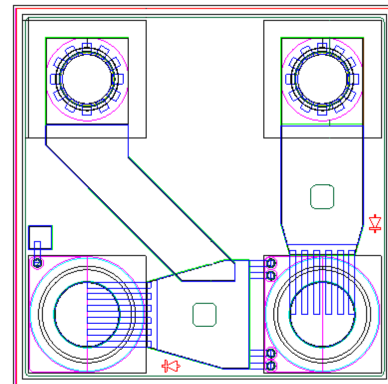
# MASW-001150-1316

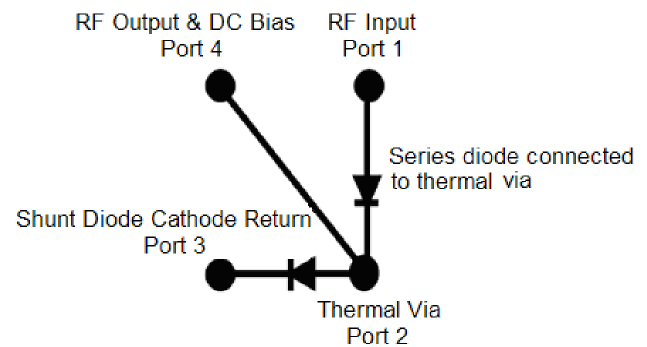
## SURMOUNT PIN Diode Switch Element with Thermal Terminal

V3

### Features

- Specified Bandwidth: 30MHz—2.5GHz
- Useable to 3.0GHz
- Low Loss <0.5dB
- High isolation >40dB
- High C.W. Incident Power, 50W at 500MHz
- Unique Thermal Terminal for Series Diode
- Surface Mount Device (No Wire Bonds)
- Rugged Silicon-Glass Construction
- Silicon Nitride Passivation
- Protective Polymer Scratch Protection
- RoHS Compliant






### Description

This device is a PIN diode series-shunt switch element with a unique integrated thermal terminal for dissipating heat in the series diode created by the DC and RF input power. The thermal terminal allows for optimum heat dissipation by providing a direct thermal path from the series diode to circuit thermal ground while also being electrically isolated. The chip is designed to provide a heat transfer conduit that does not interfere with the PIN diode anode (input) and cathode (output) electrical terminals, especially with respect to RF performance. The silicon-glass PIN diode chip is fabricated using M/A-COM Technology Solutions patented HMIC™ process. This device features silicon pedestals embedded in a low loss, low dispersion glass. Selective backside metallization is applied producing a surface mount device. The topside is fully encapsulated with silicon nitride and has an additional polymer layer to protect against damage during handling and assembly.

### Applications

This PIN diode series-shunt switch element is particularly advantageous in higher average power, 50W switch applications from 30MHZ – 3000GHz. In addition, the backside RF, D.C., and thermal I/O ports allow for direct solder re-flow attachments to the micro-strip circuit for surface mount assembly. Of particular interest, is the thermal terminal which provides the power dissipating series diode a direct connection to the circuit thermal ground for unprecedented heat transfer. This thermal terminal is electrically isolated from the other I/O ports. The chip can be configured as either a reflective or an absorptive switch.

### Ordering Information [2]

| Part Number | Package |
|---|---|
| MASW-001150-13160W | WAFFLE PACK |
| MASW-001150-13160P | POCKET TAPE |

2. Reference Application Note M513 for reel size information.

### Absolute Maximum Ratings

| Parameter | Absolute Maximum |
|---|---|
| Forward Current | 100mA |
| Reverse Voltage | - 180V |
| Operating Temperature | -55°C to +125°C |
| Storage Temperature | -55°C to +150°C |
| Junction Temperature | +175°C |
| Dissipated RF & DC Power | 500MHz, 4W |
| RF C.W. Incident Power | 500MHz, 50W |
| Mounting Temperature | +260°C for 30 seconds |
| ESD | Class 1A — HBM |
| ESD | Class M3 — MM |
| ESD | Class C3 — CDM |



**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.
**PRELIMINARY:** Data Sheets contain information regarding a product M/A-COM Technology Solutions has under development. Performance is based on engineering tests. Specifications are typical. Mechanical outline has been fixed. Engineering samples and/or test data may be available. Commitment to produce in volume is not guaranteed.

- **North America** Tel: 800.366.2266 / Fax: 978.366.2266
- **Europe** Tel: 44.1908.574.200 / Fax: 44.1908.574.300
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298

Visit www.macomtech.com for additional data sheets and product information.

*M/A-COM Technology Solutions Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*

# SURMOUNT PIN Diode Switch Element with Thermal Terminal



## Electrical Specifications @ $T_{AMB}$ = +25°C

| Symbol | Parameter | Conditions | Units | Typical | Maximum |
|---|---|---|---|---|---|
| $C_{T\ Series}$ | Total Capacitance | -25V ,30MHz | pF | 0.52 | — |
| $C_{T\ Series}$ | Total Capacitance | -25V, 1800MHz | pF | 0.37 | — |
| $C_{T\ Shunt}$ | Total Capacitance | -25V, 30MHz | pF | 0.54 | — |
| $C_{T\ Shunt}$ | Total Capacitance | -25V, 1800MHz | pF | 0.39 | — |
| $R_{S\ Series}$ | Series Resistance | 20mA, 30MHz | Ω | 1.13 | — |
| $R_{S\ Series}$ | Series Resistance | 20mA,1800MHz | Ω | 1.25 | — |
| $R_{S\ Series}$ | Series Resistance | 50mA, 30MHz | Ω | 0.93 | — |
| $R_{S\ Series}$ | Series Resistance | 50mA,1800MHz | Ω | 1.07 | — |
| $R_{S\ Shunt}$ | Series Resistance | 10mA, 30MHz | Ω | 1.00 | — |
| $R_{S\ Shunt}$ | Series Resistance | 10mA, 1800MHz | Ω | 0.99 | — |
| $V_F$ | Forward Voltage | 20mA | V | 0.82 | 0.85 |
| $V_F$ | Forward Voltage | 50mA | V | 0.88 | 0.90 |
| $I_R$ | Reverse Leakage Current | -180V | µA | — | -10.0 |
| $R_{qJL}$ | Thermal Resistance $_{Series}$ | Steady State | °C/W | 36.0 | — |
| $T_L$[1] | Minority Carrier Lifetime | $I_{F\ 10mA}/I_{R\text{-}6mA}$ | µs | 8.5 | — |

1. Measured from 50% of control voltage to 90% of output voltage

| Parameter | Units | Port 1 | Port 2 | Conditions | Minimum | Typical | Maximum |
|---|---|---|---|---|---|---|---|
| Insertion Loss | dB | - 50mA | -25V | 30MHz | — | 0.07 | 0.10 |
| | | - 50mA | -25V | 1000MHZ | — | 0.30 | 0.45 |
| | | - 50mA | -25V | 2500MHz | — | 0.60 | 0.80 |
| Return Loss | dB | - 50mA | -25V | 30MHz | 36 | 39 | — |
| | | - 50mA | -25V | 1000MHZ | 18 | 20 | — |
| | | - 50mA | -25V | 2500MHz | 11 | 13 | — |
| Isolation | dB | + 50mA | +25V | 30MHz | 60 | 63 | — |
| | | + 50mA | +25V | 1000MHZ | 40 | 42 | — |
| | | + 50mA | +25V | 2500MHz | 29 | 33 | — |
| Input IP3 | dBm | - 50mA | -25V | -50mA / -25V<br>F1 = 500MHz<br>F2 = 505MHz<br>$P_{IN}$ = +40dBm(each tone) | — | -66 | — |
| $2^{nd}$ Harmonic | dBc | - 50mA | -25V | 50mA / -25V<br>500MHz /+35dBm | — | -46 | — |
| $3^{rd}$ Harmonic | dBc | - 50mA | -25V | 50mA / -25V<br>500MHz /+35dBm | — | -60 | — |



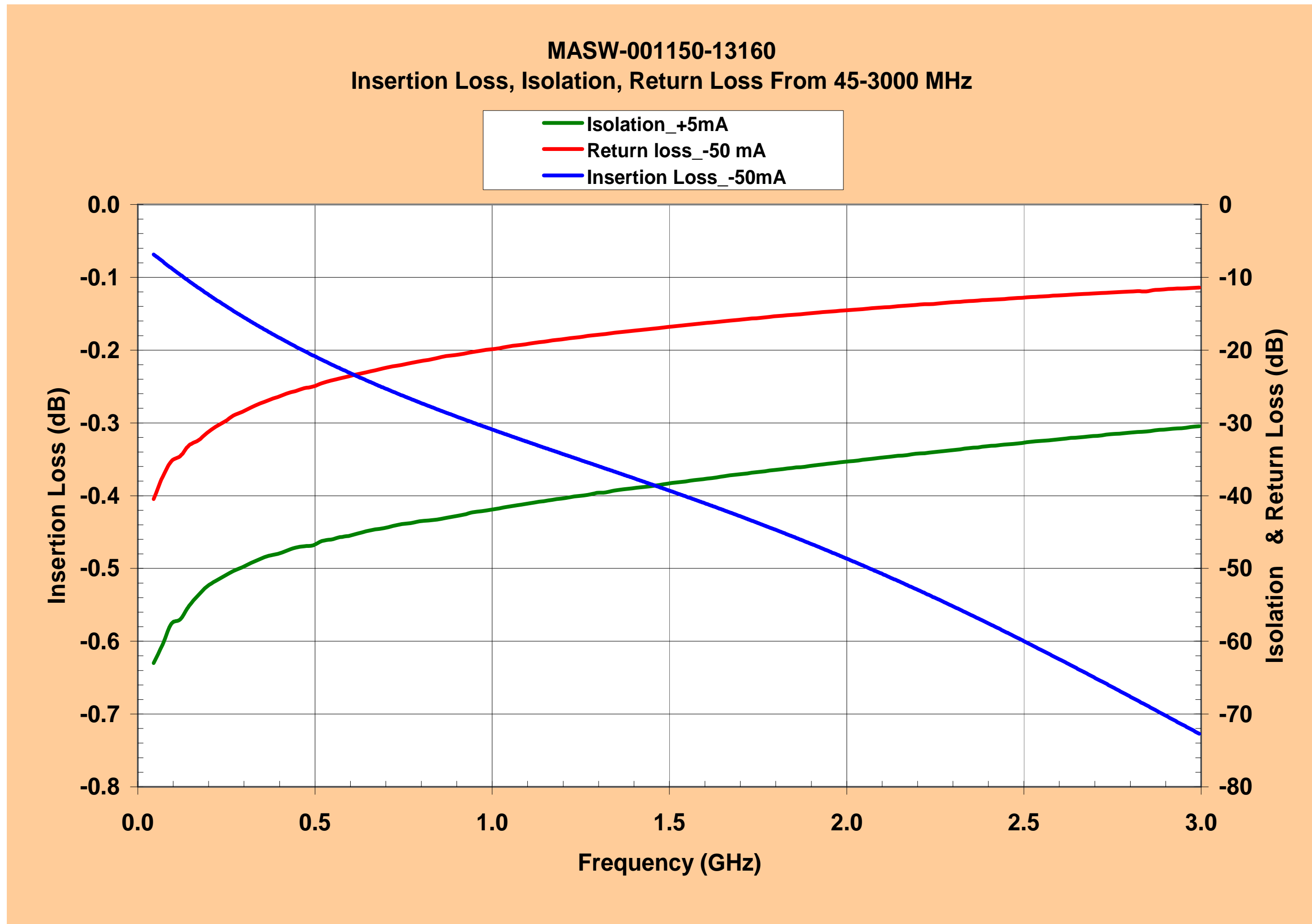
**ADVANCED:** Data Sheets contain information regarding a product M/A-COM Technology Solutions is considering for development. Performance is based on target specifications, simulated results, and/or prototype measurements. Commitment to develop is not guaranteed.
**PRELIMINARY:** Data Sheets contain information regarding a product M/A-COM Technology Solutions has under development. Performance is based on engineering tests. Specifications are typical. Mechanical outline has been fixed. Engineering samples and/or test data may be available. Commitment to produce in volume is not guaranteed.

- **North America** Tel: 800.366.2266 / Fax: 978.366.2266
- **Europe** Tel: 44.1908.574.200 / Fax: 44.1908.574.300
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298

Visit www.macomtech.com for additional data sheets and product information.

*M/A-COM Technology Solutions Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*

## Typical RF Small Signal Performance



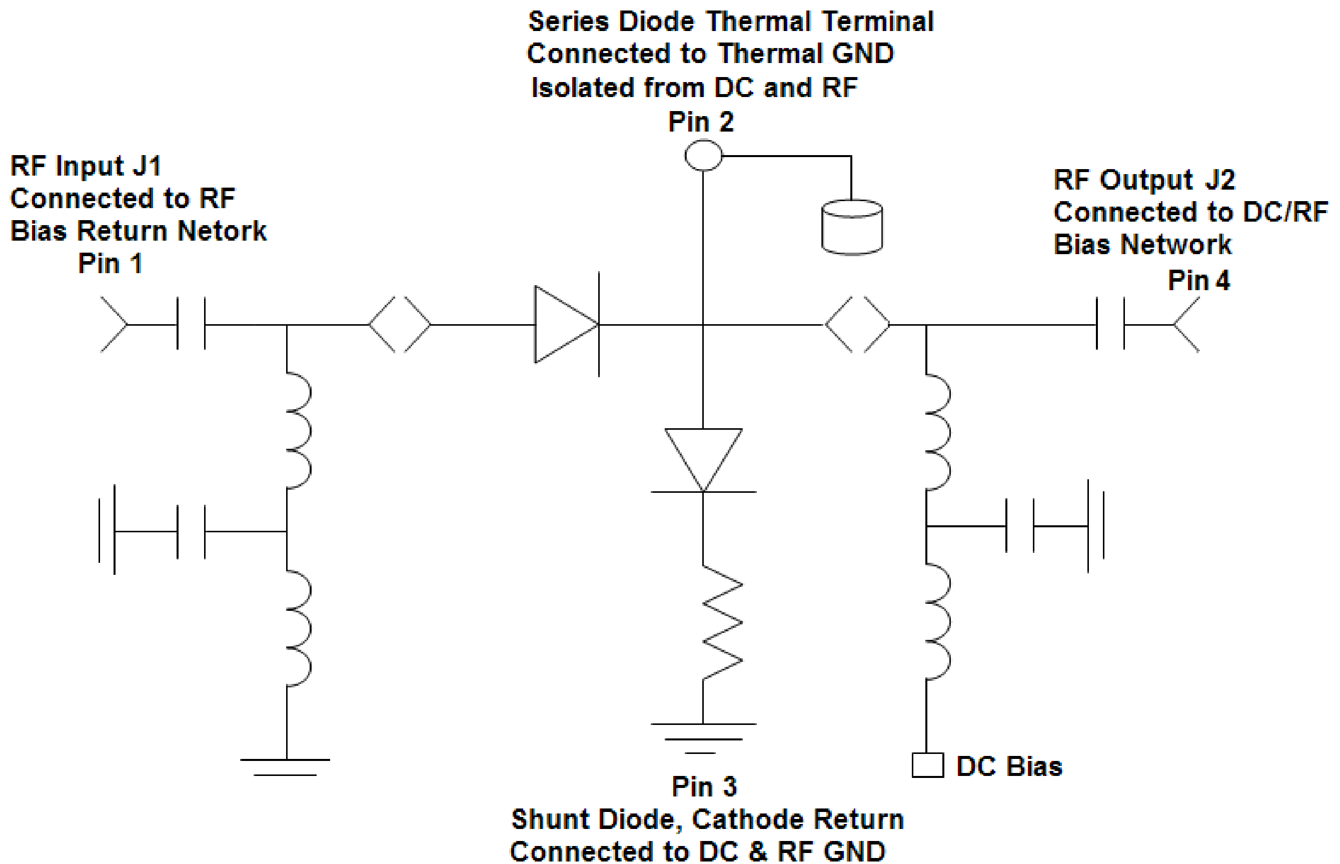



**ADVANCED:** Data Sheets contain information regarding a product M/A-COM Technology Solutions is considering for development. Performance is based on target specifications, simulated results, and/or prototype measurements. Commitment to develop is not guaranteed.
**PRELIMINARY:** Data Sheets contain information regarding a product M/A-COM Technology Solutions has under development. Performance is based on engineering tests. Specifications are typical. Mechanical outline has been fixed. Engineering samples and/or test data may be available. Commitment to produce in volume is not guaranteed.

- **North America** Tel: 800.366.2266 / Fax: 978.366.2266
- **Europe** Tel: 44.1908.574.200 / Fax: 44.1908.574.300
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298

Visit www.macomtech.com for additional data sheets and product information.

*M/A-COM Technology Solutions Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*




**Note:**

The bias circuits provided in the schematic above assumes current sources are available. If only voltage sources are available, a resistor will need to be added to the RF Input (J1) Bias Return Network. When using a D.C. voltage of 25V, a 500Ω resistor must be used to draw 50mA of current into the switch.

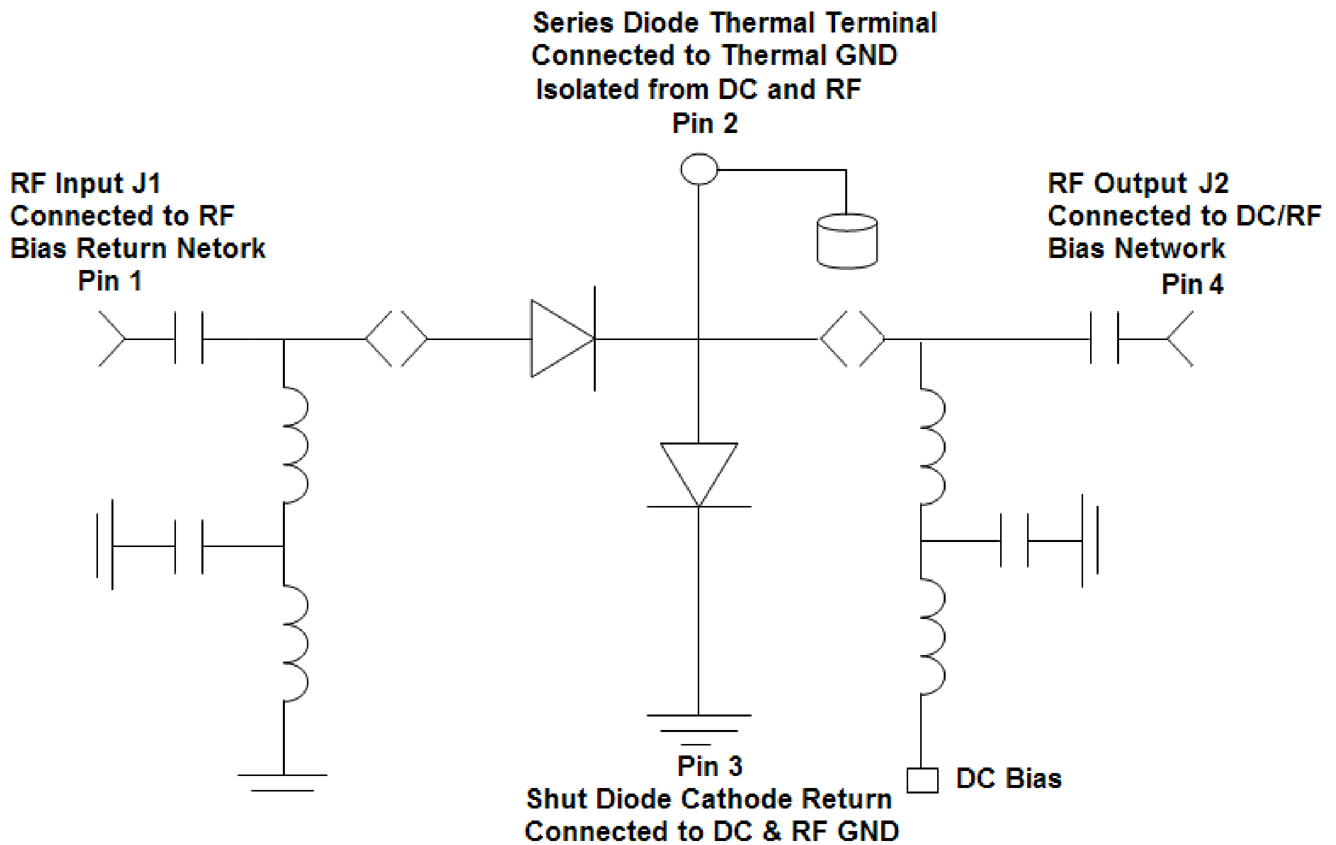


**ADVANCED:** Data Sheets contain information regarding a product M/A-COM Technology Solutions is considering for development. Performance is based on target specifications, simulated results, and/or prototype measurements. Commitment to develop is not guaranteed.
**PRELIMINARY:** Data Sheets contain information regarding a product M/A-COM Technology Solutions has under development. Performance is based on engineering tests. Specifications are typical. Mechanical outline has been fixed. Engineering samples and/or test data may be available. Commitment to produce in volume is not guaranteed.

- **North America** Tel: 800.366.2266 / Fax: 978.366.2266
- **Europe** Tel: 44.1908.574.200 / Fax: 44.1908.574.300
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298

Visit www.macomtech.com for additional data sheets and product information.

*M/A-COM Technology Solutions Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*




**Note:**

The bias circuits provided in the schematic above assumes current sources are available. If only voltage sources are available, a resistor will need to be added to the RF Input (J1) Bias Return Network. When using a D.C. voltage of 25V, a 500Ω resistor must be used to draw 50mA of current into the switch.



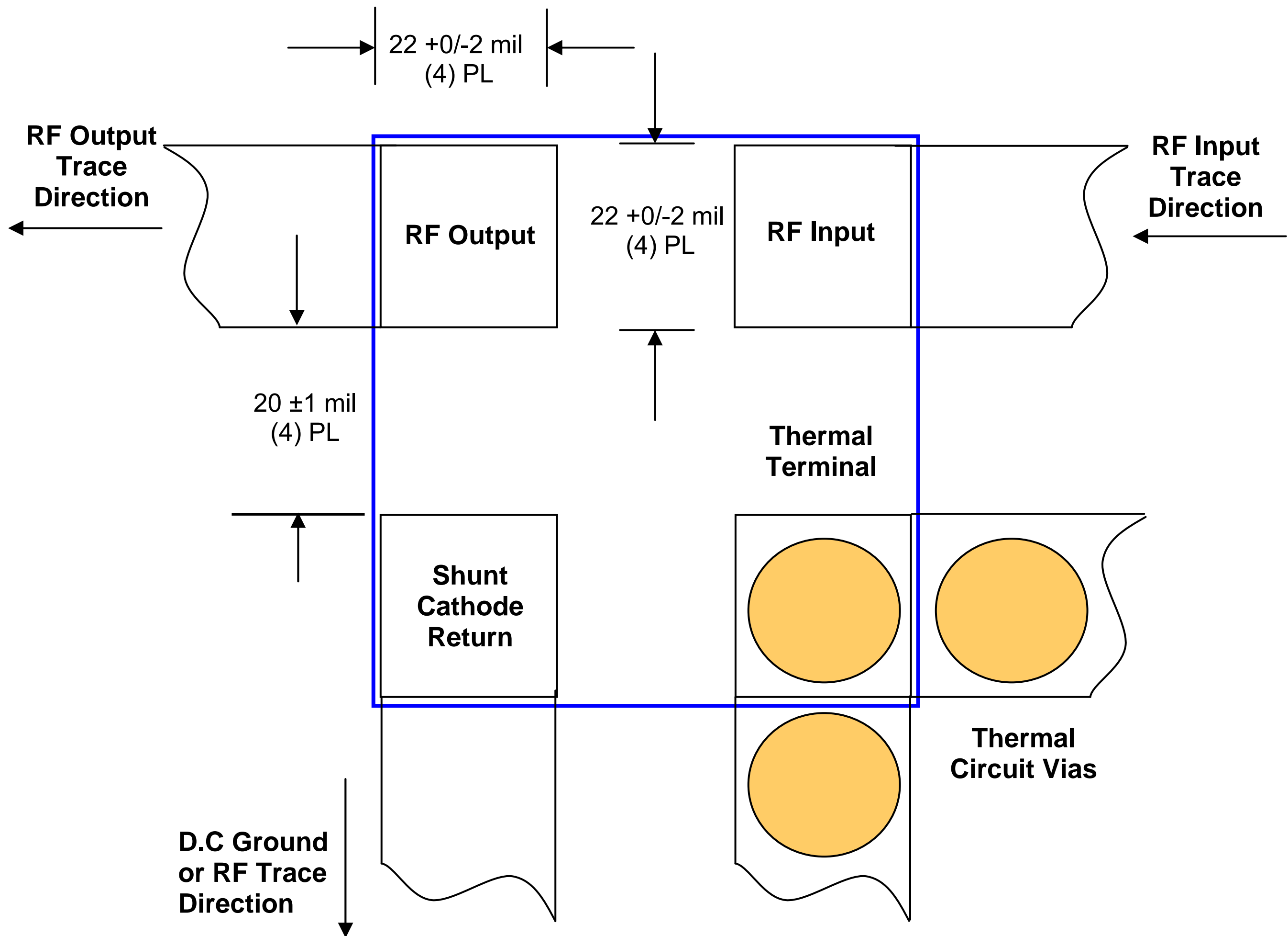
**ADVANCED:** Data Sheets contain information regarding a product M/A-COM Technology Solutions is considering for development. Performance is based on target specifications, simulated results, and/or prototype measurements. Commitment to develop is not guaranteed.
**PRELIMINARY:** Data Sheets contain information regarding a product M/A-COM Technology Solutions has under development. Performance is based on engineering tests. Specifications are typical. Mechanical outline has been fixed. Engineering samples and/or test data may be available. Commitment to produce in volume is not guaranteed.

- **North America** Tel: 800.366.2266 / Fax: 978.366.2266
- **Europe** Tel: 44.1908.574.200 / Fax: 44.1908.574.300
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298

Visit www.macomtech.com for additional data sheets and product information.

*M/A-COM Technology Solutions Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*

## RF , DC, and Thermal Circuit Footprint ( Topview )






**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.
**PRELIMINARY:** Data Sheets contain information regarding a product M/A-COM Technology Solutions has under development. Performance is based on engineering tests. Specifications are typical. Mechanical outline has been fixed. Engineering samples and/or test data may be available. Commitment to produce in volume is not guaranteed.

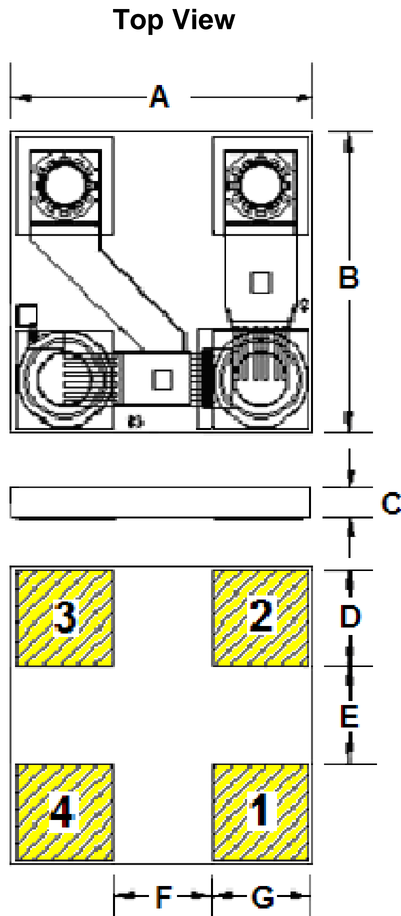
- **North America** Tel: 800.366.2266 / Fax: 978.366.2266
- **Europe** Tel: 44.1908.574.200 / Fax: 44.1908.574.300
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298

Visit www.macomtech.com for additional data sheets and product information.

*M/A-COM Technology Solutions Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*

## Chip Outline and Port Designations

**Top View**




**Bottom View**

| Dimension | Inches | | Millimeters | |
|---|---|---|---|---|
| | min. | max. | min. | max. |
| A | 0.0665 | 0.0673 | 1.69 | 1.71 |
| B | 0.0665 | 0.0673 | 1.69 | 1.71 |
| C | 0.0045 | 0.0053 | 0.115 | 0.135 |
| D | 0.0195 | 0.0205 | 0.495 | 0.520 |
| E | 0.0195 | 0.0205 | 0.495 | 0.520 |
| F | 0.0195 | 0.0205 | 0.495 | 0.520 |
| G | 0.0195 | 0.0205 | 0.495 | 0.520 |

| Ports | Function |
|---|---|
| 1 | RF Input |
| 2 | Thermal Terminal for Series Diode (Electrically isolated from other ports) |
| 3 | Shunt Diode (Cathode Return) |
| 4 | RF Output / D.C. bias |

**Notes:**

Backside Metal: 2.5µm thick Au
Hatched yellow areas are I/O ports (die solder pads)

## Ordering Information

| Part Number | Packaging |
|---|---|
| MASW-001150-13160W | Waffle Tray |
| MASW-001150-13160P | Pocket Tape |



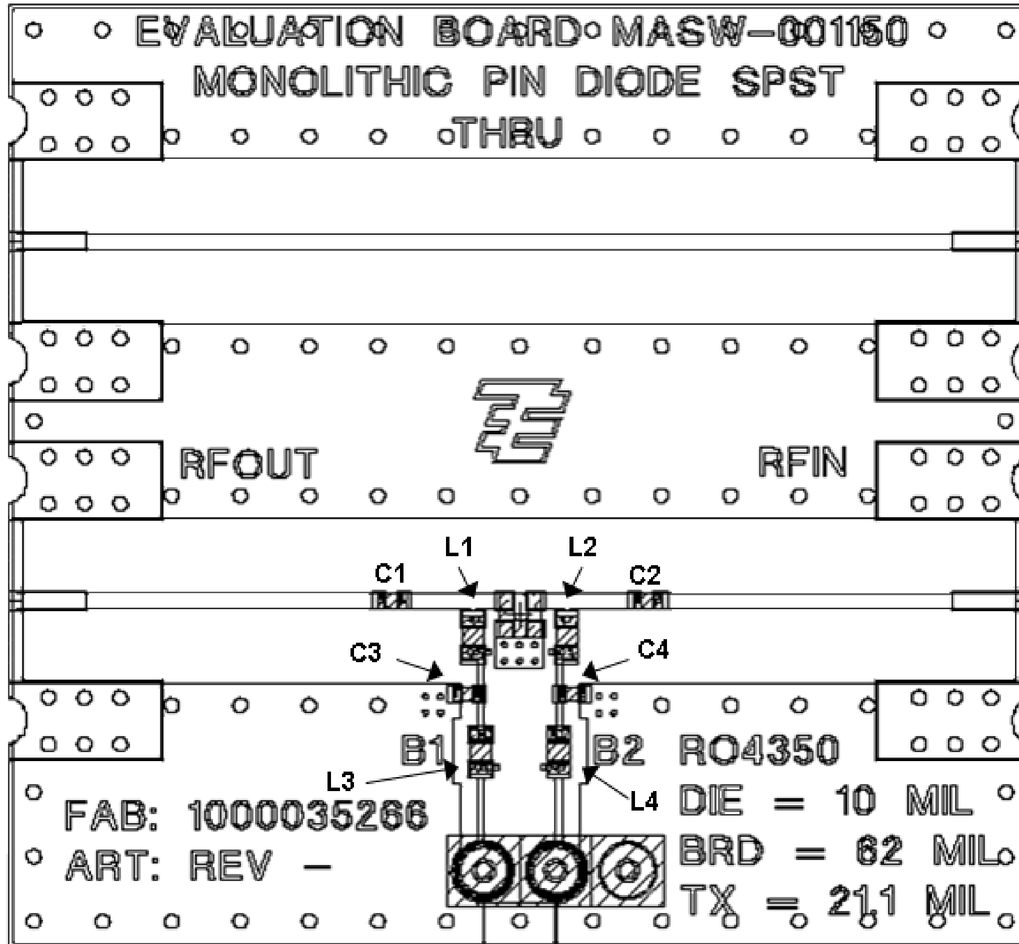
**ADVANCED:** Data Sheets contain information regarding a product M/A-COM Technology Solutions is considering for development. Performance is based on target specifications, simulated results, and/or prototype measurements. Commitment to develop is not guaranteed.
**PRELIMINARY:** Data Sheets contain information regarding a product M/A-COM Technology Solutions has under development. Performance is based on engineering tests. Specifications are typical. Mechanical outline has been fixed. Engineering samples and/or test data may be available. Commitment to produce in volume is not guaranteed.

- **North America** Tel: 800.366.2266 / Fax: 978.366.2266
- **Europe** Tel: 44.1908.574.200 / Fax: 44.1908.574.300
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298

Visit www.macomtech.com for additional data sheets and product information.

*M/A-COM Technology Solutions Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*

## Sample Test Board for 300-3000 MHz




| Component | Value | Case Size | Manufacturer |
|---|---|---|---|
| C1, C2 | 0.01µF | 0402 | Murata |
| C3, C4 | 100pF | 0402 | Murata |
| L1, L2, L3, L4 | 390nH | 0603 | Coilcraft |

### Ordering Information for Test Board

| Part Number |
|---|
| MASW-001150-001SMB |



**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.
**PRELIMINARY:** Data Sheets contain information regarding a product M/A-COM Technology Solutions has under development. Performance is based on engineering tests. Specifications are typical. Mechanical outline has been fixed. Engineering samples and/or test data may be available. Commitment to produce in volume is not guaranteed.

- **North America** Tel: 800.366.2266 / Fax: 978.366.2266
- **Europe** Tel: 44.1908.574.200 / Fax: 44.1908.574.300
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298

Visit www.macomtech.com for additional data sheets and product information.

*M/A-COM Technology Solutions Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*

## Assembly Guidelines

### 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.

### Bonding

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 or conductive epoxy attachment onto hard or soft substrates. The use of 60/40, Pb/Sn, 80/20, Au/Sn or any RoHS lead-free solder is recommended to achieve the lowest series resistance and optimum heat sink. The thermal terminal is not electrically conductive and may be soldered directly to any appropriate heat sink without affecting RF performance.

When soldering these devices to a hard substrate, hot gas die bonding is preferred. We recommend utilizing a vacuum tip and applying a force of 40 - 60 grams to the top surface of the device. When soldering, 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 40 to 60 grams of force perpendicular to the top surface of the die. All mounting pads should be heated simultaneously so that the solder under the pads flows at the same time. Avoid soldering the pads one at a time as doing so would produce an un-equal heat flow and potentially create thermal stress to the chip.

Solder reflow should not be performed by causing heat to flow through the top surface of the die. Die should be uniformly heated in a re-flow oven. Proper flow is easily determined looking down from the top since the HMIC glass is transparent and the edges of the mounting pads can be visually inspected through the die after attachment is complete. A typical soldering process profile and handling instructions are provided in Application Notes, **M538 Surface Mounting Instructions** and **M541 Bonding and Handling Procedures** on the MA-COM Technology Solutions website at www.macomtech.com

Conductive silver epoxy may also be used for die attachment, in lower Incident power applications where the average power is <1W. Apply a thin controlled amount approximately 1- 2 mils thick to minimize ohmic and thermal stresses. Take care not to bridge the gap between the chip pads with epoxy. A thin epoxy fillet should be visible around the perimeter of the pads after placement to ensure full coverage. Cure per epoxy per manufacturer's recommended schedule.



**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.
**PRELIMINARY:** Data Sheets contain information regarding a product M/A-COM Technology Solutions has under development. Performance is based on engineering tests. Specifications are typical. Mechanical outline has been fixed. Engineering samples and/or test data may be available. Commitment to produce in volume is not guaranteed.

- **North America** Tel: 800.366.2266 / Fax: 978.366.2266
- **Europe** Tel: 44.1908.574.200 / Fax: 44.1908.574.300
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298
- **Asia/Pacific** Tel: 81.44.844.8296 / Fax: 81.44.844.8298

Visit www.macomtech.com for additional data sheets and product information.

*M/A-COM Technology Solutions Inc. and its affiliates reserve the right to make changes to the product(s) or information contained herein without notice.*