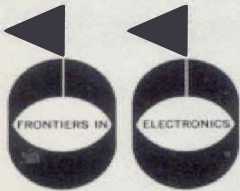


# THE GENERAL RADIO EXPERIMENTER



TYPE 1123-A  
DIGITAL  
SYNCHROMETER

## WESCON/64



- AUTOMATIC CAPACITANCE BRIDGE
- CAPACITANCE MEASURING ASSEMBLY
- MEGOHM BRIDGE
- DIGITAL SYNCHROMETER
- STANDARD-FREQUENCY OSCILLATOR
- FREQUENCY SYNTHESIZERS
- COAXIAL EQUIPMENT
- SLOTTED LINE RECORDER SYSTEM
- DIGITAL FREQUENCY METER
- DIGITAL TIME AND FREQUENCY METER
- DIGITAL-TO-ANALOG CONVERTER
- GRAPHIC LEVEL RECORDER
- SOUND AND VIBRATION ANALYZER
- WAVE ANALYZER
- TONE-BURST GENERATOR



TYPE 1680-A  
AUTOMATIC CAPACITANCE  
BRIDGE ASSEMBLY

VOLUME 38 NUMBER 8

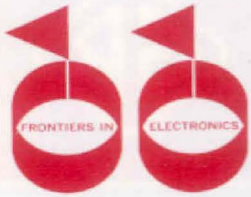
AUGUST 1964

Be sure to visit us at **WESCON/64**

LOS ANGELES SPORTS ARENA—BOOTHS 1344-1346



# AUTOMATIC BRIDGE AMONG NEW INSTRUMENTS AT WESCON



We have always considered WESCON (Western Electronic Show and Convention) a major event in our exhibit schedule, and we accordingly try to schedule the introduction of important new instruments for the occasion. Last year our TYPE 1900-A Wave Analyzer was unveiled at WESCON. This year, an automatic capacitance bridge heads the list of new products bound for Booth 1343-1346 at the Los Angeles Sports Arena.

## TYPE 1680-A AUTOMATIC CAPACITANCE BRIDGE ASSEMBLY



The "automatic bridge," up until now, either has not been a true bridge at all or has been a monster system with a five-digit price. GR, whose experience with impedance bridges goes back nearly a half-century, has now produced an instrument-sized, instrument-priced, automatic capacitance bridge that is sure to be the standard

for such instruments for many years to come.

The Automatic Capacitance Bridge Assembly requires only connection of the unknown. The bridge selects the proper range, achieves balance, and presents the value of the unknown on an in-line Numerik digital readout that includes capacitance, dissipation factor

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or conductance, decimal points, and units. All this information is also presented in binary-coded decimal form (1-2-4-2 BCD) for use by printers or other data-handling equipment. The entire balance operation consumes about a half second.

Three switch-selected generator frequencies are available: 120, 400, and 1000 cycles per second. Capacitance range is 100 picofarads (full-scale) to 100 microfarads at 400 and 1000 c/s (resolution is 0.01 picofarad) and 1 microfarad (full-scale) to 1000 microfarads with a 120-cycle signal. Dissipation-factor range is 0.0001 to 1.0, and the bridge will measure parallel conductance from 0.1 nanomho to 1 mho at 400 and 1000 c/s, 1 micromho to 1.0 mho at 120 c/s.

Basic accuracy of capacitance measurement is  $\pm 0.1\%$  of reading  $\pm 0.01\%$  of full scale. Accuracy of frequencies supplied by the transistorized oscillator is  $\pm 1\%$ .

The new bridge features several operating modes to accommodate a wide range of possible applications. In the tracking mode, for example, it will continuously follow variations in a capacitor under test, permitting automatic recording of the effects of temperature or other environmental conditions. In the tracking-sampled mode, the bridge tracks the variations but yields data only on command.

All this automation comes in a rack-bench instrument only 10½ inches high, with a price requiring only four digits (\$4850).

## TYPE 1123-A DIGITAL SYNCRONOMETER



The standard clock face of the Synchronometer® time comparator has gone the way of bridge balance controls, as you can see from the picture of our new TYPE 1123-A Digital Synchronometer. Hours, minutes, and seconds appear on an in-line Numerik digital readout. The readout, however, is only one of many significant differences between this Synchronometer and its predecessors.

The Synchronometer is a time-indicating instrument normally operated by a 100-kc input signal from a precision

frequency standard, such as the General Radio TYPE 1115-B. An automatic disabling circuit stops the "clock" if the input signal changes frequency or if it misses even one cycle. There is therefore no danger that the user will unknowingly accept data spoiled by a momentary input failure.

Synchronometer time can be compared with standard time (e.g., from WWV) within  $\pm 10$  microseconds *without* being itself disturbed. After the comparison is complete, Synchronometer



time can be synchronized against standard time with one push of a button.

The new instrument was designed with remote operation in mind. Any number of them can be started simultaneously from one location, with a pre-set time delay between local and remote units of 0 to 999.99 milliseconds.

The time indicator, as mentioned, is a six-place Numerik register. Digits can be changed during operation, and the register can be set to recycle after any number of hours from 1 to 99.

Timing pulses at frequencies from 100 kc/s down to 0.1 c/s (in decimal submultiples) are available at output connectors. A 0.2-microsecond marker is also available for high-resolution time intercomparisons, as with Loran C.

The all-solid-state Synchronometer<sup>®</sup> time comparator operates from standard ac power lines but also includes its own nickel-cadmium (explosion-proof) batteries for automatic takeover in emergencies.

Price: \$2950.00

## NEW MEMBERS OF THE GR900 FAMILY

As the GR900 precision coaxial connector gains rapidly in popularity, we are striving to meet the great demand for elements based on this coaxial design. Among those to be introduced at WESCON are:

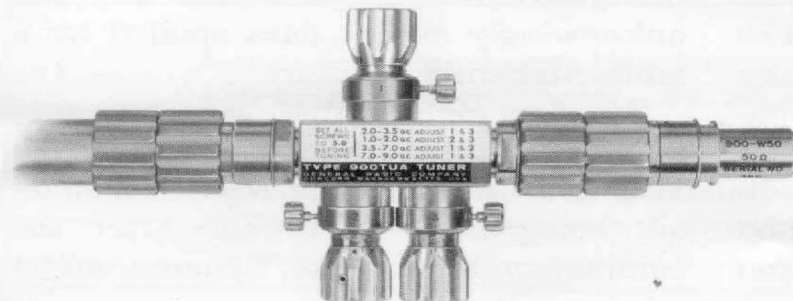
The **Type 900-TUA Tuner**, used with the TYPE 900-LB Precision Slotted Line to cancel out residual reflections of rf terminations, measuring instruments, connectors, and adaptors at frequencies between 1 and 9 Gc/s. The tuner comprises a section of 50-ohm coaxial line with three adjustable tuning screws having engraved micrometer scales. These screws are used to tune out reflections. All three can be set to a "neutral" position, where the tuner effectively becomes a reflectionless continuation of the line. The maximum VSWR that can be tuned out under all

conditions of mismatch, phase, and frequency is  $1.00 + 0.012$  times the frequency in gigacycles. Larger reflections can usually be tuned out.

The **Type 900-LZ Reference Air Line**, available in 5-, 7.5-, 10-, 15-, and 30-centimeter sections. In use, the free inner conductor is centered on the center-conductor contacts of the GR900 connectors at the ends, by means of spring-loaded inserts. The absence of any support in the line itself means that these air lines are essentially reflectionless, without even the minor discontinuity of a well designed bead.

**Several new Type 900-Q Adaptors**, which are used to connect the GR900 series to TYPES BNC, C, and TNC plugs and jacks.

**Types 900-WNC and -WNE Short-Circuit Terminations.** The former is de-



The Type 900-TUA Tuner installed between a coaxial line and a matched termination.



signed for use with the reference air line described above, the latter to produce a short circuit at the same reference plane as that of the TYPE 900-WO Open-Circuit Termination.

#### Connector Kits for Reference Air Line.

Those desiring reference air lines of lengths other than those available as

ready-made sections (see above) can now make their own sections out of GR precision rod and tubing (Part No 0900-9508 and 0900-9509, respectively). New connector kits include the necessary parts of the GR900 connector for such line fabrication as well as for the connection of reference air line to components.

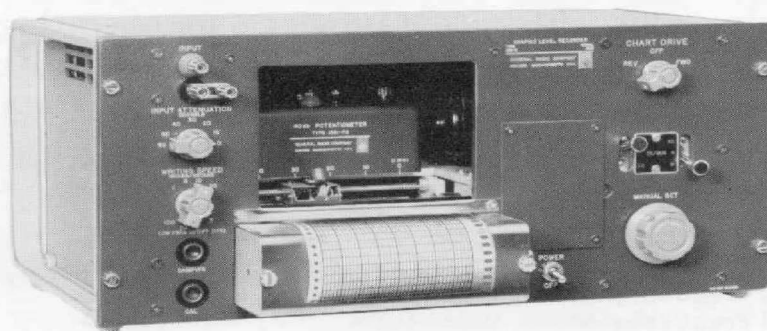


Frontiers in Electronics

... and also on display

TYPE 1360-B MICROWAVE OSCILLATOR  
TYPE 1422-CL PRECISION CAPACITOR

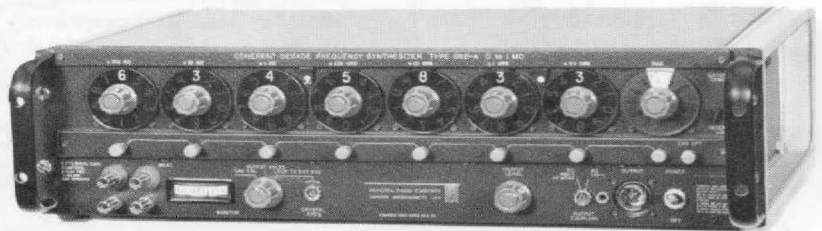
These instruments are described elsewhere in this issue.



TYPE 1521-B  
GRAPHIC LEVEL RECORDER

TYPES 1161-A AND 1162-A  
COHERENT DECADE  
FREQUENCY SYNTHESIZERS

Descriptions of these instruments will appear in the September issue of the *General Radio Experimenter*.



### 400-kc SOLID-STATE COUNTER

Experience with the TYPE 1150-A Digital Frequency Meter<sup>1</sup> and with the circuitry of its more sophisticated brother, the TYPE 1151-A,<sup>2</sup> has made possible a number of improvements that increase reliability, ease of operation, and frequency range.

A new model, the TYPE 1150-B, now replaces the original A-model. This

digital frequency meter is based on the same simple, economical ring counting units used in its predecessors. The upper frequency limit, however, has been raised from 300 kc/s to 400 kc/s,

<sup>1</sup> R. W. Frank and J. K. Skilling, "A Five-Digit Solid-State Counter for Frequency Measurements to 220 kc," *General Radio Experimenter*, 36, 4, April, 1962.

<sup>2</sup> R. W. Frank, "Zero to 300 kc with Five-Digit Accuracy," *General Radio Experimenter*, 37, 6, June, 1963.



with no increase in price. Also, for increased operating convenience, a trigger-level control has been added, so that one can optimize the input sensitivity for all waveforms from sine waves to low-duty-ratio pulses. This greatly reduces the possibility of erroneous indications from noise or other unwanted signals.

The program of the new counter is based on clock pulses of 0.01 second, in contrast to the one-second intervals of the previous model. Thus, the maximum interval between display and count is reduced to 0.01 second, regardless of the counting and display-

time settings. Hence, idle time is less, and the counter program is more efficient.

The TYPE 1150-B Digital Frequency Meter provides an economical and reliable means of frequency measurement in the electronics industry and, with appropriate transducers, has many applications in general industry.

The counter is available for either bench or rack mounting and, optionally, with output provision for operating the GR TYPE 1136-A Digital-to-Analog Converter and the TYPE 1137-A Data Printer.

—R. W. FRANK

Type		Price
1150-BM	400-kc Digital Frequency Meter, Bench Model	\$ 995.00
1150-BR	400-kc Digital Frequency Meter, Rack Model	995.00
1150-BPM	400-kc Digital Frequency Meter (with output for printer or D/A converter), Bench Model	1050.00
1150-BPR	400-kc Digital Frequency Meter (with output for printer or D/A converter), Rack Model	1050.00

### INCREASED FREQUENCY RANGE FOR THE TYPE 1151-A DIGITAL TIME AND FREQUENCY METER



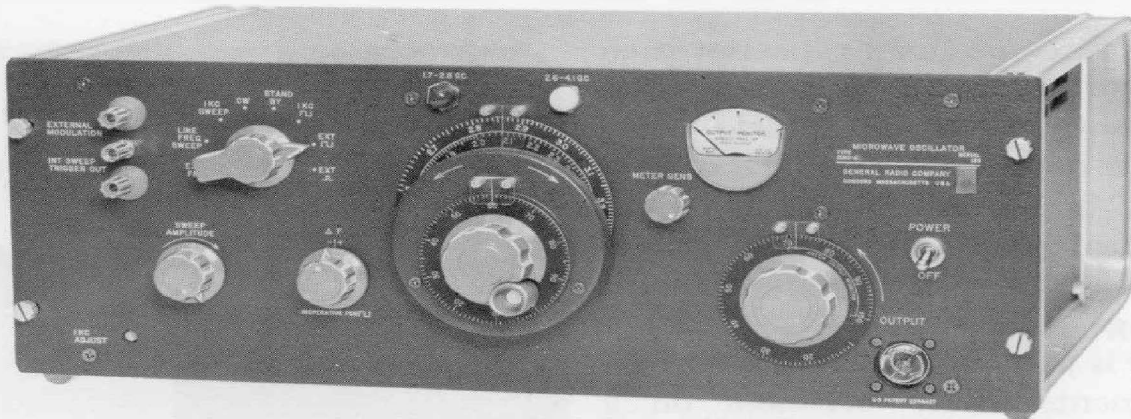
The TYPE 1151-A Digital Time and Frequency Meter <sup>1</sup> measures frequency, frequency ratio, period, and multiple

periods and is equipped with a full complement of input controls. Its guaranteed upper frequency limit, formerly 300 kc/s, has been increased to 400 kc/s, with no increase in price.

<sup>1</sup>R. W. Frank, "Zero to 300 kc with Five-Digit Accuracy," *General Radio Experimenter*, 37, 6, June, 1963.



# THE TYPE 1360-B MICROWAVE OSCILLATOR



An improved model of the popular TYPE 1360 Microwave Oscillator is now in production. Amplitude and frequency stabilities of the carrier under square-wave-modulated conditions have been markedly improved by a diode clamp circuit in the klystron repeller modulator. In addition, regulation of the supply voltage for the 1-kc square-wave generator has stabilized the modulation frequency. These improvements are particularly valuable to those customers who will use the oscillator with the TYPE 1640-A Slotted Line Recorder

System.<sup>1</sup> The stringent stability requirements on amplitude and modulation frequency in this system are due to the large available scale expansion<sup>2</sup> and the narrow audio bandwidth of the selective amplifier.

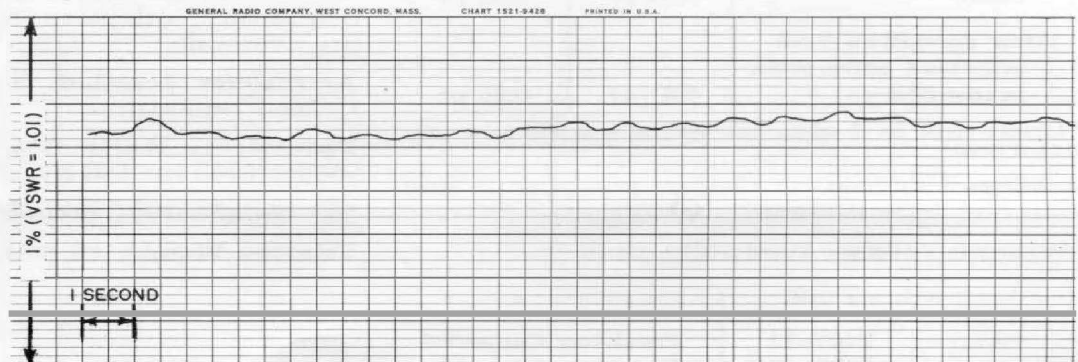
The accompanying figure is a graphic record showing the short-term amplitude stability of the new TYPE 1360-B Oscillator incorporated in a TYPE 1640-A system. The scale expansion is 1% full scale (1.01 VSWR). The line voltage was varied from 110 to 120 volts at a rate of 1 cycle per second by means of a Variac<sup>®</sup> autotransformer driven by a Type 1750-A Sweep Drive.

<sup>1</sup> To be described in a forthcoming issue of the *General Radio Experimenter*.  
<sup>2</sup> A. E. Sanderson, "A New High Precision Method for the Measurement of the VSWR of Coaxial Connectors," *IRE Transactions on Microwave Theory and Techniques*, November, 1961.

— G. P. McCouch

Type		Price
1360-B	Microwave Oscillator	\$1175.00

**Type 1360-B amplitude stability in presence of 10-volt peak-to-peak line-voltage excursions at 1-cycle rate as measured in a Type 1640-A Slotted Line Recorder System.**

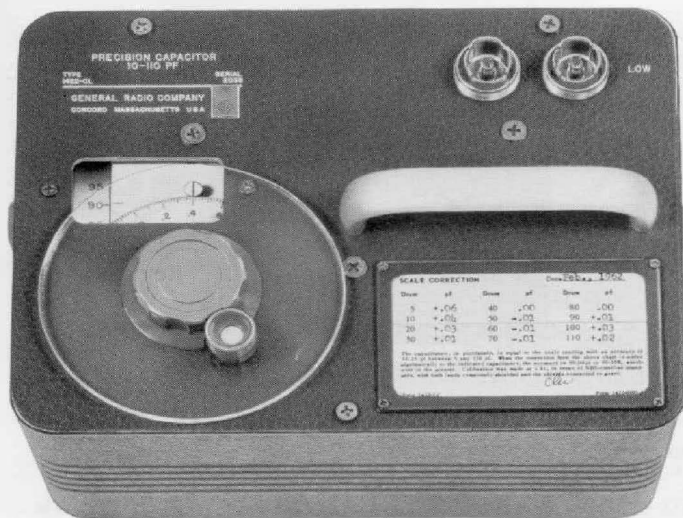




## A THREE-TERMINAL PRECISION CAPACITOR WITH LOW TERMINAL CAPACITANCES

In any three-terminal capacitor each terminal of the direct capacitance has a capacitance to ground or shield whose magnitude depends on the type of construction. In addition, when the direct capacitance is variable, these terminal capacitances are usually not constant but change with setting. When such a capacitor is used as a standard in bridge measurements or is measured on a bridge, the terminal capacitances can, if large enough, cause an error in capacitance measurement, which depends on the degree of excellence of the guard arrangement provided in the bridge and on the magnitude of the measured capacitance.

The new TYPE 1422-CL Precision Capacitor has been designed for those uses where terminal capacitances are important. Its direct capacitance range



is 10 to 110 pf; its terminal capacitances are of the order of 30 pf and 60 pf, and are quite constant with setting.\* Other specifications, as listed below, are similar to those of other units in the 1422 line.

\* The TYPE 1422-CC, which uses a different construction, has a range of 5 to 110 pf but has much larger terminal capacitance.

### SPECIFICATIONS

**Direct Capacitance Range:** 10 to 110 pf.

**Capacitance Scale:** 0.02 pf/division.

**Accuracy:** ± picofarads listed below or ± 0.03%, whichever is greater.

*Total Capacitance Capacitance Differences\**

Direct-Reading (Adjustment) —	0.1 pf	0.2 pf
After scale correction from calibration chart —	0.04 pf	0.08 pf
After correction from precision calibration (extra charge) —	0.01 pf	0.02 pf

\* Divide error by 2 when one setting is made at a calibrated point.

**Stability:** Capacitance change per year is less than one scale division.

**Maximum Voltage:** 1000 volts, peak.

**Residual Impedances (typical):**

**Series Inductance** — 0.14 μh.

**Terminal Capacitances** —

High terminal to case	min scale	33 pf
	max scale	32 pf
Low terminal to case	min scale	57 pf
	max scale	54 pf

**Insulation Resistance:** Greater than one teraohm at 23C and less than 50% RH.

**Terminals:** GR TYPE 874 locking-type coaxial connectors; adaptors to other coaxial types are available.

**Accessories Supplied:** Two TYPE 874-CL58A Cable Connectors.

**Dimensions:** Width 9½, height 7, depth 8½ inches (245 by 180 by 220 mm), over-all.

**Net Weight:** 10¾ pounds (4.9 kg).

**Shipping Weight:** 15 pounds (7 kg).

Type		Price
1422-CL	Precision Capacitor	\$340.00
1422-CLP	Precision Capacitor with precision calibration	390.00