# MA4L Series

Tyco Electronics

## Silicon PIN Limiter Diodes

M/A-COM Products
Rev. V7

### 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.

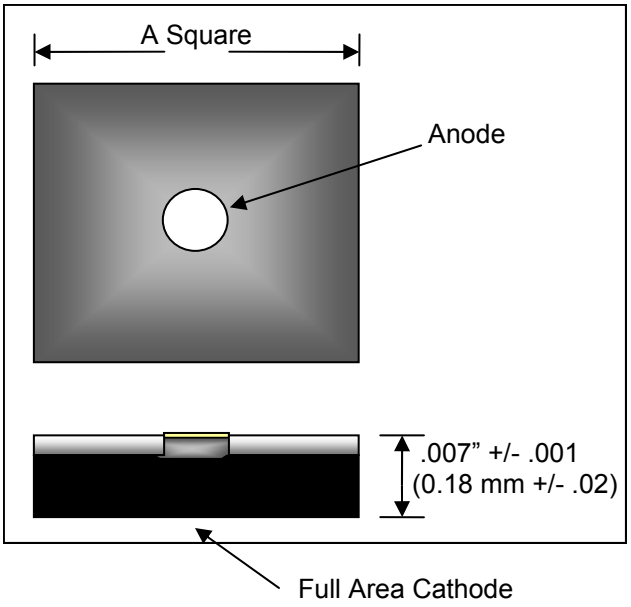
### Applications

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[1] @ $T_A$ = 25°C (Unless otherwise specified)

| Parameter | Absolute Maximum |
|---|---|
| Forward Current | 100 mA |
| Operating Temperature[1] | -55°C to +125°C |
| Storage Temperature[1] | -55°C to +150°C |
| Junction Temperature[1] | +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.




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





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## 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*[1] $R_{S\ 10mA}$ **Ohms** | **Nominal Characteristics** | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | *Carrier Lifetime @ 10 mA* **nS** | *I-Region Thickness* **µm** | *Contact Diameter* **mils** | *Thermal Resistance* **°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*[3] *Peak Power for 1 dB Limiting @ 9.4 GHz* **dBm** | *Incident*[3] *Peak Power for 10 dB Limiting @ 9.4 GHz* **dBm** | *Incident*[3] *Peak Power for 15 dB Limiting @ 9.4 GHz* **dBm** | *Recovery*[3] *Time, (3 dB) @ 50 W Peak Power* **nS** | *Maximum*[3] *Incident Peak Power* **Watts** | *Maximum*[4] *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 |

## 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: $R_S$ = Rj (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 Ω, 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 µS, 0.001 duty cycle.

4. ***Maximum C.W. Incident Power*** - Measured in a 50 Ω, 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 µm. 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 Bounder:** 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.

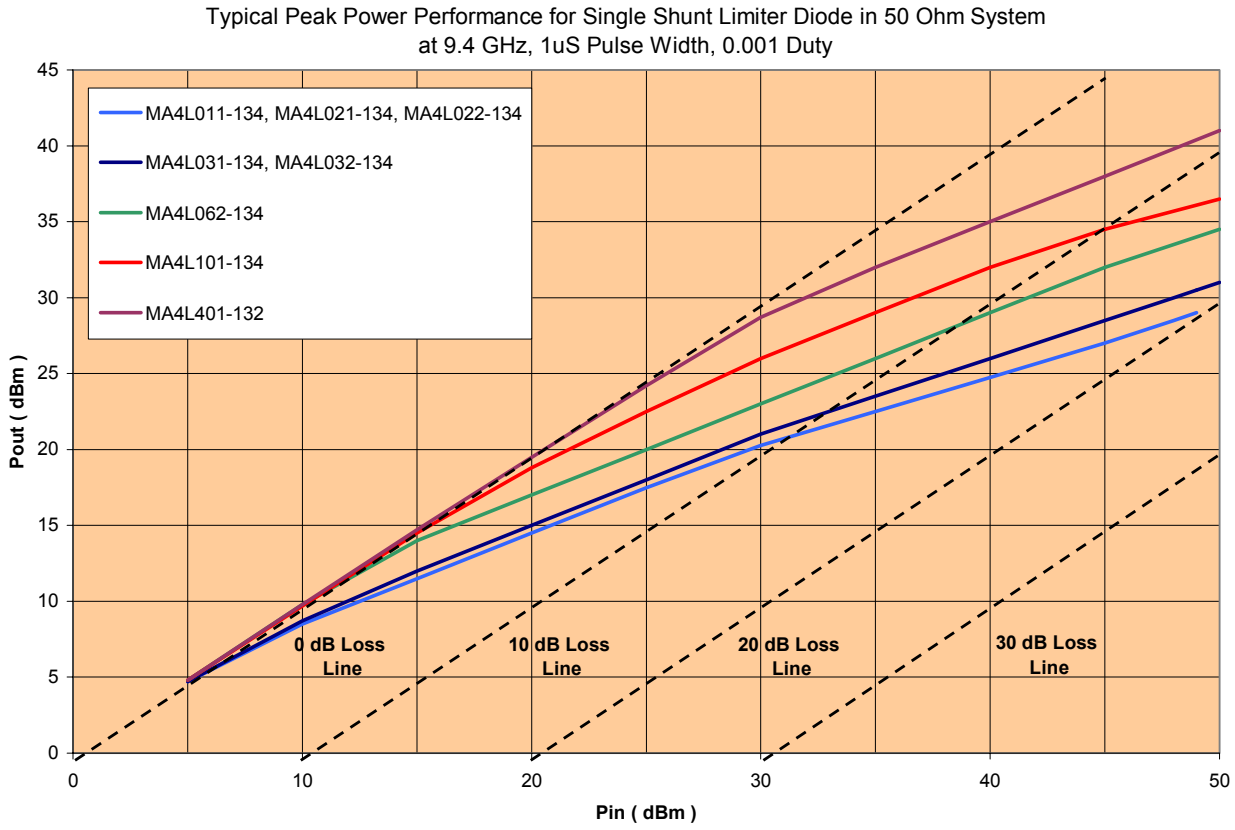
**Eutectic Die Attachment Using Reflow Oven:** See Application Note M541, "Bonding and Handling Procedures for Chip Diode Devices" at www.macom.com for recommended profile.

**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 µm. Thermosonic 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 www.macom.com.**

## Typical High Signal Peak Power Performance for the Single Shunt Limiter Diode in a 50 Ω Test Fixture (Note 3)





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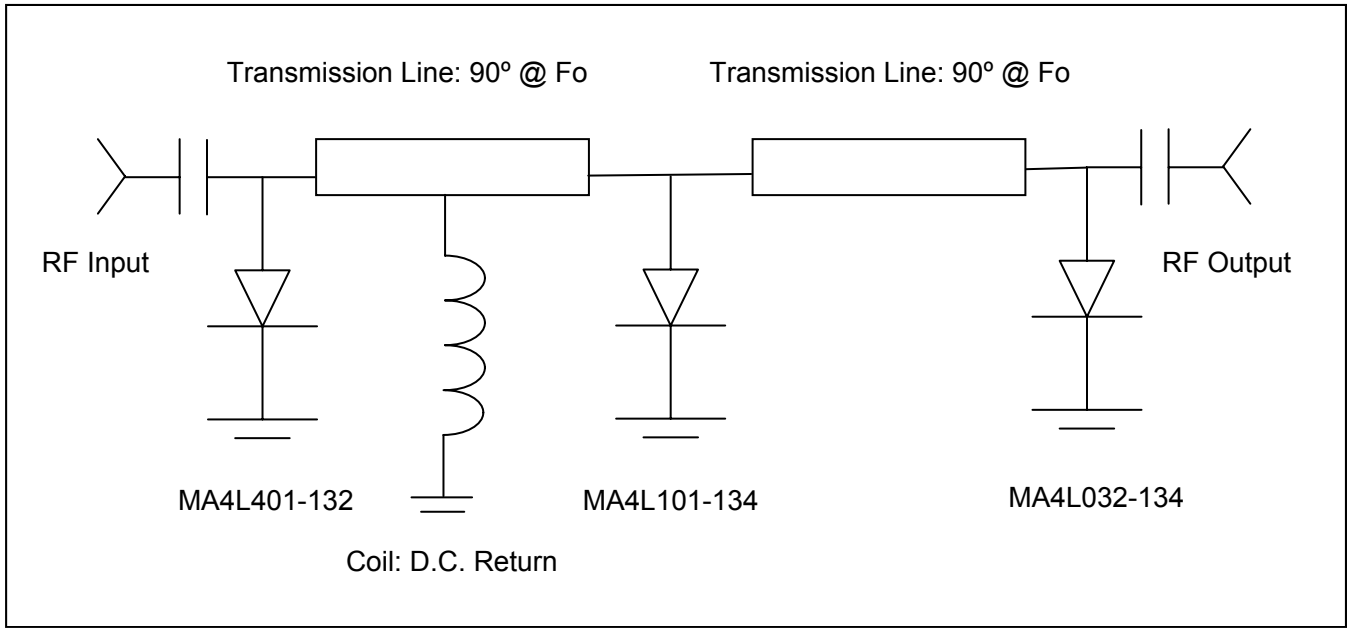
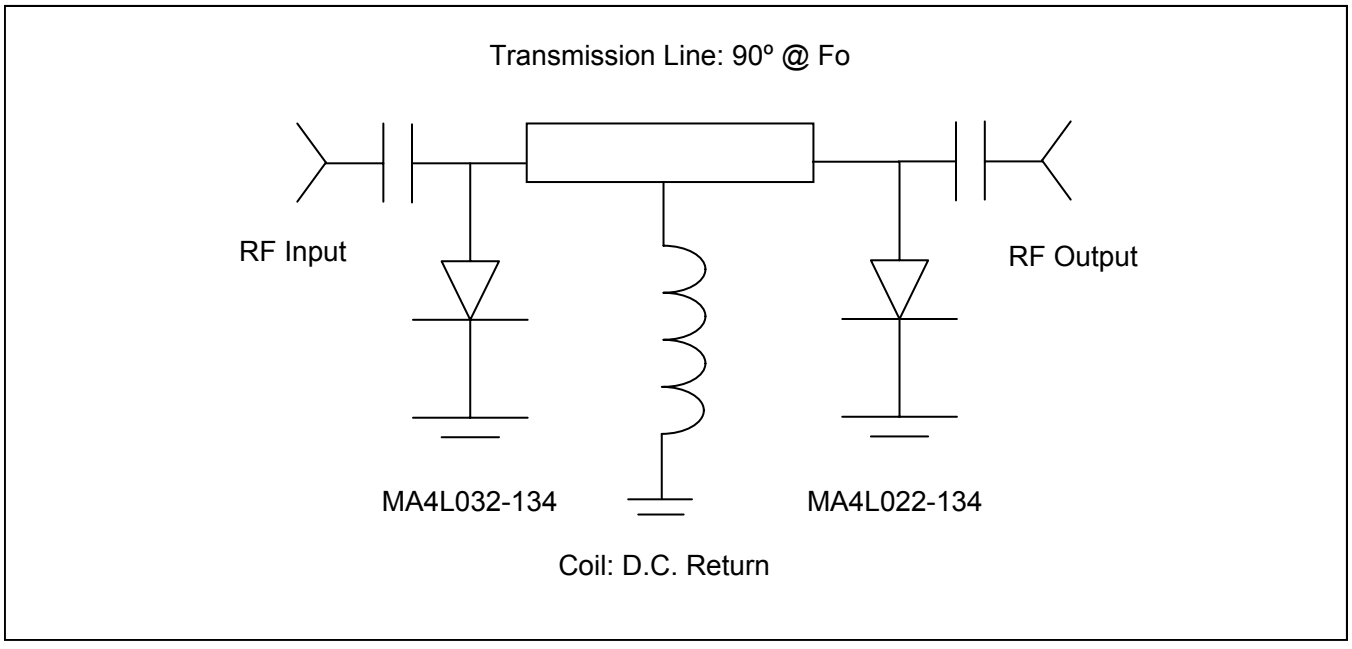
## Application Circuits

**Typical +60 dBm Peak Power, 1 µS P.W., 0.001 Duty Cycle, +20 dBm Flat Leakage Limiter Circuit**




**Typical +50 dBm Peak Power, 1 µS P.W., 0.001 Duty Cycle, +20 dBm Flat Leakage Limiter Circuit**



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

| Package Style | Package Type | Cpkg (pF) | Ls (nH) |
|---|---|---|---|
| 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 |
| 137 | Ceramic Surface Mount with Leads | 0.14 | 0.70 |
| 185 | Ceramic Surface Mount with Leads | 0.18 | 0.70 |
| 1056 | Ceramic Surface Mount with Wrap Around Contacts | 0.20 | 0.70 |

## 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





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