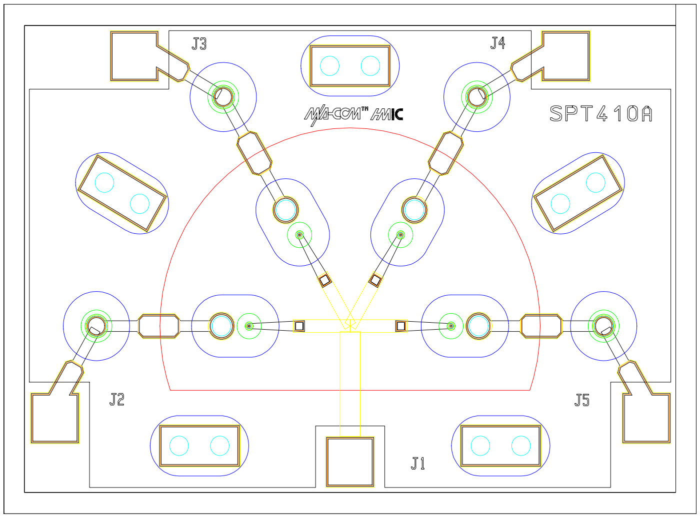
Monolithic PIN SP4T Diode Switch MASW-004100-1193

Rev. 2

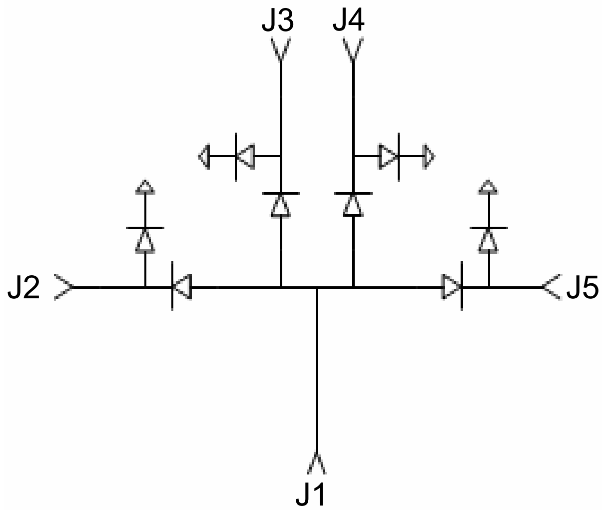
Features

- Ultra Broad Bandwidth: 50MHz to 26GHz
- 0.9 Insertion Loss , 34dB Isolation at 20GHz
- 50nS Switching Speed
- Reliable, Fully Monolithic, Glass Encapsulated Construction



Description

The MASW-004100-1193 is a SP4T series-shunt broad band switch made with M/A-COM's unique HMIC™ (Heterolithic Microwave Integrated Circuit) process, US Patent 5,268,310. This process allows the incorporation of silicon pedestals that form series and shunt diodes or vias by imbedding them in a low loss, low dispersion glass. This hybrid combination of silicon and glass gives HMIC switches exceptional low loss and remarkable high isolation through low millimeter-wave frequencies.



Applications

These high performance switches are suitable for use in multi-band ECM, radar, and instrumentation control circuits where high isolation to insertion loss ratios are required. With a standard +5V/-5V, TTL controlled PIN diode driver, 50nS switching speeds are achieved.

Absolute Maximum Ratings

T_{AMB} = +25°C (Unless Otherwise Specified)

Parameter	Value
Operating Temperature	-65°C to +125°C
Storage Temperature	-65°C to +150°C
RF C.W. Incident Power (± 20mA)	+33dBm
Bias Current (Forward)	± 20mA
Applied Voltage (Reverse)	-25 Volts

Notes:

Exceeding these limits may cause permanent damage.

Maximum Operating Conditions for Combination of RF Power, D.C. Bias, and Temperature: +30dBm C.W. @ 15 mA (per Diode) @ +85 °C.

Electrical Specifications @ T_{AMB} = +25°C, ± 20mA Bias Current (On-Wafer Measurements)

Parameter	Frequency	Minimum	Nominal	Maximum	Units
Insertion Loss	20 GHz		0.9	1.3	dB
Isolation	20 GHz	28	34		dB
Input Return Loss	20 GHz		15		dB
Output Return Loss	20 GHz		15		dB
Switching Speed[1]	10 GHz		50		nS

Notes:

1.) Typical switching speed is measured from 10% to 90% of detected RF voltage driven by a TTL compatible driver. Driver output parallel RC network uses a capacitor between 390pF – 560pF and a resistor between 150Ω – 220Ω to achieve 50nS rise and fall times.

Typical Driver Connections

Control Level (DC Current) at Port				Condition of RF Output	Condition of RF Output	Condition of RF Output	Condition of RF Output
J2	J3	J4	J5	J1-J2	J1-J3	J1-J4	J1-J5
-20mA	+20mA	+20mA	+20mA	**Low Loss**	Isolation	Isolation	Isolation
+20mA	-20mA	+20mA	+20mA	Isolation	**Low Loss**	Isolation	Isolation
+20mA	+20mA	-20mA	+20mA	Isolation	Isolation	**Low Loss**	Isolation
+20mA	+20mA	+20mA	-20mA	Isolation	Isolation	Isolation	**Low Loss**

Assembly Considerations

Cleanliness
Chips should be handled in a clean environment free of organic contamination.

Electro-Static Sensitivity
The MASW-004100-1193 PIN switch is ESD, Class 1A sensitive (HBM). Proper ESD handling equipment and procedures should be used.

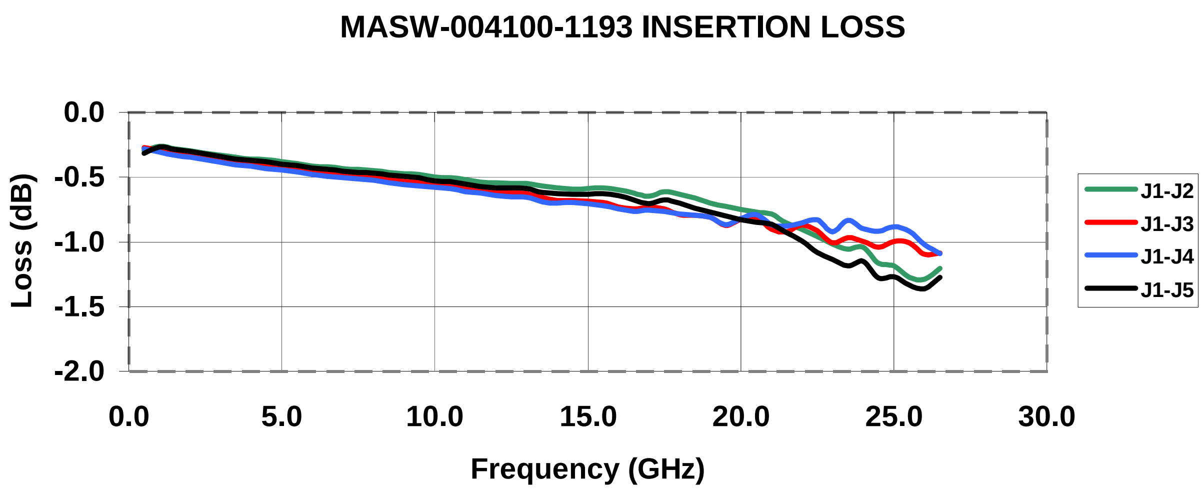
Die Wire Bonding
Thermosonic wedge wire bonding using ¼ x 3 mil sq. ribbon or Ball Bonding using 1 mil diameter gold wire is recommended. A stage temperature of 150°C and a force of 18 to 22 grams should be used. Ultrasonic energy should be adjusted to the minimum required. RF bonds should be as short as possible.

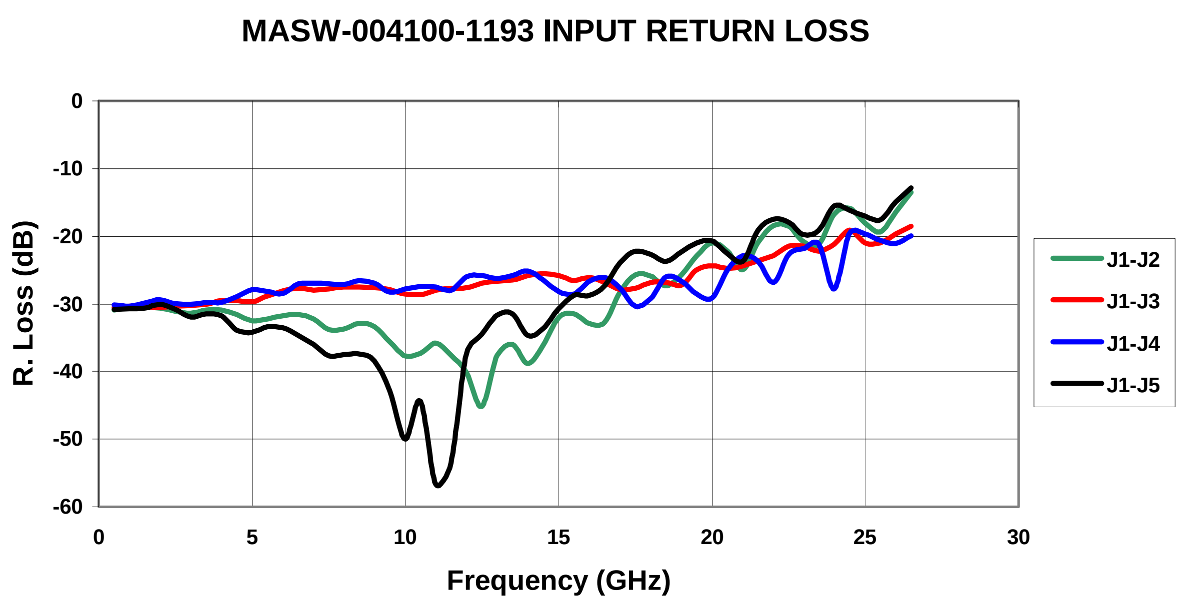
Die Mounting
These chips have a Ti-Pt-Au back metal stack that can be die mounted using a gold-tin eutectic solder preform or conductive Ag epoxy. Mounting surface must be clean and flat.

Eutectic Die Attachment
An 80/20 Gold-Tin eutectic solder preform is recommended with a work surface temperature of 255°C and a tool tip temperature of 265°C. When hot gas is applied, the tool tip temperature should be ~290°C. The chip should not be exposed to temperatures greater than 320°C for more than 20 seconds. No more than three seconds should be required for the attachment.

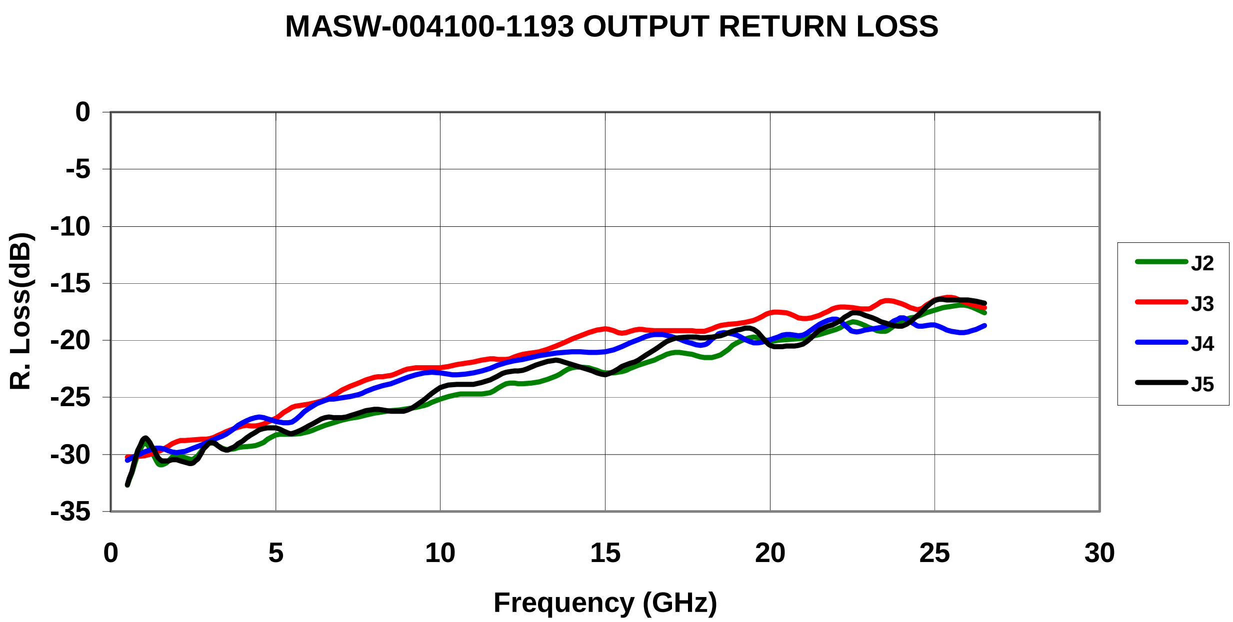
Electrical Epoxy Die Attachment
Assembly should be preheated to 125-150°C. A controlled thickness of 2 mils is recommended for best electrical and thermal conductivity. A thin epoxy fillet should be visible around the outer perimeter of the chip after placement to ensure complete coverage. Cure epoxy per manufacturer’s schedule.

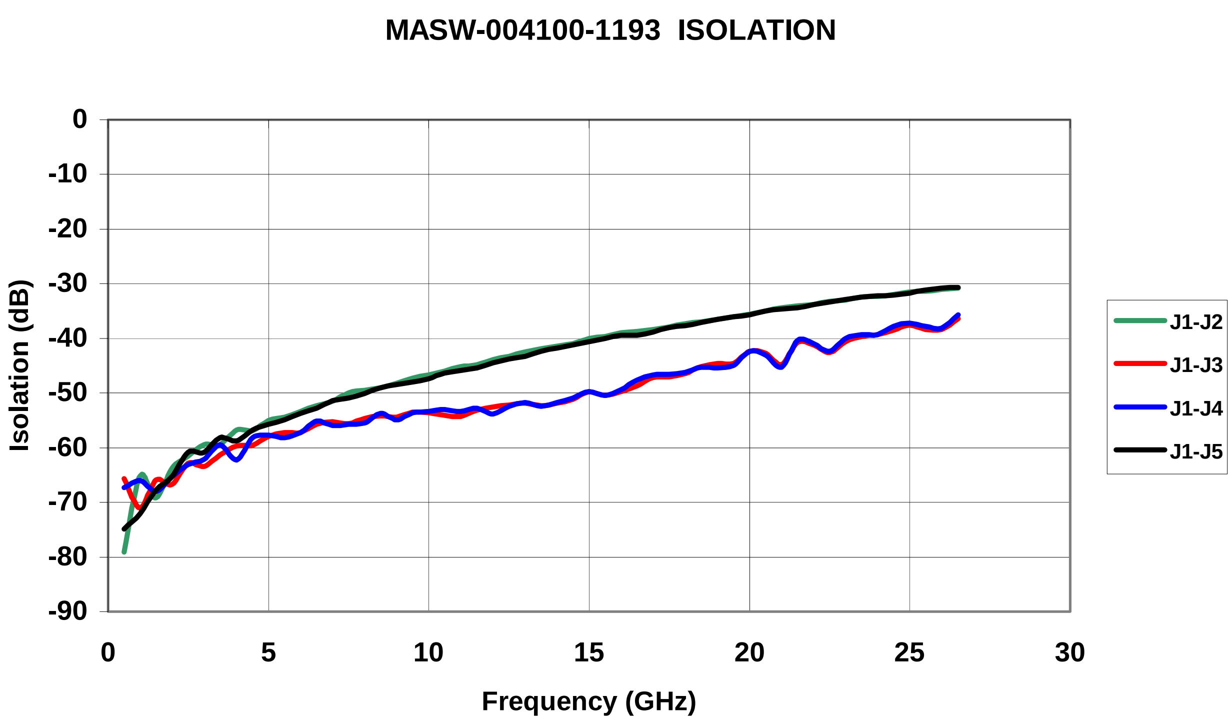
Typical Microwave Performance





Typical Microwave Performance





Operation of the MASW-004100-1193 PIN Switch

Operation of the MASW-004100-1193 PIN switch is achieved by the simultaneous application of negative DC current to the low loss port and positive DC current to the remaining isolated switching ports as shown in Figure 1. The backside area of the die is the RF and DC return ground plane. The DC return is achieved on the common port, J1. The DC control currents should be supplied by constant current source. The voltages at these points will not exceed ±1.5 volts (1.2 volts typical) for supply currents up to ±20 mA. In the low loss state, the series diode must be forward biased and the shunt diode reverse biased. For all the isolated ports, the shunt diode is forward biased and the series diode is reverse biased. The bias network design should yield > 30 dB RF to DC isolation.

Best insertion loss, P1dB, IP3, and switching speed are achieved by using a voltage pull-up resistor in the DC return path, (J1). A minimum value of |-2V| is recommended at this return node, which is achievable with a standard, ±5V TTL controlled PIN diode driver. A typical DC bias schematic for 2-18 GHz Operation is shown in Figure 1.

2 – 18 GHz Bias Network

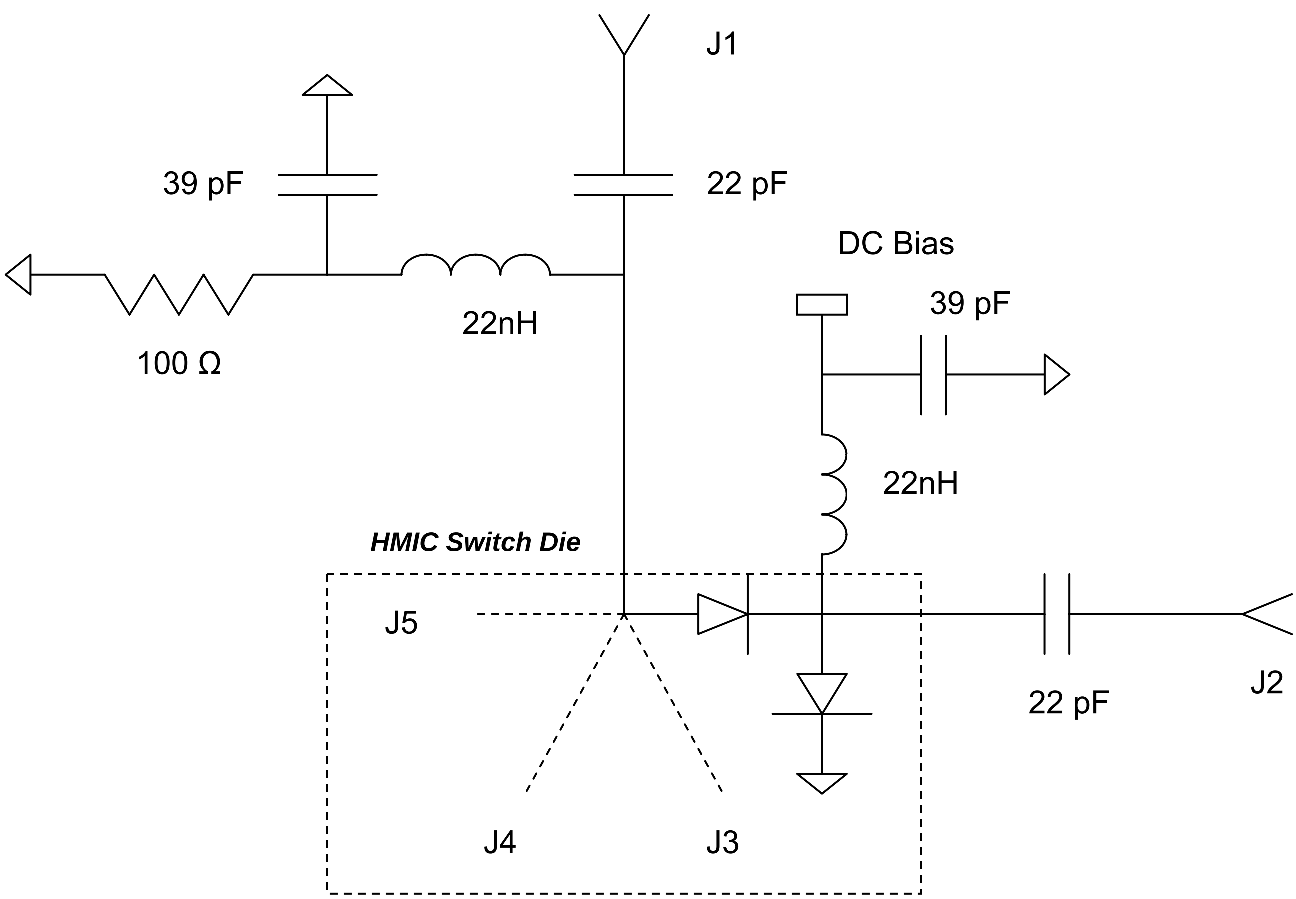
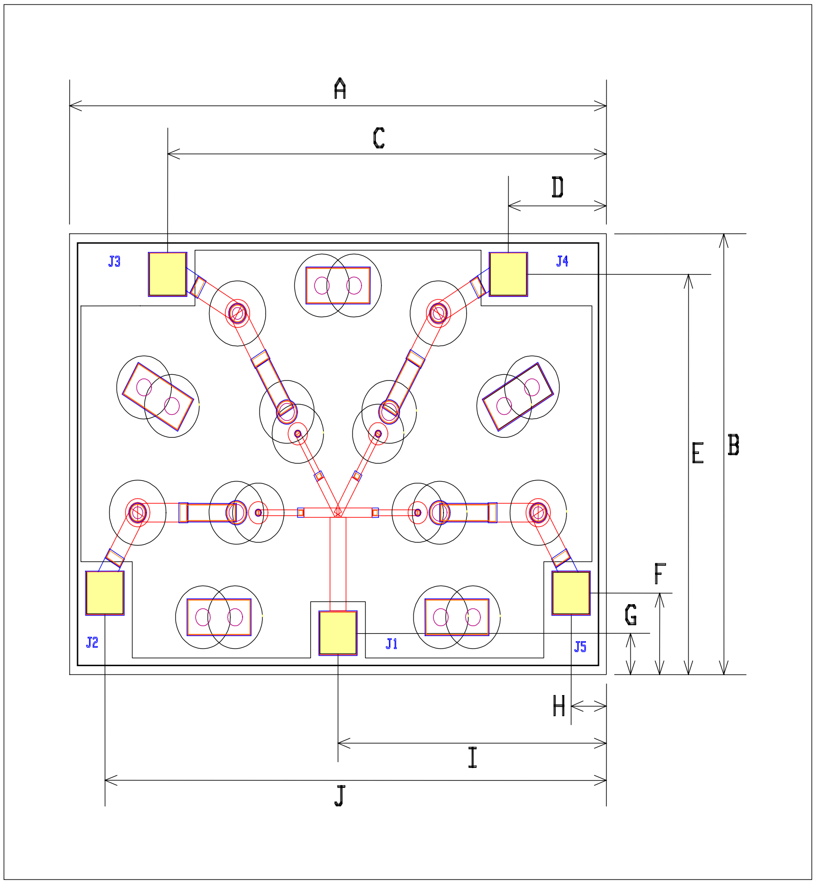


Fig. 1

MASW-004100-1193
Chip Dimensions



DIM	INCHES NOMINAL	MM NOMINAL
A	.066	1.67
B	.047	1.19
C	.054	1.37
D	.012	0.31
E	.043	1.08
F	.009	0.22
G	.004	0.11
H	.004	0.11
I	.033	0.84
J	.061	1.56
Thickness	.005	.120
Bond Pads	.005X.005	0.120X.0120

Ordering Information

Part Number	Package
MASW-004100-11930W	Waffle Pack