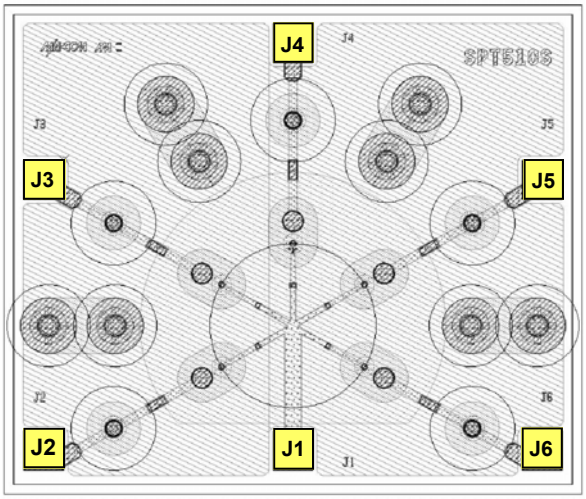
MA4SW510

HMIC™ Silicon SP5T PIN Diode Switch
RoHS Compliant

Rev. V4

Features

- Ultra Broad Bandwidth: 50MHz to 26GHz
- 1dB Insertion Loss ,
- 30dB Isolation at 20GHz
- 50nS Switching Speed
- Fully Monolithic, Glass Encapsulated Chip with Polymer Protective Coating



Yellow areas indicate 2.5µM thick gold bond pads

Description

The MA4SW510 is a SP5T 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 the 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.

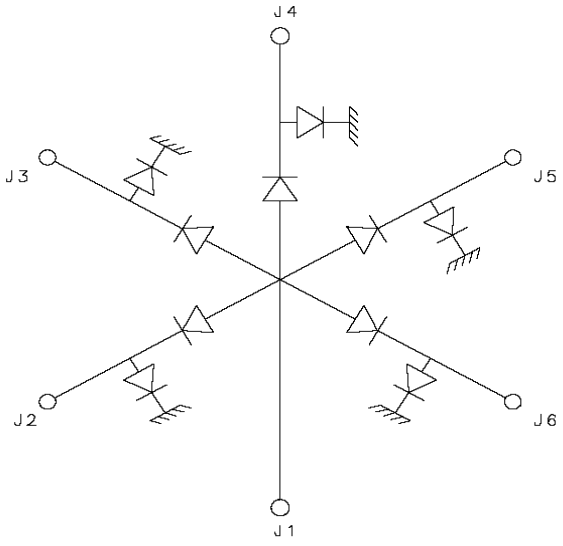
Absolute Maximum Ratings

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	+30dBm
Forward Bias Current	± 20mA
Reverse Applied Voltage	-25 Volts

Notes:

1. Exceeding any one of these values may result in permanent damage to the chip.
2. Maximum operating conditions for combination of RF power, D.C. bias and temperature:
   +30dBm C.W. @ 15mA/diode @ +85°C



MA4SW510 Schematic

- **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

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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	Condition of RF Output
J2	J3	J4	J5	J6	J2 - J1	J3 - J1	J4 - J1	J5 - J1	J6 - J1
-20 mA	+20 mA	+20 mA	+20 mA	+20 mA	**Low Loss**	Isolation	Isolation	Isolation	Isolation
+20 mA	**-20 mA**	+20 mA	+20 mA	+20 mA	Isolation	**Low Loss**	Isolation	Isolation	Isolation
+20 mA	+20 mA	**-20 mA**	+20 mA	+20 mA	Isolation	Isolation	**Low Loss**	Isolation	Isolation
+20 mA	+20 mA	+20 mA	**-20 mA**	+20 mA	Isolation	Isolation	Isolation	**Low Loss**	Isolation
+20 mA	+20 mA	+20 mA	+20 mA	**-20 mA**	Isolation	Isolation	Isolation	Isolation	**Low Loss**

RF Electrical Specifications @ T_{AMB} = 25°C, ± 20mA bias current (probed on-wafer measurements)					
Parameter	**Frequency**	**Minimum**	**Nominal**	**Maximum**	**Units**
Insertion Loss	20 GHz		0.9	1.4	dB
Isolation	20 GHz	28	38		dB
Input Return Loss	20 GHz		22		dB
Output Return Loss	20 GHz		23		dB
Switching Speed[1]	10 GHz [1]		50		nS

Note:

1.) Typical switching speed is measured from 10% to 90% of the 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.

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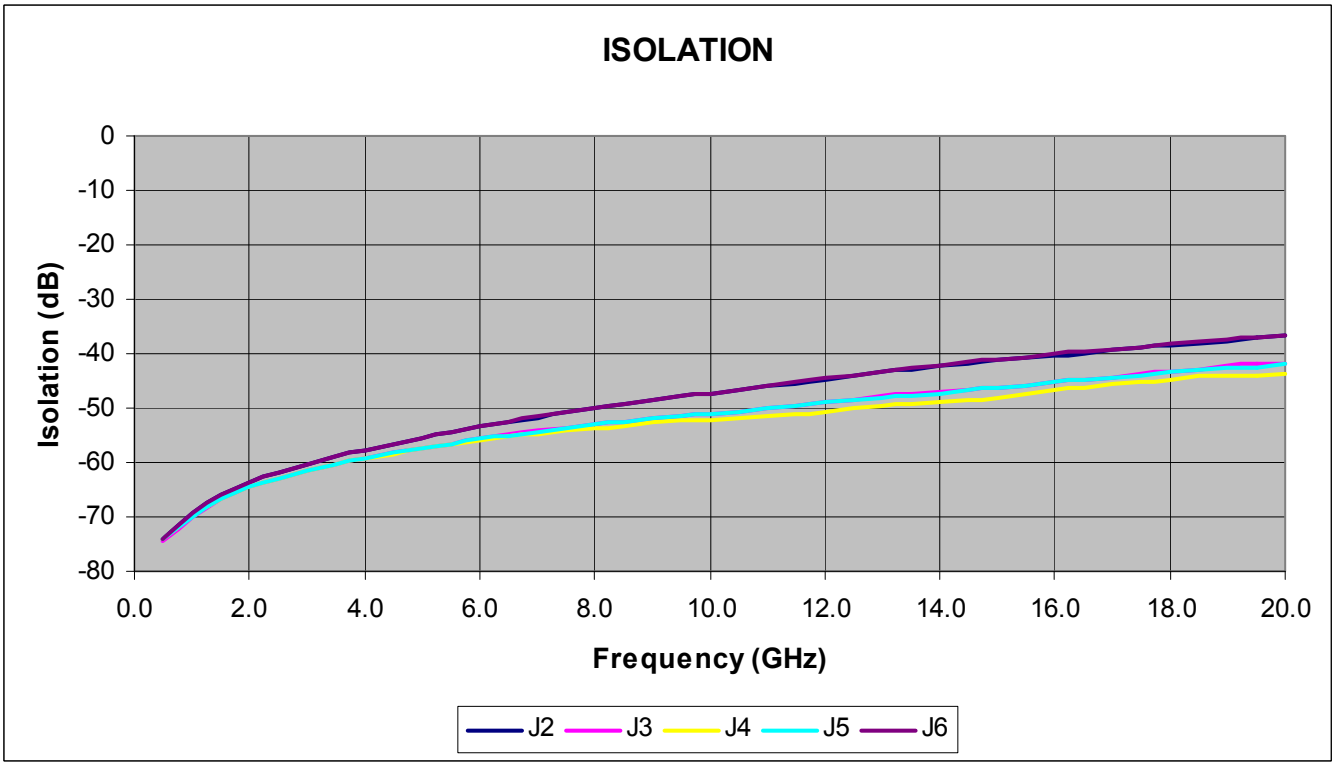
Typical Microwave Performance



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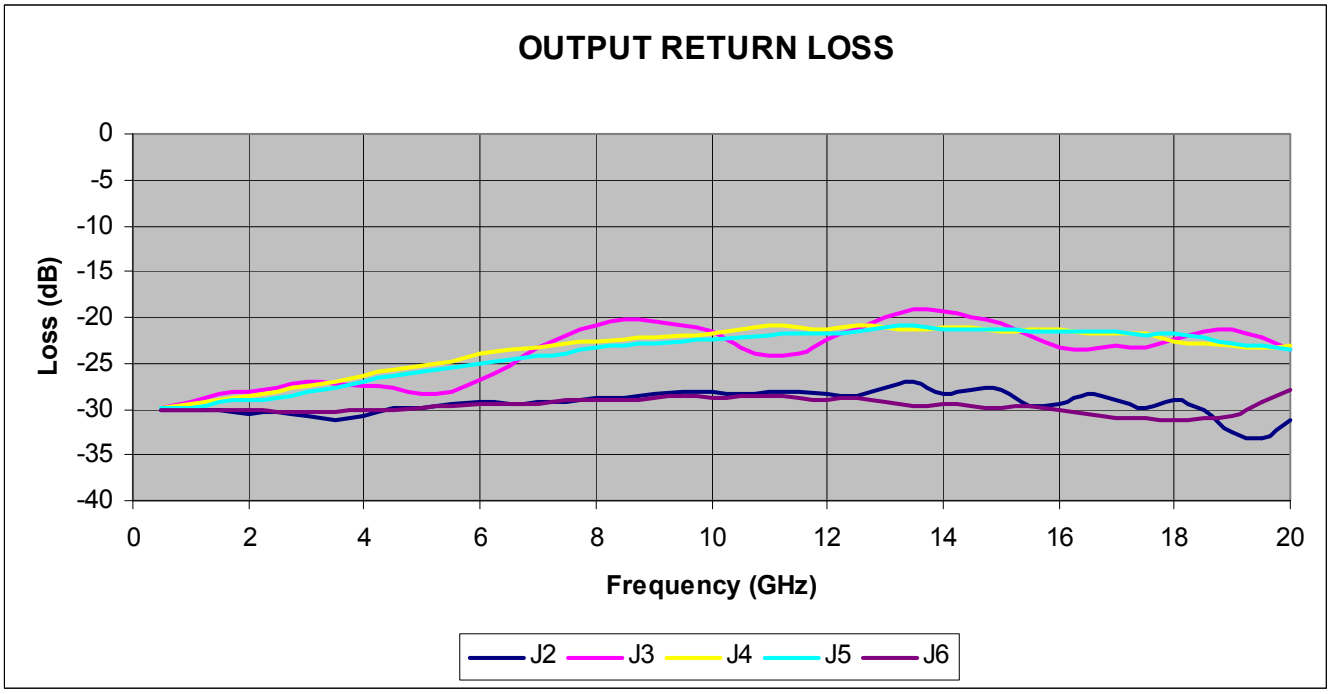

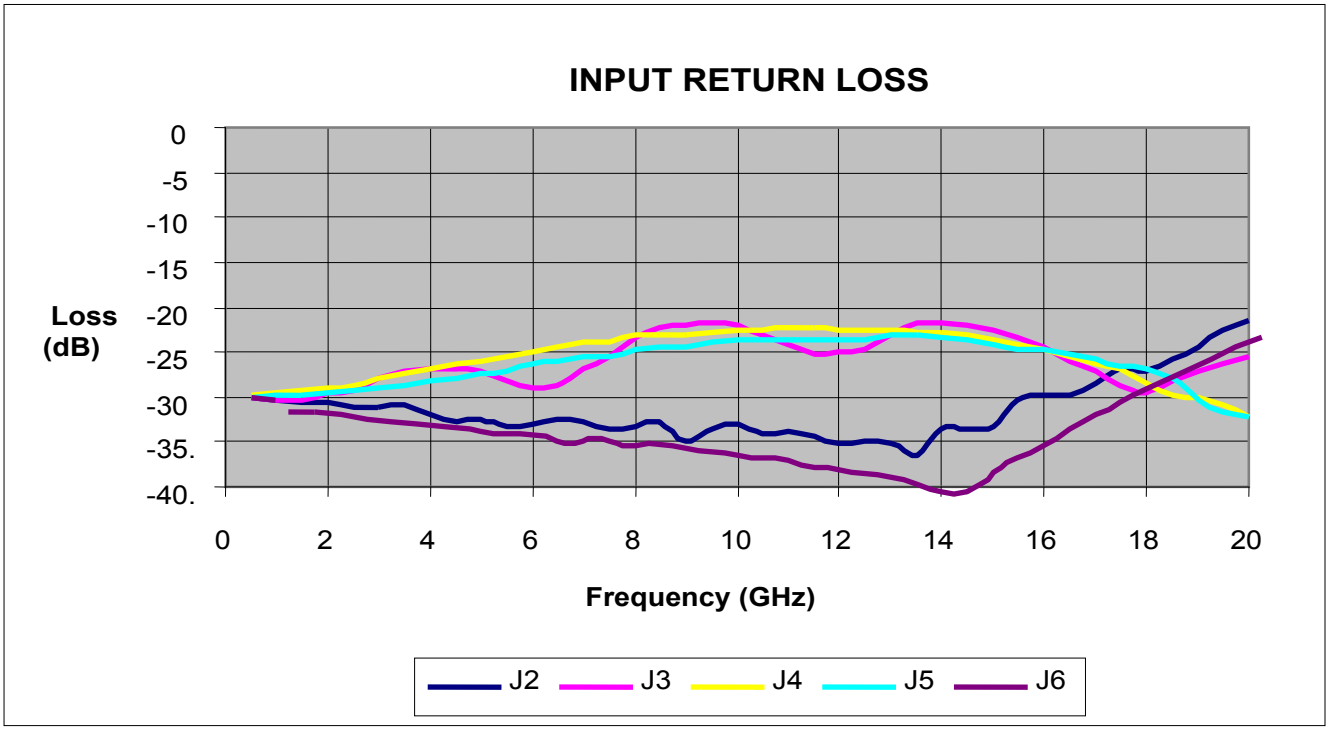

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Operation of the MA4SW510 Switch

The simultaneous application of negative DC current to the low loss port and positive DC current to the remaining Isolated ports as shown in Fig.1 achieves operation of the MA4SW510 diode switch. The backside area of the die is the RF and DC return ground plane. The DC return is achieved on common Port J1. Constant current sources should supply the DC control currents. 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 , 65V TTL controlled PIN diode driver. A typical DC bias schematic for 2-18 GHz operation is shown in Fig.1.

2 – 18 GHz Bias Network Schematic

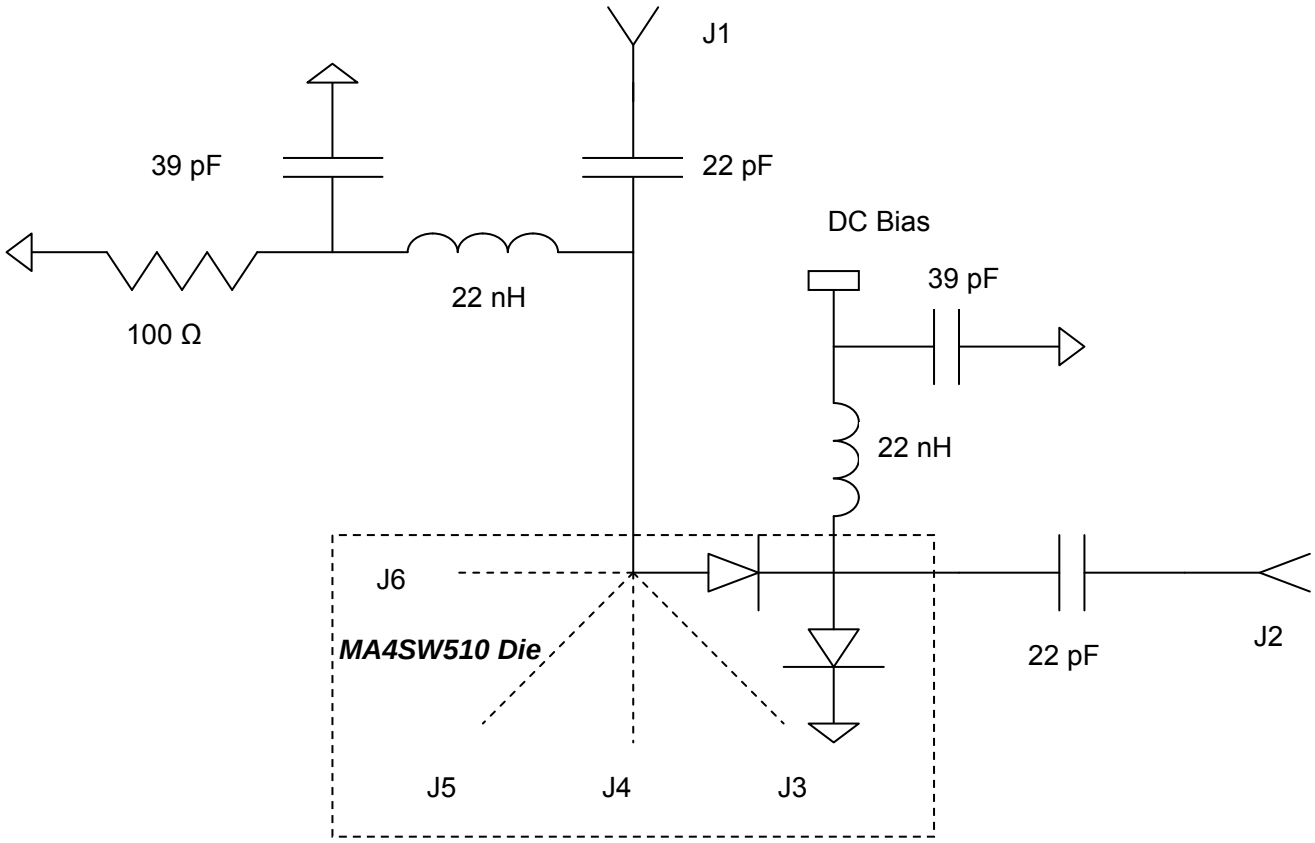

Fig. 1

ASSEMBLY AND HANDLING INSTRUCTIONS

Cleanliness

These chips should be handled in a clean environment free of organic contamination.

Electro-Static Sensitivity

The MA4SW510 PIN switch is ESD, Class 1A sensitive (HBM). The proper ESD handling procedures must be used.

Wire Bonding

Thermosonic wedge bonding using 0.003" x 0.00025" ribbon or 0.001" diameter gold wire is recommended. A heat stage temperature of 150°C and a force of 18 to 22 grams should be used. If ultrasonic energy is necessary, it should be adjusted to the minimum level required to achieve a good bond. RF bond wires should be kept as short as possible.

Chip Mounting

The HMIC switches have Ti-Pt-Au back metal. They can be die mounted with a gold-tin eutectic solder preform or conductive 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 temperature at the chip 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 attachment. Solders rich in tin should not be used.

Epoxy Die Attachment: A minimum amount of epoxy, 1-2 mils thick, should be used to attach chip. A thin epoxy fillet should be visible around the outer perimeter of the chip after placement. Cure epoxy per product instructions. Typically 150°C for 1 hour.

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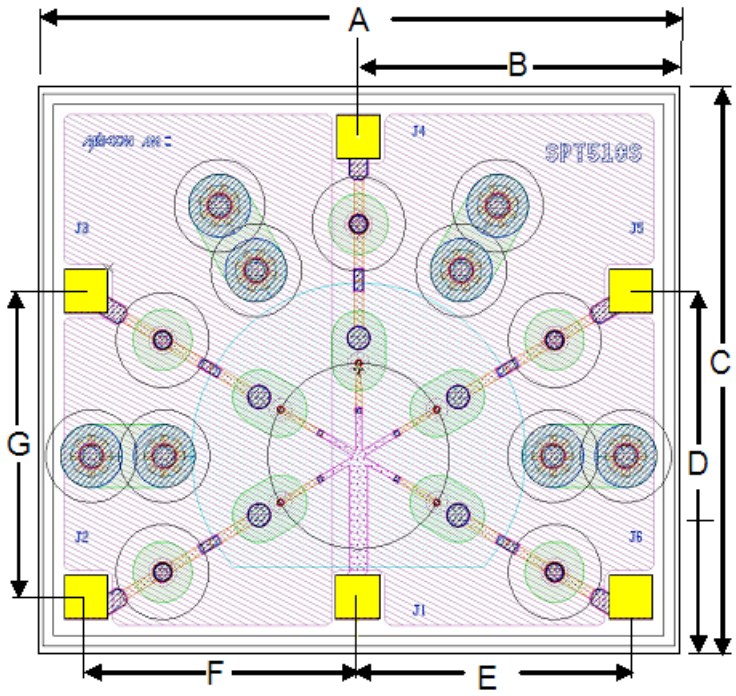
MA4SW510 Chip Dimensions



Notes:
1. Topside and backside metallization is gold , 2.5µm thick typical.
2. Yellow areas indicate bonding pads

Chip Dimensions*

DIM	INCHES	µM
A	0.0680	1723
B	0.0340	858
C	0.0580	1473
D	0.0370	938
E	0.0295	750
F	0.0295	750
G	0.0325	825
All Pads	.005 X .005	120 X 120
Thickness	0.005	127

*All chip dimension tolerances are ±.0005”

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