MICROWAVE CORPORATION v02.0805

# HMC174MS8 / 174MS8E

## GaAs MMIC T/R SWITCH DC - 3 GHz

EARTH FRIENDLY

RoHS✓ COMPLIANT

### Typical Applications

The HMC174MS8 / HMC174MS8E is ideal for:

- ISM Applications
- PCMCIA Wireless Cards
- Portable Wireless

### Features

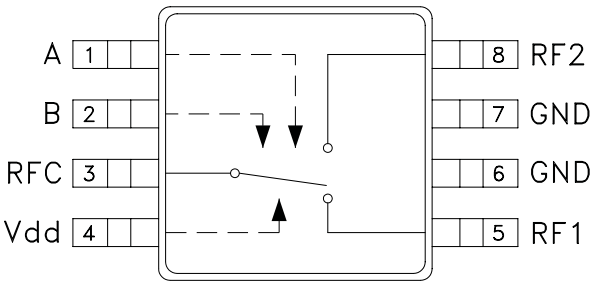
Ultra Small Package: MSOP8

High Third Order Intercept: +60 dBm

Single Positive Supply: +3 to +10V

High RF power Capabilty

### Functional Diagram



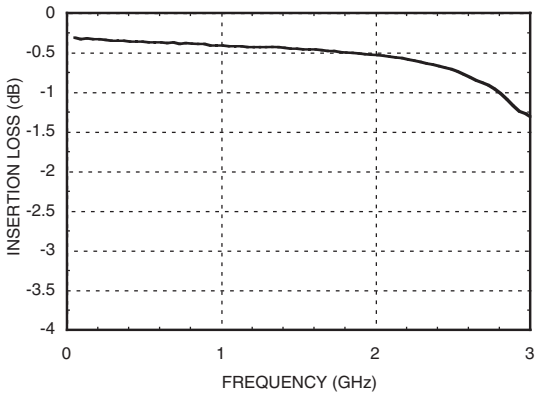

### General Description

The HMC174MS8 & HMC174MS8E are low-cost SPDT switches in 8-lead MSOP packages for use in transmit-receive applications which require very low distortion at high signal power levels. The device can control signals from DC to 3.0 GHz and is especially suited for 900 MHz, 1.8 - 2.2 GHz, and 2.4 GHz ISM applications with only 0.5 dB loss. The design provides exceptional intermodulation performance; providing a +60 dBm third order intercept at 8 Volt bias. RF1 and RF2 are reflective shorts when "OFF". On-chip circuitry allows single positive supply operation at very low DC current with control inputs compatible with CMOS and most TTL logic families.

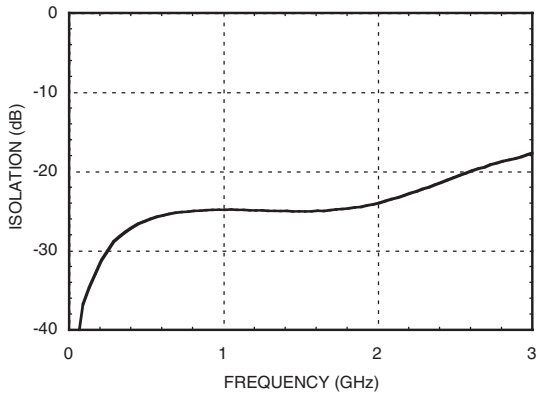
### Electrical Specifications, $T_A$ = +25° C, Vdd = +5 Vdc, 50 Ohm System

| Parameter | Frequency | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Insertion Loss | DC - 1.0 GHz<br>DC - 2.0 GHz<br>DC - 2.5 GHz<br>DC - 3.0 GHz | | 0.5<br>0.5<br>0.7<br>1.4 | 0.7<br>0.8<br>1.0<br>1.8 | dB<br>dB<br>dB<br>dB |
| Isolation | DC - 1.0 GHz<br>DC - 2.0 GHz<br>DC - 2.5 GHz<br>DC - 3.0 GHz | 22<br>20<br>17<br>13 | 25<br>24<br>21<br>17 | | dB<br>dB<br>dB<br>dB |
| Return Loss | DC - 1.0 GHz<br>DC - 2.0 GHz<br>DC - 2.5 GHz<br>DC - 3.0 GHz | 20<br>16<br>13<br>9 | 28<br>21<br>17<br>11 | | dB<br>dB<br>dB<br>dB |
| Input Power for 1dB Compression 0/8V Control | 0.5 - 1.0 GHz<br>0.5 - 3.0 GHz | 35<br>34 | 39<br>38 | | dBm<br>dBm |
| Input Third Order Intercept 0/8V Control | 0.5 - 1.0 GHz<br>0.5 - 3.0 GHz | 55<br>55 | 60<br>60 | | dBm<br>dBm |
| Switching Characteristics<br>tRISE, tFALL (10/90% RF)<br>tON, tOFF (50% CTL to 10/90% RF) | DC - 3.0 GHz | | <br>10<br>24 | | <br>ns<br>ns |

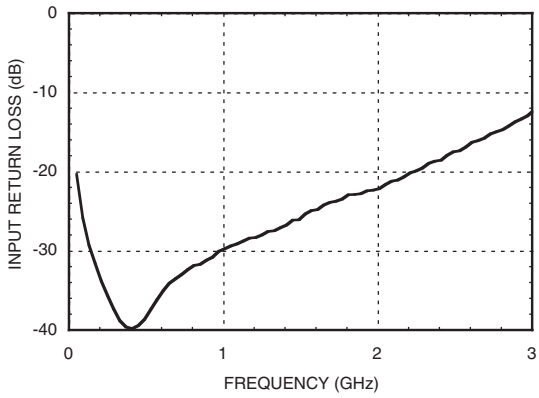
### Insertion Loss



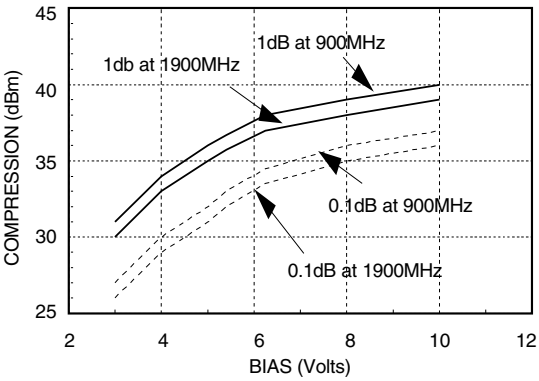

### Isolation



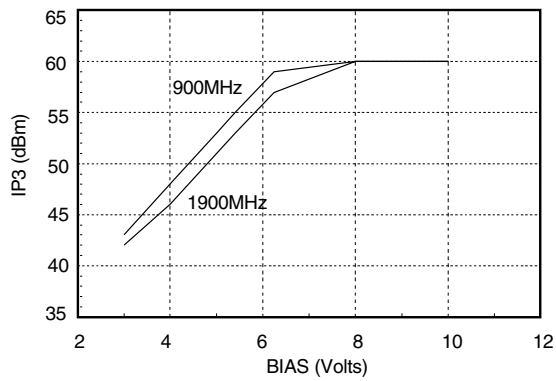

### Return Loss




### Input 0.1 and 1.0 dB Compression vs. Bias Voltage




### Input Third Order Intercept vs. Bias Voltage



## Compression vs. Bias Voltages

| | Carrier at 900 MHz | | Carrier at 1900 MHz | |
|---|---|---|---|---|
| Bias Vdd | Input Power for 0.1 dB Compression | Input Power for 1.0 dB Compression | Input Power for 0.1 dB Compression | Input Power for 1.0 dB Compression |
| (Volts) | (dBm) | (dBm) | (dBm) | (dBm) |
| 3 | 27 | 31 | 26 | 30 |
| 4 | 30 | 34 | 29 | 33 |
| 5 | 32 | 36 | 31 | 35 |
| 8 | 36 | 39 | 35 | 38 |
| 10 | 37 | 40 | 36 | 39 |

**Caution:** Do not operate in 1dB compression at power levels above +35dBm and do not 'hot switch' power levels greater than +23dBm ($V_{dd}$ = +5Vdc).

## Distortion vs. Bias Voltage

| | 1 Watt Carrier at 900 MHz | | | 1 Watt Carrier at 1900 MHz | | |
|---|---|---|---|---|---|---|
| Bias Vdd | Third Order Intercept | Second Order Intercept | Second Harmonic | Third Order Intercept | Second Order Intercept | Second Harmonic |
| (Volts) | (dBm) | (dBm) | (dBc) | (dBm) | (dBm) | (dBc) |
| 3 | 43 | 71 | 45 | 42 | 78 | 55 |
| 4 | 48 | 85 | 55 | 46 | 88 | 65 |
| 5 | 53 | 90 | 56 | 51 | 87 | 58 |
| 8 | 60 | 90 | 58 | 60 | 90 | 59 |
| 10 | 60 | 90 | 59 | 60 | 90 | 60 |

## Truth Table

***Control Input Voltage Tolerances are ± 0.2 Vdc**

| Bias | Control Input* | | Bias Current | Control Current | Control Current | Signal Path State | |
|---|---|---|---|---|---|---|---|
| Vdd (Vdc) | A (Vdc) | B (Vdc) | Idd (uA) | Ia (uA) | Ib (uA) | RF to RF1 | RF to RF2 |
| 3 | 0 | 0 | 30 | -15 | -15 | OFF | OFF |
| 3 | 0 | Vdd | 25 | -25 | 0 | ON | OFF |
| 3 | Vdd | 0 | 25 | 0 | -25 | OFF | ON |
| 5 | 0 | 0 | 110 | -55 | -55 | OFF | OFF |
| 5 | 0 | Vdd | 115 | -100 | -15 | ON | OFF |
| 5 | Vdd | 0 | 115 | -15 | -100 | OFF | ON |
| 10 | 0 | 0 | 380 | -190 | -190 | OFF | OFF |
| 10 | 0 | Vdd | 495 | -275 | -220 | ON | OFF |
| 10 | Vdd | 0 | 495 | -220 | -275 | OFF | ON |
| 5 | -Vdd | Vdd | 600 | -600 | 225 | ON | OFF |
| 5 | Vdd | -Vdd | 600 | 225 | -600 | OFF | ON |



For price, delivery, and to place orders, please contact Hittite Microwave Corporation:
20 Alpha Road, Chelmsford, MA 01824 Phone: 978-250-3343 Fax: 978-250-3373
Order On-line at www.hittite.com

# HMC174MS8 / 174MS8E

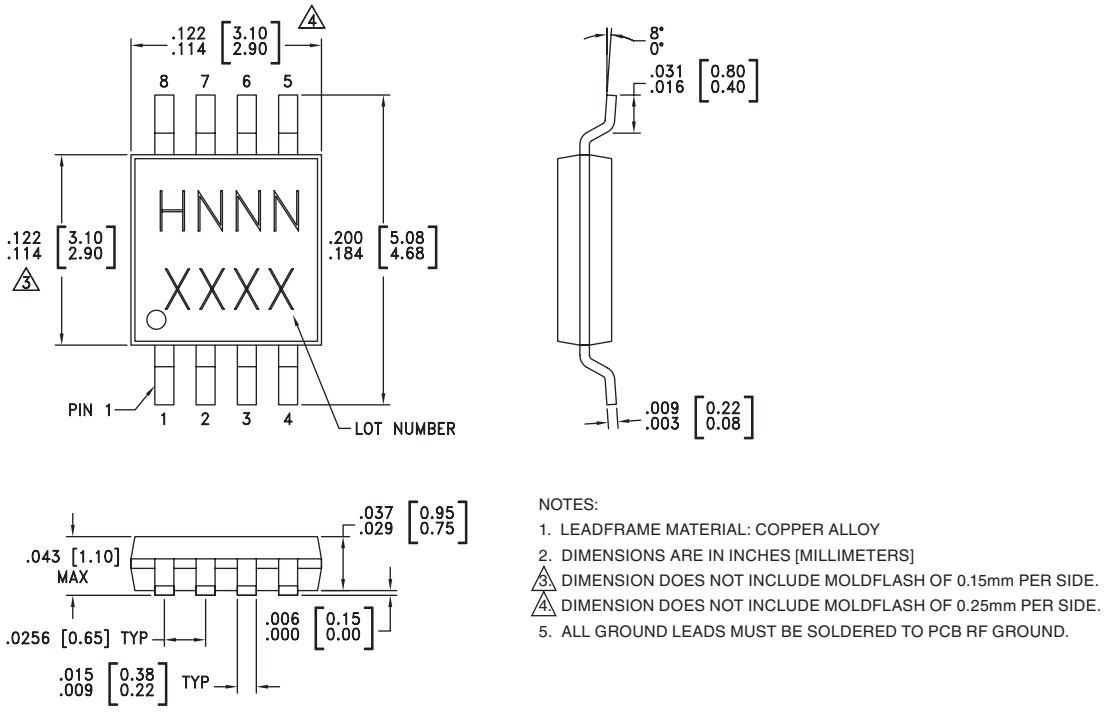
## GaAs MMIC T/R SWITCH DC - 3 GHz

## Absolute Maximum Ratings

| | |
|---|---|
| Bias Voltage Range (Vdd) | -0.2 to +12 Vdc |
| Control Voltage Range (A & B) | -0.2 to +Vdd Vdc |
| Storage Temperature | -65 to +150 °C |
| Operating Temperature | -40 to +85 °C |
| ESD Sensitivity (HBM) | Class 1A |

ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

## Outline Drawing




NOTES:

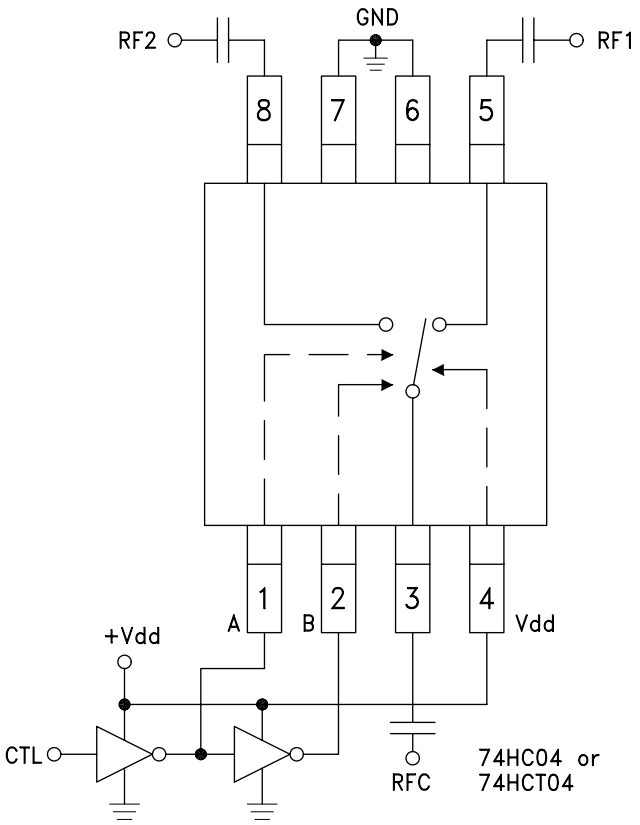
1. LEADFRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS]
3. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE.
4. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.25mm PER SIDE.
5. ALL GROUND LEADS MUST BE SOLDERED TO PCB RF GROUND.

## Package Information

| Part Number | Package Body Material | Lead Finish | MSL Rating | Package Marking [3] |
|---|---|---|---|---|
| HMC174MS8 | Low Stress Injection Molded Plastic | Sn/Pb Solder | MSL1 [1] | H174<br>XXXX |
| HMC174MS8E | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 [2] | H174<br>XXXX |

[1] Max peak reflow temperature of 235 °C
[2] Max peak reflow temperature of 260 °C
[3] 4-Digit lot number XXXX

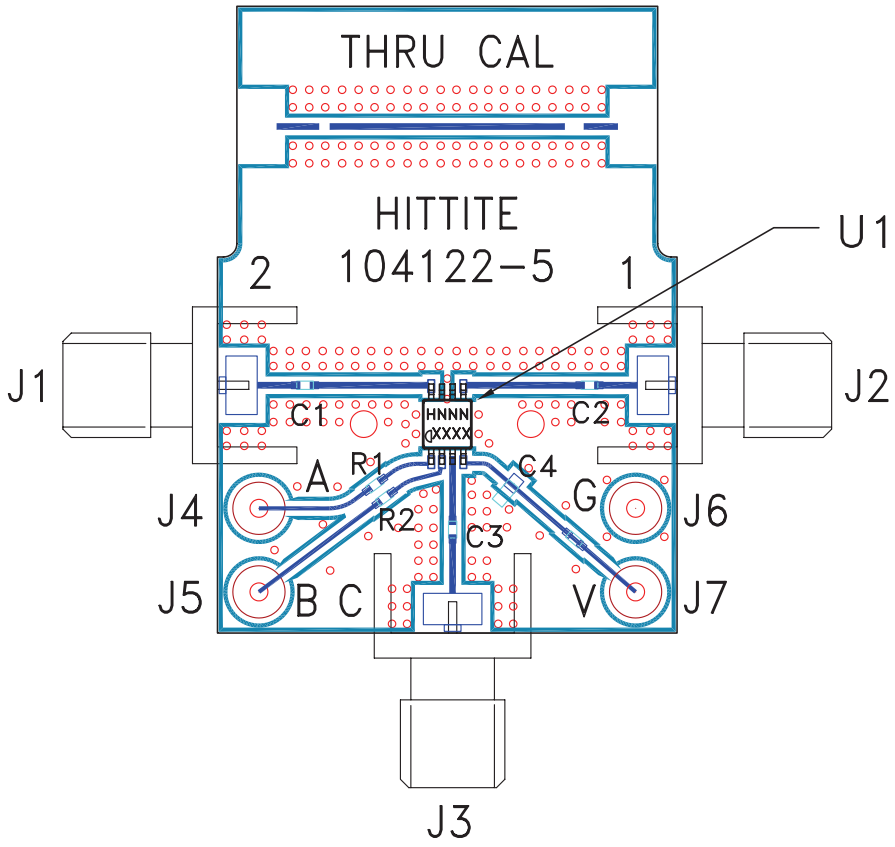
## Typical Application Circuit




**Notes:**

1. Set logic gate and switch Vdd = +3V to +5V and use HCT series logic to provide a TTL driver interface.
2. Control inputs A/B can be driven directly with CMOS logic (HC) with Vdd of 3 to 8 Volts applied to the CMOS logic gates and to pin 4 of the RF switch.
3. DC Blocking capacitors are required for each RF port as shown. Capacitor value determines lowest frequency of operation.
4. Highest RF signal power capability is achieved with V set to +10V. The switch will operate properly (but at lower RF power capability) at bias voltages down to +3V.

## Evaluation Circuit Board




## List of Materials for Evaluation PCB 104124 [1]

| Item | Description |
|---|---|
| J1 - J3 | PCB Mount SMA RF Connector |
| J4 - J7 | DC Pin |
| C1 - C3 | 100 pF capacitor, 0402 Pkg. |
| C4 | 10,000 pF capacitor, 0603 Pkg. |
| U1 | HMC174MS8 / HMC174MS8E T/R Switch |
| PCB [2] | 104122 Evaluation PCB |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

The circuit board used in the final application should be generated with proper RF circuit design techniques. Signal lines at the RF port should have 50 ohm impedance and the package ground leads and package bottom should be connected directly to the ground plane similar to that shown above. The evaluation circuit board shown above is available from Hittite Microwave Corporation upon request.