

THE GENERAL RADIO

EXPERIMENTER



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IN THIS ISSUE



New —

Vibration Pickup System
Rack-Mounted Impedance Bridge
Dallas Sales Engineering Office

EXPERIMENTER



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CONTENTS

New PZT Ceramic Vibration Pickup and Control Box for Vibration Measurements.....	3
Relay-Rack Mount for the Impedance Bridge.....	7
General Radio Comes to Texas.....	8

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COVER



The light pattern of a row of Strobotac® electronic stroboscopes under test in the GR lab was too much for our photographer (and editor) to pass up. Harry Chisholm, Electrical Inspection Supervisor, is shown adjusting flashing rate.

NEW PZT CERAMIC VIBRATION PICKUP AND CONTROL BOX FOR VIBRATION MEASUREMENTS

A new lead-zirconate-titanate accelerometer replaces the barium-titanate ceramic accelerometer as the general-purpose vibration pickup supplied with the General Radio Company's vibration-measuring instruments. This new transducer increases the upper frequency limit of the TYPE 1553-A¹ Vibration Meter from 1200 cps to 2000 cps. A newly designed control box provides a like increase in the frequency response plus an increase in over-all measuring sensitivity when the pickup is used with a TYPE 1551-C or -B Sound-Level Meter. This new control box is so designed that it can readily be adapted for use with other piezoelectric accelerometers. One such adaptation is for use with the Endevco Model 2217 Accelerometer to meet the frequency-response requirements of Mil-Std-740 (SHIPS).

The Pickup

The new TYPE 1560-P52 Vibration Pickup replaces the TYPE 1560-P51 model.² Table 1 compares the characteristics of the new and old units. Compared with its predecessor the new pickup has, in addition to increased sensitivity and increased frequency response, a lower impedance, a wider operating temperature range, and better stability.

Its high sensitivity and low impedance make it an outstanding unit for low-

¹E. E. Gross, "TYPE 1553-A Vibration Meter," *General Radio Experimenter*, 35, 11, November, 1961.

²E. E. Gross, "TYPE 1560-P11 Vibration Pickup System," *General Radio Experimenter*, 34, 11 & 12, November-December, 1960.

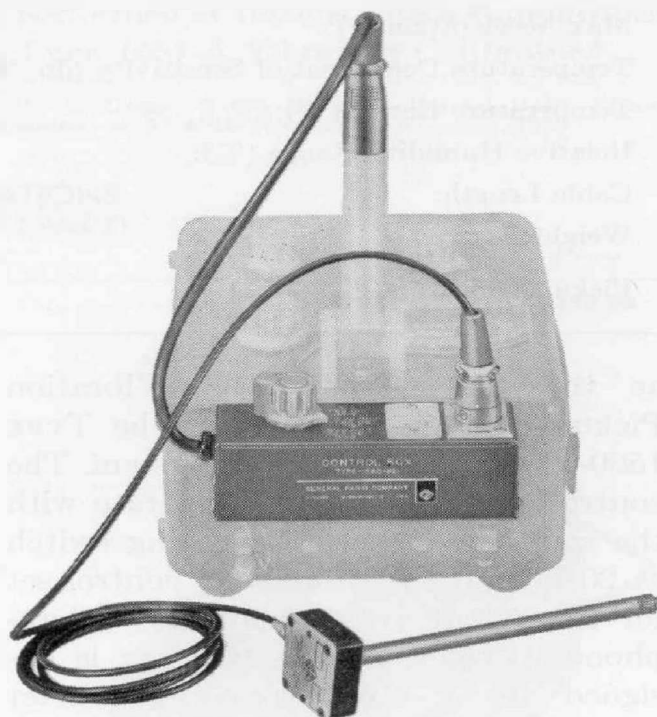


Figure 1. View of the Type 1560-P11B Vibration Pickup System, shown with the Type 1551-C Sound-Level Meter. The control box attaches to the sound-level-meter case.

frequency vibration measurements. Frequency response is flat to below 2 cps without special high-impedance pre-amplifiers. High-gain amplifiers are not required for many common vibration measurements.

The Control Box

The TYPE 1560-P21B Control Box illustrated in Figure 1 has been designed to match the TYPE 1560-P52 Vibration Pickup to the input of the TYPE 1551-C or -B Sound-Level Meter. The combination of pickup and control box is listed

TABLE 1

	Old	New
Type No.:	1560-P51	1560-P52
Material:	Barium Titanate	Lead Zirconate (PZT)
Sensitivity (mv/g):	40	75
Resonant Frequency (cps):	2300	3200
Capacitance (pf):	7000	10,000
Max Acceleration (g):	100	100
Temperature Coefficient of Sensitivity (db/°F):	0.03	0.03
Temperature Range (°F):	0 to +180	-30 to +200
Relative Humidity Range (%):	0 to 100	0 to 100
Cable Length:	5 ft (1.55 m)	5 ft (1.55 m)
Weight:	1.6 oz (45 g)	1.6 oz (45 g)
Pickup Dimensions:	1 5/8 x 1 7/16 x 9/16 in. (42 x 37 x 15 mm)	1 5/8 x 1 7/16 x 9/16 in. (42 x 37 x 15 mm)

as the TYPE 1560-P11B Vibration Pickup System and replaces the TYPE 1560-P11 Vibration Pickup System. The control box is designed to operate with the sound-level-meter weighting switch at 20 kc and the calibration control set for a -60 db (re 1 volt/ μ bar) microphone. Because the control box is designed for a fixed sound-level-meter sensitivity, the calibration adjustment (variable attenuation) required in the control box is reduced. This reduced attenuation requirement and the increased pickup sensitivity have made it

TABLE 2

db Conversion Factors for Old and New Vibration Pickup Systems

Vibration Quantity	Sound-Level-Meter reading in db with:	
	Type 1560-P11	Type 1560-P11B
Acceleration 1 in /sec ²	40	50
Velocity 1 in /sec	80	90
Displacement 1 in	110	120

possible to increase the over-all measurement sensitivity by 10 db, as illustrated in Table 2.

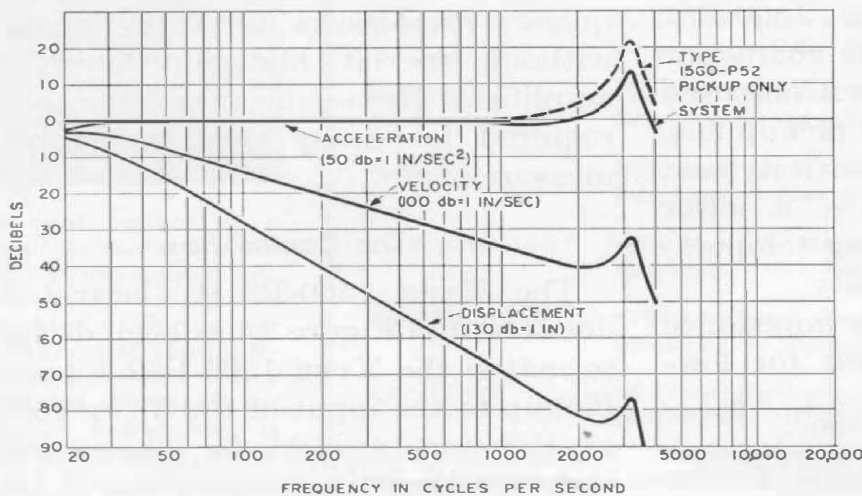


Figure 2. Frequency-response characteristics of the Type 1560-P11B Vibration Pickup System for constant applied acceleration.



The frequency-response characteristics of the TYPE 1560-P11B Vibration Pickup System in combination with the TYPE 1551-C or -B Sound-Level Meter and the response of the TYPE 1560-P52 Vibration Pickup are shown in Figure 2.

Calibration

The electrical response of the circuits in the control box is measured over the frequency range of 20-5000 cps and the response of each pickup is measured

over the frequency range of 10 to 5000 cps. Absolute sensitivity of the pickup is then determined at a low frequency by accurate measurement of the displacement of a calibrating shaker by means of a microscope and a Strobotac® electronic stroboscope. Finally, an over-all operating test of the combination is performed at 100 cps with a standardized TYPE 1557-A Vibration Calibrator.³

³E. E. Gross, "Little Dithers," *General Radio Experimenter*, 34, 11 & 12, November-December, 1960.

SPECIFICATIONS
(See Tables 1 and 2)

Type		Code Word	Price
1560-P11B	Vibration Pickup System.....	PIKUP	\$140.00

MIL-STD-740 (SHIPS)

While the TYPE 1560-P11B combination of pickup and control box meets the requirements of most vibration-measurement problems, there are some specialized measurements that require a flat response characteristic to higher frequencies. For these, the TYPE 1560-P11S2 combination is recommended, consisting of the Endeveco Model 2217 Accelerometer and the TYPE 1560-P21S1 Control Box. A small holding magnet, TYPE 1560-4020, is included. (See Figure 3.)

This system with the TYPE 1551-C or -B Sound-Level Meter provides the flat frequency response and low-noise operation required by Mil-Std-740 (SHIPS) for vibration measurement.

The response characteristics of this special control box, an Endeveco pickup, and a TYPE 1551-C or -B Sound-Level Meter are shown in Figure 4. The curves show that the electrical system does not modify the pickup response for acceleration and provides true integration for velocity measurements to well

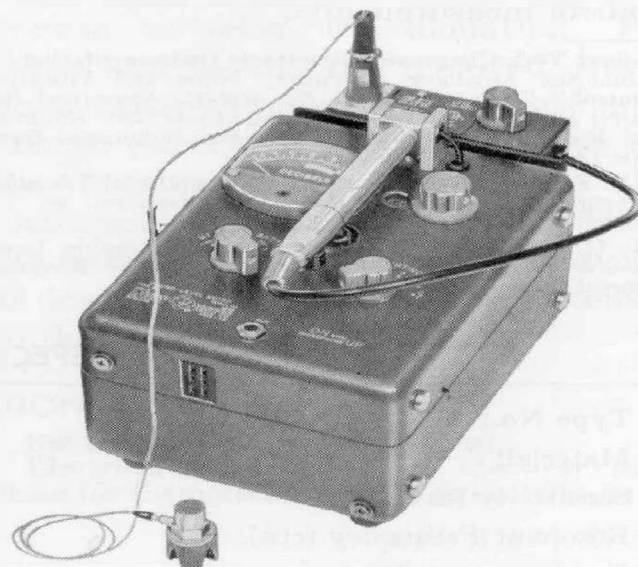


Figure 3. View of the Type 1560-P11S2 Vibration Pickup System with the Type 1551-C Sound-Level Meter.

beyond 10 kc. The two integrators for displacement measurements perform to 3000 cps. The limit here is determined by the internal noise level of the system. The decibel conversion factors for this system are:

- Acceleration — 1 in/sec² = 40 db
- Velocity — 1 in/sec = 90 db
- Displacement — 1 in = 120 db

These are the same numbers, often

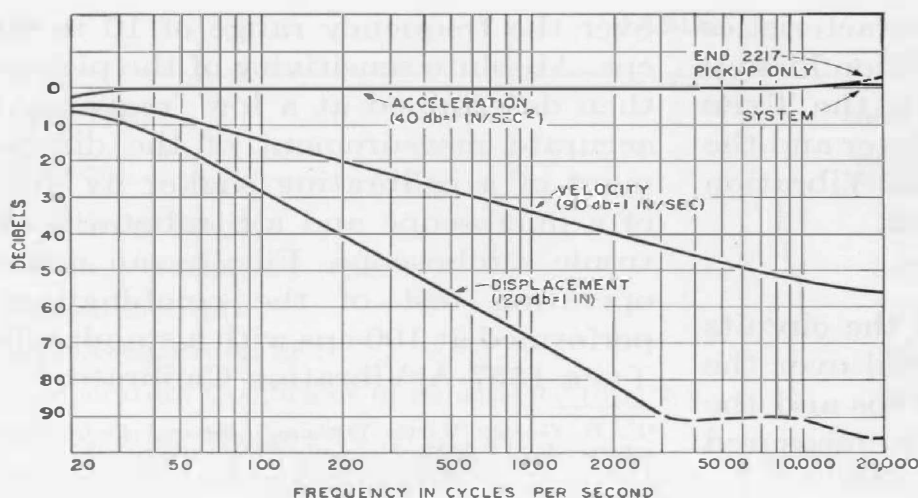


Figure 4. Frequency-response characteristics of the Type 1560-P11S2 Vibration Pickup System for constant applied acceleration. Electrical responses of the control box were measured with a source impedance equivalent to the Endeeco Model 2217 plus its connecting cable. The Endeeco 2217 response is as specified by the manufacturer.

called Chapman Numbers,⁴ that applied to an earlier vibration pickup system using a Rochelle-salt-crystal pickup and used by the Navy for shipboard noise-control measurements.

⁴Robert York Chapman, "Electronic Instrumentation for Submarine Auxiliary Machinery Noise and Vibration Control," *Technical Report No. 210-61*, Acoustical Research and Development Division, Code 380, Engineer and Repair Department, U. S. Naval Submarine Base, New London, Groton, Connecticut.

⁵J. J. Faran, "A New Analyzer for Sound and Vibration Measurement," *General Radio Experimenter*, 33, 12, December, 1959.

⁶M. C. Holtje, M. J. Fitzmorris, "A Graphic Level Recorder with High Sensitivity and Wide Ranges," *General Radio Experimenter*, 33, 6, June, 1959.

The addition of the TYPE 1554-A Sound and Vibration Analyzer⁵ to the vibration-measuring system permits measurements of very low level accelerations. The analyzer and the TYPE 1521-A Graphic Level Recorder⁶ make it possible to record the vibration spectrum, either by a continuous narrow-band analysis or a continuous one-third-octave-band analysis.

— E. E. GROSS

SPECIFICATIONS

Type No.:	Endeeco 2217
Material:	Ceramic
Sensitivity (mv/g):	72
Resonant Frequency (cps):	35,000
Capacitance (pf):	350
Max Acceleration (g):	1000
Operating Temperature Range (°F):	-65 to +250
Temperature Coefficient of Sensitivity (db/°F):	< 0.01
Relative Humidity Range (%):	0 to 100 (Hermetically sealed)
Cable Length:	8 ft, 2 in. (2.5 m)
Weight:	1.1 oz (31 g)
Pickup Dimensions:	5/8 hex x 0.70 in. (15.5 dia x 18 mm)

Type	Code Word	Price
1560-P11S2 Vibration Pickup System*	PILOT	\$355.00

*Available on special order.

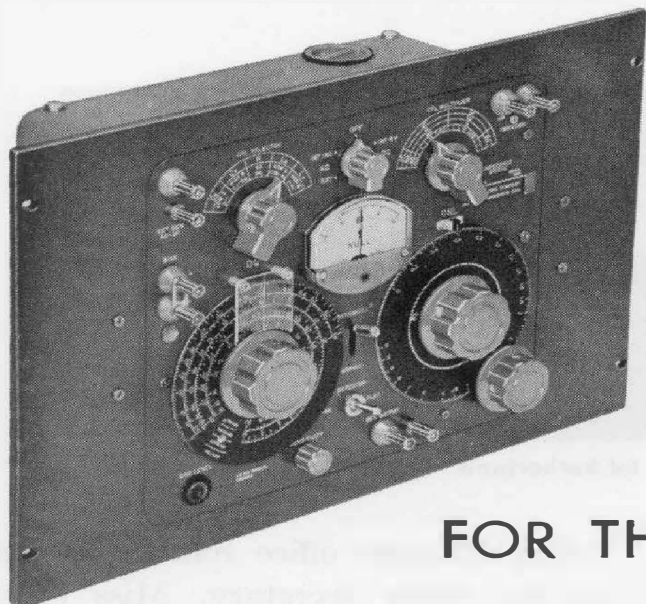


Figure 1. The new relay-rack model of the Type 1650-A Impedance Bridge.

RELAY-RACK MOUNT FOR THE IMPEDANCE BRIDGE

The General Radio Flip-Tilt Case is used on instruments where portability is an important requirement. Prominent among these is the TYPE 1650-A Impedance Bridge.¹ It is easily carried, is amply protected during transport, and opens easily for operation with the instrument panel held at any desired angle. However, for some applications, as, for instance, production-line test assemblies, relay-rack mounting is de-

sirable, and we are now prepared to supply this versatile bridge on a 19-inch relay-rack panel, as shown in Figure 1.

An adaptor panel provides the conversion to relay-rack mounting. The cover and handle are removed and a heavy, charcoal-gray, crackle-finish, aluminum panel, with suitable cutout for the instrument, is attached to the instrument by two angle brackets. These brackets make use of the same hardware as does the carrying handle for fastening to the instrument case.

¹Henry P. Hall, "A Universal Impedance Bridge," *General Radio Experimenter*, 33, 3, March, 1959.

SPECIFICATIONS

Dimensions: Panel, 19 by 12 $\frac{1}{4}$ inches (485 by 315 mm); depth behind panel, 5 inches (130 mm).

Net Weight: 17 $\frac{3}{4}$ pounds (8.5 kg).

Electrical specifications are identical with those for the portable model, TYPE 1650-A.

Type	Code Word	Price
1650-AR Impedance Bridge	BEFOG	\$460.00

U.S. Patent No. 2,872,639 and 2,966,257.

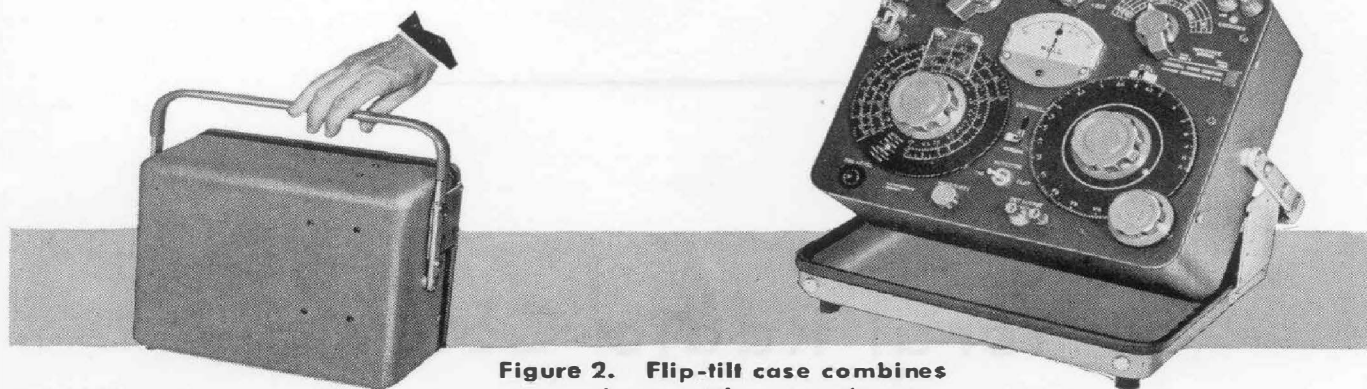
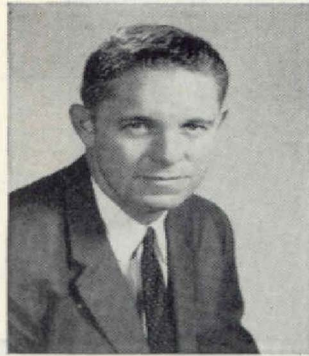


Figure 2. Flip-tilt case combines ruggedness with convenience.



GENERAL RADIO COMES TO TEXAS



Ed Sutherland



Shirley Redfield

With appropriate pride, we announce the opening of a new sales engineering office in Dallas, Texas. Territory covered by the new office, at 2501-A West Mockingbird Lane, includes all of Texas (except El Paso), Louisiana, Mississippi, Oklahoma, Arkansas, and Colorado.

Manager of the Dallas Office is Edward F. Sutherland, who for the past four years has been a member of our New York sales engineering staff. Ed is eminently qualified for his new assignment: As an electronics engineer (Cornell) with six years' experience at General Radio, he offers expert advice on measurement problems to our Texas-area customers; as one born in Texas (Houston), he speaks as a native son; and, at six-foot-seven, Ed can not only talk to Texans, but can look most of them in the eye.

Our Chicago office reluctantly gives up its senior secretary, Miss Shirley Redfield, to Dallas. Shirley, with almost 20 years at GR, is well known in the Chicago area as a member of the Executive Committee of the Chicago IRE Section.

Dallas is the latest extension of GR's traditional policy of serving customers directly. Our first district sales office was opened in 1934 in New York, and there are now 11 such offices spread from Toronto to Los Angeles. These offices are manned by engineers whose considerable knowledge of electrical measurements is yours for the telephoning. And of course that goes double in Big D, where the number is Fleetwood 7-4031 (code 214).

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