

# MA4P MELF & HIPAX™ Series

## High Power PIN Diodes

V14

### Features

- ◆ High Power Handling
- ◆ Low Loss / Low Distortion
- ◆ Voltage Ratings up to 1000 Volts
- ◆ Passivated Chip for Low Leakage Current
- ◆ Low Theta ( $\theta$ ) Due to Full Face Chip Bonding
- ◆ Leadless Low Inductance MELF Packages
- ◆ Various Package Options
- ◆ Available as Chips
- ◆ Fully RoHS Compliant
- ◆ Non-Magnetic Packages Available for MRI

### Description

M/A-COM Technology Solutions MELF and HIPAX PIN diode series are designed for usage in switch and attenuator applications requiring high power handling and low distortion. The MELF and HIPAX PIN diodes incorporate a fully passivated PIN diode chip resulting in an extremely low reverse bias leakage current. The semiconductor technology utilized in the MELF and HIPAX families draws on M/A-COM Tech's substantial experience in PIN diode design and wafer fabrication. The result is a device which has a thick I-region and long carrier lifetime while maintaining low series resistance and capacitance values. The chips of the MELF and HIPAX PIN diodes are enclosed in a rugged ceramic package and is full face bonded to metal pins on both the anode and cathode. The result is a low loss PIN diode with low thermal resistance due to symmetrical thermal paths. The parts are offered in either magnetic or non-magnetic, HIPAX (axial leaded) or Metal Electrode Leadless Faced (MELF) surface mount packages for MRI applications. The MELF is a rectangular SMQ, package which is designed for high volume tape and reel assembly. This easy to use package design makes automatic pick and place, indexing and assembly, extremely easy. The parallel flat surfaces are suitable for most key jaw or vacuum pick-up techniques. All of the solderable surfaces are tin plated and compatible with industry standard reflow and vapor phase soldering processes. See page 7 of Application Note [M538](#) on the [M/A-COM Technology Solutions](#) website for a typical solder reflow profile.

### Package Styles



401 &amp; 402



1072 &amp; 1091

### Applications

HIPAX PIN diodes are designed for use in a wide variety of switch and attenuator applications from HF through UHF frequencies and at power levels above 1kW, CW. The internal chip as well as each diode assembly has been comprehensively tested and characterized to ensure predictable and repeatable performance.

### Design Recommendations

- ◆ Low Distortion Attenuators
  - MA4P4301B
- ◆ Surface Mount Switches
  - MA4P7101F
- ◆ Cellular Radio Antenna Switches
  - MA4P1200, MA4P1250

### Absolute Maximum Ratings

 $T_{AMB} = +25^{\circ}\text{C}$  (Unless Otherwise Noted) <sup>1</sup>

| Parameter                           | Absolute Maximum      |
|-------------------------------------|-----------------------|
| D.C. Reverse Voltage ( $V_R$ )      | (See Tables)          |
| Operating Chip Junction Temperature | -55°C to +175°C       |
| Storage Temperature                 | -55°C to +200°C       |
| Installation Temperature            | +280°C for 30 Seconds |
| ESD                                 | Class 1A, HBM         |

### Notes

1. Operation of this device above any one of these parameters may cause permanent damage.

<sup>1</sup> **ADVANCED:** Data Sheets contain information regarding a product M/A-COM Technology 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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### MA4P1000 Series Electrical Specifications @ $T_{AMB} = +25^{\circ}\text{C}$

| Part Number<br>(NM Indicates Non-Magnetic) | $V_R$<br>Reverse Voltage<br>$V_{DC}$       |                   | $C_T$<br>Total Capacitance<br>pF                                 |         | $R_S$<br>Series Resistance<br>$\Omega$                              |         | $R_P$<br>Parallel Resistance<br>k $\Omega$                        |
|--------------------------------------------|--------------------------------------------|-------------------|------------------------------------------------------------------|---------|---------------------------------------------------------------------|---------|-------------------------------------------------------------------|
|                                            | <u>Condition</u><br>$I_R = 10 \mu\text{A}$ |                   | <u>Conditions</u><br>$f = 1 \text{ MHz}$<br>$V_R = 50 \text{ V}$ |         | <u>Conditions</u><br>$f = 100 \text{ MHz}$<br>$I_F = 50 \text{ mA}$ |         | <u>Conditions</u><br>$f = 100 \text{ MHz}$<br>$V_R = 0 \text{ V}$ |
|                                            | MINIMUM                                    | MAXIMUM<br>RATING | TYPICAL                                                          | MAXIMUM | TYPICAL                                                             | MAXIMUM | MINIMUM                                                           |
| MA4P1200 - 401T                            | 50                                         | 100               | 1.2                                                              | 1.5     | 0.5                                                                 | 0.75    | 5                                                                 |
| MA4P1200NM - 401T                          | 50                                         | 100               | 1.2                                                              | 1.5     | 0.5                                                                 | 0.75    | 5                                                                 |
| MA4P1250 -1072T                            | 50                                         | 100               | 0.8                                                              | 1.2     | 0.5                                                                 | 0.75    | 5                                                                 |
| MA4P1250NM -1072T                          | 50                                         | 100               | 0.8                                                              | 1.2     | 0.5                                                                 | 0.75    | 5                                                                 |
| MA4P1450 -1091T                            | 50                                         | 100               | 1.8                                                              | 2.5     | 0.5                                                                 | 0.75    | 5                                                                 |

| Part Number<br>(NM Indicates Non-Magnetic) | $V_F$<br>Forward Voltage<br>(Max. $I_{Forward} @ 1\text{V} \leq 1.5\text{A}$ ) |                   | $T_L$<br>Carrier Lifetime                  |         | Forward Bias<br>Harmonic Distortion<br>$R(2a/a) * R(3a/a)$ |         | Reverse Bias<br>Harmonic Distortion<br>$R(2a/a) - R(3a/a)$ |         |
|--------------------------------------------|--------------------------------------------------------------------------------|-------------------|--------------------------------------------|---------|------------------------------------------------------------|---------|------------------------------------------------------------|---------|
|                                            | <u>Condition</u><br>$I_F = 50 \text{ mA}$                                      |                   | <u>Conditions</u><br>$I_F = 10 \text{ mA}$ |         | <u>Conditions</u><br>$f = 100 \text{ MHz}$                 |         | <u>Conditions</u><br>$f = 100 \text{ MHz}$                 |         |
|                                            | TYPICAL                                                                        | MAXIMUM<br>RATING | MINIMUM                                    | TYPICAL | MINIMUM                                                    | TYPICAL | MINIMUM                                                    | TYPICAL |
| MA4P1200 - 401T                            | 0.85                                                                           | 1.0               | 2                                          | 8       | 80                                                         | 90      | 60                                                         | 70      |
| MA4P1200NM - 401T                          | 0.85                                                                           | 1.0               | 2                                          | 8       | 80                                                         | 90      | 60                                                         | 70      |
| MA4P1250 -1072T                            | 0.85                                                                           | 1.0               | 2                                          | 8       | 80                                                         | 90      | 60                                                         | 70      |
| MA4P1250NM -1072T                          | 0.85                                                                           | 1.0               | 2                                          | 8       | 80                                                         | 90      | 60                                                         | 70      |
| MA4P1450 -1091T                            | 0.85                                                                           | 1.0               | 2                                          | 8       | 80                                                         | 90      | 60                                                         | 70      |

#### \*Notes:

- 1.) "NM" in the base part number signifies non-magnetic package.
- 2.) "T" suffix denotes tape and reel

### Power Dissipation and Thermal Resistance Ratings @ $T_{AMB} = +25^{\circ}\text{C}$

| Package Style   | CONDITION         | MA4P1200(NM)-401T |                 | MA4P1250(NM)-1072T |                 | MA4P1450-1091T    |                 |
|-----------------|-------------------|-------------------|-----------------|--------------------|-----------------|-------------------|-----------------|
|                 |                   | P <sub>DISS</sub> | θ <sub>JC</sub> | P <sub>DISS</sub>  | θ <sub>JC</sub> | P <sub>DISS</sub> | θ <sub>JC</sub> |
| B<br>Axial Lead | No Heatsink       | 1.5 W             | 15°C/W          | —                  | —               | —                 | —               |
|                 | Lead Length 1/4"  | 5.5W              |                 | —                  | —               | —                 | —               |
| F<br>MELF       | No Heatsink       |                   |                 | 6W                 | 15°C/W          | 10W               | 5°C/W           |
|                 | Infinite Heatsink |                   |                 | 18W                |                 | 30W               |                 |

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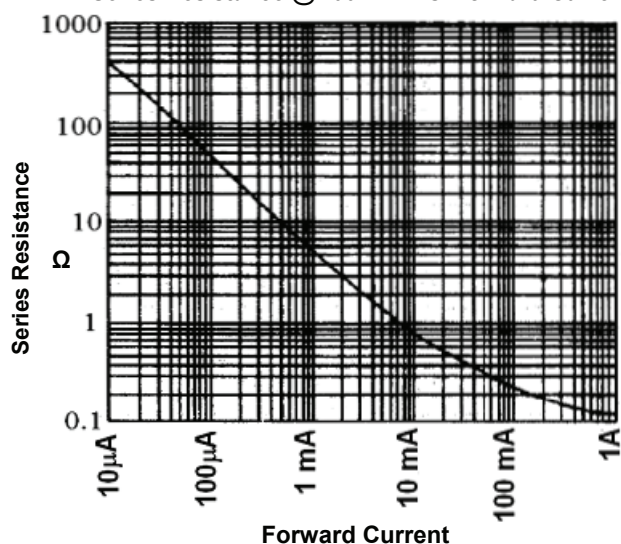
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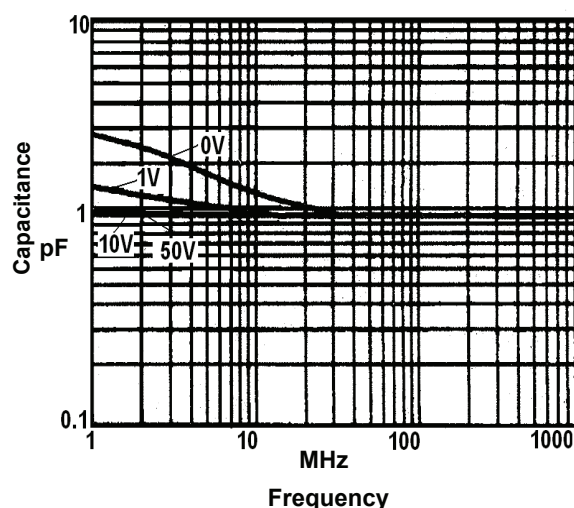
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### Typical Performance Curves @ $T_{AMB} = +25^{\circ}\text{C}$ MA4P1200 Series

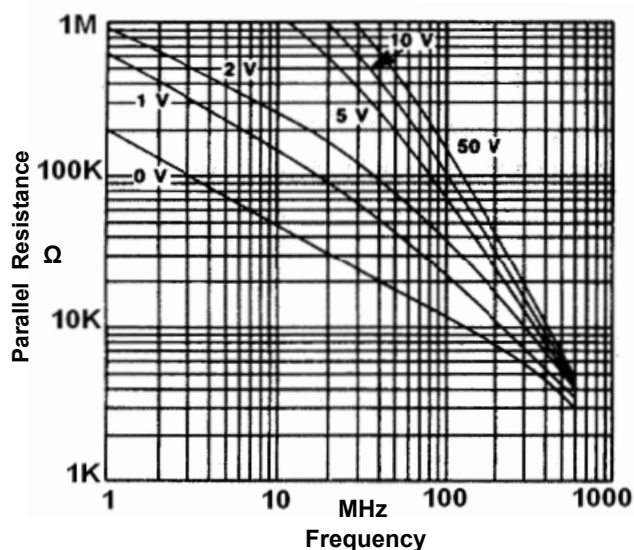
Series Resistance @ 100 MHz vs. Forward Current



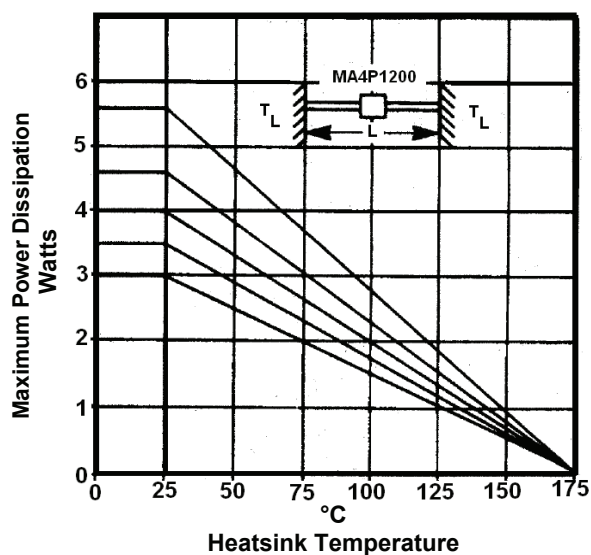
Capacitance vs. Frequency & Reverse Bias



Parallel Resistance vs. Frequency & Reverse Bias



Heatsink Temperature vs. Max. Power Dissipation



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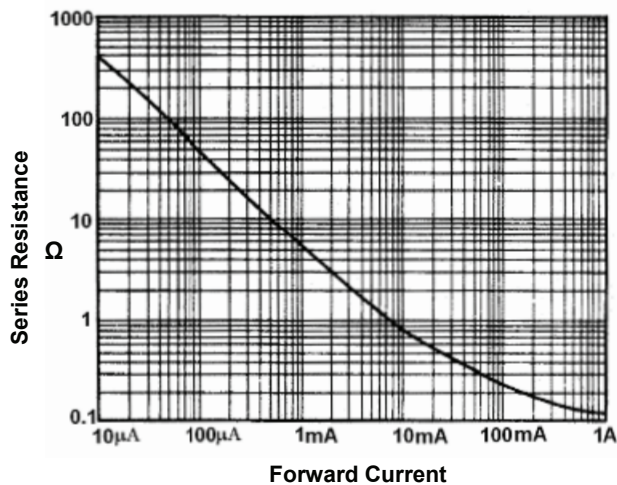
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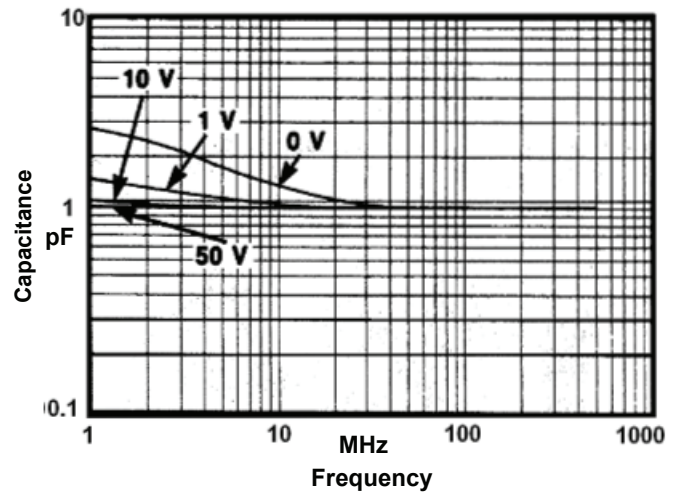
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### Typical Performance Curves @ $T_{AMB} = +25^{\circ}\text{C}$ MA4P1250 Series

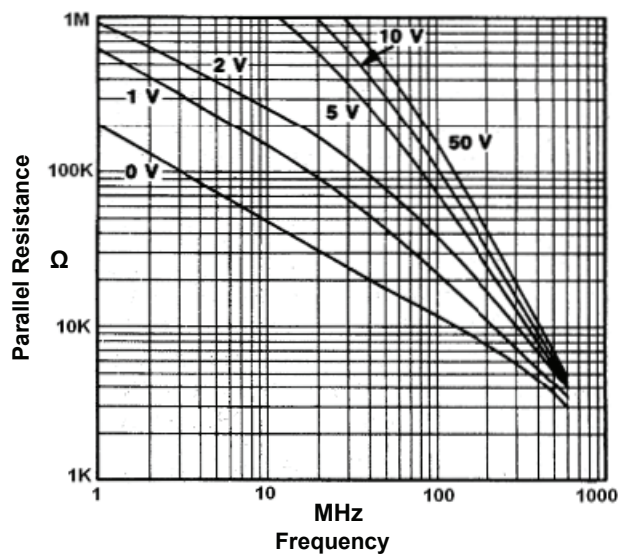
Series Resistance @ 100 MHz vs. Forward Current



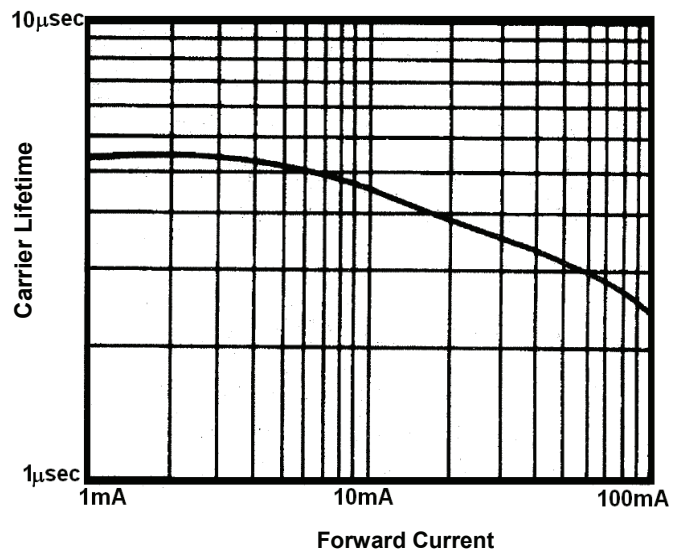
Capacitance vs. Frequency & Reverse Bias



Parallel Resistance vs. Frequency & Reverse Bias



Carrier Lifetime vs. Forward Bias Current





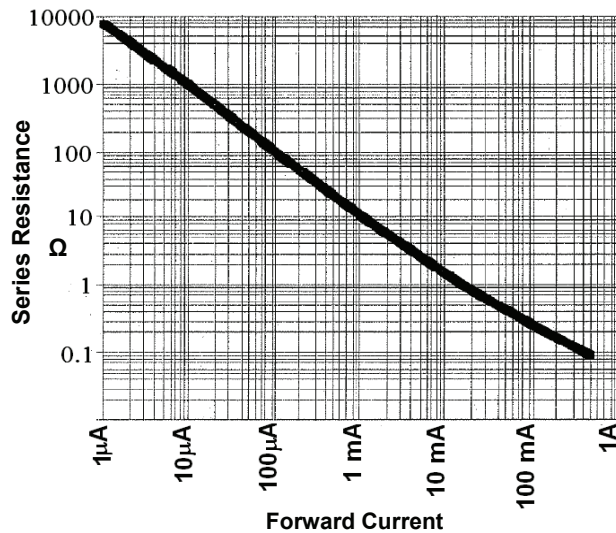
# MA4P MELF & HIPAX™ Series

## High Power PIN Diodes

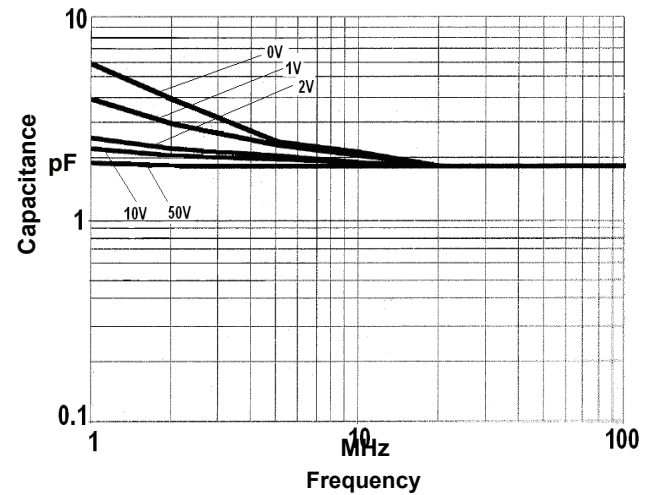
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### Typical Performance Curves @ $T_{AMB} = +25^{\circ}\text{C}$ MA4P1450 Series

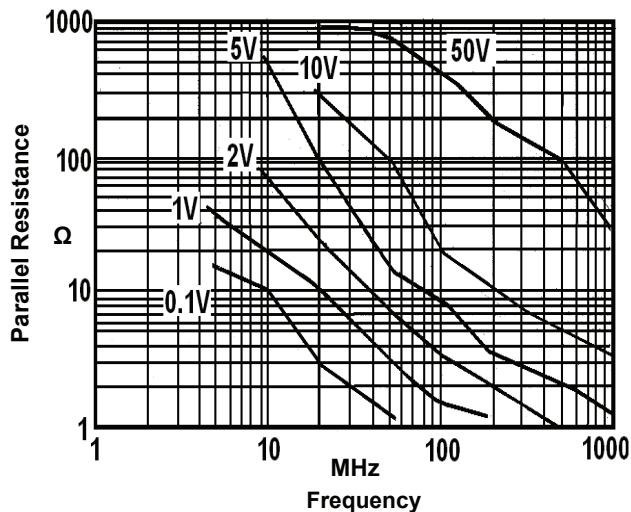
Series Resistance @ 100 MHz vs. Forward Current



Capacitance vs. Frequency and Reverse Bias



Parallel Resistance vs. Frequency and Reverse Bias



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### MA4P4000 - MA4P7100 Series Electrical Specifications @ $T_{AMB} = +25^{\circ}\text{C}$

| Parameter                   | Symbol | Condition              | MA4P4000 Series   | MA4P4300 Series   | MA4P7000 Series   | MA4P7100 Series   |
|-----------------------------|--------|------------------------|-------------------|-------------------|-------------------|-------------------|
| Maximum Series Resistance   | $R_S$  | $I_F = 100 \text{ mA}$ | 0.5 $\Omega$      | 1.0 $\Omega$      | 0.9 $\Omega$      | 0.5 $\Omega$      |
| Maximum Total Capacitance   | $C_T$  | $V_R = 100 \text{ V}$  | 2.2 pF            | 2.0 pF            | 0.7 pF            | 1.0 pF            |
| Minimum Parallel Resistance | $R_P$  | $V_R = 100 \text{ V}$  | 20 k $\Omega$     | 50 k $\Omega$     | 200 k $\Omega$    | 100 k $\Omega$    |
| Minimum Carrier Lifetime    | $T_L$  | $I_F = 10 \text{ mA}$  | 20 $\mu\text{s}$  | 15 $\mu\text{s}$  | 5 $\mu\text{s}$   | 2.5 $\mu\text{s}$ |
| Maximum Forward Voltage     | $V_F$  | $I_F = 100 \text{ mA}$ | 1.0 V             | 1.2 V             | 1.0 V             | 1.0 V             |
| Maximum Reverse Current     | $I_R$  | At max. rated voltage  | 1 $\mu\text{A}$   | 1 $\mu\text{A}$   | 1 $\mu\text{A}$   | 1 $\mu\text{A}$   |
| Nominal I-Region Width      | $\mu$  | —                      | 175 $\mu\text{m}$ | 300 $\mu\text{m}$ | 175 $\mu\text{m}$ | 100 $\mu\text{m}$ |

### Maximum Reverse Voltage Rating ( $V_R$ )

| Maximum Reverse Voltage Rating | MA4P4000 Series                                     | MA4P4300 Series                  | MA4P7000 Series                   | MA4P7100 Series                   |
|--------------------------------|-----------------------------------------------------|----------------------------------|-----------------------------------|-----------------------------------|
| 100 Volts                      | MA4P4001B-402<br>MA4P4001BNM-402<br>MA4P4001F-1091T | MA4P4301B-402<br>MA4P4301F-1091T | MA4P7001F-1072T                   | MA4P7101B-401T<br>MA4P7101F-1072T |
| 200 Volts                      | MA4P4002B-402<br>MA4P4002F-1091T                    | MA4P4302B-402                    | MA4P7002B-401T<br>MA4P7002F-1072T | MA4P7102B-401T<br>MA4P7102F-1072T |
| 400 Volts                      | —                                                   | —                                | —                                 | MA4P7104B-401T<br>MA4P7104F-1072T |
| 600 Volts                      | MA4P4006F-1091T<br>MA4P4006B-402                    | —                                | MA4P7006B-401T<br>MA4P7006F-1072T | —                                 |

#### \*Notes:

- 1.) "NM" in the base part number signifies non-magnetic package.
- 2.) "T" suffix denotes tape and reel

| Package Style     | Condition                      | MA4P4000 Series |               | MA4P4300 Series |               | MA4P7000 Series |               | MA4P7100 Series |               |
|-------------------|--------------------------------|-----------------|---------------|-----------------|---------------|-----------------|---------------|-----------------|---------------|
|                   |                                | $P_{DISS}$      | $\theta_{JC}$ | $P_{DISS}$      | $\theta_{JC}$ | $P_{DISS}$      | $\theta_{JC}$ | $P_{DISS}$      | $\theta_{JC}$ |
| B<br>Axial Leaded | 1/4" Lead Length               | 12 W            | 12.5°C/W      | 10 W            | 15°C/W        | 5 W             | 30°C/W        | 6 W             | 25°C/W        |
|                   | No Heatsink                    | 2.5 W           | —             | 2.5 W           | —             | 1.5 W           | —             | 1.5 W           | —             |
| F<br>MELF         | Infinite Heatsink              | 7.5 W           | 20°C/W        | 5 W             | 30°C/W        | 10 W            | 15°C/W        | 11.5 W          | 13°C/W        |
| Both B and F      | Single 1 $\mu\text{s}$ pulse   | 100 kW          | —             | 100 kW          | —             | 15 kW           | —             | 15 kW           | —             |
| Both B and F      | Single 100 $\mu\text{s}$ pulse | 5 kW            | 0.03°C/W      | 5 kW            | 0.03°C/W      | 300 W           | 0.5°C/W       | 300 W           | 0.5°C/W       |

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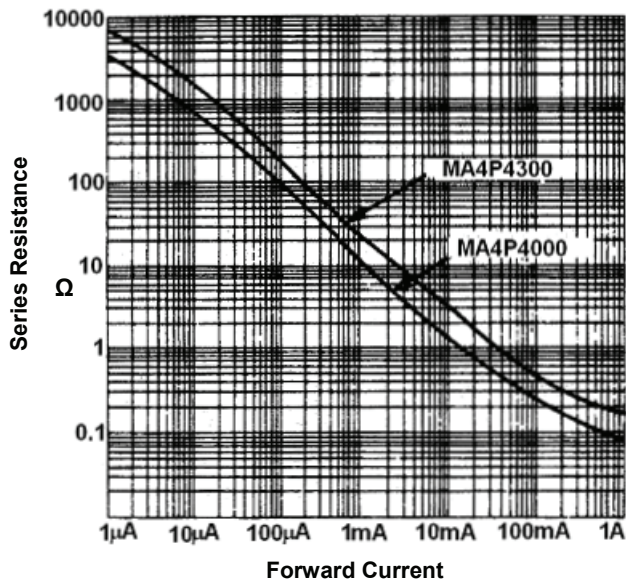
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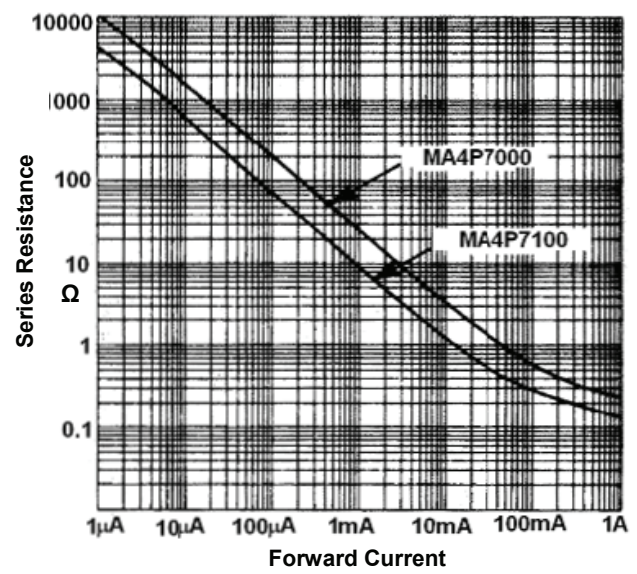
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### Typical Performance Curves @ $T_{AMB} = +25^{\circ}\text{C}$ MA4P4000, MA4P4300, MA4P7000, MA4P7100 Series

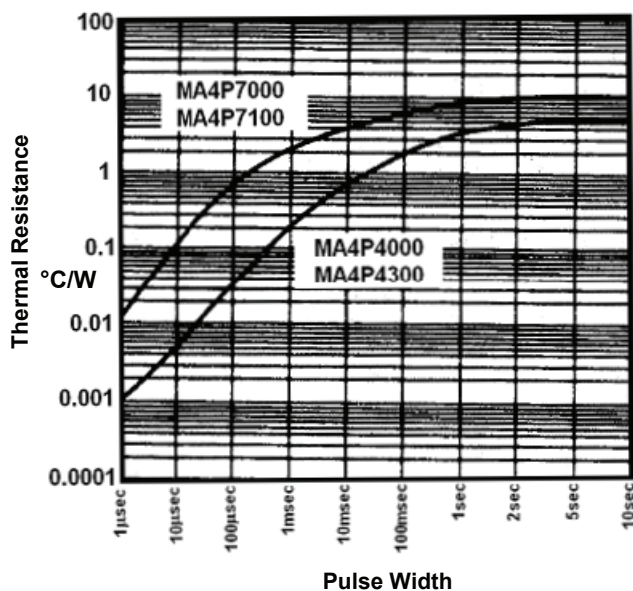
Series Resistance at 100 MHz vs. Forward Current  
MA4P4000, MA4P4300 Series



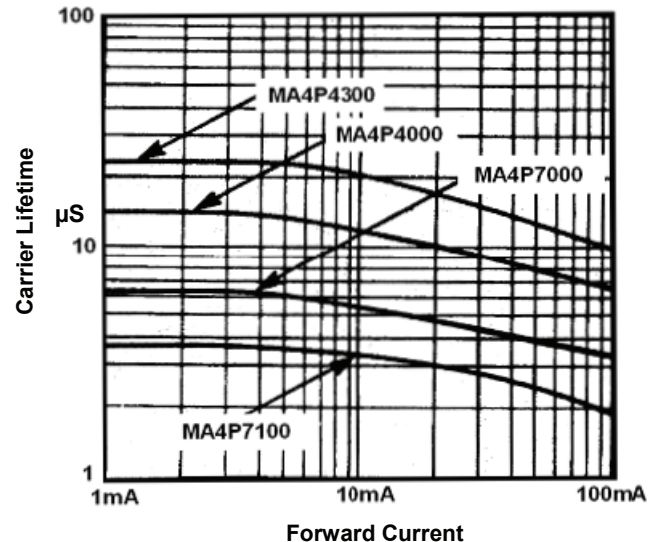
Series Resistance at 100 MHz vs. Forward Current  
MA4P7000, MA4P7100 Series



Thermal Resistance vs. Pulse Width  
MA4P4000, MA4P4300, MA4P7000 & MA4P7100 Series



Carrier Lifetime vs. Forward Bias Current  
MA4P4000, MA4P4300, MA4P7000 & MA4P7100 Series



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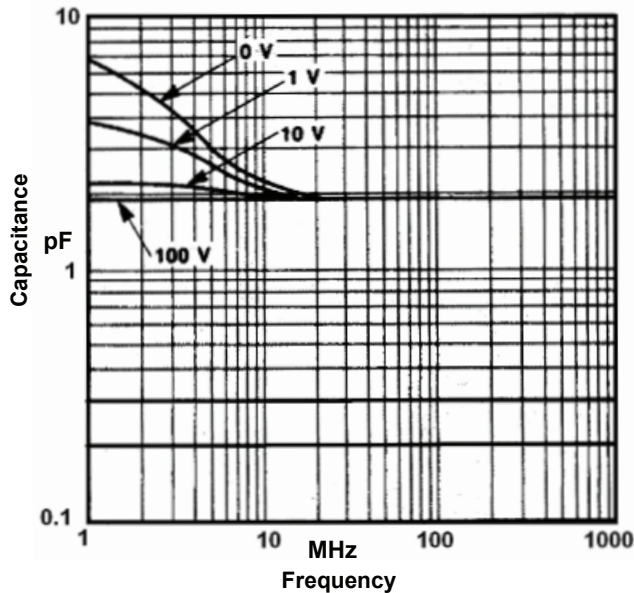
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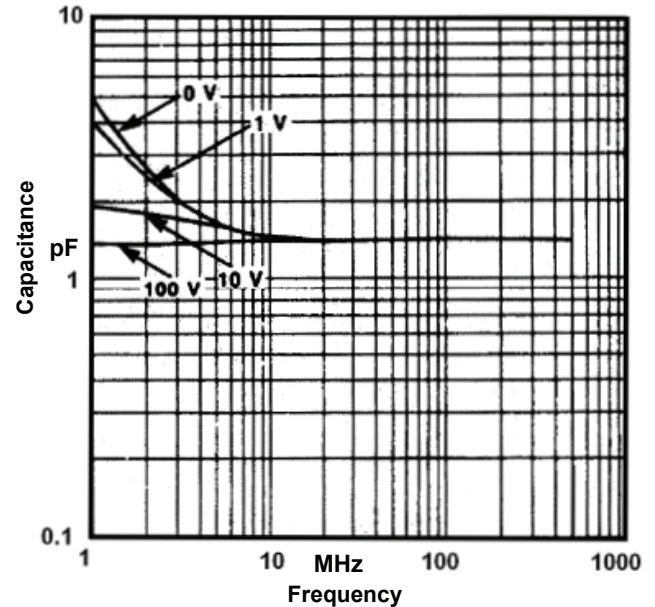
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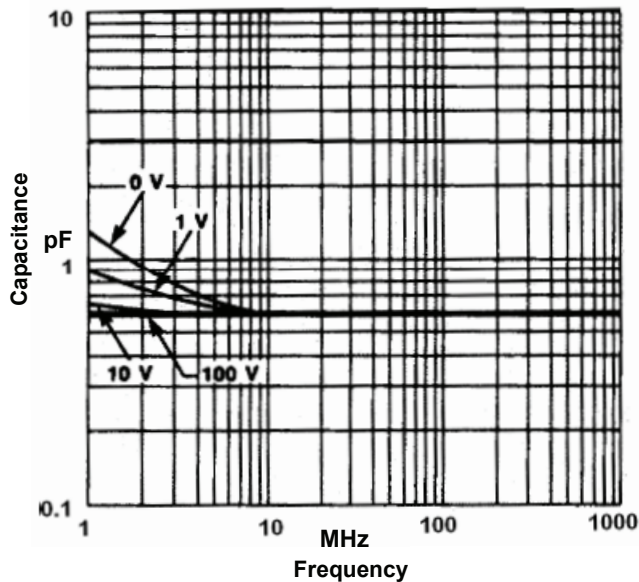
Capacitance vs. Frequency & Reverse Bias  
MA4P4000 Series



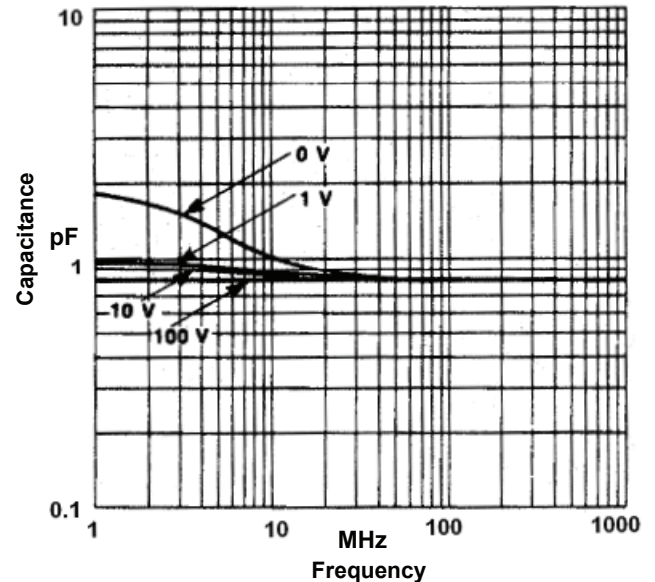
Capacitance vs. Frequency & Reverse Bias  
MA4P4300 Series



Capacitance vs. Frequency & Reverse Bias  
MA4P7000 Series



Capacitance vs. Frequency & Reverse Bias  
MA4P7100 Series



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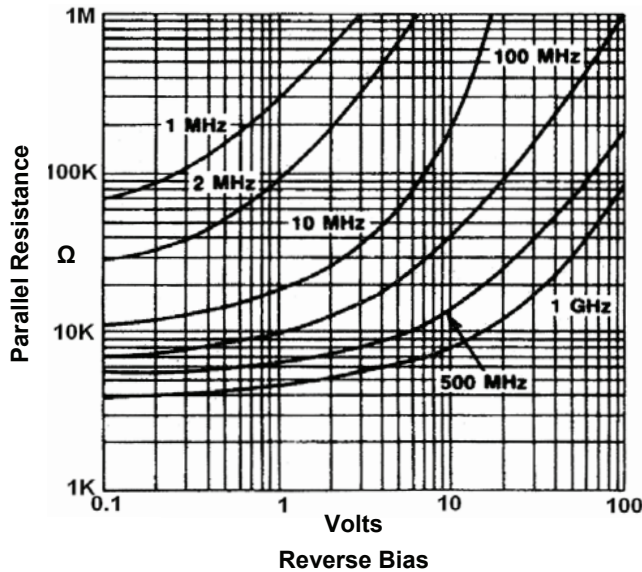
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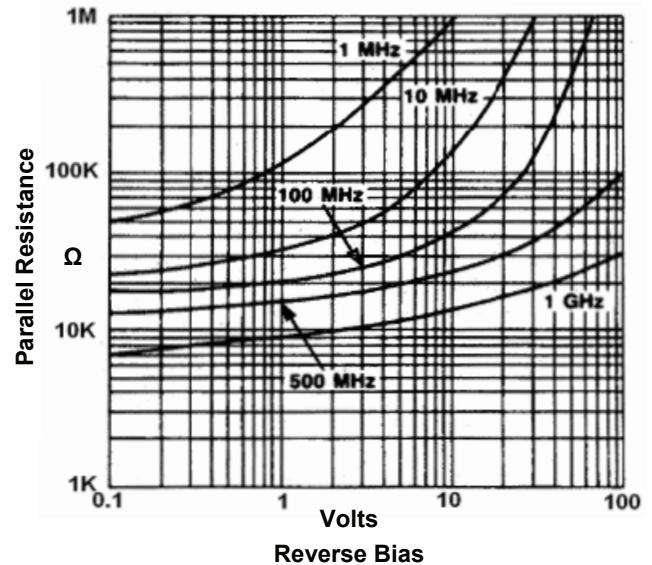
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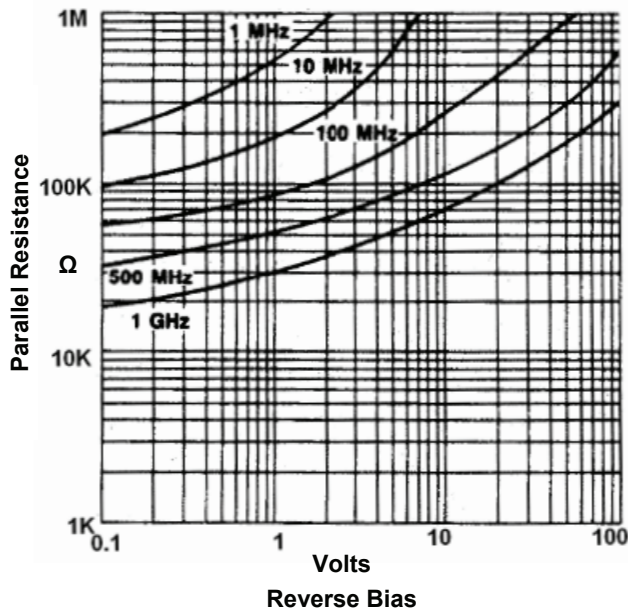
Parallel Resistance vs. Reverse Bias & Frequency  
MA4P4000 Series



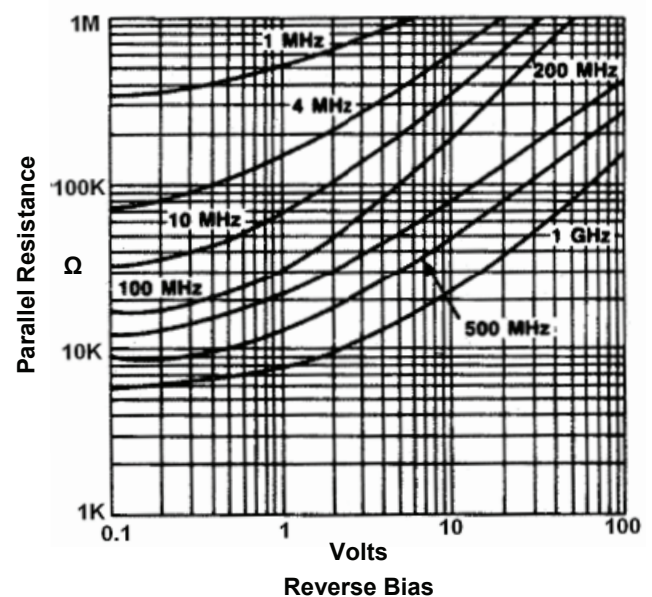
Parallel Resistance vs. Reverse Bias & Frequency  
MA4P4300 Series



Parallel Resistance vs. Reverse Bias & Frequency  
MA4P7000 Series



Parallel Resistance vs. Reverse Bias & Frequency  
MA4P7100 Series



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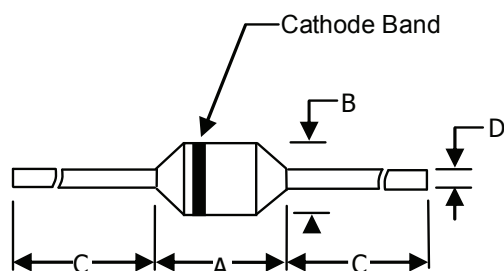
# MA4P MELF & HIPAX™ Series

## High Power PIN Diodes

V14

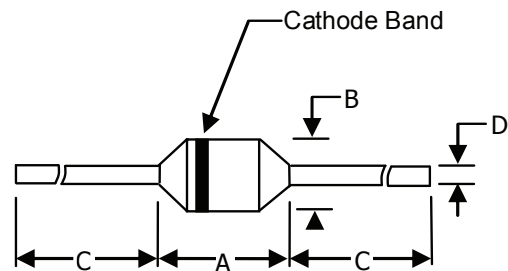
### Case Styles

#### 401 Axial Leaded Packages



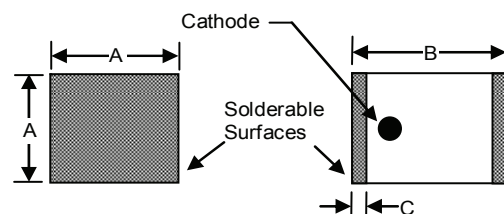
| 401 Package<br>(tape and reel only)<br>500 or 1000pcs/reel<br>specify when ordering                                        | Dimension | INCHES |       | MM    |      |
|----------------------------------------------------------------------------------------------------------------------------|-----------|--------|-------|-------|------|
|                                                                                                                            |           | MIN.   | MAX.  | MIN.  | MAX. |
| MA4P1200-401T<br>MA4P1200NM-401T<br>MA4P7002B-401T<br>MA4P7006B-401T<br>MA4P7101B-401T<br>MA4P7102B-401T<br>MA4P7104B-401T | A         | —      | 0.130 | —     | 3.30 |
|                                                                                                                            | B         | —      | 0.090 | —     | 2.29 |
|                                                                                                                            | C         | 0.975  |       | 24.77 | —    |
|                                                                                                                            | D         | 0.027  | 0.029 | 0.69  | 0.74 |

#### 402 Axial Leaded Packages



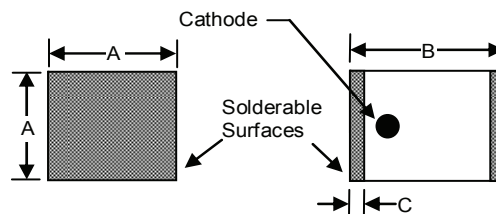
| 402 Package<br>(bulk only)<br>100pcs/bag                                                             | Dimension | INCHES |       | MM    |      |
|------------------------------------------------------------------------------------------------------|-----------|--------|-------|-------|------|
|                                                                                                      |           | MIN.   | MAX.  | MIN.  | MAX. |
| MA4P4001B-402<br>MA4P4001BNM-402<br>MA4P4002B-402<br>MA4P4006B-402<br>MA4P4301B-402<br>MA4P4302B-402 | A         | —      | 0.230 | —     | 5.84 |
|                                                                                                      | B         | —      | 0.140 | —     | 3.56 |
|                                                                                                      | C         | 0.975  |       | 24.77 | —    |
|                                                                                                      | D         | 0.039  | 0.041 | 0.99  | 1.04 |

#### 1091 MELF Surface Mount Packages



| 1091 Package<br>(tape and reel only)<br>500pcs/reel                                        | Dimension | INCHES |       | MM    |       |
|--------------------------------------------------------------------------------------------|-----------|--------|-------|-------|-------|
|                                                                                            |           | MIN.   | MAX.  | MIN.  | MAX.  |
| MA4P1450-1091T<br>MA4P4001F-1091T<br>MA4P4002F-1091T<br>MA4P4006F-1091T<br>MA4P4301F-1091T | A         | 0.138  | 0.155 | 3.51  | 3.94  |
|                                                                                            | B         | 0.181  | 0.191 | 4.57  | 4.85  |
|                                                                                            | C         | 0.011  | 0.026 | 0.279 | 0.660 |

#### 1072 MELF Surface Mount Packages



| 1072 Package<br>(tape and reel only)<br>1500 or 5000pcs/reel<br>specify when ordering                                             | Dimension | INCHES |       | MM    |       |
|-----------------------------------------------------------------------------------------------------------------------------------|-----------|--------|-------|-------|-------|
|                                                                                                                                   |           | MIN.   | MAX.  | MIN.  | MAX.  |
| MA4P1250-1072T<br>MA4P1250NM-1072T<br>MA4P7001F-1072T<br>MA4P7002F-1072T<br>MA4P7006F-1072T<br>MA4P7101F-1072T<br>MA4P7104F-1072T | A         | 0.080  | 0.095 | 2.032 | 2.413 |
|                                                                                                                                   | B         | 0.115  | 0.125 | 2.921 | 3.175 |
|                                                                                                                                   | C         | 0.008  | 0.023 | 0.203 | 0.584 |

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# MA4P MELF & HIPAX™ Series

## High Power PIN Diodes

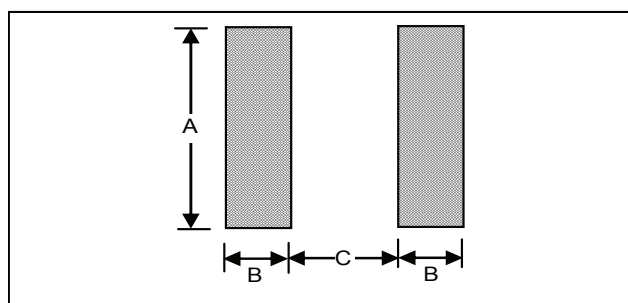
V14

### MELF Assembly Recommendations

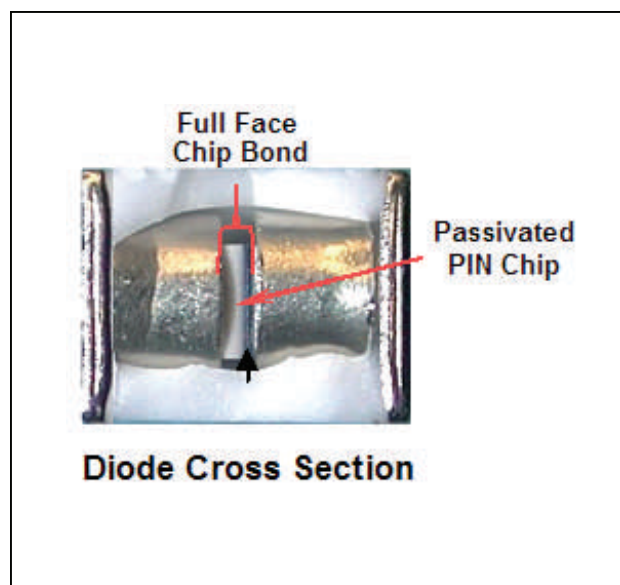
- ◆ Devices may be soldered using standard 60Sn/40Pb or RoHS compliant solders. Axial leads and solderable surfaces of MELF devices are tin plated 50 µm thick to ensure an optimum connection.

### Circuit Pad Layout for MELF Diodes

| Dimension | Package Style 1072 |      | Package Style 1091 |      |
|-----------|--------------------|------|--------------------|------|
|           | inches             | mm   | inches             | mm   |
| A         | 0.093              | 2.36 | 0.150              | 3.81 |
| B         | 0.050              | 1.27 | 0.050              | 1.27 |
| C         | 0.060              | 1.52 | 0.100              | 2.54 |



### MELF Internal Construction



### Ordering Information

MELF diodes are available in tape and reel in quantities as shown in table below

| Package Style | Quantity (7" Reel) | Bulk Devices Per Bag |
|---------------|--------------------|----------------------|
| 1072T         | 1500 or 5000       | N/A                  |
| 1091T         | 500                | N/A                  |

Tape and reel information can be found on the M/A-COM website at <http://www.macomtech.com/Application Notes/pdf/M513.pdf>

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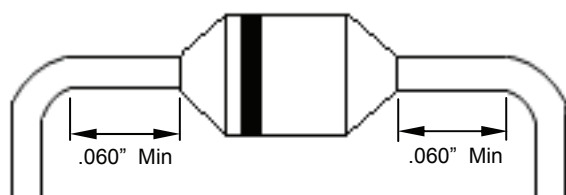
## High Power PIN Diodes

V14

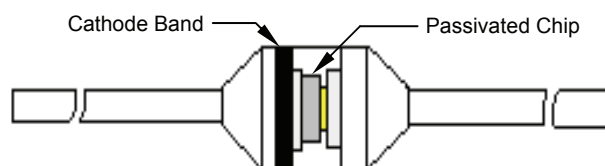
### Axial Leaded HIPAX Assembly Recommendations

- ◆ Bends on case styles 401 and 402, axially leaded devices, must be made while holding the lead firm and forming the bend no closer than .060 inches from the body of the part. Bending the lead < 0.060 inches from the body of the part is not recommended and may cause internal damage to the chip. Appropriate fixturing should be used.
- ◆ Devices may be soldered using standard 60Sn/40Pb or any RoHS compliant solders. Axial leads are tin plated 50µm thick to ensure an optimum connection.
- ◆ For recommended Sn/Pb and RoHS soldering profiles see page 7 of Application Note [M538](#) on the M/A-COM Tech-

#### Case Style 401 & 402 Minimum Bend Distance



#### Case Style 401 & 402 Internal Construction



### Ordering Information

Axial leaded diodes are available in tape and reel or bulk in quantities shown in the table below

| Package Style | Quantity Per Reel                        | Bulk Devices Per Bag |
|---------------|------------------------------------------|----------------------|
| 401T          | 500 or 1000 (specify qty. when ordering) | N/A                  |
| 402           | N/A                                      | 100                  |

### Environmental Ratings

HIPAX PIN diodes are designed to meet most environmental and electrical requirements and may be ordered screened to MIL-STD-750 specifications as described in the table below.

| TEST                      | METHOD         | DESCRIPTION/ CONDITIONS              |
|---------------------------|----------------|--------------------------------------|
| Moisture Resistance       | 1021           | 85°C, 85% Relative Humidity, 168 hrs |
| High Temperature Storage  | 1031           | +175°C, 250 Hours                    |
| HTRB                      | 1038           | 80% of rated $V_R$ , 50°C, 96 Hours  |
| Temperature Shock         | 1051           | -65°C to +175°C, 20 Cycles           |
| Fine Leak                 | 1071 Cond. H   | $1 \times 10^{-7}$ CC/Sec            |
| Constant Acceleration     | 2006           | 20,000 G's                           |
| Solderability             | 2026           | IPC/JDEC J-STD-02                    |
| Tension <sup>1</sup>      | 2036.3 Cond. A | 2 Lbs., 30 Seconds                   |
| Lead Fatigue <sup>1</sup> | 2036.3 Cond. E | 3 Cycles, 8 oz., 90°,                |

#### Note:

- 1) Test applicable to HIPAX axially leaded devices only.

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