the GENERAL RADIO Experimenter

Since 1915 — Manufacturers of Electronic Apparatus for Science and Industry

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UNIT R-C OSCILLATOR—20 CYCLES TO 500 KC

Since Van der Pol's pioneering work on R-C oscillator circuits,[1] commercial instruments using various circuit configurations have found widespread use. To the many standard features that have made the R-C oscillator so generally accepted, the new TYPE 1210-B Unit R-C Oscillator adds two new ones — square-wave output and sweepability. Taken in conjunction with those already inherent in R-C circuits, these features make this versatile instrument fully capable of meeting today's exacting standards.

The first of these new features makes possible both low-frequency and high-frequency square-wave tests of transient behavior, and the second permits the recording of frequency characteristics, either on level recorders or on cathode-ray oscillographs. Both of these uses reflect the modern need for reducing time in obtaining data, the first because one measurement yields information about both amplitude and phase characteristics, and the second because automatic data-taking eliminates laborious point-by-point measurements.

The TYPE 1210-B Unit R-C Oscillator is the latest addition to the General Radio line of Unit Instruments. Generating frequencies from 20 cycles to 500 kilocycles, it extends the coverage of the Unit Oscillators to the unbroken

[1] Van der Pol, Balth., "Relaxatietrillingen", *Tijdschr. v. h. Ned. Rad. Gen.*, Vol. 3, 1926, p. 25. Van der Mark, J. and Van der Pol, Balth., "The Production of Sinusoidal Oscillations with a Time Period Determined by a Relaxation Time", *Physica*, 1, April, 1934, pp. 437–448.

Figure 1. Panel view of the Type 1210-B Unit R-C Oscillator and the Type 1203-A Power Supply. The oscillator plugs into the power supply and can be secured to it with a bolt and butterfly nut to form a rigid assembly.

frequency range from 20 cycles to 2000 Mc.[2]

As in other Unit Instruments, standardized cabinet design has led to economy, simplicity of construction, small size and efficient space utilization. The TYPE 1210-B Unit R-C Oscillator is, therefore, inexpensive, economical of laboratory bench space, and handy to use.

Frequency-Determining Circuit

Figure 2 is a simplified schematic diagram. The heart of the oscillator is an *R-C* voltage-divider network with its output amplified and returned to its input. The two equal variable capacitors (C) are mounted on the same shaft and are controlled by a 4-inch dial which spans a little more than a decade in frequency. The deposited-carbon-film-type resistors (R) are equal, and decade frequency ranges are obtained by switching them in pairs. At the operating frequency, the phase shift through the *R-C* network is zero, the output voltage (e_2) is one-third the input voltage (e_1), and the input impedance of the network is slightly more than twice the value of R. At frequencies either side of the operating frequency, the phase shift in the *R-C* network departs from zero, and the attenuation increases. When the amplifier has a gain of three and introduces no phase shift, the circuit oscillates at a frequency inversely proportional to the *R-C* product.

$$f = \frac{1}{2\pi RC}$$

Level Control

To insure that the oscillation level is held constant in spite of changes in frequency and in line voltage, an a-v-c system is used. The speed and nature of its response is very important and, in the TYPE 1210-B Oscillator, this response has been made both rapid and critically damped. To produce the a-v-c voltage, the output from a cathode-follower circuit is rectified and compared with a stabilized reference voltage. The resultant d-c error voltage is then applied to the grid of the amplifier system.

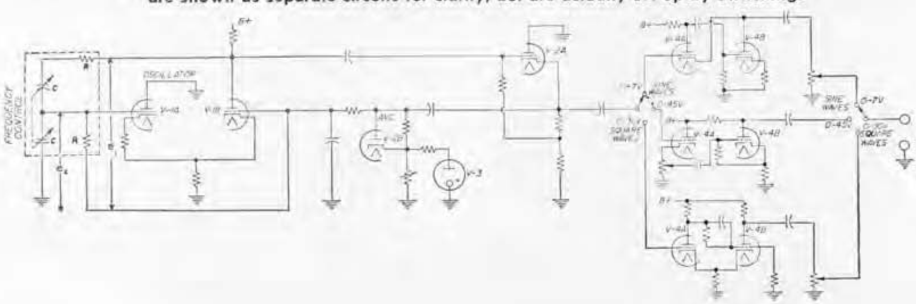
Output

The oscillator provides three different outputs that contribute to its versatility and usefulness. A three-position switch selects any one of the following:

1. *A low-impedance low-voltage output from a cathode-follower type of amplifier.* This output has good waveform over its entire range of 0–7 volts for load impedances of 500 ohms and higher and has an effective output impedance of approximately 50 ohms. The output terminals connect directly to the 5000-ohm output control, which is calibrated in decibels. This calibration is useful

[2] See *General Radio Experimenter* for May, 1950; January, 1953; September, 1953; and February, 1955.

Figure 2. Simplified schematic diagram of Type 1210-B Unit R-C Oscillator. The three output connections are shown as separate circuits for clarity, but are actually set up by switching.



with high-impedance loads and is reliable even at the lowest voltage levels, since the output is less than 3 millivolts when the control is at its extreme counter-clockwise position. Distortion s less than 1% over most of the frequency range.

2. *A high-impedance high-voltage output from a cathode-follower-driven triode amplifier.* This output delivers up to 45 volts open-circuit behind an impedance of 12.5 kilohms. Output impedance is constant, regardless of attenuator setting. Distortion can be as much as 5% on open circuit, but decreases to about 2.5% as the output is shunted down by the load.

3. *A square-wave output from a Schmitt[3] circuit.* This output furnishes square waves of 30-volt peak-to-peak amplitude (open circuit) behind 2500 ohms with 0.25 μsec rise-time and with roughly 1% overshoot. The rise time can be reduced to about 0.15 μsec by loading down the output with a resistance of 1000 ohms.

Output and distortion characteristics are shown in Figure 3.

Power Supply

In Figure 1, the oscillator is shown in combination with the Type 1203-A Unit Power Supply. This combination is satisfactory for all but the most exacting uses, since the a-v-c system incorporated in the oscillator maintains constant output under conditions of fluctuating line voltage. Frequency changes up to ±0.25% for ±10% changes of line voltage can occur at high frequencies, however, and, if these are bothersome, the Type 1201-A Unit Regulated Power Supply[4] can be substituted for the Type 1203-A with an improvement to ±0.1% or better. When the oscillator is to be used in the field, the Type 1202-A Unit Vibrator Power Supply[5] can be used to supply power from a 6-volt or 12-volt storage battery or, in the laboratory, from 115 volts a-c.

Relay-Rack Mounting

When the oscillator is to be permanently mounted in the laboratory, it becomes a rack-mounting instrument in combination with the Type 480-P4U3 Relay-Rack Panel.[6]

[3] Schmitt, O. H., "A Thermionic Trigger," *Jour. Sci. Insts.*, XV, 1, January, 1938, pp. 24–26.

[4] To be announced in a forthcoming edition of the *General Radio Experimenter*.

[5] Bousquet, A. G., "The Unit Vibrator Power Supply", *General Radio Experimenter*, Vol. XXIX, No. 9, February, 1950.

[6] Baldwin, S. P., "Relay-Rack Mounting for Unit Instruments", *General Radio Experimenter*, Vol. XXIX, No. 9, February, 1955.

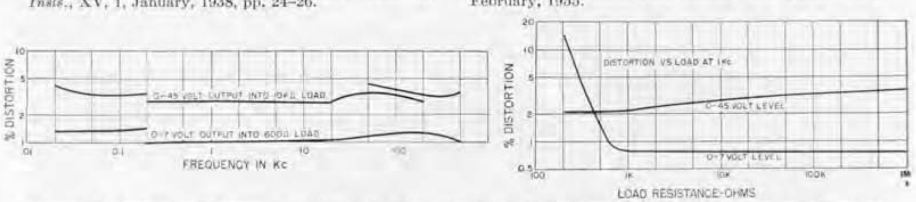
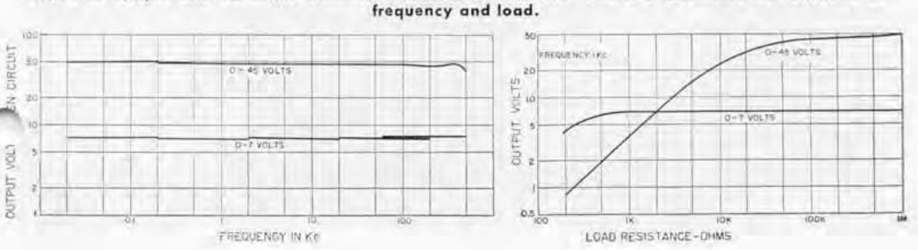


Figure 3. Output and harmonic distortion characteristics of the Unit R-C Oscillator as functions of frequency and load.



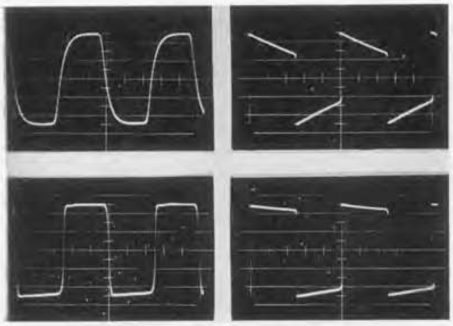


Figure 5. Oscillograms showing the square-wave outputs at extremes of the range of the Type 1210-B Unit R-C Oscillator and Type 1206-B Unit Amplifier. At the left, the lower trace is the square-wave output from the oscillator at 200 kilocycles per second, and the upper trace is the corresponding output from the amplifier. At the right, the lower trace is the 20-cycle square-wave output from the oscillator and the corresponding output from the amplifier above. Note particularly the fast rise time of the output of the Unit R-C Oscillator.

USE WITH OTHER UNIT INSTRUMENTS

1. High-Power Output

The versatility of General Radio Unit Instruments in making available useful combinations is well illustrated by the assembly of the Type 1210-B Unit R-C Oscillator and Type 1206-B Unit Amplifier[7] shown in Figure 4. The frequency range of the Unit Amplifier was established with this application in mind, and the combination constitutes a high-power R-C oscillator at low cost. The frequency characteristic, as indicated by the oscillograms of Figure 5, is adequate not only for sine-wave outputs over the entire frequency range of the Type 1210-B Unit R-C Oscillator but for most square-wave uses as well. At frequencies up to 50 kc, the full 3-watt output of the Type 1206-B can be obtained with low distortion, and, at 500 kc, the available power is still more than 0.1 watt. Within the available-power limits the frequency characteristic is flat within 2 db over the entire frequency range from 20 cycles to 500 kc.

[7] Hall, Henry P., "A Laboratory Amplifier for Audio and Ultrasonic Frequencies", *General Radio Experimenter*, Vol. XXVIII, No. 6, November, 1953.

2. Square-Wave Modulator

The amplitude of the square-wave output of this oscillator is sufficient to modulate the Type 1218-A Unit Oscillator recently announced.[8]

[8] Karplus, Eduard, "A 900-2000 Mc Unit Oscillator", *General Radio Experimenter*, Vol. XXIX, No. 9, February, 1955.

Figure 4. Panel view of Type 1210-B Unit R-C Oscillator and Type 1206-B Unit Amplifier with Type 1203-A Unit Power Supplies. The combination of these instruments delivers up to 3 watts of power with good waveform.

3. Pulse Trigger

The high-level output is sufficient to trigger the Type 1217-A Unit Pulser[9] continuously over a frequency range extending from the lower limit of the oscillator (20 cycles) to the upper limit of the pulser (100 kc).

4. Bridge Generator

The wide frequency range of this oscillator makes it particularly useful as a bridge generator in conjunction with the Type 1212-A Unit Null Detector[10] as the balance indicator.

SWEEP AND RECORDING APPLICATIONS

The frequency range from 20 cycles to 200 kc is covered in four continuous decade bands. A fifth decade band from 50 kc to 500 kc completes the range. The use of the Type 907-LA Precision Dial for the frequency control not only provides high-resolution manual tuning with a slow-motion control, but also the additional features that make possible the conversion of the simple oscillator to a sweep-type instrument.

The dial is gear-driven, with a small pinion mounted on the knob shaft engaging an internal annular gear attached to the tuning shaft. The knob is easily detached, with its shaft and gear, by the removal of two mounting screws, and replaced by the Type 908-P1 or Type 908-P2 Synchronous Dial Drive.[11] These drives are powered by small synchronous motors that automatically reverse when their motion in one direction is stopped mechanically. In combination with mechanical stops they therefore make simple, inexpensive sweep drives to cover pre-set angular

[9] Frank, R. W., "Pulses in a Small Package," *General Radio Experimenter*, XXVIII, 10, March, 1954.

[10] Richmond, Robert B., "Type 1212-A Unit Null Detector", *General Radio Experimenter*, Vol. XXVII, No. 9, February, 1953.

[11] Littlejohn, H. C., "Motor Drives for Precision Dials", *General Radio Experimenter*, Vol. XXIX, No. 6, November, 1954.

Figure 6. Setup for recording the frequency response of a small loudspeaker. The Type 1210-B Unit R-C Oscillator is swept over the frequency range of 2 kc to 20 kc by the Type 908-P1 Dial Drive. The output of the oscillator is amplified by a Type 1206-B Unit Amplifier which drives the loudspeaker. The loudspeaker is mounted in one wall of a small anechoic chamber. With the chamber completely closed, the output of the speaker is picked up by a condenser microphone, shown here as it is being put in place by the operator. This microphone is part of the Type 1551-P1 Condenser Microphone System. The signal from the microphone is amplified by the Sanborn Model 150-1400 Log Audio Preamplifier, shown in the upper right, and recorded on the Sanborn Model 151-100A Recorder Assembly, right front.

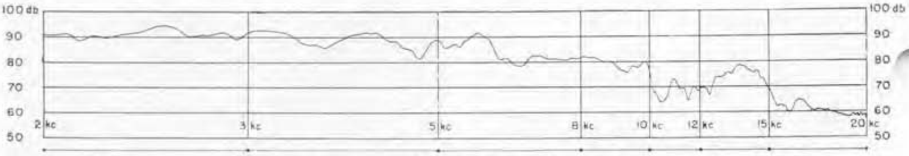


Figure 7. The recording, taken with the setup of Figure 6, showing the frequency response of the small loudspeaker. The chart speed was 5 mm/sec. Both lower and higher speeds are available on this type of recorder.

ranges of the tuning dial at constant speeds determined by the line frequency and their particular gear ratios.

Pen Recorders

Frequency characteristics obtained with sweep generators can be displayed either on pen-type recorders or on cathode-ray oscilloscopes, the method of deriving the horizontal deflection differing for the two types of device.

Pen-type recorders are generally driven horizontally by constant-speed motors, so that information is recorded as a function of time. A mechanical tie from this motor to the sweep-generator tuning shaft supplies synchronization, so that the record becomes, in effect, plotted as a function of frequency.

With the TYPE 908-P1 Synchronous Dial Drive, which has an appropriate speed for a pen-type recorder, the mechanical link between recorder and generator can be eliminated by taking advantage of the constant-speed features of the respective drive systems. The Sanborn Model 151-100A Recorder Assembly,[12] for instance, has a synchronous motor drive. Figure 6 shows the TYPE 1210-B Unit R-C Oscillator and TYPE 908-P1 Synchronous Dial Drive set up with this recorder to take the frequency characteristic of a small loudspeaker.

The gain of the system is first adjusted so that the deflection is adequate and the signal level corresponding to the deflection jibes with the vertical coordinate markings on the recording paper. The recorder is then set in motion and the TYPE 908-P1 Synchronous Dial Drive started at the desired frequency. Marks are made on the recording paper at appropriate frequencies by operation of a pushbutton provided on the recorder for that purpose, as the dial passes these frequencies. The black

[12] Sanborn Company, Cambridge, Mass.

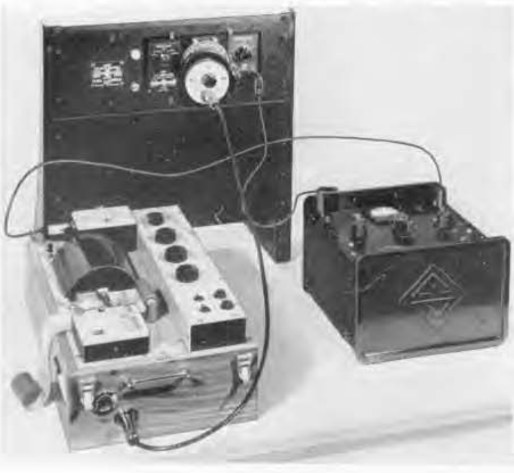


Figure 8. A setup for recording the frequency response of the Type 1550-A Octave-Band Noise Analyzer on the Bruel & Kjaer Model BL-2304 Level Recorder with the Type 1210-B Unit R-C Oscillator applying the signal to the analyzer. The recorder and oscillator are mechanically coupled by the flexible shaft and coupler so that the motor in the recorder drives the chart paper and the frequency control of the oscillator simultaneously. The Type 1210-B Unit R-C Oscillator is shown mounted on a small relay rack with a Type 480-P4U3 Relay-Rack Panel.

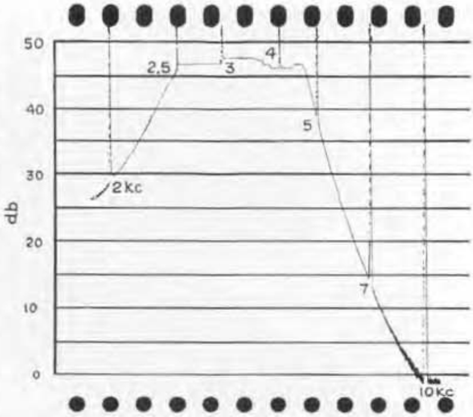


Figure 9. Record taken on the Bruel & Kjaer recorder, with the setup of Figure 8, of the response of one of the filters in the Octave-Band Analyzer. A 50-db recorder range was used to show the filter "skirts". If a detailed record of the response in the pass band were desired, a smaller recorder range could have been used. The record has been given frequency markings by the method provided in the recorder. Since the recorder and the oscillator are mechanically coupled together, only one or two of these need be recorded. Others can be put in according to the scale on the frequency dial of the oscillator, or the chart paper can be printed with a scale corresponding to the dial markings.

dots printed by this means are visible at the bottom of the record of Figure 7, which has had both horizontal and vertical coordinates inked in for clarity. This system provides maximum flexibility, because the generator and recorder need have no particular physical placement with respect to each other and may, in fact, be widely separated.

A more common arrangement is the direct mechanical link illustrated in Figure 8. This picture shows the Bruel and Kjaer Model BL-2304 Level Recorder,[13] with the Model BL-3005 Coupler and Model BL-3003 Flexible Cable recently developed by Bruel and Kjaer to drive a General Radio TYPE 907 or TYPE 908 Precision Dial.

The complete combination with the Unit R-C Oscillator is set up to record the frequency characteristic of one of the filters in the TYPE 1550-A Octave-Band Analyzer. The record itself is shown in Figure 9. This system requires physical proximity of the generator and recorder, but compensates for this lack of flexibility by making possible the starting and stopping of the record without loss of synchronism between generator and recorder.

Cathode-Ray Oscillograph

Probably today's most common device for displaying frequency-dependent phenomena is the cathode-ray oscillograph. Long-persistence phosphors make the cathode-ray oscillograph entirely practical for use with the TYPE

[13] Brush Electronics Company, Cleveland, Ohio.

Figure 10. Combination of Type 1210-P1 Detector and Discriminator with Type 1210-B Unit R-C Oscillator. The Type 1210-P1 can be attached to the right-hand end of the oscillator by similar means to that used to attach the Type 1203-A Unit Power Supply to the left-hand end of the oscillator to form a complete rigid assembly. When it is desired to mount this combination in a relay rack the oscillator and power supply mount in a Type 480-P4U3 Relay-Rack Panel, and the detector unit in a separate Type 480-P4U1 Relay-Rack Panel.

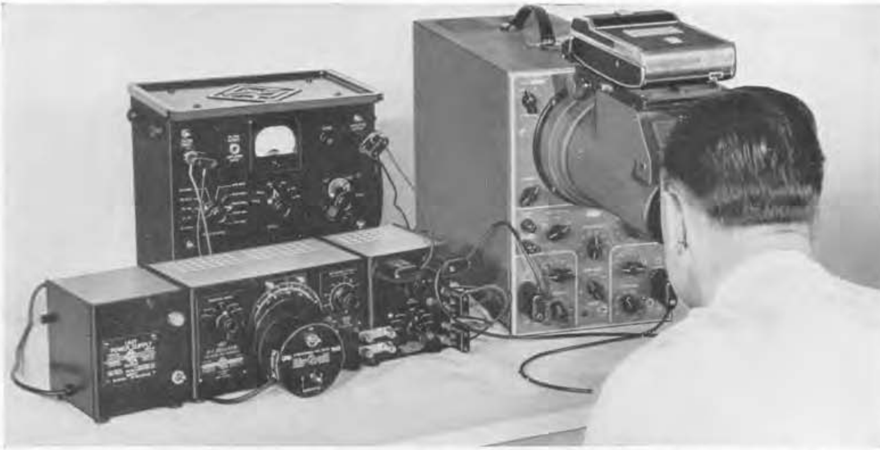


Figure 11. A setup for observing and recording the response of the octave-band analyzer on a DuMont Cathode-Ray Oscillograph. The Type 1210-B Unit R-C Oscillator, which is driven by the 908-P2 Dial Drive, supplies the signal to the analyzer, and the Type 1210-P1 Detector and Discriminator, shown attached to the oscillator, supplies the deflecting voltages to the oscillograph.

1210-B Unit R-C Oscillator and the TYPE 908-P2 Synchronous Dial Drive, which is faster than the TYPE 908-P1 and, therefore, better adapted to cathode-ray work.

With this combination, a discriminator circuit is used to produce a horizontal-deflection voltage proportional to frequency. The TYPE 1210-P1 Detector and Discriminator, shown in Figure 10, incorporates both this discriminator circuit for the horizontal sweep and a detector unit to furnish vertical drive for the oscillograph.

Figure 11 shows a setup using the combination of TYPE 1210-B Unit R-C Oscillator, a TYPE 908-P2 Synchronous Dial Drive, and a TYPE 1210-P1 Detector and Discriminator to display a frequency characteristic on a cathode-ray oscillograph. Figure 12 is a photograph of the oscillograph trace for the same filter as that shown in the record of Figure 9. The difference in shape is attributable to the fact that the vertical

Figure 12. The oscillogram taken with the arrangement of Figure 11, showing the response of one filter of the octave-band analyzer. The vertical deflection is proportional to the output of the filter, and the horizontal deflection is proportional to frequency. The behavior of the response in the pass band is clearly shown. The response in this instance changes so rapidly with frequency that there is an appreciable effect on the trace compared to the steady-state response as indicated in the right-hand picture, which shows the traces for both directions of sweep. This effect can readily be taken into account if measurements for a number of instruments are to be made on the trace, by first checking the response at the critical points for one sample curve.

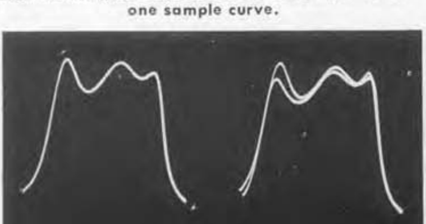
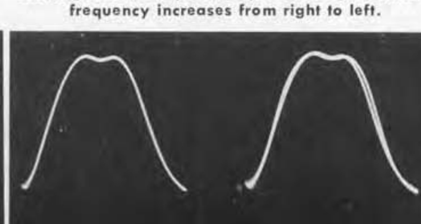


Figure 13. Photographs of a cathode-ray oscillograph display for the response of a tuned i-f stage at 455 kc made with a setup similar to that of Figure 12. The picture at the right shows both traces and illustrates how closely the two traces can be brought into coincidence by the adjustment provided in the Type 1210-P1. Because these four oscillograms were photographed through a mirror, frequency increases from right to left.



deflection in Figure 9 is logarithmic, in Figure 12 linear.

Figure 13 shows a similar curve for a 455 kc i-f transformer. With narrow-band sweeping of this type, the rate of sweep and reversal is fast enough to make possible adjustments without irritating delay in presentation of the resultant changes in characteristics of sharply tuned circuits.

DETECTOR AND DISCRIMINATOR UNIT

Type 1210-P1 Discriminator and Detector is housed in a small unit-instrument cabinet, identical in size with the Unit Power Supply, as shown in Figure 10. No power supply is required.

The circuit that provides the horizontal sweep is shown in the lower part of the elementary schematic diagram of Figure 14 and consists of a balanced diode limiter, a resistance-capacitance discriminator, which has seven different time constants selected by the lower panel switch, a detector, and an adjustable filter at the output. These elements combine to give a d-c output voltage that increases with increasing frequency of the applied signal.

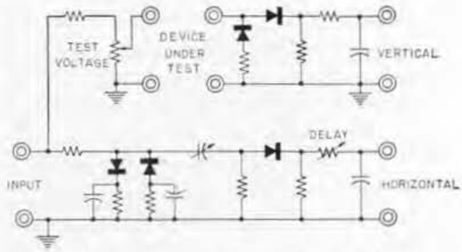
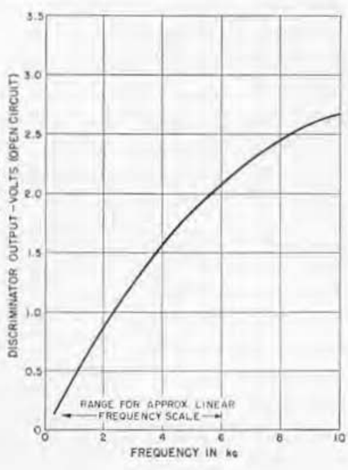
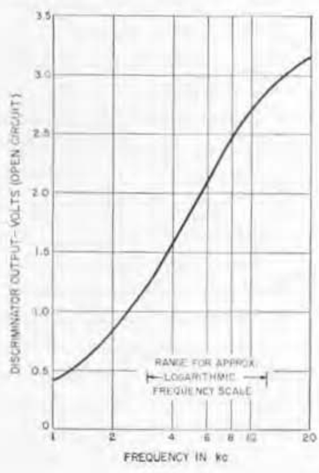


Figure 14. Elementary schematic circuit diagram of the Type 1210-P1 Detector and Discriminator.

The heart of this section is the R-C discriminator, whose a-c output increases as the frequency of the applied signal increases. This output must then be rectified to supply a d-c signal to drive the oscillograph. Reasonably good linearity is obtained over a 10:1 frequency range by using a germanium-junction diode as the rectifier. At the high-frequency end of the range the rectification is improved through the use of a point-contact rectifier in series with the junction rectifier. When the discriminator is operated at frequencies above the values covered in the normal linear range, the output produces an approximately logarithmic frequency scale for a range of 3 to 1 in frequency. This characteristic is obtained when the

Figure 15. Typical plots of the linear (left) and logarithmic (right) response ranges of the discriminator output.





selector switch on the panel is set to the frequency range next lower than that of the oscillator. Typical characteristics for both the linear and the logarithmic ranges are shown in Figure 15.

The limiter acts to reduce the effect of the sudden reversal at the ends of the sweep on the horizontal deflection voltage.

The filter, which is necessary to reduce the a-c component in the detected discriminator voltage, is designed to work down to 200 cps. This lower limit is based on providing a filter that does not seriously affect the sweep voltage but at the same time covers almost the entire range of the oscillator.

The upper part of Figure 14 shows the detector for the output of the network under test. It provides a d-c voltage that is proportional to the a-c output, and a filter is also included to reduce the a-c component of the rectified output. This detector is essentially linear for applied voltages greater than 2 volts, rms, and square law for applied voltages less than 0.5 volt, rms.

Both filter networks affect the signals fed to the oscillograph, because the signals are not really direct-current values. The sweep voltage, for example, is basically a triangularly shaped wave, modified by the filter to have rounded corners. The filter also acts, to a first approximation, to delay the signal, so that the voltage at the oscillograph occurs at a slightly later time than the corresponding voltage produced at the discriminator.

A similar effect occurs in the detector section. The time constants of these two circuits must be carefully balanced against one another so that the go and return traces will lie as accurately as possible upon each other and will not lag or lead to produce a double trace.

By making the two delays the same, one can usually bring the two patterns into good coincidence. Since this delay is dependent on the oscillograph loading of the filter system, an adjustment is included so that the delay can be set to the optimum value for a given test.

An additional effect, encountered in all sweep systems, is important. The instantaneous response of a network to a sweeping signal as it sweeps through a given frequency is not the same as for a steady-state signal of that frequency.[14] For many of the systems that one wishes to display, this effect is, fortunately, either small or can be taken into account. It is most serious when the response of the system under measurement varies rapidly with frequency, and it can be described as a delay and a modification of the response. As a result of this behavior, the response may also be different for the two directions of sweep.

The horizontal-axis amplifier in the oscillograph used with this sweep system should have sufficient sensitivity so that an input of 0.2 volt produces at least 1 cm deflection of the spot. This sensitivity is necessary for displays that cover a relatively narrow frequency range, as for example, receiver i-f systems.

Both the horizontal and vertical-axis amplifiers should be uniform in response from dc up to at least the lower audio-frequency range. There are many cathode-ray oscillographs on the market that meet both this requirement and the sensitivity requirement given above.

—A. G. Bousquet
—A. P. G. Peterson
—D. B. Sinclair

[14] Marique, J., "The Response of RLC Resonant Circuits to EMF of Sawtooth Varying Frequency", *Proceedings Institute of Radio Engineers*, Vol. 40, No. 8, August, 1952, pp. 945–950.

SPECIFICATIONS

Frequency Range: 20 to 500,000 cycles in five ranges, 20-200 cycles, 200-2000 cycles, 2-20 kilocycles, 20-200 kilocycles and 50-500 kilocycles.

Frequency Controls: A range-selection switch and a 4-inch precision gear-driven dial. The frequency dial has two scales, 2-20 and 50-500. The dial is driven by a slow-motion knob that covers each decade in approximately 4½ turns.

Frequency Accuracy: ± 3%.

Output Control: Logarithmic, calibrated 0-50 db.

Output System: A 3-position panel switch selects square-wave output, sine-wave low-impedance output or sine-wave high-impedance output.

Low-Impedance Output: 0-7 volts; constant within ± 1 db up to 200 kilocycles; output impedance, 50 ohms; distortion less than one percent from 200 cycles to 20 kilocycles, no load; less than 1.5% over entire frequency range. With 600-ohm load, at 1 kilocycle, distortion is less than 1.5%. Hum is at least 60 db below output voltage level.

High-Impedance Output: 0-45 volts; constant within ± 1 db from 200 cycles to 200 kilocycles. Distortion, less than 5 percent from 200 cycles to 200 kilocycles at no load and is reduced under load. Output impedance, 12,500 ohms. Hum is at least 50 db below maximum output voltage.

Square-Wave Output: 0-30 volts peak-to-peak; approximately ¼-microsecond rise time; about 1% overshoot; hum is at least 60 db below output voltage level; output impedance, 2500 ohms.

Output Terminals: Two jack-top 274-type binding posts, one grounded to panel.

Tubes: One 6BQ7-A, two 12AU7 and one OB2; all tubes are supplied with the instrument.

Power Supply: The Type 1203-A Unit Power Supply is recommended for operation from a 115-volt, 50-60-cycle power line. The Type 1204-B Unit Variable Power Supply can also be used. The Type 1202-A Unit Vibrator Power Supply is available for operation from either a 6-volt or a 12-volt storage battery or from a 115-volt, 50-60 cycle power line. A matching multi-point connector is supplied for connection to any other adequate supply. Power requirements are 6.3 volts ac or dc at one ampere and 300 volts dc at 50 ma.

Accessories Supplied: Multipoint connector.

Mountings: Black-crackle-finish aluminum panel and sides; aluminum cover finished in clear lacquer. Accessory panel is available for relay-rack mounting; see price list below.

Dimensions: (width) 10½ × (height) 5¾ × (depth) 7 inches over-all.

Net Weight: 6¼ pounds.

Type		*Code Word*	*Price*
1210-B	Unit R-C Oscillator	ABAFT	$140.00
1203-A	Unit Power Supply	ALIVE	40.00
1210-P1	Detector and Discriminator	DUDAD	75.00
480-P4U3	Relay-Rack Panel	UNIPANCART	12.50
480-P4U1	Relay-Rack Panel	UNIPANARCH	12.50
1206-B	Unit Amplifier	ARBOR	85.00
908-P1	Synchronous Dial Drive	SYNDO	27.50
908-P2	Synchronous Dial Drive	SYNKA	27.50

RECORDER COUPLING FOR PRECISION DIALS

In the previous article, mention is made of a means for coupling the Bruel and Kjaer Model BL-2304 Level Recorder to General Radio Type 907 and Type 908 Gear Drive Precision Dials. The Model BL-3005 Coupler and the Model BL-3003 Flexible Cable[1] have been developed by Bruel and Kjaer for use with General Radio instruments that are equipped with these dials. Figure 1 shows this coupling system attached to the General Radio Type 1304-B Beat-Frequency Audio Generator.[2]

With the setup shown, the speed of driving the frequency-control of the oscillator is selected by one set of gears in the recorder, and the speed of the recording paper is separately selected by the gear-shift mechanism on the recorder. By selecting a shaft speed of 7.5 rpm and a paper speed of 1 mm/

[1] The recorder and the attachments are available from the Brush Electronics Company, 3405 Perkins Avenue, Cleveland 14, Ohio.

[2] Woodward, C. A., "The Type 1304-B Beat-Frequency Audio Generator", *General Radio Experimenter*, Vol. XXIX, No. 1, June 1954, pp. 1-6.

Figure 1. View of the General Radio Beat-Frequency Audio Generator coupled to the Bruel and Kjaer Model BL-2304 Level Recorder by means of the new coupler and flexible cable.

second, one can use, in the recorder, BL-3602 Chart Paper, which has the correctly spaced logarithmic frequency scale for the Audio Generator already printed on it. A number of multiples of these speeds are also available, if it is desired to cover the frequency range at a faster or slower rate.

The coupling device includes a friction clutch so that the knob visible on the front can be used to override the drive and to set the dial to the desired point. The clutch also eliminates the possibility of damage when the drive is in motion as the dial hits a stop.

Because of the ability of the beat-frequency type of oscillator to scan rapidly frequencies from 20 to 20,000 cycles, the combination shown in Figure 1 is particularly valuable for studying such devices as audio-frequency networks, transducers, filters, amplifiers, and preamplifiers.

The very versatile Type 1303-A Two-Signal Audio Generator can also be used in such a setup, and the line of General Radio Unit Oscillators covering the frequency range from 20 cycles to 2000 Mc can also be driven by the recorder through the coupling means now available. For the higher frequency units, the signal must be rectified before recording because the recorder will work directly with signals only up to 200 kc. When these Unit Oscillators are used, it will also be generally desirable to use the TYPE 1263-A Amplitude-Regulating Power Supply [3] to maintain a constant signal level at the input of the device under test.

[3] Karplus, E., and Byers, W. F., "A New System for Automatic Data Display", *General Radio Experimenter*, Vol. XXIX, No. 11, April 1955, pp. 6–9.

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