Infusion Only models do not include an anti-siphon bracket or a retaining bracket. These can be ordered as a special.

Harvard PHD 22/2000 Pump Series Kits & Upgrades

ORDER #	PRODUCT
Syringe Rack Kits ¹	
PC1 70-2012	PHD 22/2000 6/10 Multi Syringe Rack
PC1 70-2013	PHD 22/2000 4 x 140 Multi Syringe Rack
PC1 70-2014	PHD 22/2000 Microliter Multi Syringe Rack
PC1 70-2015	PHD 22/2000 Anti-Siphon Kit (Infusion Only Pump)
Upgrades ²	
PC1 70-2016	PHD 22/2000 Infusion Only to Infusion/Withdrawal
PC1 70-2017	PHD 22/2000 Infusion/Withdrawal to Programmable
PC1 70-2018	PHD 22/2000 Infusion Only to Programmable

¹ These multiple syringe racks will fit any PHD 22/2000 series syringe pump listed above and are easily interchangeable.

² Upgrades are available for Infusion Only and Infusion/Withdrawal models of PHD 22/2000 series pumps. All upgrades must be factory installed.

Remote Extension Cables

Replacement cables for PHD 22/2000 remote syringe pumps including the PHD 22/2000 Hpsi, see page 31, are available in 5ft and 30ft lengths. These cables can also be used to increase or decrease the distance between the syringe pumping mechanism and the control box.

Order #	Product
PC1 72-0199	Remote Extension Cable, 1.5 m (5 ft)
PC1 72-1405	Remote Extension Cable, 9.1 m (30 ft)

Continuous Flow Tubing Segment

This continuous flow tubing segment is used with the PHD 22/2000 Push/Pull Syringe Pump. When used with the programmable model it makes continuous 24/7 flow possible.

Tubing Segment Specifications	
TUBING	0.062 in. ID Tygon® tubing
TUBING LENGTH	3 x 112 in. sections
MAX. PRESSURE	15 p.s.i.
VALVE MATERIALS	Polycarbonate, silicone

Order #	Product
PC1 61-0270	Continuous Flow Tubing Segment

Syringe Racks

The PHD 22/2000 is offered with a variety of syringe racks to meet your specific application. Multi-syringe racks provide multi-channel operation or serve as a large capacity reservoir.

- The push/pull syringe pump holds 4 syringes, 2 in each direction, for syringe sizes 0.5 µl to 30 ml
- The standard 2-syringe rack holds 2 syringes from 0.5 µl or 140 ml
- The 4 x 140 multi-rack holds four 60 ml glass or four 140 ml plastic syringes only
- 6/10 multi-rack will hold up to 10 syringes from 0.5 µl to 20 ml and up to 6 syringes from 30 ml to 60 ml
- The microliter syringe rack independently holds 4 microliter syringes, from 0.5 µl to 10 ml, enabling syringes of different sizes to run simultaneously

SYRINGE PUMPS

PHD 22/2000 Hpsi and PHD 4400 Hpsi High Volume & Pressure Programmable Syringe Pumps

PHD 22/2000 Hpsi
with four 200 ml
Stainless Steel Syringes
(syringes not included)



KEY FEATURES

- Pump up to 800 ml with four 200 ml syringes
- High accuracy and reproducibility
- Rugged construction for a lifetime of service
- Accepts only Harvard Apparatus stainless steel syringes
- Legendary reliability – 2 year warranty

APPLICATIONS

- High Pressure Injections
- Drug Delivery
- Pumping Highly Corrosive Fluids
- Injecting into High Pressure Reaction Vessels

PHD 22/2000 Hpsi Specifications

TYPE	Microprocessor multiple syringe, infusion/withdrawal programmable
ACCURACY	±0.5%
REPRODUCIBILITY	±0.05%
SYRINGES (MIN/MAX)	Holds 20 to 200 ml stainless steel syringes
FLOW RATE:	
Minimum	1.5 µl/hr
Maximum	112 ml/min
RS-232	RJ11-4 conductor
TTL	9 pin D-Sub. Connector
AVERAGE LINEAR FORCE	197 kg (433 lbs)
STEP RESOLUTION	0.0397 µm/step
VOLTAGE RANGE	Universal input 100/240 VAC, 50/60 Hz
CABLE LENGTH	152 cm (5 ft) approx.
DIMENSIONS, H x W x D:	
Control Box	9.5 x 27.9 x 22.9 cm (3.75 x 11 x 9 in)
Syringe Holder	22.9 x 43.2 x 30.5 cm (9 x 17 x 12 in)

Order #	Product
PC1 70-2023	PHD 22/2000 Hpsi Programmable Syringe Pump
PC1 72-0199	Remote Extension Cable, 1.5 m (5 ft)
PC1 72-1405	Remote Extension Cable, 9.1 m (30 ft)
PC1 70-2022	RS-232 D-Sub 9 Pin to RJ11-4 Connection Cable

PHD 4400 Hpsi Programmable



KEY FEATURES

- Accurate and smooth flow
- Easy-to-use interface
- RS-232 serial port for computer control
- Delivers over 200lbs of pumping force across a wide flow rate range
- Legendary reliability – 2 year warranty

APPLICATIONS

- High Pressure Injections
- Drug Delivery
- Pumping Highly Corrosive Fluids
- Injecting into High Pressure Reaction Vessels

PHD 4400 Hpsi Specifications

TYPE	Microprocessor single syringe, infusion/withdrawal programmable
ACCURACY	±0.35%
REPRODUCIBILITY	±0.05%
SYRINGE:	
Type	Stainless steel**
Size Minimum	2.5 ml
Size Maximum	100 ml
FLOW RATE:	
Minimum	0.0076 µl/min
Maximum	182.40 ml/min
RS-232	RJ-11 4-conductor
TTL	9-pin D-sub connector
AVERAGE LINEAR FORCE	91 kg (>200 lbs)**
STEP RESOLUTION	0.082 µm/step
VOLTAGE RANGE	Universal input 100/240 VAC, 50/60 Hz
DIMENSIONS, H x W x D	17 x 23 x 29 cm (6.7 x 9.0 x 11.4 in)
WEIGHT	6.4 kg (14 lbs)
REMOTE CABLE	9.1 m (30 ft) Length

** Plastic and glass syringes are not recommended because of high force.

Order #	Product
PC1 70-2200	PHD 4400 Hpsi Programmable Single Syringe Pump
PC1 70-2201	PHD 4400 Hpsi Remote Programmable Single Syringe Pump

SYRINGE PUMPS

NEW MFRP10 Syringe Pump

SYRINGE PUMPS MFRP10 Syringe Pump



KEY FEATURES

- Occlusion alarm
- Automatic syringe size detection
- Backup battery
- Unique clutch for one-handed loading of syringes

The MFRP10 Syringe Pump is a state-of-the-art infusion pump originally designed for human use in intensive care units and anesthesia. It is now sold for laboratory animal use only. This pump can provide continuous or bolus infusion.

MFRP10 Syringe Pump Specifications

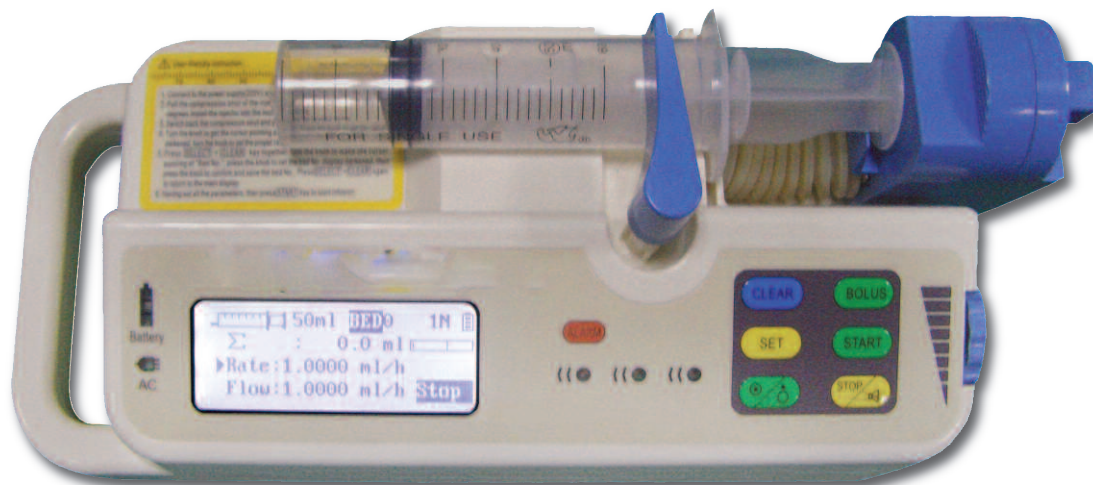
ACCURACY	±3% (excluding syringe variations)
FLOW RATE	0.01 ml/hr – 3 l/hr (dependent on syringe size)
COMPATIBLE SYRINGES:	
Becton Dickinson	1, 3, 5, 10, 20, 30, 50/60 ml
Monoject	1, 3, 6, 12, 20, 35, 60, 140 ml
Terumo	1, 3, 5, 10, 20, 30, 60 ml
B-D Glass	1, 2.5, 5, 10 ml
POWER	AC power or DC internal rechargeable
RECHARGE TIME	< 8 hours
BATTERY CAPACITY	Approximately 12 hours
USER SETTINGS	Audio Volume Alarm: LOW, NORM, or HIGH “Snooze” Alarm Delay: 2 to 60 minutes, Plunger Force: LOW, NORM, or HIGH
ALARMS/ALERTS	Battery status; Occlusion; Bolus delivery; Check clutch; Syringe status; Syringe size invalid; Plunger; Invalid number; System malfunction
STATUS ALERTS	Battery charging, in use, depleted; Delivering; Priming; Standby mode; Stop/Program
INFUSION MODES	g/kg/min, g/kg/hr, mg/kg/min, mg/kg/hr, g/min, g/hr, mg/min, mg/hr, µl/min, µl/hr, u/min, u/hr, ml/min, ml/hr, dose volume, delivery time
DIMENSIONS	24 x 10 x 15 cm (9.5 x 4.0 x 5.9 in)
WEIGHT	2.2 kg (4.9 lbs)

Order # Product

PC1 72-0088	MFRP10 Infusion Syringe Pump, 110 VAC
PC1 72-0089	MFRP10 Infusion Syringe Pump, 220 VAC

SYRINGE PUMPS

NEW Model 55 Pump



KEY FEATURES

- Accurate and smooth flow
- Syringe detection
- Advanced occlusion detection
- Battery back-up to AC power
- Wireless controller option

The Model 55 Syringe Pump is an easy to use syringe pump that can control the injection rate and total volume precisely and continuously over long periods of time. This pump has an optional wireless controller that allows you to control infusion and monitor status remotely.

Model 55 Pump Specifications

INJECTION ACCURACY	±3%
APPLICABLE SYRINGES	5 ml, 10 ml, 20 ml, 30 ml and 50 ml
FLOW RATE:	
5 ml Syringe	0.1~100 ml/hr
10 ml Syringe	0.1~100 ml/hr
20 ml Syringe	0.1~ 400 ml/hr
30 ml Syringe	0.1~600 ml/hr
50 ml Syringe	0.1~1500 ml/hr
INJECTION INCREMENT	0.1 ml/hr
FAST INJECTION QUANTITY	Exhaust impingement quantity of fast injection 10 ml/20 ml/50 ml syringe 1.0 m
KVO SPEED ADJUSTABLE RANGE	0.1 ~ 5.0 ml/hr
FAST INJECTION SPEED:	
10 ml syringe	100 ml/h
20 ml syringe	200 ml/h
50 ml syringe	500 ml/h

Model 55 Pump Specifications (continued)

ALARM FUNCTION	Alarm indication sent to infusion supervision management system
INFORMATION CAN BE	Injection complete, near completion, occlusion, low battery, disengagement, 3 independent alarms
BATTERY	Rechargeable lithium battery, 7.4V, 1600mAh
ELECTROMAGNETIC WAVE (HERTZIAN WAVE) PROTECTION	Accord with the stipulation of IEC60601-1-2 (1993 edition)
PROPER ENVIRONMENT CONDITION	Environment temperature 5~40, pressure 70~106kPa, relative humidity 30%~90%
STORAGE CONDITION	Environment temperature - 15~50°, pressure 70~106 kPa, relative humidity 30%~90%
ELECTRICAL SAFETY	accord with the stipulation of GB9706.1-1995
MAXIMUM SIZE OF OUTER SHELL	288 x 130 x 122 mm
MAXIMUM WEIGHT	< 2.5 kg
POWER	50/60Hz AC85- 265 V, 50/60 Hz
FUSES	220 V 0.2A x2, 12 V 2.5A x2
MAXIMUM POWER CONSUMPTION	25VA, running more than two hours after being charged
DIMENSIONS, H x W x D	24 x 10 x 15 cm (9.5 x 4.0 x 5.9 in)
WEIGHT	2.2 kg (4.9 lbs)

Order # Product

PC1 72-9700	Model 55 Pump with Built-in Controller
PC1 72-9702	Model 55 Pump with Wireless Monitoring

Customized Solutions - OEM and Special Syringe Pumps

Harvard Apparatus has the broadest selection and experience in fluidics components, systems and specials. Whether you are doing a one-time experiment that requires a high performance fluidic device or you are a professional engineer that requires a fluidics module to integrate into your system we have the solution. These solutions can be used to meet your application needs and requirements. Harvard Apparatus offers a wide variety of stand alone pumps and pump modules. If you do not see what you feel is the best solution for your application, give our expert technical support staff a call as we have the ability to modify existing pumps or develop new ones for special orders and OEM purchases.

A few of the application areas we have developed OEM solutions for include:

- Drug deposition onto cardiac stents
- Liquid chromatography
- Lab on a chip systems for bio-analysis

OEM Syringe Pump Modules

	Order #	Flow Rate	Average Linear Force	Control	Communications
MICROLITER SYRINGE PUMP MODULE	PC1 70-2220 or PC1 70-2225	0.001 μ l/hr to 1.33 ml/min	6 lbs	PC or other external controller	RS-232 serial input
MILLILITER SYRINGE PUMP MODULE	PC1 70-2219 or PC1 70-2226	0.001 ml/hr to 44.28 ml/min	25 lbs	PC or other external controller	RS-232 serial input
HIGH PRESSURE SYRINGE PUMP MODULE	PC1 70-2202	0.0001 μ l/hr to 220.82 ml/min	200 lbs	PC or other external controller	RS-232 serial input
PHD ULTRA™ SYRINGE PUMP MODULE	PC1 70-3506	3.06 pl/min to 215.8 ml/min	75 lbs	PC or other external controller	RS-232 and USB serial input
PHD ULTRA™ PUSH/PULL SYRINGE PUMP MODULE	PC1 70-3508	3.06 pl/min to 215.8 ml/min	75 lbs	PC or other external controller	RS-232 and USB serial input
PHD ULTRA™ 4400 SYRINGE PUMP MODULE	PC1 70-3510	3.06 pl/min to 215.8 ml/min	200 lbs	PC or other external controller	RS-232 and USB serial input

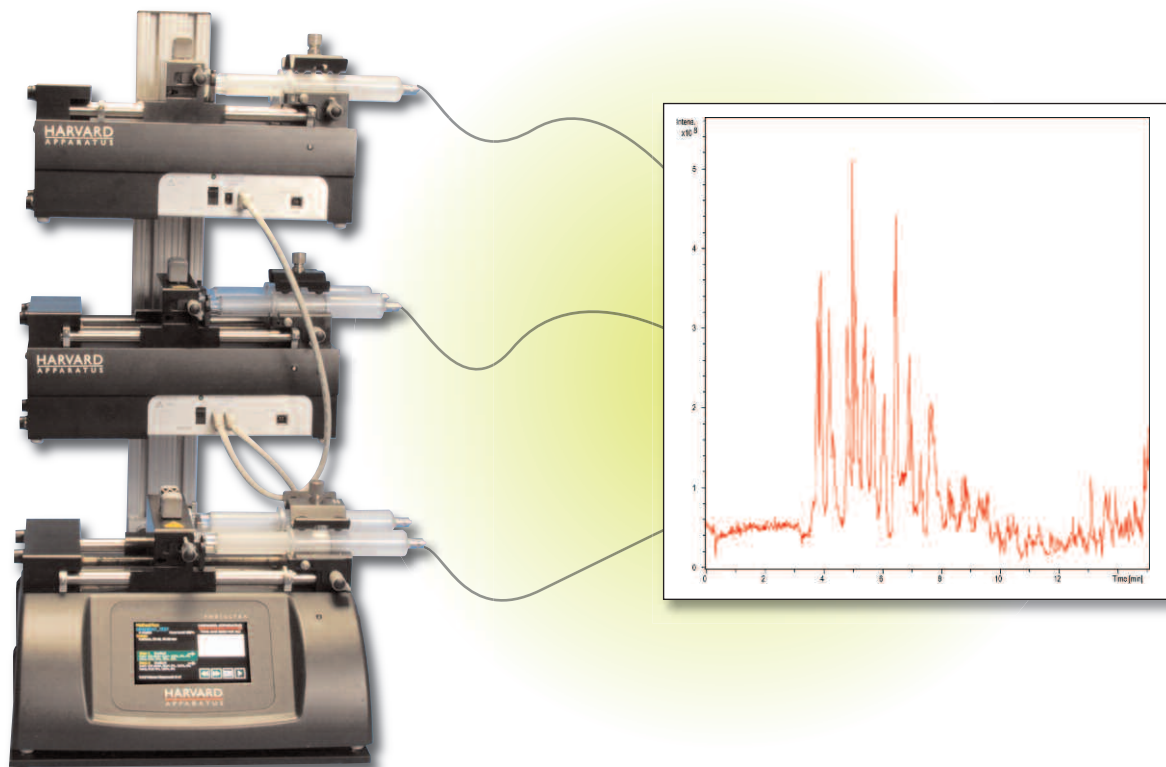
Drug Deposition onto Cardiac Stents



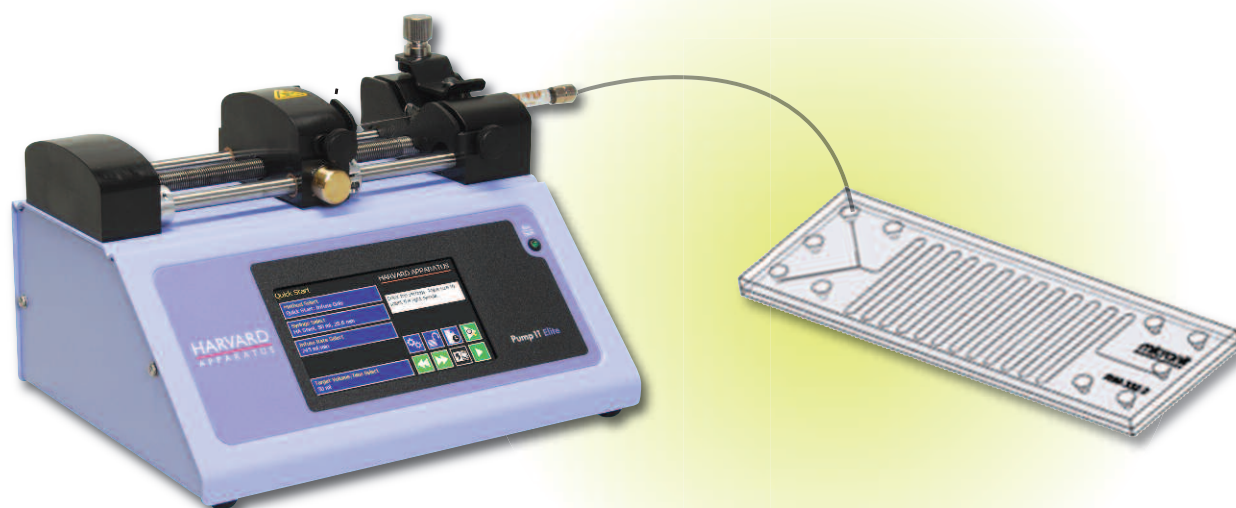
SYRINGE PUMPS

Customized Solutions - OEM and Special Syringe Pumps (continued)

Ternary Gradient System for Liquid Chromatography



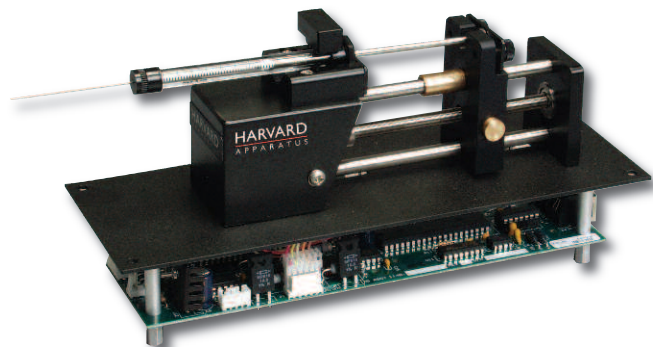
Microfluidics- Lab on a Chip!



SYRINGE PUMPS

Customized Solutions - OEM and Special Syringe Pumps (continued)

OEM Modules: Microliter Syringe Pump Module



KEY FEATURES

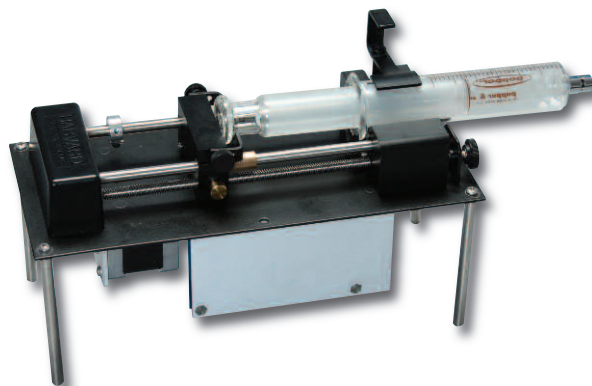
- Accuracy of $\pm 0.5\%$
- Footprint of 4.5 x 9.25 x 3.25 inches
- 0.001 μl to 1.33 ml/min
- WEEE, EU RoHS

Microliter Syringe Pump Module Specifications

TYPE	Microprocessor single syringe, infusion/withdrawal
ACCURACY	$\pm 0.5\%$
REPRODUCIBILITY	$\pm 0.1\%$
SYRINGE TYPE	Glass or plastic
SYRINGE SIZE:	
Size Minimum	0.5 μl
Size Maximum	1 ml
FLOW RATE:	
Minimum	0.001 $\mu\text{l/hr}$
Maximum	1.33 ml/min
AVERAGE LINEAR FORCE	2.73 kg (6 lbs)
CONNECTORS:	
RS-232	4 pin RJ-11 telephone jack; dual RS-232 ports
DC Power	4-pin Header (Friction lock)
POWER	+12VDC, 5%, 1A (12W) (User supplied)
DIMENSIONS:	
Overall, H x W x D	11.4 x 23.5 x 8.3 cm (4.5 x 9.25 x 3.25 x 4.5 in)
Mounting	22.2 x 7.0 cm (8.75 x 2.75 in) - Mounting holes for (4) #8 screws
WEIGHT	0.84 kg (1.85 lbs)

Order #	Product
PC1 72-2220	Microliter Syringe Pump Module without Power Supply
PC1 72-2225	Microliter Syringe Pump Module with Power Supply

OEM Modules: Milliliter Syringe Pump Module



KEY FEATURES

- Accuracy of $\pm 0.5\%$
- Footprint of 5.3 x 9.5 x 4.25 inches
- 0.001 $\mu\text{l/hr}$ to 44.28 ml/min
- WEEE, EU RoHS

Milliliter Syringe Pump Module Specifications

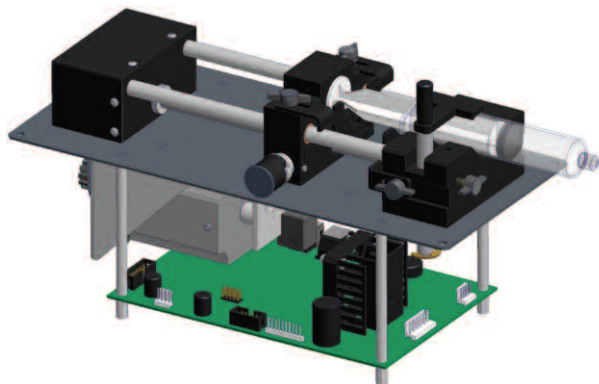
TYPE	Microprocessor single syringe, infusion/withdrawal
ACCURACY	$\pm 0.5\%$
REPRODUCIBILITY	$\pm 0.1\%$
SYRINGE TYPE	Glass or plastic
SYRINGE SIZE:	
Size Minimum	0.5 μl
Size Maximum	50/60 ml
FLOW RATE:	
Minimum	0.001 ml/hr
Maximum	44.283 ml/min
AVERAGE LINEAR FORCE	11.36 kg (25 lbs)
CONNECTORS:	
RS-232	4-pin RJ11 telephone jack; dual RS-232 ports
DC Power	2-pin Header (friction lock)
POWER	+15 to +40VDC (12W min) (user supplied)
DIMENSIONS:	
Overall, H x W x D	13.5 x 24.1 x 10.8 cm (5.3 x 9.5 x 4.25 in)
Mounting	22.9 x 9.5cm (9.0 x 3.75 in) - Mounting holes for (4) #8 Screws
WEIGHT	1.27 kg (2.8 lbs)

Order #	Product
PC1 72-2219	Milliliter Syringe Pump Module without Power Supply
PC1 72-2225	Milliliter Syringe Pump Module with Power Supply

SYRINGE PUMPS

Customized Solutions - OEM and Special Syringe Pumps (continued)

OEM Modules: High Force Syringe Pump Module



KEY FEATURES

- Accuracy of $\pm 0.5\%$
- Footprint of 6.6 x 5.5 x 11.8 in
- 0.001 $\mu\text{l/hr}$ to 220.82 ml/min
- WEEE, Eu RoHS, ETL (UL, CSA)

High Pressure Syringe Pump Module Specifications

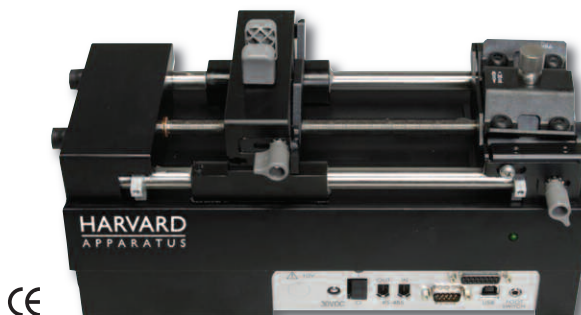
TYPE	Microprocessor single syringe, infusion/withdrawal
ACCURACY	$\pm 0.5\%$
REPRODUCIBILITY	$\pm 0.1\%$
SYRINGE TYPE	Plastic, glass or stainless steel
SYRINGE SIZE:	
Size Minimum	0.5 μl
Size Maximum	140 ml
FLOW RATE:	
Minimum	0.001 $\mu\text{l/hr}$
Maximum	220.82 ml/min
AVERAGE LINEAR FORCE	90.91 kg (200 lbs)
CONNECTORS:	
DC Power	4-pin Header (Friction lock-Molex or AMP)
RS-232	4-pin RJ-11 Telephone Jack; dual RS-232 ports
User I/O	9-pin D-Sub Female
DIMENSIONS:	
Overall, H x W x D	16.8 x 14.0 x 30.2 cm (6.625 x 5.50 x 11.875 in)
Mounting	28.9 x 12.7 cm (11.375 x 5.00 in), mounting holes for (4) #8 screws
Control Board Mounting	11.43 x 17.78 cm (4.50 x 7.00 in)- Mounting holes for (4) #8 screws
WEIGHT	3.86 kg (8.5 lbs)

** Note: operating temperature may be extended with forced air cooling

Order # Product

PC1 70-2202 High Pressure Syringe Pump Module without Power Supply

OEM Modules: PHD ULTRA™ Syringe Pump Module



KEY FEATURES

- Accuracy of $\pm 0.25\%$
- 11.75 x 5.5 x 6.5 in
- 3.06 $\mu\text{l/min}$ to 215.8 ml/min
- CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

PHD ULTRA™ Syringe Pump Module Specifications

TYPE	Microprocessor dual syringe, infusion/withdrawal
ACCURACY	$\pm 0.25\%$
REPRODUCIBILITY	$\pm 0.05\%$
SYRINGE TYPE	Plastic, glass or stainless steel
SYRINGE SIZE:	
Size Minimum	0.5 μl
Size Maximum	140 ml
FLOW RATE:	
Minimum	3.06 $\mu\text{l/min}$
Maximum	215.8 ml/min
AVERAGE LINEAR FORCE	34 kg (75 lbs) @ 100% Force Selection 30 VDC Input
CONNECTORS:	
RS-232	9 pin D-Sub Connector
RS-485	IEEE-1394, 6 pos
USB	Type B
I/O & TTL	15 pin D-Sub Connector
DIMENSIONS	
Overall, H x W x D	29.8 x 14.0 x 16.5 cm (11.75 x 5.5 x 6.5 in)
WEIGHT	5.1 kg (11.2 lbs)
REGULATORY CERTIFICATIONS	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

Order # Product

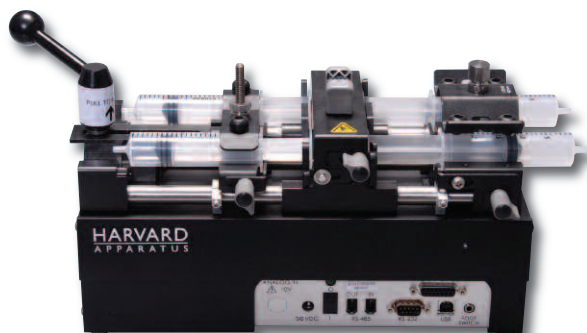
PC1 70-3506 PHD ULTRA™ Syringe Pump Module with Power Supply

SYRINGE PUMPS

Customized Solutions - OEM and Special Syringe Pumps (continued)

SYRINGE PUMPS OEM and Special Syringe Pumps

OEM Modules: PHD ULTRA™ Push/Pull Syringe Pump Module



KEY FEATURES

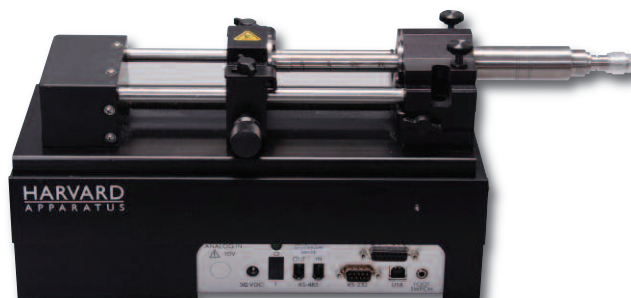
- Accuracy of $\pm 0.25\%$
- Footprint of 6.6 x 5.5 x 11.8 in
- 0.001 $\mu\text{l/hr}$ to 220.82 ml/min
- WEEE, RoHS, ETL (UL, CSA)

PHD ULTRA™ Push/Pull Syringe Pump Module Specifications

TYPE	Microprocessor four syringe, push/pull infusion/withdrawal
ACCURACY	$\pm 0.25\%$
REPRODUCIBILITY	$\pm 0.05\%$
SYRINGE TYPE	Plastic, glass or stainless steel
SYRINGE SIZE:	
Size Minimum	0.5 μl
Size Maximum	140 ml
FLOW RATE:	
Minimum	3.06 $\mu\text{l/min}$
Maximum	215.8 ml/min
AVERAGE LINEAR FORCE	34 kg (75 lbs) @ 100% Force Selection 30 VDC Input
CONNECTORS:	
RS-232	9 pin D-Sub Connector
RS-485	IEEE-1394, 6 pos
USB	Type B
I/O & TTL	15 pin D-Sub Connector
DIMENSIONS	
Overall, H x W x D	29.8 x 14.0 x 16.5 cm (11.75 x 5.5 x 6.5 in)
WEIGHT	5.1 kg (11.2 lbs)
REGULATORY CERTIFICATIONS	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

Order #	Product
PC1 70-3508	PHD ULTRA™ Push/Pull Syringe Pump Module with Power Supply

OEM Modules: PHD ULTRA™ 4400 Syringe Pump Module



KEY FEATURES

- Accuracy of $\pm 0.35\%$
- Footprint 11.75 x 5.5 x 6.5 in
- 3.06 $\mu\text{l/min}$ to 215.8 ml/min
- CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

PHD ULTRA™ 4400 Syringe Pump Module Specifications

TYPE	Microprocessor single syringe, infusion/withdrawal
ACCURACY	$\pm 0.35\%$
REPRODUCIBILITY	$\pm 0.05\%$
SYRINGE TYPE	Plastic, glass or stainless steel
SYRINGE SIZE:	
Size Minimum	0.5 μl
Size Maximum	140 ml
FLOW RATE:	
Minimum	3.06 $\mu\text{l/min}$
Maximum	215.8 ml/min
AVERAGE LINEAR FORCE	91 kg (200 lbs) @ 100% Force Selection
CONNECTORS:	
RS-232	9 pin D-Sub Connector
RS-485	IEEE-1394, 6 pos
USB	Type B
I/O & TTL	15 pin D-Sub Connector
DIMENSIONS	
Overall, H x W x D	29.8 x 14.0 x 16.5 cm (11.75 x 5.5 x 6.5 in)
WEIGHT	5.3 kg (11.2 lbs)
REGULATORY CERTIFICATIONS	CE, ETL (UL, CSA), WEEE, EU RoHS & CB Scheme

Order #	Product
PC1 70-3510	PHD ULTRA™ 4400 Syringe Pump Module with Power Supply