

# Type 1433 DECADE RESISTOR

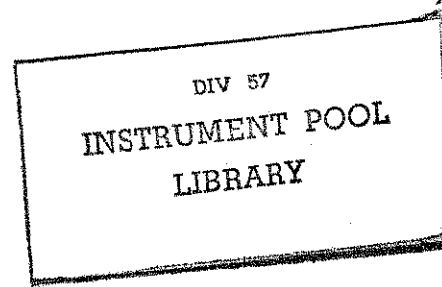
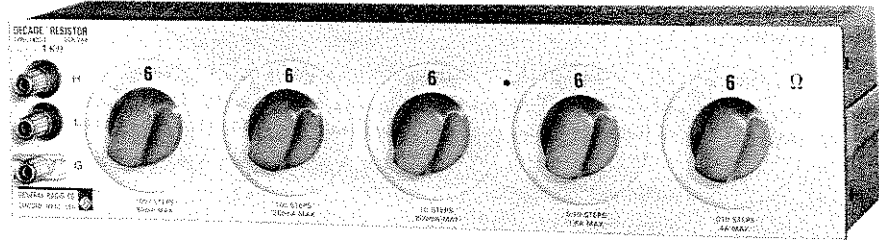
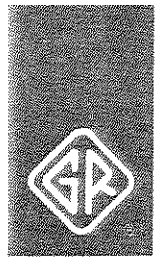


Figure 1-1. Type 1433-T Decade Resistor.

## SPECIFICATIONS

**Long-Term Accuracy:** Our two-year warranty applies to the tolerances given below unless the resistor is damaged by excessive current. These tolerances apply for low-current measurement at dc or low-frequency ac (see below).

**Over-all Accuracy:** The resistance difference between that at any setting and at the zero setting is equal to the indicated value  $\pm(0.02\% + 2 \text{ m}\Omega)$ .

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

**Max Current:** The max current for each decade is given in the table below and also appears on the panel of each decade box and on the dial plate of each decade resistance unit.

**Frequency Characteristic:** Refer to Section 3.

**Zero Resistance (R<sub>0</sub>):** 0.001  $\Omega$  per dial at dc; 0.04  $\Omega$  per dial at 1 MHz; proportional to square root of frequency at all frequencies above 100 kHz.

**Temperature Coefficient of Resistance:** Less than  $\pm 10$  ppm per degree C for values above 100  $\Omega$  and  $\pm 20$  ppm per degree C for 100  $\Omega$  and below, at room temperatures. For the 1433's the box wiring will increase the over-all temperature coefficient of the 0.1- and 0.01- $\Omega$  decades.

**Switches:** Quadruple-leaf brushes bear on lubricated contact studs of  $\frac{3}{8}$ -in. diameter in such a manner as to avoid cutting but yet give a good wiping action. A cam-type detent is provided. There are eleven contact points (0 to 10 inclusive). The switch resistance is less than 0.0005  $\Omega$ . The effective capacitance is of the order of 5 pF, with a dissipation factor of 0.06 at 1 kHz for the

standard cellulose-filled molded phenolic switch form and 0.01 on the mica-filled phenolic form used in the 510-G and 510-H units.

**Max Voltage to Case:** 2000 V pk.

**Terminals:** For 1433, low-thermal-emf jack-top binding posts on standard  $\frac{3}{4}$ -in. spacing. Shield terminal is provided. Soldering lugs for rear connection.

**Mounting:** 1433's in lab-bench cabinet, rack models include mounting hardware; 510's complete with dial plate, knob, template, and mounting screws.

**Dimensions and Weights:** in. (mm), lb (kg):

	4-dial U, K, J, L, Q	5-dial T, N, M, P, Y	6-dial W, X, B, Z	7-dial F, G, H
Width*	12 $\frac{1}{4}$ (315)	14 $\frac{3}{4}$ (375)	17 $\frac{1}{4}$ (445)	
Height	3 $\frac{1}{2}$ (89)			5 $\frac{1}{4}$ (135)
Depth	5 in. over-all, 4 in. behind panel			
Net Wt	4 $\frac{3}{4}$ (2.2)	5 $\frac{3}{4}$ (2.7)	7 (3.2)	8 $\frac{3}{4}$ (4.0)
Ship. Wt	5 $\frac{1}{2}$ (2.5)	6 $\frac{1}{2}$ (3.0)	8 $\frac{1}{2}$ (3.9)	10 $\frac{1}{4}$ (4.7)

\*Data given for bench models. All rack models same except 19 in. wide. Add approx 1 lb for rack-mount hardware.

Type 510's 3 $\frac{1}{8}$  in. (78 mm) diameter, 3 $\frac{1}{8}$  in. (85 mm) behind panel, 11 oz (0.4 kg) net weight.

### DECADE RESISTOR Type 1433

Catalog Number		Type	Total Ohms	Ohms per Step	No. of Dials	Type 510 Decades Used
Bench	Rack					
1433-9700	1433-9701	1433-U	111.1	0.01	4	AA, A, B, C
1433-9702	1433-9703	1433-K	1111	0.1	4	A, B, C, D
1433-9704	1433-9705	1433-J	11,110	1	4	B, C, D, E
1433-9706	1433-9707	1433-L	111,100	10	4	C, D, E, F
1433-9708	1433-9709	1433-Q	1,111,000	100	4	D, E, F, G
1433-9710	1433-9711	1433-T	1111.1	0.01	5	AA, A, B, C, D
1433-9712	1433-9713	1433-N	11,111	0.1	5	A, B, C, D, E
1433-9714	1433-9715	1433-M	111,110	1	5	B, C, D, E, F
1433-9716	1433-9717	1433-P	1,111,100	10	5	C, D, E, F, G
1433-9718	1433-9719	1433-Y	11,111,000	100	5	D, E, F, G, H
1433-9720	1433-9721	1433-W	11,111.1	0.01	6	AA, A, B, C, D, E
1433-9722	1433-9723	1433-X	111,111	0.1	6	A, B, C, D, E, F
1433-9724	1433-9725	1433-B	1,111,110	1	6	B, C, D, E, F, G
1433-9726	1433-9728	1433-Z	11,111,100	10	6	C, D, E, F, G, H
1433-9729	1433-9730	1433-F	111,111.1	0.01	7	AA, A, B, C, D, E, F
1433-9731	1433-9732	1433-G	1,111,111	0.1	7	A, B, C, D, E, F, G
1433-9733	1433-9734	1433-H	11,111,110	1	7	B, C, D, E, F, G, H

### DECADE- RESISTANCE UNITS Type 510

Type	Total Resistance Ohms	Resistance Per Step ( $\Delta R$ ) Ohms	Accuracy of Resistance Increments	Max Current 40° C Rise	Power Per Step Watts	$\Delta L$ $\mu H$
510-AA	0.1	0.01	$\pm 2\%$	4 A	0.16	0.01
510-A	1	0.1	$\pm 0.4\%$	1.6 A	0.25	0.014
510-B	10	1	$\pm 0.1\%$	800 mA	0.6	0.056
510-C	100	10	$\pm 0.04\%$	250 mA	0.6	0.11
510-D	1000	100	$\pm 0.02\%$	80 mA	0.6	0.29
510-E	10,000	1000	$\pm 0.02\%$	23 mA	0.5	13
510-F	100,000	10,000	$\pm 0.02\%$	7 mA	0.5	70
510-G	1,000,000	100,000	$\pm 0.02\%$	2.3 mA	0.5	—
510-H	10,000,000	1,000,000	$\pm 0.02\%$	0.7* mA	0.5	—

\*Or a max of 4000 V, pk.

# INTRODUCTION

## 1.1 PURPOSE.

The 1433 Decade Resistors are primarily used for precision measurement applications that require excellent accuracy, stability, and low zero resistance. They are convenient standards for checking the accuracy of resistance measuring devices and are often used as components in dc and low-frequency ac bridges and other precision measuring circuits. Many models can be used into the rf range. All models are easily rack-mounted for use as precision adjustments in measurement and control systems.

## 1.2 DESCRIPTION.

All 1433 Decade Resistors with four, five, and six decades are housed in 3 1/2-inch-high cabinets. The seven-decade models are approximately 5 1/2-inches high. All models are available for either bench use or installation in a relay rack. Refer to specifications.

The panel binding posts are for general use and connection may also be made at the rear, as is often preferred for rack-mounted decade boxes.

The 1433 Decade Resistors are an assembly of 510 Decade-Resistance Units in a single cabinet. Mechanical as well as electrical shielding of the units and switch contacts is provided by the aluminum cabinet and panel. The resistance elements have no electrical connection to the cabinet and panel: a separate terminal is provided for connection to the case.

Each decade has eleven contact studs and ten resistors connected in series. All contact studs in the lower-valued decades have a silver overlay to ensure stability. All decades have a silver zero-setting contact for low and constant zero resistance.

Winding methods are chosen to reduce the effects of residual reactances. The 1Ω, 10Ω, and 100Ω steps use winding techniques that minimize inductance. The 0.01Ω and 0.1Ω steps are straight wire and hairpin-shaped ribbon respectively, and the higher-valued units are straight wound on forms.

## 1.3 ACCESSORIES AVAILABLE.

Panel-Adaptor Sets are normally supplied with the relay-rack models. These sets (listed in Table 1-2) are also available for mounting 1433 bench models in a standard 19-inch relay rack.

Panel-Adaptor Set for:	Catalog Number
1433-U, -K, -J, -L, -Q	0480-2080
1433-T, -N, -M, -P, -Y	0480-2070
1433-W, -X, -B, -Z	0480-2010
1433-F, -G, -H	0480-2090

# INSTALLATION AND OPERATION

## 2.1 DIMENSIONS.

See Figures 2-1 and 2-2 for approximate dimensions of all 1433 Decade Resistor models.

No. of Decades	Dimensions	
	A	B
4	12 3/8	12 3/16
5	14 15/16	14 3/4
6	17 1/2	17 5/16

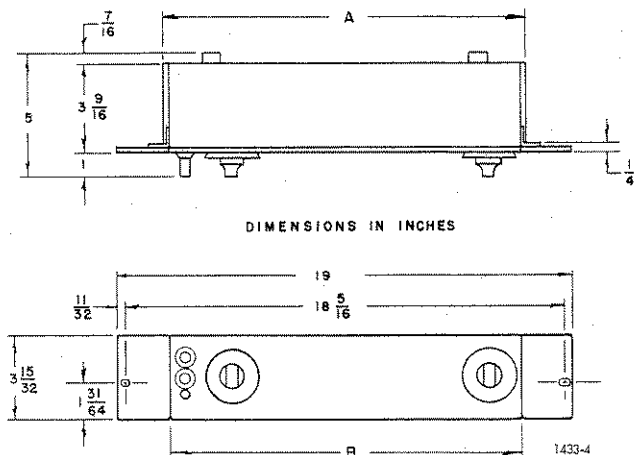


Figure 2-1. Approximate dimensions of 1433 Decade Resistors with 4, 5, and 6 decades. Dimensions A and B apply to bench instruments without Panel-Adaptor Sets.

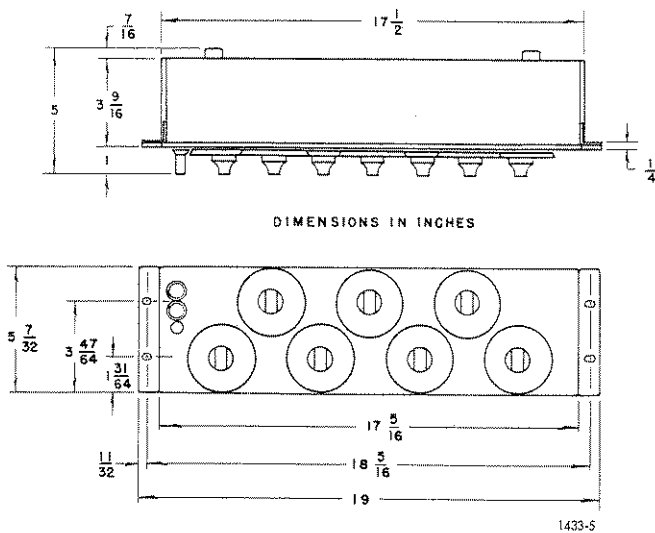


Figure 2-2. Approximate dimensions of 1433 Decade Resistors with 7 decades.

## 2.2 INSTALLATION.

To install a 1433 Decade Resistor in a standard 19-inch relay rack using the appropriate Panel-Adaptor Set, see Figure 2-3 and proceed as follows:

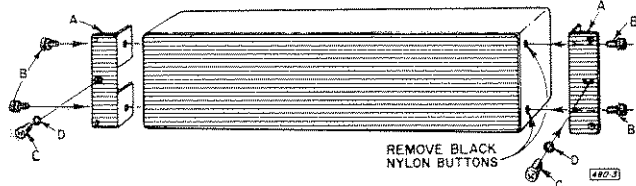


Figure 2-3. Relay-rack installation of a 1433 Decade Resistor.

a. Remove the black nylon buttons from the holes in the side panels of the instrument. These buttons are press fitted and are easily removed with a small screwdriver.

b. Install the adaptor panel (A) on each side of the instrument, using the 3/8-inch locking screws (B) supplied. The holes in the side panels are tapped 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) supplied.

## 2.3 OPERATION.



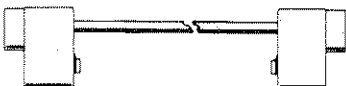
### 2.3.1 CONNECTIONS – GENERAL.

The terminals on the 1433 are standard 3/4-inch-spaced binding posts that accept banana plugs, standard telephone tips, alligator clips, crocodile clips, spade terminals, and wire sizes up to No. 10. See Figure 2-4.

The banana-plug patch cords listed in Table 2-1 are GR catalog items that are readily available for use with the 1433 and associated instruments equipped with 3/4-inch-spaced binding posts.

### 2.3.2 FRONT-PANEL CONNECTIONS.

Standard 3/4-inch-spaced binding posts are available on the front panel for general use. The high (H) and low (L) binding posts are insulated from the panel and used for regular two-terminal applications. For grounded operation, connect the ground link between the ground (G) terminal and the low (L) terminal. Refer to section 3 (Frequency Characteristics) for a detailed comparison of two- and three-terminal connections.

Type	Description	Catalog Number
 274-NQ	Double-plug patch cord, in-line cord, 36" long	0274-9860
274-NQM	Double-plug patch cord, in-line cord, 24" long	0274-9896
274-NQS	Double-plug patch cord, in-line cord, 12" long	0274-9861
 274-NP	Double-plug patch cord, right-angle cord, 36" long	0274-9880
274-NPM	Double-plug patch cord, right-angle cord, 24" long	0274-9892
274-NPS	Double-plug patch cord, right-angle cord, 12" long	0274-9852
 274-NL	Shielded double-plug patch cord, 36" long	0274-9883
274-NLM	Shielded double-plug patch cord, 24" long	0274-9882
274-NLS	Shielded double-plug patch cord, 12" long	0274-9862
274-LLB	Single-plug patch cord, black, 36" long	0274-9468
274-LLR	Single-plug patch cord, red, 36" long	0274-9492
274-LMB	Single-plug patch cord, black, 24" long	0274-9847
274-LMR	Single-plug patch cord, red, 24" long	0274-9848
274-LSB	Single-plug patch cord, black, 12" long	0274-9849
274-LSR	Single-plug patch cord, red, 12" long	0274-9850

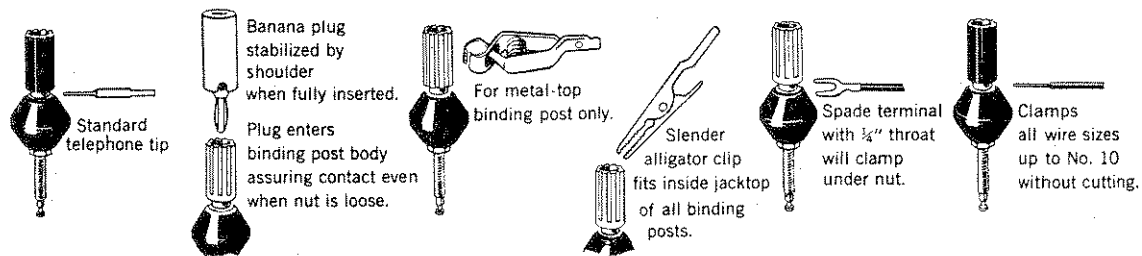


Figure 2-4. Methods of connection to binding-post terminals.

### 2.3.3 REAR CONNECTIONS.

To make connections at the rear of the instrument, refer to Figure 2-5 and proceed as follows:

a. Remove the two 6-32 screws (A) and the panel (B). The high (H) and low (L) terminals on the front panel extend directly to the rear and are available for connection when the panel is removed.

b. Make connection to the rear terminals, using leads equipped with lug or spade connectors, or solder the leads to the terminal lugs provided at the rear of the instrument. If grounded operation is desired, connect the ground link between the ground (G) terminal and the low (L) terminal on the front panel.

c. Reinstall the panel (B), using the two screws (A) previously removed.

### NOTE

In order to provide an opening for connection leads, mount the panel with its slot toward the right, as shown in Figure 2-5. When connections are not made at the rear, mount the panel with its slot facing toward the left to seal the instrument from the outside dust and dirt.

### 2.3.4 READOUT.

All 1433 decades have clear, easy-to-read dials with numbered steps from 0 to X (X = 10). When setting the decade switches, observe the decimal (reference) point on the panel and remember that X equals ten units. For example, using a 1433-T as shown in Figure 1-1, a value of  $54.3\Omega$  is obtained by setting the decade switches as follows:

$$0 \ 5 \ 4 \ . \ 3 \ 0 = 54.3\Omega$$

or

$$0 \ 5 \ 4 \ . \ 2 \ X = 54.3\Omega$$

Note in the above example, that X is equal to a value of ten  $0.01\Omega$  units in that decade, or one  $0.1\Omega$  unit in the next decade to the left.

The following example illustrates the result of setting all decades in a 1433-T to X.

Dial Settings	.....	X	X	X	.X	X
Resistance Value	.....	1	1	1	.1	0 $\Omega$

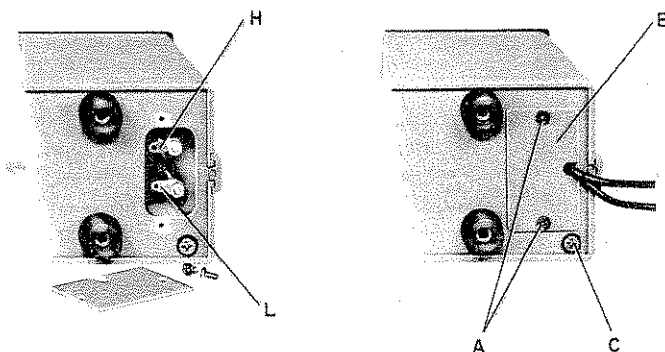


Figure 2-5. Rear view of 1433 Decade Resistor showing exposed rear terminals (left) and rear terminals fully connected (right).

## PRINCIPLES OF OPERATION

### 3.1 FREQUENCY CHARACTERISTICS.

● **Single Resistor.** As the operating frequency is raised, the residual capacitance and inductance changes the terminal resistance of a single resistor from its low-frequency value. For frequencies where the resistance and its associated re-

sidual reactances behave as lumped parameters, the equivalent circuit of such a resistor can be represented as shown in Figure 3-3. In this circuit, L is the equivalent inductance in series with the resistance R, and C is the equivalent capacitance across the terminals.

● Single 510 Decade. An equivalent circuit for a single, shielded 510 Decade Resistance Unit mounted in a 1433 decade box is shown in Figure 3-1 (the values are approximate because they depend on the value of the resistance steps used in the particular decade). The change in effective

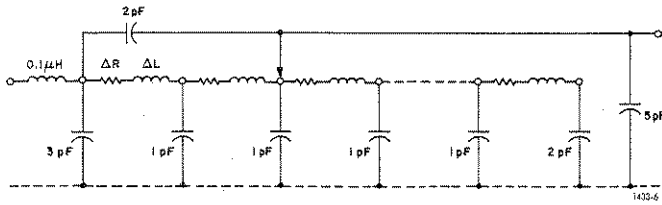


Figure 3-1. Equivalent circuit for a single decade in a decade box.

series\* resistance of an individual decade is shown in Figure 3-2. The series resistance of the high-valued decades is reduced because of shunt capacitance at higher frequencies. The series resistance of the low-valued units is increased because of skin effect.

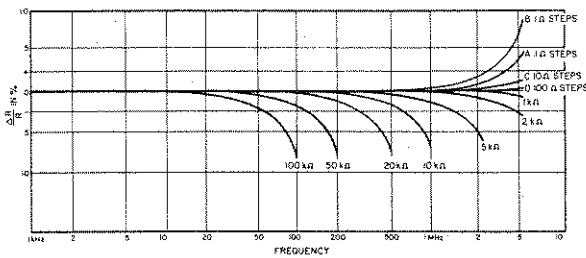


Figure 3-2. Maximum percentage change in series resistance as a function of frequency for Type 510 Decade-Resistance Units.

The parallel\*\* resistance of the high-valued decades changes much less than the series resistance because it is not affected by the lumped shunt capacitance.

● Decade Boxes. When several decades are installed in a 1433 decade box, the complete equivalent circuit becomes too complicated to be useful. A much simpler circuit, such as the one shown in Figure 3-3, is desirable.

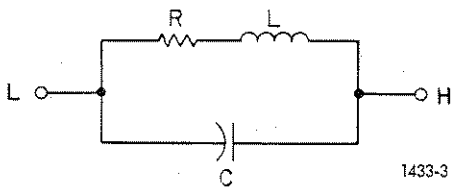


Figure 3-3. A simplified equivalent circuit for a decade box with the low (L) terminal tied to case.

\*Series resistance = real part of impedance:  $Z = R + jX$

\*\*Parallel resistance =  $\frac{1}{G}$   $G$  = real part of admittance:  
 $Y = G + jB$

In figure 3-3:

$R$  = setting of the decade box.

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

where  $L_0 \approx 0.1 \mu H$  per decade  $\times$  number of decades in unit  $+ 0.2 \mu H$ .

$\Delta L_1, \Delta L_2, \dots \approx$  values from table in specifications.

$N_1, N_2, \dots \approx$  settings of corresponding decades.

$C = C_0 + MC_1$

where  $C_0 \approx 15 pF$

$C_1 \approx 19 pF$

$M$  = number of unused decades (set to zero) preceding first decade used.

The phase angle ( $Q$ ) for this circuit is:

$$Q = \omega \left( \frac{L}{R} - RC \right).$$

At low values of  $R$ , the  $\frac{L}{R}$  term is dominant; at high values of  $R$ , the  $RC$  term is more important.

The effective series resistance is:

$$R_s = \frac{R}{1 + \omega^2 R^2 C^2}$$

The effective parallel resistance is:

$$R_p = R \left( 1 + \frac{\omega^2 L^2}{R^2} \right)$$

At low values, the series resistance remains constant to rather high frequencies because inductance has no effect on  $R_s$ . At very low values, skin effect increases  $R_s$  (see Figure 3-2).

At high values, the series resistance falls off rather rapidly with frequency, because of capacitance. The parallel resistance, however, is not affected by the lumped capacitance shown in the simple equivalent circuit (see Figure 3-3). The parallel value is affected by distributed capacitance and dielectric loss not shown. An approximate equation that considers these effects on  $R_p$  is:

$$R_p \approx R \left[ 1 + \frac{\omega^2 L^2}{R^2} - \omega R 10^{-13} - 4\omega^2 R^2 10^{-24} - 25\omega^2 R R_y 10^{-24} \right]$$

The  $\omega R 10^{-13}$  term represents dielectric loss, the next term represents distributed capacitance in the first decade used (not zero), and the last term represents distributed capacitance in the first decade if it is not used (set at zero), where  $R_y$  is the total possible value of that decade. (The last term is not used if the first decade is not set to zero.)

When the case is not tied to either terminal, the decade resistor becomes a three-terminal circuit as shown in Figure 3-4.

In Figure 3-4:

$R$  = setting of the decade box

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

where  $L_0 \approx 0.1 \mu\text{H}$  per decade  $\times$  number of decades in unit  $+ 0.2 \mu\text{H}$ .

$\Delta L_1, \Delta L_2, \dots \approx$  values from table in specifications.

$N_1, N_2, \dots \approx$  settings of corresponding decades

$C_a = 10 M_a + 8 \text{ pF}$ .

where  $M_a =$  number of unused decades (set to zero) preceding first decade used.

$C_b = 19 M_b + 20 \text{ pF}$ .

where  $M_b =$  number of decades after first used (non-zero) decade.

$C_s = 2 \text{ pF}$ .

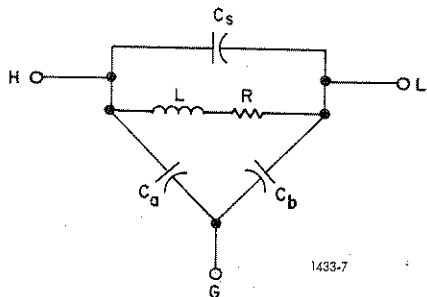


Figure 3-4. Equivalent, three-terminal circuit for a decade box with neither terminal tied to case.

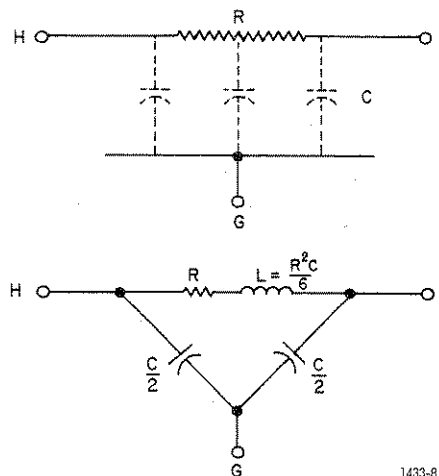


Figure 3-5. Approximation of distributed capacitance effects.

There is also some distributed capacitance ( $C_d$ ) from the resistor to the case, as shown in Figure 3-5. This capacitance has the effect of increasing the effective inductance by an amount of approximately  $N^3 R^2 C \times 10^{-3}$ ; where  $N$  is the setting of the first used (not zero) decade,  $R$  is the total value of the decade resistor, and  $C$  is 2 pF.

## 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, 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 type and serial 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 STANDARDS.

Direct-reading, resistance-measuring instruments that are accurate enough for measuring 1433 performance specifications are not commercially available. 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 SERVICE AND MAINTENANCE NOTES.

#### 4.4.1 GENERAL.

The 1433 Decade Resistor will need little service over the years. Should one of the resistance decades become faulty, it is recommended that the complete switch assembly be replaced. This can be done by competent user personnel or the instrument can be returned to General Radio for service. Use the parts list as a guide in determining which parts may be replaced.

#### 4.4.2 CABINET REMOVAL.

The cabinet is easily removed to gain access to the interior of the instrument: place the cabinet on a flat surface with the rear panel facing upward, remove the three 10-32 screws and lockwashers from the rear panel (c, Figure 2-4), and slide the cabinet up and directly away from the front panel.

To reassemble the unit, place the instrument on a flat surface with its front panel facing down, slide the cabinet into place, and reinstall the three 10-32 screws and lockwashers in the rear panel.

#### 4.4.3 PARTS REPLACEMENT.

Refer to the parts list and Figures 4-1 and 4-2 for 510 Decade Resistance Units and other parts that may require replacement.

**KNOB REMOVAL.** To remove a knob and dial assembly:

- a. Set the decade to the X position.
- b. Grasp the knob firmly with the fingers and pull it straight away from the panel.

#### CAUTION

To avoid damage to the knob and dial assembly, do not pry the knob loose with a screwdriver or similar flat tool, and do not attempt to twist the knob from the shaft.

c. Release the No. 3-32 set screw in the dial-assembly hub and pull the assembly from the shaft.

● **KNOB INSTALLATION.** To install a knob and dial assembly:

- a. Mount the dial assembly in the correct position on the shaft (see step a under KNOB REMOVAL).
- b. Make certain the dial clears the panel and lock the No. 3-32 set screw.

#### NOTE

With the dial assembly properly installed, the end of the shaft should not protrude through the dial-assembly hub so that it interferes with proper seating of the knob.

c. Place the knob on the dial-assembly hub and push it in until it snaps into the groove.

PARTS LIST		
REF. NO.	DESCRIPTION	PART NO.
J101	JACK, Binding post assembly	4060-0108
J102	JACK, Binding post assembly	4060-0108
J103	JACK, Binding post assembly	0938-2022
S101	thru	
S107*	DECADE ASSEMBLY, 510-AA, 0.01Ω/step	0510-4001
	DECADE ASSEMBLY, 510-A, 0.1Ω/step	0510-4002
	DECADE ASSEMBLY, 510-B, 1Ω/step	0510-4003
	DECADE ASSEMBLY, 510-C, 10Ω/step	0510-4004
	DECADE ASSEMBLY, 510-D, 100Ω/step	0510-4005
	DECADE ASSEMBLY, 510-E, 1 kΩ/step	0510-4006
	DECADE ASSEMBLY, 510-F, 10 kΩ/step	0510-4007
	DECADE ASSEMBLY, 510-G, 100 kΩ/step	0510-4008
	DECADE ASSEMBLY, 510-H, 1 MΩ/step	0510-4009
Mechanical Replacement Parts:		
	KNOB ASSEMBLY	5500-5420
	DIAL ASSEMBLY	5120-2033*
	DIAL ASSEMBLY	5120-2040*
	DIAL ASSEMBLY	5120-2041*
	CONNECTING WIRE LINK, Ground strap	5080-4802

\*See Figures 4-1 and 4-2  
Note: There are no Federal Stock Numbers for these parts.

**Table 4-1**  
**Resistance Per Decade — All 1433 Models**  
(Refer to Figures 4-1 and 4-2)

TYPE	S101	S102	S103	S104	S105	S106	S107
1433-U	10 Ω STEPS 250mA MAX	10 Ω STEPS 800mA MAX	0.1 Ω STEPS 1.6A MAX	0.1 Ω STEPS 4A MAX			
1433-K	100 Ω STEPS 80mA MAX	10 Ω STEPS 250 mA MAX	1 Ω STEPS 80 mA MAX	0.1 Ω STEPS 1.6A MAX			
1433-J	1 k Ω STEPS 23mA MAX	100 Ω STEPS 80mA MAX	10 Ω STEPS 250mA MAX	1 Ω STEPS 800mA MAX			
1433-L	10 k Ω STEPS 7mA MAX	1 k Ω STEPS 23mA MAX	100 Ω STEPS 80mA MAX	10 Ω STEPS 250 mA MAX			
1433-Q	100 k Ω STEPS 2.3mA MAX	10 k Ω STEPS 7mA MAX	1 k Ω STEPS 23 mA MAX	100 Ω STEPS 80mA MAX			
1433-Y	100 Ω STEPS 80mA MAX	10 Ω STEPS 250mA MAX	1 Ω STEPS 800mA MAX	0.1 Ω STEPS 1.6A MAX	0.1 Ω STEPS 4A MAX		
1433-N	1 k Ω STEPS 23mA MAX	100 Ω STEPS 80mA MAX	10 Ω STEPS 250mA MAX	1 Ω STEPS 800mA MAX	0.1 Ω STEPS 1.6A MAX		
1433-M	10 k Ω STEPS 7mA MAX	1 k Ω STEPS 23mA MAX	100 Ω STEPS 80mA MAX	10 Ω STEPS 250mA MAX	1 Ω STEPS 800mA MAX		
1433-P	100 k Ω STEPS 2.3mA MAX	10 k Ω STEPS 7mA MAX	1 k Ω STEPS 23mA MAX	100 Ω STEPS 80mA MAX	10 Ω STEPS 250mA MAX		
1433-Y	1 M Ω STEPS 0.7mA MAX	100 k Ω STEPS 2.3mA MAX	10 k Ω STEPS 7mA MAX	1 k Ω STEPS 23mA MAX	100 Ω STEPS 80mA MAX		
1433-W	1 k Ω STEPS 23mA MAX	100 Ω STEPS 80mA MAX	10 Ω STEPS 250mA MAX	1 Ω STEPS 800mA MAX	0.1 Ω STEPS 1.6A MAX	0.1 Ω STEPS 4A MAX	
1433-X	10 k Ω STEPS 7mA MAX	1 k Ω STEPS 23mA MAX	100 Ω STEPS 80mA MAX	10 Ω STEPS 250 mA MAX	1 Ω STEPS 800mA MAX	0.1 Ω STEPS 1.6A MAX	
1433-B	100 k Ω STEPS 2.3mA MAX	10 k Ω STEPS 7mA MAX	1 k Ω STEPS 23mA MAX	100 Ω STEPS 80mA MAX	10 Ω STEPS 250mA MAX	1 Ω STEPS 800mA MAX	
1433-Z	1 M Ω STEPS 0.7mA MAX	100 k Ω STEPS 2.3mA MAX	10 k Ω STEPS 7mA MAX	1 k Ω STEPS 23mA MAX	100 Ω STEPS 80mA MAX	10 Ω STEPS 250mA MAX	
1433-F	10 k Ω STEPS 7mA MAX	1 k Ω STEPS 23mA MAX	100 Ω STEPS 80mA MAX	10 Ω STEPS 250mA MAX	1 Ω STEPS 800mA MAX	0.1 Ω STEPS 1.6A MAX	0.1 Ω STEPS 4A MAX
1433-G	100 k Ω STEPS 2.3mA MAX	10 k Ω STEPS 7mA MAX	1 k Ω STEPS 23mA MAX	100 Ω STEPS 80mA MAX	10 Ω STEPS 250mA MAX	1 Ω STEPS 800mA MAX	0.1 Ω STEPS 1.6A MAX
1433-H	1 M Ω STEPS 0.7mA MAX	100 k Ω STEPS 2.3mA MAX	10 k Ω STEPS 7mA MAX	1 k Ω STEPS 23mA MAX	100 Ω STEPS 80mA MAX	10 Ω STEPS 250mA MAX	1 Ω STEPS 800mA MAX

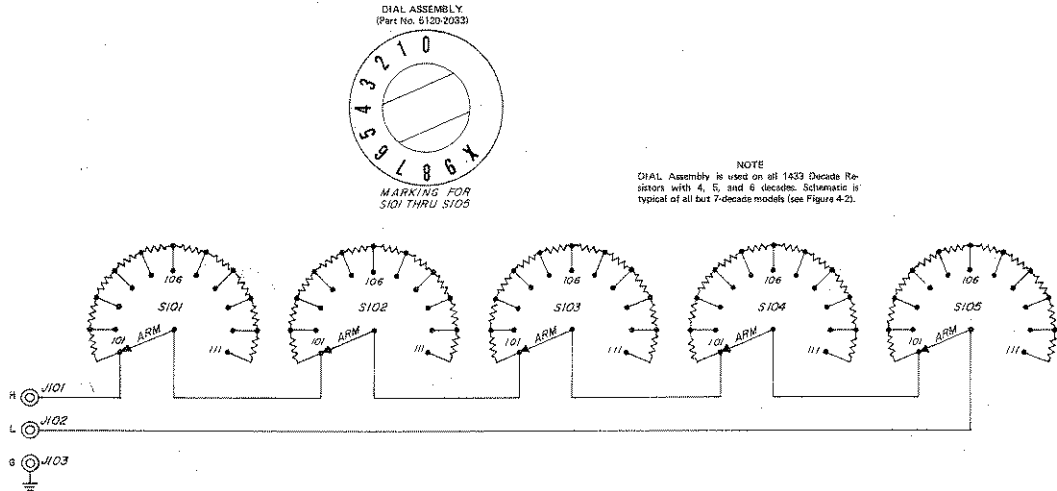


Figure 4-1. Schematic diagram for Type 1433-T, -N, -M, -P, and -Y Decade Resistors.

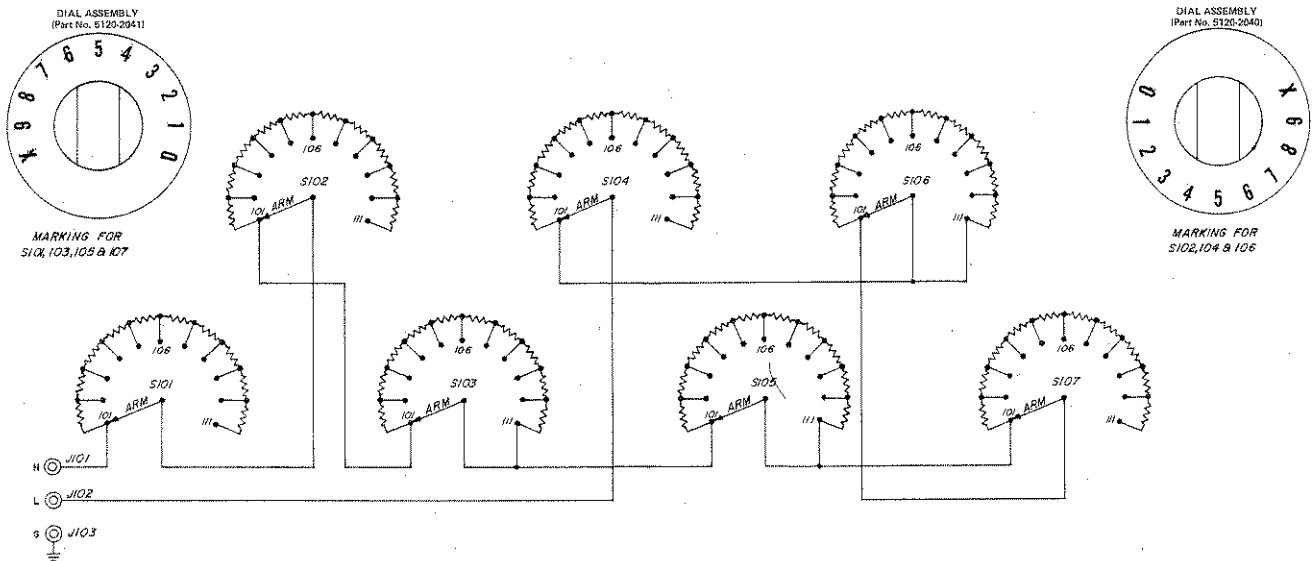


Figure 4-2. Schematic diagram for Type 1433-F, -G, and -H Decade Resistors.

## GENERAL RADIO COMPANY

### WEST CONCORD, MASSACHUSETTS 01781

\*NEW ENGLAND: 22 Baker Avenue  
West Concord, Massachusetts 01781

SYRACUSE: Pickard Building, East Molloy Road  
Syracuse, New York 13211

\*DALLAS: 2600 Stemmons Freeway, Suite 210  
Dallas, Texas 75207

\*METROPOLITAN 845 Broad Avenue  
NEW YORK: Ridgefield, New Jersey 07657

CLEVELAND: 5579 Pearl Road  
Cleveland, Ohio 44129

\*LOS ANGELES: 1000 North Seward Street  
Los Angeles, California 90038

PHILADELPHIA: Fort Washington Industrial Park  
Fort Washington, Pennsylvania 19034

\*CHICAGO: 9440 W. Foster Avenue  
Chicago, Illinois 60656

SAN FRANCISCO: 626 San Antonio Road  
Mountain View, California 94040

\*WASHINGTON 11420 Rockville Pike  
and BALTIMORE: Rockville, Maryland 20852

MONTREAL: 1255 Laird Boulevard  
Town of Mount Royal, Quebec, Canada

ORLANDO: 113 East Colonial Drive  
Orlando, Florida 32801

\*TORONTO: 99 Floral Parkway  
Toronto 15, Ontario, Canada

\*Repair services are available at these offices.

GENERAL RADIO COMPANY (Overseas), 8008 Zurich, Switzerland  
GENERAL RADIO COMPANY (U.K.) LIMITED, Bourne End, Buckinghamshire, England  
Representatives in Principal Overseas Countries

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