

NEW PRODUCT

# PHD ULTRA

SERIES

## Quick Start

### Method Select

Quick Start: Infuse/Withdraw

### Syringe Select

HA steel, 4.851 mm, 2.5 ml

### Infuse Rate Select

3.525 ml/min

### Withdraw Rate Select

3.525 ml/min

### Target Volume Select

2.5 ml

## HARVARD APPARATUS

04/23/09 12:11:56 PM

Enter user settings to the left and then press the green button to proceed. Make sure to set a target volume.



HARVARD  
APPARATUS

- **% COMPOSITION STEP CHANGES**
- **I/O INTERACTIVE EXPERIMENTS**
- **DRUG/NUTRITIONAL INFUSIONS**
- **FLOW PROGRAMMING**
- **CONTINUOUS FLOW**
- **FEEDING CELLS**
- **GRADIENTS**
- **NANOFLUIDICS**
- **ELECTRO SPINNING**
- **LARGE FLOW DELIVERIES**
- **MASS SPEC CALIBRATION**
- **REACTION CHAMBER ADDITION**
- **LOW PRESSURE CHROMATOGRAPHY**

THE **ULTIMATE PUMP** FOR SOLVING YOUR **APPLICATION**

# the PHD ULTRA™ technology goals

**HARVARD**  
APPARATUS

Harvard Apparatus is proud to introduce the new PHD ULTRA™ syringe pump. The PHD ULTRA™ sets a new standard of performance in syringe pumps for smooth, accurate and precise flow. Harvard Apparatus introduced the first commercial syringe pump in 1956 and has been involved in advanced fluidics for over 108 years. Harvard Apparatus continues to be the global leader in high-performance syringe pumps with the PHD ULTRA™, designed for the demanding Ultra Fluidics™ applications of the future.



## Solve your fluidics applications with Ultra Fluidics™ from Harvard Apparatus!

Harvard Apparatus utilized a three part approach to solve the challenges of Ultra Fluidics™ that result in a series of new features assuring a successful solution to applications from the simplest to the most complex.

### ADVANCED MECHANICS

### NEW ADVANCED PATENTED\* FLOW CONTROL MECHANICS

- Syringe holding mechanics for easier use and more performance

### NEW EZ PRO™ SOFTWARE

- Easy-to-use GUI interface
- Advanced color touch screen display
- Advanced methods architecture
- Preprogrammed quick start and advanced methods
- Alphanumeric reporting capability

### NEW MAXIMUM VERSATILITY

- Advanced configurations of racks and flow rates
- Versatile selection of models
- Largest selection of accessories
- Superior connectivity options
- Advanced fluidics features

## ADVANTAGE PHD ULTRA™ SERIES

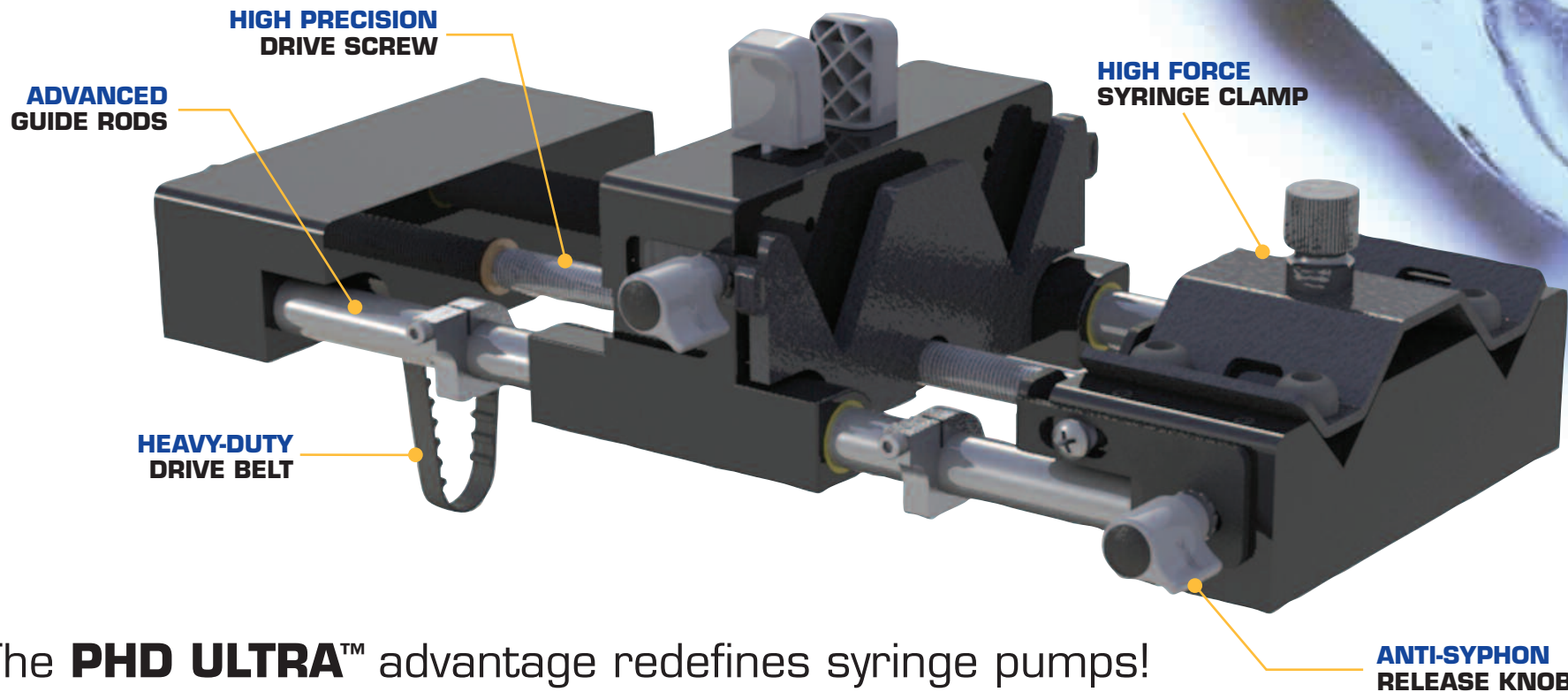
EZ PRO™  
SOFTWARE

MAXIMUM  
VERSATILITY

\*Patent pending

# ADVANCED

patented\* mechanical design  
assures high performance and  
**EZ use**



## The **PHD ULTRA™** advantage redefines syringe pumps!

The **FIRST ADVANCEMENT** is a new patented\* mechanical design for the highest performance flow of any syringe pump. Advanced mechanical translation technology from the highest tolerance drive screws to superior bearing design, combined with advanced motor microstepping allows the PHD ULTRA™ to produce maximum flow smoothness and accuracy across the broadest range of flows available.

The standard PHD ULTRA™ delivers 75 pounds of linear force across the entire range of flow. It has the power to maintain its great flow characteristics even with viscous solutions or multiple syringes on a rack. Other PHD ULTRA™ Models are available with up to 433 pounds of force for your most demanding conditions.

The PHD ULTRA™ syringe racks are constructed of rolled steel to maintain a warp free shape that eliminates the thermal expansion errors of conventional aluminum racks. This assures excellent long term performance and reliability. Lastly, the advanced front mounted controls and mechanics make loading syringes an easy task.

\*Patent pending



# EZ PRO™

software makes a complex tasks EZ without a PC

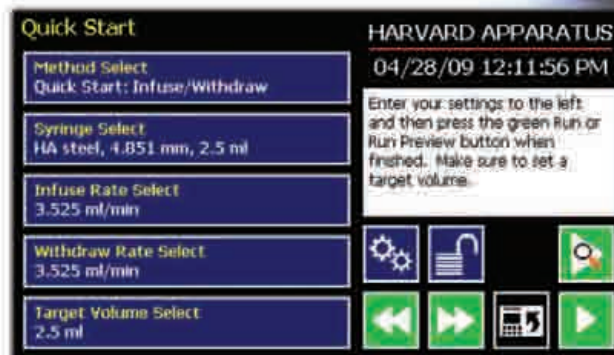
The **SECOND ADVANCEMENT** of PHD ULTRA™ is the EZ PRO™ interface. Immediate access to the Quick Start and Advanced program templates and methods wizards provide a new operational simplicity. By programming custom methods into the pump, multi-user errors are reduced. Easily transfer complex methods to other pumps and/or download methods from a PC. Forget having to duplicate method-development efforts for each new pump added to your system.

- Advanced high resolution touch screen with GUI interface and icons makes the PHD ULTRA™ EZ to operate
- Alphanumeric keyboard for methods naming, experimental conditions, and operators names

Capability controlled with a touch of your finger!



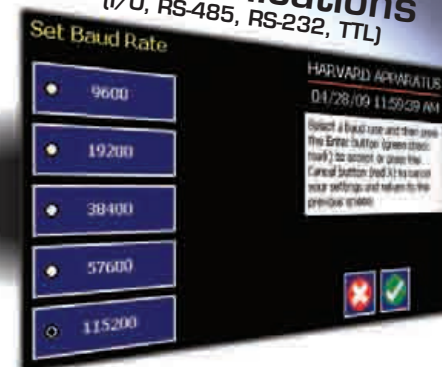
## Quick Start



## Programming



## Communications (I/O, RS-485, RS-232, TTL)



Advanced System Monitors



Method Names  
(Alphanumeric)



# EZ PRO™ SOFTWARE

advanced programming methods  
with the touch of a button!

## FLOW PROGRAMMING

Select Profile for Step 1

HARVARD APPARATUS  
04/28/09 1:21:10

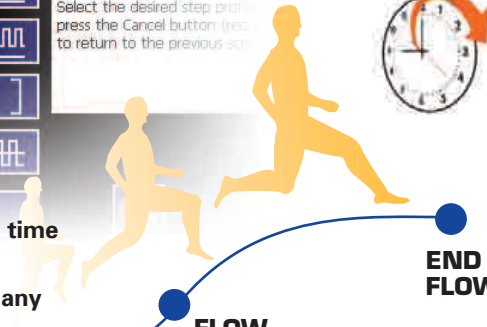
Constant Rate  Ramp  **DURATION**

Stepped  Pulse

Bolus  Concentration

Autofill

Select the desired step profile and then press the Enter button (green check mark) to accept your settings and press the Cancel button (red X) to return to the previous screen.

**START FLOW**  **END FLOW**

**FLOW FUNCTION**

Advanced Options

- Change the flow with time and volume
- Trigger an event as many times as you like

## BOLUS

Step # 4, Bolus

HARVARD APPARATUS  
04/28/09 1:28:28

Set Rate  
Rate: 106 ml/min

Set Target Volume  
0 ml

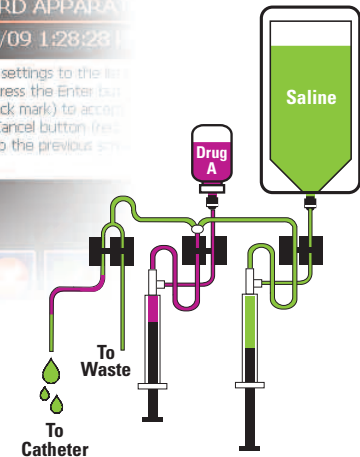
Volume  Time

Enter your settings to the screen and then press the Enter button (green check mark) to accept your settings and press the Cancel button (red X) to return to the previous screen.

**Injection of a drug (or drugs) in high quantity at once**

**Select bolus mode and program infusion bolus variables**

**The bolus injection can be made in time or volume**



## CONCENTRATION MODE

Step # 1, Concentration

HARVARD APPARATUS  
04/28/09 1:29:16


Animal Weight  
0 (grams)

Set Rate And Concentration  
0 (mg/ml)

Set Dose or Duration  
0 (mg/kg) 0 second(s)

Set # Doses & Time Between Doses  
0 Dose(s) 0 second(s)

Enter your information and then press the Enter button (green check mark) to accept your settings and press the Cancel button (red X) to cancel your settings and return to the previous screen.



- Easily calibrate flow in concentration units of mg/kg
- Calibrate to concentration of drug and animal weight

## GRADIENT CAPABILITY

Set Baud Rate

HARVARD APPARATUS  
04/28/09 11:59:30

9600

19200

38400

57600

115200

Select a baud rate and then press the Enter button (green check mark) to accept your settings and press the Cancel button (red X) to return to the previous screen.



- The PHD ULTRA™ can be preprogrammed to deliver gradients to investigate drug dosing, reaction vessel catalyst additions, solvent changes for chromatography



# VERSATILITY

of configurations  
to optimize your  
experimental set-up

The **THIRD ADVANCEMENT** of the PHD ULTRA™ is the new maximum versatility of design to work in the horizontal or vertical position. The advanced touch screen senses the orientation and switches automatically.

- **Horizontal Orientation** is for minimum dead volume experiments that are lab bench height
- **Vertical Orientation** requires minimal bench space and is for easy bubble clearance. It also reduces the dead volumes need for vertical experiments



**HORIZONTAL  
ORIENTATION**



**VERTICAL  
ORIENTATION**



# UNPARALLELED

## experimental versatility

The PHD ULTRA™ is the first high performance, programable pump with EZ to program capabilities. Many functions that used to require a PC are possible without a PC. The new patented\* mechanical design makes the PHD ULTRA™ superior in accurate, precise and smooth flow performance.

## Unparalleled fluidics operational modes across the widest flow rate range available

- **Single or Multi-Syringe Mode:** from 0.5µl to 140ml syringes pumping at a range of 0.0001µl/hr to 220.82 ml/min; 2 syringes; 4 syringes; 6 syringes; 8 syringes; 10 syringes
- **Continuous Flow:** set single flow rate or volume
- **Flow Programming:** ability to program multiple flow rates with time or volume
- **Step Gradient:** % composition step changes
- **Continuous Gradient:** binary or ternary gradients
- **Bolus Injection:** by time or volume
- **Concentration Mode:** flow delivered in mg/kg adjusted for animals weight
- **Interactive Experiments:**
  - a. Time - start or stop events on built-in, real or relative time clocks
  - b. Touch Screen Keyboard - push button or foot pedal to start and stop
  - c. PC-RS-232, RS-485, USB-connect to a computer
  - d. I/O +/-5V have the pump start or stop a program with a signal from pH, balance, reward platform, biosensor, etc...
- **Autofill:** synchronize of two pumps, each having an external reservoir connected to the syringe. One pump infuses until the syringe is empty, then the second pump starts pumping to maintain the flow while the first pump refills. This alternating process repeats creating continuous flow.
- **Pulse Profile:** set-up a continuous pulsing flow

**Syringe Selection** HARVARD APPARATUS  
04/28/09 12:22:22 PM

Custom Syringe	
Air-Tite HSW Norm-Ject	↑
Becton Dickinson Glass (all types)	▲
Becton Dickinson Plasti-pak	
Hamilton Glass (all types)	▼
Harvard Apparatus Stainless Steel	
Cadence Science, Inc. Perfektum Glass	↓

Select an existing syringe manufacturer or select custom syringe and then press Enter (green check mark) to accept or press the Cancel button (red X) to return to the previous screen.

**Select Profile for Step 1** HARVARD APPARATUS  
04/28/09 1:21:10 PM

Constant Rate	Ramp
Stepped	Pulse
Bolus	Concentration
Autofill	
Advanced Options	

Select the desired step profile or press the Cancel button (red X) to return to the previous screen.

**Step # 4, Pulse** HARVARD APPARATUS  
04/28/09 1:25:31 PM

**Set Mode** Infuse →

**Set Rates**  
Rate 1: 0 ml/min Rate 2: 0 ml/min

**Set Volume**  
0 ml

Volume  Time

**# of Pulses**  
0 Pulse(s)

Enter your settings to the left and then press the Enter button (green check mark) to accept or press the Cancel button (red X) to return to the previous screen.



\*Patent pending

# MAXIMUM

## versatility of configurations, models and connectivity

Connectivity with RS-485 can be used to daisy chain for remote operation, ganging pumps, gradients, or what ever your requirements. These methods can be tripped by the controlling pump or a PC using the USB or RS-232 ports.

The PHD ULTRA™ has various configurations: push-pull, high force, remote and standard. The I/O allows you maximum versatility so you can pump rewards, respond to physiological changes, connect balances and more.



**PUSH/PULL**



**4 x 140 MULTI-RACK**



**6 x 10 MULTI-RACK**



**MICROLITER MULTI-RACK**

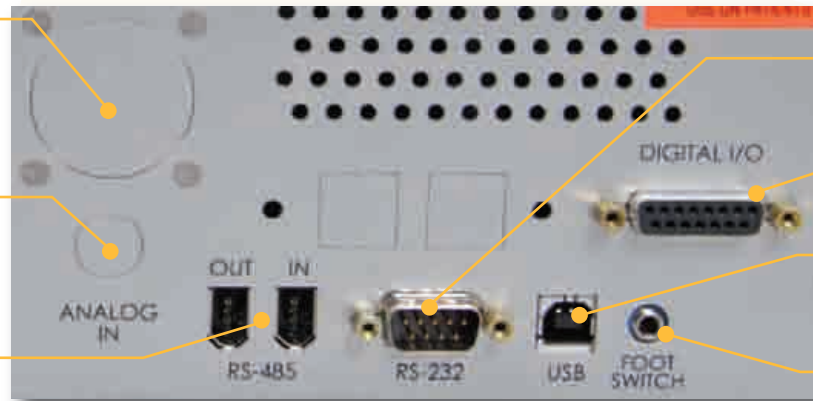


**DAISY CHAIN WITH RS-485**

**CONNECTOR FOR REMOTE MECHANISM**  
(optional)

**ANALOG CONTROL CONNECTOR**  
(optional)

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



**RS-232 SERIAL CONNECTOR**  
(for communication from PC)

**USER I/O CONNECTOR**

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

**FOOTSWITCH INPUT**  
(switch sold separately)



# ACCESSORIES

for versatile experiments

## Temperature Control

Depending upon the experiment, multiple levels of temperature control may be required. Harvard Apparatus can provide heating and cooling for chips, lines, syringes and microscopes.

### WP-10 and WP-16 Warmed Platforms

- Stage Adapters for all major brands
- Microscopes for low cost systems



### SH-27B & SF-28 Single Inline Solution Heaters

- Small size allows placement close to imaging and recording chamber to minimize convective heat losses
- Single line in-line solution heaters include T1 thermistor embedded within aluminum housing for feedback control
- Designed to operate with TC-324B or TC-344B temperature controllers
- Output temperature from ambient to 50°C



### CO<sub>2</sub> Microscope Stage Incubator

- One model fits all XY stages
- Suitable for high-magnification microscopy
- Temperature control from Ambient +3° to 50°C
- Wide selection of cell cultures support adapters



## Syringe Heater

Solution reservoir heating is an important technique used to eliminate out gassing of solutions prior to their entry to a heated perfusion chamber. Since the gas load of a solution is dependent on partial pressure and temperature, preheating the solution at atmospheric pressure before delivery to the final heater will minimize the occurrence of bubbles in the chamber's bath, even if the solution is allowed to cool on route. The ability to independently control each separate heater block allows the researcher to control the initial temperature of each solution without influencing other nearby solutions.

## Accessories

- Nanofluidic Chips
- Tubing
- Connectors
- Syringes
- Needles
- Emulsifying Needles
- Sonic Syringe
- Spill Sensor



the  
**PHD ULTRA™**  
the advantage in  
solving your fluidic  
experiments!

**DISPENSERS & INJECTORS**

Ideal for a multitude of dispensing and injecting applications

- Adhesive
- Cell injection
- MRI dyes
- Activators/Enzymes
- Flow injection
- Microreaction vessels
- Stereotaxic delivery

**SPRINGE PUMPS**

FOR YOUR MOST DEMANDING APPLICATIONS!

- Injecting into high pressure reaction vessels
- Multiple simultaneous animal feeding stations
- Micro and nanofluidics down to picoliter flows
- HPLC delivery system
- Remote operation in hazardous environments
- Electro spinning, Biomimicing spider web...

**AEROSOL FOR COATING**

At high pressure, the pump creates an aerosol for the delivery of coating materials

- Pharmaceutical tablets
- Aerosol studies

**ANIMAL INFUSIONS OR WITHDRAWALS**

The control of pumps delivering varying % of nutrients or drugs infused into animals, flush lines and withdraw

- Catheters
- Needles
- Cannulae
- Micro Dialysis

**DELIVERY OF MASS SPECTROMETRY**

Delivery of fluids to the MS

- Calibration
- Matrix addition
- ESI sample

**PROPORTIONING & DELIVERING OF MIXTURES**

Mixing gradients or proportions with independent control of two liquids

- Dial-a-mix
- Independent 2 pump control

**COMPENSATING FLOWS**

The continuous infusion and simultaneous withdrawal of liquids

- Cell cultures
- Perfusion chambers

**MICRO & NANO FLUIDICS**

µl, nano & picoliter flow, pulseless flow

- Lab-on-a-chip
- Bubble reactors



# ADVANCED

characteristics for  
picoliter to milliliter flows...  
smoother, precise flow rates

## PHD ULTRA™ Specifications

Accuracy	± 0.35%
Reproducibility	± 0.05%
Syringes (Min./Max.)	0.5 µl / 140 ml
Flow Rate:	
Minimum (0.5 µl syringe)	1.56 pl/min
Maximum (140 ml syringe)	220.97 ml/min
Display	4.3" WQVGA TFT Color Display with Touchpad
Non-Volatile Memory	Stores all settings
RS-232 Connectors	9 pin D-Sub Connector
USB Connectors	Type B
I/O & TTL Connectors	15 pin D-Sub Connector
Linear Force (Max)	34 kg (75 lbs) @ 100% Force Selection
Drive Motor	0.9° Stepper Motor
Motor Drive Control	Microprocessor with 1/16 microstepping
Number of Microsteps per one rev. of Lead Screw	12,800
Step Rate:	
Minimum	27.5 sec/µstep
Maximum	26 µsec/µstep
Pusher Travel Rate:	
Minimum	0.18 µm/min
Maximum	190.80 mm/min
Power	100 to 240 VAC: 50/60 Hz 50 W, 0.5 A fuse
Dimensions	10.16 x 21.59 x 30.48 cm (4 x 8.5 x 12 in)
Weight	4.5 kg (10 lb)
Atmospheric Specifications	
Operating Temperature	4°C to 40°C (40°F to 104°F)
Storage Temperature	-10°C to 70°C (14°F to 158°F)
Humidity	20% to 80% RH, non-condensing
Mode of Operation	Continuous
Classification	Class I
Pollution Degree	1
Installation Category	II
Regulatory Certifications	CE, UL, CSA, CB Scheme, EU RoHS

## PHD ULTRA™ Ordering Information

Order #	Order #	Product
<b>Stand Alone</b>	<b>Remote</b>	<b>Product</b>
<b>Standard Version</b>		
70-3005	70-3105	PHD ULTRA™ Infuse Only
70-3006	70-3106	PHD ULTRA™ Infuse/Withdraw
70-3007	70-3107	PHD ULTRA™ Infuse/Withdraw Programmable
<b>Push/Pull Versions</b>		
70-3008	70-3108	PHD ULTRA™ with Push/Pull Mechanism
70-3009	70-3109	PHD ULTRA™ Programmable with Push/Pull Mechanism
<b>Other Versions</b>		
70-3010	70-3110	PHD ULTRA™ 4400 Syringe Pump I/W Programmable
-	70-3111	PHD ULTRA™ Remote Hpsi Syringe Pump I/W Programmable
-	70-3112	PHD ULTRA™ Remote Hpsi Syringe Pump I/W Programmable with 10x140 Rack
70-3030	-	PHD ULTRA™ Option RS-232 RJ-11 Connectors
70-3033	-	PHD ULTRA™ Option Analog Control Input
70-3031	-	PHD ULTRA™ Option Internal Pinch Valve
70-3032	-	PHD ULTRA™ Option Internal 3-way Isolation Valve
70-3034	-	PHD Ultra Infuse Only with Fan

Specials available on request for different racks, custom flow ranges and flow characteristics in those ranges, special accessories.

## Order # Product

### Upgrades

70-3020A	6x10 Multi Syringe Rack for PHD ULTRA™
70-3021A	4x140 Multi Syringe Rack for PHD ULTRA™
70-3022A	Micro Dialysis Rack, for PHD ULTRA™ holds 4 syringes
70-3023	Anti-Siphon Kit for PHD Ultra
70-4010	Upgrade Infuse Only to I/W *
70-4011	Upgrade Infuse Only to Programmable *
70-4012	Upgrade I/W to Programmable *

\*Requires Return to Factory

### Order # Product

### Accessories

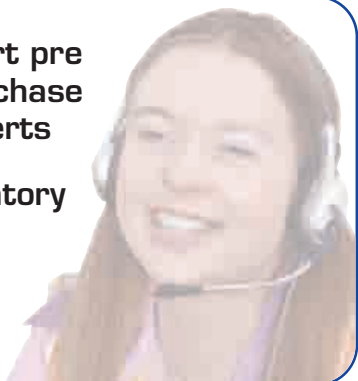
70-4000	RS-485 Cable for Pump-to-Pump Communication, 0.5m
70-4001	RS-485 Cable for Pump-to-Pump Communication, 2 m
70-4002	USB Cable for PC-to-Pump Communication, 2 m
70-4003	USB Cable for PC-to-Pump Communication, 5 m
70-4004	RS-232 Cable for PC-to-Pump Communication, 9 pin D-sub, 2 m
72-0199	Remote Extension Cable, 1.5 m (5 ft)
72-1405	Remote Extension Cable, 9.1 m (30 ft)
70-4005	Adapter, PHD Digital I/O
70-4006	Adapter, D-sub 15 to Term. Blk
72-8340	Adapter, USB to Serial
70-2215	Footswitch (w/ Phono Plug)
55-7002	Auto Fill Valve Box, Normal Pressure, 30 psi
55-7004	Auto Fill Valve Box, High Pressure, 200 psi
55-7760	Cable Assy, Daisy-chain, Legacy RS-232 RJ-11, 2 ft
72-2478	Cable Assy, Daisy-chain, Legacy RS-232 RJ-11, 7 ft
2401-086	Adapter for 25ml, 50ml, 100ml Hamilton GasTight™ Syringes
5153-209	Line Cord



# HARVARD APPARATUS

## Exceptional Technical Support

- Global support pre and post purchase by pump experts
- Global Regulatory Compliance: CB SCHEME, EU RoHS, CSA, CE, UL



### Corporate Headquarters

#### UNITED STATES



##### Harvard Apparatus

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