

M/A-COM SP4T PIN Diode with Integrated Bias Network

V 2.00

MA4SW410B-1

Features

- Broad Bandwidth Specified from 2 to 18 GHz
- Integrated D.C. Bias Network
- Exceptional Isolation to Loss Ratio
- Rugged, Fully Monolithic, Glass Encapsulated Construction

Description

The MA4SW410B-1 device is a SP4T Series-Shunt Broad Band Switch with an Integrated Bias Network utilizing 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 a low loss, low dispersion glass. This hybrid combination of Silicon and Glass gives HMIC Switches exceptional low loss and remarkable high isolation through Ku Band frequencies.

Applications

These High Performance Switches are suitable for use in Multi-Band ECM, Radar, and Instrumentation Control Circuits where High Isolation to Insertion Loss Ratios are Required. With a Standard +5 V/-5 V, TTL Controlled PIN Diode Driver, 80 nS Switching Speeds are Achieved.

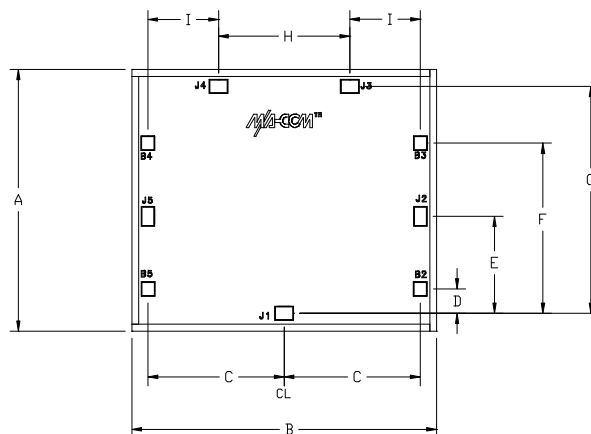
Absolute Maximum Ratings¹

@ TA = +25 °C (unless otherwise specified)

| Parameter | Value |
|-----------------------------------|-------------------|
| Operating Temperature | -65 °C to +125 °C |
| Storage Temperature | 65 °C to +150 °C |
| RF C.W. Incident Power (+/-20 mA) | + 30 dBm |
| DC Bias Current | +/-40 mA |

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

Outline Drawing



Nominal Die Dimensions

| Dim | Inches | | Millimeters | |
|--------------|------------------|------|------------------|------|
| | Min | Max | Min | Max |
| A | .085 | .058 | 2.17 | 2.27 |
| B | .106 | .110 | 2.69 | 2.79 |
| C | .048 | .052 | 1.22 | 1.32 |
| D | .007 | .011 | 0.17 | 0.27 |
| E | .033 | .034 | 0.85 | 0.86 |
| F | .057 | .061 | 1.46 | 1.56 |
| G | 0.77 | .081 | 1.96 | 2.06 |
| H | 0.46 | .050 | 1.18 | 1.28 |
| I | .024 | .028 | 0.61 | 0.71 |
| RF Bond Pads | .007 X .005 REF. | | .170 X .120 REF. | |
| DC Bond Pads | .005 X .005 REF. | | .125 X .125 REF. | |
| Thickness | 005 REF. | | .125 REF. | |

Electrical Specifications @ $T_A = +25\text{ }^\circ\text{C}$, $\pm 10\text{ mA}$ Bias Current (On-Wafer Measurements)

| Parameters | Frequency | Minimum | Nominal | Maximum | Units |
|------------------------------|-----------|---------|---------|---------|-------|
| Insertion Loss | 6 GHz | - | 0.80 | 1.0 | dB |
| | 12 GHz | - | 1.00 | 1.2 | dB |
| | 18 GHz | - | 1.40 | 1.6 | dB |
| Isolation | 6 GHz | 40 | 50 | - | dB |
| | 12 GHz | 35 | 40 | - | dB |
| | 18 GHz | 30 | 35 | - | dB |
| Input Return Loss | 6 GHz | - | 10 | - | dB |
| | 12 GHz | - | 15 | - | dB |
| | 18 GHz | - | 10 | - | dB |
| Switching Speed ¹ | - | - | 80 | - | nS |

1. Typical Switching Speed measured from 10 % to 90 % of detected RF Voltage driven by TTL compatible drivers using RC Output Spiking Network, where $R = 50 - 200\ \Omega$, $C = 390 - 560\ \text{pF}$.

Driver Connections for the MA4SW410B-1

Operation of the MA4SW Series of PIN Switches is achieved by the Simultaneous Application of Negative DC Current to the Low Loss Port and Positive DC current to the Remaining Isolated Switching Ports per the Driver Connections Table. The control currents should be supplied by constant current sources. For Insertion Loss, -10 mA bias results in approximately -2 V, and for Isolation, +10 mA yields approximately +0.9 V at the respective bias nodes. The Backside Area of the Die is the RF and DC Return Ground Plane.

Driver Connections for the MA4SW410B-1

| Control Level (DC Current) at Port | | | | Condition of RF Output | Condition of RF Output | Condition of RF Output | Condition of RF Output |
|------------------------------------|--------|--------|--------|------------------------|------------------------|------------------------|------------------------|
| B2 | B3 | B4 | B5 | J1-J2 | J1-J3 | J1-J4 | J1-J5 |
| -10 mA | +10 mA | +10 mA | +10 mA | Low Loss | Isolation | Isolation | Isolation |
| +10 mA | -10 mA | +10 mA | +10 mA | Isolation | Low Loss | Isolation | Isolation |
| +10 mA | +10 mA | -10 mA | +10 mA | Isolation | Isolation | Low Loss | Isolation |
| +10 mA | +10 mA | +10 mA | -10 mA | Isolation | Isolation | Isolation | Low Loss |

Assembly Considerations

The following precautions should be observed for successful assembly of the die.

Cleanliness

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

Electro-Static Sensitivity

The MA4SW410B-1 Series PIN Diode Switch is ESD, Class 1 sensitive. The proper ESD handling procedures should be used.

Wire Bonding

Thermosonic wedge wire bonding using $\frac{1}{4}$ x 3 mil sq. ribbon or Ball Bonding using 1 mil 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. RF bonds should be as short as possible.

Mounting

These chips have TiPtAu back metal. They can be die mounted with a gold-tin eutectic solder preform or electrically conductive epoxy. Mounting surface must be clean and flat.

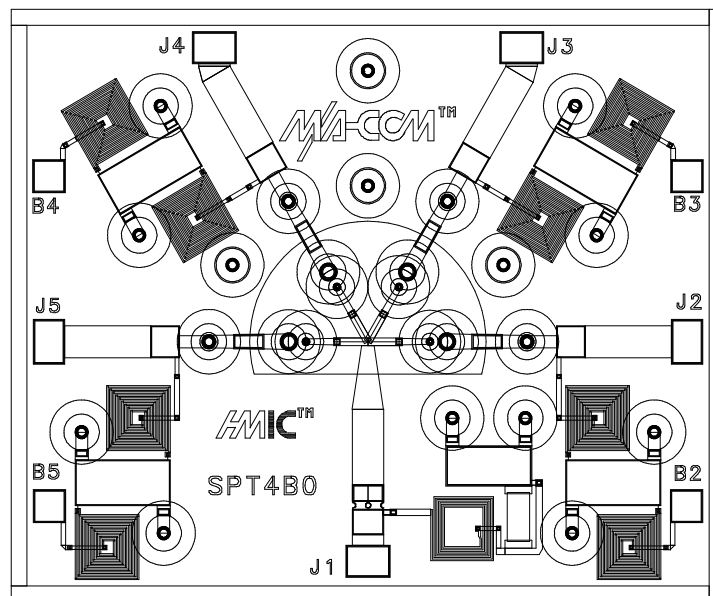
Eutectic Die Attachment

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 20 seconds. No more than three seconds should be required for the attachment.

Electrically Conductive 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 schedule.

MA4SW410B-1 Topology



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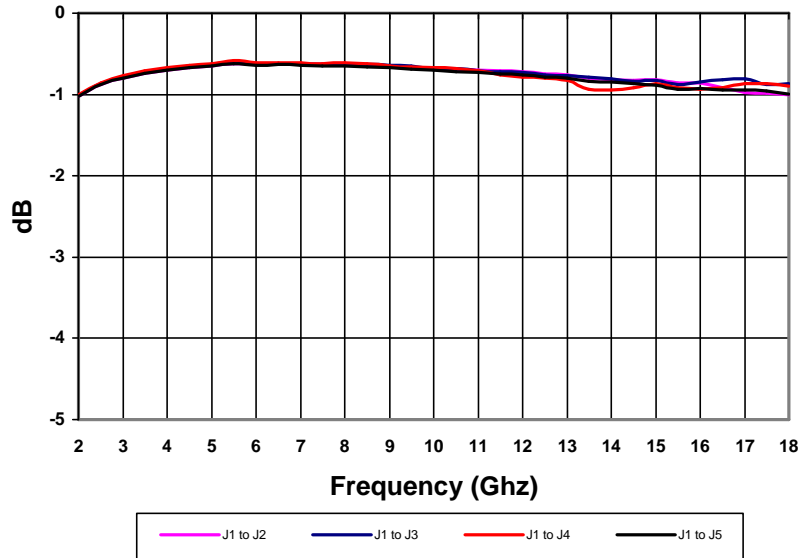
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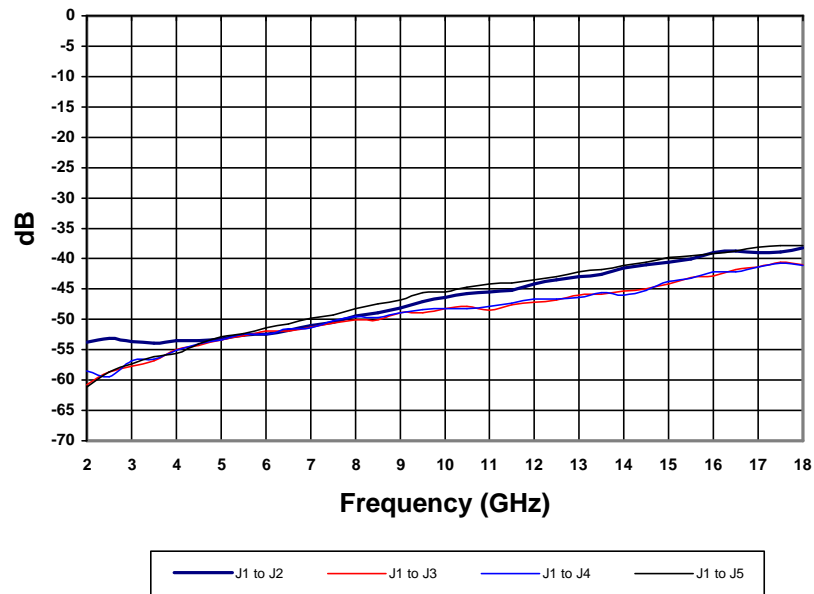
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Microwave Performance

MA4SW410B-1 Typical Insertion Loss



MA4SW410B-1 Typical Isolation



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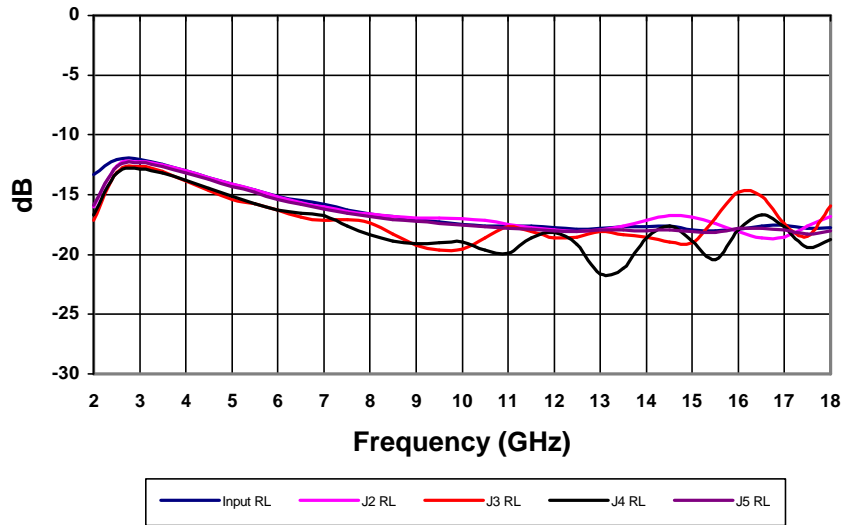
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Microwave Performance

MA4SW410B-1 Typical Return Loss



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MA4SW410B-1 Schematic

