

MICROOHMMETER AND BOND TESTER

MODEL R1L-B



Instruction Manual
PN# R1L-B-900-01
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REV. E

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NOTE: This User's Manual was as current as possible when this product was manufactured. However, products are constantly being updated and improved. To ensure you have the latest documentation, refer to www.tegam.com

10 TEGAM WAY • GENEVA, OHIO 44041 • 440-466-6100 • FAX 440-466-6110

• sales@tegam.com

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SECTION 1

INSTRUMENT DESCRIPTION

INTRODUCTION

1.1 Purpose

The Model R1L-B is a digital Microohmmeter / Bond Tester with full scale ranges from 2 m Ω to 20 Ω . The resistance reading is displayed on a 3½ digit liquid crystal display on the front panel. An over-range condition is indicated as a "1" followed by three blank digits (the decimal point is also displayed in its normal position for the range selected).

A rugged version, Model R1L-BR is also available, which is electronically identical to model R1L-B, but it has a rugged case as the enclosure rather than an open front panel.

1.2 Performance Characteristics

This is a range-selection instrument, with a rotary 5 range selector switch.

Range	Full Scale (Ω)	Resolution (Ω)	Test Current Peak (A)
1	1.999 m	1 μ	1.4
2	19.99 m	10 μ	140 m
3	199.9 m	100 μ	14 m
4	1.999	1 m	1.4 m
5	19.99	10 m	140 μ

Table 1: Specifications

Accuracy:

Accuracy on all ranges: \pm (0.25% of reading + 1 count), when powered from the batteries only.

1.3 Description of Equipment

Physical: The circuitry is enclosed in a rugged bench top case.

Dimensions: 101 mm (4") x 292 mm (11.5") x 203 mm (8"). Weight is 1.6 kg (3.6 lb). Controls and connectors are of a size and spacing such that the instrument may be operated while wearing safety gloves.

Electrical: The R1L-B is powered by an internal battery consisting of three rechargeable NiCad 'C' cells (3000 mAh) with a built-in charger. Input power for the charger is 90 to 250 VAC at 50 Hz or 60 Hz. Charging power is supplied via a removable line cord; one end of which plugs into a line filter on the front of the R1L-B, and the other end being a standard three-pin grounded line plug.

Input Protection: The R1L-B will not be damaged by a signal of 1 Vp-p applied across any pair of input terminals.

Environmental: This unit will operate over a temperature range from 0 °C to 50 °C, 75% RH non-condensing, up to 3050 m altitude.

Front Panel Controls and Displays (See figure 1)

RANGE Switch. The rotary 5 range selector switch may be used to step through all five ranges.

POWER Switch. Used to turn the power on or off to the instrument.

DISPLAY is a 3 ½ digit, displaying readings from 1.999 to 199.9.

Four binding posts for connection of test leads are marked +I, +E, -E, and -I. Proper connections to the resistor under test are described in Section 3.2 below.

WARNING
DO NOT TOUCH THE BINDING POSTS WHEN THEY ARE CONNECTED TO EXTERNAL CIRCUITS. LETHAL VOLTAGES MAY BE PRESENT AT THESE POSTS.

1.4 List of Items Furnished

- 1 each Model R1L-B with power cord
- 3 each rechargeable battery cells
- 2 each Kelvin Clip Cables, one end with a dual banana plug and the other end with a gold plated Kelvin clip
- 1 each R1L-B Instruction Manual

1.5 Storage and Shipping Requirements

Standard precautions which apply to electronic test instruments should be followed. A hard mechanical shock, such as from dropping the R1L-B, could damage the liquid crystal display. Care should be taken to prevent damage to associated cables.

The R1L-B should be stored in a relatively dust-free environment. Remove the battery cells for inactive storage of 30 days or more.

Temperature: -40 °C to +71 °C.

Relative humidity: 0 to 100%, non-condensing.

Altitude: 4570 m

See Section 5.7 below for shipping requirements.

SECTION 2

PREPARATION FOR USE AND INSTALLATION

2.1 Unpacking and Inspection

Upon receipt, the R1L-B and accessories should be carefully unpacked and removed from the shipping container. Separate the units from the packing material and inspect both the instrument and the accessories for any external damage.

- If any dents, broken, or loose parts are seen, do not use the equipment. Notify the shipping company immediately and follow their instructions as to how to proceed.
- Note that the instrument is shipped with its battery removed. Unwrap the 3 cells which comprise the battery.
- Check that all items are present. If any items are missing, notify the shipper if this is a new instrument. If not new, contact the previous user to locate the missing item(s).

2.2 Preparation for Use

Battery Installation

Be sure the power line cord is disconnected. Check that the Power Switch is in the OFF position. Remove the four screws at the corners of the R1L-B's top (control/display) panel. Carefully lift the unit out of its cabinet. Place the unit upside down on a surface which will not mar or damage the control/display panel.

WARNING

DO NOT CONNECT THE AC LINE CORD PRIOR TO REMOVING THE UNIT FROM ITS CASE OR WHILE THE UNIT IS OUT OF ITS CASE, OR ELSE THE MAINS VOLTAGE WILL PRESENT A POSSIBLE SHOCK HAZARD.

CAUTION

BE SURE TO OBSERVE THE PROPER POLARITY WHEN INSERTING THE BATTERY CELLS OR DAMAGE MAY RESULT.

Insert the battery cells, one at a time, in accordance with the polarity indications marked on both the battery cell and the battery holder. Insert the positive end of the battery cells first.

After installing the cells, reinstall the instrument in its case and secure the four corner screws.

Power Up

Plug the power cord into the R1L-B front panel receptacle, and plug the other end into a standard AC outlet. For battery operation (with charged battery cells), this step is omitted. Turn on the POWER rotary switch. Note that this switch turns on both line and battery power.

Charging the Battery Cells

Prior to battery operation, it is recommended the R1L-B Microohmmeter be plugged into AC power for at least 14 hours to charge the battery cells. To charge the battery cells, the Power Switch must be turned ON, and the Range Switch should be set to 20 Ω . With the Range Switch set to lower ranges, the charge rate decreases and the batteries will be discharged, especially on the 2 m Ω range, even with no resistance connected to the instrument. (However, the discharge rate in this range will permit operation for at least 14 hours with no resistance connected.)

WARNING

ALTHOUGH THE FRONT PANEL IS NORMALLY GROUNDLED VIA THE GROUND PIN OF THE POWER CABLE, IF THIS CONNECTION IS FAULTY AND IF THE HIGH SIDE OF THE POWER CABLE IS SHORTED TO THE PANEL, THE PANEL COULD POSSIBLY HAVE MAINS VOLTAGE ON IT; SO DO NOT TOUCH THE PANEL WHEN AC POWER IS CONNECTED.

SECTION 3

OPERATING INSTRUCTIONS

The R1L-B is designed for bench-top operation. Use the cables connecting their banana plug terminations to the four binding posts marked +I, +E, -E, and -I.

3.1 Rotary Switch Functions

Operation of the Model R1L-B is essentially extremely simple. There are only two switches.

The RANGE rotary switch manually scrolls through the five ranges.

Full scale on any range may be described as 2,000 (actually 1,999), since this is a 3½ digit meter. If the readings are exceeding 1,999 counts, step to the next higher range. If the readings are less than 2,000 counts, step down a range, so that it will read 1,999 counts, or less. The decimal point is located automatically for the correct reading.

If the selected range is too low for the value of the resistor under test, the display will show over-range.

The POWER rotary switch turns on the power to operate the unit or turns off the power to the unit. The appearance of the display will show that power is on; absence of the display indicates that either power is off, batteries are discharged, or there is some malfunction. Note that when power is turned off, it may take several seconds to discharge circuit capacity to completely blank the display. The black markings seen have no effect and disappear when power is turned back on.

3.2 General Theory Of Operation

Measurement Principle

A 4-terminal measurement method is used to determine the resistance of the item under test. This method allows the accurate measurement of low values of resistance in spite of the other resistances present in the connection leads. A known current is supplied to the item under test via two wire leads connected to the +I and -I binding posts on the R1L-B Microohmmeter front panel. Two other wire leads connected to the +E and -E binding posts on the R1L-B front panel sense the voltage developed across the resistance under test due to the supplied known current. The R1L-B then calculates the resistance of the item under test utilizing Ohm's law, and displays it on a 3 ½ digit display.

Kelvin Klip Cable Description

A Kelvin clip consists of two opposing jaws of an alligator style clip which are insulated from each other, so one jaw may be used to connect a source of current to the resistance under test, and the other jaw used to measure the voltage at the test point. The two jaws are spring loaded to clamp onto a cylinder of ½ inch diameter or less.

WARNING

OPERATING THE R1L-B MICROOHMMETER AND TAKING RESISTANCE MEASUREMENTS ON A POWERED OR ENERGIZED COMPONENT COULD CAUSE SERIOUS HARM TO THE OPERATOR AND/OR DAMAGE THE R1L-B. BE SURE THE ITEM TO BE MEASURED IS DISCONNECTED FROM OTHER COMPONENTS AND APPARATUS.

If the battery cells have not been installed, refer to section 2.2. Battery only operation will result in the most stable and accurate readings. The R1L-B may be operated while charging the batteries, however it will not conform to specifications in this configuration.

NOTE: The amount of current available for charging the battery decreases as lower resistance ranges are selected. In the 2 m Ω range, the current supplied to the resistance under test exceeds the charging current, and the battery will be drained.

To obtain the best accuracy, allow the R1L-B to warm up for 15 to 30 minutes on the 20 Ω range before making measurements. Even if in battery operation, this will not cause appreciable battery discharge. In any case, a minimum warm-up of 30 seconds is advised.

Using the Kelvin-Clip cables

Plug one Kelvin-Clip cable dual banana plug across the +E and +I binding posts, and plug the other Kelvin-Clip cable dual banana plug across the -E and -I binding posts. Note that in both cases, the small "I" marked on the dual banana plug should go into the respective I binding post.

If Kelvin-Clip cables are not used, a pair of shielded cables may be utilized. As occurs in the Kelvin-Clip cables in the above paragraph, one cable should have its shield connected to the "+I" binding post and its center conductor connected to the +E binding post. Similarly, the other cable should have its shield connected to the -I binding post and its center conductor to the -E binding post. It is also recommended that the resistance of the cables should not exceed 1 Ω .

NOTE: Particularly in the 2 m Ω range, where a test current of approximately 1.5 A is used, excessive lead resistance will prevent an accurate measurement.

Set the Range Switch to the desired measurement range and read the resistance on the liquid crystal display. If the resistance is higher than the selected range, the display will show a "1" and three blank digits, indicating over-range. The decimal point will also appear in the proper location for the selected range.

After prolonged operation on battery power, when the battery voltage approaches the end of its useful range, the "LO BAT" indicator will be seen on the display. Although the battery cells are not fully discharged and they will not be damaged by additional use, this is a warning to the operator that the battery cells need to be charged.

Use of HTP-100 probes with R1L-B

1. Connect the BLUE spade lug from the LEFT HTP-100 Probe to the RED E+ terminal of the R1L-B.
2. Connect the RED spade lug from the LEFT HTP-100 Probe to the RED I+ terminal of the R1L-B.
3. Connect the WHITE spade lug from the RIGHT HTP-100 Probe to the BLACK E- terminal of the R1L-B.
4. Connect the BLACK spade lug from the RIGHT HTP-100 Probe to the Black I- terminal of the R1L-B.
5. Hold the RED HTP-100 Probe in your left hand and the WHITE HTP-100 Probe in your right hand, and push the probe points against the surface to be measured with sufficient force to cause the points to retract slightly.

SECTION 4

PRINCIPLES OF OPERATION

The internal power supply uses a switching power supply to accept worldwide line voltages 50/60 Hz.

A filter capacitor, and constant current regulator UI complete the power supply. R1 sets the value of the constant current to approximately 500 mA, D5 is used to isolate the AC power for the battery. D7 serves to clamp the voltage to less than 5 V when the battery is disconnected.

Q1 regulates the constant current through the resistance under test. This current is measured by the $I \times R$ drop across R12, etc., depending upon the range selected. For all ranges, the $I \times R$ drop is summed with a portion of the 3.0 V reference signal existing between pins 1 and 32 of U4, the Digital Voltmeter (DVM) IC. The 3.0 V reference is effectively divided by 2 by the network of R8, R9, R10 and R11, and added to the $I \times R$ drop across R12, etc., so that this $I \times R$ drop is maintained at 1.5 V. U2, pins 1, 2 and 3, amplifies the error signal, driving Q2, which controls Q1 to reduce the error signal. The $I \times R$ drop is thus regulated, so that the test current delivered to the +I binding post remains constant. If the current tends to increase, pin 2 goes positive with respect to pin 3; this reduces the output from pin 1 to drive transistor Q2, which reduces the drive to Q1 and thereby reduces the current out of Q1, thus regulating this current. Current on the 2 m Ω range is approximately 1.5 A. Current on the other ranges decreases by 10:1 on each range because the resistor networks are adjusted to increase by 10:1 for each succeeding range. Note that the ratio of currents between ranges is precisely 10:1, but the actual value of current is not held exactly to 1.5 A, etc., because the DVM is calibrated to read the correct resistance value regardless of drift of the reference voltage and the resulting current.

The section of U2 employing pins 5, 6, and 7 is a unity gain follower to provide a voltage equal to that present at the +I

binding post, without taking any appreciable current from the output circuit.

The section of U2 utilizing pins 8, 9, and 10 checks the battery voltage by checking the voltage of pin 32 of U4. The voltage at this pin is 3.0 V below the battery voltage. Therefore, when the battery voltage drops below 3.0 V, the voltage at this pin goes negative. The output of this section of U2 then goes high, generating a Low Battery (LO BAT) signal for the liquid crystal display (LCD).

The voltage signal from the voltage binding posts is fed into the chopper amplifier U3. This amplifier has a gain of 50, putting the signal into U4, the DVM IC, at 0.15 V full scale. U4 drives the LCD, U6. U7 controls the indicated decimal points on the LCD and the LO BAT indication. U5 provides -3.6 V power to the amplifiers.

U6 is a 3½ digit liquid crystal display, driven segment by segment by U7. S2B provides the proper logic levels to the quad exclusive-OR gate U6 to locate the decimal point on the display. R33, R34, and R35 are pull-down resistors.

SECTION 5

MAINTENANCE

5.1 Inspection

These units should be inspected semi-annually. Cables should be periodically inspected to make sure they are in good condition. Check that the switches turn smoothly. Check all four binding posts to ensure that they operate smoothly.

No other maintenance is required, other than to keep the battery charged through power line operation. Charging should be done for at least 14 hours after long periods (several months) of storage or after considerable use on battery power.

5.2 Cleaning

The instrument should be cleaned periodically, as is necessary, using mild soap and a damp cloth both followed by second damp rinsing cloth.

Clean the LCD window using a soft cloth moistened with water or "Windex" type window cleaner. **DO NOT** use common paper towel products as some brands may contain fibers which could scratch the display window. **DO NOT** apply significant pressure to the LCD as it could separate from the front panel. **DO NOT** use alcohol, solvents, or harsh chemicals to clean the LCD window.

5.3 Test Equipment and Tools Required for Calibration and Repair

Calibration of the R1L-B is recommended on a yearly basis, and is done at a temperature of $23\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$.

Precision four terminal resistors with accuracy of 0.01% or better: 1 m Ω and 10 Ω

An oscilloscope: Hitachi V-1050F or equivalent.

A standard digital multimeter: (accuracy of 0.02% of reading or better) voltage ranging from 100 mV. HP/Agilent 34401A or equivalent.

Screwdrivers: Medium Phillips and small slotted for trim-pot adjustment.

5.4 Calibration

CAUTION

SAFETY PRECAUTIONS MUST BE TAKEN WHEN HANDLING THIS INSTRUMENT WHEN THE LINE CORD IS PLUGGED IN AND THE R1L-B HAS BEEN REMOVED FROM ITS CASE, TO ENSURE THAT CONTACT IS NOT MADE WITH THE AC POWER CONNECTIONS OR OTHER POTENTIALLY HARMFUL POINTS. FAILURE TO OBSERVE PROPER SAFETY PRECAUTIONS MAY CAUSE SERIOUS HARM TO THE OPERATOR AND/OR DAMAGE THE R1L-B.

1. Prior to calibration, the battery should be fully charged as per section 2.2. Allow at least 1 hour warm-up of the R1L-B before calibration.
2. Check the location of the trim pots on the Parts Layout Drawing, figure 4.
3. Connecting a shorting bus wire loop, starting at the -I binding post, connecting to the -E binding post, and then to the +E binding post. This prevents the E terminals from measuring any $I \times R$ drop across the wire. Set the Range Switch to 20 Ω full scale. Adjust R26 for a zero reading on the LCD. Note the display reading may vary by ± 1 count. Also note that this instrument resolves 1 μV per count, and you should therefore avoid heating the shorting wire with your fingers, or thermally generated voltages may cause considerable error.
4. Connect a precision 10 Ω resistor to the R1L-B using the

4-wire connection. Set the Range Switch to 20 Ω full scale. Adjust R32 so that the LCD reads 10.00.

5. Connect a precision 1 m Ω resistor to the Model R1L-B using the 4-wire connection. Set the Range Switch to 2 m Ω full scale. Adjust R18 so that the display reads 1.000.
6. When calibration is completed, disconnect the line cord, and return the R1L-B to its cabinet. Secure the panel with the four screws removed earlier.

5.5 Troubleshooting

Following are possible symptoms, diagnosis, and repair suggestions for use in trouble-shooting (the most likely causes are listed first).

Symptom	Faulty Component	Repair
No Display	Power cord Power switch U6 / U7	Check the power cord is plugged in. Check the power switch is ON. Check for a square wave at pin 40, if not present, replace U6 and/or U7.
Battery won't charge	Connections	Remove battery cells and bend contact arms inward to ensure better contact with the battery cells. Clean connections if required.
	Fuse U1	Check fuse. Check approximately 9 VDC across C1. If not check for 20 VAC across T1 secondary. If no 20 VAC, troubleshoot C1, D1, D2 and T1. If ok, check for approx. 6 VDC (ref. to common) at the output of U1. If not, replace U1.
	R1 D5	If above ok, check for approximately 4.5 VDC (ref. to common) at the anode of D5, if not, replace R1. If above ok, check for approximately 3.6 VDC (ref. to common) at the cathode of D5, if not, replace D5.

Display reads zero with cables connected to a good resistor	Current o/p	Check for proper current o/p between +I and -I.
	Kelvin Clip	If above ok, check the Kelvin cable for continuity from each side to the banana plug.
	U2	If no current, troubleshoot the const. current circuit and replace U2 or other component(s) if defective.
	U3	If the current and cables are both ok, check the volt. amplifier and replace U3 or other component(s) if defective.

Table 2: Fault Symptoms and Repair Actions

After trouble-shooting and repair, the instrument must be recalibrated in accordance with 5.4 above.

Disassembly

- First remove the line cord and any other connecting wires. Then remove the four screws at the corners of the top (display) panel. Carefully lift the unit out of its cabinet. Remove the three battery cells.
- Loosen the set screws in the knobs for the Power and Full Scale switches, and remove these knobs.
- To separate the printed circuit board from the front panel, remove the four screws appearing in a rectangular pattern around the LCD and control switches. **DO NOT** remove a fifth screw to the lower right of the Power Switch. This screw is a heat sink connection for the transistor Q1.
- Remove the four screws that secure the battery plate along with their spacers (one screw goes through the battery holder). Two of the screws have nuts and lockwashers.

Re-assembly

To reassemble the unit, repeat the above steps in reverse order, taking care to install the lockwashers on the proper screws, and using Loctite Small Screw Threadlocker 222 on all screws except those, which secure the front panel to the case.

5.6 Preparation for Shipment

The original shipping carton is not reusable.

Remove the battery cells prior to shipment (or inactive storage of 30 days or more) and package them separately. Disassemble the R1L-B as per section 5.5, and extract the negative end of the battery cells first.

Packaging must provide sufficient resilient material, in accordance with standard packaging practices, to prevent excessive shock to the power supply and display during shipment.

5.7 Overhaul Instructions

The R1L-B is an all solid-state unit and requires no periodic overhaul, other than routine cleaning, inspection of cables per section 5, and calibration per section 5.4.

However, some disassembly is required to remove and install the batteries. This level of disassembly is detailed in section 2.2 and battery cells should be removed at the negative end first.

Tools and test equipment used for disassembly, calibration, and troubleshooting of the R1L-B are listed in section 5.3.

Troubleshooting suggestions are given in section 5.5.

The only component expected to require replacement is the battery. The battery designation is listed on the Replacement Parts List, with battery cell removal and installation instructions given in section 2.2.

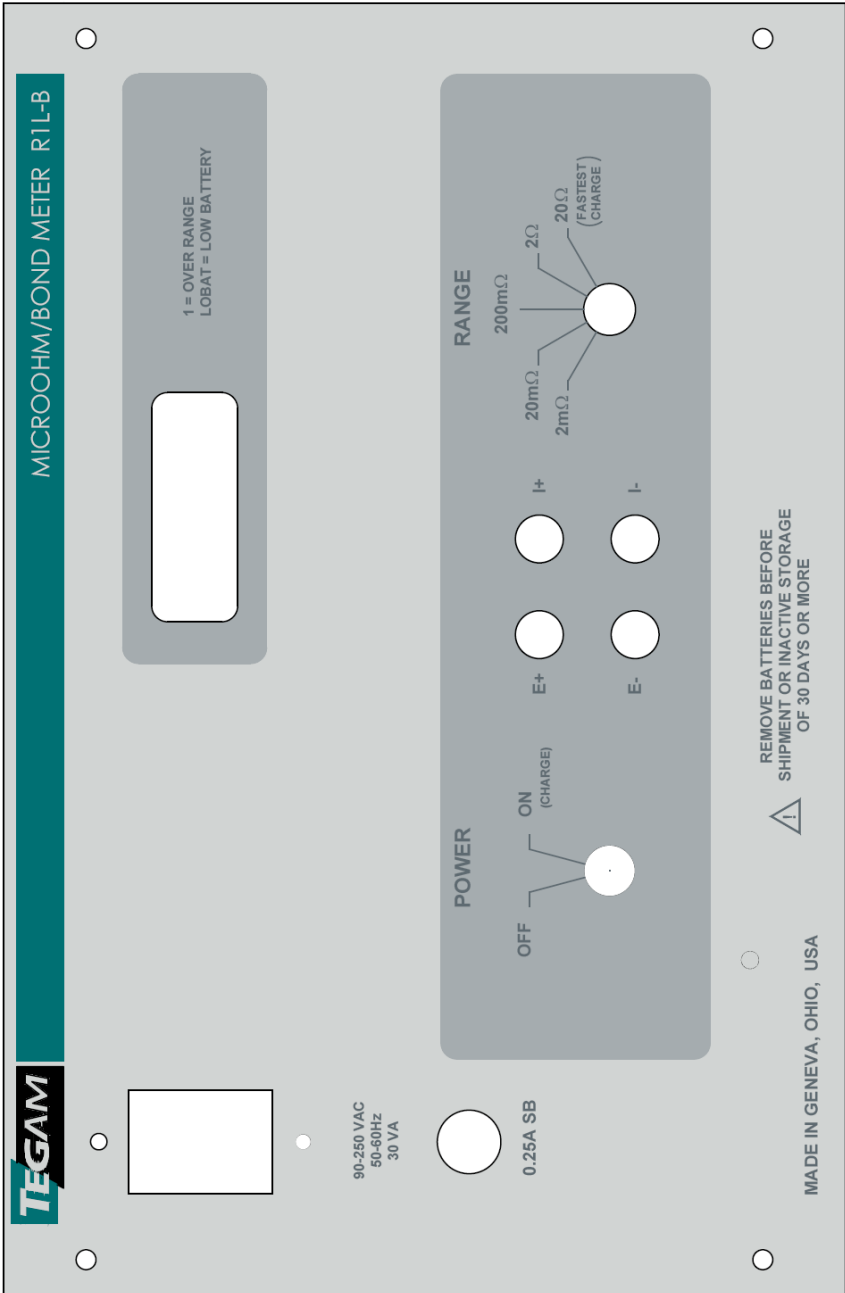
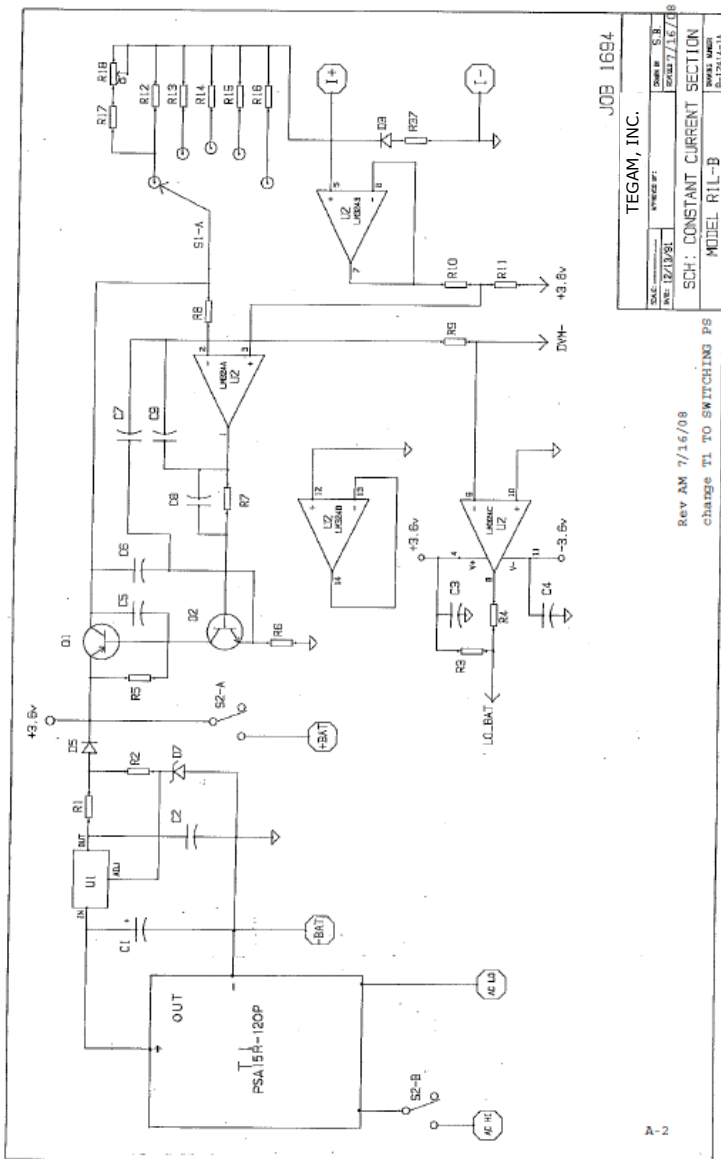


Figure 1: Front Panel Controls



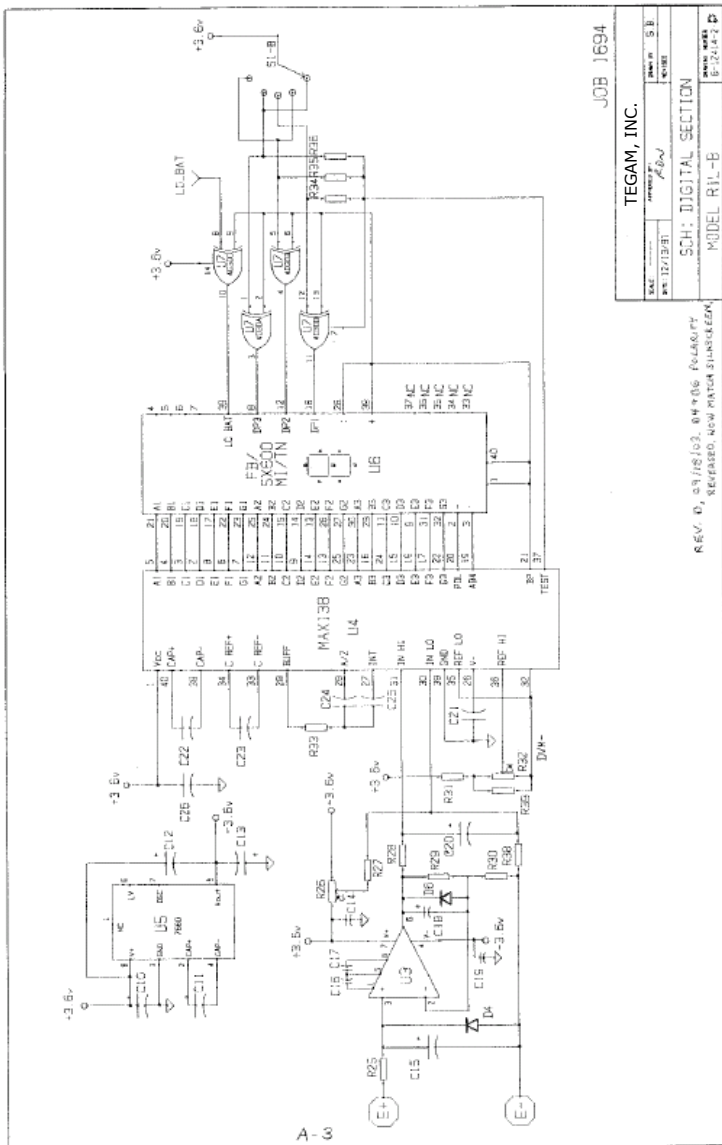
JOB 1694

TEGAM, INC.		
DATE: 12/13/81	REVISED BY:	DATE: 7/16/08
SCH: CONSTANT CURRENT SECTION		DRAWN BY: JRB
MODEL RIL-B		REVISION: 11

Rev AM 7/16/08

change T1 TO SWITCHING PS

Figure 2: Constant Current Section



JOB 1694

TEGAM, INC.	
DATE: 08/12/01	REV: 9 B
SCH: DIGITAL SECTION	
MODEL RL-B	
REVISED: 08/12/01	

REV. D, 03/18/02, RM #06 FOLIOLOGY
REVISED, NOW PART OF SHUNKEEN

Figure 3: Digital Section

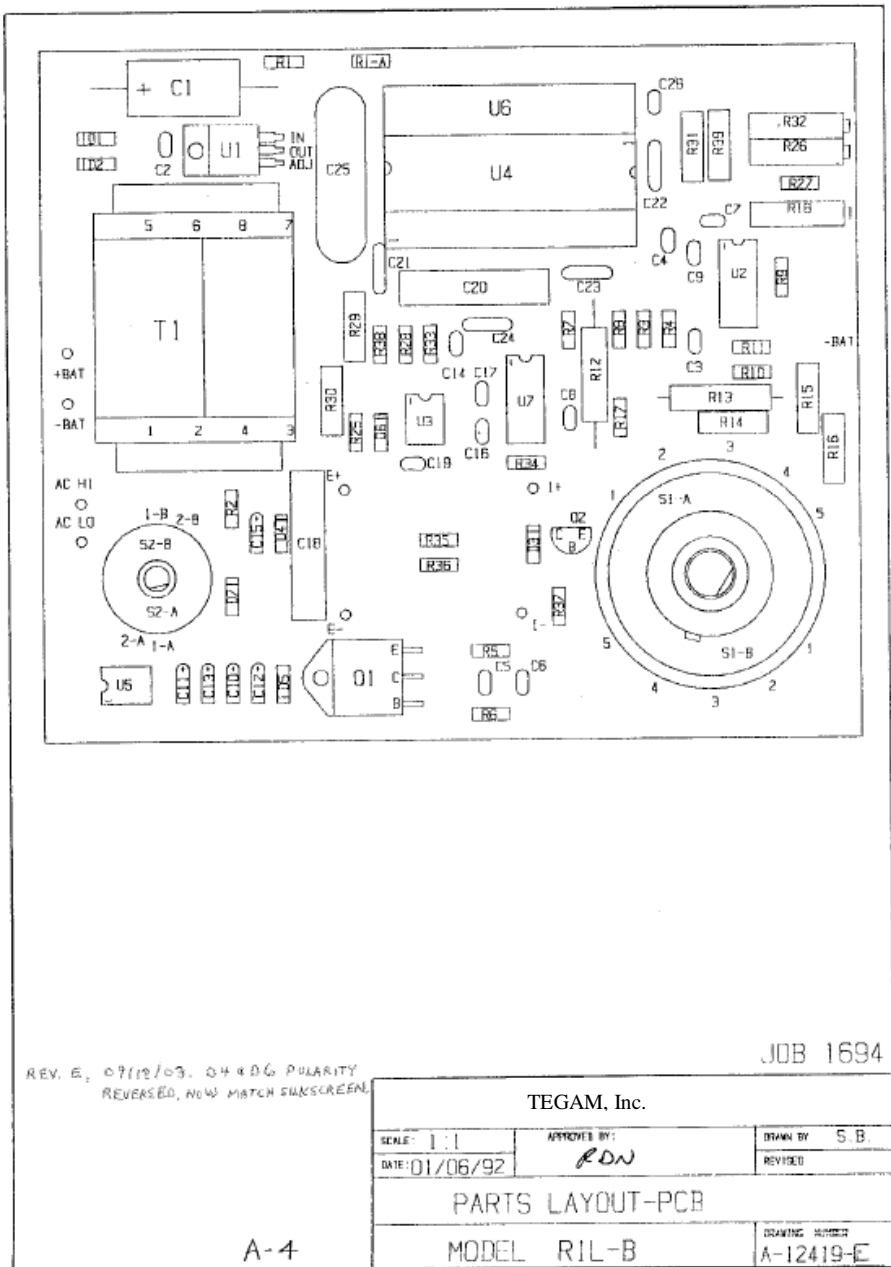
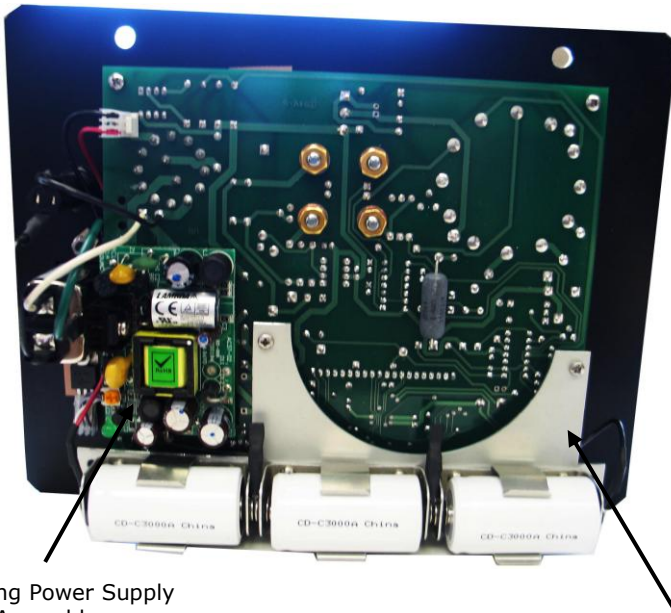


Figure 4: Parts Layout



Switching Power Supply
Assembly

Battery Panel

Figure 5: R1L-B Assembly

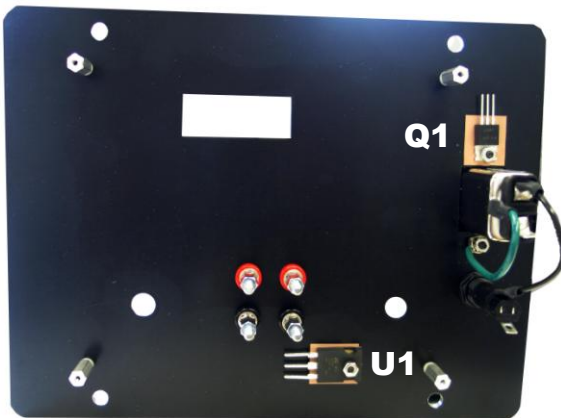


Figure 6: U1 and Q1 Position on the Board

TEGAM, Inc. Geneva, Ohio

BOM Part Number: M623 (Formerly M100338)

Bill Of Material for:

Digital Milliohm Meter PC Board

Model Number: R1L-B

By: DLK

Date: 1/5/2008 Rev 9-1-2008

Unit

ITEM	REFERENCE	QTY.	DESCRIPTION	MFGR.	MFGR. PART NO.	P.O. NO.
1		1	PC Board	PPM	A-12417-2B	
2	C1	1	220 MFD 35 WVDC	IC	227TTA035M	
				ALT Nidhicon	TVX1V221MAA	
3	C2-4, 8, 9, 14, 16, 17, 19, 21, 23, 26	12	0.1 MFD 50V	AVX	SR205E104MAA	
4	C6, 22	2	1.0 MFD 50V	ALT Kemet	C315C104M5U5CA	
				AVX	SR305E105MAA	
				ALT Sprague	2C2025U105M050B	
5	C10-13	4	6.8 MFD 15V	Sprague	173D685X9015VT	
5A	C15	1	0.1MFD 400V Met Poly	Panasonic	ECQ-E4104KZ	DIG
6	C18, 20	2	1.0 MFD 250 V Poly	Panasonic	ECQ-E2105KZS	DIG
7	C24	1	0.47 MFD 50V	Kemet	C330C474M5U5CA	
8	C25	1	0.1 MFD Polypropylene	Sprague	715P10452LD3	
9	C5, 7		NOT USED			
10	D5	1	Rect Diode	Motorola	1N4002	NEW
11	D4	1	Signal Diode	Fairchild	1N4148	
12	D3, 6	2	3.3V Zener Diode	Motorola	1N746A	NEW
13	D7	1	5.1V Zener Diode	Motorola	1N751A	NEW
14	Q1	1	Power PNP	Motorola	TIP34	NEW
				ALT Motorola	TIP2955	
15	Q2	1	Med Pwr NPN	National	PN3569	NEW
16	R1, 1-A, 37, 38	4	10 OHM	Dale	RN55D10R0F	TTI
17	R2	1	100 OHM	Dale	RN55D1000F	TTI
18	R3, 4, 34-36	5	10K	Dale	RN55D1002F	TTI
19	R5, 25	2	1K	Dale	RN55D1001F	TTI
20	R6	1	4.99 OHM	Dale	RN55D4R99F	TTI
				ALT	MF55D 4.99 1%	
21	R7	1	499 OHM	Dale	RN55D4990F	TTI
22	R8, 10	2	15K	Dale	RN55D1502F	TTI
23	R9, 11, 27	3	30.1K	Dale	RN55D3012F	TTI
24	R12	1	1.02 OHM, 1.0%, 5W*	Riedon	NP Series	RIEDON
25	R13	1	9.975 .05%, 0.5W*	Riedon	560 Series	RIEDON
26	R14	1	100, 0.05%, 0.25W*	Riedon	538 Series	RIEDON
27	R15, 30	2	1K, 0.05%, 0.25W*	Riedon	538 Series	RIEDON
28	R16	1	10K, 0.05%, 0.25W*	Riedon	538 Series	RIEDON
	*NOTE R12 = 15 PPM, R13-16 = 10 PPM					
29	R17	1	20 OHM	Dale	RN55D20R0F	TTI
30	R18	1	50 OHM Trimpot	Bourns	3008-P-1-500	
				ALT Spectrol	043P500	NEW
31	R26, 32	2	10K Trimpot	Bourns	3008-P-1-103	NEW

A5

Table 3: Parts List – PC Board Assembly

10 TEGAM WAY • GENEVA, OHIO 44041 • 440-466-6100 • FAX 440-466-6110

sales@tegam.com

TEGAM, Inc. Geneva, Ohio

BOM Part Number: M623 (Formerly M100338)

Bill Of Material for:

Digital Milliohm Meter PC Board

Model Number: R1L-B

By: DLK

Date: 1/5/2006 REV 7-16-08

Job No.

ITEM	REFERENCE	QTY.	DESCRIPTION	MFGR.	MFGR. PART NO.
34	R33	1	174K	Dale	RN55D1743F
35	R39	1	2.5K, 1%, 0.25W*	Riedon	S38 Series
36	S1*	1	Switch, Rotary 2 Pole 5 Pos*	Electrow	74-0415*
				ALT Electrow	C7D0205S-9605*
37	S2*	1	Switch, Rotary 2 Pole 2 Pos*	Electrow	77-5011*
				ALT Electrow	C5P0206N-4006*
38	T1	1	Switching Pwr Supply	PPM	PSA15R-120P
39	U1	1	Adj Regulator	National	LM317T
40	U2	1	Quad Op-Amp	National	LM324AN
41	U3	1	Chopper Op-Amp	Maxim	MAX420CPA
42	U4	1	3.5 Digit D-A LCD Out	Maxim	MAX138CPL
43	U5	1	Neg Power Supply	Intersil	ICL7660CPA
44	U6	1	LCD Display	Fema	35D050-R3PB
45	U7	1	Ex or Gate	Phillips	HEF4030BP
				ALT Harris	CD4030BE
46	XU3, 5	2	8 Pin IC Socket	Mill Max	110-99-308-41-001
47	XU2, 7	2	14 Pin IC Socket	Mill Max	110-99-314-41-001
48	XU4	1	40 Pin IC Socket	Mill Max	110-99-640-41-001
49	XU6	0.67	64 Pin Row Socket	Mill Max	316-93-164-41-008
50	For S1, 2	12	18 AWG Bus Wire 0.75" (9" Total)	Alpha	8019

Table 4: Parts List – PC Board Assembly

PPM Inc., Cleveland, Ohio BOM Part Number: M624 (Formerly M100380)
 Bill Of Material for: Main System Bill Model Number: R1L-B
 By: DLK Date: 7/18/03 Job No.

ITEM	REFERENCE	QTY	DESCRIPTION	MFGR.	MFGR. PART NO	P.O. NO.
1	B1-3	3	Nicad Cell	Panasonic	P-280CR	NEW
2	BP-, -E, +, +E	2	Dual Binding Post	Superior	BP21-2BR	NEW
3		1	Enclosure	Bopla	UMP62014FP	PHOENX
4		1	Set Kelvin Cables	PPM	M625	PPM
5	XF1	1	Fuseholder	Littlefuse	H345913	NEW
6	Fuse	1	Fuse, 1/4 Amp, 3AG	Littlefuse	312.250	NEW
7	LF1	1	Linefilter	Corcom	3EEA1	NEW
8	For LF1	1	Linecord	Qualtek	857-3/017	NEW
9		1	PC Board	PPM	M623	PPM
10		1	Front Panel	PPM	A-12452	METALP
				Metalphoto		
11		1	Plexiglass Window, Clear	PPM	A-12400	FUSCO
	Make From		3 x 1 1/4 x 1/16"	Commercial		
12		1	Display Gasket	PPM	A-12373	PPM
	Make From		3 x 1 1/4 x 1/16"	Commercial		
13		1	Battery Panel	PPM	A-12477-A	PPM
	Make From		6.54 x 2.30 x 1/16 Alum			
14		1	Cabinet Panel	PPM	A-12460	PPM
	Make From		11.10 x 3.15 x 1/16 Alum			
15	For S1, 2	2	Knob	Eagle	45KN018	
16	For B1-3	1	Battery Holder	MPD	BH13CL	
17		4	4-40 x 0.75 Alum Spacer		2108-440-A	
18		4	#4 x 1" Nylon Spacer		13sp088	
19		10	4-40 x 1/4 PPH MS SS	Commercial		
20		4	4-40 x 1 1/4 PPH MS SS	Commercial		
21		2	4-40 x 1/2 PFH MS SS	Commercial		

Table 5: Parts List – Main Board Assembly

TEGAM, Inc. Geneva, Ohio

BOM Part Number: M624 (Formerly M100380)

Bill Of Material for:

Main System Bill

Model Number: R1L-B

By: DLK

Date: 7/18/03

Job No.

ITEM	REFERENCE	QTY	DESCRIPTION	MFGR.	MFGR. PART NO.	P.O. NO.
22		8	4-40 Hex Nuts	Commercial		
23		5	#4 Split LW	Commercial		
24		1	#4 Solder Lug	HH Smith	1412-4	
25	For Q1	1	4-40 x 3/8 PPH MS SS	Commercial		
26	For Q1	1	Sil Pad	Bergquist	3223-07FR-90	DIG
27	For U1	1	4-40 x 1/4 PPH MS SS	Commercial		
28	For U1	1	Sil Pad	Bergquist	3223-07FR-90	DIG
29	For Q1, U1	2	Insulated Shoulder	Thermalloy	7721-7PPS	NEW
30	For Q1, U1	2	4-40 Hex Nut	Commercial		
31	For B1-3	3	Battery Retainer	McMaster	9723K15	10117
32		4	#6 x 5/8 PPH Sheet Metal Screw	Commercial		

Table 6: Parts List – Main Board Assembly

SECTION 6

SERVICE INFORMATION

Preparation for Calibration or Repair Service

Once you have verified that the cause for R1L-B malfunction cannot be solved in the field and the need for repair and calibration service arises, contact TEGAM customer service to obtain an RMA, (Returned Material Authorization), number. You can contact TEGAM customer service via the TEGAM website, 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 you instrument and to address the particular service request by you which is assigned to that RMA number.

Of even 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:

- | | | |
|---|---|--------------------------------------|
| <input type="checkbox"/> Evaluation | <input type="checkbox"/> Calibration Only | <input type="checkbox"/> Repair Only |
| <input type="checkbox"/> Repair & Calibration | <input type="checkbox"/> 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

TEGAM INC.
10, TEGAM WAY
GENEVA, OHIO 44041
CAGE Code: 49374

WEB: <http://www.tegam.com>

