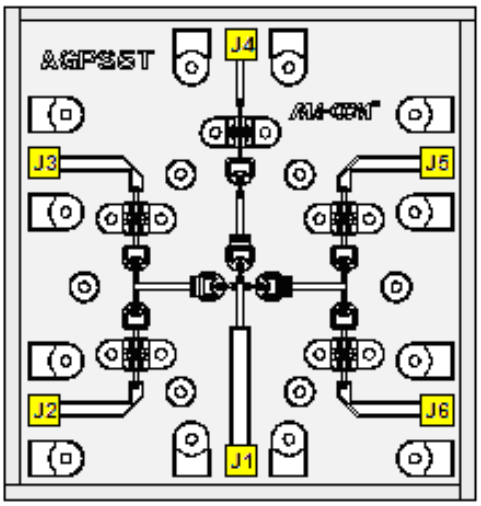
MA4AGSW5

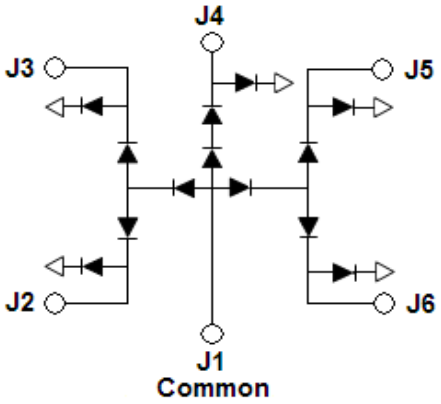
SP5T AlGaAs PIN Diode Switch V5

FEATURES

- Ultra Broad Bandwidth: 50 MHz to 50 GHz
- Functional Bandwidth : 50 MHz to 70 GHz
- 1.7dB Insertion Loss at 50 GHZ
- 35 dB Isolation at 50 GHz
- Low Current consumption.
  - -10mA for low loss state
  - +10mA for Isolation state
- MACOM's unique AlGaAs hetero-junction anode technology.
- Silicon Nitride Passivation
- Polymer Scratch protection
- RoHS Compliant



Yellow areas indicate bond pads



DESCRIPTION

MACOM's MA4AGSW5 is an Aluminum-Gallium-Arsenide, single pole, five throw (SP5T), PIN diode switch. The switch features enhanced AlGaAs anodes which are formed using MACOM's hetero-junction technology. AlGaAs technology produces a switch with less loss than a device fabricated using conventional GaAs processes. As much as a 0.3 dB reduction in insertion loss can be realized at 50 GHz. This device is fabricated on an OMCVD epitaxial wafer using a process designed for high device uniformity and extremely low parasitics. The diodes within the chip exhibit low series resistance, low capacitance, and fast switching speed. They are fully passivated with silicon nitride and have an additional polymer layer for scratch protection. The protective coating prevents damage during handling and assembly to the diode junction and the chip anode air-bridges. Off chip bias circuitry is required.

APPLICATIONS

The high electron mobility of AlGaAs and the low capacitance of the PIN diodes used makes this switch ideal for fast response, high frequency, multi-throw switch designs where the series capacitance in each off-arm will load the input. AlGaAs PIN diode switches are an ideal choice for switching arrays in radar systems, radiometers, test equipment and other multi-assembly components.

Absolute Maximum Ratings @ T_{AMB} = +25°C

Parameter	Maximum Rating
Operating Temperature	-55°C to +125°C
Storage Temperature	-55°C to +150°C
Incident C.W. RF Power	+23dBm C.W.
Breakdown Voltage	25V
Bias Current	± 25mA
Assembly Temperature	+300°C < 10 sec
Junction Temperature	+175°C

Maximum combined operating conditions for RF Power, D.C. bias, and temperature: +23 dBm C.W. @ 10 mA (per diode) @ +85°C.

SP5T AlGaAs PIN Diode Switch V5

Electrical Specifications @ T_A = 25°C, +/-10mA bias current (On-wafer measurements)

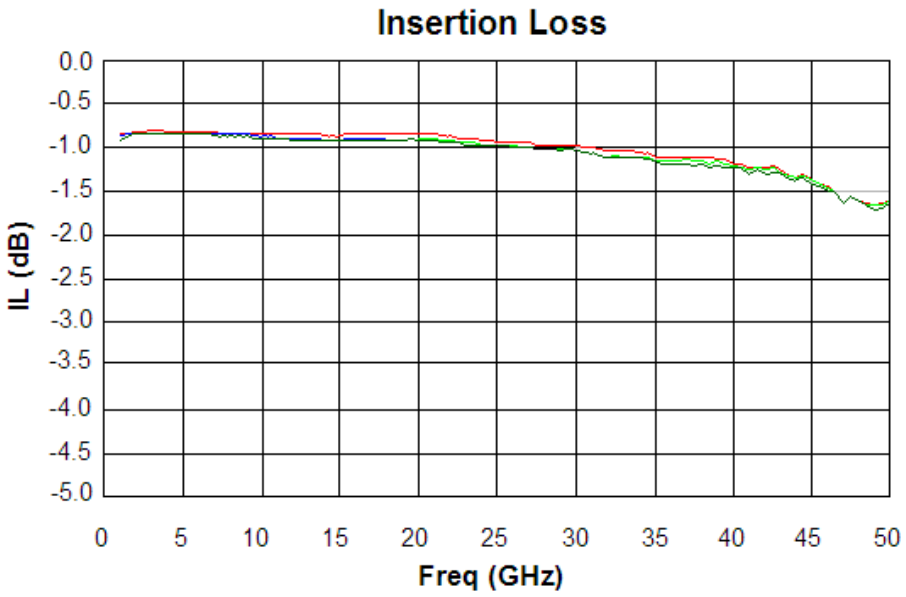
RF PARAMETER	FREQUENCY BAND	MAX	UNITS	PORT	BIAS
INSERTION LOSS	0.05 - 18 GHz	1.4	dB	J2 to J1	-10 mA @ J2, +10 mA @ J3, J4, J5, J6
	18 - 50 GHz	1.9	dB		
	0.05 - 18 GHz	1.4	dB	J3 to J1	-10 mA @ J3, +10 mA @ J2, J4, J5, J6
	18 - 50 GHz	1.9	dB		
	0.05 - 18 GHz	1.4	dB	J4 to J1	-10 mA @ J4, +10 mA @ J2, J3, J5, J6
	18 - 50 GHz	1.9	dB		
	0.05 - 18 GHz	1.4	dB	J5 to J1	-10 mA @ J5, +10 mA @ J2, J3, J4, J6
	18 - 50 GHz	1.9	dB		
	0.05 - 18 GHz	1.4	dB	J6 to J1	-10 mA @ J6, +10 mA @ J2, J3, J4, J5
	18 - 50 GHz	1.9	dB		
RF PARAMETER	**FREQUENCY BAND**	**MIN**	**UNITS**	**PORT**	**BIAS**
ISOLATION*	0.05 - 18 GHz	35.0	dB	J2 to J1	-10 mA @ J6, +10 mA @ J3, J4, J5, J2
	18 - 50 GHz	30.0	dB		
	0.05 - 18 GHz	35.0	dB	J3 to J1	-10 mA @ J6, +10 mA @ J2, J4, J5, J2
	18 - 50 GHz	30.0	dB		
	0.05 - 18 GHz	35.0	dB	J4 to J1	-10 mA @ J6, +10 mA @ J2, J3, J5, J2
	18 - 50 GHz	30.0	dB		
	0.05 - 18 GHz	35.0	dB	J5 to J1	-10 mA @ J6, +10 mA @ J2, J3, J4, J2
	18 - 50 GHz	30.0	dB		
	0.05 - 18 GHz	35.0	dB	J6 to J1	-10 mA @ J2, +10 mA @ J2, J3, J4, J6
	18 - 50 GHz	30.0	dB		
RF PARAMETER	**FREQUENCY BAND**	**MIN**	**UNITS**	**PORT**	**BIAS**
INPUT/OUTPUT RETURN LOSS	0.05 - 18 GHz	12.0	dB	J2 to J1	-10 mA @ J2, +10 mA @ J3, J4, J5, J6
	18 - 50 GHz	12.0	dB		
	0.05 - 18 GHz	12.0	dB	J3 to J1	-10 mA @ J3, +10 mA @ J2, J4, J5, J6
	18 - 50 GHz	12.0	dB		
	0.05 - 18 GHz	12.0	dB	J4 to J1	-10 mA @ J4, +10 mA @ J2, J3, J5, J6
	18 - 50 GHz	12.0	dB		
	0.05 - 18 GHz	12.0	dB	J5 to J1	-10 mA @ J5, +10 mA @ J2, J3, J4, J6
	18 - 50 GHz	12.0	dB		
	0.05 - 18 GHz	12.0	dB	J6 to J1	-10 mA @ J6, +10 mA @ J2, J3, J4, J5
	18 - 50 GHz	12.0	dB		

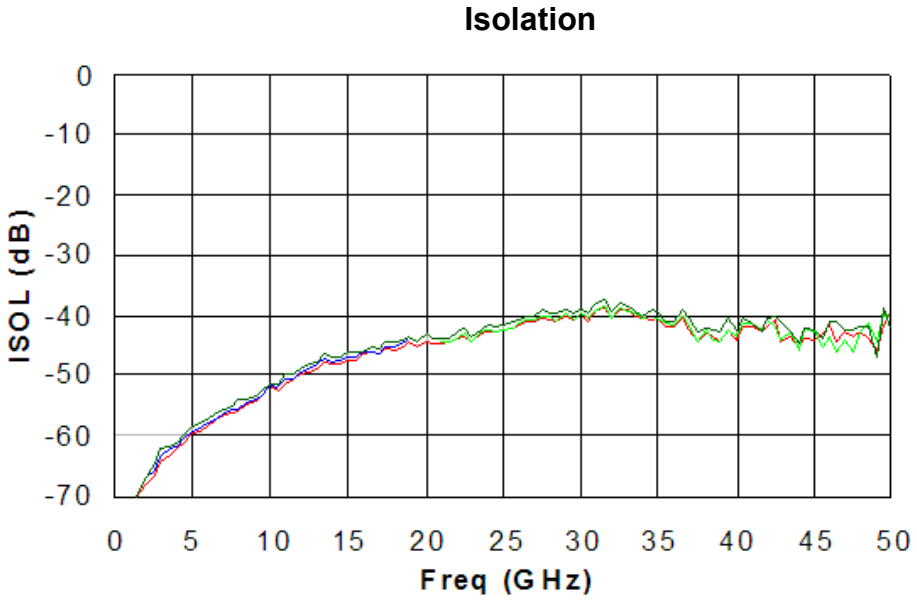
***Note:** Isolation is measured through (3) diodes from common port (input) to selected output port with (1) opposite series junction diode in low loss. Isolation for (2) diodes from common port (Input) to selected output with the same series junction diode port in low loss = 22 dB Typical.

Parameter	F (GHz)	RF Ports	Test Conditions	Typical Value	Units
Switching Speed* (10-90 % RF Voltage)	10.0	J1 to J2,J3,J4,J5,J6	+/- 5V TTL Compatible PIN Diode Driver	15	nS

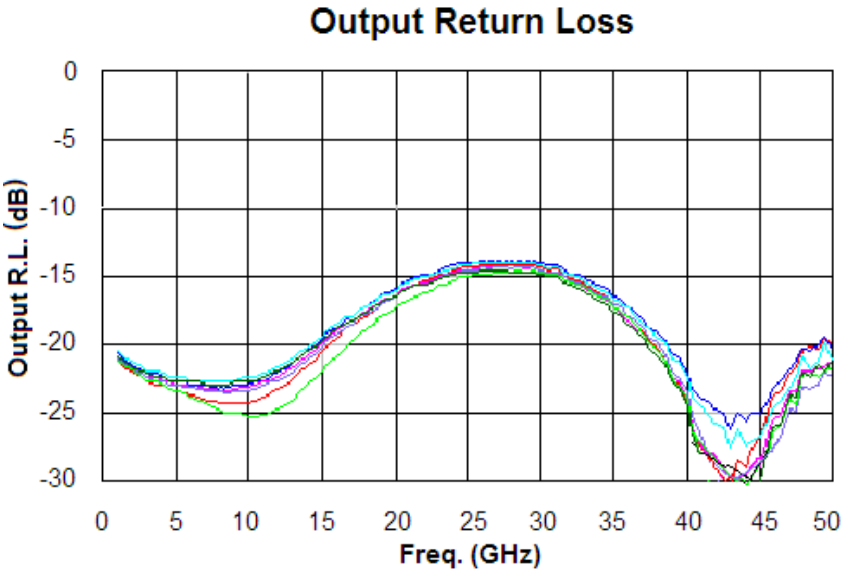
***Note:** Typical switching speed is measured from 10% to 90% of the detected RF voltage driven by a +/- 5V TTL compatible driver. Driver output parallel RC network uses a capacitor between 390 pF-560 pF and a resistor between 150-220 Ω ohms to achieve 15 ns rise and fall times.

Typical R.F. Performance (Probed on Wafer) @ +25°C





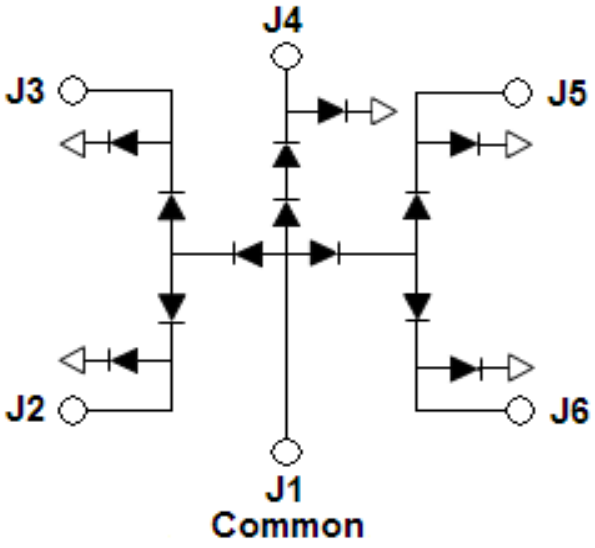
Typical RF Performance (Probed on wafer) @ +25°C



Operation of the MA4AGSW5 Switch

The simultaneous application of a negative DC current to the low loss port and positive DC current to the remaining isolated switching ports is required for the operation of the MA4AGSW5, AlGaAs, PIN switch. The backside area of the die is the RF and DC return ground plane. The DC return is connected to the common port J1. The forward bias voltage at J2, J3, J4,J5 & J6 will not exceed ±1.6 volts and is typically ± 1.4 volts with supply current of ± 30mA). In the low loss state, the series diode must be forward biased and the shunt diode reverse

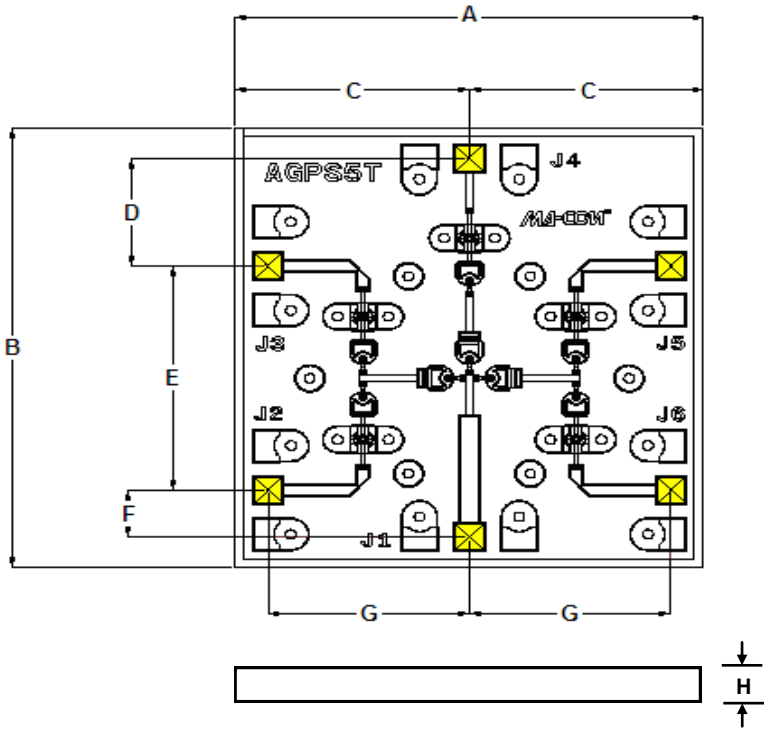
MA4AGSW5 Schematic and Driver Bias Connections



TYPICAL DRIVER CONNECTIONS

CONTROL LEVEL (DC CURRENT)					CONDITION OF RF OUTPUT				
J2	J3	J4	J5	J6	J2-J1	J3-J1	J4-J1	J5-J1	J6-J1
-10mA	+10mA	+10mA	+10mA	+10mA	**Low Loss**	Isolation	Isolation	Isolation	Isolation
+10mA	**-10mA**	+10mA	+10mA	+10mA	Isolation	**Low Loss**	Isolation	Isolation	Isolation
+10mA	+10mA	**-10mA**	+10mA	+10mA	Isolation	Isolation	**Low Loss**	Isolation	Isolation
+10mA	+10mA	+10mA	**-10mA**	+10mA	Isolation	Isolation	Isolation	**Low Loss**	Isolation
+10mA	+10mA	+10mA	+10mA	**-10mA**	Isolation	Isolation	Isolation	Isolation	**Low Loss**

Chip Dimensions and Bonding Pad Locations (In Yellow)



Dimensions				
Location	mils		mm	
	min	max	min	max
A	60.0	61.2	1.524	1.555
B	63.2	64.4	1.605	1.636
C	29.7	30.9	0.754	0.785
D	15.2	16.0	0.386	0.406
E	32.2	33.0	0.818	0.838
F	6.5	7.2	0.165	0.183
G	25.7	26.5	0.653	0.673
H	3.7	4.3	0.094	0.109
Pads	3.9	4.3	0.099	0.109

ASSEMBLY INSTRUCTIONS

CLEANLINESS

The chip should be handled in a clean environment.

STATIC SENSITIVITY

This device is considered ESD Class 1A, HBM. Proper ESD techniques should be used during handling.

GENERAL HANDLING

The protective polymer coating on the active areas of the die provides scratch and impact protection, particularly for the metal air bridge, which contacts the diode's anode. Die should primarily be handled with vacuum pickup tools, or alternatively with plastic tweezers.

ASSEMBLY TECHNIQUES

The MA4AGSW5, AlGaAs device is designed to be mounted with electrically conductive silver epoxy or with a low temperature solder perform, which does not have a rich tin content.

SOLDER DIE ATTACH

Only solders which do not scavenge gold, such as 80/20, Au/Sn or Indalloy #2 is recommended. Do not expose die to temperatures greater than 300°C for more than 10 seconds.

ELECTRICAL CONDUCTIVE EPOXY DIE ATTACH

Use a controlled thickness of approximately 2 mils for best electrical conductivity and lowest thermal resistance. Cure epoxy per manufacturer's schedule. Typically 150°C for 1 hour.

RIBBON/WIRE BONDING

Thermo-compression wedge or ball bonding may be used to attach ribbons or wire to the gold bonding pads. A 1/4 x 3 mil gold ribbon is recommended on all RF ports and should be kept as short as possible for the lowest inductance and best microwave performance. For more detailed handling and assembly instructions, see **Application Note M541, "Bonding and Handling Procedures for Chip Diode Devices" at www.macom.com.**

Ordering Information

Part Number	Packaging
MA4AGSW5	Waffle Pack
MASW-000555-13570G	Gel Pack