



**TECHNICAL MANUAL**

**FOR**

**MODEL 9340**

**PRECISION DECADE RESISTANCE BOXES**

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**TM9340-G-00**  
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# TABLE OF CONTENTS

<b>1. INTRODUCTION .....</b>	<b>1-1</b>
<b>1.1. FUNCTIONAL DESCRIPTION.....</b>	<b>1-1</b>
<b>1.2. FEATURES.....</b>	<b>1-2</b>
<b>1.3. GENERAL THEORY .....</b>	<b>1-2</b>
<b>2. SPECIFICATIONS.....</b>	<b>2-1</b>
<b>3. RECEIPT AND INSPECTION.....</b>	<b>3-1</b>
<b>3.1. GENERAL .....</b>	<b>3-1</b>
<b>3.2. PACKAGING .....</b>	<b>3-1</b>
<b>4. OPERATION AND MAINTENANCE .....</b>	<b>4-1</b>
<b>4.1. OPERATION.....</b>	<b>4-1</b>
<b>4.2. MAINTENANCE AND CALIBRATION .....</b>	<b>4-1</b>
<b>4.3. REPAIR.....</b>	<b>4-1</b>
<b>5. PARTS LISTS .....</b>	<b>5-1</b>
<b>6. DRAWINGS.....</b>	<b>6-1</b>

# TABLE OF FIGURES

<b>FIGURE 1-1: 9340 SERIES OF RESISTANCE DECADE BOXES</b> .....	1-1
<b>FIGURE 1-2: DECADE BOX SCHEMATIC DIAGRAM</b> .....	1-2

# LIST OF TABLES

<b>TABLE 2-1: MODEL SELECTION TABLE</b> .....	2-2
<b>TABLE 2-2: MODEL SPECIFICATIONS</b> .....	2-4
<b>TABLE 5-1: GENERAL ASSEMBLY PARTS LISTS</b> .....	5-1

## 1. INTRODUCTION

### 1.1. FUNCTIONAL DESCRIPTION

The Model 9340 is a Family of Precision Decade Resistance Boxes. 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 decade range of from 3 to 7 decades. Each range is available in the full resistance range of from 0.01  $\Omega$  steps to 1 T $\Omega$  steps.



**Figure 1-1: 9340 Series of Resistance Decade Boxes**

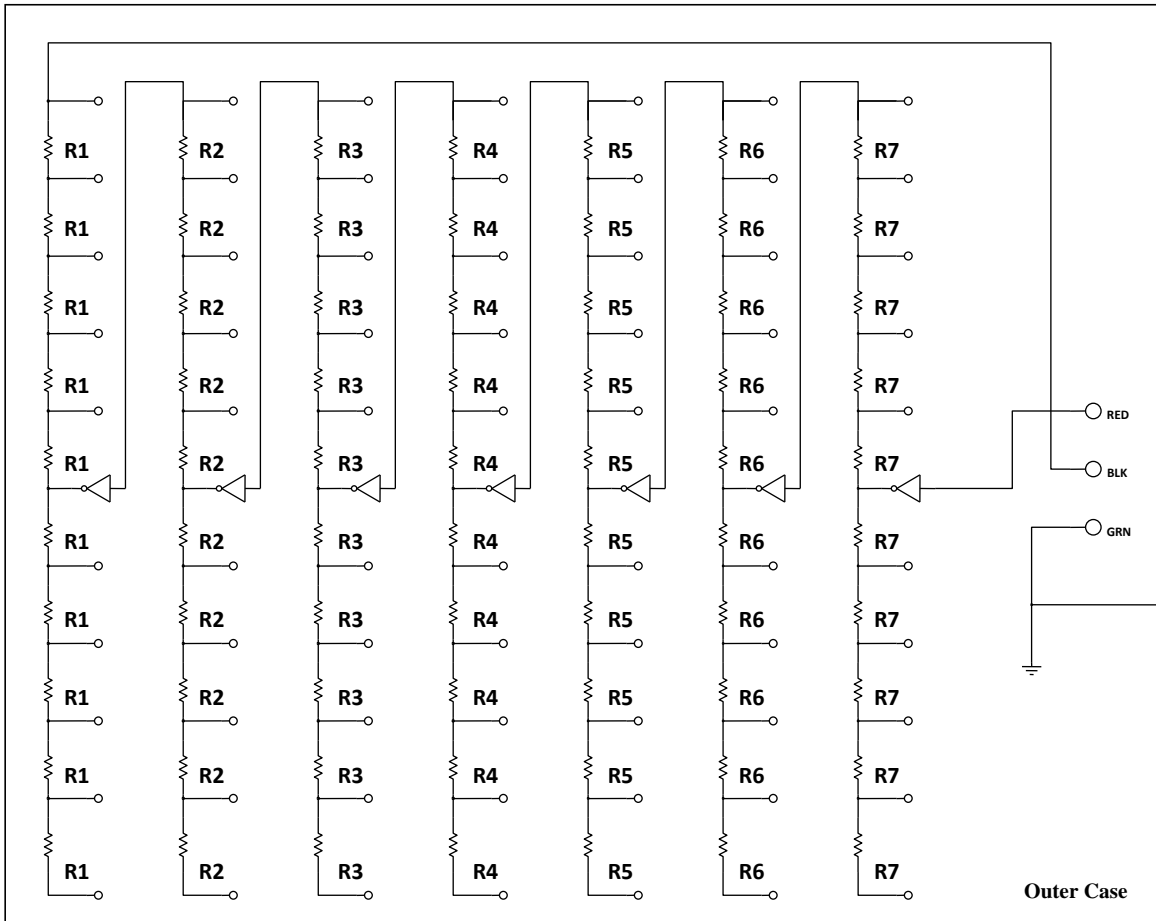
## 1.2. FEATURES

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 ppm/ $^{\circ}\text{C}$
- Zero resistance less than 1 m $\Omega$ /decade
- High reliability switches noted for 1,000,000 cycles

## 1.3. GENERAL THEORY

The 9340 series of decade boxes 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 Box Schematic Diagram**

## 2. SPECIFICATIONS

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

Zero Resistance (Typical):  $0.0030 \pm 0.001$  ohm per decade, after settling

Breakdown Voltage: 1500 Volts to case.

<b>Dimensions:</b>	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

<b>Weight:</b>	9343	2.7 kg
	9344	3.25 kg
	9345	3.9 kg
	9346	4.4 kg
	9347	5.1 kg

**Table 2-1: Model Selection Table**

Model Number	# of Decades	Minimum Step ( $\Omega$ 's)	Maximum Value( $\Omega$ '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	1.110T
9343/10T	3	10G	11.10 T

Model Number	# of Decades	Minimum Step ( $\Omega$ 's)	Maximum Value( $\Omega$ '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 ( $\Omega$ 's)	Maximum Value( $\Omega$ '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 ( $\Omega$ 's)	Maximum Value( $\Omega$ 's)
9346/10k	6	0.01	11.111 1 k
9346/100k	6	0.1	111.111 k
9346/1M	6	1	1.111 11 M
9346/10M	6	10	11.111 1 M
9346/100M	6	100	111.111 M
9346/1G	6	1k	1.111 11 G
9346/10G	6	10k	11.111 1 G
9346/100G	6	100k	111.111 G
9346/1T	6	1M	1.111 11 T
9346/10T	6	10M	11.111 1 T



Model Number	# of Decade	Minimum Step ( $\Omega$ 's)	Maximum Value( $\Omega$ 's)
9347/100k	7	0.01	111.111 1 k
9347/1M	7	0.1	1.111 111 M
9347/10M	7	1	11.111 11 M
9347/100M	7	10	111.111 1 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	Temperature	Power	Power	Amperes	Volts
		(± ppm/yr)	(± ppm/C)	(± ppm/mW)	(W/step)	(Adc/Step)	(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 kΩ	10	5	0.2	0.5	0.007	70
100 k	1 MΩ	10	5	0.2	0.5	0.002	200
1 M	10 MΩ	10	5	0.2	0.5	0.7mA	700
10 M	100 MΩ	20	20	1	0.1	0.1mA	1000
100 M	1 GΩ	50	20	50	0.01	0.01mA	1000
1 G	10 GΩ	500	100	1*	0.001	1.5uA	1500
10 G	100 GΩ	1000	250	1*	0.0001	0.15uA	1500
100 G	1 TΩ	2000	-250	-85*	N/A	0.015uA	1500
1 T	10 TΩ	3000	-2500	-110*	N/A	0.0015uA	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	10 m to 1M	10M & 100M	1G	10G	100G	1T	
	0.01% + 2	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 ΩM 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.

### **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.

# 4. OPERATION AND MAINTENANCE

## 4.1. OPERATION

The Model 9340 series of decade boxes 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 $\Omega$  selection the zero resistance value is negligible. Below the 1 k $\Omega$  selection the zero resistance value of the decade box 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 boxes 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  $\pm 20$  ppm over the range of 1  $\Omega$  to 10 M $\Omega$ . A suitably accurate Teraohmometer is required for models with resistance ranges above 1 G $\Omega$ .

## 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 box be returned to Guildline Instruments if it should be necessary to replace an entire decade switch.

## 5. PARTS LISTS

Model	General Assembly Parts List		Model	General Assembly Parts List
9343/10	18680.01.02-PL		9344/100	18697.01.02-PL
9343/100	18680.02.02-PL		9344/1k	18697.02.02-PL
9343/1k	18680.03.02-PL		9344/10k	18697.03.02-PL
9343/10k	18680.04.02-PL		9344/100k	18697.04.02-PL
9343/100k	18680.05.02-PL		9344/1M	18697.05.02-PL
9343/1M	18680.06.02-PL		9344/10M	18697.06.02-PL
9343/10M	18680.07.02-PL		9344/100M	18697.07.02-PL
9343/100M	18680.08.02-PL		9344/1G	18697.08.02-PL
9343/1G	18680.09.02-PL		9344/10G	18697.09.02-PI
9343/10G	18680.10.02-PL		9344/100G	18697.10.02-PL
9343/100G	18680.11.02-PL		9344/1T	18697.11.02-PL
9343/1T	18680.12.02-PL		9344/10T	18697.12.02-PL
9343/10T	18680.13.02-PL			
9345/1k	18630.01.02-PL		9346/10k	18660.01.02-PL
9345/10k	18630.02.02-PL		9346/100k	18660.02.02-PL
9345/100k	18630.03.02-PL		9346/1M	18660.03.02-PL
9345/1M	18630.04.02-PL		9346/10M	18660.04.02-PL
9345/10M	18630.05.02-PL		9346/100M	18660.05.02-PL
9345/100M	18630.06.02-PL		9346/1G	18660.06.02-PL
9345/1G	18630.07.02-PL		9346/10G	18660.07.02-PL
9345/10G	18630.08.02-PL		9346/100G	18660.08.02-PL
9345/100G	18630.09.02-PL		9346/1T	18660.09.02-PL
9345/1T	18630.10.02-PL		9346/10T	18660.10.02-PL
9345/10T	18630.11.02-PL			
9347/100k	18656.01.02-PL			
9347/1M	18656.02.02-PL			
9347/10M	18656.03.02-PL			
9347/100M	18656.04.02-PL			
9347/1G	18656.05.02-PL			
9347/10G	18656.06.02-PL			
9347/100G	18656.07.02-PL			
9347/1T	18656.08.02-PL			
9347/10T	18656.09.02-PL			

**Table 5-1: General Assembly Parts Lists**

<u>Decade Switch</u>	<u>Parts List</u>
0.01 $\Omega$ Decade	18675.01.02-PL
0.1 $\Omega$ Decade	18675.02.02-PL
1 $\Omega$ Decade	18675.03.02-PL
10 $\Omega$ Decade	18675.04.02-PL
100 $\Omega$ Decade	18675.05.02-PL
1k $\Omega$ Decade	18675.06.02-PL
10 k $\Omega$ Decade	18675.07.02-PL
100 k $\Omega$ Decade	18675.08.02-PL
1 M $\Omega$ Decade	18675.09.02-PL
10 M $\Omega$ Decade	18675.10.02-PL
100 M $\Omega$ Decade	18675.11.02-PL
1 G $\Omega$ Decade	18675.12.02-PL
10 G $\Omega$ Decade	18675.13.02-PL
100 G $\Omega$ Decade	18675.14.02-PL
1 T $\Omega$ Decade	18675.15.02-PL

## 6. DRAWINGS

<u>Decade Box</u>	<u>Drawing</u>
9343 Decade Box General Assembly	18680.01.02
9344 Decade Box General Assembly	18697.01.02
9345 Decade Box General Assembly	18630.01.02
9346 Decade Box General Assembly	18660.01.02
9347 Decade Box General Assembly	18656.01.02