NEW PRODUCT

# PHD ULTRA SERIES


- % 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.


### 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

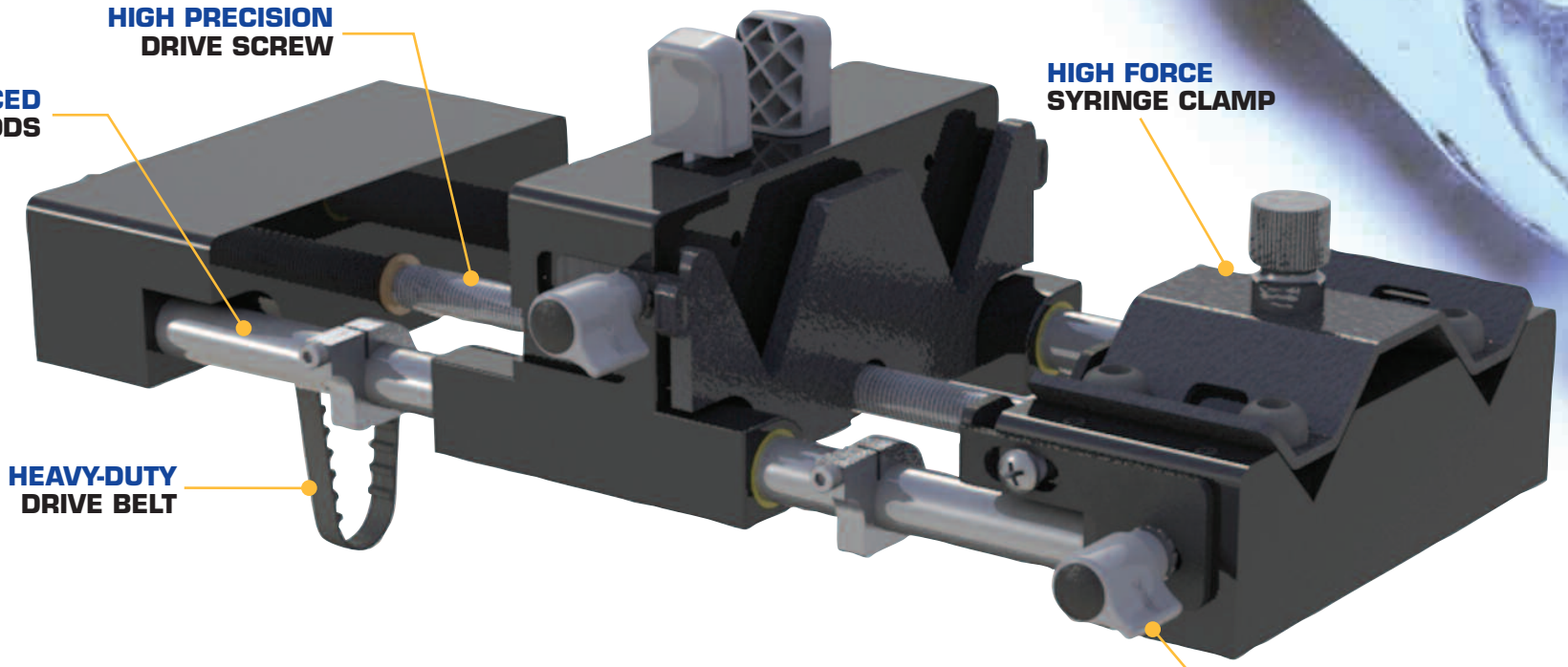
### NEW MAXIMUM VERSATILITY

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

*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**

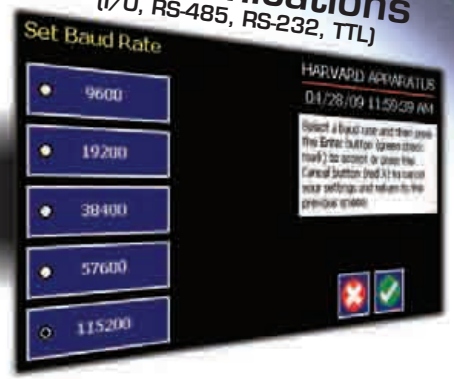
Capability controlled with a touch of your finger!

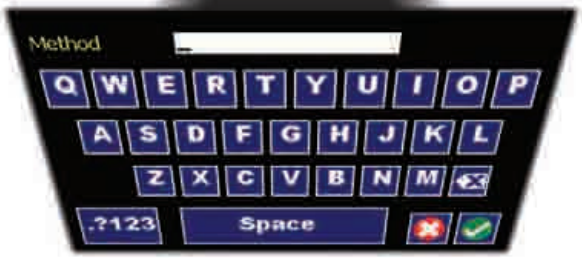
**Advanced System Monitors**

**Quick Start**


**Programming**


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




**Method Names**
(Alphanumeric)

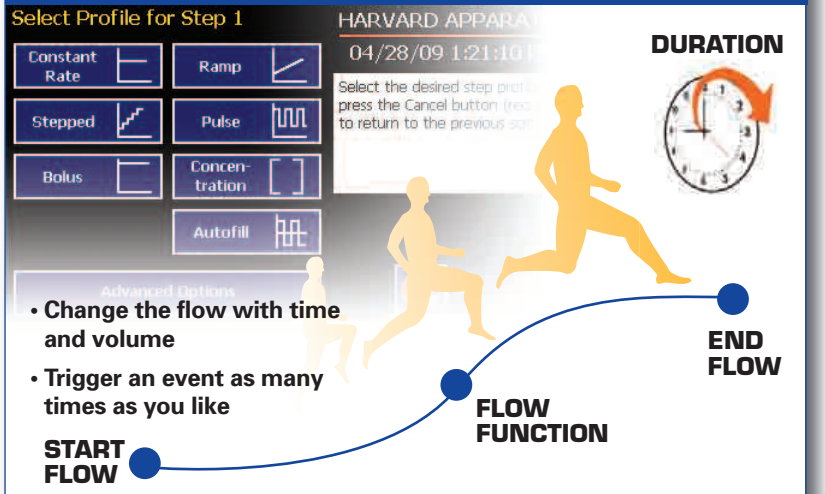

HARVARD APPARATUS

PHD ULTRA™

# EZ PRO™ SOFTWARE

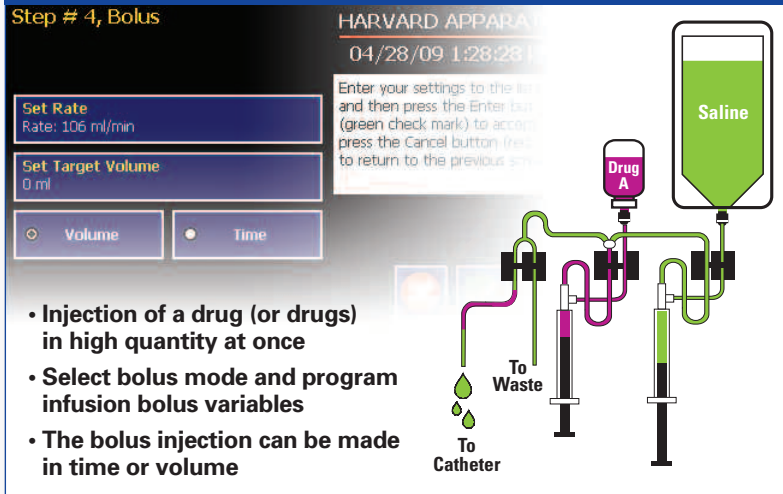
## advanced programming methods with the touch of a button!

### FLOW PROGRAMMING



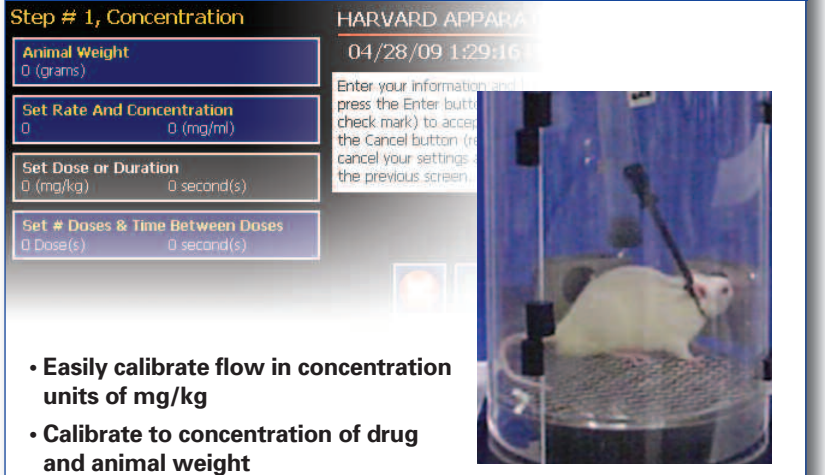

- Change the flow with time and volume
- Trigger an event as many times as you like

### BOLUS




- 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




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

### GRADIENT CAPABILITY


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


HARVARD APPARATUS

PHD ULTRA™

visit us online at www.harvardapparatus.com or call 508-893-8999

# 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**

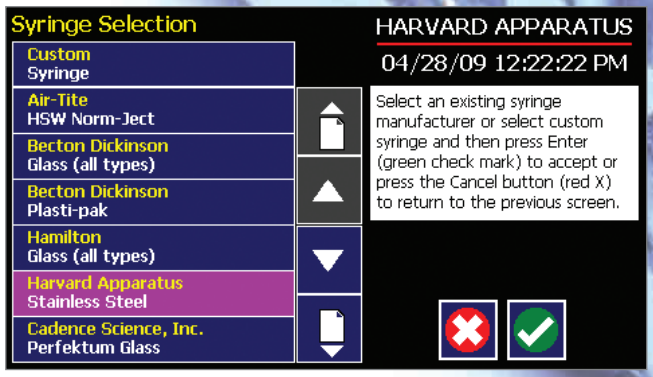

**VERTICAL ORIENTATION**

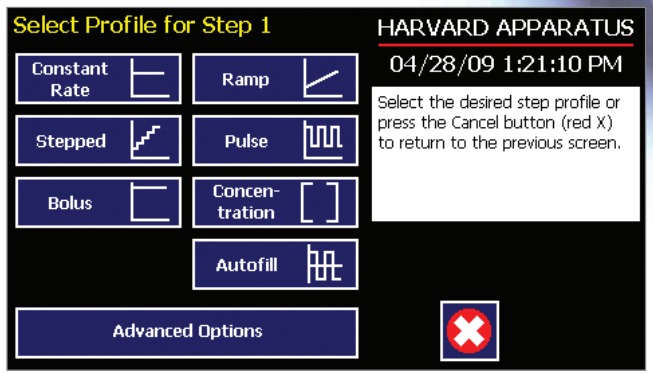
# UNPARALLELED
## experimental versatility

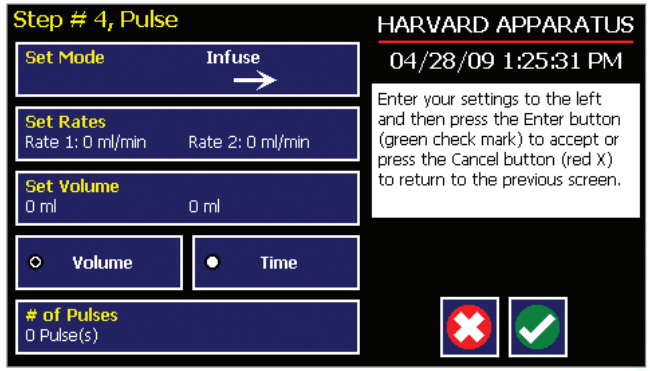
The **PHD ULTRA™** is the first high performance, programable pump with EZ to program capabilities. Many functions that used to require a PC are possible without a PC. The new patented* mechanical design makes the PHD ULTRA™ superior in accurate, precise and smooth flow performance.

## 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





*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.

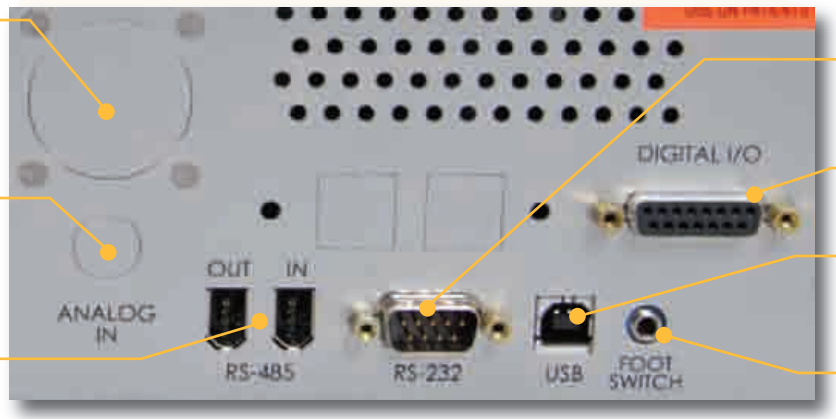
PUSH/PULL

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

### $CO_2$ 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

### SYRINGE 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
- Electo spinning, Biomimicing spider web…

### MICRO & NANO FLUIDICS

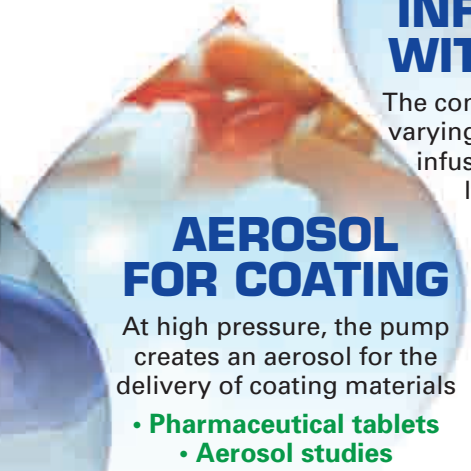
µl, nano & picoliter flow, pulseless flow

- Lab-on-a-chip
- Bubble reactors

### PROPORTIONING & DELIVERING OF MIXTURES

Mixing gradients or proportions with independent control of two liquids

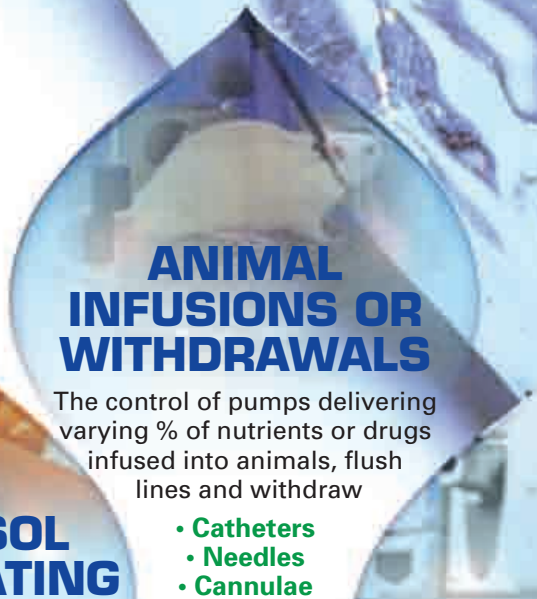
- Dial-a-mix
- Independent 2 pump control



### 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

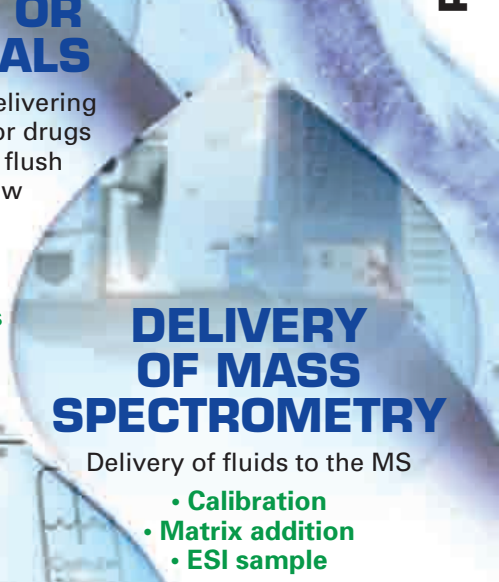
The control of pumps delivering varying % of nutrients or drugs infused into animals, flush lines and withdraw

- Catheters
- Needles
- Cannulae
- Micro Dialysis

### COMPENSATING FLOWS

The continuous infusion and simultaneous withdrawal of liquids

- Cell cultures
- Perfusion chambers



### DELIVERY OF MASS SPECTROMETRY

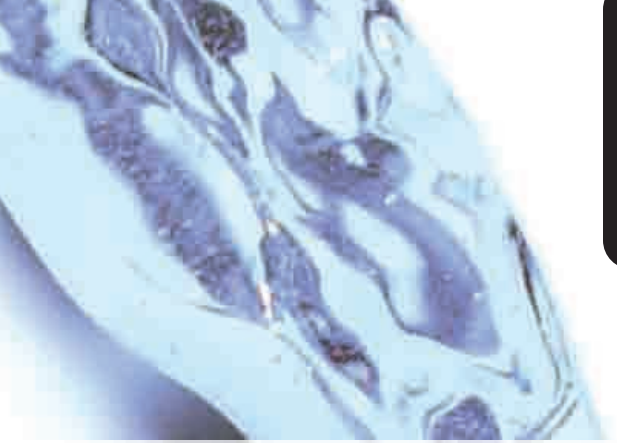
Delivery of fluids to the MS

- Calibration
- Matrix addition
- ESI sample

ADVANTAGE PHD ULTRA™ SERIES

# 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 # Stand Alone | Order # Remote | Product |
|---|---|---|
| **Standard Version** | | |
| **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 |
| **Push/Pull Versions** | | |
| **70-3008** | **70-3108** | PHD ULTRA™ with Push/Pull Mechanism |
| **70-3009** | **70-3109** | PHD ULTRA™ Programmable with Push/Pull Mechanism |
| **Other Versions** | | |
| **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 * |

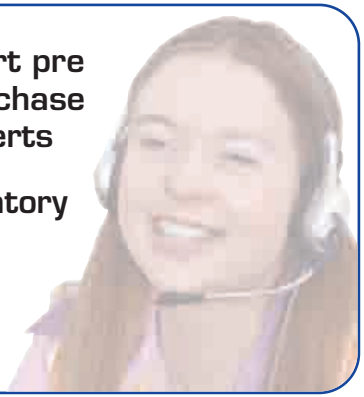
**Requires Return to Factory*

| 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

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| phone | **934.190.709** (Sales in Spain) |
| fax | **34.934.750.699** |
| e-mail | **info@panlab.com** |
| website | **www.panlab.com** |

PHD ULTRA™ ADVANTAGE SERIES