

# 1969 SUPPLEMENT TO GENERAL RADIO CATALOG T

ATTACH THIS TO THE COVER  
OF YOUR CATALOG T WITH THE  
ADHESIVE STRIP PROVIDED.

**NEW QUANTITY DISCOUNT — SEE INSIDE COVER**





# 9 Will Get You 10.....

Beginning immediately, General Radio offers the electronics industry's first across-the-board quantity discount that applies to orders for two or more of ANY GR instrument.

With 3% savings on a pair, 10% off for 10, and 20% for 100, the savings are available to ALL GR customers. Just anticipate needs, consolidate purchases and you can realize tangible savings.

It costs us less per instrument to handle quantity orders, so it should cost you less . . . and it will.

No one will ever again buy 9 of a kind at the unit price from General Radio . . . for the same cost he can have 10. You don't even have to pay list price if you buy two.

The discount schedule shown below (effective March 2, 1969) applies to all GR instruments when two or more of a kind are ordered in the same transaction.

Quantity	1	2-4	5-9	10-19	20-49	50-99	100
Discount	List	3%	7%	10%	13%	17%	20%

Example:

	Unit List	Discount	Unit Net	Total
10 Type 2000 AC Frabulators	\$100.00	10%	\$90.00	\$ 900.00
100 Type 3000 DC Wobblers	50.00	20%	40.00	4000.00
				<u>\$4900.00</u>

plan to use GR's NEW  Quantity Discount





Products in this Supplement are new since the issuance of the general catalog in February, 1968. Keep this with your copy of Catalog T for a complete, current listing of all GR products.

# 1969 SUPPLEMENT TO GENERAL RADIO CATALOG T

**General Radio Company** West Concord, Massachusetts 01776  
**General Radio Canada Limited** Toronto 15, Ontario  
**General Radio Company (Overseas)** Zurich 34, Switzerland  
**General Radio GmbH** München 80, West Germany  
**General Radio Company (U.K.) Limited** Bourne End, Bucks, England

contents		page
Pulse Generator	Type 1340	5
Counter, 500 MHz	Type 1191-B	6
Sweep-Frequency Reflectometer, to 7 GHz	Type 1641	8
Impedance Comparator	Type 1654	10
Analog Limit Comparator	Type 1782	11
Real-Time Analyzer, 3 Hz to 80 kHz	Type 1921	12
Multifilter, $\frac{1}{3}$ or octave bands	Type 1925	13
Digital Voltmeter Calibrator	Type 1822	14
Random-Noise Generator, 20 Hz to 20 MHz	Type 1383	15
Megohmmeters	Types 1863/4	16
DC Microvoltmeter/Nanoammeter, 0.2% accuracy	Type 1807	17
Audio-Frequency Microvolter	Type 1346	18
Coaxial Resistance Standards	Type 1442	19
Coaxial Capacitance Standards	Type 1407	19
Precision Fixed Attenuators, coaxial	Type 880	20
	GR900	20
Precision Adjustable Line, coaxial	GR900	20
Adjustable Short Circuit, coaxial	GR900	20
Lockable Oscillator, 900 to 2000 MHz	Type 1218-BV	21
VHF/UHF Preamplifier	Type 1237	21
Audiometer Calibration Set	Type 1565-Z	22
Earphone Coupler, type 9A	Type 1560-P83	22
Frequency synthesizer modules		22
Chart Papers for graphic level recording	Type 1521	22
Digital Limit Comparator	Type 1783	23
Variac® adjustable autotransformers	Type W8	23







## Ordering and Service Information

### WHERE TO ORDER

#### USA and Canada

Please address orders and other communications to any of the District Offices listed on the inside back cover of this catalog, or communicate directly with the Sales Engineering Office at West Concord, Mass.

#### Export Orders

Customers outside the United States and Canada are served by General Radio, by its subsidiaries, General Radio (Overseas), General Radio (U. K.) Ltd., General Radio France S.A., and General Radio GmbH, and by the export representatives listed on the inside back cover of this catalog. All communications should be directed to the appropriate export representative. For countries not listed, inquiries should be addressed to General Radio Company, West Concord, Massachusetts 01781, U. S. A., or, for customers in Europe, to General Radio Company (Overseas), Postfach 124, CH 8034 Zurich 34.

### HOW TO ORDER

Always order by both catalog number and complete description. AC-operated instruments are supplied wired for operation from 115-volt power, unless otherwise specified. Most instruments can also be supplied for operation from other common voltages and frequencies as indicated in the specifications under Power Required. Be sure to specify operating voltage and frequency if other than nominal 115 volts, 60 Hz.

For example:

Catalog No. 1900-9801, Type 1900-A Wave Analyzer, 230 V, 50 Hz, Bench Model

Special features and modifications not listed in the specifications (such as extra calibrations) are available at extra cost. Please include in your order information regarding any nonstandard features desired.

### CONDITIONS OF SALE

Determination of prices, terms and conditions of sale and final acceptance of orders are made only at General Radio Company, West Concord, Massachusetts, USA, Gen-

eral Radio Canada Limited, Toronto, Canada, or General Radio Company (Overseas), Zurich, Switzerland.

**USA and Canada:** Net 30 days if credit has been arranged; otherwise, unless payment is received before shipment, shipment will be made COD.

**Outside USA and Canada:** Terms of payment for orders placed on General Radio representatives and on General Radio sales offices are those that are mutually agreed upon. If there is no representative in your area, the terms for orders placed directly on General Radio Company or on General Radio Company (Overseas) are full payment in advance of shipment or sight draft against an irrevocable letter of credit, unless other terms have been previously arranged.

### Quantity Discount

The following quantity discounts apply for identical units and packages purchased on a single order, normally for single shipment to one destination. All items are subject to these discounts.

<b>Quantity</b>	1	2-4	5-9	10-19	20-49	50-99	100
<b>Discount</b>	List	3%	7%	10%	13%	17%	20%

### MINIMUM BILLING

The minimum billing per order is \$10.00. This applies to all purchases except repair parts and cash-with-order transactions.

### SOURCE-INSPECTION SURCHARGE

A surcharge of 1 percent (\$2.50 minimum) applies on all orders requiring inspection at our plant. The inspection surcharge applies on each shipment inspected and covers only our costs.

### SHIPPING INSTRUCTIONS

Unless specific instructions accompany the order, we shall use our judgment as to the best method of shipment. Shipments can be made by either air or surface transportation. For fast delivery, at a reasonable premium over







other means, air shipment is generally recommended and will be employed on request.

The prices listed in this catalog apply only on transactions originating in the USA, include the cost of domestic packing, are FOB our plant, West Concord, Massachusetts, and are exclusive of all taxes now in effect or that may be imposed hereafter by Federal, State, or local governments. Prices given are subject to change without notice. Formal price quotations remain in effect for 30 days. Export prices including the cost of packing are available from the offices or representatives listed on the inside back cover of this catalog. Canadian customers may obtain prices FOB Toronto from our offices in Toronto or Montreal.

### WARRANTY

We warrant that each new instrument manufactured and sold by us is free from defects in material and workmanship and that, properly used, it will perform in full accordance with applicable specifications for a period of two years after original shipment. Any instrument or component that is found within the two-year period not to meet these standards, after examination by our factory, district office, or authorized repair agency personnel, will be repaired or, at our option, replaced without charge, except for tubes or batteries that have given normal service.

### SPECIFICATION CHANGES

We reserve the right to discontinue any item without notice and to change specifications at any time without incurring any obligation to incorporate new features in instruments or parts previously sold.

### SERVICE AND PARTS

The return of instruments for repair or recalibration and the ordering of repair parts should be arranged with the most convenient General Radio office or representative. When arranging a return, be sure to give the catalog and type number, description, serial number of the instrument, date of original purchase, and details concerning the difficulty or the service desired.

When ordering repair parts, please specify the part number and description of the item as well as the type number and serial number of the instrument in which it is used. Advice on repairs to General Radio instruments may be obtained from any GR office or representative.

An instrument returned for credit will be subject to a restocking charge. If more than 6 months has elapsed since original purchase, an instrument will not be accepted for credit.

### DIMENSIONS

In this catalog, over-all dimensions are given for instruments except that the depth dimension for rack-mount instruments is actually depth behind panel, i.e., clearance required. However, no allowance is made for additional clearance that may be required for cables and connectors at rear panel.



### Handbooks

The new **Handbook of Coaxial Microwave Measurements**, available from General Radio for \$2.00, is an excellent text and reference in the fundamentals and measurement of transmission lines for the student or as a refresher for the working engineer or technician.

We have also published the **Handbook of Noise Measurement** (\$2.00), the **Handbook of Stroboscopy** (\$2.00), the **Handbook of High-Speed Photography** (\$1.00), and **The Stroboscope in the Textile Industry**.





# Speed Up Your Measurements Be More Accurate And Save Money Automate

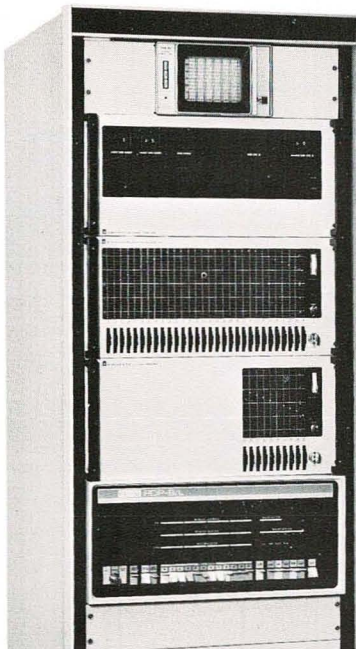
Don't spend valuable time balancing bridges or tuning analyzers by hand! Don't slow up measurements and risk error by recording data with pencil and paper.

Today, bridges balance themselves, analyzers automatically scan spectra, counters range and compute automatically. And they all display the results for more than just the eye; digital-data outputs (and often analog outputs as well) make it possible to display and record the information in a multitude of forms: typed columns of data, X-Y plots, oscilloscope displays, punched cards or tape. In real time or at your convenience, this information can be analyzed by eye, graphically, or with the aid of a computer.

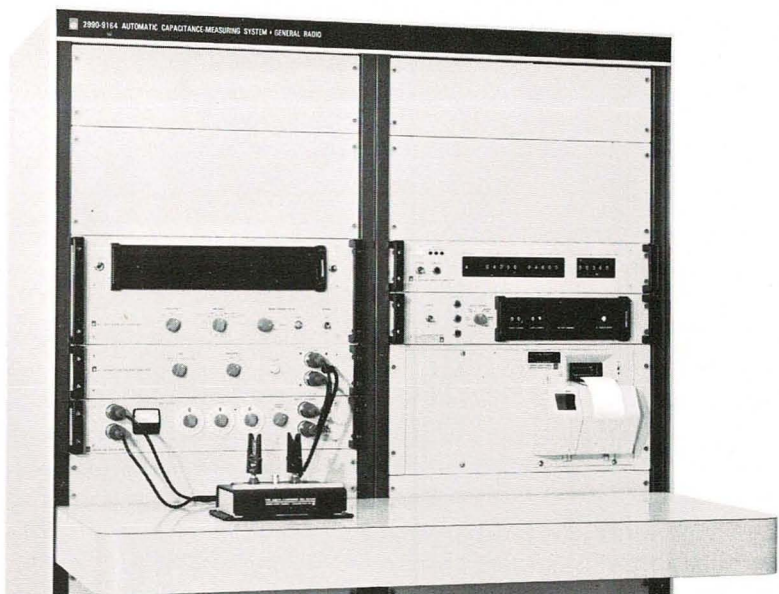
General Radio not only makes the basic measuring instruments with all this versatility, but supplies the peripheral equipment to process the data, display, store, and calculate from it.

And we will put them all together into a system, to your specifications, that will make the measurement — single handed. All the operator or a programming device need do is signal "start," and the system will connect the unknowns, measure impedance, level, frequency, or what you will, and show the data to the operator and to the waiting accessories for display, recording, or computation.

This Real-Time Analyzer System displays on an oscilloscope the signal levels in 45  $\frac{1}{3}$ -octave bands simultaneously. The multifilter's channel attenuators permit the results to be weighted or compensated in any desired manner. The computer will convert the data to a single figure of merit, compare against various criteria, etc.



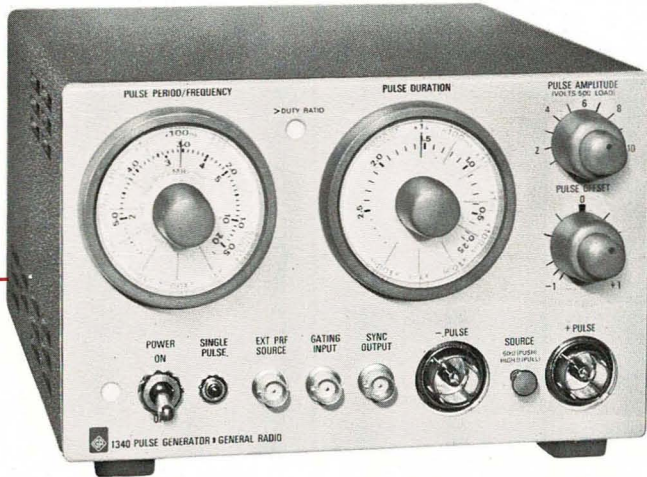
This Automatic Capacitance-Measuring System compares the measured values of biased capacitors against preset limits, indicates GO or NO GO visually and prints the values on tape color coded for GO or NO GO. The components under test can be manually connected by use of the test jig or can be automatically scanned and the location code read out and printed with the measurement data.





# PULSE GENERATOR

## Type 1340



- 0.2 Hz to 20 MHz
- 2.5-s to 25-ns duration
- 5-ns rise time
- 10-V output with  $\pm 1$ -V offset
- amplitude, period, duration modulation

The GR 1340 Pulse Generator demonstrates that an economical, general-use instrument need not be mediocre. The 1340 provides, at low cost, wide ranges of repetition frequency and duration, high output, and many performance and convenience features never before available in a single pulse generator.

A full eight decades of period and duration make the 1340 the widest-range pulse generator in its price class. A panel lamp indicates settings that exceed the generous duty-ratio limits. External signals can be used to control prf, to gate the output, and to modulate the amplitude, period, duration of the output pulses.

Both positive and negative ground-based pulses of up to 10 volts are produced simultaneously. Their amplitudes and offsets can be independently set with continuously adjustable front-panel controls. The calibrated pulse-rate and duration controls are easy to read, easy to set. Control is also provided of output impedance, single pulsing, input

threshold for external prf sources, and for generating square waves.

The sync output of the 1340 is a square wave. This not only permits pretriggering of an oscilloscope, but ensures more positive triggering since input circuits operate best with a signal that keeps reasonable duration and constant dc level at all repetition rates.

### INTEGRATED-CIRCUIT TESTING

Many features of the GR 1340 have been incorporated to aid in the testing of integrated circuits. Its 20-MHz operation, adjustable offset, square-wave output, and ability to operate at the standard 5-volt logic level with a 50- $\Omega$  source impedance are all of especial value in IC testing. The ability to sweep or linearly program the pulse amplitude, duration, and period makes the 1340 useful in automatic and semi-automatic measurements.

— See **GR Experimenter** for November-December 1968.

## specifications

### PULSE PERIOD (PRF)

**Internally Generated:** 50 ns to 5 s (20 MHz to 0.2 Hz) in 8 decade ranges. Single-pulse push button on panel.

**Externally Controlled:** 1 Hz to 20 MHz; triggers on any waveform of  $>3$  V pk-pk. Input resistance approx 100 k $\Omega$ . Output pulse is started by negative-going transition. Period control acts as input trigger-level control in external mode.

### OUTPUT-PULSE CHARACTERISTICS

**Duration:** 25 ns to 2.5 s in 8 decade ranges, or square wave.

**Rise and Fall Times:** 5 ns  $\pm$  2 ns at 5 V, 50- $\Omega$  load, and 50- $\Omega$  source resistance.

**Amplitude:** Positive and negative ground-based pulses available simultaneously with independent amplitude and offset control. Source current continuously adjustable to at least 0.2 A (i.e., across 50- $\Omega$  load, 10 V from high source resistance or 5 V from 50- $\Omega$  source).

**Source Resistance:** 50  $\Omega$ , or high (approx 1 k $\Omega$ ) shunting current source.

**Offset:** Continuously adjustable source current from  $-20$  to  $+20$  mA.

**Distortion:** Preshoot, overshoot, ringing, etc.,  $<0.5$  V (5% of max output).

**Duty Ratio:** Duty ratios of over 70% can be obtained on all ranges except decreasing to approx 50% at 50-ns period in 50-to-500-ns range.

### SYNCHRONIZING PULSE

**Waveform:** Square wave. Negative transition precedes start of output pulse by approx 35 ns; positive transition can be used for half-period pretriggering.

**Amplitude:** 2.5-V pk-pk positive square wave behind 500- $\Omega$  source impedance.

### MODULATION AND GATING

**Modulation:** Period and duration are linearly controllable by an external voltage between  $-0.5$  and  $-5.0$  V. Amplitude of the positive-pulse output is linearly controllable by an external voltage of 0 to  $+5.0$  V, the negative pulse by 0 to  $-5.0$  V.

Period and duration are modulatable over the decade range set by range switches; amplitude can be modulated over its full range. Amplitude modulation can be used for noncoherent gating of output pulse.

**Gating:** Switch closure to ground or equivalent inhibits period generator, thus providing phase-coherent gating of output pulses. An impedance of  $\leq 600$   $\Omega$  to ground inhibits output;  $+4$  to  $+8$  V allows normal output; 1340's gate 1340's.

### GENERAL

**Power Required:** 100 to 125 or 200 to 250 V, 50 to 400 Hz, 30 W.

**Accessories Supplied:** Spare fuses, power cord.

**Accessories Available:** GR874<sup>®</sup> coaxial components, attenuators, terminations, tees, etc.

**Mounting:** Convertible-Bench Cabinet.

**Dimensions** (width x height x depth): Bench,  $8\frac{1}{2}$  x  $5\frac{5}{8}$  x 13 in. (220 x 145 x 330 mm); rack, 19 x  $5\frac{1}{4}$  x  $11\frac{1}{4}$  in. (485 x 135 x 290 mm).

**Weight:** Net,  $9\frac{1}{4}$  lb (4.2 kg); shipping, 13 lb (6.0 kg).

Catalog Number	Description	Price in USA
1340-9700	1340 Pulse Generator Bench Mount Rack Mount	\$395.00 417.00
1340-9701		

All prices subject to quantity discount.







## COUNTERS

### Type 1191

- 35 MHz, to 500 MHz with scaler
- general-purpose counter-timer
- economical IC design
- programmable, all functions dc controlled
- 10-mV sensitivity



The 1191-B Counter represents several significant improvements over its predecessor. The upper-frequency limit is extended to 35 MHz, for more rapid data acquisition the minimum display time is reduced to less than 1 microsecond, and a standby-power mode of operation now lets the crystal oven remain on for maximum stability.

The 1191 is a general-purpose counter-timer for measuring frequency, period, period average, frequency ratio, and time interval. Extensive use of integrated circuits in the 1191 has resulted in an economical counter with full features and top performance.

#### OPERATION TO 500MHz

The 1191-B counter is available as the 1191-Z in combination with either of two GR scalars that extend the frequency-measuring range to 100 or 500 MHz by dividing the input frequency by a factor of 10 or 100, respectively.

In combination, the 1191 Counter and a scaler are economical and provide all the features of the counter alone, full counter-timer functions, programmability, high-speed data access, with the extra benefits of high-frequency

operation. 1191-Z models include all counter options: high-precision time base and data output.

The counter and scaler are offered in rack-mount or bench versions, the latter supplied with the two instruments mounted in a single cabinet.

#### AUTOMATIC OPERATION

Remote programmability of measurement functions, ranges, and most of the secondary controls, such as display time, makes the 1191 unexcelled as a component in automatic measuring systems. The counter functions are dc controlled, most by simple contact closures to ground. Models are available with high-speed, buffered BCD outputs from internal storage to drive auxiliary data-handling equipment.

#### OPERATOR CONVENIENCE

The readout of the 1191 is 8 digits of high-intensity neon indicators, with automatic display of decimal point and measurement dimensions. The internal storage gives continuous, flicker-free display of rapidly corrected data. The operator has control of all input trigger circuit characteristics.

#### INPUT CIRCUITS

The counter has two high-sensitivity input channels, each consisting of a high-impedance, low-noise FET circuit preceded by a 3-position step attenuator and including controls for trigger level, slope and polarity. The 1-megohm input impedance is independent of control settings to permit use of general-purpose low-capacitance oscilloscope probes. One such probe is offered as an accessory to the 1191.

#### TIME BASE

Model options allow a choice of time base to match needs and budgets. An inexpensive room-temperature-crystal oscillator affords adequate stability for many ap-



Type 1191-Z 500 MHz Counter.





plications. Or, the counter can be ordered with a more stable crystal-oscillator time base with proportional temperature control. For the greatest possible stability, either oscillator can be phase locked to an external stand-

ard frequency of 10 MHz or any submultiple down to 100 kHz. A front-panel monitor is included for this purpose. Oscillator frequency can be set with an easily accessible, rear-panel dc-voltage adjustment.

## specifications

### MEASUREMENT RANGES AND ACCURACY

**Frequency:** Dc to 35 MHz; 1- $\mu$ s to 10-s counting gate times. Accuracy,  $\pm 1$  count  $\pm$  time-base accuracy.

**Strobed Period:** Period to  $10^9$  s less display time ( $< 1 \mu$ s to 10 s), measured by counting 0.1- $\mu$ s to 10-s intervals derived from internal 10-MHz clock. Accuracy, see note.

**Single and Multiple Period:** 1 to  $10^8$  periods measured by counting internal 10-MHz clock. Accuracy, see note.

**Time Interval:** 0.1  $\mu$ s to  $10^9$  s measured by counting 0.1- $\mu$ s to 10-s intervals derived from internal 10-MHz clock. Accuracy, see note.

**Frequency Ratio:** 1 to  $10^8$ . Frequency "A", dc to 35 MHz, is measured over 1 to  $10^8$  periods of frequency "B", dc to 10 MHz. Accuracy,  $\pm 1$  count of "A"  $\pm$  trigger error of "B" (see note).

**Count:** Register capacity,  $10^8$ . Events at rates up to 35 MHz are accumulated between "start" and "stop" commands from manual panel buttons or, externally from contact closures or solid-state switches. In "count", storage is automatically disabled.

### INPUT

**Frequency:** Channel "A", dc to 35 MHz (3 Hz to 35 MHz ac-coupled); channel "B", dc to 10 MHz (3 Hz to 10 MHz ac-coupled).

**Sensitivity:** 10 mV rms sine wave, 30 mV pk-pk pulse decreasing above 20 MHz to approx 100 mV rms at 35 MHz. Trigger level variable  $\pm 100$  mV.

**Attenuator:** x1, x10, x100 (0, 20, 40 dB); low-capacitance 10:1 probe available.

**Voltage Rating:** Input voltage should not exceed 150 V on x1 or 300 V on x10 or x100.

**Impedance** (all attenuator settings): Approx 1 M $\Omega$  shunted by 35 pF. At rear connectors (supplied mounted, unwired), shunt C increases to approx 70 pF.

**Signal Polarity:** Front-panel control permits selection of positive- or negative-going signal sense for triggering.

### 10-MHz TIME-BASE

#### Room-Temperature Oscillator (standard)

**Stability:**  $< 2 \times 10^{-7}$  / $^\circ$ C from 0 $^\circ$  to 50 $^\circ$ C. Drift less than  $\pm 2 \times 10^{-6}$  per month. With  $\pm 10\%$  line-voltage variation,  $< 2 \times 10^{-8}$ .

**Manual Adjustment Range:**  $\pm 1 \times 10^{-5}$  at rear-panel control.

#### High-Precision Oscillator (in proportional-control oven) (optional)

**Stability:**  $< 2 \times 10^{-10}$  / $^\circ$ C from 0 $^\circ$  to 50 $^\circ$ C when operated continuously. Drift  $\pm 1 \times 10^{-8}$  per week, approx  $1 \times 10^{-9}$  per day after 1 month of continuous operation. With  $\pm 10\%$  line-voltage variation,  $< 2 \times 10^{-10}$ .

**Manual Adjustment Range:**  $\pm 1 \times 10^{-6}$  at rear-panel control.

**Time-Base Output:** 10-MHz square wave, 2 V pk-pk behind 50  $\Omega$  at rear-panel BNC connector.

**External Phase-Lock:** Both time-base oscillators can be locked to external standard frequency at 0.1, 1, 2.5, 5, or 10 MHz, of at least 1 V rms into 1k $\Omega$ . A front-panel phase-lock indicator lamp is provided.

**Note** — Error in time measurements:  $\pm 0.3\%$  of one period  $\div$  number of periods averaged, for a 40-dB input signal-to-noise ratio. This assumes no noise internal to the counter. For input signals of extremely high signal-to-noise ratio, the trigger error in  $\mu$ s will be  $< 0.0005 \pm$  the signal slope in V/ $\mu$ s. In addition, all time measurements are subject to the  $\pm 1$ -count gating error and to time-base accuracy.

### DATA PRESENTATION

**Display:** 8-digit display with automatically positioned decimal point and measurement dimensions. High-intensity neon readout tubes.

**Storage:** Display can be either stored or not; variable from  $< 1 \mu$ s to 10 s or infinity for display time (normal mode) and for data holdoff time (in storage mode).

**Data Output** (in some models): Fully buffered 1-2-4-8 BCD output at standard DTL levels; data zero is 0.5 V max and data 1 approx 5 V behind 6 k $\Omega$ .

### PROGRAMMING

**Input:** All instrument functions controllable by closure to ground within capabilities of DTL micrologic (2- to 6-mA sink current required), except:

Functions controlled by other than contact closure:

Input Threshold: Requires dc voltage of  $\pm 100$  mV corresponding to desired threshold level.

Display Time: Requires RC circuit to ground.

Nonprogrammable functions: Input attenuator, input ac/dc coupling, separate/common switch, self-test, internal/external control of time-base oscillator, and frequency adjustment of time-base oscillator.

### GENERAL

**Environmental:** Instrument operating range, 0 to 50 $^\circ$ C ambient.

**Power Required:** 100 to 125 or 200 to 250 V, 50 to 400 Hz, 32 W.

**Accessories Supplied:** Rack-mounting hardware set, power cord, spare fuses.

**Accessories Available:** Input probe, 1156 Decade Scaler for measurement to 100 MHz; 1157 Scaler (100-to-1) for measurement to 500 MHz; 1137 Data Printer, and other GR digital-data acquisition equipment.

### Dimensions and Weights:

		width x height x depth	net	ship
1191-B	bench	19 $\frac{3}{4}$ x 4 $\frac{7}{8}$ x 13 in. 500 x 125 x 330 mm	22 $\frac{1}{2}$ 10	29 lb 13.5 kg
	rack	19 x 3 $\frac{1}{2}$ x 10 $\frac{1}{2}$ in. 485 x 89 x 270 mm	17 $\frac{1}{4}$ 8	21 lb 10 kg
1191-Z (100 MHz)	bench	19 $\frac{3}{4}$ x 7 x 13 in. 500 x 180 x 330 mm	31 14.5	37 lb 17 kg
	rack	19 x 5 $\frac{1}{4}$ x 11 $\frac{1}{4}$ in. 485 x 135 x 290 mm	30 $\frac{1}{2}$ 14	42 lb 19.5 kg
1191-Z (500 MHz)	bench	19 $\frac{3}{4}$ x 8 $\frac{3}{4}$ x 15 in. 500 x 225 x 385 mm	33 $\frac{1}{2}$ 15.5	41 lb 19 kg
	rack	19 x 7 x 13 $\frac{1}{4}$ in. 485 x 180 x 340 mm	33 $\frac{1}{2}$ 15.5	41 lb 19 kg

## specifications — FOR INPUT PROBE — 1158-9600

**Input Impedance:** 10 M $\Omega$  shunted by approx 7 pF when used with 1191 counter.

**Attenuation:**  $\times 10$  (20 dB).

**Voltage:** 600 V dc or ac pk-pk, max up to 5.7 MHz; less at higher frequencies.

**Length:** 3 $\frac{1}{2}$  ft.

Catalog Number	Description	Price in USA
<b>1191-B Counter</b>		
1191-9710	Bench Model	\$1395.00
1191-9711	Rack Model	1395.00
1191-9712	Bench Model with Data Output Option	1495.00
1191-9713	Rack Model with Data Output Option	1495.00
1191-9714	Bench Model with High-Precision Time-Base Option	1695.00
1191-9715	Rack Model with High-Precision Time-Base Option	1695.00
1191-9716	Bench Model with both Options	1795.00
1191-9717	Rack Model with both Options	1795.00
<b>1191-Z Counter (100 MHz)</b>		
1191-9900	Bench Model with both Options	2295.00
1191-9901	Rack Model with both Options	2295.00
<b>1191-Z Counter (500 MHz)</b>		
1191-9902	Bench Model with both Options	2445.00
1191-9903	Rack Model with both Options	2445.00
1158-9600	<b>P6006 Probe</b> , Tektronix Catalog No. 010-0127-00 (not sold separately)	26.00

All prices subject to quantity discount.







# SWEEP-FREQUENCY REFLECTOMETER

## Type 1641

- 20 MHz to 7 GHz in two ranges
- residual SWR typically <1.02
- direct reading in SWR and loss
- all coaxial hardware internal
- precalibrated, simplified operation
- complete — add only source and scope



The GR 1641 Sweep-Frequency Reflectometer measures standing-wave ratio (direct reading) and return and insertion loss in dB with precision from 20 to 1500 MHz and 0.5 to 7 GHz in single or sweep frequency operation. Not just an indicator of return and transmitted signals, the 1641 contains all the required coaxial hardware: directional couplers, detectors, and terminations; only the device under test is connected externally. Once calibrated, the 1641 does not require recalibration when measurement ranges are changed. Measuring ranges as well as frequency range are broad: SWR can be determined from 1.005 to infinity, insertion loss from 0 to 50 dB.

The GR 1641 is intended to meet the many requirements for an economical, yet accurate, reflectometer that is simple in operation. In most production and quality-control testing, and frequently in design and development testing, SWR and loss, without phase information, are adequate. The 1641 is faster, easier, and less apt to add errors (residual or operational) than more complex systems. With the GR 1641 you spend your time making measurements, not connections.

### COMPLETE ASSEMBLY

With the addition of appropriate rf sources (the ones you're presently using are probably fine) and a storage oscilloscope for sweep measurements, the 1641 is ready for use, precalibrated and completely interconnected.

A panel meter on the Reflectometer reads directly in SWR and in dB for return and insertion loss and provides the most accurate readout. Sweep measurements with an oscilloscope readout are fast and simple to make and, in addition, permit simultaneous display of both SWR and loss characteristics without connection changes.

The frequency range of the Reflectometer is covered by two rf units that can be accommodated by the main chas-

sis at the same time; the instrument can be ordered with either rf unit initially, the other to be added later.

The GR900® line of precision coaxial components makes available adaptors to all popular connector types, tuners and air-line standards for highest accuracy at fixed frequencies, terminations as matched or calibrated-mismatch standards, and low-SWR precision attenuators.

### PRECISION INSTRUMENT

High accuracy is one of the key goals attained in the design of the 1641, symbolized by the use of GR900® precision coaxial connectors throughout and carried through the entire design. All measurement results are obtainable to an accuracy of a few percent depending upon the mode and frequency range of operation. The use of GR900® connectors eliminates another potential source of error; precision adaptors from common connector types to GR900® are available that have little effect on measurement accuracy. Thus, the GR 1641 can be converted to a type N or TNC precision reflectometer; typical residual SWR for such conversions is shown below.

Connector Type	Typical Residual SWR at	
	300 MHz	3 GHz
GR900®	1.007	1.015
APC7	1.01	1.02
N	1.01	1.02
TNC	1.01	1.03
OSM*	1.02	1.04

\*Registered trademark of Omni Spectra, Inc.

### APPLICATIONS

The GR 1641 Sweep-Frequency Reflectometer will measure to suit the majority of needs for determining standing-wave ratio and insertion loss as specified commonly in industrial and military testing specifications





applied to production alignment and testing and to quality-control procedures. At single or swept frequencies it can be used to aid in the adjustment of device parameters, in data collection, and in the GO-NO GO testing of devices against established limits.

The sweep mode of the Reflectometer lends itself particularly to the search for, and identification of resonances as it is fast, broadband, and will display SWR and loss simultaneously. Thus, cables and other transmission networks can be quickly analyzed, and filters, cavities, and couplers adjusted for desired performance.

Devices of many types are suitable for measurement with the 1641. The unknown can be one-, two-, or multi-port, passive or active, bi- or unidirectional. The instrument measures directly the vital characteristics of attenuators, isolators, power dividers, terminations and loads, switches, couplers, amplifiers, and many other common devices. Antenna SWR is an obvious application. By measuring insertion loss through a transmission path between two antennas, their characteristics and those of the intervening dielectric material can also be analyzed. Resolution of the 1641 is adequate for measuring connectors and other low-SWR devices.

All the above uses are enhanced by the ability of the 1641 Reflectometer to be remotely programmed. In conjunction with programmable sources and suitable data conversion, processing, and recording instruments, the 1641 can conduct computer-controlled tests for sorting or qualifying devices and for automatic data acquisition.

## AUXILIARY INSTRUMENTS

For the display of sweep-frequency measurements, the Tektronix Type 564 Storage Oscilloscope with two 2A63 Plug-ins is suitable; an accessory calibrated graticule is supplied for use with this instrument. Other oscilloscopes with a vertical sensitivity of at least 0.1 V per cm and horizontal sensitivity to suit the selected sweep generator will serve the purpose. A storage oscilloscope is recommended for use at the slow sweep rates required for low-level (low SWR and high attenuation) measurements. For permanent records, an X-Y recorder or linear strip-chart recorder can be driven from the Reflectometer output if it has at least 1-volt full-scale sensitivity and at least 1-kilohm input impedance.

Although the GR 1641 depends on an external source of test signals, its requirements are not stringent. For single or sweep-frequency operation, the source must provide at least 10 mW of leveled output into 50 ohms; additional output up to 100 mW makes possible greater resolution. The source should be capable of being 10-kHz modulated and its output leveled by signals supplied by the Reflectometer. A source with 1-kHz internal modulation can be used.

High-frequency sweep sources are available from other manufacturers and have output, leveling, and modulation capabilities compatible with the needs of the Reflectometer. For single-frequency measurements and sufficient output power for maximum resolution, select from the many General Radio high-frequency oscillators.

## Total-System Economy

0.5- to 7-GHz Reflectometer	\$3125.00
Typical storage oscilloscope	1355.00
	<b>\$4480.00</b>

## specifications

**Frequency Range:** 20 MHz to 7.0 GHz in two bands, 20 to 1500 MHz and 0.5 to 7.0 GHz.

**Characteristic Impedance:** 50 ohms, nominal.

**SWR ranges:** 1.02 to  $\infty$  and 1.005 to 2.0. Meter ranges, 1.005 to 1.03, 1.02 to 1.10, 1.05 to 1.35, 1.2 to 2.0, and 2.0 to  $\infty$ .

**Insertion- and Return-Loss Ranges:** 0 to 40 dB and 10 to 50 dB. Meter ranges, 0 to 13, 10 to 23, 17 to 30, 27 to 40, and 37 to 50 dB.

### ACCURACY

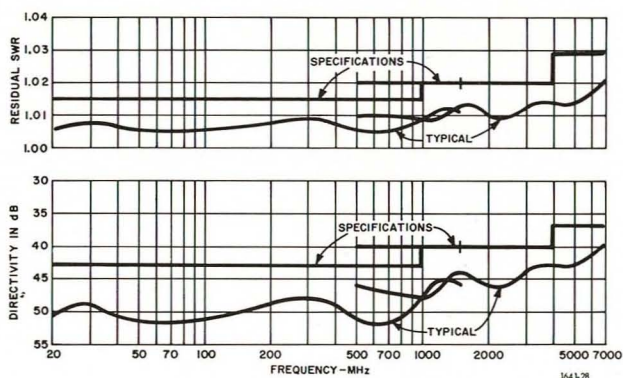
#### SWR and Return-Loss Measurement Accuracy:

Frequency	Directivity		% of Reflection Coefficient of Unknown	
	Fixed Frequency	Swept Frequency	Fixed Freq	Swept Freq
20 to 1500 MHz	>43 dB to 1 GHz >40 dB to 1.5 GHz	( $<1.015$ ) ( $<1.02$ )	3%	4%
0.5 to 7 GHz	>40 dB to 4 GHz >37 dB to 7 GHz	( $<1.02$ ) ( $<1.03$ )	6%	11%

#### Insertion Loss (in terms of insertion loss ( $\tau$ ) in dB of unknown):

Frequency	Fixed Frequency	Swept Frequency
20 to 1500 MHz	$\pm(0.1 + 0.015 \tau)$ dB	$\pm(0.3 + 0.015 \tau)$ dB
0.5 to 7.0 GHz	$\pm(0.1 + 0.015 \tau)$ dB	$\pm(0.6 + 0.015 \tau)$ dB

#### Residual Detector Match to Unknown: SWR $<1.01 + 0.007f_{\text{GHz}}$



Typical residual SWR and directivity.

**Equivalent Residual Source Match to Unknown:** SWR  $<1.03$ , 20 to 1500 MHz;  $<1.01 + 0.007f_{\text{GHz}}$ , 0.5 to 7 GHz.

### GENERAL

**Source Power Required:** Typically 10 mW for 1.02 to  $\infty$  SWR range and 0 to 40-dB loss ranges. Typically 100 mW for 1.005 to 2.0 SWR and 10 to 50-dB loss range.

**RF-Source Power:** 1 W max.

**Max RF Signal to Unknown:** 50  $\mu$ W from 20-mW source.

**Modulation Output:** 10kHz, -15 to +15 V max, on-off, 400- $\Omega$  source impedance, 1-k $\Omega$  min load impedance. Internal detector tunable to 1-kHz for use with external modulation source.

**DC-Signal Output:** 1 V max across a load of  $\geq 1$  k $\Omega$  for full-scale indication.

**Remotely Programmable Functions:** Display function (SWR or loss) and range (SWR and loss). Require contact closures to ground.

**Power Required:** 100 to 125 or 200 to 250 V, 50 to 60 Hz, 5 W.

**Accessories Supplied:** 900-W100 Standard 100- $\Omega$  Termination, 900-WNC Standard Short-Circuit Termination, 1641-P2 Transfer Detector, calibrated graticule for Tektronix 564 Oscilloscope, Patch Cords GR874-to-GR874<sup>®</sup>, Patch Cords GR874-to-BNC, power cord, spare fuse.

**Accessories Available:** Kit 1641-9605 includes in a carrying case GR900<sup>®</sup> adaptors to N, and OSM, GR874<sup>®</sup> adaptors to TNC, N, and BNC, and a 900-W50 50-ohm Standard Termination.

These and other accessories available separately, including attenuators, tuners, and reference air lines.

**Accessories Required:** Rf source, fixed frequency or swept, with 10 to 100 mW output available, leveled; oscilloscope, preferably storage, or dc recorder, to display sweep-frequency data. Fixed-frequency measurement data displayed on front-panel meter.

**Mounting:** Rack model or bench model in metal cabinet.

**Dimensions** (width x height x depth): Bench, 19 $\frac{1}{2}$  x 12 x 23 in. (495 x 305 x 590 mm); rack, 19 x 10 $\frac{1}{2}$  x 20 $\frac{1}{2}$  in. (485 x 270 x 520 mm).

**Net Weight:** Bench, 70 lb (32 kg); rack, 60 lb (28 kg).

**Shipping Weight:** Bench, 150 lb (70 kg); rack, 150 lb (70 kg).

Catalog Number	Description	Price in U.S.A.
	<b>1641 Sweep-Frequency Reflectometer</b>	
1641-9701	20 MHz to 7 GHz, bench model	\$5650.00
1641-9711	rack model	5600.00
1641-9702	20 MHz to 1500 MHz, bench model	4200.00
1641-9712	rack model	4150.00
1641-9703	0.5 GHz to 7 GHz, bench model	3175.00
1641-9713	rack model	3125.00
1641-9601	<b>RF Unit (20 MHz to 1500 MHz)</b>	2475.00
1641-9602	<b>RF Unit (0.5 GHz to 7 GHz)</b>	1450.00
1641-9605	<b>Accessory Kit</b>	398.75

All prices subject to quantity discount.







# IMPEDANCE COMPARATOR

## Type 1654

- 0.003% impedance-difference resolution
- 100 Hz to 100 kHz — 4 fixed frequencies
- wide impedance ranges:
  - 2Ω to 20 MΩ
  - 0.1 pF to 1000 μF
  - 20 μH to 1000 H
- stable solid-state circuits
- fast sorting >4000/h, with accessory limit comparator



The GR 1654 Impedance Comparator indicates on large panel meters and by analog output voltages the difference in magnitude and phase angle between two external impedances, usually a standard and an unknown. Owing to its speed and percent-deviation readout, the 1654 is of great value in the sorting, selecting, and adjusting of components in production and inspection applications.

### ACCURATE

Because the 1654 measures differences to an accuracy of 3% of full scale, the measurement accuracy and resolution as a percent of the total impedance are considerably better: as good as ±0.003%. In addition, the metering circuits of the 1654 have been linearized to ensure accurate readings without correction for up to 30% impedance differences and 0.3 radians. Solid-state circuits are used in the 1654 so that drift of the meter zero is negligible permitting more certain accuracy and fewer interruptions for readjustment.

### VERSATILE

Test voltage and frequency and measurement ranges of impedance and phase-angle difference are all selected by front-panel controls. Test voltage and measurement ranges are related and their panel switches interlocked to reflect this relationship. Four measurement ranges can be used with each test voltage. The largest test voltage, 3 volts, gives the greatest sensitivity: 0.1% and 0.001 radians, full scale. The lower voltages, 1.0 and 0.3 volts, permit measurement of more fragile components, allow easy voltage-coefficient tests, and, while limiting maximum sensitivity, extend large-difference capability to 30% and 0.3 radians, full scale.

Wide ranges of impedance, resistance, capacitance, and inductance can be compared with the 1654. Since it is a transformer bridge, the 1654's accuracy is little affected by loading or by stray impedances for most measurements. A guard terminal is provided for making three-terminal connections to minimize the effects of stray jig and cable capacitance.

### HIGH-SPEED SORTING

The 1654 Impedance Comparator can be used to advantage in manual, semi- or fully automatic selection and sorting operations. For manual sorting, the large meters reduce operator fatigue and errors. Even faster and more certain sorting is possible by use of analog output voltages proportional to the meter reading. A GR 1782 Analog Limit Comparator tests these voltages against preset upper and lower limits, and responds by lighting GO or NO GO indicators for manual sorting and by closing relay contacts that can operate automatic sorting mechanisms. A rate of up to 4 components per second can be realized by such a system.

If your production or inspection needs for impedance sorting seem to warrant automatic high-speed methods, call your General Radio sales office and ask for a proposal incorporating the GR 1654 Impedance Comparator or other automatic measuring instrument and accessory analog or digital-data instruments.

### TYPICAL USES

Rapid sorting and matching of precision components, subassemblies, and networks, manually or with automatic equipment.

Measuring the effects of time and environment on components, with high precision and continuous indication.

Rapid testing of the tracking of ganged potentiometers and variable capacitors.

Studying the frequency dependence of components.

Easy comparison of quantities usually requiring laboratory techniques, such as:

Small impedance differences.

D of low-loss dielectric materials.

$D \left( = \frac{1}{Q} \right)$  of inductors.

Q or phase angle of wire-wound resistors or potentiometers.

Balance of transformer windings.

Semiconductor capacitances.

Capacitance drift with temperature.





## specifications

**Frequencies:** Internal only 100 Hz, 1, 10, and 100 kHz,  $\pm 1\%$ .  
**Ranges:** 0.1% to 30% full-scale impedance difference; 0.001 to 0.3 radians full-scale phase-angle difference. Available ranges depend on test voltage selected as shown in the following table.

Test Voltage	Impedance Difference Full-scale Range — %					Phase-Angle Difference Full-scale Range — Radian						
	0.1	0.3	1	3	10	30	0.001	0.003	0.01	0.03	0.1	0.3
0.3 V			x	x	x	x			x	x	x	x
1 V		x	x	x	x	x		x	x	x	x	x
3 V	x	x	x	x	x	x	x	x	x	x	x	x

**Impedance Ranges (0.3-V test voltage\*):**

Full useful range	Resistance	Capacitance	Inductance
	$2\Omega$ — $20\text{ M}\Omega$	$50\text{ pF}^{**}$ — $1000\ \mu\text{F}$	$20\ \mu\text{H}$ — $1000\ \text{H}$
at 100 Hz	$2\Omega$ — $20\text{ M}\Omega$	$1000\text{ pF}$ — $1000\ \mu\text{F}$	$5\text{ mH}$ — $1000\ \text{H}$
at 1 kHz	$2\Omega$ — $2\text{ M}\Omega$	$50\text{ pF}^{**}$ — $100\ \mu\text{F}$	$500\ \mu\text{H}$ — $100\ \text{H}$
at 10 kHz	$2\Omega$ — $200\text{ k}\Omega$	$50\text{ pF}^{**}$ — $10\ \mu\text{F}$	$50\ \mu\text{H}$ — $1\ \text{H}$
at 100 kHz	$10\Omega$ — $10\text{ k}\Omega$	$50\text{ pF}^{**}$ — $0.1\ \mu\text{F}$	$20\ \mu\text{H}$ — $10\text{ mH}$

\*Low R and L limits are increased and upper C limit decreased by 10:1 for 1-V test voltage and by 100:1 for 3-V.  
 \*\*To 0.1 pF by substitution method.

**Resolution:** Meter, 0.003% and 0.00003 radian. Analog-voltage output, 0.001% and 0.00001 radian.

**Accuracy:** 3% of full scale.

**Voltage Across Standard and Unknown:** 0.3, 1, or 3 V selected by

front-panel control. Test voltage of 2 V (with 0.6 and 6 V) can be obtained on special order.

**Analog-Voltage Outputs:** Voltages proportional to meter deflections at two rear-panel connectors:  $\pm 10\text{ V}$  full scale behind  $< 10\Omega$  for 1782 Analog Limit Comparator;  $\pm 3\text{ V}$  or  $\pm 10\text{ V}$  (depending on range) full scale behind  $2\text{ k}\Omega$  for DVM, A-D converter or other use.

**Test Speed:** About 1 component per second with meter, max. With analog output voltage, about 4 components per second, except about 1 component per second at 100 Hz.

**Power Required:** 105 to 125 or 210 to 250 V, 50 to 60 Hz, 15 W.

**Accessories Available:** 1782 Analog Limit Comparator; GR decade boxes and standards of resistance, capacitance, inductance.

**Accessories Supplied:** Multiple contact connector, spare lamp and fuses, power cord.

**Mounting:** Bench model (in metal cabinet) or rack model.

**Dimensions (weight x height x depth):** Bench,  $19\frac{1}{2} \times 8\frac{3}{4} \times 15\text{ in.}$  ( $495 \times 225 \times 385\text{ mm}$ ); rack,  $19 \times 7 \times 13\frac{1}{2}\text{ in.}$  ( $485 \times 180 \times 345\text{ mm}$ ).

**Net Weight:** Bench, 40 lb (19 kg); rack, 25 lb (12 kg).

**Shipping Weight:** Bench, 60 lb (28 kg); rack, 40 lb (19 kg).

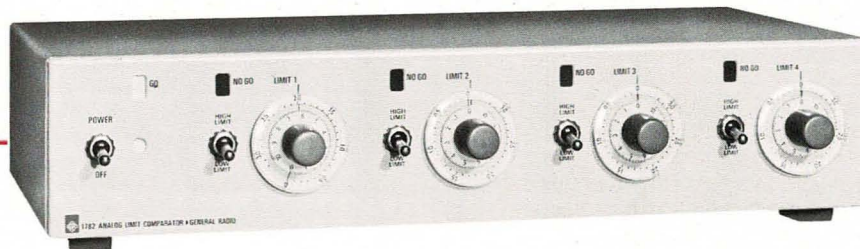
Catalog Number	Description	Price in USA
1654-9700	1654 Impedance Comparator Bench Model Rack Model	\$13 00.00 125 0.00
1654-9701		

All prices subject to quantity discount.

## ANALOG LIMIT COMPARATOR

### Type 1782

- accessory to 1654 Impedance Comparator
- 4 independent limits — use for high or low
- 2% of full scale accuracy
- GO/NO GO lights, optional contact closures



The GR 1782 Analog Limit Comparator increases the speed at which the 1654 Impedance Comparator will operate in sorting applications. It compares the analog-voltage output of the 1654 against high and low limits set on the 1782 front panel and displays GO or NO GO lights for manual sorting. Optional relay-equipped models will operate external automatic-sorting devices. Up to 4 com-

ponents per second can be measured with the two instruments together.

Four controls on the front panel permit the limits to be set to 1% resolution; each control can act as either a high limit or a low limit as selected on an adjoining switch and for  $\Delta Z$  or  $\Delta\theta$  as selected by a rear-panel switch.

## specifications

### INPUT

**Analog Voltage:**  $\pm 10\text{ V}$  full scale

**Resistance (of each comparator):**  $66\text{ k}\Omega$ , approx.

### OUTPUT

**Analog Voltage:** Identical to input.

**Decision Outputs:** Visual or relay contacts.

Visual: NO-GO lamp for each limit; GO lamp indicates measurement is within all limits.

Relay Contacts (optional): 5 SPDT contacts, 115 V rms, 0.1 A rms, max.

**Accuracy:**  $\pm 2\%$  of full scale.

**Limit Controls:** Four independent limits; can be set for + (high) or - (low) with switch adjoining each control. Dual controls: inner scale calibrated 0 to 100 (each division corresponds to 100 mV), outer scale calibrated 0 to 30 (316 mV per division).

**Test Speed:** Approx 10 tests per second, max.

**Power Required:** 105 to 125 or 210 to 250 V, 50 to 60 Hz, 20 W.

**Accessories Supplied:** 24-contact connector with relay models only, input-signal cable, power cord, spare fuses and lamp.

**Mounting:** Convertible bench cabinet.

**Dimensions (width x height x depth):** Bench,  $17 \times 3\frac{7}{8} \times 9\frac{7}{8}\text{ in.}$  ( $435 \times 99 \times 250\text{ mm}$ ); rack,  $19 \times 3\frac{1}{2} \times 8\frac{3}{8}\text{ in.}$  ( $485 \times 89 \times 220\text{ mm}$ ).

**Weight:** Net, 9 lb (4 kg); shipping, 15 lb. (7 kg).

Catalog Number	Description	Price in USA
1782-9700	1782 Analog Limit Comparator Bench Model, without relays Rack Model, without relays Bench Model, with relays Rack Model, with relays	\$550.00 570.00 625.00 645.00
1782-9701		
1782-9702		
1782-9703		

All prices subject to quantity discount.



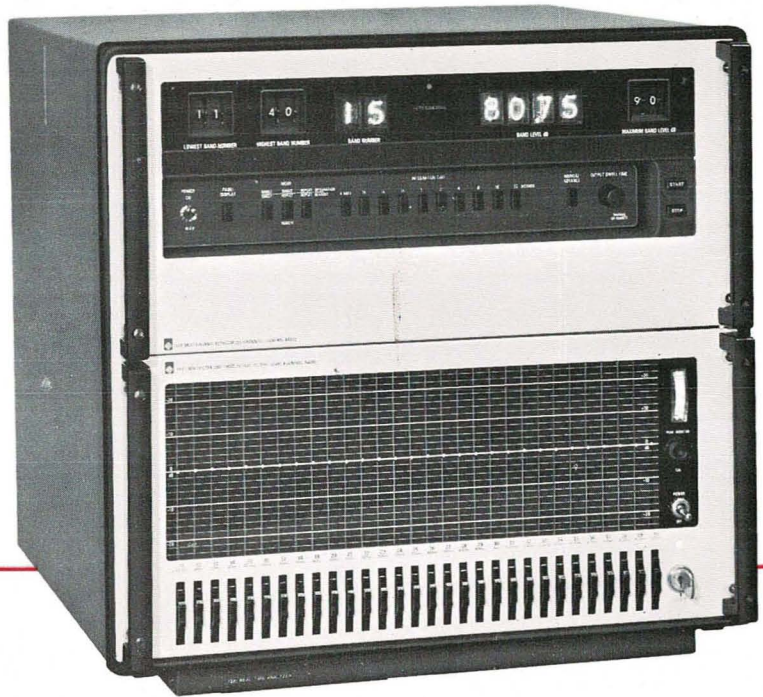




# REAL-TIME ANALYZER

## Type 1921

- 30 one-third-octave channels from 3.15 Hz to 80 kHz
- 70-dB dynamic range
- digital detector
- $\pm 0.5$ -dB basic accuracy
- analog and digital outputs



The Real-Time Analyzer uses 30 to 45 parallel filters to segment a signal into  $\frac{1}{3}$ -octave-frequency bands. Its unique digital detector derives the true rms level in all frequency bands simultaneously and presents the spectrum-level outputs in less than 1 millisecond for an entire 45-channel spectrum (or at a speed set by the display device). Measurement time is determined by the integration period (averaging time) selected; it can be set from  $\frac{1}{8}$  to 32 seconds in a binary series. The 1921 makes complete analyses in at least one-thirtieth the time required by series (tunable filter) analyzers.

The digital detector also has a full 70-dB dynamic range. Its true rms detection scheme, linear integration technique, and 70-dB maximum crest-factor capacity main-

tain its basic  $\pm 0.5$ -dB accuracy for virtually any input waveform.

The 1921 analyzer consists of a 1925 Multifilter and a 1926 Multichannel RMS Detector. Filters in the Multifilter conform to American and international standards.

The 1926 Multichannel RMS Detector processes signals from the Multifilter digitally. The outputs of the filters are sampled, the sample data converted to digital binary form, and the rms level computed from this. Averaging is by true, linear integration, which is not only faster than running-average analog circuits, that may also miss transients, but it helps identify what events in time have contributed to the answer. The computed band levels are stored in a digital memory and are available at outputs simultaneously with analog data.

### specifications

**Frequency Range:** Channels are supplied in the frequency range between 3.15 Hz to 80 kHz; one-third octave center frequencies. See table below.

**Dynamic Range:** 70 dB (60-dB range is displayed, thus allowing a crest factor margin of 10 dB at full scale.)

**Crest Factor Capacity:** 10 dB at full scale increasing linearly to 70 dB at bottom scale.

**Filters:** See specifications for Type 1925 Multifilter.

**Calibration:** Calibrated using front panel controls to display (and output in BCD) the absolute level in decibels for any reference. Indicated level range is adjustable in one-decibel steps from 60 dB to 159 dB, full scale.

**Detector Characteristic:** Rms for all waveforms, with true (linear) integration. Nine integration periods:  $\frac{1}{8}$ ,  $\frac{1}{4}$ ,  $\frac{1}{2}$ , 1, 2, 4, 8, 16, and 32 seconds.

**Detector Accuracy:** Basic accuracy (over most of amplitude and frequency range):  $\pm 0.5$  dB. Accuracy is  $\pm 1$  dB over entire amplitude and frequency range for all waveforms (including random signals) having dynamic levels within the range of the instrument.

**Digital Resolution:** 0.25 dB.

**Sensitivity:** Nominal sensitivity is 0.1 volt rms, full scale. Sensitivity can be increased to better than 5 millivolts full scale using a preamplifier (1560-P40), which derives its power from the analyzer.

**Display:** Five neon read-out tubes display band level in decibels. Two neon read-out tubes display standard band number (per USAS S1.6 and S1.11).

**Input Impedance:** 100 k $\Omega$ .

**Output:** Simultaneous analog and digital output.

**Programmability:** All panel control functions of 1926 are programmable.

**Power Required:** 100 to 125 or 200 to 250 V, 50 to 60 Hz, 100 W.

**Mounting:** Rack or bench (mounted in single metal cabinet).

**Dimensions** (width x height x depth): Bench, 19 $\frac{1}{2}$  x 19 x 20 in. (495 x 485 x 510 mm); rack, 19 x 17 $\frac{1}{2}$  x 16 in. (485 x 445 x 410 mm).

**Weight:** Net, 95 lb (44 kg); shipping (est), 175 lb (80 kg).

Catalog Number				Description	Price in USA	
With Attenuator		Without Attenuator			With Attenuator	Without Attenuator
Bench	Rack	Bench	Rack			
<b>1921 Real-Time Analyzer</b>						
One-Third-Octave Bands						
1921-9700	1921-9701	1921-9708	1921-9709	25 Hz to 20 kHz	\$9275.00	\$8925.00
1921-9702	1921-9703	1921-9710	1921-9711	12.5 Hz to 10 kHz	9355.00	9005.00
1921-9704	1921-9705	1921-9712	1921-9713	3.15 Hz to 2.5 kHz	9445.00	9105.00
1921-9706	1921-9707	1921-9714	1921-1915	100 Hz to 80 kHz	9225.00	8875.00
<b>1926 Multichannel RMS Detector</b>						
	1926-9701			30-channel, rack model	\$5775.00	
	1926-9703			45-channel, rack model	6275.00	

Note: Rack and bench versions of any model are priced the same.

All prices subject to quantity discount.

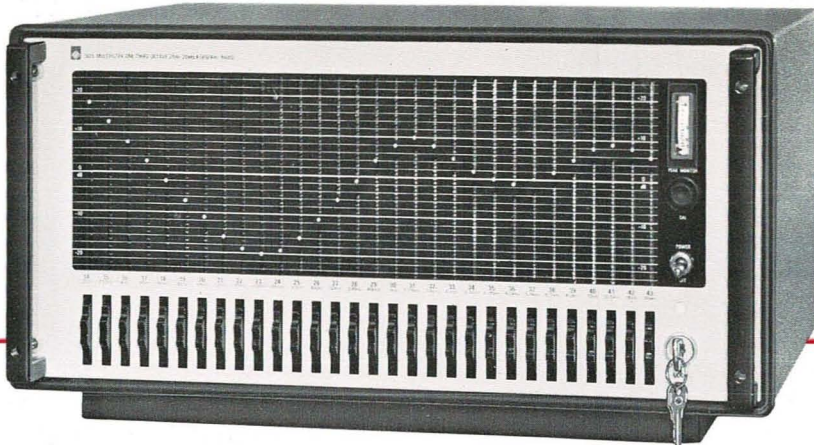






# MULTIFILTER

## Type 1925



The 1925 Multifilter is offered in several options of frequency range, filter bandwidth (octave or 1/3-octave), and with or without channel attenuators.

With the calibrated attenuators in each filter channel, the multifilter can be used alone as an equalizer or spec-

trum shaper to simulate or to compensate for irregularities in the frequency response of electrical or acoustical systems. Used with a source of noise, the 1925 can act as a spectrum synthesizer.

— See *GR Experimenter* for October 1968.

### specifications

#### Filters

**Characteristics:** See curve. Both octave-band and one-third octave-band filters are six-pole Butterworth designs. Specified bandwidths are effective bandwidths, i.e. bandwidths for noise. Filters meet all current American and international standards: 1/3-octave conforms to USAS S1.11-1966 Class III (high attenuation, the octave filters to USAS S1.11-1966 Class II (moderate rate but highest for octave-band filters). Both octave and third-octave characteristics conform to IEC Recommendation Publication 225-1966.

**Accuracy of Center Frequency:** ±2%.

**Passband Ripple:** 0.5 dB max peak to peak.

**Uniformity of Levels:** At center frequencies (attenuator at +25 dB) ± 0.25 dB at 25°C; ± 0.5 dB, 0 to 50°C.

**Noise:** <15 μV equivalent input noise.

**Distortion:** For bands centered at 25 Hz and above, harmonic distortion at band center is <0.1% at 1V output. For bands with center frequency below 25 Hz, distortion at band center is <0.25% at 1V out.

**Weighting:** A, B, and C characteristics of weighted channels conform to requirements of current American and international standards including USAS S1.4, IEC R123, and IEC R179.

#### Attenuators

**Range:** Gain in each channel adjustable in 1-dB steps from +25 dB to -25 dB relative to nominal 0-dB gain by means of panel control.

**Accuracy:** ±0.25 dB relative to +25-dB attenuation setting.

**Readout:** Panel display indicates attenuation in each channel and represents transmission between input and summed output. Display has standard 50-dB-per-decade scale factor; 10 dB per inch vertical, 5 inches per decade horizontal. Lock on panel prevents accidental changes in attenuator settings.

**Chassis** (accepts up to 30 filters)

**Overall Gain:** 0 dB nominal.

**Gain Adjustment:** +6 to -12 dB, common to all channels.

**Input Impedance:** 100 kΩ.

**Input Voltage:** AC component, ±17 V pk max referred to dc component of input. DC component, ±35 V max.

**Scanner:** Any single filter output selected by rear-panel pushbutton, or by external switch closure or programmer (1926 Multi-channel RMS Detector or 1771 Scanner Control). Two 1925's can be wired in parallel for up to 60 scanned channels.

**Peak Monitor:** Panel meter calibrated in dB re peak overload signal sensed at two circuit points. Also output signal proportional to meter reading (1 mA corresponds to full scale) for driving dc recorder.

**Outputs** (parallel-channel, scanned, summed, weighted, unfiltered)

**Impedance:** 20 Ω, nominal, except 600 Ω for summed output.

**Voltage:** ±4.2 V max (3 V rms sine wave); except gain of weighted and unfiltered outputs is 0 dB nominal at 1 kHz.

**Load Impedance:** 3 kΩ minimum for max output voltage, except summed output will accept any load without effect on linear operation.

#### General

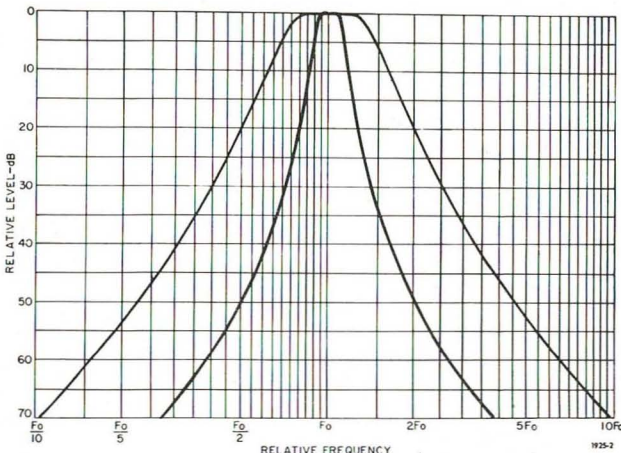
**Accessories Supplied:** Power cord, 36-terminal plugs (2), spare fuses, Handbook of Noise Measurement.

**Power Required:** 100 to 125 V or 200 to 250 V, 50 to 60 Hz, 17 W.

**Mounting:** Rack-bench mount.

**Dimensions** (width x height x depth): Bench, 19 3/4 x 9 1/8 x 14 in. (500 x 235 x 355 mm); rack, 19 x 8 3/4 x 12 1/4 in. (485 x 225 x 315 mm).

**Weight** (est): Net, 48 lb (22 kg); shipping, 100 lb (46 kg).



Catalog Number				Price in USA		
With Attenuator		Without Attenuator		Description	With	Without
Bench	Rack	Bench	Rack		Attenuator	Attenuator
1925-9700	1925-9701	1925-9712	1925-9713	<b>1925 Multifilter</b>		
1925-9702	1925-9703	1925-9714	1925-9715	<b>One-Third-Octave Bands</b>		
1925-9704	1925-9705	1925-9716	1925-9717	25 Hz to 20 kHz	\$3500.00	\$3150.00
1925-9706	1925-9707	1925-9718	1925-9719	12.5 Hz to 10 kHz	3580.00	3230.00
				3.15 Hz to 2.5 kHz	3680.00	3330.00
				100 Hz to 80 kHz	3450.00	3100.00
				<b>Octave Bands</b>		
1925-9708	1925-9709	1925-9720	1925-9721	31.5 Hz to 16 kHz	2110.00	1990.00
1925-9710	1925-9711	1925-9722	1925-9723	4 Hz to 2 kHz	2210.00	2090.00

Note: Rack and bench versions of any model are priced the same.

All prices subject to quantity discount.







# DIGITAL VOLTMETER CALIBRATOR

## Type 1822

- 100- $\mu$ V to 1000-V dc output
- 10-ppm stability, typical
- mobile secondary standard
- automatic stepping, programmable



No longer is it necessary to move a digital voltmeter into the standards laboratory and do long, tedious calibrations. The GR 1822 will not only go where the DVM's are, but it will make more exhaustive checks than before practical and does so quickly and without complex setups. Manually or automatically, the 1822 steps through enough voltages to check each digit in each range as well as linearity and possible hysteresis.

Digital voltmeters are now so sensitive and accurate that meaningful calibration requires assurance that the readings are unaffected by circuit loading, ac superimposed on the measured dc signal, and common-mode ac or dc signals. The 1822 makes these tests not only possible, but easy. A front-panel switch applies several interference voltages and output resistances to the DVM input; it also permits a polarity reversal to test the DVM's symmetry and short circuits the input to check the meter zero.

Owing to its ease of operation, the calibrator can be used frequently to check all DVM's, thus ensuring more

reliable measurements. To facilitate its use as a mobile instrument, the 1822 was designed for high stability. The dividers are in a common oil bath; the voltage-reference oven has a very short warm-up period so that seconds after being reconnected to the power line, the 1822 will be generating voltages within very close tolerances.

Three controls determine the test-voltage output of the 1822; all are operated manually at the front panel or can be remotely controlled. A range switch sets maximum values in decade ranges of from 1 mV to 1000 V; in each range, the values set by the second control are .11111, .22222, .33333, . . . . . 1.11110. A third control permits the last one, two, or four digits to be replaced by a zero (.33330, .33300, .30000) to match the resolution of the DVM and to allow common voltages to be set. An automatic stepping mode cycles the digit setting up to the maximum, then back to 1/10 full scale, then steps down-range one decade and cycles through that range in turn. By this means each digit in each position is checked and the linearity and accuracy of each range can all be easily verified by inspection.

### specifications

#### OUTPUT

**Output Voltage:** 100  $\mu$ V dc to 1111.1 V dc in 7 decade ranges.  
**Voltages Available in Each Range:** 0.11111, 0.22222, 0.33333, . . . . . to 1.11110. Zeros can be substituted for the final four, two or one digits; i.e., the output can be 0.30000, 0.33300, or 0.33330, for example.  
**Standard-Cell Output:** 1.018700 to 1.019100 V, adjustable to match saturated-cell standard. Output similar to 1-V range except 6-month accuracy is  $\pm 30$  ppm.  
**Interference Voltages:** 1, 10, 100 V  $\pm 10\%$ , dc and peak ac. Common-mode ac and dc (low terminal to case) and normal-mode ac (algebraically added to output). Ac voltage from line or external source (5-V pk).  
**Output Impedance:**  $< 0.2 \Omega$  on 1-V through 1-kV ranges; 200  $\Omega$  on 1-mV through 100-mV ranges. A 1-k $\Omega$ , 10-k $\Omega$ , or 100-k $\Omega$  output resistor can be added to above impedances by front-panel selector switch.

#### ACCURACY

**Accuracy** (6 months):  $\pm(30$  ppm of voltage + 10 ppm of full range + 3  $\mu$ V) on all ranges except  $\pm(50$  ppm of voltage + 10 ppm of full range) on 1-kV range. Accuracy of rear-panel voltages  $\leq 111$  mV,  $\pm(30$  ppm of voltage + 0.5  $\mu$ V).  
**Stability** (24 hours):  $\pm(20$  ppm of voltage + 2  $\mu$ V).  
**Warmup** (from cold start): Output within  $\pm(30$  ppm + 3  $\mu$ V) of final value after 3 m; within rated accuracy after 20 m.  
**Temperature Coefficient** (5° to 45°C):  $\pm(1.5$  ppm of output + 1.5 ppm of full range + 0.5  $\mu$ V) per degree C, except  $\pm(3$  ppm of output + 1.5 ppm of full range) per degree C in 1-kV range.  
**Line-Voltage Effects:**  $< 2$  ppm for  $\pm 10\%$  line-voltage variation.

#### GENERAL

**Noise:**  $< 2$  ppm rms of full-scale voltage, 10-Hz to 1-kHz bandwidth.  
**Programmability:** Switches controlling output range, digits, and zeros are remotely controllable by contact closures or solid-state switches with  $< 50$ -ohm "on" impedance. "On" current, 10 mA max; "off" voltage, 15 V max.  
**Settling Time:** Output within  $\pm 30$  ppm of final value in  $< 300$  ms, within rated accuracy in  $< 500$  ms, except on 1-kV range.  
**Stepping Rate:** 0.5 to 3 seconds/step, adjustable at rear panel.  
**Power Required:** 100 to 125 or 200 to 250 V, 50 to 400 Hz, 30 W.  
**Terminals:** Output, front and rear panel binding posts.  
**Accessories Supplied:** Two servicing circuit-extenders, multipin connector for remote programming input, spare fuses, power cord.  
**Accessories Available:** GR 1455-BH Decade Voltage Divider (Kelvin-Varley), GR 1807 DC Microvoltmeter/Nanoammeter as a null detector, GR 1311 Audio Oscillator as external source for interference voltages.  
**Mounting:** Bench model (in metal cabinet) or rack model.  
**Dimensions** (width x height x depth): Bench, 19 $\frac{1}{2}$  x 6 $\frac{5}{8}$  x 21 in. (495 x 170 x 540 mm); rack, 19 x 5 $\frac{1}{4}$  x 18 $\frac{1}{4}$  in. (485 x 135 x 465 mm).  
**Net Weight:** Bench, 41 lb (19 kg); rack, 33 lb (15 kg).  
**Shipping Weight:** (est) Bench, 60 lb (28 kg); rack, 53 lb (25 kg).

Catalog Number	Description	Price in USA
1822-9700	<b>1822 Digital Voltmeter Calibrator</b> Bench Model	<b>\$2800.00</b>
1822-9701	Rack Model	<b>2775.00</b>

All prices subject to quantity discount.







# RANDOM-NOISE GENERATOR

20 Hz - 20 MHz

## Type 1383

- 20 Hz to 20 MHz,  $\pm 1.5$  dB
- 30- $\mu$ V to 1-V output, open-circuit
- 50-ohm output impedance
- meter and 10-dB-per-step attenuator

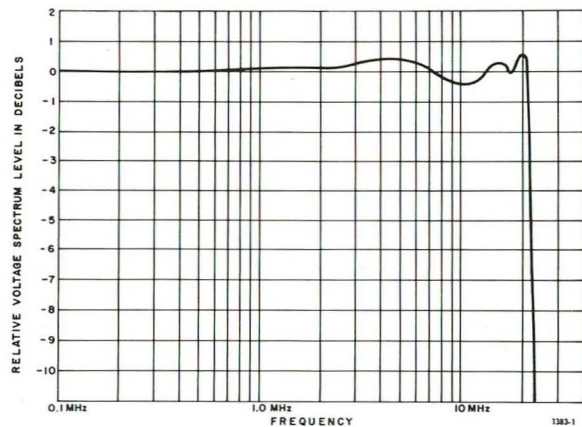


This instrument generates wide-band noise of uniform spectrum level, particularly useful for tests in video- and radio-frequency systems.

The maximum output is one volt open circuit from a 50-ohm source. An 8-step attenuator of 10 dB per step permits reduction of the output level to 30  $\mu$ V.

### Use the 1383 as a broad-band noise source for

- Intermodulation and cross-talk tests.
- Simulation of noise in carrier systems.
- Noise-interference tests in radar and telemetry.
- Determining noise bandwidth.
- Measuring noise figure.
- Setting transmission levels in communication circuits.
- Statistical demonstrations in classroom and lab.
- Determining meter response characteristics.
- Measuring noise temperature.



Typical spectrum of 1383 Random-Noise Generator output; energy-per-Hz-bandwidth vs frequency.

## specifications

**Spectrum:** Flat (constant energy per hertz of bandwidth)  $\pm 1$  dB from 20 Hz to 10 MHz,  $\pm 1.5$  dB from 10 MHz to 20 MHz.

**Waveform:** Table shows amplitude-density-distribution specifications of generator compared with the Gaussian probability-density function, as measured in a "window" of  $0.2\sigma$ , centered on the indicated values:

Voltage	Gaussian Prob. Dens. Function	Amplitude-Density Dist. of 1383 Random-Noise Gen.
0	0.0796	0.0796 $\pm 0.005$
$\pm\sigma$	0.0484	0.0484 $\pm 0.005$
$\pm 2\sigma$	0.0108	0.0108 $\pm 0.003$
$\pm 3\sigma$	0.000898	0.000898 $\pm 0.0002$

( $\sigma$  is the standard deviation or rms value of the noise voltage.)

**Output Voltage:** At least 1 V rms max, open circuit.

**Output Meter:** Indicates open-circuit output voltage ahead of 50 $\Omega$ .

**Amplitude Control:** Continuous control and 8-step, 10 dB-per-step attenuator.

**Output Impedance:** 50 $\Omega$ . Can be shorted without causing distortion.

**Output Terminals:** GR874<sup>®</sup> coaxial connector that can be mounted on either front or rear panel.

**Accessories Supplied:** Spare fuses, lamp, power cord.

**Power Required:** 100 to 125 or 200 to 250 V, 50 to 400 Hz, 40 W.

**Dimensions** (width x height x depth): Bench: 17 x 3 $\frac{7}{8}$  x 12 $\frac{3}{4}$  in. (435 x 99 x 325 mm); rack, 19 x 3 $\frac{1}{2}$  x 10 $\frac{3}{4}$  in. (485 x 89 x 275 mm).

**Weight:** Net, 14 lb (6.5 kg); shipping, 21 lb (10 kg).

Catalog Number	Description	Price in U.S.A.
1383-9700	1383 Random-Noise Generator Bench Model Rack Model	\$775.00
1383-9701		795.00

All prices subject to quantity discount.







# MEGOHMMETERS

## Type 1863

## Type 1864



- Type 1863**
- 5 test voltages: 50 to 500 V
  - 50 kΩ to 20 TΩ ( $2 \times 10^{13}\Omega$ )
  - economical, simple operation
  - direct reading, safe, stable

- Type 1864**
- 200 test voltages: 10 to 1000 V
  - 50 kΩ to 200 TΩ ( $2 \times 10^{14}\Omega$ )
  - direct reading, safe, stable
  - simple operation

If one of these GR megohmmeters doesn't exactly suit your high-resistance-measurement needs, the other one should. Although similar in appearance and accuracy, their operating ranges differ to match differing needs in the laboratory and production area.

### The Choice for Production and Inspection

The Type 1863 Megohmmeter will measure resistance at any of five common test voltages up to 500 V, has fewer controls, and is the lower priced model. It is, therefore, the best selection when several test stations are to be equipped, when the operators are inexperienced, or when specifications call for standard insulation-testing voltages.

### The Choice for Laboratory Investigations

The 1864 is the more flexible of the two instruments. The test voltage can be set to any value from 10 to 109 volts in 1-volt steps and to 1000 volts in 10-volt steps.

Thus, the 1864 can be set to any common, or uncommon, test voltage for ceramic, mica, or paper capacitors, or other devices. The reverse resistance of rectifiers can be readily measured; the low test voltages available are especially useful in measuring solid-state diodes. An additional range permits measurements up to  $2 \times 10^{14}$  ohms (200 TΩ).

Both instruments are easy to use with direct-reading meter indication and lighted range switch that shows the multiplier for each range and voltage. The maximum current possible at the terminals is limited to a safe 5 milliamperes and a panel light near the terminals warns when voltage is present. Stable power supplies and feedback voltmeter circuit minimize drift and time-wasting adjustments. Guard and ground terminals permit measurement of grounded or ungrounded two- or three-terminal resistors. The instruments are supplied for rack mounting or in a convenient, portable flip-tilt case that is a stand for the meter in use and protects it in transit and storage.

## specifications

### Voltage and Resistance Range:

Voltage	R <sub>min</sub> Full Scale	R <sub>max</sub>		Useful Ranges
		10% of Scale	2 1/2% of Scale	
<b>Type 1863</b>				
50, 100 V	50 kΩ	500 GΩ	2 TΩ	7
200, 250, 500 V	500 kΩ	5 TΩ	20 TΩ	7
<b>Type 1864</b>				
10 to 50 V	50 kΩ	500 GΩ	2 TΩ*	7*
50 to 100 V	200 kΩ	5 TΩ	20 TΩ	8
100 to 500 V	500 kΩ	5 TΩ	20 TΩ*	7*
500 to 1000 V	5 MΩ	50 TΩ	200 TΩ	8

\* Recommended limit.

**Resistance Accuracy:**  $\pm 2(\text{meter reading} + 1)\%$  on lowest 5 ranges (min reading is 0.5). For higher ranges add:

	sixth	seventh	eighth
1863	2%	4%	—
1864	2%	3%	5%

**Voltage Accuracy** (across unknown):  $\pm 2\%$ .

**Short-Circuit Current:** 5 mA approx.

**Power Required:** 100 to 125 or 200 to 250 V, 50 to 400 Hz, 13 W.

**Accessories Supplied:** Spare fuses, mounting hardware with rack models.

**Mounting:** Flip-tilt case and rack mount.

**Dimensions** (width x height x depth): Portable, 9 3/4 x 10 x 6 3/4 in. (245 x 255 x 175 mm); rack, 19 x 7 x 4 3/8 in. (485 x 180 x 120 mm).

**Net Weight:** Portable, 9 1/2 lb (4.4 kg); rack, 11 lb (5 kg).

**Shipping Weight** (est): 14 lb (6.5 kg).

Catalog Number	Description	Price in USA
1863-9700	<b>1863 Megohmmeter</b> Portable Model Rack Model	\$385.00
1863-9701		\$385.00
1864-9700	<b>1864 Megohmmeter</b> Portable Model Rack Model	485.00
1864-9701		485.00

All prices subject to quantity discount.



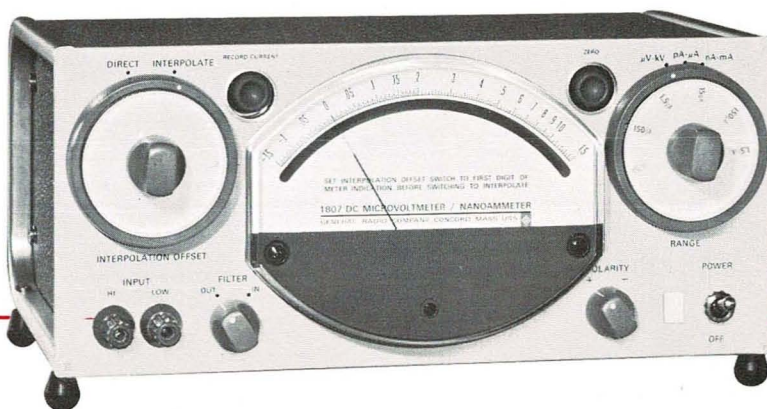




# DC MICROVOLTMETER/ NANOAMMETER

## Type 1807

- accuracy  $\pm 0.2\%$
- 500-M $\Omega$  input impedance
- resolution 0.05  $\mu\text{V}$  and 0.05 pA
- calibrated scale expansion



The GR 1807 is a sensitive dc voltmeter and ammeter. Measurements to an accuracy of  $\pm 0.2\%$  are made possible by an accurately calibrated interpolation-offset or zero-suppression feature. This permits any segment of the meter scale to be expanded for 10 times or better accuracy and resolution. High input impedance ensures full benefit from the instrument's precision without the need for loading-effect corrections. A single log/linear meter scale provides uniform accuracy over the entire range and high resolution near zero.

### NULL INDICATION

Several characteristics of the 1807 make it especially useful as a null indicator for use with dc bridges. An isolated input, excellent rejection of both dc and 60-Hz

common-mode signals, the up-scale meter zero for unambiguous null definition, high input impedance, possible operation from a battery and fine resolution near zero all contribute to this application.

### CURRENT MEASUREMENTS

Minute voltages and currents (to as little as 0.5 pico-ampere) such as are encountered in biological, chemical, and medical research can be readily measured with the GR 1807. It will also serve well in the measurement of thermal voltages, ionization currents and similar phenomena of interest in the electronics and physics laboratory. An output is provided to drive dc recorders for plotting permanent records.

— See *GR Experimenter* for August-September 1968.

### specifications

#### RANGE

**Voltage** (either polarity): 15  $\mu\text{V}$  to 1500 V full scale in 9 decade ranges; 0.05- $\mu\text{V}/\text{div}$  resolution near zero on most sensitive range.  
**Current** (either polarity): 15 pA to 1.5 mA full scale in 9 decade ranges; 0.05-pA/div resolution near zero on most sensitive range.

#### ACCURACY

**Record-Current Linearity:**  $\pm(0.1\%$  of reading + 0.5  $\mu\text{V}$ ).  
**Interpolate:**  $\pm[0.1\%$  of full scale (range) + 0.1% of reading + 0.5  $\mu\text{V}$ ].  
**Direct:**  $\pm(1.5\%$  of reading + 0.5  $\mu\text{V}$ ) above 10% of full scale. Below 10% of full scale,  $\pm(0.15\%$  of full scale + 0.5  $\mu\text{V}$ ).

#### Temperature Coefficients (typical)

**Record-Current Zero Drift:**  $\pm(0.001\%$  of full scale + 0.15  $\mu\text{V}$ ) per degree C.  
**Interpolate:**  $\pm(0.001\%$  of reading + 0.001% of full scale + 0.15  $\mu\text{V}$ ) per degree C.  
**Direct:**  $\pm(0.02\%$  of reading + 0.001% of full scale + 0.15  $\mu\text{V}$ ) per degree C.

#### INPUT IMPEDANCE

**Voltage:** 150- $\mu\text{V}$  to 1.5-V ranges,  $> 500 \text{ M}\Omega$  on direct and typically 5,000  $\text{M}\Omega$  on interpolate; 15- $\mu\text{V}$  range,  $> 50 \text{ M}\Omega$ ; 15-V to 1500-V ranges, 10.5  $\text{M}\Omega$ .  
**Current:** Internal Shunts, 1  $\text{M}\Omega$  in pA- $\mu\text{A}$  ranges, 1 k $\Omega$  in nA-mA ranges.

**Meter:** Single scale from -1.5 to 15. Logarithmic (20 dB) above 10% of full scale.

**Input Current:** Less than 5 pA.

**Noise:** Typically 0.5  $\mu\text{V}$  for  $3\sigma$  with 1 k $\Omega$  across input.

**Common-Mode Rejection:**  $>160 \text{ dB}$  for dc with up to 600 V dc max above ground;  $>120 \text{ dB}$  for 60-Hz common-mode signal of  $<8 \text{ V pk}$  with input filter.

**Record-Current Response Time** (typical): 0.1 s without input filter (1.5-Hz bandwidth), 0.3 s with filter (0.5-Hz bandwidth) on all ranges above 15  $\mu\text{V}$ ; 10 times slower on 15- $\mu\text{V}$  range.

**Maximum Overload:** Voltage: 150 V on 1.5-V range and below, 1500 V on 15-V range and above. Current: 10 mA max all ranges.

**Overload Recovery Time:** Approx 3 s for  $10^4$  overload.

**Recorder Output:** Adjustable up to  $\pm 2.5 \text{ V}$  open circuit for full scale meter deflection;  $\pm 1 \text{ mA}$  into 1.5 k $\Omega$  max load.

#### GENERAL

**Terminals:** Gold-plated copper binding posts on front and rear panels. Ground connection on rear panel only. Battery connection also on rear panel.

**Power Required:** 105 to 125, 205 to 250 V, 50 to 60 Hz, 5 W. Also operates from external 24-V dc supply; 1538-P3 Battery and Charger recommended.

**Accessories Supplied:** 274-QBJ adapts binding posts to BNC, spare fuse, power cord.

**Accessories Available:** Input probe, Tektronix type P6028; 1538-P3 Battery and Charger.

**Mounting:** Convertible-Bench Cabinet.

**Dimensions** (width x height x depth): Bench, 12 x 5 $\frac{7}{8}$  x 10 $\frac{1}{4}$  in. (305 x 150 x 260 mm); rack, 19 x 5 $\frac{1}{4}$  x 8 $\frac{1}{2}$  in. (485 x 135 x 220 mm).

**Net Weight:** Bench, 9 $\frac{1}{2}$  lb (4.4 kg); rack, 10 $\frac{3}{4}$  lb (4.9 kg).

**Shipping Weight:** Bench, 16 $\frac{1}{2}$  lb (7.5 kg); rack, 18 lb (8.5 kg).

Catalog Number	Description	Price in USA
	<b>1807 DC Microvoltmeter/Nanoammeter</b>	
1807-9700	Bench Model	\$695.00
1807-9701	Rack Model	695.00
1807-9601	<b>P6028 Probe</b> , Tek Cat 010-0074-00	18.00

All prices subject to quantity discount.



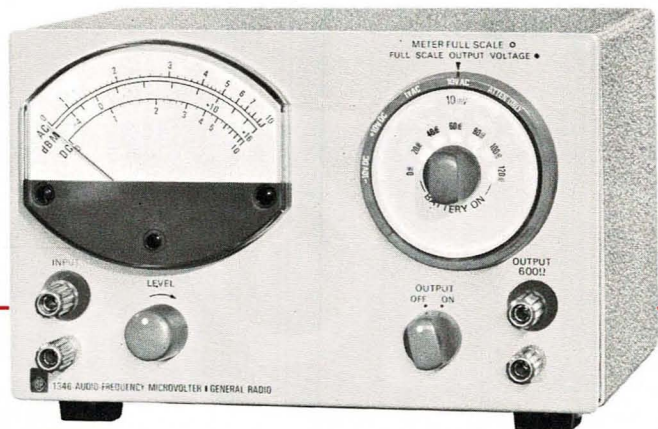




# AUDIO-FREQUENCY MICROVOLTER\*

## Type 1346

- self-contained dc source  
1  $\mu$ V to 10 V
- calibrated ac attenuator to 100 kHz  
0.1  $\mu$ V to 10 V
- use with sine-, square-waves, noise, bursts



The GR 1346 Audio-Frequency Microvolter is a metered, calibrated attenuator that can be used as a self-contained low-level dc source and, in conjunction with an appropriate oscillator, as a source of from 0.1  $\mu$ V to 10 V of any ac waveform with a spectrum up to 100 kHz.

The input to the 1346 can be a dc voltage from the instrument's internal battery (a readily available type) or from an external dc or ac source. An input attenuator provides continuous control of the voltage, which is, in turn, applied to a 20-dB-per-step output attenuator. A total of 140 dB attenuation is provided by the two controls. The meter, in ac operation, is average responding, calibrated in rms volts and in dBm.

An on-off switch permits the output to be reduced to zero without disturbing other controls or shorting the output, and the source impedance remains 600  $\Omega$ ; this is a convenience, especially at these low levels where shielding must be maintained. The zero-volt condition is of great value in incremental dc-gain measurements and in locating noise sources and ground loops in critical low-level measurements.

The 1346 is not line operated, permitting the instrument to "float" in a test setup as might be necessary to add the output of the Microvolter to another signal. Front-panel terminals are gold-plated-copper binding posts for low thermal emf.

— See **GR Experimenter** for August-September 1968.

### specifications

Function	10 V ac	1 V ac	+10 V dc	-10 V dc	Atten Only
Open-Circuit Output Voltage Range	1.0 $\mu$ V to 10 V ac	0.1 $\mu$ V to 1.0 V ac	1.0 $\mu$ V to 10 V dc		0 to -120 dB, 20 dB/step
Accuracy at 23°C (above 10% of dc full scale)	$\pm(4\% + 0.2 \mu\text{V})$ 10 Hz to 100 kHz	$\pm(4\% + 0.02 \mu\text{V})$	$\pm(3\% + 0.2 \mu\text{V})$		$\pm(0.04 \text{ dB/step} + 154 \text{ dB below input level})$ dc to 100 kHz
Source	External ac required 10.0 V into 595 $\Omega$ 1.0 V into 550 $\Omega$		Internal battery or ext dc source 10 V max		Ext ac or dc source 10 V max input
Input Impedance (approx) †	595 $\Omega$ to 25 k $\Omega$		610 $\Omega$ to 25 k $\Omega$ int battery removed		550 $\Omega$ to 5 k $\Omega$

† Varies with setting of input level control, step attenuator, and load. Can be adjusted to remain constant with step-attenuator changes for load impedance of  $\geq 50$  ohms.

**Distortion** (at 1 kHz): <0.01% in 1-V-ac mode, <0.05% in 10-V-ac mode, with level control at max setting.

**Output Impedance:** 600  $\Omega$   $\pm$ 0.5%.

**Power Required:** None required for 10-V-ac range. In other modes,

12-V dry battery: Eveready 228, RCA VS329, or Burgess PM8. Approx life, 33 hours at 2h/day in either dc mode, 316 hours at 2h/day in 1-V-ac mode.

**Mounting:** Convertible-bench cabinet.

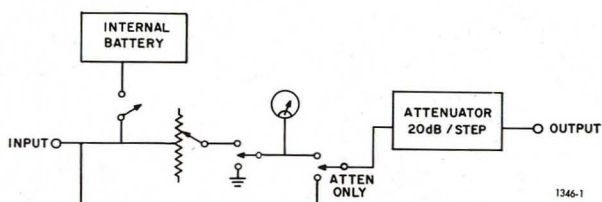
**Accessories Supplied:** Battery, mounting hardware with rack model.

**Accessories Available:** GR 1309-A and 1310-A Oscillators, 1396-B Tone-Burst Generator, 1381, 1382, and 1383 Random-Noise Generators.

**Dimensions** (width x height x depth): Bench, 8½ x 5½ x 7½ in. (220 x 145 x 190 mm); rack, 19 x 5¼ x 6 in. (485 x 135 x 155 mm).

**Net Weight:** Bench, 5 lb (2.3 kg); rack, 8 lb (3.7 kg).

**Shipping Weight:** Bench, 7 lb (3.2 kg); rack, 10 lb (4.6 kg).



Microvolter controls permit continuous and step output control, zero-volt 600- $\Omega$  output, and bypassing of meter and continuous attenuator for operation as step attenuator only.

Catalog Number	Description	Price in USA
1346-9700	<b>Audio-Frequency Microvolter *</b>	
1346-9701	Bench Model	\$285.00
8410-1380	Rack Model	310.00
	<b>Replacement Battery</b>	1.50

\* Trademark registered in USA.

All prices subject to quantity discount.





# COAXIAL RESISTANCE STANDARD



## Type 1442



- $\pm 0.05\%$ -per-year stability
- one- or two-port

The General Radio 1442's are designed to serve as standards of resistance and, used with GR coaxial capacitance standards, as standards of dissipation factor. In either role, they can be used to calibrate impedance bridges at frequencies as high as several hundred megahertz.

### specifications

**Initial DC Accuracy:**  $\pm(0.1\% + 0.3 \text{ m}\Omega)$ .  
**Stability:**  $\pm 0.05\%$  per year.  
**Dissipation:** 1 W max.  
**Capacitance** (inner to outer conductor): 5.4 pF, typical.  
**Inductance:** 9 nH, typical.  
**Temperature Coefficient of Resistance:**  $\pm 50 \text{ ppm}/^\circ\text{C}$ , except  $\pm 100 \text{ ppm}/^\circ\text{C}$  for 1442-F.

**Accessories Available:** 900-WN Short Circuit, 900-Q9 adaptor for connecting standard to  $\frac{1}{4}$ -inch x 28 threaded stud (GR 938 binding post) or tapped hole.

**Dimensions** (diameter x length):  $1 \frac{3}{16} \times 2\frac{3}{8}$  in. (31 x 61 mm).

Catalog Number	Description	Resistance	Price in USA
<b>Coaxial Resistance Standard</b>			
1442-9705	1442-F	5 $\Omega$	\$65.00
1442-9706	1442-G	10 $\Omega$	65.00
1442-9707	1442-H	20 $\Omega$	65.00
1442-9708	1442-J	50 $\Omega$	65.00
1442-9709	1442-K	100 $\Omega$	65.00
1442-9710	1442-L	200 $\Omega$	65.00
1442-9711	1442-M	500 $\Omega$	65.00
1442-9712	1442-N	1000 $\Omega$	65.00

All prices subject to quantity discount.

# COAXIAL CAPACITANCE STANDARDS

## TYPE 1407



- stable to 0.01% per year
- rf standards with GR900® connectors

The 1407 Coaxial Capacitance Standards are fixed mica capacitors of very high stability with small, stable, and known series inductance. This, and the use of precision coaxial connectors, enables the 1407 standards to be used

in the calibration of high-frequency bridges and other impedance-measuring instruments.

### specifications

**Calibration:** A certificate of calibration is supplied with each unit giving the measured capacitance at 1 kHz and at a specified temperature. The measured value is the capacitance at the reference plane of the GR900 connector. This value is obtained by comparison to a precision better than  $\pm 0.005\%$  with working standards whose absolute values are known to an accuracy typically  $\pm 0.01\%$ , determined and maintained in terms of reference standards periodically calibrated by the National Bureau of Standards.

**Stability:** The capacitance change is less than 0.01% per year.

**Accuracy:** Within  $\pm 0.05\%$ , at 1 kHz, of the nominal capacitance.

**Temperature Coefficient of Capacitance:**  $+20 \pm 10 \text{ ppm}/^\circ\text{C}$ , between 10 and 70°C.

**Dissipation Factor:**  $50 \times 10^{-6}$  typical at 1 kHz and 23°C. Max values given in table below; see curves for D vs frequency. Measured D at 1 kHz is stated in certificate to an accuracy of  $\pm 0.00005$ .

**Series Inductance:** 7 nH typical.

**Insulation Resistance:** Minimum of 5000 ohm-farads or 100 G $\Omega$ , whichever is the lesser, when measured at 500 V dc after two minutes electrification.

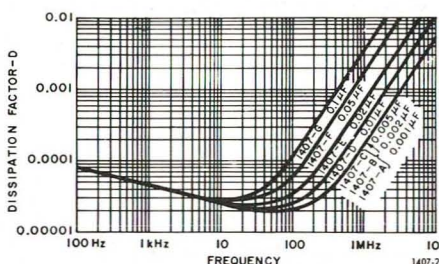
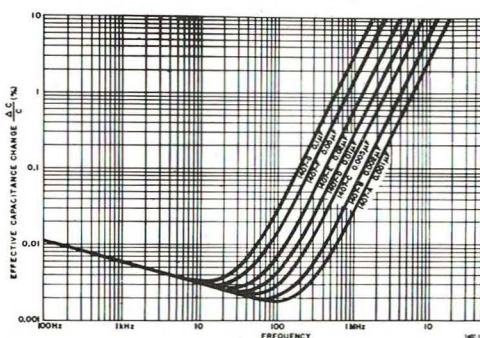
**Max Voltage:** 500 V pk.

**Terminal:** GR900 precision coaxial connector.

**Mounting:** Aluminum panel and cylindrical case.

**Dimensions** (dia x ht):  $3 \times 4\frac{3}{4}$  in. (77 x 125 mm).

**Weight:** Net,  $1\frac{1}{4}$  lb (0.6 kg); shipping, 4 lb (1.9 kg).



Catalog Number	Type	Nominal Capacitance	Max D at 1 kHz and 23°C	Price in USA
1407-9700	1407-A	0.001 $\mu\text{F}$	0.00030	\$105.00
1407-9701	1407-B	0.002 $\mu\text{F}$	0.00025	105.00
1407-9702	1407-C	0.005 $\mu\text{F}$	0.0002	105.00
1407-9703	1407-D	0.01 $\mu\text{F}$	0.0002	105.00
1407-9704	1407-E	0.02 $\mu\text{F}$	0.0002	110.00
1407-9705	1407-F	0.05 $\mu\text{F}$	0.0002	120.00
1407-9706	1407-G	0.1 $\mu\text{F}$	0.0002	125.00

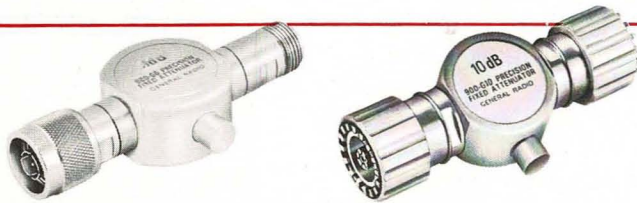
All prices subject to quantity discount.







# PRECISION COAXIAL COMPONENTS



## PRECISION FIXED ATTENUATORS — Type 880 and GR900

These 6-dB and 10-dB coaxial attenuators, available with type N connectors (type 880 attenuators) or with GR900® precision connectors, have an SWR much lower than previously available and uniform attenuation over a wide frequency range. Their use will, therefore, permit greatly improved accuracy in measuring insertion loss, impedance, power, or phase, which requires precise impedance matching of the source and detector. In particular, these attenuators are ideal for swept measurement of the above quantities. Also, in point-by-point measurements, they reduce the need to tune out residual reflections from source or detector.

In particular, the units equipped with GR900 connectors display a high degree of repeatability in SWR, contact resistance, and insertion loss, which contributes to the value of these attenuators in substitution measurements. For

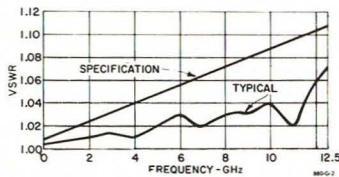
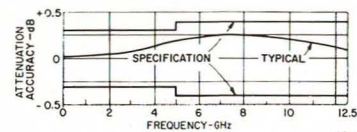
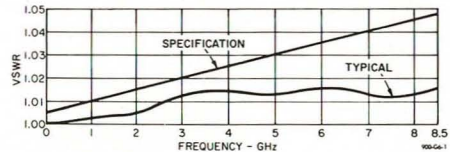
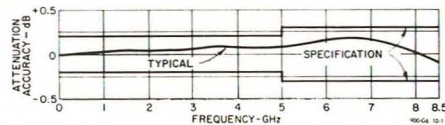
example, repeatability of insertion loss is typically  $\pm 0.002$  dB. The high repeatability and low SWR also permit attenuators to be accurately calibrated for use as attenuation standards.

### specifications

**Frequency Range:** Type 880's, dc to 12.5 GHz; GR900's, dc to 8.5 GHz.  
**Attenuation Accuracy:** Type 880's,  $\pm 0.3$  dB, 0 to 5 GHz;  $\pm 0.4$  dB, 5 to 12.5 GHz;  $\pm 0.04$  dB at dc. Type 900's,  $\pm 0.2$  dB, 0 to 5 GHz;  $\pm 0.3$  dB, 5 to 8.5 GHz;  $\pm 0.04$  dB at dc.  
**SWR:** GR900,  $< 1.005 + 0.005 f_{GHz}$ ; 880,  $< 1.008 + 0.008 f_{GHz}$ .  
**Characteristic Impedance:** 50.0  $\Omega$ .  
**DC Resistance:** 50.0  $\Omega \pm 0.03\%$  when terminated in 50.0  $\Omega$ .  
**Max Power:** 1.0 W continuous; peak, 500 W with 1-W avg.  
**Temperature Coefficient:**  $< 0.0001$  dB/°C/dB.  
**Dimensions:** 3¾ in. length (95 mm).  
**Net Weight:** GR900, 11 oz (310 g); 880, 6 oz (160 g).

Catalog Number	Description	Price in USA
<b>Precision Fixed Attenuators</b>		
0900-9850	<b>900-G6 (6 dB)</b>	<b>\$185.00</b>
0900-9851	<b>900-G10 (10 dB)</b>	<b>185.00</b>
0880-9850	<b>880-G6 (6 dB)</b>	<b>95.00</b>
0880-9851	<b>880-G10 (10 dB)</b>	<b>95.00</b>

At right: SWR and attenuation accuracy curve for Type 900's.



At left: SWR and attenuation accuracy curves for Type 880's.

## ADJUSTABLE SHORT CIRCUIT — Type 900-D20

The 900-D20 is a coaxial sliding short circuit equipped with a GR900® connector. It can be used for tuning and matching or as a reactance standard.

With the GR 900-LB Precision Slotted Line, the 900-D20 permits the measurement of the source impedance of signal sources by a method described in the 900-LB operating-instruction manual and in Reprint A126, available on request. It is also useful for the measurement of two-port components by the Deschamps method.<sup>1</sup>

The adjustable short circuit consists of a sliding spring-finger contact of hardened beryllium copper in a length of air line with silver-plated inner and outer conductors. The operating handle is calibrated in centimeters and can be locked in position.

<sup>1</sup> Deschamps, G. A., "A Simple Graphical Analysis of a Two-Port Waveguide Junction" Proc IRE, No. 42, p. 859. May 1954.



### specifications

**Frequency Range:** 0 to 8.5 GHz.  
**Reflection Coefficient** (at 0.5, 4.5, and 8.5 GHz): Closed,  $> 0.99$ ; fully extended,  $> 0.98$ , except  $> 0.99$  at 0.5 GHz.  
**Adjustment Range:** 20 cm (physical and electrical).  
**Min Electrical Length:** 2.5 cm at 0.5 GHz, 2.9 cm at 8.5 GHz.  
**Characteristic Impedance:** 50  $\Omega$ .  
**Scale Accuracy:**  $\pm 0.02$  cm.  
**Dimensions:** Length, 11 in. (280 mm) closed, 18¾ in. (480 mm) extended; diameter, 1½ in. (27 mm).  
**Weight:** 15 oz (455 g).

Catalog Number	Description	Price in USA
0900-9430	<b>900-D20 Adjustable Short Circuit</b>	<b>\$160.00</b>

## PRECISION ADJUSTABLE LINE — Type 900-LK10

The 900-LK10 is a line stretcher with very low SWR and uniform characteristic impedance and insertion loss. It is especially useful in eliminating corrections for line length between an unknown and an impedance-measuring device. It can also serve as an impedance-matching transformer and phase-adjustment element in coaxial systems. GR900® precision connectors ensure repeatable connections with low loss and reflections.

### specifications

**Frequency Range:** DC to 7 GHz.  
**Characteristic Impedance:** 50.0  $\Omega \pm 0.2\%$  at frequencies where skin-depth is negligible.  
**SWR:**  $< 1.004 + 0.004 f_{GHz}$ .

**Electrical Length:** 40  $\pm 0.1$  cm, closed;  $> 50$  cm, extended;  $> 10$  cm travel.  
**Calibration:** Scale direct reading in centimeters. Accuracy,  $\pm 0.2$  mm.  
**Insertion Loss:**  $< 0.05 \sqrt{f_{GHz}}$  dB, closed;  $< 0.06 \sqrt{f_{GHz}}$  dB, extended;  $< 0.001 \sqrt{f_{GHz}}$  dB per cm of extension.  
**Voltage:** 2500 V max.  
**Power:** 15 kW max up to 1 MHz;  $\frac{15 \text{ kW}}{\sqrt{f_{GHz}}}$  max above 1 MHz.  
**Dimensions** (dia x length): 1½ x 15½ in. (27 x 395 mm); 19¾ in. extended (500 mm).  
**Net Weight:** 24 oz (680 g).

Catalog Number	Description	Price in USA
0900-9570	<b>900-LK10 Precision Adjustable Line</b>	<b>\$245.00</b>



All prices subject to quantity discount.







# LOCKABLE OSCILLATOR

(900 to 2000 MHz)

## Type 1218-BV

A new version of a popular GR oscillator, the 1218-BV has electronic frequency control as an added capability, making it valuable in a host of additional uses. By phase locking the 1218-BV to an external reference signal, the oscillator output can have high power, inherently low noise, and the stability of the reference signal against warmup drift and microphonics.

In heterodyne systems, where a difference signal must be stable to remain within the bandwidth of a tuned detector, the 1218-BV can be used as the local oscillator. With a phase detector operating at the difference frequency, the 1218-BV can track small changes in the frequency of the test oscillator and hold the difference frequency steady.

— See *GR Experimenter* for November-December 1968.

### specifications

**Frequency Range:** 900 to 2000 MHz.

**Frequency Calibration Accuracy:**  $\pm 1\%$ .

**Warmup Frequency Drift:** 0.1% total drift, typical.

**$\Delta F$  Control (Internal):**  $\geq \pm 2$  MHz by  $\frac{7}{8}$  turn of front-panel knob.

**Power-Level Pulling (by  $\Delta F$  control):**  $< \pm 0.5$  dB for  $\pm 2$  MHz  $\Delta f$ .

**$\Delta F$  Control (Remote):** By dc voltage applied at front or rear jacks.

**Frequency:**  $> 4$  MHz total range for 50-V change.

**Voltage:** Typical useful range  $\pm 25$  V;  $\Delta F$  control sets center value from +10 to -20 V. Positive-going voltage causes frequency decrease. Applied voltage  $\pm 50$  V max.

**Interface Characteristic:** Equivalent to 10 k $\Omega$ , 150 pF, and -1.3 mA current source in parallel across terminals, one of which is grounded. Ext source should have  $< 1000 \Omega$  internal impedance; can be ac coupled.

**Step-Response Time:**  $< 1 \mu s$ , typical.

**Output Power (into 50  $\Omega$ , with 1264 or 1267 power supply):**  $> 160$  mW, 0.9 to 1.5 GHz; drops linearly to  $> 110$  mW at 2.0 GHz.

**Output Connector:** Locking GR874® connector at rear panel. Adaptors available to other connector types.

**Level Control:** Full output to at least 20-dB attenuation set by uncalibrated front-panel control.

**Modulation:** AM INPUT jack at front panel for external audio-frequency plate modulation; approx 30 V rms into 6 k $\Omega$  required for 30% amplitude modulation. GR 1311 Audio Oscillator recommended as modulator.

**Dimensions (width x height x depth):** Bench, 12 x 7 $\frac{5}{8}$  x 9 in. (305 x 195 x 230 mm); rack (with 1267 power supply), 19 x 7 x 7 in. (485 x 180 x 180 mm), 1263 or 1264 power supply adds 7 in. to rack height.

**Weight (less power supply):** Net, 14 lb (6.5 kg); shipping, 25 lb (11.5 kg).

Catalog Number		Description	Price in USA	
Bench	Rack		Bench	Rack
1218-9724		1218-BV Lockable Oscillator Oscillator/Power Supply Combinations	\$975.00	
1218-9901	1218-9902		\$1575.00	\$1620.00
1218-9903	1218-9904		\$1425.00	\$1470.00
1218-9905	1218-9906		\$1190.00	\$1220.00
		with 1263-C Amplitude-Regulating PS		
		with 1264-B Modulating PS		
		with 1267-B Regulated PS		



- 150 kHz to 1 GHz
- 10- to 30-dB gain
- $> 33$ -dB isolation

# VHF/UHF PREAMPLIFIER

## Type 1237

The 1237 is a low-noise, low-level transistor amplifier for use as a general-purpose amplifier, preamplifier, and isolator in 50-ohm systems from 150 kHz to 1 GHz.

As an accessory for the GR 1607 Transfer-Function and Immittance Bridge and in other small-signal measurements, the 1237 replaces a local-oscillator trap to isolate the local-oscillator signal from the bridge.

Used in modulated-signal detection systems, one or two 1237's ahead of the detector will result in sensitivities approaching that of heterodyne systems.

Power output of the 1237 preamplifier operating at 1-dB gain compression typically increases from -15 to 0 dBm from 50 to 400 MHz and remains about 0 dBm above 400 MHz.

### specifications

**Frequency Range:** 150 kHz to 1 GHz.

**Gain:**  $> 10$  dB (see typical curve).

**Reverse Attenuation:**  $> 33$  dB; below 700 MHz  $> 43$  dB.

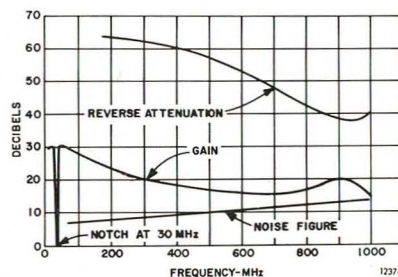
**Noise Figure:** See typical curve.

**Terminals:** Input and output, GR874® locking coaxial connectors.

**Power Required:** 100 to 125 or 200 to 250 V, 50 to 400 Hz, 1.5 W; or 9 V dc, 18 mA.

**Dimensions (width x height x depth):** 6 $\frac{1}{4}$  x 3 $\frac{1}{16}$  x 2 $\frac{1}{2}$  in. (160 x 94 x 64 mm).

**Weight:** Net, 1 $\frac{1}{2}$  lb (0.7 kg); shipping, 3 lb. (1.4 kg).



Catalog Number	Description	Price in USA
1237-9700	1237 VHF/UHF Preamplifier	\$195.00





## COHERENT DECADE FREQUENCY SYNTHESIZERS

All GR programmable synthesizers now perform better with the advent of a new programmable module for the 0.1-Hz-per-step to 100-kHz-per-step decade positions. Diode switches replace reed relays and the remote programming speed increases tenfold to less than 200  $\mu$ s; life expectancy becomes essentially unlimited.

The improved programmable modules, Type 1160-RDI-1B, are already being shipped in new instruments, replacing the 1160-RDI-1. They are also available separately to replace older modules in synthesizers, to expand the resolution capability of any less-than-fully-equipped models, or as spares. The modules are ready to plug in; the process takes only minutes and requires no special tools. They operate in any GR synthesizer in any position except the X1-MHz

and the X10-MHz stations of the 1163 and 1164 models, for which solid-state-switching modules are already available.

For programmable operation, the 1160-9480 should be ordered; it includes a programming-input filter plug to replace the one used with the original programmable decades. The new decades respond to 10-line digit control only, while the older units could also be controlled by biquinary connections.

The same decade module, Type 1160-RDI-1B, is now also used in manual, nonprogrammable models, replacing the 1160-DI-1 module. For this use, the new module is identified as 1160-9485, and is supplied without the filter plug.

Catalog Number	Description	Price in USA
1160-9485	1160-RDI-1B Digit Insertion Unit less filter plug	\$455.00
1160-9480	1160-RDI-1B Digit Insertion Unit with filter plug	505.00

All prices subject to quantity discount.

## AUDIOMETER CALIBRATION SET — Type 1565-Z EARPHONE COUPLER — Type 1560-P83



1560-P83 Earphone Coupler



1565-Z

The Type 1560-P83 Earphone Coupler is the third model available from General Radio; although not as easy to use as the other two (type 1 couplers), the type 9-A is the more popular. The GR 1560-P83 is mechanically similar to the NBS type 9-A coupler but, for greater ease of use, contains a microphone locating step not found in the NBS design. A series of carefully controlled measurements with both NBS- and GR-type couplers indicates that this minor difference in configuration causes no discernible variation in coupler response.

This earphone coupler is offered alone or as part of an Audiometer Calibration Set, Type 1565-Z, which also includes a GR 1565-A Sound-Level Meter and 1562-A Sound-Level Calibrator, all in a convenient carrying case. The Audiometer Calibration Set is an accurate, portable, and inexpensive system for the field calibration of audiometers. This set is also available containing a type 1 coupler, the GR 1560-P82 (see Catalog T).

### specifications

#### Specifications (1560-P83 Earphone Coupler)

**Coupler Type:** GR 9A type (modified version of NBS type 9-A).

**Volume:** 5.642 cm<sup>3</sup>, including volume added by microphone (GR

Type 1560-P5 microphone or cartridge).

**Axial Holding Force:** 450 grams, nominal.

**Frequency Range:** 100 to 8000 Hz. Duplicates response of NBS 9-A coupler within 1 dB at audiometric test frequencies when used with TDH-39 or TDH-49 earphones with MX41AR ear cushions.

**Dimensions:** Coupler, 2 $\frac{1}{8}$  in. diameter, 1 $\frac{1}{4}$  in. height. Over-all height, 3 $\frac{1}{2}$  in.

**Net Weight:** 8 $\frac{1}{2}$  oz (245 g).

#### Specifications (1565-Z)

**Comprises:** 1565-A Sound-Level Meter, 1560-P83 Earphone Coupler, 1562-A Sound-Level Calibrator, storage case.

**Dimensions** (width x height x depth): 11 $\frac{1}{4}$  x 4 $\frac{1}{4}$  x 10 in. (290 x 110 x 255 mm).

Catalog Number	Description	Price in USA
1560-9683	1560-P83 Earphone Coupler	\$ 40.00
1565-9901	1565-Z Audiometer Calibration Set	645.00
8410-9591	Set of Replacement Batteries	1.40

All prices subject to quantity discount.

## New Chart Papers for Graphic Level Recording

Two new chart papers are available for use with the GR 1304-B Beat-Frequency Audio Generator and 1521-B Graphic Level Recorder (the combination of which is also identified as the GR 1350-A Generator-Recorder Assembly). Both permit recordings with the 50-dB-per-decade scale factor: the type 1521-9470 Chart Paper when used with a 40-dB recorder potentiometer, the 1521-9473 when used with an 80-dB potentiometer. This scale factor is required by many testing standards, particularly the USAS S3.8-1967, "Method of Expressing Hearing Aid Performance."

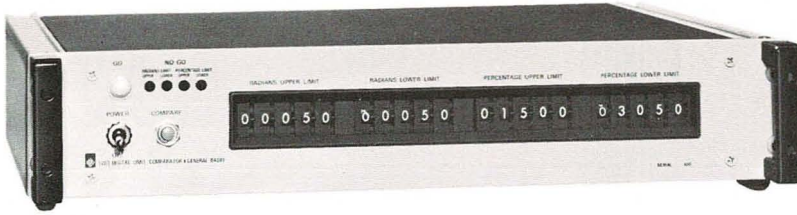
Chart Paper 1521-9471 is for special applications of the GR 1911-A Recording Sound and Vibration Analyzer, an assembly of the 1564-A Sound and Vibration Analyzer and the 1521-B Graphic Level Recorder. This chart paper has a frequency scale of 2 $\frac{1}{2}$  inches per decade.

Catalog Number	Description	Price per roll in USA
1521-9470	Chart Paper, 5"/decade for GR 1304	\$2.75
1521-9473	Chart Paper, 2 $\frac{1}{2}$ " /decade for GR 1304	2.75
1521-9471	Chart Paper, 2 $\frac{1}{2}$ " /decade for GR 1911	2.75

All prices subject to quantity discount.



## DIGITAL LIMIT COMPARATOR — Type 1783



Used with the GR 1681 Automatic Impedance Comparator System, the 1783 permits the rapid sorting of devices with impedance within a very wide range of magnitude and phase angle. The Digital Limit Comparator reacts to the difference between an unknown and a standard, so its 5-place comparison resolution can represent as small an increment as 10 parts per million in absolute impedance.

The 1783 Digital Limit Comparator automatically compares the BCD output of the Type 1681 with upper and lower limits for both impedance magnitude difference (in percent) and phase angle difference (in radians) that are preset on the front-panel thumbwheels. Panel lights show if the measured differences are in tolerance or, if not, which limit is exceeded. Relay contacts are provided to actuate external GO-NO GO indicators and sorting mechanisms.

### specifications

**Range of Limit Settings:** For both impedance and phase angle, 00000 to +19999 for upper limit, -19999 to 00000 for lower.  
**Accuracy:** Same as data source.

#### INPUT

**Data:** 10 digits, BCD, 1-2-4-2 (1-2-4-8 optional).

#### Logic Levels:

"1" =  $V_{ref}$  ( $V_{ref}$  to  $V_{ref}-2$  volts),  
 "0" =  $V_{ref}-10$  volts ( $V_{ref}-8$  to  $V_{ref}-50$  volts).  
**Input Resistance:**  $>47$  k $\Omega$  (connected to  $V_{ref}$ ).  
**Max Source Resistance:** 100 k $\Omega$ .  
**Reference Voltage ( $V_{ref}$ ):**  $\pm 50$  V with respect to chassis ground.  
**Compare Command:** Logic 1 to logic 0 transition. Min duration, 2.5 ms; input resistance,  $>50$  k $\Omega$ . Max source resistance, 20 k $\Omega$ .

#### OUTPUT

**Data:** Identical to input.  
**Comparison Result:** BCD digit, behind 10 k $\Omega$ .  
**Print Command:** Logic 1 to logic 0 transition, behind 2.2 k $\Omega$ .  
**Relay Contacts:** 5 SPDT contacts. Internal contact protection provided for 115 V, 0.1 A max. Contacts rated for 500 V max, 2 A max, 100 VA with appropriate contact protection.

Catalog Number	Description	Price in USA
1783-9801	<b>1783 Digital Limit Comparator</b> Bench Model	<b>\$2500.00</b>
1783-9811		
4205-1010	<b>Accessory Cable</b> (to sorting equipment)	<b>65.00</b>

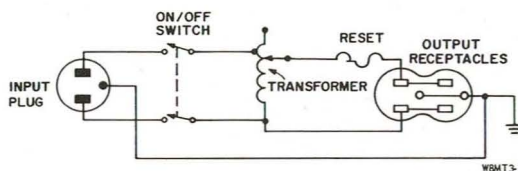
All prices subject to quantity discount.



## VARIAC® adjustable autotransformers W8MT3, W8MT3VM (Metered)

The W8MT3 and its companion metered Variac autotransformer give you the most capacity for your money of any Variac model, many convenience features, and the new General Radio "light look".

The W8MT3 and W8MT3VM are cased units that include a power cord and plug, an on-off switch that switches both sides of the input line, a dual receptacle for connection of a multiple load, a manual-reset overload protector, and a carrying handle. The W8MT3VM only has a 0-to-150 volt meter that indicates output voltage of the Variac.



W8MT3 elementary circuit.

### specifications

#### INPUT

**Voltage:** 120 V.  
**Frequency:** 50 to 60 Hz.

#### OUTPUT

**Voltage:** 0 to 140 V.  
**Rated Current:** 10 A; equivalent to 1400 W at max output voltage.  
**Meter (in W8MT3VM only):** 0 to 150 V.  
**No-Load Loss:** 12 W at 60 Hz.  
**Driving Torque:** 10 to 20 ounce-inches.  
**Replacement Brush:** Type VB2.  
**Weight:** Net, 10 lbs (4.6 kg); shipping, 20 lb (9.5 kg).

Catalog Number	Description	Price in USA
3038-5119	<b>W8MT3 Variac autotransformer</b> <b>W8MT3VM Variac autotransformer</b> (metered)	<b>\$38.00</b>
3038-5015		
3200-5900	<b>VB2 Replacement Brush</b>	<b>1.25</b>

All prices subject to quantity discount.



## Index

Adjustable Line, coaxial	20	Generators	
Adjustable Short Circuit	20	Precision DC	14
Ammeter, Nano-, DC	17	Pulse	5
Analog Limit Comparator	11	Random-Noise	15
Analyzer, Real-Time	12	Impedance Comparator	10
Attenuators, Precision Fixed, coaxial	20	Limit Comparators	
Audio-Frequency Microvolter	18	Analog	11
Audiometer Calibration Set	22	Digital	23
Autotransformers, Variac®	23	Line, Coaxial, Adjustable	20
Calibration Set, Audiometer	22	Megohmmeters	16
Calibrator, Digital Voltmeter	14	Microvolter, Audio-Frequency	18
Capacitance Standards, Coaxial	19	Microvoltmeter, DC	17
Chart Papers for graphic level recording	22	Modules, Frequency Synthesizer	22
Coaxial		Multichannel RMS Detector	12
Attenuators, Precision Fixed	20	Multifilter	13
Capacitance Standards	19	Nanoammeter, DC	17
Line, Adjustable	20	Noise Generator, Random	15
Reflectometer, Sweep-Frequency	8	Octave-Band Multifilter	13
Resistance Standards	19	Oscillator, Lockable, 900 to 2000 MHz	21
Short Circuit, Adjustable	20	Preamplifier, VHF/UHF	21
Standards	19	Pulse Generator	5
Comparators		Random-Noise Generator	15
Analog Limit	11	Real-Time Analyzer	12
Impedance	10	Recording Chart Papers	22
Digital Limit	23	Reflectometer, Sweep-Frequency	8
Counters, Digital Frequency	6	Resistance Standards, Coaxial	19
Coupler, Earphone	22	Short Circuit, Coaxial	20
DC Microvoltmeter/Nanoammeter	17	Standards	
Detector, RMS, Multichannel	12	Capacitance, Coaxial	19
Digital		Resistance, Coaxial	19
Frequency Counter	6	Sweep-Frequency Reflectometer	8
Limit Comparator	23	Synthesizer modules	22
Voltmeter Calibrator	14	Third-Octave-Band Multifilter	13
Earphone Coupler	22	UHF Preamplifier	21
Frequency Counter, Digital	6	Variac® autotransformers	23
Frequency Synthesizer, modules	22	VHF Preamplifier	21
		Voltmeter Calibrator, Digital	14
		Voltmeter, Micro-, DC	17



# GENERAL RADIO

WEST CONCORD, MASSACHUSETTS 01781  
617 369-4400

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