TYPE 510
DECADE RESISTANCE UNITS

USES

Because of their accuracy, compactness, and sturdy construction, the Type 510 Decade - Resistance Units are ideal for assembly into production test instruments, bridges, and other experimental and permanent equipment. They are particularly useful in applications where only one or two decades are needed, or where a Type 1432 Decade Resistor cannot be mounted conveniently. In many cases, the use of these units will release for general laboratory work relatively more expensive decade resistors, that would otherwise be tied up for long periods of time in experimental equipment.

DESCRIPTION

Winding methods are chosen to reduce the effects of residual reactances. The 1-, 10-, and 100 Ω steps are Ayrton-Perry wound on special 5-section card forms. The 0.01- and 0.1-ohm steps are straight wire and hairpin-shaped ribbon, respectively, while the 1000-, 10,000-, and 100,000-ohm steps are unifilar wound on thin mica cards.

Each decade is enclosed in an aluminum shield, and a knob and etched-metal dial plate are supplied. The mechanical assembly is also available complete with shield, blank dial plate, switch stops, and knob, but without resistors, as the Type 510-P3 and -P3L Switches.

FEATURES

- High accuracy — ±0.025% or better for most units.
- Excellent stability — newly developed stable resistance alloys, with final resistance adjustment after artificial aging.
- Good frequency characteristics—most Type 510 Decades can be used at frequencies as high as several hundred kilohertz, as well as at dc.
- Low temperature coefficient.
- Negligible thermal emf to copper.
- Unaffected by high humidity—even the high resistance units can be exposed to high humidity for long periods of time without significant permanent change in resistance.

SPECIFICATIONS

Accuracy of Adjustment: Each of the ten resistors in each decade is adjusted to be accurate at its terminals within the tolerances given in Table 1. Resistance increments are accurate to this same tolerance.

Total Resistance: The resistance at the decade terminals is the sum of the switch resistance (see below) and that indicated by the switch setting.

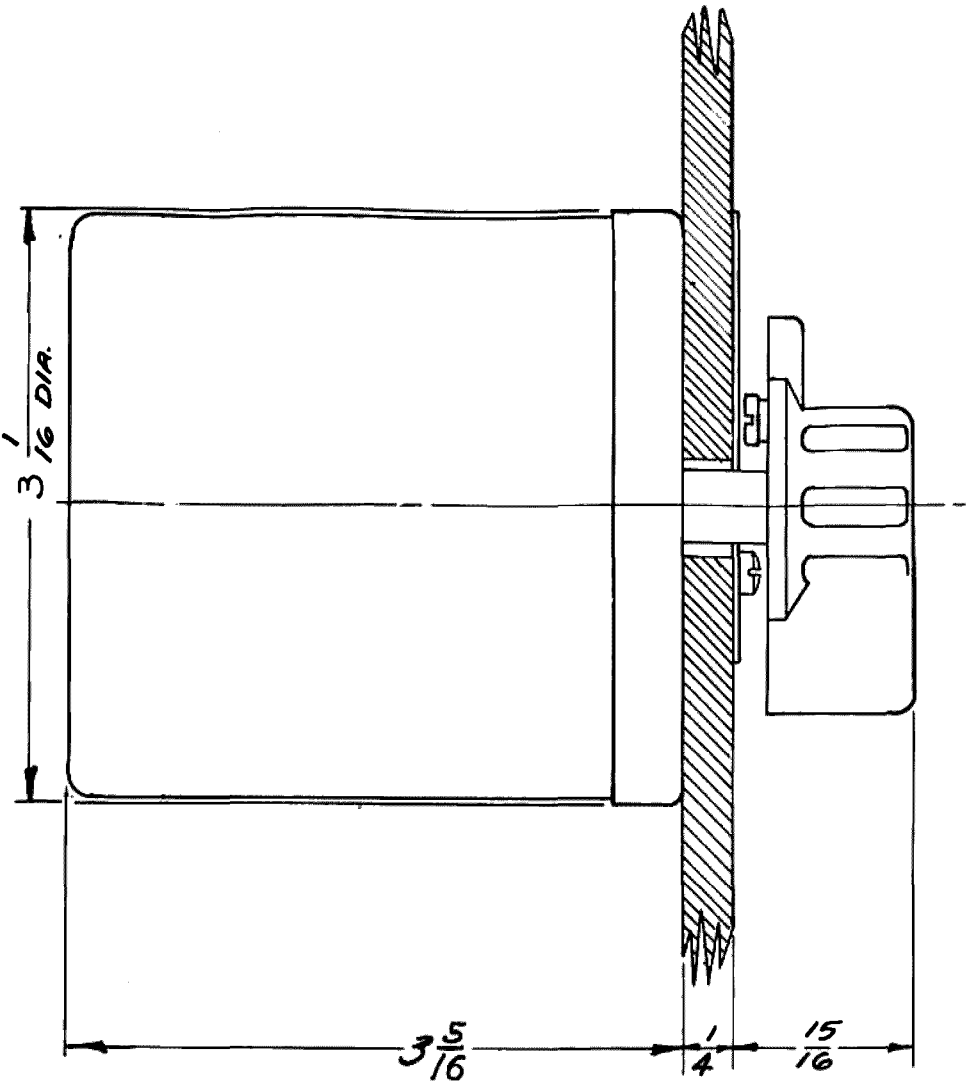
Maximum Current: See Table 2. Maximum current is engraved on the dial plate supplied with each decade.

Frequency Characteristics: The equivalent circuit of a decade resistance unit is shown on page 4. The values of the residual impedances are listed in Table 2.

The accompanying plot shows the maximum percentage change in effective series resistance of seven decades as a function of frequency. For Types 510-A and 510-B the error is due almost entirely to skin effect and is independent of switch setting. For Type 510-C the error changes slowly with dial setting and is a maximum at maximum resistance setting, while for Type 510-D a broad maximum occurs at the 600-ohm setting. For all the higher 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, 510-F, 510-G, and 510-H) are 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 amount indicated in the plot as the series-resistance change, depending on frequency and the insulating material in the switch.

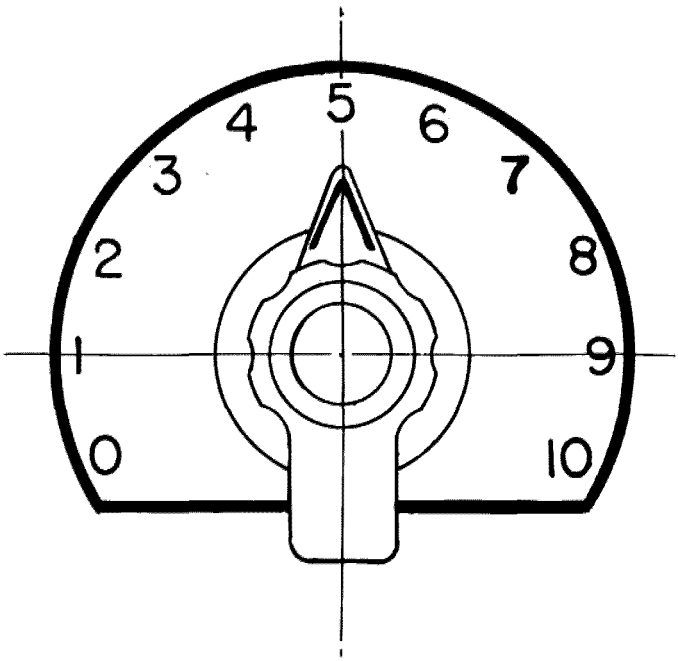
Switches: To reduce switch resistance and keep it constant, all switch contacts (studs) for the 0.01 Ω to 100 Ω steps have an extra heavy silver overlay. Switches for the 1 kΩ to 1 mΩ/step have silver contacts at the zero stud only. The switch resistance is less than 0.001 ohm. The effective capacitance of the switch is of the order of 5 μμF with a dissipation factor of 0.06 at 1 kHz for the standard cellulose-filled molded phenolic switch form, and 0.01 for the mica-filled phenolic form used in the Types 510-G and 510-H.

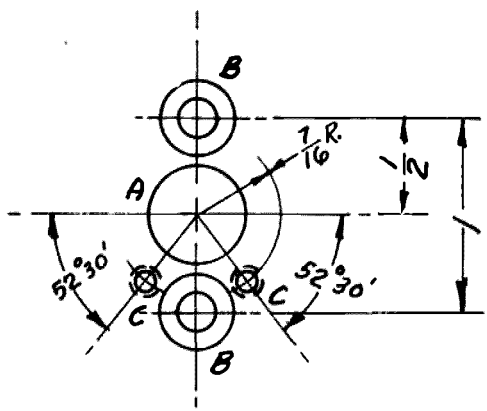


OVER-ALL DIMENSIONS

SPECIFICATIONS (Cont)

Temperature Coefficient of Resistance: Less than ±0.002% per degree Centigrade at 23° C.
Terminals: Soldering lugs are provided.
Mounting: Each decade is complete with dial plate and knob and can be mounted on any panel between 1/4 inch and 3/8 inch in thickness. A template is furnished with each unit. Thinner panels can be accommodated by the use of shorter mounting screws.
Dimensions: Over-all diameter, 3-1/16 inch (78 mm); depth behind panel, 3-5/16 inch (82 mm).
Net Weight: 510 Units, 11 ounces (0.3 kg); Type 510-P3, 10 ounces (0.3 kg).



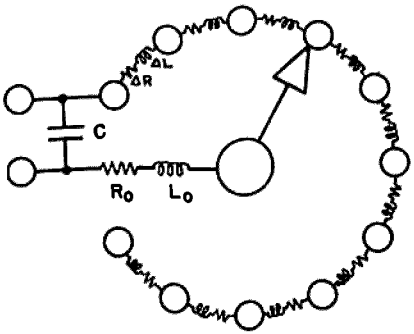


A = 13mm (.512) DRILL, (1-HOLE)
B = 13/64 (.203) DRILL, C'SK FOR #10 F.H.M.S., (2-HOLES)
C = #33 (.113) DRILL, TAP 6-32 (2 HOLES)

DRILLING LAYOUT

Table 1

Catalog Number	Type	Total Resistance Ohms	Resistance Per Step (ΔR) Ohms	Accuracy of Resistance Increments
0510-9806	**Type 510-AA**	0.1	0.01	±2%
0510-9701	**Type 510-A**	1	0.1	±0.5%
0510-9702	**Type 510-B**	10	1	±0.15%
0510-9703	**Type 510-C**	100	10	±0.05%
0510-9704	**Type 510-D**	1000	100	±0.025%
0510-9705	**Type 510-E**	10,000	1000	±0.025%
0510-9706	**Type 510-F**	100,000	10,000	±0.025%
0510-9707	**Type 510-G**	1,000,000	100,000	±0.025%
0510-9708	**Type 510-H**	10,000,000	1,000,000	±0.025%
0510-9604	**Type 510-P4**	Switch only	(Black Phenolic Frame)	
0510-9511	**Type 510-P4L**	Switch only	(Low-Loss Phenolic Frame)	



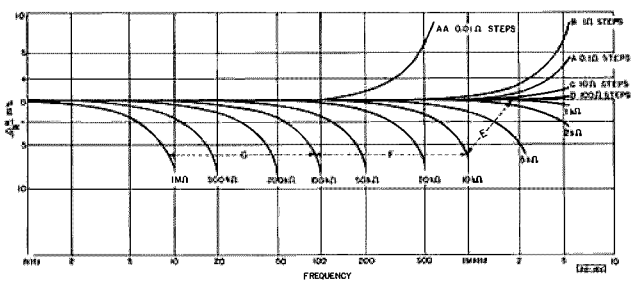
Equivalent circuit of a resistance decade, showing location and nature of residual impedances.

Table 2

Type	Resistance Per Step (ΔR) Ohms	Maximum Current 40° C Rise	Power Per Step Watts	ΔL μH	C** pF	L_o μH
Type 510-AA	0.01	4 A	0.16	0.01	7.7–4.5	0.023
Type 510-A	0.1	1.6 A	0.25	0.014	7.7–4.5	0.023
Type 510-B	1	800 mA	0.6	0.056	7.7–4.5	0.023
Type 510-C	10	250 mA	0.6	0.11	7.7–4.5	0.023
Type 510-D	100	80 mA	0.6	0.29	7.7–4.5	0.023
Type 510-E	1000	23 mA	0.5	3.3	7.7–4.5	0.023
Type 510-F	10,000	7 mA	0.5	9.5	7.7–4.5	0.023
Type 510-G	100,000	2.3 mA	0.5	—	7.7–4.5	0.023
Type 510-H	1,000,000	0.7* mA	0.5	—	13.5–5.0	0.023

*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 $\mu\mu$F greater than indicated here, depending on whether the shield is tied to the switch or to the zero end of the decade.



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

G E N E R A L R A D I O C O M P A N Y

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