

VINTAGE TEST EQUIPMENT

General Radio Impedance Bridge Type 650-A

BY WALTER H. HALL

General Radio's test instruments are noted for their accuracy and performance. In this article, Walter Hall describes that company's Type 650-A impedance bridge from the 1930s, and his restoration of one of these units. (Editor)

The General Radio Type 650-A impedance bridge is a rugged, heavy (30 pounds) and precise instrument for the testing and evaluation of piece parts of radios and other similar devices. It is relatively simple to operate since the test procedure basically involves balancing the unknown value of the item being tested against known standards.

The balance is achieved by adjusting the large dial until a "zero" or "null" is indicated on the zero-center galvanometer for DC tests, or by headphones for AC tests. When balance is achieved, the inductance, capacitance or resistance of the tested part is indicated directly by the calibrated scale of the dial and the multiplying factors of the associated switch positions.

The unit provides measurement facilities for a relatively wide range of values with a high degree of accuracy. The resistance range is from 0.001 ohms to 1 megohm; the capacitance range, from 1 micromicrofarad to 100 microfarads; and the inductance range, from 1 microhenry to 100 henrys.

During the days of early radio, the Type 650-A was used extensively for test and evaluation of piece parts, such as resistors, capacitors and inductors, to assure the parts were within specified limits. Quality control of incoming parts lots had been found essential to successful production line assembly procedures. A front panel view of a Type 650-A, which differs somewhat from the author's bridge, is shown in Figure 1. This figure is reproduced from General Radio's Catalog K, dated December 1, 1930.

RESTORING THE TYPE 650-A

I recently restored a Type 650-A, Serial No. 9118, that had sat unused for many years. In general, the device was in good condition with some nicks and knocks from use since its manufacture, possibly in the 1930s. It was complete in that no parts were missing or obviously damaged, but it was inoperable.

All interior parts seemed to be in good condi-



Figure 1. This front panel view of a Type 650-A impedance bridge shows its neat layout.

tion and showed no signs of deterioration due to the passage of time, except for some soldered connections. The 1/4-inch aluminum panel was unscarred and the moving parts were in operable condition. The carrying case is a 3/4-inch thick plywood, copper lined box, with a walnut veneer.

This particular unit included the companion General Radio 651-PI AC power unit, which provides both a 1,000-cycle tone source and amplifier and a 6-volt DC source, both of which are used, selectively, as sensing voltages to power the impedance bridge. This power unit replaced four dry cell batteries used in earlier models. Since everything seemed to be present and repairable, I proceeded to clean and inspect both the interior and the exterior to determine what restoration measures were needed.

As seen in Figure 2, the interior construction is fairly typical of professional-quality test equipment of mid-century vintage. Internal wiring is of the bus-bar type reminiscent of the early

days of radio but suitable for General Radio's type of construction. It was in the bus-bar wiring that a couple of soldered joints had become faulty.

All potentiometers and switches were cleaned and lubricated where appropriate. Retouching the walnut veneer and cleaning up the carrying case were readily accomplished, using fine sandpaper and a polyurethane liquid plastic applied with a cloth pad.

When restored and repaired, the unit was operational and accurate. For example, in a test of resistance values, a precision 100k, 1 percent resistor gave a dial indication precisely on the 100k dial marking. The inductance and capacitance values were also precisely indicated when tested using known values.

As seen in Figure 3, the restored unit is essentially like-new in all respects and probably capable of another 50 or more years of reliable service. In the General Radio Catalog K (1939), this unit was available directly from the manufacturer for \$175 plus the price of the power unit, which carries the notation "prices on request."

In that connection, the catalog also states that in the continental U.S.A., all sales were directly to the user and that intermediate sales organizations were not involved. General Radio products in general have always excelled in quality and reliability, and I'm pleased to state that my collection of vintage test equipment includes several General Radio units in near-mint condition. While possibly over-designed by today's standards, a history of proven long, reliable, service life says a whole lot about the wisdom of that company's design viewpoint.

As a survivor of much earlier times, the bridge circuit employed in the 650-A has historic importance. It was based on the Wheatstone Bridge developed by Sir Charles Wheatstone, a distinguished British scientist, during the mid-19th century.

Due to its simplicity, the Wheatstone Bridge and variations of the circuit have been used by a large number of scientists over the years. The variations include the Maxwell, Hay, and Schering bridges that are usually used for more specialized laboratory test purposes. While not as intensively used these days, the restored

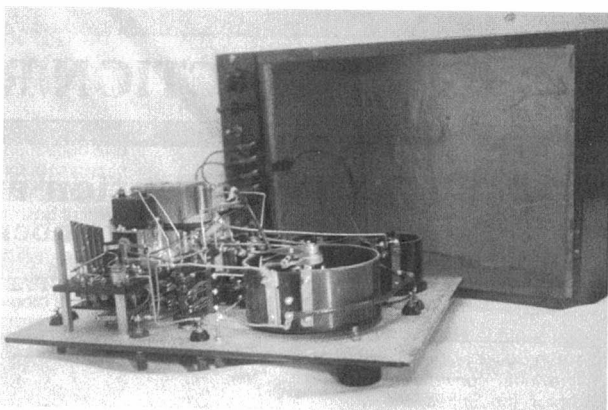


Figure 2. An interior view of the General Radio Type 650-A impedance bridge. Note the heavy, copper-shielded cabinet and the bus-bar wiring.

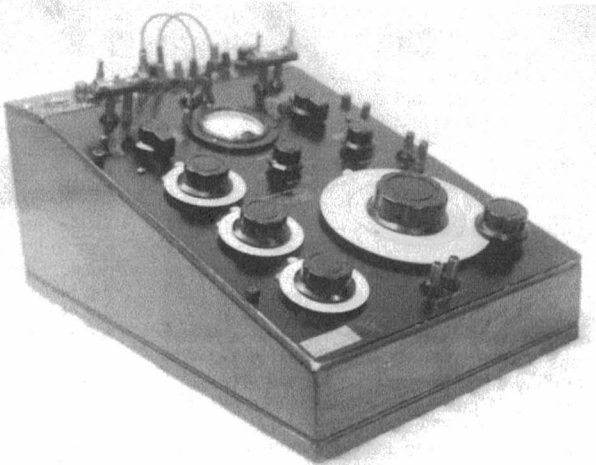


Figure 3. The restored impedance bridge looks and works like new.

Type 650-A is a well preserved example of earlier technology that can still be employed for its intended purpose with complete confidence.

References:

General Radio Company Catalog K. Cambridge, Mass., 1938.

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At a very early age, Walter Hall began experimenting with radio devices that were still somewhat of a marvelous mystery. After retiring in 1970 from a career in electronics and related fields, he continued his interest in electronics and in the selective collection of radio memorabilia, especially Hewlett-Packard and General Radio test equipment.