The GENERAL RADIO
EXPERIMENTER

ELECTRICAL MEASUREMENTS TECHNIQUE AND ITS INDUSTRIAL APPLICATIONS

VOL. XI No. 10 MARCH, 1937

TUNING THE TYPE 814-A AMPLIFIER

● **WHEN** working with single-frequency voltages, particularly in bridge measurements, the elimination of harmonics and hum by means of filters is a distinct advantage. Tuning units for this purpose were mentioned in the recently-published description of the TYPE 814-A Amplifier* and are now available for sale. Two models are offered, one operating at 60 cycles and the other at either 400 or 1000 cycles. Nearly all low-frequency bridge measurements are made at one of these frequencies.

These filters are actually parallel resonant circuits which connect directly into the grid circuit of the last tube in

*Experimenter, July-August, 1936.

FIGURE 1. Showing how the tuned circuit is plugged into a jack on the amplifier panel

ALSO IN THIS ISSUE: Three-Phase Voltage Control with the VARIAC . . page 4

the amplifier. This arrangement has several advantages for a general-purpose amplifier. For instance, the frequency response of the amplifier is then independent of the impedance from which it is working or into which it works, which would not be the case if ordinary filters were connected at either the input or the output. This means that the amplifier may be used interchangeably with head telephones, a-c galvanometers, or cathode-ray oscillographs without changing its selectivity characteristics. Furthermore, the filters are operating at a voltage level sufficiently high to eliminate ordinary inductive interference while, at the same time, there is little danger of strong signals in the attenuation band overloading the amplifier and thus affecting its response on wanted signals as sometimes happens when filters are used on the output. Although the filters introduce a small insertion loss, they do not, in any way, affect the maximum output voltage of the amplifier which would be undesirable in those cases where a cathode-ray oscillograph was to be used.

Figure 1 shows the characteristics of the two filter units. It will be noted that the attenuation to the second harmonic is approximately 20 db, and that higher harmonics are reduced still further. The attenuation to lower frequencies is also quite high, which is extremely desirable for the 400- and 1000-cycle filters, since this reduces the possibility of 60-cycle pickup.

Not only do the characteristics of these filters provide satisfactory discrimination against harmonics and hum, but they actually lower the total noise level of the amplifier by restricting the pass band to a small region. The TYPE 814-A Amplifier, in common with all other high-gain amplifiers, has some residual noise, caused mainly by the first tube and its associated circuits. Noises of this type cover practically the whole frequency spectrum and, accordingly, when the response of the amplifier is restricted to a narrow range, the total noise is reduced tremendously.

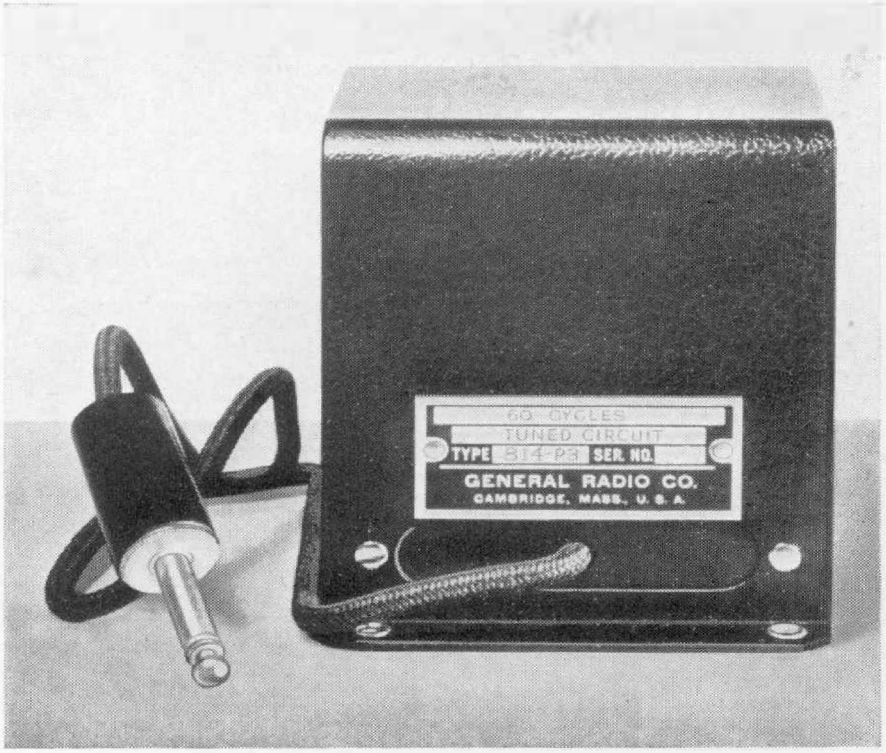


FIGURE 2. The TYPE 814-P3 tuned circuit. TYPE 814-P2 is similar in appearance, but is provided with a toggle switch so that either of two resonant frequencies can be used, 400 or 1000 cycles

In fact, when using either of the filters, the noise in the TYPE 814-A Amplifier is rendered practically inaudible. When making bridge balances this is frequently as useful as the elimination of harmonics, since it is the residual noise which often masks the threshold and makes sharp balances impossible.

These filters with the TYPE 814-A Amplifier provide a means for obtaining high amplification at a single-bridge frequency and with practically no background noise or interference, thus making possible an extremely sharp balance. The slight reduction in over-all gain at the bridge frequency caused by the initial insertion loss of the filter is generally quite negligible, because the gain of the amplifier is more than sufficient for most purposes. The restriction of the frequency response to a narrow band, however, improves the ease of balancing the bridge to an enormous degree.

Each of the filters is mounted in a small black crackle-finish case similar to that used on audio-frequency transformers and provided with a shielded cord and a plug which may be inserted directly in the jack on the panel of the amplifier. The TYPE 814-P2 is provided with a switch for shifting the response from 400 to 1000 cycles. The low price of these units and the fact that the TYPE 814-P2 is useful at two frequencies make their purchase desirable for all owners of the TYPE 814-A Amplifier. — H. H. SCOTT

SPECIFICATIONS

Dimensions: Area of base, $3\frac{5}{8}$ x 4 inches; height, $4\frac{1}{8}$ inches.
Net Weight: 4 pounds.

Type	*Frequency*	*Code Word*	*Price*
814-P2	400 and 1000 cycles	AMBLE	$17.50
814-P3	60 cycles	AMPLE	12.00

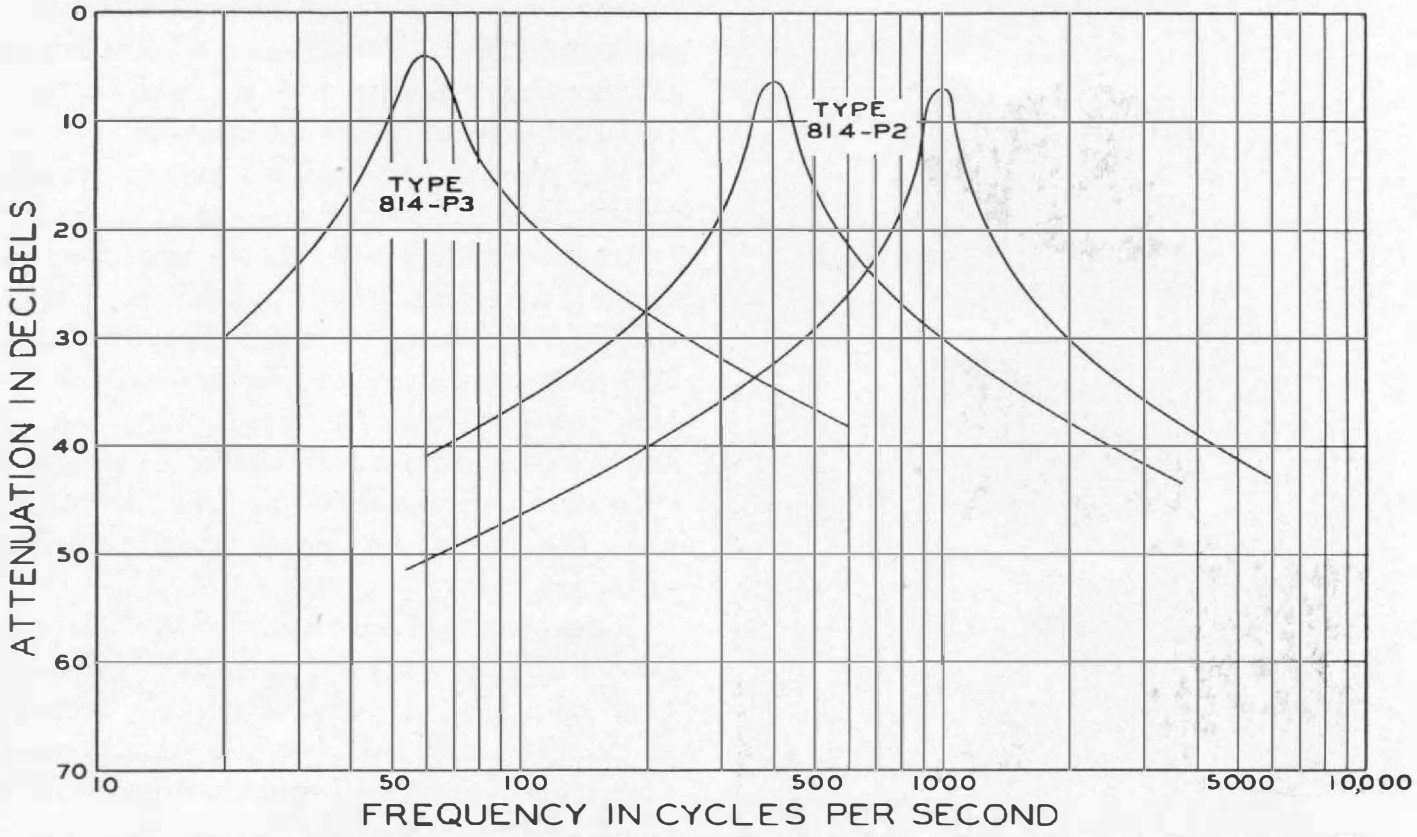


FIGURE 3. Frequency characteristics of both tuned circuits. Note that the TYPE 814-P2 is effective in removing 60-cycle hum as well as harmonics of the resonant frequency

THREE-PHASE VOLTAGE CONTROL WITH THE VARIAC

● ALTHOUGH THE VARIAC was designed primarily for use in single-phase circuits, it may be used equally well on three-phase systems if the *VARIACS* are ganged together for operation by a single control.

These ganged assemblies are useful in regulating the input voltage to three-phase rectifiers for the control of heating units for the starting and control of three-phase motors and for a number of other applications in which voltage adjustments on three-phase circuits are required.

One important application of the *VARIAC* control of rectifying units is in the radio broadcasting station, particularly on composite transmitters. Excessively high voltages applied to the filaments and plates of vacuum tubes materially shorten tube life. Subnormal voltages, on the other hand, markedly decrease the operating efficiency. Resistive voltage controls are not only wasteful of power but result in poor regulation, which in turn makes it impossible to realize the full capabilities of the balance of the transmitting equipment. The *VARIAC*, being primarily a non-dissipative device, permits the control of a considerable amount of power in a much smaller space than that required by resistive controls of the same power handling capacity.

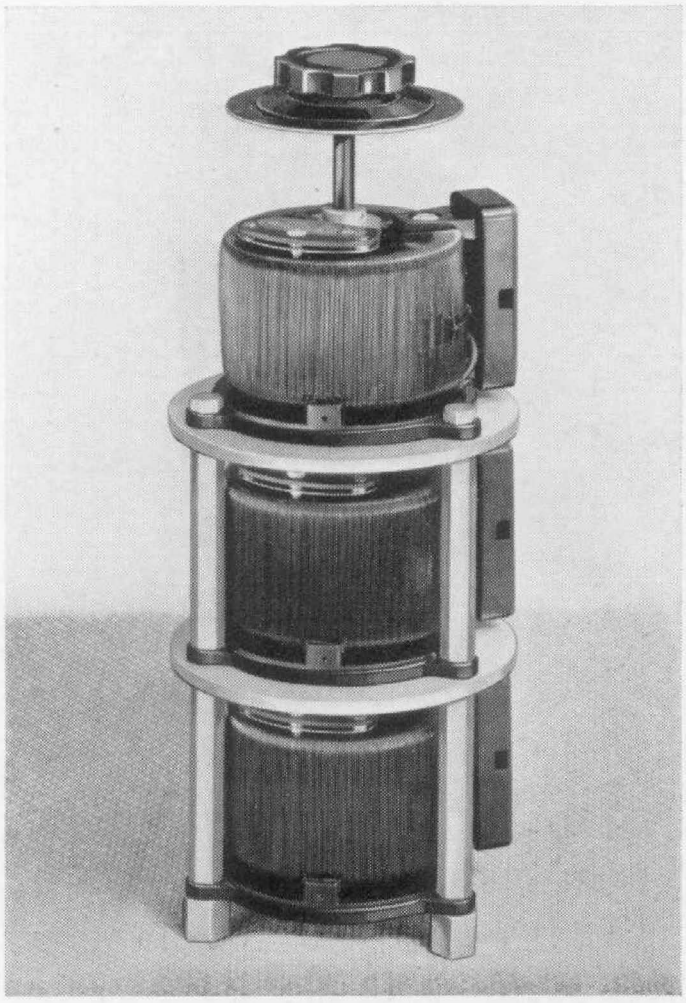


FIGURE 1. A Three-Gang Assembly of TYPE

Two- and three-gang *VARIAC* assemblies can be used on three-phase circuits in exactly the same manner as single *VARIAC* units are applied to single-phase circuits. The two most useful assemblies of *VARIAC* units are the two-gang assembly used in a delta circuit and the three-gang assembly connected in a wye. Standard TYPE 100 or TYPE 200 *VARIAC* assemblies when connected in a wye may be used to control 230-volt or 440-volt circuits.

The phase voltage of a wye-connected three-phase circuit is equal to the line voltage divided by the square root of three. Because of this the 115-volt *VARIACS* can be used to control a 230-volt three-phase line and the 230-volt models can be used on 440-volt lines. The output from such a wye-connected assembly is continuously variable between zero and full-line voltage.

The open-delta-connected three-phase circuit may be used for the control of 115-volt and 230-volt three-phase lines and for obtaining a 230-volt output from a 115-volt source. This particular connection with some of the *VARIACS* makes it possible either to

raise or to lower the output voltage from the input line value, and hence makes it possible to compensate for line voltages fluctuating either above or below the desired value. The open-delta circuits listed in Figure 3 are, for most applications, the most economical means of supplying a given amount of power but make balancing to ground somewhat difficult. If a balance-to-ground is required, the wye connection is recommended.

Another combination, the closed delta, makes it possible to obtain output power and voltage characteristics which may be useful in certain special applications. It is interesting to note that, with the TYPE 200-CUH and TYPE 100-L *VARIACS* connected according to Diagrams 2 and 5, respectively, of Figure 3, an output line voltage can be obtained which is greater than the phase voltage of any *VARIAC*.

The maximum amount of power handled by the ganged *VARIAC* assemblies is in all cases equal to the square root of three, times the product of the input line voltage and the maximum output current.

Two- and three-gang assemblies of both TYPE 100 and TYPE 200 *VARIACS* can be supplied. Figures 1 and 2 illustrate the manner in which these units are assembled. When so assembled, these *VARIACS* are intended for vertical mounting only. If horizontal mounting or back-of-panel mounting is desired, it is necessary that the assembly be reinforced longitudinally so that no bending whatsoever of the shaft will occur. Any bending will, of course, result in binding of the shaft and will make the rotation of the control dial difficult. The ganged units are assembled to order and are priced as follows.

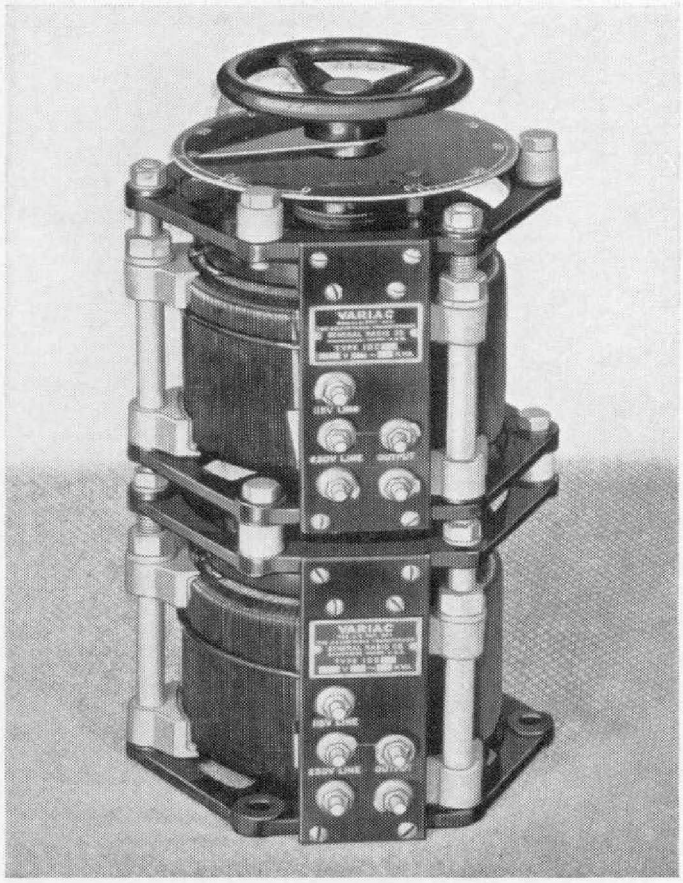


FIGURE 2. A Two-Gang Assembly of TYPE 100 *VARIACS*

The table on pages 6 and 7 lists briefly the characteristic and ratings of various combinations.

— L. E. PACKARD

Variac Type		*Price*
200-CU	Three-Gang Assembly	$ 65.00
200-CU	Two-Gang Assembly	45.00
200-CUH	Three-Gang Assembly	$77.00
200-CUH	Two-Gang Assembly	53.00
100-K or 100-L	Three-Gang Assembly	$160.00
100-K or 100-L	Two-Gang Assembly	105.00

VARIACS are manufactured and sold under U. S. Patent 2,009,013.

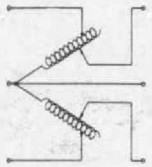
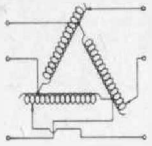
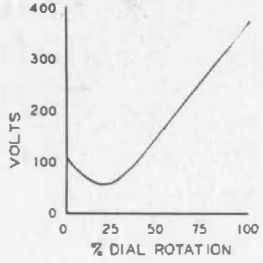
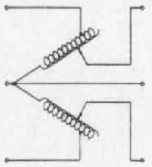
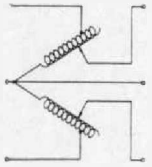
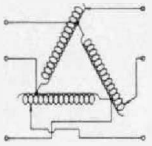
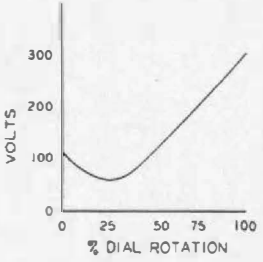
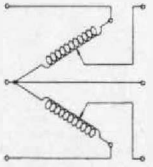
OUTPUT				INPUT				CIRCUIT	OUTPUT CHARACTERISTICS
VOLT-AMPERES		LINE CURRENT		Line Voltage	3-Phase Line Voltage	Type of Variac	Number Required		
At Maximum Voltage	At Input Voltage	Rated	Maximum						
115-VOLT CIRCUITS									
235	500	0.5	2.5	0–270	115	200-CUH	2		LINEAR
320	500	0.5	2.5	58–372	115	200-CUH	3		
1170	1500	5	7.5	0–135	115	200-CU	2		LINEAR
1600	1800	4	9	0–230	115	100-L	2		LINEAR
2000	1800	4	9	58–304	115	100-L	3		
3500	3500	15	17.5	0–115	115	100-K	2		LINEAR

FIGURE 3

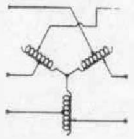
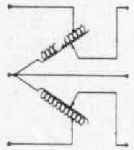
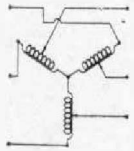
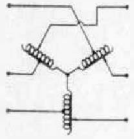
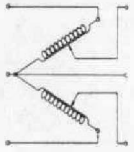
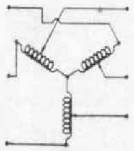
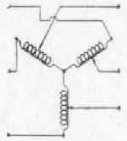
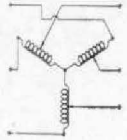
230-VOLT CIRCUITS									
430	1000	0.5	2.5	0–500	220	200–CUH	3		LINEAR
700	1000	1.5	2.5	0–270	230	200–CUH	2		LINEAR
3000	3000	5	7.5	0–230	230	200–CU	3		LINEAR
3000	3600	4	9	0–440	230	100–L	3		LINEAR
3600	3600	8	9	0–230	230	100–L	2		LINEAR
6000	6000	13	15	0–230	230	100–K	3		LINEAR
440-VOLT CIRCUITS									
1900	1900	1.5	2.5	0–440	440	200–CUH	3		LINEAR
6000	6000	7	8	0–440	440	100–L	3		LINEAR

FIGURE 3

TYPE 682-B FREQUENCY DEVIATION METER

● Type 682-B Frequency Deviation Meter replaces the older TYPE 682-A. It is similar to the old model in principle and in operation, but an input amplifier has been added. The price is $160.00, the code word, MISTY.

MISCELLANY

● **AMONG** recent visitors to General Radio: Messrs. Rosenstrom, Noren, Holstensson, Sr., and Holstensson, Jr., from Radiofabriken Luxor, Sweden; also Mr. J. F. Morrison of Bell Telephone Laboratories and Mr. J. L. Middlebrooks of Columbia Broadcasting System, both in Boston for a few days in connection with the installation of the new transmitting equipment for WEEI.

● **IRE** papers delivered: by Mr. Robert F. Field, "The Schering Bridge," at the first meeting of the new Montreal section, January 20; also by Mr. Field, "Direct-Reading Instruments," before the Buffalo Section, January 27.

● **BULLETIN 20**, entitled "The Technique of Noise Measurement" is now ready for distribution. Copies will be mailed to all purchasers of TYPE 759-A Sound Level Meters and to any others who are interested.

Please address requests to the Engineering Department.

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GENERAL RADIO COMPANY

30 STATE STREET - CAMBRIDGE A, MASSACHUSETTS

BRANCH ENGINEERING OFFICE — 90 WEST STREET, NEW YORK CITY