



## GaAs MMIC NON-REFLECTIVE DIFFERENTIAL SPDT SWITCH, DC - 4 GHz

### Typical Applications

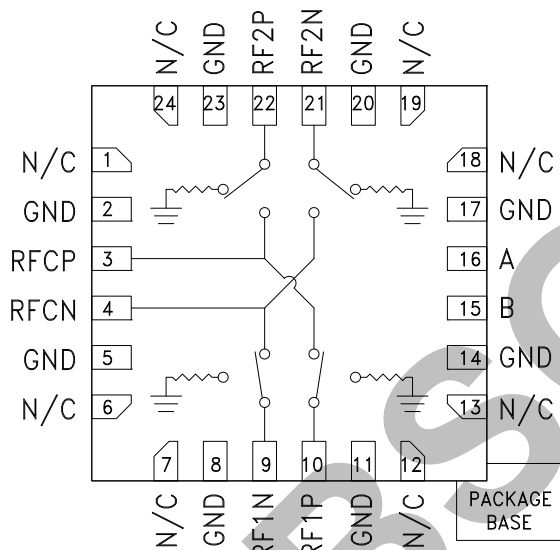
The HMC922LP4E is ideal for:

- Test & Measurement Equipment
- Antenna Diversity & Selector Selection
- Broadband Switch Matrices
- Military, EW & ECM
- SATCOM & Space

### Features

- Differential SPDT Functionality
- Low Insertion Loss: 0.8 dB
- High IP3: +50 dBm
- High Input P1dB: +35 dBm
- Positive Control: 0/+3V to 0/+5V
- 24 Lead 4x4 mm QFN Package: 16 mm<sup>2</sup>

### Functional Diagram



### General Description

The HMC922LP4E is a DC to 4 GHz high isolation GaAs MMIC non-reflective Differential SPDT switch in a low cost leadless surface mount package. The switch is ideal for antenna diversity & selector selection, broadband switch matrices, test & measurement equipment, military and space applications yielding up to 60 dB isolation, low 0.8 dB insertion loss and +50 dBm input IP3. Power handling is excellent with the switch offering a P1dB compression point of +35 dBm. On-chip circuitry allows two positive voltage controls of 0/+3V to 0/+5V at very low DC currents.

### Electrical Specifications,

$T_A = +25^\circ \text{C}$ ,  $V_{ctl} = 0/+3 \text{ Vdc}$  (Unless Otherwise Stated), 50 Ohm System

| Parameter                                                               | Frequency                                                                                                  | Min.                          | Typ.       | Max.       | Units      |
|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-------------------------------|------------|------------|------------|
| Insertion Loss                                                          | DC - 2.0 GHz<br>2.0 - 4.0 GHz                                                                              |                               | 0.8<br>1.2 | 1.2<br>1.5 | dB<br>dB   |
| Isolation:                                                              | State 1: RFCN-RF2P, RFCN-RF2N, RFCP-RF2N, RFCP-RF2P<br>State 2: RFCN-RF1P, RFCN-RF1N, RFCP-RF1N, RFCP-RF1P | DC - 2.0 GHz<br>2.0 - 4.0 GHz | 45<br>40   | 60<br>45   | dB<br>dB   |
| Isolation                                                               | State 1: RFCN-RF1P, RFCP-RF1N<br>State 2: RFCN-RF2P, RFCP-RF2N                                             | DC - 2.0 GHz<br>2.0 - 4.0 GHz | 30<br>20   | 40<br>30   | dB<br>dB   |
| Return Loss (On State, Any Port)                                        | DC - 2.0 GHz<br>2.0 - 4.0 GHz                                                                              |                               | 20<br>15   |            | dB<br>dB   |
| Input Power for 1 dB Compression                                        | $V_{ctl} = 0/+3\text{V}$<br>$V_{ctl} = 0/+5\text{V}$                                                       | 0.5 - 4.0 GHz                 | 30<br>35   |            | dBm<br>dBm |
| Input Power for 0.1 dB Compression                                      | $V_{ctl} = 0/+3\text{V}$<br>$V_{ctl} = 0/+5\text{V}$                                                       | 0.5 - 4.0 GHz                 | 27<br>32   |            | dBm<br>dBm |
| Input Third Order Intercept<br>(Two-Tone Input Power= +7 dBm Each Tone) | $V_{ctl} = 0/+3\text{V}$<br>$V_{ctl} = 0/+5\text{V}$                                                       | 0.5 - 4.0 GHz                 | 50<br>50   |            | dBm<br>dBm |
| Switching Characteristics                                               | DC - 4.0 GHz                                                                                               |                               |            |            |            |
|                                                                         | $t_{RISE} / t_{FALL}$ (10/90% RF)<br>$t_{ON} / t_{OFF}$ (50% CTL to 10/90% RF)                             |                               | 15<br>40   |            | ns<br>ns   |

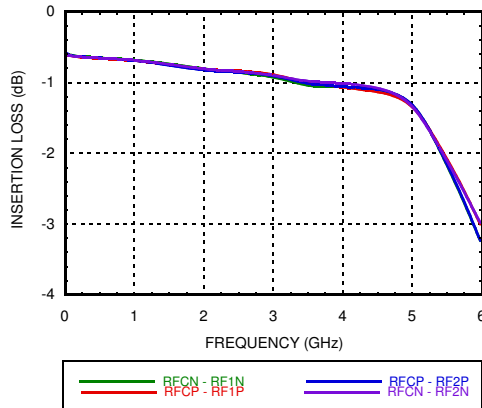
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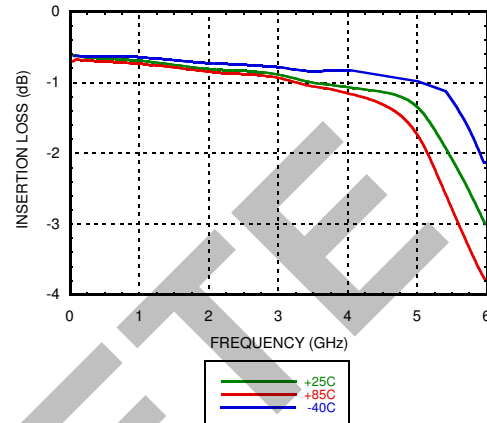


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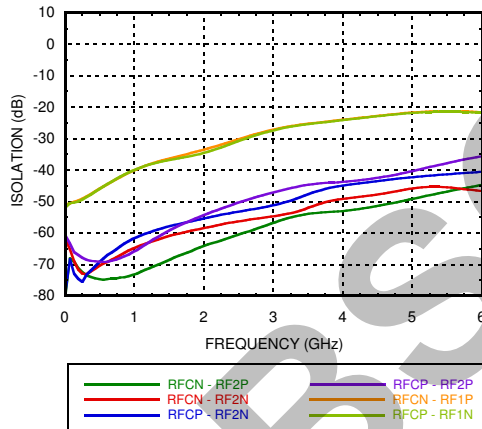
**Insertion Loss**



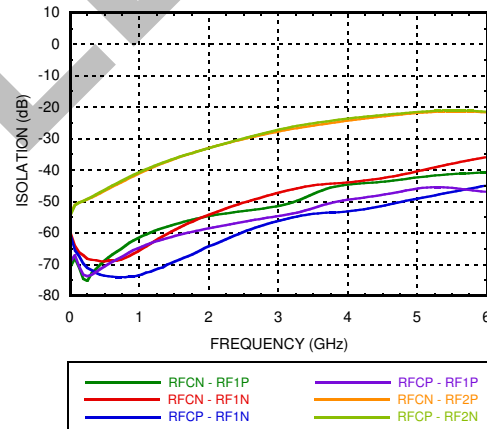
**Insertion Loss vs. Temperature**



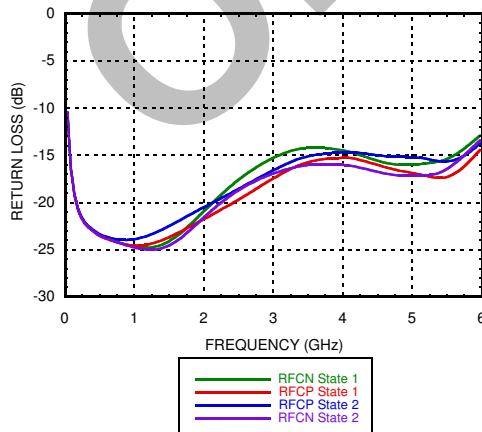
**Isolation State 1**



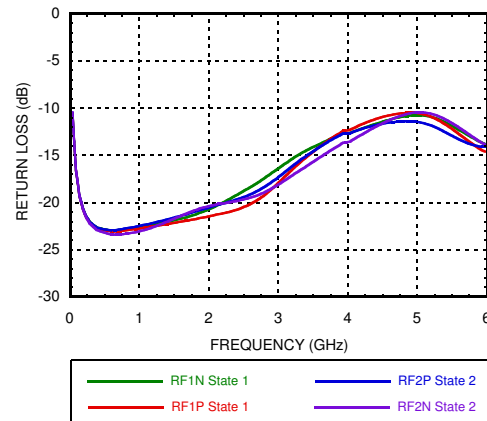
**Isolation State 2**



**Return Loss RFC**



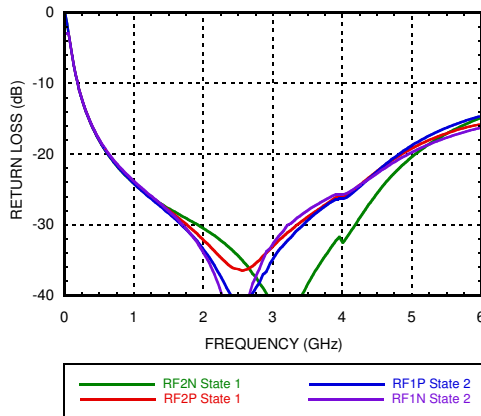
**Return Loss RF1, 2**



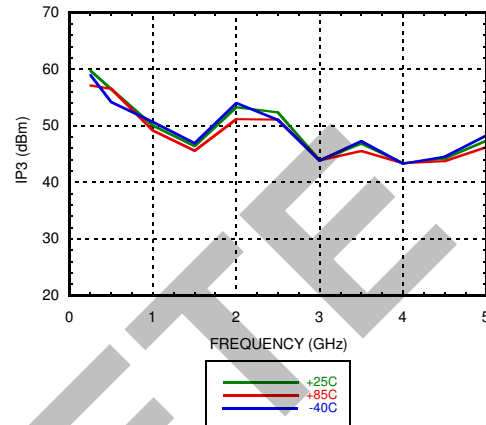


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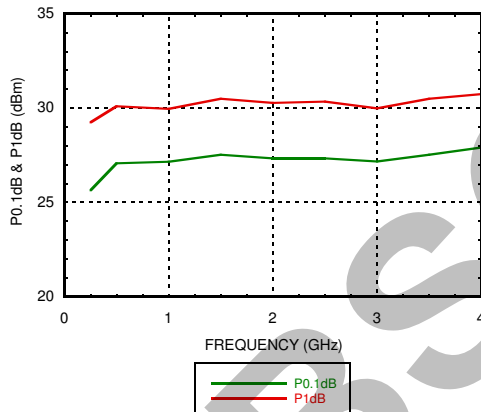
### Off State Return Loss



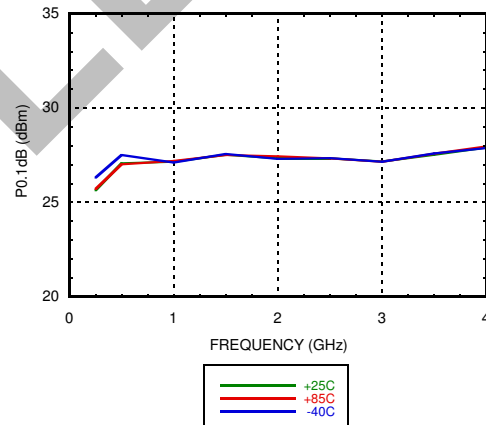
### Input IP3\* @ 3V



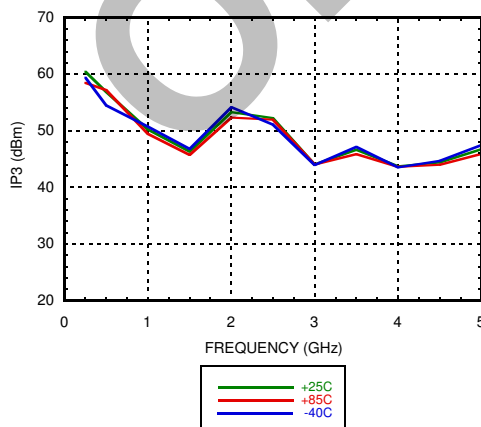
### Input 0.1dB & 1 dB Compression Point @ 3V



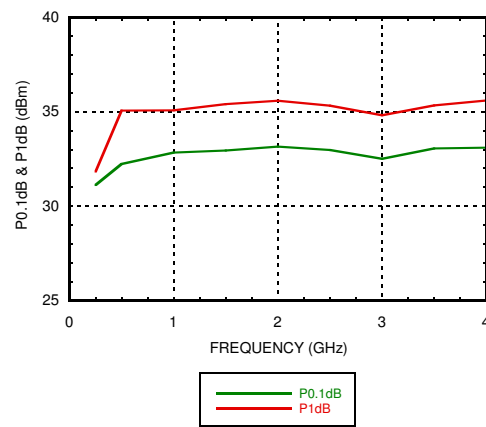
### Input 0.1dB Compression Point vs. Temperature @ 3V



### Input IP3 \* @ 5V



### Input 0.1 dB & 1 dB Compression Point @ 5V



\* Two-tone input power = +7 dBm each tone, 1 MHz spacing.

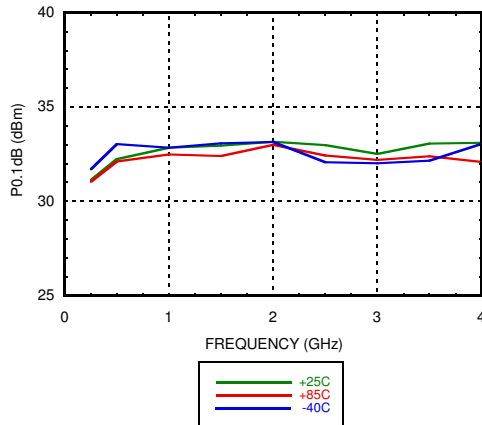
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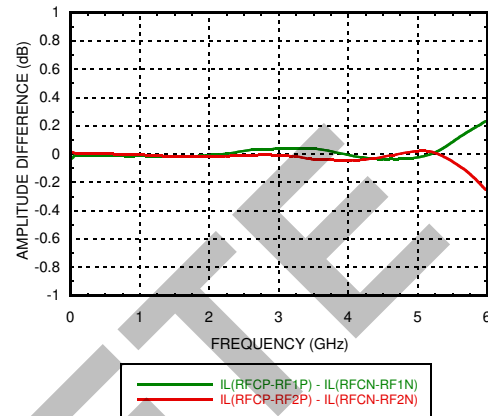


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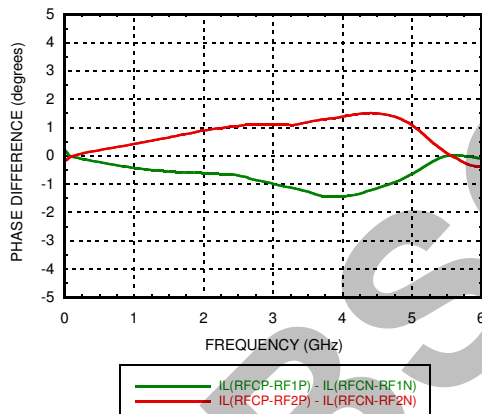
### Input 0.1 dB Compression Point vs. Temperature @ 5V



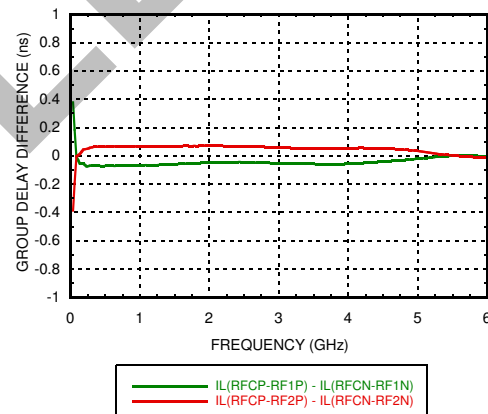
### Insertion Loss Amplitude Mismatch



### Insertion Loss Phase Mismatch



### Group Delay Mismatch



### Absolute Maximum Ratings

|                                                          |                |
|----------------------------------------------------------|----------------|
| Control Voltage (A, B)                                   | -0.5V to 8V DC |
| RF Input Power                                           |                |
| Through Path 3V/5V                                       | 32 / 34 dBm    |
| Termination Path 3V/5V                                   | 26 dBm         |
| Channel Temperature                                      | 150 °C         |
| Thermal Resistance<br>(channel to package ground paddle) |                |
| Through Path                                             | 30 °C/W        |
| Termination Path                                         | 79 °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 +0.5 Vdc @ < 1 µA Typ.   |
| High  | +3.0 to +5.5 Vdc @ 20 µA Typ. |

### Truth Table

|         | Control Input |      | Signal Path State |          |
|---------|---------------|------|-------------------|----------|
|         | A             | B    | RFCP to:          | RFCN to: |
| State 1 | High          | Low  | RF1P              | RF1N     |
| State 2 | Low           | High | RF2P              | RF2N     |

Do not operate continuously at RF power input greater than 1 dB compression and do not hot switch power levels greater than +27 dBm for control = 0/+3 Vdc, or +30 dBm for control = 0/+5 Vdc.



**ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS**

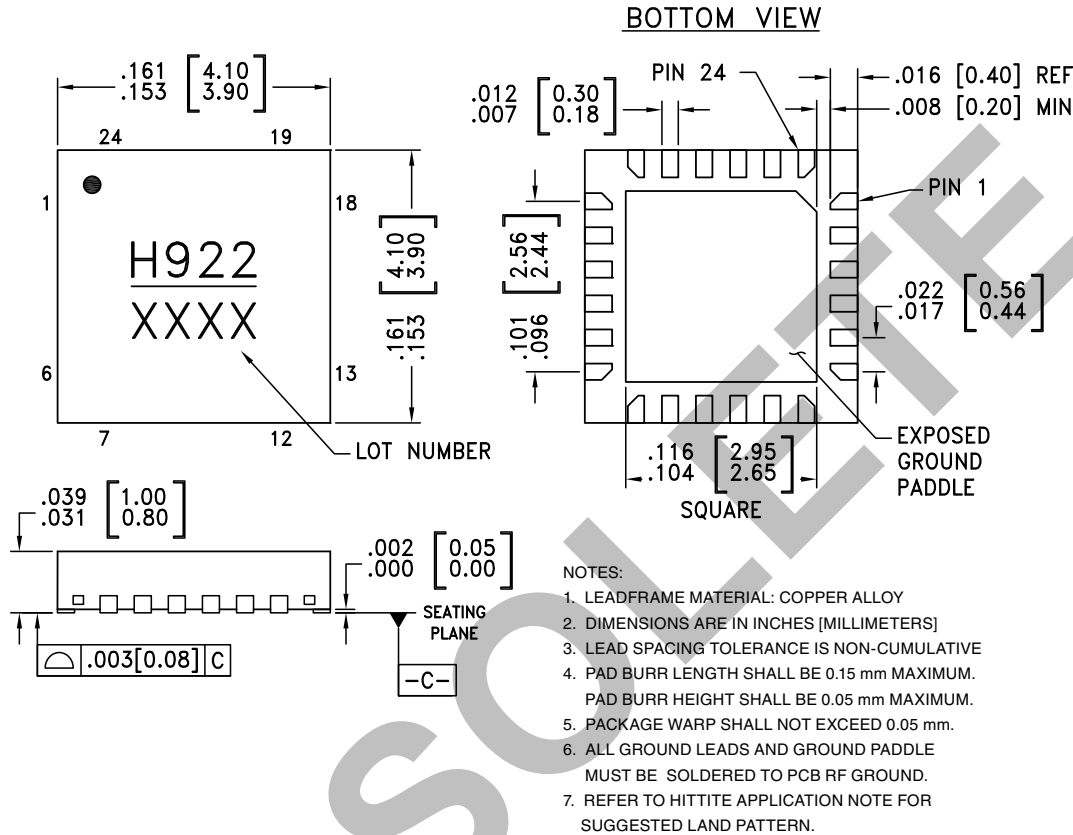
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### Outline Drawing



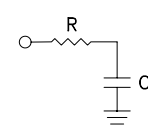
### Package Information

| Part Number | Package Body Material                              | Lead Finish   | MSL Rating          | Package Marking <sup>[1]</sup> |
|-------------|----------------------------------------------------|---------------|---------------------|--------------------------------|
| HMC922LP4E  | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL1 <sup>[2]</sup> | H922<br>XXXX                   |

[1] 4-Digit lot number XXXX

[2] Max peak reflow temperature of 260 °C

### Pin Descriptions

| Pin Number                  | Function                           | Description                                                                                                                              | Interface Schematic                                                                   |
|-----------------------------|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 3, 4, 9, 10, 21, 22         | RFCP, RFCN, RF1N, RF1P, RF2N, RF2P | These pins are DC coupled and matched to 50 Ohms. Blocking capacitors are required.                                                      |                                                                                       |
| 1, 6, 7, 12, 13, 18, 19, 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. |                                                                                       |
| 2, 5, 8, 11, 14, 17, 20, 23 | GND                                | Package bottom has exposed metal paddle that must be connected to PCB RF ground as well.                                                 |  |
| 16                          | A                                  | See truth and control voltage tables.                                                                                                    |  |
| 15                          | B                                  | See truth and control voltage tables.                                                                                                    |                                                                                       |

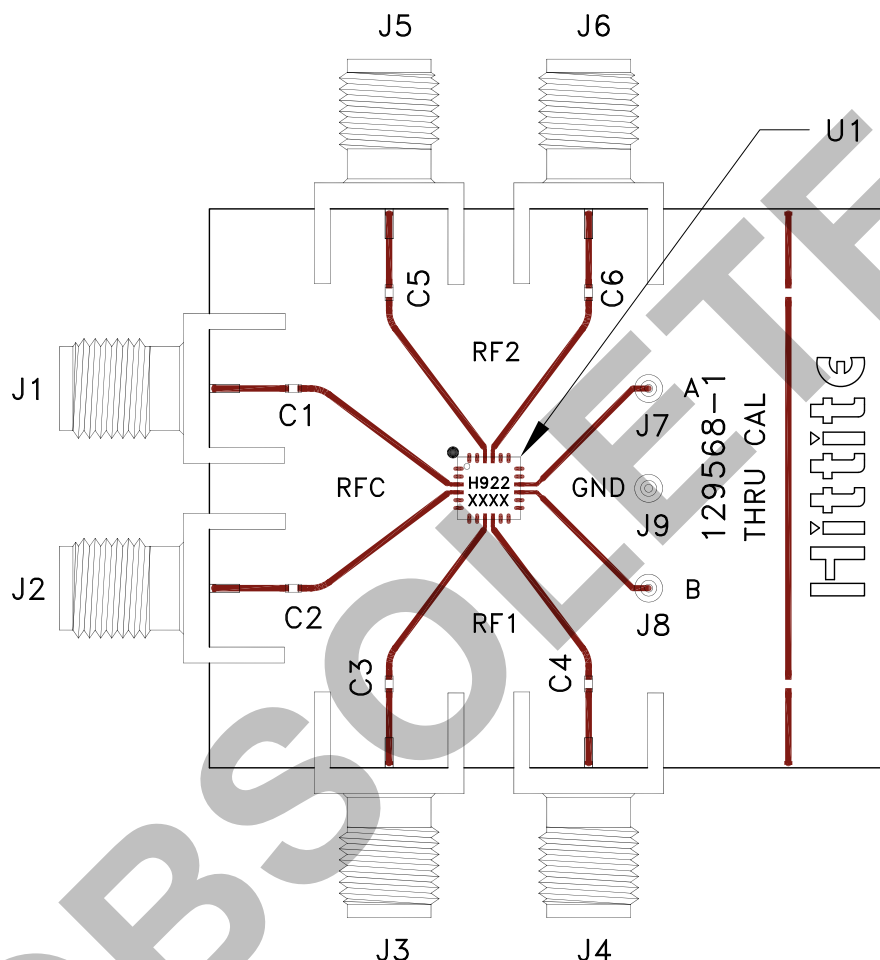
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**Evaluation PCB**



**List of Materials for Evaluation PCB 129570 [1]**

| Item    | Description                 |
|---------|-----------------------------|
| J1 - J6 | PCB Mount SMA RF Connector  |
| J7 - J9 | DC Pin                      |
| C1 - C6 | 330 pF Capacitor, 0402 Pkg. |
| U1      | HMC922LP4E SPDT Switch      |
| PCB [2] | 129568 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 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 above. A sufficient number of via holes should be used to connect the top and bottom ground planes. The evaluation circuit board shown above is available from Hittite upon request.