

# INSTRUCTION MANUAL

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## LKG 610

**Electrical Safety Analyzer**

**With 10 ECG Connectors**

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110 Toledo Street • Farmingdale, NY 11735 • USA

Homepage: [www.netech.org](http://www.netech.org)

*Dear User,*

*We appreciate your purchase of the LKG 610 Electrical Safety Analyzer. Properly used, the LKG 610 will deliver years of high performance and accuracy.*

*This instruction manual has been designed as a tool to assist you in getting the most from your LKG 610. In order to properly use and to maintain this instrument, please read the manual carefully.*

*Netech is recognized as an innovative designer and manufacturer of advanced biomedical and industrial test instruments. We are ISO 9001-2000 registered and fully committed to a continual improvement process. Further, we guarantee absolute satisfaction with our products.*

*Your business is important to us and we are dedicated to providing you with the best customer and technical service possible. Please contact us should you have any questions or concerns regarding your instrument.*

*We hope you will consider us again when you have a requirement for accurate, reliable, affordable test instruments.*

*Sincerely,*

**NETECH CORPORATION**

## Copyright

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## Quality Assurance

Netech Corporation is ISO 9001-2000 registered. This instrument was thoroughly tested and inspected according to Netech's ISO 9001-2000 quality standards (ISO/IEC 17025) and test procedures, and was found to meet those specifications when it was shipped from the factory.

## Warranty

Netech warrants the LKG 610 against defects in materials and workmanship for one year from the date of original purchase. ***The standard warranty is extended for a second year if the instrument is returned to Netech for its recommended yearly re-calibration.***

During the warranty period, we will repair or, at our option, replace at no charge a product that proves to be defective, provided you return the product shipping prepaid to Netech Corporation. This warranty does not apply if the product has been damaged by accident or misuse, or as the result of service or modification by other than Netech Corporation, or if its serial number is defaced or removed.

Netech reserves the right to discontinue the LKG 610 at any time, and change its specifications, price, or design without notice and without incurring any obligation. Netech guarantees availability of service parts for 5 years after the manufacture of the unit is discontinued.

The warranty is void if you elect to have the unit serviced and / or calibrated by someone other than Netech.

The purchaser assumes all liability for any damages or bodily injury that may result from the use or misuse of the unit by the purchaser, his employees, agents or customers.

***In no event shall Netech Corporation be liable for consequential damages***

## **Trademarks**

Netech and LKG 610 are trademarks of Netech Corporation. Any other trademark names used in this manual are only for editorial purposes and the benefit of the respective trademark owner, with no intention of improperly using that trademark.

# Safety Considerations

## General

Before using the LKG 610 read the instruction manual and become familiar with all of the functions and controls.

## Safety Symbols

### **WARNING**

The “**WARNING**” sign denotes a hazard. It calls attention to a procedure, practice or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a “**WARNING**” sign until the indicated conditions are fully understood and met.

### **CAUTION**

The “**CAUTION**” sign denotes a hazard. It calls attention to a procedure, practice or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the instrument. Do not proceed beyond a “**CAUTION**” sign until the indicated conditions are fully understood and met.



The symbol to the left is the operator's manual symbol. When you see this symbol on the instrument, refer to the operator's manual.

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## GENERAL DESCRIPTION

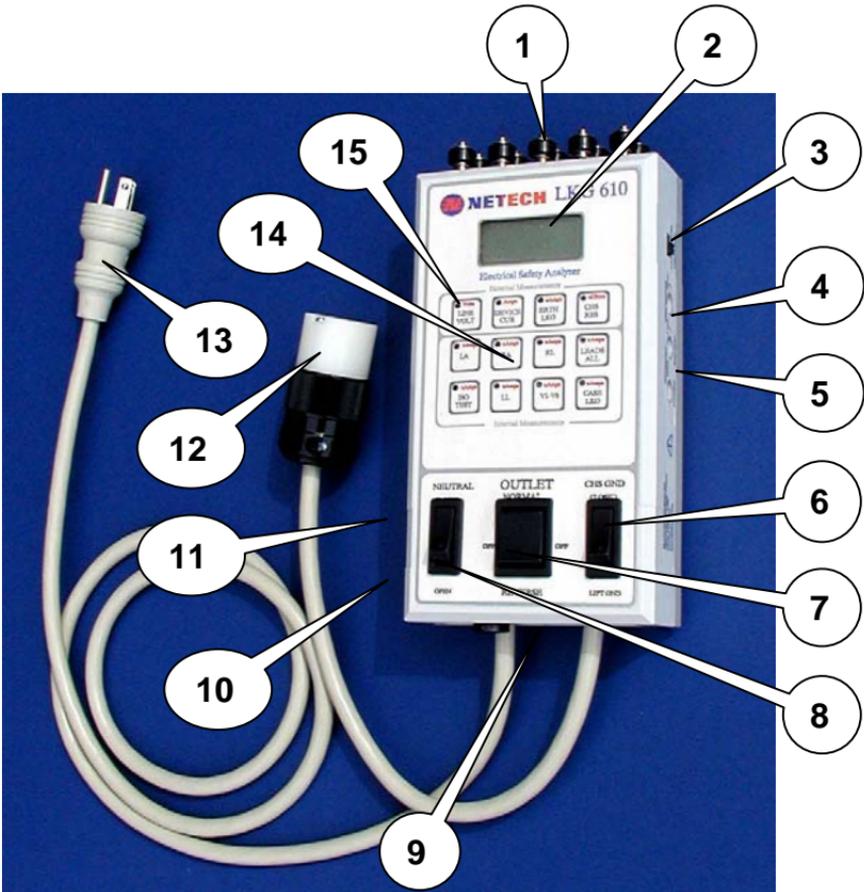
The LKG 610 is a compact Electrical Safety Analyzer designed to evaluate the electrical safety of all electrical equipment including medical devices and physiological Instrumentation.

The LKG 610 measures line voltage, outlet polarity, device current, earth leakage, chassis resistance, leads leakage, case leakage, and performs lead ISO tests and point to point measurements.

Each measurement is quickly and easily performed when its function key is pressed. The function selected and the unit of measure is indicated by an individual LED. Either the AAMI ESI -1993 or the IEC 601-1 test load may be selected.

Resistance measurements are made using the included model 503 single conductor test lead. A unique feature of the LKG 610 is its ability to verify the test readings with calibrated outputs of 200  $\mu$  Amps and 1 Ohm.

The comprehensive LKG 610 provides the best combination of features, performance, and value in a portable electrical safety analyzer.



**Figure 1**  
*Front view of the LKG 610*

## CONTROLS AND INDICATORS

1. **ECG CONNECTORS:** Universal connectors to connect ECG snaps or various sized posts.
2. **DISPLAY:** A 3.5 digit LCD presents the result of the selected test measurement.
3. **LOAD SELECTOR SWITCH:** Slide switch selects the AAMI or the IEC 601-1 test load.
4. **TEST JACKS:** Calibrated outputs are provided for resistance (1 Ohm) and leakage current (200  $\mu$ A).
5. **CHASSIS INPUT:** Connection for the 503 test cable.
6. **GROUND SWITCH:** Momentarily opens the ground connection to the test receptacle.
7. **POLARITY SWITCH:** Three-position switch selects Normal and Reverse polarity of the test receptacle and turns power Off.
8. **NEUTRAL SWITCH:** Momentarily opens the neutral line to the test receptacle.
9. **FUSE:** 20 Ampere fuse for 110 VAC model, 10 Ampere fuse for 230 VAC model.
10. **Serial Port:** Optional RS 232 Serial Port.

- 11. ZERO ADJUSTMENT:** Recessed adjustment to zero any test cable resistance variations.
- 12. TEST RECEPTACLE:** 20 Amp hospital grade receptacle for the Device Under Test.
- 13. POWER CORD:** Power cord and hospital grade plug.
- 14. KEY PAD:** Twelve push button function keys to select the test measurement.
- 15. LEDS:** An LED in the corner of each function key indicates the selected test mode and the unit of measurement displayed.

## PREPARATION FOR USE

The LKG 610 includes a test lead, part # 503, for measuring Cord Resistance and Case Leakage. Connect the LKG 610 to a 110 VAC outlet (or 220 VAC outlet for the 220 Volt Model).

Before proceeding with any measurement become familiar with the measurements and the function selector keys.

During the initial setup the last digit of the LCD will change gradually due to the time constant of the RMS to DC converter. The display will stabilize to zero in a few seconds.

### **CAUTION**

Make sure that the power requirements of the Device Under Test are within the power ratings of the LKG 610, 20 amps at 110 volts and 10 amps at 230 volts.

### **CAUTION**

***Do not leave the Device Under Test continuously turned on and connected to the LKG 610.***

### **CAUTION**

***Do not attempt to open the LKG 610. There are no user serviceable parts inside. Further, the warranty will be void if the unit is opened by anybody other than Netech trained personnel.***

## **OPERATING INSTRUCTIONS**

### **1. LINE VOLTAGE MEASUREMENT:**

The default measurement setting is line voltage (LINE VOLT). When the LKG 610 is plugged into an AC outlet, the LCD will display the measured line voltage in Volts. If the outlet polarity is reversed the display will indicate '- POL' and line voltage will not be displayed.

### **2. DEVICE CURRENT MEASUREMENT:**

Plug the Device Under Test (DUT) into the test receptacle. Set the polarity switch to normal. Press the "DEVICE CUR" key. Turn the Device Under Test (DUT) On. The display will present the Device Current in Amps.

### **3. EARTH LEAKAGE CURRENT MEASUREMENT:**

Press the "EARTH LKG" key. See Figure 2. The Earth Leakage (Ground Leakage) Current is measured through the ground conductor of the Device Under Test. This is only applicable to devices with a three-conductor power cord. The leakage measurement is made internally when the CHS GND switch is momentarily pushed to the LIFT GRND position. The display will present the measurement in  $\mu$ Amps. No other connection is required.

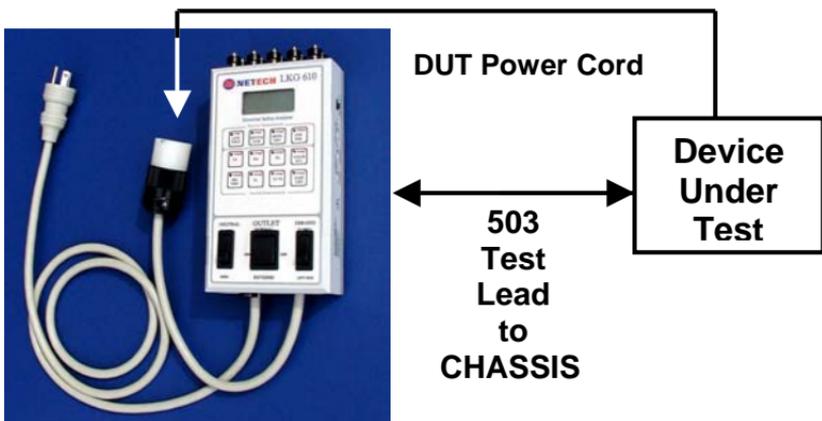
Both Earth and Case Leakage Current measurements should be made in all power switch combinations: the Polarity Switch in Normal, Reverse, and Off; and with the Neutral Switch Open and Closed.

## **CAUTION**

***When switching from Normal to Reverse or vice versa, make sure to pause the rocker switch in the OFF position (middle). Power to the outlet will be OFF in the open neutral position.***

### **4. CHASSIS RESISTANCE MEASUREMENT:**

See Figure 2. Set the Polarity Switch to the OFF (center) position. Press the key marked “CHS RES”. Plug the DUT into the test receptacle. Using the 503 test lead, connect the chassis of the DUT to the CHASSIS jack on the LKG 610. The display will present the Cord Resistance in milliOhms.



**Figure 2: Block Diagram of Cord Resistance Measurement and Case Leakage Measurement.**

## 5. LEADS LEAKAGE MEASUREMENT:

Leakage current of ECG leads may be measured individually or combined. To measure the leakage press the appropriate function key LA, RA, RL, LEADS ALL, LL, or V1-V6. The display will present the selected test measurement result in  $\mu\text{Amps}$ .

## 6. LEADS ISOLATION TEST:

### **WARNING:**

***Since the test method injects potentially hazardous current levels into the ECG and related power system, do not conduct tests in an occupied patient location or while the patient is connected to a related power system branch.***

### **CAUTION:**

***During Isolation leakage measurements the LKG 610 introduces line voltage into the patient leads. Even though it is current limited to 1milliAmp, it is potentially lethal.***

Plug the ECG device into the LKG 610. Connect the ECG leads. Press the "ISO TEST" key. The isolation leakage will be presented on the display in  $\mu\text{Amps}$ .

After 30 seconds the LED will begin flashing to indicate that the applied isolation voltage

has been removed. The previous leakage measurement will be displayed. To perform another ISO test press the “ISO TEST” key again.

## **7. CASE LEAKAGE CURRENT:**

The Case Leakage Current is measured through the test lead cable. Connect the test Lead to the case of the DUT(Device under test). The leakage measurement is made when the CHS GND switch is momentarily switched to the LIFT GRND position. The display will present the measurement in Micro Amps. No other connection is required.

To measure the Case Leakage of devices with plastic enclosures, wrap aluminum foil around the case of the DUT and connect the test lead to the foil.

## **8. POINT TO POINT TESTING:**

Use two 503 test leads plugged into the “REF GND” and “CHASSIS” EXTERNAL INPUT jacks. Push the CASE LKG key. The display will present the measurement in microAmps.

**Note: “OL” displayed in any measurement function indicates an over range condition.**

## PERFORMANCE CHECK

The following tests will confirm that the LKG 610 is performing properly.

1. Connect the LKG 610 to a 110 VAC outlet (220 VAC for the LKG 610-220). The power on default function is "Line Volt". The LCD display will present the line voltage in Volts. If the outlet polarity is reversed the LCD will indicate '- POL'.
2. The Test Lead resistance is offset internally and adjusted at the factory. The Test Lead resistance can be checked by connecting the Test Lead between the receptacle ground and the case ground (CHASSIS). When the CHS GND switch is momentarily pressed, the connection will be open and the display will read zero.

***A test lead other than the 503 may require adjustment with the zero adjustment control.***

3. Connect the Test Lead to the REF GND jack. Press the switch "CHS RES". The display will read 1000 milliOhms  $\pm$  5% (1 Ohm).
4. Connect the Test Lead to the TEST POINTS marked 200  $\mu$ A. Press the "EARTH LKG" key. The display will read 200  $\mu$ A  $\pm$  2%.

## **MAINTENANCE**

The LKG 610 requires minimum maintenance.

Periodically check the inlet plug, outlet receptacle, and wiring for any damage, wear, cracks, cuts, or other defects. Also check the case for any damage or cracks.

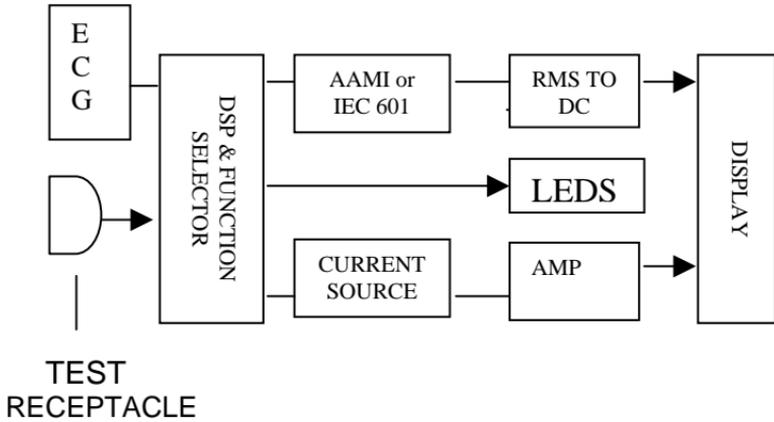
In order to ensure accuracy, the LKG 610 should be checked periodically. A calibrated output is provided at the TEST JACK for both Case Leakage and Cord Resistance functions.

When making a resistance measurement with a Test Cable other than the one supplied with the LKG 610, the user can zero the leads with the zero adjustment potentiometer. This will not affect the internal calibration of the unit.

Annual calibration is recommended. If the LKG 610 is returned to Netech for recalibration before the first year warranty expires, Netech will provide a second year warranty. The warranty is void if the LKG 610 is serviced by anyone other than Netech or if the warranty seal is broken.

## THEORY OF OPERATION

The LKG 610 circuitry can be divided into main functional blocks as shown in Figure 3. Each performs a key role in the operation of the instrument.



**Figure 3**

*Functional block diagram of the LKG 610.*

## BLOCK DIAGRAM DESCRIPTION

**Test Load:** The input test load is user selectable to AAMI ESI –1993 or to IEC 601.

**RMS Converter and Amplifier:** The input amplifier buffers the input. The RMS converter generates a DC voltage equal to the RMS value at its input. The gain Amplifier sets the gain for the measurements. When leakage current measurement is selected by the MODE switch, the AAMI LOAD is connected in front of the

INPUT AMPLIFIER, and the voltage developed across it from the leakage current is measured.

**Current Source and Amplifier:** Resistance is measured by connecting the current source to the resistance to be measured and measuring the voltage with the input amplifier.

**Test Receptacle:** This supplies power to the unit under test, 110 VAC rated at 15 Amps (220 VAC). The rocker polarity switch selects NORMAL, OFF and REVERSE polarity in the test receptacle.

**Display:** All measurements are presented on a 3-1/2 digit LCD display. Over range is indicated by showing a 1 in the most significant digit.

## SPECIFICATIONS

**METER:** 3-1/2 Digit LED display.

### LEAKAGE CURRENT:

Current measurements are made through the AAMI/ANSI ES1-1985 or IEC 601-1 test load. Meter readings correspond to the true RMS value of the current.

**Range:** 0 to 1999 microAmps

**Accuracy:** DC to 1 KHz: 1% FS  $\pm$  1 LSD

1 KHz to 100 KHz:  $\pm$  2.5% FS  $\pm$  1 LSD

100 KHz to 1 MHz:  $\pm$  4% FS  $\pm$  1 LSD

### RESISTANCE:

**Range:** 0 TO 1999 MilliOhms.

**Accuracy:**  $\pm$  1 % Full Scale  $\pm$  1 LSD

### DEVICE CURRENT:

**Range:** 0 to 19.99 Amps

**Accuracy:**  $\pm$  2% Full Scale  $\pm$  1 LSD

### LINE VOLTAGE:

**Range:** 1 to 300 Volts

**Accuracy:**  $\pm$  2% + 1 Volt

### TEST RECEPTACLE:

Hospital Grade 110 VAC -20 Amp or 220 VAC 10 Amp.

The rocker polarity switch selects NORMAL, OFF and REVERSE Polarity to the test receptacle, and a momentary Neutral switch will open the neutral line to the test receptacle.

**POWER REQUIREMENTS:**

110 VAC 50-60Hz, 20 Amps (535 Model)

220 VAC, 10 Amps (535-220 Model)

**PHYSICAL DIMENSIONS:**

Size: 8.0 X 4.5 X 2.0 inches

(20.3 X 11.4 X 5.0 cm)

Weight: 2.5 lbs (1.1 kg)

**ENVIRONMENTAL:**

Operating range: 59 to 95<sup>0</sup> F (15 to 35<sup>0</sup> C)

Storage Temperature: 0 to 122<sup>0</sup> F (-18 to 50<sup>0</sup> C)

Relative Humidity: 90% (max) at Temperatures

**STANDARD ACCESSORIES:****Description****Part Number**

User Manual

535-MANUAL

Test Cable

503

Soft Carrying Case

535-Case

## APPENDIX

## INSTRUCTIONS FOR RETURN

### **Damaged in Transit:**

All shipments are carefully examined by NETECH and carefully packaged for shipment. They are insured in the customer's name with the carrier. On receipt, if the shipping container appears to have been damaged during shipment, the instrument should be thoroughly inspected. The delivering carrier's paper should be signed noting the apparent damage. If the instrument is damaged beyond use, a new order should be placed with NETECH while awaiting reimbursement from the carrier for the damaged instruments.

### **Malfunction:**

Please follow these steps for the repair or recalibration of your NETECH instrument:

1. Obtain a Service /Repair Form from our website at

[www.electricalsafetyanalyzers.com](http://www.electricalsafetyanalyzers.com)

or from

Customer Service Department  
Phone: 631-531-0100  
Fax: 631-531-0101  
Toll Free: 800-547-6557

2. Complete the Service Form indicating the instrument's model number, serial number, shipping, and billing information. Include the

purchase order number or credit card information for the cost of the repair and/or recalibration.

3. Securely package your instrument in a strong box, surrounded by at least two inches of suitable shock absorbing material.

4. Include a copy of the purchase order, or reference your purchase order on your packing slip.

5. Include the completed Service Form.

6. Ship the instrument to the following address:

**NETECH CORPORATION  
110 TOLEDO STREET  
FARMINGDALE, NY 11735, USA  
ATTN: SERVICE DEPT.**

*Please visit our web site:  
[www.electricalsafetyanalyzers.com](http://www.electricalsafetyanalyzers.com) for the latest  
product updates and new product releases.*