



Operator MANUAL
FOR
MODEL 9340
PRECISION DECADE RESISTANCE STANDARDS

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OM9340-G2-00
22 December, 2025

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1. INTRODUCTION

1.1. FUNCTIONAL DESCRIPTION

The Model 9340 is a Family of Precision Decade Resistance Standards. It combines techniques established at Guildline in the construction and stabilizing of resistors, and low uncertainty switching techniques used in many of our instruments. The Model 9340 Series is available in models with 3 to 7 decades, and in ohmic values from 0.01 Ω steps to 1 T Ω steps.



Figure 1-1: 9340 Series of Resistance Decade Standards

1.2. FEATURES

The main features of the Model 9340 series are:

- Resistance range from $.01 \Omega$ to $11 T\Omega$
- Accuracy better than $\pm 0.01\%$
- Temperature coefficient less than $5 \mu\Omega/\Omega /^\circ\text{C}$
- Zero resistance less than $1 \text{ m}\Omega/\text{decade}$
- High reliability switches noted for 1,000,000 cycles

1.3. GENERAL THEORY

The 9340 series of decade standards consist of 3, 4, 5, 6 or 7 decades of resistors switched in a series circuit. Figure 1-1 illustrates schematically the circuit of the Model 9347. The Models 9343, 9344, 9345, 9346 and 9347 are identical except for the number of decades. The value of the resistances are related to the total resistance of the unit. These values are listed in Table 2-2.

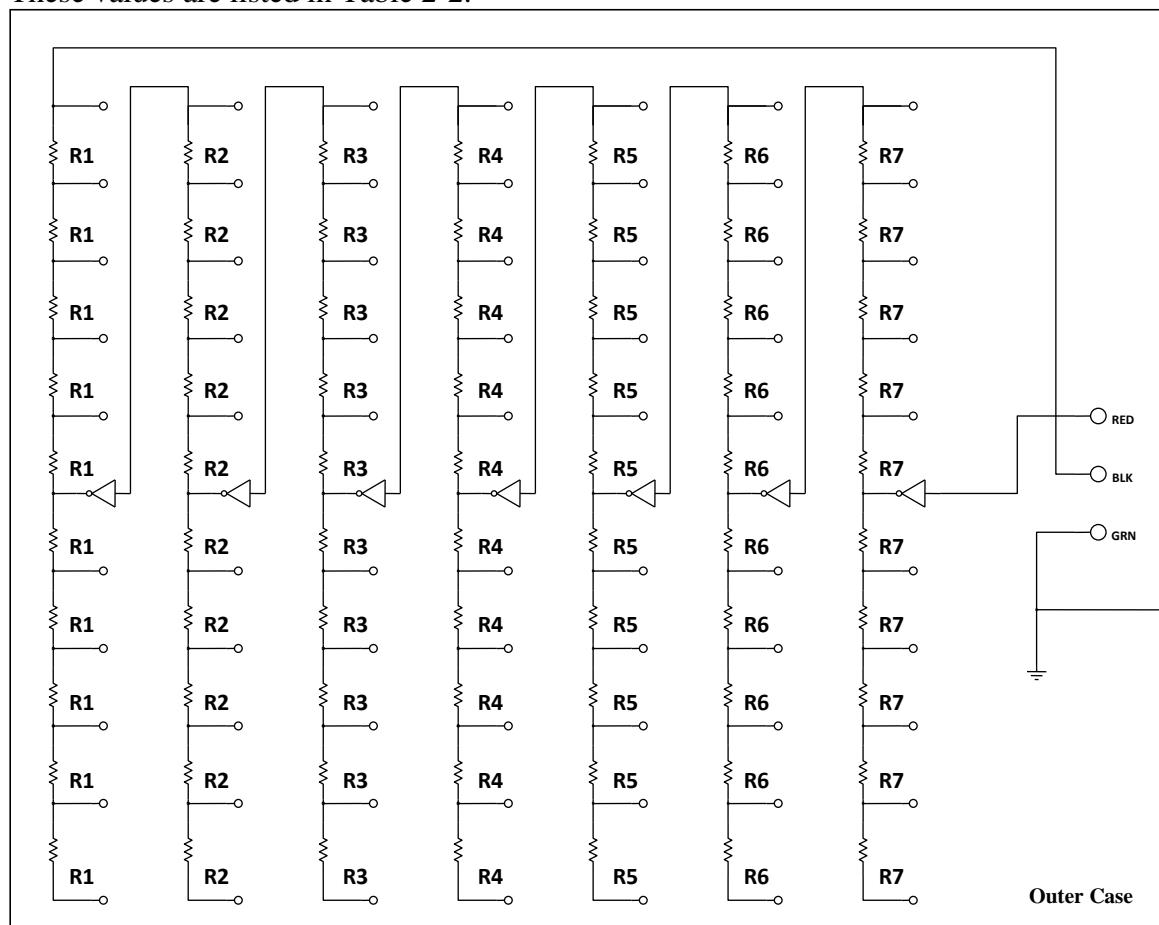


Figure 1-2: Decade Standard Schematic Diagram

2. SPECIFICATIONS

Number of Decades Available: 3, 4, 5, 6 & 7

Zero Resistance (Typical): 0.0030 ± 0.001 ohm per dial, after settling

Breakdown Voltage: 1500 Volts to case.

Dimensions:

9343	11.8cm X 23.3cm X 10.3cm high
9344	11.8cm X 29.0cm X 10.3cm high
9345	11.8cm X 34.7cm X 10.3cm high
9346	11.8cm X 40.5cm X 10.3cm high
9347	11.8cm X 46.1cm X 10.3cm high

Weight:

9343	2.7 kg
9344	3.25 kg
9345	3.9 kg
9346	4.4 kg
9347	5.1 kg



Section 2

Table 2-1: Model Selection Table

Model Number	# of Decades	Minimum Step (Ω's)	Maximum Value (Ω's)
9343/10	3	0.01	11.10
9343/100	3	0.1	111.0
9343/1k	3	1	1.110 k
9343/10k	3	10	11.10 k
9343/100k	3	100	111.0 k
9343/1M	3	1k	1.110 M
9343/10M	3	10k	11.10 M
9343/100M	3	100k	111.0 M
9343/1G	3	1M	1.110 G
9343/10G	3	10M	11.10 G
9343/100G	3	100M	111.0 G
9343/1T	3	1G	1.110 T
9343/10T	3	10G	11.10 T

Model Number	# of Decades	Minimum Step (Ω's)	Maximum Value (Ω's)
9344/100	4	0.01	111.1
9344/1k	4	0.1	1.111 k
9344/10k	4	1	11.11 k
9344/100k	4	10	111.1 k
9344/1M	4	100	1.111 M
9344/10M	4	1k	11.11 M
9344/100M	4	10k	111.1 M
9344/1G	4	100k	1.111 G
9344/10G	4	1M	11.11 G
9344/100G	4	10M	111.1 G
9344/1T	4	100M	1.111 T
9344/10T	4	1G	11.11 T

Model Number	# of Decades	Minimum Step (Ω's)	Maximum Value (Ω's)
9345/1k	5	0.01	1.1111 k
9345/10k	5	0.1	11.111 k
9345/100k	5	1	111.11 k
9345/1M	5	10	1.1111 M
9345/10M	5	100	11.111 M
9345/100M	5	1k	111.11 M
9345/1G	5	10k	1.1111 G
9345/10G	5	100k	11.111 G
9345/100G	5	1M	111.11 G
9345/1T	5	10M	1.1111 T
9345/10T	5	100M	11.111 T

Model Number	# of Decades	Minimum Step (Ω's)	Maximum Value (Ω's)
9346/10k	6	0.01	11.1111 k
9346/100k	6	0.1	111.111 k
9346/1M	6	1	1.11111 M
9346/10M	6	10	11.1111 M
9346/100M	6	100	111.111 M
9346/1G	6	1k	1.11111 G
9346/10G	6	10k	11.1111 G
9346/100G	6	100k	111.111 G
9346/1T	6	1M	1.11111 T
9346/10T	6	10M	11.1111 T

Model Number	# of Decades	Minimum Step (Ω's)	Maximum Value (Ω's)
9347/100k	7	0.01	111.1111 k
9347/1M	7	0.1	1.111 111 M
9347/10M	7	1	11.111 11 M
9347/100M	7	10	111.1111 M
9347/1G	7	100	1.111 111 G
9347/10G	7	1k	11.111 11 G
9347/100G	7	10k	111.111 1 G
9347/1T	7	100k	1.111 111 T
9347/10T	7	1M	11.111 11 T

Table 2-2: Model Specifications

MSD (Most Significant Dial)	Maximum Dial Output (x10 Setting) (ohms)	Coefficients			Maximum Limits		
		Stability ($\pm \mu\Omega/\Omega$ /yr)	Temperature ($\pm \mu\Omega/\Omega$ /C)	Power ($\pm \mu\Omega/\Omega$ /mW)	Power (W/step)	Amperes (Adc/step)	Volts (volts/step)
0.01	0.1 Ω	500	5	0.2	0.5	7	0.07
0.1	1 Ω	50	5	0.2	0.5	2	0.2
1	10 Ω	20	5	0.2	0.5	0.7	0.7
10	100 Ω	10	5	0.2	0.5	0.2	2
100	1 k Ω	10	5	0.2	0.5	0.07	7
1 k	10 k Ω	10	5	0.2	0.5	0.02	20
10 k	100 k Ω	10	5	0.2	0.5	0.007	70
100 k	1 M Ω	10	5	0.2	0.5	0.002	200
1 M	10 M Ω	10	5	0.2	0.5	0.7 mA	700
10 M	100 M Ω	20	20	1	0.1	0.1 mA	1000
100 M	1 G Ω	50	20	50	0.01	0.01 mA	1000
1 G	10 G Ω	500	100	1*	0.001	1.5 uA	1500
10 G	100 G Ω	1000	250	1*	0.0001	0.15 uA	1500
100 G	1 T Ω	2000	-250	-85*	N/A	0.015 uA	1500
1 T	10 T Ω	3000	-2500	-110*	N/A	0.0015 uA	1500

Accuracy – Accuracy is based on the most significant dial (MSD) that is used for the resistance output. The accuracy of the MSD dial used for the resistance output determines the accuracy of all the dial settings for the resistance output desired. Accuracy for 1 MΩ and below is based on subtraction of Zero Resistance (nulling out all dial zero resistances and lead resistance).

MSD (MOST SIGNIFICANT DIAL) USED						
Accuracy	10m to 1M	10M & 100M	1G	10G	100G	1T
	0.01% + 2 mΩ	0.1%	1%	2%	5%	6%

Examples show a 9346 Series models dials set to various outputs to show accuracy calculations.

Example 1 – A 9346/10k Decade Standard is set to **7.96912 kΩ**. The most significant dial would be 1k. Since the 1k Dial (set to 7 Position) is most significant dial used, the accuracy would be 0.01% + 2 mΩ for all the 9340 Dial Settings for the entire resistance output.

Example 2 – A 9346/100M Decade Standard is set to **23.1573 MΩ**. The most significant dial would be the 10 MΩ Dial. For this output, this dial would be set to the 2 Position with remaining dials set to values as shown. Since the 10 MΩ dial is the most significant dial used, the accuracy would be 0.1% for all the 9340 Dial Settings for the entire resistance output.

Example 3 – A 9346/1T Decade Standard is set to **100.59 GΩ**. Since the 1 TΩ Dial was not used this resistance requires only the 100 GΩ dials and below. The 100 GΩ is the most significant dial used so the accuracy would be 5% for all the 9340 Dial Settings for the entire resistance output. If the 1 TΩ Dial were used as the most significant dial, the accuracy would change to 6% for the output needed.



Section 2

3. RECEIPT AND INSPECTION

3.1. GENERAL

Remove the instrument from its shipping container. The instrument was thoroughly tested and inspected before shipment and should be free from any electrical or mechanical damage when received. Nevertheless, you should perform an inspection for physical damage, ensure all items on the packing list are present and test the instrument, electrically, as soon as possible after receipt. Refer to the warranty card at the front of the manual if any damage or deficiencies are found.

3.2. PACKAGING

We recommend that the shipping container be retained for future storage or transportation of this instrument.



Section 3

4. OPERATION AND MAINTENANCE

4.1. OPERATION

The Model 9340 series of decade standards are calibrated at the front panel red and black binding posts. The accuracy specification is determined as the resistance value offset from the zero selection resistance value.

Above 1 k Ω selection the zero resistance value is negligible. Below the 1 k Ω selection the zero resistance value of the decade standard needs to be taken into consideration to effect the specified accuracy.

The green binding post case ground terminal may be used to reduce susceptibility to electromagnetic and electrostatic influences.

4.2. MAINTENANCE AND CALIBRATION

The Model 9340 series of decade standards require minimal maintenance other than periodic calibration and ensuring the front panel terminals are clean. Cleaning may be accomplished by wiping with ISO-propanol and allowing to dry over a 12 hour period before use.

Calibration should be performed using a 6½ Digital Multimeter with a minimum accuracy specification of better than $\pm 20 \mu\Omega/\Omega$ over the range of 1 Ω to 10 M Ω . A suitably accurate Teraohrometer is required for models with resistance ranges above 1 G Ω .

4.3. REPAIR

Although the Model 9340 series has been designed to operate for many years without the need of repairs, circumstances beyond the control of the manufacturer may require replacement of specific resistor elements or entire decade switch assemblies.

The screws in the top panel may be removed to allow access to the switching circuitry by carefully lifting the top panel assembly out of the bottom portion of the enclosure.

Careful soldering so as not to overheat the switch terminals is required when replacing specific resistance elements. It is recommended that the defective resistance elements be cut out of the circuit and that the replacement element be attached to a short portion of the element lead left in contact with the switch terminals. This method will reduce any effects from applying heat to the circuit elements.

It is recommended that the decade standard be returned to Guildline Instruments if it should be necessary to replace an entire decade switch.