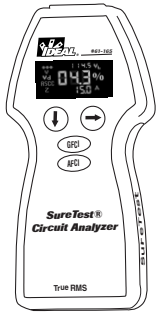
ND 5481-4 61-164 165 Ins 11/21/06 1:28 PM Page 1



#61-164
#61-165

SureTest® Circuit Analyzer

Instruction Manual

Introduction

Utilizing patented technology, the SureTest® circuit analyzers "look behind walls" to identify wiring problems that can lead to personal shock hazards, electrical fires, or equipment performance issues. Personal shock hazards stem from poor grounding, false grounds, and/or no ground fault protection. Electrical fires are primarily caused from arc faults and high resistance points that lead to glowing connections in the circuit wiring. And, equipment performance issues arise due to insufficient voltage available under load, poor ground impedance, and high ground-to-neutral voltage. In fact, it's estimated that 80% of power quality performance issues are related to the faulty wiring issues stated above.

Product Features

- True RMS
- Measures voltage drop under 12, 15 and 20-amp loads
- Measures voltage: Line, Ground-to-Neutral, Peak, Frequency
- Measures Hot, Neutral and Ground conductor impedances
- Identifies proper wiring in 3-wire receptacles
- Identifies false (bootleg) grounds
- Tests GFCIs for proper operation
- Tests AFCIs for proper operation (61-165)
- Checks for Shared Neutrals that lead to AFCI nuisance tripping (61-165)
- Verifies dedicated circuits (with 61-176 adapter)
- Includes 1-ft. extension cord and carrying case

General Operation

The SureTest® Circuit Analyzer takes only seconds to test each outlet and circuit under a full load. This test tool checks for various wiring conditions including: correct wiring, polarity reversal and no ground per UL-1436. A simple menu gives access to measurements of line voltage, voltage drop under a full load condition, ground-neutral voltage and line impedances. The ground fault circuit interrupter (GFCI) test is performed separately in accordance with UL-1436 and disrupts the electrical supply if a functional GFCI is present.

Distributed by:
TESTERS AND TOOLS.COM
Trust Experience Reliability
sales@testersandtools.com
Tel: 602-795-4033, Fax: 602-795-4624

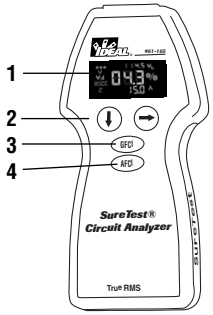
The SureTest® w/AFCI, #61-165, also tests arc fault circuit interrupter (AFCI) devices to ensure that AFCI breakers protecting the circuit have been installed correctly. This test disrupts the electrical supply if a functional AFCI is present. This tool also checks for a shared neutral condition that leads to AFCI nuisance tripping.

To maintain stated accuracies during repeated use, allow 20 seconds between insertions to adequately dissipate any heat buildup during the load testing.

⚠ **WARNING:** Do not use on outputs from UPS systems, light dimmers or square wave generating equipment as damage to the analyzer will occur.

SureTest Circuit Analyzer

1. Menu Structure
2. Navigation Buttons
3. GFCI Test Button
4. AFCI Test Button



Menu Navigation

The microprocessor's top priorities are to take live measurements and then analyze the data. Hence, the microchip occasionally will not recognize the keypad buttons being rapidly depressed, while it's executing these routines. To avoid this issue, hold down the keypad button each time until the menu changes.

The measurements taken by the SureTest are broken into five main menus positioned down the left side of the display: Wiring Configuration (•••), Voltage (**V**), Voltage Drop (**V_D**), **ASCC**, and Impedance (**Z**). To navigate to each of the main menus, use the down arrow button (↓).

The Wiring Configuration (•••) screen indicates correct wiring, reverse polarity, hot/ground reversal and no ground conditions by sequencing the three balls. The label on the back of the product explains the wiring sequence indications.

The Voltage (**V**) menu displays the True RMS line voltage in real-time. This main menu has a sub-menu positioned horizontally at the bottom of the screen that displays the line voltage (**RMS HN**), ground-to-neutral voltage (**RMS GN**), Peak voltage (**Peak**), and Frequency (**Hz**). To navigate through the submenu, use the side arrow button (→).

The Voltage Drop ($\mathbf{V_D}$) screen dual displays percent voltage drop with a 15 amp load along with the resultant loaded voltage ($\mathbf{V_L}$). This main menu has a submenu, which also displays the percent voltage drop and loaded voltage with 20 amp and 12 amp loads. To navigate through the submenu, use the side arrow button (→).

The **ASCC** screen displays the **A**vailable **S**hort-**C**ircuit **C**urrent that the branch circuit can deliver through the breaker during a bolted fault (dead-short) condition.

The Impedance (**Z**) main menu displays the impedance in ohms (Ω) of the hot conductor. This main menu has a sub-menu positioned horizontally at the bottom of the screen that also displays the neutral (**N**) and ground (**G**) conductor impedances. To navigate through the submenu, use the side arrow button (→). Note that testing the ground impedance will trip a GFCI protected circuit.

GFCI Test Button

Depressing this button displays the GFCI main menu. Two tests can be performed in this menu: **GFCI** and **EPD**. The GFCI tests **G**round **F**ault **C**ircuit **I**nterrupting devices by faulting 6-9mA from hot-to-ground per UL-1436. The **EPD** tests those breakers, which have an **E**quipment **P**rotective **D**evice feature that trips the breaker if a ground fault of greater than 30mA is detected. Pressing the side arrow button (→) navigates between these two tests. Once the desired test is highlighted, depress the GFCI test button on the keypad to activate the test.

AFCI Test Button

Depressing this button displays the AFCI main menu. Two tests can be performed in this menu: **AFCI** and **NEUT**. The AFCI tests **A**rc **F**ault **C**ircuit **I**nterrupting devices by creating a 106-141 amp short-duration arc between the hot and neutral conductors per UL1436. The **NEUT** tests for a Shared **Neut**ral or falsely grounded neutral conductor, which causes AFCI breakers to nuisance trip with normal loads. This test applies 300mA between hot and neutral to ensure that the AFCI breaker does not trip.

Testing Procedure

Wiring Verification

Immediately after being inserted into a receptacle, the SureTest displays the IDEAL logo while it performs a battery of tests. The first test result displayed is the wiring condition. The SureTest checks for the following conditions and indicates the test result on the display.

Wiring Condition	Display Indication H G N
Correct Wiring	○ ○ ○
No Ground	○ ● ○
Polarity Reversal	✳ ○ ✳
Open/Hot Neutral	● ● ●
False Ground	○ Ⓕ ○

Legend
○ On
● Off
✳ Flashing

If the wiring condition is other than normal, the SureTest is limited on its measurements that can be performed. If a no ground condition exists, only the line voltage and voltage drop measurements are available. In a hot/ground reversal, open neutral or open hot condition, the unit will not have any power so the display will be blank.

Notes:

1) Will not detect two hot wires in a circuit.
2) Will not detect a combination of defects.
3) Will not detect reversal of grounded and grounding conductors.

False Ground Indication

NEC article 250-23(a) only allows for a neutral-to-ground bond to occur at the main panel. The SureTest suggests any improper neutral-to-ground bonds within 15-20 feet upstream (towards the panel) of the tester. If this bond improperly occurs in the branch circuit through a bootleg ground via a jumper wire at the outlet device or inadvertent contact of the ground wire to the neutral connection, the SureTest indicates a false ground condition. Note that if the SureTest is within 15-20 feet of the main panel, the unit will indicate a false ground condition on a properly wired circuit due to its close proximity to the proper ground-neutral bond in the main panel.

Voltage Measurements

The line voltage measurement should be 120VAC +/-10% fluctuation at 60 Hz. The peak voltage should be 1.414 times the rms line voltage reading for a clean sine waveform. Ground-to-neutral voltage should be less than 2 VAC. In a single-phase circuit, a higher ground-neutral voltage indicates excessive current leakage between the neutral and ground conductors. In a 3-phase circuit with a shared neutral, a high ground-neutral voltage could indicate an unbalanced load between the three phases or harmonic distortion on the shared neutral. Excessive ground-neutral voltage may result in inconsistent or intermittent equipment performance.

Troubleshooting Tips for Voltage Issues

⚠ **WARNING:** Do not exceed the unit's maximum voltage rating of 250VAC.

Measurement	Expected Result	Problem	Possible Causes	Possible Solutions
Line Voltage 120VAC 220VAC	108-132VAC 198-242VAC	High/low	Too much load on the load on circuit.	Redistribute loads on the circuit.
			High resistance connection within the circuit or at the panel.	Locate high resistance connection/device and repair/replace.
			Supply voltage too high/low.	Consult power company.
Neutral-Ground Voltage	<2VAC Voltage	High G-N >2VAC	Current leaking from neutral to ground.	Identify source of leakage: multiple bonding points, equipment or devices.
			Unbalanced 3-phase system.	Check load balance and redistribute load.
			Triplen harmonics returning on neutral in 3-phase system.	Oversize neutral to impedance. Reduce harmonic effect via filter or other methods.
Peak Voltage 120VAC 220VAC	153-185VAC 280-342VAC	High/low peak voltage	Supply voltage too high/low.	Consult power company.
			High Peak Loads on line caused by electronic equipment on line.	Evaluate number of electronic devices on circuit and redistribute if necessary.
Frequency	60HZ	High/low frequency	Supply frequency too high/low.	Consult power company.

Voltage Drop (V_D) Measurements

The SureTest measures the line voltage, applies a load on the circuit, measures the loaded voltage, then calculates the voltage drop. Results are displayed for 12A, 15A, and 20A loads. The National Electrical Code recommends 5% as the maximum voltage drop for branch circuits for reasonable efficiency (NEC article 210-19. FPN 4). And, the voltage under load (V_L) should not drop below 108VAC for reliable equipment operation.

A good branch circuit should start out with less than 5% voltage drop at the furthest receptacle from the panel at the end of the cable run. Then, each receptacle tested in sequence towards the panel should show a steady decrease in voltage drop. If the voltage drop is above 5% and does not noticeably decrease as you get closer to the first device on the circuit, then the problem is between the first device and the panel. Visually check the terminations at the first device, the wiring between the device and the panel, and the circuit breaker connections. High resistance points can usually be identified as hot spots using an infrared thermometer or by measuring the voltage across the breaker. If the voltage drop exceeds 5% but noticeably decreases as you nearer the panel, the circuit may have undersized wire, too long of a cable run, or too much current on the circuit. Check the wire to ensure that it is sized per code and measure the current on the branch circuit. If a voltage drop reading changes significantly from one receptacle to the next, then the problem is a high impedance point at or between two receptacles. It is usually located at a termination point, such as a bad splice or loose wire connection, but it might also be a bad receptacle.

Troubleshooting Tips for Voltage Drop

Measurement	Expected Result	Problem	Possible Causes	Possible Solutions
Voltage Drop	<5%	High Voltage Drop	Too much load on the circuit.	Redistribute the load on the circuit.
			Undersized wire for length of run.	Check code requirements and re-wire if necessary.
			High resistance connection within the circuit or at the panel.	Locate high resistance connection/ device and repair/replace.

ASCC Measurement

The SureTest calculates the Available Short-Circuit Current (ASCC) that the branch circuit can deliver through the breaker during a bolted fault (dead-short) condition.

The ASCC is calculated by dividing the line voltage by the circuit's line impedance (hot + neutral). Depressing the side arrow (→) displays the worst-case scenario where all three conductors (hot, neutral, ground) are shorted together -- the neutral and ground provide a lower impedance via a parallel return path. Note that this second test will trip a GFCI. See the following equations for clarification.

$ASCC_1$ = Line Voltage (V_{HN})/ (Hot Ω + Neu Ω)

$ASCC_2$ = Line Voltage (V_{HN})/ (Hot Ω + 1/(1/Neu Ω + 1/ Grd Ω)

Impedance (Z) Measurements

If the voltage drop measurement exceeds 5%, analyze the hot and neutral impedances. If one is significantly higher than the other, the problem is with the conductor with the much higher impedance. Then, check all connections on that conductor back to the panel. If both impedances appear high, the source can be undersized wire for the length of run, a bad device, or poor connections at the pigtails, devices, or panel.

The ground impedance measured should be less than 1 ohm as a rule of thumb to ensure that fault current has a sufficient path back to the panel. IEEE states the ground impedance should be less than 0.25 ohms to ensure the ground conductor can safely return any fault current which could damage equipment on the circuit. Surge suppression systems require a good ground to adequately protect equipment from transient overvoltages. Note that a small amount of current is applied to the ground conductor to accurately measure its impedance. By the inherent nature of this test, a GFCI protected circuit will trip unless the device is temporarily removed from the circuit.

Troubleshooting Tips - Impedances

Measurement	Expected Result	Problem	Possible Causes	Possible Solutions
Hot and Neutral Impedance	<0.048Ω/foot of 14 AWG wire	High conductor impedance	Too much load on branch circuit.	Redistribute the load on the circuit.
	<0.03Ω/ foot of 12 AWG wire		Undersized wire for length of run.	Check code requirements and rewire if necessary.
	<0.01Ω/ foot or 10 AWG wire		High resistance connection within the circuit or at the panel.	Locate high resistance connection/device and repair/replace.
Ground Impedance	< 1 Ω to protect people	High ground impedance	Undersized wire for length of run.	Check code requirements and re-wire if necessary.
	<0.25Ω to protect equipment		High resistance connection within the circuit or at the panel.	Locate high resistance connection/device and repair/replace.

GFCI Testing

To test the GFCI device, the SureTest® creates an imbalance between the hot and neutral conductors by leaking a small amount of current from hot to ground using a fixed value resistor. The test current applied by the SureTest® should not be less than 6mA or greater than 9mA per UL-1436. A functional GFCI should sense the imbalance and disconnect the power. The SureTest displays the actual test current in milliamps and trip time in milliseconds.

To conduct a GFCI test, press the GFCI button to enter the GFCI main menu. The GFCI symbol in the display should be highlighted as the default test. If EPD is lit, then use the side arrow (→) to highlight the GFCI symbol. Then, press the GFCI button to activate the test. The actual current being leaked to ground is displayed. The TEST icon and hourglass symbol appear on the display to let the user know that the GFCI test is being performed. The GFCI device should trip within the UL established guideline causing the display to blank out with the loss of power. When the GFCI device is reset, the unit displays the actual trip time that the GFCI took to respond to the current imbalance and open the circuit. Pressing the down arrow button (↓) returns it to the wiring verification mode. If the GFCI fails to trip, the SureTest terminates the test after 6.5 seconds. Further inspection should determine whether the GFCI circuitry is faulty, the GFCI is installed incorrectly, or if the circuit is protected by a GFCI device.

UL Guideline for trip time: $T=\left(\frac{20}{I}\right)^{1.43}$ Where: T = seconds (s), I = milliamps (mA)

Notes:

1) In order to test a GFCI in a 2-wire system (no ground), the #61-175 ground continuity adapter must be used. Connect the alligator clip on the adapter to a ground source, such as to a metal, water or gas pipe.
2) All appliances or equipment on the ground circuit being tested should be unplugged to help avoid erroneous readings.

In addition to performing a GFCI test for evaluating personal protection from shock hazards, the SureTest can also conduct testing to ensure equipment protection from ground faults exceeding 30mA. The method of operation is the same as the GFCI test noted in the first paragraph above but uses a different resistor to create a 30mA leakage current from hot-to-ground. To conduct an EPD test on an Equipment Protective Device, press the GFCI button to enter the GFCI main menu. The GFCI symbol in the display should be highlighted as the default test. Press the side arrow (→) button to highlight the EPD symbol. Then, press the GFCI button to activate the test. The actual current being leaked to ground is displayed. The TEST icon and hourglass symbol appear on the display to let the user know that the

EPD test is being performed. The EPD should trip causing the display to blank out with the loss of power. When the EPD is reset and power is restored, the unit displays the actual trip time that the EPD took to respond to the current imbalance and open the circuit. Pressing the down arrow button (↓) returns it to the wiring verification mode. If the EPD fails to trip, the SureTest terminates the test after 6.5 seconds. Further inspection should determine whether the EPD circuitry is faulty, the EPD is installed incorrectly, or if the circuit is protected by an EPD.

Troubleshooting Tips

Measurement	Expected Result	Problem	Possible Causes	Possible Solutions
GFCI Test	GFCI trips within trip time	GFCI doesn't trip within proper trip time.	GFCI maybe installed improperly.	Check wiring for proper installation in accordance with manufacturer's instructions and NEC.
		GFCI doesn't trip.	GFCI may be defective.	Check wiring and ground. Replace GFCI if necessary.

AFCI Testing (#61-165 only)

The SureTest® w/AFCI applies 8-12 current pulses in less than a half second across hot-to-neutral with each pulse no longer than 8.3ms in duration, and having an amplitude of 106-141 amps in accordance with UL1436. A functional AFCI breaker should recognize these current pulses as a dangerous arc and disconnect the power to the circuit. To restore power, reset the breaker at the panel.

To properly test the AFCI, execute the following steps:

1) Consult the AFCI manufacturer's installation instructions to determine that the AFCI is installed in accordance with the manufacturer's specifications.
2) Plug in the SureTest and check for correct wiring of receptacle and all remotely connected receptacles on the branch circuit. Then, go to the panel and operate the test button on the AFCI installed in the circuit. The AFCI must trip. If it does not, do not use the circuit - consult an electrician. If the AFCI does trip, reset the AFCI.
3) Return to the tester and press the AFCI button on the tester to enter the AFCI main menu. The AFCI symbol in the display should be highlighted as the default test. If NEUT is lit, then use the side arrow (→) to highlight the AFCI symbol. Then, press the AFCI button to activate the test. The TEST icon and lightning bolt symbol light brightly on the display to let the user know that the AFCI test is being performed. The AFCI device should trip causing the display to blank out with the loss of power. If the AFCI fails to trip, the SureTest® will not lose power and the display shows a dimly lit lightning bolt. This non-trip condition would suggest:
   a) A wiring problem with a totally operable AFCI, or
   b) Proper wiring with a faulty AFCI.
   Consult with an electrician to check the condition of the wiring and AFCI.
4) CAUTION: AFCIs recognize characteristics unique to arcing, and AFCI testers produce characteristics that mimic some forms of arcing. Because of this, the tester may give a false indication that the AFCI is not functioning properly. If this occurs, recheck the operation of the AFCI using the test and reset buttons. The AFCI's test button function should demonstrate proper operation.

   Note: The AFCI circuitry is protected by a thermal sensor to assure long life. If a thermometer icon appears in the display during repeated AFCI testing, the sensor delays further testing until the circuitry cools. At that point, the testing will automatically continue.

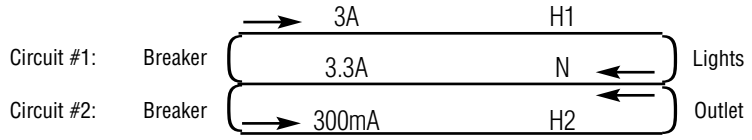
Shared Neutral Test (#61-165 only)

AFCI breakers are prone to nuisance tripping when wired with a shared neutral or when the neutral conductor is accidentally grounded before the panel. The AFCI tripping occurs because it senses an imbalance between the current going out on the hot and the current returning on the neutral. A shared neutral between two hot conductors creates this imbalance. See the illustration below to see how this imbalance can occur.

The SureTest can test for these conditions by applying a small load of 300mA between hot and neutral to simulate a normal load and ensure that the AFCI breaker does not trip. To conduct a shared neutral test, press the AFCI button to enter the AFCI main menu. Press the side arrow (→) to highlight the NEUT symbol. Then, press the AFCI button to activate the test. The TEST icon will light brightly while the test is being conducted. The AFCI breaker should not trip. If the breaker does trip, a shared neutral is the probable cause.

Illustration:

SureTest Shared Neutral Test w/300mA load



Troubleshooting Tips

Measurement	Expected Result	Problem	Possible Causes	Possible Solutions
AFCI Test	AFCI trips	AFCI does not trip.	AFCI installed incorrectly.	Check wiring and re-wire device according to manufacturer's instructions.
			AFCI defective.	Replace AFCI.
			High source of line impedance or resistance.	Check for high voltage drop.
Shared Neutral Test	AFCI does not trip	AFCI does trip.	Shared neutral exists.	Re-wire circuit per AFCI manufacturer's Instructions.

Optional Accessories

#61-183 Alligator Clip Adapter

This adapter allows the SureTest to analyze non-outlet based circuits for branch circuit safety and performance. Simply plug the alligator clip adapter into the IEC connection on the front of the SureTest. Then, properly connect the hot (black), neutral (white) and ground (green) alligator clips onto the circuit. Correct test results are dependent on making good connections with the alligator clips onto the circuit.

⚠ **WARNING:** The SureTest is designed for 120/240VAC circuits only. Do not exceed the rating of the SureTest with this adapter.

This adapter also allows the operator to use the SureTest (#61-165 only) to verify AFCI protection on non-outlet based circuits in bedrooms, such as on circuits used for lighting, ceiling fans, and smoke detectors.

#61-175 Ground Continuity Adapter

This adapter allows the operator to verify that a cabinet or equipment chassis has been properly bonded to the system ground. Plugging the SureTest into the ground continuity adapter isolates the SureTest from the electrical ground. If the equipment is properly grounded, then connecting the alligator clip from the ground continuity adapter to the cabinet or equipment chassis should provide a pathway to ground, and consequently a normal wiring condition on the SureTest.

After the ground continuity adapter has been connected, the SureTest can be used to measure the ground impedance of the cabinet or equipment chassis back to the panel. See the section on Line Impedance Measurements for test instructions for ground impedance.

This adapter can also be used to test GFCI receptacles on 2-wire circuits. Connect the alligator clip on the adapter to a ground, such as a metal water or gas pipe prior to testing the GFCI.

#61-176 Isolated Ground Adapter

This adapter allows the operator to verify that a receptacle is completely isolated from the system ground that is bonded to other devices on the branch circuit. Test the ground impedance of the receptacle and record the ohms value. (See the section on Line Impedance Testing for details on obtaining the ground impedance value). Remove the SureTest and plug it into the isolated ground adapter. Attach the alligator clip to the center receptacle screw or metal junction box, and re-insert the SureTest into the receptacle and record the ohms value.

The isolated ground adapter creates a parallel pathway to ground, which results in a lower ground impedance reading with the adapter versus with the receptacle with the isolated ground. If the two readings are the same, then the receptacle does not have an isolated ground. If the reading taken with the isolated ground adapter is lower, then the receptacle has an isolated ground.

Maintenance

Clean case with a damp cloth and mild detergent. Do not use abrasives or solvents.

Service and Replacement Parts:

This unit has no user-serviceable parts. To inquiry about service information, call Technical Support at 877 201-9005 or visit our website at www.testersandmeters.com.
Repair address is:

IDEAL INDUSTRIES, INC.
Attention: Repair Dept.
1000 Park Ave.
Sycamore, IL 60178

General Specifications

Characteristics	Description
Display	128 x 64 OLED with backlight
Display update for Volt	Less than 2.5 times Second.
Over-range Indication on all functions	Display "OL"
Operating Environment,	
Relative Humidity	32°F to 122°F (0°C to 50°C) at <80%RH
Storage Environment:	32°F to 122°F (0°C to 50°C) at <80% RH
Case Construction:	ABS UL 94V/0/5VA rated
Altitude:	6561.7 ft (2000m)
Dimensions:	6.4" (L) x 3" (W) x 1.4" (D) 162mm (L) x 76mm (W) x 36mm (D)
Weight:	9.4 oz (267g)
Safety:	UL61010B-1, Cat III-300V UL-1436 for AFCI, GFCI & Outlet
	c UL us
Accessories:	Includes 1' plug adapter, carrying case, instruction manual. Optional alligator clip adapter available.

⧈ Double Insulation

Instrument has been evaluated and complies with insulation category III (overvoltage category III). Pollution degree 2 in accordance with IEC-644. Indoor use.

Measurement Specifications:

All specifications are at 23°C ± 5°C at less than 80% relative humidity.
Accuracy is state as ± ([% of range] + [counts]).
AC converter is true rms sensing.

Measurement	Ranges	Resolution	Accuracy
Line Voltage	85.0 - 250.0 VAC	0.1V	1.0% ± .2V
Peak Line Voltage	121.0 - 354.0 VAC	0.1V	1.0% ± .2V
Frequency	45.0 - 65.0 Hz	0.1Hz	1.0% ± .2Hz
% Voltage Drop	0.1% - 99.9%	0.1%	2.5% ± .2%
Voltage Loaded	10.0 - 250.0 VAC	0.1V	2.5% ± .2V
Neutral-Ground V	0.0 - 10.0 VAC	0.1V	2.5% ± .2V
Impedance - Hot Neutral, & Ground	0.00 Ω - 3.00 Ω > 3 Ω	0.01Ω	2.5% ± .02Ω Unspecified.
GFCI Trip Time	1mS to 6.500S counter.	1 mS	1.0% ± 2mS
GFCI Trip Current	6.0 - 9.0 mA	0.1 mA	1.0% ± .2mA
EPD Trip Current	30.0 - 37.0 mA	0.1 mA	1.0% ± .2mA

Limited Warranty

This meter is warranted to the original purchaser against defects in material or workmanship for two years from the date of purchase. During this warranty period, IDEAL INDUSTRIES, INC. will, at its option, replace or repair the defective unit, subject to verification of the defect or malfunction. This warranty does not apply to defects resulting from abuse, neglect, accident, unauthorized repair, alteration, or unreasonable use of the instrument.

Any implied warranties arising out of the sale of an IDEAL product, including but not limited to implied warranties of merchantability and fitness for a particular purpose, are limited to the above. The manufacturer shall not be liable for loss of use of the instrument or other incidental or consequential damages, expenses, or economic loss, or for any claim or claims for such damage, expenses or economic loss.

State laws vary, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights, which vary from state to state.

Warranty limited solely to repair or replacement; no warranty of merchantability, fitness for a particular purpose or consequential damages.

Distributed by:

TESTERS AND TOOLS.COM
Trust Experience Reliability
sales@testersandtools.com
Tel: 602-795-4033, Fax: 602-795-4624

IDEAL INDUSTRIES, INC.
Sycamore, IL 60178, U.S.A.
800-435-0705 Customer Assistance / Service d'assistance à la clientèle au / Asistencia al Cliente
www.idealindustries.com
ND 5481-4 Made in U.S.A. / Fabriqué aux USA / Fabricado en EE.UU.