Product Overview

Sophisticated Life Science Research Instrumentation

TSE Blood Pressure Monitor

Non-Invasive-209002series

Automatic multi-channel system for the determination of systolic blood pressure and heart frequency

www.TSE-Systems.com

Rel. June 2005

TSE Blood Pressure Monitor

Non-Invasive - 209002series

General information

Measuring blood pressure non-invasively in laboratory animals has now become easy using the fully computerized microprocessor-based **TSE Non-Invasive Blood Pressure Monitoring System, 209002series**.

Measurement is performed ***non-invasively*** on the tail of the conscious, unanesthetized animal with the aid of a pressure cuff ("Tail-Cuff Method“) and an animal-specific pulse transducer.

The system accurately and reliably determines heart rate and systolic arterial blood pressure in up to 72 measuring channels simultaneously facilitating rapid screening of large animal populations.

The rodent system

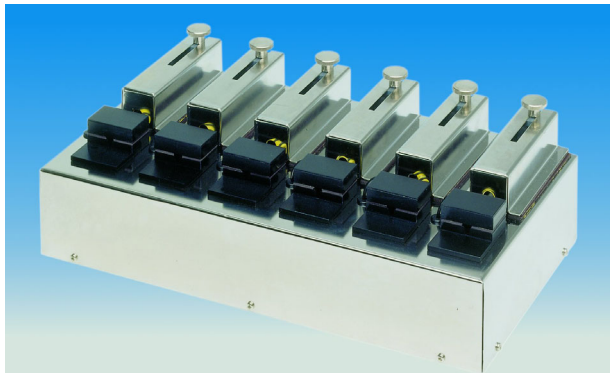
The rodent system (mice & rats) is based on an **opto-electronic** detection mechanism. The newly-designed opto-electronic transducer is the heart of the system, which is available in ***advanced*** or ***basic*** configuration. Its components are:

- pulse transducers,
- pressure cuffs with pressure tubing,
- an animal restraining device,
- a control unit with built-in amplifier and pressure generator; in the advanced setup with integrated temperature control,
- a special BP-interface or BP-PCMCIA card for use with a space-saving laptop (designed for use with IBM-AT compatible computers)
- the BP software for Windows.

For good pulse signal recognition the animals must usually be warmed slightly in order to achieve an adequate blood flow through the tail resulting in a reliable and strong pulse wave (temperature-induced dilatation of the caudal arteries since these vessels serve as the principal outlet for body temperature control). Several methods can be used here.

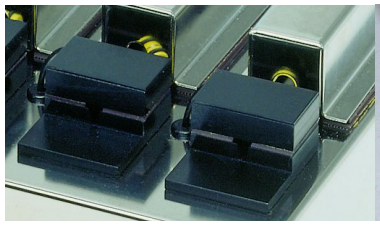
1. Advanced system setup

During measurement the animals are fixed in restraining units and mounted onto a special **measuring platform** with **integrated heating**.



6-channel platform for mice

The tail is placed in a tail groove restricting motoric activity (tail movements) that could disturb the correct identification of the pressure values. The special construction also ensures easy placement of the pressure cuff and the opto-sensor combination.



Sensor configuration

Pressure cuff

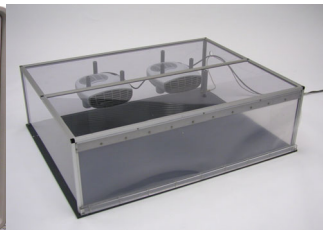
Heating is performed by warming up the platform base via a heating element and an electronic temperature control that is part of the control unit. In most cases a short warming up time is sufficient.

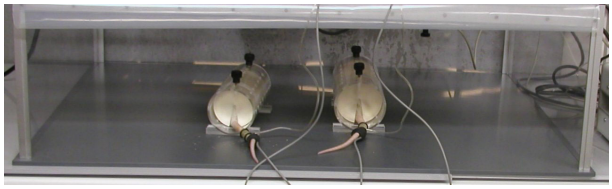
This measuring platform is available with 1 up to 72 measuring places. Several smaller platforms can also be combined to form a modular multi-station setup.

2. Basic system setup

The opto-electronic rodent system is also available ***without measuring platform***. In this case the pulse sensor combination is mounted into a ring-shaped cuff. The animals are placed into stand-alone restrainers (different sizes available) .

In the basic setup warming-up can be done using an infra-red heat lamp or using the **TSE Heating Box** with built-in electronic temperature control and continuous fresh air supply. Here up to 6 animals can be warmed up simultaneously.





Measuring principle

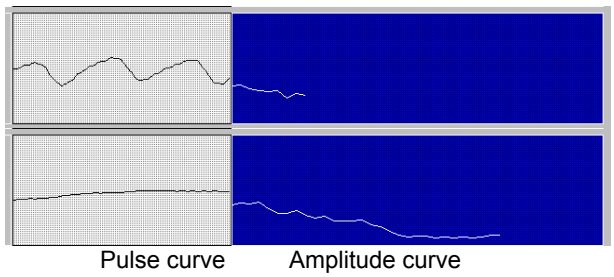
An **optical pulse sensor** is used for pulse signal recognition. A highly sensitive infrared LED combination measures the light transmission through the tail.

The alterations in the diameters of the arteries caused by variations in blood pressure result in an altered light transmittance, which is recognized by the sensor and converted into an electrical signal. After electronic amplification and filtering to eliminate interference this signal is available for display and evaluation (**pulse curve**).

The heart rate (**Bpm**) is obtained by continuous calculation from the pulse signal.

Occluding pressure on the tail is provided by a pressure pump built into the control unit. The air coming from the pump is led through thin flexible plastic tubing into an inflatable **pressure cuff** placed around the animal's tail. This cuff consists of a short plastic tube with variable inner diameter to which a rubber membrane is connected forming a closed system indifferent to changes in atmospheric pressure.

Due to the continuous pressure rise in the cuff the blood flow in the tail artery is gradually occluded. When the artery is closed the pulse wave can no longer be picked-up by the sensor: the corresponding pressure value is recorded as systolic pressure **SAP1**. If desired the system subsequently also monitors the returning of the pulse wave with the onset of pressure release (cuff deflation). The pressure in the cuff at the moment of the first reappearance of the pulsation is recorded as systolic pressure **SAP2**. Both cuff inflation and deflation run at a user-defined speed.



Pulse curve Amplitude curve

During the measurement the waveform of the **maximum pulse signal amplitude** is displayed on the computer screen. The tail cuff pressure is continuously shown as a bar graph.

The measuring values can be printed out and stored in an export file for further statistical evaluation.

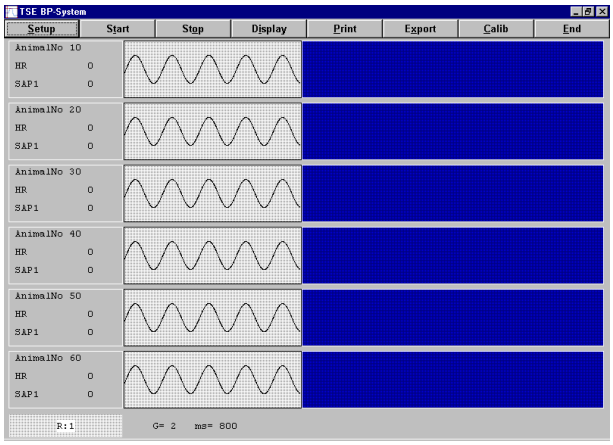
The measuring system for larger animals

The system can also be configured for larger animals such as dogs. In this case ring-shaped piezo-electric transducers are generally used to record the pulse signal. No heating is required in these animals. This highly sensitive transducer transforms the pressure waves in the tail artery into an electrical signal. Apart from the different sensor technology the measurement corresponds to the rodent system.

Performing measurements

Here the 6-channel software is described as an example.

After starting the program you see the main menu:



Display mode shown with artificially generated signal

The **numerical display window** on the left is reserved for output of the animal number, the heart rate, the pressure value(s) as well as the mean pressure value. The exact configuration varies according to the measuring mode.

A large display window shows 2 waveforms:

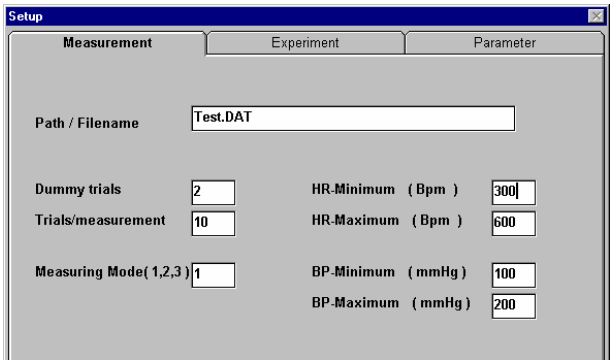
- In the left-hand window the pulse signal which the sensor recognizes appears. Before the measurement this display can be used to check the quality of the signal and to adjust the amplification optimally.
- In the right-hand window the maximum amplitude of the pulse signal is shown. In the display mode before the start of the measurement this window is empty.

In the **status line** the following information is displayed:

- phase information (such as “Dummy”, “E-Delay” etc.),
- the running number of the measurement series in the file (R),
- the running number of the trial (N),
- the amplification factor G and
- the width of the pulse window in milliseconds.

Before the start of a measurement a series of settings must be made in the **Setup**.

Setup/Measurement



A measurements consists of 1...20 single trials which are carried out automatically one after the other (**trials/measurement**). The trials are carried out either directly after each other or after an operator-defined pause has elapsed.

The number of trials which have to be carried out in order to obtain a meaningful mean value for the blood pressure should be determined by making test measurements.

The measuring data of these trials are stored in a results file that is given a name by the user (**Path/File name**).

For training the animals or during the warming-up phase before the measurement itself is started so-called **dummy trials** *can* be carried out whose data are **not** stored in the results file.

3 different **measuring modes** are available:

- Mode 1 = SAP determination while pressure in the cuff is rising (standard method)
- Mode 2 = SAP determination while pressure in the cuff is decreasing

- Mode 3 = SAP determination during rising and decreasing pressure

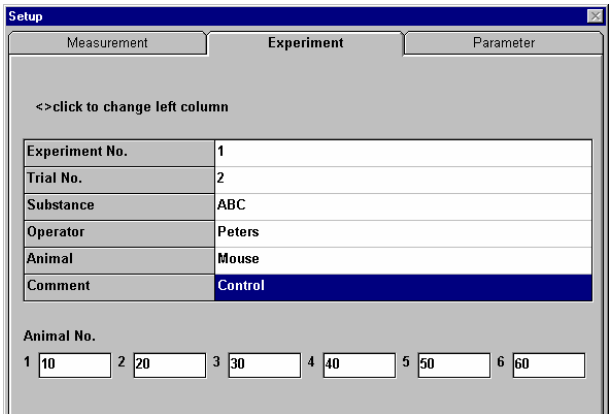
The limits for the detection of the heart rate are entered in the fields **HR-Minimum/Maximum (Bpm)**. The values should be set *as close as possible* to the expected heart frequency of the animal to accelerate the measurement.

BP-Minimum is the pressure level in the cuff at which monitoring the signal amplitude starts during the measurement in modes 1 & 3 and at which the decreasing pressure curve ends in modes 2 & 3. At the start of a trial in modes 1 & 3 the cuff is inflated **rapidly** from zero to **BP-Minimum**. Pressure increase beyond the **BP-Minimum** is carried out with the operator-defined steps.

BP-Maximum is the upper cuff pressure limit during measurements in modes 1 & 3. In mode 2 the starting pressure at which the step-by-step pressure reduction starts is determined by BP-Maximum. The value must be slightly higher than the expected systolic pressure.

Setup/Experiment

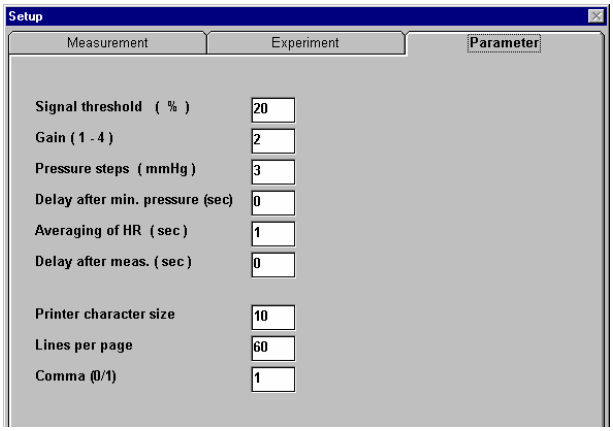
Several entry fields are available for identifying the measurement. The name of the entry fields can be edited by the operator.



Setup/Parameter

The measuring procedure is defined by a variety of control parameters.

1. **Signal threshold (%)**. The signal threshold determines the percentage level which the amplitude of the pulse signal must have during pressure alteration compared with the initial pulse signal so that the conditions "no more signal“ (for pressure increase) or "signal present again“ (for pressure decrease) can be detected and therefore the SAP value can be determined. The ideal value must be determined in test measurements and depends on the signal quality.
2. **Gain.** The amplifying factor for the pulse transducer sets the required amplitude of the pulse signal.
3. **Pressure steps (mmHg).** Pressure alteration values, i.e. the smallest step by which the pressure is increased or decreased during the measurements. A small value slows down the measurement but increases the accuracy.



The measuring process consists of a sequence of **phases** whose lengths are determined by the operator.

4. **Delay after min. pressure (sec)**. Pause between reaching the starting pressure and the start of the step-by-step pressure alteration.
5. **Averaging of HR (sec)**. Time for averaging the heart rate. The program measures the intervals between the individual signals in the pulse window and calculates the mean interval for the set time (**BPM** phase). This value is converted to **Bpm**.
6. **Delay after measuring (sec).** When a trial has been completed the pressure in the cuff is released completely and a pause of the selected time is then allowed to elapse; after this pause the next heart rate determination is carried out. The pause (E-Delay) is used for the regeneration of the pulse signal after occlusion.

Preparing the animals

- Preheat the measuring platform or the heating box.
- Place the animals in the restrainers and place the restrainers on the preheated measuring platform or in the box.
- Pass the tails through the pressure cuffs (to be placed at the base of the tail). Slide the

pressure cuff up the tail until it is fixed gently in position.

- On the measuring platform place the tails into the tail groove and fix the end of the tail with adhesive tape. Place the upper sensor unit on top of the lower one (magnetic adhesion).
- In the ring-shaped configuration slide the sensor cuff on the tail.

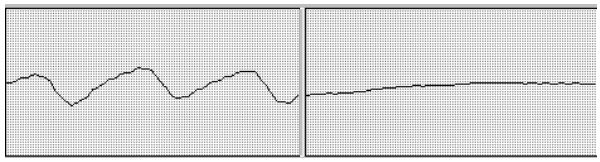
Measurement

The following procedure describes a measurement in **measuring mode 1** (i.e. pressure determination only as pressure increases).

Before the start of the measurement the **pulse signal** recorded by the pulse sensor is shown. The quality of the curve should now be checked. A clear pulse curve with no interference should be recognizable. It may be necessary to correct the **amplification factor**.

The **heart rate** is now calculated continuously from the pulse signal.

1. If the quality of the pulse signal is adequate and if the heart rate is sufficiently stable then the **measuring mode** is started.
2. A display axis for the cuff pressure now appears. The scale starts with the BP-Minimum and ends with the BP-Maximum.
3. The cuff pressure now increases rapidly to BP-Minimum.
4. If "Delay after min. pressure“ has been defined then when the minimum pressure has been achieved a pause of the defined length will be allowed to elapse (DELAY phase).
5. The pressure cuff will now be inflated step-by-step with the step entered under pressure step in mmHg. This is the DUMMY or MEASURE phase.
6. In the left-hand small window the recorded pulse signal continues to be displayed.
7. In the right-hand window the maximum amplitude of this pulse signal is shown as a curve.
8. During the measuring process a check is made each time the pressure is increased as to whether the pulse signal is still existent (amplitude > signal threshold).
9. From a certain pressure onwards it can be seen that the pulse signal – as a result of the increasing occlusion of the artery – is smaller. The reduced amplitude is shown on the right as a decreasing curve.
10. When the amplitude falls below the signal threshold the corresponding pressure value is identified as SAP1. The amplitude level above which "No signal“ is recognized depends selection of the Signal threshold parameter. If no SAP can be determined it may necessary to change this parameter.



Before occlusion After occlusion

11. The pressure is increased until BP-Maximum is reached.
12. Pressure is then completely released from the cuff.
13. If only 1 trial was to be carried out the measurement is now finished. With more than 1 trial or with previous dummy trials the system is then in a measuring pause, the E-DELAY – if one has been defined. The next heart rate determination is then carried out. Then the next pressure measurement is carried out, maybe with a previous DELAY phase. Measurements within the series are numbered consecutively (N).

When the measurement is finished a **table of measurements** appears:

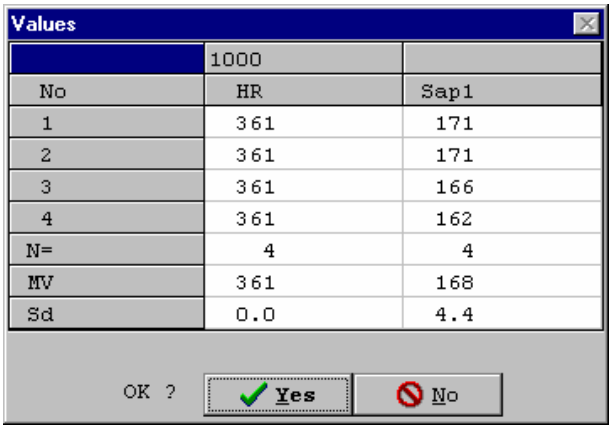


Table for Mode 1

Depending on the mode, SAP1 (Mode 1, 2) or SAP1+SAP2 (Mode 3) are listed as well as the heart rate. For a number of single measurements N>1 the table additionally contains the mean value (MV) and the standard deviation (Sd). After confirming with YES the values are stored in the raw data file.

Using the menu point **Display** the content of a stored file can be shown as a list.

```
0002    09:24                12.02.1999
          1000
            HR   Sap1
 1         361    171
 2         361    171
 3         361    166
 4         361    162
N=           4      4
MV         361    168
Sd         0.0    4.4
```

The list is made up of the following information:

- Running number of the series of measurements in the file
- Starting time of series of measurements
- Starting date
- Animal number
- For each trial heart rate (HR) and the pressure value(s) SAP1 or SAP1/SAP2
- If the number of trials is >1 then the number (N), mean value (MV) and standard deviation (Sd) will be shown.

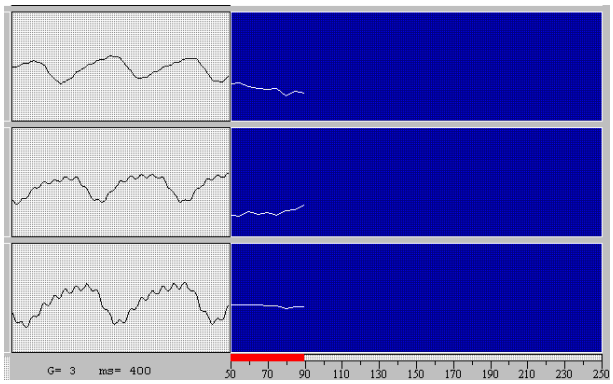
The list shown with the **Display** switch can also be printed out.

Exporting the data

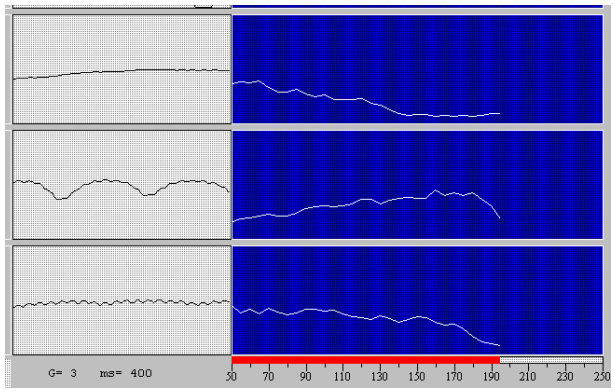
A measuring data file can be stored in an export file.

This file can be imported into EXCEL directly for further statistical calculations. The decimal separator in this table can be selected by the operator.

Example of a measurement in rats (3-channel-system)



After the start of the pressure increase (MEASURE phase). The pulse signal appears in the left window. The cuff starts to inflate.



The pressure in channel 1 and 3 has already reached a level where the pulse signal cannot be recognized any longer. In channel 2 there is still a pulse signal.

TSE BP-System
Experiment No.: 1
Trial No.: 2
Animal: Mouse
Operator B.

	05.03.99				
1	15:39	b17		b18	
		HR	**Sap1**	**HR**	**Sap1**
	1	479	134	595	112
	2	533	127	572	104
	3	488	135	662	104
	4	501	127	554	104
	5	502	129	610	110
	6	447	128	576	107
	7	475	127	541	107
	8	612	134	569	110
	9	0	134	575	104
	10	429	135	518	104
	N	9	10	10	10
	Mv	496	131	577	107
	Sd	53.1	3.7	39.5	3.1
2	15:44	b17		b18	
		HR	**Sap1**	**HR**	**Sap1**
	1	506	144	585	107
	2	441	145	588	110
	3	487	143	571	109
	4	468	141	616	100
	5	451	138	600	94
	6	483	136	619	107
	7	460	141	589	114
	8	505	139	590	107
	9	546	142	585	107
	10	512	138	647	104
	N	10	10	10	10
	Mv	486	141	599	106
	Sd	32.1	2.9	22.3	5.5
3	15:50	b17		b18	
		HR	**Sap1**	**HR**	**Sap1**
	1	535	142	648	91
	2	534	139	658	120
	3	577	131	607	110
	4	523	136	620	110
	5	540	135	623	114
	6	520	126	566	0
	7	542	127	628	112
	8	567	127	645	107
	9	521	132	646	107
	10	529	132	616	107
	N	10	10	10	9
	Mw	539	133	626	109
	Sd	19.2	5.3	26.6	7.8

Partial List of Users in Europe

- Abbott (formerly Knoll), Ludwigshafen, Germany
- Aventis (formerly Hoechst), Frankfurt, Germany
- Bayer, Wuppertal, Germany
- Ingenium Pharmaceuticals, Munich, Germany
- KRKA Pharmaceuticals, Novo Mesto, Slowenia
- Lilly, Hamburg, Germany
- LPT Laboratory for Pharmacology & Toxicology, Hamburg, Germany
- Max-Dellbrueck-Center, Berlin, Germany
- Medizinische Hochschule Hannover, Germany
- Merck, Darmstadt, Germany
- Novartis Pharma, Basel, Switzerland
- Pfizer, Amboise, France
- RCC, Itingen, Switzerland
- Tropon (Bayer Group), Koeln, Germany
- University of Aarhus, Denmark
- University (Charité) Berlin, Germany
- Free University Berlin, Germany
- University of Bialystok, Poland
- University of Bochum, Germany
- University of Bonn, Germany
- University of Bremen, Germany
- University of Goettingen, Germany
- University of Graz, Austria
- University of Hamburg, Germany
- University of Heidelberg, Germany
- University of Jena, Germany
- University of Leipzig, Germany
- University of Lublin, Poland
- University of Luebeck, Germany
- University of Muenster, Germany
- University of Poznan, Poland
- University of Regensburg, Germany
- University of Rostock, Germany
- University of Stuttgart, Germany
- University of Turku, Finnland

References

1. Zenclussen AC, Fest S, Joachim R, Klapp BF, Arck PC. *Introducing a mouse model for pre-eclampsia: adoptive transfer of activated Th1 cells leads to pre-eclampsia-like symptoms exclusively in pregnant mice.* Eur. J. Immunol. **2004**; 34: 377-387.
2. Saam T, Ehmke H, Haas C, Ritz E. *Effect of endothelin blockade on early cardiovascular remodeling in the one-clip-two-kidney hypertension of the rat.* Kidney & Blood Pressure Research **2003**; 26: 325-332.
3. Schulz A, Standke D, Kovacevic L, Mostler M, Kossmehl P, Stoll M, Kreutz R. *A major gene locus links early onset albuminuria with renal interstitial fibrosis in the MWF rat with polygenetic albuminuria*. J Am Soc Nephrol **2003**; 14: 3081-3089.
4. Brunner F, Woelkart G, Haleen S. *Defective intracellular calcium handling in monocrotaline-induced right ventricular hypertrophy: protective effect of long-term endothelin-A receptor blockade with 2-benzo[1,3]dioxol-5-yl-3-benzyl-4-(4-methoxy-phenyl-)-4-oxobut-2-enoate-sodium (PD 155080).*The Journal of Pharmacology and Experimental Therapeutics **2002**; 300: 442 – 449.
5. Gschwend S, Pinto-Sietsma SJ, Buikema H, Pinto YM, van Gilst WH, Schulz A, de Zeeuw D, Kreutz R. *Impaired coronary endothelial function in a rat model of spontaneous albuminuria*. Kidney International **2002**; 62(1): 181-191.
6. Kammerl MC, Richthammer W, Kurtz A, Kraemer BK. *Angiotensine II feedback is a regulator of renocortical renin, COX-2, and nNOS expression*. Am J Physiol Regulatory Integrative Comp Physiol **2002**; 282: R1613 - R1617.
7. Schulz A, Litfin A, Kossmehl P, Kreutz R. *Genetic dissection of increased urinary albumin excretion in the Munich Wistar Frömter rat*. J Am Soc Nephrol **2002**; 13: 2706-2714.
8. Vitzthum H, Castrop H, Meier-Meitinger M, Riegger GA, Kurtz A, Kramer BK, Wolf K. *Nephron specific regulation of chloride channel CLC-K2 mRNA in the rat*. Kidney International **2002**; 61(2): 547-54.
9. Blumberg FC, Wolf K, Sandner P, Lorenz C, Riegger GAJ, Pfeifer M. *The NO donor molsidomine reduces endothelin-1 gene expression in chronic hypoxid rat lungs.* Am J Physiol Lung Cell Mol Physiol **2001**; 280: L258 - L263.
10. Kohler R, Kreutz R, Grundig A, Rothermund L, Yagil C, Yagil Y, Pries AR, Hoyer J. *Impaired function of endothelial pressure-activated cation channel in salt-sensitive genetic hypertension*. J Am Soc Nephrol **2001**; 12(8): 1624-9.
11. Rothermund L, Luckert S, Kossmehl P, Paul M, Kreutz R. *Renal endothelin ETA/ETB receptor imbalance differentiates salt-sensitive from salt-resistant spontaneous hypertension*. Hypertension **2001**; 37: 275-280.
12. Kreutz R, Kovacevic L, Schulz A, Rothermund L, Ketteler M, Paul M. *Effect of high NaCl diet on spontaneous hypertension in a genetic rat model with reduced nephron number*. Journal of Hypertension **2000**; 18: 777-782.
13. Rothermund L, Pinto YM, Hocher B, Vetter R, Leggewie S, Kobetamehl P, Orzechowski HD, Kreutz R, Paul M. *Cardiac endothelin system impairs left ventricular function in renin-dependent hypertension via decreased sarcoplasmic reticulum Ca^{2+} uptake*. Circulation **2000**; 102(13): 1582-8.

◆ Ordering Information

Cat. No.	Description
1-Channel-System	
209000-9002-1-S	**Blood Pressure Measuring System** **1-channel, non-invasive, 9002-series.** Expandable. Fully automatic system for use with awake laboratory animals such as mice, rats, dogs, mini-pigs, primates or other species. Up to 50 measurements in 15 minutes per measuring channel. Acquisition and analysis of systolic blood pressure and heart frequency. Analog and digital display of measuring values. Ready to export data to Excel or other statistics packages or graphics software. Complete and consisting of (for connecting to PC or Notebook): • control unit with integrated preamplifier unit and pumping unit for inflation of pressure cuff • software package BP01 for WINDOWS • special interface BP01 for PC (a PCMCIA interface for notebooks is available for an extra charge) ***Required:*** • platform 209000-9002-1-S-Px for 1 mouse or 1 rat or • choice of 1 cage (if desired) & 1 pulse transducer & 1 pressure cuff. Also available as a multi-channel system (2-72 channels)
209000-9002-1-S-PM	Platform for 1 Mouse, heatable, for non-invasive Blood Pressure Measuring System 9002-series Complete with: • 1 cage • 1 pulse transducer • 1 pressure cuff
209000-9002-1-S-PR	Platform for 1 Rat, heatable, for non-invasive Blood Pressure Measuring System 9002-series Complete with: • 1 cage • 1 pulse transducer • 1 pressure cuff *(please specify sizes)*
2-Channel-System	
209000-9002-2-S	**Blood Pressure Measuring System** **2-channel, non-invasive, 9002-series.** Expandable. Fully automatic system for use with awake laboratory animals such as mice, rats, dogs, mini-pigs, primates or other species, parallel measurement Up to 50 measurements in 15 minutes per measuring channel = 100 measurements in 15 minutes Acquisition and analysis of systolic blood pressure and heart frequency. Analog and digital display of measuring values. Ready to export data to Excel or other statistics packages or graphics software. Complete and consisting of (for connecting to PC or Notebook): • control unit with integrated preamplifier unit and pumping unit for inflation of pressure cuff • software package BP02 for WINDOWS • special interface BP02 for PC (a PCMCIA interface for notebooks is available for an extra charge) ***Required:*** • platform 209000-9002-2-S-Px for 2 mice or 2 rats or • choice of 2 cages (if desired) & 2 pulse transducers & 2 pressure cuffs

	Also available as 1-channel- or multi-channel system (3-72 channels)
209000-9002-2-S-PM	Platform for 2 Mice, heatable, for non-invasive Blood Pressure Measuring System 9002-series Complete with: • 2 cages • 2 pulse transducers • 2 pressure cuffs
209000-9002-2-S-PR	Platform for 2 Rats, heatable, for non-invasive Blood Pressure Measuring System 9002-series Complete with: • 2 cages • 2 pulse transducers • 2 pressure cuffs *(please specify sizes)*
4-Channel-System	
209000-9002-4-S	**Blood Pressure Measuring System** **4-channel, non-invasive, 9002-series.** Expandable. Fully automatic system for use with awake laboratory animals such as mice, rats, dogs, mini-pigs, primates or other species, parallel measurement Up to 50 measurements in 15 minutes per measuring channel = 200 measurements in 15 minutes Acquisition and analysis of systolic blood pressure and heart frequency. Analog and digital display of measuring values. Ready to export data to Excel or other statistics packages or graphics software. Complete and consisting of (for connecting to PC or Notebook): • control unit with integrated preamplifier unit and pumping unit for inflation of pressure cuff • software package BP04 for WINDOWS • special interface BP04 for PC (a PCMCIA interface for notebooks is available for an extra charge) ***Required:*** • platform 209000-9002-4-S-Px for 4 mice or 4 rats or • choice of 4 cages (if desired) & 4 pulse transducers & 4 pressure cuffs Also available as 1-channel-system or multi-channel system (2-72 channels)
209000-9002-4-S-PM	Platform for 4 Mice, heatable, for non-invasive Blood Pressure Measuring System 9002-series Complete with: • 4 cages • 4 pulse transducers • 4 pressure cuffs
209000-9002-4-S-PR	Platform for 4 Rats, heatable, for non-invasive Blood Pressure Measuring System 9002-series Complete with: • 4 cages • 4 pulse transducers • 4 pressure cuffs *(please specify sizes)*
6-Channel-System	
209000-9002-6-S	**Blood Pressure Measuring System** **4-channel, non-invasive, 9002-series.** Expandable. Fully automatic system for use with awake laboratory animals such as mice, rats, dogs, mini-pigs, primates or other species, parallel measurement Up to 50 measurements in 15 minutes per measuring channel = 300 measurements in 15 minutes Acquisition and analysis of systolic blood pressure and heart frequency. Analog and digital

	display of measuring values. Ready to export data to Excel or other statistics packages or graphics software. Complete and consisting of (for connecting to PC or Notebook): • control unit with integrated preamplifier unit and pumping unit for inflation of pressure cuff • software package BP06 for WINDOWS • special interface BP06 for PC (a PCMCIA interface for notebooks is available for an extra charge) ***Required:*** • platform 209000-9002-6-S-Px for 6 mice or 6 rats or • choice of 6 cages (if desired) & 6 pulse transducers & 6 pressure cuffs Also available as 1-channel-system or multi-channel system (2-72 channels)
209000-9002-6-S-PM	Platform for 6 Mice, heatable, for non-invasive Blood Pressure Measuring System 9002-series Complete with: • 6 cages • 6 pulse transducers • 6 pressure cuffs
209000-9002-6-S-PR	Platform for 6 Rats, heatable, for non-invasive Blood Pressure Measuring System 9002-series Complete with: • 6 cages • 6 pulse transducers • 6 pressure cuffs *(please specify sizes)*
209000-9002-EXT-1	**"1-Channel-Extension" Blood Pressure Measuring System 9002-series** *Extends a system by 1 channel* *Example: If you want to upgrade a 2-channel-system to a 5-channel-system you have to order 3 pcs. "1-Channel-Extension" 209000-9002-EXT-1* This extension is possible for a total number of up to 6 channels. If you want to extend your system to a larger number of channels this is only possible in steps of 6 channels - please refer to 209000-9002-EXT-6. Fully automatic, non-invasive, for mouse up to dog Complete and consisting of (for connecting to PC or Notebook): • Extension of the control unit with integrated preamplifier unit and pumping unit for inflation of pressure cuff, • Extension software package BPXX for WINDOWS for 1 channel • Extension special interface BPXX for PC for 1 channel (a PCMCIA interface for notebooks is available for an extra charge) ***The following items have to be ordered separately:*** ***Restrainer cages, pulse transducers, pressure cuffs***
209000-9002-EXT-6	**"6-Channel-Extension" Blood Pressure Measuring System 9002-series** *Extends a 6-channel- to a 12-channel-system* (or a 12-channel- to a 18-channel-system or a 18-channel- to a 24-channel system etc) Fully automatic, non-invasive, for mouse up to dog. Complete and consisting of (for connecting to PC or Notebook): • Extension of the control unit with integrated preamplifier unit and pumping unit for inflation of pressure cuff, • Extension software package BP06 to BP12 for WINDOWS • Extension special interface BP06 to BP12 for PC (a PCMCIA interface for notebooks is available for an extra charge) ***The following items have to be ordered separately:*** ***Restrainer cages, pulse transducers, pressure cuffs***
209000-9002-INT-NB	BP 9002-series **PCMCIA interface for Notebooks** instead of PC interface – Extra Charge

Restrainer Cages	
1. Mouse	
209000-KM-K-K	Animal Restrainer for Mouse **small** made of plastic (NMR suitable)
209000-KM-G-K	Animal Restrainer for Mouse **large** made of plastic (NMR suitable)
2. Rat	
209000-KR-042	Animal Restrainer for Rats **extra small** made of plastic (NMR suitable), inner diameter: approx. 42 mm
209000-KR-052	Animal Restrainer for Rats **small** made of plastic (NMR suitable), inner diameter: approx. 52 mm
209000-KR-062	Animal Restrainer for Rats **medium** made of plastic (NMR suitable), inner diameter: approx. 62 mm
209000-KR-072	Animal Restrainer for Rats **large** made of plastic (NMR suitable), inner diameter: approx. 72 mm
209000-KR-080	Animal Restrainer for Rats **extra large** made of plastic (NMR suitable), inner diameter: approx. 80 mm
209000-KR-090	Animal Restrainer for Rats **XXL** made of plastic (NMR suitable), inner diameter: approx. 90 mm
209000-KR-100	Animal Restrainer for Rats **XXXL** made of plastic (NMR suitable), inner diameter: approx. 100 mm
Pulse Transducer	
209000-PU03	Pulse Transducer, inner diameter 3 mm
209000-PU04	Pulse Transducer, inner diameter 4 mm
209000-PU05	Pulse Transducer, inner diameter 5 mm
209000-PU06	Pulse Transducer, inner diameter 6 mm
209000-PU07	Pulse Transducer, inner diameter 7 mm
209000-PU08	Pulse Transducer, inner diameter 8 mm
209000-PU09	Pulse Transducer, inner diameter 9 mm
209000-PU10	Pulse Transducer, inner diameter 10 mm
209000-PU11	Pulse Transducer, inner diameter 11 mm
209000-PU12	Pulse Transducer, inner diameter 12 mm
209000-PU13	Pulse Transducer, inner diameter 13 mm
209000-PU14	Pulse Transducer, inner diameter 14 mm
209000-PU15	Pulse Transducer, inner diameter 15 mm
209000-PU16	Pulse Transducer, inner diameter 16 mm
209000-PU17	Pulse Transducer, inner diameter 17 mm
209000-PU18	Pulse Transducer, inner diameter 18 mm
209000-PU19	Pulse Transducer, inner diameter 19 mm
209000-PU20	Pulse Transducer, inner diameter 20 mm
Pressure Cuff	
209000-DR040	Pressure Cuff, inner diameter 4.0 mm
209000-DR065	Pressure Cuff, inner diameter 6.5 mm
209000-DR095	Pressure Cuff, inner diameter 9.5 mm
209000-DR110	Pressure Cuff, inner diameter 11 mm
209000-DR130	Pressure Cuff, inner diameter 13 mm
209000-DR250	Pressure Cuff, inner diameter 25 mm
Rubber Diaphragm	
209000-GU040	Rubber Diaphragm for Pressure Cuff 4.0 mm inner diameter (set = 3 pcs.)
209000-GU065	Rubber Diaphragm for Pressure Cuff 6.5 mm inner diameter (set = 3 pcs.)
209000-GU095	Rubber Diaphragm for Pressure Cuff 9.5 mm inner diameter (set = 3 pcs.)
209000-GU110	Rubber Diaphragm for Pressure Cuff 11 mm inner diameter (set = 3 pcs.)
209000-GU130	Rubber Diaphragm for Pressure Cuff 13 mm inner diameter (set = 3 pcs.)
209000-GU250	Rubber Diaphragm for Pressure Cuff 25 mm inner diameter (set = 3 pcs.)
O-Ring Set	
209000-OR040	O-Ring Set for Pressure Cuff 4.0 mm inner diameter (set = 2 pcs.)
209000-OR065	O-Ring Set for Pressure Cuff 6.5 mm inner diameter (set = 2 pcs.)
209000-OR095	O-Ring Set for Pressure Cuff 9.5 mm inner diameter (set = 2 pcs.)
209000-OR110	O-Ring Set for Pressure Cuff 11 mm inner diameter (set = 2 pcs.)
209000-OR130	O-Ring Set for Pressure Cuff 13 mm inner diameter (set = 2 pcs.)
209000-OR250	O-Ring Set for Pressure Cuff 25 mm inner diameter (set = 2 pcs.)

Assembling Cone	
209000-MO040	Assembling Cone for Pressure Cuff 4.0 mm inner diameter
209000-MO065	Assembling Cone for Pressure Cuff 6.5 mm inner diameter
209000-MO095	Assembling Cone for Pressure Cuff 9.5 mm inner diameter
209000-MO110	Assembling Cone for Pressure Cuff 11 mm inner diameter
209000-MO130	Assembling Cone for Pressure Cuff 13 mm inner diameter
209000-MO250	Assembling Cone for Pressure Cuff 25 mm inner diameter
Tubing	
209000-DS	Special Tubing for all Pressure Cuffs (set = 6 m)

Example: A complete **6-channel Mouse** system consists of

1. System 209000-9002-6-S
2. Platform 209000-9002-6-S-PM

■ **Worldwide**

TSE Systems GmbH
Siemensstrasse 21
61352 Bad Homburg
Germany
Phone: + 49-(0)6172-789-0
Fax: + 49-(0)6172-789-500

■ **USA/Canada/Mexico**

TSE Systems, Inc.
784 S. Poseyville Road
Midland, MI 48640
USA
Phone: 1-989-698-3067
Fax: 1-989-698-3068
Toll-Free (USA/Canada)
Phone: 1-866-466-8873
Fax: 1-866-467-8873

■ **India**

Axiom Biotek Inc.
Uniline House, 2nd Floor
198/23, Ramesh Market, East of Kailash
New Delhi 110 065
India
Phone: 0091-11-26469031
Fax: 0091-11-26481469
E-mail: harish@axiombiotek.com

www.TSE-Systems.com
info@TSE-Systems.com