

# M/A-COM 77 GHz GaAs Multi-Throw PIN Diode Switch

V 4.00

# MA4GC6772

## Features

- 77 GHz Frequency Response
- 4.0 dB Insertion Loss
- 24 dB Isolation
- 2nS Switching Speed
- Silicon Nitride Passivation
- Polyimide Scratch Protection
- Designed for Automated Pick and Place Insertion
- Qualified for Automotive Environments

## Description

M/A-COM's MA4GC6772 is a Gallium Arsenide Monolithic PIN Diode Switch designed for 77 GHz Automotive Applications. This Monolithic Switch performs transmit and receive multiplexing functionality.

Port designations are:

1. 3 Antenna Ports (J1, J2, J3) : Transmit/Receive
2. 1 Source Port (J5) : Main VCO Signal Input
3. 1 L.O. Port (J6) : Offset VCO Signal Output
4. 1 Mixer Port (J4) : Mixer Port

Each RF Port contains DC blocking capacitors and a D.C. Bias Network consisting of High Impedance Lines and RF bypass capacitors. This device has 100 um square gold plated bonding pads at all RF and DC ports. RF and DC Ground Backside Gold Plating allows conventional chip bonding techniques using 80Au/20Sn Solder, Indalloy Solder, or electrically conductive silver epoxy.

This device is fabricated on OMCVD epitaxial wafers using a process designed for highly repeatable electrical characteristics and extremely low device parasitics.

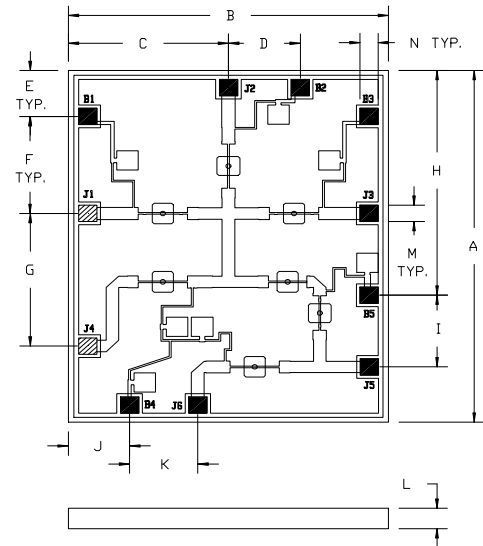
These diodes are fully passivated with Silicon Nitride and have an additional layer of Polyimide for scratch and impact protection. This protective coating prevents damage to the junction and circuit during automated or manual assembly.

## Applications

This device has highly reliable, very low parasitic diodes that allows its use through higher millimeter frequencies for exceptional loss to isolation ratio multi-throw switch performance.

Typical Applications include Tranceivers, Automotive Cruise Control Systems, and Radiometry Switch Functions.

## OD-S-1243



| DIM. | INCHES     |        | MILLIMETERS |       |
|------|------------|--------|-------------|-------|
|      | MIN.       | MAX.   | MIN.        | MAX.  |
| A    | 0.0845     | 0.0855 | 2.148       | 2.172 |
| B    | 0.0688     | 0.0698 | 1.748       | 1.772 |
| C    | 0.0341     | 0.0351 | 0.868       | 0.892 |
| D    | 0.0150     | 0.0160 | 0.383       | 0.407 |
| E    | 0.0106     | 0.0116 | 0.271       | 0.295 |
| F    | 0.0229     | 0.0239 | 0.583       | 0.607 |
| G    | 0.0315     | 0.0325 | 0.802       | 0.826 |
| H    | 0.0538     | 0.0548 | 1.368       | 1.392 |
| I    | 0.0168     | 0.0178 | 0.428       | 0.452 |
| J    | 0.0127     | 0.0137 | 0.324       | 0.348 |
| K    | 0.0142     | 0.0152 | 0.363       | 0.387 |
| L    | 0.0035     | 0.0043 | 0.090       | 0.110 |
| M    | 0.004 REF. |        | 0.100 REF.  |       |
| N    | 0.004 REF. |        | 0.100 REF.  |       |

## NOTES

1. BOND PAD MATERIAL: 2.5 μM THICK GOLD
2. HATCHED AREAS INDICATE BOND PADS
3. BACKSIDE METAL: 1.0 μM THICK GOLD

Electrical Specifications,  $T_A = +25\text{ }^\circ\text{C}$ 

| Parameters           | Units    | Minimum Specification | Typical Specification | Maximum Specification | Bias Conditions          |
|----------------------|----------|-----------------------|-----------------------|-----------------------|--------------------------|
| Forward Voltage, +Vf | V        | 1.15                  | 1.25                  | 1.40                  | +10 mA per Diode         |
| Leakage Current, -Ir | nA       | -200                  | -20                   |                       | -15 V per Diode          |
| DC Slope Resistance  | $\Omega$ |                       | 4.8                   | 6.4                   | +10 mA & 11 mA per Diode |

Reference Millimeter Wave Data @  $F = 77\text{ GHz}$ ,  $T_A = +25\text{ }^\circ\text{C}$ 

| MA4GC6772       |                      |        |                |              |   |
|-----------------|----------------------|--------|----------------|--------------|---|
| Parameters      | Conditions           | Avg.   | Bias Condition |              | Comments  |
|                 |                      |        | -5 V           | +10 mA       |   |
| Insertion Loss  | J4 to (J1-J3)        | 3.8 dB | B1, B2, B3, B4 | B5           | <ul style="list-style-type: none"> <li>Receive State</li> <li>Transmit State</li> <li>Source to LO Loss</li> </ul>                          |
|                 | J5 to (J1-J3)        | 4.0 dB | B1, B2, B3, B5 | B4           |   |
|                 | J5 to J6             | 2.0 dB | B1, B2, B3, B4 | B5           |   |
| Isolation       | J4 to (J1-J3)        | 24 dB  | B1, B2, B3, B5 | B4           | <ul style="list-style-type: none"> <li>Transmit State</li> <li>Receive State</li> <li>At any Switch State</li> <li>Receive State</li> </ul> |
|                 | J5 to (J1-J3)        | 30 dB  | B1, B2, B3, B4 | B5           |   |
|                 | J1, J2, J3           | 24 dB  | -              | -            |   |
|                 | J5 to J4             | 35 dB  | B1, B2, B3, B4 | B5           |   |
| VSWR            | All Ports            | 1.5:1  | Same as Loss   | Same as Loss | <ul style="list-style-type: none"> <li>Low Loss Condition only (Reflective in Isolation Mode)</li> </ul>                                    |
| Switching Speed | 10% - 90% RF Voltage | 2 nS   | 0 to 5 V TTL   | 0 to 5 V TTL | <ul style="list-style-type: none"> <li>Switching Speed is Driver Dependent</li> </ul>   |

Absolute Maximum Ratings<sup>1</sup>

| Parameter              | Value                   |
|------------------------|-------------------------|
| Operating Temperature  | -25 °C to +85 °C        |
| Storage Temperature    | -65 °C to +150 °C       |
| D.C. Bias Current      | +15 mA per Diode        |
| D. C. Reverse Voltage  | -15 Volts @ -10 $\mu$ A |
| RF C.W. Incident Power | + 23 dBm C.W.           |
| Mounting Temperature   | +300 °C for 10 seconds  |

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

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■ 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

## Handling

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.

## Static Sensitivity

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 GaAs devices are designed to be mounted with electrically conductive silver epoxy or with a lower temperature solder preform.

## Solder Die Attach

All die attach and bonding methods should be compatible with gold metal. This device utilizes Tungsten metallization under the gold. Solder which does not scavenge gold, such as 80 Au/20 Sn or Indalloy #2 is recommended. Do not expose die to a temperature greater than 300 °C for more than 10 seconds.

## Electrical Conductive Epoxy Die Attach

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

## Ribbon/Wire Bonding

Wedge thermocompression bonding may be used to attach ribbons to the bonding pads. Gold ribbons should be ½ x 3 mil sq. for all RF ports (J1-J6) for lowest inductance.

Ribbon or Wire bonding is recommended for all DC ports, (B1-B5). Use either ½ x 3 mil sq. gold ribbon or 1 mil dia. gold wire.