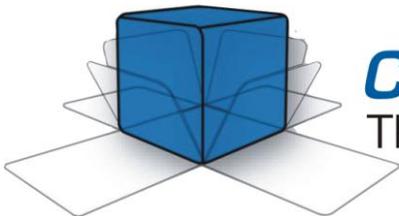


***MegaPulse***  
IMPULSE TESTER  
***D5-P:2011 V2***

**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 D5-P:2011 V2 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 D5-P:2011 V2 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.

## Section 2

### Getting Started

This section contains information for the unpacking, inspection, preparation for use and storage of your Compliance West product.

### Unpacking and Inspection

#### Packaging

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. Please save the shipping carton and packing material for the carriers inspection. Our customer support department will assist you in the repair or replacement of your instrument. Please do not return your product without first notifying us and receiving an RMA (return material authorization) number. To receive an RMA number, please contact our customer support department at (1-800-748-6224)

#### Product Package for D5-P:2011 V2

The container include the following:

	Description	PN Number
D5-P:2011 V2 Tester	Megapulse Tester	
	User Manual	
	High Voltage Test Lead, Red	HVLR (Qty 3)
	High Voltage Test Lead, Black	HVLB (Qty 2)
	High Voltage Jumper, Red	HVLEC13, Option 100X includes one Jumper and option 34 also includes one Jumper. Total Qty 3 if all options are ordered.
	18 AWG AC Power Cord	70-101
TestMinder	User Manual	
	Software CD	Megapulse TestMinder USB V1.3 or newer
	RS232 cable	60-134
	USB box	00-USBDBOX
	USB cable	60-221

#### Returning the Instrument

When is necessary to return the instrument for servicing or calibration, repackage the instrument in its original container, please include all accessories and test leads. Indicate the nature of the problem or type of service needed. Also, please mark the container as “FRAGILE” to insure proper handling.

If you do not have the original packaging materials, please follow these guidelines:

- Wrap the instrument in a bubble pack or similar foam including all the included cables.
- Use a strong double-wall container that is made for shipping instrumentation.
- Use a layer of shock absorbing material 70 to 100mm (3 to 4 inch) thick around all sides of the instrument. Protect the control panel with cardboard.
- Seal the container securely.

- Mark the container as “FRAGILE” to insure proper handling.
- Please contact Compliance West USA (1-800-748-6224) to inform about the service for your instrument.

## **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.

## Section 3

### Specifications and Controls

#### Megapulse D5-P:2011 V2 Specifications

##### **ELECTRICAL**

Charge Voltage:	0 - 5000 V tolerance $\pm 1\%$
Main Capacitance:	32 $\mu\text{F}$ $\pm 5\%$ (Dry capacitor type, 2.5 million cycles life)
Inductances:	500 $\mu\text{H}$ and 25 mH $\pm 10\%$
Main Resistances:	100 $\Omega$ , 50 $\Omega$ and 400 $\Omega$ $\pm 1\%$ non inductive.
Voltage Control:	Manually, by turning a knob in the front panel.
Polarity Control:	Positive and Negative. Alternating control available with optional computer control.
Voltage Display:	4 Digit LED Display.
Voltage Meter resolution:	5V
Duty Cycle:	1 pulse every 20s.
Line Voltage:	120V AC, 50/60Hz * (optional different line voltages available 100V, 110V, 220V, 230V, 240V)

##### **ENVIROMENTAL**

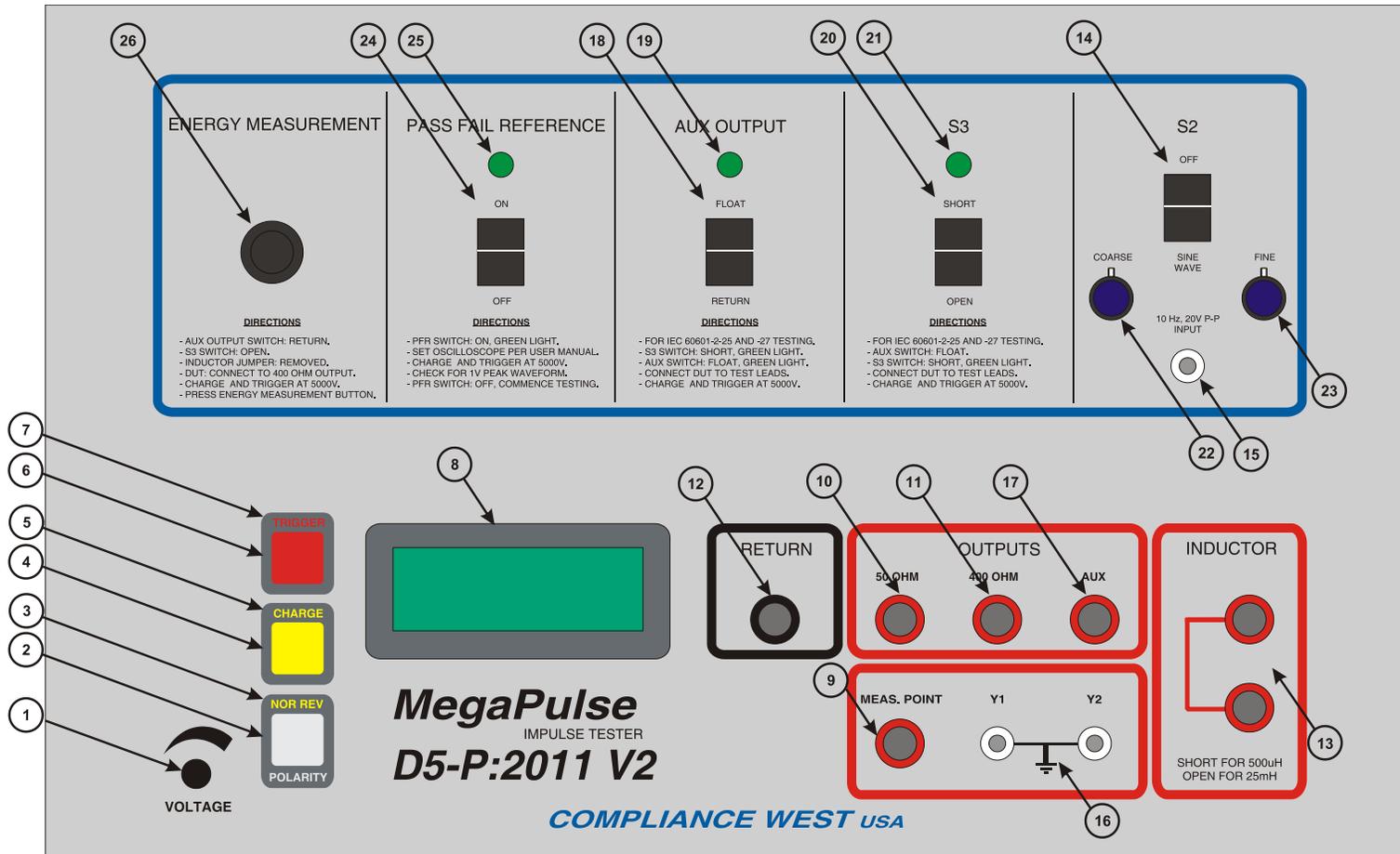
Operating Temperature:	15-40 °C
Relative Humidity Range:	0-90% non-condensing

##### **GENERAL**

Dimensions:	17" wide x 18" high x 17" in deep
Weight:	45 lbs approx.

## 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 D5-P:2011 V2 Front Panel**

ITEM	NAME	FUNCTION
1	VOLTAGE 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	POLARITY 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 lit.
3	NOR REV indicator	Indicates the state of the Output Polarity switch. <b>NOR</b> indicates Normal (Positive) position. <b>REV</b> indicates Reverse (Negative) position.
4	CHARGE 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	CHARGE 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	TRIGGER switch	Triggers the output impulse waveform. The impulse waveform will appear across the output leads.
7	TRIGGER 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	VOLTAGE 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	MEAS. POINT jack	Used to perform the Pass/Fail reference test.
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.

ITEM	NAME	FUNCTION
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, <b>SHORT</b> the two impedance jacks for 500uH, leave <b>OPEN</b> for 25mH.
14	S2 switch	This switch is provided to protect the Signal Generator from the output pulse of the D5-P:2011 V2 when <b>CLOSED</b> , and to allow the required 20V p-p signal to be injected when <b>OPEN</b> .
15	BNC INPUT 10Hz, 20Vp-p	BNC Input provided on front panel is for connecting the output signal generator. See Figure 12 Part 9A. <b>Note:</b> 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.
17	AUX OUTPUT jack	The <b>AUX OUTPUT</b> is connected at the grounded side of the 100ohm resistor, but this output is only used when it is required to float the 100ohm resistor.
18	AUX OUTPUT switch	It is used to control the AUX output position (Floated or Grounded).
19	AUX OUTPUT indicator	This Green indicator is lit to show that <b>AUX OUPUT</b> switch is set on the <b>FLOAT</b> position.
20	S3 switch	Used when testing for common mode of figure 201.103, S3 switch should be closed only when auxiliary output is floated from ground
21	S3 indicator	This Green indicator is lit to show that <b>S3</b> switch is set on the <b>SHORT</b> position.
22	COARSE adjustment (optional)	It is used to adjust the amplitude of the sine waveform. Only for models with Sine Wave Generation option.
23	FINE adjustment (optional)	It is used to fine adjust the amplitude of the sine waveform. Only for models with Sine Wave Generation option.
24	PASS FAIL REFERENCE switch	The D5-P:2011 V2 Include the Defib-5P Pass Fail reference circuitry, to use properly follow the directions on front panel.
25	PASS FAIL REFERENCE indicator	This Green indicator is lit to show that the pass/fail reference is connected (AUX OUTPUT must be grounded).
26	ENERGY switch	By pressing this switch, the front display will blink showing for a few seconds the energy measurement from the last pulse. Note: This function only work when the Megapulse unit is not charging or triggering.

**Table 1. Controls, Indicators, Connectors – MegaPulse D5-P:2011 V2 Front Panel**

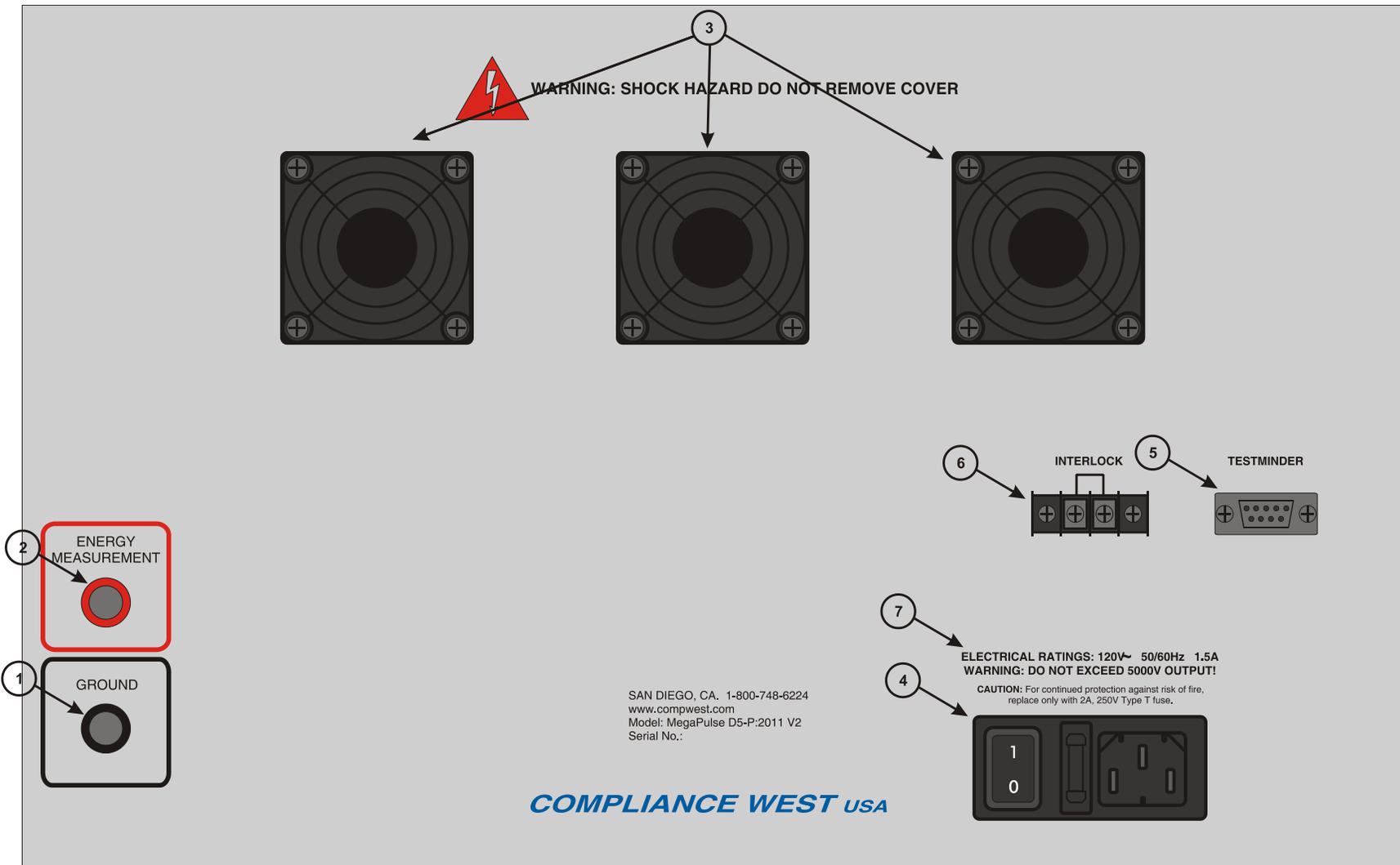
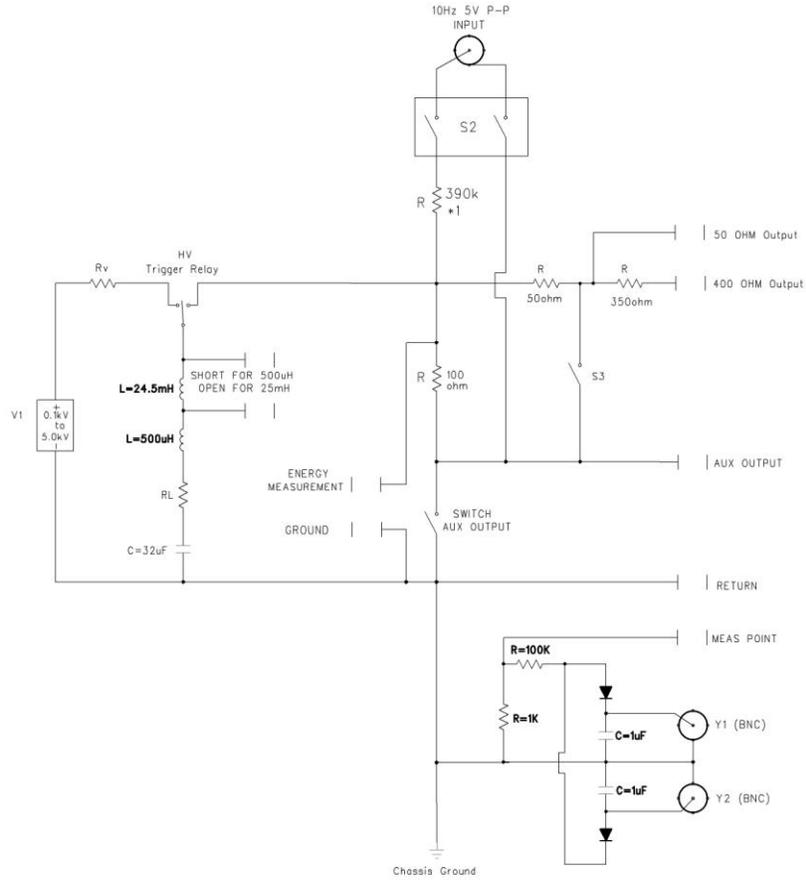


Figure 2. Controls, Indicators, Connectors – MegaPulse D5-P:2011 V2 Rear Panel

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	Fans	Design to cool down the tester.
4	Appliance Inlet / Fuse holder / Power Switch	Use supplied cordset to connect the MegaPulse D5-P:2011 V2 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	Allow the communication between the tester and computer interface; a RS-232 to USB.
6	Interlock Switch	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.
8	100X jumper (optional)	HV jumper to disconnect the internal 100ohm resistor and use external Energy measurement devices like Fluke 7000DP and 7010. Only for models with 100X option.

**Table 2. Control, Indicators, Connectors – MegaPulse D5-P:2011 V2 Rear Panel**

## General High Voltage Electrical Diagram



**Figure 3. General High Voltage Electrical Diagram– MegaPulse D5-P:2011 V2**

## Section 4

### Operating Instructions

The D5-P:2011 V2 Medical Defibrillation tester consists of two parts; the pulse generation portion and the measurement portion. Please refer to the general electric circuit shown in Figure 3 to show the function of the D5-P:2011 V2.

#### Charge and Trigger a Pulse

The following procedure will explain how to generate a high voltage pulse with the MegaPulse unit.

##### CAUTION

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

1. Turn the **VOLTAGE** Adjust Knob to minimum. Set Aux output switch to “Return” position. Set S3 to “Open” position.
2. If the Megapulse includes option 100X, install the 100X jumper on the rear panel.
3. If the Megapulse includes option 34, set the Trigger time switch to 200mS, install the 50k ohm jumper on the front panel.
4. Push the yellow **CHARGE** button to start charging the internal high voltage capacitor. Verify the red **TRIGGER** indicator is now lit.
5. Turn clockwise the **VOLTAGE** Adjust Knob to increase the charging voltage level which is displayed on the front led display.
6. Once the desired voltage is reached, press the red **TRIGGER** button to deliver the high voltage pulse (be sure not to touch the output and return leads when pressing the trigger switch).
7. Turn the **VOLTAGE** Adjust Knob to minimum.
8. Turn the rear-panel Power Switch OFF.

#### Discharging Residual Voltage

Note that the Voltage meter may indicate that some residual voltage is present on the main storage capacitor, even when the Megapulse tester is first turned ON. This is due to inherent charging of the internal capacitors. The following procedure will explain how to discharge a remaining voltage stored on the main internal capacitor.

##### CAUTION

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

1. Turn the rear-panel Power Switch OFF. Set Aux output switch to “Return” position. Set S3 to “Open” position.
2. If the Megapulse includes option 100X, install the 100X jumper on the rear panel.
3. If the Megapulse includes option 34, set the Trigger time switch to 200mS, install the 50k ohm jumper on the front panel.
4. Disconnect the high voltage cables from the outputs connectors (50 ohm, 400 ohm, Aux Output, Energy Measurement point and 50K ohm “If included”).
5. Turn the rear-panel Power Switch ON.

6. Press the red **TRIGGER** button to discharge the main capacitor into the internal resistor of the Megapulse unit.
7. Turn the rear-panel Power Switch OFF.

## Polarity Pulse Selection

### NOTE

**If the red Trigger light is lit or more than 200V remains on the internal capacitor, the polarity pulse selection will be automatically blocked for safety reasons.**

1. Turn the rear-panel Power Switch ON. Positive polarity always is set by default after the unit is turned ON.
2. Press the POLARITY switch button to toggle between positive and negative.

## Front Keyboard Enable

If the MegaPulse D5-P:2011 V2 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: Enable of Front Keyboard disables the Voltage Stop.

1. Turn OFF the MegaPulse P tester.
2. Press and hold the **TRIGGER** and **NOR-REV** buttons.
3. Turn ON the Megapulse P tester.
4. Wait until the display shows rESE.
5. Release the TRIGGER and NOR-REV buttons.

## Voltage Stop Disable

If the MegaPulse D5-P:2011 V2 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.

1. Turn OFF the MegaPulse P tester.
2. Press and hold the **TRIGGER** and **NOR-REV** buttons.
3. Turn ON the Megapulse P tester.
4. Wait until the display shows rESE.
5. Release the TRIGGER and NOR-REV buttons.

## Checkout Pulse Procedure

The following procedure will verify that the high voltage pulse is generated properly by the D5-P:2011 V2 tester. We recommend that this procedure be conducted periodically to ensure proper operation of the tester.

The following items are needed to conduct this procedure:

- High voltage oscilloscope probe (1000:1)
- Digital Oscilloscope

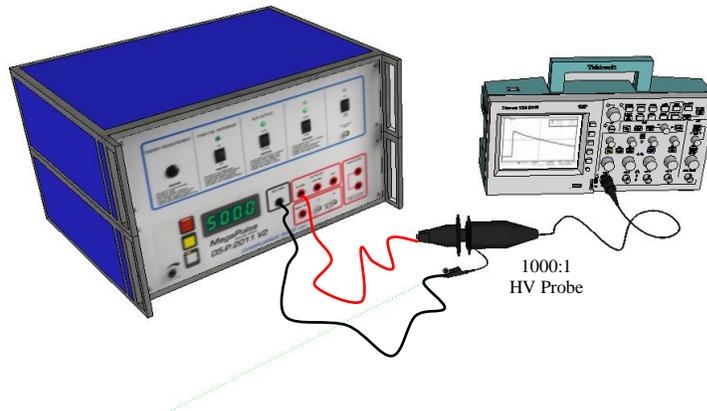
Always ensure that the measuring instruments are rated for the voltage and frequency response involved. A digital oscilloscope or probe with a low frequency response will result in erroneous readings that could be miss-read.

### CAUTION

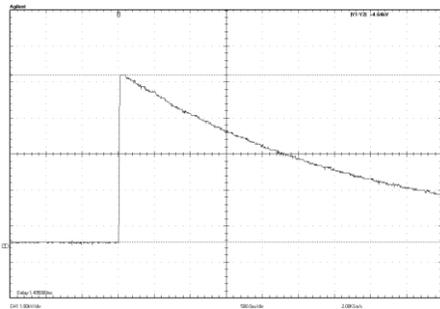
**High voltage generated by the MegaPulse tester is exposed during this test. A risk of shock exists. Exercise care when using the MegaPulse tester.**

1. Turn the rear-panel Power Switch OFF. Set Aux output switch to “Return” position. Set S3 to “Open” position.
2. If the Megapulse includes option 100X, install the 100X jumper on the rear panel.
3. If the Megapulse includes option 34, set the Trigger time switch to 200mS, install the 50k ohm jumper on the front panel.
4. Disconnect all high voltage cables from the outputs (50 ohm, 400 ohm, Energy Measurement Point and 50k ohm if included).
5. Turn the **VOLTAGE** Adjust Knob to minimum.
6. Turn the rear-panel Power Switch ON. If residual voltage is shown on led display:
  - a. Press the red **TRIGGER** button to discharge the main capacitor into the internal resistor of the Megapulse unit.
7. Select the internal inductance of 500uH by placing on the front panel the Inductance Jumper.
8. Plug the high voltage test lead (black) into the Return jack, located on the front panel.
9. Plug the high voltage test lead (red) into the 50 ohm jack, located on the front panel.
10. Connect the ends of the test leads to the measuring instrument. See Figure 4 as an example.
11. Set the next capturing setting on the digital oscilloscope in order to capture the high voltage pulse:
  - a. Vertical Scale = 1.00KV / div.
  - b. Horizontal Scale = 500uS / div
  - c. Trigger Level = + 1kV
  - d. Slope transition “Low to High.”
  - e. Set “High Frequency Reject” mode.
  - f. Set “Single Pulse” capture mode.
12. Charge and Trigger the pulse at 5000V.
  - a. Push the yellow **CHARGE** button to start charging the internal high voltage capacitor. Verify the red TRIGGER indicator is now lit.
  - b. Turn clockwise the **VOLTAGE** Adjust Knob to increase the charging voltage level which is displayed on the front led display.
  - c. Once the desired voltage is reached, press the red TRIGGER button to deliver the pulse (be sure not to touch the output and return leads when pressing the trigger switch).
13. Verified the amplitude of the positive pulse captured on the digital oscilloscope:
  - a. V<sub>peak</sub> about 4.64KV, see figure 5 (When inductor shorted for 500uH).
  - b. V<sub>peak</sub> about 3.90KV, see figure 6 (When inductor open for 25mH).
14. Select a negative pulse by pressing the polarity button, and verify the yellow REV indicator is lit.
15. Change the capturing setting on the digital oscilloscope in order to capture the negative pulse:
  - a. Trigger Level = -1kV.
  - b. Slope transition “High to Low”
16. Charge and Trigger the pulse at 5000V.

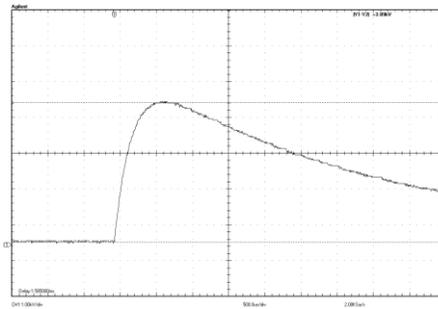
- a. Push the yellow **CHARGE** button to start charging the internal high voltage capacitor. Verify the red TRIGGER indicator is now lit.
  - b. Turn clockwise the **VOLTAGE** Adjust Knob to increase the charging voltage level which is displayed on the front led display.
  - c. Once the desired voltage is reached, press the red TRIGGER button to deliver the pulse (be sure not to touch the output and return leads when pressing the trigger switch).
17. Verified the amplitude of the negative pulse captured on the digital oscilloscope:
- a.  $V_{peak}$  about - 4.64KV (When inductor shorted for 500uH).
  - b.  $V_{peak}$  about - 3.90KV (When inductor open for 25mH).



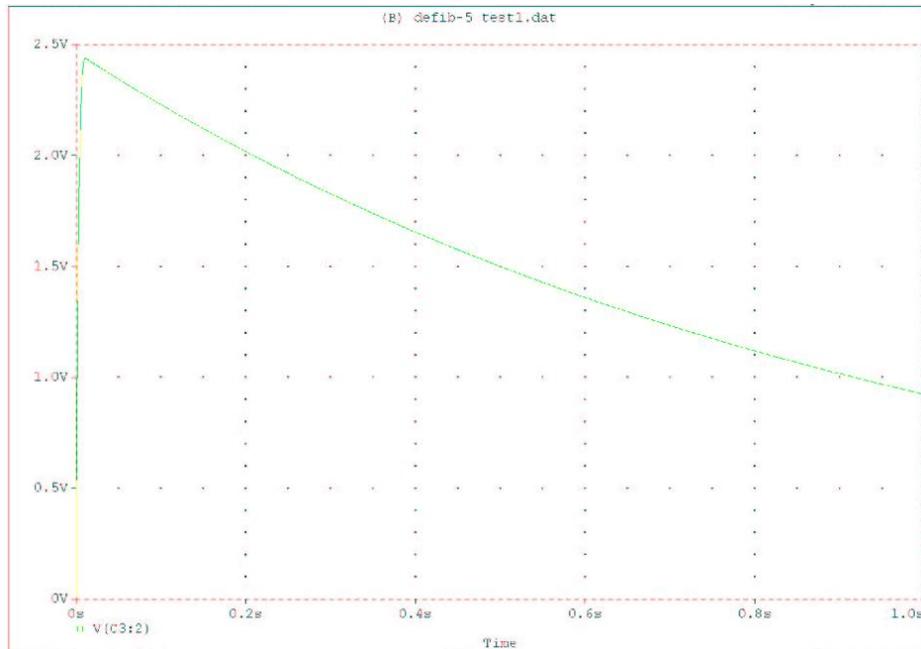
**Figure 4. Checkout Pulse Setup**



**Figure 5.  $V_{peak} = 4.65kV$  with 500uH inductor**



**Figure 6.  $V_{peak} = 3.90kV$  with 25mH inductor**



**Figure 7. Y1 Y2 Test Output**

### External Interlock

The external interlock is a two position terminal block located on the rear panel.

When the External Interlock is open:

- TRIGGER and CHARGE lights will be blinking.
- The front keyboard will be disabled.
- If the unit is connected with a computer with the TestMinder software, the interlock status will be shown on the computer, condition that will also disable polarity changes, charge, and trigger conditions.

When the Interlock is closed, it enables all normal operations of the Megapulse D5-P:2011 V2 features.

### TestMinder

The Testminder is an USB adaptor that enables the control of your tester from a Windows-equipped computer. The Testminder software allows to setup testing parameters as: “time between pulses”, “polarity”, “Voltage”, “Pulse Cycles”, etc. A record of every test can be saved in a computer file as “.txt” or “.csv” format. The “.csv” file can be read by Microsoft Excel.

For detailed information related with this option, see user manual:

“TestMinder\_MegaPulse\_P\_USB\_rev1.3.pdf” or newer version

It can be downloaded at [www.compwest.com](http://www.compwest.com).

## Energy Measurement

Many medical equipment standards require energy measurements to be taken during surge testing. The D5-P:2011 V2 allows calculation of these measurements in two different ways; by using the automatic energy measurement system included in the tester or by connecting an external high voltage acquisition system to capture the pulse using the rear panel receptacles and manually calculating the energy using the formula shown in Figure 8.

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

**Figure 8. Formula to Calculate Energy**

Where:

- “s” is the voltage pulse captured with a high voltage acquisition system \*.
- “dt” is the difference on time between samples of the acquisition system.
- “T” is the total duration of the pulse.
- “R” is the resistance value where the pulse is applied \*\*.
- “E” is the energy in joules.

\* The high voltage acquisition system can be a 1000:1 oscilloscope probe connected to a digital oscilloscope capable of executing advanced mathematical functions. The oscilloscope would then be used to calculate the energy by calculating the area under the curve.

\*\* The D5-P:2011 V2 has been designed with a resistor value R of  $100\Omega \pm 1\%$ , which will result in a value between 99 and 101  $\Omega$ . We recommend a using a value of 100  $\Omega$  during energy calculations as a good approximation of the value for “R” over the test period.

### Energy Measurement using System Included on D5-P:2011 V2

The Megapulse D5-P:2011 V2 tester is equipped with a internal high voltage pulse acquisition system connected directly to the internal 100 ohm resistor. This system automatically calculates the energy for each single pulse delivered.

**Note 1:** To calculate the energy, this automated measurement system uses the mathematical formula showed on figure 8, where  $R = 100\Omega$ .

**Note 2:** This automatic option only operates when the D5-P:2011 V2 tester has the following settings:

- AUX OUTPUT switch is in the RETURN position
- S3 switch is in the OPEN position
- INDUCTOR jumper is OPEN for 25mH
- Charge Voltage is between 3500V - 5000V

To perform the automatic energy measurement follows the next steps:

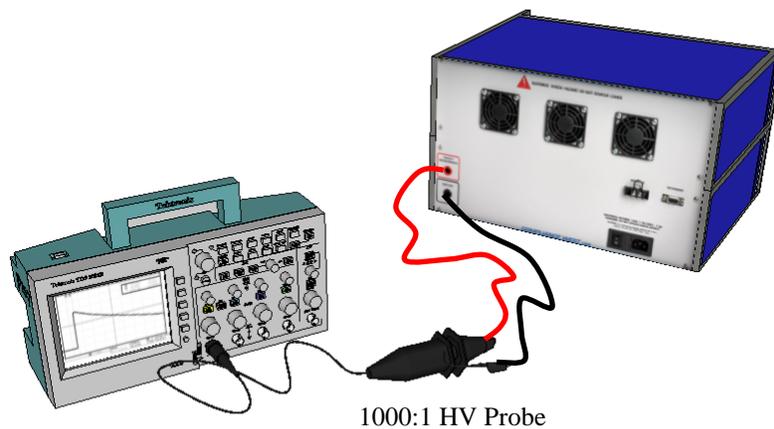
1. Select the desired polarity.
2. Charge and Trigger the D5-P:2011 V2 between 3500V - 5000V
3. Press the Energy Measurement Button. The front display will blink for a few seconds showing the energy measurement in joules from the last pulse. If the display shows the word “none”, it means the last pulse was not captured.

Criteria to validate the energy results:

1. Measure the energy with open circuit (No DUT connected to the D5-P:2011 V2)
2. Measure the energy with the DUT connected on the output.
3. Subtract the two energies measured on steps 1 and 2, and the difference on these two readings must not exceed the % established on the standard that the user is following.

### Energy Measurement with an External Acquisition System

The Megapulse D5-P:2011 V2 tester is equipped with two high voltage connectors located on the rear panel to have access directly to the 100Ω resistor, allowing energy measurements with an external high voltage acquisition system. The acquisition system must be capable of executing the advanced mathematical formula shown on figure 8. The Figure 9 shows an example of how connect the external acquisition system.



**Figure 9. Energy Measurement with an External Acquisition System**

### Measurement Terminals Y1 and Y2

There are two BNC jacks on the front panel of the D5-P:2011 V2, 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 MΩ. 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.

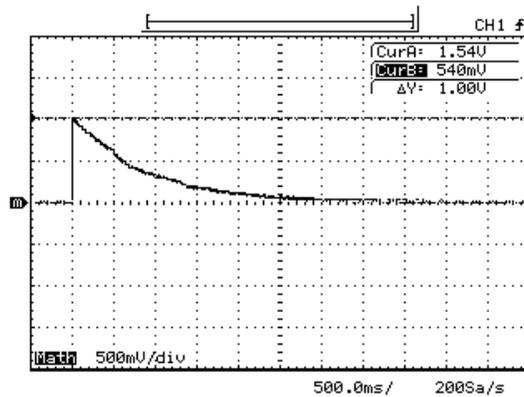
## Pass Fail Reference Built in

The Pass Fail Reference Built in circuit is designed to allow the user perform a quick check test of the Y1-Y2 measurement system of the D5-P:2011 V2 tester.

To perform a quick test using the Pass Fail Reference Built in follow the next steps:

1. Set the Pass Fail switch to the ON position.
2. Set Aux output switch to “Return” position.
3. Set S3 to “Open” position.
4. Select the 500uH inductance by placing on the front panel the red high voltage jumper.
5. Only if option 100X is included on the D5-P:2011 V2 tester, install the 100X jumper on the rear panel.
6. Only if option 34 is included on the D5-P:2011 V2 tester:
  - a. set the time switch to 200mS
  - b. Install the 50k $\Omega$  jumper on the front panel. Select
7. Using two BNC cables, connect the D5-P:2011 V2 to an oscilloscope as follows:
  - a. Y1 to CH1
  - b. Y2 to CH2
8. Set the oscilloscope with the next parameters:
  - a. Set the Math function A-B on the oscilloscope.
  - b. Set channel 1 and 2 at 1X with 500mV.
  - c. Set the trigger on channel 1 at 100mV.
  - d. Set the time at 500ms.
  - e. Activate the Math function and turn off channel 1 and 2
9. Press the CHARGE button and adjust the voltage at 5000V with the front voltage knob, then press the TRIGGER button to capture the output waveform in the oscilloscope.
10. The oscilloscope should display a waveform similar to Figure 10, with a peak value of approximately 1 volt.

**Note:** If on the oscilloscope the horizontal time is set less than 500mS, it may capture transient noise because the internal mechanical relays are switching the high voltage, but the correct criteria for Y1-Y2 signal must be on the 500mS scale.



**Figure 10. Y1-Y2 Waveform using a Defib-5P Pass/Fail Reference**

# Section 5

## Testing with the D5-P:2011 V2

To perform actual testing, the D5-P:2011 V2 should be connected to the EUT as shown in the standard which the EUT is being tested to. See figures 11 and 12 for examples of the MegaPulse D5-P:2011 V2 connections for testing parameters of IEC60601. They can be used as a key for the inputs and outputs of the MegaPulse D5-P:2011 V2. Note the actual connections on the front panel of the D5-P:2011 V2 have been added to Figure 50 of IEC 601 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:

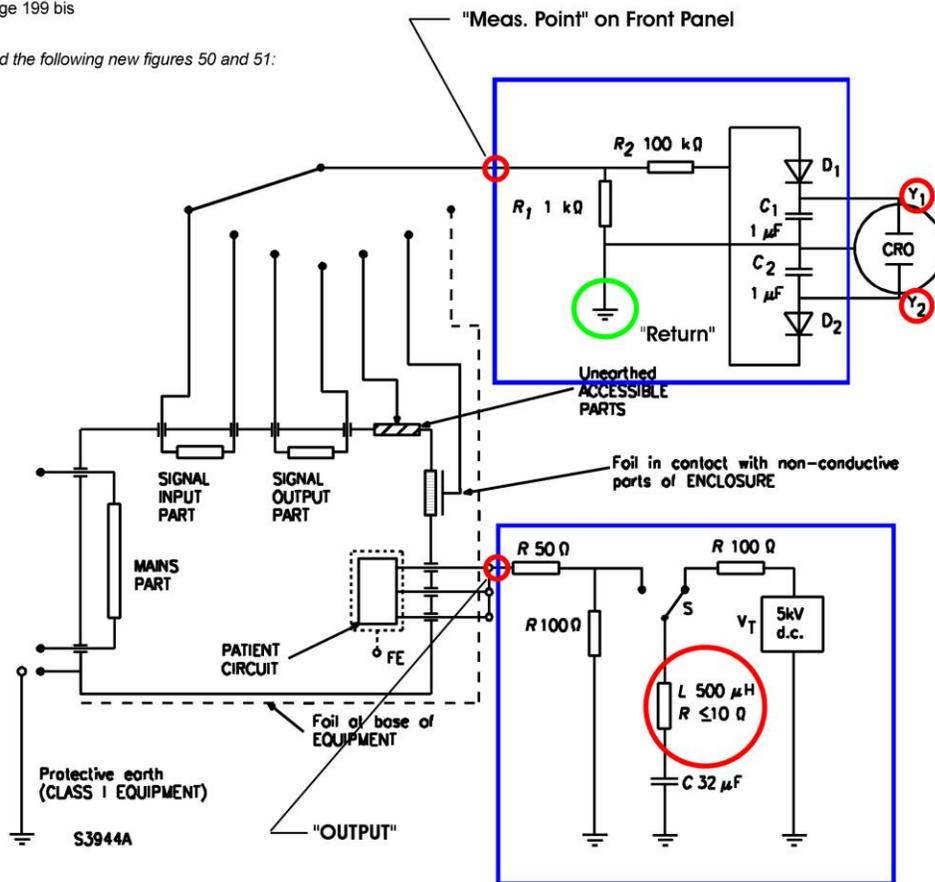


Figure 50 – Application of test voltage to bridged PATIENT CONNECTIONS for DEFIBRILLATION-PROOF APPLIED PARTS (see subclause 17 "h))

Figure 11. Example of D5-P:2011 V2 Connections on Figure 50 of IEC60601

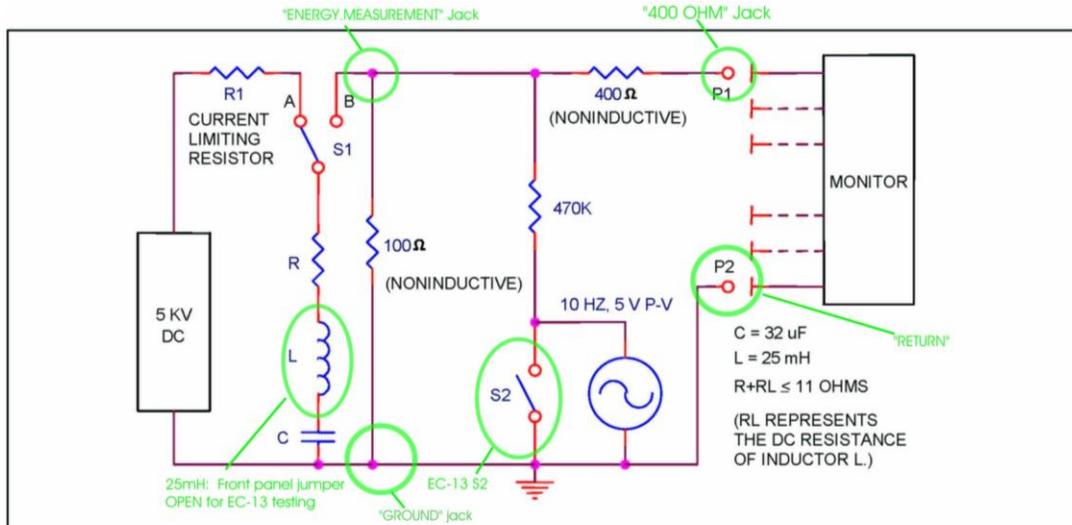


Figure 9A—Test circuit for defibrillator overload tests (5.2.2.2.1 and 5.2.2.2.2)

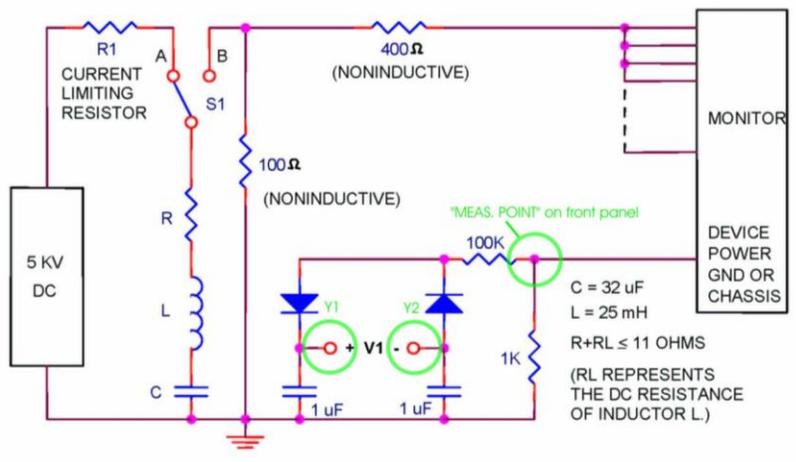


Figure 9B—Test circuit for operator safety test (5.2.2.2.3)

- 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.

**NOTE:**

All D5-P:2011 V2 meet the specifications of IEC 60601-2-27 ed 3.0 where a 390KΩ resistor replaced the 470KΩ.

Figure 12. Example of D5-P:2011 V2 Connections on Figures 9A and 9B of IEC60601

## Section 6

### Options

This section contains a list of available options for D5-P:2011 V2.

Option Name	Description
34	Incorporates a circuit for Invasive Blood Pressure test (IEC 60601-2-34 Issue 2)
100X	HV jumper to disconnect the internal 100ohm resistor and use external Energy measurement devices like Fluke 7000DP and 7010.
MPxxx	Different Line voltages, replace on the part number xxx for 100, 110, 220, 230 or 240 depending the line voltage. (120V for standard configuration).
VH	Continuous Full Voltage - Charges and maintains the voltage fixed at 5000V.
SG	Built in Sine Wave Generator 20Vp-p.
GVAC	Vacuum trigger relay (20sec. duty cycle only)

#### Circuit for Invasive Blood Pressure test (IEC 60601-2-34 Issue 2)

This option gives you the convenience to select the discharge resistor 100ohm or 100kohm with a high voltage jumper located in the front panel; it also has an additional output impedance of 50kohm and switch to select trigger duration of 200ms or 20 seconds, this resistance values are need when testing to IEC 60601-2-34. Ed. 2.0, If testing IEC 60601-2-34. Ed. 3.0 no need of adding option 34.

#### 100X

The 100X Option is offered as a separate upgrade to the unit. The Purpose of the 100X Option is to disconnect the internal 100Ω resistor and allow the user to connect an external load for energy measurement purposes.

To connect or disconnect the internal 100Ω resistor, the D5-P:2011 V2 with option 100X is equipped with two high voltage red connectors located on the rear panel. These two connectors are labeled with:

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

**OPEN FOR EXTERNAL LOAD:** Internal 100Ω is disconnected (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.

To connect an external load for energy measurement purposes follow the next steps:

1. Turn OFF the D5-P:2011 V2 tester.
2. Connect the 100X Jumper in the rear panel for internal load.
3. Unplug all the cables from the outputs.
4. Set Aux output switch to “Return” position.
5. Set S3 to “Open” position.
6. Select the internal inductance to 25 mH by removing the red inductance jumper.
7. Only if the option 34 is included on the D5-P:2011, set the Trigger time switch to 200mS and, install the 50k ohm jumper on the front panel. Select the internal inductance of
8. Turn ON the D5-P:2011 V2 tester.
9. Press the TRIGGER button to discharge the tester and make sure the front meter display reads a safe low voltage.
10. Turn OFF the MegaPulse D5-P:2011 V2.
11. Remove the 100X Jumper in the rear panel for external load.
12. Connect an external load at the Energy Measurement and Ground connectors.
13. Turn ON the MegaPulse D5-P:2011 V2.
14. Tester is ready to CHARGE and TRIGGER with 100X Option.

To return the D5-P:2011 V2 tester to normal operation condition follow the next steps:

1. Turn OFF the D5-P:2011 V2 tester.
2. Remove the load connected to Energy Measurement and Ground connectors.
3. Connect the 100X Jumper in the rear panel for internal load.
4. Turn ON the D5-P:2011 V2 tester.
5. Tester is ready to CHARGE and TRIGGER.
6. Turn OFF the D5-P:2011 V2 tester.

## **Continuous Full Voltage**

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:

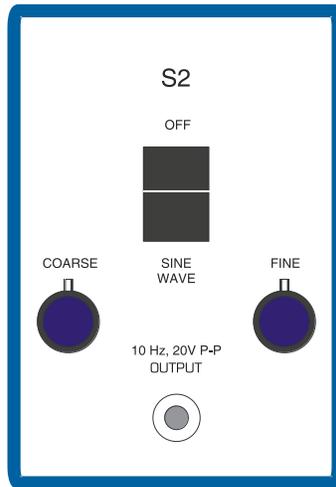
1. Click “Options” on the TestMinder MP Remote Control Software Window.
2. Click “Enable” or “Disable” on the Stop Voltage Option.
3. Click “OK”.

## Sine Wave Generator

The Sine Wave Generator option is offered as a separate upgrade to the unit. The sine wave is adjustable and must be set up using an oscilloscope. The Sine Wave Generator signal characteristics are defined as follows:

- Frequency = 10Hz
- The sine wave is adjustable from 200mVp-p to 22Vp-p
- Coarse and Fine adjustments for the peak voltage
- The BNC is an output to monitor on an oscilloscope

A 1M $\Omega$  impedance input on the oscilloscope needs to be used in order to measure the sine waveform.



**Figure 13. Sine Wave Generator option**

To operate the Sine Wave Generator option follows the next steps:

1. Put the S2 switch in the **SINE WAVE** position.
2. Attach the 10 Hz sine wave BNC output to an oscilloscope with a 1M $\Omega$  impedance input.
3. Adjust the sine wave amplitude using the coarse and fine adjustments.
4. Put the S2 switch in the **OFF** position.
5. Charge and Trigger the pulse according to the directions in the user manual.
6. After the pulse, put the S2 switch in the **SINE WAVE** position to apply the sine wave.

## Vacuum Trigger Relay

### **WARNING:**

For this option never exceed 20 second duty cycle

This is high voltage filled with gas of sulfur hexafluoride type SF<sub>6</sub>, because of the way the gas performs during switching. SF<sub>6</sub> is an excellent insulator but once the switch is closed, if the relay bounces the SF<sub>6</sub> becomes easily ionized and carries the arc current, this makes the relay electronically bounce less and dramatically reduces contact wear.

## Section 7

### Maintenance and Calibration

#### Service Information

The MegaPulse D5-P:2011 V2 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.

#### Calibration Information

The Megapulse D5-P:2011 V2 has been fully calibrated at the factory in accordance to our published specifications. It is recommended that you have this instrument re-calibrated and safety check done at least once per year. 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. Contact Compliance West USA for the latest calibration procedure. Have ready the serial number of the Megapulse D5-P:2011 V2 tester.

#### Technical Assistance

Technical Assistance from Compliance West USA is available:

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

**Hours:** 8:00 AM - 4:00 PM Pacific Time.

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

Contact:

Compliance West USA  
650 Gateway Center Way, Suite D  
San Diego, CA., 92102  
United States of America.

**Phone:** (619) 878-9696

**FAX:** (619) 794-0404