



# LKG 601

## ELECTRICAL SAFETY ANALYZER

### INSTRUCTION MANUAL



**Netech Corporation**  
110 Toledo St, Farmingdale, NY 11735,  
<http://www.NetechCorp.us>  
<http://www.PressureMeter.com>

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## Warranty

Netech warrants the LKG 601 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 recalibration.

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. Only serialized products are covered under this warranty.

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 601 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 Corporation.

The warranty covering your product becomes void when the tamper-resistant Quality Seal is removed or broken without proper factory authorization.

We strongly recommend, therefore, that you send your instrument to Netech Corporation for factory service and calibration, especially during the original warranty period.

The purchaser assumes all liability for any damages or bodily injury, which 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

### **Warranty Registration**

Please register to receive special offers, free software updates, and more. Plus, you'll qualify for exclusive complimentary benefits that vary by region. Any failure to complete and submit this registration will not diminish your rights found in the limited warranty that accompanied your product at purchase.

## Notices

### Patents / Copyright

Copyright © 2012 by Netech Corporation. All rights reserved. No part of this publication may be reproduced or transmitted in any form other than for the purchaser's personal use without written permission from Netech Corporation.

### Trademarks

LKG 601 is 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.

## Quality Assurance

Netech is ISO 9001-2015 Certified. This instrument was thoroughly tested and inspected according to Netech's ISO 9001-2015 quality standards and test procedures are found to meet those specifications when it was shipped from the factory.

## Calibration

LKG 601 is calibrated using standards traceable to National Institute of Standards and Technology (NIST) and the unit is shipped with a calibration certificate.

## Safety Considerations

This manual contains operating and safety instructions for the safe operation and to maintain the equipment in a safe condition. The safety instructions are either warnings or cautions to protect the user and the equipment from injury or damage. Do not use this equipment for any other purpose than stated.

### 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 the entire instrument. Do not precede 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.

## Returns and Credits

Please note that only serialized products and their accessory items (i.e., products and items bearing a distinct serial number tag) are eligible for partial refund and/or credit. Non-serialized parts and accessory items (e.g., cables, carrying cases, auxiliary modules, etc.) are not eligible for return or refund. Only products returned within 60 days from the date of original purchase are eligible for refund/credit.

In order to receive a partial refund/credit of a product purchase price on a serialized product, the product must not have been damaged by the customer or by the carrier chosen by the customer to return the goods, and the product must be returned complete (meaning with all manuals, cables, accessories, etc.) and in “as new” and resalable condition.

Products not returned within 60 days of purchase, or products, which are not in “as new”, and resalable condition, are not eligible for credit return and will be returned to the customer. The Return Procedure (see below) must be followed to assure prompt refund / credit.

## Restocking Charges

Products returned within 30 days of original purchase are subject to a minimum restocking fee of 15 %. Products returned in excess of 30 days after purchase, but prior to 60 days, are subject to a minimum restocking fee of 20 %. Additional charges for damage and / or missing parts and accessories will be applied to all returns.

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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 Netech Corporation, we recommend using United Parcel Service, Federal Express, DHL or Air Parcel Post. We also recommend that you insure your shipment for its actual replacement cost. Netech Corporation 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.

## Returns for Refund / Credit

A Return Material Authorization (RMA) number must be obtained from our service or customer service dept, before a product is returned for refund or credit. The RMA number should be clearly marked on the package along with a statement indicating the reason for return.

## Repair and Calibration

Products returned for repair or recalibration must obtain a RMA (Return Material Authorization) from our service department after completing a service request form our website <http://netechcorp.us/RmaRequests/index> or contact:




Netech Corporation  
Service Dept.  
110 Toledo Street  
New York, 11735  
Email: [Service@NetechCorp.us](mailto:Service@NetechCorp.us)



## Models and Part Numbers

Part Number	Description
510-110	Electrical Safety Analyzer (110 V) with Hard case
510-220	Electrical Safety Analyzer (220 V) with Hard case
510-110-220	Electrical Safety Analyzer 110 V and 220V Operation with Hard Case

## Standard Accessories

Item	Description	Picture
503	Test Lead For Electrical Safety Analyzer	
535-CASE	Hard Carrying Case	
30250	Universal Plug Adapter NEMA 5 – 15P (Included with 510-110-220 unit)	
30255	Universal Plug Adapter NEMA 6 – 15P (Included with 510-110-220 unit)	

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## General Overview

### Introduction

The LKG 601 is a compact, low cost Electrical Safety Analyzer designed to evaluate the basic electrical safety of all electrical systems including medical devices and physiological instrumentation.

The LKG 601 measures Electrical Leakage Current, Power Cord Ground Resistance, and Device Current.

The LKG 601 is simple to operate. A three- position switch selects the test to be performed. The user may select either the AAMI ESI-1993 or the IEC 601-1 test load to compensate for high frequency components in the measurement.

Accurate resistance measurements are made via a simple method using a single conductor cable. No special cables are required. A calibrated output is provided through a test jack to verify the performance of the LKG 601.

### Key Features

- Compact
- Easy to Use
- Measures:
  - Device Current
  - Cord (Ground) Resistance
  - Ground Leakage Current
  - Case (Chassis) Leakage Current
- Test Jack for Calibrated Outputs
- True RMS Measurement
- AAMI or IEC 601 Test Load Selectors





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## Specifications

**Display:** 3-1/2 Digit LCD Display

**LEAKAGE CURRENT:** 0-1999 Micro Amps. All Current measurements are made through the AAMI/ANSI ES1-1985 or IEC 601-1 test load. The meter readings correspond to the true RMS value of the current.

**Accuracy:**  $\pm 1\%$  of reading,  $\pm 1$  LSD: DC to 1 KHz,  
 $\pm 2.5\%$  of reading  $\pm 1$  LSD  
1 KHz to 100 KHz,  
 $\pm 5\%$  of reading  $\pm 1$  LSD  
100 KHz to 1 MHz

**RESISTANCE:** 0 TO 1999 Milli Ohms.

**Accuracy:**  $\pm 1\%$  of reading  $\pm 1$  LSD

**DEVICE CURRENT:** 0 to 19.99 Amps

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

**TEST RECEPTACLE:** Hospital Grade 110 VAC -15 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, 15 Amps or 220 VAC, 10 Amps maximum rated for the test outlet and 0.1 Amp rated for the unit.

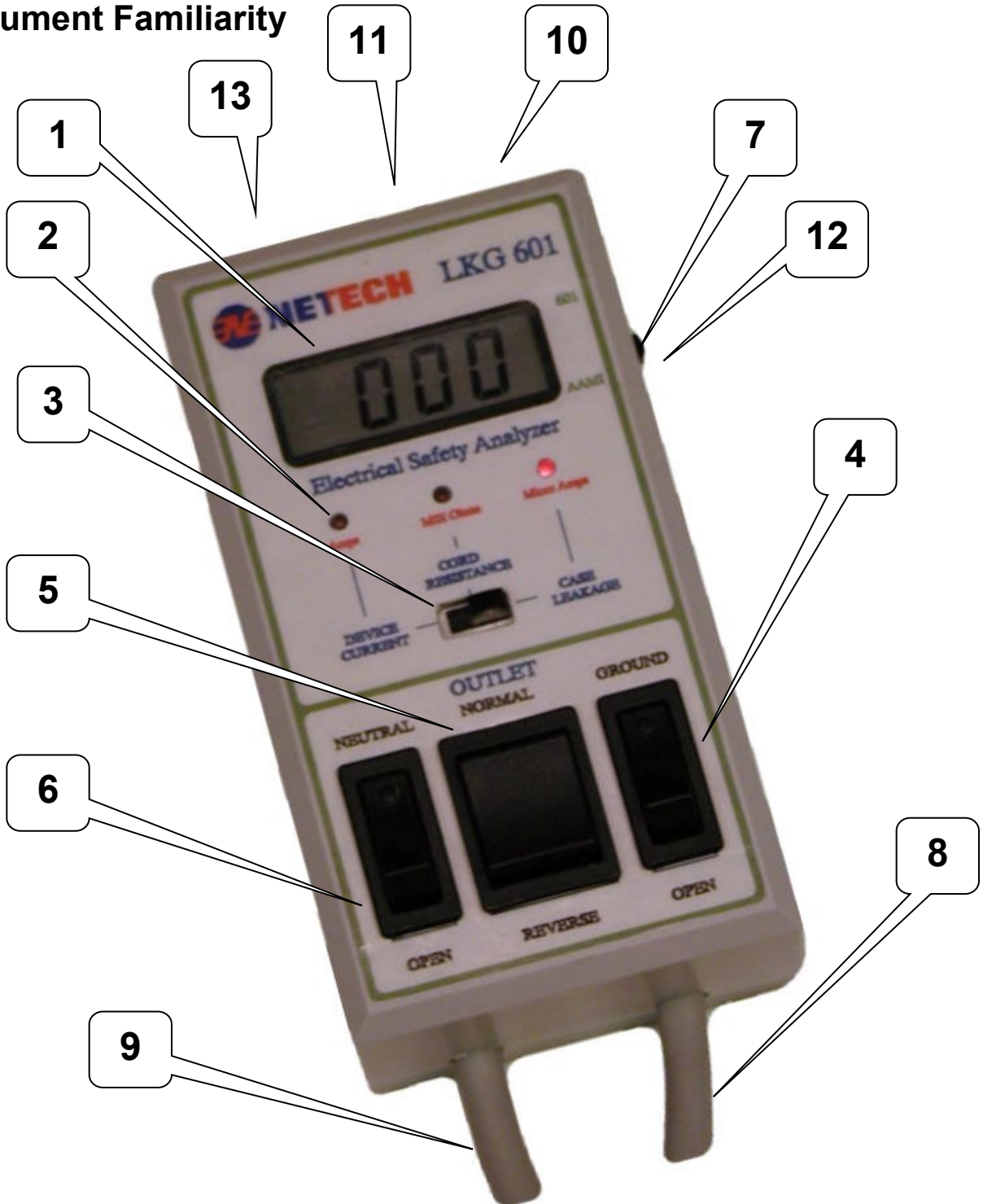
**PHYSICAL DIMENSIONS:** Size: 5.5x 3.25 x 2.5 Inches  
Weight: 1 lbs (.45kg)

**ENVIRONMENTAL:** Operating range: 59 to 950 F (15 to 400 C) Storage Temperature: 0 to 1220 F (-20 to 600 C) Relative Humidity: 90% (max) at temperatures

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Instrument Familiarity





## Controls & Indicators

Item	Name	Description
1	Display	A 3½ Digit LCD indicates the result of the measurement being made
2	LEDs	3 red LEDS indicate the selected test mode.
3	Mode Switch	Three-position slide switch to select the test measurement. A lit red LED indicates the selection.
4	Ground Switch	A switch to momentarily open the ground connection to the test receptacle
5	Polarity Switch	A three-position switch to select the normal and reverse polarity of the test receptacle. The center position shuts the power off to the test receptacle.
6	Neutral Switch	A switch to momentarily open the neutral line to the test receptacle.
7	Load Selector Switch	A slide switch on the right side of the instrument to select either the AAMI or the IEC 601-1 test load.
8	Test Receptacle	A 20 AMP power receptacle for the Device Under Test
9	Power Cord	The power cord supplies power to the analyzer and to the Device Under Test
10	Case Ground	A red jack is provided for connecting the test lead to the case (chassis) of the Device Under Test. The Cord Resistance and Case Leakage are measured using this cable
11	Test Jacks	A calibrated output is provided at the test jack for resistance and current functions. This performs a self-check of the LKG 601
12	Zero Adjustment	This recessed adjustment allows for the zeroing of the display to eliminate test cable resistance variations
13	Fuse	15 Ampere fuse is in an accessible fuse holder for 110 Volt model. The 230 Volt model uses a 10-Ampere fuse

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## Preparation for Use

The LKG 601 includes a test lead (PN: 503) for measuring Cord Resistance and Case Leakage. No other cables are required to perform measurements.

There are three models of LKG 601 available. Prior to using the device identify the Part number and the model purchased.

The following are the part numbers and the operational voltages.

1. PN: 510-110, for 110 Volt devices only.
2. PN: 510-220, for 220 Volt devices only.
3. 510-110-220 dual voltage operation.

*Please refer to the ADDENDUM for the preparation, setup and safe operation of the dual voltage LKG 601.*

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

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 601, 15 amps at 110 volts and 10 amps at 230 volts.**

**Do not leave the Device Under Test continuously turned on and connected to the LKG601.**

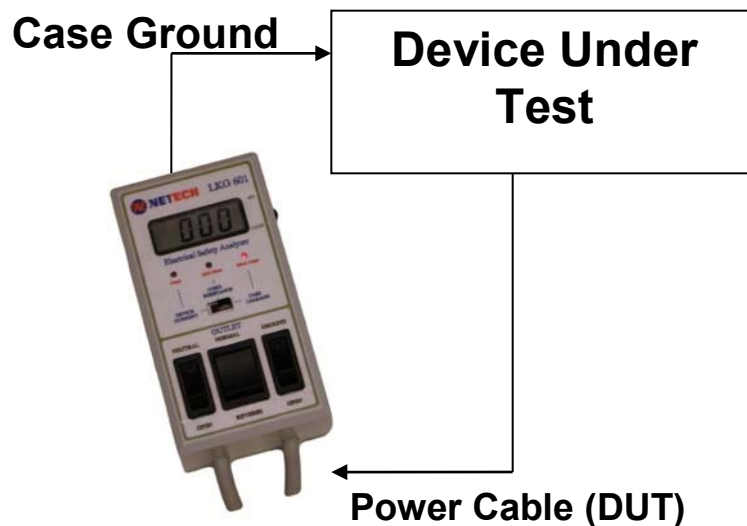
**Before testing 220 Volt devices make sure the LKG 601 is plugged to a 220 Volt outlet using the adapter and connect the 220 Volt device to the LKG 601 using the universal adapter supplied**

## Operating Instructions

### Cord Resistance Measurement:

See Figure 2.

- Set the polarity switch to the off (center) position.
- Move the MODE switch to CORD RESISTANCE. Plug the Device Under Test into the test outlet.
- Using the test lead provided, connect the chassis of the Device Under Test to the Case Ground jack on the LKG 601.
- The display will indicate the Power Cord Resistance in milliohms.



**Figure 2**  
*Block Diagram for Cord Resistance measurement and  
Case Leakage measurement (external)*

### Case Leakage Current Measurements:

Move the Mode switch to CASE LEAKAGE. See Figure 2.

The Earth Leakage (or 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 Ground switch is momentarily opened. The LCD will display the measurement in Micro Amps. There is no other connection required.

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

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 Ground switch is momentarily opened. The LCD will display the measurement in Micro Amps.

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

### CAUTION

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

### Device Current Measurements:

Move the Mode switch to DEVICE CURRENT. Set the polarity switch to normal. Turn the DUT On. The LCD will display the Device Current in Amps.

### CAUTION

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



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## Performance Check

1. Connect the LKG 601 to a live 110 VAC (or 220 VAC for the LKG 601-220) outlet. Display will turn on and read  $0 \pm 1$  when the Mode switch is in the Case Leakage position. In the CORD RESISTANCE position the display will show the numeral one (1) in the left position indicating that the cord circuit is open.
2. Move the Mode selector switch to all three positions and test the LED indication.
3. Check the continuity between receptacle ground and case ground using the test cable. If necessary adjust the display to zero. When the open ground switch is pressed down the connection will be open.
4. Connect the Test Lead to the TEST JACK
5. Move the selector switch to CORD RESISTANCE. The reading should be 1010 milliohms  $\pm 5\%$ .
6. Move the switch to CASE LEAKAGE. The display will indicate 200 Micro Amps  $\pm 2\%$ .

These tests will confirm that the LKG 601 is working properly.

## Theory of Operation

The LKG 601 circuitry can be divided into main functional blocks as shown in Figure 3. Each performs a key role in the operation of the instrument.

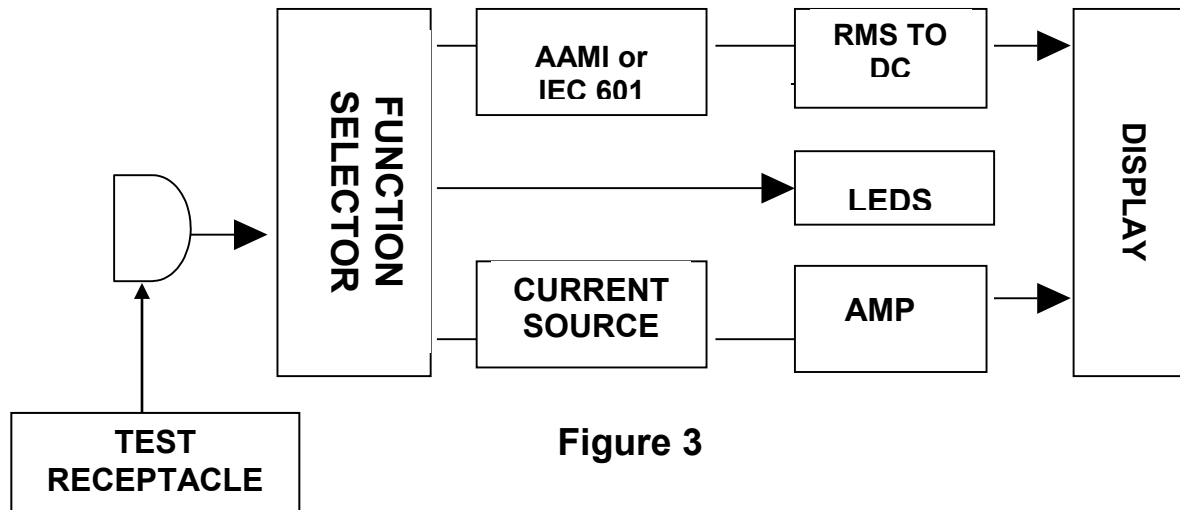


Figure 3

*Functional block diagram of the LKG 601*

## 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 the MODE switch selects leakage current measurement, 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 REVERSES polarity in the test receptacle.

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





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## Maintenance and Storage

### Maintenance

The LKG 601 requires only minimum maintenance.

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

In order to ensure the accuracy, it is recommended that the unit be checked periodically. A calibrated output is provided at the TEST JACK for Case Leakage and Cord Resistance functions. This feature is useful to check the integrity of the unit.

When making a resistance measurement with a Test Cable other than the one supplied with the LKG 601, the user can zero the leads by adjusting the zero adjustment potentiometer. This will not affect the internal calibration of the unit.

Annual calibration is recommended. If the LKG 601 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 601 is serviced by anyone other than Netech or if the warranty seal is broken.

### Calibration / Service

The mechanical assembly of LKG 601 contains no parts that can be serviced by the user. The unit should be returned to Netech Corporation for repair or calibration. The alignment and adjustment parameters are critical to the robust and efficient performance of the unit and can be performed only at the factory.

The unit is factory calibrated with NIST traceable standards and recommended to be calibrated once a year.

Netech maintains a complete repair and recalibration service at a very low cost and fast turnaround. Estimates for repair and recalibration are available upon request.

**LKG 601 contains NO USER SERVICEABLE PARTS and calibration/ service should be performed only by Netech.** Attempt to repair / service the unit outside Netech voids the warranty.

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## Returning the LKG 601 for Re-Calibration

Products returned to Netech for repair or recalibration requires a RMA (Return Authorization Number) for speedy processing of the service required.

To obtain a RMA number follow the link <http://www.NetechCorp.us> and fill in the required information, Email [service@netechcorp.us](mailto:service@netechcorp.us) or call 800-547-6557 (US & Canada), International 631-531-0100.

When shipping units to the factory enclose a copy of the RMA and the number should be on used as the reference in the shipping label.

**The shipment should be addressed to:-**

**Attn: Service Department  
Netech Corporation  
110 Toledo St.  
Farmingdale, New York 11735.**



LKG 601 (PN: 510-110-220) shown with the universal adapter for 220 Volt devices.

### CAUTION

**LKG 601 dual voltage model (PN: 510-110-220) designed for use in 110 Volt Ac powered equipments or 220 AC powered equipments.**

**For 220 volt devices make sure the device is 220 Volt AC and the wall outlet is 220 Volt.**

**Plug the 220 Volt adapters to the wall outlet and connect the 220 volt AC device in to the LKG 601 using the second adapter.**

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**Appendix**

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