HIGH BURNOUT Ku-BAND BROADBAND COAXIAL MIXER DIODES

The superior RF burn-out resistance characteristics of the MA-41201 family of point contact diodes eases the requirements imposed on receiver protection devices in pulsed radar systems and provides an added degree of reliability in both pulsed and CW systems.

The development of this series is the result of extensive studies on microwave mixer diode burn-out and has been made possible by the development of improved burn-out resistance measurement techniques by M/A-COM Silicon Products, Inc.

MODEL NUMBER[1]	CASE STYLE	MAX. NOISE FIGURE[2] (dB)	TYP. CONV. LOSS, L_C (dB)	MAX. VSWR[3] (RATIO)	MAX. VSWR[4] (RATIO)	Z_{IF} RANGE[5] (OHMS)	RF BURNOUT RATING[6] (WATTS)
MA-41201G	11	7.0	5.5	1.5	2.5	300-565	10
MA-41201F	11	7.5	6.0	1.5	2.5	300-565	10
MA-41201E	11	8.0	6.0	1.5	2.5	300-565	10
MA-41201D	11	8.5	6.5	1.5	2.5	300-565	10

NOTES:

1. All mixer diodes are available as matched pairs and and can be ordered by adding the suffix "M" to the diode model number. Also, forward and reverse single diodes can be ordered as matched pairs by adding the suffix "MR" to the diode model number. Bin matching is available upon request. Matching criteria:
   ΔNF = 0.3 dB maximum.
   ΔZ_{IF} = 25 ohms maximum.
2. Test conditions: single sideband noise figure is measured at 16 GHz; IF = 30 MHz, NF_{IF} = 1.5 dB, R_L = 100 ohms, JAN 201 mount, I_{RECT} = 1.4 mA.
3. VSWR at 16 GHz in JAN 201 mount, R_L = 100 ohms, I_{RECT} = 1.4 mA.
4. VSWR 12.5 — 17.5 GHz swept in MA-595C mount, R_L = 22 ohms. (Maximum VSWR of MA-595C mount with 65 + j0 load ≈ 1.2:1 from 12.5 — 17.5 GHz.)
5. Test conditions: RF power = 1.0 W, R_L = 100 ohms, F_O = 16 GHz, JAN-201 mount.
6. The RF pulse exposure is 10 watts peak, 3 ns pulse, 15,000 pulses. This test is performed on 100% of the product. The test circuit is shown on page 12 in this catalog.

APPLICATION NOTES

Burn-out studies by M/A-COM Silicon Products, Inc., show that mixer diode erg burn-out ratings do not provide adequate correlation with actual radar system operation. For example, although diodes of the MA-41202 series show an average degradation of less than 0.2 dB when subjected to a 5 — 10 erg video pulse burn-out test, 50% of the diodes show noise figure degradation of 1 dB when subjected to 10^6 or more 18 W peak, 10 ns pulses (approximately 1 erg/pulse). Although classic burn-out theory[1] indicates that the total pulse energy content is the determining factor in short pulse burn-out, stress testing with RF pulses of 2 to 50 ns duration and constant peak power has shown that RF burn-out of both standard 1N23 and these special types, is only partially dependent on total pulse energy. Further, tests show that RF burn-out degradation is also related to peak RF pulse power (or, specifically, peak RF voltage) for pulses of 2 to 5 ns duration.

These tests, which have been made possible by special short RF pulse generating equipment developed by M/A-COM Silicon Products, Inc., have shown good correlation with operating radar systems.

Over 20,000 hours of operation on MA-41202 diodes has shown no measurable degradation of diode noise figure. Diodes were operated in balanced mixers behind TR-tubes selected to have 7-10 watts peak leakage (and 50 mW flat leakage).

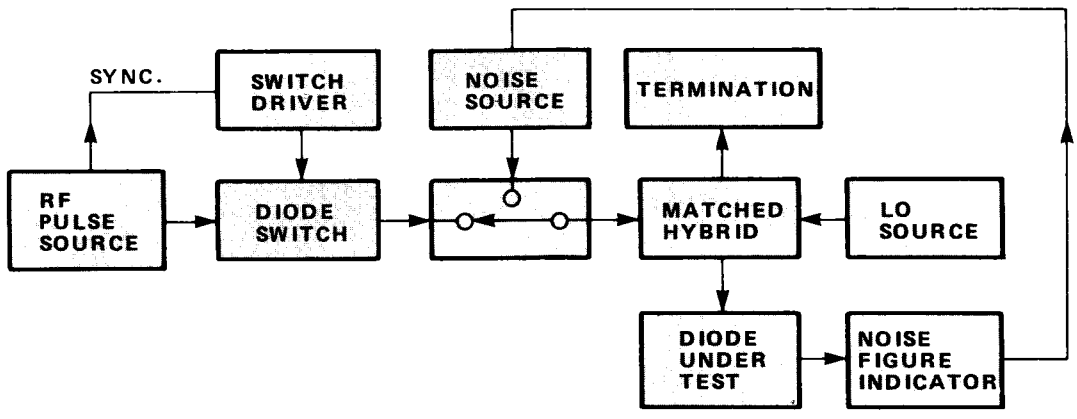
Another consistency with the peak RF voltage theory of burn-out was noted during simulation testing. That is the otherwise anomalous radar system behavior noted when source pulse risetime is altered. Typically, RF pulse risetime must be held above some minimum value in order to prevent mixer diode burn-out. But, for shorter RF pulse risetimes, a TR-tube's turn-on time is shorter and the spike leakage pulse contains less total energy! The difference is that at fast turn-on rates, the TR-tube allows a higher peak power leakage spike. Hence, the mixer diode is exposed to a higher incident peak RF voltage.

Extensive burn-out testing with a short pulse RF source shows that Torrey line pulse burn-out tests are not adequate when comparing devices made by different fabrication techniques.

NOTE:

(1.) Torrey & Whitmer, "Crystal Rectifiers" Radiation Labs Series, McGraw-Hill, 1948.

RF PULSE BURN-OUT TEST SYSTEM



HIGH BURNOUT LOWER BARRIER SCHOTTKY MIXER DIODES FOR L-K_a BAND

These specially fabricated silicon Schottky barrier mixer diodes offer exceptional resistance to RF burnout while retaining desirable operating characteristics. These devices are of planar epitaxial construction. The fabrication methods include highly accurate control of thicknesses and material resistivity coupled with tightly controlled photolithography, metallization and passivation techniques. The results are uniform RF and IF impedances provided by the very tight tolerances in junction capacitances. Separate devices are designed for use in L-Band through Ka-Band. High reliability versions screened to MIL-STD-750 are available.

Optimum noise performance for these devices is at an LO power level of 0 dBm.

The case styles recommended for optimum RF performance along with high reliability capability are of the bonded diode construction with ceramic metallized hermetic seals. These case styles are the 119, 120, and 186. The 119 case style is recommended for waveguide or coaxial broadband applications through Ka-Band. It is also utilized in stripline circuits where the diodes are mounted in a coaxial section at the end of stripline circuit boards.

MODEL NUMBER[1,2,3,6]	FREQ. RANGE (GHz)	MAX. NOISE FIGURE[4] (dB)	MAX. VSWR (RATIO)	IF IMP. (OHMS)	AVAIL. CASE STYLES
MA-4E390	1-8	6.5	1.5	300-500	3, 54, 119, 120, 135, 185
MA-4E391	8-12	7.0	1.5	300-500	3, 54, 119, 120, 135, 185
MA-4E392	12-18	7.5	1.5	300-500	54, 119, 120, 135, 185
MA-4E393	18-26	8.0	1.5	300-500	119, 120, 135, 185
MA-4E394	26-40	8.5	1.5	300-500	120, 135, 185

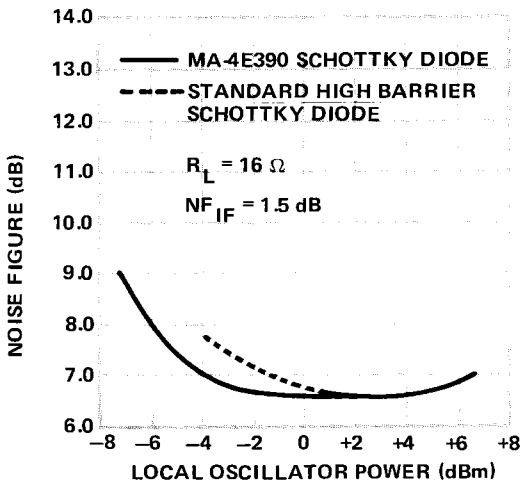
TYPICAL PERFORMANCE FOR MA-4E390

RF PARAMETERS[3,4]									RF BURNOUT (τ = 1 μs)
P_{LO} = 1 mW			P_{LO} = 0.75 mW			P_{LO} = 0.5 mW			
NF (dB)	I_{DC} (mA)	Z_{IF}[5] (OHMS)	NF (dB)	I_{DC} (mA)	Z_{IF}[5] (OHMS)	NF (dB)	I_{DC} (mA)	Z_{IF}[5] (OHMS)	POWER (WATTS)
6.5	1.2	420	6.6	0.9	450	6.8	0.5	500	12.0

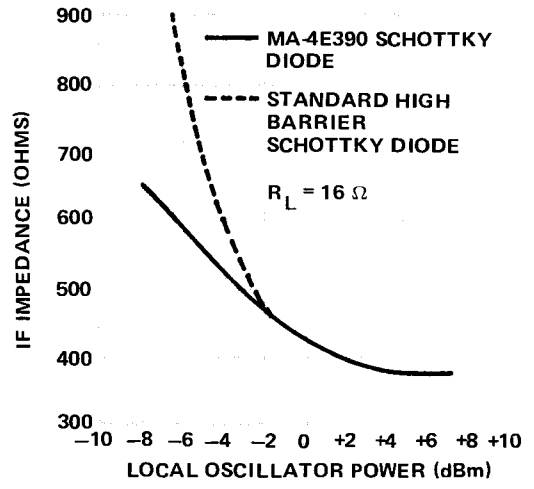
NOTES:

1. All units available as matched pairs by adding the suffix "M". Matching criteria for packaged pairs: ΔNF = 0.3 dB, maximum, ΔZ_{IF} = 25 ohms, maximum. Matching criteria for chips: ΔC = 0.5 pF, maximum at V_R = 0; ΔV_F = 10 mV maximum at I_F 1.0 mA. To specify case style, add the case style number as a suffix to the basic diode model number.
2. R_S is typically 8.0 ohms.
3. Junction capacitance at zero volts is typically 0.1 pF.
4. Test condition: Noise figure is single sideband measured with 30 MHz IF, NF_{IF} = 1.5 dB maximum and LO power = 1.0 mW. Excess gas tube noise at 9.375 GHz is 15.3 ±0.5 dB; 16.0 GHz gas tube noise is 16.0 ±0.5 dB.
5. Test frequency: 1 kHz
6. These diodes are thermo-compression bonded in all case styles except in case styles 3, 54, and 135. The maximum solder temperature for all case styles except 120 is 230°C for 5 seconds. For case style 120, maximum solder temperature is 200°C for 5 seconds.
7. Case style 135 is a chip.

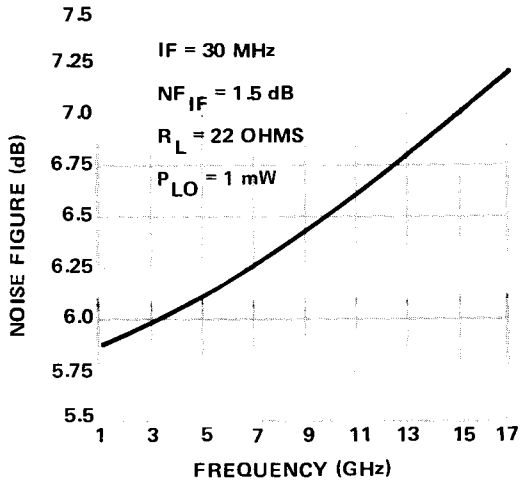
TYPICAL PEFORMANCE



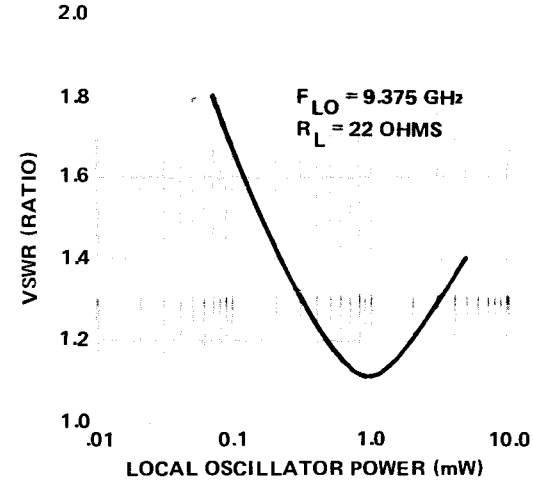
NOISE FIGURE VS LOCAL OSCILLATOR POWER



IF IMPEDANCE VS LOCAL OSCILLATOR POWER



NOISE FIGURE VS FREQUENCY



VSWR VS LOCAL OSCILLATOR POWER