



# Protective Ground Set Tester

Operating Instructions For Models:  
C4033220 (120V) and PSC4033220003 (230V)



*NOTICE: Before operating a CHANCE® Protective Ground Set Tester, thoroughly read, understand, and follow these instructions. Keep these instructions with the product for future reference.*



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## Guide to Warnings within Manual

The following is a list of warnings used within this manual and should be read in its entirety to ensure safe practices.

 **DANGER**

A DANGER refers to operating procedures, techniques, etc., that if not followed carefully could RESULT IN DEATH.

 **WARNING**

A WARNING refers to operating procedures, techniques, etc., that if not followed carefully could RESULT IN INJURIES OR DEATH.

 **CAUTION**

A CAUTION refers to operating procedures, techniques, etc., that if not followed carefully could RESULT IN DAMAGE TO EQUIPMENT or LOSS OF SERVICE to customers.

**NOTICE**

A NOTICE refers to information that is considered important but not hazard related.

## Product Safety

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### **WARNING**

The equipment covered in this manual must only be used by competent and fully-trained professionals following all warnings, regulations, codes, and employer's work practices.

These instructions do not claim to cover all details or variations in equipment, nor to provide for all possible conditions to be met concerning installation, operation, or maintenance of this equipment. If further information is desired or if particular problems are encountered which are not sufficiently covered in this guide, contact Hubbell Power Systems, Inc.

### **WARNING**

ELECTRICAL SHOCK HAZARD. This product contains no user serviceable parts. Do not disassemble or attempt to repair. Do not use if damaged.

Protective Ground Sets must always be visually inspected before each use and prior to electrical testing. Electrical testing should be performed regularly and prior to a repaired ground set being returned to service. Inspection and testing should be performed in accordance with ASTM F2249.

### **CAUTION**

Exposure to moisture, chemicals that can cause corrosion, and/or temperatures outside of the specified storage range will damage the tester and void the warranty.

# Function and Design Overview

The upgraded CHANCE® Protective Ground Set Tester uses a 7.5 V direct current (DC) source to measure the resistance present in protective ground sets. The output current through the ground set is applied at a minimum of 10 amps by an internal current limiting resistor. The tester uses a four-wire approach to obtain accurate resistance measurements. The measurement system is auto-ranging to give  $\pm 2\%$  accuracy from 1 milliohm ( $m\Omega$ ) to 1 ohm.

The use of DC test current provides ease of use advantages over AC. There is no need to uncoil the protective ground set nor suspend it off the ground to perform the test. The efficient design functions as a milliohm meter displaying the resistance connected across the block input terminals with the press of a button.

Troubleshooting capabilities allow the user to locate areas of high resistance using the set of provided test leads.

## Feature Descriptions

1. **Block Input Terminals**  
These permanently installed tin plated copper blocks are threaded on top and on the sides for versatile mounting of input adapters.
2. **Display**  
When the 'INPUT SELECT' switch is in the 'BALL STUDS' position, the measured value shown on the display will be the resistance measured from one ball stud connection through the protective ground set to the other ball stud connection. When the 'INPUT SELECT' switch is in the 'TEST LEADS' position, the value shown will be the resistance measured between the test lead contact points. A protective ground set must be attached to the ball studs for the test leads to function.
3. **Power Module**  
Contains power cord plug socket, main power switch, and fuse holder compartment.
4. **Test Lead Input Jacks**  
The red and black test leads plug in to these receptacles.
5. **Self-Test Cable**  
Used to verify the functionality of the protective ground set tester before each use. Connect each clip of the Self-Test Cable to the two ball studs to perform the test.
6. **Power Cord**  
For connection to appropriate AC power source.
7. **Ball Studs**  
These tin plated copper studs thread into the top or side of the block input terminals, allowing for easy connection to common ground set clamps.
8. **Test Leads**  
Test leads are used in troubleshooting mode to locate high resistance areas of the protective ground set.
9. **Single Test Switch**  
Initiates the protective ground set tester to make a single resistance measurement and hold the value.
10. **Input Select Switch**  
Allows selection of measurement input between the test leads or the ball stud connections.
11. **Continuous Test Switch**  
When switched to the 'ON' position, the protective ground set tester will continuously take measurements until it times out automatically after 8 minutes. When switched to the 'OFF' position, the ground set tester will hold the last measurement taken.
12. **Resistance Chart**  
This chart shows resistance values per foot for common Class K cable sizes and was the latest version available at the time of print. Industry standards are subject to change without notice. Always refer to ASTM F2249 for the latest resistance charts.

[illegible]

## Legacy Models

If your device has a QR code directly printed on the front panel toward the bottom right then it is the newest C4033220 model. In that case, this section is not applicable. This section outlines key information for legacy models manufactured before the latest model.

While these models are no longer in active production, we continue to provide support for users with these models in service. This section includes compatibility information, maintenance guidelines, upgrade paths, and support options for discontinued units.

Factory authorized repair service is available in limited capacity for the C4033220 and PSC4033221 models. Limited parts for the PSC4033221 with block inputs and the C4033220 (without block inputs) are available while supplies last. Archived manuals and literature may be available upon request. Please contact the factory to inquire. These devices contain no user serviceable internal parts. Unauthorized modifications may void support coverage.

### Legacy Models and Upgrade Recommendations

| Legacy Model      | Production Years | Identifying Features                                          | Recommended Upgrade |
|-------------------|------------------|---------------------------------------------------------------|---------------------|
| <b>C403-3220</b>  | 2008-2026        | Standard input terminals, cable size switch, Pass / Fail LEDs | <b>C4033220</b>     |
| <b>PSC4033221</b> | 2023-2026        | Block input terminals, cable size switch, Pass / Fail LEDs    | <b>C4033220</b>     |

The upgraded model C4033220 includes block input terminals which allow for the installation of the ball studs and other input adapters in the horizontal position in addition to the vertical position present on previously manufactured models. The horizontal mounting option allows for larger ground clamps to be mounted to the tester on the sides rather than on top where the display may be blocked and sensitive components could potentially be damaged.

The power supply has also been upgraded to provide additional current flow when testing longer cables.

Obsolete Pass / Fail LEDs along with the cable size selector switch are no longer present on the upgraded model C4033220.

Charts containing the allowable resistance per foot on common cable sizes can be found within the ASTM F2249 industry standard.

A QR code is now present on the front graphic overlay. Scanning this QR code with a smart device will link to additional online product resources.

## Setup and Self-Test Procedure

The operation of the Protective Ground Set Tester can be verified using the Self-Test Cable included with the tester.

1. Place the tester on a table of convenient height and plug it into an appropriate AC outlet: 120 V for model C4033220 or 230 V for model PSC4033220003. Refer to the Specifications page for information regarding power input requirements.
2. Thread the ball studs into the block input terminals. The ball studs can be positioned horizontally, vertically, or any combination thereof.

### CAUTION

HAND TIGHTEN ONLY. Never overtighten the ball studs or other accessories. Tightening with a wrench will result in damage to the threads.

3. Securely connect the Self-Test Cable to both ball studs as shown in the illustration below.
4. Turn on the unit.
5. Place the 'INPUT SELECT' switch in the 'BALL STUDS' position.
6. Place the 'CONTINUOUS TEST' switch in the 'OFF' position.
7. Press and release the 'SINGLE TEST' switch.
8. The measured resistance of the Self-Test Cable will be shown on the display. The resistance measured should be **between 3.0 and 6.5 mΩ\***. If the measured resistance is outside these values, retighten the ball studs and check to make sure that the Self-Test Cable has good electrical connections. After retesting, if the measured resistance is still not between 3.0 and 6.5 mΩ\*, discontinue use of the tester and contact M.W. Bevins for service.

The Self-Test Cable is not designed with tight tolerances for accuracy testing.

NOTE: \*mΩ (milliohm) = 0.001 ohm



# Protective Ground Set Test Procedure

## NOTICE

Refer to the latest ASTM F2249 resistance chart for allowable resistance.



## WARNING

ALWAYS perform Self-Test Procedure prior to testing protective ground sets, and any time input accessories (ball studs, elbow adapters, bushing probes, or bus bar adapters) are removed and/or installed.

Failure to do so may result in erroneous test results and using ground sets with high resistance during a fault current could result in serious injury or death.

1. Use a wire brush to remove any oxidation or contamination from the clamps of the ground set being tested. Then securely connect the ground set to the ball studs. A low resistance connection must be maintained while testing the ground set. The image on next page shows typical test setup.

A resistance value will only be displayed when a ground set is connected between both input terminals, regardless of testing mode.

*NOTE: Follow all ground clamp manufacturer's torque specifications when connecting and tightening the ground clamps.*

2. Place the 'INPUT SELECT' switch in the 'BALL STUDS' position.
3. Place the 'CONTINUOUS TEST' switch in the 'OFF' position.
4. Press and release the 'SINGLE TEST' switch.
5. The display will show the total resistance measured between the two block input terminals in mΩ (milliohms)\*. This value includes the ball studs and the entire protective ground set including clamps, ferrules, and the cable itself.

**Refer to the latest ASTM F2249 maximum allowable resistance charts to determine if the measured resistance of the protective ground set should be considered PASS or FAIL.**

*NOTE: When measuring the protective ground set, cable length is expressed in feet (ferrule to ferrule measurement to the nearest inch, not including shrouded portion of some ferrules which cover the cable insulation).*

*NOTE: \*mΩ (milliohm) = 0.001 ohm*

# Protective Ground Set Test Procedure (2)

## Expected Ground Set Resistance

The resistance through a protective ground set will be equal to the resistance of the cable itself, cable-to-ferrule connections, and ground clamps installed on the ferrules. The resistance of the cable is found by multiplying the resistance per foot for Class K copper cable by the number of feet of the cable. Table 1 supplies the resistance per foot for various Class K cable sizes. The clamps and connections should be less than 0.16 mΩ\*. Since there are two clamps, 0.32 mΩ\* must be added for the clamps and connections. For example, the expected resistance for a 32 foot 1/0 protective ground set will be less than 1.05 x 32 ft x 0.1030 mΩ/ft + 0.32 mΩ = 3.7808 mΩ\*\* A 5% margin of error is included in the formula to consider manufacturing tolerances and cable degradation over time.

Pass/Fail DC resistance values for Class K and M copper grounding jumper assemblies can be found within the latest ASTM standard F2249; at [www.astm.org/bos](http://www.astm.org/bos).

**Table 1: Resistance per foot for various sizes of Class K grounding cable at 68°F**

| Cable Size    | 4/0       | 2/0       | 1/0       | #2        |
|---------------|-----------|-----------|-----------|-----------|
| mΩ** PER FOOT | 0.0520 mΩ | 0.0826 mΩ | 0.1030 mΩ | 0.1640 mΩ |

Notes:  
\* mΩ (milliohm) = 0.001 ohm  
\*\*Derived from ASTM F2249 Standard.

The following image shows a typical test setup required to test a protective ground set.



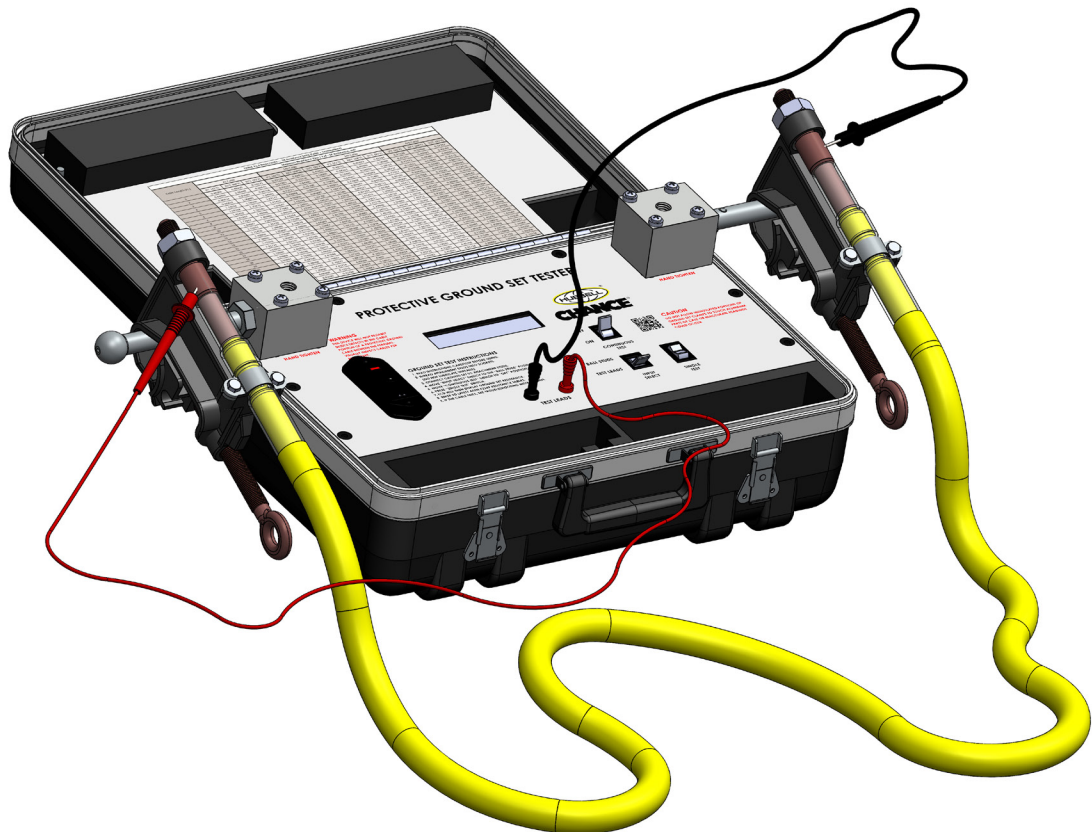
## Troubleshooting with Test Leads

The following section describes how to use the Test Leads in troubleshooting a ground set. Using this method, the high resistance area(s) of the ground set can be identified.

1. Install the red and black test leads into the corresponding ports at the front of the tester.
2. Place the 'INPUT SELECT' switch in the 'TEST LEADS' position.
3. Place the 'CONTINUOUS TEST' switch in the 'ON' position. This causes the protective ground set tester to repeatedly make measurements. The protective ground set tester will continuously make measurements until it times out automatically after 8 minutes or until the mode is changed. After timing out, simply toggle the continuous test switch off and back on to reset the timer.
4. In this mode the display will show the resistance between the red and black test leads. Start by probing from one end of the protective ground set. Take resistance readings between attachment stud and clamp body, clamp body to cable ferrule, and cable ferrule to the opposite cable ferrule. Repeat test starting on the opposite end of the protective ground set.
5. The display will show the measured resistance in  $m\Omega$  from one probe to the other when contacting the ground set.

### Troubleshooting with Test Leads (2)

The following image shows a typical test setup required to troubleshoot a protective ground set.



## Display Messages

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### Firmware version

The firmware version is displayed briefly during bootup.

### Over range

The text “OVER RANGE” will appear on the display when the tester is attempting to measure across the block input terminals but no protective ground set is connected.

### Cont mode stop cycle switch

The continuous test mode has timed out after approximately 8 minutes. Cycle the Continuous Test switch to resume.

### Erratic display

If no protective ground set is connected to the ball studs, and the ‘INPUT SELECT’ switch is in the ‘TEST LEADS’ position, the display will be erratic. The erratic display is unpredictable and does not indicate resistance.

### Calibrate error

The calibration factors have been corrupted. New calibration factors must be generated. Discontinue use and contact M.W. Bevins for service.

### Power supply error

The power supply did not boot properly. Power cycle unit to recover. If the unit continues to display the error, discontinue use and contact M.W. Bevins for service.

## Accessories

**P4033120**

Ball Stud, 1 inch (25 mm) Diameter  
Included with tester

**PSC4034035**

Ball Stud, 30 mm Diameter

**T4033159**

Straight Stud Terminal

**C4033449**

Elbow Adapter, 15 & 25 kV  
for 1/2 in Probe

**PSC4032947**

Elbow Adapter, 35 kV  
for 1/2 in Probe

**PSC4033796**

Elbow Adapter, 35 kV  
for 3/4 in Probe

**C4033449**

Bus Bar Clamp Adapter

# Specifications

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## Power Input Requirements

- **Model C4033220:** 120 V AC (50/60 Hz)
- **Model PSC4033220003:** 230 V AC (50/60 Hz)
- **Source Voltage:** Receptacles, including portable generators and inverters, must meet or exceed the minimum utility grade power requirements governed by the industry standards IEEE 1250 and IEC 60038. This is to ensure that this electronic equipment can be operated reliably and accurately.
- **Replacement Fuse:** 2 A, 250 V

## Performance & Measurement

- **Measurement Units:** m $\Omega$  (milliohms)
- **Test Current:** Minimum 10 A DC
- **Accuracy:**  $\pm 2\%$  @ 1 m $\Omega$  to 1  $\Omega$
- **Continuous Mode Timeout:** 8 minutes - cycle Continuous Test switch to reset
- **Recommended Calibration Interval:** Two years for standard use. One year for extended use applications such as testing laboratories. If improper readings are ever suspected, discontinue use immediately and contact M.W. Bevins for service.

## Physical

- **Net Weight:** 21 lb
- **Dimensions:** 17.5" L X 12" W X 7.5" H

## Operating Conditions

- **Temperature Range:** -4°F to 158°F (-20°C to 70°C)
- **Humidity Range:** 5% to 95% RH

## Storage

- **Recommendation:** Store in a dry, indoor location
- **Temperature Range:** -22°F to 176°F (-30°C to 80°C)
- **Recommended Temperature:** 66°F to 73°F (19°C to 23°C)
- **Humidity Range:** 5% to 95% RH
- **Recommended Humidity:** 45%  $\pm$  8% RH

## Limitations

- Never use if damaged or malfunctioning
- Protect from jostling during transportation
- Store in a dry, indoor location
- Refer to the latest ASTM F2249 resistance charts for pass/fail thresholds



## CAUTION

Exposure to moisture, chemicals that can cause corrosion, and/or temperatures outside of the specified storage range will damage the tester and void the warranty.

## Service & Calibration

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For Hubbell Power Systems authorized service or factory calibration, please contact:

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