

# INTRINSICALLY SAFE MICROOHMMETER

## MODEL R1L-E2A



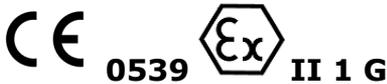
Instruction Manual  
PN# R1L-E2A-900-01  
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REV. G

### **An Agency Related Document:**

Those sections identified as controlled cannot be changed without approval of the Notified Body; however, other changes must be evaluated specifically for how it impacts any scheduled drawing or document.

## Markings and Warnings

(This section, Markings and Warnings, is controlled and may only be changed with approval of the Notified Body.)



Ex ia IIA T4 Ga  
 $-20C \leq Ta \leq +50C$   
 DEMKO 11 ATEX 1048757X  
 IECEX UL 11.0006X  
 Control Drawing 13742

Ground Indicator For Use in Hazardous Locations



Class I Zone 0, Group IIA  
 Class I Division 1, Group D

## SAFETY WARNINGS

This unit is intrinsically safe. **WARNING:** Substitution of components may impair intrinsic safety. See accompanying instruction manual for operating and maintenance instructions.

**WARNING:** Batteries are part of the intrinsically safe system. Use only the specific battery type and manufacturers listed in the user manual. Use of other batteries could impair intrinsic safety. Do not mix batteries of different manufactures. Do not mix fresh batteries with old batteries.

**WARNING:** To reduce the risk of ignition of a flammable or explosive atmosphere, batteries must be changed only in a location known to be non-hazardous.

**WARNING:** When operated in a potentially explosive atmosphere, this unit may not be used if capacitance, inductance or other circuitry is connected to the bond or structure under test.

**WARNING:** To prevent ignition of flammable or combustible atmospheres, read, understand and adhere to manufacturer's live maintenance procedures.

**WARNING:** Panel Bezel is a Light Metal alloy. Avoid risk of ignition caused by impact or friction sparks resulting from impact to or friction with the panel bezel by protecting the panel and bezel from impact and friction.

## **AVERTISSEMENTS DE SURETE**

Cette unité est intrinsèquement sûre. **AVERTISSEMENT:** la substitution des composants peut altérer la sûreté intrinsèque. Voyez le manuel d'instruction pour des instructions d'opération et d'entretien.

**AVERTISSEMENT:** Les piles font partie du système d'une sécurité inhérente. Employez seulement le type et les fabricants spécifiques de piles énumérés dans le manuel d'utilisation. L'utilisation d'autres piles a pu altérer la sûreté intrinsèque. Ne mélangez pas les types de pile. Ne pas mélanger des piles neuves avec des piles usagées

**AVERTISSEMENT:** Pour réduire le risque d'allumage d'une atmosphère inflammable ou explosive, les piles doivent être changées seulement dans une zone connue pour être non-dangereuse.

**AVERTISSEMENT:** Quand opérée dans une atmosphère potentiellement explosive, cette unité ne peut pas être utilisée si la capacitance, l'inductance ou les autres circuits sont connectés au lien ou à la structure sous l'essai.

**AVERTISSEMENT:** Pour empêcher l'allumage des atmosphères inflammables ou combustibles, lisez, comprenez et adhérez aux procédures d'entretien sous tension.

**AVERTISSEMENT :** La monture de panneau est un alliage léger en métal. Évitez le risque d'allumage provoqué par des étincelles d'impact ou de frottement en résultant de l'impact à ou du frottement avec la monture de panneau en protégeant le panneau et la monture contre l'impact et le frottement.

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## SECTION 1

### INSTRUMENT DESCRIPTION

#### 1.1 Introduction

The TEGAM Model R1L-E2A is an intrinsically safe portable bond meter/microohmmeter designed to measure low values of resistance, from 1  $\mu\Omega$  to 20  $\Omega$ . A four point measurement method is utilized in order to eliminate any errors caused by the resistance of the measuring leads. Two leads are used to pass a constant regulated current through the resistance under test, and two leads are used to measure the resulting voltage drop across the resistance under test. The R1L-E2A then uses Ohm's law to calculate the resistance and displays the value digitally on a liquid crystal display (LCD). The R1L-E2A cycles the current ON and OFF during the measurement. During the OFF state, thermal and offset voltages, occurring in the voltage measurement chain, are stored, and then used as a correction during the ON current time.

The current used for the measurement is well regulated to be constant over large changes in the unknown resistance and/or the resistance of the test leads. If the resistance under test becomes too high on a given range, the display shows a "1" followed by three blanks.

#### 1.2 Performance Characteristics

The R1L-E2A has five resistance ranges, with test current, resolution, and scale as shown below in Table 1.

Range	Full Scale ( $\Omega$ )	Resolution ( $\Omega$ )	Test Current Peak (A)
1	1.999 m	1 $\mu$	1.3
2	19.99 m	10 $\mu$	130 m
3	199.9 m	100 $\mu$	13 m
4	1.999	1 m	1.3 m
5	19.99	10 m	0.13 m

Table 1: Range Specifications

Accuracy: All ranges: 0.1% of reading  $\pm$  2 counts.

Accuracy may become degraded in the presence of significant levels of RF field. At a RF field strength of 3 V/m, accuracy is 1% of reading  $\pm$  2 counts for the four lowest ranges (1.999 m $\Omega$  full scale through 1.999  $\Omega$  full scale) and 2% of reading  $\pm$  2 counts on the 19.99  $\Omega$  full scale range.

Operating Temperature: -20 °C to +50 °C.

Relative humidity: 0 to 90%, non-condensing.

### 1.3 Description of Equipment

A rugged heavy-duty static-dissipative ABS/Polycarbonate plastic case is supplied to contain and protect the R1L-E2A. When closed, a gasket seals the lid to keep out water and dirt, while the R1L-E2A is transported through rain or other environmentally hostile conditions. When the lid is open, a second gasket provides additional, although reduced protection, for the front panel. The removable battery access cover also has a gasket. The front panel is aluminum with durable polycarbonate graphical overlay. The lid of the R1L-E2A case further serves as a storage area for the supplied pair of test probes and instruction manual.

**Dimensions** of the case are 17" W x 11.5" D x 7.1" H.

**Weight** is 18 pounds (including test probes, power cord, battery cells, and manual).

With the lid open for operation, the front panel and its controls are readily accessible. Controls and connectors may be operated while wearing safety gloves.

**Electrical:** Power is from three alkaline D-cells. Current drain depends on the measurement range selected, and battery capacity. Based on an average drain of 150 mA, and brand new D cells and a 25 °C ambient, the battery cells will typically give up to 80 hours of operation (with the backlight OFF). Increasing battery drain and decreasing temperature both result in decreased battery capacity. Extended use on the 2 m $\Omega$  range or with backlight on will reduce operating time dramatically. At low ambient in the 2 m $\Omega$  range, battery life

will be approximately three hours of continuous measurement for new cells. Continuous measurement is very unlikely, and high current is only drawn when test probes are connected and touching a low-resistance surface. It is expected that in most foreseeable conditions, one set of batteries will allow at least eight hours of normal intermittent testing activity.

**CAUTION**

**THIS INSTRUMENT IS TO BE OPERATED FROM BATTERY POWER ONLY. CONNECTION OF AN EXTERNAL SUPPLY WILL RESULT IN A HAZARDOUS CONDITION AND MAY DAMAGE THE R1L-E2A**

### **Front Panel Controls and Displays** (Refer to figure 1)

**POWER ON/OFF pushbutton** switch turns battery power ON and OFF for the R1L-E2A. It is protected by a ring to make accidental actuation more difficult.

The **RANGE switch** is used to select the desired resistance range for the resistance under test. There are five ranges marked 2 m $\Omega$ , 20 m $\Omega$ , 200 m $\Omega$ , 2  $\Omega$ , and 20  $\Omega$ . Note that although the ranges are marked "2" etc., the actual reading limit is 1.999 m $\Omega$ , etc. Resistance readings on any range exceeding 1999 (with appropriate decimal point) show as an "over-range" condition, indicated by a display of "1" followed by three blanks.

**BACKLIGHT pushbutton** is a momentary pushbutton switch which controls PC board circuitry to cycle through three states for the backlight. The default state is OFF, which occurs each time the R1L-E2A is powered up, regardless of previous history, and is indicated by the full black circle. Depressing the pushbutton once causes the backlight to cycle to its half-bright state indicated by the half-lighted circle. Depressing the switch a second time causes the backlight to cycle to its full-bright state, indicated by the non-filled circle. A third depression of the backlight switch will cycle the backlight to OFF.

**DISPLAY** is a 3½ digit LCD with decimal points, reading from 0.001 m $\Omega$  to 19.99  $\Omega$  full scale.

**LOW BATTERY** is indicated by "LOBAT" on the display, in addition to the resistance reading.

**Four binding posts** are provided for the connection of test probes. (Only HTP-101A or SKP-8 test probes may be used in an explosive atmosphere). The two binding posts labeled +I and -I supply a constant current to the resistance under test. The binding posts labeled +E and -E sense the voltage developed across the resistance under test. The binding posts are color coded to match the colors of the spade lug insulations on the supplied test probes.

### Test Probes

The Model R1L-E2A unit is shipped with one or both of the test probes: a pair of pistol-shaped test probes (HTP-101A) and/or a pair of Kelvin Probes (SKP-8). The probes are color coded; a red one for use with the left hand, and a white one for use with the right hand. Each probe is attached to an eight foot length of cable comprised of two 12 AWG insulated wires for the HTP-101A and 18 AWG insulated wires for the SKP-8. The ends of the probe cables terminate in spade lugs, which have color coded insulation corresponding to the colors of the front panel binding posts. The cable strain relief has a band with appropriate left or right identification.

Each test probe has two sharply-pointed spring-loaded conductors extending from the nose. One conductor of each probe is for current, and the other is for voltage.

When firmly pressed against a surface, the pointed conductors of the HTP-101A retract with a rotating motion, to help cut through non-conductive surface films. When not in use, the probes are meant to be stored in the lid of the R1L-E2A case.



## 1.4 List of Items Furnished

- 1 each Model R1L-E2A Microohmmeter.
  - 1 set of Alkaline Battery Cells Approved for R1L-E2A.
  - 1 each Instruction Manual.
- Depending on the configuration ordered:
- 1 set of Pistol-shaped Test Probes (HTP-101A) and/or
  - 1 set of Kelvin Probes (SKP-8).

## 1.5 Storage and Shipping Requirements

Storage Temperature: -40 °C to +71 °C.  
Relative humidity: 0 to 100%, non-condensing.

The Model R1L-E2A is a rugged instrument and requires no special covering, preservation, or special cradles. During shipment, packaging must provide sufficient resilient material in accordance with standard packaging practices to prevent excessive shock to the power supply and display.

## SECTION 2

### PREPARATION FOR USE AND INSTALLATION

#### 2.1 Unpacking and Inspection

Upon receipt, the R1L-E2A and its accessory kit should be carefully unpacked and removed from the shipping container. Separate the units from the packing material and inspect the instrument for any external damage.

- If any dents, broken, or loose parts are seen, do not use the equipment. Notify TEGAM immediately.
- Note that the instrument is shipped with its batteries removed. Unwrap the three D-cells which were shipped with the unit.

Release the two latches which secure the lid of the Model R1L-E2A Microohmmeter and open the lid. Since the lid is well gasketed, it may be difficult to open if there is an appreciable difference between external and internal air pressure. Check for the presence of two test probes stored in the cavity in the lid. If the test probes or instruction manual are not present, and the instrument is new, report this immediately to TEGAM.

#### 2.2 Operational Warnings and Considerations Prior to Use

(This section, Operational Warnings and Considerations Prior to Use, is controlled and may only be changed with approval of the Notified Body.)

##### 2.2.1 Batteries

Use only Alkaline or Manganese D Cells that have been proven by a Nationally Recognized Testing Laboratory to meet the requirements of UL60079-11, section 10.5.2. Use of any other battery will invalidate the Type certificate and will create a hazardous condition. The only batteries that TEGAM has secured such testing on, and which are approved for use in the

R1L-E2A are listed on the Type Certificate and are:

- Energizer E95

**WARNING**

**DO NOT INSTALL, CHANGE, OR REMOVE THE R1L-E2A BATTERY CELLS IN AN EXPLOSIVE ATMOSPHERE! A SPARK MIGHT BE GENERATED, WHICH COULD RESULT IN AN EXPLOSION.**

**WARNING**

**BATTERIES ARE PART OF THE INTRINSICALLY SAFE SYSTEM. USE ONLY RECOMMENDED BATTERIES. DO NOT MIX BATTERIES. USE OF ANY OTHER BATTERY OR MIXED BATTERIES MAY RESULT IN A HAZARDOUS CONDITION.**

### 2.2.2 Test Probes

Only HTP-101A or SKP-8 test probes or leads may be used in an explosive atmosphere.

**WARNING**

**USE ONLY HTP-101A OR SKP-8 TEST PROBES AND CABLE SETS WITH R1L-E2A IN POTENTIALLY HAZARDOUS ENVIRONMENTS. USE OF ANY OTHER COMBINATION OF PROBE AND CABLE INVALIDATES THE TYPE CERTIFICATION AND MAY RESULT IN A HAZARDOUS CONDITION.**

### 2.3 Preparation for Use

Note that the Model R1L-E2A is shipped with its battery cells removed. Three battery cells are shipped with each new unit.

- Loosen the six captive screws around the outside edge of the battery access panel using a Phillips No. 2 screwdriver, and remove the panel.
- Check for correct polarity and install the three D-cells in the battery holder. When installing the cells, rotate them slightly to ensure connection to the battery holder contacts. The cells are connected in series for a nominal voltage of 4.5 V.

- Use only Alkaline or Manganese D Cells that have been proven by a Nationally Recognized Testing Laboratory to meet the requirements of UL60079-11, section 10.5.2. Use of any other battery will invalidate the Type certificate and will create a hazardous condition. The only batteries that TEGAM has secured such testing on, and which are approved for use in the R1L-E2A are listed on the Type Certificate and are:
  - Energizer E95
- Reinstall the battery access panel and tighten the six captive screws to secure it.

If the test probes are to be used, connect their leads to the corresponding color-coded binding post on the R1L-E2A front panel, as shown in figure 2a and 2b. Only HTP-101A or SKP-8 test probes or leads may be used in an explosive atmosphere. Ensure they are properly connected for a four-wire measurement. For example, if measuring the value of a low value resistor, connect the +I and -I current leads to the ends of the resistor leads away from the resistor body. Connect the +E and -E leads between the current leads and the resistor body at the points between which the resistance value is to be determined, making sure the +E lead is on the same side of the resistor as the +I lead, and the -E lead is on the same side of the resistor as the -I lead.

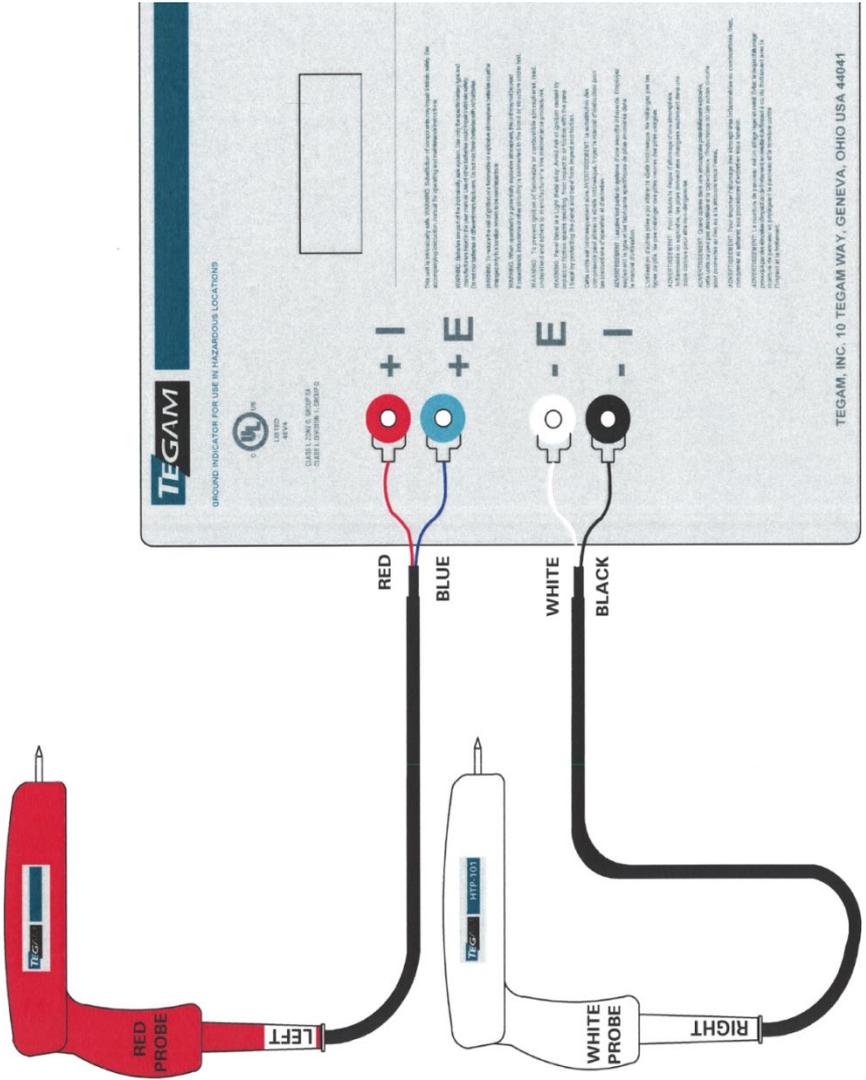


Figure 2a: HTP-101A Probe Connections



## SECTION 3

### OPERATING INSTRUCTIONS

The Model R1L-E2A Microohmmeter is designed for bench-top or field operation. If not already done, connect the two test probes, matching their spade lug insulation color to the corresponding binding post color on the R1L-E2A front panel. The red probe is for the left hand and the white probe for the right hand, as per their labels.

Depress the alternate action POWER ON/OFF switch button once to turn on power. The appearance of any character on the LCD indicates the presence of power.

Rotate the RANGE switch to the desired measurement range.

If operating in an area of low illumination, depress the BACKLIGHT switch. Depressing the BACKLIGHT switch once will turn the backlight on to half-bright; depressing the switch again, will turn the backlight on to maximum brightness, and depressing the switch a third time will turn the backlight OFF.

Whenever power to the R1L-E2A is turned OFF, the backlight will return to its default OFF condition. Also note that operation of the backlight will decrease battery life, hence it should not be left ON, when not required.

To make a measurement, pick up the two pistol shaped probes, with the left (red) one in the left hand and the right (white) one in the right hand (as shown in figure 2a). When using the SKP-8 Kelvin probes, hold the red probe in the left hand and the white probe in the right hand. Make sure that the label is facing inward as shown in the figure 2b. The pin near the label is the voltage (sense) pin. Press the conductive tips of the two probes firmly against the surface to be measured. The spring-loaded conductive pins will be pushed back, to help penetrate non-conductive surface coatings. In case of the HTP-101A probes, the pins will rotate as they retract.

The resistance reading will show up on the display. If the measurement is over-range, the display will read "1" followed by three blanks. In that case, turn the range switch to the next higher range.

When the battery voltage has fallen to a value near the end of its useful life, "LOBAT" will be seen on the display. The unit will not be damaged by further use, but this is a warning that readings may not be accurate, especially on the 2 m $\Omega$  range which uses a nominal 1.3 A test current. The battery cells should be replaced when "LOBAT" appears.

Depress the POWER ON/OFF switch to OFF, when through using the instrument, to avoid depleting the battery.

Disconnect the test probes and store them in the case lid with the instruction manual, upon completion of the measurement task.

## SECTION 4

### SERVICE INFORMATION

#### Preparation for Calibration or Repair Service

The R1L-E2A may only be repaired at TEGAM, Inc., as it is a labeled unit with requirements for intrinsic safety and use in an explosive atmosphere. As part of the process in meeting these requirements, the R1L-E2A internal printed circuit board has a conformal coating, a large area of hard encapsulation, and some areas of soft encapsulation. If a problem exists and repair is required, please contact TEGAM, Inc. for a return authorization number. You can contact TEGAM customer service via the TEGAM website, [www.tegam.com](http://www.tegam.com) or by calling 440.466.6100 (*All Locations*) OR 800.666.1010 (*United States Only*).

The RMA number is unique to your instrument and will help us identify your instrument and to address the particular service request by you which is assigned to that RMA number.

Of even greater importance, a detailed written description of the problem should be attached to the instrument. Many times repair turnaround is unnecessarily delayed due to a lack of repair instructions or of a detailed description of the problem. This description should include information such as measurement range, and other instrument settings, type of components being tested, are the symptoms intermittent?, conditions that may cause the symptoms, has anything changed since the last time the instrument was used?, etc. Any detailed information provided to our technicians will assist them in identifying and correcting the problem in the quickest possible manner. Use a copy of the Repair and Calibration Service form provided on the next page.

Once this information is prepared and sent with the instrument to our service department, we will do our part in making sure that you receive the best possible customer service and turnaround time possible.

#### **Expedite Repair & Calibration Form**

Use this form to provide additional repair information and service instructions. The Completion of this form and including it with your instrument will expedite the processing and repair process.

RMA#:		Instrument Model #:	
Serial Number:		Company:	
Technical Contact:		Phone Number:	
Additional Contact Info:			

**Repair Instructions:**

- Evaluation
- Calibration Only
- Repair Only
- Repair & Calibration
- Z540

**Detailed Symptoms:**

Include information such as measurement range, instrument settings, type of components being tested, is the problem intermittent? When is the problem most frequent?, has anything changed with the application since the last time the instrument was used?, etc.


## Warranty

TEGAM, Inc. warrants this product to be free from defects in material and workmanship for a period of one year from the date of shipment. During this warranty period, if a product proves to be defective, TEGAM Inc., at its option, will either repair the defective product without charge for parts and labor, or exchange any product that proves to be defective.

TEGAM, Inc. warrants the calibration of this product for a period of one year from date of shipment. During this period, TEGAM, Inc. will recalibrate any product, which does not conform to the published accuracy specifications.

In order to exercise this warranty, TEGAM, Inc., must be notified of the defective product before the expiration of the warranty period. The customer shall be responsible for packaging and shipping the product to the designated TEGAM service center with shipping charges prepaid. TEGAM Inc. shall pay for the return of the product to the customer if the shipment is to a location within the country in which the TEGAM service center is located. The customer shall be responsible for paying all shipping, duties, taxes, and additional costs if the product is transported to any other locations. Repaired products are warranted for the remaining balance of the original warranty, or 90 days, whichever period is longer.

## Warranty Limitations

The TEGAM, Inc. warranty does not apply to defects resulting from unauthorized modification or misuse of the product or any part. This warranty does not apply to fuses, batteries, or damage to the instrument caused by battery leakage.

The foregoing warranty of TEGAM is in lieu of all other warranties, expressed or implied. TEGAM specifically disclaims any implied warranties of merchantability or fitness for a particular purpose. In no event will TEGAM be liable for special or consequential damages. Purchaser's sole and exclusive remedy in the event any item fails to comply with the foregoing express warranty of TEGAM shall be to return the item to TEGAM; shipping charges prepaid and at the option of TEGAM obtain a replacement item or a refund of the purchase price.

## Statement of Calibration

This instrument has been inspected and tested in accordance with specifications published by TEGAM Inc. The accuracy and calibration of this instrument are traceable to the National Institute of Standards and Technology through equipment, which is calibrated at planned intervals by comparison to certified standards maintained in the laboratories of TEGAM Inc.

### Contact Information

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