

### Features

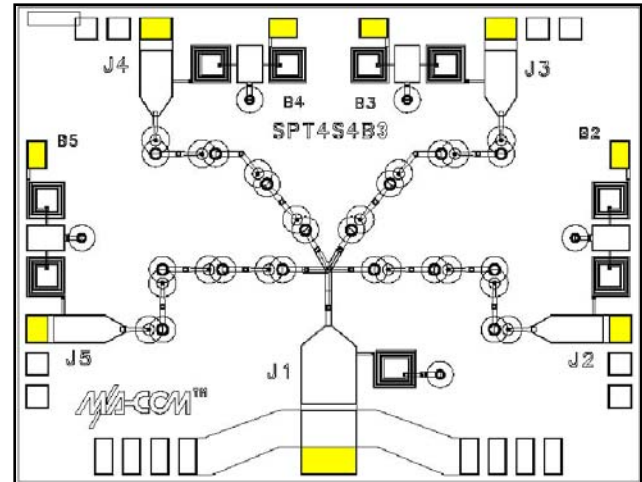
- ◆ Frequency of Operation: 24 +/- 2 GHz
- ◆ Fully Integrated Bias Network
- ◆ Low Power Consumption  
+12mA for Insertion Loss, 0V for Isolation
- ◆ The Device is Wire Bond Compensated at all RF Ports for RF Matching
- ◆ Rugged, Monolithic, Glass Encapsulated Construction
- ◆ RoHS Compliant

### Description

The MA4SW424B-1 is a SP4T switch with an integrated bias network which utilizes M/A-COM Technology Solutions HMIC™ (Heterolithic Microwave Integrated Circuit) process, US Patent 5,268,310. This process allows the incorporation of silicon pedestals that form series and/or shunt diodes or vias by imbedding them in a low loss, low dispersion glass. By using small spacing between elements, this combination of silicon and glass gives HMIC devices exceptional low loss and high isolation performance with exceptional repeatability through lower millimeter frequencies. Five, 4.5 X 5.5 mil, RF bond pads facilitate the use of low inductance ribbon bonds, while gold backside metallization allows for manual or automatic chip bonding using electrically conductive silver epoxy. Each RF bond pad has an adjacent tuning pad. The user can use bias and add the appropriate wire or ribbon (inductance) to optimize the RF match and performance for the particular frequency of interest.

### Applications

The MA4SW424B-1 SP4T, switch is designed for 24 GHz automotive switching applications. Insertion loss is achieved with +12 mA @ +4 V and isolation is achieved with 0V D.C. bias. The RF bias network is integrated into the HMIC switch for ease of use and space considerations.



Gold bond pads are shown here in yellow.

### Absolute Maximum Ratings<sup>1</sup>

| Parameter                 | Absolute Maximum |
|---------------------------|------------------|
| Forward Current           | +40mA            |
| Operating Temperature     | -55°C to +125°C  |
| Storage Temperature       | -55°C to +150°C  |
| Junction Temperature      | +175°C           |
| RF Incident Power @ +20mA | 30 dBm           |

1. Exceeding any of these limits may cause permanent damage to the chip.

### Electrical Specifications for Switch Ports @ $T_{AMB} +25^{\circ}\text{C}$

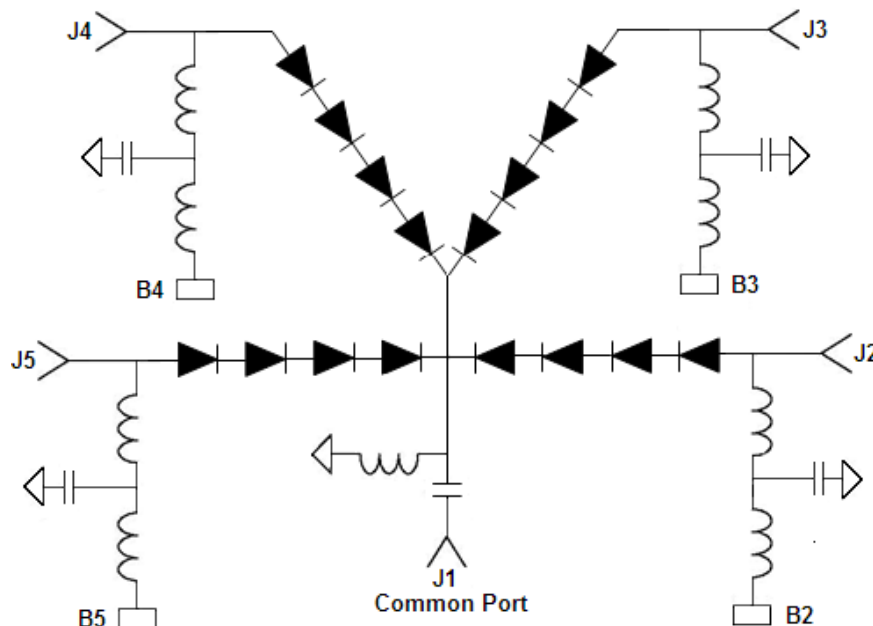
| Parameter                    | Conditions | Units | Minimum | Typical | Maximum |
|------------------------------|------------|-------|---------|---------|---------|
| Insertion Loss               | 24 GHz     | dB    | -       | 3.0     | 3.5     |
| Isolation                    | 24 GHz     | dB    | 37      | 50      | -       |
| Input Return Loss            | 24 GHz     | dB    | -       | 9       | -       |
| Switching Speed <sup>1</sup> | 24 GHz     | nS    | -       | 200     | -       |

Note 1: Switching speed is measured from 10% to 90% of detected RF signal driven by TTL compatible drivers using an RC spiking network where  $R = 50 - 200\Omega$ , and  $C = 390 - 560\text{pF}$ .

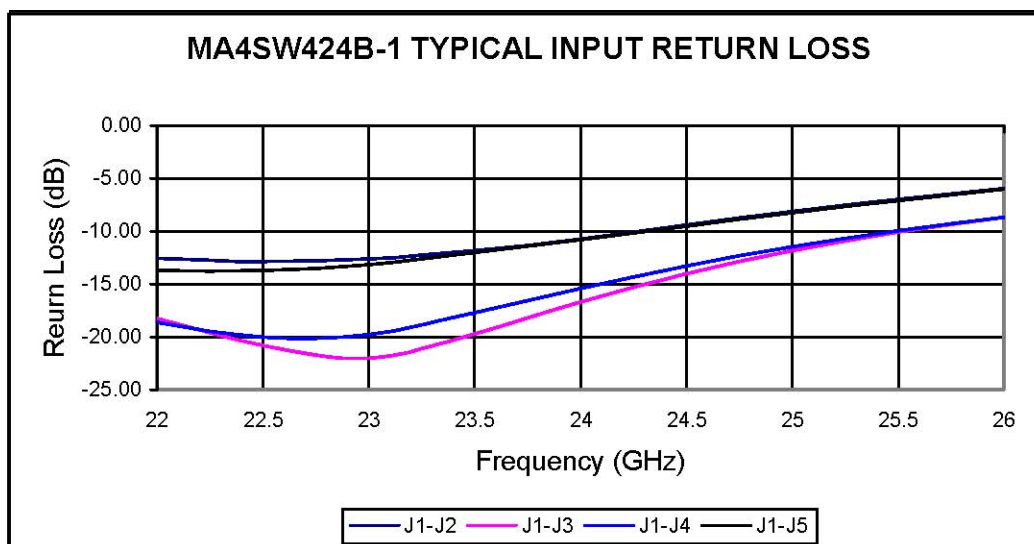
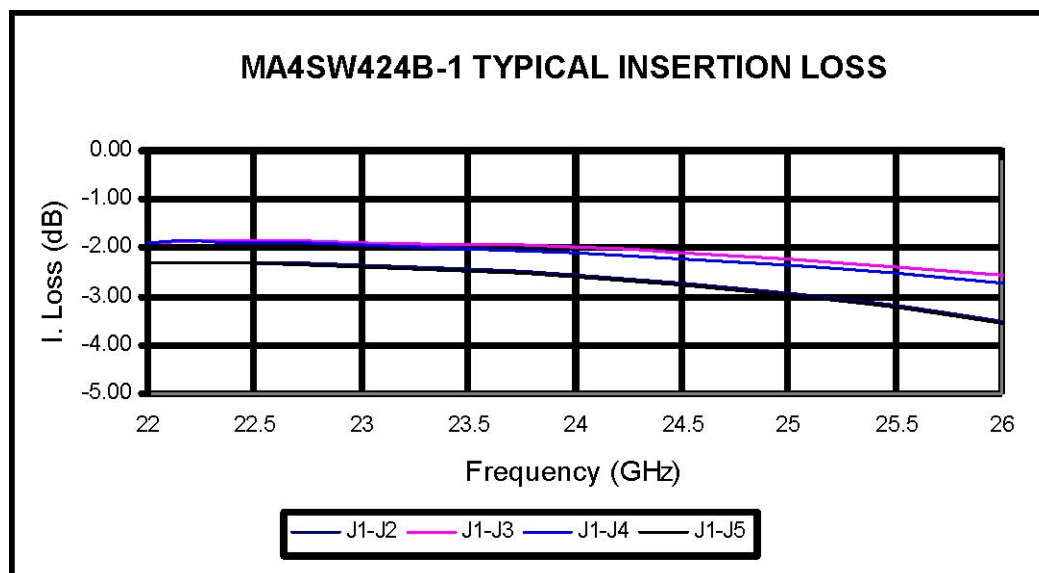
### Operation of the MA4SW424B-1

Operation of the MA4SW424B-1 series PIN diode switch is achieved by the application of a D.C. current (12mA) to the bias port of the selected insertion loss port and 0V bias for the isolated ports. The control currents should be supplied by constant current sources.

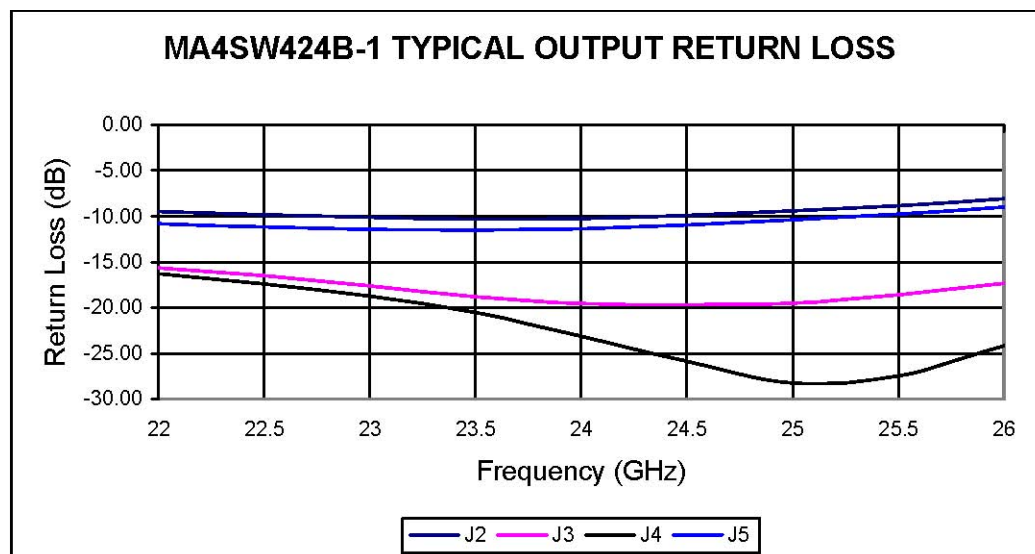
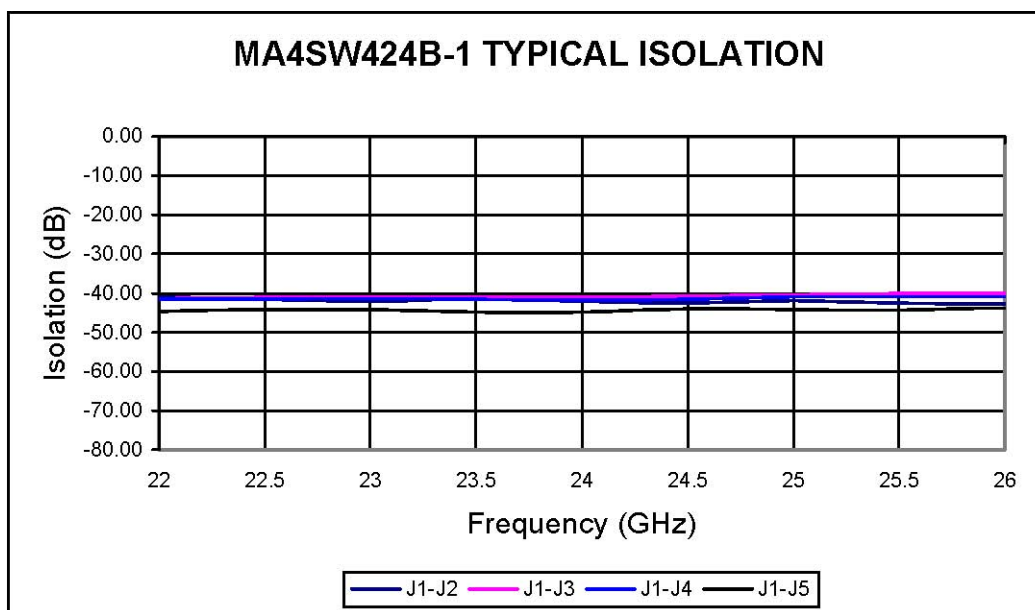
| D.C Bias Conditions |              |              |              | RF Output Conditions |                 |                 |                 |
|---------------------|--------------|--------------|--------------|----------------------|-----------------|-----------------|-----------------|
| B2                  | B3           | B4           | B5           | J1-J2                | J1-J3           | J1-J4           | J1-J5           |
| <b>+12mA</b>        | 0 Volts      | 0 Volts      | 0 Volts      | <b>Low Loss</b>      | Isolation       | Isolation       | Isolation       |
| 0 Volts             | <b>+12mA</b> | 0 Volts      | 0 Volts      | Isolation            | <b>Low Loss</b> | Isolation       | Isolation       |
| 0 Volts             | 0 Volts      | <b>+12mA</b> | 0 Volts      | Isolation            | Isolation       | <b>Low Loss</b> | Isolation       |
| 0 Volts             | 0 Volts      | 0 Volts      | <b>+12mA</b> | Isolation            | Isolation       | Isolation       | <b>Low Loss</b> |



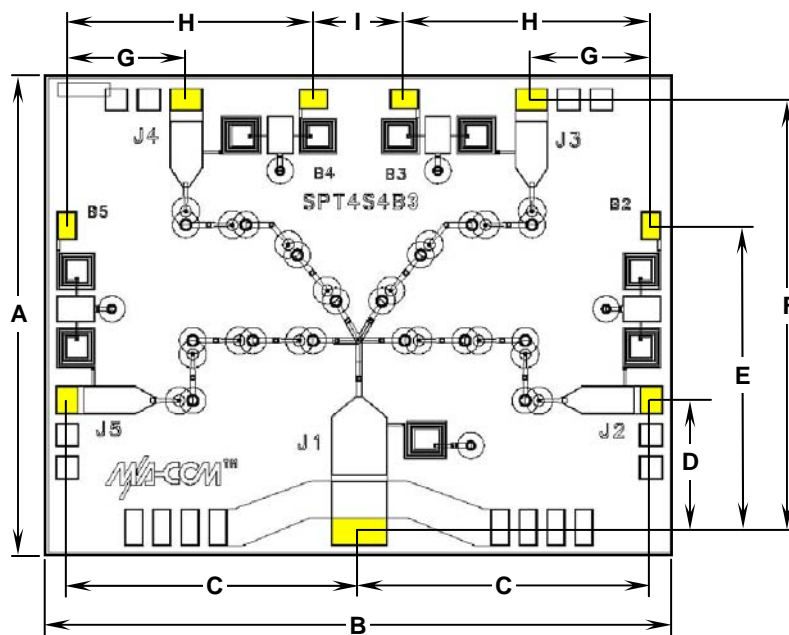
## Typical Performance @ $T_{AMB} +25^{\circ}\text{C}$



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### Chip Dimensions



| Dimension | Mils |     | Millimeters |      |
|-----------|------|-----|-------------|------|
|           | Min  | Max | Min         | Max  |
| A         | 100  | 104 | 2.54        | 2.64 |
| B         | 131  | 135 | 3.33        | 3.43 |
| C         | 61   | 62  | 1.55        | 1.57 |
| D         | 27   | 28  | 0.70        | 0.72 |
| E         | 64   | 65  | 1.63        | 1.65 |
| F         | 91   | 92  | 2.31        | 2.33 |
| G         | 25   | 26  | 0.63        | 0.65 |
| H         | 52   | 52  | 1.31        | 1.33 |
| I         | 19   | 20  | 0.48        | 0.50 |

#### Notes:

1. All RF (J) bond pads are 4.5 X 5.5 mils (0.177 X .217 mm).
2. All DC (B) bond pads are 4.0 X 5.5 mils (0.157 X .217 mm).
3. Chip thickness 5 mils (.127 mm)

### Assembly Considerations

#### Cleanliness

These chips should be handled in a clean environment free of organic contamination.

#### Electro-Static Sensitivity

The MA4SW424B-1 PIN diode switch is ESD, Class 1A sensitive (HBM). The proper ESD handling procedures must be followed.

#### Wire Bonding

Thermo-compression wedge bonding using 0.003" x 0.00025" ribbon or 0.001" diameter gold wire is recommended. A heat stage temperature of 150°C and a force of 18 to 22 grams should be used. If ultrasonic energy is necessary, it should be adjusted to the minimum level required to achieve a good bond. RF bond wires should be kept as short as possible.

#### Chip Mounting

The HMIC switches have Ti-Pt-Au back metal. They can be die mounted with conductive silver epoxy. Mounting surface must be clean and flat. A minimum amount of epoxy, 1-2 mils thick, should be used to attach chip. A thin epoxy fillet should be visible around the outer perimeter of the chip after placement. Cure epoxy per product instructions. Typically 150°C for 1 hour.

### Ordering Information

| Part Number | Packaging          |
|-------------|--------------------|
| MA4SW424B-1 | Die in Waffle Pack |