MANUAL

GOSSEN METRAWATT

SECULIFE PS300

Universal Patient Simulator

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2/08.26

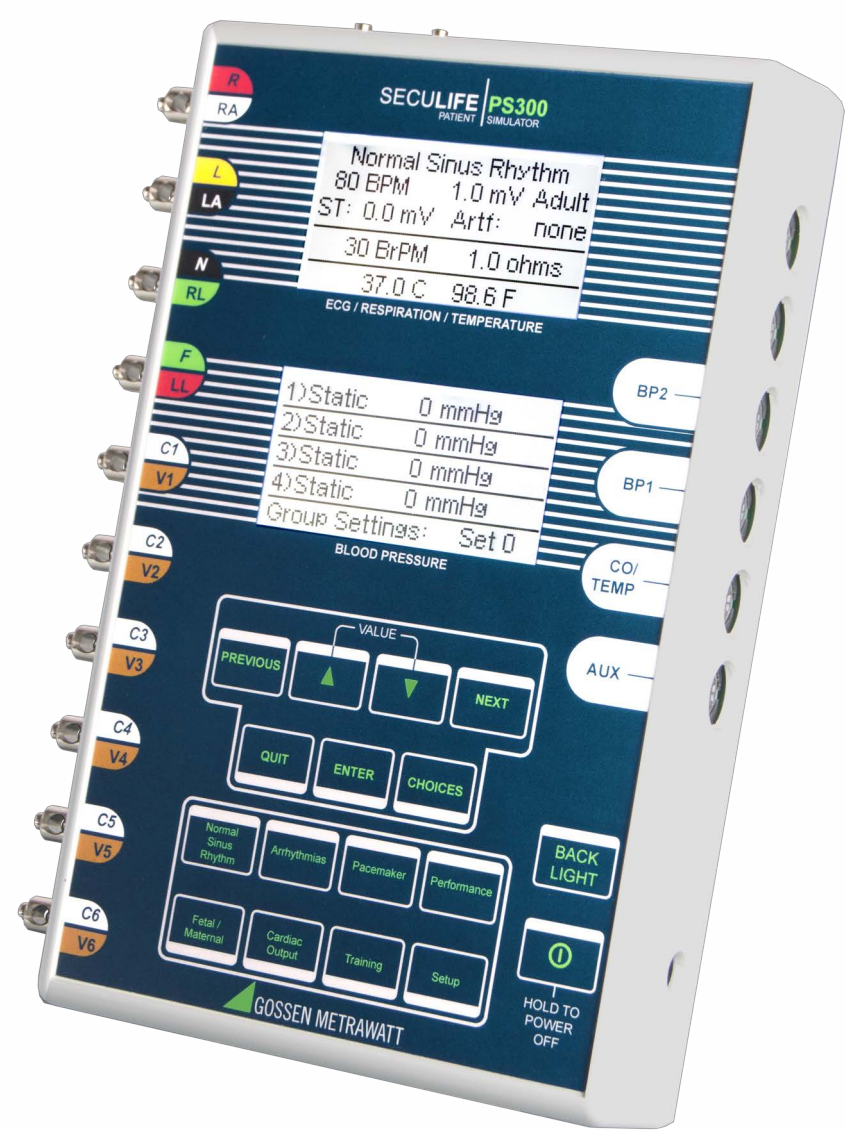

Table of Contents

1 Safety Instructions 4
2 Application 6
2.1 Intended Use / Use for Intended Purpose 6
2.2 Use for Other than Intended Purpose 6
2.3 Liability and Guarantee 6
2.4 Opening the Instrument / Repairs 6
3 Documentation 7
3.1 Information Concerning these Instructions 7
3.2 Identification of Warnings 7
3.3 Identifiers 8
3.4 Symbols in the Documentation 8
3.5 Definition of Terms 8
4 Getting Started 8
5 The Instrument 9
5.1 Scope of Delivery 9
5.2 Optional Accessories 9
5.3 Instrument Overview 9
5.4 Symbols on the Instrument and the Included Accessories 10
5.5 Relevant Standards 10
5.6 Technical Data 11
6 Operation 14
6.1 Power Supply 14
6.2 Turning the Instrument On and Off 15
6.3 Control Keys 15
6.4 Connectors 16
7 Configuration (Setup) 17
7.1 Output Setup 17
7.2 System Setup 17
8 Simulations 19
8.1 Test Setup (For Each Simulation) 19
8.2 Normal Sinus Rhythm 20
8.3 Arrhythmias 21
8.4 Pacemaker 26
8.5 Performance 28
8.6 Blood Pressure 30
8.7 Respiration 32
8.8 Temperature 33
8.9 SPO2 (Optional Feature) 33
8.10 Fetal / Maternal (Optional Feature) 34
8.11 Cardiac Output (Optional Feature) 36
9 Training Mode 38
10 Storage and Transport 40
11 Maintenance 40
11.1 Cleaning 40
11.2 Calibration 40
12 Repair 41
13 Service and Contact 41
14 Certifications 42
14.1 CE Declaration 42
14.2 Calibration Certificate 42
15 Disposal and Environmental Protection 42
15.1 Disposal of Old Devices, Batteries and Rechargeable Batteries 42
15.2 Disposal of Packaging Materials 42
15.3 Regulations for the Federal Republic of Germany 42

1 Safety Instructions



Read and follow these instructions carefully and completely in order to ensure safe and proper use.

The instructions must be made available to all persons who use the instrument.

Keep for future reference.

General

- The device may only be used by adequately trained and qualified personnel in the commercial trades. It is not a consumer product.
- Observe and comply with all safety regulations which are applicable for your work environment.
- Wear suitable and appropriate personal protective equipment (PPE) whenever working with the instrument.
- The functioning of active medical devices (for example pacemakers, defibrillators) and passive medical devices may be affected by voltages, currents and electromagnetic fields generated by the instrument and the health of their users may be impaired. Implement corresponding protective measures in consultation with the manufacturer of the medical device and your physician. If any potential risk cannot be ruled out, do not use the instrument.

Accessories

- Use only the specified accessories (included in the scope of delivery or listed as optional accessories) with the instrument.
- Carefully and completely read and adhere to the product documentation for optional accessories. Retain these documents for future reference.

Handling

- Use the instrument in undamaged condition only.
  Inspect the instrument before use. Pay particular attention to damage, interrupted insulation or kinked cables. Damaged components must be replaced immediately.
- Use the accessories and all cables in undamaged condition only.
  Inspect accessories and all cables before use. Pay particular attention to damage, interrupted insulation or kinked cables.
- If the instrument or its accessories don't function flawlessly, permanently remove the instrument/accessories from operation and secure them against inadvertent use.
- If the instrument or accessories are damaged during use, for example if they're dropped, permanently remove the instrument/accessories from operation and secure them against inadvertent use.
- If there are any signs of interior damage to the instrument or accessories (e.g. loose parts in the housing), permanently remove the instrument/accessories from operation and secure them against inadvertent use.
- The instrument and the accessories may only be used for the tests/measurements described in the documentation for the instrument.
- The instruments and accessories of Gossen Metrawatt GmbH are designed to ensure optimum compatibility with the Gossen Metrawatt GmbH products that are expressly provided for them. Unless otherwise expressly confirmed in writing by Gossen Metrawatt GmbH, they are neither intended nor suited for use with other products.
- Route cables in an orderly fashion, e.g. the mains power cable and cables for accessories. Loose, disorderly cables result in unnecessary danger of tripping and falling.

Operating Conditions

- Do not use the instrument and its accessories after long periods of storage under unfavorable conditions (e.g. humidity, dust or extreme temperature).
- Do not use the instrument and its accessories after extraordinary stressing due to transport.
- Do not expose the instrument to direct sunlight for long periods of time. Overheating may cause damage to the instrument.
- Only use the instrument and its accessories within the limits of the specified technical data and conditions (ambient conditions, IP protection code, measuring category etc.).
- Do not use the instrument in potentially explosive atmospheres. Danger of explosion!
- Do not use the instrument in areas subject to the risk of fire. Danger of fire!
- Implement adequate measures for protection against electrostatic discharge (ESD).

Rechargeable or Regular Batteries

- Use (rechargeable) batteries in undamaged condition only. Risk of explosion and fire in the case of damaged (rechargeable) batteries!
  Inspect the (rechargeable) batteries before use. Pay particular attention to leaky and damaged (rechargeable) batteries.
- When using (rechargeable) batteries, the respective test/measuring instrument may only be used with inserted and secured battery compartment lid. Otherwise, dangerous voltages may occur at the battery terminals under certain circumstances.
- Do not use the instrument while the internal rechargeable batteries are being charged.
- Only charge undamaged rechargeable batteries. Risk of explosion and fire in the case of damaged rechargeable batteries!
  Inspect the rechargeable batteries before charge. Pay particular attention to leaky and damaged rechargeable batteries.

Measurement Cables and Establishing Contact

- Plugging in the measurement cables must not necessitate any undue force.
- Never touch conductive ends (e.g. of test probes).
- Fully unroll all measurement cables before starting a test/measurement. Never perform a test/measurement with the measurement cable rolled up.
- Avoid short circuits due to incorrectly connected measurement cables.
- Ensure appropriate contacting (e.g. on the test probes, crocodile clips, Kelvin probes, etc.).
- Do not move or remove contacts (e.g. the test probes, alligator clips, Kelvin probes etc.) until testing/measurement has been completed.

Calibration

- Comply with national calibration regulations and laws.

Data Security

- Always create a backup copy of your measurement/test data.

2 Application

Please read this important information!

2.1 Intended Use / Use for Intended Purpose

The SECULIFE PS300, hereinafter referred to as instrument, is a patient simulator designed for testing of monitoring and arrhythmia systems. It provides ECG, blood pressure, and respiration simulations, with optional features for SpO2 (with SECULIFE SP BASE), fetal/maternal (with Fetal/maternal option), and cardiac output testing (with Cardiac Output option).

The instrument has stored in its memory all of the digitalized waveforms. It sends the individual lead waveforms to D/A converters, which generate accurate analog representations. The waveforms are then sent through resistor networks, developing the appropriate signals on the output terminals.

Safety of the operator, as well as that of the instrument, is only assured when it's used for its intended purpose.

2.2 Use for Other than Intended Purpose

Using the instrument for any purposes other than those described in the condensed operating instructions or these instrument operating instructions is contrary to use for intended purpose.

2.3 Liability and Guarantee

Gossen Metrawatt GmbH assumes no liability for property damage, personal injury or consequential damage resulting from improper or incorrect use of the product, in particular due to failure to observe the product documentation. Furthermore, all guarantee claims are rendered null and void in such cases.

Nor does Gossen Metrawatt GmbH accept any liability for data loss.

2.4 Opening the Instrument / Repairs

The instrument may only be opened by authorized, trained personnel in order to ensure flawless, safe operation and to assure that the guarantee isn't rendered null and void. Even original replacement parts may only be installed by authorized, trained personnel.

Unauthorized modification of the instrument is prohibited.

If it can be ascertained that the instrument has been opened by unauthorized personnel, no guarantee claims can be honored by the manufacturer with regard to personal safety, measuring accuracy, compliance with applicable safety measures or any consequential damages.

3 Documentation

3.1 Information Concerning these Instructions

Read these instructions carefully and attentively. They contain all necessary information for safe use of the instrument. Comply with them in order to protect yourself and others from injury, and to avoid damaging the instrument.
The latest version of these instructions is available on our website

https://www.gossenmetrawatt.de/en/services/download-center/

Errors and suggestions

These instructions have been prepared with utmost care in order to ensure correctness and completeness. Unfortunately, errors can never be entirely avoided. Continuous improvement is part of our quality goal, so we always appreciate your comments and suggestions.

Gender Equality

For better readability, only the masculine form is used in these instructions in a grammatically impartial sense. The feminine and diverse forms are of course always implied as well.

Trademark Law

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Due to a policy of continuous development Gossen Metrawatt GmbH reserves the right to alter the equipment specification and description outlined in this publication without prior notice and no part of this publication shall be deemed to be part of any contract for the equipment unless specifically referred to as an inclusion within such contract.

3.2 Identification of Warnings

DANGER
Death or serious injury is almost certain.

WARNING
Death or serious injury is possible.

CAUTION
Minor or moderate injury is possible.

ATTENTION
Damage to the product or the environment is possible.

Note
Important information.

Tip
Useful additional information or application tip.

3.3 Identifiers

The following identifiers are used in this documentation:

Identifier	Meaning
✓ Prerequisite	A condition etc. which must be fulfilled before a given action can be taken
1. Procedural step	Steps of a procedure which must be completed in the specified order
↳ Result	Result of a procedural step
• Enumeration – Enumeration	Bullet lists
Fig. 1: Caption	Description of the content of a figure
Table 1:	Description of the content of a table
Footnote	Comment

3.4 Symbols in the Documentation

The following icons are used in this documentation:

Icon	Meaning
	Read and adhere to the product documentation.
	General warning symbol.
	Warning regarding electrical voltage.

3.5 Definition of Terms

Term	Definition
Instrument	SECULIFE PS300
DUT	Device under Test

4 Getting Started

This chapter gives you an overview of the initial steps with the instrument.

1. Read and adhere to the product documentation.
   In particular observe all safety information in the documentation, on the tester and on the packaging.
   ⇨ "Safety Instructions" 🗎3
   ⇨ "Application" 🗎5
   ⇨ "Documentation" 🗎6
2. Familiarize yourself with the instrument, read the entire document carefully, see ⇨ "The Instrument" 🗎8.
3. Familiarize yourself with the instrument's operation, see ⇨ "Operation" 🗎13.
4. Perform simulations/tests, see ⇨ "Simulations" 🗎18.

Further topics of interest: Maintenance, see ⇨ "Maintenance" 🗎39.

5 The Instrument

5.1 Scope of Delivery

Please check for completeness.

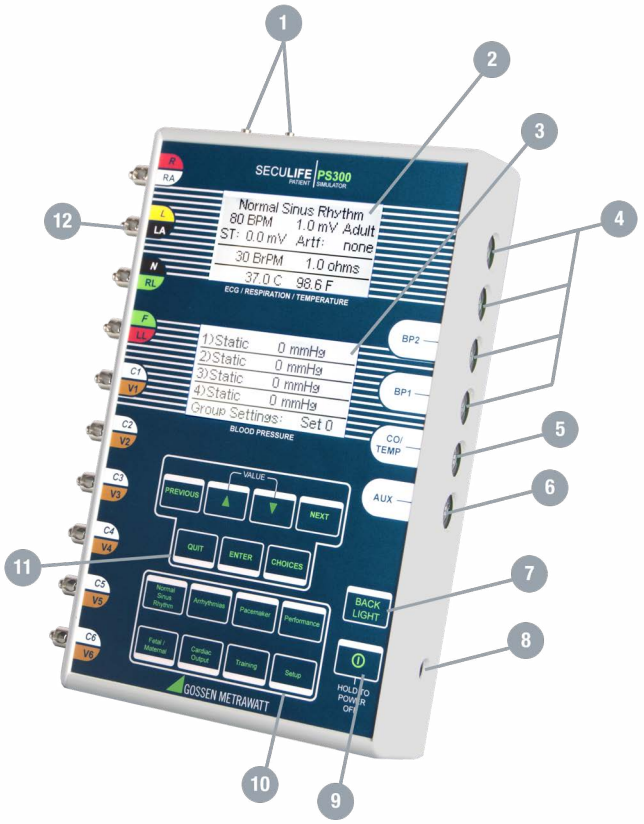
1 × SECULIFE PS300 instrument
1 × Power supply with interchangeable adapters (US, UK, AUS and European)
1 × Carrying case
1 × Quick Start Guide
1 × Calibration certificate

5.2 Optional Accessories

Some measurements necessitate optional accessories:

Type	Description	Article Number
SECULIFE PS300	Patient simulator with standard accessories	M695N
SECULIFE SP BASE	Digital SpO2 simulator	M696B
Software addon	Fetal/maternal option software addon	Z695P
Software addon	Software addon and hardware cardiac output module	Z695O
Cable	BP Criticare, Critikon-Dinamap Plus, Invivo Research, Ivy Biomedical, North American Drager, Ohmeda, Physio-Control, Protocol Systems, SpaceLabs TK-1, 1050, 1700, PCMS, Tektronix-Squip, Vitatek-Squib TK-1 (6M)	BC20-41301
Cable	BP Data Scope -DS-1, Datascope (all) Colin (BP-308, BP-408), SMEC (6F)	BC20-41308

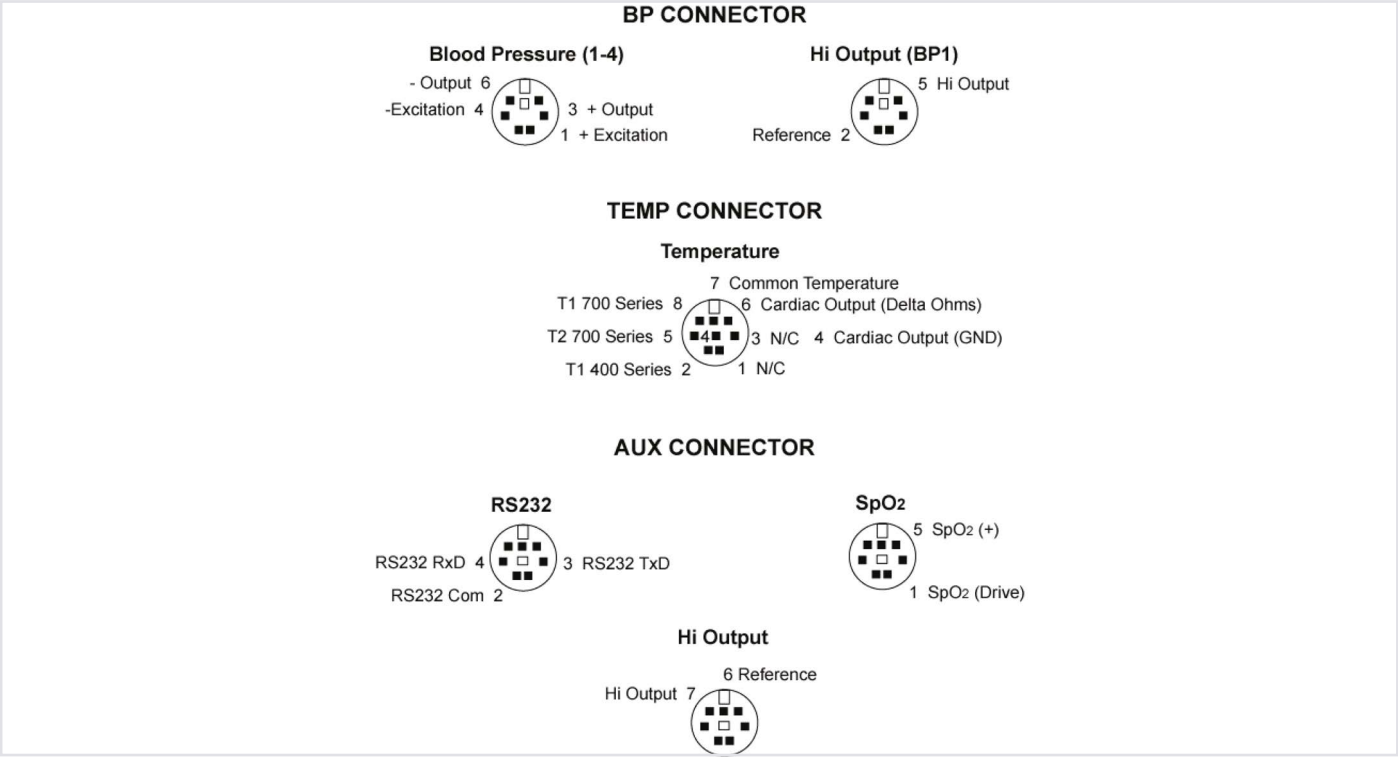
5.3 Instrument Overview



1	Lead continuity test connections
2	Display 1
3	Display 2
4	6-pin mini-DIN plug connector (blood pressure cable)
5	8-pin mini-DIN plug connector (category selection)
6	7-pin mini-DIN plug connector (aux functions)
7	Backlight key
8	Power supply connector
9	Power key
10	Touch keys for category selection
11	Touch keys for parameters, settings
12	10 Universal patient lead connectors (RA R, LA L, RL(-) N, LL F, C1 C1, C2 C2, C3 C3, C4 C4, C5 C5, C6 C6)

5.3.1 Output Connections

The following are representations of the socket connectors found on the instrument. They are viewed as if looking at the socket in the instrument, not the cable pins.



5.4 Symbols on the Instrument and the Included Accessories

	Warning concerning a point of danger (attention, observe documentation!)
	Power supply
	European conformity marking
	The tester may not be disposed of with household trash ⇨ "Disposal and Environmental Protection" 🗎41.

5.5 Relevant Standards

The tester has been manufactured and tested in accordance with the following safety regulations:

DIN EN 61010-1 IEC 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
DIN EN 60529 IEC 60529	Test instruments and test procedures Degrees of protection provided by enclosures (IP code)
DIN EN 61326-1 IEC 61326-1	Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements
DIN EN 61326-2-1 IEC 61326-2-1	Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-1: Particular requirements – Test configurations, operational conditions and performance criteria for sensitive test and measurement equipment for EMC unprotected applications

5.6 Technical Data

General Specifications

Power Supply	2 batteries	9 V PP3
	External power supply	9 V_{DC}, 200 mA (without SECULIFE SP BASE)
Ambient Conditions	Operating temperature	+15 °C … +40 °C (59 °F … 104 °F)
	Storage temperature	–20 °C … +65 °C (–4 °F … +149 °F)
	Relative atmospheric humidity	20 % … 80 %, no condensation allowed
	Elevation	Max. 2000 m
Electromagnetic Compatibility (EMC)	Interference emission	EN 61326-1 class A
	Interference immunity	DIN EN 61326-1 / IEC 61326-1 DIN EN 61326-2-1 / IEC 61326-2-1
Mechanical Design	Housing (W × H × D)	approx. 22,7 cm × 15,3 cm × 4,3 cm / 8,9” × 6” × 1,7”
	Weight	approx. 191 g / <2 lbs
	Display	2 × LCD, 128 × 64 pixel, white LED backlight

ECG Simulation

Rate	NSR		BPM	30, 40, 45, 60, 80, 90, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300
	Performance waveforms	Sine	Hz	0.1, 0.5, 5, 10, 40, 50, 60, 100
		Square		0.125, 2.000
		Triangle		2.000, 2.500
		Pulse	BPM	30, 60, 120
		R-Wave		30, 60, 80, 120, 200, 250
	Accuracy		%	±1
Width	Pulse		ms	60
	R-wave (haver triangle)		ms	8, 10, 12, 20, 30, 40, 50, 60, 70, 80, 90, 100, 120, 130, 140, 150, 160, 170, 180, 190, 200
Amplitude			mV	0.05, 0.10, 0.15, 0.20, 0.25, 0.30, 0.35, 0.40, 0.45, 0.50, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0
	Accuracy	@ lead II	%	±2
		except for R-wave ≤20 ms @ lead II		±5
High Level	200 time amplitude			
	Accuracy		%	±5
QRS Interval		Adult	ms	80
		Pediatric		40
ST Segment (Elevation)			mV	±0, 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8
Lead to Lead Impedance	RL, LL, RA, LA		Ω	500, 1000, 1500, 2000
	V1 … V6			1000

Pacemaker Waveforms

Rate		BPM	75
	Accuracy	%	±1
Width		ms	0.1, 0.5, 1.0, 1.5, 2.0
	Accuracy	%	±5

Amplitude		mV	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
	Accuracy	%	±10

IBP Simulation

Channels	2		
Static Pressure		mmHg	-10, -5, 0, 20, 40, 50, 60, 80, 100, 150, 160, 200, 240, 250, 300, 320, 400
	Accuracy	mmHg	± (2 % of reading + 2 mmHg)
Impedance		Ω	300
	Accuracy	%	±10
Excitation Range		V RMS	2 … 16
Excitation Frequency	DC to 5 kHz		
Sensitivity	5 or 40 µV / V / mmHg		
Respiration Artifact		mmHg	0 … 16

Respiration Simulation

Rate		Apnea	BrPM	75
	Accuracy		%	±1
Impedance Delta			Ω	0.1, 0.2, 0.5, 1.0, 2.0, 3.0
	Accuracy		%	±10 +0.05 Ω
Baseline			Ω	500, 1000, 1500, 2000
	Accuracy		%	±5
Lead		LA or LL		

Temperature Simulation

Selection	°C (°F)	0, 24, 30, 37, 40 (32.0, 75.2, 86.0, 98.6, 104.0)
Accuracy	°C	±0.1
Type	YSI series 400 and 700 (temperature cables not included)	

Fetal / Maternal Simulation

Fetal Heart Rate	BPM	60, 90, 120, 140, 150, 210, 240
Inter Uterine Pressure Response Types	Uniform deceleration, early deceleration, late deceleration, uniform acceleration	
IUP Wave	Bell curve with 90 mmHg peak and 90 s width	
IUP Trigger	manual, auto: 2 m, 3 m, 5 m	

Cardiac Output

Injectate Volume		cc	10
Injectate Temperature		°C	0 or 24
	Accuracy	%	±2
Injectate Calibration Coefficient	0 °C		0.542
	20 °c		0.595
Blood Temperature		°C (°F)	37 (98.6)
	Accuracy	%	±2
Cardiac Output		l/min	2.5, 5.0, 10.0
	Accuracy	%	±2
Simulations	Normal flow, faulty injectate, left-to-right shunt, temperature calibration pulse		
Temperature Calibration Pulse	1.5 °C down for 1 s		
	Accuracy	%	±1
Catheter Type	Baxter Edwards, 93a-131-7f		

6 Operation

6.1 Power Supply

The instrument can be powered with batteries (not included) or the external power supply (included in delivery).

Note

The external power supply is required for continuous stationary use and use of optional accessories.

6.1.1 External Power Supply (Battery Eliminator)

The external power supply delivered with the instrument comes with interchangeable adapters (US, UK, AUS and European).

Note

The power supply will not charge the battery.

1. Select and the adapter suitable to your region and connect it to the power supply.
2. Connect the power supply to the power supply connector on the instrument.
3. Connect the power supply to the mains.

↳ The instrument can be used.

6.1.2 Batteries

The instrument uses batteries which you have to insert into the rear battery compartment.You installed batteries when you first put the instrument into operation (see Quick Start Guide).

Battery Status

The percentage of life left in the batteries can be viewed in the System Setup screen, see ⇨ "System Setup" 🗎16.
When the instrument detects a low battery condition (5% battery life remaining), a warning window will appear once per minute to alert you. In this case, replace the batteries as soon as possible.The **QUIT** key may be used to clear this window and continue use of the instrument; however it is recommended not to do so.
If the battery is not replaced before the battery reaches a critical level, the instrument will shut down.

Replacing Batteries

WARNING

Risk of electric shock or short circuit

If the instrument is already switched on during preparation, this may result in dangerous electric currents passing through the body.

- Ensure that the instrument is switched off and disconnect all test leads.

ATTENTION

Damage to the instrument caused by unsuitable batteries

Using non-specified batteries can lead to malfunctions, leakage, or permanent damage to the multimeter.

- Use only batteries that meet the technical specifications.

Note

The two required 9 V batteries are not included and must be provided by the user.
You will need a screwdriver to loosen the screws.

✓ Suitable batteries are on hand ⇨ "Technical Data" 🗎10.
✓ A screwdriver is on hand.

1. Loosen the screws on the battery compartment from the base of the housing.
2. Remove the old batteries.
3. Dispose of batteries in an legally compliant manner ⇨ "Disposal and Environmental Protection" 🗎41.
4. Insert twonew 9 V batteries into the battery compartment, observing the polarity symbols:
   Insert the battery with the positive terminal (+) first. Then, carefully push the negative terminal (–) into its final position.
5. Screw the battery compartment cover back into place.

↳ The instrument can be used.

6.2 Turning the Instrument On and Off

Turn On
To turn on the instrument, the power key must be held for one second.

Power-Up Function
The power-up function allows the instrument to automatically boot up using your setting configuration. You can select the setting in the System Setup ⇨🗎16.

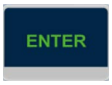
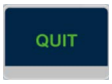
Turn Off
To turn off the instrument, the power key must be held for one second.

Auto Power Off
The instrument can be programmed to automatically turn off after a selected number of minutes of no key activity to conserve the battery. This time is selectable in the System Setup ⇨🗎16.

6.3 Control Keys

The instrument is controlled by 17 touch keys. With them you navigate the displayed parameters, select options, choose a category, and control the instrument's setup and power. When a key is pressed, an audio click indicates acceptance, while an invalid key produces a tone.
Two displays provide information about the current status of the ECG, respiration, temperature and blood pressure settings.

General Keys

Touch key	Meaning	Used in this Manual
	Highlight the block cursor through the displayed information; highlighting the parameter available for selection	PREVIOUS
		NEXT
	Change options for the highlighted parameter. The cursor will flash if the parameter is changed.	UP
		DOWN
	Selects the changed option.	ENTER
	Returns to the previous state, without any changes being made.	QUIT
	Displays the options for the selected parameter.	CHOICES

Category Keys
Seven category keys allow for quick setting of output waveforms. The , , , , ,  and  keys move the display directly to the selected category. The **UP** and **DOWN** and **ENTER** keys can be used to quickly scroll through the available options and select the desired settings.

The  key opens a screen that allows the user to select the instrument's general output settings, as well as setup for the system.

Touch key	Meaning	Used in this Manual
	Enters the NSR category.	Normal Sinus Rhythm
	Enters the arrhythmia category and changes the first line to the first arrhythmia choice.	Arrhythmia

Pacemaker	Enters the pacemaker category and changes the first line to the first pacemaker waveform choice.	**Pacemaker**
Performance	Enters the machine performance testing category and changes the first line to the first performance waveform option.	**Performance**
Fetal / Maternal	Sets the conditions for and starts the optional fetal/maternal mode.	**Fetal / Maternal**
Cardiac Output	Sets the conditions for and starts the optional cardiac output mode.	**Cardiac Output**
Training	Sets the conditions for and starts the special training mode.	**Training**
Setup	Opens a screen that allows you to do output settings and system setup.	**Setup**

Power Key

Touch key	Meaning	Used in this Manual
⏻	Turns the instrument on and off. To do so, the key must be held for 1 second.	**Power**

Backlight

Touch key	Meaning	Used in this Manual
BACK LIGHT	Turns the backlight on or off at any time. Backlight setting ⇨ "System Setup" 🗎16.	**BACKLIGHT**

6.4 Connectors

Universal Patient Lead Connectors

The 10 universal patent lead connectors allow for 12 lead ECG simulation with independent outputs. AHA and IEC color-coded labels are located on the face of the instrument to aid in connecting the corresponding U.S. and international patient leads.

AHA Label	IEC Label	Description
RA	R	Right arm
LA	L	Left arm
RL	N	Right leg (reference or ground)
LL	F	Left leg
V1 V2 V3 V4 V5 V6	C1 C2 C3 C4 C5 C6	

Blood Pressure

There are two 6-pin mini-DIN plug connectors on the right side of the instrument for connection of the blood pressure cables. Full blood pressure simulation is available through these connectors. The circuits are totally isolated.

Temperature

There is an 8-pin mini-DIN plug connector on the right side of the instrument for connection of a temperature cable. Temperatures are simulated for both YSI 400 and YSI 700 probe types (not included, must be provided).

High Level Output (+)

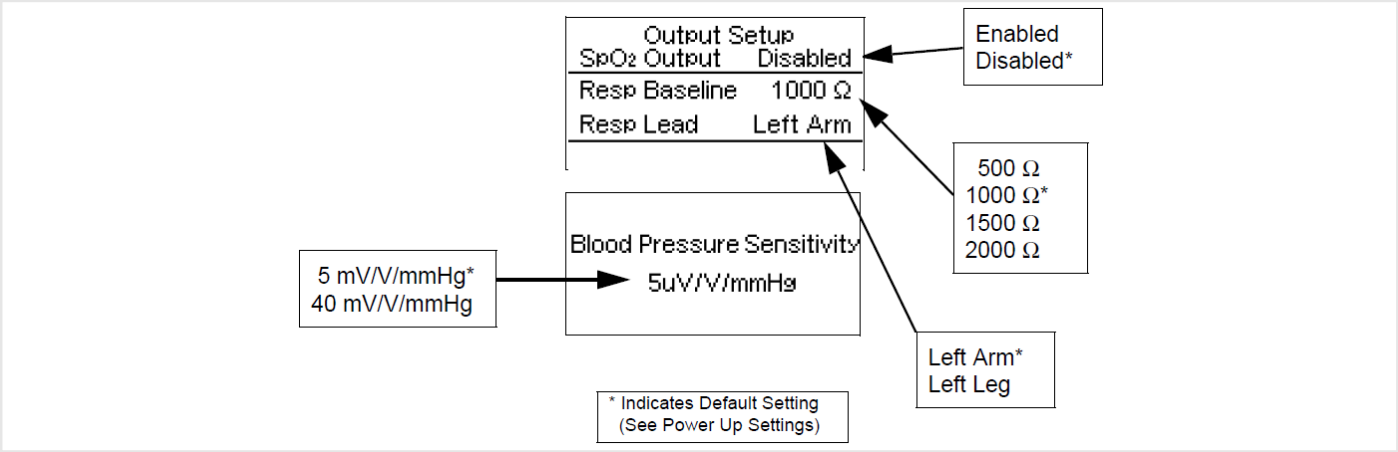
A high level ECG output signal (200 × amplitude setting) is available in the BP1 6-pin mini-DIN connector.

7 Configuration (Setup)

The instrument allows for setup of the outputs and the system parameters.

7.1 Output Setup

The Output Setup screen allows for the setting of the parameters that control the placement and level of the outputs.



1. Press the **Setup** key once.

↳ The instrument shows the Output Setup Screen.

2. To change the desired parameters use **PREVIOUS** and **NEXT** to select the parameter to change and using **UP** and **DOWN** to scroll to the desired value.
   Alternately, to see a submenu of all the options for a highlighted parameter, use **CHOICES**.
   Use **UP** and **DOWN** to scroll to the desired option.
3. Press the **ENTER** key to confirm the new setting.

↳ The instrument outputs accordingly.

4. Use **QUIT** to exit from the setup screens.

7.2 System Setup

The System Setup screen allows for the setting of the parameters controlling various function of the instrument as well as the viewing of battery life and software information.
Parameters and the available range of settings:

Parameter	Description	Range
Auto Off Timer	The elapsed time after which the instrument will automatically power down. This timer is reset with each key press.	0 min … 30 min (0 = off)
Backlight Time	The elapsed time after which the backlight will automatically turn off in battery mode. (Not applicable to power supply mode).	off 1 s … 30 s manual (= controlled by key)
Backlight Intensity	Sets the intensity of the backlight. Recommendation: Lower intensity to extend battery life in battery mode.	0 % … 100 %
Battery Life	Displays current life of the batteries.	0 … 100 % (read only)
Top LCD Contrast	Sets the contrast of the upper display.	0 … 20
Bottom LCD Contrast	Sets the contrast of the lower display.	0 … 20
Power up with	Selects the values that will be used when the instrument is first turned on. Detailed description below.	Default/Last/Custom/ Set current as Custom
Auto Step Time	Sets the interval that is used with the auto increment features in BPM, BP rate and performance.	1 s … 60 s
Software	Displays current software/firmware.	Version (read only)

Power up setting details:

Setting	Description
Default	If this option is selected the following settings will be used every time the instrument is turned on. ECG – NSR: 80 BPM, 1.0 mV, Adult QRS, 0.0 mV ST Elevation, Artifact - None, SpO2 Output Disabled ECG – Arrhythmia: 1.0 mV, Artifact - None, 0.0 mV ST Elevation, Premature - Atrial PAC - Auto ECG – Pacemaker: Pulse Amplitude 5 mV, Pulse Width 1.0 ms, Atrial Waveform, 1.0 mV, 0.0 mV ST Elevation, Artifact - None ECG – Performance: 2 Hz Square Wave, 1.0 mV, R-Wave Width 10 ms, R-Wave Rate 60 BPM Respiration: 20 BrPM, delta 1.0 Ω, 1000 Ω baseline, LA lead Blood Pressure: 0 mmHg, 5 uV / V / mmHg sensitivity, 0 mmHg Respiration Artifact Temperature: 37 °C (98.6 °F) Fetal/Maternal: Fhr 120 BPM, Mhr 80 BPM, Manual, Uniform Deceleration Cardiac Output: Test – Normal, Rate - 2.5 l/min, Injectate - 0 °C Auto Timer 30 min Backlight Time 5 s Backlight Intensity 100 % Contrast Adjust 10 Power Up With Default Auto Step Time 5 s Swan-Ganz Step Time15 s
Last	If this option is selected, the instrument will remember the settings that were being used when it was turned off and bring them back when the power is turned on.
Custom	If this option is selected, you may save a unique set of parameters and the instrument will recall them every time the power is turned on.
Set Current as Custom	This option is an easy way to save the current configuration is as the custom power up values.

Changing a Setting

1. Press the **Setup** key twice.

↳ The instrument shows the Output Setup Screen on the first press and the System Setup upon the second press.

2. To change the desired parameters use **PREVIOUS** and **NEXT** to select the parameter to change and using **UP** and **DOWN** to scroll to the desired value.
   Alternately, to see a submenu of all the options for a highlighted parameter, use **CHOICES**.
   Use **UP** and **DOWN** to scroll to the desired option.
3. Press the **ENTER** key to confirm the new setting.

↳ The instrument's setting has been changed accordingly.

4. Use **QUIT** to exit from the setup screens.



8 Simulations

8.1 Test Setup (For Each Simulation)

WARNING

Electric shock hazard

Never connect the simulator to a patient monitor while it is simultaneously attached to a human being.

- Ensure the device under test (DUT) is completely isolated from any human during simulation.

Note

Connecting cables as well as adapters required are not included with the instrument and must be provided.

1. Connect the DUT to the instrument using compatible cabling (incl. adapters if required) and the respective terminal on the instrument.
2. Turn the instrument on by pressing the **Power** button.

↳ The instrument will turn on with the setup it was set with ⇨ "System Setup" 🗎16.

3. See the following chapters for detailed information on how to conduct simulations.

8.2 Normal Sinus Rhythm

The instrument can send waveforms to ECG machines in 3-, 5- or 12-lead configurations. It has independent outputs for each signal lead, referenced to the right leg.
Normal sinus rhythm (NSR) occurs when the heartbeat is normal, beating at a rate between 50 and 100 beats per minute (BPM) with a standard QRS waveform shape and height. The instrument simulates NSR with a default pulse of 80 BPM, an amplitude of 1.0 mV on lead II, a P–R interval of 160 milliseconds, and no artifact or ST segment elevation.
Parameters:

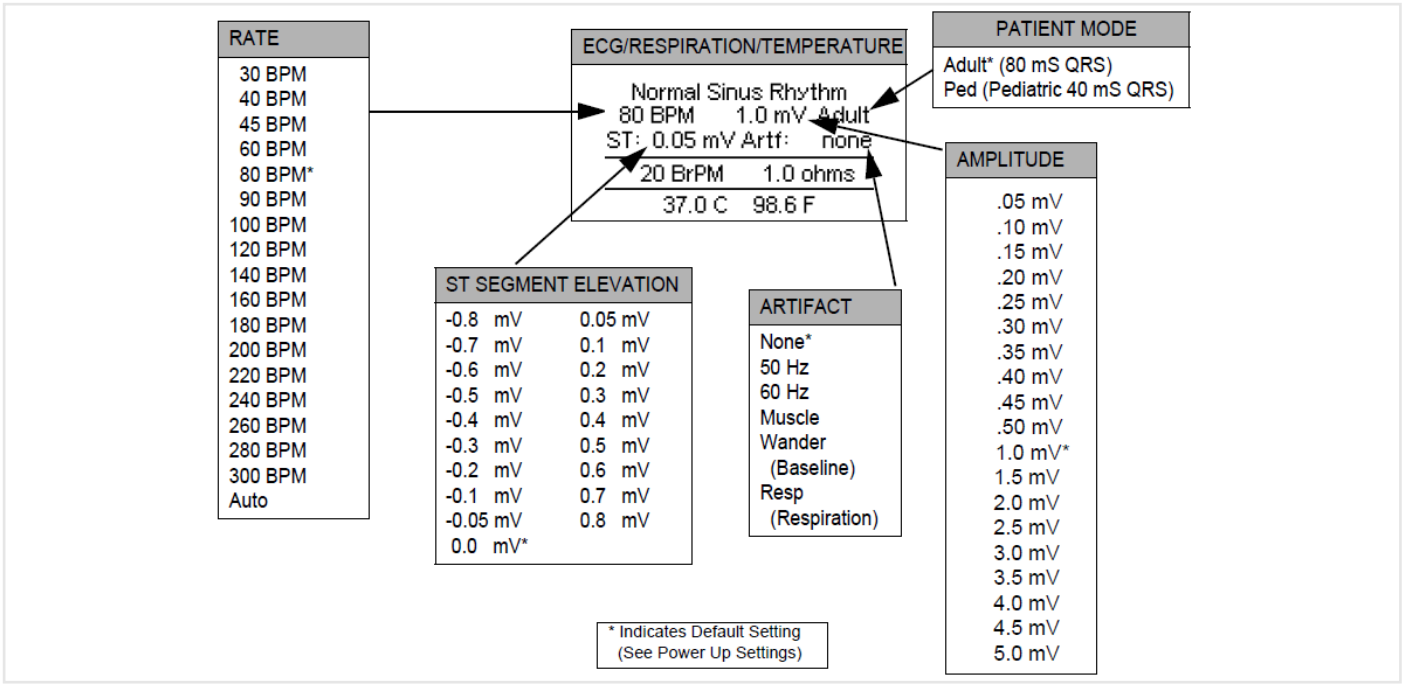
Rate	BPM	30, 40, 45, 60, 80, 90, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300
Amplitude (Lead II)	mV	0.05, 0.10, 0.15, 0.20, 0.25, 0.30, 0.35, 0.40, 0.45, 0.50, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0
ST Segment elevation	mV	± 0, 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8
Artifacts	50 Hz, 60 Hz, muscle, baseline wander, respiration	
QRS interval	Adult (80 ms) or pediatric (40 ms)	
Automatic mode		

Note

ST Segment elevation or depression is only active in Adult NSR at or below 180 BPM.

1. Place the instrument into NSR mode by pressing **Normal Sinus Rhythm**.

↳ The display will resemble the following:



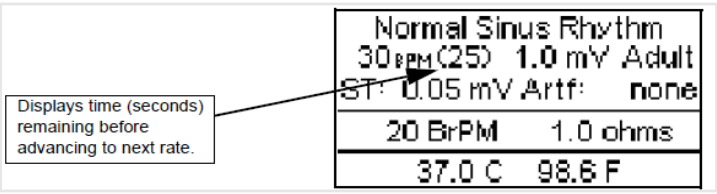
2. To change the desired parameters use **PREVIOUS** and **NEXT** to select the parameter to change and using **UP** and **DOWN** to scroll to the desired value.
   Alternately, to see a submenu of all the options for a highlighted parameter, use **CHOICES**.
   Use **UP** and **DOWN** to scroll to the desired option.
3. Press the **ENTER** key to confirm the new setting.

↳ The simulation starts and the instrument outputs accordingly.

4. Compare the values shown on the instrument with those shown on the DUT. Evaluate the DUT accordingly.
5. To stop, press QUIT at any point.

Automatic Mode

If the RATE parameter is set to AUTO, the instrument will automatically sequence through all of the BPM settings, starting with 30 BPM, incrementing at a fixed interval. The interval may be set in the System Setup Menu under Auto Step Time.
When in this mode, the time remaining in each step is displayed. The ENTER key may be used to manually advance to the next step. To stop and exit, press QUIT.



8.3 Arrhythmias

The instrument can send arrhythmia waveforms to ECG machines in 3-, 5- or 12-lead configurations. It has independent outputs for each signal lead, referenced to the right leg.
There are 36 arrhythmias available that model abnormal heartbeats:

Premature	FHR Response	Ventricular	Conduction
Atrial PAC - Auto*	Atrial Fib - Coarse	Pair of PVCs - Auto	1st Deg Heart Block
Atrial PAC - Man	Atrial Fib - Fine	Pair of PVCs - Man	2nd Deg Heart Block
Nodal PNC - Auto	Atrial Flutter	Run of 5 PVCs - Auto	3rd Deg Heart Block
Nodal PNC - Man	Atrial Tach	Run of 5 PVCs - Auto	Rt Bundle Branch Block
PVC 1 - Auto	Paroxysmal Atrial Tach	Run of 11 PVCs - Auto	Lf Bundle Branch Block
PVC 1 - Man	Supravent Tach	Run of 11 PVCs - Man	
PVC 1 Early - Auto	Sinus Arrhythmia	6 PVCs per Min	
PVC 1 Early - Man	Missed Beat - Auto	12 PVCs per Min	
PVC 1 R on T - Auto	Missed Beat - Man	24 PVCs per Min	
PVC 1 R on T - Man	Nodal Rhythm	Freq Multifocal PVCs	
PVC 2 - Auto		Bigeminy	
PVC 2 - Man		Trigeminy	
PVC 2 Early - Auto		Vent Tach	
PVC 2 Early - Man		Vent Fib – Coarse	
PVC 2 R on T - Auto		Vent Fib – Fine	
PVC 2 R on T - Man		Asystole	
Multifocal PVCs - Auto			
Multifocal PVCs - Man			

For ease of selection, they are grouped into four basic categories:

36 different arrhythmias	
4 general groups	Supraventricular
	Premature
	Ventricular
	Conduction
Manual and automatic triggering	

There are 12 arrhythmias that have both automatic and manual versions (Auto /Man indicated above). Both versions output the same waveform; however, in the manual version, the arrhythmia is triggered each time the **ENTER** key is pressed. In the auto versions, the arrhythmia is automatically triggered periodically.

Detailed parameter description

Premature		
Abbreviation	**Arrhythmia**	**Description**
Atrial PAC – Auto	Prematural atrial contraction	NSR of 80 BPM with periodic abnormal 25 % early P waves (Continuous)
Atrial PAC – Man		NSR of 80 BPM with periodic abnormal 25 % early P waves (One-time event)
Nodal PNC – Auto	Prematural nodal contraction	NSR of 80 BPM with periodic abnormal 25 % early nodal beat (PNC, 7 NSR) (Continuous)
Nodal PNC – Man	Prematural nodal contraction	NSR of 80 BPM with periodic abnormal 25 % early nodal beat (One-time event)

Premature		
Abbreviation	**Arrhythmia**	**Description**
PVC 1 – Auto	Standard type 1 Premature ventricular contraction	NSR of 80 BPM with periodic left focus premature ventricular beats with 20 % premature timing (PVC Type 1, 9 NSR) (Continuous)
PVC 1 – Man		NSR of 80 BPM with periodic left focus premature ventricular beats with 20 % premature timing (One-time event)
PVC 1 Early – Auto	Early type 1 Premature ventricular contraction	NSR of 80 BPM with periodic left focus premature ventricular beats with 33 % premature timing (One-time event)
PVC 1 Early – Man		NSR of 80 BPM with periodic left focus premature ventricular beats with 65 % premature timing, placing R on the previous T (PVC type 1, 9 NSR) (Continuous)
PVC 1 R on T – Auto	R on T type 1 Premature ventricular contraction	NSR of 80 BPM with periodic left focus premature ventricular beats with 65 % premature timing, placing R on the previous T (PVC type 1, 9 NSR) (Continuous)
PVC 1 R on T – Man		NSR of 80 BPM with periodic left focus premature ventricular beats with 65 % premature timing, placing R on the previous T (One-time event)
PVC 2 – Auto	Standard type 2 Premature ventricular contraction	NSR of 80 BPM with periodic right focus premature ventricular beats with 20 % premature timing (PVC type 2, 9 NSR) (Continuous)
PVC 2 – Man		NSR of 80 BPM with periodic right focus premature ventricular beats with 20 % premature timing (One-time event)
PVC 2 Early – Auto	Early type 2 Premature ventricular contraction	NSR of 80 BPM with periodic right focus premature ventricular beats with 33 % premature timing (PVC type 2, 9 NSR) (Continuous)
PVC 2 Early – Man		NSR of 80 BPM with periodic right focus premature ventricular beats with 33 % premature timing (One-time event)
PVC 2 R on T – Auto	R on T type 2 Premature ventricular contraction	NSR of 80 BPM with periodic right focus premature ventricular beats with 65 % premature timing, placing R on the previous T (PVC type 2, 9 NSR) (Continuous)
PVC 2 R on T – Man		NSR of 80 BPM with periodic right focus premature ventricular beats with 65 % premature timing, placing R on the previous T (One-time event)
Multifocal PVCS – Auto	Multifocal Premature ventricular contraction	NSR of 80 BPM with type 1 and type 2 PVCs (PVC Type 1, 2 NSR, PVC type 2, 2 NSR) (Continuous)
Multifocal PVCS – Man		NSR of 80 BPM with type 1 and type 2 PVCs (PVC Type 1, 2 NSR, PVC type 2) (One-time event)

FHR Response		
Abbreviation	**Arrhythmia**	**Description**
Atrial Fib – Coarse	Artial fibrillation	Absence of P-wave, irregular P-R interval rate and a high level signal (Continuous)
Atrial Fib – Fine		Absence of P-wave, irregular P-R interval rate and a low level signal (Continuous)
Atrial Flutter	Atrial flutter	Repeating sequence of 5 atrial beats and 1 ventrical beat for twelve seconds, followed by a repeating sequence of 3 atrial beats and 1 ventrical beat for six seconds, followed by a repeating sequence of 2 atrial beats and 1 ventrical beat for six seconds (Continuous)
Atrial Tach	Atrial tachycardia	160 BPM (Continuous)
Paroxysmal Atrial Tach	Paroxysmal atrial tachycardia	160 BPM for five seconds / 80 BPM for ten seconds (Continuous)
Supravent Tach	Supraventricular tachycardia	200 BPM (Continuous)
Sinus Arrhythmia	Sinus arrhythmia	Normal beats at a fluctuating rate from 60 BPM … 100 BPM (Continuous)
Missed Beat – Auto	Missed beat	NSR of 80 BPM with a missed beat (missed beat, 36 NSR) (Continuous)
Missed Beat – Man		NSR of 80 BPM with a missed beat (One-time event)
Nodal Rhythm	Nodal rhythm	60 BPM with very short P-R interval (Continuous)

Ventricular		
Abbreviation	**Arrhythmia**	**Description**
Pair of PVCs – Auto	Pair of premature ventricular contractions	NSR of 80 BPM with periodic group of 2 Type 1 PVCs (2 PVC type 1, 36 NSR) (Continuous)
Pair of PVCs – Man		NSR of 80 BPM with periodic group of 2 type 1 PVCs (One-time event)
Run of 5 PVCs – Auto	Run of 5 premature ventricular contractions	NSR of 80 BPM with periodic group of 5 type 1 PVCs (5 PVC type 1, 36 NSR) (Continuous)
Run of 5 PVCs – Man		NSR of 80 BPM with periodic group of 5 type 1 PVCs (One-time event)
Run of 11 PVCs – Auto	Run of 11 premature ventricular contractions	NSR of 80 BPM with periodic group of 11 type 1 PVCs (11 PVC type 1, 36 NSR) (Continuous)
Run of 11 PVCs – Man		NSR of 80 BPM with periodic group of 11 type 1 PVCs (One-time event)
6 PVCs per Min	6 premature ventricular contractions per minute	NSR of 80 BPM with 6 type 1 PVCs per minute (Continuous)
12 PVCs per Min	12 Premature ventricular contractions per minute	NSR of 80 BPM with 12 type 1 PVCs per minute (Continuous)
24 PVCs per Min	24 Premature ventricular contractions per minute	NSR of 80 BPM with 24 type 1 PVCs per minute (Continuous)

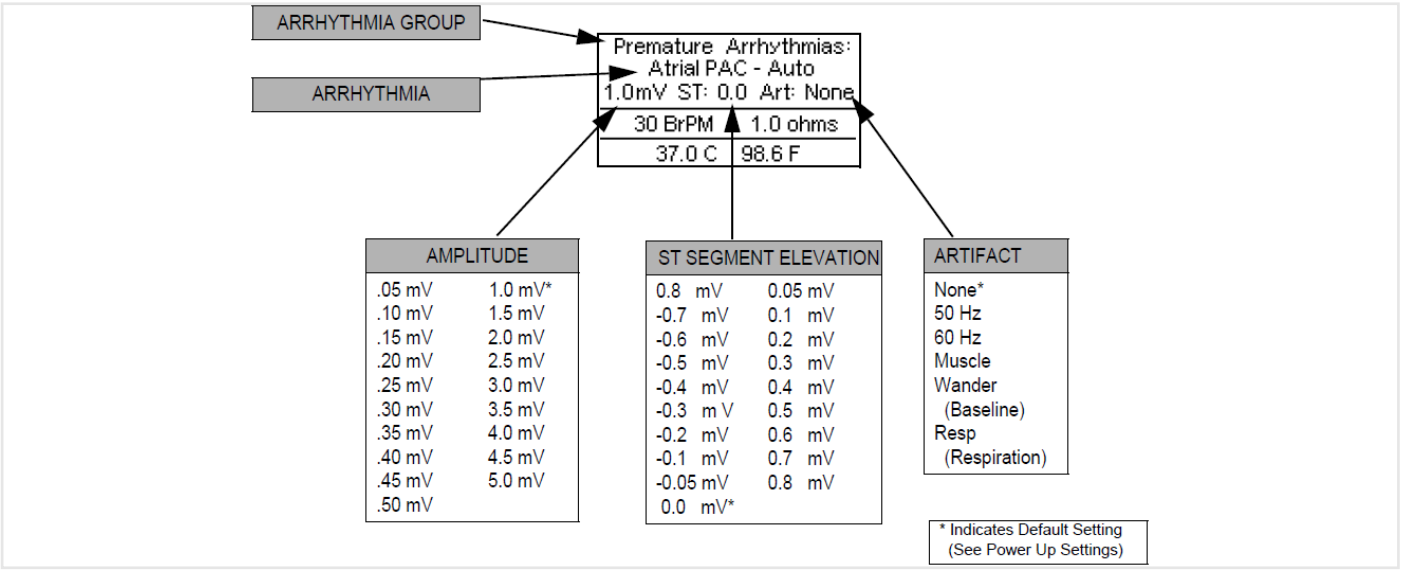
Ventricular		
Abbreviation	**Arrhythmia**	**Description**
Freq Multifocal PVCs	Frequent multifocal premature ventricular contractions	NSR of 80 BPM with every fourth beat being an alternating type 1 and type 2 PVC (Continuous)
Bigeminy	Bigeminal rhythm	NSR of 80 BPM with every other beat a type 1 PVC (Continuous)
Trigeminy	Trigeminal rhythm	NSR of 80 BPM with every third beat a type 1 PVC (Continuous)
Vent Tach	Ventricular tachycardia	160 BPM, No P-wave, Beats similar to type 1 PVC (Continuous)
Vent Fib – Coarse	Ventricular fibrillation	Irregular waveform with no real P-wave or clear R-R interval and a high signal level (Continuous)
Vent Fib – Fine		Irregular waveform with no real P-wave or clear R-R interval and a low signal level (Continuous)
Asystole	Asystole	Flat line signal (Continuous)

Conduction		
Abbreviation	**Arrhythmia**	**Description**
1st Deg Heart Block	First degree heart block	80 BPM with a long P-R interval of 250 ms (Continuous)
2nd Deg Heart Block	Second degree heart block	80 BPM with increasing P-R interval for four beats (160 ms, 220 ms, 400 ms, 470 ms) followed by a P wave without a QRS (Continuous)
3rd Deg Heart Block	Third degree heart block	80 BPM with P wave rate of 80 BPM and QRS rate of 30 BPM (Continuous)
Rt Bundle Branch Block	Right bundle branch block	80 BPM with normal P-wave and P-R interval but wider QRS complexes (Continuous)
Lf Bundle Branch Block	Left bundle branch block	

Simulation

1. Place the instrument into **arrhythmia** mode by pressing **Arrhythmias**.

↳ The display will resemble the following:



2. To change the desired parameters use **PREVIOUS** and **NEXT** to highlight the parameter to change and using **UP** and **DOWN** to scroll to the desired value.
   (While in the Arrhythmia Group choice screen, the key may be used for a second time to jump directly to the arrhythmias choices for that group.)
   Alternately, to see a submenu of all the options for a highlighted parameter, use **CHOICES**.
   Use **UP** and **DOWN** to scroll to the desired option.
3. Press the **ENTER** key to confirm the new setting.

↳ The simulation starts and the instrument outputs accordingly.

4. If manual mode was selected: Press **ENTER** to cause an arrhythmia.
5. Compare the values shown on the instrument with those shown on the DUT. Evaluate the DUT accordingly.
6. To stop, press QUIT at any point.

8.4 Pacemaker

The instrument can send paced waveforms to ECG machines in 3-, 5- or 12-lead configurations. It has independent outputs for each signal lead, referenced to the right leg.
Seven different pacemaker waveforms may be simulated. Additionally, the width and amplitude of the pacer pulse may be selected.

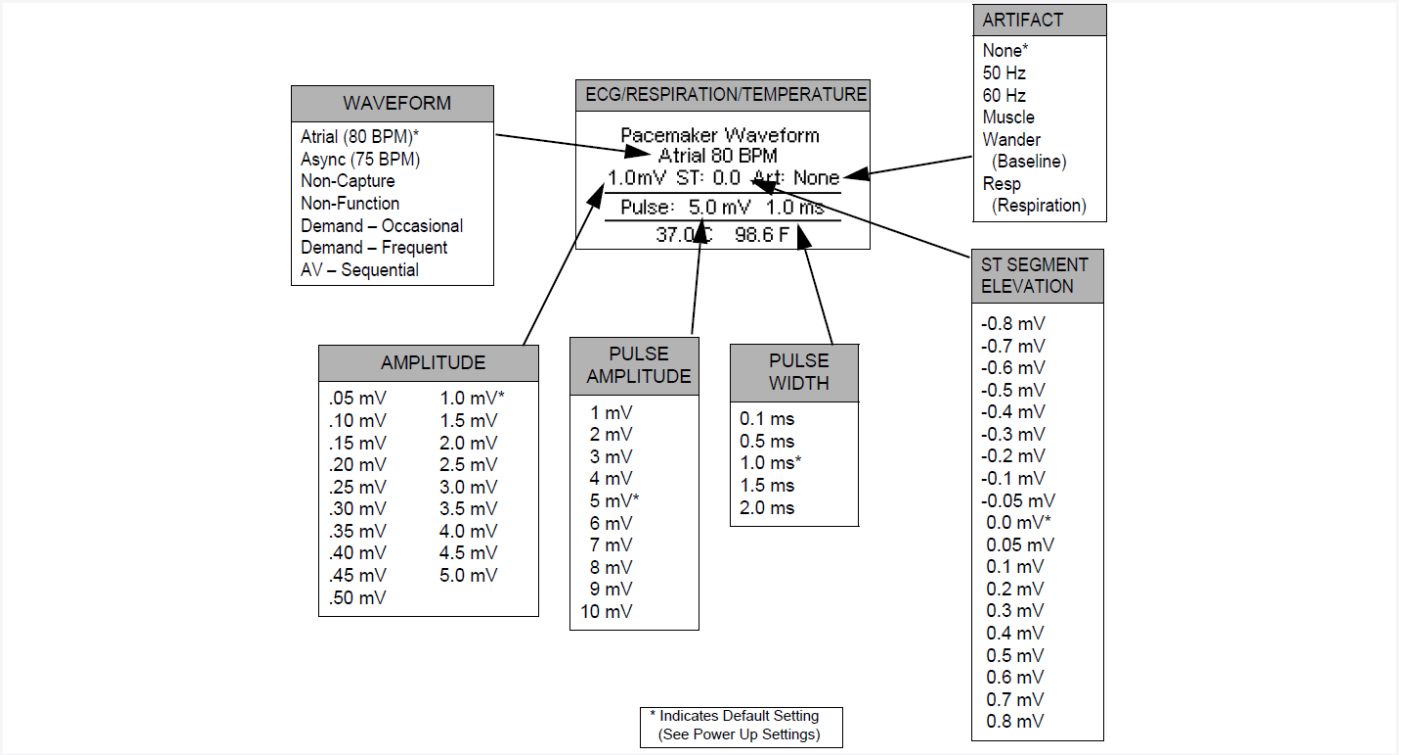
Waveform	Unit	Atrial pacer, asynchronous, non-capture, non function, demand occasional, demand – frequent, AV – sequential
Pulse height	mV	1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Pulse width	ms	0.1, 0.5, 1.0, 1.5, 2.0

The seven paced simulation signals are available to model heartbeats accompanied by a pacemaker.

Pacemaker		
Abbreviation	**Arrhythmia**	**Description**
Atrial Pacer	Atrial pacemaker wave	80 BPM with pacer pulse at the start of each P wave
Asynchronous	Asynchronous pacemaker wave	75 BPM with pacer pulse at the start of each QRS wave and no P wave
Non-Capture	Ventricular pacemaker wave with periodic non-response	75 BPM Ventricular paced beats with every tenth beat not responding
Non-function	Ventricular pacemaker wave with no heart response	75 BPM Ventricular paced beats with no heart response
Demand – Occasional	Demand pacemaker wave with occasional sinus beats	20 NSR beats followed by 20 ventricular paced beats
Demand – Frequent	Demand pacemaker wave with frequent sinus beats	40 NSR beats followed by 40 ventricular paced beats
AV – Sequential	AV-sequential pacemaker wave	75 BPM with pacer pulse at the start of both the P and QRS waves

1. Place the instrument into pacemaker mode by pressing **Pacemaker**.

↳ The display will resemble the following:



2. To change the desired parameters use **PREVIOUS** and **NEXT** to select the parameter to change and using **UP** and **DOWN** to scroll to the desired value.
   Alternately, to see a submenu of all the options for a highlighted parameter, use **CHOICES**.
   Use **UP** and **DOWN** to scroll to the desired option.
3. Press the **ENTER** key to confirm the new setting.

↳ The simulation starts and the instrument outputs accordingly.

4. Compare the values shown on the instrument with those shown on the DUT. Evaluate the DUT accordingly.
5. To stop, press **QUIT** at any point.

8.5 Performance

The instrument can send performance waveforms to ECG machines in 3-, 5- or 12-lead configurations. It has independent outputs for each signal lead, referenced to the right leg.

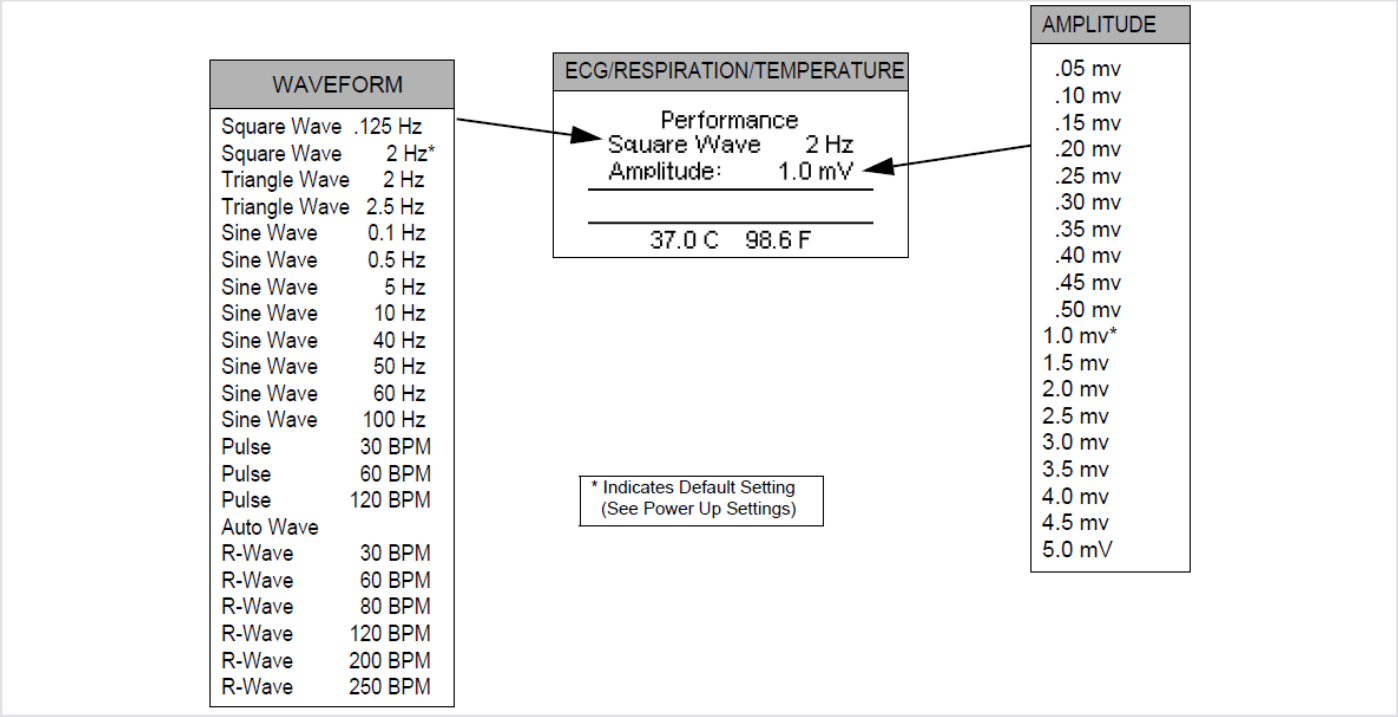
There are 15 performance waves and 6 R-waves available for testing and verifying.The instrument will generate sine, square, triangular and pulse waveforms with adjustable amplitudes for performance testing. A special automatic mode is available to auto sequence through the entire range of waveforms. Also, a R-wave (haver triangle) waveform may be selected with separate amplitude and width settings.

Settings Overview:

Sine	Hz	0.1, 0.5, 5, 10, 40, 50, 60, 100
Square	Hz	0.125, 2.0
Triangle	Hz	2.0, 2.5
Pulse	BPM / width ms	30, 60, 120 / 60
Amplitude (lead II)	mV	0.05, 0.10, 0.15, 0.20, 0.25, 0.30, 0.35, 0.40, 0.45, 0.50, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0
Automatic mode		
R wave rate	BPM	30, 60, 80, 120, 200, 250
R wave width	ms	8, 10, 12, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200
R wave amplitude (lead II)	mV	0.05, 0.10, 0.15, 0.20, 0.25, 0.30, 0.35, 0.40, 0.45, 0.50, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0

1. To place the instrument into the performance mode, press the category key **Performance**.

↳ The display will resemble the following:



2. To change the desired parameters use **PREVIOUS** and **NEXT** to select the parameter to change and using **UP** and **DOWN** to scroll to the desired value.
   Alternately, to see a submenu of all the options for a highlighted parameter, use **CHOICES**.
   Use **UP** and **DOWN** to scroll to the desired option.
3. Press the **ENTER** key to confirm the new setting.

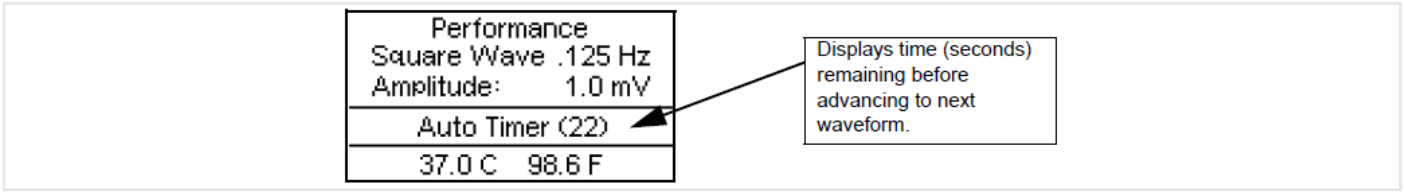
↳ The simulation starts and the instrument outputs accordingly.

4. Compare the values shown on the instrument with those shown on the DUT. Evaluate the DUT accordingly.
5. To stop, press QUIT at any point.

Auto Wave

If the waveform parameter is set to Auto Wave, the instrument will automatically sequence through all of the performance

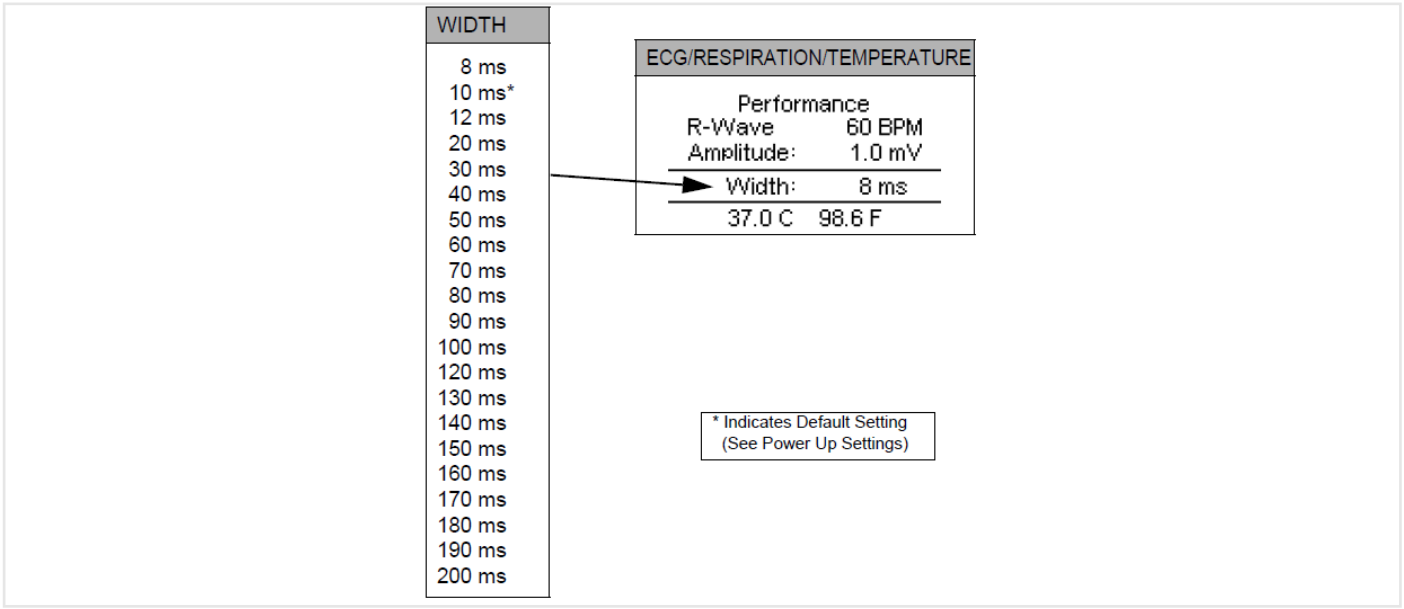
waves, starting with square wave 125 Hz, incrementing at a fixed interval. The interval may be set in the System Setup menu under **Auto Step Time**. A countdown timer is sown on the display:



When in this mode, the time remaining in each step is displayed. The **ENTER** key may be used to manually advance to the next step. To stop and exit, press **QUIT**.

R-Wave

When one of the 6 R-wave waveforms is selected, the display changes to allow the setting of the width.



1. To select width use **PREVIOUS** and **NEXT** to select the parameter, to change use **UP** and **DOWN** to scroll to the desired value.
   Alternately, to see a submenu of all the options for a highlighted parameter, use **CHOICES**.
   Use **UP** and **DOWN** to scroll to the desired option.
2. Press the **ENTER** key to accept the new setting.

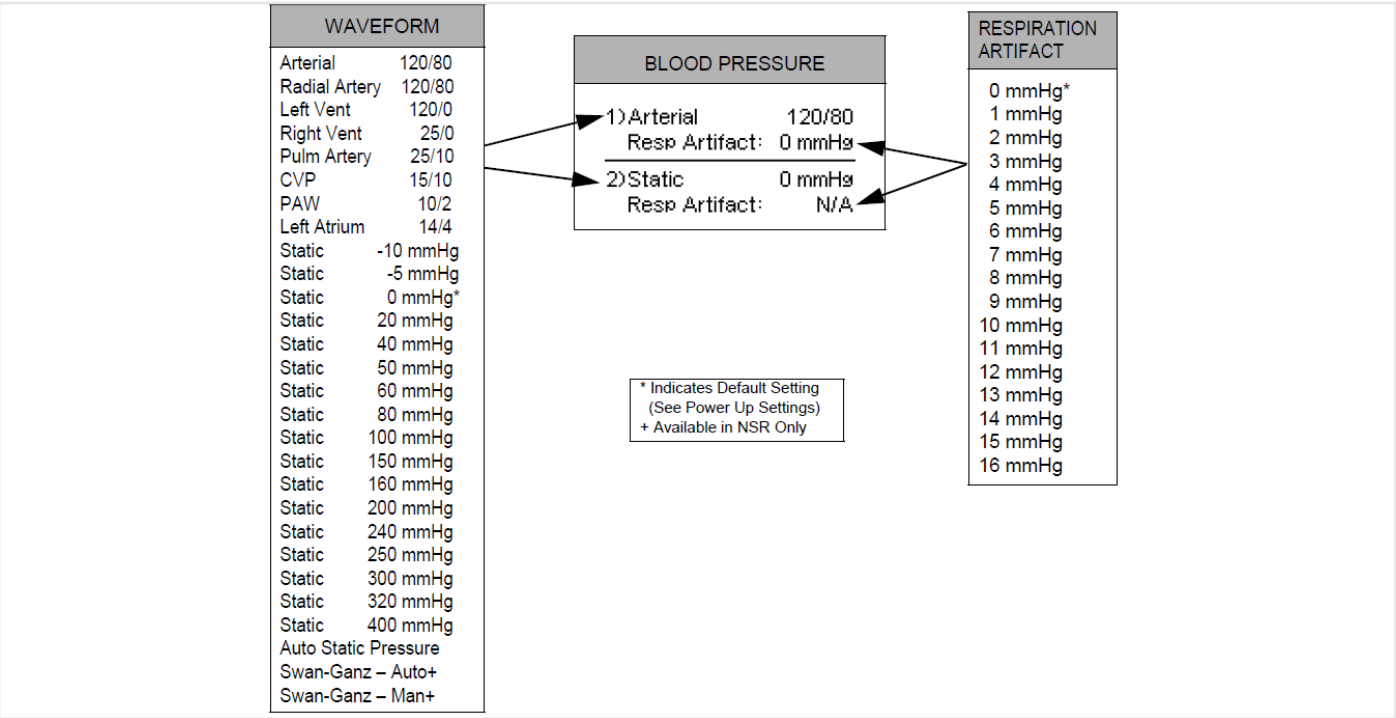
8.6 Blood Pressure

The instrument offers two blood pressure channels and will simulate the set blood pressure wave in Normal Sinus Rhythm, Arrhythmia and Performance mode.
There are 25 blood pressure settings available: 17 static and 8 dynamic. In the static mode, the BP outputs are fixed at the selected level or sequenced through the list using the automatic mode selection. In the dynamic mode, the selected waveform is synchronized with the ECG and provides a continuous output. Additionally, a respiration artifact may be added. A special Swan-Ganz simulation will allow for manual or automatic simulation of that sequence.
Each channel has independent settings:

Static	mmHg	–10, –5, 0, 20, 40, 50, 60, 80, 100, 150, 160, 200, 240, 250, 300, 320, 400
Automatic static pressure mode		
8 dynamic waveforms		
Respiration artifact	mmHg	0 … 16
Sensitivity	µV/V/mmHg	5 or 40
Swan-Ganz-simulation		

1. Set the transducer sensitivity (**Blood Pressure Sensitivity** parameter) to correlate with the DUT ⇨ "Output Setup" 🗎16.
2. To place the instrument into a performance mode, press the corresponding category key (e.g. **Normal Sinus Rhythm**).
3. Use **PREVIOUS** and **NEXT** to highlight the appropriate channel (second display).

↳ The display will resemble the following:



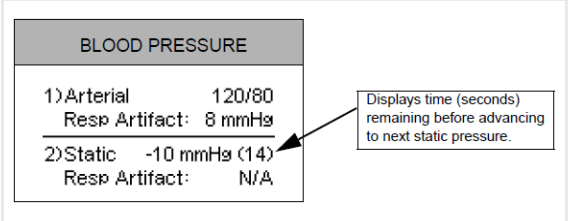
4. To change the desired parameters use **PREVIOUS** and **NEXT** to select the parameter to change and using **UP** and **DOWN** to scroll to the desired value.
   Alternately, to see a submenu of all the options for a highlighted parameter, use **CHOICES**.
   Use **UP** and **DOWN** to scroll to the desired option.
5. Press the **ENTER** key to confirm the new setting.

↳ The simulation starts and the instrument outputs accordingly.

6. Compare the values shown on the instrument with those shown on the DUT. Evaluate the DUT accordingly.
7. To stop, press **QUIT** at any point.

Auto Static Pressure

If auto static pressure is selected, the channel will automatically sequence through all of the static pressure settings, starting with –10 mmHg, incrementing at a fixed interval. The interval may be set in the System Setup menu under **Auto Step Time**. Each channel can be set independently.
When in this mode, the time remaining in each step is displayed. The **ENTER** key may be used to manually advance to the next step. To stop and exit, press **QUIT**.



Swan-Ganz

The Swan-Ganz simulation is a special feature that will run the typical sequence for a Swan-Ganz catheter. This can be done either manually, with the user triggering each step, or automatically, with the instrument continuously running the sequence with each step at a fixed time interval.

The sequence may be run on any channel while in the normal sinus rhythm screen, but only on one channel at a time.

1. Set the transducer sensitivity (**Blood Pressure Sensitivity** parameter) to correlate with the DUT ⇨ "Output Setup" 🗎16.
2. To place the **instrument** into a performance mode, press the corresponding category key (e.g. **Normal Sinus Rhythm**).
3. Use **PREVIOUS** and **NEXT** to highlight the appropriate channel (second display).
4. Press the **ENTER** key to select the **Swan-Ganz – Man** or **Swan-Ganz – Auto** waveform.

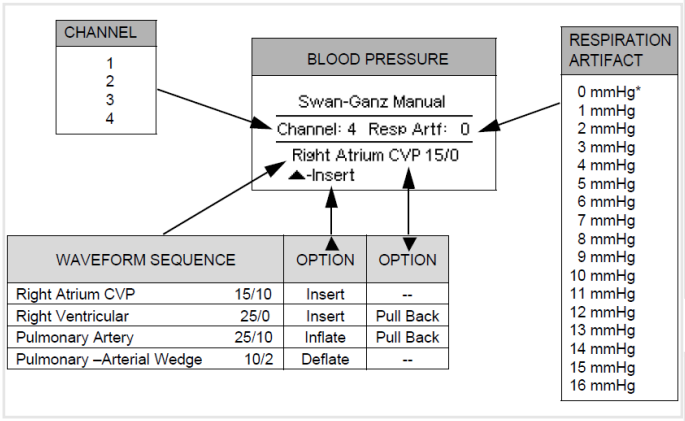
↳ When either of these waveforms is selected, a special screen will be displayed to step through the specific Swan-Ganz information.

Manual_

You controlthe sequence using the keys **UP** and **DOWN**. (The **UP** and **DOWN** keys will not be visible when the BP or respiration artifact parameters are selected for change.)

The instrument will auto select BP based on the channel that was used to enter the mode. However, it may be changed before beginning a sequence.

The functions of the keys vary with the steps. The display will indicate the current options on each screen.

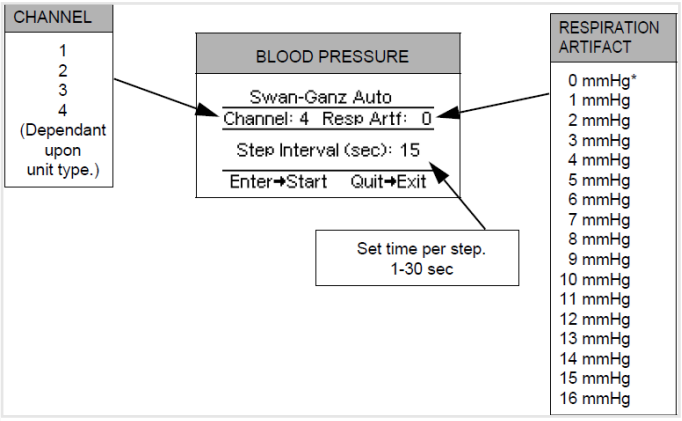


To stop and exit, press **QUIT**.

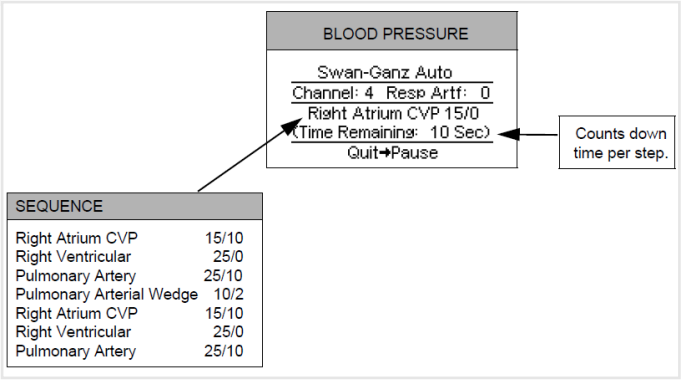
Auto:

The instrument continually runs the sequence. The time remaining before proceeding to the next step is counted down in the display. The instrument will auto select BP based on the channel.

The following is a typical setup screen:



The following is a typical running screen:



To stop and exit, press **QUIT** and confirm the query by pressing **QUIT** again.

8.7 Respiration

Respiration can be simulated in Normal Sinus Rhythm and Arrhythmia mode.
Respiration is simulated at 8 different rates (Breaths Per Minute) as well as an apnea (0 BrPM) setting. The amplitude is settable as delta Ω. The signal is generated by a variation in the impedance in either the LL or LA lead (selectable).

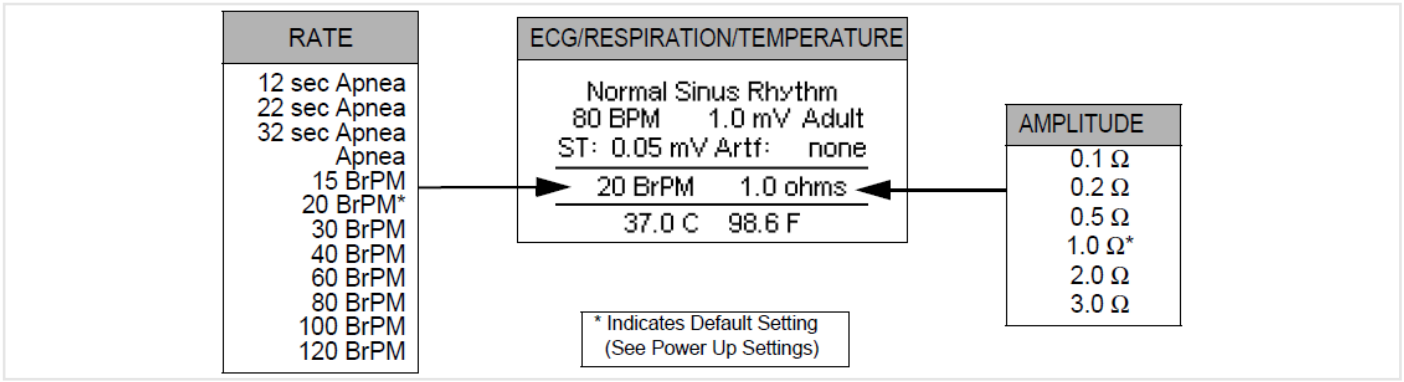
Rate	BrPM	15, 20, 30, 40, 60, 80, 100, 120
Baseline impedance	Ω	500, 1000, 1500, 2000
Lead		LA or LL
Delta impedance	Ω	0.1, 0.2, 0.5, 1.0, 2.0, 3.0
Apnea	s + continuous	12, 22 and 32

Note

The delta impedance signal can be inserted in either the LL or LA lead. T

1. Set the baseline impedance (**Resp Baseline** parameter) and Lead (**Resp Lead** parameter) to correlate with the DUT ⇨ "Output Setup" 16.
2. To place the **instrument** into a performance mode, press the corresponding category key (e.g. **Normal Sinus Rhythm)**.

↳ The display will resemble the following:



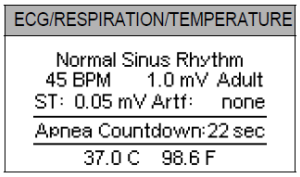
3. To change the desired parameters use **PREVIOUS** and **NEXT** to select the parameter to change and using **UP** and **DOWN** to scroll to the desired value.
   Alternately, to see a submenu of all the options for a highlighted parameter, use **CHOICES**.
   Use **UP** and **DOWN** to scroll to the desired option.
4. Press the **ENTER** key to confirm the new setting.

↳ The simulation starts and the instrument outputs accordingly.

5. Compare the values shown on the instrument with those shown on the DUT. Evaluate the DUT accordingly.
6. To stop, press **QUIT** at any point.

Timed Apnea

1. To trigger a one time event apnea for one of the specific periods (12, 22 or 32 seconds), highlight the desired period and press **ENTER**. The respiration display will change:



2. The display will count down the apnea period and then revert to the previous BrPM setting, display and output.
3. To stop and exit, press **QUIT**.

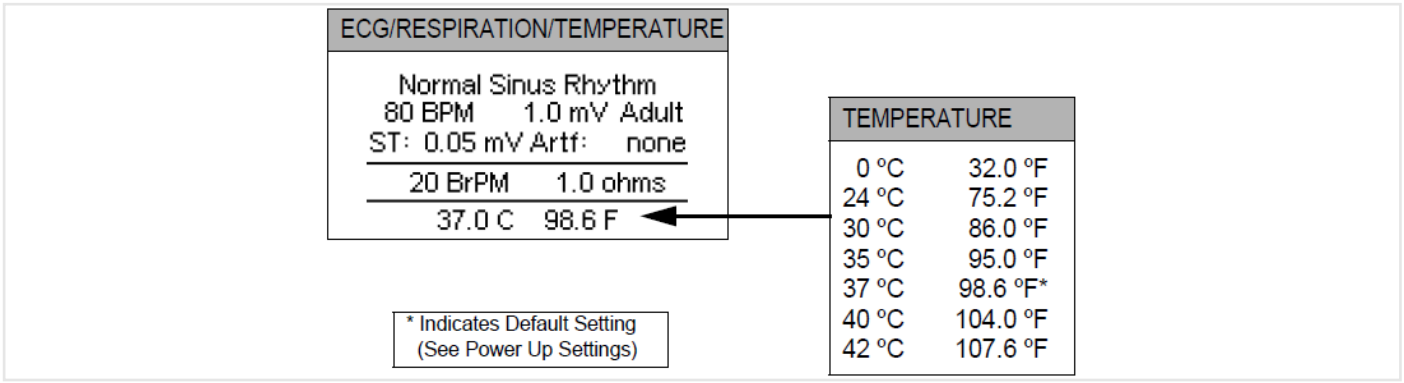
8.8 Temperature

The instrument simulates 7 temperatures in Normal Sinus Rhythm, Arrhythmia, Pacemaker and Performance mode.
The output requires a connected YSI 400 or YSI 700 temperature cable (not included in delivers). The instrument provides two different NTC resistance curves to simulate the electrical characteristics of YSI 400 and YSI 700 temperature sensors in parallel at the output.
Overview:

YSI 400 series and 700 series		
Selections	°C (°F)	0, 24, 30, 35, 37, 40, 42 (32.0, 75.2, 86.0, 95.0, 98.6, 104.0, 107.6)

1. To place the instrument into a performance mode, press the corresponding category key (e.g. **Normal Sinus Rhythm)**.

↳ The display will resemble the following:



2. To change the desired parameters use **PREVIOUS** and **NEXT** to select the parameter to change and using **UP** and **DOWN** to scroll to the desired value.
   Alternately, to see a submenu of all the options for a highlighted parameter, use **CHOICES**.
   Use **UP** and **DOWN** to scroll to the desired option.
3. Press the **ENTER** key to confirm the new setting.

↳ The simulation starts and the instrument outputs accordingly.

4. Compare the values shown on the instrument with those shown on the DUT. Evaluate the DUT accordingly.
5. To stop, press QUIT at any point.

8.9 SPO_2 (Optional Feature)

The instrument can drive an external SpO_2 simulator, the optionally available SECULIFE SP BASE. The output is available in all modes except in arrhythmia and performance modes.

1. Power the instrument by the external power supply (battery mode does not provide enough power).
2. Plug the SECULIFE SP BASE into the 7-pin mini DIN AUX connector of the instrument.
3. Enable the SpO_2 output in the Setup Output screen ⇨ "Output Setup" 🗎16.

↳ The instrument will, if selected in the Setup Output menu, provide a pulse synchronized SpO_2 output for all NSR rates:

Rate	BPM	30, 40, 45, 60, 80, 90, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300
SpO_2 output	%	80, 90, 97

For more information on the SECULIFE SP BASE, see it's product documentation.

8.10 Fetal / Maternal (Optional Feature)

The instrument can simulate a combined fetal/maternal ECG, if the optionally available fetal/maternal software addon has been installed.

This features simulates a fetal scalp electrode and a maternal thigh electrode. Additionally, it produces a pressure waveform that simulates uterine contractions which can be triggered manually or set to occur periodically.

Parameter overview:

Maternal heart rate	BPM	30, 40, 45, 60, 80, 90, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300
Fetal heart rate	BPM	60, 90,120,140, 150, 210, 240
IUP period (trigger)	min	Manual (single contraction), 2 min, 3 min, 5 min
FHR (during contraction)	Uniform deceleration, early deceleration, late deceleration, uniform acceleration	

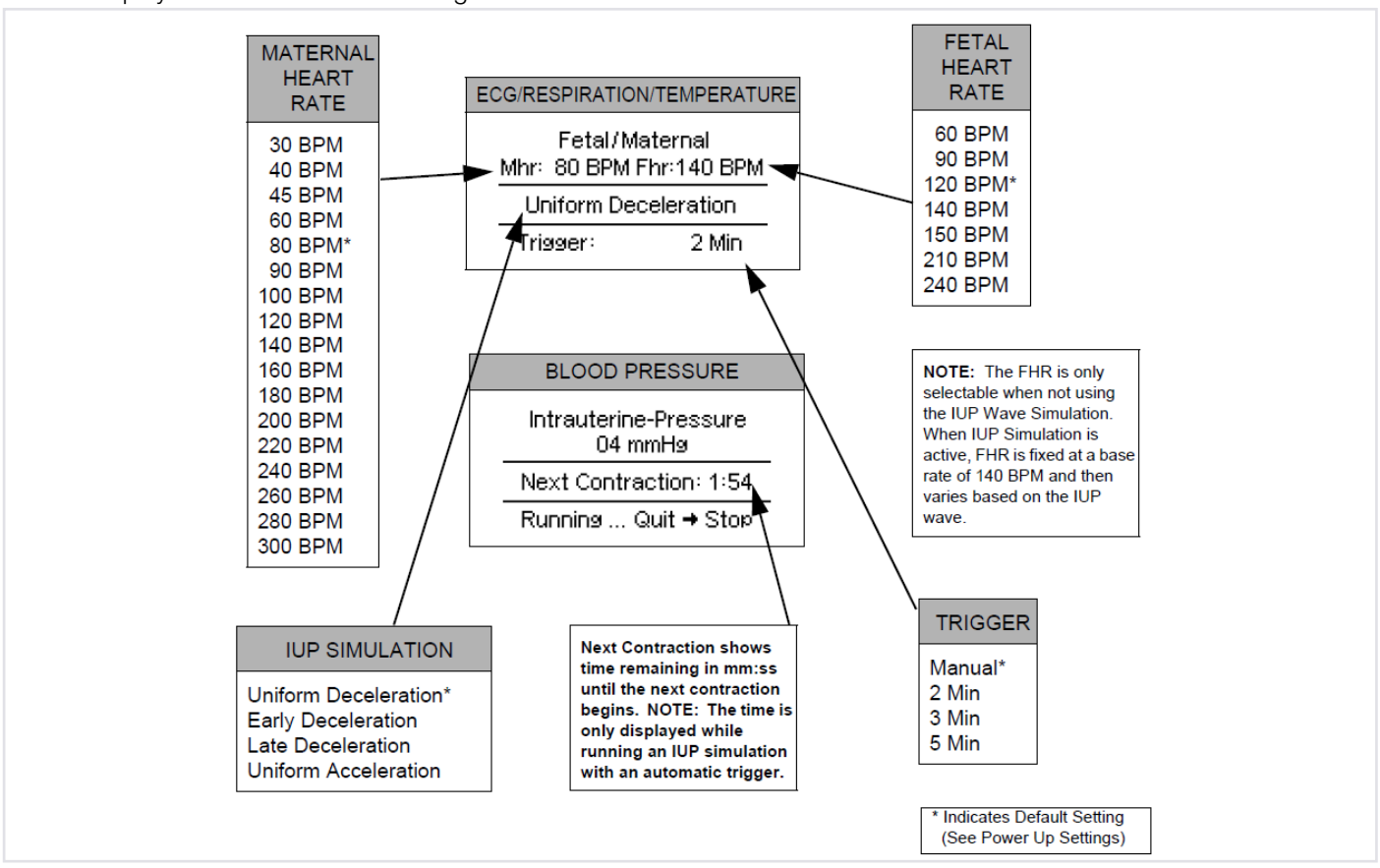
The IUP feature is designed to simulate the IUP and corresponding FHR that might occur during labor. The base 140 BPM FHR will respond to the contractions based on the setting as follows:

IUP Simulation Type	FHR Response
Uniform deceleration	The FHR goes from 140 BPM down to 100 BPM and back again. The rate follows the 90 seconds bell curve of the contraction but is delayed by 30 seconds.
Early deceleration	The FHR goes from 140 BPM down to 100 BPM and back again. The rate follows the 90 seconds bell curve of the contraction.
Late deceleration	The FHR goes from 140 BPM down to 100 BPM and back again. The rate follows the 90 seconds bell curve of the contraction but is delayed by 45 seconds.
Uniform acceleration	The FHR goes from 140 BPM up to 175 BPM and back again. The rate follows the 90 seconds bell curve of the contraction.

The IUP wave is a bell-shaped curve with a peak of 90 mmHg and duration of 90 seconds. When active, the FHR and IUP displays continuously update to show the current output values. The IUP waveform appears on blood pressure channel 1 (BP1) and simulates an intra-amniotic catheter connected to a pressure transducer.

1. Place the instrument into fetal/maternal mode by pressing **Fetal/Maternal**.

↳ The display will resemble the following:



2. To change the desired parameters use **PREVIOUS** and **NEXT** to highlight the parameter to change and using **UP** and **DOWN** to scroll to the desired value.
   Alternately, to see a submenu of all the options for a highlighted parameter, use **CHOICES**.
   Use **UP** and **DOWN** to scroll to the desired option.
3. Press the **ENTER** key to confirm the new setting.

↳ The simulation starts and the instrument outputs accordingly.

4. If the IUP period is set to Manual, press **Manual** to simulate a contraction.
   If a time is selected, use the ENTER key is used to start a continuous cycle with a contraction IUP wave starting every 2 min, 3 min or 5 min.
5. Compare the values shown on the instrument with those shown on the DUT. Evaluate the DUT accordingly.
6. To stop, press QUIT at any point.

8.11 Cardiac Output (Optional Feature)



The instrument can simulate thermodilution cardiac output measurements for DUTs which utilize Baxter-Edwards type catheters, if the optionally available cardiac output has been purchased. It consists of a software addon to be installed and a hardware cardiac output module.

Thermodilution enables the calculation of cardiac output by measuring the temperature change of the blood after a specific volume of a solution at room temperature or below (typically 0°C or 24°C) is injected into the heart. A thermistor on the catheter measures the blood temperature. The simulation provides an output curve that the DUT (cardiac output monitor) uses as a blood temperature input.

The instrument drives the external cardiac output module. The module provides a common connection point for the cabling and a manual simulation setting for the injectate temperature. Abnormal waveforms simulate injectate failure and left-to-right shunt conditions. A special calibration pulse that causes a 1.5 °C drop in temperature is also provided.

Parameter Overview:

Injectate temperature	°C	0, 24
Injectate flow	l/min	2.5, 5.0, 10.0
Other outputs	Faulty-injectate, left-to-right shunt, calibrated temperature pulse	

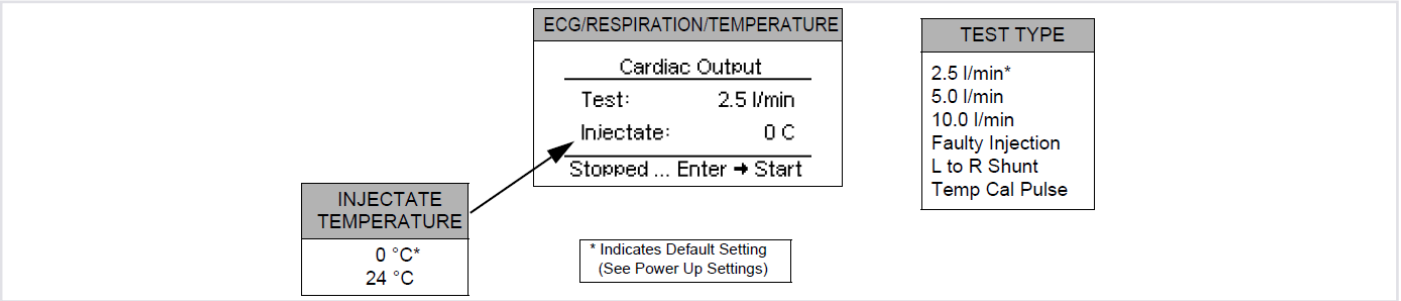
Normal	This test allows the selection of a flow rate (2.5, 5.0 or 10.0 l/min). When run, it will produce the normal temperature curve for the selected injectate temperature (0 °C or 24 °C). The DUT should interpret this as the selected flow rate.
Faulty Injectate	This is an abnormal output meant to simulate a condition where the injectate is not delivered in a smooth flow.
Left-to-Right Shunt	This is an abnormal output meant to simulate a physiological condition where the blood is shunted across the heart rather than to the lungs.
Temperature Calibration Pulse	This is a calibration output waveform that drops the normal 37 °C temperature output to 35.5 °C for 1 second.

1. Connect the external module to the **CO/Temp** port on the instrument.
2. Connect the blood temperature sensor line (BT thermistor cable) from the DUT to the small 4-pin connector on the external module.
3. Turn on the DUT and the instrument.

↳ The DUT should show a blood temperature of about 37 °C.

4. Configure the instrument setup to match the DUT:
   - Catheter; Baxter Edwards 93a – 131 – 7f
   - Calibration coefficient: 0.542 for 0 °C injectate or 0.595 for 24 °C injectate
5. Adjust the trim pot on the external module until the DUT shows the desired injectate temperature (0 °C or 24 °C).
6. Place the instrument into cardiac output mode by pressing **Cardiac Output**.

↳ The display will resemble the following:



7. To change the desired parameters use **PREVIOUS** and **NEXT** to highlight the parameter to change and using **UP** and **DOWN** to scroll to the desired value.
   Alternately, to see a submenu of all the options for a highlighted parameter, use **CHOICES**.
   Use **UP** and **DOWN** to scroll to the desired option.

Note

The temperature selected here is different than the selection made on the module, which sets the injectate temperature on the DUT. This test parameter tells the SECULIFE PS300 which injectate temperature to simulate.

8. Press the **ENTER** key to confirm the new setting.
↳ The simulation starts and the instrument outputs accordingly.The test will run one complete cycle.
9. Compare the values shown on the instrument with those shown on the DUT. Evaluate the DUT accordingly.
10. Use **the ENTER key** to repeat as often as desired. Use **QUIT** to terminate the cycle at any point.

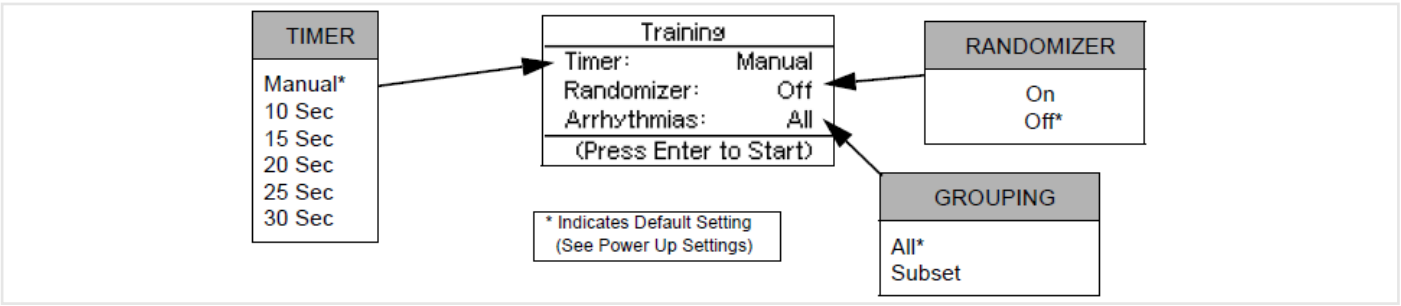
9 Training Mode

The instrument has a unique training mode feature that helps users practice identifying arrhythmias. The instrument sequences through arrhythmias, enabling users to view the output on their equipment, identify the arrhythmia, and verify their conclusion by comparing it to the correct name displayed. Users can select manual or timed sequencing and choose whether arrhythmias display in order or randomly. Subsets of the arrhythmias can be selected to allow for individualization.
Parameter overview:

Timer	s	manual, 10, 15, 20, 25, 30
Randomizer	off, on	
Arrhythmias	all, subset	

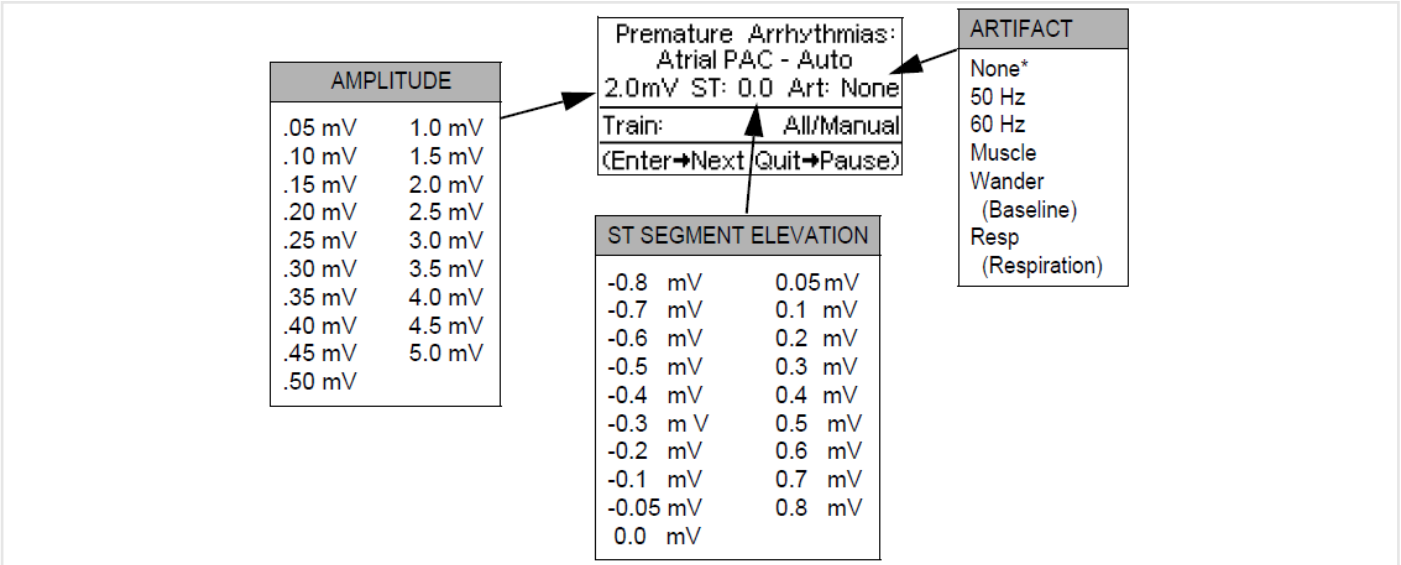
1. Press the category key **TRAINING** to place the instrument into training mode.

↳ The display will resemble the following:



2. To change the desired parameters use **PREVIOUS** and **NEXT** to highlight the parameter to change and using **UP** and **DOWN** to scroll to the desired value.
   Alternately, to see a submenu of all the options for a highlighted parameter, use **CHOICES**.
   Use **UP** and **DOWN** to scroll to the desired option.
3. Press the **ENTER** key to confirm the new setting.

↳ The simulation starts and the instrument outputs accordingly.



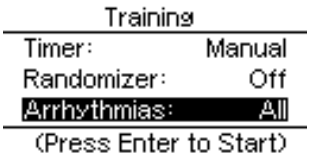
4. Compare the values shown on the instrument with those shown on the DUT. Evaluate the DUT accordingly.
5. If in the timed mode, the instrument will switch to the next arrhythmia automatically at the set time.
   If in the manual mode, press **ENTER** to go to the next arrhythmia when ready.
6. To pause or exit the training mode during a session, use the **QUIT** key. If you want to exit, confirm the query with **QUIT**. If you want to pause, press **ENTER** when ready to continue.

Subset (Training with Specific Arrhythmias)

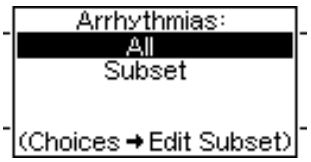
The subset feature allows the user to select specific arrhythmias for a more controlled training. This feature is selected by setting the GROUPING parameter to Subset.

The selection of the subset is done by marking those specific arrhythmias or groups of arrhythmias of interest. After a subset of arrhythmias has been selected, it will remain in memory. It may then be edited at any time prior to starting a training session.

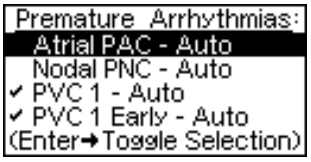
1. Highlight **Arrhythmias** and use **CHOICES** to open the choices screen.



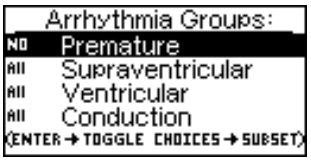
2. Highlight **Subset** and use **CHOICES** to open the **Arrhythmia Groups** submenu screen.



3. To select all the arrhythmias in a group, use the **UP** and **DOWN** key to scroll to the category and use **ENTER** to toggle the indicator to **ALL**.
   To select none of the arrhythmias in a group, use **ENTER** to toggle the indicator to **NO**.
   (If the group is pre-selected with ALL, all of the arrhythmias will be checked, thus making it easy to deselect a few in the next step. If the group is pre-selected with NO, none of the arrhythmias will be checked, thus making it easy to select a few in the next step.)
4. To select some of the arrhythmias in a group, use **CHOICES** to display the list of arrhythmias for a specific group. Then use **UP** and **DOWN** to scroll through the arrhythmias. Any arrhythmia marked with a check (✓) will be included in the subset. Use to toggle the selection of an arrhythmia on and off.



5. When completed selecting the desired arrhythmias from that group, use **QUIT** to return to the **Group** submenu. **SOME** will appear to indicate a partial selection of the arrhythmias in that group.



6. If desired, modify additional groups in the same manner.
7. When done with all the groups, use **QUIT** again to return to the training mode.

10 Storage and Transport

ATTENTION

Improper storage

Damage to the product and measuring error due to environmental influences.

- Store the instrument in a protected location and only within the limits of permissible ambient conditions. The ambient conditions (temperature, humidity etc.) can be found in chapter “Technical Data” ⇨🗎10.

ATTENTION

Improper transport

Damage to the product and measuring error.

- Transport the instrument only within the limits of permissible ambient conditions (temperature, humidity etc.) ⇨🗎10.
- Only use the included pouch to transport the instrument.

11 Maintenance

11.1 Cleaning



DANGER

Life endangering due to electric shock!

The instrument and its accessories are operated with electrical power, therefore there is a general risk of electric shock. This can be fatal or cause serious injuries.

- The instrument, the accessories and all connected conductors must be voltage-free before and during cleaning. Switch the test instrument off and disconnect it from the mains power supply.
- Never immerse the instrument/accessories in water or other fluids.
- Never touch the instrument/accessories with wet or moist hands.

ATTENTION

Unsuitable cleaning agents

Unsuitable cleaning agents such as aggressive or abrasive cleansers result in damage to the instrument/ accessories.

- Use a cloth which has been slightly dampened with water for cleaning.
- Avoid the use of cleansers, abrasives or solvents.

Keep the outside surfaces of the instrument and any accessories clean.

11.2 Calibration

Using your device and the stressing it is subjected to in doing so may result in deviation from the specified levels of accuracy. We recommend a calibration interval of once per year.
For calibrations please contact GMC-I Service GmbH, see chapter "Service and Contact" ⇨🗎 40.



Note

Date on calibration certificate / Calibration interval begins upon receipt

Your devices comes with a calibration certificate that has a date. It may date back some time if your device was stored a certain time before being sold.
The devices are stored according to the defined conditions. The developing drift therefore is negligible for a time period of approximately 1 year.
The characteristics of the device are thus within the specifications and you can set the first calibration interval as from receipt.

12 Repair

If your instrument requires repair, please contact our service department ⇨ "Service and Contact" 🗎40.

Note

Loss of warranty and guaranty claims

Unauthorized modification of the instrument is prohibited. This also includes opening the instrument.
If it can be ascertained that the instrument has been opened by unauthorized personnel, no guarantee claims can be honored by the manufacturer with regard to personal safety, measuring accuracy, compliance with applicable safety measures or any consequential damages.

- The instrument may only be repaired or opened by authorized, qualified personnel who are familiar with the associated dangers.
- Original replacement parts may only be installed by authorized, qualified personnel.
- The instrument may not be placed back into operation until troubleshooting and repair have been performed, and calibration and dielectric strength have been tested and approved at our factory, or at one of our authorized service centers.

13 Service and Contact

You can reach Gossen Metrawatt GmbH directly and uncomplicated, we have one number for everything!
Whether it's a support question, or individual desire, we answer every request at:

+49-911-8602-0	Monday–Thursday:	8:00 a.m. – 4:00 p.m.
	Friday:	8:00 a.m. – 2:00 p.m.
You can also e-mail to:	info@gossenmetrawatt.com	

Do you prefer support via e-mail?

Measuring and test instruments:	support@gossenmetrawatt.com
Industrial equipment:	support.industrie@gossenmetrawatt.com

Enquiries concerning training and seminars can also be submitted by e-mail and online:

training@gossenmetrawatt.com

https://www.gossenmetrawatt.com/training

For repairs, replacement parts, and calibrations[1] please contact GMC-I Service GmbH:

+49-911-817718-0
service@gossenmetrawatt.com
www.gmci-service.com

Beuthener Str. 41
90471 Nürnberg
Germany

1.DAkkS calibration laboratory per DIN EN ISO/IEC 17025.
Accredited at the Deutsche Akkreditierungsstelle GmbH under registration no. D-K-15080-01-01.

14 Certifications

14.1 CE Declaration

The instrument fulfills all requirements of applicable EU directives and national regulations. We confirm this with the CE mark. The CE declaration is available upon request.

14.2 Calibration Certificate

A calibration certificate is included with the instrument.

15 Disposal and Environmental Protection

Proper disposal makes an important contribution to the protection of our environment and the conservation of natural resources.

ATTENTION

Environmental damage

Improper disposal results in environmental damage.

Follow the instructions concerning return and disposal included in this section.

15.1 Disposal of Old Devices, Batteries and Rechargeable Batteries

Old devices and (rechargeable) batteries contain valuable raw materials that can be recycled, as well as hazardous substances which can cause serious harm to human health and the environment, and they must be recycled and disposed of correctly.



The symbol depicting a crossed-out garbage can on wheels refers to the legal obligation of the owner or end-user not to dispose of old devices and batteries or rechargeable batteries with unsorted municipal waste ("household trash"). The (rechargeable) batteries must be removed from the old device (where possible) without destroying them and the old device and the (rechargeable) batteries must be disposed of separately. The type and chemical composition of the (rechargeable) battery are indicated on the battery's labelling. If the abbreviations "Pb" for lead, "Cd" for cadmium or "Hg" for mercury are included, the (rechargeable) battery exceeds the limit value for the respective metal.

You are obliged to comply with respective local requirements and implement them correctly on site. Further information can be obtained, for example, from the responsible authorities or the local distributor.

Please also observe the owner's or end user's responsibility with regard to deleting personal data, as well as any other sensitive data, from old devices before disposal.

15.2 Disposal of Packaging Materials

Packaging and its parts must be correctly disposed of separately from unsorted municipal waste ("household trash").

You are obliged to comply with respective local requirements and implement them correctly on site. Further information can be obtained, for example, from the responsible authorities or the local distributor.

We recommend retaining the original packaging materials in case you might require servicing or calibration in the future.



WARNING

Danger of asphyxiation resulting from foils and other packaging materials

Children and other vulnerable persons may suffocate if they wrap themselves in packaging materials, or their components or foils, or if they pull them over their heads or swallow them.

- Keep packaging materials, as well as their components and foils, out of the reach of babies, children and other vulnerable persons.

15.3 Regulations for the Federal Republic of Germany

The following comments refer specifically to the legal situation in the Federal Republic of Germany.

Old devices, electrical or electronic accessories and batteries or rechargeable batteries

Old devices, electrical or electronic accessories, batteries and rechargeable batteries used in Germany can be returned free of charge to Gossen Metrawatt GmbH or the service provider responsible for their disposal in compliance with applicable regulations, in particular laws concerning packaging and hazardous goods. Batteries and rechargeable batteries must be returned in the discharged state or with appropriate precautions against short circuiting. Further information regarding returns can be found on our website.

Packaging Materials

Packaging which is not subject to so-called system participation is returned to the appointed service provider. Further information regarding returns can be found on our website.

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