DELTA 2200

Bipolar Defibrillator
Analyzer / AED Tester with built-in 12 lead ECG Simulator

Operating Manual

NETECH

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DELTA 2200 Operating Manual Rev0

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Quality Assurance

Netech is ISO 9001-2000 Certified. This instrument was thoroughly tested and inspected according to Netech's ISO 9001-2000 quality standards and test procedures and found to meet those specifications when it was shipped from the factory.

Warranty

Netech warrants the DELTA 2200 against defects in materials and workmanship for one year from the date of original purchase. The standard warranty is extended for a second year if the instrument is returned to Netech for its recommended yearly recalibration.

During the warranty period, we will repair or, at our option, replace at no charge a product that proves to be defective, provided you return the product shipping prepaid to Netech Corporation. This warranty does not apply if the product has been damaged by accident or misuse or as the result of service or modification by other than Netech Corporation, or if its serial number is defaced or removed.

Netech reserves the right to discontinue the DELTA 2200 at any time, or change its specifications, price, or design without notice and without incurring any obligation. Netech will make a concerted effort to supply service parts for 5 years after discontinuation.

The warranty is void if you elect to have the unit serviced and / or calibrated by someone other than Netech or its authorized distributors.

The purchaser assumes all liability for any damages or bodily injury, which may result from the use or misuse of the unit by the purchaser, his employees, agents, or customers. ***In no event shall Netech Corporation be liable for consequential damages***

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This Manual is provided to explain the operation of the DELTA 2200 Defibrillator Analyzer / ECG Simulator test instrument.

It is intended for the biomedical engineering or clinical engineering technician involved in the testing of defibrillators.

The operator must be familiar with and follow the safety protocols recommended by the device manufacturer.

Safety Notes:

1. **Before using the DELTA 2200 read the instruction manual and become familiar with the functions and controls.**

2. **Discharge a defibrillator only into the paddle contacts of the DELTA 2200. Do not discharge a defibrillator into any other connectors of the DELTA 2200.**

3. **The operating instructions of the manufacturers of all defibrillators and pacemakers being tested must be followed. Special attention should be paid to automatic and semi-automatic defibrillators.**

4. **Keep the DELTA 2200 in a fat surface close to the unit under test.**

5. **Before discharging the energy into DELTA 2200, place the paddle firmly on the discharge plate to prevent arching.**

1.1 Introduction

The **DELTA 2200** is the upgraded version of the Netech's most popular DELTA 2000. It is designed to test all functions of Bi-Phasic defibrillators and AEDs. The compact and lightweight design makes it ideal for ambulances as well as field service technicians. It is by far the smallest defibrillator analyzer in the market with the best value.

This manual covers proper operation of **DELTA 2200. It is recommended to get familiar with the functions of DELTA 2200 prior to testing the defibrillators.**

The **DELTA 2200** is designed to accurately measure the output parameters of defibrillators. It simulates a wide variety of arrhythmia waveforms for testing automatic defibrillators and ECG equipment.

The DELTA 2200 is compact, lightweight, and rugged. It is operated via easy to use menus displayed on its large display. It can be battery or AC operated.

1.1.1 Defibrillator Test Functions

The DELTA 2200 measures the delivered energy of a defibrillator in Joules (watt – seconds). The built in test load (50 Ohms) simulates the human body's impedance. The energy is measured in two ranges: 1-100 Joules (LOW) or 1 – 1000 Joules (HI). The Peak Voltage and Current are displayed simultaneously.

The cardioversion delay time of a defibrillator in its synchronized mode is measured in milliseconds from the R wave peak of the simulated ECG waveform.

The defibrillator pulse waveform can be replayed via the ECG jacks on the rear panel or through the paddles to print on a recorder or view on an oscilloscope.

1.1.2 ECG / Arrhythmia Simulator Functions

The DELTA 2200 simulates a normal sinus rhythm ECG waveform along with several arrhythmias. It also generates sine, square, triangle, and pulse performance waveforms.

1.2   Safety Considerations

Before using the DELTA 2200, the operator must follow the safety precautions listed in this manual.

1.2.1 Defibrillators

Defibrillators deliver high voltage shocks to a patient in order to stop a heart attack. The defibrillator discharge pulse is potentially dangerous. Proper safety precautions must be observed while handling the Defibrillators.

1.2.2 Automatic Defibrillators

Automatic defibrillators discharge automatically when they detect a life threatening heart condition, which requires a shock.

The DELTA 2200simulates a vide variety of arrhythmia waveforms. When the instrument is connected to an automatic defibrillator and a ventricular fibrillation (VFB) or ventricular tachycardia waveform is selected, the defibrillator will discharge. The fully automatic defibrillator will warn the user that it is about to discharge. Always heed the audible warnings of the defibrillator. Use the recommended paddle adapters for connecting to the DELTA 2200. Do not touch the paddle or electrode contacts.

1.3   Specifications

1.3.1 Defibrillator Tester

Energy Measurement

Load Resistance: 50 Ohms ± 1% Non Inductive.
Range (High): 700 Joules.
Resolution: 1 Joule.
Range (Low): 1 – 100 Joules.
Resolution: 0.1 Joules.
Maximum Voltage: 5200 volts (HI Range)
                          1750 volts (Low Range).
Maximum Current: 100 Amp (HI Range)
                          32 Amps (Low Range).
Accuracy: HI Range: ± 2% of the Reading ± 2 Joules.
                 LOW Range: ± 2% of Reading ± 0.1 Joule.

Cardioversion (Sync.) Time

Range: 0-250 ms.
Measurement: From peak of R wave.
Accuracy: 1% of Full Scale ± 1 ms.

Discharge Waveform Output

Real Time: Output 1000: 0.5 Volts.
Stored: Time expansion 200:1 repeated every 8 seconds.

1.3.3 ECG Arrhythmia Simulator

ECG Waveforms:
    Normal Sinus Rhythm
    Rates: 30, 60, 80, 120, 180, 240, 300 BPM
Performance Waveforms:
    Sine, Square, Triangle, and Pulse
    Rates: 0.5, 1, 2, 10, 15, 20, 25, 40 Hz.
Arrhythmia Waveforms:
    VFBC, VFBF, VTAC, AFIB, PVC, PVC1, PVC2, BGY, RBB,
    AFIB, AFT, PVCM.

Amplitudes: 0.5, 1, 1.5, 2, 2.5, 3 mv.

Waveform Output:

Low Level: 12 Lead ECG and Paddle

Hi Level: Output Jacks

Accuracy:

Rate: $\pm$ 1 %

Amplitude: $\pm$ 2% (LA-LL), $\pm$ 10% (Paddles)

1.3.4 RS 232 Output

A computer interface is available to print test results or to save them on a PC. The test results can be saved directly to a Palm Pilot using Notch's optional palm software.

1.3.5 Power Requirements

Two 9 - Volt Alkaline Batteries or AC adapter.

1.3.6 Physical Characteristics

1.3.6.1 Dimensions

10.4 x 7.2 x 4 in. (26.4 x 18.2 x 10.2 cm)

1.3.6.2 Weight

3.0 lbs (1.4 Kg)

1.3.7 Environmental Operating Specifications

Storage Temperature: -25 to 50° C
Operating temperature: 15 to 40° C
Maximum Humidity: 95% Relative Humidity

1.4   Accessories

1.4.1 Standard Accessories

AC Adapter (110-220 VAC)	302 (110-220 VAC)
Operating Manual	635-USER-MANUAL
Service Manual	635-SERV-MANUAL
Carrying Case	635-CASE
Universal Paddle Adapters (set of 2)	653
Un-terminated Banana Plug (set of 2)	6383-02

1.4.2 Optional Accessories

Serial Printer Interface Cable	903
AED Paddle Adapters:	
HP	651-HP
Zoll	651-Zoll
Physio Control	651-Physio
Marquette	651-MARQ
Laerdhal	651-LAED

For all other models: **Please contact Netech**
                              support@netech.org

OPERATING INSTRUCTIONS   Section 2

2.1   Getting Started

Before unpacking the DELTA 2200 inspect the shipping box for any visual damage. If damage is found, do not unpack the unit and immediately notify the shipping carrier.

If no damage is found to the shipping box, open the box and perform a visual inspection of the Delta 2200. If any damage to the unit is observed please contact Netech Customer Service.

The Netech warranty statement is listed in the warranty section of this manual. When shipping an instrument to Netech for repair or calibration make sure that the instrument is properly packed. An RMA # (return merchandise authorization) must be obtained form Netech prior to shipping the unit back to Netech. RMA # can be requested by competing the from at http://www.defibrillatoranalyzer.com/rma.asp or http://www.netech.org/rma.asp . The RMA # must be included with the shipment. All shipping must be fright prepaid.

The unit should be shipped to the following address
Attn: Service Department
Netech Corporation
110 Toledo Street
Farmingdale, NY 11735, USA

If the unit is shipped from outside USA, please indicate that " DELTA 2200 - test Instrument" retuning back to USA for repair or recalibration.

2.1 Controls and Indicators

Figure 1

1. Defib. Paddle Contacts: Apex (R) Sternum (L) 2. Serial Port 3. ECG Output – 10 Lead 4. ECG Hi Level	5. Defibrillator discharge real Time Output 6. LCD Display 6. Function Keys 7. Power On/ Off Switch 8. DC Power Input
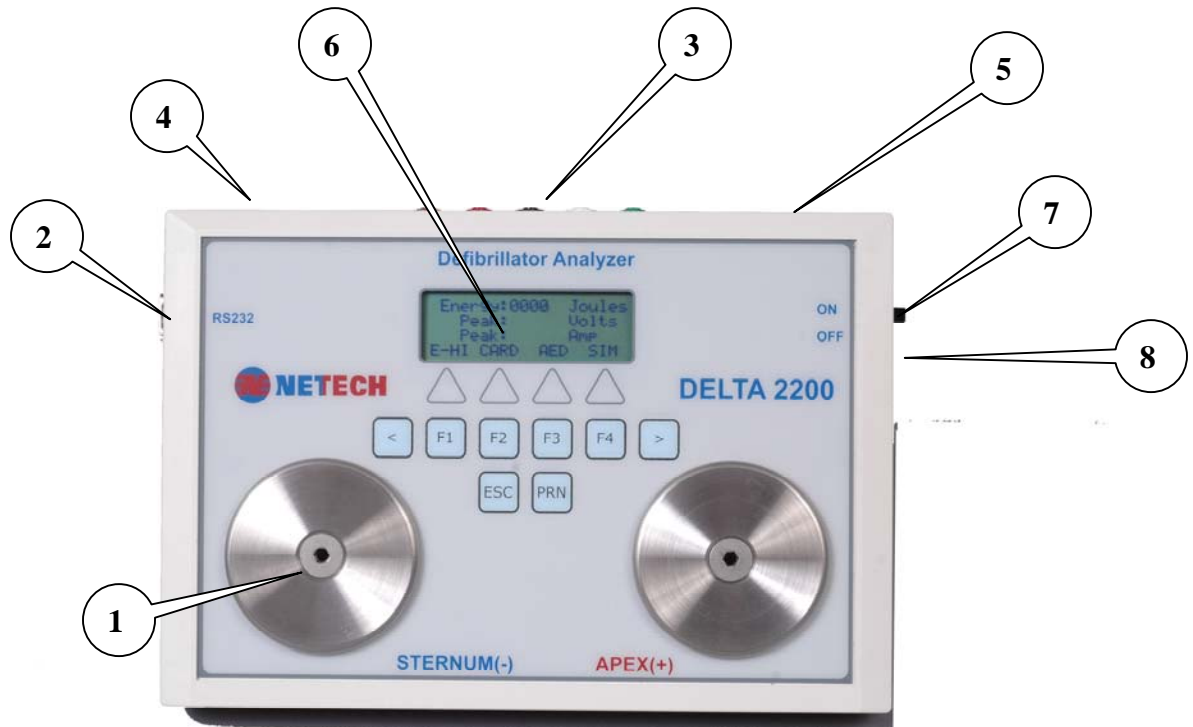
Figure 1

Before proceeding to use the DELTA 2200 make sure you read this manual and become familiar with the functions all of the controls and the menu operation.

The DELTA 2200 is battery powered. The power On / Off switch **(7)** is located on the top right hand side of the instrument.

When the instrument is turned on, the version and revision level of the software are displayed for about 5 seconds.

2.3 RS 232 Setup

The DELTA 2200 can be connected to a printer or a PC via the RS 232C SERIAL PORT located on the side of the instrument.
The default settings for the serial communication are:
Baud Rate = 9600, Data Bits = 8, Parity = None, Stop Bit = 1

Note: These settings must be the same for the PC or the Printer. To retrieve the data into a Palm Pilot use the optional interface cable for the Palm Pilot.

2.4 Menu Structure

The DELTA 2200 is easily operated via a menu system utilizing an eight key keypad located on the front of the instrument below the display.

Menus appear on the display above the four keys labeled:
[F1] [F2] [F3] [F4].

These keys select functions listed on the display.

There are four lower keys special function keys labeled:
[←] [ESC] [PRN] [→].

The '**ESC**' key has two different functions.

2.4.1 Power up Menu

Defibrillator Power Up Initialization Menu: Displayed for 3 Seconds

```
            D  e  l  t  a      2  2  0  0



D  E  f  i  b  /  S  i  m      V  e  R      2  .  0  r  6
```

Defibrillator Main Menu: Automatically Displayed After Power Up

```
   E  n  e  R  g  y  :  0  0  0  0        J  o  u  L  E  s
      P  E  a  k  :                    V  o  l  T  S
      P  E  a  k  :                    A  m  p
E  -  H  I     C  A  R  D      A  E  D        S  I  M
```

F1	F2	F3	F4

2.4.1.1 Defibrillator Menu:

Then if [F1] Key Is Pressed: Energy Range will Switch to Low

```
   E  n  E  R  g  y  :  0  0  .  0  0        J  o  u  L  E  S
      P  E  a  k  :                    V  o  l  T  S
      P  E  a  k  :                    A  m  p
E  -  L  O     C  A  R  D      A  E  D        S  I  M
```

F1	F2	F3	F4

2.4.1.2 Cardioversion Test Menu:

If [F2] Key Is Pressed: Menu will switch to the Cardioversion Function

```
    E  n  e  R  g  y  :   0   0   0   0           J  o  u  L  E  s
             P  E  a  k  :                        V  o  l  T  S
             P  E  a  k  :                        A  m  p
 E  -  H  I      C  A  R  D           A  E  D           S  I  M
```

F1	F2	F3	F4

Display will read this:

```
    C  a  r  D  i  o  :  -  0   0   0           m  S



    E  n  e  R  g  y  :   0   0   0   0           J  o  u  L  E  S
             E  C  G   :       6  0      b  p  m
 E  -  H  I      C  A  R  D           A  E  D           S  I  M
```

F1	F2	F3	F4

2.4.1.3   AED Test Menu:

If [F3] Key Is Pressed: Menu will switch to AED Function

```
    E  n  e  R  g  y  :   0   0   0   0           J  o  u  L  E  s
             P  E  a  k  :                        V  o  l  T  S
             P  E  a  k  :                        A  m  p
 E  -  H  I      C  A  R  D           A  E  D           S  I  M
```

F1	F2	F3	F4

Then the display will read:

```
    E  n  e  R  g  y  :   0   0   0   0           J  o  u  L  E  s



 A  R  R  T  H                                  E  C  G
```

F1	F2	F3	F4

2.4.1.4 ECG Simulator Menu:

If [F4] Key Is Pressed Function　　　　**Menu will Switch to the Simulator**

E n E R g y : 0 0 0 0		J o u L E s	
P E a k :		V o l T S	
P E a k :		A m p	
E - H I 　 C A R D	A E D	S I M	

F1	F2	F3	F4

S i m u L a t o r			
A M P : 　 1 m V			
E C G : 6 0 b p m			
E C G 　 A R R T H 　 P E R F		A M P L	

F1	F2	F3	F4

2.5　Testing A Defibrillator

2.5.1 Energy Measurement

The DELTA 2200 has high and low energy measurement ranges. Up to 1000 joules may be measured in the high range mode and up to 100 joules may be measured in the low range mode.

- Turn the DELTA 2200 on and move the function selector switch to the DEFIB mode. The Defibrillator Main Menu, will be displayed.

- The DELTA 2200 is in the energy measurement mode and is ready to make an energy measurement.

- To measure energy in the low range press the F1 key. 'E-HI' will change to 'E-LO' See Figure 2.

- Determine method of discharge. Reusable paddles may be fired directly on the contact pads Item (1) Figure 1.

Note: If an adapter interface is to be used for testing AEDs be sure to install Netech Part Number 653 over the contact pads.

- Turn on the defibrillator to be tested and select the energy output following the manufacturer's instruction manual. To measure the energy, discharge the defibrillator paddles. If you are in the low range, and the discharged energy exceeds 100 joules, the display will flash '**HIGH**'.

Figure 2

Defibrillator Main Menu

	E	N	E	r	g	y	:	0	0	0	0		J	o	u	l	e	s
			P	e	a	k	:						V	o	l	t	s	
			P	e	a	k	:						A	m	p			
E	-	H	I		C	A	R	D		A	E	D			S	I	M	

F1	F2	F3	F4

Defibrillator Menu: Energy Range   'E-LO' F1 Key Pressed

	E	N	E	r	g	y	:	0	0	.	0	0		J	o	u	l	e	s
			P	e	a	k	:							V	o	l	t	s	
			P	e	a	k	:							A	m	p			
E	-	L	O		C	A	R	D			A	E	D			S	I	M	

F1	F2	F3	F4

2.5.2 Peak Voltage and Current

Each time the defibrillator is discharged, the display will update the peak voltage and the peak current (displayed in Amps) measurement readings.

2.5.3 Viewing Waveform Output

2.5.3.1 Stored For Display On a Defibrillator Monitor

After the defibrillator is discharged, and while the DELTA 2200 is in the energy mode, the captured waveform will be available through the ECG leads, the paddle contacts, and the high level output jack on the side panel Item 4 Figure 1.

Waveforms on the ECG leads and paddles are amplitude scaled to provide maximum output. Time is scaled to provide a time expansion of 1:200, where 5mS would equal 1 Second. The Discharged wave is repeated at 8-second intervals.

2.5.3.2 Real Time Display On an Oscilloscope

An attenuated defibrillator discharge waveform can be displayed on an oscilloscope. The amplitude reduction is 1000:1 volts.

Connect an oscilloscope to the side panel output jack located on the rear panel, Item 5 Figure 1.

Set the sweep to 1 ms/div and the vertical gain to 1 volt. Discharge the defibrillator on the paddle contacts, and observe the waveform on the Oscilloscope.

If it is a storage oscilloscope, activate the storage mode before discharging energy to the DELTA 2200.

2.5.4 Measuring Cardio-version (Sync.) Time

The DELTA 2200 measures the synchronization time (cardio-version time) of the defibrillator. A simulated ECG waveform @ 60 BPM is output through the ECG jacks and the paddle contact plates. During normal operation, the defibrillator recognizes and responds to this trigger by discharging within a certain period of time.

The DELTA 2200 is capable of measuring the cardio-version (sync.) time if the defibrillator discharge energy is within ± 250 ms of the peak of the R wave.

- Press 'CARD' soft key [F2] from the Main menu.

- A simulated ECG waveform @ 60BPM is output through the ECG leads and paddles.

- Select the source of the ECG waveform on your defibrillator. Observe the ECG coming out of the DELTA 2200 on your defibrillator monitor.

- Set the defibrillator to the synchronize mode.

- Discharge the energy on the DELTA 2200.

- The Cardio-version (sync.) time will be displayed.

- If the Cardio-version time is greater than ± 250 ms of the peak of the R wave, the DELTA 2200will display '**over range**'.

Cardioversion Test Menu: **[F2] Key Pressed = Cardio. Time**

	C	a	R	d	i	o	:	-	0	0	0			m	s			
	E	n	E	r	g	y	:		0	0	0	0			J	o	u	L	E	s
			E	C	G		:			6	0			b	p	m		
E	-	H	I			C	A	R	D			A	E	D			S	I	M

F1	F2	F3	F4

2.6 Testing Semi-Automatic or Automatic Defibrillators

Refer to the defibrillator manufacturer's service manual for specific device inspection requirements.

Note:Observe all safety precautions. For fully automatic defibrillators use the correct paddle adapter for the defibrillator under test. The paddle contact plates must not be exposed during discharge.

2.6.1 Selecting Waveforms

Press the 'AED' [F3] soft key in the Defib main menu. Energy values will be indicated on the top line of the display. Possible Arrhythmia [F1] selections and ECG [F4] selections will be displayed on the bottom line of the display.

Select the desired Arrhythmia waveform by pressing [F1] for the list of advisory shock waveforms to the defibrillator. Use the [<] and [>] to scroll through the selections.

The twelve available selections are:

[VFBC], [VFBF], [VTAC], [AFIB], [RBB], [PAC], [PVC], [PVC1], [PVC2], [BGY], [AFT], and [PVCM]

The waveform selected will be indicated on the third line of the display.

Defibrillator Main Menu: [F3] Key Pressed AED Selection

	E	n	E	r	g	y	:	0	0	0	0		J	o	u	l	e	s
			P	e	a	k	:						V	o	l	t	s	
			P	e	a	k	:						A	m	p			
E	-	H	I		C	A	R	D			A	E	D			S	I	M

F1	F2	F3	F4

AED Test Menu: [F1] Key Pressed for Arrhythmia Selection

E	n	E	r	g	y	:	0	0	0	0		J	o	u	l	e	s
A	R	R	T	H										E	C	G	

F1	F2	F3	F4

AED, Arrhythmia Selection Menu: 'F1' Key Pressed for VFB Course

E	n	e	r	g	y	:	0	0	0	0		J	o	u	l	e	s
	W	a	v	e	:	V	F	B		C	o	u	r	s	e		
V	F	B	C		V	F	B	F		V	T	A	C			A	F	I	B

F1	F2	F3	F4

2.6.2 Measuring Energy

Connect the paddle adapters to the circular contact plates (for fully automatic defibrillators) or place the paddles firmly on the paddle contacts (for semi automatic defibrillators with paddles) and discharge the defibrillator.

The DELTA 2200 will display the measured energy.

2.7 Printing Defibrillator Measurement Data

Press the 'PRN' key on the Keypad to print the measured test data from the DELTA 2200 in the defibrillator mode.

The first time the 'PRN' key is pressed, the header shown below in Fig A will be printed, followed by the measured test data in Fig B

```
              NETECH
           DEFIB TESTER
            DELTA 2200
       Date:_____
        Control No._____
       Model No._____
        Serial No._____
       Manf._____
        Hospital:_____
       BMET:_____
        Remarks:_____
        Pass_____  Fail_____
    ─────────────────────────────

       Energy set: _____
          Energy: 103 Joules
        Peak Voltage: 1739 Volts
         Peak Current: 34 Amp
```

Fig A

Fig B

If the 'PRN' key is pressed, when the instrument is in the defibrillator- Cardioversion mode, the measured data will be printed as shown in Fig C

```
       Energy set: _____
       Cardio Time: 31 mS
       Energy: 103 Joules
       Peak Voltage: 1739 Volts
       Peak Current: 34 Amp
```

Fig C

2.8   ECG ARRHYTHMIA SIMULATOR

The DELTA 2200 is a 12 lead ECG arrhythmia simulator. In addition to   simulating a normal sinus rhythm and 12 arrhythmia waveforms, the instrument will generate four different performance waveforms.

 The Simulator's main menu provides options for arrhythmia, ECG, and performance waveform selections along with amplitude selections.

2.8.1 Generating a Normal Sinus Rhythm Waveform

Connect the patient cable of the ECG monitoring instrument to be tested to the ECG Leads connectors on the side of the DELTA 3000.

Press the '**SIM**' [F4] key from either the energy or cardio menu of the Defibrillator Tester to turn on the ECG Arrhythmia Simulator.

Press the '**ECG**' [F1] key for normal sinus rhythm. The default settings for normal sinus rhythm are 80 bpm and 1 milli volt amplitude.

Cardio Menu: **Press '**SIM**' [F4] Key for Simulator**

		C	a	r	d	i	o	:	-	0	0	0			m	S			
		E	n	e	r	g	y	:	0	0	0	0			J	O	u	l	e	s
			E	C	G		:		6	0		b	p	m					
E	-	H	I		C	A	R	D			A	E	D			S	I	M	

F1	F2	F3	F4

Main ECG Simulator Menu: **Press '**ECG**' [F1] Key to Select Rate**

					S	i	m	u	l	A	t	o	r						
					A	m	p	:		1	m	v							
					E	C	G	:		6	0	b	p	m					
E	C	G			A	R	R	T	H		P	E	R	F		A	M	P	L

F1	F2	F3	F4

To change the heart rate, bpm, press the appropriate key. Rates of 30, 60, 80, 120, 180, 240, and 300 are available.

The [←] and [→] keys will scroll through the rate selection menu. Press the [ESC] key to return to the Simulator Main Menu.

2.8.2 Generating Arrhythmia Waveforms

Press the '**ARRTH**' [F2] key to view the available arrhythmias. The default arrhythmia is VFB course and the amplitude is set at 1 millivolt.

The [←] and [→] keys to scroll through the arrhythmia selection menu.

Press the appropriate key to select an arrhythmia waveform.

The selected arrhythmia will be displayed on the third line of the simulator menu display.

2.8.3 Arrhythmia Waveform Definitions

VFBC   Ventricular Fibrillation Course, the amplitude of the waveform is equal to the display.

VFBF   Ventricular Fibrillation Fine, the amplitude of the waveform is one half the value of the display.

VTAC   Ventricular Tachycardia

AFIB   Atrial Fibrillation

RBB   Right Bundle Branch Block

PAC   Premature Atrial Contraction

PVC   Premature Ventricular Contraction, one PVC followed by 10 normal beats.

PVC1 Premature Ventricular Contraction, one PVC followed by 7 normal beats.

PVC2 Premature Ventricular Contraction, run of 5 PVC's followed by 9 normal beats.

BGY Bigeminy
AFT Atrial Flutter

PVCM Premature Ventricular Contraction, manually placed each time the '**PVCM**' key is pressed. NSR rate is 60 bpm.

2.8.4 Amplitude Selection

Note:Select Amplitude if you require amplitude other than the default 1 mV, prior to any other selections

Press the '**AMPL**' [F4] key in the Simulator Main Menu to select the amplitude.

The [←] and [→] keys to advance through the amplitude selection menu. There are eight choices: 0.5, 1, 1.5, 2, 2.5, 3, 4, and 5 mV.

The selected amplitude will be displayed on the second line of the Simulator Menu display.

The selected amplitude will remain in effect as long as you are in the simulator menu.

Note:When the DELTA 2200 is switched to the energy mode from the simulator menu, the waveform amplitude will return to the default value of 1 mV.

2.8.5 Generating Performance Waveforms

Sine, square, triangle, and pulse waveforms are available for the performance testing of ECG monitoring equipment.

Press the '**PERF**' [F3] key in the Simulator Main Menu to select performance waveforms.

Press, either the '**SINE**' [F1], the '**SQUR**' [F2], the '**TRI**' [F3], or the '**PULS**' [F4] key to select the desired waveform.

The default amplitude setting of the performance waveforms is 1 mv.

Press the '**AMPL**' [F4] key in the Simulator Main Menu to change the amplitude.

The selected amplitude will remain during testing until it is changed.

The amplitude will revert to the 1 mv default setting when the DELTA 2200is turned off.

The default frequency of the sine, square, and triangle waveforms is 2 Hz.

Frequencies of 0.5, 1, 2, 10, 15, 20, 25, or 40 Hz may be selected.

Press either the [←] or [→] key to scroll through the frequency selections.

Press the key corresponding to the frequency to be selected.

The Pulse waveform is a 20 ms waveform repeated every 4 seconds (240 bpm).

Simulator Menu: **With Triangle Performance Waveform**
Selected

					S	i	m	u	l	a	t	o	r					
					A	m	p	:			1	m	V					
					W	a	v	e	:	T	r	i			2	H	z	
<	0	.	5				1				2				1	0		>

F1	F2	F3	F4

Simulator Menu: **With Pulse Performance Waveform**
Selected

					S	i	m	u	l	a	t	o	r					
					A	m	p	:			1	m	V					
		2	0	m	s		P	u	l	s	e		@	4	S	e	c	

F1	F2	F3	F4

2.14.1 Printing Without a Header

Press the [**PRN]** key on the Keypad to print the measured test data from the DELTA 2200.

The DELTA 2200 will send data to the printer port each time the display updates with current parameter measurements.

Press the '**PRN**' key again to stop the continuous printing of parameter measurements.

PC Quick Link Software

To store the results in a PC using Quick Link, PC wedge, Hyper-Terminal or other Communications software follow these steps:

Using the line setting option select: Baud Rate=9600, Data Bits=8, Parity=None, Stop Bits=1.

Connect the RS232 cable from the DELTA 2200 to the serial port of the PC (DB-9 connector) and in the Modem setup option of Quick Link select the COM port.

Select the file option to Receive File.

→"ASCII" and enter a file name to which the DELTA 2200 results are to be stored.

Once the above selections have been made you may proceed with our download.

Press the [**Esc]** Key to get back to the main Function Menu. Use the '←' or '→' to scroll until '**Pri**' appears on the Display.

Press the appropriate [F] Key.

Press the '**PrH**' [F3] key to add a header.

Then Press '**PC**' [F2] key to download the information to the PC File.

The file can be printed out or edited using any text editor.

Press the '**NO**' [F4] key to return to the main Function Menu.

2.15.4 Format Selections For Seiko Serial Printers (PRsF)

Different print formats may be selected. Press the '**PrFS**' [F3] key from the Auxilary Menu, to select a different format. User may press the '←' or '→' keys to scroll through the selections. The selections are listed :

TAB	Fix horizontal space
LF	Line feed
FF	Form feed
CR	Carriage return
DW	Double width print
DCLR	Reset double width print
HW	Condensed print
HCLR	Reset condensed print
EMP	Emphasize print
ECLR	Reset emphasize print
DST	Double strike
CLR	Reset double strike
MarR	Right margin set
BS	Back space
RST	Reset to power on mode
MarL	Left margin set
PRT	Print 16 characters

3.1 Introduction

DELTA 2200 can be interfaced to a PC using serial port. The out puts are sent to PC or printer in ASCI form. Many generic software interfaces are available. Due to rapid changes in the PC hardware and software NETECH is unable to recommend any particular product at this time.

The easiest way to get the test results to a PC with the serial port is by using Hyper Terminal communication. It is not the scope of this manual to describe the Hyper Terminal. Follow the operating system manual to setup the Hyper terminal. The serial port settings are listed below:

3.2 Serial Port Set Up Procedure

Set up the Hyper Terminal in the PC.

Connect DELTA 2200 to the PC using a serial port cable.

Set Up:

- Baud rate: 9600
- Data bits: 8 bit
- Parity: None
- Stop bits: 1
- Flow control: None

3.3 Receiving and Saving Data

Follow step 3.1-3.2 for receiving data using Hyper Terminal.

Press the '**PRN**' key on the DELTA 2200.

The data will be sent to the Hyper Terminal.

Fill up the Blank fields as shown in Fig A below.

Set the test values for the instrument to be tested, see Fig B below.

Save the file.

NETECH [▭]
DEFIB TESTER
DELTA 2200
Date:
Control No.
Model No.
Serial No.
Manf.
Hospital:
BMET:
Remarks:
Pass: [▭]   Fail: [▭]

Fig A

Energy set:
Energy: 103 Joules
Peak Voltage: 1739 Volts
Peak Current: 34 Amp

Fig B

4.1 Introduction

The DELTA 2200 Defibrillator Analyzer / ECG Simulator is a precision, multi-purpose analyzer that performs tests on all defibrillators and all pacemakers. It is a microcontroller based design and utilizes sophisticated algorithms to control all system activities.
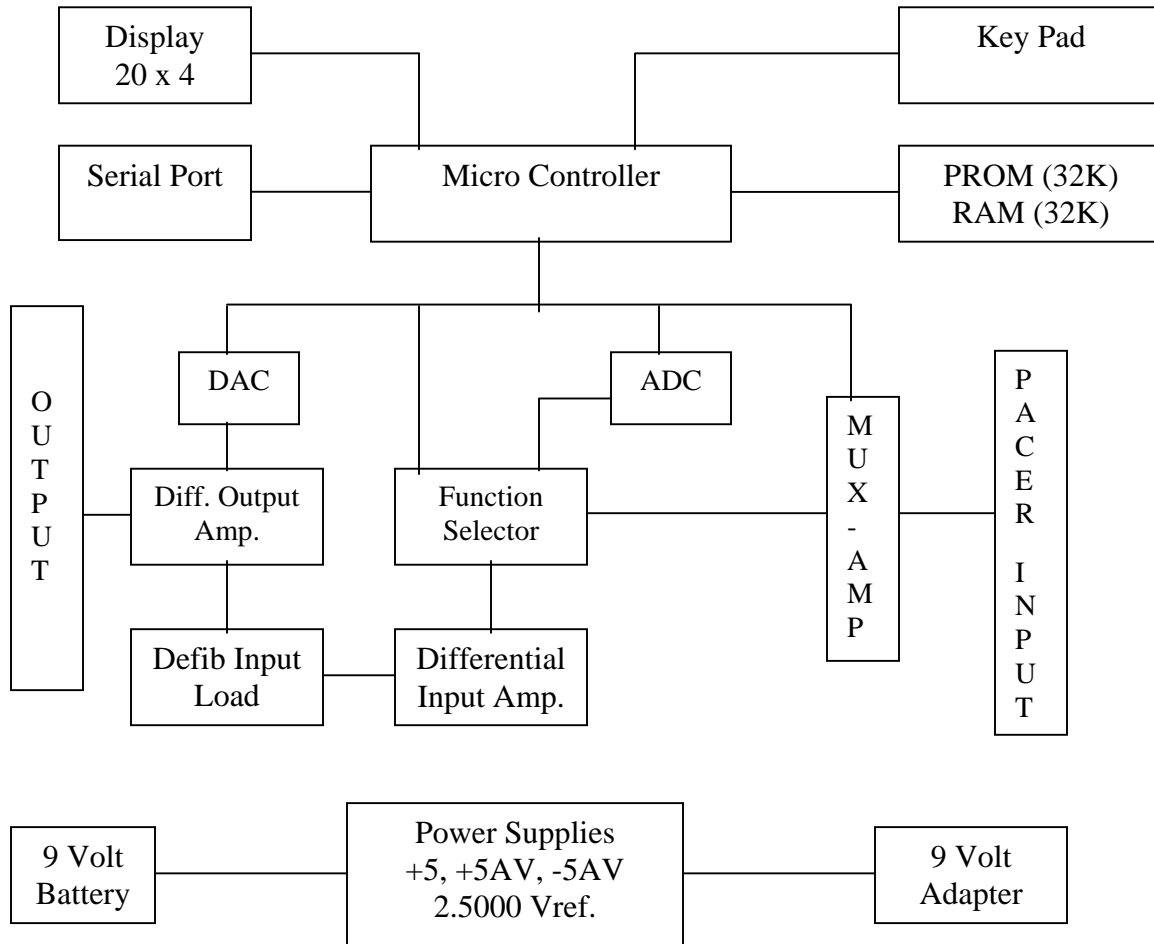
4.2 Defibrillator Output Measurement

The energy of the Defibrillator that is discharged into the 50-Ohm load of the DELTA 2200 is calculated using the formula:

Energy $E = [V^2 (t)] /R$. Where 'V' is the discharge Voltage across the load resistor 'R' and 't' is the duration of the waveform in seconds.

The DELTA 2200 measures the instantaneous voltage (attenuated by a factor of 2000/1.1), every 105 microseconds for a duration of 65 milliseconds. The Microcontroller computes the energy by summing up the squared voltages multiplied by the time and divides the product by 50 (load resistance).

The peak voltage measurement is performed by obtaining the largest value of the samples after a pulse measurement is recorded. The peak current is computed from the peak voltage divided by the load resistance of 50 Ohms.

4.4   Circuit Block Descriptions

```
┌─────────────┐                      ┌─────────────┐
│  Display    │                      │   Key Pad   │
│  20 x 4     │                      │             │
└─────────────┘                      └─────────────┘

┌─────────────┐   ┌─────────────────┐   ┌─────────────┐
│ Serial Port │   │ Micro Controller│   │ PROM (32K)  │
│             │   │                 │   │ RAM (32K)   │
└─────────────┘   └─────────────────┘   └─────────────┘
```

O U T P U T		DAC		ADC		M U X - A M P	P A C E R I N P U T

	Diff. Output Amp.		Function Selector				

	Defib Input Load		Differential Input Amp.				

9 Volt Battery	Power Supplies +5, +5AV, -5AV 2.5000 Vref.	9 Volt Adapter

Block Diagram

4.4.1 Defibrillator Input Load

The input load consists of two 25 Ohm 95 Watt 1% wire wound resistors that simulate the impedance of the human thorax under high voltage conditions.

4.4.2 Differential Input Amplifier

The Input amplifier performs a differential voltage measurement across the input load. The output of the amplifier is fed to the ADC and the scope output amplifier with a gain of 2. The discharge waveform is sensed by the ADC and sampled at the rate of 1000 times per second and saved in the memory. The captured waveform is time scaled to 1:200 and output through the D/A converter. The stored waveform can be observed through the paddles and the ECG leads.

4.4.4 ECG Outputs

ECG and Arrhythmia waveforms are generated by the DAC and are available at the ECG leads, the High Level Output Jacks, and the Defib paddle contacts.

4.4.5 Power Supplies

The DELTA 2200 is powered by two 9 Volt Alkaline batteries. The volt is converted into +5V, +5AV by low dropout linear regulators. The –5AV is generated by a charge pump regulator. The +5AV and –5AV is used to power the op amps and +5V is used for the digital circuits. A precision 2.5000 Voltage reference is generated from the 9 Volt source. The 2.5000 reference voltage is used for the ADC and D/A converters. The +5V regulator incorporates low battery detection and when the battery voltage is lower than 6.5Volt, it sends a low battery signal to the micro controller.

An external DC power jack is provided for use with the Netech AC adapter (PN: 302). When the AC Adapter is plugged into the DC jack the battery Voltage gets disconnected.

4.4.6 Key Pad

The DELTA 2200 functions are controlled by the Menu and key interaction by the user. The 8 momentary Keys are used to control the function of the instrument. The Keys are directly interfaced with the Micro controller. When a key is pressed the micro controller responds by changing the appropriate menu on the display.

4.4.7 Display

The display is a 20 Character 4 Line LCD that interfaces directly with the micro controller. The contrast of the display is adjusted by a potentiometer.

4.4.8 Micro Controller Board

The DELTA 2200 incorporates a 8XC55 based micro controller with 3 programmable timers and serial ports. The frequency of the crystal oscillator is 11.0598Mhz.

4.4.9 Memory

The memory consists of 32 K internal ROM, 32 K external ROM, and 32 K RAM. The internal and external PROM contains the software necessary to control the Delta 3000. The static RAM is used during program execution to hold buffers and stack operation.

4.4.10 Serial Port

The serial communications originates from the processor's asynchronous port 0. The communications protocol is user configurable.

4.4.11 Analog to Digital Conversion

The input signals from the 50 Ohm load for the defib and the pacer input signals are routed through the selector switch to the ADC input. The ADC is a bipolar 13 bit (12 bit plus sign) successive approximation type with an auto calibration feature. The reference voltage is set at 2.5000 Volts by the precision reference.

4.4.12 Digital to Analog Conversion

The D/A converter is a dual 8 bit type. The reference of the first DAC is set at 2.5000 Volts precision reference. The waveform is generated by the second DAC whose reference voltage is controlled by the first ADC for scaling purposes (amplitude selections). The output signal is then offset and inverted by the Op amp to form a symmetrical signal with respect to ground. The signal is further scaled and buffered for the high level output. The single ended signal is amplified differentially and attenuated to 1mV (default amplitude) and fed to the 50 Ohm load. This signal is sensed by the automatic defib to trigger the output pulse.

5.1 Troubleshooting Chart

The following chart is provided for basic troubleshooting.
Problems other than those listed should be addressed to the
Netech Technical Service Department by e-mail at
techsupport@netech.org or contact 631-531-0100.

Description	Cause	Action
On Power up the Display is blank	The Battery Voltage may be low or the display contrast is set low	Replace with new battery or use AC adapter.
When Defib is fired into the unit the display freezes.	This occurs when hi EMI fields produced by The Defib.	Turn Unit off and then turn it On.
The display shows non ASCI Characters	Memory corruption	Turn Unit off and then turn it On.
Low battery warning	Battery is low	Replace battery

6.4   Schematics

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