

# MA4SPS402



**SURMOUNT™ PIN Diode**  
**RoHS Compliant**

Rev V6

## Features

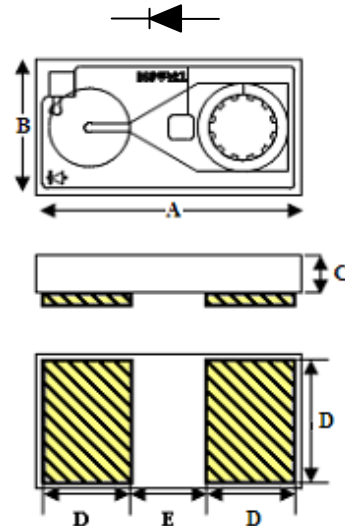
- ◆ Surface Mount
- ◆ No Wire Bonding Required
- ◆ Rugged Silicon-Glass Construction
- ◆ Silicon Nitride Passivation
- ◆ Polymer Scratch Protection
- ◆ Low Parasitic Capacitance and Inductance
- ◆ Higher Average and Peak Power Handling
- ◆ RoHS Compliant

## Description

This device is a Silicon-Glass PIN diode chip fabricated with M/A-COM Technology Solutions patented HMIC™ process. This device features two silicon pedestals embedded in a low loss, low dispersion glass. The diode is formed on the top of one pedestal and connections to the backside of the device are facilitated by making the pedestal sidewalls electrically conductive. Selective backside metallization is applied producing a surface mount device. This vertical conic topology provides for exceptional heat transfer from the active area. The topside is fully encapsulated with silicon nitride and has an additional polymer layer for scratch and impact protection. These protective coatings prevent damage to the junction and the anode air-bridge during handling and assembly.

## Applications

These surmount devices are suitable for usage in moderate incident power (5W C.W.) or higher incident peak power (50W) series, shunt, or series-shunt switches. Lower parasitic inductance, 0.45nH, and excellent RC constant (0.23pS), make the devices ideal for higher frequency switch elements compared to their plastic device counterparts.



1. Backside metal: 0.1  $\mu\text{m}$  thick.
2. Yellow hatched areas indicate backside ohmic gold

| DIM | INCHES |       | MM    |       |
|-----|--------|-------|-------|-------|
|     | Min.   | Max.  | Min.  | Max.  |
| A   | 0.046  | 0.051 | 1.170 | 1.290 |
| B   | 0.017  | 0.021 | 0.432 | 0.533 |
| C   | 0.004  | 0.006 | 0.102 | 0.203 |
| D   | 0.015  | 0.017 | 0.381 | 0.432 |
| E   | 0.014  | 0.016 | 0.356 | 0.406 |

## Absolute Maximum Ratings @ $T_{\text{AMB}} = 25^{\circ}\text{C}$ (unless otherwise specified)

| Parameter                       | Absolute Maximum      |
|---------------------------------|-----------------------|
| Forward Current                 | 250mA                 |
| Reverse Voltage                 | -100V                 |
| Operating Temperature           | -55°C to +125°C       |
| Storage Temperature             | -55 °C to +150°C      |
| Junction Temperature            | +175°C                |
| Dissipated Power<br>( RF & DC ) | 1W                    |
| Mounting Temperature            | +280°C for 30 seconds |

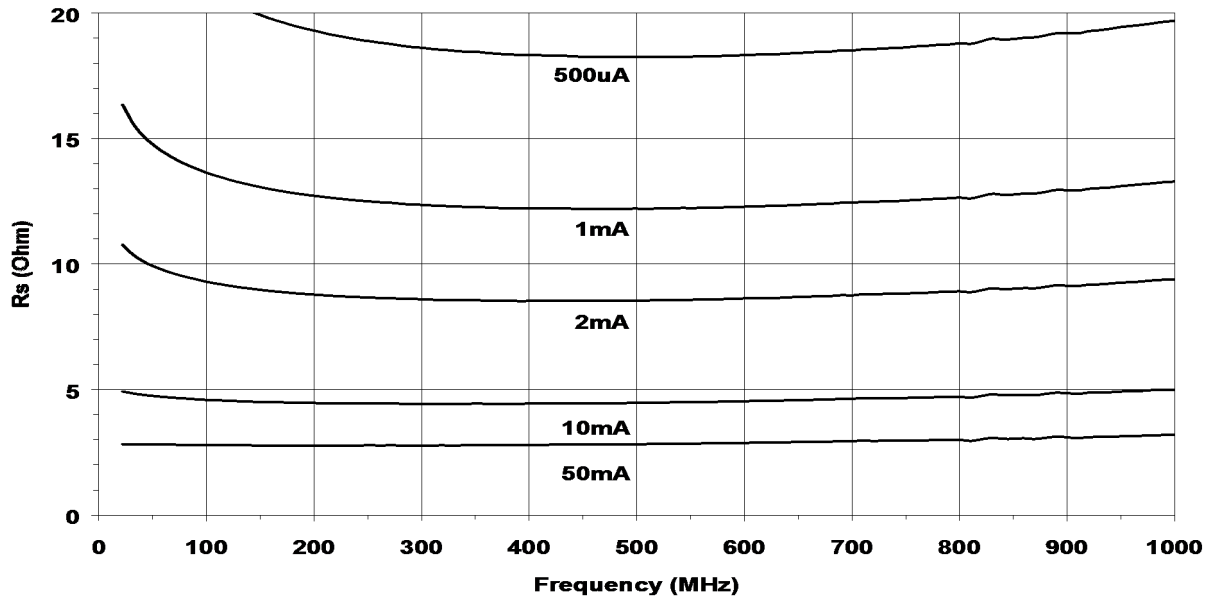
**Electrical Specifications @ T<sub>AMB</sub> = +25°C**

| Symbol                        | Conditions                               | Units | Min. | Typical | Max. |
|-------------------------------|--|-------|------|---------|------|
| C <sub>T</sub> <sup>1,3</sup> | -40V, 1MHz                               | pF    |      | 0.055   | 0.06 |
| C <sub>T</sub> <sup>1,3</sup> | -40V, 1GHz                               | pF    |      | 0.045   |      |
| R <sub>S</sub> <sup>2,3</sup> | 10mA, 1GHz                               | Ω     |      | 5.0     | 5.8  |
| V <sub>F</sub>                | 10mA                                     | V     |      | 0.90    | 1.00 |
| V <sub>R</sub>                | -10μA                                    | V     | -70  | -100    |      |
| I <sub>R</sub>                | -70V                                     | μA    |      | -0.1    | -10  |
| R <sub>θJL</sub> <sup>4</sup> | I <sub>H</sub> =1A, I <sub>L</sub> =10mA | °C/W  |      | 150     |      |
| T <sub>L</sub>                | +10mA / -6mA<br>( 50% - 90% V )          | nS    |      | 200     | 400  |

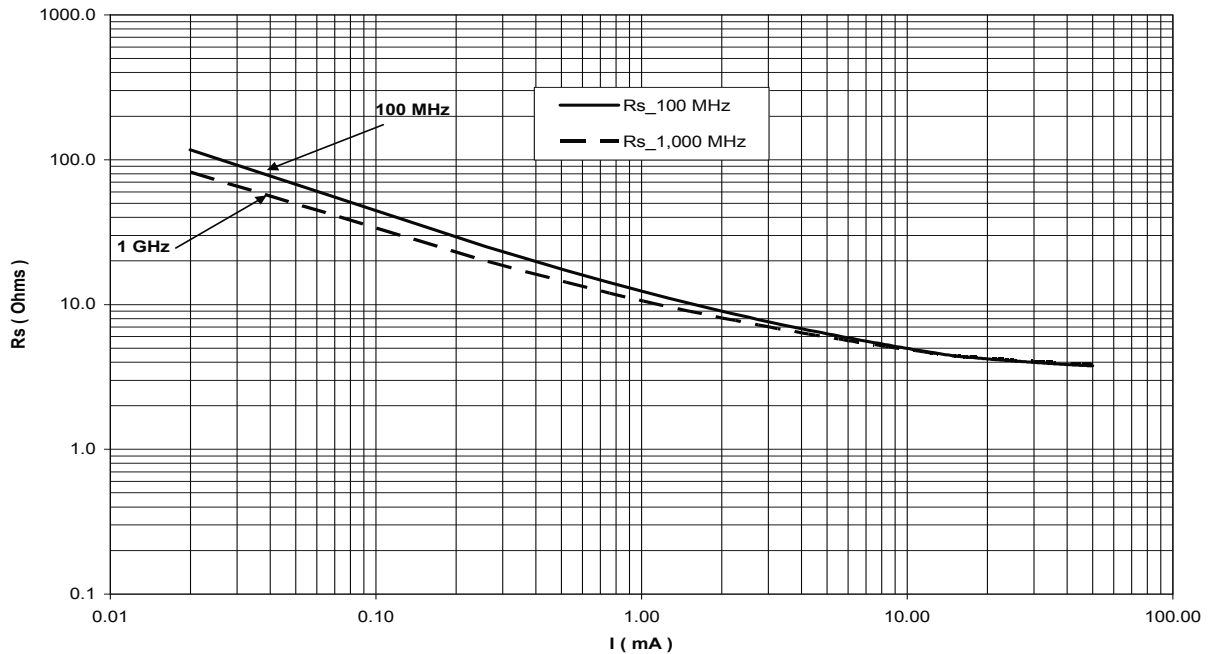
1. Total Capacitance, C<sub>T</sub>, is equivalent to the sum of Junction Capacitance and Parasitic Capacitance.  
 $C_T = C_J$  (Junction Capacitance) + C<sub>PAR</sub> (Parasitic Capacitance)
2. Series resistance R<sub>S</sub> is equivalent to the total diode resistance:  
 $R_S = R_J$  (Junction Capacitance Junction Resistance) + R<sub>O</sub> (Ohmic Resistance)
3. R<sub>S</sub> and C<sub>T</sub> are measured on an HP4291A Impedance Analyzer with die mounted in an ODS-186 package with conductive silver epoxy.
4. Steady-state R<sub>θJL</sub> measured with die mounted in an ODS-186 package with conductive silver epoxy.

## MA4SPS402 Typical RF Performance @ $T_{AMB} +25^{\circ}\text{C}$

$R_s$  as a Function of Forward Current and Frequency

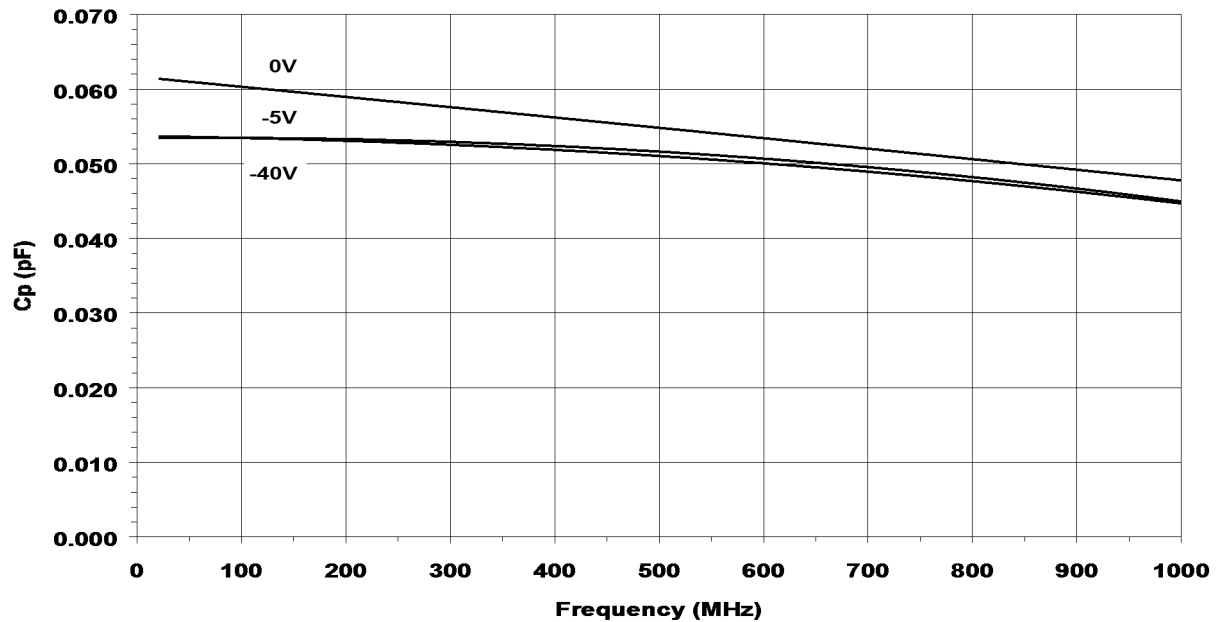


MA4SPS402  $R_s$  vs  $I$  at 100 MHz and 1,000 MHz

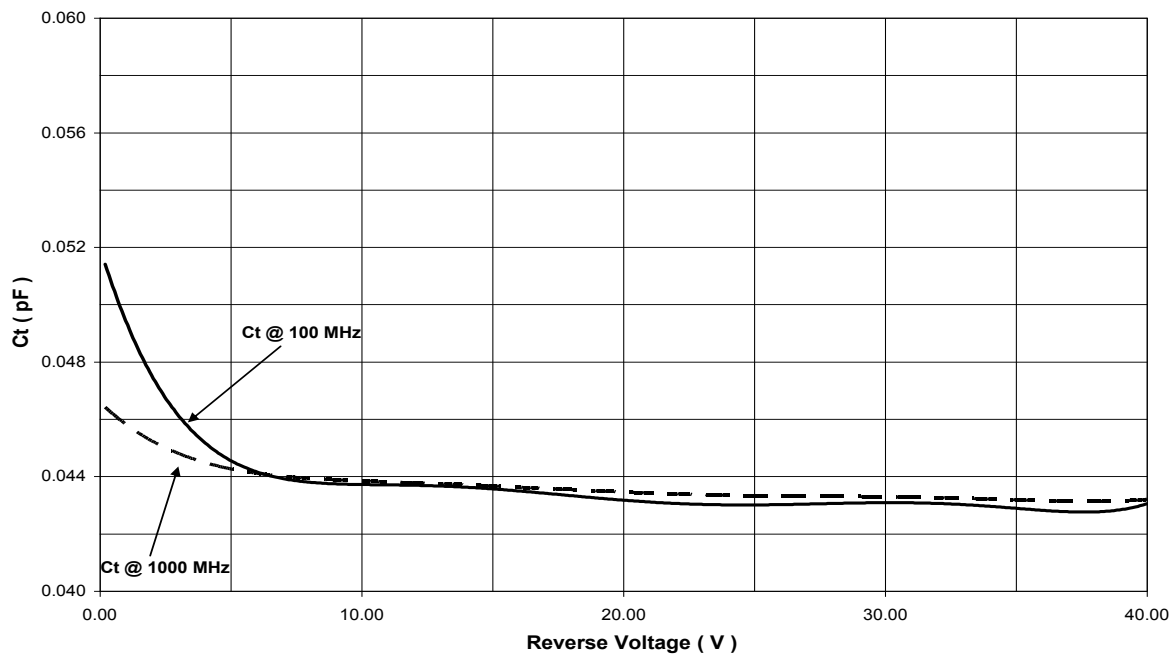


## MA4SPS402 Typical RF Performance @ $T_{AMB} +25^{\circ}C$

$C_T$  as a Function of Reverse Voltage and Frequency

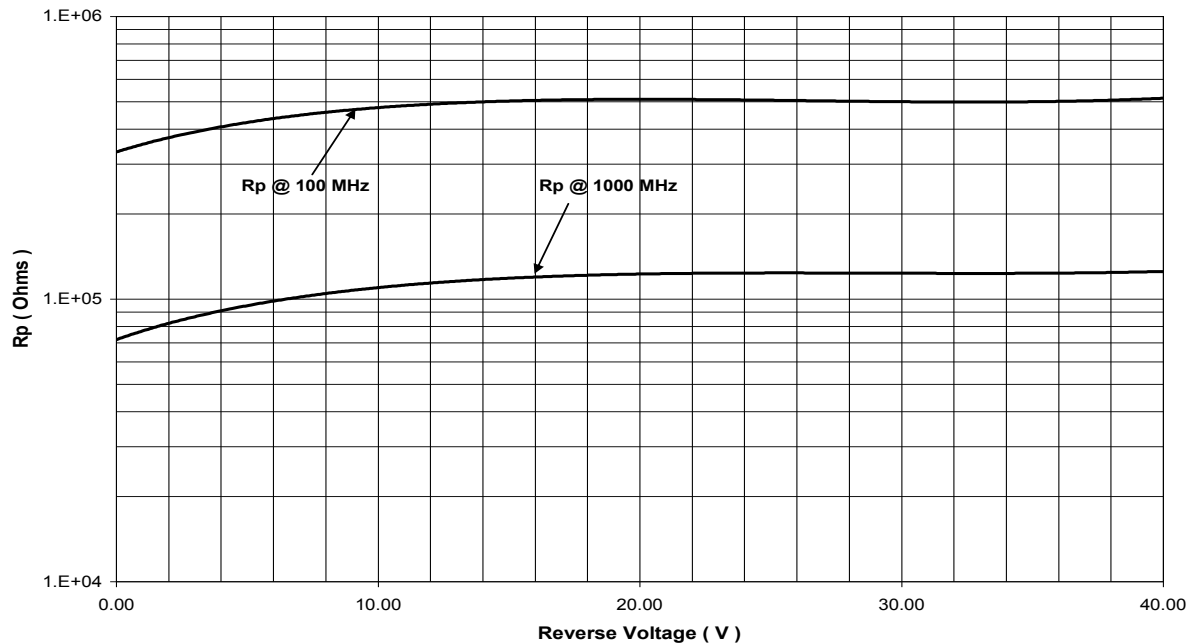


MA4SPS402  $C_t$  vs V at 100 MHz and 1,000 MHz

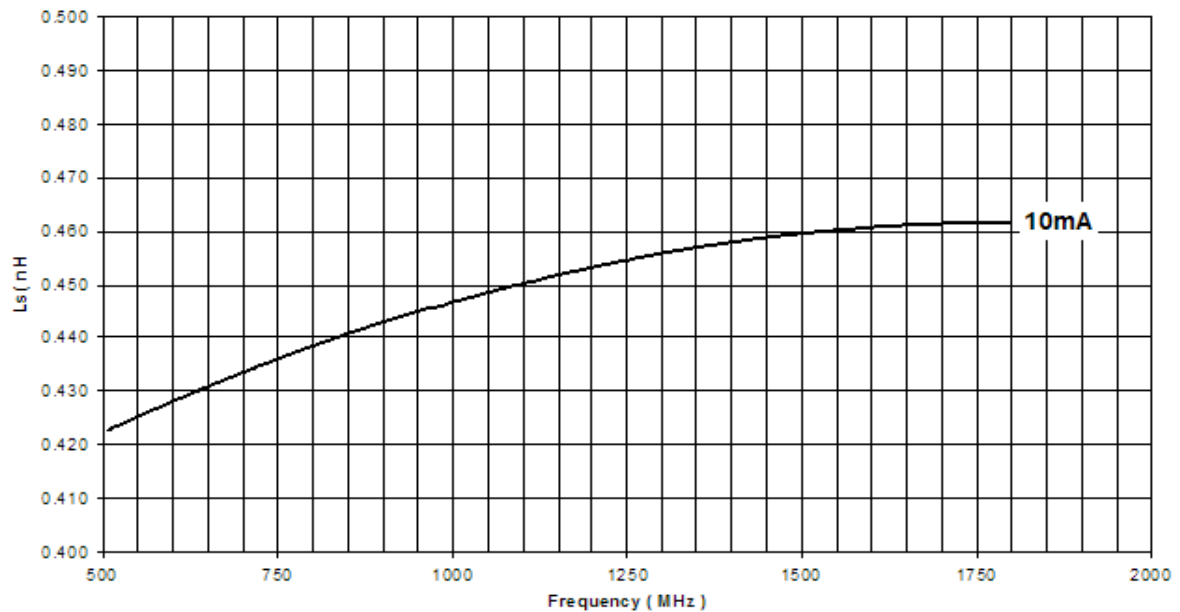


## $R_p$ as a Function of Reverse Voltage and Frequency

MA4SPS402  $R_p$  vs V at 100 MHz and 1,000 MHz



## $L_s$ as a Function of Forward Current and Frequency



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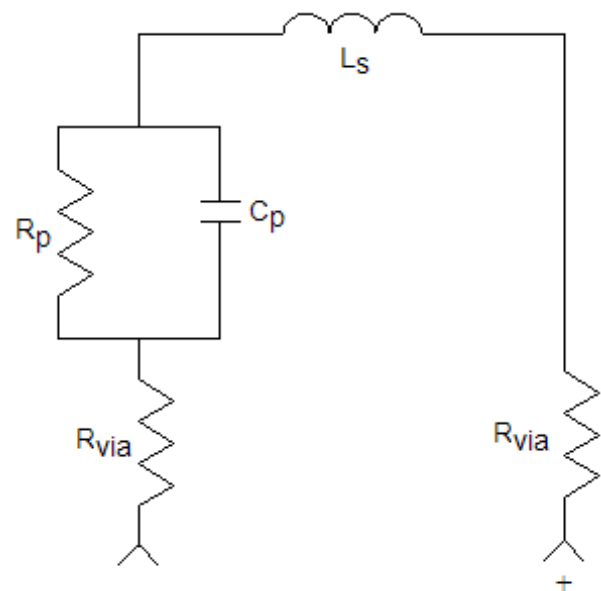
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## MA4SPS402 ADS SPICE Model & Schematic

### MA4SPS402 SPICE Model

|                               |             |
|-------------------------------|-------------|
| PinDiodeModel                 | wBv=100 V   |
| NLPINM1                       | wPmax=1.0 W |
| Is=1.0E-14 A                  | Ffe=1.0     |
| Vi=0.0 V                      |             |
| Un=900 cm <sup>2</sup> /V-sec |             |
| Wi=6.5 um                     |             |
| Rr=20 K Ohm                   |             |
| Cmin=0.045                    |             |
| Tau=0.20 usec                 |             |
| Rs=0.1 Ohm                    |             |
| Cj0=0.06 pF                   |             |
| Vj=0.7 V                      |             |
| M=0.5                         |             |
| Fc=0.5                        |             |
| Imax=1.0E+6 A/m <sup>2</sup>  |             |
| Kf=0.0                        |             |
| Af=1.0                        |             |

### MA4SPS402 Schematic



Note:  $R_s = 2 * R_{via} + R_p$

## Handling

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

## Die Attach

Attachment to a circuit board is made simple through the use of surface mount technology. Mounting pads are conveniently located on the bottom surface of these devices and are removed from the active junction locations. These devices are well suited for solder attachment onto hard and soft substrates. The use of 80/20, Au/Sn, 60/40, Sn/Pb or RoHS compliant solders is recommended. Conductive silver epoxy solder may also be used but could result in an increase in series and thermal resistance.

When soldering these devices to a hard substrate, hot gas die bonding is preferred. We recommend utilizing a vacuum tip and force of 60 to 100 grams applied to the top surface of the device. When soldering to soft substrates, it is recommended to use a lead-tin interface at the circuit board mounting pads. Position the die so that its mounting pads are aligned with the circuit board mounting pads and reflow the solder by heating the circuit trace near the mounting pads while applying 60 to 100 grams of force perpendicular to the top surface of the die. The solder joint must not be made one pad at a time. Doing so could create unequal heat flow and produce thermal and/or mechanical stresses. It is also not recommended to reflow solder by causing heat to flow through the top surface of the die. Since the HMIC glass is transparent, the edges of the mounting pads can be visually inspected through the die after attach is completed.

Recommended temperature and re-flow profiles for 60/40, Sn/Pb and RoHS compliant solders are provided in [Application Note M538](#) , “Surface Mounting Instructions“.

## Ordering Information

MA4SPS402 SURMOUNTS may be ordered in either gel packs or tape and reeled by adding the appropriate suffix per the table below. Tape and reel dimensions are provided in [Application Note M513](#) located on the M/A-COM website at [www.macomtech.com](http://www.macomtech.com).

| Part Number |                    |                              |
|-------------|--------------------|------------------------------|
| Waffle Pack | Gel Pack           | Tape and Reel<br>Pocket Tape |
| MA4SPS402   | MADP-000402-12530G | MADP-000402-12530P           |

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