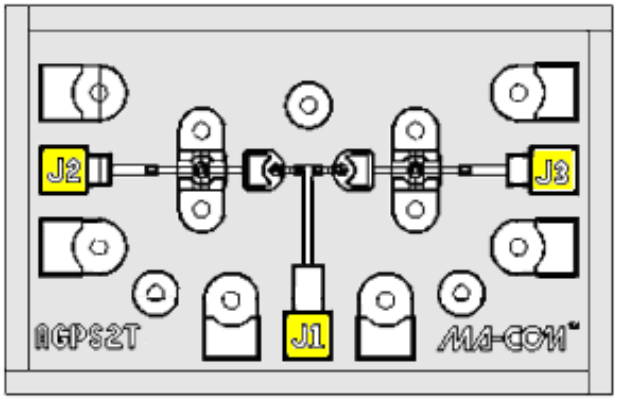
SPDT AlGaAs PIN Diode Switch

MA4AGSW2

Rev. V8

Features

- Ultra Broad Bandwidth: 50 MHz to 50 GHz
- Functional Bandwidth: 50 MHz to 70 GHz
- Insertion Loss: 0.7 dB
- Isolation: 33 dB @ 50 GHz
- Low Current Consumption:
  -10 mA for Low Loss State
  +10 mA for Isolation State
- MACOMs Unique AlGaAs Hetero-Junction Anode Technology
- Silicon Nitride Passivation
- Polymer Scratch Protection
- RoHS Compliant



Yellow areas indicate bond pads

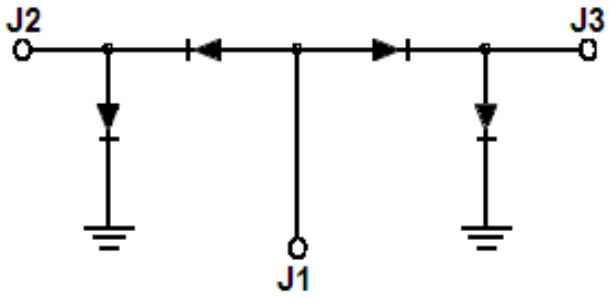
Applications

- Aerospace & Defense
- ISM

Description

The MA4AGSW2 is an Aluminum-Gallium-Arsenide, single pole, double throw (SPDT), 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.

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. AlGaAs PIN diode switches are an ideal choice for switching arrays in radar systems, radiometers, test equipment and other multi-assembly components.



Ordering Information

Part Number	Package
MA4AGSW2	waffle pack
MASW-000552-13210G	Gel Pack

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Electrical Specifications:
T_A = +25°C, ±10 mA Bias Current[1], ±5 V (on-wafer measurements)

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss	0.05 - 18 GHz 18 - 50 GHz	dB	— —	0.5 0.7	0.6 0.9
Isolation	0.05 - 18 GHz 18 - 50 GHz	dB	45 28	47 33	— —
Input Return Loss	0.05 - 18 GHz 18 - 50 GHz	dB	— —	22 21	— —
Output Return Loss	0.05 - 18 GHz 18 - 50 GHz	dB	— —	25 22	— —
Switching Speed[2] (10 - 90% RF Voltage)	±5 V TTL Compatible PIN Diode Driver, 10 GHz	ns	—	20	—

1. Bias current of ±10 mA is recommended for optimal performance.
2. Typical switching speed is measured from 10% to 90% of the detected RF voltage driven by a ±5 V TTL compatible driver. Driver output parallel RC network uses a capacitor between 390 - 560 pF and a resistor between 150 - 220 Ω to achieve 15 ns rise and fall times.

Absolute Maximum Ratings[3,4,5] @ T_A = +25°C

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

3. Maximum combined operating conditions for RF Power, DC bias, and temperature: 23 dBm C.W. @ 10 mA (per diode) @ +85°C.
4. Exceeding any one or combination of these limits may cause permanent damage to this device.
5. MACOM does not recommend sustained operation near these survivability limits.

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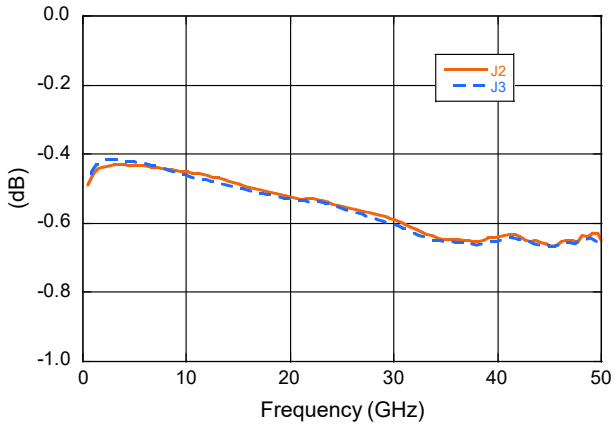
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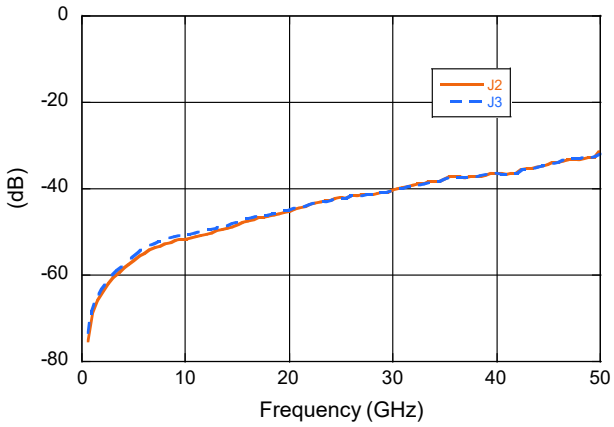
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Typical RF Performance Curves @ +25°C (probed on wafer)

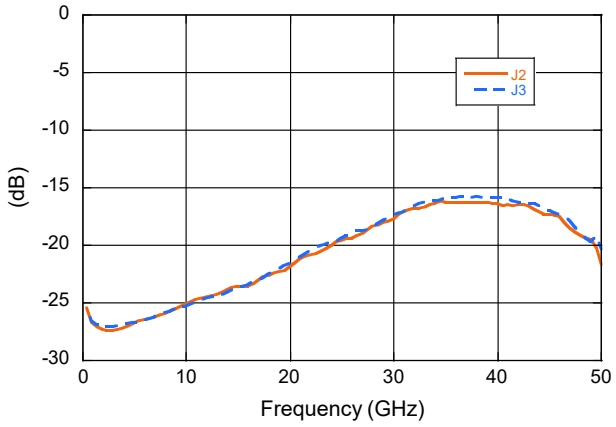
Insertion Loss @ -10 mA



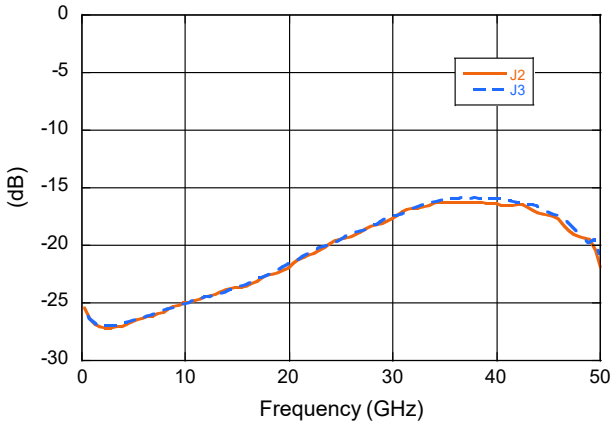
Isolation @ +10 mA



Input Return Loss @ -10 mA



Output Return Loss @ -10 mA



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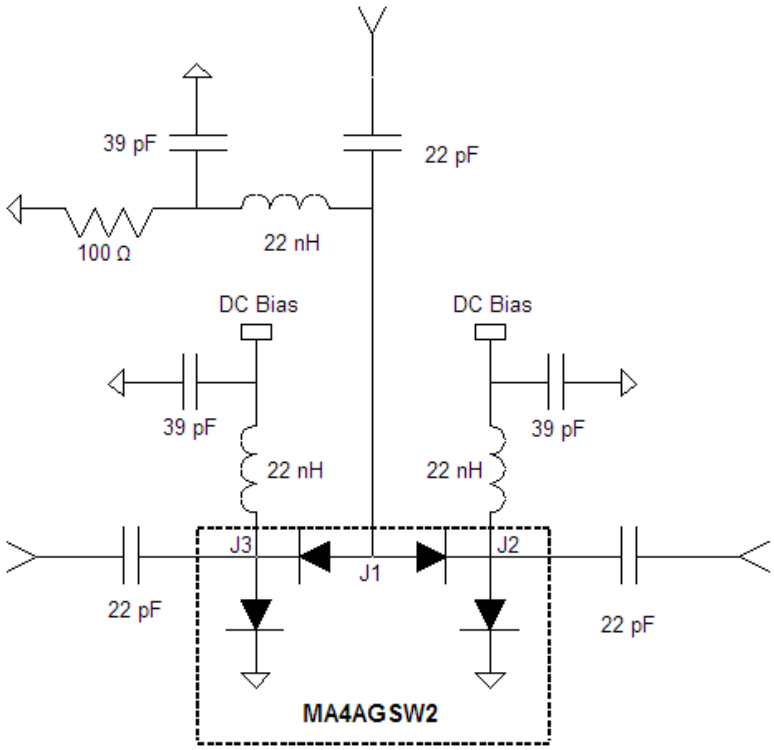
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Operation of the MA4AGSW2 Switch

The simultaneous application of a negative DC current to the low loss port and positive DC current to the remaining isolated switching port is required for the operation of the MA4AGSW2, 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 will not exceed ±1.6 V and is typically ±1.4 V with supply current of ±10 mA. In the low loss state, the series diode must be forward biased and the shunt diode reverse biased. While for the Isolated port, the shunt diode is forward biased and the series diode is reverse biased. The bias network design shown below should yield >30 dB RF to DC Isolation.

The lowest 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.

MA4AGSW2 Schematic with a Typical External 2 - 18 GHz Bias Network



Typical Driver Connections

Control Level (DC Current)		RF Output State	
J2	J3	J2 - J1	J3 - J1
-10 mA	+10 mA	Low Loss	Isolation
+10 mA	-10 mA	Isolation	Low Loss

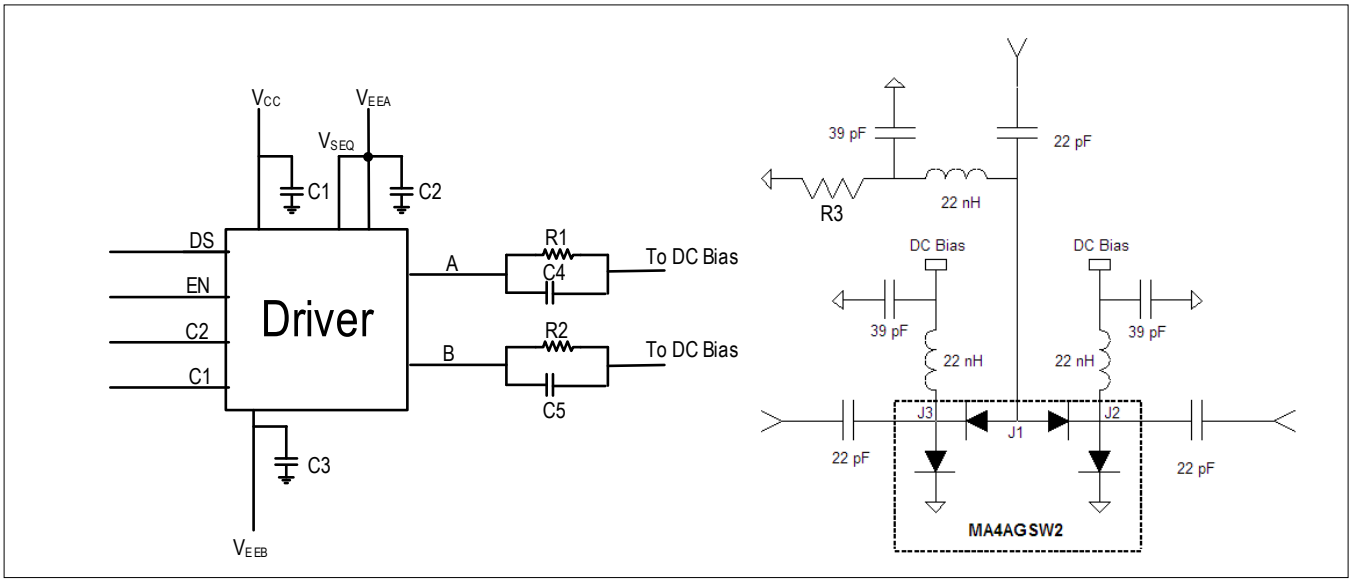
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MA4AGSW2 with MADR-011022 Driver Application Schematic 2 - 18 GHz



Parts List[6]

Part	Value
C1, C3	0.1 µF
C2	47 pF
C4, C5	470 pF
R1, R2	360 Ω
R3	500 Ω

6. Resistor values calculated to provide ~10 mA of bias current given V_{CC} = 5 V, V_{EEB} = -10 V, voltage drop at driver output 0.4 V and V_F of switch diodes 1 V.

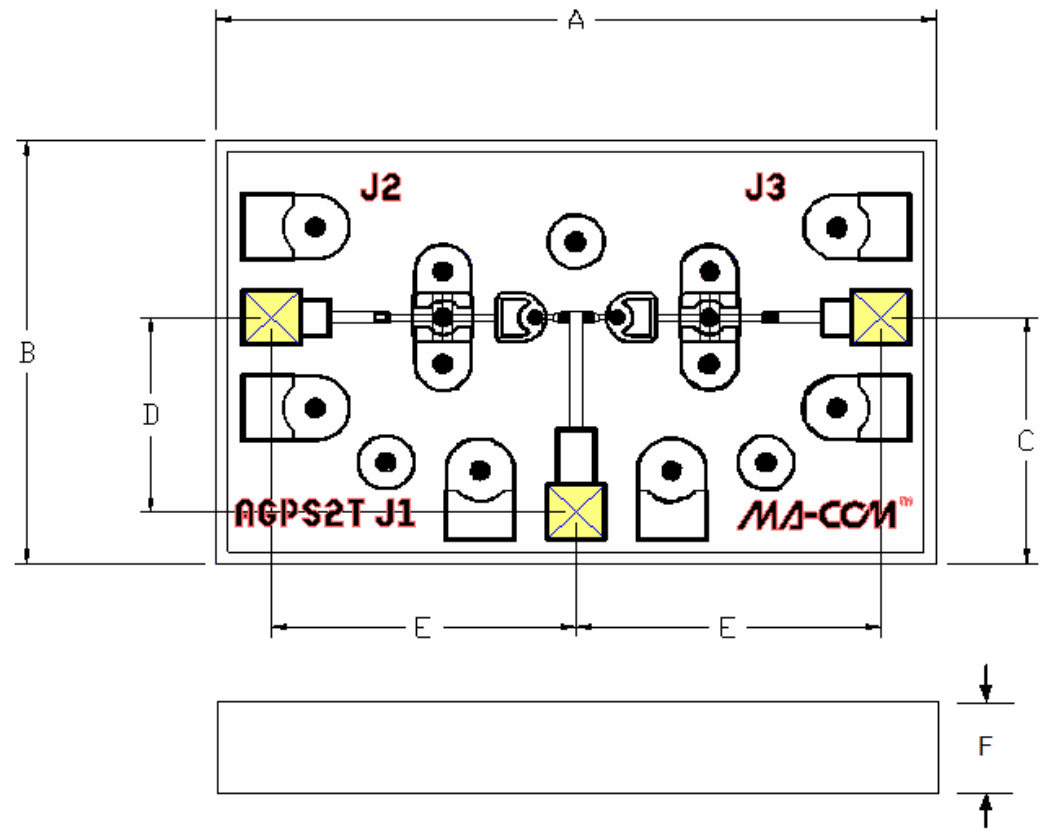
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Chip Dimensions and Bonding Pad Locations (In Yellow)



Dimensions	mils			mm		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	48.0	49.0	50.0	1.219	1.245	1.270
B	29.7	30.7	31.7	0.754	0.780	0.805
C	17.3	17.8	18.3	0.439	0.452	0.465
D	13.7	13.9	14.1	0.348	0.358	0.358
E	20.3	20.5	20.7	0.516	0.521	0.526
F	3.5	4.0	4.5	0.094	0.099	0.109
Pads X-Y	3.5	4.0	4.5	0.089	0.102	0.114

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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 MA4AGSW2, AlGaAs switch 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 80Au/20Sn or Indalloy #2 is recommended. Do not expose die to temperatures >300°C for more than 10 seconds.

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.

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