BC Biomedical
A UNIT OF BC GROUP INTERNATIONAL, INC.

DEFIBRILLATOR ANALYZERS

DA-2006

DA-2006P
W/ PACER ANALYZER

USER MANUAL

BC BIOMEDICAL
DA-2006 SERIES
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This User Manual covers the following units:

- DA-2006
- DA-2006P

WARNING - USERS

The DA-2006 Series Analyzers are for use by skilled technical personnel only.

WARNING - USE

The DA-2006 Series Analyzers are intended for testing only and they should never be used in diagnostics, treatment or any other capacity where they would come in contact with a patient.

WARNING - MODIFICATIONS

The DA-2006 Series Analyzers are intended for use within the published specifications. Any application beyond these specifications or any unauthorized user modifications may result in hazards or improper operation.

WARNING - CONNECTIONS

All connections to patients must be removed before connecting the DUT to the DA-2006 Series Analyzers. A serious hazard may occur if the patient is connected when testing with the Analyzer. Do not connect any leads from the patient directly to the Analyzer or DUT.

WARNING - LIQUIDS

Do not submerge or spill liquids on the DA-2006 Series Analyzers. Do not operate the Analyzer if it may have been exposed to fluid.

CAUTION - CLEANING

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

CAUTION - AC ADAPTOR

Unplug the AC Adaptor before cleaning the surface of the DA-2006 Series Analyzers.

CAUTION - SERVICE

The DA-2006 Series Analyzers are intended to be serviced only by authorized service personnel. Troubleshooting and service procedures should only be performed by qualified technical personnel.

CAUTION - ENVIRONMENT

Exposure to environmental conditions outside the specifications can adversely affect the performance and accuracy of the DA-2006 Series Analyzer. If the Analyzer is outside the Operating Specifications, allow it to acclimate to specified conditions for at least 30 minutes before attempting to operate it.

CAUTION - INSPECTION

The DA-2006 Series Analyzers should be inspected before each use for wear and should be serviced if any parts are in question.

NOTICE – INDICATIONS FOR USE

The DA-2006 and DA-2006P Analyzers are used to determine that defibrillators and transcutaneous pacemakers are performing within their performance specifications through the measurement of energy output. The DA-2006 tests defibrillators while the DA-2006P additionally tests transcutaneous pacemakers.

NOTICE – CE

The DA-2006 Series Analyzers bear the CE mark
Based on the following testing standards:

ELECTROMAGNETIC COMPATIBILITY DIRECTIVE

EMC – Directive 89/336/EEC and 2004/108/EC as amended by 92/31/EEC, 93/68/EEC and 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 and Line Conducted Emissions

EN 61000-3-2	Harmonic Current Emissions
EN 61000-3-3	Voltage Fluctuation and Flicker

IMMUNITY– CLASS C

EN 61000-4-2	Electrostatic Discharge
EN 61000-4-3	Radiated Electric Field Immunity
EN 61000-4-4	Electrical Fast Transients / Bursts
EN 61000-4-5	Surge Voltage
EN 61000-4-6	Conducted Disturbance
EN 61000-4-11	Voltage Dips and Short Interrupts

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**
	**Hazardous Voltage**
	**Per European Council Directive 2002/95/EC, do not dispose of this product as unsorted municipal waste.**
CAT I	IEC Measurement Category I – CAT I equipment designed to protect against transients in equipment on circuits not directly connected to MAINS. Under no circumstances should the terminals of the Analyzer be connected to any MAINS voltage

NOTICE – ABBREVIATIONS

AAMI	**Association for the Advancement of Medical Instrumentation**
AHA	**American Heart Association**
A, Amps	**Amperes**
ANSI	**American National Standards Institute**
ASCII	**American Standard Code for Information Interchange**
BPM	**Beats Per Minute**
C	**Celsius**
°	**degree(s)**
dt	**Delta Time, Change in Time**
DUT	**Device Under Test**
E	**Energy**
ECG	**Electrocardiogram**
Euro	**European**
Hz	**Hertz**
IEC	**International Electrotechnical Commission**
J	**Joule(s)**
kg	**kilogram(s)**
Lbs	**pounds**
µA	**microampere(s)**
µH	**microhenry**
µV	**microvolt(s)**
µsec	**microsecond(s)**
mA	**milliampere(s)**
mm	**millimeter(s)**
ms, mS, msec	**millisecond(s)**
mV	**millivolts**
NEDA	**National Electronic Distributors Association**
Ω	**Ohm(s)**
P	**Power**
ppm	**pulse per minute**
R	**Resistance, ohms**
Sec, S	**seconds**
USA	**United States of America**
V	**Volt(s)**
VDC	**Volt(s) Direct Current**

NOTICE – DISCLAIMER

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BC BIOMEDICAL
DA-2006 SERIES
DEFIBRILLATOR ANALYZER

The Model DA-2006 Series is a microprocessor-based instrument family that is used in the testing of defibrillators. They measure the energy output and provide information about the defibrillation pulse. They are used on manual, semi-automatic and automatic defibrillators with monophasic or biphasic outputs.

The DA-2006P model additionally provides a Transcutaneous Pacemaker analysis function. It measures and displays pacer pulse information as well as performing Refractory Period, Sensitivity and Immunity testing.

All models have a built in 50 Ω human body simulation load as well as 12 lead ECG with arrhythmias and performance waveforms. Additionally, they have a Parallel Printer port, a RS-232 serial communications port, oscilloscope output, high-level ECG output, as well as provision for an AC adaptor.

The DA-2006 Series makes viewing and selecting the desired waveforms and test data quick and intuitive, with all operational information being available on the 240 by 64 pixel graphic display, allowing for easy maneuvering through parameters and scrolling through available options.

The following are highlights of some of the main features:

DA-2006 (Basic Features):

- SIMPLE TO OPERATE
- GRAPHICS DISPLAY WITH SIMULTANEOUS DETAILED STATUS OF PARAMETERS AND SCROLLING CONTROL OF OPTIONS
- ON SCREEN VIEWING OF DEFIBRILLATOR AND PACEMAKER WAVEFORMS
- DROP DOWN CHOICE SCREENS LIST ALL OPTIONS FOR PARAMETERS
- MONOPHASIC AND BIPHASIC COMPATIBLE
- 5000 V, 1000 JOULE CAPACITY
- HIGH AND LOW RANGES
- CARDIOVERSION DELAY MEASUREMENT
- CHARGE TIME MEASUREMENT
- WAVEFORM STORAGE AND PLAYBACK
- 10 UNIVERSAL PATIENT LEAD CONNECTORS
- POWERED BY 9 VOLT BATTERY OR OPTIONAL AC ADAPTOR
- LOW BATTERY INDICATOR
- DISPLAY BACKLIGHT
- PARALLEL PORT FOR PRINTING
- FULL REMOTE OPERATION VIA RS-232
- FLASH PROGRAMMABLE FOR UPGRADES

- AUTO SEQUENCE TESTING CAPABLE OF STORING 50 CUSTOM TEST SEQUENCES

DA-2006P ADDS:

- PACEMAKER OPTION
    - 26 SELECTABLE INTERNAL LOADS
    - FULL PULSE ANALYSIS
    - DEMAND SENSITIVITY TEST
    - REFRACTORY PERIOD TESTS
    - 50/60 Hz INTERFERENCE TEST SIGNALS
    - INPUT TERMINALS AND CIRCUITRY PROTECTED AGAINST ACCIDENTAL DEFIBRILLATOR DISCHARGE INTO PACEMAKER TEST TERMINALS

ENERGY OUTPUT MEASUREMENT GENERAL

The unit measures the energy in the output pulse of both monophasic and biphasic defibrillators.

- PULSE TYPE: Monophasic or Biphasic
- LOAD RESISTANCE: 50 Ω ± 1%, non-inductive (<1 µH)
- DISPLAY RESOLUTION: 0.1 Joules
- MEASUREMENT TIME WINDOW: 100 ms
- ABSOLUTE MAX PEAK VOLTAGE: 6000 Volts
- CARDIOVERSION DELAY: 0 to 6000 ms
- CARDIOVERSION RESOLUTION: 0.1 ms

ENERGY OUTPUT MEASUREMENT HIGH RANGE

The high range allows for a large pulse with high voltage and current.

- VOLTAGE: ≤ 5000 Volts
- MAX CURRENT: 100 Amps
- MAX ENERGY: 1000 Joules
- TRIGGER LEVEL: 100 Volts
- PLAYBACK AMPLITUDE: 1 mV / 1000 V Lead I
- TEST PULSE: 125 Joules ± 20%

ENERGY OUTPUT MEASUREMENT LOW RANGE

The low range allows greater resolution on smaller pulses.

- VOLTAGE: < 1000 Volts
- MAX CURRENT: 20 Amps
- MAX ENERGY: 50 Joules
- TRIGGER LEVEL: 20 Volts
- PLAYBACK AMPLITUDE: 1 mV / 1000 V Lead I
- TEST PULSE: 5 Joules ± 20%

ENERGY OUTPUT MEASUREMENT OTHER

OSCILLOSCOPE OUTPUT

- HIGH MEASUREMENT RANGE: 1000:1 amplitude-attenuated
- LOW MEASUREMENT RANGE: 200:1 amplitude-attenuated

WAVEFORM PLAYBACK

- OUTPUT – LEAD 1 & PLATES
- GRAPHICS SCREEN
- 200:1 Time Base Expansion

SYNC TIME MEASUREMENTS

- TIMING WINDOW: Starts at peak of each R-wave
- TEST WAVEFORMS: All waveform simulations available

CHARGE TIME MEASUREMENT

- From 0.1 to 99.9 sec

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, 40, 45, 60, 80, 90, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300 BPM
- AMPLITUDE: 0.50, 1.0, 1.5, 2.0 mV (Lead II)

ECG PERFORMANCE FUNCTIONS

The unit can generate Sine, Square, Triangular, and Pulse waveforms with adjustable amplitudes for performance testing.

- SINE: 0.1, 0.2, 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)

ARRHYTHMIA FUNCTIONS

The unit can simulate 12 different arrhythmias.

- VENTRICULAR FIBRILLATION
- ATRIAL FIBRILLATION
- SECOND DEGREE A-V BLOCK
- RIGHT BUNDLE BRANCH BLOCK
- PREMATURE ATRIAL CONTRACTION
- EARLY PVC
- STANDARD PVC
- R ON T PVC
- MULTIFOCAL PVC
- BIGEMINY
- RUN OF 5 PVC
- VENTRICULAR TACHYCARDIA

SHOCK ADVISORY TESTS

The unit can simulate 8 different waveforms to test the shock algorithm of advanced defibrillators:

- ASYSTOLE
- COARSE VENTRICULAR FIBRILLATION
- FINE VENTRICULAR FIBRILLATION
- MULTIFOCAL VENTRICULAR TACHYCARDIA @ 140 BPM
- MULTIFOCAL VENTRICULAR TACHYCARDIA @ 160 BPM
- POLYFOCAL VENTRICULAR TACHYCARDIA @ 140 BPM
- POLYFOCAL VENTRICULAR TACHYCARDIA @ 160 BPM
- SUPRAVENTRICULAR TACHYCARDIA @ 90 BPM

TRANSCUTANEOUS PACER ANALYZER (DA-2006P)

The unit can test external transcutaneous pacemakers. It has a wide variety of loads and can measure the Pacer Pulse, Demand Sensitivity and Refractory Periods (Pacing and Sensing):

- LOAD:
  - RANGE: 50, 100, 150, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800, 1900, 2000, 2100, 2200, 2300 Ω
- PULSE:
  - PULSE CURRENT: 4 TO 300 mA (100 ohm load)
  - RATE: 30 TO 800 ppm
  - WIDTH: 0.6 to 80 ms
- DEMAND SENSITIVITY:
  - WAVEFORMS:
    - SELECTIONS: SQUARE, TRIANGLE, HAVERSINE
    - WIDTH: 10, 25, 40, 100, 200 ms
  - ECG:
    - AMPLITUDE – OUT: 0 to 4 mV
  - PACER INPUT (50 TO 400 Ω):
    - AMPLITUDE – OUT: 0 to 10 mV / 50 Ω
    - RATE – IN: 30 to 100 ppm
  - PACER INPUT (500 TO 2300 Ω & OPEN):
    - AMPLITUDE – OUT: 0 to 100 mV
    - RATE – IN: 30 to 100 ppm
  - DEFIBRILLATOR PLATES:
    - AMPLITUDE – OUT: 0 to 10 mV
    - RATE – IN: 30 to 100 ppm
- REFRACTORY PERIOD:
  - PACING: 20 to 500 ms
  - SENSING: 20 to 500 ms
- 50/60 HZ INTERFERENCE TEST SIGNAL:
  - ECG OUTPUT: 0, 0.4, 0.8, 1.2, 1.6, 2.0, 2.4, 2.8, 3.2, 3.6, 4.0 mV
  - PACER INPUT 50 OHM: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 mV
  - PACER INPUT 100 OHM: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20 mV
  - PACER INPUT 150 OHM: 0, 3, 6, 9, 12, 15, 18, 21, 24, 27, 30 mV
  - PACER INPUT 200 OHM: 0, 4, 8, 12, 16, 20, 24, 28, 32, 36, 40 mV
  - PACER INPUT 300 OHM: 0, 6, 12, 18, 24, 30, 36, 42, 48, 54, 60 mV
  - PACER INPUT 400 OHM: 0, 8, 16, 24, 32, 40, 48, 56, 64, 72, 80 mV
  - PACER INPUT ≥ 500 OHM: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 mV
  - DEFIBRILLATOR PLATES: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 mV
- INPUT CIRCUITRY PROTECTION
  - INPUT CIRCUITRY IS PROTECTED AGAINST DAMAGE IN THE EVENT OF AN ACCIDENTAL DEFIBRILLATOR DISCHARGE INTO THE PACEMAKER TEST INPUT TERMINALS

STANDARD ACCESSORIES:

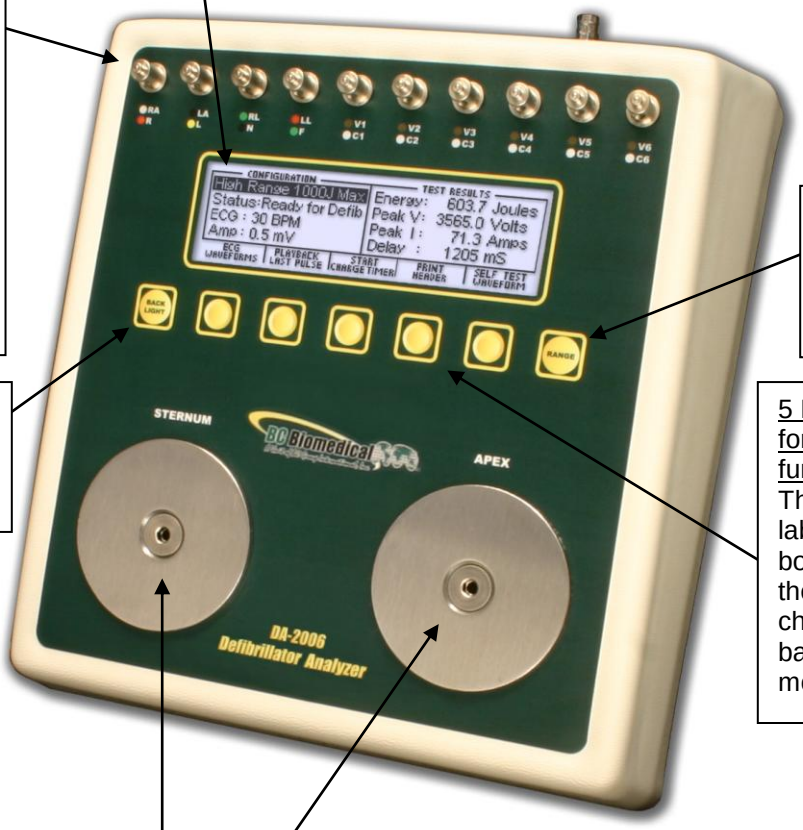
BC20 - 00432	INTERNAL PADDLE ADAPTERS (2 adapters)
BC20 - 21103	AC ADAPTOR (USA Version)
(or)	
BC20 - 21101	AC ADAPTOR (Euro Version)
BC20 - 00427	PLASTIC ELECTRODE PLATES (2 plates)

OPTIONAL ACCESSORIES:

BC20 - 30108	BC BIOMEDICAL SOFT-SIDED CARRYING CASE
BC20 - 41341	RS-232 COMMUNICATIONS CABLE (DB-9M to DB-9F)
BC20 - 41339	USB TO RS-232 ADAPTER (USB-A TO DB-9M)
BC20 - 00420	PHYSIO-CONTROL DEFIB / PACE TEST CABLE
BC20 - 00421	MARQUETTE DEFIB / PACE TEST CABLE
BC20 - 00423	ZOLL DEFIB/PACE TEST CABLE
BC20 - 00424	PHYSIO-CONTROL PACE ONLY TEST CABLE
BC20 - 00425	ZOLL PACE ONLY TEST CABLE
BC20 - 00426	HP / AGILENT / LAERDAL / AAMI DEFIB / PACE TEST CABLE

LAYOUT

This section looks at the layout of a DA-2006 and gives descriptions of the elements that are present.



LCD Graphical Display:
Shows Parameters for Test Data and Waveforms

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

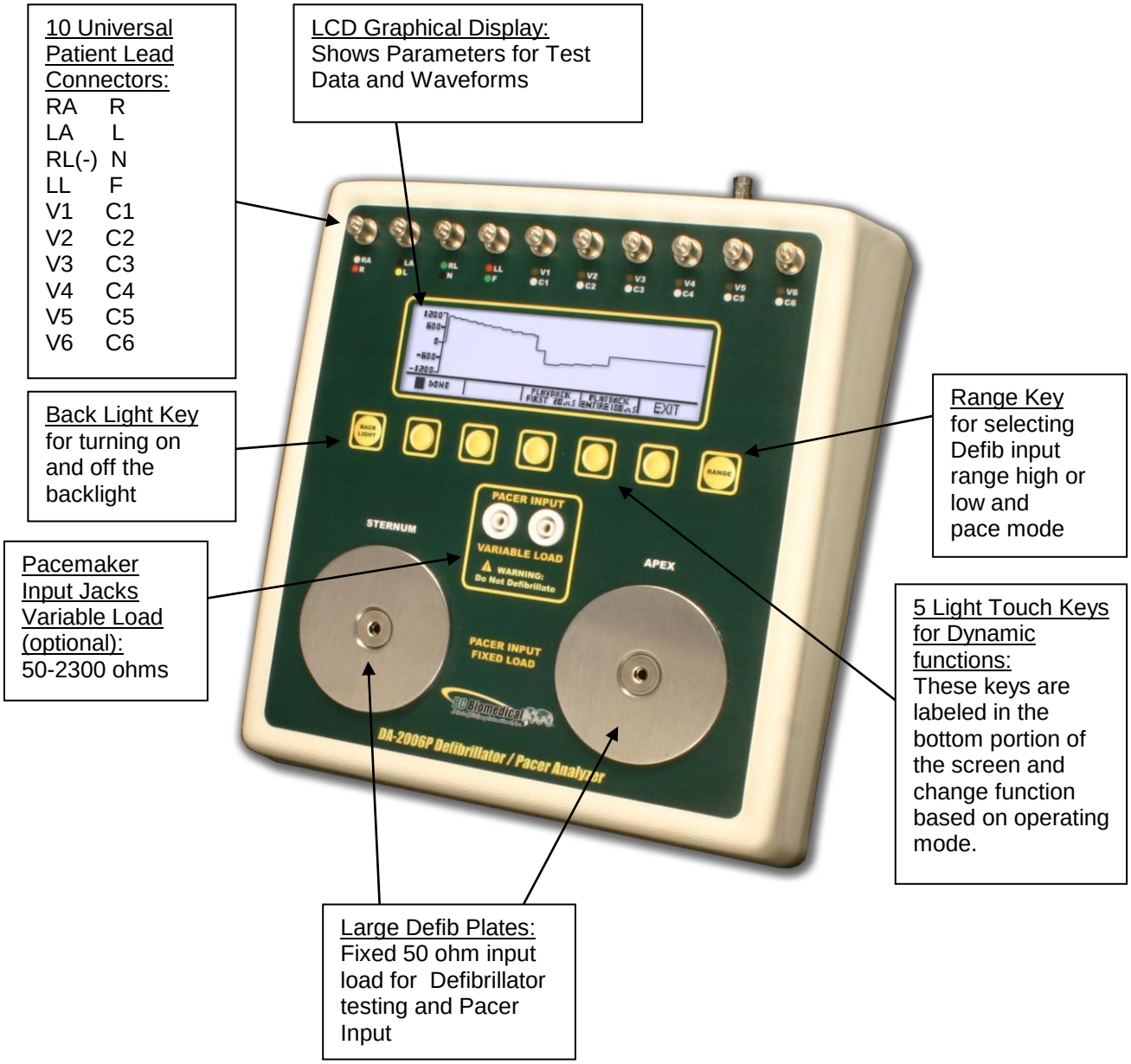
Range Key
for selecting Defib input range high or low

Back Light Key
for turning on and off the backlight

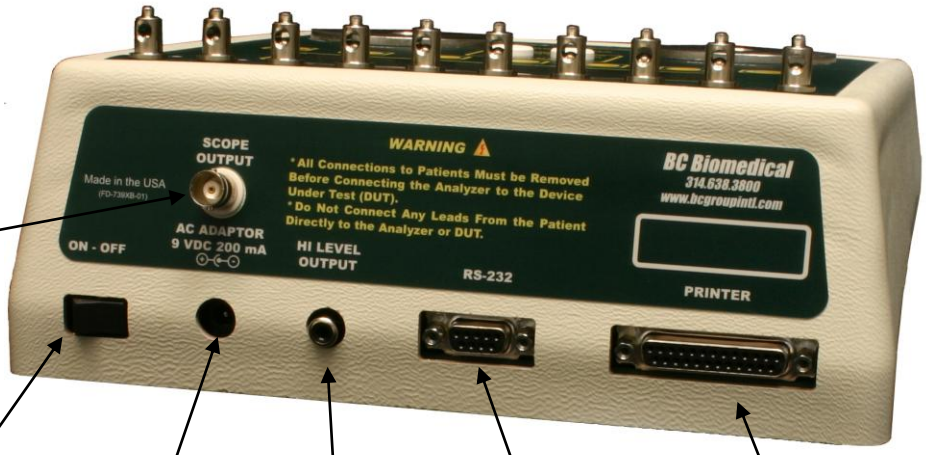
5 Light Touch Keys for Dynamic functions:
These keys are labeled in the bottom portion of the screen and change function based on operating mode.

Large Defib Plates:
Fixed 50 ohm input load for Defibrillator testing

This section looks at the layout of a DA-2006P and gives descriptions of the elements that are present.



This section looks at the layout of the back and gives descriptions of the elements that are present.



Oscilloscope output
BNC connector for easy viewing of input waveforms

Power Switch

AC Adaptor:
2.1 mm Jack

High Level ECG output
RCA Jack

Serial Port
Female 9-Pin D-Sub Connector

Parallel Port
Female 25-Pin D-Sub Connector

NOTE

The DA-2006 and the DA-2006P offer the same features, with the DA-2006P having the addition of a Transcutaneous Pacemaker Analyzer function (See Pacemaker Analyzer section for more details).

General Operation

The unit is controlled by 7 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 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 large LCD graphics display with backlight provides the user with information about the current status of the device configuration options, test results and more. The display identifies the function of each key on a dynamic basis. As the operation mode changes, the key functions change to suit the operating mode.

Range Key

The 

key scrolls through the ranges of the DA-2006 Series analyzers. Depressing the key will allow the user to select between High Defibrillator Range (1000J max), Low Defibrillator Range (50J max) and, with the DA-2006P, Pacemaker Range. The default mode on power up is High Defibrillator Range.

Backlight Key

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 user programmable delay when running on battery power.

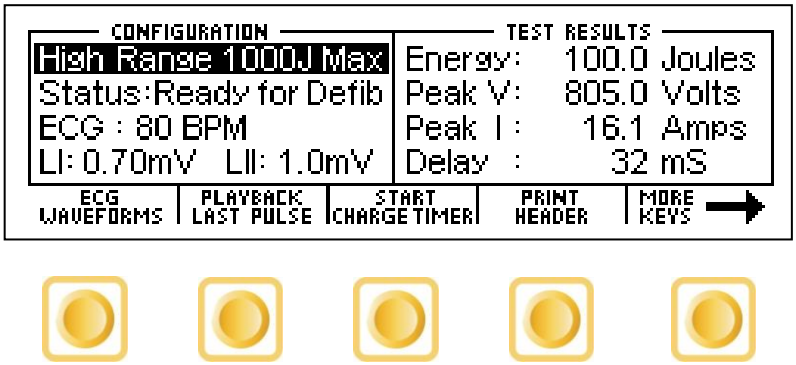
The 

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

Function Keys

There are five  keys that are used to provide general operational control. The functions of the keys vary depending on the current screen. The section of the screen just above the key indicates its current meaning.

NOTE: Only functions that are available to the user will be visible at any given time.



Sample Function Key Labeling

ECG Waveforms

The microprocessor sends the waveforms to a Digital to Analog converter that generates an accurate analog representation. The waveforms are then sent through a resistor network, developing the appropriate signals on the output terminals.

Universal Patient Lead Connectors

The 10 Universal Patient Lead Connectors allow for 12 lead ECG simulations. 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 (V1-V6) (U.S. and Canada) also referred to as pericardial, precordial or unipolar chest leads Chest Leads (C1-C6) (International)

High Level Output (+)

A high level ECG output signal (200x Amplitude Setting) is available on the RCA jack located on the rear of the unit.

RS-232 Serial Port

A female 9-pin D-Sub connector is provided for the connection of the unit to a PC. This link can be used for either remote interfacing or flash downloading of software upgrades.

Parallel Port

A female 25-pin D-Sub connector is provided for the connection of a printer via a Centronics parallel interface.

Oscilloscope Output

A BNC connector is provided to connect an oscilloscope to the unit. This output provides an attenuated version of the input signal.

Power Switch

A rocker switch is provided on the rear of the unit to turn the power on and off.

Battery

The unit utilizes two 9 Volt Alkaline Batteries in the bottom battery compartments. When the unit detects a LOW BATTERY condition (10% Battery Life), a warning window will appear once per minute to alert the user.

AC Adaptor

The unit has a 2.1 mm jack for powering the unit with an AC Adaptor.

Note: The AC Adaptor does not charge the batteries.

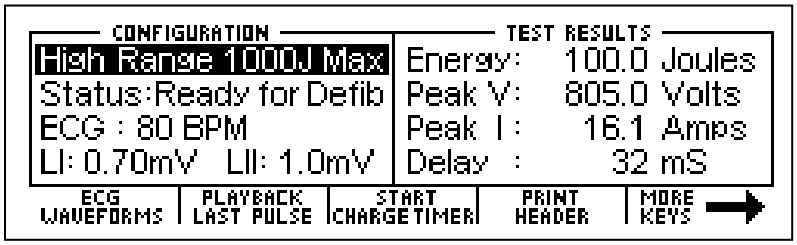
DEFIBRILLATOR ANALYZER

MAIN SCREEN

When the DA-2006 is first powered up, the Defibrillator Analyzer MAIN SCREEN will be displayed. This screen shows the current CONFIGURATION, the TEST RESULTS and the available FUNCTION KEYS. All defibrillator tests are run from the MAIN SCREEN. When the unit detects an input of greater than 100 Volts on the Defibrillator Plates (20 Volts in Low Range), it will automatically begin a test.

The default configuration is the High Range Defibrillator mode. This mode allows for a waveform of up to 1000 Joules to be analyzed.

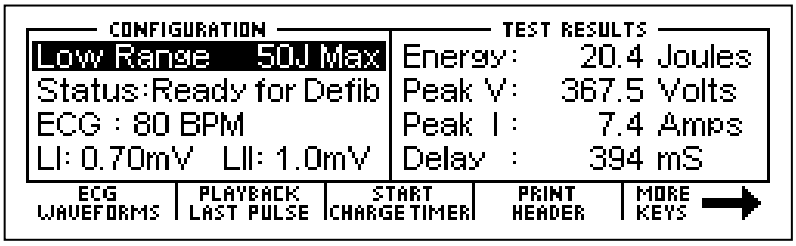
The following is a sample screen for this mode:



The 

key may be used to toggle the unit to the Low Range Defibrillator mode. This mode allows for waveforms up to 50 Joules to be analyzed. The Defibrillator Analyzer works the same in both ranges. The lower range simply provides for a higher resolution for pulses with smaller amplitudes.

The following is a sample screen for this mode:

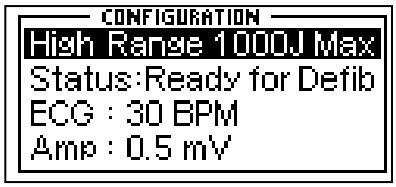


NOTE: The 

key will also put the DA-2006P into the Transcutaneous Pacemaker Analyzer mode (See Pacemaker Analyzer section for more information).

CONFIGURATION

The CONFIGURATION section of the MAIN SCREEN displays the current setup of the unit.



RANGE

The first line displays the range value for the pulse. It may be either 1000 Joules or 50 Joules max. This setting may be changed using the 

key.

NOTE: This line also allows for the selection of the Pacer Analyzer that is an option available in the DA-2006P model. The 

key will toggle to Pacer to put the unit into the Pacemaker Analyzer mode (See Pacemaker Analyzer section for more information).

STATUS

This line provides information about the current status of the analyzer.

ECG

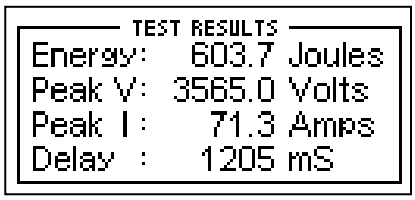
This line displays the selection that is active on the ECG terminals. This setting may be changed in the ECG WAVEFORMS screen.

AMP

This line displays the amplitude that has been selected for the ECG terminals. This setting may be changed in the ECG WAVEFORMS screen.

TEST RESULTS

The TEST RESULTS section of the MAIN SCREEN displays the results of the last pulse. It will continue to be displayed until the power is turned off, another test is run or the range is changed.



NOTE: The unit automatically starts a test when it sees a voltage greater than 100 Volts on the Defibrillator Plates (20 Volts in Low Range).

NOTE: Test results are immediately sent to the printer port as soon as the data is available.

ENERGY

This line displays the total energy of the last pulse.

PEAK V

This line displays the peak voltage of the last pulse.

PEAK I

This line displays the peak current of the last pulse.

DELAY

This line normally displays the delay from the peak of the R wave until the start of the Defib Energy pulse. The line is replaced by the CHARGE TIME if this test has been run (see START CHARGE TIMER SCREEN for more information).

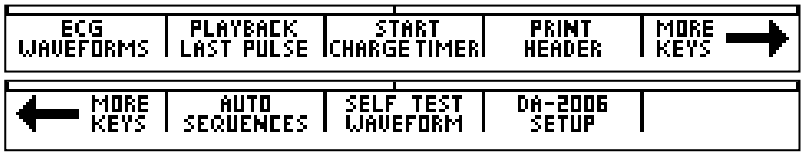
CHG TIME

This line displays if the Charge Timer has been run. It shows the time required to charge the Device Under Test (DUT). This test is started with the 

key.

FUNCTION KEYS

The FUNCTION KEYS section of the MAIN SCREEN displays the current functions of the keys found below the display. These keys allow for navigation to supporting screens and initiation of specific features.



ECG WAVEFORMS

This key enters the ECG WAVEFORMS screen where all ECG parameters are set.

PLAYBACK LAST PULSE

This key enters the PLAYBACK LAST PULSE screen where a graphical representation of the last pulse may be viewed and sent out.

START CHARGE TIMER

This key brings up the CHARGE TIMER screen and starts the pre-warn timer. It is used to test the charge time for the defibrillator.

PRINT HEADER

This key sends the Report Header to the printer.

MORE KEYS

These keys toggle between the Primary and Secondary Function Keys.

AUTO SEQUENCES

This key brings up the AUTO SEQUENCE MENU, which is used to view or run the Auto Sequences stored in the unit.

SELF TEST WAVEFORM

This key sends an internal test pulse to the unit, allowing for the display of the results to give an indication that the system is working properly.

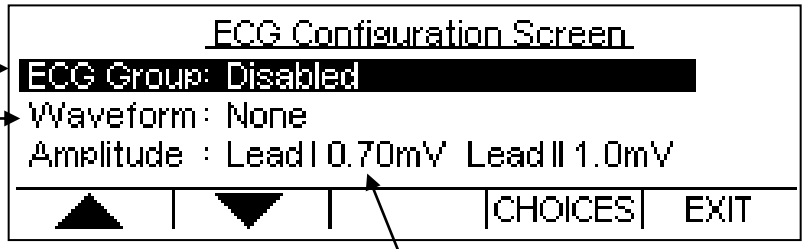
DA-2006 SETUP

This key brings up the SYSTEM CONFIGURATION SCREEN, which allows for adjusting the various system configuration parameters.

ECG WAVEFORMS SCREEN

The DA-2006 ECG output can be connected in 3, 5 or 12 lead configurations. Pressing the ECG WAVEFORMS key from the MAIN SCREEN will allow the user to configure the waveform that is used for the ECG output.

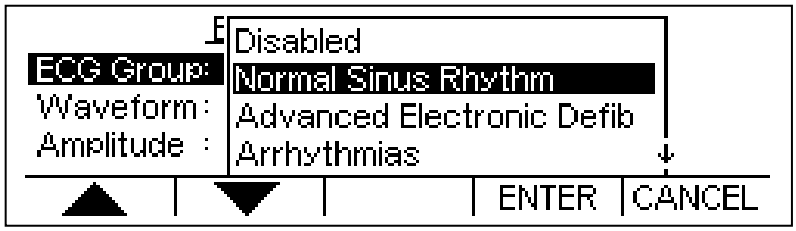
The following is a sample of the ECG waveform configuration screen:



ECG GROUP	WAVEFORM
Disabled	None
NSR	30,40,45,60,80,90, 100,120,140,160, 180,200,220,240, 260,280,300 BPM
AED	Asystole
	Coarse Vfib
	Fine Vfib
	Multifocal Vtach 140
	Multifocal Vtach 160
	Polyfocal Vtach 140
	Polyfocal Vtach 160
	SupraVent Tach 90
Arrhythmias	Vfib
	Afib
	Second Deg Block
	RBBB
	PAC
	PVC Early
	PVC STD
	PVC R on T
	MF PVC
	Bigeminy
	Run of 5 PVC
	Vtach
Performance	0.125, 2 Hz Square
	2, 2.5 Hz Triangle
	0.1,0.2,0.5,5,10,40,50,60,100 Hz Sine
	30, 60, 120 BPM Pulse

AMPLITUDE
Lead I 0.35 mV Lead II 0.5 mV Lead I 0.70 mV Lead II 1.0 mV Lead I 1.05 mV Lead II 1.5 mV Lead I 1.40 mV Lead II 2.0 mV

The ECG Group, Waveform and Amplitude can be selected using ▲▼ to highlight the parameter and using CHOICES to open a drop down menu of all the options for the highlighted parameter.



Use ▲▼ to scroll to the desired option. Then ENTER is used to accept the new setting. The CANCEL key can be used to return to the ECG waveform configuration screen without making a new selection.

The EXIT key is used to return to the MAIN SCREEN.

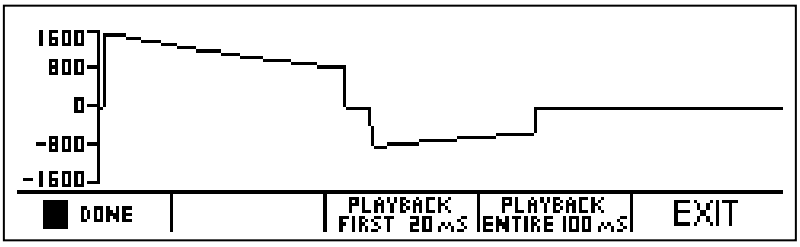
The following is a brief description of how the DA-2006 simulates the available arrhythmias:

Abbreviation	Arrhythmia	Description
Vent Fib – Fine	Ventricular Fibrillation	Irregular waveform with no real P-wave or clear R-R interval and a low signal level (Continuous)
Atrial Fib	Atrial Fibrillation	Absence of P-wave, irregular P-R interval rate and a high level signal (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)
PAC	Premature Atrial Contraction	NSR of 80 BPM with Periodic Abnormal 25% early P waves (PAC, 7 NSR) (Continuous)
PVC Early	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 Std	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 R on T	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)
Multifocal PVCS	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)
Bigeminy	Bigeminal Rhythm	NSR of 80 BPM with every other beat a Type 1 PVC (Continuous)
Run of 5 PVCs	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)
Vent Tach	Ventricular Tachycardia	160 BPM, No P-wave, Beats similar to Type 1 PVC (Continuous)

PLAYBACK LAST PULSE SCREEN

The DA-2006 can display a graphical representation of the last pulse. This screen may be accessed by pressing the PLAYBACK LAST PULSE key from the Defibrillator Analyzer MAIN SCREEN. The playback allows the user to view the Defibrillator pulse in a time-expanded form. Samples are stored internally at 0.1 ms intervals. The PLAYBACK LAST PULSE SCREEN shows these samples expanded by a time factor of 200.

In playback mode, the samples are shown on the display and sent out the ECG leads, Defibrillator Plates and the High Level output. The following is a sample of the waveform that is shown in the display:



The scale shown on the screen is automatically adjusted to provide the maximum resolution available.

The PAUSE key can be used to pause the screen at any point while a pulse is being played back. This key replaces the DONE key when a pulse is being played back.

The PLAY key can be used to play (continue) the waveform if it has been paused. This key replaces the PAUSE key.

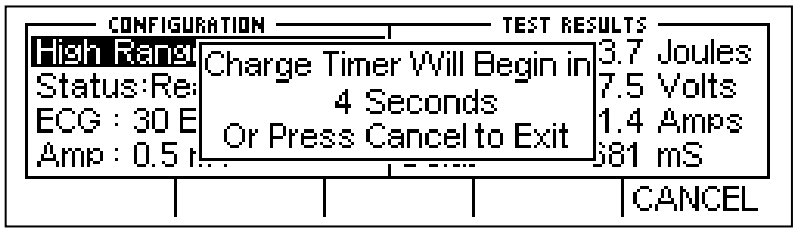
The PLAYBACK FIRST 20 MS key starts a playback of only the first 20 ms of the waveform.

The PLAYBACK ENTIRE 100 MS key starts a playback of the entire 100 ms of the waveform.

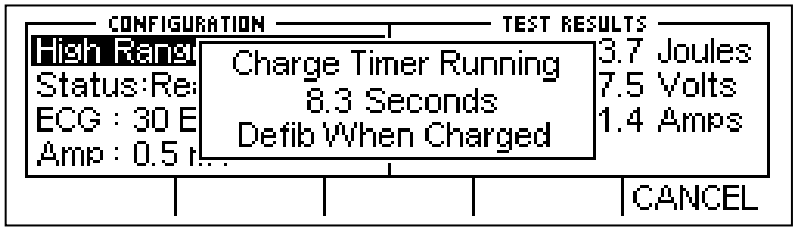
At any time, the EXIT key or ■ DONE key can be depressed to return to the MAIN SCREEN.

START CHARGE TIMER SCREEN

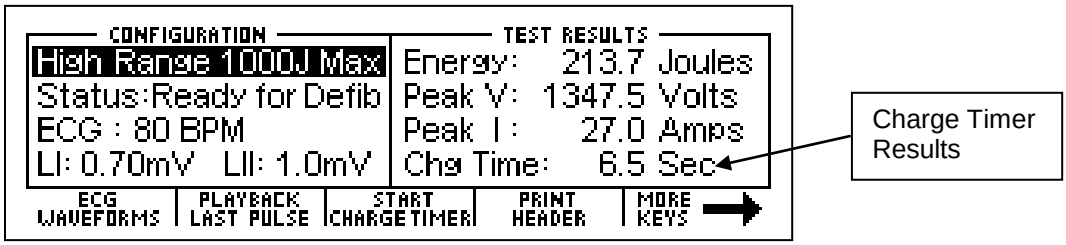
A special timer has been incorporated into the DA-2006 to analyze the charging circuit of the Device Under Test (DUT). The START CHARGE TIMER SCREEN can be accessed by pressing the START CHARGE TIMER key from the MAIN SCREEN. To synchronize the charge timer with the defibrillator charge time, a Pre-Warning Countdown period is started. When the timer reaches zero, the defibrillator charge should be initiated. The following is an example of the countdown timer:



When the timer reaches zero, a beep will sound and the charge timer will begin counting up. The following is an example of the count up timer:



The DUT should be discharged as soon as it becomes charged. When the DUT is discharged, the timer will automatically stop. The display will show the results of the Defibrillator pulse analysis as well as the time required to charge the DUT:

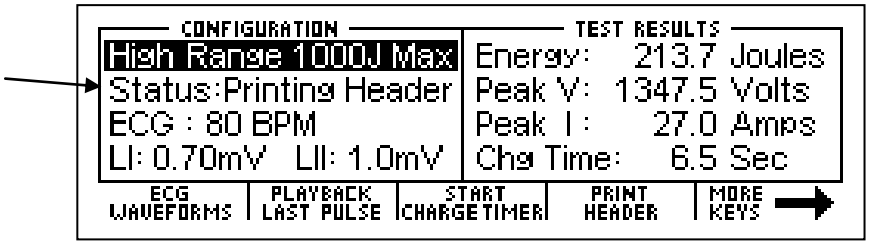


At any time, the CANCEL key can be depressed to end the timer and return to the MAIN SCREEN.

PRINT HEADER

The DA-2006 provides a header for recording test data as well as the results of each pulse that is discharged into the unit. Test results are immediately sent to the printer port as soon as the data is available. The header is sent by pressing the PRINT HEADER key from the MAIN SCREEN.

The status line of the configuration section will indicate that the header has been sent to the printer.



The following is the print header and sample data that are used for the Defibrillator Analyzer mode.

BC Biomedical
DA-2006 Defibrillator Analyzer

DA-2006 Serial Number: _____
Dut Manufacturer: _____
Dut Model: _____
Dut Serial Number: _____
Technician: _____
Location: _____

Date: _____

PASS FAIL

Comments: _____
_____
_____

Test Data:

Test#	Ecg Wave	Ecg Amp	Defib Load	Dut Setting	DA-2006 Measurements: Energy	Voltage	Current	Dely/ChgT
1	None	1.0 mV	50ohm	_____J	112.5J	1085.0V	21.7A	0mS

NOTE: Printing the header also resets the test number printed on the data sheet.

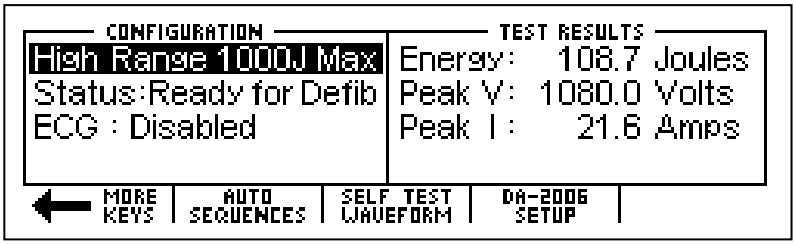
NOTE: In the test results, the user must manually write the power setting of the DUT.

SELF TEST WAVEFORM

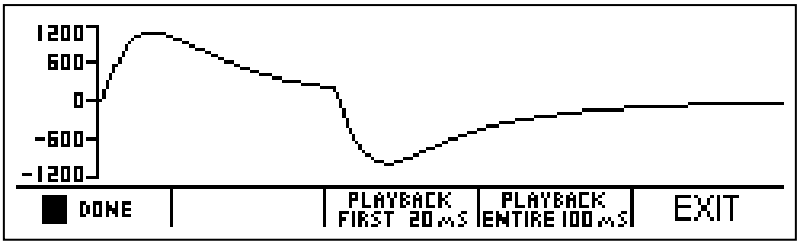
The DA-2006 has built in test waveforms that will give an indication that the system is working properly. The Self Test Waveform may be sent by pressing the SELF TEST WAVEFORM key from the MAIN SCREEN.

After the waveform has been sent, the results will be reflected in the test results section of the MAIN SCREEN and the PLAYBACK LAST PULSE SCREEN. The Self Test Waveform is not calibrated, but will provide a waveform that is approximately 125 Joules when configured for the High Range and 5 Joules when configured for the Low Range.

The following is an example of the MAIN SCREEN with the results of the Self Test Waveform:



The following is an example of the PLAYBACK LAST PULSE SCREEN, showing a graphical representation of the Self Test Waveform:



RUNNING A DEFIBRILLATOR TEST

WARNING - CONNECTIONS

All connections to patients must be removed before connecting the DUT to the DA-2006 Series Analyzers. A serious hazard may occur if the patient is connected when testing with the Analyzer. Do not connect any leads from the patient directly to the Analyzer or DUT.

INTRODUCTION

The DA-2006 will analyze the pulse output of a monophasic or biphasic defibrillator. The primary measure of the output is the Energy that it contains. Other information deals with the maximum voltage and current as well as the pulse timing with respect to the R-wave.

The human body has characteristic impedance that may vary, but 50 ohms is used for comparative defibrillator testing. The DA-2006 has a large internal 50 ohm non-inductive, high-power resistor to simulate a human body. It is sized to safely and reliably accept repeated pulses at the maximum energy levels.

The energy contained in a pulse is determined mathematically based on the fact that the energy is defined as the integral of the power curve. The following formulas describe the basic computation:

Power: $P = V^2 / R$

Energy: $E = \int P \, dt$

$= \int V^2 / R \, dt$

$= \int V^2 \, dt / R$

This computation is implemented digitally by taking timed samples of the voltage every 100 µsec for 100 msec (1000 readings). Each value is then squared and divided by the resistance (50 ohms). The sum of these 1000 values times 10 is then the Energy in Joules (Watt Seconds) contained in the pulse.

DEFIBRILLATION TEST

The setup for a Defibrillation Test is dependent on the physical hardware involved. For the sake of this example we will assume a standard defibrillator with 5 lead ECG.

NOTICE – PERFORMING TESTS

REFER TO DUT MANUFACTURER'S SERVICE MANUAL FOR TEST PROCEDURES AND MEASUREMENT LIMITS.

(1) Connect ECG leads to the corresponding universal connector on the DA-2006. The connectors are marked with both the AHA and International color codes.

(2) Turn on the DA-2006.

(3) The unit will come up in the "High Range Defibrillator" mode. This range is used for normal adult testing.

NOTE: If it is desirable to run a test at 50 Joules or less with a peak voltage of 1000 Volts or less, the unit may be changed to the "Low Range Defibrillator" mode using the 

key.

(4) Select "Ventricular Fibrillation" from the ECG WAVEFORM SCREEN with an amplitude of 1 mV. This is necessary for most automatic defibrillators.

(5) Place the Defibrillator Paddles on the DA-2006 contact plates. The APEX is on

the right and the STERNUM is on the left.

NOTE: Reversing the paddles will not cause any damage to the unit or error in the energy reading. However, it will cause the polarity of the oscilloscope output and the playback waveform to be inverted.

(6) Holding the paddles firmly in place, charge the Defibrillator and discharge it into the DA-2006.

WARNING

Observe all precautions noted by the Defibrillator Manufacturer when using the Defibrillator.

(7) The DA-2006 will automatically sense the voltage rise across the internal 50 ohm load and begin taking readings. After the sampling is done (100 ms) the unit will compute and display the results.

a. The power pulse is available at the oscilloscope output in real time at 200:1 signal attenuation when in low range and 1000:1 signal attenuation when in high range.

b. After the computation, the pulse is automatically played back at a 200:1 time base expansion (200 times slower) on both the ECG leads and the Paddle plates. The signal level is 1 mV per 1000 Volts on Lead 1.

c. At the same time, the test results are sent to the printer.

(8) The Status line will change to indicate the various steps as they are being done.

(9) At the end of the process the results are continuously displayed in the Test Results section of the MAIN SCREEN. They will remain there until another test is performed, the range is changed or the power is turned off.

(10) The user may repeat the playback of the waveform at any time by changing to the PLAYBACK LAST PULSE SCREEN using the PLAYBACK LAST PULSE key. In this screen the pulse may be viewed in 20 msec segments and paused for review.

NOTE: The pulse is sent to the ECG and Paddle outputs at the same time it is being displayed on the screen.

CARDIOVERSION TEST

A Cardioversion Test is simply an energy test with special attention being given to the timing. The DA-2006 continuously monitors for the R-wave timing and displays, if possible, the delay between the R-wave and the pulse. In Cardioversion testing, the Defibrillator is set to deliver a pulse based on a specific delay after the R-wave.

WARNING

This section is provided as a guide to familiarize the user with the DA-2006 Series. It is not intended to provide the necessary test sequence for every Defibrillator. The user must consult the manufacturer's manual for each DUT to determine the correct test procedure to follow.

(1) Connect ECG leads to the corresponding universal connector on the DA-2006. The connectors are marked with both the AHA and International color codes.

(2) Turn on the DA-2006.

(3) The unit will come up in the "High Range Defibrillator" mode. This range is used for normal adult testing.

NOTE: If it is desirable to run a test at 50 Joules or less with a peak voltage of 1000 Volts or less, the unit may be changed to the "Low Range Defibrillator" mode using the 

key.

(4) Select the desired ECG Waveform and Amplitude to be tested from the choices on the ECG WAVEFORM SCREEN.

NOTE: The selected waveform must contain a QRS complex.

(5) Set the Defibrillator to Synchronized Cardioversion mode.

(6) Place the Defibrillator Paddles on the DA-2006 contact plates. The APEX is on the right and the STERNUM is on the left.

NOTE: Reversing the paddles will not cause any damage to the unit or error in the energy reading. However, it will cause the polarity of the oscilloscope output and the playback waveform to be inverted.

(7) Holding the paddles firmly in place, charge the Defibrillator and discharge it into the DA-2006.

WARNING

Observe all precautions noted by the Defibrillator Manufacturer when using the Defibrillator.

(8) The DA-2006 will automatically sense the voltage rise across the internal 50 ohm load and begin taking readings. After the sampling is done (100 ms) the unit will compute and display the results.

a. The power pulse is available at the oscilloscope output in real time at 200:1 signal attenuation when in low range and 1000:1 signal attenuation when in high range.

b. After the computation, the pulse is automatically played back at a 200:1 time base expansion (200 times slower) on both the ECG leads and the Paddle plates. The signal level is 1 mV per 1000 Volts on Lead 1.

c. At the same time, the test results are sent to the printer.

(9) The Status line will change to indicate the various steps as they are being done.

(10) At the end of the process the results are continuously displayed in the Test Results section of the MAIN SCREEN. They will remain there until another test is performed, the range is changed or the power is turned off.

NOTE: Special note should be made of the “Delay: xxx msec” line in the results. This will show the delay between the peak of the R-wave and the start of the Pulse.

The user may repeat the playback of the waveform at any time by changing to the PLAYBACK LAST PULSE SCREEN using the PLAYBACK LAST PULSE key. In this screen the pulse may be viewed in 20 msec segments and paused for review.

NOTE: The pulse is sent to the ECG and Paddle outputs at the same time it is being displayed on the screen.

CHARGE TIME TEST

The charging time of a Defibrillator is nothing more than a measurement of the time required for the Defibrillator to charge. It is used to test the battery, charging circuitry and capacitor. The DA-2006 provides a simple way to start and stop the timer. It also records the results.

WARNING

This section is provided as a guide to familiarize the user with the DA-2006 Series. It is not intended to provide the necessary test sequence for every Defibrillator. The user must consult the manufacturer's manual for each DUT to determine the correct test procedure to follow.

(1) Turn on the DA-2006.

(2) The unit will come up in the "High Range Defibrillator" mode. This range is used for normal adult testing.

(3) Set the Defibrillator to its maximum power setting.

(4) Depress the START CHARGE TIMER key.

(5) While the Pre-Warning Countdown is running, place the Defibrillator Paddles on the DA-2006 contact plates. The APEX is on the right and the STERNUM is on the left.

NOTE: Reversing the paddles will not cause any mage to the unit or error in the energy reading. However, it will cause the polarity of the oscilloscope output and the playback waveform to be inverted.

(6) Holding the paddles firmly in place, wait until the Pre-Warning Countdown equals zero and then immediately start charging the Defibrillator.

(7) As soon as the DUT is fully charged, discharge it into the DA-2006.

WARNING

Observe all precautions noted by the Defibrillator Manufacturer when using the Defibrillator.

(8) At the end of the process the results are continuously displayed in the Test Results section of the MAIN SCREEN. They will remain there until another test is performed, the range is changed or the power is turned off.

NOTE: The last line in the Test Results section of the screen will show "Chg Time: xxx.x sec"

SHOCK ADVISORY ALGORITHM TEST

The Shock Advisory Algorithm Test works with the analysis and prompting functions on automatic and semiautomatic Defibrillators. These circuits look at ECG waveforms and prompt the user to “Shock” or “No Shock” based on national and international guidelines. The following table outlines these guidelines:

SHOCK ADVISORY ALGORITHM TEST	
ECG SIGNALS	**ACTION**
Asystole	No Shock
Supra Ventricular Tachycardia @ 90 BPM	No Shock
Polyfocal Ventricular Tachycardia @ 140 BPM	No Shock
Multifocal Ventricular Tachycardia @ 140 BPM	No Shock
Coarse Ventricular Fibrillation	Shock
Fine Ventricular Fibrillation	Shock
Polyfocal Ventricular Tachycardia @ 160 BPM	Shock
Multifocal Ventricular Tachycardia @ 160 BPM	Shock

WARNING

This section is provided as a guide to familiarize the user with the DA-2006 Series. It is not intended to provide the necessary test sequence for every Defibrillator. The user must consult the manufacturer’s manual for each DUT to determine the correct test procedure to follow.

(1) Connect ECG leads to the corresponding universal connector on the DA-2006. The connectors are marked with both the AHA and International color codes.

(2) Turn on the DA-2006.

(3) The unit will come up in the “High Range Defibrillator” mode. This range is used for normal adult testing.

(4) Select the desired AED Waveform and Amplitude to be tested from the choices on the ECG WAVEFORM SCREEN.

(5) Set the Defibrillator to analyze the ECG waveform in the automatic or semiautomatic mode.

(6) Observe and record the response of the Defibrillator to the various waveforms.

TRANSCUTANEOUS PACEMAKER ANALYZER

The DA-2006P can analyze pacemaker pulses as well as determine Refractory periods and Sensitivity levels of on-demand pacemakers. For maximum versatility, the DA-2006P has 26 internally selectable pacemaker loads ranging from 50 ohms to 2300 ohms. The DA-2006P can also test the noise immunity of the DUT by generating a 50 or 60 Hz noise waveform with amplitude up to 100 mV. For sensitivity testing, the DA-2006P can output a Square, Triangle or Haversine waveform with widths ranging from 10ms to 200ms. The input circuitry of the DA-2006P is protected against damage in the case of an accidental defibrillator discharge into the Pacemaker Input terminals.

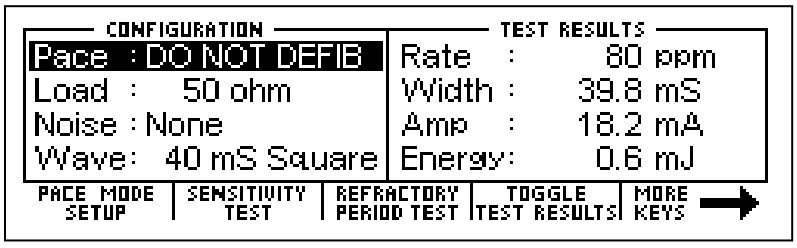
The 

key is used to change to the Pacemaker Analyzer mode.

PACE MAIN SCREEN

The Pacemaker Analyzer MAIN SCREEN shows the current CONFIGURATION, the TEST RESULTS and the available FUNCTION KEYS.

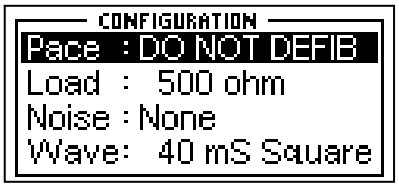
The following is a sample of the PACE MAIN SCREEN:



NOTE: The Test Results section of the PACE MAIN SCREEN contains eight lines of data that can be toggled to view the first 4 lines or the second 4 lines (See TEST RESULTS section of manual for more information).

CONFIGURATION

The CONFIGURATION section of the PACE MAIN SCREEN displays the current setup of the unit.



LOAD

This line displays the selected load. This setting may be changed in the PACE MODE SETUP screen. The load choice determines what impedance is used at the pacemaker input as well as whether the unit uses the Pacer Input Terminals or the Defibrillator Plate Input Terminals.

NOISE

This line displays the selected noise output. This setting may be changed in the PACE MODE SETUP screen.

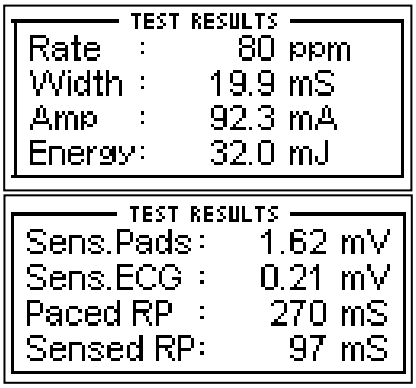
WAVE

This line displays the selected output waveform. This setting may be changed in the PACE MODE SETUP screen. The selected waveform is the output to the pacer on the ECG Terminals, Pacer Terminals and Defibrillator Plate Terminals.

TEST RESULTS

The TEST RESULTS section of the PACE MAIN SCREEN displays the results of the last test. It will continue to be displayed until the power is turned off or another test is run.

The Test Results section of the PACE MAIN SCREEN contains eight lines of data that can be toggled to view the first 4 lines or the second 4 lines by pressing the TOGGLE TEST RESULTS key.



RATE

This line displays the rate of the pacemaker pulse that is present at the selected load.

WIDTH

This line displays the width of the pacemaker pulse that is present at the selected load.

AMP

This line displays the current of the pacemaker pulse that is present at the selected load.

ENERGY

This line displays the energy of the pacemaker pulse that is present at the selected load.

SENS PADS

This line displays the sensitivity at the pads for the selected waveform during the last Sensitivity Test.

SENS ECG

This line displays the sensitivity at the ECG leads for the selected waveform during the last Sensitivity Test.

PACED RP

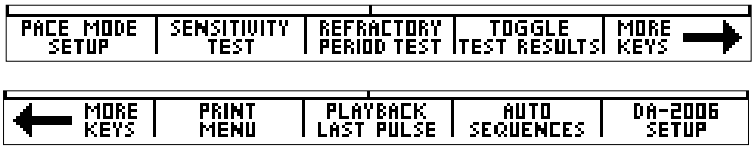
This line displays the paced refractory period detected at the selected load during the last Refractory Period Test.

SENSED RP

This line displays the sensed refractory period detected at the selected load during the last Refractory Period Test.

FUNCTION KEYS

The FUNCTION KEYS section of the PACE MAIN SCREEN displays the current functions of the keys found below the display. These keys allow for navigation to supporting screens and initiation of specific features.



Primary Function Keys

Secondary Function Keys

PACE MODE SETUP

This key enters the PACE MODE SETUP SCREEN where all pace parameters are chosen.

SENSITIVITY TEST

This key activates a Sensitivity Test.

REFRACTORY PERIOD TEST

This key activates a Refractory Period Test.

TOGGLE TEST RESULTS

This key toggles the test result section to view the first 4 lines or the second 4 lines of data.

MORE KEYS

These keys toggle between the Primary and Secondary Function Keys.

PRINT MENU

This key enters the PRINT SCREEN that allows the printing of the header or the test data.

PLAYBACK LAST PULSE

This key enters the PLAYBACK LAST PULSE screen where a graphical representation of the last pulse may be viewed and sent out.

AUTO SEQUENCES

This key brings up the AUTO SEQUENCE MENU, which is used to view or run the Auto Sequences stored in the unit.

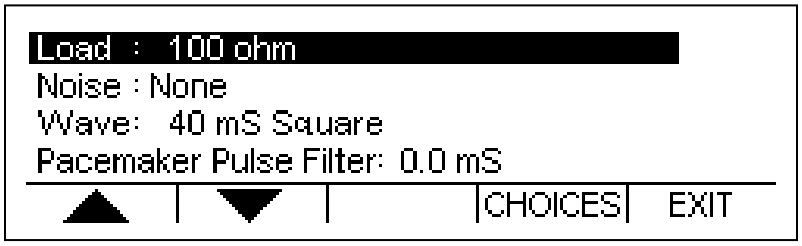
DA-2006 SETUP

This key brings up the SYSTEM CONFIGURATION SCREEN, which allows for adjusting the various system configuration parameters.

PACER MODE SETUP SCREEN

The DA-2006P can be configured to run a large number of tests under various load conditions. This screen is used to configure the unit for these tests. The pacemaker configuration screen is accessed by pressing the PACE MODE SETUP key from the PACE MAIN SCREEN. In this screen, the user can select the desired Load, the output Noise waveform, the Sensitivity Test waveform, and the Pacemaker Pulse Filter.

The following is a sample of the Pacemaker configuration screen:



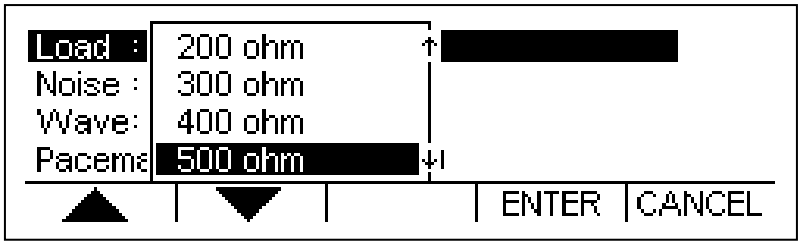
LOAD
Defib Plates Input (50Ω)
50 ohm
100 ohm
150 ohm
200 ohm
200 ohm
300 ohm
400 ohm
500 ohm
600 ohm
700 ohm
800 ohm
900 ohm
1000 ohm
1100 ohm
1200 ohm
1300 ohm
1400 ohm
1500 ohm
1600 ohm
1700 ohm
1800 ohm
1900 ohm
2000 ohm
2100 ohm
2200 ohm
2300 ohm
Open

NOISE
10 mV 50 Hz
9 mV 50 Hz
8 mV 50 Hz
7 mV 50 Hz
6 mV 50 Hz
5 mV 50 Hz
4 mV 50 Hz
3 mV 50 Hz
2 mV 50 Hz
1 mV 50 Hz
NONE
1 mV 60 Hz
2 mV 60 Hz
3 mV 60 Hz
4 mV 60 Hz
5 mV 60 Hz
6 mV 60 Hz
7 mV 60 Hz
8 mV 60 Hz
9 mV 60 Hz
10 mV 60 Hz

WAVEFORM
10 ms Square
25 ms Square
40 ms Square
100 ms Square
200 ms Square
10 ms Triangle
25 ms Triangle
40 ms Triangle
100 ms Triangle
200 ms Triangle
10 ms SSQ
25 ms SSQ
40 ms SSQ
100 ms SSQ
200 ms SSQ

PULSE FILTER
0.0 – 2.0 ms

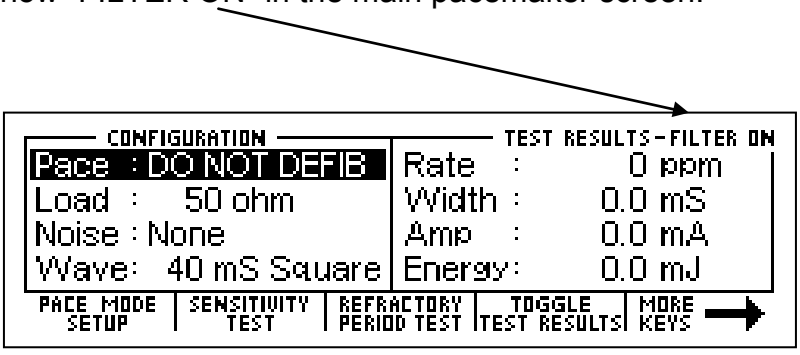
These settings can be selected using ▲▼ to highlight the parameter and using CHOICES to open a drop down menu of all the options for the highlighted parameter.



Use ▲▼ to scroll to the desired option. Then ENTER is used to accept the new setting. The CANCEL key can be used to return to the Pacemaker configuration screen without making a new selection.

The EXIT key is used to return to the PACE MAIN SCREEN.

PACEMAKER PULSE FILTER - This filter eliminates noise pulses from being detected as pacemaker pulses. Any pulses that have a width less than the Pacemaker Pulse Filter setting will be ignored. When set to 0.0, the filter is disabled. When the filter is ON, an indicator will show “FILTER ON” in the main pacemaker screen.



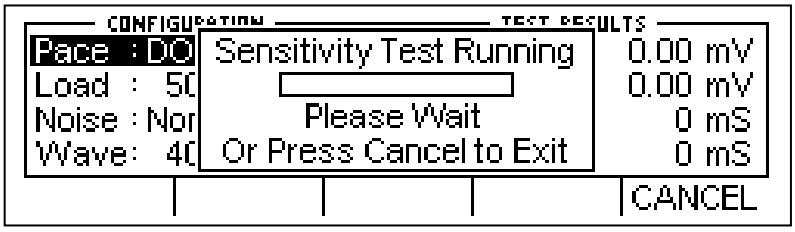
SENSITIVITY TEST

The Sensitivity Test is used to determine the smallest waveform that the pacemaker can detect. For this test, the selected waveform is generated outside of the refractory period of the pacemaker. The DA-2006P uses a successive approximation approach to determine the smallest output waveform that can be detected by the pacemaker. The Sensitivity Test may be initiated by pressing the SENSITIVITY TEST key from the PACE MAIN SCREEN.

WARNING

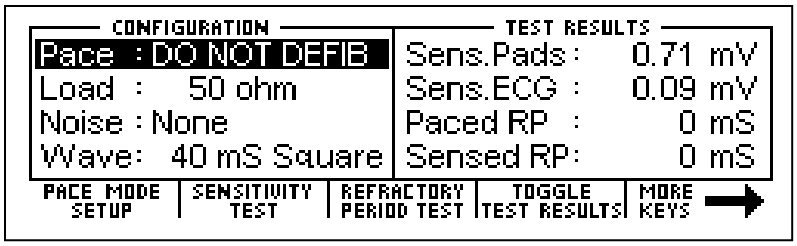
This section is provided as a guide to familiarize the user with the DA-2006P. It is not intended to provide the necessary test sequence for every Pacemaker. The user must consult the manufacturer's manual for each DUT to determine the correct test procedure to follow.

While this test is running, the following display will show the progress of the test:



At any time, the CANCEL key can be depressed to stop the test and return to the PACE MAIN SCREEN.

At the end of the test, the display will show the pacemaker amplitude sensitivity at the Pacer Terminals and the ECG Terminals.



REFRACTORY PERIOD TEST

For on-demand pacemakers, the pacemaker should ignore any ECG activity after a pacer pulse for a specific period of time. This time period is known as the Refractory Period. The Paced Refractory Period is the time after the pacemaker pulse that ECG activity is ignored. If an ECG pulse is present inside the refractory period, it is ignored. If an ECG pulse is detected outside of the refractory period, the pacemaker will re-synchronize to the sensed ECG pulse. For each sensed ECG pulse, there is a second refractory period. This is known as the Sensed Refractory Period. It is the period of time after the sensed ECG pulse that ECG activity is ignored. The Refractory Period Test may be initiated by pressing the [REFRACTORY PERIOD TEST] key from the PACE MAIN SCREEN.

WARNING

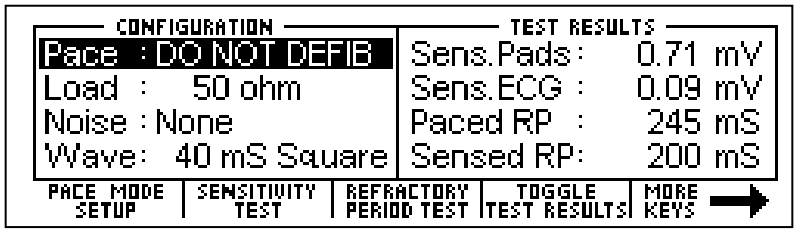
This section is provided as a guide to familiarize the user with the DA-2006P. It is not intended to provide the necessary test sequence for every Pacemaker. The user must consult the manufacturer's manual for each DUT to determine the correct test procedure to follow.

While the Refractory Period test is running, the display will indicate the progress of the test:

NOTE: It is important that the pulse rate does not change for the duration of the Refractory Test.

At any time, the CANCEL key can be depressed to stop the test and return to the PACE MAIN SCREEN.

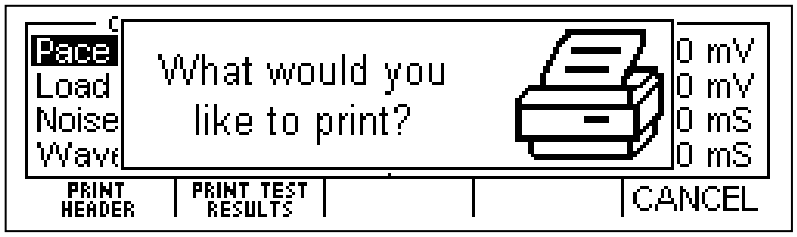
When the test is completed, the display will update with the Paced Refractory Period and Sensed Refractory Period in the Test Results.



PRINT MENU SCREEN

The DA-2006P allows the user to print the latest Pacemaker Analysis data or a header. The PRINT MENU SCREEN is accessed by pressing the PRINT MENU key from the PACE MAIN SCREEN.

The following is an example of the print menu screen:



The header is sent by pressing the PRINT HEADER key.

The test data is sent by pressing the PRINT TEST RESULTS key.

The CANCEL key can be depressed to return to the PACE MAIN SCREEN.

The following is the print header and sample data that are used for the Pacemaker Analyzer mode:

BC Biomedical
DA-2006P Transcutaneous Pacemaker Analyzer

DA-2006 Serial Number: _____
Dut Manufacturer: _____
Dut Model: _____
Dut Serial Number: _____
Technician: _____
Location: _____

Date: _____

PASS FAIL

Comments: _____
_____
_____

LOAD SETTING: 500 ohm

			DA-2006P Measurements:							
Test#	Output Noise	Output Waveform	Rate ppm	Width ms	Ampl mA	Enrg mJ	S.Pads mV	S.ECG mV	PRP mS	SRP mS
1	None	40mS Sqr	80	10.1	19.9	0.3	7.99	0.04	306	298

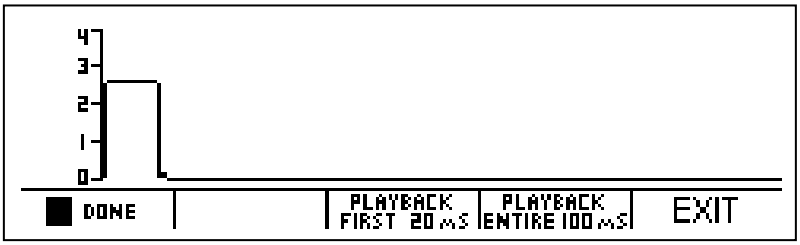
NOTE: Since Pacemaker pulses are normally continuous, the test data must be printed manually via the Print Menu.

NOTE: Printing the header also resets the test number printed on the data sheet.

PLAYBACK LAST PULSE SCREEN

The DA-2006P can display a graphical representation of the last pulse. This screen may be accessed by pressing the PLAYBACK LAST PULSE key from the PACE MAIN SCREEN. The playback allows the user to view the Pacemaker pulse in a time-expanded form. Samples are stored internally at 0.1 ms intervals. The PLAYBACK LAST PULSE SCREEN shows these samples expanded by a time factor of 200.

In playback mode, the samples are shown on the display and sent out the ECG leads, Defibrillator Plates, and the High Level output. The following is a sample of the waveform that is shown in the display:



The scale shown on the screen is automatically adjusted to provide the maximum resolution available.

The PAUSE key can be used to pause the screen at any point while a pulse is being played back. This key replaces the DONE key when a pulse is being played back.

The PLAY key can be used to play (continue) the waveform if it has been paused. This key replaces the PAUSE key.

The PLAYBACK FIRST 20 MS key starts a playback of only the first 20 ms of the waveform.

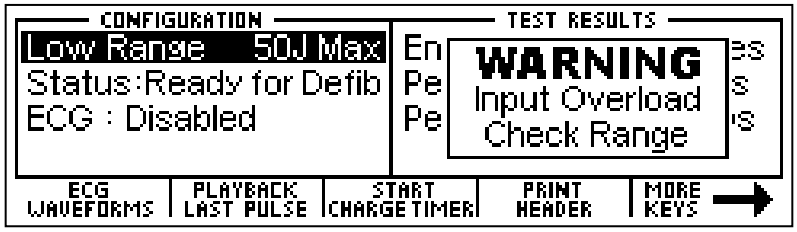
The PLAYBACK ENTIRE 100 MS key starts a playback of the entire 100 ms of the waveform.

At any time, the EXIT key or ■ DONE key can be depressed to return to the MAIN SCREEN.

MESSAGES

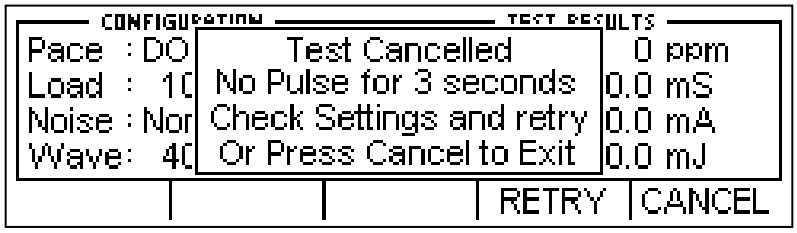
INPUT OVERLOAD

The “Warning Input Overload Check Range” message can display during Defibrillator testing. The range should be checked to see if it should be changed to High Range for the current Joule setting.



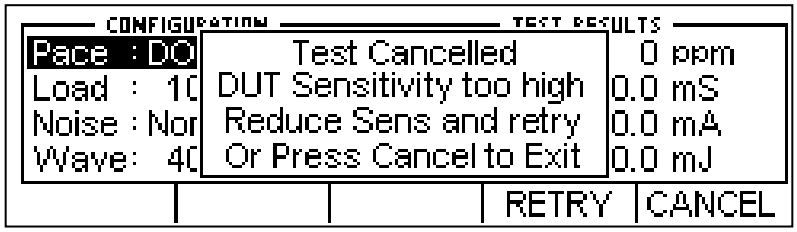
NO PULSE (DA-2006P Only)

The “Test Cancelled No Pulse for 3 seconds” message can display during Refractory or Sensitivity Pacer testing. The settings should be checked and the test rerun.



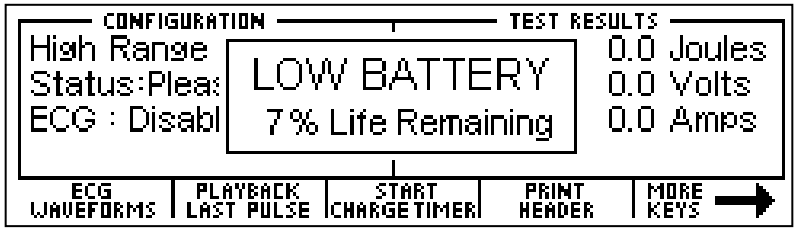
SENSITIVITY TOO HIGH (DA-2006P Only)

The “Test Cancelled DUT Sensitivity too high” message can display during Pacer testing. This happens when the Pacemaker does not detect the pulse generated by the DA-2006P. It could be that it is connected improperly or set to Async mode. This can occur during either the Sensitivity or Refractory test modes.



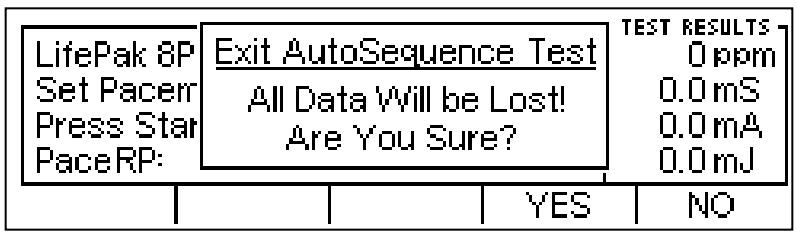
LOW BATTERY

This message indicates that the batteries are low and should be replaced.



EXITING AUTO SEQUENCE TESTING

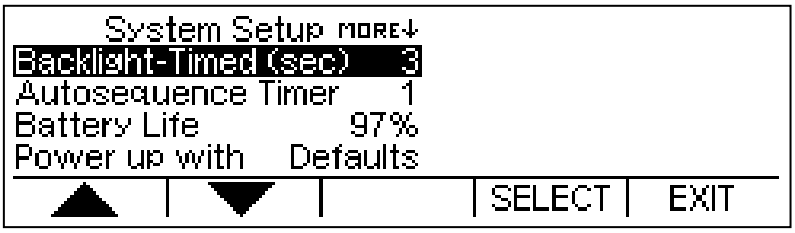
The “Exit Auto Sequence Test All Data Will be Lost!” message will display in the Auto Sequencing Mode when [EXIT] is pushed. If the data is needed, it should be printed prior to exiting.



SYSTEM SETUP

The SYSTEM SETUP SCREEN allows for the configuration of the system settings. The settings can be selected using ▲▼ to highlight the parameter and using SELECT to allow the editing of the parameter. The ▲▼ keys are used to edit the setting, then ENTER is used to accept the new setting. The CANCEL key can be used to return to the configuration screen without making a new selection.

The EXIT key is used to return to the MAIN SCREEN.



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

Parameter	Description	Range
Backlight-Timed	Off – Always off 1-20 sec – The elapsed time after which the backlight will automatically turn off. Always On – The backlight will be manually controlled by backlight key)	Off, 1-20 sec, Always On
Autosequence Timer	Sets the delay between Auto Sequence tests when the test passes.	1-20 sec
Battery Life	Displays current life of the batteries. At 5%, a warning screen will appear. At 10%, 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
Software	Displays current software program.	(Read Only)

POWER UP SETTINGS

The DA-2006 Series 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 or Custom selections.

DEFAULT

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

Range – Defib, High Range mode

ECG – Output Disabled

Pacemaker Load – 100 ohm

Pacemaker Noise Waveform- None

Pacemaker Output Waveform – 40 ms Square wave.

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.

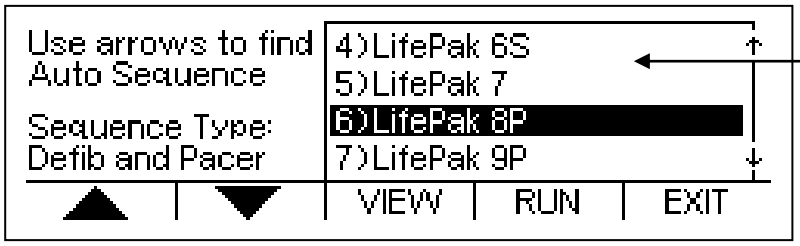
SET CURRENT AS CUSTOM

The user simply configures the unit to the desired default conditions, selects this option and presses ENTER. The current configuration is then saved as the Custom Power up values.

AUTO SEQUENCE FUNCTION

The DA-2006 Series allows the user run up to 50 pre-programmed sequences of tests (Auto Sequences). The tests are configured with an easy to use PC program. Each test can be configured to test Defibrillator, Transcutaneous Pacemaker or both. (For programming Auto Sequences, see the Auto Sequence Programming section). Once configured, the tests are then downloaded to the DA-2006 unit through the RS232 serial interface.

The AUTO SEQUENCE SCREEN is accessed using the AUTO SEQUENCES key.



AUTO SEQUENCES
LifePak 4
LifePak 5
LifePak 6
LifePak 6S
LifePak 8P
LifePak 9P
LifePak 9PM
LifePak 10
LifePak 10P
LifePak 10PM
HP 78660A
HP XLPM
Nihon Kohden 7000
Laerdal HS 2000
Marquette 1500PM
Zoll PD 2000
Zoll M-Series DSW
Zoll AED Plus
Blank Tests 20-50

In this menu, the ▲ ▼ keys are used to select the desired test. The VIEW key can be used to enter the VIEW MODE which will allow the user to view the programed test options of the selected test. The RUN key will run the selected test and enter the RUN MODE which will step the technician through the programmed test as well as identify whether each step has passed or failed based upon the pre-programmed test limits that are part of each Auto Sequence.

The following table shows the possible test sequence with the details and options that can be selected using the PC program:

Test	Description	Fields	Options
Defibrillator Test Sequence			
Defib Energy Tests	Measures defibrillator discharge energy	Steps	1-20 xxx Joules
		Energy Level Limits	0-99%
		VFIB ECG Output	yes/no
Maximum Energy Test	Measures time required for defibrillator to charge to maximum energy	Do Test?	yes/no
		Energy Level Limits	xxx Joules
		Max Allowed Charge Time	x sec
Cardioversion Tests	Measures Cardioversion Delay	Steps	1-3 xxx Joules
		Energy Level Limits	0-99%
ECG Performance Test	Tests defibrillator ECG input	Steps	Up to 10
		Waveform Outputs and Amplitudes	x Waveform Group x Waveform Lead II = x.x mV
Pacemaker Test Sequence (DA-2006P Only)			
Pulse Rate and Amplitude Tests	Measures Pacemaker Pulse Rate and Amplitude	Steps	1-20
		Pulse Rate, Pulse Amplitude and Load settings	xxx ppm xx mA xxx ohms
		Limits for Rate and Amplitude	0-99%
Asynchronous Test	Tests Pacemaker Asynchronous Mode	Do Test?	yes/no
		Pulse Rate and Load	xxx ppm xxx ohms
Demand Mode Tests	Measures Pacemaker Sensitivity at Pacemaker Pads and ECG leads	Steps	1-5
		Pulse Rate, Load and Output Waveform	xxx ppm xxx ohms x Waveform
Refractory Test	Measures Paced Refractory Period and Sensed Refractory Period	Do Test?	yes/no

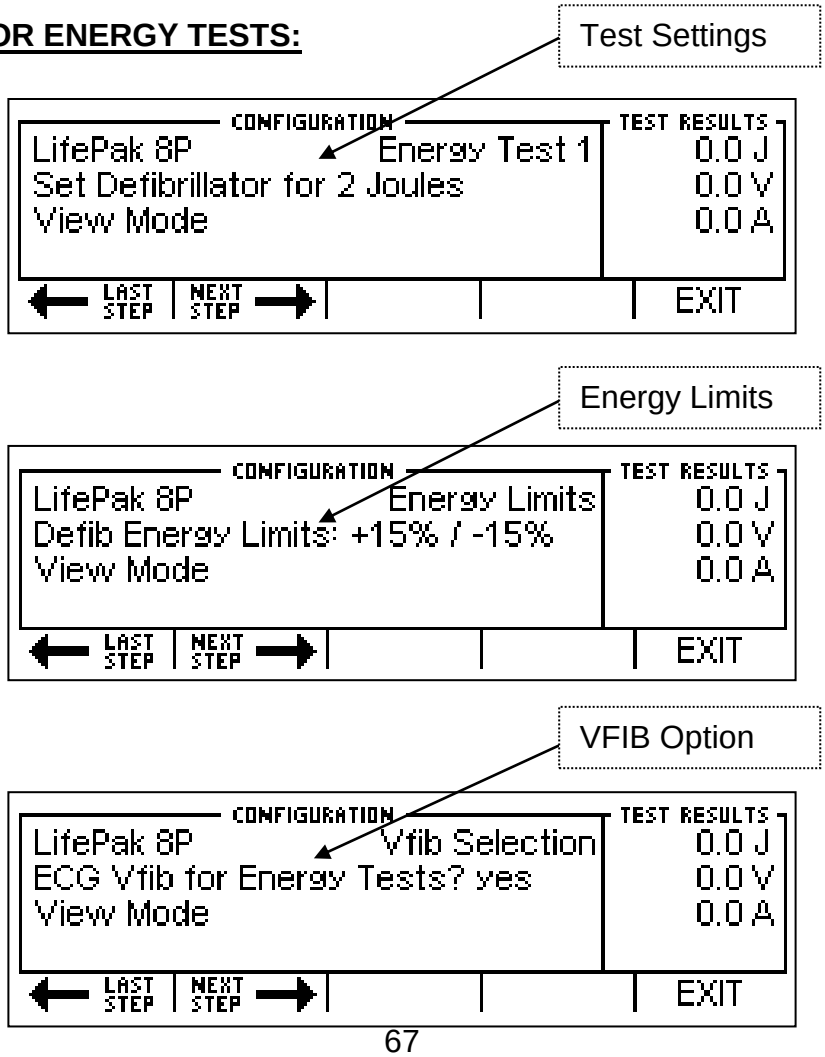
VIEW MODE

The VIEW MODE allows the user to look at the test configuration. Each test setting will be shown, as well as the test limits that identify a valid or invalid test result. The screens that are displayed in the VIEW MODE are determined by the Auto Sequence selected on the AUTO SEQUENCE SCREEN and its configuration as defined with the PC program.

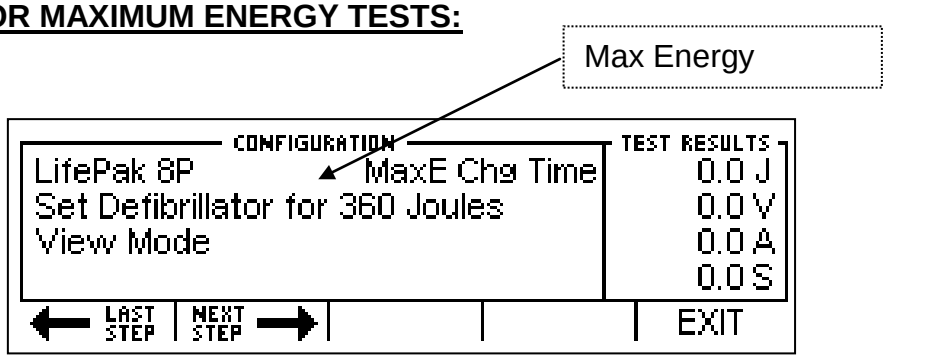
The following screens are examples of what could be shown in the VIEW MODE if all test options are selected:

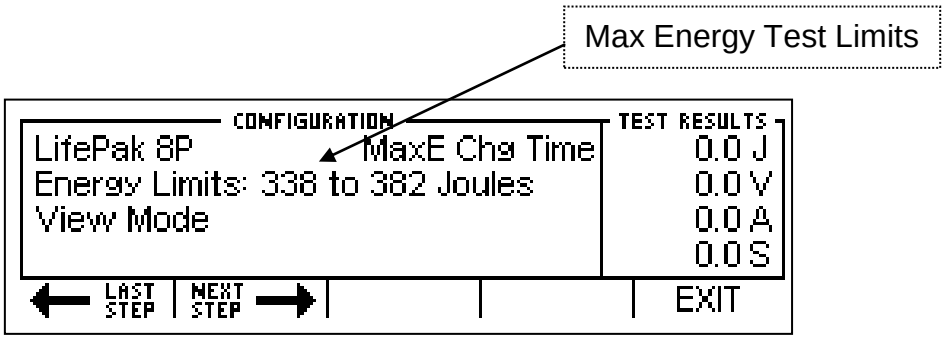
NOTE: If any particular test option is disabled using the PC Program, it will not be shown in the VIEW MODE.

DEFIBRILLATOR ENERGY TESTS:

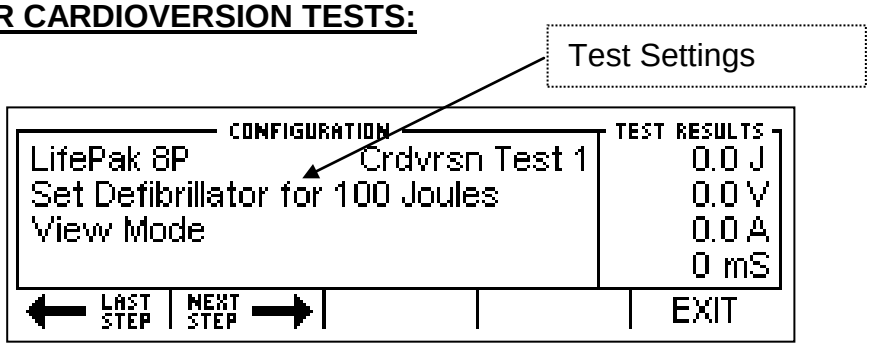


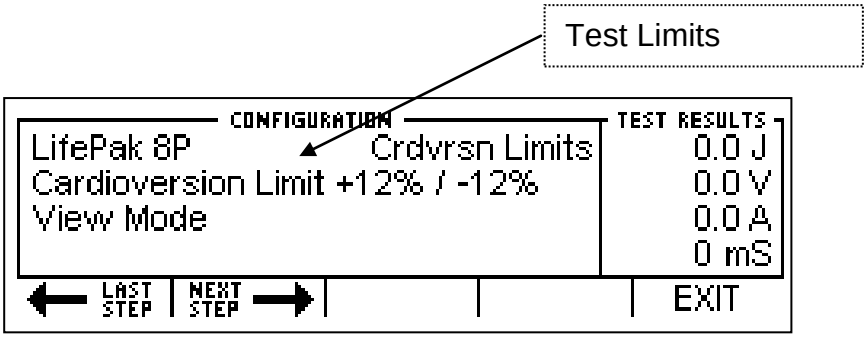
DEFIBRILLATOR MAXIMUM ENERGY TESTS:



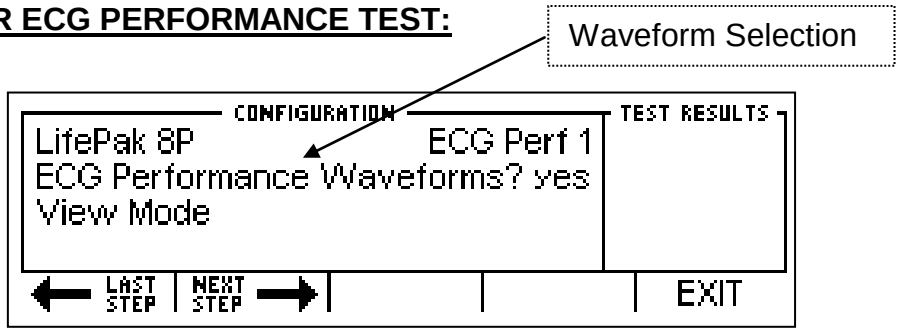


DEFIBRILLATOR CARDIOVERSION TESTS:



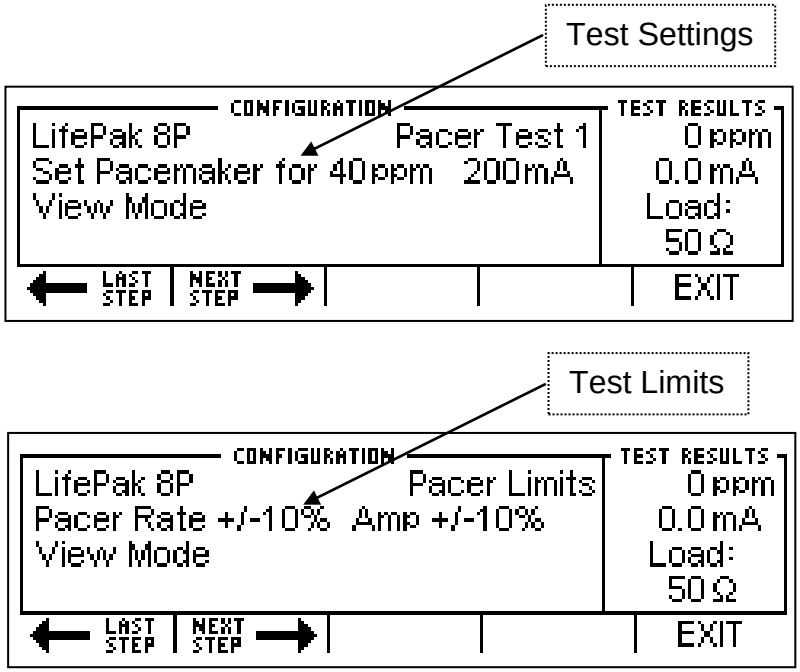


DEFIBRILLATOR ECG PERFORMANCE TEST:

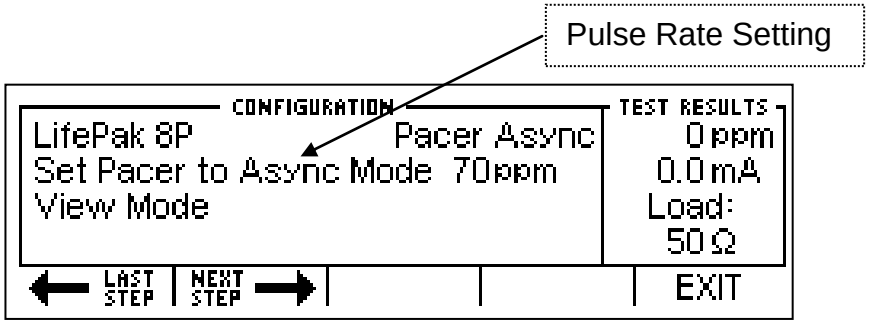


NOTE: The individual selected waveforms are not displayed in the VIEW MODE.

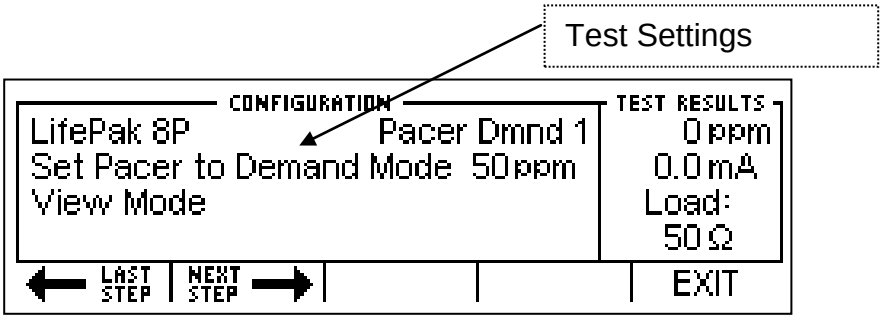
PACEMAKER PULSE AND AMPLITUDE TESTS: (DA-2006P Only)



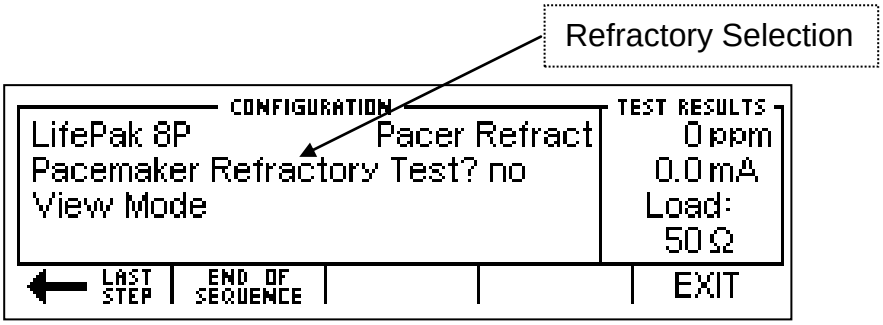
PACEMAKER ASYNCHRONOUS MODE TEST: (DA-2006P Only)



PACEMAKER DEMAND MODE TESTS: (DA-2006P Only)



PACEMAKER REFRACTORY TEST: (DA-2006P Only)



RUN MODE

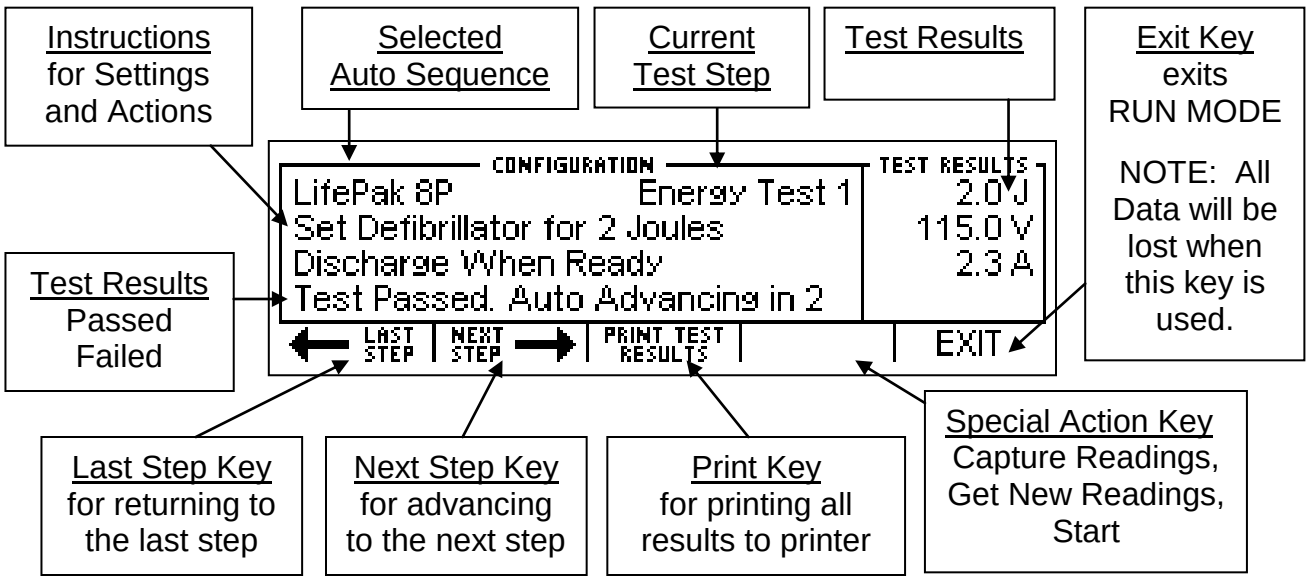
The RUN MODE allows the user to run the test configuration. The screens that are displayed in the RUN MODE are determined by the Auto Sequence selected on the AUTO SEQUENCE SCREEN and its configuration as defined with the PC program.

Running an Auto Sequence will provide a consistent, guided procedure for testing equipment. This is a semi-automated process that will provide immediate feedback to the user if the DUT passes or fails individual tests. A programmable timer is provided to automatically progress through the test when a given test passes. This timer is set in the Auto Sequence Timer parameter in the SYSTEM SETUP SCREEN.

NOTE: If any particular test option is disabled using the PC Program, it will not be shown in the RUN MODE.

NOTE: Some tests, like Performance Waveforms, do not have quantitative analyses and therefore require the user to manually progress through the test.

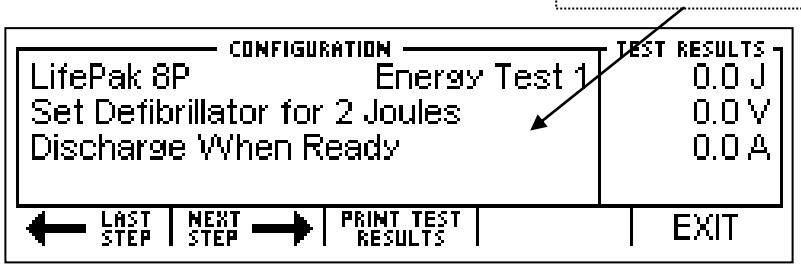
The following sample screen shows the common elements present during the RUN MODE:



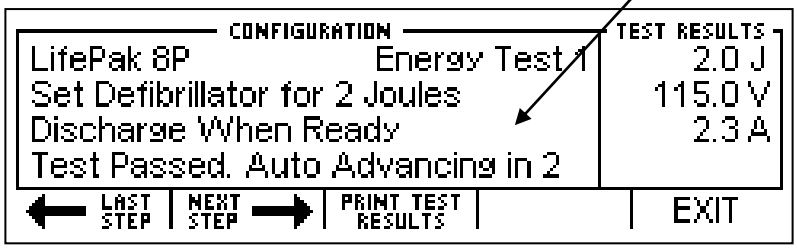
The following screens may be shown in the RUN MODE if all test options are selected:

DEFIBRILLATOR ENERGY TESTS:

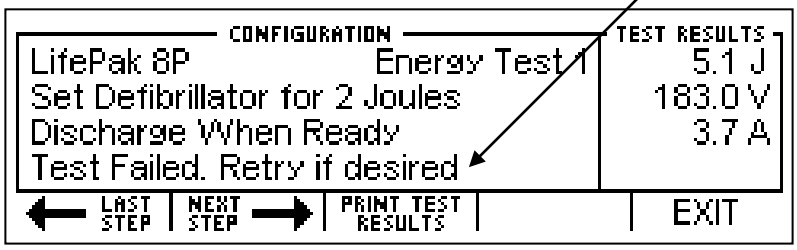
Test Setup and Action



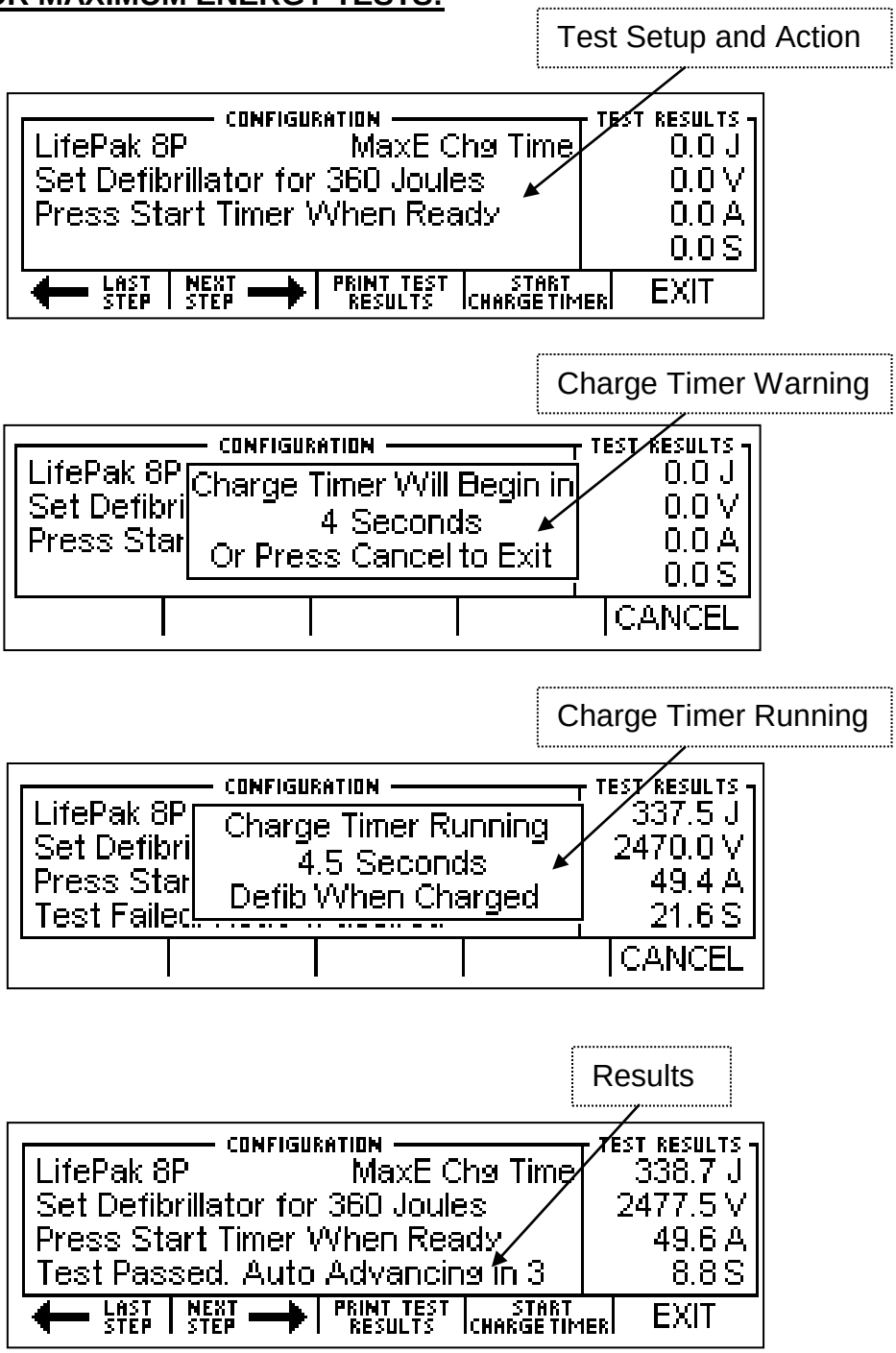
Test Passed



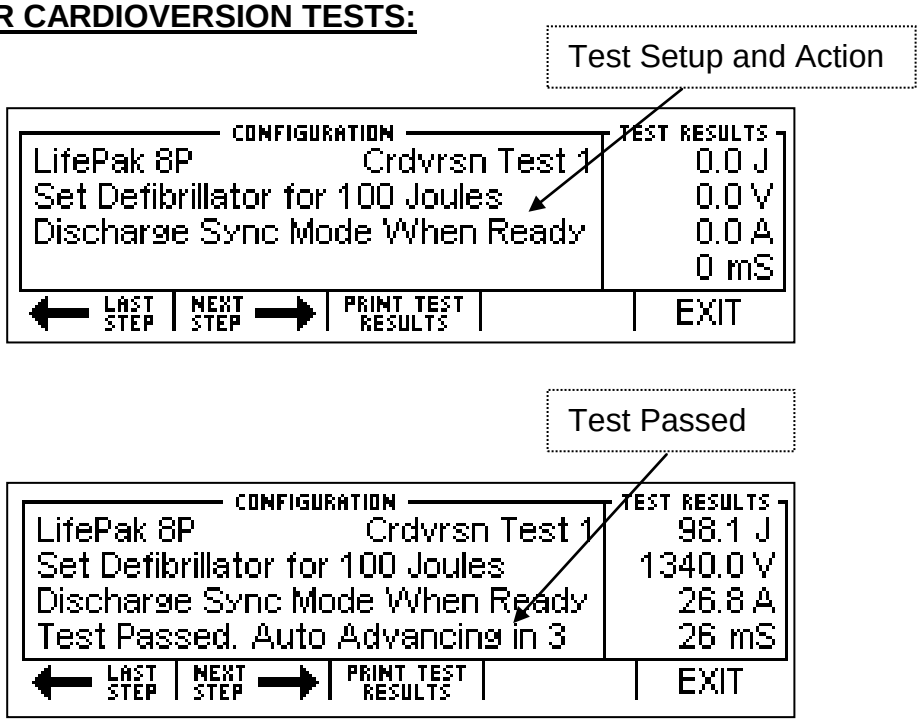
Test Failed



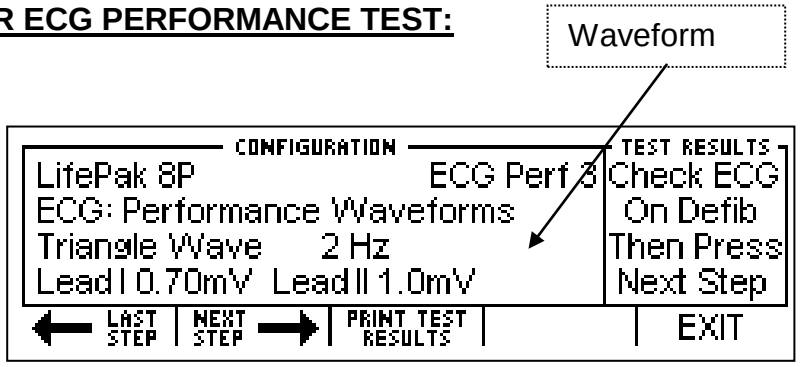
DEFIBRILLATOR MAXIMUM ENERGY TESTS:



DEFIBRILLATOR CARDIOVERSION TESTS:

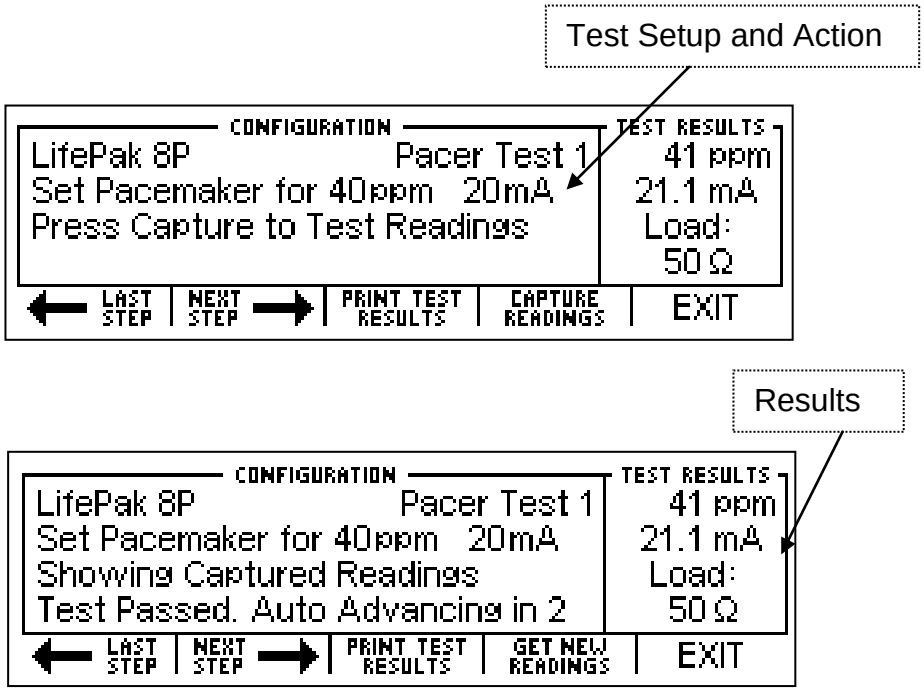


DEFIBRILLATOR ECG PERFORMANCE TEST:



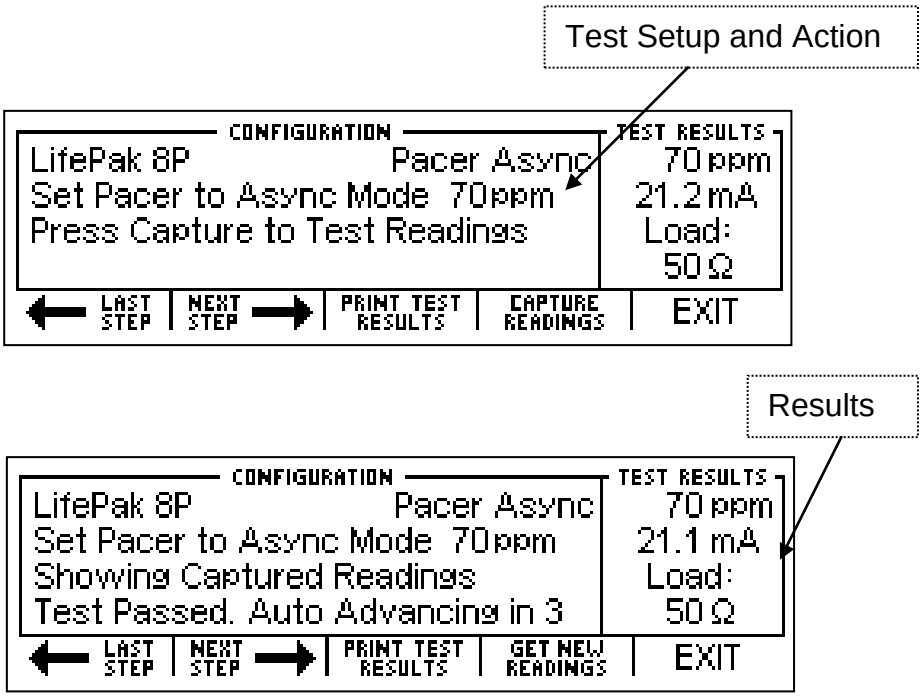
NOTE: Some tests, like Performance Waveforms, do not have quantitative analyses and therefore require the user to manually progress through the test.

PACEMAKER PULSE AND AMPLITUDE TESTS: (DA-2006P)



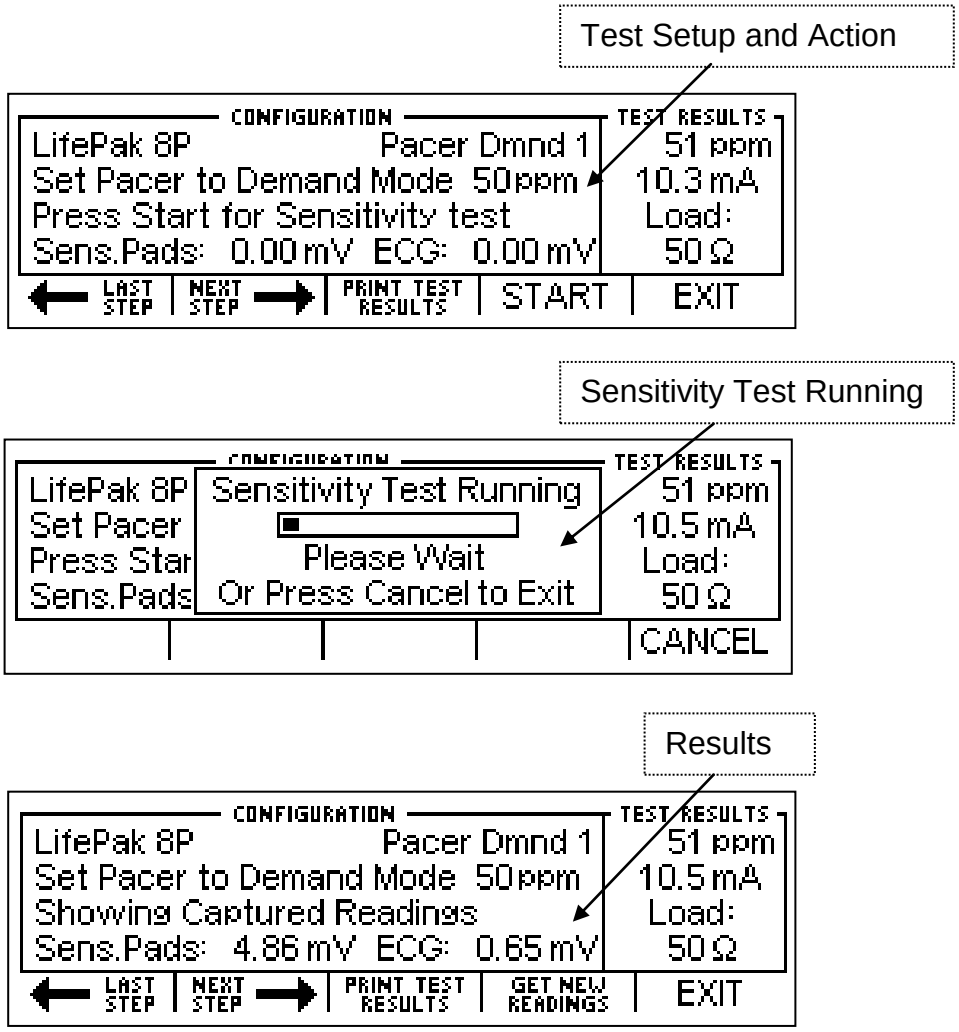
NOTE: If the test fails or new readings are desired, the Get New Readings Key can be used to replace the current readings. The current readings will be lost, even if they are from a test that passed.

PACEMAKER ASYNCHRONOUS MODE TEST: (DA-2006P Only)



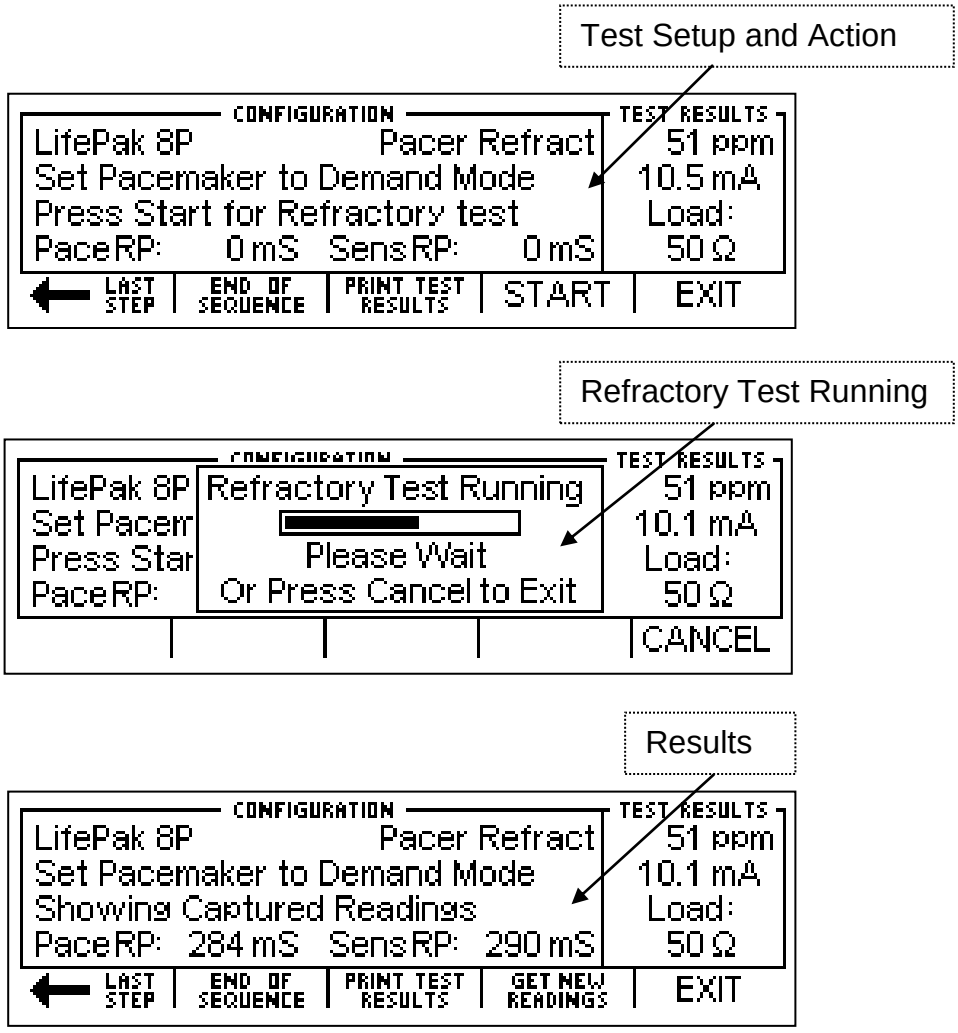
NOTE: If the test fails or new readings are desired, the Get New Readings Key can be used to replace the current readings. The current readings will be lost, even if they are from a test that passed.

PACEMAKER DEMAND MODE TESTS: (DA-2006P Only)



NOTE: If the test fails or new readings are desired, the Get New Readings Key can be used to replace the current readings. The current readings will be lost, even if they are from a test that passed.

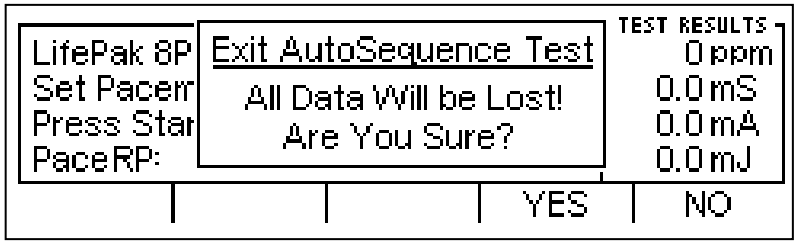
PACEMAKER REFRACTORY TEST: (DA-2006P Only)



NOTE: If the test fails or new readings are desired, the Get New Readings Key can be used to replace the current readings. The current readings will be lost, even if they are from a test that passed.

EXITING AUTO SEQUENCE TESTING MESSAGE

The “Exit Auto Sequence Test All Data Will be Lost!” message will display in the Auto Sequencing Mode when EXIT is pushed. If the data is needed, it should be printed prior to exiting.



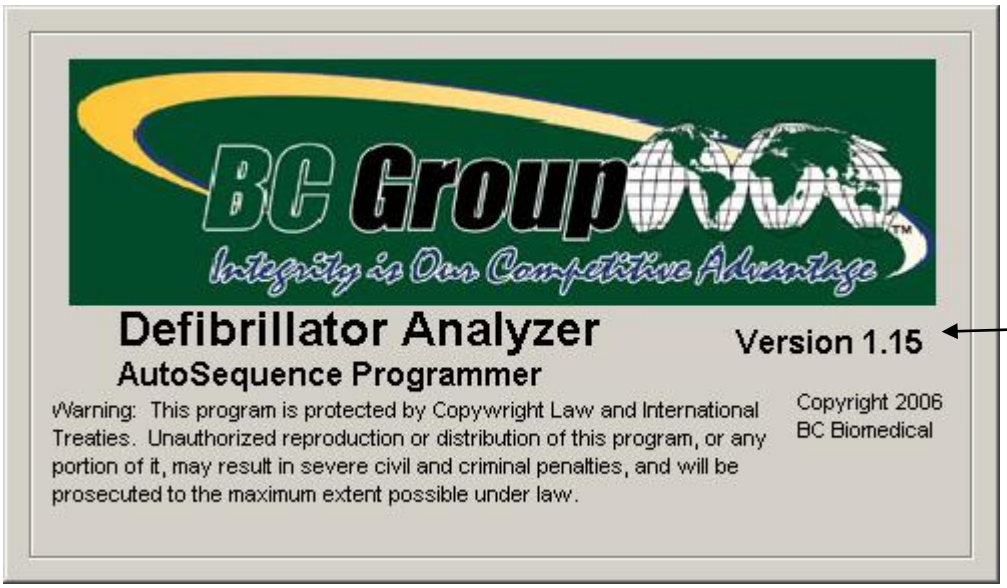
PROGRAMMING AUTO SEQUENCES

Auto Sequences are programmed with an easy to use PC interface. This section shows how to use the Auto Sequence configuration software.

NOTE: In the Auto Sequence PC interface, the DA-2006 Series is noted as DA-2006/P.

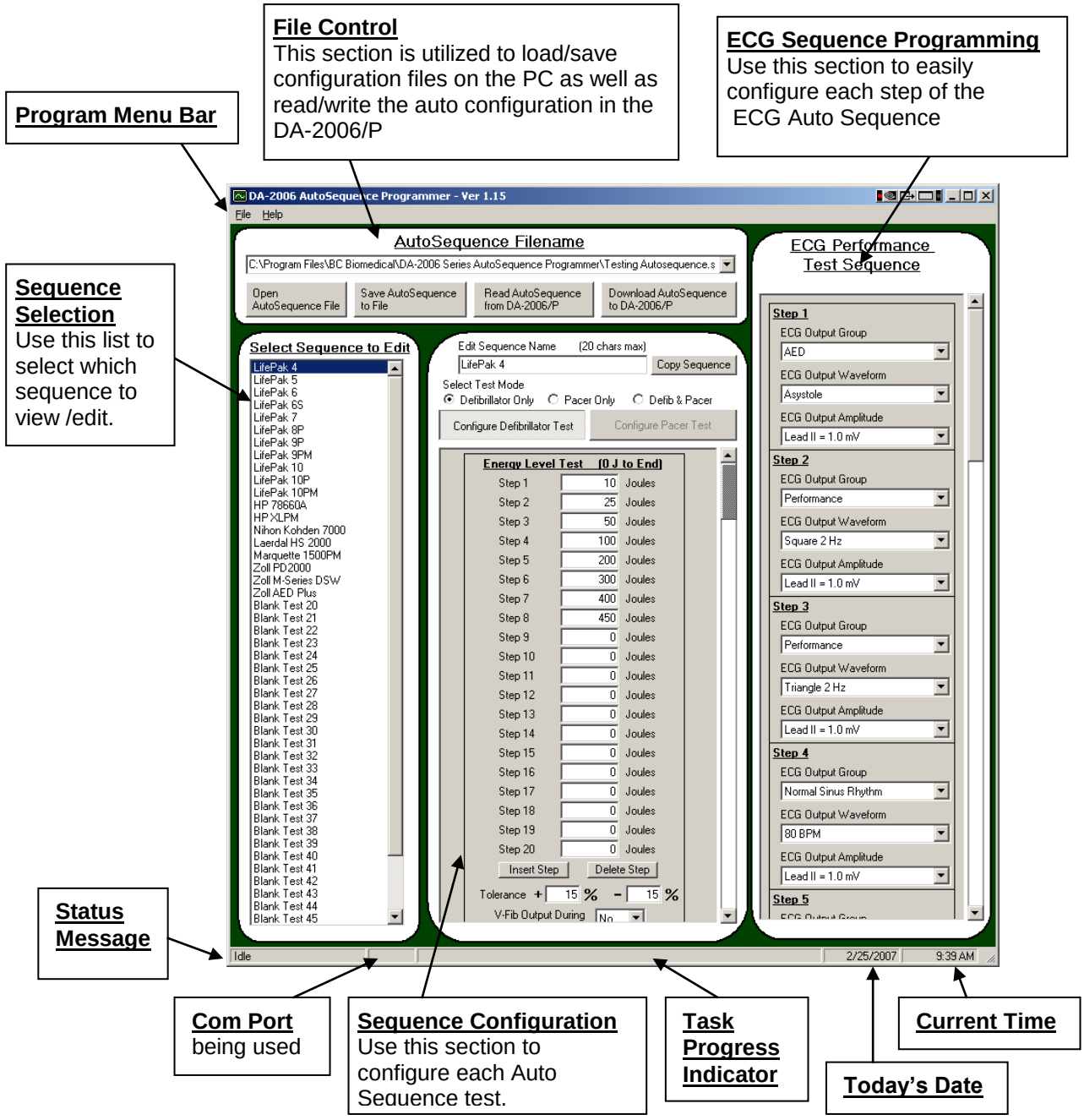
SPLASH SCREEN

The Splash Screen identifies the version of the program. This screen will be displayed for 5 seconds, or until the user presses a key or clicks the screen with the mouse.

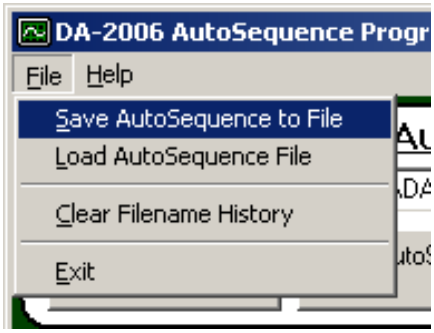


OVERVIEW

The following is a general overview of the PC Interface used for Programming Auto Sequences. Each part of this screen is described in full detail later in this section.



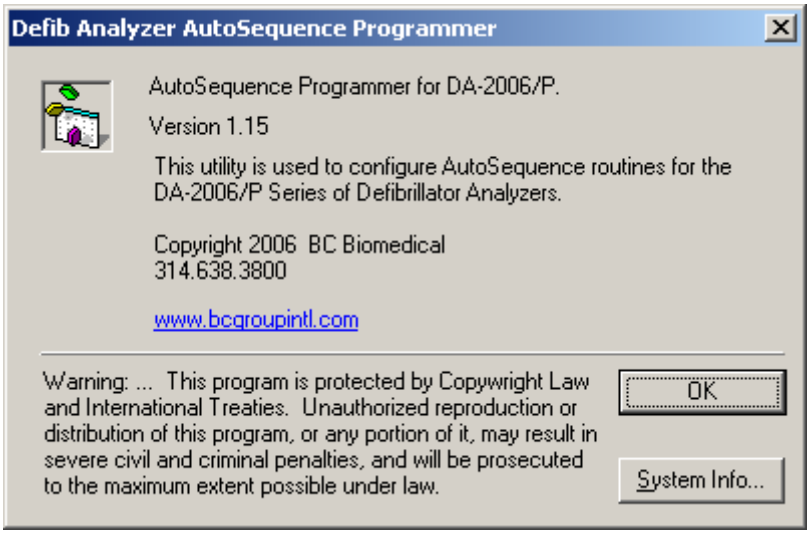
PROGRAM MENU



The program menu contains shortcuts to file operations as well as program version information.

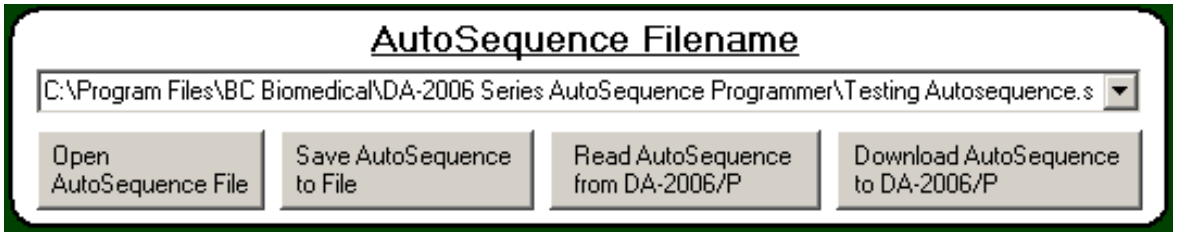
From the File Menu, you can Save or Load Auto Sequences as well as Clear the History of files that were used. You can also Exit the program from this menu.

The Help Menu provides access to program version information, shown below:



FILE CONTROL

The file control section allows the user to Load and Save Auto Sequence files, greatly expanding the number of pre-programmed sequences from 50 to virtually unlimited. The user also uses the File Control section to Load and Store Auto Sequences on the DA-2006/P.



Dropdown List – This list shows the history of files that have recently been used. This provides quick access for switching between common Auto Sequence files.

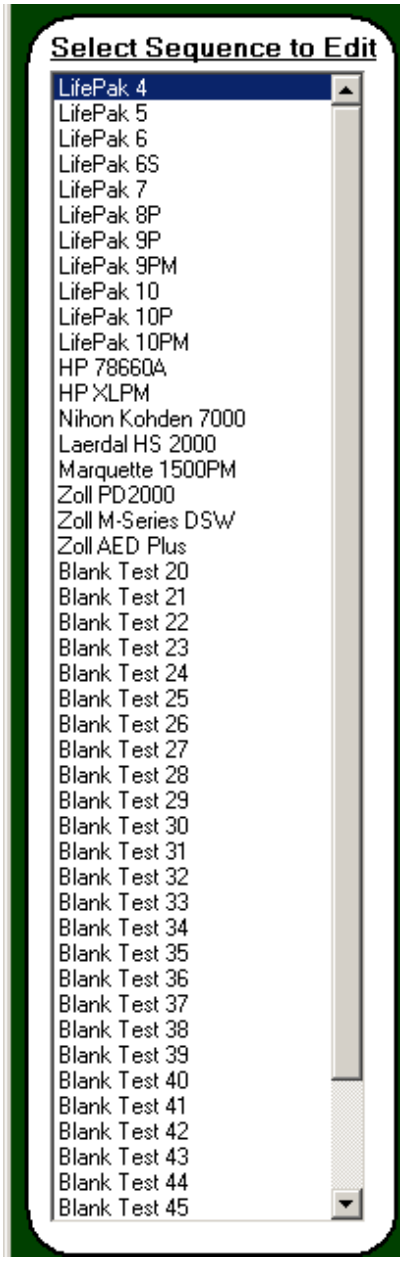
Open Auto Sequence File – This button brings up the standard Windows Open File dialog box. It is used to load an existing configuration file.

Save Auto Sequence to File – This button brings up the standard Windows Save File dialog box. It is used to save the current configuration to a file for future reference.

Read Auto Sequence from DA-2006/P – This button is used to load the configuration currently stored in the DA-2006/P.

Download Auto Sequence to DA-2006/P – This button is used to send the configured Auto Sequence to the DA-2006/P, where it is stored in non-volatile flash memory.

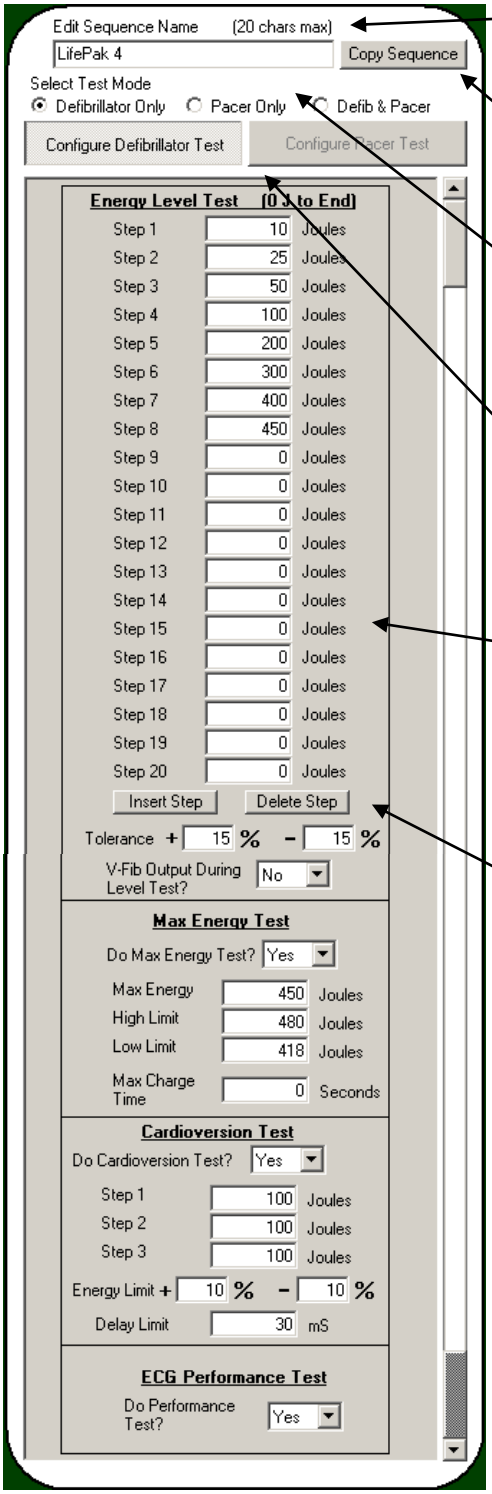
SEQUENCE SELECTION



This section shows a list of all of the names of the Auto Sequences. It is used to select an individual sequence for configuration. Once selected, the configuration window will change to display the settings for the selected sequence.

SEQUENCE CONFIGURATION

The sequence configuration window displays all of the configuration settings for each Auto Sequence. This sample screen shows a defib test configuration.



Sequence Name – This name can be any string of up to 20 standard ASCII characters. NOTE: Not all ASCII characters are valid and will be ignored.

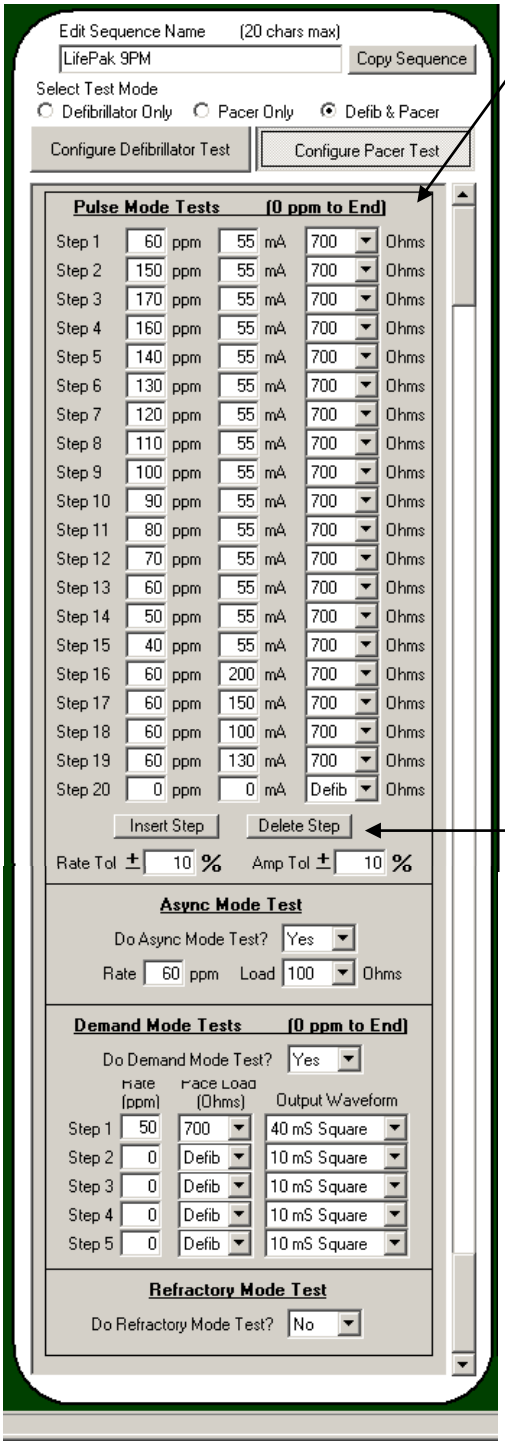
Copy Sequence Button – This button opens the Copy Sequence Screen that allows the user to quickly configure similar test sequences.

Test Mode Selections – These selections allow each test to be configured as a Defibrillator Only, a Pacer Only or a Defib & Pacer test.

Configure Test Buttons – These buttons are used to alternate between defib and pacer test configuration windows.

Defibrillator Test Details – Each of the potential tests and test details for the Defibrillator are displayed for configuration. For ease of programming, individual steps can be deleted or added and individual tests can be included or not included.

Insert and Delete Steps Buttons – These buttons will open the Insert Steps Screen or the Delete Steps Screen.

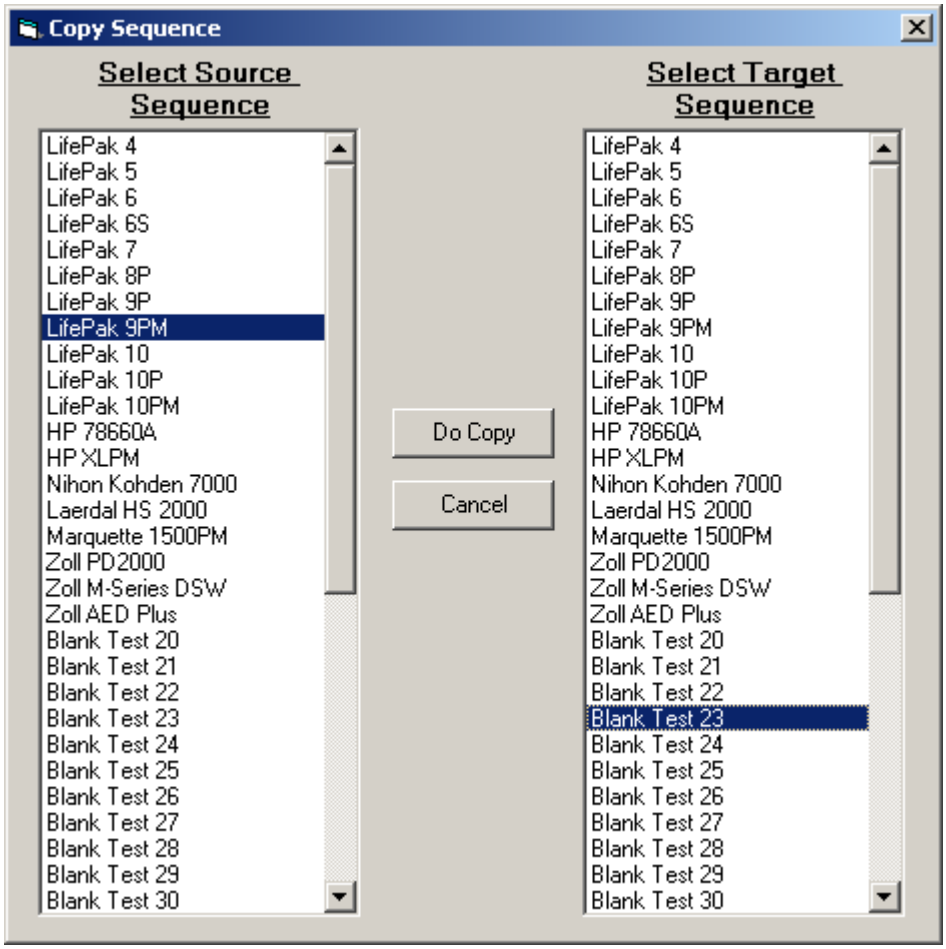


Pacer Test Details – Each of the potential tests and test details for the Pacer are displayed for configuration. For ease of programming, individual steps can be deleted or added and individual tests can be included or not included.

Insert and Delete Steps Buttons – These buttons will open the Insert Steps Screen or the Delete Steps Screen.

Copy Sequence Screen

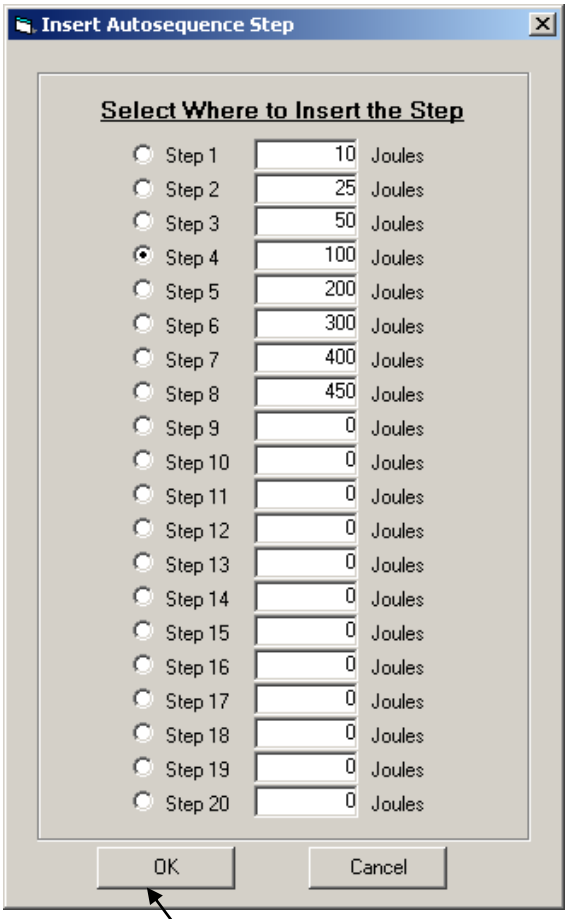
This function allows the user to quickly configure similar Auto Sequences. Simply select the source and target test sequences, press OK, and the target sequence will be overwritten with the configuration from the source sequence configuration. The Cancel button will exit the window without modifying any configuration settings.



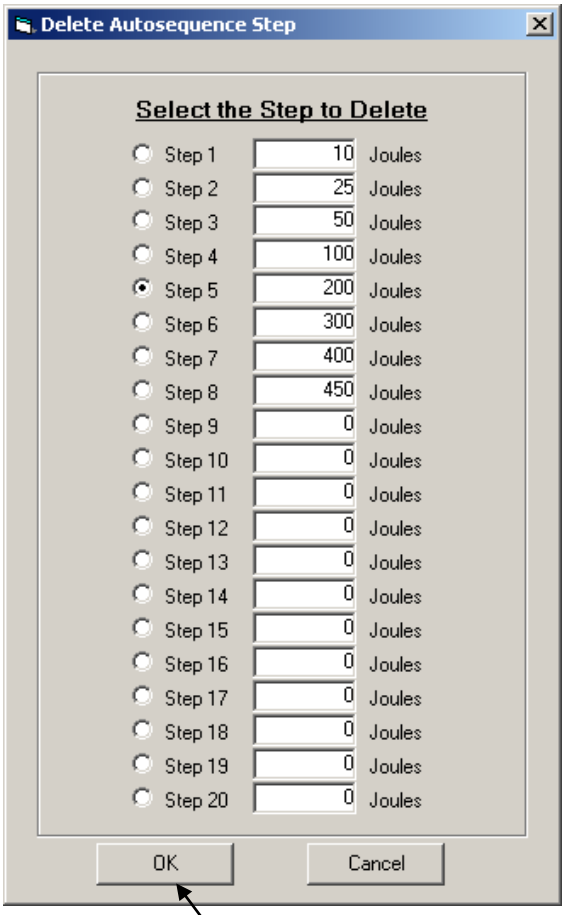
Insert Step and Deleting Step Screens

The insert and delete functions allow the user to quickly modify an existing test configuration. Deleting a step will move all of the tests following the deleted test up by one step and clear the final step. Inserting a step will shift all following steps down by one step and clear the selected step location.

Defibrillator Examples:

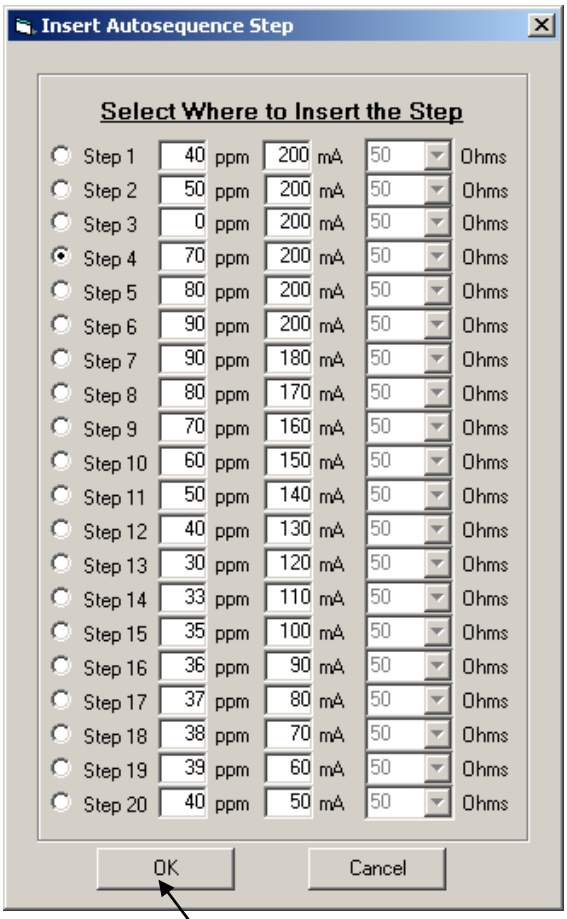


Pressing OK here would shift steps 4-19 down by one step and insert a blank step at step 4.

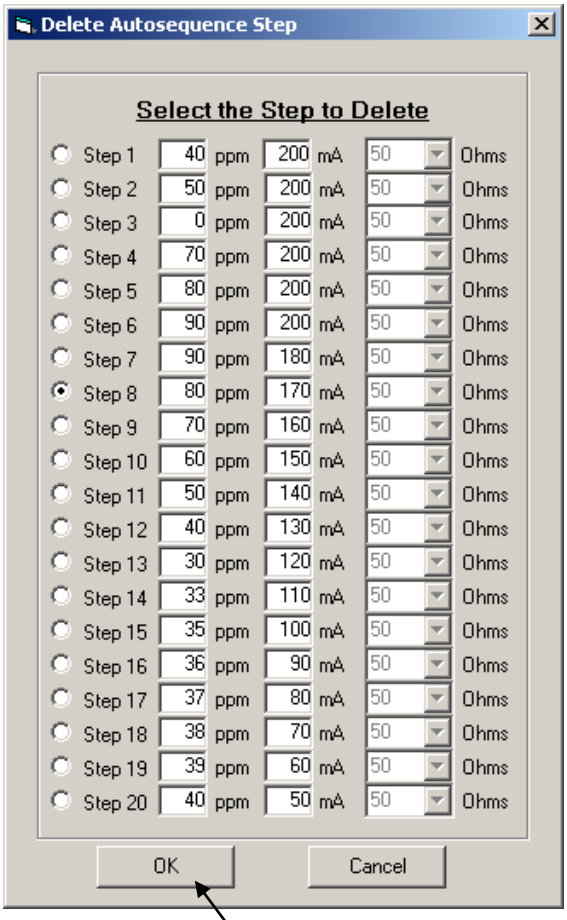


Pressing OK here would shift steps 6-20 up by one step and insert a blank step at step 20.

Pacer Examples:

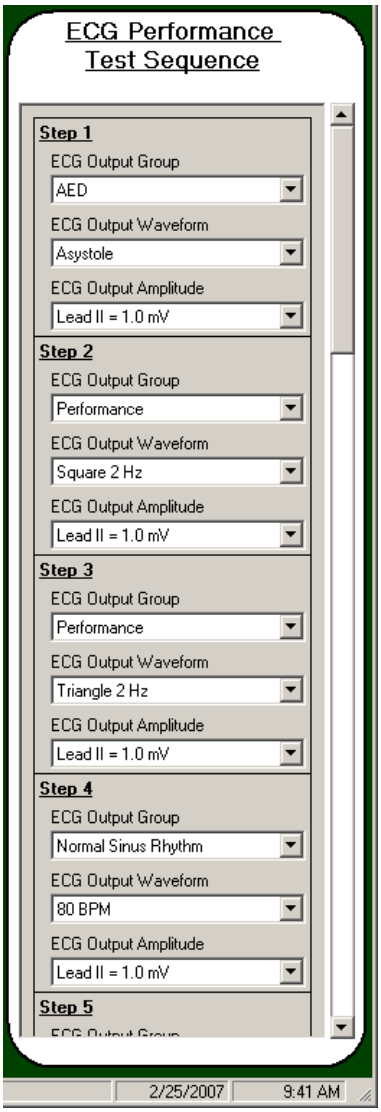


Pressing OK here would shift steps 4-19 down by one step and insert a blank step at step 4.



Pressing OK here would shift steps 6-20 up by one step and insert a blank step at step 20.

ECG CONFIGURATION SECTION



This section configures the ECG Performance sequence when the ECG Performance Test option is set to YES for a Defibrillator Test.

The ECG sequence consists of up to 10 steps. Each step consists of a selected waveform group (Disabled, NSR, AED, Arrhythmia or Performance), output waveform and output amplitude.

There is only one ECG sequence for all 50 Auto Sequence tests.

To use less than 10 steps, set the ECG output group of the next step after the last to “Disabled.”

MANUAL REVISIONS

Revision #	Program #	Revisions Made
Rev 01	DT7395CA	Preliminary Manual
Rev 02	DT7395CA	Miscellaneous Editing Updates
Rev 03	DT7395CA	Pictures Updated
Rev 04	DT7395CD	Accessories Added
Rev 05	DT7395CF	Added Pacer Graphing, Auto Sequences
Rev 06	DT7395CF	Miscellaneous Editing Updates
Rev 07	DT7395CG	Added minimum pacemaker pulse width
Rev 08	DT7395CG	CE page and Miscellaneous Edits
Rev 09	DT7395CG	Miscellaneous Edits
Rev 10	DT7395CG	Added Indications for Use
Rev 11	DT7395CG	Updated Manual Format, 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.

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.

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P:\MANUALS\BCGroup\…\DA-2006_UM_Rev_11.doc

SPECIFICATIONS

ENERGY OUTPUT MEASUREMENT				
METHOD	Monophasic or Biphasic			
LOAD RESISTANCE	50 Ω ± 1%, Non-Inductive (< 1 µH)			
DISPLAY RESOLUTION	0.1 J			
MEASUREMENT TIME WINDOW	100 ms			
ABSOLUTE MAX PEAK VOLTAGE	6000 V			
PULSE WIDTH	100 ms			
CHARGE TIME MEASUREMENT	0.1 to 99.9 s			
	HIGH RANGE		**LOW RANGE**	
VOLTAGE	≤ 5000 V		≤ 1000 V	
CURRENT	≤ 100 A		≤ 20 A	
ENERGY	≤ 1000 J		≤ 50 J	
ACCURACY	≤ 100 J	± 2 J	≤ 20 J	± 0.4 J
	> 100 J	± 2% of reading	> 20 J	± 2% of reading
TRIGGER LEVEL	100 V		20 V	
PLAYBACK AMPLITUDE	1 mV / 1000 V Lead 1		1 mV / 1000 V Lead 1	
TEST PULSE	125 J ± 20%		5 J ± 20%	
OSCILLOSCOPE OUTPUT ATTENUATION	1000:1		200:1	
CARDIOVERSION	DELAY		0 to 6000 ms	
	RESOLUTION		0.1 ms	
	ACCURACY		± 2 ms	
WAVEFORM PLAYBACK	OUTPUT		LEAD I & PLATES	
	SCREEN		200:1 Time Base Expansion	
SYNC TIME MEASUREMENTS	TIMING WINDOW		Starts at peak of each R-wave	
	TEST WAVEFORMS		All waveform simulations available	
	DELAY TIME ACCURACY		± 1 ms	

PATIENT SIMULATOR		
ECG WAVEFORM RATES	ECG NSR	30, 40, 45, 60, 80, 90, 100, 120, 140, 160, 180, 200, 220, 240, 260, 280, 300 BPM
	SINE	0.1, 0.2, 0.5, 5, 10, 40, 50, 60, 100 Hz
	SQUARE	0.125, 2.000 Hz
	TRIANGLE	2.000, 2.500 Hz
	PULSE WAVE	30, 60, 120 BPM; 60 ms width
AMPLITUDE	0.5, 1.0, 1.5, 2.0 mV (Lead II)	
ACCURACY	RATE	± 1%
	AMPLITUDE	± 2% @ Lead II
HIGH LEVEL	OUTPUT	200 times Amplitude
	ACCURACY	± 5%
QRS DURATION	80 ms	
LEAD TO LEAD IMPEDANCE	1000 Ω	
ECG ARRHYTHMIA SELECTIONS	Ventricular Fibrillation	
	Atrial Fibrillation	
	Second Degree A-V Block	
	Right Bundle Branch Block	
	Premature Atrial Contraction	
	PVC Early	
	PVC Standard	
	PVC R on T	
	Multifocal PVC	
	Bigeminy	
	Run of 5 PVCs	
	Ventricular Tachycardia	

PATIENT SIMULATOR (continued)	
ECG SHOCK ADVISORY ALGORITHM TEST SELECTIONS	Asystole
	Coarse Ventricular Fibrillation
	Fine Ventricular Fibrillation
	Multifocal Ventricular Tachycardia @ 140 BPM
	Multifocal Ventricular Tachycardia @ 160 BPM
	Polyfocal Ventricular Tachycardia @ 140 BPM
	Polyfocal Ventricular Tachycardia @ 160 BPM
	SupraVentricular Tachycardia @ 90 BPM

TRANSCUTANEOUS PACEMAKER ANALYZER			
TEST LOAD	LOAD VALUES	50, 100, 150, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800, 1900, 2000, 2100, 2200, 2300 Ω	
	ACCURACY	50 to 1300 Ω	± 1%
		1400 to 2300 Ω	± 1.5%
PULSE CURRENT	RANGE	4 to 300 mA (100 Ω load)	
	ACCURACY	± 5% or ± 0.5 mA (whichever is greater)	
	LIMIT	50 – 600 Ω	300 mA
		700 Ω	286 mA
		800 Ω	250 mA
		900 Ω	222 mA
		1000 Ω	200 mA
		1100 Ω	182 mA
		1200 Ω	167 mA
		1300 Ω	154 mA
		1400 Ω	143 mA
		1500 Ω	133 mA
		1600 Ω	125 mA
		1700 Ω	118 mA
		1800 Ω	111 mA
		1900 Ω	105 mA
		2000 Ω	100 mA
		2100 Ω	95 mA
		2200 Ω	91 mA
		2300 Ω	87 mA

TRANSCUTANEOUS PACEMAKER ANALYZER (continued)			
PULSE RATE	RANGE	30 to 800 ppm	
	ACCURACY	± 1% or 2 ppm (whichever is greater)	
PULSE WIDTH	RANGE	0.6 to 80 ms	
	ACCURACY	± 1% or ± 0.3 ms (whichever is greater)	
VOLTAGE	VARIABLE LOAD INPUT	200 V	
	FIXED LOAD INPUT	15 V	
OSCILLOSCOPE OUTPUT	AMPLITUDE ATTENUATION	0 – 15 V	10.24:1
		15 – 60 V	41:1
		> 60 V	164:1
	MAX OUTPUT	200 V	
DEMAND SENSITIVITY	WAVEFORMS	Square, Triangle, Haversine	
	WIDTH	10, 25, 40, 100, 200 ms	
	OUTPUT AMPLITUDE	ECG OUTPUT	0 to 4 mV
		PACER INPUT (50 TO 400 OHMS)	0 to 10 mV / 50 Ω
		PACER INPUT (500 TO 2300 OHMS & OPEN)	0 to 100 mV
		DEFIBRILLATOR PLATES	0 to 10 mV
	OUTPUT RESOLUTION	ECG OUTPUT	40 µV
		PACER INPUT (50 TO 400 OHMS)	40 µV
		PACER INPUT (500 TO 2300 OHMS & OPEN)	1 mV
		DEFIBRILLATOR PLATES	0.1 mV
	OUTPUT ACCURACY	± 2%	
	INPUT RATE	ECG OUTPUT	N/A
		PACER INPUT	30 to 100 ppm
		DEFIBRILLATOR PLATES	30 to 100 ppm
REFRACTORY PERIOD	PACING	20 to 500 ms	
	SENSING	20 to 500 ms	
	ACCURACY	± 2 ms	

TRANSCUTANEOUS PACEMAKER ANALYZER (continued)			
50/60 HZ INTERFERENCE TEST SIGNAL	ECG OUTPUT	0, 0.4, 0.8, 1.2, 1.6, 2.0, 2.4, 2.8, 3.2, 3.6, 4.0 mV	
	PACER INPUT	50 Ω	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 mV
		100 Ω	0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20 mV
		150 Ω	0, 3, 6, 9, 12, 15, 18, 21, 24, 27, 30 mV
		200 Ω	0, 4, 8, 12, 16, 20, 24, 28, 32, 36, 40 mV
		300 Ω	0, 6, 12, 18, 24, 30, 36, 42, 48, 54, 60 mV
		400 Ω	0, 8, 16, 24, 32, 40, 48, 56, 64, 72, 80 mV
		≥ 500 Ω	0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 mV
	DEFIBRILLATOR PLATES	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 mV	

PHYSICAL & ENVIRONMENTAL		
DISPLAY	LCD Graphical 240 X 64 Pixels, Backlit	
CONSTRUCTION	ENCLOSURE	Royalite R59 UL Flame Rating 94 V-0
	OVERLAY	Lexan, Back printed
SIZE	4.10 x 9.77 x 10.65 Inches (104.1 x 248.2 x 270.5 mm)	
WEIGHT	≤ 5.0 Lbs (≤ 2.27 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 1604 Alkaline or equivalent)	
AC ADAPTOR	9 to 10 VDC, ≥ 200 mA  BC20 - 21103 (USA Version) BC20 - 21101 (Euro Version)	
RS-232 COMMUNICATIONS	BAUD	115200
	DATA BITS	8
	START BITS	1
	STOP BITS	1
	PARITY	None
	HANDSHAKING	None
	CONNECTIONS	Female DB-9
PARALLEL PRINTER PORT	CONNECTIONS	Female DB-25

NOTES

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DA-2006 Series User Manual
08/12 – Rev 11