THE GENERAL RADIO EXPERIMENTER

VOLUME 38 NUMBER 3 MARCH 1964

SPECIAL IEEE SHOW ISSUE

THE GENERAL RADIO EXPERIMENTER

Published Monthly by the General Radio Company

VOLUME 38 NUMBER 3 MARCH 1964

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The General Radio EXPERIMENTER is mailed without charge each month to engineers, scientists, technicians, and others interested in electronic techniques in measurement. When sending requests for subscriptions and address-change notices, please supply the following information: name, company address, type of business company is engaged in, and title or position of individual.

IEEE—1964

Opening March 21 at the Coliseum, New York — the electronics industry's largest and oldest show. Simultaneously, at the Hilton Hotel, other electrical apparatus will be on display.

General Radio will be at the Coliseum as usual. As in past years, the GR booth will be on the third floor, directly opposite the escalator. This will be the thirtieth year that General Radio has exhibited its wares at this show, having participated in every scheduled annual IRE exhibit since the first one was held in 1930.

Not surprisingly, surveys have shown that the primary attraction for most engineers is the third-floor exhibit of instruments and test equipment. Measurement and test are basic to both science and industry, and each year's show brings new tools to aid the busy engineer.

FIVE NEW FOR '64

GR will show four brand-new instruments, plus one not seen previously at this show: A frequency synthesizer, a tone-burst generator, a standard-frequency oscillator, a megohm bridge, and an electric-wave analyzer. These new devices are supplemented by many recently announced products, most of which you have read about in the *Experimenter*, plus others from General Radio's extensive line of over 900 cataloged items. All are described briefly on the following pages. Complete descriptions of the new instruments will appear soon in the *Experimenter*.

So, come to the greatest electronics show on earth, and be sure to drop in at Booths 3201 to 3208 for a closer look at GR's new and up-to-date instruments. Our development and sales engineers will be on hand to help you.

A Glimpse of the Future

Booths 3201-3208
General Radio Company

IEEE SHOW
March 23-26, 1964 • New York City

COHERENT DECADE FREQUENCY SYNTHESIZERS

TYPE 1161-A and TYPE 1162-A

The new General Radio frequency synthesizers combine the simplicity and resettability of step adjustment with the convenience of search and comparison provided by continuous adjustment.

The TYPE 1162-A Coherent Decade Frequency Synthesizer supplies known frequencies from 0 to 1 Mc in step increments as small as 0.1 cps and includes also a continuously adjustable decade that can be switched in beyond the smallest discrete step or at any point in the digit series. The TYPE 1161-A is nearly identical, except that its maximum frequency is 100 kc and its smallest discrete step is 0.01 cps.

Heart of each of the new synthesizers is a set of seven identical plug-in modules, called DI (for digit-insertion) units, operating from a built-in 5-Mc, room-temperature, crystal oscillator. For maximum accuracy, this oscillator can be phase locked to an external frequency standard operating at 5 Mc or any submultiple thereof, such as the TYPE 1115-B Standard-Frequency Oscillator.

The continuously adjustable decade (CAD) develops a frequency whose major portion (some 90%) is derived from the crystal oscillator. The remainder is produced by a stable, free-running oscillator. The resultant frequency can be quickly standardized by comparison with the output of the DI units.

Operation of the synthesizers is simple and straightforward. The seven rotary switches on the DI units are set so that the desired frequency is indicated by the rear-lit, in-line dials. Comma and decimal point are included in the read-out. To replace any digit, and those following it, by the CAD, one simply pushes a button below that decade. Only those digits that are in circuit are illuminated. When used to supplement the frequency determined by the digital setting, the CAD can, theoretically, be set to a resolution of better than 0.0001 cps in the TYPE 1162-A and 0.00001 in the TYPE 1161-A. Practically, of course, the usable resolution is determined by the oscillator stability and the time interval of interest.

Output voltage, indicated by a front-panel meter, is adjustable up to 2 volts into 50 ohms. Both ac and dc output coupling means are provided. The panel meter is also used to indicate phase-lock to an external standard and as a zero-beat indicator to calibrate the CAD against any selected series of frequency digits set on the DI dials.

The frequency of the CAD can also be varied by an externally introduced voltage for sweeping, fm modulation, or phase-locking to external signals. The external-control input is dc coupled. Frequency markers can be derived from the calibration circuitry. The output frequency is readily applied to automatic recording of the frequency response of networks and the frequency drift of oscillators.

In addition to the main output of the synthesizer, several other useful outputs are provided: 100 kc, 1 Mc, 5 Mc, 42 Mc, 50 Mc, 5.0-5.1 Mc, 50-51 Mc, and 18 volts dc.

Each synthesizer is available complete with all seven DI units (A-models) or in a stripped-down version (A3C-models) with only the first three digits installed. Other digits can be added to the latter when desired. The continuously adjustable decade is included in each version, so that 6-figure resolution can be achieved in the stripped-down models. You may buy only as many digits as you need.

Small and compact (5¼-inch rack panel), each synthesizer includes a power supply for line operation. Battery operation is also possible, with a single battery supplying 22 to 28 volts.

Type	*Max f*	*Digits*	*Price**
1162-A	1 Mc	7	To be announced at our booth
1162-A3C	1 Mc	3	
1161-A	100 kc	7	
1161-A3C	100 kc	3	

* YOU WILL BE PLEASANTLY SURPRISED.

TYPE 1115-B STANDARD-FREQUENCY OSCILLATOR

This new crystal oscillator combines high stability with the physical ruggedness necessary to withstand vibration and shock. It uses a 5-Mc, 5th-overtone crystal in an all-solid-state circuit of silicon transistors. Both crystal and circuit are held at constant temperature by a proportionally controlled oven. Fiberglas-epoxy etched circuits, cased transformers, and Mil grade electrolytic capacitors make the unit acceptable for many military and government applications.

Sine-wave output is available at 5 Mc, 1 Mc, and 100 kc, each 1 volt into 50 ohms.

Power supply is 90–130/180–260 volts at 40 to 1000 cps or 24 to 35 volts dc. A nickel-cadmium battery is floated across the internal dc supply. In the event of power failure, the battery will operate the standard up to 35 hours.

- Stability: Frequency variations with load or voltage are of the order of 1 or 2 parts in 10^{11}. Temperature effects are less than 1×10^{-11} per degree C.
- Spectral Purity: Line width at the 2000th harmonic (10 Gc) is 0.25 cps.
- Aging: Less than 5 in 10^{10} per day after 30 days; less than 1 in 10^{10} is typical after one year.

Price: **$2050.00**

TYPE 1900-A WAVE ANALYZER

This new heterodyne-type wave analyzer has many features that recommend it to the modern electronics laboratory, among them:

- Wide frequency range — 20 to 54,000 cps.
- Three bandwidths — 3, 10, and 50 cps.
- Two recorder outputs — dc and 100 kc.
- 80-db dynamic range for 100-kc output.
- Input impedance of one megohm for all ranges.
- Self-contained voltage-calibrating system.
- 30 microvolts to 300 volts, full-scale.
- Three meter speeds for easier noise analysis.
- Linear frequency scale for optimum tuning characteristics over full range.
- A 3-position function switch selects any one of three modes of operation:

NORMAL — The filtered input component is available at the output jack.

AFC — Same as NORMAL, but with afc added to hold analyzer in tune despite small drifts in frequency.

TRACKING GENERATOR — The output is a sine wave, tunable over the 54-kc range and always in tune with the analyzer. Thus, the analyzer can be used as both generator and detector, simultaneously.

Four quartz crystals are used in the 100-kc i-f filter to achieve the desired selectivity.

The 80-db dynamic range of the 100-kc output makes possible many measurements with a graphic level recorder that are not possible with most analyzers.

The features of a large, mirror-backed meter, in-line frequency readout, ex-

cellent frequency settability, high frequency stability, and a quick calibration test make the analyzer exceptionally easy to use.

The TYPE 1900-A Wave Analyzer will be described in an early issue of the *Experimenter*. It is available in bench or relay-rack mount and, assembled with the TYPE 1521 Graphic Level Recorder, as the TYPE 1910-A Recording Wave Analyzer.

Price: **$2150.00**

TYPE 1396-A TONE-BURST GENERATOR

The TONE-BURST GENERATOR is a unique instrument, which, when fed from an external oscillator, generates pulses, or bursts, of the input frequency. It is useful for testing the time response of ac circuits and for simulating the pulsed ac signals commonly used in audio and ultrasonic equipment, such as sonar.

In addition to its many applications in the direct measurement of sonar transducers and amplifiers, it has been used as a generator for bridge measurements where high peak power is needed but average power must be kept within the dissipation capabilities of the bridge arms. Other important applications are in the measurement of loudspeaker transients and of room acoustics.

The input-signal frequency range is dc to 500 kc. The number of cycles in the burst and the time interval between bursts are adjustable by front panel controls. Burst duration (open gate) and closed-gate intervals can be 2, 4, 8, 16, 32, 64 and 128 cycles or 1, 3, 7, 15, 31, 63 and 127 cycles. Closed-gate intervals can also be set from one millisecond to 10 seconds in one-period increments. Open and closed intervals are independent.

The output burst is coherent, i.e., both the starting and ending phase of the burst is invariant from pulse to pulse. The starting and ending phase is adjustable by front-panel controls over a range of 0 to 360°. A description will appear in an early issue of the *Experimenter*.

Price: **$490.00**

TYPE 1644-A MEGOHM BRIDGE

This new megohm bridge, which replaces the venerable TYPE 544, has many new features that will recommend it to those who measure high resistance, insulation resistance, volume resistivity, and capacitor leakage:

- Ten decade ranges to measure resistance values from 1000 ohms to 1000 teraohms (10^3 to 10^{15} ohms).
- 1% accuracy to 10^{13} ohms.
- $\triangle R$ dial with $\pm 5\%$ range for measurement of small differences to 0.1% — can be used for matching resistors and for voltage-coefficient measurements.
- Self-checking circuits allow quick intercomparison of all internal resistance standards against those of lowest value, which are GR precision wirewound units. Adjustable trimmers are provided for the three highest-value resistance standards to keep them in agreement with the more stable lower-value standards.
- High-sensitivity null detector with electrometer-tube input provides excellent resolution.
- Seven test voltages from 10 volts to 1000 volts in 1-2-5 steps. For any intermediate values, one simply plugs an external resistor into panel binding posts.
- Ratio arms of bridge circuit have 100:1 ratio, so voltage across unknown varies less than 1% as balance control is turned over its full range (versus 10% in TYPE 544-B).
- Highly regulated power supply and quick charging and discharging circuits are provided for leakage measurements on capacitors.
- Guarded for two- and three-terminal measurements on grounded or ungrounded unknowns located either at bridge terminals or at considerable distances with connection through shielded cables.
- Flip-Tilt case provides both portability and optimum viewing angle.

Price: **$625.00**

. . . and see these recently announced products

TYPE 1564-A
Sound and Vibration Analyzer

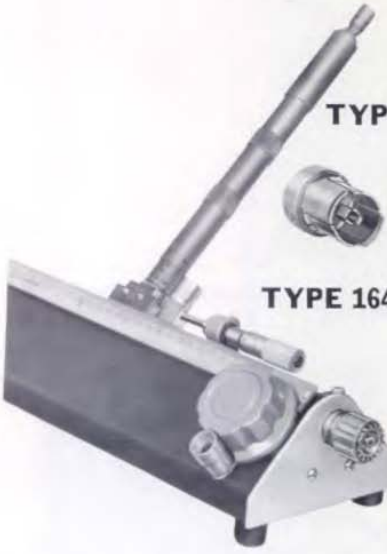
Continuously variable, 2.5 cps to 25 kc in four decade ranges; ⅓-octave and 1/10-octave band pass. Can be driven by TYPE 1521 Graphic Level Recorder for automatic recording of sound and vibration spectra. See *Experimenter*, September–October, 1963.

TYPE 1862-C Megohmmeter

Direct-reading to 2,000,000 megohms at a test voltage of 500 volts and to 200,000 megohms at 100 volts. For rapid measurements of resistors and insulation resistance. See *Experimenter*, July, 1963.

TYPE 900 Precision Coaxial Connectors and Elements

Low VSWR (<1.002 to 1 Gc, <1.01 to 9 Gc), low loss, low leakage. Precision-built for standardization and other exacting requirements. See *Experimenter*, February-March and November, 1963.



TYPE 874 Coaxial Elements

General Radio's well known line of connectors, fittings, attenuators, terminations, filters, lines, and line stretchers, with adaptors to most other commonly used types.

TYPE 1640-A Slotted Line Recorder System

A precision slotted line, TYPE 900-LBA, with a modified TYPE 1521 Graphic Level Recorder for the automatic plotting of VSWR on 4-inch chart paper. Sensitivity can be set to correspond to full-scale values of VSWR from 1.008 to 1.20. See *Experimenter*, November, 1963 for a description of the slotted line. The complete system will be described in an early issue.

TYPE 938-G, -H, -J Binding Posts

Binding-post body and stud are copper to minimize thermal emf to copper wire. Copper parts are gold plated to maintain low and constant connection resistance. Tops, either metal or insulated, have double-hexagon (12-point) shape for easy finger tightening and to fit common 12-point socket and box wrenches.

TYPE 1615-A Capacitance Bridge

Measures 2-terminal and 3-terminal capacitance from 10^{-17} to 10^{-6} farads (10 attofarads to 1 microfarad) with a resolution of 1 in 10^6 and an accuracy of 0.01% over most of the range; also measures loss as either dissipation factor or conductance. See *Experimenter*, August-September, 1962.

COUNTERS

The new, improved TYPE 1150-B DIGITAL FREQUENCY METER (10 cps to 400 kc) and the TYPE 1151-A DIGITAL TIME AND FREQUENCY METER (dc to 400 kc), supplemented by the TYPE 1136-A DIGITAL-TO-ANALOG CONVERTER and the TYPE 1137-A DATA PRINTER. See *Experimenter*, April, 1962, June, 1963, and December, 1963.

TYPE 1025-A Standard Sweep-Frequency Generator

A standard-signal generator with swept-frequency or cw output — accurately known output voltage; marker calibrated and adjustable in frequency and amplitude; 0.7 to 230 Mc in ten bands, plus two bandspread ranges. See *Experimenter*, January 1963.

TYPE 1308-A Audio Oscillator and Power Amplifier

A 20 cps-to-20 kc generator for frequency changing and for measurements at high power levels. Full-scale output ranges of 4, 12.5, 40, 125, 400 volts, rms; 0.5, 1.6, 5 amperes; in any combination up to 200 va. See *Experimenter*, January 1964.

TYPE 1806-A
Electronic Voltmeter

A peak-responding instrument accurate to 2% of indication (*not* full scale) usable up to 1500 Mc (±2 db). Ac, dc, and ohms scales; voltage scale is logarithmic. Probe is new design, with accessory tips, ground clips, etc. Available in Flip-Tilt case or on relay-rack panel. See *Experimenter*, July 1963.

TYPE 1608-A
Impedance Bridge

A precision *R-L-C-G* bridge with 0.1% accuracy, digital readout, automatic decimal-point location, and illuminated indication of the units of measurement. Internal oscillator and detector for 1-kc operation; modules for other frequencies can be supplied. See *Experimenter* for March, 1962.

VARIAC®
adjustable autotransformers

The first practical device of this kind was originated by General Radio in 1933. Constant improvement in design and manufacture ensures continuance of the reliable performance that is characteristic of the VARIAC brand.

General Radio Company