MA4SW510B-1

SP5T PIN Diode Switch with Integrated Bias Network

V 1.00

Features

- Ultra Broad Bandwidth: 2 GHz to 18 GHz
- 1.8 dB Insertion Loss, 35 dB Isolation at 18 GHz
- Reliable. Fully Monolithic, Glass Encapsulated Construction

Description

The MA4SW510B-1 is a SP5T Series-Shunt broad band switch with integrated bias networks made with M/A-COM's 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 low loss glass. By using small spacing between elements, this combination of silicon and glass gives HMIC devices low loss and high isolation performance through 18 GHz.

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 +5 V/-5 V, TTL controlled PIN diode driver, 80 ns switching speeds are achieved.

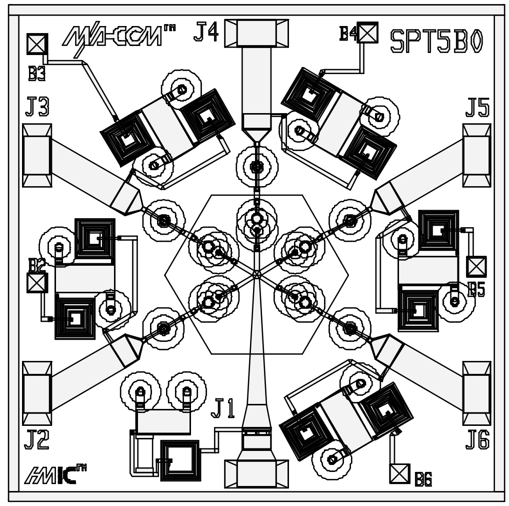
Absolute Maximum Ratings[1]

@ 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
DC Bias Current (Forward)	+/- 40 mA
Applied Voltage (Reverse)	15 V

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

MA4SW510B-1 Layout



Nominal Chip Dimensions

Chip Dimensions (µm)		
	X	Y
Chip	3120	3120
Pad Dimensions (µm)		
	X	Y
RF	400	175
DC	125	125
Pad Locations (µm)		
	X	Y
J1	0	0
J2	-1385	+500
B2	-2285	+1200
J3	-1385	+2000
B3	-1385	+2700
J4	0	+2770
B4	+700	+2770
J5	+1385	+2000
B5	+1385	+1300
J6	+1385	+500
B6	+900	0
Pad Locations Relative to J1		

Electrical Specifications @ T_A = 25 °C, +/- 10 mA Bias Current (On-Wafer Measurements)

Parameters	Frequency	Minimum	Typical	Maximum	Units
Insertion Loss	6 GHz	-	0.9	1.0	dB
	12 GHz	-	1.2	1.5	dB
	18 GHz	-	1.8	2.1	dB
Isolation	6 GHz	40	48	-	dB
	12 GHz	30	40	-	dB
	18 GHz	25	35	-	dB
Input Return Loss	6 GHz	-	20	-	dB
	12 GHz	-	20	-	dB
	18 GHz	-	17	-	dB
Output Return Loss	6 GHz	-	19	-	dB
	12 GHz	-	19	-	dB
	18 GHz	-	17	-	dB
Switching Speed[1]	10 GHz	-	80	-	nS

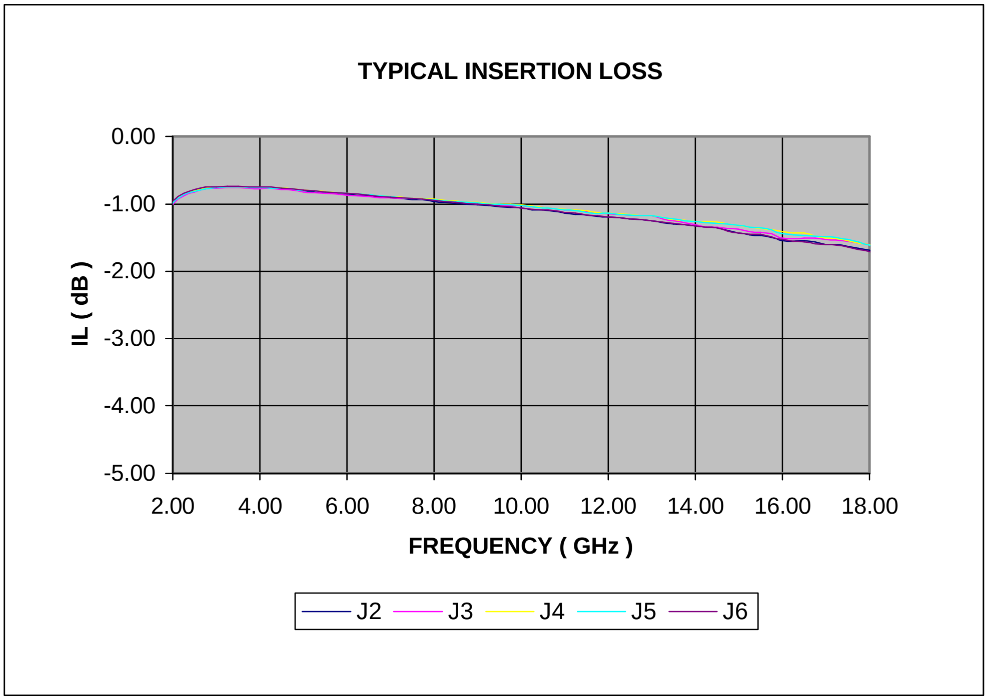
1. Typical switching speed is measured from 10% to 90% of the detected RF voltage driven by a TTL compatible driver. Driver output parallel RC network uses a capacitor between 390 pF - 560 pF and a resistor between 150 - 220 Ohms to achieve 80 ns rise and fall times.

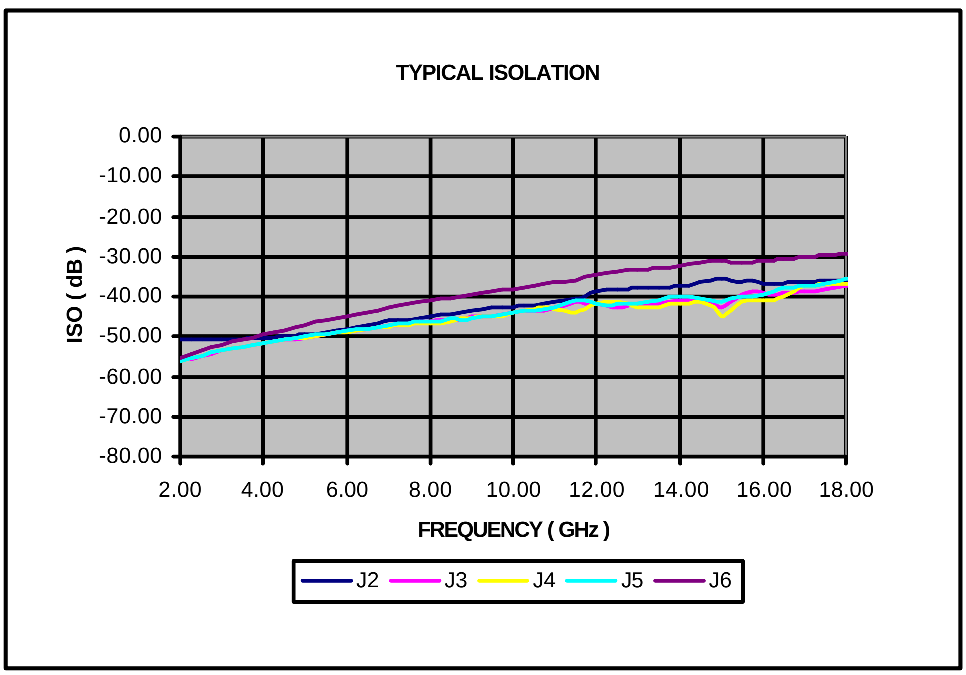
Typical Driver Connections

Control Level (DC Current)					Condition of RF Output				
B2	B3	B4	B5	B6	J2-J1	J3-J1	J4-J1	J5-J1	J6-J1
-10 mA	+10 mA	+10 mA	+10 mA	+10 mA	**Low Loss**	Isolation	Isolation	Isolation	Isolation
+10 mA	**-10 mA**	+10 mA	+10 mA	+10 mA	Isolation	**Low Loss**	Isolation	Isolation	Isolation
+10 mA	+10 mA	**-10 mA**	+10 mA	+10 mA	Isolation	Isolation	**Low Loss**	Isolation	Isolation
+10 mA	+10 mA	+10 mA	**-10 mA**	+10 mA	Isolation	Isolation	Isolation	**Low Loss**	Isolation
+10 mA	+10 mA	+10 mA	+10 mA	**-10 mA**	Isolation	Isolation	Isolation	Isolation	**Low Loss**

Note: Typical Switching Speed measured from 10 % to 90 % of detected RF signal driven by a TTL compatible driver.

Microwave Performance





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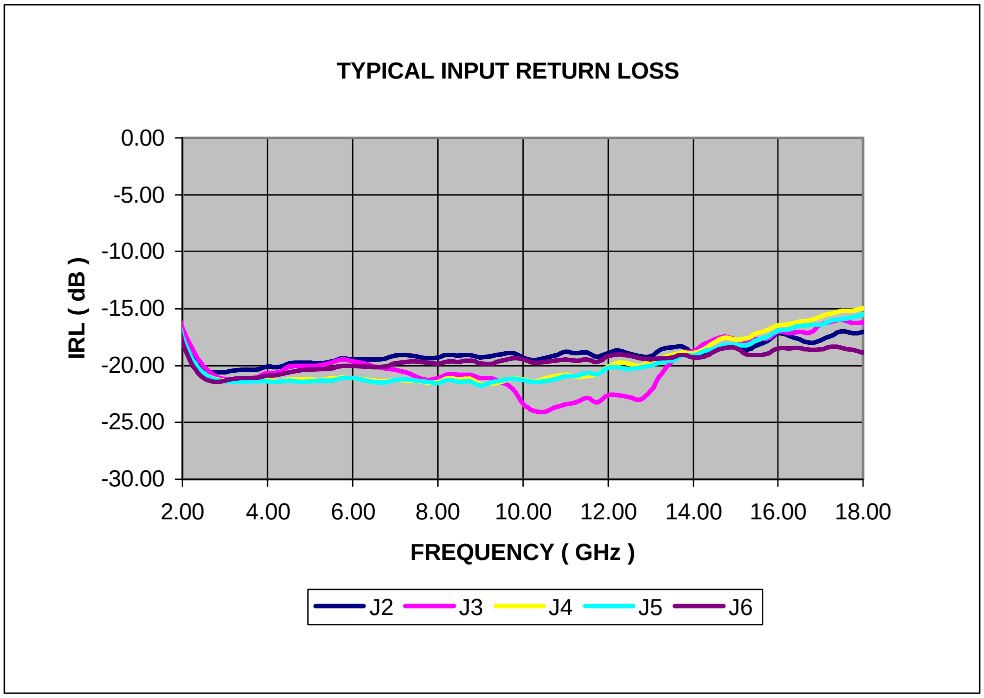
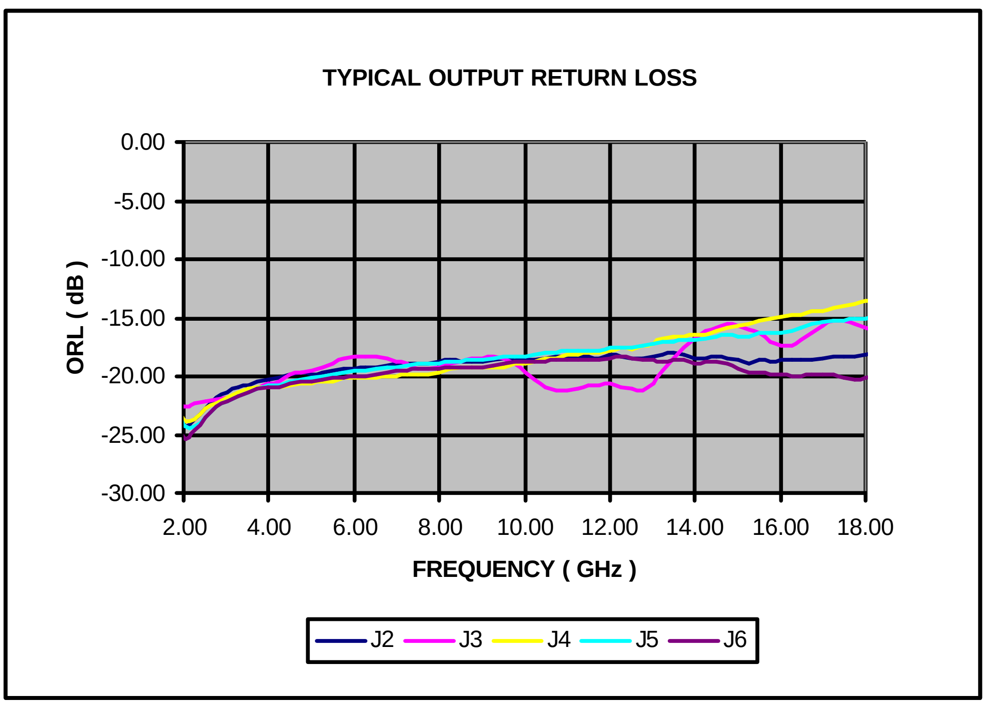
Microwave Performance





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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.

Wire Bonding

Thermosonic wedge wire bonding using 0.003" x 0.00025" ribbon or 0.001" diameter gold wire is recommended. A stage temperature of 150 ^{o}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 to minimize inductance.

Mounting

These chips have Ti-Pt-Au back metal. They can be die mounted with a 80Au/20Sn or Sn62/Pb36/Ag2 solder preform or electrically conductive Ag epoxy. Mounting surface must be clean of oils and contaminants and flat.

Eutectic Die Attachment

An 80/20 gold-tin eutectic solder preform is recommended with a work surface temperature of 255 ^{o}C and a tool tip temperature of 265 ^{o}C. When hot gas is applied, the tool tip temperature should be 290 ^{o}C. The chip should not be exposed to temperatures greater than 320 ^{o}C for more than 10 seconds. No more than three seconds should be required for the attachment.

Epoxy Die Attachment

Assembly should be preheated to 125-150 ^{o}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 recommended schedule.

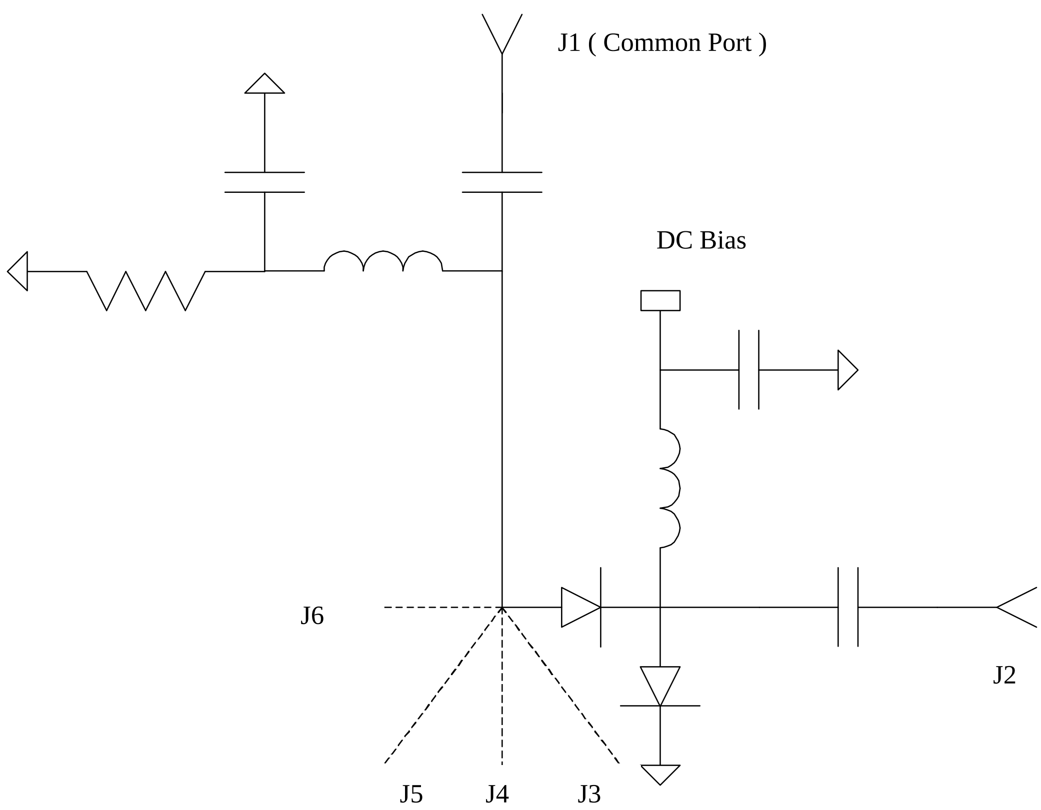
Operation of the MA4SW510B-1 Switch

The Simultaneous Application of Negative DC Current to the Low Loss Port and Positive DC current to the Remaining Isolated Ports as shown in the schematic provides successful RF operation of the MA4SW Series of PIN Diode Switches. The Backside Area of the Die is the RF and DC Return Ground Plane. The DC Bias Return is located on Common Port J1. Constant Current Sources should supply the DC Control Currents.

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 while the Series Diode is Reverse Biased.

This Design Improves Insertion Loss, P1dB, IP3, and Switching Speed by Incorporating a Voltage Pull-up Resistor (~ 100 Ω) in the DC Return Path, (J1) under Insertion Loss Bias. A Typical Value of | -3 V | is achieved at the Insertion Loss Bias Node using +/- 20 mA, with a Standard , +/- 5 V TTL Controlled PIN Diode Driver.

Fig 1: MA4SW510B-1 Schematic



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