

Softron

Non-Invasive Blood Pressure Meter for Large Animals

BP-2010E

Miniature pigs, Beagle dogs, monkeys, rabbits, guinea pigs, and others

Operating Manual

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1. System Overview

BP-2010E is an upgraded product of BP-98E and uses the same measurement principle. It measures blood pressure indirectly and non-invasively by the oscillometric method, and displays and stores results via the LCD and an SD card. Measurement time is short and operation is very simple. For details, see Chapter 3, Blood Pressure Measurement.

1.1 Device Features

- Short measurement time — Blood pressure measurement can be completed in a short time (approximately 15 seconds).
- Terminal software BPTerm10EU — Via the USB interface, the blood pressure meter can connect directly to a PC to monitor blood-flow pulse waves and pressure changes in real time, and to store waveforms and measurement results (heart rate, blood pressure, etc.) to files.
- SD card storage and waveform browse — With an SD card inserted, measurement data can be stored directly to the SD card. Stored data files on the SD card can also be browsed conveniently; waveforms and measurement results are clear at a glance.
- Printer connection — If a printer is connected to BP-2010E, measurement results (mean, standard deviation, standard error, coefficient of variation) can be printed.
- Multiple animal species — Cats, dogs, monkeys, cattle, horses, and many other animals can be measured.
- Statistical values of measurement results — After the specified number of measurements is reached, the instrument can automatically calculate the mean and standard deviation of heart rate, systolic pressure, mean pressure, and diastolic pressure.
- Automatic re-pressurization — Even if the measured blood pressure exceeds the set pressurization value, BP-2010E automatically controls pressurization (increments of 50 mmHg each time, up to two additional pressurizations). In addition, BP-2010E can automatically detect abnormal deflation speed, cuff damage, and sensor abnormalities, thereby ensuring measurement accuracy.

1.2 Specifications

Item	Specification
Measurement method	Oscillometric Method
Pressurization range	Max. 350 mmHg
Maximum heart rate	600 BPM
Systolic blood pressure	Cuff pressure at the start of the approximation curve
Mean blood pressure	Cuff pressure at the maximum of the approximation curve
Diastolic blood pressure	Calculated value
Power supply	AC 100/220 V, 50/60 Hz, 10 W
Main unit dimensions	236 mm × 236 mm × 100 mm
Cuffs (accessories)	NO.11, NO.12, NO.13 — 1 each
Operating manual	1
AC power cord	1
Operating temperature / humidity	20°C–30°C / 20–80% (no condensation)
Printer port	9-pin serial (DB9)
USB interface	Connection to PC

1.3 Cuff and Main Unit Maintenance

Please observe the following during use:

- Wrap the cuff moderately around the animal's tail or limb to be measured.

- BP-2010E is a high-precision instrument. During storage and use, protect it from pressure, shock, chemicals, and dust.
- Gently wipe the surface of the main unit with water or alcohol to remove dust and other debris.
- If load is applied at the root of a connecting cable, the cable may break and become unusable.
- After long-term use, the cuff may become damaged; inspect it before measurement.

1.4 Components

Basic configuration

Item	Qty
BP-2010E main unit	1
Cuff (NO.11)	1
Cuff (NO.12)	1
Cuff (NO.13)	1
Connecting tubing (2 m)	1
USB data cable	1
SD data storage card	1
Power cord	1
Operating manual	1

Optional configuration

- PC communication terminal software

2. Main Unit Description

2.1 Front Panel Layout

The front panel has an LCD display, indicator lamps, keys, and a pressure tubing connector, as shown in Figure 2-1:

Figure 2-1 Front panel
[Illustration in Chinese edition — not embedded here]

[Figure 2-1 Front panel — see Chinese edition for illustration]

LED lamps

- System: System indicator (green). Lit when the blood pressure meter is operating normally.
- Heart Rate: Heart-rate indicator (red). Flashes once per heartbeat.

Connection

- Pressure: Cuff connector.

2.2 Front Panel Components and Functions

The keys and LCD of BP-2010E have different meanings and functions in the states “waiting before blood pressure measurement,” “measuring blood pressure,” “measurement finished,” and “menu mode.”

Waiting before blood pressure measurement (after power-on and system start, the meter enters the waiting state)

- Rotary knob: (1) Rotate left/right to adjust sensitivity. (2) Long-press the rotary knob to browse all measured results.
- START/STOP key: Press to start measurement.
- Info/Back key: (1) Press to set animal information. (2) Long-press to browse the SD card.

During blood pressure measurement (after pressurization is complete)

- START/STOP key: End measurement and display results.

After blood pressure measurement ends

- Info/Back key: Return to the waiting screen.

Menu settings

- Rotary knob: (1) Rotate left/right: when not editing, switch options; when editing, adjust values. (2) Press to enter or exit an edit item.
- START/STOP key: Long-press to enter the extended menu.
- Info/Back key: Return to waiting before measurement.

2.3 Rear Panel Layout

The rear panel has power, GND grounding, printer interface, USB interface, switch, SD slot, and related connectors (as shown).

Figure 2-3 Rear panel — see Chinese edition for illustration
[Illustration in Chinese edition — not embedded here]

[Figure 2-3 Rear panel — see Chinese edition for illustration — see Chinese edition for illustration]

2.4 Rear Panel Components and Functions

- POWER: Power switch and three-pin power inlet, AC 100 V / AC 220 V.
- GND: Grounding terminal.
- PRINTER: Connect to a printer to print measurement results.
- SD: SD card slot.
- USB: Connect to a PC via USB cable for software communication.

3. Blood Pressure Measurement

Blood pressure and heart-rate measurement are affected by environmental factors. Measure animals under as similar objective conditions as possible to reduce measurement error and ensure stable results.

3.1 Preparation Before Measurement

- A quiet, warm environment without people present is preferable for measurement.
- If measurement is not performed in the animal room, move the animal to the measurement site in advance so that it can adapt to the measurement environment. If the measurement environment differs greatly from the animal room, calm the animal so that it becomes stable.
- If the measurement environment temperature is low, more time will be needed before a measurable state is reached.
- Understand the living habits of the animal to be measured and practice restraint several times. After repeated training, the animal will become accustomed and can stabilize quickly.

3.2 Cuff Selection and Use

Cuff selection criteria

Select cuff size according to animal body size and weight. Standard cuffs NO.10, NO.11, and NO.12 can meet measurement needs for guinea pigs, rabbits, miniature pigs, monkeys, and Beagle dogs. For large animals such as cattle and sheep, configure cuff NO.13.

Cuff specifications

No.	Size	Standard wrap range	Remarks
NO.10	2.5 cm	3.5–6.0 cm	
NO.11	3.0 cm	5.0–7.0 cm	
NO.12	4.0 cm	7.5–10.5 cm	
NO.13	5.0 cm	8.5–13.0 cm	Generally configured for large animals such as cattle and sheep; or for arm/leg measurement of Beagle dogs and cynomolgus monkeys

Note: Smaller animals such as guinea pigs require a smaller cuff (not standard configuration). A custom cuff must be ordered separately.

How to use the cuff

After selecting the cuff size, select the cuff deflation speed according to the animal's heart rate. At the same deflation speed setting, larger cuffs generally deflate relatively more slowly.

Fixation sites: For guinea pigs and rabbits, the cuff is generally fixed on a forelimb; for miniature pigs, on a forelimb or the tail; for cats and dogs, on the tail; for monkeys, on the upper arm. When fixing the cuff on the animal, determine the overlapping-line position carefully.

3.3 Basic Blood Pressure Measurement Procedure

Turn on the main unit power. After the logo is displayed, if the blood pressure meter is working normally, the device enters the waiting stage, as shown in Figure 3-1. The screen is divided from top to bottom into three parts: information display area, waveform display area, and status bar.

Figure 3-1 Waiting-stage screen
[Illustration in Chinese edition — not embedded here]

[Figure 3-1 Waiting-stage screen — see Chinese edition for illustration]

The information display area includes:

- HR: Real-time heart rate
- BP: Current pressure value
- Sense: Sensitivity setting
- MaxP: Maximum pressurization setting
- Type: Animal type setting
- NO.: Number of measurements completed / total number of measurements (if Sum is set to Off in System setup, only the number completed is shown)
- HR, SBP, MBP, DBP: Most recent measurement results (heart rate, systolic, mean, and diastolic pressure)

The status bar has five parts: (1) system time, (2) operation prompts, (3) animal ID, (4) PC connection status, (5) SD card status. PC and SD card status indications are as follows:

Category	Status
PC connection	PC not connected
PC connection	PC connected and available

Category	Status
PC connection	PC connected but disabled
SD card	SD not inserted
SD card	SD inserted and initializing
SD card	SD inserted and available
SD card	SD inserted but disabled or write-protected
SD card	SD inserted but capacity full

Press the Start/Stop key to start measurement, as shown in Figure 3-3. Before pressing START/STOP, check that the cuff is wrapped around the animal's limb to avoid excessive pressure damaging the cuff.

Figure 3-3 Start of measurement
[Illustration in Chinese edition — not embedded here]

[Figure 3-3 Start of measurement — see Chinese edition for illustration]

During measurement, the display is as shown in Figure 3-4:

Figure 3-4 During measurement (example: rabbit)
[Illustration in Chinese edition — not embedded here]

[Figure 3-4 During measurement (example: rabbit) — see Chinese edition for illustration]

When measurement ends, the display is as shown in Figure 3-5:

Figure 3-5 End of measurement
[Illustration in Chinese edition — not embedded here]

[Figure 3-5 End of measurement — see Chinese edition for illustration]

At this point one measurement is complete. If a printer is used, the measurement result is output. If automatic-start mode is active, the next measurement follows according to the TimeMode or Time sequence settings in the software. After the set number of measurements is completed, if Sound in the System setup menu is ON, BP-2010E emits a “beep—beep—beep—beep—beep—” sound to indicate that measurement has finished. Pressing START/STOP then starts the next round of measurements. If an error occurs during measurement, a “beep—” sounds and an error message is displayed; press Info/Back or the rotary knob to continue measuring until the set number of measurements is completed (for special errors, an error message is shown and measurement is terminated). When a measurement error is caused by movement of the animal's limb during measurement, a prompt dialog appears as shown in Figure 3-6:

Figure 3-6 Measurement error
[Illustration in Chinese edition — not embedded here]

[Figure 3-6 Measurement error — see Chinese edition for illustration]

When the set number of measurements is completed, if Sound in the System setup menu is ON, BP-2010E emits “beep—beep—beep—beep—beep—” to announce completion, and the Result menu appears automatically showing the mean, SD, SE, and CV of the measurements. These values are displayed on screen only and are not saved to the SD card; however, if a printer is connected they will be printed in sequence, ending with “beep—beep—beep—”. Rotating the knob left/right browses measurement result data in order. Pressing the knob deletes the currently viewed item; long-pressing the knob deletes all measurement results.

3.4 Printer Connection and Output

If the accessory miniature thermal serial printer is connected to the BP-2010E main unit and the print option is enabled, results can be printed.

Example: automatic measurement performed 3 times — first, second, and third measurements. At the end of measurement, the rounded mean is displayed.

Output data explanation:

Symbol	Meaning
No.	Measurement count
SBP	Systolic blood pressure
MBP	Mean blood pressure
DBP	Diastolic blood pressure
SD	Standard Deviation
SE	Standard Error
CV	Coefficient of Variation

If the total number of measurements is not set, statistical results are not output at the end. Pressing START/STOP prints all measurement results.

Note: If the printer is not ready, BP-2010E will not print. Confirm that the printer is connected and restart BP-2010E.

4. System Settings

System settings include basic settings, extended settings, and animal information.

4.1 Basic Settings (System setup)

In the waiting stage, long-press START/STOP for more than 1 second to enter basic settings (Figure 4-1). Press Info/Back to return to the waiting stage.

System setup configures measurement-related parameters. If any of MaxPress, Sense, Speed, AutoP, Sum, DBP, Sound, or Type is changed, previously measured results are cleared.

Figure 4-1 System setup
[Illustration in Chinese edition — not embedded here]

[Figure 4-1 System setup — see Chinese edition for illustration]

In System setup menu mode, rotate the knob on the device panel to select different parameter items. Press the knob to enter edit mode (value blinks); rotate the knob to change the value; press the knob again to finish editing.

Key operations in System setup are shown in Table 4-2:

Key	Function
START/STOP	Long-press to enter Extended setup

Key	Function
Info/Back	Short-press: if an item is being edited and has been changed, a prompt appears; otherwise return to waiting
Knob	Switch edit items; after entering edit mode, change values; short-press to enter/finish an edit item

Table 4-2 Key operations in System setup

Parameter items in System menu setup mode are described in Table 4-3:

Parameter	Description	Range	Remarks
MaxP	Pressurization range	100–350 mmHg	Each left/right knob step changes 10 mmHg
Sense	Measurement sensitivity	0–3 / 3–7	In automatic-start mode, standard sensitivity is 2. Generally 3 or 4 is appropriate
AutoP	Automatic pressurization	On / OFF	If ON, after pressurization to the upper limit, if pulse waves still appear, the cuff automatically pressurizes by <50 mmHg>
Speed	Deflation speed	1–3	1: 200→100 mmHg in 3–4 s; 2: 200→100 mmHg in 2–3 s; 3: 200→100 mmHg in 1–2 s
Sum	Number of measurements (auto statistics)	1–10 / OFF	After automatic measurement completes, the system automatically displays valid data and mean, SD, SE, CV for the set number
DBP	DBP / MBP measurement	On / OFF	If ON, measure diastolic, mean, and systolic pressure; if OFF, measure only systolic pressure
Sound	Buzzer	On / OFF	ON = on; OFF = off
Type	Animal type	Rabbit/Monkey / Dog / Other	R/M: HR above 150; Dog: HR 80–180; Other: HR 40–100
Default Setting	Restore default settings		

Table 4-3 System menu parameter items

4.2 Extended Settings (Extended setup)

Long-press START/STOP for more than 1 second to enter System setup; after releasing, long-press START/STOP again for more than 1 second to enter Extended setup (Figure 4-4). Press Info/Back to return to the waiting stage.

Figure 4-4 Extended setup menu
[Illustration in Chinese edition — not embedded here]

[Figure 4-4 Extended setup menu — see Chinese edition for illustration]

Set the system clock as shown in Figure 4-5:

Figure 4-5 Set system clock
[Illustration in Chinese edition — not embedded here]

[Figure 4-5 Set system clock — see Chinese edition for illustration]

Year, month, day, hour, minute, and second can be set. The setting range is from 2000-01-01 00:00:00 to 2099-12-31 23:59:59.

Key operations in Extended setup are shown in Table 4-6:

Key	Function
START/STOP	None

Key	Function
Info/Back	Short-press: if an item is being edited and has been changed, a prompt appears; otherwise return to waiting
Knob	Switch edit items; after entering edit mode, change values; short-press to enter/finish an edit item

Table 4-6 Key operations in Extended setup

Parameter items in Extended setup menu mode are described in Table 4-7:

Parameter	Description	Range	Remarks
Printer	Printer	On / OFF	RS232C: baud rate 19200
USB	USB communication	On / OFF	
Save SD	SD card save	Never / No Error / Always	Never: do not save; No Error: save when measurement has no error; Always: save every measurement
Device ID	Device ID	1–16	
Draw wave	Real-time waveform display speed	Slow / Normal / Fast	Scan speed
Set time	Set system clock		
Time sync	Time synchronization	On / OFF	Synchronize time with PC software
Result Wait	Result wait	On / OFF	When enabled, each measurement result is displayed for 10 seconds; when off, the result screen is not held and the next operation starts immediately. Disable this function when using automatic cyclic blood pressure monitoring.

Table 4-7 Extended setup menu items

4.3 Animal Information (Information Setting)

In the waiting stage, press Info/Back to enter animal information setting (Figure 4-8) and set animal information. Press Info/Back again to return to the waiting stage. The left side of the animal information setting screen shows animal parameters; the right side shows a soft keyboard. Rotate the knob to select a parameter; press the knob to edit the current parameter (soft keyboard activates). Then rotate the knob to switch among soft-keyboard characters; press the knob to enter the selected character. Press the knob on OK to finish editing the current parameter.

Figure 4-8 Animal information setting
[Illustration in Chinese edition — not embedded here]

[Figure 4-8 Animal information setting — see Chinese edition for illustration]

Animal information setting parameters are described in Table 4-9:

Parameter	Description	Range	Remarks
Animal NO.	Animal number	Digits only; max length 3	Keyboard state as in Figure 4-10
Study NO.	Study number	Digits only; max length 3	Keyboard state as in Figure 4-10
Weight	Animal body weight	Any characters; max length 8	Keyboard state as in Figure 4-11
Sex/Age	Sex / age	Any characters; max length 8	Keyboard state as in Figure 4-11
Comment	Remarks	Any characters; max length 32	Keyboard state as in Figure 4-11

Table 4-9 Animal information setting parameters

When not in edit mode, the software keyboard is shown in gray. Keys are as in Table 4-10:

Key	Function
START/STOP	None

Key	Function
Info/Back	Short-press: if an item is being edited and has been changed, a prompt appears; otherwise return to waiting
Knob	Switch edit items; short-press to enter edit

Table 4-10 Key operations when not in edit mode

When editing an item, an edit cursor appears and the soft-keyboard area is highlighted (Figures 4-11 and 4-12). If a key is gray, it is skipped automatically when switching keys.

Figure 4-11 Edit mode (digits only)
[Illustration in Chinese edition — not embedded here]

[Figure 4-11 Edit mode (digits only) — see Chinese edition for illustration]

Figure 4-12 Edit mode (any characters allowed)
[Illustration in Chinese edition — not embedded here]

[Figure 4-12 Edit mode (any characters allowed) — see Chinese edition for illustration]

In edit mode, keys are as in Table 4-11:

Key	Function
START/STOP	Short-press: switch between Backspace (←) and other keys; long-press: toggle upper/lower case
Info/Back	Short-press: if the edited item has been changed, a prompt appears; otherwise return to waiting
Knob	Rotate left/right to switch key selection; short-press to enter key value; long-press to enter a space

Table 4-11 Key operations in edit mode

5. SD Card Browse

In the waiting state, long-press Info/Back for 1 second to enter SD card browse (Figure 4-13). This system supports FAT16/FAT32 formatted SD cards up to 16 GB.

Figure 4-13 SD card browse initial screen
[Illustration in Chinese edition — not embedded here]

[Figure 4-13 SD card browse initial screen — see Chinese edition for illustration]

The left side shows the SD card file tree. Only blood-pressure data files or folders with filenames shorter than 16 characters are displayed. Icons indicate whether a folder is collapsed or expanded, and also identify files. The right side shows information for the selected file.

Key operations in SD card browse are shown in Table 4-13:

Key	Function
START/STOP	Short-press to display SD card capacity information
Info/Back	Short-press to return to waiting stage
Knob	Select and browse files; short-press to expand a folder; long-press to delete a file or folder

Table 4-13 Key operations in SD card browse

When rotating the knob, if it stops on a file, the system automatically displays the file (Figure 4-14). If it stops on a folder, the right-side display is cleared automatically.



[Figure 4-14 SD card file browse — see Chinese edition for illustration]

Press START/STOP to display SD card capacity information, as shown in Figure 4-15:



[Figure 4-15 SD card capacity information — see Chinese edition for illustration]

In SD file browse menu mode, rotate the knob left/right to select the file path and the data file to view. The right side of the screen shows the waveform graph, HR, SBP, MBP, and DBP values, and animal parameter information.

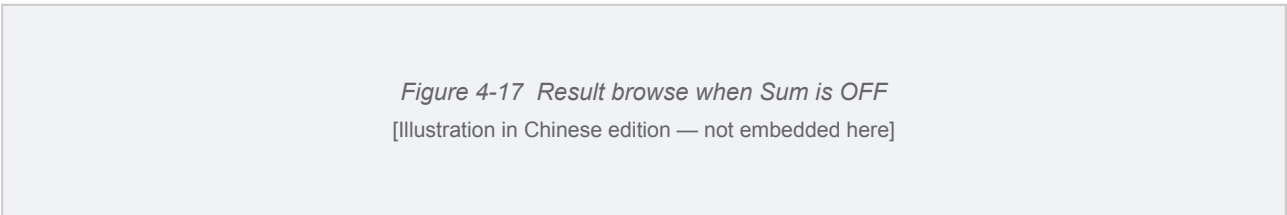
6. Browse Measurement Results

In the waiting stage, long-press the knob to browse all measurement results. Rotate the knob to select a result, as shown in Figures 4-16 and 4-17.

When the number of results exceeds one page, results are shown page by page (page indicator at lower right). When browsing up to the top item or down to the bottom item, continuing up/down automatically turns the page. File is the filename saved for that measurement; if no file was saved to the SD card, File is blank. If a total number of measurements is set (Sum is not OFF), the system automatically calculates the average (AV), standard deviation (SD), standard error (SE), and coefficient of variation (CV). Key operations are shown in Table 4-18:



[Figure 4-16 Result browse when Sum is set to 2 — see Chinese edition for illustration]



[Figure 4-17 Result browse when Sum is OFF — see Chinese edition for illustration]

Key	Function
START/STOP	Short-press to print all results
Info/Back	Short-press to return to waiting stage

Key	Function
Knob	Rotate to switch the current item; short-press to delete one measurement result; long-press to delete all results

Table 4-18 Key operations for browsing results

7. Frequently Asked Questions

7.1 Initialization Problems

1. Problem: No display when power is turned on, or BP-2010E does not display normally.

Check: Whether the power cable is correctly connected.

Action: There may be a problem with the blood pressure meter main unit.

7.2 Problems During Testing

1. Problem: Cannot print.

Check: Whether the printer option is On, and whether the printer is ready (paper, cable, On-Line status, etc.).

Action: Check settings, connections, and BP-2010E configuration.

7.3 Problems When Communicating with PC via Software

1. Problem: Waveform cannot be detected.

Check: Whether the USB interface is correctly connected, and whether USB is enabled in BP-2010E settings.

Action: Check whether the cable is normal, whether USB settings in BP-2010E are correct, and whether the driver is installed properly.

2. Problem: Cannot print data on the computer.

Check: Printer connection settings are correct.

Action: Check connection status and print settings (driver correctly installed, etc.).

7.4 Error Displays at End of Measurement and Remedies

1. Display: Err Lo

Cause: The animal's blood flow is small and the waveform is small; measurement cannot be performed. Pulse-wave oscillation cannot be detected during measurement.

Action: Increase sensitivity and check whether the cuff position is correct.

2. Display: Err Hi

Cause: During deflation, pulse-wave amplitude is too large and exceeds the range.

Action: Reduce pulse-wave sensitivity and restart measurement.

3. Display: Err 1

Cause: During measurement, the animal's cuffed limb moved or noise entered. If the waveform display looks normal, the cause may be that deflation speed is too slow.

Action: Calm the animal; during measurement do not shake the tubing connecting the cuff and main unit. If the cause is slow deflation, increase deflation speed. If deflation speed is already 3, check whether the animal type is selected correctly.

4. Display: Err 2

Cause: Abnormal oscillation, or blood flow too small to produce sufficient oscillation waves; when the pressurization upper limit is reached, pulses still appear — pressurization is insufficient.

Action: Confirm cuff position, raise the pressurization upper limit by 20 mmHg, and measure again.

5. Display: Err 3

Cause: Approximation curve cannot be obtained.

Action: Confirm cuff position and measure again.

6. Display: Err 4

Cause: Abnormal deflation/exhaust speed.

Action: Check whether the cuff is damaged and whether cuff size is appropriate; measure again. Check whether animal species (heart-rate range) setting is appropriate. If excessively slow deflation occurs repeatedly, the exhaust valve has aged and requires factory adjustment and maintenance.

7. Display: Err Air

Cause: Abnormal deflation/exhaust speed, usually too fast; cuff leak or cuff not properly connected to BP-2010E.

Action: Check cuff, main unit, and tubing connections; replace damaged parts. Place a pencil in the cuff, bend the small tubing at the main-unit connector, and pressurize. If the displayed pressure rapidly reaches the pressurization upper limit, the leak is in the external connecting tubing; otherwise the leak is inside the main unit.

8. Standard Kit and Accessories

We provide the following standard kit.

8.1 Standard Kit

Name	Specification / Qty
NO.11 cuff	1
NO.12 cuff	1
NO.13 cuff	1
Connecting tubing (2 m)	1
USB data cable	1
SD data storage card	1
Power cord	1

Note: Guinea-pig-specific cuffs must be customized according to guinea pig size.