

Leeds & Northrup 1972 General Catalog



L&N Facilities at Your Service

Leeds & Northrup's corporate headquarters, administrative offices, research, engineering and main manufacturing facilities are located at North Wales, Pa. Additional manufacturing facilities are located in Philadelphia and Ellport, Pa.

The North Wales complex is designed not only for efficient plant operations but also to provide the facilities required to supply you with modern, reliable and precision instrumentation for your process and research needs. These facilities include:

- Modern, efficient research center.
- Analog and digital process simulation laboratories.
- Electronic data processing center.
- Standard and calibration laboratory.
- Electronically controlled fabricating machinery.
- Rigid quality-control stations.
- Automated warehousing and shipping.
- Fully-equipped, multi-classroom customer training center.

This partial list represents only a small part of L&N total facilities and capabilities—facilities and capabilities which have made and sustain L&N as a world leader in the field of instrumentation.

If you have any questions about L&N facilities, contact your local L&N Field Office. You'll find an L&N Field Engineer ready to answer your questions. Or better still, visit our North Wales complex—your personal inspection is always welcome.

Addresses and phone numbers of L&N Field Offices are listed on Inside Back Cover.

Leeds & Northrup

Aerial view shows Leeds & Northrup's 150-acre administrative, research



and manufacturing complex at North Wales, Pa. (suburban Philadelphia).





Leeds & Northrup

Electrical Test & Calibration Equipment

L&N offers a complete line of portable and high precision electrical test and calibration equipment for process and laboratory applications. This equipment includes Bridges and Potentiometers, Comparators and Ratio Sets, Portable Test and Calibration Equipment, Reference Standards for a variety of electrical measurements, Temperature Standards, Null Detectors, Amplifiers and Power Supplies.

Many of these instruments can be supplied with an L&N Report of Calibration as indicated, and as an added service, L&N can provide periodic recalibration for instruments of L&N manufacture. If NBS Reports of Calibration or Test are required, L&N can arrange for them. For complete details on calibration services, contact your local L&N Field Office.

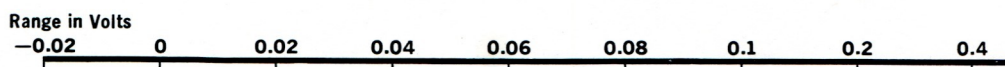
To facilitate your selection of an L&N Bridge or Potentiometer, this section includes Selection Guides—one for bridges, one for potentiometers. These guides summarize ranges and accuracies to permit easy comparison of instruments. L&N bridges and potentiometers range from the sophisticated 8079-B ER Thermometer Bridge and K-6 Potentiometer to those of lesser accuracy—the “work-horses” which are in continuous use in thousands of laboratories and schools, and in industry throughout the world.

In this section product descriptions are condensed. Only pertinent specifications and prices are listed to provide enough information to make a purchasing selection. If additional information is needed, send for the literature listed with the product specifications, or contact your local L&N Office.

Selection Guide - L&N D-C Potentiometers

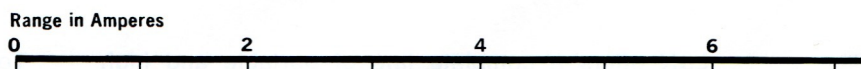
RANGES AND LIMITS OF ERROR* (Stated accuracies shown are without L&N Report of Calibration; higher accuracies

POTENTIOMETERS FOR VOLTAGE MEASUREMENTS



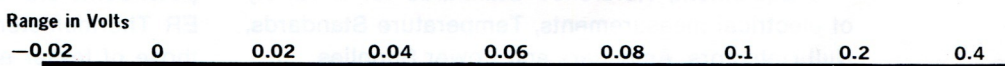
7556 7556-1	X1	$\pm(0.0005\% + 1 \mu V)$
	X.1	$\pm(0.0015\% + 0.1 \mu V)$
	X.01	$\pm(0.0025\% + 0.02 \mu V)$
7556 & 7594-2 (Volt Box)		
7555 7555-1	X1	$\pm(0.003\% + 3 \mu V)$
	X.1	$\pm(0.005\% + 0.3 \mu V)$
	X.01	$\pm(0.005\% + 0.1 \mu V)$
7554 7554-1	X1	$\pm(0.005\% + 20 \mu V)$
	X.1	$\pm(0.007\% + 2.0 \mu V)$
	X.01	$\pm(0.007\% + 0.5 \mu V)$
7564	1600	
	160	
	16	
	1.6	$\pm(0.005\% + 15 \mu V)$
	0.16	$(\pm 0.006\% + 1.5 \mu V)$
	0.016	$\pm(0.006\% + 0.5 \mu V)$
7645	X1	$\pm 0.0005 V$
	X.1	$\pm 0.0001 V$
	X.01	$\pm 0.00001 V$
8687-3 8687-1	X1	$\pm(0.03\% + 30 \mu V)$
	X.1	$\pm(0.04\% + 3 \mu V)$
8691-2 8691-1	X1	$\pm(0.05\% + 150 \mu V)$
	X.1	$\pm(0.05\% + 15 \mu V)$

POTENTIOMETERS FOR CURRENT MEASUREMENTS



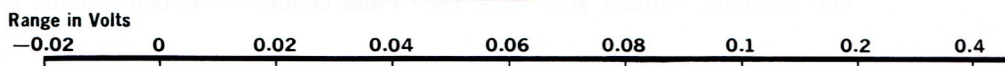
7555 & 4385 (Shunt Box)
7554 & 4385 (Shunt Box)
7645 & 4385 (Shunt Box)

POTENTIOMETERS FOR EMF & THERMOCOUPLE MEASUREMENTS



8686-3 8686-1	$\pm(0.03\% + 3 \mu V \text{ W/O R.J.C.})$
8690-2 8690-1	$\pm(0.05\% + 20 \mu V \text{ W/O R.J.C.})$
8692-2 & 8693-2 8692-1 & 8693-1	Direct-reading in °F or °C ($\pm 0.2\%$ of range specified)
8694-2 & 8695-2	Direct-reading in °F or °C ($\pm 0.3\%$ of range specified)
8696-2	$\pm 0.3\%$ of range W/O R.J.C.

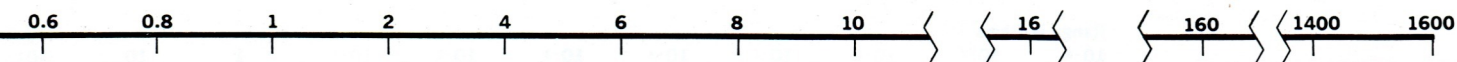
POTENTIOMETER FOR CORROSION POTENTIALS



8697-2	X1	
	X.1	$\pm(0.05\% \text{ of Reading} + \text{One Scale Division})$
	X.01	$\pm(0.05\% \text{ of Reading} + \text{One Scale Division})$

* Unless otherwise specified, all limits of error are in terms of percent of reading.
Note: "-1" suffix indicates rack-mounted instrument.

are attainable with certification.)



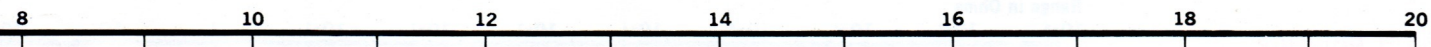
$\approx \pm 0.0025\%$

$\pm(0.015\% + 15 \text{ mV})$

$\pm(0.035\% + 15 \text{ mV})$

$\pm(0.007\% + 1.5 \text{ mV})$

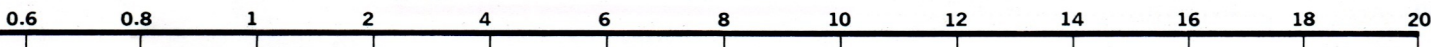
$\pm(0.008\% + 150 \mu\text{V})$



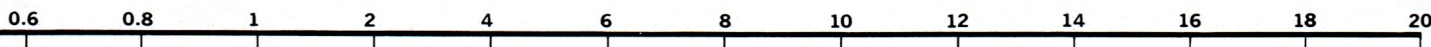
$\pm 0.025\%$

$\pm 0.027\%$

$\pm(\text{Percent Error of 7645} + 0.02\%)$



$\pm 0.03\%$

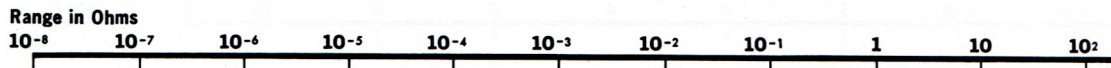


$\pm(0.05\% \text{ of Reading} + \text{One Scale Division})$

Selection Guide — L&N Bridges

RANGES AND LIMITS OF ERROR . . . D-C BRIDGES For Resistance and Temperature Measurements

MULTI-TEROHM BRIDGE

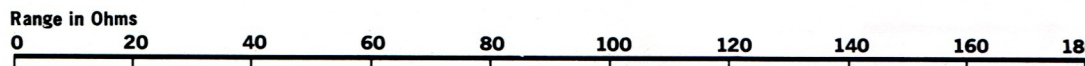


4233-A11

WHEATSTONE BRIDGES

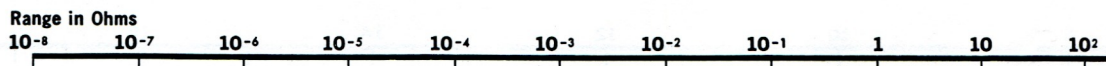
4232-2B		±0.001 Ω
4232-3B (rack-mounting)		
4737, 4737-1		
4737-A□		
4736, 4736-1		
4289-3		
4289-1		
5300, 5305, 5430-AM-1		±(0.15% + 0.01 Ω)
4760		
4270		(±0.5%)
4283-2		

TEMPERATURE BRIDGES



8079-B		±(0.0005% + 2 steps on lowest dial)
8071 (G3), 8072 (G4)	±0.00002 Ω	
8069 (G2)	±0.0005 Ω	±0.001%
8067 (G1)	±0.0002 Ω	±0.02%
8064-3	±0.005 Ω	±0.05%
8064-1		
8064-A-3	±0.005 Ω	
8064-A1		
8017-2	Range as specified . . . ±0.3% of range	

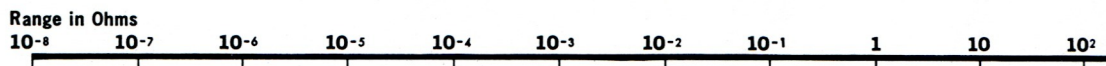
KELVIN BRIDGES



4300 & 4320	2 μΩ	±0.055%	Resolution—0.01 microhm
4287-3		±0.03% to ±0.05%	
4287-1			
4870	±0.2% incl. 4872-□ (0 to 105% of Standard)		
4340	(*)	±0.5%	
4288-2		±1.0%	

RANGES AND LIMITS OF ERROR . . . A-C BRIDGES For Resistance and Conductance Measurements

RESISTANCE BRIDGES

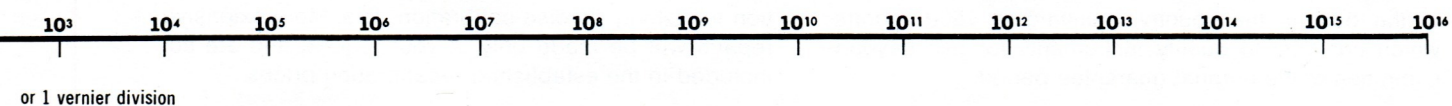
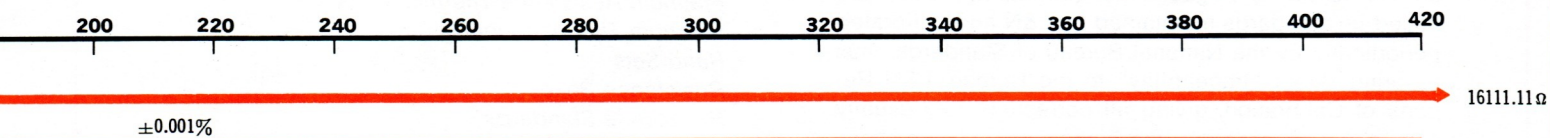
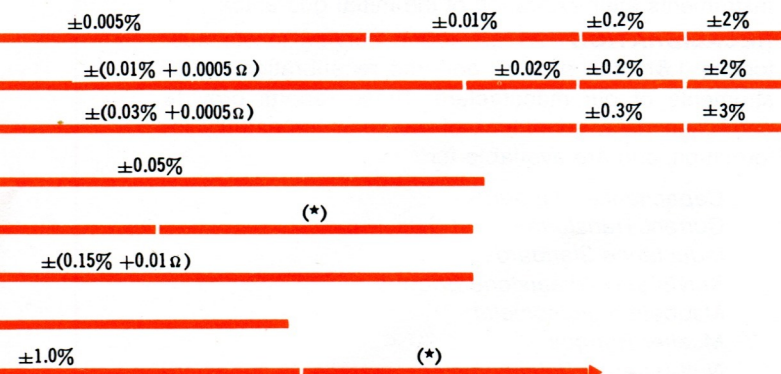
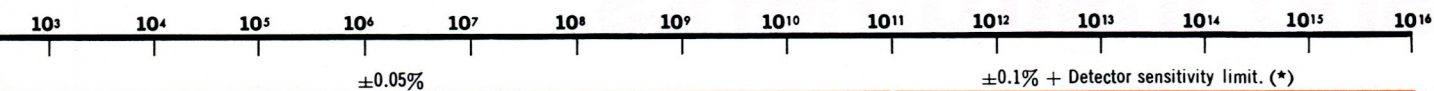


4666		±0.02%
4866**		
4960		
4959**		±0.15%

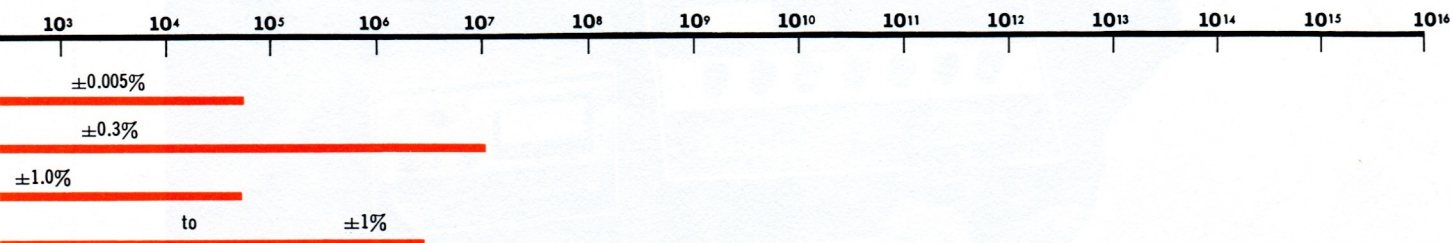
* To determine limits of error within these range spans, refer to specifications of individual instruments. Unless otherwise specified, all limits of error are in terms of percent of reading.

** Also has reciprocal scale for direct reading of measured conductance.

Note: "-1" suffix indicates rack-mounted instrument.



Resolution—To 0.01 microhm with internal standards, to 0.0001 microhm with auxiliary standards.



Calibration of Standards and Instruments

NBS REPORTS OF CALIBRATION—Occasionally you may require calibration of precision-type standards and measuring instruments purchased from L&N. When these calibration needs have special aspects requiring that the work be done by the National Bureau of Standards, and the equipment is a basic standard, the Bureau will accept a request for calibration. L&N supplies an NBS Report of Calibration with the 4210-C1 Thomas One-Ohm Standard (charge included in price) and will, on request, procure an NBS Report of Calibration (at additional charge) for 8700, 8710 and Std 780-B platinum thermocouples. For all other equipment, you should negotiate directly with the Bureau to arrange for calibration.

L&N REPORTS OF CALIBRATION—As a service to our customers, we can provide an L&N Report of Calibration for some of our primary standards, bridges and potentiometers (as noted in the particular specifications on the following pages). The calibration values are based on standards maintained by L&N and calibrated periodically by the National Bureau of Standards, thus assuring direct "traceability" to the Bureau. L&N Reports of Calibration, giving all correction data usually considered necessary by the Bureau, are in some cases included in the price of the instrument; where available but not included, they can be supplied at nominal additional charge. The availability of each report, with its price, is noted in this catalog with the appropriate instrument. Reports are specified by adding suffix "-B" to the Catalog Number.

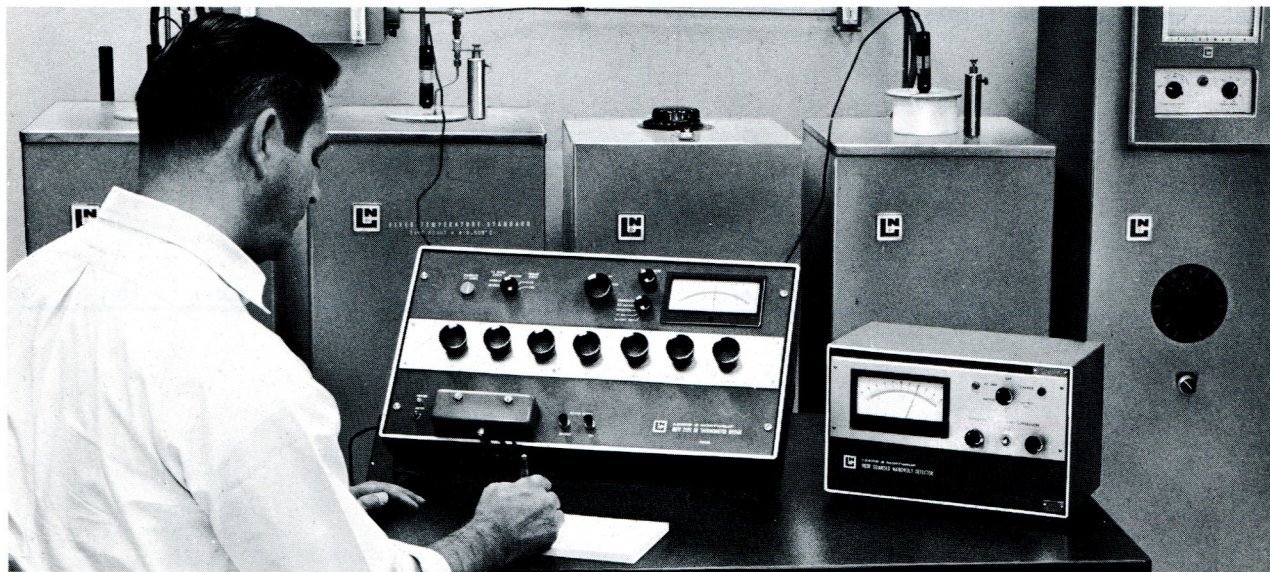
A series of Calibration Reports on a given instrument over a period of time provides a history of performance and establishes a pattern of stability. The performance of our certification facilities has been recognized as one of the best in the country, resulting in valid reports which continue to qualify instruments for use beyond expiration of the original guarantee period.

For instruments of lesser accuracy, checking procedures are followed which duplicate those of new instruments. Statements of Conformance re-qualify these instruments after expiration of the initial guarantee.

RECALIBRATION—As an added service to our customers, L&N can provide periodic recalibration for instruments of our manufacture. These reports provide correction data, conditions of test, and traceability information, and are available for:

- Capacitance Standards*
- Current Transformer Test Sets*
- Inductance Standards*
- Kelvin and Wheatstone Bridges*
- Macbeth Illuminometer*
- Mueller Bridges*
- Null-Balance Potentiometers (portable & precision)*
- Optical Pyrometers*
- Platinum Resistance Thermometers*
- Platinum Thermocouples*
- Ratio Sets*
- Resistance Boxes*
- Resistance Standards*
- Shunts*
- Standard Cells*
- Temperature Bridges*
- Volt Boxes*
- Voltage Dividers*

Established fees for this service cover: a general condition "trouble-shooting" check of your instrument; an overall cleaning, including exposed contacts, slide-wires, terminals, etc.; amalgamating of terminals when necessary; and the preparation of a Report of Calibration furnishing precise calibration data. More extensive repairs will be made only at your request and are not included in the established recalibration prices.





Leeds & Northrup

Portable Test & Calibration Equipment

8686-3 Precision Millivolt Potentiometer



Provides millivolt measurements with highest accuracy in an L&N portable instrument.

- Double range with two decades and slidewire, with central readout window.
- Self contained; built-in electronic null detector, standard cell and batteries.
- Manual reference-junction compensation.

SPECIFICATIONS

Catalog Number 8686-3 Portable Precision Millivolt Potentiometer; includes new 324190 electronic null detector (see p. J -14). 8686-2 also available; has 1.0 μV sensitivity at 50k Ω for applications involving high external source resistances.

Ranges Low: -10.1 to +100.1 mV (without input reversal). High: +1010 to +1020 mV (standard cell calibrations).

Limits of Error Without reference junction compensation $\pm(0.03\%$ of reading + 3 microvolts); with reference junction compensation $\pm(0.03\%$ of reading + 6 μV).

Readout All dial readings appear in a central readout window.

Case Metal, with handle and removable lid.

Dimensions 14 $\frac{1}{4}$ " x 11 $\frac{1}{2}$ " x 7 $\frac{1}{2}$ " (362 x 292 x 190 mm).

Weight Net, 21 lb (9.5 kg); shipping, 27 lb (12.2 kg).

Options L&N Report of Calibration.

Price 8686-3: \$610.00; 8686-2: \$670.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet B0.1111.

8687-3 Precision Volt Potentiometer



A portable, double range instrument for general purpose usage.

- Double range with high accuracy.
- Two decades and slidewire, with central readout window.
- Self contained; built-in electronic null detector, standard cell and batteries.

SPECIFICATIONS

Catalog Number 8687-3 Portable Precision Volt Potentiometer; includes new 324190 electronic null detector (see p. J -14). 8687-2 also available; has 1.0 μV sensitivity at 50k Ω for applications involving high external source resistances.

Ranges Low: 0 to 0.1601 volt. High: 0 to 1.601 volt.

Limits of Error (High Range) $\pm(0.03\%$ of reading + 30 μV). (Low Range) $\pm(0.04\%$ of reading + 3 μV).

Readout All dial readings, except the decimal multipliers appear in a central readout window.

Case Metal, with handle and removable lid.

Dimensions 14 $\frac{1}{4}$ " x 11 $\frac{1}{2}$ " x 7 $\frac{1}{2}$ " (362 x 292 x 190 mm).

Weight Net, 21 lb (9.5 kg); shipping, 27 lb (12.2 kg).

Options L&N Report of Calibration.

Price 8687-3: \$ 675.00; 8687-2: \$735.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet B0.1110.

8690-2 Millivolt Potentiometer



A portable potentiometer for routine checking of thermocouples, recorders and controllers.

- Measurements from -11.0 to $+101.0$ mV.
- Long 27.5" scale provides high resolution.
- Self contained; built-in electronic null detector, standard cell and batteries.
- Manual reference-junction compensator for thermocouple measurements.

SPECIFICATIONS

Catalog Number 8690-2 Portable Millivolt Potentiometer.

Range -11.0 millivolts to $+101.0$ millivolts.

Limits of Error Without reference junction compensation: $\pm(0.05\%$ of reading $+15 \mu\text{V}$); with reference junction compensation: $\pm(0.05\%$ of reading $+30 \mu\text{V}$).

Batteries Self contained.

Case Metal with handle and removable lid.

Dimensions $12\frac{1}{32}" \times 8\frac{29}{32}" \times 7\frac{9}{16}"$ (306 x 226 x 192 mm).

Weight Net, 13 lb (5.9 kg); shipping, 17 lb (7.7 kg).

Options L&N Report of Calibration.

Price \$391.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet B0.1113.

8691-2 Millivolt Potentiometer



A portable potentiometer providing measurements up to 1,110 mV (1.11 volts) with high accuracy and resolution.

- Double Range; decade and slidewire operation with in-line readout.
- Self contained; built-in electronic null detector, standard cell, and batteries.
- Provides calibrated d-c source.

SPECIFICATIONS

Catalog Number 8691-2 Portable Millivolt Potentiometer.

High Range 0 to 1110 millivolts (1.11 volts).

Low Range 0 to 111 millivolts.

Limits of Error (High Range) $\pm(0.05\%$ of reading $+150 \mu\text{V}$).

Limits of Error (Low Range) $\pm(0.05\%$ of reading $+15 \mu\text{V}$).

Case Metal, with handle and removable lid.

Dimensions $12\frac{1}{32}" \times 8\frac{29}{32}" \times 7\frac{9}{16}"$ (306 x 226 x 192 mm).

Weight Net, 13 lb (5.9 kg); shipping, 17 lb (7.7 kg).

Options L&N Report of Calibration.

Price \$391.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet B0.1112.

8692-2, 8693-2 Temperature Potentiometers

Self-contained instrument with built-in electronic null detector, standard cell and batteries.

- Wide selection of thermocouple and millivolt ranges—direct reading in degrees F or C.
- Automatic reference-junction compensation on thermocouple ranges.
- Two-turn slidewire operation with central readout window.
- Long 27.5" scale provides high resolution.

SPECIFICATIONS

Catalog Numbers 8692-2-□, Portable Temperature Potentiometer, Single Range. 8693-2-□-□, Portable Temperature Potentiometer, Double Range.

Range 8692-2-□, any single range as specified. See table. 8693-2-□-□, any two ranges as specified. See table. (Special ranges are available.)

RANGES

Type of Thermocouple	Range	Smallest Scale Division	Suffix Number*
Iron & Constantan (Type J)	0 to 300 F	0.5 F	048
	-100 to +500 F	1.0 F	009
	0 to 1000 F	2.0 F	003
	400 to 1200 F	2.0 F	172
	0 to 1600 F	5.0 F	142
	0 to 2000 F	5.0 F	049
	900 to 2000 F	2.0 F	164
	-55 to +105 C	0.5 C	513
	0 to 200 C	0.5 C	007
	-100 to +400 C	1.0 C	166
	0 to 500 C	1.0 C	022
	0 to 800 C	2.0 C	057
	0 to 1100 C	2.0 C	165
	0 to 700 F	2.0 F	200
Chromel & Alumel (Type K)	0 to 1200 F	2.0 F	024
	0 to 2000 F	5.0 F	001
	0 to 2500 F	5.0 F	143
	1000 to 2500 F	5.0 F	046
	0 to 600 C	1.0 C	062
	0 to 1200 C	2.0 C	047
	500 to 1200 C	2.0 C	167
	0 to 700 F	2.0 F	200
	0 to 1200 F	2.0 F	024
	0 to 2000 F	5.0 F	001



Limits of Error $\pm 0.2\%$ of range span.

Batteries Self contained.

Case Metal, with handle and removable lid.

Dimensions $12\frac{1}{32}'' \times 8\frac{29}{32}'' \times 7\frac{1}{16}''$ (306 x 226 x 192 mm).

Weight Net, about 13 lb (5.9 kg); shipping about 17 lb (7.7 kg).

Options Special ranges are available.

Price 8692-2-□: \$337.00; 8693-2-□-□: \$412.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number. Include desired range suffix(es) from table.

For more information, see Data Sheet B1.1120.

Type of Thermocouple	Range	Smallest Scale Division	Suffix Number*
Platinum, 10% Rhodium & Platinum (Type S)	0 to 2500 F	5.0 F	033
	0 to 3200 F	5.0 F	144
	2000 to 3200 F	2.0 F	052
	0 to 1600 C	5.0 C	067
Platinum, 13% Rhodium & Platinum (Type R)	0 to 3200 F	5.0 F	145
Copper & Constantan (Type T)	-340 to +230 F	-340 to -100 F 2.0 F	168
	-100 to +400 F	-100 to +230 F 1.0 F	032
	0 to 650 F	1.0 F	201
	-200 to +150 C	-200 to -150 C 2.0 C	170
		-150 to +50 C 1.0 C	
		50 to 150 C 0.5 C	
	-100 to +300 C	1.0 C	146
	0 to 400 C	1.0 C	169
Millivolts	-5 to 0 to +5	0.02	084
	0 to 10	0.02	044
	0 to 25	0.05	127
	0 to 50	0.10	045

No reference-junction compensation provided on millivolt ranges

*To specify, add suffix number(s) to 8692-2-□ or 8693-2-□-□. For the double range 8693, the range number listed first is the "A", or top range. The range number listed second is the "B", or bottom range.

8694-2, 8695-2

Compact Temperature Potentiometers



Single-dial portable instruments for thermocouple temperature measurements.

- Wide selection of thermocouple ranges.
- Automatic reference-junction compensation.
- Completely portable with sturdy, lightweight metal case.
- Self contained; built-in electronic null detector, standard cell, and batteries.

SPECIFICATIONS

Catalog Numbers 8694-2-□, Compact Temperature Potentiometer, Single Range; 8695-2-□-□, Compact Temperature Potentiometer, Double Range.

Range 8694-2-□, any single range as specified; see table. 8695-2-□-□, any two ranges as specified; see table. Special ranges are available.

Limit of Error $\pm 0.3\%$ of span.

Case Metal, with plastic handle.

Dimensions $6\frac{1}{8}'' \times 7\frac{3}{4}'' \times 5\frac{7}{8}''$ (156 x 197 x 149 mm).

Weight Net $4\frac{1}{2}$ lb (2 kg); shipping, 7 lb (3.2 kg).

Price 8694-2-□: \$241.00; 8695-2-□-□: \$289.00.

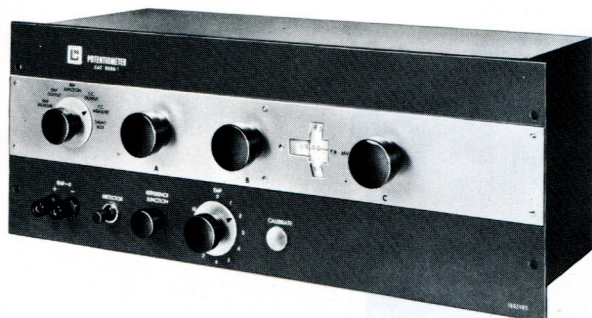
Ranges

Type of Thermocouple	Range	Smallest Scale Division	Suffix Number		
			For 8694-2	For 8695-2 Inside Scale "A"	For 8695-2 Outside Scale "B"
Iron & Constantan (Type J)	-100 to +400 F	2 F	828	428	828
	0 to 1200 F	5 F	829	429	829
	0 to 2000 F	10 F	830	430	830
	300 to 1200 F	5 F	831	431	831
	1000 to 2000 F	5 F	832	432	832
Chromel & Alumel (Type K)	0 to 1200 F	5 F	833	433	833
	0 to 2500 F	10 F	834	434	834
	1100 to 2500 F	5 F up to 2000 F, 10 F above.	835	435	835
Plat., 10% Rhodium & Platinum (Type S)	0 to 3200 F	20 F up to 1200 F, 10 F above.	836	436	836
	1500 to 3200 F	10 F	837	437	837
Plat., 13% Rhodium & Platinum (Type R)	0 to 3200 F	20 F up to 1200 F, 10 F above.	838	438	838
	1500 to 3200 F	10 F	839	439	839
Copper & Constantan (Type T)	-200 to +250 F	2 F	840	440	840
	0 to 750 F	5 F	841	441	841
	-100 to +400 F	2 F	842	442	842
	-320 to +100 F	2 F up to 0 F, 1 F above	858	458	858

ORDERING INSTRUCTIONS **GSA** Specify catalog number. Include desired range suffix(es) from table.

For more information, see Data Sheet B1.1121.

Panel Mounted Potentiometers



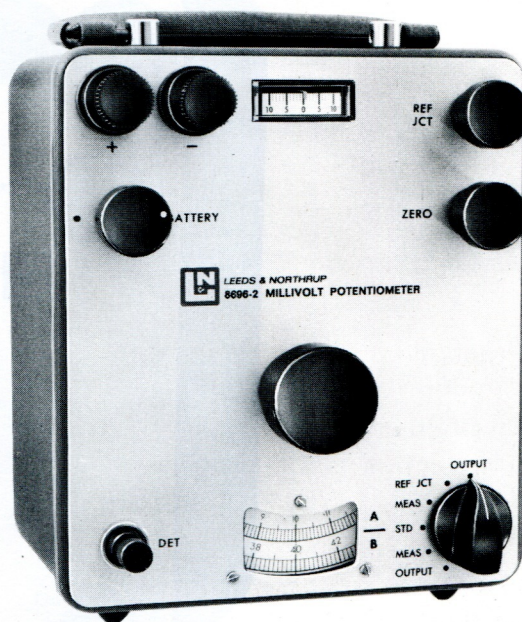
A number of potentiometers are available in a 19" panel mounted configuration. These have the same basic specifications as the portable test and calibration instruments except they do not include self-contained null-detectors.

ORDERING INSTRUCTIONS GSA The following instruments are available for 19" panel mounting. To order, specify catalog number(s) of desired item(s).

Catalog Number	Price
8690-1	\$420.00
8691-1	\$420.00
8692-1	\$364.00
8693-1	\$439.00
8686-1	\$655.00
8687-1	\$720.00

For more information, see Data Sheets B0.1211 and B0.1212.

8696-2 Compact Millivolt Potentiometer



A completely portable instrument with sturdy, lightweight metal case.

- **Single-dial operation; 0 to 64 mV in two over-lapping ranges.**
- **Self contained; built-in electronic null detector, standard cell, and batteries.**
- **Manual reference-junction compensator for thermocouple measurements.**

SPECIFICATIONS

Catalog Number 8696-2 Compact Millivolt Potentiometer.

Ranges 0 to 22 millivolts and 20 to 64 millivolts.

Limits of Error Without reference junction compensation: $\pm(0.3\%$ of range). With reference junction compensation: $\pm(0.3\%$ of range + $45 \mu\text{V}$).

Case Metal, with plastic handle.

Dimensions $6\frac{1}{8}'' \times 7\frac{3}{4}'' \times 5\frac{7}{8}''$ (156 x 197 x 149 mm).

Weight Net, 7 lb (3.2 kg).

Price \$289.00.

ORDERING INSTRUCTIONS GSA Specify catalog number.

For more information, see Data Sheet B0.1114.

9914 Control Loop Tester

A compact instrument for testing and checking-out control systems. Provides all necessary functions for control loop check out or precision calibration using an auxiliary potentiometer.

- Current and voltage source for controllers or transmitters.
- Millivoltage source for recorders.
- Battery-operated.
- Direct reading dual-range meter.

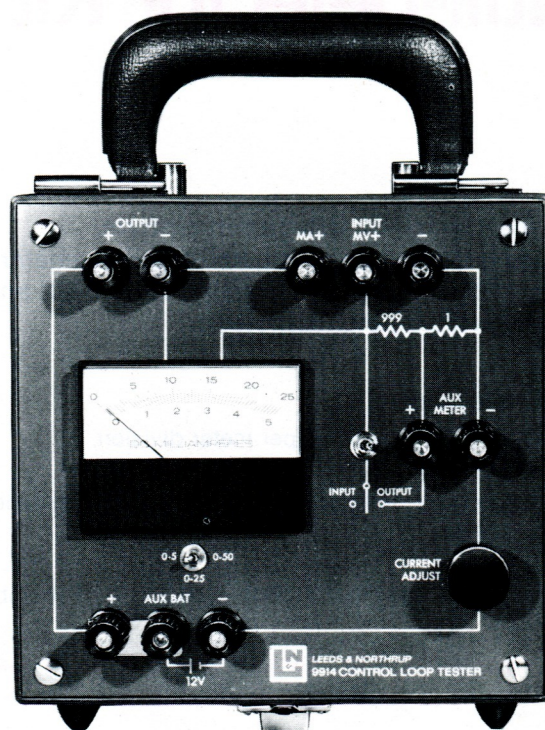
SPECIFICATIONS

Current Output Adjustable from 0-50 milliamperes, d-c, 2½" meter, dual-range; 0-5 milliamperes, 0.1 mA/div.; 0-25 milliamperes, 0.5 mA/div.; 0-50 milliamperes, 1.0 mA/div.

Meter Accuracy ±2%.

Internal Standard 1.0 ohm ±0.05% for use with potentiometer.

Internal Voltage Divider 1000 ohms, ratio accuracy ±0.1%.



Internal Load Resistor 1000 ohms, ±0.1%.

Binding Posts Five-way for maximum versatility.

Dimensions 7¼" (w) x 7¼" (l) x 7" (d) including feet and removable hinged lid (184 x 184 x 178 mm).

Weight 6¾" lb (3.1 kg).

Price \$209.00.

ORDERING INSTRUCTIONS Specify catalog number.

For more information, see Data Sheet B0.1001.

8697-2 Portable Volt Potentiometer

Designed to measure corrosion potentials between buried metals (pipelines, cables, tower supports) and the earth, as a guide to applying cathodic protection. Also useful for measuring control-point voltages of Zener diodes.

- Measurements of potentials to 11.10 volts.
- Self-contained; built-in electronic null detector, standard cell and batteries.
- Switch-and-slidewire operation with in-line readout windows.
- Reverse polarity switch.

SPECIFICATIONS

Catalog Number 8697-2.

Range X1 range: 0 to 11.10 V; X.1 range: 0 to 1.110 V; X.01 range: 0 to 0.111 V.

Limits of Error ±(0.05% of reading + one scale division).

Case Metal with vinyl finish, handle and removable lid.

Dimensions 12½" x 8½" x 7¾" (306 x 226 x 187 mm).

Weight 13 lb (5.9 kg).

Price \$885.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, contact your local L&N Field Office.

324050 Null-Detector Kit

An electronic null detector in kit form, designed to replace the pointer galvanometer in catalog numbers 8690, 8691, 8692, 8693 and 8697 portable potentiometers.

SPECIFICATIONS

Sensitivity 50 microvolts per meter division.

Input Resistance 10,000 ohms.

Power Supply Self-contained, two 4.05 volt batteries.

Price \$64.00.

ORDERING INSTRUCTIONS Specify part number 324050.

For more information, contact your local L&N Field Office.



324190 Null-Detector Kit

An electronic null detector in kit form, designed to replace the light-beam galvanometer in catalog numbers 4287, 4289, 8064, 8064-A, 8686 and 8687 portable bridges and potentiometers.

SPECIFICATIONS

Sensitivity 5 microvolts per meter division.

Input Resistance 5600 ohms.

Noise Less than 3 microvolts peak-to-peak.

Response Time Less than 1 second, 0 to 90% deflection.

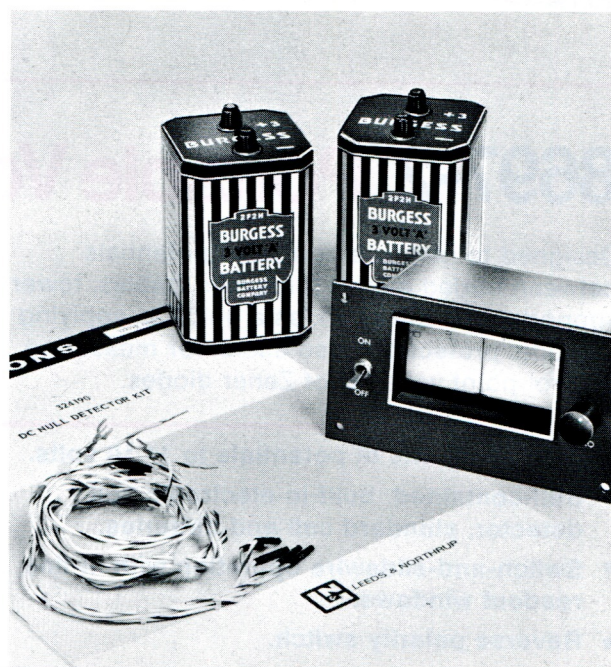
Maximum Input Overload Input protected against continuous overloads up to 35 volts.

Power Requirements ± 3 volts at 2 milliamperes (batteries included in kit).

Price \$125.00.

ORDERING INSTRUCTIONS Specify part number 324190.

For more information, contact your local L&N Field Office.



4287-3 Precision D-C Kelvin Bridge



A portable bridge for precision measurements and calibration of meters, components, windings and other instruments.

- Precise low-resistance measurements from 0.0001 to 110.100 ohms.
- Direct reading—two decades plus slidewire, with central readout window.
- Terminals provided for external detector, unknown, external battery, or external standard to extend range of the bridge.

SPECIFICATIONS

Catalog Number 4287-3 Portable Precision Kelvin Bridge; includes new 324190 electronic null detector (see p. J-14); has sufficient sensitivity to detect the following changes: 0.05% at 0.0001 Ω , 0.01% at 0.001 Ω , 0.005% or better at 0.01 Ω or higher. 4287-2 also available; has increased sensitivity over 4287-3 by an approximate factor of 10; useful when using range extension feature.

Ranges 0.0001 ohm to 110.1 ohms in six ranges.

Limits of Error $\pm 0.05\%$ of reading. Improves to $\pm 0.03\%$ as the "A" dial is switched from the 1 to the 10 position.

Readout All readings, except decimal multipliers, appear in a central readout window.

Case Metal, with handle and removable lid.

Dimensions 14 $\frac{1}{4}$ " x 11 $\frac{1}{2}$ " x 7 $\frac{1}{2}$ " (362 x 292 x 190 mm).

Weight Net, 23 $\frac{1}{2}$ lb (10.6 kg); shipping, about 29 lb (13.2 kg).

Options L&N Report of Calibration.

Price 4287-3: \$790.00; 4287-2: \$870.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet B5.1110.

4289-3 Precision D-C Wheatstone Bridge



For precision measurements and calibration of meters, components, windings and other instruments.

- Highest accuracy in an L&N Portable Wheatstone Bridge.
- Measurements from 1 ohm to 11.01 megohms.
- Two decades plus slidewire operation with central readout window.

SPECIFICATIONS

Catalog Number 4289-3 Portable Precision Wheatstone Bridge; includes new 324190 electronic null detector (see p. J-14); has sufficient sensitivity to detect the following changes: 0.01% or better from 1 Ω to 10 Ω , 0.001% or better from 10 Ω to 100k Ω , 0.005% from 100k Ω to 1M Ω , 0.045% from 1M Ω to 10M Ω . 4289-2 also available; has increased sensitivity over 4289-3 by an approximate factor of 10, useful when monitoring small resistance changes at megohm levels.

Range 1 ohm to 11.01 megohms in 7 ranges.

Limits of Error $\pm 0.05\%$ of reading. Improves to $\pm 0.03\%$ of reading as the first dial is switched from the 1 to the 10 position.

Readout All dial readings, except decimal multipliers, appear in a central readout window.

Case Metal with removable lid and handle.

Dimensions 14 $\frac{1}{4}$ " x 11 $\frac{1}{2}$ " x 7 $\frac{1}{2}$ " (362 x 292 x 190 mm).

Weight Net 21 lb (9.5 kg); shipping, 27 lb (12.2 kg).

Options L&N Report of Calibration.

Price 4289-3: \$745.00; 4289-2: \$805.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet B5.1120.

8064-3 Resistance Thermometer Bridge



A portable bridge for precise temperature or temperature-difference measurements.

- Precise resistance thermometer measurements from 0 to 160.1 (or 1060.1) ohms readable to 0.001 ohm.
- Used with either three- or four-lead resistance thermometers.
- Two decades and slidewire operation with central readout window.

SPECIFICATIONS

Catalog Number 8064-3 or 8064-A3 Portable Resistance Thermometer Bridge; equipped with new 324190 electronic null detector (see p. J-14), provides sufficient sensitivity to detect resistance changes of 0.0005Ω or 0.001%, whichever is greater, using the bridge high-current mode. 8064-2 and 8064-A2 also available; has increased sensitivity over 8064-3 by an approximate factor of 10.

Ranges 0 to 160.1Ω (8064-2 and 8064-3); 0 to 1060.1Ω (8064-A2 and 8064-A3).

Limits of Error ±0.05% of reading or ±0.005 ohms, whichever is larger.

Readout All readings appear in a central readout window.

Case Metal with handle and removable lid.

Dimensions 14¼" x 11½" x 7½" (262 x 292 x 190 mm).

Weight Net, 20 lb (9.1 kg); shipping 26 lb (11.8 kg).

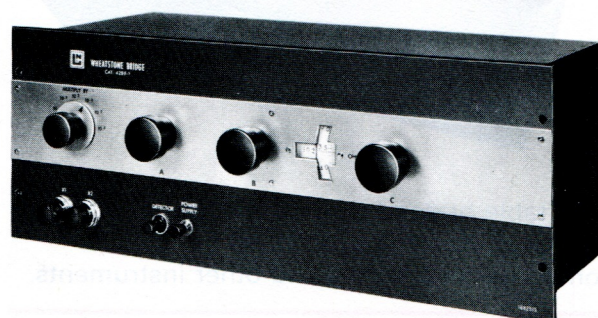
Options L&N Report of Calibration.

Prices 8064-3: \$710.00; 8064-A3: \$725.00; 8064-2: \$775.00; 8064-A2: \$795.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet B1.2110.

Panel-Mounted Bridges



A number of bridges are available in a 19" panel mounted configuration. These have the same basic specifications as the portable test and calibration instruments except they do not include self-contained null-detectors.

ORDERING INSTRUCTIONS **GSA** The following instruments are available for 19" panel mounting. To order, simply specify catalog number(s) of desired item(s).

Catalog Number	Price
8064-1	\$600.00
8064-A1	\$680.00
4287-1	\$655.00
4289-1	\$600.00

For more information, see Data Sheets B1.2211 and B5.1201.

4288-2 Compact D-C Kelvin Bridge



For routine measurements of rods, wires, windings, etc. from 0.0001 to 11.00 ohms.

- Self-contained electronic null detector and batteries; also has provisions for external batteries.
- Completely portable with sturdy, lightweight metal case.

SPECIFICATIONS

Catalog Number 4288-2 Compact Portable Kelvin Bridge.

Range 0.0001 to 11 ohms in 5 ranges.

Limits of Error $\pm 1.0\%$ of reading.

Readout All dial readings, except decimal multiplier, appear in central readout window.

Batteries Self contained.

Case Metal, with plastic handle.

Dimensions $6\frac{1}{8}'' \times 7\frac{3}{4}'' \times 5\frac{7}{8}''$ (156 x 197 x 149 mm).

Weight Net, $5\frac{1}{2}$ lb (2.5 kg); shipping, 8 lb (3.6 kg).

Price \$311.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet B5.1111.

8017-2 Compact Temperature Bridge



For routine temperature measurements; used with either three- or four-lead resistance thermometers for temperature or temperature-difference measurements.

- Direct reading for any span of 20 F (10 C) or more.
- Completely portable with self-contained electronic null detector.

SPECIFICATIONS

Catalog Number 8017-2 Compact Temperature Bridge.

Range Specify any span of 20 F (10 C) or more for any standard resistance thermometer.

Limit of Error $\pm 0.3\%$ of span.

Measuring Dial Single scale, $13\frac{1}{2}''$ long, calibrated for specified temperature range and resistance thermometer.

Batteries Self contained.

Case Metal, with plastic handle.

Dimensions $6\frac{1}{8}'' \times 7\frac{3}{4}'' \times 5\frac{7}{8}''$ (156 x 197 x 149 mm).

Weight Net, $4\frac{1}{2}$ lb (2 kg); shipping, 7 lb (3.2 kg).

Price \$289.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet B1.2120.

4283-2 Compact D-C Wheatstone Bridge



For routine measurements from 0.3 to 300,000 ohms; checking and testing electrical components; intercomparison of resistors, etc.

- Completely portable with sturdy lightweight metal case.
- Self contained; built-in electronic null detector and batteries.

SPECIFICATIONS

Catalog Number 4283-2, Compact D-C Wheatstone Bridge.

Range 0 to infinity in six ranges.

Limits of Error $\pm 1.0\%$ of reading when using internal standards to provide scale readings between 0.3 and 3 for unknown resistance between 0.3 and 300,000 ohms.

Readout All dial readings, except decimal multipliers, appear in central readout window.

Case Metal, with plastic handle.

Dimensions $6\frac{1}{8}'' \times 7\frac{3}{4}'' \times 5\frac{7}{8}''$ (156 x 197 x 149 mm).

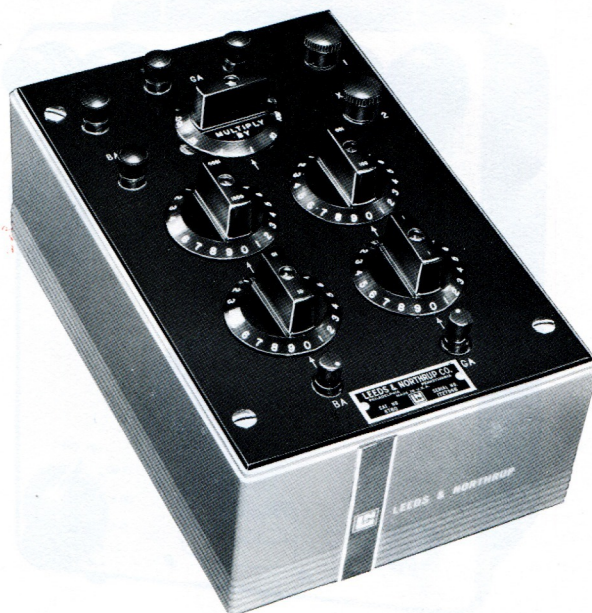
Weight Net, $4\frac{1}{2}$ lb (2 kg); shipping, about 7 lb (3.2 kg).

Price \$289.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet B5.1121.

4760 D-C Wheatstone Bridge



For resistance measurements of moderate accuracy from 1 ohm to 9.999 megohms.

- Enclosed rheostat switches.
- Rheostat decades may be used as adjustable four-dial resistance box.

SPECIFICATIONS

Catalog Number 4760.

Range 1 ohm to 9.999 megohms.

Rheostat Range 0 to 9999 ohms in steps of 1 ohm; four decades, 9 (1 + 10 + 100 + 1000) ohms.

Limits of Error Overall bridge error: $\pm(0.15\% + 0.01 \text{ ohm})$.

Case Gray metal.

Dimensions $9\frac{5}{8}'' \times 6\frac{3}{8}'' \times 5\frac{1}{8}''$ (244 x 162 x 130 mm).

Weight $5\frac{1}{2}$ lbs (2.5 kg).

Price \$300.00.

ORDERING INSTRUCTIONS Specify catalog number.

For more information, see Data Sheet A5.1223.

5300 and 5305 Type S Test Sets



Small portable Wheatstone bridges designed primarily for ordinary resistance testing. The 5300 has provisions for locating grounds and crosses by the Murray and Varley Loop Tests.

- Routine resistance testing from 1 to 9,999,000 ohms.
- Provision for external batteries and galvanometer.
- Rugged construction for portable use.
- 5300 has provisions for Murray and Varley loop tests.

SPECIFICATIONS

Catalog Numbers 5300 (Type S-1); 5305 (Type S-2).

Ratio Arms Enclosed dial switch having seven multiplying values: 0.001, 0.01, 0.1, 1, 10, 100 and 1000.

Rheostat Four decades 9 (1 + 10 + 100 + 1000) ohms. Enclosed dial switches.

Limits of Error Overall bridge error: $\pm(0.15\% + 0.01 \text{ ohm})$. Of ratio, $\pm 0.5\%$; in rheostat arm, resistance change from zero setting of dials equals dial setting $\pm(0.1\% + 0.01 \text{ ohm})$.

Galvanometer Built-in, pointer type.

Case Oak, with hinged lid and carrying strap.

Dimensions $9\frac{1}{2}'' \times 8\frac{1}{2}'' \times 6\frac{1}{8}''$ (241 x 216 x 156 mm).

Weight Approx. 10 lb (4.5 kg).

Price 5300: \$316.00; 5305: \$263.00.

ORDERING INSTRUCTIONS Specify catalog number.

For more information, see Data Sheet B5.1122.

5430-AM-1 Type U Test Set



A portable Wheatstone bridge designed to identify faulty wires in cables, locate grounds, shorts, etc. by the Murray, Varley and other loop tests.

- Enclosed-dial ratio and rheostat switches with knurled knobs for easy manipulation.
- May be used as a four-dial adjustable resistance.
- Provision for Murray, Varley and Hilborn loop tests.

SPECIFICATIONS

Catalog Number 5430-AM-1.

Ratio Arms Enclosed dial switch. Multiplying values of 1/1000, 1/100, 1/10, 1/9, 1/4, 1/1, 10/1, 100/1 for resistance measurements and for Varley loop tests. Also settings of M1000, M100 and M10 for ratios in Murray loop tests.

Rheostat Enclosed dial switches. Four decades, 10 (1 + 10 + 100) ohms + (9 X 1000 ohms and Infinity).

Limits of Error Overall accuracy: $\pm(0.15\% + 0.01 \text{ ohm})$.

Galvanometer Self-contained, pointer-type.

Batteries Three Size "D" batteries.

Case Metal, with plastic carrying handle and removable lid.

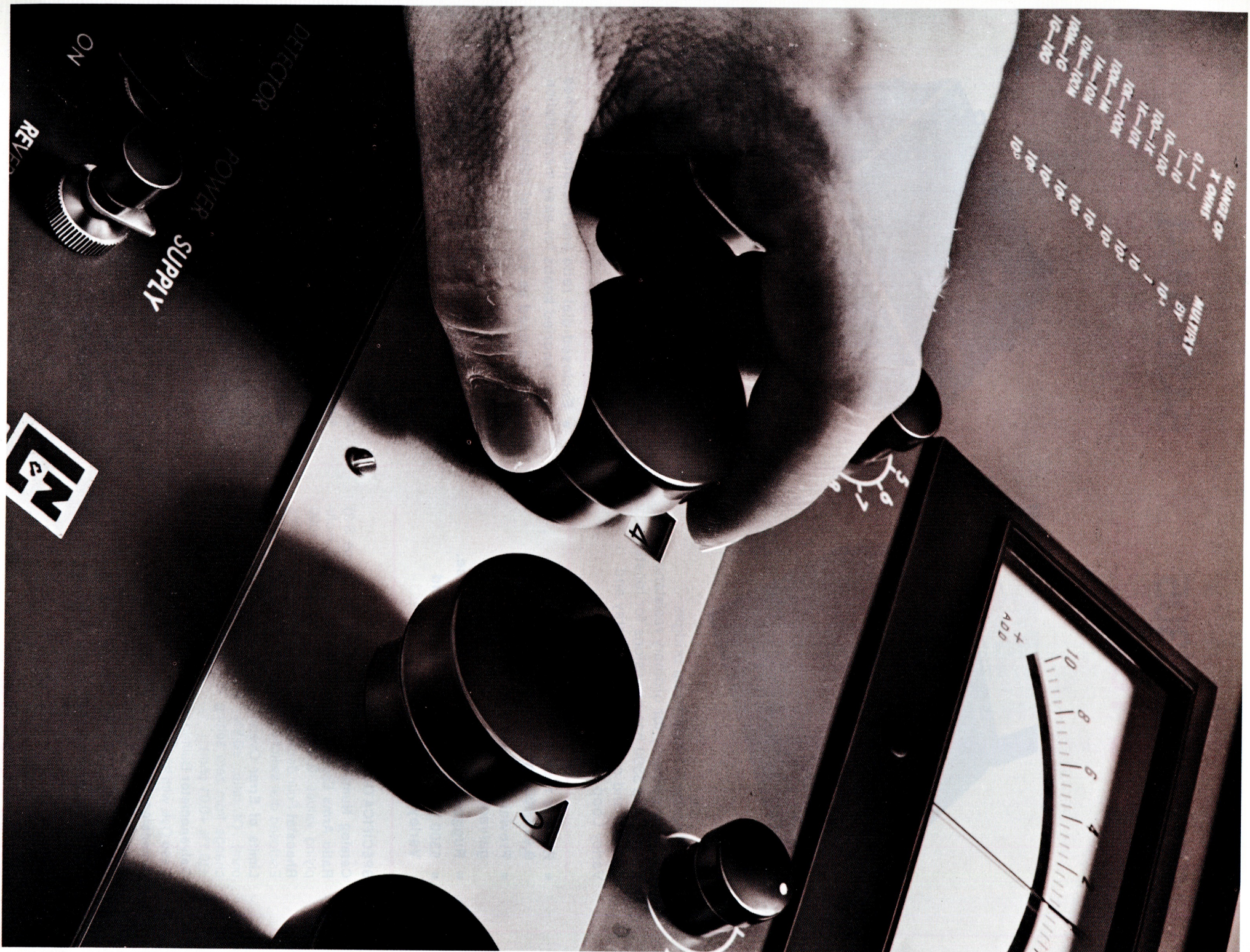
Dimensions $8\frac{3}{4}'' \times 6\frac{7}{8}'' \times 6\frac{3}{8}''$ (213 x 175 x 162 mm).

Weight Approx. $8\frac{3}{4}$ lb (4 kg).

Price \$321.00.

ORDERING INSTRUCTIONS Specify catalog number.

For more information, see Data Sheet B5.1131.





Leeds & Northrup

High-Precision Test and Calibration Equipment

4210 Thomas-Type One-Ohm Standard



Prime standard for use in maintaining value of the ohm. The resistance element consists of specially selected wire, made to L&N's exacting specifications.

- Measured value accurate to one part per million.
- NBS report of calibration available.

SPECIFICATIONS

Catalog Numbers 4210-B: Includes Items (a) & (b)
4210-C1: Includes Items (a), (b), & (c).

- (a) L&N Report of Value which states the measured value to 0.1 part per million (0.00001%) at 25.0° C, accurate to 0.5 part per million (0.00005%) and includes the alpha and beta values for the R_t equation. Also includes statement regarding the minor effect of changes in barometric pressure.
- (b) A computer-calculated tabulation of resistance change from 25° C for every 0.1° C between 18 and 30° C. The change is expressed in parts per million and is listed in the table to the nearest 0.1 ppm.
- (c) NBS Report of Value which states the measured value to 0.01 part per million at 25.00° C, accurate to

0.08 part per million (0.000008%). Also includes statement regarding the minor effect of changes in barometric pressure.

Resistance Adjusted to one absolute ohm between potential leads.

Limit of Error Adjusted within 5 parts per million (0.0005%) of nominal value at 25 C.

Stability Typically does not exceed 1 part per million per year under conditions of normal use.

Current Rating 0.1 ampere in stirred oil.

Connections Four-terminal, current/potential type. Resistance of current and potential leads, approximately 0.0011 to 0.0013 ohm each.

Protective Case A special carrying case is supplied containing a foam polystyrene form to hold the unit firmly in place.

Dimensions 7" (w) x 6½" (h) x 3¾" (OD) (178 x 165 x 95 mm).

Weight 3 lb (1.4 kg), packaged for shipment, 9¼ lb (4.2 kg).

Price 4210-B: \$575.00. 4210-C1: \$700.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A5.1111.

4214-B 10,000-Ohm Resistance Standard



Highest quality standard suitable for the calibration of other high accuracy resistive devices. Terminal spacing and height are equal to the 4210 Thomas One-Ohm Standard permitting the standard to be used in existing oil bath fixtures. May be used with equal accuracy in air when mounted inside the thermally lagged carrying case.

SPECIFICATIONS

Catalog Number 4214-□; add Suffix "B" or "C1"—see below.

Accuracy The initial resistance value is adjusted to 10,000 ohms ± 3 ppm (0.0003%), between potential terminals at 25 C.

REPORT OF CALIBRATION

B Suffix L&N report of value, traceable to the National Bureau of Standards, which states the resistance value to 0.1 ppm with a calibration uncertainty of ± 1 ppm at 25 C. The Report of Calibration also includes corrections at 0.1 C intervals from 18 C to 30 C.

C1 Suffix Same as B plus NBS report of value stated to 0.1 ppm with an uncertainty of ± 1 ppm at 25 C.

Stability Changes of resistance will not exceed ± 2

ppm during the first year; ± 1 ppm during the second year.

Construction The resistance elements are mounted in a rugged brass protective container and are hermetically sealed with glass-to-metal seals against the effects of humidity.

Power Rating 0.1 watt.

Phase Angle The phase angle is such that up to 1592 Hz the equivalent resistance does not deviate from the d-c value by more than 5 ppm.

Dielectric Soakage Effect Resistance is stabilized to within ± 0.1 ppm of final value within 10 seconds with 10 volts applied to the resistance standard.

Thermal EMF Under normal test conditions, the thermal EMF at the terminals does not exceed ± 0.1 microvolt.

Dimensions Standard only: 6 $\frac{5}{8}$ " (168mm) high x 4" (102mm) diameter. Terminal spacing, 6 $\frac{1}{4}$ " (159mm). Carrying Case: 8 $\frac{1}{4}$ " (210mm) wide x 6 $\frac{1}{4}$ " (159mm) deep x 7 $\frac{1}{8}$ " (181 mm) high.

Weight Standard only: 5 $\frac{1}{2}$ lbs. (2.5 kg)
Standard in case: 12 lbs. (5 kg)

Price 4214-B: \$575.00; 4214-C1: \$745.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog no.
For more information, see Data Sheet A5.1111.

4321-B and 4323-B Hamon Transfer Standards

A pair of Hamon Transfer Standards is used to build up from the one-ohm level of the Thomas One-ohm Standard to the 10,000-ohm level.

The physical configuration of the Hamon Standards is the same as that of the 4210 Thomas Standard and the 10,000-ohm 4214.

Construction of the Hamon Standard is patterned essentially after the design suggested by B. V. Hamon in the Journal of Scientific Instruments, December, 1954. This design uses precisely adjusted lead resistances and mercury-wetted links to assure accuracy and repeatability of the highest degree.

SPECIFICATIONS

Catalog Numbers 4321-B, 100 Ohms; 4323-B, 10,000 Ohms.

Resistance Values 4321-B: 100-Ohms when connected in series (permanent connection); 1-Ohm when connected in parallel (commutator supplied); 10-Ohms with nine of its ten resistors connected in series-parallel arrangement by means of a separately ordered commutator. See "Accessories" at Right.

4323-B: 10,000-Ohms when connected in series (permanent connection); 100-Ohms when connected in parallel; 1,000-Ohms with nine of its ten resistors connected in series-parallel. See "Accessories" at Right.

Transfer Accuracy

Theoretical

0.01 ppm for 1/100 transfer; 0.5 ppm for 1/10 transfer using the optional series-parallel commutator.

Practical

A step up procedure using both standards and the Cat. 8403 Bridge and Bath permits a transfer from 1 ohm to 10,000 ohms with a ratio uncertainty of about 0.3 ppm. This includes effects of temperature variation, detector resolution, and bridge reproducibility as well as the ratio error of the Hamon standards.

L&N Report of Calibration A report of calibration is included with each transfer standard giving the three resistance values (parallel, series-parallel, and series) to the nearest 0.1 ppm with a limit of error of ± 2 ppm at time of test.



Temperature Coefficient Within ± 5 ppm per degree centigrade at 25 C. A table is provided with the standards giving corrections from 25 C for every 0.1 C from 20 to 30 C. Corrections are given to the nearest 0.1 ppm. Alpha, beta, and peak are also given.

Stability Approximately 5 ppm per year.

Adjustment Tolerance Resistors are adjusted to within 10 ppm of nominal value and matched to 1 ppm.

Power Coefficient Within ± 0.1 ppm/0.1 watt if power is applied for less than one minute. If the same power is applied for both the series and parallel connections, at least partial cancellation of this source of error can be achieved.

Housing Insulated metal box with hinged lid for each standard. Oil-filled metal container (4321 only), with a thermometer well provided in center, houses the ten four-terminal resistors. Entire unit may be immersed in oil. Box has provision for storing a commutator and the series links.

Dimensions 4½" (114 mm) diameter nickel plated brass enclosure. Height is 6¾" (171 mm) and outside dimension of current terminals is 6¾" (171 mm).

Weight 14 lb (10.9 kg).

Accessories 169004 Commutator for parallel connection, supplied with 4321-B. 169005 Commutator for connecting nine of the ten resistors in series-parallel.

Price 4321-B: \$1735.00; 4323-B: \$1420.00.

ORDERING INSTRUCTIONS GSA Specify catalog no.

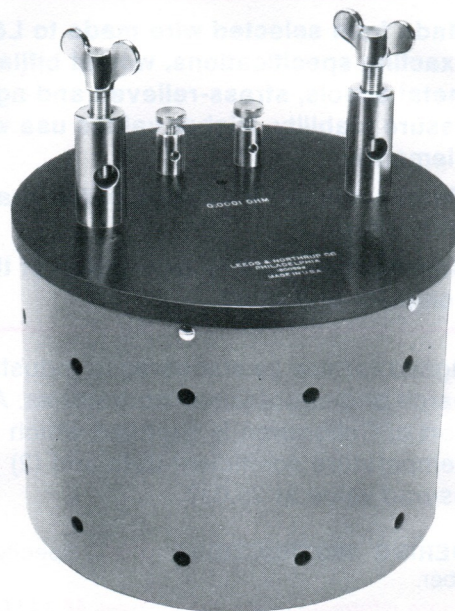
For more information, see Data Sheet A5.1111.

4221-B, 4222-B and 4223-B Reichsanstalt- Type Resistance Standards



Low-resistance comparison standards (0.001 to 0.1 ohm). Used in the accurate measurement of current with a potentiometer, and as standards for comparison in low-resistance measurements.

4224-B-A L&N- Type 0.0001-Ohm Resistance Standard



Four-terminal resistance standards with high current capacity. Similar to the Reichsanstalt resistors, these resistors are designed to be used in measuring relatively high currents, or as four-terminal resistance standards with high current capacity.

ORDERING INSTRUCTIONS **GSA** Specify catalog number. *For more information, see Data Sheet A5.1111.*

SPECIFICATIONS

Type	Integral Standards			Intermediate Standards		Wattage Rating	Limit of Error**			Size	Price
	Catalog Number	Resistance (Ohms)	Current Rating (Amperes)	Catalog Number	Resistance (Ohms)		Adjustment to Nominal Value	Measured Value Stated to:	Accuracy of Measured Value***		
L&N	4224-B-A150	0.0001	150	—	—	—	±0.01%	±0.001%	±0.003%	7" x 7½" x 3½"	\$ 885.00
	4224-B-A300		300						±0.005%	10½" dia. x 12" (h)	1570.00
Reichsanstalt	4223-B	0.001	30 100	—	—	1 Watt 10 Watts	±0.005%	±0.0001%	±0.002% (30 amps) ±0.05% (100 amps)	7" x 7½" x 3½"; 3 lb.	520.00
	4222-B	0.01	10 30		4222-B-X □ *				±0.001% (for smaller current figure) ±0.05% (for larger current or wattage fig.)	7" x 6" x 3½" 2 lb.	4222-B \$221.00 4222-B-X 294.00
	4221-B	0.1	3 10		4221-B-X □ *						4221-B 221.00 4221-B-X 294.00

*To specify desired resistance, add the basic resistance multiplier in the blank following the letter "X". Example: 4222-B-X5 identifies a 0.05-ohm standard (five times the basic resistance of 0.01-ohm). Intermediate values are also available, consult an L&N Field Office.

**The value of resistance given is in terms of the U.S. Legal Unit and is traceable to a set of reference standards maintained by L&N and calibrated at regular intervals by the NBS.

***At time of calibration. Measured value will remain stable for a period of one year within 10 ppm for standards 0.01 ohm and above; 20 ppm below 0.01.

4015-Series NBS-Type Resistance Standards

- Made from selected wire made to L&N's exacting specifications, wound bifilar on metal spools, stress-relieved and aged to assure stability. Higher values use woven elements.
- Metal container insulation better than 10^{14} ohms.
- Construction permits immersion of the complete unit in oil.

Designed for use as standards in industrial, research and educational laboratories. An L&N Report of Calibration is supplied which gives (1) temperature coefficient data and (2) measured value at 25.0 C.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A5.1111.



SPECIFICATIONS

Type	Integral Standards			Intermediate Standards		Wattage Rating	Limit of Error**			Size	Price	
	Catalog Number	Resistance (Ohms)	Current Rating (Amperes)	Catalog Number*	Resistance (Ohms)		Adjustment to Nominal Value	Measured Value Stated to:	Accuracy of Measured Value***			
National Bureau of Standards	4015-B	0.1	3	—	—	1 Watt	±0.05%	±0.01%	±0.05%	4" x 1 1/2"	\$95.00	
	4020-B	1	0.3 1.0	4020-B-X □	2 to 9 ohms in increments of 1 ohm	0.1 Watt 1 Watt	±0.003% ****	±0.0001%	±0.001%**** (for smaller current figure) ±0.02% (for larger current or wattage figure)		4020-B 95.00 4020-B-X 168.00	
	4025-B	10	0.1 0.3	4025-B-X □	15 to 95 ohms in increments of 5 ohms						4025-B 95.00 4025-B-X 168.00	
	4030-B	100	0.03 0.1	4030-B-X □	110 to 990 ohms in increments of 10 ohms						4030-B 95.00 4030-B-X 168.00	
	4035-B	1000	0.01 0.03	4035-B-X □	1100 to 9900 ohms in increments of 100 ohms						4035-B 95.00 4035-B-X 168.00	
	4040-B	10,000	0.003 0.01	4040-B-X □	11,000 to 99,000 ohms in increments of 1000 ohms						4040-B 95.00 4040-B-X 168.00	
	4045-B	100,000	0.001 0.003	—	—	0.1 Watt	±0.005%	±0.0001%	±0.002%		111.00	
	4050-B	1,000,000	0.0003	—	—						116.00	

*To specify desired resistance, add the basic resistance multiplier in the blank following the letter "X". Examples: 4020-B-X5 identifies a 5-ohm standard; 4030-B-X5 a 500-ohm standard, 4035-B-X7.5 a 7500-ohm standard, etc. For "intermediate" values, consult your nearest L&N office.

**The value of resistance given is in terms of the U.S. Legal Unit and is traceable to a set of reference standards maintained by L&N and calibrated at regular intervals by the NBS.

***At time of calibration, Measured value will remain stable for a period of one year within 10 ppm for standards up to 10K ohms; 20 ppm above 10K.

****Applies to integral standards only. For intermediate values, adjustment is ±0.005%, and accuracy is ±0.002% for smaller wattage figure.

4333 and 4334 Secondary- Standard Resistors



Can be used as working-standard resistors for general laboratory application, or as range-extending standards for the 4287-2 Kelvin Bridge.

SPECIFICATIONS

Catalog Number 4333 or 4334.

Resistance 4333, 0.001 ohm; 4334, 0.0001 ohm.

Current Rating 30 amperes.

Limit of Error 4333: $\pm 0.02\%$; 4334: $\pm 0.2\%$.

Dimensions $3\frac{1}{4}'' \times 5\frac{1}{2}'' \times 3\frac{3}{4}''$ (83 x 140 x 95 mm).

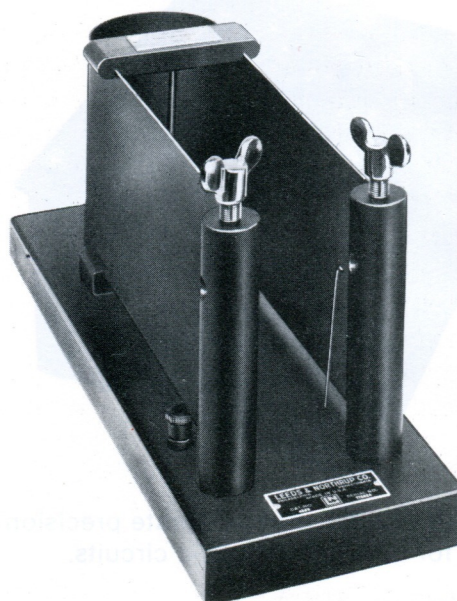
Weight $1\frac{1}{4}$ lb (0.6 kg).

Price 4333: \$247.00. 4334: \$294.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet B5.1201.

4360-Series Shunts



These low-resistance standards, or shunts, are primarily for use in accurate measurements of large currents by the potentiometric method. The 4360, 4361, and 4363 resistors consist of a continuous strip of resistive material in one or more folds, held in position by spacers. The others are made up of parallel strips of this material between heavy copper terminals. An L&N Report of Calibration is available (add suffix "-B").

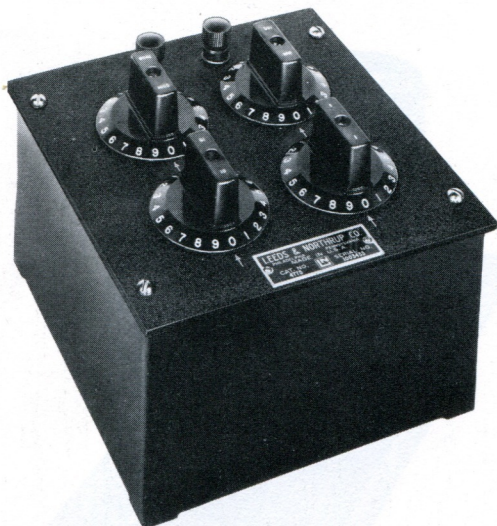
ORDERING INSTRUCTIONS **GSA** Specify catalog no.

For more information, see Data Sheet A5.1111.

SPECIFICATIONS

Catalog Number	Resistance, Absolute Ohms	Current Rating, Amperes	Limit of Error	Dimensions	Weight	Price	Add for Suffix "-B"
4360	0.1	15	$\pm 0.04\%$ when cooled by air at ordinary room temperature.	$15'' \times 7'' \times 3\frac{1}{2}''$	3 lb	\$145.00	\$104.00
4361	0.01	100		$20'' \times 8'' \times 7\frac{1}{2}''$	15 lb	452.00	120.00
4363	0.001	300		$18\frac{3}{4}'' \times 6\frac{1}{2}'' \times 9\frac{1}{2}''$	13 lb	410.00	120.00
4364	0.001	500		$36'' \times 5\frac{1}{2}'' \times 5''$	25½ lb	620.00	152.00
4369	0.00004	1500		$20\frac{3}{8}'' \times 4\frac{7}{8}'' \times 4''$	35½ lb	685.00	152.00
4372	0.00002	2000		$20\frac{3}{8}'' \times 4\frac{7}{8}'' \times 4''$	35½ lb	735.00	176.00
4375	0.00001	3000		$20\frac{3}{8}'' \times 4\frac{7}{8}'' \times 4''$	35½ lb	790.00	176.00

4775, 4776 Enclosed-Switch Resistance Boxes



Inexpensive standards of moderate precision designed for general use in d-c circuits.

SPECIFICATIONS

Catalog Number 4775 or 4776.

Resistance 4775: 9999 ohms; 4776: 999.9 ohms.

Decade Steps 4775: $9(1 + 10 + 100 + 1000)$. 4776: $9(0.1 + 1 + 10 + 100)$.

Limit of Error Resistance change from zero setting, measured across binding posts, equals dial settings $\pm(0.1\% + 0.01 \text{ ohm})$. Statement assumes that box is in regular use, or that dials will be rotated before box is put into use after a period of idleness.

Dimensions $5\frac{5}{8}'' \times 6\frac{1}{8}'' \times 4\frac{3}{8}''$ (143 x 156 x 111 mm).

Weight 4 lb (1.8 kg).

Price 4775: \$132.00. 4776: \$132.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog no.

For more information, see L&N Data Sheet A5.1121.

4233-P. WYE-Delta High-Resistance Standard



This high-resistance standard is used for checking the 4233-All Wide-Range Resistance Bridge at nominal resistances of 10^8 to 10^{15} ohms.

Price Contact your local L&N Field Office for price.

ORDERING INSTRUCTIONS Specify catalog number. Add appropriate suffix to correspond to the exponent of 10 of the desired resistance value. Example, 4233-P-12 = 10^{12} ohms nominal value.

For more information, see Data Sheet A5.1231.

4790 Six-Dial Microhm Resistance Box

Designed to facilitate the calibration of high accuracy instruments having decade-type ratio or rheostat arms that are relatively low in resistance but high in precision.

SPECIFICATIONS

Catalog Number 4790.

Decades, Ohms Six Waidner-Wolff decades: $(-1 \text{ to } 10)(0.1 + 0.01 + 0.001 + 0.0001 + 0.00001 + 0.000001)$. Total resistance change of approximately 1.1 ohms in steps of $1 \mu\text{ohm}$.

Limit of Error $\pm(0.05\% + 10 \mu\text{ohm})$ for changes in resistance above the zero setting of all dials. An optional L&N Report of Calibration is available.

Residual Resistance 10 ohms $\pm 0.01\%$.

Wattage Rating 0.15.

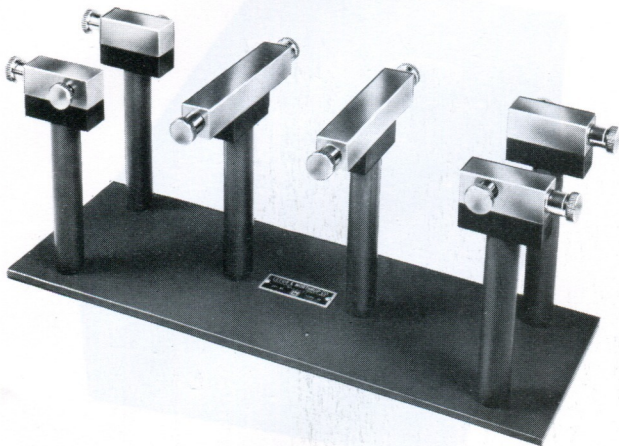
Dimensions 19" (l) x 5" (w) x 7 $\frac{1}{4}$ " (h) (483 x 127 x 184 mm).

Price \$3435.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog no.

For more information, contact your local L&N Field Office.

Accessories for Primary Resistance Standards



Provides quick, low-resistance series and/or parallel connections of NBS-type resistance standards.

- Manufactured in accordance with NBS design.
- Amalgamated top surfaces of solid-copper blocks present extremely low contact resistances.
- Flat contact surfaces easy to clean and amalgamate.
- Insulation resistances better than 10 terohms.

SPECIFICATIONS

Catalog Number 4001.

Dimensions 6½" x 6½" x 14½".

Price \$310.00.

052845 Oil-Resistant Label (Pkg. of 100)

Useful for noting temperature coefficient data, correction data and certification dates on standards. Adhesive-backed aluminum, 1⅜" x 2⅛", it can be attached to standard and immersed in oil indefinitely.

Catalog Number 052845.

Price \$11.40.

127287 Mercury-Cup Stand

For supporting and interconnecting NBS- or Reichsanstalt-Type Standards. Height adjustable from 5⅝" to 8⅝". Screw terminals on both sides. Two stands required to support one standard.

Catalog Number 127287.

Price \$43.50.

128436 Amalgamated Copper Shorting Link (Male)

Physically replaces an NBS-Type Standard ⅜" diameter, nickel-plated copper rod, with 3" span between centers of amalgamated ends.

Catalog Number 128436.

Price \$14.90.

128488 Amalgamated Binding-Post Terminal (Female)

For connecting a Standard to an instrument binding post through a mercury contact surface. Copper bar, 1⅛" x 3½" x ¼", with hole in one end for binding post and mercury pool at other end.

Catalog Number 128488.

Price \$12.80.

113004 Oil-Absorbent Material (50-lb. Bag)

For convenient removal of oil from standards after they are taken from oil bath. Highly absorbent, the soft particles can be readily brushed from the standard and will not scratch the surface.

Catalog Number 113004.

Price \$12.80.

ORDERING INSTRUCTIONS GSA Specify catalog no. *For more information, see Data Sheet A5.1111.*

4754, 4755 and 4756 Shielded A-C Resistance Boxes



The 4754, 4755 and 4756 are moderate accuracy a-c resistance boxes providing standards of resistance from d-c through high frequencies.

ORDERING INSTRUCTIONS **GSA** Specify catalog no. L&N Report of Calibration is available. Add -B suffix to catalog number.

For more information, see Data Sheet A5.1121.

4764 Shielded A-C Resistance Box



An adjustable low-reactance standard of resistance. Used in research for precise measurements with a-c bridges at audio and higher frequencies.

- Idle resistors completely disconnected; eliminates effective capacitance.
- Electrostatic shielding.

SPECIFICATIONS

Catalog Number 4764.

Total Resistance 11,111.1 ohms.

Decade Steps 10 (0.01 + 0.1 + 1 + 10 + 100 + 1000).

Limit of Error $\pm(0.05\% + 0.005 \text{ ohm})$ in terms of resistance change from zero setting.

Contact Stability $\pm 0.0002 \text{ ohm per decade}$.

Dimensions 10 $\frac{1}{8}$ " x 15 $\frac{7}{8}$ " x 7 $\frac{1}{16}$ " (257 x 403 x 179 mm).

Weight 15 lb (6.8 kg).

Price For price, contact your local L&N Field Office.

ORDERING INSTRUCTIONS Specify catalog number.

For more information, see Data Sheet A5.1121.

SPECIFICATIONS AND PRICES FOR 4754, 4755 AND 4756

List Number	Total Resistance, Ohms	Decade Steps	Limit of Error in Resistance Change from Zero Setting	Contact Stability	Current Rating, Amperes		Dimensions	Price	Add for Suffix "-B"
4754	11,110	10 (1 + 10 + 100 + 1000)	Dial Settings $\pm(0.05\% + 0.005 \text{ ohm})$	$\pm 0.0005 \text{ ohm per decade}$	Highest Decade in Use:		15 $\frac{7}{8}$ " x 4 $\frac{1}{2}$ " x 6" weight approx. 7 lb	\$237.00	\$140.00
4755	11,111	10 (0.1 + 1 + 10 + 100 + 1000)			0.1	1.6	19 $\frac{1}{4}$ " x 4 $\frac{1}{2}$ " x 6" weight approx. 9 lb	308.00	160.00
4756	111,110	10 (1 + 10 + 100 + 1000 + 10,000)			1	0.5			
					10	0.11			
					100	0.035			
					1000	0.011			
					10,000	0.003	19 $\frac{1}{4}$ " x 4 $\frac{1}{2}$ " x 6" weight approx. 9 lb	319.00	160.00

4631 Secondary Standard A-C Resistors

Used as working standards for a-c measurements, each of these resistors consists of an insulated manganese-alloy wire woven into a resistance webbing, mounted on a ceramic form.

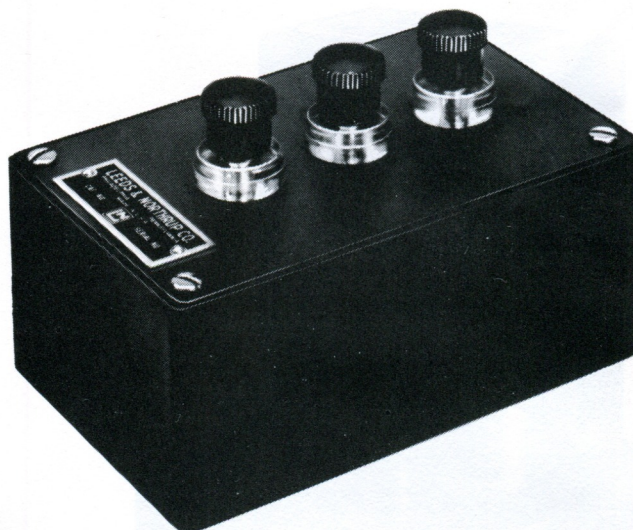
- Woven construction.
- Electrostatic shielding.
- Acrylonitrile-styrene binding posts.

ORDERING INSTRUCTIONS Specify catalog number. L&N Report of Calibration is available. Add "-B" suffix to catalog number.

For more information, contact your local L&N Field Office.

SPECIFICATIONS AND PRICES

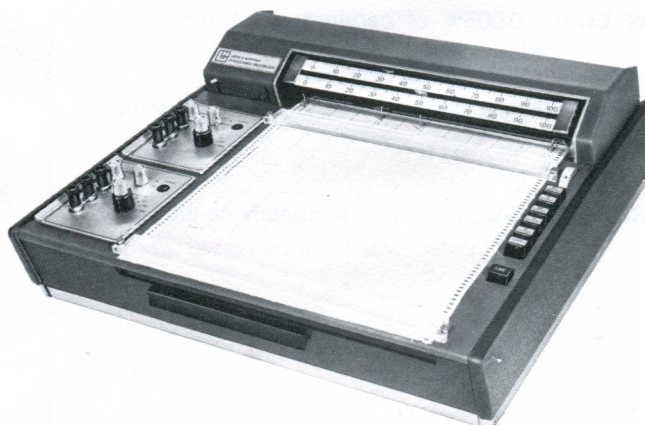
Catalog Number	D-C Resistance, Ohms	Current Rating, Amperes	Residual Inductance or Capacitance	Limit of Error	Dimensions and Weight	Price	Add for Suffix "-B"
4631	1000	0.031	1 μ H for 1000-ohm standard; less than 2.5 pF for other standards. These values change less than 5% between 1 and 50 kHz	$\pm 0.05\%$ in d-c resistance. Change of resistance with frequency is less than 0.01% for frequencies up to 50 kHz	3 $\frac{3}{4}$ " x 5 $\frac{1}{2}$ " x 3 $\frac{3}{4}$ " weight 1 $\frac{1}{4}$ lb.	\$65.00	\$17.60
4632	2000	0.022				65.00	
4633	3000	0.018				65.00	
4634	4000	0.016				65.00	
4640	10,000	0.010				70.00	
4642	20,000	0.007				70.00	



Recorders For Laboratory Applications

L&N offers a complete array of analog recorders for laboratory applications. These recorders include the Speedomax Type XL, W/L and Infotrak instruments. The Type XL recorders are available for low-profile one- or two-channel recording, and for flat-bed recording with one- or two-channels or with X-Y plus X-t functions. The Infotrak recorder provides analog records on standard 5" x 8" file cards for periodic, cyclic or transient measurements. The Speedomax W/L provides simultaneous 2-pen recording on a 9 $\frac{7}{8}$ " strip chart.

For a complete description of these recorders for laboratory applications, see Section G, "Indicators And Recorders".



7308 Unsaturated Standard Cell



Recommended for use with null potentiometers for measurements of high or moderate precision.

- Copper-lined bakelite case.
- Low temperature coefficient.

SPECIFICATIONS

Catalog Number 7308.

EMF Within limits of 1.01884 to 1.01964 volts.

Limit of Error $\pm 0.005\%$ of certified value (includes Eppley certificate).

Internal Resistance Approx. 500 ohms.

Dimensions $4\frac{1}{8}'' \times 4'' \times 5\frac{3}{16}''$ (105 x 102 x 132 mm).

Weight 2 lb (0.9 kg).

Price \$53.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog no.
For more information, contact your local L&N Field Office.

7311 Standard Voltage Reference



A compact unit combining four reliable Eppley saturated standard cells in a temperature-controlled air bath.

- Saturated type cells.
- Portable and shippable.
- Constant-temperature air bath.
- High-resolution mercury thermometer.

SPECIFICATIONS

Catalog Number 7311.

Input Voltage 115 V, 60 Hz a-c with automatic change-over to 12 V d-c standby.

Voltage Stability 1 ppm.

Power Consumption < 8 watts.

Operating Temperature 28 C, nominal to ± 0.01 C; also available at 32 C.

Thermometer Range 27.8 to 28.2 C in 0.02 graduations; readable to 0.01 C.

Dimensions $12\frac{3}{4}'' \times 9\frac{3}{4}'' \times 11''$ (324 x 248 x 279 mm).

Weight 30 lb (13.6 kg).

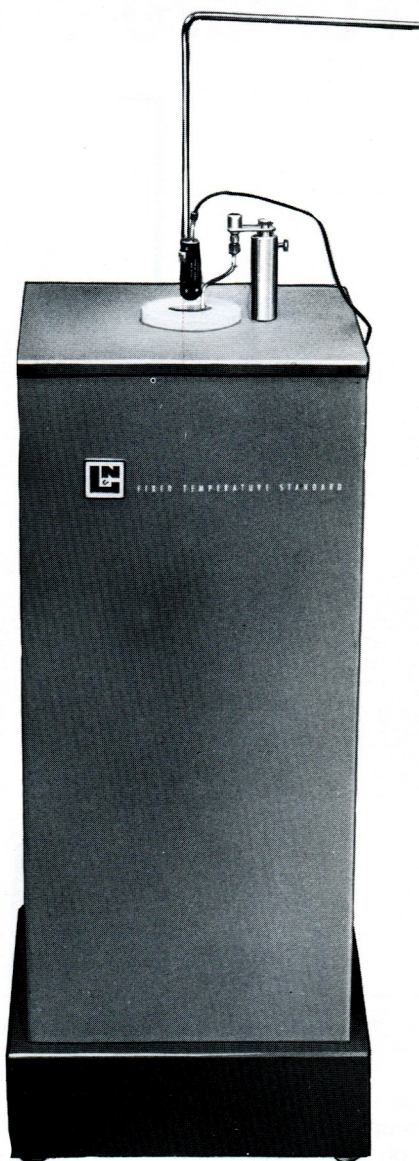
Price \$895.00*.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A0.1111.

*F.O.B., Newport, Rhode Island.

8411 Fixed Temperature Standards



- Interchangeable cells and equalizing blocks.
- 18" immersion depth (45.7 cm).
- Long-duration temperature plateaus.
- Simple control system.

The 8411 provides a known, fixed reference temperature for calibration of resistance thermometers or thermocouples. The fixed temperature point provided by this equipment is the freezing point of a pure metal.

ORDERING INSTRUCTIONS Specify catalog number from table.

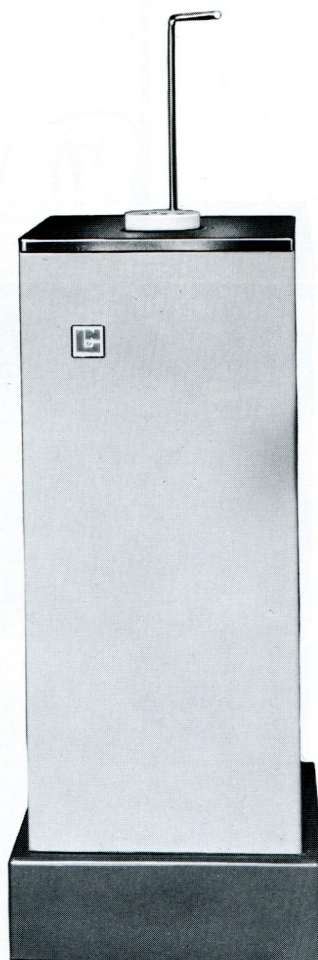
For more information, see L&N Data Sheet A1.0122.

SPECIFICATIONS

Metal	Freezing Points*		Catalog Number	Price	Freezing-Point Cell Only	Price	Cell Enclosure	Equalizing Block
	C	F						
Indium	156.61	313.89	8411-IN	\$3130.00	8411-IN-C	\$1110.00	130053 Pyrex \$260.00	127543 Copper \$475.00
Tin	231.91	449.4	8411-SN	2675.00	8411-SN-C	660.00		
Cadmium	321.03	609.8	8411-CD	2490.00	8411-CD-C	470.00		
Lead	327.4	621.1	8411-PB	2490.00	8411-PB-C	470.00		
Zinc	419.505	787.1	8411-ZN	2490.00	8411-ZN-C	450.00		
Antimony	630.5	1166.9	8411-SB	2845.00	8411-SB-C	775.00	130055 Vycor \$414.00	127604 Aluminum-Bronze \$562.00
Aluminum	660.1	1220.2	8411-AL	2830.00	8411-AL-C	765.00		

*/PTS-48

9009 Thermocouple Calibration Furnace



The 9009 vertical electric furnace is used for the precise comparison of thermocouples up to a maximum temperature of 2000 F; a choice of three equalizing blocks is provided, depending upon the maximum temperature desired.

- **Temperature uniformity.**
- **Completely factory-assembled.**
- **Gold temperature-limit fuse for overheat protection.**

ORDERING INSTRUCTIONS Selection of the furnace and controls is specified by adding one of the following suffixes as the first suffix to the furnace Catalog Number 9009-□-□:

A1 or -A2: Manual control with Powerstat. -A1 is mounted by customer; -A2 is factory-mounted and wired, within a steel panel enclosure. Dimensions: 18¼" square base, 16¼" square body, 42" high.

A3 or -A4: Steel enclosed control panel with all accessories factory-mounted and wired. Dimensions: 18¼" square base, 16¼" square body, 62" high. -A3 uses an

Electromax 2-Position Signaling Controller; -A4 uses a Speedomax H Model S Indicating and Recording Controller for 2-action D.A.T. Control.

For the second suffix, specify power requirements of 115 V or 230 V.

Prices.

Calibrating Furnaces.

9009-A1-115 (or 230): \$1545.00 (includes Powerstat and contactor).

9009-A2-115 (or 230): \$1335.00; Temperature Control Panel: \$886.00.

9009-A3-115 (or 230): \$1412.00; Temperature Control Panel: \$974.00.

9009-A4-115 (or 230): \$1412.00; Temperature Control Panel: \$981.00.

Equalizing Blocks.

127379 Copper, Max. 800 F: \$309.00.

127383 Al-Bronze Alloy, Max. 1850 F: \$479.00.

127382 Inconel, Max. 2000 F: \$550.00.

ORDERING INSTRUCTIONS Specify catalog number.

For more information, see L&N Folder A1.1121.

8401 Precision Constant-Temperature Bath



The 8401 Constant-Temperature Bath is ideal for precise comparison of saturated standard cells, resistance standards, electrolytic-conductivity cells and other laboratory devices that require an extremely stable and uniform temperature environment. The bath features a large, unhindered work area measuring 18" square and 9" deep. Working temperatures range from 0 to 100 C. Constancy and uniformity are within ± 0.001 C without attention for at least 24 hours in the range of 15 to 60 C, under laboratory environments, and within ± 0.003 C in the ranges of 0 to 15 C and 60 to 100 C.

Overall cabinet dimensions are 43" x 51" x 26".

Price \$6825.00 for standard cell applications; add \$88.00 for each cell bank (regardless of number of cells per bank). For overheat control add \$116.00.

ORDERING INSTRUCTIONS **GSA** Select and specify catalog number from following table.

Basic Catalog Number	First Element		Second Element	Third Element
	Add Suffix	For Application	Add Suffix	Add Suffix
8401	A□□*	For Standard Cells		
	-B	For Resistance Standards	-6, For 60 Hertz	-1 Overheat Control supplied
	-C	For Conductivity Cells and General Purpose Use	-5, For 50 Hertz	-0 Overheat Control not supplied

*For standard cells the complete suffix for the first element consists of three figures.

First Figure (A1, A2, etc. up to A5) defines type of cell bank: A1 □□, Eppley 3-cell; A2 □□, Eppley 4-cell; A3 □□, Eppley 5-cell; A4 □□, Eppley 6-cell; and A5 □□, Weston 4-cell;

Second Figure is a numeral from 1 to 10 specifying the number of cell banks to be accommodated.

Third Figure is a letter P, for leads to binding posts, or R, for leads to rotary switches.

For more information, see Data Sheet A1.0121.

8403 Precision Bridge and Bath



This precision resistance-standard measuring facility combines the features of a constant-temperature oil bath and a Kelvin-Wheatstone Ratio Set. It is designed to facilitate the calibration of high-accuracy d-c resistance standards. All ratio-set resistors and terminals, as well as the resistors to be calibrated, are immersed in oil to minimize temperature fluctuations and provide an ideal calibration environment. Separate areas are provided for conditioning, measuring and draining of resistors. Provisions are made for either two-terminal Wheatstone-bridge measurements or four-terminal Kelvin-bridge measurements, and for connecting series, parallel, and series/parallel combinations for checking intermediate-value standards. Connections between the resistors to be measured and the ratio set are made by mercury contacts, thus eliminating the need for inter-connecting wires. Binding posts are provided at all ratio-set terminals which allow connections to resistors in a remote bath for temperature-coefficient determinations.

SPECIFICATIONS

Catalog Number 8403.

Oil Bath Operating Range 20 to 30 C.

Constancy and Uniformity ± 0.01 C.

Setability Better than 0.001 C.

Bridge Resolution 0.1 ppm.

Limit of Error ± 1 ppm on 100:100 ratio; ± 20 ppm on other ratios without corrections.

Readout Rear-projection-type digital display.

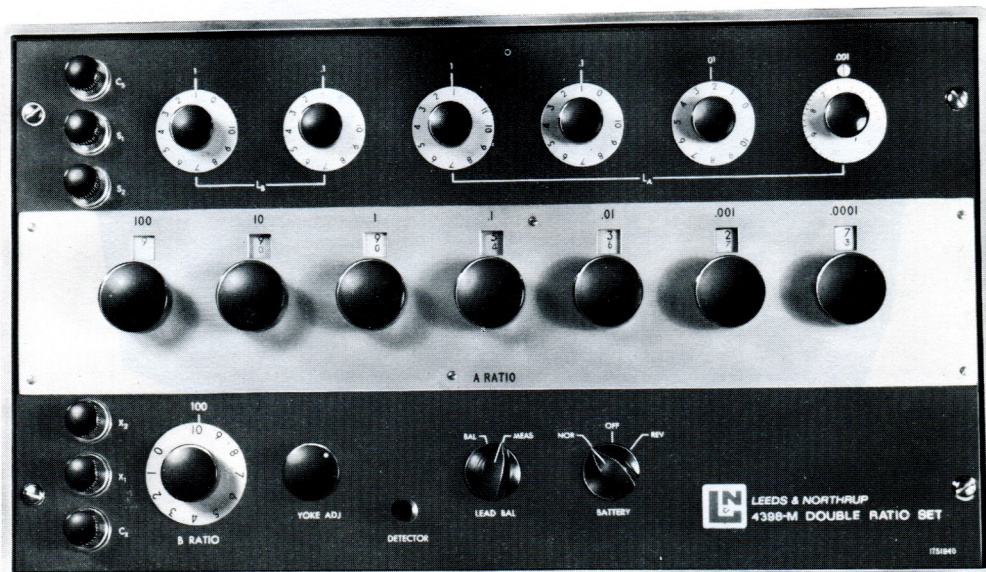
Detector Built-in Nanovolt Detector.

Cabinet All-metal cabinet with stainless-steel tank and work surface; capacity approximately 50 gallons; 65 $\frac{7}{8}$ " (w) x 31 $\frac{3}{8}$ " (d) x 55 $\frac{1}{2}$ " (h) overall.

Price For price, contact your local L&N Field Office.

ORDERING INSTRUCTIONS Specify catalog number.
For more information, see L&N Data Sheet A5.1111.

4398-M Seven-Dial Ratio Set



Combines high precision and accuracy with convenient operating features. Provides both rapid and accurate measurements of medium to low resistances.

- **Multi-functional—Double Ratio Set for two- or four-terminal measurements; Direct Reading Ratio Set for resistance comparisons up to 1-megohm; Precise two-terminal Resistance Box, range 100 to 2111.1110 ohms in steps of 0.0001.**
- **Continuously adjustable ratios from 100:1111.1110 to 1111.1110:100.**
- **In-line covered dial readout.**
- **Built-in lead compensation, resolution: 0.0002 ohm per scale division.**
- **Functional design, retractable legs for 30° or 50° inclination of top plate.**

SPECIFICATIONS

Catalog Number 4398-M (for bench use); 4398-M1 (for rack-mounting).

Ratio Selection Provided by fully-enclosed rotary switches with silver-silver alloy contacts.

A-Ratio Seven decades spanning 100 to 1111.1110 ohms in steps of 0.0001 ohm. All except the 100-ohm/step decade are Waidner-Wolff shunt-type to minimize the effects of contact resistance.

B-Ratio One decade spanning 0 to 1000 ohms in steps of 100 ohms.

Yoke Ratios Electrically the same as the "A" and "B"

battery ratios and mechanically coupled to them to turn simultaneously to the same resistance setting.

Resolution When A-ratio is set at a nominal 1000 ohms, the resolution is 0.1 ppm.

Ratio Resistors All 100-ohm resistors are selected-peak Evanohm, and all other critical resistors are wound from selected wire made to L&N's exacting specifications, matched for temperature coefficient and treated for stability.

Resistance Box Two rear-mounted terminals, RL and RH, permit use of the "A" and "B"-ratios as a two-terminal resistance box.

Limits of Error

Magnitude	Application
20-ppm	Double Ratio Set without corrections.
10-ppm	Double Ratio Set with corrections.
0.2-ppm	Double Ratio Set using direct substitution.
0.2-ppm	Direct Reading Ratio Set using direct substitution.

±0.003% for change from minimum setting } Two-terminal Resistance Box

Dimensions 19¼" (w) x 11" (h) x 9½" (d) with legs retracted; 11¾" (d) with legs extended.

Weight Net, 24 lb (10.9 kg); shipping, 28 lb (12.7 kg).

Options L&N Report of Calibration; add "-B" to catalog number. Provision for automated readout through data handling equipment; add "-R" to catalog number.

Note: A completely packaged and pre-wired facility with matched components is available. Request data sheet for complete details.

Price \$3625.00; add \$340.00 for "-B" suffix; and \$315.00 for "-R" suffix.

ORDERING INSTRUCTIONS **GSA** Specify catalog no. For more information, contact your local L&N Field Office.

4399 Seven-Dial Precision Potential Divider



Used for calibrating the highest accuracy potentiometers, voltage dividers, and resistance standards, and for comparing intermediate value resistors of extreme precision. It is basically a Kelvin-Varley slidewire and can serve as either a universal ratio set or as a voltage divider.

- Permits "in-house" calibration of highest precision equipment.
- In-line digital readout.
- All resistors and switches housed in thermal-equalizing chamber.
- Electrostatic and thermal shielding.
- Low output impedance permits high detector sensitivity.
- External binding posts for calibration of 2nd, 3rd, and 4th decades without removal from case.

SPECIFICATIONS

Catalog Number 4399 (bench-top); 4399-1 (rack-mounting).

Input Resistance 2,111.1110 units, in steps of 0.0001 unit.

Resolution 0.0001 unit (0.05 ppm).

Range of Adjustment 2,111.1110 units, in steps of 0.0001 unit.

Limits of Error When used as a universal ratio set at 25 C, the limits of error for each pair of related readings are as follows:

Dial Changed	Standard Limit of Error	Limit of Error With Report of Calibration
100	0.002 unit	0.0003 unit
10	0.001 unit	0.0001 unit
1	0.0004 unit	0.0001 unit
0.1	0.0002 unit	0.0001 unit
Three lowest dials	0.0001 unit each	0.0001 unit

No error for dials not moved in a related pair of readings.

Potential-Division Limit of Error ± 1 ppm of total input.

Stability Within ± 1 ppm of total range for a period of one year after shipment.

Impedance to Detector Less than 600 ohms without range extension.

Case 4399: extruded aluminum case with vinyl cover; 4399-1: sheet metal case.

Dimensions 4399: 19 $\frac{1}{4}$ " (w) x 10 $\frac{3}{4}$ " (d) x 9 $\frac{3}{16}$ " (h); 4399-1: 19" (w) x 10 $\frac{1}{32}$ " (h) x 7 $\frac{1}{16}$ " (d).

Options Provision for automated readout through data-handling equipment; add "-R" to catalog number. L&N Report of Calibration is available; add "-B" suffix to catalog number.

Accessory 4399-C Lead Compensator for balancing leadwires and terminal resistances when voltage dividers or universal ratio sets are connected in parallel for calibration.

NOTE: A completely packaged and pre-wired facility with matched components is available. Request data sheet for complete details.

Price 4399: \$3720.00; add \$380.00 for "-B" suffix; and \$315.00 for "-R" suffix. 4399-1: \$3720.00; add \$315.00 for "-R" suffix; add \$380.00 for "-B" suffix. 4399-C: \$820.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog no. For more information, see L&N Data Sheet A11.1112.

4393-2 Universal Ratio Set



Used for the d-c comparison of odd-value resistors with certified standards, and the calibration of precision potentiometers. Can also be used as a 5-dial direct-reading ratio set, a 6-dial precision resistance box, and as a microvolt potentiometer for comparing voltage sources such as standard cells.

- In-line digital ratio readout.
- All resistors housed in thermal equalizing chamber.
- Electrostatic and thermal shielding.
- Principal resistors have matched temperature coefficients.

SPECIFICATIONS

Catalog Number 4393-2.

Used as 6-Dial Universal Ratio Set Total nominal resistance is 2111.110 ohms; adjustable range is $20 \times 100 + 10 (10 + 1 + 0.1 + 0.01 + 0.001)$ ohms. When used as ratio device the following limits of error apply at 25 C: (1) $\pm 0.002\%$ for ratio settings involving one or more steps above the zero position on the "100" dial. (2) For

typical ratio settings involving changes in dials below 100, the accuracy of reading is within two steps on the 0.001 dial. Instrument is generally calibrated by user, in which case correction data to 0.1 ppm is attainable.

Used as 5-Dial Direct-Reading Ratio Set Adjustable arm can be varied from 944.445 to 1055.555 ohms giving range of approximately $\pm 5.5\%$. Resolution is ± 1 ppm. Limit of error of ± 2 ppm may be obtained when comparing resistors which have values within 0.5% of each other, ± 5 ppm for resistors which differ by more than 0.5%.

Used as 6-Dial Resistance Box Range is 0 to 2111.11 ohms; $20 \times 100 + 10 \times (10 + 1 + 0.1 + 0.01 + 0.001)$ ohms. Change of each step above zero residual is nominal value $\pm (0.01\% + 0.005 \text{ ohm})$. Residual zero resistance will not exceed 0.02 ohm.

Applied Voltage Customarily 2 to 4 volts d-c; up to 50 volts d-c may be applied if permitted by apparatus under test.

Option L&N Report of Calibration is available; add "B" suffix to Catalog Number.

Case Metal case and dust cover.

Dimensions 24"(w) x 8½"(h) x 10"(d) (610 x 216 x 254 mm).

Weight including lid, 37 lb (16.8 kg).

Price \$3310.00; add \$296.00 for "B" suffix.

ORDERING INSTRUCTIONS **GSA** Specify catalog no. For more information, see Data Sheet A11.1211.

4395 Precision Voltage Divider



Provides a precise means of dividing a known d-c or a-c voltage into parts. Principal applications include measurement of unknown voltages, calibrating slidewires, and standardizing a large adjustable voltage with respect to a smaller, accurately known standard.

- High resolution (1 ppm).
- In-line digital readout.
- Electrostatic shielding.

SPECIFICATIONS

Catalog Number 4395 (bench-top); 4395-1 (rack-mounting).

Input Resistance 100,000 ohms $\pm 0.1\%$.

Ratio Dials Three, adjustable in fixed steps of 9 x 10,000, 9 x 1000, and 9 x 100.

Ratio Slidewire Continuously adjustable, calibrated 0 to 100, smallest scale division 5 ppm, resolution 1 ppm.

Limit of Error ± 1 main slidewire division for any setting from 1 to 100,000.

Input-Voltage Rating 200 volts continuous; 300 volts for test periods of about $\frac{1}{2}$ hour; d-c to 1000 Hz.

Case Metal with vinyl dust cover (4395); sheet metal (4395-1).

Dimensions 4395: 19 $\frac{1}{4}$ " (w) x 9" (h) x 7 $\frac{1}{2}$ " (d); 4395-1: 19" (w) x 9" (h) x 5 $\frac{5}{8}$ " (behind relay rack).

Weight 12 lb (5.4 kg).

Option L&N Report of Calibration is available; add "-B" suffix to catalog number.

Price \$780.00; add \$152.00 for "-B" suffix.

ORDERING INSTRUCTIONS Specify catalog number.

For more information, contact your local L&N Field Office.

4258 Kohlrausch Slidewire



Used principally as an adjustable ratio for Wheatstone-bridge circuits, the Kohlrausch slidewire is helix wound on an insulating drum.

SPECIFICATIONS

Catalog Number 4258.

Slidewire About 15' long, in 10-turn helix; resistance about 7 ohms.

Scale Vertical, 10 divisions; circular, 100 unit divisions with half divisions indicated.

Limit of Error ± 0.25 unit-division.

Current Rating 0.5 A.

Dimensions 9 $\frac{1}{4}$ " x 11" x 8 $\frac{7}{8}$ " (235 x 279 x 225 mm).

Weight 14 lb (6.4 kg).

Price \$1105.00.

ORDERING INSTRUCTIONS Specify catalog number.

For more information, contact your local L&N Field Office.

8693-A12-127 Direct-Reading Thermocouple Comparator



Provides a rapid new approach to the comparison of a group of similar thermocouples with a reference thermocouple of the same type. Combines a modified 8693 Temperature Potentiometer with selector switch for connecting each of 16 thermocouples to the measuring circuit; a power supply for the potentiometer; and a zero-center, adjustable-span Speedomax H recorder. All components are mounted and pre-wired in a slope-front metal cabinet designed for convenient operation.

- Automatic reference-junction compensation.
- Wide application in inspection and maintenance departments, secondary standards labs and aircraft-engine test and repair depots.
- Provides direct reading and permanent chart record of thermocouple error and correction.

SPECIFICATIONS

Catalog Number 8693-A12-127-□

Range Double range. Millivolt range 0 to 25 mV plus thermocouple range selected from 32 standard ranges (see specifications for 8693 potentiometer).

Limits of Error Temperature: $\pm 0.2\%$ of the temperature range. Temperature Difference: $\pm 0.5\%$ of the recorder span.

Modified 8693 Potentiometer Readings for both ranges appear in a central readout window and are read directly from the slidewire scales. Potentiometer is powered by a line-operated constant voltage power supply.

Speedomax H Recorder Zero-Center, Adjustable-Span strip-chart recorder. Adjustable between 0.3 and 50 millivolts; setability better than 0.5 microvolt.

Cabinet Metal, finished in a durable light-gray baked enamel with lifting handles.

Dimensions $22\frac{3}{16}$ " (w) x $27\frac{3}{16}$ " (h) x $18\frac{5}{16}$ " (d) at bottom (563 x 690 x 465 mm).

Weight 100 lb (45.4 kg).

Price \$2130.00.

ORDERING INSTRUCTIONS Specify catalog number; add suffix for thermocouple range.

For more information, see Data Sheet A1.1122.

4232-B Six-Dial High-Precision Guarded Wheatstone Bridge



Designed to satisfy the most demanding applications. Provides high-accuracy six figure read-out. Supplied with an L&N Report of Calibration tracing accuracy directly to N.B.S. These bridges are used in standardizing laboratories as a primary resistance-measuring instrument... are employed in making and adjusting high precision resistors... and are used as the final authority for inspection of purchased components.

- Resistors made to L&N's exacting specifications.
- Guarded and shielded construction.
- L&N Report of Calibration supplied.
- May be used as a two- or four-terminal resistance standard, a ratio set, or a limit bridge.

SPECIFICATIONS

Catalog Number 4232-2B (bench top); 4232-3B (rack-mounting).

Range 0.1 ohm to 11,111.1 megohms, with setability to 10 ppm or better.

Ratio Selection Two positive-detent rotary switches; 56 combinations available.

Ratio Resistors 1, 10, 100, 1000, 1000, 10,000, 10,000 and 100,000 ohms.

Rheostat Six decades: 10,000, 1000, 100, 10, 1 and 0.1 ohms per step.

Limits of Error Limits of Error at time of adjustment at 25 C with a minimum of 1000 ohms in the rheostat

arm: $\pm 0.005\%$ of reading for 20 ohms up to 1.11 megohm; ± 0.001 ohm for 20 ohms or below; $\pm 0.01\%$ above 1.11 megohm to 111 megohms; $\pm 0.2\%$ above 111 megohms to 1111 megohms; $\pm 2\%$ above 1111 megohms.

Current Rating

Rheostat Arm Used as Resistance Box		Ratio Resistors	
Decade Ohms	Amperes	Ohms	Amperes
10,000	0.003	100,000	0.0016
1000	0.010	10,000	0.005
100	0.035	1000	0.016
10	0.11	100	0.05
1	0.5	10	0.16
0.1	1.6	1	0.5

Detector Keys Three low-thermal spring-return push-buttons for choice of detector sensitivity.

Power Supply Keys Two spring-return pushbuttons; ON and REVERSE. Both lockable.

Terminals Front: four. Sloping Rear Panel: twelve. A ground terminal is also provided.

Data Certificate L&N Report of Calibration supplied with each instrument. This Report is based on standards maintained by L&N and certified at intervals by N.B.S.

Case Metal, gray finish.

Dimensions 19" (w) x 10½" (h) x 9½" (d) (8¾" behind panel) (483 x 264 x 241 mm).

Weight 30 lb (13.6 kg).

NOTE: A completely packaged and pre-wired facility with matched components is available. See Data Sheet for complete details.

Price 4232-2B: \$2310.00. 4232-3B: \$2260.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A5.1221.

4737 Guarded Wheatstone Bridge



Available in a choice of four models, the 4737 Guarded Wheatstone Bridge is the ideal instrument for two-terminal resistance measurements from 0.1 ohm to 11,111 megohms when laboratory precision is required. These bridges are particularly useful in calibrating resistors on a production-line basis, performing critical laboratory experiments or making routine resistance measurements. The 4737-A20 bench-top and 4737-A21 rack-mounting models are complete facilities consisting of a six-decade Wheatstone Bridge, 0.5-microvolt sensitivity null detector and guarded power supply.

- Completely guarded and shielded.
- Automatic voltage selection prevents overheating.
- Available as complete facility (bench-top, rack or console) as well as bench-top or rack-mounting bridge.
- L&N Report of Calibration available.

SPECIFICATIONS

Catalog Number 4737 Bench-Type; 4737-1 for 19"

Relay Rack; 4737-A20 Bench-Type Facility; 4737-A21 19" Rack-Type Facility.

Range 0.1 ohm to 11,111 megohms.

Limit of Error $\pm(0.01\% + 0.0005 \text{ ohm})$ up to 10 megohms, $\pm 0.02\%$ from 10 megohms to 100 megohms, $\pm 0.2\%$ from 100 megohms to 1111 megohms, and $\pm 2\%$ above 1111 megohms.

Rheostat Switches Six decades in steps of $10 \times (1000 + 100 + 10 + 1 + 0.1 + 0.01)$ ohms.

Calibration Points Five Teflon feed-through terminals on rear terminal plate provide accessible current and potential points for calibration purposes.

Multiplier Dial Eleven-position switch from 10^{-1} to 10^9 . Ratio resistors vary from 0.01 to 10 K, with 10 K always in at least one bridge ratio arm.

Current Rating Of rheostat arm used as resistance box, determined by highest decade in use; for 0.01 ohm, 3.5 A; for 0.1 ohm, 1.1 A; for 1 ohm, 0.35 A; for 10 ohm, 0.11 A; for 100 ohm, 0.035 A; for 1000 ohm, 0.011 A.

Dimensions 4737: $19\frac{1}{4} \times 11 \times 9\frac{1}{2}$ (489 x 279 x 235 mm).

Weight 24 lb (6.4 kg).

Option L&N Report of Calibration is available; add "-B" suffix to catalog number.

Price 4737: \$905.00; add \$292.00 for "-B" suffix. 4737-1: \$905.00; 4737-A12: \$2135.00; 4737-A20: \$1295.00; 4737-A21: \$1295.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A5.1224.

4736 Guarded Wheatstone Bridge



A compact six-dial Wheatstone bridge.

- **Measurements to 11,111 megohms with high accuracy.**
- **In-line readout of all values.**
- **Provision is made for using the rheostat decades as an adjustable resistance box.**

SPECIFICATIONS

Catalog Number 4736 Bench-type; 4736-1 Rack-type.

Range 0.1 ohm to 11,111 megohms.

Limit of Error $\pm(0.03\% + 0.0005 \text{ ohm})$ up to 100 meg-

ohms, $\pm 0.3\%$ from 100 megohms to 1,000 megohms, and $\pm 3.0\%$ above 1,000 megohms.

Readout All readings plus the range-multiplier are displayed in a series of in-line windows for ease of readout and operation.

Dimensions 4736: 19" x 7" x 5⁹/₁₆" (483 x 178 x 141 mm). 4736-1: 19" x 7" x 6⁹/₁₆" (483 x 178 x 166 mm).

Weight 4736: 12 lb. 4736-1: 12 lb (5.4 kg).

Option L&N Report of Calibration is available; add "-B" suffix to Catalog Number.

Price \$750.00; add \$252.00 for "-B" suffix.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A5.1225.

4233-A11 Wide-Range Resistance Bridge



Unique circuitry and special features for accurate measurements of extremely high resistances. It consists of a multi-terohm bridge, null detector, batteries and other components in a self-contained facility.

- Matched, aged resistors of relatively low value (none over 1 megohm).
- Complete assembly of compatible components.
- Completely guarded and electrostatically shielded.

SPECIFICATIONS

Catalog Number 4233-A11

Range 100 ohms to 10^{16} ohms.

Bridge Resolution 1 ppm or 0.1 ohm, whichever is greater.

Limit of Error The accuracy is restricted by detector sensitivity and applied voltage when measuring extremely high values of resistance as indicated below. The combined overall limits of error of the facility, including bridge limits and detector sensitivity limits, are:

Resistance Standard Arm Six decades of $10 \times (10^6 + 10^5 + 10^4 + 10^3 + 10^2 + 10)$ ohms.

Electronic Null Detector (Boonton Type 56AR-S2)

- a. Sensitivity: $\pm 0.2 \mu\text{V}$ per division at 40 megohms source impedance on most sensitive setting.
- b. Input Impedance: 10 megohms on lower sensitivity ranges, over 40 megohms on higher ranges.
- c. Noise Level: Less than $1 \mu\text{V}$ peak to peak.

Cabinet Sloping-front metal console.

Dimensions Approximately $22\frac{3}{16}$ " (w) x $27\frac{3}{16}$ " (h) x $18\frac{7}{16}$ " (d) (563 x 690 x 465 mm).

Weight 190 lbs (86.1 kg).

Recommended Accessory 4233-P-□ Wye-Delta High-Resistance Standards.

Price For price, contact your local L&N Field Office.

ORDERING INSTRUCTIONS Specify catalog number.

For more information, see Data Sheet A5.1231.

Ratio Dial Setting	Max. Value of "X"	Max. Overall Limit of Error	Breakdown of Maximum Limit of Error Due to:	
			Bridge	Detector Sensitivity (at 90 volts bridge voltage)
10^{-2}	10^5 Ohms	$\pm 0.05\%$	$\pm 0.05\%$	Negligible
10^{-1}	10^6	$\pm 0.05\%$	$\pm 0.05\%$	Negligible
1	10^7	$\pm 0.05\%$	$\pm 0.05\%$	Negligible
10	10^8	$\pm 0.05\%$	$\pm 0.05\%$	Negligible
10^2	10^9	$\pm 0.05\%$	$\pm 0.05\%$	Negligible
10^3	10^{10}	$\pm 0.05\%$	$\pm 0.05\%$	Negligible
10^4	10^{11}	$\pm 0.1\%$	$\pm 0.1\%$	Negligible
10^5	10^{12}	$\pm 0.15\%$	$\pm 0.1\%$	$\pm 0.05\%$
10^6	10^{13}	$\pm 0.6\%$	$\pm 0.1\%$	$\pm 0.5\%$
10^7	10^{14}	$\pm 5.1\%$	$\pm 0.1\%$	$\pm 5\%$
10^8	10^{15}	$\pm 50.1\%$	$\pm 0.1\%$	$\pm 50\%$
10^9	10^{16}	$\pm 500.1\%$	$\pm 0.1\%$	$\pm 500\%$

8079-B Type ER Thermometer Bridge



Combines high accuracy with convenience of operation through use of a multi-patented circuit configuration. Equally well suited for the measurement of two, three and four lead resistance devices of either decade or odd values.

- **Seven-dial in-line readout: 0-16111.110 ohms in 4 ranges.**
- **Minimal effects from lead resistance unbalances through use of special bridge arm configuration.**
- **L&N Report of Calibration supplied; permits even and odd value resistance measurements to an accuracy of ± 5 ppm (0.0005 %).**
- **Can be used as a precision four-terminal resistance box.**

SPECIFICATIONS

Case 8079-B Bench Type: cast aluminum case. 8079-1-B Rack Type: sheet metal case.

Dimensions 8079-B: 19¼" (w) x 9½" (d) with legs retracted, 11¾" (d) with legs extended, x 11" (h); 8079-1-B: 19" (w) x 10½" (h) x 8½" (d) behind relay rack.

Weight 25 lb; shipping weight: 29 lb.

Options Provision for automated readout through data-handling equipment; add "-R" to catalog number.

Accessory 8070-C5 (or 8070-C5-1, rack mounted) Thermometer Commutator. Allows selection of as many as five thermometers for the purpose of calibration by the comparison method or for differential or discrete temperature measurements. Recommended null detector, 9828-2; see p. J-61.

Price 8079-B and 8079-1-B: \$5460.00; 8070-C5: \$268.00; 8070-C5-1: \$268.00; add \$315.00 for "-R" suffix.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A1.2213.

8079B

Measurement Ranges			Warranted Accuracy *	Resolution	Resistance Standard Calibration Resolution
Mult.	Ohms	Steps			
X0.1	0-16.111110	1×10^{-6}	± 20 ppm of reading or 4×10^{-6} ohms whichever is greater	1 microhm (1.0 milli-degree Celsius with 0.23 ohm thermometer)	1 ohm value: 1.0 ppm resolution 10 ohm values: 0.1 ppm resolution
X1	0-161.11110	1×10^{-5}	± 20 ppm of reading or 4×10^{-5} ohms whichever is greater	10 microhms (0.1 milli-degree Celsius with 25.5 ohm thermometer)	100 ohm values: 0.1 ppm resolution
X10	0-1611.1110	1×10^{-4}	± 20 ppm of reading or 4×10^{-4} ohms whichever is greater	100 microhms	1000 ohm values: 0.1 ppm resolution
X100	0-16111.110	1×10^{-3}	± 20 ppm of reading or 4×10^{-3} ohms whichever is greater	1000 microhms	10,000 ohm values: 0.1 ppm resolution

*For one year period, without corrections, including range change uncertainty.

8067 Type G-1 **Mueller Bridge**



Where the accuracy of the Type G-2 Mueller Bridge is not required, the Type G-1 may be used for precision temperature measurements by the electrical resistance-thermometer method.

- Designed for measurements with three-terminal thermometers.
- Commutator for four-terminal resistance thermometers available.
- Report of Calibration available.

SPECIFICATIONS

Catalog Number 8067.

Range 0 to 81.111 ohms, in steps of 0.0001 ohm.

Measuring Arm Consists of three shunted decades to give steps of 0.0001, 0.001, and 0.01 ohm, two decades at the ends of the ratio arms of 0.1 and 1-ohm

steps, and binding posts on the end of the measuring arm by means of which 0, 10, 20, 25, 25.5, 30, 40, 50, 60 or 70 ohms may be inserted.

Ratio Arms 500 ohms each; adjustable to equality.

Limits of Error ± 0.0002 ohm up to one ohm, $\pm 0.02\%$ from one ohm to 81.111 ohms.

Dimensions 11 $\frac{1}{4}$ " (w) x 14 $\frac{3}{4}$ " (l) x 5 $\frac{1}{4}$ " (d); 6 $\frac{1}{8}$ " (d) with cover (286 x 375 x 133; 156 mm).

Weight 25 lb (11.3 kg).

Option L&N Report of Calibration is available; add "-B" suffix to catalog number.

Accessory 8068 Mercury Commutator for use with four-terminal potential lead thermometers. A three-pole, double-throw, mercury contact switch with plug-blocks for zero readings.

Price 8067: \$1660.00; add \$336.00 for "-B" suffix. 8068: \$332.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A1.2212.

8069-B Type G-2 Mueller Bridge



Invaluable in the research laboratory for precise, convenient resistance thermometer measurements from 0 to 111.111 ohms in steps of 100 microhms.

- **Constant-temperature chamber with separate thermostatic control unit for critical resistors.**
- **Commutator for four-lead resistance thermometers.**
- **L&N Report of Calibration supplied with bridge.**
- **Milliammeter indicates current in thermometer.**
- **Mercury switches provided for higher-resistance decades and commutator.**

SPECIFICATIONS

Catalog Number 8069-B.

Range 0 to 111.111 ohms in steps of 0.0001 ohm.

Measuring Arm Consists of three shunted decades to give resistance steps of 0.0001, 0.001 and 0.01 ohm, two decades at ends of the ratio arms of 0.1 and 1-ohm steps, and a mercury-cup dial decade of 10-ohm steps.

Constant-Temperature Chamber Chamber with thermostatically-controlled heater holds measuring resistors constant within ± 0.01 C at about 35 C.

Commutator Mercury-cup commutator incorporated in top plate adapts instrument for measurements with four-lead resistance thermometers.

Ratio Arms 1,000 ohms each. Adjustable to equality.

Ratio & Zero Plugs To facilitate adjusting ratio and obtaining zero reading. Located on top plate.

Limit of Error (When measuring absolute resistance) $\pm 0.001\%$ or 50 microhms, whichever is larger, using Report of Calibration corrections.

Dimensions 9 $\frac{1}{4}$ " (d) x 21 $\frac{1}{4}$ " (l) x 13" (w); 10" (d) with cover (235 x 540 x 330 mm).

Weight 40 lb (18.1 kg).

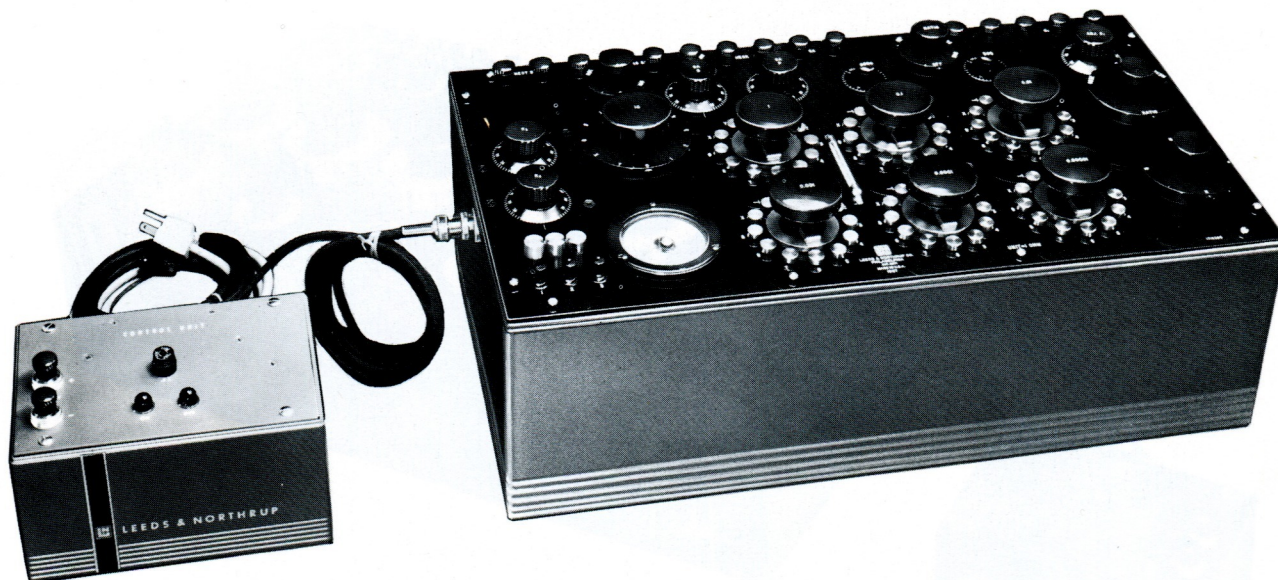
Thermostatic Control Unit Separate unit, supplied with bridge. See description for 8071-B Mueller Bridge.

Price \$5460.00 includes Report of Calibration.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A1.2212.

8071-B Type G-3 Mueller Bridge



A high-precision, high-accuracy, d-c resistance-thermometer bridge for use with either standard or special three- or four-lead resistance thermometers.

- **Constant-temperature chamber with separate thermostatic control unit for critical resistors.**
- **Commutator for four-lead resistance thermometer.**
- **Milliammeter indicates current in thermometer.**
- **Mercury switches provided for higher-resistance decades and commutator.**
- **L&N Report of Calibration supplied with bridge.**

SPECIFICATIONS

Catalog Number 8071-B.

Range 0 to 422.1111 ohms in steps of 0.00001 ohm.

Ratio Arms Double set of ratio arms provided; one set of 500 ohms each, one set of 3000 ohms each.

Rheostat Arm Four Waidner-Wolff (series-parallel) decades of 10 x (0.00001) ohm, 10 x (0.0001) ohm, 10 x (0.001) ohm and 10 x (0.01) ohm. Two decades at the end of the ratio arms of 10 x (0.1) ohm and 10 x (1) ohm.

A 10 x (10) ohm decade and a three-position 100 ohms-per-step switch.

Limits of Error (When measuring absolute resistance) $\pm 0.001\%$ or ± 20 microhms whichever is larger, using L&N Report of Calibration.

Constant-Temperature Chamber Insulated chamber with thermostatically controlled heater maintains critical bridge resistors at constant temperature of about 35 C to a stability of ± 0.01 C.

Dimensions 25" (l) x 13½" (w) x 10½" (d) (635 x 343 x 267 mm).

Weight 46 lb (20.9 kg).

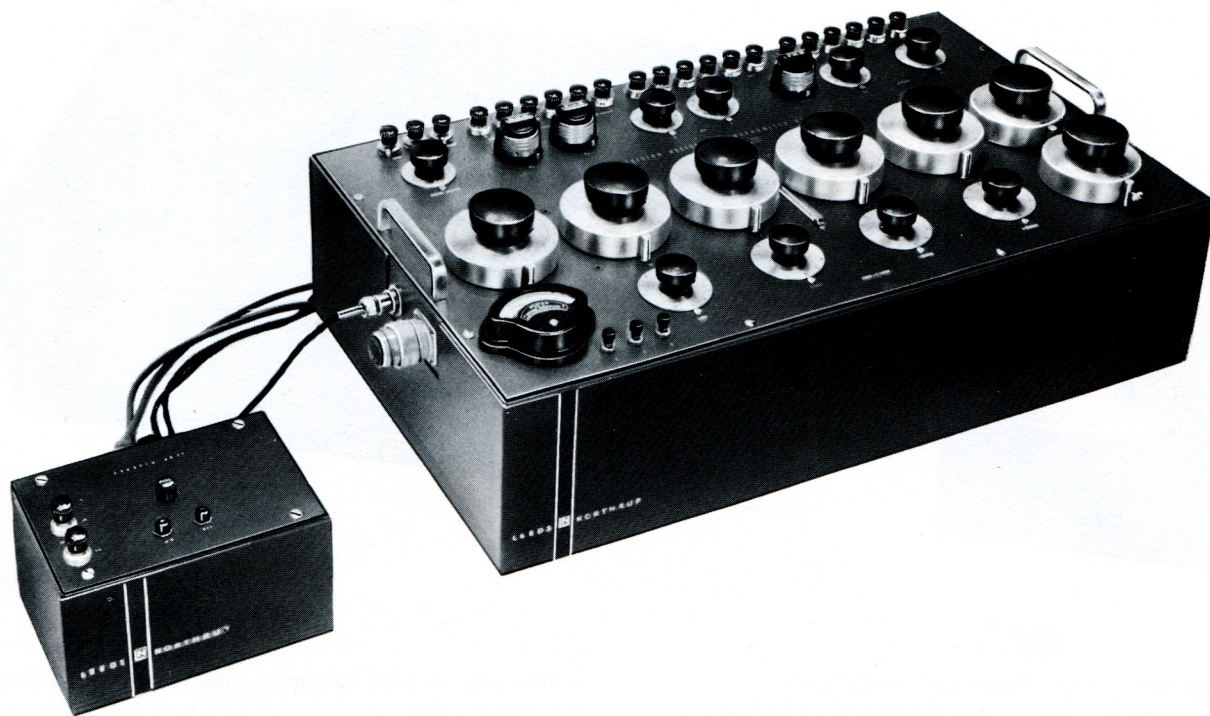
Thermostatic Control Unit (Applicable to Type G-4, G-3 and G-2 Mueller Bridges) Separate unit, supplied with bridge, includes: (1) transistorized heater-control circuit; (2) transformer for galvanometer lamp; (3) on-off indicating lights; (4) terminals for a 6-volt battery; and (5) three cords with plugs for connections to 120-volt, 60-hertz supply, lamp in the 2100 Lamp-and-Scale Device, and heater and mercury thermo-regulator in the bridge. Connections for an external 6-volt storage battery are included as a standby feature; if line power supply is lost, battery provides continuous power for heater in the thermally insulated block. The unit is mounted in a metal case, 8½" x 5½" x 6½" (221 x 151 x 156 mm), and is rated at 20 watts on 120 volts, 60 hertz; weight 7¼ lb (3.3 kg).

Price \$8925.00, includes Report of Calibration.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, contact your local L&N Field Office.

8072-B Type G-4 **Mueller Bridge**



The G-4 is a high-accuracy d-c Mueller bridge for making laboratory temperature measurements of primary platinum resistance thermometers.

- **Highest commercially available precision for resistance thermometer measurements of 0 to 422.11111 ohms in steps of 1 microhm.**
- **Constant-temperature chamber with separate thermostatic control unit for critical resistors.**
- **Commutator for four-lead resistance thermometer.**
- **Milliammeter indicates current in thermometer.**
- **Mercury switches provided for higher-resistance decades and commutator.**
- **L&N Report of Calibration supplied with bridge.**

SPECIFICATIONS

Catalog Number 8072-B.

Range 0 to 422.11111 ohms in steps of 0.000001 ohm.

Ratio Arms Each arm is 500 ohms. A ten-turn, infinite resolution potentiometer at the apex of the arms adjusts the ratio arms accurately for unity ratio.

Rheostat Arm Five Waidner-Wolff (series-parallel) decades of 10 x (0.000001) ohm, 10 x (0.00001) ohm, 10 x (0.0001) ohm, 10 x (0.001) ohm, 10 x (0.01) ohm. Two decades at the end of the ratio arms of 10 x (0.1) ohm and 10 x (1) ohm. A 10 x (10) ohm decade and four-position 100 ohms-per-step switch. Rheostat arm may be used as a four-terminal, high-precision, adjustable resistor.

Limits of Error (When measuring absolute resistance) $\pm 0.001\%$ or 5 microhms, whichever is larger, using L&N Report of Calibration corrections.

Constant Temperature Chamber Insulated chamber with a thermostatically-controlled heater maintains the critical bridge resistors at a temperature of about 35 C to a stability of ± 0.01 C.

Case Aluminum case and top plate, case lined with cork, protective lid.

Dimensions 28½" x 16¼" x 10¾" (724 x 413 x 273 mm).

Weight Approximately 70 lb (31.8 kg).

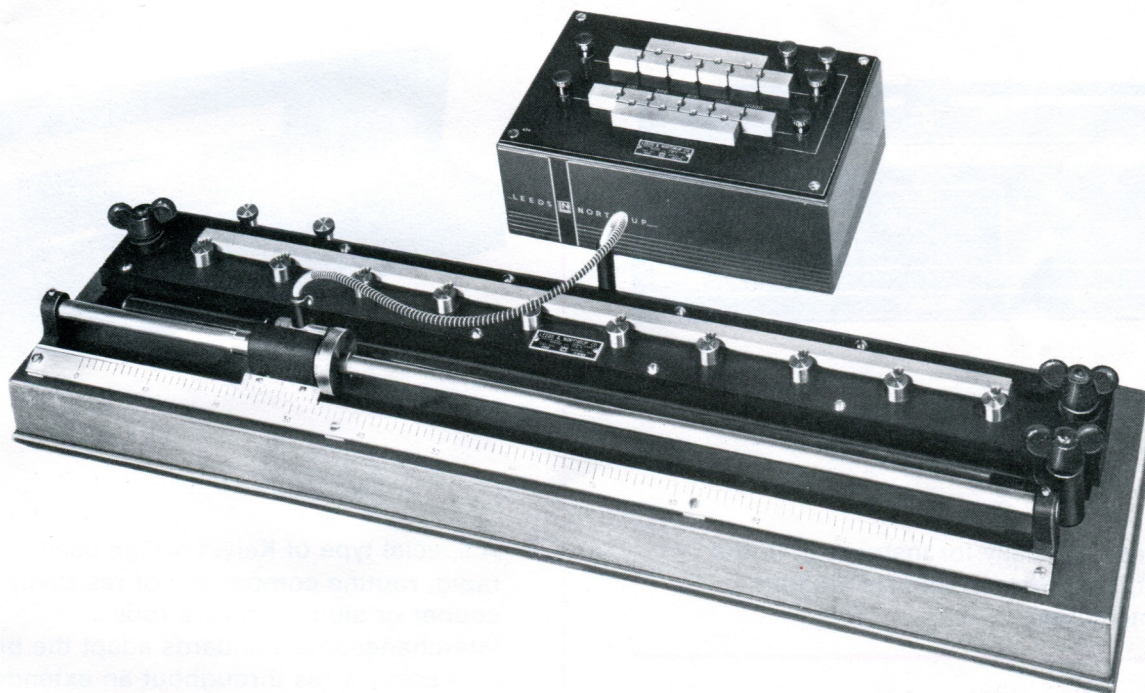
Price For price, contact your local L&N Field Office.

ORDERING INSTRUCTIONS Specify catalog number.

For more information, contact your local L&N Field Office.

Precision Kelvin Bridge

Consists of
4300 Adjustable Standard plus 4320 Ratio Box



For precise measurements of low resistances up to 1 ohm, readable to 0.01 microhm on lowest range. Has selected fixed ratios and a continuously adjustable standard.

- **Ratio box**—double set of ratio resistors; binding posts provided for detector, adjustable standard and resistance under test.
- **Adjustable standard**—large diameter calibrated bar and nine fixed resistors; current terminals provided for connections to external battery.

SPECIFICATIONS

Adjustable Standard

Catalog Number 4300.

Range Extremes of ratio available: 100:10,000—1.01 ohms maximum, each vernier division 100 microhms, 10,000:100—0.000101 ohm maximum, each vernier division 0.01 microhm.

Total Resistance Consists of 9 fixed steps of 0.001 ohm, plus a continuously adjustable bar of 0.001 ohm.

Limits of Error Of fixed steps: up to 0.005 ohm, ± 2

microhms; above 0.005 ohm, $\pm 0.04\%$. Of adjustable bar: ± 2 microhms.

Current Rating For 10-minute period: 50 A in entire standard, 150 A in bar alone. For continuous duty: 30 A in entire standard, 90 A in bar alone.

Case Polished mahogany.

Dimensions $30\frac{7}{8}" \times 8\frac{7}{8}" \times 6\frac{7}{8}"$ (784 x 225 x 175 mm).

Weight $21\frac{1}{2}$ lb (9.7 kg).

Option L&N Report of Calibration is available; add "—B" suffix to catalog number.

Kelvin Bridge Ratio Box

Catalog Number 4320.

Ratio Arms Double set of ratio resistors: 100, 300, 400, 1000, 10,000 ohms respectively, plug-and-block selected.

Limits of Error Of ratios: $\pm 0.015\%$; of ratio resistors: $\pm 0.05\%$ of nominal value.

Dimensions $11\frac{3}{8}" \times 7\frac{3}{8}" \times 6\frac{1}{8}"$ (289 x 187 x 156 mm).

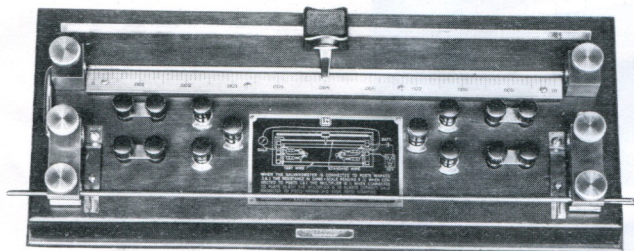
Weight 10 lb (4.5 kg).

Option L&N Report of Calibration is available; add "—B" suffix to catalog number.

Price 4300 \$1575.00; add \$240.00 for "—B" suffix. 4320 \$685.00; add \$104.00 for "—B" suffix.

ORDERING INSTRUCTIONS Specify catalog number.
For more information, see Data Sheet A5.1211.

4340 Students' Kelvin Bridge



Designed especially for instruction in the Kelvin-bridge method and for student experimentation.

- **Three ratio values.**
- **Copper wire with statement of resistance value supplied for checking.**
- **Binding posts provided for connecting external detector and battery.**

SPECIFICATIONS

Catalog Number 4340.

Range 0.00001 ohm to 0.1 ohm.

Ratio Arms Three ratio values: 0.1, 1 and 10.

Standard Bar, total resistance, 0.01 ohm. Attached scale has 100 divisions.

Limits of Error Of ratio: $\pm 0.2\%$. Of standard: ± 1 scale division.

Current Rating For continuous duty, 15 A.

Dimensions 19 $\frac{3}{8}$ " x 8 $\frac{1}{4}$ " x 4 $\frac{1}{4}$ " (499 x 210 x 108 mm).

Weight 9 lb (4.1 kg).

Price \$555.00.

ORDERING INSTRUCTIONS Specify catalog number.

For more information, contact your local L&N Field Office.

4870 Hoopes Conductivity Bridge



A special type of Kelvin bridge used for the rapid, routine comparison of resistivity of copper or aluminum wire rods. Interchangeable standards adapt the bridge for testing wires throughout an extended range of sizes.

- **Scale calibrated to read percent conductivity of sample.**
- **Copper-lined compartment may be oil-filled for faster temperature equalization.**
- **Calibrated slidewire to compensate for error in weight.**
- **A glass window in the lid permits reading the scale with the cover closed.**

SPECIFICATIONS

Catalog Number 4870.

Conductivity Range 0 to 105% of standard.

Limit of Error $\pm 0.2\%$ conductivity when used with 4872 Copper Standards.

Weight Compensator Adjustable slidewire, range $\pm 15\%$.

Dimensions 48" x 10" x 9" (1219 x 254 x 229 mm).

Weight 70 lb (31.8 kg).

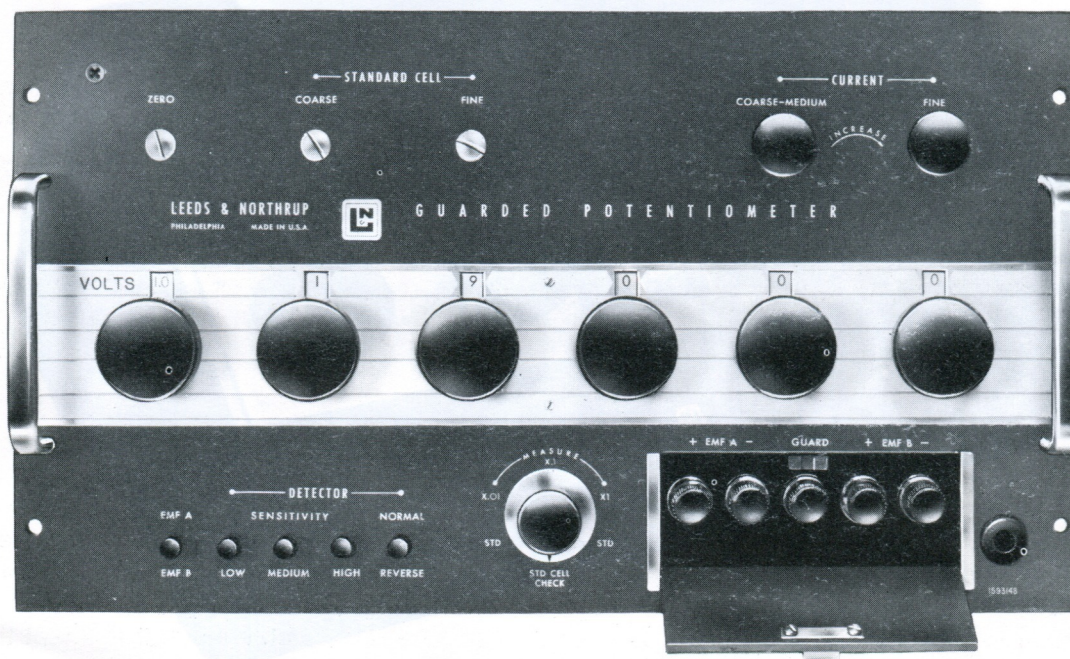
Price \$6300.00.

ORDERING INSTRUCTIONS Specify catalog number.

For more information, contact your local L&N Field Office.

7556 Type K-6

Six-Dial Guarded Potentiometer



A precise voltage-measuring instrument that may be used for emf measurements up to 1500 volts with a suitable volt box, for standard-cell checking and calibration, for measuring resistances by comparison or by IR-drop methods, and for calibrating other precision potentiometers.

- Triple-range measurements to 1.6 volts with highest accuracy presently available.
- Six-dial in-line readout.
- Matched resistors made to L&N's exacting specifications.
- Battery, detector and standard-cell circuits individually guarded.

SPECIFICATIONS

Catalog Numbers 7556 (bench-top); 7556-1 (rack-mounting).

Ranges Three: 0 to 1.6 volts in steps of 1.0 μV (X1); 0 to 0.16 volt in steps of 0.1 μV (X0.1); 0 to 0.016 volt in steps of 0.01 μV (X0.01).

Limits of Error High Range: $\pm(0.0005\%$ of reading

+ 1 μV); Medium Range: $\pm(0.0015\%$ of reading + 0.1 μV); Low Range: $\pm(0.0025\%$ of reading + 0.02 μV).

Thermal EMF Considerably less than 0.1 μV thermal emf, of very short duration, is developed during operation of switches.

Guarded Circuits Battery, standard cell and detector.

Calibration All necessary calibration points (eight) are brought out to rear terminals.

Case Metal, with hinged door on front plate for access to input terminals.

Dimensions 7556: 19 $\frac{3}{32}$ " (w) x 10 $\frac{3}{4}$ " (h) x 7 $\frac{5}{16}$ " (490 x 273 x 185 mm) (d); 7556-1 (for mounting in 19" relay rack): 10 $\frac{15}{32}$ " (h) x 7 $\frac{1}{2}$ " (d) (256 x 191 mm).

Weight 32 lb (14.5 kg).

Options Provision for automated readout through data-handling equipment; add "-R" to catalog number. L&N Report of Calibration is available; add "-B" suffix to catalog number.

NOTE: A completely packaged and pre-wired facility with matched components is available. See Data Sheet for complete details.

Price 7556: \$3595.00; add \$208.00 for "-B" suffix; 7556-1: \$3540.00; add \$208.00 for "-B" suffix. Add \$315.00 for "-R" suffix.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A0.1211.

7555 Type K-5 Universal Guarded Potentiometer



A direct-reading, high-precision potentiometer designed for multi-purpose laboratory use.

- High-precision measurements over three ranges up to 1.6 volts.
- Central readout window with decimal automatically positioned.
- Completely guarded construction with thermal and electrostatic shielding.
- Cast aluminum case with retractable legs.

SPECIFICATIONS

Catalog Number 7555 (bench-top); 7555-1 (rack-mounting).

Ranges High: $-50 \mu\text{V}$ to $+1.611050$ volts; Middle: $-5 \mu\text{V}$ to $+0.1611050$ volt; Low: $-0.5 \mu\text{V}$ to ± 0.01611050 volt.

Limits of Error Standard: High Range (1.6): $\pm(0.003\%$ of reading $+ 3 \mu\text{V})$; Middle Range (0.16): $\pm(0.005\%$ of reading $+ 0.3 \mu\text{V})$; Low Range (0.016): $\pm(0.005\%$ of reading $+ 0.1 \mu\text{V})$.

Current Standardization Provided by one coarse-medium rheostat and one ten-turn fine rheostat. Resolution is better than 0.5 ppm.

Standard-Cell Adjustment Value is set on main dials,

to better than 0.3 ppm resolution when SC is in the range of 1.0175 to 1.0205 volts.

Range Switch Permits selection of three ranges: 1.6 (high), 0.16 (middle) and 0.016 (low). Automatically positions decimal point in readout window.

Auxiliary EMF Circuit 16-position rotary switch for current, resistance, energy and other measurements of different, but related emfs (e.g., wattmeter calibration).

Case Cast aluminum case and vinyl dust cover on 7555; 7555-1 has sheet-metal case.

Readout All readings, including decimal points, appear in-line in a central readout window.

Dimensions 7555-1: 19" (w), $\times 10\frac{1}{2}$ " (h) $\times 8\frac{1}{2}$ " (d) behind panel. 7555: 19 $\frac{1}{4}$ " (w) $\times 11$ " (h) $\times 9\frac{1}{2}$ " (d). 11 $\frac{3}{8}$ " deep with legs extended.

Weight 7555: 33 lb.; 7555-1: 22 lb.

Options L&N Report of Calibration: Using corrections shown on this certificate, the limits of error at 25 C become: High Range (1.6): $\pm(0.001\%$ of reading $+ 2 \mu\text{V})$; Middle Range (0.16): $\pm(0.003\%$ of reading $+ 0.2 \mu\text{V})$; Low Range (0.016): $\pm(0.003\%$ of reading $+ 0.1 \mu\text{V})$. Add "-B" suffix to catalog number for this Report.

NOTE: A completely packaged and pre-wired facility with matched components is available. See Data Sheet for complete details.

Price \$1100.00; add \$168.00 for "-B" suffix.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A0.1213.

7554 Type K-4 Universal Guarded Potentiometer



A direct-reading, precision potentiometer with convenience and capability for a variety of potentiometric measurements.

- Precision measurements over three ranges up to 1.6 volts.
- Central readout window with decimal automatically positioned.
- Thermal and electrostatic shielding.
- Completely guarded construction.
- Cast aluminum case with retractable legs.

SPECIFICATIONS

Catalog Numbers 7554 (bench-top); 7554-1 (rack-mounting).

Ranges High: $-500 \mu\text{V}$ to 1.61050 volts; Middle: $-50 \mu\text{V}$ to 0.161050 volt; Low: $-5 \mu\text{V}$ to $+0.0161050$ volt.

Limits of Error Standard: High Range (1.6): $\pm(0.005\%$ of reading $+ 20 \mu\text{V})$; Middle Range (0.16): $\pm(0.007\%$ of reading $+ 2.0 \mu\text{V})$; Low Range (0.016): $\pm(0.007\%$ of reading $+ 0.5 \mu\text{V})$.

Readout A centralized display of numerical values provides direct readability to four or five digits, and provides automatic positioning of the decimal point.

Current Standardization Provided by one ten-turn "Coarse" rheostat and one ten-turn "Fine" rheostat. Resolution is better than 4.0 ppm.

Standard-Cell Adjustment Value of standard cell (within the range of 1.0175 to 1.0205 volts) is set on main dials. Resolution is better than 8.0 ppm.

Case 7554 has cast aluminum case. 7554-1 has sheet-metal case.

Dimensions 7554: $19\frac{1}{4}"$ (w) $\times 11"$ (h) $\times 9\frac{1}{2}"$ (d). 7554-1: $19"$ (w) $\times 10\frac{1}{32}"$ (h) $\times 8\frac{1}{2}"$ (d).

Weight 7554 about 32 lbs.; 7554-1 about 21 lbs.

Option L&N Report of Calibration is available; add "-B" suffix to catalog number.

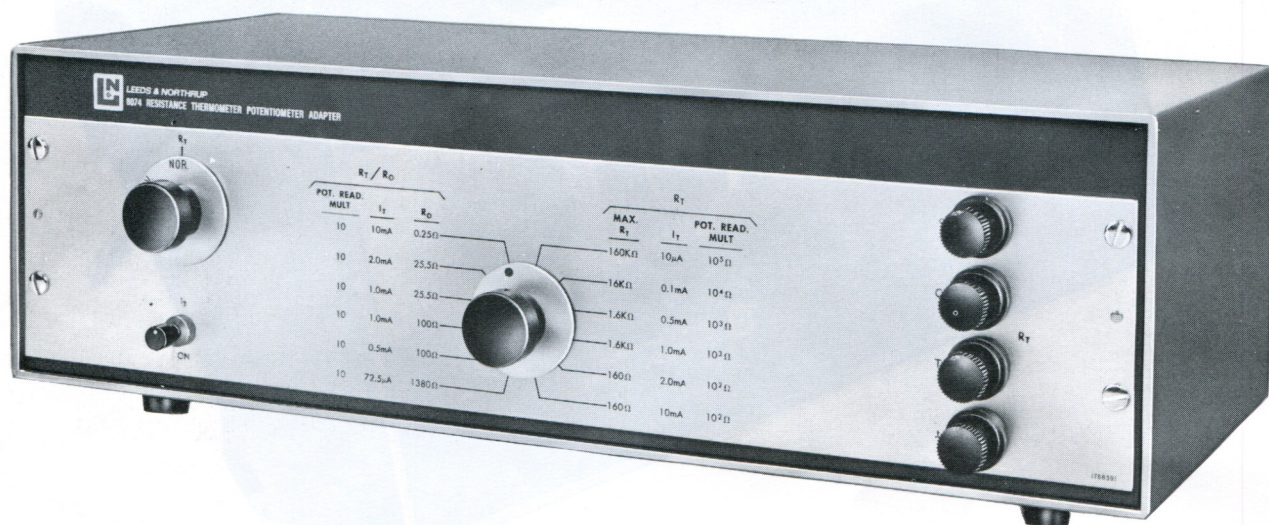
NOTE: A completely packaged and pre-wired facility with matched components is available. See Data Sheet for complete details.

Price \$765.00; add \$128.00 for "-B" suffix.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A0.1214.

8074 Resistance Thermometer Potentiometer Adapter



A line-operated solid-state adapter for use with K-4, K-5 and K-6 Potentiometers in making four-terminal resistance measurements and R_t/R_o ratio measurements for certain types of resistance thermometers.

- Resolution down to $1\mu\Omega$ per step.
- Linear output for deviation measurements.
- Direct reading of resistance ratio or resistance.
- Independent of lead and connection resistance.
- Controlled current... can be metered directly.

SPECIFICATIONS

Catalog Number 8074 (bench-type); 8074-1 (rack mounting). Includes thermometer current supply, potentiometer current divider, standard resistors and

switch-selected interconnecting circuitry.

Ranges Resistance measurements: up to $160,000\Omega$. Ratio measurements: R_t/R_o , measurements can be made up to a maximum ratio of 16.

Accuracy When referenced to an external standard or for measurements of R_t/R_o , the system limit of error is essentially that contributed by the potentiometer.

Stability (Thermometer Current Supply) Short term: better than 10 ppm for 10 minutes under reference conditions. Long term: not required because of ease of standardization.

Power Requirements 115 V/230 V $\pm 15\%$, 48/62 Hz, less than 5 watts.

Mounting 8074: bench-top, metal box. 8074-1: relay-rack.

Dimensions 8074: $6\frac{5}{32}$ " (h) x $19\frac{11}{32}$ " (w) x $9\frac{9}{16}$ " (d) (156 x 491 x 243 mm). 8074-1: $5\frac{7}{32}$ " (h) x 19" (w) x $9\frac{7}{32}$ " (d) (133 x 483 x 234 mm).

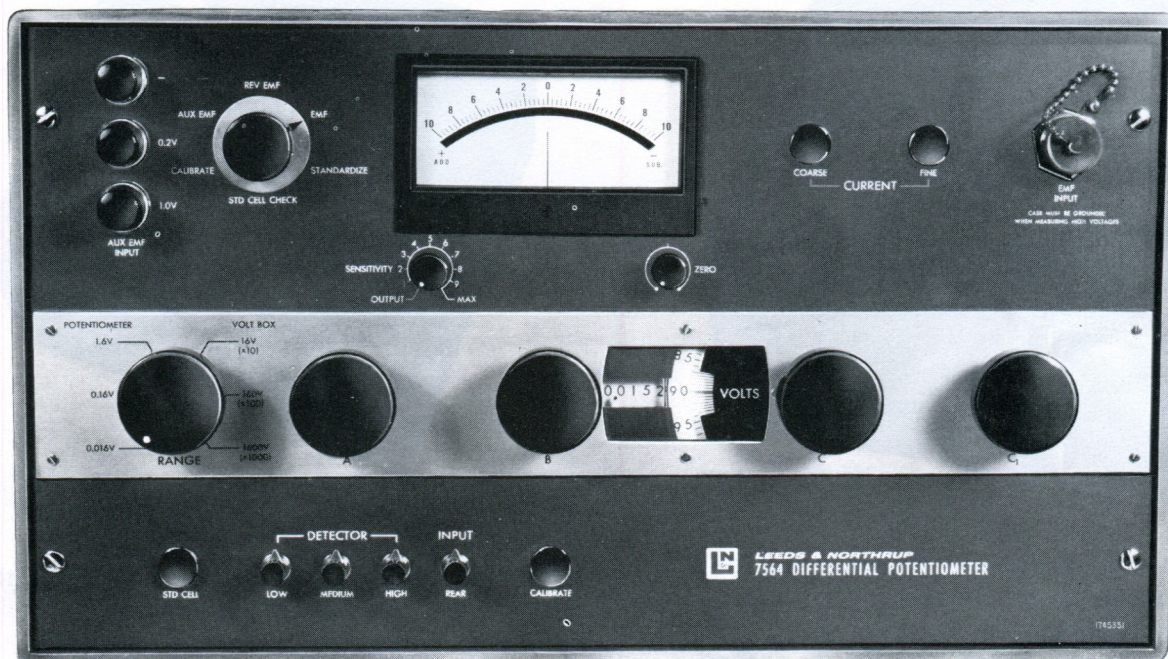
Weight 8074: 19 lb (8.62 kg); 8074-1: 13 lb (5.90 kg).

Price \$1500.00.

ORDERING INSTRUCTIONS Specify catalog number.

For more information, contact your local L&N Field Office.

7564 Differential Potentiometer



A compact differential potentiometer facility with built-in solid-state detector, guarded power supply, precision volt-box, and thermally-lagged standard cell.

- **Wide Range**—Measures from 0.5 μ V to 1600 volts.
- **Human-engineered for convenience and safety.**
- **Centralized readout with automatic decimal point placement.**
- **Self calibration checks of "B" to "A" dial ratios.**
- **Recorder output for measuring "differential" changes in an external EMF using the potentiometer as a set point.**

SPECIFICATIONS

Catalog Number 7564, Bench-top; 7564-1, Rack-mounted.

Ranges Six, switch-selected; 0.016 V, 0.16 V, 1.6 V, 16 V, 160 V, 1600 V.

Readout A centralized display of numerical values

provides direct readability to four or five digits, and provides automatic positioning of the decimal point.

Warranted Accuracy 50 to 150 ppm.

Detector 5" mirror-back scale; 50 K minimum input impedance; 0.5 μ V sensitivity up to 10 K source impedance.

Power Supply Guarded; 2.0 V at 12.1 mA; 5 ppm regulation per 10-volt line change; temperature coefficient of less than ± 4 ppm/ $^{\circ}$ C; and stable to within 10 ppm per 24 hours.

Standard Cell Unsaturated; thermally-lagged; stability better than 8 ppm per 3 months; value stated to within 10 μ V.

Volt Box 1 megohm input resistance for ranges above 1.6 V.

Case 7564, cast aluminum, with retractable legs for two-position mounting. 7564-1, sheet metal for rack mounting.

Dimensions 7564: 19 $\frac{1}{4}$ " x 11" x 9 $\frac{1}{2}$ " (489 x 279 x 241 mm). 7564-1: 19" x 10 $\frac{15}{32}$ " x 8 $\frac{1}{2}$ " (483 x 266 x 216 mm).

Weight 7564: 34 lb (15.4 kg); 7564-1: 23 lb (10.4 kg).

Option L&N Report of Calibration is available; add "—B" suffix to catalog number.

Price \$1560.00; add \$208.00 for "—B" suffix.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A0.1215.

7582, 7592 and 7593 Volt Boxes



These volt boxes are specifically designed for use with Type K Potentiometers in the d-c calibration of voltmeters and wattmeters, and in other applications in which the voltages exceed the maximum range of the potentiometers.

- High-quality enclosed silver-alloy switches.
- Low current drain on the unknown voltage.
- Open position on selector switch . . . line connections need not be removed.

SPECIFICATIONS

Catalog Numbers 7582: 15, 150 and 300 volts. 7592: 3, 7.5, 15, 30, 75, 150, 300 and 750 volts. 7593: 3, 7.5, 15, 30, 75, 150, 300, 750 and 1500 volts.

Ohms Per Volt 750.

Output Voltage 150 mV.

Limit of Error $\pm 0.02\%$.

Case Metal, with vinyl cover.

Dimensions $6\frac{7}{8}" \times 6\frac{1}{2}" \times 5\frac{1}{2}"$ (177 x 167 x 140 mm).

Weight 5 lb (2.3 kg).

Option L&N Report of Calibration is available; add "-B" suffix to catalog number.

Price 7582: \$188.00; add \$100.00 for "-B" suffix; 7592: \$305.00; add \$148.00 for "-B" suffix; 7593: \$428.00; add \$160.00 for "-B" suffix.

ORDERING INSTRUCTIONS GSA Specify catalog no.

For more information, see Data Sheet A0.1311.

4385 Shunt Box



The 4385 Shunt Box is designed for use with L&N Type K Potentiometers in the precise measurement of d-c currents and in the calibration of d-c ammeters and wattmeters.

- High-quality enclosed silver-alloy switches.
- Low power dissipation reduces errors due to self-heating.

SPECIFICATIONS

Catalog Number 4385.

Range 0.075, 0.15, 0.3, 0.75, 1.5, 3, 7.5 and 15 amperes.

Total Resistance 2.0 ohms.

Output Voltage 150 mV.

Limit of Error $\pm 0.02\%$ at 25 C.

Case Metal, with vinyl cover.

Dimensions $6\frac{7}{8}" \times 6\frac{1}{2}" \times 5\frac{1}{2}"$ (177 x 167 x 140 mm).

Weight 4 lb (1.8 kg).

Option L&N Report of Calibration is available; add "-B" suffix to catalog number.

Price \$198.00; add \$260.00 for "-B" suffix.

ORDERING INSTRUCTIONS GSA Specify catalog no.

For more information, see Data Sheet A0.1321.

9912 Run-Up Box



A battery-operated, low-resistance source of adjustable d-c millivoltage for checking and calibrating instruments which require current flow for their operation, such as deflection-type millivolt indicators.

- Convenient range selection . . . 0 to 60 and 60 to 120 mV.
- Adjustable series resistance.
- Coarse and fine millivoltage output adjustments with run-up knob.

SPECIFICATIONS

Catalog Number 9912.

Ranges 0 to 60 and 60 to 120 mV, adjustable to better than ± 0.02 mV.

Output Series Resistance Adjustable from 0 to 25 ohms, to within 0.5 ohm.

Battery 1.5 volts (self-contained).

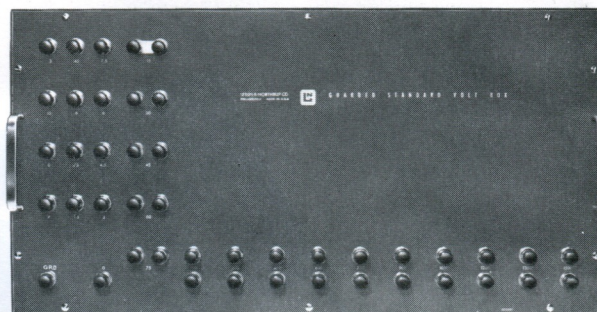
Dimensions $5\frac{1}{8}'' \times 3\frac{7}{8}'' \times 2\frac{5}{8}''$ (130 x 98 x 67 mm).

Weight $1\frac{1}{2}$ lb (0.7 kg).

Price \$83.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog no.
For more information, see Data Sheet B1.1113.

7594-2 Guarded Standard Volt Box



A high-accuracy, guarded d-c volt box designed as a comparison standard to certify other volt boxes.

- Twenty-five ranges to 1500 volts.
- Accuracy to a few ppm.
- Usable in any plane.
- Rapid self-calibration.

SPECIFICATIONS

Catalog Number 7594-2.

Range 0 to 1500 volts with taps at: 0.15, 0.30, 0.45, 0.60, 0.75, 1.5, 3.0, 4.5, 6.0, 7.5, 15, 30, 45, 60, 75, 150, 300, 450, 600, 750, 900, 1050, 1200, 1350, and 1500 volts.

Limits of Error All ratios adjusted to within 0.001% (± 10 ppm) of nominal (initial); guaranteed maximum drift (first year) ± 10 ppm. Effect of self-heating on ratios: (up to 750 V) ± 1 ppm max.; (up to 1500 V) ± 5 ppm max.

Measuring-Circuit Resistance $1333\frac{1}{3}$ ohms per volt, 2 megohms total.

Guard-Circuit Resistance $1333\frac{1}{3}$ ohms per volt, 2 megohms total.

Input Impedance 667 ohms per volt at max. tap voltage.

Dimensions $30'' \times 15\frac{7}{8}'' \times 8\frac{3}{4}''$ (762 x 403 x 222 mm).

Weight 40 lb (18.1 kg).

Option L&N Report of Calibration is available; add "-B" suffix to catalog number.

Price \$4160.00; add \$380.00 for "-B" suffix.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A0.1311.

7645 Students' Potentiometer



Offers many outstanding features designed to demonstrate the potentiometer principle. Also provides accuracy necessary for investigational work and instrument calibration.

- Triple-range measurements to 1.6 volts with high accuracy.
- Provision for use of slidewire as ratio arms of Wheatstone-bridge circuit.
- Metal case and top plate provide electrostatic shielding.
- In-line readout at central window.

SPECIFICATIONS

Catalog Number 7645.

Ranges 0 to 1.6 volts; 0 to 0.16 volt; 0 to 0.016 volt.

Limits of Error High Range: ± 0.0005 volt; Medium Range: ± 0.0001 volt; Low Range: ± 0.00001 volt.

Binding Posts For external battery, standard cell, keys and galvanometer. Individual binding posts permit using the slidewire in d-c or a-c bridge circuits.

Case Gray metal with vinyl dust cover.

Dimensions $7\frac{1}{2}'' \times 10\frac{3}{4}'' \times 5''$ (190 x 273 x 127 mm).

Weight $6\frac{1}{2}$ lb (2.9 kg).

Price \$338.00.

ORDERING INSTRUCTIONS Specify catalog number.

For more information, see Data Sheet A0.1221.

9828 D-C Null Detector



A solid-state, a-c guarded instrument designed for use in detector or amplifier applications involving signals down to the 0.1 microvolt level.

- 200 dB common mode rejection with line operation.
- Input-to-line isolation equivalent to 10^{10} ohms shunted by 50 picofarads.
- Zero stability of 200 nanovolts per 24 hours, noncumulative.
- All silicon solid-state circuitry.
- A-C guarded to improve common mode rejection.

SPECIFICATIONS

Catalog Number 9828 Bench type in extruded aluminum case; 9828-1 Rack type in sheet metal case.

Ranges Four: switch-selected calibrated ranges: $\pm 2.5 \mu\text{V}$, $\pm 25 \mu\text{V}$, $\pm 250 \mu\text{V}$, $\pm 2.5 \text{ mV}$; plus continuously adjustable control which provides up to 20:1 attenuation on any range.

Accuracy (10 mV Output) $\pm(1\% \text{ of range} + 0.1 \text{ microvolt})$.

Maximum Sensitivity 0.1 microvolt per meter division.

Input Resistance Greater than 100 K Ω on all ranges.

Output Fixed: 5-0-5 millivolts corresponding to full scale meter deflection; output resistance is 100 ohms. Adjustable: 5.5-0-5.5 millivolts to 50-0-50 millivolts corresponding to full scale meter deflection; output

resistance is 110 ohms at low end of adjustment range, increasing to 1000 ohms at high end.

D-C Common Mode Rejection Input shorted, greater than 200 dB; 1000 Ω source resistance, greater than 150 dB.

50-60 Hz Common Mode Rejection Guard and common mode source connected to input "+": input shorted, greater than 200 dB (p-p/DC) or 191 dB (RMS/DC); 1000 Ω source resistance, greater than 180 dB (p-p/DC) or 171 dB (RMS/DC).

50-60 Hz Normal Mode Rejection Greater than 90 dB (p-p) or 81 dB (RMS).

Input-to-Line Isolation 10^{10} ohms shunted by 50 picofarads.

Guarding 10^9 ohms shunted by 0.002 microfarads between guard and ground.

Dimensions 9828 Bench Mounting: 6 $\frac{5}{32}$ " (h) x 19 $\frac{11}{32}$ " (w) x 9 $\frac{9}{16}$ " (d). 9828-1 Relay Rack Mounting: 5 $\frac{7}{32}$ " (h) x 19" (w) x 9 $\frac{7}{32}$ " (d).

Weight 9828: 18 lb., 9828-1: 12 lb.

Options An adjustable $\pm(0 \text{ to } 1 \text{ volt})$ active output is available as an option; add "-A" suffix to catalog number.

Price \$450.00; add \$30.00 for "-A" suffix.

Catalog Number 9828-2; for applications requiring greater sensitivity than that supplied by the 9828. Same as 9828 detector except for sensitivity, ranges and price.

Sensitivity 1 microvolt full scale.

Ranges Four, switch-selected calibrated ranges: $\pm 1 \mu\text{V}$, $\pm 10 \mu\text{V}$, $\pm 100 \mu\text{V}$, $\pm 1 \text{ mV}$.

Price \$495.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A12.1214.

9829 Linear Amplifier



A high accuracy, high stability, solid-state, a-c guarded amplifier designed for use as a high impedance preamplifier or direct-reading indicator in applications involving d-c signal levels from 0.1 microvolt to 100 volts.

- **Output linearity better than $\pm 0.05\%$ of range.**
- **Response time (to within 0.1% of balance) within 1.5 seconds up to $10^4\Omega$ source resistance.**
- **Input-to-line isolation equivalent to 10^{10} ohms shunted by 50 picofarads.**
- **200 dB common mode rejection with line operation.**
- **All silicon solid-state circuitry.**

SPECIFICATIONS

Catalog Number 9829 Bench type in extruded aluminum case. 9829-1 Rack type in sheet metal case.

Ranges $\pm 10\ \mu\text{V}$, $\pm 100\ \mu\text{V}$, $\pm 1\ \text{mV}$, $\pm 10\ \text{mV}$, $\pm 100\ \text{mV}$, $\pm 1\ \text{V}$, $\pm 10\ \text{V}$, $\pm 100\ \text{V}$ with multipliers of X1 and X3 on each range.

Accuracy As an amplifier (5 mV output) $3\ \mu\text{V}$ and $10\ \mu\text{V}$ ranges $\pm(0.3\%$ of reading + 0.05% of range + $0.1\ \mu\text{V}$).

$30\ \mu\text{V}$ to $10\ \text{mV}$ ranges $\pm(0.05\%$ of reading $\pm 0.05\%$ of range + $0.1\ \mu\text{V}$).

$30\ \text{mV}$ to $100\ \text{V}$ ranges $\pm(0.08\%$ of reading + 0.05% of range + $0.1\ \text{mV}$).

As a Direct Reading Indicator (Meter)

$3\ \mu\text{V}$ to $10\ \text{mV}$ ranges $\pm(2\%$ of range $\pm 0.1\ \mu\text{V}$), equivalent to $\pm(1\%$ of F.S. + $0.1\ \text{V}$).

$30\ \text{mV}$ to $100\ \text{V}$ ranges $\pm(2\%$ of range + $0.1\ \text{mV}$), equivalent to $\pm(1\%$ of F.S. + $0.1\ \text{mV}$).

Maximum Sensitivity $0.1\ \mu\text{V}$ per meter division.

Input Impedance $3\ \mu\text{V}$ and $10\ \mu\text{V}$ Ranges ≥ 10 megohms; $30\ \mu\text{V}$ and $100\ \mu\text{V}$ Ranges ≥ 50 megohms; $300\ \mu\text{V}$ to $10\ \text{mV}$ Range ≥ 100 megohms; $30\ \text{mV}$ to $100\ \text{V}$ Ranges 10 megohms.

Output Calibrated: 5-0-5 millivolts corresponding to fullscale meter deflection; output impedance is 100 ohms. Adjustable: Active output adjustable from 0 to 1 volt for full scale output and can supply up to 1 volt across a $1\ \text{K}\Omega$ load; output impedance is less than 1 ohm.

D-C Common Mode Rejection Input shorted, greater than $200\ \text{dB}$. 1000Ω source resistance, greater than $160\ \text{dB}$.

50-60 Hz Common Mode Rejection Input shorted, greater than $200\ \text{dB}$ (P-P/dc) or $191\ \text{dB}$ (RMS/dc). 1000Ω source resistance, greater than $180\ \text{dB}$ (P-P/dc) or $171\ \text{dB}$ (RMS/dc).

50-60 Hz Normal Mode Rejection Greater than $90\ \text{dB}$ (P-P/dc) or $81\ \text{dB}$ (RMS/dc).

Input to Line Isolation 10^{10} ohms shunted by 50 picofarads.

Guarding 10^9 ohms shunted by 0.002 microfarad between guard and ground.

Dimensions 9829 Bench Mounting: $6\frac{5}{32}$ " (h) x $19\frac{1}{32}$ " (w) x $9\frac{1}{16}$ " (d). 9829-1 Relay Rack Mounting: $5\frac{7}{32}$ " (h) x 19 " (w) x $9\frac{7}{32}$ " (d).

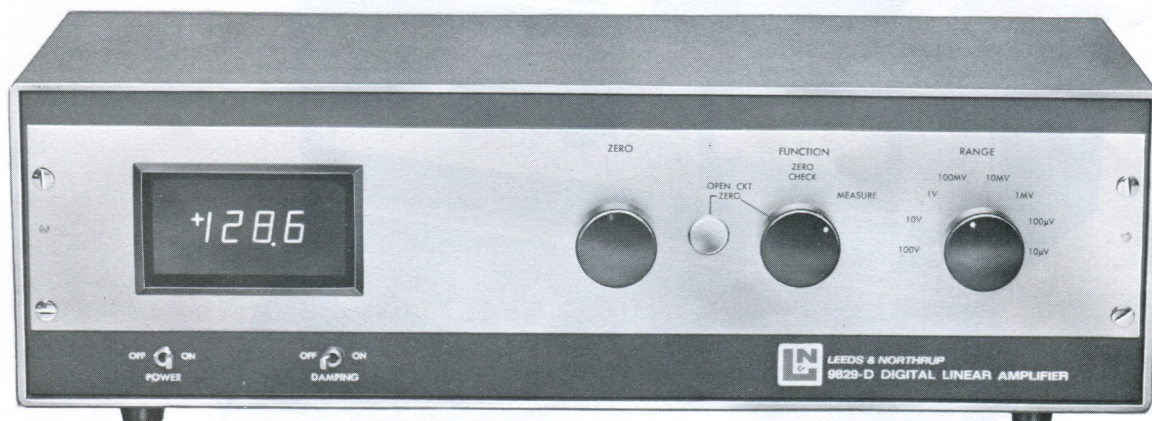
Weight 9829: $19\ \text{lb.}$; 9829-1: $13\ \text{lb.}$

Price \$795.00.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A12.1215.

9829-D Digital Linear Amplifier



Highly accurate, highly stable, solid-state, a-c guarded amplifier designed for use as a direct-reading *digital* voltmeter or high-impedance preamplifier in applications involving d-c signal levels from 0.1 μ V to 200 V. Can also be used as a calibrated deviation indicator for bridges, potentiometers and ratio sets.

- Amplifier linearity better than $\pm 0.05\%$ of range.
- Ranges up to 100 V full-scale with 100% over-range capability.
- Analog plus buffered digital outputs.
- 200 db common mode rejection with line operation.
- Seven-segment cold-cathode display for clear, wide-angle viewing at distances up to 40 feet.

SPECIFICATIONS

Catalog Number 9829-D Bench-Type in extruded aluminum case. 9829-D-1 Rack-Type in sheet metal case.

Ranges Eight switch-selected ranges: $\pm 10 \mu$ V, $\pm 100 \mu$ V, ± 1 mV, ± 10 mV, ± 100 mV, ± 1 V, ± 10 V, ± 100 V nominal with 100% over-range.

Accuracy As an amplifier (5 mV output):

100 μ V to 10 mV ranges— $\pm(0.05\%$ of reading + 0.05% of range + 0.1 μ V);

100 mV to 100 V ranges— $\pm(0.08\%$ of reading + 0.05% of range + 0.1 mV);

10 μ V range— $\pm(0.3\%$ of reading + 0.1 μ V).

As a direct-reading digital voltmeter:

100 μ V to 10 mV ranges— $\pm(0.15\%$ of reading + 0.15% of range);

100 mV to 100 V ranges— $\pm(0.18\%$ of reading + 0.15% of range);

10 μ V range— $\pm(0.4\%$ of reading + 0.1 μ V).

Linearity $\pm 0.05\%$ of range for amplifier.

Visual Display Non-blinking 7-segment cold-cathode display, $3\frac{1}{2}$ digits for all ranges except $2\frac{1}{2}$ digits for 10 μ V. Polarity indication; moving decimal point; over range indication.

Input Impedance 10 μ V range, ≥ 10 megohms; 100 μ V range, ≥ 50 megohms; 1 mV and 10 mV ranges, ≥ 100 megohms; 100 mV to 100 V ranges, 10 megohms.

Outputs Analog: 5-0-5 mV corresponding to a full-scale digital display of 1000 plus buffered digital output.

D-C Common Mode Rejection Input shorted, greater than 200 db; 1000 Ω source resistance, greater than 160 db.

50-60 Hz Common Mode Rejection Input shorted, greater than 200 db (P-P/d-c) or 191 db (RMD/d-c); 1000 Ω source resistance, greater than 180 db (P-P/d-c) or 171 db (RMS/d-c).

50-60 Hz Normal Mode Rejection Greater than 90 db (P-P/d-c) or 81 db (RMS/d-c).

Input To Line Isolation 10^{10} ohms shunted by 50 picofarads.

Guarding 10^9 ohms shunted by 0.002 microfarad between guard and ground.

Power Requirements Line operation: 115/230 V $\pm 15\%$ switch-selected, 48/62 Hz, 15 watts.

Dimensions 9829-D, $6\frac{5}{32}$ " (h) x $19\frac{1}{32}$ " (w) x $9\frac{9}{16}$ " (d) (156 x 491 x 243 mm). 9829-D-1, $5\frac{7}{32}$ " (h) x 19" (w) x $9\frac{7}{32}$ " (d) (133 x 483 x 134 mm).

Weight 9829-D, 21 lb (9.5 kg); 9829-D-1, 15 lb (6.8 kg).

Price \$1200.00

ORDERING INSTRUCTIONS Specify catalog number. For more information contact your local L&N Field Office.

324093 Kit

For Mounting the 9828 Null Detector... 9829 or 9829-D Amplifier



A kit of parts is available to mount the 9828 D-C Null Detector or 9829 Linear Amplifier or 9829-D Digital Linear Amplifier on the top of an instrument case. This kit can be used with the following instruments: 4232 Wheatstone Bridge; 4398-M Seven-Dial Ratio

Set; 4737 Wheatstone Bridge; 7554 Type K-4 Potentiometer; 7555 Type K-5 Potentiometer; 8079-B ER Thermometer Bridge. Photo, above, shows 9828 Null Detector mounted on top of 4398-M Double Ratio Set.

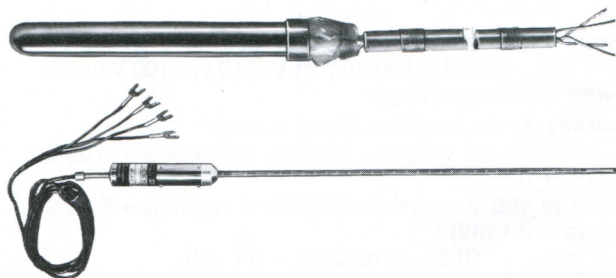
Price \$20.00.

ORDERING INSTRUCTIONS **GSA** To order kit, specify catalog number 324093. *For more information, contact your local L&N Field Office.*

Thermocouples and Resistance Thermometers for Laboratory Use

For precision laboratory work, L&N carries a line of thermocouples and resistance thermometers. The thermocouples are constructed of wire calibrated at NBS; an L&N Report of Calibration or an NBS Report can be provided at an additional charge. The platinum resistance thermometers are constructed to minimize the effects of internal and external strains . . . to exclude contamination . . . and to remain stable over long periods. These thermometers can be supplied with an L&N Report of Calibration.

For details on these thermocouples and resistance thermometers, see Section B, "Sensors".



9838 Guarded Nanovolt Null Detector



For use with highest-precision potentiometers ratio sets and bridges. This new solid-state nanovolt null detector features 5-nanovolt sensitivity, low noise, superior a-c rejection, and stable zero.

- Advanced circuitry and construction.
- 5-nV per division sensitivity.
- Available as bench-top or panel-mounted unit.
- Line or battery operation.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A12.1212.

SPECIFICATIONS

Catalog Number	Sensitivity (per division)	Noise	Input Impedance	Zero Stability	A-C Rejection (60-Hz)		Response Time (0 to 90%)		Meter	Case	Price
					Common Mode	Normal Mode	Source Resistance	Time			
9838 (bench-top)	Continuously Adjustable; 5 nV below 30 ohm 10 nV - 300 ohm 30 nV - 1000 ohm	Less than 10 nV peak-to-peak with 300 ohms source resistance	300 ohms	Better than 30 nV, non-cumulative after 1 hour warmup	Greater than 10 ⁸ /1 (160 dB)	Greater than 10 ⁴ /1 (80 dB)	0-100 -1000	2.7 Sec 3.5 Sec	50-0-50 μ A 4" scale 50 2-mm div.	7½" x 12½" x 7"; 13 lb.	\$1010.00
9838-1 (panel-type)										7" x 19" x 7"; 10 lb.	1010.00
2437-0-□□* (bench-top)	Continuously Adjustable; 0.5 μ V below 5K 1.0 μ V 5K-50K	Less than 0.5 μ V peak-to-peak with 50K source resistance	50,000 ohms	Less than 1.0 μ V per hour, non-cumulative after warm-up	10 ⁷ /1 (140 dB)	30,000:1 (90 dB)	0-1K 10K 50K	1.2 Sec 4.1 Sec 5.2 Sec	50-0-50 μ A 1.3" scale 20 1.6-mm div.	4" x 6" x 8"; 3½ lb.	*
2437-1-□□* (panel-type)										4¾" x 6" x 8"; 2 lb.	*
2437-2-□□* (component-type)										3" x 5½" x 5½"; 1½ lb.	*

*Power Supply Options and prices for 2437; see table.

OPTIONS & PRICES FOR 2437 NULL DETECTORS

Option	2437-0-□□ Suffix	Price	2437-1-□□ Suffix	Price	2437-2-□□ Suffix	Price
No power supply	00	\$225.00	00	\$225.00	00	\$182.00
External batteries (2000 hours operation)	10	231.00	10	231.00	10	188.00
Mercury-battery power supply (275 hours operation)	20	255.00	—	—	—	—
Rechargeable battery supply, 120 V, 50/60 Hz	30	313.00	—	—	—	—
Rechargeable battery supply 230 V, 50/60 Hz	31	342.00	—	—	—	—
Line-powered supply, 120 V, 50/60 Hz	40	272.00	40	272.00	40	229.00
Line-powered supply, 230 V, 50/60 Hz	41	284.00	41	284.00	41	241.00

2437 High-Impedance Null Detector



A compact null detector featuring a solid-state circuit and easy-to-read meter. Available in a variety of models—bench-top, panel-mounted and as a component.

- Metal-oxide-silicon field-effect-transistor input chopper.
- Excellent sensitivity at high impedance.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A12.1212.

2430 Type E Guarded D-C Galvanometer



A high-sensitivity galvanometer for general use. Deflections from null are indicated on a translucent scale by movement of a primary light spot split by an index line.

- Self-contained, compact unit.
- Guarded construction.
- Primary and secondary light spots.

2435 Reflecting Type Galvanometer



An internal-magnet galvanometer system with moderately high sensitivity.

2340 D-C Pointer Galvanometer

A self-contained, compact galvanometer with moderate sensitivity.

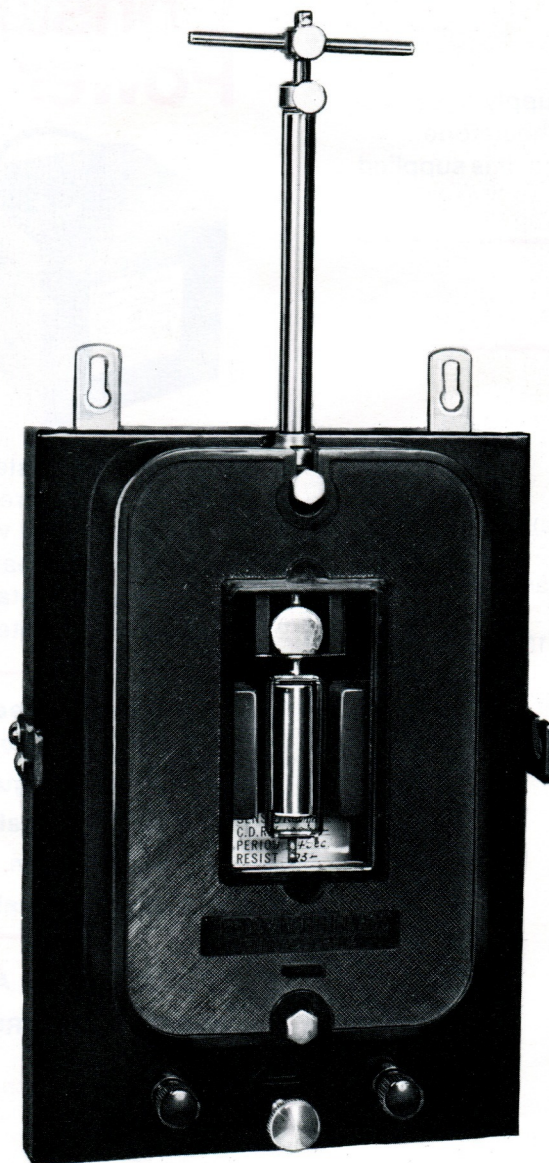
ORDERING INSTRUCTIONS Specify catalog number(s) of desired galvanometer(s). *For more information, see Data Sheets A12.1112. (Cat. 2430) and A12.1113. (Cats. 2435, 2340).*

SPECIFICATIONS AND PRICES

Catalog Number	Sensitivity* (Per Scale Division)	Period (Sec)	Resistance (Ohms)		Scale	Lamp Requirements	Dimensions and Weight	Price
			External Critical Damping	System				
2430-a	0.5 μ V	3.0	30 to 90	10	100 1-mm divisions 5-0-5 and 0-10	120 V, 60 or 50 Hz	6 $\frac{1}{4}$ " x 13 $\frac{1}{2}$ " x 9 $\frac{1}{4}$ " weight approx. 14 lb.	\$303.00
2430-c	0.005 μ A	2.5	300 to 500	25				
2430-d	0.0005 μ A	3.0	15,000 to 30,000	550				
2430-e	0.001 μ A	3.0	5000 to 8000	175				
2435-a	0.1 μ A	4.0	35	35	50 1-mm divisions 25-0-25	120 V, 60 or 50 Hz	3 $\frac{27}{32}$ " x 7 $\frac{9}{32}$ " x 5 $\frac{1}{4}$ " weight approx. 3 lb.	182.00
2435-b	0.06 μ A	3.0	100	40				
2435-c	0.025 μ A	3.0	1000	90				
2435-d	0.010 μ A	3.5	10,000	500				
2340-a	1.0 μ A	4.0	35	35	20 1-mm divisions 10-0-10	—	2 $\frac{3}{4}$ " x 5 $\frac{3}{8}$ " x 5 $\frac{3}{16}$ " weight approx. 1 lb.	92.00
2340-b	0.6 μ A	3.5	100	40				
2340-c	0.25 μ A	3.5	1000	90				
2340-d	0.1 μ A	4.0	10,000	500				

*Sensitivities are at least as high as stated; other characteristics within 20%.

2239 D-C Moving-Coil Reflecting Galvanometers



The 2239 is a moving-coil, reflecting-type galvanometer, with a wide selection of sensitivities, periods, and critical damping resistances. The galvanometer is equipped with a $\frac{5}{8}$ " plane mirror and a detachable lens of 1 meter focus.

SPECIFICATIONS AND PRICES

Price See table.

ORDERING INSTRUCTIONS Specify catalog number.

For more information on the 2239 and accessories, contact your local L&N Field Office.

Catalog Number	Sensitivity* (Per mm at 1 meter)	Period (Sec)	Resistance (Ohms)		Dimensions and Weight	Price
			External Critical Damping	System		
2239-a	0.014 μ A	8	10,000 to 100,000	125	6 $\frac{1}{4}$ " x 14" x 2 $\frac{1}{4}$ " ; weight 6 lb	\$182.00
2239-b	0.001 μ A	14	10,000 to 25,000	1000		
2239-c	1.5 μ V	12	165	35		
2239-d	0.002 μ C**	26	10,000	2000		
2239-e	0.011 μ C**	24	270	60		
2239-f	0.0002 μ A	18	46,000	8000		

*Sensitivities are at least as high as stated; other characteristics, within 20%. Microvolt sensitivities are for critical damping resistance in series. System resistance includes suspensions.

**Ballistic sensitivities given.

9876-M-1 D-C Power Supply

A line-operated bridge-voltage supply designed for use with general purpose Wheatstone bridges. Completely self-contained, it is supplied for 19" relay-rack mounting.

- Large easily-read meter.
- Any output from 0 to 100 volts.

SPECIFICATIONS

Catalog Number 9876-M-1.

Input 120 V, 50/60 Hz.

Range 0 to 10 V and 0 to 100 V.

Meter Accuracy ± 0.2 V (10 V range), ± 2.5 V (100 V range).

Maximum Current 800 mA up to 6 V and 100 mA up to 10 V; 20 mA (on 100 V range).

Dimensions 5¼" (h) x 19" (w) x 7¼" (d) (133 x 508 x 174 mm).

Weight 8 lb (3.6 kg).

Price \$252.00

ORDERING INSTRUCTIONS **GSA** Specify catalog no.

For more information, contact your local L&N Field Office.

9878 and 9879 Guarded D-C Constant Voltage Power Supplies



Produces a constant d-c output voltage to a constant load regardless of small line voltage and temperature variations. A replacement for the storage battery or dry cell batteries often used to obtain the standard current required by a potentiometer.

- Eliminates need for frequent standardization.
- Completely guarded.
- Electrostatically shielded.
- Line isolation.
- Long term stability of 100 ppm/yr.

SPECIFICATIONS AND PRICES See table.

ORDERING INSTRUCTIONS **GSA** Specify catalog number.

For more information, see Data Sheet A12.3111.

SPECIFICATIONS AND PRICES

Catalog Number	Input	Output	Stability							Dimensions and Weight	Price
			Output Regulation	Temp. Coefficient	Max. Ripple	Drift Stability	Max. Random Noise	Isolation			
								AC	DC		
9878	117 V ± 10%, 50/60 Hz, 6 VA	2.0 V d-c ± 2% at 12.1 mA (for 7555); 2.0 V d-c ± 2% at 11 mA (for 7556)	0.005% max. immediate change of output per 10 V line change; 0.001% max. final change of output per 10 V line change*	Less than 0.0002%/°C*	0.001% RMS at 60 and 120 Hz	0.01% per year 0.001% per 24 hrs 0.0002% per hr** 0.00005% per 10 min**	Less than 0.0003% (0.6 Hz to 2 kHz)	Less than 8, x 10 ⁻⁹ amperes	Guard to ground greater than 10,000 megohms	6" x 6" x 7¼"; weight, approx. 5 lb	\$426.00
9879	117 V ± 10%, 50/60 Hz, 3 VA	2.0 V d-c ± 0.3% at 12.1 mA	0.0005% max. immediate change of output per 10 V line change; 0.001% max. final change of output per 10 V line change*	Less than 0.0005%/°C*	0.001% RMS at 60 and 120 Hz	0.01% per year 0.001% per 24 hrs 0.0005% per hr*** 0.0002% per min***	Less than 0.0003% (0.6 Hz to 2 kHz)	Less than 25 nA, RMS	Guard to ground greater than 500 megohms at 85% relative humidity	2⅞" x 2⅞" x 4⅞"; weight approx. 1½ lb	\$163.00
099034	2.0 V d-c ± 0.3% at 24.44 mA										

*At 20-30 degrees C. **After 3-hour warmup. ***After 1-hour warmup.

Type 31 Rotary Switch

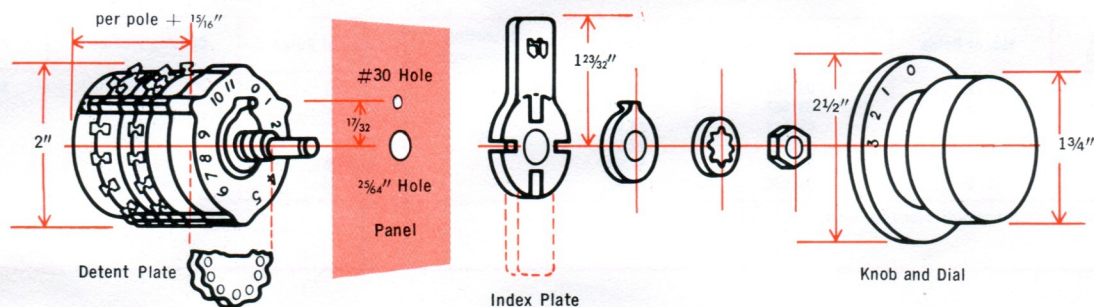
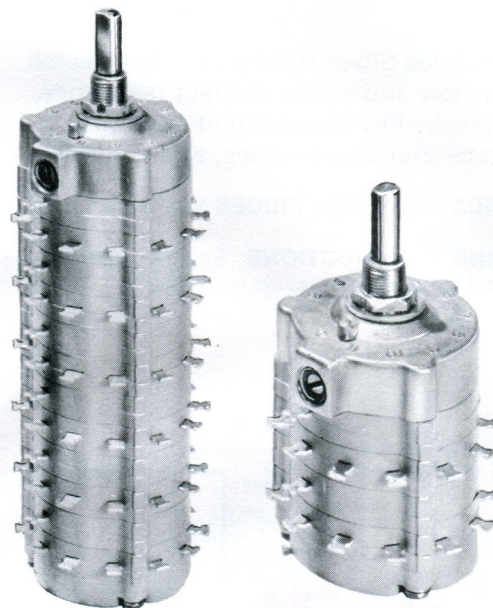
The Type 31 Rotary Switch is used for a wide variety of laboratory and industrial applications where switch design requires low and stable contact resistance and low thermals. Available in a number of switching combinations, from single-pole, 12- or 16-position to six-pole, 12- or 16-position, this switch is durable and reliable, and provides both convenience and smooth operation.

The Type 31 Switch can also be supplied in a cast-aluminum housing for permanent mounting or bench-top use, to connect a number of individual primary elements to a single-point indicator or recorder (see p. B-47).

SPECIFICATIONS AND PRICES See table.

ORDERING INSTRUCTIONS Specify catalog number(s) and quantity of desired switches.

For more information, contact your Local L&N Field Office.



SPECIFICATIONS AND PRICES

Type	Wafer Material	Switch Shaft	Poles	Switch Only		Switch Assembly	
				Catalog Number	Price***	Catalog Number	Price***
12-Position	Molded alkyd	Linen-base phenolic	1	31-3-0-1	\$21.80	8256-1-□	\$30.00
			2	31-3-0-2	31.30	8256-2-□	39.00
			3	31-3-0-3	41.90	8256-3-□	50.00
			4	31-3-0-4	52.00	8256-4-□	59.00
			5	31-3-0-5	63.00	8256-5-□	70.00
			6	31-3-0-6	73.00	8256-6-□	80.00
	Lexan	Molded acrylonitrile-styrene copolymer**	1	031261	32.90	8256-1A-□	41.00
			2	031262	45.00	8256-2A-□	54.00
			3	031263	58.00	8256-3A-□	66.00
			4	031264	71.00	8256-4A-□	78.00
			5	031265	84.00	8256-5A-□	91.00
			6	031266	97.00	8256-6A-□	104.00
16-Position	Molded alkyd	Molded acrylonitrile-styrene copolymer**	1	031142	38.20	8257-1-1	45.00
			2	031272	51.00	8257-2-1	58.00
			3	031273	68.00	8257-3-1	71.00
			4	031274	78.00	8257-4-1	84.00
			5	031275	85.00	8257-5-1	96.00
			6	031276	102.00	8257-6-1	109.00

*Switch assembly includes switch, knob, dial and index. Final suffix number indicates type of knob-and-dial marking, and must be included where optional: "1" for blank dial, with optional top or bottom indexing; "2" for dial numbered 0-10, bottom reading, clockwise rotation; or "3" for dial numbered 0-10, top reading, clockwise rotation. Dial markings for "2" and "3" are approximately 3/16" high, 30° apart, with one 60° space between 10 and 0.

**Switches having an acrylonitrile shaft are of higher quality than those having a phenolic shaft, and are similar in design to those used in the 4393 Universal Ratio Set, the 4394 Ratio Set and the Type K Potentiometers.

***Subject to quantity discounts when purchased in lots of ten or more.

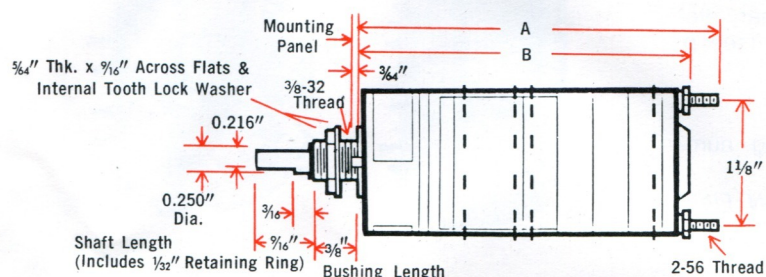
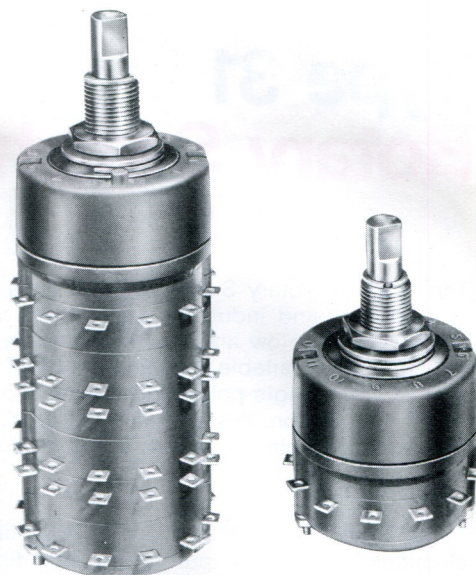
Type 01 Rotary Switch

The 01-Series Silver Rotary Selector Switch provides low and stable contact resistance, exceptionally low-thermal emf and long life at temperature extremes, at a low price.

SPECIFICATIONS AND PRICES See table.

ORDERING INSTRUCTIONS Specify catalog number(s) and quantity of desired switch(es).

For more information, contact your local L&N Field Office.



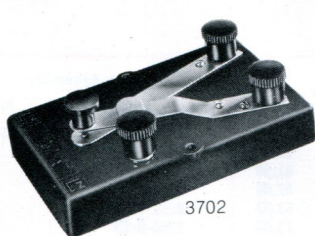
DIMENSIONS

No. of Poles	Maximum Depth Behind Panel (inches)	
	A	B
1	1.503	1.605
2	1.821	1.917
3	2.139	2.230
4	2.457	2.542
5	2.775	2.917
6	3.093	3.230

Detenting (Indexing)	No. of Poles	Catalog Number	Price*	Detenting (Indexing)	No. of Poles	Catalog Number	Price*
30°	1	031561	\$16.50	60°	1	031567	\$16.50
	2	031562	20.20		2	031568	20.20
	3	031563	23.90		3	031569	23.90
	4	031564	27.60		4	031570	27.60
	5	031565	31.30		5	031571	31.30
	6	031566	35.00		6	031572	35.00

*Quantity discounts available on orders for 10 or more.

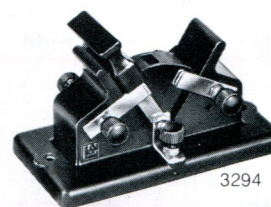
Keys and Pinch-Type Switch



3702



3701



3294

SPECIFICATIONS AND PRICES*

Catalog Number	Type	Characteristics	Price**
3702	Tapping Key	Single-contact and short-circuit key, used with galvanometers. When key is depressed, galvanometer deflects; so arranged that, when released, a damping resistance (not included) may be connected across galvanometer, assuring quick return to zero. Tungsten contacts; brass spring; bakelite base, with holes for mounting. 3" x 4 7/8" x 1 1/2" (overall height).	\$23.00
3701	Tapping Key	Double-contact key, used for closing two circuits with one movement. Similar to 3702, but provides two circuits, insulated from each other, operated by same motion. Top circuit closed before bottom circuit. When used with Wheatstone bridge, battery circuit is closed first, then galvanometer circuit. 3" x 4 7/8" x 2" (overall height).	29.00
3294	Pinch-Type Switch	For use as a practically thermal-free galvanometer-reversing switch and for general use in measuring circuits. Blades move through only 60°, held in open position by clicking device. Connections may be made within base to form a reversing switch. Has beryllium-copper blades, solid copper jaws, copper circuit through binding posts. Phenolic base has holes for mounting. 2 1/2" x 5" x 3 1/2" (overall height).	17.00

*To order, specify catalog number(s) of desired item(s).

**Subject to quantity discounts.

Laboratory Facilities



L&N can supply test and calibration equipment pre-wired and mounted in convenient table-top facilities. For ease of operation, the panel of the measuring instrument slopes away from the operator. The detector panel slopes toward the operator for direct, eye-level viewing and glare reduction.

The table below lists standard facilities that are available for short term delivery. For more information on these facilities, contact your local L&N Field Office.

ORDERING INSTRUCTIONS Specify catalog number.

Catalog Number+	Components	Facility Price+	Catalog Page Reference
4232-A31-B	Wheatstone Bridge Facility: Includes 4232-3B Wheatstone Bridge, 9828-1 Null Detector and 9876-M-1 Power Supply.	\$3340.00	J-42, J-61, J-68
4398-M-A30	Double-Ratio Set Facility: Includes 4398-M-1 Seven-Dial Ratio Set and 9828-1 Null Detector.	\$4405.00*	J-37, J-61
4398-M-A31	Double Ratio Set Facility: Same as 4398-M-A30 Facility except that it also includes a 9876-M-1 Power Supply.	\$4640.00*	J-37, J-61, J-68
4399-A30	Potential Divider Facility: Includes 4399-1 Seven-Dial Precision Potential Divider and 9828-1 Null Detector.	\$4540.00*	J-38, J-61
4399-A31	Potential Divider Facility: Same as 4399-A30 Facility except that it also includes a 9876-M-1 Power Supply.	4800.00*	J-38, J-61, J-68

Catalog Number+	Components	Facility Price+	Catalog Page Reference
7554-A30	Type K-4 Potentiometer Facility: Includes 7554-1 Type K-4 Potentiometer, 9828-1 Null Detector, 7308 Standard Cell and 7597 Battery.	\$1620.00	J-55, J-61, J-32
7554-A31	Same as 7554-A30 Facility except that a 9879 Power Supply is supplied in place of battery.	\$1725.00**	J-55, J-68, J-32
7555-A31	Type K-5 Potentiometer Facility: Includes 7555-1 Type K-5 Potentiometer, 9828-1 Null Detector, 7308 Standard Cell and 9879 Power Supply.	\$2080.00**	J-54, J-61, J-32, J-68
7555-A32	Same as 7555-A31 Facility except that it includes the 9838-1 Null Detector in place of the 9828-1.	\$2640.00**	J-54, J-65, J-32, J-68
7556-A32	Type K-6 Potentiometer Facility: Includes 7556-1 Type K-6 Potentiometer, 9828-1 Null Detector, 7308 Standard Cell and 9878 Power Supply.	\$4765.00*	J-53, J-61, J-32, J-68
7556-A33	Same as 7556-A32 Facility except that it includes a 9838-1 Null Detector in place of the 9828-1 Detector.	\$5355.00*	J-53, J-65, J-32, J-68
7556-A34	Same as 7556-A32 except that it includes a 9829-1 linear amplifier in place of the 9828-1.	\$5110.00	J-53, J-61, J-32, J-68
8693-A12-127	Direct-Reading Thermocouple Comparator.	\$2130.00	J-41

+All facilities can be supplied with an optional Report of Calibration; for details, contact your local L&N Field Office. A Report of Calibration is supplied as a standard item with the 4232-A31-B Facility.

**"-R" readout option is available at additional price of \$315.00.

**Can be supplied with following options at additional price: "-C1" selector switch and "-D1" reference junction. For details, contact your local L&N Field Office.

Laboratory "High-Boy" Consoles



L&N can provide a complete assembly of laboratory instruments in a "high-boy" console for your sensing, indicating and recording requirements. L&N assumes responsibility for assembly, wiring, and checkout of the complete system. These attractive consoles permit a more efficient use of space available in the modern instrumentation laboratory, and provide a greatly improved appearance compared with the usual odd-sized boxes and exposed interwiring.

The "high-boy" consoles are especially dimensioned for optimum flexibility to mount the desired combination of instruments and accessories, and all related components. Mounting within the console minimizes the possibility of physical damage to instruments and protects interconnections from mechanical disturbances and drafts. Interconnections to accessories are direct. Equipment is angled for optimum convenience of the operator. There is no need for an auxiliary stand to position a null detector at the proper height.

These consoles provide an integral desk top, storage cabinet and top shelf. Casters are provided for ease of mobility. Brakes on the front casters and turn-down legs

provide stability when permanently located. Consoles can be interlocked side-by-side for a neat measuring-station arrangement.

Three basic high-boy console styles are available:

- (1) All instruments slope-mounted on one plane, 15 degrees from the vertical.
- (2) Combination of 15-degree slope (15 $\frac{3}{4}$ ") and vertically-mounted instruments (8 $\frac{3}{4}$ ").
- (3) Combination of 15-degree slope (12 $\frac{1}{4}$ ") and vertically-mounted instruments (12 $\frac{1}{4}$ " $\frac{1}{2}$ ").

The basic high-boy console is also available separately for mounting your existing instrumentation.

Dimensions 56 $\frac{1}{2}$ " (h) x 23" (w) x 26" (d); 23" (w) x 15" (d) writing surface.

Catalog Number For console only (does not include instruments, hood or filler plates): 4000.

Price For console only (does not include instruments, hood or filler plates): \$685.00.

For more information on consoles, contact your local L&N Field Office.





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