

# Analog Devices Welcomes Hittite Microwave Corporation

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## GaAs MMIC SP4T NON-REFLECTIVE SWITCH, DC - 20 GHz

### Typical Applications

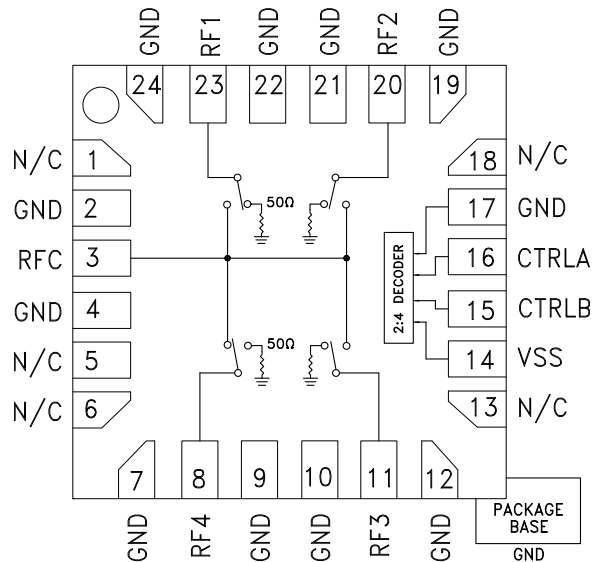
The HMC641LP4E is ideal for:

- Telecom Infrastructure
- Microwave Radio & VSAT
- Military & Space Hybrids
- Test Instrumentation
- SATCOM & Sensors

### Features

- Broadband Performance: DC - 20 GHz
- High Isolation: 45 dB @ 10 GHz
- Low Insertion Loss: 2.3 dB @ 10 GHz
- Integrated 2:4 TTL Decoder
- 24 Lead 4x4 mm SMT Package: 16 mm<sup>2</sup>

### Functional Diagram

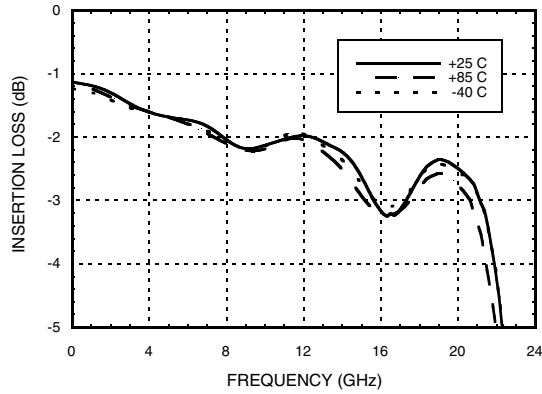
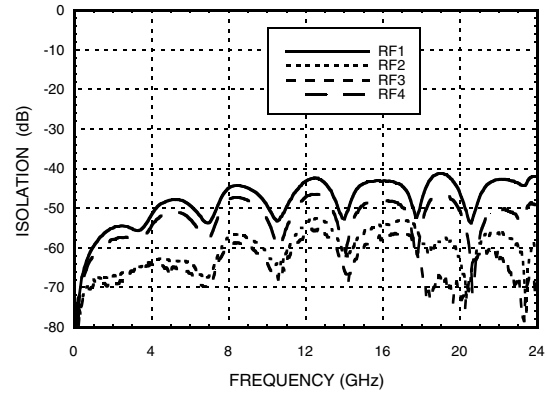
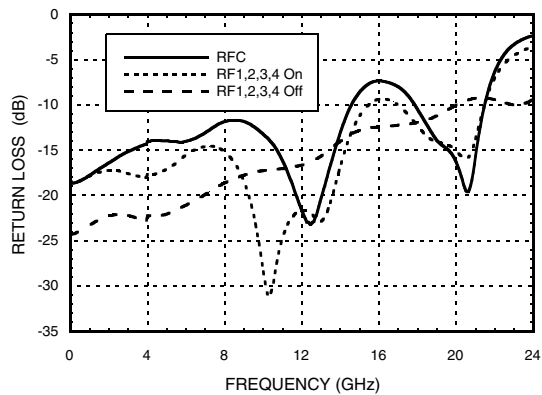
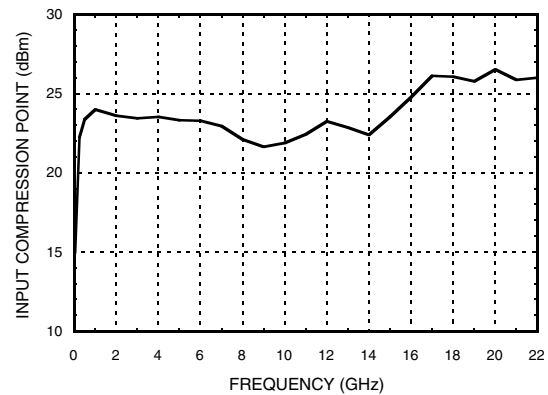
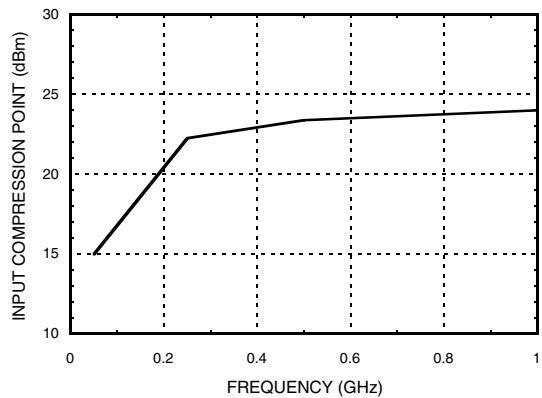
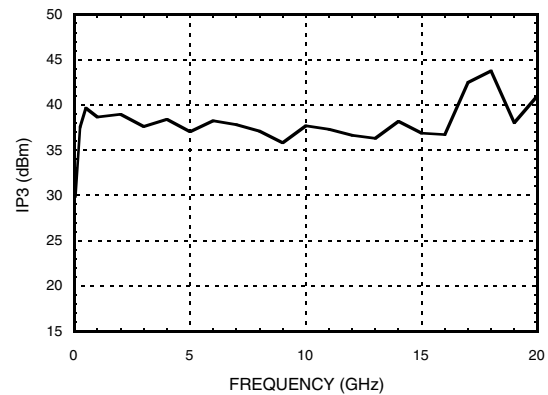


### General Description

The HMC641LP4E is a broadband non-reflective GaAs pHEMT SP4T switch in a compact 4x4 mm plastic package. Covering DC to 20 GHz, this switch offers high isolation, low insertion loss and on-chip termination of isolated ports. This switch also includes an on board binary decoder circuit which reduces the number of required logic control lines from four to two. The HMC641LP4E is controlled with 0/ -5V logic, exhibits fast switching speed and consumes much less DC current than pin diode based solutions. The HMC641LP4E is also available in die form as the HMC641.

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

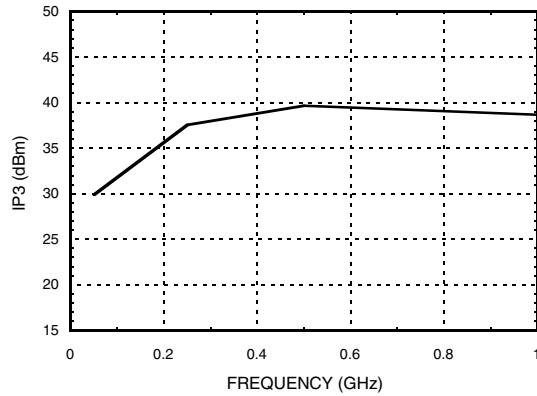
| Parameter   | Frequency       | Min.        | Typ. | Max. | Units |
|---|-----------------|-------------|------|------|-------|
| Insertion Loss  | DC - 12 GHz     |             | 2.0  | 3.2  | dB    |
|   | DC - 20 GHz     |             | 3.0  | 4.2  | dB    |
| Isolation (RFC to RF1 - RF4)  | DC - 12 GHz     | 30          | 42   |      | dB    |
|   | DC - 20 GHz     | 30          | 40   |      | dB    |
| Return Loss   | "On State"      | DC - 12 GHz | 18   |      | dB    |
|   |                 | DC - 20 GHz | 17   |      | dB    |
| Return Loss   | "Off State"     | DC - 20 GHz | 13   |      | dB    |
| Input Power for 1 dB Compression  | 0.05 - 0.25 GHz | 10          | 15   |      | dBm   |
|   | 0.25 - 20 GHz   | 20          | 22   |      | dBm   |
| Input Third Order Intercept<br>(Two-Tone Input Power= +14 dBm Each Tone)                  | 0.05 - 0.25 GHz |             | 30   |      | dBm   |
|   | 0.25 - 20 GHz   |             | 38   |      | dBm   |
| Switching Characteristics<br>tRISE, tFALL (10/90% RF)<br>tON, tOFF (50% CTL to 10/90% RF) | DC - 20 GHz     |             | 15   |      | ns    |
|   |                 |             | 88   |      | ns    |


**GaAs MMIC SP4T NON-REFLECTIVE SWITCH, DC - 20 GHz**
**Insertion Loss vs. Temperature**

**Isolation**

**Return Loss**

**1 dB Input Compression Point**

**1 dB Input Compression Point (Low Frequency Detail)**

**Input Third Order Intercept Point @ 0 dBm Tone Power**




## GaAs MMIC SP4T NON-REFLECTIVE SWITCH, DC - 20 GHz

### Input Third Order Intercept (Low Frequency Detail)



### Absolute Maximum Ratings

|   |                |
|---|----------------|
| Bias Voltage (Vss)  | -7V            |
| Control Voltage Range (CTRLA & CTRLB)                             | Vss -1V to +1V |
| Maximum Input Power   | +24 dBm        |
| Channel Temperature   | 150 °C         |
| Thermal Resistance Channel to ground paddle (Insertion Loss Path) | 199 °C/W       |
| Thermal Resistance Channel to ground paddle (Terminated Path)     | 219 °C/W       |
| Storage Temperature   | -65 to +150 °C |
| Operating Temperature   | -40 to +85 °C  |
| ESD Sensitivity (HBM)   | Class 1A       |



ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS

### Truth Table

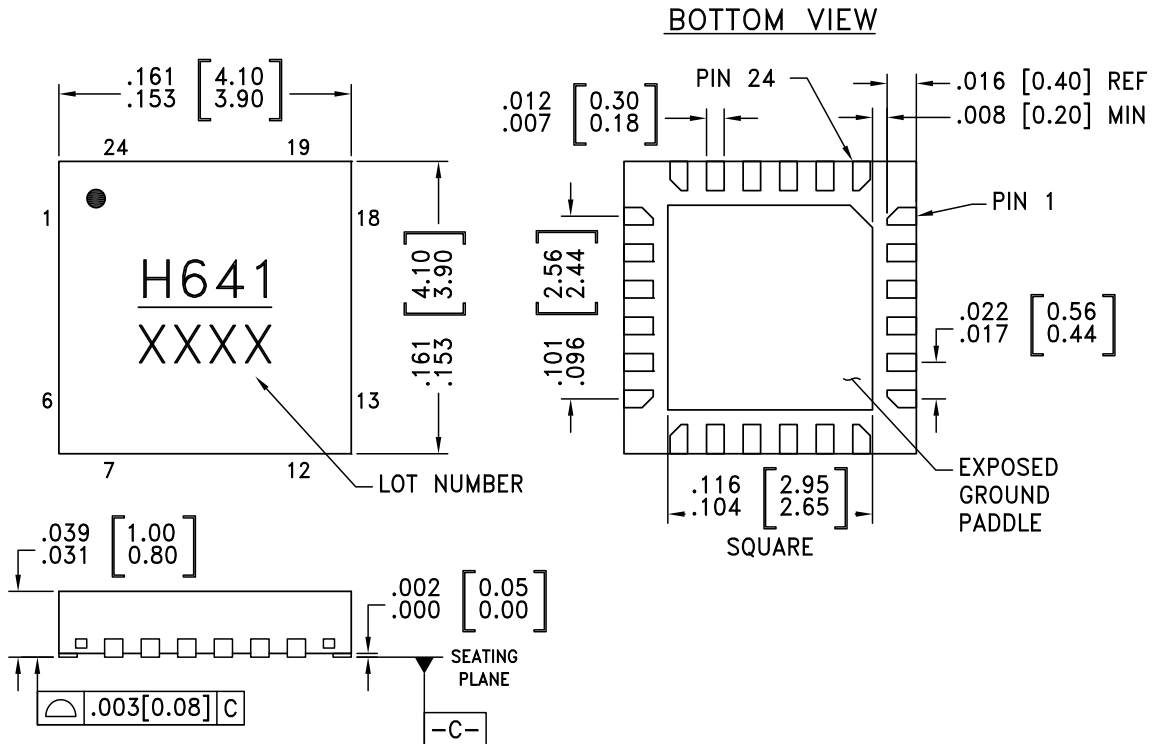
| Control Input |       | Signal Path State |
|---------------|-------|-------------------|
| CTRLA         | CTRLB | RFC to:           |
| High          | High  | RF1               |
| Low           | High  | RF2               |
| High          | Low   | RF3               |
| Low           | Low   | RF4               |

### Bias Voltage & Current

| Vss Range = -5 Vdc ±10% |                |                |
|-------------------------|----------------|----------------|
| Vss (Vdc)               | Iss (Typ) (mA) | Iss (Max) (mA) |
| -5                      | 1.7            | 5.0            |

### TTL/CMOS Control Voltages

| State | Bias Condition             |
|-------|----------------------------|
| Low   | -2.5V to 0V @ 30 µA Typ.   |
| High  | -5V to -3.8V @ 1.7 µA Typ. |

**Outline Drawing**

**NOTES:**

1. LEADFRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS]
3. LEAD SPACING TOLERANCE IS NON-CUMULATIVE
4. PAD BURR LENGTH SHALL BE 0.15 mm MAXIMUM.  
PAD BURR HEIGHT SHALL BE 0.05 mm MAXIMUM.
5. PACKAGE WARP SHALL NOT EXCEED 0.05 mm.
6. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
7. REFER TO HITTITE APPLICATION NOTE FOR SUGGESTED LAND PATTERN.


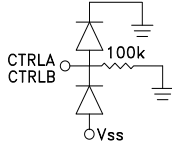
**Package Information**

| Part Number | Package Body Material                              | Lead Finish   | MSL Rating          | Package Marking <sup>[1]</sup> |
|-------------|--|---------------|---------------------|--------------------------------|
| HMC641LP4E  | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 <sup>[2]</sup> | H641<br>XXXX                   |

[1] 4-Digit lot number XXXX

[2] Max peak reflow temperature of 260 °C

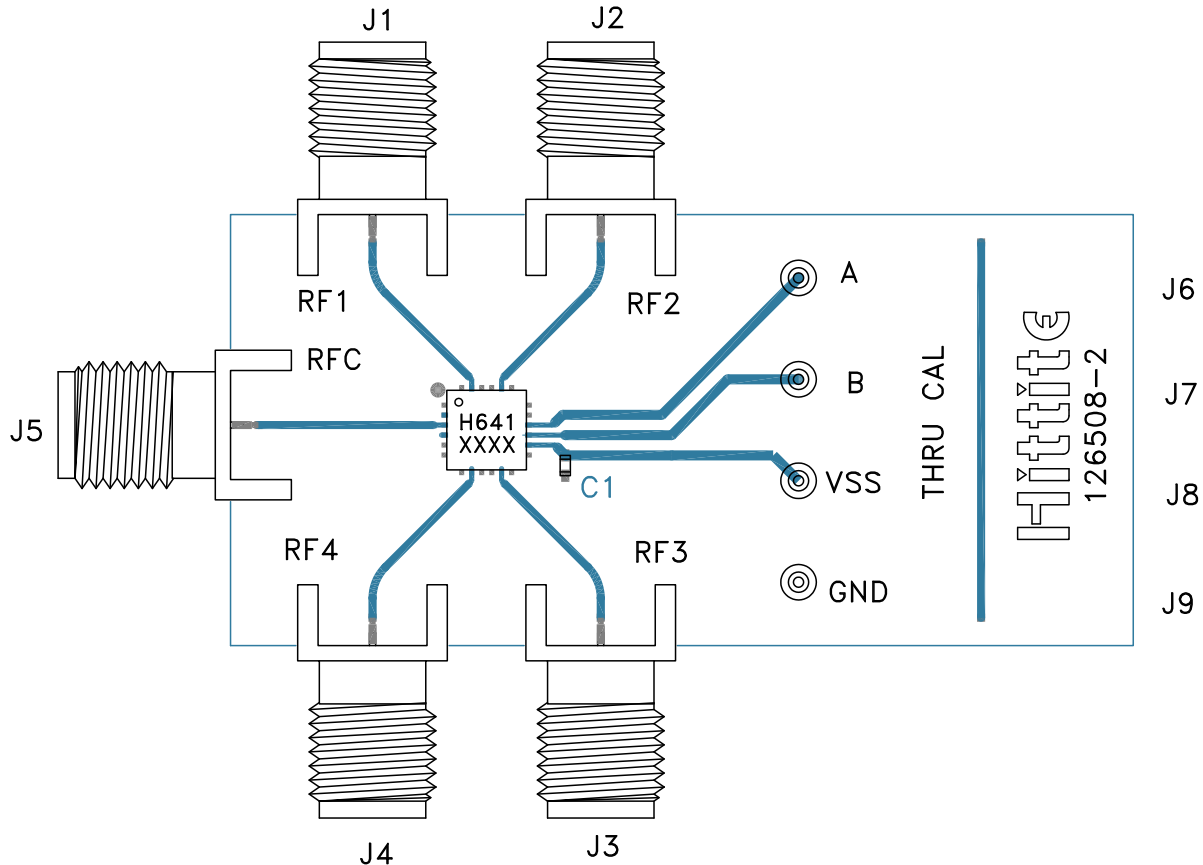

**GaAs MMIC SP4T NON-REFLECTIVE SWITCH, DC - 20 GHz**
**Pin Descriptions**

| Pin Number  | Function | Description  | Interface Schematic   |
|---|----------|--|---|
| 1, 5, 6, 13, 18   | N/C      | These pins are not connected internally; however, all data shown herein was measured with these pins connected to RF/DC ground externally. |   |
| 2, 4, 7, 9, 10, 12, 17, 19, 21, 22, 24<br>Ground Paddle | GND      | These pins and the exposed ground paddle must be connected to RF/DC ground.  |    |
| 3   | RFC      | This pin is DC coupled and matched to 50 Ohms. A blocking capacitor is required if RF line potential is not equal to 0V.                   |   |
| 8   | RF4      | This pin is DC coupled and matched to 50 Ohms. A blocking capacitor is required if RF line potential is not equal to 0V.                   |   |
| 11  | RF3      | This pin is DC coupled and matched to 50 Ohms. A blocking capacitor is required if RF line potential is not equal to 0V.                   |   |
| 14  | Vss      | Supply Voltage -5 Vdc ± 10%.   |   |
| 15  | CTRLB    | See Truth Table and Control Voltage Table.   |  |
| 16  | CTRLA    | See Truth Table and Control Voltage Table.   |   |
| 20  | RF2      | This pin is DC coupled and matched to 50 Ohms. A blocking capacitor is required if RF line potential is not equal to 0V.                   |   |
| 23  | RF1      | This pin is DC coupled and matched to 50 Ohms. A blocking capacitor is required if RF line potential is not equal to 0V.                   |   |



## GaAs MMIC SP4T NON-REFLECTIVE SWITCH, DC - 20 GHz

### Evaluation PCB



### List of Materials for Evaluation PCB 126511 <sup>[1]</sup>

| Item               | Description                  |
|--------------------|------------------------------|
| J1 - J5            | PCB Mount SMA Connector      |
| J6 - J9            | DC Pin                       |
| C1                 | 1000 pF Capacitor, 0402 Pkg. |
| U1                 | HMC641LP4E Switch            |
| PCB <sup>[2]</sup> | 126508 Evaluation PCB        |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350 or Arlon FR4

The circuit board used in the application should use RF circuit design techniques. Signal lines should have 50 Ohm impedance while the package ground leads and exposed paddle should be connected directly to the ground plane similar to that shown. A sufficient number of via holes should be used to connect the top and bottom ground planes. The evaluation board should be mounted to an appropriate heat sink. The evaluation circuit board shown is available from Hittite upon request.