

HAND HELD MEGOHMMETER

MODEL R1M-B



Operation and Maintenance Manual

PN# R1M-B-900-01
Publication Date: July 2012
REV. C

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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

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SECTION 1

INSTRUMENT DESCRIPTION

INTRODUCTION

1.1 Purpose

The Model R1M-B Megohmmeter is a compact portable instrument used to measure high resistance values, up to 200 M Ω . A voltage range is provided in addition, to permit measurements of circuits, which have voltage applied. Ranges are 1 to 200 M Ω for resistance, and 3 to 600 VAC RMS for voltage. It will also detect and display the presence of DC voltage; but can't be used to measure DC voltage accurately. Test voltage is 500 VDC. The R1M-B is packaged in a high-impact housing designed to withstand the wear and tear of industrial applications.

1.2 Performance Characteristics

This is a digital reading instrument.

Ranges:

Resistance Range: 1 to 199.9 M Ω

Voltage Range: 3 to 600 VAC RMS

Accuracy:

Resistance measurement accuracy: \pm (3% of rdg + 1 count)

Voltage measurement accuracy: \pm (5% of rdg + 1 count)

Test Signal Accuracy: 500 VDC \pm 10%

1.3 Description of Equipment

Physical: A high impact plastic case is provided to contain and protect the instrument. A pouch is provided to contain and protect the instrument and test leads with their clips. The input terminals are insulated banana jacks for operator safety. Two 40" leads with probes and removable insulated alligator clips are provided.

Dimensions: 178 mm (7") x 91 mm (3.6") x 30 mm (1.2").
Weight is 0.6 lb (including the battery).

Electrical: Power for the unit is supplied by a standard 9 V alkaline battery. With voltage present, the LED will stay bright (as long as the TEST pushbutton is depressed), and the R1M-B will display voltage and NOT resistance.

Environmental: This unit will operate over a temperature range from 0 to 50 °C, 75% RH non-condensing, up to 3050 m altitude. Withstand functional shock of 40 G for 11 ms.
Vibration: 20 G maximum at 5 to 55 Hz.

Front Panel Controls and Displays

A **TEST pushbutton** is the only control required, since the internal circuit makes all the decisions regarding function and range. A LED is provided to indicate that voltage is present on the DUT, and the R1M-B is in the voltage measurement mode.

DISPLAY is a 3½ digit LCD, displaying readings from 1.999 to 199.9. The LCD with digits ½ inch high displays the voltage and resistance readings. A "LO BAT" legend comes on to indicate a low battery voltage. If the resistance is over 200 MΩ, the least three significant digits of the display will blank, indicating an over-range condition.

TEST VOLTAGE Jack is recessed to prevent any accidental encounter.

WARNING
VOLTAGES AS HIGH AS 600 V MAY BE PRESENT ON THE TEST LEADS OR INSIDE THE CASE OF THIS INSTRUMENT!! DO NOT TOUCH ANY COMPONENTS WITH BARE HANDS OR WITH UNINSULATED PROBES!

1.4 List of Items Furnished

- 1 each Model R1M-B
- 2 Two test cables, over 40 inch long, with probes and detachable alligator clips
- 1 each R1M-B Instruction Manual
- 1 each Carrying Pouch

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 R1M-B, could damage the LCD. Care should be taken to prevent damage to associated cables.

The R1M-B should be stored in a relatively dust-free environment.

Temperature: -40 to +71 °C.

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

Altitude: 4570 m

See Section 5.5 below for shipping requirements.

SECTION 2

PREPARATION FOR USE AND INSTALLATION

2.1 Unpacking and Inspection

Upon receipt, the R1M-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.
- 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

Remove the instrument and accessories from the pouch. If the battery has been removed, replace it, using the instruction listed in Section 5.3 below.

If desired, screw the red and black alligator clips onto the probe ends of the test leads.

CAUTION
USE EXTREME CARE WHEN ATTACHING THESE CLIPS.
HANDLE ONLY ONE CLIP AT A TIME AND HANDLE IT
THROUGH THE RUBBER BOOT.

Connections to DUT

Plug the banana plug ends of the test leads into the red and black banana jacks on the R1M-B. Connect the red alligator clip to one end of the resistor under test. Connect the black alligator clip to the other end of the resistor under test.

When the megohmmeter is first turned on by operating the "TEST" button, the instrument automatically functions as a digital AC voltmeter, reading any voltage present on the test leads and displaying that voltage on the LCD display. At the same time, the "VOLTS" LED is on. If voltage is present, the instrument will not take resistance readings. However, if voltage is not present, the LED will dim or turn off (after the initial flash) and the meter will switch to the megohmmeter mode; the internal 500 VDC supply is connected to the test leads and the display reads $M\Omega$. The button must be held in for several seconds to allow time for the 500 V and resistance readings to stabilize. As long as the TEST button is depressed, the instrument will continue to take readings. When the button is released, the power will automatically turn off to maximize battery life and to minimize the risk to the operator of being shocked by the 500 V across the test probes during resistance measurements. Note that the current is limited to less than 5 mA, but this is still enough to produce a shock.

SECTION 3

OPERATING INSTRUCTIONS

The R1M-B is designed for bench-top or field operation.

3.1 General Theory Of Operation

A 2-terminal measurement method is used to determine the resistance of the item under test. The R1M-B calculates the resistance of the item under test utilizing Ohm's law and displays it on a 3 ½ digit display.

Press the TEST pushbutton. If the test leads are connected to a "live" circuit, the "VOLTS" LED will come on and the digital display will read that voltage. Although the display is calibrated to read 3 V, if there is no voltage present, the R1M-B will automatically switch to the megohmmeter mode. The LED will dim, or turn off, after flashing momentarily, and the display will indicate the resistance across the terminals. With a new battery, the LED will get dimmer, if it shuts off completely; this is a sign of a weak battery.

NOTE: Hold the button in for five seconds to ensure getting an accurate reading.

If the resistance exceeds 200.0 M Ω , the three least significant digits of the display will blank. This shows that the resistance is over-range and beyond the capability of this instrument.

Note that 1 M Ω is the lowest value of resistance that may be measured accurately with the R1M-B. Since lower resistance values will draw more current, prolonged operation with lower resistance values will reduce battery life and should be avoided.

SECTION 4

PRINCIPLES OF OPERATION

The 9 V battery powers the R1M-B only while the "TEST" pushbutton is depressed.

When power is applied, the counter-timer, U4, automatically resets so that its output Q is LO. This is inverted by a section of U5, putting a HI signal on pins 5 and 12 of U3. This closes the two "E" switches in U3, putting the circuit in the voltmeter mode.

In the voltmeter mode, an input voltage connected between TP1 and TP2 will force a current through R22 (150 k), R23 and Q1 (for positive half cycles) and D5 and D6 (for negative half cycles) and R1 and R2. With 600 V applied, current is approximately 3.7 mA. This develops a voltage of 1.86 V across R2, as the input signal to U1, an RMS to DC converter, which will output the same level of DC signal on pin 6. This signal is attenuated 11:1 by R14 and R30 to 170 mV and connected to pin 4 of U3, a CMOS quad analog switch. In the voltmeter mode, this switch is closed, feeding this signal to pin 3, which is connected to the signal input (pin 31) of U6, the A-D converter. At the same time, a 300 mV reference voltage, attenuated by R9, is connected to pin 11 of U3 and feeds through U3 via pin 10 to the reference input (pin 36) of U6. Since U6 functions as a ratio meter, the display reads 170 mV divided by the reference, or 600 (with R9 adjusted to output 280 mV); the decimal point is not turned on for voltage measurements.

With external voltage across the test leads, the output of U1 on pin 6, connected to the + input of the comparator U2A, keeps its output on pin 1 HI. This is connected to pin 6, the Master Reset, of U4, keeping it in its reset state. Thus, its output Q on pin 8 stays LO, keeping the meter in the voltage mode.

With no input voltage present, there is no output from U1 to the + input of the comparator. Since the - input is biased

slightly positive, the output will stay LO. With no HI signal on its Master Reset pin, U4 functions as a counter-timer. A 50 kHz signal from U6 is applied to pin 3, the clock input. After 65,536 cycles, or approximately one second, U4's output goes HI, putting the circuit in the ohmmeter mode. This HI signal is coupled through diode D1 to pin 2 of U2A, putting a large bias on the comparator U2A to prevent it from changing state due to an output from U1 caused by the ohmmeter signal.

With U4's output on pin 8 HI, pins 6 and 13 of U3 go HI and pins 5 and 12 go LO. This closes the two "R" switches in U3 and opens the two "E" switches, putting the meter in the resistance mode.

In the resistance mode, the input signal from TP2 to Common is the current through the test resistance caused by the 500 V supply. With 200 M Ω , this is 2.5 mA. This current develops a voltage of 20 mV across R1 and R2, approximately 8 k. This signal passes through the closed switch pin 1 to pin 2 of U3 to the reference input of the A-D comparator U6. At the same time, a fraction of the 500 V supply (approximately 40 mV) from the wiper of R27 passes through the closed switch pin 8 to pin 9 of U3 to the signal input of U6. U6 functions as a ratio meter, and increasing input current (caused by a decrease in the test resistor) increases the denominator, causing a smaller reading. Thus the instrument functions to display the value of test resistance.

U2B functions as a instrumentation amplifier to convert the signal from U6, which is held at 3 V below Vcc, to a 0.3 V reference. The trimpot R9 divides this reference slightly to provide the A-D converter's reference in the voltmeter mode.

U2C functions as a comparator to compare the 0.3 V reference to a signal which is a fraction of Vcc, the battery voltage. When the battery voltage falls below 7.5 V, the output of this comparator (on pin 8) goes HI, acting as a Low battery signal. This signal is connected to pin 8 of U5, an

Exclusive-OR gate, whose output on pin 10 turns on the LO BAT indication on the display, U7.

U2D functions as a comparator to turn on the "VOLTS" LED, I1, when in the voltage mode (U4 output is HI).]

U8 is a pulse-width modulation control circuit which drives the primary of T1. The secondary and a voltage doubler rectifier supplies the 500 V for resistance measurements. When in the voltmeter mode, this circuit is disabled by a signal from U5, pin 3. The transistor, Q1, is turned on by this same signal.

SECTION 5

MAINTENANCE

No regular maintenance is required, other than battery replacement. Battery life is a function of the number of operations and the resistance values measured; lower values of resistance draw more current, resulting in shorter life. For normal anticipated operation, battery life should exceed one year.

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 pushbutton operates smoothly.

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 window, as it could separate from the front panel. **DO NOT** use alcohol, solvents, or harsh chemicals to clean the LCD window.

5.3 Battery Replacement

The battery should be replaced once a year or whenever the low battery indicator on the display comes on during operation. At that time, the instrument may be recalibrated.

CAUTION

USE CAUTION WHEN REPLACING THE BATTERIES, WHILE THE UNIT IS DISASSEMBLED, AND WHEN MAKING THE ADJUSTMENTS LISTED. MAKE SURE THAT THE TEST SWITCH IS NOT OPERATED ACCIDENTALLY. MORE THAN 500 VDC AND 600 VAC MAY BE PRESENT IN THE OHMMETER. THESE VOLTAGES COULD BE FATAL.

Remove the battery, replacing it with a standard 9 V alkaline battery. Be very careful that the new battery is installed with the same polarity as the original battery (check that the larger battery contact mates with the small contact on the battery connector). Install the battery with the connector near the outside corner of the case, after tucking the wires under the PC board.

Disassembly

To disassemble the R1M-B for battery replacement or for recalibration, remove the four screws on the bottom of the case and carefully separate the two halves of the enclosure.

Re-assembly

Reassemble the case, inserting the lower part of the bottom section into the upper section first, to help position the battery. Then reinstall the four screws.

Since this is a very compact low-cost unit, it is suggested that it be discarded in the event of serious malfunction. However, if so desired, troubleshoot, using the drawings in the Appendix and the theory of operation described above. To drop the printed-circuit board for access to the components, use a hex socket wrench to hold the lower spacers, and then remove the top screws.

5.4 Calibration

1. For voltage calibration, use an Electronic Development Corp. Model 4601, or other AC voltage standard with accuracy better than 0.1%, set to 60 Hz output frequency. Connect the voltage standard to the R1M-B input terminals. Set the standard to 300.0 V out. Push the TEST button on the R1M-B and adjust R9 until it reads 300.
2. For resistance calibration, connect the test leads to a PPM, Inc., Model R3-1,110M, or other high resistance standard. Set the resistance standard to 200 M Ω and adjust R27 until the R1M-B reads 198.0. This is to ensure that 200 M Ω does not read over-range (1 .).
3. After all checks are made, reassemble the megohmmeter. Recheck the operation to ensure that nothing was changed during assembly.

5.5 Preparation for Shipment

The original shipping carton is not reusable.

The Model R1M-B requires no special covering, preservation or special cradles. Packaging must provide sufficient resilient material, in accordance with standard packaging practices, to prevent excessive shock to the display during shipment.

The battery should be removed prior to shipment and packaged separately.

5.6 Overhaul Instructions

The R1M-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.

REFERENCE	DESCRIPTION	MFGR.	MFGR. PART NO.
B1	PC Board	CDT	12539-2A
C1-2, 5-7, 14, 19-20	Battery 9 V Alkaline	Rayovac	A1604-1
C4,8	0.1 MFD, 50 VDC	Thomson	EC04WD0104MCB
C10	10 MFD, 35 V	IC	106TTA035M
C11	100 PF, 50 V	Stantel	8121-M0500101KC
C12,17	0.068 MFD, 50 V	AVX	SR205C683KAA
C13	1 MFD, 50 V	AVX	SR305E105MAA
C15	0.47 MFD, 50 V	AVX	SR305E474MAA
C16,18	47 MFD, 16 V	IC	476TTA016M
C21,22	0.01 MFD, 50 V	AVX	SR155E103MAA
C23	0.01 MFD, 500 V	IC	103GQR500Z
D1,2,3,4,8	22 MFD, 40 V	Philips	2222 021 37229
D5,6	Signal Diode	Motorola	1N4148
D7	Hi-Voltage Rectifier	Motorola	1N4007
I1	Zener, 6.8 V	Motorola	1N754A
J1	L.E.D.	Liteon	LTL 307E
Q1	Battery Clip	Keystone	232
R1	Hi-Voltage NPN	Motorola	MJE1320
R5,8,17,19,24	7.5 k	Dale	RN55D7501F
R2,10,23	10 k	Dale	RN55D1002F
R3	499 Ω	Dale	RN55D4990F
R4	499 k	Dale	RN55D4993F
R11	3.32 k	Dale	RN55D3321F
R6,7	2.61 k	Dale	RN55D2611F
R15,R18	80.6 k	Dale	RN55D8062F
R9,R27	24.9 k	Dale	RN55D2492F
R12,13,14	Trimpot, 5 k	Bourns	3006P-1-502
R16	49.9 k	Dale	RN55D4992F
R20	75 k	Dale	RN55D7502F
R21	200 Ω	Dale	RN55D2000F
R22	2 Ω	Dale	CF1/4-20HMS 5%
R25,R30	150 k, 5%, 3 W	RCD	RSF3B150K 5%
R26	4.99 k	Dale	RN55D4991F
R28,R29	191 k	Dale	RN55D1913F
S1	10 M	Dale	RN55D1005F
T1	PB, Form A	Takamisawa	TS-12MDN
TP1	Hi-Voltage XFMR	Mohawk Elec	A-12525
TP2	Red Banana Jack	Multicontac	23-0190-1
FOR TP1,2	Blk Banana Jack	Multicontac	23-0190-4
U1	Test Cable Set	PPM	PO-8534
U2	RMS To DC Converter	A-D	AD736JN
U3	OP-AMP	National	LM324AN
U4	Quad Analog Switch	RCA	CD4066BE
U5	Timer	RCA	CD4541BE
U6	QUAD EXC OR	RCA	CD4030BE
U7	3 1/2 Digit A/D Convrt	Maxim	MAX130CPL
U8	LCD Display	FEMA	35-N-050-192
	Pulse-Width Mod Ctrl	TI	TL494CN
	Feet	McMaster	9723K-107

All resistors are 1/4 W, 1%, metal-film, unless otherwise noted.

Table 1: Parts List – Board Assembly

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

• sales@tegam.com

Manufacturer	Cage Code
ANALOG DEVICES	6H956
AVX	16299
BOURNS	F0978
CDT (ADVANCED ELECTROCIRCUITS)-SEE TEGAM	
DALE	24546
FEMA	OP7Z6
ILLINOIS CAPACITOR	74840
KEYSTONE ELECTRONICS	91833
LITEON	0APZ0
MAXIM	1ES66
MCMaster CARR	OKVE6
MOHAWK ELECTRIC MFG CO	74075
MOTOROLA	0G546
MULTI-CONTACT	0WCJ0
NATIONAL SEMICONDUCTOR	0G557
PHILIPS	0TBA7
PPM-SEE TEGAM	
RAYOVAC	59768
RCA (HARRIS)	000926
RCD COMPONENTS	56637
STANTEL (NICHICON)	54498
TAKAMISAWA (KOA)	59124
TEGAM	49374
TEXAS INSTRUMENTS	8T904
THOMSON	0H0J3

Table 2: Vendor Cage Code Directory

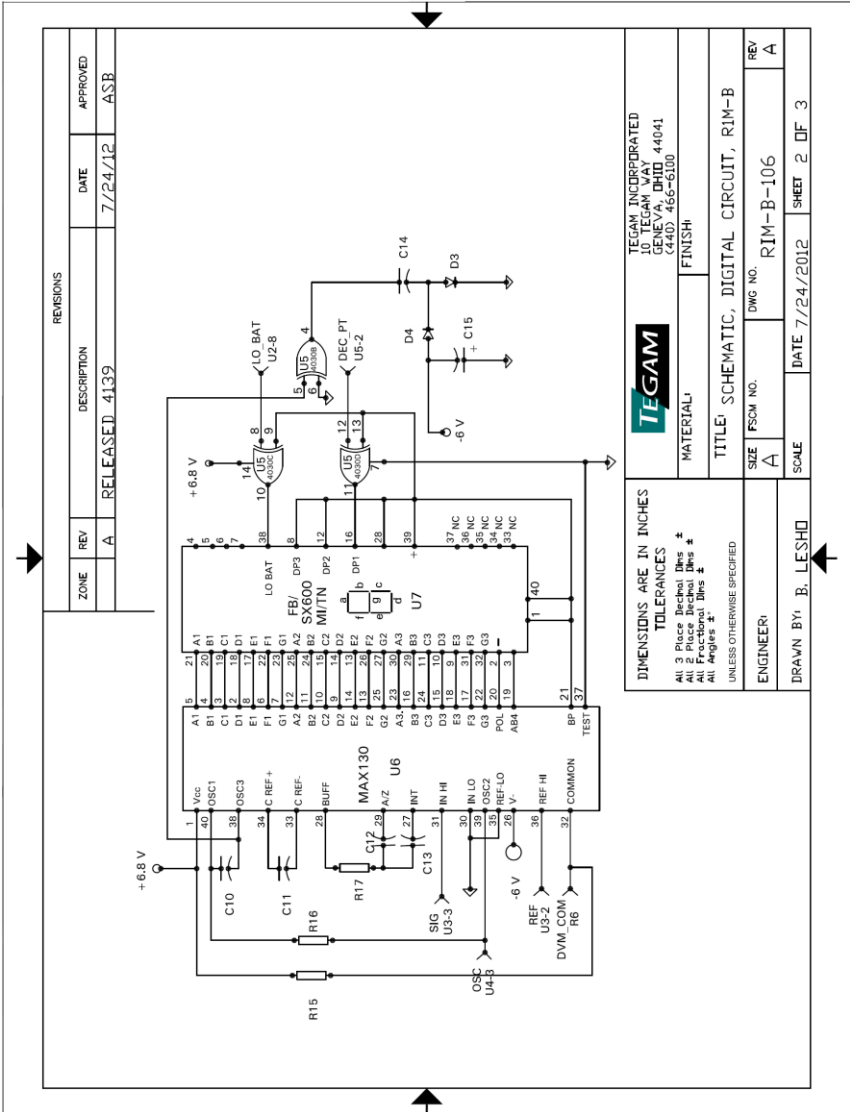
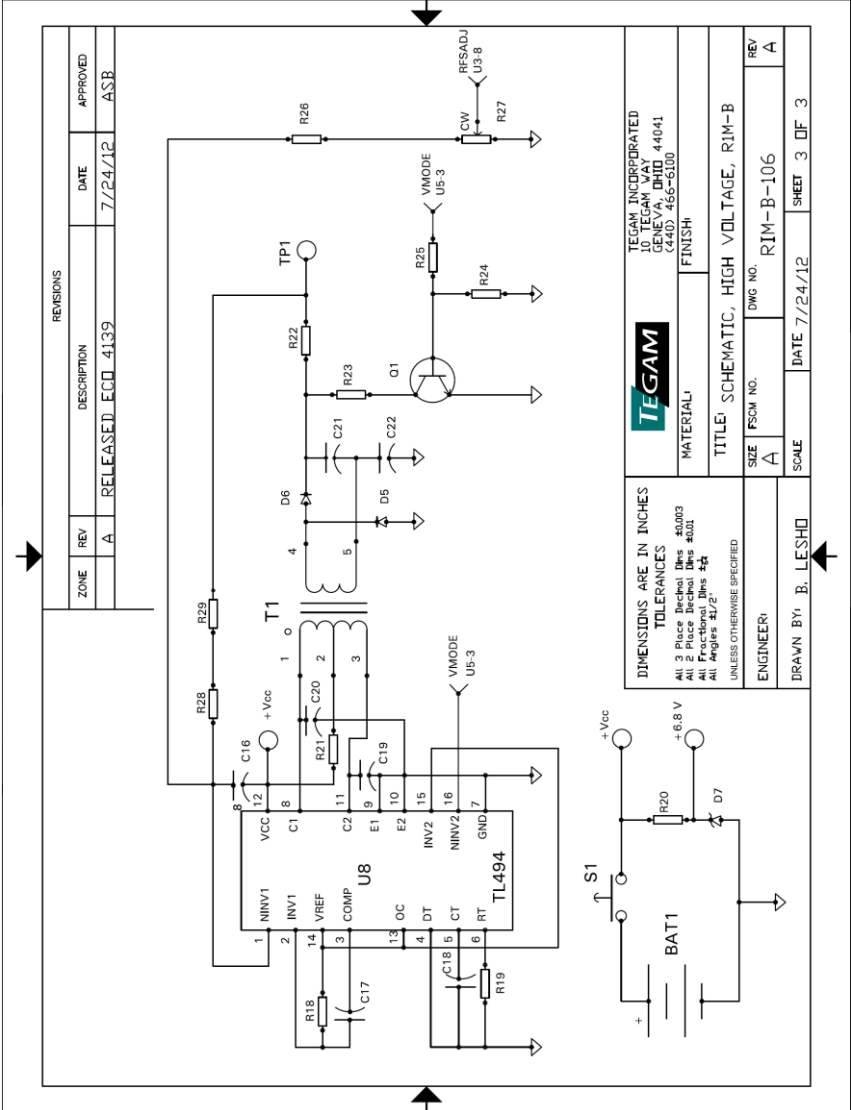


Figure 2: Digital Board Schematic



TEGAM		TEGAM INCORPORATED 10 TEGAM WAY GENEVA, OHIO 44041 (440) 466-6100	
MATERIAL:		FINISH:	
TITLE: SCHEMATIC, HIGH VOLTAGE, RIM-B			
SIZE	FSCM NO.	DWG NO.	REV
A		RIM-B-106	A
SCALE	DATE	SHEET	DF
	7/24/12	3	3

Figure 3: High Voltage Supply Schematic

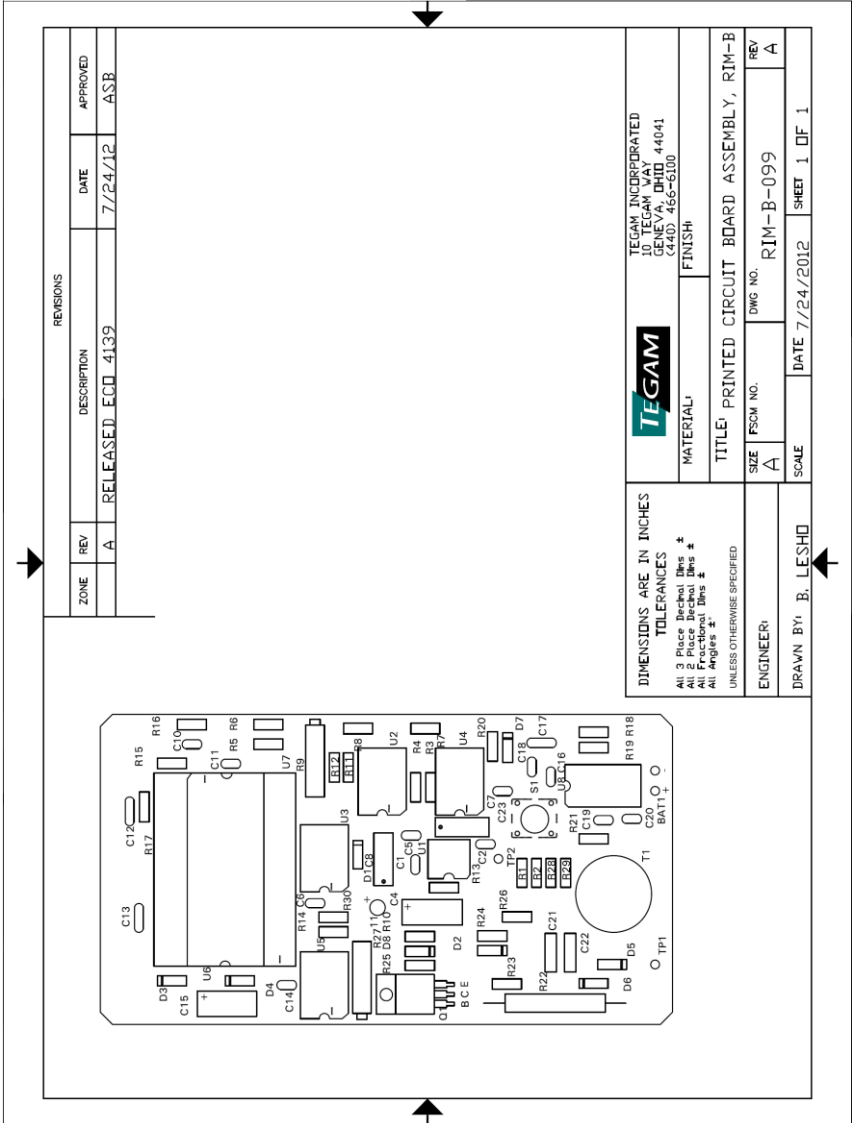


Figure 4: Parts Layout

SECTION 6

SERVICE INFORMATION

Preparation for Calibration or Repair Service

Once you have verified that the cause for R1M-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

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CAGE Code: 49374

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