FLUKE®
Biomedical

ProSim™ 8

Vital Signs Simulator

Getting Started Manual

PN 3984515
January 2011, Rev. 3, 3/16

Warranty and Product Support

Fluke Biomedical warrants this instrument against defects in materials and workmanship for one year from the date of original purchase OR two years if at the end of your first year you send the instrument to a Fluke Biomedical service center for calibration. You will be charged our customary fee for such calibration. 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 covers the original purchaser only and is not transferable. The warranty does not apply if the product has been damaged by accident or misuse or has been serviced or modified by anyone other than an authorized Fluke Biomedical service facility. NO OTHER WARRANTIES, SUCH AS FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSED OR IMPLIED. FLUKE SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES, INCLUDING LOSS OF DATA, ARISING FROM ANY CAUSE OR THEORY.

This warranty covers only serialized products and their accessory items that bear a distinct serial number tag. Recalibration of instruments is not covered under the warranty.

This warranty gives you specific legal rights and you may also have other rights that vary in different jurisdictions. Since some jurisdictions do not allow the exclusion or limitation of an implied warranty or of incidental or consequential damages, this limitation of liability may not apply to you. If any provision of this warranty is held invalid or unenforceable by a court or other decision-maker of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

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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- 850-4608 or 1-440-248-9300. In Europe, email techsupport.emea@flukebiomedical.com or call +31-40-2965314.

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.

Returns and Repairs

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 1-440-498-2560.

Repair and calibration:

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

In the U.S.A. and Asia:
Cleveland Calibration Lab
Tel: 1-800-850-4608 x2564
Email: globalcal@flukebiomedical.com

In Europe, Middle East, and Africa:
Eindhoven Calibration Lab
Tel: +31-40-2675300
Email: ServiceDesk@fluke.com

To ensure the accuracy of the Product is maintained at a high level, Fluke Biomedical recommends the product be calibrated at least once every 12 months. Calibration must be done by qualified personnel. Contact your local Fluke Biomedical representative for calibration.

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

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Manufacturing Location

The ProSim™ 8 Vital Signs Simulator is manufactured at Fluke Biomedical, 6920 Seaway Blvd., Everett, WA, U.S.A.

Introduction

The Fluke Biomedical ProSim™ 8 Vital Signs Simulator (hereafter the Product) is a full-featured, compact, portable simulator, used to measure the performance of patient monitors.

Intended Use

The Product is intended to be used to test and verify the basic operation of patient monitoring devices or systems used to monitor various physiological parameters of a patient, including ECG, Respiration, Invasive blood pressure, Non-invasive blood pressure, Temperature, and Cardiac output. Additionally, the Devices provide an optical signal to verify that the electronics within the pulse oximeter probe are functional.

The intended user is a trained biomedical equipment technician who performs periodic preventative maintenance checks on patient monitors in service. Users can be associated with hospitals, clinics, original equipment manufacturers and independent service companies that repair and service medical equipment. The end user is an individual, trained in medical instrumentation technology.

This Product is intended to be used in the laboratory environment, outside of the patient care area, and is not intended for use on patients, or to test devices while connected to patients. This Product is not intended to be used to calibrate medical equipment. It is intended for over the counter use.

Safety Information

In this manual, a **Warning** identifies hazardous conditions and actions that could cause bodily harm or death. A **Caution** identifies conditions and actions that could damage the Product, the equipment under test, or cause permanent loss of data.

⚠⚠ Warnings

To prevent personal injury, use the Product only as specified, or the protection supplied by the Product can be compromised.

To prevent possible electrical shock, fire, or personal injury:

- **Read all safety Information before you use the Product.**
- **Do not touch voltages >30 V ac rms, 42 V ac peak, or 60 V dc.**
- **Do not use the Product around explosive gas, vapor, or in damp or wet environments.**
- **Examine the case before you use the Product. Look for cracks or missing plastic. Carefully look at the insulation around the terminals.**
- **Do not use the Product if it is damaged.**
- **Disable the Product if it is damaged.**
- **Use this Product indoors only.**
- **Do not connect directly to mains.**
- **Use the correct terminals, function, and range for measurements.**
- **Do not use the Product if it operates incorrectly.**
- **Use only current probes, test leads, and adapters supplied with the Product.**
- **Remove all probes, test leads, and accessories that are not necessary for the measurement.**

- **Remove all probes, test leads, and accessories before the battery door is opened.**
- **The battery door must be closed and locked before you operate the Product.**
- **Replace the batteries when the low battery indicator shows to prevent incorrect measurements.**
- **Remove the batteries if the Product is not used for an extended period of time, or if stored in temperatures above 50 °C. If the batteries are not removed, battery leakage can damage the Product.**
- **Use only the mains power cord and connector approved for the voltage and plug configuration in your country and rated for the Product.**
- **Replace the mains power cord if the insulation is damaged or if the insulation shows signs of wear.**
- **Use only the external mains power supply included with the Product.**
- **Connect the battery charger to the mains power outlet before the Product.**
- **Do not put metal objects into connectors.**
- **Do not connect the Product to a patient or equipment connected to a patient. The Product is intended for equipment evaluation only and should never be used in diagnostics, treatment, or any other capacity where the Product would come in contact with a patient.**

- **Batteries contain hazardous chemicals that can cause burns or explode. If exposure to chemicals occurs, clean with water and get medical aid.**
- **Do not disassemble the battery.**
- **Do not disassemble or crush battery cells and battery packs.**
- **Do not put battery cells and battery packs near heat or fire. Do not put in sunlight.**
- **Do not short the battery terminals together.**
- **Do not keep cells or batteries in a container where the terminals can be shorted.**
- **Remove the input signals before you clean the Product.**
- **Use only specified replacement parts.**
- **Have an approved technician repair the Product.**

⚠⚠ Warnings

For safe operation and maintenance of the Product:

- **Repair the Product before use if the battery leaks.**
- **Use only Fluke Biomedical approved power adapters to charge the battery.**

Symbols

Table 1 describes symbols used in association with the Product.

Table 1. Symbols

Symbol	Description	Symbol	Description
	WARNING - RISK OF DANGER. Consult user documentation.		WARNING. HAZARDOUS VOLTAGE. Risk of electric shock.
	Magnetic Field		Input jack for the DC output of the AC-DC supply connector.
	Conforms to European Union directives.		Certified by CSA Group to North American safety standards.
	Conforms to relevant Australian EMC standards.		Complies with 47 CFR Part 15 requirements of the U.S. Federal Communications Commission.
	Conforms to relevant South Korean EMC Standards.	 Li-ion	Spent Lithium batteries should be disposed of by a qualified recycler or hazardous materials handler per local regulations. Contact your authorized Fluke Service Center for recycling information.
	This product complies with the WEEE Directive marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste. Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as category 9 "Monitoring and Control Instrumentation" product. Do not dispose of this product as unsorted municipal waste.		

Instrument Familiarization

Table 2 is a list of Product top-panel controls and connections shown in Figure 1.

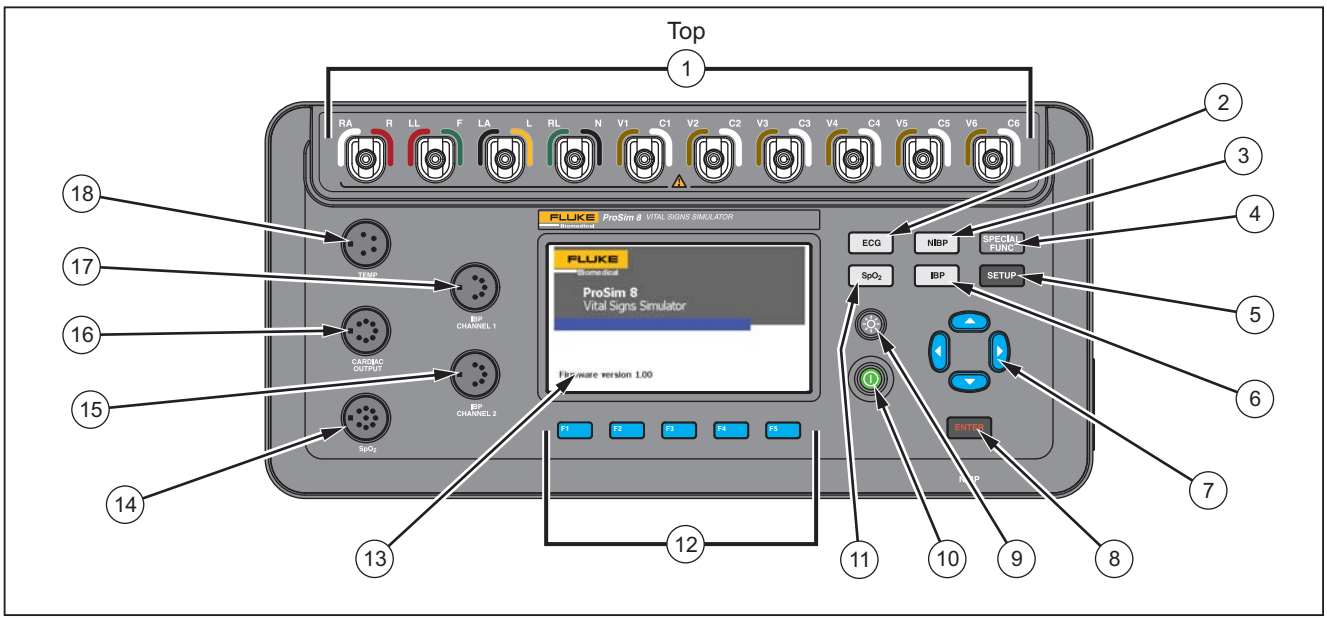

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Figure 1. Top-Panel Controls and Connections

Table 2. Top-Panel Controls and Connections

Item	Name	Description
①	ECG Posts	Connection posts for Device Under Test (DUT) ECG leads.
②	ECG Function	Accesses the ECG waveforms (adult, pediatric, and arrhythmias), and ECG test functions (performance waves, QRS detection, Tall T wave rejection, and R wave detection).
③	NIBP Button	Accesses the Non-Invasive Blood Pressure (NIBP) functions.
④	Special Functions	Accesses the temperature, respiration, cardiac output, fetal simulation, autosequences, and view memory functions.
⑤	SETUP Button	Accesses the setup controls.
⑥	IBP Button	Accesses the Invasive Blood Pressure (IBP) functions.
⑦	Navigation Buttons	Cursor control buttons for navigating menus and lists.
⑧	Enter Button	Sets the highlighted function.
⑨	Backlight Button	Turns the display backlight on and off.
⑩	Power Button	Turns the Product on and off.
⑪	SpO2 Button	Accesses the SpO2 functions.
⑫	Function Softkeys	Keys F1 through F5 are used to select from a number of selections that appear in the LCD display above each function softkey.

Table 2. Top-Panel Controls and Connections (cont.)

Item	Name	Description
⑬	LCD Display	Color display.
⑭	SpO2 Connector	Connector to the SpO2 accessory.
⑮	IBP Channel 2 Connector	Connector to an IBP input of the patient monitor.
⑯	Cardiac Output Connector	Connector to the Cardiac input of the patient monitor.
⑰	IBP Channel 1 Connector	Connector to the IBP input of the patient monitor.
⑱	Temperature Connector	Connector to the Temperature input of the patient monitor.

Table 3 is a list of Product controls and connections shown in Figure 2.

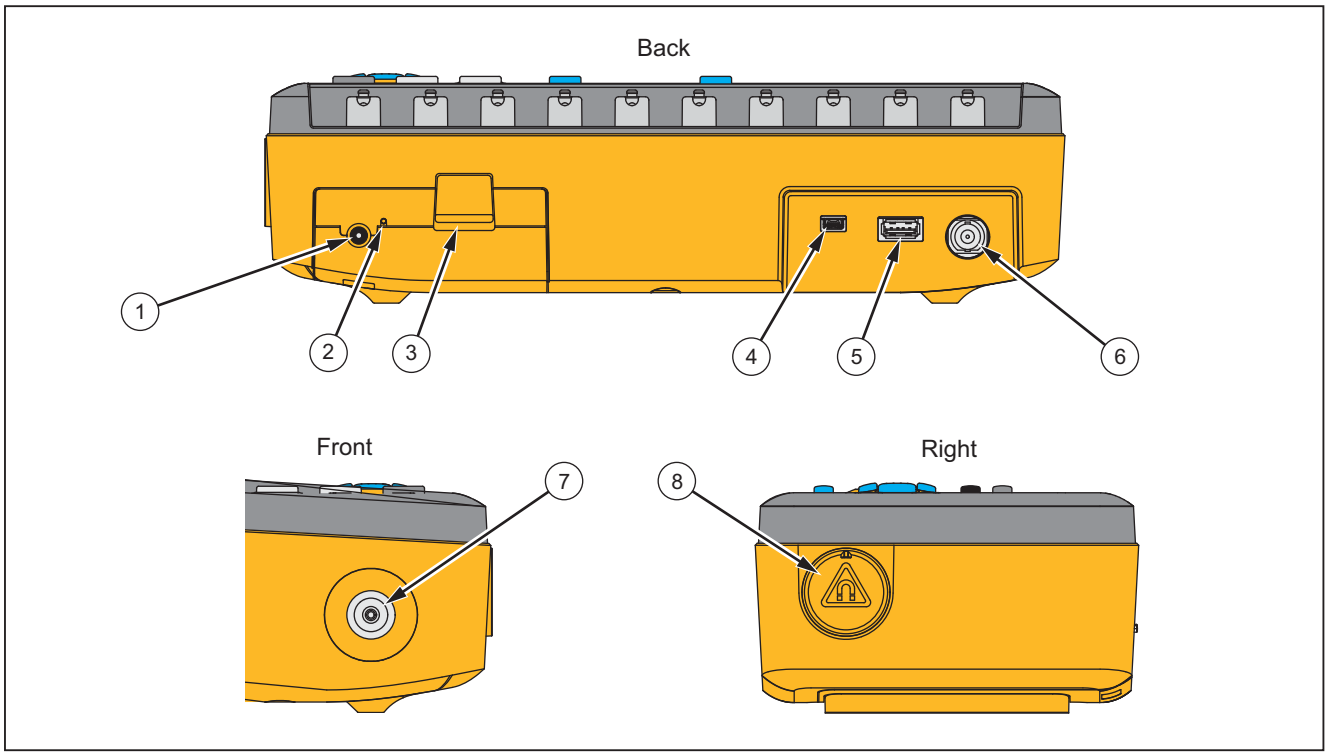

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Figure 2. Back, Front, and Side Panel Connections

Table 3. Back, Front, and Side Panel Connections

Item	Name	Description
①	AC/DC Supply Connector	Input jack for the DC output of the AC/DC supply connector.
②	Battery Charge LED	Battery charges when LED shows red. Green shows battery charge is complete.
③	Battery Latch	Locks the battery pack into the Product. Push down to remove the battery pack.
④	Mini B USB Device Port	Used to connect to a PC for remote control or download test results data to a PC.
⑤	USB A Controller Port	For external keyboard, barcode reader, or printer.
⑥	ECG BNC Connector	High-level output of ECG signal.
⑦	Air Port Connector	Pressure port for NIBP cuff and monitor.
⑧	Magnetic Holder for SpO2 Finger Module	Holds the SpO2 Optical Emitter and Detector finger module in two orientations.

How to Turn the Product On

After you unpack and inspect the Product, fully charge the battery before the first use. Afterwards, charge the battery when the Product shows the low battery message. See the Users Manual for detailed instructions.

Push ⏻ on the front panel to turn the Product on. The startup screen shows on the display. When the self test is complete and no errors are sensed, the Home screen shows in the display. The Product is ready to use. See the Users Manual for detailed instructions.

General Specifications

Temperature

- Operating ..... 10 °C to 40 °C (50 °F to 104 °F)
- Storage ..... -20 °C to +60 °C (-4 °F to +140 °F)

Humidity ..... 10 % to 90 % non-condensing

Altitude ..... 3000 meters (9843 ft)

Size (L x W x H) ..... 30.22 cm x 14.48 cm x 8.64 cm (11.9 in x 5.7 in x 3.4 in)

Display ..... LCD Color Display

Communication

- USB Device Upstream Port ..... Mini-B connector for control by a computer
- USB Host Controller Port ..... Type A, 5 V output, 0.5 A max load. Connector for keyboard, barcode reader, and printer
- Wireless ..... IEEE 802.15.4 for control by a computer
- USB Device Virtual COM Port Settings
  - Baud Rate ..... 115 200 bps
  - Data bits ..... 8 data bits
  - Stop Bits ..... 1 stop bit
  - Flow Control ..... Hardware (RTS/CTS)

Power ..... Lithium-Ion rechargeable, 7.2 V, 31 Wh battery, 4300 mAh

Battery Charger ..... 100 V to 240 V, 50/60 Hz input, 15 V/2.0 A output. For best performance, the battery charger should be connected to a properly grounded ac receptacle

Battery Life ..... 9 hours (minimum), 100 NIBP cycles typical

Weight ..... 1.81 kg (4 lb)

Wireless Radio

Frequency Range ..... 2412 MHz to 2462 MHz

Output Power ..... <1 mW

Safety ..... IEC 61010-1: Overvoltage Category II, Pollution Degree 2

Electromagnetic Compatibility (EMC)

International ..... IEC 61326-1: Portable Electromagnetic Environment CISPR 11: Group 1, Class A

Group 1: Equipment has intentionally generated and/or uses conductively-coupled radio frequency energy that is necessary for the internal function of the equipment itself.

Class A: Equipment is suitable for use in all establishments other than domestic and those directly connected to a low-voltage power supply network that supplies buildings used for domestic purposes. There may be potential difficulties in ensuring electromagnetic compatibility in other environments due to conducted and radiated disturbances.

Emissions that exceed the levels required by CISPR 11 can occur when the equipment is connected to a test object. The equipment may not meet the immunity requirements of this standard when test leads and/or test probes are connected.

Korea (KCC) ..... Class A Equipment (Industrial Broadcasting & Communication Equipment)

Class A: Equipment meets requirements for industrial electromagnetic wave equipment and the seller or user should take notice of it. This equipment is intended for use in business environments and not to be used in homes.

USA (FCC) ..... 47 CFR 15 Intentional Radiators: This device complies with part 15 of the FCC Rules.

Operation is subject to the following two conditions:

(1) This device may not cause harmful interference.

(2) This device must accept any interference received, including interference that may cause undesired operation. (15.19).

Changes or modifications not expressly approved by Fluke could void the user's authority to operate the equipment. (15.21)

Detailed Specifications

Normal-Sinus-Rhythm Waveform

ECG Reference ..... The ECG amplitudes specified are for Lead II (calibration), from the baseline to the peak of the R wave. All other leads are proportional.

Normal Sinus Rhythm ..... 12-lead configuration with independent outputs referenced to right leg (RL). Output to 10 Universal ECG Jacks, color-coded to AHA and IEC Standards.

High-Level Output ..... 0.5 V/mV ±5 % of the ECG amplitude setting available on a BNC connector.

Amplitude ..... 0.05 mV to 0.5 mV (0.05 mV steps); 0.5 mV to 5.0 mV (0.25 mV steps). Other leads are proportional to Lead II (reference lead) in percentage per:

Lead I 70
Lead II 100
Lead III 30
Lead V1 24
Lead V2 48
Lead V3 100
Lead V4 120
Lead V5 112
Lead V6 80

Amplitude Accuracy ..... ±(2 % of setting + 0.05 mV)
ECG Rate ..... 10 BPM to 360 BPM in 1 BPM steps
Rate Accuracy ..... ±1 % of setting
ECG Waveform Selection ..... Adult (80 ms) or pediatric (40 ms) QRS duration
ST-Segment Elevation ..... Adult mode only. -0.8 mV to +0.8 mV (0.1 mV steps)
Additional steps: +0.05 mV and -0.05 mV
Power-On Default ..... 60 BPM, 1.0 mV, adult QRS and ST-segment elevation of 0 mV

Pacemaker Waveform

Pacer-Pulse

Amplitude ..... 0 mV (off), ±2 mV, ±4 mV, ±6 mV, ±8 mV, ±10 mV, ±12 mV, ±14 mV, ±16 mV, ±18 mV, ±20 mV, ±50 mV, ±100 mV, ±200 mV, ±500 mV, and ±700 mV for lead II (reference lead)

Accuracy

Reference lead II ..... ±(5 % setting + 0.2 mV)
All other leads ..... ±(10 % setting + 0.4 mV)

Pacer-Pulse Width ..... 0.1 ms, 0.2 ms, 0.5 ms, 1.0 ms, and 2.0 ms ±5 %
Paced Arrhythmias ..... Atrial 80 BPM
Asynchronous 75 BPM
Demand with frequent sinus beats
Demand with occasional sinus beats
Atrio-Ventricular sequential
Noncapture (one time)
Nonfunction
Power-On Default ..... Amplitude 10 mV, width 1.0 ms, atrial waveform

Arrhythmia

Baseline NSR ..... 80 BPM

PVC Focus ..... Left focus, standard timing (except where specified)

Supraventricular Arrhythmia ..... Atrial fibrillation (coarse or fine); atrial flutter; sinus arrhythmia; missed beat (one time); atrial tachycardia; paroxysmal atrial tachycardia; nodal rhythm; and supraventricular tachycardia.

Premature Arrhythmia ..... Premature atrial contraction (PAC); premature nodal contraction (PNC); PVC1 left ventricular; PVC1 left ventricular, early; PVC1 left ventricular, R on T; PVC2 right ventricular; PVC2 right ventricular, early; PVC2 right ventricular, R on T; and multifocal PVCs

Ventricular Arrhythmia ..... PVCs 6 per minute, 12 per minute, or 24 per minute; frequent multifocal PVCs; bigeminy; trigeminy; multiple PVCs (one-time run of 2 PVCs, 5 PVCs, or 11 PVCs); mono-ventricular tachycardia (120 BPM to 300 BPM in 5 BPM steps); poly-ventricular tachycardia (5 types); ventricular fibrillation (coarse or fine); and Asystole

Conduction Defect ..... First-, second-, or third-degree heart block; and right- or left-bundle-branch block

Advanced Cardiac Life Support

Shockable Pulseless Arrest Rhythms ..... Ventricular fibrillation (coarse), ventricular fibrillation (fine), unstable polymorphic ventricular tachycardia

Non Shockable Pulseless Arrest Rhythms ..... Asystole

Symptomatic Bradycardia ..... Sinus Bradycardia (<60 BPM)
2nd Degree AV Block, Mobitz Type I
2nd Degree AV Block, Mobitz Type II
Complete/3rd Degree AV Block
Right Bundle Branch Block
Left Bundle Branch Block

Symptomatic Tachycardia

Regular Narrow-complex Tachycardias (QRS <0.12 seconds)

Sinus Tachycardia ..... >150 BPM

Supraventircular Tachycardia ..... SVT

Regular Wide-complex Tachycardias (QRS ≥0.12 seconds)

Sinus Tachycardia ..... >150 BPM

Supraventircular Tachycardia ..... SVT with aberrancy

Irregular Tachycardia ..... Atrial Fibrillation (Coarse and fine), Atrial Flutter, unstable monomorphic ventricular tachycardia (120 BPM to 300 BPM), Torsade De Pointes/Polymorphic ventricular tachycardia (long QT interval)

ECG-Performance-Testing

Amplitude (peak-to-peak) ..... 0.05 mV to 0.5 mV (0.05 mV steps) 0.5 mV to 5.0 mV (0.25 mV steps) Other leads are proportional to Lead II (reference lead) in percentage per:

Lead I 70

Lead II 100

Lead III 30

Lead V1 through V6 100

Pulse Wave ..... 30 BPM, 60 BPM, with 60 ms pulse width

Square Wave ..... 0.125 Hz, 2.0 Hz, 2.5 Hz

Triangle Wave ..... 0.125 Hz, 2.0 Hz, 2.5 Hz

Sine Wave ..... 0.05 Hz, 0.5 Hz, 1 Hz, 2 Hz, 5 Hz, 10 Hz, 25 Hz, 30 Hz, 40 Hz, 50 Hz, 60 Hz, 100 Hz, and 150 Hz

R-wave Detection

- Waveform ..... Triangular pulse
- Rate ..... 30 BPM, 60 BPM, 80 BPM, 120 BPM, 200 BPM, and 250 BPM
- Width ..... 8 ms to 20 ms in 2 ms steps, and 20 ms to 200 ms in 10 ms steps
- Width Accuracy ..... ±(1 % of setting + 1 ms)

QRS Detection

- Widths ..... 8 ms to 20 ms in 2 ms steps and 20 ms to 200 ms in 10 ms steps
- Width Accuracy ..... ±(1 % of setting + 1 ms)
- Rate ..... 30 BPM, 60 BPM, 80 BPM, 120 BPM, 200 BPM, and 250 BPM
- R-Wave up slope ..... 0.875 amplitude, 0.4375 x width
- R-Wave down slope ..... Full amplitude, 0.5 x width
- S-Wave up slope ..... 0.125 amplitude, 0.0625 x width

Tall T-Wave Rejection

- Waveform
  - QT Interval ..... 350 ms
  - T-Wave width ..... 180 ms
  - T-Wave Shape ..... ½ sinewave
- Amplitude ..... 0 % to 150 % reference lead amplitude in 10 % steps
- Rate ..... 80 BPM

Rate Accuracy ..... ±1 % of setting

Amplitude Accuracy ..... ±(2 % of setting + 0.05 mV)

ECG Artifact

Type ..... 50 Hz, 60 Hz, muscular, baseline wander, respiration

Size ..... 25 %, 50 %, 100 % of the normal sinus R-Wave for each lead

Lead Select ..... All, RA, LL, LA, V1, V2, V3, V4, V5, V6

Fetal / Maternal-ECG

Fetal Heart Rate (Fixed) ..... 60 BPM to 240 BPM in 1 BPM steps

Fetal Heart Rate (IUP) ..... 140 BPM at beginning, then varies with pressure

Intrauterine-Pressure Waveforms ..... Early deceleration, late deceleration, and acceleration

Wave Duration ..... 90 seconds, bell-shaped pressure curve, from 0 mmHg to 90 mmHg and returning to 0 mmHg

IUP Period ..... 2 minutes, 3 minutes, or 5 minutes; and manual

Default Settings ..... FHR 140 BPM, early deceleration wave, manual

Invasive Blood Pressure

Channels ..... 2, each independently settable with identical parameters and are individually electrically isolated from all other signals

Input/output Impedance ..... 300 Ω ±10 %

Exciter Input Range ..... 2.0 V to 16.0 V peak

Exciter-Input Frequency Range ..... DC to 5000 Hz

Transducer Sensitivity ..... 5 µV/V/mmHg (default) or 40 µV/V/mmHg

Pressure Accuracy ..... ±(1 % of setting + 1 mmHg) Accuracy guaranteed for DC excitation only

Static Pressure ..... -10 mmHg to +300 mmHg in 1 mmHg steps

Pressure Units ..... mmHg or Kpa

Dynamic Waveforms

Types (default pressures)	Arterial (120/80) Radial artery (120/80) Left ventricle (120/00) Right ventricle (25/00) Pulmonary artery (25/10) Pulmonary-artery wedge (10/2) Right atrium (central venous or CVP) (15/10)
Pressure Variability	Systolic and diastolic pressures are independently variable in 1 mmHg steps.
Swan-Ganz Sequence	Right atrium, right ventrical (RV), pulmonary artery (PA), pulmonary artery wedge (PAW)
Cardiac Catheterization	
Chambers	Aortic, Pulmonary valve, and Mitral valve
Respiration Artifact	
Arterial, radial artery, and left ventricle	5 % to 10 % multiplication
Other	5 mmHg or 10 mmHg
BP Output	Circular DIN 5-Pin
Power-On Default	0 mmHg

Respiration

Rate	0 BrPM (OFF), 10 BrPM to 150 BrPM in 1 BrPM steps
Waves	Normal or ventilated
Ratio (inspiration:expiration)	
Normal	1:1, 1:2, 1:3, 1:4, 1:5
Ventilated	1:1
Impedance Variations (Δ Ω)	0.00 Ω to 1.00 Ω in 0.05 Ω steps and 1.00 Ω to 5.00 Ω in 0.25 Ω steps
Delta Accuracy	±(5 % of setting + 0.1 Ω)

Baseline ..... 500 Ω, 1000 Ω (default), 1500 Ω, 2000 Ω, Leads I, II, III
Baseline Accuracy ..... ±5 %
Respiration Lead ..... LA or LL (default)
Apnea Selection ..... 12 seconds, 22 seconds, or 32 seconds (one-time events), or continuous (Apnea ON = respiration OFF)
Power-On Default ..... 20 BrPM, delta 1.0 Ω

Temperature

Temperature ..... 30.0 °C to 42.0 °C in 0.5 °C steps
Accuracy ..... ±0.4 °C
Compatibility ..... Yellow Springs, Inc. (YSI) Series 400 and 700
Output ..... Circular DIN 4-pin

Cardiac Output

Catheter Type ..... Baxter Edwards, 93a-131-7f
Calibration Coefficient ..... 0.542 (0 °C injectate), 0.595 (24 °C injectate)
Blood Temperature ..... 36 °C (98.6 °F) to 38 °C (100.4 °F) ±0.2 °C in 1 °C steps
Injectate Volume ..... 10 cc
Injectate Temperature ..... 0 °C or 24 °C
Cardiac Output ..... 2.5 liters per minute, 5 liters per minute, 10 liters per minute ±7.5 %
Faulty-Injectate Curve ..... Waveform for simulation available
Left-to-Right-Shunt Curve ..... Waveform for simulation available
Calibrated Pulse ..... 1.5 °C for 1 second
Connector ..... Circular DIN 7 pin
Power-On Default ..... 5 liters per minute, 0 °C injectate, 37 °C blood temperature

Non-Invasive Blood Pressure

Pressure Units ..... mmHg or kPa

Manometer (Pressure Meter)

- Range ..... 0 mmHg to 400 mmHg
- Resolution ..... 0.1 mmHg
- Accuracy ..... ±(0.5 % reading +0.5 mmHg)

Pressure Source

- Target Pressure Range ..... 15 mmHg to 400 mmHg
- Resolution ..... 1 mmHg

NIBP Simulations

- Pulse ..... 2 mmHg max into 500 ml NIBP system
- Volume of air moved ..... 1.25 ml max
- Simulations ..... Systolic/diastolic (MAP)
  - Adult ..... 60/30 (40), 80/50 (60), 100/65 (77); 120/80 (93); 150/100 (117); and 200/150 (167) and 255/195 (215)
  - Neonatal ..... 35/15 (22); 60/30 (40); 80/50 (60);100/65 (77);120/80 (93) and 150/100 (117)
  - Pressure variability ..... Systolic and diastolic pressures are variable by 1 mmHg
- Repeatability ..... Within ±2 mmHg (at maximum pulse size independent of device under test)
- Synchronization
  - Normal Sinus heart rates ..... 30 BPM to 240 BPM
    - Maximum rate at 1 ml ..... 240 BPM achievable with pulses up to 1 ml
    - Maximum rate at 1.25 ml ..... 180 BPM
  - Arrhythmias ..... Premature atrial contraction (PAC), Premature ventricular contraction (PVC), atrial fibrillation, and missed beat.

Leak Test

Target Pressure ..... 20 mmHg to 400 mmHg
Elapsed time ..... 0:30 minutes:seconds to 5:00 minutes:seconds in 30 second steps
Range ..... 0 mmHg/minute to 200 mmHg/minute
Internal Leak rate ..... <2 mmHg/min into 500 ml rigid volume
Pressure Relief Test Range ..... 100 mmHg to 400 mmHg

Oximeter SpO2 Optical Emitter and Detector (optional)

% O_2

Range ..... 30 % to 100 %
Resolution ..... 1 %
Accuracy
With oximeter manufacturer's R-curve
Saturation within UUT specific range..... ±(1 count + specified accuracy of the UUT)
Saturation outside UUT specific range ..... monotonic with unspecified accuracy
With Fluke Biomedical R-curves
91 % to 100 % ..... ±(3 counts + specified accuracy of the UUT)
81 % to 90 % ..... ±(5 counts + specified accuracy of the UUT)
71 % to 80 % ..... ±(7 counts + specified accuracy of the UUT)
Below 71 % ..... monotonic with unspecified accuracy

Heart Rate

Range ..... 30 BPM to 300 BPM in 1 BPM steps. Oximeter SpO2 Optical Emitter and Detector is synchronized with ECG rate delayed by 150 ms.
Accuracy ..... ±1 % of setting

Transmission (Ratio of detector current to LED current, expressed in parts per million (ppm))

Range	0 ppm to 300.00 ppm
Resolution	0.01 ppm
Accuracy	+50 %/-30 % for compatible monitors, unspecified for others. Selected by finger size and color: Dark, thick finger, medium finger, light, thin finger, neonatal foot.

Pulse Amplitude

Range	0 % to 20.00 %
Resolution	0.01 %

Artifact

Respiration

Range	0 % to 5 % of transmission
Resolution	1 %
Rate	all ProSim respiration simulation settings

Ambient Light

Range	0X to 5X transmitted light
Resolution	1X
Frequency	DC, 50 Hz, 60 Hz, and 1 kHz to 10 kHz in 1 kHz steps

Masimo Rainbow Technology	Masimo Rainbow technology with an optional adapter supplied by Masimo that allows the ProSim two wavelength to test the Rainbow multiple wavelength system

Compatible Manufacturer Products

With manufacturer R-curve	Nellcor, Masimo, Nonin, and Nihon Kohden
With Fluke Biomedical R-curve	Mindray, GE-Ohmeda, Philips/HP, and BCI

Pre-Defined Simulations

Normal
Hypertensive
Hypotensive
Tachycardic
Bradycardic
Ventricular Fibrillation
Asystole

Autosequences (default)

Monitor testing sequence
Medical training sequence
Oximeter testing sequence
Cardiac failure sequence
Arrhythmia sequence
Exercise sequence
Respiration sequence
Performance Wave Test
IBP testing sequence
Temperature sequence