# **MegaPulse** series
# Capacitor Impulse Tester

Instruction Manual

***COMPLIANCE***
***WEST USA***

*Dear Customer:*

*Congratulations! Compliance West USA is proud to present you with your MegaPulse 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 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 creepage, 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 high voltages at potentially lethal current levels. Currents of as little as 5 mA at 120 volts can cause death; and any MegaPulse model can deliver lethal current levels for a 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 dielectric withstand 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 can be shut off at any time by turning OFF the rear power switch. Note that there are residual voltages inside the equipment that may take up to 5 minutes to bleed off to safe levels.

The MegaPulse tester is provided with a **VOLTAGE ADJUST** knob on the front panel. This should always be adjusted fully counterclockwise 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.

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 withstand 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. Optionally, the MegaPulse may be equipped with the IFD Insulation Fault Detector, which is described elsewhere in this Manual. It allows the MegaPulse to detect Insulation Breakdown events during the impulse test according to the sensitivity level set by the operator.

Even when the MegaPulse is equipped with the IFD option, it is Operator's responsibility to monitor the output waveform and determine Passing or Failing results. In monitoring the impulse waveform, consider the following points:

1.Measurement Considerations: 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. In order to ensure proper waveform readings, we recommend using a calibrated and properly adjusted Tektronix P6015 1000:1 probe directly connected to the MegaPulse outputs. It is imperative to adjust the P6015 for use with your particular oscilloscope in accordance with the Tektronix procedure described in the P6015 manual. This adjustment must be conducted every time a different oscilloscope is used; otherwise results will be erroneous.

2.. Polarity Considerations: Pressing the POLARITY switch on the front panel will have no effect on the output. The Polarity Switch is not required for testing capacitors to IEC 384-14, and is therefore disabled on the MegaPulse Capacitor Testers.

3. Voltage Meter Considerations: 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). Except as noted below, all MegaPulse testers display the peak value of the pulse on the front panel meter.

The following models display the theoretical voltage[1] of the bulk capacitor on the front panel meter in accordance with the special use of the model:

| | |
|---|---|
| MegaPulse 1.2x50-2.5 | (EN60950) |
| MegaPulse 1.2x50-7 | (EN60950) |
| MegaPulse 10x700-2.5 | (EN60950) |
| MegaPulse 10x700-7 | (EN60950) |
| MegaPulse Defib-5 | (EN60601 and EC-13) |
| MegaPulse Capacitor [2] | (IEC 384-4) |

4. Test Results: 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.

[1] Some MegaPulse testers are built to requirements in technical standards., where a circuit diagram is given as the sole criterion of the impulse. In these cases, Compliance West USA has modeled the circuit using perfect components of the values given, and then designed and built a tester which will mimic the theoretical output, but using real-world components. Currently, the Standards which describe the impulse using a circuit diagram also define the voltage of the bulk capacitor, not the output voltage, with the exception of IEC 384-14. Compliance West USA has determined that the theoretical output voltage achieved when the required bulk capacitor voltage is applied is the important performance criterion, so we have set the meter to read the correct bulk capacitor voltage when the output voltage is consistent with our simulations. Consequently, the actual bulk cap voltage may be considerably higher than the meter voltage because of real-world losses, but the output voltage will be in agreement with the theoretical output voltage required by the Standard.

[2] In IEC 384-14, the output voltage is specified with the capacitor under test included in the circuit. In this case, the voltage displayed on the MegaPulse front panel is the theoretical bulk cap voltage, as the actual pulse output voltage is impossible to predict. Proper output voltage must be set empirically for each different model capacitor tested. Further, the values of the circuit are selected for performance of the circuit in accordance with the intent of the Standard, as the actual values specified do not yield intended results.

# Section 2

## Introduction and Specifications

### Introduction

This manual contains complete operating, maintenance and calibration instructions for the Compliance West USA MegaPulse series Impulse Tester.

- The surge output is extremely short in duration, but voltages and currents can be lethal. Be sure of your test setup before you energize the MegaPulse.
- Before the test can commence, the unit must be armed by pressing the **CHARGE** Button. Voltage can be set using the front panel knob.
- Voltage will flow through the front panel jacks when the **TRIGGER** button is pressed.
- After the **CHARGE** button is pressed, and before the **TRIGGER** button is pressed, hazardous voltages exist on internal parts. For safety's sake, make it a habit to disconnect any leads and press the **TRIGGER** button to discharge internal voltages if the MegaPulse is to be left idle for an extended period.

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

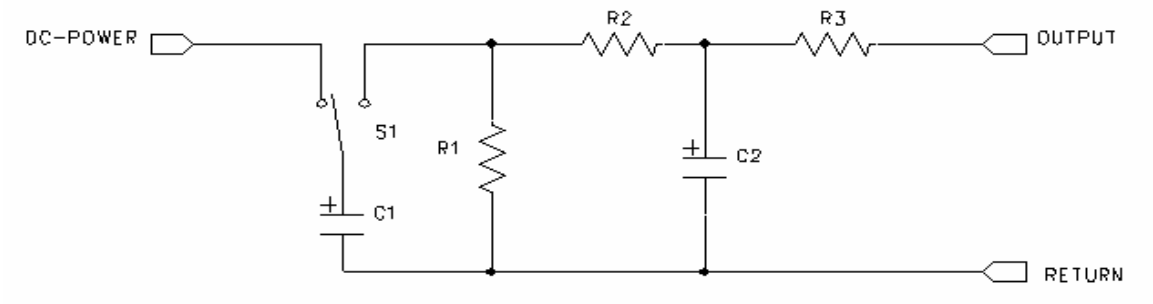
**Figure 1.**

### Specifications

Specifications for each individual model in the MegaPulse series are listed in Table 1. Component designations referenced in Table 1 are as shown in Figure 1.

### Tolerances

When Standard authorities specify accuracy in the defining document, that accuracy criteria is used for MegaPulse calibration.
Most Standards do not specify accuracy. In that case, we use IEC 1180-1:
Voltage Peak Value: ±3%
Voltage Rise Time: ±30%
Voltage Duration: ± 20%
Vrise = $1.67(t_{90} - t_{30})$
Vdur, Idur = Time from virtual origin to 50% peak voltage on trailing edge.
Current Peak Value: ±10%
Current Rise Time: ± 20%
Current Duration: ± 20%
Irise= $1.25(t_{90} - t_{30})$



| Model | Waveform* | Max. Voltage | C1 | R1 | R2 | C2 | R3 |
|---|---|---|---|---|---|---|---|
| 10x700-2.5 | 10 x 700/6 x 300 uS | 2500V | 20 uF | 50 Ohms | 15 Ohms | 0.2 uF | 25 Ohms |
| 10x700-7 | 10 x 700/6 x 300 uS | 7000V | 20 uF | 50 Ohms | 15 Ohms | 0.2 uF | 25 Ohms |
| 1.2x50-2.5 | 1.2 x 50/1 x 20 uS | 2500V | 1 uF | 76 Ohms | 13 Ohms | 0.033 uF | 25 Ohms |
| 1.2x50-7 | 1.2 x 50/1 x 20 uS | 7000V | 1 uF | 76 Ohms | 13 Ohms | 0.033 uF | 25 Ohms |
| 1.2x50-12 12 Ω Fast Charge ∂ | 1.2 x 50/1 x 20uS | 12300V | 2.75 uF | 40 Ohms | 7 Ohms | 0.05uF | 0 Ohms |
| 1.2x50-12.3-1 | 1.2x50uSec 500 ohms | 12,300 | 0.5uF | 147 Ohms | 328 Ohms | 1 nF | 253 Ohms |
| 1.2x50/8x20-7.3-1 2 ohm | (V) 1.2x50uSec 2 ohms (I) 8x20uSec | 7300 | No | Circuit | Values | Specified | |
| 10x1000s-1 | 10 x 1000/10 x 1000 uS | 1000V | No | Circuit | Values | Specified | |
| 10x360s-1 | 10 x 360/10 x0360 uS | 1000V | No | Circuit | Values | Specified | |
| 2x10s-2.5 | 2 x 10/2 x 10uS | 2500V | No | Circuit | Values | Specified | |
| Defib-5 | 20 x 2200/50 x 800 uS | 5000V | 32 uF (1) | 100 Ohms | 50 Ohms | None (open) | 0 Ohms |
| Antenna Surge | Not defined | 10000V | 1 nF | - | 1 kOhm | - | - |
| DF-1 (Fig. B.2) | 4x18000uS (Current) | 1000V (2kVoptional) | 200uF | 1000 Ohms | 10 Ohms | - | 10-20 Ohms |
| Capacitor Tester: | | | | | | | |
| Line 1 | 1.2 x 50/0 x 7 uS | 8000V | 0.25 uF | 234 Ohms | 62 Ohms | 7800 pF | 0 Ohms |
| Line 2 | 1.2 x 50/0 x 7 uS | 8000V | 0.25 uF | 234 Ohms | 45 Ohms | 7800 pF | 0 Ohms |
| Line 3 | .7 x 40/0 x 4 uS | 8000V | 0.25 uF | 234 Ohms | 27 Ohms | 7800 pF | 0 Ohms |
| Line 4 | 0 x 40/0 x 4 uS | 8000V | 0.25 uF | 234 Ohms | 27 Ohms | None (open) | 0 Ohms |
| Line 5 | 0 x 40/4 x 40 uS | 4000V | 20 uF | 3 Ohms | 25 Ohms | 3300 pF | 0 Ohms |
| Line 6 | .2 x 40/ 0 x 35 uS | 4000V | 20 uF | 3 Ohms | 13 Ohms | 3300 pF | 0 Ohms |
| Line 7 | .2 x 40/0 x 30 uS | 4000V | 20 uF | 3 Ohms | 9 Ohms | 3300 pF | 0 Ohms |
| Line 8 | .2 x 40/0 x 30 uS | 4000V | 20 uF | 3 Ohms | 7 Ohms | 3300 pF | 0 Ohms |
| Line 9 | .1 x 40/0 x 25 uS | 4000V | 20 uF | 3 Ohms | 5 Ohms | 3300 pF | 0 Ohms |
| Line 10 | .08 x 40/0 x 20 uS | 4000V | 20 uF | 3 Ohms | 3 Ohms | 3300 pF | 0 Ohms |

* Legend: A x B/C x D  A= Voltage rise time  B= Voltage duration  C= Current rise time  D= Current duration

Voltage rise time (A) is defined as follows (per ANSI/IEEE C62.41 and other standards): trise = $1.67(t_{90} - t_{30})$, where $t_{90}$ and $t_{30}$ = the times of the 90% and 30% amplitude points on the leading edge of the waveform.

Voltage duration (B) is defined (per ANSI/IEEE C62.41 and other standards) as the time between virtual origin and the time of the 50% pint on the tail. The virtual origin is the point where a straight line between the 30% and 90% points on the leading edge of the waveform intersects the V = 0 line.

Current rise time (C) is defined as follows (per ANSI/IEEE C62.41 and other standards): trise = $1.25(t_{90} - t_{10})$, where $t_{90}$ and $t_{10}$ = the times of the 90% and 10% amplitude points on the leading edge of the waveform.

Current duration (D) is defined (per ANSI/IEEE C62.41 and other standards) as the time between virtual origin and the time of the 50% pint on the tail. The virtual origin is the point where a straight line between the 10% and 90% points on the leading edge of the waveform intersects the I = 0 line.

∂ Indicates Models using Compliance West USA IEC 65 Switch.

Note 1: 32 uF capacitor in series with a 500uH inductor having a DC resistance no greater than 10 Ohms.

| Common specifications: | | | |
|---|---|---|---|
| Meter Accuracy:<br>2500V output versions: ±20 V<br>5000V, 7000V versions: ±40 V<br>All models: better than 1% of full-scale reading | Environmental:<br>15-40°C operating temperature<br>0-90% Relative Humidity, non-condensing | Electrical:<br>Input Voltage: See ratings plate<br>Input Current: 1 -7 A (model specific) | Mechanical:<br>Weight: Approx. 16-85 lbs.<br>Dimensions: 11.25”W x 12”D x 5”H<br>To 24”W x 20”D x 36”H |

**Table 1. MegaPulse series specifications**

# 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 Impulse Tester
- Two high-voltage test leads
- 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 two 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.

### Selection of a Suitable Power Cord

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 O or 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 2 and described in Table 2. The rear panel features of the MegaPulse are shown in Figure 3 and described in Table 3.

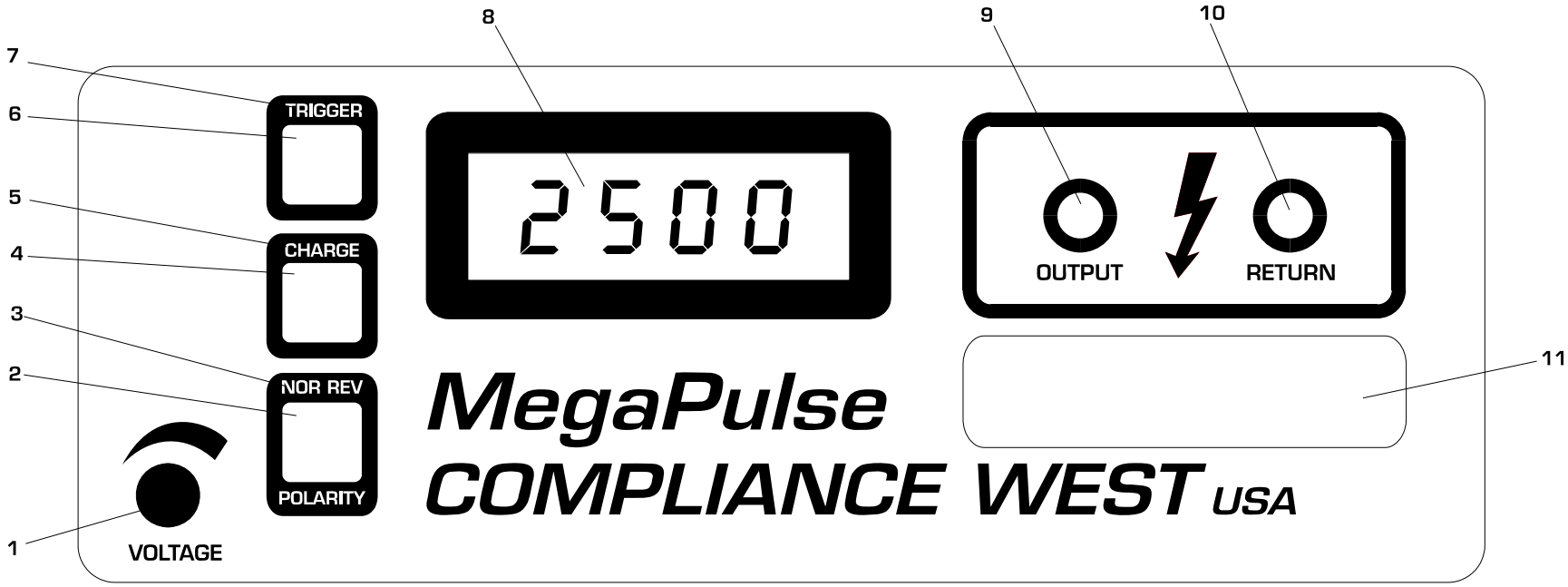



**Figure 2. Controls, Indicators, Connectors – MegaPulse series Front Panel**

| ITEM | NAME | FUNCTION |
|---|---|---|
| 1 | **VOLTAGE** Adjust Knob | Turn Clockwise to increase the output voltage after the **CHARGE** 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 | The polarity switch has no function on the MegaPulse Capacitor Models. |
| 3 | **NOR REV** indicator | No function on the MegaPulse Capacitor Models. |
| 4 | **CHARGE** switch | Press this switch to begin charging the impulse storage capacitor (C1 in Figure 1). The **CHARGE** indicator will turn off after the **CHARGE** switch is pressed, and the **TRIGGER** indicator will turn on. The voltage on the capacitor will appear on the LED Display, Item 8. This voltage will appear across the output leads when the **TRIGGER** switch is pressed. Note that the **POLARITY** switch is prevented from operating after the **CHARGE** switch has been pressed. |
| 5 | **CHARGE** indicator | This Yellow indicator is lit to show that pressing the **CHARGE** switch is the next logical step in a test sequence. Pressing the Charge switch causes the **CHARGE** indicator to go out. |
| 6 | **TRIGGER** switch | Press this switch (after pressing the **CHARGE** switch to charge the storage capacitor) to trigger the output impulse waveform. The impulse waveform will appear across the output leads. |
| 7 | **TRIGGER** indicator | This Red indicator is lit to show that pressing the **TRIGGER** switch is the next logical step in a test sequence. This indicator will turn on after the **CHARGE** switch is pressed, and will remain on until the **TRIGGER** switch is pressed. Pressing the **TRIGGER** switch causes the **TRIGGER** indicator to go out. |
| 8 | Voltage meter | Displays the output voltage set point. This voltage is the open-circuit peak voltage that will appear across the output leads when the trigger button is pressed. The voltage reading will increase from zero to the voltage set point when the Charge switch 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 **TRIGGER** switch will discharge the capacitors (be sure to disconnect the output and return leads when discharging the capacitors). |
| 9 | **OUTPUT** jack | The impulse waveform appears on the **OUTPUT** jack, referenced to the **RETURN** jack. When the **POLARITY** switch is in the Normal position (**NOR** indicator is lit) the output will be a positive pulse. When the **POLARITY** switch is in the Reverse position (**REV** indicator is lit) the output will be a negative pulse. |
| 10 | **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. |
| 11 | Model designation area | Specifies Capacitor Model. |

**Table 2. Controls, Indicators, Connectors – MegaPulse series Front Panel**

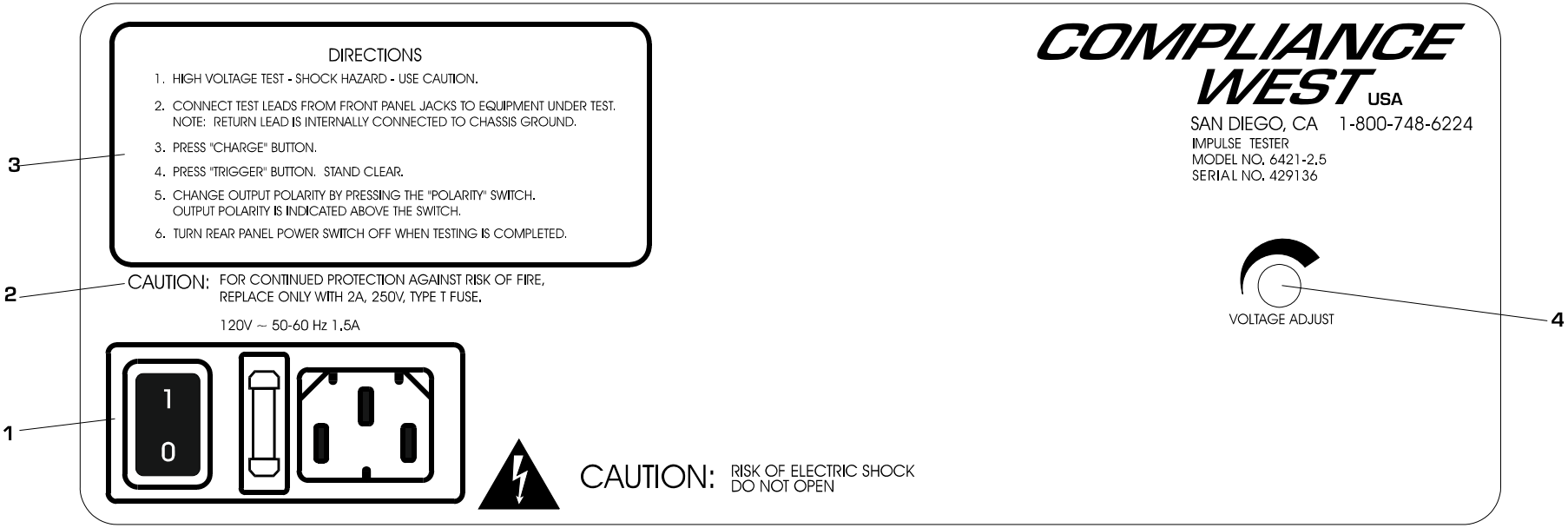



**Figure 3. Controls, Indicators, Connectors – MegaPulse series Rear Panel**

## Table 3. Control, Indicators, Connectors – MegaPulse series Rear Panel

| ITEM NO. | NAME | FUNCTION |
|---|---|---|
| 1 | Appliance Inlet / Fuse holder / Power Switch | Use supplied cordset to connect Tester to appropriate source of supply. Fuse holder provides access for Fuse replacement, and the Power Switch is used to turn the tester ON and OFF. |
| 2 | Fuse replacement warning / Rating of supply | Specifies replacement fuse and required supply voltage. |
| 3 | Directions | Not provided on MegaPulse Capacitor Series. |
| 4 | Voltage Adjust | Not provided on MegaPulse Capacitor Series. |


**Figure 4. Controls, Indicators, Connectors – MegaPulse series Breakdown Detection**

| ITEM NO. | NAME | FUNCTION |
|---|---|---|
| 1 | Pass Light | Indicates no Arc and Leakage Current through insulation lower than Sensitivity Control's setpoint. |
| 2 | Fail Light | Indicates Arc and/or Leakage Current through insulation higher than Sensitivity Control's setpoint. |
| 3 | Sensitivity Control | Sets Pass/Fail point for the Breakdown Detection circuit. See "Breakdown Detection Circuit" for details in control operation. |

Table 4. Control, Indicators, Connectors – MegaPulse series Breakdown Detection

## Initial Checkout Procedure

The following procedure will verify that the 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 Impulse Tester. A measuring instrument or probe with a low frequency response will result in erroneous readings that could be mis-read. We recommend using a calibrated Tektronix P6015 1000:1 probe, adjusted for the oscilloscope used, in accordance with the probe's User's Manual.

**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 know is turned fully counterclockwise.
2. Plug the Output and Return test leads in to 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-frequency 1000:1 probe such as the Tektronix P6015). Note that the **RETURN** lead is referenced to the chassis of the MegaPulse tester.
4. 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).
5. Push the yellow **CHARGE** button. Verify the red **TRIGGER** indicator is now lit.
6. 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.
7. Note for the following models only:
   MegaPulse 1.2x50-2.5
   MegaPulse 1.2x50-7
   MegaPulse 10x700-2.5
   MegaPulse 10x700-7
   MegaPulse Defib-5
   MegaPulse Capacitor:
8. These testers read bulk cap voltage on the meter. 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 theoretical voltage on the main impulse storage capacitor (C1 in Figure 1). 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.
9. Now, connect the oscilloscope directly to the 1000:1 BNC Voltage Jack on the front panel of the MegaPulse. CHARGE and TRIGGER the MegaPulse again, and note the resulting waveform. The BNC output pulse exhibits noise and time artifacts and is not for measurement purposes. It is for reference only.
10. Adjust the **VOLTAGE** knob fully counterclockwise, to the minimum position. Turn the rear-panel power switch OFF.

## Testing

This section describes how the MegaPulse 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 know is turned fully counterclockwise.
2. Plug the Output and Return test leads in to the jacks on the front panel that correspond to the capacitor value being tested.
3. Connect the ends of the test leads to the capacitor under test.
4. Connect an appropriate measuring instrument (typically an oscilloscope with a high-frequency 1000:1 probe such as a Tektronix P6015) across the capacitor under test in order to monitor the results of the impulse test. Note that the **RETURN** lead is referenced to the chassis of the MegaPulse tester. (Some testers may have a 1000:1 BNC Voltage jack on the front panel for direct connection to an oscilloscope. Due to timing and Vpeak errors on this output, use this jack for reference only, to verify that a pulse has been delivered, but not for evaluation of the pulse itself. )
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. Remember the voltage on the front panel meter is the theoretical bulk cap voltage. Experimentation will be required to set the output voltage at precisely 2.5, 4, or 8kV. Follow these guidelines as a starting point.
   Capacitor Series A: (For .01uF cap)
   Meter reading of 9260V will correspond to approximately 8kV out.
   Capacitor Series B: (For .1uF cap)
   Meter reading of 4255V will correspond to approximately 4kV out.
   Each different type and value of capacitor tested will require the voltage to be reset. It is suggested that a log of the appropriate meter reading for each type and style of capacitor tests is kept to minimize time spent in future setups for the same capacitor.
8. Push the red **TRIGGER** button, and view the resulting impulse waveform on the measuring instrument.
9. Voltage and current waveforms are replicated only for .01 uf (Series A) and .1uF (Series B) capacitor values only. Connection of a different value of capacitor, or using any of the other taps will result in a different waveform. Evaluation of the resulting waveform signature for known good and bad samples can be used to determine a pass/fail point for the particular devices under test. Optionally, the MegaPulses are available with an arc detection circuit which can report a insulation system breakdown. For further information on the use of this option, please refer to the section “Breakdown Detection Circuit Operation”.

# Section 4

## Optional Features

MegaPulses are optionally equipped with extra features, and some MegaPulses are equipped for specific uses. These special instructions are included in this Section.

## Optional TestMinder Operation

TestMinder computer operation is described in a specific manual included with your tester, if so equipped.

Please be sure to start TestMinder before the MegaPulse. For safety considerations, the MegaPulse output should be set to zero when energized.

## Optional Breakdown Detection Circuit

The MegaPulse tester can optionally be configured with a Breakdown Detection circuitry that can detect a quickly decaying waveform, indicative of a breakdown in the insulation system being tested. This circuit detects abnormal current flows and interprets this flow as a failure of the insulation system being tested.

Proper operation requires calibration of the Sensitivity Control when the output voltage is changed. For best results, a known good and a known bad sample of the insulation system can be used to set the Sensitivity Control. If these samples are not available, a starting setpoint can be set with the supplied calibration resistor (50 ohms).

### Sensitivity setting using known good and known bad samples

1. Remove power to the MegaPulse and turn the Voltage Control to zero. Turn the Sensitivity Control to the maximum setting, i.e. the knob pointer at 5 o'clock.
2. Using the supplied High Voltage Test leads, connect the known bad sample across the High Voltage outputs of the MegaPulse.
3. Energize the MegaPulse and press the Charge Button. Use the Voltage Control to set the output to the desired level as shown on the MegaPulse voltage meter.
4. Press the TRIGGER button. The green PASS light should illuminate.
5. Retest, turning the Sensitivity Control to a progressively lower setting, until the red FAIL light lights. In general, the pointer on the knob will be at approximately 2 o,clock for 10-12kV and approximately 8 o'clock for 1-2kV test voltages.
6. Check the setting by substituting the known good sample in the circuit, and ensuring the result is a green PASS light. If it is not, the difference in resistance between the known good and known bad samples appears the same to the Breakdown Detection Circuit. It may help to repeat the setup using the known bad sample, and working to define the point of failure exactly by repeating tests until the exact point where the red FAIL light illuminates.
7. If the output voltage of the MegaPulse is changed, the Sensitivity Control should be reset.

### Approximate Sensitivity Setting using the supplied 50 ohm resistor

If known good and known bad samples are not available, an approximate setting, using a 50 ohm resistor, is a recommended starting point. Depending on requirements of the particular test being conducted, a higher or lower resistance may be indicated. We have chosen the 50 ohm resistor as a balance between repeatability and sensitivity. As the resistance of the test resistor increases, current flow decreases, and this may result in repeatability problems during the test setup. We recommend using the 50 ohm resistor at first, until the operator is familiar with the MegaPulse operation; at which time he may wish to experiment with other resistances as setpoints.

1. Remove power to the MegaPulse and turn the Voltage Control to zero. Turn the Sensitivity Control to the maximum setting, i.e. the knob pointer at 5 o'clock.
2. Using the supplied High Voltage Test leads, connect the test resistor across the High Voltage outputs of the MegaPulse.
3. Energize the MegaPulse and press the Charge Button. Use the Voltage Control to set the output to the desired level as shown on the MegaPulse voltage meter.
4. Press the TRIGGER button. The green PASS light should illuminate.
5. Retest, turning the Sensitivity Control to a progressively lower setting, until the red FAIL light lights. In general, the pointer on the knob will be at approximately 2 o,clock for 10-12kV and approximately 8 o'clock for 1-2kV test voltages.
6. If the output voltage of the MegaPulse is changed, the Sensitivity Control should be reset.

## Safety Interlock Option

The safety interlock option is a two-position terminal block on the rear panel of the MegaPulse. It is shipped from the factory with the two positions shorted together for normal operation. If an external interlock switch is desired, connect it across the switch. Additional switches are connected in series with the first switch. Opening any of the external switches will disable the front panel buttons **POLARITY, CHARGE,** and **TRIGGER.** NOTE: If the charge button was pressed before the external interlock switch was opened, the internal capacitors will still be charged.

## Section 5

**Technical Assistance**

For Technical Assistance
Phone: (800) 748-6224

Technical Assistance is available from Compliance West USA between the hours of 8:30 AM and 5:00 PM Pacific Time.

Compliance West USA
2120 Jimmy Durante Blvd., Suite 124
Del Mar, CA 92014

Phone: (858) 481-6454
FAX: (858) 481-8527

Technical information is also available on our web site at: www.compwest.com

# Section 6

## Maintenance and Calibration

**WARNING**

**THESE SERVICE INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.**

### Introduction

This section of the manual contains maintenance information for the MegaPulse series impulse tester. This maintenance information is divided into service information, general maintenance, a performance test, and a calibration procedure. The performance test is recommended as an acceptance test when the instrument is first received, and later as a preventative maintenance tool to verify proper instrument operation. A 1-year calibration cycle is recommended to maintain the specifications given in Section 1. The test equipment required for the performance test is an oscilloscope and high voltage probe, and a calibrated current shunt. The test equipment required for the calibration procedure is a DMM able to read the maximum specified peak output voltage of the MegaPulse tester.

### 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

#### Interior Access

*NOTE*

*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.*

#### Calibration Access

Use the following procedures to gain access to the calibration adjustments of your instrument.

1. Set Line Power switch to OFF.

2. Disconnect the power cord from the rear of the instrument.

3. Remove the four upper screws on the top panel of the unit.

4. Grasp the top cover of the enclosure and slide it backward until it is free of the tester.

5. All calibration adjustments are now accessible.

*NOTE*

*With the power cord replaced, the instrument is operational for service.*

**WARNING**

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

6. To reassemble, reverse steps 1-5 above.

## Cleaning

**CAUTION**

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

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).

## Discharging the Bulk Capacitor

Extreme caution must be used when working on the MegaPulse internal circuits because of the possibility that the capacitor may be charged.

1. To discharge the capacitor: Using an insulated screwdriver or similar, press down on the center of the relay on the bottom rear tray of the tester. This will cause the contactor to function manually, and discharging the capacitor charge through the internal waveshaping network.

2. To short the capacitor: There may be instances where the capacitor voltage is desired to be zero. After the capacitor is discharged, use a test lead with banana plugs on both ends and short the + and – points on the top tray. DO NOT try to discharge the capacitor using this method; the only safe way to discharge the capacitors is described in Para. 1 of this Section. Before energizing the MegaPulse, this shorting jumper must be removed, or damage to the charging circuit may result.

## Performance Test

The performance test evaluates the performance of your instrument to ensure that the logic, lights and high voltage sections are working properly. This test is recommended for incoming inspection, as a preventative maintenance check, and to verify proper operation during the calibration procedure. It is not necessary to disassemble the instrument to conduct these tests. If the instrument fails any part of the performance test, repair is indicated.

Allow the instrument to stabilize and perform the test at an ambient temperature of 23°C ±5°C (73°F ±9°F).

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 know is turned fully counterclockwise.
2. Plug the Output and Return test leads in to the jacks on the front panel. The output lead should be connected to the jack appropriate for testing the following capacitor value:
   Series A: .01uF
   Series B: .1 uF
3. Connect the ends of the test leads to an appropriate measuring instrument (typically an oscilloscope with a high-frequency 1000:1 probe such as a Tektronix P6015). Note that the **RETURN** lead is referenced to the chassis of the MegaPulse tester.
4. Connect a capacitor across the tester leads:
   Series A: .01 uF.
   Series B: .1 uF.
5. Turn the Tester on.
6. 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).

7. Push the yellow **CHARGE** button. Verify the red **TRIGGER** indicator is now lit.
8. Adjust the **VOLTAGE** knob so that the front panel LED display is reading as follows"
   Series A: 9260 volts.
   Series B: 4255 volts.
9. Push the red **TRIGGER** button, and view the resulting impulse waveform on the measuring instrument. The peak voltage should be as follows:
   Series A: 8000V ±3%
   Series B: 4000V ±3%
10. A copy of the actual voltage waveforms (rise and duration) that were measured on your instrument before shipping are included at the end of this manual (figures 4 and 6). These waveforms are identified by the serial number of your MegaPulse tester in the upper left-hand corner of the figure(s). Compare the impulse waveform to these "as shipped" waveforms, as well as the ideal waveforms (theoretical calculated values) that are also included at the end of this manual (figures 5 and 7). If the measured waveform is significantly different than the ideal waveform, then additional evaluation and/or repair of the MegaPulse tester is warranted.
11. 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 (C1 in Figure 1). 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.
12. Adjust the **VOLTAGE** knob fully counterclockwise, to the minimum position. Turn the rear-panel power switch OFF.

If the results of the performance test are not in accordance with the above, service is required. Remove the Tester from service and contact the manufacturer for servicing information. If the results of the tests above are correct, proceed with the Calibration Procedure.

## Calibration Procedure

The Calibration Procedure should be performed annually and any time the instrument has been repaired. The calibration procedure consists of calibrating the meter reading to agree with the voltage output.

The Performance test in the previous section should be performed with satisfactory results before conducting the Calibration procedure.

Before starting the Calibration procedure, perform the Calibration access procedure given earlier in this Section.

*NOTE*

*Allow the instrument to stabilize for approximately five minutes. Perform all calibration adjustments at an ambient temperature of 23°C ±5°C (73°F ±9°F).*

**WARNING:**

**Calibration Adjustments Are Performed On Live Circuits. Exercise Caution At All Times, And Use A Non-Conductive Tool For All Adjustments.**

### Voltage Calibration Adjustment

Use the following procedure to calibrate the output voltage. Pot R6 and R7 are located on the back side of the front panel LED display board. Verify the location of these two potentiometers after the top cover of the tester has been removed, but before the power cord has been plugged into the tester. Also verify the location of the positive (+) and negative (-) Voltage Output Test Points, which are used to measure the output voltage.

1. Plug in the power cord. Adjust the front panel **VOLTAGE** knob fully counterclockwise to the minimum position. Turn the rear-panel power switch ON. The **CHARGE** indicator should be lit.
2. Adjust R6 so that the voltage reading on the front panel LED display is as close to zero as possible. Note that the display may read some residual voltage of approximately 10 volts.
3. Connect a suitable 1000:1 high frequency probe such as a Tektronix P6015 across the output leads.

4. Press the **CHARGE** button. Use the **VOLTAGE** adjustment knob to increase the output voltage to near the maximum rated peak output voltage of the MegaPulse tester. Using the correct respective taps on the front of the MegaPulses, clip the noted capacitance values between the output leads and adjust the output until the peak voltage is as noted within a tolerance of ±3%.

   Series A: .01uF, output peak 8000V
   Series B: .1uF, output peak 4000V

5. Using a non-conductive screwdriver, adjust R7 so that the voltage reading on the front panel LED display voltage is the theoretical bulk capacitor voltage. Please note, this voltage may be very different from the voltage actually appearing on the bulk cap. The theoretical bulk cap voltage is the voltage on the bulk cap if all circuit components were perfect, and has no bearing on the actual voltage seen in the real world. Theoretical bulk cap voltage is as follows:
   Series A: 9250V
   Series B: 4255V
6. Turn the **VOLTAGE** adjust knob back down to zero. Allow the output voltage to decay down to a safe level (this may take a few minutes). Remove the DC voltage meter leads.
7. Turn the rear-panel power switch OFF, and replace the top cover of the MegaPulse tester.

If the results of the calibration procedure are not in accordance with the above, service is required. Remove the Tester from service and contact the manufacturer for servicing information. If the results of the tests above are correct, the tester may be put back into use.