MegaPulse

IMPULSE TESTER

1.2x50-12.3PF-1
500ohm 0.5J

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 1.2x50-12.3PF-1 500ohm 0.5J 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.

Rev 1.0, March 2016

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Section 1

An Introduction to Impulse Testing with the MegaPulse PF 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 12000V 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 1000 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 1.2x50-12.3PF-1 500ohm 0.5J 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 digital VOLTAGE ADJUST knob on the front panel. This voltage setting should always confirmed by pressing the VOLTAGE ADJUST knob before starting any test.

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

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

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

Using the MegaPulse Impulse Tester

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

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

Pressing the POLARITY switch on the front panel can change the polarity of the output waveform. The polarity is Normal when the **NOR** indicator is lit. In this case, the high voltage will appear on the **OUTPUT** as a positive pulse relative to the **RETURN** jack. When the polarity switch is in the Reverse position (**REV** indicator is lit), the high voltage will appear on the **OUTPUT** as a negative pulse relative to the **RETURN** jack. The polarity switch only operates when the **CHARGE** LED is lit, i.e. the output is not charged.

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

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

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

Section 2

Introduction

This manual contains complete operating, maintenance and calibration information for the Compliance West USA MegaPulse 1.2x50-12.3PF-1 500ohm 0.5J Impulse Tester.

- In case of trouble, the test can be immediately terminated at any time by turning the rear-panel power switch to the OFF position.
- Before the test can commence, the unit must be armed by pressing the **CHARGE** Button. The test will not begin until the **TRIGGER** Button is pushed.

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

Specifications

Specifications for the MegaPulse 1.2x50-12.3PF-1 500ohm 0.5J are listed in the Error! Reference source not found. below and the component designations are shown in **Figure 1**.

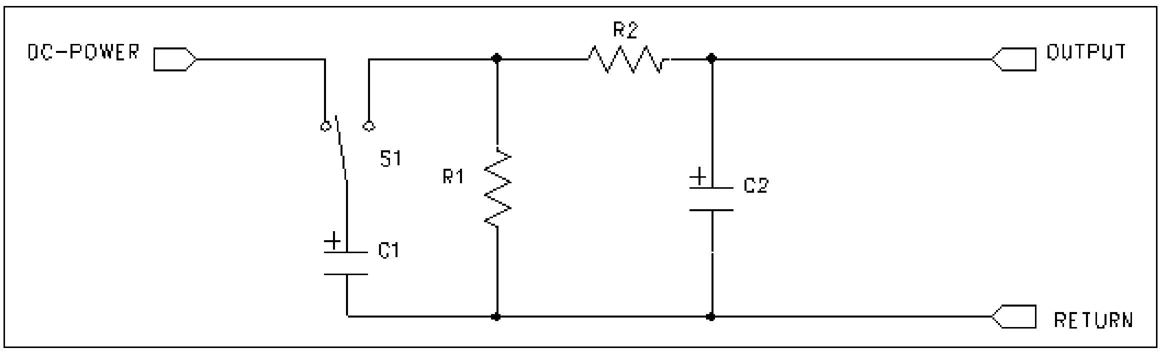

Figure 1. General Electrical diagram.

Output	Waveform	Voltage	C1	R1	R2	C2
1000 Vp, 0.5 J	1.2x50 us	1000Vp +0, -10%	1 µF	68 Ω	500Ω	0.8 nF
5000 Vp, 0.5 J	1.2x50 us	5000Vp +0, -10%	40 nF	1700 Ω	500Ω	0.8 nF
12000 Vp, 0.5 J	1.2x50 us	12000Vp +0, -10%	6.9 nF	9792 Ω	500Ω	0.8 nF

Table 1. Nominal Component Values for MegaPulse Circuit.

Note: Multiple output if apply, otherwise single one.

The nominal component values are determined based on the requirement to have 0.5 Joules (J) of stored energy in capacitor C1, and deliver the 1.2 x 50 uS open-circuit impulse waveshape with the specified peak voltage (Vp) to the output through a series resistance (R3) of 500 Ohms.

Nominal component values are determined from the calculations provided in IEC 60255-5 Annex C, which is copied in **Figure 2**.

60255-5 © IEC:2000

Annex C
(informative)

Guidance for impulse voltage tests

Recommended impulse withstand test generator assembly

For the generation of the impulse voltages as specified in 6.1.3.2, an assembly as shown in figure C.1 and consisting of components as given in table C.1 for test voltages of 1 kV and 5 kV is recommended.

Table C.1 – Components of the test generator [1)]

Test voltage kV	R_1 kΩ	R_2 kΩ	C_1 µF	C_2 nF
1	0,068	0,5	1,0	0,8
5	1,8	0,5	0,039	0,8

1) Tolerances for the values of each component shall be ±1 %.

Component values for impulse voltages other than 1 kV and 5 kV can be calculated from the expressions below.

$R_1 = 0{,}068 \times 10^{-3} \times V_T^2\ \Omega$ $\quad$ $R_2 = 500\ \Omega$

$C_1 = 1/V_T^2$ F $\quad$ $C_2 = 0{,}8$ nF

where V_T is in volts.

Figure 2. Annex C from IEC 60255-5

Note that the tolerance of R2 and C2 are 1% as specified, however the component values of R1 and C1 may be modified to account for secondary circuit effects in order to generate the specified output waveform, which is described in **Figure 3**, as copied from IEC 60255-5.

60255-5 © IEC:2000

6.1.3.2 Waveform and generator characteristics

A standard lightning impulse in accordance with IEC 61180-1 shall be used (see annex C of this standard for further information). The generator characteristics shall be verified according to IEC 61180-2.

The parameters are as follows:

- front time: 1,2 µs ± 30 %;
- time to half-value: 50 µs ± 20 %;
- output impedance: 500 Ω ± 10 %;
- output energy: 0,5 J ± 10 %.

The length of each test lead shall not exceed 2 m.

Figure 3. Waveform characteristics from IEC 60255-5

Methods of calculation of front time (T_1) and time to half-value (T_2) are as specified in IEC 61180-1, shown in **Figure 4**.

6.1.1.2 *Virtual front time T_1*

1,67 times the interval T_1 between the instants when the impulse is 30 % and 90 % of the peak value (points A and B, figure 1).

6.1.1.4 *Virtual time to half-value T_2*

The time interval between the virtual origin O_1 and the instant when the voltage has decreased to half the peak value.

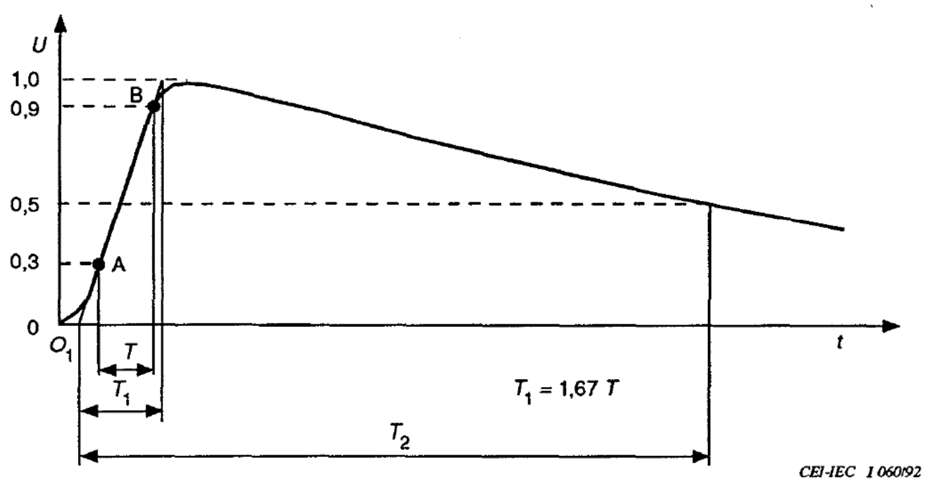

Figure 4. Waveform time measurements from IEC 61180-1

Recommended test voltages and tolerance on peak voltage are as specified in IEC 60255-5 section 6.1.3.3, which is shown in **Figure 5**.

60255-5 © IEC:2000

6.1.3.3 Selection of impulse test voltage

The impulse test voltage is based on the rated impulse voltage, taking altitude into account as shown in table 5.

Table 5 – Impulse test voltages

Rated impulse voltage kV	Minimum test voltages and corresponding altitudes kV				
	Sea level	**200 m**	**500 m**	**1 000 m**	**2 000 m**
0,33	0,35	0,35	0,35	0,34	0,33
0,5	0,55	0,54	0,53	0,52	0,5
0,8	0,91	0,9	0,9	0,85	0,8
1,5	1,75	1,7	1,7	1,6	1,5
2,5	2,95	2,8	2,8	2,7	2,5
4	4,8	4,8	4,7	4,4	4,0
6	7,3	7,2	7,0	6,7	6,0
8	9,8	9,6	9,3	9,0	8,0
12	14,8	14,4	14,0	13,3	12,0

The rated impulse voltage of the measuring relay shall be selected from table 2, corresponding to the overvoltage category specified and to the rated voltage of the relay.

For measuring relays and protection equipment circuits which are to be directly supplied via voltage and current transformers or directly connected to the station battery supply, the impulse voltage test shall be performed by applying a rationalised impulse test voltage of 5 kV (with a relative tolerance of $^{0}_{-10}$ %) independent of the test altitude. The test generator as specified in IEC 61180-1 shall be used [1)].

For other circuits, the peak impulse test voltage shall be not less than the values given in table 5 (with a relative tolerance of $^{0}_{-10}$ %). The test generator as specified in annex C shall be used with characteristics as specified in 6.1.3.2 [2)].

The impulse test voltages given in table 5 which are in excess of 5 kV and require special test equipment shall be subject to agreement between manufacturer and user.

Figure 5. Test Voltages and Tolerance from IEC 60255-5

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 1.2x50-12.3PF-1 500ohm 0.5J Tester
- Two high-voltage test leads, 1 red and 1 black
- An 18 AWG Line Power Cord
- This Instruction Manual

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

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

AC Line Voltage Requirements

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

Fuse Replacement

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

Use the following procedure to replace the fuse F1:

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

Front and Rear Panel Features

Before using your Tester, take a few minutes to become familiar with the use of its controls, indicators and connectors. The front panel features of the MegaPulse are shown in **Figure 6** and described in **Table 2.** The rear panel features of the MegaPulse are shown in **Figure 7** and described in **Table 3.**.

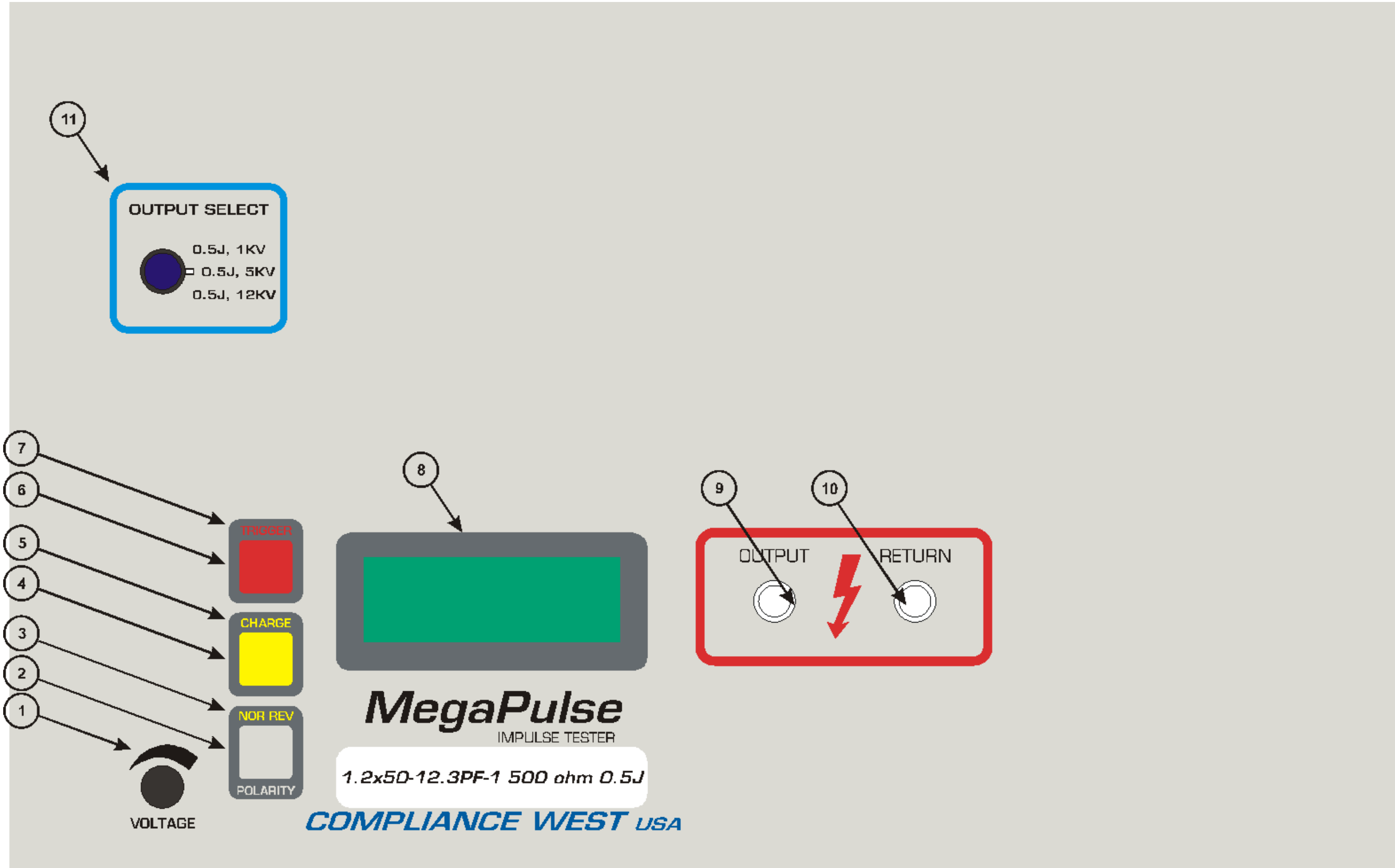

Figure 6. Controls, Indicators, Connectors – MegaPulse 1.2x50-12.3PF-1 500ohm 0.5J Front Panel (image for reference only)

ITEM	NAME	FUNCTION
1	**VOLTAGE** Adjust Knob	Adjust the digital voltage set point in the tester. Press the voltage knob to display the voltage set point. This setting will blink for a few seconds on the front meter. Turn Clockwise to increase the setting Voltage Setting Point before pressing **CHARGE** button.
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 **CHARGE** indicator is lit and the voltage on the display meter is less than 180V. The polarity is Normal when the **NOR** indicator is lit and, Reverse when the **REV** indicator is lid.
3	**NOR REV** indicator	Indicates the state of the Output Polarity switch. **NOR** indicates Normal (Positive) position. **REV** indicates Reverse (Negative) position.
4	**CHARGE** switch	Starts the charge process of the tester capacitor. The **CHARGE** indicator will turn off after the **CHARGE** switch is pressed, and the **TRIGGER** indicator will turn on. The charge process will stop after 2 minutes if the **TRIGGER** button is not 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. **CHARGE** indicator is lit when the tester is turn ON an after pressing **TRIGGER** button. **CHARGE** indicator will go out after pressing **CHARGE** button. **CHARGE** and **TRIGGER** 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. **TRIGGER** indicator is lit for 2 minutes after the **CHARGE** button is pressed. **TRIGGER** indicator will go out after pressing **TRIGGER** button. **TRIGGER** and **CHARGE** Indicators will be blinking if the Interlock Switch is open (Only testers with Interlock Switch Option) **TRIGGER** indicator will blink at when the Voltage. This effect will remain on until the **TRIGGER** 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 CHARGE 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 **TRIGGER** 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.
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	**OUTPUT** switch	Used to select the waveshaping network components that are specified for each nominal output voltage. Refer to **Table 1** for additional details. (optional, just in case that multiple output was ordered)

Table 2. Controls, Indicators, Connectors – MegaPulse 1.2x50-12.3PF-1 500ohm 0.5J Front Panel

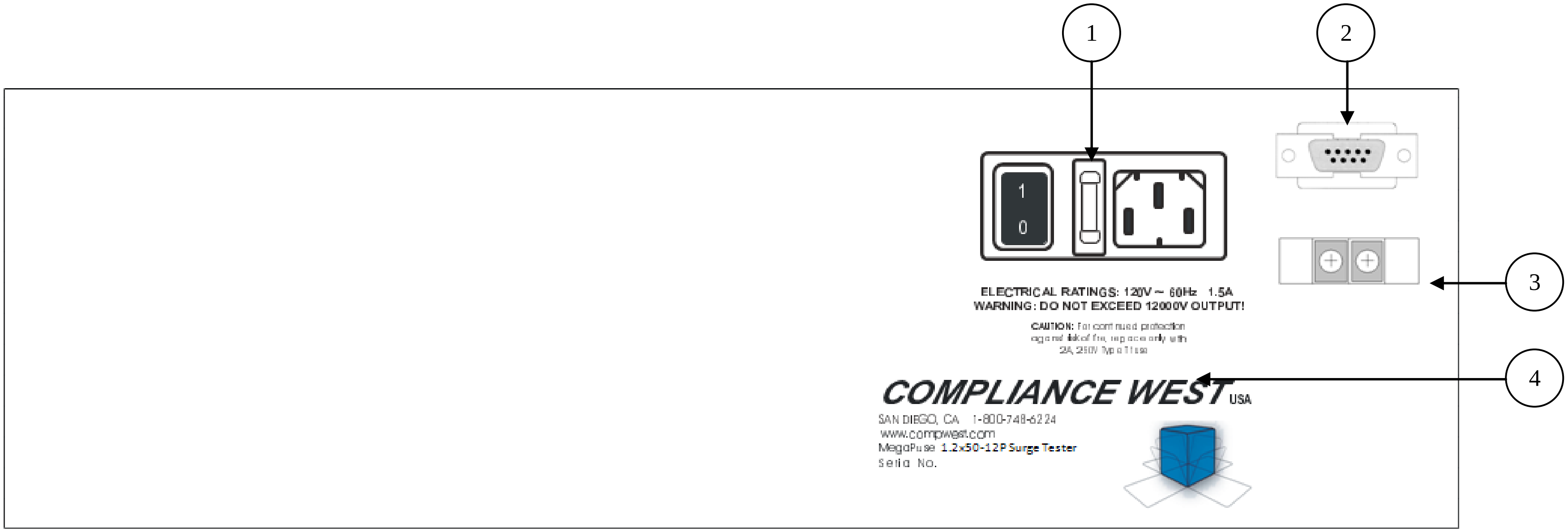

Figure 7. Controls, Indicators, Connectors – MegaPulse 1.2x50-12.3PF-1 500ohm 0.5J Rear Panel (image for reference only)

ITEM NO.	NAME	FUNCTION
1	Appliance Inlet / Fuse holder / Power Switch	Use supplied cordset to connect the MegaPulse 1.2x50-12.3PF-1 500ohm 0.5J 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.
2	RS-232 Interface (Optional)	Allow the communication between the tester and computer interface; a RS-232 to USB is available.
3	Interlock Switch (Optional)	Emergency Stop Close: Enables the tester buttons for operation. Open: Stops any process in the tester and disables the buttons. The **TRIGGER** and **CHARGE** Indicators will be blinking
4	Fuse replacement warning / Rating of power supply	Specifies replacement fuse and required supply voltage.

Table 3. Control, Indicators, Connectors – MegaPulse 1.2x50-12.3PF-1 500ohm 0.5J Rear Panel

Setting the Peak Output Voltage

Select the desired output using the Output switch (if apply, **Figure 6** item 11). Adjust the output voltage setting using the Voltage adjust knob (**Figure 6** item 1) to the voltage specified in **Table 4**. Note that the front panel meter reads the voltage of C1. Depending on the waveshaping network that is selected, this voltage will be higher than the peak voltage of the output waveform. **CAUTION: DO NOT SET THE VOLTAGE ABOVE THE MAXIMUM VOLTAGE SETTING SPECIFIED IN Table 4. DOING SO MAY DAMAGE THE EQUIPMENT**

Output Switch Setting	Desired Peak Output Voltage (Vp) (1)	Output Voltage Setting (Vs)	Maximum Voltage Setting	Calculation for other voltages
1000V	950V	985	1500	Vp = 0.96 Vs
5000V	4750V	5050	6500	Vp = 0.94 Vs
12000V	11400V	14500	14500	Vp =0.78 Vs

Table 4. Output Voltage Setting.

1. Note that the tolerance on the peak output voltage is +0, -10%. Therefore the center of this tolerance band is -5%, corresponding to 950V, 4750V, 11400V for the 1000V, 5000V, and 12000V settings respectively.

2. Multiple output if apply, otherwise single one.

Initial Checkout Procedure

The following procedure will verify that the MegaPulse 1.2x50-12.3PF-1 500ohm 0.5J 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 1.2x50-12.3PF-1 500ohm 0.5J tester. A measuring instrument or probe with a low frequency response will result in erroneous readings that could be mis-read.

CAUTION

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

1. Connect the tester to a proper source of supply using the included 18 AWG power supply cord.
2. Plug the Output and Return test leads into the jacks on the front panel.
3. Connect the ends of the test leads to an appropriate measuring instrument (typically an oscilloscope with a high-voltage probe). Note that the **RETURN** lead is referenced to the chassis ground of the tester. See **Figure 8** as an example.
4. Turn the Tester on. Toggle the **POLARITY** switch if necessary so that the **NOR** indicator is lit.
5. Note that the Voltage meter may indicate that some residual voltage is present on the main storage capacitor, even when the tester is first turned ON. This is due to inherent charging of the internal capacitors. Pressing the **TRIGGER** switch will discharge the capacitors (be sure not to touch the output and return leads when pressing the trigger switch).
6. Adjust the digital **VOLTAGE** knob to the desire value.
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 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.
9. 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.
10. Repeat steps 5 through 8, except this time toggle the **POLARITY** switch so that the **REV** indicator is lit. Note that the impulse waveform will now be a negative pulse, so it will probably be necessary to make adjustments to the measuring instrument to get a proper reading.
11. Adjust the digital **VOLTAGE** knob to “00000”. Turn the rear-panel power switch OFF.

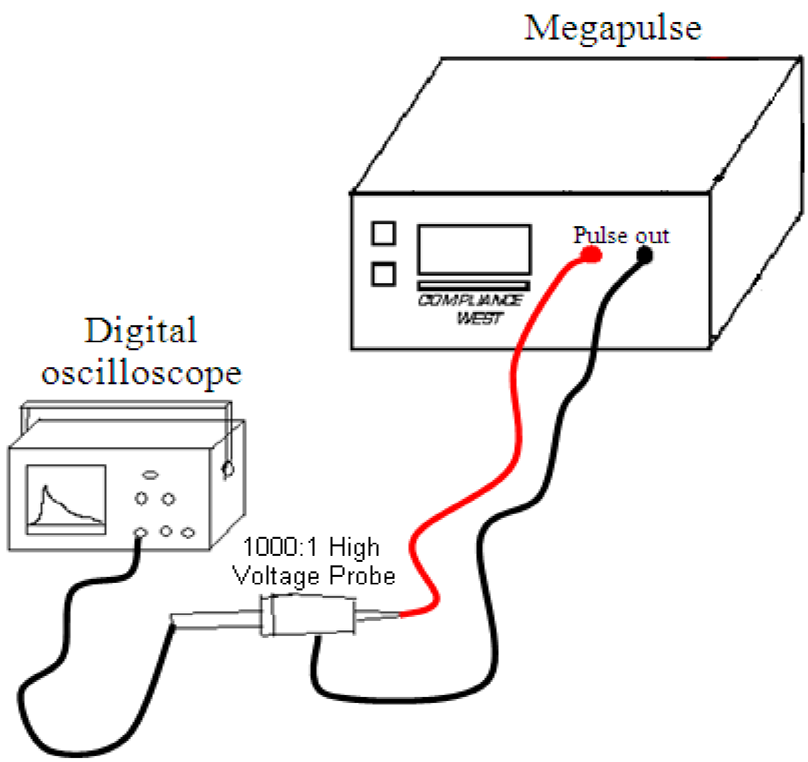

Figure 8. Waveform Measurement Setup.

Testing

This section describes how the MegaPulse 1.2x50-12.3PF-1 500ohm 0.5J 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.
2. Plug the Output and Return test leads into the jacks on the front panel.
3. Connect the ends of the test leads to the equipment under test.
4. Turn the Tester on.
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. Adjust the digital **VOLTAGE** knob to the desire value. **CAUTION: DO NOT SET THE VOLTAGE ABOVE THE VALUES SPECIFIED IN Table 5. DOING SO MAY DAMAGE THE EQUIPMENT:**

Switch Setting	Maximum Voltage Setting
0.5J, 1KV	1500V
0.5J, 5KV	6500V
0.5J, 12KV	14500V

Table 5. Maximum Voltage Settings.

Note: Multiple output if apply, otherwise single one.

7. Push the yellow **CHARGE** button. Verify the red **TRIGGER** indicator is now lit.
8. Push the red **TRIGGER** button, when the desired voltage is displayed on the front panel meter.
9. 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.

Section 4

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**

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

Section 5

Maintenance and Calibration

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

Introduction

This section of the manual contains maintenance information for the MegaPulse 1.2x50-12.3PF-1 500ohm 0.5J impulse tester. A 1-year calibration cycle is recommended to maintain the specifications of the factory. The test equipment required for the performance test is a digital oscilloscope, high voltage oscilloscope probe, digital meter and a high voltage probe.

Service Information

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

General Maintenance

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

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

Cleaning

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

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

Calibration Information

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

Voltage Stop Disable / Keyboard Enable by Keyboard.

If the MegaPulse 1.2x50-12.3PF-1 500ohm 0.5J tester includes TestMinder option and has the Voltage Stop by the PC command activated, it is possible to disable it using the next keyboard sequence:

Note: Disabling Voltage Stop enables the keyboard.

Turn OFF the MegaPulse P tester.

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

Turn ON the MegaPulse P tester.

Wait until the display shows **rESE**.

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

Appendix A

Impulse Testing Waveforms and Relay Performance

Background: Over the years, Compliance West USA has used a number of different relays to switch impulse waveforms. Relay choice varies depending primarily on the voltage that is being switched, and the maximum current than can flow. Other considerations include whether a single-pole or double-pole relay is needed. The range of voltages and currents varies greatly. The purpose of this document is to provide a better understanding of the switching event, and provide guidelines for the interpretation of measured results.
Terminology: The following definitions are used in this document:

> Switching time - The time delay starting at the point that the normally-closed contact (NC) opens, until the normally-open contact (NO) initially closes.
>
> Pre-arcing - During switching, the arc-over that occurs from the Common (COM) contact to the NO contact before the NO contact initially closes.
>
> Contact bounce - After the NO contact has initially closed, the contact may re-open because of the mechanical impact between the COM contact and the NO contact. Contact bounce may be reduced by dampening and spring-loading contacts.

Pre-arcing creates plasma. Plasma (according to Wikipedia) is highly conductive and can generally be considered a short-circuit. Most research in the area of electrical arcs is generally focused on circuit breakers and contactors that are moving from a closed state to an open state in order to disconnect the power source from the load. In this case arcing occurs and plasma is created when the contacts begin to open. This causes the currently to be maintained even while the contacts are open because of the low impedance of the plasma. While this is interesting, the understanding of this event is of limited use when considering contacts that are closing rather than opening.

For high voltage relays, switching time is relatively long, on the order of 10-20ms. This is because the COM contact moves at a finite speed over a large contact gap distance. Therefore it is reasonable to expect that the power source (that is charging the capacitor) is fully disconnected from the stored-energy component (capacitor) before pre-arcing takes place.

During switching, as the COM contact is moving towards the NO contact, arcing starts. The contact gap at which arcing occurs depends on voltage, gas composition (air or some other gas, or partial vacuum), and contact geometry (sharp points will arc at larger distances than smooth, rounded surfaces). In fact, *for fast impulse waveforms (such as 1.2 x 50uS) the entire waveform output will be generated during pre-arcing, and the output waveform will have dropped to near-zero before the COM contact closes with the NO contact.*

This is a very important observation to understand, as it greatly impacts the interpretation of disturbances that are measured during relay switching.

Consider a relay with a contact-gap distance ℓ that is closing at a speed $V = d\ell/dt$. As soon as the gap distance is smaller than the breakdown voltage of the air gap (or other gas), plasma is generated and the circuit can be considered closed (COM is essentially connected to the NO contact). At this point the stored energy may start to discharge (depending on the size of the storage capacitor) and the output voltage will certainly start to rise, as energy is transferred from the storage capacitor to the waveshaping network. Keep in mind that at this point, the relay contacts are still moving at speed V and have not yet initially closed.
At the same time that the COM contact is approaching the NO contact, the voltage of the waveshaping network (connected to the NO contact) is rising from zero to the voltage of the storage capacitor (connected to the COM contact). Current is flowing in the arc as energy is transferred from the COM contact to the NO contact. The arc will be sustained as long as there is "significant" current flowing. However *if the waveshaping network becomes "charged" such that the current drops below the threshold needed to*

maintain the arc, the arc will be extinguished. For high-energy impulse tests, there is a large amount of current flowing, which allows the arc to be maintained. **Figure A 1** shows a test circuit schematic, **Figure A 2** shows the ideal (simulated) output waveform, and **Figure A 3** shows the actual output, highlighting the point at which the arc is extinguished.

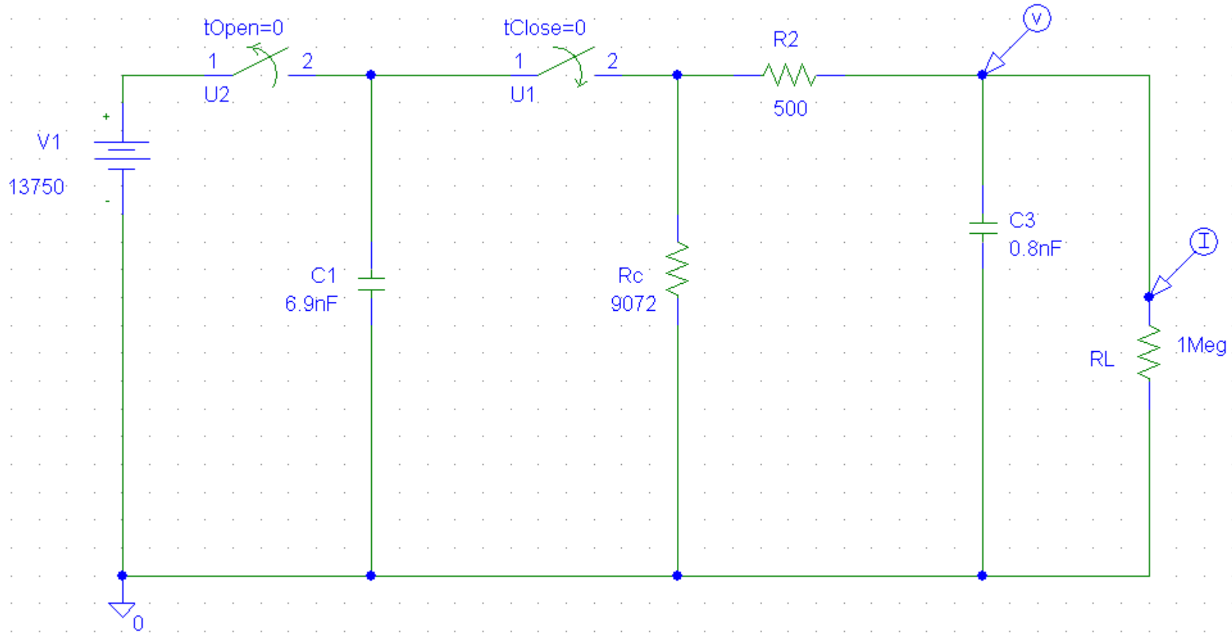

Figure A 1. Test circuit.

Figure A 2. Simulated output waveform.

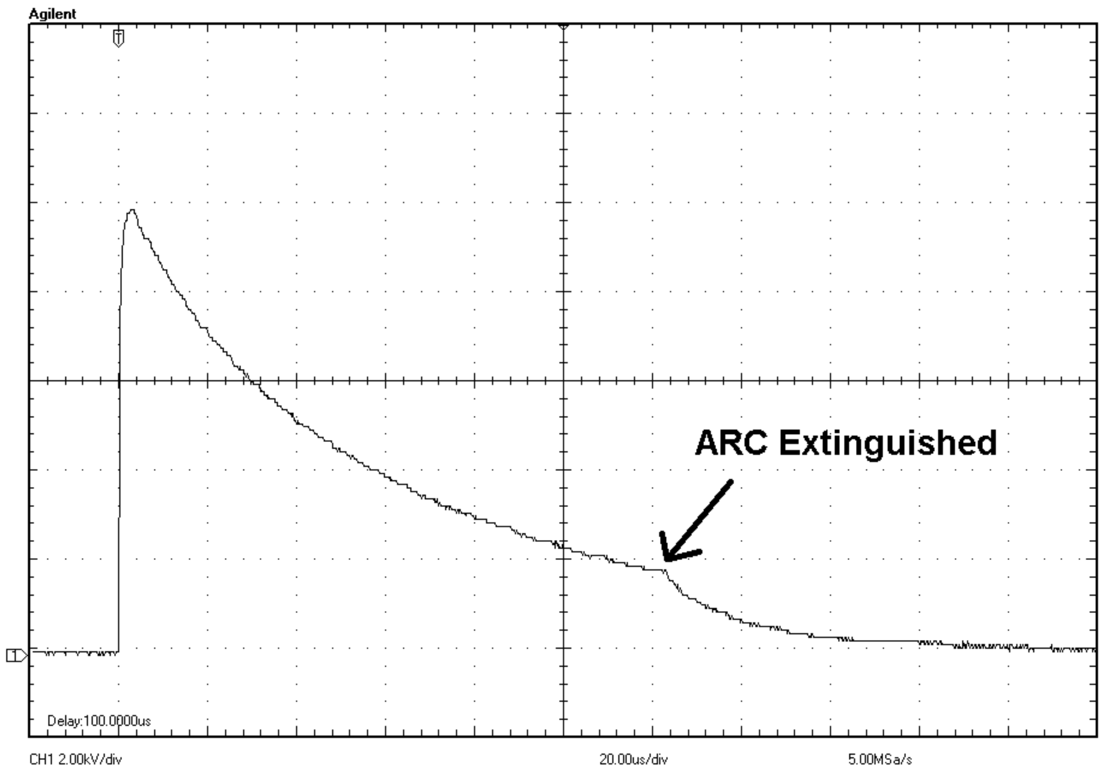

Figure A 3. Actual output showing the arc being extinguished as the contact is closing.

The reason the output voltage drops more quickly when the ARC is extinguished can be understood by reviewing the circuit schematic in **Figure A 1**: While there is an arc, C1 is connected in the circuit, and the RC time constant is: (Rc + R2) x (C1 + C3). When the arc is extinguished, the circuit has a shorter time constant: (Rc + R2) x (C3).

As soon as the arc is extinguished, a high impedance exists again between the COM contact and the NO contact. Therefore a voltage difference will again develop between the two contacts. Keep in mind that at the same time, the contacts are still approaching each other at speed V: *at some point before the contacts close, the contact gap will be small enough that breakdown may again occur across the contact gap*. This arcing - extinguish - re-arcing cycle may repeat more than once during the switching time. This condition is shown in **Figure A 4**.

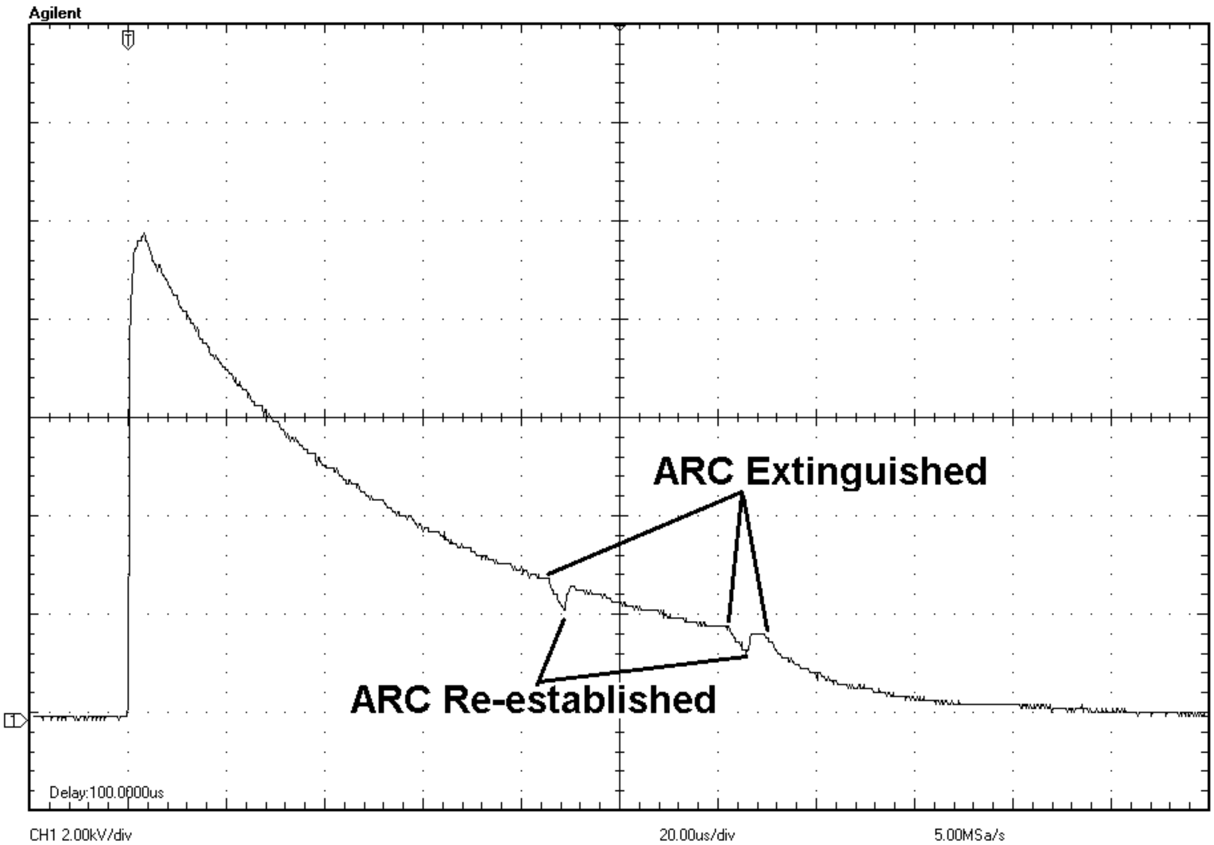

Figure A 4. Arc - extinguish - re-arcing cycle.

Because of the circuit topology, these arc-extinguish transients will take place only at the tail of the waveform, when the voltage is less than 50% of the peak output. Because the output is "clean" from the peak to the 50% voltage level, the duration of the waveform is easily measured and calculated; the transients have no effect on the calculation. In fact, the waveform definitions (from IEC 60060-1 and other standards) do not specify the wave shape after the voltage has decayed to below 50% of the peak value.

In practice, these transients have no effect out the test being conducted however *these transients should not be confused for a dieletric breakdown of the EUT*. A dielectric breakdown occurs near the peak of the impulse waveform as the voltage is still rising, or immediately after the peak. **Figures A 5-7** show typical waveforms when a breakdown occurs. These can be used as a guide for interpreting "failing" test results.

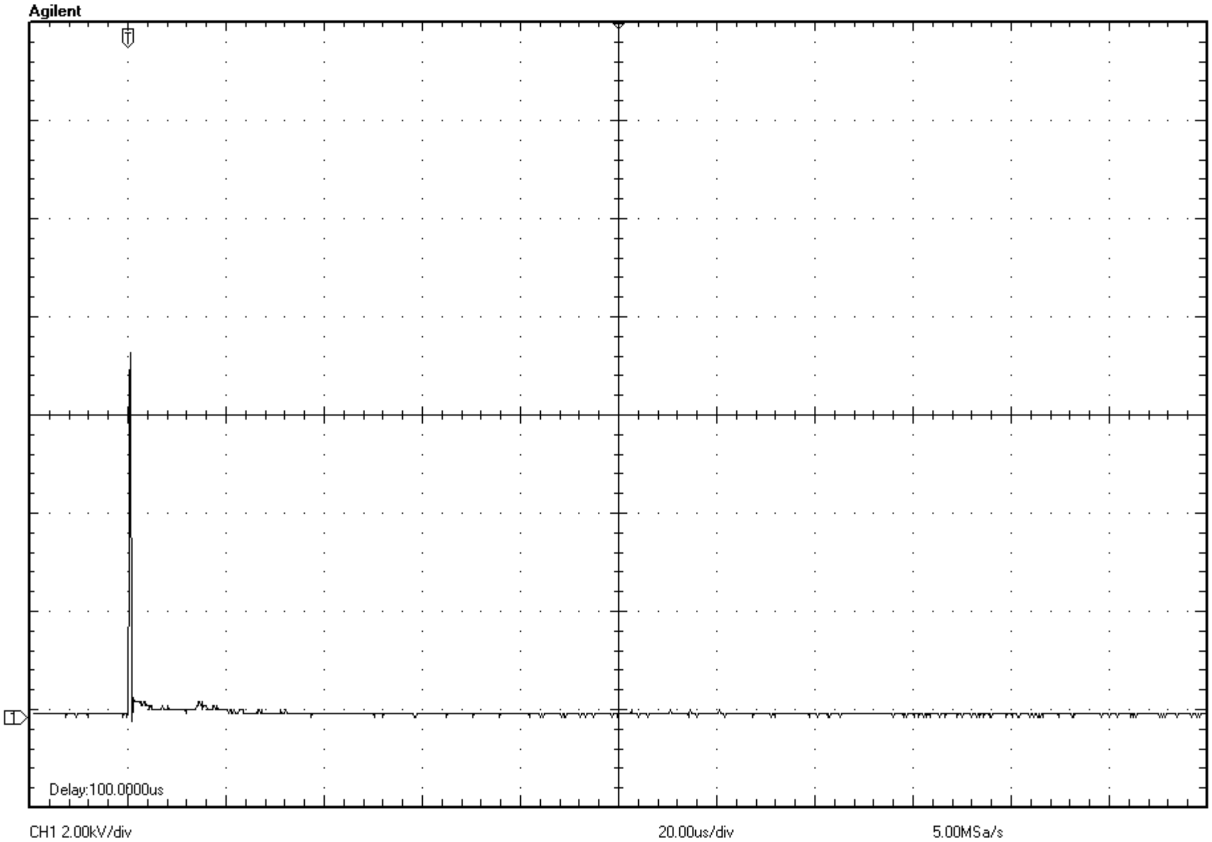

Figure A 5. Breakdown as the voltage is rising.

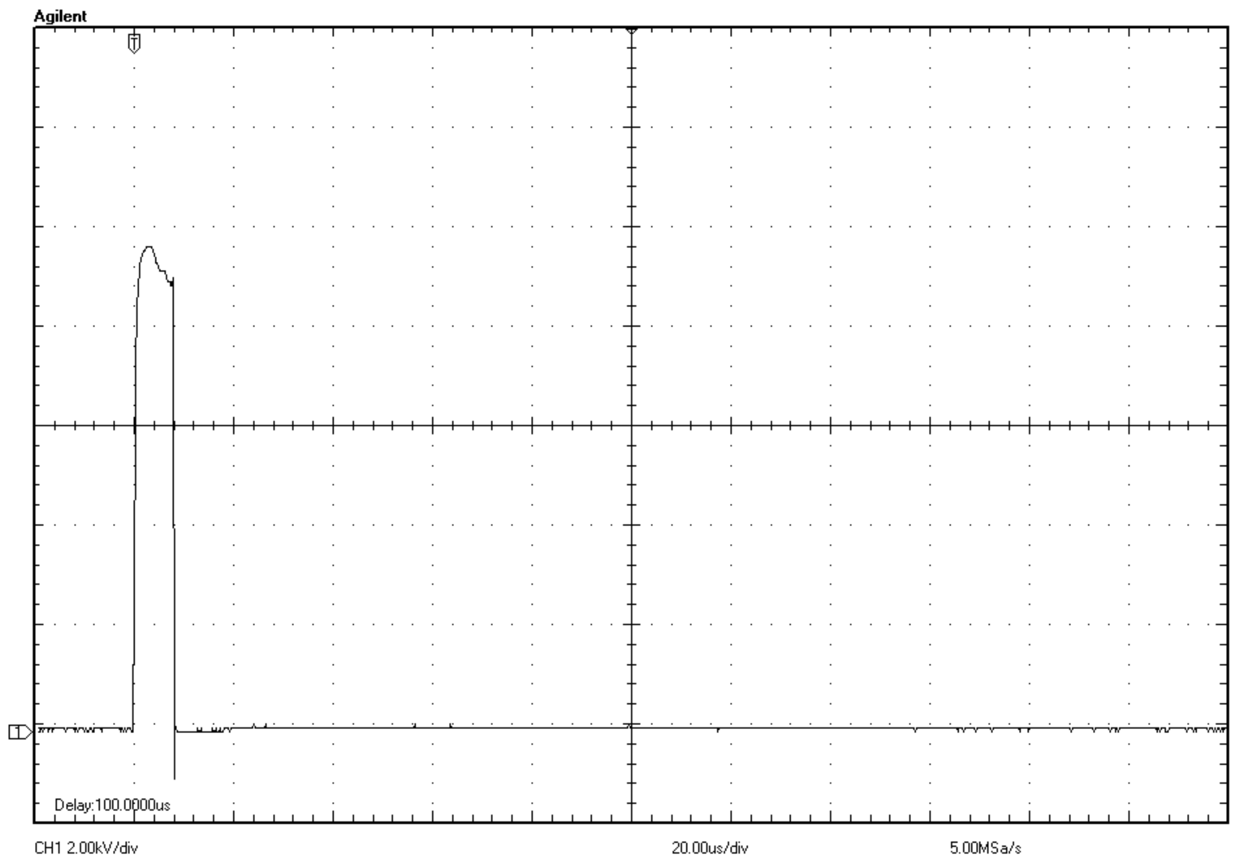

Figure A 6. Dieletric breakdown immediately after Vpeak.

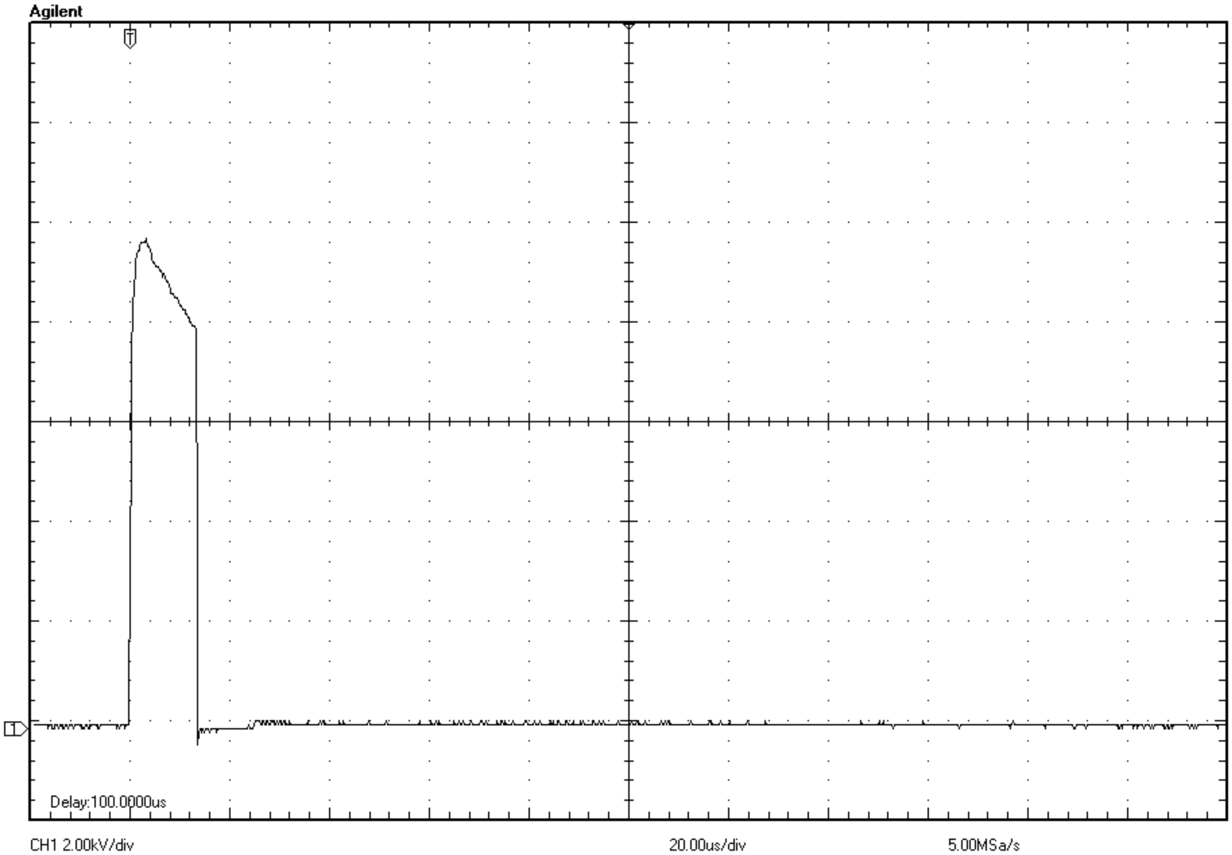

Figure A 7. Dielectric breakdown after Vpeak (delayed breakdown).