Softron

Non-Invasive Blood Pressure Meter

For Mice&Rats

Model：BP-2010A

Version：1.0.2_202409

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The BP-2010A Intelligent Non-Invasive Blood Pressure Meter for Rats and Mice uses the tail-cuff method, employing an optical volumetric pulse wave measurement technique to indirectly and non-invasively measure the blood pressure of rodents. During measurement, the rodent is restrained and kept warm, with the sensor positioned at the base of the tail. Once the pulse wave stabilizes, pressure is applied to obtain four physiological indicators: Heart Rate (HR), Systolic Blood Pressure (SBP), Mean Blood Pressure (MBP), and Diastolic Blood Pressure (DBP).

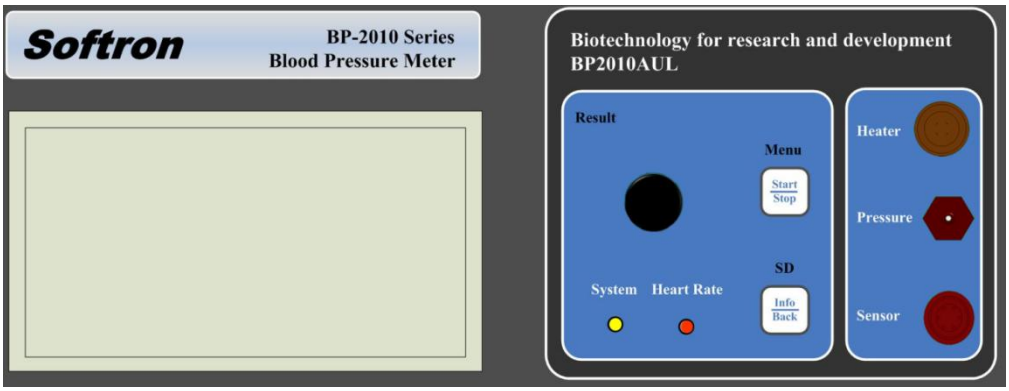
This system offers two modes of operation:

- **Standalone Mode:** Measurement can be performed directly on the main unit without a computer. The results are saved to an SD card, and an external thermal printer can be used to print the data.
- **PC-Connected Mode:** The main unit can be connected to a computer via a USB cable. By launching the software on the computer, measurements are controlled, and the results are saved on the computer. Data can also be optionally saved on the SD card simultaneously.

1. Main Unit Structure and Functions

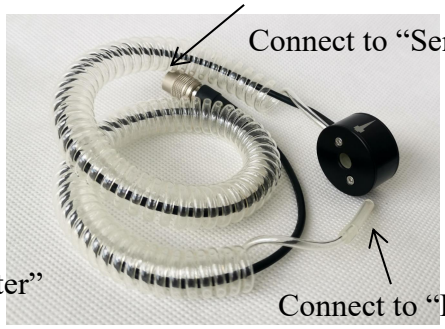
1.1. Front Panel

The front panel includes an LCD display, indicator lights, buttons, a thermal tube socket, and a pressure sensor socket, as shown in the figure:



Front panel

- **System:** System indicator light (blue); it illuminates when the blood pressure Meter is functioning normally.
- **Heart Rate:** Heart rate indicator light (red); it flashes briefly with each detected pulse signal.
- **Heater:** connects to the thermal tube to provide a heating function.
- **Pressure:** connects to the air tube of the pressure sensor. A 1.5 cm silicone sleeve is fitted on the end of the air tube to facilitate easy connection and disconnection.
- **Sensor:** connects to the plug of the pressure sensor.



Thermal tube

Pressure sensor

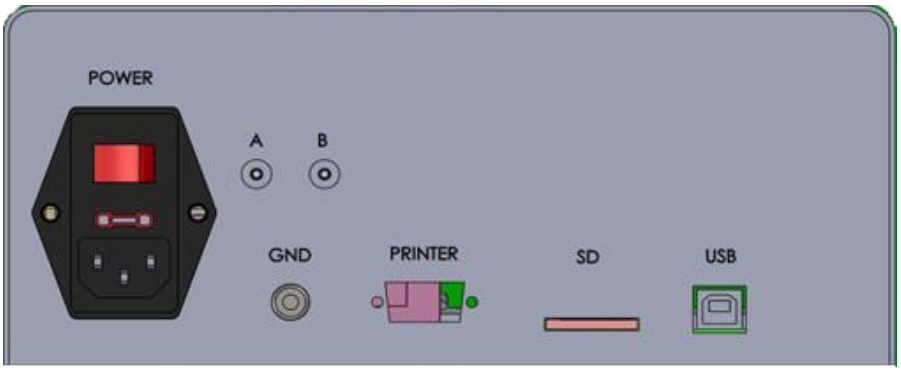
Button Functions (in the Main Monitoring Interface)

- **Start/Stop:** Short press to control the start and stop of measurement; long press to enter the system parameter settings interface.
- **Info/Back:** Short press to enter the animal information input interface; long press to enter the SD card browsing interface.
- **Rotary Knob:** Rotate to adjust sensitivity; long press to enter the measurement results browsing interface.

Note: *In different interfaces, each button may have different function definitions.*

1.2. Rear Panel

The rear panel includes a power switch, grounding port, printer interface, SD card slot, and USB interface.



- **POWER:** Power switch, AC 110-220V, 50/60Hz.
- **GND:** Grounding port.
- **PRINTER:** Thermal printer interface; connects to a mini thermal printer for real-time printing of measurement results. RS232 DB9 male connector, baud rate 115200.
- **SD:** SD card slot; supports SD cards up to 32GB in FAT16/FAT32 format.
- **USB:** connects to a computer via USB cable for communication with software.

2. Device Connection

2.1. Introduction to Device Components

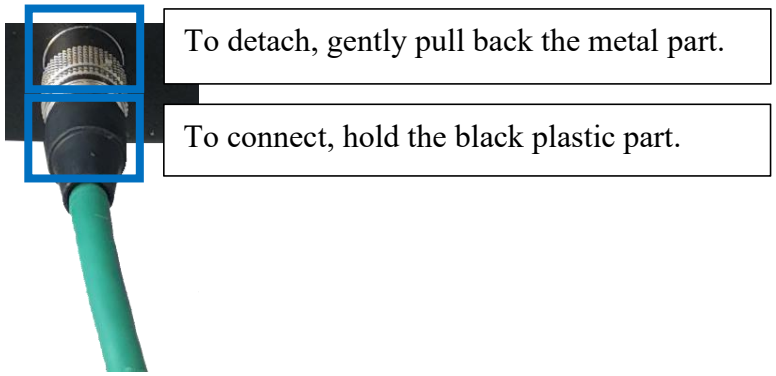
Number	Name	Image	Description.
1	Main Unit		The system is responsible for measuring, displaying, printing, and saving data.
2	Thermal tube		Provide Temperature Control for the Animal: Works in conjunction with the cylindrical restraint mesh and canvas cover to ensure the animal is kept warm during the measurement process.
3	Stabilizing foam pad		Stabilize the thermal tube and Animal: Prevents rolling and ensures stability, while also reducing vibration interference. Additionally, it blocks cold air from the table, enhancing the warming efficiency.
4	Rat Pressure Sensor		Rat Pressure Sensor (Standard Configuration): The standard rat pressure sensor included is size M (inner diameter 12mm). Optional accessories include: Size S (inner diameter 10mm)

			Size L (inner diameter 15mm) Choose the appropriate pressure sensor based on the size of the rat's tail.
5	Cylindrical restraint mesh for rats		The system includes two sizes (large and medium) for rats, to be selected based on the rat's weight, or a combination of the two sizes can be used.
6	Canvas cover for rats		The system includes three sizes (large, medium, and small), to be selected based on the weight of the rat。
7	Mouse Pressure Sensor		The inner diameter is 5mm.
8	Cylindrical restraint mesh for mice		The system includes two sizes (large and medium) for mice, to be selected based on the mouse's weight, or a combination of the two sizes can be used.
9	Canvas cover for mouse		The system includes three sizes (large, medium, and small), to be selected based on the weight of the mouse
10	Multi-port thermal heater		Optional accessory. The heater has 3 heating sockets, allowing for the connection of 3 thermal tubes. This function is equivalent to the Heater socket on the main unit. The heater is powered separately by its own power cable and does not need to be connected to the main unit.
11	SD Card		Inserted into the SD card slot on the back of the main unit, used to store measurement results.
12	USB Cable		When operating the measurement via the main unit, no connection to a computer is required. When using computer software to operate the measurement, connect the main unit and the computer via the USB cable.
13	Power Cable		Provides power to the main unit or heater.
14	Rubber Membrane		The rubber membrane is used in conjunction with the pressure sensor. It is a consumable, and can be replaced when damaged.

2.2. Single-channel Equipment Connection

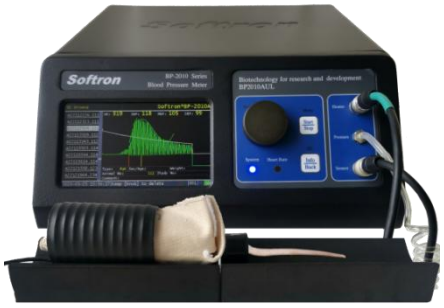
(1) Insert the power cable into the power socket on the back of the main unit to supply power to the main unit.
(2) Connect the pressure sensor plug and the air tubing to the Sensor socket and Pressure interface on the front of the main unit, respectively.
(3) Connect the thermal tub to the Heater socket on the front of the main unit.
(4) Insert the SD card into the SD card slot on the back of the main unit.

*To connect, hold the black plastic part, gently rotate and push it in. When the positions align, you will hear a "click" sound. Then, push it further in. To detach, gently pull back the metal part.



2.3. Multi-channel Equipment Connection

(1) Insert the power cables into the power sockets on the back of both the main unit and the multi-port thermal heater to supply power to both devices.
(2) Connect the pressure sensor plug and the air tubing to the Sensor socket and Pressure interface on the front of the main unit, respectively.
(3) Connect the thermal tubs to either the Heater on the front of the main unit or the multi-port thermal heater. If you choose the main unit's Heater socket, set the temperature on the main unit or computer software. If you choose the multi-port thermal heater's socket, adjust the temperature using the knob on the multi-port thermal heater.
(4) Insert the SD card into the SD card slot on the back of the main unit.



Single-channel Equipment

Multi-channel Equipment

3. Preparations Before Measurement

Blood pressure and heart rate measurements are influenced by environmental factors. To reduce measurement errors and ensure stable results, try to perform measurements under the same external conditions.

(1) Choose a quiet and warm environment for measuring the rodent's blood pressure.
(2) If the measurement environment differs significantly from the animal's housing environment, transfer the rodents to the measurement location 20-30 minutes in advance to allow it to acclimate to the new environment.
(3) If the measurement environment has a lower temperature, the rodents will need a longer time to reach a measurable state. Be sure to increase the thermal tube's temperature and extend the warming time.
(4) Do not conduct measurements on the floor; measurements should be done on a laboratory bench because rodents are less likely to remain still on the floor, and the stabilizing foam pad should be at the same height as the main unit.
(5) Do not perform measurements near air conditioners or ventilation outlets, as the lower temperature in these areas can affect the rodent's warming conditions.
(6) Understand the living habits of the animal being measured. Arrange some practice sessions before the formal measurement. After several training sessions, the rodent will become accustomed to the process and settle down more quickly and calmly.

4. Animal Restraint and Warming

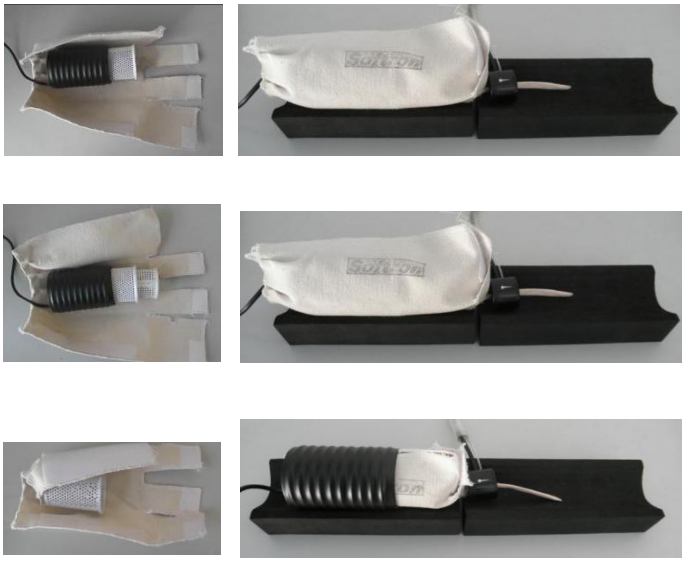
4.1. Animal Restraint

Animal restraint uses a cylindrical restraint mesh, canvas cover, and thermal tube to match the natural behavior of rodent. This method helps reduce the anxiety and discomfort of the animal, lowering the release of stress hormones, and results in more accurate blood pressure data closer to

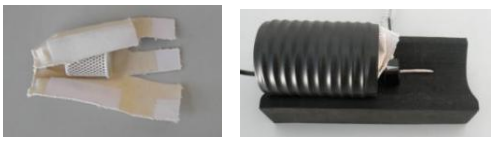
the natural state. Cylindrical restraint mesh and canvas cover come in various sizes, so choose the appropriate size based on the weight and body type of the rodents.

The choice of cylindrical restraint mesh and canvas cover: the restrained space should be suitable for the size of the rodent—neither too cramped nor too large, so that the rodent can quickly settle into a calm and stable state.

- For rats, the restraint method depends on their weight:



- For mice, the restraint method:



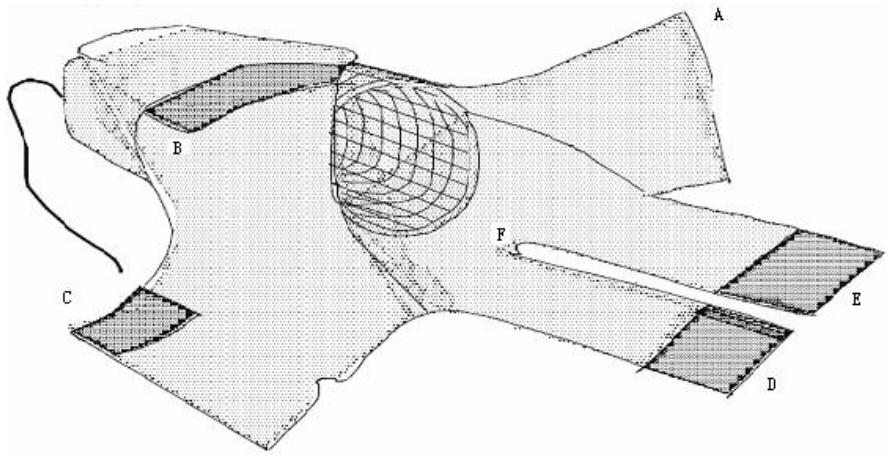
These restraint methods can be divided into two categories:

1. The first method has the canvas cover on the outermost layer, wrapping the thermal tube and the cylindrical restraint mesh. This method is suitable for heavier rats.
2. The second method has the thermal tube on the outermost layer, with the canvas cover wrapping around the cylindrical restraint mesh and placed inside the thermal tube. This method is suitable for mice and smaller rats.

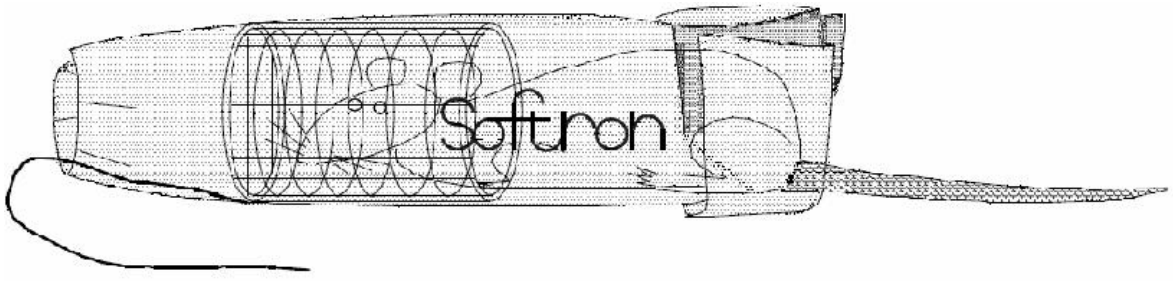
First Restraint Method:

(1) Place the cylindrical restraint mesh inside the thermal tube, then place the thermal tube inside the canvas cover with the connecting wires facing outward.
(2) Secure the velcro at position A (outer side) and B (inner side) to wrap around the thermal tube.

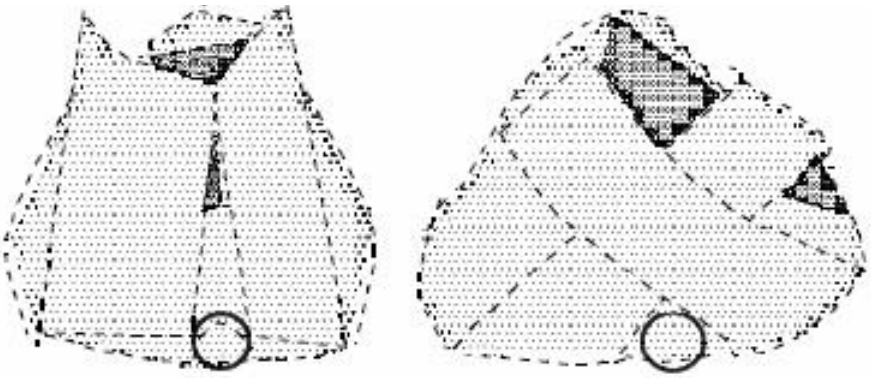
(3) Hold the canvas cover with your left hand and lay it flat on the table. Use your right hand to unfold the fabric at the opening as shown in the diagram.
(4) With your right hand, gently grasp the rodent, orienting its head forward, and place it into the cylindrical restraint mesh. Fold the fabric at position C and stick it to the outer velcro at position A.
(5) Place the rodent's tail at position F. Lift the lower fabric pieces D and E, and attach them to the outer side of fabric C.



(6) After securing, slightly loosen A and B to allow the thermal tube to move forward or backward, adjusting the space to fit the rodent. Ensure the rodent's tail extends out from position F, then re-secure A and B. If the cylindrical restraint mesh or canvas cover is too large for the rodent's size, the rodent will turn or look backward inside the cylindrical restraint mesh. If too small, the rodent will retreat and attempt to escape the canvas cover.
(7) Practice the restraint several times. After the rodent gets used to it, it will settle into a calm and stable state. If the rodent doesn't calm down at first, start by tightening the canvas cover and then loosen it slightly once the rodent has settled.
(8) The correct restraint position is as shown below, where the rodent's head and front limbs are inside the cylindrical restraint mesh, while the hind limbs are resting on the canvas cover.

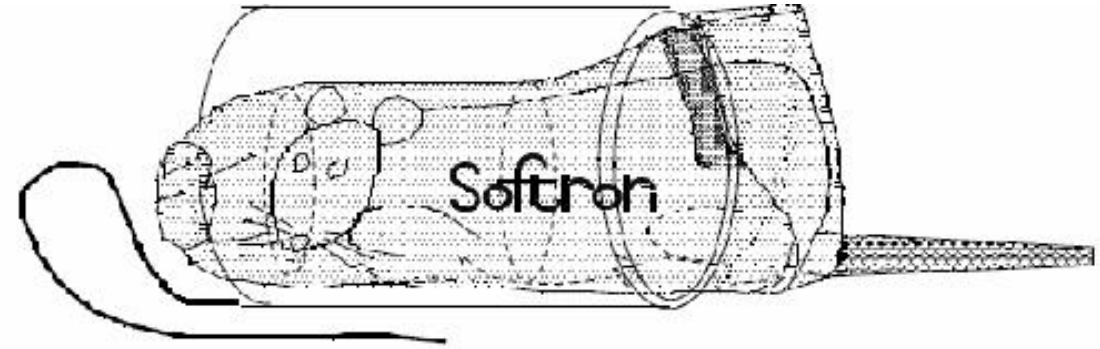


(9) If the rodent's hind limbs tend to slip out of the canvas cover, you can cross the fabric pieces D and E to secure them.
(10) Once the rodent is secured, place it on the stabilizing foam pad and position the pressure sensor near the root of the rodent's tail, aligning the tip of the sensor (marked by the symbol "▬") with the tip of the tail.



Fabric pieces parallel Fabric pieces crossed

Second Restraint Method - Suitable for Small Mice and Smaller Rats:
Wrap the canvas cover around the cylindrical restraint mesh, place the rodent inside, and secure the canvas cover. Afterward, place them inside the thermal tube. The restraint method is shown in the diagram below:



This method ensues that the thermal tube is placed on the outer layer, with the canvas cover and cylindrical restraint mesh inside, providing a secure and stable environment for the rodent. This is ideal for smaller animals, ensuring they remain calm and still for accurate measurements.

4.2. Animal Warming

After restraining the animal, set the thermal tube temperature. Under room temperature conditions, the typical temperature range for the thermal tube is 37-39°C. After warming for 5-10 minutes, the rodent should enter a stable, measurable state, characterized by regular and steady pulse waves.

If the measurement environment is colder, it is recommended to increase the temperature of the thermal tube and extend the warming time. From the time of restraint to completing the measurement, it should not exceed 15 minutes. If the measurement is not completed after 15

minutes of warming and restraint, it is advised to return the rodent to its cage to rest, then remeasure after some time.

4.3. Multi-port thermal heater

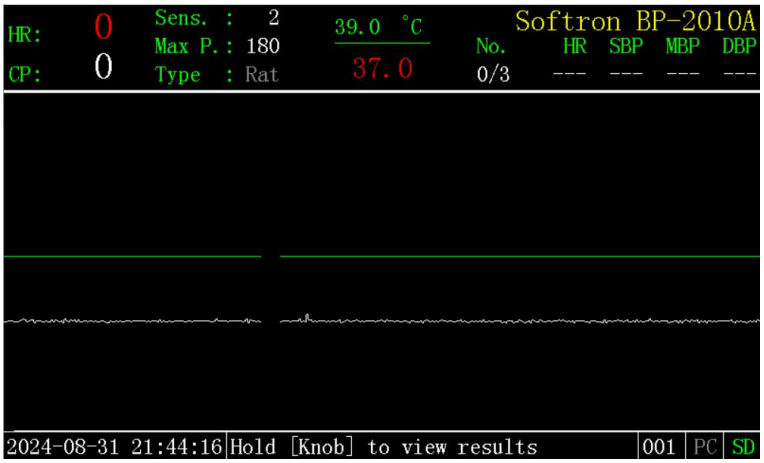
The multi-channel system includes a multi-port thermal heater, which is used to heat and maintain the temperature of the thermal tubes. The multi-port thermal heater is a standalone unit and does not need to be connected to the main unit.

The front of the multi-port thermal heater has three sockets, each with a corresponding indicator light. Connect the thermal tube to the multi-port thermal heater and turn on the power switch. The temperature range that can be set is between 30-40°C. Rotate the knob and align the white indicator line on the knob with the desired temperature. When the indicator light is on, it means the thermal tube is heating. When the light is off, it means the thermal tube has reached the set temperature.

5. Blood Pressure Measurement On Main Unit

5.1. Main Interface

Turn on the main unit to enter the main interface for monitoring mode. The screen is divided into three sections from top to bottom: Information Display Area, Waveform Display Area and Status Bar



(1) Information Display Area

- **HR:** Instantaneous heart rate, derived from the fluctuations in the pulse waveform (green line). If there is noise interference on the pulse waveform, the instantaneous heart rate value will be affected by this interference.
- **CP:** Current pressure value, corresponding to the white pressure line.
- **Sens.:** Sensitivity, representing the strength of the pulse signal. This value can be set in the System Setup interface.
- **Max P:** Maximum pressure value, which is the highest pressure applied to the rodent tail by the pressure sensor. This value is usually set 30-50 mmHg higher than the rodent's systolic pressure to stop blood flow in the tail. It can be set in the System Setup interface.
- **Type:** The type of animal being measured. This value can be set in the System Setup interface.
- **℃:** The temperature of the thermal tube is displayed above the horizontal line, while the real-time temperature of the thermal tube is shown below it. The temperature display turns red when heating is active, and green when the set temperature is reached. This value can be set in the System Setup interface.
- **No.:** Indicates the number of completed measurements. In the System Setup, if the Auto-S function is set to "Off" , this will show the cumulative number of completed measurements. If any parameters, animal information, or the rodent tail is disconnected from the pressure sensor, the count will reset. If the Auto-S function is set to "On", it shows "completed measurements/total set measurements" (e.g., 3/10). The count of “completed measurements” will reset if any parameters or information is changed or the rodent tail is disconnected from the sensor.
- **HR, SBP, MBP, DBP:** Displays the results of the most recent measurement, showing Heart Rate (HR), Systolic Blood Pressure (SBP), Mean Blood Pressure (MBP), and Diastolic Blood Pressure (DBP).

(2) Waveform Display Area

- The white line represents the pressure line. In pulse monitoring mode, the pressure line is a straight line, with the CP value showing 0 or slight fluctuations.
- The green line represents the pulse waveform. By placing the pressure sensor on the rodent tail, the pulse signal can be monitored in real time.

(3) Status Bar

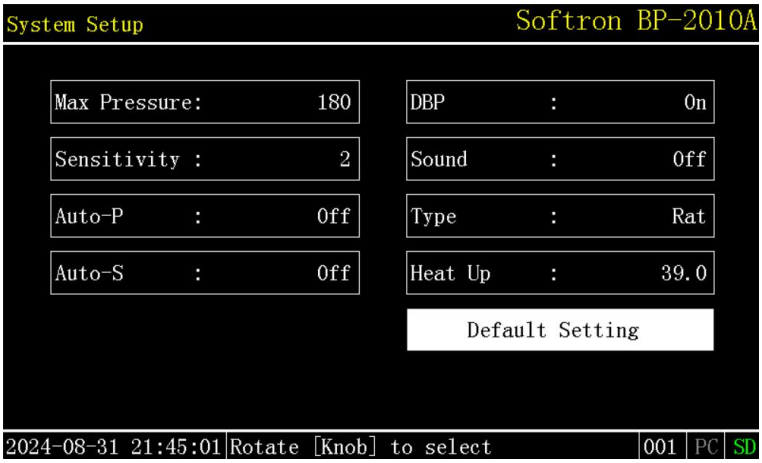
- The status bar displays system time, operation prompts, animal ID, connection status with the PC, and SD card status. The PC and SD card status indicators are as follows:

Name	Status Display	Description
PC	PC	PC not connected to the main unit.

	PC	PC connected to the main unit, but PC software not started.
	PC	PC connected to the main unit, PC software working properly.
	PC	PC connected to the main unit, but disabled.
SD	SD	SD card not inserted into the main unit.
	??	SD card inserted into the main unit, initializing.
	SD	SD card inserted into the main unit, functioning properly.
	SD	SD card inserted into the main unit, but disabled or write-protected.
	SD	SD card inserted into the main unit, but full.

5.2. System Setup

To access the System Setup interface, press and hold the Start/Stop button on the main unit while on the main screen in monitoring mode.



Steps to navigate and modify parameters:

(1) Rotate the knob to move the highlighted selection to the option you want to modify.
(2) Press the knob to select the option; the parameter value will blink, indicating it's in edit mode.
(3) Rotate the knob to adjust the value. Press the knob again to save the change.
(4) Press the Info/Back button briefly to exit the current interface.

Parameter Description:

(1) Max Pressure

- The maximum pressure applied to the rodent's tail via the pressure sensor. This value typically needs to be 30-50mmHg higher than the rodent's systolic blood pressure to stop blood flow in the tail.
- If the Max Pressure value is too low, blood flow will not be blocked, and an error will occur. If the value is too high, it may cause discomfort to the animal.
- Recommended Max Pressure: 180mmHg for rats, 150mmHg for mice.
- You can adjust the Max Pressure value based on the actual blood pressure of the rodent.

(2) Sensitivity

- Increasing the Sensitivity value will increase the pulse wave signal strength; decreasing it will reduce the signal strength.
- A recommended sensitivity value of 2-3 is generally sufficient. You can adjust this value based on the actual signal strength, but avoid setting it too high to prevent a decrease in noise resistance.

(3) Auto-P

- **On:** If the set Max Pressure is too low to block blood flow and pulse waves are still detected after reaching the Max Pressure, the system will automatically increase pressure by 50mmHg, up to two additional times.
- **Off:** Turns off the auto pressure addition function.
- This feature is typically not used for mice.

(4) Auto-S

- **On:** When enabled, the system will automatically start measurements once the pulse waves stabilize, based on the number of Auto-S (1-10). After completing the set number of measurements, the system will display the results, including the average (AV), standard deviation (SD), standard error (SE), and coefficient of variation (CV).
- During the wait for pulse waves stabilizing, manual measurements can also be performed, and these results will be included in the count.
- If the rodent remains stable with minimal movement, this function can reduce manual intervention.
- **Off:** Disables this function.

(5) DBP

- **On:** Measures four indicators: HR (Heart Rate), SBP (Systolic Blood Pressure), MBP (Mean Blood Pressure), and DBP (Diastolic Blood Pressure).
- **Off:** For rodent in shock or ischemic states, abnormal waveform leads to measurement errors. In such cases, setting this option to "Off" will measure only HR and SBP for more reliable results.

(6) Sound

- **On:** The system will emit a beep sound ("beep") whenever it detects a fluctuation, including pulse waves and noise, and when any button is pressed or the system provides a prompt.
- **Off:** Disables the buzzer.

(7) Type

- **Rat:** Select this option for rat measurement mode.
- **Mouse:** Select this option for mouse measurement mode.
- **Other:** This option is usually not applicable.

(8) Heat up

- **Set the temperature of the thermal tube.** A recommended range is 37-39°C. If the measurement environment is colder, you can increase the temperature slightly.
- **Off:** Disables the heating function.

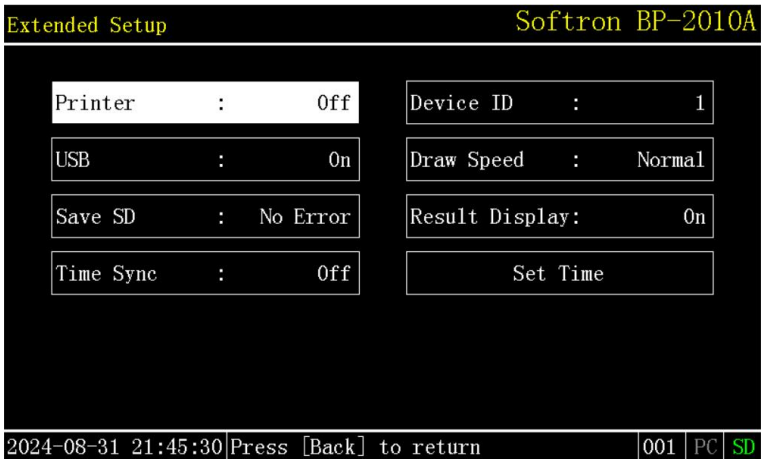
(9) Default Setting

- Selecting this option will restore all settings to their default values.

5.3. Extended Setup

The Extended Setup allows you to configure additional settings beyond the basic system parameters. Follow these steps to access and modify the settings:

(1) In the main monitoring interface, **long press** the **Start/Stop** button to enter the **System Setup** interface.Once in the System Setup, **long press** the **Start/Stop** button again to enter the **Extended Setup** interface.
(2) Rotate the knob to highlight the option you wish to modify.
(3) Press the knob to select the highlighted option. The parameter value will begin flashing, indicating it is in edit mode.
(4) Rotate the knob to change the parameter value.Press the knob again to save the changes.
(5) Once the settings are complete, briefly press the **Info/Back** button to return to the main monitoring interface.



Extended Setup Parameters:

(1) Printer

- Connect the main unit to a thermal printer. When set to "On", the measurement results will be printed.

(2) USB

- When using a computer to control the measurements, select "On" to establish communication between the computer and the main unit.
- If set to "Off", communication between the computer and main unit will not work properly.

(3) Save SD

- **"Never":** No measurement results are saved.
- **"No Error":** Only the results of measurements that completed without errors are saved to the SD card.
- **"Always":** All measurement results, including those with errors, will be saved to the SD card.

(4) Time Sync

- **"On":** When the computer control software is opened, a dialog box will appear, allowing the date and time of the computer to be synchronized with the main unit.
- **"Off":** Synchronization is disabled, but you can still set the time on the main unit manually in the Set Time option.

(5) Device ID

- When multiple main units are connected to the same system software as a workstation, each main unit needs a unique device ID. If only one main unit is used, set the Device ID to "1".

(6) Draw Speed

This sets the speed at which the waveform is drawn on the screen.

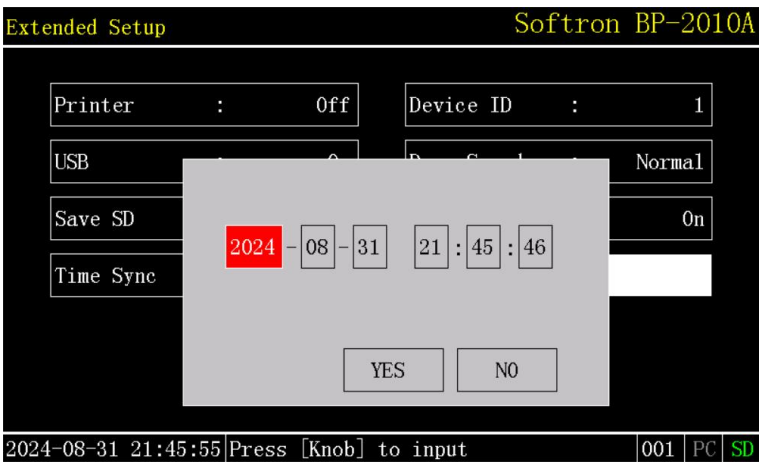
- **"Slow":** Slow drawing speed.
- **"Normal":** Normal drawing speed.
- **"Fast":** Fast drawing speed.

(7) Result Display

- **"On":** After each measurement, the waveform will display on the screen for 10 seconds before automatically returning to the monitoring status. You can also press the Info/Back button at any time to return to the monitoring status.
- **"Off":** The waveform will not stay on the screen after the measurement; it will immediately return to the monitoring status.

(8) Set time

- To set the date and time on the main unit, the interface is as shown below. The setting range is from 2000-01-01, 00:00:00 to 2099-12-31, 23:59:59. After completing the settings, select "YES" to save the changes. If the date and time are not saved after restarting, please contact the manufacturer for maintenance.



5.4. Animal Information

(1) In the main interface monitoring state, short press the **Info/Back** button to enter the Animal Information interface.

(2) Rotate the knob to move the highlighted bar to the option you need to modify, then press the knob to activate the on-screen keyboard.

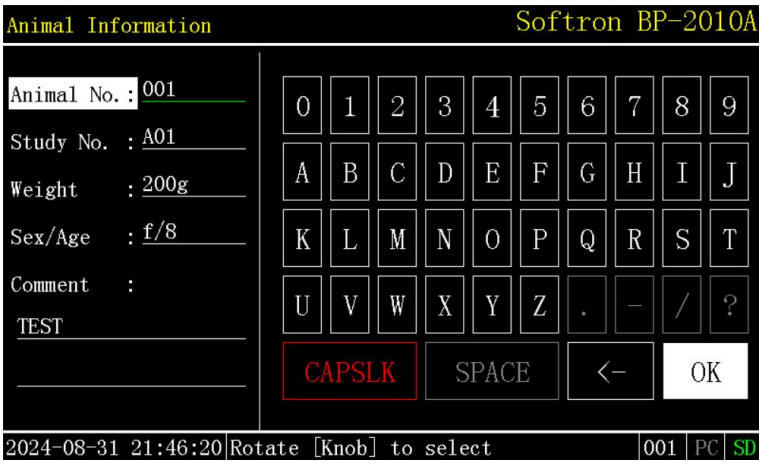
(3) Rotate the knob to switch between different characters, and press the knob to input the selected character. Press the **"CAPSLK"** key to toggle between uppercase and lowercase letters, press the **"<--"** key to delete the previous character, and press the **"OK"** key to save the changes and exit the on-screen keyboard.

Two shortcut operations:

While the on-screen keyboard is activated, press the **Start/Stop** button briefly to jump directly to the **"OK"** key. If you press the **Start/Stop** button again, the changes will be saved, and the on-screen keyboard will be exited.

While the on-screen keyboard is activated, press the **Info/Back** button briefly to jump directly to the **"<--"** key. If you press the **Info/Back** button again, the changes will not be saved, and the on-screen keyboard will be exited.

(4) Press the **Info/Back** button briefly to exit this interface.

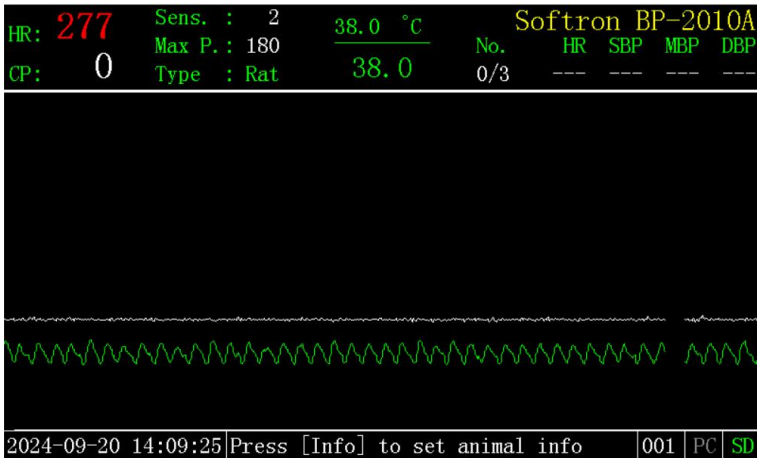


Parameter	Description	Remark
Animal No.	· The maximum length is 8 characters. The system automatically selects the last 3 characters as the file suffix for result saving, used to distinguish data sources. · It is recommended to input 3 characters as the animal ID (e.g., 001, 002). If more than 3 characters are entered, ensure that the last 3 characters are unique for each animal.	This option is mandatory.
Study No.	The maximum length is 8 characters.	This option is optional.
Weight	The maximum length is 8 characters.	This option is optional.
Sex/Age	The maximum length is 8 characters.	This option is optional.
Comment	The maximum length is 8 characters.	This option is optional.

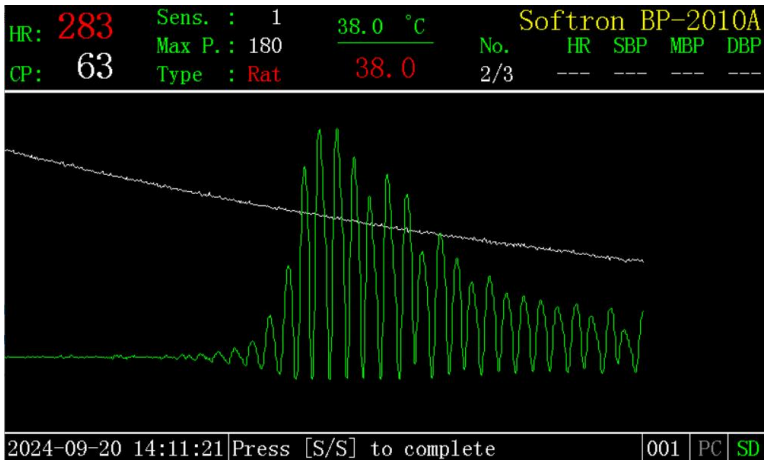
5.5. Measuring Blood Pressure

After completing the System Setup, Extended Setup, and Animal Information, proceed to the blood pressure measurement phase.

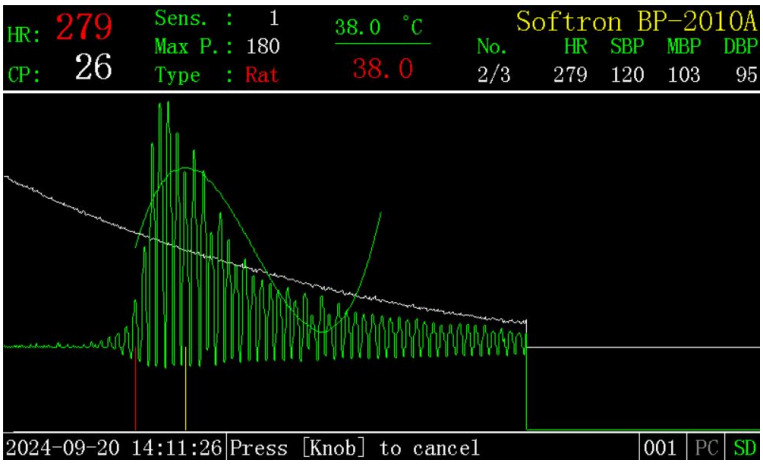
(1) Confirm that the pressure sensor is placed around the base of the rodent's tail in the direction indicated by the symbol "「▬」". The device will automatically detect whether the tail is inserted into the pressure sensor. If the tail is not detected, the system will not initiate pressurization, even if forced, and the measurement cannot begin.
(2) Ensure the rodent is properly warmed to an appropriate state: the green line should display regular and steady pulse waves. Generally, when the tail temperature reaches approximately 35°C or higher, blood pressure can be effectively measured. This can be observed as the tail feeling slightly warmer than the palm.
(3) Make sure the rodent is in a stable state with no movement interference. If there is slight movement, gently stroke the tail by hand to soothe the rodent. If the rodent moves excessively, check its position within the restraining device. For behaviors like turning its head or flipping, adjust its position promptly. Ensuring the rodent's comfort is key to successful measurement.
(4) Once the pulse wave is regular and steady and the rodent is stable with no movement interference, briefly press the Start/Stop button to initiate pressurization and measurement. The system will quickly increase the pressure in the sensor to the preset Max Pressure value, then gradually decrease the pressure at a controlled rate. The CP in the information display area will show the current real-time pressure value. The system records the changes in pressure and pulse wave during the process. After the measurement is complete, the results will be displayed. Briefly press the Info/Back button to return to the monitoring state.



Before the measurement



During the measurement



Measurement completed

(5) If an error occurs during the measurement, the system will display a pop-up message indicating the error type and recommended solutions. You can briefly press the **Info/Back** button or the knob to return to the monitoring state.

(6) After completing several measurements, switch to the next rodent. Briefly press the **Info/Back** button to enter the animal information input interface, update the animal ID, and then start the next measurement. Adjust the **Max Pressure** and **Sensitivity** parameters as needed based on the rodent's condition.

(7) If the **Auto-S** function is enabled, the system will automatically detect the pulse wave. Once the pulse wave stabilizes, the system will begin measurement automatically. After completing the set number of measurements, the system will display all measurement results along with the average value (AV), standard deviation (SD), standard error (SE), and coefficient of variation (CV).

5.6. Error Types and Solutions

During the measurement process, if an error occurs, the system will provide an error message and corresponding solution. The system's error messages and solutions are based on two fundamental conditions:

(1) The animal has been adequately warmed, and the pulse wave is regular and steady.
(2) The **Max Pressure** value is appropriate.

Before adjusting parameters according to the system's suggested solutions, first check the animal's pulse wave condition and the **Max Pressure** value.

Error	Error Message	Solutions
Err 1	Animal moved,or noise in.	Wait animal to calm down.
Err 2	Unusual vibration happened.	check the tube, cuff and connection.
Err 3	Measurement error.	check the tube.cuff and connections.
Err 4	Exhaust speed isn't proper.	check the cuff and exhaust speed setting.
Err Air	Air leak, or tube disconnected.	check the cuff and tube.
Err Lo	Pulse wave is too weak.	Increase sense.
Err Hi	Pulse wave is too strong.	Decrease sense.

Common Errors:
If the animal is not sufficiently warmed and/or the **Max Pressure** value is inappropriate, it may affect the system's ability to identify the error type.

(1) **Insufficient Warming:**
If the animal is not sufficiently warmed and pressurization is initiated before the pulse wave becomes regular and steady, the system may display the error type **Err Lo**. In this case, check the warming state of the rodent and wait for the pulse wave to stabilize before re-measuring.

(2) **Max Pressure Value Too Low:**
If the **Max Pressure** value is set too low and the **Auto-P** function is not enabled, blood flow may not be completely blocked during pressurization, leading to an **Err 2** message. To resolve this, increase the **Max Pressure** value and re-measure.

(3) **Max Pressure Value Too High:**
If the **Max Pressure** value is set too high, significantly exceeding the rodent's systolic pressure, it may prevent obtaining a complete waveform, resulting in an **Err 2** message. In this case, lower the **Max Pressure** value and re-measure.

5.7. Viewing Measurement Results

(1) Viewing Statistical Analysis Results

The number of completed measurements will be displayed under "No." in the main screen's information display area. On the main screen, long press the knob to display the results for the corresponding measurement number. If the results span more than one page, they will be displayed in pages (the page number will be shown in the bottom-right corner). When scrolling to the top or bottom of the list, continuing to scroll will automatically flip to the next page.

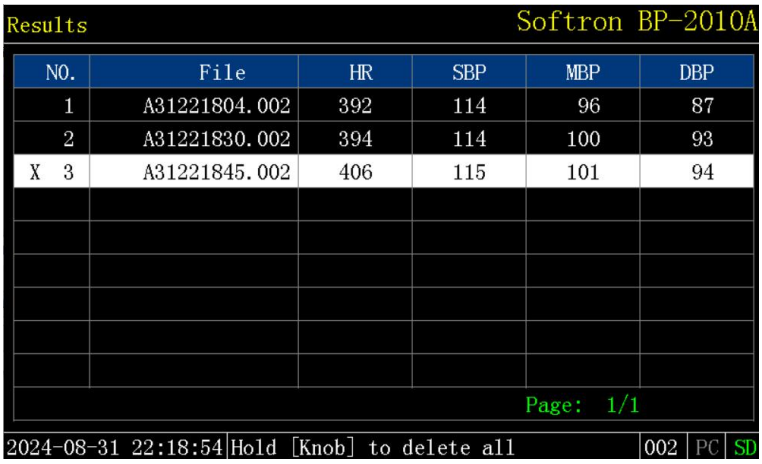
(If any parameters or animal information are changed, the "No." value will reset to zero and the count will start over. In this case, previous measurement results cannot be viewed.)

"File" refers to the file name of the measurement results. If the data has not been saved to the SD card, the file field will be empty. If the **Auto-S** function is enabled, the system will automatically calculate the average value (AV), standard deviation (SD), standard error (SE), and coefficient of variation (CV).

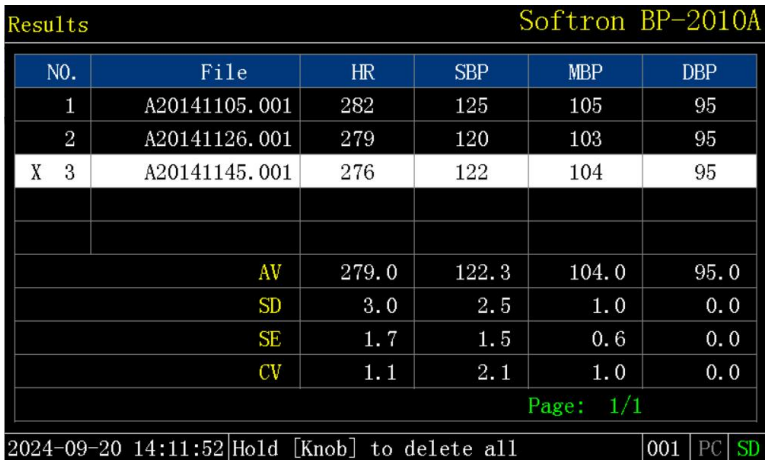
On this screen, rotate the knob to select a specific data point. Briefly press the knob to delete the selected data from the display. Long press the knob to delete all data from the display. Deleting data here only removes it from the display and does not affect its saved status on the SD card.

If an external thermal printer is connected, briefly press the “Start/Stop” button to print all current measurement results.

Briefly press the **Info/Back** button to exit this interface.



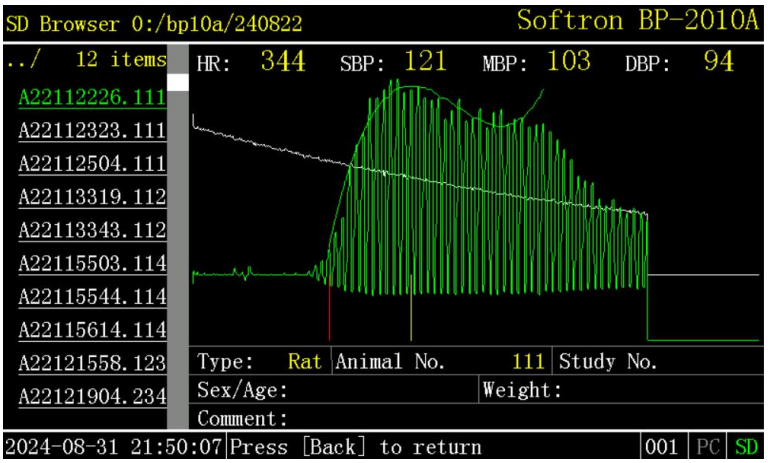
Auto-S is “Off”



Auto-S is “On”

(2) Viewing Measurement Results from the SD Card

In the main screen's monitoring state, long press the **Info/Back** button to enter the SD Browser interface. The left side displays the file tree of the **SD** card, with folder names corresponding to the dates (year, month, day) when the data was saved. Rotate the knob to select a folder, then press the knob to open the folder and view the data files inside.

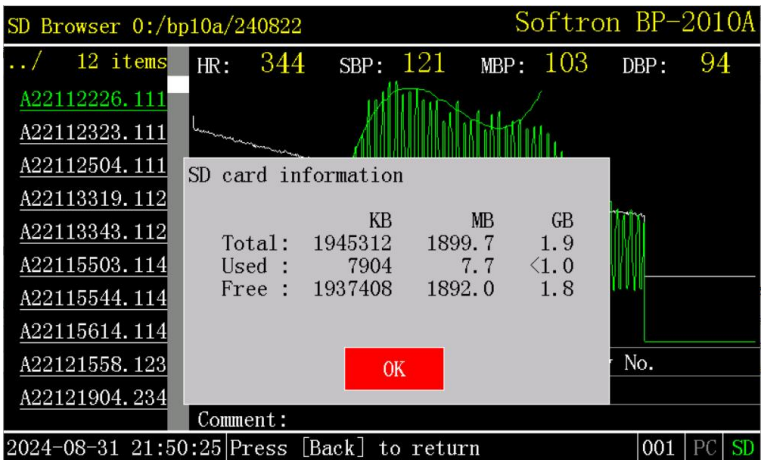


The data file name corresponds to the time when the data was saved (day, hour, minute, second), with the suffix being the last 3 digits of the animal ID (if the animal ID is longer than 3 digits, the system will automatically select the last 3 digits; if it is shorter than 3 digits, the system will automatically add leading zeros).

When the knob is rotated to a specific file, the data information and waveform for that file will automatically be displayed on the right side.

Briefly press the Start/Stop button to display the **SD card**'s capacity information.

Briefly press the **Info/Back** button to exit the **SD Browser** interface.



SD card's capacity information

6. Replacing the Rubber Membrane

6.1. Replacing the Rubber Membrane for the Rat Pressure Sensor

(1) Remove the pressure sensor from the main unit and use a screwdriver to unscrew the screws on the pressure sensor.
(2) Remove the old rubber membrane and check the two light channels on the inner wall of the pressure sensor. Ensure that the channels are sealed with the transparent and there is no air leakage (see Figure 1).
(3) Pass the new rubber membrane through the cylinder and use blunt tweezers and your fingertip to fold the membrane back. Adjust any twisted sections to ensure the membrane is flat (see Figure 2).
(4) Close the cover and tighten the screws. Ensure that the covers on both sides fit well. If there is a gap between the cover and the main body, it will affect the pressure sensor's sealing, potentially causing air leaks (see Figure 3).
(5) After replacing, connect the pressure sensor to the main unit and test the pressure sensor to ensure there is no air leakage and no **Err Air** or **Err 4** errors. If the screws are tightened too much, it will increase pressure on the rubber membrane. Adjust the screw tightness to an appropriate level, ensuring there is no air leakage.

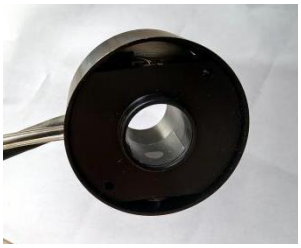


Figure 1

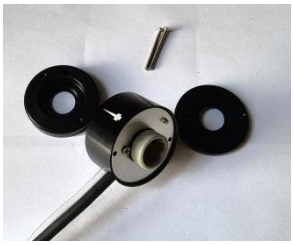


Figure 2

Figure 3

6.2. Replacing the Rubber Membrane for the Mouse Pressure Sensor

1. Remove the pressure sensor from the main unit and use a screwdriver to unscrew the screws on the pressure sensor.
2. Remove the old rubber membrane and check the two light channels on the inner wall of the pressure sensor. Ensure that the channels are sealed with the transparent and there is no air leakage.
3. Pass the new rubber membrane through the cylinder and use blunt tweezers and your fingertip to fold the membrane back. Adjust any twisted sections to ensure the membrane is flat (see Figure 4).
4. Place the black rubber ring over the folded rubber membrane (see Figure 5).
5. Close the cover and tighten the screws (see Figure 6).

6. After replacing, connect the pressure sensor to the main unit and test the pressure sensor to ensure there is no air leakage and no **Err Air** or **Err 4** errors.

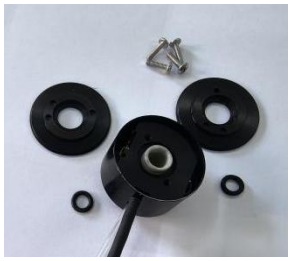


Figure 4

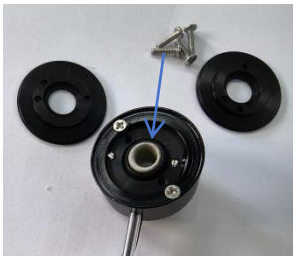


Figure 5

Figure 6

Note: *The rubber membrane used must be provided by the manufacturer, as the quality of the rubber membrane affects the sealing of the pressure sensor, infrared transmittance, and other factors, which in turn impact the accuracy of blood pressure measurements.*

7. Equipment Maintenance

(1) This system is a high-precision instrument. Please take care to protect it from pressure, vibration, chemicals, and dust during storage and use.
(2) Gently wipe the surface of the main unit and the pressure sensor with water or alcohol to remove dust and other debris.
(3) Do not apply weight to the root of the connecting cable, as this may cause the cable to break and become unusable.
(4) The rubber membrane is made of rubber, and it may degrade over time or due to prolonged exposure to ultraviolet light, rendering it unusable.
(5) If the equipment is not in use for an extended period, remove the rubber membrane from the pressure sensor. It is best to seal the rubber membrane and store it in a 4°C refrigerator.
(6) After use, clean the dirt with a cotton swab dipped in water or alcohol. If the rubber membrane becomes cloudy, it will affect the measurement.
(7) If the cylindrical restraint mesh or canvas cover becomes contaminated with urine or feces, it may cause the rodent to avoid the odor and become agitated. Please clean and dry them before reuse.

8. Using the Printer

If a micro thermal printer is connected to the **PRINTER** port on the back of the main unit, and the Printer option in the **Extended Setup** interface is set to **"On"**, the measurement results can be printed.

For example:

Automatic measurements were performed 3 times:

1st time:

```
------ Softron   BP-98A ------
No.    HR      SBP      MBP      DBP
  1   292      111       97       89
```

2nd time:

```
------ Softron   BP-98A ------
No.    HR      SBP      MBP      DBP
  1   292      111       97       89
  2   304      109       99       94
```

3rd time:

```
------ Softron   BP-98A ------
No.    HR      SBP      MBP      DBP
  1   292      111       97       89
  2   304      109       99       94
  3   293      116      101       94
-------------------------------------
 AV  296.3    112.0     99.0     92.3
 SD    6.7      3.6      2.0      2.9
 SE    3.8      2.1      1.2      1.7
 CV    2.2      3.2      2.0      3.1
```