

### Features

- Lower Insertion Loss and Noise Figure
- Higher Peak and Average Operating Power
- Various P1dB Compression Powers
- Lower Flat Leakage Power
- Reliable Silicon Nitride Passivation

### Description

M/A-COM produces a series of small and medium I-region length silicon PIN diodes specifically designed for high signal limiter applications. Each of these devices provides circuit designers with lower insertion loss at zero bias, faster signal response and recovery times, and lower flat leakage power. This series of diode is available as passivated chips (ODS-132 or ODS-134) as well as hermetic surface mount and cylindrical ceramic packages. Consult factory for specific package style availability.

### Applications

The MA4L Series of PIN limiter diodes are designed for use in passive limiter control circuits to protect sensitive receiver components such as low noise amplifiers (LNA), detectors, and mixers covering the 10 MHz to 18 GHz frequency band.

### Absolute Maximum Ratings<sup>1</sup> @ T<sub>A</sub> = 25°C (Unless otherwise specified)

Parameter	Absolute Maximum
Forward Current	100 mA
Operating Temperature <sup>1</sup>	-55°C to +125°C
Storage Temperature <sup>1</sup>	-55°C to +150°C
Junction Temperature <sup>1</sup>	+175°C
RF Peak & C.W. Incident Power	Per Performance Table
Mounting Temperature	+320°C for 10 sec.

1. Zero Watts of D.C. and RF power dissipation is allowed at +175°C for semiconductor reliability.
2. Exceeding ratings may cause permanent damage.

### Popular Case Styles and Associated Parasitics (Table 1)

Package Style	Package Type	Cpkg (pF)	Ls (nH)
134	Die Form	-	-
132	Die Form	-	-
30	Ceramic Pill	0.18	0.60
31	Ceramic Pill	0.18	0.60
32	Ceramic Pill	0.30	0.40
36	Ceramic Pill	0.18	0.60
120	Ceramic Pill	0.17	0.50
137	Ceramic Surface Mount with Leads	0.14	0.70
186	Ceramic Surface Mount with Leads	0.18	0.70
1056	Ceramic Surface Mount with Wrap Around Contacts	0.20	0.70
1088	Ceramic Surface Mount with Leads	0.20	0.70

<sup>1</sup> **ADVANCED:** Data Sheets contain information regarding a product MA-COM Technical Solutions is considering for development. Performance is based on target specifications, simulated results, and/or prototype measurements. Commitment to develop is not guaranteed.  
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- **Europe** Tel: 44.1908.574.200 / Fax: 44.1908.574.300
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298

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# MA4L Series



## Silicon PIN Limiter Diodes

MA-COM Products  
Rev. V8

### Un-Packaged Die Electrical Specifications at 25°C

Part Number	Minimum Reverse Voltage $V_R$	Maximum Reverse Voltage $V_R$	Minimum $C_{j0V}$ pF	Maximum $C_{j0V}$ pF	Maximum <sup>1</sup> $R_{S\ 10mA}$ Ohms	Nominal Characteristics			
						Carrier Lifetime @ 10 mA nS	I-Region Thickness $\mu\text{m}$	Contact Diameter mils	Thermal Resistance $^{\circ}\text{C/W}$
MA4L011-134	15	35	0.13	0.24	2.10	10	2	1.0	175
MA4L021-134	20	35	0.14	0.24	2.10	10	2	1.0	175
MA4L022-134	20	35	0.13	0.23	2.00	10	2	1.0	175
MA4L031-134	30	50	0.14	0.21	2.00	20	3	1.4	150
MA4L032-134	30	50	0.13	0.20	2.50	15	3	1.5	150
MA4L062-134	50	75	0.07	0.15	2.50	70	4	1.5	150
MA4L101-134	100			0.15	2.00	90	13	3.5	30
MA4L401-132	250			0.30	1.20	800	25	4.5	25

### Nominal High Signal Performance @ 25°C

Part Number	Incident <sup>3</sup> Peak Power for 1 dB Limiting @ 9.4 GHz dBm	Incident <sup>3</sup> Peak Power for 10 dB Limiting @ 9.4 GHz dBm	Incident <sup>3</sup> Peak Power for 15 dB Limiting @ 9.4 GHz dBm	Recovery <sup>3</sup> Time, (3 dB) @ 50 W Peak Power nS	Maximum <sup>3</sup> Incident Peak Power Watts	Maximum <sup>4</sup> CW Input Power Watts
MA4L011-134	7	30	40	10	80	2
MA4L021-134	8	31	41	15	90	3
MA4L022-134	8	31	41	15	90	3
MA4L031-134	10	33	43	25	125	4
MA4L032-134	11	34	44	25	125	4
MA4L062-134	15	38	50	75	200	5
MA4L101-134	20	45	53	100	250	6
MA4L401-132	30	52	60	250	1000	10

### Common Package Availability By Limiter Series

Part Number Prefix	MA4L011 (MADL-000011)	MA4L021 (MADL-000021)	MA4L022 (MADL-000022)	MA4L031 (MADL-000031)	MA4L032 (MADL-000032)	MA4L062 (MADL-000062)	MA4L101 (MADL-000101)	MA4L401 (MADL-000401)
Case Style	1056, 1088, 137, 186, 30, 31, 32	1056, 120, 31	1056, 137, 120, 30, 32, 186	1056, 186, 31	1056, 186, 31, 32	1056	186, 30	1056, 120, 30, 31

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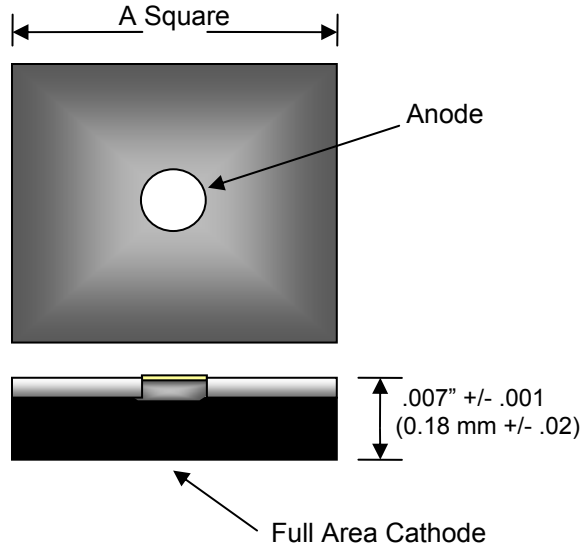
# MA4L Series



Silicon PIN Limiter Diodes

M/A-COM Products  
Rev. V8

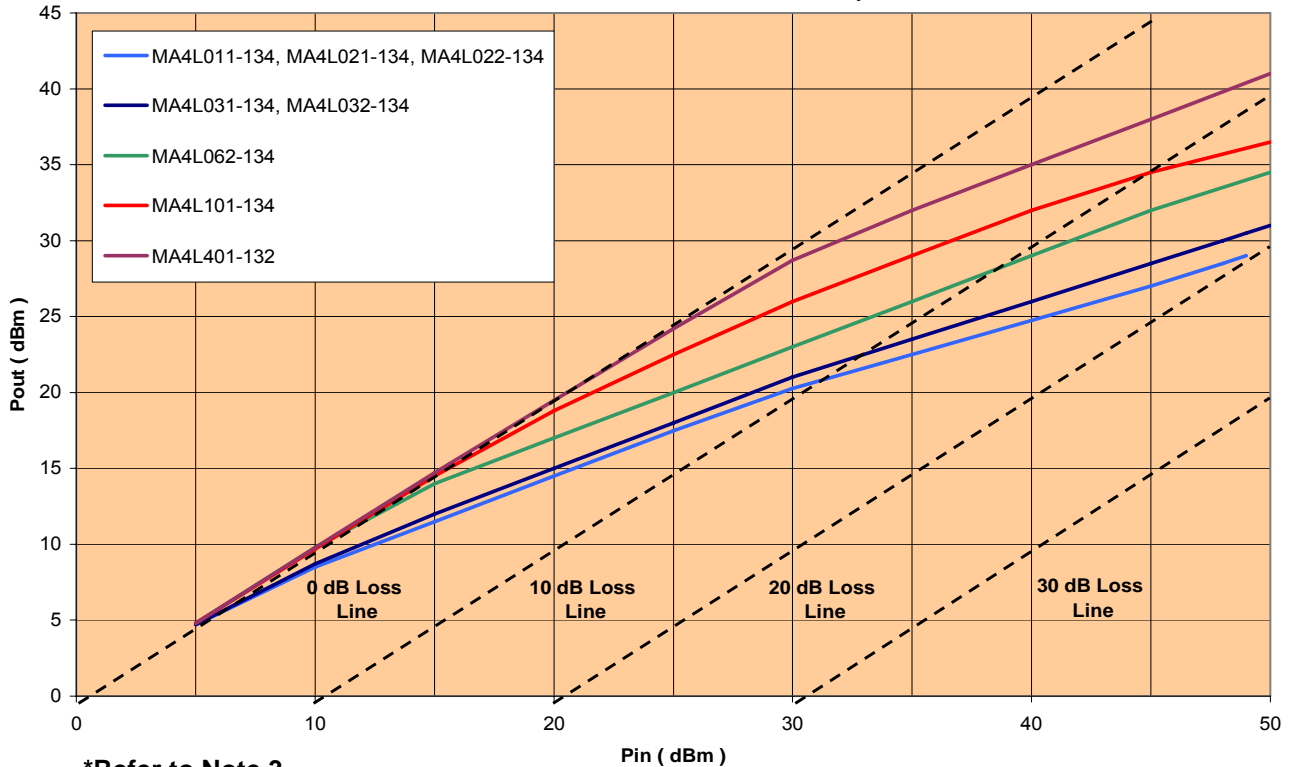
## Die Dimensions



ODS	Dimension	Mils	mm
134	A	13 +/- 2.0	0.33 +/- 0.05
132	A	20 +/- 2.0	0.51 +/- 0.05

For package dimensions please refer to following link:  
<http://www.macom.com/TechApps/OutlineDrawings.asp>

Typical Peak Power Performance for Single Shunt Limiter Diode in 50 Ohm System  
at 9.4 GHz, 1uS Pulse Width, 0.001 Duty



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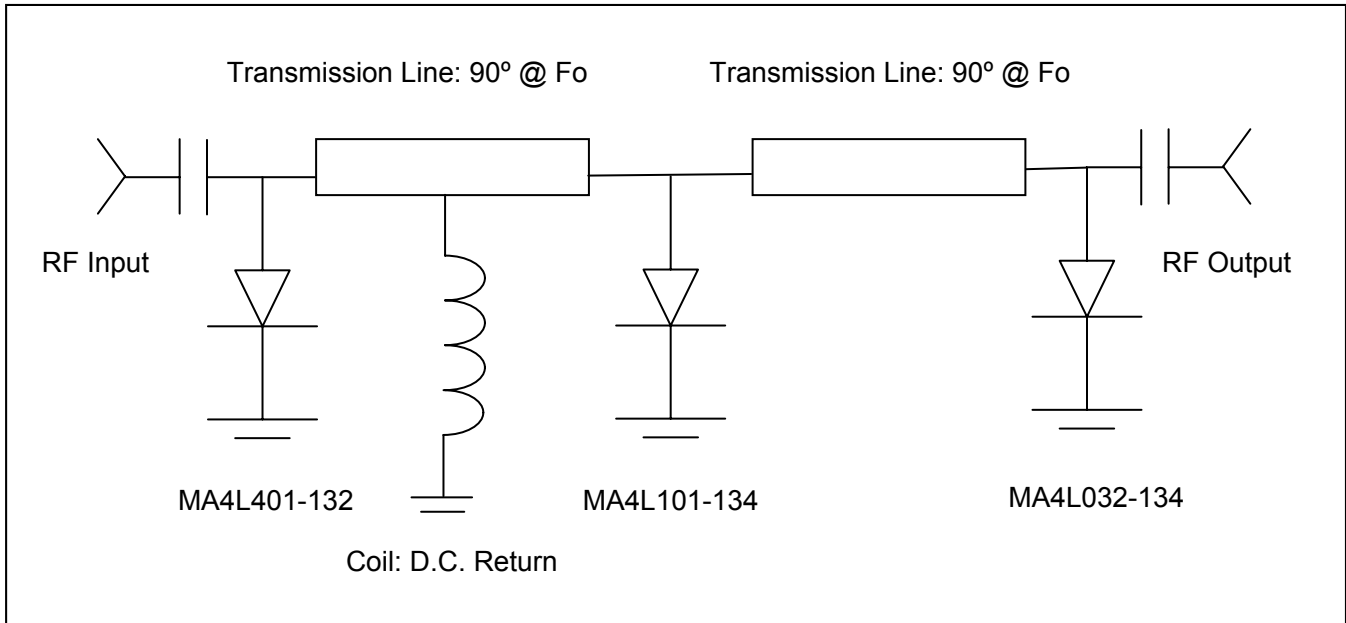
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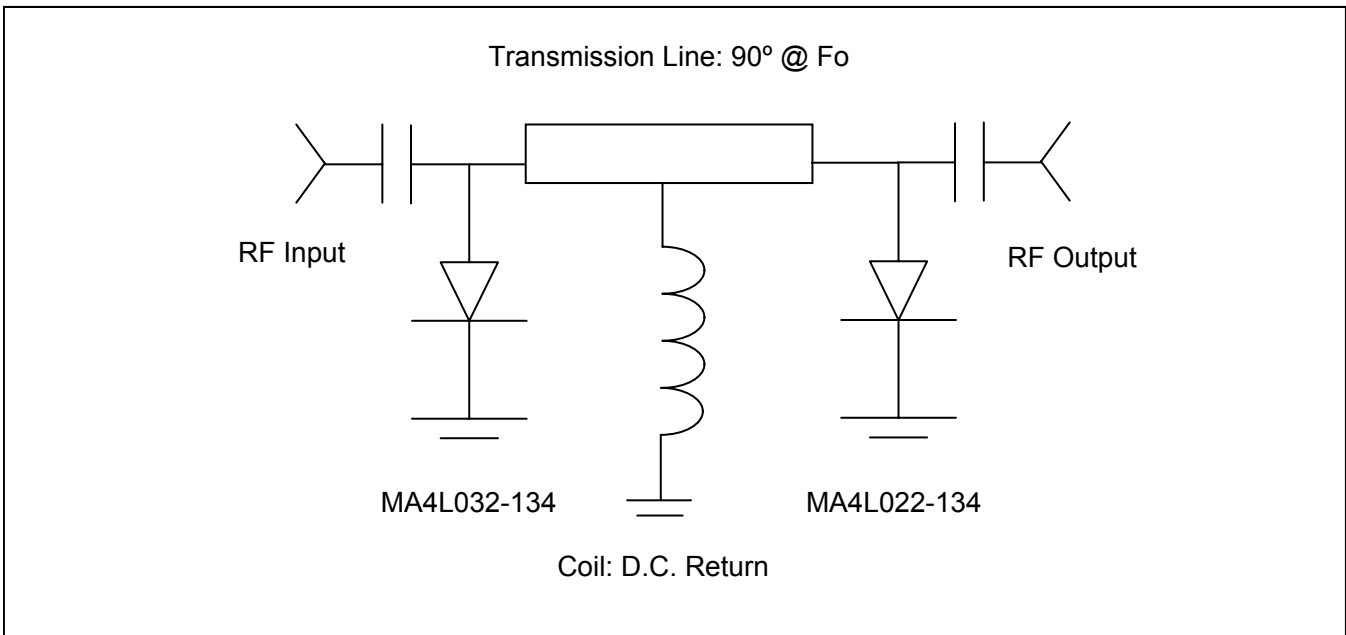
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## Application Circuits

### Typical +60 dBm Peak Power, 1 $\mu$ S P.W., 0.001 Duty Cycle, +20 dBm Flat Leakage Limiter Circuit



### Typical +50 dBm Peak Power, 1 $\mu$ S P.W., 0.001 Duty Cycle, +20 dBm Flat Leakage Limiter Circuit



## Notes for Specifications and Nominal High Signal Performance Table:

1. **Maximum Series Resistance** -  $R_S$ , is measured at 500 MHz in the ODS-30 package and is equivalent to the total diode resistance:  $R_S = R_j$  (Junction Resistance) +  $R_C$  (Ohmic Resistance)
2. **Nominal C.W. Thermal Resistance** -  $\Theta_{TH}$  is measured in ceramic pill package, ODS-30, mounted to a metal (infinite) heatsink. Diode only thermal resistance values are approximately 2 °C/W lower in value than the ODS-30 listed package values.
3. **Maximum High Signal Performance** - Measured using a single shunt diode (die) attached directly to the gold plated RF housing ground with 2 mil thick conductive silver epoxy in a 50  $\Omega$ , SMA, connectorized test fixture. Chip anode contact is thermo-sonically wire bonded using a 1 mil. dia. gold wire onto a 7.2 mil thick Rogers 5880 duroid microstrip trace. A shunt coil provides the D.C. return. Test frequency = 9.4 GHz, RF pulse width = 1.0  $\mu$ S, 0.001 duty cycle.
4. **Maximum C.W. Incident Power** - Measured in a 50  $\Omega$ , SMA, connectorized housing @ 4 GHz utilizing a TWT amplifier and the same single diode assembly configuration as stated in Note 3 above.

## Die Handling and Mounting Information

**Handling:** All semiconductor chips should be handled with care in order to avoid damage or contamination from perspiration, salts, and skin oils. For individual die, the use of plastic tipped tweezers or vacuum pick up tools is strongly recommended. Bulk handling should ensure that abrasion and mechanical shock are minimized.

**Die Attach:** The die have Ti-Pt-Au back and anode metal, with a final gold thickness of 1.0  $\mu$ m. Die can be mounted with a gold-tin, eutectic solder perform or conductive silver epoxy. The metal RF and D.C. ground plane mounting surface must be free of contamination and should have a surface flatness or < +/- 0.002”.

**Eutectic Die Attachment Using Hot Gas Die Bouncer:** An 80/20, gold tin eutectic solder perform is recommended with a work surface temperature of 255°C and a tool tip temperature of 220°C. When the hot gas is applied, the temperature at the tool tip should be approximately 290°C. The chip should not be exposed to temperature greater than 320°C for more than 10 seconds.

**Eutectic Die Attachment Using Reflow Oven:** See Application Note M541, “Bonding and Handling Procedures for Chip Diode Devices” . Link below.

**Epoxy Die Attachment:** A thin, controlled amount of electrically conductive silver epoxy should be applied at approximately a 1-2 mils thickness to minimize ohmic and thermal resistances. A thin epoxy fillet should be visible around the perimeter of the chip after placement to ensure full area coverage. Cure conductive epoxy per manufacturer’s schedule.

**Die Bonding:** The anode bond pads on these die have a Ti/Pt/Au metallization scheme, with a final gold thickness of 1.0  $\mu$ m. Thermo-sonic wedge wire bonding of 0.001” diameter gold wire is recommended with a stage temperature of 150°C and a force of 18 to 40 grams. Ultrasonic energy should be adjusted to the minimum required. Automatic ball bonding can also be used.

**See Application Note M541, “Bonding and Handling Procedures for Chip Diode Devices” for more detailed handling and assembly instructions at following link:**

<http://www.macom.com/Application%20Notes/pdf/m541.pdf>

## Part Numbering and Ordering Information

1. The die only P/N's use either the -132 or -143 suffix (See Electrical Specification Table).
2. The packaged P/N's use the associated suffix as defined in Table 1 instead of the die number. For example, the MA4L032-134 die in the 186 style package becomes: MA4L032-186. In some cases the alternate prefix is required. As an example, the alternate part number may be MADL-000032-018600, where the "DL" identifies part as diode limiter, the "000032" is part identifier, "0186" is case style. Please contact factory for proper part number for ordering.
3. For package dimensions please refer to following link:  
<http://www.macom.com/TechApps/OutlineDrawings.asp>