BC Biomedical
A UNIT OF BC GROUP INTERNATIONAL, INC.

MULTI-PARAMETER PATIENT SIMULATOR

PS-2105

USER MANUAL

BC BIOMEDICAL
PS-2105
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This User Manual covers the following units:

- PS-2105

WARNING - USERS

The PS-2105 is for use by skilled technical personnel only.

WARNING - USE

The PS-2105 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-2105. A serious hazard may occur if the patient is connected when testing with the PS-2105.

CAUTION - MODIFICATIONS

The PS-2105 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-2105 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-2105 should be inspected before each use for obvious signs of abuse or wear. The PS-2105 should not be used and should be serviced if any parts are in question.

CAUTION - CLEANING

Do not immerse. The PS-2105 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-2105. Do not operate the PS-2105 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-2105. Allow the PS-2105 to acclimate to specified conditions for at least 30 minutes before attempting to operate it.

NOTICE – CE

The PS-2000 Series Simulators bear the CE mark
Based on the following testing standards:

ELECTROMAGNETIC COMPATIBILITY DIRECTIVE

EMC – Directive 89/336/EEC as amended by 92/31/EEC and 93/68/EEC & Directive 91/263/EEC[TTE/SES]

EN 61326-1:1997 + A1:1998 + A2:2001 + A3:2003
"Electrical equipment for measurement, control and laboratory use – EMC requirements"

This equipment has been type tested by an independent, accredited testing laboratory and compliance was demonstrated to the above standard to the extent applicable.

EMISSIONS
Radiated Emissions

EN 61326:1997 Annex C

IMMUNITY– CLASS C

EN 61000-4-2:1995	Electrostatic Discharge
EN 61000-4-3:2006	Radiated Electric Field Immunity

LOW VOLTAGE DIRECTIVE

EC – Directive 73/23/EC

EN 61010-1:2001
"Safety requirements for electrical equipment for measurement, control, and laboratory use – General requirements"

This equipment has been type tested and compliance was demonstrated to the above standard to the extent applicable.

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**
C	**Celsius**
°	**degree(s)**
DUT	**Device Under Test**
ECG	**Electrocardiogram**
F	**Fahrenheit**
Hz	**hertz**
IEC	**International Electrotechnical Commission**
Lbs	**pounds**
LED	**Light Emitting Diode**
mm	**millimeter(s)**
mV	**millivolt(s)**
NEDA	**National Electronic Distributors Association**
USA	**United States of America**
VDC	**Volts Direct Current**

NOTICE – DISCLAIMER

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NOTICE – CONTACT INFORMATION

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BC BIOMEDICAL
PS-2105
PATIENT SIMULATOR

The Model PS-2105 is a Microprocessor based Patient Simulator. It provides ECG Simulation with 36 arrhythmias, 17 waveforms with constant QRS duration, 15 machine performance-testing waveforms and 7 paced rhythms, plus a unique training mode and an optional SpO_2 Output.

The PS-2105 makes viewing and selecting the desired waveforms and parameters quick and intuitive, with all operational information being available at the same 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:

PS-2105 (BASIC FEATURES):

- SIMPLE TO OPERATE
- NO CODES TO REMEMBER OR ENTER
- 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 AND PERFORMANCE
- 10 UNIVERSAL PATIENT LEAD CONNECTORS
- 9 VOLT BATTERY POWER
- % BATTERY LIFE DISPLAY
- LOW BATTERY INDICATOR
- DISPLAY BACKLIGHT
- 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. Available settings:

- RATE: 30, 40, 45, 60, 80, 90, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300 BPM
- AMPLITUDE: 0.5, 1.0, 1.5, 2.0 mV (Lead II)
- S-T SEGMENT ELEVATION: ± 0, 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 mV.
- ARTIFACTS: 50 HZ, 60 HZ, MUSCLE, BASELINE WANDER, RESPIRATION

- QRS INTERVAL:
  ADULT (80 ms) OR PEDIATRIC (40 ms)
- AUTOMATIC MODE

ECG-PERFORMANCE FUNCTIONS

The unit 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. Available settings:

- SINE:
  0.1, 0.5, 5, 10, 40, 50, 60,100 Hz
- SQUARE:
  0.125, 2 Hz
- TRIANGLE:
  2, 2.5 Hz
- PULSE:
  30, 60, 120 BPM; 60 ms WIDTH
- AMPLITUDE:
  0.5, 1.0, 1.5, 2.0 mV (Lead II)
- AUTOMATIC MODE

PACEMAKER FUNCTIONS

Seven different pacemaker waveforms may be simulated. Additionally, the width and amplitude of the pacer pulse may be selected. Available settings:

- WAVEFORMS:
  ATRIAL PACER, ASYNCHRONOUS, NON-CAPTURE,
  NON-FUNCTION, DEMAND - OCCASIONAL,
  DEMAND - FREQUENT, AV - SEQUENTIAL
- PULSE HEIGHT:
  1, 2, 5, 10 mV
- PULSE WIDTH:
  0.1, 0.5, 1.0, 1.5, 2.0 ms

ARRHYTHMIA FUNCTIONS

The unit can simulate 36 different arrhythmias. For ease of selection, they are arranged into four basic groups. Where applicable, both manual and automatic triggering of the waveform is available. Available settings:

- 36 DIFFERENT ARRHYTHMIAS
- FOUR GENERAL GROUPS:
  SUPRAVENTRICULAR
  PREMATURE
  VENTRICULAR
  CONDUCTION

MANUAL AND AUTOMATIC TRIGGERING

TRAINING

The unit has a special training mode that may be used to aid users in practicing the identification of arrhythmias. A series of settings allows the feature to be customized to fit the exact training requirement. Available settings:

- TIMER:
  MANUAL, 10, 15, 20, 25, 30 SEC
- RANDOMIZER:
  OFF, ON
- ARRHYTHMIAS:
  ALL, SUBSET

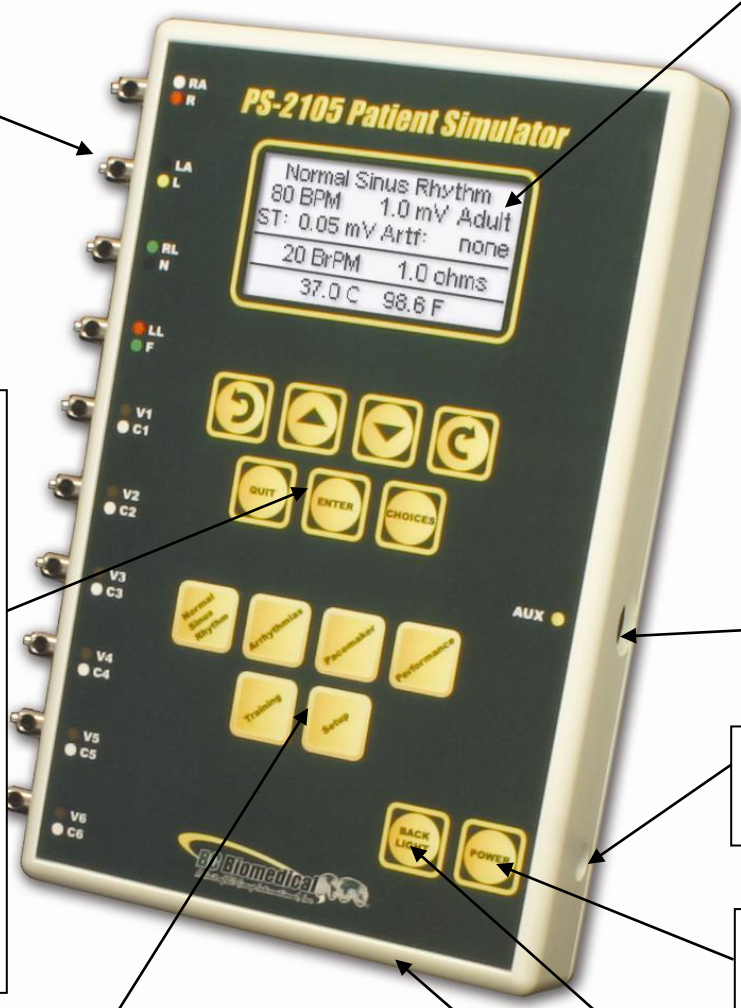
SPO2 SIMULATION (Option)

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 NSR rates. Available settings:

- RATE: 30, 40, 45, 60, 80, 90, 100, 120, 140, 160, 180 BPM
- SpO_2 OUTPUT:
  80, 90, 97 %

LAYOUT

This section looks at the layout of a PS-2105 and gives descriptions of the elements that are present.



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

Graphical LCD Display:
Shows Parameters for ECG, including BPM, Adult/Pediatric, Amplitude, Artifact and ST Segment

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

7-Pin Mini-DIN Plug Connector for Aux Functions

Battery Eliminator Receptacle

Power Key for Turning Unit On and Off

6 Light Touch Keys for Category Selection:
Normal Sinus Rhythm
Arrhythmias
Pacemaker
Performance
Training
Setup

9V Battery Compartment (Back)

Back Light Key for turning on and off the backlight

General Operation

The unit is controlled by 15 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 graphical LCD display provides the user with information about the current status of the ECG 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.

Five 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 

key enters the NSR category.

The 

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

The 

key enters the pacemaker category and changes the first line in the display to the first pacemaker waveform choice

The 

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

The 

key opens a screen that allows the user to set the conditions for and start the special training mode.

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.

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 Aux 7-Pin mini-DIN connector.

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 9-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

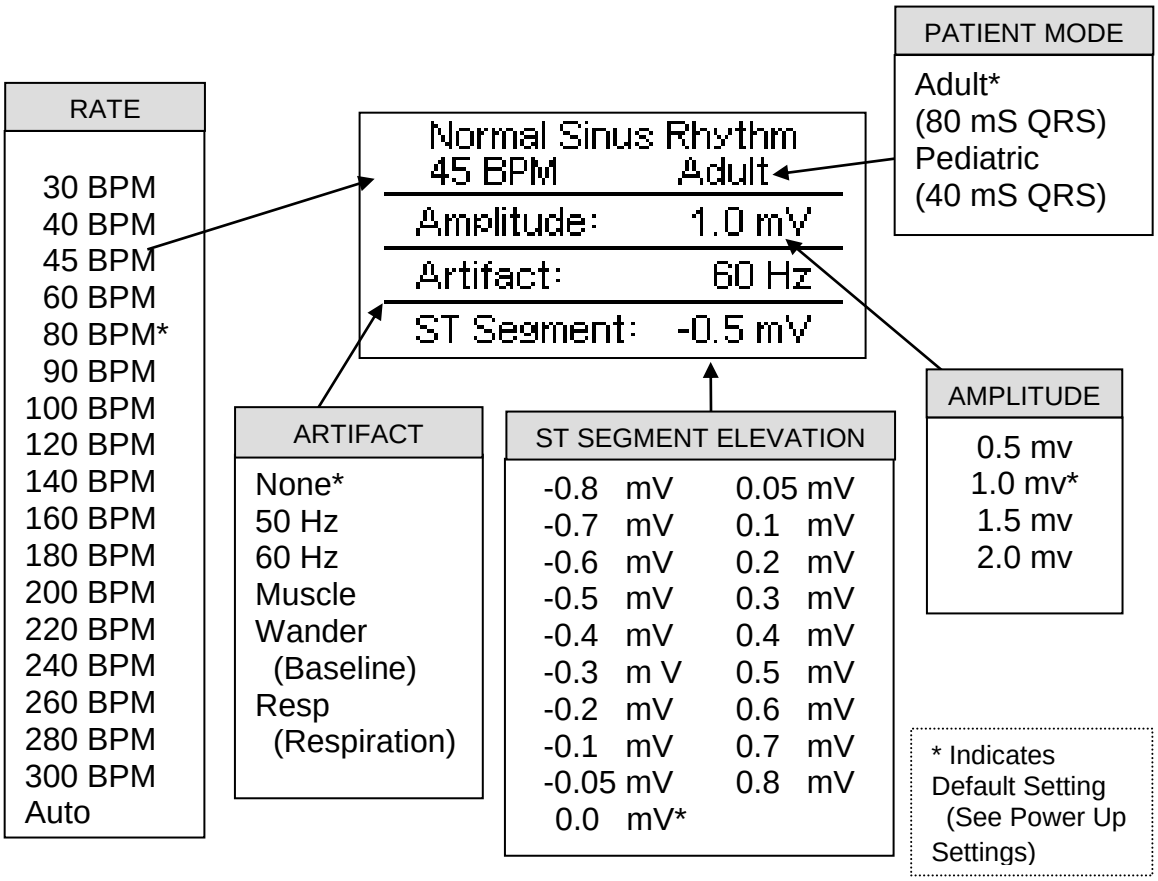
The PS-2105 can send waveforms to ECG machines in 3, 5 or 12-lead configurations. It has independent outputs for each signal lead, referenced to the right leg.

Normal Sinus Rhythm (NSR) occurs when the heartbeat is normal, beating at a rate between 50 and 100 BPM with a standard QRS waveform shape and height. The PS-2105 simulates the NSR with a default pulse of 80 BPM, amplitude of 1.0 mV on Lead II, P-R interval of 160 milliseconds, no Artifact and no ST Segment elevation.

The PS-2105 is placed into NSR mode by pressing the 

category key.

The display will resemble the following:

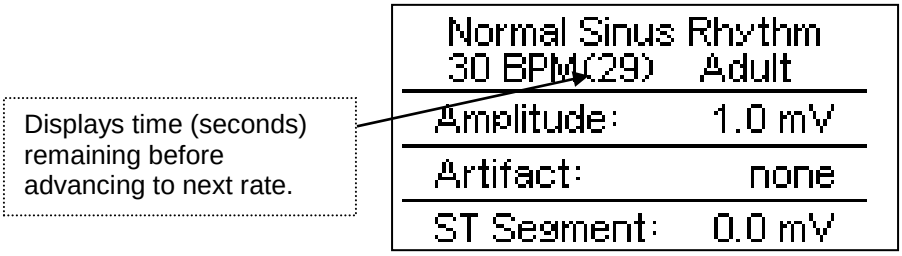


The rate, amplitude, adult/pediatric, artifact and ST elevation or depression can be selected by using  to highlight the parameter to change and using  to scroll to the desired value. Then  is used to accept the new setting.

Alternately, to see a submenu of all the options for a highlighted parameter, use  . Use  to scroll to the desired option. Then  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  key can be used to exit the Auto Mode during the sequence.

NOTE: ST Elevation or Depression is only active in Adult NSR at or below 180 BPM.

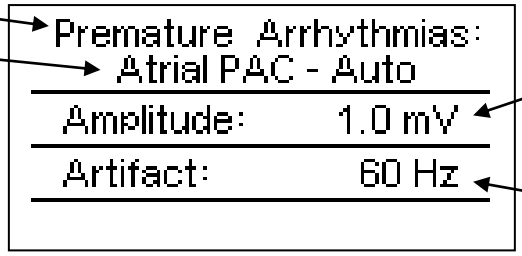
ECG – ARRYTHMIAS

The PS-2105 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. The PS-2105 is placed into ARRHYTHMIA mode by pressing the 

category key.

The display will resemble the following:



AMPLITUDE

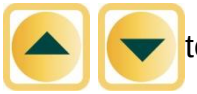
0.5 mV
1.0 mV*
1.5 mV
2.0 mV

ARTIFACT

None*
50 Hz
60 Hz
Muscle
Baseline Wander
Respiration

* Indicates Default Setting (See Power Up Settings)

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

The grouping, 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.

NOTE: 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.

Auto/Manual

There are 12 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-2105 simulates the available Arrhythmias:

PREMATURE		
Abbreviation	**Arrhythmia**	**Description**
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)
Nodal PNC – Auto	Premature Nodal Contraction	NSR of 80 BPM with Periodic Abnormal 25 % early Nodal beat (PNC, 7 NSR) (Continuous)
Nodal PNC – Man	Premature Nodal Contraction	NSR of 80 BPM with Periodic Abnormal 25 % early Nodal beat (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)
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	Standard Type 2 Premature Ventricular Contraction	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	Early Type 2 Premature Ventricular Contraction	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	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 (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)

SUPRAVENTRICULAR		
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	Artial Fibrillation	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 to 100 BPM (Continuous)
Missed Beat – Auto	Missed Beat	NSR of 80 BPM with a missed beat (Missed Beat, 36 NSR) (Continuous)
Missed Beat – Man	Missed Beat	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	Pair of Premature Ventricular Contractions	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	Run of 5 Premature Ventricular Contractions	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	Run of 11 Premature Ventricular Contractions	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)
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	Ventricular Fibrillation	Irregular waveform with no real P-wave or clear R-R interval and a low signal level (Continuous)
Asystole	Asystole	Flat line signal (Continuous)

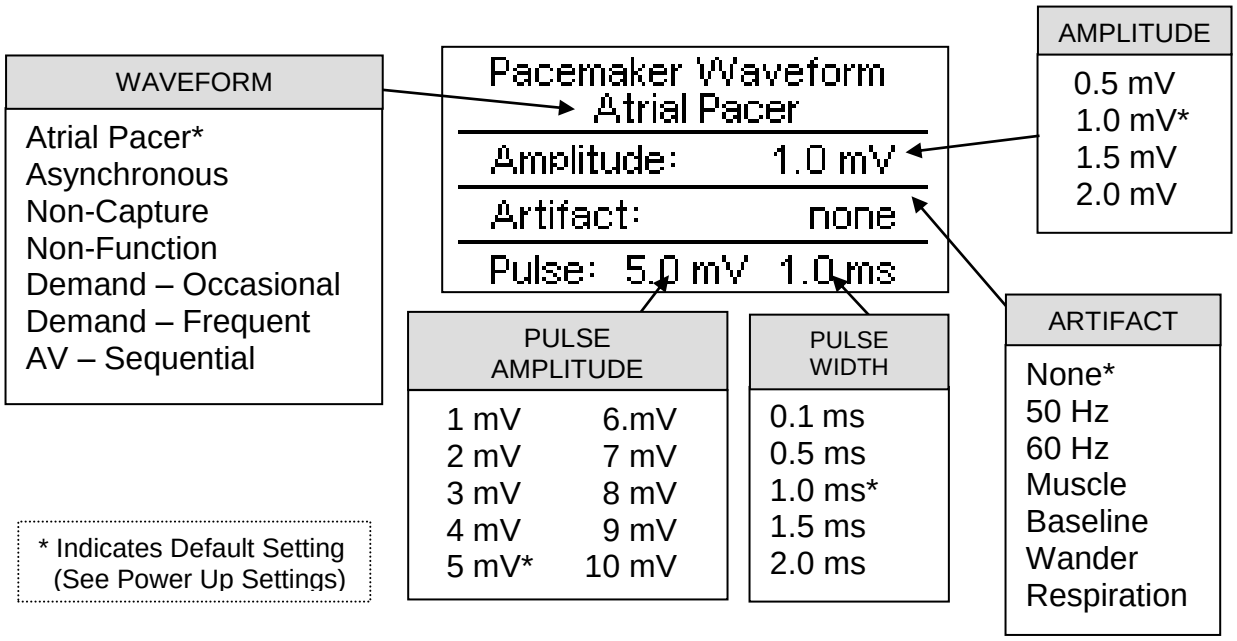
CONDUCTION		
Abbreviation	**Arrhythmia**	**Description**
1st Deg Heart Block	First Degree Heart Block	80 BPM with a long P-R interval of 250 ms (Continuous)
2nd Deg Heart Block	Second Degree Heart Block	80 BPM with increasing P-R interval for four beats (160, 220, 400, 470 ms) followed by a P wave without 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	80 BPM with Normal P-wave and P-R interval but wider QRS complexes (Continuous)

ECG – PACEMAKER

The PS-2105 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.

There are 7 paced simulation signals available which model when a pacemaker accompanies the heartbeat. The PS-2105 is placed into PACEMAKER mode by pressing the Pacemaker category key.

The display will resemble the following:



The pacemaker rhythms and signals 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 

is used to accept the new setting.

The following is a brief description of how the PS-2105 simulates the available Pacemaker Waveforms:

PACEMAKER		
Abbreviation	**Waveform**	**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

ECG – PERFORMANCE

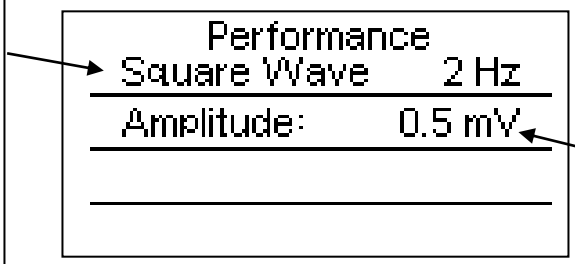
The PS-2105 can send performance waveforms to ECG machines in 3, 5 or 12-lead configurations. It has independent outputs for each signal lead, referenced to the right leg.

There are 15 Performance waves available for testing and verifying. The PS-2105 is placed into PERFORMANCE mode by pressing the 

category key.

The display will resemble the following:

WAVEFORM
Square Wave .125 Hz
Square Wave 2 Hz*
Triangle Wave 2 Hz
Triangle Wave 2.5 Hz
Sine Wave 0.1 Hz
Sine Wave 0.5 Hz
Sine Wave 5 Hz
Sine Wave 10 Hz
Sine Wave 40 Hz
Sine Wave 50 Hz
Sine Wave 60 Hz
Sine Wave 100 Hz
Pulse 30 BPM
Pulse 60 BPM
Pulse 120 BPM
Auto Wave



AMPLITUDE
0.5 mV
1.0 mV*
1.5 mV
2.0 mV

* Indicates Default Setting
(See Power Up Settings)

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

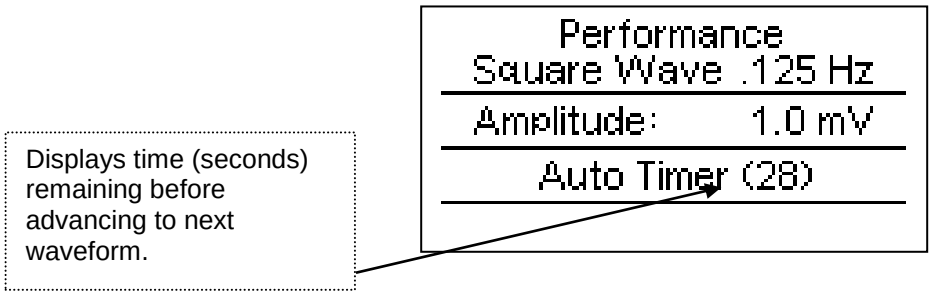
is used to accept the new setting.

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

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:



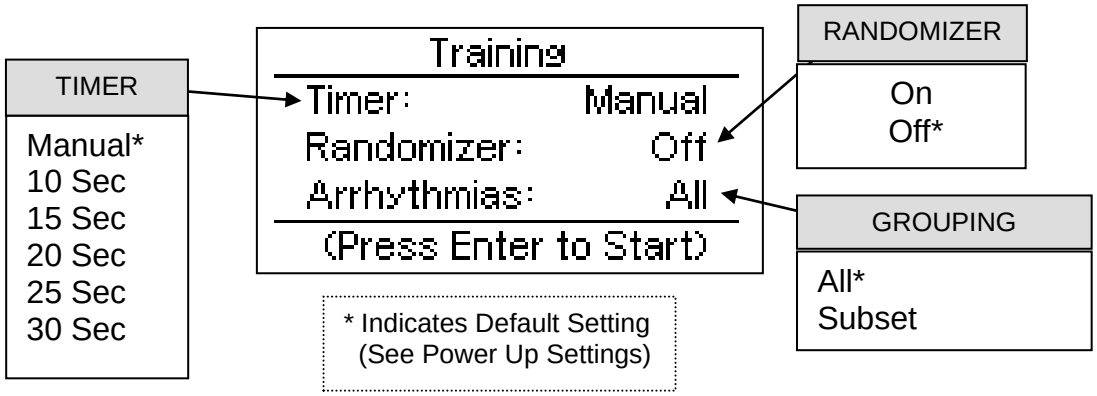
The QUIT key can be used to exit the Auto Mode during the sequence.

TRAINING

The PS-2105 provides the unique feature of a Training Mode to aid the user in practicing the identification of arrhythmias. The unit will sequence through the arrhythmias, allowing the user to look at the output on their equipment, identify the arrhythmia and then verify their conclusion with the correct name shown on the display. The user can select either manual or timed sequencing, as well as whether the arrhythmias will display in order or randomly. Subsets of the Arrhythmias can be selected to allow for individualization.

The PS-2105 is placed into TRAINING mode by pressing the Training category key.

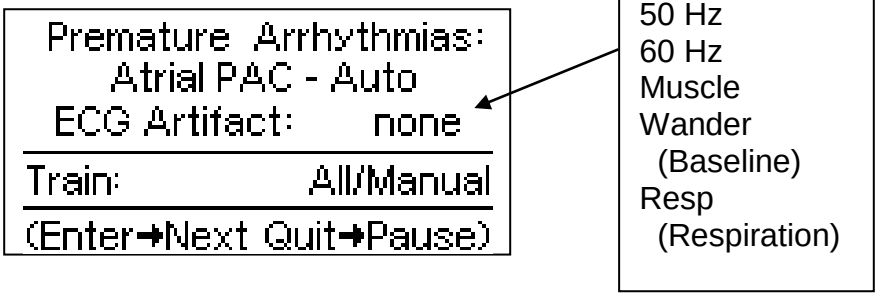
The display will resemble the following:



The Timer, Randomizer and Arrhythmias 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.

When ready to begin the Training, use ENTER. The appropriate arrhythmia screen will be displayed with Training Mode indicated.



If in the timed mode, the unit will switch to the next arrhythmia automatically at the set time. If in the manual mode, use ENTER to go to the next arrhythmia when ready.

To pause or exit the Training Mode during a session, use QUIT. The following message box will be displayed:

SUBSET

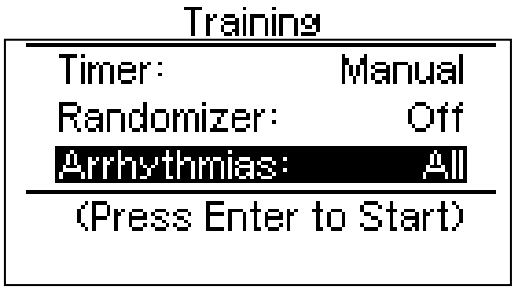
The subset feature allows the user to select specific arrhythmias for a more controlled training. This feature is selected by setting the “Arrhythmias:” parameter to “Subset.”

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.

The following procedure is used to modify the subset:

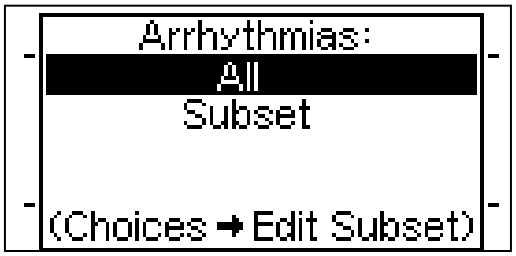
1. From the main screen, highlight Arrhythmias: and use 

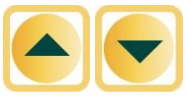
to open the choices screen.

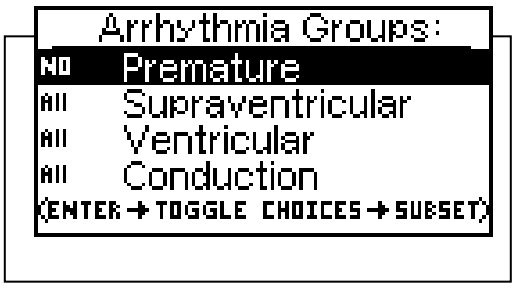


2. Highlight Subset and use 

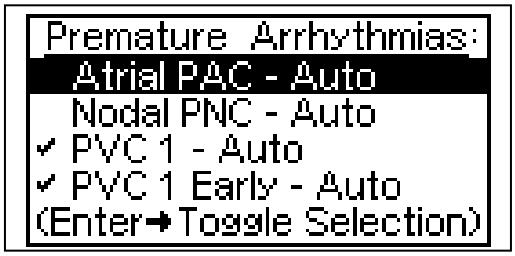
to open the Arrhythmia Groups Submenu screen.



3. To select all the arrhythmias in a group, use  to scroll to the category and  to toggle the indicator to “ALL”. To select none of the arrhythmias in a group, use  to toggle the indicator to “NO”.

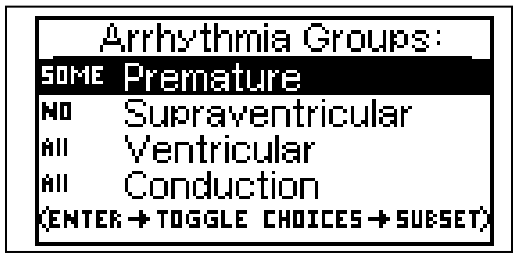


4. To select some of the arrhythmias in a group, use  to display the list of arrhythmias for a specific group. Then use  to scroll through the arrhythmias. Any arrhythmia marked with a check (✔) will be included in the subset. Use  to toggle the selection of an arrhythmia on and off.



NOTE: If the group is pre-selected with “ALL”, all of the arrhythmias will be checked, thus making it easy to deselect a few. If the group is pre-selected with “NO”, none of the arrhythmias will be checked, thus making it easy to select a few.

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,



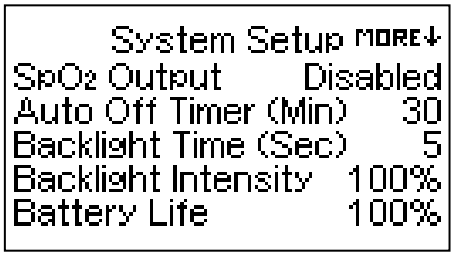
Additional groups may be modified in the same manor. When done with all the groups, use QUIT again to return to the Training Mode.

SETUP

The PS-2105 allows for setup of the System Parameters through the Setup category key.

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
SpO_2 Output	Sets the ability to drive an external SpO_2 module (MSP-2100)	Enabled/Disabled
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%
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)
Contrast Adjust	Sets the contrast of the display screen.	0-20
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 and Performance.	1 to 60 sec
Software	Displays current software program.	(Read Only)

POWER UP SETTINGS

The PS-2105 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, 0.0 mV ST Elevation, Artifact - None, SpO_2 Output Disabled

ECG – Arrhythmia: 1.0 mV, Artifact - None, Premature - Atrial PAC - Auto

ECG – Performance: 2 Hz Square Wave, 1.0 mV

ECG – Pacemaker: Artial, 5 mV Amplitude, 1.0 ms Width

SystemSetup:

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-2105 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.

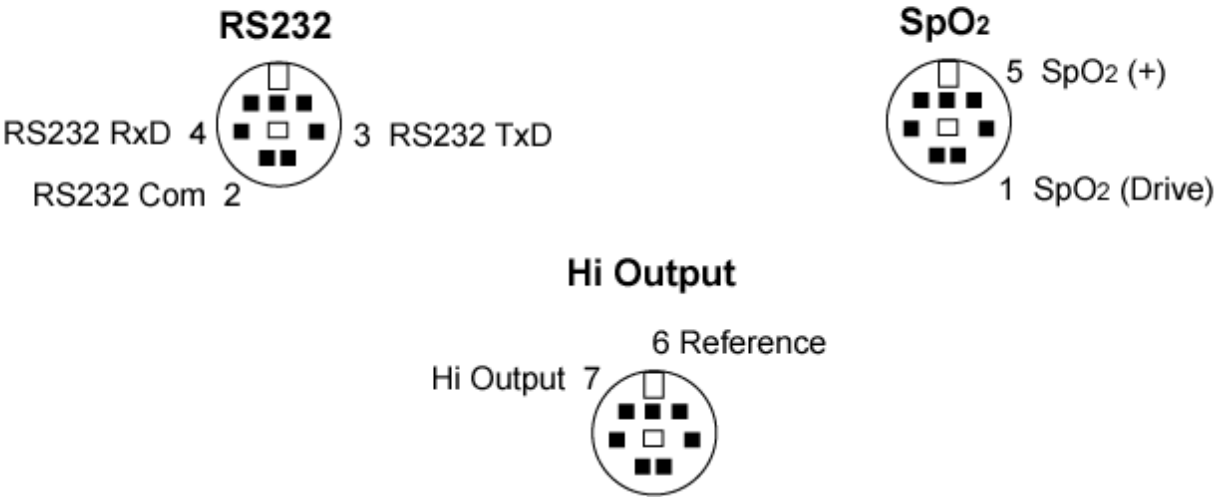
The module plugs directly into the AUX (7 pin mini din) connector and is powered from the PS-2105. The output is only functional when the unit is powered from the Battery Eliminator provided with the MSP-2100 Module, since the batteries do not have enough power to run this option.

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

OUTPUT CONNECTIONS

The following is a representation of the socket connector found on the unit. It is viewed as if looking at the socket in the unit, not the cable pins.

AUX CONNECTOR



MANUAL REVISIONS

Revision #	Program #	Revisions Made
Rev 01	DT7348	Origination
Rev 02	DT7348	Misc. Updates
Rev 03	DT7348	Overlay Additions
Rev 04	DT7348CC	Format Updated, Pictures Updated, Misc. Edits

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.

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

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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.

P:\MANUALS\BCGroup\…\PS-2000\PS2105_UM_Rev04.doc

SPECIFICATIONS

ECG SIMULATION			
RATE	NORMAL SINUS RHYTHM	30, 40, 45, 60, 80, 90, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 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, 2.5 Hz
		PULSE	30, 60, 120 BPM; 60 ms width
	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%	
QRS DURATION	ADULT	80 ms	
	PEDIATRIC	40 ms	
ST SEGMENT (ELEVATION)	± 0, 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 mV		
LEAD TO LEAD IMPEDANCE	1000 Ω		

PACEMAKER WAVEFORMS		
RATE	75 BPM	
	ACCURACY	± 1%
AMPLITUDE	1, 2, 3, 4, 5, 6, 7, 8, 9, 10 mV	
	ACCURACY	± 10%
WIDTH	0.1, 0.5, 1.0, 1.5, 2.0 ms	
	ACCURACY	± 5%

PHYSICAL & ENVIRONMENTAL		
DISPLAY	LCD Graphical 128 X 64 Pixels, White LED Backlight	
CONSTRUCTION	ENCLOSURE	ABS Plastic
	FACE PLATE	Lexan, Back printed
SIZE	8.80 x 6.04 x 1.72 Inches (223.5 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 BC20-21103 (USA Version) BC20-21101 (Euro Version)

NOTES

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PS-2105 Patient Simulator User Manual
09/12 – Rev 04