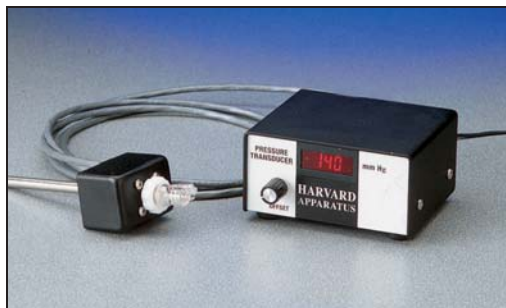


# Cardiovascular



Research Grade Blood Pressure Transducer, see page J2



**NEW** SC1000 Blood Pressure Analysis System for Mice and Rats, see pages J8 and J9



**NEW** MC4000 Multi-Channel Blood Pressure System, see pages J10 and J11



**NEW** Advanced Auto Inflate Blood Pressure Monitor, see page J12



HSE-HA Electronic Pressure Calibrators, see page J13

- **Research Grade Blood Pressure Transducers**.....see page J2

- NEW** **Venous Pressure Transducer P75**.....see page J3

- NEW** **ISOTEC Transducers**.....see page J3

- **Isolated Physiologic Pressure Transducers**.....see page J4

- NEW** **Millar Micro-Tip Pressure Transducers**.....see page J5

- **Transonic Flow Probes**.....see pages J6 - J7

- NEW** **SC1000 Blood Pressure System for Mice & Rats**.....see pages J8 - J9

- NEW** **MC4000 Multi-Channel Blood Pressure System for Mice & Rats**.....see pages J10 - J11

- **Harvard Ltd Advanced NIBP Auto Inflate Blood Pressure Monitor**.....see page J12

- **HSE-HA Electronic Pressure Calibrator**.....see page J13

- **Vascular Occluders**.....see page J14

- NEW** **Transducer Selection Chart**.....see page J15

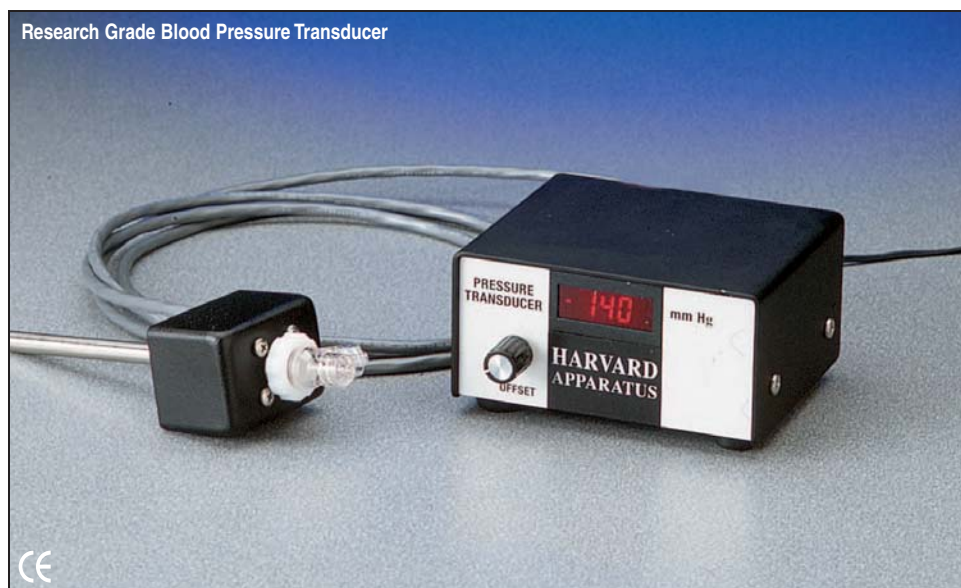
- **PLUGSYS Measuring & Control Modules for Cardiovascular Studies**.....see pages J16 - J17

- **HSE-HA Haemodyn W for Haemodynamic Studies**.....see pages J18 - J19

- **HSE-HA PLUGSYS Module TTFM for Flow Measurements**.....see page J20

- **HSE-HA PLUGSYS Cases**.....see page J20

## Research Grade Blood Pressure Transducer



### This research grade blood pressure transducer is for use with:

- BS4 72-3732 Data Acquisition System for the IBM-PC with Windows and BS4 72-3733 Data Acquisition System for the Macintosh
- Harvard Apparatus TR2 Chart Recorder, see page 170
- Modular Universal Oscillograph, see pages 166 and 167
- Student Oscillograph, see page 168

This physiological blood pressure transducer uses a semi-disposable dome of medical grade Silastic® with an integral silicone rubber diaphragm. Blood only contacts the diaphragm. Domes are supplied sterile and can be re-sterilized and reused without affecting calibration. Replacement domes are available as accessories.

This transducer converts picofarad changes of capacitance into high-level DC voltages using a new electronic circuit (U.S. Patent #4,142,144). This circuit is extremely sensitive and stable, producing a signal suitable for direct connection to recorders, oscillographs and computers.

The transducer amplifier has a 3-digit back lit LCD display that reads directly in mmHg up to 999. Amplifiers can be stacked for multiple use. It is possible on special order to have as many as 4 amplifiers operated by one transformer.

Please note that replacement domes listed on this page are for Harvard Apparatus' newer model transducer **ONLY**. The newer model is distinguished by a black threaded ring at the base of the dome. The older models have a white ring at the base of the dome. We are no longer able to offer replacement domes for these older units.

### Specifications

<b>Output Voltage</b>	Factory set at 1.0 V/100 mmHg via BNC connector; calibrated up to 300 mmHg
<b>Linearity</b>	±1.5% of full scale
<b>Compliance</b>	14 µl displacement /100 mmHg, including 305 mm (12 in) of standard 3 mm (1/8 in) ID vinyl tubing
<b>Dome Volume</b>	300 µl
<b>Pressure Range</b>	-50 to +300 mmHg
<b>Overload Pressure</b>	3000 mmHg
<b>Zero Offset Control</b>	-50 to +100 mmHg
<b>Natural Frequency</b>	> 500 Hz, dry
<b>Electrical Isolation</b>	> 1 kV
<b>Carrier Frequency</b>	2 MHz
<b>Output Impedance</b>	2 kΩ
<b>Input Liquid Connectors</b>	Dual transparent female Luer lock
<b>Drift</b>	Negligible after 5 min. warm-up
<b>Sterilization of Transducer</b>	Chemical: Alcide, Cidex, etc.
<b>Dimensions:</b>	
<b>Transducer, H x W x D</b>	43 x 30 x 55 mm (1-1/2 x 1-1/8 x 2-1/4 in)
<b>Handle, OD x L</b>	9.7 x 76.2 mm (3/8 x 3 in)
<b>Amplifier, H x W x D</b>	51 x 95 x 86 mm (2 x 3-3/4 x 3-3/8 in)
<b>Display</b>	LCD, 7.6 mm (0.3 in) high numbers
<b>Weight</b>	908 g (2 lb)

<b>Catalog No.</b>	<b>\$</b>	<b>Product</b>
BS4 72-4496		Research Grade Blood Pressure Transducer, 115 VAC, 60 Hz
BS4 72-4497		Research Grade Blood Pressure Transducer, 230 VAC, 50 Hz
BS4 72-4498		Replacement Dome, pkg. of 1 (older units require retrofit)

## NEW Venous Pressure Transducer P75



- For low liquid and gas pressure measurement  $\pm 75$  mmHg
- Increased sensitivity and baseline stability
- Applications include:
  - Venous blood pressure
  - Esophageal pressure with fluid filled catheter
  - Perfusion pressure on isolated lung and liver
  - Perfusion pressure on perfused hollow organs like the esophagus
- Robust construction, easy to fill bubble free

The P75 has a removable Macrolon<sup>®</sup> dome with a pressure connection and a vent connection at the side, so that it can be filled free of air bubbles. The dome connections have a male Luer taper so that suitable stopcocks can be attached. The transducer has a metal housing. The actual pressure sensor inside is made from ceramic and therefore has excellent resistance to different media. The transducer's rugged construction can withstand pressure overloads up to 4000 mmHg without damage. It works together with any DC bridge amplifier (e.g., PLUGSYS TAM-A).

### Specifications

<b>Pressure Range</b>	$\pm 75$ mmHg ( $\pm 100$ cmH <sub>2</sub> O)
<b>Volume Displacement</b>	0.06 mm <sup>3</sup> /10 mmHg
<b>Linearity</b>	$\pm 0.15$ mmHg
<b>Long-Term Drift</b>	$\pm 0.04$ mmHg
<b>Overload</b>	-760 (= vacuum) to 4000 mmHg
<b>Measurement Media</b>	All gases and liquids which do not attack Macrolon <sup>®</sup>
<b>Temperature Range</b>	0° to 50°C
<b>Zero Drift</b>	$\pm 0.04$ mmHg/10°C (0° to 50°C)
<b>Range Drift</b>	$\pm 0.04$ mV/10°C ( $\pm 0.04$ mmHg/10°C) (0° to 50°C)
<b>Electrical Data:</b>	
<b>Supply Voltage</b>	5 V (4.5 to 5.5 V) DC only
<b>Current Loading</b>	15 mA max.
<b>Sensitivity</b>	1 mV/mmHg, nominal
<b>Output Resistance</b>	300 $\Omega$ , nominal
<b>Frequency Range</b>	0 to 100 Hz
<b>Connection Cable</b>	Approx. 1.5 m (4.9 ft) long
<b>Suitable Amplifiers</b>	Any bridge amp providing 5V DC excitation voltage
<b>Mechanical Data:</b>	
<b>Pressure Connections</b>	Luer taper, male
<b>Weight</b>	0.35 kg (0.8 lb)
<b>Dimensions, H x W x D</b>	40 x 40 x 35 mm (1.57 x 1.57 x 1.38 in)
<b>Mounting Rod, OD x L</b>	8 x 70 mm (0.31 x 2.76 in)

Catalog No.	\$	Product
BS4 73-0020		Blood Pressure Transducer P75 for PLUGSYS Module
BS4 73-0021		Blood Pressure Transducer P75 for Harvard Apparatus Transducer Interface
BS4 73-0022		Blood Pressure Transducer P75 for Grass Amplifiers
BS4 73-0023		Blood Pressure Transducer P75 for Gould 6600 Series
BS4 73-0024		Blood Pressure Transducer P75 for Gould 4600 Series
BS4 73-0025		Replacement Dome for Venous Blood Pressure

## NEW ISOTEC™ Transducers



- Inexpensive
- Reliable
- Accurate
- Low volume displacement
- From mouse to pigs
- Easy to fill

This ISOTEC™ Transducer is an inexpensive pressure transducer. It can be used for measurement of arterial pressure in vivo as well as for perfusion pressures in isolated perfused organs such as heart or kidney. The ISOTEC™ Transducer consists of a cable with a plug on each end and the transducer head itself, which can easily be replaced.

### Specifications

<b>Operating Pressure</b>	-50 to 300 mmHg
<b>Overpressure</b>	-500 to 4000 mmHg
<b>Sensitivity</b>	5 $\mu$ V/V/mmHg
<b>Accuracy</b>	< $\pm 1.5\%$ of reading or $\pm 1.0$ mmHg (whichever is greater, as result of combined errors of linearity, hysteresis, repeatability and sensitivity)
<b>Excitation Voltage</b>	10 V DC or AC RMS (up to 5 kHz) max
<b>Zero Offset</b>	$\pm 30$ mmHg max
<b>Temperature Coefficient Zero Offset</b>	$\pm 0.25$ mmHg/°C max
<b>Zero Drift with Time</b>	< $\pm 1.0$ mmHg/8 hrs
<b>Temperature Coefficient of Sensitivity</b>	$\pm 0.08\%$ /°C max
<b>Operating Temperature</b>	10° to 40°C
<b>Storage Temperature</b>	-25° to 70°C
<b>Volume Displacement</b>	< 0.04 mm <sup>3</sup> /100 mmHg
<b>Input Impedance</b>	> 500 $\Omega$
<b>Output Impedance</b>	< 900 $\Omega$
<b>Leakage Current</b>	< 10 $\mu$ A RMS at 115 VAC, 60 Hz
<b>Natural Frequency</b>	> 6700 Hz in air

Catalog No.	\$	Product
BS4 73-0089		ISOTEC™ Pressure Transducer for PLUGSYS Module
BS4 73-0090		ISOTEC™ Pressure Transducer for Harvard Apparatus Transducer Interface
BS4 73-0091		ISOTEC™ Pressure Transducer for Grass Amplifiers
BS4 73-0092		ISOTEC™ Pressure Transducer for Gould 6600 Series
BS4 73-0093		ISOTEC™ Pressure Transducer for Gould 4600 Series
BS4 73-0094		Replacement Cable
BS4 73-0095		Replacement Transducer Head
BS4 73-0096		Three-Way Stopcock 9560R
BS4 73-0097		One-Way Stopcock 9500
BS4 73-0098		Stand for ISOTEC™ Transducer, Rod Height 11 cm
BS4 73-2996		Stand for ISOTEC™ Transducer, Rod Height 30 cm
BS4 73-0568		ISOTEC™ Transducer Holder, mounts on 8 mm OD rod
BS4 73-2803		ISOTEC™ Transducer Holder, mounts on 12 mm OD rod

## Isolated Physiologic Pressure Transducers



BS4 60-0280 Standard Isolated Physiologic Pressure Transducer

BS4 60-0281 Miniature Isolated Physiologic Pressure Transducer

- Ideal for measuring pressure from venous through atrial ranges
- Available in P23XL standard or P10EZ miniature size
- For use with:
  - Harvard Apparatus Amplifier
  - HSE-HA PLUGSYS Modules
  - Grass Amplifiers
  - Protocol Propac Monitor
  - Gould Electronic 6600 and 4600 series of amplifiers

These solid state isolated pressure transducers measure from -50 to +300 mmHg with a 100 mmHg shunt cal resistor. Safety is assured by an isolated sensing mechanism and plastic case. They are defibrillator protected. These transducers are supplied individually with two reusable polycarbonate domes and an interface cable. Select the transducer based on your required size, pressure and equipment to be used.

Transducer interface cables with integral connector are also sold separately. This permits the same transducer to be connected to different equipment. Simply purchase the necessary interface cable based on the equipment you will be using. The cable is 3.7 m (12 ft) long with a mating connector for instrument specified. Replacement reusable polycarbonate domes are available separately. They are supplied individually non-sterile (may be sterilized a limited number of times). Disposable diaphragm domes are also available and are supplied in a box of 12, individually packaged.

*For Research Grade Isometric and Isotonic Transducers, see pages 12 and 13.*

### Specifications

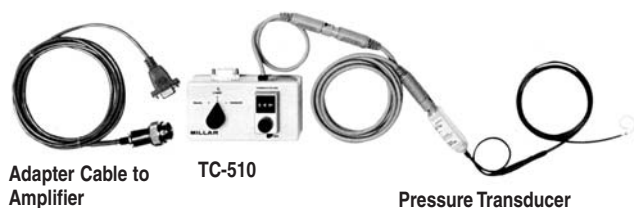
<b>Pressure Range</b>	-50 to +300 mmHg
<b>Over-Pressure Tolerance</b>	10,000 mmHg
<b>Bridge Resistance:</b>	
<b>Input Resistance</b>	1,000 W, nominal
<b>Output Resistance</b>	350 W, nominal
<b>Excitation Voltage</b>	Up to 10 VAC or DC rms max., up to 5 kHz
<b>Zero Offset</b>	±40 mmHg, max.
<b>Sensitivity</b>	5 µV/V mmHg ±1%
<b>Thermal Coefficient:</b>	
<b>Of Sensitivity</b>	±0.1 %/°C
<b>Of Zero</b>	±0.3 mmHg/°C
<b>Electrical Leakage</b>	> 2 µA at 120 VAC, 60 Hz
<b>Defibrillator Withstand</b>	400 watt-seconds, max. across 50 W load
<b>Volume Displacement</b>	0.04 mm <sup>3</sup> /100 mmHg pressure
<b>Non-Linearity</b>	±1.5 mmHg/0 to 30 mmHg
<b>Hysteresis</b>	±0.1 mmHg/0 to 10 mmHg
<b>Cable Length</b>	3.7 m (12 ft)
<b>Operating Temperature</b>	20° to 40°C (68° to 104°F)
<b>Weight (Without Cable):</b>	
<b>Standard P23XL</b>	15 g (1.46 oz)
<b>Miniature P10EZ</b>	5 g (0.18 oz)
<b>Length (Including Dome):</b>	
<b>Standard P23XL</b>	40 mm (1.58 in)
<b>Miniature P10EZ</b>	37 mm (1.46 in)

### Isolated Physiologic Pressure Transducer

Amplifier	Transducer with Interface Cable		Interface Cable Only	
	Standard P23XL	Miniature P10EZ	\$	\$
Harvard Apparatus	BS4 72-2461	BS4 72-2466		BS4 60-0298
HSE-HA	BS4 72-2880	BS4 72-2881		BS4 72-2882
Grass	BS4 72-2462	BS4 72-2467		BS4 60-0300
Propac	BS4 72-2463	BS4 72-2468		BS4 60-0297
Gould 4600	BS4 72-2464	BS4 72-2469		BS4 60-0299
Gould 6600	BS4 72-2465	BS4 72-2470		BS4 60-0296

Catalog No.	\$	Product
BS4 60-0280		P23XL Pressure Transducer without Connection Cable (domes ordered separately, see below)
BS4 60-0281		P10EZ Pressure Transducer without Connection Cable (domes ordered separately, see below)
BS4 72-2883		Interface Cable, Universal Connector to Tinned Leads (no connector), For Use with Other Equipment, Mating Connector Required
BS4 60-0283		Reusable Polycarbonate Dome for P10EZ Miniature, Luer Lock Fitting, pkg. of 1
BS4 60-0294		Disposable Diaphragm Dome for P10EZ Miniature, Rotating Luer Lock Fitting, pkg. of 12
BS4 60-0290		Reusable Polycarbonate Dome for P23XL Standard Size, Linden Fitting, pkg. of 1
BS4 60-0292		Disposable Diaphragm Dome for P23XL Standard Size, Rotating Luer Lock Fitting, pkg. of 12
BS4 60-0293		Disposable Diaphragm Dome for P23XL Standard Size, Standard Linden Fitting, pkg. of 12

## **NEW** MILLAR MICRO-TIP® Pressure Transducer



MILLAR transducers are essential for any studies where accurate analyses of pressures and pressure waveforms are required; particularly where first and second derivatives of waveforms are to be computed. Signals from these transducers are suitable for storage on high frequency response data acquisition systems or for online computer analysis.

MILLAR MICRO-TIP® Catheter Pressure Transducers were developed to overcome the well-known problems and errors associated with fluid-filled catheter pressure measurement systems. The pressure sensor, which has an extremely high natural frequency, is located at the distal end of the catheter. High-fidelity pressure and sound measurements without phase and amplitude errors can be made simultaneously directly at the source.

The MICRO-TIP® pressure sensor is a patented ultraminiature semiconductor gauge designed specifically for catheter transducer applications. It has exceptional thermal stability and linearity, with negligible hysteresis. These transducers are primarily for short-term applications. Baseline stability should be tested periodically by independent means. They have a high signal-to-noise ratio and provide good resolution of low level sounds and pressures. Overpressures of several thousand mmHg will not damage the sensor and its low mass makes it insensitive to acceleration forces and "catheter whip".



Millar Micro-Tip Pressure Transducers						
Catalog No.	Model	Animal	Main Size	Catheter Length (cm)	Tip Type	Specifics
BS4 73-0928 \$	SPC 320	Rat	2F	140	Straight	
BS4 73-0877 \$	SPC 330	Rabbit	3F	65	Straight	
BS4 73-0878 \$	SPC 330A	Rabbit	3F	130	Straight	
BS4 73-0879 \$	SPC 340	Rabbit	4F	120	Straight	
BS4 73-2990 \$	SPC 350	Dog	5F	120	Curved	MRI Compatible
BS4 73-0889 \$	SPC 350S	Dog	5F	120	Straight	MRI Compatible
BS4 73-2991 \$	SPC 450	Dog	5F	120	Curved	Lumen* MRI Compatible
BS4 73-0910 \$	MPC 500	Dog	5F	70	Straight	Disposable

\*Lumen for slow injection or sampling ID 0.4mm



### Ultraminiature Pressure Transducers

These ultraminiature pressure sensors were developed for measuring pressures in small laboratory animals. In these models, the catheter body is smaller than the tip sensor to allow flexibility and to minimally obstruct the vessels or valves through which it passes.

- Measures the pressure at the source
- Standardized sensitivity 5V/mmHg
- Precalibrated and interchangeable
- Pressure range -50 to +300 mmHg
- Frequency response flat up to 10 kHz
- Ultraminiature type for LVP measurement in mice
- Reusable
- MRI-Compatible models available, call for details

### Ultraminiature Pressure Sensor

Catalog No.	Model	Animal	Main Size	Catheter Length (cm)	Sensor Type	Specifics
BS4 73-2899 \$	SPR 835	Mouse	-	-	0.8F	#
BS4 73-0880 \$	SPR 671	Mouse	-	65	1.4F	#
BS4 73-0230 \$	SPR 407	Rat	1.5F	140	2F	
BS4 73-0908 \$	SPR 249	Rat	2F	140	3F	
BS4 73-2992 \$	SPR 524	Rabbit	2.5F	100	3.5F	Disposable

# Requires Interface cable BS4 73-0940

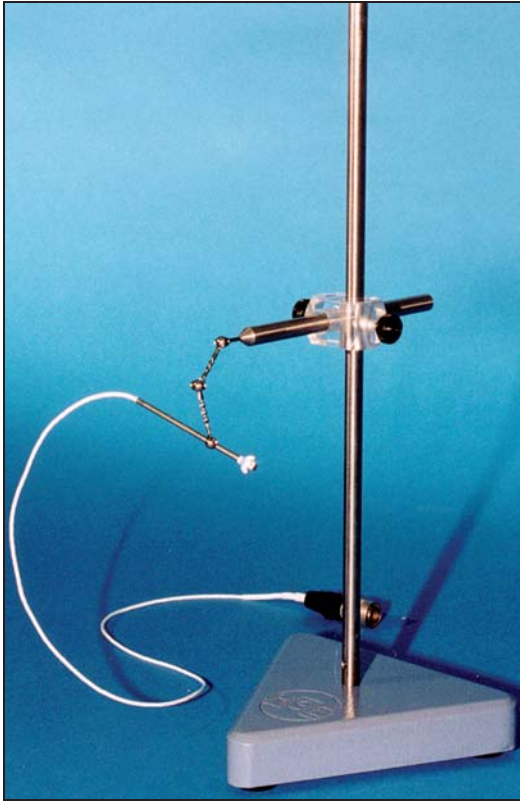
### Model TC-510 Control Unit

The Transducer Control Unit is essential as a passive interface between the pressure sensor of any standardized sensitivity MILLAR MICRO-TIP® Catheter Pressure Transducer and strain gauge pressure amplifiers, which supply bridge excitation voltage and have balance and calibration controls for full-bridge strain gauge pressure transducers. The Model TC-510 includes controls for balancing and calibration. A connector cable with the appropriate connector to attach the TC-510 Control Unit to the recorder preamplifier is required.



Catalog No.	\$	Product
BS4 73-2908		Control Unit Model TC-510 without Cable
BS4 73-0940		Cable TEC-10D to Connect SPR-671/835 to TC-510
BS4 73-2907		Adapter Cable to Connect TC-510 to PLUGSYS Amplifiers
BS4 73-2905		Adapter Cable to Connect TC-510 to Grass Amplifiers
BS4 73-2904		Adapter Cable to Connect TC-510 to Gould 6600 Amplifiers

## Transonic Flow Probes for PLUGSYS Module TTFM

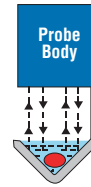


- Non-constrictive perivascular flowprobes
- For acute and chronic measurement of flow in arteries and veins
- large range of other vessel diameters from 500  $\mu\text{m}$  to 36 mm
- Probes for micro-measurements in mice or rats
- Probes with Dual-beam "X"-Pattern for ascending aorta flow measurement
- Inline Flowprobes for extracorporeal circuits (Isolated perfused organs)

These Transonic Flow Probes work with the TTFM Transonic Time Flow Meter shown on page J20. The TTFM Flow Meter requires a PLUGSYS case. Basic information for the cases is on page J20. For full details and specifications on the cases, see the Physiology Section I.

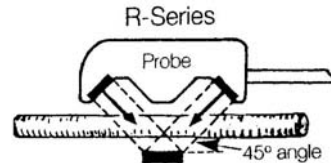
*Probes type R and S are available with back cable exit (in a right angle to the vessel) or with side cable exit (parallel to the vessel). As a standard we deliver the probes with back cable exit. For side cable exit please specify when ordering.*

*A range of Accessories and special connectors for chronic applications are available, please call for information.*



### Microcirculation Probes (V-Series)

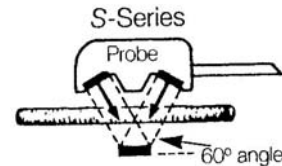
0.5 mm to 1 mm for direct volume flow measurement in vessels down to 250  $\mu\text{m}$  in rat or mouse.



### Standard Probes (R-Series)

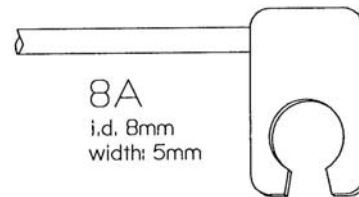
**1 to 8 mm**

For direct measurement of volume flow for vessels from 1 to 8 mm diameter. These probes have the transducers positioned at an  $45^\circ$  angle to the vessel.



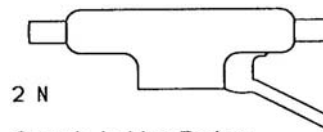
### Standard Probes (S-Series) 2 to 24 mm

For direct measurement of volume flow for vessels from 2 to 24 mm diameter. These probes have the transducers positioned at an  $60^\circ$  angle to the vessel. This reduces the flow probe body size and reflector width for placement of the probe in applications where space is limited.



### Cardiac Output Probes (A-Series) 8 to 36 mm

For direct measurement of highly turbulent flow profiles such as the ascending aorta and pulmonary artery of larger animals. Sizes from 8 to 36 mm are available.



### Extracorporeal inline-probes (N-Series) are available in sizes from 1.2 mm to 22.2 mm

These probes can be spliced into laboratory tubings for greatest adaptability in experiments requiring high resolution volume flow measurements, particularly in the low flow range. Ideal for isolated organ preparations. The probes can be calibrated for accurate measurement of blood, saline, or buffer perfusates.

## Transonic Flow Probes for PLUGSYS Module TTFM

Transonic Transit Time Flow Probes											
Probe Type	Catalog No.	\$	Vessel OD chronic	Vessel OD acute	Resolution ml/min	Range ml/min			Probe length mm	Probe width mm	Cable length m
						Sc. Low	Sc. Normal	Maximum			
0.5V	BS4 73-2969		n/a	0.25 - 0.5	0.05	2.5	10	50	6.5	4.0	0.6
0.7V	BS4 73-2970		n/a	0.35 - 0.7	0.075	5.0	20	100	7.6	3.5	0.6
1.0RB	BS4 73-1057		0.5 - 1.0	0.7 - 1.2	0.05	5	20	100	6.5	4.0	0.6
1.5RB	BS4 73-1058		1.0 - 1.5	1.2 - 1.8	0.075	10	40	200	7.6	3.5	0.6
2RB	BS4 73-1062		1.3 - 2.3	1.8 - 2.5	0.1	25	100	500	13.0	6.0	1.0
3RB	BS4 73-1063		1.9 - 3.3	2.5 - 3.7	0.2	50	200	1 L	17.2	7.0	1.0
4RB	BS4 73-1064		2.2 - 4.0	3.3 - 4.4	0.4	100	400	2 L	21.0	8.0	1.0
5RB	BS4 73-1068		2.7 - 5.0	3.8 - 5.3	0.4	100	400	2 L	21.0	8.0	1.0
6RB	BS4 73-1065		3.3 - 6.0	4.4 - 6.6	1.0	250	1 L	5 L	24.0	8.0	1.0
8RB	BS4 73-1069		4.4 - 8.0	6.6 - 8.8	2.0	500	2 L	10 L	26.5	8.0	1.0
2SB	BS4 73-1181		1.3 - 1.8	1.5 - 2.0	0.1	25	100	500	8.7	3.3	1.0
2.5SB	BS4 73-1182		1.5 - 2.4	1.8 - 2.5	0.1	25	100	500	8.7	3.3	1.0
3SB	BS4 73-1183		2.4 - 3.4	2.5 - 3.7	0.4	50	200	1 L	9.0	5.0	1.0
4SB	BS4 73-1184		3.0 - 4.0	3.3 - 4.4	0.8	100	400	2 L	13.3	6.0	1.0
6SB	BS4 73-1185		4.0 - 6.0	4.4 - 6.6	2.0	250	1 L	5 L	13.5	6.7	1.0
8SB	BS4 73-1186		5.8 - 8.0	6.6 - 8.8	4.0	500	2 L	10 L	18.8	7.5	1.0
10SB	BS4 73-1187		7.3 - 10.0	8.3 - 11.0	8.0	500	2 L	10 L	18.7	8.5	1.0
12SB	BS4 73-1066		8.6 - 12.0	9.8 - 13.0	8.0	1 L	4 L	20 L	22.5	8.5	1.0
14SB	BS4 73-1188		10.0 - 14.0	11.3 - 15.0	16.0	1 L	4 L	20 L	26.2	8.5	1.0
16SB	BS4 73-1067		12.0 - 16.0	13.3 - 17.7	20.0	2.5 L	10 L	50 L	36.0	10.0	1.0
20SB	BS4 73-0986		14.0 - 19.0	16.0 - 21.0	40.0	2.5 L	10 L	50 L	31.0	9.0	1.0
8A	BS4 73-1196		6 - 8	6 - 8	4	500	2 L	10 L	8 ID	5	2.0
10A	BS4 73-1203		8 - 10	8 - 10	4	500	2 L	10 L	10 ID	7.37	2.0
12A	BS4 73-2972		9 - 12	9 - 12	8	1 L	4 L	20 L	12 ID	8	2.0
14A	BS4 73-2973		11 - 14	11 - 14	8	1 L	4 L	20 L	14 ID	9	2.0
16A	BS4 73-1056		12 - 16	12 - 16	20	2.5 L	10 L	50 L	16 ID	10	2.0
20A	BS4 73-2974		16 - 20	16 - 20	20	2.5 L	10 L	50 L	20 ID	12	2.0
24A	BS4 73-2975		19 - 24	19 - 24	40	5 L	20 L	100 L	24 ID	15	2.0
28A	BS4 73-2976		22 - 28	22 - 28	40	5 L	20 L	100 L	28 ID	17	2.0
32A	BS4 73-2977		25 - 32	25 - 32	80	10 L	40 L	200 L	32 ID	20	2.0
36A	BS4 73-2978		28 - 36	28 - 36	80	10 L	40 L	200 L	36 ID	22	2.0
1N	BS4 73-0144		n/a	1.2 tube ID	0.05	2	20	30	25		1.0
2N	BS4 73-0233		n/a	3.2 tube ID	0.1	25	100	150	42		1.0
4N	BS4 73-1190		n/a	4.8 tube ID	0.4	100	400	600	61		1.0
6N	BS4 73-1191		n/a	6.3 tube ID	1	250	1 L	1.5 L	70		1.0
8N	BS4 73-1192		n/a	9.5 tube ID	2	500	2 L	3 L	96		1.0
12N	BS4 73-1193		n/a	12.7 tube ID	8	1 L	4 L	6 L	85		1.0
16N	BS4 73-1194		n/a	19.0 tube ID	20	2.5 L	10 L	15 L	88		1.0
20N	BS4 73-1195		n/a	22.2 tube ID	20	2.5 L	10 L	15 L	96		1.0

For PLUGSYS TTFM Module and PLUGSYS Cases, see page J20.

# Blood Pressure Systems

## SC1000 Blood Pressure Analysis System for Mice and Rats (NIBP)



- Single or Dual Channel Operation (requires additional specimen platform)
- Simultaneous measurements on two animals
- “V-Notch” sensor assembly helps to stabilize the tail
- Interchangeable Specimen Platforms
- Uses standard latex balloons in tail-cuff
- Rugged all metal construction with epoxy coating
- Holders available in four standard sizes
- Custom Algorithms designed specifically for non-invasive measurements
- Fast and Accurate measurements for pulse, diastolic, systolic and MAP
- Precise Correlation with intra-arterial measurements

The SC1000 combines the latest in blood pressure analysis technology with the economy of single channel operation. Measurement results include Pulse Rate, Systolic, Diastolic, and MAP. The system is expandable by easily adding a second specimen platform for use with either mice or rats. All measurement results correlate precisely with intra-arterial methods and the data is automatically saved for exporting to any common spreadsheet. The SC1000 is accurate, efficient and time saving.

The SC1000 incorporates custom algorithms for measuring diastolic blood pressure independently of systolic pressure. Other systems calculate the diastolic pressure based on the systolic measurement. The parameter settings for determining diastolic and systolic BP are adjustable by the user. This feature allows the user to make adjustments to the system settings for correlation with simultaneous intra-arterial measurements.

Measurement data collected by the SC1000 can be retrieved by the user by paging through the measurement results with the keypad and recording them manually as they are displayed on the vacuum fluorescent display. A more automated collection method can be utilized by connecting the SC1000 to a Palm Pilot or other PDA through the onboard RS232 serial port. The PDA Interface works with any Palm OS® based system such as a Palm IIIc® or other handheld device. By using the PDA Interface, measurement data can be automatically stored. The stored data can be imported to a PC for viewing the measurement waveforms. For complete automation, the SC1000 may be connected to a notebook or desktop computer for data collection and control, real-time viewing of the pulse waveform, and storage of all results and waveform data in computer files. The results data and associated waveforms can be retrieved at any time for review and analysis. In addition, the results data can be exported as a .csv file for use in any common spreadsheet.

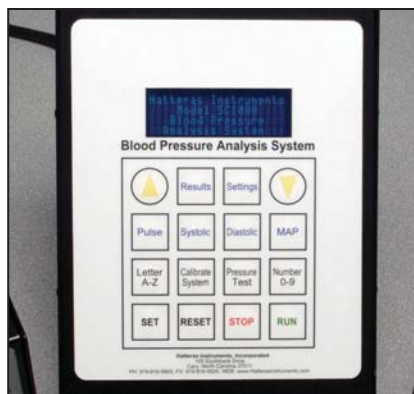
Pulse Detection is accomplished with a very sensitive solid-state photodiode detector in combination with a high intensity light emitting diode. The specially designed “V” shaped sensor assembly helps stabilize the animals’ tail.

The animal holders are especially designed to minimize the difficulty of securing untrained animals when making blood pressure measurements. Each system is supplied with one size 1 specimen holder. Other size holders are available separately. The control unit can accept a second specimen platform thus making it a dual channel system. The specimen platform is species specific, but the control unit is non-specific. Therefore you may use 2 rat platforms, 2 mice platforms or 1 rat and 1 mouse platform.



# Blood Pressure Systems

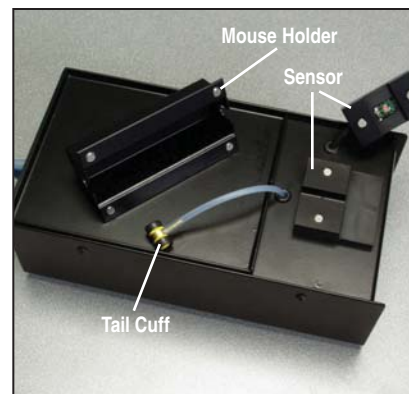
## SC1000 Blood Pressure Analysis System for Mice and Rats (NIBP)



BS4 72-7073 & BS4 72-7074 SC1000  
Control Unit Keypad



BS4 72-7073 & BS4 72-7074 SC1000  
Control Unit Backside



BS4 72-7075 Additional Mouse Platform

### The SC1000 Blood Pressure Analysis System includes:

- Master Control Unit
- Specimen Platform for either mouse or rat with one size 1 specimen holder
- Airline, power cable and interconnect cable
- Accessory Kit (contains tail-cuff balloons, tool for making end caps, etc.)
- Operator's Manual

### The following is optional equipment or software:

- Additional specimen platform
- Different size specimen holders
- Palm PDA (consult factory for models available)
- SC1000 Palm OS® Version Software
- SC1000 Comm for Windows® Software

Catalog No.	\$	Product
BS4 72-7073		SC1000 Blood Pressure Analysis System for Mice, 85 to 240 VAC, 50/60 Hz*
BS4 72-7074		SC1000 Blood Pressure Analysis System for Rats, 85 to 240 VAC, 50/60 Hz*
BS4 72-7075		Additional Mouse Platform with Size 1 Mouse Holder and CAT5 Cable
BS4 72-7076		Additional Rat Platform with Size 1 Rat Holder and CAT5 Cable
BS4 72-7077		Palm PDA (consult factory for models available)
BS4 72-7078		SC1000 Comm for Windows® Software
BS4 72-7079		SC1000 Palm OS® Version Software
<b>Accessories</b>		
BS4 72-7084		Specimen Holder for Mice, Size 1, for Mice Up to 30 Grams
BS4 72-7085		Specimen Holder for Mice, Size 2, for Mice 30 to 45 Grams
BS4 72-7086		Specimen Holder for Mice, Size 3, for Mice 45 to 60 Grams
BS4 72-7087		Specimen Holder for Mice, Size 4, for Mice Over 60 Grams
BS4 72-7102		Specimen Holder for Rats, Size 1, for Rats Up to 250 Grams
BS4 72-7103		Specimen Holder for Rats, Size 2, for Rats 250 to 400 Grams
BS4 72-7104		Specimen Holder for Rats, Size 3, for Rats 400 to 550 Grams
BS4 72-7105		Specimen Holder for Rats, Size 4, for Rats 550 to 700 Grams
BS4 72-7106		Specimen Holder for Rats, Size 5, for Rats 700 to 850 Grams
BS4 72-7107		Specimen Holder for Rats, Size 6, for Rats 800 to 1000 Grams

\*Note: All units are supplied with USA standard power cords.

# Blood Pressure Systems

## MC4000 Multi-Channel Blood Pressure System (NIBP)



- For Mice and Rats
- Multi-Channel System
- Large populations of animals can be easily evaluated
- Analysis time in the lab is greatly reduced while accuracy is improved
- Record keeping and reporting is simplified by the database software
- Custom Algorithms designed specifically for non-invasive measurements
- Fast and accurate measurements for pulse, diastolic, systolic and MAP
- Precise correlation with intra-arterial measurements
- Waveform Data Conversion for determining cardiovascular function
- Adjustable System Parameters for customizing experiments
- Dual Specimen Platform Operation for increased capability

The MC4000 Blood Pressure Analysis System is a totally automated computer controlled blood pressure analysis system that can be used with mice and rats. The system is non-invasive and can simultaneously obtain 15 measurements in less than 15 minutes on four animals. Measurement results include the mean and standard deviation for pulse, systolic, diastolic and MAP. The diastolic pressure is measured, not calculated. The custom designed software includes a built-in database for saving and organizing the results data and allows the user to produce inquiries and generate reports. In addition, the waveform data can be saved for each measurement for later viewing and additional analysis.

The Specimen Platform has a removable specimen tray with animal holders that are magnetically coupled to the tray. The tray helps to contain any solids and liquids that result during measurements thus making clean up easier. It also protects the specimen platform. A vacuum fluorescent display provides system status during measurements. The computer controlled platform temperature is also displayed for each channel.

Pulse detection is accomplished with a very sensitive solid-state photodiode detector in combination with a high intensity light emitting diode. The specially designed "V" shaped sensor assembly helps stabilize the animals' tail.

The Power Unit supplies electrical power and air to the Specimen Platform. Dual Specimen Platforms can be supplied from a single Power Unit.

The animal holders are especially designed to minimize the difficulty of securing untrained animals when making blood pressure measurements. This system is supplied standard with size 1 specimen holders for either mice or rats. Different size holders are available separately.

Measurement waveform data collected by the MC4000 is automatically saved and can be retrieved by the user at any time for additional analysis. Measurement results are also automatically saved and in addition to being incorporated into the database they can be exported to any common spreadsheet software program. Another function of the software supplied with the system allows the user to retrieve a stored measurement and extract the waveform data in .csv format with the time and voltage levels reported as text values.

The MC4000 can be expanded for dual platform operation by adding another specimen platform. The platforms are connected to the power unit through a molded DB15 cable. Connection of the platform to a portable or desktop computer is through a standard RS232 serial port with a null-modem cable.

### Viewing Waveforms

While obtaining measurements, the signal waveform is displayed in real-time. The data is scrolled on the display screen rather than repeatedly redrawn as is standard with other systems. When the waveform data is viewed after saving, the amplitude and time axis can be scaled for an up close view of any portion of the waveform. In addition, the waveform graph can be copied and pasted into common software such as Word for Windows®, PowerPoint® or many others. This feature allows a researcher to produce efficient and professional looking reports.

## MC4000 Multi-Channel Blood Pressure System (NIBP)



### The MC4000 Blood Pressure Analysis System includes:

- Custom Blood Pressure Analysis Software
- Power/Utility Unit
- Multi-channel Specimen Platform with 4 size 1 specimen holders for either mice or rats
- Airline, power cables, interconnect cables
- Accessory Kit (contains tail-cuff balloons, tool for making end caps, etc.)
- Operator's Manual

### The following is optional equipment:

- Additional specimen platform
- Different size mouse and rat holders

This Blood Pressure Analysis System is supplied standard with 1 specimen platform and 4 specimen holders. To increase the system's capacity, simply purchase a second specimen platform. This will allow up to 8 animals to be studied.

### Specifications

#### Dimensions, H x W x D

Mouse Platform	10.2 x 43.2 x 27.9 cm (4 x 17 x 11 in)
Rat Platform	10.2 x 50.8 x 35.6 cm (4 x 20 x 14 in)
Power	85 to 240 VAC, 50/50 Hz*

\*All units are supplied with USA standard power cords

Catalog No.	\$	Product
BS4 72-7080		MC4000 Blood Pressure Analysis System for Mice
BS4 72-7081		MC4000 Blood Pressure Analysis System for Rats
BS4 72-7082		Additional Specimen Platform for Mice, includes multi-channel specimen platform, four size 1 mouse holders, necessary power and communications cables and accessory kit
BS4 72-7083		Additional Specimen Platform for Rats, includes multi-channel specimen platform, four size 1 rat holders, necessary power and communications cables and accessory kit
<b>Accessories</b>		
BS4 72-7084		Specimen Holder for Mice, Size 1, for Mice Up to 30 Grams
BS4 72-7085		Specimen Holder for Mice, Size 2, for Mice 30 to 45 Grams
BS4 72-7086		Specimen Holder for Mice, Size 3, for Mice 45 to 60 Grams
BS4 72-7087		Specimen Holder for Mice, Size 4, for Mice Over 60 Grams
BS4 72-7102		Specimen Holder for Rats, Size 1, for Rats Up to 250 Grams
BS4 72-7103		Specimen Holder for Rats, Size 2, for Rats 250 to 400 Grams
BS4 72-7104		Specimen Holder for Rats, Size 3, for Rats 400 to 550 Grams
BS4 72-7105		Specimen Holder for Rats, Size 4, for Rats 550 to 700 Grams
BS4 72-7106		Specimen Holder for Rats, Size 5, for Rats 700 to 850 Grams
BS4 72-7107		Specimen Holder for Rats, Size 6, for Rats 800 to 1000 Grams

# Blood Pressure Systems

## **NEW** Advanced NIBP Auto Inflate Blood Pressure Monitor



- Automatic Cuff Inflation
- Non-Invasive Tail Cuff
- Automatic Calculation of Systolic, Diastolic and Mean Blood Pressures
- Continuous Heart Rate Monitor
- Digital Display of all pressures and heart rate
- Analog Outputs for Pressure, Heart Rate and Cardiac Trace
- Continuous Measuring to memory
- Variable Pulse Gain and Respiration Filter
- Digital Signal Processing
- Printer Connection
- Serial connection to PC

The New Harvard Apparatus Advanced Blood Pressure Monitor uses a non-invasive cuff to measure blood pressure indirectly based upon the Korotkoff method, which is accurate to within 10 mm/Hg of a direct blood pressure measurement.

The main feature of this system is its ability to be able to perform continuous measurements of blood pressure as a completely stand alone system, using an internal pump to automatically inflate the cuff. The system can run in two automatic modes continuous and single, and features all the necessary outputs and connections to form a highly sophisticated blood pressure monitoring system.

In continuous mode the system will automatically measure, store and display blood pressure and heart rate at user specified intervals. The system can store 99 sets of measurements internally. These can be recalled and viewed using the built in display or a printer may be connected allowing the results to be printed as a table.

When running in single mode a single measurement only will be made and recorded each time the start key is pressed, after which the results will be stored in the internal memory.

Each time a set measurement is completed it is given a number so that it can be identified when it is recalled from the memory.

The memory stores all blood pressure measurements (systolic, diastolic, and mean), heart rate and the time since the previous measurement as well as the identifying number for each set of results.

An output may be configured representing the pressure as a voltage. The output can be set to represent systolic, diastolic or mean blood pressures and an offset and calibration function provided.

There are two outputs for the cardio side of the system; one output is the cardiac trace of the subject. The other output is a voltage representation of the heart rate, which may be configured to show continuous heart rate, or the heart rate from the last measurement. A calibration facility is provided on this output as well.

A serial connection is provided on the rear panel and this allows the Blood Pressure Monitor to have full two-way communications with a PC, using dedicated software.

### Specifications

<b>Pressure Range</b>	0 to 300 mmHg Systolic 0 to 300 mmHg Diastolic 0 to 300 mmHg Mean
<b>Heart Rate Range</b>	0 to 1000 bpm
<b>Pressure Output</b>	0 to 300 mV equates to 0 to 300 mmHg
<b>Heart Rate Output</b>	0 to 1000 mV equates to 0 to 1000 bpm
<b>Cardiac Trace Output</b>	1 volt peak to peak
<b>Continuous Mode Time Interval</b>	60 sec to 600 sec
<b>Memory</b>	99 sets of results can be stored (1 Set = Exp No, Heart Rate, Systolic, Diastolic, Mean)
<b>Connections</b>	BNC Pressure Output Socket BNC Heart Rate Output Socket BNC Cardiac Trace Output Socket Centronix Printer Connection 9 Pin Serial Connection 9 Pin Remote Connection
<b>Power</b>	110-115 Volts 60Hz or 220-230 Volts 50Hz, switchable

Catalog No.	\$	Product
BS4 40-3000		RTBP Control Unit Only, 110V/230V Switchable
BS4 40-3002		RTBP Tail Cuff with Sensor for Mouse
BS4 40-3003		RTBP Tail Cuff with Sensor for 70-125 g
BS4 40-3004		RTBP Tail Cuff with Sensor for 100-150 g
BS4 40-3005		RTBP Tail Cuff with Sensor for 150-300 g
BS4 40-3006		RTBP Tail Cuff with Sensor for 350-500 g
BS4 40-3007		RTBP Tail Cuff with Sensor for 500-750 g
BS4 40-3008		RTBP Restrainer Standard for Mouse
BS4 40-3009		RTBP Restrainer Standard for 70-125 g
BS4 40-3010		RTBP Restrainer Standard for 100-150 g
BS4 40-3011		RTBP Restrainer Standard for 150-300 g
BS4 40-3012		RTBP Restrainer Standard for 350-500 g
BS4 40-3013		RTBP Restrainer Standard for 500-750 g
BS4 40-3014		RTBP Restrainer Heated for Mouse
BS4 40-3015		RTBP Restrainer Heated for 70-125 g
BS4 40-3016		RTBP Restrainer Heated for 100-150 g
BS4 40-3017		RTBP Restrainer Heated for 150-300 g
BS4 40-3018		RTBP Restrainer Heated for 350-500 g
BS4 40-3019		RTBP Restrainer Heated for 500-750 g
BS4 40-3020		RTBP Software Windows '98

## HSE-HA Electronic Pressure Calibrators



The calibrator KAL 84 is used for calibrating pressure sensors. It represents a combination of a pressure generator (hand pump) and a pressure meter with digital display. The instrument provides a simple means for testing and calibrating both pressure sensors and complete pressure measuring equipment. High accuracy and excellent reproducibility, together with a specially rugged construction, provide the unit with all the properties required for laboratory applications.

After the unit has been switched on and connected to the pressure sensor to be calibrated

(test object), the required pressure is set with the small hand-wheel. The built-in pressure meter measures the set pressure accurately and indicates it in digital form. Since the generated pressure is identical at the built-in pressure meter and at the test object, the pressure measured by the test object corresponds exactly to the pressure indicated by the KAL 84.

Models with different pressure ranges are available. Each model has an application-specific range (range 1) and can be switched to a corresponding SI range (range 2) in Pascal (Pa) or Kilopascal (kPa).

- Maintenance free
- 4 units available:
  - 0 to 200 mmHg
  - 0 to 300 mmHg
  - 0 to 20 mmH<sub>2</sub>O
  - 0 to 200 mmH<sub>2</sub>O
- Calibration certificate on request

### Specifications

<b>Range</b>	Measurement and calibration range for appropriate model (see table below)
<b>Linearity</b>	±0.5% FS ±1 digit for mercury models, ±1% FS ±1 digit for water models
<b>Hysteresis</b>	0.1% FS
<b>Overpressure Limit</b>	200% FS for mercury models 500% FS for water models
<b>Response Time</b>	T <sub>E</sub> = 20 ms, time constant can be switched to 0.1 sec or 1 sec
<b>Analog Output</b>	0 to 1 V for 100% nominal range, load resistance at least 2 kΩ
<b>Temperature Range:</b>	
<b>Nominal</b>	+10°C to +50°C
<b>Operating</b>	0°C to +60°C
<b>Pressure Connections</b>	6.5 mm OD for 5 mm ID tubing
<b>Power Supply</b>	9 V rechargeable battery, mains adapter
<b>Dimensions, H x W x D</b>	100 x 260 x 180 mm (3.9 x 10.2 x 7.1 in)
<b>Weight</b>	Approx. 3 kg (6.6 lb)
<b>Optional Certificate</b>	Linearity test certificate, DKD (German calibration service, see below)

### Electronic Pressure Calibrators

115 VAC, 60 Hz	230 VAC, 50 Hz	Model	Liquid	Range 1	Range 2	Used for Calibration of:
BS4 73-0012 \$	BS4 73-0013	KAL 84 H	Mercury	0 to 199.9 mmHg	0 to 26.66 kPa	Blood Pressure Transducer like ISOTEC, P23Db XL, Millar or Others
BS4 73-0014 \$	BS4 73-0015	KAL 84 SH	Mercury	0 to 300.0 mmHg	0 to 39.99 kPa	Blood Pressure Transducer like ISOTEC, P23Db XL, Millar or Others
BS4 73-0016 \$	BS4 73-0017	KAL 84 L	Water	0 to 19.99 mmH <sub>2</sub> O	0 to 196.0 Pa	Low-Range Differential Pressure Transducer like DP45-14 at 10 mmH <sub>2</sub> O as Nominal Value for PTM (Pneumotachometer)
BS4 73-0018 \$	BS4 73-0019	KAL 84 M	Water	0 to 199.9 mmH <sub>2</sub> O	0 to 1960 Pa	Low-Range Differential Pressure Transducer like DP45-24 or MPX, Type 399

Catalog No.	\$	Product
BS4 73-0977		Calibration Certificate with KAL84 Purchase
BS4 73-2918		Recalibration of KAL84 with certificate (Requires Return of Unit)

*For Pressure Transducers, see pages J2 to J5.  
For Differential Pressure Transducers, see page F42.*

## Vascular Occluders



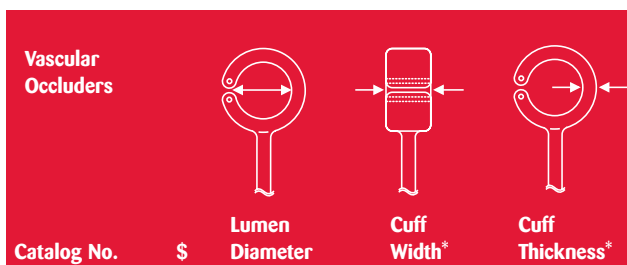
Vascular Occluders

- Total or partial occlusion
- Reliable determination of zero-flow baseline in blood flow measurements
- For acute or chronic studies
- Autoclavable

These vascular occluders are made entirely of silicone rubber, a material proven to be physiologically compatible. The occluder is a cuff and tube design. The cuff is secured around vessel or soft tissue organ using suture material. The tube is externalized to the animal at the desired site.

The site need not be near the occlusion location. To occlude the vessel, simply inject air or water in the actuating tubing with a syringe. This inflates the cuff diaphragm which occludes the vessel. To deflate, simply withdraw the air or water. The response is very rapid and may be maintained for several hours or as long as the occluder is pressurized. Occlusion is accomplished without traction on the vessel or displacement of surrounding tissues.

Both standard and heavy duty occluders are offered. They are supplied with a 90 cm actuating tubing. Other lengths are available by special order. Tubing diameter depends on cuff size. For cuffs measuring from 2 mm to 8 mm, the tubing measures 0.76 mm ID x 1.6 mm OD (0.030 x 0.065 in). For cuffs measuring from 10 mm to 24 mm, the tubing measures 1 mm ID x 2.1 mm OD (0.040 x 0.085 in).



Catalog No.	\$	Lumen Diameter	Cuff Width*	Cuff Thickness*
<b>Standard Occluders</b>				
BS4 72-6115		1.5 mm	5 mm	1.5 mm
BS4 62-0109		2 mm	5 mm	1.5 mm
BS4 62-0110		3 mm	5 mm	1.5 mm
BS4 62-0111		4 mm	5 mm	2 mm
BS4 62-0112		5 mm	5 mm	2 mm
BS4 62-0113		6 mm	7 mm	2 mm
BS4 62-0114		8 mm	7 mm	2 mm
BS4 62-0115		10 mm	8 mm	2 mm
BS4 62-0116		12 mm	8 mm	2.5 mm
BS4 62-0117		14 mm	8 mm	2.5 mm
BS4 62-0118		16 mm	12 mm	2.5 mm
BS4 62-0119		20 mm	12 mm	2.5 mm
BS4 62-0120		24 mm	12 mm	2.5 mm
<b>Heavy-Duty Occluders</b>				
BS4 62-0121		10 mm	9 mm	4 mm
BS4 62-0122		12 mm	9 mm	4 mm
BS4 62-0123		14 mm	9 mm	4 mm
BS4 62-0124		16 mm	13 mm	4 mm
BS4 62-0125		20 mm	13 mm	4 mm
BS4 62-0126		24 mm	13 mm	4 mm

\*Approximate dimensions.

## **NEW** Chart for Amplifier and Transducers Selection

Below is a chart that details which amplifier is used for measurement of a specific physiological parameter. Follow down the left hand column until you reach the parameter you want to measure and then move towards the right until you reach the column that displays the species you are studying. There may be a single transducer/sensor or multiple units to select from. Please see individual pages for complete product details.

Physiological Signal	Amplifier	Transducers											
		Mouse		Rat/Guinea Pig		Rabbit/Cat		Dog		Pig			
Left Ventricular Pressure (LVP)	TAM-A BS4 73-0065	SPR-835*	BS4 73-2899	SPR-407*	BS4 73-0230	SPC-320*	BS4 73-0928	SPC-350*	BS4 73-0889	SPC-350*	BS4 73-0889		
		SPR-671*	BS4 73-0880	SPR-249*	BS4 73-0908	SPC-330*	BS4 73-0877	SPC-360*	BS4 73-0881	SPC-360*	BS4 73-0881		
						SPC-340*	BS4 73-0879	SPC-370*	BS4 73-0882	SPC-370*	BS4 73-0882		
Aortic Pressure (AP)	TAM-A BS4 73-0065	ISOTEC	BS4 73-0089	ISOTEC	BS4 73-0089	ISOTEC	BS4 73-0089	ISOTEC	BS4 73-0089	ISOTEC	BS4 73-0089		
				P23XL	BS4 72-2880	P23XL	BS4 72-2880	P23XL	BS4 72-2880	P23XL	BS4 72-2880		
Central Venous Pressure (VP)	TAM-A BS4 73-0065	P75	BS4 73-0020	P75	BS4 73-0020	P75	BS4 73-0020	P75	BS4 73-0020	P75	BS4 73-0020		
	TAM-D BS4 73-1793												
Pulmonary Artery Pressure (PAP)	TAM-A BS4 73-0065	P75	BS4 73-0020	P75	BS4 73-0020	P75	BS4 73-0020	P75	BS4 73-0020	P75	BS4 73-0020		
Aortic Flow (AF)	TTFM BS4 73-0146	1.0RB**	BS4 73-1057	2SB**	BS4 73-1181	4SB**	BS4 73-1184	14AX**	BS4 73-2973	16AX**	BS4 73-1056		
		1.5RB**	BS4 73-1058	2.5SB**	BS4 73-1182	6SB**	BS4 73-1185	16AX**	BS4 73-1056	20AX**	BS4 73-2974		
				2.0RB**	BS4 73-1062	8SB**	BS4 73-1186	20AX**	BS4 73-2974	24AX**	BS4 73-2975		
									28AX**	BS4 73-2976			
Carotid Artery Flow (CAF)	TTFM BS4 73-0146	0.5V**	BS4 73-2969	1.0RB**	BS4 73-1057	1.5RB**	BS4 73-1058	3RB**	BS4 73-1063	8SB**	BS4 73-1186		
		0.7V**	BS4 73-2970	1.5RB**	BS4 73-1058	2.0RB**	BS4 73-1062	4RB**	BS4 73-1064	10SB**	BS4 73-1187		
				2.0RB**	BS4 73-1062	2.5SB**	BS4 73-1182	5RB**	BS4 73-1068	12SB**	BS4 73-1066		
								6RB**	BS4 73-1065	14SB**	BS4 73-1188		
								8RB**	BS4 73-1069	16SB**	BS4 73-1067		
Femoral Artery Flow (FAF)	TTFM BS4 73-0146	0.5V**	BS4 73-2969	1.0RB**	BS4 73-1057	1.5RB**	BS4 73-1058	3RB**	BS4 73-1063	8SB**	BS4 73-1186		
		0.7V**	BS4 73-2970	1.5RB**	BS4 73-1058	2.0RB**	BS4 73-1062	4RB**	BS4 73-1064	10SB**	BS4 73-1187		
				2.0RB**	BS4 73-1062	2.5SB**	BS4 73-1182	5RB**	BS4 73-1068	12SB**	BS4 73-1066		
								6RB**	BS4 73-1065	14SB**	BS4 73-1188		
								8RB**	BS4 73-1069	16SB**	BS4 73-1067		
Coronary Artery Flow (CF)	TTFM BS4 73-0146	–		–		1.0RB**	BS4 73-1057	1.0RB**	BS4 73-1057	2RB**	BS4 73-1062		
						2.0RB**	BS4 73-1062	2RB**	BS4 73-1062	3RB**	BS4 73-1063		
								3RB**	BS4 73-1063	4RB**	BS4 73-1064		
ECG	ECGA BS4 73-0149	Needles# BS4 59-8526	Needles# BS4 59-8526	Needles# BS4 59-8526	Needles# BS4 59-8526	Needles# BS4 59-8526	Needles# BS4 59-8546	Needles# BS4 59-8546	Needles# BS4 59-8546	Needles# BS4 59-8546	Needles# BS4 59-8546		
	EGM BS4 73-1778											Adhesive# BS4 73-3022	Adhesive# BS4 73-3022
	WLA BS4 73-1779												
MAP	BPA BS4 73-0153	Tip	BS4 73-0150	Tip	BS4 73-0150	Standard	BS4 73-0409	Standard	BS4 73-0409	Standard	BS4 73-0409		
	MAPM BS4 73-1780												
Segment Length, Wall Thickness	EIM*** BS4 73-0222	–		SA5-2	BS4 73-3463	SL5-2	BS4 73-0217	SL5-2	BS4 73-0217	SL5-2	BS4 73-0217		
	SNM*** BS4 73-0218					WT5-2	BS4 73-0618	WT5-2	BS4 73-0618	WT5-2	BS4 73-0618		
Wall Thickening	EIM*** BS4 73-0222	–		–		DMT20-1	BS4 73-3466	DMT10-1	BS4 73-3464	DMT10-1	BS4 73-3464		
	DDM*** BS4 73-0785					DMT20-2	BS4 73-3467	DMT10-2	BS4 73-3465	DMT10-2	BS4 73-3465		
Temperature	TCAM BS4 73-1792	RET-3	BS4 52-1591	RET-2	BS4 52-1583	RET-1	BS4 52-1526	RET-1	BS4 52-1526	RET-1	BS4 52-1526		

\* The Millar Tip pressure transducers for LVP measurement need a TC-510 control unit (BS4 73-0232) to be connected to the amplifier

\*\* The type of reflector and the type of connector must be specified (acute or chronic application) for all the flowprobes

\*\*\* The measurement of dimensions (wall thickness, segment length, wall thickening) requires an external amplifier system (System 6 case BS4 73-0216 with Sonomicrometer Module BS4 73-0218 or Doppler displacement Module BS4 73-0785), the signals are linked to the PLUGSYS system using the EIM module

# HSE-HA Cardiovascular Setups

Specialized Tools For Bioresearch

## Typical Cardiovascular Setups

Determine what type of cardiovascular studies will be performed and choose the appropriate components. Some typical cardiovascular setups are shown below.

### For Blood Pressure Measurements



TAM-A



TAM-D



Aortic Pressure (Isotec)



Venous Pressure (P75)



Left Ventricular Pressure (Millar)

### For ECG Measurements



ECGA



EGM



WLA



Needle Electrodes



Adhesive Electrodes

### For Heart Dimensions Measurements



EIM



Model 6 with SNM & DDM



Segment Length SL5



Wall Thickness WT5



Wall Thickening DMT

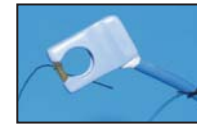
### For Blood Flow Measurements



TTFM



Peripheral, Coronary Flow



Aortic Flow

### For MAP Measurements



MAPM



BPA

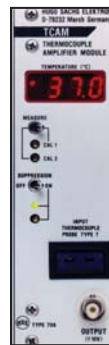


Electrode for Rodents



Electrode for Large Species

### For Temperature Measurements



TCAM



RET-1 for Large Animals



RET-2 for Rats Guinea-Pig



RET-3 for Mouse



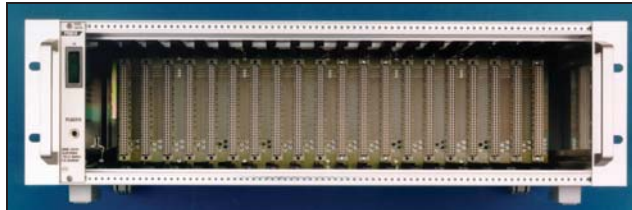
## PLUGSYS Measuring and Control Modules for Cardiovascular Studies

### How to...

#### 1. Select what parameter you are measuring:

The chart on the facing page shows basic equipment required to perform certain measurements for cardiovascular studies. Once you have selected the appropriate sensors and PLUGSYS amplifier module(s), you must select a PLUGSYS case to house the amplifier modules.

#### 2. Select your PLUGSYS Case:



PLUGSYS Case 603

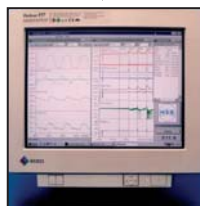
There are 3 cases available. The Mini Case 609 is 4 slot units wide. The second case available is the Model 601. It is 10 slot units in width and can accommodate more amplifier modules. The last case is the Model 603. This is the largest case with 20 slot units of width. Most PLUGSYS amplifier modules are 2 slots wide, but there are some that are wider and some that are narrower. Please review the specification details on each PLUGSYS module you require so that you purchase the correct case.

#### 3. Select how you want to record your data:

To a Data Acquisition System



PLUGSYS Hardware



HAEMODYN Software

To Printer



ROM



Recorder

Once you have selected the case, you must decide how you want to record your measured signal(s). You can select to take the signal to a data acquisition system or a more traditional chart recorder. For either option you must purchase hardware to make the connection between the back of the PLUGSYS case and the computer or printer. Please see the Physiology Section I for complete details on the hardware, cases and other amplifier modules.



- Left ventricular pressure
- Arterial pressure
- Venous pressure
- Blood flow
- Heart rate
- ECG
- dp/dt and more!

Typical setup for haemodynamic studies on rodents. Other systems available for dogs, cats and other species with HSE-HA HAEMODYN Software.

#### Catalog No. \$ Product

##### Equipment Required for Inserting PLUGSYS Amplifier Modules

BS4 73-0045 PLUGSYS Basic System Case Type 603

##### Equipment Required for Arterial Pressure Measurement:

BS4 73-0065 TAM-A Transducer Amplifier Module

BS4 73-0089 ISOTEC Pressure Transducer

BS4 73-0096 3-Way Stopcock Type 9560 R

BS4 73-0097 1-Way Stopcock Type 9500

BS4 73-0098 Stand For ISOTEC

##### Equipment Required for ECG Analysis:

BS4 73-0149 ECGA PLUGSYS ECG Amplifier Module

##### Equipment Required for Left Ventricular Pressure Measurement in Rodents:

BS4 73-0065 TAM-A Transducer Amplifier Module

BS4 73-2908 Control Unit Model TC-510

BS4 73-2907 TC-510 Adapter Cable

BS4 73-0908 Millar-Tip-Catheter SPR 249 3 F

##### Equipment Required for Left Ventricular Pressure Measurement in Dogs:

BS4 73-0065 TAM-A Transducer Amplifier Module

BS4 73-2908 Control Unit Model TC-510

BS4 73-2907 TC-510 Adapter Cable

BS4 73-0880 Millar-Tip-Catheter SPC 350 5 F

##### Equipment Required for Venous Pressure Measurement:

BS4 73-0065 TAM-A Transducer Amplifier Module

BS4 73-0020 Pressure Transducer P75, see page J3

BS4 73-0096 3-Way Stopcock Type 9560 R

BS4 73-0097 1-Way Stopcock Type 9500

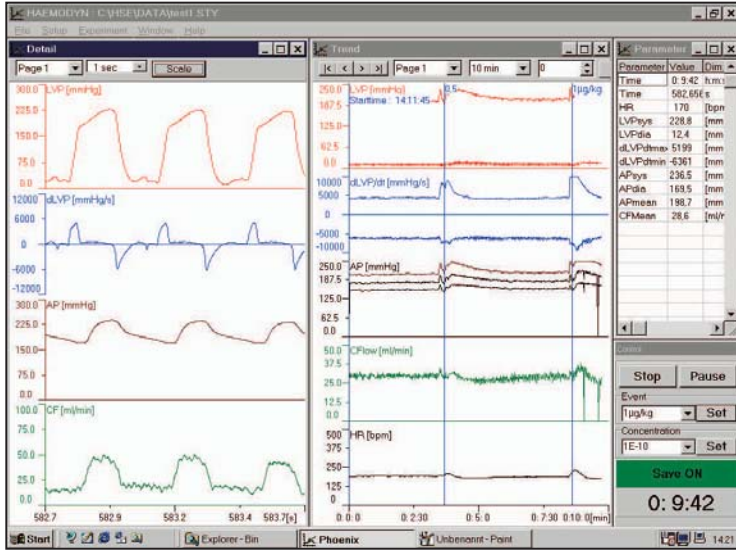
BS4 73-0500 Stand with Triangular Base

##### Equipment Required for Data Acquisition:

BS4 73-0161 HSE-HA Data Acquisition Hardware, PLUGSYS Version

BS4 73-1690 HSE-HA HAEMODYN W Software

## HSE-HA HAEMODYN® W for Haemodynamic Studies



- 16-channel data acquisition software for haemodynamic experiments
- For Windows® NT, 2000 or XP
- To measure signals such as left ventricular pressure, aortic pressure, aortic flow, atrial pressure, atrial flow, coronary flow, length measurement, pO<sub>2</sub>, pCO<sub>2</sub>, pH, temperature, etc.
- Easy to use, reduced settings by using configuration files
- Storage of raw data with possibility for replay — complete experiments can be replayed
- Indication of the measured signals and parameters online in numerical tabular form or graphical detail and trend windows
- Allows data exchange interface by converting the data into the ASCII delimited format
- Monitors the experimental sequence by placing event markers and concentration information
- Very easy graphical selection of specific data points by cursors for evaluation, data reduction and export
- Export of a raw data sequence into ASCII delimited format

The HSE-HA HAEMODYN software can be adapted to virtually any experimental investigation for haemodynamic experiments. Acquisition can cover signals such as left ventricular pressure, aortic pressure, aortic flow, atrial pressure, atrial flow, coronary flow, segment length and wall thickness measurement, pO<sub>2</sub>, pCO<sub>2</sub>, pH, temperature, etc. Various parameters can be derived from these signals, e.g. systolic, diastolic, mean and rate (frequency) values for pressures, dp/dt, contractility index CI, minimal, maximal, and mean flows, etc. During data acquisition, all acquired signals and derived parameters are stored on the hard disc and can be displayed on the screen.

The HSE-HA HAEMODYN software is available in a basic version which includes the minimal necessary algorithms that can be upgraded to a more complex system including all the available algorithms. The configuration of the system is defined in configuration files to reduce the amount of settings necessary and to ensure a stable and secure system. The user only needs to calibrate the signals and fix the graphics scaling. All the hardware definitions and algorithms used are defined in the configuration files. This reduces the amount of information necessary in the SOP's and the possibility of wrong settings. The configuration files can be changed and the software used in combination with a set of different configuration files to match the different experiments.

## HSE-HA HAEMODYN® W for Haemodynamic Studies

HAEMODYN is a menu-controlled software and employs special algorithms to calculate the standard haemodynamic parameters.

The HSE-HA HAEMODYN software has a maximum of 16 channels, i.e. up to 16 different raw signals can be handled. The assignment of the signals to the individual channels is determined in the configuration files. The sample rate, the type of signals and the algorithm used for analysis are also defined in the configuration file. The arrangement of the graphic detail (raw signals) and trend (calculated parameters) is defined in the menu. The user has only to set up which of the available signals he wants to acquire and display, which of the possible parameters he wants to evaluate and display, enter the experimental protocol, and finally calibrate before he starts the data acquisition.

### The HSE-HA Data Acquisition Hardware for HAEMODYN W software is available in three versions:

- **PLUGSYS Version**

This version consists of the PCI A/D board DT301, ROM-DL, DIM and the cable for connecting to a DIM Data Interface Module installed in the PLUGSYS basic system case, see Section I

- **Stand Alone Version**

This version consists of the PCI A/D board DT301, connection cable and a BNC input box where signals from external amplifiers can be connected.

- **USB Stand Alone Version**

This version consists of a USB connection cable and a USB input box where signals from amplifiers can be connected.

### Hardware requirements for HAEMODYN:

Both the PLUGSYS and stand alone versions require the following computer hardware:

Computer	PC Pentium at least 500 MHz with one free PCI-slot
RAM	28 MB of RAM
Operating System	Windows 2000/XP or 64 MB RAM Windows NT
Hard Disk Space	With at least 3.2 Gbytes
Floppy Drive	1.44 MB
CD-ROM Drive	Required
Monitor	17 or 19 inch
Backup Media	MO drive, CD recorder or ZIP drive

### Commonly used signals on haemodynamic experiments are:

LVP	Left Ventricular Pressure
AP	Arterial Pressure
VP	Venous Pressure
CF	Coronary Flow
AF	Arterial Flow
WT	Wall Thickness or Left Ventricle Diameter
EKG	Electrocardiogram
pO <sub>2</sub>	Oxygen Partial Pressure
pCO <sub>2</sub>	Carbon Dioxide Partial Pressure pH

It is also possible to acquire other signals such as temperature. The maximum number of signals is 16.

### The basic version of HAEMODYN calculates the following parameters online:

From LVP Signal	LVPsys, LVPdia, LVPEDP, dP/dtmin, dP/dtmax, Heart Rate, Mean Pressure
From All Pressures	Systolic, Diastolic and Mean Pressure, Heart Rate
From All Flows	Mean, Max. and Min. Flow
From Distance	Max., Min. and Amplitude (Max-Min)
From Electrogram	Only the Heart Rate
From pO <sub>2</sub> Signals	Mean Value
From pCO <sub>2</sub> Signals	Mean Value
From pH Signals	Mean Value

It is also possible to calculate specific values from these parameters by writing a formula (e.g., the ratio of  $dP/dt_{min} / dP/dt_{max}$  or  $LVP_{EDP} / \text{heart rate}$ , etc.).

### Optional software modules are available for:

LVP Advanced	Tau, Time to Peak (Contractility Time), Relaxation Time and Contractility Index $CI = dP/dt_{max} / P$
Flow Advanced	Endsystolic Flow, Enddiastolic Flow
Respiration Module	Respiratory Rate, Max. Inspiratory Flow, Max. Expiratory Flow, Tidal Volume

Specific parameters which are not mentioned in this list are available by special order. Please call Harvard Apparatus Technical Customer Service for more details.

Catalog No.	\$	Product
BS4 73-1690		HSE-HA HAEMODYN W Data Acquisition Software for Windows® NT/2000/XP
BS4 73-0161		HSE-HA Data Acquisition Hardware PLUGSYS Version
BS4 73-0235		HSE-HA Data Acquisition Hardware Stand Alone Version
BS4 73-3330		HSE-HA Data Acquisition Hardware USB Stand Alone Version
BS4 73-0237		Optional LVP Advanced Software Module
BS4 73-0238		Optional Flow Advanced Software Module
BS4 73-0239		Optional Respiration Software Module
BS4 73-2900		Print Option for HAEMODYN Software

*For Blood Pressure Transducers, see pages J2 to J5.*

*For Information on PLUGSYS Amplifier Modules for Haemodynamic Studies, see page J16.*

## HSE-HA PLUGSYS Modules



### Transonic Transit Time Flowmeter Module (TTFM)

The Transit Time Flowmeter (TTFM) is an ultrasonic Transit Time flowmeter for animal research. It incorporates a complete 1-channel Transonic® ultrasonic transit time flowmeter. It can be used either with in-line flow probes or perivascular probes from Transonic®.

An extensive selection of probes for vessel diameters from 0.5 to 36 mm are available for chronic and acute studies. The extracorporeal in-line-probes, ideal for isolated organ preparations, are available in sizes from 1.2 to 22.2 mm. The module features a built-in digital display for direct reading of mean flow and an analog instrument to show flow, signal quality and scale factors. The TTFM has mean and pulsatile outputs for recording, both can be used simultaneously.

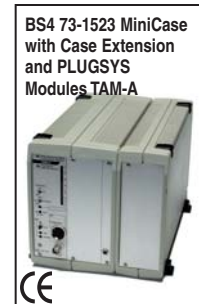
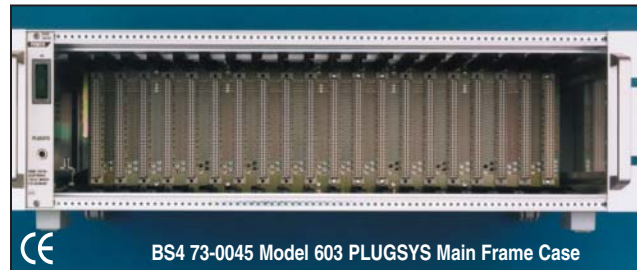
### Specifications

<b>Digital Display</b>	Shows average flow rate in ml/min or L/min
<b>Analog Display</b>	For monitoring analog flow, quality of ultrasound signal and scale factors; analog display also shows flow signal in MEAS. mode, signal quality in TEST mode and scale factors in CAL mode
<b>Normal/Loflow</b>	Loflow scale selection for increased sensitivity (x4) on low flows
<b>Zero Flow</b>	Automatic zero adjustment by pressing button
<b>MEAS/CAL/TEST</b>	Switch to select three modes: Measure/Calibration/Test
<b>Zero/Scale</b>	Delivers 0 flow and scale flow signal at output for calibrating connected recorder or data acquisition systems; scale factor depends on connected probe
<b>Flow Direction</b>	Can be inverted by switch polarity in case flow probe mounted in wrong direction
<b>Low-Pass Filter</b>	Three filter positions (100/30/10 Hz) for smoothing pulsatile output; 0.1 Hz fixed for mean output
<b>Signal Output</b>	<ol style="list-style-type: none"> <li>On front panel through BNC sockets <math>\pm 10</math> Volt FS, pulsatile and mean</li> <li>Through bus connector to PLUGSYS measuring system (jumper selectable) <math>\pm 10</math> V FS, pulsatile and mean</li> </ol>
<b>Synchronization</b>	For applications with two or more TTFM modules, synchronization output or input can be connected on PLUGSYS bus; selector on unit selects master or slave mode
<b>Power Supply</b>	5 V 0.6 A through connector from PLUGSYS bus system
<b>PLUGSYS Width</b>	4 slot units
<b>Connector</b>	DIN 41612, 96-pin VG

Catalog No.	\$	Product
BS4 73-0146		Transit Time Flowmeter Module TTFM

See pages J6 and J7 for Flow Probes  
TTFM flowmeter cannot be purchased as a stand alone flowmeter. Please call for details.

## HSE-HA PLUGSYS System Cases and Minicase



The PLUGSYS system is a modular amplifier and case system. There are 3 available cases to select from depending on your application needs. For full details and specifications on the cases, see the Physiology Section I.

### Specifications

#### Dimensions, H x W x D:

<b>PLUGSYS Case 603</b>	132 x 483 x 435mm (5.2 x 19 x 17.1 in)
<b>PLUGSYS Case 601</b>	150 x 235 x 420mm (5.9 x 9.25 x 16.5 in)
<b>PLUGSYS Case 609</b>	160 x 160 x 250mm (6.3 x 6.3 x 9.8 in)

#### Weight:

<b>PLUGSYS Case 603</b>	6.5 kg (14.3 lbs)
<b>PLUGSYS Case 601</b>	4.8 kg (10.6 lbs) without PLUGSYS modules
<b>PLUGSYS Caset 609</b>	1.4 kg (3.1 lbs) approx. without PLUGSYS modules

#### Power:

<b>PLUGSYS Case 603</b>	110/220 VAC, 50/60 Hz, built-in line filter
<b>PLUGSYS Case 601</b>	85 to 264 VAC (40 Watts)
<b>PLUGSYS Caset 609</b>	85 to 264 VAC (40 Watts)

#### Module Positions:

<b>PLUGSYS Case 603</b>	20 slot units maximum
<b>PLUGSYS Case 601</b>	10 slot units maximum
<b>PLUGSYS Caset 609</b>	4 slot units maximum

Catalog No.	\$	Product
BS4 73-1521		PLUGSYS Case, Type 601
BS4 73-0045		PLUGSYS Case, Type 603
BS4 73-1523		PLUGSYS Minicase, Type 609