Model 2575A

Wideband Current Shunt / Precision Resistance Standard

Operation Manual

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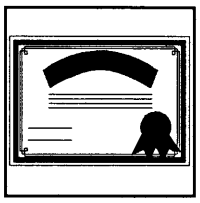
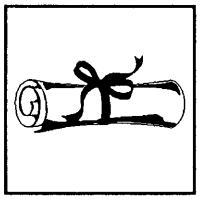
CERTIFICATION



Valhalla Scientific, Inc. certifies that this instrument was thoroughly tested and inspected and found to meet published specifications when shipped from the factory. Valhalla Scientific, Inc. further certifies that its calibration measurements are traceable to the National Institute of Standards and Technology to the extent allowed by NIST's calibration facility.

WARRANTY



The warranty period for this instrument is stated on your invoice and packing list. Please refer to these to determine appropriate warranty dates. We will repair or replace the instrument during the warranty period provided it is returned to Valhalla Scientific, Inc. freight prepaid. No other warranty is expressed or implied. We are not liable for consequential damages. Permission and a return authorization number must be obtained directly from the factory for warranty repairs. No liability will be accepted if returned without such permission. Due to continuing product refinement and due to possible parts manufacturer changes, Valhalla Scientific reserves the right to change any or all specifications without notice.

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SECTION I UNPACKING AND INSTALLATION

1-1. Introduction

The Valhalla Model 2575A is an AC/DC Current Shunt that can be used as a laboratory standard for current or as a resistance standard. Also included is a built-in precision buffer amplifier with a gain of 10.000.

The 2575A offers six isolated, switch-selectable decade ranges from 2mA to 100A full scale. Each shunt is a four-terminal, non-inductive type resistance element ensuring a flat frequency response throughout the bandwidth of the instrument. The shunts may be forced-air cooled to minimize temperature rise and maximize thermal stability.

The full scale voltage drop at the non-amplified output terminals for the lower shunts is 200.00mV. The full scale voltage drop across the 100A shunt is 100.00mV.

The 2575A provides six decades of four-terminal resistors from .001Ω to 100Ω. Each can be used as a laboratory standard resistor. Each range is independently adjustable for ease of calibration.

Also included in the Model 2575A is a built-in precision buffer amplifier with a gain of 10.000. This amplifier has a frequency response from DC to 10KHz. The amplifier can also be used with external inputs by placing the range switch to EXT. Inputs should not exceed 200mV. The output of the amplifier is suitable for driving thermal transfer systems, if desired.

1-2. Initial Inspection

If the external shipping container shows evidence of damage, it should be immediately brought to the attention of the carrier and such damage noted on the bill of lading.

Unpack the instrument and retain the shipping container until the instrument has been inspected for possible damage in shipment. If shipment damage is apparent, notify the carrier and obtain authorization for repairs before returning the instrument to the factory. If the external shipping container shows evidence of damage, but the instrument shows no external damage, it may be advisable to check the performance of the unit to determine that the instrument has not sustained hidden damage.

1-3. Power Requirements

The instrument is shipped from the factory for operation at 115VAC or 230VAC 50/60 Hz. This voltage range is selectable via the rear panel switch. When 115VAC is selected, the unit will operate at line voltages from 80 to 130 volts. When 230VAC is selected, the unit will operate at line voltages from 160 to 250 volts. A ¼ Amp Slo-Blo fuse is used in the 115V position. A .125Amp Slo-Blo fuse is used in the 230V position. Refer to Table 2-3.

1-4. Installation

If the Model 2575A is to be used in the bench top configuration, installation requires only that the line cord be connected to the rear panel connector and the other end inserted into the appropriate

wall receptacle. A rear panel mounted fuse provides protection for the internal circuits.

Optional brackets are available to mount the unit in a standard 19" equipment rack, designated as Option RX3. Due to its size and center of gravity, the unit should be supported on both sides and along its entire length by the use of trays or slides. If it is to be transported while in the rack, the unit should be securely mounted to prevent upward or downward movement.

Proper ventilation must be maintained in order to assure maximum performance from your Model 2575A. Note the location of the air vents on the rear of the instrument. A free flow of air should be provided around these vents. Performance is degraded at higher temperatures as specified in Section 2. At no time should the ambient air temperature around this instrument exceed 50°C while operating.

SECTION II SPECIFICATIONS

2-1. General

This section contains accuracy, operating and environmental specifications for the Model 2575A.

Table 2-1. Ranges and Accuracy (1 year @ 25°C ±5°C) [2]

Range Name & Maximum Input	Shunt Value	DC Accuracy (% of Range)	AC Accuracy (% of Range)	Frequency Response
100A	0.001Ω	±0.05%	±0.1%	DC to 1KHz
20A	0.01Ω	±0.02%	±0.1% [1]	DC to 10KHz
2A	0.1Ω	±0.02%	±0.1%	DC to 10KHz
200mA	1Ω	±0.01%	±0.1%	DC to 10KHz
20mA	10Ω	±0.01%	±0.1%	DC to 10KHz
2mA	100Ω	±0.01%	±0.1%	DC to 10KHz
Notes:	[1] AC accuracy is ±0.5% of range above 1000Hz. [2] Outside the specified temperature range, add ±0.001% of range per °C.			

Table 2-2. Amplifier Characteristics

Amplitude Gain:	10.000
Gain Accuracy (relative to input):	± 0.01% of output ± 100μV at DC
Frequency Response:	± 0.05% of output to 10KHz
Input Resistance:	> 10^{10} Ω
Output Resistance:	0.1Ω max
Maximum Input Voltage: (without damage)	± 300mV DC or AC_{peak}

Table 2-3. Physical Specifications

Temperature Range:	0°C to 50°C
Power:	80 to 130VAC, 47 to 63Hz *or* 160 to 250VAC, 47 to 63Hz 15VA max
Size:	4" H x 17" W x 11.5" D 10cm H x 43cm W x 30cm D
Weight:	8 lbs net, 18 lbs shipping 4kg net, 8.5kg shipping

SECTION III AVAILABLE OPTIONS

3-1. General

This section lists the options available for the Model 2575A AC/DC Shunt. Standard accessories include a detachable power cord and an operation manual.

3-2. Optional Accessories

Option RX3: Rack Ears

Option RX3 is a set of rack ears that adapt the Model 2575A for installation in a standard 19" equipment rack.

Option I-150: Current Transformer

Option I-150 is a clamp-on current transformer (CT) that extends the AC current measurement capability of the 2575A to 150 amps. The 1000:1 ratio is 2% accurate from 50Hz to 400Hz. The device accommodates conductors up to ½" in diameter.

Option I-1000: Current Transformer

Option I-1000 is a clamp-on current transformer (CT) that extends the AC current measuring capability of the 2575A to 1000 amps. The 1000:1 ratio is 2% accurate from 50Hz to 400Hz. The device accommodates conductors up to 2" in diameter.

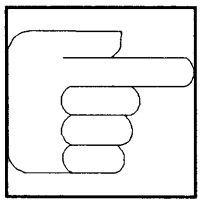
Option BBL: Banana to Banana Cable

Option BBL is a 4' shielded coaxial cable terminating in double banana connectors.

Option HC: Heavy-Duty Cable

Option HC is a 4AWG heavy-duty cable designed to connect the Valhalla Model 2555A 100 amp output terminals to the Model 2575A 100 amp input terminals.

SECTION IV OPERATION



4-1. General

This section of the manual contains complete operating instructions for the Model 2575A AC/DC Current Shunt. Included are control functions, connection methods, and operational precautions.

4-2. Power ON/OFF

A push-button mounted on the 2575A front panel is used to apply or remove AC line power to the instrument. Illumination of the front panel indicator confirms application of power.

☞ The unamplified output terminals may be used regardless of whether or not the 2575A is connected to the AC line power. In this situation, however, no cooling is provided to the shunts and prolonged use of high currents should be avoided.

4-3. Front Panel

The location and function of the front panel controls is described in Table 4-1.

4-4. Rear Panel

The location and function of the rear panel controls is described in Table 4-2.

4-5. Using the 2575A to Measure Current

The following method is recommended when using the 2575A to measure AC or DC current:

1) Approximate the maximum value of current that is likely to be encountered during the test. Use this value to select a shunt of the 2575A that has a rated current that is greater than this amount.

CAUTION!

Shunts can be damaged by the application of currents greater than the rating of the shunt. If the amount of current to be measured is unknown, start by making connections to the 100 Amp terminals. This prevents damage to the lower shunts. Once the level has been approximated, choose the appropriate shunt and make new connections as necessary.

2) Connect the input current to the selected shunt using a gauge of wire that is appropriate to the amount of current to be measured. Heavy-duty lugs or Valhalla Option "HC" should be used when connecting to the 100 Amp terminals. Use the table below as a guide:

Range	Recommended Wire
< 2A	20 - 22 AWG
2A	18 - 20 AWG
20A	14 - 16 AWG
100A	3 - 4 AWG

2) Select the appropriate range with the Range Selector knob.

3) Connect the measuring device (DVM, thermal transfer standard, etc.) to the amplified or unamplified output terminals as desired. The unamplified

terminals may be used even if the 2575A is not plugged into the AC line.

☞ The fullscale output voltage of the unamplified terminals is ±200mV DC or AC_{RMS}. The fullscale output voltage of the amplified terminals is ±2V DC or AC_{RMS}.

☞ The shunts are isolated through the selector switch. It is not necessary to remove a load connected to one range in order to connect a load to another range.

☞ The amplified output may drive a load of 10mA maximum.

4-6. Using the 2575A as a Resistance Standard

The Model 2575A may be used as a laboratory resistance standard. The resistor values are 0.001Ω, 0.01Ω, 0.1Ω, 1Ω, 10Ω and 100Ω. Four-wire resistance measurement should be made in the following manner:

1) Select the resistor to be used by referring to the markings near the terminals on the 2575A front panel.

2) Connect the current sourcing terminals of the ohmmeter to the appropriate 2575A shunt input terminals.

3) Connect the voltage sensing terminals of the ohmmeter to the 2575A Output Voltage terminals. The unamplified terminals should be used.

4) Select the working shunt with the Range Selector knob.

☞ The Valhalla Model 2575A is designed for use in a 4-wire resistance configuration. While it is possible to use the 2575A as a 2-wire resistor, this configuration is not specified and may produce large inaccuracies.

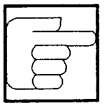
4-7. Using the Built-In Precision Amplifier

The Valhalla Model 2575A incorporates a precision buffer amplifier which may be used by itself or with the shunts as described above. If the amplifier is to be used by itself, the following steps should be performed:

1) Set the Range Selector knob to "EXT".

2) Connect the input signal to the *left* set of "Output Voltage" terminals. These terminals double as the input terminals to the precision amplifier. The maximum input voltage should not exceed ±200mV DC or AC_{RMS}.

3) Connect the measuring device to the *right* set of "Output Voltage" terminals. The maximum output voltage is ±2V DC or AC_{RMS}. The maximum current provided by the amplifier is 10mA.



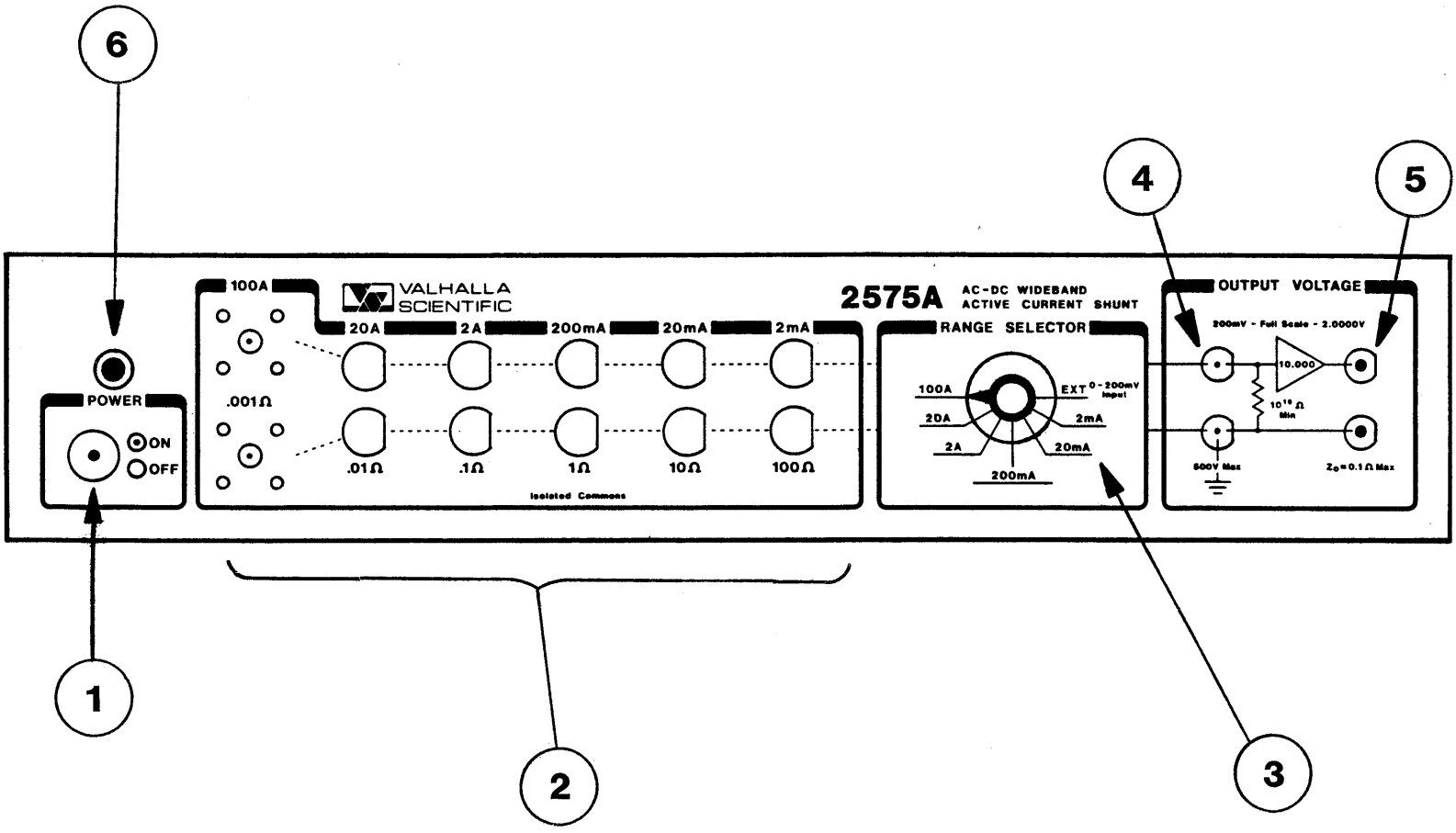


Figure 4-1. 2575A Front Panel

Index #	Device	Function/Description
1	Power Switch	Energizes/De-energizes internal power
2	Shunt Terminals	Current input
3	Range Selector	Selects shunt range or amplifier input
4	Output/Input	Unamplified shunt output/Amplifier input
5	Output	Amplified output terminals
6	ON Indicator	Power applied to internal circuitry

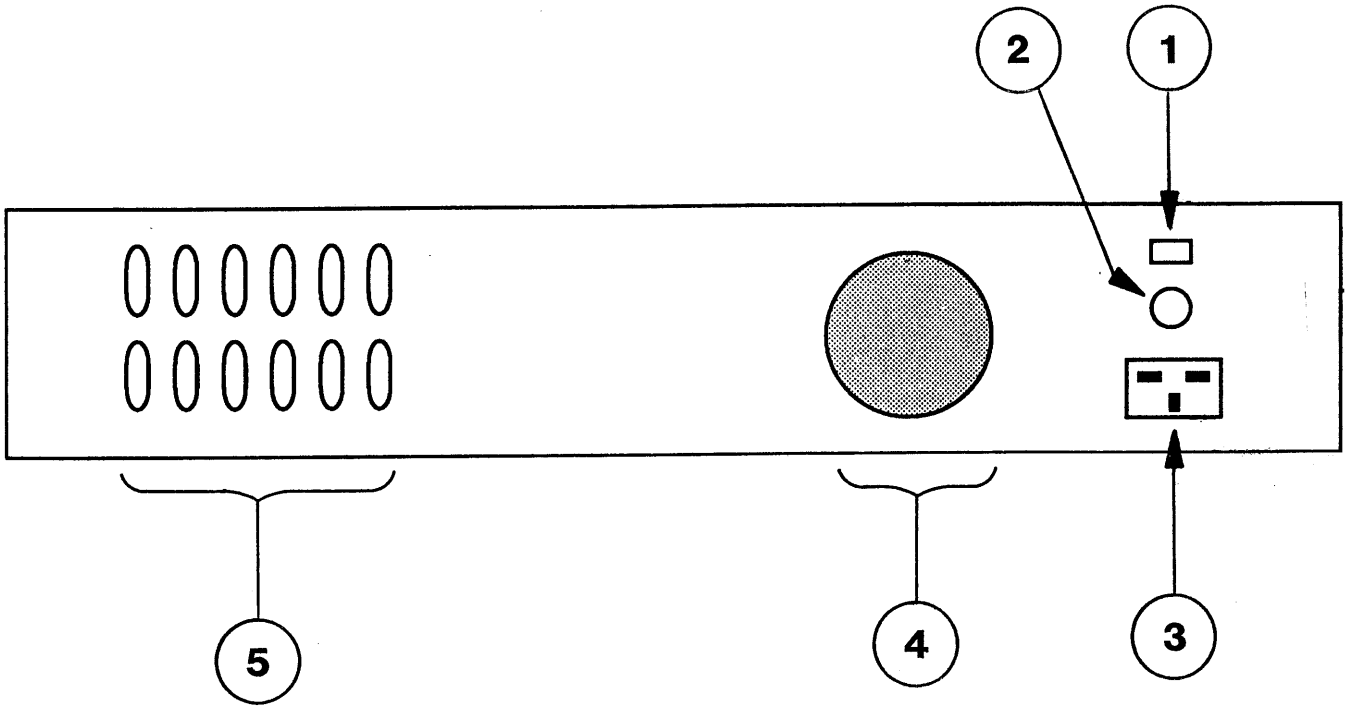
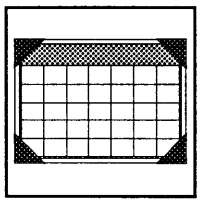


Figure 4-2. 2575A Rear Panel

Index #	Device	Function/Description
1	115/230 switch	Set for local AC line power (see section 1-3)
2	Fuse	Protects the internal circuitry (see section 1-3)
3	Receptacle	Use a 3-prong type cord only (provided)
4	Fan	Air inlet - DO NOT BLOCK
5	Grill	Air outlet - DO NOT BLOCK

SECTION V CALIBRATION



5-1. General

The Model 2575A should be calibrated at regular intervals to ensure continued accuracy. This interval may be determined by usage, however the instrument has a factory calibration interval of 12 months.

5-2. Required Test Equipment

a) Digital Voltmeter with a DC accuracy of at least 0.005% and ranges of 200mV and 2V (HP3458A or equivalent)

b) DC Voltage Source 0.001% accuracy (Valhalla 2701C or equivalent)

c) Current Calibrator with ranges of 100A, 10A, 1A, .1A, .01A and .001A (Valhalla 2555A or equivalent)

d) Precision Resistors with known values to within ±0.003%

Value	Current Rating
0.001Ω	100A
0.01Ω	10A
0.1Ω	1A
1Ω	100mA
10Ω	10mA
100Ω	1mA

5-3. Description of Procedure

The Valhalla Model 2575A is calibrated using a stable source of DC current (the Valhalla Model 2555A) and a highly accurate DC voltmeter. It may be noted that the accuracy of the 2555A is not as high as the 2575A. By using the current source as a *transfer standard* (transfers the accuracy of the standard resistors), the shunt may be calibrated to a tolerance that nears the uncertainty of the standard resistor used. For this reason, the results of the calibration depend to a great deal upon the quality of the standard resistors used. A typical calibration setup is shown in Figures 5-1 and 5-2.

In Figure 5-1, the current source is adjusted to produce a precise value of current by measuring the voltage drop across the standard resistor which has a known value.

For example to adjust the current source to produce exactly 100 Amps, the voltage across the .001Ω resistor is measured. The current source is adjusted until the reading on the voltmeter reflects that of the standard resistor (using Ohm's Law: V=IR). The output of the current source is now a precise 100.00 Amps.

The leads are then moved as shown in Figure 5-2 to the Model 2575A 100A shunt terminals. The voltage at the output terminals is monitored with the precision voltmeter. The appropriate potentiometer is adjusted for a reading of exactly 100.00mV, indicating that the shunt is now trimmed to a precise value (i.e. 0.0010000 ohms).

5-4. DC Calibration

The calibration adjustments are made using potentiometer adjustments located inside the 2575A. One adjustment for each shunt is provided, as well as one for the buffer amplifier. Adjustments are accessed by removing the top front bezel, and the top cover. For maximum stability, the cover should be kept in place as much as is practical. Potentiometer placement is

shown on the board itself and on drawing number 2575-600 at the back of this manual.

Apply AC power and allow the 2575A to warm-up for at least 15 minutes in a stable environment with the covers in place before proceeding.

5-4-1. Amplifier Adjustment

1) Set the 2575A Range Selector to "EXT".

2) Connect the DC voltage source at 100mV to the *left* set of "Output Voltage" terminals of the 2575A. These terminals also serve as the amplifier input terminals.

3) Connect the voltmeter to the *right* set of "Output Voltage" terminals.

4) Adjust RV7 until the voltmeter reads 1.00000 volt.

5) Reverse the polarity of the input voltage and balance RV7 for an equal deviation at both input polarities. Both readings must be within $\pm 200\mu V$.

5-4-2. Shunt Adjustments

1) Connect the calibration equipment as shown in Figure 5-1 using the desired values shown in Table 5-1.

2) Adjust the value of the current source until the output is exactly equal to the Test Current shown in Table 5-1. This is calculated using Ohm's Law: V=IR.

Where:

R = the precise value of the standard resistor
I = the value of test current shown in Table 5-1
V = the voltage across the standard resistor

100 Amp Shunt Example:

R = 0.0010270 Ω
I = 100.00 amps
V = .10270 volts

The current source should be adjusted until the voltmeter reads 0.10270 volts. The current source has now been trimmed to produce a precise 100 amps.

3) Make the connections as shown in Figure 5-2.

4) Adjust the appropriate potentiometer of the 2575A for a voltmeter reading of 100.00mV.

All shunts are calibrated using the same procedure as was used above for the 100 amp shunt, but the values shown in Table 5-1 are substituted accordingly. The shunts may be calibrated in any order desired.

5-5. AC Calibration

The AC frequency response of this instrument is inherent in its design and requires no periodic adjustments. The frequency response *should* be checked whenever a repair is made to the amplifier or to any shunt resistor. If you should doubt the integrity of your instrument, please contact the factory.

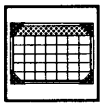


Table 5-1. Calibration Variables

2575A Range	2555A Range	Standard Resistor	Test Current [1]	Adjust	DVM Reading
100A	100A	0.001Ω	100 Amps	RV1	100.00mV
20A	20A	0.01Ω	10 Amps	RV2	100.00mV
2A	2A	0.1Ω	1 Amp	RV3	100.00mV
200mA	200mA	1Ω	100 mAmps	RV4	100.00mV
20mA	20mA	10Ω	10 mAmps	RV5	100.00mV
2mA	2mA	100Ω	1 mAmp	RV6	100.00mV

[1] The test current should be verified and adjusted as necessary using the standard resistors as a reference prior to making any adjustment on the 2575A. (See Section 5-4.)

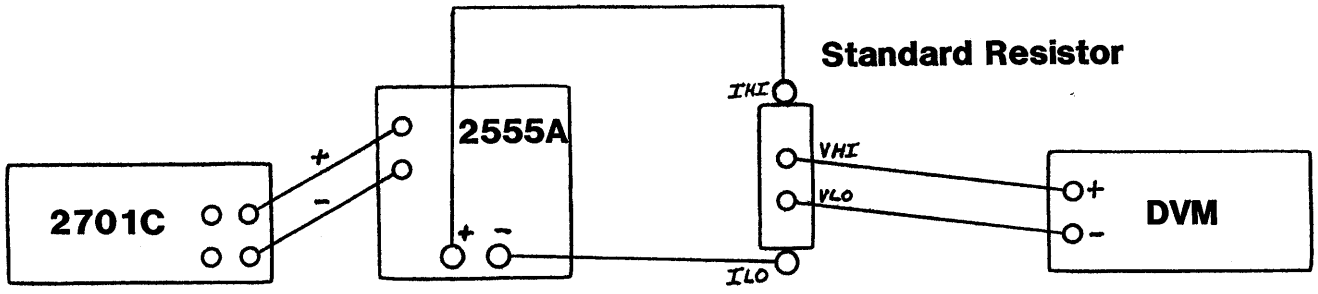


Figure 5-1. Test Current Verification and Adjustment

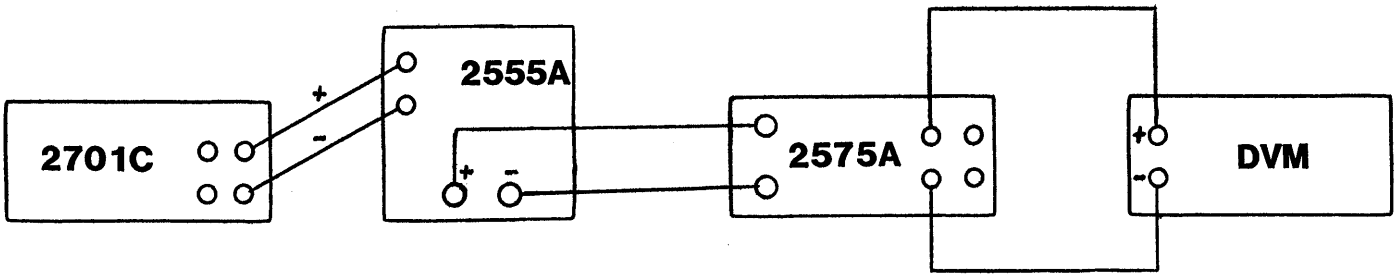


Figure 5-2. Model 2575A Calibration Setup