



## Tech Note

## BP-100 Intravascular Blood Pressure Transducer

### Overview

The BP-100 is a clinical blood pressure transducer modified for use with digital recording equipment in research applications. It consists of an active element and a molded 5 ft. extension cable. Although the elements are rugged and will be able to withstand many uses, they are not permanent. Replacement elements can be purchased directly from iWorx/CB Sciences, Inc.

The sensor employed in this blood pressure (BP) transducer, and all disposable BP transducers, are laser cut strain gauges. Since all these strain gauges are made by a machine, the output of the gauge indicating pressure is linear relationship, without variation between transducers. These facts make the calibration of the transducer much easier.

The transducer element is open at both ends. One end is typically connected to a blood vessel with a piece of heparinized P.E. tubing. The other end of the element is connected through a 3-way stopcock to a syringe which is used for flushing the transducer and the lines. To accurately report pressure, these transducers must be completely filled with fluid. Bubbles in the transducer or the lines will produce unwanted results.



Figure 1: BP-100 transducer with DIN8 connector.

### Equipment Setup

1. Plug the male connector of a DIN8 extension cable into one of the DIN inputs of an iWorx data acquisition unit or amplifier. Plug the DIN8 connector of the BP-100 into the female connector of the DIN8 extension cable.
2. Attach the cannula from the subject's artery to the 3-way stopcock that is on the input of the BP-100 element. The cannula, stopcock, and transducer should be filled with heparinized saline solution to prevent clotting.

### Start the Software

When using an iWorx data recording unit with its own DIN inputs, like an iWorx 214, or an iWorx amplifier, like the ETH-401, coupled to an iWorx 118:

1. Click the Windows Start menu, move the cursor to Programs and then to the iWorx folder and select LabScribe; or click on the LabScribe icon on the Desktop.
2. When the program opens, select Preferences from the Edit menu. Select the Channel preferences dialogue window. Name the channel to which the BP-100 or the amplifier supporting the BP-100 is connected. Set the Mode and Function for this channel to Record and Raw Data, respectively. Also, set the sampling rate and display time. Click OK.
3. If you plan to use these settings again, click on the Settings menu and select the Edit Group to add this setting file to your group of settings.

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## Calibration

There are two ways to calibrate the BP-100.

### Method 1: Manometer Calibration

1. Turn the valve of the 3-way stopcock so that the line going to the animal is closed.
2. Connect a manometer to the unused port on the 3-way stopcock.
3. Check that the pressure on the manometer is 0 (zero) mmHg. Start recording.
4. Pressurize the manometer to 100 mmHg and adjust the range displayed on the recorder so that the change in the signal from 0 to 100 mmHg can be seen easily.
5. Mark the record to indicate the pressures that are recorded.
6. Bleed pressure from the manometer until it drops back to 50mmHg. Mark the record again.
7. Stop recording the signal.
8. Position the section of the recording that contains the step from 100 to 50 mmHg in the center of the screen.
9. Use the units conversion function of the recording software to complete the calibration of the transducer. If you are using LabScribe software to record data:
  - Position one of the blue cursors in the **Main** window at the section of the recording that equals 100 mmHg;
  - Position the second cursor on the section equal to 50 mmHg.
  - **Right-click** on the recording window of the channel to which the BP-100 is connected.
  - Select **Units...** from the **Right-click** menu of the recording channel.
  - Select **2 point cal** from the menu in the upper left corner of the Units Conversion window. Notice that the voltages from the positions of the cursors are automatically entered into the value equations.
  - Enter the two pressures, **50** and **100**, used in the calibration recording in the corresponding boxes on the right side of the conversion equations.
  - Enter the name of the units, **mmHg**, in box below the pressures.
  - Put a check mark in the box next to **Apply Units to All Blocks**.
  - Click on the **OK button** in the lower right corner of the window to activate the units conversion.

### Method 2: Conversion Factor

The transducer element used in the BP-100 has a very high degree of uniformity since the sensor is robotically cut by laser and respond identically. The output of the BP-100 is 5 microvolts ( $\mu\text{V}$ ) per millimeter of mercury (mmHg) for every volt of excitation voltage applied (V). If 10 Volts (+/-5V) are applied to the BP-100 as the excitation voltage, the output of the BP-100 is 50 microvolts per millimeter of mercury ( $\mu\text{V}/\text{mmHg}$ ) at 1X gain.

When the BP-100 is used with select iWorx data acquisition units and amplifiers, the amplification applied automatically to the output signal of the BP-100 is 400X. The devices include the iWorx data acquisition units with transducer inputs, and the iWorx ETH-256 and ETH-401 amplifiers. For example, if a BP-100 is connected to a DIN8 input of an iWorx 214 data acquisition unit, a 20mV signal displayed on the LabScribe **Main window** is equal to 1 mmHg:

$$\begin{aligned}5\mu\text{V}/\text{V applied}/\text{mmHg} \times 10\text{V applied} &= 50\mu\text{V}/\text{mmHg} \\50\mu\text{V}/\text{mmHg} \times 400\text{X gain} &= 20\text{mV}/\text{mmHg}\end{aligned}$$

Since the voltage applied to the transducer by any of these devices is the same, 10V, the inverse of this factor can be used to convert the voltage output of the BP-100 recorded with LabScribe software to pressure:

$$(1000\text{mV}/\text{V})/(20\text{mV}/\text{mmHg}) = 50\text{mmHg}/\text{V recorded.}$$

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The BP-100 can be calibrated by using the calibration factor, 50mmHg/V, on the **Units Conversion window** of recording channel:

- If you are using LabScribe software to record data, record a couple of seconds of data from the BP-100.
- Right-click on the recording window of the channel to which the BP-100 is connected.
- Select **Units...** from the **Right-click** menu of the recording channel.
- Select **slope & offset** from the menu in the upper left corner of the **Units Conversion window**.
- In the box to the right of **slope**, enter the number **50** if the BP-100 is connected to an iWorx data acquisition unit with DIN 8 inputs, or an ETH-401, or an ETH-256 with its gain set at X1. If additional gain is applied to the output of the BP-100 when it is used with an ETH-256, the **slope** is equal to **50** divided by the gain factor. For example, if a gain of X5 is applied to the output of the BP-100, the conversion factor entered as the **slope** is **10**.
- In the box to the right of **offset**, enter the number **0**.
- In the box to the right of **Name**, enter **mmHg**.
- Put a check mark in the box next to **Apply Units to All Blocks**.
- Click on the **OK button** in the lower right corner of the window to activate the units conversion.

### Care

1. After using the transducer, flush out the element using a syringe filled with distilled water. Open the 3-way stopcock on the transducer to the air and allow all the parts of the element to dry.
2. During testing or use, do not apply too much pressure to the sensor. Pressures of 500 mmHg or more can fracture the plastic enclosure and cause leaks.
3. The removable caps supplied with the transducer element are only dust covers; these caps are not air tight.
4. These transducers are nonlinear at pressures less than 7mmHg.

### Specifications

Operating Pressure:	+0.50 to +300 mmHg
Over Pressure:	-500 to +500 mmHg
Sensitivity:	5 $\mu$ V/V/mmHg at X1 Gain
Excitation Voltage:	$\pm$ 5 VDC
Temperature Effect:	$\pm$ 0.25 mmHg/ $^{\circ}$ C
Impedance:	<900 W
Part Number:	BP-100
Replacement Element:	BP-100 RE