

High to Ultra High Value Series of Temperature Controlled Resistance Standards



**Guildline Instruments 6636 Series** is a modular series of Temperature Stabilized Resistance Standards that can be rack mounted or simply set on a bench. The 6636 Series provides a logical extension to the popular 6634A series of Temperature Stabilized Resistance Standards.

**THE 6636 UNIQUE DESIGN ALLOWS PRIMARY LABORATORIES TO SIGNIFICANTLY ENHANCE THEIR HIGH TO ULTRA HIGH VALUE RESISTANCE MEASUREMENT UNCERTAINTIES**

The 6636 can be configured with up to 6 standard decade resistance values available covering the range of 10 M $\Omega$  to 100 T $\Omega$ . Each resistance element is isolated and has an N-type terminal connection at the back panel. Special resistance and decade values are available in the range of 10 M $\Omega$  to 100 T $\Omega$ . All models purchased with less than 6 resistance standards can be expanded at any time with a factory upgrade.

### FEATURES

- Resistance Range: 10 M $\Omega$  to 100 T $\Omega$  In Single Decade Increments
- Temperature Coefficients as low as  $\pm 0.2$  ppm/ $^{\circ}$ C
- Stabilities as low as  $< 6$  ppm/year
- N-Type Design Ensures Low Noise Connections
- Eliminates Air and Oil Bath Requirements
- Ambient Temperature Range:  $23^{\circ}$ C  $\pm 5^{\circ}$ C
- Internal PRT Stability:  $\pm 0.02^{\circ}$ C / Year
- Custom Internal Temperature Set Points
- Low Thermal EMF's – Shielded Chamber
- Temperature Regulation:  $\pm 0.01^{\circ}$ C Over a 1 Year Period
- Guarded Resistance Element Chamber
- Custom Values / Models Available
- CE Marked with World-Wide Voltage and Frequencies Available

High and Ultra High Resistance Standards have inherently large temperature coefficients associated with them, the effect of which is greatly reduced by placing them in a  $30^{\circ}$ C temperature stabilized chamber. Chamber temperature set points of  $35^{\circ}$ C and  $40^{\circ}$ C are available on request.

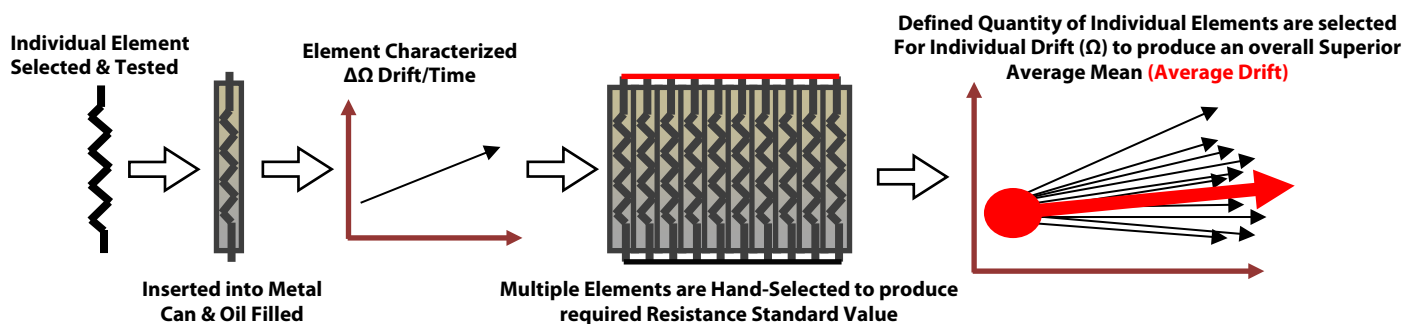
The Temperature monitoring is provided by a precision PRT sensor installed in the chamber. The 6636 can be used in a wide ambient temperature range of  $23^{\circ}$ C  $\pm 5^{\circ}$ C without adding material uncertainty effects for temperature. By maintaining a highly controlled temperature environment around the elements, the uncertainty of these values is significantly reduced. For example, the 6636-100G Resistance Standard temperature coefficient element is 25x better than a Standard Air Resistor of the same value for even a tight laboratory environment control of  $1^{\circ}$ C. The 6636 is designed to allow primary Laboratories to significantly enhance their Accreditation uncertainties associated with high resistance.

# 6636 Series of Temperature Stabilized Resistance Standards

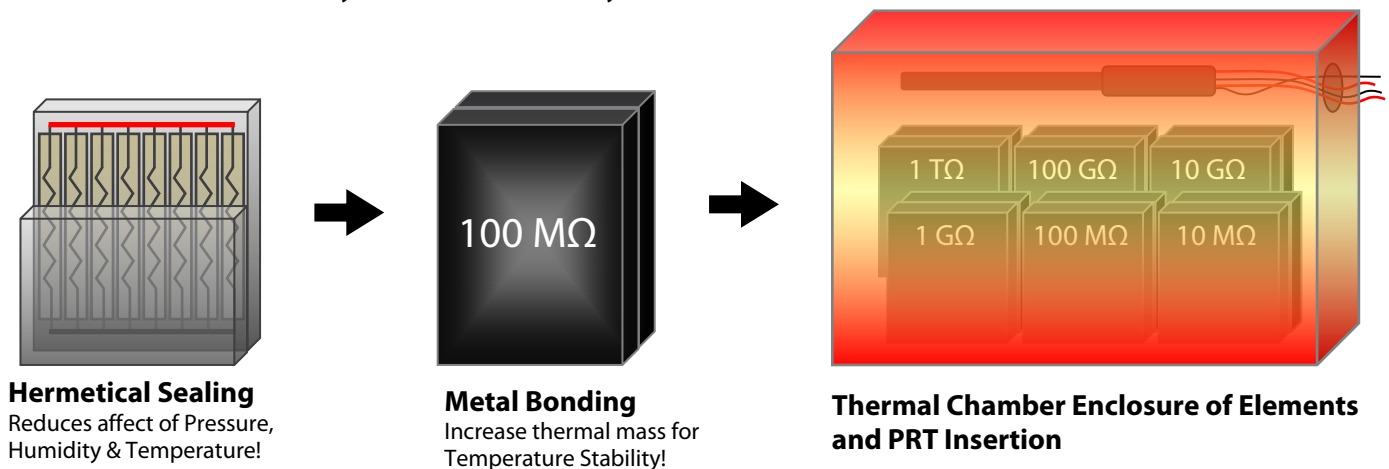
The design of Guildline's 6636 Series Resistance Standards is **based on over 60 years** of innovation, design **knowledge**, and **manufacturing experience** in building resistance standards. Guildline Standards are the best by design and by manufacture.

One key advantage of Guildline Resistance Standards is that each Resistance Value is **made up from multiple resistance elements**, not just a single element which is the technique used by most manufacturers. This approach **lowers the drift** that is seen with a single element and reduces the internal noise generated inside the reference resistor. Some other advantages are the **use of a PRT** vs a thermistor for **internal temperature control**, and the Guildline 6636 Standard **does not require any fans** like competitive models. The result is **industry leading annual drift** rates and **very quiet** measurements.

The **design starts** with every resistance element going through an exacting process that ensures quality and long term stability. This **process is diagrammed** as shown:



After the elements have been characterized, selected and assembled, the elements are then encased and hermetically sealed. This **dramatically reduces the affect of humidity and pressure**. Then, to ensure thermal stability, the entire sub-assembly is metal bonded. These elements are built up, electrically isolated, and inserted into a Temperature Controlled Chamber as per the following diagrams. The PRT is then added to monitor the temperature and provide feedback control for **stability within  $\pm 0.01$  °C**. These design attributes result in **extremely small temperature coefficients** – even in a loosely controlled laboratory environment.

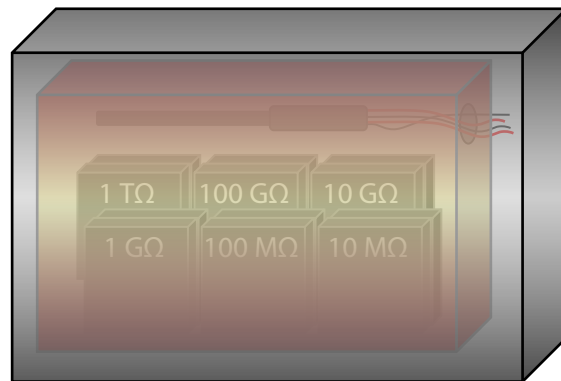


**This 6636 multi-element design is unique to Guildline.** Other manufactures say they also use a multi-resistor design, but in reality their design is actually a single main element (e.g. 100 MΩ) with multiple inexpensive TRIM resistors used to get close to the nominal value. However they misleadingly state that they use a multi-resistor design! This is a totally different and much cheaper design and the result is a more unstable resistor with poor secondary performance - even though on paper their specifications are often stated to match Guildline's.

# 6636 Series of Temperature Stabilized Resistance Standards

Another consideration is Electro-Magnetic Interference (**EMI**) or Radio Frequency (**RF**) impact on the performance of 6636 resistance elements. The entire Temperature (Thermal) Chamber, with all the elements, is placed inside another **EMI/RF Enclosure**. By incorporating an enclosed shielded chamber, coupled along with a **tightly controlled temperature environment**, measurement **uncertainties** can be **significantly controlled and reduced** for the first time in high to ultra high value resistance standards.

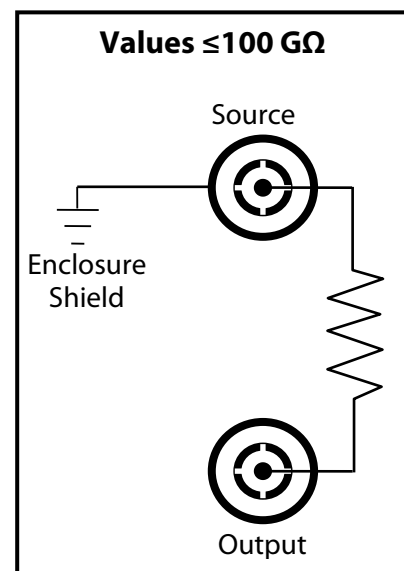
The resistor elements are **securely mounted** to the inside of a **hermetically sealed** aluminum enclosure. As previously stated, the resistance element itself is composed of multi-resistors, and encapsulated in a bonding material selected for its resistance to humidity and barometric pressure.



**EMI/RF Chamber Enclosure**

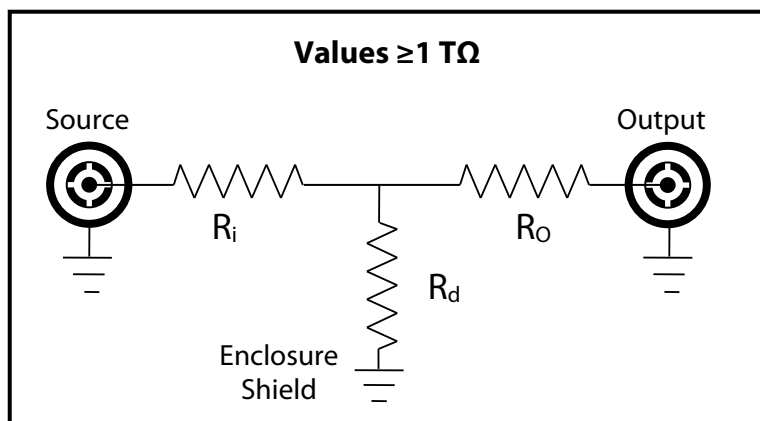
**For Resistance values to 100 GΩ**, a pair of input/output **Type N connectors** provides the termination for the standard. The "SOURCE" terminal connects to the supply of the measurement system, while the "OUTPUT" terminal connects to the measurement/detector. This layout schematic is shown to the right.

**For Resistance values >100 GΩ**, the input and output terminals are still the same type of "**N**" connectors as the lower values, but the elements are configured in a different design. 1 TΩ and above elements use a 3 terminal design that **minimizes the effect of current leakages** from the source and output connectors. The high stability is achieved by use of a resistance divider network. Note in the diagram below, Resistor Values  $R_i$  (Source Resistor) and  $R_o$  (Output Resistor) are actually composed and built as described for the 3 terminal design.



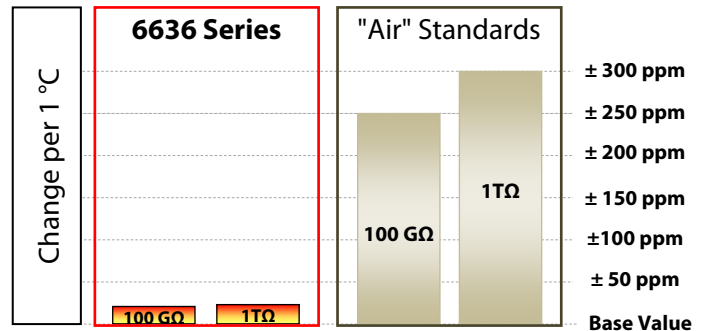
The Divider Resistor ( $R_d$ ) is a very high precision resistor used to adjust the values of the Input and Output Resistors (i.e.  $R_i$  and  $R_o$ ) to give the desired nominal value. This design provides for a **very high quality and stable** standard and is **not as reactive to environmental** parasites as typically found in other high value resistance standards. This configuration (shown right) is also sometimes referred to as a delta-wye configuration.

This divider network design **produces excellent measurement and highly stable results** when used with **ultra-precise** High Resistance Measurement Standards such as **Teraohmmeters** and **Active Arm (Dual Source) Bridges**.



## 6636 Series of Temperature Stabilized Resistance Standards

High to Ultra-High Resistance standards cannot be placed in oil (i.e. the insulation property of oil is not high enough). Hence, one of the biggest advantages a customer achieves with Guildline's Temperature Stabilized Resistance Standards is the **control of the temperature around the elements**. The internal temperature chamber will regulate at set-point to a stability of  $\pm 0.01\text{ }^\circ\text{C}$  as long as the laboratory environmental temperature is  $23\text{ }^\circ\text{C} \pm 5\text{ }^\circ\text{C}$ . This means the Temperature Coefficient of the resistance element, which can be as large an uncertainty contribution as the annual drift itself, is now **substantially reduced** - even in a more loosely controlled laboratory when compared to Precision Air Resistance Standards. The chart to the right shows the **affect of only a single (1 °C) change** in the laboratory's environment. The 6636 Values will not change anymore than shown, even for a 5 °C change in the laboratory environment!



**Multiple Element Build - Element Sealing and Bonding - Excellent Temperature Control - EMI Shielded** - No other Resistance Standard today can match the 6636's performance when used with Electrometers, Teraohmmeters, TeraOhm Bridge-Meters, Active Arm Bridge Systems, Dual Source Bridges or other High Resistance Measurement Instruments. In addition to the performance of the 6636 Series of Temperature Stabilized Resistance Standards, Guildline provides other standards that make the measurement process much more automated and controlled!



Check out **Guildline's 6564 High to Ultra-High Resistance Scanners!** These Scanners are the first commercial scanners capable of **operating with measurement capabilities** to  $10\text{ }^\Omega$  ( $10^{16}$ ) and at voltages to 1000 Vdc. This capability has never previously been commercially available, and will greatly improve the measurement and calibration throughput of high and ultra-high ohm resistors now that standard laboratories can easily and quickly **automate single and multiple** high to ultra-high resistance measurements. The 6564 Series Scanners provides  $>10^{16}$  isolation, measurements to  $10\text{ }^\Omega$ , and with voltages up to 1000 V with no guarding required!

If-fact, the **6636 Temperature Stabilized Resistance Standard** is the recommended Resistance Standard called out for in the most highly automated, easiest to use, high resistance measurement system commercially available today - the **6535 High to Ultra-High Resistance Measurement System!**

You can see the how the 6636 Series is incorporated with the previously mentioned 6564 Scanner. Add in any of our **6530 TeraOhm Bridge-Meters** and you have the most accurate and automated High to Ultra-High Resistance Measurement and Source Systems available from anyone!

The **6535 System's unique design and modularity** allows customers to purchase what they need today and be assured of an upgrade path to support future requirements. The System is delivered in a single rack, fully wired, tested, integrated and ready for use with an installed 6636 Resistance Standard, a 16 Channel 6564 High Resistance Scanner, and the 6530 TeraOhm Bridge-Meter. The System's total height **is less than 10U or  $\approx 18$  inches or 46 cm total height.**





# 6636 Series of Temperature Stabilized Resistance Standards

## 6636 Specifications

Nominal Resistance ( $\Omega$ ) <sup>1</sup>	Nominal Initial Tolerance <sup>2</sup> (+/- ppm)	12 Month Stability <sup>3</sup> (+/- ppm)	Temperature Coefficient (+/- ppm/°C)	Maximum Voltage ( $V_{dc}$ )
10 M	35	6	0.2	1000
100 M	50	15	0.2	1000
1 G	100	35	0.2	1000
10 G	200	100	1	1000
100 G	500	200	10	1000
1 T	1000	500	15	1000
10 T	3500	750	25	1000
100 T	6000	1000	35	1000

**Note 1:** For Values  $\geq 1$  T $\Omega$ , configuration is a divided network as described in this data sheet.

**Note 2:** Nominal initial tolerance is defined as the maximum variation of resistance mean values as initially adjusted at the point of sale.

**Note 3:** Stability is exclusive of the effects of applying power above 20 mW, but not exceeding the maximum voltage, in terms of hysteresis and short term temperature stabilization.

**Calibration Note:** Calibrated in air at 23 °C traceable to the SI unit of electric resistance. Calibration uncertainties expanded and expressed at the 95 % level of confidence. An ISO/IEC 17025 accredited certificate and report of calibration stating the calibrated value and estimated uncertainty is provided with each resistor.

GENERAL SPECIFICATIONS								
<b>Temperature Stability</b> ▶		± 0.01 °C over 1 year, exclusive of self heating effects of the resistors						
<b>Resistance Range</b> ▶		10 M $\Omega$ to 100 T $\Omega$ . (Special values between 10 M $\Omega$ and 100 T $\Omega$ available at time of order.) For lower values see Guidline 6634A Series.						
<b>PRT Sensor</b> ▶	Temperature Set-point	Stability (1 Year)		Resistance		Scale		
	30 °C ± 0.5 °C	± 0.02 °C		100 $\Omega$ ± 0.1 % at 0 °C		(0-100 °C) 0.392 $\Omega$ /°C		
<b>Power Requirements</b> ▶	VAC: 100, 120, 220, 240 V ± 10 %		Frequency: 50/60 Hz ± 10 %		15 VA Maximum			
<b>Environmental</b> ▶	Operating	18 °C to 28 °C, < 50 % RH, non-condensing						
	Storage	-20 °C to 60 °C, < 90 % RH, non-condensing						
<b>Dimensions Rack Mount</b>	Height (Bench Top Adder)		Width		Depth		Weight (Bench Top Adder)	
	132 mm (142 mm)	5.2 in (5.6 in)	440 mm	17.4 in	503 mm	19.8 in	9.4 kg (11 kg)	20.7 lbs (24 lbs)

ORDERING INFORMATION	
6636-6/Range	Six Element Decade Standard (Specify Decade Range)
6636-5/Range	Five Element Decade Standard (Specify Decade Range)
6636-4/Range	Four Element Decade Standard (Specify Decade Range)
6636/SSRV	Single element substitution of any decade value
6636/SPRV	Single element substitution of any special value
/TM6636	Technical Manual (Included)
/ST-X	Optional Internal Temperature Set point (Specify 35 °C or 40 °C)
Note: ISO/IEC 17025 Report of Calibration and Calibration Certificate Included	
* Precision Leads Are Available – Call for more information!	

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