Model 9711A Series

Multi-Tap DC Current Shunt

Technical Manual

NOTICE

TM9711A-D1-00
29 November, 2024

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1.0 INTRODUCTION

This manual provides an overview of the 9711A DC Multi-Tap Current Shunt and also contains the necessary information required to perform a calibration or verification test. General product information, product description and performance specifications are also included.

The phone number in the USA and Canada to obtain Product Support, Calibration Service or Replacment Parts is (800) 310-8104.

To contact Guildline Instruments, the following information is provided.

USA and Canada Telephone: (613) 283-3000
USA and Canada Fax: 1-613-283-6082

Outside US and Canada Telephone: + [0] [1] 613 283-3000
Outside US and Canada Fax: + [0] [1] 613 283-6082

You can also contact Guildline Instruments Limted via their Email or Websites.

Email is: sales@guildline.com
Website is: www.guildline.com

1.1 Warranty

Guildline Instruments warrants its products to be free of defects in manufacture and normal operation for a period of two (2) years from the date of purchase, except as otherwise specified. This warranty applies only in the country of original purchase and only to the original purchaser, who is also the end user. Equipment, which is defective or fails within the warranty period, will be repaired or replaced at our factory without charge at the discretion of Guildline Instruments.

In addition, systems engineered by Guildline Instruments are warranted to be free of defects in overall system operation for a period of two (2) years from the date of receipt by the original purchaser.

Third party system components purchased by Guildline carry the warranty of the original equipment manufacturer and will be accepted for claim by Guildline Instruments at our factory only after warranty authorization by the original manufacturer.

Note: Annual recommended recalibration is NOT included as part of the warranty.

Limitation of Warranty

Warranty coverage does not apply to equipment which has failed due to misuse, neglect, accident or abnormal conditions of operation or if modifications or repairs have been made without prior authorization of Guildline instruments.

Damage in Shipment to Original Purchase

Instrument(s) should be thoroughly inspected immediately on receipt for visible damage. Any damage should be reported to the carrier and further inspection and operational tests should be carried out if appropriate to determine if there is internal damage. Contact Guildline Instruments before returning for repair. The customer or purchaser must complete all final claims with the carrier.

Regular charges will apply to non-warranty service. External service charges and expenses will be billed at cost plus handling.

1.2 To Obtain Warranty or Calibration and Repair Service

Call for a Return Material Autorization (RMA) number. RMA's are required for all Warranty Returns and/or Calibration and Repair Service Requests. Telephone, Fax and email addresses to contact Guildline are provided previously.

Guildline Instruments will pay for all warranty costs including shipping to and from the original shipment point. However, if the instrument is purchased within one country and shipped to another, Guildline will only pay for shipping to and from the original ship to country or customer point.

1.2.1 USA Warranty Return Address

USA Customers should use the following address to return instruments for warranty service or calibration support.

Guildline Instruments Limited
C/O AN Deringer
800 Proctor Avenue
Ogdensburg, NY 13669

Mark on the outside of the box:
RMA # _____________
Model #_____________
Serial #_____________
The Statement: "Canadian manufactured goods being returned for repair."

1.2.2 Returns All Other Countries

For all other countries, including Canada please ship to:

Guildline Instruments Limited
21 Gilroy Street, PO Box 99
Smiths Falls, ON K7A 4S9

Mark on the outside of the box:
RMA # _____________
Model #_____________
Serial #_____________
The Statement: "Canadian manufactured goods being returned for repair."

1.3 Safety Information

WARNING: During usage and calibration high voltages or high currents may be present. Use caution when working above 40 Volts DC or currents above 1 mA. Such voltages or currents can cause death.

The 9711A DC Shunts are designed to work within operating specifications. Applying more than the recommended current will damage the unit.

Inspect the 9711A for damage such as cracked connectors prior to use. If the unit has a burned smell or smoke is visible during use, discontinue use immediately.

If test equipment used with DC Shunts overloads or trips, this could be a sign that the 9711A requires repair.

Inspect all test leads used with the Multi-Tap DC Current Shunt for damaged insulation or exposed metal. Check all test leads for continuity.

Ensure all test leads are correctly connected prior to applying current or voltage.

Do not use Multi-tap DC Current Shunts around explosive gas, vapor or dust.

2.0 9711A SPECIFICATIONS

2.1 Uncertainty Specifications

The specifications apply from Full Rate Current down to 10% of the full rated current. For example the 300 A Range can be used from 300 A down to 30 A or the 100 A Range can be used down to 10 A. Ensure current cables used can handle the full rated current.

Resistance (Ohms)	Full Rated Current Range (A)	1 Year Accuracy [1, 2]	Temperature Coefficient (µΩ/Ω/^{0}C) or (ppm/°C)	Power Dissipation at Rated Current (mW)
10 kΩ	0.01 mA	± 0.01 %	5	0.001 mW
1 kΩ	0.1 mA	± 0.01 %	5	0.01 mW
100 Ω	1 mA	± 0.01 %	5	0.1 mW
10 Ω	0.01 A	± 0.01 %	5	1 mW
1 Ω	0.1 A	± 0.01 %	5	10 mW
0.1 Ω	1 A	± 0.01 %	10	100 mW
0.01 Ω	10 A	± 0.01 %	10	1 W
1 mΩ	100 A	± 0.05 %	30	10 W
0.333 mΩ	300 A	± 0.1 %	30	30 W

Note 1: Calibrated in air at 23 ± 1^{0}C referred to the unit of resistance as maintained by a National Metrology Institute, and expressed as a deviation from nominal with a total combined uncertainty to a level of confidence of 95%..

Note 2: A traceable report of calibration stating the measured values and uncertainty is provided with each unit at test currents of 1/10 of rated current and full rated current to a maximum of 100A and a minimum of 0.1 mA,

2.2 General Specifications

GENERAL SPECIFICATIONS				
Environmental	Temperature		Humidity	
Operating	5 ^{0}C to 38 ^{0}C	41 ^{0}F to 100 ^{0}F	< 70 % RH non-condensing	
Storage	-20 ^{0}C to 55 ^{0}C	-4 ^{0}F to 131 ^{0}F	< 90 % RH non-condensing	
Exterior Dimension (Rack Mount)	222 mm (H)	482 mm (W)	183 mm (D)	13.6 kg
	8.7" (H)	19" (W)	7.2" (D)	30 lbs

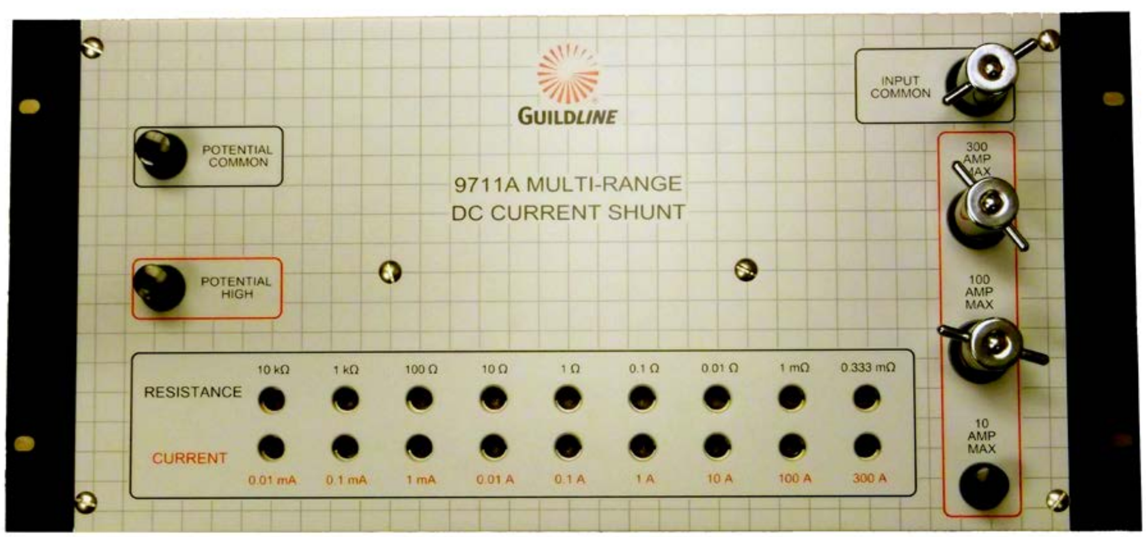
3.0 OVERVIEW OF THE 9711A

3.1 General

The Model 9711A is a self-contained 9 range, 4 terminal shunt, for precision current measurements up to 300 A. The design optimizes a number of important factors such as the effects of self-heating, temperature coefficient, size, weight, ease of operation and total measuring range.

It provides wide range precise current measuring capability when used with a potentiometer or digital voltmeter as a readout.

The shunt resistors are mounted in air to minimize size and weight, yet self heating is a negligible source of error from 20 ^{0}C to 30 ^{o}C. Self-heating has only a small effect for a still wider range of ambient temperatures. The resistors are made of selected zeranin wire and are non-inductively wound, up to 1 A. The unit consists of nine (9) shunts, of the 4-terminal configuration. Each shunt provides a 100 mV drop at the nominal rated current. The maximum current rating is 140% of nominal for all ranges except the 100 A and 300 A ranges, for which the maximum is 110 % of the nominal current rating.



3.2 Operating Instructions

3.2.1 Maximum Current

Determine the maximum current that will be measured. If maximum current to be measured is unknown, good instrumentation practice would be to approximate it at a value that is certain not to be exceeded.

3.2.2 Range Selector Plugs

Insert a pair of range selector plugs into the appropriate female receptacles on the front panel. One plug is inserted over the other (in a vertical line). For example, if the range selected is 10 A, insert the two plugs in the two receptacles directly over the engraved portion marked with the numeral "10 A / 0.01 Ω".

3.2.3 10 A Measurements and Below

For measurements up to and including 10 A, connect the shunt current terminals “10 A max” and “Input Common” in series with the current source and the item under test, (see page 22). Note the polarity of the connections, C1 to “10 A max” post, C2 to “Common”. If a DC ammeter is being calibrated make sure the meter deflects up scale. If not, reverse it’s lead connections. Use leads of sufficient size to carry the rated current. A Connect the milli-voltmeter being used as a readout instrument (DVM, DC potentiometer, etc., with a range of 0 mV to 100mV) to the two binding posts marked Potential in the space between them. “P1” or “High” shall be connected to “Potential High”, “P2” or “Low” to “Potential Common”.

> Note 1: ·Polarity from the source is unimportant insofar as the shunt is concerned as long as the potential and current connections agree, i.e., both "common" binding posts must be connected in the same polarity. When using a different current source than Guidline 6623A-300 Range extender, its mandatory that current and potential connections are according to polarity.

> Note 2: If the readout device is a low resistance milli-voltmeter, inaccuracies can result proportional to the current drain. All potentiometers have a finite resistance so their use will result in some loss of accuracy due to circuit loading.

If a DVM is employed, its input resistance should be checked to see that it is sufficiently high to be negligible. For example, worst case would be measurements from 0-10 µA that use the 10 kohm resistor. If the DVM has a 100 megohm input resistance, its effect is 100 µΩ/Ω or 0.01% that would add an offset to the measurment. On higher current ranges the effect would be neglible. Consideration should be for thermal emf errors when using a less accurate DVM. This can be checked by checking the zero point and taking 2 readings with the current reversed for the second reading etc.

3.2.4 Measurements above 10 A

For measurements above 10 A (up to and including 300 A), observe the same procedures as described in 3 (a) above, except connect one lead to the 100 A or 300 A binding post as required (instead of to the 10 A binding post). Be certain the range plugs are inserted into the correct range positions before application of the test current."

3.2.5 mV Output

Each shunt has a 100 mV output with the application of the rated current. In actual measurement, it is this voltage or fraction thereof, which the readout instrument indicates. It's reading in mV is directly proportional to the current applied. For example, if connections are made to the 10 A shunt, a 100 mV reading indicates a 10 A flow within ±0.01% (plus the accuracy of the readout instrument). A 90 mV reading indicates a 9 A flow, etc. Direct readings in A can he obtained for all ranges up to, and including, the 100 A range by arbitrarily fixing the decimal point of the readout instrument. When making measurements using the 300 A range, readings must be interpolated as follows:

Test current	Readout in mV
300 A	(100 ± 0.1) mV
270 A	(90 ± 0.09) mV
240 A	(80 ± 0.08) mV
210 A	(70 ± 0.07) mV
180 A	(60 ± 0.06) mV
150 A	(50 ± 0.05) mV
120 A	(40 ± 0.04) mV
90 A	(30 ± 0.03) mV
60 A	(20 ± 0.02) mV
30 A	(10 ± 0.01) mV

On the 300 A range, to obtain a reading in Ampres, the indication of the milli-voltmeter is multiplied by 3 and the decimal point arbitrarily fixed.

3.2.6 Full Rated Accuracy

Each shunt can be used at rated nominal current to full accuracy with no duty cycle limitations. For the 100 A and 300 A ranges time should be allowed for the meter readings to settle to due to thermal dissipation effects.

Note: If an overload has inadvertently been applied, for best accuracy allow the shunt to cool for approximately 2 hours before using again. It is good instrumentation practice to reduce power to zero before disconnecting the shunt.

3.2.7 Basic Uncertainty

The basic uncertainty that can be attained overall is the accuracy of the shunt resistor in use plus the accuracy of the readout instrument. This value is in "% of full scale" and/or "% of reading" depending on how the readout instrument is rated. As an exAle. using a DVM with ±0.01% full scale accuracy and the 10 A range of the shunt, overall accuracy is ±0.01% full scale plus ±0.01% of reading. If a DC potentiometer of ±0.01% accuracy of reading is employed instead of the DVM, accuracy is in % of reading.

Note: Most readout instruments, have a residual error at the low end of their range which may be a significant accuracy factor. Examine the specifications of the milli-voltmeter used to determine what these errors are. For this reason it is good instrumentation practice to use that shunt range which will provide the highest millivolt output for a given current flow. As an example, if the 10 A range is being used for measurements of 1 A or below, change to the 1 A range. Higher accuracy can be achieved by using the deviation from nominal data provided on the certificate of calibration."

3.3 Additional Applications of the Model 9711A

Each shunt can be employed as a separate 4 terminal standard resistor for measurements of resistance. The operating procedure is identical to that described previously. The circuit would include a resistance in series with the "current" connections rather than an instrument under test (although it could include both if desired). By measuring the voltage drop separately across the resistance under test the two resistors can he compared.

Note: When comparing standard resistors as described above, accuracy of comparison is directly proportional to current stablity if using a single milli-voltmeter to measure the drop across each resistor and switching from the standard to the unit under test. If two milli-voltmeters are employed overall accuracy must include the accuracy of both readout instruments.

4.0 CALIBRATION AND PERFORMANCE VERIFICATION

4.1 Introduction

The following section describes the calibration and performance verification procedures for the 9711A Series of Multi-tap DC Current Shunts. It is recommended that DC Shunt be calibrated at the currents listed in Table 3 for each resistance values.

4.2 Calibration Overview

This calibration procedure covers the entire range of the 9711A Series of Multi-Tap DC Shunts. The 9711A Series has 9 shunt calibration resistance values with each reistance value requireing verification at various currents. This requires the ability to generate currents up to 300 A and measurement resistance down to 0.333 mΩ.

The 9711A recommended calibration interval is 12 months. There are two different methods using the specifications of the 9711A:

Nominal value one year specification:
Most customers prefer to utilized the 9711A as standard whose ohmic values remain within the nonimal range. This means that the values listed for each resistance range will be within the 1 year specification. For example, the 1 Ohm (0.1 A Range) will be within the 12 month tolerance of 0.01%.

Calibrated values and expanded uncertainty
The second method is to use the last calibrated results and their uncertainties of each range. This offers the opportunity to lower the uncertainties, but requires the maintenance of histories of all values and ranges. Possible drift shall be taken into concideration.

It is up to the individual customer to determine which method they will incorporate within their calibration procedure. The calibration process to determine the validity of the UUT measurement, regardless of the applicaton philopsy they will use, is exactly the same for either method.

The two calibration processes and tables are provided. Paragraph 4.6 and Table 4 are used if the nominal calibration process is used. Paragraph 4.7 and Table 5 are used if the customer is using the drift of the unit vs nominal value.

4.3 Calibration Interval and Performance

It is recommended that the 9711A series be calibrated at the manufacturer’s recommended 12 month interval. As with all Standards that have resistance elements, it is highly recommended that past history be used to determine drift rates and allow user confidence that the unit will remain within calibration for the next calibration period.

Each 9711A is manufacturered to provide some of the best (i.e. lowest) uncertainies when compared to other commercially available Multi-tap DC Current Shunts. After recalibration the user should determine the Resistance Calibration Uncertainties by applying a uncertainty calculation that includes uncertainties for drift, standards and equipment used, the calibration and laboratory enviroment, and other uncertainties appplicable to that calibration.

Guildline offers Resistance Calibration Services, both accredited and non-accredited. We can provide very good turn-around times with some of the lowest uncertainties available today. 9711A Users may find the use of Guildline Calibration Services an excellent convenience as well as a great alternative to maintaining their own calibration facilities to support these standards.

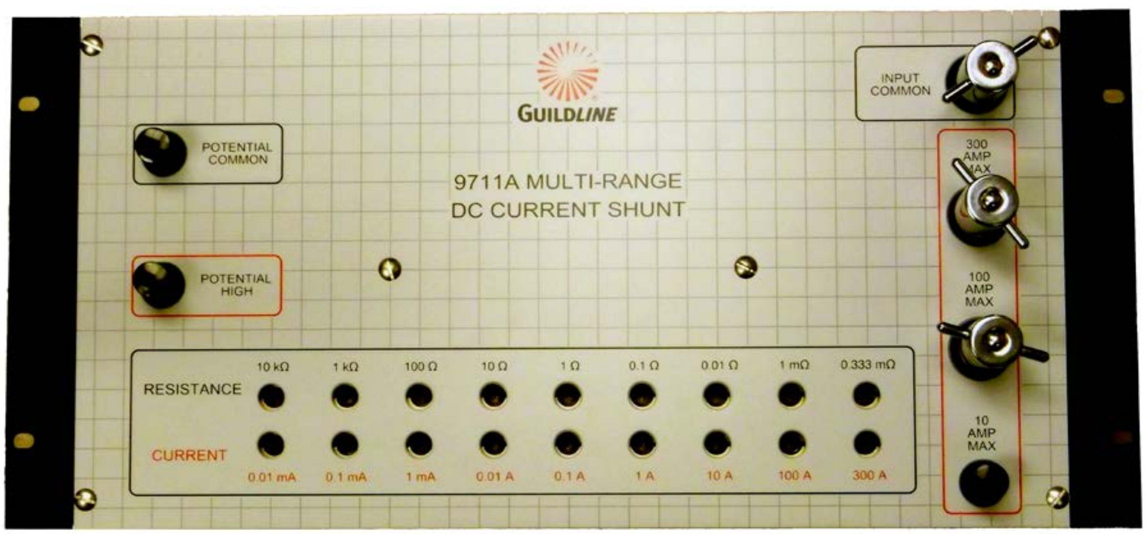


Figure 4-1: 9711A Terminals Location

4.4 Equipment and Standards Required for Calibration

The following Resistance Standards and Test Equipment is required for calibration.

Standards and Equipment Required:

Complete 6625A Resistance Measurement System with 6623A-300A Range Extender Installed (See Below for Alternative Acceptable Equipment Models).

Or (Alternative Standards)

(a) Direct Current Comparator Resistance Bridge (Acceptable Models)

Guildline Instruments 6622A Series DCC Resistance Bridge
Guildline Instruments 6675 or 6675A Series DCC Resistance Bridge
Guildline Instruments Model 9975A

(b) Laboratory Grade Primary Resistance Standard (Acceptable Models)

Guildline Instruments 6634A-X Temperature Stabilized Resistance Standards
Guildline Instruments 9334A Series Air Resistance Standards

(c) Low Thermal Lead Sets or Low Thermal Wire (Acceptable Models) (for Rs) and Appropriately rated leads for Current Leads (150 mA to 300 A)

Guildine 6622A : Precision Lead Set For Resistance Bridge
SCW-30:18AWG : 18 Gauge Low Thermal Wire

(d) Optional (For Automation and Connections)

- Guildline 6664B/C 4-Wire, 16 Channel Low Thermal Scanner , MAX current 1 A / 0.1Ω
- Guildline Bridgeworks-R or C Resistance Software
- 6623-100A Range Extender (Limits 300 A Range Calibration to a maximum of 100 A)

4.5 Routine Calibration

This routine calibration procedure describes the calibration currents required for the 9711A Multi-Tap Current Shunt. The procedure is intended to be used as a reference for qualified metrology personnel who have a primary level standards laboratory with equipment available to support an instrument of this level of standards accuracy.

Qualified personnel means that the technician or metrologist performing the calibration has the necessary level and understanding on Direct Current Comparator Resistance Measurements and full understanding of the DCC Bridge operation’s and will take precautions to avoid introducing errors from sources such as guard errors, thermal emfs, temperature and or EMI errors and others. The procedure assumes operators will make adequate allowance for equipment stabilization and measurement settling times.

For the best uncertainties with least operational influence on the measurements, it is recommended that customers use automation technologies such as Bridgeworks-R or Bridgeworks-C Software, IEEE control and 6664 Low Thermal Scanners (can be used for automation of measurements up to 2 A).

Calibration Note

Always check availability of equipment and standards prior to starting the calibration If the required equipment is not available, do not proceed with the calibration.

Ensure all equipment used is within the calibration validity interval.

Before beginning the calibration, inspect the UUT for damage and cleanliness. If the UUT is not in suitable condition for calibration, please clean or repair before proceeding.

A Input	Range Resistance	Recommended Test Currents	Foot Notes	Comments
(30 to 300) A	0.333 mΩ	30 A, 300 A 100A opt	1, 4	Minimum of 6623A-300A Range Extender required for Currents above 150 A. Calibrate in order (minimum current to maximum current)
(10 to 100) A	1 mΩ	10 A, 100 A	1,2	6623A-300A Range Extender required Calibrate in order (minimum current to maximum current)
(1 to 10) A	0.01 Ω	1 A, 10 A	2	6623A-300A Range Extender required Calibrate in order (minimum current to maximum current)
(0.1 to 1) A	0.1 Ω	0.1 A, 1 A	2	6623A-300A Range Extender required Calibrate in order (minimum current to maximum current)
(10 to 100) mA	1 Ω	0.01 A, 0.1 A	1	6623A-300A Range Extender required Calibrate in order (minimum current to maximum current)
(1 to 10) mA	10 Ω	1 A, 10 mA	1	Only 6622A Bridge Required (No Range Extender needed) for Remaining Tests. Calibrate in order (minimum current to maximum current)
(0.1 to 1) mA	100 Ω	0.1 A, 1 mA	1	Only 6622A Bridge Required (No Range Extender needed) for Remaining Tests. Calibrate in order (minimum current to maximum current)
0.1 mA	1 kΩ	0.1 mA	1	Only 6622A Bridge Required (No Range Extender needed) for Remaining Tests.
0.1 mA	10 kΩ	0.1 mA	1	Only 6622A Bridge Required (No Range Extender needed) for Remaining Tests.

1 – Requires 6623A Series Range Extender
2 – Requires either 6623A Series Range Extender or 6623A-2A (With Built in Supply)
3 – Can use any of the recommended Bridges
4 – Optional Calibration Points can be used in place of Standard Point or added to standard points for calibraiton.

Table 4-1: List of Recommended Test Currents or Voltages For Resistance Values

4.6 Nominal Value Calibration Procedure

4.6.1 Record the UUT Information on Table 4.

(a) Allow the 9711A to stabilize at Calibration environment for a 24 hour period. Ensure that the room is properly ventilated to dissipate heat up to 30 Watts of power for the calibration process. Remove the T-Nuts from input common, 300 A and 100A posts, remove the knurled nuts from potential high, common and 10 A post. Inspect the contact surface carefully for mechanical damages. Using Isopropanol and Kim Wipes, carefully clean the contact surfaces of every post. Provide min period of 30 minutes for the Isopropanol to vaporize.

(b) In sam fashion like (b), inspect and clean the contact surfaces of your test cables. Corrosion, dust and dirt could lead to faulty results.

(c) Note the applicable Hazardous Material Regulations and Guidelines, ask your Health and Safety advisor about the usage of Isopropanol.

(d) Setup DCC Bridge and Range Extender and other standards used for appropriate measurement (refer to Standards Manuals used).

4.6.2 Calibration of 0.01 mA (10 kΩ) to 1 A (0.1 Ω) Ranges

(a) Connect the the 6622A Series Bridge directly (C1 and C2) to the 9711A:
- C1 – 10 A Max; C2 – Input Common; P1 – Potential High; P2 – Potential Common

Note: The cables will remain connected in this configuration for the remainder of the calibration.

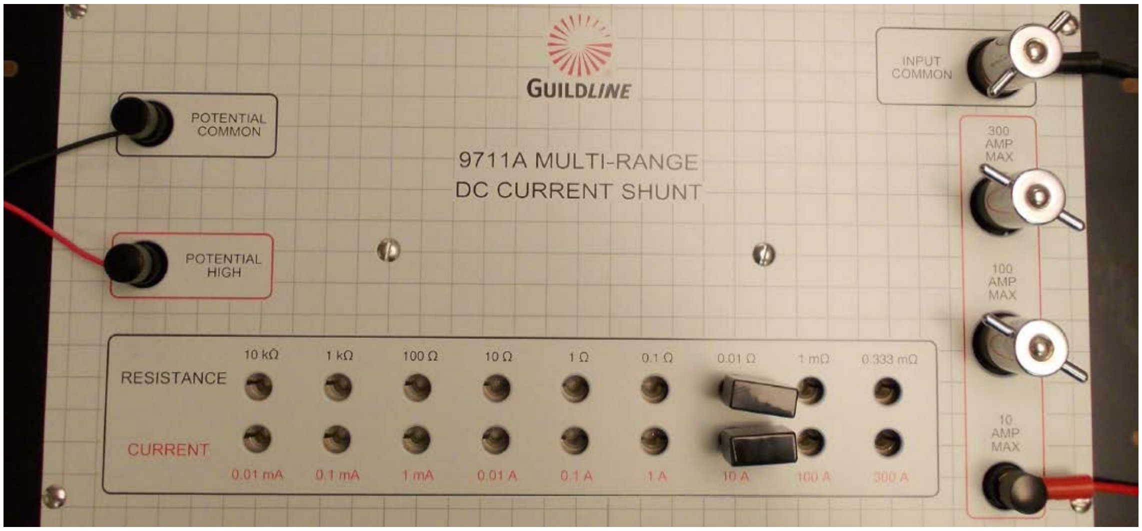


Figure 4-2: 9711A Connections

(b) Move the two Range Plugs to 10 kΩ / 0.01 mA. Allow the UUT to stablize 10 minutes prior to starting the measurements

(c) Output the first current (starting with lowest current) for the 0.1 A and after proper bridge measurement cycle (refer to user manuals for bridge, record the UUT value under MEASURED VALUE on the worksheet.

(d) Unit value should be between the minimum and maximum values. If not, unit will require repair.

(e) Repeat for all currents listed for each test point. Always start with lowest current (minimum heat dissipation) and work to highest current.

(f) Repeat Steps b through d for remaining values.

4.6.3 Calibration of 1 A (100 mOhm) Range

(a) Disconnect the current (C1 and C2) lead sets and connect a cable capable of handling 1 A to the UUT's 1 A Terminal and Input Common Terminals. Connect the other end to the 6623A Range Extenders 2 A Input Common cable connection to the high and low terminals. Potential Cables should remain connected as before.

(b) Move the two Range Plugs to 1 A. Allow the UUT to stablize 10 minutes prior to starting the measurements

(c) Output the first current (starting with lowest current) for the 1 A and after proper bridge measurement cycle (refer to user manuals for bridge),), record the UUT value under MEASURED VALUE on the worksheet.

(d) Unit value should be between the minimum and maximum values. If not, unit will require repair.

(e) Repeat for all currents listed for each test point. Always start with lowest current (minimum heat dissipation) and work to highest current.

4.6.4 Calibration of 10 A (10 mOhm) Range

(a) Disconnect the 1 A Current Cables Cable and connect a cable capable of handling 10 A to the 9711 "10 A max" and "Input Common" Terminals. On the 6623A Range Extender, move the Input Common cable connection to the appropriate range extender 15 A output high and low. Potential Cables should remain connected as before.

(b) Move the two Range Plugs to "10 A / 0.01 Ω"A. Allow the UUT to stablize 10 minutes prior to starting the measurements

(c) Output the first current (starting with lowest current) for the 10 A and after proper bridge measurement cycle (refer to user manuals for bridge), record the UUT value under MEASURED VALUE on the worksheet.

(d) Unit value should be between the minimum and maximum values. If not, unit will require repair.

(e) Repeat for all currents listed for each test point. Always start with lowest current (minimum heat dissipation) and work to highest current.

4.6.5 Calibration of 100 A (1 mOhm) Range

(a) Common and Potential Cables should remain connected as before. Disconnect the 10 A Current Cables and connect a cable capable of handling 300 A to the UUT's 100 A and Input Common (Right side) and to the 6623A-300 Range Extender 300 A output. Potential Cables should remain connected as before.

(b) Move the two Range Plugs to 100 A. Allow the UUT to stablize 10 minutes prior to starting the measurements

(c) Output the first current (starting with lowest current) for the 100 A and after proper bridge measurement cycle (refer to user manuals for bridge), record the UUT value under MEASURED VALUE on the worksheet.

(d) Unit value should be between the minimum and maximum values. If not, unit will require repair.

(e) Repeat for all currents listed for each test point. Always start with lowest current (minimum heat dissiapation) and work to highest current.

4.6.6 Calibration of 300 A (0.333 mOhm) Range

(a) Connect leads capable of handling 300 A to the 9711A Input Common (Right side) and the 300 A Terminals to the 6623A-300 Range Extender output high and low.

(b) Connect the Bridge Rx terminals to the UUT Common and Potential Terminals on the left side (4 to 2 wire connection).

(c) Set the two range plugs to the 300 A terminals.

(e) Output the first current (starting with lowest current first) for the 300 A and after proper bridge measurement cycle (refer to user manuals for bridge), record the UUT value under MEASURED VALUE on the worksheet.

(f) Unit value should be between the minimum and maximum values. If not, unit will require repair.

(g) Repeat for all currents listed for each 300 A test point. Always start with lowest current (minimum heat dissapation) and work to highest current.

Note: Measurement Tips.

Consider the following when setting up the measurement

Verify that the max voltage or current applied in the measurement will not exceed the specs for the UUT or the STD.

Verify the reversal rate is appropriated for the measurement and the uncertainty desired.

Ensure that you know whether the measurement you are reading on the bridge is either a ratio or actual ohms value.

If using a PC, verify that the number of samples and logging delay are appropriate.

If using a PC set the environmental parameters in BridgeWorks .

Verify guard and ground connections (see 6622A Manual).

If using a scanner, ensure that the proper channels for Rx and Rs are selected.

UUT Serial Number	Calibration Temperature	Calibration Date	Last Calibration Date

0.000 01 A Range	Nominal Value: 10 kΩ		12 Month Tolerance: ±100 ppm
CALIBRATION CURRENT (ADC)	Lower Value Limit	Measured Value	Upper Value Limit
0.000 1	9 999.000 Ω		10 001.000 Ω

0.0001 A Range	Nominal Value: 1 kΩ		12 Month Tolerance: ±100 ppm
CALIBRATION CURRENT (ADC)	Lower Value Limit	Measured Value	Upper Value Limit
0.000 1	999.900 0 Ω		1000.100 0 Ω

0.001 A Range	Nominal Value: 100 Ω		12 Month Tolerance: ±100 ppm
CALIBRATION CURRENT (ADC)	Lower Value Limit	Measured Value	Upper Value Limit
0.0001	99.990 00 Ω		100.010 00 Ω
0.001	99.990 00 Ω		100.010 00 Ω

0.01 A Range	Nominal Value: 10 Ω		12 Month Tolerance: ±100 ppm
CALIBRATION CURRENT (ADC)	Lower Value Limit	Measured Value	Upper Value Limit
0.001	9.999 000 Ω		10.001 000 Ω
0.01	9.999 000 Ω		10.001 000 Ω

0.1 A Range	Nominal Value: 1 Ω		12 Month Tolerance: ±100 ppm
CALIBRATION CURRENT (ADC)	Lower Value Limit	Measured Value	Upper Value Limit
0.01	0.999 900 0 Ω		1.000 100 0 Ω
0.1	0.999 900 0 Ω		1.000 100 0 Ω

Table 4-2 : 9711A Nominal Calibration Data Worksheet

UUT Serial Number	Calibration Temperature	Calibration Date	Last Calibration Date

1 A Range	Nominal Value: 0.1 Ω		12 Month Tolerance: ±100 ppm
Calibration Current (ADC)	Lower Value Limit	Measured Value	Upper Value Limit
0.1	0.099 990 0 Ω		0.100 010 0 Ω
1.0	0.099 990 0 Ω		0.100 010 0 Ω

10 A Range	Nominal Value: 0.01 Ω		12 Month Tolerance: ±100 ppm
Calibration Current (ADC)	Lower Value Limit	Measured Value	Upper Value Limit
1	0.009 999 0 Ω		0.01 000 10 Ω
10	0.009 999 0 Ω		0.01 000 10 Ω

100 A Range	Nominal Value: 1 mΩ		12 Month Tolerance: ±500 ppm
Calibration Current (ADC)	Lower Value Limit	Measured Value	Upper Value Limit
10	0.000 999 50 Ω		0.001 000 50 Ω
100	0.000 999 50 Ω		0.001 000 50 Ω

300 A Range	Nominal Value: 0.333 mΩ		12 Month Tolerance: ±1000 ppm
Calibration Current (ADC)	Lower Value Limit	Measured Value	Upper Value Limit
30	0.000 332 966 7 Ω		0.000 333 633 3 Ω
100*	0.000 332 966 7 Ω		0.000 333 633 3 Ω
300	0.000 332 966 7 Ω		0.000 333 633 3 Ω

* Optional Current Point

9711A Nominal Calibration Data Worksheet (Continued)

4.7 Optional Calibration Procedure (Drift Verification)

4.7.1 Calibration of 300 A (0.333 mOhm) Range

(a) Record the last calibration date and previous values for each range on Table 4. The last calibration date is used to determine if the unit has met 1 year specifications.

(b) Allow the 9711A to stabilize at Calibration environment for a 24 hour period. Ensure that the room is properly ventilated to dissipate heat up to 30 Watts of power for the calibration process.

(c) Setup DCC Bridge and Range Extender and other standards used for appropriate measurement (refer to Standards Manuals used).

(d) Connect leads capable of handling 300 A to the 9711A Input Common (Right side) and the 300 A Terminals to the range extender output high and low.

(e) Connect the Bridge Rx terminals to the UUT Common and Potential Terminals on the left side (4 to 2 wire connection).

(f) Set the two range plugs to the 300 A terminals.

(g) Output the first current (starting with lowest current first) for the 300 A and after proper bridge measurement cycle (refer to user manuals for bridge), record the measured value under column "C" on the worksheet.

(h) Calculate Actual Deviation and compare to Maximum Deviation. Unit should be within maximum deviation values. If not, unit will require repair.

(i) Repeat for all currents listed for each 300 A test point. Always start with lowest current (minimum heat dissapation) and work to highest current.

4.7.2 Calibration of 100 A (1 mOhm) Range

(a) Common and Potential Cables should remain connected as before. Disconnect the 300 A Red Cable and connect a cable capable of handling 100 A to the UUT's Input Common (Right side) and 100 A Terminals and to the range extender output high and low.

(b) Move the two Range Plugs to 100 A. Allow the UUT to stablize 10 minutes prior to starting the measurements

(c) Output the first current (starting with lowest current) for the 100 A and after proper bridge measurement cycle (refer to user manuals for bridge), record the measured value under column "C".

(d) Calculate Actual Deviation and compare to Maximum Deviation. Unit should be within maximum deviation values. If not, unit will require repair.

(e) Repeat for all currents listed for each test point. Always start with lowest current (minimum heat dissiapation) and work to highest current.

4.7.3 Calibration of 10 A (10 mOhm) Range

(a) Disconnect the 100 A Red Cable and connect a cable capable of handling 10 A to the 9711A 10 A Terminal and range Extender current output. Move the Input Common cable connection to the appropriate range extender output low. Common and Potential Cables should remain connected as before.

(b) Move the two Range Plugs to 10 A. Allow the UUT to stablize 10 minutes prior to starting the measurements

(c) Output the first current (starting with lowest current) for the 10 A and after proper bridge measurement cycle (refer to user manuals for bridge), record the measured value under column “C”.

(d) Calculate Actual Deviation and compare to Maximum Deviation. Unit should be within maximum deviation values. If not, unit will require repair.

(e) Repeat for all currents listed for each test point. Always start with lowest current (minimum heat dissipation) and work to highest current.

4.7.4 Calibration of 1 A (100 mOhm) Range

(a) Disconnect the 10 A Red Cable and connect a cable capable of handling 1 A to the 9711A 1 A Terminal and and range Extender current output. Move the Input Common cable connection to the appropriate range extender output low. Common and Potential Cables should remain connected as before.

(b) Move the two Range Plugs to 1 A. Allow the UUT to stablize 10 minutes prior to starting the measurements

(c) Output the first current (starting with lowest current) for the 1 A and after proper bridge measurement cycle (refer to user manuals for bridge), record the measured value under column “C”.

(d) Calculate Actual Deviation and compare to Maximum Deviation. Unit should be within maximum deviation values. If not, unit will require repair.

(e) Repeat for all currents listed for each test point. Always start with lowest current (minimum heat dissipation) and work to highest current.

4.7.5 Calibration of 100 mA and below (1 Ohm) Ranges

(a) Remove the Range Extender cable and connect leads from the 10A to the Bridge directly.

(b) Move the two Range Plugs to 0.1 A. Allow the UUT to stablize 10 minutes prior to starting the measurements

(c) Output the first current (starting with lowest current) for the 0.1 A and after proper bridge measurement cycle (refer to user manuals for bridge), record the measured value under column "C".

(d) Calculate Actual Deviation and compare to Maximum Deviation. Unit should be within maximum deviation values. If not, unit will require repair.

(e) Repeat for all currents listed for each test point. Always start with lowest current (minimum heat dissipation) and work to highest current.

(f) Repeat Steps b through d for remaining values.

Note: Measurement Tips.

Consider the following when setting up the measurement

Verify that the max voltage or current applied in the measurement will not exceed the specs for the UUT or the STD.

Verify the reversal rate is appropriated for the measurement and the uncertainty desired.

Ensure that you know whether the measurement you are reading on the bridge is either a ratio or actual ohms value.

If using a PC, verify that the number of samples and logging delay are appropriate.

If using a PC set the environmental parameters in BridgeWorks .

Verify guard and ground connections (see 6622A Manual).

If using a scanner, ensure that the proper channels for Rx and Rs are selected.

UUT Serial Number	Calibration Temperature	Calibration Date	Last Calibration Date

300 A Range		Nominal Ohmic Value:	0.333 mΩ	
		12 Month Tolerance [1]	±1000 ppm	
A	B	C	D	E
Calibration Current (Adc)	Ohmic Value Last Calibration	Ohmic Value Current Calibration	Actual Deviation (Ω) [2]	Maximum Deviation (Ω) [3]
30				
100				
300*				

* Optional

100 A Range		Nominal Ohmic Value:	1 mΩ	
		12 Month Tolerance [1]	±500 ppm	
A	B	C	D	E
Calibration Current (Adc)	Ohmic Value Last Calibration	Ohmic Value Current Calibration	Actual Deviation (Ω) [2]	Maximum Deviation (Ω) [3]
10				
100				

10 A Range		Nominal Ohmic Value:	0.01 Ω	
		12 Month Tolerance [1]	±100 ppm	
A	B	C	D	E
Calibration Current (Adc)	Ohmic Value Last Calibration	Ohmic Value Current Calibration	Actual Deviation (Ω) [2]	Maximum Deviation (Ω) [3]
1				
10				

Table 4-3 : 9711A Optional Calibration Data Worksheet

UUT Serial Number	Calibration Temperature	Calibration Date	Last Calibration Date

1 A Range		Nominal Ohmic Value:	0.1 Ω	
		12 Month Tolerance [1]	±100 ppm	
A	B	C	D	E
Calibration Current (Adc)	Ohmic Value Last Calibration	Ohmic Value Current Calibration	Actual Deviation (Ω) [2]	Maximum Deviation (Ω) [3]
0.1				
1				

0.1 A Range		Nominal Ohmic Value:	1 Ω	
		12 Month Tolerance [1]	±100 ppm	
A	B	C	D	E
Calibration Current (Adc)	Ohmic Value Last Calibration	Ohmic Value Current Calibration	Actual Deviation (Ω) [2]	Maximum Deviation (Ω) [3]
0.01				
0.1				

0.01 A Range		Nominal Ohmic Value:	10 Ω	
		12 Month Tolerance [1]	±100 ppm	
A	B	C	D	E
Calibration Current (Adc)	Ohmic Value Last Calibration	Ohmic Value Current Calibration	Actual Deviation (Ω) [2]	Maximum Deviation (Ω) [3]
0.001				
0.01				

9711A Optional Calibration Data Worksheet (continued)

UUT Serial Number	Calibration Temperature	Calibration Date	Last Calibration Date

0.001 A Range		Nominal Ohmic Value: 100 Ω		
		12 Month Tolerance [1] ±100 ppm		
A	B	C	D	E
Calibration Current (Adc)	Ohmic Value Last Calibration	Ohmic Value Current Calibration	Actual Deviation (Ω) [2]	Maximum Deviation (Ω) [3]
0.000 1				
0.00 1				

0.000 1 A Range		Nominal Ohmic Value: 1 kΩ		
		12 Month Tolerance [1] ±100 ppm		
A	B	C	D	E
Calibration Current (Adc)	Ohmic Value Last Calibration	Ohmic Value Current Calibration	Actual Deviation (Ω) [2]	Maximum Deviation (Ω) [3]
0.000 1				

0.000 01 A Range		Nominal Ohmic Value: 10 kΩ		
		12 Month Tolerance [1] ±100 ppm		
A	B	C	D	E
Calibration Current (Adc)	Ohmic Value Last Calibration	Ohmic Value Current Calibration	Actual Deviation[2]	Maximum Deviation[3]
0.000 1				

Note 1 – 12 Month Specification is a drift spefication. This is the maximum drift per year allowed. If UUT has not been calibrated in last 12 months, this specification will increase by the actual time since the last calibration.

Note 2 – To Calculate Actual Deviation (in Ohms) use the following formula:

Actual Deviation Current Calibration Ohmic Value – Last Calibration Ohmic Value

Note 3 – To Calculate Maximum Deviation (in Ohms) use the following formula:

Maximum Deviation = Last Calibration Ohmic Value x 12 Month Tolerance

9711A Optional Calibration Data Worksheet (continued)

5.0 MAINTENANCE

Maintenance of the resistor consists only of routinely inspecting the unit for physical damage and cleanliness. Cleanliness is especially important on the high value resistors (1 Megaohm and greater). These should be cleaned with isopropanol and a soft brush or cloth. Special care should be taken to ensure that the terminal connectors are clean.

5.1 Maintenance, Inspection and Cleaning

5.1.1 Inspection

Inspect the shunt panel before operation. It should be free from physical damage with no broken or bent binding posts.

5.1.2 Cleaning

Front panel by wiping with a dryt lint-free cloth. Male plugs and receptacles can be wiped with a crocus cloth if they appear discolored. Do not use sand paper. Avoid using a cleanser since many leave a film.

Caution

Do not remove rear cover to clean inside of shunt box. Physical movement of shunts can cause mounting stress and changes in resistance values.

5.2 Troubleshooting

5.2.1 Steps for Trouble Shooting the 9711A

5.2.1.1 A visual inspection is most important. Check to see if rear cover or panel is warped or distorted. If it is, the entire unit should be re-calibrated at once.

5.2.1.2 If the binding post heads on the front panel are broken, they should be replaced.

5.2.1.3 If an electrical overload has been applied beyond the rating of each resistor, the entire unit should be re-calibrated at once. (Note: A burned shunt will have a distinct charred odor).

5.2.1.4 If an open or intermittent circuit is found in the instrument, (no reading or varying reading on millivoltmeter), check as follows:

5.2.1.5 All lead connections to binding posts must be tight. Leads should be checked for continuity using a circuit tester. See that plugs are firmly inserted in female receptacles.

5.2.1.6 Lead connectors, plugs and receptacles should be checked for clean surfaces. Clean, if required, using a crocus cloth.

5.2.1.7 Readout instrument should indicate and be stable when tested in another circuit in accordance with the manufacturer's instructions.

5.2.1.8 Power source should be tested for output. If no output, troubleshoot in accordance with manufacturer's instructions.

Note: A skipping or variable rheostat in the circuit can cause results similar to a broken lead or bad connnection.

5.2.2 Short Circuit Troubleshooting

If a short circuit is found in the instrument, check as follows:

5.2.2.1 Verify proper connection of all leads

5.2.2.2 Physical condition of vented rear cover. If cover indented badly, it could short circuit two or more resistors by touching them. Remove the cover from the rear panel taking care not to put pressure on any resistors. Straighten the cover. Examine the internal circuit visually for possible snorting of components. Reinstall the cover observing the same precautions.

5.2.2.3 Compare each resistor to a standard resistor

5.2.2.4 If tests above are negative, the problem may be in the internal wiring or resistors in the shunt. Each shunt can be tested separately for continuity without removing the rear vented cover, by inserting the two plugs in the paired female receptacles for each range and using an ohmmeter between the "10 A max." or "100 A" or "300 A" binding post and the "Input Common" binding post. If a defective shunt or internal connection is found (or suspected), the entire unit should be returned for possible repair. (See Warranty information in front of this manual for instructions).

5.3 Replaceable Parts

The following tables list the replaceable parts. **Note that once a part has been replaced, the unit may be required to be recalibrated.**

To Contact Guildline Instruments, the following information is provided.

USA and Canada Telephone: (613) 283-3000
USA and Canada Fax: 1-613-283-6082

Outside US and Canada Telephone: +[1] 613 283-3000
Outside US and Canada Fax: [1] +613 283-6082

You can also contact Guildline Instruments Limted via their Email or Websites.

Email is: sales@guildline.com
Website is: www.guildlinecom

9711A Spare Parts Listing

Part Number:	12294-01-01			
Manufacturer:	Guildline Instruments		Cage Code:	35939
Description:	9211A/9711A Taper Plug Assembly for Range Selection - Precision Machined, Sold in Set (2 Plugs as shown)			
Dimensions:	(each Plug) 0.94” Tall, 1.0” Wide and 0.5” Thick			
Weight:	(Each Plug) 0.60 oz. (17 g)			

Part Number:	11000.01.10			
Manufacturer:	Guildline Instruments		Cage Code:	35939
Description:	Large Binding Post Head (300A, 100A and Common Terminals)			
Dimensions:	1⅛” length, 1¾ width, ⅞” diameter			
Weight:	2.79 oz, 79g			

Part Number:	17749.01.12			
Manufacturer:	Guildline Instruments		Cage Code:	35939
Description:	Small Binding Post Head			
Dimensions:	⅝” length, ⅝” diameter			
Weight:	0.32 oz, 9g			

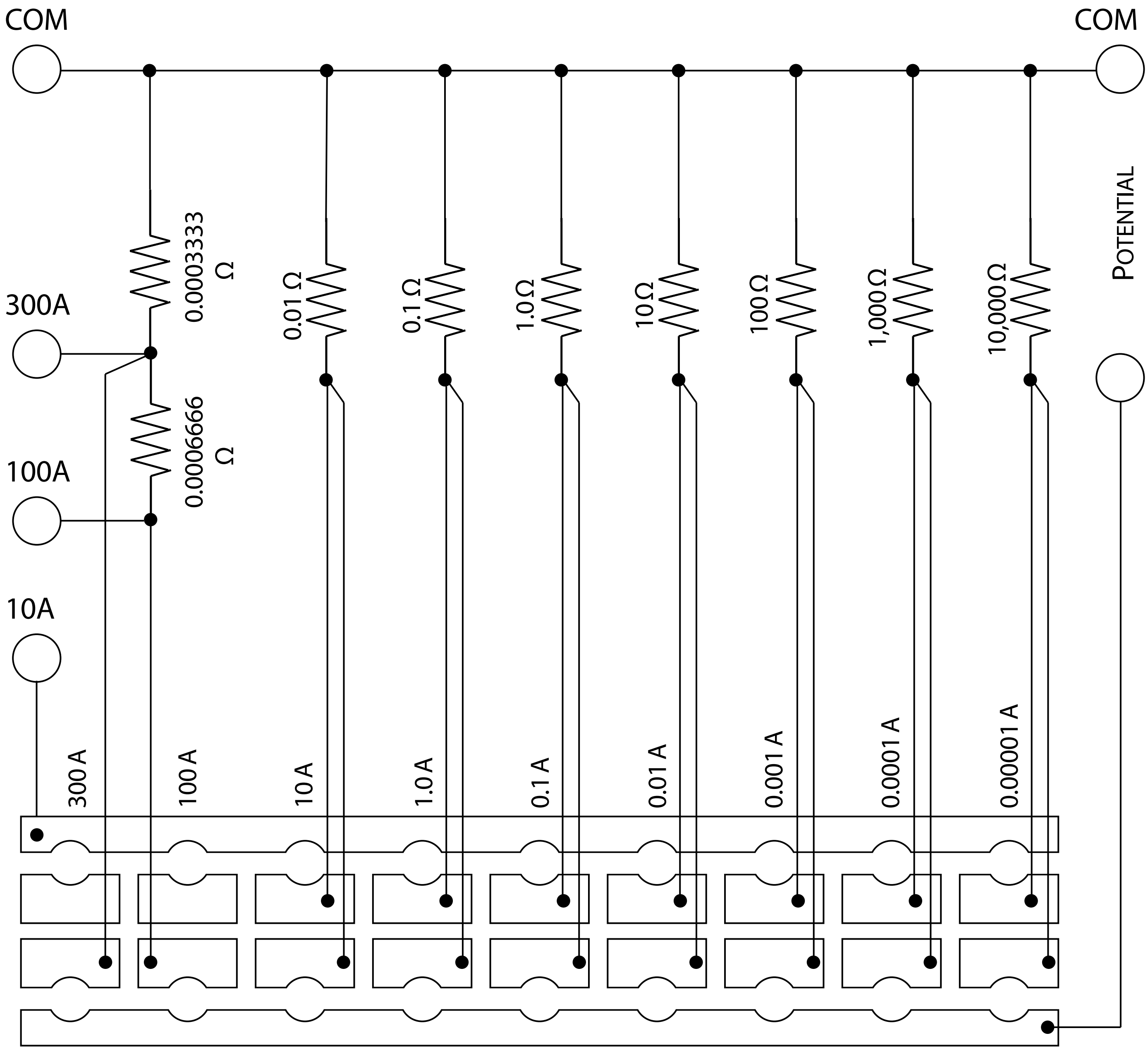


Figure 5-1: 9711A Schematic Layout