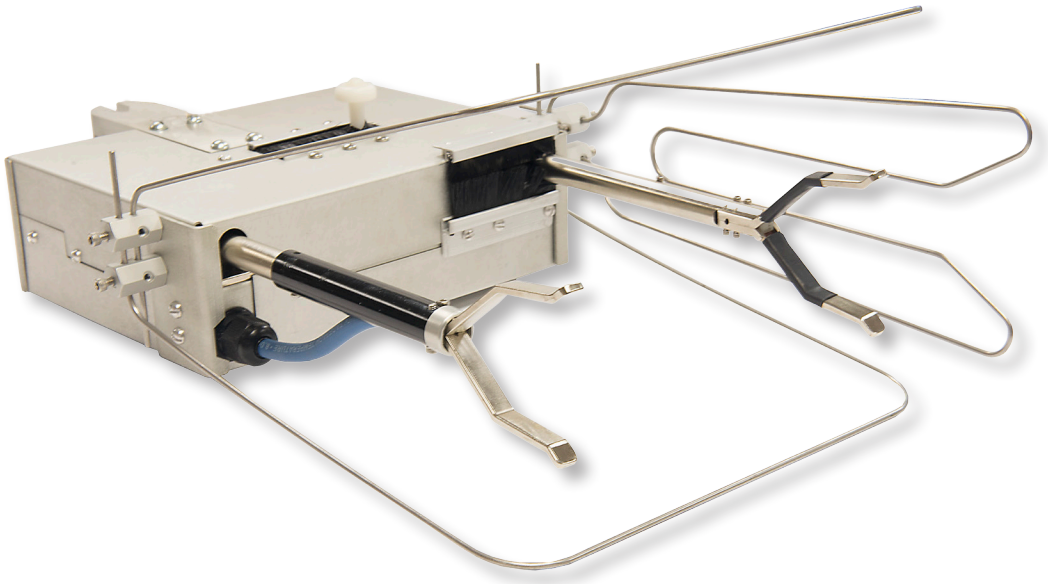
Hubbell Power Systems
Polymer Insulator Tester

Operating Instructions Manual
PSC403-3679 Rev.3



Hubbell has a policy of continuous product improvement. Please visit hubbellpowersystems.com to confirm current design specifications.
This product was the result of collaborative research performed by the Electric Power Research Institute Inc.

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⚠ CAUTION

The equipment covered in this manual must be used and serviced by competent, trained personnel familiar with and following approved work and safety practices. This equipment is for use by such personnel and this manual is not intended as a substitute for adequate training and experience in safe procedures for this type of equipment.

These instructions neither cover all details or situations in equipment use, nor do they provide for every possible contingency to be encountered in relation to installation, operation or maintenance. Should additional information and details be desired or if situations arise which are not covered adequately for the user's purpose, the specifics should be referred to Hubbell Power Systems.

NOTICE

Before operating the Polymer Insulator Tester, thoroughly read, understand and follow these instructions. Keep these instructions in the device case for future reference.

⚠ WARNING

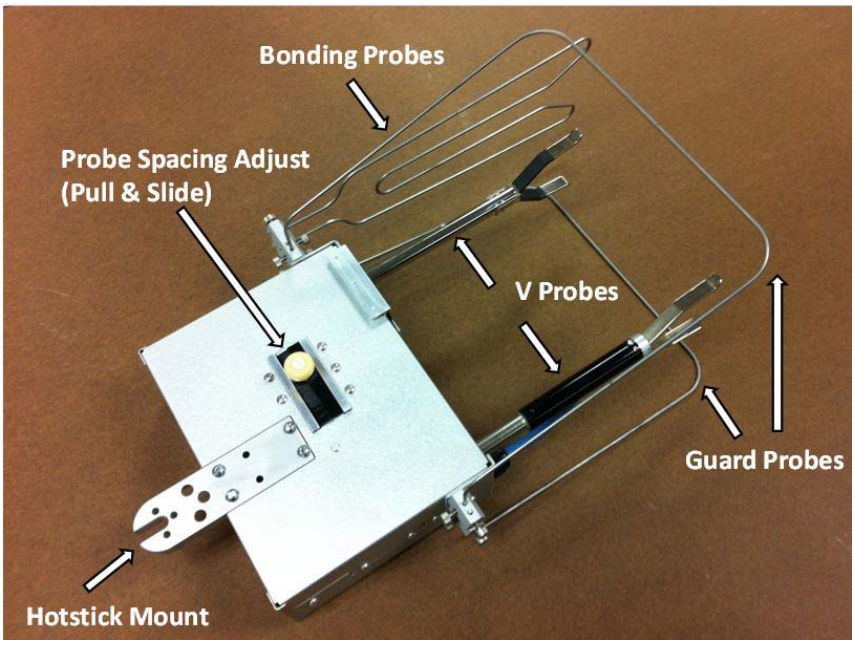
Use only with the appropriate length universal pole even if wearing rubber gloves. Maintain proper working clearance between operator and all energized parts of the system. Failure to follow these warnings could result in personal injury.

NOTICE

This document is only intended to provide guidance on utilizing the functions of the Polymer Insulator Tester (PIT) Tool. It does not provide guidance on how to assess the condition of an insulator.

1. Overview

The Polymer Insulator Tester (PIT) instrument is used to test the electrical integrity of non-ceramic or polymer insulators. The instrument is made for use in the field under energized or de-energized conditions. The tester must be used with a hot stick of appropriate length that provides adequate safe clearances. The unit attaches to the hotstick via the universal fitting.



V Probes - The PIT test instrument has two forked V probes that interface directly with the insulator sheath. A mechanical adjustment is provided on the instrument so that the user can match the V probe spacing to the insulator shed spacing. The V probes are spring-loaded and must contact the insulator with positive pressure in order to take a measurement. One of the V probes transmits an electrical stimulus signal to the insulator, while the other V probe has a built-in sensor that is designed to receive the stimulus signal.

⚠WARNING

When the PIT tool is making a measurement a high voltage exists between the probes (approximately 1.5 kV @ 1.5 MHz). Contact with the probes during operation should be avoided to prevent injury.

Guard Probes - The PIT test instrument has guard probes that shield the V probes from the 60-Hz electric field of the power lines. The guard probes are made of spring steel that allows them to bend upon contact with the insulator sheds. The guard probes are easily removable for replacement or storage but must be installed for proper measurements.

Bonding Probe - The PIT test instrument has a bonding probe on one side that contacts the insulator end fitting when measurements are made at the end sheds. On the energized side, the bonding probe will conduct an arc as it approaches the insulator and protects the instrument. The user must make sure that the instrument is oriented with the bonding probe side nearest the end fitting (Energized or De-energized) when measurements are taken at the first few, and last few, sheds.

2. Calibration

The instrument stores calibration measurements that are taken from a known good insulator or are known to represent a good insulator of a particular size/rating/brand. Measurements are compared to the calibration values in order to establish pass/fail results. Instrument calibration depends primarily on the following factors:

Probe Spacing
Insulator Diameter
Insulator Polymer Thickness
Ambient Temperature

The user must calibrate the instrument when any of the above factors have changed or if the unit has not been calibrated within the last 24 hours, preferably each time it is used, and recognize changes in test conditions that might require recalibration.

Note:
1. *Insulators with different fiberglass rod sizes require calibration.*
2. *Insulators with different thicknesses of rubber surrounding the fiberglass rod require calibration. Different manufacturers may have different thicknesses.*
3. *The size, number, and style of insulator sheds are not necessarily a factor.*
4. *Ambient temperature changes must be fairly significant (e.g., 10 degrees Celsius = 18 degrees Fahrenheit or more) to require a new calibration. Normal operating temperature is 0° - 50°C.*

To make testing different size insulators in the field easier, the instrument can store three (3) different calibrations in memory (Cal1, Cal2, and Cal3). The stored calibrations are retained even after a power cycle. The calibration that is selected can be confirmed from the WiFi interface (see WiFi Operation Section). Short sections of insulator rods without sheds are provided in the PIT transit case as part of the kit to aid with calibration when a known good insulator of the same type as that being tested in the field is not available. These sample rods are intended to be used for calibration measurements prior to testing insulators of the same size in the field.

The instrument selects the calibration to use based on the probe engagement conditions when it is powered on. Calibration mode is ready for selection when the green calibration lights and the white LED light are flashing.

Manual Calibration
In order to calibrate manually, use the following steps:

NOTICE

It is important that the PIT instrument is not handheld by the user when taking calibration measurements. The instrument should be mounted to the hotstick so that its configuration is the same as it will be when taking the insulator measurements in the field.

Step 1: Power up the instrument and select the calibration mode that you want to change.

Cal Preset 1
- Power on the unit using the power switch.
- When the green lights start flashing, engage and release either one of the v-probes.
- The unit will beep twice after the power up has completed. The white LED will be flashing and only one of the green LEDs will be illuminated.

Cal Preset 2
- Power on the unit using the power switch.
- When the green lights start flashing, engage and hold in the v-probe on the bonding probe side until the unit beeps.
- The white LED will be flashing and two of the green LEDs will be illuminated.

Cal Preset 3
- Power on the unit using the power switch.
- When the green lights start flashing, engage and hold in the v-probe opposite of the bonding probe side until the unit beeps.
- The white LED will be flashing and all three of the green LEDs will be illuminated.

Step 2: Wait until the instrument boot-up is complete and the White LED is flashing which signifies that it is ready for a calibration measurement.

Step 3: Engage the instrument to the sample insulator rod with the unit installed on the hotstick just like it will be used in the field.

Step 4: Wait for the measurement to complete like normal.

Step 5: Turn off the instrument.

Step 6: Repeat for Cal 1, 2, 3 as desired.

Note: The new calibration values are stored in permanent memory immediately after the measurement and will not be lost.

Selecting a Calibration Setting for Use

Only one calibration preset can be active during operation. The desired preset is activated as follows:

Cal Preset 1
- Power on the unit using the power switch.
- Do not engage either of the v-probes.
- After power up, 1 green LED will be illuminated.

Cal Preset 2
- Engage and hold in the v-probe on the bonding probe side.
- Power on the unit using the power switch.
- Continue holding in the v-probe until the unit powers up and beeps twice.
- 2 green LEDs will be illuminated.

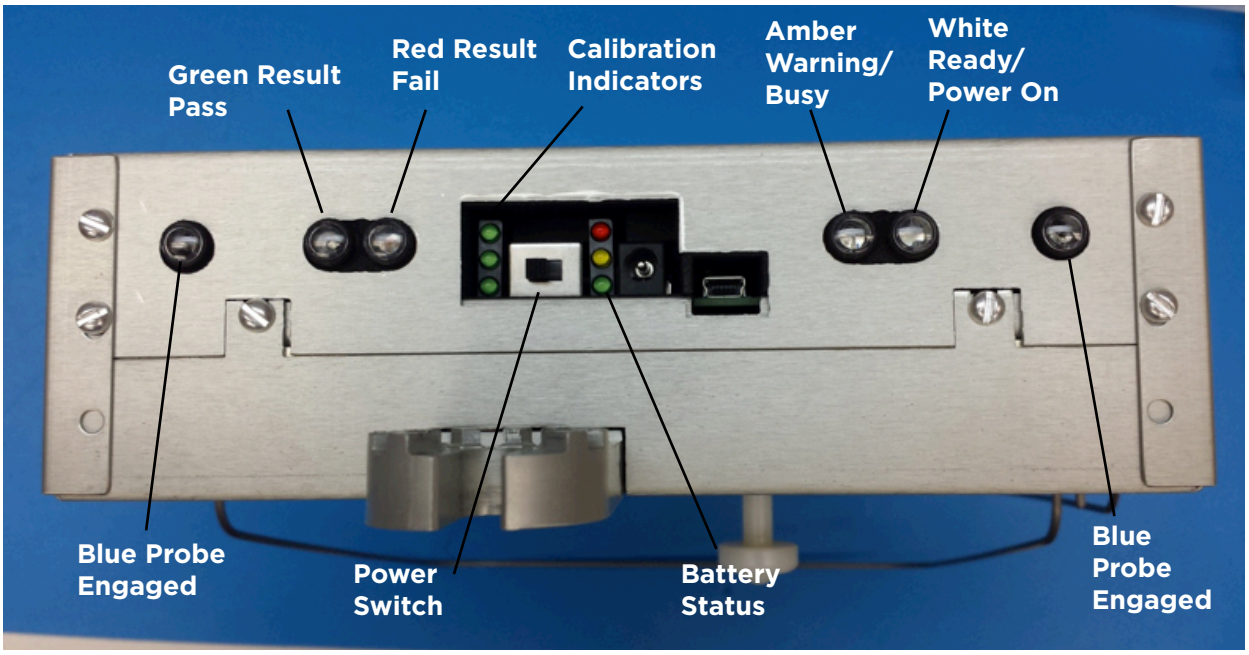
Cal Preset 3
- Engage and hold in the v-probe opposite of the bonding probe side.
- Power on the unit using the power switch.
- Continue holding in the v-probe until the unit powers up and beeps twice.
- 3 LEDs will be illuminated.

Note: Factory re-calibration is not required unless operator suspects an issue or unit has been mishandled.

3. Basic Operation

Measurements are triggered automatically upon engagement of the probes with the insulator. For basic operation, the user adjusts the probe spacing so they easily fit between the insulator sheds, sets the power switch to the ON position, waits for the instrument to boot up, and then engages the V probes with an insulator. The instrument automatically takes a measurement once the V probes are both engaged for about one second. Feedback is provided to the user with LEDs and audible tones to indicate instrument status, probe engagement status, and measurement status. The audible tones are generally redundant with the LED information but audible tones are helpful when visual sight of the LEDs is obstructed due to the insulator position with respect to the hotstick.

Note: the PIT instrument must be calibrated before it can report valid pass/fail results (see Calibration Section for details on that)



Instrument Status - The White LED indicates that power is ON. When first powered ON, the instrument beeps and then the 3 green calibration lights flash for several seconds while internal memory is being read. When the memory read is complete, all of the LEDs are flashed and two more beeps are sounded. The unit then turns on WiFi and after a few more seconds beeps one more time to indicate that WiFi is available if needed. At this point, only the White LED should be on indicating that the instrument is ready to take a measurement. If the White LED is flashing, then the instrument needs to be calibrated (see Calibration Section for details). If the Amber LED is on, then the instrument has a low battery state and must be corrected before it can be used (See Battery Charging Section for details).

Probe Engagement Status - The two Blue LEDs on the ends correspond with the two V probes and indicate their engagement status. Different tone beep rates are associated with the two V probes so that when only one probe is engaged the user can tell which side to apply more pressure to even if the Blue LEDs are not visible.

Measurement Status - A steady Amber LED and audible tone indicate that a measurement is taking place. This takes about one second, after which the results are immediately displayed. The Green LED and a slow beep indicate a good section of insulator is detected, while the Red LED and a fast lower frequency tone indicate a bad section of insulator is detected. Simultaneous illumination of the Green, Amber, and Red LEDs and a fast higher frequency tone indicate an invalid measurement which most commonly occurs when the one or both of the probes are disengaged from the insulator in the middle of a measurement. The measurement status indications continue until the probes are disengaged.

4. Making a Measurement

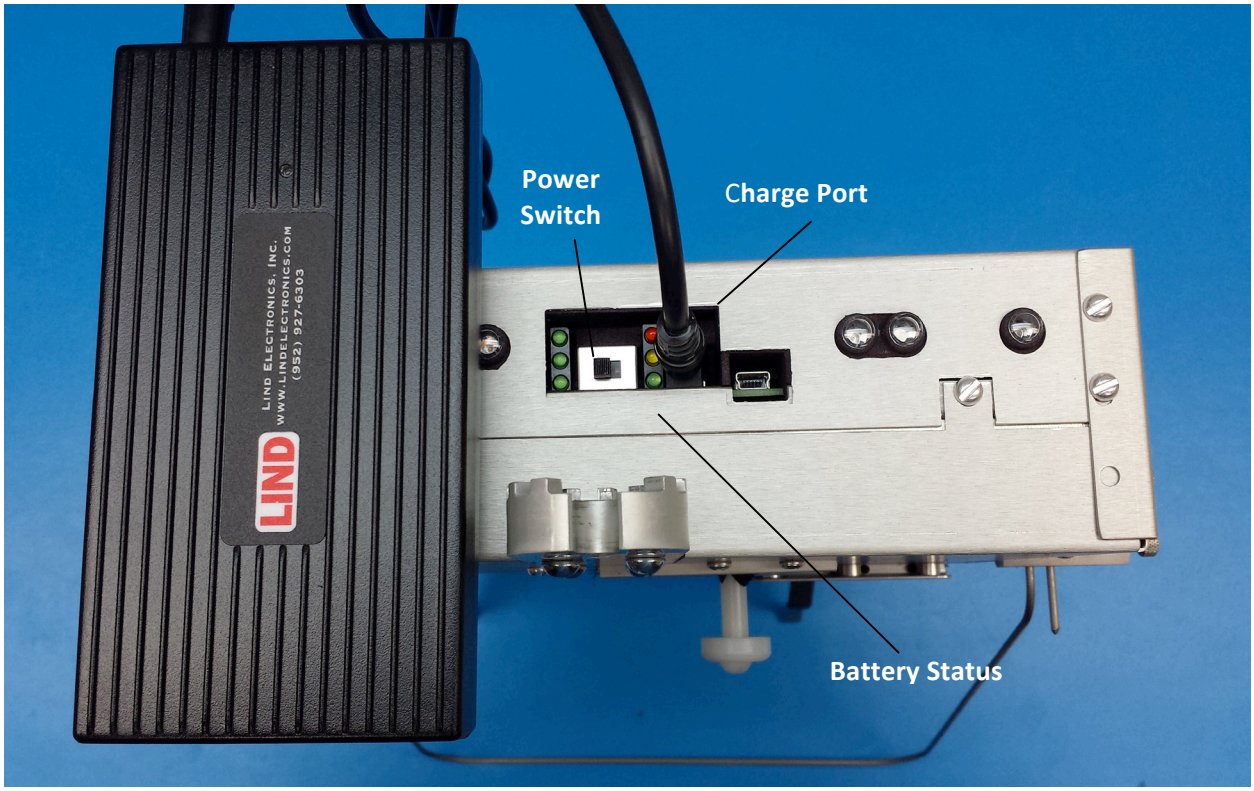
The following process is used to make a measurement:

1. The PIT tool must be attached to a hotstick using the universal hotstick fitting
2. Adjust the spacing between the probes so that the PIT tool V-Probes will engage on the sheath section of an insulator without interfering with the sheds.
3. The PIT tool should be calibrated using the process described in Section 2. A calibration should be performed if:
    a. The unit has not been calibrated in 12 hours
    b. A different type of insulator is being tested to that calibrated on
    c. The temperature has changed significantly since the calibration (e.g., 10 degrees Celsius = 18 degrees Fahrenheit or more). Normal operating temperature is 0° - 50°C.
    d. The spacing between the probes has been adjusted
4. The unit is switched on using the Power Switch and is fully booted when the White LED is on.
5. The unit is pushed, using a hotstick, so that the V-probes engage the sheath section of the insulator as shown in the figure below.
    a. Each spring loaded V-probe must be fully engaged for a measurement to be initiated. Whether a probe engaged is indicated by
        i. A blue light in-line with each probe
        ii. An audible tone (each probe has a different tone associated with it)
    b. When both probes are simultaneously engaged a measurement will start indicated by a beeping sound. The probes must not be removed during this time as an invalid measurement will result (reported by all LEDS flashing)
    c. When the measurement is complete it will be reported to the user whether the tested section is considered “Pass or Fail” by a Green or Red LED and audible tone.
    d. When the V-probes are disengaged from the sheath section the LWNCI stops reporting whether the section tested has passes or failed.
    e. The “bonding probe” (shown in previous photograph) should be on the side that is closest to either end fitting of the insulator. This only becomes critical when the unit is closer than 300 mm (12”) away from an end fitting.

f. When measuring the section of insulator adjacent to either of the end fittings, the “bonding probe” should be in contact with the metal end fitting (or corona ring) to prevent arcing. If arcing is present between PIT tool and the insulator end fitting a measurement should not be made.

5. Battery Charging

The PIT instrument uses a rechargeable Lithium Ion battery pack located inside the unit. It is expected to provide good service life and is not intended for field replacement. The battery pack should be fully charged overnight prior to each day of use. The battery is sized to last a full 8-hour day but it is advisable to only power the instrument when it's actively being used. The battery has internal protection circuitry that will disable it if it becomes over-discharged. If this ever happens, it should automatically recover when charged again.



A charger is provided along with cables for use with standard 110V AC wall outlets and with standard 12V DC vehicle power outlets. The instrument has built-in circuitry and status LEDs for the battery charging function. Battery charging is only possible when the instrument Power Switch is in the OFF position. The Amber Battery Charge Status LED indicates when power is applied to the Battery Charging Jack and the Power Switch is in the OFF position to allow charging. The Green Battery Charge Status LED indicates when charging is complete; this may take several hours depending on the state of charge. The Red Battery Charge Status LED indicates when charging has failed or has been suspended; this is likely due to a battery problem but may also have to do with the ambient conditions (e.g. the temperature may be too cold). If the Red Battery Charge Status LED persists after multiple charging attempts, then the battery will need to be replaced.

6. WiFi Operation

The PIT instrument has an embedded wireless user interface to allow monitoring from a WiFi-enabled device such as a lap top computer. The instrument uses an adhoc network to communicate. It does not have Internet connectivity. The WiFi-enabled device must have an Opera Mini or Chrome® browser; it does not need any other special software or app. Internet Explorer is not recommended at this time because it does not properly render the user interface graphics which may cause confusion. Once the instrument is powered up and WiFi is activated, the WiFi enabled device should see a network named "pwenLWNCl_open".

To connect to a laptop computer, load the two GUI files (Connect LWNCI and Disconnect LWNCI) supplied on the thumb drive included with the instrument onto the laptop's desktop. Once that is complete, double click the file "Connect LWNCI" and then press any key.

Turn the polymer insulator tester on and calibrate if necessary. Left click on you internet icon on your laptop and find "pwenLWNCl_open". Select and click on "connect". Next, go to your Opera Mini or Chrome browser and enter HTTPS://192.168.1.1:8085 in the address line. On the next page, select "Advanced" and then select "Proceed to 192.168.1.1 (unsafe)". Select "Continue" on the Hubbell home page. You do not need to fill in the user name or password. The tester will beep twice to indicate you have successfully connected and the test page will be visible on your laptop. To disconnect, close your browser and right click on the " Disconnect LWNCI" GUI and select Run as administrator.

7. Measurement Interpretation

PIT instrument measurements use three primary metrics as follows:

Abbreviation	Metric	Description
pkA	Peak Sensor Channel A	Received signal peak amplitude during resonance on one side of the "V" fork
pkB	Peak Sensor Channel B	Received signal peak amplitude during resonance on other side of the "V" fork
Freq	Resonant Frequency	Strongest frequency detected after sweeping the transmit signal

Metric values are reported on a 0-4095 scale, i.e., a 12-bit digital reading. Pass or fail results are determined by comparing these readings to calibration readings along with a plus-and-minus tolerance that defines the acceptable range.

Several other secondary metrics are used to validate the measurement. Examples of secondary metrics are battery voltage, battery current, temperature, resonant frequency failure, etc. If any secondary metrics fail then the measurement is considered invalid or indeterminate. If all secondary metrics pass then the measurement result is determined to be green (pass) or red (fail) based on the primary metrics when compared to the calibration values and tolerances. If any primary metrics fail then the result is reported as a failure.

8. USB Port

The PIT instrument has a USB port located next to the power switch. This interface provides diagnostic, firmware, and internal memory utilities. At this point it is not documented and only intended for engineering development purposes.

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