the GENERAL RADIO Experimenter

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A 900–2000 Mc UNIT OSCILLATOR

With the addition of the new TYPE 1218-A Unit Oscillator, the series of GR Unit Oscillators shown in Figure 2 now covers the frequency range from 0.5-2000 Mc. The lowest-frequency unit has two frequency ranges, the others have only one. They all are simple triode oscillators with output adjustable from a low value to about 200 milliwatts. The oscillators are well shielded for use in the measurement laboratory to drive bridges, slotted lines, and other impedance-measuring equipment, and as power sources in general testing and measurement systems. Heater and plate power can be obtained from any available power source but ordinarily one of the small GR Unit Power Supplies will be used. The new oscillator covers the frequency range of 900 to 2000 megacycles, used mostly for aircraft navigation and marine services.

Tube

The oscillator tube used in the Type 1218-A 900–2000 Mc Unit Oscillator is the 5675-type pencil triode shown in Figure 3. This tube has small internal electrodes of conventional cylindrical design, but grid connections are brought out to a large circumferential terminal which requires disc seal construction. The cylindrical plate, grid and cathode electrodes are all located on the plate side of the grid disc, and tuning between plate and grid is possible with a quarter-wave line section at frequencies as high as 2000 Mc. At the same frequency a ¾ wave-length section is required to tune between grid and cathode.

Tuning Elements

Since the high Q of the short coaxial grid plate line determines performance and stability of the oscillator, the longer grid cathode line has been coiled up in a 3½″ diameter circle to save space. It is housed in a shallow cylindrical compartment, which is shown in Figure 4 with the shield cover removed. The mechanical design of the oscillator is

Figure 1. View of the Type 1218-A Unit Oscillator.

Also
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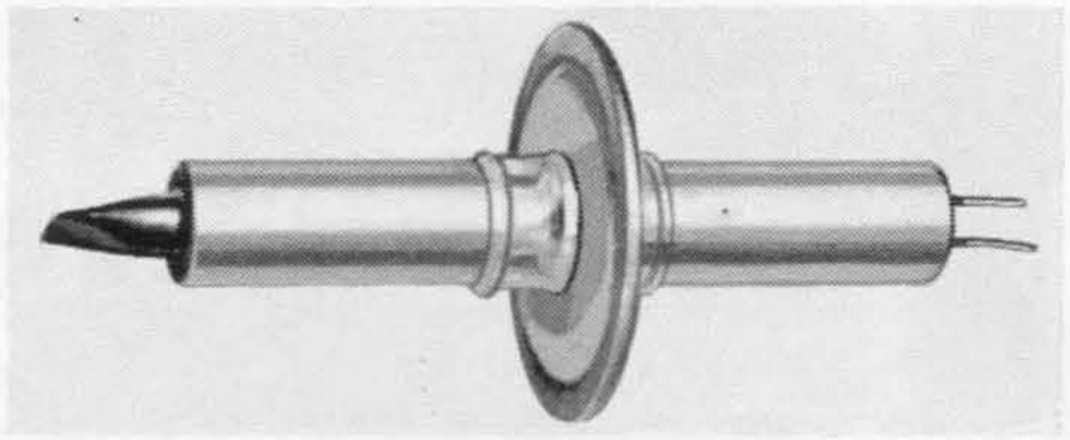


Figure 3. The 5675-type pencil tube used in the Type 1218-A Unit Oscillator.

determined by this construction, which requires a linear motion for plate tuning and a rotational motion for the cathode in a plane perpendicular to the plate line. Of equal importance for the final design was the decision to use sliding contacts in the two tuned circuits. With the new materials and methods now available, reliable sliding contacts can be produced, and f-m noise due to vibration and microphonics is lower in contact-type circuits than in circuits that have closely spaced parts to produce wide frequency ranges.

Output Coupling

A current maximum at all frequencies occurs only at the point of the movable short-circuit in the grid-plate quarter-wave line. Coupling to the load is accomplished at this point, and means are provided for adjusting the coupling in the movable plunger.

Drive Mechanism

The complete oscillator is shown in Figure 1. Like all other Unit Oscillators, it consists of a casting with large round shields and an L-shaped bracket that carries the frequency dial. The TYPE 874 Output Connector and a knob for fine tuning are located on top of the casting. Figure 4 and Figure 5 show how some of the mechanical problems have been solved. The ¼″ wide berillium copper band and the rack and pinion visible in Figure 5 provide the linkage between the main frequency dial, which is rotated through 200° by 8 turns of the vernier dial, the short-circuit plunger of the plate grid line, which moves linearly by 1¾″, and the contact arm on the grid cathode line which rotates 200°. With these drives the oscillator can be tuned to audio beats.

Power Supply

Like all other Unit Oscillators, the new TYPE 1218-A works best from a 300-volt power supply with about one half this voltage on the plate of the oscillator tube. The large plate series resistor required for this operation helps to stabilize the oscillator and protects the tube from overloads. To avoid complications in the r-f output circuit, the B supply is grounded at the plate potential of the oscillator tube. To reduce undesirable fm when commonly available 6.3 volt a-c heater power is used, a rectifier and filter for the cathode heater voltage have been included.

Figure 2. Group of Unit Oscillators covering a frequency range of 0.5 to 2000 megacycles. The lengths of the bars in front of the units indicate their frequency coverage on a logarithmic scale.

OPERATING CONSIDERATIONS

Several modes of operation which have not been possible on previous Unit Oscillators have been provided. A 3-position switch selects the desired operation, and allows the application of external control or modulating voltages at a telephone jack. Schematic diagrams corresponding to the switch positions are shown in Figure 6.

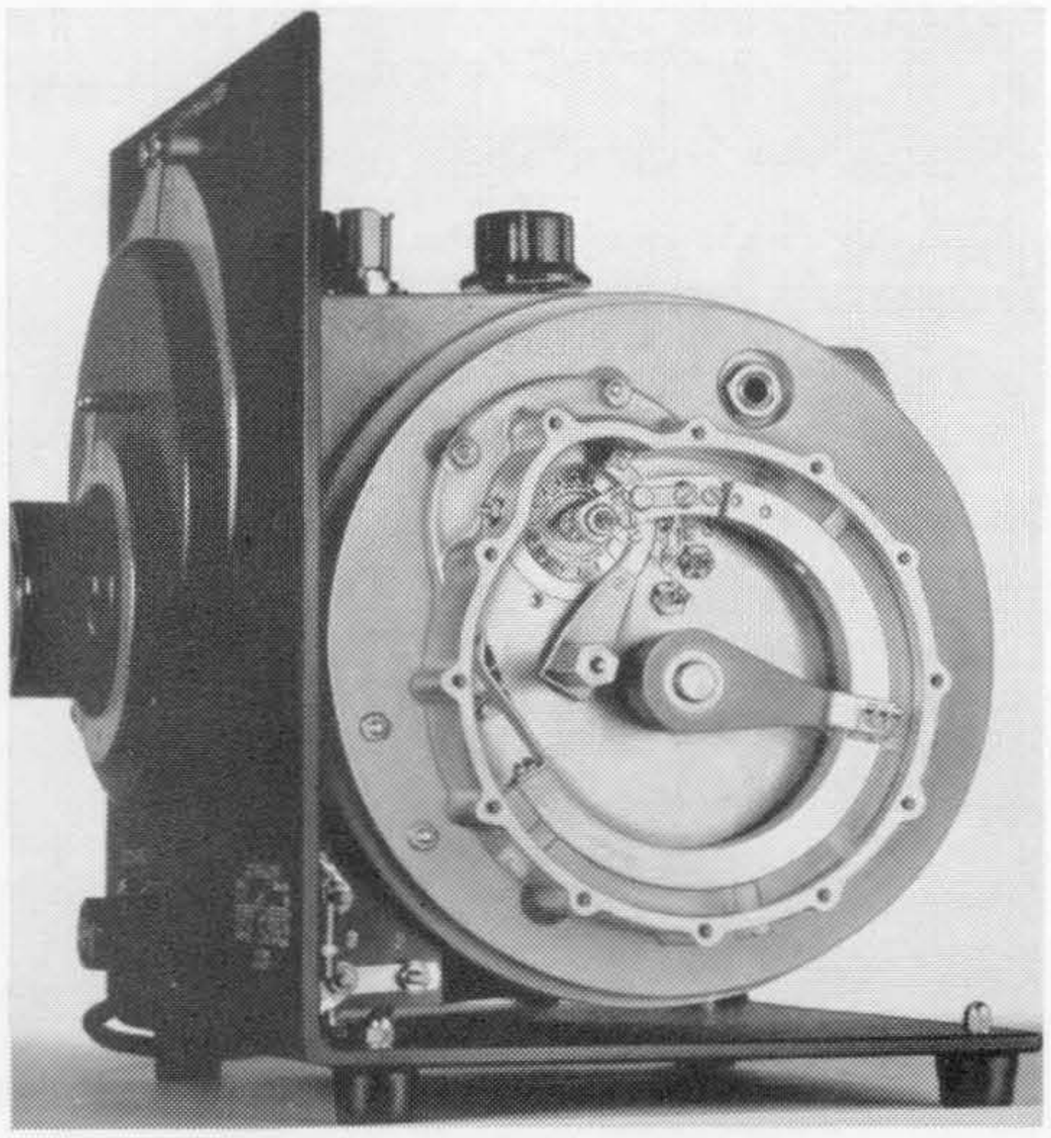


Figure 4. View of the right-hand end of the oscillator assembly with cover removed to show the cathode line.

Normal Operation

Normal operation is obtained in the first switch position labeled CW. Figure 6a shows that the plate circuit can be opened at the ground point by plugging in at the panel jack and that a control voltage can be inserted in series with the plate voltage. As with all other Unit Oscillators, audio voltage can be applied here to obtain sinusoidal amplitude modulation to allow the use of high-gain audio amplifiers after an r-f detector.

No control voltage is required for CW operation, unless it is desired to change the amplitude or to hold the oscillator output constant as the frequency is varied. To accomplish this, a voltage derived from an output monitor can be inserted at the panel jack. While a feedback system of this sort can be set up using the 874-VR Voltmeter Rectifier and an amplifier, automatic output control is so useful and almost indispensable for some applications, that an amplitude-regulating power supply has been developed for this purpose and will be announced in a few months.

Square-Wave Modulation

Amplitude modulation, obtained by superimposing a-c voltages on the d-c plate voltage of the oscillator tube, introduces undesirable frequency modulation, which increases rapidly with carrier frequency. Square-wave modulation that turns the oscillator on and off eliminates this difficulty. Ordinarily considerable square-wave power is required to turn the oscillator off completely or to give large output if the d-c plate voltage is eliminated. To obtain satisfactory operation with low power, the circuit is changed in the SQUARE WAVE position of the selector switch as shown in Figure 6b. A large resistor is inserted in the grid circuit, which makes the oscillator un-

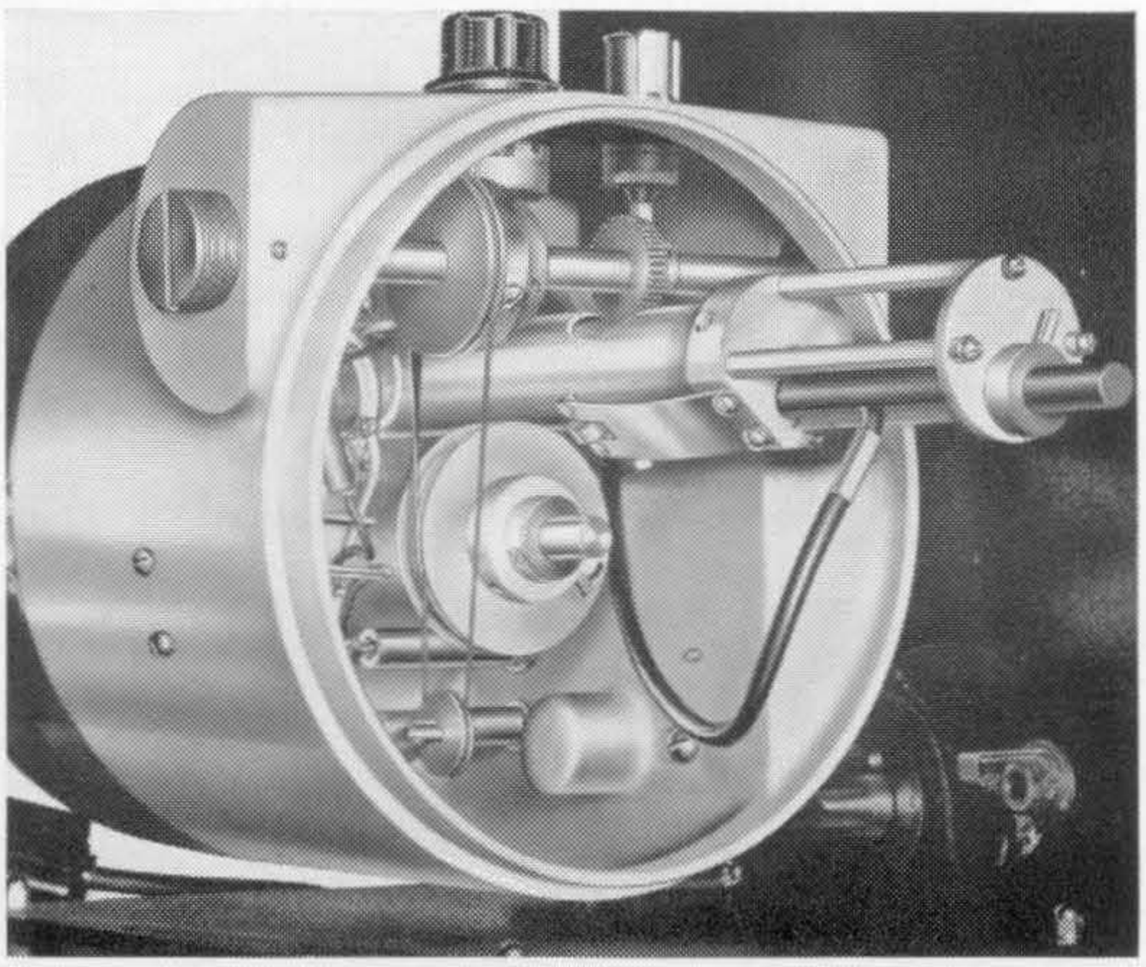


Figure 5. View of the left-hand end of the oscillator casting with cover removed showing the drive mechanism.

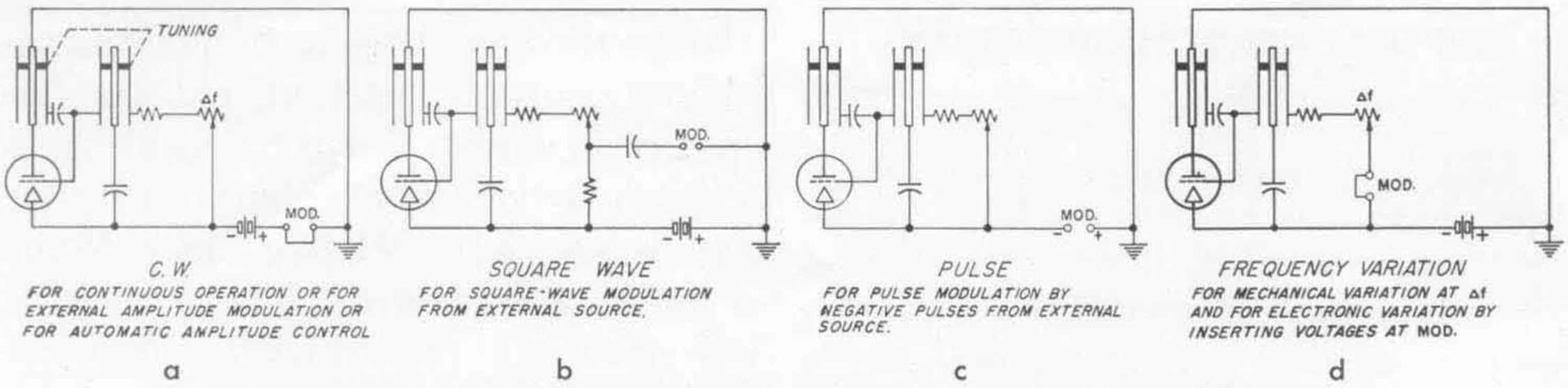


Figure 6. Schematic diagrams of oscillator for various modulation conditions.

stable so that it can be triggered with relatively low power. Good square-wave modulation from about 100 to 5000 cycles can be obtained, with square wave input as shown in Figure 7. Figure 8 shows the output produced if sine waves are applied in the SQUARE WAVE position of the selector switch.

Pulse Modulation

For pulse modulation, the d-c plate supply is removed in the PULSE position of the selector switch, and pulses are applied to the cathode. This circuit is shown in Figure 6c. For full output, 150 volts are required. The build-up time of this Unit Oscillator varies from about 3 to 10 microseconds, depending on carrier frequency and load. The decay time is of the order of 0.5 microseconds. While this performance is not adequate to reproduce faithfully short pulses, it is possible to obtain reasonably good output pulses down to about 1 microsecond. If a monitoring scope is available, the input pulse can be adjusted to equal the observed rise time and the desired pulse length. Characteristic 1 and 5-microsecond output pulses, obtained with input pulses of 6 and 10 microseconds, at 1500 Mc, are shown in Figures 9 and 10. A Type 1217-A Unit Pulser with a suitable amplifier was used as the modulating source.

Frequency Increments

Small frequency variations, of the order of 20 kc to 100 kc, can be obtained by varying mechanically the resistance in the grid circuit. The 1000-ohm resistor, Δ f, at the top of the main casting, has been provided for this purpose. In series with this variable resistor is a fixed resistor of 2000 ohms and a telephone jack that is normally closed. This circuit is shown in Figure 6d. Increasing the grid circuit resistance beyond 3000 ohms tends to make the oscillator unstable, but bias voltages with low internal impedance can be introduced at the telephone jack to change the frequency by about 0.1%. Since both sides of the bias voltage are high against ground, the modulator jack on the front panel cannot be used for this purpose, and a second jack, shown in Figure 4, has been provided. The circuit can be used for electronic frequency control in

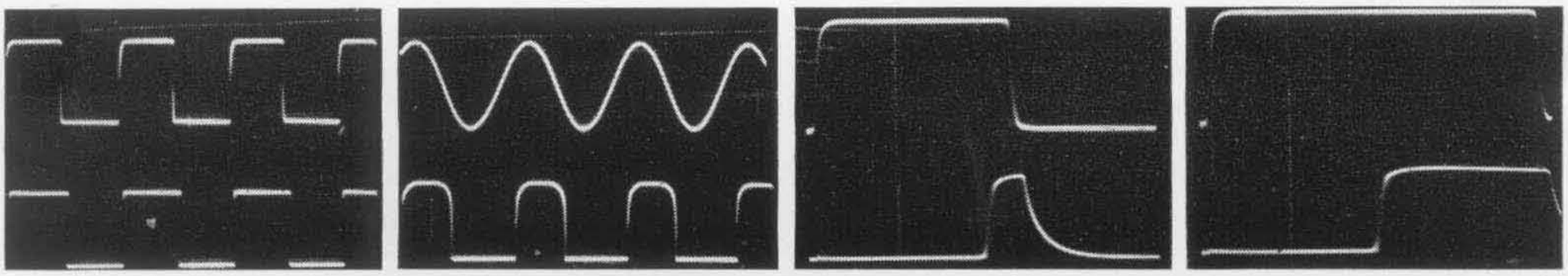
Oscillograms of modulation waveforms. Repetition rate is 1000 cycles per second. Upper trace is the input waveform; lower trace the output.

Figure 7. Square-wave modulation. The rise and fall time is faster in the r-f output than in the input.

Figure 8. Sine-wave input, square-wave output.

Figure 9. 6μsec input pulse, 1μsec output pulse.

Figure 10. 10μsec input pulse, 5μsec output pulse.



a closed-loop system as well as for frequency modulation.

ACCESSORIES

The TYPE 1218-A Unit Oscillator is well suited for use as a generator in measurements with the TYPE 1602-B Admittance Meter and the Type 874-LBA Slotted Line. In conjunction with the TYPE 874-MR Mixer Rectifier and the TYPE 1216-A Unit I-F Amplifier, it functions as the heterodyning oscillator in a u-h-f detector assembly. With the addition of a TYPE 874-GA Adjustable Attenuator and the Type 874-VR, -VI Voltmeter, the oscillator becomes a standard-signal generator.

Amplitude modulation to 100% with negligible fm, and pulsing with a high degree of carrier suppression can be obtained with the TYPE 1000-P7 Balanced Modulator. In addition, the extensive line of General Radio TYPE 874 Coaxial Elements is available for adapting the oscillator to other uses in the laboratory. — EDUARD KARPLUS

SPECIFICATIONS

Frequency Range: 900–2000 Mc.

Frequency Control: 6″ dial with direct reading frequency calibration over 200°. Slow motion drive, 8 turns.

Frequency Calibration Accuracy: ± 1%.

Frequency Drift: Approximately 0.1% per day.

Output Power: At least 200 milliwatts into a 50-ohm load. Maximum power can be delivered to load impedances normally encountered in coaxial systems.

Output Connector: TYPE 874 Coaxial Connector; adaptors to other types of coaxial connectors are available.

Modulation: Sinusodial amplitude modulation in the plate circuit; automatic output control with amplitude-regulating power supply; square-wave modulation in the grid circuit; pulse modulation in the plate circuit; frequency variation in the grid circuit. For general use, square-wave modulation is recommended.

Power Supply Required: 300 v, 30 ma, d c; 6.3 v, 0.135 a, a c or d c. TYPE 1203-A Unit Power Supply is recommended for operation from 50-to-60-cycle power line of 115 volts. TYPE 1202-A Unit Vibrator Power Supply is recommended for operation from a 6 or 12-volt storage battery.

Tube: TYPE 5675 UHF triode.

Mounting: The oscillator is housed in an aluminum casting and is shielded with two spun-aluminum covers. The assembly is mounted on an L-shaped panel and chassis finished in black crackle lacquer. TYPE 480-P7U1 adaptor panel is available to mount the oscillator in a relay rack. See page 8.

Accessories Supplied: TYPE 874-R22 Patch Cord, TYPE 874-C Cable Connector, TYPE 874-PB Panel Connector, multipoint connector, and telephone plug.

Accessories Available: Unit Power Supplies; Unit Oscillators and Unit Pulser for modulation; TYPE 1000-P7 Balanced Modulator; TYPE 874 Coaxial Elements, including adaptors, attenuators, volt-meters, filters, mixers, and lines. See the General Radio catalog and recent issues of the EXPERIMENTER for details.

Dimensions: Width, 12½ × height, 10⅜ × depth, 9½ inches overall.

Net Weight: 14¾ pounds.

Type		*Code Word*	*Price*
1218-A	**Unit Oscillator**	CARRY	**$465.00**

U. S. Patent Nos. 2,125,816 and 2,548,437.

NEW ADAPTABILITY FOR UNIT INSTRUMENTS

General Radio Unit Instruments are rapidly becoming recognized as a convenient and inexpensive solution to the problem of equipping the electronics laboratory with basic measuring equipment—power supplies, generators, amplifiers and detectors. They are particularly useful in the educational laboratory, because they can be assembled like building blocks into combinations for particular purposes, thus giving the student an understanding of the elements of which more specialized instruments are composed, while their modest prices provide a welcome relief to the strain on the departmental budget.

For the industrial organization, Unit Instruments perform reliably and at low cost many of the everyday jobs of the electronic engineering laboratory, and their simplicity of operation combined with compact construction makes them equally well suited for many production tests.

Two new developments, described on the following pages, bring to the Unit line a still greater flexibility of application. The Type 1202-A Unit Vibrator Power Supply, operating from batteries, provides power for Unit Instruments in the field, where a-c power lines are not available; and the Type 480 Panels permit permanent installation on relay racks in the laboratory.