AlGaAs SPST Reflective PIN Diode Switch

V 1.00

MA4AGSW1

Features

- Ultra Broad Bandwidth: 50 MHz to 50 GHz
- Functional Bandwidth : 50 MHz to 70 GHz
- Dual shunt diode configuration
- 0.35 dB Insertion Loss, 46 dB Isolation at 50 GHz
- Low Current consumption:
  -5 V for Low Loss State
  +10 mA for Isolation State
- M/A-COM's unique patent pending AlGaAs hetero-junction anode technology
- Silicon Nitride Passivation
- Polymide Scratch protection

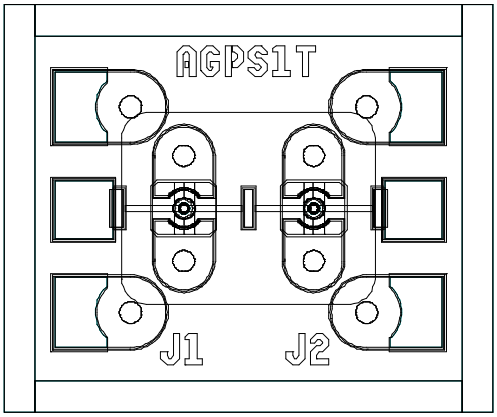
Description

M/A-COM's MA4AGSW1 is an Aluminum-Gallium-Arsenide anode enhanced, SPST PIN diode switch. AlGaAs anodes, which utilize M/A-COM's patent pending hetero-junction technology, produce less diode resistance than conventional GaAs processes. These devices are fabricated on a OMCVD epitaxial wafer using a process designed for high device uniformity and extremely low parasitics. The diodes themselves exhibit low series resistance, low capacitance, and extremely 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 air bridges during handling. Off-chip bias circuitry is required and allows maximum design flexibility.

Applications

The low capacitance of the PIN diodes used makes it ideal for use in microwave and millimeter wave switch designs, where ultra low insertion loss is required. The very high shunt conductance of the diodes dramatically improves isolation at millimeter wave frequencies. These AlGaAs PIN switches are used in switching arrays for radar systems, high-speed ECM circuits, and millimeter wave measurement instrumentation.

MA4AGSW1 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	+ 30 dBm @ -5 V
Reverse Voltage	25 V
Bias Current	30 mA per Diode

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

Nominal Chip Dimensions

Chip Dimensions (µm)		
	X	Y
Chip	780	650
Pad Dimensions (µm)		
	X	Y
RF	100	100
Pad Locations (µm)		
	X	Y
J1	0	0
J2	+530	0
Pad Locations Relative to J1		

Electrical Specifications @ T_A = 25 °C, - 5 V @ 0 mA, or +10 mA Bias Current (On-Wafer Measurements)

RF Specifications					
Parameters	**Frequency**	**Minimum**	**Typical**	**Maximum**	**Units**
Insertion Loss	0.05 - 18 GHz 18 - 50 GHz	-	0.2 0.3	0.3 0.6	dB
Isolation	0.05 - 18 GHz 18 - 50 GHz	20 40	22 46	-	dB
Input Return Loss	0.05 - 18 GHz 18 - 50 GHz	-	30 16	-	dB
Output Return Loss	0.05 - 18 GHz 18 - 50 GHz	-	30 16	-	dB
Switching Speed	10 GHz	-	10	-	ns

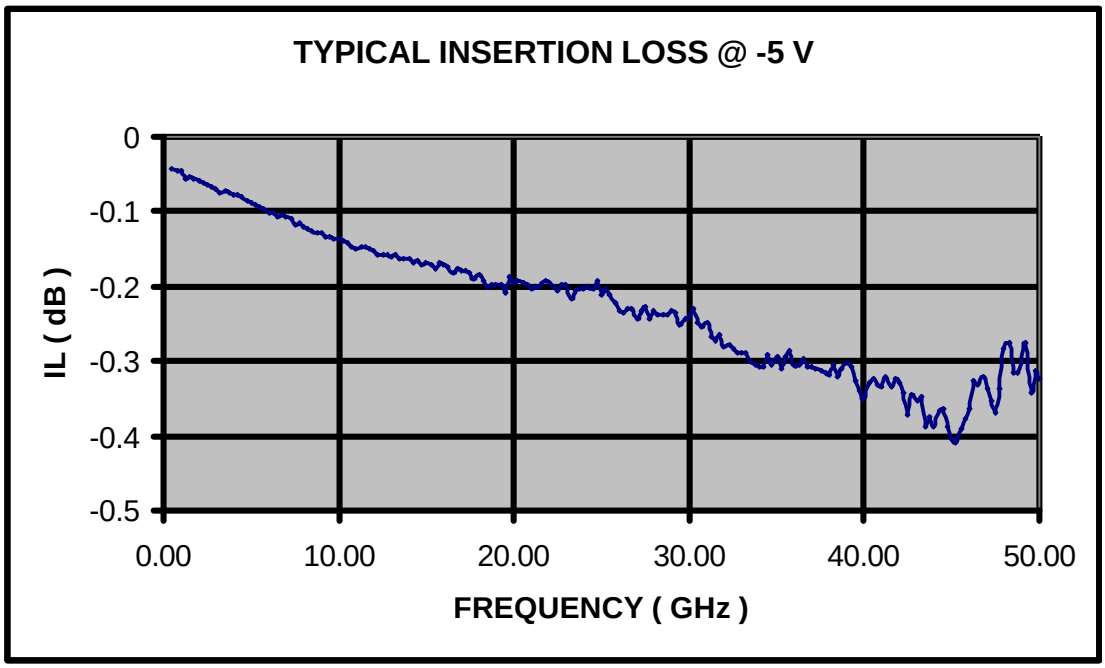
NOTES:

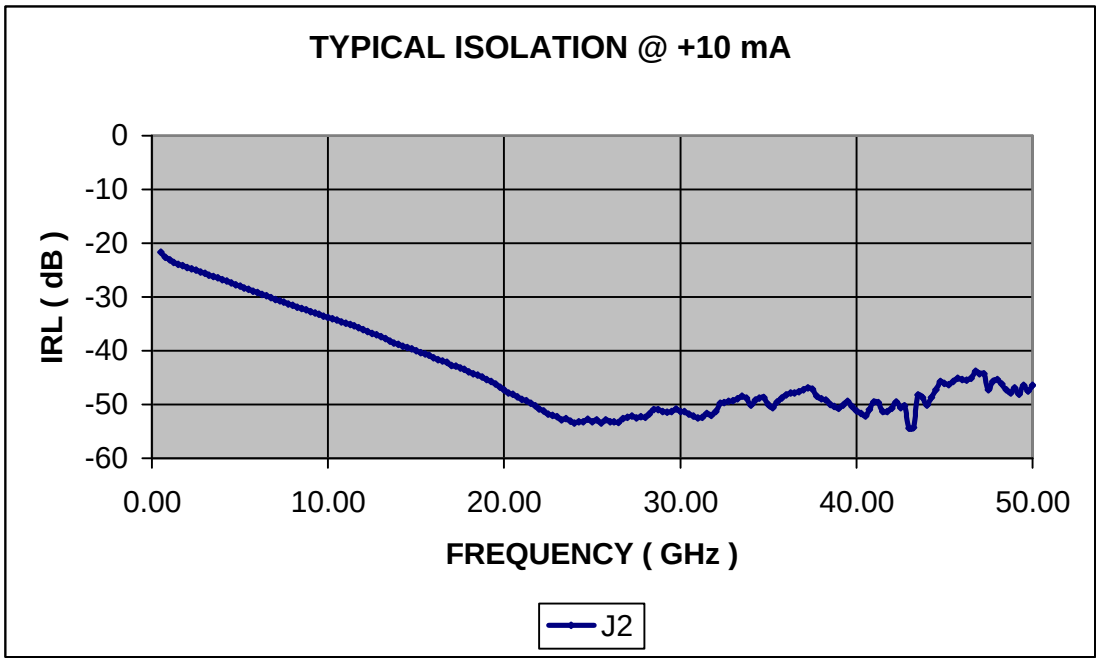
1. Typical switching speed is measured from 10% to 90% of the detected RF voltage driven by a TTL compatible driver. Driver output parallel RC network uses a capacitor between 390 pF - 560 pF and a resistor between 150 - 220 Ohms to achieve 20 ns rise and fall times.

Typical Driver Connections

Control Level (DC Current)	**RF Output Conditions**
J1 or J2	**J1-J2**
-5 V	**Low Loss**
+10 mA	Isolation

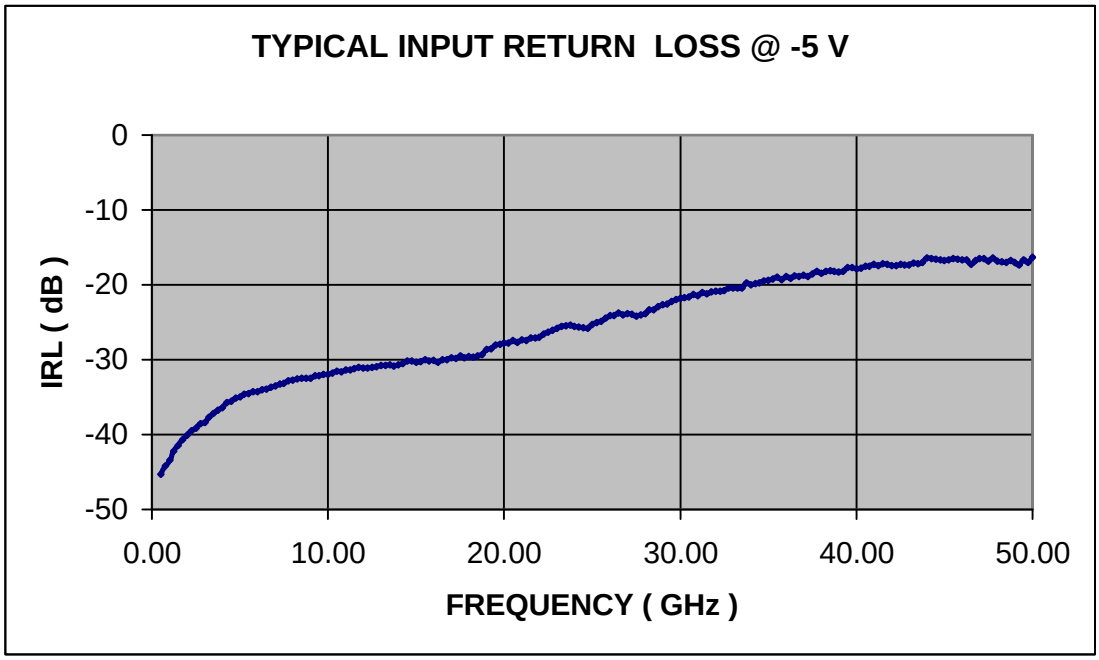
Microwave and Millimeter Wave Performance

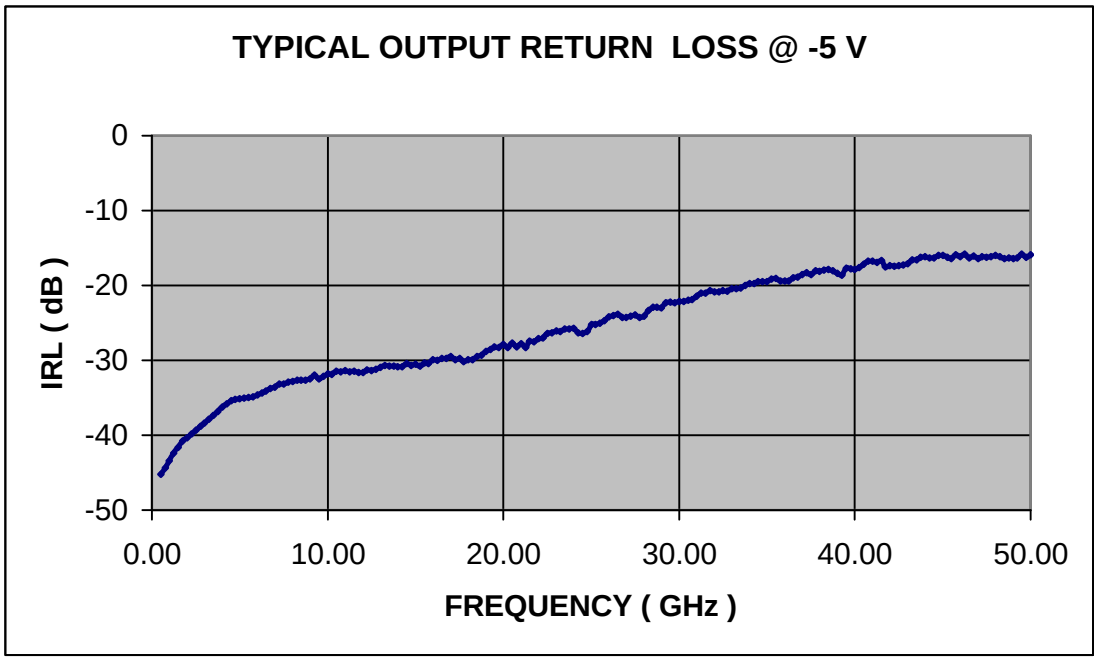




- **North America:** Tel. (800) 366-2266
- **Asia/Pacific:** Tel.+81-44-844-8296, Fax +81-44-844-8298
- **Europe:** Tel. +44 (1344) 869 595, Fax+44 (1344) 300 020

Microwave and Millimeter Wave Performance (cont'd)





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 MA4AGSW1

The Application of 0 V or a Negative DC Voltage to either J1 or J2 provides Insertion Loss for the MA4AGSW1 SPST Reflective Switch. Isolation is achieved with +10 mA total D.C. current. Constant Current Sources should supply the DC Control Current. The Forward Bias Diode Voltages at the Bias Node will not exceed | 1.6 volts |, (| 1.4 | volts typical for Supply Currents up to + 30 mA). The Backside Area of the Die is the RF and DC Return Ground Plane. The Bias Network Design should yield > 30 dB RF to DC Isolation.

Best Insertion Loss, P1dB, IP3, and Switching Speed is Achieved by applying a Minimum Value of | -2 V | at the D.C. Bias Node, which is achievable with a Standard, +/- 5 V TTL Controlled PIN Diode Driver. Typical PIN Diode Driver Open Circuit Output Voltages are within | 1V | of the Power Supply Voltages.

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MA4AGSW1 Schematic with 2-18 GHz Bias Network