PRECISION INSTRUMENTS FOR TEST AND MEASUREMENT

Operation Manual

Model 1232-A, -AP Tuned Amplifier & Null Detector

IET LABS, INC.
534 Main Street, Westbury, NY 11590
www.ietlabs.com
TEL: (516) 334-5959 • (800) 899-8438 • FAX: (516) 334-5988

To navigate our easy to use website for quick access to specifications and prices:

1. Select **Find a Product** to go to a convenient scrolling thumbnail catalog and then to detailed data sheets as desired; or:
2. Select **STANDARDS DECADES STROBES** for products formerly manufactured by **GenRad (General Radio)** or **QuadTech.**

Since 1976, IET labs has had a long-standing commitment to **conform the instruments and standards we offer to the customer's needs** rather than to have the customer settle for what is available. We devote our customer service and applications entirely to the customer's satisfaction in the quality standards, test instruments and calibration service we provide.

- Combinations of functions, special ranges, ratings, or accuracies.
- Replacement for discontinued models from other manufacturers.
- Calibration and repair services - NIST traceable.
- Compliant with ISO 9001, ISO 17025, ANSI Z540-1-1994, and MIL-STD-45662A.

Capabilities

- **R**: 20 μΩ-1 TΩ
- **C**: <1 pF - 1 F
- **L**: 100 μH-100 H

- Accuracy to 1 ppm
- Resolution to 0.1 ppm
- Voltage to 20 kV
- Power to over 1000 W
- Programmable IEEE-488 or BCD

The World Standard in Metrology Since 1915
Now continuing the GenRad tradition

Featuring instruments formerly manufactured by GenRad/General Radio/QuadTech

WARRANTY

We warrant that this product is free from defects in material and workmanship and, when properly used, will perform in accordance with applicable IET specifications. If within one year after original shipment, it is found not to meet this standard, it will be repaired or, at the option of IET, replaced at no charge when returned to IET. Changes in this product not approved by IET or application of voltages or currents greater than those allowed by the specifications shall void this warranty. IET shall not be liable for any indirect, special, or consequential damages, even if notice has been given to the possibility of such damages.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTIBILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

WARNING

OBSERVE ALL SAFETY RULES
WHEN WORKING WITH HIGH VOLTAGES OR LINE VOLTAGES.

Dangerous voltages may be present inside this instrument. Do not open the case
Refer servicing to qulified personnel

HIGH VOLTAGES MAY BE PRESENT AT THE TERMINALS OF THIS INSTRUMENT

WHENEVER HAZARDOUS VOLTAGES (> 45 V) ARE USED, TAKE ALL MEASURES TO AVOID ACCIDENTAL CONTACT WITH ANY LIVE COMPONENTS.

USE MAXIMUM INSULATION AND MINIMIZE THE USE OF BARE CONDUCTORS WHEN USING THIS INSTRUMENT.

Use extreme caution when working with bare conductors or bus bars.

WHEN WORKING WITH HIGH VOLTAGES, POST WARNING SIGNS AND KEEP UNREQUIRED PERSONNEL SAFELY AWAY.

CAUTION

DO NOT APPLY ANY VOLTAGES OR CURRENTS TO THE TERMINALS OF THIS INSTRUMENT IN EXCESS OF THE MAXIMUM LIMITS INDICATED ON THE FRONT PANEL OR THE OPERATING GUIDE LABEL.

1232-A, -AP Tuned Amplifier & Null Detector Instruction Manual

Bolton, Massachusetts, U.S.A. 01740-1107
February, 1992

Contents

Symbol  IEC417 **on equipment signifies that the manual contains information to prevent injury or equipment damage**

IET LABS, INC.
534 Main Street
Westbury, NY 11590
www.ietlabs.com 516-334-5959 F:516-334-5988

Printed in U.S.A. Form 1232-0100-00

Contents

Instruction Manual Changes

Specifications, Page iii

Power: Nine mercury cells in series have been replaced by eight "AA" alkaline batteries, manufacturers part number:

Everready E91
Duracell MN1500
Ray-O-Vac B15

Estimated battery life is 250 hours.

Service and Maintenance, Paragraph 4.3, Battery Installation, Page 8

Remove the instrument cover per paragraph 4.2, Removal of Cover.

Remove the old batteries and replace with eight new ones, installed per polarity marking.

Electrical Parts List, Page 20

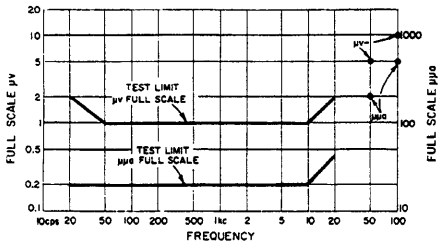
Nine mercury cells have been replaced by eight "AA" alkaline batteries, manufacturers part number listed above.

Specifications

TYPE 1232-A TUNED AMPLIFIER AND NULL DETECTOR

Frequency Response: TUNABLE FILTERS: 20 Hz to 20 kHz in 3 ranges; between 2% and 6% bandwidth to 15 kHz; 2nd harmonic at least 34 dB down from peak, 3rd at least 40 dB down; rejection filter on two highest ranges reduces 60-Hz level to at least 60 dB below peak response (50-Hz level is down >50 dB). Dial accuracy is ±3%. FIXED-TUNED FILTERS: 50 kHz, 2nd harmonic is 44 dB down; 100 kHz . . . 53 dB down. FLAT RESPONSE: ±3 dB from 20 Hz to 100 kHz.
Sensitivity: See plot. Typically better than 0.1 μV over most of the frequency range.
Noise Level: REFERRED TO INPUT: See plot. Noise figure at 1 kHz is less than 2 dB at an optimum source impedance of 27 kΩ. REFERRED TO OUTPUT: Less than 5 mV on FLAT filter-frequency position, min gain setting, and −20-dB switch position; less than 50 mV in MAX SENS position.
Input: IMPEDANCE: Approx 50 kΩ at max gain; varies inversely with gain to 1 MΩ at min gain. MAX SAFE VOLTAGE: 200 V ac or 400 V dc.
Output: VOLTAGE GAIN: Approx 120 dB on the tunable ranges: 100 dB, flat range; 106 dB at 50 kHz; 100 dB at 100-kHz position. LEVEL: 1 V into 10 kΩ when meter indication is full scale. INTERNAL IMPEDANCE: 3 kΩ. METER LINEARITY: dB differences are accurate to ±5% ±0.1 division for inputs of less than 0.3 V. COMPRESSION (meter switch to LOG): Reduces fullscale sensitivity by 40 dB. Does not affect bottom 20% of scale. ATTENUATION (meter switched to −20 dB): Linear response with 20-dB less gain than MAX SENS.
Distortion (filter switch in FLAT position): <5% (due to meter rectifiers).
Terminals: Input, GR874®coaxial connector; output, binding posts.
Available: 1232-P2 Preamplifier to maintain sensitivity of 1232-A at low frequencies when operating from a source impedance above 100 kΩ; rack-adaptor sets (see below) convert 1232 alone, or with companion instruments, to 19-in. rack-mount width.
Power: 12 V dc, from 9 mercury (M72) cells in series. Est battery life 1500 hours. Optionally, a rechargeable battery (non-mercury) can be supplied on special order.
Mechanical: Convertible bench cabinet. DIMENSIONS (wxhxd): Bench, 8x6x7.5 in. (203x152x190 mm). WEIGHT: 5.75 lb (2.6 kg) net, 8 lb (3.7 kg) shipping.

Description	Catalog Number
1232-A Tuned Amplifier and Null Detector	**1232-9701**
1232-AP Tuned Amplifier and Null Detector, with preamplifier	**1232-9829**
Rack-Adaptor Sets	
480-P308, for 1232-A alone	**0480-9838**
480-P316, for 1232-A with 1310 or 1311 oscillator or similar 8-in. wide instrument with convertible-bench cabinet	**0480-9836**
480-P317, for 1232-AP (with preamp) and companion 8-in. instrument	**0480-9837**
Replacement Battery, 9 req'd	**8410-1372**



Minimum input for full-scale meter deflection as a function of frequency.

TYPE 1232-P2 PREAMPLIFIER

(Accessory supplied with Type 1232-AP and Type 1240-AP only)

Voltage Gain: Approx 0.7.
Noise (referred to input): Open-circuit equivalent 0.1 pA; short-circuit equivalent, 0.3 μV (when used with Type 1232-A tuned to 100 Hz).
Impedances: INPUT: >100 mΩ in parallel with 70 pF. OPTIMUM SOURCE: 3 MΩ. OUTPUT: 10 kΩ.
Connectors: GR874® on cables, input and output.
Power: 12 V, 200 μA, supplied by 1232-A.
Mechanical: Special cabinet. DIMENSIONS (wxhxd): 0.75x6x7.5 in. (19x152x190 mm). WEIGHT: 0.94 lb (0.43 kg) net, 4 lb (1.9 kg) shipping.

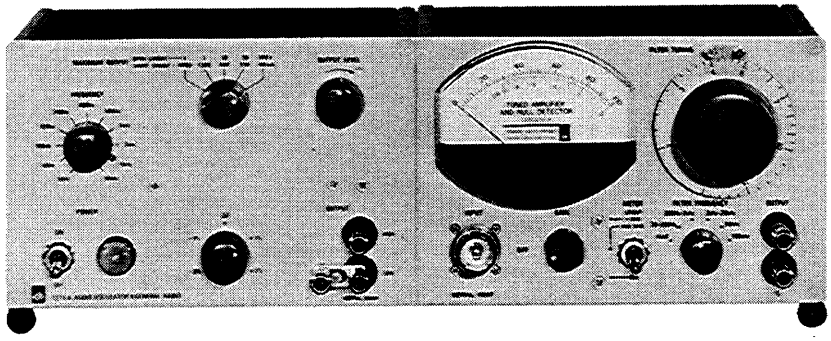
Description	Catalog Number
1232-P2 Preamplifier	**1232-9602**

TYPE 1240-A, -AP BRIDGE OSCILLATOR-DETECTORS

The Type 1240-A Bridge Oscillator-Detector is a rigid assembly of a Type 1311 Audio Oscillator and a Type 1232 Tuned Amplifier and Null Detector. The Type 1240-AP includes the Type 1232-P2 Preamplifier in addition to the above instruments. These compact assemblies are convenient for use with audio-frequency bridges and other null-balance devices.

The units are secured with an Adaptor Plate Set (P/N 0480-9836 for 1240-A, 0480-9837 for 1240-AP) and bolted together near the rear of the instruments. The assembly fits a standard 19-inch relay rack. For bench use, the two wings of the relay-rack adaptor set can be removed and the four rubber feet can be installed in the corners of the oscillator-detector assembly.

Operating instructions for the Type 1232-A or -AP Tuned Amplifier and Null Detector are given in this book. A separate instruction book is supplied for the Type 1311 Audio Oscillator.



GR 1240-A Bridge Oscillator-Detector.

Introduction—Section 1

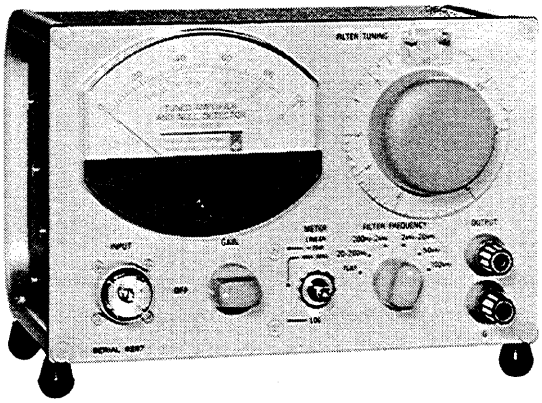


Figure 1. Type 1232-A Tuned Amplifier and Null Detector.

1.1 PURPOSE

The Type 1232-A Tuned Amplifier and Null Detector (Figure 1) is a sensitive, low-noise amplifier continuously tunable from 20 Hz to 20 kHz, with additional fixed-tuned frequencies of 50 kHz and 100 kHz. Intended primarily as a bridge detector, the Type 1232-A can also be used as a detector of high-frequency modulated signals (with a crystal demodulator), a wave analyzer at audio frequencies, and a preamplifier for transducers.

The Type 1232-P2 Preamplifier can be added to improve the signal-to-noise ratio and consequently the effective sensitivity of the Type 1232-A when the latter is to be driven by very high (greater than 100 kΩ) impedance sources.

1.2 DESCRIPTION

The Type 1232-A consists of a low-noise preamplifier, a frequency-selective stage (feedback amplifier and null network), an amplifier-compressor stage, and a meter-rectifier circuit (see block diagram, Figure 2). The total gain of the amplifier is about 120 dB. Full-scale meter sensitivity is 1 microvolt or better over most of the frequency range.

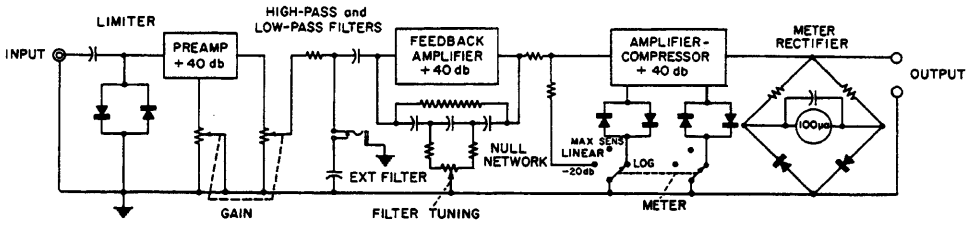


Figure 2. Functional diagram of the null detector.

With the Type 1632 Inductance Bridge, this null detector permits inductance balances to a resolution of 1 part in 10^6. Comparable precision for capacitance balance can be obtained with the Type 1615 and 716 Capacitance Bridges.

The amplifier is powered by 12 Vdc, supplied by nine mercury batteries in series. The output is 1 V into 10,000 ohms.

Front mountings are extendible to tilt instrument face.

The Type 1232-P2 Preamplifier is a detachable accessory that consists of a low-noise field-effect transistor used in common-source configuration. Power for the preamp is provided by the B + supply of the Type 1232-A.

1.3 CONTROLS AND CONNECTORS OF THE TYPES 1232 AND 1232-P2.

TABLE 1

	Name	*Type*	*Function*
Type 1232	FILTER TUNING	Continuous rotary control	Tunes filter within selected tuning range.
	FILTER FREQUENCY	6-position rotary switch	Selects desired frequency characteristic; tuning-frequency range of 20-200 Hz, 200 Hz-2 kHz, or 2-20 kHz; flat, 50-kHz or 100-kHz response.
	GAIN	Rotary control	Turns instrument on or off and controls gain.
	METER	3-position toggle switch	Selects full-gain linear, -20-dB linear, or logarithmic response.
	INPUT	GR874 Locking Coaxial Connector	Input terminals.
	OUTPUT	Pair of Type 938 Binding Posts	Output terminals.
	EXTERNAL FILTER	Phone jack	Connection for external filter.
Type 1232-P2	HIGH Z, LOW Z	Toggle switch	Determines whether Preamplifier is included in input to Type 1232 (HIGH Z) or shunted (LOW Z).
	INPUT	GR874 Connector and Cable Assembly	Input terminals.
	OUTPUT	GR874 Connector and Cable Assembly	Output terminals (to be applied to INPUT of Type 1232).

1.4 USE OF EXTERNAL FILTERS.

Filters can be connected at the EXTERNAL FILTER jack. When a telephone plug is inserted in this jack, the built-in shunt filter is disconnected. The external filter may be either a series-tuned circuit to trap out an undesired frequency or an antiresonant parallel-tuned circuit to improve the selectivity at the desired frequency. For the purpose of calculating the Q of the external filter, the source impedance is about 700 ohms. Since the external filter is plugged into the circuit at a point beyond the 60-Hz rejection filter and where there is 80-dB gain to the meter circuit, it is important that the external filter be shielded and preferably that it use a toroidal inductor for minimum sensitivity to hum pickup.

Principles of Operation–Section 2

2.1 PREAMPLIFIER OF THE TYPE 1232-A.

The preamplifier stage of the Type 1232-A Tuned Amplifier and Null Detector is designed to minimize noise from both low-impedance sources, such as inductance bridges at low frequencies, and high-impedance sources, such as capacitance bridges at low frequencies. A transistor with a noise figure of 3 to 5 dB at an optimum source impedance of 50 kilohms is used. By use of negative feedback, the input impedance of the preamplifier is also made 50 kilohms, and the noise level indicated on the output meter is relatively constant and independent of source impedance.

The input transistor is protected from possible damage due to large overloads by a limiter consisting of a series capacitor and two shunt silicon rectifier diodes. This circuit effectively prevents signals greater than 1 volt, peak-to-peak, from reaching the input transistor and does not contribute noise or distortion to low-level signals.

Maximum gain of the preamplifier is about 40 dB, which is adequate to swamp the noise of succeeding stages. After preamplification, the signal passes through a set of series and shunt filters, which are designed to reject frequencies above and below the selected tuning range. Typical filter characteristics are shown in Figure 3. On all switch positions except FLAT and 20 – 200 Hz, another rejection filter reduces the response at 60 Hz to greater than 60 dB below peak response.

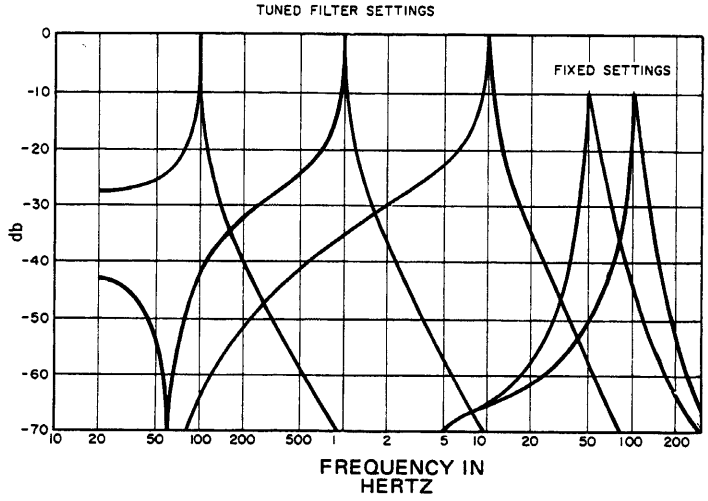


Figure 3. Typical filter characteristics of the Type 1232-A.

2.2 FREQUENCY-SELECTIVE AMPLIFIER.

This amplifier consists of three stages with negative feedback through a null network, which has its null at the desired operating frequency. Since there is negative feedback at all frequencies but the desired one, the over-all response peaks at this frequency and is roughly equivalent to that of a tuned circuit with a Q of about 20 (5% bandwidth). The unique feature of this null network is its one-potentiometer tuning. Many null networks require three variable elements, either ganged capacitors or ganged potentiometers. This leads to many problems in alignment and tracking the three elements to maintain a good null. The Hall null network has a perfect null in theory for any position of the tuning potentiometer, and it is possible to cover a 10:1 tuning range with a 40-dB exponential potentiometer. Tuning capacitors are switched to change ranges, maintaining the impedance level of the null network approximately constant for the three tuning ranges.

Since the 50-kHz and 100-kHz null networks need not be tunable, conventional twin-T null networks are used.

On the FLAT position of the range switch, all filters are switched out and the frequency response is flat to within ±3 dB from 20 Hz to 100 kHz. The overall gain of the amplifier is reduced by 26 dB to keep the noise level on the output meter equal to about 10 percent of full scale at maximum gain.

2.3 NULL NETWORK.

The Type 1232-A Tuned Amplifier and Null Detector uses an RC null network with only one variable component to adjust the frequency of the null. This avoids the use of ganged variable components, which must track closely to maintain stability when used in highly selective feedback amplifiers. The network (Figure 4), consisting of three-terminal RC circuits, gives a complete null without being balanced against a voltage divider, and permits frequency adjustment with a single potentiometer. The tuning law for this circuit is

$$\omega_o = \frac{1}{RC\sqrt{\alpha(1-\alpha)\,(1+2k)}}$$

In order to span a 10-to-1 logarithmic frequency range, the potentiometer must have an exponential characteristic of over 100 to 1.

The selectivity of the transfer admittance, $\frac{I_o}{E_{in}}$ (or y_{21}) is quite constant

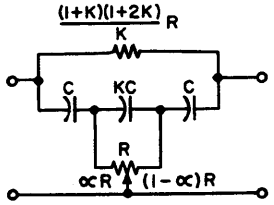


Figure 4. Null circuit of the Type 1232-A Tuned Amplifier and Null Detector.

as the null frequency is changed. In order to use this characteristic, the network must be driven by and loaded by low impedances. Therefore, it is used in a feedback circuit with an amplifier having low input and output impedances and a transfer resistance $\frac{E_o}{I_{in}}$ (or a real z_{21}) that is chosen to give the desired selectivity. This combination provides a second-harmonic rejection of 34 dB over each 10-to-1 frequency range.

2.4 AMPLIFIER-COMPRESSOR.

With the METER switch set to either linear position, the amplifier-compressor functions as a linear amplifier, driving the meter rectifier circuit and supplying the output terminals with about 1.4 V for full-scale deflection of the meter. The MAX SENS position provides full gain for very low-level applications. When maximum sensitivity is not required, use the LINEAR – 20 dB position for a less noisy output. With this switch setting, the noise generated in the input and selective amplifier stages is attenuated. The dc supplied to the last transistor is sufficient to drive the output meter to full scale, but very little more, so that it is impossible to damage the meter by overdriving the amplifier.

For null detector use, the METER switch is thrown to LOG, effectively compressing the upper part of the meter scale. Two pairs of silicon diodes are switched in shunt with the collector resistors of two transistors to provide a nonlinear collector impedance. Owing to the voltage offset of the silicon diodes, the bottom 20 percent of the meter scale is virtually unaffected. A signal level corresponding to 100 percent deflection for linear response will drop to 50 percent for logarithmic response. An increase of 20 dB increases the reading to 80 percent, and another 20 dB raises the reading to 100 percent.

2.5 METER CIRCUIT.

The meter circuit uses a full-wave rectifier in order to double the ripple frequency that passes through the meter and thus to prevent the needle from vibrating visibly at 20 Hz. Resistors are used in place of two of the rectifiers in the conventional full-wave bridge in order to linearize the relation between meter indication and signal level, and to minimize distortion. No dc amplification was incorporated into the meter circuit, so that there is no need for a dc zero adjustment on the front panel and no possibility of dc zero instability. High-impedance, crystal-type earphones can be connected to the output terminals.

Operation—Section 3

3.1 USE AS AN AMPLIFIER OR PREAMPLIFIER.

To use the Type 1232-A or -AP Tuned Amplifier and Null Detector as an amplifier:

a. Connect the input signal to the INPUT connector of the Type 1232 or, if used, the Type 1232-P2. Adaptors for connectors other than Type 874 are available from General Radio. If the output impedance of the source of this signal is greater than 100 kΩ, set the switch on the Type 1232-P2, if used, to HIGH Z; otherwise set the switch to LOW Z.

NOTE

For connection to binding posts, use a Type 874-R34 Patch Cord. (Hum pickup is too great with a Type 874-Q2 Adaptor.)

b. Set the METER switch to LINEAR —20 dB (unless maximum sensitivity is required.)

c. Set the FILTER FREQUENCY switch for the desired characteristic: FLAT, 20-200 Hz, 200 Hz — 2 kHz, 2-20 kHz, 50 kHz, or 100 kHz.

d. With the GAIN control, turn the instrument on and adjust the gain to the desired level. The total range of the GAIN control is 120 dB, and attenuation in dB is roughly proportional to the rotation angle of the control knob.

e. The OUTPUT terminals may be connected to an oscilloscope or headphones. The red binding post is high, the black binding post is ground.

The high sensitivity of this instrument permits its use as a preamplifier for transducer outputs or oscilloscope input.

3.2 USE AS A NULL DETECTOR FOR BRIDGE BALANCING.

To use this instrument as a detector for bridge measurements;

a. Connect the INPUT terminals of the Type 1232-A or -AP to the DETECTOR terminals of the bridge as in paragraph 3.1, step a.

b. Set the METER switch to LOG.

c. Set the FILTER FREQUENCY and FILTER TUNING controls to the desired frequency.

d. With generator and unknown connected to the bridge, set the GAIN control of the Type 1232-A for approximately half-scale deflection of the output meter, and tune the FILTER TUNING control for maximum output.

The bridge balance can now be made in the conventional manner, by readjustment of the GAIN control as balance is approached.

3.3 USE IN AUDIO SPECTRUM ANALYSIS.

The tuned amplifier can be used as an audio-frequency wave analyzer with a sensitivity of 1 μV and a bandwidth of about 5 percent. For approximate measurements, the gain can be assumed to be constant with frequency. More accurate measurements can be obtained if the amplifier is first calibrated with a constant-amplitude, variable-frequency signal. The typical variation of peak response vs frequency is shown in Figure 5.

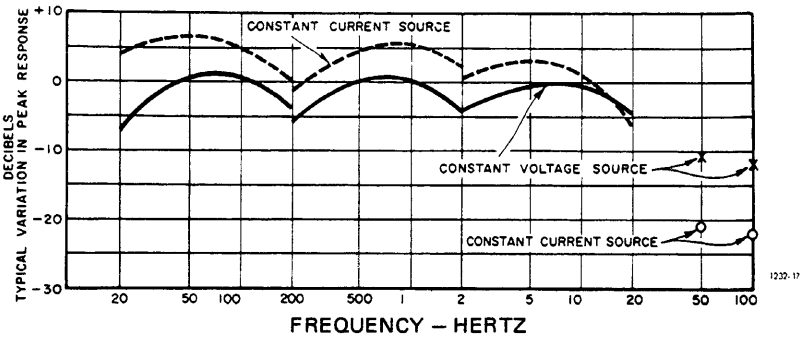


Figure 5. Typical variation in peak response with frequency for constant gain-control setting.

ELECTRICAL PARTS LIST

PC BOARD P/N 1232-2711

REFDES	DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
C 200	CAP ALUM 5 UF 50V	4450-3900	56289	30D505G050
C 201	CAP MICA 220 PF 5PCT 500V	4700-0519	81349	CM05FD221JN
C 202	CAP CER TRIM 8-50 PF	4910-1170	72982	557-051 E 8-50PF
C 204	CAP MICA 30 PF 5PCT 500V	4700-0237	81349	CM05ED300JN
C 205	CAP ALUM 200 UF 6V	4450-2610	56289	30D207G006
C 206	CAP MICA 100 PF 5PCT 500V	4700-0660	81349	CM05FD101JN
C 207	CAP ALUM 100 UF 15V	4450-2800	56289	30D107G015
C 208	CAP ALUM 100 UF 15V	4450-2800	56289	30D107G015
C 209	CAP MYLAR .22UF 10 PCT 100V	4860-7981	56289	410P 0.22 UF 10PCT
C 210	CAP TANT 10 UF 20PCT 20V	4450-5100	56289	150D106X0020B2
C 211	CAP CER TUB 680PF 5PCT 500V NM 0V NM	4404-1685	72982	315Z5R680PF10PCT500
C 212	CAP ALUM 5 UF 50 V	4450-3900	56289	30D505G050
C 213	CAP CER TUB 680PF 5PCT 500 V NM 0V NM	4404-1685	72982	315Z5R680PF10PCT500
C 214	CAP ALUM 5 UF 50V	4450-3900	56289	30D505G050
C 215	CAP ALUM 5 UF 50V	4450-3900	56289	30D505G050
C 216	CAP ALUM 5 UF 50V	4450-3900	56289	30D505G050
C 217	CAP ALUM 15 UF 15V	4450-3700	56289	30D156G015
C 218	CAP ALUM 5 UF 50V	4450-3900	56289	30D505G050
C 219	CAP MYLAR .464UF 2 PCT 100V	4860-7990	56289	410P 0.464 UF 2PCT
C 220	CAP MYLAR .464UF 2 PCT 100V	4860-7990	56289	410P 0.464 UF 2PCT
C 221	CAP MYLAR .464UF 2 PCT 100V	4860-7990	56289	410P 0.464 UF 2PCT
C 222	CAP MICA 464PF 1PCT 500V	4710-0535	81349	CM05FD464FN
C 223	CAP MICA 464PF 1PCT 500V	4710-0535	81349	CM05FD464FN
C 224	CAP MICA 464PF 1PCT 500V	4710-0535	81349	CM05FD464FN
C 225	CAP MICA 1000PF 1PCT 500V	4710-0100	81349	CM06FD102FN
C 226	CAP MICA 1000PF 1PCT 500V	4710-0100	81349	CM06FD102FN
C 227	CAP MICA 1000PF 1PCT 500V	4710-0100	81349	CM06FD102FN
C 230	CAP MYLAR .01UF 2 PCT 100V	4860-7650	56289	410P .01 UF 2PCT
C 231	CAP MYLAR .00681UF 2 PCT 200V	4860-7505	56289	410P .00681 UF 2PCT
C 255	CAP TANT 4.7 UF 20PCT 10V	4450-4700	56289	150D475X0010A2
C 256	CAP MICA 1000 PF 5PCT 500V	4700-1190	81349	CM06FD102JN
CR 200	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR 201	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR 202	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR 203	DIODE RECTIFIER 1N4003	6081-1001	14433	1N4003
CR 204	DIODE 1N191 90PIV IR 125UA GE	6082-1008	14433	1N191
CR 205	DIODE 1N191 90PIV IR 125UA GE	6082-1008	14433	1N191
L 201	CHOKE MOLDED 1000 UH 10PCT	4300-5000	99800	3500-32
L 202	CHOKE MOLDED 390 UH 10PCT	4300-4390	99800	3500-22
R 200	RES COMP 33 K 5PCT 1/2W	6100-3335	81349	RCR20G333J
R 201	RES COMP 33 K 5PCT 1/2W	6100-3335	81349	RCR20G333J
R 203	RES COMP 1.0 K 5PCT 1/2W	6100-2105	81349	RCR20G102J
R 204	RES COMP 220 K 5PCT 1/2W	6100-4225	81349	RCR20G224J
R 205	RES COMP 220 K 5PCT 1/2W	6100-4225	81349	RCR20G224J
R 206	RES COMP 1.0 K 5PCT 1/2W	6100-2105	81349	RCR20G102J
R 207	RES COMP 22 K 5PCT 1/2W	6100-3225	81349	RCR20G223J
R 208	RES COMP 470 OHM 5PCT 1/2W	6100-1475	81349	RCR20G471J
R 210	RES COMP 22 K 5PCT 1/2W	6100-3225	81349	RCR20G223J
R 211	RES COMP 10 OHM 5PCT 1/2W	6100-0105	81349	RCR20G100J
R 212	RES COMP 10 K 5PCT 1/2W	6100-3105	81349	RCR20G103J
R 213	RES COMP 470 OHM 5PCT 1/2W	6100-1475	81349	RCR20G471J
R 214	RES COMP 110 K OHM 5PCT 1/2W	6100-4115	81349	RCR20G114J
R 215	RES COMP 150 K 5PCT 1/2W	6100-4155	81349	RCR20G154J
R 216	RES COMP 27 K 5PCT 1/2W	6100-3275	81349	RCR20G273J
R 217	RES COMP 47 K 5PCT 1/2W	6100-3475	81349	RCR20G473J
R 218	RES COMP 100 K 5PCT 1/2W	6100-4105	81349	RCR20G104J
R 220	RES COMP 4.7 K 5PCT 1/2W	6100-2475	81349	RCR20G472J
R 221	RES COMP 2.7 K 5PCT 1/2W	6100-2275	81349	RCR20G272J
R 222	RES COMP 47 K 5PCT 1/2W	6100-3475	81349	RCR20G473J
R 223	RES COMP 10 K 5PCT 1/2W	6100-3105	81349	RCR20G103J
R 224	RES COMP 12 K 5PCT 1/2W	6100-3125	81349	RCR20G123J
R 225	RES COMP 3.9 K 5PCT 1/2W	6100-2395	81349	RCR20G392J
R 226	RES COMP 3.3 K 5PCT 1/2W	6100-2335	81349	RCR20G332J
R 227	RES COMP 1.8 K 5PCT 1/2W	6100-2185	81349	RCR20G182J
R 228	RES COMP 3.0 K OHM 5PCT 1/2W	6100-2305	81349	RCR20G302J
R 230	RES COMP 9.1 K OHM 5PCT 1/2W	6100-2915	81349	RCR20G912J
R 231	RES COMP 22 K 5PCT 1/2W	6100-3225	81349	RCR20G223J
R 232	RES COMP 9.1 K OHM 5PCT 1/2W	6100-2915	81349	RCR20G912J
R 233	RES FLM 31.6K 1 PCT 1/8W	6250-2316	81349	RN55D3162F
R 234	RES FLM 31.6K 1 PCT 1/8W	6250-2316	81349	RN55D3162F

ELECTRICAL PARTS LIST (cont)

NULL DETECTOR PC BOARD P/N 1232-2711

REFDES	DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
R 235	RES FLM 3.32K 1 PCT 1/8W	6250-1332	81349	RN55D3321F
R 236	RES FLM 3.32K 1 PCT 1/8W	6250-1332	81349	RN55D3321F
R 237	RES FLM 40.2K 1 PCT 1/8W	6250-2402	81349	RN55D4022F
R 238	RES COMP 1.0 K 5PCT 1/2W	6100-2105	81349	RCR20G102J
R 239	RES FLM 5.11K 1 PCT 1/8W	6250-1511	81349	RN55D5111F
R 240	RES FLM 5.11K 1 PCT 1/8W	6250-1511	81349	RN55D5111F
R 241	RES FLM 1.1K 1 PCT 1/8W	6250-1110	81349	RN55D1101F
R 242	RES FLM 4.99K 1 PCT 1/8W	6250-1499	81349	RN55D4991F
R 243	RES FLM 4.99K 1 PCT 1/8W	6250-1499	81349	RN55D4991F
R 244	RES FLM 1.05K 1 PCT 1/8W	6250-1105	81349	RN55D1051F
R 251	RES COMP 2.7 K 5PCT 1/2W	6100-2275	81349	RCR20G272J

MECHANICAL PARTS LIST

DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
FILTER TUNING KNOB ASM	5520-5520	24655	5520-5520
GAIN & FILTER FREQ KNOB ASM	5500-5221	24655	5500-5221
BATTERY HOLDER TUBE	1232-6000	24655	1232-6000
FILTER TUNING DIAL INDICATOR	5470-0650	24655	5470-0650
RIGHT END FRAME ASM	5310-3066	24655	5310-3066
LEFT END FRAME ASM	5310-3067	24655	5310-3067
FEET (4 REQUIRED)	5260-0700	24655	5260-0700

ELECTRICAL PARTS LIST

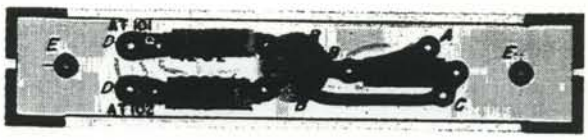
1232-P2 PREAMPLIFIER CHASSIS MOUNTED PARTS

REFDES	DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
S 101	SWITCH TOG MIN 2POS DPDT STEADY	7910-0791	95146	MTA-206N

1232-P2 PREAMPLIFIER PC BOARD P/N 1232-2730

REFDES	DESCRIPTION	PART NO.	FMC	MFGR PART NUMBER
C 101	CAP MYLAR .001UF 10 PCT 200V	4860-7309	56289	410P .001 UF 10PCT
Q 101	TRANSISTOR 2N3457	8210-1082	17856	2N3457
R 101	RES COMP 1.0 C 20PCT 1/2W	6100-3108	81349	RCR20G108
R 102	RES COMP 10 K 5PCT 1/2W	6100-3105	81349	RCR20G103J
R 103	RES COMP 1.0 K 5PCT 1/2W	6100-2105	81349	RCR20G102J

Figure 12. Block diagram of the Type 1232-A Tuned Amplifier and Null Detector.



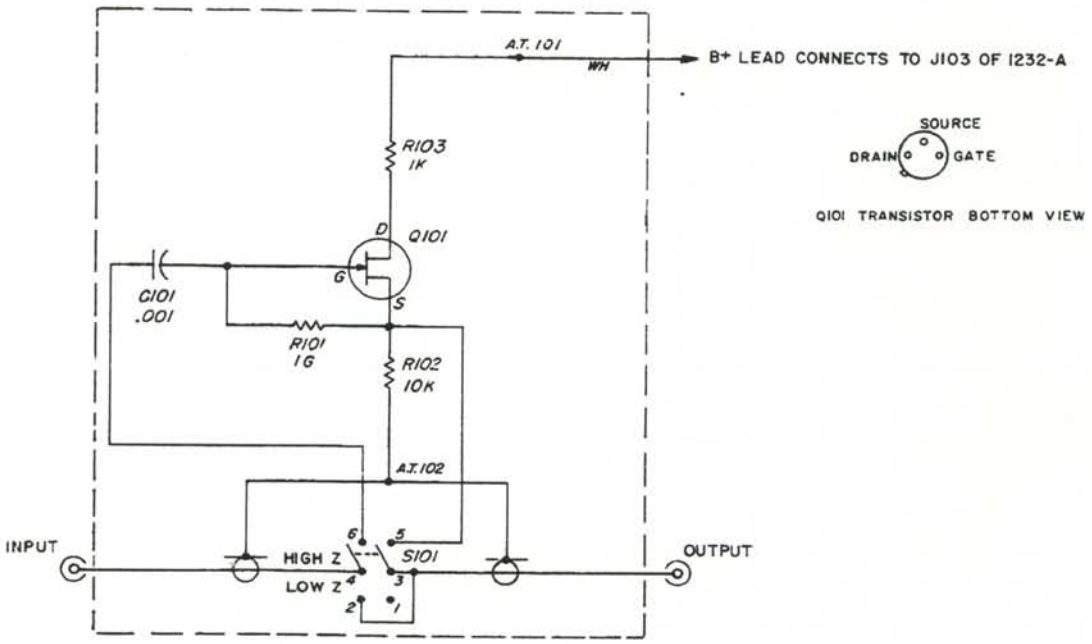


Figure 14. Schematic diagram and etched board layout of the Type 1232-P2 Preamplifier. The etched board part number is 1232-2730.

IET LABS, INC.
Standards • Decades • Strobes • Sound Level Meters • Bridges
Formerly manufactured by
GenRad
534 Main Street, Westbury, NY 11590
TEL: (516) 334-5959 • (800) 899-8438 • FAX: (516) 334-5988
www.ietlabs.com