MASW-001150-13160W

RoHS Compliant

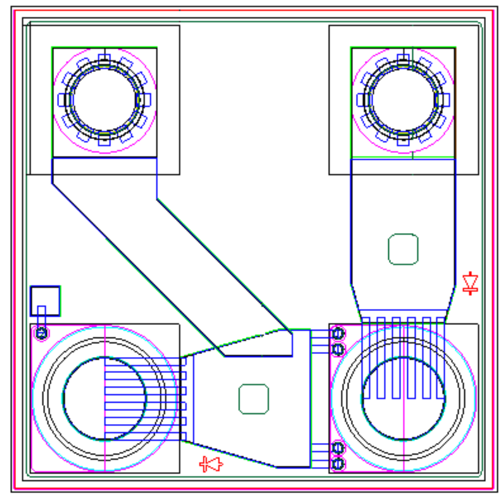
Tyco Electronics

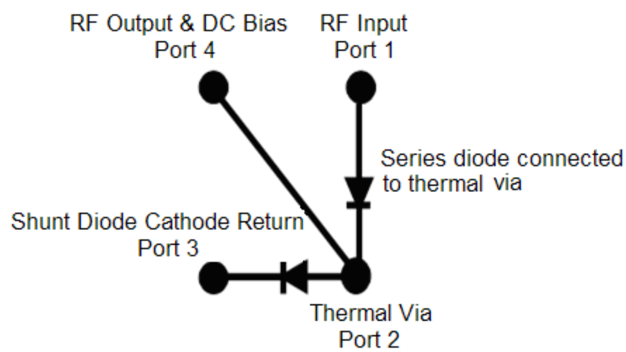
Surface Mount PIN Diode Switch Element with Thermal Terminal

M/A-COM Products

Features

- ♦ 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 & Polymer Scratch





Description

This device is a PIN diode series-shunt switch element with a unique 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's 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 – 2500MHz. 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.

Absolute Maximum Ratings

T_{AMB} = +25°C (unless otherwise specified)

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

- **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

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

Surface Mount 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	$I_{F\ 10mA}/I_{R\ 6mA}$	µs	8.5	—

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

Parameter	Units	Conditions	Minimum	Typical	Maximum
Frequency	MHz	0dBm	30	1000	2500
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 F1 = 500MHz F2 = 505MHz P_{IN} = +40dBm(each tone)	—	66	—
2nd Harmonic	dBc	50mA / -25V 500MHz /+35dBm	—	46	—
3rd Harmonic	dBc	50mA / -25V 500MHz /+35dBm	—	60	—

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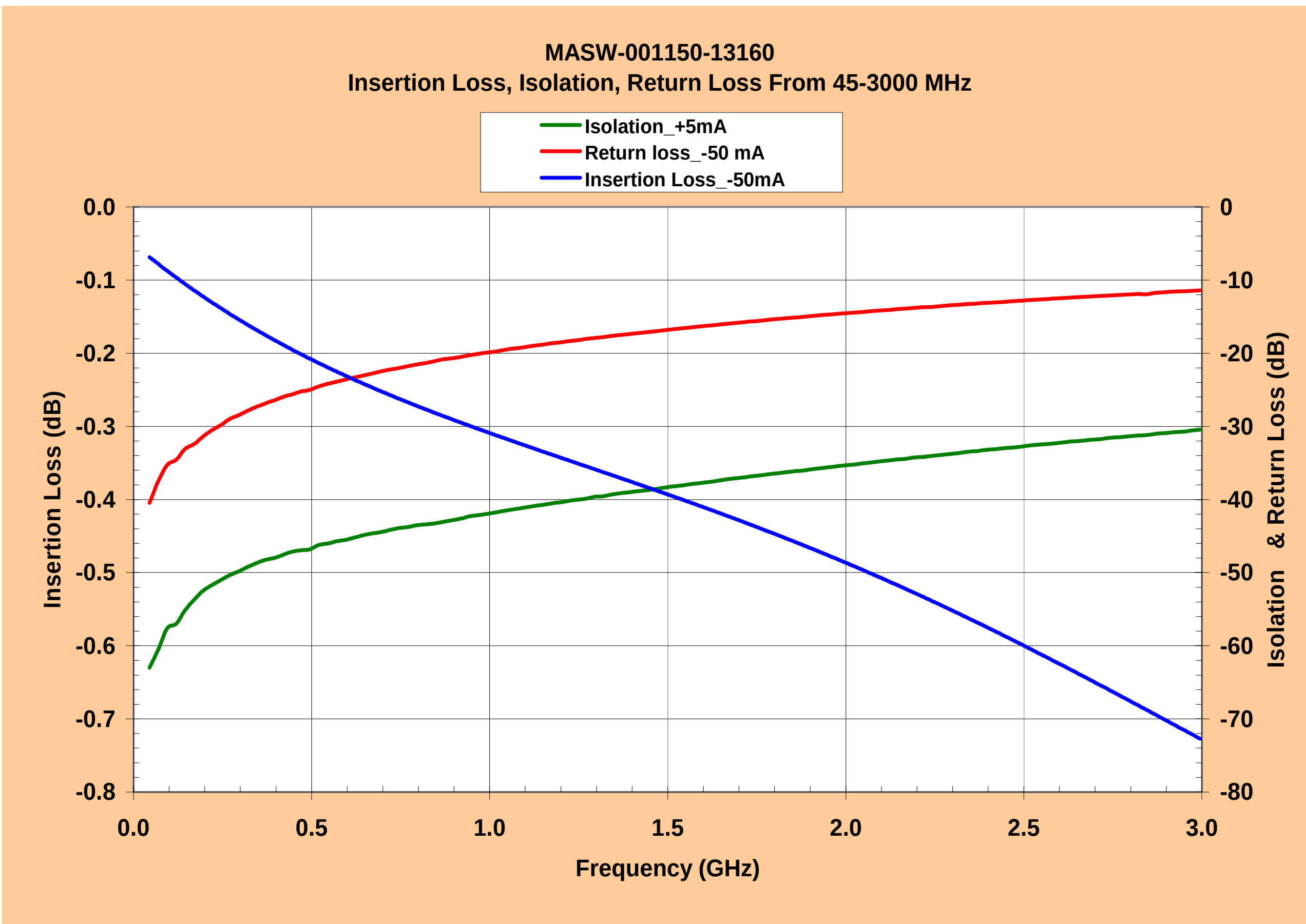
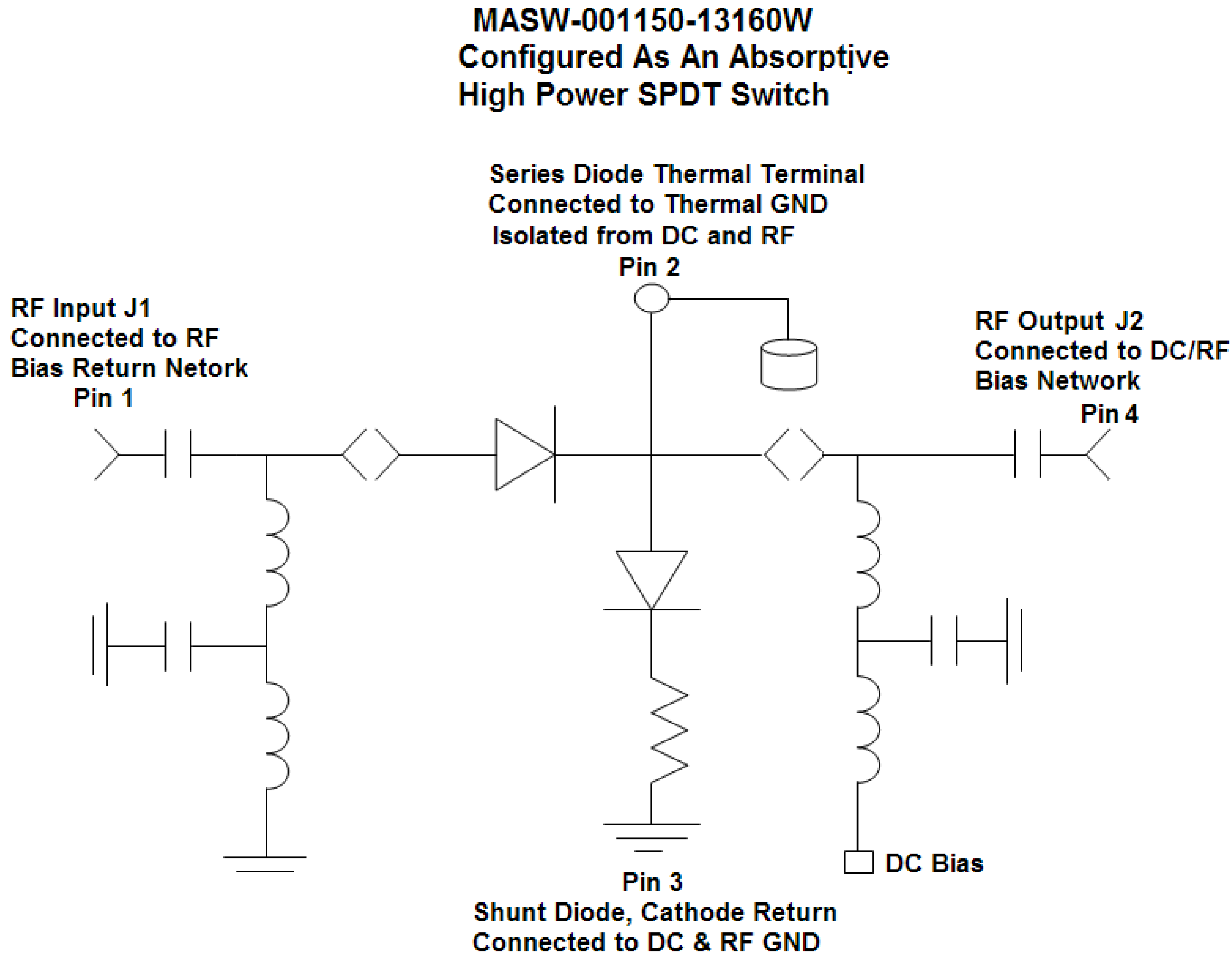
Typical RF Small Signal Performance





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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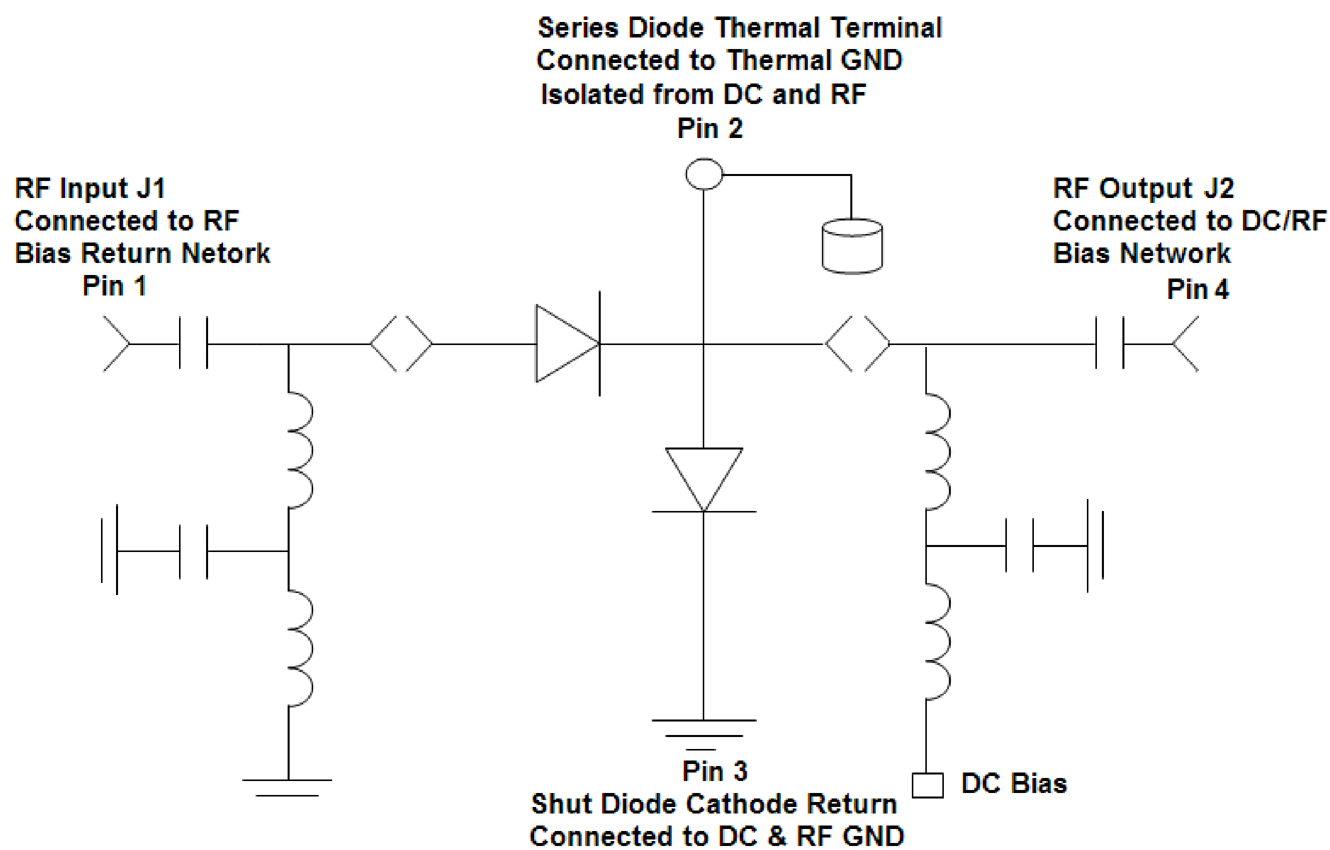
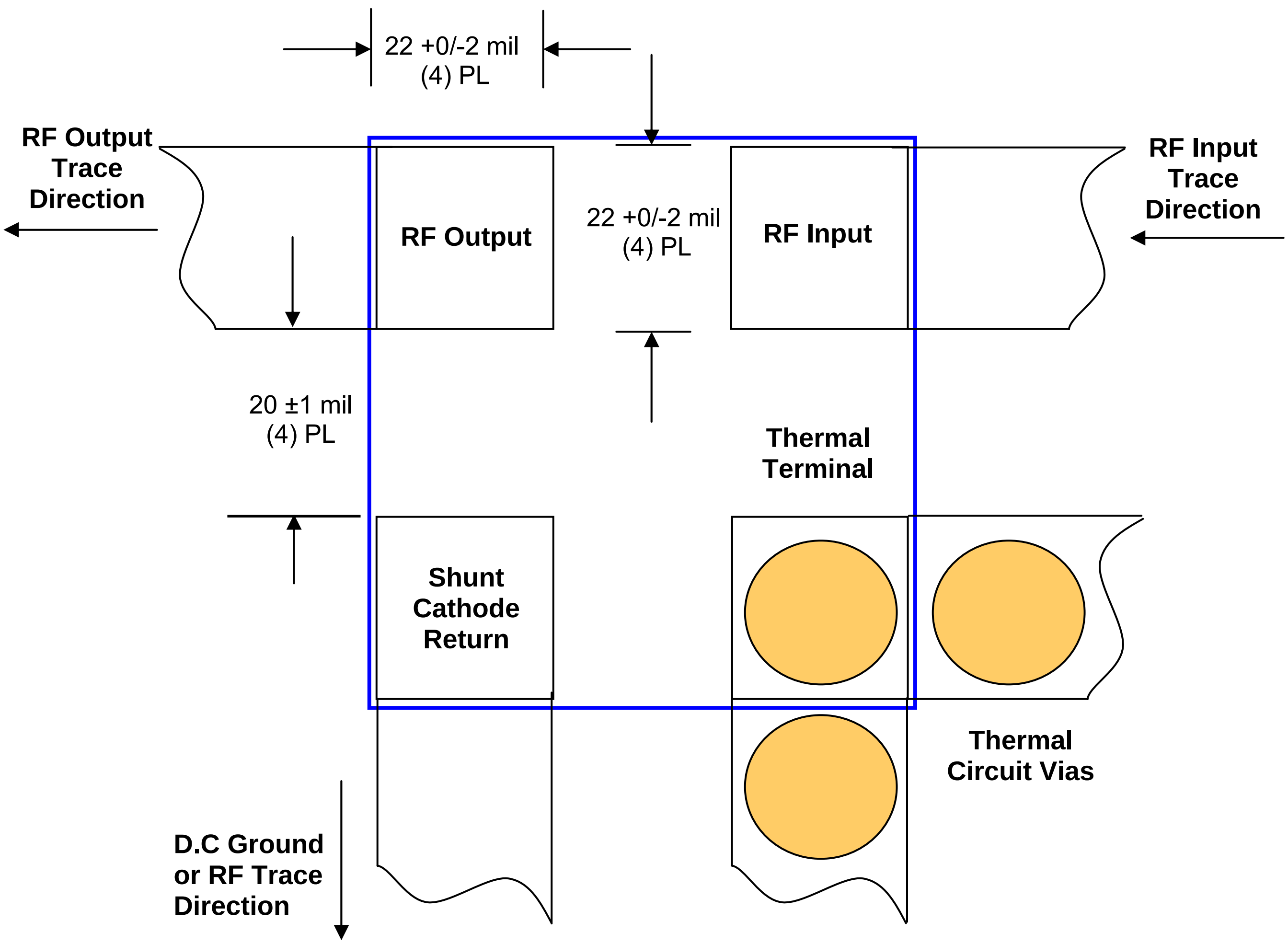
MASW-001150-13160W
Configured As A Reflective
High Power SPDT Switch



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.

RF , DC, and Thermal Circuit Footprint (Topview)



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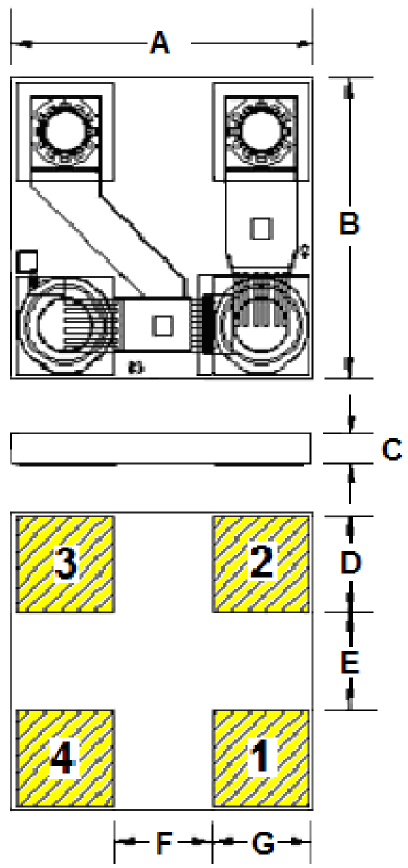
Chip Outline and Port Designations

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

- **North America** Tel: 800.366.2266 / Fax: 978.366.2266
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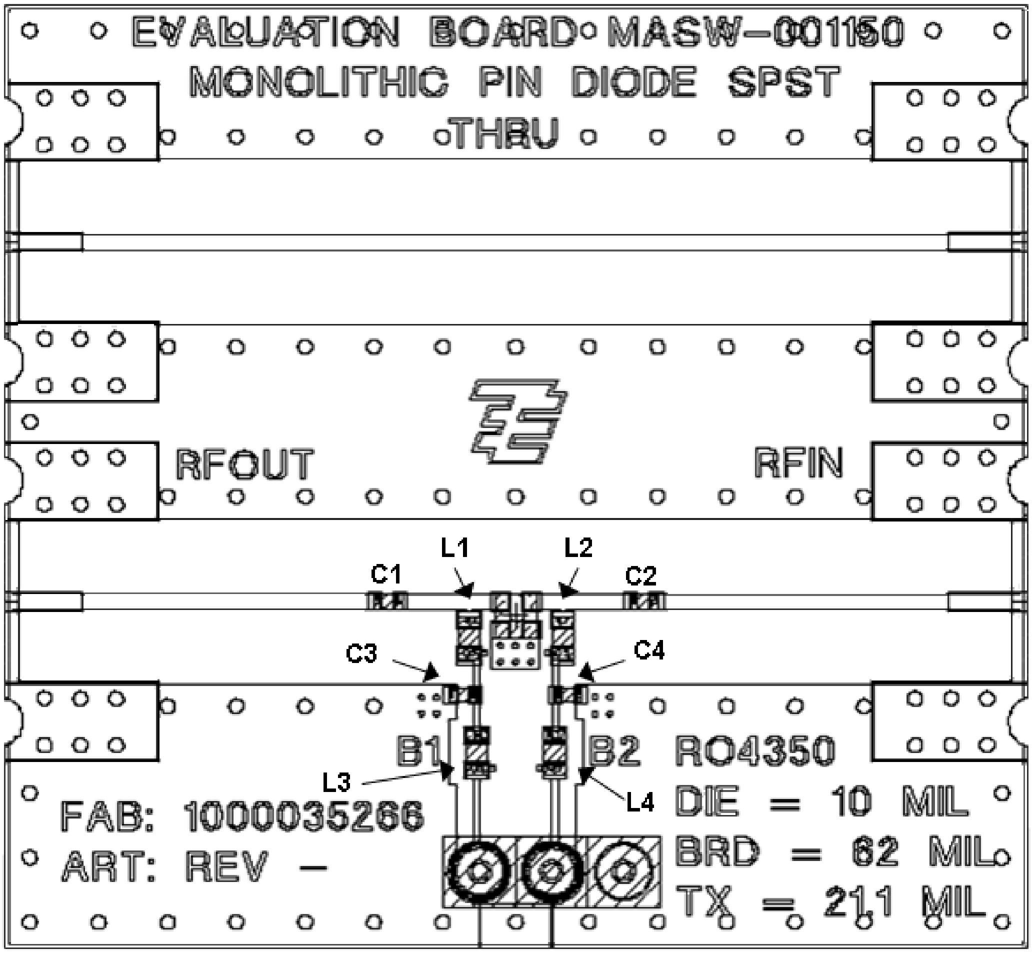
Sample Test Board for 300-3000 MHz



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

- **North America** Tel: 800.366.2266 / Fax: 978.366.2266
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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 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 website at www.macom.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.

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