

Valhalla Scientific, Inc.

Models 2724A Resistance Standard (Specifications)

The accuracy specifications below are valid for the indicated period of time from the date of calibration. Accuracies are valid at the calibration temperature $\pm 5^{\circ}\text{C}$ for calibration temperatures within the range of 15°C to 30°C , following a 1 hour warm-up. Add 21 ppm for Valhalla's traceability uncertainty to the National Institute of Standards and Technology (NIST). The specifications apply to connections using the full 4-wire configuration only. For 2-wire operation, add $\pm 40\mu\text{V}$.

2724A Active Slow-Mode Specifications

Resistance Range (Ω)	Accuracies (ppm of setting)			Stability (DC to 1Hz)	
	90 Days	180 Days	360 Days	24 Hour	1 Year
0 to 120 ^[1]	$\pm 7\text{ppm} \pm 2\text{m}\Omega$	$\pm 9\text{ppm} \pm 3\text{m}\Omega$	$\pm 11\text{ppm} \pm 4\text{m}\Omega$	$\pm 2\text{ppm}$	$\pm 10\text{ppm}$
.12K to 1.2K	$\pm 7\text{ppm} \pm 7\text{m}\Omega$	$\pm 9\text{ppm} \pm 9\text{m}\Omega$	$\pm 11\text{ppm} \pm 11\text{m}\Omega$	$\pm 2\text{ppm}$	$\pm 10\text{ppm}$
1.2K to 12K	$\pm 7\text{ppm} \pm 50\text{m}\Omega$	$\pm 9\text{ppm} \pm 63\text{m}\Omega$	$\pm 11\text{ppm} \pm 75\text{m}\Omega$	$\pm 2\text{ppm}$	$\pm 10\text{ppm}$
12K to 120K	$\pm 7\text{ppm} \pm 500\text{m}\Omega$	$\pm 9\text{ppm} \pm 630\text{m}\Omega$	$\pm 11\text{ppm} \pm 750\text{m}\Omega$	$\pm 2\text{ppm}$	$\pm 10\text{ppm}$
120K to 1.2M	$\pm 12\text{ppm} \pm 5\Omega$	$\pm 15\text{ppm} \pm 7\Omega$	$\pm 18\text{ppm} \pm 9\Omega$	$\pm 2\text{ppm}$	$\pm 10\text{ppm}$
1.2M to 12M	$\pm 20\text{ppm} \pm 50\Omega$	$\pm 25\text{ppm} \pm 63\Omega$	$\pm 30\text{ppm} \pm 75\Omega$	$\pm 2\text{ppm}$	$\pm 10\text{ppm}$
12M to 120M	$\pm 40\text{ppm} \pm 1\text{K}\Omega$	$\pm 50\text{ppm} \pm 1.5\text{K}\Omega$	$\pm 60\text{ppm} \pm 2\text{K}\Omega$	$\pm 500\Omega$	$\pm 50\text{ppm}$
.12G to 1.2G	$\pm 0.1\% \pm 50\text{K}\Omega$	$\pm 0.15\% \pm 63\text{K}\Omega$	$\pm 0.2\% \pm 75\text{K}\Omega$	$\pm 50\text{K}\Omega$	$\pm 50\text{ppm}$
1.2G to 11G	$\pm 0.1\% \pm 5\text{M}\Omega$	$\pm 0.15\% \pm 6.3\text{M}\Omega$	$\pm 0.2\% \pm 7.5\text{M}\Omega$	$\pm 5\text{M}\Omega$	$\pm 0.05\%$

[1] Specified up to 30mA. Above 30mA add $\pm 0.15\text{ppm}$ per milliwatt to the accuracy specification.

Resistance Range (Ω)	Test Current		Temperature Coefficient	Settling Time	
	Min	Max		Change in Test I	Change in Ω
0 to 120	500 μA	120mA	1.5ppm/ $^{\circ}\text{C}$	2 seconds	2 seconds
.12k to 1.2k	50 μA	12mA	1.5ppm/ $^{\circ}\text{C}$	2 seconds	2 seconds
1.2k to 12k	5 μA	1.2mA	1.5ppm/ $^{\circ}\text{C}$	2 seconds	2 seconds
12k to 120k	500nA	120 μA	1.5ppm/ $^{\circ}\text{C}$	2 seconds	2 seconds
120k to 1.2M	50nA	12 μA	3ppm/ $^{\circ}\text{C}$	2 seconds	2 seconds
1.2M to 12M	5nA	1.2 μA	5ppm/ $^{\circ}\text{C}$	3 seconds	2 seconds
12M to 120M	500pA	120nA	15ppm/ $^{\circ}\text{C}$	4 seconds	2 seconds
.12G to 1.2G	50pA	12nA	15ppm/ $^{\circ}\text{C}$	6 seconds	3 seconds
1.2G to 11G	5pA	1.2nA	15ppm/ $^{\circ}\text{C}$	15 seconds	5 seconds

* This is 12mA maximum if Option CPR is installed.

2724A Active Fast-Mode Specifications

Resistance Range (Ω)	Accuracy	Settling Times		Maximum Test Current (I)	Temp Coeff (Ω per $^{\circ}\text{C}$)	Freq Resp ^[2]
		Change in Test I	Change in Value			
0 to 120 ^[1]	$\pm 0.04\Omega$	0.1ms	5ms	120mA	0.006	3kHz
.12K to 1.2K	$\pm 0.4\Omega$	0.1ms	5ms	12mA	0.06	3kHz
1.2K to 12K	$\pm 4\Omega$	0.1ms	5ms	1.2mA	0.6	3kHz
12K to 120K	$\pm 40\Omega$	0.2ms	5ms	120 μA	6	2kHz
120K to 1.2M	$\pm 400\Omega$	1ms	5ms	12 μA	60	500Hz
1.2M to 12M	$\pm 6\text{K}\Omega$	10ms	10ms	1.2 μA	600	50Hz
12M to 120M	$\pm 60\text{K}\Omega$	500ms	100ms	120nA	6K Ω	[3]
.12G to 1.2G	$\pm 600\text{K}\Omega$	5 seconds	2 seconds	12nA	60K Ω	[3]
1.2G to 12G	$\pm 6\text{M}\Omega$	15 seconds	5 seconds	1.2nA	600K Ω	[3]

[1] Specified at 30mA. Above that add $\pm 0.15\text{ppm}$ per milliwatt to the accuracy specification.

[2] Maximum frequency of test current. Additional error of up to 0.05% at maximum frequency.

[3] These ranges unspecified for AC.

2724A CPR Mode Specifications (Slow or Fast Mode)

Cardinal Point Resistance	Accuracies (Deviation from displayed value)			Stability (DC to 1Hz)	
	90 Days	180 Days	360 Days	24 Hour	1 Year
100Ω nom.	±7ppm ±2mΩ	±9ppm ±3mΩ	±11ppm ±4mΩ	±2ppm	±10ppm
1KΩ nom.	±7ppm ±7mΩ	±9ppm ±9mΩ	±11ppm ±11mΩ	±2ppm	±10ppm
10KΩ nom.	±7ppm ±50mΩ	±9ppm ±63mΩ	±11ppm ±75mΩ	±2ppm	±10ppm
100KΩ nom.	±7ppm ±500mΩ	±9ppm ±630mΩ	±11ppm ±750mΩ	±2ppm	±10ppm
1MΩ nom.	±12ppm ±5Ω	±15ppm ±7Ω	±18ppm ±9Ω	±2ppm	±10ppm
10MΩ nom.	±20ppm ±50Ω	±25ppm ±63Ω	±30ppm ±75Ω	±2ppm	±15ppm

CPR	Max Test I	Temperature Coefficient	Settling Time	
			Fast Mode	Slow Mode
100Ω	12mA	1.5ppm/°C	0.1ms	100ms
1kΩ	12mA	1.5ppm/°C	0.1ms	100ms
10kΩ	1.2mA	1.5ppm/°C	0.1ms	100ms
100kΩ	120μA	1.5ppm/°C	0.1ms	100ms
1MΩ	12μA	3ppm/°C	0.3ms	1 sec
10MΩ	1.2μA	5ppm/°C	3ms	5 sec

Miscellaneous Specifications

Output Configuration:

Selectable 2-wire or 4-wire low thermal EMF terminals; front and rear provided in parallel

Leakage Current:

±2pA ±0.2pA/°C

Maximum Noise and Thermals (4-wire mode):

	DC to 10Hz	10Hz to 10kHz
Standard Mode:	±4μV	±40μV
Fast Mode:	±30μV	±300μV
CPR Mode:	±2μV	±20μV

Environmental and Physical Specifications

Dimensions:

89mm (3.5")H x 432mm (17")W x 432mm (17")D

Weights:

7.2 kg (16 lb) net, 10.5kg (23 lb) shipping

Power Requirements:

115 or 230VAC ±10% @ 50 to 400Hz; 50VA max

Temperature:

Operating: 0°C to 50°C
Storage: -30°C to 70°C

Humidity:

Up to 70% RH at 40°C (non-condensing)