FLUKE®

Biomedical

QED 6

Defibrillator Analyzer

Users Guide

PN 2204510
September 2007

Warranty and Product Support

Fluke Biomedical warrants this instrument against defects in materials and workmanship for one year from the date of original purchase. 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 Fluke Biomedical. This warranty covers the original purchaser only and is not transferable. The warranty does not apply if the product has been damaged by accident or misuse or has been serviced or modified by anyone other than an authorized Fluke Biomedical service facility. NO OTHER WARRANTIES, SUCH AS FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSED OR IMPLIED. FLUKE SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES, INCLUDING LOSS OF DATA, ARISING FROM ANY CAUSE OR THEORY.

This warranty covers only serialized products and their accessory items that bear a distinct serial number tag. Recalibration of instruments is not covered under the warranty

This warranty gives you specific legal rights and you may also have other rights that vary in different jurisdictions. Since some jurisdictions do not allow the exclusion or limitation of an implied warranty or of incidental or consequential damages, this limitation of liability may not apply to you. If any provision of this warranty is held invalid or unenforceable by a court or other decision-maker of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

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Unpacking and Inspection

Follow standard receiving practices upon receipt of the instrument. Check the shipping carton for damage. If damage is found, stop unpacking the instrument. Notify the carrier and ask for an agent to be present while the instrument is unpacked. There are no special unpacking instructions, but be careful not to damage the instrument when unpacking it. Inspect the instrument for physical damage such as bent or broken parts, dents, or scratches.

Technical Support

For application support or answers to technical questions, either email techservices@flukebiomedical.com or call 1-800- 648-7952 or 1-425-446-6945.

Claims

Our routine method of shipment is via common carrier, FOB origin. Upon delivery, if physical damage is found, retain all packing materials in their original condition and contact the carrier immediately to file a claim. If the instrument is delivered in good physical condition but does not operate within specifications, or if there are any other problems not caused by shipping damage, please contact Fluke Biomedical or your local sales representative.

Standard Terms and Conditions

Refunds and Credits

Please note that only serialized products and their accessory items (i.e., products and items bearing a distinct serial number tag) are eligible for partial refund and/or credit. Nonserialized parts and accessory items (e.g., cables, carrying cases, auxiliary modules, etc.) are not eligible for return or refund. Only products returned within 90 days from the date of original purchase are eligible for refund/credit. In order to receive a partial refund/credit of a product purchase price on a serialized product, the product must not have been damaged by the customer or by the carrier chosen by the customer to return the goods, and the product must be returned complete (meaning with all manuals, cables, accessories, etc.) and in "as new" and resalable condition. Products not returned within 90 days of purchase, or products which are not in "as new" and resalable condition, are not eligible for credit return and will be returned to the customer. The Return Procedure (see below) must be followed to assure prompt refund/credit.

Restocking Charges

Products returned within 30 days of original purchase are subject to a minimum restocking fee of 15 %. Products returned in excess of 30 days after purchase, but prior to 90 days, are subject to a minimum restocking fee of 20 %. Additional charges for damage and/or missing parts and accessories will be applied to all returns.

Return Procedure

All items being returned (including all warranty-claim shipments) must be sent freight-prepaid to our factory location. When you return an instrument to Fluke Biomedical, we recommend using United Parcel Service, Federal Express, or Air Parcel Post. We also recommend that you insure your shipment for its actual replacement cost. Fluke Biomedical will not be responsible for lost shipments or instruments that are received in damaged condition due to improper packaging or handling.

Use the original carton and packaging material for shipment. If they are not available, we recommend the following guide for repackaging:

- Use a double-walled carton of sufficient strength for the weight being shipped.
- Use heavy paper or cardboard to protect all instrument surfaces. Use nonabrasive material around all projecting parts.
- Use at least four inches of tightly packed, industry-approved, shock-absorbent material around the instrument.

Returns for partial refund/credit:

Every product returned for refund/credit must be accompanied by a Return Material Authorization (RMA) number, obtained from our Order Entry Group at 1-800-648-7952 or 1-425-446-6945.

Repair and calibration:

To find the nearest service center, go to www.flukebiomedical.com/service, or

In the U.S.A.:
Cleveland Calibration Lab
Tel: 1-800-850-4606
Email: globalcal@flukebiomedical.com

Everett Calibration Lab
Tel: 1-888-993-5853
Email: service.status@fluke.com

In Europe, Middle East, and Africa:
Eindhoven Calibration Lab
Tel: +31-402-675300
Email: ServiceDesk@fluke.com

In Asia:
Everett Calibration Lab
Tel: +425-446-6945
Email: service.international@fluke.com

Certification

This instrument was thoroughly tested and inspected. It was found to meet Fluke Biomedical's manufacturing specifications when it was shipped from the factory. Calibration measurements are traceable to the National Institute of Standards and Technology (NIST). Devices for which there are no NIST calibration standards are measured against in-house performance standards using accepted test procedures.

WARNING

Unauthorized user modifications or application beyond the published specifications may result in electrical shock hazards or improper operation. Fluke Biomedical will not be responsible for any injuries sustained due to unauthorized equipment modifications.

Restrictions and Liabilities

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Manufacturing Location

The QED 6 Defibrillator Analyzer is manufactured in Everett, Washington by Fluke Biomedical, 6920 Seaway Blvd., Everett, WA, U.S.A.

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Description

The Fluke Biomedical QED 6 Defibrillator Analyzer, hereafter referred to as the Analyzer, is a highly versatile and portable instrument. Regular testing of defibrillators and pacemakers is critical to ensure safe and effective operation. The Analyzer accurately verifies the output characteristics of all defibrillators and tests the parameters of non-invasive pacemakers. The Analyzer is battery operated and completely portable. Simple-to-use menu softkeys allow quick access to tests.

The Analyzer measures:

- The delivered energy in joules (watt-seconds) from a defibrillator by simulating the human body's resistance
- The flow of current through that simulated resistance. The standard resistance used by the Analyzer is 50 Ω. Defibrillator energy is measured in one of two ranges: 0-100 joules, or 0-1000 joules.

  Note

  The defibrillator pulse waveform can be replayed via the ECG jacks or paddle plates for viewing on a recorder, or on an oscilloscope for greater detail.
- Synchronization time in milliseconds. This parameter is measured by timing the firing delay from either the Q-wave (base) or R-wave (peak) simulated by the Analyzer. The simulated waveform is present at both the ECG jacks and the paddle plates.
- The peak voltage and peak current (amps) of the defibrillator pulse. Overshoot voltage and current measurements of the defibrillator pulse are calculated and displayed.
- The defibrillator's charge time (the time it takes for a defibrillator to reach its maximum charge setting).

Waveforms, including ECG, arrhythmias, and performance, help verify monitor and recorder accuracy, and also test the automatic defibrillator's ability to recognize the maximum charge and fire.

All waveforms are present at the ECG jacks, the paddle plates and scope output. Utilities allow the setting of Serial RS232 communication parameters to download results to a printer or computer. Display contrast can be adjusted to obtain the best view of the LCD display.

Unpacking and Inspection

Use the following checklist when unpacking the Analyzer to check for damage during shipment. If the Analyzer has been damaged, call your Fluke Biomedical representative immediately. If you must return the Analyzer to Fluke for service, follow the procedure given under *Packing Instructions*.

- Perform a visual inspection to ensure the front panel and case are intact.
- Check the LCD display to ensure that it is unbroken.
- Place the Analyzer on a level surface and power up the instrument. If the message, WARNING - LOW BATTERY!! appears on the display, replace the battery.

General Safety Considerations

Read the Users Manual before operating the Analyzer.

Symbols

Table 1-1 describes the symbols associated with the Analyzer.

Table 1-1. Symbols

Symbol	Description
⚠	Important information; refer to manual.
	Do not dispose of this product as unsorted municipal waste. Go to Fluke's website for recycling information.
	Conforms to relevant Australian EMC requirements
⚠	Hazardous voltage
CE	Conforms to European Union directives
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.

Warnings and Cautions

A **Warning** identifies hazardous conditions and actions that could cause bodily harm or death.

A **Caution** identifies conditions and actions that could damage the Analyzer, the equipment under test, or cause permanent loss of data.

⚠⚠ Warning

To avoid possible electrical shock or personal injury, follow these guidelines:

- **Use this Analyzer only in the manner specified by the manufacturer or the protection provided may be impaired.**
- **Do not use the product if it operates abnormally.**
- **Remove all test leads and disconnect the battery eliminator before replacing the battery.**
- **Do not use the product around explosive gases or in wet or dusty environments.**
- **Inspect the defibrillator daily. Examine the paddles, lead wires, and power cord for cracks and frays.**
- **If the defibrillator is line powered, be sure that it is plugged into a grounded receptacle. Do not touch the electrical contact surfaces of the defibrillator paddles.**
- **Grip one paddle handle firmly in each hand. Apply to the Analyzer plates. Keep the paddles firmly depressed to prevent arcing that can cause injury to the operator and/or damage to the Analyzer or defibrillator.**
- **Do not touch the contact plates on the Analyzer when the defibrillator paddles are being pressed onto the plates. Do not use any electrical paste or pads when testing a defibrillator with the Analyzer.**

⚠ Caution

To avoid damage to the Analyzer or adverse affects on its performance, follow these guidelines:

- **Do not expose the system to temperature extremes. Ambient temperatures should remain between 0 °C and 40 °C, with a relative humidity less than 90 %. System performance may be adversely affected if temperatures fluctuate above or below this range.**
- **Clean the Analyzer only by wiping it down with a clean, lint-free cloth dampened with a mild detergent solution. Do not spray liquid directly on or immerse the unit.**

Instrument Familiarization

Figure 1-1 is an isometric illustration of the Analyzer, and the Front Panel Layout is shown in Figure 1-2.

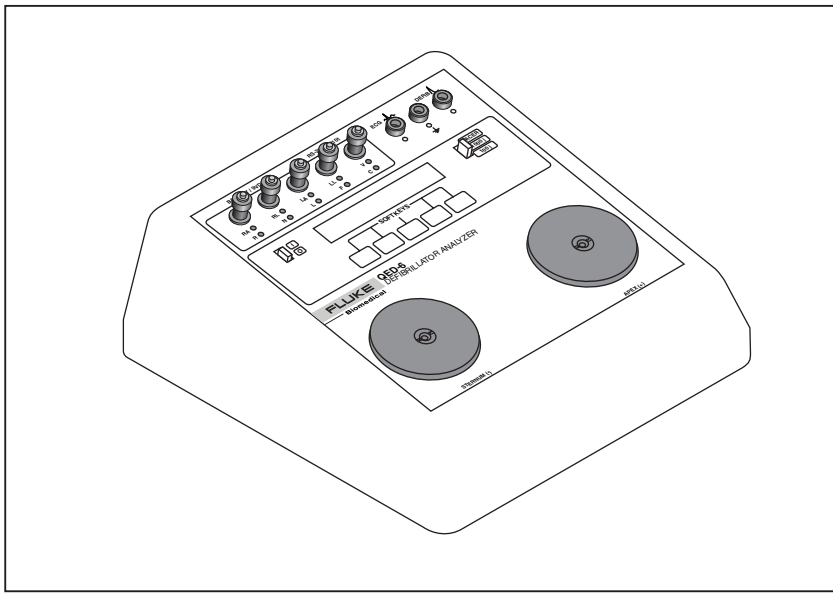

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Figure 1-1. Analyzer Isometric View

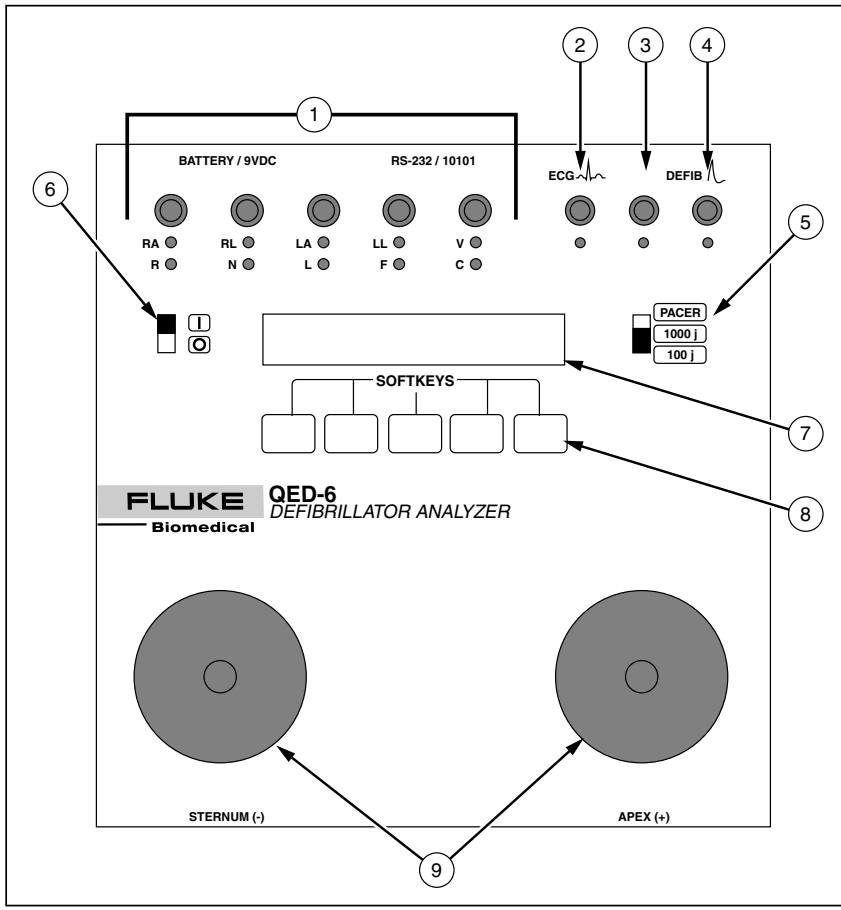

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Figure 1-2. Analyzer Front Panel Layout

Front Panel

The front panel of the Analyzer includes the elements described in Table 1-2.

Table 1-2. Front Panel Elements

Number	Element	Function
①	Universal ECG jacks	Utilize AHA and International color coding, allowing for waveform output to monitor/recorder.
②	High Level ECG Banana jack	Provides 1 volt peak output of the selected waveform.
③	Common Banana jack	Provides ground for the “High Level ECG” and “Defib Scope Out” jacks.
④	Defib Scope Out Banana jack	Provides pulse output to an oscilloscope.
⑤	Range switch	Allows for defibrillator settings from 0 to 1000 joules (high), for power below 0-100 joules (low) for increased accuracy, and a PACER range setting for pacer output measurements.
⑥	Power switch	Enables the Analyzer (I = ON, O = OFF).
⑦	LCD display: 24 characters x 2 lines.	The upper line of the LCD display provides messages and test results, while the bottom line displays menu choices.
⑧	Five softkeys	Used to select the desired function highlighted on the lower line of the display.
⑨	Two nickel-plated Defibrillator Paddle Plates	Available for defibrillator paddle contact. All waveforms are present at the paddle plates simultaneously with the ECG jacks.

Back Panel

The Back Panel includes a battery holder that houses a 9-volt alkaline battery, and a dc battery eliminator jack. An RS232 D-9-pin serial port allows communications to a computer, serial printer, or other Fluke test equipment.

Upgrading the Analyzer

A number of pre-configured Analyzer models are available. In addition, older models may be upgraded by contacting the Fluke Biomedical Service Center. Available Analyzer models are listed in Table 1-3.

Table 1-3. Available Analyzer Models

Model	Characteristics
QED 6	Base unit. Features output energy, synchronization time, peak measurements, bi-directional RS232.
QED 6M	Features output energy, sync time, peak measurements, overshoot, bi-directional RS232, waveforms, charge time measurements, 28 programmable autosequences.
QED 6H	Output energy, sync time, peak measurements, overshoot, bi-directional RS232, waveforms, charge time measurements, 28 programmable autosequences, pacer output measurements and pacer refractory period measurements.

Specifications

The following are specifications for the Analyzer. Please contact your Fluke Biomedical service representative for more information regarding the device specifications.

General

Display	2-line x 24-character LCD supertwist alphanumeric
Power	One 9 V Alkaline (Duracell MN1604 or equivalent); 12 hours continuous operation; low battery indication; 9 V battery eliminator input.
Weight	4.54 lb
Dimensions	26.67 x 24.13 x 10.16 cm
Environmental Operating Specs	
Storage Temperature	-25 to 50 °C
Operating Temperature	0 to 40 °C
Maximum Humidity	90 % Relative Humidity

Output Power Measurement

Load Resistance	50 Ω ±1 % non-inductance (< 10 µH), 160 W
Range	
1000 J	0-1000.0 J
100 J	0-100.0 J
Resolution	0.1 J
Max. Vage	
1000 J	5500 V
100 J	1750 V
Max. Current	
1000 J	110 A
100 J	35 A
Measurement	1000 J: 66 ±5 V
Trip Levels	100 J: 20 ±5 V
Pulse Width	1-50 ms
Accuracy	
1000 J Range	±2 % of reading
100-1000 J	±2 Js
100 J Range	±2 % of reading ±0.1 J

Synchronization Measurements

Range	0-199.9 ms
Measurement	From peak of R-wave From base of R-wave
Accuracy	1 % of fullscale or ±2 ms

ECG Waveforms

QRS complex

Rates	30, 60, 120, 180, 240 BPM
Rate Accuracy	±1 % of setting
Amplitude	Fixed at 1 mV Lead II (RA-LL) Fixed at 1.1 mV (Apex- Sternum)
Amplitude Accuracy	±2 % (RA-LL) ±10 % (Apex-Sternum)

Performance Waveforms

Pulse	30, 60 BPM, pulse width 60 ms
Triangle Wave	2 Hz
Square Wave	0.125 Hz, 2 Hz, 50 % duty cycle
Sine Waves	10, 40, 50, 60, 100 Hz
Time Base Accuracy	±1 % of setting
Amplitude	Fixed at 1 mV Lead II (RA-LL) (Triangle wave 2 mV Lead II) (RA-LL) Fixed at 1.1 mV (Apex-Sternum)
Amplitude Accuracy	±2 % (RA-LL) ±10 % (Apex-Sternum)

Defib Waveform Playback

Time Base Expansion ..... 100:1 @ 25 mm/sec paper speed; each division equals 40 ms

Amplitude Scaling

Lead II (RA-LL)

1000 J Range ..... 1 mV = 3000 V

100 J Range ..... 1 mV = 900 V

ECG Output

1000 J Range ..... 0.5 V = 3000 V

100 J Range ..... 0.5 V = 900 V

Arrhythmias

Afib, Vfib, Atach, Vtach, Aflutter, RUN, PVC, R on T, Idioventricular

Rate Accuracy ..... ±1 %

Amplitude ..... Fixed at 1 mV Lead II (RA-LL)
Fixed at 1.1 mV (Apex-Sternum)

Amplitude Accuracy ..... ±2 (RA-LL) ±10 % (Apex-Sternum)

Scope Outputs

ECG Hi-Level ..... Fixed at 1 V
Accuracy: ±2 %

Defib Output ..... Real Time

Pacer Range ..... 1 V = 3.11 V

1000 J Range ..... 1 V = 1450 V

100 J Range ..... 1 V = 440 V

Amplitude Accuracy ..... ±2 % of scale

External Non-Invasive Pacer Measurements

Load	50 Ω ±1 %, non-inductive (< 10 µH) (Apex-Sternum)
R-wave Amplitude	1.1 mV ±10 % (Apex-Sternum) 1 mV ±2 % Lead II (RA-LL)
Pulse Width	1-50 ms
Peak Vage	0-12.5 V
Peak Current	4-250 mA < 4 mA = 0.0 mA
Rate	25-400 ppm < 25 ppm = 0 ppm
Refractory Period	
Sensed	110-500 ms < 110 ms = 110 ms
Pulsed	70-500 ms < 70 ms = 70 ms
Accuracy	±2 % of fullscale for pulse width, peak voltage current ±1 % of fullscale for rate and refractory period measurements

Calibration Screen

Load	50 Ω ±1 % (Apex-Sternum)
Amplitude scaling	Apex (+) to Sternum (-)
Pacer Range	318 counts/V
1000 J Range	0.683 counts/V
100 J Range	2.252 counts/V
Accuracy	±15 counts
Measurement Range	Apex (+) to Sternum (-)
Pacer Range	(0-12.86) = (0-4095)
1000 J Range	(0-5995) = (0-4095)
100 J Range	(0-1814) - (0-4095)
Zero Vage Input	0 ±2 counts

Peak / Overshoot

Vage Accuracy	
1000 J Range	±10 V
100 J Range	±25 V
Current Accuracy	±1 A

Accessories

The following are accessories for the Analyzer. To order, contact your Fluke Biomedical equipment dealer and use the Fluke Biomedical part numbers provided. Table 1-4 lists standard accessories shipped with the tester. Table 1-5 lists optional accessories that must be ordered separately.

Table 1-4. Standard Accessories

Description	Qty Supplied	Part Number
QEDR Tags	100	2241744
Users Guide	1	2204510
Warranty Card	1	NA
Internal Paddle Adapters	2	2204198

Table 1-5. Optional Accessories

Description	Part Number
Carrying Case	2204282
RS232/Printer Cable, Serial	2204485
Printer (Seiko DPU 414-30B)	2248899
Printer Paper for DPU 414-30B	2248737
Converter Data, Serial-Parallel 110 V	2391907
Power Supply for DPU 414-30B Printer (110 V)	2235375
Automatic Paddle Adapters	
Hewlett Packard	2200125
Marquette	2392362
Laerdhal	2392396
Physio Control (Automatic Defibrillation)	2392355
Physio Control (Pacer)	2230648
Zoll Cable Assembly	2200140
9 v dc, 300 mA Adapter	2527552

Chapter 2
Operation

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Introduction

The Analyzer uses a 2-line x 24-character LCD display and softkeys to simplify operation. See Figure 2-1.

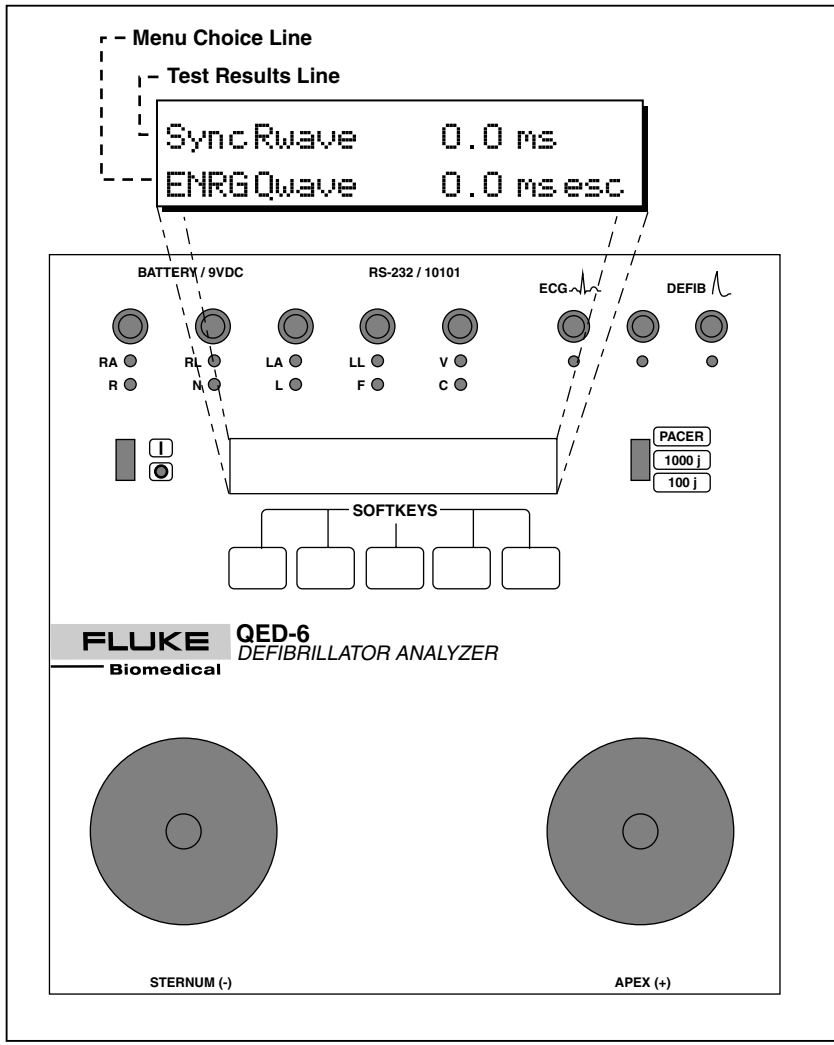

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Figure 2-1. Analyzer Front Panel Display

The top line of the LCD display is used for test results and the bottom line provides menu choices.

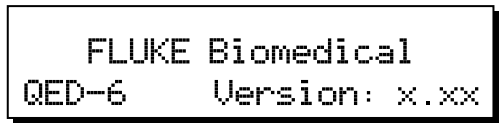
The five-position softkey pad is used to control the functions of the instrument. Make a menu selection by pressing the corresponding softkey. An audible beep verifies the selection. The microprocessor scans the softkey keypad every 10 ms to check for softkey presses.

Powering Up

The Analyzer is powered by a 9-volt alkaline battery. An external power jack is provided for use with a 9 V dc modular power source that plugs into the ac line. Plugging into this jack mechanically disconnects the battery.

The low battery detection circuit outputs a low level digital signal when the battery voltage reaches 6.1 volts. This signal is polled along with the function softkeys every 10 ms and, if a low battery condition occurs, the display indicates WARNING - LOW BATTERY!! To continue, replace the battery or use an external power source.

Upon power-up, the microprocessor receives software instructions from the resident firmware and provides information to the user on the Analyzer display or on a remote display via the serial port. The following message appears briefly on the display, identifying the software version:



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After a short delay, the display changes to **Main Menu 1**:

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Explore the functions of the softkeys and the menus, as follows:

1. Press the **ENERG**, **SYNC**, **PEAK** or **WAVE** softkey to access a submenu of specific functions.
2. Press **more** to toggle between **Main Menu 1** and **Main Menu 2**.

3. Press **esc** in any submenu to return to the previous menu and, ultimately, to **Main Menu 1**.

Figures 2-2 and 2-3 provide overviews of the menus and functions associated with **Main Menu 1** and **Main Menu 2**, respectively. Figure 2-4 provides an overview of the Autosequence menu structure, accessed from the **AUTO** option of **Main Menu 2**.

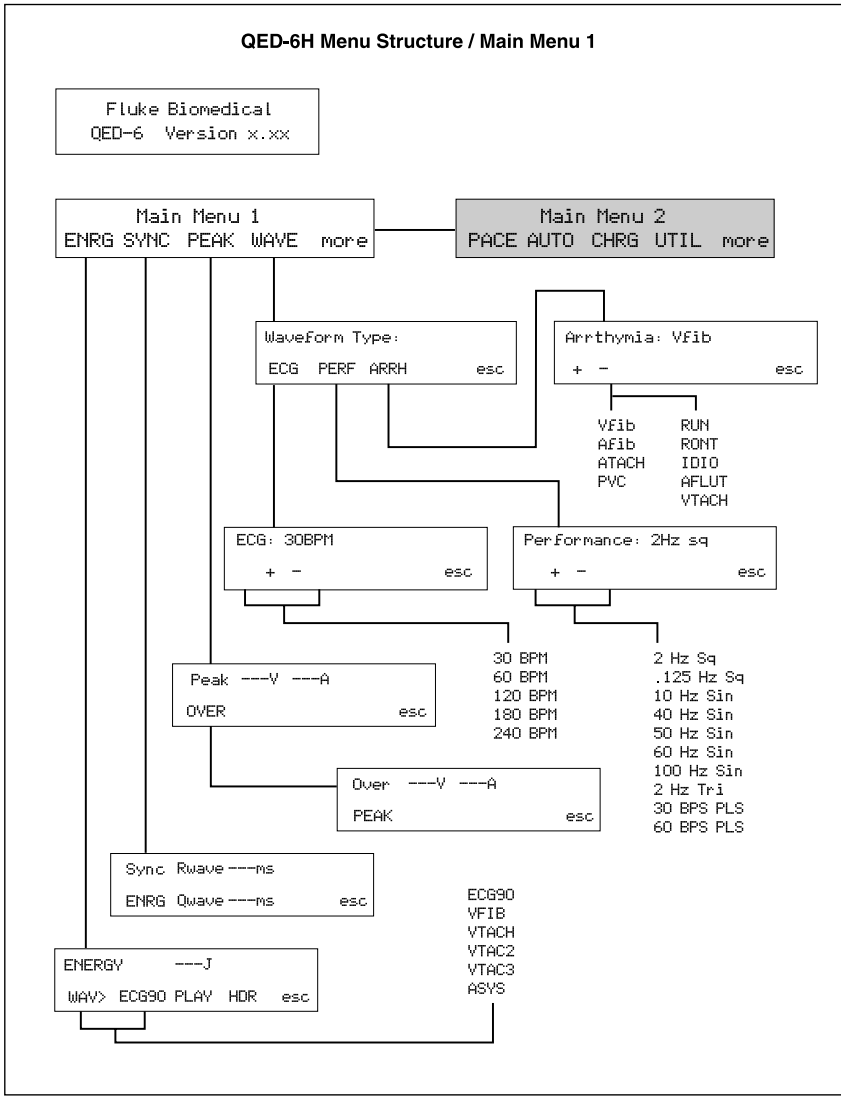

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Figure 2-2. Main Menu 1 Functions

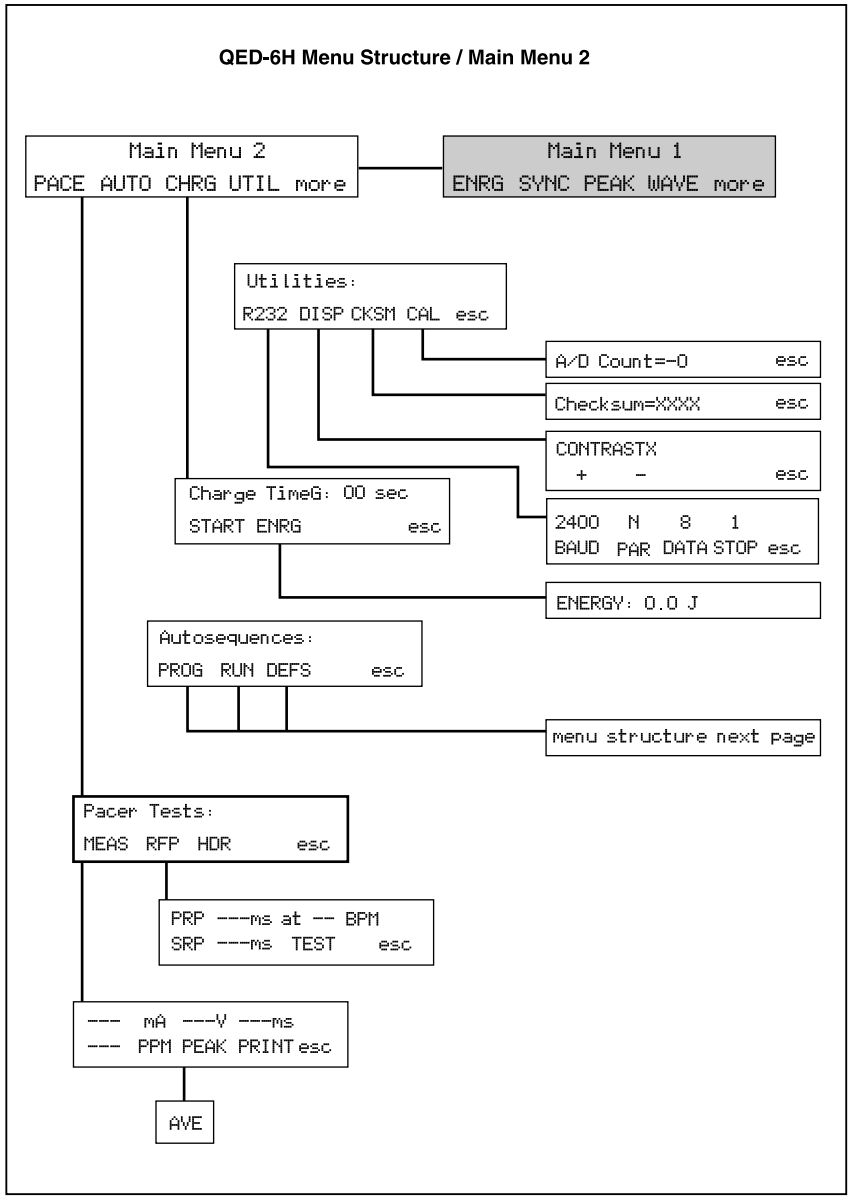

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Figure 2-3. Main Menu 2 Functions

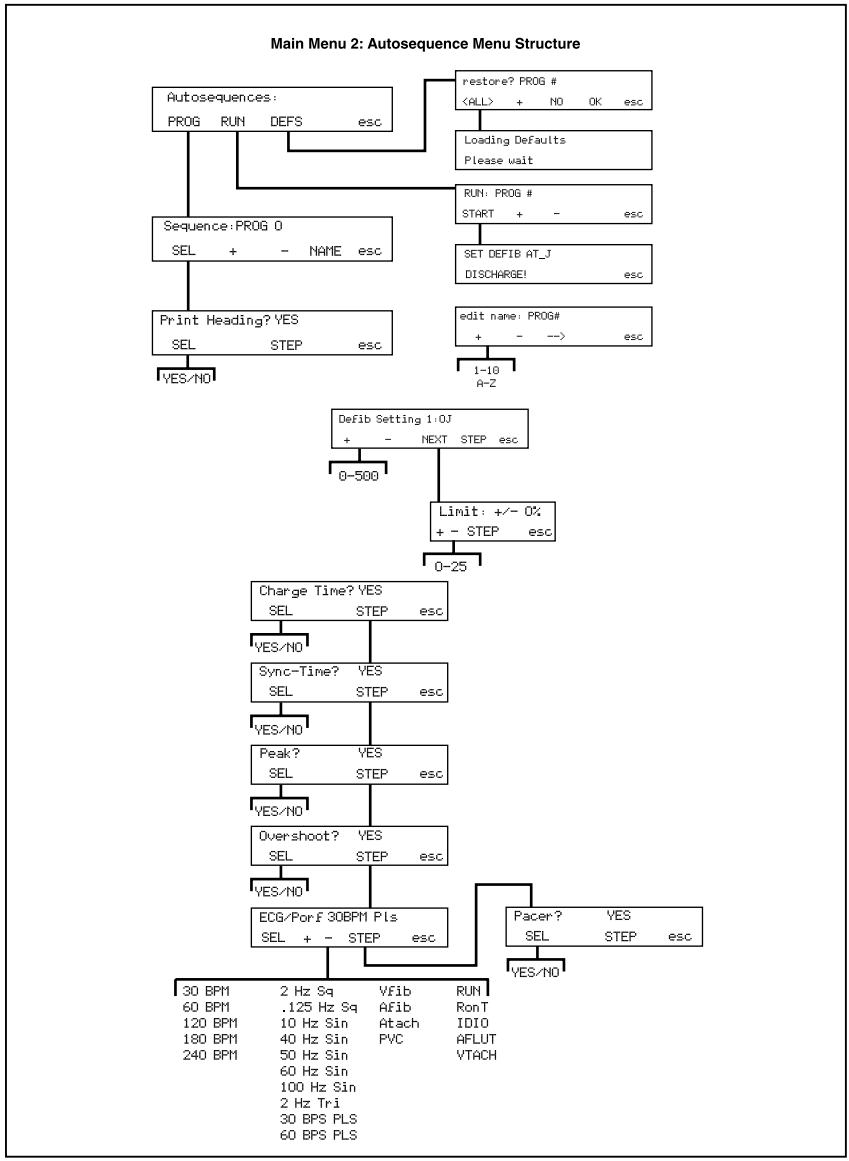

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Figure 2-4. Autosequence Menu Structure (Main Menu 2)

Adjusting Display Contrast

Display contrast on the Analyzer may be adjusted to optimize viewing of menus and test data.

To set the display contrast:

1. From **Main Menu 2**, press the **UTIL** softkey to display the following:

fcf055.eps

2. Press the **DISP** softkey to access the display **Contrast** menu:

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3. Press the **+** softkey to increase the numerical value and decrease the contrast; press the **–** softkey to decrease the numerical value and increase the contrast. The default is 5.
4. Press the **esc** softkey to store the last displayed value in memory.

Measuring Defibrillator Energy

To measure defibrillator energy:

1. Power up the defibrillator to be tested and select the energy output according to the manufacturer's instructions.
2. Power up the Analyzer.
3. From **Main Menu 1**, press the **ENRG** softkey to access the **Energy** menu:

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4. Press the **WAV>** softkey to browse through a list of available waveforms in Energy Mode. These waveforms are described in Table 2-1.

Table 2-1. Available Waveforms

Waveform	Description
ECG90	The default waveform; after a discharge, the ECG90 resumes.
VFIB	Ventricular Fibrillation
VTACH	125 BPM, VTACH
VTAC2	240 BPM, Monomorphic
VTAC3	300 BPM, Polymorphic
ASYS	Asystole

The waveform appears through the ECG adapters and Analyzer front panel paddles and is available to trigger an automatic defibrillator to discharge.

After the defibrillator discharges, the output switches to a **90 BPM ECG** waveform. If the range switch is set to **Pacer**, the following message appears momentarily:

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4. Set the range switch appropriately, as follows:
   - Select the 1000 joule high range (**1000 J**) for defibrillator outputs over 100 joules or for an unknown defibrillator output power.
   - Select the 100 joule low range (**100 J**) for outputs under 100 joules.
5. Simultaneously press the two defibrillator paddles onto the contact electrode plates on the front of the Analyzer. See Figure 2-5.

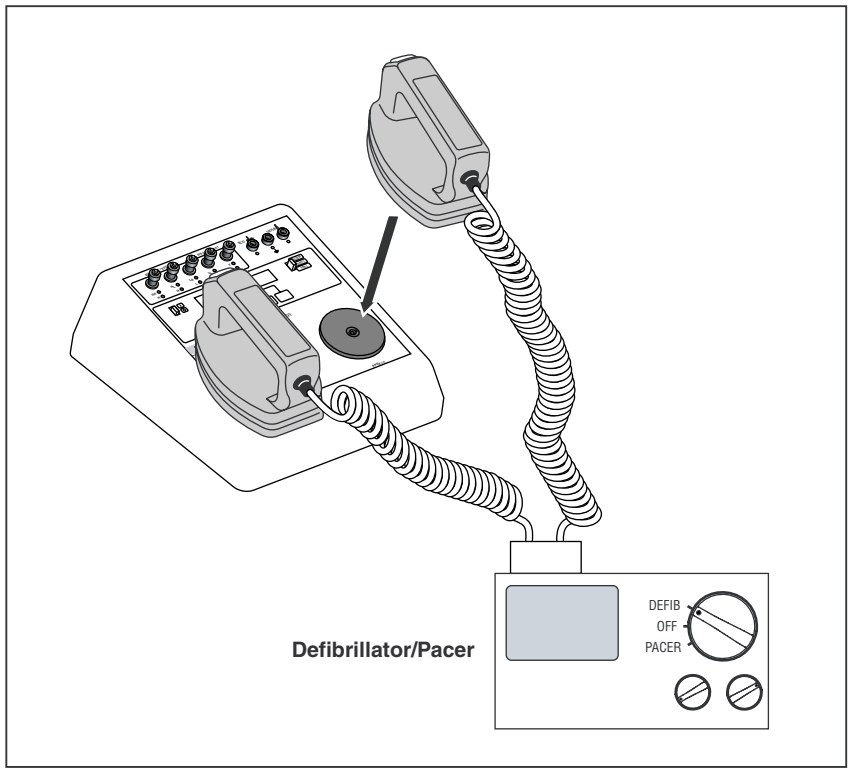

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Figure 2-5. Defibrillator Energy Testing

6. Initiate a discharge from the defibrillator.
7. Observe the output settings and the actual readings displayed on the Analyzer and record them on the QEDR Performance Tag as shown in Figure 2-6.

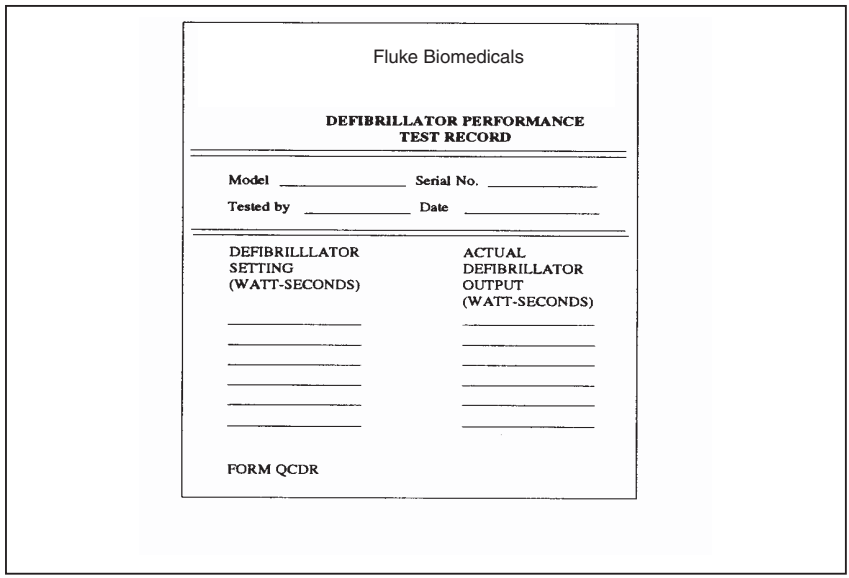

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Figure 2-6. QEDR Performance Tag

Note

The Analyzer continues to display the reading until the next defibrillator pulse is fired.

Evaluating Ability to Fire

This test evaluates an automatic defibrillator for its ability to fire automatically after recognizing ventricular fibrillation and / or ventricular tachycardia.

To test the ability of the defibrillator to fire automatically:

1. Attach the optional automatic defibrillator paddle adapters to the Analyzer.
2. Connect the ECG patient leads to the Analyzer, as shown in Figure 2-7.

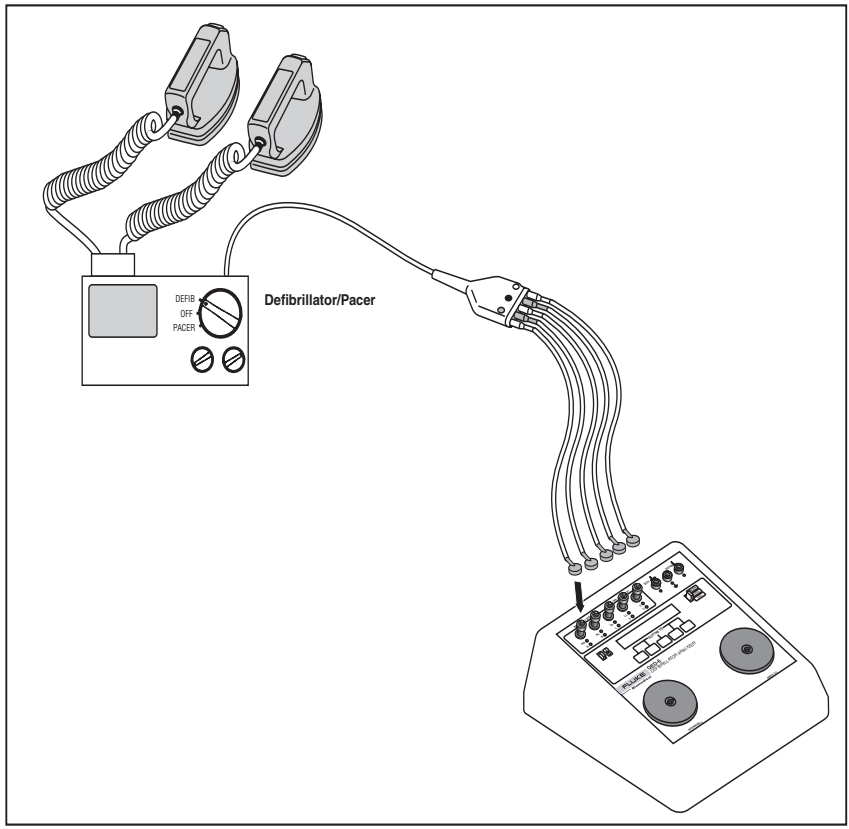

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Figure 2-7. ECG Lead Configuration

3. From the **Energy** menu, press the **WAV>** softkey until the **VFIB** option appears; then press the **VFIB** softkey.

   A ventricular fibrillation waveform is simulated by the Analyzer through the ECG jacks and paddle plates. When a discharge is complete, the Analyzer outputs a 90 BPM Normal Sinus Rhythm.

4. Press the **WAV>** softkey until the **VTACH** option appears; then press the **VTACH** softkey.

   A ventricular tachycardia is simulated by the Analyzer through the ECG jacks and paddle plates. When the discharge is complete, the Analyzer outputs a 90 BPM Normal Sinus Rhythm.

Defibrillator Pulse Playback

The Analyzer allows the user to play the defibrillator pulse waveform for the purpose of analysis. Playback is accomplished using a strip recorder or defibrillator monitor through the ECG jacks or scope output. The waveform can also be reviewed on an oscilloscope through the high-level ECG outputs.

To play back the defibrillator pulse:

1. Power up the defibrillator and the Analyzer.
2. From **Main Menu 1**, press the **ENRG** softkey to access the **Energy** menu, and press the **WAV>** softkey to access the **WAV** submenu.
3. Connect the ECG patient leads to the Analyzer as shown in Figure 2-7.
4. After the defibrillator discharges, press the **PLAY** softkey. The last defibrillator pulse is replayed.

Viewing Oscilloscope Output

The Analyzer provides two banana jacks for real-time viewing on an oscilloscope with storage capability

To view the output on an oscilloscope, carry out the steps under each of the subheadings, below:

Preparation for Viewing

1. Connect the Oscilloscope to the Analyzer, using a banana plug and a scope probe to ensure signal integrity, as indicated:
    - Ground – Attach the ground from the scope probe to the common (black) jack on the Analyzer.
    - Output – Attach the positive lead of the scope probe to the defibrillator output.

2. Make the following settings:

   a. Set the oscilloscope trigger on **external** and connect a lead between the input of the oscilloscope and the external trigger input.

   b. Set the time scale on the oscilloscope to 1 ms / division and adjust to the desired expansion after observing the waveform output.

   c. Set the gain on the oscilloscope to 0.2 v / division and adjust to the desired level after observing the waveform.

3. Activate the storage control on the oscilloscope.

4. For most applications, set the oscilloscope input coupling control to ac mode.

Note

If the defibrillator under test uses a discharge waveform with sizable dc components (trapezoidal or pulsatile discharge), improved output waveform fidelity can be obtained by placing the oscilloscope in the dc-coupling mode.

Viewing a Test

1. Initiate a test by following the steps described under *Measuring Defibrillator Energy*, above.

   The waveform is 1/1450 when in the 1000 joule range and 1/440 in the 100 joule range of the input voltage through 50 Ω. The actual magnitude of the discharge voltage can be obtained by using the following equation:

   $V_{discharge} = V_{scope}\,(1450)$ High range

   $V_{discharge} = V_{scope}\,(440)$ Low range

2. Observe the waveform as it appears on the oscilloscope. Repeatedly discharge the defibrillator while adjusting the time and the gain to the optimal scale for observing the waveform.

Note

If the waveform does not appear on the oscilloscope, readjust the trigger levels on the oscilloscope and repeat the appropriate steps in the procedure.

Measuring Synchronization

The Analyzer measures the synchronization time (cardioversion delay time) of synchronized defibrillators. A 90 BPM ECG waveform is output through the ECG jacks and the paddle plates. During normal operation, the defibrillator recognizes and responds to this trigger by discharging within a certain amount of time.

The Analyzer is capable of measuring up to 199.9 ms in delay time from either the peak or the base edge of the R wave. Typical acceptable delay times are within 60 ms from the peak of the R wave.

To measure synchronization:

1. Turn the defibrillator to be tested to **ON** and select the desired energy output in accordance with the manufacturer's instructions.
2. Connect the ECG patient leads to the Analyzer as shown in Figure 2-7.
3. Power up the Analyzer by sliding the power switch forward to the **ON** position. The Analyzer displays **Main Menu 1**:

fcf002.eps

4. Press the **SYNC** softkey to enter the **Sync** menu:

fcf011.eps

Sync time measurements are performed as shown in Figure 2-8, below:

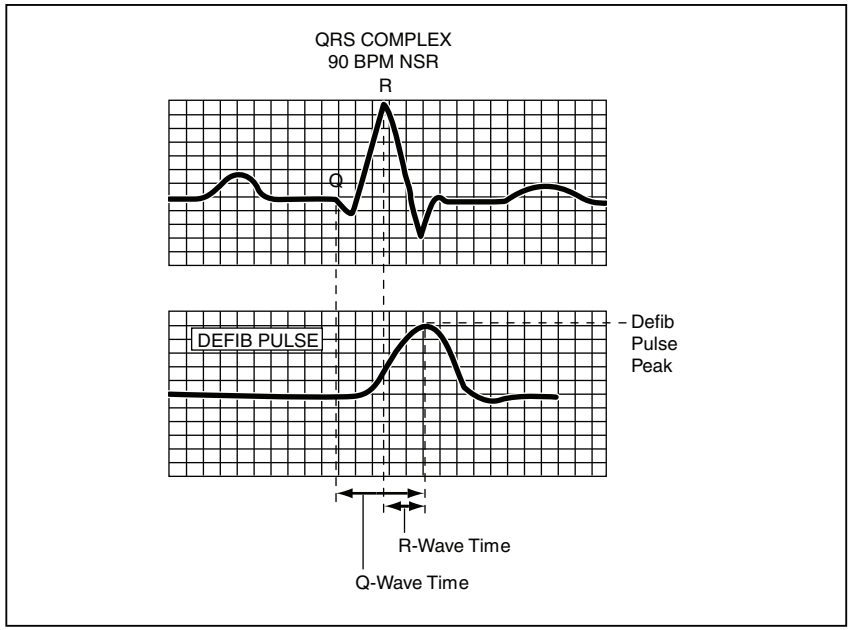


Figure 2-8. Sync Time Measurements

5. Set the range switch appropriately, as follows:
   - Select the 1000 joule high range for defibrillator outputs over 100 joules or for an unknown defibrillator output power.
   - Select the 100 joule low range for outputs under 100 joules.
6. Place the defibrillator in synchronous mode.
7. Simultaneously press both defibrillator paddles to the contact plates of the Analyzer.
8. Initiate a discharge from the defibrillator.
9. Press the **ENRG** softkey to view the energy readings on the display, as shown below.

fcf020.eps

Note

The LCD displays the reading for about two seconds.

Generating Test Waveforms

The Analyzer generates a series of test waveforms designed to verify the accuracy of ECG machine / monitors. These waveforms, shown in Table 2-2 , are available for simulation via ECG jacks or paddle plates and are calibrated for lead II at 1 mV.

Table 2-2. Test Waveforms

ECG	Performance	Arrhythmia
30 BPM	30 BPM Pulse	Atrial Fibrillation
60 BPM	60 BPM Pulse	Atrial Flutter
120 BPM	2 Hz Triangle (2 mV)	Atrial Tachy
180 BPM	0.125 Hz Square (50 % dc)	Idioventricular
240 BPM	2.0 Hz Square (50 % dc)	PVC
	10 Hz Sine	R on T
	40 Hz Sine	Run
	50 Hz Sine	Ventricular Fib.
	60 Hz Sine	Ventricular Tachy
	100 Hz Sine	

To generate waveforms for testing:

1. Turn the defibrillator to be tested to **ON**.
2. Connect the ECG patient leads to the Analyzer as shown in Figure 2-7.

3. Power up the Analyzer by sliding the power switch forward to **ON**. **Main Menu 1** displays:

fcf002.eps

4. Press the **WAVE** softkey to access the **Waveform Type** menu:

fcf022.eps

5. Press the softkey corresponding to the desired wave simulation:
   - **ECG** for ECG waveforms
   - **PERF** for performance waveforms
   - **ARRH** for arrhythmia waveform

   For example:

fcf023.eps

   To select the next available option within a waveform simulation, press the **UP** softkey; to select a previous option, press the **DOWN** softkey.

6. Observe the waveform on the monitor under test.

Note

*The selected waveform plays continuously until another is selected or until the **esc** softkey is pressed.*

Testing High Level Out

All waveforms available through the ECG jacks are simultaneously output through the High Level jacks. This scheme offers the user a 1-volt peak signal for testing purposes.

To test a High Level signal, use an oscilloscope and a scope probe to measure the output waveform on the high level output. Refer to *Generating Test Waveforms*, above, for procedure.

Note

Use a scope probe to guarantee signal integrity.

Measuring Peak Voltage, Current, and Overshoot

To measure the peak voltage and current of the defibrillator pulse:

1. Power up the defibrillator to be tested and select the energy output, following the manufacturer's instructions.
2. Power up the Analyzer. **Main Menu 1** displays:

fcf002.eps

3. Press the **PEAK** softkey to access the **--- V --- A** (current and voltage) menu:

fcf025.eps

Pressing the **Peak / OVER** softkey toggles the measurement between **Peak** current and voltage and **Over** current and voltage.

4. Set the range switch appropriately, as follows:
   - Select the 1000 joule high range for defibrillator outputs over 100 joules or for an unknown defibrillator output power.
   - Select the 100 joule low range for outputs under 100 joules.
5. Simultaneously press the two defibrillator paddles onto the contact electrode plates on the front of the Analyzer.
6. Initiate a discharge from the defibrillator.
7. Observe the LCD on the Analyzer and record the defibrillator voltage and current.

Note

The LCD continues to display the reading until the next defibrillator pulse is fired.

Measuring Charge Time (Models M and H)

To measure the charge time of Models M and H:

1. From **Main Menu 1**, press **more** to access **Main Menu 2**. The following displays:

fcf026.eps

2. From **Main Menu 2**, press the **CHRG** softkey to display the following:

fcf027.eps

3. Set the range switch appropriately, as follows:
   - Select the 1000 joule high range for defibrillator outputs over 100 joules or for an unknown defibrillator output power.
   - Select the 100 joule low range for outputs under 100 joules.

4. Press the two defibrillator paddles onto the contact electrode plates on the front of the Analyzer.
5. Press the **START** softkey and initiate the defibrillator charge cycle.
6. As soon as the defibrillator reaches full charge, discharge it, noting the time (in seconds) on the display. The maximum for the Analyzer is 60 seconds. After 60 seconds, the Analyzer displays **OVER**.

Pacemaker (Non-Invasive) Testing

1. From **Main Menu 1**, press **more** to access **Main Menu 2**. The following displays:

fcf026.eps

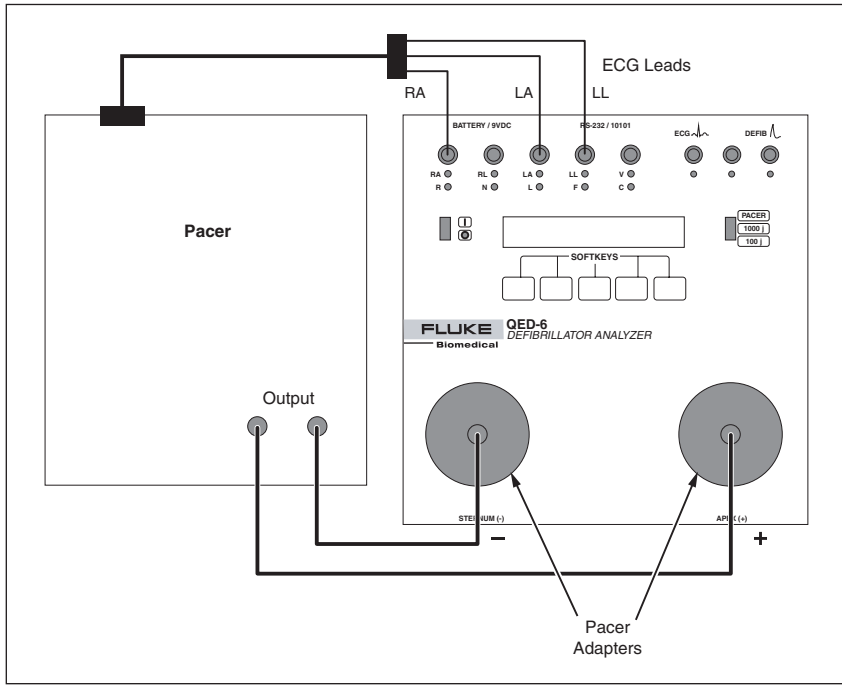
2. Set the range switch to **pacer**. Otherwise the unit displays the following message:

fcf029.eps

3. From **Main Menu 2**, press the **PACE** softkey to display the **Pacer Tests** menu:

fcf030.eps

4. Connect the output from the pacer to the Analyzer, as shown in Figure 2-9.



fcf015.eps

Figure 2-9. Connecting Pacemaker Output to Analyzer

Note

The Pacer can be in either demand or non-demand mode.

5. Press the **MEAS** softkey to display the following:

fcf031.eps

Three hyphens (---) indicate that no pacer pulses were received.

6. Set the pacer at various current and heart rate settings. The results are displayed. Press the **PRINT** softkey for a hard copy.

Note

Pacer voltage and current are displayed as average voltage and current. If a printer is connected to the Analyzer, the printout also documents peak voltage and current. If computer control is being used, no peak values are available. All voltage measurements are referenced to the internal 50 Ω load.

Pacemaker Refractory Period Testing

To test the pacer refractory period:

1. Set the pacer in demand mode.
2. From **Main Menu 1**, press **more** to access **Main Menu 2**. The following displays:

fcf026.eps

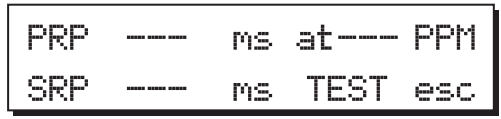
3. Set the range switch to **pacer**. Otherwise the unit beeps and displays the following message:

fcf029.eps

4. From **Main Menu 2**, press the **PACE** softkey to display the **Pacer Tests** menu:

fcf032.eps

5. Press **RFP** to select refractory period testing. Refer to Figure 2-9 for setup. The following menu appears.



fcf033.eps

Three hyphens (---) indicate that no pacer pulses have been received. Definitions of the other abbreviations on the display are:

- **PRP** – Pulsed refractory period; the time (typically 20-500 ms) after a pulse is delivered from the pacemaker, during which the pacemaker does not detect cardiac activity.
- **PPM** – pacing rate at which the test was performed
- **SRP** – sensed refractory period; the period after the pacemaker senses cardiac activity during which it does not detect further cardiac activity.

6. Press the **TEST** softkey to start testing. The dashed lines flash, indicating that the test is in progress and pulses are detected. When the refractory period has been determined, the results are displayed.

Note

At slow rates, it may take one to three minutes to determine the refractory tests. The test is quicker at higher pacing rates. The results are automatically output via the RS232 port. Do not alter the pacing rate during refractory measurements or incorrect data may be recorded.

Programming an Automatic Test Sequence

The Model H can store in memory up to 28 automatic sequences to fully test defibrillator performance according to protocol. Standard defaults for Programs 0-27 for the Model H are listed in Table 2-3.

Table 2-3. Autosequencing Defaults (Model H)

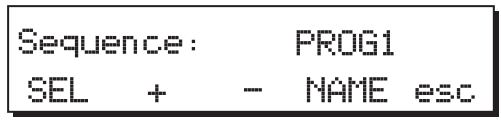
Performance Parameter	Default
Print Heading	Yes
Energy Measurements	10 J 100 J 200 J 300 J 360 J
Energy Limits + / -	5%
Charge Time	Yes
Sync Time	Yes
Peak	No
Overshoot	No
ECG performance	30 BPM 120 BPM 240 BPM 2 Hz Sq .125 Hz Sq 10 Hz Sin 40 Hz Sin 50 Hz Sin 60 Hz Sin 100 Hz Sin 2 Hz Tri 60 BPM PLS Fib
Pacer	No

To program an automatic test sequence, carry out the following steps and those listed under individual headings, below:

1. From **Main Menu 2**, press the **AUTO** softkey to display the **Autosequences** menu:

fcf034.eps

2. Press the **PROG** softkey to access the individual programs to be modified.



fcf035.eps

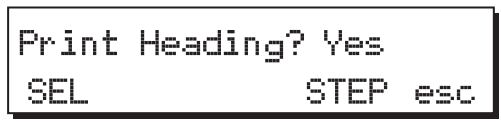
Program Selection

1. Select the automatic test sequence to be modified by pressing the **+** or **-** softkeys to increase / decrease program numbers.

   Available programs are named **PROG** and numbered 0-27, but you can press the **NAME** softkey and modify the program name and number.

2. Press the **SEL** softkey to confirm the program selected for modification and to attach a header.

   You are asked if you wish to attach a header to the data to be output after the test sequence has been run.



fcf036.eps

3. Press the **SEL** softkey to toggle between **Yes** and **No**.

Defib Setting

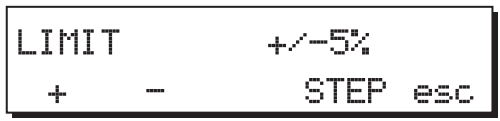
1. Press **STEP** to advance to the next check item, **Defib Setting**.

fcf037.eps

2. Press **+** or **-** to increase or decrease the defib setting.
3. Press **NEXT** for the next defib setting.

Energy Limits

1. Press **STEP** to advance to the next check item, **Limit**.

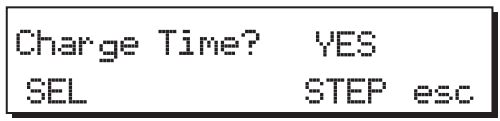


fcf038.eps

2. Press the **+** or **-** softkeys to increase / decrease the accuracy limit.

Charge Time

1. Press **STEP** to advance to the next check item, **Charge Time**.



fcf039.eps

2. Press the **SEL** softkey to toggle between **Yes** and **No**.

Sync Time

1. Press **STEP** to advance to the next check item, **Sync-Time**.

fcf040.eps

2. Press the **SEL** softkey to toggle between **Yes** and **No**.

Peak

1. Press **STEP** to advance to the next check item, **Peak**.

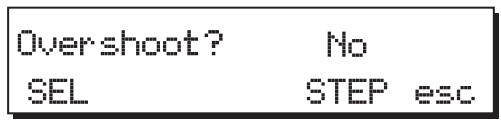
fcf041.eps

2. Press the **SEL** softkey to toggle between **Yes** and **No**.

   Selecting **Yes** includes **Peak Voltage** and **Peak Current** measurements.

Overshoot

1. Press **STEP** to advance to the next check item, **Overshoot**.



fcf042.eps

2. Press the **SEL** softkey to toggle between **Yes** and **No**.

ECG Performance

1. Press **STEP** to advance to the next check item, **ECG/Perf**.

fcf043.eps

2. Press **+** or **-** to advance to the next waveform.
3. Press **SEL** to program / deprogram a waveform. An * indicates that the item is programmed.

Pacer

1. Press **STEP** to advance to the next check item, **Pacer**.

fcf044.eps

2. Press the **SEL** softkey to toggle between **Yes** and **No**.
3. Press **STEP** to return to the program menu.

fcf045.eps

4. Press the **esc** softkey. You are asked, "**Save Changes?**"
5. Press the **YES** softkey to save the program or the **NO** softkey to return without saving; both return to the **Autosequences** menu:

fcf046.eps

6. Press the **esc** softkey to return to **Main Menu 2**.

Note

The changes are saved until the program is modified again, or the Analyzer is reset to factory defaults.

Running an Automatic Test Sequence

To run an automatic test sequence:

1. From **Main Menu 2**, press the **AUTO** softkey to display the **Autosequences** menu:

fcf046.eps

2. Press the **RUN** softkey to select an autosequence program, which are numbered 0 - 27.

fcf047.eps

3. Press the **+** or **-** softkey to increase / decrease the program numbers.
4. When the desired program number displays, press the **START** softkey to start the selected program.

   The Analyzer prompts the user through the complete autosequence program. Data output (if requested) to a printer or computer occurs after the test sequence has been run.

Note

If the range switch is not already set to the appropriate range or to ***pacer*** *for PACE tests, the Analyzer sounds an audible alarm, and a warning message appears until the condition is corrected.*

Printing the Analyzer Report Header

All test reports created by the Analyzer can be printed via the RS232 port.

To print the report header:

1. From **Main Menu 1**, press the **ENRG** softkey to access the **Energy** menu:

fcf006.eps

2. Press the **HDR** softkey to forward the header via the serial port to the target device (computer or serial printer).

To print a report header from the Pacer menu:

1. From **Main Menu 1**, press the **more** softkey to access **Main Menu 2**:

fcf026.eps

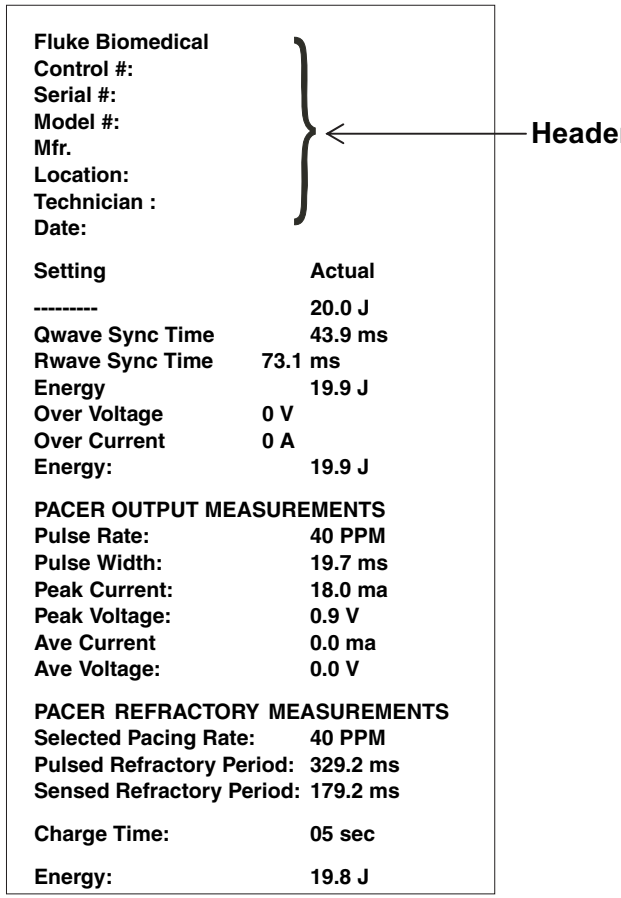
2. Press the **PACE** softkey to access the **Pacer** menu:
3. Press the **HDR** softkey to forward the header via the serial port to the target device (computer or serial printer).

   An example of a standard printout (manual operation) with a header is shown in Figure 2-10. During manual operation, results are output to the printer (or computer) immediately after each test is performed.

   Note

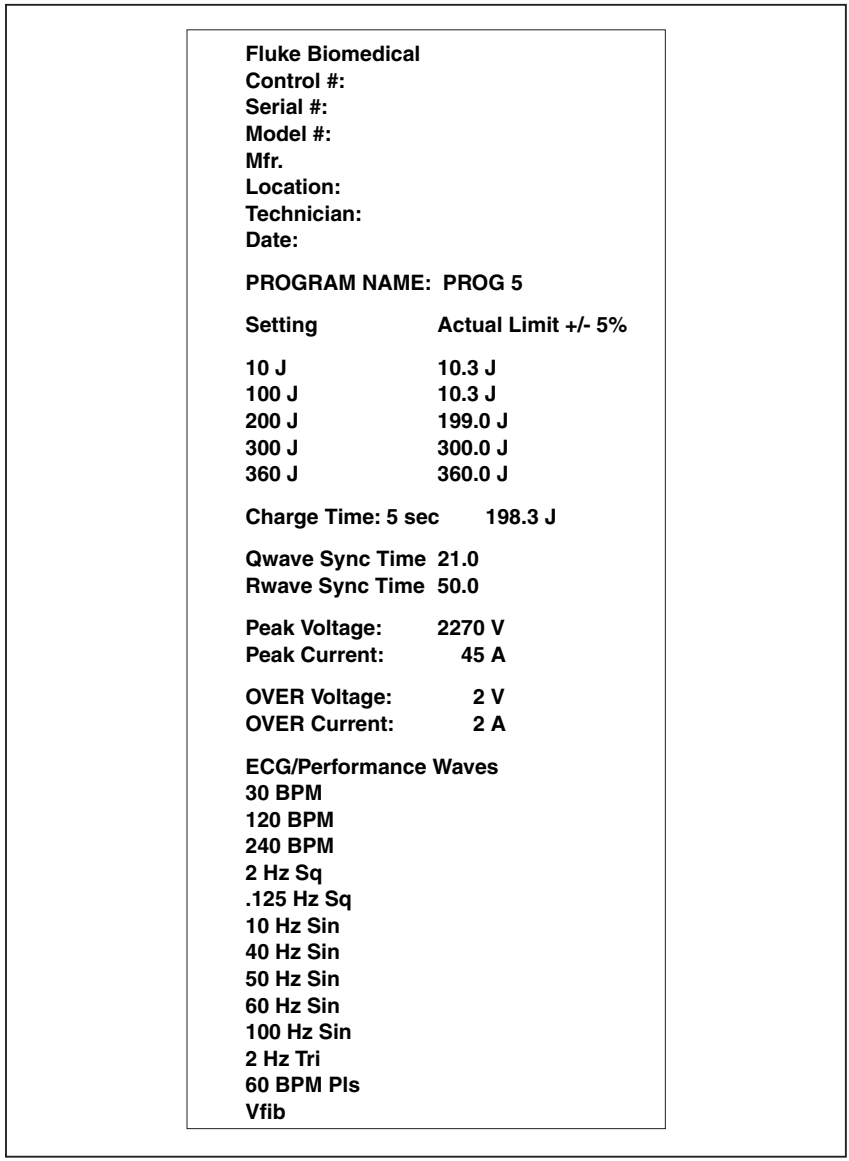
   These results do not appear on the display when no printer or computer is attached to the Analyzer.

   An example of a standard printout (automatic sequence) with a header is shown in Figure 2-11. In Autosequencing mode, all results are output to the printer (or computer) after the sequence is complete.



fcf050.eps

Figure 2-10. Manual Output with Header



fcf051.eps

Figure 2-11. Automatic Sequence Output with Header

```
PACER OUTPUT MEASUREMENTS
Pulse Rate:                40 PPM
Pulse Width:               0.0 ms
Peak Current:              0.0 ma
Peak Voltage:              0.0 V
Ave Current                0.0 ma
Ave Voltage:               0.0 V

PACER REFRACTORY MEASUREMENTS
Selected Pacing Rate:      40 PPM
Pulsed Refractory Period:  329.2 ms
Sensed Refractory Period:  195.4 ms
```

fcf054.eps

Figure 2-11. Automatic Sequence Output with Header (cont.)

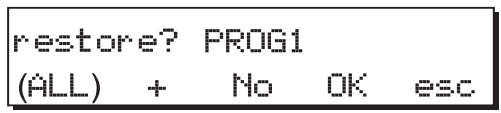
Resetting the Analyzer to Factory Defaults

To reset the Analyzer defaults:

1. From **Main Menu 2**, press the **AUTO** softkey to display the **Autosequences** menu:

fcf048.eps

2. Press the **DEFS** (defaults) softkey to access the **restore** menu.



fcf049.eps

3. Select one of the following options:
   - Press **(ALL)** to restore all 28 factory default programs.
   - Press **+** to scroll through the programs; stop when the desired program name appears.

- Press **No** or **esc** to back up one menu level.
- Press **OK** to restore the selected program to factory defaults. The Analyzer displays a confirmation message that defaults are loading.

4. When finished, press **esc** once to return to the **Autosequences** menu or twice to return to **Main Menu 2**.

Remote Operation

The Analyzer RS232 bi-directional interface allows communications with a PC, allowing the PC to send commands to the Analyzer. Such operation requires a Fluke RS232 cable and a bi-directional D-9 connector. The RS232 serial communications port originates from the microprocessor asynchronous serial port 0.

When the parameters are properly set, test data gathered by the Analyzer is automatically sent to the PC via the RS232 port for inclusion in a test form. The information sent to the computer is identical to the data sent to the printer.

During operation, the Analyzer senses that an RS232 cable or printer is attached and sends data to the appropriate device. If neither is attached, test data appears on the display.

Note

The null modem supplied with the Fluke serial cable is not required when data is being transferred to a computer.

The Data Computer Equipment (DCE) wiring configuration is shown in Table 2-4.

Table 2-4. Serial Port Wiring Configuration

Pin	Function
1	Unused
2	RX
3	TX
4	DTR
5	Unused
6	Unused
7	Unused
8	Serial
9	232 Ground

Use the Fluke serial cable to transfer data from the Analyzer serial port to any IBM (or compatible) computer or printer. The Data Terminal Equipment (DTE) wiring configuration is shown in Table 2-5.

Table 2-5. Serial Cable Wiring Configuration

Pin	Function
1	Unused
2	TX
3	RX
4	RTS
5	CTS
6	DSR
7	232 Ground
8-25	Unused

The communications protocol is user-configurable, and the setup is performed by software internal to the processor.

Preparing for Serial Communications

Several steps are required to prepare the Analyzer for serial communications with an attached computer. The first is setting parameters for RS232 data transfer.

Note

Ensure that the Baud Rate, Parity, Data, and Stop Bits settings selected for the Analyzer match those set on the computer.

To set RS232 parameters on the Analyzer:

1. From **Main Menu 1**, press **more** to access **Main Menu 2**. The following displays:

fcf026.eps

2. From **Main Menu 2**, press the **UTIL** softkey to display the following:

fcf055.eps

3. Press the **R232** softkey to display the following:

fcf056.eps

4. Press the softkey corresponding to the parameter to be changed. Repeated pressing of the softkey cycles through the settings. The following settings are recommended:
   - Baud Rate: 300, 600, 1200, 2400, 9600
   - Parity: None, Even, Odd
   - Stop Bits: 1 or 2
   - Data Bits: 7 or 8

   The Analyzer factory default setting is 2400, N, 8, 1.
5. Press the **esc** softkey to store the last displayed parameters in memory.
6. Press **esc** to return to **Main Menu 2**.

Ansur Software Control

Ansur test automation systems allow a solutions-based approach to complete testing of the medical device under test (DUT). Ansur helps you create standard work using the test template/sequence (which is based on your written test procedure) and integrates all test results into a single test report that can be printed or archived. Ansur manages test procedures by allowing both manual and visual automated test sequences.

The software works hand-in-hand with Fluke Biomedical testers and simulators, creating a seamless integration for:

- Visual inspections
- Preventive maintenance
- Work procedures
- Performance tests
- Safety tests

Ansur software utilizes plug-in modules to work with a wide array of Fluke Biomedical instruments. The plug-in module is a software interface to the Ansur program. Plug-ins provide test elements used by Ansur. This gives the benefit of using the same user interface for all testers and simulators supported by an Ansur plug-in. See the *Fluke Biomedical Ansur QED 6 Plug-in User Manual* for detailed information.

When you purchase a new Fluke Biomedical tester or simulator, you can update your existing Ansur software by installing a new plug-in. Each plug-in module lets you work only with the options and capabilities you need for the instrument you are testing.

Chapter 3
Maintenance, Service, and Calibration

Contents **Page**

Maintenance

The Analyzer requires little maintenance or special care; however, it is a calibrated measuring instrument and should be treated as such. The optional carry case is recommended for storage. It is further recommended that the storage environment be free from vibration.

Avoiding Damage

Do not drop the instrument or subject it to any mechanical abuse that could cause a shift in the calibrated settings.

⚠ Caution

To avoid damage to the Analyzer or adverse affects on its performance, do not expose the system to temperature extremes. Ambient temperatures should remain between –25 °C and 50 °C, with a relative humidity less than 90 %.

Cleaning

Clean the exterior of the Analyzer occasionally with a cloth dampened with a mild detergent solution.

⚠ Caution

To avoid damage to the Analyzer or adverse affects on its performance, do not spray liquid directly on or immerse the unit.

Carefully wipe down the cables and inspect them for damage and deterioration of the insulation. Check the cable connections for integrity.

Troubleshooting

This section provides a brief troubleshooting guide to help you pinpoint potential problems with the Analyzer. Refer any additional problems to the Fluke Biomedical Service Center.

Description	Cause	Action
WARNING – LOW BATTERY!! appears on display	Low battery	Replace battery
Two beeps per second on power up	Defective or incorrectly inserted RAM	Call the Fluke Biomedical Service Center
Four beeps per second on power up	Defective, misprogrammed, or incorrectly inserted EPROM	Call the Fluke Biomedical Service Center
Infrequent resets during operation	High EMI fields produced by defibrillator units	Reset the power on the Analyzer and continue operation

Service and Calibration

If the new Analyzer fails to operate successfully or if it needs a recommended yearly calibration, please contact the Fluke Biomedical Service Center immediately, as indicated under *Warranty and Product Support*.

⚠ Caution

To avoid damage to the Analyzer or adverse affects on its performance, allow only qualified technical personnel to service the Analyzer.

Battery Replacement

The replacement battery for the Analyzer is a standard 9 V alkaline battery.

⚠⚠ Warning

To avoid possible electrical shock or personal injury, disconnect all test leads and the ac adapter before opening the battery door.

To replace the battery:

1. Disconnect all test leads and the ac adapter from the Analyzer.
2. Open the battery compartment door on the back panel.
3. Remove the battery, disconnecting it from the snap contacts.
4. Connect the 9 V alkaline replacement battery to the snap contacts.
5. Place the battery into the compartment and close the door until it clicks.

Packing

If repairs or calibration are required, return the Analyzer to the factory or the nearest service center.

1. Before returning the Analyzer for factory service, contact Fluke Biomedical Service Center for a required Return Authorization Number.
2. Provide the following information:
   - The Analyzer serial number
   - The specific steps that reproduce your problem

- A daytime phone number
- Your name / company
- A fax number (if available)

3. Pack the instrument carefully, using the original shipping container and packing materials supplied by Fluke Biomedical. If the original packing materials are not available, refer to *Return Procedures* for a list of preferred materials or contact Fluke Biomedical for replacement packing.

Note

Failure to pack the instrument properly could void the warranty.

Shipping

1. Place the Return Authorization Number in a prominent place on the outside of the packing box, and refer to the number in any correspondence with Fluke Biomedical Service.
2. Enclose your return address and Return Authorization Number.
3. Insure the unit for full retail value and ship to the nearest Fluke Biomedical Service Center.