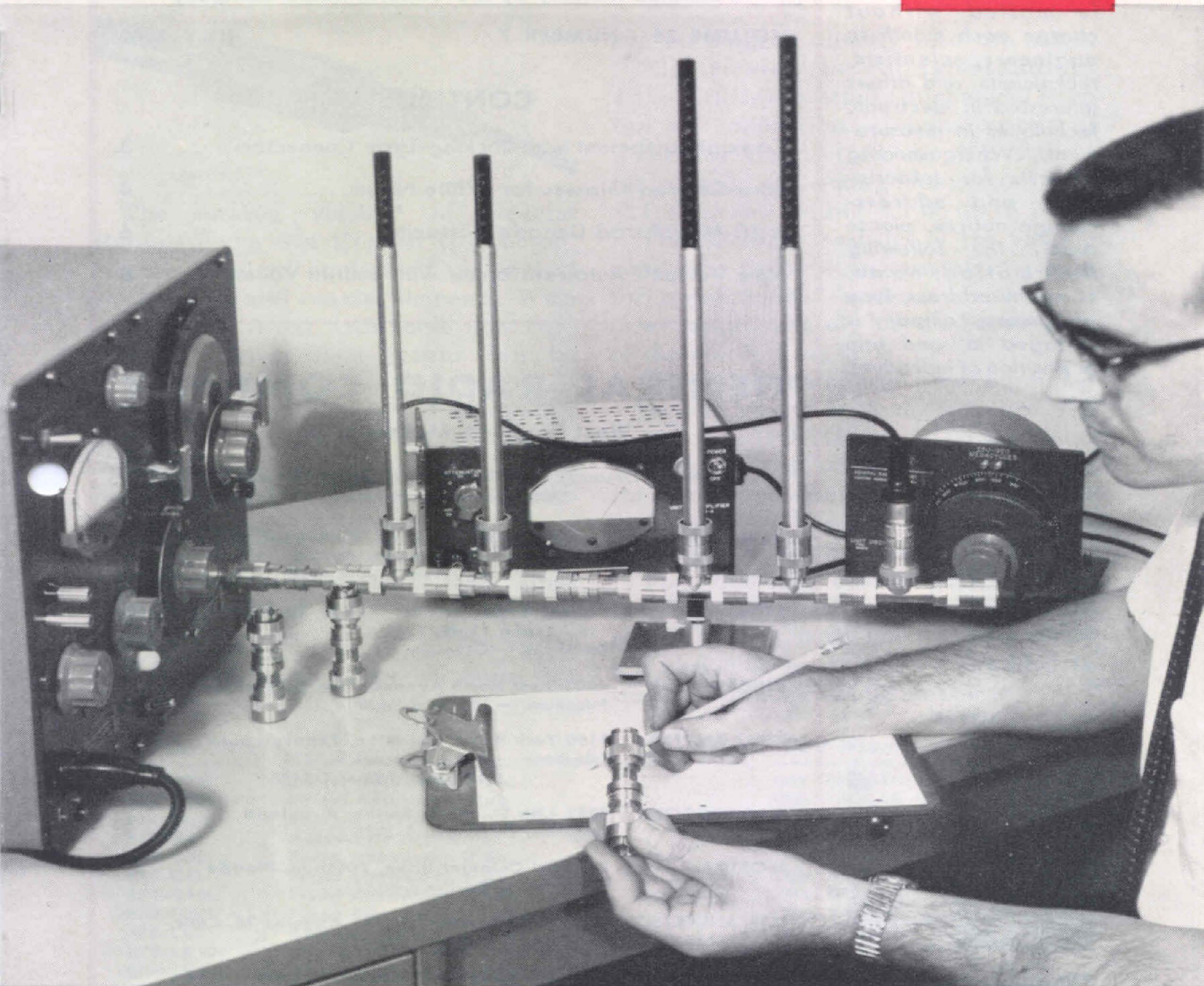


THE GENERAL RADIO EXPERIMENTER



VOLUME 36 No. 7

JULY, 1962

IN THIS ISSUE



New —

- Coaxial Elements
- Pink-Noise Filter
- Decade Capacitor
- Metered Variac® Autotransformer

EXPERIMENTER



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

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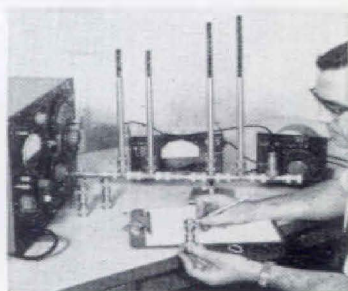
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COVER



The assembly shown here is used for the calibration of coaxial attenuators. The excellent shielding of the locking Type 874 Connectors is particularly valuable in this measurement.

COAXIAL EQUIPMENT WITH LOCKING-TYPE CONNECTORS



The locking version¹ of General Radio's TYPE 874 Coaxial Connector* is now standard equipment on several instruments and coaxial elements. With components fitted with these new connectors, measurement setups can be assembled that possess an exceptionally high degree of mechanical rigidity and electrical stability. At the user's option, however, the locking feature can be disregarded, and the basic quick-connect/disconnect feature of the TYPE 874 Connector will permit rapid changes and substitution of parts. Further, since both the locking and the non-locking types are completely compatible, either

can be plugged directly into the other.

Electrically, the voltage-standing-wave ratio is essentially unchanged from the low value that is characteristic of TYPE 874 Connectors. Typical figures for a pair of locking connectors are: <1.02 up to 3 Gc and <1.06 up to 7 Gc.

The shielding qualities of the locking connector produce an outstanding gain for measurement systems. Leakage is down approximately 50 db below that of the non-locking type.

Coaxial instruments now equipped with locking-type connectors are the TYPE 1602-B UHF Admittance Meter and the TYPE 874-LBA Slotted Line. In the admittance meter, only the detector connector, for mechanical reasons, remains a non-locking type.

The following coaxial elements are now available with either type of connector. Those with locking connectors are identified by the letter L added to the type number, as listed below.

¹"New and Improved Coaxial Connectors," *General Radio Experimenter*, 35, 10, October, 1961.
*U.S. Patent No. 2,548,457.

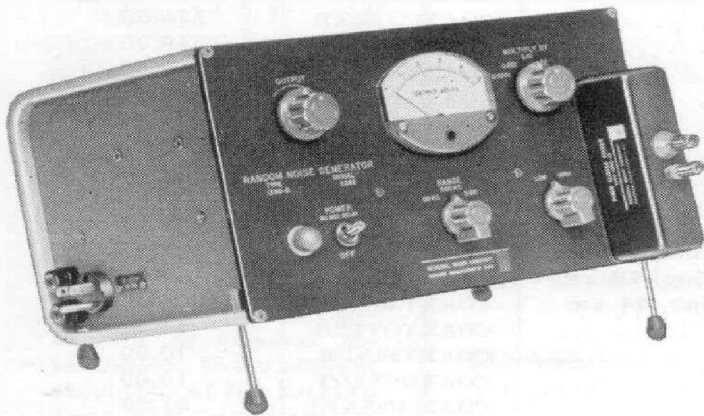
Type		Code Word	Price
874-D20L	20-cm Adjustable Stub.....	COAXCOUGAR	\$16.00
874-D50L	50-cm Adjustable Stub.....	COAXJAGUAR	19.00
874-EL-L	Ell.....	COAXYLLAMA	10.50
874-GAL	Adjustable Attenuator.....	COAXYHORSE	67.00
874-G3L	Fixed Attenuator, 3 db.....	COAXYBISON	38.00
874-G6L	Fixed Attenuator, 6 db.....	COAXBADGER	32.00
874-G10L	Fixed Attenuator, 10 db.....	COAXBEAVER	32.00
874-G20L	Fixed Attenuator, 20 db.....	COAXYCAMEL	32.00
874-LAL	Adjustable Line.....	COAXYTAPIR	27.00
874-LK10L	Constant-Impedance Adjustable Line, 10 cm	COAXYHIPPO	42.00
874-LK20L	Constant-Impedance Adjustable Line, 22 cm	COAXYRHINO	42.00
874-LTL	Constant-Impedance Trombone Line, 44 cm	COAXYMOOSE	97.00
874-MRL	Mixer Rectifier.....	COAXYOTTER	34.50
874-R22L	Patch Cord.....	COAXYFIXER	10.00
874-TL	Tee.....	COAXOCELOT	14.00
874-VCL	Variable Capacitor.....	COAXMONKEY	61.00
874-VQL	Voltmeter Detector.....	COAXYLEMUR	32.00
874-VRL	Voltmeter Rectifier.....	COAXAGOUTI	32.00



ROSE-COLORED GLASSES FOR WHITE NOISE

Broad-band electrical noise, often referred to as random noise, has proved to be a remarkably useful test signal when supplied by a controlled generator such as the TYPE 1390-B Random-Noise Generator.¹ Such a signal, embracing a wide range of frequencies and having a randomly varying instantaneous amplitude, closely approximates the signals normally encountered in many busy communication systems.²

The output of such a generator is characterized by a uniform spectrum over the frequency band to which the instrument is set. When the spectrum is uniform over a broad band, i.e. 20 cps to 20 kc, the noise is frequently referred to as "white" (constant energy per cycle) in that particular band. If this noise output is analyzed with a constant-percentage-bandwidth analyzer, such as the TYPE 1554-A Sound and Vibration Analyzer,³ the amplitude-frequency characteristic of the white noise appears to



The Filter connects directly into the output terminals of the Random-Noise Generator, as shown.*



View of the Type 1390-P2 Pink-Noise Filter.

slope upward with increasing frequency. The bandwidth of the analyzer increases in direct proportion to the frequency to which the analyzer is tuned. Since noise voltage increases as the square root of the bandwidth, it can be seen that the voltage output of the generator increases by a factor of 1.4 (3 db) when the analyzer frequency is doubled, thus giving the amplitude-frequency characteristic a slope of 3 db per octave.

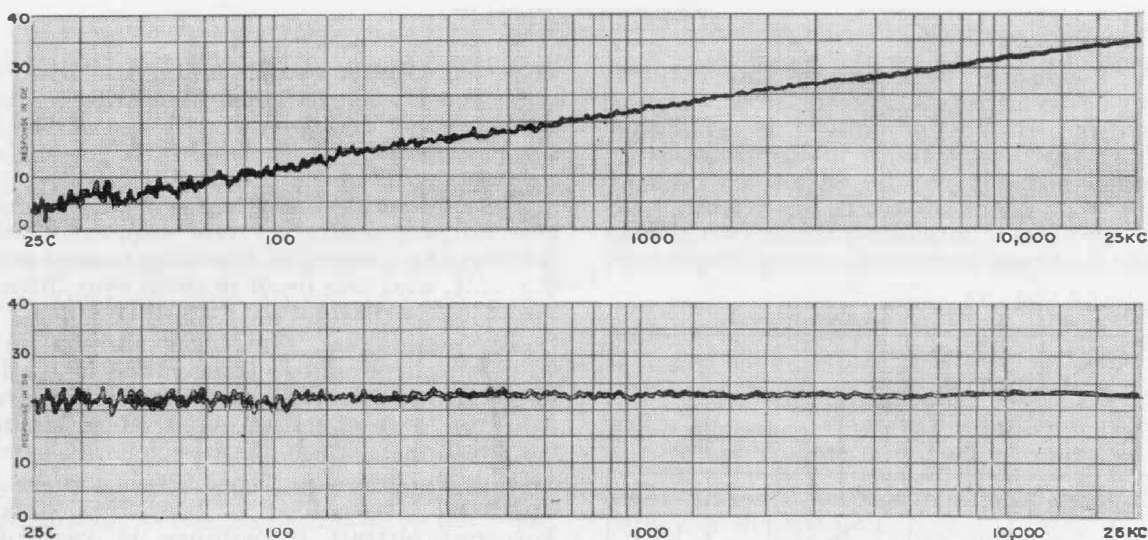
If the random-noise generator is used as a source for a system under test, and if the output of the system is to be analyzed by a constant-percentage-bandwidth analyzer, it is usually desirable to compensate for this sloping characteristic at the output of the generator. The resulting output is then known as "pink" noise,⁴ that is, noise having constant energy per octave.

¹A. P. G. Peterson, "A New Generator of Random Electrical Noise," *General Radio Experimenter*, 34, 1, January, 1960.

²S. S. Stevens, J. P. Egan, and G. A. Miller, "Methods of Measuring Speech Spectra," *Journal of the Acoustical Society of America*, Vol 19, No. 5, September, 1947, pp 771-780.

³J. J. Faran, "A New Analyzer for Sound and Vibration," *General Radio Experimenter*, 33, 12, December, 1959.

⁴C. G. Mayo and D. G. Beadle, "Equipment for Acoustic Measurements (Part 4)," *Electronic Engineering*, Vol 23, December, 1951, pp 462-465.



(Upper curve) White noise output of the Type 1390-B Random-Noise Generator as measured by a one-third-octave bandwidth and (lower curve) pink noise output of the filter.

The TYPE 1390-P2 Pink-Noise Filter converts the electrical output of the random-noise generator from "white" noise to "pink" noise in the audio-frequency range. It is designed to plug into the output binding posts of the TYPE 1390-B Random-Noise Generator, but can also be used at any point in a system where such a filter characteristic is needed, provided that the source impedance is less than 1 kilohm and the load impedance is at least 20 kilohms. The input terminals are recessed plugs at the rear, and the output terminals are binding posts on the front. For shielding, the case of the filter is grounded to the low input and output terminals.

This RC low-pass filter has an amplitude-frequency characteristic of -3 db per octave from 20 cps to 20 kc. Beyond 20 kc the attenuation has been made 6 db per octave in order to reduce the unwanted frequencies outside the audio-frequency range.

Pink noise has been found to have a wide variety of applications. Some

noises that occur in nature, such as the low-frequency noise in semiconductors and certain acoustical background noises, are closer in spectral characteristics to pink noise than to white noise. To simulate electrical signals generated in such cases, it is convenient to use pink noise.

Frequency-response measurements on electroacoustical and electromechanical equipment constitute the most important use. With sine-wave excitation, measurement results are difficult to interpret because of the large amplitude fluctuations that may occur. When the data are averaged over a narrow range of frequencies, the response curve is considerably smoother and much easier to use. "Warble tones" are often used for this purpose. A more convenient method, however, is to use pink noise as the tone source and the TYPE 1554-A Sound and Vibration Analyzer, with one-third-octave bandwidth, as the measuring system. The frequency-response characteristic can be automatically recorded with the TYPE 1521-A Graphic Level Recorder.⁵

—J. J. FARAN

⁵M. C. Holtje and M. J. Fitzmorris, "A Graphic Level Recorder with High Sensitivity and Wide Ranges," *General Radio Experimenter*, 33, 6, June, 1959.

SPECIFICATIONS

Frequency Response: Sloping at the rate of -3 db per octave from 20 cps to 20 kc. Sloping at the rate of -6 db per octave at all higher frequencies. Output voltage is approximately -5 db with respect to the input voltage at 20 cps and -35 db at 20 kc. It lies within 1 db of the straight line connecting these two points on a graph of output in decibels vs log frequency.



Attenuation-frequency characteristic of the Pink-Noise Filter.

Over-all Output Level: When the filter is used with the Random-Noise Generator, set for the 20-kc range, the output voltage of the filter is approximately 30 db below its input, and the voltage level in each one-third-octave band is approximately 17 db below that. Thus, when the output meter of the generator indicates 3 volts, the output of the filter is approximately 0.1 volt, and the level in each one-third-octave band is approximately 15 millivolts.

Input Impedance: The filter should be driven from a source whose impedance is 1 kilohm or less. Input impedance is variable from 6.5 kilohms + load resistance at zero frequency to 6.7 kilohms at high frequencies.

Output Impedance: The filter should not be operated into a load of less than 20 kilohms. Internal output impedance is variable from 6.5 kilohms + source resistance at low frequencies to approximately 200 ohms at high frequencies.

Input Voltage: 15 volts rms, maximum.

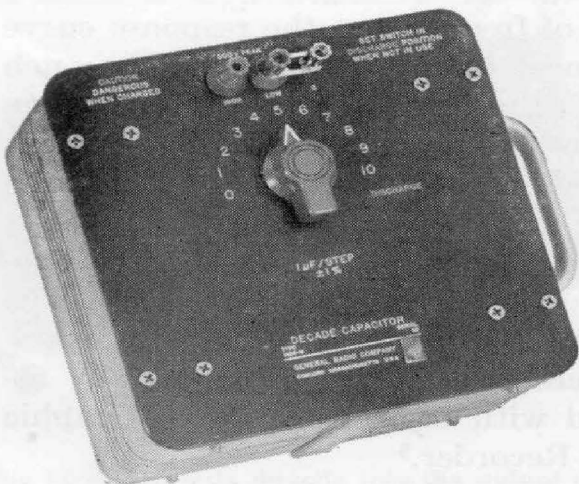
Terminals: Input terminals are recessed banana pins on 3/4-inch spacing at rear of unit. Output terminals are jack-top binding posts with 3/4-inch spacing.

Dimensions: Width 1 3/8, height 5, depth 2 1/8 inches (35 by 127 by 73 mm), over-all.

Net Weight: 5 1/2 ounces (155 g).

Type		Code Word	Price
1390-P2	Pink-Noise Filter.....	FATAL	\$45.00

A 10-MICROFARAD DECADE CAPACITOR



Following the successful introduction of the TYPE 1424-A Standard Polystyrene Decade Capacitor in June 1961,¹ it appeared that many users of a 10-microfarad-total decade might not need its sophisticated performance specifications. Accordingly, another version of this decade capacitor, the TYPE 1424-M, is being introduced, having less rigorous performance specifications and being appreciably lower in price. It is made from twenty 1/2-microfarad sealed foil-

¹P. K. McElroy, "A New 10-Microfarad Capacitance Standard," *General Radio Experimenter*, 35, 6, June, 1961.



paper capacitors, of noninductive or extended-foil construction, employing a viscous impregnant to improve stability with time and position as compared to older types of paper units. Despite the difference in form of the capacitors, the effective internal inductance is about the same as that of the TYPE 1424-A, and

the natural period of the capacitor with the terminals shorted is also essentially the same.

In appearance the TYPE 1424-M Decade Capacitor resembles the TYPE 1424-A; dimensions are the same except for depth, which is $1\frac{3}{4}$ inches less.

— P. K. McELROY

SPECIFICATIONS

Nominal Value: 0 to 10 microfarads, in steps of 1 microfarad.

Adjustment Accuracy: $\pm 1\%$ at 1 kc.

Stability: Change is less than $\pm 0.35\%$ per year.

Frequency: Calibrated at 1 kc. Variation with frequency down to 60 cps is typically less than $+0.7\%$. At higher frequencies, terminal capacitance rises as resonant frequency, f_o , is approached (see curves). The increase can be

calculated from $\frac{\Delta C}{C} = \left(\frac{f}{f_o}\right)^2$. f_o varies from approximately 570 kc at $1 \mu f$ down to 240 kc at $10 \mu f$.

Voltage Recovery: Less than 5%, final, of original charging voltage after a charging period of 1 hour, and a 10-second discharge through a resistance equal to one ohm per volt of charging.

Dissipation Factor: Less than 0.005 at 1 kc. (See curves for variation with frequency.)

Temperature Coefficient: Approximately $+180$ ppm per degree C.

Maximum Operating Temperature: 90 C.

Insulation Resistance: Greater than ten thousand ohm-farads.

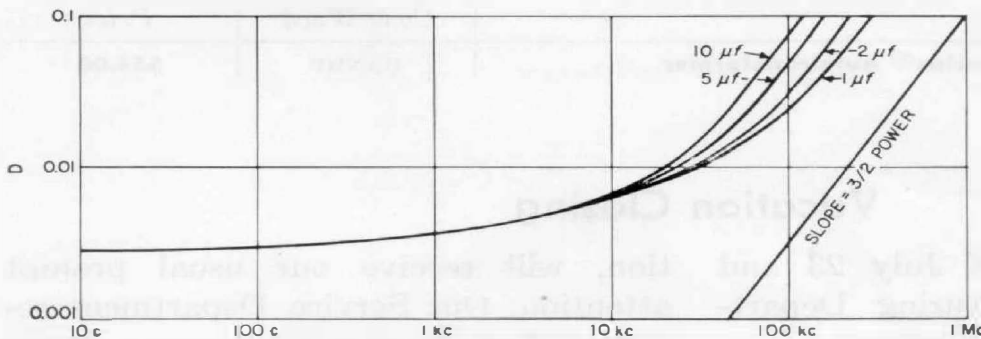
Maximum Voltage: 500 volts peak, up to 2 kc.

Mounting: Aluminum cabinet and panel, finished in gray.

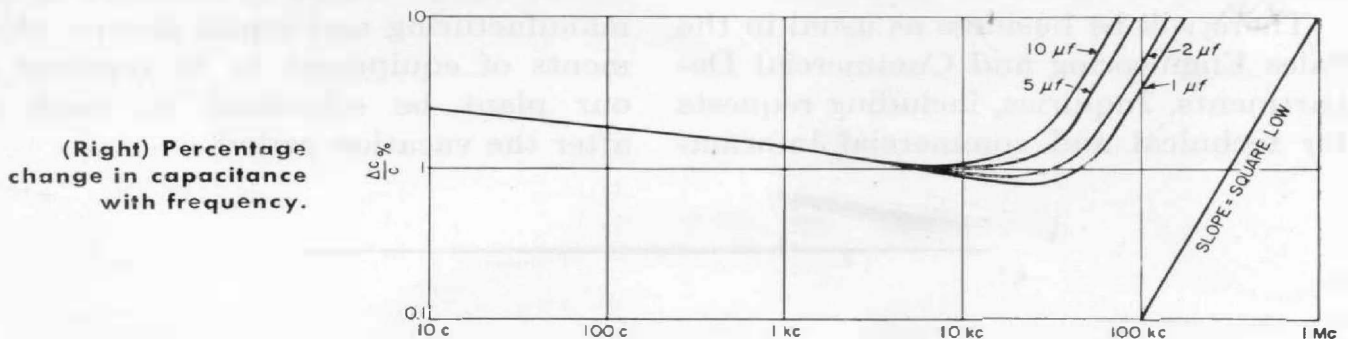
Terminals: A separate ground terminal is provided, permitting 2- or 3-terminal use.

Dimensions: Width 8, height 6, depth $9\frac{1}{2}$ inches (205 by 150 by 240 mm), over-all.

Net Weight: $7\frac{3}{4}$ pounds (3.5 kg).



(Left) Variation in dissipation factor with frequency.



(Right) Percentage change in capacitance with frequency.

Type	Code Word	Price
1424-M	REFER	\$195.00

Decade Capacitor



NEW VARIAC[®] AUTOTRANSFORMER WITH BUILT-IN VOLTMETER



This new VARIAC autotransformer consists of a TYPE W5 VARIAC Auto-transformer and a voltmeter, mounted in a metal case, finished in hammertone gray, with switch, cord, plug, and convenient carrying handle. Line cord and output receptacle are 3-wire types. A double-pole on-off switch disconnects both sides of the input-line. The load circuit is protected by a circuit breaker.

SPECIFICATIONS

Input Volts: 120.
Frequency: 50 to 60 cps.
No-Load Loss: 9 watts.
Output Volts: 0 to 140.
Maximum Load Current: 5 amperes.
Voltmeter Range: 0 to 150 volts.

Terminals: Line, 3-wire cord and plug. Load, 3-wire output receptacle.

Dimensions: (TYPE W5 case) Width 4 $\frac{1}{8}$, height 6 $\frac{5}{8}$, depth 5 $\frac{1}{2}$ inches (125 by 170 by 140 mm), over-all.

Net Weight: 8 $\frac{1}{4}$ pounds (3.8 kg).

Type		Code Word	Price
W5MT3VM	Metered Variac [®] Autotransformer.....	DANDY	\$54.00

U.S. Patent No. 2,949,592.

Vacation Closing

During the weeks of July 23 and July 30, our Manufacturing Departments will be closed for vacation.

There will be business as usual in the Sales Engineering and Commercial Departments. Inquiries, including requests for technical and commercial informa-

tion, will receive our usual prompt attention. Our Service Department requests that, because of absences in the manufacturing and repair groups, shipments of equipment to be repaired at our plant be scheduled to reach us after the vacation period.

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