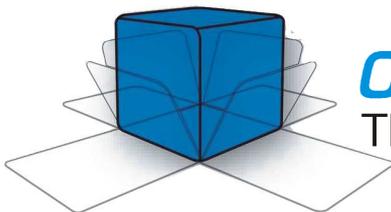


# *MegaPulse*

IMPULSE TESTER

# *Defib-5P*

Instruction Manual



***COMPLIANCE WEST USA***

The blue box that tests. And tests.



*Dear Customer:*

*Congratulations! Compliance West USA is proud to present you with your MegaPulse Defib-5 P Impulse Tester. Your instrument features a groundbreaking logic-controlled circuit design and ergonomic front panel and represents the latest in high voltage impulse testing.*

*To fully appreciate all the features of your new instrument, we suggest that you take a few moments to review this manual. Compliance West USA stands by your instrument with a full one-year warranty. If the need arises, please don't hesitate to call on us.*

*Thank you for your trust and confidence.*



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# **Section 1**

## **An Introduction to Impulse Testing with the MegaPulse P series tester**

The impulse test is designed to simulate impulse surges which occur in everyday life due to nearby lightning strikes, switching transients, and other high-frequency faults on the power distribution network. Impulse testing is the fundamental method for empirical verification of the adequacy of insulation. Other methods of ensuring adequate insulation (AC or DC Dielectric Withstand testing, measurement of over-surface creep age, through-air clearance, or distance-through-insulation) are all extrapolated from the results of impulse testing. The impulse test is performed to ensure that the insulation in question will be able to function properly when subjected to similar impulse surges in the field.

### **Safety Precautions**

The impulse withstand test can generate voltages in excess of 5000V peak at potentially lethal current levels. Currents of as little as 5mA at 120 volts can cause death; the MegaPulse can deliver currents of more than 100 Amps peak for very short time duration. The potential for serious injury or death exists and personnel should be aware when they conduct this test.

### **Test Personnel**

Personnel require special training to conduct the impulse test. They should understand electrical fundamentals clearly, and be aware that high voltage is adept and creative at completing a path to ground. Instructions should include a warning against any metal jewelry. Operators should not allow others in the testing area, especially when tests are being conducted. Organization is to be stressed. The operator should keep the area free of unused leads and equipment.

### **Testing Area**

The area used for conducting the impulse test should be as remote as possible from normal production line activities. Only personnel actually conducting the test should be allowed in the area, and it should be taped or roped off to preclude casual entry by other employees. In addition, the area should be marked "WARNING - HIGH VOLTAGE TESTING" or the equivalent to warn others of the nature of the testing taking place.

The bench being used should be non-conductive, and any exposed metal parts should be tied together and grounded. If a conductive surface must be used, it should be grounded. Because of sparking during an impulse test failure, it is not safe to conduct impulse testing in combustible atmospheres.

It is imperative that a good ground be provided to the MegaPulse tester. Before connecting the equipment, ensure that the building wiring provides a low-resistance ground. If the MegaPulse tester is used on a high-resistance grounding circuit, dangerous high voltages may be present to the operator. In addition, the power to the Testing Area should be provided with an easily reached shutoff switch which can be actuated by personnel outside the Area if needed.

## Safety Techniques

The high voltage circuit of the MegaPulse Defib-5 P can be shut off at any time by turning OFF the rear power switch. Always press TRIGGER to discharge the tester before turning OFF.

The MegaPulse tester is provided with a **VOLTAGE ADJUST** knob on the front panel. This should always be adjusted to the minimum position at the start of testing. In addition, this knob should be adjusted back to the minimum position at the completion of all testing.

The MegaPulse tester is provided with a **CHARGE** switch that is in the unarmed "Standby" setting when the tester is first turned ON. When the yellow **CHARGE** button is lit, the tester will not provide high voltage until the **CHARGE** Button and the **TRIGGER** Button have been pressed in order. To prevent inadvertent operation, the operator should be instructed not to press the **CHARGE** Button until the test is ready.

The MegaPulse tester has been designed for one-touch operation with the right hand. If possible, it should be set up to the left and in front of the equipment under test. The equipment under test should be connected to the MegaPulse tester and then left alone by the operator. After the operator is clear of the Tester and the equipment under test, the operator should turn the rear-panel power switch to ON, press the **CHARGE** Button, adjust the voltage to the desired level (as displayed on the front panel meter), then press the **TRIGGER** Button, with his right hand. This will allow the greatest separation between the operator and the test being conducted. Note that the CHARGE process will stop after 2 minutes if the TRIGGER button is not pressed.

The MegaPulse tester is designed to bleed the high voltage away after the test has concluded. In order to ensure that any voltage present in the equipment being tested has been completely bled away, the operator should not unplug the equipment under test from the MegaPulse until the front panel meter reads a safe level (40 volts or less is generally considered a safe level). Pressing the **TRIGGER** button before disconnecting main power (or turning the equipment off) will ensure that the internal capacitors are discharged as much as possible.

## Using the MegaPulse Impulse Tester

The impulse test involves high voltage and caution should be exercised when using the tester. The **RETURN** lead is referenced to building ground when properly connected. However, both the **OUTPUT** and **RETURN** leads must always be treated as Hazardous whenever the power switch of the MegaPulse is in the ON position.

The MegaPulse impulse tester generates the impulse waveform only; it does not determine Passing or Failing results. It is the operator's responsibility to monitor the output waveform and determine Passing or Failing results. In monitoring the impulse waveform, consider the following points: The Impulse waveform is high voltage and high frequency (short duration). Always ensure that the measuring instrument (usually an oscilloscope with a high-voltage probe) is rated for the voltage involved, and that the frequency response of the instrument and probe are capable of measuring the output waveform of the MegaPulse Impulse Tester. A measuring instrument or probe with a low frequency response will result in erroneous readings that could be mis-read.

Pressing the **POLARITY** switch on the front panel can change the polarity of the output waveform. The polarity is Normal when the **NOR** indicator is lit. In this case, the high voltage

will appear on the **OUTPUT** as a positive pulse relative to the **RETURN** jack. When the polarity switch is in the Reverse position (**REV** indicator is lit), the high voltage will appear on the **OUTPUT** as a negative pulse relative to the **RETURN** jack. The polarity switch only operates when the **CHARGE LED** is lit, i.e. the output is not charged.

Note that the voltage meter may indicate that some residual voltage is present on the main storage capacitor, even when the tester is first turned ON. This is due to inherent charging of the internal capacitors. Pressing the **TRIGGER** switch will discharge the capacitors (be sure not to touch the output and return leads when pressing the trigger switch).

Note that the peak amplitude of the measured output waveform is proportional to the voltage that is read on the front panel of the MegaPulse, but it will always be somewhat lower. This is because the meter on the MegaPulse is measuring the voltage on the main impulse storage capacitor. This voltage will intentionally dissipate to some extent before reaching the output leads. Therefore, it is important to measure the peak amplitude of the output waveform, and adjust the output of the MegaPulse accordingly.

Determination of Passing and Failing results can prove difficult. To obtain the most accurate results, it is generally necessary to perform multiple impulse tests on a few different test samples (that have adequate insulation to pass the impulse test). Take note of the impulse waveshape, amplitude, and duration. Also note how much variance there is in the waveshape from test to test. Also (if possible), perform impulse testing on some test samples that are known to have inadequate (or damaged) insulation. Take note of the impulse waveshape, amplitude, and duration, when an insulation breakdown occurs.

## Section 2

### Introduction

This manual contains complete operating, maintenance and calibration information for the Compliance West USA MegaPulse Defib-5 P Impulse Tester.

- In case of trouble, the test can be immediately terminated at any time by turning the rear-panel power switch to the OFF position.
- Before the test can commence, the unit must be armed by pressing the **CHARGE** Button. The test will not begin until the **TRIGGER** Button is pushed.
- Operator instructions are printed on the rear panel for quick reference.
- Voltage is discharged by a resistor bank within the MegaPulse tester upon test completion. Discharge progress is shown on the front panel meter.

Your tester is warranted for a period of one year upon shipment of the instrument to the original purchaser.

## **Section 3**

### **Operation**

This section describes how to set up and make measurements with your Tester. We recommend that you read the entire section carefully so that you can use all of the features of your Tester.

#### **Setting up your Tester**

Your Tester is shipped in a special protective container that should prevent damage to the instrument during shipping. Check the shipping order against the contents of the container and report any damage or short shipment to Compliance West USA. The container should include the following:

- The MegaPulse Defib-5 P Tester
- Five high-voltage test leads, 3 red and 2 black
- Inductance jumper, red
- An 18 AWG Line Power Cord
- This Instruction Manual

If reshipment of the instrument is necessary, please use the original shipping container. If the original shipping container is not available, be sure that adequate protection is provided to prevent damage during shipment. We recommend that the instrument be surrounded by at least three inches of shock-absorbing material on all sides of the container.

Remove the tester from its container and place it on a test bench.

#### **AC Line Voltage Requirements**

AC line voltage requirements for your Tester are noted on the rear panel of the instrument. Do not connect the instrument to a different voltage source. The cord packaged with your MegaPulse Tester is for use in the United States. If another power cord must be used, the cord must be rated for the maximum current noted on the rear panel. It must also meet the requirements of IEC 227 or IEC 245, and mains cords that are certified or approved by any recognized national test house are regarded as meeting this requirement.

## **Fuse Replacement**

There is a user-replaceable fuse (F1) located on the rear panel of the instrument. It is located behind a door in the Power Inlet-Power Switch-Fuse Holder device. The fuse rating is noted on the rear panel. Do not attempt to replace it with a fuse of any other rating.

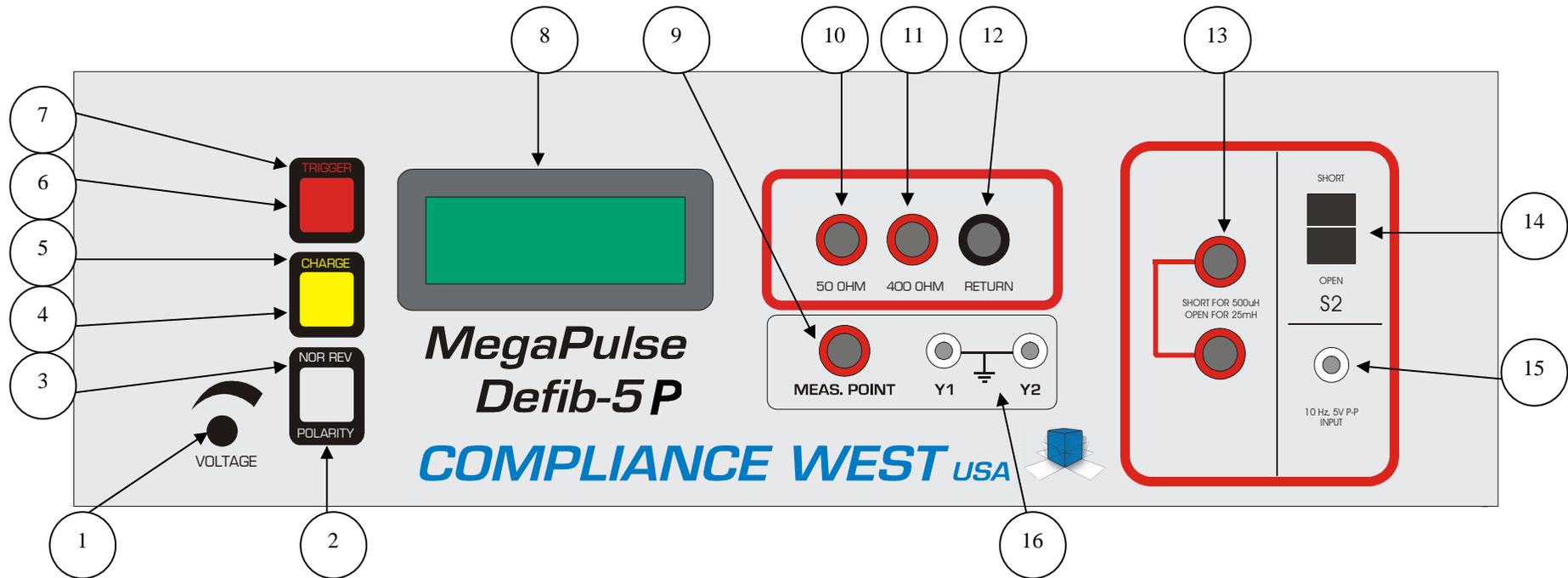
Use the following procedure to replace the fuse F1:

1. Turn the power switch to the OFF position.
2. Unplug the instrument from the source of supply.
3. Remove the power inlet cord from the instrument.
4. Using a small screwdriver, pry open the fuse holder door.
5. Replace the fuse with a new one of the correct rating.
6. Replace the fuse holder door and power inlet cord.

## **Front and Rear Panel Features**

Before using your Tester, take a few minutes to become familiar with the use of its controls, indicators and connectors. The front panel features of the MegaPulse are shown in Figure 1 and described in Table 1. The rear panel features of the MegaPulse are shown in Figure 2 and described in Table 2.





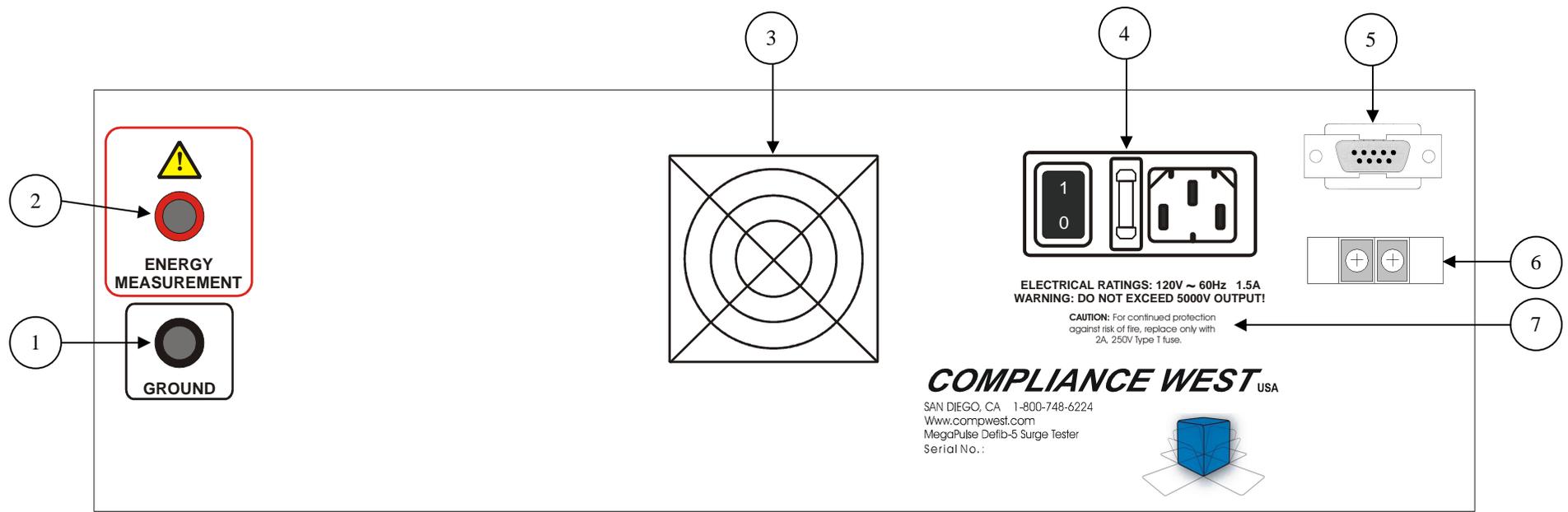
**Figure 1. Controls, Indicators, Connectors – MegaPulse Defib-5 P Front Panel**

ITEM	NAME	FUNCTION
1	<b>VOLTAGE</b> Adjust Knob	Adjust the voltage set point in the tester. Turn Clockwise to increase the output voltage after the <b>CHARGE</b> button has been pressed. Turn the knob fully counterclockwise (lowest voltage setting) before the start of each test, and after the end of each test.
2	<b>POLARITY</b> switch	Toggles the output pulse polarity from Normal to Reverse, Normal for positive and Reverse for Negative, The pulse will appear on the Output jack relative to the return jack The polarity switch only operates when the <b>CHARGE</b> indicator is lit and the voltage on the display meter is less than 180V. The polarity is Normal when the <b>NOR</b> indicator is lit and, Reverse when the <b>REV</b> indicator is lid.
3	<b>NOR REV</b> indicator	Indicates the state of the Output Polarity switch. <b>NOR</b> indicates Normal (Positive) position. <b>REV</b> indicates Reverse (Negative) position.
4	<b>CHARGE</b> switch	Starts the charge process of the tester capacitor. The <b>CHARGE</b> indicator will turn off after the <b>CHARGE</b> switch is pressed, and the <b>TRIGGER</b> indicator will turn on. The charge process will stop after 2 minutes if the <b>TRIGGER</b> button is not pressed.
5	<b>CHARGE</b> indicator	This Yellow indicator is lit to show that pressing the <b>CHARGE</b> switch is the next logical step in a test sequence. <b>CHARGE</b> indicator is lit when the tester is turn ON an after pressing <b>TRIGGER</b> button. <b>CHARGE</b> indicator will go out after pressing <b>CHARGE</b> button. <b>CHARGE</b> and <b>TRIGGER</b> Indicators will be blinking if the Interlock Switch is open. (Only testers with Interlock Switch Option)
6	<b>TRIGGER</b> switch	Triggers the output impulse waveform. The impulse waveform will appear across the output leads.
7	<b>TRIGGER</b> indicator	This Red indicator is lit to show that the tester can be trigger. <b>TRIGGER</b> indicator is lit for 2 minutes after the <b>CHARGE</b> button is pressed. <b>TRIGGER</b> indicator will go out after pressing <b>TRIGGER</b> button. <b>TRIGGER</b> and <b>CHARGE</b> Indicators will be blinking if the Interlock Switch is open (Only testers with Interlock Switch Option) <b>TRIGGER</b> indicator will blink at when the Voltage. This effect will remain on until the <b>TRIGGER</b> switch is pressed. (Only testers with PC Interface option)
8	<b>VOLTAGE</b> meter	Displays the output voltage set point. The voltage reading will increase from zero to the voltage set point when the <b>CHARGE</b> button is pressed. Note that the Voltage meter may indicate that some residual voltage is present on the main storage capacitor, even when the tester is first turned ON. This is due to inherent charging of the internal capacitors. Pressing the <b>TRIGGER</b> switch will discharge the capacitors. Note that the peak amplitude of the measured output waveform is proportional to the voltage that is read of the front panel of the MegaPulse, but it will always be somewhat lower. This is because the meter on the MegaPulse is measuring the voltage on the main impulse storage capacitor. This voltage will intentionally dissipate to some extent before reaching the output leads. The meter will start to flash at <b>5050V</b> to indicate that voltage is in the maximum limits. If unit includes PC Interface and the Keyboard is locked, the display will show OFF when a button is pressed.
9	<b>MEAS. POINT</b> jack	Used to perform the Pass/Fail reference test. See figure 7. This is the point which is connected to the voltage divider network to determine Pass/Fail results of the test.

ITEM	NAME	FUNCTION
10	50 ohm OUTPUT jack	The impulse waveform appears on the <b>OUTPUT</b> jack, referenced to the <b>RETURN</b> jack. When the <b>POLARITY</b> switch is in the Normal position ( <b>NOR</b> indicator is lit) the output will be a positive pulse. When the <b>POLARITY</b> switch is in the Reverse position ( <b>REV</b> indicator is lit) the output will be a negative pulse.
11	400 ohm OUTPUT jack	The impulse waveform appears on the <b>OUTPUT</b> jack, referenced to the <b>RETURN</b> jack. When the <b>POLARITY</b> switch is in the Normal position ( <b>NOR</b> indicator is lit) the output will be a positive pulse. When the <b>POLARITY</b> switch is in the Reverse position ( <b>REV</b> indicator is lit) the output will be a negative pulse.
12	RETURN jack	This is the return for the impulse waveform. This jack is referenced to the chassis of the MegaPulse, and is referenced to earth ground as long as the MegaPulse is properly grounded. Even though this jack is referenced to ground, it should be treated as hazardous whenever the MegaPulse is turned ON.
13	INDUCTANCE jumper	Depending on which testing standard is being followed, an inductance of either 500uH or 25mH will be required. Using the included inductance jumper, SHORT the two impedance jacks for 500uH, leave OPEN for 25mH.
14	S2 switch	This switch is provided to protect the Signal Generator from the output pulse of the Defib-5 P when CLOSED, and to allow the required 5V p-p signal to be injected when OPEN. See Figure 5 Part 9A.
15	BNC INPUT 10Hz, 5V P-P	BNC Input provided on front panel is for connecting the output signal generator. See Figure 5 Part 9A. If the unit includes the Sine Wave Generation option, the item 15 will be a BNC OUTPUT 10Hz, for monitoring the Sine Wave with an oscilloscope.
16	Y1 – Y2 outputs	These differential outputs are to be connected to two different channels of an oscilloscope. The outputs are then subtracted and the resulting waveform is used to judge acceptability of the EUT. See Figure 6.

**Table 1. Controls, Indicators, Connectors – MegaPulse Defib-5 P Front Panel**





**Figure 2. Controls, Indicators, Connectors – MegaPulse Defib-5 P Rear Panel**

ITEM NO.	NAME	FUNCTION
1	Ground for Energy Measurement	This jack is used along with the ENERGY MEASUREMENT jack to calculate the energy. This jack is referenced to the chassis of the MegaPulse, and is referenced to earth ground as long as the MegaPulse is properly grounded. Even though this jack is referenced to ground, it should be treated as hazardous whenever the MegaPulse is turned ON.
2	Energy Measurement jack	This jack is necessary to verify the value of the 100 ohm resistor. The 100 ohm resistor value is measured between the ENERGY MEASUREMENT jack and the GROUND jack on the rear panel.
3	Fan	Design to cool down the tester.
4	Appliance Inlet / Fuse holder / Power Switch	Use supplied cordset to connect the MegaPulse Defib-5 P tester to an appropriate source of supply. Fuse holder provides access for Fuse replacement, and the Power Switch is used to turn the tester ON and OFF.
5	RS-232 Interface (Optional)	Allow the communication between the tester and computer interface; a RS-232 to USB is available.
6	Interlock Switch (Optional)	Emergency Stop Close: Enables the tester buttons for operation. Open: Stops any process in the tester and disables the buttons. The <b>TRIGGER</b> and <b>CHARGE</b> Indicators will be blinking
7	Fuse replacement warning / Rating of power supply	Specifies replacement fuse and required supply voltage.

**Table 2. Control, Indicators, Connectors – MegaPulse Defib-5 P Rear Panel**



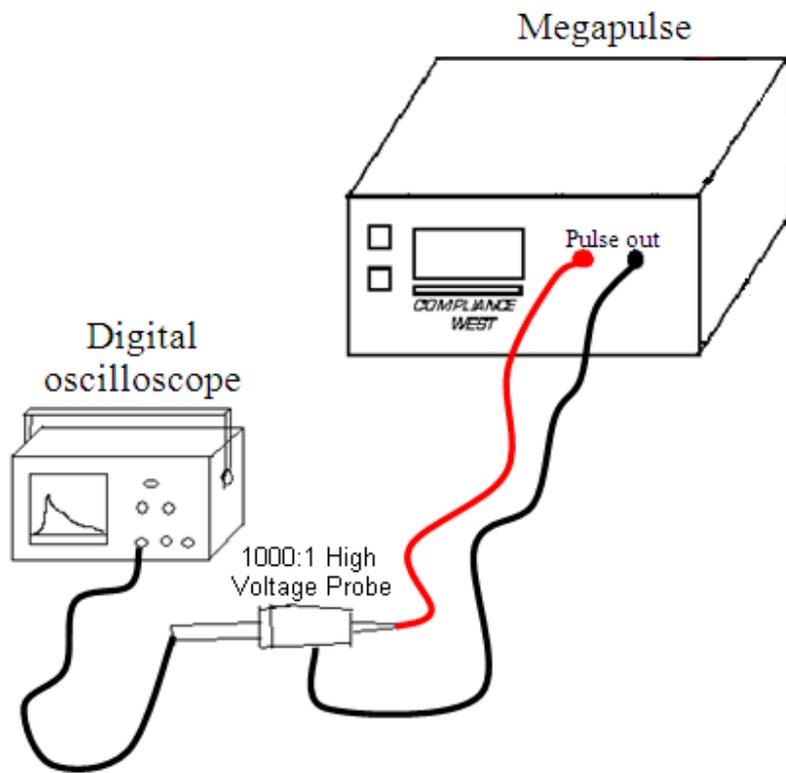
## Initial Checkout Procedure

The following procedure will verify that the MegaPulse Defib-5 P tester is working correctly. We recommend that this procedure be conducted periodically to ensure proper operation of the tester. The following items are needed to conduct this procedure: A measuring instrument to monitor the output waveform. Always ensure that the measuring instrument (usually an oscilloscope with a high-voltage probe) is rated for the voltage involved, and that the frequency response of the instrument and probe are capable of measuring the output waveform of the MegaPulse Defib-5 P tester. A measuring instrument or probe with a low frequency response will result in erroneous readings that could be mis-read.

### CAUTION

**High voltage generated by the MegaPulse tester is exposed during this test. A risk of shock exists. Exercise care when using the MegaPulse tester.**

1. Connect the tester to a proper source of supply using the included 18 AWG power supply cord. Make sure that the front panel **VOLTAGE** adjust knob is turned fully counterclockwise.
2. Plug the Output and Return test leads into the jacks on the front panel.
3. Connect the ends of the test leads to an appropriate measuring instrument (typically an oscilloscope with a high-voltage probe). Note that the **RETURN** lead is referenced to the chassis ground of the tester. See Figure 3 as an example.
4. Turn the Tester on. Toggle the **POLARITY** switch if necessary so that the **NOR** indicator is lit.
5. Note that the Voltage meter may indicate that some residual voltage is present on the main storage capacitor, even when the tester is first turned ON. This is due to inherent charging of the internal capacitors. Pressing the **TRIGGER** switch will discharge the capacitors (be sure not to touch the output and return leads when pressing the trigger switch).
6. Push the yellow **CHARGE** button. Verify the red **TRIGGER** indicator is now lit.
7. Adjust the **VOLTAGE** knob so that the front panel LED display is reading a voltage that is suitable for the measuring instrument that is being used. Push the red **TRIGGER** button, and view the resulting impulse waveform on the measuring instrument.
8. Note that the peak amplitude of the measured output waveform is proportional to the voltage that is read of the front panel of the MegaPulse, but it will always be somewhat lower. This is because the meter on the MegaPulse is measuring the voltage on the main impulse storage capacitor. This voltage will intentionally dissipate to some extent before reaching the output leads.
9. Repeat steps 5 through 8, except this time toggle the **POLARITY** switch so that the **REV** indicator is lit. Note that the impulse waveform will now be a negative pulse, so it will probably be necessary to make adjustments to the measuring instrument to get a proper reading.
10. Adjust the **VOLTAGE** knob fully counterclockwise, to the minimum position. Turn the rear-panel power switch OFF.



**Figure 3: Waveform Measurement Setup**

## Testing

This section describes how the MegaPulse Defib-5 P tester is used to conduct a test. The test can be stopped immediately at any time by turning OFF the rear-panel power switch.

1. Connect the tester to a proper source of supply using the included 18 AWG power supply cord. Make sure that the front panel **VOLTAGE** adjust knob is turned fully counterclockwise.
2. Plug the Output and Return test leads into the jacks on the front panel.
3. Connect the ends of the test leads to the equipment under test.
4. Turn the Tester on. Toggle the **POLARITY** switch as needed so that the **NOR** or **REV** indicator is lit.
5. Note that the Voltage meter may indicate that some residual voltage is present on the main storage capacitor, even when the tester is first turned ON. This is due to inherent charging of the internal capacitors. Pressing the **TRIGGER** switch will discharge the capacitors (be sure not to touch the output and return leads when pressing the trigger switch).
6. Push the yellow **CHARGE** button. Verify the red **TRIGGER** indicator is now lit.
7. Adjust the **VOLTAGE** knob so that the front panel LED display is reading a voltage that is suitable for the measuring instrument that is being used. Push the red **TRIGGER** button, when the desired voltage is displayed on the front panel meter.
8. Note that the peak amplitude of the measured output waveform is proportional to the voltage that is read of the front panel of the MegaPulse, but it will always be somewhat lower. This is because the meter on the MegaPulse is measuring the voltage on the main impulse storage capacitor. This voltage will intentionally dissipate to some extent before reaching the output leads.

### **Defib-5 P Checkout and Operation**

The Defib-5 P Medical Defibrillation tester consists of two parts; the pulse generation portion and the measurement portion. Please refer to the boxes shown in Figure 4, which is IEC 601-1, Figure 50 edited to show the function of the Defib-5 P. The lower box shows the part of the Defib-5 P which generates the pulse, while the upper box shows the measurement network. The rest of Figure 3 is the EUT.

### **Use of Measurement Terminals Y1 and Y2**

There are two BNC jacks on the front panel of the Defib-5 P, labeled Y1 and Y2. These are used to verify that the Applied Part or Chassis of the Equipment Under Test does not exceed 1 Volt peak in accordance with IEC/EN/UL 60601-1. A marginally failing product will cause the voltage on the oscilloscope to rise to 1 Volt (ref. 60101-1 clause 17h). Note that this voltage does not have the same waveshape as the defibrillation pulse. The measurement point has a voltage rise time constant of 2 mSec (derived empirically). The decay time of the measurement point is driven by the impedance of the oscilloscope, which is typically 1 M $\Omega$ . In this case, the decay time would have a time constant of 1 second. When testing using the math function, the time base should be set at 500mS/division. If a smaller time base is used, there could be transient noise on the waveform.

## **Verification of Measurement Circuit Operation**

To verify proper oscilloscope setup and to ensure that you can capture a waveform, set up the time base of the oscilloscope to 100mS/division (NOTE: this time base is different when testing Equipment Under Test). Connect the Defib-5 P Y1 and Y2 jacks to the Ch1 and Ch2 inputs respectively of an oscilloscope using appropriate BNC cables. Set up the oscilloscope to perform a (Ch1 - Ch2) math function. (Depending on the particular oscilloscope used, it will be necessary to experiment with the trigger setting in order to ensure that you will be able to capture the signal.)

Connect the Measuring Point input jack on the front panel of the Defib-5 P directly to the Output jack on the front panel of the Defib-5 P using the lead supplied with the tester. Set the output of the Defib-5 P to minimum using the Voltage Knob. Press the CHARGE button, and adjust the Voltage output so that the front panel meter reads 100 volts (note that this is much lower than the standard test voltage of 5000 volts). Press the TRIGGER button and verify that the voltage captured by the oscilloscope rises to approximately 2.5 volts. Refer to Figure 6 on page 23, which shows approximately what the waveform should look like. This will show that the voltage divider network of the Defib-5 P which is connected to the Y1 and Y2 jacks is functioning as intended.

## **Testing with the Defib-5 P**

To perform actual testing, the Defib-5 P should be connected to the EUT as shown in the standard which the EUT is being tested to. See figures 4 and 5 for examples of the MegaPulse Defib-5 P connections for testing parameters of IEC60601. They can be used as a key for the inputs and outputs of the MegaPulse Defib-5 P. Note the actual connections on the front panel of the Defib-5 P have been added to Figure 50 of IEC 601 in Figure 1 for illustrative purposes. Make sure to confirm your specific circuit connections based on the standard the EUT is being tested to in order to verify your test connections are correct.

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Add the following new figures 50 and 51:

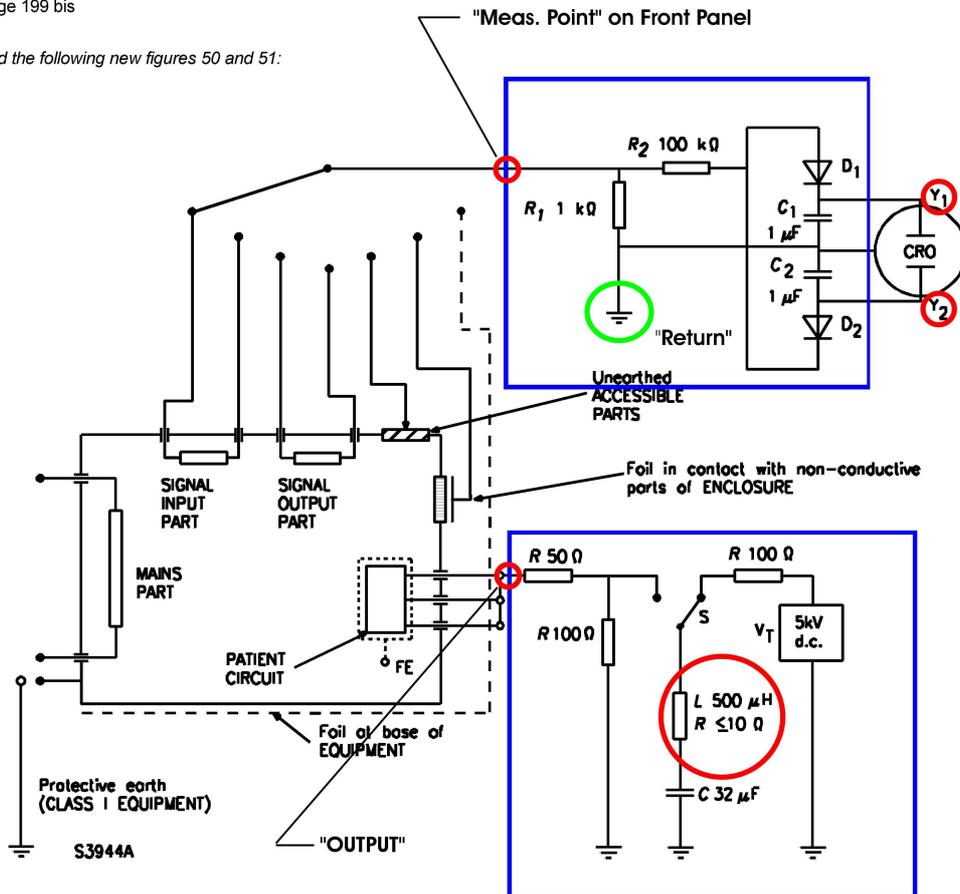


Figure 50 – Application of test voltage to bridged PATIENT CONNECTIONS for DEFIBRILLATION-PROOF APPLIED PARTS (see subclause 17 \*h))

#### Figure 4: Example of Defib-5 P Connections on Figure 50 of IEC60601

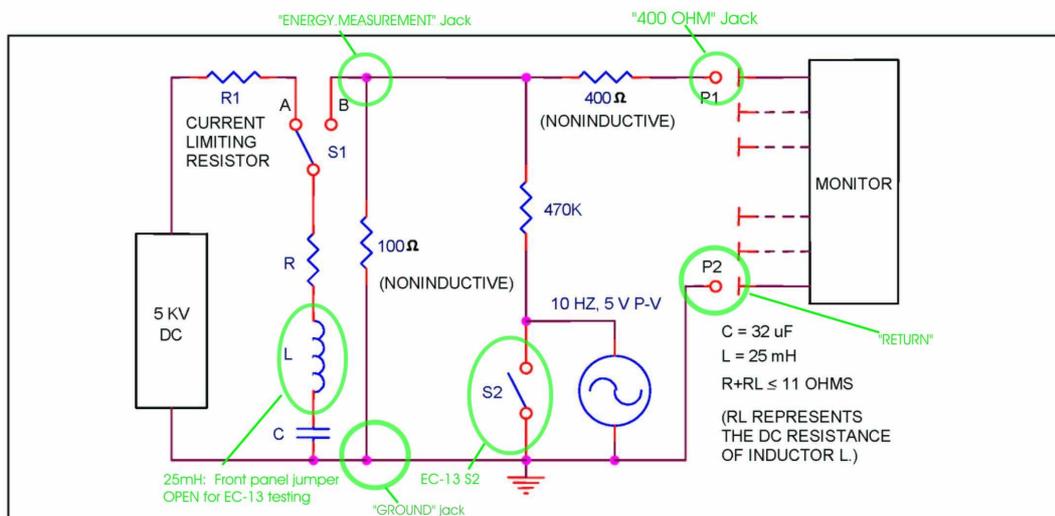


Figure 9A—Test circuit for defibrillator overload tests (5.2.2.2.1 and 5.2.2.2.2)

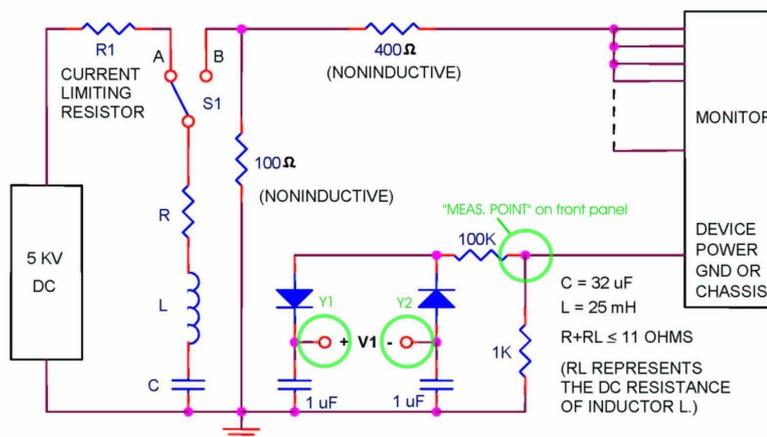


Figure 9B—Test circuit for operator safety test (5.2.2.3)

NOTE 1—The values of R, L, and C may be varied so long as the waveform conforms to the limits specified in applicable document 2.3.

NOTE 2—The manufacturer's recommended patient cable shall be used.

NOTE 3—The 470 K resistor of 9 A must withstand 5 kV. Using ten 47 K, 1/8 W resistors in series should suffice.

NOTE 4—The switch S1 must withstand peak currents of 60 A in the closed position, and in the open position it must not break down for voltages up to 5000 V.

Figure 5: Example of Defib-5 P Connections on Figures 9A and 9B of IEC60601



Figure 6: Y1 Y2 Test Output

## 100X Option

The 100X Option is offered as a separate upgrade to the unit. The Purpose of the 100X Option is to remove the internal 100Ω resistor by disconnecting the circuit with a Red jumper located in the rear panel.

### How to connect an external load for energy measurement purposes?

- 1) Turn OFF the MegaPulse Defib-5P.
- 2) Connect the Red Jumper in the rear panel for internal load.
- 3) Unplug all the cables from the outputs.
- 4) Turn ON the MegaPulse Defib-5P.
- 5) Press the TRIGGER button to discharge the tester and make sure the front meter display reads a safe low voltage.
- 6) Turn OFF the MegaPulse Defib-5P.
- 7) Remove the Red Jumper in the rear panel for external load.
- 8) Connect an external load at the Energy Measurement and Ground connectors.
- 9) Turn ON the MegaPulse Defib-5P.
- 10) Tester is ready to CHARGE and TRIGGER with 100X Option.

### How to return the MegaPulse Defib-5P to normal operation?

- 1) Turn OFF the MegaPulse Defib-5P.
- 2) Remove the load connected to Energy Measurement and Ground connectors.
- 3) Connect the Red Jumper in the rear panel for internal load.
- 4) Turn ON the MegaPulse Defib-5P.
- 5) Tester is ready to CHARGE and TRIGGER.

### Jumper Functions:

**SHORT FOR INTERNAL LOAD:** Internal 100Ω load connected.

**OPEN FOR EXTERNAL LOAD:** Internal 100Ω open (Note: Use an external load at the Energy Measurement and Ground connectors).

### WARNING:

If the Jumper is OPEN FOR EXTERNAL LOAD and the external load is not connected the unit will not discharge properly. The external load should not be less than 95Ω or more than 1000Ω.

## Continuous Full Voltage Option

The Continuous Full Voltage option is offered as a separate upgrade to the unit. The purpose of the Continuous Full Voltage option is to maintain the voltage charge at  $5000V \pm 15V$ , until the TRIGGER button is pressed. With this option the unit is capable of charging 5000V in 12s.

**Note:**

The charge time can be adjusted with the Voltage Knob. With the voltage knob at the maximum the unit is able to charge in less than 12 seconds, however we recommend not to exceed the 12s duty cycle to avoid overheating of the unit.

When operating the unit with the Testminder Option the Continuous Full Voltage Option can be enabled or disabled by following the next steps:

- 1.- Click "Options" on the TestMinder MP Remote Control Software Window.
- 2.- Click "Enable" or "Disable" on the Stop Voltage Option.
- 3.- Click "OK".

## Section 4 Energy Measurement

### Energy Formula

Many Medical Equipment standards are requiring Energy Measurements to be taken during Surge Testing. The Defib-5 P allows these measurements to be taken using receptacles on the rear panel. Measurement of the energy dissipated in the 100 ohm resistor is best accomplished using an oscilloscope which can calculate energy using the formula:

$$E = \int_0^T p(t) dt = \frac{1}{R} \int_0^T s^2(t) dt$$

where “s” is the voltage. Please note that the resistance will be a factor when calculating the power using the formula shown on the right, as discussed below in the “Power Calculation using Voltage” section.

### Considerations of the value of the 100 ohm resistor for Energy Measurement

The Compliance West USA Defib-5 P has been designed with a 5% tolerance for the 100 ohm resistor value, which will result in a value of between 95 and 105 ohms during the course of continuous testing with a pulse output every 30 seconds for the standard product, (every 10 seconds for the Defib-5 P equipped with the FCD Option). Measurement of the 100 ohm resistor using the Power Measurement receptacles on the rear panel of the tester when the tester is cold will be approximately 103-105 ohms to allow for heating effects which will lower the resistance. We recommend a value of 100 ohms be used during power calculations as a good approximation of the value of the resistors over the test period.

### Testing Methods

We strongly recommend that a pulse and power calculation be made with open circuit outputs (no DUT connected to the Defib-5 P). This will output the entire pulse through the 100 ohm resistor, and is necessary to obtain before the DUT is connected. The resulting energy measurement can be used to determine the total energy output by the Defib-5 P.

### Voltage Meter Display Accuracy

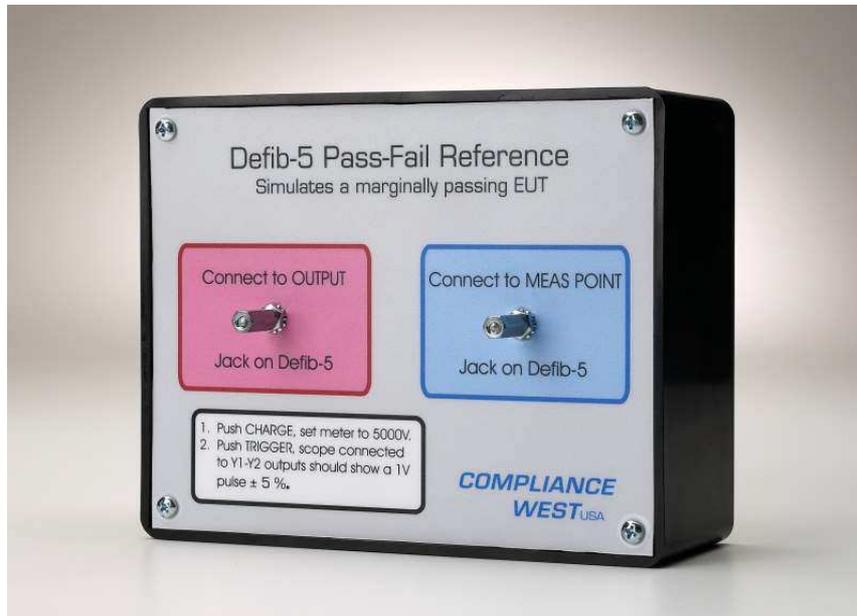
The MegaPulse Defib-5P Voltage Meter Display maintain a +/-1% accuracy on the bulk-cap reading. This is required by the IEC 60-601-1 standard.

$$\text{Voltage Meter Display} = \pm 1\% \text{ Bulk-cap Voltage}$$

## Section 5

### Defib-5 Pass/Fail Reference

The Defib-5 Pass/Fail Reference is designed to allow the operator to ensure operation of the Defib-5 P high voltage output circuit and the measurement circuit at full voltage. The Defib-5 P Pass/Fail Reference relies on a common ground between the Return jack and the oscilloscope.



To use:

Connect the 50 ohm OUTPUT jack to the RED electrode on the Pass/Fail Reference. Connect the MEAS. POINT jack to the BLUE electrode on the Pass/Fail Reference. There is no ground connection on the Pass/Fail reference, which takes the place of the DUT in EN 60601, Figure 50. Oscilloscope ground is supplied by the BNC jack connections. See Figure 7 for reference.

Set the oscilloscope in accordance with the instructions in Paragraph 1 of the Verification of Measurement Circuit Operation, set time at 500ms/division. If a smaller time base is used, there could be transient noise on the waveform.

Set the Defib-5 P meter to read 5000V, and Trigger the output.

The oscilloscope should display a waveform similar to Figure 8, with a peak value of approximately 1 volt.

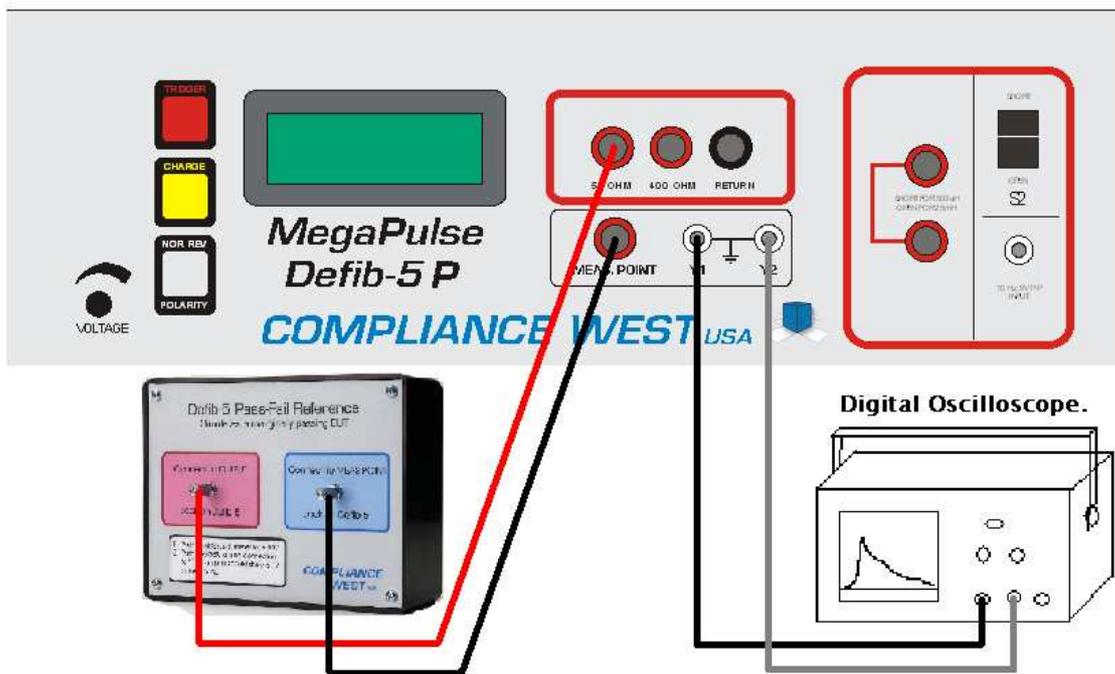


Figure 7: Defib-5 Pass-Fail Reference Setup.

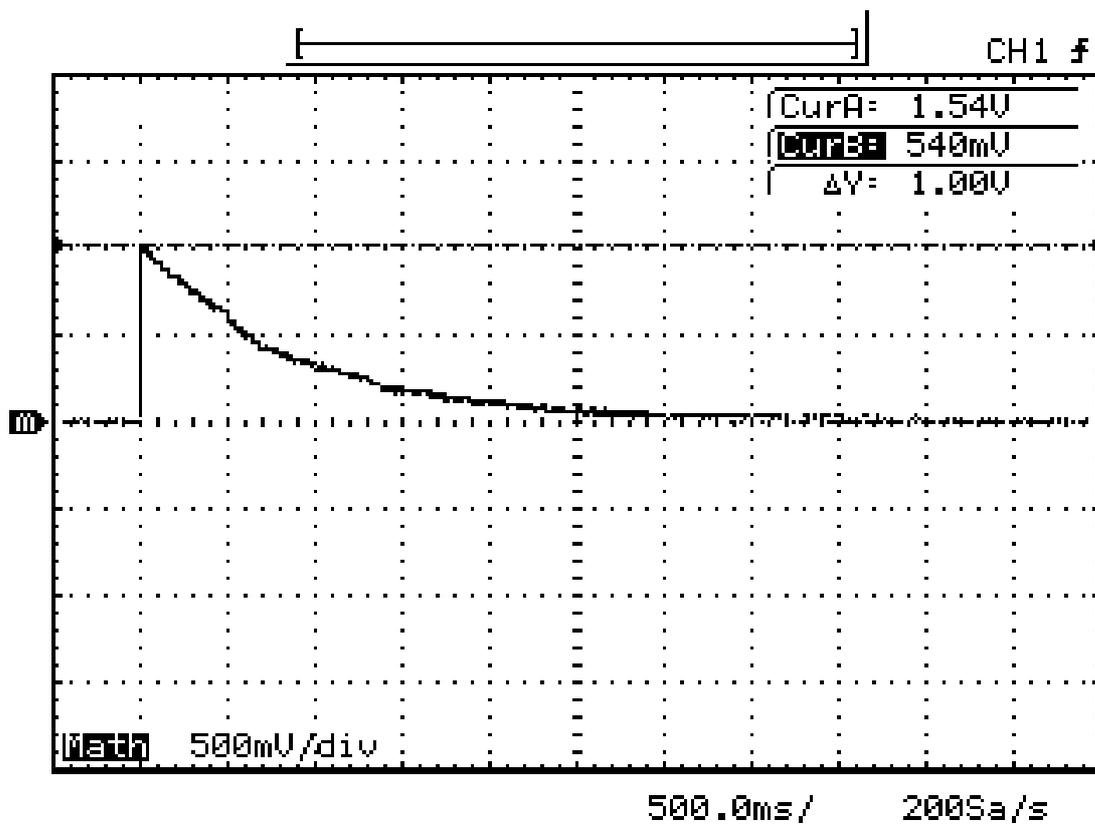


Figure 8: Y1-Y2 Waveform using a Defib-5 Pass/Fail Reference



## **Section 6**

### **Capacitor Bank Maintenance Schedule**

The Defib-5 P uses capacitors which are subject to maintenance every 20,000 cycles. If the Defib-5 P is equipped with option FCD the maintenance cycle is increased to 2.5M cycles of operation. At this time, the capacitor bank of the Defib-5 P must be replaced. Consult the factory for further details. Symptoms of capacitor bank failure are increased or decreased pulse width and low charge power. The Defib-5 P capacitor bank is to be checked for proper value at every annual calibration. If the value is outside the tolerance of 32uF +/- 5%, the capacitor bank must be replaced.

The value of the capacitor bank can be determined by qualified service personnel. Please contact Compliance West USA for assistance regarding the capacitor bank value.

## Section 7

### Technical Assistance

Technical Assistance from Compliance West USA is available:

**Phone:** (800) 748-6224

**Hours:** 8:30 AM - 4:30 PM Pacific Time.

Also available on our web site at: [www.compwest.com](http://www.compwest.com)

Contact:

Compliance West USA  
2120 Jimmy Durante Blvd, Suite 118  
Del Mar, CA., 92014  
United States of America.

**Phone:** (858) 481-6454

**FAX:** (858) 481-8527

## **Section 8**

### **Maintenance and Calibration**

#### **WARNING**

**MAINTENANCE AND CALIBRATION INSTRUCTIONS ARE FOR QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THE CONTAINED IN THE OPERATING INSTRUCTIONS.**

#### **Introduction**

This section of the manual contains maintenance information for the MegaPulse Defib-5 P impulse tester. A 1-year calibration cycle is recommended to maintain the specifications of the factory. The test equipment required for the performance test is a digital oscilloscope, high voltage oscilloscope probe, digital meter and a high voltage probe.

#### **Service Information**

The MegaPulse tester is warranted to the original purchaser for a period of 1 year. This warranty does not cover problems due to misuse or neglect. Malfunctions which occur within the limits of the warranty will be corrected at no charge. Mail the instrument post paid to the manufacturer. Dated proof of purchase is required for all in-warranty repairs. The manufacturer is also available for calibration and / or repair of instruments that are beyond their warranty period. Contact the manufacturer for a cost quotation. Ship the instrument and your remittance according to the instructions given by the manufacturer.

#### **General Maintenance**

To avoid contaminating the PWB with oil from your fingers, handle it by the edges or wear gloves. If the PWB becomes contaminated, refer to the cleaning procedures given later in this section.

#### **WARNING**

**Dangerous voltages exist when energized. Exercise extreme care when working on an energized circuit.**

#### **Cleaning**

Clean the front panel and case with a mild solution of detergent and a damp sponge. Clean dust from the PWB with clean, dry, low pressure (<20 psi)

#### **CAUTION**

**Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. These solutions will react with the plastic materials used in the instrument.**

## Calibration Information

The Calibration Procedure should be performed annually and any time the instrument has been repaired. The calibration procedure should be performed at an ambient temperature of 23°C ±5°C (73.4°F ±9°F). The procedure consists on internal components tolerance verification and calibrating the meter reading to agree with the capacitor bank. The Calibration procedure must be performed by qualified personnel, for more information contact Compliance West USA.

### Voltage Stop Disable / Keyboard Enable by Keyboard.

If the MegaPulse Defib-5 P tester includes TestMinder option and has the Voltage Stop by the PC command activated, it is possible to disable it using the next keyboard sequence:

**Note: Disabling Voltage Stop enables the keyboard.**

**Turn OFF** the MegaPulse P tester.

Hold in the **TRIGGER** and **NOR-REV** buttons.

**Turn ON** the MegaPulse P tester.

Wait until the display shows **rESE**.

Release the **TRIGGER** and **NOR-REV** buttons.