

CONTROLLED
COPY



GenRad

TYPE 1434 DECADE RESISTORS

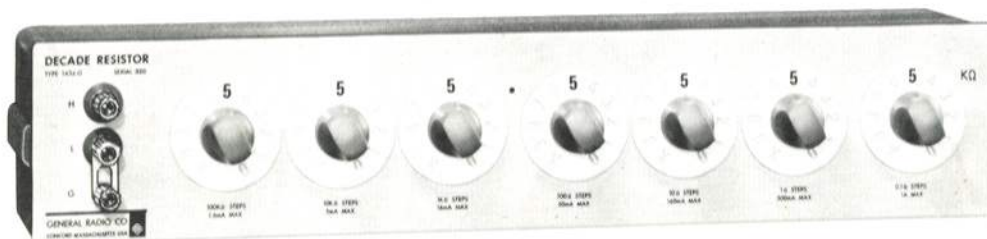
2C0034

MOTOROLA
METROLOGY

2C0034



1434-N



1434-G

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

SPECIFICATIONS

Accuracy: Tolerances apply at low currents and at dc or low-frequency ac.

Over-all: The difference between the resistances at any setting and at the zero setting is equal to the indicated value $\pm(0.02\% + 5 \text{ m}\Omega)$, except for the 1434-QC, which may have an additional error of $\pm 1 \Omega$ when the rheostat is used.

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

Zero Resistance: Approx $3 \text{ m}\Omega$ per dial at low frequencies; except for the 1434-QC, approx $30 \text{ m}\Omega$.

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.

Total Resistance of Decade	Resistance Per Step	Incremental Accuracy*	Max Current
1 Ω	0.1 Ω	$\pm 3.0\%$	1 A
10 Ω	1.0 Ω	$\pm 0.3\%$	0.3 A
100 Ω	10 Ω	$\pm 0.05\%$	160 mA
1 k Ω	100 Ω	$\pm 0.02\%$	50 mA
10 k Ω	1 k Ω	$\pm 0.02\%$	16 mA
100 k Ω	10 k Ω	$\pm 0.02\%$	5 mA
1 M Ω	100 k Ω	$\pm 0.02\%$	1.6 mA
100- Ω Rheostat**	1 Ω /div	$\pm 1 \Omega$	200 mA

* At low currents and low frequencies.

** Used in 1434-QC.

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

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

Switches: Multiple wiper, 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 $3\frac{1}{2}$ -in. high, 19-in. relay-rack unit.

Mechanical Data:

Models	Width		Height		Depth		Net Weight		Shipping Weight	
	in.	mm	in.	mm	in.	mm	lb	kg	lb	kg
M, N, P, QC	11 $\frac{3}{4}$	300	2 $\frac{3}{4}$	70	4 $\frac{1}{4}$	108	3	1.4	4	1.9
B, X	13 $\frac{3}{4}$	350	2 $\frac{3}{4}$	70	4 $\frac{1}{4}$	108	3 $\frac{1}{4}$	1.5	4	1.9
G (bench)	17 $\frac{1}{2}$	440	3 $\frac{1}{2}$	89	5	127	6	2.8	7	3.2
G (rack)	19	483	3 $\frac{1}{2}$	89	3 $\frac{1}{2}$	89	6	2.8	7	3.2

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

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:

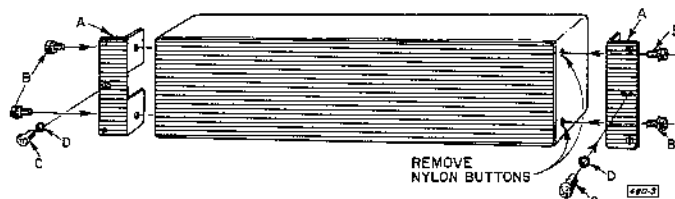


Figure 2. Relay-rack installation of Type 1434-G.

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:

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

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

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

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

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

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

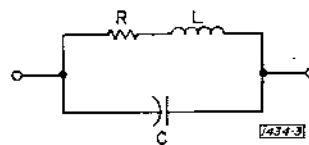


Figure 3. Equivalent circuit of a resistor.

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

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

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

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

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

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.

Our warranty 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 the nearest GR service facility, giving full information of the trouble and of steps taken to remedy it. Describe the instrument by type, serial, and ID numbers. (Refer to front and rear panels.)

4.2 GR FIELD SERVICE.

Instrument Return. Before returning an instrument to General Radio for service, please ask our nearest office for a "Returned Material" number. Use of this number in correspondence and on a tag tied to the instrument will ensure proper handling and identification. After the initial warranty period, please avoid unnecessary delay by indicating how payment will be made, i.e., send a purchase-order number or (for transportation charges) request "C.O.D."

For return shipment, please use packaging that is adequate to protect the instrument from damage, i.e., equivalent to the original packaging. Advice may be obtained from any GR office.

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.

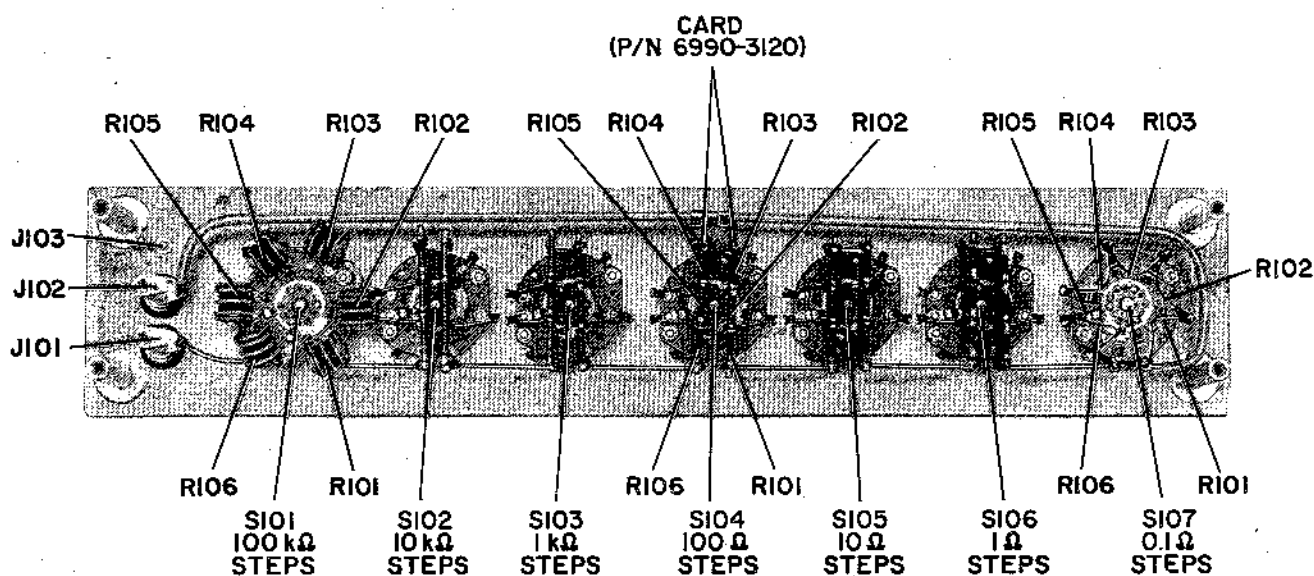


Figure 5. Rear interior view of the Type 1434-G showing the location of resistors, R101 through R106.

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

Type	Switch Numbers						
	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 1 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 $\Omega \pm 2.5\%$	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	24655	7890-4930	
	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	24655	7890-4930	
	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	24655	7890-4930	
	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	24655	7890-4930	
	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	24655	7890-4930	
	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	24655	7890-4930	

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

PARTS LIST (Cont)

Ref.	Description	GR Part No.	FMC	Mfg. Part No.
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

Ref.	Description	GR Part No.	FMC	Mfg. Part No.
All type 1434 models	CONNECTOR (for binding posts)	5080-4800	24655	5080-4800
Type 1434 -N,-M,-P, -QC,-B,-X	FOOT	5260-1800	70485	832, 1/2"
Type 1434 -G only	FOOT	5260-1200	70485	#18, 3/4"
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)	5520-5320	24655	5520-5320
	KNOB (part of 5520-5320)	5520-5300	24655	5520-5300
	FASTENER, Retainer (part of 5520-5320)	5220-5402	24655	5220-5402

Federal Mfg. Code

Code	Manufacturer
24655	GenRad Inc., Concord, Mass. 01742
70485	Atlanta-India Rubber Works, Inc., Chicago, Ill. 60607

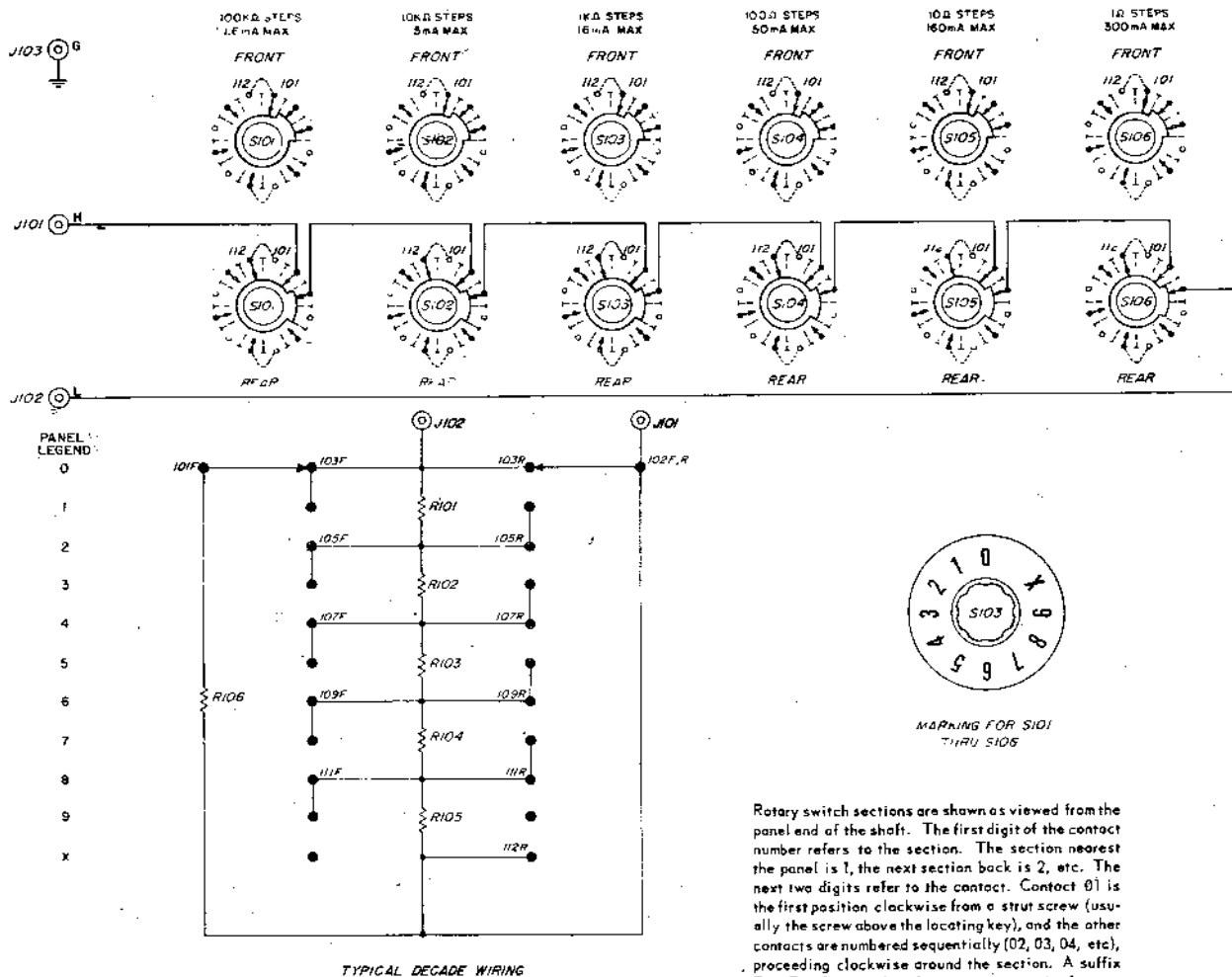


Figure 6. Schematic diagram for the Type 1434-B Decade Resistor (typical connections and wiring for all Type 1434 models.



GenRad

WARRANTY

We warrant that this product is free from defects in material and workmanship and, when properly used, will perform in accordance with applicable GenRad specifications. If within one year after original shipment it is found not to meet this standard, it will be repaired or, at the option of GenRad, replaced at no charge when returned to a GenRad service facility. Changes in the product not approved by GenRad shall void this warranty. GenRad shall not be liable for any indirect, special, or consequential damages, even if notice has been given of the possibility of such damages.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

GenRad policy is to maintain product repair capability for a period of ten years after original shipment and to make this capability available at the then prevailing schedule of charges.



GenRad

300 BAKER AVENUE, CONCORD, MASSACHUSETTS 01742

ATLANTA 404 394-5380 • BOSTON 617 646-0550 • CHICAGO 312 992-0800 • DALLAS 214 234-3357
DAYTON 513 294-1500 • LOS ANGELES 714 540-9830 • NEW YORK (N.Y.) 212 954-2722, (N.J.) 201 791-8990
SAN FRANCISCO 408 985-0642 • WASHINGTON, DC 301 948-7071
TORONTO 416 252-3395 • ZURICH (01) 55 24 20

300 BAKER AVENUE
CONCORD, MASSACHUSETTS 01742

Printed in U.S.A.

Form 1434-0100-E
March 1979
ID-4275