SP4T Monolithic PIN Diode Switch

V 1.00

MA4SW410

Features

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

Description

The MA4SW410 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 +5 V/-5 V, TTL Controlled PIN Diode Driver, 50 nS Switching Speeds are Achieved.

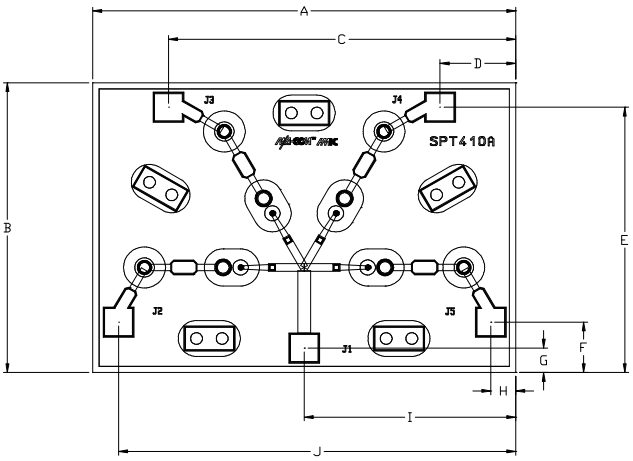
Absolute Maximum Ratings[1]

@ TA = +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 (+/-20 mA)	+ 30 dBm
Bias Current Forward	+/-50 mA
Applied Voltage (Reverse)	25 Volts

1. Exceeding any of these values may result in permanent damage

Outline Drawing



Nominal Die Dimensions

Dim	Inches	Millimeters
	Nominal	Nominal
A	.066	1.67
B	.047	1.17
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

Note: Bond Pads are 0.12 mm x 0.12 mm

Electrical Specifications @ T_A = + 25 °C, +/- 20 mA Bias Current (On-Wafer Measurements)

Parameters	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

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 390 – 560 pF and a Resistor between 150 – 220 Ohms to achieve 50 nS 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
-20 mA	+20 mA	+20 mA	+20 mA	Low Loss	Isolation	Isolation	Isolation
+20 mA	-20 mA	+20 mA	+20 mA	Isolation	Low Loss	Isolation	Isolation
+20 mA	+20 mA	-20 mA	+20 mA	Isolation	Isolation	Low Loss	Isolation
+20 mA	+20 mA	+20 mA	-20 mA	Isolation	Isolation	Isolation	Low Loss

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Assembly Considerations

The following precautions should be observed for successful assembly of the die.

Cleanliness

These chips should be handled in a clean environment. Do not attempt to clean die after installation.

Electro-Static Sensitivity

The MA4SW Series PIN switches are ESD, Class 1 sensitive. The proper ESD handling 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 Ti-Pt-Au back metal. They can be die mounted with 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 perimeter of the chip after placement. Cure epoxy per manufacturer's schedule.

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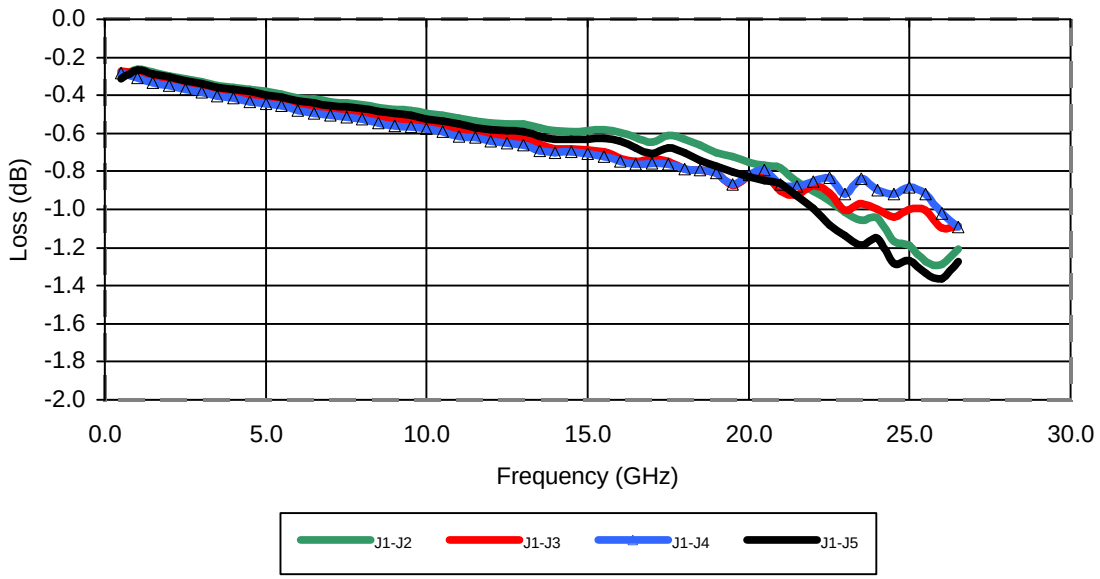
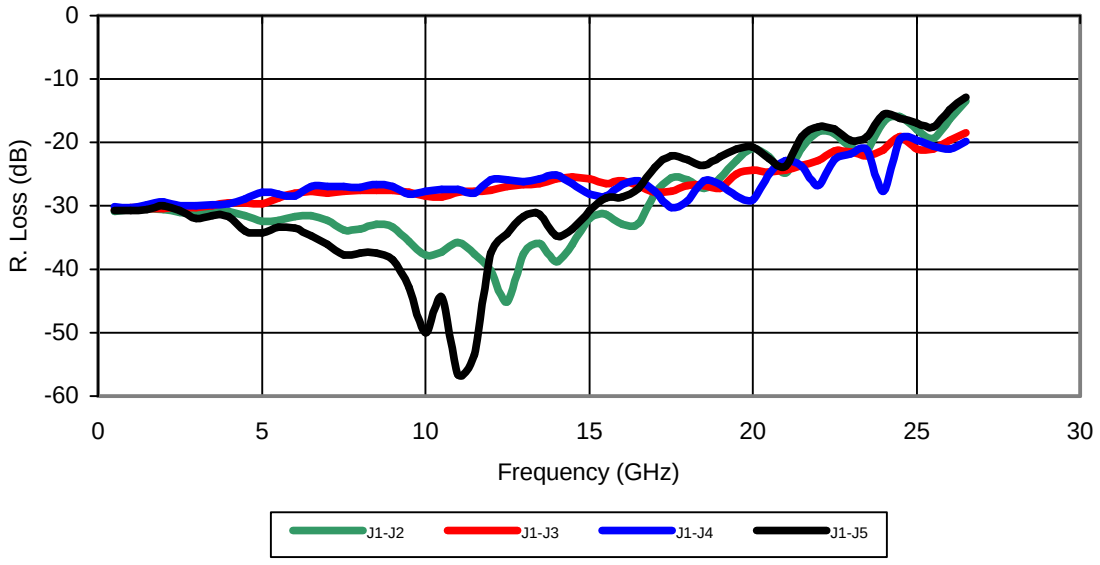
Typical Microwave Performance

MA4SW410 TYPICAL INSERTION LOSS



MA4SW410 TYPICAL INPUT RETURN LOSS



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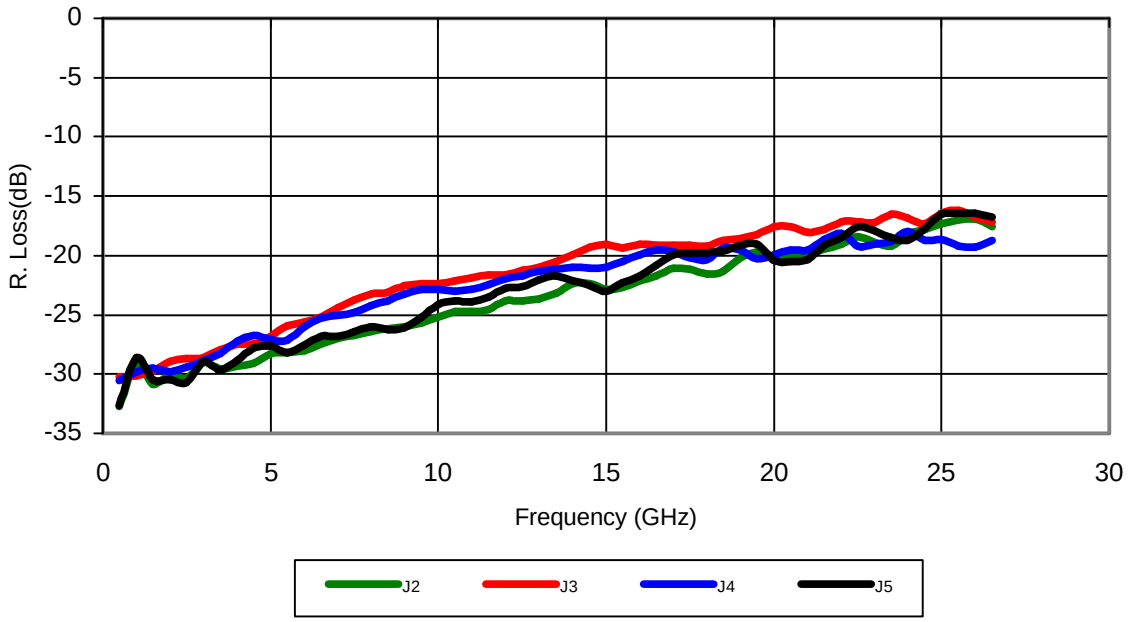
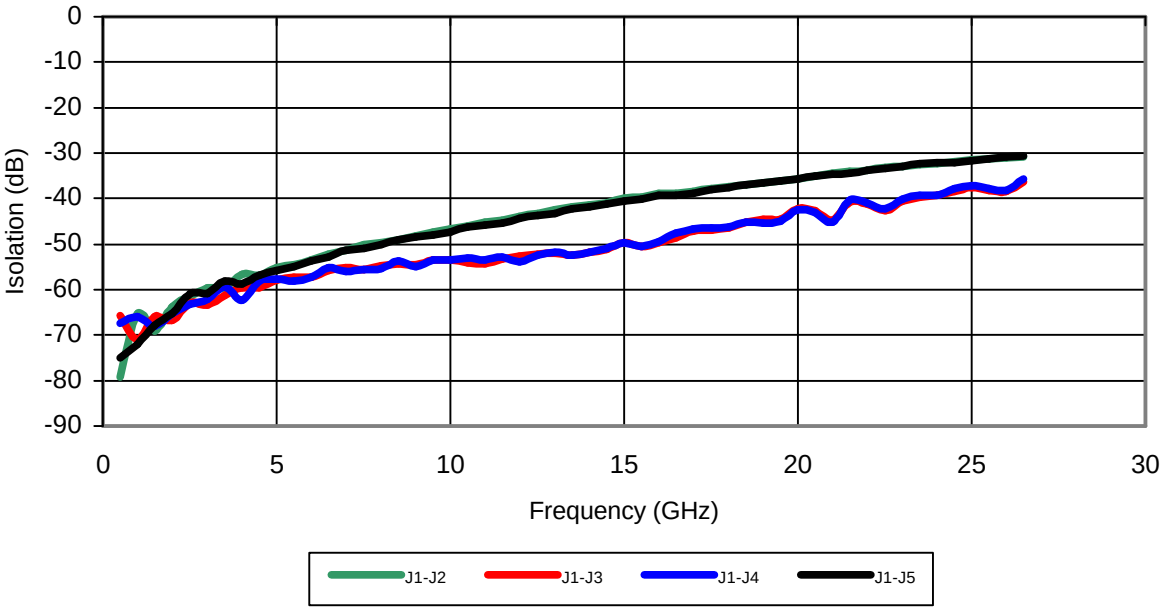
Typical Microwave Performance

MA4SW410 TYPICAL OUTPUT RETURN LOSS



MA4SW410 TYPICAL ISOLATION



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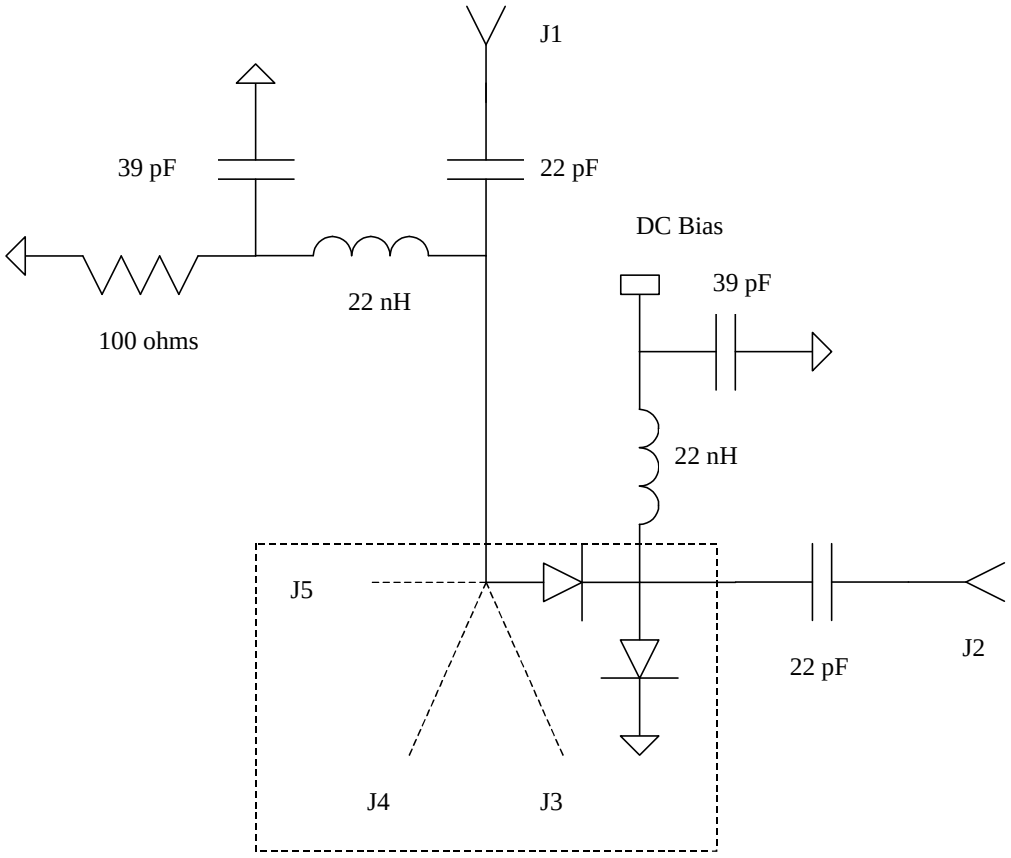
Operation of the MA4SW410 Switch

Operation of the MA4SW Series of PIN Switches 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 Figure1. The Backside Area of the Die is the RF and DC Return Ground Plane. The DC Return is achieved on Common Port J1. The DC Control Currents should be supplied by Constant Current Sources. The voltages at these points will not exceed ± 1.5 volts (1.2 volts typical) for Supply Currents up to ± 50 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 is Achieved by using a Voltage Pull-up Resistor in the DC Return Path, (J1). A Minimum Value of | -2 V | is recommended at this Return Node, which is achievable with a Standard , +/-5 V TTL Controlled PIN Diode Driver. A Typical DC Bias Schematic for 2-18 GHz Operation is shown in Figure 1.

Figure 1:2 - 18 GHz Bias Network



HMIC Switch Die