# Positron Porcelain Insulator Tester

**With Instant GO/NOGO Graphical Capability**

# Model # 3781301P/50 & 3781301P/60

## For Porcelain and Glass Insulator Strings

# User Manual

## Description and Operation Guide



Disclaimer Notice: Although Positron Inc. has made every effort to ensure the accuracy of the information contained herein, this document is subject to change.

POSITRON

**CAUTION**

**IMPORTANT SAFETY NOTICE**

**This instrument is intended to be used in high voltage environments.**

**It should be used ONLY by personnel trained to work in those environments.**

**Although this instrument does not make electrical contact with the high voltages,**

**IT IS ESSENTIAL THAT THIS INSTRUMENT IS USED COUPLED WITH A SUITABLE**

**HIGH DIELECTRIC STRENGTH HOT STICK THAT HAS A VOLTAGE RATING**

**EQUIVALENT TO OR GREATER THAN THE VOLTAGE ON THE DEVICES OR LINES**

**BEING TESTED.**

**NOTE** **To be used on AC lines only**

# Contents

# Chapter 1

## General Information

# 1.0 General Information

## 1.1 Publication Information

**© 2018 Positron Inc.**

**Positron Porcelain Insulator Tester**

**Description and Operation Guide**

User Manual Part #: **925W378130-09E**

Publication date: December 2018

**Published By**
Positron Inc.
5101 Buchan Street, suite 220
Montréal, Québec
H4P 2R9 Canada

**Trademarks**

Positron Insulator Tester is a trademark of Positron Inc.

The Insulator Testers are manufactured by Positron Inc. in Montreal, Canada. The Positron Insulator Testers is protected by US patents including "METHOD AND APPARATUS FOR THE VERIFICATION OF AN ELECTRICAL INSULATOR DEVICE BASED ON THE ANALYSIS OF THE ELECTRICAL FIELD ALONG THE INSULATOR".

Product names, other than Positron's, mentioned herein may be trademarks and/or registered trademarks of their respective companies.

**Confidentiality Notice**

The information contained in this document is the property of Positron Inc. Except as specifically authorized in writing by Positron Inc., the holder of this document:

1) shall keep all information contained herein confidential and shall protect same in whole or in part from the disclosure and dissemination to all third parties, and

2) shall use same for operating and maintenance purposes only.

## 1.2 About this Guide

This guide introduces and describes the operation of Positron's Live Line High Voltage Insulator Tester used as a maintenance tool to test and report defects in Porcelain Insulators and for use as a safety tool to determine the condition of high-voltage insulators prior to beginning Live-Power Line work.

## 1.3 How to use this Guide

This guide was designed to describe the operational modes of the Porcelain Insulator Testers.

The reader is invited to use the digital (PDF) version of this document to allow searching by keywords. Select **Edit,** then **Find** from the pull-down menu, or select **Ctrl+F** to access the **Find** menu.

## 1.4 List of Associated References

**[1]** "Suspension Insulator Puncture Insulator Tester"; Report No. ELE 92-62; Bonneville Power Administration Division of Laboratories; December 7, 1992.

**[2]** G.H. Vaillancourt, J.P. Bellerive, M. St-Jean, C. Jean, "New Live Line Insulator Tester for Porcelain Insulators on High-Voltage Power Line," IEEE Transactions on Power Delivery, Vol. 9, January 1994, pp. 208-219.

**[3]** "J.C. Pohlman, C.R. Davis, "Cracked Insulators Create Hazardous Working Conditions During Restoration after Extreme Ice Storms," Proceedings of ESMO-95, Columbus, Ohio, USA, October 29 - November 3, 1995, IEEE Paper 95CH35755.

**[4]** A.S. Jagtiani, J.R. Booker, "Aging of Porcelain Insulators Under Mechanical and Electrical Stress on EHV AC Lines," Proceedings of ESMO-95, Columbus, Ohio, USA, October 29 - November 3, 1995, IEEE Paper ESMO 95-CP-08.

**[5]** G. H. Vaillancourt, M. Hamel, J. Frate, "Experience with Two Faulty Composite Insulators Detection Methods in Hydro-Quebec," Conference Proceedings of 10th International Symposium on High Voltage Engineering, Montreal, Canada, August 25-29, 1997.

**[6]** G. H. Vaillancourt, P. Bilodeau, "Diagnostic Testing of Composite Insulators Used on Series Compensation Platforms in Hydro-Quebec," Conference Proceedings of 11th International Symposium on High Voltage Engineering, London, England, August 22-27, 1999.

**[7]** G. H. Vaillancourt, S. Carignan, C. Jean, "Experience with the detection of faulty composite insulators on High-Voltage power lines by the E-field measurement method," IEEE Transactions on Power Delivery, Val. 13, No. 2, April 1998, pp 661-666.

**[8]** Y.C. Chen, C. R. Li, X. Liang, S. Wang, "The Influence of Water and Pollution on Diagnosing Defective Composite Insulators by E-field Mapping," Conference Proceedings of 11th International Symposium on High Voltage Engineering, London, England, August 22-27, 1999.

**[9]** D. H. Shaffner, D. L. Ruff, G. H. Vaillancourt, "Experience with a Composite Insulator Testing Instrument based on the Electric Field method" ESMO 2000, Montreal, Canada, October 8-12, 2000.

[**10**] L. J. Fernandez, J. M. Munoz, A. Andrés, "Electric field measurement on composite insulators using live working techniques", 5th International Conference on Live Maintenance, ICOLIM 2000, Madrid, Spain, May 17-19, 2000.

[**11**] I. Gutman (SE), A. Pigini (IT) et al. "Assessment of Composite Insulators by means of Online Diagnosis", CIGRE WG B2.21 2013.

**[12**] C. Jean, "High Voltage Insulator Testing based on Electric Field method" 2015 INMR World Congress Conference, Munich, Germany, September 2015.

# Chapter 2

## Overview

# 2.0 Introduction to the Porcelain Insulator Tester

## 2.1 Personnel Terminology Used in this Guide

The Porcelain Insulator Tester is used by the High-voltage Tower Workers/Technicians. In this guide, the High-voltage Tower Worker/Technician who uses the tester to scan the porcelain insulator string is referred to as the "**Tester Operator**".

The Foreman or other members of the supporting Ground Crew operate the Tablet/Laptop used in the field together with the Insulator Tester. In this guide they are referred to as the "**Tablet Operator"**.

## 2.2 General

The document describes the operation of Positron's Porcelain Insulator Tester, enabling **GO/NOGO decision-making** for live-line testing of High Voltage Insulator performance:

**Model # 3781301P/50: Porcelain Insulator Tester, 50Hz**
**Model # 3781301P/60: Porcelain Insulator Tester, 60Hz**

Refer to Figure 1 for a detailed drawing of the unit.

With the Porcelain Insulator Tester mounted onto a user-supplied hot-stick, the user moves the Tester along the insulator string. Any conductive defect in an insulator causes a distortion in the Electric Field (E-Field) surrounding the insulator. This distortion of the E-Field indicates a faulty insulator. The fault is detected and identified by the Insulator Tester, and the data is downloaded to a database installed on the Tablet/Laptop for analysis. The graph displaying the E-Field along the insulator is clearly displayed on the Tablet/Laptop while in the field enabling th**e user to determine the condition of the insulators in the insulator string and make a GO/NOGO** (safe or dangerous) decision.

The bells on the Porcelain insulator strings are counted by the Insulator Tester's two integrated infrared detectors, referred to as IR1 and IR2 (see Figure 1), and the E-Field at each bell is recorded. Defective bells are easily identified using the resulting data graphs that present the contour of the E-Field along the porcelain insulator string. The Insulator Tester contains a microprocessor that processes and records the information scanned.

After an insulator string is scanned by the Insulator Tester Operator, the Tablet Operator downloads the Insulator Tester's data via a Bluetooth communication link to the Tablet/Laptop for immediate analysis.

The data is stored in ASCII format in order to be compatible with any text editor, including Excel spreadsheet and Microsoft NOTEPAD, plus the ASCII data can be imported into existing customer databases.

**NOTE**

- Verify the Date and Time settings of the Tablet/Laptop
- It is important to disable the WIFI of the Tablet/Laptop to avoid long operating system updates and to avoid interference with the long range Bluetooth communication link while performing a testing session.

## 2.3 Overview

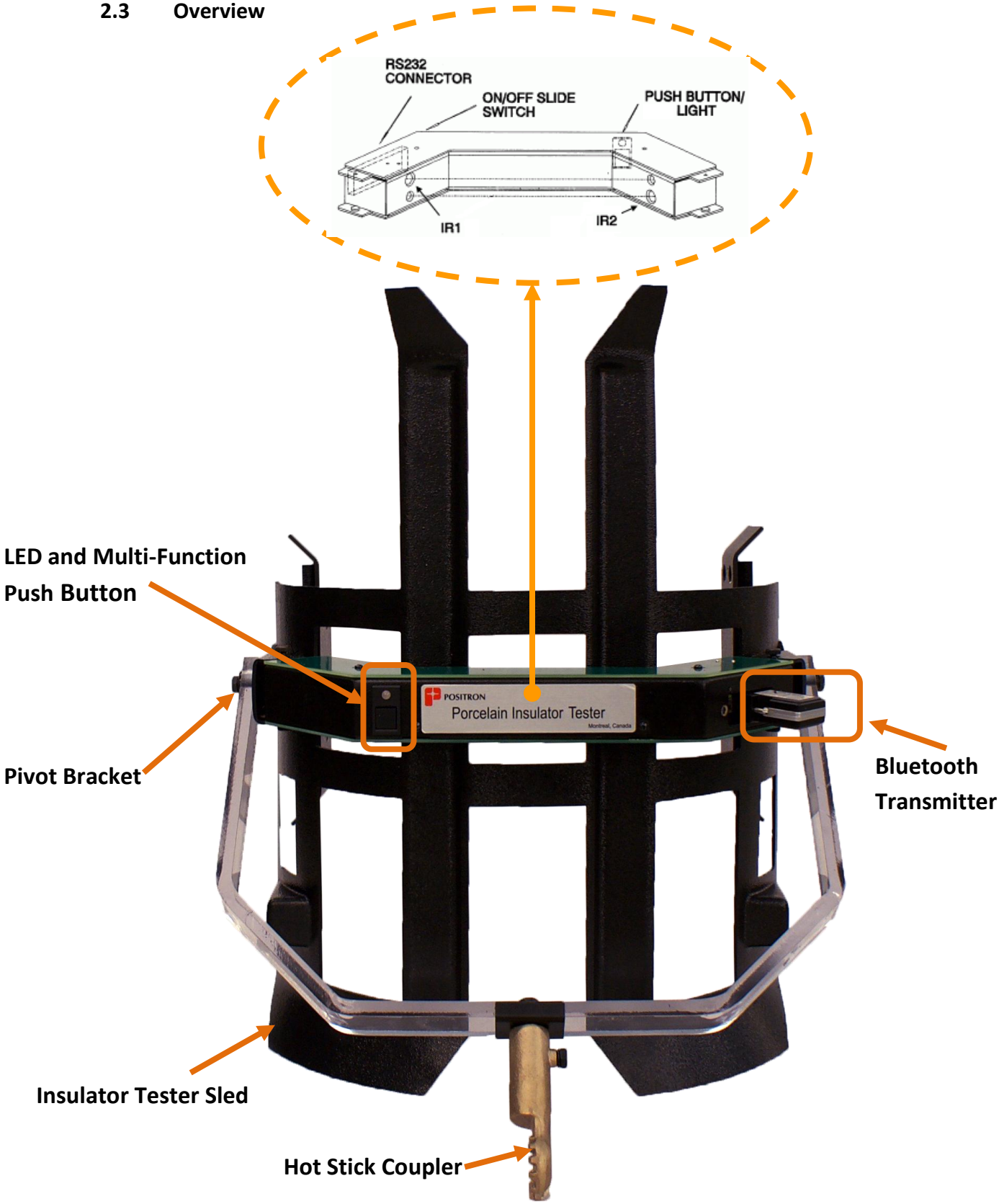



**Figure 1: Porcelain Insulator Tester (P-Tester)**
**Model #s 3781301P/50 (50Hz) & 3781301P/60 (60Hz)**

## 2.4 Porcelain Insulator Tester Model Numbers

For ordering information, contact Positron Customer Support:

North America: 1-888-577-5254, Option 9, Option 1

International: 001-514-345-2220, Option 9, Option 1

**Testers and Model Numbers**

| **Item Description** | **Model Number** |
|---|---|
| Porcelain Insulator Tester, 50 Hz, standard 10” sled | 3781301P/50 |
| Porcelain Insulator Tester, 60 Hz, standard 10” sled | 3781301P/60 |
| 220Vac/120Vac cable charger replacement | 378126 |
| Rechargeable battery pack replacement for the Insulator Tester | 378127 |
| 12Vdc auxiliary automotive power cable charger replacement | 378128 |
| RS232 Bluetooth adapter replacement | 378325/3 |
| Replacement adjustable sled for Porcelain insulators with diameters from 23cm to 33cm (9” to 13”) | 378612 |
| Alternative adjustable sled for Porcelain insulators with diameters from 23cm to 33cm (9” to 13”) | 378603 |
| 50 Hz E-field Insulator Tester for Porcelain Insulators (no sled) | 378605 |
| 60 Hz E-field Insulator Tester for Porcelain Insulators (no sled) | 378606 |
| Replacement cover plate for Insulator Tester power switch | 378613 |

# Chapter 3

## Porcelain Insulator Tester Elements

# 3.0 Description of the Porcelain Insulator Tester Kit

## 3.1 The Porcelain Tester Kit

The Porcelain Insulator Tester kit consists of:

- User manual
- A Quick Start Guide
- A rugged carrying case
- An Insulator Tester E-Field Probe
- An adjustable Porcelain Insulator Tester Sled
- USB key loaded with Insulator Tester user manual and PC software installer
- A 12Vdc auxiliary automotive power cable charger
- Additional sled spacer set to accommodate various insulator sizes
- An RS232 Bluetooth Serial Adaptor, pre-paired with the Tablet/Laptop
- A Tablet/Laptop with Insulator Tester Data Processing Software installed
- Plug-in wall transformer: 120Vac/220Vac input, 12Vdc output (includes international wall-plug adaptors)
- Spare switch cover

The Tester Operator Interface (see Figure 2) consists of:

- a push-button
- a Status LED
- an internal tone generator


**Figure 2**

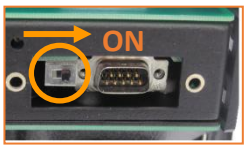
An ON/OFF switch is located to the left of the RS-232 connector underneath the Power Switch Cover. Remove the Power Switch Cover and slide the switch to the right to switch the Insulator Tester on. Slide the switch toward the left to switch the Insulator Tester off. See Figure 3.

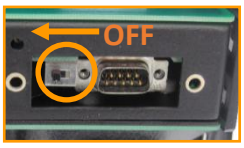
CAUTION

**DO NOT SWITCH THE POWER OFF BEFORE DOWNLOADING DATA.**
When the power is switched off the accumulated data in the Probe is lost.


Location of Power Switch Cover


Power Switch Cover




Power Switch

Figure 3

The Insulator Tester uses two infrared detectors to identify the direction of the scanning motion. Please refer to Figure 4. The two infrared detectors are identified as IR1 and IR2.

The RS232 connector port is used to recharge the Insulator Tester's battery and to connect a Bluetooth adapter for data transfer.

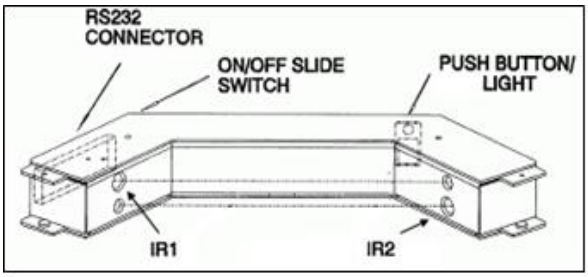



Figure 4

## 3.2 Tester Charger

The Insulator Tester's battery is recharged using a 120Vac/220Vac universal wall charger connected to a cable with a DB-9, RS232 female connector to connect to the Insulator Tester. A set of AC charger adaptors is provided to accommodate various country standards. For charging the Insulator Tester in the field, a 12Vdc auxiliary automotive charger cable terminated in a DB-9 connector is supplied to recharge the battery from a car or truck.

Both the AC power charger and the automotive DC charger are equipped with an LED status to report on the charging status. When first plugged in to charge, the LED will glow red. After 9 hours on charge, the LED will glow green, indicating that the charging time is completed.

**NOTE**

The battery should be recharged overnight the day before a testing session. The battery charge will last one day with the power switch in the ON position.

The battery can be recharged with the power switch in the ON or OFF position, however the Insulator Tester will charge faster when switched off.

**CAUTION**

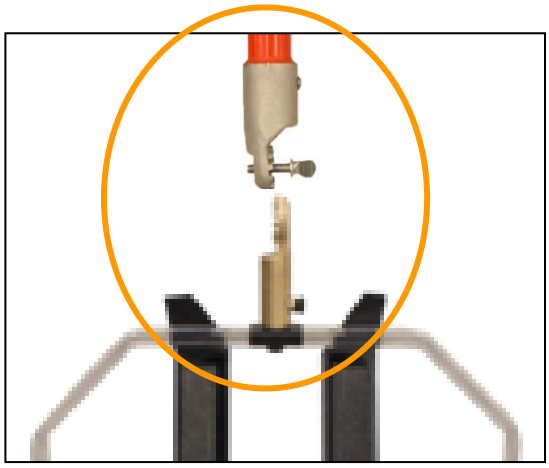
The data accumulated by the Insulator Tester must be transferred via Bluetooth to a Tablet/Laptop prior to switching the Insulator Tester off or the data will be lost.

## 3.3 Insulator Tester Sled

The Insulator Tester mounts on a non-metallic sled. The sled permits the Insulator Tester to slide along an insulator string.

Together, the sled and Insulator Tester attach to a hot stick via the coupler mounted on the sled's bracket. See Figure 5.


**3781301P/x Insulator Tester mounted on sled showing hot stick coupler**

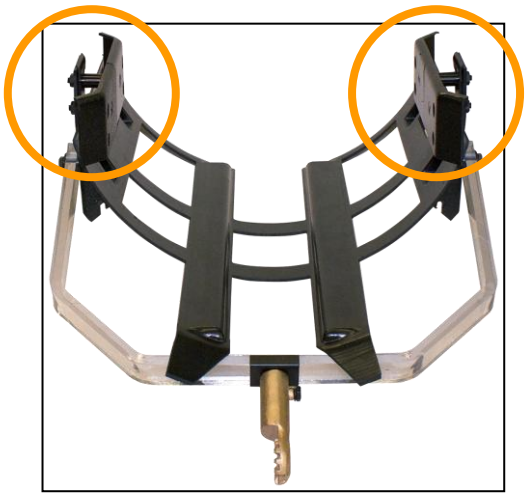


**Insulator Tester Sled Hot stick Coupler**

**Figure 5**

## 3.4 Sled Adjustments

The sled is equipped with adjustable skids to accommodate the different insulator sizes. A spacer kit is provided if the sled skids require adjustment. See Figure 6.



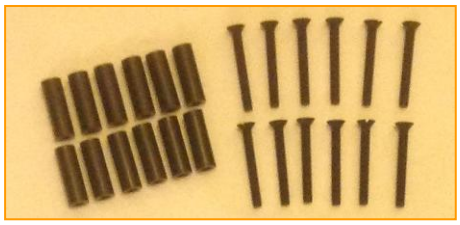


**Figure 6**

## 3.5 Tablet/Laptop PC

### 3.5.1 General

A Tablet/Laptop is provided with the Insulator Tester. The Tablet/Laptop is Bluetooth-enabled and is shipped paired with the Bluetooth adapter of the Insulator Tester. Refer to Figure 7.
The Insulator Tester Data Processing Software is pre-installed on the Tablet/Laptop.

The Tablet/Laptop is used on-site for transfer of the data from the Insulator Tester after one or more scans of one insulator to immediately view the resulting graphs (interactive mode). The transfer of data to the Tablet on-site avoids the risk of data loss should the Insulator Tester be switched off.

Figure 7

CAUTION

**The Tablet/Laptop should <u>not</u> be used by a High-voltage Tower Worker/Technician for safety reasons. The Tablet/Laptop is to be operated by a member of the Tablet Team on the ground.**

### 3.5.2 Separating the Tablet While in the Field

When using the Tablet/Laptop in the field, it is best to separate the Tablet from its associated keyboard, as shown in Figure 8. The operating procedure in the field does not require the keyboard.

When attached, the keyboard is useful when creating insulator lists and preparing for the field visit.

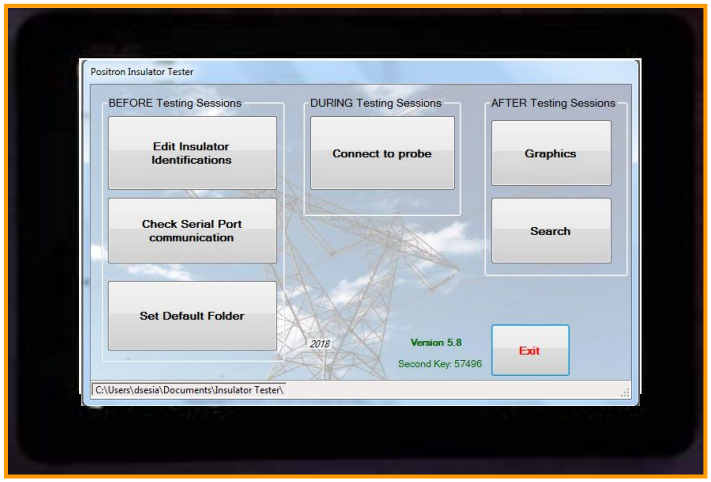
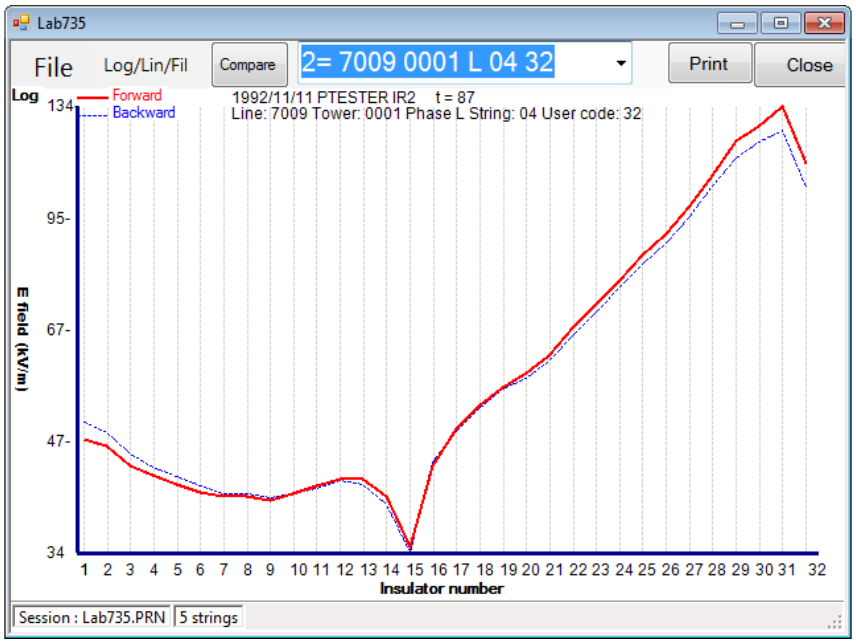



Figure 8

The Tablet's large *"Touch Buttons"* are used to operate the Windows-based Positron Insulator Tester Software in the field.

While the **Ground Operator (Tablet Operator)** is using the Tablet/Laptop on the ground, the **Tower Technician (Tester Operator)** tests the insulator string. Once a scan of an insulator is completed, the **Tablet Operator** immediately downloads the results via the Windows-based software to the Tablet and can see the profile of the E-field surrounding the tested insulator string, thereby revealing its health, and determining immediately if a hazardous condition exists prior to live line transmission work.




**Example Only**

After a remote (tower to ground) download (interactive mode), the Tablet Operator can choose to **Accept** or **Reject** the data from the last insulator tested. Once data is accepted or rejected, the data in the Insulator Tester is flushed, allowing the crew to proceed to scan the next insulator string or the same insulator string again.

**The intensity of the Tablet's screen display is factory adjusted to its maximum setting. If this setting was changed by a user, it is important to adjust the intensity of the screen back to the maximum (Select 100% after selecting the small battery icon).**

**Additionally, polarized sunglasses may prevent easily seeing the display on the Tablet screen in Landscape mode (long edge of the Tablet screen is horizontal).**

**In this situation, rotate the Tablet 90o to switch to Portrait mode (short edge of the Tablet screen is horizontal). Otherwise, avoid the use of polarized sunglasses during use.**

# Chapter 4

## Windows Based Software

# 4.0 Windows-based Insulator Tester Software

The Positron Insulator Tester Software is factory-installed on the Tablet/Laptop shipped with the Insulator Tester. Similarly, the RS232 Bluetooth adapter has been factory-paired with the Tablet/Laptop shipped.

## 4.1 Insulator Tester Software Description

The Tablet/Laptop is Windows based and has the Positron Insulator Tester Software pre-installed. All data formats are backward compatible. The long range Bluetooth Class I device enables on-the-spot remote downloading.

The Windows-based Insulator Tester Software is used:

A) **BEFORE** the testing session:

- To create and store one or more lists of insulators to identify the insulator strings to test
- To test the Bluetooth communication between the Tablet and the Insulator Tester
- To set up a working folder

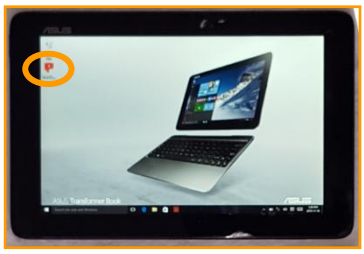
B) **DURING** the testing session

- To remotely download the data scanned by the Insulator Tester
- To identify last scanned insulator from the list
- To display the graphic representation of the E-field along with the identification of the insulator
- To make on-site **GO/NOGO** decisions based on the severity of the defects detected
- To retain or discard the immediate results of a downloaded insulator test
- To signal the Insulator Tester Operator to repeat the scan or proceed with the next scan.
- To put the Insulator Tester in sleep mode after the testing of all insulators of a tower

C) **AFTER** the testing session

- To use as a reference database to evaluate insulator degradation over time
- To display the relative health of insulators using graph of the E-field along an insulator string taken during live-line conditions
- To use this information to determine where and when preventative action needs to be taken to prevent failures
- To use as a tool in the asset management associated with all manner of HV insulators, station hollow posts, bushings, lightning arrestors, etc, of both Porcelain and Composite (Polymeric) varieties

The Insulator Tester Software has been pre-installed on the Tablet/Laptop supplied with the unit. The icon for the Insulator Tester Software appears on the main-touch screen.



## 4.2 The Bluetooth Serial Adaptor

The long-range (100m) Bluetooth serial adaptor is powered by the Probe Module and has been paired with the Tablet/Laptop supplied with the Porcelain Insulator Tester.

## 4.3 Instant Graphical GO/NO-GO Reporting Capability

The Positron Porcelain Insulator Tester enables an on-site **GO/NOGO** decision making capability. A scan instantly downloaded to the Tablet/Laptop from the Insulator Tester is used to get a graphic representation of the E-field distribution of a porcelain insulator string showing all defective discs. A decision for emergency replacement or establishing safety levels for live-line work can then be made.

During the scanning of an insulator, the Insulator Tester Operator manipulates the Insulator Tester with a hot stick, while the Tablet Operator uses the Tablet/Laptop on the ground. Once the scan is done, the Tablet Operator can immediately download the data to get the graphic representation of the distribution of the E-field along the porcelain insulator.

Once the Tablet Operator has downloaded the data from the Insulator Tester and has viewed the graph of the insulator's E-field, the Tablet Operator can choose to **Accept** or **Reject** the scan using the Windows-based Insulator Tester software interface installed on the Tablet/Laptop. In either case, the data in the Insulator Tester gathered during the scan will be deleted after download to the Tablet/Laptop.

# Chapter 5

## Using the Porcelain Insulator Tester & Software

# 5.0 Using the Interactive Insulator Tester & Software

The Porcelain Insulator Tester and Tablet/Laptop are used together in the field. The Tablet Operator controls the Tablet/Laptop running the Windows-based Insulator Tester Software while the Insulator Tester Operator controls the Porcelain Insulator Tester and scans the insulator string.

After a scan of a porcelain insulator, the Tablet Operator can instantly download the resulting data obtained by the Insulator Tester Operator. Once downloaded, the Tablet Operator can view the E-field profile of the scanned insulator on the screen of the Tablet/Laptop and the relative health of the insulators in the string can be assessed while in the field.

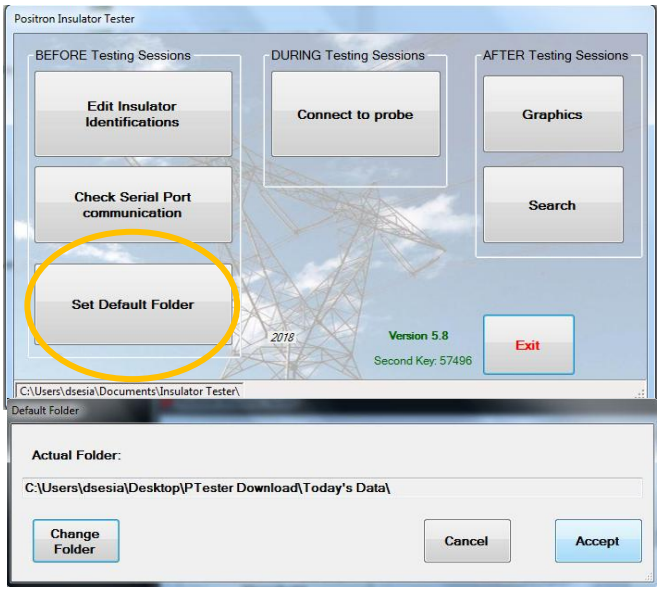
Using the Tablet/Laptop, the Tablet Operator can choose to **Accept** or **Reject** the scan. In both cases, once a choice has been made by the Tablet Operator the data in the Insulator Tester is erased. If the choice is made to **Accept** the scan, the data is stored on the Tablet/Laptop.

## 5.1 BEFORE Testing Sessions

If required, adjust the date and the time of the tablet. Begin by double-clicking the Insulator Tester icon. Ensure that the Bluetooth feature is enabled on the Tablet/Laptop.

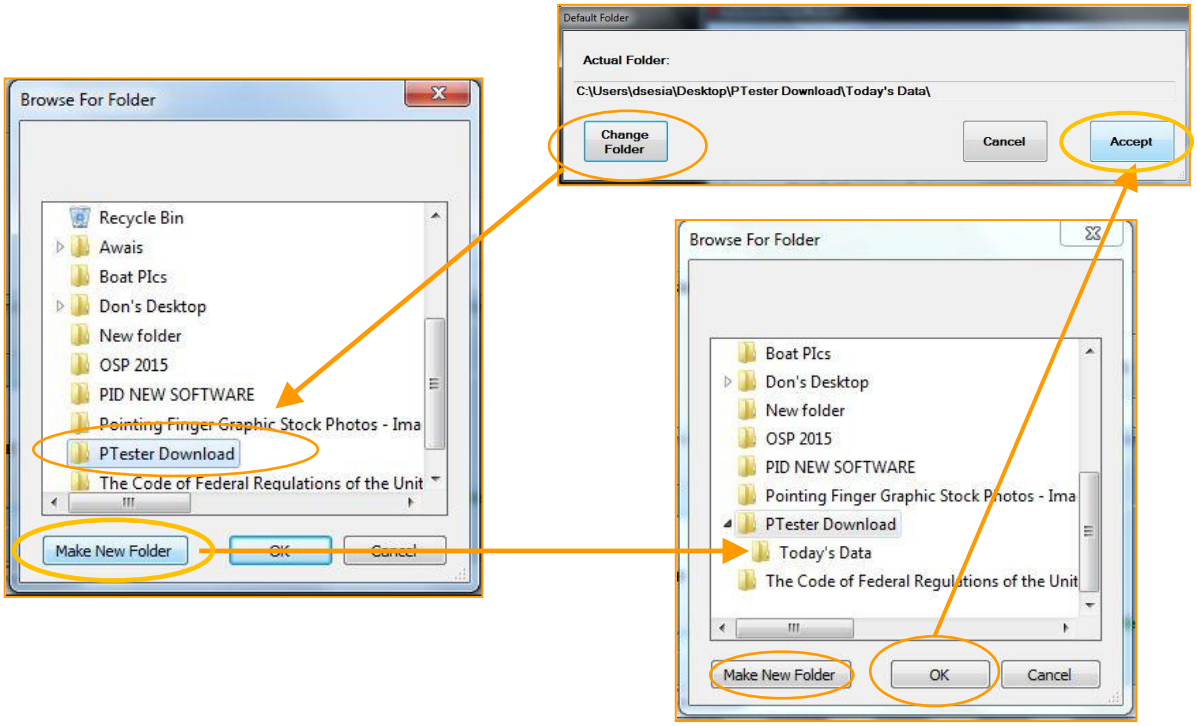

### 5.1.1 Select the Default Folder

First, set the Default folder where the data will be stored. From the screen, select **Set Default Folder**. A dialogue box will be returned showing you the default file location.



### 5.1.2 Changing the Folder

You can change the default location and folder name by selecting **Change Folder**. The **Change Folder** selection and Windows OS will guide you through the steps. Be sure to select **Accept** at the end of the process.



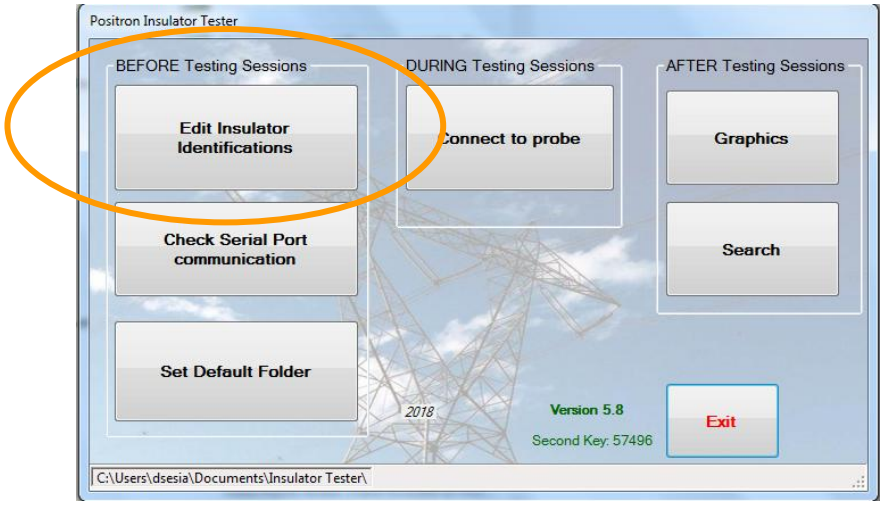

### 5.1.3 Create a List of Insulator Identifications

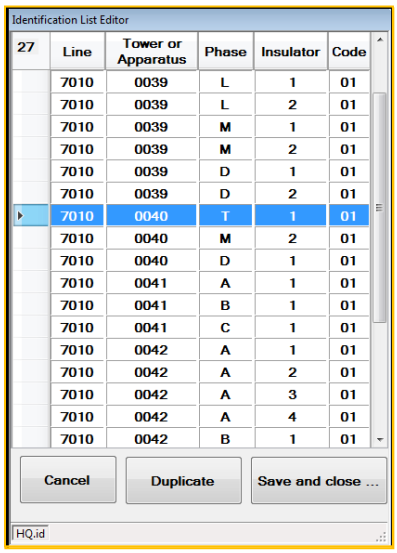
Create a listing of all insulators to be tested during an upcoming Testing session. This list will be used during a testing session to identify each insulator. This is best done with the Tablet engaged with the keyboard for ease of typing.

To create an Insulator Identification List, you have 3 choices:

- Select **Edit Insulator Identifications** and type in the list on the tablet PC
- Install the Positron Tester Software on any Windows based Desktop and type in the list. This part of the software is not copy protected; no Software Activation Key is required for this operation. The file created has the suffix ".ID". This file can then be copied from the Desktop to the Tablet PC using the USB memory stick supplied with the equipment. Copy the file in the Folder selected in the previous section of the manual: "Changing the Folder"
- If the Power Utility has already a long list of Insulator Identifications in Excel or ASCII format, Positron can assist in the conversion to ".ID" format. Note: The ".ID" file can be edited using any ASCII editor such as Microsoft Notepad.

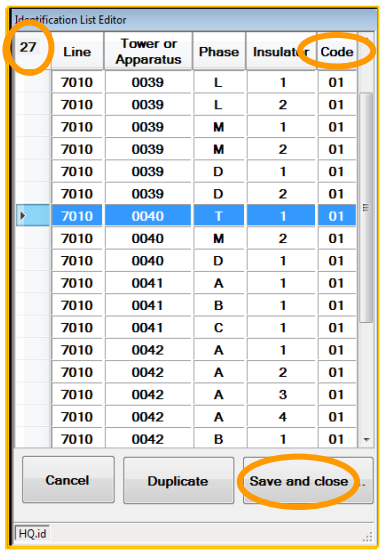
A dialogue window will open so you can open the **Default.id** file. This will be used to enter the information identifying the insulators to be scanned.



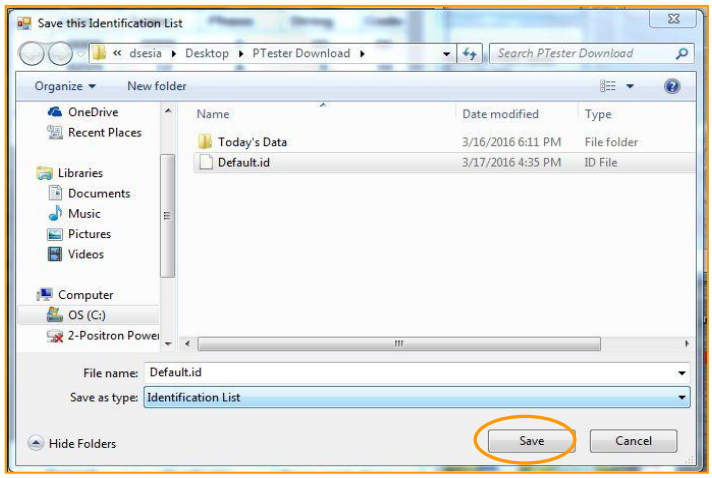

The **Identification List Editor** will open. Edit a field by clicking into it and move to the next field using the **TAB** key on your keyboard. The **ENTER** key will bring you to the field immediately beneath.

With the list completed, select **Save and Close**. This will open the **Save this Identification List** dialogue box.




(**Note** that number shown in the upper-left corner of the **Identification List Editor** corresponds to the number of entries there are in the list. Enter any user defined code in the **Code** field.)

Enter a name for your list, and click **Save**. The list is saved with a file suffix of **".ID"**.



### 5.1.4 Verifying Communication Before a Testing Session

Prior to going out in the field to use the Porcelain Insulator Tester, testing the Bluetooth communication between the Insulator Tester and the Tablet/Laptop is advised. This can only be done with the PC Insulator Tester software activated. After communication has been established, the Insulator Tester and Bluetooth adaptor can be switched off again before going out into the field.

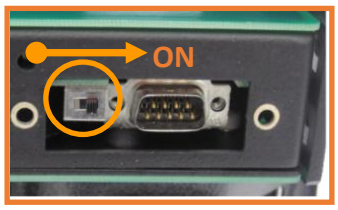
### 5.1.5 Switching the Probe On

To switch on the Insulator Tester, remove the Power Switch Cover and move the power switch to the right, toward the DB-9 connector, as shown in Figure 9. The Insulator Tester will first enter the Power-On Self-Test (**POST**). See 5.1.5.1 for details.

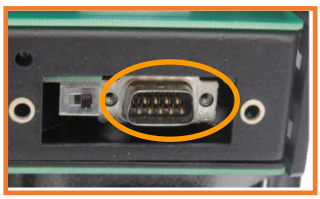
Ensure the slide switch on the Bluetooth adapter is in the DCE position. Insert the Bluetooth Serial adapter into the DB-9 Serial port of the Insulator Tester. The Bluetooth Serial adapter is powered by the battery of the Insulator Tester.


**Location of Power Switch Cover**


**Locate Power Switch Cover and remove**




**Slide the Power Switch to the right to the "ON" position, toward the DB-9 connector**



**Ensure the slide switch on the Bluetooth transmitter is in the DCE position.**

**Figure 9**

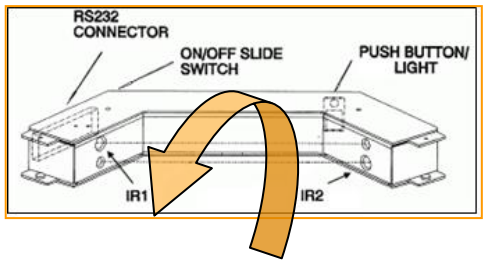
#### 5.1.5.1 Power-On Self-Test (POST) of the Insulator Tester

Upon switching the Insulator Tester on, the **POST** process commences and the infrared detectors are verified.

**The power-up sequence for the 3781301P/x Porcelain Insulator Tester is described below:**

1. Apply power by sliding the switch located on the side of the Insulator Tester, underneath the Switch Cover, toward the RS232 connector
2. The LED will flash **Amber** once
3. The LED will then flash **Green** four times
4. After which, a long tone begins and the LED will flash **Amber** 10 times or less if the IR sensors (IR1, IR2) are manually interrupted.
5. If the **Red** LED begins flashing, then the Insulator Tester's infrared sensors are being obstructed. Ensure that there are no obstructions and that the lenses are not fouled. The **Red** LED will stop flashing the moment the infrared beams are unobstructed.

To fully check the 2 infrared beams (IR1, IR2), make a hand-pass through the beams, inside the sled near the Insulator Tester at the beginning of the long tone**.**

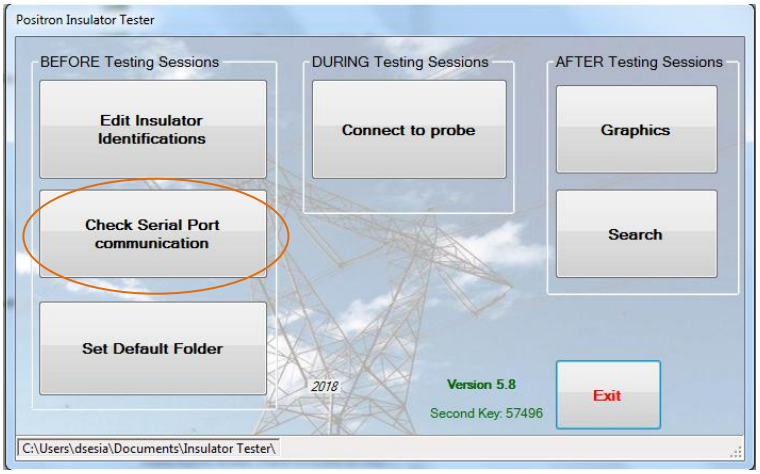



Once the infrared beams have been interrupted, or after flashing 10 times, the LED and the tone will shut off.

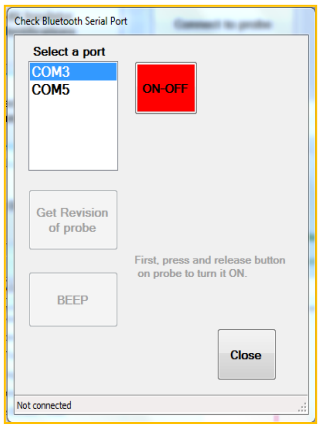
Once the Insulator Tester has been switched on and the **POST** procedure is finished, communications between the Insulator Tester and the Windows-based software on the Tablet/Laptop must be tested.

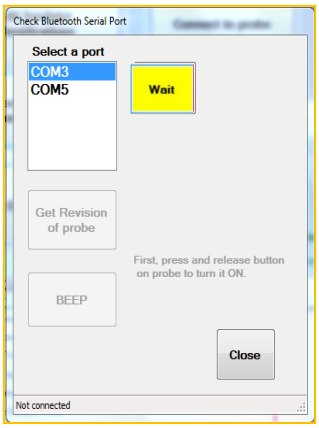
### 5.1.6 Check Bluetooth Serial Port Communication

Select the **Check Serial Port Communication** button to verify Bluetooth connectivity between the Tablet/Laptop and the Insulator Tester prior to going into the field.




The **Check Bluetooth Serial Port** dialogue screen will appear. Select the COM Port used by the Tablet/Laptop to communicate with the Bluetooth adapter.



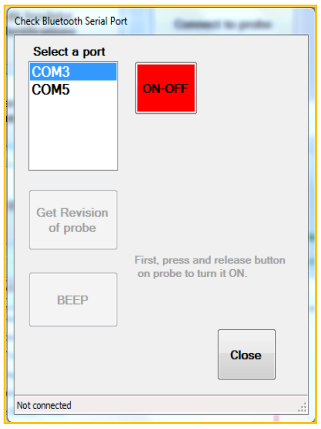





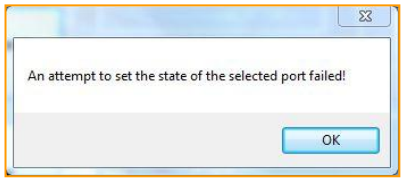
Select the RED **ON-OFF** button. The button will change to YELLOW and “Wait” will appear until Bluetooth communication is established, and then it will change to GREEN.

**NOTE**

If the button does not change to **YELLOW** and read "Wait", but changes to **GREEN** immediately, try another port. If the button flashes **YELLOW** before **GREEN**, you have connected to the correct COM port. If the incorrect COM Port has been selected, an error message may be returned. If so, change the COM Port and retry.








These steps verify communication with the Tablet and the Insulator Tester's Bluetooth RS232 Adapter. Take note of the COM port associated with the Bluetooth Adapter. This COM port will need to be reconnected once the unit is taken to the field for a scanning session.

It is important not to transport the Insulator Tester to the testing location with the Bluetooth Adapter inserted in the DB9 connector. This is to avoid possible physical damage during transport.

**NOTE**

**The buttons in the Insulator Tester Software change to GREEN once each software function receives an acknowledgment from the Insulator Tester. If a button in the Insulator Tester Software changes to RED after it has been GREEN, the Insulator Tester may be in sleep mode and the Push Button of the Insulator Tester must be pressed to bring the unit into Awake Mode.**

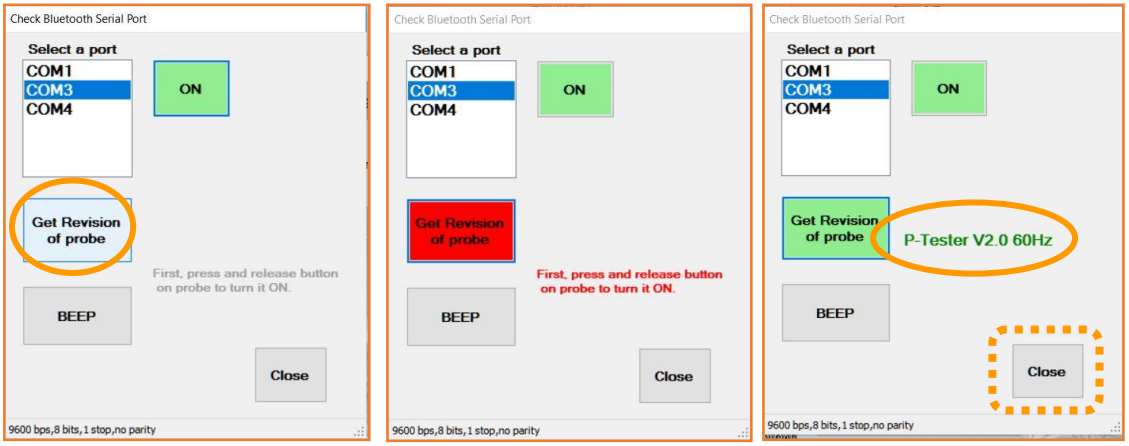
### 5.1.7 Get (Firmware) Revision of Probe

Select **Get Revision of Probe** to receive the Insulator Tester's internal Firmware Revision level. Normally, this function is used by Positron Technical Support when troubleshooting the Insulator Tester. In this instance, the function is used as a confirmation that the Tablet/Laptop can communicate a command to the Insulator Tester and that the Insulator Tester will respond via the Bluetooth communication through the associated COM Port.

Once you have selected **Get Revision of Probe,** communication between the Tablet and Insulator Tester is established. Ensure that the Probe is in **Awake Mode** by pressing the push button of the Insulator Tester probe. See Figure 10. If required, select **BEEP** after the Insulator Tester is awakened.


**Figure 10**

This step verifies that the Tablet/Laptop can communicate with the Probe. Once Bluetooth connectivity and functional communication are verified, first press the **Close** button to close the "**Check Bluetooth Serial Port**" dialog. Then the Power switch of the Probe can be switched OFF after pressing the **Close** button to save power. The Probe will be switched on again in the field when scanning is to begin.

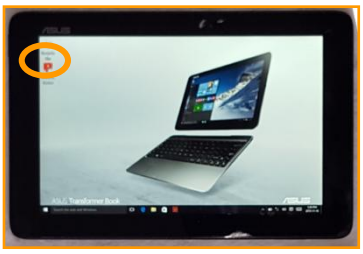



**Firmware Revision shown above is for illustrative purposes only.**

NOTE

**Before going out into the field for an insulator scanning session, ensure the Positron Insulator Tester and Tablet/Laptop are fully charged. The batteries of the Tablet/Laptop are best maintained for longer life by recharging before the battery charge depletes below 50%.**

## 5.2 DURING Testing Sessions



It is important to disable the WIFI of the Tablet/Laptop to avoid long operating system updates and interference to the Bluetooth communication link while performing a testing session.

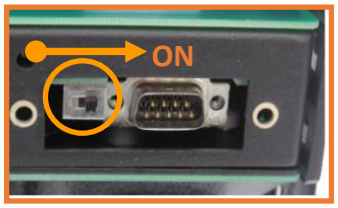
Equipped with the Tablet separated from the keyboard, the Tablet Operator launches the Insulator Tester Software. Optionally, the camera of the Tablet/Laptop can be used take a picture of the tested tower.

To activate the Probe, remove the Power Switch Cover and move the power switch to the right, toward the DB-9 connector, as shown in Figure 11. The Insulator Tester will first enter the Power-On Self-Test (**POST**) as described in 5.1.5.1.

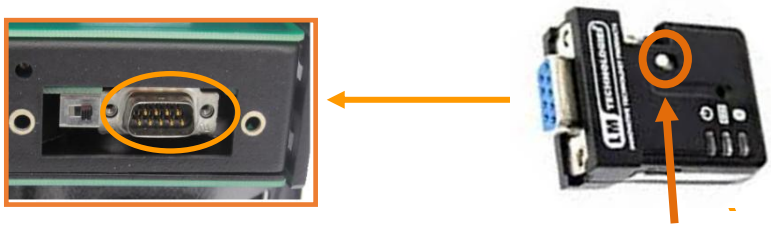
Ensure the slide switch on the Bluetooth adapter is in the DCE position. Insert the Bluetooth Serial adapter into the DB-9 Serial port of the Insulator Tester. The Bluetooth Serial adapter is powered by the battery of the Insulator Tester.


**Location of Power Switch Cover**


**Locate Power Switch Cover and remove**



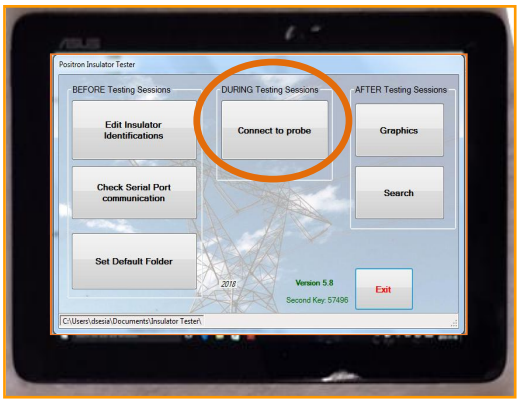

**Slide the Power Switch to the right to the "ON" position, toward the DB-9 connector**



**Ensure the slide switch on the Bluetooth transmitter is in the DCE position.**

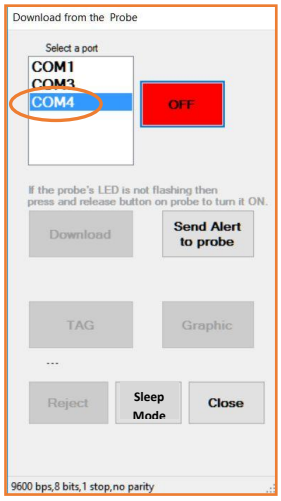
**Figure 11**

Ensuring that the Insulator Tester has been switched **ON**, select **Connect to Probe** and reconnect to the same COM port noted in the communications check performed prior to going out in the field for a scanning session.

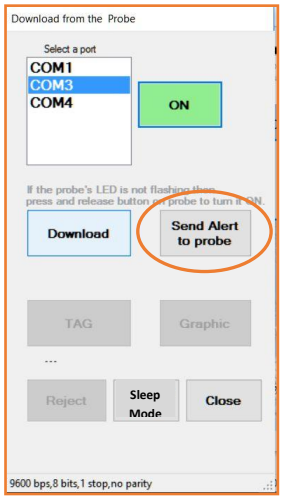



Select the appropriate COM Port, and Select **ON.**

Use the **Send Alert to Probe** button in the field to check the communication link. The Probe will respond with an annunciating tone.








With communication confirmed, the Insulator Tester Operator can now ascend the Tower. Once in position, the Insulator Tester Operator should press the Insulator Tester's button to ensure it is in **Awake Mode**. If not, the Tablet Operator will be unable to signal the Insulator Tester. Ensure that the LED of the Insulator Tester is flashing GREEN.

After 8 minutes of no communication, the Insulator Tester will go into Sleep mode. The Tablet Operator can keep the Insulator Tester awake by sending a download request or by pressing the **Send Alert to probe** button in the Windows based Insulator Tester Software interface.

### 5.2.1 Scanning an Insulator

To scan a Porcelain Insulator String, the operator has two choices:

- **Two-Way scan:** On Horizontal and V strings configuration, it is easier to perform a Two-Way scan because the weight of the Tester is counter-balanced by the hot-stick or the top of the insulator string while sliding over. Before the sled is touching the insulator string in the middle, the weight of the Tester is counter-balanced by the length of the hot-stick. After the scan is completed, the sled is removed from the insulator string and the weight of the Tester is counter-balanced again by the length of the hot-stick. One or more discs scan overlapping is required between location 1 and 5 to make sure every insulator is scanned at least twice. See Figure 13.
- **One-Way scan:** On Vertical string configuration, it is easier to perform a One-Way scan because the backward scan requires too much force to move the sled upward while the hot-stick is horizontal. See Figure 15

**Note:** The choice of the One-Way or Two-Way scan and the order (phase B before phase A, etc.) of testing of the insulators in a tower is normally the decision of the Tester Operator (not the Tablet Operator) during a testing session.

#### 5.2.1.1 Performing a Two-Way Scan

Once the Insulator Tester is securely fastened to the sled and the hot stick is attached, follow this procedure, per Figure 13:

1. Following the instructions of the Tablet Operator, press the Push-button on the Insulator Tester (See Figure 12) and place the Insulator Tester a minimum of 4 bells (disks) away from the grounded end. See the **Green Zone** in Figure 13.


**Figure 12**

2. Then slide the Insulator Tester to the beginning of the grounded end of the porcelain insulator string.
3. Slide the Insulator Tester toward the high voltage end of the string. A tone will sound each time a reading is taken at each insulator disk,
4. Slide the Insulator Tester back toward you a minimum of 2 bells (disks) beyond where you initially placed the unit so that the backward scan will overlap the beginning of the scan.

5. Remove the Insulator Tester from the insulator string and wait for the download initiated by the Tablet Operator.

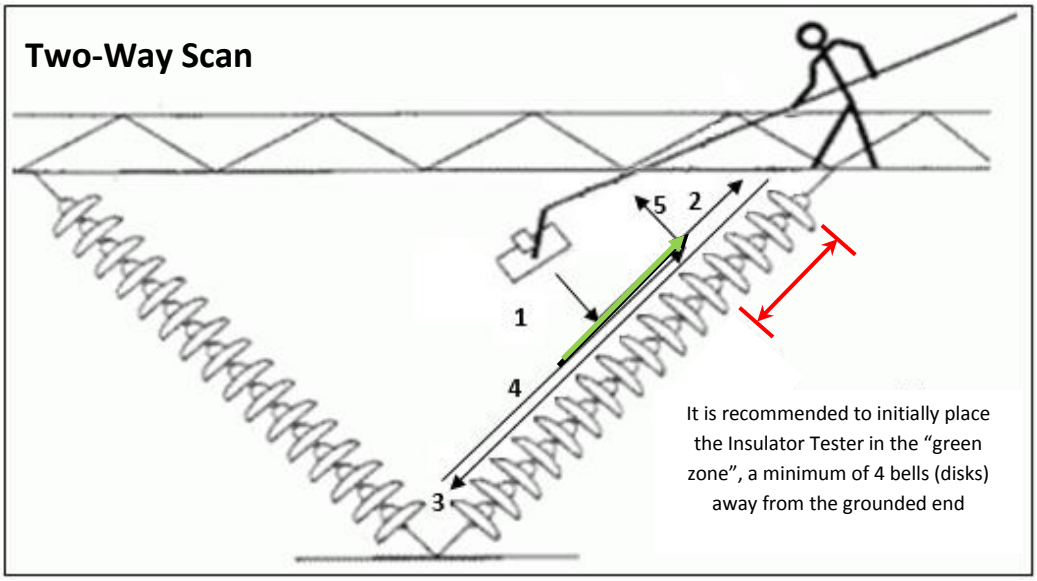



**Figure 13**

- After selecting **Connect to Probe,** the Tablet Operator will **Download** the scanned data to the Tablet/Laptop PC to identify the insulator, view the resulting graph and will **Accept** or **Reject** the scan. In either case, the data is wiped from the Insulator Tester leaving the Insulator Tester ready for the next scan.
- The Tablet Operator selects **Send Alert to Probe** and the annunciator tone attracts the attention of the Insulator Tester Operator so the Tablet Operator communicates the next step to the Insulator Tester Operator.
- This process is repeated for each insulator string. The Tester Operator doesn't have to press the button on the probe between each scan, unless the probe has timed out after 8 minutes of no activity.

### 5.2.1.2 Performing a One-Way Scan

A One-Way Scan (forward only) can be used if performing a Two-Way Scan (forward and backward) on the insulator string is impractical due to awkward positioning. The data gathered is valid and will produce accurate results and graphs. The backward pass is essentially for a second reading as a comparator. This is why the E-field readings shown on the **RED** (forward) and **BLUE** (backward) traces on the graphs closely match. A One-Way scan is practical on vertical insulator strings since the Tester Operator is working with gravity, reducing the required effort to perform a scan. It is impractical to attempt to slide the Insulator Tester upwards counter to the force of gravity.


**Figure 14**

1. Following the instructions of the Tablet Operator, press the Push-button on the Insulator Tester (See Figure 14) and place the Insulator Tester a minimum of four (4) bells (disks) away from the grounded end. See the **Green Zone** in Figure 15.

2. Then slide the Insulator Tester to the beginning of the grounded end of the porcelain insulator string.

3. Slide the Insulator Tester toward the high voltage end of the string. A tone will sound each time a reading is taken at each insulator disk.

4. Remove the Insulator Tester from the insulator string and wait for the download initiated by the Tablet Operator.

**NOTE**

Although only a **One-Way** scan is necessary, it is sometimes more convenient to do a Two-Way scan based on the orientation of the insulators.

If a **One-Way** scan is used, the insulator can be scanned an optional second time if a fault is suspected and to see if it matches the first scan, thereby confirming the validity of the first scan.

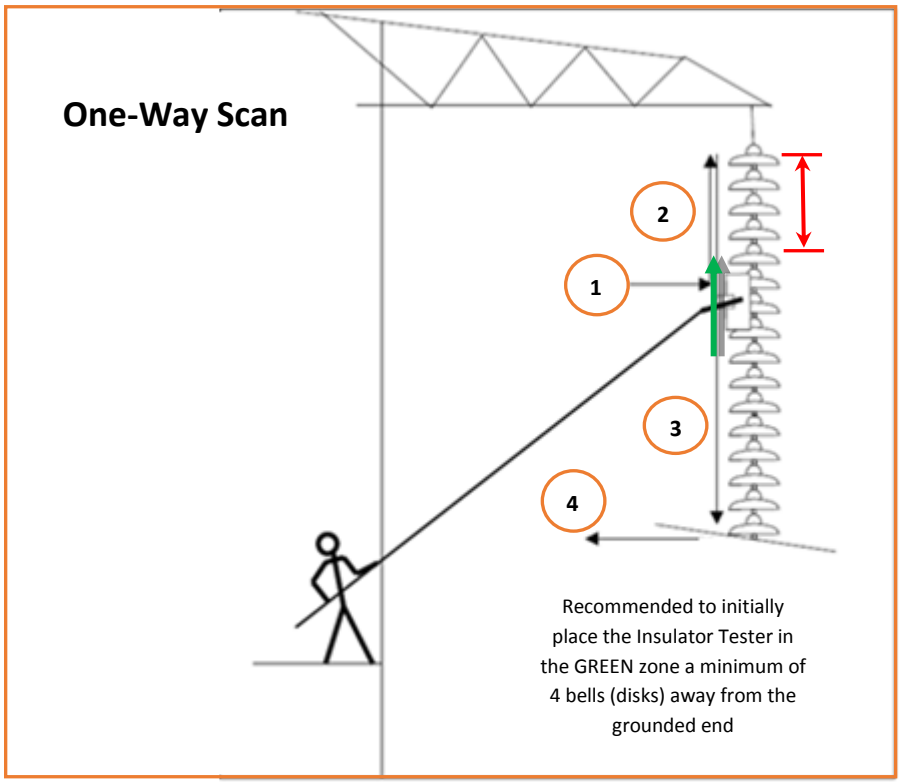


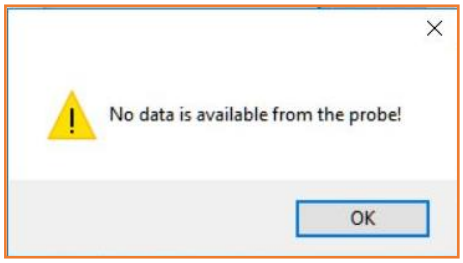

**Figure 15**

### 5.2.2 Downloading Data

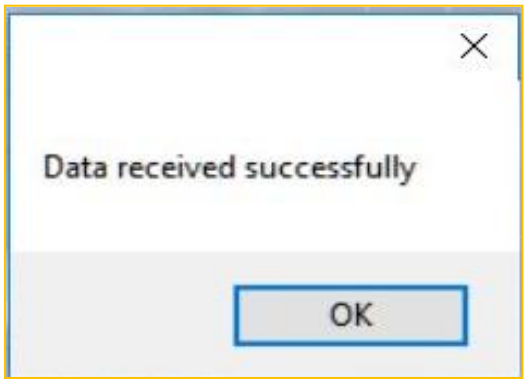
The results of the scans downloaded immediately after the scan are viewed on the Tablet/Laptop PC.

**NOTE**

During the Download process, if a system message is returned stating "**No data is available from the Probe**" this indicates that the Insulator Tester Software is in communication with the Insulator Tester, but that there is no data in the Insulator Tester to download. The **Download** button will still turn **GREEN**, indicating that the Windows-based Insulator Tester Software is able to communicate with the Insulator Tester, but that no data was present.



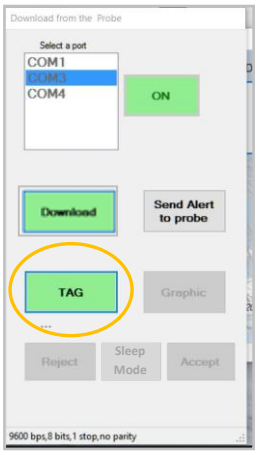

A successful **Download** will be confirmed by a system message stating **Data received successfully** and the **TAG** button will turn **GREEN.**

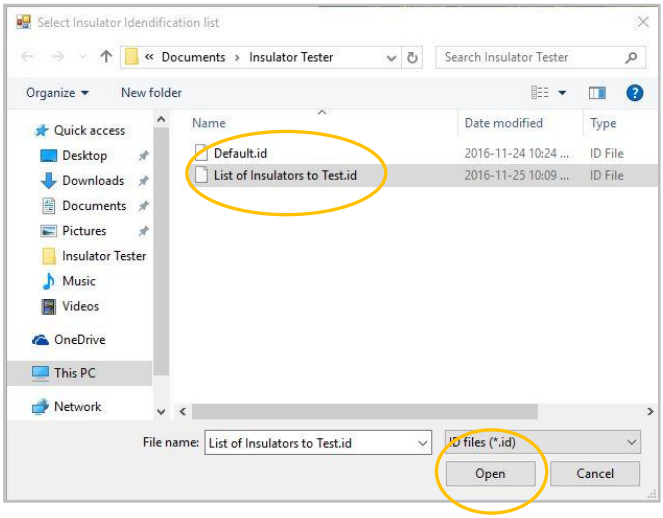


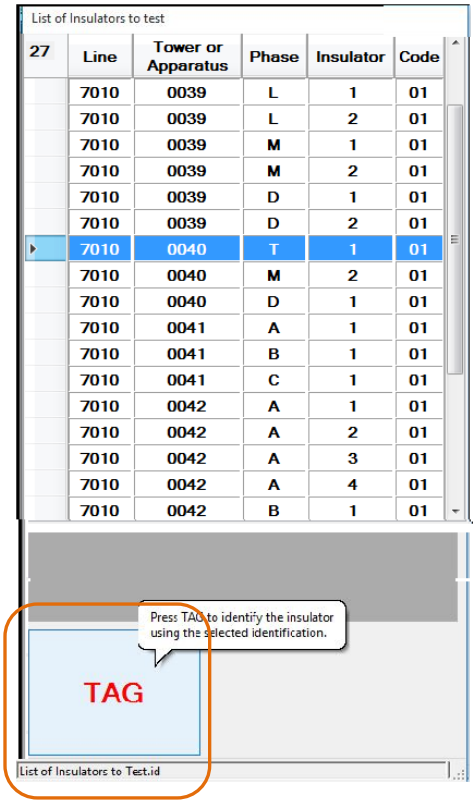


The **Download from the Probe** dialog box on the Tablet will open, showing the graph of the E-Field of the scanned insulator. From this screen, you can associate the insulator scan with an ID created earlier in the Insulator Identification List.

Select **TAG** and the **Select Insulator Identification List** will open.



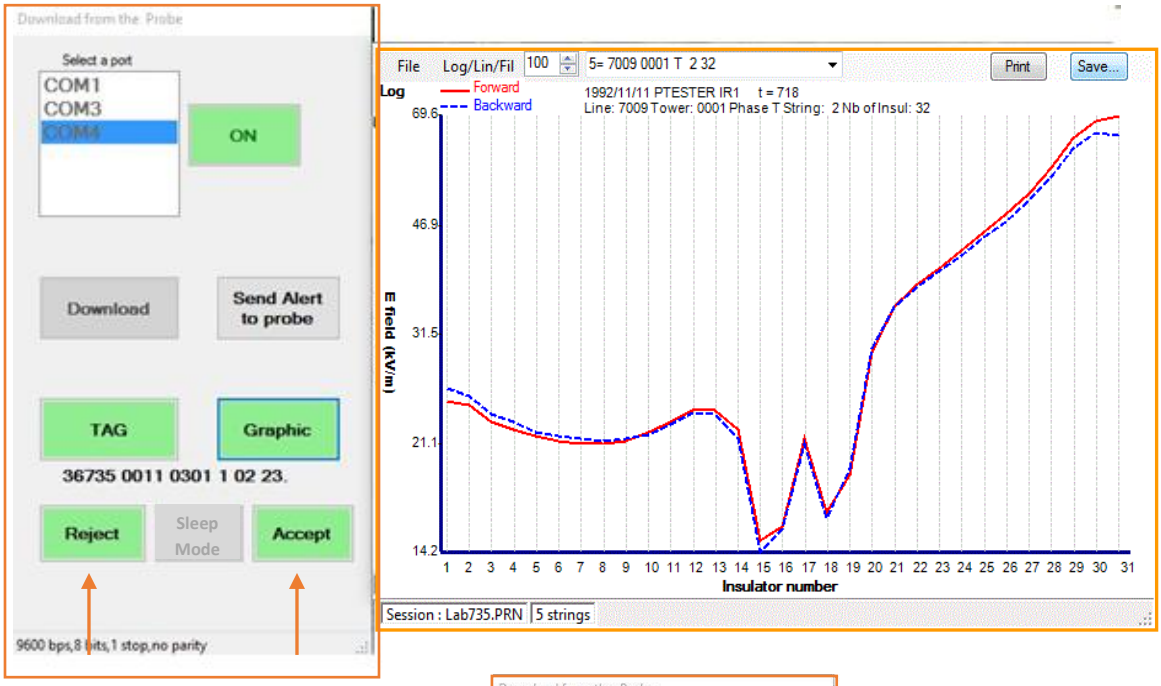

From the **Select Insulator Identification List** you can select and open the Insulator ID List created before the testing session.

Select the Insulator just scanned from the list created earlier, and select **TAG.**

Select **Graphic** to see one or more graphs of the E-Field from scans of the last tested insulator. If more than one scan was done on the last tested insulator, click or touch **Graphic** to see the next related graphic.

An instant determination can be made by the Tablet Operator whether to **Reject** or **Accept** the last insulator scan. Here are some examples of scans to be rejected:

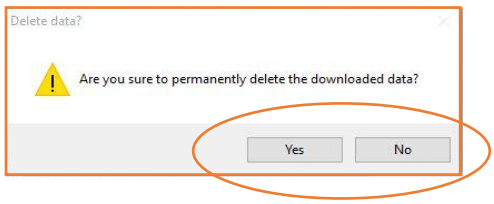
- **Incomplete scan:** The Tester operator stopped for any reasons the scan before reaching the end of the scan
- **Disc missing:** The sled jumped over a disc because the operator didn't apply enough pressure on the hot-stick
- **Forward and backward curves don't match:** If Two-Way scan has been performed, the two curves should be almost identical
- **Practice session:** The first time, it is recommended to perform some "dummy" scans to get used to the manipulation of the hot-stick




If the scan is rejected, a system message will be returned asking if you are sure you want to delete the downloaded data. If **rejected**, the data is erased from the Insulator Tester software.

If **accepted**, the data from the scan, with all identifiers, is retained in the results database of the Insulator Tester Software.

**Note:** In the graph above insulators 15, 16, 18 and 19 are defective.

In the example shown below, the data was accepted by the Tablet Operator.



Once accepted, the next insulator may be scanned. The Tablet Operator can attract the attention of the Insulator Tester Operator by selecting **Send Alert to Probe** and issue the instructions for another insulator scan.

If this was the last planned scan, the Tablet Operator may elect to:

A) Select **Sleep Mode to** put the Insulator Tester into **sleep mode** (The Insulator Tester can be awakened by pressing the Push Button of the Insulator Tester).

B) Optionally, select **Close** button to close the current window (The Bluetooth will disconnect to save power).

If during the process any of the software interface buttons changes to RED when selected, it may mean that the Insulator Tester has gone into sleep mode. The Insulator Tester Operator must be signaled by the Tablet Operator to wake the Insulator Tester by pressing the Insulator Tester's Push Button.

## 5.3 Using the Tester without the Tablet and Bluetooth

It is possible to use the tester in a mode without downloading the data after each scan. This mode requires the Tester Operator to push the button on the probe after each scan in order to store the data in the probe. The data stored in the probe can be downloaded at a later time.

**We do not recommend this method as it has the following disadvantages:**

- The user does not get instantaneous feedback on the condition of the insulator tested.
- A dangerous condition will not be known until after the data is downloaded.
- If a scan is improperly done, this will only be known later and a return trip might be necessary.
- It requires the user to take notes and later correlate manually these notes with actual towers and insulators identification.
- The database created would contain only the E-Field data. The insulator and tower identifications associated with the E-field curves would therefore not be included within the database for future use.

**Advantage of using the Tablet/PC with Bluetooth:**

- The use of the tablet enables the manager to download or type in a list of the towers and insulators to be tested so that the Tablet Operator has an assigned task list for the field work.
- The Tablet Operator and Tester Operator can work together without having to take notes to correlate the towers and insulators tested data curves with the tower identification and each insulator. The curves are instantly tagged by the Tablet Operator to the tower and insulator including phase, etc. This saves a lot of time and also errors that can occur when using a manual identification method.

**Bulk downloading stored data from the probe to a PC:**

- This can be done via the Bluetooth provided with the Tester to a Bluetooth enabled PC.

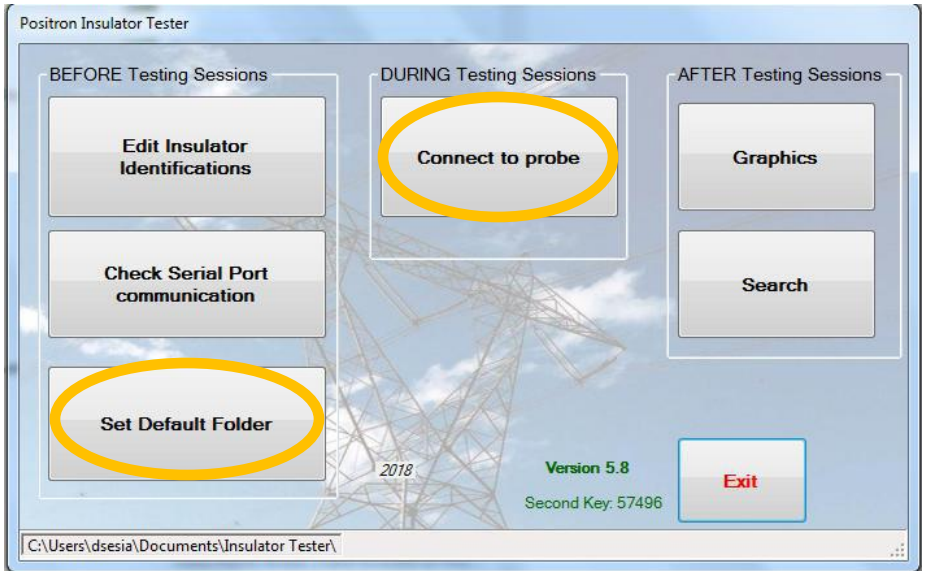
**The following procedure is applicable ONLY for bulk download from the probe if the tablet and Bluetooth are not used in the field. Disregard this procedure when using the Positron Tester in the recommended manner with the tablet/PC and Bluetooth while using the Tester in the field.**

**To download bulk E-field data stored in the probe:**

1- Connect the Bluetooth transmitter adapter to the probe (Ensure the slide switch on the adapter is in the **DCE** position)

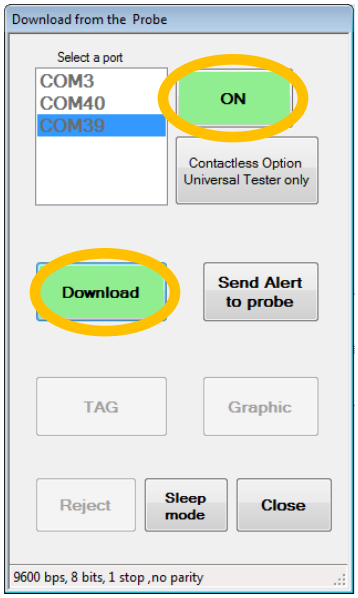
2- Press the push button on the probe


3- Start the Positron software on the Bluetooth enabled Tablet/Laptop PC, select the folder by pressing the "**Set Default Folder**" button then press "**Connect to probe**"

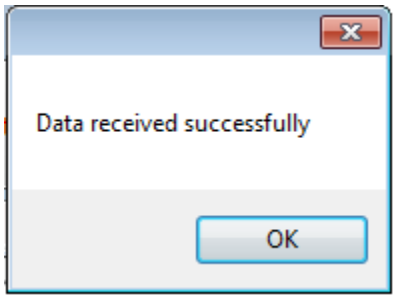



**Main Menu**

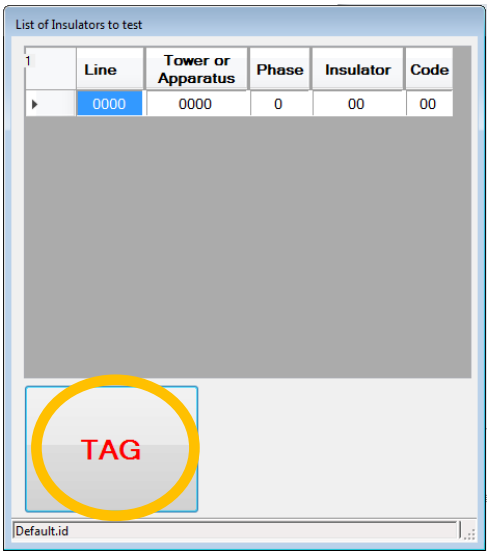
4- Select the COM port and press "**Download**"



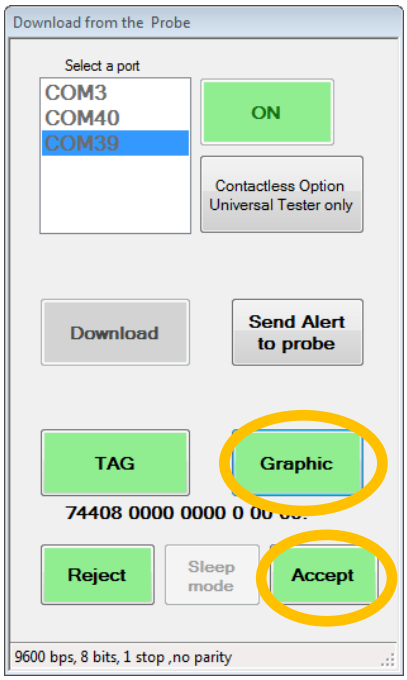

5- After receiving the message "**Data received successfully**", press the "**TAG**" button

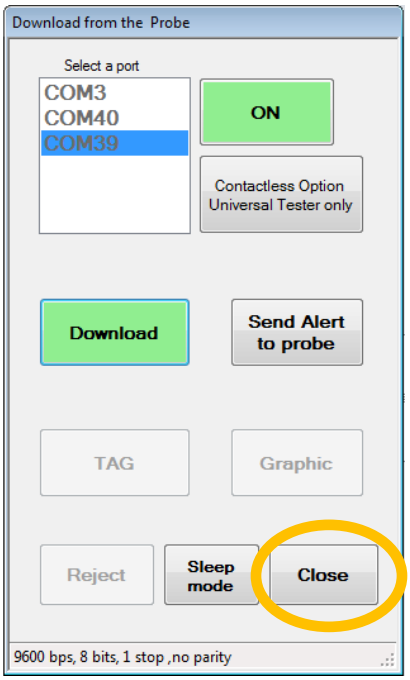



6- Select “Default.id” file, select the first line in the list then press on “TAG” button




7- Press “**Graphic**”, close the graphic displayed, press “**Accept**” then press “**Close**”



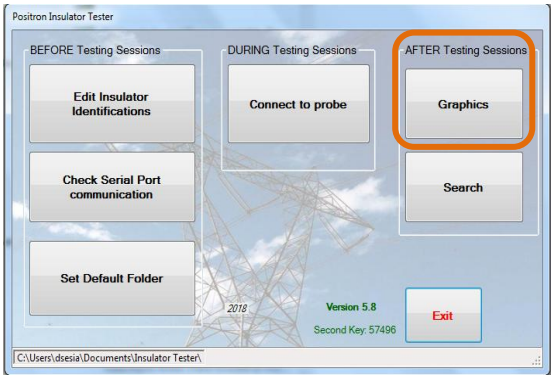

8- The E-field data is stored in the database located into the previously selected folder. The database consists in two ASCII files: Date.PRN and Date.LOG.

9- Press on the “**Graphics**” button on the Main Menu to display the graphics. The Graphics will not have any insulator identification into their title.

## 5.4 AFTER Testing Sessions

### 5.4.1 Displaying Graphs

At any time before, during or after a testing session, press the "Graphics" button on the Tablet screen to display the graphs from the data stored in the Tablet/Laptop. Refer to Chapter 6 for interpretation of the graphs.

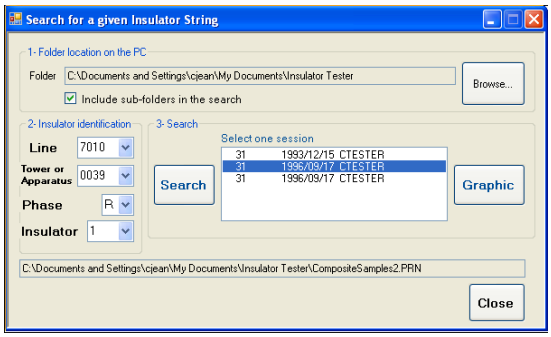


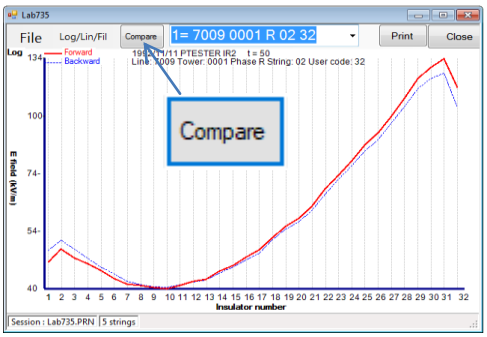

### 5.4.2 Searching the Database

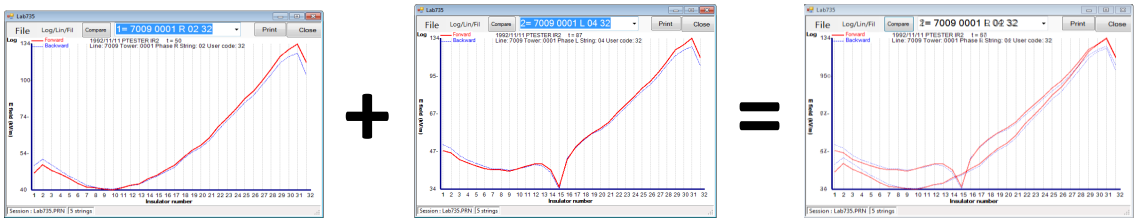
**Search** a database for a given insulator in the database to evaluate its degradation over time. See Section 6.6 for a description of superimposed graph comparison.

To **search** for an insulator:

- Browse and select the "**Search**" button from the menu of the Insulator Tester Software,
- Select the folder (and optionally all its subfolders)
- then choose an insulator
- display the chosen insulator
- select the next insulator
- display its graphic and reduce its opacity to superimpose many graphics
- the degradation over time becomes evident



One graph superimposed on another using the **Compare** feature

## 5.5 Important General Notes

- ✓ Always use the same Bluetooth adapter with its paired Tablet/Laptop.
- ✓ If the Insulator Tester has not been used for more than six (6) months, recharge its Ni-Cad battery before switching ON the power of the Insulator Tester.
- ✓ The Insulator Tester's battery should be recharged overnight (9 hours minimum) before each day of testing. If the power switch remains ON, the battery will discharge completely after two days.
- ✓ Recharge the battery of the Insulator Tester and the Tablet/Laptop before a day of testing.
- ✓ Switch the power OFF when the Insulator Tester is left unused. To switch the Insulator Tester OFF, remove the cover and move the slide switch away from the RS232 connector.
- ✓ To verify that the power is ON, press the push-button; the LED should flash, then press the push-button again to shut the light OFF.
- ✓ Do not use the Insulator Tester and the Tablet/Laptop in rain or snow or during lightning.
- ✓ To recharge the battery, remove the RS232 cover (3" x 1"), plug the charger cable to the Insulator Tester and plug the universal wall transformer to a 120/220 Vac source, 50 or 60 Hz.
- ✓ If the battery is completely discharged (No light on power-up), switch the Insulator Tester OFF while the battery is recharging. Under normal circumstances, it is not necessary to switch the Insulator Tester OFF during a recharge.

Switching the Insulator Tester OFF will erase all data in the Insulator Tester.

**WARNING**

The equipment covered in this manual should be used and serviced only by competent and trained personnel familiar with and following good work safety practices. This equipment is intended solely for the use by such trained personnel. This manual is not intended as a substitute for adequate training and experience. Appropriate safety procedures must be followed at all times in the use of this equipment.

**NOTE**

**This equipment will detect any conductive defect irrespective of the cause of the conductive defect. Conductive defects can be manufacturing defects or internal defects due to deterioration or caused by mechanical failure or cracks or due to conductive pollution. The tester does not detect non-conductive defects including mechanical defects that have not resulted in a conductive defect.**

# Chapter 6

## Interpreting Graphic Results

# 6.0 Interpreting Graphic Results

## 6.1 Understanding the Graphic

The data transfer software on the Tablet/Laptop creates ASCII files. MS-Excel or any text editor, such as Microsoft NOTEPAD, can import these files. The tagging of an insulator creates, an ASCII file ".LOG", which contains time tag and insulator identification pairs. The associated data file ".PRN" contains the same time tag which is used to identify the data.

The Insulator Tester detects the sliding direction using two infrared detectors, and this is represented in the resulting graphs. The curves on the graph are generated using two different line colors depending on the direction of the sled when the reading is acquired. See Figure 16 below.

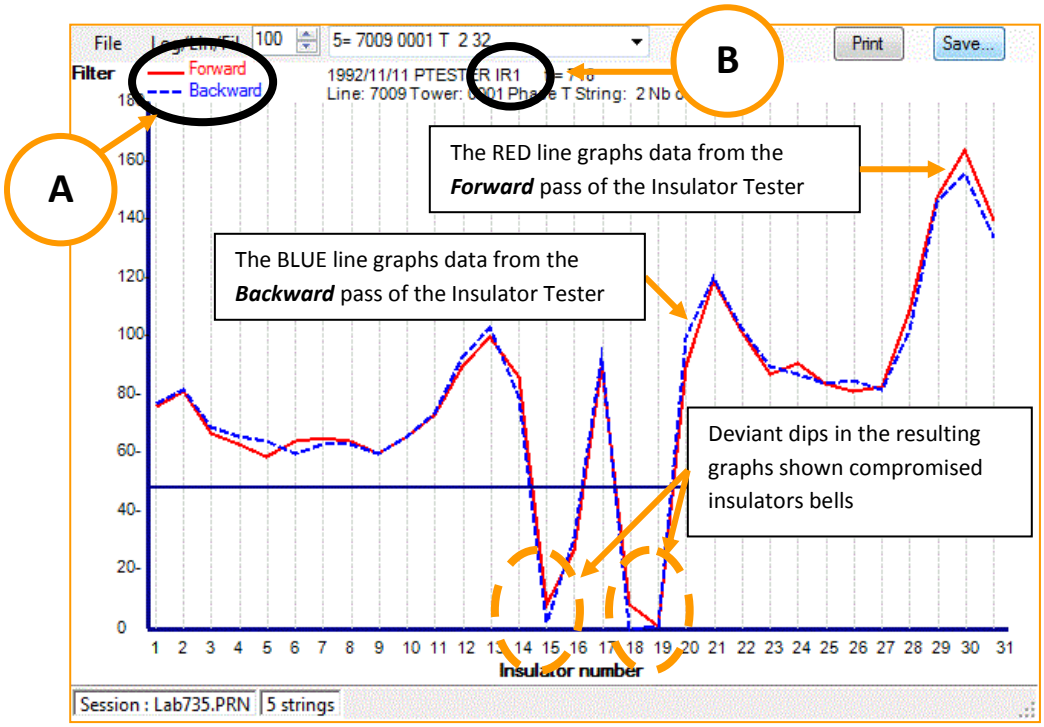
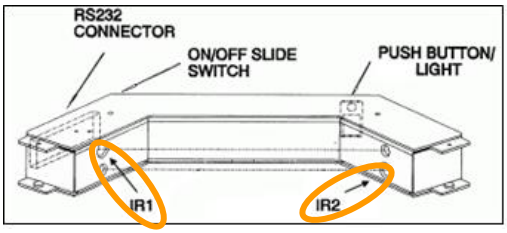



**Figure 16: Example of Insulator Scan of Porcelain Insulator String on Filter Scale**
**Badly compromised porcelain insulator bells shown at #'s 15, 16, 18 & 19.**

A) The solid **RED** line indicates the readings taken on the **forward** pass of the Insulator Tester. The broken **BLUE** line indicates the readings taken on the **backward** pass of the Insulator Tester.

B) On the graph above **IR1** indicates the orientation of the Insulator Tester relative to the forward scan. The direction of the Insulator Tester as represented by the graphs depends on which of the two Infra-Red beams of the Insulator Tester is broken first: **IR1** or **IR2.**



Example: In Figure 16, above (see **B)**, "IR1" indicates that the infrared beam **IR1** has been interrupted first during the forward scan.

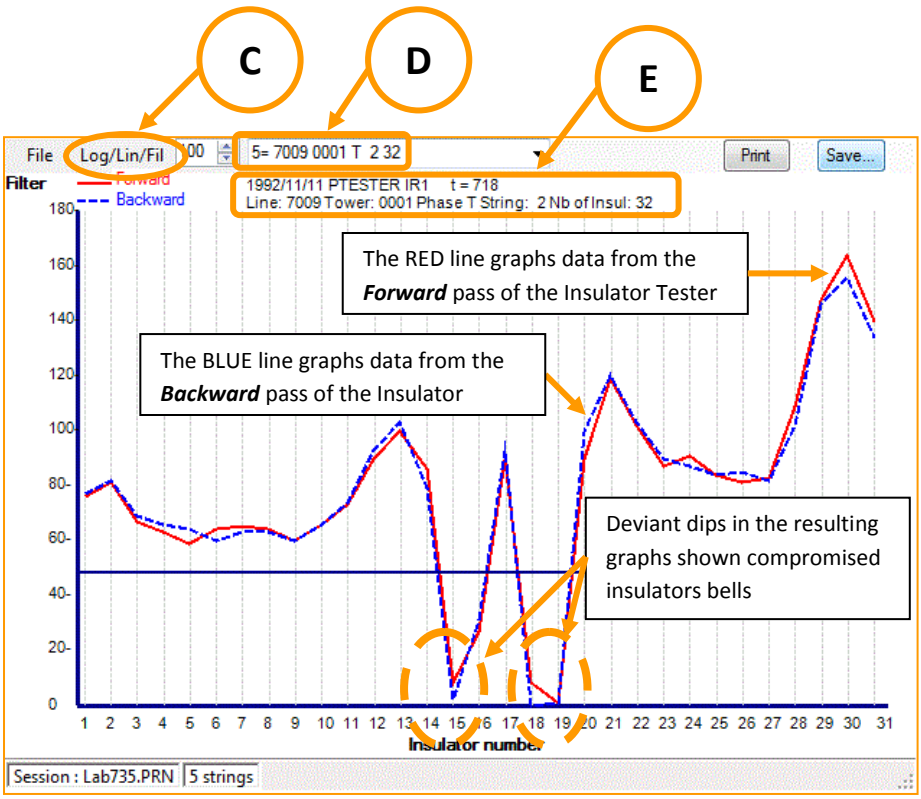



**Figure 17**

C) **Log/Lin/Fil** (Figure 17) indicates the scaling upon which the graphic results of the scans will be represented. This scaling option is made available by the Windows-based Insulator Tester Software for very High Voltage insulator strings of 12 or more Porcelain insulators.

D) This section of the graph offers a truncated identifier for the porcelain insulators being scanned.

   i. **7009** identifies the particular power transmission line being scanned
   ii. **0001** identifies a particular tower associated with the power transmission line being scanned
   iii. **T** indicates the power phase associated with the power transmission line being scanned
   iv. **2** indicates that it is the 2nd insulator for the given phase,
   v. **32** represents a user-defined code and can be any alphanumeric characters. These last 2 characters are not used by the Search function. The other alphanumeric characters are used for the "Search in Database" function.

E) Shows additional information associated with the scan including:

   i. Date of scan
   ii. Type of Insulator Tester (PTESTER = Porcelain Insulator Tester)

iii. Orientation of the Insulator Tester and direction as identified by the Infra-Red beam (**IR1**) first broken by an insulator bell during the forward scan
iv. t= indicates the number of seconds since midnight.

## 6.2 Linear Log and Filter Graphic Options

The "Linear" display mode is used to display the E-Field readings from the Insulator Tester on a linear scale. It is normally used for lower voltage applications (less than 12 insulators).

The "Log" display mode is used to amplify the small variations in the lower portion of the curve for porcelain insulator strings of 12 or more bells.

The "Filter" display mode is used to simplify the identification of the punctured porcelain discs.

## 6.3 Porcelain Insulator Tester Results: Healthy Insulators

The graph below shows the insulator number on the horizontal axis, with "1" being the insulator near the ground side. The vertical axis represents the strength of the electrical field in kilovolts/meter, expressed as "E-field (kV/m)". The E-field is determined longitudinally at each bell along the energized insulator string by the probe of the Insulator Tester.

### 6.3.1 Linear Graph

This **linear** (**Lin)** graph (Figure 18) indicates a healthy porcelain insulator string. The identical curves of the **Forward** (red) and **Backward** (blue) passes confirm the scanning integrity of insulator bells along the string.

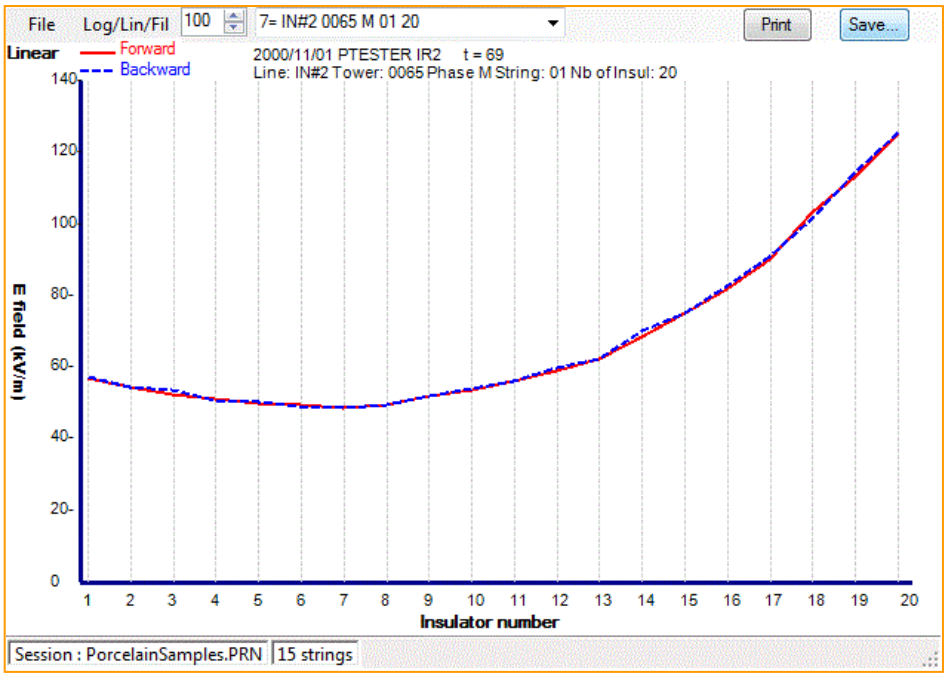



**Figure 18: Graph of Porcelain Insulator String displaying a healthy set of porcelain insulator bells shown using *Linear* mode.**

### 6.3.2 Logarithmic Graph

The **logarithmic** (**Log**) scale (Figure 19) amplifies the small variations in the lower portion of the curve of the E-field readings taken by the Insulator Tester enabling early detection of minor defects or low contamination.

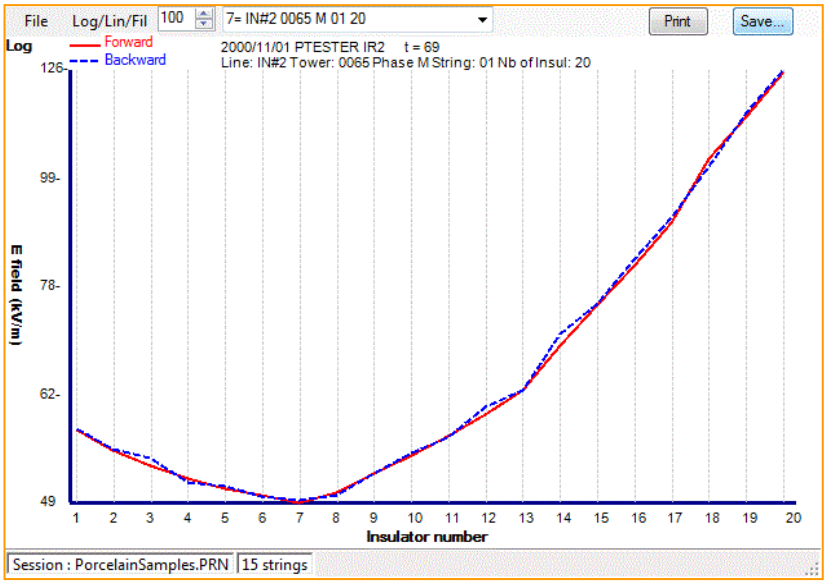



**Figure 19: Graph of Porcelain Insulator String displaying a healthy set of porcelain insulator bells shown using *Log* mode.**

## 6.4 Porcelain Insulator Tester Results: Unhealthy Insulators

### 6.4.1 Linear graph

This **linear** (**Lin)** graph (Figure 20) indicates an ***unhealthy*** porcelain insulator string. The identical curves of the **Forward** (red) and **Backward** (blue) scans confirm where perforations or other defects exist in the porcelain insulator string being scanned.

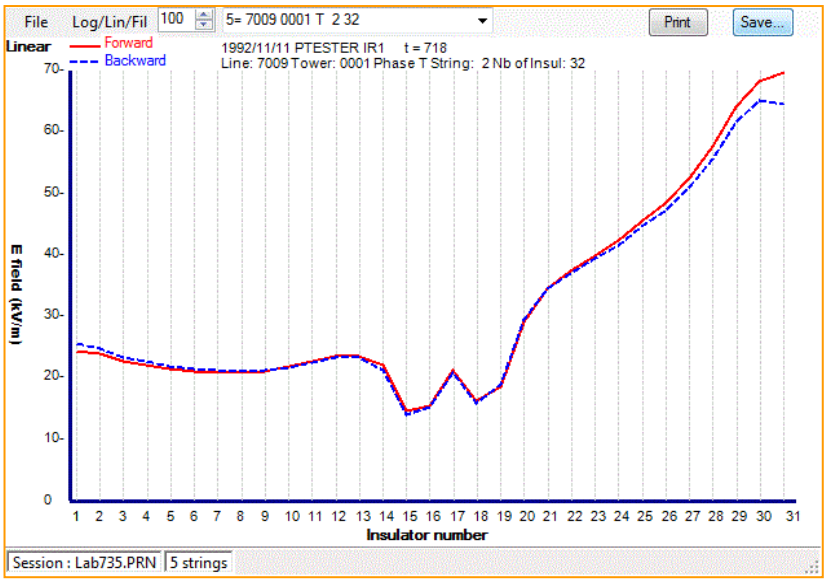


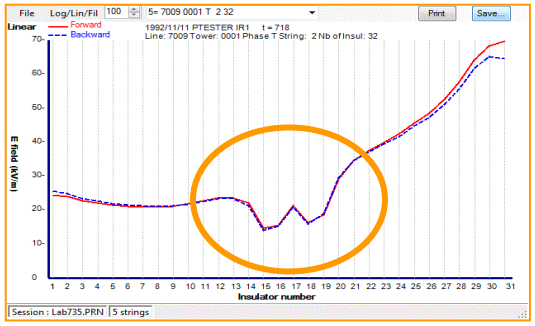

**Figure 20: Graph of Porcelain Insulator String displaying compromised porcelain insulator bells shown using *Linear* mode.**

**Compromised bells are shown as #'s 15, 16, 18 & 19**

### 6.4.2 Logarithmic Graph

This **Logarithmic** graph (Figure 21) amplifies the variations of the E field in the lower portion of the curve.

The readings shown in the linear graph are represented in the logarithmic graph below so greater detail can be observed.



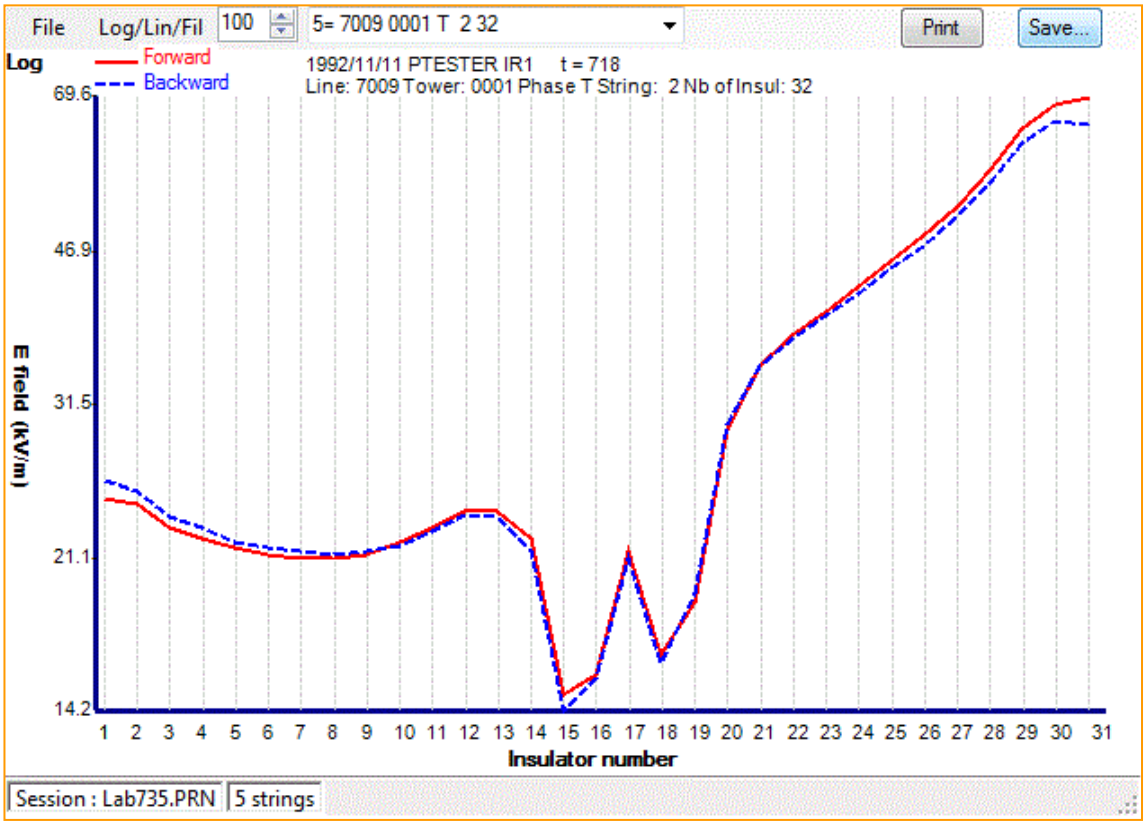



**Figure 21: Graph of Unhealthy Porcelain Insulator String**

**Compromised bells are shown as #'s 15, 16, 18 & 19**

### 6.4.3 Filter Graph

The **Filter** (**Fil)** setting (Figure 22) uses a special digital filter algorithm to assist in the interpretation of the graph: Insulators under the blue line are punctured. Note: The vertical axis shows no unit in the Filter mode.

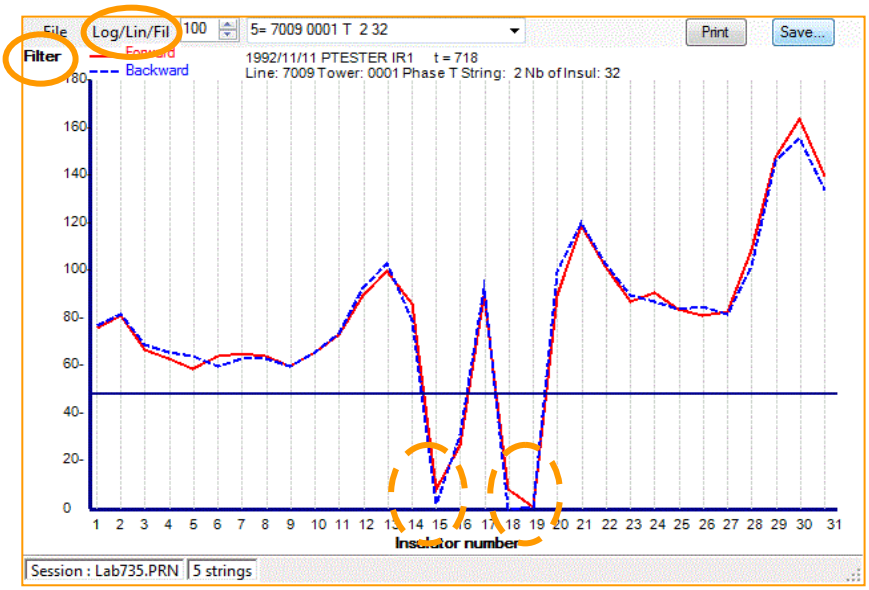



**Figure 22: Example of Insulator Scan of Porcelain Insulator String on Filter Scale showing badly compromised porcelain insulator bells shown at #'s 15, 16, 18 & 19.**

### 6.4.4 Comparing Historical Graphs

Graphs can be superimposed for comparison. Refer to Figure 23. Place one graph over the other and select **Compare** to reduce the opaqueness so one graph is visible through the other.

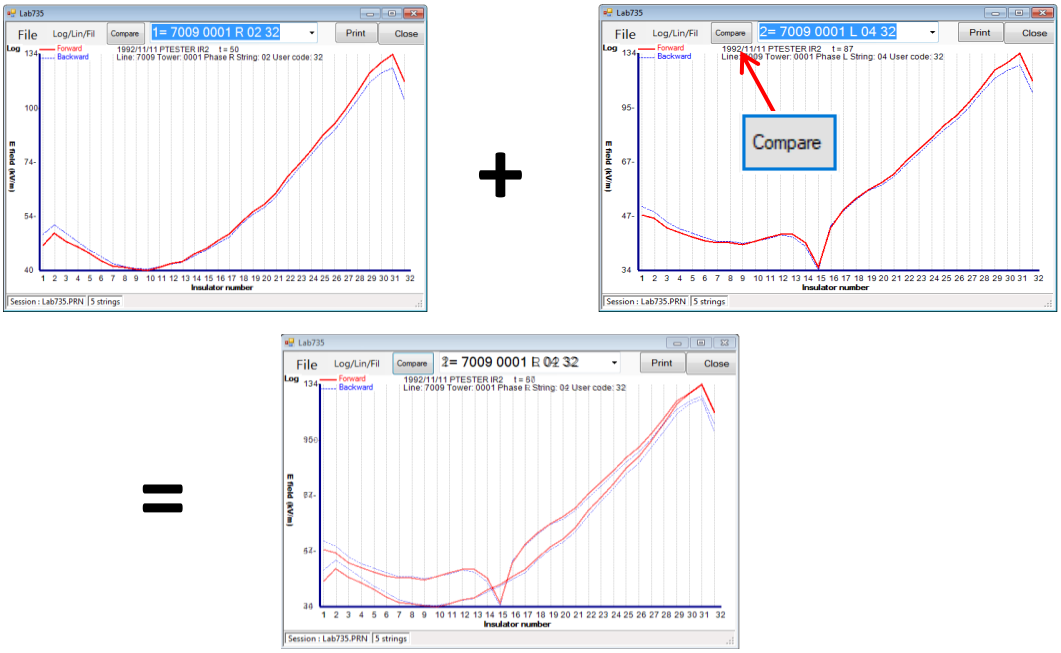



**Figure 23:** One Porcelain insulator graph superimposed on another using the **Compare** feature

# Chapter 7

## Specifications

# 7.0 Specifications

| Parameter | Specifications |
|---|---|
| Maximum insulators per string (Porcelain) | 60 insulators |
| Minimum insulators per string | 5 insulators |
| Scanning speed | From 0 to 6 insulators/s |
| Maximum voltage | 1,000 kV phase to ground |
| Minimum battery recharging time | 10 hours (one night) |
| Cumulative use between charges | 12 hours |
| Maximum period between battery charges | 1 day |
| Operating temperature range:<br>• Probe<br>• Bluetooth Adapter | <br>-4°F to 140°F (-20°C to +60°C)<br>14°F to 158°F (-10°C to +70°C) |
| Porcelain Tester Dimensions<br>Insulator diameter | 14" x 19" x 9" (36 cm x 48 cm x 23 cm)<br>9” to 13” (23 cm to 33 cm) |
| Weight (Porcelain Tester) | 3.5 lbs (1.6 kg) |
| Humidity | 95% |
| Factory calibration<br>(User recalibration is not required) | 500 raw units = 100 kV/m longitudinally |

**NOTE** To be used on AC lines only

# Chapter 8

## Recommended Practices

# 8.0 Recommended Practices

## 8.1 Sequence of Operation as per the Quick Start Guide

**DURING a Testing Session**

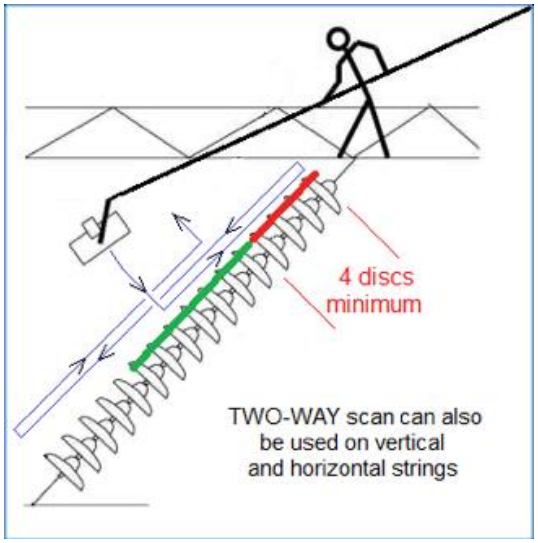
*Ground Operator:* Connect and check the Bluetooth link before beginning
*Tower Operator:* Climb the tower
*Tower Operator:* Press the push-button on the probe (if required after timeout)

*Tower Operator:* **Scan** one insulator (see Scanning Procedure below)
*Ground Operator:* Press the **Download** button on the Tablet/ PC
*Ground Operator:* Press the **TAG** button and select the insulator's identification
*Ground Operator:* Press the **Graphic** button
*Ground Operator:* Press the **Accept** or **Reject** button
*Ground Operator:* Press the **Alert** button for instructions to the Tower Operator

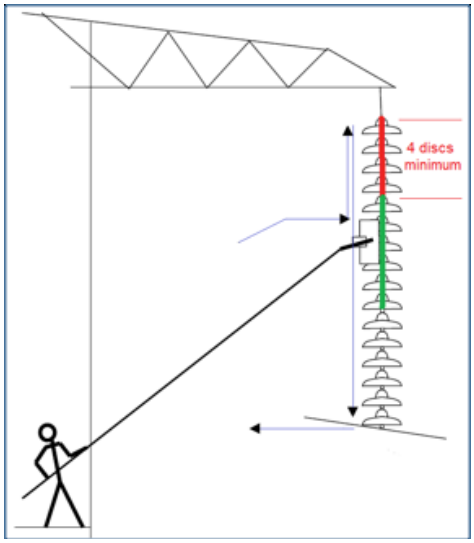
Repeat **Scan**, **Download**, **TAG**, **Graphic, Accept** and **Alert** for each insulators in the tower

*Ground Operator:* Press **Close** to save power when all insulators are tested
*Ground Operator:* Switch probe **OFF**

**Scanning procedure:**




**Two-Way scan**




**One-Way scan**

## 8.2 Recommended Safety Procedure

The Tester operator on the tower is standing below the HV line.

A second person on the tower is recommended for safety reasons.

## 8.3 Horizontal and V Strings

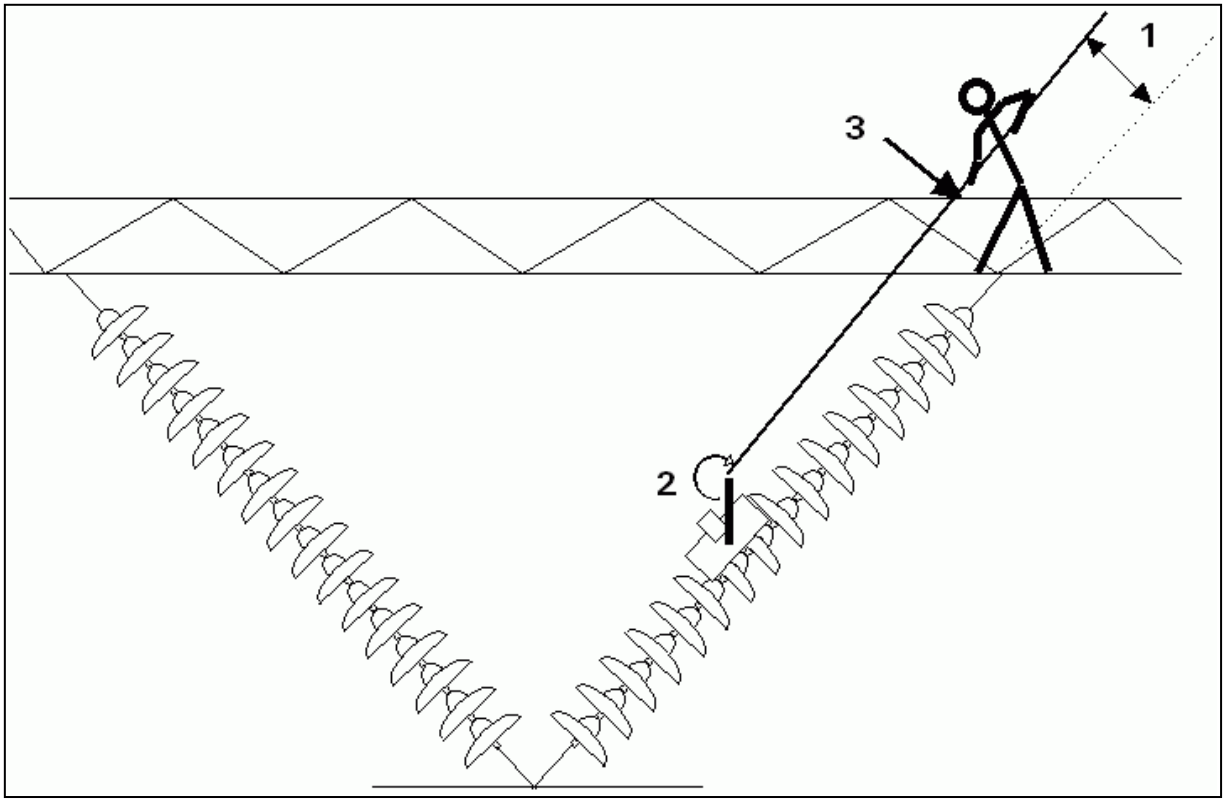



**Figure 24**

1. To facilitate the manipulation, the hot stick should be almost parallel to the string of insulators, per Figure 24.
2. The angle should be adjusted as shown on the above figure.
3. Apply constant pressure downward to keep the sled against the insulator at all times.

## 8.4 Vertical String (Preferred method)

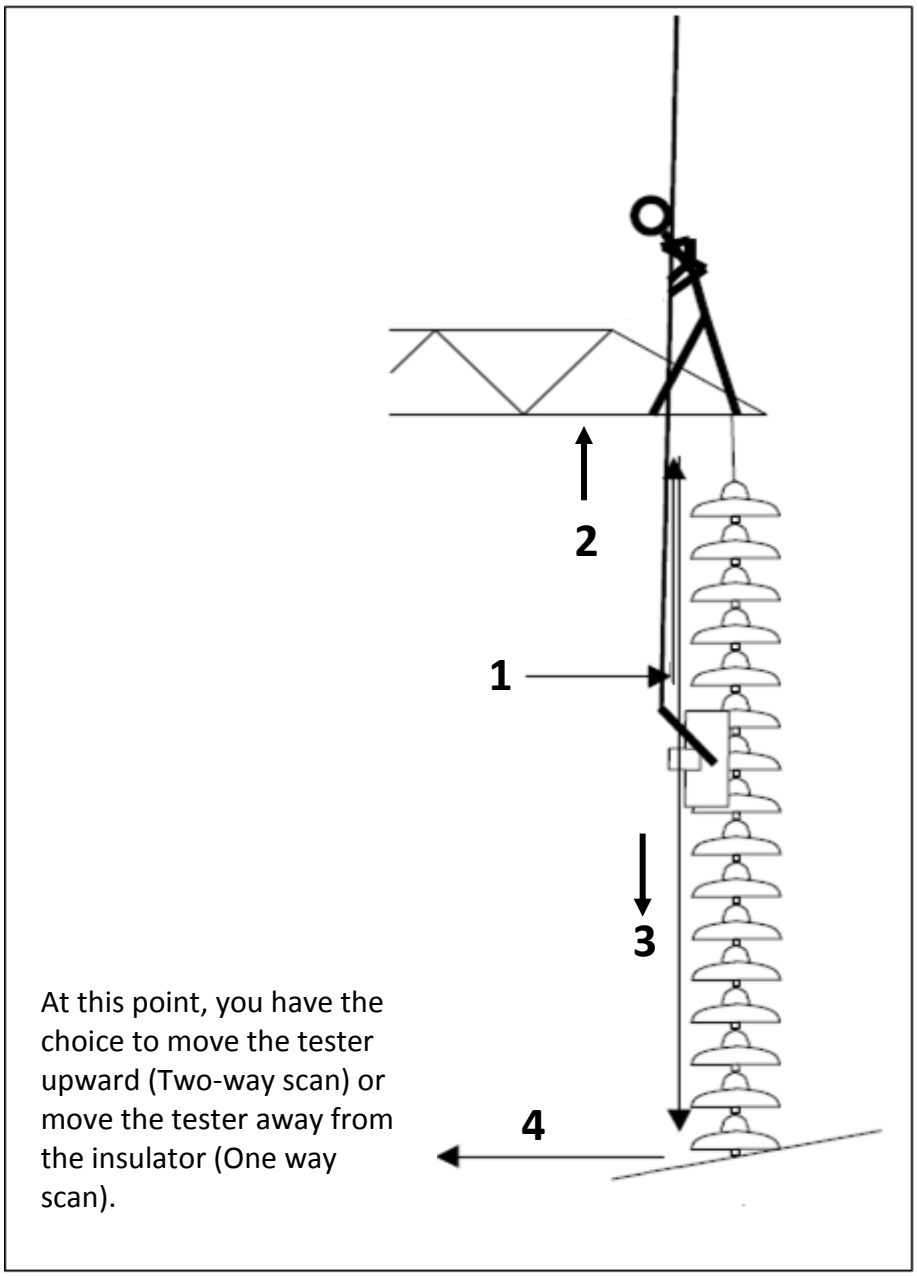



**Figure 25**

1. To facilitate the manipulation, the hot stick should be almost vertical, per Figure 25.
2. Apply pressure toward the insulator string to keep the sled against the insulators at all times.

## 8.5 Vertical String (Alternate Method)

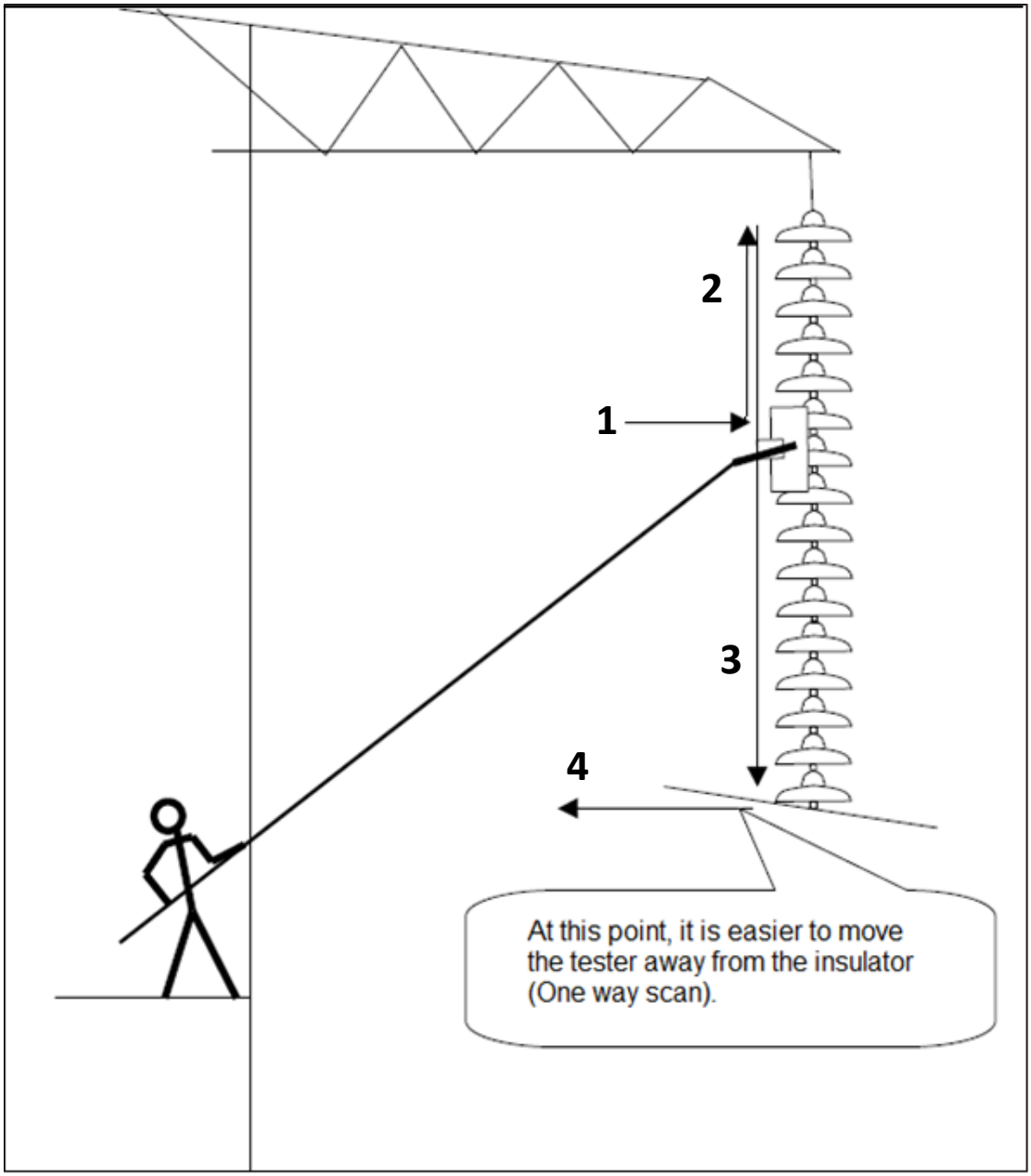



**Figure 26**

The Tester Operator should be located below the high voltage line to simplify the small backward portion of the scan (See “movement #2” in Figure 26.).

# Chapter 9

## Important Information

# 9.0 Important Information

## 9.1 Service and Support

**Positron Contact Information**

| **General information:** | **Receiving address:** |
|---|---|
| Positron Inc.<br>5101 Buchan Street<br>Suite 220<br>Montreal, Québec, Canada<br>H4P 2R8<br>US and Canada: 1-888-577-5254<br>International: 1-514-345-2214<br>Fax: 1-514-345-2271<br>E-mail: info@positronpower.com<br>Web site : www.positronpower.com | Positron Inc.<br>5180 Pare Street<br>Montreal, Québec, Canada<br>H4P 1P3 |
| Repairs | US and Canada: 1-888-577-5254, Option 1<br>International: 001-514-345-2220, Option 1 |

We can communicate also by Skype if pre-advised by e-mail.

## 9.2 Technical Customer Support

Positron is committed to providing excellent ongoing technical support to its customers. A team of specialists is always available for telephone consultations, or for on-site visits to assist in maintenance and troubleshooting.

For more information, or assistance in the planning, configuration, use and interpretation of data produced by the equipment, contact Technical Customer Support (TCS) at 1-888-577-5254, Option 1, Option 3 (US and Canada) or +1-514-345-2220 Option 1, Option 3 (International).Or, email scarbonaro@positronpower.com. Skype calls can be arranged.

## 9.3 Customer Training

Full customer training courses on the operation and results interpretation of Positron Insulator Testers are available. For information, contact Positron.

## 9.4 Repair Service

All warranty repairs are performed at no cost. Positron reserves the right to repair or replace any equipment that has been found to be defective.

For information about out-of-warranty repairs, contact Positron's Repair department at 1-888-577-5254 (US and Canada) or +1-514-345-2220 (International).

Due to the varied nature of repairs, no specific turnaround can be guaranteed, but average turnaround time is two weeks from date of receipt. In emergency situations, special arrangements can be made. All repaired items are warranted for a period of 180 days, or balance or warranty, whichever is longer.

Before returning any items to Positron for repair, warranty repair or replacement, call or e-mail the Repair Department (info@positronpower.com) to obtain a Return Material Authorization (RMA) number. Parts returned without RMA numbers cannot be accepted. The RMA number must always be clearly marked on all boxes and crates and on all shipping documents.

To accelerate the repair process, whenever possible, include a report detailing the reason for return with the unit(s). Also, please include the name and phone number of a contact person should our Repair department need further information.

When packing items being returned for repair, please ensure they are properly packed and shipped in their carrying cases to avoid further damage.

## 9.5 Warranty

Subject to the provisions of this paragraph, Positron warrants that the equipment shall perform in accordance with Positron's specifications. The warranty on the electronic Probe and the Bluetooth device is three (3) years from the date of shipment. The warranty on the tablet/PC is one (1) year. The warranty y covers workmanship, materials and labor. Positron shall, at its sole discretion, repair or replace the problem unit. A detailed warranty description is available on request.

During the warranty period, freight costs to ship defective equipment to Positron are borne by the Customer, while the return of replaced or repaired equipment is at Positron's expense. To obtain an RMA for warranty repair, e-mail customerservice@positronpower.com.

## 9.6 Limitation of Liability

Subject to anything to the contrary contained herein, Positron's sole obligation and liability and the customer's sole remedy for Positron's negligence, breach of warranty, breach of contract or for any other liability in any way connected with or arising out of, the equipment or any services performed by Positron shall be as follows:

- In all situations involving performance or non-performance of the equipment or any component thereof, the customer's sole remedy shall be, at Positron's option, the repair or replacement of the equipment or said component.

- For any other claim in any other way related to the subject matter of any order under, the customer shall be entitled to recover actual and direct damages; provided that Positron's liability for damages for any cause whatsoever, and regardless of the form of the action, whether in contract or in tort (including negligence), shall be limited to the value of the order.

Positron shall not be obligated to repair or replace any item of the equipment which has been repaired by others, abused or improperly handled, improperly stored, altered or used with third party material or equipment, which material, or equipment may be defective, of poor quality or incompatible with the equipment supplied by Positron, and Positron shall not be obligated to repair or replace any component of the equipment which has not been installed according to Positron specifications.

IN NO EVENT SHALL POSITRON BE LIABLE FOR ANY INDIRECT, INCIDENTAL, SPECIAL, CONSEQUENTIAL, PUNITIVE, EXEMPLARY OR SIMILAR OR ADDITIONAL DAMAGES INCURRED OR SUFFERED INCLUDING LOSS OF PROFITS, LOSS OF REVENUES, LOSS OF DATA, LOSS OF BUSINESS

INFORMATION, LOSS OF GOODWILL, LOSS OF LIFE, STAFF INJURY, LOSS OF EXPECTED SAVINGS OR BUSINESS INTERRUPTION ARISING OUT OF OR IN CONNECTION WITH THE EQUIPMENT, A PURCHASE ORDER SUPPLIES, MAINTENANCE SERVICES OR OTHER SERVICES FURNISHED HEREUNDER, EVEN IF POSITRON HAS BEEN ADVISED OR IS AWARE OF THE POSSIBILITY OF SUCH DAMAGES.

EXCEPT AS EXPRESSLY SET FORTH IN THIS AGREEMENT, POSITRON DISCLAIMS ANY FURTHER CONDITIONS, REPRESENTATIONS OR WARRANTIES, WHETHER WRITTEN OR ORAL, EXPRESSED OR IMPLIED, INCLUDING THE CONDITIONS AND WARRANTIES OF MERCHANTABILITY, MERCHANTABLE QUALITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, PERFORMANCE AND THOSE ARISING FROM STATUE, TO THE EXTENT PERMITTED BY LAW. POSITRON DOES NOT WARRANT THAT THE SYSTEM WILL OPERATE WITHOUT INTERRUPTION OR THAT IT WILL BE ERROR FREE.

## 9.7 Disclaimer Notice

The equipment covered in this manual should be used and serviced only by competent and trained personnel familiar with and following good work safety practices. This equipment is intended solely for the use by such trained personnel and is not intended as a substitute for adequate training and experience. Appropriate safety procedures must be followed at all times in the use of this equipment.

The descriptive information contained in this manual is not intended to and does not cover all details, usages, or methods of use of this equipment, and such information is not intended to discuss all situations or contingencies which might be encountered with respect to the operation, maintenance or use of the equipment. This information is provided for purposes of description only and is not to be relied upon or utilized by any purchaser as instructions, warranties, specifications or use certifications. Although Positron Inc. has made every effort to ensure the accuracy of the information contained herein, this document is subject to change without notice due to ongoing product development. Any additional information which may be required by any purchaser regarding the use, maintenance, installation or operation of this equipment should be referred to Positron Inc.

## 9.8 Cancellation and Rescheduling Charges

Should the customer cancel, prior to shipment, any part of an order, the customer agrees to pay to Positron cancellation charges, not as a penalty, which shall total all expenses, including labor expenses, incurred by Positron prior to said cancellation. Modified equipment that has been specially developed for the customer's specific applications shall not be subject to cancellation. Cancellation or rescheduling is not permissible after shipment of the System.

## Positron's Suite of Insulator Products

Simply slide the tester sled along the insulator (string).

Positron's Insulators Testers and software enhances worker safety with an Instant Graphical Download of the insulator's surrounding E-field for immediate on-site viewing, providing immediate warning for **DANGEROUS** conditions.

## Porcelain Tester

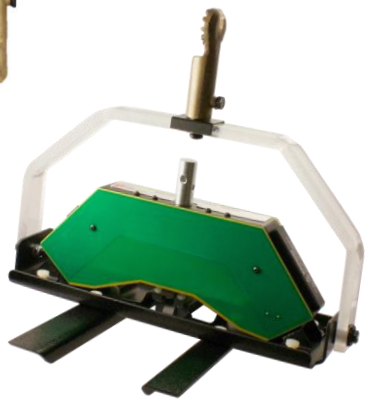
The Porcelain Tester is used for Porcelain and Glass insulators.


## Composite Tester

The Composite Tester is used to detect floating or connected defects for Composite (or Polymeric) insulators


## Universal Substation Insulator Tester

The Universal Substation Insulator Tester has been specifically designed for use in fully energized equipment in substations to test bushings and insulators of all shapes and sizes.



**Positron's Mapping System** displays at a glance the health and location of the insulators in the power network.