# MA4P MELF & HIPAX Series

## High Power PIN Diodes

V16

## Features

- High Power Handling
- Low Loss / Low Distortion
- Voltage Ratings up to 1000 Volts
- Passivated Chip for Low Leakage Current
- Low Theta (θ) 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

The MELF and HIPAX PIN diode series are designed for usage in switch and attenuator applications requiring high power handling and low distortion. These 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 MACOM '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 MELF (Metal Electrode Leadless Faced) 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 Application Note M538 for a typical solder reflow profile.

Many of MACOM's HIPAX PIN diodes are also available as chips. Please consult the "Silicon PIN Chip Datasheet" for availability and specifications.

## Package Styles

401 & 402

1072 & 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 1 kW, 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

**$T_A$ = +25°C (Unless Otherwise Noted)[1]**

| Parameter | Absolute Maximum |
|---|---|
| DC 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.



*MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*
Visit www.macom.com for additional data sheets and product information.

*For further information and support please visit:*
***https://www.macom.com/support***

### MA4P1000 Series Electrical Specifications @ $T_A$ = +25°C

| Part # (NM Indicates Non-Magnetic) | $C_T$ Total Capacitance pF | | $V_R$ Reverse Voltage VDC | | $R_S$ Series Resistance W | | $R_P$ Parallel Resistance kW |
|---|---|---|---|---|---|---|---|
| | $V_R$ = 50 V, 1 MHz | | $I_R$ = 10 mA | | $I_F$ = 50 mA, 100 MHz | | $V_R$ = 0 V, 100 MHz |
| | Typ. | Max. | Min. | Max. | Typ. | Max. | Min. |
| MA4P1200 - 401T | 1.2 | 1.5 | 50 | 100 | 0.5 | 0.75 | 5 |
| MA4P1200NM - 401T | 1.2 | 1.5 | | | | | |
| MA4P1250 -1072T | 0.8 | 1.2 | | | | | |
| MA4P1250NM -1072T | 0.8 | 1.2 | | | | | |
| MA4P1450 -1091T | 1.8 | 2.5 | | | | | |

| Part # (NM Indicates Non-Magnetic) | $V_F$ Forward Voltage (Max. $I_{Forward}$ @ 1V ≤ | | $T_L$ Carrier Lifetime | | Forward Bias Harmonic Distortion R(2a/a) * R(3a/a) | | Reverse Bias Harmonic Distortion R(2a/a) – R(3a/a) | |
|---|---|---|---|---|---|---|---|---|
| | $I_F$ = 50 mA | | $I_F$ = 10 mA, $I_R$ = 6 mA | | $P_{IN}$ = 30 W, 100 MHz $I_F$ = 50 mA | | $P_{IN}$ = 0 dBm, $V_R$ = 0 V, 100 MHz | |
| | Typ. | Max. | Min. | Typ. | Min. | Typ. | Min. | Typ. |
| MA4P1200 - 401T | 0.85 | 1.0 | 2 | 8 | 80 | 90 | 60 | 70 |
| MA4P1200NM - 401T | | | | | | | | |
| MA4P1250 -1072T | | | | | | | | |
| MA4P1250NM-1072T | | | | | | | | |
| MA4P1450 -1091T | | | | | | | | |

*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 @ $T_A$ = +25°C

| Package Style | Condition | MA4P1200(NM)-401T | | MA4P1250(NM)-1072T | | MA4P1450-1091T | |
|---|---|---|---|---|---|---|---|
| | | $P_{DISS}$ | $\theta_{JC}$ | $P_{DISS}$ | $\theta_{JC}$ | $P_{DISS}$ | $\theta_{JC}$ |
| B Axial Lead | No Heatsink | 1.5 W | 15°C/W | — | — | — | — |
| | Lead Length 1/4" | 5.5 W | | — | — | — | — |
| F MELF | No Heatsink | — | | 6 W | 15°C/W | 10 W | 5°C/W |
| | Infinite Heatsink | — | | 18 W | | 30 W | |

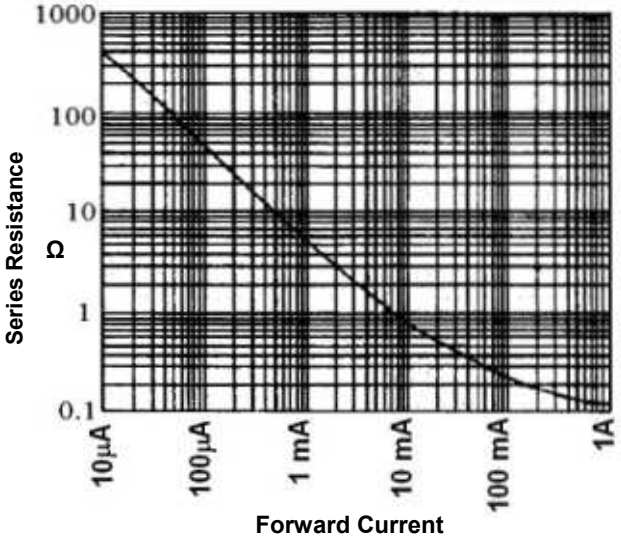



*MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*
Visit www.macom.com for additional data sheets and product information.

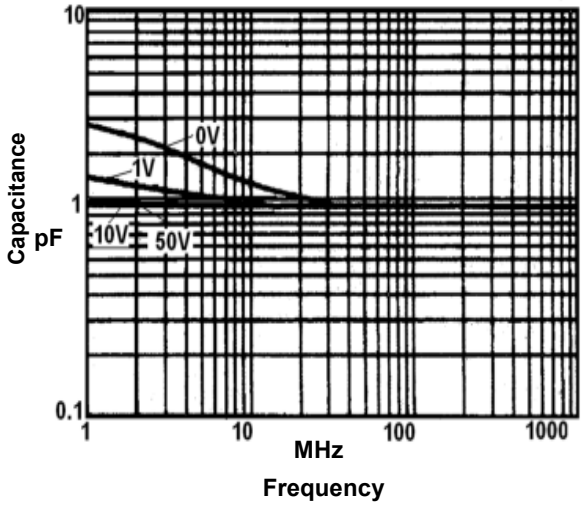
*For further information and support please visit:*
***https://www.macom.com/support***

### Typical Performance Curves @ $T_A$ = +25°C
### MA4P1200 Series

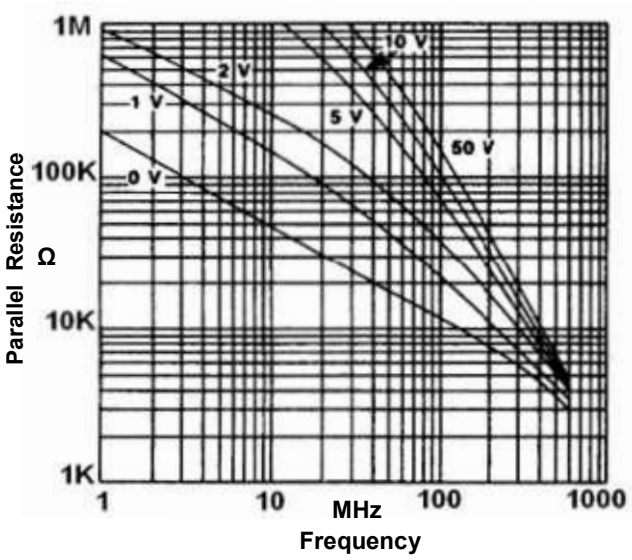
*Series Resistance @ 100 MHz vs. Forward Current*



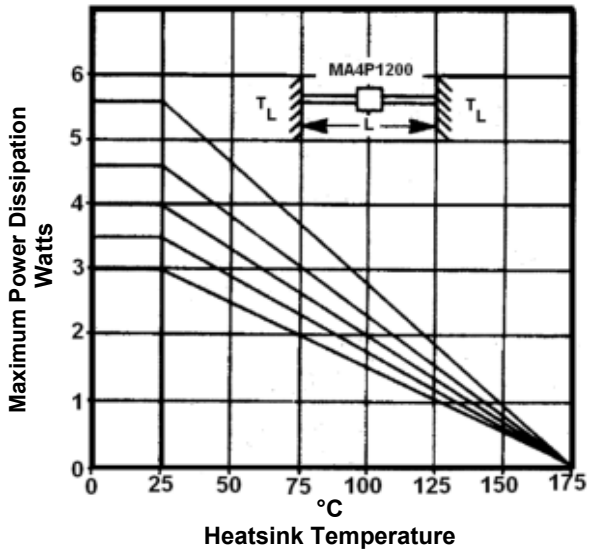

*Capacitance vs. Frequency & Reverse Bias*




*Parallel Resistance vs. Frequency & Reverse Bias*




*Heatsink Temperature vs. Max. Power Dissipation*





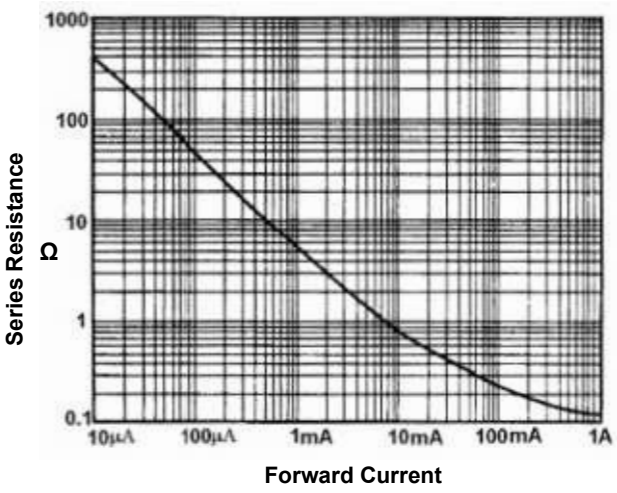


*MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*
Visit www.macom.com for additional data sheets and product information.

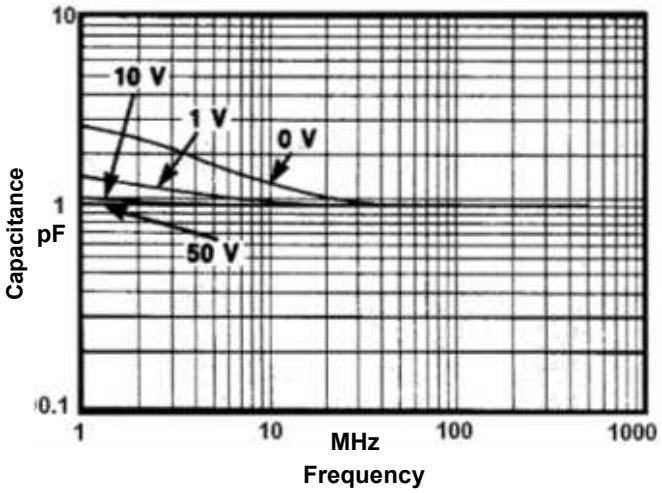
*For further information and support please visit:*
***https://www.macom.com/support***

### Typical Performance Curves @ $T_A$ = +25°C
### MA4P1250 Series

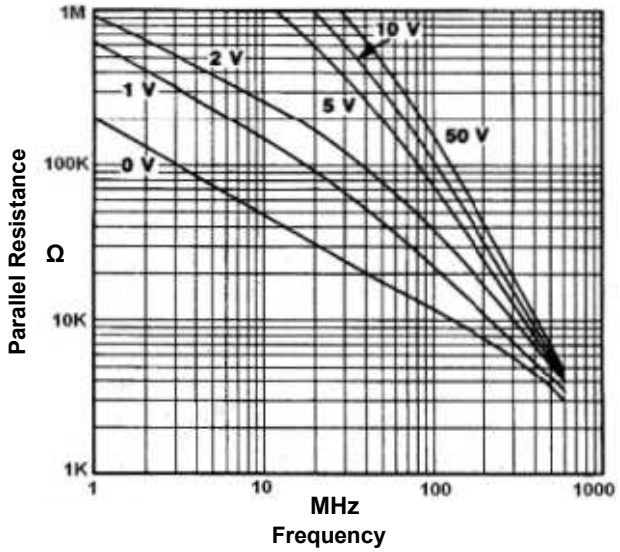
*Series Resistance @ 100 MHz vs. Forward Current*



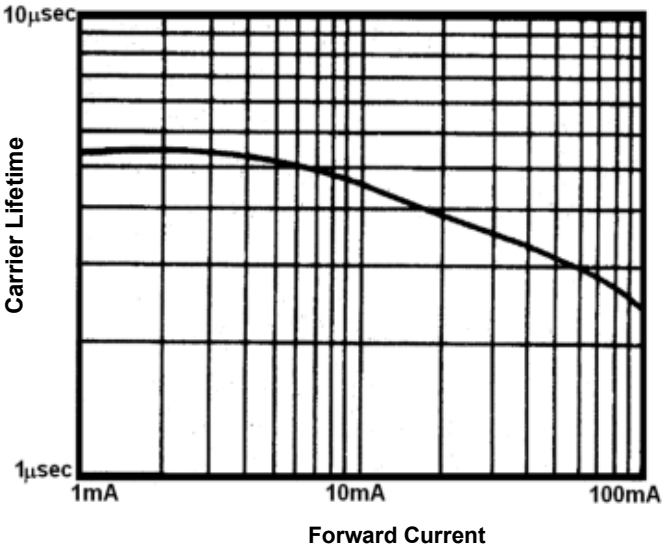

*Capacitance vs. Frequency & Reverse Bias*




*Parallel Resistance vs. Frequency & Reverse Bias*




*Carrier Lifetime vs. Forward Bias Current*





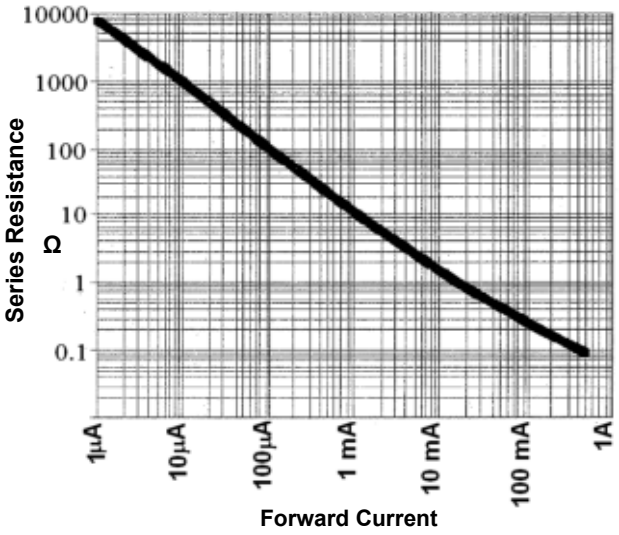


*MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*
Visit www.macom.com for additional data sheets and product information.

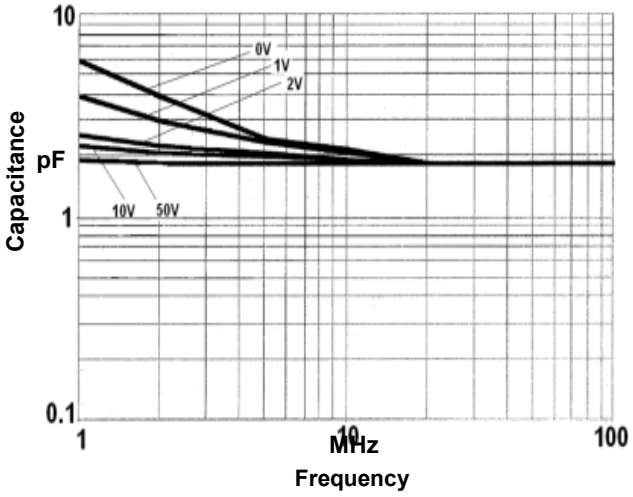
*For further information and support please visit:*
***https://www.macom.com/support***

### Typical Performance Curves @ $T_A$ = +25°C
### MA4P1450 Series

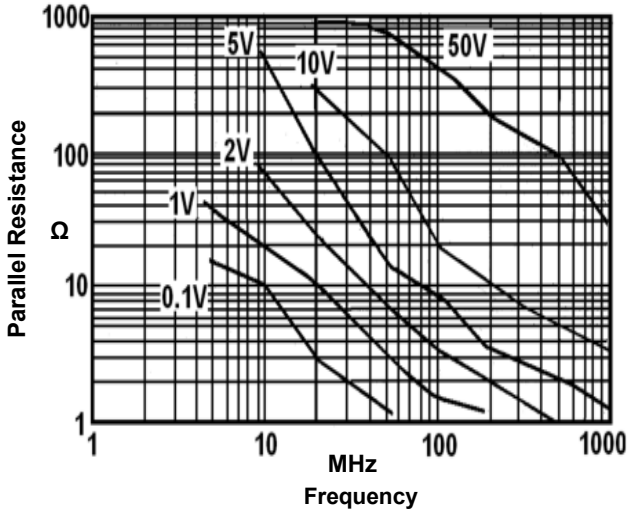
*Series Resistance @ 100 MHz vs. Forward Current*




*Capacitance vs. Frequency and Reverse Bias*




*Parallel Resistance vs. Frequency and Reverse Bias*







*MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*
Visit www.macom.com for additional data sheets and product information.

*For further information and support please visit:*
***https://www.macom.com/support***

### MA4P4000 - MA4P7100 Series Electrical Specifications @ $T_A$ = +25°C

| Parameter | Symbol | Condition | MA4P4000 Series | MA4P4300 Series | MA4P7000 Series | MA4P7100 Series |
|---|---|---|---|---|---|---|
| Maximum Series Resistance | $R_S$ | $I_F$ = 100 mA | 0.5 Ω | 1.0 Ω | 0.9 Ω | 0.5 Ω |
| Maximum Total Capacitance | $C_T$ | $V_R$ = 100 V | 2.2 pF | 2.0 pF | 0.7 pF | 1.0 pF |
| Minimum Parallel Resistance | $R_P$ | $V_R$ = 100 V | 20 kΩ | 50 kΩ | 200 kΩ | 100 kΩ |
| Minimum Carrier Lifetime | $T_L$ | $I_F$ = 10 mA | 20 µs | 15 µs | 5 µs | 2.5 µs |
| Maximum Forward Voltage | $V_F$ | $I_F$ = 100 mA | 1.0 V | 1.2 V | 1.0 V | 1.0 V |
| Maximum Reverse Current | $I_R$ | At max. rated voltage | 1 µA | 1 µA | 1 µA | 1 µA |
| Nominal I-Region Width | µ | — | 175 µm | 300 µm | 175 µm | 100 µm |

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

| Maximum Reverse Voltage Rating | MA4P4000 Series | MA4P4300 Series | MA4P7000 Series | MA4P7100 Series |
|---|---|---|---|---|
| 100 V | MA4P4001B-402<br>MA4P4001BNM-402<br>MA4P4001F-1091T | MA4P4301B-402<br>MA4P4301F-1091T | MA4P7001F-1072T | MA4P7101B-401T<br>MA4P7101F-1072T |
| 200 V | MA4P4002B-402<br>MA4P4002F-1091T | MA4P4302B-402 | MA4P7002B-401T<br>MA4P7002F-1072T | MA4P7102B-401T<br>MA4P7102F-1072T |
| 400 V | — | — | — | MA4P7104B-401T<br>MA4P7104F-1072T |
| 600 V | 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 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 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 µs pulse | 100 kW | — | 100 kW | — | 15 kW | — | 15 kW | — |
| Both B and F | Single 100 µs | 5 kW | 0.03°C/W | 5 kW | 0.03°C/W | 300 W | 0.5°C/W | 300 W | 0.5°C/W |

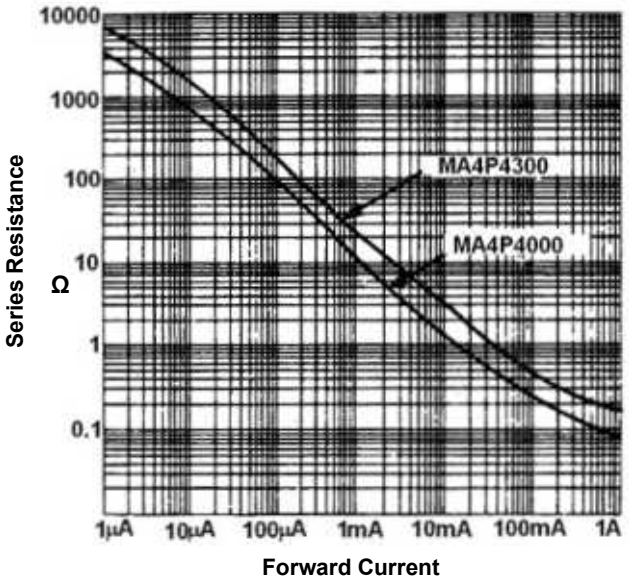



*MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*
Visit www.macom.com for additional data sheets and product information.

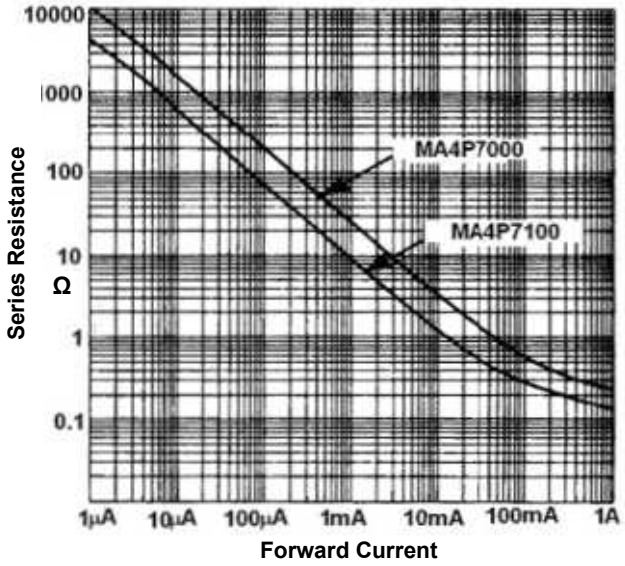
*For further information and support please visit:*
***https://www.macom.com/support***

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

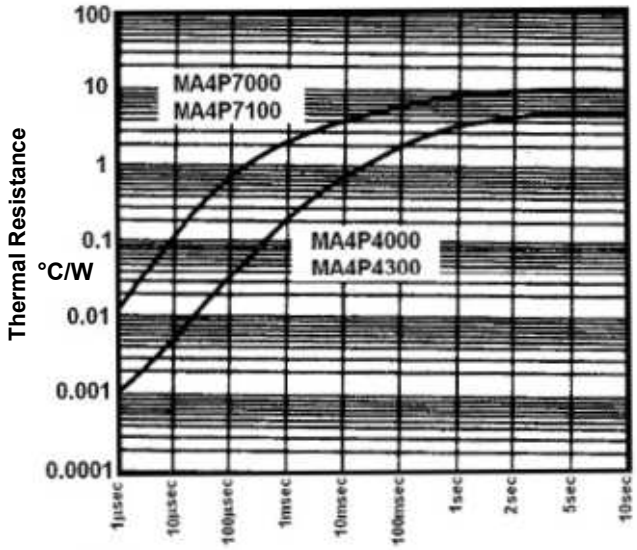
*Series Resistance at 100 MHz vs. Forward Current*
*MA4P4000, MA4P4300 Series*



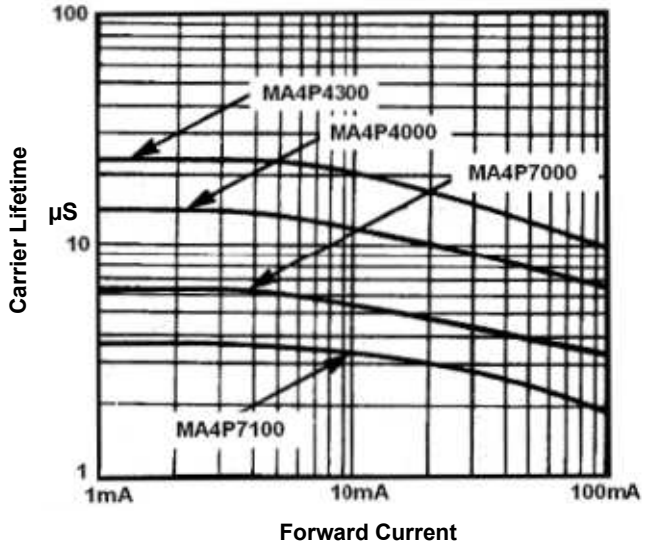

*Series Resistance at 100 MHz vs. Forward Current*
*MA4P7000, MA4P7100 Series*




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




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





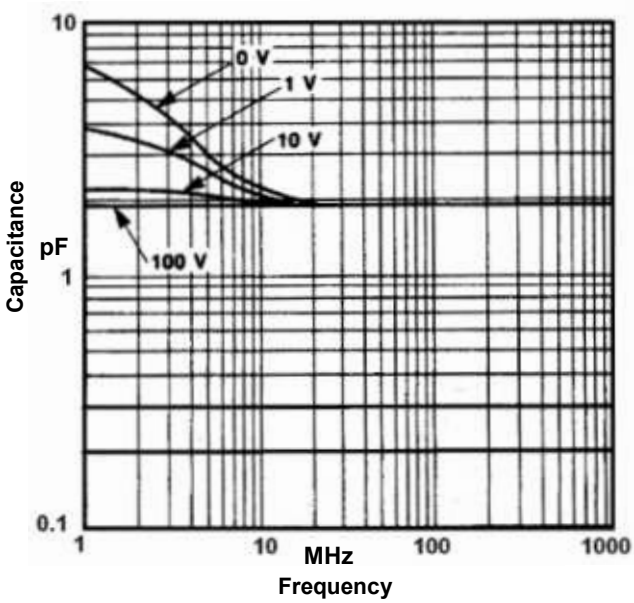


*MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*
Visit www.macom.com for additional data sheets and product information.

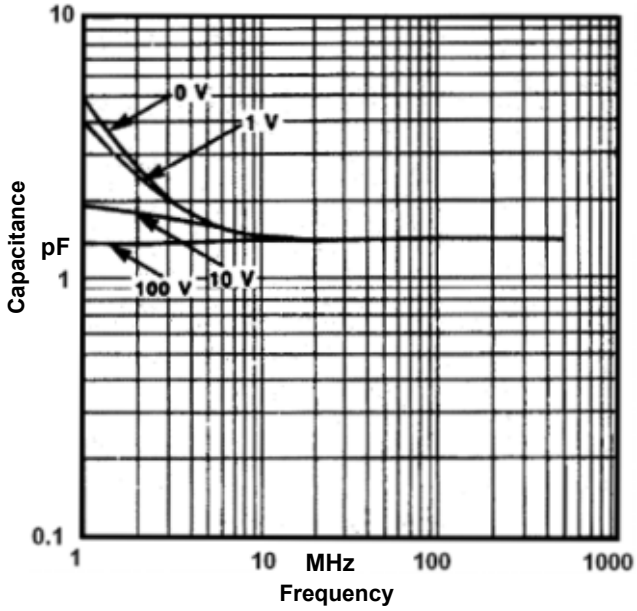
*For further information and support please visit:*
***https://www.macom.com/support***

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

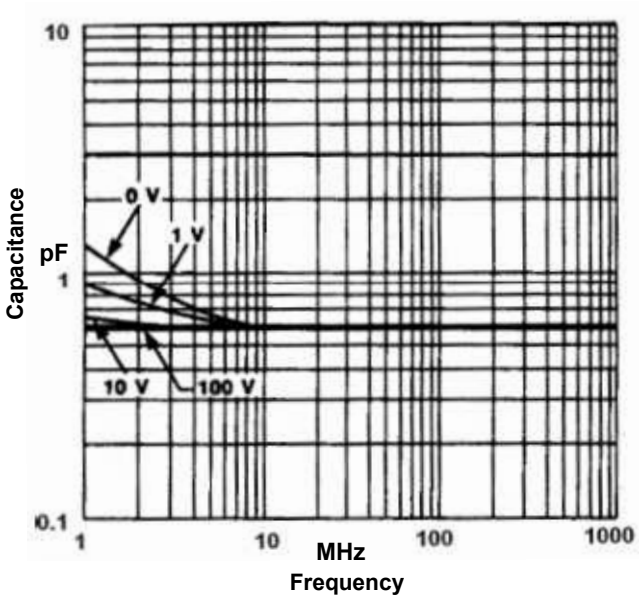
*Capacitance vs. Frequency & Reverse Bias*
*MA4P4000 Series*



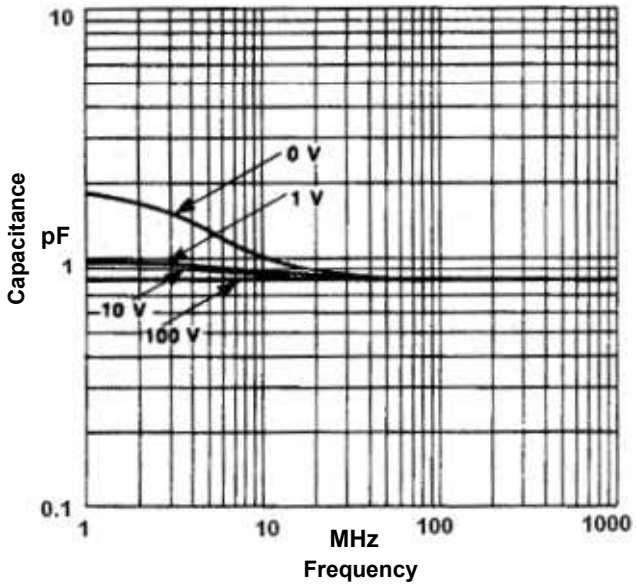

*Capacitance vs. Frequency & Reverse Bias*
*MA4P4300 Series*




*Capacitance vs. Frequency & Reverse Bias*
*MA4P7000 Series*




*Capacitance vs. Frequency & Reverse Bias*
*MA4P7100 Series*





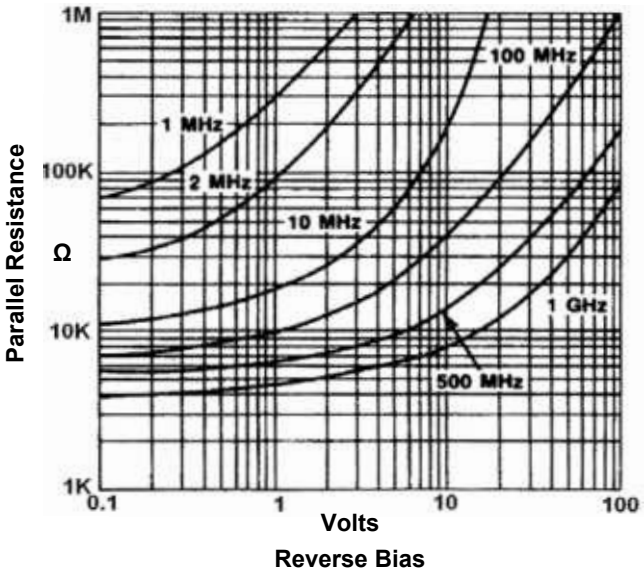


*MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*
Visit www.macom.com for additional data sheets and product information.

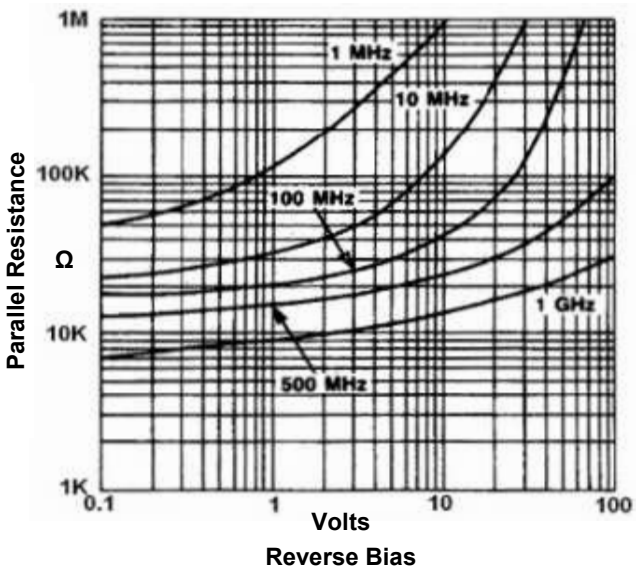
*For further information and support please visit:*
***https://www.macom.com/support***

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

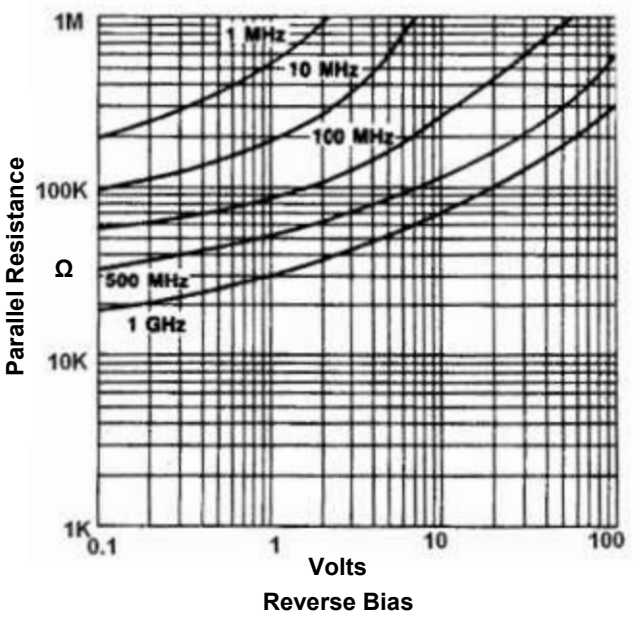
***Parallel Resistance vs. Reverse Bias & Frequency***
***MA4P4000 Series***



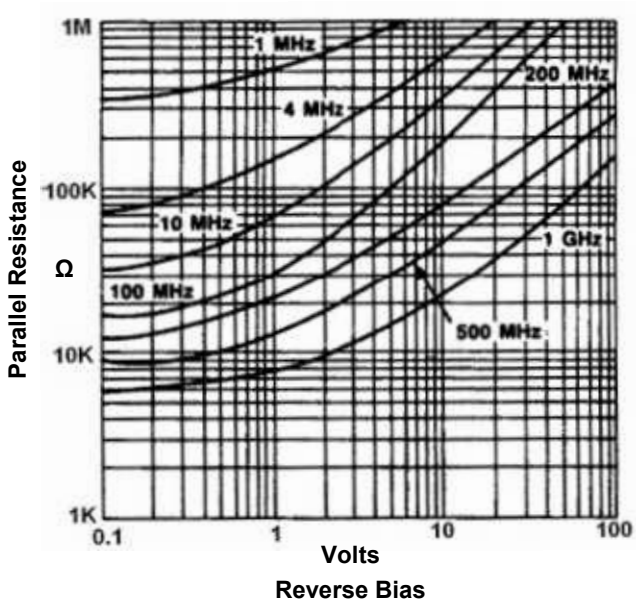

***Parallel Resistance vs. Reverse Bias & Frequency***
***MA4P4300 Series***




***Parallel Resistance vs. Reverse Bias & Frequency***
***MA4P7000 Series***




***Parallel Resistance vs. Reverse Bias & Frequency***
***MA4P7100 Series***





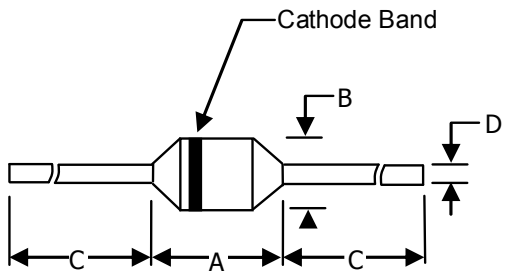


*MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*
Visit www.macom.com for additional data sheets and product information.

*For further information and support please visit:*
***https://www.macom.com/support***

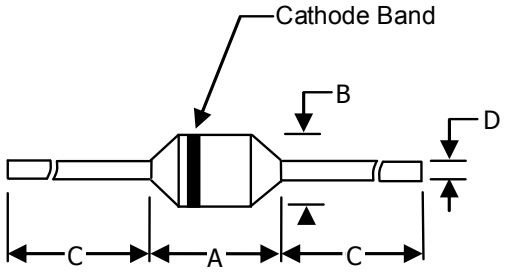
## Case Styles

### 401 Axial Leaded Packages



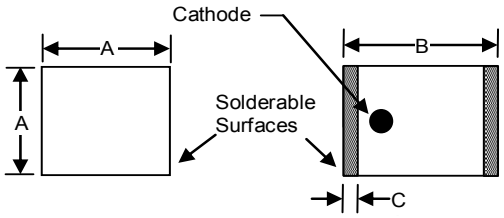

| 401 Package (tape and reel only) 500 or 1000 pcs/reel specify when ordering | Dimension | INCHES | | MM | |
|---|---|---|---|---|---|
| | | Min. | Max. | Min. | Max. |
| MA4P1200-401T<br>MA4P1200NM-401T<br>MA4P7002B-401T<br>MA4P7006B-401T<br>MA4P7101B-401T<br>MA4P7102B-401T<br>MA4P7104B-401T | A | — | 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



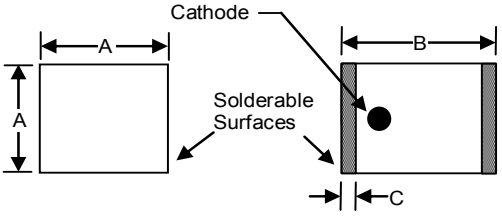

| 402 Package (bulk only) 100 pcs/bag | Dimension | INCHES | | MM | |
|---|---|---|---|---|---|
| | | Min. | MAX | Min. | Max. |
| MA4P4001B-402<br>MA4P4001BNM-402<br>MA4P4002B-402<br>MA4P4006B-402<br>MA4P4301B-402<br>MA4P4302B-402 | A | — | 0.230 | — | 5.84 |
| | B | — | 0.140 | — | 3.56 |
| | C | 0.975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

### 1091 MELF Surface Mount Packages




| 1091 Package (tape and reel only) 500 pcs/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 (tape and reel only) 1500 or 5000 pcs/reel 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 |




*MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*
Visit www.macom.com for additional data sheets and product information.

*For further information and support please visit:*
***https://www.macom.com/support***

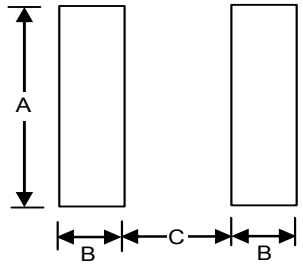
## MELF Assembly Recommendations

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.

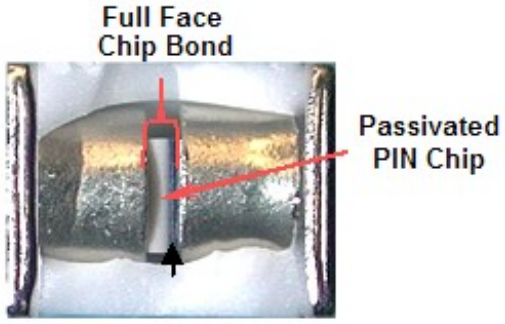
For recommended Sn/Pb and RoHS soldering profiles See Application Note M538 on the MACOM website.

## Circuit Pad Layout for MELF Diodes

| Dimension | Package Style | | | |
|---|---|---|---|---|
| | 1072 | | 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




Diode Cross Section

## 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 in application note M513 the MACOM website.*




*MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*
Visit www.macom.com for additional data sheets and product information.

*For further information and support please visit:*
***https://www.macom.com/support***

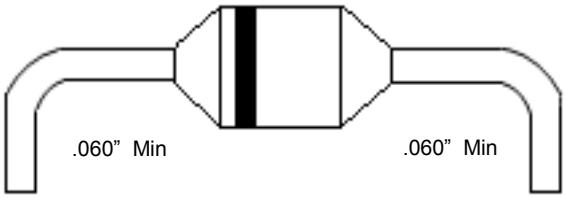
## Axial Leaded HIPAX Assembly Recommendations

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.

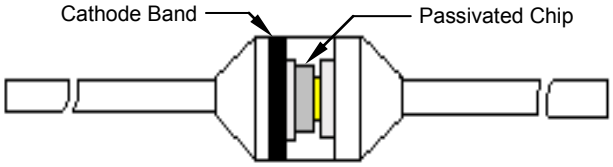
Devices may be soldered using standard 60Sn/40Pb or any RoHS compliant solders. Axial leads are tin plated 50 µm thick to ensure an optimum connection.

For recommended Sn/Pb and RoHS soldering profiles see Application Note M538 on the MACOM website.

### 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[1] | 2036.3 Cond. A | 2 Lbs., 30 Seconds |
| Lead Fatigue[1] | 2036.3 Cond. E | 3 Cycles, 8 oz., 90°, |

**Note:**

1) Test applicable to HIPAX axially leaded devices only.




*MACOM Technology Solutions Inc. (MACOM) and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*
Visit www.macom.com for additional data sheets and product information.

*For further information and support please visit:*
***https://www.macom.com/support***

MACOM Technology Solutions Inc. All rights reserved.

Information in this document is provided in connection with MACOM Technology Solutions Inc ("MACOM") products. These materials are provided by MACOM as a service to its customers and may be used for informational purposes only. Except as provided in MACOM's Terms and Conditions of Sale for such products or in any separate agreement related to this document, MACOM assumes no liability whatsoever. MACOM assumes no responsibility for errors or omissions in these materials. MACOM may make changes to specifications and product descriptions at any time, without notice. MACOM makes no commitment to update the information and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to its specifications and product descriptions. No license, express or implied, by estoppels or otherwise, to any intellectual property rights is granted by this document.

THESE MATERIALS ARE PROVIDED "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, CONSEQUENTIAL OR INCIDENTAL DAMAGES, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. MACOM FURTHER DOES NOT WARRANT THE ACCURACY OR COMPLETENESS OF THE INFORMATION, TEXT, GRAPHICS OR OTHER ITEMS CONTAINED WITHIN THESE MATERIALS. MACOM SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR LOST PROFITS, WHICH MAY RESULT FROM THE USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.