



Figure 1. Type 1232-P2 Pre-amplifier attached to the 1232-A Tuned Amplifier and Null Detector

## A PREAMP FOR USE WITH BRIDGE DETECTORS

In the quest for low noise in an amplifier, one must accept the fact that no one amplifying device is optimum for signal sources of widely differing impedance levels. Some compromise is therefore inevitable in the design of the input stage of a sensitive null detector that is to be used in a variety of applications. The low-noise transistor used in the TYPE 1232-A Tuned Amplifier and Null Detector<sup>1</sup> is suitable for use with most impedance-bridge sys-

tems. However, some measurements requiring extremely high sensitivity present a very high impedance to the detector, and in such cases the detector could benefit from a preamplifier with a very high optimum-source resistance. The new 1232-P2 FET Preamplifier (Figure 1), designed to fill this need, can increase sensitivity by a factor of 10 or more in some measurements.

Plots of typical equivalent input noise vs resistance for the 1232-A alone and with the 1232-P2 are shown in Figure 2. The input noise can be char-

<sup>1</sup> A. E. Sanderson, "A Tuned Amplifier and Null Detector with One-Microvolt Sensitivity," *General Radio Experimenter*, July 1961.

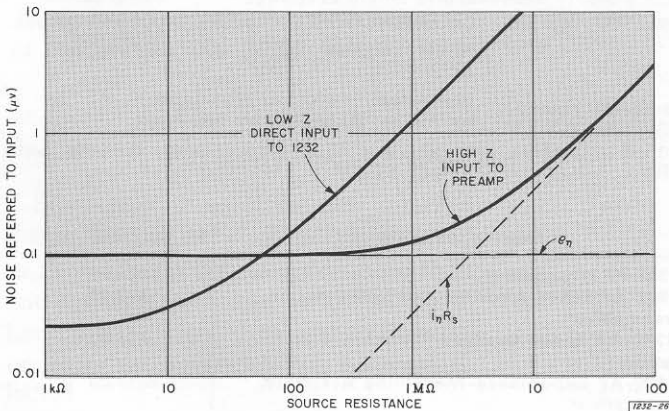


Figure 2. Equivalent input noise vs source resistance for 1232-A alone and for combination of 1232-A and 1232-P2.

acterized by an equivalent voltage noise generator,  $e_n$ , and a current noise generator,  $i_n$ . On the plot of equivalent input noise *voltage* vs resistance,  $e_n$  is a horizontal line and  $i_n \times R_s$  is a diagonal line. Note that the two curves cross at 60 kilohms and that below this value the 1232-A is better without the preamplifier.

One application where the addition of the preamplifier is a distinct advantage is the measurement of low-loss dielectric samples on the GR 1615-A Capacitance Bridge. Here the unknown capacitance is usually less than 1000 pF, the lowest *D* range is usually used (and not the *G* ranges), and the frequency is usually under 500 Hz. On the lowest *D* range, the output capacitance of the 1615-A is approximately 1600 pF +  $C_x$  + cable capacitance. If  $C_x$  and the cable capacitance are small, the output impedance will be about 1 M $\Omega$  at 100 Hz, and the preamplifier will improve sensitivity by a factor of about 10, as shown by Figure 2. As the frequency increases, the impedance decreases, and eventually the 70-pF capacitance of the preamplifier's input

cable negates the use of the preamplifier, even with a source of infinite impedance.

The preamplifier is of no advantage on the higher *D* range, where bridge capacitance is 10 times as great as on the lowest *D* range, or on the *G* ranges, where the output impedance is shunted by 100 kilohms.

The circuit of the preamplifier consists of a single source-follower stage, using a field-effect transistor. A switch allows the user to bypass the preamplifier in applications where the 1232-A is better off alone. The preamplifier is housed in a thin "pancake" box that is easily added to the side of the 1232-A or between the 1311-A Oscillator and the 1232-A in assemblies. The resulting combinations are available as the TYPES 1232-AP (1232-A plus preamplifier) and 1240-AP (1232-A plus preamplifier plus 1311-A). The entire TYPE 1620 Capacitance Measuring Assembly, when supplied with the preamplifier, is designated TYPE 1620-AP.

— H. P. HALL

### SPECIFICATIONS

**Input Impedance:** Greater than 100 M $\Omega$  in parallel with 70 pF.

**Output Impedance:** 10 k $\Omega$ .

**Voltage Gain:** Approx 0.7.

**Noise (referred to input):** Open-circuit equivalent, 0.1 pA; short-circuit equivalent, 0.3  $\mu$ V (when used with Type 1232-A tuned to 100 Hz).

**Optimum Source Impedance:** 3 M $\Omega$ .

**Connectors:** GR874 on cables, input and output.

**Power Required:** 12 V, 200  $\mu$ A, supplied by 1232-A.

**Dimensions** (width-height-depth):  $\frac{3}{4}$  by 6 by 7 $\frac{1}{2}$  in (20 by 150 by 190 mm).

**Weight: Net,** 15 oz (425 grams); **shipping,** (est) 3 lb (1.4 kg).

Catalog Number	Description	Price in USA
1232-9602	Type 1232-P2 Preamplifier	\$ 95.00
1232-9829	Type 1232-AP Tuned Amplifier and Null Detector, with preamplifier	485.00
1240-9829	Type 1240-AP Bridge Oscillator-Detector, with preamplifier	725.00
1620-9829	Type 1620-AP Capacitance-Measuring Assembly, with preamplifier	2325.00