TYPE 941-A TOROIDAL TRANSFORMER

This transformer is designed for use as an impedance-matching or bridging transformer in low level 600-ohm communication systems. It employs a toroidal, "doughnut-shaped" core, which is preferable to the familiar shell-type core in two respects.* (1) The toroidal core is much more astatic and thus less susceptible to external magnetic fields while, conversely, it produces smaller external magnetic fields. (2) A tighter degree of coupling between primary and secondary windings can be obtained than with a shell core. The resulting lower leakage reactance extends the high frequency flat characteristic about a decade higher than that of a conventional shell-core transformer, while the high permeability core used is beneficial in the low-frequency range.

This TYPE 941-A Transformer, therefore, is especially useful where either a high degree of astaticism or an ultra-wide frequency range is desired.

The core carries two identical semi-circumferential inner windings, 1-2, 3-4, which are used either in series or in parallel combinations. Over these are wound two identical semi-circumferential outer windings, 5-6, 7-8, which are likewise used either in series or in parallel combinations. These four windings terminate in eight individual terminals on the panel. We have designated such an arrangement as a "duplex" transformer.

Performance Characteristics

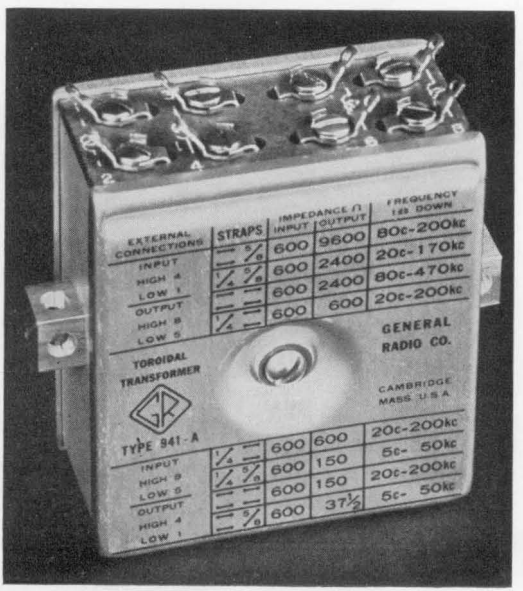
Each outer winding has twice the number of turns of each inner winding. This permits the impedance-matching ratios 1:1, 4:1, and 16:1 in either direction. All four windings are employed simultaneously in each case, which is decidedly beneficial. When working either into or out of the design value of 600 ohms, the characteristics shown in the table on page 6 are obtained.

The 941-A may be used as a matching transformer with other terminating impedances. When both terminating impedances are 600 ohms or less (as in Circuits 4, 5, 6, and 7), a frequency span ratio of 10^4 for a 1 db drop from the flat characteristic is obtained. For a conventional shell-core transformer, this ratio is about 10^3. The low-frequency limit of this range is determined by the ratio of the generator impedance, Z, to the primary inductance, L_p. For a 1 db drop:

$$f = \frac{0.156\ Z}{L_p}$$

As either terminating impedance increases appreciably above 600 ohms (as in Circuits 1, 2, and 3), the frequency span ratio will be reduced, since the high-frequency extent is ultimately limited by resonance between leakage

Figure 1. View of the Type 941-A Transformer.



*Horatio W. Lamson, "Some Advantages of the Toroidal Transformer in Communication Engineering," *Tele-Tech*, May, 1950. Reprints are available on request.

Circuit	Terminating Impedances Ω	Ω	Connect Inner Windings	Connect Outer Windings	Frequency for 1 db drop	Flat Insertion Loss Less than
1	600	9600	Parallel	Series	80 c — 200 Kc	0.3 db
2	600	2400	Series	Series	20 c — 170 Kc	0.2 db
3	600	2400	Parallel	Parallel	80 c — 470 Kc	0.2 db
4	600	600	Series	Parallel	20 c — 200 Kc	0.1 db
5	150	600	Series	Series	5 c — 50 Kc	0.7 db
6	150	600	Parallel	Parallel	20 c — 200 Kc	0.2 db
7	37.5	600	Parallel	Series	5 c — 50 Kc	0.8 db

inductance and transformer capacitance. It will be noted that for matching impedances 1:4 or 4:1, a choice of connections is available. Circuits 2 and 5 extend the lower range while Circuits 3 and 6 extend the higher range of the flat characteristic. When the ratio is 1:1, Circuit 4, the leakage inductance is only about 360 microhenries.

A concept of the feasible operating level for this transformer may be gained from the following 60-cycle rms distortion values:

At 31 VU level (1.26 watts), less than 1.0%.

At 30 VU level (1 watt), less than 0.5%.

At 27 VU level (0.5 watt), less than 0.2%.

At 15 VU level (0.032 watt), less than 0.1%.

When the transformer is used in an unbalanced system, it is important that the input or output terminals marked "low" (Nos. 1 and 5) be either directly strapped (if permissible) or be at essentially the same dynamic potential. Otherwise, the extent of the high-frequency range will be shortened appreciably.

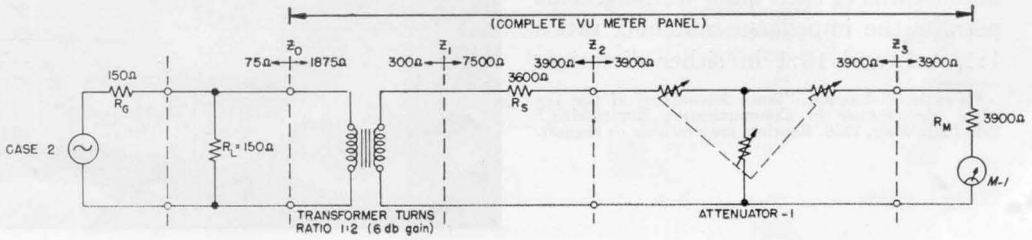
In a typical application, the TYPE 941-A can be used as a bridging transformer, Circuit 5, for applying a 600-ohm VU meter to a 150-ohm audio system, as shown in Figure 2.

Physical Characteristics

The transformer is housed in a rectangular aluminum case. A centricore of spirally-wound, 3-mil tape, specially insulated and annealed, is used. Multilayer progressive windings are applied by a toroidal winding machine developed for this purpose. The impregnated toroid is clamped between felt washers by a central screw which is insulated from the case. All circuits are insulated for 500 volts from the case. The performance data given above, together with appropriate diagrams for strapping the terminals and making external connections, are printed on one large face of the case. One small face consists of a phenolic panel carrying eight combination screw-clamp and solder terminals. These terminals are numerically identified and the internal connections are indicated. Two double-drilled mounting blocks permit the transformer to be mounted: (1) on its large face, (2) on its small face opposite the terminal panel, or (3) projecting through a hole 3⅛″ x 1⅝″ in an assembly chassis.

—HORATIO W. LAMSON

Figure 2. Circuit showing how the transformer can be used to adapt a 600-ohm VU indicator to 150-ohm lines.



SPECIFICATIONS

Initial Inductance: Inner windings, in series, 5 to 6 henrys; outer windings, in series, 20 to 24 henrys.

Resistance: Inner windings, in series, 9 ohms; outer windings, in series, 34 ohms.

Dimensions: Aluminum case, $3\frac{5}{8}$ x $3\frac{1}{8}$ x $1\frac{5}{8}$ inches. Mounting blocks project $\frac{9}{32}$ inch beyond case in $3\frac{1}{8}$ inch dimension.

Mounting Dimensions: $3\frac{3}{8}$ inches on centers. Mounting holes are drilled for clearance with 10-32 machine screws.

Net Weight: $13\frac{1}{2}$ ounces.

Type		*Code Word*	*Price*
941-A	**Toroidal Transformer**	TRANTORCAT	**$35.00**

NEW, SPECIAL TERMINAL BOXES FOR V-5 AND V-10 VARIACS*

Variac users have frequently requested special terminal facilities and features impossible to accommodate in the limited space provided by the standard "T" terminal box regularly supplied on V-5MT, V-5HMT, V-10MT, and V-10HMT Variacs. In response to such requests, we now offer a new, larger, rectangular terminal box with plenty of room for almost any special terminal arrangement that may be required. Unlike the standard "T" box, the new box has a removable cover for easy access to its interior.

Boxes are designated alphabetically, in order of their design. This designation is coordinated with the standard type numbering system already established for "V" line postwar Variacs. Thus a V-5MTC shown in Figure 1 is a 115-volt, 5-ampere Variac with case and terminal box, the latter provided with knockouts. Figure 2 illustrates a V-5MTE Variac, 115-volt, 5-ampere, cased model, with three-wire cord and plug for a safety ground circuit, and a two-pole switch.

These two combinations are carried in stock for both the V-5 and the V-10 sizes. Other combinations are available, including models with fuses, cord, plug, and switch. These can be supplied on special order in quantity lots.

*T.M. Reg. U. S. Pat. Off. U. S. Pat. 2,009,013.

Figure 1. View of the Type V-5MTC Variac with cover to terminal box removed.

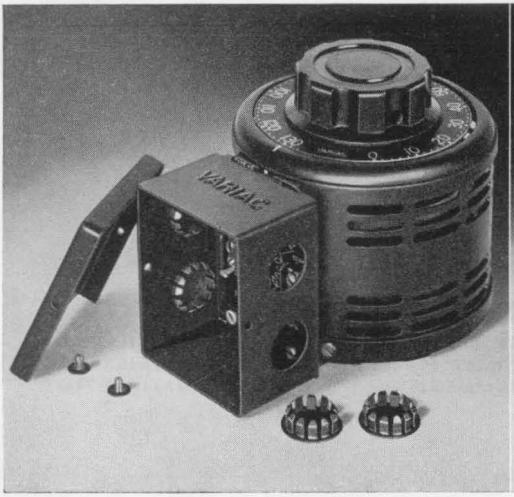


Figure 2. View of the Type V-5MTE Variac.