C9970

Voltage Detector

Users Guide

PN 1286912 (English)
May 2007 Rev. 6, 11/2021 (English)

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4/04

Introduction

The C9970 Voltage Detector (the Product) is a high-voltage probe used for detecting hazardous voltage on objects such as power ground wires, street light fixtures, mobile homes, metal frameworks, metal conduit, pedestals, newly-driven ground rods, homes covered with metallic siding, and electrical machinery.

Contact Fluke

Fluke Corporation operates worldwide. For local contact information, go to our website: www.flukenetworks.com.

To register your product, or to view, print, or download the latest manual or manual supplement, go to our website.

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Safety Information

A **Warning** identifies hazardous conditions and procedures that are dangerous to the user. A **Caution** identifies conditions and procedures that can cause damage to the Product or the equipment under test.

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury:

- **Read all safety information before you use the Product.**
- **Carefully read all instructions.**
- **Do not alter the Product and use only as specified, or the protection supplied by the Product can be compromised.**
- **Do not use the Product if it operates incorrectly.**
- **Do not use the Product if it is altered or damaged.**
- **Only qualified personnel who have been trained and are knowledgeable about the dangers associated with hazardous voltages should use this product.**
- **Be sure to know and follow your company's procedures for every application. Any conflict between the procedures specified in this manual and those of your company must be resolved before using the Product.**

- **Comply with local and national safety codes. Use personal protective equipment (approved rubber gloves, face protection, and flame-resistant clothes) to prevent shock and arc blast injury where hazardous live conductors are exposed.**
- **Measure a known voltage first to make sure that the Product operates correctly.**
- **Do not use the Product around explosive gas, vapor, or in damp or wet environments.**
- **Do not touch voltages >30 V ac rms, 42 V ac peak, or 60 V dc.**
- **Limit operation to the specified measurement category, voltage, or amperage ratings.**
- **If the voltage to be measured is unknown, do not directly contact the voltage. Use the voltage alert function to determine if the voltage is hazardous.**
- **Hold the product behind the flashguard.**
- **Do not operate the Product with covers removed or the case open. Hazardous voltage exposure is possible.**
- **Have an approved technician repair the Product.**
- **Use only specified replacement parts.**
- **Repair the Product before use if the battery leaks.**
- **Batteries contain hazardous chemicals that can cause burns or explode. If exposure to chemicals occurs, clean with water and get medical aid.**
- **Remove the batteries if the Product is not used for an extended period of time, or if stored in temperatures above 50 °C. If the batteries are not removed, battery leakage can damage the Product.**
- **Do not keep cells or batteries in a container where the terminals can be shorted.**
- **Do not put battery cells and battery packs near heat or fire. Do not put in sunlight.**

⚠ Caution

To avoid possible damage to the Product or to the equipment under test:

- **Use the proper terminals and function for your measurements.**
- **Do not drop the Product or subject it to severe mechanical stress which may damage the protective insulation or internal circuitry. If the Product fails a test described in** *Periodic Performance Checks***, do not use the Product and contact Fluke. See** *Contact Fluke***.**

- **Do not expose the Product to extreme temperatures (below -40 °C or above +60 °C) or chemicals that may soften, crack, or otherwise damage the plastic housing.**
- **Although the Product is water resistant, do not expose it to water. If needed, dry the Product completely and check for proper operation before use. See** *Periodic Performance Checks***. (If a test plug is unavailable, a 110 V ac to 120 V ac, 60 Hz source may be temporarily substituted with caution.)**
- **Do not drill, punch, engrave, or otherwise modify the housing of the Product. Do not use adhesives, adhesive labels, inks, solvents, on the Product or expose the Product to chemicals which may alter the housing. If you deface or alter the Product, you may lower or destroy the Product's sensitivity to hazardous voltages and will void the warranty.**
- **Keep the conductive cap over the probe end of the Product when the Product is not in use to avoid damage to the tip and a possible hazard to the user. The carbide tip is sharp and may pose a hazard to the user.**
- **Do not subject the Product to possible pressure or damage from other tools or material. Pressure may cause the switch to operate and discharge the battery. Do not store the Product near strong magnets.**
- **Clean the Product with a soft cloth, mild soap, and water.**

Symbols

Table 1 lists the symbols that can be used on the Product or in this document.

Table 1. Symbols

Symbol	Description
	Consult user documentation.
	WARNING. RISK OF DANGER.
	WARNING. HAZARDOUS VOLTAGE. Risk of electric shock.
	Earth ground
	This product complies with the WEEE Directive marking requirements. The affixed label indicates that you must not discard this electrical/electronic product in domestic household waste. Product Category: With reference to the equipment types in the WEEE Directive Annex I, this product is classed as category 9 "Monitoring and Control Instrumentation" product. Do not dispose of this product as unsorted municipal waste.

Theory of Operation

The Product uses electronics and a high-voltage mechanical design to indicate the presence of dangerously-high ac and dc voltages. To do so, the Product first determines the voltage difference between the body of the user and the object under test. Then, the Product compares that difference to an internal safety reference. If the voltage difference exceeds the safety reference, the Product indicates danger. The user does not need to interpret readings.

The capacitance between the handle of the Product and the hand of the user is part of the measuring circuit and may affect the sensitivity of the Product. When a user works aloft near power transmission lines and is isolated from ground, voltages can be induced onto the body of the user. The induced voltages may cause the Product to indicate danger when no danger exists. The induced voltages are harmless, but they must be discharged. See *Aerial Tests*.

Safety Gloves

The Product is designed to detect voltages ≥110 V, 60 Hz, ac. The use of gloves reduces the sensitivity of the Product and may cause erroneous results. See *Theory of Operation*.

If you wear gloves and the Product does not detect hazardous voltage, do a second test without gloves and follow the results of the second test.

If you wear gloves and use the Product to do a test and the Product detects hazardous voltage, do not retest without gloves. Move away from the test area and refer to the safety procedures of your company.

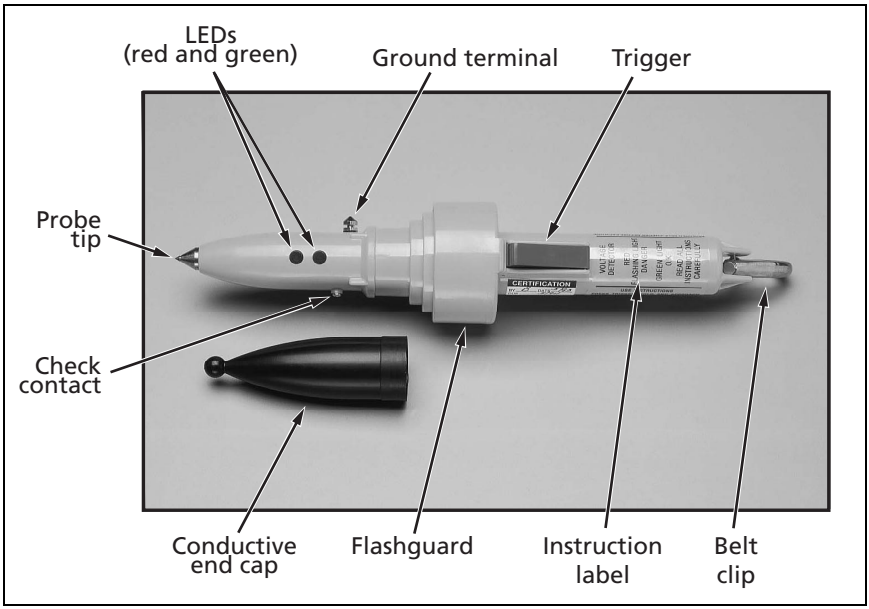
Features of the Product

Figure 1 shows the features of the Product: a yellow, plastic, two-piece unit.

The front housing includes the carbide probe tip, two LEDs (one green and one red), a check contact, a ground terminal, and a battery (not shown).

The rear housing, which acts as a handle, includes a set of concentric rings called the flashguard, the on/off switch called the trigger, an instruction label, and a belt clip.

Figure 1. Features of the Product



Accessories

The section below describes how to use some of the accessories available for use with the Product. They may be purchased separately or as part of a kit.

Temporary Bond

The temporary bond (the Bond) is a heavy-duty insulated cord equipped with a large clamp on one end and a small clamp on the other end. Use the Bond to temporarily ground a light fixture, metallic conduit, power company hardware, power ground wire, or other metallic object in a work space that could become energized if a fault develops. If a fault develops, the temporary bond provides a direct path to ground for the foreign potential.

⚠⚠ Warning

If a fault develops while the Bond is connected to a metallic object, the insulation may overheat and emit smoke. If the Bond overheats, avoid contact with the Bond and immediately descend from the work if you are aloft.

To connect the Bond:

1. Put on insulating gloves.
2. Connect the small clamp to a reliable ground source such as a cable suspension strand.
3. Use the Product to test a metallic object such as a fixture, conduit, or bare vertical ground wire and verify there is no voltage present before you connect the Bond. See *AC Hazardous Voltage Tests* and *DC Hazardous Voltage Test*.
4. Connect the large clamp to the metallic object: . Do not connect the Bond to a support bracket of multiple line wire, the suspension strand of isolated cable, street light wires, terminals that wires are attached to, or a fixture that causes the red LED to flash.

   You may remove the insulating gloves after the temporary bond is in place and all protection requirements are met. Leave the temporary bond in place until you complete the work at that location for the day.

To disconnect the Bond:

1. Put on insulating gloves.
2. Disconnect the large clamp from the metallic object.
3. Disconnect the small clamp from the ground source.

Ground Cord

The 25-ft retractable ground cord (the Cord) has clamps on both ends and is designed for use in aerial applications where the user is near power transmission lines and isolated from ground. When used appropriately, the Cord and the conductive plastic end cap of the Product eliminate induced body voltage to prevent false hazard indications.

Test Plug

The test plug (the Plug) is ac-operated and provides a suitable, current-limited, reference voltage to verify proper operation of the Product. Use the Plug to verify the lowest voltage (threshold voltage) at which the Product indicates danger. See *Test Plug Threshold Test*.

Periodic Performance Checks

Do a self check test or a test plug threshold (sensitivity) test periodically to verify the Product works properly. A self check test verifies proper operation of most of the circuits, A test plug threshold test verifies the proper sensitivity and insulation of the Product.

Do a self check test each time before you use the Product. Do a test plug threshold test at least weekly or if the Product has been subjected to severe mechanical stress.

⚠⚠ Warning

If the Product fails the self check or test plug threshold test, do not use the Product. Contact Fluke to repair or verify the integrity of the Product.

Self Check Test

If the Product fails a step below, do not continue with the test.

To do a self check test:

1. Clean and dry the entire housing and make sure the housing does not have any cracks. Moisture, dirt, and other foreign matter reduces the insulating properties of the plastic surface.
2. Grasp the handle with your bare hand and push the trigger.
3. If the green LED does not illuminate or is very dim, replace the battery. If the green LED does not illuminate after you replace the battery, the Product fails the test.
4. Push and hold the trigger with one hand and use your other hand to touch the probe tip and the check contact (see Figure 3). You may need to wet the fingers that touch the probe tip and check contact to make the red LED flash. The Product passes this step when the red LED flashes and the green LED turns off.
5. Continue to hold the trigger and remove your hand from the probe tip and the check contact. As long as you hold the trigger, the red LED flashes when the Product works properly and passes the test.

Figure 2. Self Check Test

Test Plug Threshold Test

To do a test plug threshold test:

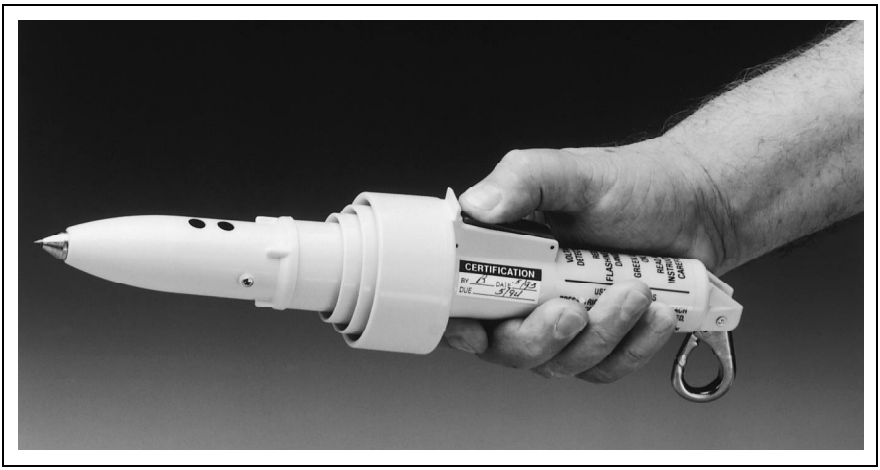
1. Do a self check test. See *Self Check Test*.
2. Use an ohmmeter to verify the integrity of the Plug. The resistance from the test point to either or both of the two prongs should be 300 KW ±1 %. Do not use a faulty test plug.
3. Insert the Plug into a standard, 3-wire, 110 V ac to 120 V ac outlet. The Plug provides the proper reference voltage for the threshold test.
4. Touch the Product to the screw head test point on the Plug. The Product passes the test if the red LED flashes to indicate the Product detects dangerous voltage. The Product fails the test If the green LED emits light.

Use the Product

To use the Product:

1. Do a self check. See *Self Check Test*.
2. Remove the conductive end cap from the probe tip. Do not unscrew the front and rear housing while removing the cap.
3. Hold the rear housing with your bare hand (except when gloves are required), and use your thumb to operate the trigger. See Figure 3.

Figure 3. Hold the Product



AC Hazardous Voltage Tests

⚠⚠ Warning

Do not make contact exposed bare wire with the metal tip of the probe.

The Product detects hazardous ac voltage conditions at 60 Hz. At frequencies <60 Hz, the Product requires higher voltages to detect a hazardous condition. At frequencies >60 Hz, the Product requires less voltage to detect a hazardous condition. Grounding is required when you do a test aloft near power transmission lines. See *Aerial Tests*.

To test for the presence of hazardous ac voltage:

1. Do a self check test. See *Self Check Test*.

Note

Do not connect the ground lead to the Product.

2. Push and hold the trigger and approach an object to test. The tip must be the closest point to the object under test. If the red LED flashes, immediately move away from the object because high voltage is present.
3. Hold the probe tip against the object. If needed, turn the Product from side to side to make a reliable contact. Paint, other surface finishes, or corrosion may interfere with the connection.

⚠⚠ Warning

Avoid unsecured objects, dangling wires, etc., which can move if probed. While you try to get an accurate reading through the corrosion, the object may suddenly swing around and hit you.

4. To avoid false indications due to static electrical discharge, maintain contact with the Product and the object as you release the trigger and push and hold the trigger again.
5. Continue to hold down the trigger as you remove the Product from the object, and observe the LEDs:
   - The green LED emits light to indicate a safe condition.
   - The red LED flashes to indicate the presence of dangerous voltages. Move away from the object and refer to the safety procedures of your company.

DC Hazardous Voltage Test

The Product indicates the presence of dc voltages between 6 V dc and 1000 V dc.

To test for hazardous dc voltage:

1. Do a self check test. See *Self Check Test*.
2. Do an ac hazardous voltage test. If the ac hazardous voltage test indicates no hazardous voltage, continue with the test.
3. Test the continuity of an insulated grounding cord, such as the temporary bond, that has a clamp on each end.
   a. Connect the clamp on one end of the cord to the tip of the probe on the Product. To use the Bond as the grounding cord, connect the large clip to the tip of the probe.
   b. Push and hold the trigger on the Product.
   c. Touch the clamp on the other end of the cord to the check contact on the Product. If the red LED flashes, you can use the cord in the next step.

Note

This test verifies whether this ground cord can be used with the Product. The test does not verify the cord's current-handling ability for use as a bond.

4. Connect one clamp of the insulated grounding cord to the ground terminal of the Product (see Figure 1) and the other clamp to a known earth ground. Do not loosen the ground terminal on the Product.

5. Hold the probe tip against the object. If needed, turn the Product from side to side to make a reliable contact. Paint, other surface finishes, or corrosion may interfere with the connection.
6. To avoid false indications due to static electrical discharge, maintain contact with the Product and the object as you release the trigger and push and hold the trigger again.
7. Continue to hold down the trigger as you remove the Product from the object, and observe the LEDs:
   - The green LED emits light to indicate a safe condition.
   - The red LED flashes to indicate the presence of dangerous voltages. Move away from the object and refer to the safety procedures of your company.

Aerial Tests

When you work aloft in an insulated bucket or on a ladder where you are near power transmission lines and isolated from ground, to prevent false indications due to the voltage induced on you:

1. Put on company-required protective equipment, such as a hard hat, eye protection, etc.
2. Put the conductive end cap on the belt-clip end of the handle. Push until the end cap is firmly in place.
3. Do a self check test. See *Self Check Test*.
4. Connect one end of the ground cord to a known earth ground. Connect the other end of the ground cord to the contact knob on the end cap.
5. Ascend to a height to do a voltage test, but do not touch an object such as hardware, light fixture, or wiring that you suspect may contain a hazardous voltage.
6. Test the suspect object for hazardous voltage as described earlier and observe the LEDs:
   - If after you press the trigger and touch the probe tip to the object, the green LED remains illuminated and the red LED remains off, place a temporary bond and proceed with your work. See Temporary Bond.
   - If the red LED flashes, a hazardous condition exists. Descend immediately and refer to the safety procedures of your company.

Applications

This section describes additional instructions and safeguards for more specific applications. These instructions expand the previous instructions, but they do not replace them.

Ground Level

Mobile homes, trailers, metal sheath buildings, ground rods and electrical machinery all present potential electrical hazards and always require testing. Before starting any work operation, test the skin and frame (or both frames in the case of double wide mobile homes).

In some cases, such as when driving a ground rod, you may wear rubber gloves during the work operation. To do the final test, hold the Product with your bare hand.

If the Product detects a hazardous voltage, notify the property owner for corrective action according to the procedures of your company. Do not make contact with the potential hazard until all hazardous voltages are removed and the Product indicates a safe condition.

Telephone Cable Sheath

A cable sheath continuity may be interrupted to locate plant, locate faults, or to make splices. Use the Product to test the sheath before and after you open the sheath.

Damaged Cable Closure

To work with a damaged cable closure:

1. If a telephone, CATV, or power pedestal closure (all closures used in joint-buried plant) is damaged or disturbed, (for example, knocked over or hit by a car) or you suspect a trouble condition that involves power, contact the power company.
2. After the power company repairs all the closures, use the Product to test the pedestal before you contact it with your body.
3. If the Product indicates a safe condition, remove the cover of the closure and visually inspect the cable sheath ground.
4. If the cable sheath ground is not intact or is loose, use the Product to test the cable sheath to verify you can safely do the repairs.
5. If you need to open the bonds between the telephone facilities and power or across cable sheath openings, place a temporary bond
   a. Put on eye protection and insulating gloves.
   b. Place a temporary bond strap before you open the bond. If the temporary bond cannot be placed due to physical conditions, contact the power company to de-energize the power.

⚠⚠ Warning

Until you install a permanent bond, use a temporary bond strap to maintain electrical continuity of all bonds, including cable shield bonds in closure or at splice locations.

Base of Pole: Telephone Plant Repairs

Before you climb a telephone pole, verify there are no hazards. On the telephone pole or adjacent spans, examples of hazards include but are not limited to potential electrical hazards such as a vertical power ground wire, vertical metallic power conduit, street light fixture, power company primary disconnect hardware, or other foreign metal objects, improper clearance from power conductors or equipment, dangling power wires, inadequate clearance on pole-to-pole guys from power wires or energized attachment, or other hazards.

If a vertical power ground wire is present or if a vertical metallic power conduit or other power company hardware extends to the base of the pole, do a voltage test of the wire before you climb or work on the pole. If the ground wire is broken, test the portion of the wire that goes up the pole unless the break exists above the telephone space. Do not test a broken ground wire or fixture in the power company's space (≥40 inches above the highest telephone attachment). Refer to the safety procedures of your company

If the Product does not indicate a hazardous voltage, you can climb a pole that carries vertical power ground wires. Avoid simultaneous contact between power ground wires and telephone cable or guys because a small voltage may be present that may cause a shock that might cause you to a fall from the pole.

If an ungrounded street light fixture is <40 inches above or below telephone attachments and is on a pole not that does not carry a telephone cable or a bare vertical power ground wire, wear insulating gloves when you do repairs. Avoid contact with the fixture because you cannot place a temporary bond to an effective ground.

⚠⚠ Warning

Do not make contact with supply wires going to the fixture.

Ungrounded Insulated Conductors

Ungrounded insulated conductive objects in the presence of live ac current may act as antennae for ac potential. If a voltage test indicates the conductive object is not safe, avoid the object.

Traffic Lights

Be careful near traffic light wiring or other wiring which may become energized momentarily. Voltage test results received during one part of a cycle may not be valid during another part of a cycle.

Battery Replacement

When replacing batteries, work in a dry place. Replace with an IEC 6F22 carbon-zinc battery.

⚠ Caution

Some 9 V batteries may be slightly oversized. If an oversized battery is installed, the metal shield can separate from the circuit board. If the replacement battery seems tighter than the original, use a different brand of battery.

The battery should be checked periodically and replaced yearly.

To replace the battery:

1. Unscrew the handle in a counter-clockwise direction and slide the handle back from the front assembly of the Product. Do not attempt to loosen the check contact or the ground terminal.
2. Gently slide the battery out of the metal shield, attach a new battery, and slide the new battery back into the metal shield. Do not put the battery wires between the metal shield and the side of the battery. Do not bend or distort the metal shield.
3. Slide the handle over the shield and rotate the handle in a clockwise direction until snug, but do not overtighten the handle. Line up the LEDs with the trigger, or the probe switch may not operate. For the O-ring to seal properly and for appropriate LED alignment, the seal must be snug.

Specifications

Voltage sensing ranges	6 V dc to 1000 V dc, direct contact 100 V ac to 1000 V ac, 60 Hz, non-contact voltage
LEDs	Green LED indicates no hazardous voltage. Red LED indicates hazardous voltage.
IP rating	IP 40
Operating temperature	-10 °C to 50 °C
Operating relative humidity	0 % to 95 %, 0 °C to 30 °C 0 % to 75 %, 30 °C to 40 °C 0 % to 45 %, 40 °C to 55 °C
Altitude	2000 m
Battery	IEC 6F22 9 V zinc-carbon
Low battery indicator	Green LED is dim or off when you press the trigger