OPERATING INSTRUCTIONS

TYPE 1450

DECADE ATTENUATORS

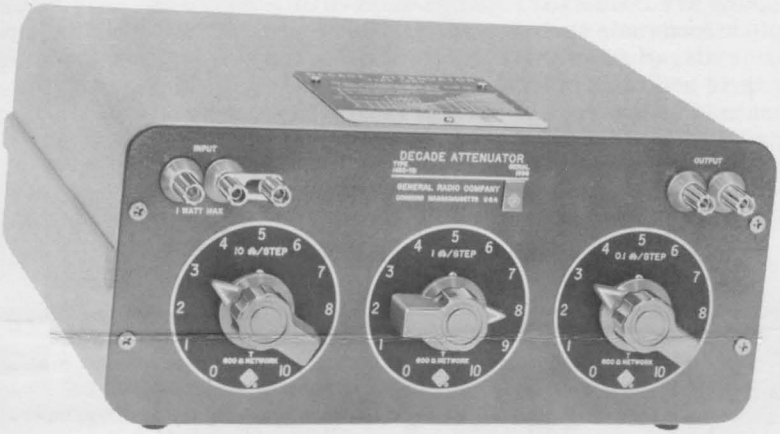

Figure 1. Type 1450-TB Decade Attenuator.

The Type 1450 Decade Attenuators (Figure 1) are precision adjustable attenuators designed for use either in balanced H- or unbalanced T-type 600-ohm circuits. They are especially useful for precise power-level measurements, transmission-efficiency tests, gain or loss measurements on transformers, filters, amplifiers and similar equipment, and for calibrating other attenuators. Each type is available in two- or three-decade ranges as follows:

Type	Decades	Range
1450-HA	2	110 db in steps of 1 db
1450-TA	2	110 db in steps of 1 db
1450-HB	3	111 db in steps of 0.1 db
1450-TB	3	111 db in steps of 0.1 db

Each decade in the assembly is a separate unit and consists of a series of T or balanced-H resistive attenuation pads having, respectively, 1, 2, 3, and 4 units of attenuation. These are inserted into the circuit in series by cam-operated switches in the proper sequence to introduce an aggregate of 0, 1, 2, ----9, 10 units of attenuation.

Each T-type pad contains two equal series resistors on the high side of the line. Their midpoint is joined to the common side of the line through the proper shunt resistor.

Each H-type pad contains four equal series resistors, two of which are inserted on each side of the line. The midpoint of each pair is joined to a floating line, common to all pads of the instrument, by one of the two equal shunt resistors.

To extend the high-frequency operating range of these attenuators, the four individual pads of the decade are not only completely shielded from each other, but, in addition, each pad is provided with a bisecting shield, which separates its input and output series resistors and the associated switches.

In the T-type instruments, this universal shield is permanently grounded to the control panel and cabinet. The low or common sides of all individual pads are connected together and are attached to the low input and the low output terminals (see Figure 2). There are thus two input and two output terminals, all four insulated, with one of each pair being the common side. There is, in addition, a binding post attached to the control panel. This binding post may be strapped to the low input post, if desired.

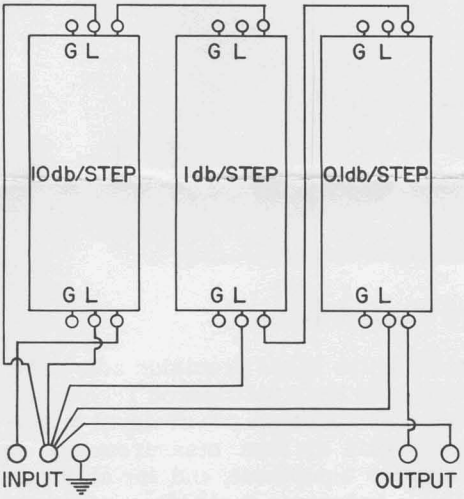

Figure 2. Wiring for T-type instrument with three pads.

The wiring of the common sides of the component decades to the low input binding post has been carefully planned in order to avoid common resistance in the shunt return paths of the individual pads. A common resistance in the low lead of as little as a few milliohms causes detectable errors in attenuation changes at high attenuations. For this reason, the low side of each decade is individually returned to a massive low input post, and the low-side return of the 100-db-total unit is split into two parts, with the 40-db-pad common separately wired. The bus connecting the low input and low output terminals is not so critical since it is merely in series with the load. Be sure to make low-side input connections to the low input post. Be careful to avoid any common impedance in the low-side wiring.

The low-side posts are separated from the panel and case so that the user can avoid undesirable pickup and noise in ground loops by proper selection of the exact point to which the common sides of the pads are tied. If

this consideration is not critical, the link to the ground binding post tied to the panel can be used.

Ordinarily, the low binding post will be essentially at the potential of panel and shields, even though tied to a remote ground. In this case the catalog statements about frequency range are valid. With the binding-post arrangement supplied, however, it is possible to operate the attenuators with the common side floating off ground or separated from ground by a finite impedance. Under these conditions, the upper-frequency limit for catalog accuracy is reduced, and the behavior of the attenuators approaches that of the H-type models.

To accomodate certain applications the center-balanced common line in the H-type instruments is left floating and is brought out to an insulated terminal on the panel. No point in the network is grounded to the cabinet and universal shield. However, if permissible, the common line should be strapped to the universal shield and cabinet in order to eliminate cross-talk between the several pads. Provision is made for doing this. Under proper conditions either side of the system may be used as a T-type 300-ohm attenuator.

These attenuators are designed for intensive use. The control shaft of each decade is carried on two ball bearings. End stops are provided for the 100-db decade, but, for convenience, they are omitted from the lower-range decades.

OPERATING CHARACTERISTICS

With the exception of certain uncritical shunt elements in the Type 1450-HB, each resistor in these attenuators has a noninductive winding and a low temperature coefficient. Each resistor is adjusted to be within 0.25 percent of its theoretical value. The aggregate switch resistance may introduce attenuation errors not exceeding the following values:

Type	Maximum Insertion Loss Resulting From Switch Resistance (as a function of generator impedance)	
	600 Ω	Zero
1450-HA	0.006 db	0.012 db
1450-TA	0.003 db	0.006 db
1450-HB	0.009 db	0.018 db
1450-TB	0.005 db	0.009 db

These switch errors will vertually disappear in the difference in attenuation between any two settings.

The low-frequency absolute calibration for a given dial setting thus has an accuracy of ±0.02 db plus ±0.25 percent of the dial indicated value in db plus the switch resistance error indicated in the foregoing table. This statement holds for the insertion loss in db provided with the attenuator is terminated in a purely resistive impedance of 600 + j0 ohms. When so terminated the input impedance will lie within the limits 600 ± 3 ohms at all switch settings. An etched plate on the cabinet indicates the mismatch loss when the output load departs from 600 ohms.

Due to careful design and construction, the high-frequency attenuation of the Type 1450-HA and 1450-HB Decade Attenuators will hold within 0.1 db ±1 percent of its low-frequency value in db at any given setting up to approximately 200 kc, provided the output load remains a purely resistive 600 ohms.

Certain resistors in the T-type pads are shunted with small compensating capacitors, so that the Type 1450-TA and 1450-TB Decade Attenuators can be expected to hold a frequency discrimination within 0.1 db ±1 percent of the indicated value up to frequencies in excess of 200 kc and under certain conditions up to 500 kc with zero reactance in the output load.

In order to meet these high-frequency specifications the system must be grounded directly at the cabinet of the attenuator or at a suitable ground-loop-avoiding point which is separated from the ground potential of the cabinet by a negligible impedance.

It is desirable to limit the power dissipation to 1 watt in any individual resistor. Under extreme conditions (maximum setting of the 100-db decade), this means a limitation in the power introduced at the input terminals to 1 watt for the T-type and 2 watts for the H-type instruments. This condition will be met, regardless of the output load, provided that the RMS input terminal voltage does not exceed 25 volts for the T-type and 35 volts for the H-type attenuators.

SERVICING THE SWITCH CONTACTS

During an extended idle period, the switch contacts may accumulate a slight smudge which makes their contact resistance erratic. This defect would be most noticeable in the 0.1-db-per-step decades. If a few rotations of the control shaft fail to eliminate this trouble, proceed as follows, taking care not to disturb the adjustment of the switches:

1. Remove the cover of the erratic decade.
2. By rotating the shaft open a given pair of the switch contacts.
3. Insert a narrow strip of hard surfaced paper between the open switch points. Do not use abrasive paper.
4. By rotating the shaft close the switch points with their natural pressure against the paper strip.
5. Withdraw the paper strip by pulling in a direction perpendicular to the axis of contact, thus wiping the smudge from the two contact points without disturbing their spring adjustment.
6. Repeat the above with all switches.

As a check, set all the control switches to zero. Then, with "clean" switches, the resistance between corresponding high-side input and output terminals should not exceed 0.48 ohm for the two-decade attenuators and 0.72 ohm for the three-decade attenuators. These figures average 30.0 milliohms per switch, including the wiring.

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