FLUKE®

Biomedical

PS420

Multiparameter Simulator

Users Manual

PN 2631808
April 2006, Rev. 1, 12/07

Warranty and Product Support

Fluke Biomedical warrants this instrument against defects in materials and workmanship for one full year from the date of original purchase. During the warranty period, we will repair or, at our option, replace at no charge a product that proves to be defective, provided you return the product, shipping prepaid, to Fluke Biomedical. This warranty does not apply if the product has been damaged by accident or misuse or as the result of service or modification by other than Fluke Biomedical. IN NO EVENT SHALL FLUKE BIOMEDICAL BE LIABLE FOR CONSEQUENTIAL DAMAGES.

Only serialized products and their accessory items (those products and items bearing a distinct serial number tag) are covered under this one–year warranty. PHYSICAL DAMAGE CAUSED BY MISUSE OR PHYSICAL ABUSE IS NOT COVERED UNDER THE WARRANTY. Items such as cables and nonserialized modules are not covered under this warranty.

Recalibration of instruments is not covered under the warranty.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state, province to province, or country to country. This warranty is limited to repairing the instrument to Fluke Biomedical's specifications.

Warranty Disclaimer

Should you elect to have your instrument serviced and/or calibrated by someone other than Fluke Biomedical, please be advised that the original warranty covering your product becomes void when the tamper-resistant Quality Seal is removed or broken without proper factory authorization. We strongly recommend, therefore, that you send your instrument to Fluke Biomedical for factory service and calibration, especially during the original warranty period.

Notices

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Unpacking and Inspection

Follow standard receiving practices upon receipt of the instrument. Check the shipping carton for damage. If damage is found, stop unpacking the instrument. Notify the carrier and ask for an agent to be present while the instrument is unpacked. There are no special unpacking instructions, but be careful not to damage the instrument when unpacking it. Inspect the instrument for physical damage such as bent or broken parts, dents, or scratches.

Technical Support

For application support or answers to technical questions, either email techservices@flukebiomedical.com or call 1-800- 648-7952 or 1-425-446-6945.

Claims

Our routine method of shipment is via common carrier, FOB origin. Upon delivery, if physical damage is found, retain all packing materials in their original condition and contact the carrier immediately to file a claim. If the instrument is delivered in good physical condition but does not operate within specifications, or if there are any other problems not caused by shipping damage, please contact Fluke Biomedical or your local sales representative.

Standard Terms and Conditions

Refunds and Credits

Please note that only serialized products and their accessory items (i.e., products and items bearing a distinct serial number tag) are eligible for partial refund and/or credit. Nonserialized parts and accessory items (e.g., cables, carrying cases, auxiliary modules, etc.) are not eligible for return or refund. Only products returned within 90 days from the date of original purchase are eligible for refund/credit. In order to receive a partial refund/credit of a product purchase price on a serialized product, the product must not have been damaged by the customer or by the carrier chosen by the customer to return the goods, and the product must be returned complete (meaning with all manuals, cables, accessories, etc.) and in "as new" and resalable condition. Products not returned within 90 days of purchase, or products which are not in "as new" and resalable condition, are not eligible for credit return and will be returned to the customer. The Return Procedure (see below) must be followed to assure prompt refund/credit.

Restocking Charges

Products returned within 30 days of original purchase are subject to a minimum restocking fee of 15 %. Products returned in excess of 30 days after purchase, but prior to 90 days, are subject to a minimum restocking fee of 20 %. Additional charges for damage and/or missing parts and accessories will be applied to all returns.

Return Procedure

All items being returned (including all warranty-claim shipments) must be sent freight-prepaid to our factory location. When you return an instrument to Fluke Biomedical, we recommend using United Parcel Service, Federal Express, or Air Parcel Post. We also recommend that you insure your shipment for its actual replacement cost. Fluke Biomedical will not be responsible for lost shipments or instruments that are received in damaged condition due to improper packaging or handling.

Use the original carton and packaging material for shipment. If they are not available, we recommend the following guide for repackaging:

- Use a double–walled carton of sufficient strength for the weight being shipped.
- Use heavy paper or cardboard to protect all instrument surfaces. Use nonabrasive material around all projecting parts.
- Use at least four inches of tightly packed, industry-approved, shock-absorbent material around the instrument.

Returns for partial refund/credit:

Every product returned for refund/credit must be accompanied by a Return Material Authorization (RMA) number, obtained from our Order Entry Group at 1-800-648-7952 or 1-425-446-6945.

Repair and calibration:

To find the nearest service center, go to www.flukebiomedical.com/service or

In the U.S.A.:
Cleveland Calibration Lab
Tel: 1-800-850-4606
Email: globalcal@flukebiomedical.com

Everett Calibration Lab
Tel: 1-800-850-4606
Email: service.status@fluke.com

In Europe, Middle East, and Africa:
Eindhoven Calibration Lab
Tel: +31-402-675300
Email: ServiceDesk@fluke.com

In Asia:
Everett Calibration Lab
Tel: +425-446-6945
Email: service.international@fluke.com

Certification

This instrument was thoroughly tested and inspected. It was found to meet Fluke Biomedical's manufacturing specifications when it was shipped from the factory. Calibration measurements are traceable to the National Institute of Standards and Technology (NIST). Devices for which there are no NIST calibration standards are measured against in-house performance standards using accepted test procedures.

WARNING

Unauthorized user modifications or application beyond the published specifications may result in electrical shock hazards or improper operation. Fluke Biomedical will not be responsible for any injuries sustained due to unauthorized equipment modifications.

Restrictions and Liabilities

Information in this document is subject to change and does not represent a commitment by Fluke Biomedical. Changes made to the information in this document will be incorporated in new editions of the publication. No responsibility is assumed by Fluke Biomedical for the use or reliability of software or equipment that is not supplied by Fluke Biomedical, or by its affiliated dealers.

Manufacturing Location

The PS420 Multiparameter Simulator is manufactured by Fluke Biomedical, 6045 Cochran Rd. Cleveland, Ohio 44139.

Table of Contents

List of Tables

List of Figures

PS420 Multiparameter Simulator

Introduction

The PS420 Multiparameter Simulator (hereafter called the Simulator) is a compact, lightweight, high-performance simulator for use by trained service technicians for patient monitor testing. Through settings that you manipulate, it simulates various electrocardiogram, respiration, blood pressure, temperature, and cardiac output conditions. The Simulator offers two-channel simulation.

Safety

⚠⚠Warning. Read before using the Simulator.

To avoid personal injury, follow these guidelines:

- **Do not use in any manner not specified in the Users Manual. Otherwise, the protection provided by this product may be impaired.**
- **Always press power off on the Simulator and unplug the Battery Eliminator before cleaning the outer surface.**
- **Inspect the product. If the Simulator appears damaged or appears to operate in a manner not specified in the manual, DO NOT CONTINUE USE. Return for service.**
- **Avoid spilling liquids on the Simulator; fluid seepage into internal components creates corrosion and a potential shock hazard. Do not operate the instrument if internal components are exposed to fluid.**

Do not open this product. There are no user replaceable parts.

⚠Caution

The Simulator should be calibrated annually. Only qualified technical personnel should perform troubleshooting and service procedures on the Simulator.

Do not expose the Simulator to temperature extremes. Ambient operating temperatures should remain between 15 and 35 °C. Simulator performance may be adversely affected if temperatures fluctuate above or below this range.

Refer to Table 1 for descriptions of symbols found on the Simulator.

Table 1. Symbols

Symbol	Description
	See Users Manual.
	Caution risk of electric shock
	Manufacturer's declaration of product compliance with applicable EU directives
	Battery Eliminator Port
	Do not dispose of this product as unsorted municipal waste. Go to Fluke's website for recycling information.

Specifications

General

Display/Control ..... 16 alphanumeric display keys; two switches for Respiratory Leads LL/LA and Power ON/OFF

Interface ..... RS232 bi-directional interface. Baud rate: 9600

ECG Output Connectors ..... 10 AHA/IEC color-coded connectors accepting ECG snaps and pins.

Power ..... 9 V alkaline battery or battery eliminator

Case ..... High impact plastic

Weight (w/o battery) ..... 0.343 kg / 12.1 oz.

Environmental ..... Indoor use

Temperature, Operating ..... 15 to 35 °C (59 to 95 °F)

Temperature, Storage ..... 0 to 50 °C (32 to 122 °F)

Maximum Humidity, Operating ..... 80 % relative humidity up to 31 °C (88 °F), decreasing linearly to 50 % relative humidity at 40 °C (104 °F).

Maximum Humidity, Storage ..... 95 %

Altitude ..... Up to 2000m

Dimensions

- Height ..... 16.0 cm (6.3 in.)
- Width ..... 10.7 cm (4.2 in.)
- Depth ..... 3.4 cm (1.4 in.)

Part No ..... PS420 Multiparameter Simulator (PN 2631290)

Accessories

Item	Part Number
Standard Accessories	
Users Manual CD-ROM	2631721
Users Manual (printed)	2631808
9 VDC Battery Eliminator	2647372
Optional Accessories	
Cardiac Output Adapter Box	2462200
Temperature Cable	*
Blood Pressure Cable	*
Cardiac Output Cable	*
* Contact your local Fluke Biomedical Sales Agent for further details	

ECG

12 Lead ECG with nine independent outputs referenced to RL

Baseline Impedances.....500, 1000, 1500 or 2000 Ohms for Leads I, II, and III
High Level Output .....1000 x (Lead II)
Rates.....30, 40, 60, 80, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, and 300 BPM
Default Rate .....80 BPM.
Rate Accuracy.....± 1% of selection

Adult or Pediatric Waveform

ECG Amplitudes.....0.5, 1.0, 1.5, and 2.0 mV
Amplitude Accuracy .....± 2 %. (Lead II)
Superimposed Artifact.....50 and 60 Hz, muscle, baseline wander, and respiration

ECG Performance

Square Wave.....0.125 and 2.0 Hz
Pulse .....30, 60, and 120 BPM 60 ms pulse width
Sine Wave .....5, 5, 10, 40, 50, 60, and 100 Hz
Triangle Wave .....2.0 and 2.5 Hz

ST Segment Analysis

Elevated or Depressed.....-.8 mV to +.8 mV in .1 mV steps

Pacemaker Selections

Pacer Spike Amplitude (2, 4, 6, 8, and 10 mV in Lead II)
Pacer Spike Duration (0.1, 0.5, 1.0, 1.5, and 2.0 ms)
Asynchronous Pacemaker
Pacer Non-Function
Pacer Non-Capture
Demand Occasional Sinus
Demand Frequent Sinus
AV Sequential

Arrhythmia Selections

Base Rate of 80 BPM	
Sinus Arrhythmia	PVCs 24 / minute
Atrial (PAC) *	Frequent Multifocal PVCs
Missed Beat *	Bigeminy
Atrial Tachycardia	Trigeminy
Atrial Flutter	Pair PVCs *
Nodal (PNC) *	Run 5 PVCs *
Nodal Rhythm	Run 11 PVCs *
Supraventricular Tachycardia	Ventricular Tachycardia
PVC1 Left Ventricular Focus *	Ventricular Fibrillation (Coarse)
PVC1 Early, LV Focus *	Ventricular Fibrillation (Fine)
PVC1 R on T, LV Focus *	Asystole
PVC2 Right Ventricular Focus *	Conduction Defects
PVC2 Early, RV Focus *	First Degree
PVC2 R on T, RV Focus *	Second Degree
Multifocal PVCs *	Third Degree
Atrial Fibrillation Coarse/Fine	Right Bundle Branch Block
PVCs 6 / minute	Left Bundle Branch Block
PVCs 12 / minute	
* Will go to NSR ECG @ 80 BPM after completion	

Blood Pressure

Input/Output Impedance ..... 350 Ohms
Exciter Input Limit ..... ± 10 V
Exciter Input Frequency Range ..... DC to 4000 Hz
Transducer Sensitivity ..... 5 or 40 µV/V/mmHg
Level Accuracy ..... ± 1% ± 1 mmHg
Static Levels
BP 1 ..... -10, 0, 80, 160, 240, 320, and 400 mmHg
BP 2 ..... -10, 0, 50, 100, 150, 200, and 240 mmHg
Channel Selections
Arterial 120/80 ..... Channels 1 and 2
Radial Artery 120/80 ..... Channels 1 and 2
Left Ventricle 120/00 ..... Channels 1 and 2
Right Ventricle 25/00 ..... Channels 1 and 2
Central Venous 15/10 ..... Channel 2
Pulmonary Artery 25/10 ..... Channel 2
Pulmonary Wedge 10/2 ..... Channel 2
Left Atrium 14/4 ..... Channel 2
Automatic Swan/Ganz ..... Every 20 seconds
Manual Swan/Ganz ..... Changes every time entry is selected

Synchronized with all normal sinus rates

Physiologically tracks all arrhythmia selections

Cardiac Output Option

Catheter Type ..... Baxter-Edwards, 10 cc
Blood Temperature ..... 37 °C (98.6 °F) and 36 °C (95.9 °F)
CO for 2 Degrees C ..... 3, 5, and 7 L/Min
CO for 20 Degrees C ..... 3, 5, and 7 L/Min
Cal Pulse ..... Of 1 degree C for 1 second; of delta 402 Ohms for 4 seconds
Accuracy ..... ± 5 %
Computational Constant
2 Degrees C 0.561
20 Degrees C 0.608
Left to Right Shunt * ..... 2 and 20 Degrees C
Faulty Injectate * ..... 2 and 20 Degrees C

*Note: These four CO simulations are examples of defective (uncalibrated) curves.

Respiration

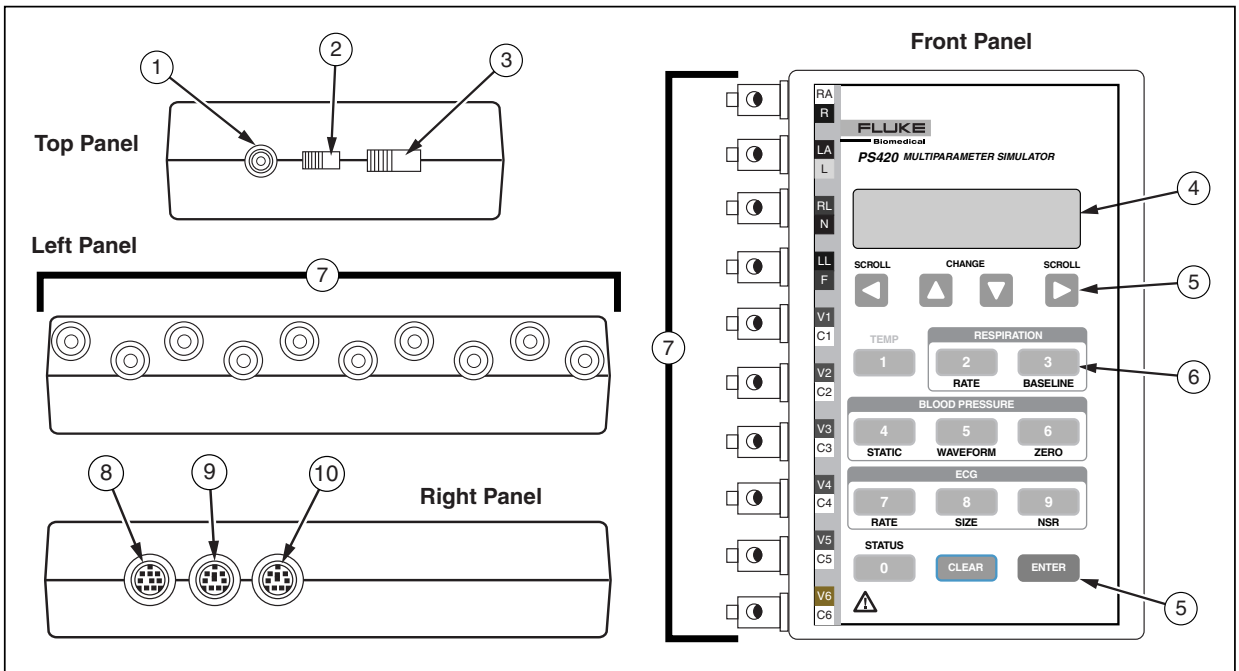
Baseline Impedances ..... 500, 1000, 1500, 2000 Ohms (Leads I - III)
Lead Selection ..... LL or LA
Impedance Variations ..... 0.2, 0.5, 1.0, and 3.0 Ohms
Impedance Accuracy ..... ± 5 %
Rates ..... 0 (apnea), 15, 20, 30, 40, 60, 80, 100, 120 BPM
Apnea ..... 12 sec, 22 sec, 32 sec, and continuous
Rate Accuracy ..... ± 2 %

Temperature

30 °C (86 °F), 35 °C (95 °F), 37 °C (98.6 °F), 40 °C (104 °F), 42 °C (107.6 °F), compatible with YSI 400/700 series
Accuracy ..... ± 0.25 Degree C

Controls and Terminals

Refer to Figure 1 and Table 2 for descriptions of Simulator controls and terminals.



ebt001f.eps

Figure 1. Controls and Terminals

Table 2. Controls and Terminals

Item	Name	Description
①	Battery Eliminator	For use in operating the Simulator from any standard electrical outlet. To ensure safe operation, use only the Fluke Biomedical Battery Eliminator (PN 2647372). **⚠⚠Warning** **Caution risk of electric shock. Use only the Battery Eliminator specified in this manual or the protection provided may be impaired.**
②	Power Switch	Switches the power on and off.
③	LA - LL Slide Switch	Selects the reference lead, either LA (left arm) or LL (left leg). The position of the switch must correspond to the type of patient monitor in use.
④	LCD Display	15 mm x 60 mm (.58 in. x 2.37 in.) window displaying up to two lines of 20-point font.
⑤	Control Keys	
	ENTER	Enters the selected code line value into memory.
	CLEAR	Clears the code line value from the LCD window.
	SCROLL	Causes the code line number to increase or decrease. The display arrows indicate which **SCROLL** to use. The right **SCROLL** ► increases the code lines by 1, while the left **SCROLL** ◄ decreases the code lines by 1.

Table 2. Controls and Terminals (cont.)

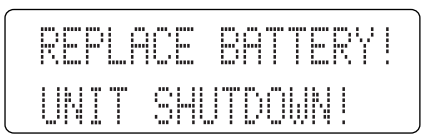
Item	Name	Description
⑤	**CHANGE**	These keys are functional when the top line in the LCD window displays the up/down arrows ▲▼. They allow you to increment or decrement the current setting. The **up CHANGE** arrow ▲ increases the preset codes by 1, while the **down CHANGE** arrow ▼ decreases the preset codes by 1.
⑥	Keypad Soft Keys	These keys have two functions: numeric and one-step selection of Simulator functions.
	0 / STATUS	Enters a numeric 0 to code line. Displays current parameter settings.
	1 / TEMP	Enters a numeric 1 to code line. Changes temperature.
	2 / RATE	Enters a numeric 2 to code line. Changes respiration rate.
	3 / BASELINE	Enters a numeric 3 to code line. Changes baseline resistance.
	4 / STATIC	Enters a numeric 4 to code line. Sets BP channels static levels.
	5 / WAVEFORM	Enters a numeric 5 to code line. Sets BP channels to BP waveforms.
	6 / ZERO	Enters a numeric 6 to code line. Sets BP channels to zero level.
	7 / RATE	Enters a numeric 7 to code line. Changes ECG rate for NSR.
	8 / SIZE	Enters a numeric 8 to code line. Changes ECG amplitude (lead II).
	9 / NSR	Enters a numeric 9 to code line. Selects Normal Sinus Rhythm (80 BPM).

Table 2. Controls and Terminals (cont.)

Item	Name	Description	
⑦	ECG Connectors	Ten snap and multi-banana connectors for ECG output, allowing for connection to any twelve-lead ECG. These terminals are labeled and on the top panel. The labels are AHA/IEC color-coded to aid in matching them to corresponding patient leads. Labels and their definitions are as follows:	
		Label	Definition
		RA / R	Right Arm
		LA / L	Left Arm
		RL / N	Right Leg (Reference or grounded)
		LL / F	Left Leg
		V1 / C1 to V6 / C6	V leads (US and Canada). Also referred to as pericardial, precardial or unipolar chest leads, and chest leads (IEC)
⑧	CO / Temp 1& 2	8-pin mini-DIN plug connector for the Cardiac Output and Temperature cables. These cables are available separately from your Fluke Biomedical Sales Agent.	
⑨	BP 1	8-pin mini-DIN connector for BP cable plugs.	
⑩	BP 2 / RS-232	8-pin mini-DIN plug connector for BP cable plugs, as above, and for connecting an RS-232.	

Powering the Simulator

The Simulator uses a 9 V alkaline battery (Duracell® MN1604 or equivalent). It is designed to use as much of the battery as possible. When it detects less than about 5.6 volts, it goes into a shutdown mode, sounds a continuous tone alarm, and displays the following message:



The battery is in the base of the instrument. Use a 9-volt alkaline battery (Duracell® MN1604 or equivalent). Do not use mercury, air, or carbon-zinc batteries.

⚠ Warning

The 9-volt alkaline battery provided with the Simulator may explode or leak if recharged, inserted improperly, disposed of in a fire, or mixed with different battery types. Dispose of the battery in accordance with any applicable state or local regulations.

As an alternative to a battery, you can power the Simulator with the Fluke Biomedical Battery Eliminator, PN 2647372.

⚠⚠Warning

Caution risk of electric shock. Use only the Battery Eliminator specified in this manual or the protection provided may be impaired.

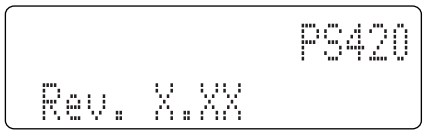
Note

Remove the battery and disconnect the Battery Eliminator if you do not intend to use the Simulator for an extended period of time.

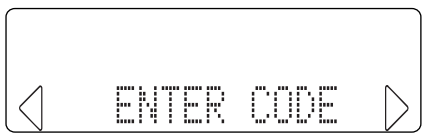
Operating the Simulator

Connect the Simulator to the device under test. Use the Simulator's alphanumeric keypad to enter the code presets. The Simulator then transmits these values to the device. The following steps walk you through a sample procedure.

1. Switch the Simulator ON. The LCD window displays the program version for about two seconds.

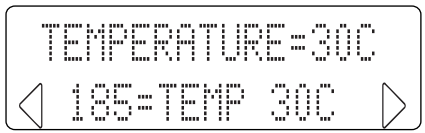


The window then displays the code entry display.

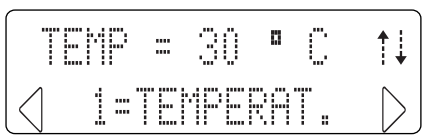


The display arrows indicate which **SCROLL** to use. The right **SCROLL** ▶ increases the preset codes by 1, while the left **SCROLL** ◀ decreases the preset codes by 1. For example, pressing the right **SCROLL** once will display the first preset, “0=VIEW”.

2. Key in the required preset code. For example, to simulate a 30 °C (86 °F) temperature (code line 185), press menu keys 1 + 8 + 5. Then, press the **ENTER** key. This now becomes the preset temperature. Press **CLEAR** to return to the default code entry display.



3. To adjust some settings you can use the keypad’s two-function alphanumeric keys. For temperature, as an example, press 1, then **ENTER**. The LCD displays the current preset.



Note the two additional up and down arrows. These indicate which way to increase or decrease the preset. Use the menu **CHANGE** arrows for scrolling through the presets. The up **CHANGE** arrow ▲ increases the preset codes by 1, while the down **CHANGE** arrow ▼ decreases the preset codes by 1. You can then advance through the temperature settings shown in Table 3.

Table 3. Temperature Settings

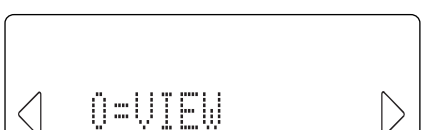
Code	Temperature
189	42 °C (107.6 °F)
188	40 °C (104 °F)
187	37 °C (98.6 °F)
186	35 °C (95 °F)
185	30 °C (86 °F)

After reaching the required preset, press **ENTER**. This now becomes the active temperature. Press **CLEAR** to return to the default code entry display.

Note

*Only use the **ENTER** key when scrolling through the current settings. Using a **SCROLL** or **CHANGE** key interrupts the scrolling operation.*

At any point, you can view the Simulator's current parameter settings simply by pressing STATUS (0). The Simulator then displays "0=VIEW".



Press **ENTER**. The first parameter setting ("ECG=NSR") is then displayed. Thereafter, each time you press **ENTER**, the Simulator displays current settings in the sequence shown in Table 4.

Table 4. Current Settings

Display	Description
ECG NSR	Normal sinus rhythm in BPM.
NSR QRS	Adult or pediatric waveform.
ECG AMPL	ECG amplitude in mV.
RESP RATE	Respiration rate in RPM.
R DELTA	Impedance variation in ohms.
BASELINE	Baseline impedance in ohms.
TEMPERATURE	Temperature in °C.
BP SENS	Transducer sensitivity in µV.
BP1, BP2	Blood pressure channel settings in mmHg.

Simulating Functions

This section describes simulation procedures by function. If you are unfamiliar with basic Simulator operation, refer to Operating the Simulator.

Temperature

The Simulator replicates normal, hypothermic, and hyperthermic conditions with five temperature presets. All temperature outputs are compatible with YSI 400/700 series probes. Temperature can be set through direct code entry, as below, by keying the preset code and pressing **ENTER**. You can also use the **SCROLL** keys ◄ ► to cycle through the other presets before pressing **ENTER**.

In addition, you can select and adjust settings by first keying **1 = TEMPERAT**. or **190**. If you key **1,** press **ENTER** and use the **CHANGE** keys ▲ ▼ to cycle through the presets. Then press **ENTER** to set the temperature. If you key **190,** press **ENTER** and use the **SCROLL** keys ◄ ► to cycle through the other presets. Then press **ENTER** to set the temperature.

Code	Display	Selects temperature of:
185	TEMP 30C	30 °C (86 °F)
186	TEMP 35C	35 °C (95 °F)
187	TEMP 37C	37 °C (98.6 °F)
188	TEMP 40C	40 °C (104 °F)
189	TEMP 42C	42 °C (107.6 °F)

Respiration

Respiration Rate

The Simulator replicates nine rate settings. These can be set through direct code entry, as below, by keying the preset code and pressing **ENTER**. You can also use the **SCROLL** keys ◄ ► to cycle through the other presets before pressing **ENTER**. In addition, you can select and adjust settings by first keying 2 **RATE**. If you key 2, press **ENTER** and use the **CHANGE** keys ▲ ▼ to cycle through the other presets. Then press **ENTER** to set the rate.

Code	Display	Selects respiration rate of:
152	RESPPM 0	0 RPM
153	RESPPM 15	15 RPM
154	RESPPM 20	20 RPM
155	RESPPM 30	30 RPM
156	RESPPM 40	40 RPM
157	RESPPM 60	60 RPM
158	RESPPM 80	80 RPM
159	RESPPM 100	100 RPM
160	RESPPM 120	120 RPM

Baseline Impedance

The baseline resistance selection of 500, 1000, 1500, and 2000 Ohms is between leads LA, RL, RA, and LL. The resistance for the V leads is 1020 Ohms between any V leads (V1-V6).

The impedance can be set through direct code entry, as below, by keying the preset code and pressing **ENTER**. You can also use the **SCROLL** keys ◀ ▶ to cycle through the other presets before pressing **ENTER**.

In addition, you can select and adjust settings by first keying **3 = BASELINE**. If you key **3,** press **ENTER** and use the **CHANGE** keys ▲ ▼ to cycle through the other presets. Then press **ENTER** to set the impedance.

Code	Display	Selects baseline resistance of:
166	BASEL 500	500 Ohms
167	BASEL 1000	1000 Ohms
168	BASEL 1500	1500 Ohms
169	BASEL 2000	2000 Ohms

Note

When you switch the Simulator on, the baseline impedance is set at 1000 Ohms. If changed, some monitors check lead impedance and, if too high (e.g., 2000 Ohms), may revert to their inoperative modes.

Impedance Variations

The Simulator replicates impedance variations of 0.2, 0.5, 1.0, 2.0, and 3.0 and 2000 delta Ohms. Use the LA/LL switch on the top panel to select which lead will have the respiration signal on it. This will not affect the baseline operation.

The variation can be set through direct code entry, as below, by keying the preset code and pressing **ENTER**. You can also use the **SCROLL** keys ◄ ► to cycle through the other presets before pressing **ENTER**.

Code	Display	Selects respiration delta Ohms:
161	R DELTA .2	0.2 Ohms
162	R DELTA .5	0.5 Ohms
163	R DELTA 1	1.0 Ohms
164	R DELTA 2	2.0 Ohms
165	R DELTA 3	3.0 Ohms

Apnea

The Simulator replicates the general apnea types by duration only: continuous; and 12, 22, and 32 seconds. Apnea can be set through direct code entry, as below, by keying the preset code and pressing **ENTER**. You can use the **SCROLL** keys ◄ ► to cycle through the other presets before pressing **ENTER**.

Code	Display	Selects respiration apnea:
144	APNEA ON	ON. Respiration rate of 0 RPM.
145	APNEA OFF	OFF. Respiration reverts to previously selected respiration rate.
146	12 SEC APN	For 12 seconds.
147	22 SEC APN	For 22 seconds.
148	32 SEC APN	For 32 seconds.

Blood Pressure

The Simulator synchronizes dynamic blood pressure waveforms with all NSR rates and tracks all arrhythmia selections. Both blood pressure channels (BP-1 and 2) can be controlled. Each channel can act independently or can be set together for universal settings.

The Simulator will set the blood pressure channels to a zero level on power up. This is to allow you to set up the monitoring equipment under test.

Transducer Sensitivity (All Channels)

Before simulation can begin, blood pressure transducer sensitivity must be set to correlate with the monitor manufacturer's specifications: 40 µV/V/mmHg (code 76) or 5 µV/V/mmHg (code 77). Simulator accuracy is ± 1%, ± 1 mmHg.

The sensitivity is set through direct code entry by keying the preset code and pressing **ENTER**.

Waveform (All Channels)

The Simulator can set a single waveform for all blood pressure channels. This is set by first selecting **5 = WAVEFORM**. After selecting **5,** press **ENTER**. The LCD will display BP CHANNELS SET. The waveforms will appear only during ECG waveforms where blood pressure waveforms occur (e.g., during the asystole selection, all pressure channels drop to 0 level).

Blood Pressure Artifact (All Channels)

You can insert a respiratory artifact, as required, into any waveform over all channels. Insert artifacts by keying **84**, then pressing **ENTER**. Stop insertion by keying **85**, and then pressing **ENTER**.

BP Static Levels (All Channels)

The blood pressure static level can be set through direct code entry, as below, or selected and adjusted through first selecting **4 = STATIC**. After selecting **4,** press **ENTER**, and then use the **CHANGE** keys ▲▼ to scroll to the available presets.

BP Static Levels, Channels 1 and 2

BP Static Levels, Channels 1 and 2 can be set through direct code entry, as below, or selected and adjusted through first selecting **94 = P1,2 STAT**. After selecting **94,** press **ENTER**, and then use the **CHANGE** keys ▲▼ to scroll to the available presets. Note that this will affect all pressure channels, and the Simulator will not display the levels for BP channels 1 and 2.

Code	Display	Sets
207	BP STAT L0	BP channel to static level 0.P1= -10 P2= -10 P3= -5 P4= -5
208	BP STAT L1	BP channel to static level 0.P1=0 P2=0 P3=0 P4=0
209	BP STAT L2	BP channel to static level 0.P1=80 P2=50 P3=20 P4=20
210	BP STAT L3	BP channel to static level 0. P1=160 P2=100 P3=40 P4=40
211	BP STAT L4	BP channel to static level 0. P1=240 P2=150 P3=60 P4=60
212	BP STAT L5	BP channel to static level 0. P1=320 P2=200 P3=80 P4=80
213	BP STAT L6	BP channel to static level 0. P1=400 P2=240 P3=100 P4=100

Channel BP-1

Code	Display	Selects:
78	P1 ARTERIA	Arterial waveform, 120/80.
79	P1 RADIAL	Radial waveform, 120/80.
80	P1 LVNT	Left ventricle waveform, 120/00.
81	P1 RVNT	Right ventricle waveform, 25/00

Channel BP-2

Code	Display	Selects:
86	P2 ARTERIA	Arterial waveform, 120/80.
87	P2 RADIAL	Radial waveform, 120/80.
88	P2 LVENT	Left ventricle waveform, 120/00.
89	P2 RVNT	Right ventricle waveform, 25/00.
90	P2 PULAR	Pulmonary arterial waveform, 25/10.
91	P2 PULWDG	Pulmonary wedge waveform, 10/2.
92	P2 L ATRIU	Left atrium waveform, 14/4.
93	P2 CVP	Central venous waveform (right atrium), 15/10.

ECG/Arrhythmia

The Simulator replicates 37 different types of arrhythmias, from inconsequential types of PNCs to asystole. In addition, the Simulator can send waveforms to test any electrocardiograph, and can accommodate twelve-lead configurations with independent outputs for each signal lead referenced to the right leg (RL).

Adult and Pediatric NSR QRS

An adult NSR with a QRS width of 80 ms, or a pediatric NSR with a QRS width of 40 ms, can be set. These will remain in effect throughout ECG and arrhythmia selections until changed by reentering the below codes and pressing **ENTER**.

Code	Display	Selects:
11	PEDIATRIC	Pediatric NSR with QRS width of 40 ms.
12	ADULT	Adult NSR with QRS width of 80 ms.

NSR

The Simulator replicates fifteen normal sinus rhythms, or NSRs. These NSRs can be set through direct code entry, as below, or selected and adjusted through first selecting **9 = NSR**. After selecting **9,** press **ENTER**, and then use the **CHANGE** keys ▲ ▼ to scroll to the available presets.

Code	Display	Selects NSR rate of:
170	NSR 30BPM	30 BPM
171	NSR 40BPM	40 BPM
172	NSR 60BPM	60 BPM
173	NSR 80BPM	80 BPM
174	NSR 100BPM	100 BPM
175	NSR 120BPM	120 BPM
176	NSR 140BPM	140 BPM
177	NSR 160BPM	160 BPM
178	NSR 180BPM	180 BPM
179	NSR 200BPM	200 BPM
180	NSR 220BPM	220 BPM
181	NSR 240BPM	240 BPM
182	NSR 260BPM	260 BPM
183	NSR 280BPM	280 BPM
184	NSR 300BPM	300 BPM

Arrhythmias: Premature Beats

Code	Display	Selects:
13	PVC1 LVF	PVC with left ventricle focus. The Simulator then assumes NSR at 80 BPM.
14	PVC1 E LVF	Early PVC with left ventricle focus. The Simulator then assumes NSR at 80 BPM.
15	R ON T LVF	R on T PVC with left ventricle focus. The Simulator then assumes NSR at 80 BPM.
16	PVC2 RVF	PVC with right ventricle focus. The Simulator then assumes NSR at 80 BPM.
17	PVC2 E RVF	Early PVC with right ventricle focus. The Simulator then assumes NSR at 80 BPM.
18	R ON T RVF	R on T PVC with right ventricle focus. The Simulator then assumes NSR at 80 BPM.
19	MULTIFOCAL	Multifocal PVCs. The Simulator then assumes NSR at 80 BPM.
20	ATRIAL PAC	Atrial premature contraction. The Simulator then assumes NSR at 80 BPM.
21	NODAL PNC	Nodal premature contraction. The Simulator then assumes NSR at 80 BPM.

Arrhythmias: Ventricular

Code	Display	Selects:
24	PAIR PVCS	Pair of PVCs. The Simulator then assumes NSR at 80 BPM.
25	RUN 5 PVCS	Run of 5 PVCs. The Simulator then assumes NSR at 80 BPM.
26	RUN 11 PVC	Run of 11 PVCs. The Simulator then assumes NSR at 80 BPM.
27	BIGEMINY	Bigeminy rhythm.
28	TRIGEMINY	Trigeminy rhythm.
29	PVCS 6/M	6 PVCs per minute.
30	PVCS 12/M	12 PVCs per minute.
31	PVCS 24/M	24 PVCs per minute.
32	FREQ MULTI	Frequent multifocal rhythm.
33	VENT TACHY	Ventricular tachycardia.
34	VENT FIB 1	Ventricular fibrillation.
35	VENT FIB 2	Ventricular fibrillation at 1/2.
36	ASYSTOLE	Asystole. No ECG.

Arrhythmias: Atrial

Code	Display	Selects:
38	ATRL FIB1	Atrial fibrillation.
39	ATRL FIB2	Atrial fibrillation 1/2 value.
40	ATRIAL FLT	Atrial flutter.
41	SINUS ARRH	NSR with irregular rate.
42	MISSED	Missed beat. The Simulator then assumes NSR at 80 BPM.
43	ATRL TACHY	Atrial tachycardia.
44	NODAL RHYT	Nodal rhythm.
45	SUPRAVENT	Supraventricular tachycardia.

Arrhythmias: Conduction Defects

Code	Display	Selects:
47	RT BNDL BB	Right bundle branch block rhythm.
48	LT BNDL BB	Left bundle branch block rhythm.
49	1ST DEG BL	1st degree heart block rhythm.
50	2ND DEG BL	2nd degree heart block rhythm.
51	3RD DEG BL	3rd degree heart block rhythm.

ST Elevation and Depression Waves

These can be set through direct code entry, as below, or adjusted and set through first selecting **52 = ST WAVES** or **142** = **ST WAVES**. After selecting **52** or **142,** press **ENTER**, and then use the **CHANGE** keys ▲▼ to scroll to the available presets.

Code	Display	Selects ST wave of:
236	ST +.8 mV	+.8 mV elevation
237	ST +.7 mV	+.7 mV elevation
238	ST +.6 mV	+.6 mV elevation
239	ST +.5 mV	+.5 mV elevation
240	ST +.4 mV	+.4 mV elevation
241	ST +.3 mV	+.3 mV elevation
242	ST +.2 mV	+.2 mV elevation
243	ST +.1 mV	+.1 mV elevation
244	ST - .1 mV	-.1 mV depression
245	ST - .2 mV	-.2 mV depression
246	ST - .3 mV	-.3 mV depression
247	ST - .4 mV	-.4 mV depression
248	ST - .5 mV	-.5 mV depression
249	ST - .6 mV	-.6 mV depression
250	ST - .7 mV	-.7 mV depression
251	ST - .8 mV	-.8 mV depression

ECG Waveform

The Simulator replicates four ECG waveform amplitudes, with a ± 2% accuracy of selection (Lead II). The Simulator uses them as references only during arrhythmia simulations. They are set through direct code entry, as below, or selected and adjusted through first selecting **8 = ECG AMPL**. After selecting **8,** press **ENTER**, and then use the **CHANGE** keys ▲▼ to scroll to the available presets. Then, press **ENTER** to set the amplitude. This setting remains in effect until changed, or until you switch the Simulator off.

Code	Display	Selects ECG amplitude of:
191	ECGSEN .5	0.5 mV
192	ECGSEN 1	1.0 mV
193	ECGSEN 1.5	1.5 mV
194	ECGSEN 2	2.0 mV

ECG Rate

The Simulator replicates fifteen heart rates, with a ± 1% accuracy of selection. These are set by selecting **7 = RATE**. After selecting **7** and pressing **ENTER**, use the **CHANGE** keys ▲▼ to scroll to the available presets. Then press **ENTER** to set the rate.

Code	Display	Selects ECG rate of:
170	ECG = 30BPM	30 BPM
171	ECG = 40BPM	40 BPM
172	ECG = 60BPM	60 BPM
173	ECG = 80BPM	80 BPM
174	ECG = 100BPM	100 BPM
175	ECG = 120BPM	120 BPM
176	ECG = 140BPM	140 BPM
177	ECG = 160BPM	160 BPM
178	ECG = 180BPM	180 BPM
179	ECG = 200BPM	200 BPM
180	ECG = 220BPM	220 BPM
181	ECG = 240BPM	240 BPM
182	ECG = 260BPM	260 BPM
183	ECG = 280BPM	280 BPM
184	ECG = 300BPM	300 BPM

Superimposed Artifacts

The Simulator replicates five different artifacts. Their purpose is to evaluate the effect of these type artifacts on ECG accuracy. After selecting the artifact, press **ENTER** to transmit it to the ECG. The Simulator deactivates the artifact when you make another ECG or arrhythmia selection.

Code	Display	Selects:
53	50 HZ ARTI	50 Hz artifact (European lines).
54	60 HZ ARTI	60 Hz artifact (US lines).
55	MUSCLE ART	Muscle artifact.
56	BASE WANDR	Baseline wandering.
57	RESP ARTIF	Respiration artifact.

Pacemaker

The Simulator replicates six paced rhythms/signals. After selecting the required rhythm, press **ENTER**. Use the **CHANGE** keys ▲▼ to scroll through the available rhythms.

Code	Display	Selects:
58	ASYNCHRONO	Asynchronous pacemaker rhythm.
59	DEMND FSIN	Pacemaker rhythm with frequent sinus beats.
60	DEMND OSIN	Pacemaker rhythm with occasional sinus beats.
61	AV SEQUENT	Atrial ventricular pacemaker rhythm.
62	NONCAPTURE	Noncapture event. The Simulator then assumes asynchronous pacemaker.
63	NON FUNCT	Non-function pacemaker rhythm.

Pacemaker Pulse Amplitudes, Lead II

When you select any pacemaker waveform, you can adjust and set pulse amplitudes in Lead II. These can be set through direct code entry, as below, or selected and adjusted through first selecting **64 = PACE AMP**. After selecting **64,** press **ENTER**, and then use the **CHANGE** keys ▲▼ to scroll to the available presets.

Code	Display	Sets pacemaker pulse amplitude (Lead II) of:
224	PACE 2 mV	2 mV
225	PACE 4 mV	4 mV
226	PACE 6 mV	6 mV
227	PACE 8 mV	8 mV
228	PACE 10 mV	10 mV

Pacemaker Pulse Width

When you select any pacemaker waveform, you can adjust and set pulse width. These can be set through direct code entry, as below, or selected and adjusted through first selecting **65 = PACE WIDTH**. After selecting **65** press **ENTER**, and then use the **CHANGE** keys ▲▼ to scroll to the available presets.

Code	Display	Sets pacemaker pulse width of:
229	PACE 0.1mS	0.1 ms
230	PACE 0.5mS	0.5 ms
231	PACE 1 mS	1.0 ms
232	PACE 1.5mS	1.5 ms
233	PACE 2 mS	2.0 ms

Cardiac Output

The software detects the cardiac output option when you connect the Simulator to the patient monitor's cardiac-output computer using the available accessories. Refer to your local Fluke Biomedical representative regarding the available optional Cardiac Output Adapter Box and cables.

To set up the cardiac output procedure while using the Cardiac Output Adapter Box, you must match the computational constant for the injectate temperature required. You must then adjust the injectate temperature pot to the required value for the model used. Use the following procedure:

1. Set the computational constant on your monitor under test to 0.561 for 2 °C, or 0.608 for 20 °C injectate temperature.
2. Connect the cable from the Cardiac Output Adapter Box to the **CO/Temp1&2** port on the right side of the Simulator.
3. Connect the cable for the injectate temperature into the **INJEC. TEMP.** port on the Cardiac Output Adapter Box.
4. Connect the cable for the blood temperature into the **BLOOD TEMP.** port on the Cardiac Output Adapter Box.
5. You may also connect other temperature probes through the **TEMP. 1&2** port on the Cardiac Output Adapter Box.
6. Rotate the **INJEC. TEMP.** dial on the face of the Cardiac Output Adapter Box until the monitor under test indicates the proper injectate temperature. This will be either 2 °C or 20 °C.

Note

*The number value on the **INJEC. TEMP.** dial is a relative setting for obtaining the same value on identical monitors. It does not indicate a numerical temperature value.*

Once you have the injectate temperature set to either 2 °C or 20 °C, you are ready to run the appropriate simulation from the Simulator. Select the appropriate test code and then press **ENTER**.

Code	Display	Selects:
107	3L/M @ 2C	Cardiac output wave of 3 L/min for 2 degrees. Computational constant is 0.561.
108	5L/M @ 2C	Cardiac output wave of 5 L/min for 2 degrees. Computational constant is 0.561.
109	7L/M @ 2C	Cardiac output wave of 7 L/min for 2 degrees. Computational constant is 0.561.
110	3L/M @ 20C	Cardiac output wave of 3 L/min for 20 degrees. Computational constant is 0.608.
111	5L/M @ 20C	Cardiac output wave of 5 L/min for 20 degrees. Computational constant is 0.608.
112	7L/M @ 20C	Cardiac output wave of 3 L/min for 20 degrees. Computational constant is 0.608.
113	FLT INJ 2	Faulty injection cardiac output wave for 2 degrees. Computational constant is 0.561.
114	L- T SHT 2	Left to right shunt cardiac output wave for 2 degrees. Computational constant is 0.561.
115	FLT INJ 20	Faulty injection cardiac output wave for 20 degrees. Computational constant is 0.608.
116	L- R SHT 20	Left to right shunt cardiac output wave for 20 degrees. Computational constant is 0.608.

Code	Display	Selects:
117	CAL WAVES	Calibrated cardiac output waves.
118	NONCAL WVE	Uncalibrated cardiac output waves. Gives 4 different values per 3, 5, and 7 L/min waves.
119	CAL 1 SEC	Calibration pulse of 1 degree for 1 second.
120	CAL 4 SEC	Calibration pulse of a delta of 402 Ohms for 4 seconds.
121	SET BT 37C	37 °C (98.6 °F)
122	SET BT 36C	36 °C (95.9 °F)

When the monitor under test indicates that it is ready to perform a Cardiac Output calculation, press **ENTER** on the Simulator to generate a test. The 4-second calibration pulse provides a delta change of 402 Ohms. This provides a standard for testing cardiac output units.

If you select any cardiac output waveform key a second time while a waveform is proceeding, the selected waveform will stop. The blood temperature will return to 37 °C (98.6 °F.)

ECG Performance Testing

Square Wave

Code	Display	Selects:
128	2 Hz SQR	2.0 Hz square waveform.
129	.125 Hz SQ	0.125 Hz square waveform.

Triangle Wave

Code	Display	Selects:
130	2 Hz TRIAN	2.0 Hz triangle waveform.
131	2.5 Hz TRI	2.5 Hz triangle waveform

Pulse Wave

Code	Display	Selects:
132	PULSE 30	Pulse of 30 BPM, width of 60 ms.
133	PULSE 60	Pulse of 60 BPM, width of 60 ms.

Sine Wave

Code	Display	Selects:
135	SINE .5 Hz	0.5 Hz sine wave.
136	SINE 5 Hz	5.0 Hz sine wave.
137	SINE 10 Hz	10.0 Hz sine wave.
138	SINE 40 Hz	40.0 Hz sine wave.
139	SINE 50 Hz	50.0 Hz sine wave.
140	SINE 60 Hz	60.0 Hz sine wave.
141	SINE 100Hz	100.0 Hz sine wave.

Cleaning

Clean only with a damp, lint-free cloth, using mild detergent, and wipe down gently.

⚠ Caution

Do not pour fluid onto the Simulator surface; fluid seepage into the electrical circuitry may cause Simulator failure.

⚠ Caution

Do not use spray cleaners on the Simulator; such action may force cleaning fluid into the Simulator and damage electronic components.