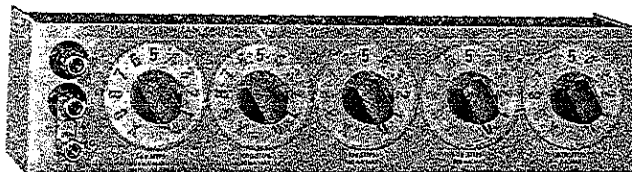
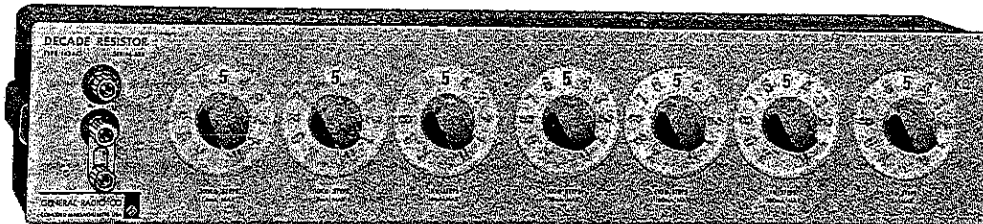


TYPE 1434 DECADE RESISTORS



1434-N



1434-G

Figure 1. Type 1434-N and -G Decade Resistor boxes.

SPECIFICATIONS

Accuracy

Long-term: Two-year warranty applies to the tolerances given barring damage by excessive current. Tolerances apply at low currents and at dc or low-frequency ac.

Over-all: The resistance difference between that at any setting and at the zero setting is equal to the indicated value $\pm(0.05\% + 5 \text{ m}\Omega)$.**

Incremental: See table. This is the accuracy of the change in resistance between any two settings of the same dial.

Zero Resistance: Approx 3 m Ω per dial at low frequencies except for the 1434-QC for which it is approx 30 m Ω .

Max Current: See table; these values also appear on the panel of each decade box. When this max current is passed through a decade, the temporary change in value will be less than the accuracy specification. Currents appreciably higher than this will cause permanent damage.

Temperature Coefficient: $< \pm 10 \text{ ppm}/^\circ\text{C}$ at room temperature, except for the low-valued units where the $+0.4\%/^\circ\text{C}$ temperature coefficient of the zero resistance must be added.

Frequency Characteristics: Generally similar to those of the 1433 Decades.

Switches: Multiple, solid-silver-alloy switches are used to obtain low and stable zero resistance.

Terminals: Jack-top binding posts on standard 3/4-in. spacing. A shield terminal is also provided. The 1434-G has lug connections accessible from the rear.

Mounting: All types except the 1434-G are in small cabinets for bench use. The 1434-G is also designed for bench use but, with the addition of mounting hardware, becomes 3 1/2-in. high, 19-in. relay-rack unit.

Total R of Decade	Resistance Per step	Incremental Accuracy*	Max Current	Inductance Per step
1 Ω	0.1 Ω	$\pm 3.0\%$	1 A	0.01 μH
10 Ω	1.0 Ω	$\pm 0.3\%$	0.3 A	0.05 μH
100 Ω	10 Ω	$\pm 0.08\%$	160 mA	0.08 μH
1 k Ω	100 Ω	$\pm 0.05\%$	50 mA	0.18 μH
10 k Ω	1 k Ω	$\pm 0.05\%$	16 mA	1.8 μH
100 k Ω	10 k Ω	$\pm 0.05\%$	5 mA	22.0 μH
1 M Ω	100 k Ω	$\pm 0.05\%$	1.6 mA	
100 Ω **	1 Ω /div	$\pm 1 \Omega$	200 mA	

Mechanical Data:

Models	Width		Height		Depth		Net Weight		Shipping Weight	
	in.	mm	in.	mm	in.	mm	lb.	kg.	lb.	kg.
M, N, P, QC	1.75	45	2.25	57	7.0	178	3.2	1.4	4.4	2.0
B, X	1.5	38	2.25	57	7.0	178	3.0	1.4	4.4	1.9
G (bench)	1.75	45	3.25	83	7.0	178	6.0	2.7	8.3	3.8
G (rack)	1.9	48	3.25	83	7.0	178	6.0	2.7	8.3	3.8

*At low currents and low frequencies. **Except 1434-QC — add $\pm 1 \Omega$ if rheostat moved from zero.

Catalog Number	Description	Total Resistance (Ω)	Resistance Per Step	Number of Decades
Decade Resistor				
1434-9714	1434-N	11,111	0.1 Ω	5
1434-9713	1434-M	111,110	1.0 Ω	5
1434-9716	1434-P	1,111,100	10 Ω	5
1434-9576	1434-QC	1,111,105	1 Ω /div	4 + rheostat
1434-9702	1434-B	1,111,100	1.0 Ω	6
1434-9724	1434-X	111,111	0.1 Ω	6
1434-9707	1434-G	1,111,111	0.1 Ω	7

NOTE: This instrument is equipped with our new snap-on knob for added convenience and safety. Refer to the Service Section for details.

SECTION 1

INTRODUCTION

1.1 PURPOSE.

The Type 1434 Decade Resistors are laboratory-quality decade boxes designed for laboratory measurement, testing, and development work. Their accuracy, incremental as well as total-value, is adequate for all but the most exacting applications. Their small size and clear readout make them particularly useful in experimental and educational laboratory setups.

1.2 DESCRIPTION

The seven Decade Resistors in the Type 1434 series are listed in the specifications. The Types

1434-M, -N, and -P contain five decades of resistance in a small cabinet. The Type 1434-QC has four decades plus a rheostat to provide 1-ohm resolution in a 1-megohm box. The larger Type 1434-G has seven decades and is easily converted into a 3 1/2-inch-high, 19-inch-wide relay-rack unit using the angle brackets and dress strips supplied. This decade box also has lug terminals at the rear, as well as the standard front-panel binding posts. The Types 1434-B, and -X contain six decades.

Six high-quality resistors are used in these decades. The resistors are combined by switching in such a way that the resistance increases by steps, with no discontinuities, just as if 10 resistors were used.

SECTION 2

OPERATING PROCEDURE

2.1 MOUNTING.

All Type 1434 Decade Resistor boxes are housed in small cabinets for bench use. The Type 1434-G is also supplied with additional mounting hardware for installation in a relay rack. To install the Type 1434-G in a relay rack:

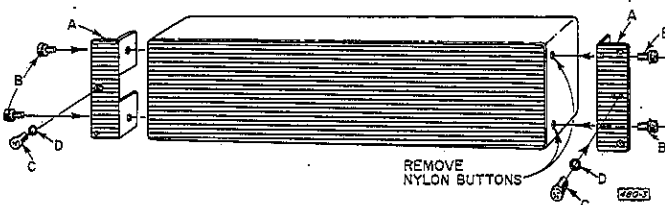


Figure 2. Relay-rack installation of Type 1434-G.

a. Remove the nylon buttons from the holes at the side panels of the instrument. These buttons are press-fitted and are easily removed with a small screw-driver.

b. Install the 3 1/2-by-7/8-inch adaptor-panel assemblies (A, Figure 2) on each side of the instru-

ment, using the 3/8-inch locking screws (B) supplied. The holes in the side-panel of the instrument are tapped with a 10-32 thread to receive these screws.

c. Mount the assembly in a standard 19-inch relay-rack cabinet, using the 5/8-inch No. 10-32 screws (C) and nylon washers (D) provided.

2.2 REAR CONNECTIONS, TYPE 1434-G.

This decade box has lug terminals at the rear. To make connections, remove the two 4-40 screws and the small rectangular plate from the rear panel. The lug terminals are now accessible for use and connections can be completed.

2.3 READOUT.

The rheostat in the Type 1434-QC has a selector dial with ten 10-ohm increments plus additional readout to 1-ohm per graduation. All other decades in the Type 1434 instruments have clear, easy-to-read dials with numbered steps from 0 to X (X = 10).

SECTION 3

PRINCIPLES OF OPERATION

3.1 RESISTORS.

Because of its accuracy, long-term stability, low and uniform temperature coefficient, and relative immunity to ambient humidity conditions, the wire-wound resistor is the most suitable type for use at audio and radio frequencies, as well as at dc.

Resistors designed for ac use differ from those intended for use only at dc in that low series reactance and stability of resistance as frequency is varied are important design objectives.

The residual capacitance and inductance become increasingly important as the frequency is raised, acting to change the terminal resistance from its low-frequency value. For frequencies where the resistance and its associated residual reactances behave as lumped parameters, the equivalent circuit of a single resistor can be represented as shown in Figure 3. L is the equivalent inductance in series with resistance R, and C is the equivalent capacitance across the terminals of the resistor.

3.2 AC CHARACTERISTICS.

The simple equivalent circuit for a single resistor (Figure 3) may also be used for a decade box although L and C will be made up of many components of inductance and capacitance. Using this equivalent circuit, the phase angle of a decade box is:

$$\theta = \frac{\omega L}{R} - \omega RC \text{ radians}$$

The phase angle will be inductive at low values of R and capacitive at high values.

The value of resistance is dependent on whether series or parallel resistance is to be considered.*

Simplified formulas for these parameters are:

$$R_{\text{series}} = \frac{R}{1 + \omega^2 R^2 C^2}$$

$$R_{\text{parallel}} = R \left(1 + \frac{\omega^2 L^2}{R^2} - \omega^2 R^2 C_D^2 \right)$$

$$\text{where } C = C_0 + MC_1$$

$$C_0 \sim 20 \text{ to } 30 \text{ pF}$$

$$C_1 \sim 15 \text{ pF}$$

$$M = \text{Number of unused decades (set to zero) preceding largest decade used.}$$

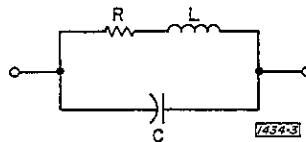


Figure 3. Equivalent circuit of a resistor.

$$L = L_0 + N_1 \Delta L_1 + N_2 \Delta L_2 + \dots$$

$$L_0 \sim 0.1 \mu\text{H per dial} \times \text{number of dials in unit.}$$

$$\Delta L_1, \Delta L_2, \dots \sim \text{values shown in specifications.}$$

$$N_1, N_2, \dots = \text{readings of corresponding dials.}$$

$$C_D \sim 2 \text{ pF (effective distributed capacitance)}$$

The total capacitance from the decades to the case is about 125 pF for the Type 1434-G and 100 pF for the other instruments in the Type 1434 series.

These approximate values are valid for the two-terminal connection (case tied to lower terminal). The resistance measured with the case guarded (three-terminal connection) will be more inductive.

*For further explanation, refer to the General Radio catalog.

SECTION 4

SERVICE AND MAINTENANCE

4.1 WARRANTY.

We warrant that each new instrument manufactured and sold by us is free from defects in material and workmanship, and that, properly used, it will perform in full accordance with applicable specifications for a period of two years after original shipment. Any instrument or component that is found within the two-year period not to meet these standards, after examination by our factory, District Office, or authorized repair agency personnel, will be repaired, or at our option, replaced without charge, except for tubes or batteries that have given normal service.

4.2 SERVICE.

The two-year warranty stated above attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions, please write or phone our Service Department, giving full information of the trouble and of steps taken to remedy it. Be sure to mention the serial and type numbers of the instrument.

Before returning an instrument to General Radio for service, please write to our Service Department or nearest District Office, requesting a "Returned Material Tag." Use of this tag will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

4.3 MINIMUM PERFORMANCE TESTS.

Direct-reading, resistance-measuring bridges such as the L and N-4232 or the ESI-PVB instruments, when calibrated with appropriate precision standards (such as the GR 1440 series), have the required accuracy for measuring the performance of Type 1434 Decade Resistors. It is suggested that the following National Bureau of Standards publications be referred to for information on apparatus and procedures necessary for such measurements.

- Methods, apparatus, and procedures for the comparison of precision standard resistors. F. Wenner, J. Research, NBS 25, 229, (1940).

- Precision resistors and their measurement, J. L. Thomas, NBS Circular 470, 32 p (1948).

- Calibration procedures for dc resistance apparatus, P.B. Brooks, NBS Mono 39, (1962).

4.4 TROUBLE-SHOOTING.

Wire-wound resistors in the Type 1434 instruments can be replaced by trained personnel, or the unit may be returned to General Radio for service.

To determine if a particular decade is in error, set the decade step-selector dial to step 9 and measure the value of resistance, with all other decades set to 0. Step 9 is the only setting using all six resistors in the decade (see Figure 4); an incorrect reading at this setting will indicate that one or more of these resistors is in error.

	STEP SETTING										
	0	1	2	3	4	5	6	7	8	9	X
R101		■	■	■	■	■	■	■	■	■	■
R102				■	■	■	■	■	■	■	
R103						■	■	■	■	■	
R104									■	■	■
R105											■
R106		■		■		■		■		■	

EXPLANATION: Resistors R101 thru R105 are connected in series for even-numbered steps 2, 4, 6, 8, and X (X = 10). R106 is alternately connected in parallel with the last series resistor for odd-numbered steps 1, 3, 5, 7, and 9.

EXAMPLE: For step 5, R101 and R102 are connected in series with the parallel combination of R103 and R106.

Figure 4. Chart showing resistors used with step settings on Type 1434 Decade Resistors.

To isolate a troublesome resistor in a decade, measure the resistance at various step settings with all other decades in the instrument set at 0. (See Figure 4 for resistors used with different dial settings.) The following procedure is recommended:

- a. Check R106 first by measuring the resistance at step 1 and then at step 2. An incorrect reading for step 1 and a correct reading for step 2 indicates that R106 is in error.
- b. If R106 checks satisfactorily, additional measurements taken at settings 4, 6, 8, and X will

indicate which of the other five resistors is giving trouble.

In addition to the 1.0 Ω /div. rheostat used in the Type 1434-QC, three different types of resistors are used on the decades. The type of resistor used depends on the resistance and required accuracy of the decade steps. The resistors and their physical locations are shown in Figure 5.

Refer to the parts list for a complete listing and description of the decade switches used in all Type 1434 models.

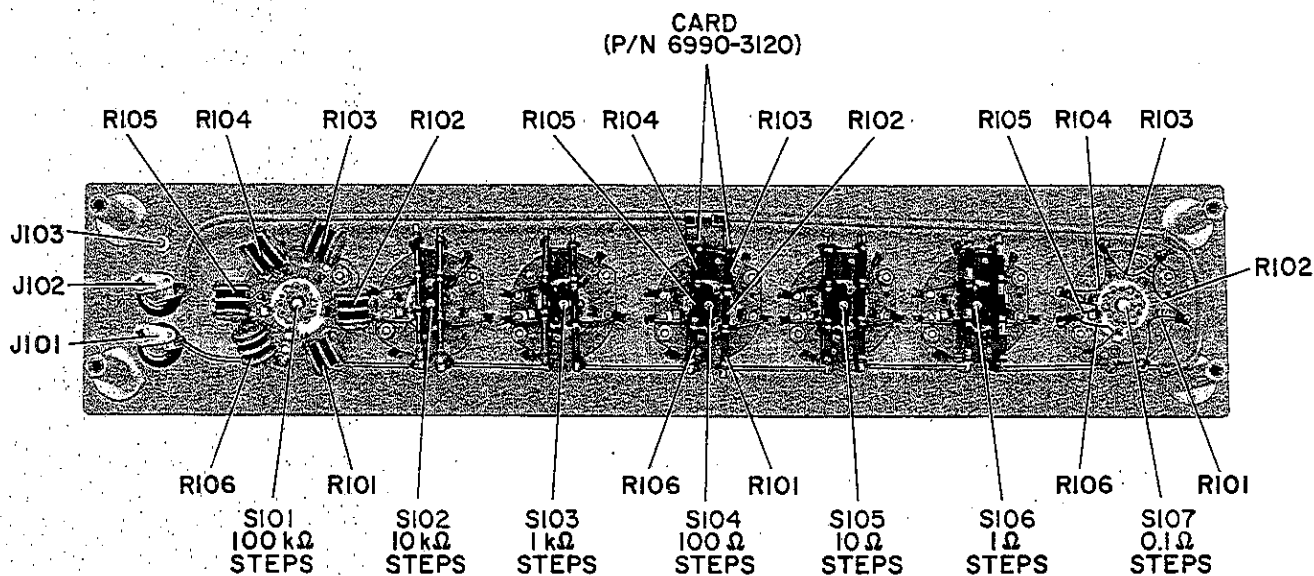


Figure 5. Rear interior view of the Type 1434-G showing the location of resistors, R101 through R106.

4.5 KNOB REMOVAL.

If it should be necessary to remove the knob on a front-panel control, either to replace one that has been damaged or to replace the associated control, proceed as follows:

a. Grasp the knob firmly with the fingers and pull the knob straight away from the panel.

CAUTION

Do not pull on the dial to remove a dial/knob assembly. Always remove the knob first.

b. Observe the position of the set screw in the bushing, with respect to any panel marking (or at the full ccw position of a continuous control).

c. Release the setscrew and pull the bushing off the shaft.

d. Remove and retain the black Nylon thrust washer, behind the dial/knob assembly, as appropriate.

NOTE

To separate the bushing from the knob, if for any reason they should be combined off the instrument, drive a machine tap a turn or two into the bushing for a sufficient grip for easy separation.

4.6 KNOB INSTALLATION.

To install a knob assembly on the control shaft:

a. Place the black Nylon thrust washer over the control shaft, if appropriate.

b. Mount the bushing on the shaft, using a small slotted piece of wrapping paper as a shim for adequate panel clearance.

c. Orient the setscrew on the bushing with respect to the panel-marking index and lock the setscrew.

NOTE

Make sure that the end of the shaft does not protrude through the bushing or the knob won't set properly.

d. Place the knob on the bushing with the retention spring opposite the setscrew.

e. Push the knob in until it bottoms and pull it slightly to check that the retention spring is seated in the groove in the bushing.

NOTE

If the retention spring in the knob comes loose, reinstall it in the interior notch with the small slit in the outer wall.

Table 1
INCREMENTAL RESISTANCE OF
TYPE 1434 DECADES

Switch Numbers

Type	S101	S102	S103	S104	S105	S106	S107
1434-N	1 k Ω /step	100 Ω /step	10 Ω /step	1 Ω /step	0.1 Ω /step		
1434-M	10 k Ω /step	1 k Ω /step	100 Ω /step	10 Ω /step	1 Ω /step		
1434-P	100 k Ω /step	10 k Ω /step	1 k Ω /step	100 Ω /step	10 Ω /step		
1434-QC	100 k Ω /step	10 k Ω /step	1 k Ω /step	100 Ω /step	1 Ω /division*		
1434-B	100 k Ω /step	10 k Ω /step	1 k Ω /step	100 Ω /step	10 Ω /step	1 Ω /step	
1434-X	10 k Ω /step	1 k Ω /step	100 Ω /step	10 Ω /step	1 Ω /step	0.1 Ω /step	
1434-G	100 k Ω /step	10 k Ω /step	1 k Ω /step	100 Ω /step	10 Ω /step	1 Ω /step	0.1/step

*Although listed in the table as a switch, the 1 Ω /division decade is actually a potentiometer.

PARTS LIST

(Refer to Table I for identification of decade values used with specific Type 1434 models)

<i>Ref.</i>	<i>Description</i>	<i>GR Part No.</i>	<i>FMC</i>	<i>Mfg. Part No.</i>	<i>Fed. Stock No.</i>
1 Ω /div. decade	RESISTOR, Potentiometer, R107*, 106.7 Ω \pm 2.5%	0973-4191	24655	0973-4191	
0.1 Ω /step decade (See Fig. 5)	SWITCH ASSEMBLY, includes R101 thru R106	1434-2000	24655	1434-2000	
	SWITCH ASSEMBLY, includes R101 thru R106	1434-2010	24655	1434-2010	
1 Ω /step decade	RESISTOR, Wire-wound on card, includes R101 thru R103 or R104 thru R106 (part of 1434-2010)	6990-3002	24655	6990-3002	
	SWITCH, Rotary (part of 1434-2010)	7890-4930	76854	HEC	
	SWITCH ASSEMBLY, includes R101 thru R106	1434-2020	24655	1434-2020	
10 Ω /step decade	RESISTOR, Wire-wound on card, includes R101 thru R103 or R104 thru R106 (part of 1434-2020)	6990-3021	24655	6990-3021	
	SWITCH, Rotary (part of 1434-2020)	7890-4930	76854	HEC	
	SWITCH ASSEMBLY, includes R101 thru R106	1434-2030	24655	1434-2030	
100 Ω /step decade (See Fig. 5)	RESISTOR, Wire-wound on card, includes R101 thru R103 or R104 thru R106 (part of 1434-2030)	6990-3121	24655	6990-3121	
	SWITCH, Rotary (part of 1434-2030)	7890-4930	76854	HEC	
	SWITCH ASSEMBLY, includes R101 thru R106	1434-2040	24655	1434-2040	
1 k Ω /step decade	RESISTOR, Wire-wound on card, includes R101 thru R103 or R104 thru R106 (part of 1434-2040)	6990-3221	24655	6990-3221	
	SWITCH, Rotary (part of 1434-2040)	7890-4930	76854	HEC	
	SWITCH ASSEMBLY, includes R101 thru R106	1434-2050	24655	1434-2050	
10 k Ω /step decade	RESISTOR, Wire-wound on card, includes R101 thru R103 or R104 thru R106 (part of 1434-2050)	6990-3321	24655	6990-3321	
	SWITCH, Rotary (part of 1434-2050)	7890-4930	76854	HEC	
	SWITCH ASSEMBLY, includes R101 thru R106	1434-2060	24655	1434-2060	
100 k Ω /step decade (See Fig. 5)	RESISTOR, Wire-wound, 200 k Ω \pm 0.05% (part of 1434-2060)	6991-2201	24655	6991-2201	
	SWITCH, Rotary (part of 1434-2060)	7890-5460	76854	HEC	

*Padded with R107A: Resistor, composition \pm 5%
(Value determined by Laboratory)

PARTS LIST (Cont)

<i>Ref.</i>	<i>Description</i>	<i>GR Part No.</i>	<i>FMC</i>	<i>Mfg. Part No.</i>	<i>Fed. Stock No.</i>
Type 1434 -N, -M, -P, QC, -B, -X	JACK, Binding post, insulated (J101 and J102)	0938-3000	24655	0938-3000	
Type 1434 -G only	JACK, Binding post, insulated (J101 and J102)	0938-3046	24655	0938-3046	
All Type 1434 models	JACK, Binding post, uninsulated, ground (J103)	0938-3022	24655	0938-3022	

MECHANICAL REPLACEMENT PARTS

<i>Ref.</i>	<i>Description</i>	<i>GR Part No.</i>	<i>FMC</i>	<i>Mfg. Part No.</i>	<i>Fed. Stock No.</i>
All type 1434 models	CONNECTOR (for binding posts)	5080-4800	24655	5080-4800	5940-927-7452
Type 1434 -N, -M, -P, -QC, -B, -X	FOOT	5260-1800	70485	832, 1/2"	5340-854-6120
Type 1434 -G only	FOOT	5260-1200	70485	#18, 3/4"	6625-918-9449
Type 1434 -G only	PANEL-ADAPTOR SET	0480-2080	24655	0480-2080	
All Type 1434 models	DIAL ASSEMBLY, 0 to X	5120-2172	24655	5120-2172	
Type 1434 -QC only	DIAL ASSEMBLY, 00 to 90 (for 1 Ω /div.decade only)	5120-2171	24655	5120-2171	
All Type 1434 models	KNOB ASSEMBLY (for all decades) KNOB (part of 5520-5320) FASTENER, Retainer (part of 5520-5320)	5520-5320 5520-5300 5220-5402	24655 24655 24655	5520-5320 5520-5300 5220-5402	

Federal Mfg. Code

<i>Code</i>	<i>Manufacturer</i>
24655	General Radio Co., Concord, Mass. 01742
70485	Atlanta-India Rubber Works, Inc., Chicago Ill. 60607
76854	Oak Mfg. Co., Crystal Lake, Ill.

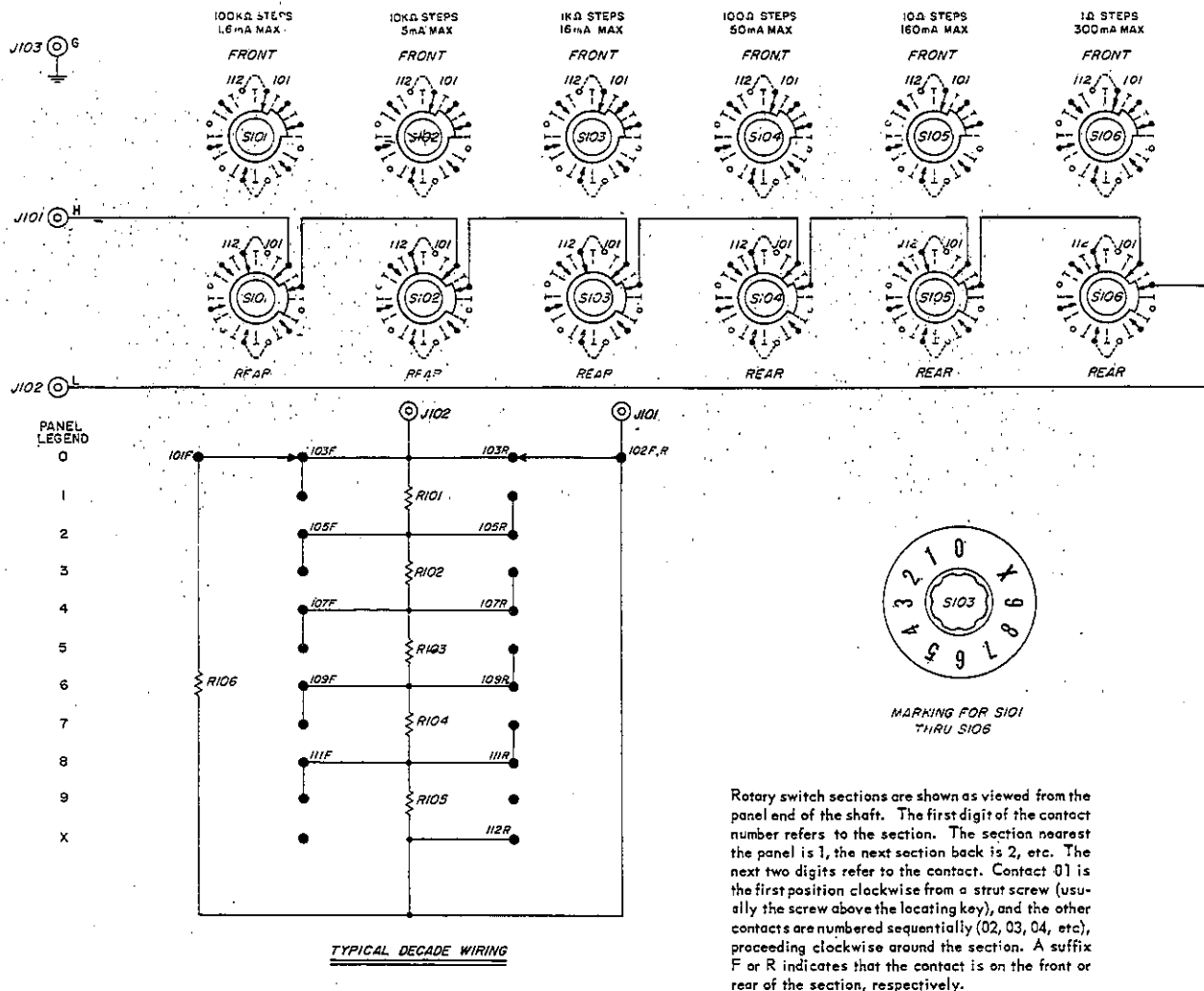


Figure 6. Schematic diagram for the Type 1434-B Decade Resistor (typical connections and wiring for all Type 1434 models).



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