

THE NEW TYPE 1432 DECADE RESISTORS

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● **THE PRECISION DECADE RESISTOR** is as useful and as necessary in the electrical measurement laboratory of today as is the wrench or the screwdriver on the mechanic's bench. Such everyday items reach, over the years, a certain stability of design not enjoyed by their more glamorous cousins in new and rapidly moving fields. But even monkey wrenches are re-

designed and improved as new materials and processes become available.

This spring the old familiar TYPE 602 Decade Resistor appears in new packaging and under a new type number. Although the new cabinet is the most visible feature, far more important are the increased accuracy and stability. The basic accuracy of the resistance units is now $\pm .05\%$, better by a factor of two than that of their predecessors. Such a change is not accomplished overnight — in anticipation of this move, about 90% of GR precision resistors have been within the new tolerances for the past several years, and a large percentage of the last production runs of the TYPE 602 met the accuracy specifications of the TYPE 1432.

A TYPE 1432 Decade Resistor consists of a combination of TYPE 510

Figure 1. View of a Type 1432-A Decade Resistor. Inset at lower left shows Type 510-D Decade-Resistance Unit.



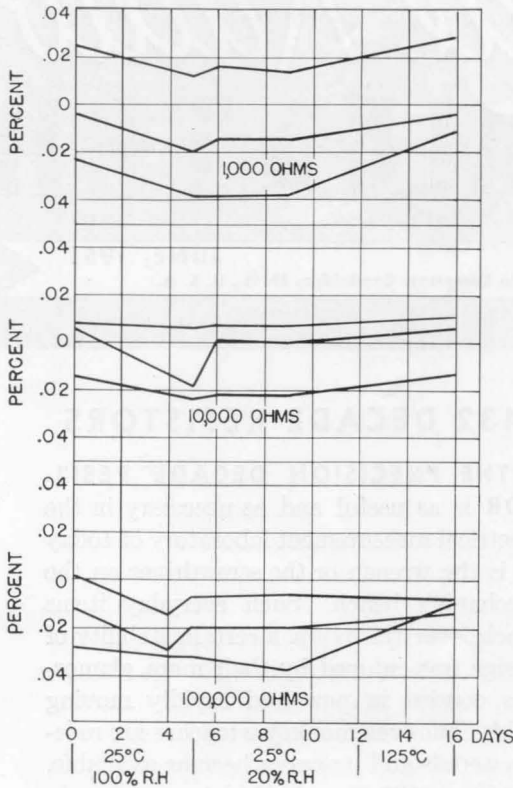


Figure 2. Measured deviations of typical resistance cards when subjected to extreme conditions of temperature and humidity. Long-term tests show a similar degree of stability.

Decade Resistance Units mounted on an aluminum panel and encased in a welded aluminum cabinet. Ample mechanical strength is assured by the use of $\frac{3}{16}$ -inch panel and $\frac{1}{8}$ -inch walls. A considerable reduction in volume is realized — $\frac{1}{8}$ -inch aluminum replacing $\frac{5}{8}$ -inch hardwood reduces both width and length by a full inch. Excellent electrostatic shielding and good thermal characteristics are also assured by this construction. A separate binding post for connection to the case is provided, thus permitting shielding of the resistors whether used grounded or ungrounded. Other time-proved features, such as engraving the current carrying capacity of each decade on the panel, are included.

Whether sold separately or assembled into "resistance boxes," the TYPE 510 Decade Units carry the new accuracy specifications, which, in the following table, are compared to the old.

Type	Resistance per Step	Percent Tolerance	
		New	Old
510-A	.1 Ω	± 0.5	± 1.0
510-B	1. Ω	± 0.15	± 0.25
510-C	10. Ω	± 0.05	± 0.10
510-D	100. Ω	± 0.05	± 0.10
510-E	1000. Ω	± 0.05	± 0.10
510-F	10. k Ω	± 0.05	± 0.10
510-G	100. k Ω	± 0.05	± 0.10

Mere accuracy of adjustment, however, is not sufficient in a laboratory resistor. The stability of resistance value is equally important, if not more so. The resistor units used in General Radio Decades have a stability considerably better than the accuracy of adjustment and can be expected to stay within their specified tolerances well beyond the one-year warranty period.

Both the improved accuracy and greater stability result largely from the use of new resistance alloys made available during the past decade. These improved alloys have a low temperature coefficient that is substantially constant over a wide range of operating temperature, a high specific resistivity low thermal emf to copper, and a remarkable insensitivity to changes in resistance induced by mechanical strain. Furthermore, fine wire drawn of these alloys is much less susceptible to deterioration under conditions of high humidity than are the older alloys.

The new alloys are used in the 100 Ω , 1 k Ω , 10 k Ω , and 100 k Ω units. Manganin is still used in the lower-resistance units, where wire diameter is larger and atmospheric conditions are not so significant in determining long-time stability.

Figure 2 shows the performance of groups of 1 k Ω , 10 k Ω , and 100 k Ω cards



DECADE, TYPE 510	A	B	C	D	E	F	G
OHMS PER STEP	0.1	1	10	100	1000	10000	100000
TYPE 1432-N	•	•	•	•	•	•	•
TYPE 1432-M	•	•	•	•	•	•	•
TYPE 1432-P	•	•	•	•	•	•	•
TYPE 1432-K	•	•	•	•	•	•	•
TYPE 1432-J	•	•	•	•	•	•	•
TYPE 1432-L	•	•	•	•	•	•	•
TYPE 1432-Q	•	•	•	•	•	•	•
TYPE 1432-F	•	•	•	•	•	•	•
TYPE 1432-C	•	•	•	•	•	•	•
TYPE 1432-A	•	•	•	•	•	•	•

Figure 3. Chart showing the ranges of Type 1432 Decade Resistors currently available.

recently taken at random from production stock and subjected to temperature and humidity cycling. The excellent performance on these accelerated short-term tests has been duplicated by long-term tests over a period of years. Groups of these resistance units, used as working standards in our shops and laboratories, have shown a stability of better than 0.01% under constant usage over a period of years.

The 100,000-ohm unit is a new design, replacing the spool-wound resistors formerly employed for this resistance value. The winding form is a thin mica card of the type employed successfully for over

twenty years in 1000-ohm and 10,000-ohm units. The high-resistivity alloy, in a wire having a diameter of one-thousandth of an inch, allows the desired resistance to be wound on a form of substantially the same size as used for lower-resistance units. These new 100,000 ohm cards result not only in improved performance but also in a reduction in the price of the TYPE 510-G Decade Resistance Unit, which uses ten of these cards.

The TYPE 1432 Decade Resistor is offered in three-, four-, and five-decade boxes in a total of ten different combinations. Included in these are four boxes containing the one-megohm decade, TYPE 510-G. With seven decades having increments per step ranging from 0.1 ohm to 100 k Ω , there are three possible 5-dial combinations, four possible 4-dial combinations, and five possible 3-dial combinations. Figure 3 indicates, by type number, the combinations available. The suffix letter formerly used is retained—thus TYPE 602-J is replaced by TYPE 1432-J.

— IVAN G. EASTON

SPECIFICATIONS

Frequency Characteristics: Identical with those of the previous design, TYPE 602. A discussion of the frequency characteristics of these resistors will be found in the *Experimenter* for December, 1940, under the title "Radio Frequency Characteristics of Decade Resistors."

Residual Impedances:

Zero Resistance (R_0): 0.002 to 0.003 ohm per dial at dc; 0.04 ohm per dial at 1 Mc; proportional to square root of frequency at all frequencies above 100 kc.

Zero Inductance (L_0): 0.10 μ h 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 μ mf 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 capaci-

tance is 45 to 30 μ mf. If the highest decade in the assembly is in use, the effective capacitance is 15 to 10 μ mf, regardless of the settings of the lower-resistance decades.

Temperature Coefficient of Resistance: Less than $\pm 0.002\%$ per degree Centigrade at room temperatures, except for the 0.1 Ω decade, where the box wiring will increase the over-all temperature coefficient.

Accuracy of Adjustment: All cards are adjusted within $\pm 0.05\%$ of the stated value between card terminals, except for the 1-ohm cards which are adjusted within $\pm 0.15\%$ and the 0.1-ohm units which are adjusted within $\pm 0.5\%$.

Maximum Current: Same as for previous models, TYPE 602. Values for 40° Centigrade rise are engraved on panels directly above switch knobs.

Terminals: Jack-top binding posts set on General Radio standard $\frac{3}{4}$ -inch spacing. Shield terminal is provided.



Mounting: Aluminum panel and cabinet.

Dimensions: Width, $4\frac{5}{16}$ inches; height, $4\frac{1}{16}$ inches; length, $10\frac{5}{16}$ inches for 3-dial, 13 inches for 4-dial, and $15\frac{3}{4}$ inches for 5-dial box.

Net Weight: TYPE 1432-A, C, F, 4 pounds, 2 ounces; TYPE 1432-J, K, L, Q, 5 pounds, 2 ounces; TYPE 1432-M, N, P, 6 pounds, 5 ounces.

<i>Type</i>	<i>Resistance</i>	<i>No. of Dials</i>	<i>Type 510 Decades Used</i>	<i>Code Word</i>	<i>Price</i>
1432-F	111 ohms total, in steps of 0.1 ohm	3	A, B, C	DELTA	\$ 56.00
1432-K	1,111 ohms total, in steps of 0.1 ohm	4	A, B, C, D	DEFER	75.00
1432-C	11,100 ohms total, in steps of 10 ohms	3	C, D, E	DEBAR	65.00
1432-J	11,110 ohms total, in steps of 1 ohm	4	B, C, D, E	DEBIT	83.00
1432-N	11,111 ohms total, in steps of 0.1 ohm	5	A, B, C, D, E	DEMON	99.00
1432-L	111,100 ohms total, in steps of 10 ohms	4	C, D, E, F	DECAY	87.00
1432-M	111,110 ohms total, in steps of 1 ohm	5	B, C, D, E, F	DEMIT	107.00
1432-A	1,110,000 ohms total, in steps of 1000 ohms	3	E, F, G	DEMUR	96.00
1432-Q	1,111,000 ohms total, in steps of 100 ohms	4	D, E, F, G	DEPOT	113.00
1432-P	1,111,100 ohms total, in steps of 10 ohms	5	C, D, E, F, G	DETER	133.00

TYPE 510 DECADE-RESISTANCE UNIT

For building into the equipment, the individual resistance decades used in the TYPE 1432 Decade Resistors are available as the TYPE 510 Decade Resistance Units.

Accuracy specifications are given in the table on page 2. Other specifications remain unchanged from previous models. Units are supplied complete with dial plate, knob, and drilling template. See also photograph on page 1.

<i>Type</i>	<i>Resistance</i>		<i>Code Word</i>	<i>Price</i>
	<i>Total</i>	<i>Per Step</i>		
510-A	1 ohm	0.1 ohm	ELATE	\$12.00
510-B	10 ohms	1 ohm	ELDER	14.00
510-C	100 ohms	10 ohms	ELEGY	14.00
510-D	1,000 ohms	100 ohms	ELBOW	16.50
510-E	10,000 ohms	1,000 ohms	ELECT	18.50
510-F	100,000 ohms	10,000 ohms	ELVAN	21.50
510-G	1,000,000 ohms	100,000 ohms	ENTER	40.00

A MULTIRANGE FILTER FOR AUDIO AND ULTRASONIC AMPLIFIERS

The TYPE 1231-B Amplifier and Null Detector has proved a useful instrument for balancing impedance bridges at audio and ultrasonic frequencies up to about 100 kc. In order to eliminate harmonics and minimize background noise, amplifier selectivity, even at the expense of some insertion loss, is almost universally desirable. Antiresonant *L-C* filters, tuned for 60 cycles (TYPE 1231-P2) and for either 400 cycles or 1 kc

(TYPE 1231-P3), have been available to convert the TYPE 1231-B into a tuned amplifier at these specific frequencies.

The new TYPE 1231-P5 Filter extends the frequency range and provides tuning at eleven discrete frequencies at which impedance measurements are frequently made, namely, 50, 100, 200, and 500 cycles and 1, 2, 5, 10, 20, 50, and 100 kc. This filter is particularly useful in dielectric measurements with the TYPE

