BP-100
Blood Pressure Monitor
Instruction Manual

Read instructions carefully before operating this device.
1. This device is not to be used for Human Life Support applications.
2. To avoid possible electrical shock, do not operate this device if it is wet or has had liquids spilled onto it.
3. Service or calibration procedures should only be performed by qualified personnel familiar with the electrical hazards of line-powered devices.

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STATEMENT OF WARRANTY
IF THIS INSTRUMENT FAILS WITHIN A PERIOD OF ONE YEAR FROM THE DATE OF DELIVERY OR INSTALLATION, CWE, INC. WILL, AT ITS OPTION, REPAIR OR REPLACE IT FREE OF CHARGE TO THE PURCHASER. THIS WARRANTY EXCLUDES DAMAGE INCURRED THROUGH ABUSE OR ACCIDENT AND CONSUMABLE ITEMS OR COMPONENTS SUCH AS BATTERIES. CWE, INC. DOES NOT ASSUME ANY LIABILITY FOR ANY CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OR MISUSE OF THIS INSTRUMENT. THIS WARRANTY IS APPLICABLE ONLY TO THE ORIGINAL PURCHASER OF THE INSTRUMENT, AND IS NON-TRANSFERABLE.

IF YOU HAVE A PROBLEM
Please call or write describing your problem. We can often identify what is wrong, and suggest a solution without recourse to returning the device. Defective units under warranty should be returned to the factory along with a note describing the nature of the fault. Every effort will be made to ensure prompt repair or replacement of the device.

FACTORY SERVICE
Out of warranty or damaged instruments may be returned to the factory postage prepaid for service at prevailing rates. Upon request, a written or verbal quotation for such service will be issued after examination of the unit but prior to commencing repairs or service. Address requests for service or technical information to:

CWE, Incorporated
Technical Support Department
315 E. County Line Rd., Ardmore, PA 19003 U.S.A.
TEL (610)642-7719 FAX (610)642-1532

LIFE SUPPORT POLICY
Instruments manufactured by CWE, Incorporated are not authorized for use as critical components in human life support devices or systems. "Life support devices or systems", as used herein, are devices or systems whose failure to perform, whether through misuse, failure, or proper operation, can reasonably be expected to result in significant injury to the operator or subject persons.

USER INFORMATION:
Serial Number: ____________
Software Revision: ____________

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available on the rear panel. All these connections require a standard BNC cable.

Transducer connection: Connect the BP transducer to the 6-pin connector on the rear panel. If a standard clinical-type transducer is used, the instrument is pre-calibrated. Leave the transducer open to atmosphere at this time.

Power ON: Turn on the BP-100. After a brief welcome screen, the main monitoring screen will appear. Since no pulsatile pressure is detected, an alarm message may appear.

Zero the transducer: Press and hold the ZERO pushbutton until the zero message stops flashing, then release the pushbutton. The zero offset will be measured, applied to the readings, and stored in non-volatile memory. This procedure is only required when a new or different transducer is used.

Monitoring: Connect the transducer to the arterial cannula, and flush if necessary. After a few seconds, the display should start updating the BP measurements.

Comments: The BP-100 operates automatically, but requires a pulsatile BP source to derive the measurements. If you are attempting to monitor a static or damped (very slowly changing) pressure source, then the fast mode should be used (see Section 3.8).

3.0 OPERATION

3.1 DISPLAY

The BP-100 uses a highly readable vacuum-florescent graphic display for maximum visibility under any lighting conditions. The main measurement screen is shown below:

![BP-100 Main measurement screen](image)

Figure 2: BP-100 Main measurement screen

The screen shows the three primary measurements, systolic, diastolic, and heart rate in large characters. Mean pressure is shown at the bottom right of the display. All pressures are displayed as mmHg. The small numbers at the top center, prefixed with the up and down arrows, are the high and low alarm settings. In
addition, a message area at the bottom of the screen displays operator prompts and warning messages. These messages are always displayed in inverse text. In the default operating mode, the measurements are updated at 2.5 second intervals.

3.2 TRANSDUCER INPUT

The BP-100 accepts standard clinical-type BP transducers. These are intended to be interchangeable, and have a standardized output for any given pressure (see Specifications for details). If you are using another type of transducer with different characteristics, please refer to Section 4.0 Transducer Span Calibration.

The transducer input on the rear panel is a 6-pin WK6-32S connector. This is directly compatible with Grass™ pressure transducers and those supplied by CWE, Inc. Other standard-output BP transducers can likely be used, and adapter cables for the WK6-32S connector are available for most commercially available BP transducers.

The TRANSDUCER INPUT connector is wired as follows:

- Pin 1  +$V_{exc}$ (+5.00V)
- Pin 2  + signal
- Pin 3  - signal
- Pin 4  -$V_{exc}$ (0.00V)
- Pin 5  no connection
- Pin 6  ground

3.3 ALARM SETTINGS

Adjustable high and low pressure alarms are provided. These alarms apply only to the systolic pressure. To adjust either setting, hold the ALARM SET toggle switch in either the SET HIGH or SET LOW position, and turn the adjacent ADJ knob until the desired setting is displayed. When setting either alarm, SET will be displayed in the message area of the display.

3.4 ALARM ENABLE / DISABLE

When a pressure alarm condition is detected, ALM will always be displayed in the message area, and the ALARM LED will turn on. If an audible indication of the alarm condition is desired, select ALARM ENABLE. If DISABLE is selected, the audible beeping will be suppressed, but the visible indicators will still be active.
3.5 PULSE LED

The red PULSE LED will flash briefly as each heart beat is detected. If this LED is not blinking, check that the transducer is not blocked. Flushing the transducer will normally correct this condition.

3.6 TRANSDUCER ZERO

Modern interchangeable BP transducers are factory trimmed for very low offset and a standardized output signal. However, small offsets need to be corrected. This process has been automated in the BP-100, and only needs to be performed once when a new transducer is connected to the instrument. After the procedure is complete, the offset value is stored in non-volatile memory, and will be applied when the instrument is next used.

With the transducer open to atmosphere (usually by opening a stopcock), press and hold the ZERO pushbutton. The word ZERO will flash on and off in the message area for two seconds. Continue to hold the pushbutton down until the message stops flashing, and then release the pushbutton. The transducer offset correction value will be computed and stored. The transducer can then be opened to the arterial cannula, and the correct measurements will be displayed.

3.7 CAL PUSHBUTTON

The CAL function causes a known calibration output to be produced on the SIGNAL, SYSTOLIC, DIASTOLIC, and HR outputs. This function is useful for calibrating attached data acquisition systems.

Press and hold the CAL pushbutton. The display will show CAL in the message area, and the various pressure values and the respective analog outputs will be updated. While holding the CAL pushbutton, the systolic calibration value can be changed using the ADJ knob. The diastolic value will also change proportionately. The calibration value is stored in non-volatile memory following this procedure, and will be displayed when the CAL function is next used.

Note the one difference between CAL and normal monitoring: for convenience, the systolic value shown is also applied to the PRESSURE SIGNAL OUTPUT. This is done to allow a known calibration to be easily applied to the commonly recorded SIGNAL OUTPUT.
3.8 FAST MODE

In normal operation, the computed measurements are updated on the screen every 2.5 seconds. These measurements are all derived from (and require) the pulsatile arterial pressure signal. In some cases, the user may want a simple pressure measurement not dependent on a pulsatile signal. The BP-100 allows this through use of a special fast mode. This mode should also be used for calibrating a pressure transducer.

![BP-100 Fast mode screen](image)

To select fast mode, turn the BP-100 power OFF. While holding down the cal pushbutton, turn power ON. Release the cal pushbutton. The BP-100 will now enter the fast mode. The word FAST will be displayed in the message area, and the monitored pressure will be shown and rapidly updated in the systolic position on the display. The other displayed measurements will all indicate 000. The monitored pressure will be output as usual on the SIGNAL OUTPUT.

The automatic zeroing function can be performed in fast mode. Press and hold the ZERO pushbutton until the word FAST stops flashing. Release the pushbutton. The zero offset will be measured and applied, and the instrument will be returned to fast mode.

To exit fast mode, briefly press the CAL pushbutton. This will return the instrument to normal monitoring operation.

3.9 ANALOG OUTPUTS

**Pressure outputs:** The three pressure outputs, SIGNAL, SYSTOLIC, and DIASTOLIC, are all scaled identically. The output scaling is 10mV/mmHg (for example, 100mmHg would be output as 1.00V).

**Heart rate output:** The HR OUTPUT is scaled as 5mV/bpm (for example, a rate of 200bpm would be output as 1.00V).

The front panel PRESSURE SIGNAL OUTPUT and the rear panel SIGNAL OUT are the same.
3.10 SERIAL RS232 OUTPUT

The rear panel rs232 out jack provides a serial output for remote computer monitoring of the measurements. This connection requires a serial cable wired as follows:

3.5mm stereo phone jack  9-pin DSUB female

<table>
<thead>
<tr>
<th>Pin</th>
<th>3.5mm</th>
<th>9-pin DSUB</th>
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<tbody>
<tr>
<td>TIP</td>
<td>pin 2</td>
<td>pin 2</td>
</tr>
<tr>
<td>RING</td>
<td>pin 3</td>
<td>pin 3</td>
</tr>
<tr>
<td>SHELL</td>
<td>pin 5</td>
<td>pin 5</td>
</tr>
</tbody>
</table>

Serial port configuration: 9600,N,8,1

Data format: The data is sent as a simple ASCII text string as follows:

```
sss.s,ddd.d,rrr<CR><LF>
```

Where **sss.s** is systolic pressure in mmHg, **ddd.d** is diastolic pressure in mmHg, **rrr** is heart rate in beats-per-minute, followed by carriage return and line feed characters. This string is sent out each 2.5 seconds, and reflects the updated measurement screen values.

A terminal program such as Windows HyperTerminal can easily capture this data. The saved file can then be dropped into a spreadsheet or other analysis software for further study.

3.11 GROUND POST

A GROUND (or earth) terminal is provided on the rear panel. This is a hard chassis ground, and can be used to connect this equipment to an external earth ground for electrical safety purposes.
3.12 POWER SUPPLY

Use only the power supply included with the instrument. This is a 5VDC @ 1A regulated supply, with universal mains input (it will operate anywhere in the world).

**CAUTION:** Use of a different power supply can cause serious damage to the instrument, and will void the warranty.

4.0 TRANSDUCER CALIBRATION

A standard clinical-type BP transducer has an output of $5\mu\text{V}/V_{\text{exc}}/\text{mmHg}$ (or $5\mu\text{V per volt of excitation per mmHg applied pressure}$). Some specialized transducers may have a different gain factor. The BP-100 allows the user to adjust the internal SPAN (or gain) to match the transducer used. The most convenient way to calibrate the transducer is to use fast mode (see Section 3.8).

Turn power OFF, and enter fast mode by briefly holding down the CAL pushbutton while turning power back ON.

With the new transducer connected, perform the ZERO correction (see Section 3.6). This will correct for any initial zero offset.

Apply a known pressure to the transducer, and adjust the rear-panel SPAN knob until the correct pressure is displayed.

Repeat the ZERO correction, and recheck the span calibration. You may have to repeat this a few times since zero and span are somewhat interactive.

Briefly press the CAL pushbutton to exit fast mode. The transducer can now be connected to the arterial pressure source for monitoring.
5.0 SPECIFICATIONS

Input type ............................................. differential instrumentation amplifier
Input impedance ...................................... 1Megohm
Excitation voltage ..................................... 5.0VDC
Transducer compatibility .......................... DC bridge-type
Transducer input jack ................................. 6-pin WK6-32S
Transducer output (nominal) ...................... 5uV/V/mmHg
Pressure measurement range ...................... 0 – 310mmHg
Frequency response ..................................... 1kHz
Pressure accuracy ...................................... ±1mmHg
Pressure resolution (displayed) .................. 1mmHg
Pressure resolution (analog outputs) .......... 0.1mmHg
Pressure signal, Systolic, Diastolic analog output scaling ... 10mV/mmHg
Heart rate (BPM) analog output scaling .......... 5mV/bpm
Output impedance (all outputs) .................... 10 ohms
Analog output connectors ......................... BNC jacks
Serial data output format ......................... 9600 baud, 8 data bits, no parity, 1 stop bit
Serial data interval .................................... set of readings sent every 2.5 seconds
Serial output connector (rear panel) .......... 3.5mm 3-cond mini phone plug
Display ...................................................... vacuum florescent graphic display
Dimensions, main unit ............................... 9W x 2.5H x 7D in. (23 x 6.3 x 18cm)
Power requirements ................................. 120/240V universal input, 10VA

4.0 ORDERING INFORMATION

<table>
<thead>
<tr>
<th>PART No.</th>
<th>ITEM</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-10000</td>
<td>BP-100</td>
<td>Blood Pressure Monitor w/ pwr supply and transducer + cable</td>
</tr>
<tr>
<td>10-04100</td>
<td>DTX-1</td>
<td>Blood pressure transducer (requires adapter cable)</td>
</tr>
<tr>
<td>10-04210</td>
<td>TC-GRA</td>
<td>Adapter cable for above</td>
</tr>
<tr>
<td>10-04103</td>
<td>BP-MINI</td>
<td>Miniature catheter-tip transducer with cable</td>
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