Type 1432 DECADE RESISTOR

Type 510 DECADE-RESISTANCE UNIT

FEATURES: ±0.025% accuracy. ■ Low thermal emf to copper. Low zero resistance. ■ Low temperature coefficient of resistance. Resistance increments, as well as total value, are always correctly indicated. Good frequency characteristics. ■ Residual reactances are small and known. Excellent stability. ■ Unaffected by high humidity.

USES: The TYPE 1432 Decade Resistors are primarily intended for precision measurement applications where their excellent accuracy, stability, and low zero resistance are important. They are convenient resistance standards for checking the accuracy of resistance measuring devices and are used as components in dc and audio-frequency impedance bridges. Many of the models can be used up into the radio frequency range. While they are also useful as substitution boxes for optimizing electronic circuitry, the less expensive TYPE 1434 Decade Resistors are recommended for such less exacting applications.

The individual decades (TYPE 510 Decade-Resistance Units) are available for applications requiring only one decade or as components to be built into experimental equipment, production test equipment, or commercial instruments.

DESCRIPTION: Each TYPE 510 Decade-Resistance Unit is enclosed in an aluminum shield, and a knob and etched-metal dial plate are supplied. The switch assemblies, less resistors, are also available as the TYPE 510-P and -P4L Switches.

The TYPE 1432 Decade Resistor is an assembly TYPE 510 Decade-Resistance Units in a single cabine Mechanical as well as electrical shielding of the uni and switch contacts is provided by the attracti aluminum cabinet and panel. The resistance elemen have no electrical connection to the cabinet and pan for which a separate shield terminal is provided.

Each decade has eleven contact studs and t resistors in series. All the contact studs in the lowe valued decades have a silver overlay to ensure stabili of resistance, and all the decades have a silver conta on the zero setting to give low and constant ze resistance.

Winding methods are chosen to reduce the effects residual reactances. The 1-, 10-, and 100-ohm steps u winding techniques that minimize inductance. The 0.0 and 0.1-ohm steps are straight wire and hairpin-shap ribbon respectively, and the high valued units a straight wound on mica forms.

SPECIFICATIONS

Long-Term Accuracy: ±0.025% for resistance settings on decades above 100 Ω per step. For lower resistance settings, see table. Our general two-year warranty applies to these tolerances unless the unit is damaged by excessive current. Tolerance shown applies to both resistance increments and total resistance after correction for zero resistance.

Maximum Current: The maximum 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.

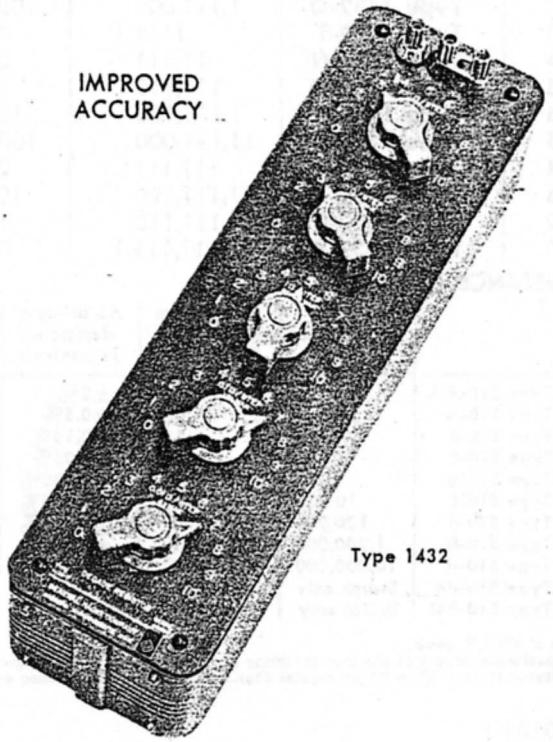
Frequency Characteristic: The accompanying plot shows the maximum percentage change in effective series resistance, as a function of frequency for the individual decade units. For low-resistance decades the error is due almost entirely to skin effect and is independent of switch setting, while for the high-resistance units the error is due almost entirely to the shunt capacitance and its losses and is approximately proportional to the square of the resistance setting.

The high-resistance decades (TYPES 510-E, -F, -G, and -H) are very commonly used as parallel resistance elements in resonant circuits, in which the shunt capacitance of the decades becomes part of the tuning capacitance. The parallel resistance changes by only a fraction (between a tenth and a hundredth) of the series-resistance change, depending on frequency and the insulating material in the switch.

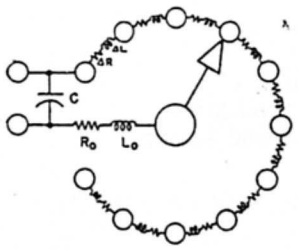
Characteristics of the TYPE 1432 Decade Resistors are simil to those of the individual TYPE 510 units, modified by the i creased series inductance, L_s, and shunt capacitance, C, due the wiring and the presence of more than one decade in t assembly. At total resistance settings of approximately 10 ohms or less, the frequency characteristics of any of these deca resistors are substantially the same as those shown for the Ty 510 units. At higher settings, shunt capacitance becomes t controlling factor, and the effective value of this capacitan depends upon the settings of the individual decades.

Type 510

IMPROVED ACCURACY

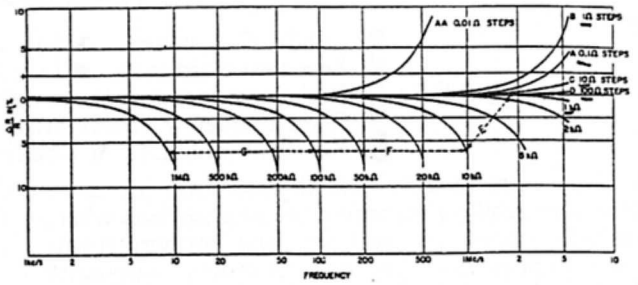


Type 1432



(Left) Equivalent circuit of a resistance decade, showing location and nature of residual impedances.

(Right) Maximum percentage change in series resistance as a function of frequency for Type 510 Decade-Resistance Units.



Typical Values of R_0, L_0, and C for the Decade Resistors:

Zero Resistance (R_0): 0.001 Ω per dial at dc; 0.04 Ω per dial at 1 Mc/s; proportional to square root of frequency at all frequencies above 100 kc/s.

Zero Inductance (L_0): 0.1 μH per dial.

Effective Shunt Capacitance (C): This value is determined largely by the highest decade in use. With the low terminal connected to shield, a value of 15 to 10 pF per decade may be assumed, counting decades down from the highest. Thus, if the third decade from the top is the highest resistance decade in circuit (i.e., not set at zero), the shunting terminal capacitance is 45 to 30 pF. If the highest decade in the assembly is in use, the effective capacitance is 15 to 10 pF, regardless of the settings of the lower-resistance decades.

Temperature Coefficient of Resistance: Less than ±10 ppm per degree C for values above 100 Ω and ±20 ppm per degree C for 100 Ω and below, at room temperatures. For the TYPE 1432 Decade Resistors, the box wiring will increase the over-all temperature coefficient of the 0.1- and 0.01-Ω decades.

Switches: Quadruple-leaf brushes bear on lubricated contact studs of ⅜-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 Ω. The effective capacitance is of the order of 5 pF, with a dissipation factor of 0.06 at 1 kc/s for the standard cellulose-filled molded phenolic switch form and 0.01 on the mica-filled phenolic form used in the TYPE 510-G and 510-H units.

Maximum Voltage to Case: 2000 V peak.

Terminals: For TYPE 1432, low-thermal-emf jack-top binding posts on standard ¾-in spacing. Shield terminal is provided. TYPE 510 units have soldering lugs.

Mounting: TYPE 1432, lab-bench cabinet TYPE 510, complete with dial plate, knob, template, and mounting screws.

Mechanical Data:

Type 1432	*Width*		*Height*		*Length*		*Net Wt*		*Ship Wt*	
	in	*mm*	*in*	*mm*	*in*	*mm*	*lb*	*kg*	*lb*	*kg*
4-Dial	4 5/16	110	4¾	125	13	330	5¼	2.4	6	2.8
5-Dial	4 5/16	110	4¾	125	15¾	400	6¼	2.9	7	3.2
6-Dial	4 5/16	110	4¾	125	18¼	465	7½	3.5	9	4.1
Type 510	*Diameter*		*Depth Behind Panel*				*oz*	*kg*	*lb*	*kg*
	3 1/16	78	3 5/16	85			11	0.4	2	1

DECADE RESISTORS

Catalog Number		*Total Ohms*	*Multiple of*	*No. of Dials*	*Type 510 Decades Used*
1432-9721	**Type 1432-U**	111.1	0.01 ohm	4	AA, A, B, C
1432-9711	**Type 1432-K**	1111	0.1	4	A, B, C, D
1432-9710	**Type 1432-J**	11,110	1	4	B, C, D, E
1432-9712	**Type 1432-L**	111,100	10	4	C, D, E, F
1432-9717	**Type 1432-Q**	1,111,000	100	4	D, E, F, G
1432-9720	**Type 1432-T**	1111.1	0.01	5	AA, A, B, C, D
1432-9714	**Type 1432-N**	11,111	0.1	5	A, B, C, D, E
1423-9713	**Type 1432-M**	111,110	1	5	B, C, D, E, F
1432-9716	**Type 1432-P**	1,111,100	10	5	C, D, E, F, G
1432-9725	**Type 1432-Y**	11,111,000	100	5	D, E, F, G, H
1432-9724	**Type 1432-X**	111,111	0.1	6	A, B, C, D, E, F
1432-9726	**Type 1432-Z**	11,111,100	10	6	C, D, E, F, G, H
1432-9702	**Type 1432-B**	1,111,110	1	6	B, C, D, E, F, G
1432-9723	**Type 1432-W**	11,111.1	0.01	6	AA, A, B, C, D, E

DECADE-RESISTANCE UNITS

Catalog Number		*Total Resistance Ohms*	*Resistance Per Step (ΔR) Ohms*	*Accuracy of Resistance Increments*	*Maximum Current 40° C Rise*	*Power Per Step Watts*	*ΔL μH*	*C** pF*	*L_0 μH*
0510-9806	**Type 510-AA**	0.1	0.01	±2%	4 A	0.16	0.01	7.7–4.5	0.023
0510-9701	**Type 510-A**	1	0.1	±0.5%	1.6 A	0.25	0.014	7.7–4.5	0.023
0510-9702	**Type 510-B**	10	1	±0.15%	800 mA	0.6	0.056	7.7–4.5	0.023
0510-9703	**Type 510-C**	100	10	±0.05%	250 mA	0.6	0.11	7.7–4.5	0.023
0510-9704	**Type 510-D**	1000	100	±0.025%	80 mA	0.6	0.29	7.7–4.5	0.023
0510-9705	**Type 510-E**	10,000	1000	±0.025%	23 mA	0.5	3.3	7.7–4.5	0.023
0510-9706	**Type 510-F**	100,000	10,000	±0.025%	7 mA	0.5	9.5	7.7–4.5	0.023
0510-9707	**Type 510-G**	1,000,000	100,000	±0.025%	2.3 mA	0.5	—	7.7–4.5	0.023
0510-9708	**Type 510-H**	10,000,000	1,000,000	±0.025%	0.7* mA	0.5	—	13.5–5.0	0.023
0510-9604	**Type 510-P4**	Switch only	(Black Phenolic Frame)						
0510-9511	**Type 510-P4L**	Switch only	(Low-Loss Phenolic Frame)						

* Or a maximum of 4000 V, peak.
** The larger capacitance occurs at the lowest setting of the decade. The values given are for units without the shield cans in place. With the shield cans in place, the shunt capacitance is from 10 to 20 pF greater than indicated here, depending on whether the shield is tied to the switch or to the zero end of the decade.

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