

PRECISION MEASURING INSTRUMENTS



SELECTOR GUIDE FOR PRECISION MEASURING INSTRUMENTS

Classification	Model Number	Measuring Range (Accuracy)											Page				
		0.1	1	10	100 μ V	1	10	100mV	1	10	100	1,000V					
DC potentiometers	2722							(± 0.01 to $\pm 0.02\%$)									3
	2723						(± 0.01 to $\pm 0.02\%$)										

Classification	Model Number	Measuring Range (Accuracy)													Page		
		0.1	1	10	100m Ω	1	10	100 Ω	1	10	100k Ω	1	10	100M Ω			
Wheatstone bridge	2768							(± 0.01 to $\pm 0.05\%$)									5
	2755							(± 0.1 to $\pm 0.6\%$)									6
Double bridge	2752							($\pm 0.3\%$)									7
	2769																6
Standard resistor	2781																8
	2792																
	2794																
Variable resistor	278610							(± 0.05 to $\pm 2\%$)									11
	278620							(± 0.05 to $\pm 0.5\%$)									
	279301							($\pm 0.01\%$)									10
	279303																
	2791																

Classification	Model Number	Measuring Range (Accuracy)				Page										
		0.1	1	10	100 μ V											
Galvanometer	2707															Rear cover
	2708															

2722 & 2723 Precision DC Potentiometers

Models 2722 and 2723 are high-quality DC potentiometers. Utmost care has been taken in the selection of materials, components, and circuit design to insure high accuracy and stability. These potentiometers are recommended for use in test rooms and laboratories as secondary standard instruments or in work shops and inspection departments of factories for fine checking. Model 2722 measures voltages from 10 mV to 1.6V at an accuracy of 0.01% in five or six digits. Model 2723 is especially designed for low-voltage measurement from 0.1 μ V to 111 mV at an accuracy of 0.01% in five or six digits.

- **±0.01% accuracy**
- **Simple operation**

YOKOGAWA's unique circuitry permits large and stable operational current in the potentiometer, assuring ready balance and efficient measurement.

- **Easy readout**

Meter readings are arranged in-line and the decimal point is automatically shifted by range selector operation, giving quick readout without error.

- **Perfect shielding and guarded circuits**

- **Stable operation**

The manganin resistance wire is selected to give a temperature coefficient of $\pm 0.001\%/^{\circ}\text{C}$, and is stabilized by both artificial and natural aging after winding and before calibration of the resistance value.

- **Effects of parasitic emf eliminated**

- **Heat-insulated pushbutton keys**



Optional accessories for 2722 & 2723

Model number and name	Description	Page
2854 DC precision current supply	Essential	5
2707 electronic galvanometer	Essential for 2722 (2707 or 2709)	Rear cover
2781 precision standard resistor	For A, W and Ω measurements	9
2792 standard resistor		9
2743 standard shunt	For A and W measurements	5
2744 volt ratio box	For A and W measurements (for 2722)	5
2745 selector switch	For measurements of up to 6 channels	5

SPECIFICATIONS

Model	2722	2723
Unit	Absolute	Absolute
Measuring Range	1.5V Range: -0.00010 to 1.6111V 0.15V Range: -0.000010 to 0.16111V	100mV Range: -0.010 to 111.110mV 10mV Range: -0.0010 to 11.1110mV 1mV Range: -0.00010 to 1.11110mV
Readout	5 to 6 digits	5 to 6 digits
Measuring Dial	On 1.5V range: Dial I. 100mV x 15 steps Dial II. 10mV x 10 steps Dial III. 1mV x 10 steps Dial IV. -0.10mV to +1.10mV continuously variable (Slide dial: 10 μ V x 120 div.)	On 10mV Range: Dial I. 1mV x 10 steps Dial II. 0.1mV x 10 steps Dial III. 0.01mV x 10 steps Dial IV. -0.0010mV to +0.0110mV continuously variable (Slide dial: 0.1 μ V x 120 div.)
Minimum Division	1.5V Range: 10 μ V 0.15V Range: 1 μ V	100mV Range: 1 μ V 10mV Range: 0.1 μ V 1mV Range: 0.01 μ V
Accuracy (at ambient temperature of 23 \pm 2.5 $^{\circ}$ C)	1.5V Range: \pm (0.01% of reading + 10 μ V) 0.15V Range: \pm (0.02% of reading + 1 μ V)	100mV Range: \pm (0.01% of reading + 1 μ V) 10mV Range: \pm (0.02% of reading + 0.2 μ V) 1mV Range: \pm (0.02% of reading + 0.05 μ V)
Circuit Current	27.5mA adjustable with Coarse, Medium, and Fine Dials	22mA adjustable with Coarse, Medium, and Fine Dials
Standard Cell Dial	1.01770 to 1.01980V continuously variable (one division : 20 μ V)	
Internal Resistance	Approx. 28 to 125 Ω	Approx. 18 Ω constant
Battery Voltage	4 to 4.5V DC (27.5mA)	4 to 4.5V DC (22mA)
Galvanometer Sensitivity Control	By means of four built-in tap keys - three for sensitivity control and one for short-circuiting the galvanometer input	
Polarity Reversing Switch	Built-in, to reverse the galvanometer input.	Built-in, to reverse the polarity of the unknown voltage, standard cell, and battery.



2743

170 x 30 x 35 mm 0.2 kg
(6-3/4 x 1-1/4 x 1-3/8" 0.4 lbs)



2744

110 x 491 x 145 mm 5.5 kg
(4-3/8 x 19-3/8 x 5-3/4" 12.1 lbs)



2745

159 x 216 x 100 mm 1.7 kg
(6-1/4 x 8-1/2 x 4" 3.7 lbs)

OPTIONAL ACCESSORIES FOR DC POTENTIOMETERS (2722, 2723)

2743 STANDARD SHUNT (For 2722, 2723)

2743 is used mainly for the measurement of large current.

Rated voltage drop: 100 mV. **Accuracy:** $\pm 0.05\%$.

Code	274301	274302	274303	274304	274305	274306
Rated current	2A	5A	10A	20A	50A	100A

2744 VOLT RATIO BOX (For 2722)

2744 is a voltage divider to be used for accurate measurement of voltage from 1.6 to 1,500V.

Rated value: 3, 7.5, 15, 30, 75, 150, 300, 750, 1,500V.

Accuracy: $\pm 0.01\%$ (3 to 150V), $\pm 0.02\%$ (300 to 1,500V).

2745 SELECTOR SWITCH (For 2722 & 2723)

2745 is provided with 2 circuits and 6 contacts, and used for the measurement of unknown voltage of up to six channels. The contact points are made of silver, eliminating thermal emf.

2768 Precision Wheatstone Bridge



2768

310×491×140mm 10kg
(12-1/4×19-3/8×5-1/2" 22lbs)

Model 2768 is a precision bridge used for exact determination of resistance in the 100 mΩ to 110 MΩ range with accuracy of 0.01 to 0.05%. Since this instrument includes a high-sensitivity transistorized galvanometer and bridge power source, no auxiliary device is required.

- **Superior resistor element**
- **Minimized contact resistance**
- **Guarding and shielding**

Materials of high insulation resistance and low absorption are employed. Guard circuits are provided to insure stable operation even in highly humid atmospheres. The instrument is housed in a (grey) metal case to assure the operator of excellent shielding.

- **Heat-insulated pushbutton keys**

If the operator's body temperature were carried to the galvanometer sensitivity control keys, a temperature difference would arise at the contact point and produce thermal emf resulting in measurement error. To eliminate this effect, the pushbutton keys for the galvanometer sensitivity control are heat-insulated with phenol resin.

SPECIFICATIONS

Measuring Method: Null method (in-line readout).

Measuring Range:

Range	Measuring Range	Min. Division
x 100 mΩ	0.10000 to 1.11110 Ω	10 μΩ
x 1 Ω	1.0000 to 11.1110 Ω	0.1 mΩ
x 10 Ω	10.000 to 111.110 Ω	1 mΩ
x 100 Ω	100.00 to 1111.10 Ω	10 mΩ
x 1 kΩ	1.0000 to 11.1110 kΩ	0.1 Ω
x 10 kΩ	10.000 to 111.110 kΩ	1 Ω
x 100 kΩ	100.00 to 1111.10 kΩ	10 Ω
x 1 MΩ	1.0000 to 11.1110 MΩ	100 Ω
x 10 MΩ	10.000 to 111.110 MΩ	1 kΩ

Measuring Arm: 0 to 11, 111Ω adjustable in 0.1Ω steps, (consists of five decades: 1,000Ω x 10 + 100Ω x 10 + 10Ω x 10 + 1Ω x 10 + 0.1Ω x 10).

Multiplier: x 100mΩ, x 1Ω, x 10Ω, x 100Ω, x 1kΩ, x 10kΩ, x 100kΩ, x 1MΩ and x 10MΩ.

Accuracy: (At 23 ± 2°C, less than 75%)

x 100mΩ range ... ±0.5mΩ, x 1Ω range ... ± (0.02% of setting + 0.5mΩ), x 10Ω, x 100kΩ & x 1MΩ ranges ... ±0.02% of setting, x 100Ω, x 1kΩ & x 10kΩ ranges ... ±0.01% of setting, x 10MΩ range ... ±0.05% of setting.

Maximum Allowable Input: 0.2W continuously for ratio arm, 0.2 W continuously per element for measuring arms.

Galvanometer (built-in): Max. sensitivity ... approx. 10μV/div. (provided with a sensitivity adjuster), power source ... single 9V battery (JIS 6F22 or equivalent), battery life ... approx. 300 hous.

Insulation Resistance: More than 1,000MΩ at 250V DC at ambient humidity of less than 75% between electric circuit and case.

Dielectric Strength: 500V AC for one minute between electric circuit and case.

Case: Grey metal case, with plastic feet and carrying handles.

Bridge Power Source (built-in): Power source range ... 1.5/3/6/15 V selectable, power source battery ... four 1.5V batteries (JIS R20P, ANSI D, Mono 1.5V or equivalent) and single 9V battery (JIS 6F22, ANSI 6F22, Energieblock 9V or equivalent).

2755 Portable Wheatstone Bridge



Model 2755 measures resistances from 1Ω to 10 MΩ by operation of dials and switches. Batteries and a galvanometer are self-contained. The front control panel is provided with power and galvanometer circuit selectors, one ratio arm dial, and four measuring arm dials.

Model 2755 is also equipped with a Murray and Varley Loop Tester for convenient location of line faults such as "shorts" and "grounds" in power, telephone, telegraph, and signal cables.

- No auxiliary attachment required
- Galvanometer with a built-in protection circuit
- Compact, lightweight (2 kg)
- Built-in Murray & Varley loop tester

SPECIFICATIONS

Measuring Range: 1,000 Ω to 10.00 MΩ.
Measuring Arms: 1 Ω × 10 + 10 Ω × 10 + 100 Ω × 10 + 1,000 Ω × 10 (min. one step: 1 Ω).
Ratio Arms (Multiplier): × 0.001, × 0.01, × 0.1, × 1, × 10, × 100, × 1,000 (M10, M100, M1000 . . . Murray & Varley loop testing).
Accuracy: ±0.1% of reading on 100 Ω to 100 kΩ range, ±0.3% of reading on 10 Ω to 1 MΩ range, ±0.6% of reading on 1 Ω to 10 MΩ range.
Temperature Coefficient of Resistance Elements: ±5 × 10⁻⁵ /°C at ambient temperature of 5 to 35°C (41 to 95°F), ±2 × 10⁻⁵ /°C at ambient temperature 20 to 35° (68 to 95°F).
Galvanometer: Sensitivity . . . 0.9 μA/div., internal resistance . . . Approx. 150 Ω, external critical damping resistance . . . Approx. 800 Ω, period . . . within 1.5 seconds.
Power Source: Three 1.5 V batteries (built-in).
Operating Temperature Range: 5 to 35°C (41 to 95°F).
Humidity Range: 85% max., relative humidity.
Outer Case: ABS resin,
Accessory supplied at no extra cost: Carrying case.

2769 Portable Double Bridge

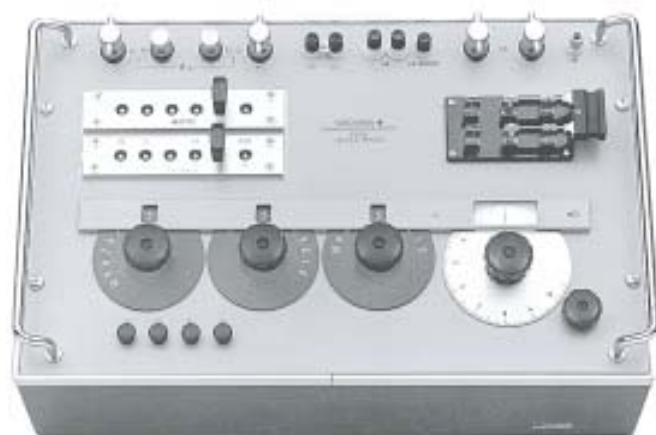


Model 2769 is a compact, portable Kelvin double bridge designed for measuring low resistance from 0.1 mΩ to 110 Ω with four multiplication plugs and one measuring dial. It has built-in standard resistors, bridge power source and high-sensitivity taut-band suspension system electronic DC galvanometer.

SPECIFICATIONS

Measuring Range: 0.1 mΩ* to 110Ω.
Measuring Dial: 1.00 to 11.00 Ω at × 1.
Multipliers: × 0.0001*, × 0.001, × 0.01, × 0.1, × 1, × 10 (plug-in system).
Min. Division: 0.005 mΩ at × 0.0001*, 0.05 mΩ at × 0.001, 0.5 mΩ at × 0.01, 5 mΩ at × 0.1, 50 mΩ at × 1, 0.5 Ω at × 10.
Accuracy: ±(0.05 Ω × multiplier + 0.01 mΩ) at temperature range of 5 to 35°C and humidity range of less than 85%.
Current Rating: 10A at × 0.0001* (0.01Ω), 3A at × 0.001 (0.1Ω), 1A at × 0.01 (1Ω), 0.3A at × 0.1 (10Ω), 0.1A at × 1 (100Ω), 0.01A at × 10 (1,000Ω).
Galvanometer: Built-in electronic DC galvanometer, voltage sensitivity . . . approx. 20 μV/div. sensitivity changeover; G₀ . . . (input resistance: approx. 11 kΩ). G₁ . . . approx. 1/11 of G₀ sensitivity. G₂ . . . approx. 1/110 of G₀ sensitivity. power source; one 9 V battery (JIS 6F22), battery life; approx. 300 hours.
Operating Temperature Range: 5 to 35°C (41 to 95°F).
Humidity Range: Less than 85% relative humidity.
Bridge Power Source: Two 1.5 V batteries (JIS R20P). External power source is also usable. Terminals for an external battery are provided.
***Note:** Standard Resistor (Model 2771) is required for measurement on 0.1 to 1.1mΩ range at 0.0001 multiplier.
Accessory supplied at no extra cost: Carrying case.
Optional Accessories: 2771 standard resistor, 2753 measuring cords (Page 8), 2754 clamp device (Page 8).

2752 Precision Double Bridge



2752
310×491×140mm 11.5kg
(12-1/4×19-3/8×5-1/2" 25.3lbs)

Model 2752 is a precision laboratory standard Kelvin bridge for measuring resistance below 100Ω to an accuracy of ± 0.03 to 0.05% . This instrument is used not only for high-precision measurement of resistance but also for measurement of electrical conductivity of conductors and calibration of low resistance instruments. It is also designed for testing large-capacity shunts and measuring lead resistance per unit length of bar or wire conductors in combination with accessory.

- **Laboratory-grade accuracy** – ± 0.03 to $\pm 0.05\%$
- **Quick readout without error**
- **Excellent long-term stability**

The resistance elements are made of selected manganin wire, stabilized by both artificial and natural aging after being wound.

- **Perfect guard system**
- **Stable measurement**

The dial switches offer low contact resistance and little change due to aging, giving stable operation. Inner/outer contact type plugs are used for changing the multiplication factor, assuring little change in the resistance due to reinsertion of plugs.

- **Built-in standard resistors**
- **Bar resistor measurement**

SPECIFICATIONS

- Measuring Range:** $0.10000m\Omega$ to 111.10Ω in five digits.
- Measuring Arm:** (at Multiplier $\times 1$): $100m\Omega \times 10 + 10m\Omega \times 10 + 1m\Omega \times 10 + (0.05 \text{ to } 1.05m\Omega)$.
- Minimum Division:** $0.00001m\Omega$ at $\times 0.001$, $0.0001m\Omega$ at $\times 0.01$, $0.001m\Omega$ at $\times 0.1$, $0.01m\Omega$ at $\times 1$, $0.1m\Omega$ at $\times 10$ and $1m\Omega$ at $\times 100$.
- Multiplier:** $\times 0.001$, $\times 0.01$, $\times 0.1$, $\times 1$, $\times 10$ and $\times 100$.
- Accuracy:** At resistance of potential leads and current leads less than $10m\Omega$ /wire; $\pm(0.03\%$ of reading $+ 1\mu\Omega$) at $23\pm 2.5^\circ\text{C}$, $\pm(0.05\%$ of reading $+ 1\mu\Omega$) at 10 to 40°C .
- Current Rating:** 30A at $\times 0.001$, 10A at $\times 0.01$, 3A at $\times 0.1$, 0.5A at $\times 1$, 0.15A at $\times 10$, 0.05A at $\times 100$.
- Case:** Grey metal case, with plastic feet and carrying handles.

Insulation Resistance: More than $100M\Omega$ at 500V DC between the electric circuit and case.

Dielectric Strength: 500V AC for one minute between electric circuit and case.

Optional Accessories: 2707 electronic galvanometer (rear cover), 2012 DC volt-ammeter, 2791 slide resistor (Page 12), 2753 measuring cords, 2754 clamp device.

OPTIONAL ACCESSORIES FOR 2752 & 2769

2753 MEASURING CORDS

2753 is a set of cords, and used for connecting the resistor to be measured.

Current Cords: One pair, 2m each, approx. $3m\Omega$.

Voltage Cords: One pair, 2m each, approx. $8m\Omega$.

Clamp Fixture: Attached to the end of each cord.

Weight: Approx. 4.1 kg (9.0 lbs).

2754 CLAMP DEVICE

2754 is used for resistance measurement of bar or wire conductor. 2754 enables easy measurement of resistance per unit length.

Distance between Voltage Terminals: 500mm ($19-3/4''$).

Current Cords: One pair, 500mm each, approx. $1m\Omega$.

Voltage Cords: One pair, 500mm each, approx. $2.5m\Omega$.



2781, 2792 & 2794 Standard Resistors



2781 HIGH-PRECISION STANDARD RESISTOR

Model 2781 is an one-ohm prime resistance standard ideally suited for preservation and maintenance of resistance value in laboratories and instrument rooms. In order to ensure long-term stability as a reference standard, resistors are manufactured under close supervision with special consideration given to the use of carefully selected manganin wire for resistor elements. Each element is bifilar wound, carefully adjusted, and thoroughly annealed.

- Nominal value – $1\ \Omega$
- Calibrated limit of error – $\pm 2\ \text{ppm}$
- Selected manganin wire resistor element
- Thoroughly annealed and aged for long-term stability
- Double-sealed brass container with inert gas enclosed
- Suitable for use as a reference standard of resistance in laboratories and instrument rooms

2794 STANDARD RESISTORS

Model 2794 resistors are intermediated-value resistance standards which can be used as comparison standards of resistance. Four different models are available – 0.1 to $100\ \Omega$ – and all models are accurate to a calibrated limit of error of $\pm 5\ \text{ppm}$, and six-month stability of within $\pm 5\ \text{ppm}$. A test certificate including one-year stability data is furnished with each resistor.

- Intermediated-value resistance standards – 0.1 to $100\ \Omega$ in 4 steps
- Calibrated limit of error – $\pm 5\ \text{ppm}$
- Stability – changes of resistance do not exceed $\pm 5\ \text{ppm}$ per six months
- Selected manganin wire resistor element of low temperature coefficient
- Suitable for use as a comparison standard of resistance

2792 STANDARD RESISTORS

Model 2792 resistors are low- to high-value resistance standards which can be used for accurate DC measurements in combination with a potentiometer or bridge. The different models are available, ranging from $0.001\ \Omega$ to $1\ \text{M}\Omega$. The resistor elements of the $0.001\ \Omega$ to $10\ \text{k}\Omega$ models (4-terminal construction) are of selected manganin wire, and those of the $100\ \text{k}\Omega$ and $1\ \text{M}\Omega$ models (3-terminal construction), nickel and chromium wire. All resistors are fully processed to assure the permanence of resistance.

- Low- to high-value resistance standards – $0.001\ \Omega$ to $1\ \text{M}\Omega$ in 10 steps
- Calibrated limit of error – $\pm 10\ \text{ppm}$ to $\pm 100\ \text{ppm}$
- Suitable for precision DC measurements using a potentiometer or bridge

SPECIFICATIONS

2781 HIGH-PRECISION STANDARD RESISTOR

Nominal Value: 1 Ω .

Construction: Double-sealed brass container with 4-terminal construction.

Accuracy to Nominal Value: ± 20 ppm at $20 \pm 0.2^\circ\text{C}$, power consumption of less than 0.02W, 4-terminal connection, and in stirred oil.

Calibrated Limit of Error: ± 2 ppm at $20 \pm 0.2^\circ\text{C}$, power

consumption of less than 0.02W, 4-terminal connection, and in stirred oil.

Power Rating: Less than 1W.

Dimensions: Approx. 120 dia. \times 183mm (4-5/8 dia. \times 7-1/8").

Weight: Approx. 3.1kg (6.8 lbs).

Attached Document: Test certificate . . . 1 copy.

2794 STANDARD RESISTORS

Code	Nominal Value	Terminal Construction	Accuracy at $20 \pm 0.2^\circ\text{C}$, less than 0.1W, in stirred oil	Calibrated Limit of Error	Temperature Coefficient		Insulation Resistance (at 0 to 40°C)	Dielectric Strength (between resistor and the case)
					$\alpha_{20} (\times 10^{-6} / ^\circ\text{C})$	$\beta (\times 10^{-6} / ^\circ\text{C}^2)$		
279403	0.1 Ω	4-terminal	$\pm 0.002\%$	$\pm 0.0005\%$	-2 to +8	Less than -0.7	More than $10^{10} \Omega$ at 500V DC	1,500V AC for one minute
279404	1 Ω							
279405	10 Ω							
279406	100 Ω							

Temperature Coefficient – Change of resistance with temperature is expressed by the following equation:

$$R_t = R_{20} [1 + \alpha_{20} (t - 20) + \beta (t - 20)^2]$$

where,

R_t ; resistance at $t^\circ\text{C}$,

R_{20} ; resistance at 20°C

Self-Heating: Less than 6°C/W at 20°C .

Change of Resistance with Temperature: Within ± 20 ppm at $20 \pm 2^\circ\text{C}$.

Temperature Coefficient: At an ambient temperature from 15 to 35°C .

Change of Resistance with Power: Within ± 20 ppm against power fluctuations from 0.1 to 0.7W at $20 \pm 2^\circ\text{C}$, in air.

Power Rating: 3W.

Change of Resistance with Time: Within ± 5 ppm for six months (within YOKOGAWA'S test period).

Dimensions: Approx. 174 \times 150mm (6-7/8" \times 5-7/8) 104mm dia. (4-4/8" dia.).

Weight: Approx. 1.5kg (3.3 lbs).

Attached Document: Test certificate . . . 1 copy (includes measured data at 20°C , change of resistance with temperature from 15 to 35°C , and change of resistance with time for one year).

2792 STANDARD RESISTORS

Code	Nominal Value	Terminal Construction	Accuracy (at $20 \pm 1^\circ\text{C}$)	Calibrated Limit of Error (at $20 \pm 0.2^\circ\text{C}$)	Temperature Coefficient		Insulation Resistance (at 0 to 40°C)	Dielectric Strength (between resistor and the case)
					$\alpha_{20} (\times 10^{-6} / ^\circ\text{C})$	$\beta (\times 10^{-6} / ^\circ\text{C}^2)$		
279201	0.001 Ω	4-terminal	$\pm 0.02\%$	$\pm 0.01\%$	-5 to +15	Less than -0.7	More than $10^{10} \Omega$ at 500V DC	1,500V AC for one minute
279202	0.01 Ω		$\pm 0.01\%$	$\pm 0.005\%$	-5 to +15	Less than -0.7		
279203	0.1 Ω		$\pm 0.005\%$	$\pm 0.001\%$	-5 to +10	Less than -0.7		
279204	1 Ω		$\pm 0.005\%$	$\pm 0.001\%$	-5 to +10	Less than -0.7		
279205	10 Ω		$\pm 0.005\%$	$\pm 0.001\%$	-5 to +10	Less than -0.7		
279206	100 Ω		$\pm 0.005\%$	$\pm 0.001\%$	-5 to +10	Less than -0.7		
279207	1 k Ω		$\pm 0.005\%$	$\pm 0.001\%$	-5 to +10	Less than -0.7		
279208	10 k Ω		$\pm 0.005\%$	$\pm 0.001\%$	-5 to +10	Less than -0.7		
279209	100 k Ω	3-terminal	$\pm 0.005\%$	$\pm 0.002\%$	-10 to +10	Less than -0.05	More than $10^{12} \Omega$ at 1,000V DC	2,000V AC for one minute
279210	1 M Ω		$\pm 0.01\%$	$\pm 0.005\%$	-10 to +10	Less than -0.05		

Temperature Coefficient – Change of resistance with temperature is expressed by the following equation:

$$R_t = R_{20} [1 + \alpha_{20} (t - 20) + \beta (t - 20)^2]$$

where,

R_t ; resistance at $t^\circ\text{C}$,

R_{20} ; resistance at 20°C

Power Rating: 3W.

Dimensions: Approx. 174 \times 150mm (6-7/8" \times 5-7/8) 104mm dia. (4-4/8" dia.).

Approx. 104 dia. \times 147mm (279209, 279210)

Weight: Approx. 1.5kg (3.3 lbs).

Attached Document: Test certificate 1 copy.

2793 Decade Resistance Boxes



279301

110 x 491 x 140 mm 4.8 kg
(4-3/8 x 19-3/8 x 5-1/2" 10.6 lbs)

Model 2793 is a high-accuracy, stable DC variable resistor with 6 dials and is available in two styles: 279301 for medium resistance from 0.1 to 1,111.210Ω in 1mΩ steps (best suited for calibration of resistance thermometers or bridges); 279303 for high resistance from 0 to 111,1110 MΩ in 100Ω steps (suitable for calibration of insulation resistance testers or bridges).

279301

- High accuracy and stability
- High reproducibility

Excellent reproducibility is obtainable because dial switches with low contact resistance are used. For example, changes in contact resistance is within ±1.1mΩ at 0.1Ω setting.

- 1mΩ resolution
- Simple, quick dial operation
- In-line display for easy reading
- Ideal for calibration of resistance thermometers and bridges

Due to its high accuracy and a dial system, various types of resistance thermometers and bridges can be calibrated accurately and promptly.

- Excellent anti-shock and -vibration properties

279303

- Up to 100MΩ in 100Ω step
- Low voltage coefficient

Variation of the resistance value is less than ±0.1% at 1MΩ and 10MΩ steps against 100V application, and less than ±0.04% at 100Ω, 1kΩ, 10kΩ, and 100kΩ steps against 10V application.

- Shock- and vibration-proof construction
- Easy-to-read in-line indication
- Best suited for calibration of insulation resistance testers and bridges

SPECIFICATIONS

279301

Resistance Range: 0.100 to 1,111.210 Ω (Minimum resistance is 0.100Ω).

Dial Composition: 0.001Ω × 10 + 0.01Ω × 10 + 0.1Ω × 11 + 1Ω × 10 + 10Ω × 10 + 100Ω × 10

Resolution: 0.001 Ω

Accuracy: ±(0.01% + 2 mΩ) at temperature 23 ± 2°C, humidity 45 to 75%, and 0.1 W power application

Max. Allowable Input Power: 0.25 W/step. Within 1 W

for overall instrument.

Max. Allowable Input Current:

50 mA (100 Ω steps), 150 mA (10 Ω steps), 500 mA (1 Ω steps), and 1.5 A (0.1 Ω steps).

Insulation Resistance: More than 500 MΩ at 500 V DC between panel and circuit.

Dielectric Strength: 1,000 V AC for one minute between panel and circuit.

Temperature Coefficient:

Temperature coefficient	Dial	100 Ω step	10 Ω step	1 Ω step	0.1 Ω step
α_{20} ($\times 10^{-6}/^{\circ}\text{C}$)		-5 to +10	-5 to +20	Approx. 20 to 90	Approx. 90 to 900
β ($\times 10^{-6}/^{\circ}\text{C}^2$)		-0.3 to -0.7	-	-	-

Variation of resistance with temperature change is given by the following equation:

$$R_t = R_{20} [1 + \alpha_{20}(t - 20) + \beta (t - 20)^2]$$

where, R_t : Resistance value at $t^{\circ}\text{C}$

R_{20} : Resistance value at 20°C

279303

Resistance Range: 0 to 111,1110 MΩ.

Dial Composition: 100 Ω × 10 + 1 kΩ × 10 + 10 kΩ × 10 + 100 kΩ × 10 + 1 MΩ × 10 + 10 MΩ × 10.

Accuracy: 100 Ω, 1 kΩ, 10 kΩ and 100 kΩ steps ... ±(0.05% + 0.05 Ω)

1 MΩ and 10 MΩ steps ... ±0.2%

(At temperature 23 ± 2°C, humidity below 75%, including residual resistance of approx. 0.05Ω).

Max. Allowable Input:

100 Ω step	100 mA
1 kΩ step	30 mA
10 kΩ step	10 mA
100 kΩ step	3 mA (100 to 600 kΩ)
	2,000 V (700 kΩ to 1 MΩ)
1 MΩ step	2,000 V
10 MΩ step	2,000 V

Temperature Coefficient:

100 Ω, 1 kΩ step ... $\alpha_{20} = (-2 \text{ to } +20) \times 10^{-6}/^{\circ}\text{C}$
 $\beta = -(0.3 \text{ to } 0.7) \times 10^{-6}/^{\circ}\text{C}^2$

10 kΩ, 100 kΩ, 1 MΩ, 10 MΩ step ±30 × 10⁻⁶/°C

Variation of resistance with temperature change is given by the following equation:

$$R_t = R_{20} [1 + \alpha_{20}(t - 20) + \beta (t - 20)^2]$$

where, R_t : Resistance value at $t^{\circ}\text{C}$

R_{20} : Resistance value at 20°C

Insulation Resistance: More than 10¹¹ Ω at 1,000 V DC between panel and circuit.

Dielectric Strength: 2,500 V AC for one minute between panel and circuit.

2786 Decade Resistance Boxes



2786
116 x 497 x 120 mm 3.5 kg
(4-5/8 x 19-5/8 x 4-3/4" 7.7 lbs)

Models 278610 and 278620 six-dial decade resistance boxes allow quick and easy setting of a wide range of resistance. These resistance boxes are used in combination with voltage or current standards to adjust voltage or current, as dummy load resistances or as an arm of AC bridges.

SPECIFICATIONS

Available Models:

Model Number	Resistance Range
278610	0.1 to 111,111 Ω (six decade dials)
278620	1 to 1,111,110 Ω (six decade dials)

Residual Resistance: Less than 23m Ω .

Power Rating: 0.3W/step, within 3W for overall instrument.

Maximum Allowable Input: 0.5W/step, 5W for overall instrument.

Maximum Circuit Voltage: 250V.

Operating Temperature Range: 0 to 40 $^{\circ}$ C (32 to 104 $^{\circ}$ F).

Storage Temperature Range: -10 to 50 $^{\circ}$ C (14 to 122 $^{\circ}$ F).

Humidity Range: 25 to 85%, relative humidity.

Insulation Resistance: More than 500M Ω at 500V DC.

Dielectric Strength: 1,500V AC for one minute.

Accuracy and Temperature Coefficient (2786):

Step	Accuracy ^{*1}	Temperature Coefficient ^{*2}		Reference Data	
		$\alpha_{23} (\times 10^{-6} / ^{\circ}\text{C})$	$\beta (\times 10^{-6} / ^{\circ}\text{C}^2)$	Current Rating	Max. Allowable Input Current ^{*3}
0.1 Ω	± 2	± 250	-0.4 to -0.8	1.7A	2.2A
1 Ω	± 0.5	± 100	-0.4 to -0.8	550mA	710mA
10 Ω	± 0.1	± 20	-0.4 to -0.8	170mA	220mA
100 Ω	± 0.05	± 10	-0.4 to -0.8	55mA	71mA
1k Ω	± 0.05	± 10	-0.4 to -0.8	17mA	22mA
10k Ω	± 0.1	± 50	± 0.1	5.5mA	7.1mA (10k Ω to 30k Ω) 250V (40k Ω to 100k Ω)
100k Ω	± 0.1	± 50	± 0.1	250V (200k Ω to 1M Ω) 1.7mA (100k Ω)	250V

Notes:

*1. At standard reference conditions of 23 \pm 3 $^{\circ}$ C ambient temperature, 45 to 75% humidity and less than 0.1W application.

*2. The resistance value at t $^{\circ}$ C can be expressed by the following equation:

$$R_t = R_{23} [1 + \alpha_{23} (t - 23) + \beta (t - 23)^2]$$

Where, R_t : Resistance value at t $^{\circ}$ C.

R_{23} : Resistance value at 23 $^{\circ}$ C.

*3. Within five minutes.

2791 Slide Resistors



2791
125 x 510 x 85 mm 2.7 kg
(5 x 20-1/8 x 3-3/8" 6 lbs)

Model 2791 is composed of resistance wire with an insulating coating wound on a frame of special ceramic and a sliding brush that maintains contact with the wire. Resistance is continuously variable and can be increased or decreased as desired.

The device permits current and voltage to be accurately adjusted without disconnecting the circuit. The resistor is widely used in testing laboratories and also in industrial tests and inspection of machinery and equipment.

SPECIFICATIONS

Available Models:

Code	Nominal Value	Allowable Input Current
279101	4,800 Ω	0.18 A
279102	1,400 Ω	0.35 A
279103	600 Ω	0.5 A
279105	170 Ω	1.0 A
279108	39 Ω	2.0 A
279110	10 Ω	4.0 A
279112	4.7 Ω	6.0 A

Allowable Deviation: $\pm 20\%$ of nominal value.

Insulation Resistance: More than 5M Ω at 500V DC between terminal and case.

Dielectric Strength: 1,000V AC for one minute between terminal and case.

2707 Electronic Galvanometer



270710

113 x 106 x 46 mm 0.45 kg
(4-1/2 x 4-1/4 x 1-7/8" 1 lb)

Model 2707 is a compact transistorized electronic galvanometer using a battery. With sensitivity of $10\mu\text{V}/\text{div.}$, this instrument is highly suited to field measurements and as an indicator for complex measuring instruments.

- 10 $\mu\text{V}/\text{div.}$ sensitivity
- Stable measurement
Zero drift is as low as $1\mu\text{V}/\text{h}$ or $1\mu\text{V}/20^\circ\text{C}$
- Overload protection circuit
- 300 hours battery life

Measuring Range: $\pm 250\mu\text{V}$ $\begin{matrix} +20\% \\ -10\% \end{matrix}$
Maximum Sensitivity: $10\mu\text{V}/\text{div.}$ $\pm 10\%$
Input Resistance: Approx. $9\text{k}\Omega$
Response Time: Approx. 3 seconds.
Common Mode Rejection: More than 140 dB at DC and commercial frequency (50 and 60 Hz).
Normal Mode Rejection: More than 60 dB.
Vibration of Pointer: Unrecognizable.
Drift: Less than $1\mu\text{V}/10$ minutes or $2\mu\text{V}/20^\circ\text{C}$.
Max. Allowable Input: 5 V.
Life of Battery: Approx. 300 hours when continuously used.
Power Source: One 9V battery (JIS 6F22 or equivalent).

2708 Galvanometer



2708

113 x 106 x 46 mm 0.4 kg
(4-1/2 x 4-1/4 x 1-7/8" 0.9lbs)

Model 2708 Galvanometer is a compact pointer type with a quick response (2 seconds). It employs a shock- and vibration-proof taut-band suspension system. This unit is also suitable for classroom applications.

- 0.9 $\mu\text{A}/\text{div.}$, 270 $\mu\text{V}/\text{div.}$ sensitivity
- Quick response – 2 seconds
- Shock- and vibration-proof taut band suspension system
- Compact and lightweight (0.4 kg)
- Can be tilted to any desired angle with accessory stand

Current Sensitivity: 0.9 $\mu\text{A}/\text{div.}$ $\pm 10\%$
Voltage Sensitivity: 270 $\mu\text{V}/\text{div.}$ $\pm 15\%$
Response Time: Approx. 2 secnds.
External Critical Resistance: 200 Ω .

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Yokogawa M&C Corporation

World Wide Web site at
<http://www.yokogawa.com/MCC>

NOTICE

- Before using the product, read the instruction manual carefully to ensure proper and safe operation.

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