GaAs PIN Diode Chips

V3

Features

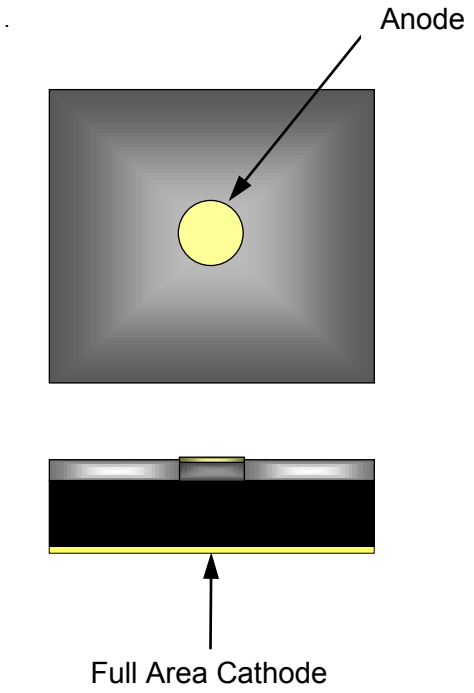
- May be Driven Directly by TTL Signals
- RoHS Compliant
- Low Series Resistance
- Fast Switching Speed
- No Reverse Bias Required
- RoHS Compliant

Description

Gallium Arsenide PIN diodes offer improved performance characteristics over silicon in many microwave semiconductor applications. These benefits result from the intrinsic semiconductor properties of GaAs. Its inherent high carrier mobility results in a low resistance fast switching device. The low carrier concentration in the I region layer produces a near zero punch through bias voltage. Gallium Arsenide's high band gap also assures it will operate at high operating temperatures.

Switching speeds in the low nanosecond range using an inexpensive TTL buffer logic is attainable with GaAs PIN diodes. This performance can be achieved because GaAs PIN diodes exhibit high impedance at a positive bias (up to .5V). Reverse bias is not required for many GaAs PIN diode applications. Low loss, in switch and phase shifter circuits at frequencies up to 40 GHz is possible as a result of low parasitic series resistance in the conducting and non-conducting states.

M/A-COM's Technology Solutions GaAs PIN diode chips are also available in several different package styles. (See page 4 of this datasheet)



Absolute Maximum Ratings[1]

Parameter	Maximum Value
Operating Temperature	-65°C to +175°C
Storage Temperature	-65°C to +175°C
Power Dissipation	0.25W @ 25°C
Junction Temperature	+175°C
Mounting Temperature	+320°C for 10 seconds

1. **Exceeding these limits may cause permanent damage.**

MIL-STD 750 Environmental Ratings

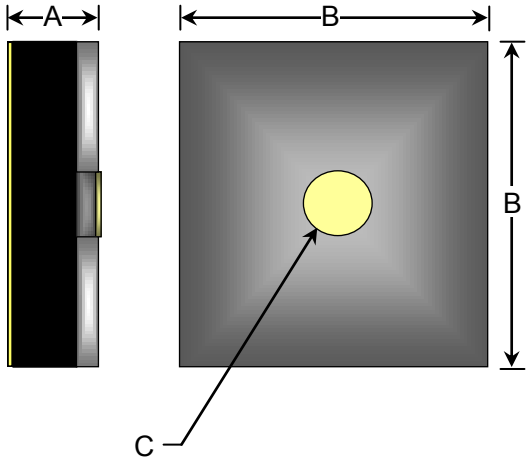
Parameter	Method	Level
Temp. Cycling	1051	5cycles -65°C to +150°C
Vibration	2056	15g's
Constant Acceleration	2006	20,000g"s
Moisture Resistance (Packaged diodes)	1021	10 Days

GaAs Chip Specification @ T_{AMB} = +25°C

Part Number	*Max. Rev. Volt.*[1] *V_R < 10 µA* V_{DC}	*Max. Cap. 1 MHz C_j @ -10 V* pF	*Max. Series Res.*[2] *1 GHz R_S @ 20 mA* Ω	*Nominal Characteristics*	
				Carrier Lifetime T_L @ I_{FOR} = 10 mA I_{REV} = 6 mA ηS	*Switching Speed*[3] *7 GHz* ηS
MA4GP022-277	50	0.15	1.0	20	10
MA4GP030-277 [4]	100	0.06	2.0	25	15

Notes:
1. V_R (Reverse Voltage) is sourced and the resultant reverse leakage current, Ir, is measured to be <10µA.
2. Chip is mounted into case style ODS 30 ceramic package.
3. Switching speed is measured between 1 dB and 20 dB loss in a shunt mounted switch.
4. Available as chip with flying leads. Part number is MADP-000030-13930G.

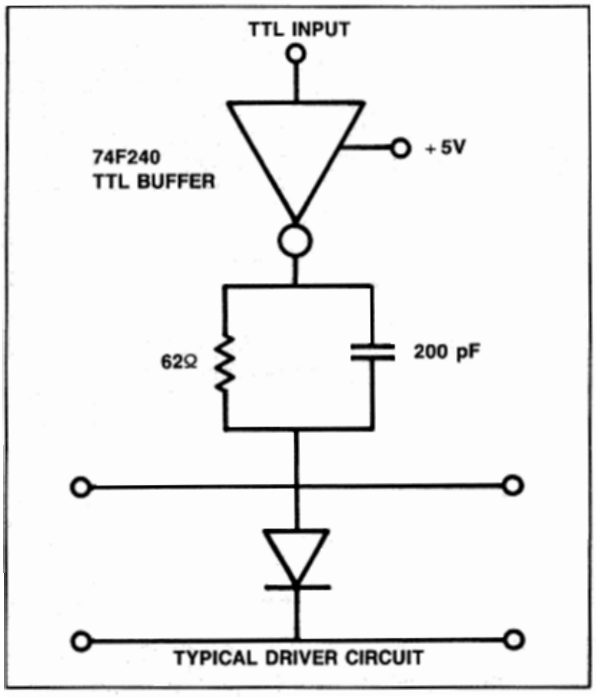
Case Style 277 (Chip)



Anode

Dimension	Mils	Millimeters
A	7 ± .5	.178 ± .013
B	11 ± 1	.279 ± .025
C	2.2 ± .3	.056 ± .008

Typical TTL Driver Circuit



Typical Performance @ T_{AMB} = +25°C

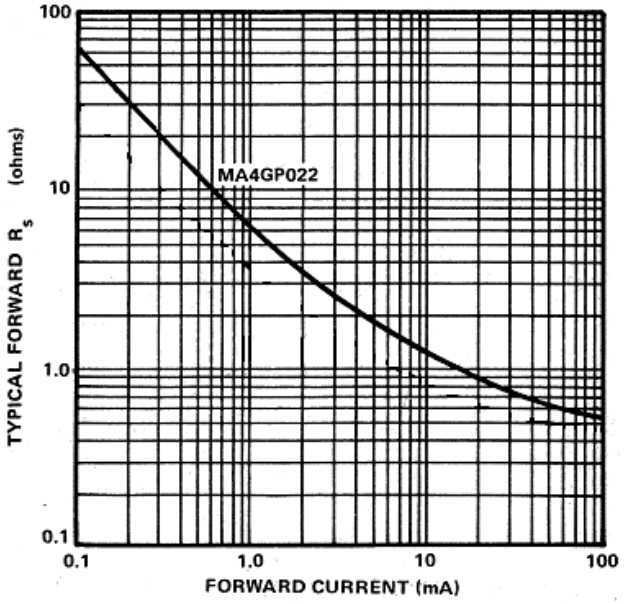


FIGURE 1. Typical Forward R_S vs. Forward Current at 1 GHz

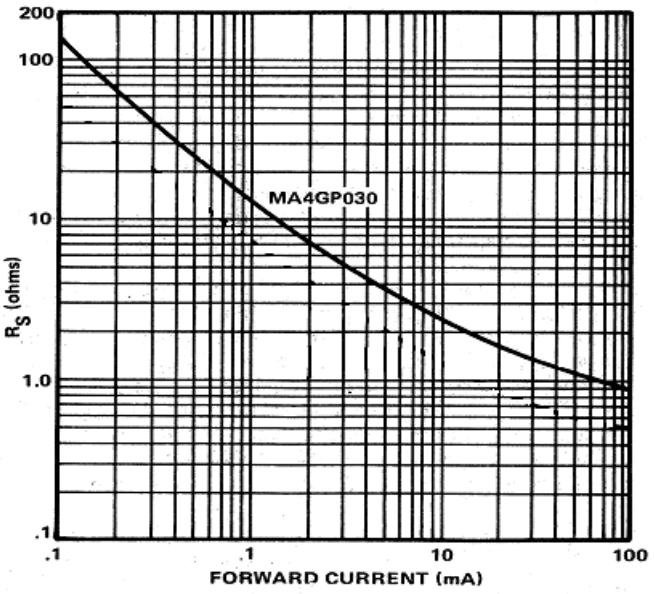


FIGURE 2. Typical Forward R_S vs. Forward Current at 1 GHz

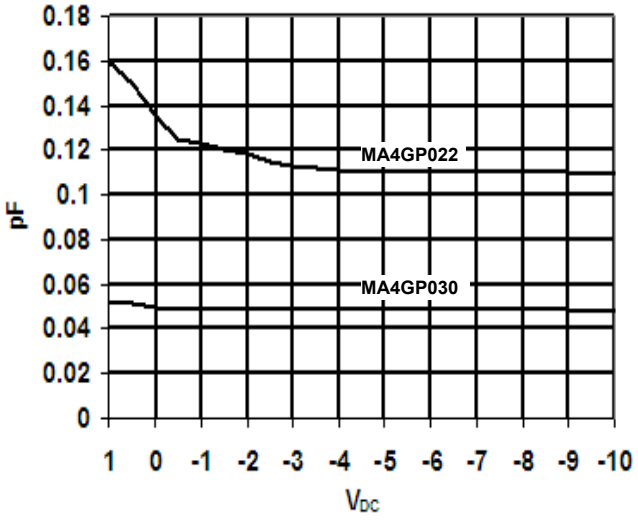


Figure 3. Typical Capacitance vs. Voltage at 1 GHz

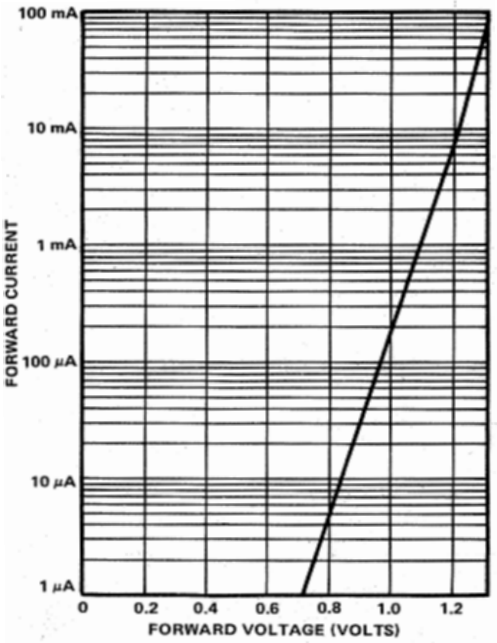


FIGURE 4. Typical Characteristics at 25° C Forward Current vs. Forward Voltage (All GaAs PIN Diodes)

Ordering Information

The GaAs Chip Specifications shown in the table on page 2 are for the stand alone die, package style 277. Note that the table lists the bare die junction capacitance and that the total capacitance for the base part in an alternative package will differ. The total capacitance in an alternative package can be computed by adding the capacitance shown in the table on page 2 to the parasitic capacitance of the alternative package as defined in the **Package Parasitics** table below. The base part numbers are only available in the case styles shown in the **Package Style Availability** table below. To order, indicate the base part number followed by a dash and the desired package style.

***For example*:** The MA4GP030-30 is the MA4GP030 chip in the 30 style package.

Package Parasitics

Package Style	Inductance (nH)	Cap. (pF)
30	0.40	0.18
120	0.40	0.13
137	0.40	0.13
276	0.40	0.13
277	N/A (Chip)	N/A (Chip)
1056	0.20	0.20
1393*	See note*	See note*

Note: Chip with flying leads. Inductance and capacitance will vary according to final lead length after installation.

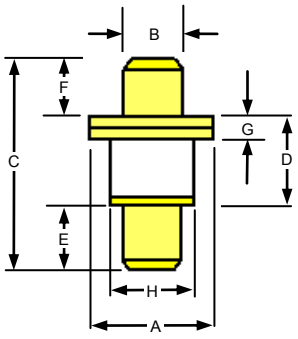
Package Style Availability

Base Part Number	Package Styles
MA4GP022	137, 277
MA4GP030	30, 120, 276, 277, 1056, 1393*

***Note:**To order the MA4GP030 chip with flying leads use part number MADP-000030-13930G.

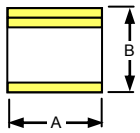
Alternative Package Styles

Style 30



Dimension	Mils	Millimeters
A	121 ± 4	3073 ± 102
B	62 ± 2	1575 ± 51
C	215 ± 10	5461 ± 254
D	91 ± 6	2311 ± 152
E	62 ± 2	1575 ± 51
F	62 ± 2	1575 ± 51
G	20 ± 4	508 ± 102
H	81 ± 2	2057 ± 51

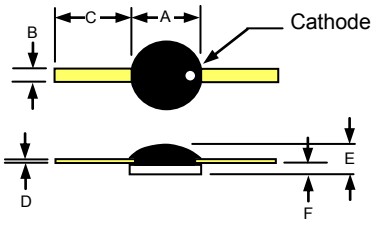
Style 120



Dimension	Mils	Millimeters
A	53 ± 2	1346 ± 51
B	45 ± 5	1143 ± 127

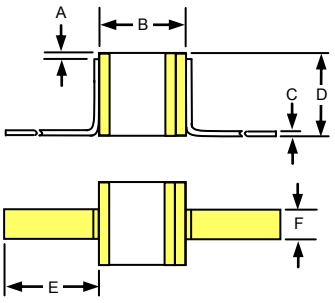
Alternative Package Styles (cont'd)

Style 137



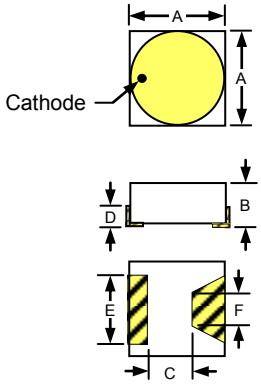
Dimension	mils	mm
A	100 ± 10	2540 ± 254
B	20 ± 2	508 ± 51
C	100 ± 5	2540 ± 127
D	4 ± 1	102 ± 25
E	50 max.	1270 max.
F	14 max.	356 max.

Style 276



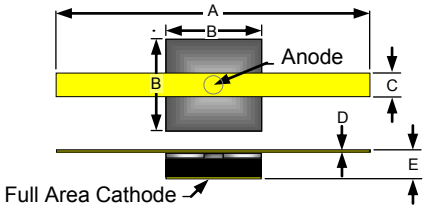
Dimension	mils	mm
A	15 ± 5	381 ± 127
B	45 ± 5	1143 ± 127
C	5 max.	127 max.
D	53 ± 2	1346 ± 51
E	200 min.	5080 min.
F	20 ± 1	508 ± 25

Style 1056



Dimension	mils	mm
A	70 ± 5	1778 ± 127
B	37 ± 4	940 ± 102
C	33 ± 3	838 ± 76
D	15 ± 2	381 ± 51
E	12 ± 2	305 ± 51
F	48 ± 5	1219 ± 127

Style 1393



Dimension	mils	mm
A	300 ± 50	7.62 ± 1.27
B	12 ±1	0.305 ± 0.025
C	5 ± 1	0.127 ± 0.025
D	0.25 ± .05	0.0064 ± 0.0013
E	7 ± 1	0.178 ± 0.025

Die Handling and Mounting 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 pickups is strongly recommended for 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 or electrically conductive silver epoxy. The metal RF and D.C. 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°C is recommended. When hot forming gas is applied, the work area temperature should be approximately 290°C. The chip should not be exposed to temperatures greater than 320°C for more than 10 seconds.

Eutectic Die Attachment Using Reflow Oven: See Application Note M538 pgs 13&14, "Surface Mounting Instructions" at www.macomtech.com for recommended time-temperature profile.

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: It is recommended that thermo-compression or thermo-sonic bonding be used with little or no ultrasonic power. The wire or ribbon used should be smaller than the anode contact diameter. A bonder heat stage temperature setting of 200°C, tool tip temperature of 150°C and a force of 18 to 50 grams is suggested. If ultrasonic scrubbing is necessary, the amplitude should be adjusted to the minimum level required to achieve a good bond. Use of excessive energy may cause the GaAs to fracture and the metallization on the anode to delaminate from the chip.

For more detailed handling and assembly instructions, see Application Note M541, "Bonding and Handling Procedures for Chip Diode Devices" at www.macomtech.com.