INSTRUCTION MANUAL

MODEL
3207
DIGITAL
MICRO-OHM METER

Ballantine Laboratories, Inc.
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90-10353-5 November 2012

LIMITED WARRANTY

Ballantine Laboratories, Inc. warrants its products to be free from defects in material and workmanship. Rigorous quality control permits a standard new equipment warranty on material and workmanship of one year from date of shipment. During the in-warranty period, we will service or, at our option, replace at the factory, any device that fails in normal use to meet its published specifications. Computers, batteries, relays, and thermal elements that have given normal service are exempted. Special systems will have warranty periods as listed in their quotation.

The company makes no warranties or representations as to performance of products or as to service to purchaser or to any other person, except as set forth in the company's limited warranty accompanying delivery of products. The company reserves the right to change the warranty and service policy set forth in such limited warranty, or otherwise, at any time without further notice and without liability to purchaser or to any other person by reason of any such change unless considered unenforceable or unlawful under applicable law: i) All implied warranties, including, but not limited to implied warranties of merchantability and fitness for a particular purpose, are hereby excluded, ii) The liability of the company, if any, for damages relating to allegedly defective products shall, under legal or equitable theory, be limited to the actual price paid by purchaser for such products and shall in no event include incidental or consequential damages of any kind, iii) 90 day warranty on all factory service repairs.

Ballantine Laboratories, Inc.
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CERTIFICATION

Ballantine Laboratories, Inc. certifies that this equipment meets all applicable Ballantine specifications at time of shipment from the factory as determined by thorough testing and inspection. Ballantine further certifies that its measurements are traceable to the United States National Institute of Standards and Technology. All instruments used in calibrating Ballantine products are standardized by systematic reference to NIST-traceable standards.

REFERENCE STANDARDS

DC	10mV-750V	0.002%-0.003%
20Hz-50kHz	0.5V-500V	0.004%
20Hz-10MHz	0.5V-100V	0.05%
DC-30MHz	0.5V-100V	0.35%
DC-700MHZ	10uV-0.5V	1%-NIST
10MHz-1000MHz	1V-300V	1%-NIST

WORKING STANDARDS

STANDARD RESISTORS, BALLANTINE 1380A
THERMAL VOLTAGE CONVERTERS, BALLANTINE 1394A
TRANSFER STANDARD, BALLANTINE 1605A
MICROPOTENTIOMETERS, BALLANTINE 440
RATIO TRANSFORMERS, GERTSCH

Ballantine's Quality Assurance program satisfies the requirements of MIL-I-45208

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Figure 1-1. Model 3207 Digital Micro-Ohmmeter

(Shown with optional Kelvin Clips)

UNPACKING AND INITIAL INSPECTION

Check for following items when you unpack your instrument from the carton

1. INSTRUMENT (MODEL) : MICRO OHMMETER 3207 1
2. AC MAINS CORD: 1
3. SPARE FUSES
   - a) 1 Amp : 1
   - b) 250 mA (or 500 mA for Option – 05)
   - (IN MAINS INLET COMPARTMENT): 1
4. SCREWDRIVER FOR ZERO ADJUSTMENT: 1
5. INSTRUCTION MANUAL: 1
6. RS 232 CABLE: 1
7. ANY OPTIONS AS PER CUSTOMER'S ORDER.

IMPORTANT NOTICE !

Immediately upon receipt, the product should be carefully examined WITHOUT DELAY to ensure that no damage has occurred in transit. If mechanical or electrical damage is noticed, the insurance underwriters, the carriers and ourselves must be notified WITHIN TEN DAYS of receipt of the product. The insurance underwriters and/or carriers only will entertain claims for transit damage if this procedure is followed.

SECTION 1
GENERAL INFORMATION

1.1 Introduction

The Ballantine Model 3207 is a fully portable digital micro-ohm-meter with a 4½ digit LED display, capable of measuring low resistance with 0.1 micro Ohm resolution. It provides a RS232 COM PORT for computer interface. It employs the proven 4-wire method where a fixed DC current is applied to the DUT and the voltage drop across the DUT is measured and displayed as a proportional resistance reading. This method is used to eliminate the effects of lead resistance on the accuracy of measurements. It is a highly reliable, powerful performance and heavy duty instrument. It is a direct reading instrument leading to simple, speedy and accurate measurements.

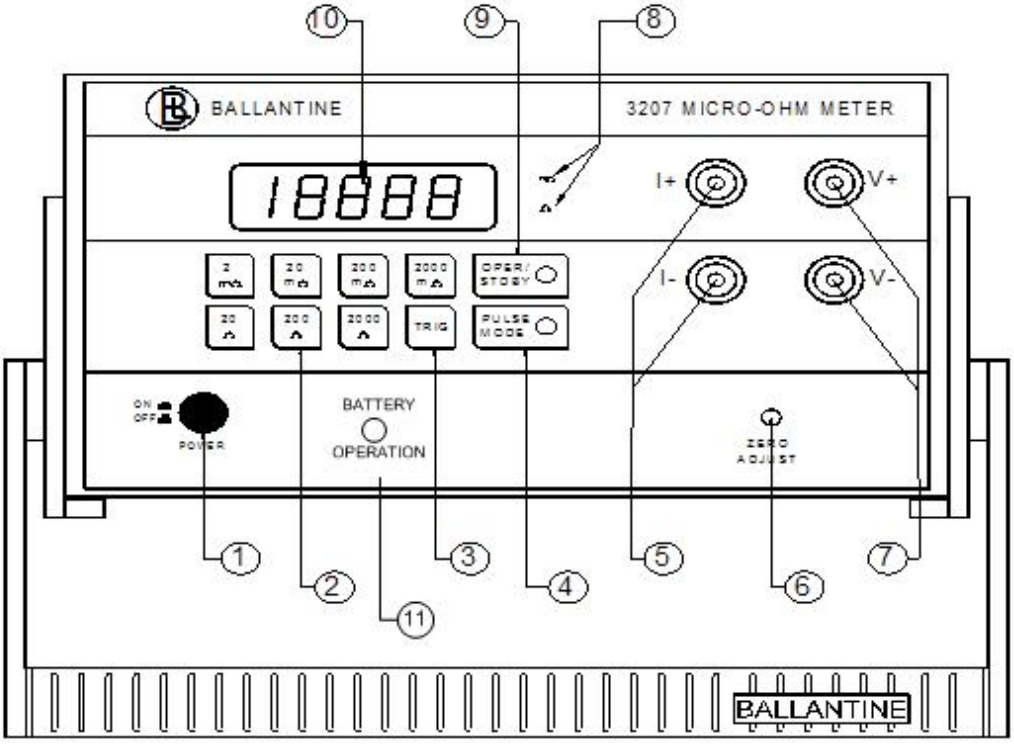
1.2 Features

Important features of the micro-ohm meter model 3207 includes:

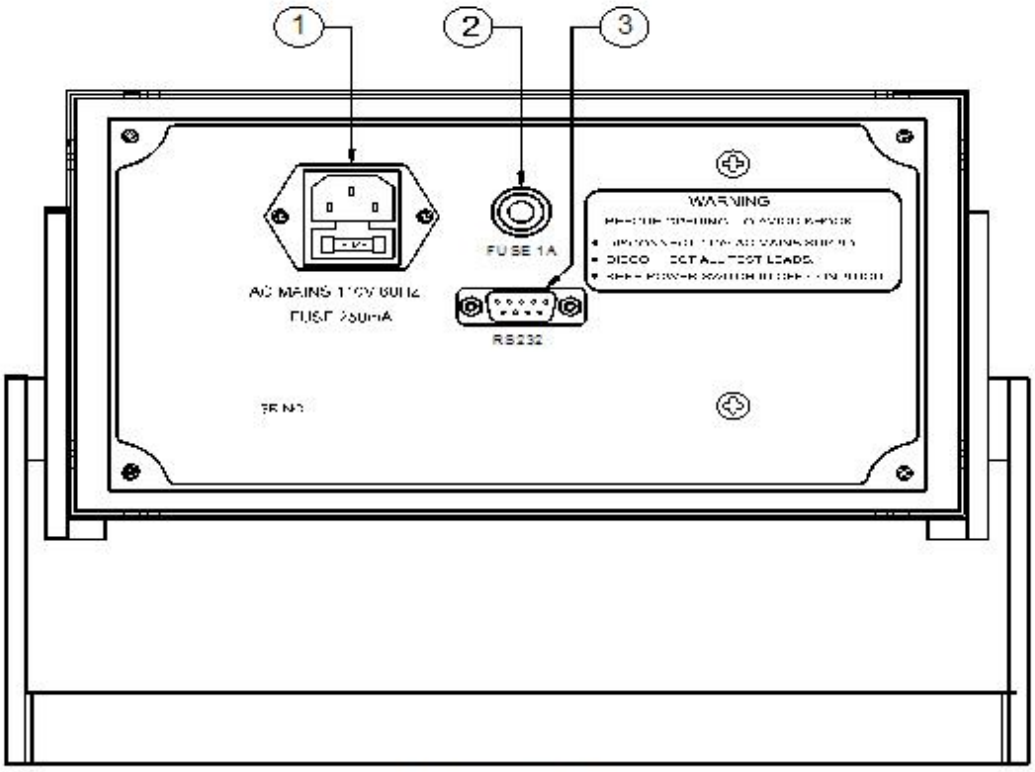
1. Accuracy: ± (0.5% + .5dgts) for 2 mΩ & ± (0.05% + .5dgts) for other ranges.
2. Pulse Mode operation
3. Digital 4½ digit LED direct reading instrument with0.1μΩ resolution.
4. Operating on 115V, 60Hz AC mains.
5. 4 Wire measurement method to avoid lead resistance.
6. Easy to operate, soft touch keys for range selection.
7. Rugged and Reliable design.
8. Designed for user safety.
9. Long term calibration stability.
10. Computer interface. (RS232 communication port.)

1.3 Applications:

- Resistance measurement of wires, cables, conductor etc.
- Winding resistance measurement of motors, transformers and generators.
- Contact resistance measurement of Relay, contactor, switches and LT switchgear.
- Resistance measurement of welding joints and metallic bonds.
- Resistive component and semiconductor devices etc.



FRONT VIEW



REAR VIEW

1.4 Controls, Indicators and Terminals

	DESCRIPTION	FUNCTION
FRONT PANEL		
1.	**ON/OFF** Switch	-Switches ON the instrument when pressed. - Switches OFF the instrument when released.
2.	**2,20,200,2000** Range selector switches	Tactile switch (soft touch) used to select appropriate range and function.
3.	**TRIG** switch	To trigger PULSE mode operation.
4.	**PULSE MODE**	PULSE mode when LED ON. CONTINUOUS mode when LED OFF.
5.	**I+ & I-**	Output terminals used to send defined current through the resistance under test.
6.	**ZERO** adjust	ZERO adjust preset, is accessible through the front panel and is used to zeroing the initial reading on display.
7.	**V+ & V-**	Input terminals used to measure voltage across the resistance being measured
8.	**mΩ & Ω**	Indicating selection of mΩ/Ω function
9.	**OPER/STDBY**	OPERATE mode when LED ON. ZERO adjust mode (STAND BY) when LED OFF.
10.	**LED DISPLAY**	4 ½ digit LED display.
11.	**LED (BATTERY OPERATION)** **(only for the Option – 05)**	OPERATE on BATTERY when LED ON OPERATE on AC MAIN when LED OFF
REAR PANEL		
1.	**AC Mains Inlet With 250 mA Fuse**	Receptacle for AC mains input power cable.
2.	**Input Protection fuse 1A Fast Blow**	For protection of the current source.
3.	**RS 232 Communication Port**	For computer interface.

1.5 Optional Accessories Available

No.	Test Lead Type	Intended Use
1	"C" clamp probe assembly with 10 meter long lead	To measure resistance of copper wires (having big diameter), copper bars, copper/ carbon rods etc. (P/N 85-60198-1)
2	Heavy Duty Bond testing probe assembly	To measure resistance of copper bars, carbon rods solid metals etc. (P/N 85-10314-0)
3	Test Lead with Gold Plated Alligator clip	To measure resistance of transformer winding, Barrater resistor, contact resistance of relay, LT switch gear contact resistance. (P/N 85-60288-0)
4	Test lead with Heavy Duty Alligator clip.	This lead is useful to measure resistance of transformer winding, coils, motor winding, copper foils etc. (P/N 85-60199-1)
5	Test Lead with Gold Plated Kelvin Clip	To measure small size resistors. To measure resistance of transformer winding, coils, inductors etc. (P/N 85-60197-0)

1.6 Accessory supplied with Instrument

No.	Accessory	Intended Use / Part Number
1	RS 232 Cable	To interface with computer
2	AC Mains Power Cable	P/N 33-10000-0
3	Manual	P/N 90-10353-5

For connections refer to the setup diagram in Section 7.

1.7 OPTIONS

The 3207 Micro-Ohm Meter can be ordered with the following options:

Option	Ballantine Part Number	Description
Base unit	3207	Standard Ballantine 3207 Micro-Ohm Meter. Operates from AC Mains (115VAC or 220VAC as ordered)
-05	3207-05	Ballantine 3207 Micro-Ohm Meter with Battery Option. Operates from AC Mains (115VAC or 220VAC as ordered), or from the internal rechargeable battery when AC Mains supply is absent. In this option the instrument has an LED on the front panel that will be OFF when the unit operates on AC Mains and will turn ON when the unit operates on battery (see the Figure 1.7-1). The unit can operate for minimum 1 hour continuously at 1A before requiring recharging. To recharge the battery simply connect the unit to an AC Mains. The battery will fully charge in approximately 2 hours. Internal circuitry senses the absence of AC power and will automatically switch to battery operation.

Figure 1.7-1 Ballantine 3207-05 Micro-Ohm Meter with Battery Option

SECTION 2
SAFETY INFORMATION

2.1 Safety requirements

- **ALWAYS** observe the safety consideration and cautions. Read and understand manual for operational and safety considerations.
- Always inspect your Micro ohmmeter, test leads, mains cable and accessories for any sign of damage or abnormality before every use. If any abnormal condition exists (i.e. broken or damaged test leads, mains cable, cracked case, display not reading etc.) do not attempt to take any measurements, as this may cause malfunction.
- Never touch exposed wiring, connections, test leads tips or any live circuit conductors when attempting to make measurements.

2.2 Safety Symbol and Terms:

- ⚠ Indicates read the Instruction Manual carefully before operating the instrument to avoid damage to the instrument as well as injury to the operators.

Terms :

- The **WARNING** heading used in this manual indicates precautions to be followed in order to avoid injury or fatalities to the person. Always review the associated information very carefully before performing the indicated procedure.
- The **CAUTION** heading used in this manual indicates precautions to be followed in order to avoid injury/ damage to the instrument. Such damage may invalidate the warranty.
- The **NOTE** heading in this manual states the important information to the user.

2.3 Warning:-

- Do not operate this instrument in explosive atmosphere (i.e. in the presence of flammable gases or fumes, vapor dust).
- Ensure the proper grounding of Instrument.

2.4 Caution:

- Use the rated fuse to meet the voltage and current requirements given in the specification.
- Use only manufacturer supplied typical Leads for typical application as referred in this manual.
- Always turn off all power from the resistance under test.
- Do not connect the current or voltage leads of the instrument to any carrying source since this may result in damage to the instrument and void the warranty.
- The instrument should be operated from an AC power source with its neutral at or near ground (earth) potential. The instrument is not intended for operation from two phases of a multiphase AC system.

SECTION 3
PREPARATION OF OPERATION.

3.1 Installation:

The instrument is fully solid state and dissipates minimum heat and no special cooling is required. However the instrument should not be used where ambient environment is beyond the temperature limits indicated in the specifications. The instrument is shipped ready for use as a portable or bench instrument.

Warning !

Do not operate the instrument where inflammable gases are present to avoid fire hazard.

3.2 Power requirement;

The instrument requires Single Phase 115V, 60Hz AC mains supply with proper grounding.

Warning !

The instrument is provided with a three terminal power cord, which will ground the case when connected to a three terminal grounding outlet. If a grounding outlet is not available, an adapter must be used which provides a good grounding connection.

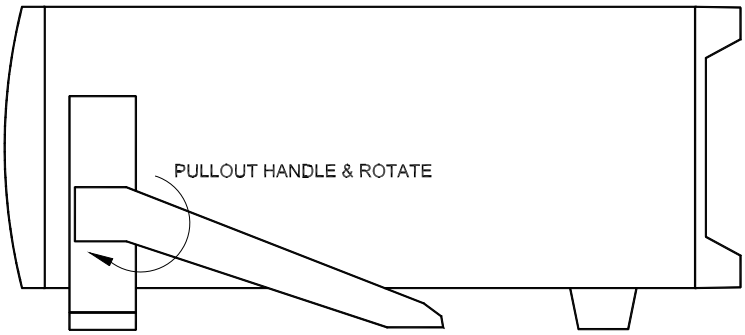
Caution

Use the specified AC mains voltage, otherwise you may damage the instrument and void the warranty.

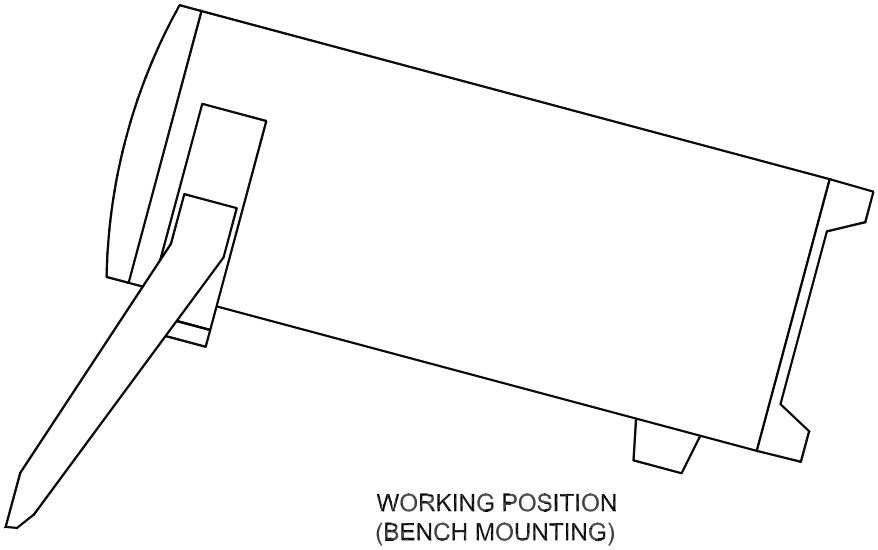
3.3 Bench Mounting:

This Instrument is fitted with four rubber feet. It is intended to stand on a bench. The Instrument is provided with carrying handle which also serve as a tilt-stand to adjust the viewing angle of the Instrument from the bench level. Refer to fig. 3.1

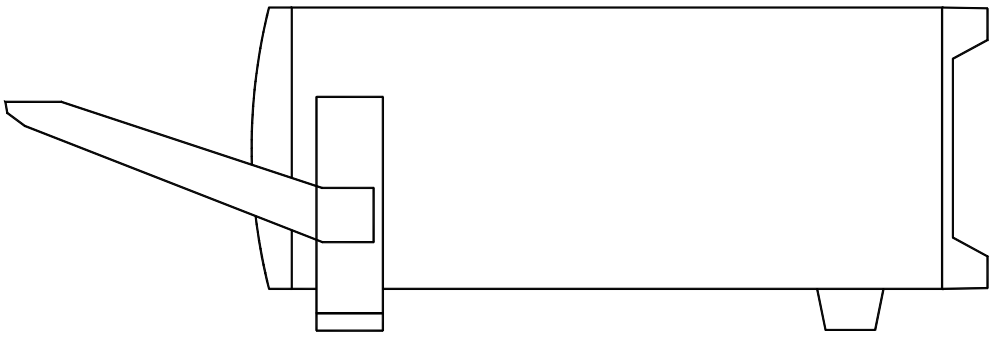
BENCH MOUNTING



PACKING POSITION



WORKING POSITION
(BENCH MOUNTING)



CARRYING POSITION

FIG 3.1

3.4 Using test leads:

Use Appropriate test leads for specific application (see Section 1.5).

3.5 Zeroing The Instrument

Ensure that the instrument is warmed up for five minutes.

Ensure that correct range required for the measurement is selected through switches (e.g. 2mΩ TO 2000Ω)

Ensure that PULSE / CONT mode is off

Select OPERATE mode. Connect DUT. Disconnect the I+ terminal.

If display is not 0000, adjust the reading to Zero using a screwdriver through the hole provided on the front panel.

Reconnect the I+ terminal.

Caution

Use the special Screwdriver provided with the instrument for zeroing, otherwise it may damage the adjustment and void the warranty.

3.6 Pulse Mode Operation

NOTE: - The Trigger switch shall be operated momentarily.

In this mode, current through the resistor is supplied only for a short duration whenever the trigger switch is pressed, and the reading is stored until the next measurement cycle is initiated. This results in minimum heating of the resistance under test. PULSE mode operation permits accurate measurement of resistance, which are temperature dependent. It is useful for non-destructive measurement of fuse links, riveted joints, welds, solder joints, relay and switch contacts, etc.

Caution

Pulse mode operation must be used only for non-inductive resistors. Under no circumstances should it be used to measure inductive resistances, otherwise you may obtain erroneous readings and/or damage the instrument.

3.7 Continuous Mode Operation

In CONT mode, current is continuously supplied to the sample. This mode is recommended for making measurements of inductive loads like: transformer winding, coil winding and motor winding.

3.8 Precautions To Be Taken For Various Types Of Measurement:

Fuses: While measuring the resistance of fuses, the test current must be observed otherwise the fuse may blow. To avoid this, read section 6.1 `Specifications'. `Test leads with gold plated Kelvin clips' are recommended for this measurement.

Bus bars: Disconnect the supply before measurement. `C clamp assembly with 10 meter long leads is recommended for this measurement.

Small resistors: Do not check the resistor in circuit otherwise you may get erroneous readings and also damage the instrument. `Test lead with gold plated Kelvin clips' are recommended for such measurements.

HV transformers:

Caution

Discharge the inductors before making connections for measurement.
Ensure firm contact during connections, to avoid HV generated Back EMF due to the interruption of current through the inductance of the winding.

Note

Caution is to be followed especially while measuring transformer-winding resistance, of large power transformers in the order of 1 MVA and above or in motor windings. When the inductive resistance under test is adjacent to high voltage (HV) ac generation and/or transmission equipment, they are likely to pick up noise which may result in unstable readings. This instrument is specially designed to reject unwanted pick up. In spite of this, if the display instability is found to be excessive, this is due to the noise present e.g. EMI

(Electromagnetic Interference). In such cases, take your instrument away from the source of noise by using long leads to get stable readings. Also, due to limited compliance voltage and current, the time required to obtain a steady reading is substantial when making winding resistance measurements of transformers of capacities higher than 8 MVA.

However, when fast response measurements are to be made on high inductance loads, this instrument is not recommended.

NOTE:

Due to its high gain, the Instrument may give 3 to 4 counts flicker on 2 milliohm range.

SECTION 4
MAKING MEASUREMENT

4.1 Making Measurement: -

Note:

For unknown resistances (Devices Under Test) always start with a higher range selection.

Ensure warm up of the Instrument for the specified time.

- Select PULSE / CONT mode as per requirement.
- Select Ω / mΩ mod.
- Select the appropriate range by pressing one of the 2mΩ to 2000Ω range switches.

Note

Pulse mode operation does not require Zeroing of the instrument and if done gives erroneous readings.

- Ensure Zeroing of the instrument (for CONT. mode only).

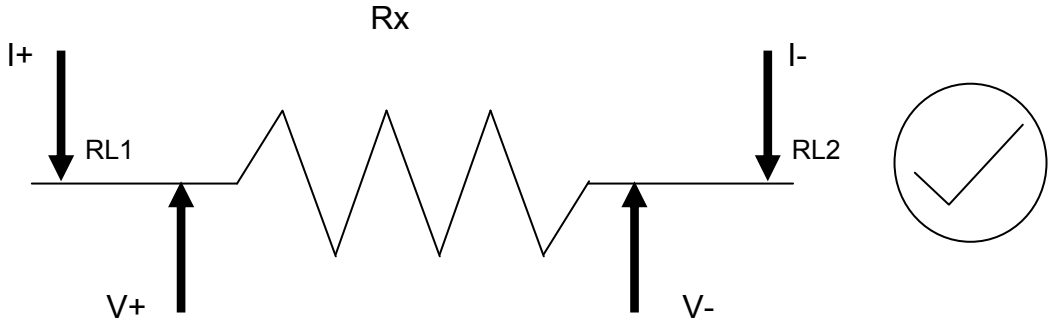
Caution

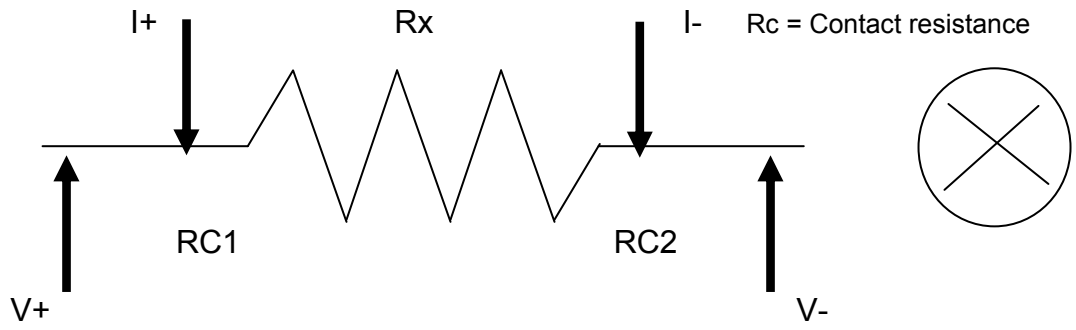
Always turn OFF the power from the resistance under test. Do not connect the current or voltage leads of the instrument to any line circuit since this may result in damage to the instrument and void the warranty.

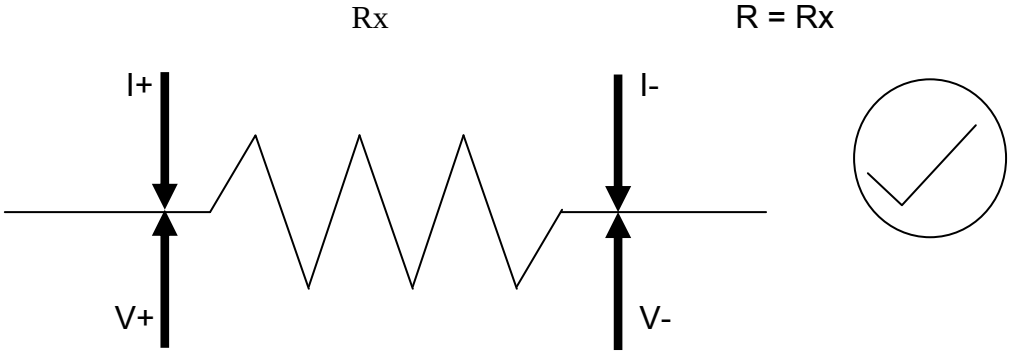
- Make the connections to the Device Under Test (Refer Fig. No. 4.1) by using appropriate test leads (refer section 1.5)
- Observe the display, if it blinks in the CONT mode or blank in the PULSE mode, then select the next higher range.
- The Display will update continuously during CONT mode and will be latched in the PULSE mode.

CONNECTION OF RESISTANCE UNDER MEASUREMENT

Rx = Res. Under measurement
RL = Lead resistance
R = Measured value
R = Rx







4.2 COMPUTER INTERFACING.

The **3207** Micro ohm meter is equipped with an isolated 3 wire RS232 interface for PC. The interface is available as a 9 pin 'D' type female connector located on the rear panel of the instrument.

Hardware signals:

1. **Pin Number 2 is Receive Data pin, which will mate with Pin Number 2 of the 9 Pin connector of the PC Serial Port.**
2. **Pin Number 3 is Transmit Data pin, which will mate with Pin Number 3 of the 9 Pin connector of the PC Serial Port.**
3. **Pin Number 5 is Ground pin, which will mate with Pin Number 5 of the 9 Pin connector of the PC Serial Port.**

To install HyperTerminal on your PC,

Click on 'Start'

Select 'Setting'

Select 'Control Panel'

Click on 'Add/Remove Programs'

Select 'Windows Setup'

Double Click on 'Communication'

Select 'HyperTerminal'

Click on 'OK'.

To Run HyperTerminal,

Click on 'Start'

Select 'Program'

Select 'Accessories'

Select 'Communications'

Click on 'HyperTerminal'.

The software of the instrument accepts the command tokens as listed below from the PC and takes the necessary actions.

While interfacing, select parameters as

1. BAUD RATE = 9600.
2. PARITY = NONE
3. DATA BITS = 8
4. STOP BITS = 1

COMMAND TOKEN		ACTION PERFORMED
CHARACTER	**ASCII VALUE in HEX**	
'0'	30	Selects 2mΩ Range
'1'	31	Selects 20mΩ Range
'2'	32	Selects 200mΩ Range
'3'	33	Selects 2000mΩ Range
'4'	34	Selects 20Ω Range
'5'	35	Selects 200Ω Range
'6'	36	Selects 2000Ω Range
'i' OR 'I'	69 OR 49	Increments the range
'd' OR 'D'	64 OR 44	Decrements the range
'r' OR 'R'	72 OR 52	Reads the range selected returning the ASCII value from '0' to '6' of the range.
't' OR 'T'	74 OR 54	Reads the 5 digit (Max) count *
'o' OR 'O'	6F OR 4F	Operate Mode
's' OR 'S'	73 OR 53	Stand-By mode

*Interpretation of count

For example: If the count is 668,then read the range. If the range is '2' (range=200mΩ), then read the count as 6.68 mΩ.

No.	ASCII character	Range selected	Maximum display
1	'0'	2mΩ	1.9999
2	'1'	20mΩ	19.999
3	'2'	200mΩ	199.99
4	'3'	2000mΩ	1999.9
5	'4'	20Ω	19.999
6	'5'	200Ω	199.99
7	'6'	2000Ω	1999.9

SECTION 5

CARE AND MAINTENANCE

5.1 Care and Maintenance:

Your Instrument is a precise electronic device; do not tamper with the circuitry. To prevent electric shock hazard, turn OFF the power and disconnect the probes or connectors from the mains before removing the case, if needed.

5.2 Replacing the Fuse:

Caution: For continued protection against fire or other hazard, replace only with a fuse of the specified voltage and current ratings.

Power Line Fuse

Line Voltage	Fuse
115V, 60Hz	250mA
115V, 60Hz	500mA (for the Option –05)

Input Protection Fuse

Voltage Rating	Fuse
115V	1A

Follow these steps to replace the Fuse.

1. Switch OFF the Instrument.
2. Disconnect the Test Leads and Mains Cord.
3. Remove the defective Fuse by taking off the fuse holder.
4. Install a new Fuse in the Fuse holder.

5.3 General Maintenance:

Any Adjustments, Maintenance or repair of the instrument, or Fuse replacement should be done only by qualified service personnel.

1. Use and store your instrument only in normal temperature environments. Extreme temperature can shorten the life of electronic devices and distort or melt plastic parts.
2. Keep your instrument Dry. If it does get wet, wipe it dry immediately. Liquids might contain minerals that can corrode the electronic circuits.
3. Handle your instrument gently and carefully. Dropping it can cause damage and cause the instrument to work improperly.
4. Keep your instrument away from Dust and Dirt which can cause premature wear of moving parts like switches.
5. Prior to cleaning the cabinet, disconnect the mains plug from the power outlet. Clean only with a damp soft cloth and a commercially available mild household cleaner. Ensure that no water gets inside the instrument to prevent possible shorts and damage to the instrument.

Caution

Modifying or tampering with your instrument's internal components can cause a malfunction and will invalidate its warranty.

5.4 Reshipment:

- If reshipment is necessary please use the original shipping packing material or equivalent.
- Ensure that freight and insurance are prepaid.
- In all correspondence please indicate the Name, Sr. No., Model No. and Date of Purchase and source and any additional information that will help if troubleshooting is necessary.

SECTION 6
SPECIFICATIONS

6.1 Electrical:

Range (Ohm)	Resolution (Ohm)	Accuracy ± (% rdg + dgt)	FS rdg. (Ohm)	DC Current applied to DUT	Power dissipation in the sample at mid-scale
2m	0.1µ	±(0.5+5)	1.9999m	1A	1mW
20m	1µ	±(0.05+5)	19.999m	1A	10mW
200m	10µ	±(0.05+5)	199.99m	100 mA	1mW
2000m	100µ	±(0.05+5)	1999.9m	10 mA	0.1mW
20	1m	±(0.05+5)	19.999	10mA	1mW
200	10m	±(0.05+5)	199.99	1mA	0.1mW
2000	100m	±(0.05+5)	1999.9	0.1mA	0.01mW

Note: Accuracies are valid from 1/10th of the range to FS of range and valid at.

Temperature: 25^{o}C ± 3^{o}C at 55% ± 10 % RH.
Tempco. : 150 ppm/^{o}C.

Warm up time for stated accuracy – 5 minutes
Over range – blinking Zero display.

6.2 Environmental :

Temperature:

Operating : 0^{o}C to 40^{o}C

Storage : 0^{o}C to 50^{o}C

Humidity : < 90% RH Non Condensing.

6.3 General :

Power : 115 VAC ± 10%, 60Hz, single phase (220VAC on order)

Dimensions : 340 (D) x 258(W) x 145(H) mm (approx.)

Net Weight : 3.2 Kg.(approx.) (4.0 Kg. for Option –05)

Shipment Weight : 5.2 Kg. (approx.)

Display Update Rate : 2.5 times / second

Reading Display : 4 $^{1/2}$ digit , Height :-14mm.

Indicators : Ω and mΩ using 2 LED's

Overload Protection : 115V AC / DC Sense terminals and Source terminals Protected by 1Amp Fuse.

Accessories Supplied :

1Amp, 250mA fuses,

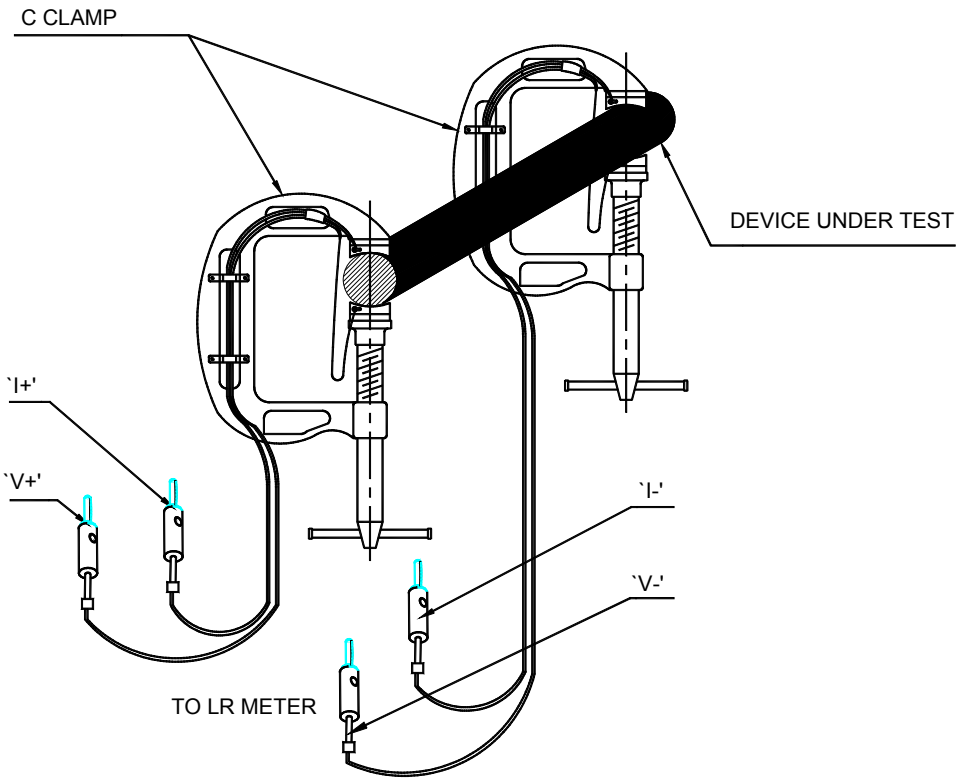
Mains cord

RS 232 Cable.

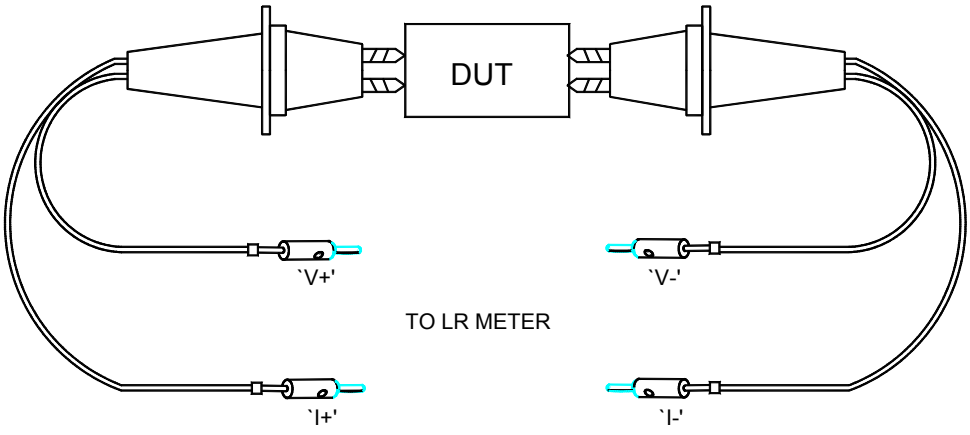
Accessories Optional :

1. "C" Clamp probe assembly with 10 meter long lead. (P/N 85-60198-1)
2. Heavy Duty Bond testing probe assembly. (P/N 85-10314-0)
3. Test leads with Gold Plated Alligator clips. (P/N 85-60288-0)
4. Test leads with Heavy Duty Alligator clips. (P/N 85-60199-1)
5. Test leads with Gold Plated Kelvin clips. (P/N 85-60197-0)

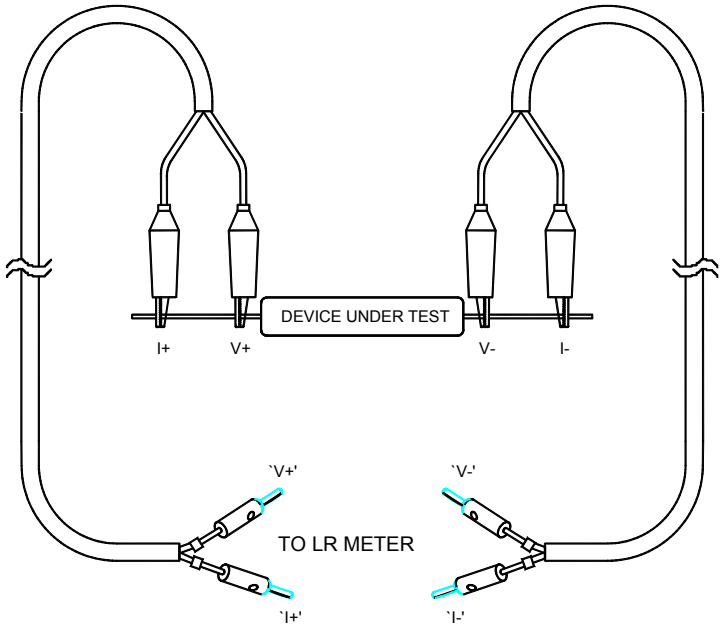
SECTION 7
OPTIONAL ACCESSORIES



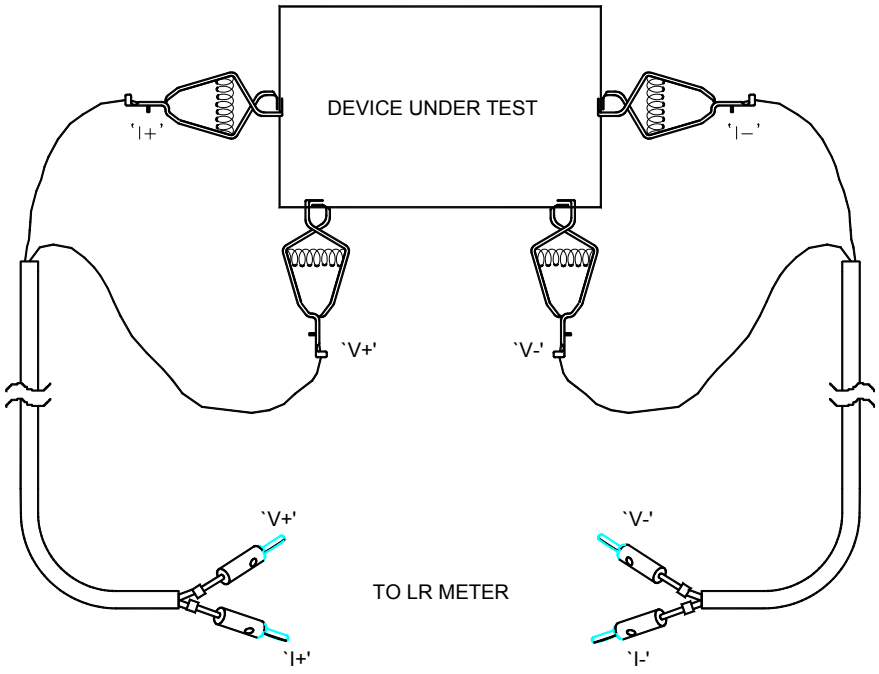
1. C CLAMP ACCESSORIES



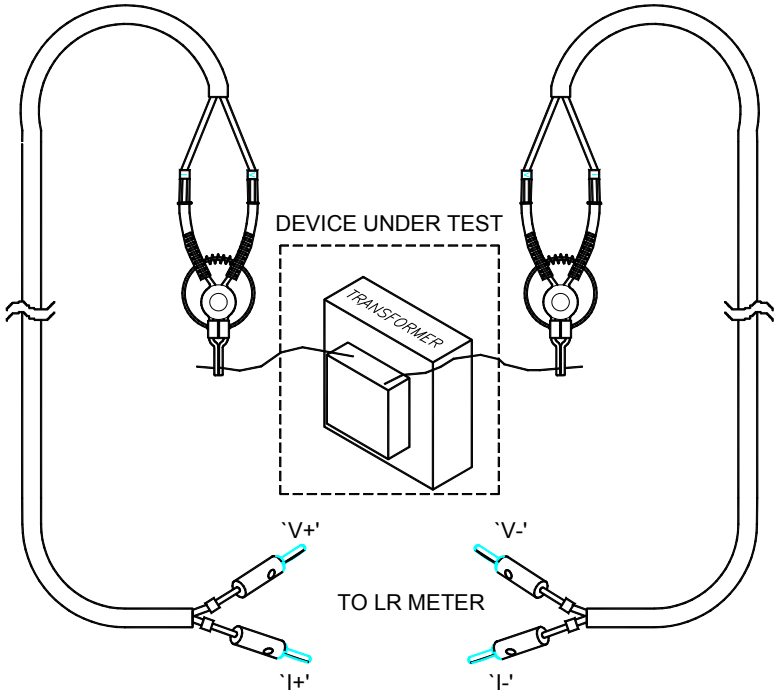
2. HEAVY DUTY BONDING RESISTANCE TEST PROBE ASSEMBLY



3. TEST LEADS WITH GOLD PLATED ALLIGATOR CLIPS



4. TEST LEADS WITH HEAVY DUTY ALLIGATOR CLIPS



5. TEST LEADS WITH GOLD PLATED KELVIN CLIPS

ATTACHMENT - CALIBRATION FORM

CalForm

Page 1 of 1

✓ In Tolerance ✖ Out of Tolerance

Form# : 3207 Rev : 0 Form ID: 10982

Noun : Micro-Ohmmeter Procedure : MRF Manual

Model : 3207 Mfr : Ballantine Laboratories Inc.

	Nominal	As Found		As Left		Min	Max
Accuracy (CONT Mode)							
2 mOhm	1.0000					0.9945	1.0055
20 mOhm	10.000					9.990	10.010
200 mOhm	100.00					99.90	100.10
2000 mOhm	1000.0					999.0	1001.0
20 Ohm	10.000					9.990	10.010
200 Ohm	100.00					99.90	100.10
2000 Ohm	1000.0					999.0	1001.0
Accuracy (PULSE Mode)							
2 mOhm						0.9945	1.0055
20 mOhm	10.000					9.990	10.010
200 mOhm	100.00					99.90	100.10
2000 mOhm	1000.0					999.0	1001.0
20 Ohm	10.000					9.990	10.010
200 Ohm	100.00					9.990	100.10
2000 Ohm	1000.0					9.990	1001.0

End of Datasheet

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