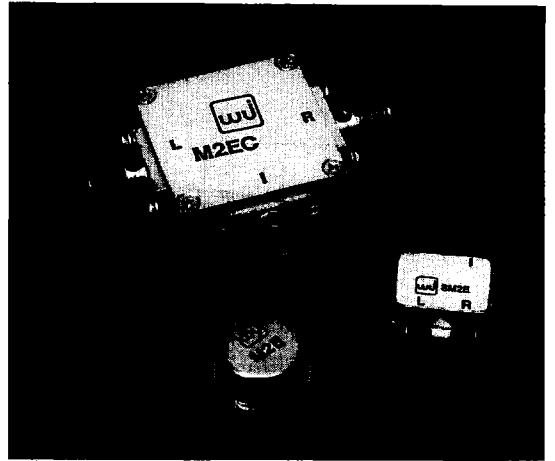




M2E/M2EC/SM2E

DOUBLE-BALANCED MIXER

- ◆ LO } 10 TO 1000 MHz
- RF }
- ◆ IF DC TO 600 MHz
- ◆ LO DRIVE +20 dBm (NOMINAL)
- ◆ HIGH INTERCEPT POINT: +30 dBm (TYP.)
- ◆ HERMETICALLY SEALED
- ◆ AVAILABLE IN SURFACE MOUNT
- ◆ MIL-M-28837 EQUIVALENT LEVEL SCREENING AVAILABLE



Guaranteed Specifications^{1,2,3}

Characteristics	Typ.	+25°C	-54°C to +85°C	Test Conditions	
SSB Conversion Loss and SSB Noise Figure (Max.)	7.0 dB	7.5 dB	7.8 dB	f_R 10 to 300 MHz f_L 10 to 300 MHz	
	8.0 dB	9.0 dB	9.3 dB	f_I 10 to 200 MHz f_I 10 to 600 MHz	
	8.5 dB	9.5 dB	9.8 dB	f_R 10 to 1000 MHz f_L 10 to 1000 MHz	
Isolation (Min.)				f_I 10 to 200 MHz	
	f_L at R	40 dB	35 dB	34 dB	f_L 10 to 100 MHz
	f_L at I	45 dB	35 dB	34 dB	f_L 100 to 400 MHz
	f_L at R	35 dB	25 dB	24 dB	f_L 400 to 1000 MHz
	f_L at I	35 dB	25 dB	24 dB	f_R 10 to 1000 MHz
	f_R at I	20 dB	14 dB	13 dB	
Conversion Compression	1.0 dB			$f_R = +20$ dBm $f_L = +25$ dBm	
Desensitization Level	1.0 dB			$f_{R2} = +18$ dBm $f_L = +25$ dBm	

Notes:

1. Measured in a 50-ohm system with nominal LO drive and downconverter application only, unless otherwise specified. The I-Port frequency range extends to DC for phase detection, pulse modulation, or attenuator applications, I-Port VSWR degrades from a 50-ohm system at low IF frequencies.
2. Guaranteed conversion loss values for M2EC are 0.5 dB worse than values listed and guaranteed over 0°C to 50°C temperature range only.
3. Typical values are measured at +25°C and are not guaranteed.

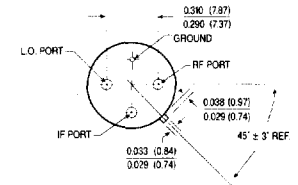
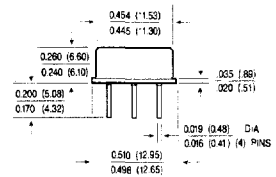
Absolute Maximum Ratings

Operating Temperature.....-54°C to +100°C
 Storage Temperature-65°C to +100°C
 Peak RF Input Power at +85°C+27 dBm RMS, +30 dBm Peak
 Peak Input Current at 25°C100 mA DC

Weight M2E: 2 grams (0.07 oz.) max.
 M2EC: 22 grams (0.78 oz.) max.
 SM2E: 3 grams (0.11 oz.) max.

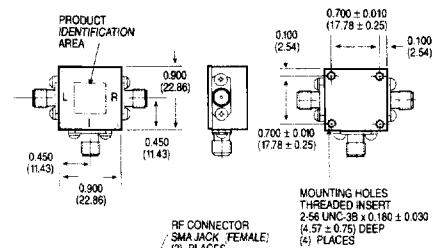
Outline Drawings

M2E



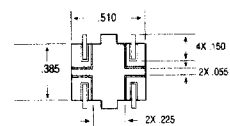
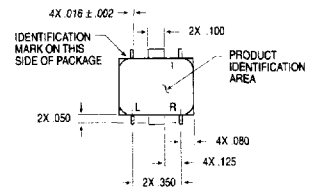
DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

M2EC

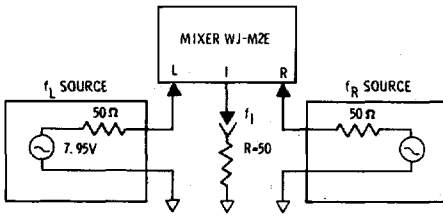


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

SM2E

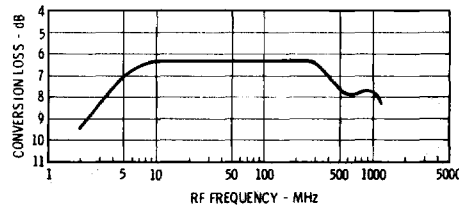


DIMENSIONS ARE IN INCHES (MILLIMETERS) ±.015 (.38) UNLESS OTHERWISE SPECIFIED

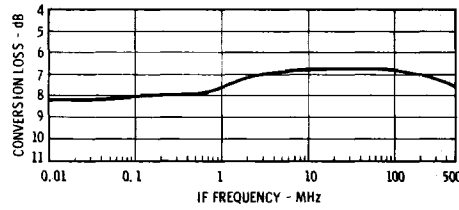


Mixer Test Circuit: When terminated as shown, the mixer impedance at the R- and I-ports is 50 ohms. The impedance at the L-port is nonlinear and is a function of the f_L level. For most applications, the f_L level should be as shown. This is equivalent to delivering 100 milliwatts (+20 dBm) into a 50 ohm load. The f_R level should be below 39.8 milliwatts (+16 dBm) in order to avoid conversion compression with f_L at +20 dBm.

Conversion Loss vs. Frequency

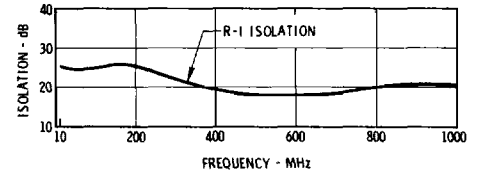
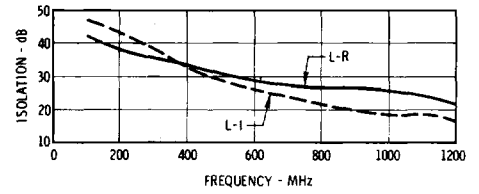


$f_{LO} > f_{RF}$
 $P_{LO} = +20$ dBm
 $P_{RF} = -10$ dBm
 $f_{IF} = \text{BETWEEN } 1 \text{ MHz and } 100 \text{ MHz}$



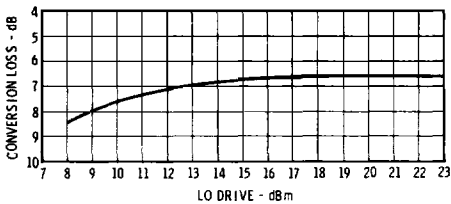
$f_{LO} > f_{RF}$
 $P_{LO} = +20$ dBm
 $f_{RF} = 100 \text{ MHz @ } -10 \text{ dBm}$

Isolation



$f_{LO} = 700 \text{ MHz @ } +20 \text{ dBm}$
 $P_{RF} = -10 \text{ dBm}$

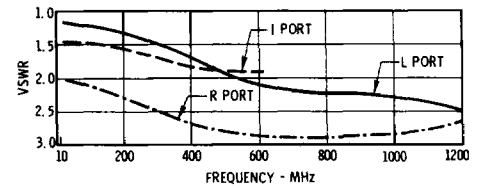
Conversion Loss vs. LO Drive



$f_{LO} = 400 \text{ MHz}$
 $f_{RF} = 300 \text{ MHz @ } -10 \text{ dBm}$

Drive Level: The minimum recommended drive level is +14 dBm. The maximum recommended drive level is +25 dBm.

VSWR



$P_{RF} = P_{IF} = -10 \text{ dBm}$
 $P_{LO} = +20 \text{ dBm}$
 $f_{LO} = 1000 \text{ MHz}$

Definition: In a mixer application where the input must be wideband two signals (f_{R1} and f_{R2}) may mix with the local oscillator signal (f_L) to produce in-band, two-tone third-order intermodulation products $[(2f_{R2} - f_{R1}) \pm f_L]$.

Two-Tone Suppression vs. Input Level:

With each dB decrease in input level, the 3rd order product is decreased an additional 2 dB. As shown, the WJ-M2E will reduce third-order products typically 68 dB with both input signals at 0 dBm and 88 dB with both input signals at -10 dBm. The input intercept point for the WJ-M2E is +34 dBm. This is about 24 dB higher than the intercept point for a standard low-level double-balanced mixer. The 1 dB compression level is typically +21.5 dBm as shown by the graph. This yields a dynamic range in a 1 MHz bandwidth of +126 dB using the following relationship: $Dynamic\ Range = P_{input} - (-111\ dBm/MHz + B + NF)$ where; P_{input} is the input level for 1 dB compression, B is the bandwidth relative to 1 MHz in dB and NF is the noise figure.

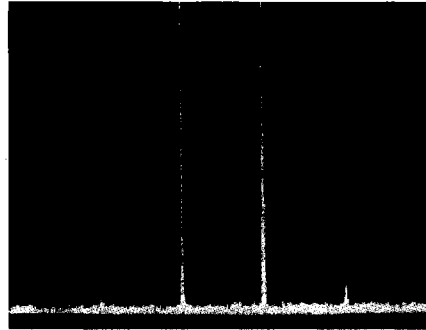
The spurious free dynamic range is given as follows:

$$DR_{spur\ free} = \frac{2}{3} (I.P. - (-111\ dBm/MHz + B + NF))$$

$$DR_{spur\ free} = \frac{2}{3} (34 + 111 - 6.5) = 92.3\ dB\ in\ a\ 1\ MHz\ bandwidth.$$

each mixer at +23 dBm. The M2E provides nearly 70 dBm suppression to the third order at the 320 MHz frequencies.

M2E



M9D

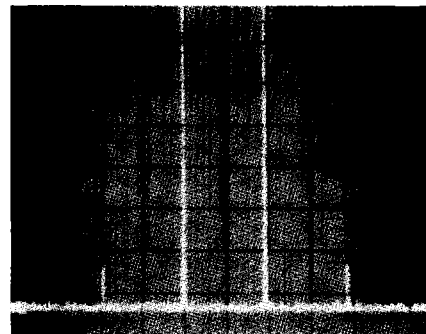


Fig. 1

The M2E is also compared with the pace setting WJ-M9E in Fig. 2. The M2E provided performance equal to the M9E with only +25 dBm LO drive compared with +27 dBm required on the M9E. In addition the frequency response of the M2E is extended to 1000 MHz, and it occupies only 1/10 the volume.

M2E

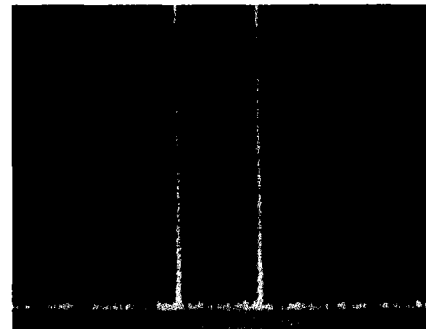
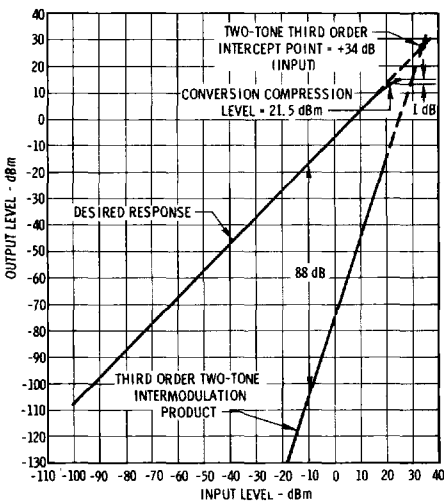


Fig. 2



This performance represents the highest dynamic range achieved using passive components in an ultra small TO-8 package. The spectrum analyzer photos of Fig. 1 compare the M2E to the M9D mixer with the LO drive of

M9E

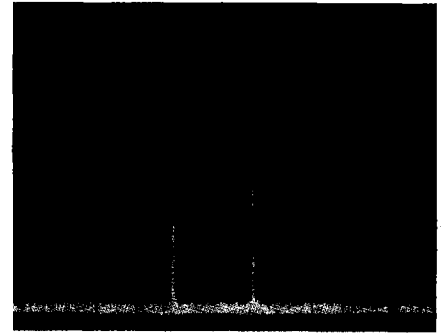


Fig. 2 (continued)

Third Order Performance When Used With LO Drive Amplifier and IF Amplifier:

The third order IM intercept point is shown plotted in Fig. 3 compared using the WJ-PA2 as an LO drive amplifier to a padded LO source from a commercial test amplifier. Measured intercepts as high as +38 dBm were achieved both with and without the PA2. The WJ-PA2 is a TO-8 Amplifier that provides +25 dBm output power from 10 to 300 MHz with a nominal gain of 11 dB. The third order two-tone was equal to or better using the PA2 directly coupled to the LO port as compared to driving from a padded commercial source.

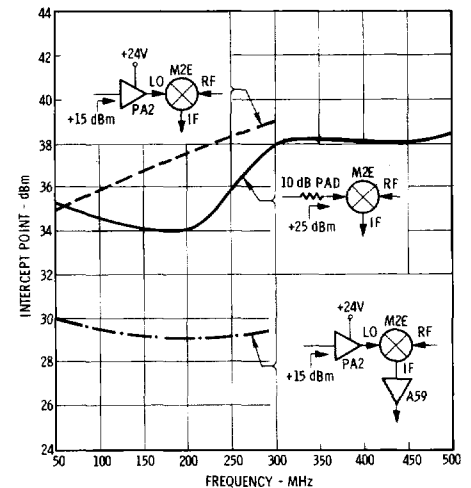


Fig. 3 Third-Order Input Intercept Point vs. Frequency

Typical Two-Tone Intermodulation Performance at 25°C

The input IM point was also measured using the A59 on the IF port of the M2E and this curve is also plotted in Fig. 3. There was a 4 or 5 dB decrease in IM point which is attributable to the intercept of the A59 being approximately equal to the output intercept of the M2E. To minimize the reduction there should be at least a 6 dB intercept margin between the output IM point of one unit to the input IM point of one unit to the input point of the following unit.

The third order of the M2E versus frequency out to 500 MHz is shown plotted in Fig. 4 of three different LO drive levels. The curves show that the IM point is more constant at the +25 dBm LO drive level than at lower levels. Occasionally a lower level may cause better IM suppression due to phasing in the mixer diodes which cause partial cancellation. In general, the IM can be expected to vary as a function of LO drive about 1 dBm per dB of LO drive. This result is plotted in Fig. 5.

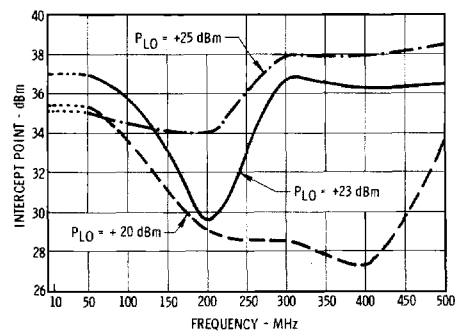


Fig. 4 Third-Order IM Point vs. Frequency and LO Drive.

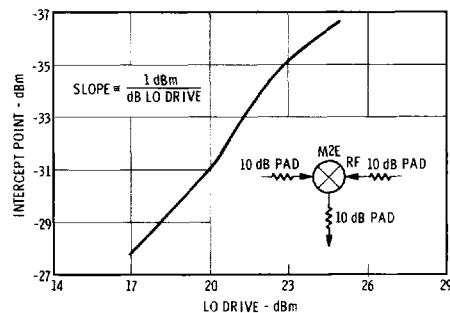


Fig. 5 Intercept Point vs. LO Drive

The output IM point is shown plotted in Fig. 6 for the PA driving the LO port for +15 dBm LO and +10 dBm LO levels with the A59 on the IF port.

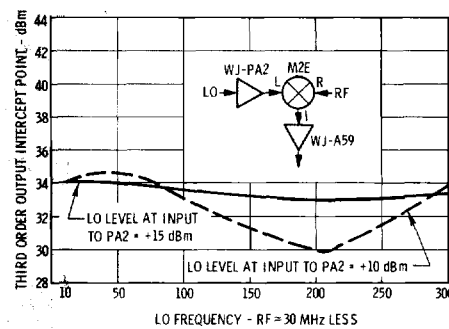


Fig. 6 Third-Order Output IM Point vs. Frequency

The output intercept is also plotted in Fig. 7 with an A59 on both the IF and RF ports for +15 dBm and +10 dBm to the input of the PA2.

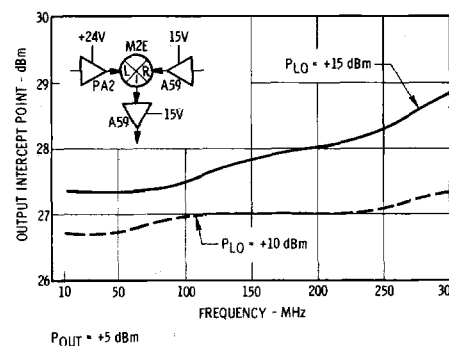


Fig. 7 Output Intercept Point vs. Frequency

Single Tone IM Signal Levels: Intermodulation signals resulting from the mixing of harmonics of the input signals are shown in Table 1 below for the WJ-M2E and WJ-M9E.

HARMONICS of f_{RF}	0	1	2	3	4	5
5			>105	83	101	101
4	88	95	82	97	89	88
3	70	77	67	65	71	53
2	40	54	62	64	59	61
1	14	0	25	18	31	36
0	M2E	7	17	8	18	
		M9E	9	8	19	5

HARMONICS of f_{LO}

f_{RF} and f_{LO} at 300 and 310 MHz, respectively
 LO drive +25 dBm
 RF signal level +0 dBm

Table 1

WJ-M2E/M2EC/SM2E

The data for this table was obtained using the setup shown in Fig. 8 where the LO port was direct coupled to the output of the WJ-PA2 TO-8 amplifier. Similar performance should be expected from other LO drive sources provided reasonable match is provided.

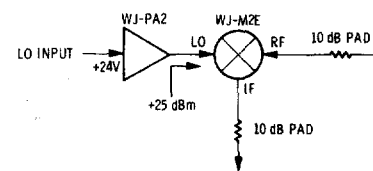


Fig. 8

Mixing products are indicated by the number of dB below the $f_L \pm f_R$ output. The typical performance in the table was obtained with f_R and f_L at 300 and 310 MHz respectively, f_L at +25 dBm, f_R at 0 dBm, and all resistive terminations.

For the odd f_R and f_L products and the even f_R and f_L products the two mixers are comparable. For the even f_L mixing with the odd f_R and the odd f_L mixing with the even f_R , the M9E typically offers a few dB higher suppression. Improved performance is obtained at lower frequencies for the even mixing with odd and the even mixing with even products. The odd mixing with odd are not suppressed because of mixer balance and therefore are more constant with frequency.