OPERATING INSTRUCTIONS

TYPE 874-MR
RECTIFIER MIXER

1. PURPOSE. The Type 874-MR Mixer Rectifier can be used as the first detector in a heterodyne frequency converter to permit an amplifier or radio receiver to serve as a uhf detector. With a suitable local oscillator and low-frequency receiver or i-f amplifier the mixer rectifier provides means of detecting signals up to 7000 Mc.

2. DESCRIPTION. The Type 874-MR Mixer Rectifier consists of a short coaxial line with a 250-ohm series resistor and a crystal rectifier, terminated in a low-pass filter with a cut-off frequency of 40 Mc. (See Figure 1.) The output of a local oscillator is applied to the Type 1N21-B crystal diode through the 250-ohm resistor, while the signal to be detected is applied directly to the diode. The 250-ohm resistor insures that the impedance presented to the signal will always be reasonably high. The high-frequency signal is heterodyned down to 30 Mc or less and amplified by a radio receiver or i-f amplifier.

3. LOCAL OSCILLATOR. Recommended oscillators are the following:

Oscillator	Frequency Range
Type 1208-B Unit Oscillator	65-500 Mc
Type 1209-B Unit Oscillator	250-920 Mc
Type 1209-BL Unit Oscillator	180-600 Mc
Type 1215-B Unit Oscillator	50-250 Mc
Type 1218-A Unit Oscillator	900-2000 Mc
Type 1360-A Microwave Oscillator	1.7-4.1 Gc
Type 1361-A UHF Oscillator	450-1050 Mc

The above oscillators have adjustable output coupling loops terminated in Type 874 Coaxial Connectors which permit direct connection to the mixer rectifier.

4. OUTPUT AMPLIFIER. A Type 1216-A Unit I-F Amplifier is recommended for use as the output amplifier. Also satisfactory is a communications receiver with a pass band of at least 20 kc, and with enough sensitivity so that a one-microvolt signal produces a noticeable S-meter deflection. The receiver can be tuned to any desired output frequency from the mixer rectifier up to 30 Mc, but it is usually better to tune to the higher frequencies to minimize confusion from spurious responses (refer to paragraph 7.) A reasonable pass band is necessary to allow for the normal frequency variation in both the local-oscillator and input signals.

5. OTHER ACCESSORIES. In some instances, a poor match between the signal source and the mixer crystal may cause low sensitivity. The match can usually be improved by the insertion of a short air line (such as the Type 874-L10 or 874-EL), an adjustable-length line, and/or a tuning stub between the signal source and the mixer.

In applications where a matched 50-ohm load is required, a Type 874-G10 or -G20 Pad should be inserted between the mixer rectifier and the signal circuit, since the mixer rectifier does not have a 50-ohm input impedance. The pad also tends to make the local oscillator voltage applied across the crystal (and hence the conversion efficiency) less dependent on the output impedance of the signal circuit at the local-oscillator frequency. Figure 2 shows the standing-wave ratios obtained with various pads.

6. CONNECTIONS. Connect the local oscillator (refer to paragraph 3) to the mixer connector marked L.O.[1], and connect the signal source to the connector marked INPUT[2] at the opposite end. For the best possible shielding, the mixer should be connected directly to the signal source. A length of double-shielded coaxial cable may be used where less than maximum shielding is acceptable.

The connector on the branch end of the mixer is the converter output, and this should be connected to a communications receiver or suitable i-f amplifier (refer to paragraph 4). The patch cord to the receiver input should be kept as short as possible. One length of a Type 874-R22 Patch Cord is satisfactory for use with most receivers. Type 874 Adaptors are available for most other types of connectors.

7. CHOICE OF FREQUENCIES. Set the local-oscillator frequency either above or below the signal frequency by an amount equal to the desired output frequency. At frequencies below about 100 Mc it is suggested that the local oscillator be kept on the high-frequency side of the signal to be detected to secure maximum rejection of the local-oscillator voltage by the output filter.

The second, third, and higher harmonics of the local-oscillator frequency can be used to beat with a signal with a slight reduction in sensitivity. This method of operation makes it possible to extend the frequency range considerably above the upper limit of the local oscillator. Since the harmonics are generated in the crystal mixer, the conversion is not dependent on the harmonic content of the local oscillator. Best results are generally obtained with the lowest or next-to-lowest possible harmonic.

Since it is possible for harmonics of the local oscillator to beat with harmonics of the high-frequency signal, precautions should be taken to avoid setting the local oscillator to beat with a harmonic of the signal rather than with the fundamental. Usually the magnitudes of the harmonics are too small to cause trouble. However, to eliminate possible confusion, the proper local-oscillator frequency, f_o, should be calculated from the equation:

$$f_o = \frac{f_s \pm f_r}{n}$$

[1]Marked R in earlier models.
[2]Marking omitted in earlier models.

where f_s is the signal frequency, f_r is the frequency of the i-f amplifier or radio receiver, and n is the harmonic number.

The desired and undesired responses may be fairly close to each other if the frequency is high and a high harmonic of the local oscillator is used. For instance, if the signal frequency is 300 Mc, the i-f 30 Mc, and the third harmonic of the local oscillator used, true responses will be obtained at local-oscillator frequencies of

$$\frac{300 - 30}{3} = 90 \text{ Mc} \quad \text{and} \quad \frac{300 + 30}{3} = 110 \text{ Mc}$$

If the second harmonic of the 300-Mc signal is present, it will produce responses in the vicinity of 100 Mc at

$$\frac{600 - 30}{6} = 95 \text{ Mc} \quad \text{and} \quad \frac{600 + 30}{6} = 105 \text{ Mc}$$

To minimize possible confusion, keep the local-oscillator harmonic low and the i-f high, thus reducing the number of possible responses and spreading them over as wide a frequency band as possible. For instance, if the fundamental of the local oscillator were used in the previous example, true responses would be obtained at 270 and 330 Mc, and responses due to the second harmonic of the 300-Mc signal at 285 and 315 Mc. Type 874-F Low-Pass Filters are also useful for eliminating undesired harmonics.

8. LOCAL-OSCILLATOR OUTPUT VOLTAGE. The output voltage required from the local oscillator depends on the signal source impedance at the local oscillator frequency, since the signal circuit appears directly in shunt with the crystal, and the 250-ohm resistor is connected in series with the local-oscillator input. Adjust the local-oscillator output so that, with the signal source connected, the crystal diode current, as measured with a d-c milliammeter across the output terminals, does not exceed 5 milliamperes. Currents as low as 0.2 ma can be used with no appreciable loss in sensitivity. At lower currents the sensitivity drops rapidly. In some instances the signal circuit may effectively short-circuit the crystal, causing a loss of all crystal current. To remedy this, vary the frequency slightly or change the length of line between the signal source and the mixer. The insertion of a section of Type 874-L10 Air Line is usually a satisfactory solution.

9. CRYSTAL REPLACEMENT. To replace the Type 1N21-B crystal diode, first remove the branch section of the mixer rectifier by unscrewing the knurled cylinder from the body of the unit, and then remove the small screw holding the spring that bears on the tip of the crystal cartridge.

SPECIFICATIONS

Frequency Range: 40-7000 Mc, and at lower and higher frequencies with decreased sensitivity.
Local Oscillator Output: Must be sufficient to produce at least 0.2 ma crystal current, and must be adjustable to keep crystal current below 5 ma.
Output-Filter Cutoff Frequency: 40 Mc.
Conversion Loss at 30-Mc Output: Depends on load impedance. About 6 db with Type 1216-A Unit I-F Amplifier when local-oscillator fundamental is used.
Typical Sensitivity: 5μv for discernible deflection on communications receiver S meter or meter on Type 1216-A.
Accessories Required: Local oscillator. Type 1216-A Unit I-F Amplifier or suitable communications receiver. Patch cords for input and output connections.

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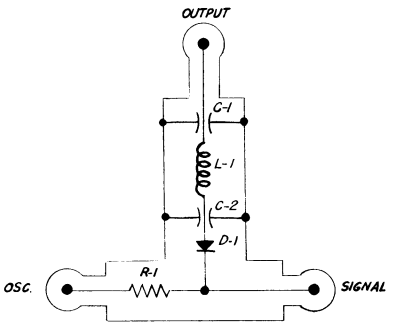

Figure 1. Schematic Diagram.

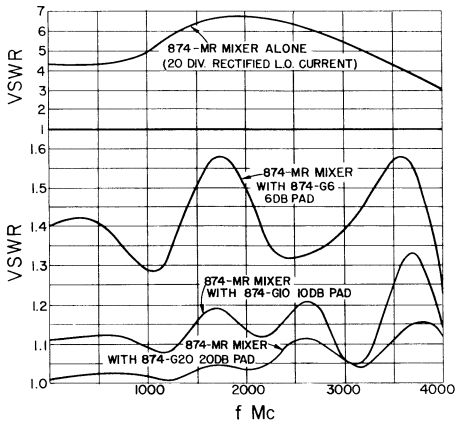

Figure 2. VSWR Curves with Various Pads.

PARTS LIST

REF	DESCRIPTION	GR NO.	REF	DESCRIPTION	GR NO.
R1	RESISTOR, 247.5Ω±1%	REU-10-4	D1	CRYSTAL DIODE	1N21B
C1	CAPACITOR, 10μμf	Built in	L1	CHOKE, 3.3μh ±5%	ZCHA-45
C2	CAPACITOR, 10μμf	Built in			

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WEST CONCORD, MASSACHUSETTS

NEW YORK: Broad Avenue at Linden
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