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## GaAs MMIC SPDT NON-REFLECTIVE SWITCH, DC - 12 GHz



### Typical Applications

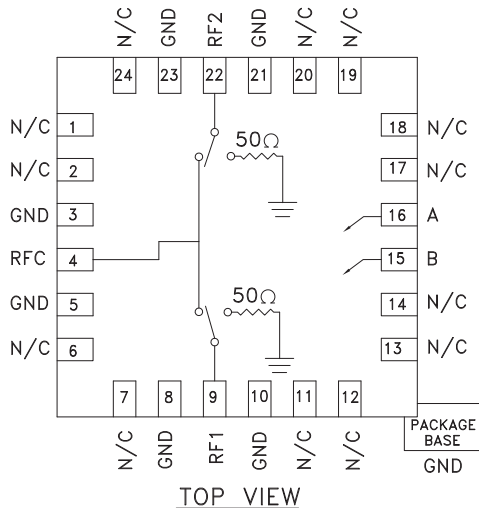
The HMC232LP4(E) is ideal for:

- Telecom Infrastructure
- Microwave Radio & VSAT
- Military Radios, Radar & ECM
- Test Instrumentation

### Features

- Isolation: 60 dB @ 3 GHz  
52 dB @ 6 GHz
- Input P1dB: +27 dBm
- Insertion Loss: 1.5 dB Typical @ 6 GHz
- Non-Reflective Design
- 24 Lead 4x4mm QFN Package: 16mm<sup>2</sup>
- Included in the HMC-DK005 Designer's Kit

### Functional Diagram



### General Description

The HMC232LP4(E) is a broadband high isolation non-reflective GaAs MESFET SPDT switch in a low cost leadless QFN surface mount plastic package. Covering DC to 12 GHz, the switch features >60 dB isolation up to 3 GHz and >42 dB isolation up to 12 GHz. Input P1dB compression is +27 dBm typical, while input IP3 is +50 dBm. The switch operates using complementary negative control voltage logic lines of -5/0V and requires no bias supply.

### Electrical Specifications, $T_A = +25^\circ C$ , With 0/-5V Control, 50 Ohm System

| Parameter  | Frequency      | Min.          | Typ. | Max. | Units |
|--|----------------|---------------|------|------|-------|
| Insertion Loss   | DC - 3.0 GHz   |               | 1.4  | 1.7  | dB    |
|  | DC - 6.0 GHz   |               | 1.5  | 1.8  | dB    |
|  | DC - 9.0 GHz   |               | 2.0  | 2.3  | dB    |
|  | DC - 12.0 GHz  |               | 2.7  | 3.1  | dB    |
| Isolation  | DC - 3.0 GHz   | 55            | 60   |      | dB    |
|  | DC - 6.0 GHz   | 47            | 52   |      | dB    |
|  | DC - 9.0 GHz   | 40            | 45   |      | dB    |
|  | DC - 12.0 GHz  | 37            | 42   |      | dB    |
| Return Loss  | "On State"     | DC - 6.0 GHz  |      | 18   | dB    |
|  |                | DC - 9.0 GHz  |      | 16   | dB    |
|  |                | DC - 12.0 GHz |      | 11   | dB    |
| Return Loss RF1, RF2   | "Off State"    | DC - 12.0 GHz |      | 14   | dB    |
| Input Power for 1 dB Compression   | 0.5 - 12.0 GHz | 24            | 27   |      | dBm   |
| Input Third Order Intercept<br>(Two-Tone Input Power= +7 dBm Each Tone, 1 MHz Tone Separation) | 0.5 - 12.0 GHz | 45            | 50   |      | dBm   |
| Switching Characteristics<br>tRISE, tFALL (10/90% RF)<br>tON, tOFF (50% CTL to 10/90% RF)      | DC - 12.0 GHz  |               | 3    |      | ns    |
|  |                |               | 6    |      | ns    |

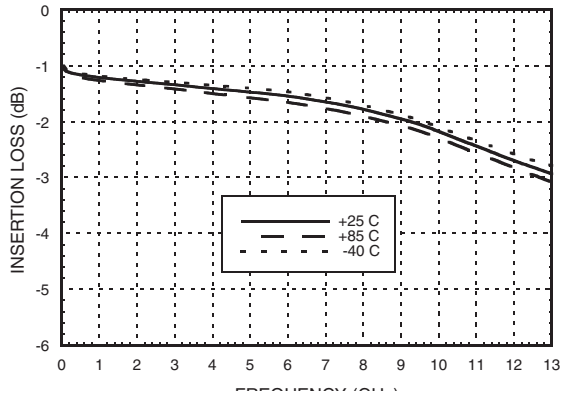
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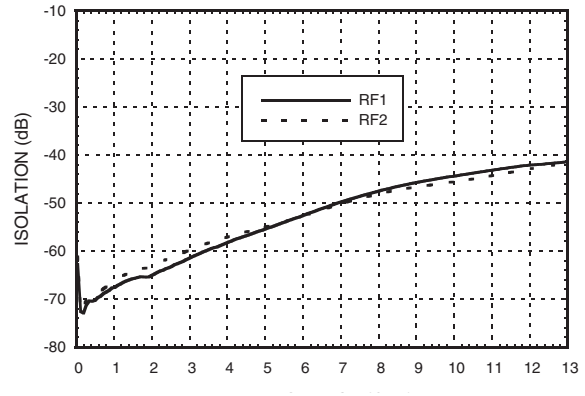
**GaAs MMIC SPDT NON-REFLECTIVE SWITCH, DC - 12 GHz**



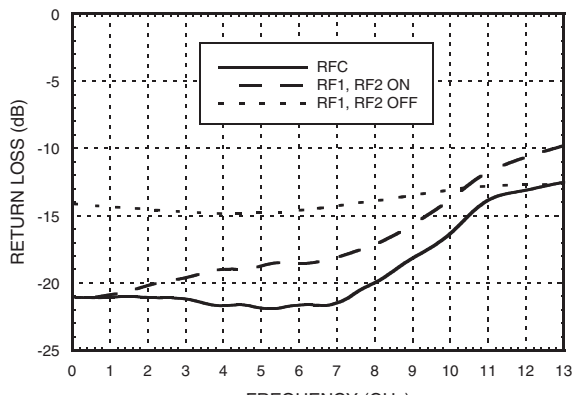
**Insertion Loss**



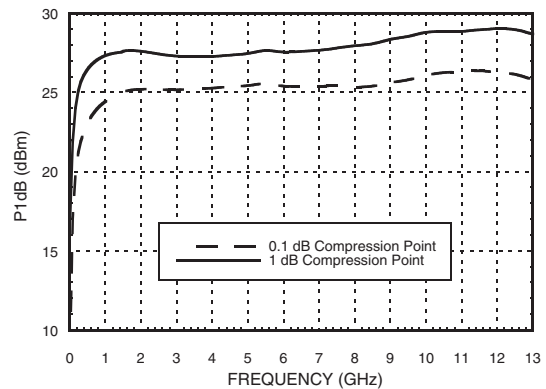
**Isolation**



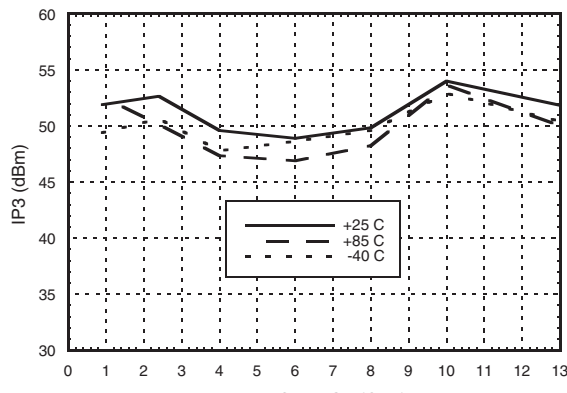
**Return Loss**



**0.1 and 1 dB Input Compression Point**



**Input Third Order Intercept Point**



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## GaAs MMIC SPDT NON-REFLECTIVE SWITCH, DC - 12 GHz



### Absolute Maximum Ratings

|   |                    |
|---|--------------------|
| RF Input Power (Vctl = -5V)<br>(0.5 - 12 GHz)               | +30 dBm (@ +50 °C) |
| RF1, RF2 Termination  | +23.5 dBm          |
| Control Voltage Range (A & B)                               | +1V to -7.5V       |
| Channel Temperature   | 150 °C             |
| Thermal Resistance (R <sub>TH</sub> )<br>(junction to lead) | 94 °C/W            |
| Storage Temperature   | -65 to +150 °C     |
| Operating Temperature                                       | -40 to +85 °C      |
| ESD Sensitivity (HBM)                                       | Class 1A           |

### Control Voltages

| State | Bias Condition                                  |
|-------|---|
| Low   | 0 to -0.2V @ 10 uA Max.                         |
| High  | -5V @ 10 uA Typ. to -7V @ 45 uA Typ. (±0.5 Vdc) |

### Truth Table

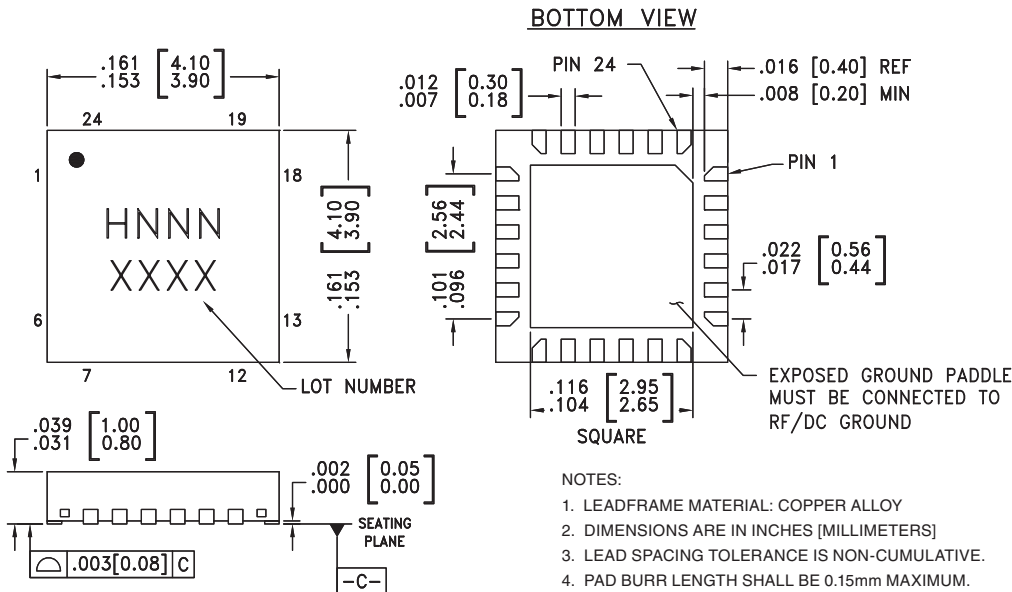
| Control Input |      | Signal Path State |            |
|---------------|------|-------------------|------------|
| A             | B    | RFC to RF1        | RFC to RF2 |
| High          | Low  | ON                | OFF        |
| Low           | High | OFF               | ON         |

Caution: Do not "Hot Switch" power levels greater than +27 dBm (Vctl = 0/-5 Vdc).



**ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS**

### Outline Drawing



### Package Information

| Part Number | Package Body Material                              | Lead Finish   | MSL Rating          | Package Marking <sup>[3]</sup> |
|-------------|--|---------------|---------------------|--------------------------------|
| HMC232LP4   | Low Stress Injection Molded Plastic                | Sn/Pb Solder  | MSL1 <sup>[1]</sup> | H232<br>XXXX                   |
| HMC232LP4E  | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 <sup>[2]</sup> | <u>H232</u><br>XXXX            |

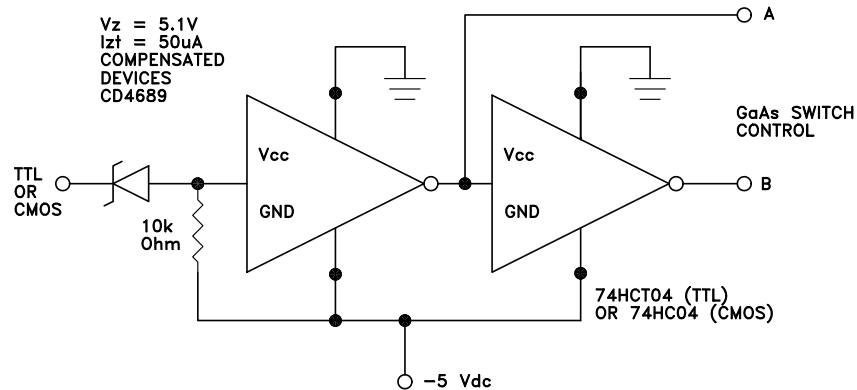
[1] Max peak reflow temperature of 235 °C

[2] Max peak reflow temperature of 260 °C

[3] 4-Digit lot number XXXX



**Suggested Driver Circuit**

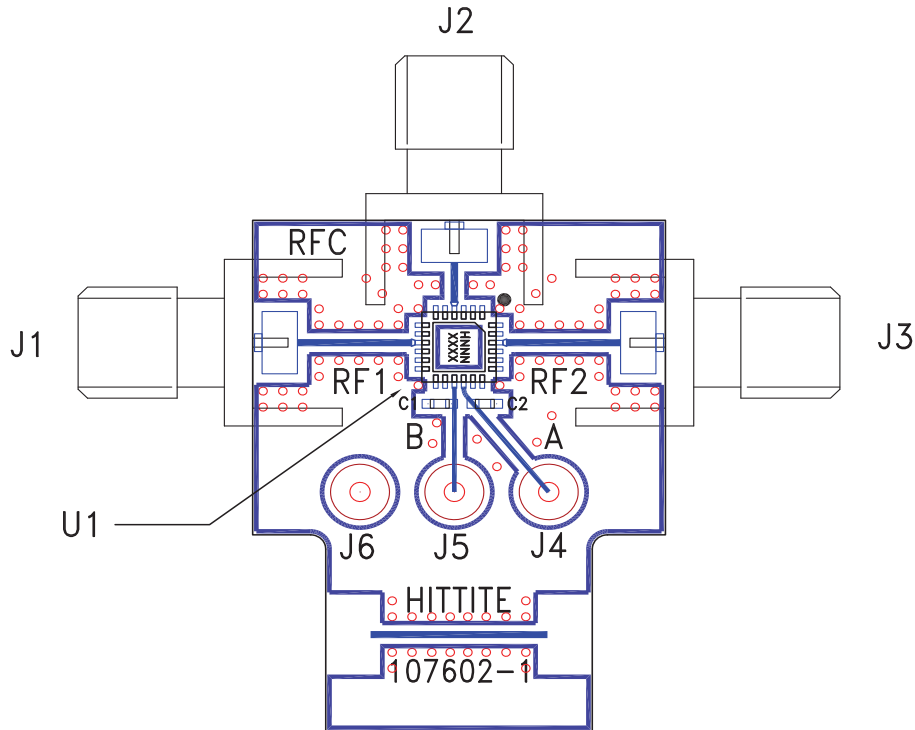


**Pin Descriptions**

| Pin Number                                     | Function      | Description  | Interface Schematic |
|--|---------------|--|---------------------|
| 1, 2, 6, 7, 11, 12, 13, 14, 17, 18, 19, 20, 24 | N/C           | The pins are not connected internally; however, all data shown herein was measured with these pins connected to RF/DC ground externally. |                     |
| 3, 5, 8, 10, 21, 23                            | GND           | Package bottom must also be connected to PCB RF ground.  |                     |
| 4, 9, 22                                       | RFC, RF1, RF2 | This pin is DC coupled and matched to 50 Ohm. Blocking capacitors are required if RF line potential is not equal to 0V.                  |                     |
| 15   | B             | See truth table and control voltage table.   |                     |
| 16   | A             | See truth table and control voltage table.   |                     |



**Evaluation PCB**



**List of Materials for Evaluation PCB 107723 [1]**

| Item    | Description                        |
|---------|------------------------------------|
| J1 - J3 | PCB Mount SMA RF Connector         |
| J4 - J6 | DC Pin                             |
| C1, C2  | 100 pF Capacitor, 0603 Pkg.        |
| U1      | HMC232LP4 / HMC232LP4E SPDT Switch |
| PCB [2] | 107602 Evaluation PCB              |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

The circuit board used in the 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.



v04.0110

**HMC232LP4 / 232LP4E****GaAs MMIC SPDT NON-REFLECTIVE  
SWITCH, DC - 12 GHz****Notes:****11****SWITCHES - SPDT - SMT**