



Hatteras Instruments SC1000 Blood Pressure Analysis System Technical Synopsis

Introduction

The SC1000 Blood Pressure Analysis System 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.

System Features

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 on-board RS232 serial port. Measurement results can be saved and exported to any common spreadsheet software program. The waveform data can also be saved for viewing at a later time by using the SC1000 Comm Windows based interface program. The SC1000 Comm also allows the user to connect the SC1000 to a PC for data collection and control and to obtain real-time viewing of the pulse waveform. The software in both the Palm and Windows applications allows the user to set up experiments prior to entering the lab and to then download the experiment settings to the SC1000 once connected to the device. Up to 50 measurements can be obtained during a measurement session.

The following SC1000 parameters are user adjustable:

Researcher ID • Specimen ID • Experiment ID • Preliminary Cycles • Measurement Cycles • Minimum Pulse Amplitude • Number of Consecutive Peaks • Ignore Peaks Smaller Than • Maximum Pressure • Pulse Timeout • Measurement Timeout • Time between Measurements • Systolic Threshold • Diastolic Threshold • Systolic Signal Criterion • Diastolic Signal Criterion • Calibrate System • Pressure Test • Single or Dual Operation • Platform Temperature.

The SC1000 can be expanded for dual channel operation by adding another specimen platform. The platforms are connected to the control unit through a standard CAT5 cable.

Highlights of System Features

- ◆ **Custom Algorithms** designed specifically for non-invasive measurements.
- ◆ **Fast and Accurate** measurements for pulse, diastolic, systolic and MAP.
- ◆ **Precise Correlation** with intra-arterial measurements.
- ◆ **PDA Interface** for connecting the SC1000 to a personal digital assistant.
- ◆ **SC1000 Comm Windows®** program for total automation of the system.
- ◆ **Adjustable System Parameters** for customizing experiments.
- ◆ **Dual Channel Operation** for increased capability.

SC1000 Components

The SC1000 Blood Pressure Analysis System includes:

- ◆ Master Control Unit
- ◆ Specimen Platform
- ◆ Airline, power cable, interconnect cable
- ◆ Accessory Kit (contains tail-cuff balloons, tool for making end caps, etc.)
- ◆ Operators Manual

The following is optional equipment or software:

- ◆ Additional specimen platform
- ◆ Palm Pilot PDA (typically supplied with Palm IIIC)
- ◆ SC1000 Palm OS® Version Software
- ◆ SC1000 Comm for Windows® Software

Master Control Unit: The SC1000 master control unit is the heart of the system. The control unit contains an embedded microprocessor and flash memory making future software upgrades easy by interfacing to a PDA or computer. It is not necessary to open the equipment to replace program storage electronic components. Revised software can be implemented electronically. In addition, the control unit contains the power supply, control solenoids, air pump, vacuum fluorescent display, keypad and other hardware. Onboard communication is via an RS232 serial port for interfacing to the PDA or computer. Connection to the specimen platform is through a CAT5 connector. The unit has an on/off switch built into the socket for accepting the power cable. An externally accessible fuse provides fault protection for the equipment. Power for the specimen platform is supplied from the control unit through the CAT5 cable.

Specimen Platform: The specimen platform is available for either mice or rats. Included with the platform is an animal holder for containing the specimen during measurements. The main components of the specimen platform are the sensor assembly, LED assembly, tail-cuff, and electronics. The sensor assembly houses a very sensitive photodiode integrated circuit for sensing the blood flow through the animals tail. This is an important feature of the SC1000. Other systems use old technology photocells that are noisy and prone to failure. The LED assembly contains a bright red LED for illuminating the animals tail so that the blood pulse may be detected. The tail-cuff is constructed of brass with PTFE resin end caps for securing the tail-cuff bladder. The bladder is a common latex balloon. The specimen platform electronics incorporates a 12 bit A/d converter that gives signal resolution of +/- 2,048 values for each sample. Most

other systems use 8 bit A/D conversion allowing only +/-128 values which results in reduced accuracy. The signal sample rate is 200 samples per second. The analog to digital conversion takes place at the signal source. This eliminates the possibility of additional noise problems that can occur when transferring the signal over lengthy cables before being digitized. The pressure measurement is also made at the source as a pressure transducer is built into the specimen platform electronics. This feature eliminates the problems with pressure gradients that can occur when only one pressure transducer is used through a common pressure header for determining all pressure readings. The specimen platform incorporates a flexible strip heater attached to the underside of the top of the platform for maintaining a comfortable environment for the animal. The temperature is user settable and precisely controlled by the control unit microprocessor by using a precision temperature sensor for feedback control. Other systems use only a variable transformer with a dial setting that is inaccurate and potentially harmful to the animals by allowing the platform to overheat. *Heating the animal is not necessary with the SC1000.* The ability to keep the platform from being cold thus ensuring the comfort of the animal is the only reason that the heater is used.

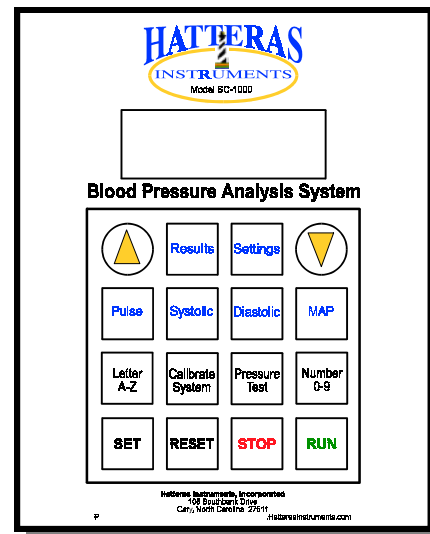
Highlights of System Components

- ◆ **Master Control Unit** with embedded microprocessor circuitry.
- ◆ **Flash Memory** allowing electronically implemented software upgrades.
- ◆ **Integrated System** contains power supply, air pump, solenoids, etc. in one unit.
- ◆ **RS232 Serial Port** for communications with PDA or Computer.
- ◆ **CAT5 communications** between control unit and specimen platform.
- ◆ **Specimen Platform** for mice or rats.
- ◆ **12 Bit A/D Conversion** for superior signal resolution.
- ◆ **Photodiode Integrated Circuitry** for sensing pulse.
- ◆ **Temperature Regulation** through microprocessor control.
- ◆ **Specially Designed Holders** for containing untrained animals.
- ◆ **Special "V" Grooved Sensor Assembly** to help prevent movement of tail.
- ◆ **Fast Setup** of system by connecting power cable, CAT5 cable, and airline.

SC1000 System Operation

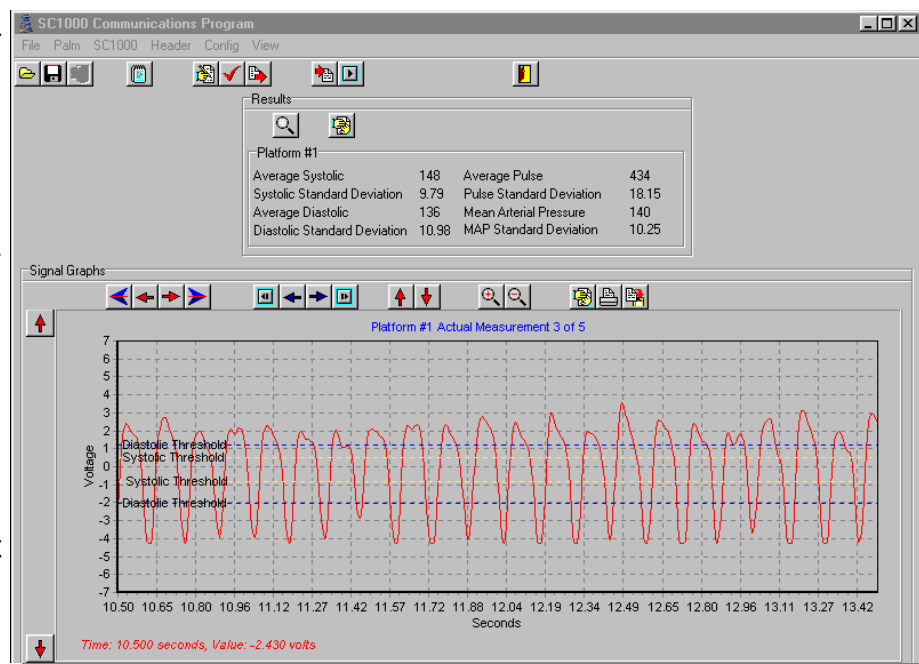
Operation of the SC1000 Blood Pressure Analysis System is completely automatic. Once an animal is placed on the specimen platform, pressing the "Run" button on the keypad initiates the measurement process. The system automatically detects a pulse, inflates the tail-cuff and measures the diastolic and systolic pressure and calculates the mean arterial pressure (MAP). Each measurement is part of a measurement set. When the measurement set is complete, the system calculates the mean and standard deviation for the pulse, diastolic, systolic and MAP. A measurement set can consist of up to 50 measurements. Once the measurement process is complete, the data can be obtained by pressing the "Results" key and either of the keys for "Pulse", "Systolic", "Diastolic" or "MAP". While viewing the results, the data can be paged to see the individual measurements that were obtained to make the results report. All measurement results are saved in the internal memory of the system until another experiment is conducted. The measurement results can be manually recorded or automatically recorded

and saved by connecting the SC1000 to a PDA or computer. When operating as a stand-alone unit, all system parameters for the SC1000 can be accessed and changed from the keypad. When connected to a PDA or computer, the settings can be pre-set and automatically downloaded to the system as part of the experiment process. Interfacing to a PDA allows automated data collection and storage. Interfacing to a computer running the SC1000 Comm for Windows® application provides completely automated control of the measurement process and also allows real-time viewing of the signal waveforms. The figure to the right shows the keypad layout for the master control unit.



SC1000 Comm for Windows®

The SC1000 Comm for Windows® application software is especially designed to make blood pressure measurements on rodents easy and efficient. All system functions are easily accessible through the standard Windows® point and click format. Initialization parameters can be customized and saved under a “Header” menu so that experiments can be easily repeated.



Information
Date/Time Downloaded: 02/07/02 11:44:53

Notes

Initialization Parameters

Researcher ID	Owens	Pulse Timeout	45 Sec.
Experiment ID	Pharma, Inc.	Measurement Timeout	60 Sec.
Specimen ID	ZR701	Time between Measurements	2.50 Sec.
Specimen ID #2		Systolic Threshold	20%
Preliminary Cycles	5	Diastolic Threshold	60%
Measurement Cycles	10	Systolic Signal Criterion	90% of Signal, 0.50 Sec
Movement Detection	No	Diastolic Signal Criterion	90% of Signal, 0.50 Sec
Minimum Pulse Amplitude	20%	Diastolic Calculated	No
Number of Consecutive Peaks	30	Validate Measurement	No
Ignore Peaks Smaller than	0.50%	Single or Dual Operation	Single
Maximum Pressure	250 mmHg	Platform Temperature	100 F

Insert into Header

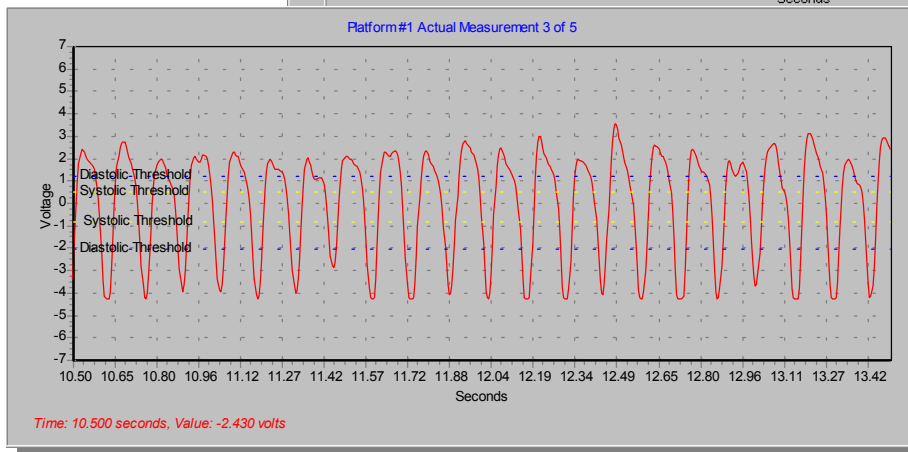
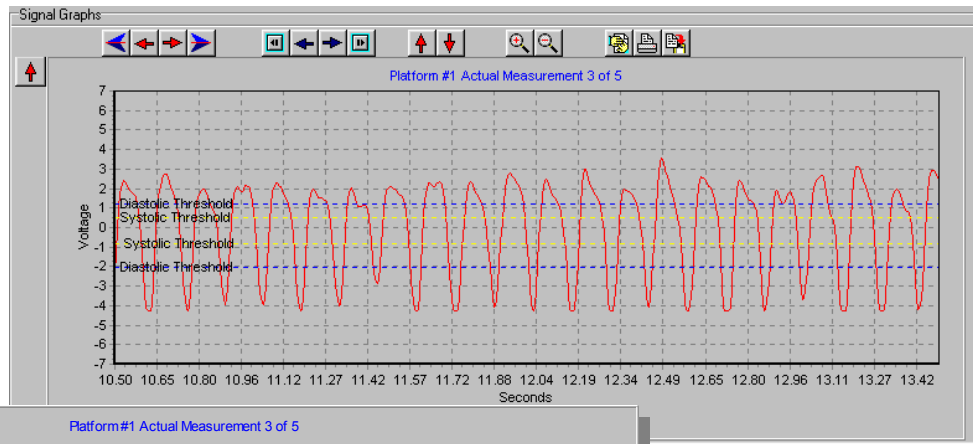
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Saving Data

All experiment data, including the signal waveform, is saved under the experiment ID. When an experiment is retrieved for viewing the results and waveforms, the initialization parameters can be also be viewed and notes can be added to the file and saved. The data is also stamped with the date and time that the experiment was conducted.

Viewing Waveforms

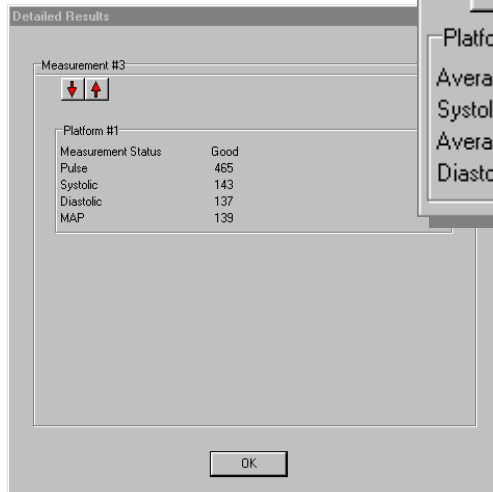
While obtaining measurements, the signal waveform is displayed in real-time. The data is scrolled on the display screen rather than repeatedly redrawn as is standard with other systems. When the waveform data is viewed after saving, the amplitude and time axis can be scaled for an up close view of any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



This feature allows a researcher to produce efficient and professional looking reports. The image above is a screen capture showing the computer display as seen when using the program. The image to the left has been

copied and pasted into this document using the “copy graph” feature of the software. The graph may also be printed by selecting the print function on the waveform display.

Viewing Results

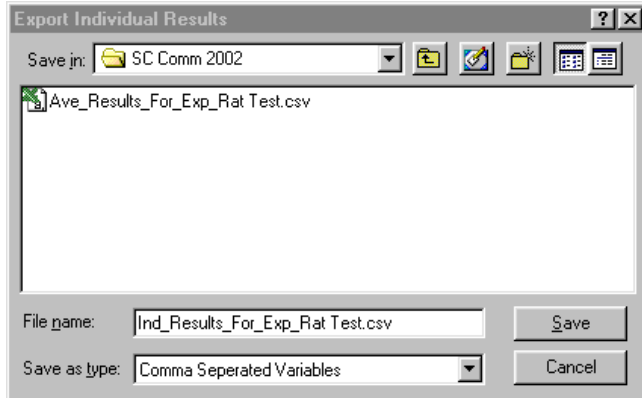


Results			
Platform #1			
Average Systolic	197	Average Pulse	400
Systolic Standard Deviation	5.97	Pulse Standard Deviation	23.36
Average Diastolic	158	Mean Arterial Pressure	171
Diastolic Standard Deviation	28.18	MAP Standard Deviation	19.26

Experiment results are displayed in a results table directly above the waveform graphical display on the computer screen. The detailed results for a measurement set can be viewed by selecting the “Detailed Results” symbol on the results table. When viewing the detailed results, data for each

measurement is displayed individually. Arrow keys on the display allow viewing of each successive measurement.

Exporting Results



Exporting results to a common spreadsheet is as easy as selecting “Export Results” from the main screen file menu. When the “Export Average Results” window appears, the file name block contains the name of the most recent experiment. The experiment name can be changed by opening another folder and selecting the desired file or by retyping the file name. By clicking the “Save” button, the average results are saved in a comma separated value format that can

be opened in any common spreadsheet program. After saving the average results, the user is prompted to save the individual results to complete the process.

Closing Comments...

As a researcher your time is very valuable. Efficient use of your time is important and so are the results of your work. The Hatteras Instruments *SC1000 Blood Pressure Analysis System* can ensure that your time is well spent and that the quality of your work is exceptional. Blood pressure measurements are completed in record time and with extremely accurate results that correlate precisely with intra-arterial values.

With the *SC1000*:

- ◆ Large populations of animals can be easily evaluated with a dual channel system.
- ◆ Setup time in the lab can be greatly reduced through the PDA interface.
- ◆ Complete automation of system operation and record keeping is simplified with the *SC1000 Comm for Windows®* software.

Your time couldn't be better spent and neither could your money. The *SC1000* is the fastest, most accurate and most economical system available. Give us a call and get started on your way to BP measurement success. After all, with the *SC1000 Blood Pressure Analysis System* for use with rodents.....it's as easy as it gets!

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