

**Accessories Supplied:**

- 1 TYPE 874-R20 3-foot Coaxial Cable (50  $\Omega$ )
- 1 TYPE 874-C Coaxial Cable Connector
- 1 TYPE CAP-35 Power Cord

**Other Accessories Available:** Not supplied, but available on order are TYPE 874-GF 20 db Attenuator Pad, TYPE 874-GG 10 db Attenuator Pad, TYPE 874-K Coupling Capacitor, and TYPE 1000-P6 Crystal Modulator.

**Mounting:** The aluminum cabinet has a black wrinkle finish. The left-hand side houses the TYPE 1021-P1 Power Supply; the right-hand side houses the TYPE 1021-P2 U-H-F Unit. Panels are black crackle-finished aluminum.

**Dimensions:** (Height) 14 $\frac{3}{8}$  x (width) 20 $\frac{1}{4}$  x (depth) 10 $\frac{9}{16}$  inches, overall.

**Net Weight:** 34 pounds.

**Type 1021-AV V-H-F Standard-Signal Generator**

Same as TYPE 1021-AU (above) except as noted.

**Carrier Frequency Range:** 50 Mc to 250 Mc in one band.

**Incidental Frequency Modulation:** For 50% amplitude modulation the incidental fm is approximately 100 parts per million for frequencies up to 100 Mc, and is approximately 500 parts per million at 250 Mc. When lower values of inci-

dental fm are required, the TYPE 1000-P6 Crystal Modulator or the TYPE 1023-A Amplitude Modulator is recommended.

**Tubes:** Supplied with the instrument:

- 1 GE 12AT7 (Oscillator)
- Other tubes as listed above.

**Net Weight:** 36 pounds.

Type		Code Word	Price
1021-AU	U-H-F Standard-Signal Generator, 250-920 Mc* . . . . .	EVADE	\$615.00
1021-AV	V-H-F Standard-Signal Generator, 50-250 Mc* . . . . .	EVENT	595.00
1021-P2	U-H-F Oscillator Unit only, 250-920 Mc* . . . . .	ETHIC	420.00
1021-P3	V-H-F Oscillator Unit only, 50-250 Mc* . . . . .	EVOKE	400.00

\*U. S. Patent No. 2,125,816; also Patent Applied For.

## AN AMPLITUDE MODULATOR FOR VIDEO FREQUENCIES

The TYPE 1000-P6 Crystal Diode Modulator is a small, convenient device for amplitude modulating the output of a radio-frequency source. With standard-signal generators it modulates the radio-frequency signal at normal attenuator output levels, and, because it is isolated from the oscillator by an attenuator, reaction on the oscillator frequency, or incidental fm, is usually completely negligible.

The crystal diode modulator is designed for wide-band modulation, 0 to 5 megacycles, at carrier frequencies between 20 and 1000 megacycles. Hence

it is particularly useful in testing television receivers, whether in the laboratory, in production, or in the service shop. It converts a conventional standard-signal generator or oscillator to a useful test-signal generator for television receivers, and its range covers both the currently used bands and the proposed new u-h-f bands, as well as receiver intermediate frequencies.

This modulator is also useful with other types of receivers operating within its carrier-frequency range, for a-m tests where the incidental fm that is inherent in a directly modulated oscillator cannot be tolerated.

As shown in Figure 2, the TYPE 1000-P6 Crystal Diode Modulator consists of a crystal diode between input and output terminals, a simple output filter to

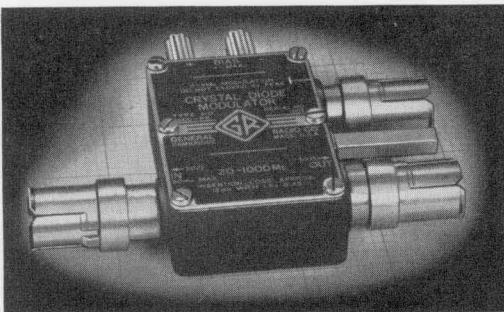


Figure 1. View of the Type 1000-P6 Crystal Diode Modulator.

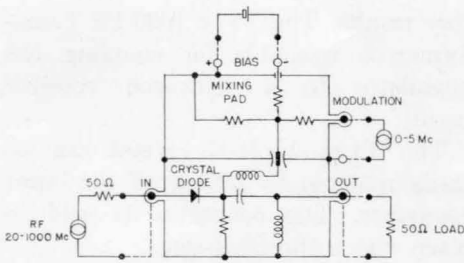


Figure 2. Circuit of the modulator.

prevent appreciable modulating voltage appearing in the output, and a means of isolating and applying modulating and bias voltages. Since the resistance of the crystal diode is a function of the voltage across it, this resistance can be modulated by applying a varying voltage. This unit, therefore, when inserted in series with a radio-frequency generator and its load, will produce amplitude modulation.

The modulator has been designed to operate between 50-ohm source and load impedances. The r-f source impedance must be low, not only at the carrier frequency but also at the modulating frequency and dc, in order that the modulation and bias will be properly applied to the crystal. The use of 50-ohm, 10- or 20-db, resistive pads<sup>1</sup> at the input and output of the modulator will make its characteristics relatively independent of the source and load impedance and, in addition, the combination will present an essentially constant impedance to the source and load. 20-db pads are preferable if the attenuation can be tolerated.

The maximum r-f input voltage should be limited to about 50 millivolts behind 50 ohms to avoid serious carrier and modulation distortion. Below this level, the percentage modulation is practically

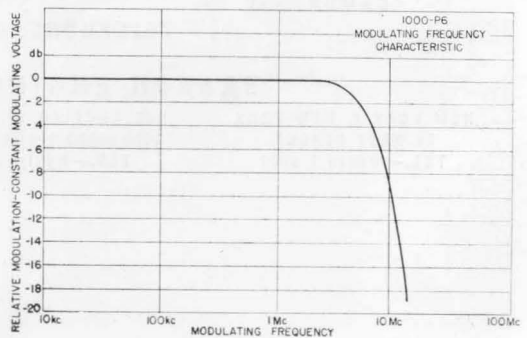
<sup>1</sup>Such as General Radio TYPE 874-GF Fixed Attenuator (20 db) or TYPE 874-GG Fixed Attenuator (10 db).

Figure 3. Modulating frequency characteristic.

independent of the radio frequency applied so that any desired attenuation can be introduced ahead of the modulator.

For sine-wave modulation, bias can be applied by connecting a 1.5-volt battery to the bias terminals. This reduces the crystal resistance from the high unbiased condition to a value that is approximately in the center of the characteristic of an average crystal. Increasing the bias increases the output. If means are available for observing the modulation characteristic, some improvement may be had by adjusting the bias for optimum results. With an asymmetrical modulating signal, an adjustable bias supply is recommended if the maximum capabilities of the modulator are to be obtained. Since dc can also be applied through the modulation terminals, the bias may be included as part of the modulating voltage. If no bias at all is applied, the modulator will function on the negative cycles of the modulating voltage to produce a chopped output. Of course, no bias is necessary if the applied modulation consists only of negative pulses.

A suitable source of television video signals for test purposes is a standard television receiver tuned to a local television station. The output can be taken from the plate circuit of the last video amplifier by means of a large coupling capacitor and a suitably compensated voltage divider. The polarity of the video signal obtained at this point is





correct for applying to the modulator, and a large voltage division is possible, permitting a minimum disturbance of the receiver circuit conditions. The exact modulating and bias voltages required are best determined experimentally. A 60:1 voltage divider at the output of the television receiver supplying the video signal has been found to give satisfac-

tory results. The TYPE 1000-P5 Transformer is available for coupling the modulator to a television receiver input.

The TYPE 1N21-B crystal can be easily replaced by taking off the input connector. The connector is held in place with a threaded ring.

—W. F. BYERS

SPECIFICATIONS

**Carrier Frequency Range:** 20 to 1000 megacycles. The insertion loss increases approximately 10 db at a carrier frequency of 10 megacycles due to output filter.

**Modulating Frequency Range:** 0 to 5 megacycles. Response is approximately 2 db down at 5 megacycles with a gradual roll-off to prevent serious phase distortion of video signals.

**Impedance:** The impedance looking into either the input or output terminals is a function of the bias and modulating voltages. This unit was designed for use with a 50-ohm source and a 50-ohm load. The impedance at the modulation terminals is approximately 600 ohms.

**Modulation:** With no greater than 50 millivolts r-f input, 30% amplitude modulation can be obtained at carrier frequencies between 20 and 1000 Mc. For optimum sine-wave modulation, an average crystal requires 1.5 volts at the bias terminal. The insertion loss under these conditions is approximately 12 db, and approximately 0.2 volt r-m-s at the modulation terminals will produce 30% modulation. Maximum percentage modulation is an inverse function of carrier frequency, and at 1000 megacycles is limited to about 30%. Peak modulation voltage

with respect to ground should not exceed 4 volts.

**Terminals:** The radio-frequency and modulating terminals are provided with TYPE 874 Coaxial Connectors. The modulation terminals will accept either a TYPE 874 Coaxial Connector or a TYPE 274-M Plug.

**Crystal Diode:** 1N21B.

**Accessories Supplied:** One TYPE 274-M Plug.

**Other Accessories Required:** Terminal adaptors, unless generator and load are equipped with TYPE 874 Coaxial Connectors; 1.5-volt battery for fixed bias, or a 3-volt battery and a 10,000-ohm rheostat for adjustable bias.

**Accessories Available:**

- TYPE 874-GF Fixed Attenuator, 20 db
  - TYPE 874-GG Fixed Attenuator, 10 db
  - TYPE 874-R20 Patch Cord
  - TYPE 1000-P5 V-H-F Transformer
- (For descriptions and prices, see *Experimenter*, Nov. '49 and Jan. '50.)

**Dimensions:** (Width) 5 x (height) 4 x (depth) 1 1/16 inches, overall.

**Net Weight:** 1 pound.

Type	Code Word	Price
1000-P6   Crystal Diode Modulator*	APPLE	\$35.00

\*U. S. Patent No. 2,125,816; also Patent Applied For.

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