



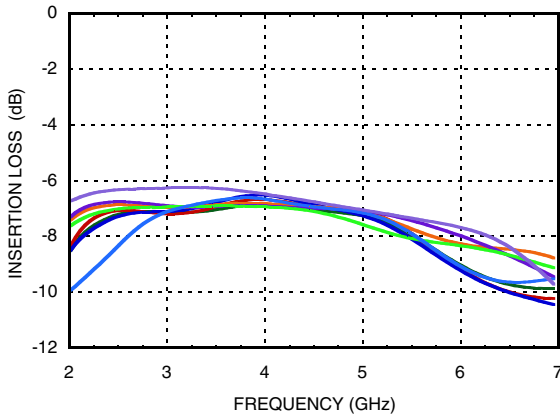
**THE DATASHEET OF
HMC649ALP6ETR**



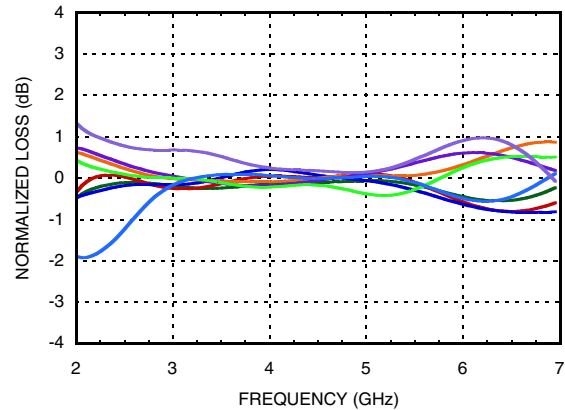


**GaAs MMIC 6-BIT DIGITAL
PHASE SHIFTER, 3 - 6 GHz**

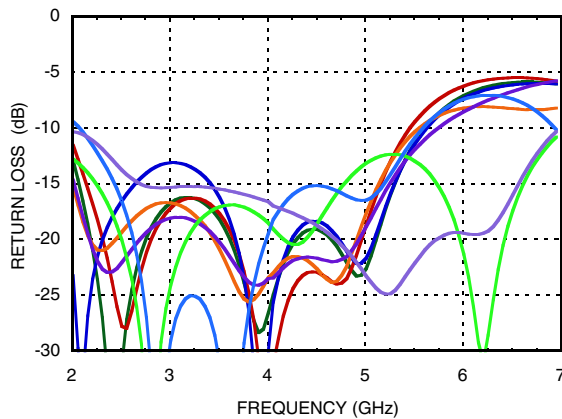
Insertion Loss, Major States Only



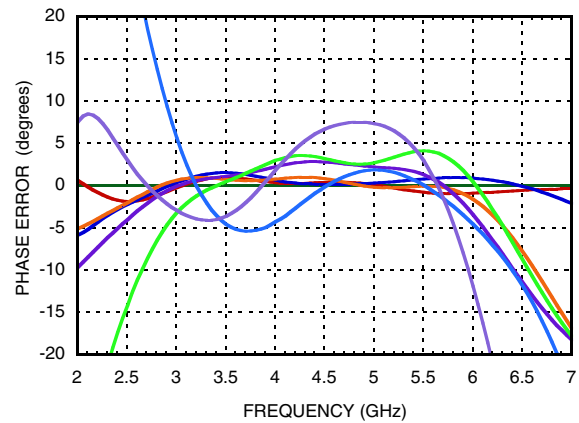
Normalized Loss, Major States Only



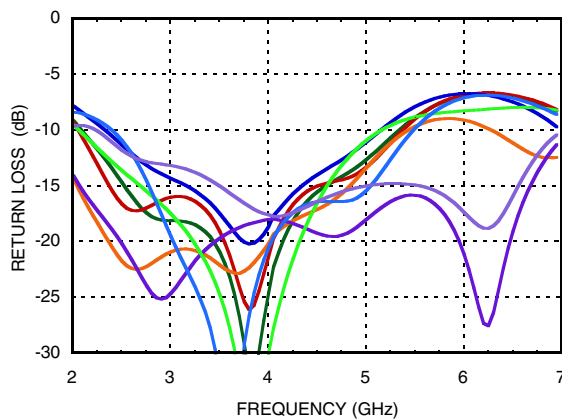
Input Return Loss, Major States Only



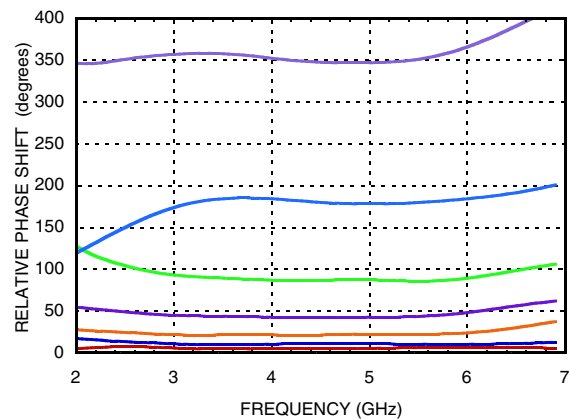
Phase Error, Major States Only



Output Return Loss, Major States Only



**Relative Phase Shift
Major States Including All Bits**



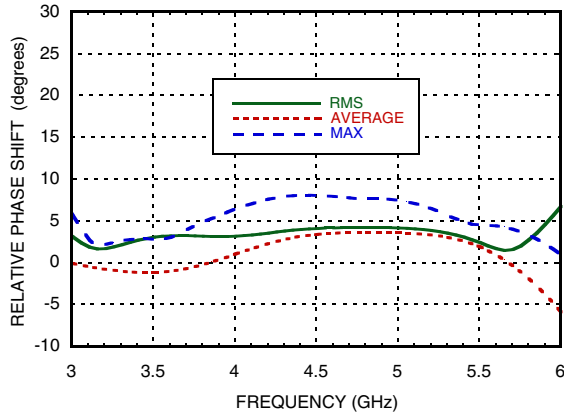
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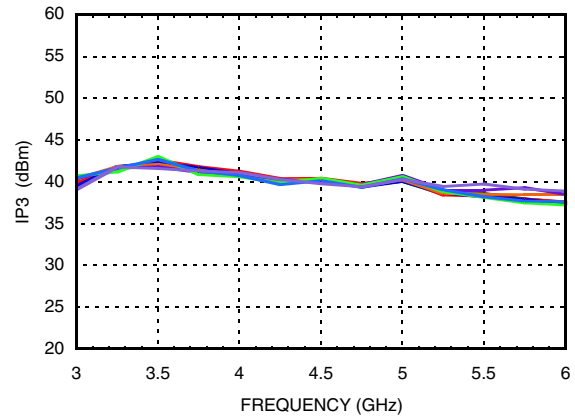
**GaAs MMIC 6-BIT DIGITAL
PHASE SHIFTER, 3 - 6 GHz**



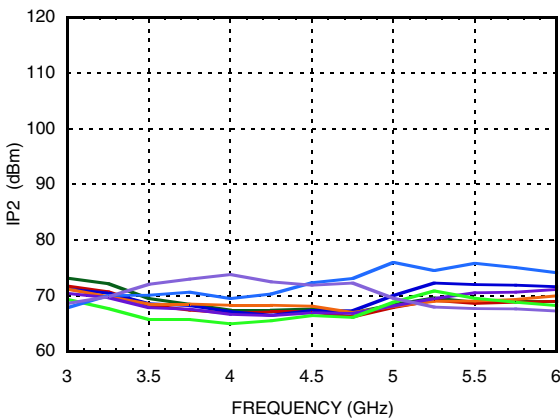
**Relative Phase Shift,
RMS, Average, Max, All States**



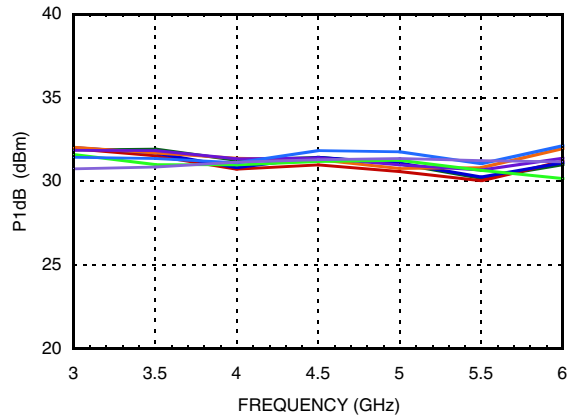
Input IP3, Major States Only



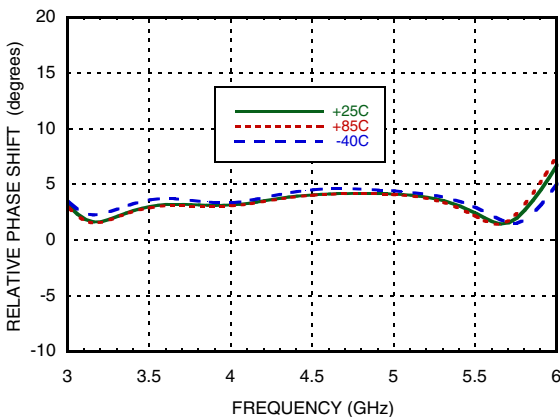
Input IP2, Major States Only



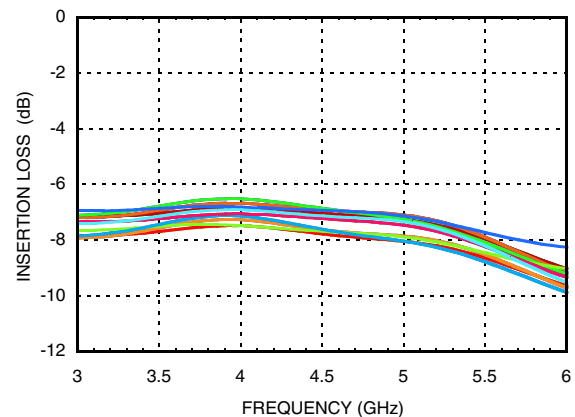
Input P1dB, Major States Only



RMS Phase Error vs. Temperature



**Insertion Loss vs. Temperature,
Major States Only**

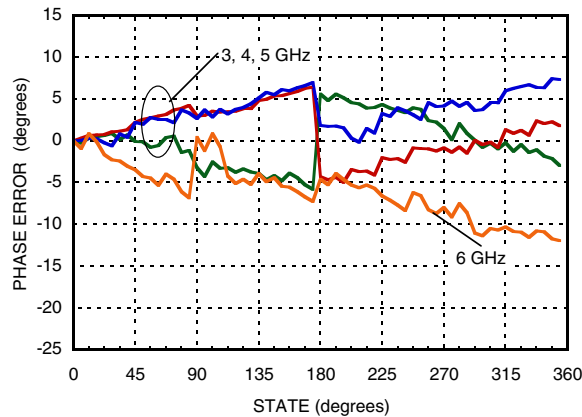


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Phase Error vs. State



Bias Voltage & Current

| | |
|------|-------|
| Vdd | Idd |
| 5.0 | 5.4mA |
| Vss | Iss |
| -5.0 | 5.4mA |

Control Voltage

| State | Bias Condition |
|----------|---------------------------|
| Low (0) | 0 to 0.2 Vdc |
| High (1) | Vdd ±0.2 Vdc @ 35 µA Typ. |

Absolute Maximum Ratings

| | |
|---|-----------------------|
| Input Power (RFIN) | 32 dBm (T= +85 °C) |
| Bias Voltage Range (Vdd) | -0.2 to +12V |
| Bias Voltage Range (Vss) | +0.2 to -12V |
| Channel Temperature (Tc) | 150 °C |
| Thermal Resistance (channel to ground paddle) | 200 °C/W |
| Storage Temperature | -65 to +150 °C |
| Operating Temperature | -40 to +85 °C |
| ESD Sensitivity (HBM) | Class1A (Passed 250V) |



ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Truth Table

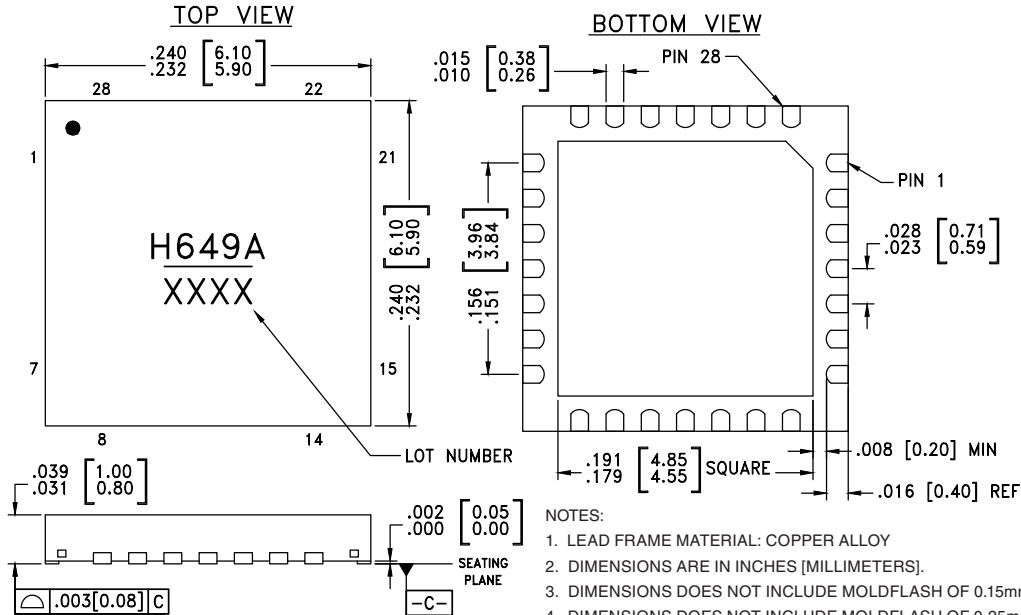
| Control Voltage Input | | | | | | Phase Shift (Degrees) RFIN - RFOUT |
|-----------------------|-------|-------|-------|-------|-------|---------------------------------------|
| Bit 1 | Bit 2 | Bit 3 | Bit 4 | Bit 5 | Bit 6 | |
| 0 | 0 | 0 | 0 | 0 | 0 | Reference* |
| 1 | 0 | 0 | 0 | 0 | 0 | 5.625 |
| 0 | 1 | 0 | 0 | 0 | 0 | 11.25 |
| 0 | 0 | 1 | 0 | 0 | 0 | 22.5 |
| 0 | 0 | 0 | 1 | 0 | 0 | 45.0 |
| 0 | 0 | 0 | 0 | 1 | 0 | 90.0 |
| 0 | 0 | 0 | 0 | 0 | 1 | 180.0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 354.375 |

Any combination of the above states will provide a phase shift approximately equal to the sum of the bits selected.
*Reference corresponds to monotonic setting



GaAs MMIC 6-BIT DIGITAL PHASE SHIFTER, 3 - 6 GHz

Outline Drawing



NOTES:

1. LEAD FRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS].
3. DIMENSIONS DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE
4. DIMENSIONS DOES NOT INCLUDE MOLDFLASH OF 0.25mm PER SIDE
5. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
6. CLASSIFIED AS MOISTURE SENSITIVITY LEVEL (MSL) 1.

Package Information

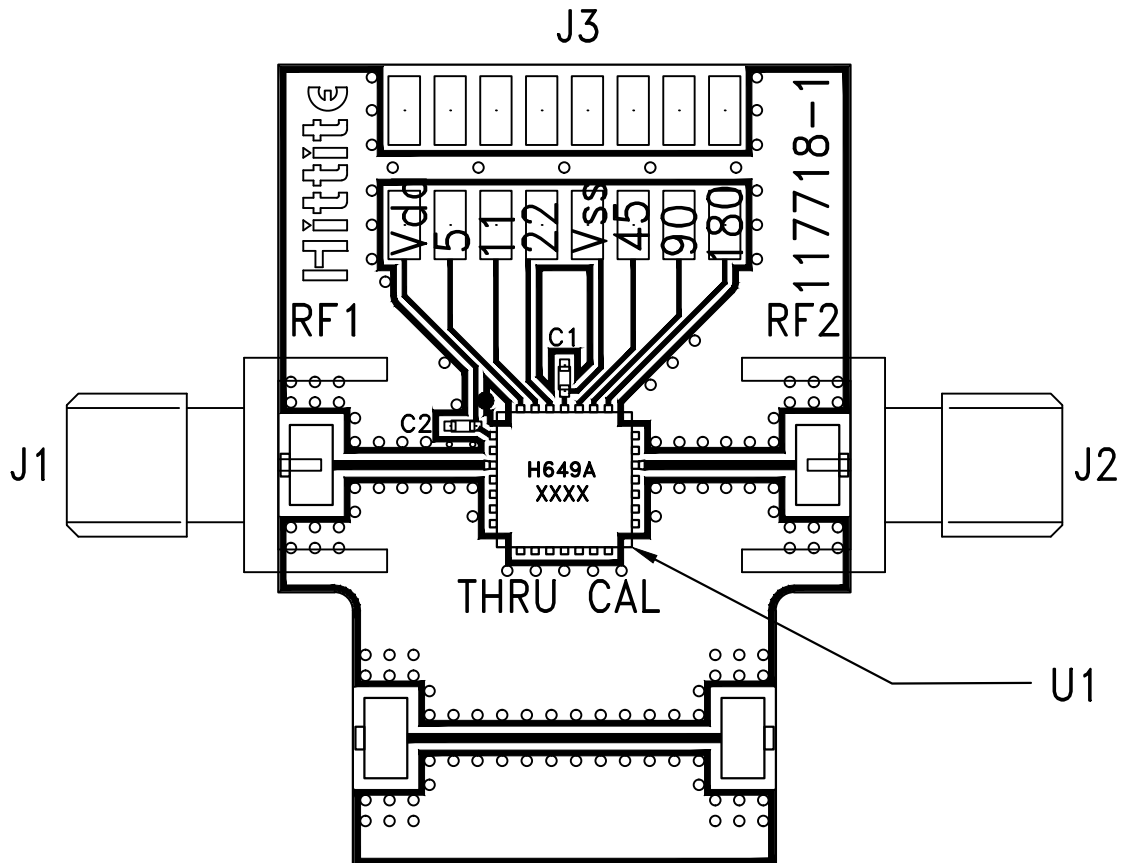
| Part Number | Package Body Material | Lead Finish | MSL Rating | Package Marking ^[2] |
|-------------|--|---------------|---------------------|--------------------------------|
| HMC649ALP6E | RoHS-compliant Low Stress Injection Molded Plastic | 100% matte Sn | MSL3 ^[1] | H649A XXXX |

[1] Max peak reflow temperature of 260 °C

[2] 4-Digit lot number XXXX

Pin Descriptions

| Pin Number | Function | Description | Interface Schematic |
|--------------------|---------------------------------------|--|---------------------|
| 1 | Vdd | Voltage Supply | |
| 2, 20 | GND | These pins and exposed ground paddle must be connected to RF/DC ground. | |
| 3 | RFIN | This port is DC coupled and matched to 50 Ohms. | |
| 4 - 18, 21 | N/C | No connection required. These pins may be connected to RF/DC ground without affecting performance. | |
| 19 | RFOUT | This port is DC coupled and matched to 50 Ohms. | |
| 22 - 24 26 - 28 | BIT6, BIT5, BIT4, BIT3, BIT2, BIT1 | Control Input. See truth table and control voltage tables. | |
| 25 | Vss | Voltage Supply | |


**GaAs MMIC 6-BIT DIGITAL
PHASE SHIFTER, 3 - 6 GHz**
Evaluation PCB

List of Materials for Evaluation PCB EV1HMC649ALP5 [1][3]

| Item | Description |
|---------|---|
| J1 - J2 | PCB Mount SMA RF Connector |
| J3 | Header 2mm, 16 pins |
| C1, C2 | 1000pF, 0402 pkg |
| U1 | HMC649ALP6E 6-Bit Digital Phase Shifter |
| PCB [2] | 117718 Evaluation PCB |

[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Rogers 4350

[3] Please refer to part's pin description and functional diagram for pin out assignments on evaluation 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 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.

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