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

POSITRON

Contents

Chapter 1

General Information

1.0 General Information

1.1 Publication Information

Positron Porcelain Insulator Tester,
Description and Operation Guide
User Manual Part # 925W378130-06E

Publication date: December 2017

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

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1.2 About this Guide

This guide introduces and describes the operation of Positron's Live Line High Voltage 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.

1.4 List of Associated References

[1] "Suspension Insulator Puncture 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 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 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

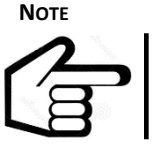
Refer to Figure 1 on page 7 for a detailed drawing of the unit.

With the Porcelain Insulator Tester field Probe mounted onto a user-supplied hot-stick, the user passes the unit along the insulator string. Any conductive defect in an insulator will cause a change in the electric field surrounding the insulator. This perturbation of the electric field indicates a faulty insulator. The fault is detected, identified, and measured by the Probe, and the data is downloaded to a database installed on the Tablet/PC for analysis. The graph displaying the E-Field along the insulator is clearly displayed on the Tablet/Laptop while in the field enabling **GO/NOGO** decision-making on-the-spot.

Porcelain insulators, or "bells", are counted by the field Probe's two integrated infrared detectors, referred to as IR1 and IR2 (see Figure 1), and the electric field at each bell is recorded. Defective bells are easily identified using the resulting data graphs that present the contour of the electric field along the porcelain insulator string. The field Probe contains a microprocessor-based recording system.

After an insulator string is scanned by the Tower Operator, the Ground Operator downloads the Probe's data via a long range 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.



- 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 while performing a testing session.

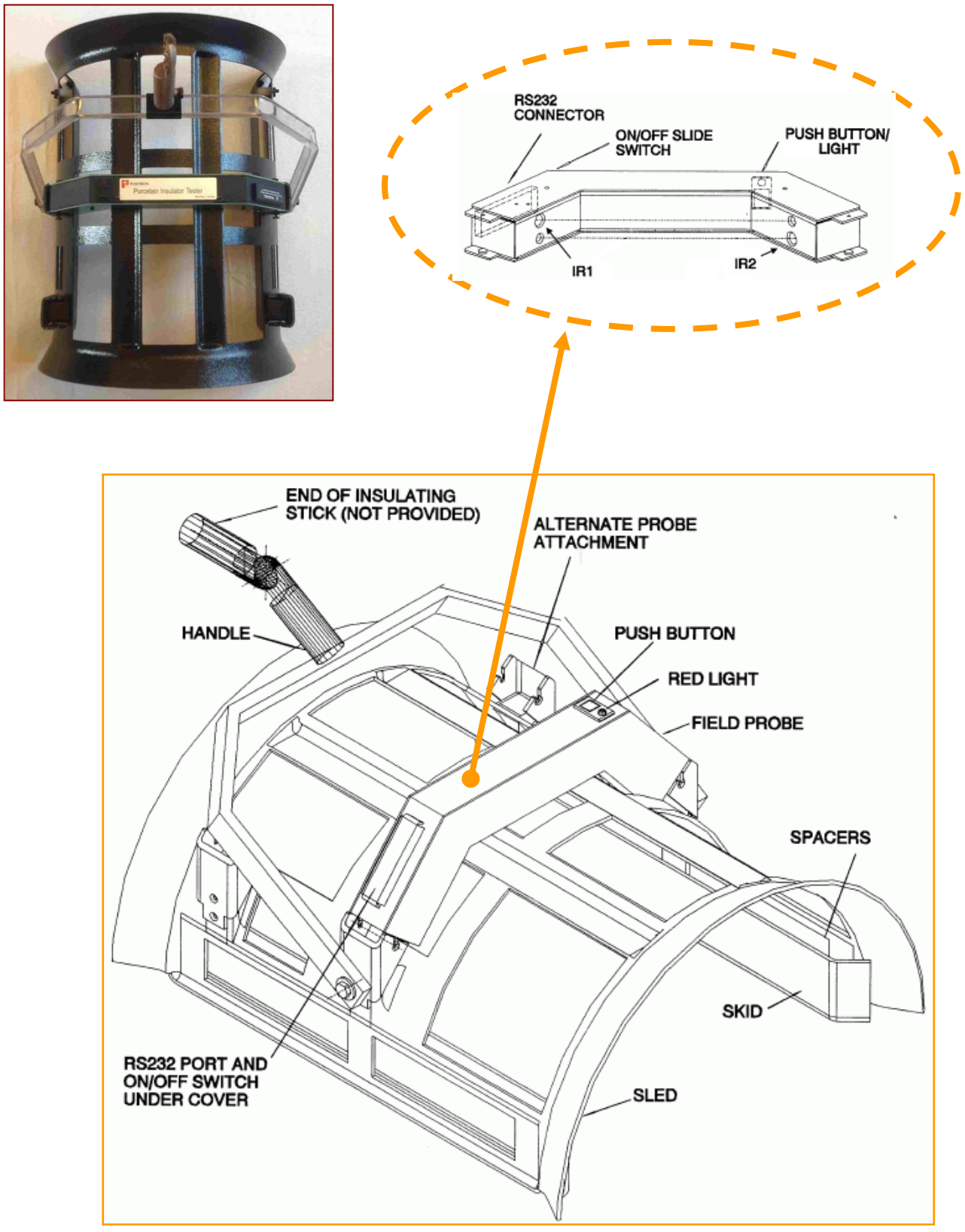


Figure 1: Porcelain Insulator Tester (P-Tester) Model #s 3781301P/50 (50Hz) & 3781301P/60 (60Hz)

2.2 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

Table 1: Testers and Model Numbers

Item Description	Model Number
Porcelain tester, 50 Hz, standard 10” sled	3781301P/50
Porcelain tester, 60 Hz, standard 10” sled	3781301P/60
220Vac/120Vac cable charger replacement	378126
Rechargeable battery pack replacement for the Probe	378127
12Vdc auxiliary automotive power cable charger replacement	378128
RS232 Long Range Bluetooth adapter replacement	378325/3
Replacement adjustable standard sled for Porcelain insulators with diameters from 23cm to 33cm (9” to 13”)	378602
Modified adjustable sled for Porcelain insulators with diameters from 23cm to 33cm (9” to 13”) (sled modified to accommodate Arcing Horn or Insulator End Plates)	378603
50 Hz field Probe for Porcelain Insulators (no sled)	378605
60 Hz field Probe for Porcelain Insulators (no sled)	378606
Replacement cover plate for Probe power switch (Min Order 25 pcs)	378613

Chapter 3

Porcelain Insulator Tester Elements

3.0 Description of the Porcelain Insulator Tester Kit

3.1 The Porcelain Tester

The Porcelain Insulator Tester kit consists of:

- User manual
- A Quick Start Guide
- A rugged carrying case
- An Insulator Tester Electric Field Probe
- An adjustable Porcelain Insulator Tester Sled
- USB key loaded with Insulator Tester user manual
- A 12Vdc auxiliary automotive power cable charger
- Additional sled spacer set to accommodate various insulator sizes
- An RS232 Long Range 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 Operator Interface (see Figure 2) consists of:

- a push-button,
- a Status LED and
- 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 Probe on. Slide the switch toward the left to switch the Probe off. See Figure 3.

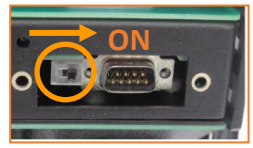
DO NOT SWITCH THE POWER OFF BEFORE DOWNLOADING DATA.

When the power is switched off the accumulated data in the Probe is lost. Once the data has been downloaded, slide the switch away (left) from the RS232 connector to shut the unit off.

Location of Power Switch Cover

Power Switch Cover

Figure 3



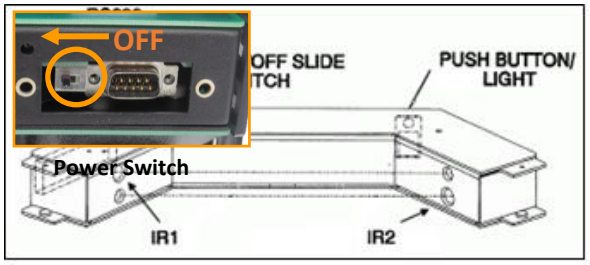


Figure 4

The Electric field Probe 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 Probe's battery and to connect a long range Bluetooth adapter for data transfer.

3.2 Probe Charger

The Probe'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 Probe. A set of AC charger adaptors is provided to accommodate various country standards. For charging the Probe 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 Probe will charge faster when switched off.

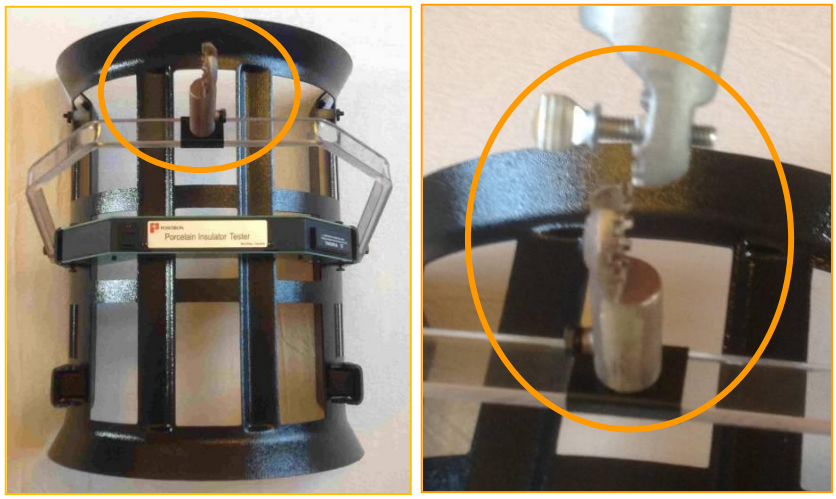
CAUTION

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

3.3 Insulator Tester Sled

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

Together, the sled and Probe 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

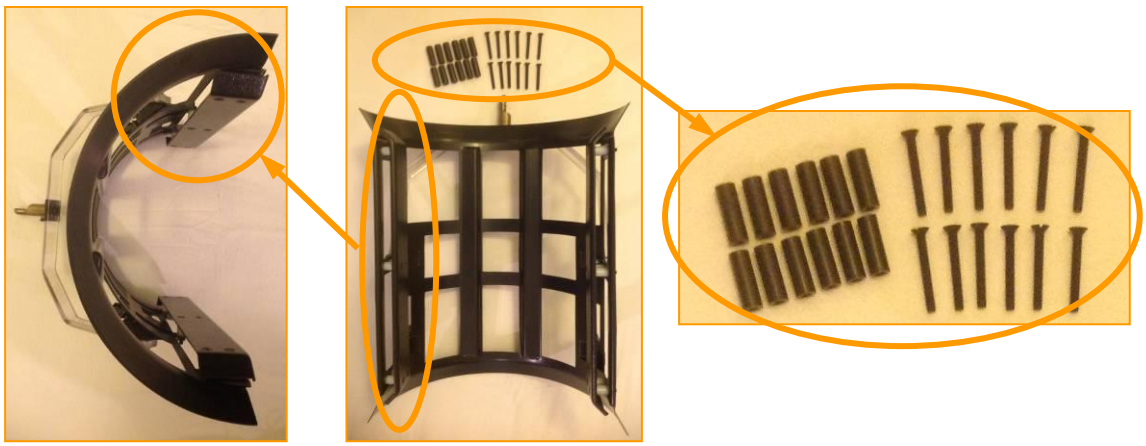


Figure 6

provided if the sled skids require adjustment. See Figure 6.

3.5 Position of the Probe on the Sled

There is a choice of two positions to mount the Probe on the sled. The mid-sled position is used in most situations.

Situations may arise where, due to mechanical interference, you may need to be able to scan the last insulator bell in a string, close to its grounded or live ends. In this case, the alternate position is used as shown. See Figure 7.

In those situations, two scans may be required to reach both ends of a string. The title of the resulting graph indicates which infrared beam (IR1 or IR2) has been interrupted first in order to identify the orientation of the sled when the Probe is installed on the alternate attachment and sled flipping takes place.

Figure 7

3.6 Alternative Adjustable Sled

Positron offers an alternative adjustable Probe sled to accommodate insulators equipped with an Arcing Horn or Insulator End-Plates.

Regular Adjustable Sled
Model # 378602

Modified Alternative Adjustable Sled
Model # 378603

3.7 Tablet/Laptop PC

3.7.1 General

A Tablet/Laptop PC is provided with the Probe. The Tablet/Laptop is Bluetooth-enabled and is shipped paired with the Bluetooth adapter of the Probe. Refer to Figure 8.

The Insulator Tester Data Processing Software is pre-installed on the Tablet/Laptop.

Figure 8

The Tablet/Laptop is used on-site for transfer of the data from the Probe 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 tester be switched off.

CAUTION

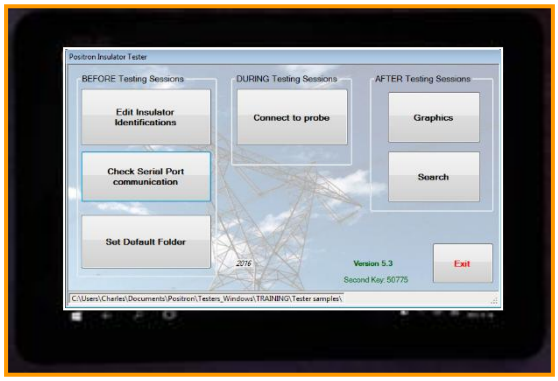
The Tablet/Laptop must not be used by the Tower Operator for safety reasons. The Tablet/Laptop is to be operated by a Ground Operator.

3.7.2 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 9.

Figure 9

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



The Tablet has a generously sized touch screen. Large *"Touch Buttons"* are used to operate the Windows-based Positron Insulator Tester Software in the field.

While the Ground Operator is using the Tablet/Laptop on the ground, the Tower Operator tests the insulator. Once a scan of an insulator is completed, the Ground 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, the Ground Operator can choose to **Accept** or **Reject** the data from the last insulator tested. Once data is accepted or rejected, the data in the Probe 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 90^{o} 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 was 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 and forward 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 insulator's identifications used to identify in the field each insulator prior to generating a graph of the insulator E-field
- To test the Bluetooth communication between the Tablet and the Probe
- To set a different working folder

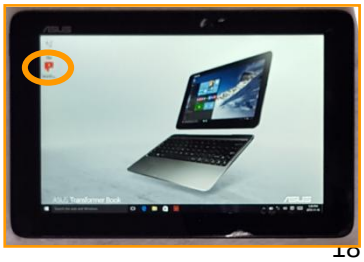
B) **DURING** the testing session

- 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 Tower Operator
- To put the probe 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 during live-line conditions
- 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 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 Probe 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 Tower Operator manipulates the Insulator Tester with a hot stick, while the Ground Operator uses the Tablet/Laptop. Once the scan is done, the Ground Operator can immediately download the data to get the graphic representation of the distribution of the E-field along the porcelain insulator.

Once the Ground Operator has downloaded the data from the Probe and has viewed the graph of the insulator's E-field, the Ground 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 Probe gathered during the scan will be deleted after download to the Tablet/Laptop.

In the rare case where the Tablet/Laptop is not used in the field, the data can be stored in the probe by pressing the button on the probe after each insulator string scan. The data can then be downloaded to a PC at the end of a testing session. This method is not recommended because the graphic will have no insulator identification and the Instant Graphical GO/NO-GO reporting capability will be absent.

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 Ground Operator controls the Tablet/Laptop running the Windows-based Insulator Software while the Tower Operator controls the Porcelain Insulator Tester and scans the insulator string.

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

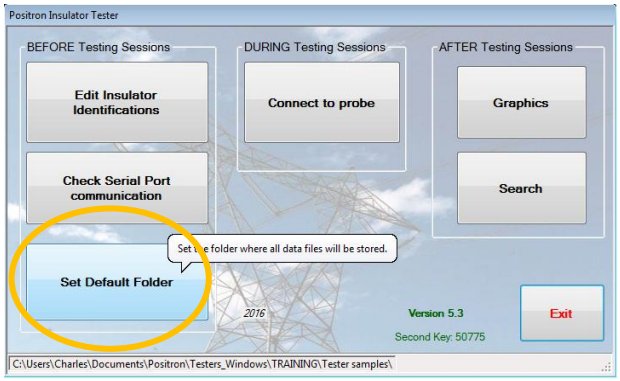
Using the Tablet/Laptop, the Ground Operator can choose to **Accept** or **Reject** the scan. In both cases, once a choice has been made by the Ground Operator the data in the Probe is erased. If the choice is made to **Accept** the scan, the data is stored on the Tablet/Laptop.

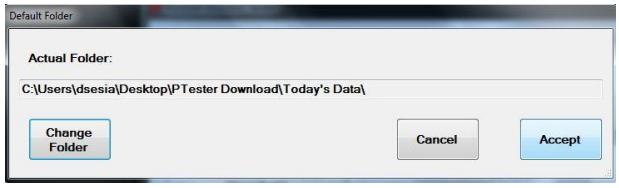
5.1 BEFORE Testing Sessions

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

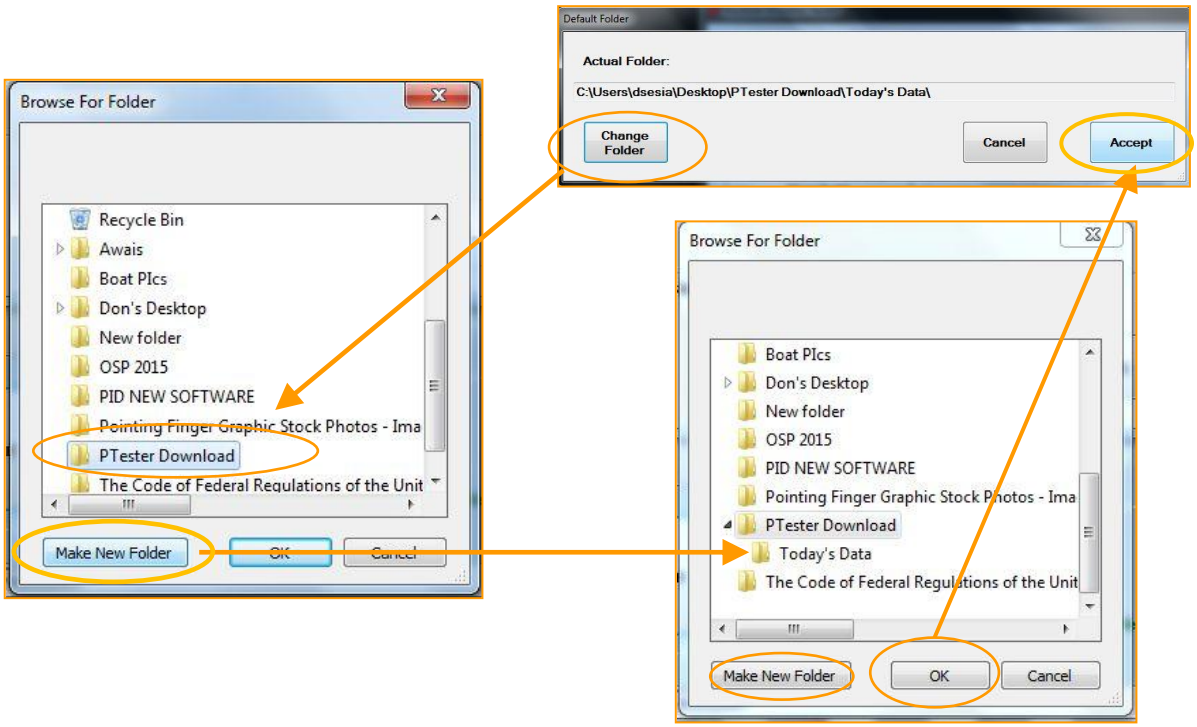
First, set the Default folder where the data will be stored. From the screen, select **Set Default Folder**. A dialogue box will be returned showing you the default file location.





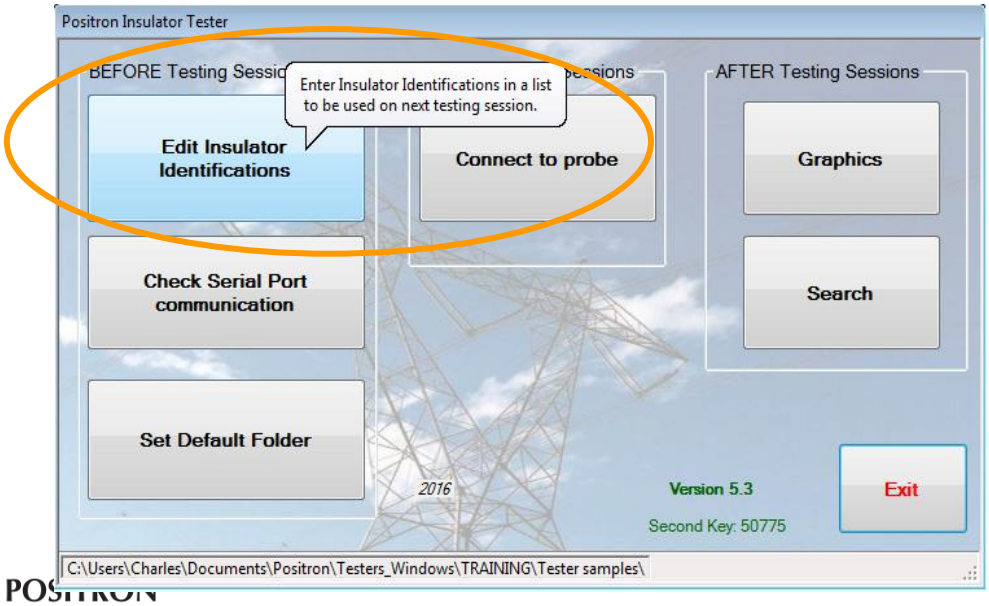
5.1.2 Changing the Folder

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.

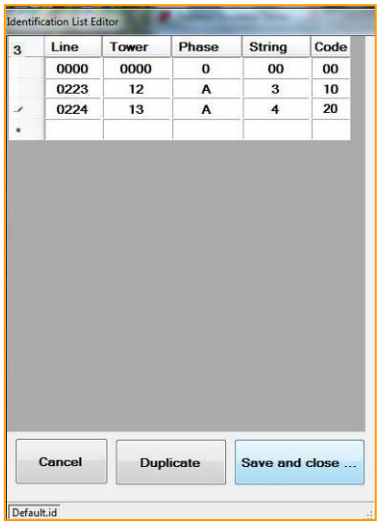


5.1.3 Create a List of Insulator Identifications

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. Select **Edit Insulator Identifications.**



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.

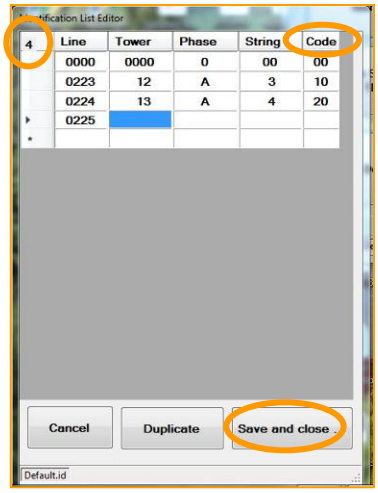


The **Identification List Editor** will open. Edit a field by clicking into it and move to the next field using the **TAB** key on your keyboard. The **ENTER** key will bring you to the field immediately beneath.

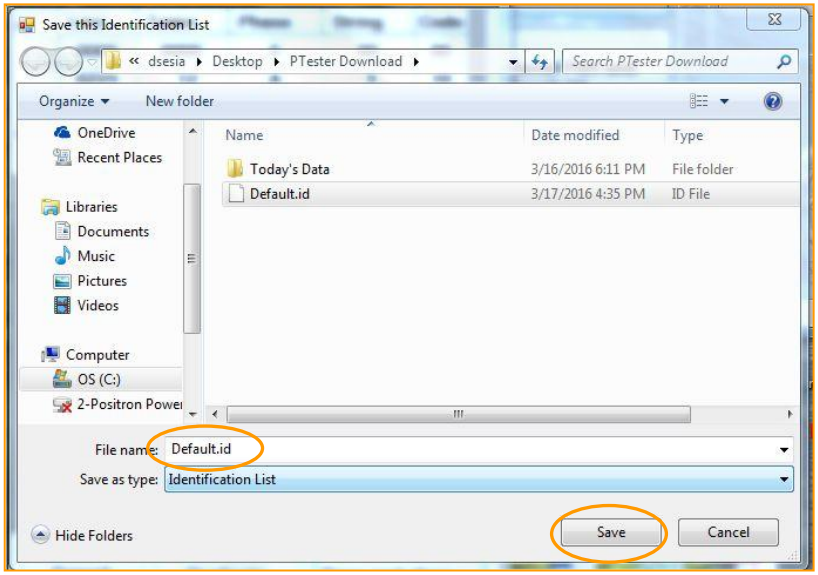
With the list completed, select **Save and Close**.

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.



This will open the **Save this Identification List** dialogue box.



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 long-range Bluetooth communication between the Probe and the Tablet/Laptop is advised. This can only be done with the Probe activated. After communication has been established, the Probe and long range Bluetooth adaptor can be switched off again before going out into the field.

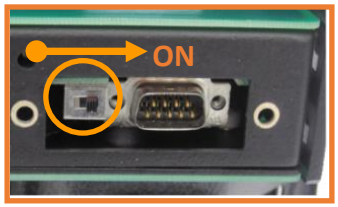
5.1.5 Switching the Probe On

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 10. The Probe will first enter the Power-On Self-Test (**POST**). See 5.1.5.1 for details.

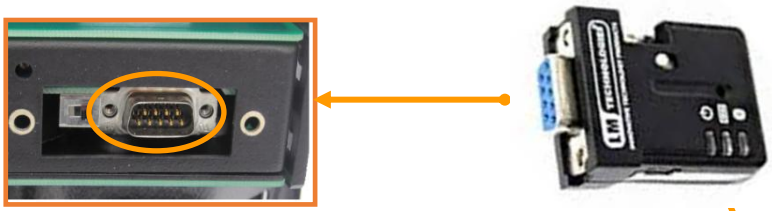
Ensure the slide switch on the Bluetooth adapter is in the DCE position. Insert the long range Bluetooth Serial adapter into the DB-9 Serial port of the Insulator Tester Probe. The long range Bluetooth Serial adapter is powered by the battery of the Probe.

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 adapter is in the DCE position.

Figure 10

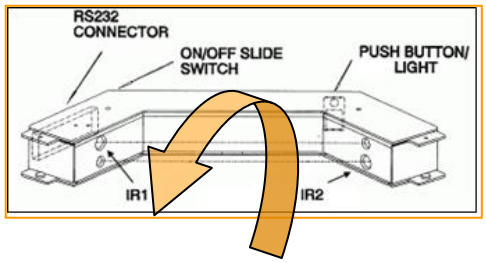
5.1.5.1 Power-On Self-Test (POST) of the Probe

Upon switching the Probe 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 Probe, 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, the LED will flash **Amber** 10 times and shut off during which the Infrared beams and sensors are tested (IR1, IR2).
5. If the **Red** LED begins flashing, then the Probe'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 Probe at the beginning of the long tone**.**

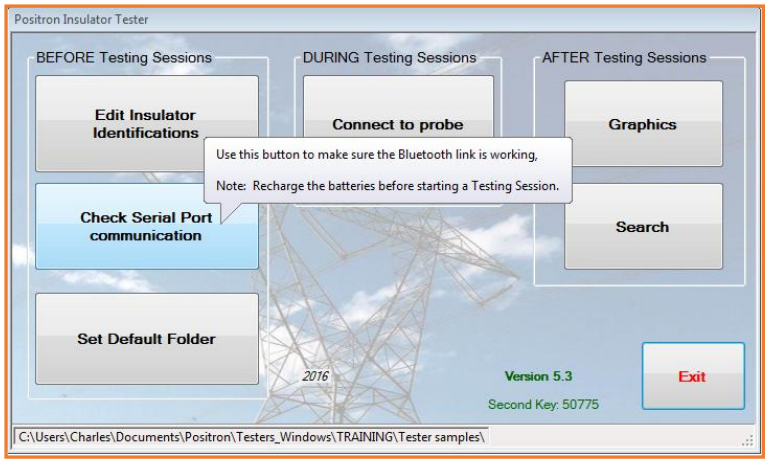


Once the infrared beams have been broken, or after flashing 10 times, the LED and the tone will shut off.

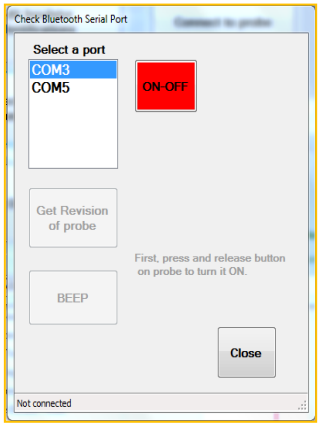
Once the Probe has been activated and the **POST** procedure is finished, communications between the Probe and the Windows-based software on the Tablet/Laptop must be tested.

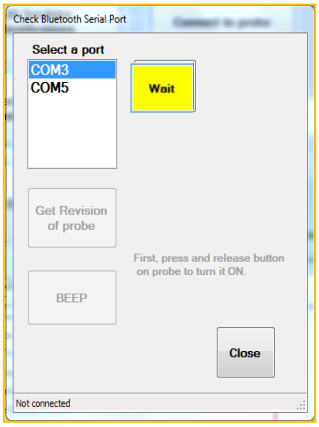
5.1.6 Check Long-Range Bluetooth Serial Port Communication

Select the **Check Serial Port Communication** button to verify long range Bluetooth connectivity between the Tablet/Laptop and the Probe 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.

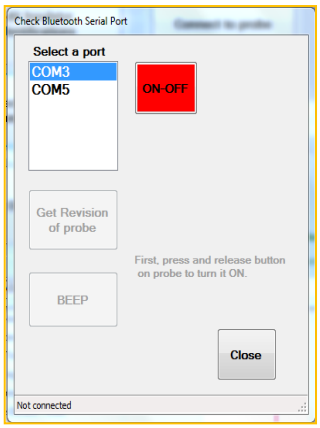


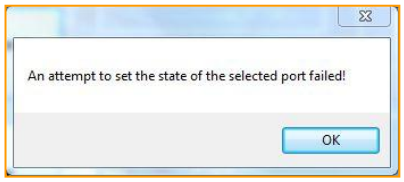


Select the RED **ON-OFF** button. The button will change to YELLOW and “Wait” will appear until Bluetooth communication is established, and then it will change to GREEN.

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 Probe's long range Bluetooth RS232 Adapter.

Take note of the COM port associated with the long range 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 Probe to the testing location with the long range 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 Probe. If a button in the Insulator Tester Software changes to RED after it has been GREEN, the Probe may be in sleep mode, and the Push Button of the Probe must be pressed to bring the unit into Awake Mode.

5.1.7 Get Revision of the Probe

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

Once you have selected **Get Revision of the Probe,** communication between the Tablet and Probe is established. Ensure that the Probe is in **Awake Mode** by pressing the push button of the Insulator Tester Probe. See Figure 11. If required, select **Get Revision of the Probe** after the Probe is awakened.

This step verifies that the Tablet/Laptop can communicate with the Probe. Once Bluetooth connectivity and functional communication are verified, the Probe can be switched off. The Probe will be switched on again in the field when scanning is to begin.

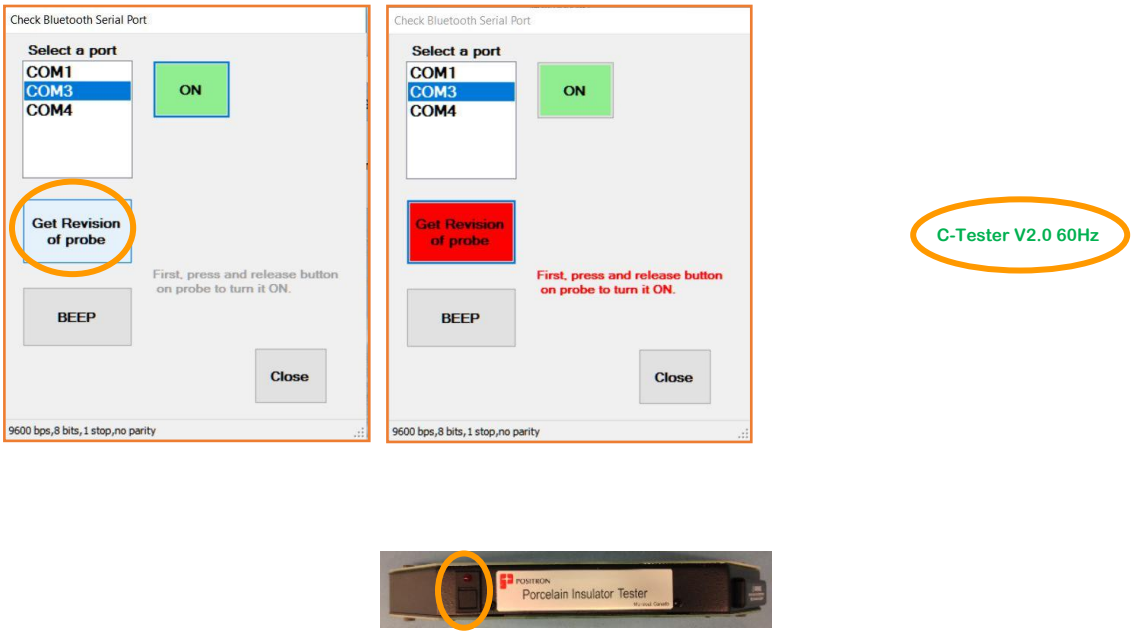
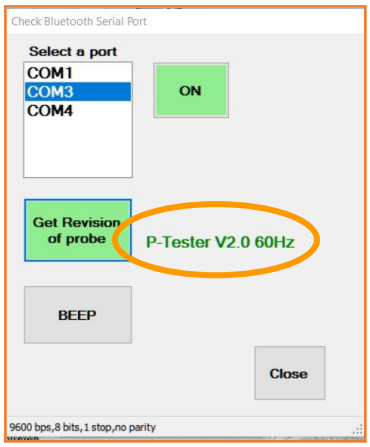


Figure 11



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 while performing a testing session.

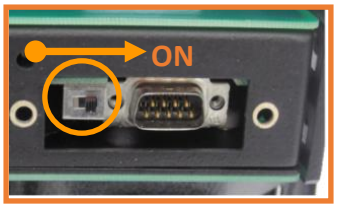
Equipped with the Tablet separated from the keyboard, the Ground Operator launches the Insulator Tester Software. Optionally, the camera of the Tablet/Laptop can be used take a picture of the tested tower.

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 12. The Probe will first enter the Power-On Self-Test (**POST**) as described in 5.1.5.1.

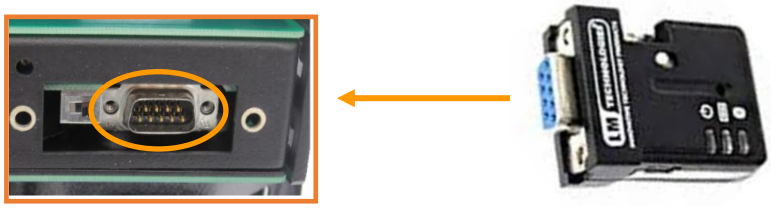
Ensure the slide switch on the Bluetooth adapter is in the DCE position. Insert the long range Bluetooth Serial adapter into the DB-9 Serial port of the Insulator Tester Probe. The long range Bluetooth Serial adapter is powered by the battery of the Probe.

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



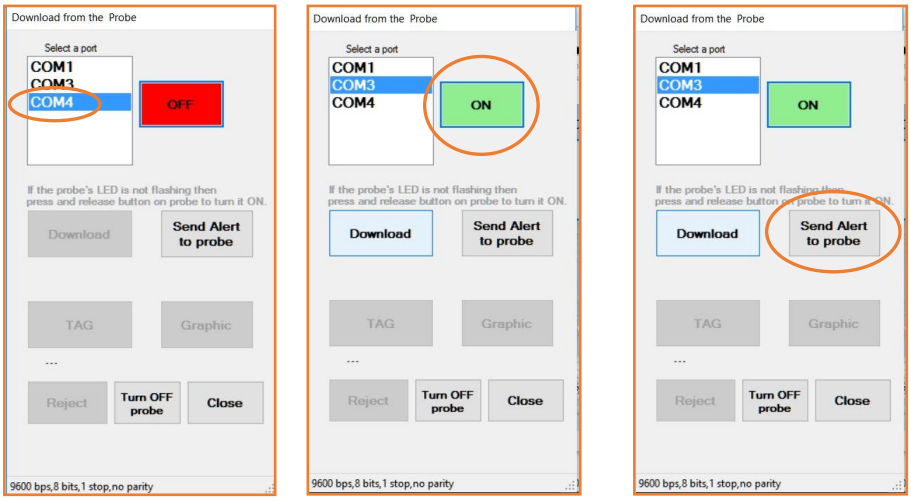
Ensure the slide switch on the Bluetooth adapter is in the DCE position.

Figure 12

Connect to the Probe prior to Tower Operator ascension. Ensuring that the Probe 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.**

It is recommended to connect the Bluetooth in the field prior to Tower Operator ascension. 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 Tower Operator can now ascend. Once in position, the Tower Operator should press the Probe's button to ensure it is in **Awake Mode**. If not, the Ground Operator will be unable to signal the Probe. Ensure that the LED of the Probe is flashing GREEN.

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

5.2.1 Scanning an Insulator

5.2.1.1 Performing a Full Scan (Two Way)

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

Figure 12

1. Following the instructions of the Ground Operator, press the Push-button on the Probe to wake up the probe, if required, (See Figure 12) and place the Tester a minimum of 4 bells (disks) away from the low voltage end. See the **Green Zone** in Figure 13.
2. Then slide the tester to the beginning of the low voltage end of the porcelain insulator string.
3. Slide the 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 tester back toward you a minimum of 2 bells (disks) beyond where you initially placed the unit.
5. Remove the Probe from the insulator string and wait for instructions from the Ground

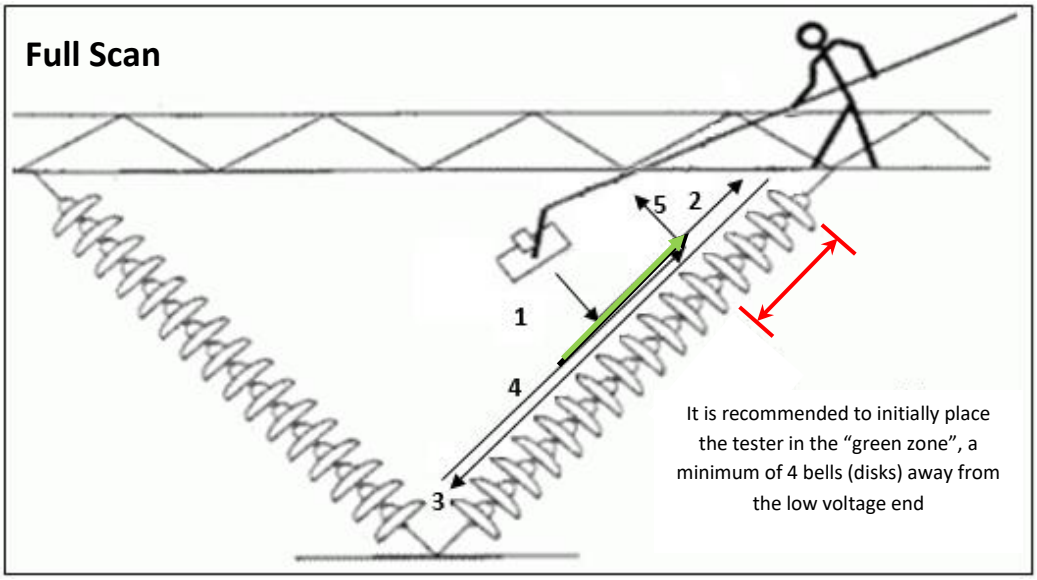


Figure 13

Operator.

- The Ground Operator will **Download** the scanned data to the Tablet/Laptop PC to view the resulting graph and will **Accept** or **Reject** the scan. In either case, the data is wiped from the Probe leaving the Probe ready for the next scan.

- The Ground Operator selects **Send Alert to Probe** and the annunciator tone attracts the attention of the Tower Operator so the Ground Operator communicates the next step to the Tower Operator.
- This process is repeated for each insulator string

5.2.1.2 Performing a One-Way Scan

A One-Way Scan (forward only) can be used if performing a Full 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)

Figure 14

traces on the graphs closely match.

1. Following the instructions of the Ground Operator, press the Push-button on the Probe to wake up the Probe, if required, (See Figure 14) and place the Tester a minimum of four (4) bells (disks) away from the low-voltage end. See the **Green Zone** in Figure 15.
2. Then slide the tester to the beginning of the low voltage end of the porcelain insulator string.
3. Slide the 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 Probe from the insulator string and wait for instructions from the Ground Operator.

NOTE

If the orientation of the Probe is reversed prior to a second **One-Way Scan** the indication of the first broken Infra-Red beam (IR1 or IR2) will be different. This is useful if the alternate attachment is used on the sled.

If a **One-Way Scan** is used, the insulator can be scanned a second time to confirm the validity of the first scan.

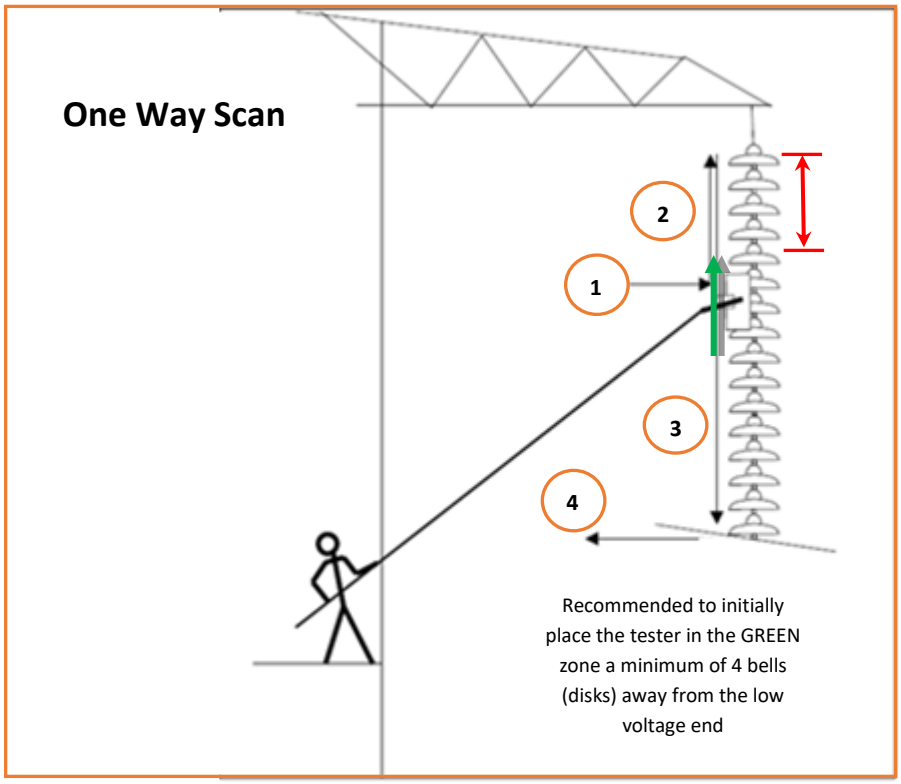

One Way Scan
2
1
3
4
Recommended to initially place the tester in the GREEN zone a minimum of 4 bells (disks) away from the low voltage end

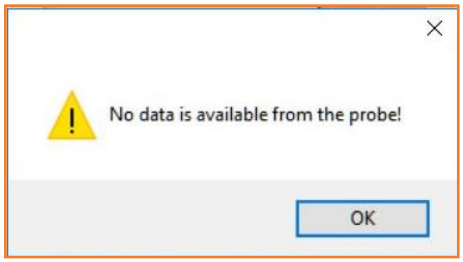
Figure 15

5.2.2 Downloading Data

The results of the scans are downloaded immediately after the scan and viewed on the Tablet/Laptop. To initiate the download, the ground operator presses the Download button on the Tablet/Laptop, afterward the **Download**, the data is erased from the Probe.

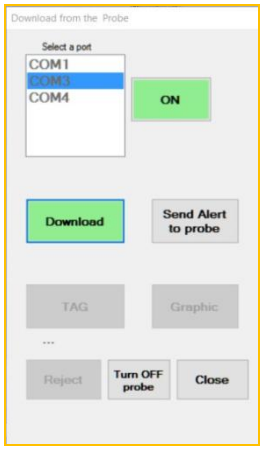
NOTE

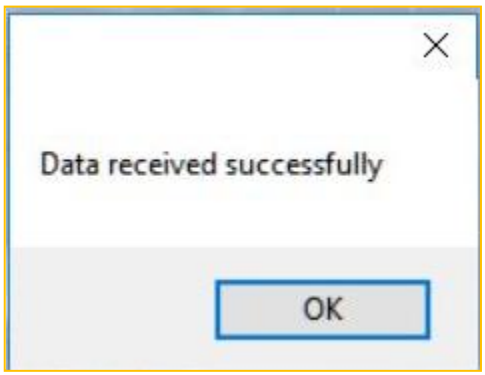
During the Download process, if a system message is returned stating "**No data is available from the Probe**" this indicates that the Insulator Tester Software is in communication with the Probe, but that there is no data in the Probe to download. The **Download** button will still turn **GREEN**, indicating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



Probe, but that no data was resident.

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





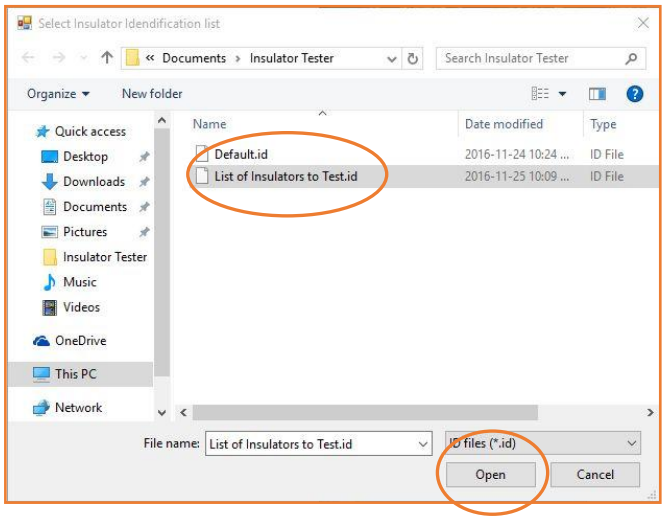
The **Download from the Probe** dialog box will open, showing the graph of the E-Field of the scanned insulator. From this screen, you can associate the insulator scan with an ID created earlier in the Insulator Identification List.

In the rare occasion were the Tablet/Laptop is not used in the field, the data is stored in the Probe by pressing the push-button on the Probe after each insulator string scan. In this

situation, a validation process takes place to verify the completeness of the two-way scan, meaning that all disks are scanned at least twice: forward and backward. An audible and visual indication will inform the Tower Operator if the above condition is not satisfied.

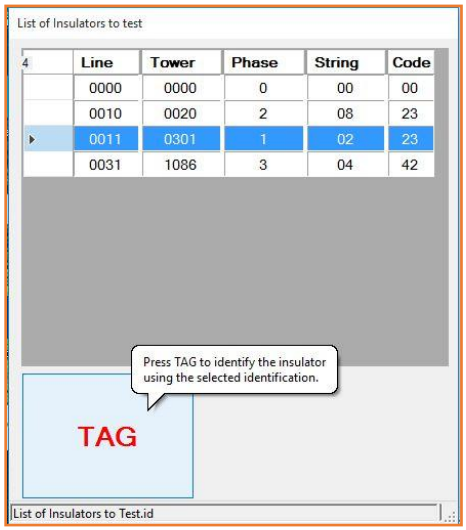
This validation doesn't take place for a one-way scan. Note that in absence of a Tablet/Laptop, the insulator cannot be identified on its graphic. It is highly recommended to use the Tablet/Laptop in the field, in which case, the present paragraph can be ignored.

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



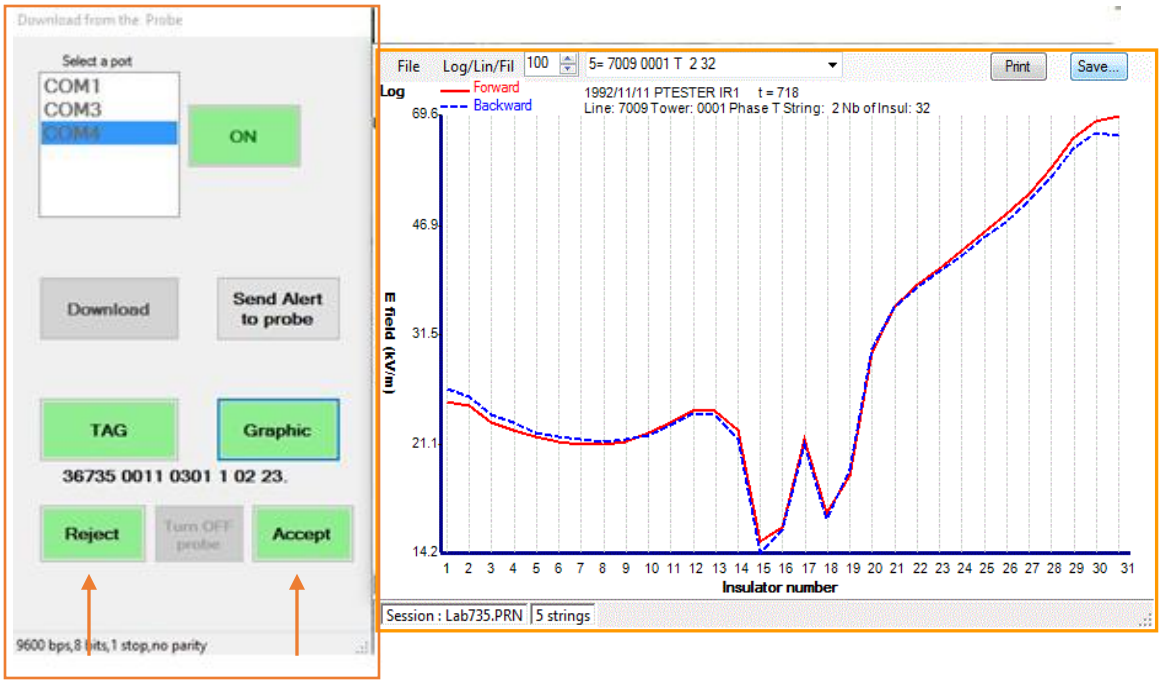
From the **Select Insulator Identification List** you can select and open the Insulator ID List created before the testing session.

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



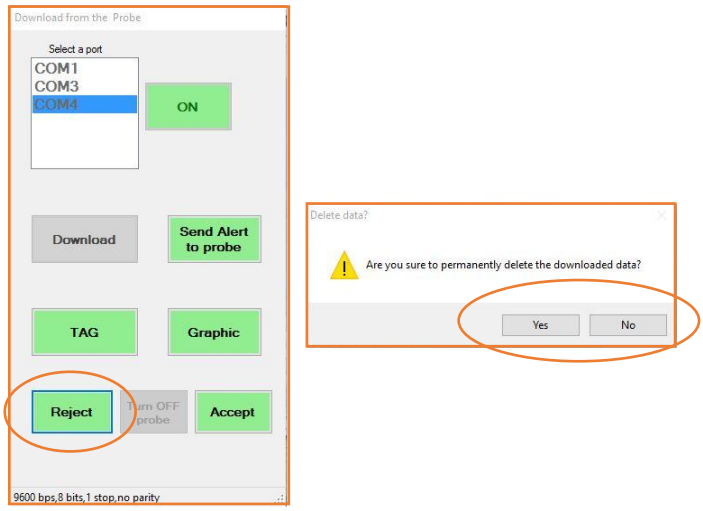
Select **Graphic** to see one or more graphs of the E-Field from scans of the last tested insulator. If more than one scan was done on the last tested insulator, click or touch the graphic to see the next related graphic.

An instant determination can be made by the Ground Operator whether to **Reject** or **Accept** the



last insulator scan.

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 Probe, ready to re-scan the insulator.



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

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

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

A) Select **Turn OFF** the **Probe** button and put the Probe into **sleep mode**. (The Probe can be awakened by pressing the Push Button of the Probe.)

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 Probe has gone into sleep mode. The Tower Operator must be signaled to wake the Probe by pressing the Probe's Push Button.

5.3 AFTER Testing Sessions

5.3.1 Displaying Graphs

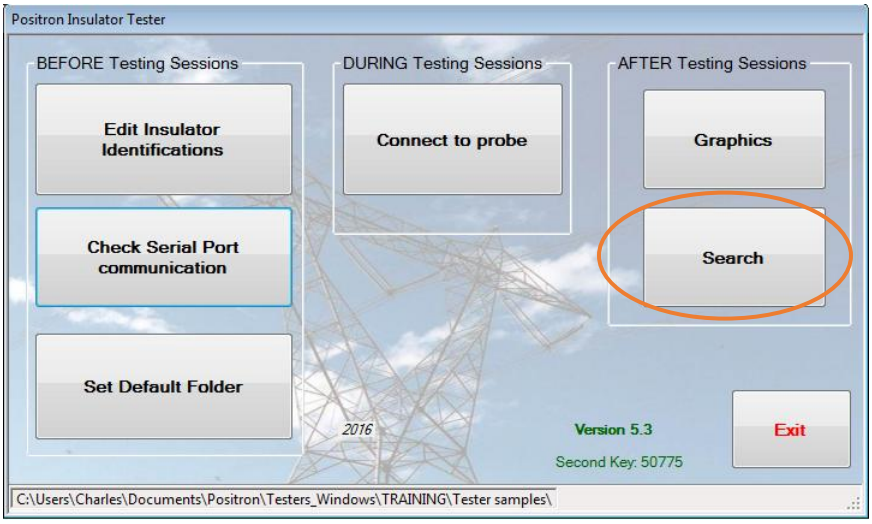
At any time before, during or after a testing session, press the “Graphics” button on the Tablet screen to display the graphs from the data stored in the Tablet/Laptop. Refer to Chapter 6 for interpretation of the graphs

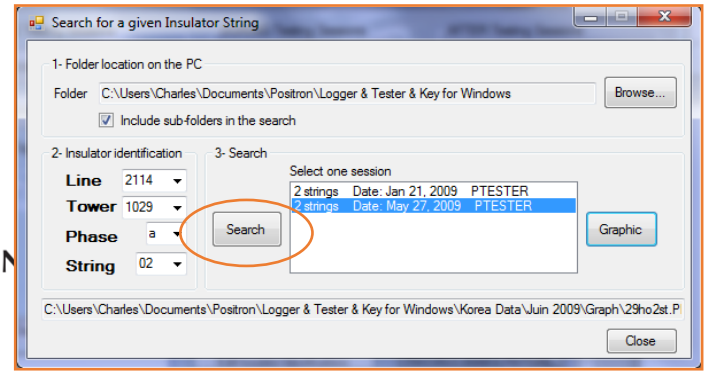
5.3.2 Searching the Database

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





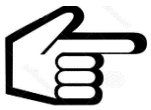
5.4 Important General Notes

- ✓ Always use the same Bluetooth adapter with its paired Tablet/Laptop.
- ✓ If the Probe has not been used for more than six (6) months, recharge its Ni-Cad battery before switching ON the power of the Probe.
- ✓ The Probe'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 Probe and the Tablet/Laptop before a day of testing.
- ✓ Switch the power OFF when the Probe is left unused. To switch the Probe 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 Probe and the Tablet/Laptop in rain or snow.
- ✓ To recharge the battery, remove the RS232 cover (3" x 1"), plug the charger cable to the Probe 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 Probe OFF while the battery is recharging. Under normal circumstances, it is not necessary to switch the Probe OFF during a recharge.

NOTE

Switching the Probe OFF will erase all data in the Probe.

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.

This equipment will not detect any non-conductive defects including non-conducting mechanical defects.

Chapter 6

Interpreting Graphic Results

6.0 Interpreting Graphic Results

6.1 Understanding the Graphic References

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 Probe 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

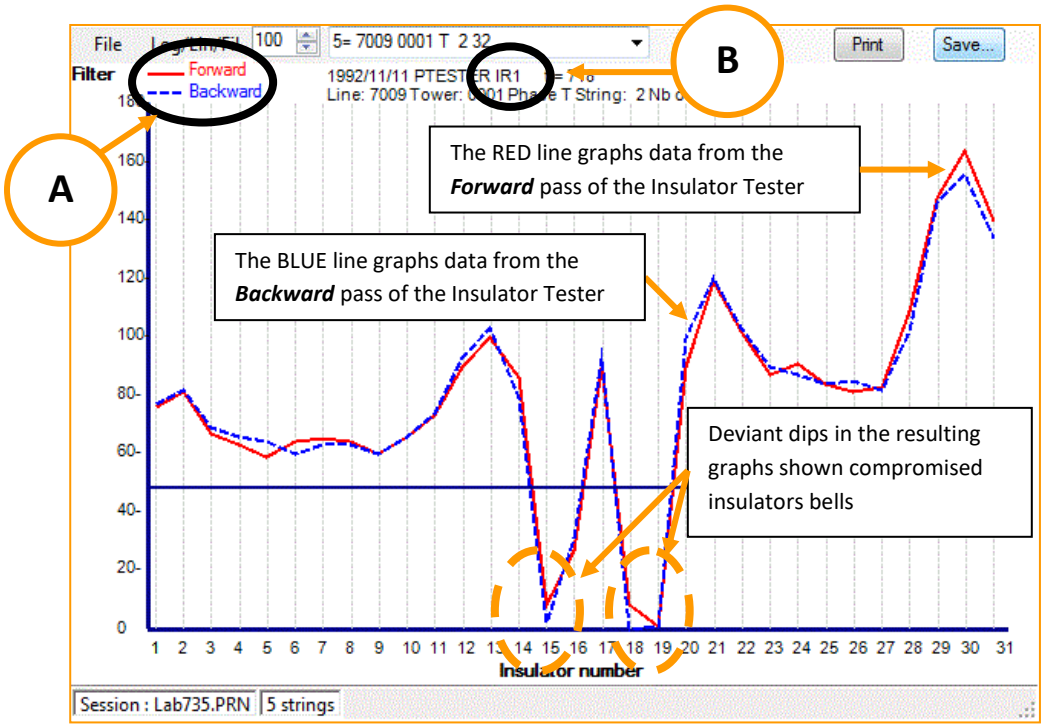
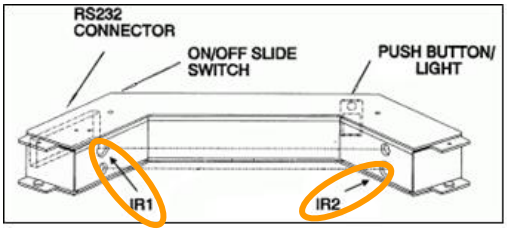


Figure 16: Example of Insulator Scan of Porcelain Insulator String on Filter Scale

depending on the direction of the sled when the reading is acquired. See Figure 16 below.

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) Indicates the orientation of the Probe relative to the forward scan. The direction of the Probe as represented by the graphs depends on which of the two Infra-Red beams of the Probe 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.

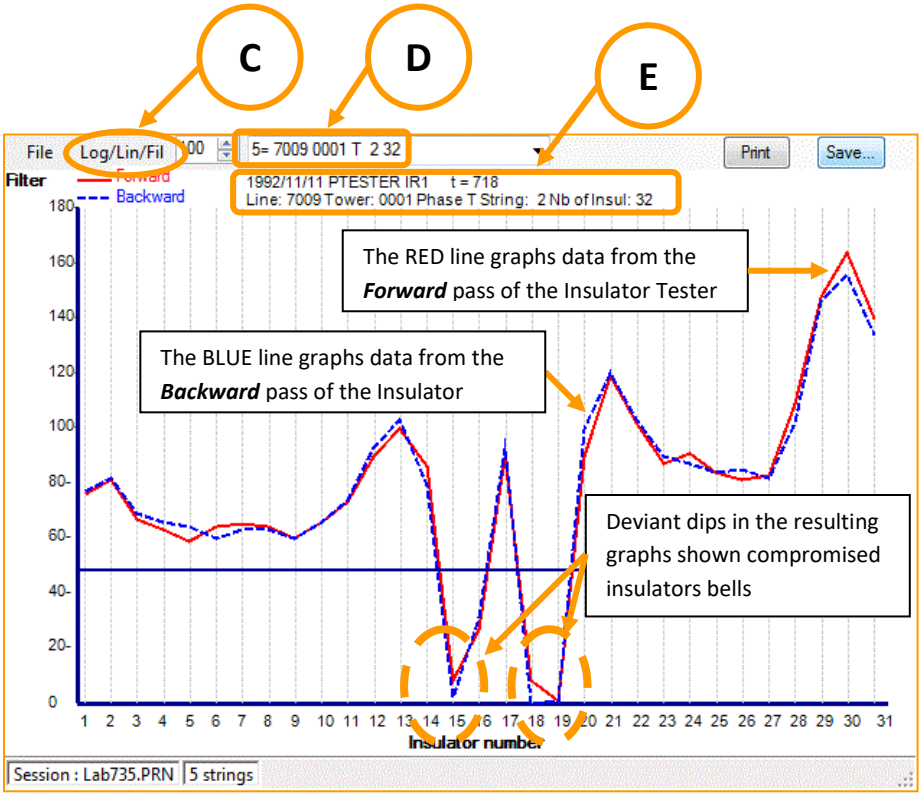


Figure 17

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 14 or more Porcelain insulators.

D) This section of the graph offers a truncated identifier for the porcelain testers 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 software. 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 Tester)

iii. Orientation of the Probe 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 for the porcelain to display the electric field readings from the Probe on a linear scale. It is normally used for lower voltage applications (less than 14 insulators).

The “Log” display mode is used to amplify the small variations in the lower portion of the curve for porcelain insulator strings of 14 or more bells.

The “Filter” display mode is used to simplify the identification of the perforated 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 tower side. The vertical axis represents the strength of the electrical field in kilovolts/meter, expressed as “E-field (kV/m)”. The E-field is measured 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 confirms the scanning integrity of insulator bells along the string.

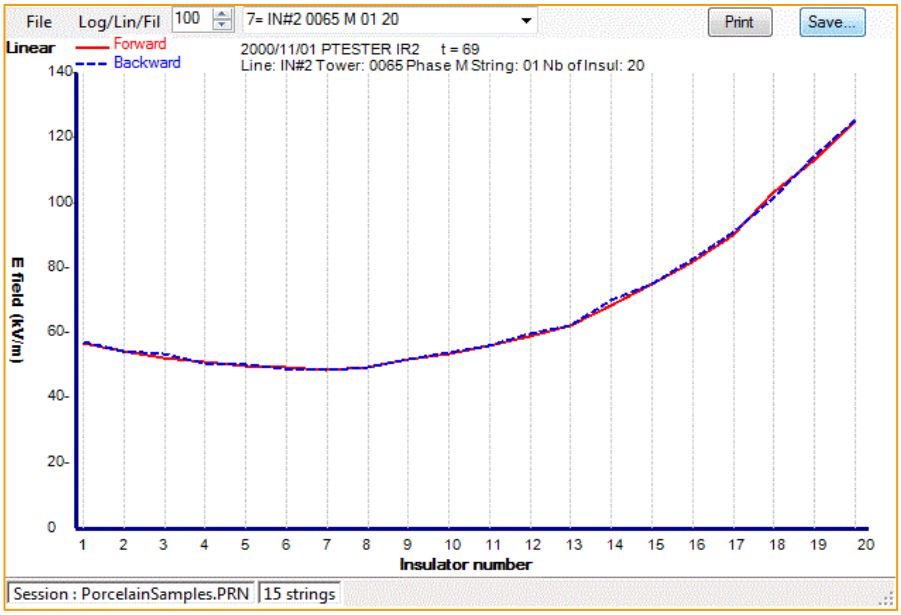


Figure 18: Graph of Porcelain Insulator String displaying a healthy set of porcelain insulator bells shown using *Linear* mode.

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 Probe of the Insulator Tester enabling early detection of minor defects or low contamination.

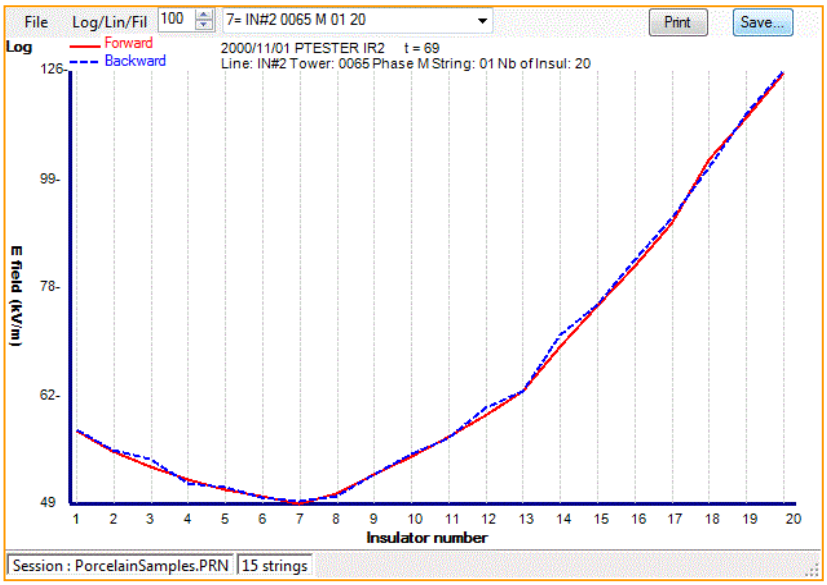


Figure 19: Graph of Porcelain Insulator String displaying a healthy set of porcelain insulator bells shown using *Log* mode.

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

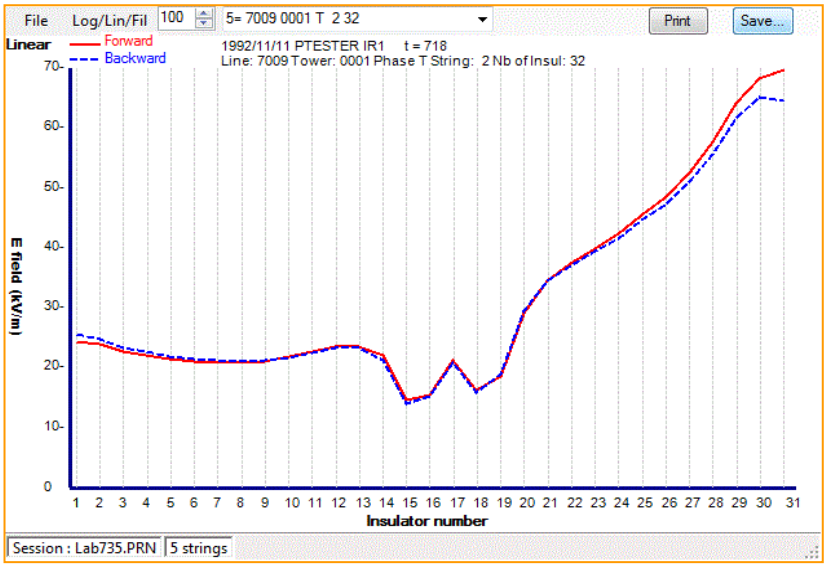


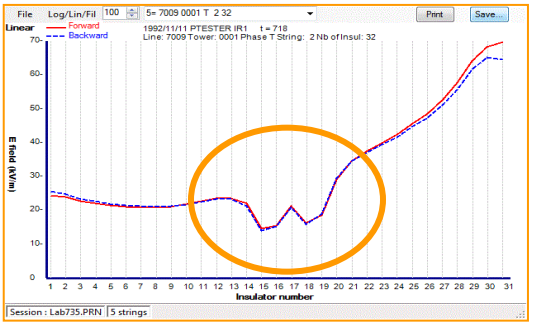
Figure 20: Graph of Porcelain Insulator String displaying compromised porcelain insulator bells shown using *Linear* mode.

defects exist in the porcelain insulator string being scanned.

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 derived.



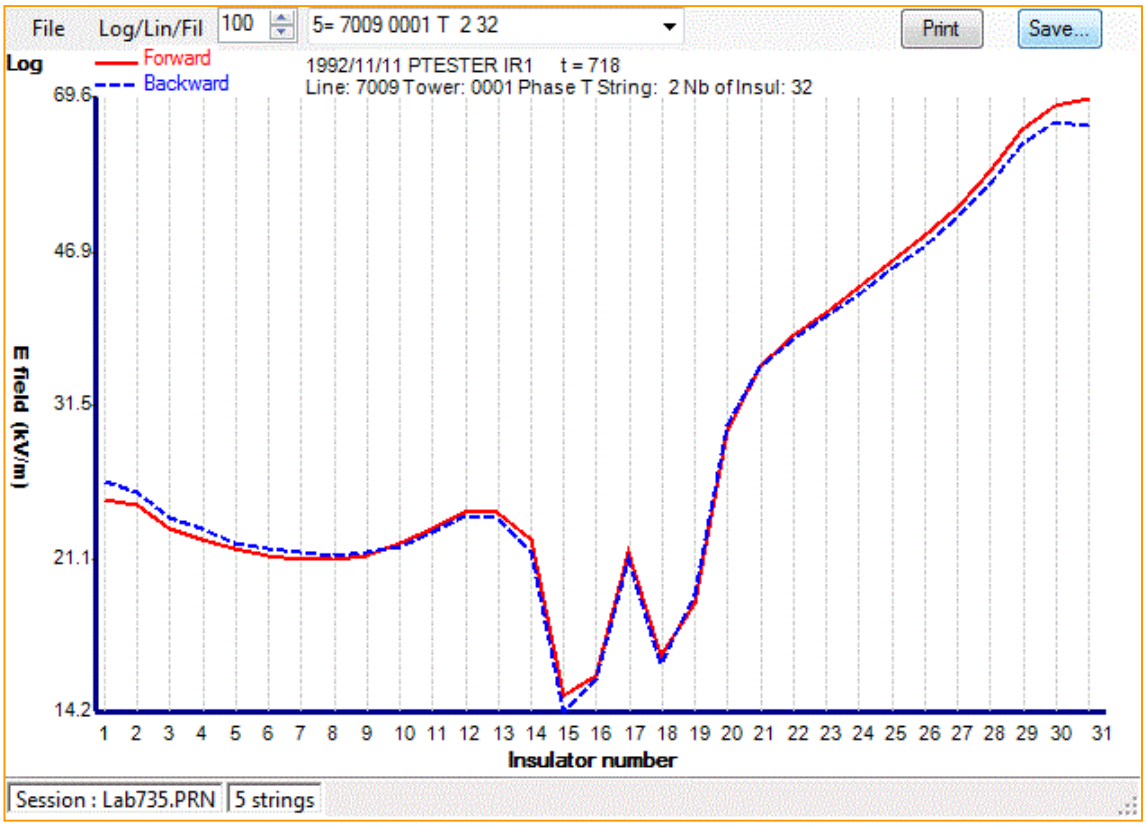


Figure 21: Graph of Unhealthy Porcelain Insulator String

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 to assist in the interpretation of the

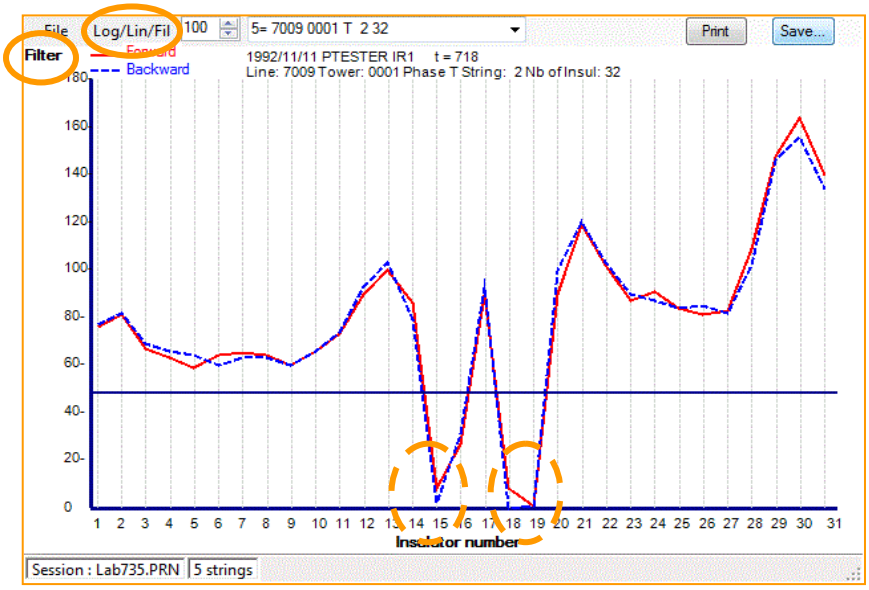


Figure 22: Example of Insulator Scan of Porcelain Insulator String on Filter Scale showing badly compromised porcelain insulator bells shown at #'s 15, 16, 18 & 19.

graph: Insulators under the blue line are punctured. Note: The vertical axis has no unit.

6.4.4 Comparing Historical Graphs

Graphs can be superimposed for comparison. Refer to Figure 23. Place one graph over the other, and reduce the opaqueness down from 100 until one graph is visible through the other.

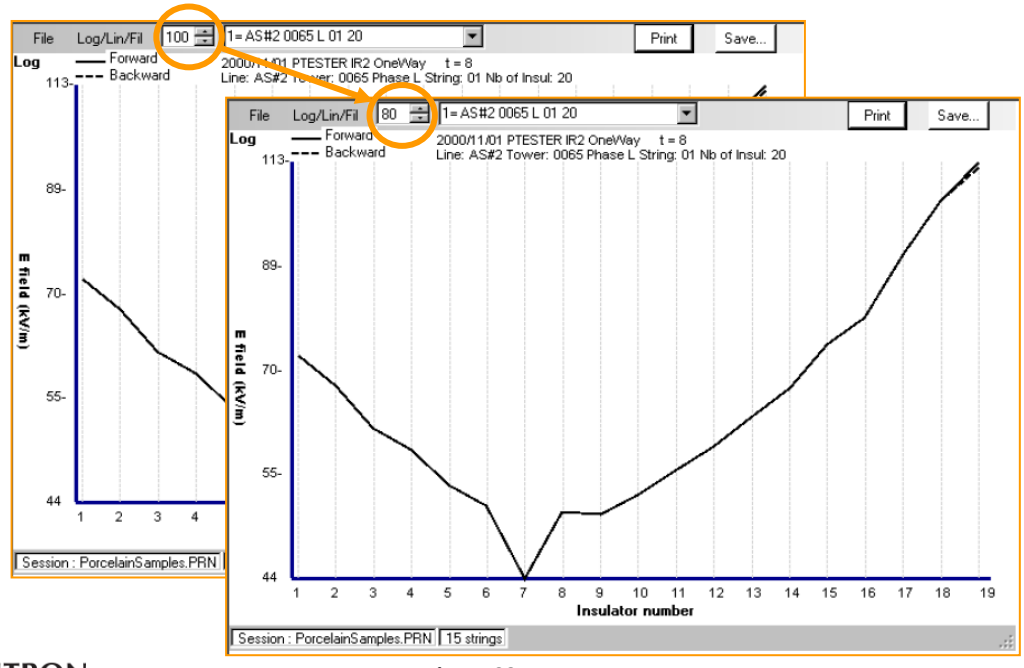


Figure 23

Chapter 7

Specifications

7.0 Specifications

Parameter	Specifications
Maximum insulators per string (Porcelain)	70 insulators
Minimum insulators per string	5 insulators
Scanning speed	From 0 to 6 insulators/s
Maximum corona protection	1 million Volts
Minimum battery recharging time	10 hours (one night)
Cumulative use between charges	12 hours
Maximum period between battery charges	1 day
Operating temperature range: • Probe • Bluetooth Adapter	 -22°F to 122°F (-30°C to 50°C) -4°F to 167°F (-20°C to 75°C)
Dimensions (Porcelain) Insulator diameter	14" x 19" x 9" (36 cm x 48 cm x 23 cm) 9” to 13” (23 cm to 33 cm)
Weight (Porcelain)	3.5 lbs. (1.6 kg)
Humidity	90%
Factory calibration (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 Horizontal and V Strings

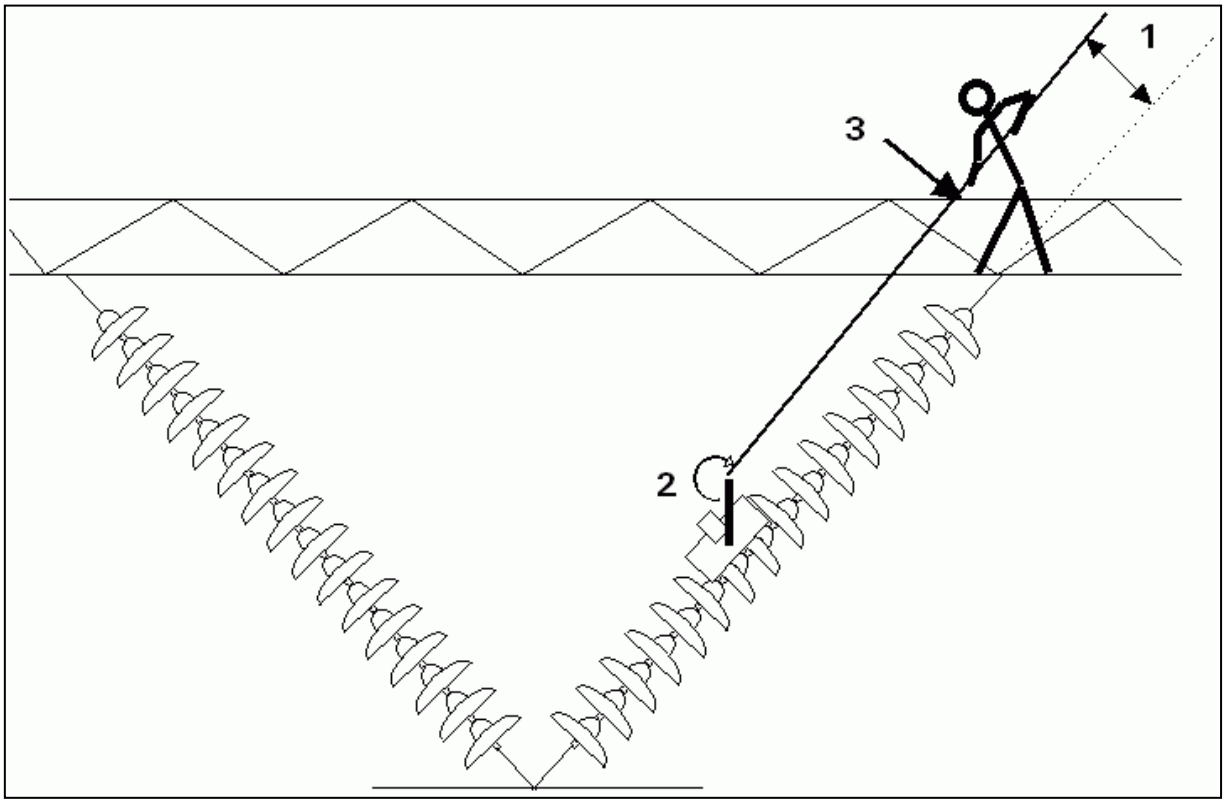


Figure 24

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.

8.2 Vertical String (Preferred method)

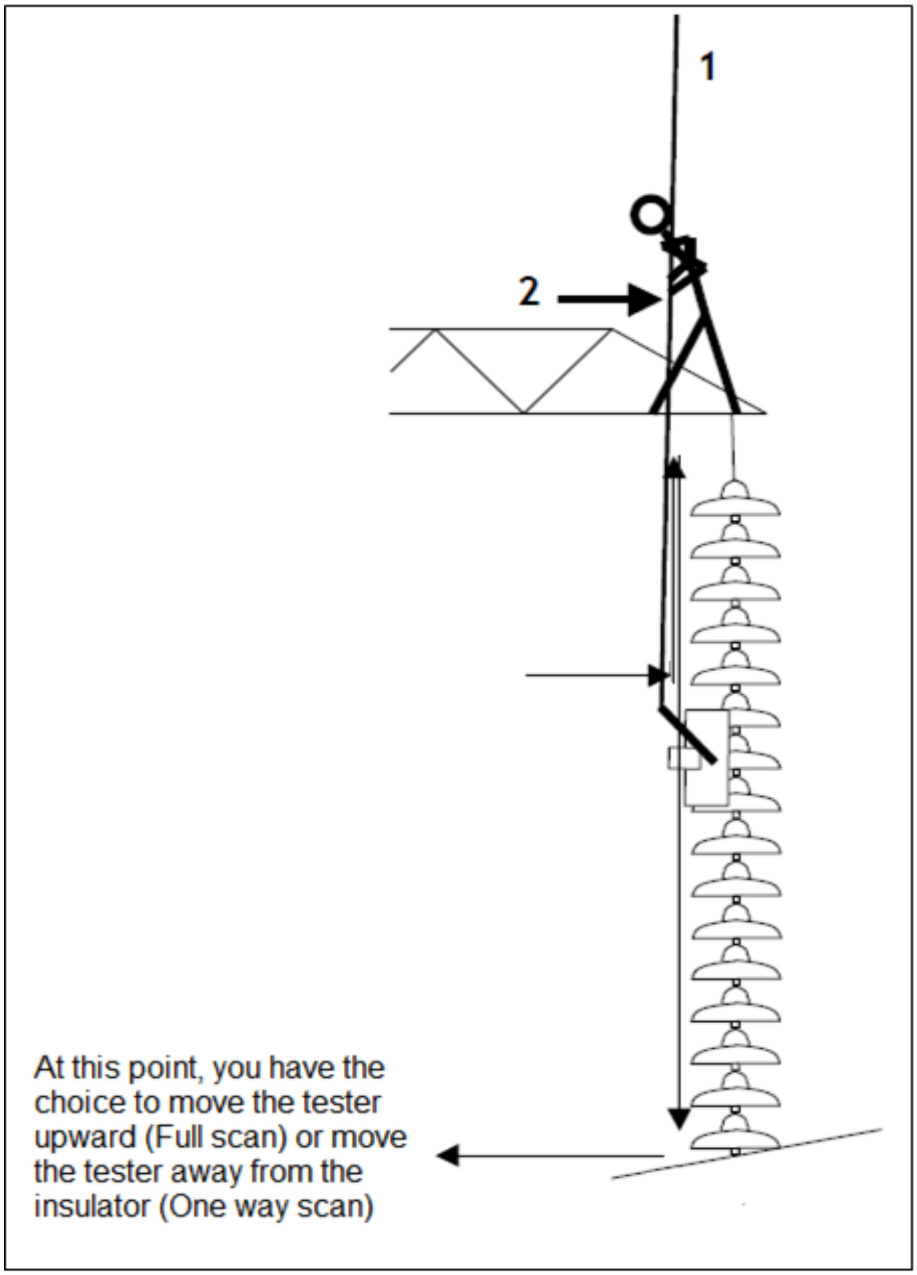


Figure 25

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.

8.3 Vertical String (Alternate method)

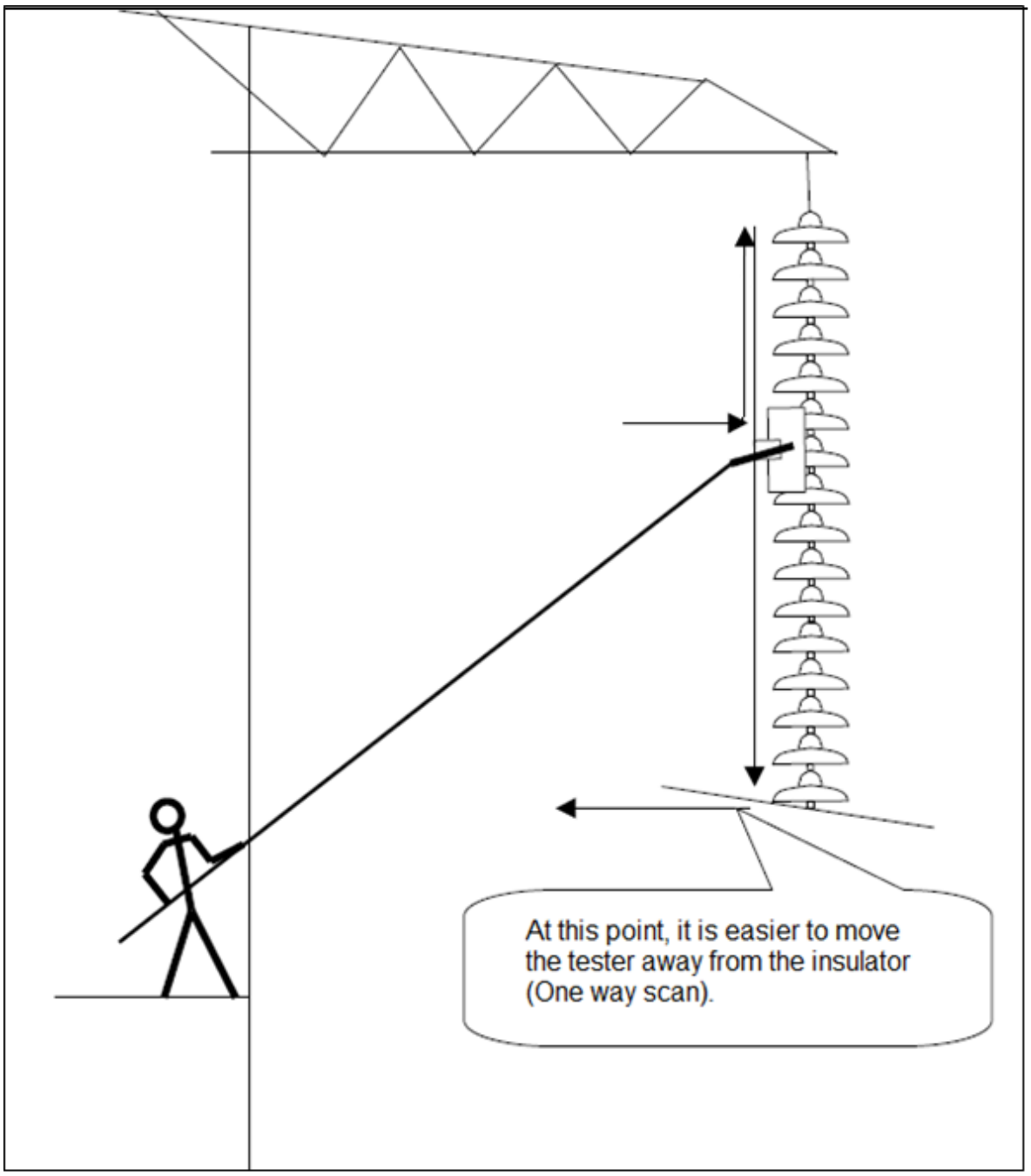


Figure 26

Chapter 9

Important Information

9.0 Important Information

9.1 Service and Support

Positron Contact Information

General information	Positron Inc. 591 Buchan Street Montreal, Québec, Canada H4P 2R9 US and Canada: 1-888-577-5254 International: 1-514-345-2214 Fax: 1-514-345-2271 E-mail: info@positronpower.com Web site : www.positronpower.com
Repairs	US and Canada: 1-888-577-5254, Option 1 International: 001-514-345-2220, Option 1

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 pricing information or assistance in the planning, configuration, use and interpretation of data of 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).

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 001-514-345-2220 (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.

Before returning any items to Positron for repair, warranty repair or replacement, call the Repair Department 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. Bulk repairs (more than five items) will require additional processing time, so please take this into consideration when requesting an RMA.

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 remains valid for two (2) years from the date of shipment. The warranty fully covers workmanship, materials and labor. Positron shall, at its sole discretion, repair or replace the problem unit.

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.

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

Insulator Testers for High Voltage Live Lines

- Instantaneous graphical indication
- Safe, easy to use and lightweight (1.6 Kg)
- No electrical contact with insulators
- Early detection and recording of faults
- Works on energized insulators up to 1,000,000 Volts
- **SAFETY** and maintenance tool
- Used for all Porcelain, Composite and Glass Insulators
- Provides contamination assessment
- Reliable, proven, deployed **WORLDWIDE**

Protect the Safety of Personnel
Working in Close Proximity to Live High Voltage Insulators

Fast & Simple to Use

Simply slide the tester sled along the insulator (string). It instantly provides an audible and visual alarm if a dangerous condition exists and it automatically records all insulator defects.

Porcelain Tester

The Porcelain Tester is used for Porcelain and Glass insulators. It has a feature that will provide Instant Status Reporting for DANGER conditions.

Composite Tester

The Composite Tester is used for Composite insulators. It has a GO/NO-GO feature to instantly report DANGER.

Universal Tester

The Universal Tester works at all voltage levels for all types of insulators. It is useful for lower voltage lines (below 115 kV) and is ideal for substation enviroments (conical shaped insulators, bushings, station posts, lightning arresters, etc.).