

## GaAs MMIC SOT26 SPDT SWITCH DC - 3 GHz

FEBRUARY 2001

v01.0700

### Features

LOW INSERTION LOSS: 0.4 dB

ULTRA SMALL PACKAGE: SOT26

INPUT IP3: +45 dBm

POSITIVE CONTROL: 0/+3V @ 10  $\mu$ A

### General Description

The HMC197 is a low-cost SPDT switch in a 6-lead SOT26 plastic package for use in general switching applications which require very low insertion loss and very small size. The device can control signals from DC to 3.0 GHz and is especially suited for 900 MHz, 1.8-2.2GHz, and 2.4GHz ISM applications with less than 1dB loss. The design provides exceptional insertion loss performance, ideal for filter and receiver switching. RF1 or RF2 is a reflective short when "Off". The two control voltages require a minimal amount of DC current and offer compatibility with most CMOS & TTL logic families. The HMC197 is especially suited for PCMCIA wireless card and cellular phone applications. See HMC221 for same performance in an alternate SOT26 pin-out.



### Guaranteed Performance $V_{ctl} = 0/+3$ to $+8 V_{dc}$ , $-40$ to $+85$ deg C

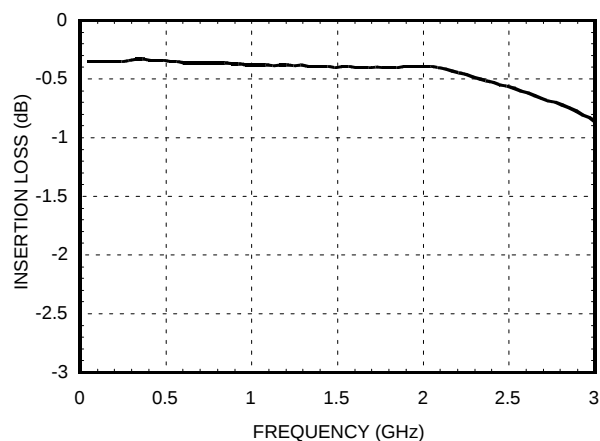
| Parameter                                                                                 | Frequency     | Min. | Typ. | Max. | Units |
|-------------------------------------------------------------------------------------------|---------------|------|------|------|-------|
| Insertion Loss                                                                            | DC - 1.0 GHz  |      | 0.4  | 0.7  | dB    |
|                                                                                           | DC - 2.0 GHz  |      | 0.45 | 0.8  | dB    |
|                                                                                           | DC - 2.5 GHz  |      | 0.7  | 0.9  | dB    |
|                                                                                           | DC - 3.0 GHz  |      | 0.8  | 1.1  | dB    |
| Isolation                                                                                 | DC - 1.0 GHz  | 24   | 28   |      | dB    |
|                                                                                           | DC - 2.0 GHz  | 24   | 28   |      | dB    |
|                                                                                           | DC - 2.5 GHz  | 18   | 22   |      | dB    |
|                                                                                           | DC - 3.0 GHz  | 14   | 18   |      | dB    |
| Return Loss                                                                               | DC - 1.0 GHz  | 20   | 30   |      | dB    |
|                                                                                           | DC - 2.0 GHz  | 16   | 22   |      | dB    |
|                                                                                           | DC - 2.5 GHz  | 14   | 17   |      | dB    |
|                                                                                           | DC - 3.0 GHz  | 10   | 13   |      | dB    |
| Input Power for 1dB Compression<br>( $V_{ctl} = 0/+5V$ )                                  | 0.5 - 1.0 GHz | 25   | 30   |      | dBm   |
|                                                                                           | 0.5 - 3.0 GHz | 23   | 29   |      | dBm   |
| Input Third Order Intercept<br>( $V_{ctl} = 0/+5V$ , +7 dBm each tone)                    | 0.5 - 1.0 GHz | 40   | 45   |      | dBm   |
|                                                                                           | 0.5 - 3.0 GHz | 38   | 43   |      | dBm   |
| Switching Characteristics<br>tRISE, tFALL (10/90% RF)<br>tON, tOFF (50% CTL to 10/90% RF) | DC - 3.0 GHz  |      | 3    |      | nS    |
|                                                                                           |               |      | 10   |      | nS    |

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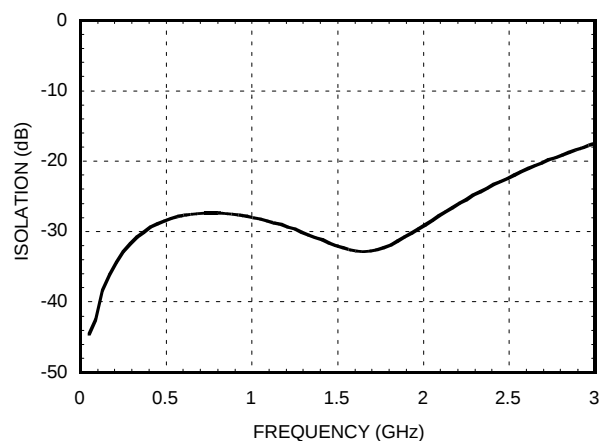
v01.0700

FEBRUARY 2001

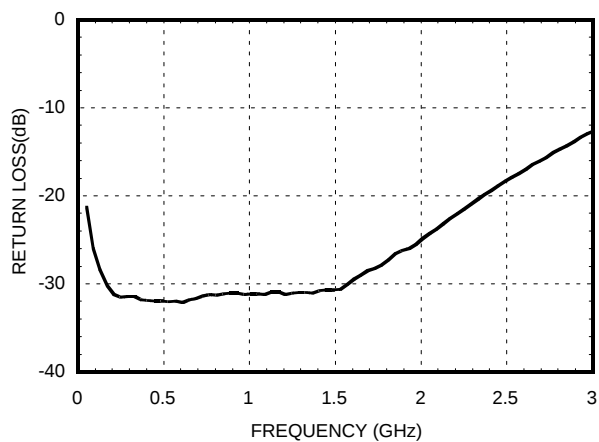
### Insertion Loss



### Isolation



### Return Loss



7

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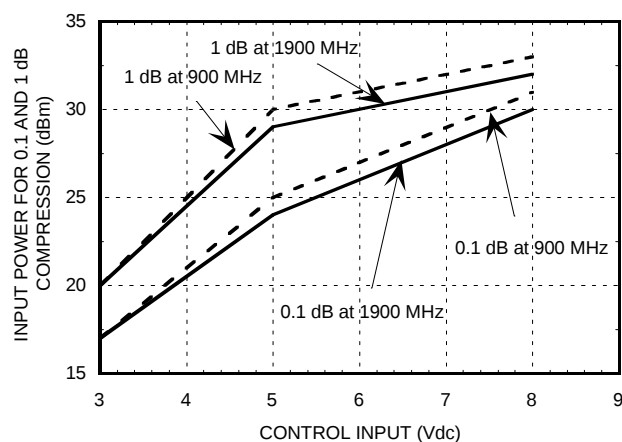


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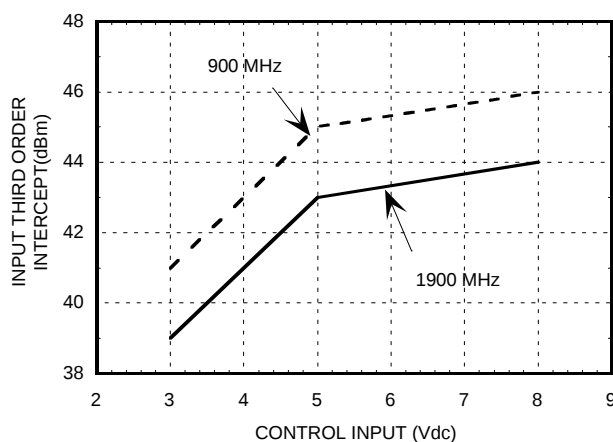
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### Input 0.1 and 1.0 dB Compression vs Control Voltage



### Input Third Order Intercept vs Control Voltage



7

### Compression vs Control Voltage

| Control Input<br>(Vdc) | Carrier at 900MHz                       |                                       | Carrier at 1900MHz                      |                                       |
|------------------------|-----------------------------------------|---------------------------------------|-----------------------------------------|---------------------------------------|
|                        | Input Power for 0.1dB Compression (dBm) | Input Power for 1dB Compression (dBm) | Input Power for 0.1dB Compression (dBm) | Input Power for 1dB Compression (dBm) |
| +3                     | 17                                      | 20                                    | 17                                      | 20                                    |
| +5                     | 25                                      | 30                                    | 24                                      | 29                                    |
| +8                     | 31                                      | 33                                    | 30                                      | 32                                    |

### Distortion vs Control Voltage

| Control Input<br>(Vdc) | Third Order Intercept (dBm)<br>+7 dBm Each Tone |          |
|------------------------|-------------------------------------------------|----------|
|                        | 900 MHz                                         | 1900 MHz |
| +3                     | 41                                              | 39       |
| +5                     | 45                                              | 43       |
| +8                     | 46                                              | 44       |

Caution: Do not operate in 1dB compression at power levels above +31 dBm (  $V_{ctl} = +5$  Vdc) and do not 'hot switch' power levels greater than +20 dBm (  $V_{CTL} = +5$  Vdc).

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

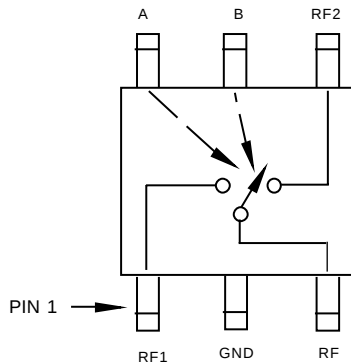


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v01.0700

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### Functional Diagram



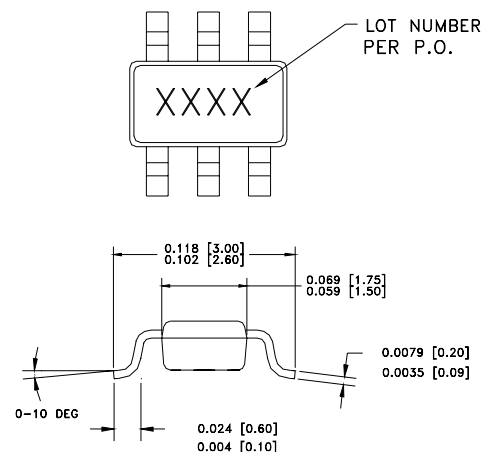
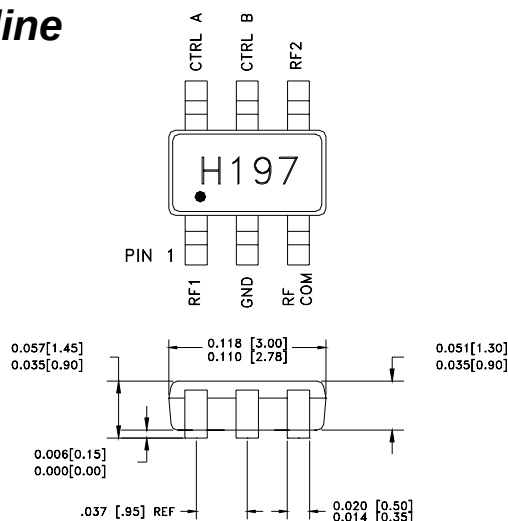
### Absolute Maximum Ratings

|                               |                    |
|-------------------------------|--------------------|
| Control Voltage Range (A & B) | -0.2 to +12Vdc     |
| Storage Temperature           | -65 to +150 deg. C |
| Operating Temperature         | -40 to +85 deg. C  |

### Truth Table \*Control Input Tolerances are +/- 0.2 Vdc

| Control Input * |         | Control Current |         | Signal Path |           |
|-----------------|---------|-----------------|---------|-------------|-----------|
| A (Vdc)         | B (Vdc) | Ia (uA)         | Ib (uA) | RF to RF1   | RF to RF2 |
| 0               | +3      | -10             | 10      | On          | Off       |
| +3              | 0       | 10              | -10     | Off         | On        |
| 0               | +5      | -55             | 55      | On          | Off       |
| +5              | 0       | 55              | -55     | Off         | On        |
| 0               | +7      | -210            | 210     | On          | Off       |
| +7              | 0       | 210             | -210    | Off         | On        |
| 0               | +8      | -280            | 280     | On          | Off       |
| +8              | 0       | 280             | -280    | Off         | On        |

### Outline



- 1) MATERIAL:  
A) PACKAGE BODY: LOW STRESS INJECTION MOLDED PLASTIC, SILICA & SILICONE IMPREGNATED  
B) LEADFRAME MATERIAL: COPPER ALLOY
2. PLATING: LEAD-TIN SOLDER PLATE
3. DIMENSIONS ARE IN INCHES (MILLIMETERS)  
UNLESS OTHERWISE SPECIFIED TOL. ARE  $\pm 0.005$  ( $\pm 0.13$ )

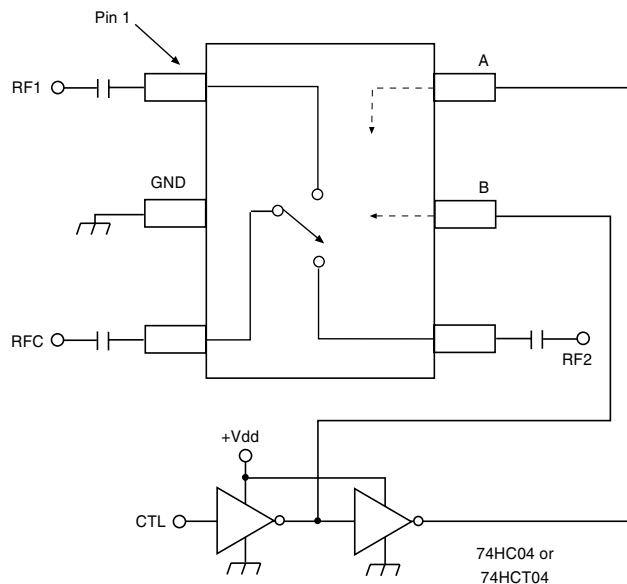


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### Typical Application Circuit



#### 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 5 to 8 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 Vdd = +8V and A/B set to 0/+8V.

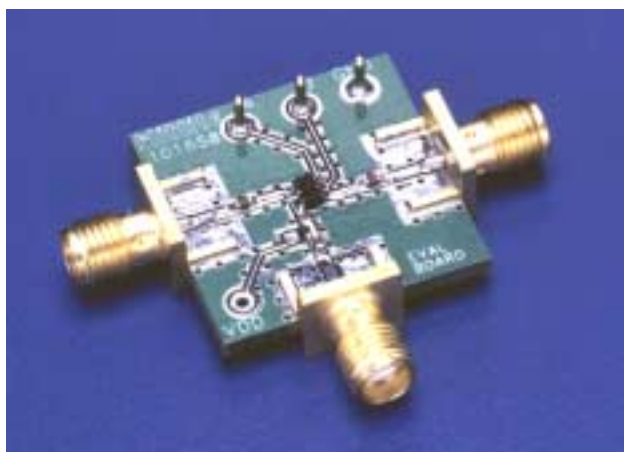


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### *Evaluation Circuit Board*



The circuit board used in the final application should use RF circuit design techniques. Signal lines should have 50 ohm impedance while the package ground leads should be connected directly to the ground plane similar to that shown below. A sufficient number of VIA holes should be used to connect the top and bottom ground planes. The evaluation circuit board as shown is available from Hittite upon request.

### *Evaluation Circuit Board Layout Design Details*

|                          |                                       |
|--------------------------|---------------------------------------|
| Layout Technique         | Grounded Co-Planar Waveguide (GCPW)   |
| Material                 | FR4                                   |
| Dielectric Thickness     | 0.028" (0.71 mm)                      |
| 50 Ohm Line Width        | 0.037" (0.94 mm)                      |
| Gap to Ground Edge       | 0.010" (0.25 mm)                      |
| Ground VIA Hole Diameter | 0.014" (0.36 mm)                      |
| Connectors               | SMA-F (EF - Johnson P/N 142-0701-806) |

7

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