



### 7334 SERIES FEATURES

- ◆ Typical AC/DC Error <1.0 ppm at 1kHz
- ◆ Stability < 2.5 ppm/Year
- ◆ Temperature Coefficient < 0.2 ppm/°C
- ◆ Oil or Air Baths not Required
- ◆ Resistance Range 1 Ω to 10k Ω
- ◆ Either Binding Posts or optional BNC style Connectors are available
- ◆ Compact and Ruggedized
- ◆ Nominal Accuracy < 2 ppm
- ◆ Voltage Hysteresis < 0.1 ppm
- ◆ Report of Calibration Traceable to NMIs Included
- ◆ Guard and Shield Compliant
- ◆ Operating Range 18 °C to 28 °C
- ◆ Special Values Available On Request

GUILDLINE INSTRUMENTS 7334 SERIES of Resistance Standards are designed for high accuracy resistance calibration in air, without the need for stabilization in a temperature controlled bath. These standards are suitable for both AC and DC applications.

They can be used as working standards or highly reliable and rugged transfer standards. They are extremely useful as references for AC Temperature Bridges, for the calibration of resistance ranges of multi-function calibrators and high accuracy DVMs, as well as being used in more classical standards and calibration in resistance measurements.

Hysteresis error is typically better than to 0.1 ppm when stressed at 3 times the maximum voltage, and less than 0.3 ppm over a temperature cycle between 0°C & 40°C.

Connections to these resistance standards are made via gold plated 5-way binding posts. In DC measurement, these gold plated binding posts yield the lowest thermal EMF when connected with gold, copper or silver. BNC connectors are also available upon request.

***The 7334 Series Precision Resistance Standards are True AC/DC Standards with Essentially NO AC/DC Error Up to 1 kHz, and are Available in a Wide Range of Standard and Custom Values.***

The impedance of the resistor is expressed as:

$$Z(f) = R(f) \cdot (1 + j2\pi f\tau)$$

Where R(f) is the real part of the impedance, f is the frequency in Hz and  $\tau$  is the time constant of the standard. Parameter R(0) is the resistance measured with DC energisation. The 7334 standards have very flat frequency response.

The resistive component is virtually independent of frequency, with typically less than 1.0 ppm of AC/DC difference between DC and 1000 Hz. The 7334 series of standards are almost purely resistive with very small time constant. For a 7334-100 Ω, the time constant is typically less than 10 ns.

## 7334 SERIES OF AC/DC PRECISION RESISTANCE STANDARDS

The AC/DC difference is so insignificant that it is almost negligible, when compared to measurement noise. A user can confidently use the Guildline 7334 Series for DC resistance calibration, as a reference with an AC temperature bridge, as an AC impedance standard, or elsewhere in AC/DC metrology that calls for a stable, precision standard.

Special values such as 0.25 Ω, 25 Ω, 300 Ω, 400 Ω and 2.9064 kΩ and others are available. Of interest is not only the 7334 elements available in a single "Air" Case configuration as shown on the first page, but Guildline has also put the 7334 elements in an enclosed "Temperature Chamber (TC)" 6634A Style Case. The following 7334TC was built for Temperature Measurement and Source applications such as calibration of Fluke Super Thermometers and for use with ASL AC Temperature Bridges. The 10 element sets in this unit are (2 x10 Ω), (2 x 25Ω), (2 x100 Ω), (2 x300 Ω), and (2 x 400 Ω).



Note that these sets shown, when calibrated by an independent **National Measurement Institute (NMI)**, were reported as "Element Value" White and "Element Value" Black. The results are very impressive as per the following Calibration Report and explanation.

Resistor	Current	Frequency	$\delta(f)$	$U(\delta)$	Resistor	Current	Frequency	$\delta(f)$	$U(\delta)$
400 Ω white	1.5 mA	60 Hz	-0.3 μΩ/Ω	3.2 μΩ/Ω	25 Ω white	6.3 mA	60 Hz	-0.4 μΩ/Ω	2.9 μΩ/Ω
		90 Hz	+0.2 μΩ/Ω	3.2 μΩ/Ω			90 Hz	+0.2 μΩ/Ω	2.8 μΩ/Ω
400 Ω black	1.5 mA	60 Hz	+0.1 μΩ/Ω	3.2 μΩ/Ω	300 Ω white	1.8 mA	60 Hz	-0.3 μΩ/Ω	3.2 μΩ/Ω
		90 Hz	-0.2 μΩ/Ω	3.2 μΩ/Ω			90 Hz	-0.1 μΩ/Ω	3.2 μΩ/Ω

**Definition of the calibrated quantity**

The ac-dc difference of the magnitude of the impedance  $\delta(f)$  is defined as

$$\delta(f) = \frac{|Z|_{ac} - R_{dc}}{R_{dc}}$$

where:  $|Z|_{ac}$  is the magnitude of the impedance measured with ac current and  $R_{dc}$  is the resistance measured with dc current.

**Measurement uncertainties**

The uncertainty  $U(\delta)$  stated is the expanded measurement uncertainty obtained by multiplying the standard measurement uncertainty by the coverage factor  $k = 2$ . It has been determined in accordance with the "Guide to the Expression of Uncertainty in Measurement (GUM)". The value of the measurand then normally lies, with a probability of approximately 95 %, within the attributed coverage interval.

The Temperature Chamber (TC) allows the precision resistance standards to be enclosed in a highly stable environment for temperature and Electronic Magnetic Interference (EMI). Each resistance element is isolated and has a 4 terminal connection at the back panel. The resistance elements are maintained at  $30 \pm 0.01$  °C in this temperature stabilized chamber. A minimum of 4 elements to a maximum of 10 elements must be ordered in a temperature chamber configuration.

## ***7334 SERIES OF AC/DC PRECISION RESISTANCE STANDARDS***

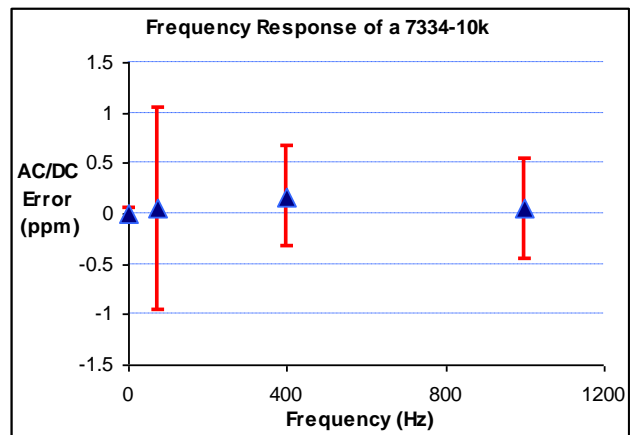
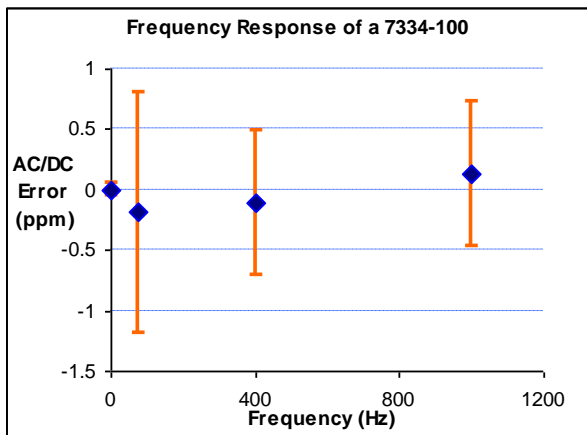
By placing the elements in a chamber, the temperature coefficient (affects due to Laboratory Environment) is reduced by a **factor of 40 times**. This means temperature is not an impact on measurements when used is just about any standard Metrology Laboratory running  $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ . For example, in Air, a 100 ohm element has a temperature coefficient of 0.2 ppm/ $^{\circ}\text{C}$  (which is the best of all manufacturers), but placing the same element in the Temperature chamber, reduces this coefficient to 0.005ppm/ $^{\circ}\text{C}$ .



Even for element in the Air Enclosure (shown), the results are impressive. Examine the following graphs for a 7334-100  $\Omega$  and a 7334-10 k $\Omega$  Air Element that was calibrated at the National Physical Laboratory (NPL) in the UK (NMI). Both Air Standards show exceptional results.



### AC/DC error of a 7334-100 $\Omega$ and a 7334-10 k $\Omega$ , calibrated by the National Physical Laboratory (NPL) of UK



7334 AND 7334TC GENERAL SPECIFICATIONS									
<b>Environmental</b>	Temperature				Humidity				
Operating	18 $^{\circ}\text{C}$ to 28 $^{\circ}\text{C}$				<70% RH non-condensing				
Storage	-20 $^{\circ}\text{C}$ to 60 $^{\circ}\text{C}$				15% to 80% RH				
<b>Dimensions</b>	Height		Width		Length		Weight		
	mm	Inches	mm	Inches	mm	Inches	kg	lbs	
Air (All Values)	88	3.8	124	4.9	79	3.1	0.6	1.4	
Temperature Chamber (TC) Model	132	5.2	440	17.4	503	19.8	11	24	
Power (TC Model Only)	VAC: 100, 120, 220, 240V $\pm$ 10%, Frequency: 50/60 Hz $\pm$ 10%, 15 VA Maximum								

# 7334 SERIES OF AC/DC PRECISION RESISTANCE STANDARDS

## SERIES SPECIFICATIONS

Model (Nominal $\Omega$ )	Nominal Value ( $\Omega$ )	Initial <sup>1</sup> Tolerance $\pm$ ppm	Stability 12 Months $\pm$ ppm	Typical AC/DC Difference @ 1kHz ( $\pm$ ppm)	Maximum Excitation (mA)	Temperature Coefficient <sup>3</sup> $\pm$ ppm/ $^{\circ}$ C	
						Air	(TC) Chamber
<b>7334-1</b>	1	2	2.5	<3.0	316	1	0.025
<b>7334-2.5</b>	2.5	2	2.5	<3.0	200	1	0.025
<b>7334-10</b>	10	2	2.5	<1.0	100	0.2	0.005
<b>7334-25</b>	25	2	2.5	<1.0	64	0.2	0.005
<b>7334-100</b>	100	2	2.5	<1.0	32	0.2	0.005
<b>7334-300</b>	300	2	2.5	<1.0	19	0.2	0.005
<b>7334-400</b>	400	2	2.5	<1.0	16	0.2	0.005
<b>7334-1k</b>	1k	2	2.5	<1.0	10	0.2	0.005
<b>7334-10k</b>	10k	2	2	<1.0	3.2	0.2	0.005
Special Values Available On Request							

- Note 1:** Nominal initial tolerance is defined as the maximum variation of resistance mean values as initially adjusted at the point of sale.
- Note 2:** Calibrated under DC excitation, in air at 21, 23 and 25  $^{\circ}$ C referred to the unit of resistance as maintained by a NMI, and expressed as a total uncertainty with a coverage factor of  $k = 2$ . A traceable report of calibration stating the measured values and uncertainty is provided with each resistor.
- Note 3:** Temperature hysteresis: < 0.3 ppm between 0  $^{\circ}$ C and 40  $^{\circ}$ C and Voltage hysteresis: negligible to < 0.1 ppm. When placed inside a enclosed Temperature Chamber (7334TC), the temperature coefficient is reduced by a factor of x40 (eg 10k would = 0.005 ppm/ $^{\circ}$ C).

**For DC Resistance Standards, please refer to the Guildline 9334A, 9336, 9336, 6634A and 6636 Series of Standards.**

### ORDERING INFORMATION

7334-Value	Resistance Standard (List Ohmic Value) with Binding Posts
7334-Value/BNC	Resistance Standard (List Ohmic Value) with BNC Connectors
7334TC-X (# Elements)	Resistance Standard (List Ohmic Values) in Temperature Chamber
/CC	Certificate of Calibration Included
/RPT	Report of Calibration Included (Non-Accredited)
/RPT 17025	Report of Calibration NMI Accredited (Optional/Charge)
/TM7334	Technical Manual (included)
7334-12	SCW lead pair with gold plated banana plugs, 1.5m in length
73340-2	Copper conductors and guard, trimmed ends, xm in length Teflon insulated lead with 4 stranded silver coated
73340-BNC	Teflon insulated lead with 4 stranded silver coated BNC connectors and guard, trimmed ends, 2m in length

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