

# MASW-001150-1316

## SURMOUNT PIN Diode Switch Element with Thermal Terminal

V5

### Features

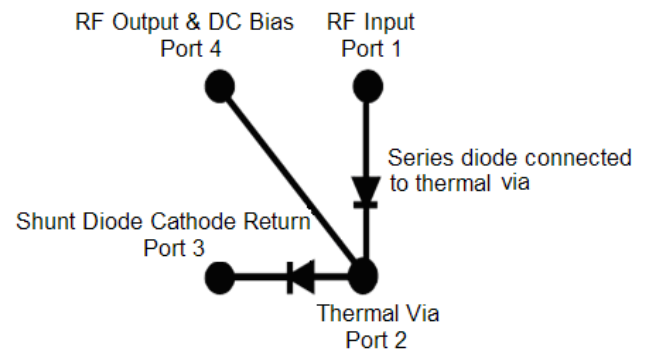
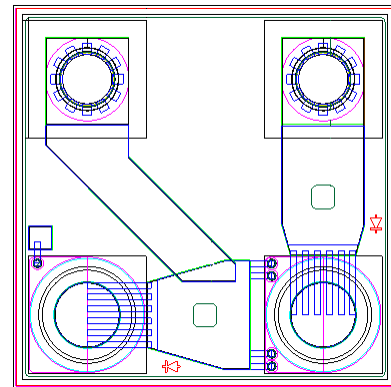
- Specified Bandwidth: 45MHz—2.5GHz
- Useable 30MHz to 3.0GHz
- Low Loss <0.5dB
- High isolation >40dB
- High C.W. Incident Power, 50W at 500MHz
- High Input IP3, +66dBm @ 500MHz
- Unique Thermal Terminal for Series Diode
- Surface Mount Device (No Wire Bonds)
- Rugged Silicon-Glass Construction
- Silicon Nitride Passivation Protective Polymer
- Protective Polymer Scratch Protection
- RoHS Compliant

### Description

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 connection between the series diode and the circuit heatsink 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 chip is fabricated using M/A-COM Technology Solutions patented HMIC™ process and features silicon pedestals embedded in a low loss, low dispersion glass for low leakage current. The top-side 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 high average power, 50W, switch applications from 30MHz – 3GHz. The backside RF, D.C., and thermal I/O ports allow for direct solder re-flow, surface mount, attachment to a micro-strip circuit assembly. The thermal terminal design provides the, power dissipating, series diode a direct connection to the circuit thermal ground for unprecedented heat transfer. The thermal terminal port is electrically isolated from the I/O ports and can be configured as either a reflective or an absorptive switch.



### Ordering Information <sup>2</sup>

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

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## SURMOUNT PIN Diode Switch Element with Thermal Terminal

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

Symbol	Parameter	Conditions	Units	Typical	Maximum
C <sub>T Series</sub>	Total Capacitance	-25V ,30MHz	pF	0.52	—
C <sub>T Series</sub>	Total Capacitance	-25V, 1800MHz	pF	0.37	—
C <sub>T Shunt</sub>	Total Capacitance	-25V, 30MHz	pF	0.54	—
C <sub>T Shunt</sub>	Total Capacitance	-25V, 1800MHz	pF	0.39	—
R <sub>S Series</sub>	Series Resistance	20mA, 30MHz	Ω	1.13	—
R <sub>S Series</sub>	Series Resistance	20mA,1800MHz	Ω	1.25	—
R <sub>S Series</sub>	Series Resistance	50mA, 30MHz	Ω	0.93	—
R <sub>S Series</sub>	Series Resistance	50mA,1800MHz	Ω	1.07	—
R <sub>S Shunt</sub>	Series Resistance	10mA, 30MHz	Ω	1.00	—
R <sub>S Shunt</sub>	Series Resistance	10mA, 1800MHz	Ω	0.99	—
V <sub>F</sub>	Forward Voltage	20mA	V	0.82	0.85
V <sub>F</sub>	Forward Voltage	50mA	V	0.88	0.90
I <sub>R</sub>	Reverse Leakage Current	-180V	μA	—	-10.0
R <sub>qJL</sub>	Thermal Resistance	Steady State	°C/W	36.0	—
T <sub>L</sub> <sup>1</sup>	Minority Carrier Lifetime	I <sub>F</sub> 10mA/I <sub>R</sub> 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	-25V	- 50mA	45MHz	—	0.07	0.10
		-25V	- 50mA	1000MHZ	—	0.30	0.45
		-25V	- 50mA	2500MHz	—	0.60	0.80
Return Loss	dB	-25V	- 50mA	45MHz	36	39	—
		-25V	- 50mA	1000MHZ	18	20	—
		-25V	- 50mA	2500MHz	11	13	—
Isolation	dB	-25V	+ 50mA	45MHz	60	63	—
		-25V	+ 50mA	1000MHZ	40	42	—
		-25V	+ 50mA	2500MHz	29	33	—
Input IP3	dBm	-25V	- 50mA	-50mA / -25V F1 = 500MHz F2 = 505MHz P <sub>IN</sub> = +40dBm(each tone)	—	+66	—
2 <sup>nd</sup> Harmonic	dBc	-25V	- 50mA	50mA / -25V 500MHz /+35dBm	—	-46	—
3 <sup>rd</sup> Harmonic	dBc	-25V	- 50mA	50mA / -25V 500MHz /+35dBm	—	-60	—

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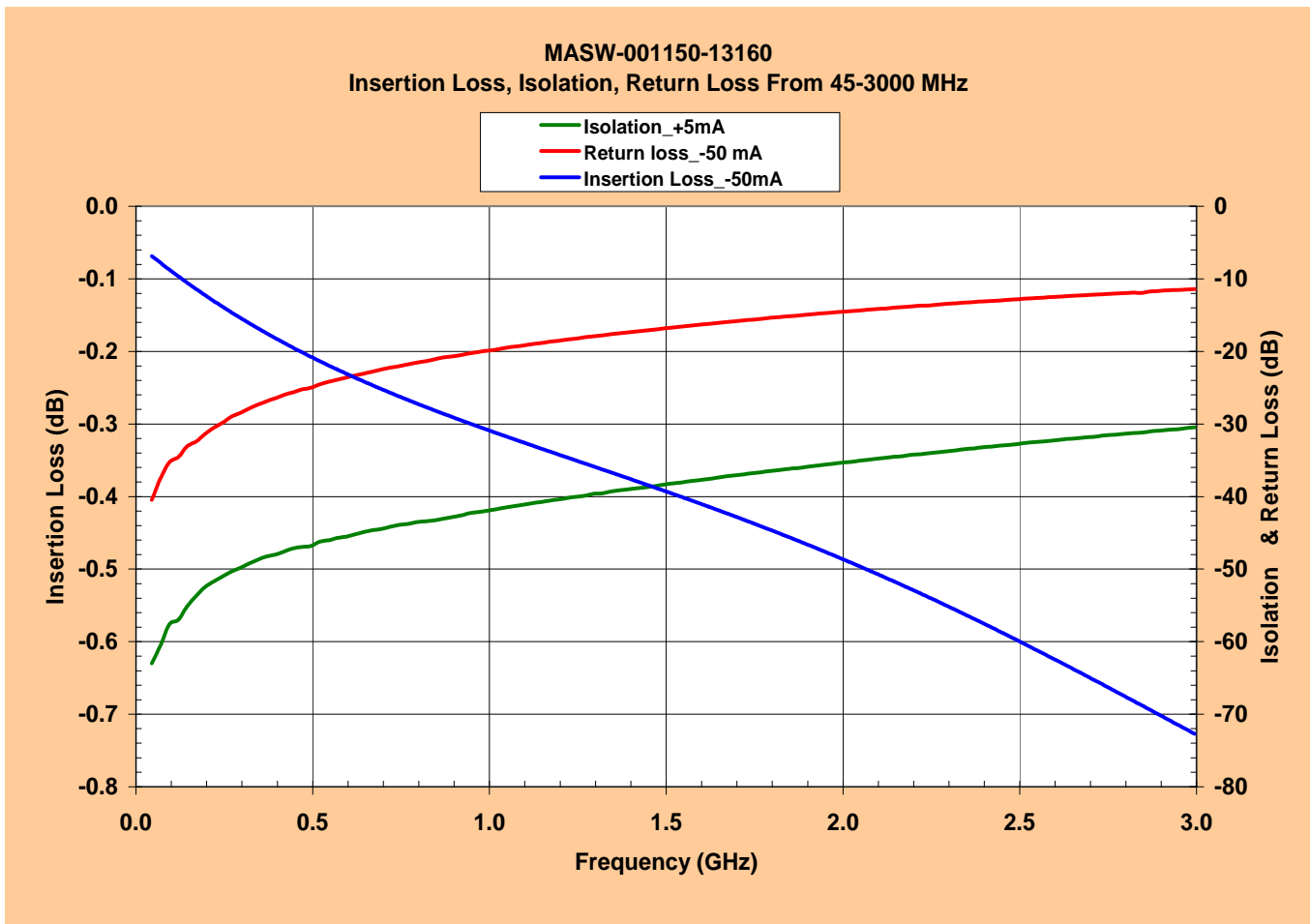
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### Typical RF Small Signal Performance



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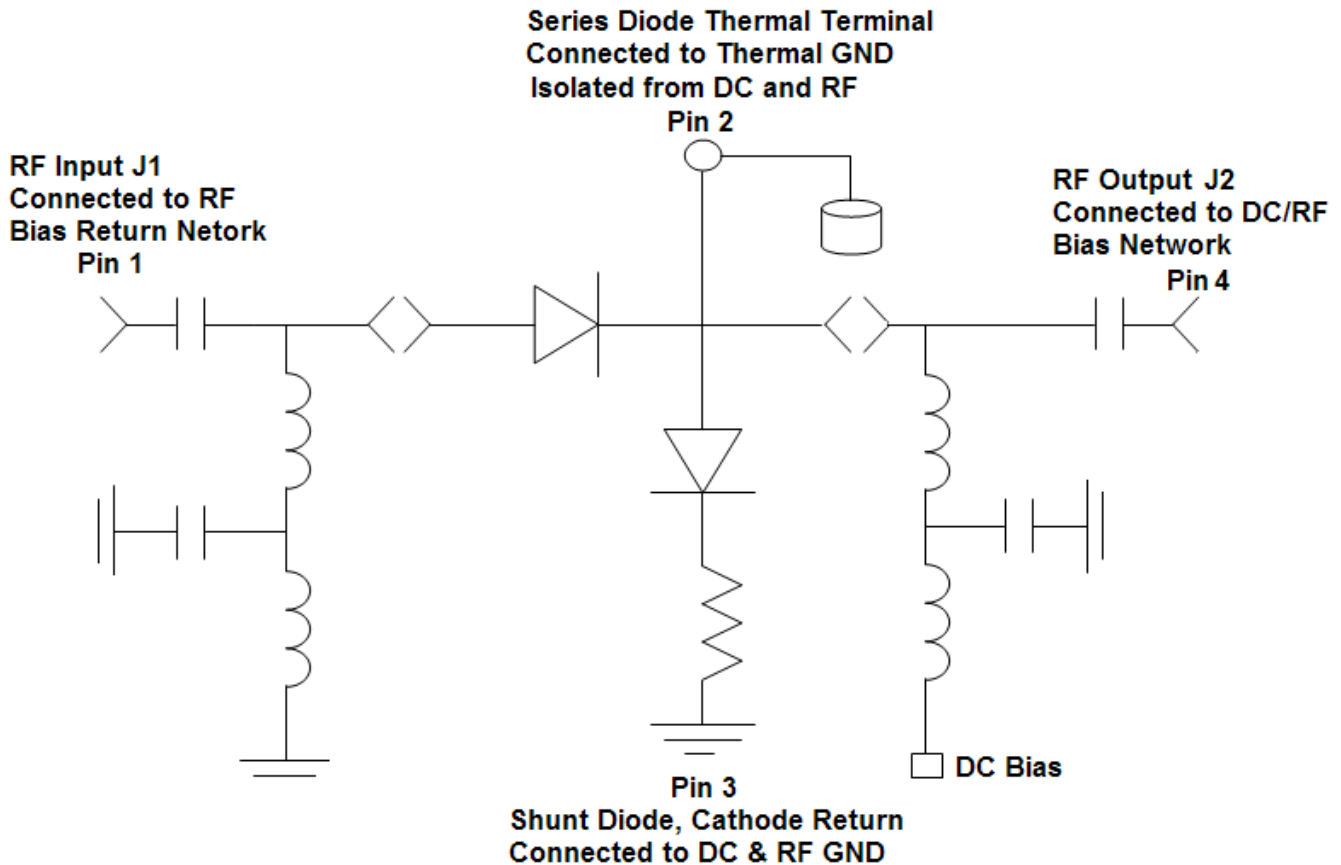
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# MASW-001150-1316

## SURMOUNT PIN Diode Switch Element with Thermal Terminal

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### MASW-001150-13160W Configured as an Absorptive High Power SPST Switch



#### 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.

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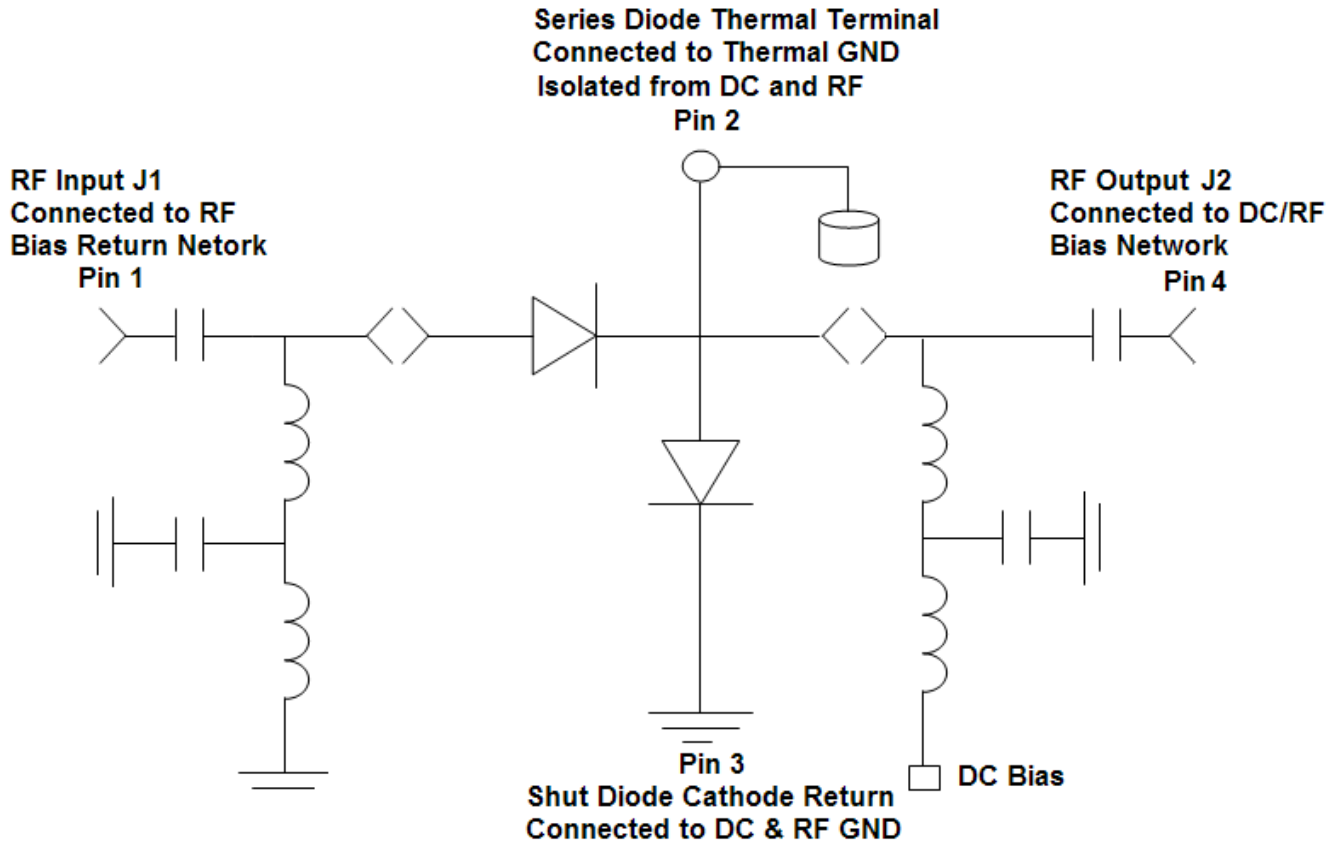
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# MASW-001150-1316

## SURMOUNT PIN Diode Switch Element with Thermal Terminal

V5

### MASW-001150-13160W Configured as a Reflective SPST Switch



#### 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.

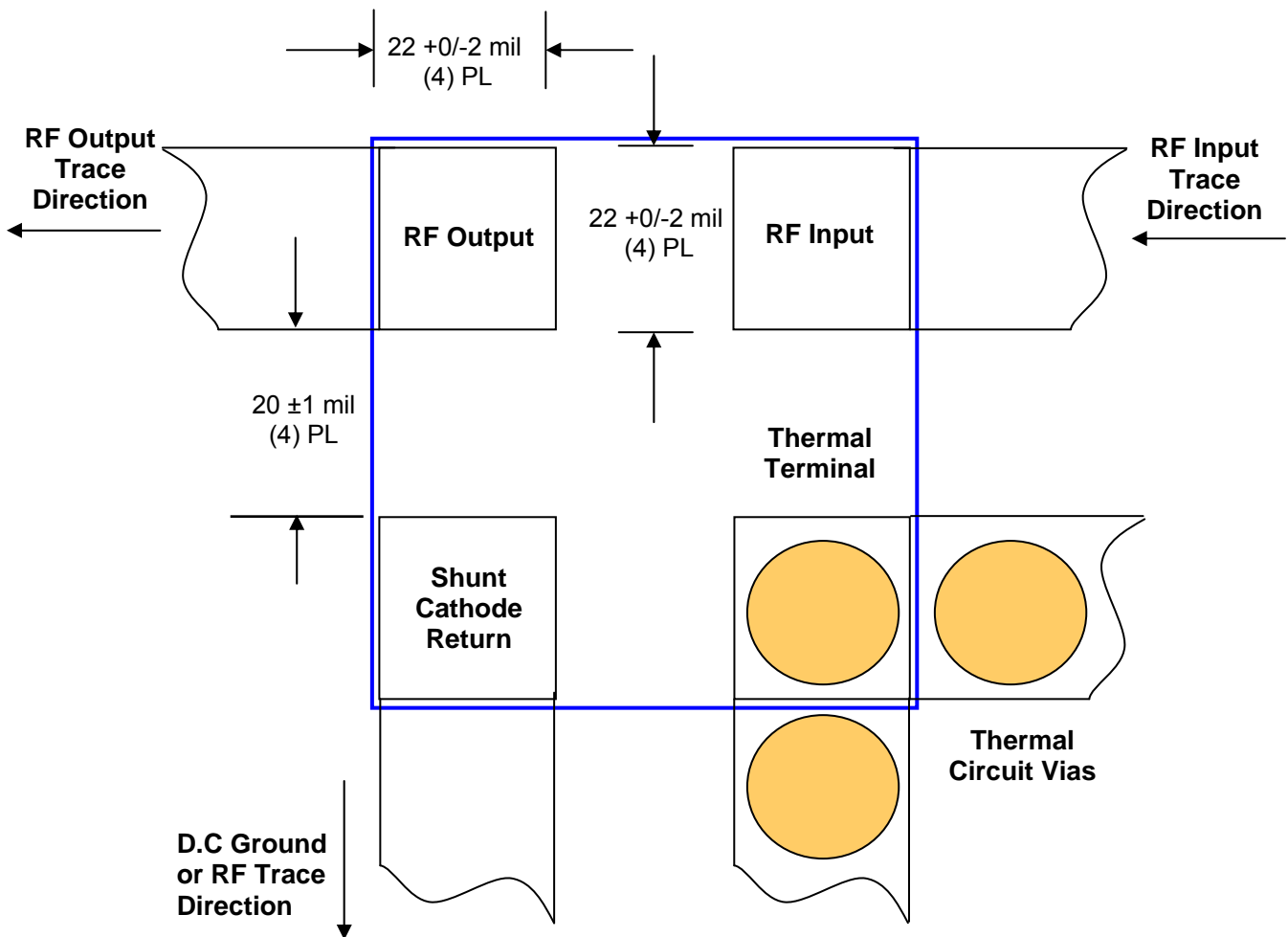
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### RF , DC, and Thermal Circuit Footprint ( Topview )



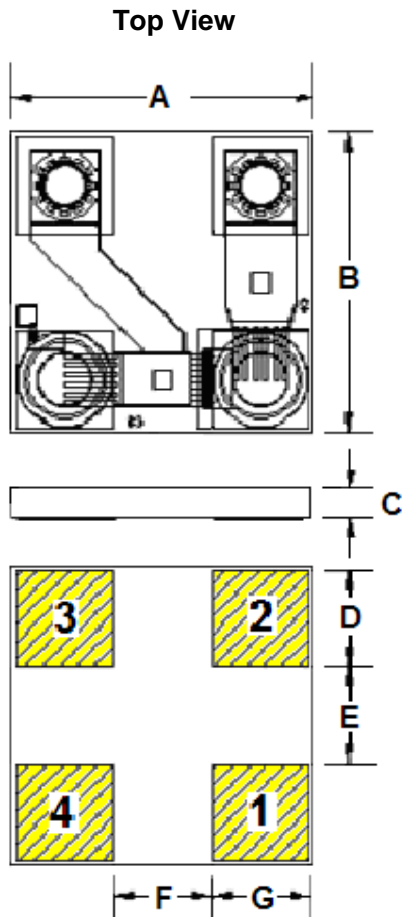
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### Chip Outline and Port Designations



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)

Bottom View

### Ordering Information

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

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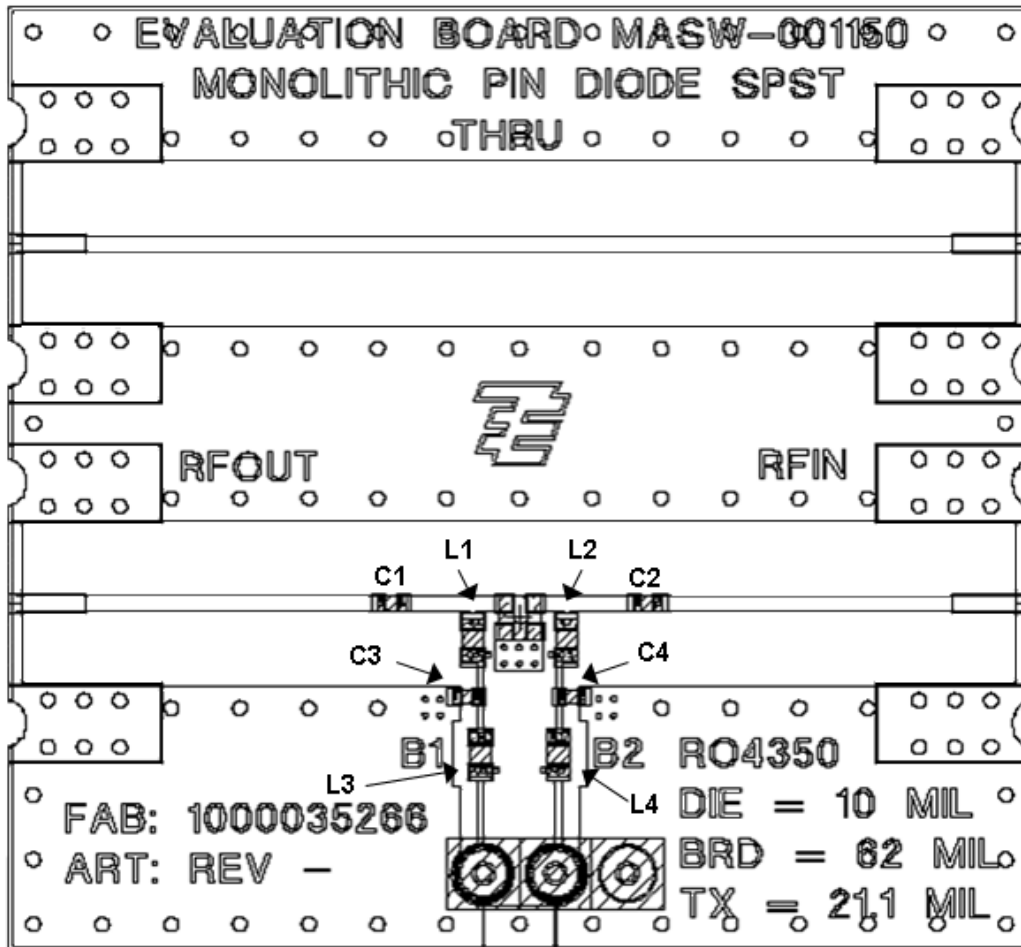
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### Sample Test Board for 300-3000 MHz



Component	Value	Case Size	Manufacturer
C1, C2	0.01 $\mu$ F	0402	Murata
C3, C4	100pF	0402	Murata
L1, L2, L3, L4	390nH	0603	Coilcraft

### Ordering Information for Test Board

Part Number
MASW-001150-001SMB

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## 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 60Pb/40Sn, 80Au/20Sn 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. 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 evenly and at the same time. Avoid soldering the pads one at a time as doing so may produce non-uniform heat flow which potentially could create thermal stress to the chip.

Die should be uniformly heated in a re-flow oven and not by causing heat to flow directly 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 top surface of the die to ensure proper solder flow and attachment. 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](http://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 and maximize heat transfer. 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 epoxy per manufacturer's recommended schedule. Typically 150°C for one hour.