MA4SW610B-1

SP6T PIN Diode Switch with Integrated Bias Network
2 - 18GHz

Rev. V2

Features

- Ultra Broad Bandwidth: 2GHz to 18GHz
- 1.9dB Insertion Loss, 35dB Isolation at 18GHz
- Reliable. Fully Monolithic, Glass Encapsulated Construction

Description

The MA4SW610B-1 is a reflective SP6T 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, low dispersion 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 +5V/-5V, TTL controlled PIN diode driver, 80ns switching speeds are achieved.

Absolute Maximum Ratings[1]

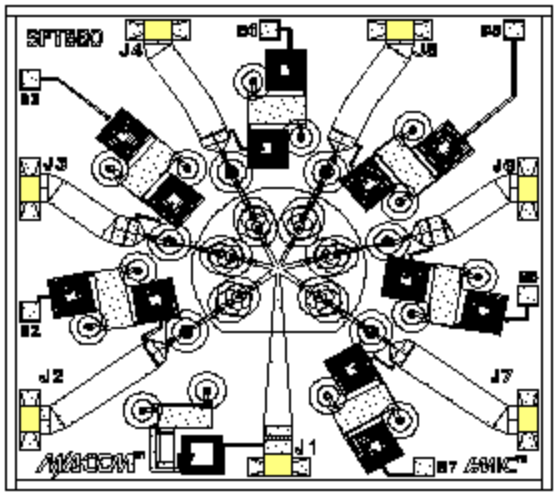
@ T_{AMB} = +25°C (unless otherwise specified)

Parameter	Value
Operating Temperature	-65°C to +125°C
Storage Temperature	-65°C to +150°C
RF CW Incident Power	+30dBm
DC Bias Current (Forward)	+/- 20mA
Applied Voltage (Reverse)	15V

Note:

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

MA4SW610B-1 Layout



Nominal Chip Dimensions

Chip Dimensions (mm)		
	X	Y
Chip	3370	3120
Pad Dimensions (mm)		
	X	Y
RF	400	125
DC	125	125
Pad Locations (mm)		
	X	Y
J1	0	0
J2	-1535	+300
B2	-1535	+1000
J3	-1535	+1800
B3	-1535	+2500
J4	-750	+2820
B4	-50	+2820
J5	+750	+2820
B5	+1450	+2820
J6	+1535	+1800
B6	+1535	+1100
J7	+1535	+300
B7	+900	0
Pad Locations Relative to J1		

Notes:

1) Topside and backside metallization is gold , 2.5µm thick typical.
2) Yellow areas indicate bondpads

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

Parameters	Frequency	Minimum	Typical	Maximum	Units
Insertion Loss	6 GHz	-	1.0	1.4	dB
	12 GHz	-	1.3	2.0	dB
	18 GHz	-	1.9	2.9	dB
Isolation	6 GHz	43	49	-	dB
	12 GHz	35	43	-	dB
	18 GHz	30	39	-	dB
Input Return Loss	6 GHz	-	18	-	dB
	12 GHz	-	20	-	dB
	18 GHz	-	16	-	dB
Output Return Loss	6 GHz	-	19	-	dB
	12 GHz	-	22	-	dB
	18 GHz	-	20	-	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 390pF - 560pF and a resistor between 150 - 220Ω to achieve 80ns rise and fall times.

Typical Driver Connections

Control Level (DC Current)						Condition of RF Output					
B2	B3	B4	B5	B6	B7	J2-J1	J3-J1	J4-J1	J5-J1	J6-J1	J7-J1
-10 mA	+10 mA	+10 mA	+10 mA	+10 mA	+10 mA	**Low Loss**	Isolation	Isolation	Isolation	Isolation	Isolation
+10 mA	**-10 mA**	+10 mA	+10 mA	+10 mA	+10 mA	Isolation	**Low Loss**	Isolation	Isolation	Isolation	Isolation
+10 mA	+10 mA	**-10 mA**	+10 mA	+10 mA	+10 mA	Isolation	Isolation	**Low Loss**	Isolation	Isolation	Isolation
+10 mA	+10 mA	+10 mA	**-10 mA**	+10 mA	+10 mA	Isolation	Isolation	Isolation	**Low Loss**	Isolation	Isolation
+10 mA	+10 mA	+10 mA	+10 mA	**-10 mA**	+10 mA	Isolation	Isolation	Isolation	Isolation	**Low Loss**	Isolation
+10 mA	+10 mA	+10 mA	+10 mA	+10 mA	**-10 mA**	Isolation	Isolation	Isolation	Isolation	Isolation	**Low Loss**

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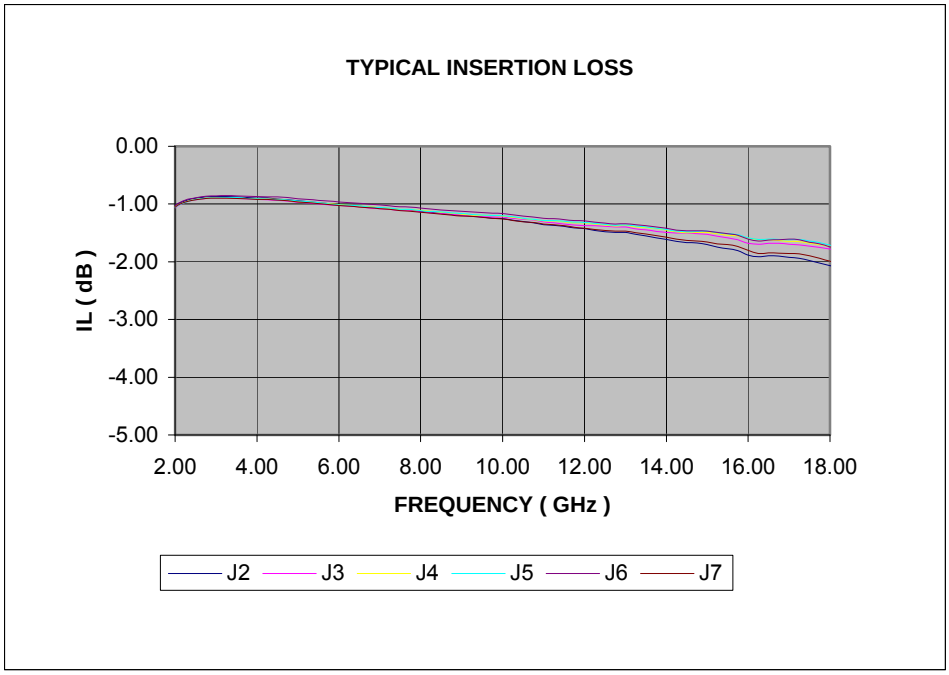
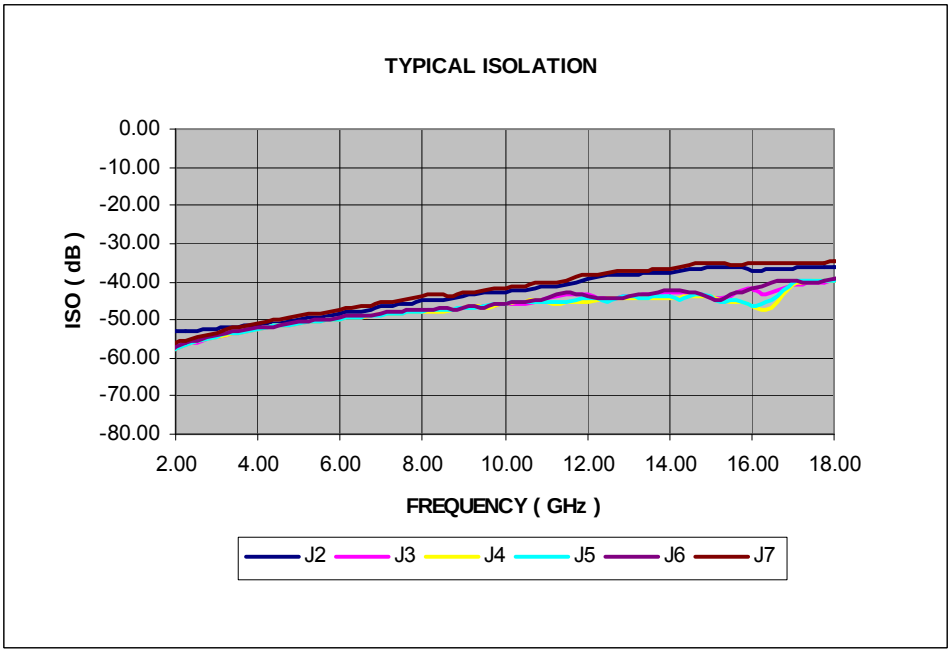
Typical R.F. Microwave Performance





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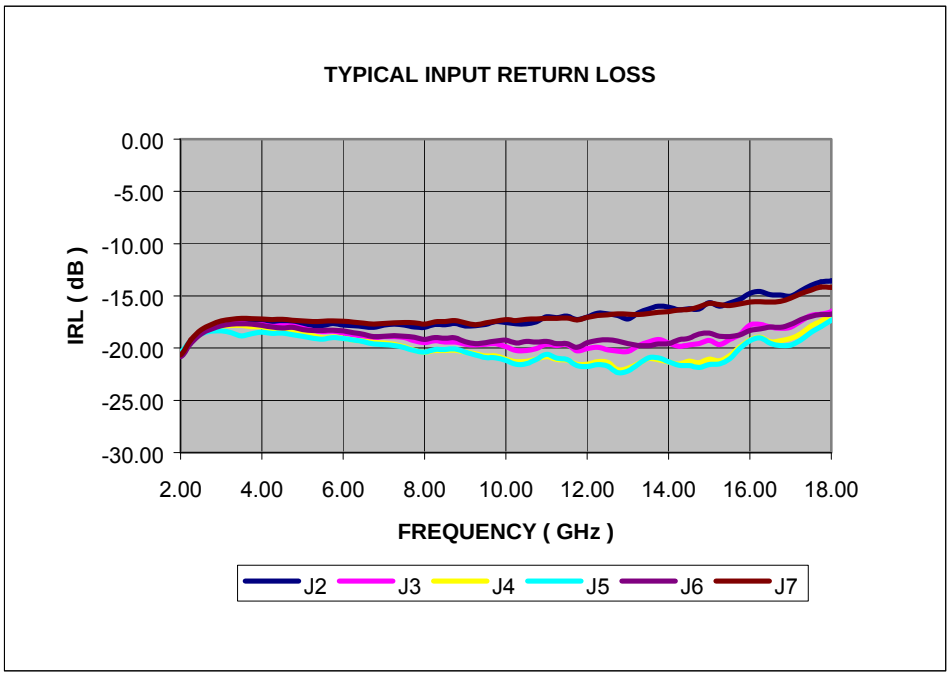

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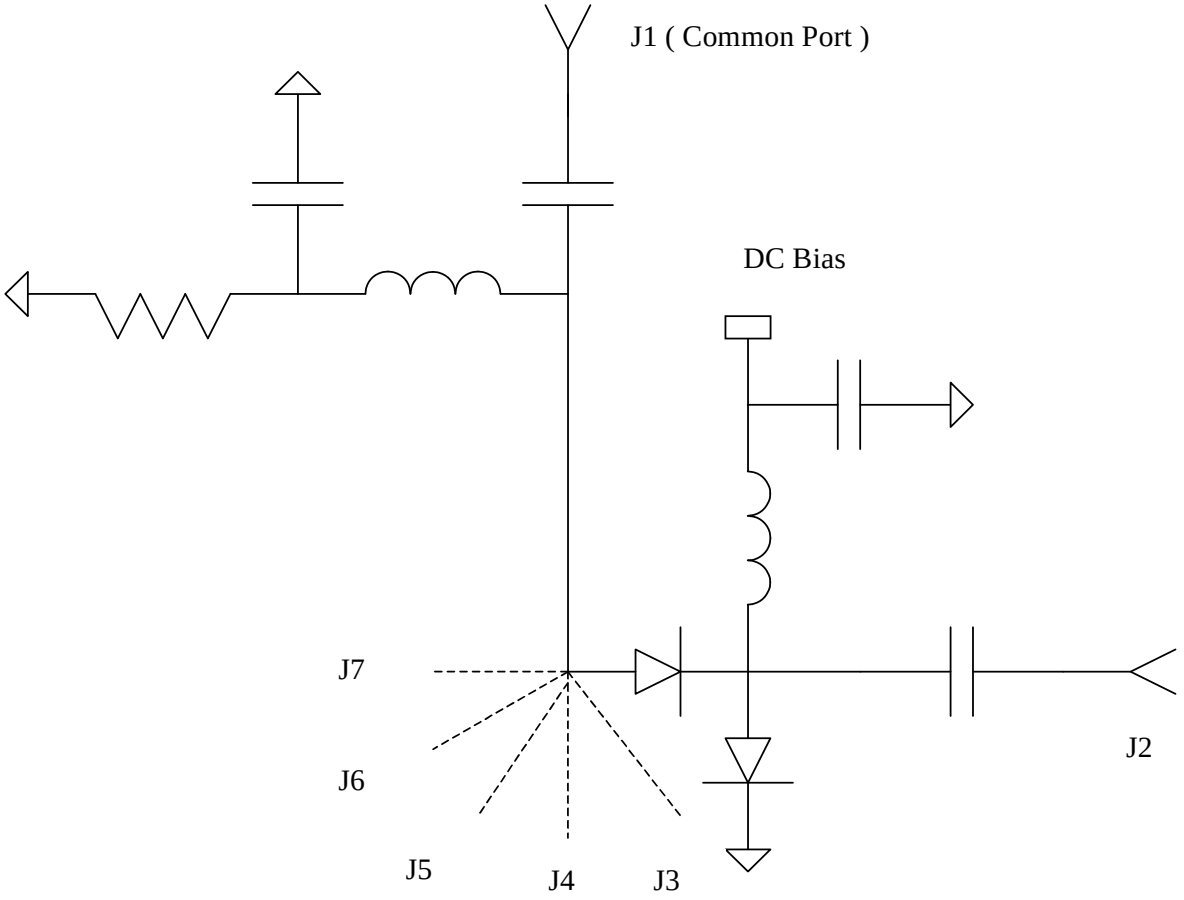
Operation of the MA4SW610B-1 Switch

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 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 ±20mA, with a Standard , ±5V TTL Controlled PIN Diode Driver.

MA4SW610B-1 Schematic



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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 free of dust and contaminants.

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°C and a force of 18 to 22 grams should be used. Ultrasonic energy should be adjusted to the minimum required to achieve a good bond. 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 °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 10 seconds. No more than 3 seconds should be required for the attachment.

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 recommended schedule.

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