

SURMOUNT™ Low, Medium, and High Barrier Silicon Schottky Diodes

Rev. V1

Features

- Extremely Low Parasitic Capacitance and Inductance
- Surface Mountable in Microwavable Circuits, No Wirebonds Required
- Rugged HMIC Construction with Polyimide Scratch Protection
- Reliable, Multilayer Metalization with a Diffusion Barrier, 100% Stabilization Bake (300°C, 16 hours)
- Lower Susceptibility to ESD Damage

Description and Applications

The MA4E2502 SURMOUNT™ Series Diodes are Silicon Low, Medium, and High Barrier Schottky Devices fabricated with the patented Heterolithic Microwave Integrated Circuit (HMIC) process. HMIC circuits consist of Silicon pedestals which form diodes or via conductors embedded in a glass dielectric, which acts as the low dispersion, microstrip transmission medium. The combination of silicon and glass allows HMIC devices to have excellent loss and power dissipation characteristics in a low profile, reliable device.

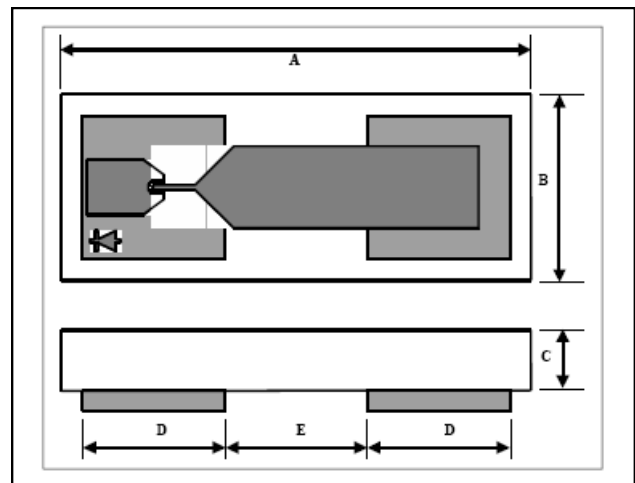
The Surmount Schottky devices are excellent choices for circuits requiring the small parasitics of a beam lead device coupled with the superior mechanical performance of a chip. The Surmount structure employs very low resistance silicon vias to connect the Schottky contacts to the metalized mounting pads on the bottom surface of the chip. These devices are reliable, repeatable, and a lower cost performance solution to conventional devices. They have lower susceptibility to electrostatic discharge than conventional beam lead Schottky diodes.

The multilayer metallization employed in the fabrication of the Surmount Schottky junctions includes a platinum diffusion barrier, which permits all devices to be subjected to a 16-hour non-operating stabilization bake at 300°C.

The “0502” outline allows for Surface Mount placement and multi-functional polarity orientations.

The MA4E2502 Family of Surmount Schottky diodes are recommended for use in microwave circuits through Ku band frequencies for lower power applications such as mixers, sub-harmonic mixers, detectors, and limiters. The HMIC construction facilitates the direct replacement of more fragile beam lead diodes with the corresponding Surmount diode, which can be connected to a hard or soft substrate circuit with solder.

Case Style 1246



| DIM | INCHES | | MILLIMETERS | |
|-------|--------|--------|-------------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| A | 0.0445 | 0.0465 | 1.130 | 1.180 |
| B | 0.0169 | 0.0189 | 0.430 | 0.480 |
| C | 0.0040 | 0.0080 | 0.102 | 0.203 |
| D Sq. | 0.0128 | 0.0148 | 0.325 | 0.375 |
| E | 0.0128 | 0.0148 | 0.325 | 0.375 |

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Electrical Specifications @ 25°C

| Model Number | Type | Recommended Freq. Range | Vf @ 1 mA (mV) | Vb @ 10 μ A (V) | Ct @ 0 V (pF) | Rt Slope Resistance (Vf1-Vf2)/(10.5mA-9.5mA) (Ω) |
|--------------|----------------|-------------------------|--------------------|---------------------|----------------------|---|
| MA4E2502L | Low Barrier | DC - 18 GHz | 330 Max 300 Typ | 3 Min 5 Typ | 0.12 Max 0.10 Typ | 16 Typ 20 Max |
| MA4E2502M | Medium Barrier | DC - 18 GHz | 470 Max 420 Typ | 3 Min 5 Typ | 0.12 Max 0.10 Typ | 12 Typ 18 Max |
| MA4E2502H | High Barrier | DC - 18 GHz | 700 Max 650 Typ | 3 Min 5 Typ | 0.12 Max 0.10 Typ | 11 Typ 15 Max |

1. Rt is the dynamic slope resistance where $R_t = R_s + R_j$, where $R_j = 26 / I_{dc}$ (I_{dc} is in mA)

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. The top surface of the die has a protective polyimide coating to minimize damage.

The rugged construction of these Surmount devices allows the use of standard handling and die attach techniques. It is important to note that industry standard electrostatic discharge (ESD) control is required at all times, due to the sensitive nature of Schottky junctions.

Bulk handling should insure that abrasion and mechanical shock are minimized.

Absolute Maximum Ratings @ 25°C (unless otherwise noted) ¹

| Parameter | Absolute Maximum |
|---|------------------|
| Operating Temperature | -40°C to +125°C |
| Storage Temperature | -40°C to +150°C |
| Junction Temperature | +175°C |
| Forward Current | 20 mA |
| Reverse Voltage | 5 V |
| RF C.W. Incident Power | +20 dBm |
| RF & DC Dissipated Power | 50 mW |
| Electrostatic Discharge (ESD) Classification ² | Class 0 |

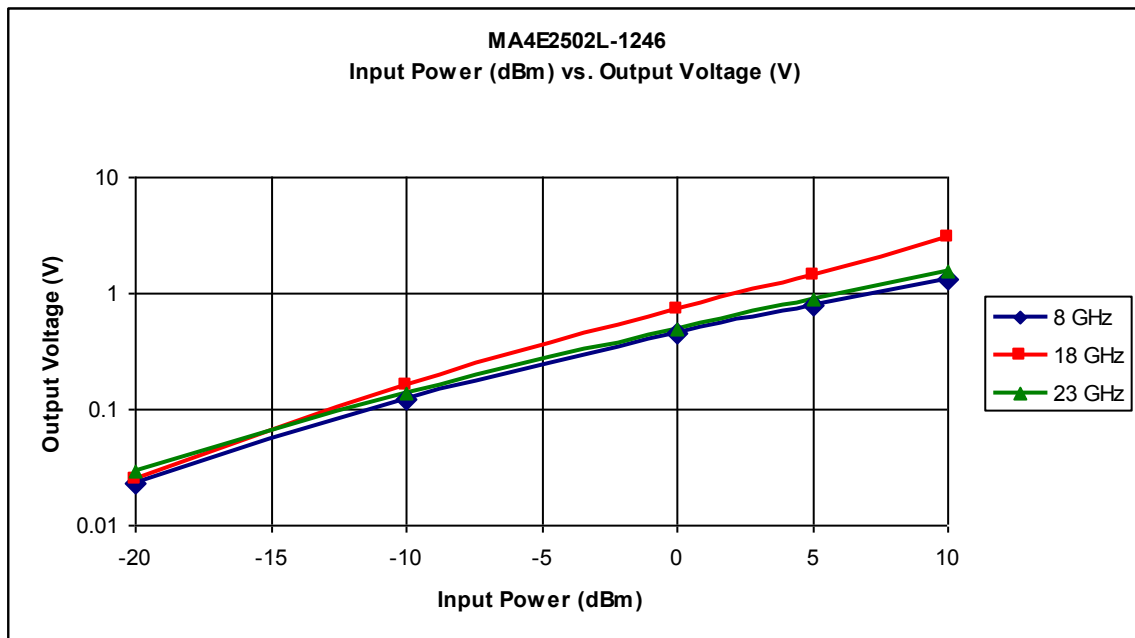
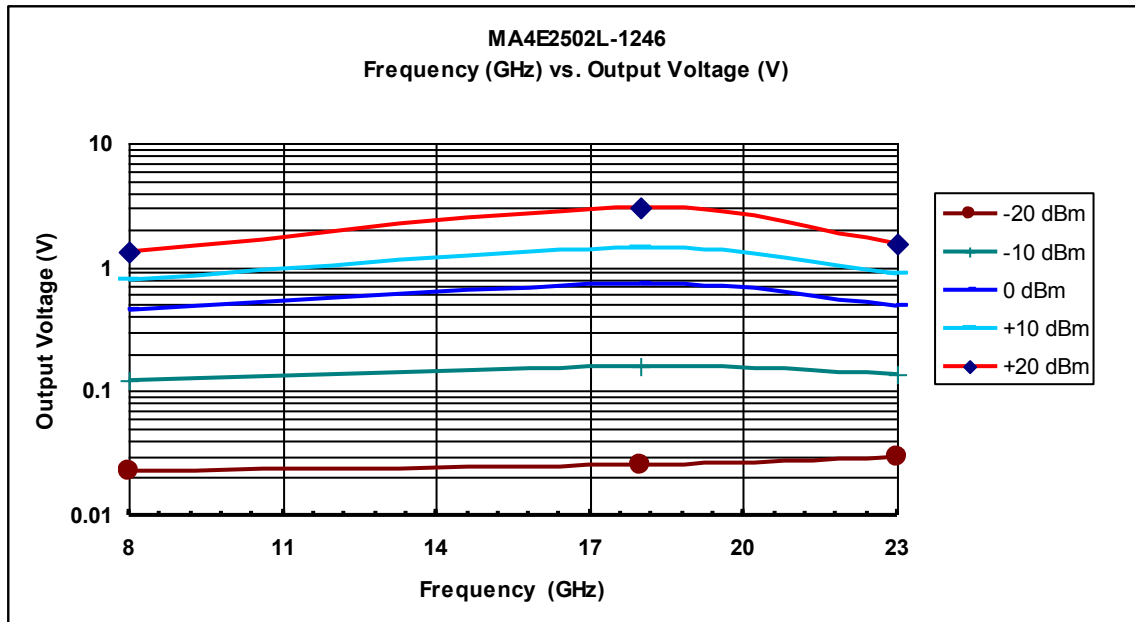
2. Human Body Model

Die Bonding

Die attach for these devices is made simple through the use of surface mount die attach technology. Mounting pads are conveniently located on the bottom surface of these devices, and are opposite the active junction. The devices are well suited for high temperature solder attachment onto hard substrates. 80Au/20Sn and Sn63/Pb37 solders are acceptable for usage. Die attach with Electrically Conductive Silver Epoxy is Not Recommended.

For Hard substrates, we recommend utilizing a vacuum tip and force of 60 to 100 grams applied uniformly to the top surface of the device, using a hot gas bonder with equal heat applied across the bottom mounting pads 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. Reflow the solder paste by applying equal heat to the circuit at both die-mounting pads. The solder joint must Not be made one at a time, creating unequal heat flow and thermal stress. Solder reflow should Not be performed 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 die attach is completed.

Applications Section



The MA4E2502L-1246 chip was evaluated in a detector circuit in which the Schottky diode terminates a 50 ohm transmission line on a duroid substrate. The chip was attached to the terminal of a 3.5mm connector and the output voltage was measured through a bias tee on a voltmeter. Matching was not attempted.

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MA4E2502L Low Barrier SPICE PARAMETERS

| Is (nA) | Rs (Ω) | N | Cj0 (pF) | M | Ik (mA) | Cjpar (pF) | Vj (V) | FC | BV (V) | IBV (mA) |
|---------|--------|------|----------|-----|---------|------------|---------|-----|--------|----------|
| 26 | 12.8 | 1.20 | 1.0 E-2 | 0.5 | 14 | 9.0 E-2 | 8.0 E-2 | 0.5 | 5.0 | 1.0 E-2 |

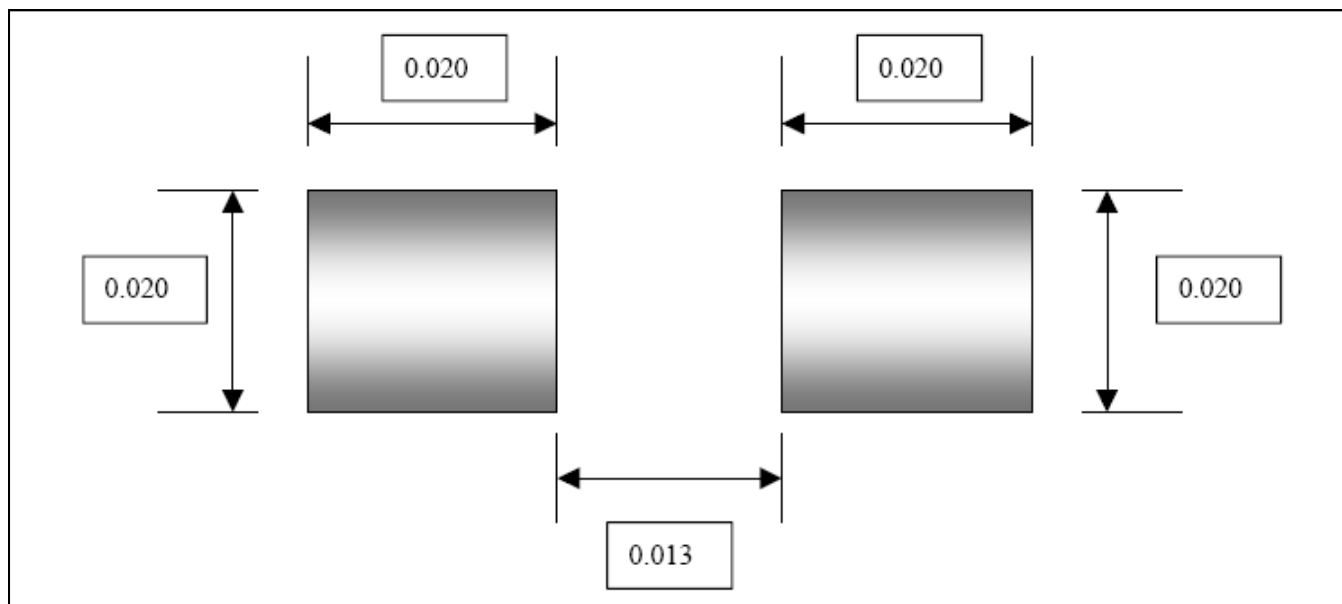
MA4E2502M Medium Barrier SPICE PARAMETERS

| Is (mA) | Rs (Ω) | N | Cj0 (pF) | M | Ik (mA) | Cjpar (pF) | Vj (V) | FC | BV (V) | IBV (mA) |
|---------|--------|------|----------|-----|---------|------------|---------|-----|--------|----------|
| 5 E-1 | 9.6 | 1.20 | 1.0 E-02 | 0.5 | 10 | 9.0 E-2 | 8.0 E-2 | 0.5 | 5.0 | 1.0 E-2 |

MA4E2502H High Barrier SPICE PARAMETERS

| Is (mA) | Rs (Ω) | N | Cj0 (pF) | M | Ik (mA) | Cjpar (pF) | Vj (V) | FC | BV (V) | IBV (mA) |
|---------|--------|------|----------|-----|---------|------------|---------|-----|--------|----------|
| 5.7 E-1 | 6.5 | 1.20 | 1.0 E-02 | 0.5 | 4 | 9.0 E-2 | 8.0 E-2 | 0.5 | 5.0 | 1.0 E-2 |

Circuit Mounting Dimensions (Inches)

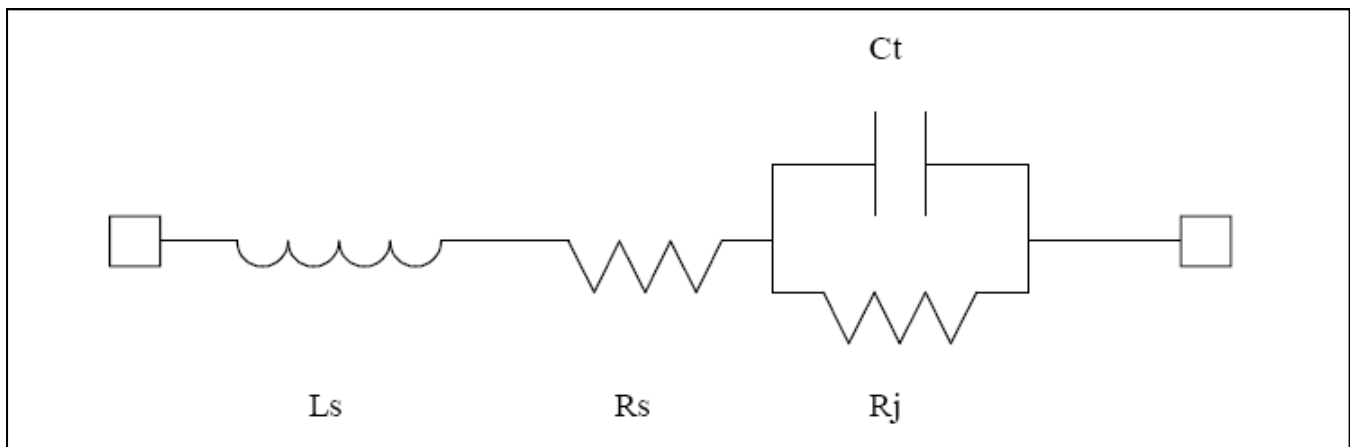


Ordering Information

| Part Number | Package | Standard Quantity |
|--------------------|---------------------|-------------------|
| MA4E2502L-1246W | Wafer on Frame | * |
| MA4E2502L-1246 | Die in Carrier | 100 |
| MADS-002502-1246LP | Pocket Tape on Reel | 3000 |
| MA4E2502M-1246W | Wafer on Frame | * |
| MA4E2502M-1246 | Die in Carrier | 100 |
| MADS-002502-1246MP | Pocket Tape on Reel | 3000 |
| MA4E2502H-1246W | Wafer on Frame | * |
| MA4E2502H-1246 | Die in Carrier | 100 |
| MADS-002502-1246HP | Pocket Tape on Reel | 3000 |

* Call factory for standard quantities for full wafers on frames.

MA4E2502 Diode Schematic



Schematic Values

| Model Number | Ls (nH) | Rs (Ω) | Rj (Ω) | Ct (pF) |
|--------------|---------|--------|---------------------------|---------|
| MA4E2502L | 0.45 | 12.8 | 26 / I _{dc} (mA) | 0.10 |
| MA4E2502M | 0.45 | 9.6 | 26 / I _{dc} (mA) | 0.10 |
| MA4E2502H | 0.45 | 6.5 | 26 / I _{dc} (mA) | 0.10 |

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6

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