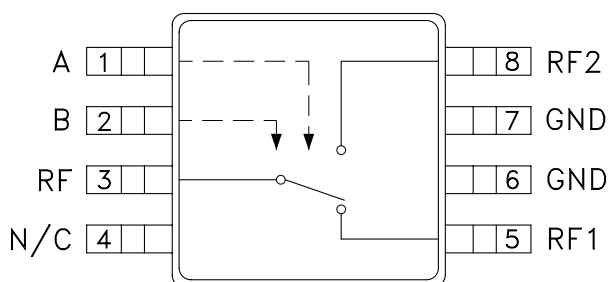


### Typical Applications

The HMC194MS8 is ideal for:

- Cellular/PCS Base Stations
- Portable Wireless
- MMDS & WirelessLAN

### Functional Diagram



### Features

Ultra Small Package: MSOP8

High Isolation: 50 dB

Positive Control: 0/+3V to 0/+7V

### General Description

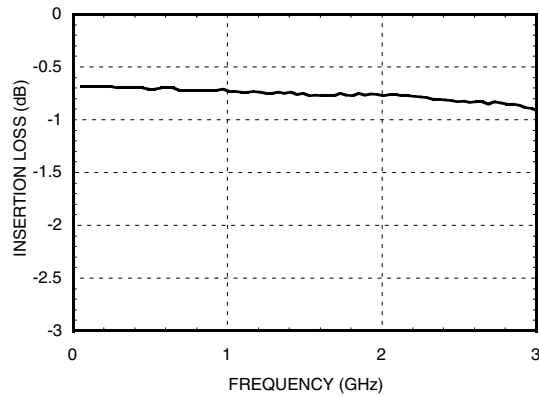
The HMC194MS8 is a low-cost SPDT switch in an 8-lead MSOP package for use in applications which require high isolation between two RF paths. The device can control signals from DC to 3 GHz and has been optimized to provide extremely high isolation with minimal insertion loss in medium and low power applications. On chip circuitry allows positive voltage control operation at very low DC currents with control inputs compatible with CMOS and most TTL logic families. RF1 and RF2 are reflective opens when "OFF".

### Electrical Specifications, $T_A = +25^\circ\text{C}$ , $V_{ctl} = 0/+5\text{ Vdc}$ , 50 Ohm System

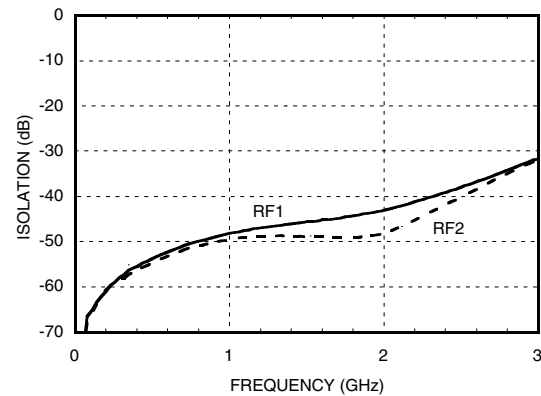
| Parameter                                                                                      | Frequency     | Min.    | Typ.    | Max. | Units |
|------------------------------------------------------------------------------------------------|---------------|---------|---------|------|-------|
| Insertion Loss                                                                                 | DC - 1.0 GHz  |         | 0.7     | 0.9  | dB    |
|                                                                                                | DC - 2.0 GHz  |         | 0.7     | 0.9  | dB    |
|                                                                                                | DC - 2.5 GHz  |         | 0.8     | 1.1  | dB    |
|                                                                                                | DC - 3.0 GHz  |         | 0.9     | 1.4  | dB    |
| Isolation<br>RF1 / RF2<br>RF1 / RF2                                                            | DC - 1.0 GHz  | 45 / 47 | 49 / 51 |      | dB    |
|                                                                                                | DC - 2.0 GHz  | 39 / 43 | 42 / 46 |      | dB    |
|                                                                                                | DC - 2.5 GHz  | 31      | 35      |      | dB    |
|                                                                                                | DC - 3.0 GHz  | 24      | 28      |      | dB    |
| Return Loss                                                                                    | DC - 1.0 GHz  | 18      | 21      |      | dB    |
|                                                                                                | DC - 2.0 GHz  | 14      | 17      |      | dB    |
|                                                                                                | DC - 2.5 GHz  | 13      | 17      |      | dB    |
|                                                                                                | DC - 3.0 GHz  | 13      | 17      |      | dB    |
| Input Power for 1 dB Compression<br>0/+5V Control                                              | 0.5 - 1.0 GHz | 19      | 23      |      | dBm   |
|                                                                                                | 0.5 - 3.0 GHz | 17      | 21      |      | dBm   |
| Input Third Order Intercept<br>(Two-tone Input Power = +7 dBm Each Tone)<br>0/+5V Control      | 0.5 - 1.0 GHz | 39      | 43      |      | dBm   |
|                                                                                                | 0.5 - 3.0 GHz | 37      | 41      |      | dBm   |
| Switching Characteristics<br><br>tRISE, tFALL (10/90% RF)<br>tON , tOFF (50% CTL to 10/90% RF) | DC - 3.0 GHz  |         | 10      |      | ns    |
|                                                                                                |               |         | 24      |      | ns    |

## GaAs MMIC SPDT SWITCH DC - 3 GHz

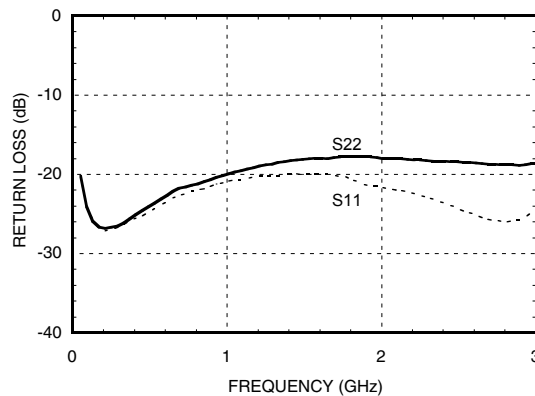
**Insertion Loss**



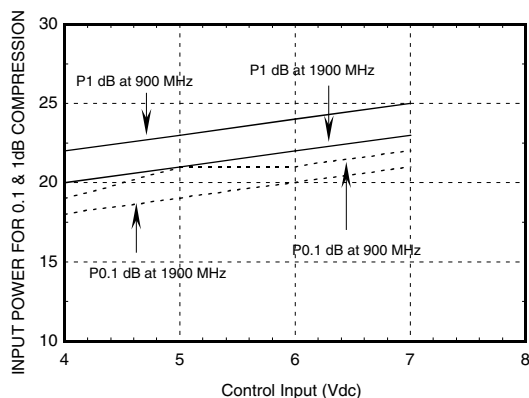
**Isolation**



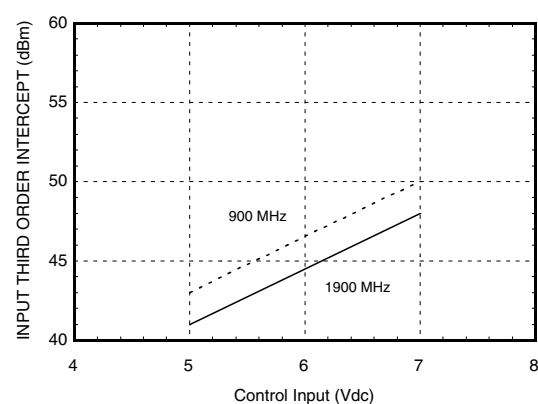
**Return Loss**



**Input 0.1 and 1.0 dB  
Compression vs. Control Voltage**



**Input Third Order  
Intercept Point vs. Control Voltage**



## GaAs MMIC SPDT SWITCH DC - 3 GHz

### Compression vs. Control Voltage

| Bias<br>V <sub>dd</sub> | Carrier at 900 MHz                       |                                          | Carrier at 1900 MHz                      |                                          |
|-------------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|
|                         | Input Power<br>for 0.1 dB<br>Compression | Input Power<br>for 1.0 dB<br>Compression | Input Power<br>for 0.1 dB<br>Compression | Input Power<br>for 1.0 dB<br>Compression |
| (V <sub>dc</sub> )      | (dBm)                                    | (dBm)                                    | (dBm)                                    | (dBm)                                    |
| +4                      | 19                                       | 22                                       | 18                                       | 20                                       |
| +5                      | 21                                       | 23                                       | 19                                       | 21                                       |
| +6                      | 21                                       | 24                                       | 20                                       | 22                                       |
| +7                      | 22                                       | 25                                       | 21                                       | 23                                       |

Caution: Do not operate in 1dB compression at power levels above +25 dBm and do not "hot switch" power levels greater than +18 dBm (Control = 0/+5V<sub>dc</sub>).

DC blocks are required at ports RFC, RF1 and RF2.

### Distortion vs. Control Voltage

| Control Input<br>(V <sub>dc</sub> ) | Third Order Intercept (dBm)<br>+7 dBm Each Tone |          |
|-------------------------------------|-------------------------------------------------|----------|
|                                     | 900 MHz                                         | 1900 MHz |
| +5                                  | 43                                              | 41       |
| +7                                  | 50                                              | 48       |

### Truth Table

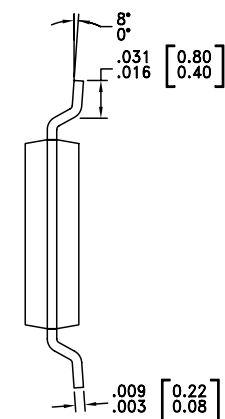
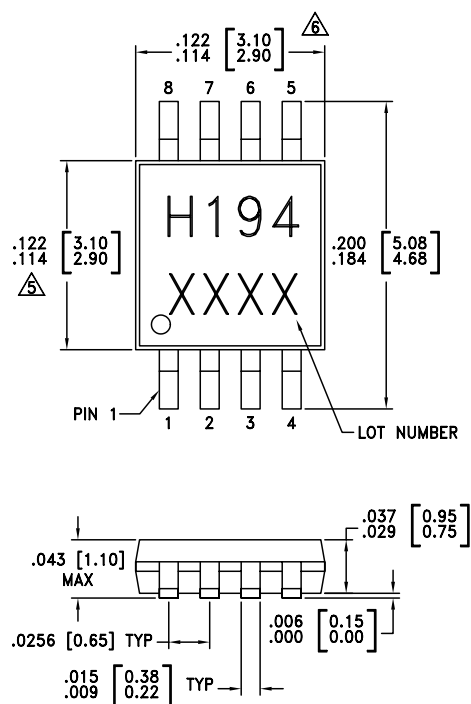
\*Control Input Voltage Tolerances are  $\pm 0.2$  V<sub>dc</sub>.

| Control Input*          |                         | Control Current              |                              | Signal Path State |              |
|-------------------------|-------------------------|------------------------------|------------------------------|-------------------|--------------|
| A<br>(V <sub>dc</sub> ) | B<br>(V <sub>dc</sub> ) | I <sub>a</sub><br>( $\mu$ A) | I <sub>b</sub><br>( $\mu$ A) | RF to<br>RF1      | RF to<br>RF2 |
| 0                       | +3                      | -23                          | +23                          | ON                | OFF          |
| +3                      | 0                       | +23                          | -23                          | OFF               | ON           |
| 0                       | +5                      | -95                          | +95                          | ON                | OFF          |
| +5                      | 0                       | +95                          | -95                          | OFF               | ON           |
| 0                       | +7                      | -190                         | +190                         | ON                | OFF          |
| +7                      | 0                       | +190                         | -190                         | OFF               | ON           |

### Absolute Maximum Ratings

|                               |                  |
|-------------------------------|------------------|
| Control Voltage Range (A & B) | -0.2 to +7.5 Vdc |
| Storage Temperature           | -65 to +150 °C   |
| Operating Temperature         | -40 to +85 °C    |

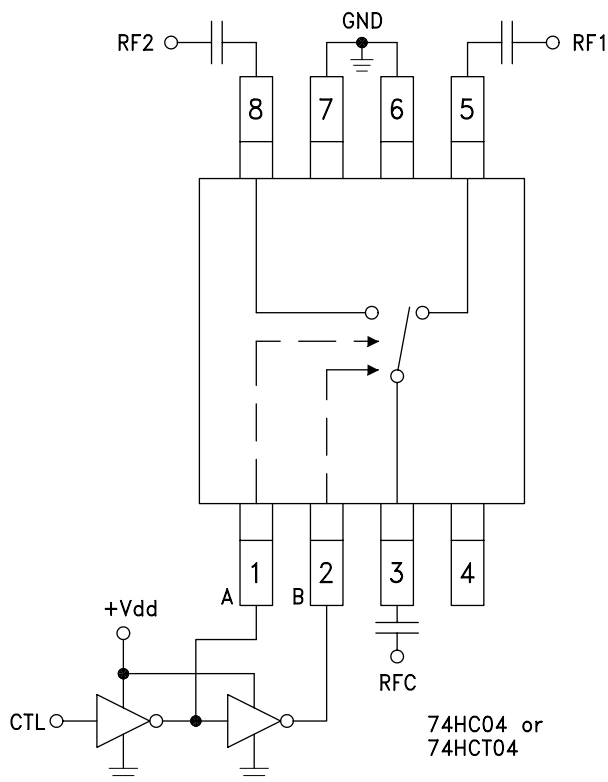
### Outline Drawing



#### NOTES:

1. PACKAGE BODY MATERIAL: LOW STRESS INJECTION MOLDED PLASTIC SILICA AND SILICON IMPREGNATED.
2. LEADFRAME MATERIAL: COPPER ALLOY
3. LEADFRAME PLATING: Sn/Pb SOLDER
4. DIMENSIONS ARE IN INCHES [MILLIMETERS].
5. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE.
6. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.25mm PER SIDE.
7. ALL GROUND LEADS MUST BE SOLDERED TO PCB RF GROUND.

### Typical Application Circuit

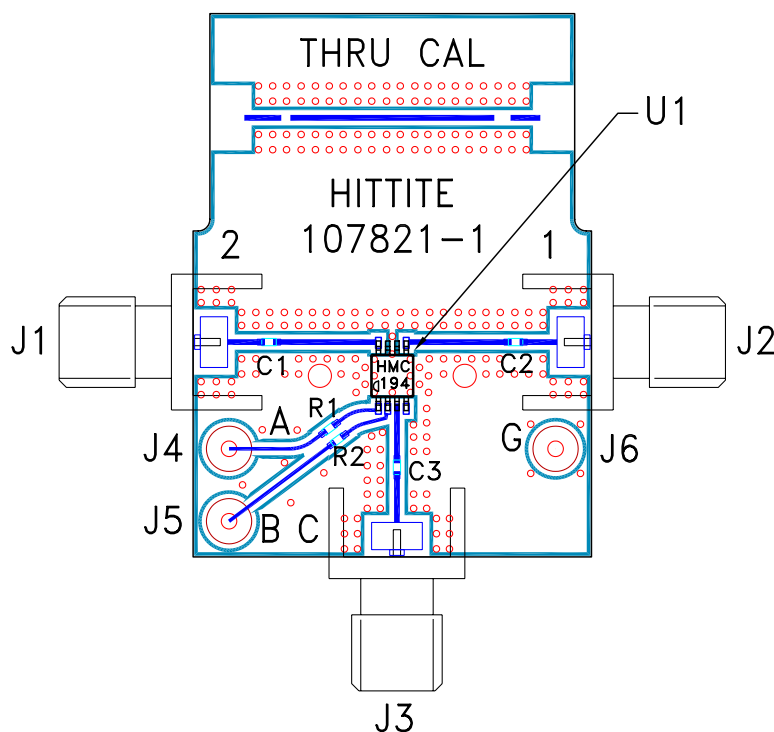


#### Notes:

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 7 Volts applied to the CMOS logic gates.
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 Control set to 0/+7V.

**See “Design Techniques Enhance Isolation in Switch Assemblies”  
for HMC194MS8 Applications, “Application Notes” Section.**

### Evaluation Circuit Board



### List of Material

| Item                                  | Description                      |
|---------------------------------------|----------------------------------|
| J1 - J3                               | PC Mount SMA RF Connector        |
| J4 - J6                               | DC Pin                           |
| C1 - C3                               | 100 pF capacitor, 0402 Pkg.      |
| R1, R2                                | 100 $\Omega$ resistor, 0402 Pkg. |
| U1                                    | HMC194MS8 SPDT Switch            |
| PCB*                                  | 107821 Evaluation PCB            |
| * 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 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.