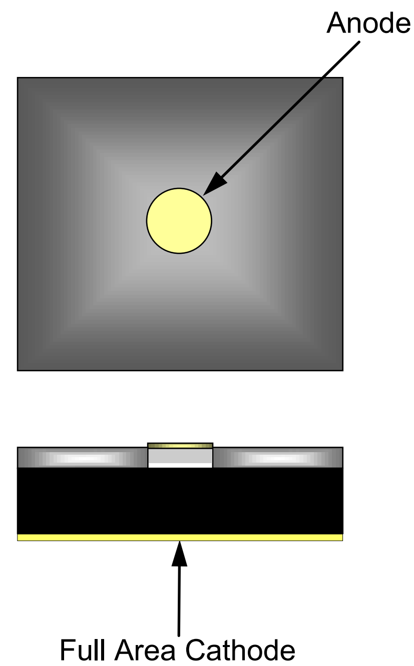
Silicon PIN Chips

Rev. V22

Features

- Switch & Attenuator Die
- Extensive Selection of I-Region Lengths
- Hermetic
- Glass Passivated Cermachip
- Oxide Passivated Planar Chips
- Voltage Ratings to 3000 V
- Fast Switching Speed
- Low Loss
- High Isolation
- RoHS* Compliant



Description

MACOM offers a comprehensive line of low capacitance, planar and mesa, silicon PIN diode chips which use ceramic glass and silicon nitride passivation technology. The silicon PIN chip series of devices cover a broad spectrum of performance requirements for control circuit applications. They are available in several choices of I-region lengths and have been optimally designed to minimize parametric trade offs when considering low capacitance, low series resistance, and high breakdown voltages. Their small size and low parasitics, make them an ideal choice for broadband, high frequency, micro-strip hybrid assemblies.

The attenuator line of PIN diode chips are a planar or mesa construction and because of their thicker I-regions and predictable R_S vs. I characteristics, they are well suited for low distortion attenuator and switch circuits. Incorporated in the chip's construction is MACOM's, time proven, hard glass, Cermachip process. The hard glass passivation completely encapsulates the entire PIN junction area resulting in a hermetically sealed chip which has been qualified in many military applications. These Cermachip diodes are available in a wide range of voltages, up to 3,000 volts, which are capable of controlling kilowatts of RF power.

Many of MACOM 's silicon PIN diode chips are also available in several different package styles. Please refer to the "Packaged PIN Diode Datasheet" for case style availability and electrical specifications located on the MACOM website. Also for high voltage, high power devices refer to MA4PK2000.

Absolute Maximum Ratings[1]

T_A = +25°C (Unless otherwise specified)

Parameter	Absolute Maximum
Forward Current (I_F)	Per P/N R_s vs. I Graph
Reverse Voltage (V_R)	Per Specification Table
Power Dissipation (W)	$\frac{175°C - T_{ambient}°C}{Theta}$
Operating Temperature	-55°C to +175°C
Storage Temperature	-55°C to +200°C
Junction Temperature	+175°C
Mounting Temperature	+320°C for 10 seconds

1. Exceeding these limits may cause permanent damage to the chip

* Restrictions on Hazardous Substances, European Union Directive 2011/65/EU.

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Electrical Specifications: T_A = +25°C

Low Capacitance PIN

Part Number	Maximum Characteristics			Nominal Characteristics			
	Reverse Voltage[2] V_R <10 µA	Capacitance 1 MHz C_J @ -10 V	Series Res. 500 MHz R_S @ 10 mA	Carrier Lifetime[3] T_L	Reverse Recovery Time[4] T_{RR}	I Region Length	Theta
	VDC	pF	Ω	ηs	ηs	µm	°C/W
MA4P161-134	100	0.10	1.50	150	15	13	65
MA4P203-134	100	0.15	1.50	150	25	13	75
MA4P7493-134	150	0.05	1.80	80	8	19	60
MADP-000165-01340W	200	0.06	2.50	200	20	19	30
MADP-000135-01340W	200	0.15	1.20	440	44	19	30

Attenuator PIN

Part Number	Maximum Characteristics			Nominal Characteristics				
	Reverse Voltage[2] V_R <10 µA	Capacitance 1 MHz C_J @ -100 V	Series Res. 100 MHz R_S @ 10 mA	Carrier Lifetime[3] T_L	Series Res. 100 MHz R_S @ 10 µA	Series Res. 100 MHz R_S @ 1 mA	I Region Length	Theta
	V_{DC}	pF	Ω	µs	Ω	Ω	mils	°C/W
MA47416-132	200	0.15	6	2	2000	30	4	30
MA47418-134	200	0.15	3	1	500	15	2	25

2. Reverse Voltage (V_R) is sourced and the resultant reverse leakage current (I_R) is measured to be <10 µA.
3. Nominal carrier life time (T_L) specified at I_F = + 10 mA , I_{REV} = - 6 mA.
4. Nominal reverse recovery time specified at I_F = + 20 mA , I_{REV} = - 200 mA.

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Electrical Specifications: T_A = +25°C (cont.)

Cermachip PIN

Part Number	Maximum Characteristics			Nominal Characteristics		
	Reverse Voltage[5] V_R <10 µA	Capacitance 1 MHz C_J @ -100 V	Series Res. 100 MHz R_S @ 100 mA	Carrier Lifetime[6]	I Region Length	Theta
	V_{DC}	pF	Ω	µs	µm	°C/W
MA4P303-134	200	0.15 @ 10 V	1.5 @ 10 mA[8]	0.3	20	30
MA4P404-132	250	0.20 @ 50 V	0.70 @ 50 mA[8]	0.6	30	20
MA4P504-132	500	0.20	0.60	1	50	20
MA4P505-131	500	0.35	0.45	2	50	14
MA4P506-131	500	0.70	0.30	3	50	11
MADP-000488-13740W	900	0.19 @ 50 V	1.6 @ 50 mA	4	140	45
MA4P604-131	1000	0.30	1.00	3	90	10
MA4P606-131	1000	0.60	0.70	4	90	8
MA4P607-212	1000	1.30	0.40	12	127	4
MA4PK3000-1252[7]	3000	2.90	0.25 @ 500 mA[9]	60	350	1.5

5. Reverse Voltage (V_R) is sourced and the resultant reverse leakage current (I_R) is measured to be <10 µA.
6. Nominal carrier life time (T_L) specified at I_F = + 10 mA , I_{REV} = - 6 mA.
7. Upon completion of circuit installation, the chip must be covered with a dielectric conformal coating such as SYLGARD 539® to prevent voltage arcing.
8. Test Frequency = 500 MHz
9. Test Frequency = 4 MHz

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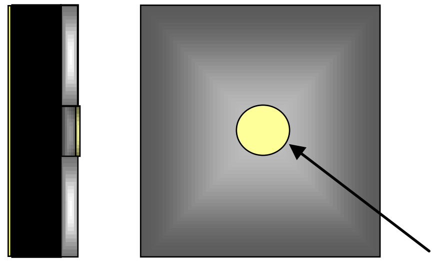
Chip Dimensions



Low Capacitance PIN Chip

Part Number	Nominal Characteristics (mils.)		
	Anode Diameter ± 0.5	Chip Size ± 0.5	Chip Thickness ± 0.5
MA4P161-134	3.5	13 x 13	6.0
MA4P203-134	3.1	13 x 13	6.0
MA4P7493-134	3.8	13 x 13	6.5
MADP-000165-01340W	1.8	13 x 13	7.0
MADP-000135-01340W	3.1	13 x 13	10.0

Attenuator PIN Chip

Part Number	Nominal Characteristics (mils.)		
	Anode Diameter ± 0.5	Chip Size ± 2.0	Chip Thickness ± 1.0
MA47416-132	7.5x7.5[10]	19 x 19	7.0
MA47418-134	7.5	13 x 13	7.0

10. Anode top contact is square.

Cermachip PIN Chip

Part Number	Nominal Characteristics (mils.)		
	Anode Diameter ± 0.5	Chip Size ± 2.0	Chip Thickness ± 1.0
MA4P303-134	3.0	13 x 13	10.0
MA4P404-132	6.8	20 x 20	10.0
MA4P504-132	6.8	20 x 20	10.0
MA4P505-131	13.0	27 x 27	11.0
MA4P506-131	15.8	27 x 27	12.0
MADP-000488-13740W	12.2	23 x 23	13.5
MA4P604-131	17.0	27 x 27	13.5
MA4P606-131	21.0	32 x 32	14.0
MA4P607-212	37.0	62 x 62	18.5
MA4PK3000-1252	85.0	172 x 172	28.0

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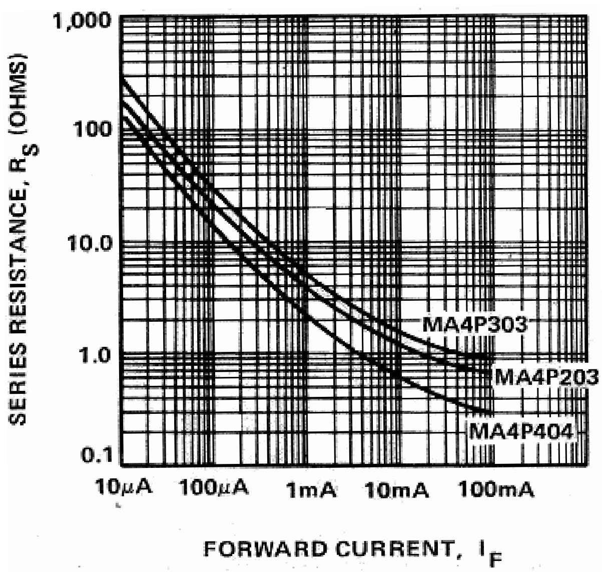
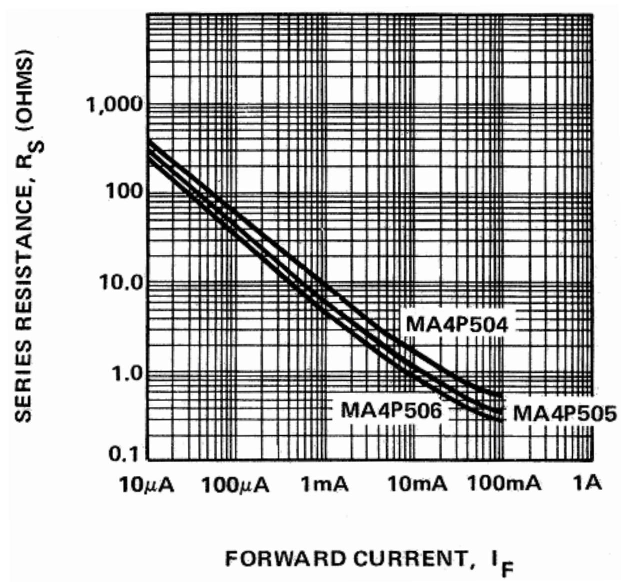
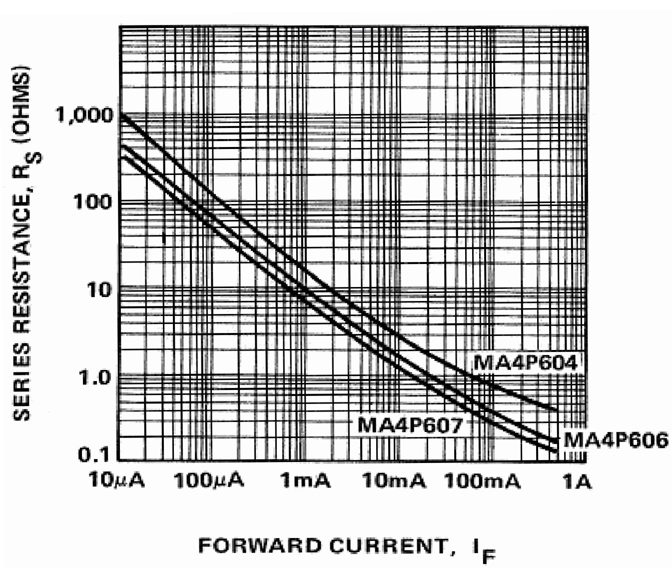
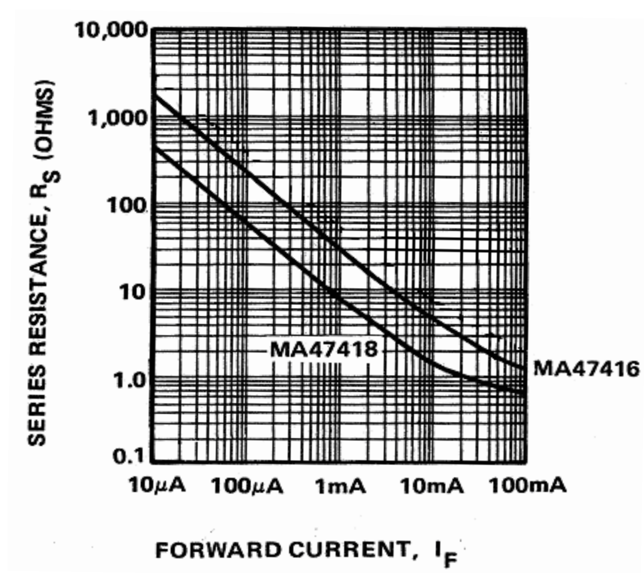
Typical Series Resistance vs. Forward Current Performance









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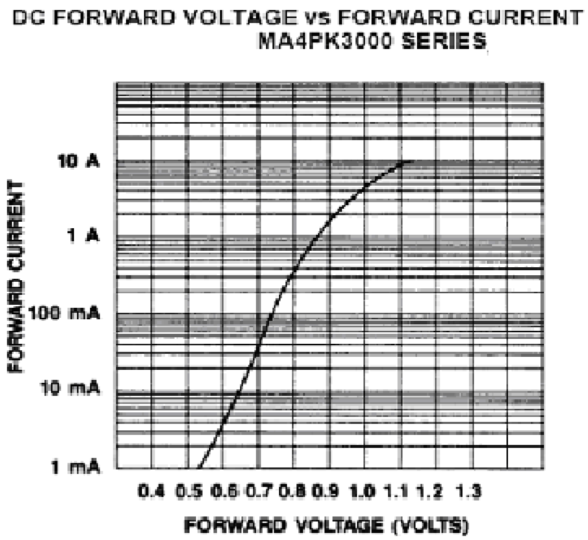
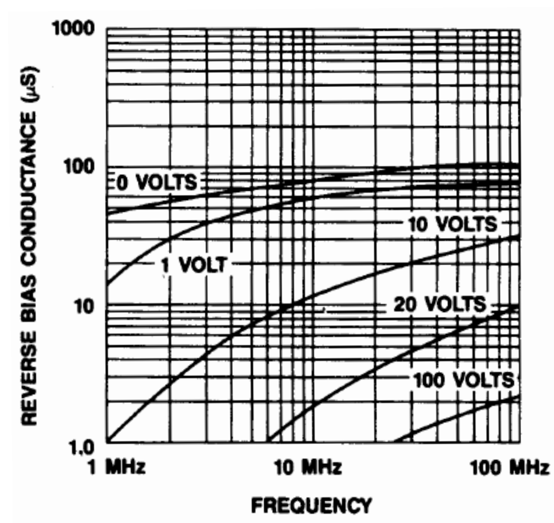
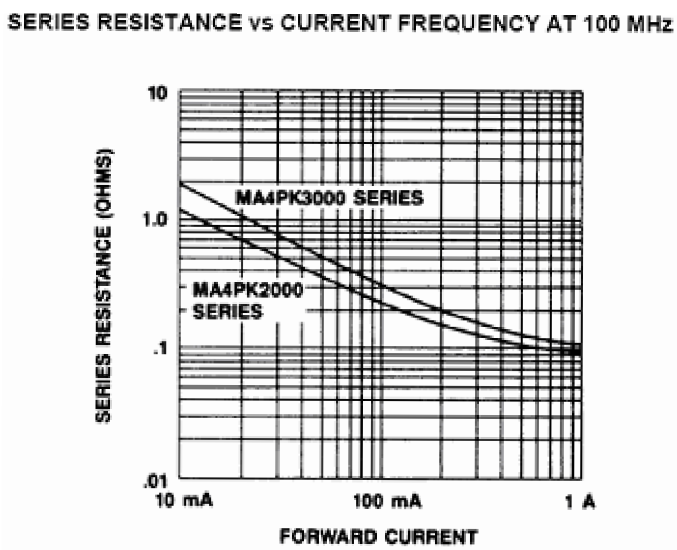
MA4PK3000 (3kV) Chip



Reverse Bias Conductance vs. Frequency and





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Die Handling and Bonding Information

Handling:

All semiconductor chips should be handled with care to avoid damage or contamination from perspiration, salts, and skin oils. The use of plastic tipped tweezers or vacuum pickup is strongly recommended for the handling and placing of individual components. Bulk handling should ensure that abrasion and mechanical shock are minimized.

Die Attach Surface:

Die can be mounted with an 80Au/Sn20, eutectic solder preform, RoHS compliant solders or electrically conductive silver epoxy. The metal RF and DC ground plane mounting surface must be free of contamination and should have a surface flatness of < ±0.002”.

Eutectic Die Attachment Using Hot Gas Die Bonder:

A work surface temperature of 255^{o}C is recommended. When hot forming gas (95%N/5%H) is applied, the work area temperature should be approximately 290^{o}C. The chip should not be exposed to temperatures greater than 320^{o}C for more than 10 seconds.

Eutectic Die Attachment Using Reflow Oven:

For recommended reflow profile refer to Application Note 538 “Surface Mounting Instructions”,

Electrically Conductive Epoxy Die Attachment:

A controlled amount of electrically conductive, silver epoxy, approximately 1 - 2 mils in thickness, should be used to minimize ohmic and thermal resistance. 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. Typically 150°C for 1 hour.

Wire and Ribbon Bonding:

The die anode bond pads have a Ti-Pt-Au metallization scheme, with a final gold thickness of 1.0 micron. Thermo-compression or thermo-sonic wedge bonding of either gold wire or ribbon is recommended. A bonder heat stage temperature setting of 200^{o}C, tool tip temperature of 150°C and a force of 18 to 50 grams is suggested. Ultrasonic energy may also be used but should be adjusted to the minimum amplitude required to achieve an acceptable bond. Excessive energy may cause the anode metallization to separate from the chip. Automatic ball or wedge bonding may also be used.

For more detailed handling and assembly instructions, see Application Note M541, “Bonding and Handling Procedures for Chip Diode Devices”.

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