BC Biomedical
A UNIT OF BC GROUP INTERNATIONAL, INC.

MULTI-PARAMETER PATIENT SIMULATOR

PS-2110

USER MANUAL

BC BIOMEDICAL
PS-2110
TABLE OF CONTENTS

This User Manual covers the following units:

- PS-2110

WARNING - USERS

The PS-2110 is for use by skilled technical personnel only.

WARNING - USE

The PS-2110 is intended for testing only and should never be used in diagnostics, treatment or any other capacity where it would come in contact with a patient.

WARNING - CONNECTIONS

All connections to patients must be removed before connecting the DUT to the PS-2110. A serious hazard may occur if the patient is connected when testing with the PS-2110.

CAUTION - MODIFICATIONS

The PS-2110 is intended for use within the published specifications. Any application beyond these specifications or any unauthorized user modifications may result in hazards or improper operation.

CAUTION - SERVICE

The PS-2110 is intended to be serviced only by authorized service personnel. Troubleshooting and service procedures should only be performed by qualified technical personnel.

CAUTION - INSPECTION

The PS-2110 should be inspected before each use for obvious signs of abuse or wear. The PS-2110 should not be used and should be serviced if any parts are in question.

CAUTION - CLEANING

Do not immerse. The PS-2110 should be cleaned by wiping gently with a damp, lint-free cloth. A mild detergent can be used if desired.

CAUTION - LIQUIDS

Do not submerge or spill liquids on the PS-2110. Do not operate the PS-2110 if it may have been exposed to fluid.

CAUTION - ENVIRONMENT

Exposure to environmental conditions outside the specifications can adversely affect the performance of the PS-2110. Allow the PS-2110 to acclimate to specified conditions for at least 30 minutes before attempting to operate it.

CALIBRATION INTERVAL

To ensure the accuracy of the PS-2110 Series, BC Group International, Inc. recommends that it be calibrated at least once every 12 months. Calibration must be done by qualified personnel. Contact BC Group International, Inc. for calibration.

EU DECLARATION OF CONFORMITY

CE

Manufacturer Name: BC Group International, Inc. **Tel:** +1 314 638 3800
Manufacturer Address: 3801 Elm Point Industrial Dr. **FAX:** +1 314 638 3200
St. Charles, MO 63301 USA **EMAIL:** sales@bcgroupintl.com

BC Group International, Inc. hereby declares under our sole responsibility that the product,

Product:	PS-2100 Series; may be followed by additional letters
Product Description:	Patient Simulator (PS)
Year of CE marking:	2007

is in accordance with the European Union harmonized legislation as described within the following Directive(s):

2014/30/EU	ELECTROMAGNETIC COMPATIBILTY (EMC)
2014/35/EU	LOW VOLTAGE (LVD)

and in conformity with the following Harmonized Standard(s):

EN 61010-1:2010, 10th Edition	SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL, AND LABORATORY USE – GENERAL REQUIREMENTS
EN 61326-1:2013, 13th Edition	ELECTRIACAL EQUIPMENT FOR MEASUREMENT, CONTROL AND LABORATORY USE – EMC REQUIREMENTS – PART 1: GENERAL REQUIREMENTS
EN 61000-3-2:2014, 2014 Edition	ELECTROMAGNETIC COMPATIBILITY (EMC) - PART 3-2: LIMITS - LIMITS FOR HARMONIC CURRENT EMISSIONS (EQUIPMENT INPUT CURRENT LESS THAN OR EQUAL TO 16 A PER PHASE)
EN 61000-3-3:2013, 2013 Edition	ELECTROMAGNETIC COMPATIBILITY (EMC) - PART 3-3: LIMITS - LIMITATION OF VOLTAGE CHANGES, VOLTAGE FLUCTUATIONS AND FLICKER IN PUBLIC LOW-VOLTAGE SUPPLY SYSTEMS, FOR EQUIPMENT WITH RATED CURRENT LESS THAN OR EQUAL TO 16 A PER PHASE AND NOT SUBJECT TO CONDITIONAL CONNECTION

A Technical file is maintained at the above address and is available, in full or in part, when additional documentation is required to show compliance with the applicable Directive(s) and Regulations referenced above.

I, the undersigned, of BC Group International, Inc. do hereby declare that the product(s) specified above, in its intended use as described within the product's User Manual, is in compliance with the directive(s) and standard(s) referenced above.

Place: BC Group International Inc.
3801 Elm Point Industrial Dr.
St. Charles, MO 63301 USA

Signature: _____
Mel Roche
President

Date: 7/27/16

Document No.: 65-734665-10-00
Revision: 00

Form: 65-700071-10 (00)

NOTICE – SYMBOLS

Symbol	Description
	**Caution** (Consult Manual for Further Information)
	**Center Negative**
	Per European Council Directive 2002/95/EC, do not dispose of this product as unsorted municipal waste.

NOTICE – ABBREVIATIONS

AHA	**American Heart Association**
ANSI	**American National Standards Institute**
BPM	**Beats Per Minute**
BrPM	**Breaths Per Minute**
C	**Celsius**
°	**degree(s)**
ECG	**Electrocardiogram**
F	**Fahrenheit**
Hz	**hertz**
IEC	**International Electrotechnical Commission**
IBP	**Invasive Blood Pressure**
kHz	**kilohertz**
LED	**Light Emitting Diode**
µV	**microvolt(s)**
mA	**milliamp(s)**
mm	**millimeter(s)**
mV	**millivolt(s)**
ms	**millisecond(s)**
NEDA	**National Electronic Distributors Association**
NSR	**Normal Sinus Rhythm**
Ω	**ohm(s)**
Lbs	**pounds**
RMS	**Root Mean Square**
USA	**United States of America**
V	**Volt(s)**
VDC	**Volts Direct Current**

NOTICE – DISCLAIMER

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NOTICE – CONTACT INFORMATION

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BC BIOMEDICAL
PS-2110
PATIENT SIMULATOR

The Model PS-2110 is a Microprocessor based Patient Simulator. It provides ECG, Blood Pressure, Respiration and Temperature Simulation. There are 12 arrhythmias, a pacemaker rhythm, a Fetal/Maternal rhythm, seven waveforms with constant QRS duration and 12 machine performance testing waveforms.

The PS-2110 makes viewing and selecting the desired waveforms and parameters quick and intuitive, with all operational information being available at one time on a cursor-based graphic display, allowing for easy maneuvering through parameters and scrolling through available options.

The following are highlights of some of the main features:

- SIMPLE TO OPERATE
- NO CODES TO REMEMBER OR ENTER
- BACKLIT GRAPHICS DISPLAY WITH SIMULTANEOUS DETAILED STATUS OF PARAMETERS AND SCROLLING CONTROL OF OPTIONS
- DROP DOWN CHOICE SCREENS LIST ALL OPTIONS FOR PARAMETERS
- SPECIAL POWER UP FEATURE ALLOWS THE USER TO CHOOSE TO USE DEFAULT, LAST OR CUSTOM SETTINGS
- AUTO SEQUENCES FOR BPM, STATIC-PRESSURE LEVELS AND PERFORMANCE
- 10 UNIVERSAL PATIENT LEAD CONNECTORS
- 9 VOLT BATTERY POWER
- % BATTERY LIFE DISPLAY
- LOW BATTERY INDICATOR
- AVAILABLE BATTERY ELIMINATOR
- FLASH PROGRAMMABLE FOR UPGRADES

ECG FUNCTIONS

The unit can produce a wide variety of ECG simulations. The user simply selects the parameters that match the desired output.

- RATE:
  30, 60, 80, 120, 180, 240, 300 BPM
- AMPLITUDE:
  0.5, 1.0, 1.5, 2.0 mV (Lead II)
- AUTOMATIC MODE

PACEMAKER FUNCTION

A pacemaker waveform may be simulated.

- WAVEFORM:
  ASYNCHRONOUS
- PULSE HEIGHT:
  1.0 mV
- PULSE WIDTH:
  1.0 ms

FETAL/MATERNAL

A combination of fetal and maternal ECG waveforms may be simulated.

- FETAL HEARTRATE:
  120 BPM

ARRHYTHMIA FUNCTIONS

The unit can simulate 12 different arrhythmias. Where applicable, both manual and automatic triggering of the waveform is available.

- 12 DIFFERENT ARRHYTHMIAS
- MANUAL AND AUTOMATIC TRIGGERING

ECG-PERFORMANCE FUNCTIONS

The unit will generate Sine, Square and Triangular waveforms with adjustable amplitudes for performance testing. A special Automatic mode is available to auto sequence through the entire range of waveforms.

- SINE:
  0.1, 0.5, 5, 10, 40, 50, 60, 100 Hz
- SQUARE:
  0.125, 2.000 Hz
- TRIANGLE:
  2.000 Hz
- AMPLITUDE:
  0.5, 1.0, 1.5, 2.0 mV (Lead II)
- AUTOMATIC MODE

RESPIRATION

Respiration is simulated at 8 different rates plus apnea, with the ability to select from 2 Baseline Impedances, the Lead in which it will appear, and the Delta Ohms (amplitude) of the signal.

- RATE:
  15, 20, 30, 40, 60, 80, 100, 120 BrPM
- BASELINE IMPEDANCE:
  500, 1000 Ω
- LEAD:
  LA or LL
- DELTA IMPEDANCE:
  0.1, 0.2, 0.5, 1.0, 2.0, 3.0 Ω
- APNEA: CONTINUOUS (0 BrPM)

BLOOD PRESSURE

Both static and dynamic invasive pressures are simulated. In the static mode the BP output is 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.

- STATIC:
  0, 20, 40, 80, 100, 200, 250, 300 mmHg
- AUTOMATIC STATIC PRESSURE MODE
- 6 DYNAMIC WAVEFORMS
- SENSITIVITY:
  5 and 40 µV/V/mmHg

TEMPERATURE

The unit will simulate three temperatures. This is done by providing the necessary ohmic levels for both the YSI 400 and 700 Series thermistors.

- YSI SERIES 400 and 700 SIMULATION
- SELECTIONS:
  30, 37, 40 °C (86.0, 98.6, 104.0 °F)

LEAD TEST FUNCTION

The unit provides a set of test terminals to quick check leads. It will determine if a lead has less than 1000 Ohms resistance.

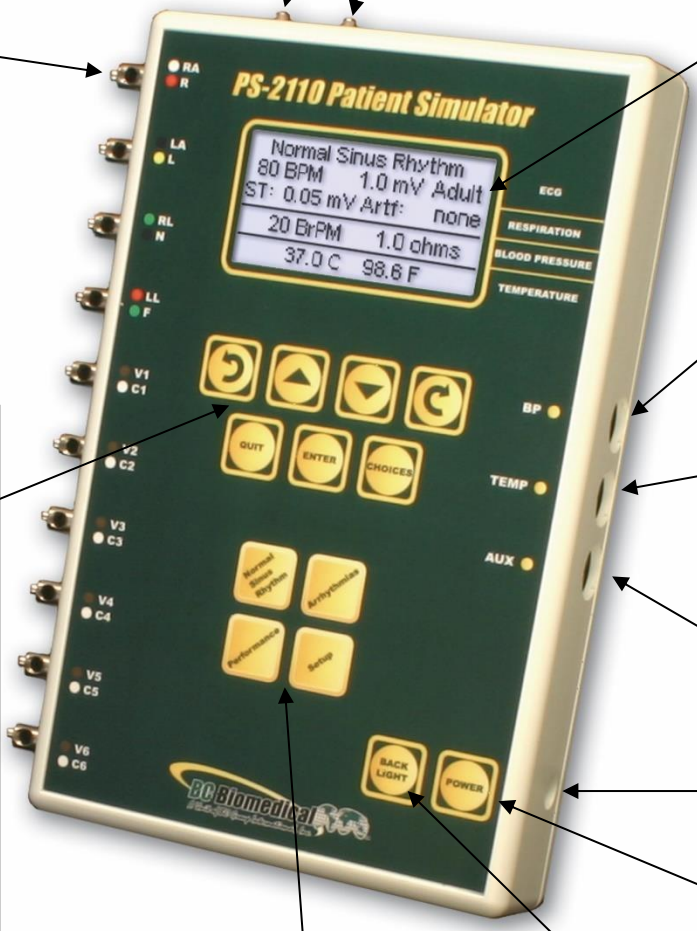
SPO2 SIMULATION (Option)

When used with the MSP-2100 external module and FingerSim family of SpO_2 finger simulators, the system will provide a pulse synchronized SpO_2 output for all NSR rates.

- RATE:
  30, 60, 80, 120, 180, 240, 300 BPM
- SpO_2 OUTPUT:
  80, 90, 97 %

LAYOUT

This section looks at the layout of a PS-2110 and gives descriptions of the elements that are present.



Lead Test Connections

10 Universal Patient Lead Connectors:
RA R
LA L
RL(-) N
LL F
V1 C1
V2 C2
V3 C3
V4 C4
V5 C5
V6 C6

LCD Graphical Display:
Shows Parameters for ECG, Respiration, Blood Pressure and Temperature

6-Pin Mini-DIN Plug Connector for Blood Pressure Cable

8-Pin Mini-DIN Plug Connector for Temperature Cable

7-Pin Mini-DIN Plug Connector for Aux Functions

Battery Eliminator jack

Power Key for Turning Unit On and Off

Back Light Key for turning on and off the backlight

7 Light Touch Keys for Selecting Parameters and Settings:
LEFT and RIGHT Curved Arrows for Moving through Parameters
UP and DOWN Arrows for Scrolling through Options
ENTER for Selecting Option
CHOICES for Displaying Submenu of All Options for a Given Parameter
QUIT for Returning to Previous Status

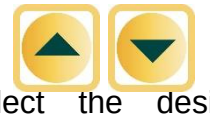
4 Light Touch Keys for Category Selection:
Normal Sinus Rhythm
Arrhythmias
Performance
Setup

General Operation

The unit is controlled by 13 light touch keys. They allow the user to move around within the displayed parameters, select the desired options, choose a specific category and control the setup and power for the unit. When a key is depressed there is an audio click when it is accepted, or a razz tone if the key is invalid.

A graphics LCD display provides the user with information about the current status of the ECG, Respiration, Blood Pressure and Temperature settings. The  keys move the block cursor through the displayed information; highlighting the parameter available for selection. The  keys change the options for the highlighted parameter. The cursor begins flashing if the parameter has been changed. The  key selects the changed option. The  key returns to the previous state, without any changes being made.

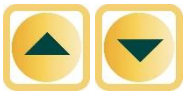
To make option selection even easier and to make memorizing and using codes unnecessary, the  key will bring up a screen that displays all the options for the selected parameter. The  and  keys can then be used to quickly scroll through the available options and select the desired setting.

Three category keys allow for quick setting of output waveforms. The  ,  and  keys move the display directly to the selected category. The  or  keys can then be used to scroll through and select the desired settings.

The 

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

Category Keys

The category,  and 

keys can be used to select ECG waveforms.

The 

key enters the NSR category and gives access to the seven BPM (Beats Per Minute) settings with constant QRS duration.

The 

key enters the arrhythmia category and changes the first line in the display to the first arrhythmia choice.

The 

key enters the machine performance testing category and changes the first line in the display to the first performance waveform choice.

Power Key

The 

key turns the unit on and off. To turn off the unit, the key must be held for 1 second.

Backlight

The Graphic LCD display may be viewed with or without the backlight. Depressing any key will activate the backlight. However, since the backlight will drain the battery if left on, it will automatically shut off after a few seconds when running on battery power. (Note: This time is selectable in the System Setup screen).

The intensity of the backlight can be adjusted in the System Setup screen to conserve battery life.

The 

key is provided to toggle the backlight on or off at any time.

NOTE: The backlight parameter in the System Setup screen may be set to Off, 1-30 sec Timed or Manual.

ECG Waveforms

The microprocessor 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.

Respiration

Respiration waveforms are provided that have adjustable rates from 15 to 120 BrPM (Breaths Per Minute) as well as an Apnea (0 BrPM) setting. The signal is generated by a variation in the impedance in either the LL or LA lead (selectable). The amplitude is settable from 0.5 to 3.0 ohms.

Blood Pressure

IBP pressure simulation is available through the 6-pin mini-DIN plug connector on the right side of the unit. The circuit is totally isolated.

Temperature

There is an 8-pin mini-DIN plug connector on the right side of the unit for connection of a Temperature cable. Temperatures are simulated for both YSI 400 and YSI 700 probe types. There are three different temperatures selectable for each.

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 unit 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	V Leads (U.S. Canada), also referred to as pericardial, precordial or unipolar chest leads Chest Leads (International)

High Level Output (+)

A high level ECG output signal (200 x Amplitude Setting) is available in the BP 6-Pin mini-DIN connector.

Lead Test Terminals

There are two test terminals on the top of the unit that allow for a quick test of the continuity of the lead cables. Connecting one end of the cable to one terminal and the other end to the other terminal will test the cable. If the cable is OK (less than 1000 ohms), the LEAD TEST ACTIVE screen will be displayed.

Auto Power Off

The unit may be programmed to automatically turn off after a selected number of minutes of no key activity to conserve the battery. (Note: This time is selectable in the System Setup screen).

Battery

The unit utilizes two 9 Volt Alkaline Batteries in the rear battery compartment. When the unit detects a LOW BATTERY condition (5% Battery Life), a warning window will appear once per minute to alert the user. The 

key may be used to clear this window and continue use of the unit. If the battery is not replaced before the battery reaches a critical level (0 % Battery Life), the unit will shut down. (The percentage of life left in the batteries can be viewed in the System Setup screen.)

Battery Eliminator

The unit has a 2.1 mm jack for connecting a 10-Volt Battery Eliminator (Optional).

Note: The Battery Eliminator will not charge the battery.

Power Up Settings

The unit may be setup to turn on using either the factory default settings, the same settings that it had when last turned off or a custom set of parameters as previously saved by the user (See Power Up Settings section for details).

Automatic Modes

The ECG NSR Rate, ECG Performance and Static Blood Pressure Parameters all allow for an automatic setting. In each of these, the unit will sequence through the full range of settings automatically at a fixed rate (as selected in the Auto Step Time Parameter). When in this mode, the time remaining in each step is displayed.

The 

key may be used to manually advance to the next step. The 

key is used to terminate the mode.

ECG – NORMAL SINUS RHYTHM

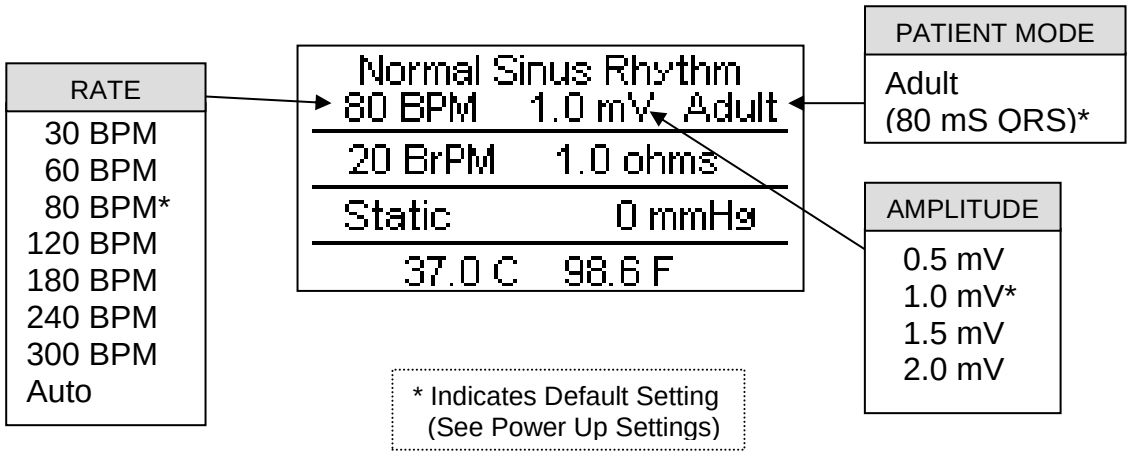
The PS-2110 can send NSR waveforms to ECG machines in 3, 5 or 12 lead configurations. It has independent outputs for each signal lead, referenced to the right leg.

NSR occurs when the heartbeat is normal, beating at a rate between 50 and 100 BPM with a standard QRS waveform shape and height. The PS-2110 simulates the NSR with a default rate of 80 BPM, amplitude of 1.0 mV on Lead II and P-R interval of 160 milliseconds.

The PS-2110 is placed into NSR mode by pressing the 

category key.

The display will resemble the following:



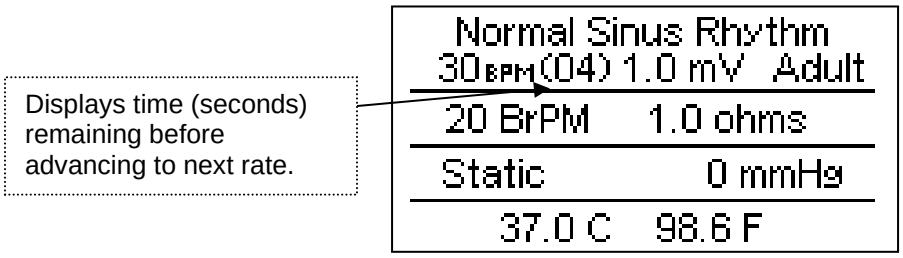
The rates and amplitudes can be selected by using  to highlight the parameter to change and using  to scroll to the desired value. Then 

is used to accept the new setting.

Alternately, to see a submenu of all the options for a highlighted parameter, use CHOICES. Use ▲ ▼ to scroll to the desired option. Then ENTER is used to accept the new setting.

Auto Rate

If the BPM parameter is set to AUTO, the unit 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".



The QUIT key can be used to exit the Auto Mode during the sequence.

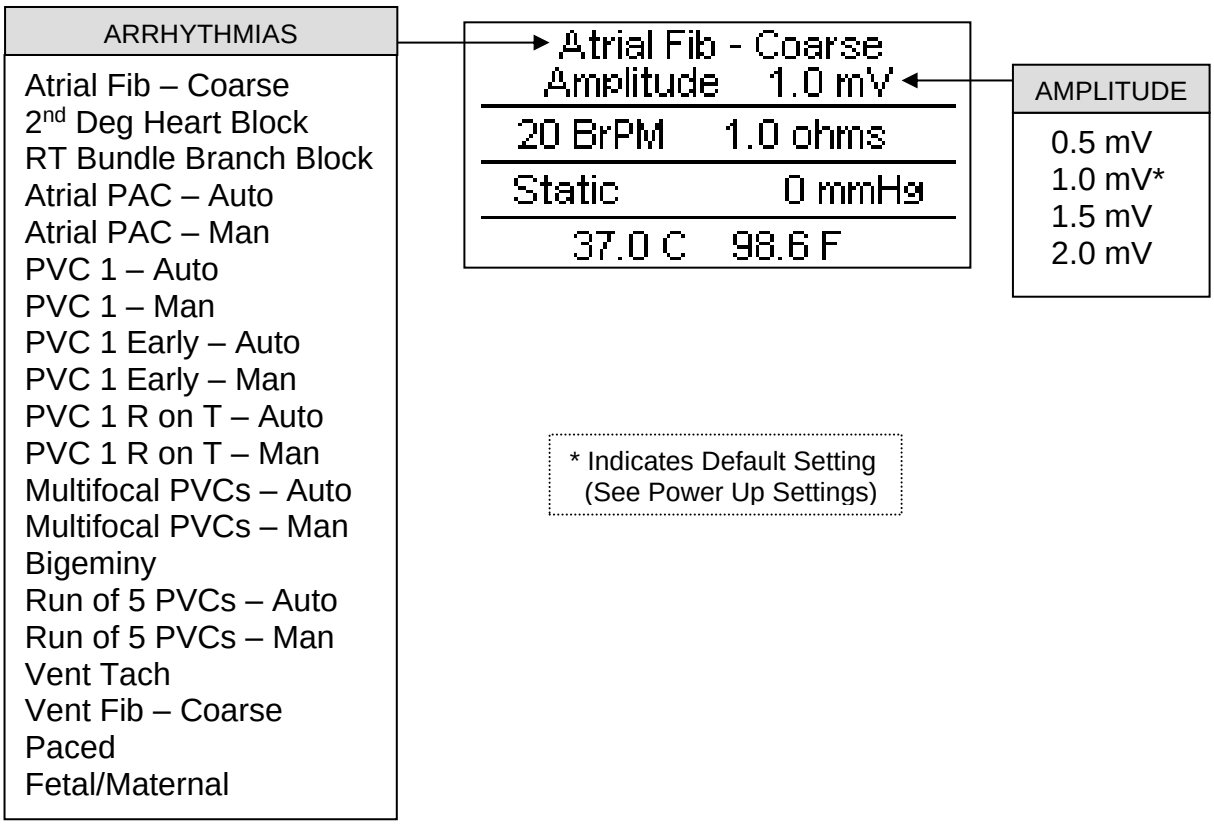
ECG – ARRHYTHMIAS

The PS-2110 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 12 Arrhythmias available that model abnormal heartbeats, plus Paced and Fetal/Maternal. The PS-2110 is placed into ARRHYTHMIA mode by pressing the 

category key.

The display will resemble the following:



The arrhythmias and amplitude can be selected by using  to highlight the parameter to change and using  to scroll to the desired option. Then  is used to accept the new setting.

Alternately, to see a submenu of all the options for a highlighted parameter, use 
Use  to scroll to the desired option. Then  is used to accept the new setting.

Auto/Manual

There are 6 arrhythmias that have both Automatic and Manual versions. Both versions output the same waveform; however, in the Manual version, the arrhythmia is triggered each time  is depressed. In the Auto versions, the arrhythmia is automatically triggered periodically.

The following is a brief description of how the PS-2110 simulates the available Arrhythmias:

Abbreviation	Arrhythmia	Description
Atrial Fib	Atrial Fibrillation	Absence of P-wave and irregular P-R interval rate (Continuous)
2nd Deg Heart Block	Second Degree Heart Block	80 BPM with increasing P-R interval for four beats (160, 220, 400, 470 ms) followed by a P wave without a QRS (Continuous)
Rt Bundle Branch Block	Right Bundle Branch Block	80 BPM with Normal P-wave and P-R interval but wider QRS complexes (Continuous)
Atrial PAC – Auto	Premature Atrial Contraction	NSR of 80 BPM with Periodic Abnormal 25% early P waves (PAC, 7 NSR) (Continuous)
Atrial PAC – Man	Premature Atrial Contraction	NSR of 80 BPM with Periodic Abnormal 25% early P waves (One-Time event)
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	Standard Type 1 Premature Ventricular Contraction	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 (PVC Type 1, 9 NSR) (Continuous)
PVC 1 Early - Man	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 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	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 (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)

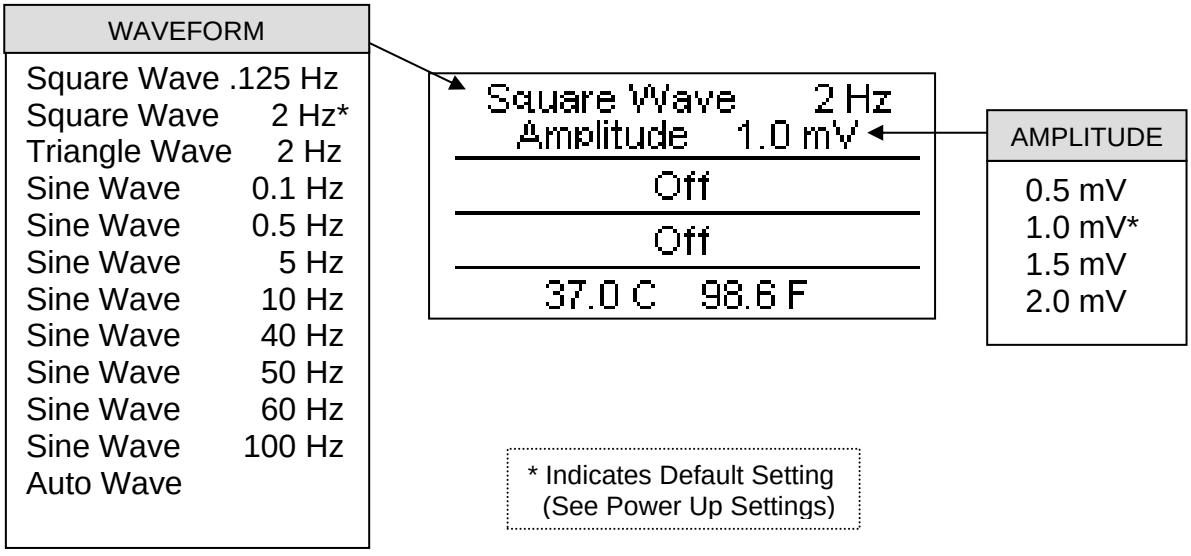
Multifocal PVCS – Man	Multifocal Premature Ventricular Contractions	NSR of 80 BPM with Type 1 and Type 2 PVCs (PVC Type 1, 2 NSR, PVC TYPE 2) (One-Time event)
Bigeminy	Bigeminal Rhythm	NSR of 80 BPM with every other beat a Type 1 PVC (Continuous)
Run of 5 PVCs – Auto	Run of 5 Premature Ventricular Contractions	NSR of 80 BPM with periodic group of 5 Type 1 PVCs (5 PVC Type 1, 36 NSR) (Continuous)
Run of 5 PVCs – Man	Run of 5 Premature Ventricular Contractions	NSR of 80 BPM with periodic group of 5 Type 1 PVCs (One-Time event)
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 (Continuous)
Paced	Paced Rhythm	Ventricular paced beats at 75 BPM with no P-waves (Continuous)
Fetal / Maternal	Fetal/Maternal ECG	Maternal NSR at 80 BPM with Fetal Heart Rate at 120 BPM (Continuous)

ECG – PERFORMANCE

The PS-2110 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 11 Performance waves available for testing and verifying. The PS-2110 is placed into PERFORMANCE mode by pressing the Performance category key.

The display will resemble the following:



These waves and amplitudes can be selected by using ↺ ↻ to highlight the parameter to change and using ▲ ▼ to scroll to the desired option. Then ENTER is used to accept the new setting.

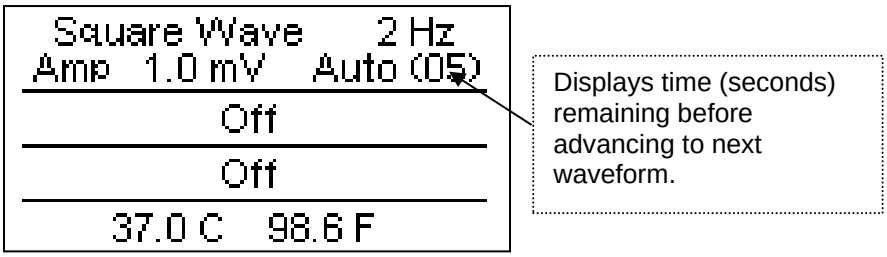
Alternately, to see a submenu of all the options for a highlighted parameter, use CHOICES. Use ▲ ▼ to scroll to the desired option. Then ENTER is used to accept the new setting.

NOTE: Respiration and Blood Pressure outputs are disabled during performance waves.

Auto Wave

If the Performance parameter is set to AUTO, the unit 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 shown in the display:



The QUIT key can be used to exit the Auto Mode during the sequence.

BLOOD PRESSURE

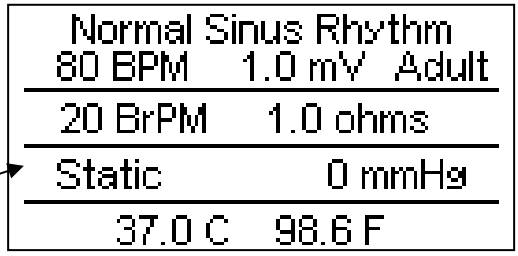
NOTE: The Transducer Sensitivity (5 uV/V/mmHg or 40 uV/V/mmHg) must be set to correlate with the monitoring equipment before simulation can begin. (See SETUP for selection information).

The PS-2110 offers one Blood Pressure Channel and will simulate the set Blood Pressure wave during ECG waveforms where it occurs.

There are 14 Blood Pressure settings available. Each of the six dynamic waveforms will synchronize with the NSR rate or arrhythmia selection.

The display will resemble the following:

WAVEFORM	
Arterial	120/80
Left Vent	120/0
Right Vent	25/0
Pulm Artery	25/10
CVP	15/10
PAW	10/2
Static	0 mmHg*
Static	20 mmHg
Static	40 mmHg
Static	80 mmHg
Static	100 mmHg
Static	200 mmHg
Static	250 mmHg
Static	300 mmHg
Auto Static Pressure	



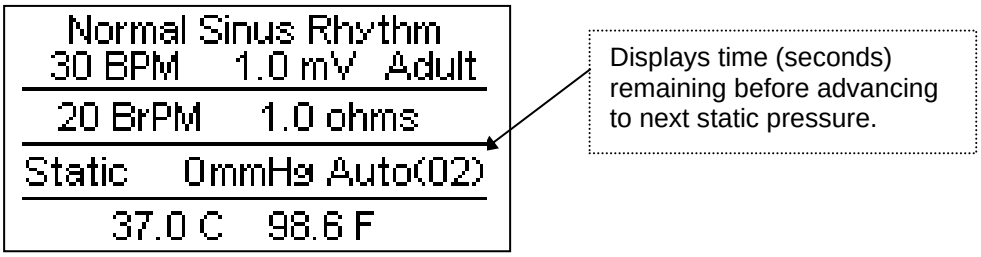
* Indicates Default Setting
(See Power Up Settings)

These settings can be selected by using  to highlight the parameter to change and using  to scroll to the desired option. Then  is used to accept the new setting.

Alternately, to see a submenu of all the options for a highlighted parameter, use  . Use  to scroll to the desired option. Then  is used to accept the new setting.

Auto Static Pressure

If Auto Static Pressure is selected, the channel will automatically sequence through all of the Static Pressure settings, starting with 0 mmHg, incrementing at a fixed interval. The interval may be set in the System Setup Menu under “Auto Step Time”.



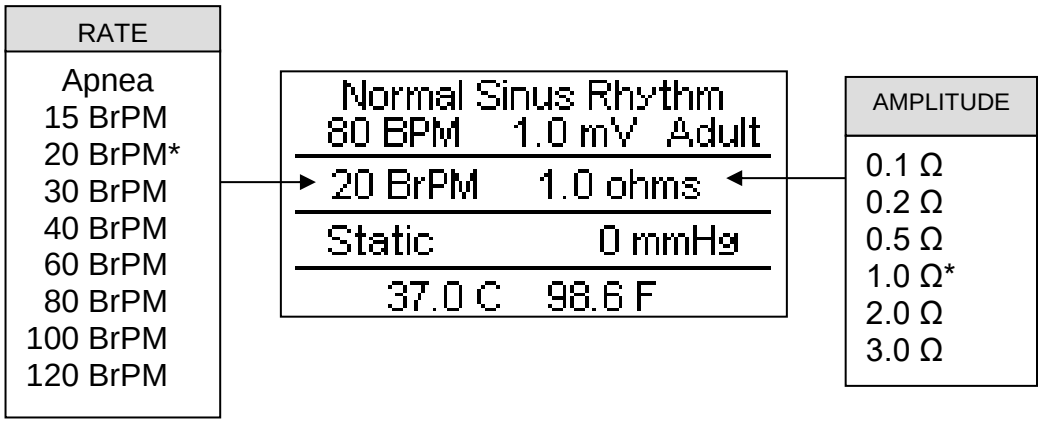
The  key can be used to exit the Auto Mode during the sequence.

RESPIRATION

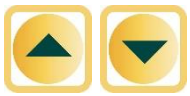
NOTE: The delta ohm Respiration Signal can be inserted in either the LL or LA lead. The Baseline impedance can be set to either 500 or 1000 Ohms. These must be set to correlate with the monitoring equipment before simulation can begin. (See SETUP for selection information).

There are 9 rate settings available.

The display will resemble the following:



* Indicates Default Setting
(See Power Up Settings)

These rates and Impedance Variations can be selected by using  to highlight the parameter to change and using  to scroll to the desired option. Then  is used to accept the new setting.

Alternately, to see a submenu of all the options for a highlighted parameter, use  . Use  to scroll to the desired option. Then  is used to accept the new setting.

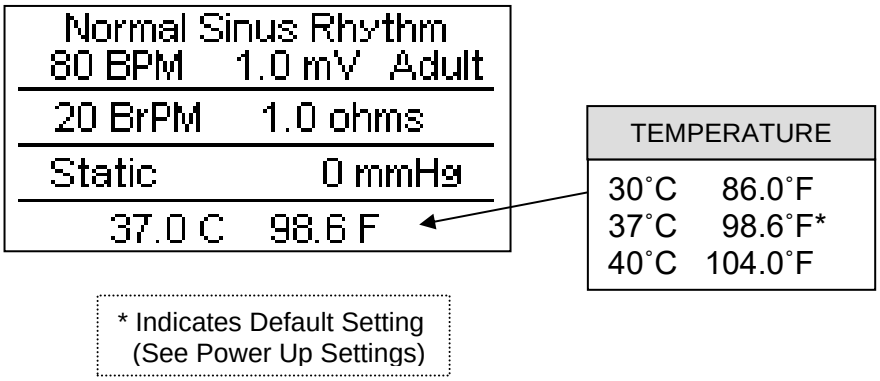
TEMPERATURE

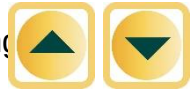
The PS-2110 simulates 3 temperatures that are independent from the rest of the functions of the unit. The temperature setting can be selected at any time.

The output will simulate both YSI 400 and YSI 700 Temperature probes.

(Note: Both outputs are available at the output connector simultaneously.)

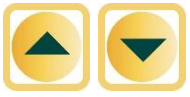
The display will resemble the following:



These temperatures can be selected by using  to highlight the parameter to change and using  to scroll to the desired option. Then 

is used to accept the new setting.

Alternately, to see a submenu of all the options for a highlighted parameter, use 

. Use  to scroll to the desired option. Then 

is used to accept the new setting.

SETUP

The PS-2110 allows for setup of the Outputs and the System Parameters through the 

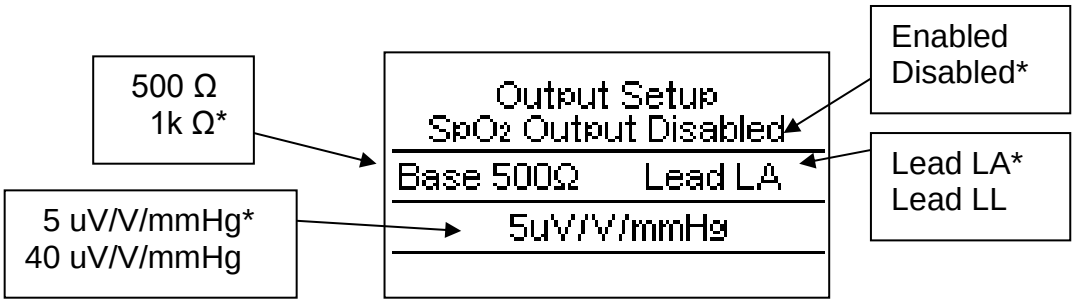
category key. Depressing the key multiple times toggles between the Output and System Setup screens.

The Output Setup screen allows for the setting of the SpO_2 Output, Respiration Baseline Ohms, Respiration Lead and the Blood Pressure Sensitivity parameters. These should be set according to the device under test.

Output Setup

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

The display will resemble the following:

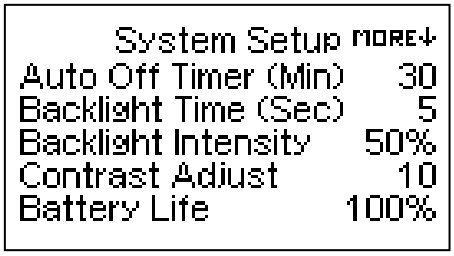


* Indicates Default Setting
(See Power Up Settings)

System Setup

The System Setup screen allows for the setting of the parameters controlling various function of the unit as well as the viewing of Battery Life and Software information.

The display will resemble the following:



These settings can be selected by using  to highlight the parameter to change and using  to scroll to the desired option. Then  is used to accept the new setting.

Use  or  ,  or  to exit from the setup screens.

The following is a brief description of the parameters and the available range of settings:

Parameter	Description	Range
Auto Off Timer	The elapsed time after which the unit will automatically power down. This timer is reset by each key depression. (Setting the value to 0 eliminates this feature.)	0-30 min
Backlight Timed	Off – Always off 1-30 sec – The elapsed time after which the backlight will automatically turn off. Manual – The backlight will be manually controlled by backlight key.	Off, 1-30 sec, Manual
Backlight Intensity	Sets the intensity of the backlight. (Note: Lower intensities extend battery life.)	0-100%
Contrast Adjust	Sets the contrast of the display screen.	0-20
Battery Life	Displays current life of the batteries. At 5%, a warning screen will appear. At 0%, the unit will power down automatically.	5-100% (Read Only)
Power up with	Selects the values that will be used when the unit is first turned on. It is also used to Set the Custom Defaults, if used. (See Power Up Settings).	Default/Last/Custom/ Set Custom Defaults
Auto Step Time	Sets the interval that is used with the Auto increment features in BPM, BP Rate and Performance.	1 to 60 sec
Software	Displays current software program.	(Read Only)

POWER UP SETTINGS

The PS-2110 allows the user to tailor the settings that the unit will have on Power Up. The “Power Up With” parameter in the System Setup Menu allows for the selection of either Default, Last or Custom selections.

Default

If this option is selected the following settings will be used every time the unit is turned on.

ECG – NSR: 80 BPM, 1.0 mV, Adult QRS, SpO_2 Output Disabled

ECG – Performance: 2 Hz Square Wave, 1.0 mV

Respiration: 20 BrPM, delta 1.0 Ω, 1000 Ω baseline, LA lead

Blood Pressure: 0 mmHg, 5 uV/V/mmHg sensitivity

Temperature: 37 °C (98.6 °F)

System Setup:

Auto Timer Off	30 min
Backlight Time	5 sec
Backlight Intensity	100%
Contrast Adjust	10
Power Up With	Default
Auto Step Time	5 sec

Last

If this option is selected, the unit 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, the user may save a unique set of default parameters and the unit will recall them every time the power is turned on.

Set Current as Custom

To create the set of custom default parameters, this fourth choice is provided in this parameter. The user simply configures the unit to the desired default conditions, selects this option and presses 

. The current configuration is then saved as the Custom Power up values.

SPO_2 (Option)

The PS-2110 has the ability to drive an external SpO_2 module. This module (MSP-2100) accepts the FingerSim family of SpO_2 finger simulators (fingers are available with SpO_2 of 80, 90 and 97 %). The output pulses the fingers at the NSR BPM rate (up to 180 BPM). The output is off in Arrhythmia and Performance Modes.

The module plugs directly into the AUX (7 pin mini din) connector and is powered from the PS-2110. The output is only functional when the unit is powered from the Battery Eliminator provided with the MSP-2100 Module, since the batteries do no have enough power to run this option.

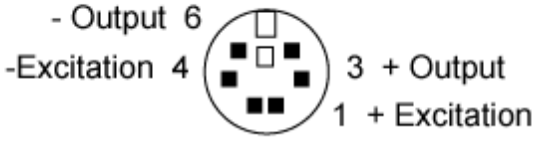
The output is enabled and disabled in the Setup Output screen.

OUTPUT CONNECTIONS

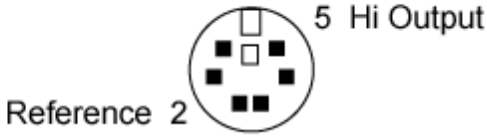
The following are representations of the socket connectors found on the unit. They are viewed as if looking at the socket in the unit, not the cable pins.

BP CONNECTOR

Blood Pressure

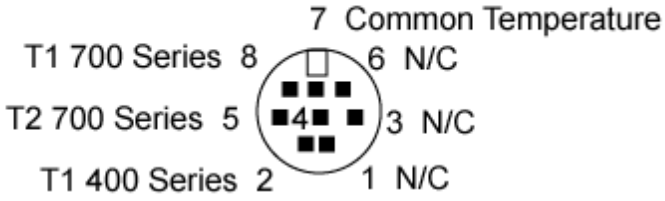


Hi Output



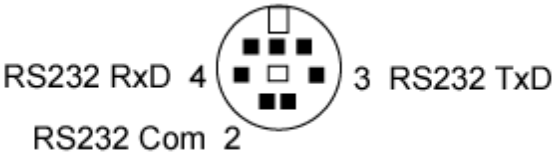
TEMP CONNECTOR

Temperature

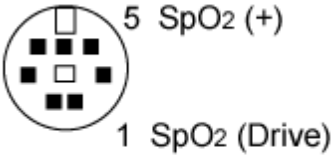


AUX CONNECTOR

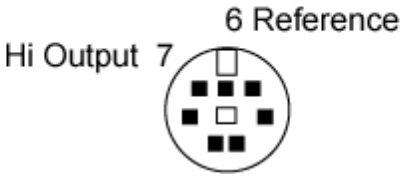
RS232



SpO_2



Hi Output



MANUAL REVISIONS

Revision #	Program #	Revisions Made
Rev 01	DT7346	Origination
Rev 02	DT7346	Misc. Edits
Rev 03	DT7346	Misc. Edits
Rev 04	DT7346	Overlay Addition
Rev 05	DT7346CC-T1	Format Updated, Pictures Updated
Rev 06	DT7346CD	Battery Eliminator Updated, Misc. Edits
Rev 07	DT7346CD	Updated Respiration Resistance Spec.

LIMITED WARRANTY

WARRANTY: BC GROUP INTERNATIONAL, INC. WARRANTS ITS NEW PRODUCTS TO BE FREE FROM DEFECTS IN MATERIALS AND WORKMANSHIP UNDER THE SERVICE FOR WHICH THEY ARE INTENDED. THIS WARRANTY IS EFFECTIVE FOR TWELVE MONTHS FROM THE DATE OF SHIPMENT.

EXCLUSIONS: THIS WARRANTY IS **IN LIEU OF** ANY OTHER WARRANTY EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF **MERCHANTABILITY** OR FITNESS FOR A PARTICULAR PURPOSE.

BC GROUP INTERNATIONAL, INC. IS NOT LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

NO PERSON OTHER THAN AN OFFICER IS AUTHORIZED TO GIVE ANY OTHER WARRANTY OR ASSUME ANY LIABILITY.

REMEDIES: THE PURCHASER'S SOLE AND EXCLUSIVE REMEDY SHALL BE: (1) THE REPAIR OR REPLACEMENT OF DEFECTIVE PARTS OR PRODUCTS, WITHOUT CHARGE. (2) AT THE OPTION OF **BC GROUP INTERNATIONAL, INC.**, THE REFUND OF THE PURCHASE PRICE.

SPECIFICATIONS

ECG SIMULATION			
RATE	NORMAL SINUS RHYTHM	30, 60, 80, 120, 180, 240, 300 BPM	
	PERFORMANCE WAVEFORMS	SINE	0.1, 0.5, 5, 10, 40, 50, 60, 100 Hz
		SQUARE	0.125, 2.0 Hz
		TRIANGLE	2.0 Hz
	ACCURACY	± 1%	
AMPLITUDE	0.5, 1.0, 1.5, 2.0 mV (Lead II)		
	ACCURACY	± 2% @ Lead II	
HIGH LEVEL	OUTPUT	200 times Amplitude	
	ACCURACY	± 5%	
LEAD TO LEAD IMPEDANCE	RL, LL, RA, LA	500, 1000 Ω	
	V1-V6	1000 Ω	

IBP SIMULATION		
STATIC PRESSURE	0, 20, 40, 80, 100, 200, 250, 300 mmHg	
	Accuracy	± (2% of Reading + 2 mmHg)
IMPEDANCE	300 Ω	
	Accuracy	± 10%
EXCITATION RANGE	2 to 16 V RMS	
EXCITATION FREQUENCY	DC to 5 kHz	
SENSITIVITY	5 or 40 µV/V/mmHg	

RESPIRATION		
RATE	Apnea, 15, 20, 30, 40 ,60, 80, 100, 120 BrPM	
	Accuracy	± 1%
IMPEDANCE DELTA	0.1, 0.2, 0.5, 1.0, 2.0, 3.0 Ω	
	Accuracy	± 10% + 0.05 Ω
BASELINE	500,1000 Ω	
	Accuracy	± 5%
LEAD	LA or LL	

TEMPERATURE SIMULATION	
SELECTION	30, 37, 40 °C (86.0, 98.6, 104.0 °F)
ACCURACY	± 0.1 °C
TYPE	YSI Series 400 and 700

PHYSICAL & ENVIRONMENTAL		
DISPLAY	128 X 64 Pixels Graphical LCD, White LED Backlight	
CONSTRUCTION	ENCLOSURE	ABS Plastic
	FACE PLATE	Lexan, Back printed
ENCLOSURE	8.97 x 6.04 x 1.72 Inches (227.8 x 153.4 x 43.7 mm)	
WEIGHT	< 2 Lbs (0.91 kg)	
OPERATING RANGE	15 to 40 °C (59 to 104 °F)	
STORAGE RANGE	-20 to 65 °C (-4 to 149 °F)	

ELECTRICAL		
BATTERY	9V Alkaline Battery (2 Required) (ANSI/NEDA 1604A or equivalent)	
BATTERY ELIMINATOR	WITHOUT MSP-2100	9 VDC, 200 mA  BC20-21100 (USA Version) BC20-21101 (Euro Version)
	WITH MSP-2100	10 VDC, 500 mA  BC20-211114 (Universal)
LEAD TEST IMPEDENCE	< 1000 Ω	

NOTES

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PS-2110 User Manual
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