

# X-Band PIN Diode Limiter

## 6 - 12 GHz



MADL-011088-DIE

Rev. V1

### Features

- Insertion Loss <0.5 dB
- Return Loss >18 dB
- Handles 39 dBm CW Power
- Low Flat Leakage Power <15 dBm
- Die Size: 1.78 x 0.98 mm
- RoHS\* Compliant
- External DC Bias May Be Applied

### Applications

- ISM/MM
- Radar
- EW

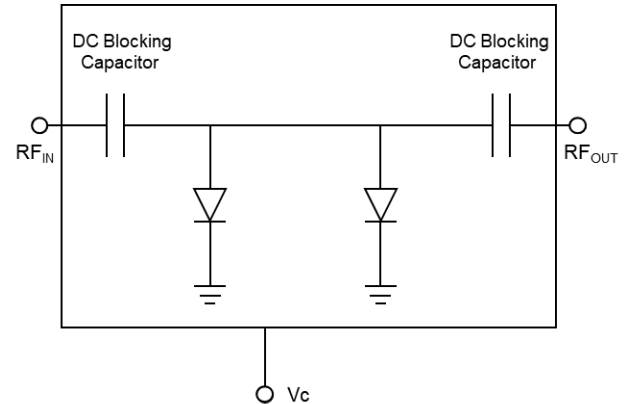
### Description

The MADL-011088-DIE is an integrated AlGaAs PIN Diode limiter. It is DC de-coupled at both the input and output ports and can be used with or without DC bias applied.

The limiter DC bias can be grounded to achieve low insertion loss, typically 0.35 dB up to 12 GHz. When applying a DC bias up to 0.7 V, ultra low flat leakage of less than 14 dBm across the power range can be achieved.

The MADL-011088-DIE can limit up to 39 dBm incident CW power at room temperature. It is available in die form with a compact die dimension of 1.78 x 0.98 mm.

### Functional Schematic



### Pin Configuration

Pin #	Pin Name	Description
1, 3, 4, 6	GND	Ground
2	RF <sub>IN</sub>	RF Input
5	RF <sub>OUT</sub>	RF Output
7	V <sub>C</sub>	Limiter DC Bias

### Ordering Information

Part Number	Package
MADL-011088-DIE	Die in Gel Pack

\* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

**Electrical Specifications: Freq. 6 - 12 GHz,  $T_A = 25^\circ\text{C}$ ,  $Z_0 = 50 \Omega$** 

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss	$P_{IN} = -10 \text{ dBm}$ , $V_C = 0 \text{ V}$ $P_{IN} = -10 \text{ dBm}$ , $V_C = 0.7 \text{ V}$	dB	—	0.35 0.45	0.6 0.7
Input Return Loss	$P_{IN} = -10 \text{ dBm}$ , $V_C = 0 \text{ V}$	dB	16	21	—
Output Return Loss	$P_{IN} = -10 \text{ dBm}$ , $V_C = 0 \text{ V}$	dB	16	21	—
CW Incident Power	—	dBm	—	39	—
CW Flat Leakage	$P_{IN} > 32 \text{ dBm}$ , $V_C = 0 \text{ V}$ $P_{IN} > 25 \text{ dBm}$ , $V_C = 0.7 \text{ V}$	dBm	—	17.5 12.0	19 14
Spike Leakage Power	$P_{IN} = 40 \text{ dBm}$ , 100 $\mu\text{s}$ , 1% DC, $V_C = 0 \text{ V}$ , 12 GHz $P_{IN} = 40 \text{ dBm}$ , 100 $\mu\text{s}$ , 1% DC, $V_C = 0.7 \text{ V}$ , 12 GHz	dBm	—	21.4 19.0	—
Recovery Time (1 dB Insertion Loss)	$P_{IN} = 40 \text{ dBm}$ , 100 $\mu\text{s}$ , 1% DC, $V_C = 0 \text{ V}$ , 12 GHz $P_{IN} = 40 \text{ dBm}$ , 100 $\mu\text{s}$ , 1% DC, $V_C = 0.7 \text{ V}$ , 12 GHz	ns	—	50 95	—
Input IP3	10 MHz Offset, $P_{IN}/\text{tone} = 0 \text{ dBm}$ , $V_C = 0 \text{ V}$ , 12 GHz 10 MHz Offset, $P_{IN}/\text{tone} = 0 \text{ dBm}$ , $V_C = 0.7 \text{ V}$ , 12 GHz	dBm	—	38 25	—

**Absolute Maximum Ratings<sup>1,2</sup>**

Parameter	Absolute Maximum
Incident CW RF Power @ +85°C	35
Bias Voltage	1 V
Junction Temperature <sup>3</sup>	+150°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-55°C to +150°C

- Exceeding any one or combination of these limits may cause permanent damage to this device.
- MACOM does not recommend sustained operation near these survivability limits.
- Operating at nominal conditions with  $T_J \leq +150^\circ\text{C}$  will ensure  $\text{MTTF} > 1 \times 10^6$  hours.

**Handling Procedures**

The protective polymer coating on the active areas of the die provides scratch and impact protection, particularly for the metal air bridge, which contacts the diode's anode. Die should primarily be handled with vacuum pickup tools, or alternatively with plastic tweezers.

**Static Sensitivity**

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling HBM Class 1B devices.

# X-Band PIN Diode Limiter 6 - 12 GHz

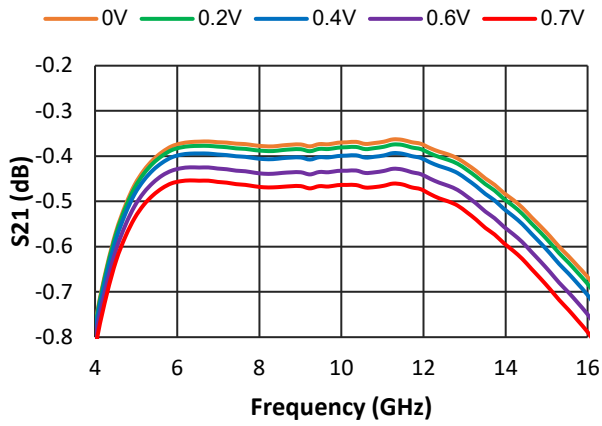


MADL-011088-DIE

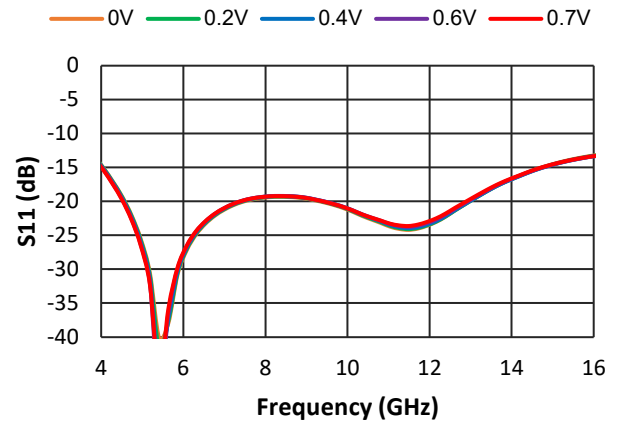
Rev. V1

Typical Small-Signal Performance, On-Wafer:  $T_A = 25^\circ\text{C}$ ,  $Z_0 = 50 \Omega$

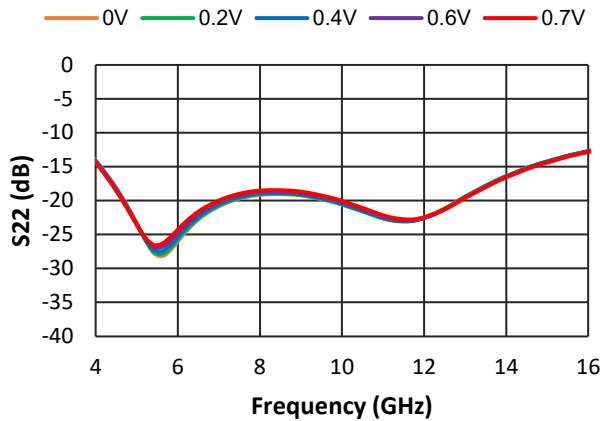
Insertion Loss over  $V_C$  Bias



Input Return Loss over  $V_C$  Bias



Output Return Loss over  $V_C$  Bias



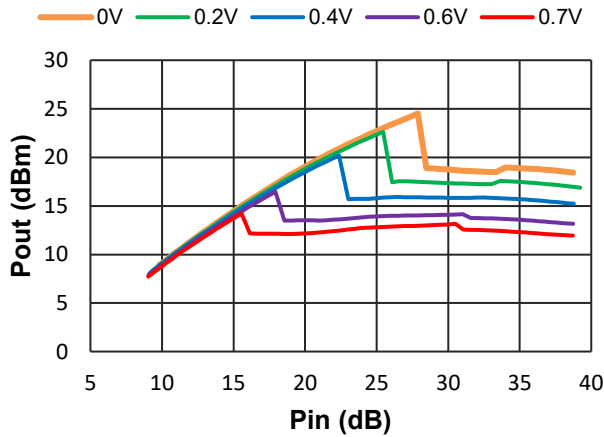
# X-Band PIN Diode Limiter 6 - 12 GHz



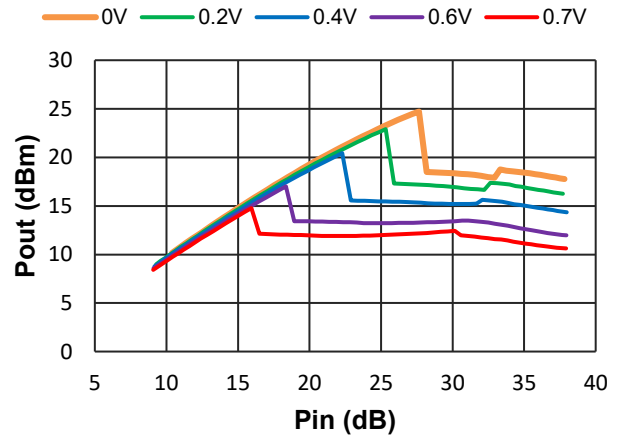
MADL-011088-DIE  
Rev. V1

## Typical RF Power Performance, Die On-Board: $T_A = 25^\circ\text{C}$ , $Z_0 = 50 \Omega$

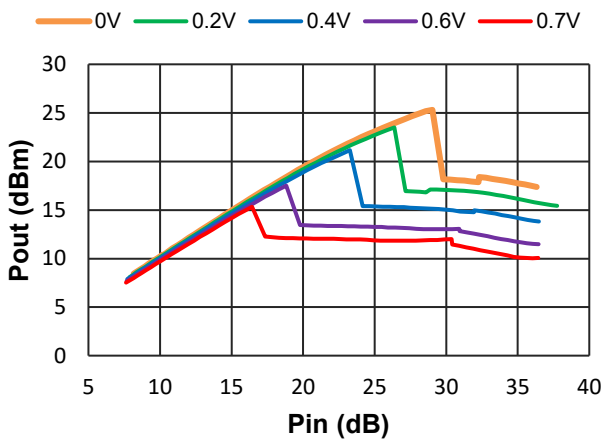
CW Flat leakage Power over  $V_C$  Bias at 8 GHz



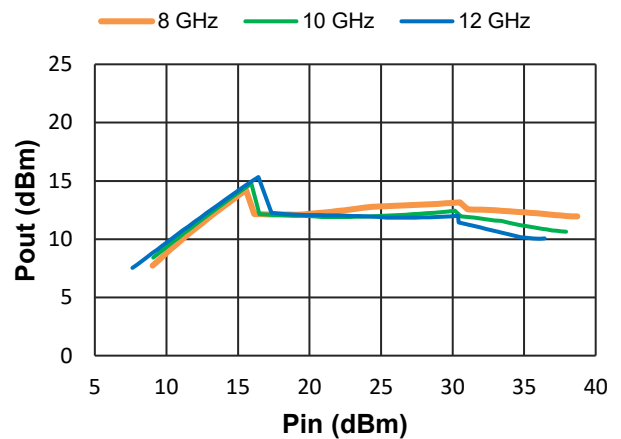
CW Flat leakage Power over  $V_C$  Bias at 10 GHz



CW Flat leakage Power over  $V_C$  Bias at 12 GHz

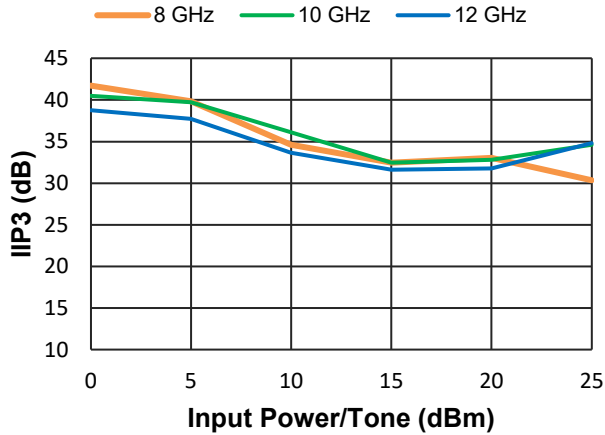


CW Flat leakage Power over Frequency at  $V_C = 0.7 \text{ V}$

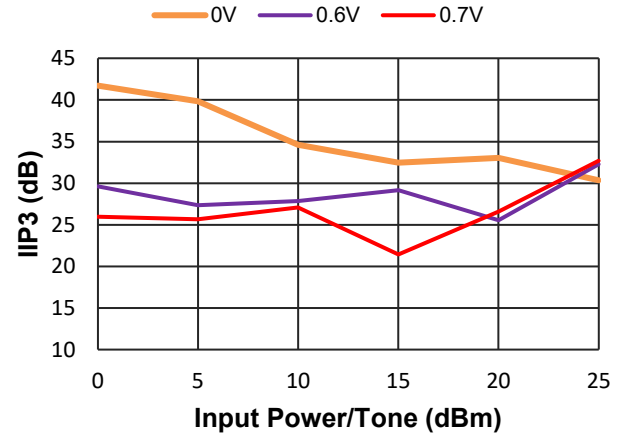


### Typical RF Power Performance, Die On-Board: $T_A = 25^\circ\text{C}$ , $Z_0 = 50 \Omega$

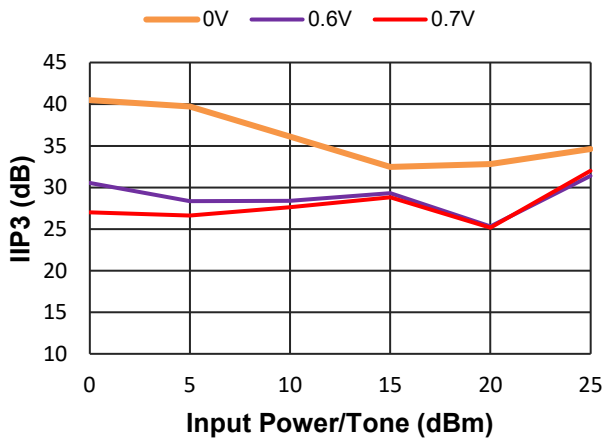
Input IP3 over Frequency at  $V_C = 0 \text{ V}$



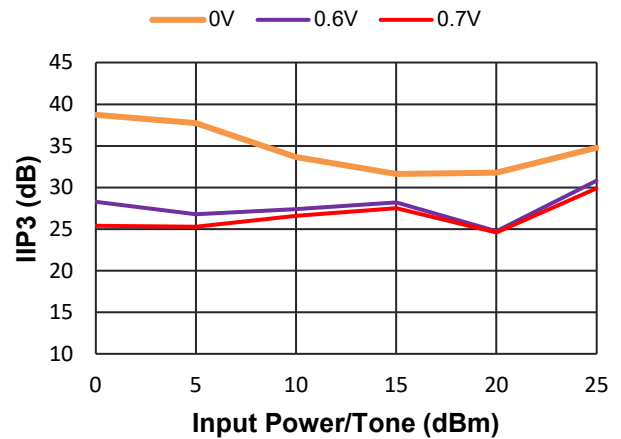
Input IP3 over  $V_C$  Bias at 8 GHz



Input IP3 over  $V_C$  Bias at 10 GHz



Input IP3 over  $V_C$  Bias at 12 GHz



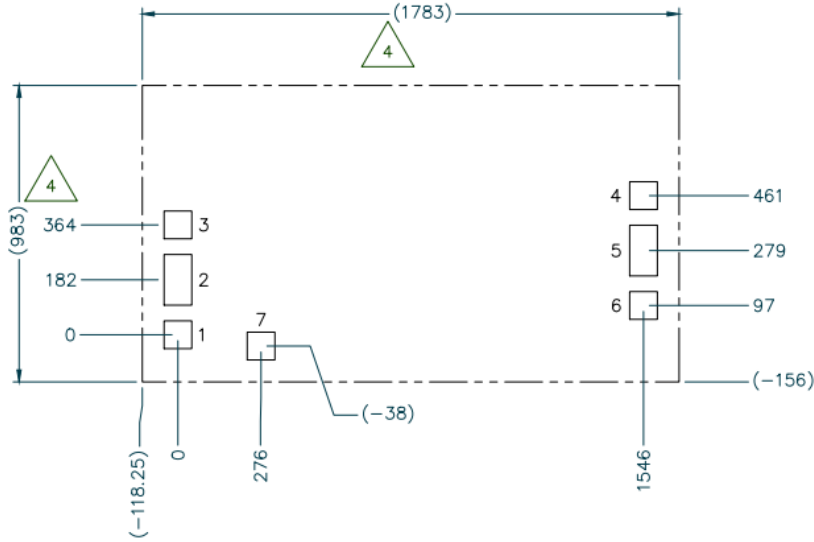
# X-Band PIN Diode Limiter 6 - 12 GHz



**MADL-011088-DIE**

Rev. V1

## Die Outline Drawing



BOND PAD DIM ( $\mu\text{m}$ )			
PAD	X ( $\mu\text{m}$ )	Y ( $\mu\text{m}$ )	REF. DES.
1,3,4,6	100	100	GND
2	100	180	RF <sub>INPUT</sub>
5	100	180	RF <sub>OUTPUT</sub>
7	100	100	V <sub>C</sub>

**NOTES:**

1. UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS SHOWN ARE  $\mu\text{m}$  WITH A TOLERANCE OF  $\pm 5\mu\text{m}$ .
2. DIE THICKNESS IS  $100 \pm 10\mu\text{m}$
3. BOND PAD/BACKSIDE METALLIZATION: GOLD.

△ 4. OVERALL DIMENSIONS ARE FINAL, POST-SINGULATION, TOLERANCE  $\pm 10\mu\text{m}$  EACH DIMENSION.