

VRS High-Resistance Standards User and Service Manual



VRS im/April 2019

◆ PRECISION INSTRUMENTS FOR TEST AND MEASUREMENT ◆



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Chapter 1

INTRODUCTION

1.1 Introduction

The VRS Series is an economical set of precision high resistance standards in one convenient enclosure. The resistors feature high stability, low temperature coefficient and low voltage coefficient.

The VRS is designed for calibration of megohmmeters and for general calibration and laboratory applications.

A wide range of values is available - from 1 k Ω to 10 T Ω . Operating voltages up to 10 kV may be specified.

Leakage is kept to a minimum by the use of binding posts specially mounted on a Kel-F base.

The VRS Series comes in two available styles to best suit the application of the user. Performance of both styles is the same.

Style 1 shown in Figure 1-1 features:

- A single set of binding posts
- A rotary switch
- A **GROUND** terminal connected to case
- A **GUARD** terminal connected to the body of the switch to virtually eliminate leakage



Figure 1-1: VRS Unit - Rotary Switch Style

Style 2 shown in Figure 1-2 features:

- Individual binding posts for each value
- A **GROUND** terminal connected to case

This style does not require a **GUARD** terminal because it has no metal parts inside the unit.



Figure 1-2: VRS Unit - Binding Post Style

Chapter 2

SPECIFICATIONS

For convenience to the user, the pertinent specifications are given in a typical **OPERATING GUIDE**, like the one shown in Figure 2-1, affixed to the case of the instrument.

2.1 Specifications

Nominal value	Max voltage	Initial adjustment to nominal	Temperature coefficient	Voltage coefficient (\pm ppm/V)	Stability
1 k Ω	50 V	20 ppm	3 ppm/ $^{\circ}$ C	-	10 ppm/year
10 k Ω	150 V	20 ppm	3 ppm/ $^{\circ}$ C	-	10 ppm/year
100 k Ω	500 V	20 ppm	3 ppm/ $^{\circ}$ C	-	10 ppm/year
1 M Ω	1,250 V	20 ppm	5 ppm/ $^{\circ}$ C	<1	15 ppm/year
10 M Ω	5,000 V	50 ppm	25 ppm/ $^{\circ}$ C	<1	20 ppm/year
100 M Ω	5,000 V or 10,000 V	100 ppm	25 ppm/ $^{\circ}$ C	1	100 ppm/year
1 G Ω	5,000 V or 10,000 V	0.50%	25 ppm/ $^{\circ}$ C	1	500 ppm/year
10 G Ω	5,000 V or 10,000 V	0.50%	50 ppm/ $^{\circ}$ C	2	500 ppm/year
100 G Ω	5,000 V or 10,000 V	1%	50 ppm/ $^{\circ}$ C	5	500 ppm/year
1 T Ω	5,000 V or 10,000 V	2%*	100 ppm/ $^{\circ}$ C	<20 (10 ppm typical)	500 ppm/year
10 T Ω	5,000 V or 10,000 V	5%*	300 ppm/ $^{\circ}$ C	<20 (10 ppm typical)	--

* 1 T Ω and 10 T Ω calibrated at 1000 V

Table 2-1: VRS Electrical Specifications

Operating Temperature Range:

18 $^{\circ}$ C to 28 $^{\circ}$ C

Calibration Conditions:

Two-terminal measurements with **GND** (and **GUARD** if applicable), at 23 $^{\circ}$ C, RH <50%, low voltage;

1 T Ω and 10 T Ω calibrated at 1,000 V

Storage Temperature:

0 $^{\circ}$ C to 40 $^{\circ}$ C

Mechanical:

VRS Style	Dimensions	Weight
Rotary Switch	16.7cm W x 16.7cm H x 22.9cm D (6.6" W x 6.6" H x 9" D)	2 kg (4.5 lbs)
Binding Post	31.2cm W x 11.4cm H x 12.7cm D (12.3" W x 4.5" H x 5" D)	

Table 2-2: VRS Mechanical Specifications

Terminals:

The binding posts are constructed of tellurium copper for low thermal emf and low resistance, (relevant only for the low resistances that may be included in the VRS unit.)

Rotary Switch style: Three 5-way binding posts for **H**, **L**, and **GUARD**, along with an additional binding post for **CASE GND**.

Binding Post style: Series of 5-way binding posts for 2-terminal measurement, along with two additional binding posts for case **GND**.

VRS-100 SERIES HIGH RESISTANCE STANDARD OPERATING GUIDE

Nominal value Ω	Max Voltage V	Accuracy	TC ppm/°C	VC ppm/V	Stability per year	Date	Date	Date	Date
1 k	50	20 ppm	3	-	10				
10 k	150	20 ppm	3	-	10				
100 k	500	20 ppm	3	-	10				
1 M	1,250	20 ppm	5	<1	15				
10 M	5,000	50 ppm	25	<1	20				
100 M	5000	100 ppm	25	1	100				
1 G	5000	0.50%	25	1	500				
10 G	5000	0.50%	50	1	500				
100 G	5000	1%	50	5	500				
1 T	5000	2%*	100	<20	500				
10 T	5000	5%*	300	<20	--				
By									
Rec. Due									

MODEL: **VRS-100-9-1k-ROT** SN: **E2-1144334**

Observe all safety rules when working with high voltages or line voltages. Connect the shield to earth ground in order to maintain the case at a safe voltage. Whenever hazardous voltages (>45 V) are used, take all measures to avoid accidental contact with any live components: a) Use maximum insulation and minimize the use of bare conductors. b) Remove power when adjusting the capacitor. c) Post warning signs and keep personnel safely away.

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CAGE CODE: 62015 VRS-100BLBL/p9/VRS-100-9-1K/old style/90%/cat 05-06

Figure 2-1: Typical Operating Guide Affixed to Unit

MODEL INFORMATION

Model Number	Style	Resistance Values	Value Range
VRS-100-9-1k-ROT	Rotary Switch	9 values	1 k Ω to 100 G Ω
VRS-100-10-1k-ROT	Rotary Switch	10 values	1 k Ω to 1 T Ω
VRS-100-9-1k-BP	Binding Post	9 values	1 k Ω to 100 G Ω
VRS-100-10-1k-BP	Binding Post	10 values	1 k Ω to 1 T Ω
VRS-100-11-1k-BP	Binding Post	11 values	1 k Ω to 10 T Ω
VRS-100-X-X-X	Custom Select	Custom Select	Custom Select

Table 2-3: Model Information

Chapter 3

OPERATION

3.1 Initial Inspection and Setup

This instrument was carefully inspected before shipment. It should be in proper electrical and mechanical order upon receipt.

An **OPERATION GUIDE** is attached to the case of the instrument to provide ready reference to specifications and calibration history. See Figure 2-1.

3.2 Connection



Keep unit in a sealed environment when not in use.

Do not handle binding post area with bare hands.

Maintain binding post area clean for minimum electrical leakage.

3.2.1 Electrical Considerations

The selected resistance is brought out using insulated, low-thermal-emf, binding posts labeled **HI** and **LO**.

A third terminal labeled **GUARD** is brought out for the rotary switch style; it interrupts and eliminates leakage to the switch body.

A fourth binding post labeled **GND** (Ground) is connected to the case and may be used accordingly as a guard or shield terminal.

3.3 Connection to Guard Terminal (Rotary Switch Style)

A **GUARD** terminal is brought out for the rotary switch style; it interrupts and eliminates leakage to the switch body. This terminal should be connected to the guard circuit or terminal of the measuring instrument. It may be also connected to the ground terminal of the test instrument if a guard terminal is not available on the instrument.

Refer to the instructions for the DMM or high resistance meter or bridge being used.

3.4 Environmental Conditions

3.4.1 Operating Temperature and Humidity

For optimal accuracy, use VRS models in an environment of $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$. Because of the high resistances involved, RH should be $<50\%$. The instrument should be allowed to stabilize at those temperatures after any significant temperature variation.

3.4.2 Storage Conditions

The VRS Series should be maintained within the storage temperature range of 0°C to 40°C to maintain its accuracy within the specified limits.

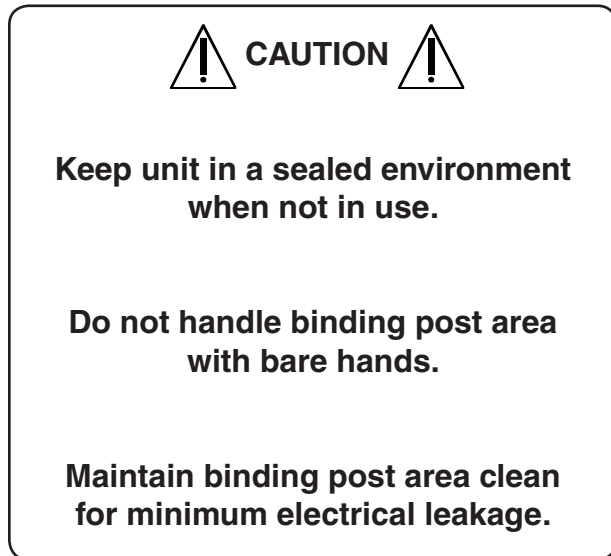
When not in use, the VRS unit should be stored in a sealed case or a plastic bag to minimize the intrusion of humidity and contaminants. A packet of desiccant should be placed in the container.

Chapter 4

MAINTENANCE

4.1 Preventive Maintenance

Keep the unit in a sealed clean enclosure with desiccant at laboratory temperature and RH <50%. This will help prevent possible contamination and intrusion of moisture.



When necessary, the front panel should be cleaned to eliminate any leakage paths around the binding posts. To clean the front panel, wipe the front panel clean using alcohol and a lint-free cloth.

4.2 Calibration

4.2.1 Calibration Interval

The recommended calibration interval for the VRS Series is twelve (12) months.

4.2.2 General Considerations

Before starting the calibration procedure, you need to consider the following:

- Calibration environment should be 23°C and <50% RH.
- Test instruments should be sufficiently more accurate than the VRS unit.
- The uncertainty of the measurement instruments has to be considered in the calibration to allow a band of uncertainty.
- The testing equipment and the VRS unit should stabilize at laboratory conditions for at least 24 hours.
- Use gloves when working inside the unit.
- Proper metrology practices should be followed to eliminate leakage.

4.2.3 Required Equipment

Many combinations of standards, transfer standards, meters, and bridges may be used to calibrate this instrument. Possible choices include Resistance Standards or Transfer Standards for 1 kΩ, through 10 TΩ (or 10 TΩ).

IET options include:

- HATS-Y
- SRL Series

4.2.4 Calibration Procedure

To calibrate the VRS unit, **proceed as follows**:

1. Set up the calibration equipment in the resistance-measurement mode.
2. Measure leakage from every terminal (except **GUARD**) to **GROUND**.
The leakage should be $>100\text{ T}\Omega$ ($>1\text{ P}\Omega$ if the unit has a $1\text{ T}\Omega$ step.)
3. If applicable, rotate the switch a few times in each direction.
4. Determine the allowable upper and lower limits for each resistance setting based on the specified accuracy and the confidence band.
Allow a confidence band for the uncertainty of the measuring instrument and setup.
5. Confirm that the resistances fall within these limits.

If any resistances fall outside these limits, the resistors may require service or replacement. Consult IET Labs.

4.3 Schematics

Figure 4-1 gives the schematic of VRS, Rotary-Switch Style.

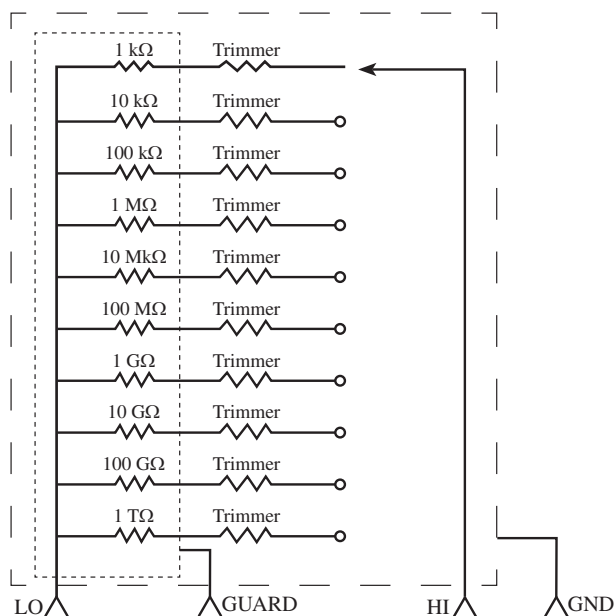


Figure 4-1: VRS Schematic, Rotary-Switch Style

Figure 4-2 gives the schematic of VRS, Binding-Post Style.

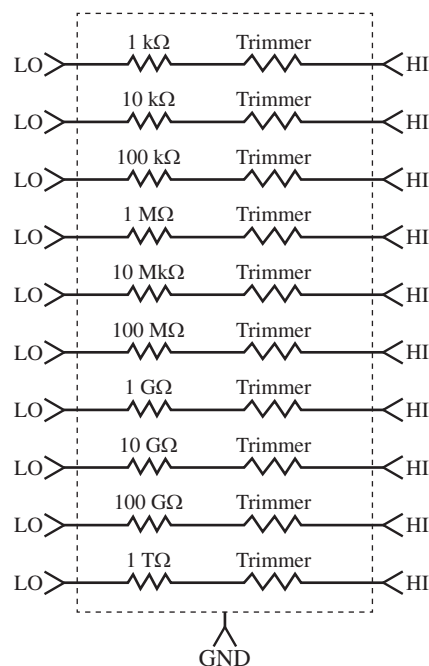


Figure 4-2: VRS Schematic, Binding-Post Style