AlGaAs SPST Non-Reflective PIN Diode Switch

V 1.00

MA4AGSW1A

Features

- Ultra Broad Bandwidth: 18 GHz to 50 GHz
- Functional Bandwidth : 10 GHz to 70 GHz
- 1.0 dB Insertion Loss, 35 dB Isolation at 50 GHz
- M/A-COM's unique patent pending AlGaAs hetero-junction anode technology
- Silicon Nitride Passivation
- Polymide Scratch protection

Description

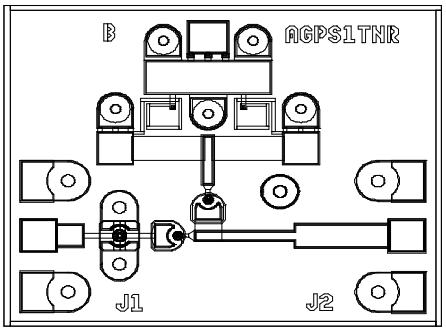
M/A-COM's MA4AGSW1A is an Aluminum-Gallium Arsenide anode enhanced, SPST Non-Reflective PIN diode switch. AlGaAs anodes, which utilize M/A-COM's patent pending hetero-junction technology, which produce less loss than conventional GaAs processes, as much as 0.3 dB reduction in insertion loss at 50 GHz. These devices are fabricated on a OMCVD eptaxial wafer using a process designed for high device uniformity and extremely low parasitics. The diodes themselves exhibit low series resistance, low capacitance, and fast switching speed. They are fully passivated with silicon nitride and have an additional layer of a polymer for scratch protection. The protective coating prevents damage to the junction and the anode airbridges during handling. Off-chip bias circuitry is required and allows maximum design flexibility.

Applications

The output port of this device (J2), is 50 Ohms terminated during Isolation mode, which allows the signal to be absorbed rather than reflected back. This technique makes it ideal for instrumentation and radar applications.

The low capacitance of the PIN diodes used makes it ideal for use in lower loss and higher isolation microwave and millimeter wave switch designs. The lower series resistance of the AlGaAs diodes reduces the total insertion loss and distortion of the devices. These AlGaAs PIN switches are used as the switching arrays for radar systems, radiometers, and other multi-function components.

MA4AGSW1A Layout



Absolute Maximum Ratings[1] @ TA = +25 °C (Unless otherwise specified)

Parameter	Maximum Rating
Operating Temperature	-55 °C to +125 °C
Storage Temperature	-65 °C to +150 °C
Incident C.W. RF Power	+ 23 dBm C.W.
Reverse Voltage	25 V
Bias Current	+/- 30 mA

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

Nominal Chip Dimensions

Chip Dimensions		
	µm	mil
Width (X)	1810	71.3
Length (Y)	1650	65.0
Pad Locations		
	X (µm)	Y (µm)
J1	0	0
J2	-750	0
J3	-750	+825
J4	0	+1240
J5	-750	+825
J6	+750	0
Pad Locations Relative to J1		

Note: Bond pads are 120 µm x 120 µm

Electrical Specifications @ T_A = 25 °C (On-Wafer Measurements)

Frequency Range = 18 GHz to 50 GHz				
Parameters	**Ports**	**Bias Condition**	**Spec's**	**Comments**
Insertion Loss	J1 to J2	-5 V @ J1, and 0 V @ B	1.2 dB	@ 50 GHz
Input Return Loss	J1 to J2	-5 V @ J1, and 0 V @ B	15 dB	@ 50 GHz Insertion Loss State
Output Return Loss	J1 to J2	-5 V @ J1, and 0 V @ B	18 dB	@ 50 GHz Insertion Loss State
Isolation	J1 to J2	+10 mA @ J1 and @ B	30 dB	@ 50 GHz
Output Return Loss	J2 to J1	+10 mA @ J1 and @ B	18 dB	@ 50 GHz 50 Ohm Matched at J2 Only in Isolation State
Switching Speed	J1 to J2	10 GHz	5 nS	Typical Switching speed measured from 10% to 90% detected RF.

NOTES:

1. J1 = Input
2. J2 = Output
3. TTL Driver uses a Parallel 390 pF and 180 Ohm Output Network

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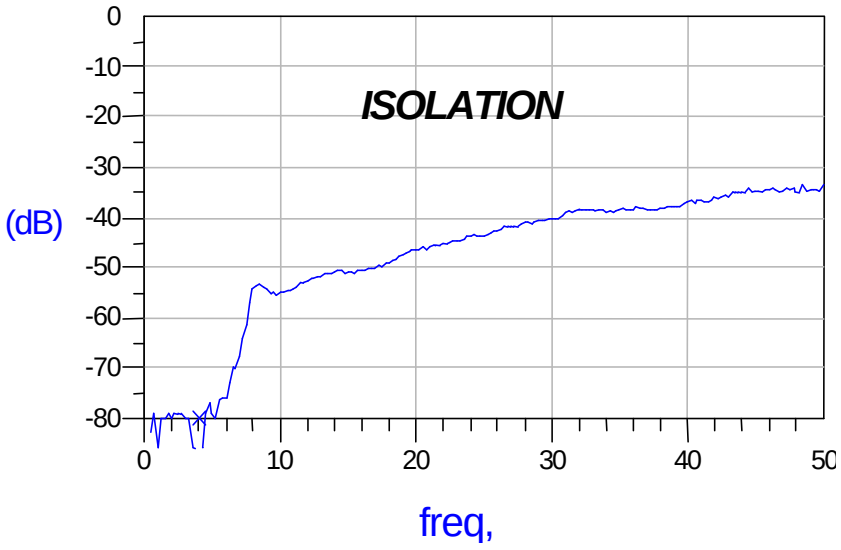
Typical Performance (On Wafer Measurements)



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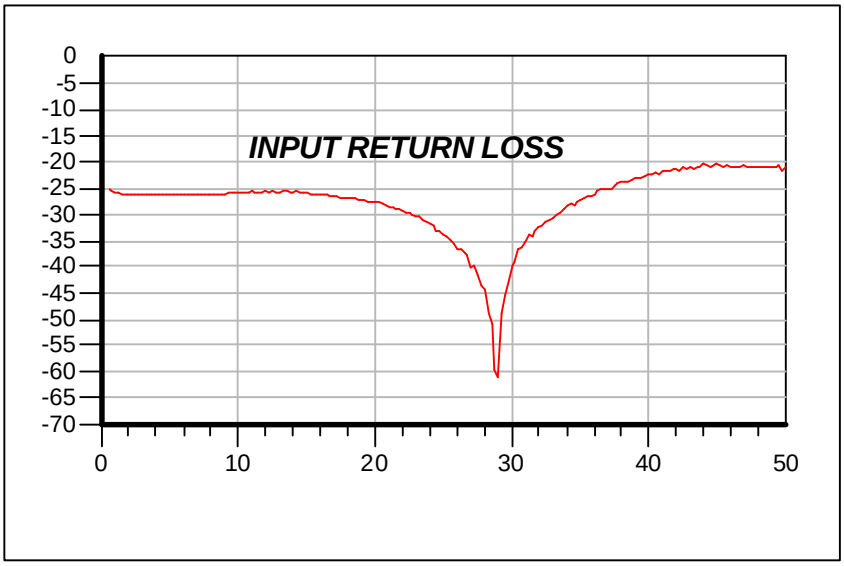
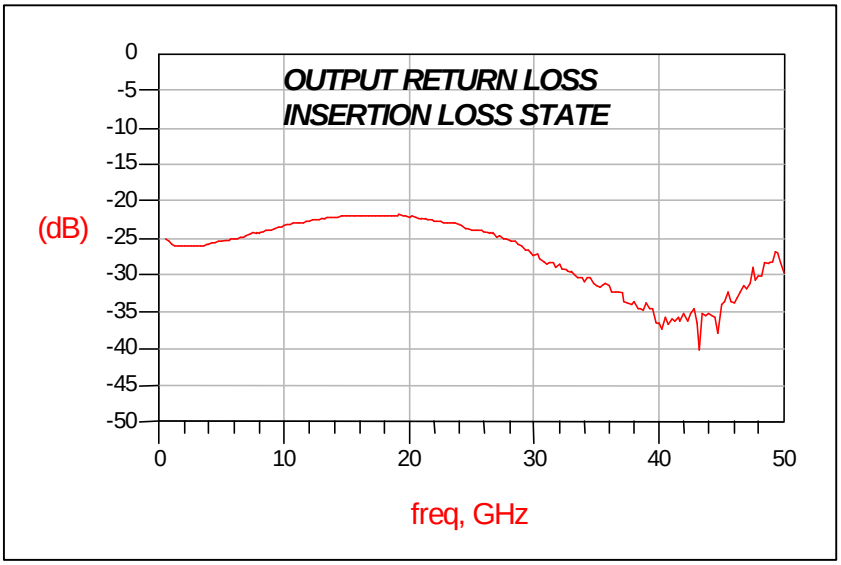
Typical Performance (On Wafer Measurements) (cont'd)





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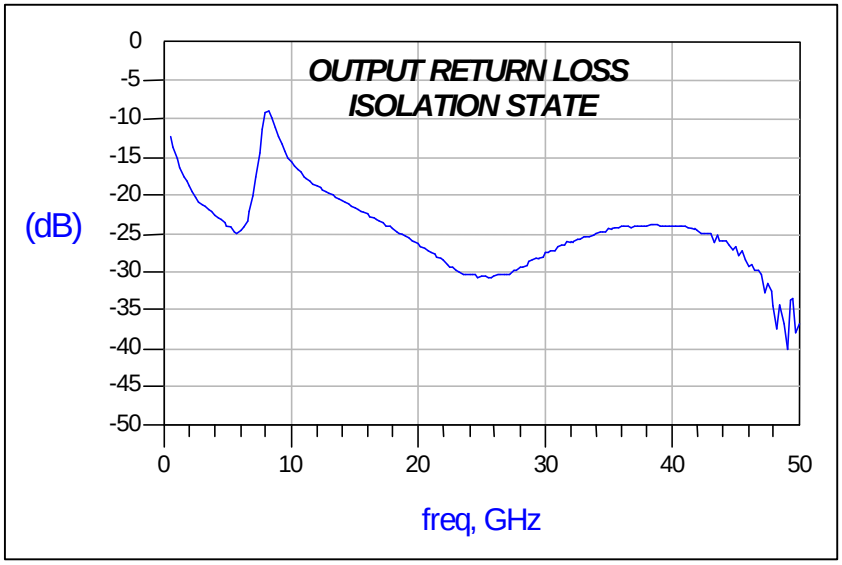
Typical Performance (On Wafer Measurements) (cont'd)



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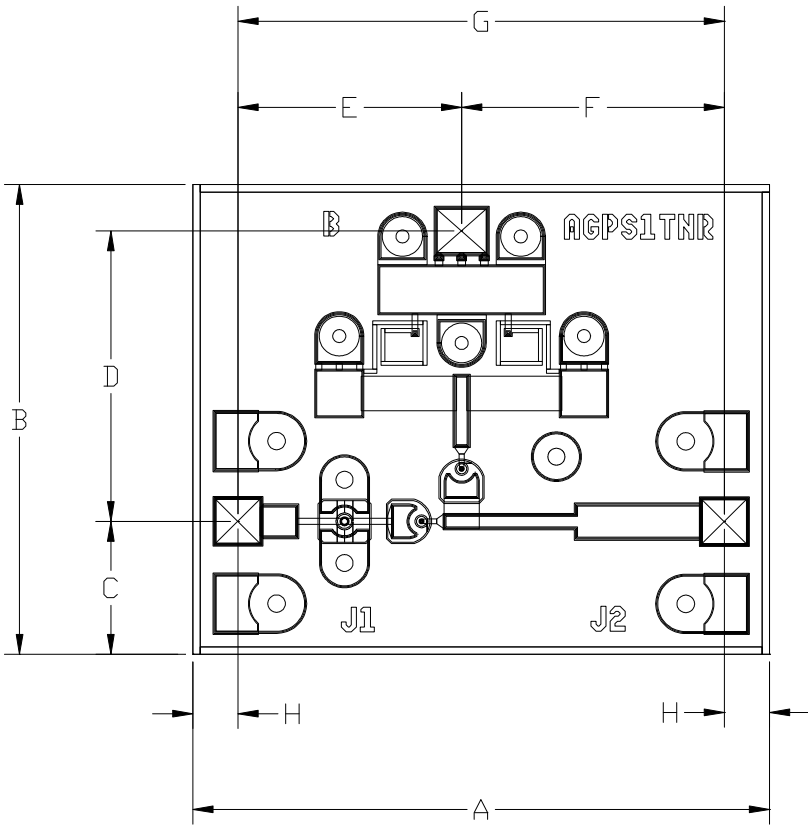
MA4SWAG1A Outline



Dimensions

Dim	mm		mils	
	Min.	Max.	Min.	Max.
A	1.14	1.17	44.7	45.9
B	0.94	0.97	37.1	38.3
C	0.26	0.28	10.2	11.0
D	0.58	0.59	22.9	23.3
E	0.44	0.45	17.4	17.8
F	0.51	0.53	20.2	21.0
G	0.96	0.98	37.8	38.6
H	0.08	0.11	3.0	4.1
Thickness	0.09	0.11	3.7	4.3

Assembly Considerations

The following precautions should be observed to avoid damaging these chips.

Cleanliness

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

Electro-Static Sensitivity

These Devices are considered ESD Class1. Proper ESD techniques should be used when handling these devices.

General Handling

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

Mounting Techniques

These AlGaAs devices are designed to be mounted with electrically conductive silver epoxy or with a lower temperature solder perform, which is not rich in Sn content.

Solder Die Attachment

All die attach and bonding methods should be compatible with gold metal. Solder which does not scavange gold, such as 80Au/20Sn or Sn62/Pb36/Ag2 is recommended. Do not expose die to a temperature greater than 300 °C for more than 10 seconds.

Electrically Conductive Epoxy Die Attachment

Assembly can be preheated to approximately 125 °C. Use a controlled thickness of approximately 2 mils for best electrical and thermal conductivity. Cure epoxy as per manufacturer's schedule. For extended cure times, temperatures should be kept below 150 °C.

Ribbon/Wire Bonding

Wedge thermocompression bonding or ball bonding may be used to attach ribbons or wires to the RF bonding pads. Gold ribbons should be 1/4 x 3 mil sq. for all RF ports for lowest inductance and best microwave performance.

Operation of the MA4AGSW1A

One External Bias Network and One External D.C Return is required for successful operation of the MA4AGSW1A Absorptive SPST AlGaAs PIN Diode Switch. The Backside Area of the Die is the RF and D.C. Return Ground Plane.
In the Low Loss State, the Series Diode must be Forward Biased with Negative Current at D.C. Bias 1 and the Match Diode is Biased at 0 V at D.C. Bias B. In the Isolated State, the Shunt Diode and the Match Diode are Both Forward Biased at D.C. Bias 1 and D.C. Bias B (Series Diode becomes Reverse Biased). This Isolation State Bias Results in a Good 50 Ohms Match into Port J2. The RF to D.C. Bias Truth table is shown in Table I. The Bias Network Design should yield > 30 dB RF to DC Isolation.

MA4AGSW1A Schematic

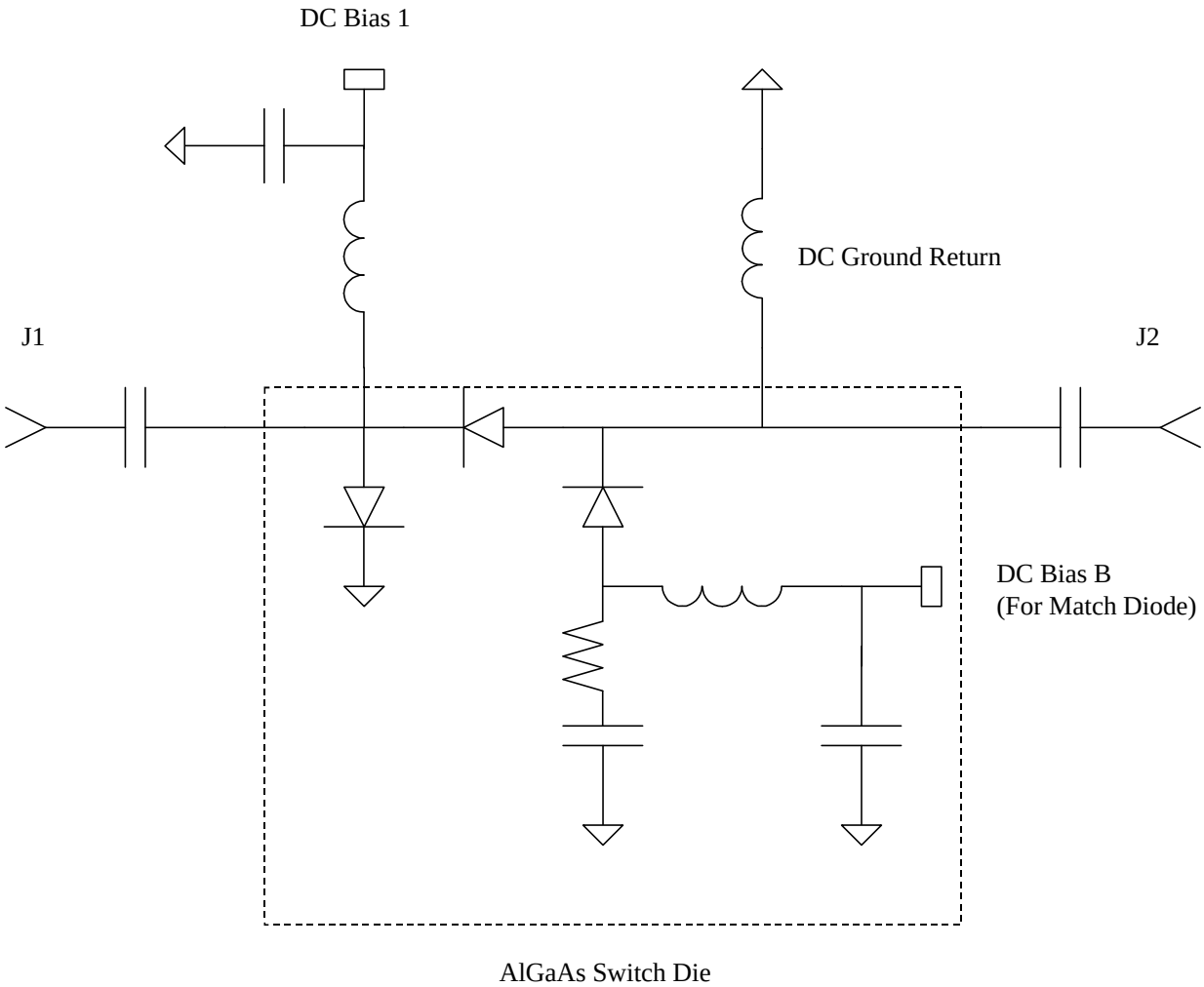


Table I: D.C. to RF Truth Table

J1-J2 Low Loss: Good VSWR at J1 & J2	J1-J2 Isolation: Good VSWR at J2
D.C. Bias 1 = -10 mA	D.C. Bias 1 = +10 mA
D.C. Bias B = 0 V	D.C. Bias B = +10 mA

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