DATA SHEET

SR104

Transportable Resistance Standard

- **10 kilohms value for accurate transfers**
- **Temperature coefficient 0.1 ppm per °C**
- **Stability 0.5 ppm per year after second year**
- **Accuracy 3 ppm initial; 1 ppm calibration accuracy**
- **Traceability test report provided**
- **5-Terminal construction for guarded 4-terminal calibrations**
- **Internal temperature sensor facilitates precise measurement**

The Model SR104 is a totally portable calibration standard. It consists of a 5-terminal resistor configuration plus an internal temperature sensor, hermetically sealed inside an oil-filled container. The container is insulated from the outside case to provide additional thermal lag. Included with each instrument is an ESI test report giving temperature coefficient data and resistance calibration traceable to the standards maintained by the National Bureau of Standards in Washington, D.C.

Establishing a reference level at 10kΩ instead of the traditional 1Ω, the Model SR104 offers a substantial improvement in accuracy and stability at the working resistance level.

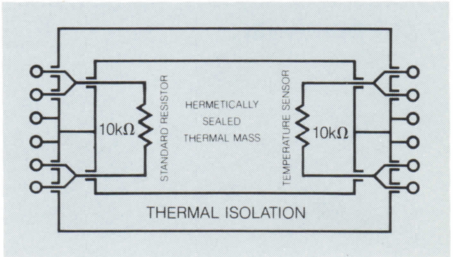
The 10kΩ value places the standard in the center of the commonly used resistance range, an even four decades away from 1Ω and four decades from 100MΩ. Accurate transfers can be made using the 100:1 transfer technique embodied in ESI's SR1010 and SR1050 Resistance Transfer Standards. With the Model SR104 and these transfer standards, high-value resistance to 1,000MΩ can be precisely determined.

The 10kΩ value is not seriously affected by typical lead resistances, contact resistances and parallel leakage resistances. Many of the critical resistances in modern instrument design are centered around this value. A 10kΩ standard, close to the unknown in these cases, makes calibration easier. The five-terminal construction allows four-terminal measurements to eliminate lead and contact resistance effects, while the fifth terminal provides guarding to cancel insulation resistance effects.

The 10kΩ value is a good impedance match to bridges such as ESI's Model 242D Resistance Measuring System. This results in better measurement precision due to reduced power dissipation and improved signal-to-noise ratio.

Model SR104 also offers an extremely low temperature coefficient. This facilitates precise laboratory comparisons without critical environmental control.

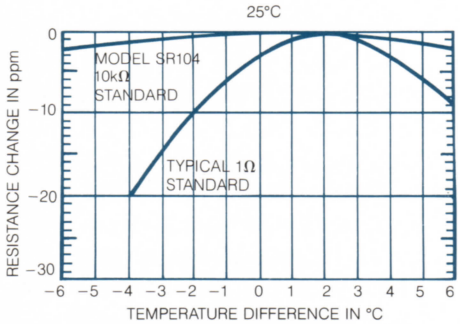
An ideal 1Ω standard should have its point of zero temperature



coefficient at 25°C as this is the temperature where most oil baths are maintained. In actual practice, however, the typical 1Ω standard will not be stable if its peak temperature is lower than 26°C. In fact, 27°C is a more typical peak for good commercial units with many having peaks above 30°C.

By referring to the comparison graph it can be seen that at 25°C a typical 1Ω standard has a temperature coefficient of greater than +2 ppm/°C. This means precise temperature control is needed to make precision resistor measurements ... an expensive and inconvenient requirement.

On the other hand, the SR104 has a temperature coefficient typically less than 0.35 ppm /°C anywhere in the 18° to 28°C range. Since the SR104 has thermal insulation plus an internal temperature sensor, it can be used in air without the inconvenience of precision temperature control and measurement.



Temperature Coefficient Comparison between Model SR 104 and Typical 1 Ohm Standard Resistor

Virtually immune to the thermal and mechanical shock often encountered in commercial transport, its initial accuracy is 3 ppm (1 ppm calibration accuracy), with a stability of 1 ppm/year.

Stability of the SR104 is guaranteed better than ±0.5 ppm/year after two years, based upon continued test results with National Standards Laboratories since 1967. Temperature of the standard is determined by measuring the copper resistance temperature sensor, which has a convenient temperature coefficient of 1000 ppm/°C.

Specifications

Standard Values	10kΩ
Initial Accuracy	±3 ppm
Calibration Accuracy	±1 ppm
Stability	±1 ppm/year the first 2 years; ±0.5 ppm/year thereafter
Power Rating	1W. Momentary 100W overloads will not cause failure.
Breakdown Voltage	500V peak to case
Construction	Matched set of highly stabilized unifilar resistors
Power Coefficient	Less than 1 ppm/W
Dimensions	Height 10.0 in. (25.4cm) Width 8.10 in. (20.57cm) Depth 12.25 in. (31.12cm)
Weight	10.5 lbs (4.73kg) net 12 lbs (5.40kg) shipping
Insulation Resistance	All resistor terminals maintain at least 10^{12} to ground
AC-DC Difference	Does not exceed ±5 ppm from 0 to 1,592Hz.

Temperature coefficient

Alpha (temperature coefficient) better than ±0.1 ppm/°C at 23°C. (SP3958 version: better than ±0.2 ppm/°C at 23°C). Beta (½ rate of change of temperature coefficient) does not exceed +0.03 ppm/°C² over the range of 18°C to 28°C. Performance listed above is as a passive device with no ovens or external power requirements.

Thermal emf

Under normal conditions, thermal emf at the terminals does not exceed ±0.1μV.

Thermal lagging

The resistor is provided with thermal lagging which has time constant of one hour minimum.
$(1 - \frac{1}{e}$ of total change in one hour).

Internal temperature sensor

10kΩ resistor with 1000 ppm/°C temperature coefficient. Thermometer well provided for calibration.

Calibration data

ESI test report supplied with unit gives resistance calibration and temperature coefficient, traceable to standards at NBS in Washington, D.C.

Dielectric soakage effect

Resistance stabilizes to within ±0.1 ppm of final value within 5 seconds with 10V applied to the resistor.

Current reversal

Resistance value changes less than ±0.1 ppm with reversal of current through the resistor.

Termination

5-terminal construction (4-terminal resistor with ground intercept) on both standard resistor and temperature sensor. Dual ground terminals are employed. All terminals are gold plated tellurium copper.

Hermetic sealing

Resistor is completely hermetically sealed in oil with metal-to-glass seals. The resistor changes value less than ±0.1 ppm with normal atmospheric pressure and humidity changes.

Shock

Resistor does not change more than ±0.2 ppm when subjected to 2 drops of 3 feet each to a concrete floor on each of three mutually perpendicular faces (6 drops total).

Packaging

Resistor is mounted in a sturdy white Formica covered box having a removable lid (all exposed outside and inside surfaces and edges are 1/16 in. thick Formica bonded to a wood core). All walls are at least ⅜ in. thick. Corners are braced with ½ in. aluminum angle their entire length and are bonded with epoxy resins under heat and pressure to make a waterproof joint. The lid is mounted with two slip hinges and two latches for sealing when closed. A carrying handle is on the lid.

Standard equipment

Model SR104 includes a 13502 Instruction Manual.

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