FLUKE®
Biomedical

ESA609
Electrical Safety Analyzer

Users Manual

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Technical Support

For application support or answers to technical questions, either email techservices@flukebiomedical.com or call 1-800- 850-4608 or 1-440-248-9300. In Europe, email techsupport.emea@flukebiomedical.com or call +31-40-2965314.

Claims

Our routine method of shipment is via common carrier, FOB origin. Upon delivery, if physical damage is found, retain all packing materials in their original condition and contact the carrier immediately to file a claim. If the instrument is delivered in good physical condition but does not operate within specifications, or if there are any other problems not caused by shipping damage, please contact Fluke Biomedical or your local sales representative.

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Return Procedure

All items being returned (including all warranty-claim shipments) must be sent freight-prepaid to our factory location. When you return an instrument to Fluke Biomedical, we recommend using United Parcel Service, Federal Express, or Air Parcel Post. We also recommend that you insure your shipment for its actual replacement cost. Fluke Biomedical will not be responsible for lost shipments or instruments that are received in damaged condition due to improper packaging or handling.

Use the original carton and packaging material for shipment. If they are not available, we recommend the following guide for repackaging:

- Use a double–walled carton of sufficient strength for the weight being shipped.
- Use heavy paper or cardboard to protect all instrument surfaces. Use nonabrasive material around all projecting parts.
- Use at least four inches of tightly packed, industry-approved, shock-absorbent material around the instrument.

Returns for partial refund/credit:

Every product returned for refund/credit must be accompanied by a Return Material Authorization (RMA) number, obtained from our Order Entry Group at 1-440-498-2560.

Repair and calibration:

To find the nearest service center, go to www.flukebiomedical.com/service or

In the U.S.A.:

Cleveland Calibration Lab
Tel: 1-800-850-4608 x2564
Email: globalcal@flukebiomedical.com

Everett Calibration Lab
Tel: 1-888-99 FLUKE (1-888-993-5853)
Email: service.status@fluke.com

In Europe, Middle East, and Africa:

Eindhoven Calibration Lab
Tel: +31-40-2675300
Email: ServiceDesk@fluke.com

In Asia:

Everett Calibration Lab
Tel: +425-446-6945
Email: service.international@fluke.com

To ensure the accuracy of the Product is maintained at a high level, Fluke Biomedical recommends the product be calibrated at least once every 12 months. Calibration must be done by qualified personnel. Contact your local Fluke Biomedical representative for calibration.

Certification

This instrument was thoroughly tested and inspected. It was found to meet Fluke Biomedical's manufacturing specifications when it was shipped from the factory. Calibration measurements are traceable to the National Institute of Standards and Technology (NIST). Devices for which there are no NIST calibration standards are measured against in-house performance standards using accepted test procedures.

WARNING

Unauthorized user modifications or application beyond the published specifications may result in electrical shock hazards or improper operation. Fluke Biomedical will not be responsible for any injuries sustained due to unauthorized equipment modifications.

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Manufacturing Location

The ESA609 Electrical Safety Analyzer is manufactured at Fluke Biomedical, 6920 Seaway Blvd., Everett, WA, U.S.A.

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Electrical Safety Analyzer

Introduction

The Fluke Biomedical ESA609 Electrical Safety Analyzer (the Analyzer) is a full-featured, compact, portable analyzer that verifies the electrical safety of medical devices. The Analyzer tests to domestic (ANSI/AAMI ES1, NFPA 99) and international (and parts of IEC 62353 and IEC 60601-1) electrical-safety standards. The integrated ANSI/AAMI ES1 and IEC 60601-1 patient loads are easy to select.

The Analyzer does the following tests:

- Line (Mains) voltage
- Ground Wire (or Protective Earth) Resistance
- Equipment current
- Ground Wire (Earth) leakage
- Chassis (Enclosure) leakage
- Direct equipment leakage
- Point to point leakage and resistance

Intended Use

The Product is an electronic signal source and measurement device for verifying the electrical safety of medical devices.

The intended user is a trained biomedical equipment technician who performs periodic preventative maintenance checks on medical equipment in service. Users can be associated with hospitals, clinics, original equipment manufacturers and independent service companies that repair and service medical equipment. The end user is an individual, trained in medical instrumentation technology.

This Product is intended to be used in the laboratory environment, outside of the patient care area, and is not intended for use on patients, or to test devices while connected to patients. This Product is not intended to be used to calibrate medical equipment. It is intended for over-the-counter use.

Safety Information

In this manual, a **Warning** identifies hazardous conditions and actions that could cause bodily harm or death. A **Caution** identifies conditions and actions that could damage the Analyzer, the equipment under test, or cause permanent loss of data.

Table 1 is a list of symbols used on the product and in this manual.

Table 1. Symbols

Symbol	Description
	Risk of Danger. Important information. See Manual.
	Hazardous voltage. Risk of electric shock.
	Fuse
	Conforms to relevant North American Safety Standards.
	Conforms to European Union directives
	Conforms to relevant Australian EMC standards

Table 1. Symbols (cont.)

Symbol	Description
	Conforms to relevant South Korean EMC Standards.
	This product complies with the WEEE Directive (2002/96/EC) 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. Go to Fluke's website for recycling information.

⚠⚠ Warning

To prevent possible electrical shock, fire, or personal injury, follow these guidelines:

- **Read all safety information before you use the Product.**
- **Use the Product only as specified, or the protection supplied by the Product can be compromised.**
- **Do not connect to live output terminals. The Product can supply voltages that can cause death. Standby mode is not sufficient to prevent electrical shock.**
- **Do not apply more than the rated voltage, between the terminals or between each terminal and earth ground.**
- **Limit operation to the specified measurement category, voltage, or amperage ratings.**
- **Use Product-approved measurement category (CAT), voltage, and amperage rated accessories (probes, test leads, and adapters) for all measurements.**
- **Measure a known voltage first to make sure that the Product operates correctly.**
- **Use the correct terminals, function, and range for measurements.**
- **Do not touch voltages > 30 V ac rms, 42 V ac peak, or 60 V dc.**
- **Do not use the Product around explosive gas, vapor, or in damp or wet environments.**
- **Do not use the Product if it is damaged.**
- **Disable the Product if it is damaged, by removing the power cord and fuses.**
- **Do not use the Product if it operates incorrectly.**
- **Examine the case before you use the Product. Look for cracks or missing plastic. Carefully look at the insulation around the terminals.**
- **Do not use test leads if they are damaged. Examine the test leads for damaged insulation, exposed metal, or if the wear indicator shows. Check test lead continuity.**
- **Use this Product indoors only.**

- **Use only the mains power cord and connector approved for the voltage and plug configuration in your country and rated for the Product.**
- **Make sure the ground conductor in the mains power cord is connected to a protective earth ground. Disruption of the protective earth could put voltage on the chassis that could cause death.**
- **Replace the mains power cord if the insulation is damaged or if the insulation shows signs of wear.**
- **Connect the common test lead before the live test lead and remove the live test lead before the common test lead.**
- **Keep fingers behind the finger guards on the probes.**
- **Do not use test leads if they are damaged. Examine the test leads for damaged insulation and measure a known voltage.**
- **Do not use a current measurement as an indication that a circuit is safe to touch. A voltage measurement is necessary to know if a circuit is hazardous.**

Unpacking the Analyzer

Carefully unpack all items from the box and check that you have the following items:

- ESA609
- Safety Sheet
- Users Manual CD
- Carrying case
- Power cord
- ESA USA Accessory Kit (USA, Australia, and Israel only)
- ESA EUR Accessory Kit
- Null Post Adapter

Instrument Familiarization

Front Panel

Figure 1 and Table 2 describe the front-panel controls and connections of the Analyzer.

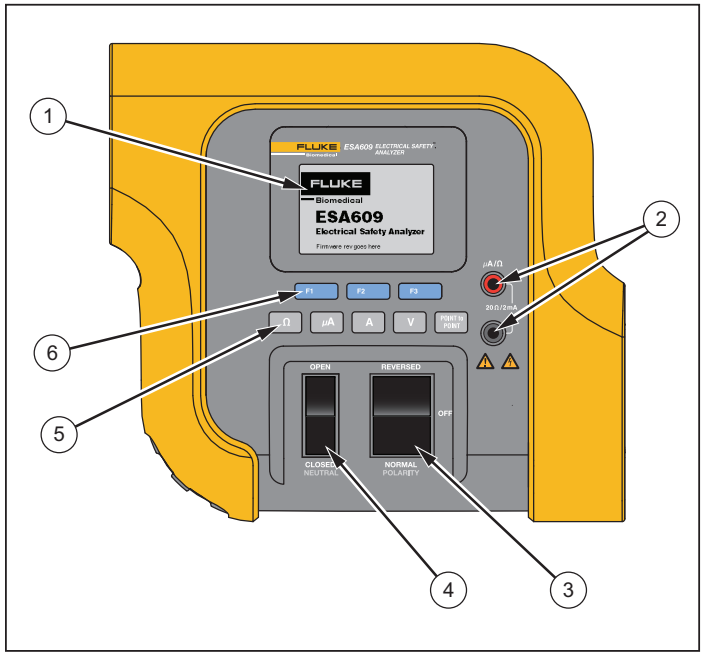

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Figure 1. Front-Panel Controls and Connections

Table 2. Front-Panel Controls and Connections

Item	Name	Description
①	Display	The LCD display.
②	Input Jacks	Test lead connectors, these provide the DUT connections.
③	Polarity Rocker Switch	Changes the polarity of the equipment outlet connections between normal and reversed.
④	Neutral Rocker Switch	Changes the configuration of the neutral connection between open and closed
⑤	Test Function Buttons	Selects the various Analyzer test functions.
⑥	Function Softkeys	Selects from the options that appear in the LCD display above each function softkey.

Side Panels

Figure 2 and Table 3 describe the side-panel connections of the Analyzer.

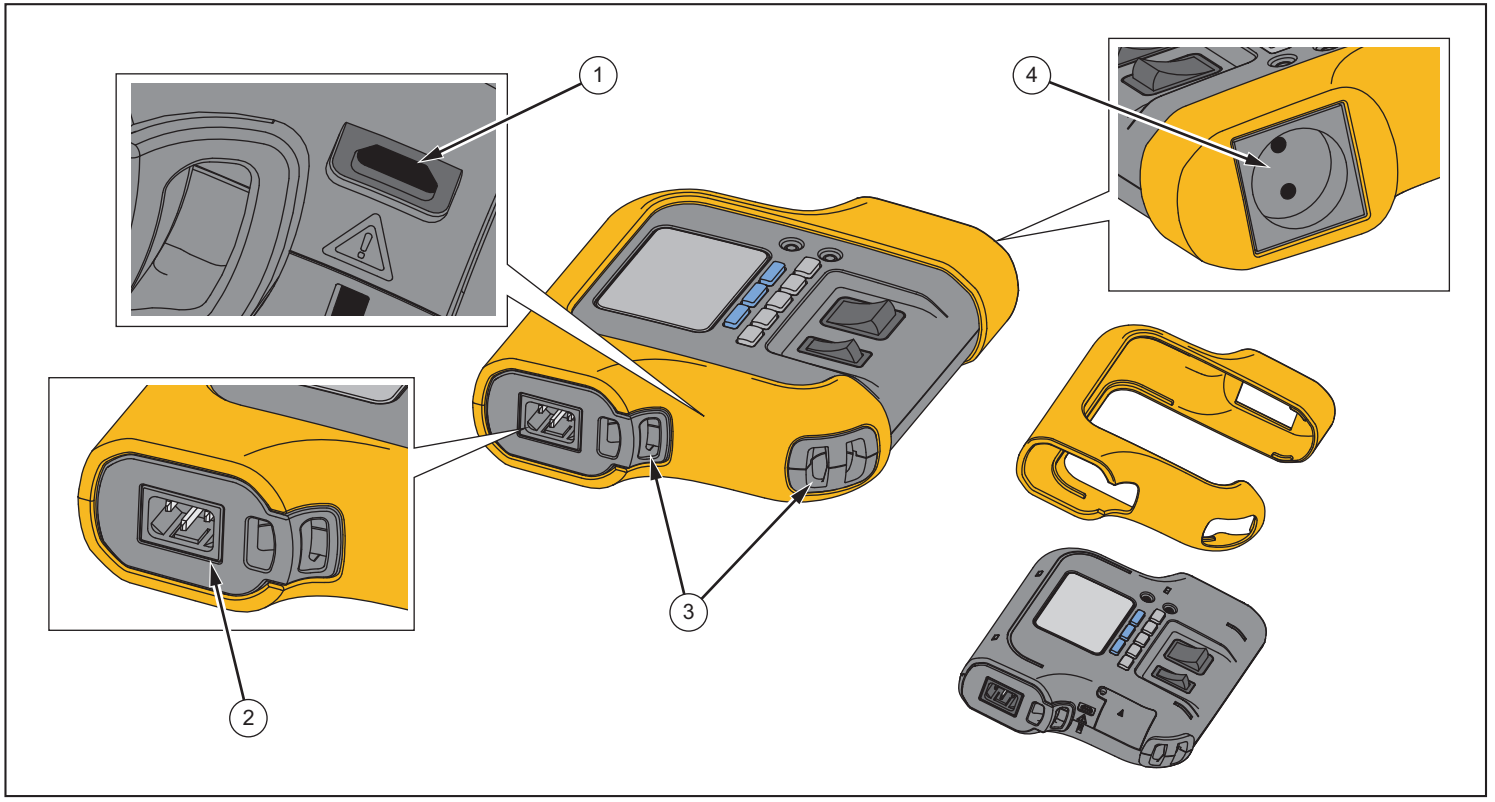

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Figure 2. Side-Panel Connections

Table 3. Side-Panel Connections

Item	Name	Description
①	Calibration Port	Port for calibrating the instrument. (Located under the holster.) For use by authorized service center only.
②	Power Input Connector	A grounded male three-prong (IEC 60320 C19 or C13) connector that accepts the line-power cord.
③	Handstrap Location	The slots used to attach the handstrap to the analyzer, see Figure 3.
④	Equipment Outlet	Equipment outlet, specific to the version of the Analyzer, which provides a DUT connection.

Product Handstrap

Use the handstrap to carry the Analyzer, see Figure 3.

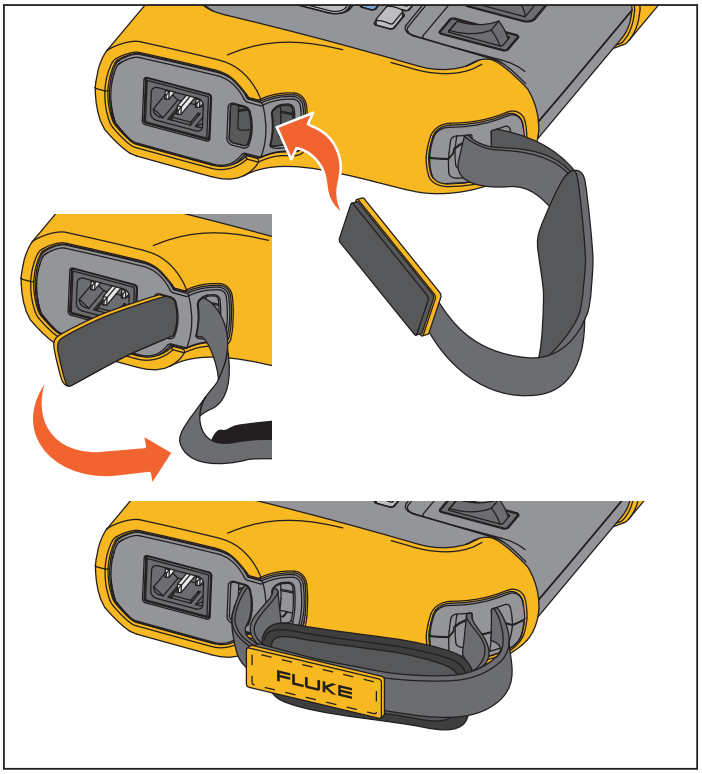

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Figure 3. Product Handstrap

Connect the Analyzer to Line Power

⚠⚠Warning

To prevent possible electrical shock, fire, or personal injury, do not use an extension cord or adapter plug.

Connect the Analyzer to a properly grounded three-prong outlet. The Analyzer will not properly test a DUT when the ground lead is open.

The Analyzer is intended for use with single-phase, grounded power. It is not intended for dual, split-phase or three-phase power configurations. But it can be used with any power system that supplies the correct voltages for single-phase and is grounded.

Connect the DUT to the Analyzer

A Device Under Test (DUT) can be connected in a number of different ways depending on the device and the number of connections needed for a full electrical safety test. Figure 4 shows a DUT connected to the test receptacle and a separate connection to the DUT's enclosure or protective earth ground.

⚠⚠Warning

To prevent possible electrical shock, fire, or personal injury, follow these guidelines:

- **Do not touch exposed metal on banana plugs, they can have voltages that could cause death.**
- **Remove circuit power before you connect the Product in the circuit when you measure current. Connect the Product in series with the circuit.**
- **Connect an approved three-conductor mains power cord to a grounded power outlet.**
- **Do not put the Product where access to the mains power cord is blocked.**
- **Do not put metal objects into connectors.**

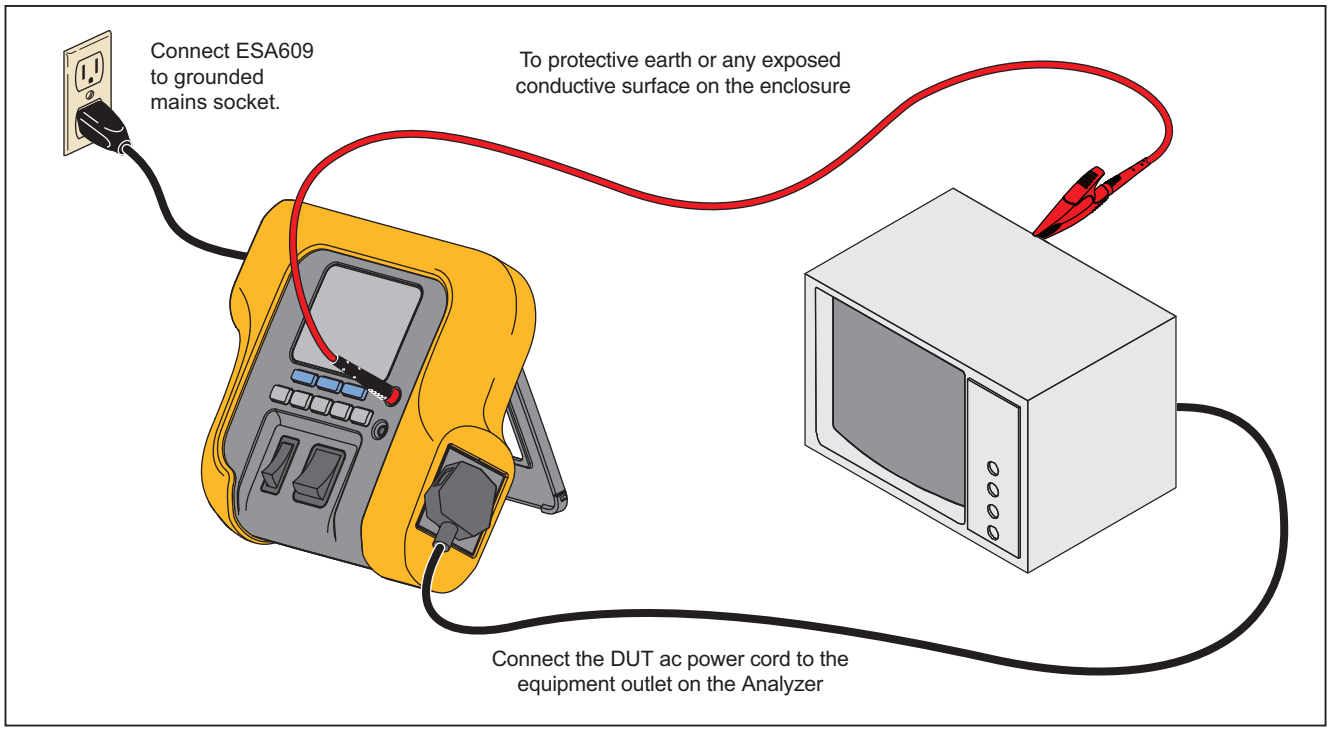

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Figure 4. DUT Connections to the Analyzer

Turn on the Analyzer

To turn on the Analyzer, connect the power cord and plug the cord into an outlet. The Analyzer will perform a series of self-tests and then display the message shown in Figure 5 when the self-test has completed successfully.

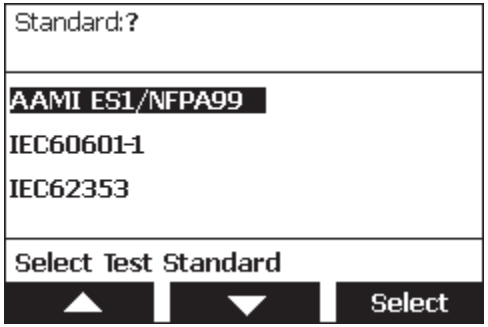

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Figure 5. Start screen

During the self-test, the Analyzer checks its ac mains input for proper polarity, ground integrity and voltage level. If the polarity is reversed, the Analyzer indicates this condition. If the ground is open, the Analyzer displays this fault. If the mains voltage is too high or too low, the Analyzer displays this fault and does not continue until the supply voltage is corrected and the Analyzer power cycled off and then on again.

Accessing the Analyzer's Functions

Use the test function buttons on the Analyzer to select the type of test. Use the menus to select specific tests or setup options. For example, press [μA] and the Analyzer shows the available leakage current tests at the bottom of the display. Press a softkey (F1 through F3) under a specific test to setup for or perform the selected test.

When an option, such as the Earth condition, is not displayed, it cannot be changed. However, the Analyzer indicates the setting.

Setting Up the Analyzer

Use the rocker switches to switch between normal and reversed polarity.

Performing Electrical Safety Tests

The Analyzer performs a number of different electrical and performance tests on biomedical equipment. The following sections describe the various tests and how to perform them using the Analyzer.

Setting the Test Standard

The Analyzer performs electrical safety testing based on a number of different safety standards: AAMI ES1/NFPA99, IEC 62353, and IEC 60601-1. AAMI is the Analyzer's default standard.

To select another standard:

1. Press the softkey labeled **Standard** to open the scroll box above the softkey label.
2. Press ⏶ or ⏷ to scroll through the standard selections.

Some electrical tests may not be applicable for a specific standard. In these cases, the Analyzer's menu will not display the excluded test as a selection.

Performing Mains Voltage Testing

The Mains Voltage test measures the voltage on the mains input through three separate measurements. To access the Mains Voltage test, press V. A Mains Voltage test is shown in Figure 6.

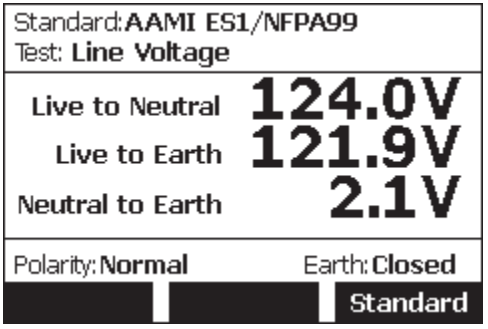

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Figure 6. Mains Voltage Test

Performing a Ground-Wire (Protective-Earth) Resistance Test

The Ground-Wire (Protective-Earth) Resistance test measures the impedance between the Analyzer's test receptacle's PE terminal and the exposed conductive parts of the DUT that are connected to the DUT's Protective Earth.

Prior to conducting any leakage tests with the Analyzer, it is best to test the integrity of the ground connection between the Analyzer's test receptacle ground and the DUT's Protective earth ground or enclosure with this test.

To perform a ground-wire resistance test:

1. Press [Ω] to show the resistance function menu.
2. Connect one end of a test lead to the Ω/A jack as shown in Figure 4.
   - If using an accessories probe, connect it to the other end of the test lead and place the probe tip into the Ground Pin of the Analyzer's test receptacle (black input jack).
   - If using an alligator clip accessory, connect it to the other end of the test lead, place the null post adapter in the Ground Pin of the Analyzer's test receptacle (black input jack), and clamp the alligator clip to the null post adapter.
3. Press the softkey labeled **Zero**. The Analyzer zeroes out the measurement to cancel the test lead resistance.
4. Connect the test lead coming from the red jack to the DUT enclosure or protective earth connection.
5. Plug the power cord from the DUT into the Analyzer's test receptacle. The measured resistance displays as shown in Figure 7 after any the DUT connections are made.

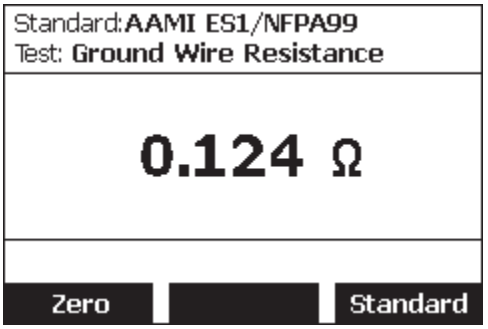

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Figure 7. Ground-Wire Resistance Test

⚠⚠ Warning

To avoid electric shock, remove the null post adapter from the test receptacle after a test lead zero is performed. The test receptacle becomes potentially hazardous during some of the test conditions.

A low resistance reading is required to confirm a good ground connection through the power cord. Refer to the appropriate electrical safety standard for the specific limit value to be followed.

Figure 8 shows the electrical connections between the Analyzer and the DUT. Table 4 lists the abbreviations used in the schematics and their descriptions.

Table 4. Schematic Abbreviations

Abbreviation	Meaning
MD	Measuring Device (ESA609 Analyzer)
FE	Functional Earth
PE	Protective Earth
Mains	Mains Voltage Supply
L1	Live Conductor
L2	Neutral Conductor
DUT	Device Under Test
DUT_L1	Device Under Test Live conductor
DUT_L2	Device Under Test neutral conductor
DUT_PE	Device Under Test protective earth
REV POL	Reversed mains supply polarity
PE Open	Open protective earth
⏦	Test Voltage

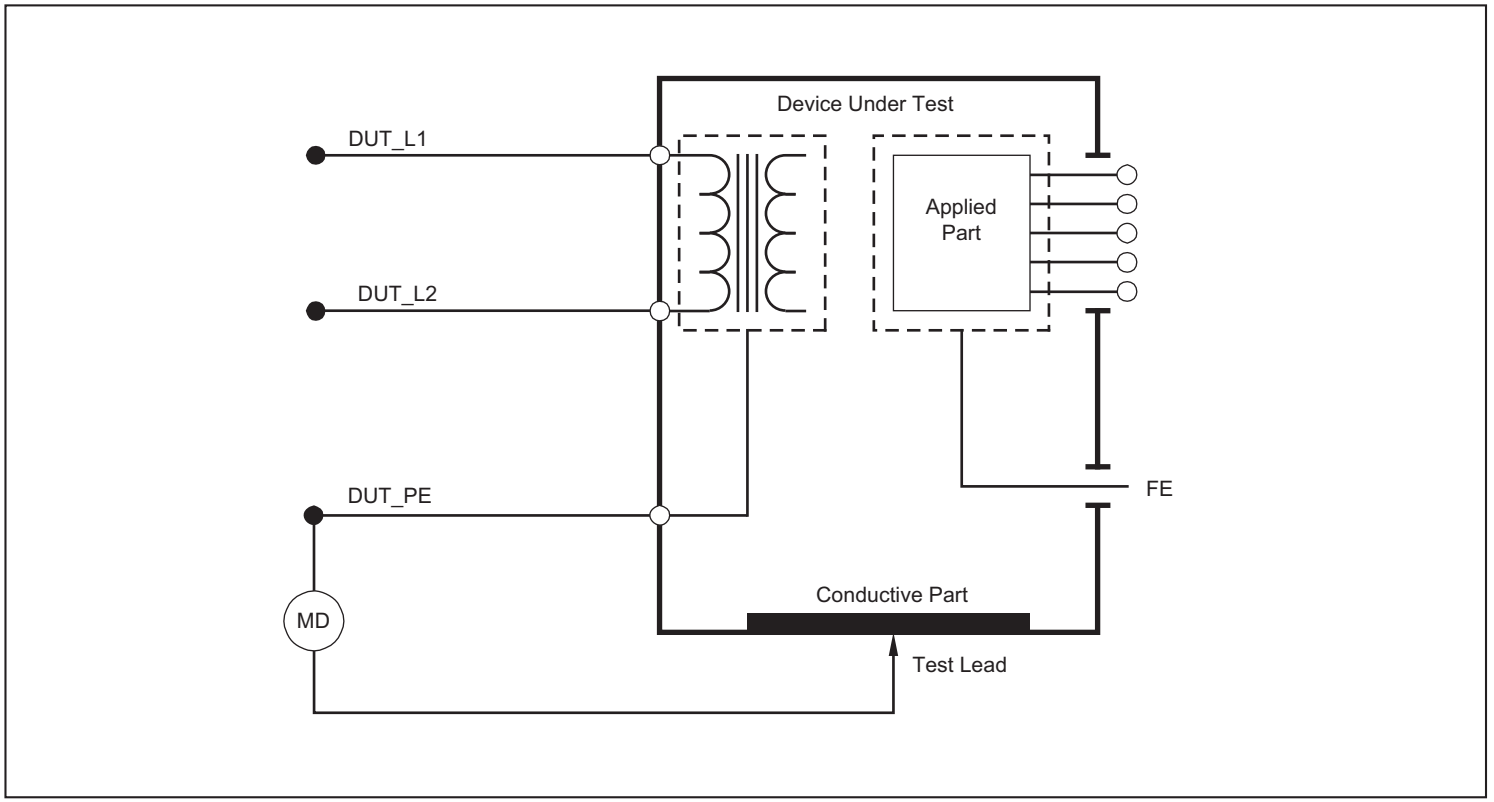

Figure 8. Ground-Wire (Protective-Earth) Resistance Measurement Schematic

Performing a Current Consumption Test

To measure the current consumed by the DUT, press [A]. The Analyzer displays the current flowing through the mains connections of the test receptacle.

Performing Leakage Current Tests

The Analyzer measures leakage current for a number of different DUT configurations.

The leakage tests that are available depend on which standard is selected. See the “Selecting the Test Standard” section earlier in this manual to change the standard the Analyzer is using.

Table 5 lists tests that have different names based on which standard is selected.

Table 5. Test Names Based on Selected Standard

IEC60601	AAMI/NFPA 99
Protective-Earth Resistance	Ground-Wire Resistance
Earth-Leakage Current	Ground-Wire Leakage Current
Touch- or Enclosure-Leakage Current	Chassis-Leakage Current

Press [μA] to access the leakage current main test shown in Figure 9.

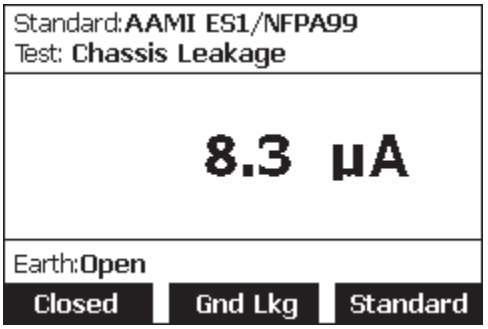

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Figure 9. Leakage Current Test

Note

The display shown in Figure 9 is a leakage current test when AAMI is the selected standard.

All leakage currents are displayed in as RMS only. The initial result is displayed in the appropriate parameter based on the standard selected.

Measuring Ground-Wire (Earth) Leakage Current

Note

The Ground-Wire (Earth) Leakage test is available for AAMI, 60601, and not IEC 62353.

To measure the current flowing in the DUT's protective earth circuit, press the softkey labeled **Ground Wire** (pending the standard) from the leakage current main menu. Figure 10 shows the electrical connections between the Analyzer and the DUT during a Ground-Wire (Earth) Leakage Current Test.

Within the Ground-Wire Leakage Current test there are a few combination measurements that can be performed.

Press rocker switches to change polarity or to open or close the neutral connection.

Note

When changing polarity, Fluke strongly advises you to perform the action slowly. Allow about 3 seconds to switch from one position to the other. It is possible to damage the analyzer if you switch too quickly.

There is no need to open up the test receptacle earth (ground), since this is done internally during the measurement.

The following outlet conditions apply when performing this test:

- Normal Polarity
- Normal Polarity, Open Neutral
- Reversed Polarity
- Reversed Polarity, Open Neutral

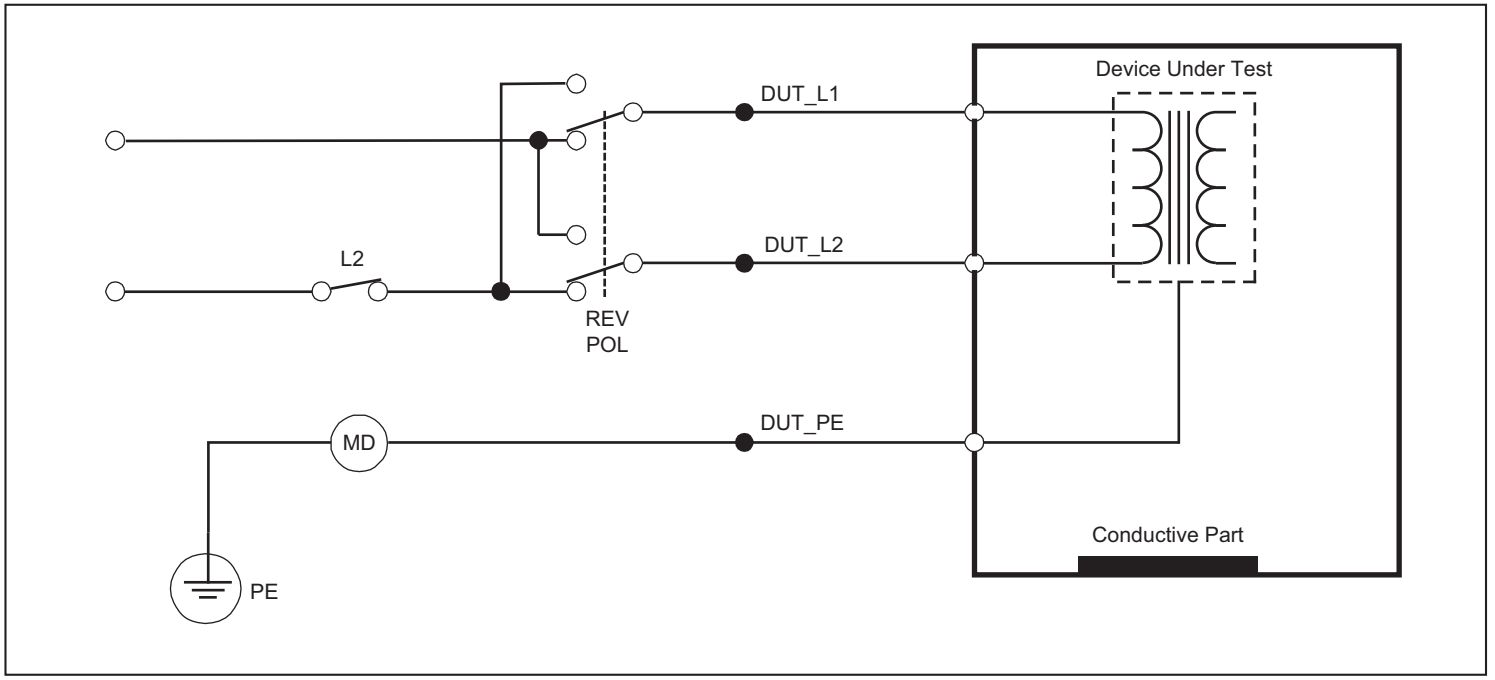


Figure 10. Earth-Leakage Current Test Schematic

Performing a Chassis (Enclosure) Leakage Test

Note

The Chassis (Enclosure) Leakage test is only available for the IEC 60601 or ANSI/AAMI ES1 standard selections.

The Chassis (Enclosure) Leakage Test measures the current flowing between the DUT's enclosure and protective earth. Figure 11 shows the electrical connections between the Analyzer and the DUT.

To perform a Chassis (Enclosure) Leakage Test:

1. Connect a lead between the Analyzer's Ω/A jack and the DUT's enclosure.
2. Press the softkey labeled **Chassis** from the Leakage Current Test menu.
3. The Analyzer displays the measured current.

The Chassis Leakage test can be performed with a number of fault conditions on the test receptacle.

- Press the polarity rocker switch to change the polarity.
- Press the neutral rocker switch to open or close the neutral connection.
- Press the softkey labeled **Open** to open the receptacle's earth connection or press the softkey labeled **Closed** to close the earth connection.

The following outlet conditions apply when performing this test:

- Normal Polarity
- Normal Polarity, Open Earth
- Normal Polarity, Open Neutral
- Reversed Polarity
- Reversed Polarity, Open Earth
- Reversed Polarity, Open Neutral

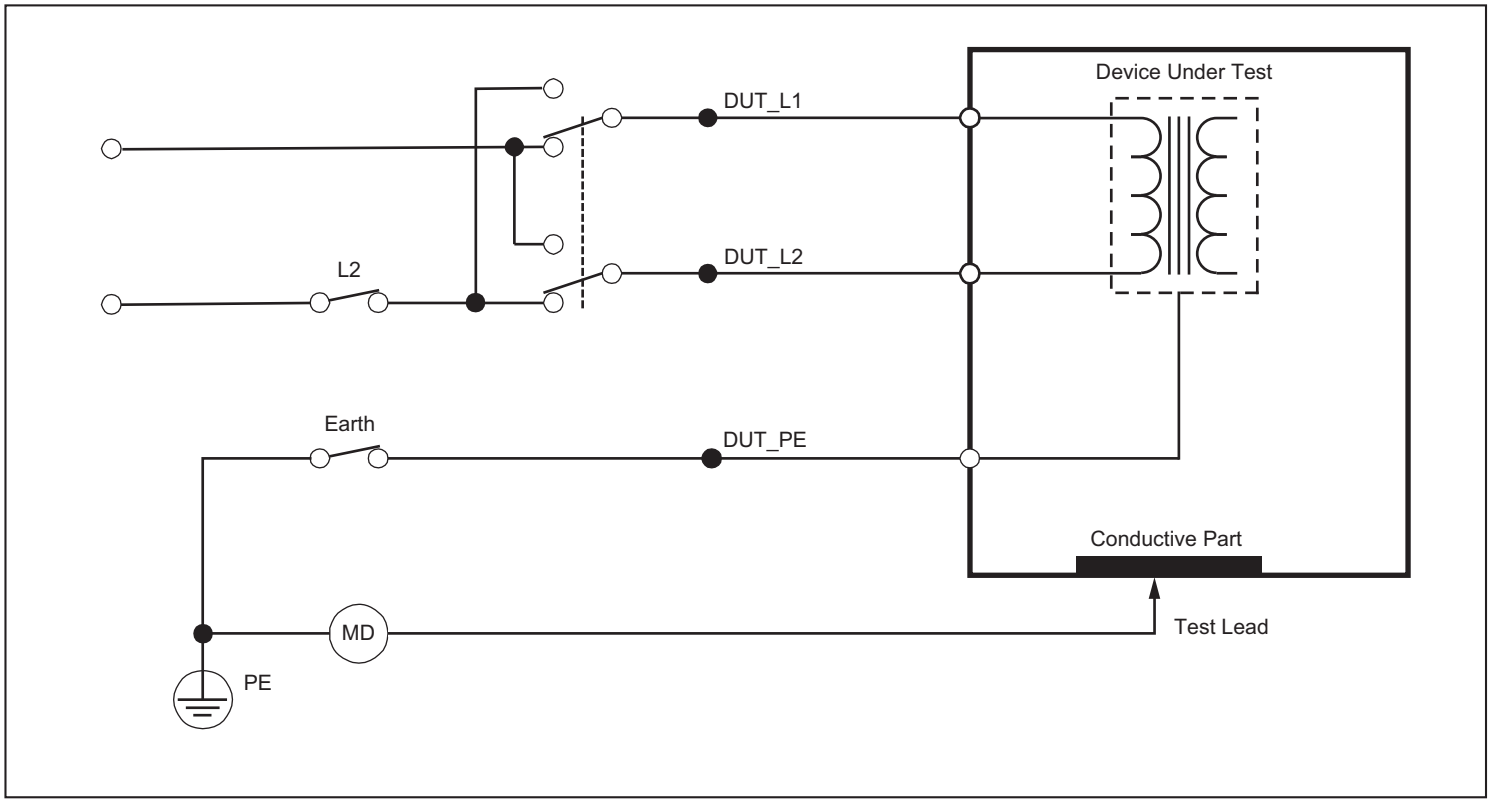


Figure 11. Enclosure-Leakage Current Test Schematic

Performing a Direct-Equipment Leakage Test

Note

The Direct-Equipment Leakage test is available when the EN62353 standard is selected.

The Direct-Equipment Leakage Current test measures the leakage current between the exposed conductive surface on the housing, to mains earth.

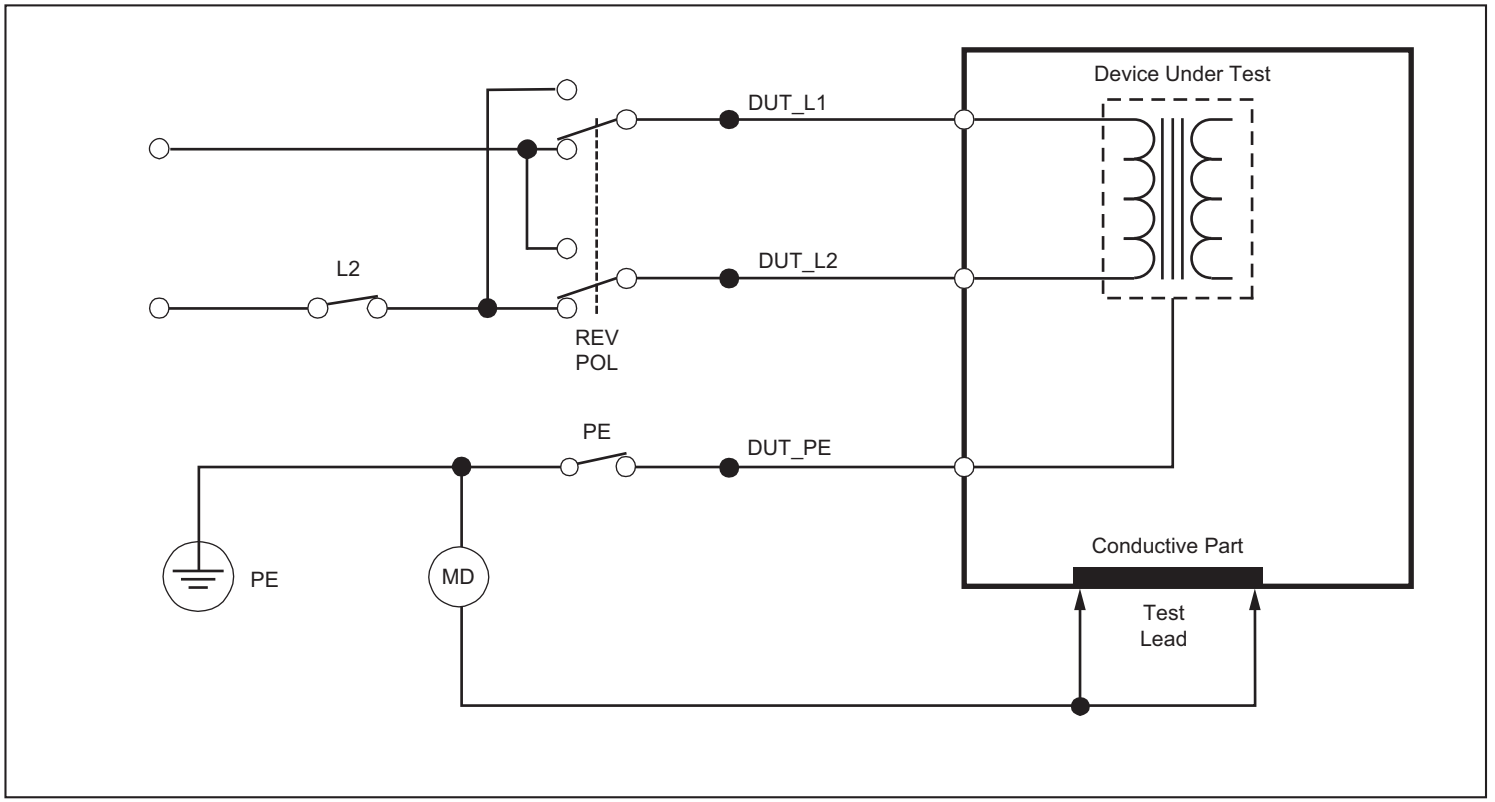
To perform a direct-equipment test, press [μA].

The direct-equipment test is the default test and should already be selected.

Figure 12 shows the electrical connections between the Analyzer and the DUT during a Direct-Equipment Leakage Current Test.

The following outlet conditions apply when performing this test:

- Normal Polarity, Closed Earth
- Normal Polarity, Open Earth
- Reversed Polarity, Closed Earth
- Reversed Polarity, Open Earth



hpf24.eps

Figure 12. Direct-Equipment Leakage Test Schematic

Making Point-To-Point Measurements

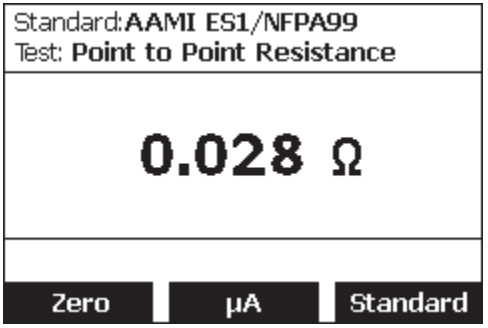
The Analyzer can make resistance and low current measurements through its Point-to-Point function. To access the Point-to-Point menu press [POINT TO POINT]. Use the softkeys F1 through F3 to select the measurement function.

Measuring Resistance

To make a resistance measurement:

1. Press the softkey labeled **Resistance** from the Point-To-Point menu.
2. Insert test leads in the red (Ω/A) and black jacks.
3. Null lead resistance by shorting the leads together and pressing the softkey labeled **Zero**.
4. Place the probes across the unknown resistance and read the measurement in the Analyzer's display.

The Analyzer will measure resistances up to 20.0 Ω. Figure 13 is an example of the Resistance Test.



fis118.bmp

Figure 13. Point-to-Point Resistance Test

Measuring Leakage Current

The Analyzer can make true rms measurements up to 2 mA. To make a current measurement:

1. Press the softkey labeled **Leakage** from the Point-To-Point menu.
2. Insert test leads in the red (Ω/A) and black jacks.
3. Place the leads on the two points the unknown current may flow and read the measurement in the Analyzer's display.

Maintenance

The Analyzer needs little maintenance or special care. However, treat it as a calibrated measuring instrument. Avoid dropping or other mechanical abuse that could cause a shift in the calibrated settings.

⚠⚠ Warning

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

- **Remove the mains power cord. Stop for two minutes to let the power assemblies discharge before you open the fuse door.**
- **Replace a blown fuse with exact replacement only for continued protection against arc flash.**
- **Do not operate the Product with covers removed or the case open. Hazardous voltage exposure is possible.**
- **Disconnect the mains power cord before you remove the Product covers.**
- **Remove the input signals before you clean the Product.**
- **Use only specified replacement parts.**
- **Use only specified replacement fuses.**
- **Have an approved technician repair the Product.**

Testing and Replacing the Fuses

For electrical protection of the equipment outlet, the Analyzer uses one fuse in the live (L1) line and one fuse in the neutral (L2) line.

To test the fuses, do the following while referring to Figure 14:

1. Remove the holster.
2. Remove the fuse door from the Analyzer by removing the screw holding the fuse door with a #2 Phillips head screwdriver and lifting the fuse door from the Analyzer.
3. Remove the fuses from the Analyzer.
4. Using a multimeter, measure the continuity of each fuse.

   If one or both fuses do not show continuity, replace the fuse(s) with fuses that have the same current and voltage rating. Appropriate fuse ratings are posted on the case bottom label of the Analyzer. Table 6 lists available fuses with Fluke Biomedical part numbers.
5. Reinstall the fuse door and secure it with the screw.

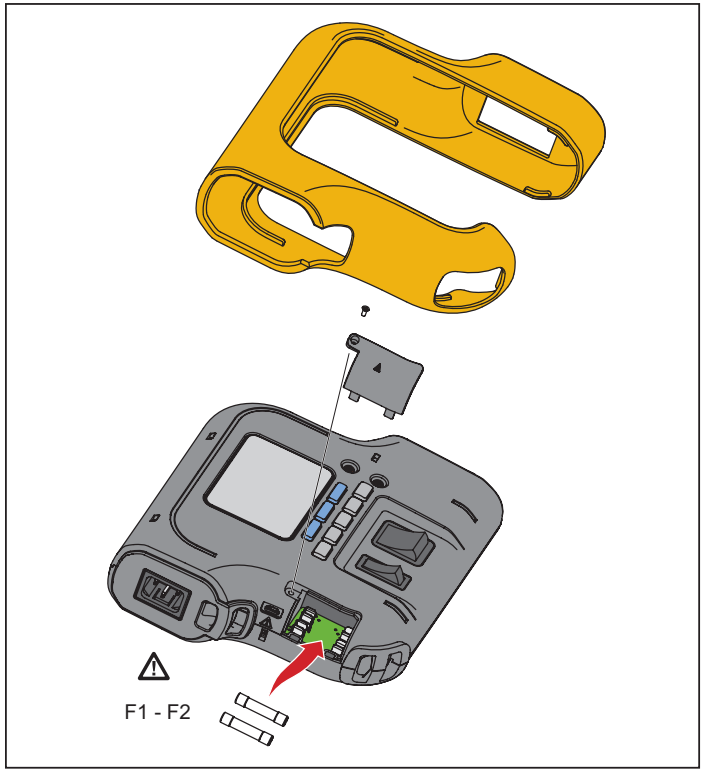


Figure 14. Fuse Access

Cleaning the Analyzer

⚠⚠ Warning

To avoid electric shock, do not clean the Analyzer plugged into mains or attached to a DUT.

⚠ Caution

Do not pour fluid onto the Analyzer surface; fluid seepage into the electrical circuitry may cause the Analyzer to fail.

⚠ Caution

Do not use spray cleaners on the Analyzer; such action may force cleaning fluid into the Analyzer and damage electronic components.

Clean the Analyzer occasionally utilizing a damp cloth and mild detergent. Take care to prevent the entrance of liquids.

Wipe down the adapter cables with the same care. Inspect them for damage to and deterioration of the insulation. Check the connections for integrity before each use.

Replaceable Parts

Table 6 lists the replaceable parts for the Analyzer.

Table 6. Replaceable Parts

Item		Fluke Biomedical Part Number
ESA609 Safety Sheet		4370092
ESA609 Users Manual CD		4370089
Power Cord	USA	2238680
	UK	2238596
	Australia	2238603
	Europe	2238615
	France/Belgium	2238615
	Thailand	2238644
	Israel	2434122
	Switzerland	3379149
Null Post Adapter		3326842
Carrying Case		2248650
Handstrap		4375466

Table 6. Replaceable Parts (cont.)

Item			Fluke Biomedical Part Number
Fuse	USA	⚠T20 A 250 V Fuse (Time Lag), 1¼ in x ¼ in	2183691
	Australia, Switzerland	⚠T10 A 250 V Fuse (Time Lag), 1¼ in x ¼ in	109298
	Europe, UK, Thailand, France/Belgium, Israel	⚠T16 A 250 V Fuse (Time Lag), 6.3 mm x 32 mm	3321245
ESA USA/AUS/ISR Accessory Kit: Test Lead Set TP1 Test Probe Set AC285 Alligator Clip Set			3111008
ESA EUR Accessory Kit: Test Lead Set TP74 Test Probe Set AC285 Alligator Clip Set			3111024
⚠ To ensure safety, use exact replacement only.			

Accessories

Table 7 lists the available accessories for the Analyzer.

Table 7. Accessories

Item	Fluke Biomedical Part Number
Test Leads with Retractable Sheath	1903307
Ground Pin Adapters	2392639
15 A – 20 A Adapter	2195732

Specifications

Temperature

Operating	0 °C to 50 °C (32 °F to 122 °F)
Storage	-20 °C to 60 °C (-4 °F to 140 °F)
Humidity	10 % to 90 % non-condensing
Altitude	
120 V ac mains supply voltage	5000 m
230 V ac mains supply voltage	2000 m
Display	LCD display
Modes of Operation	Manual
Power	
115 Volt power outlet	90 V ac rms to 132 V ac rms, 47 Hz to 63 Hz, 20 A maximum
230 Volt power outlet	180 V ac rms to 264 V ac rms, 47 Hz to 63 Hz, 16 A maximum
Power input	115 V 20 A - 2.6 kVA and 230V at 16 A - 4.2 kVA
Weight	0.7 kg (1.5 lb)
Size	22.9 cm x 17.8 cm x 6.4 cm (9 in x 7 in x 2.5 in)
Safety	IEC 61010-1: Overvoltage Category II, Measurement 300V CAT II, Pollution Degree 2
Electromagnetic Environment	IEC 61326-1: Portable
Emissions Classification	IEC CISPR 11: Group 1, Class A.
	Group 1 have intentionally generated and/or use conductively coupled radio-frequency energy which is necessary for the internal functioning of the equipment itself. Class A equipment is suitable for use in non-domestic locations and/or directly connected to a low-voltage power supply network.
Electromagnetic Compatibility	Applies to use in Korea only. Class A Equipment (Industrial Broadcasting & Communication Equipment) [1]
	[1] This product meets requirements for industrial (Class A) electromagnetic wave equipment and the seller or user should take notice of it. This equipment is intended for use in business environments and is not to be used in homes.
Agency approvals	CE, CSA, Australia RCM

Detailed Specifications

Test Standard Selections ..... ANSI/AAMI ES-1/NFPA99, IEC 62353, and IEC 60601-1

Mains Voltage Measurement

Range ..... 90.0 V ac rms to 264.0 V ac rms

Accuracy ..... ±(2 % of reading + 0.2 V)

Earth Resistance

Modes ..... Two wire

Test Current ..... >200 mA dc

Range ..... 0.000 Ω to 20.000 Ω

Accuracy ..... ±(1 % of reading + 0.010 Ω)

Equipment Current

Range ..... 0.0 A ac rms to 20.0 A ac rms

Accuracy ..... ±(5 % of reading + (2 counts or 0.2 A, whichever is greater))

Duty cycle ..... 15 A to 20 A, 5 min. on/5 min. off
10 A to 15 A, 7 min. on/3 min. off
0 A to 10 A, continuous

Leakage Current

Modes ..... True-rms

Patient Load Selection ..... AAMI ES1-1993 Fig. 1
IEC 60601: Fig. 15

Crest factor ..... ≤3

Ranges ..... 0.0 µA to 1999.9 µA

Accuracy

DC to 1 kHz ..... ±(1 % of reading + (1 µA, whichever is greater))

1 kHz to 100 kHz ..... ±(2.5 % of reading + (1 µA, whichever is greater))

100 kHz to 1 MHz ..... ±(5 % of reading + (1 µA, whichever is greater))