PRODUCT TYPE - SMT

HMC648ALP6E

v01.0217

GaAs MMIC 6-BIT DIGITAL PHASE SHIFTER, 2.9 - 3.9 GHz

Typical Applications

The HMC648ALP6E is ideal for:

- EW Receivers
- Weather & Military Radar
- Satellite Communications
- Beamforming Modules
- Phase Cancellation

Features

Low RMS Phase Error: 1.2°

Low Insertion Loss: 5 dB

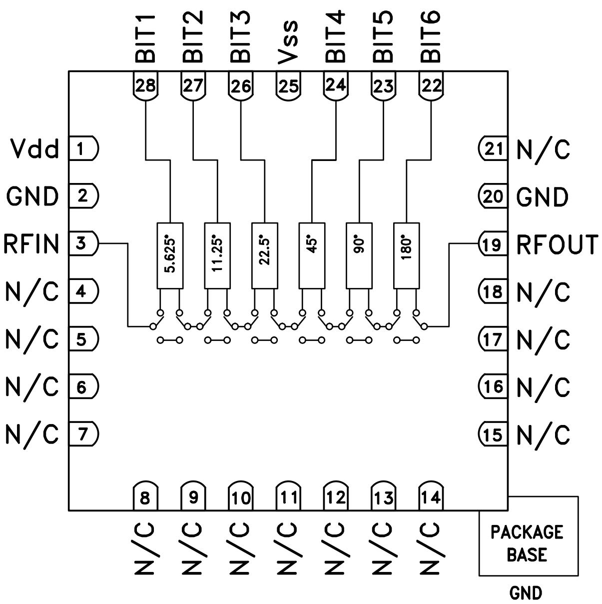
High Linearity: +45 dBm

Positive Control Logic

360° Coverage, LSB = 5.625°

28 Lead 6x6mm SMT Package: 36mm²

Functional Diagram



General Description

The HMC648ALP6E is a 6-bit digital phase shifter which is rated from 2.9 - 3.9 GHz, providing 360 degrees of phase coverage, with a LSB of 5.625 degrees. The HMC648ALP6E features very low RMS phase error of 1.2 degrees and extremely low insertion loss variation of ±0.5 dB across all phase states. This high accuracy phase shifter is controlled with positive control logic of 0/+5V. The HMC648ALP6E is housed in a compact 6x6 mm plastic leadless SMT package and is internally matched to 50 Ohms with no external components.

Electrical Specifications

T_A = +25° C, Vss= -5V, Vdd= +5V , Control Voltage= 0/ +5V, 50 Ohm System

Parameter	Min.	Typ.	Max.	Units
Frequency Range	2.9		3.9	GHz
Insertion Loss*		5	8	dB
Input Return Loss*		16		dB
Output Return Loss*		17		dB
Phase Error*		±5	+10 / -15	deg
RMS Phase Error		1.2		deg
Amplitude Settling Time (50% cntl to +/- 0.1dB margin of final RFout)		175		nS
Phase Settling Time (50% cntl to +/-1 degree margin of final RFout)		125		nS
Insertion Loss Variation*		±0.5		dB
Input Power for 1 dB Compression		31		dBm
Input Third Order Intercept		45		dBm
Control Voltage Current		35	250	µA
Bias Control Current		5	15	mA

*Note: Major States Shown

For price, delivery, and to place orders: Analog Devices, Inc., One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106
Phone: 781-329-4700 • Order online at www.analog.com
Application Support: Phone: 1-800-ANALOG-D

HMC648A* PRODUCT PAGE QUICK LINKS

Last Content Update: 11/29/2017

COMPARABLE PARTS

View a parametric search of comparable parts.

EVALUATION KITS

- HMC648A Evaluation Board

DOCUMENTATION

Data Sheet

- HMC648ALP6E: GaAs MMIC 6-Bit Digital Phase Shifter 2.9 - 3.9 GHz Data Sheet

TOOLS AND SIMULATIONS

- HMC648ALP6E S-Parameters

REFERENCE MATERIALS

Product Selection Guide

- RF, Microwave, and Millimeter Wave IC Selection Guide 2017

DESIGN RESOURCES

- HMC648A Material Declaration
- PCN-PDN Information
- Quality And Reliability
- Symbols and Footprints

DISCUSSIONS

View all HMC648A EngineerZone Discussions.

SAMPLE AND BUY

Visit the product page to see pricing options.

TECHNICAL SUPPORT

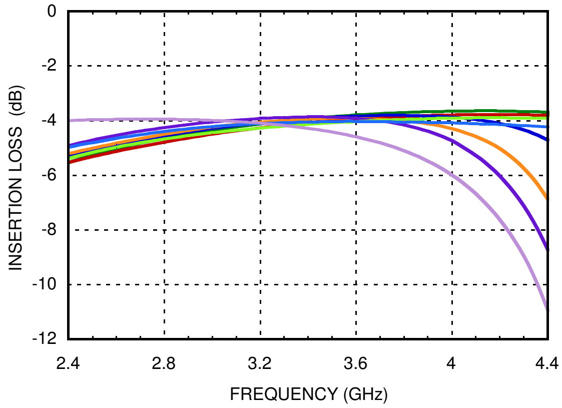
Submit a technical question or find your regional support number.

DOCUMENT FEEDBACK

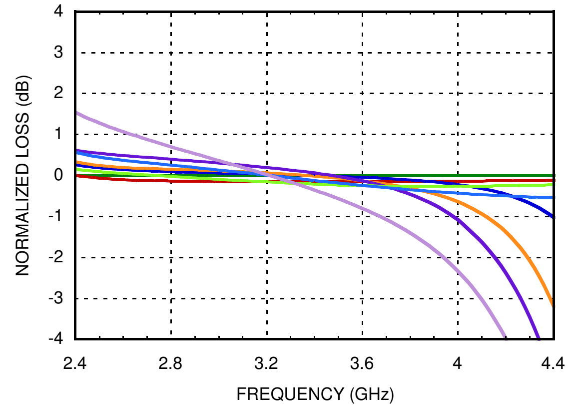
Submit feedback for this data sheet.

GaAs MMIC 6-BIT DIGITAL PHASE SHIFTER, 2.9 - 3.9 GHz

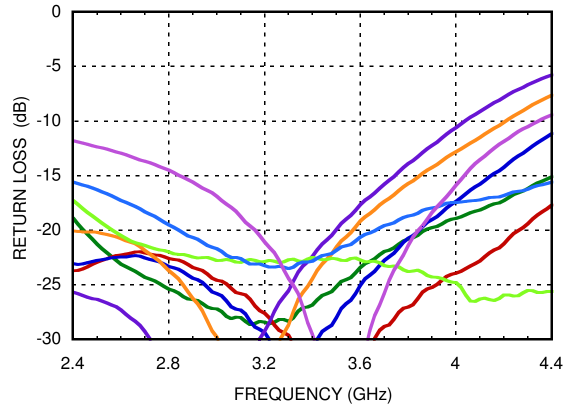
Insertion Loss, Major States Only



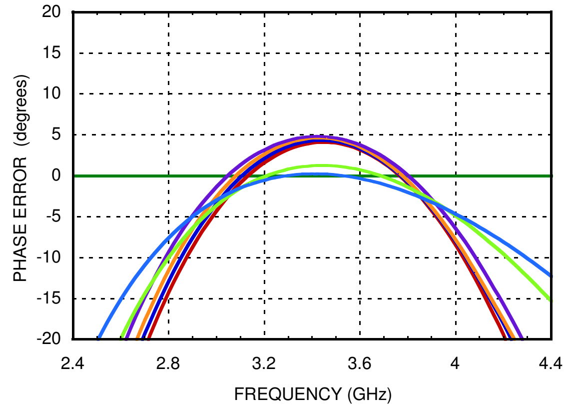
Normalized Loss, Major States Only



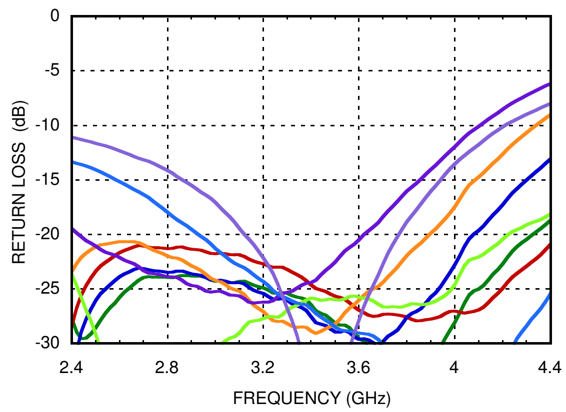
Input Return Loss, Major States Only



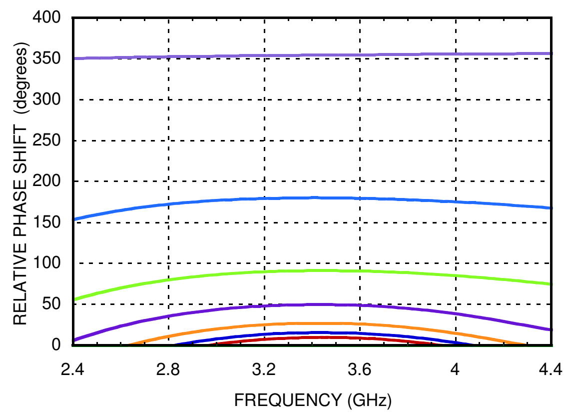
Phase Error, Major States Only



Output Return Loss, Major States Only



Relative Phase Shift
Major States Including All Bits



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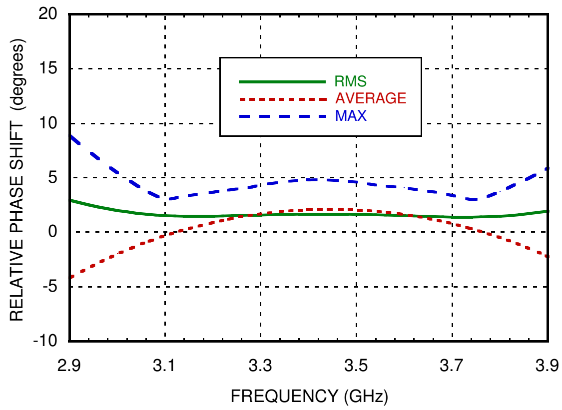
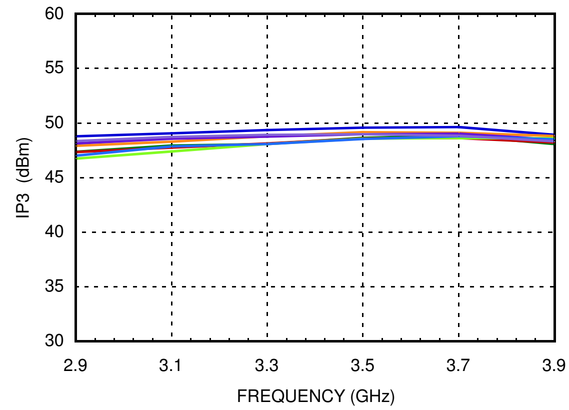
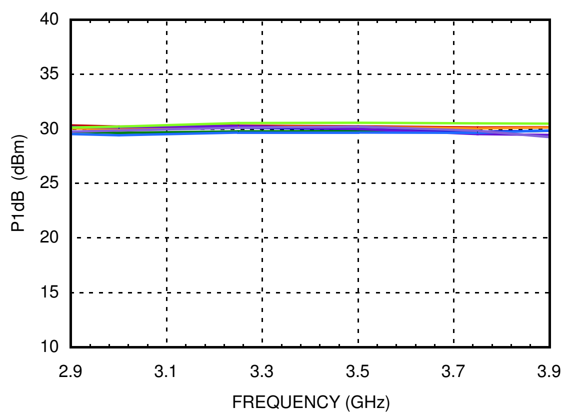
Relative Phase Shift, RMS, Average, Max, All States



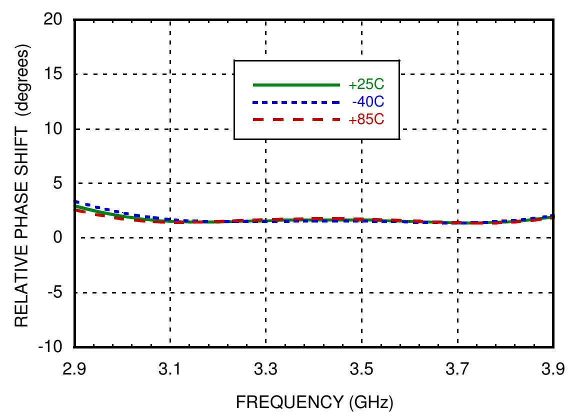
Input IP3, Major States Only



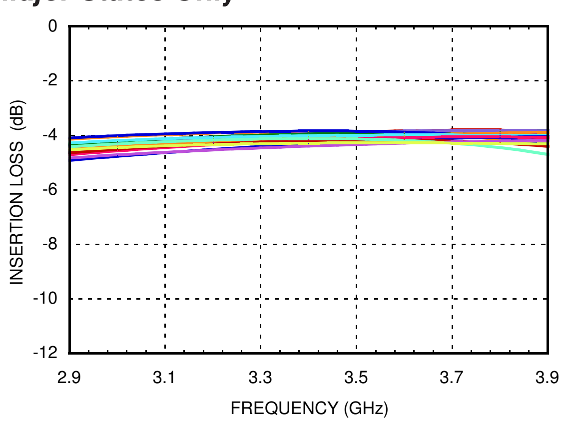
Input P1dB, Major States Only



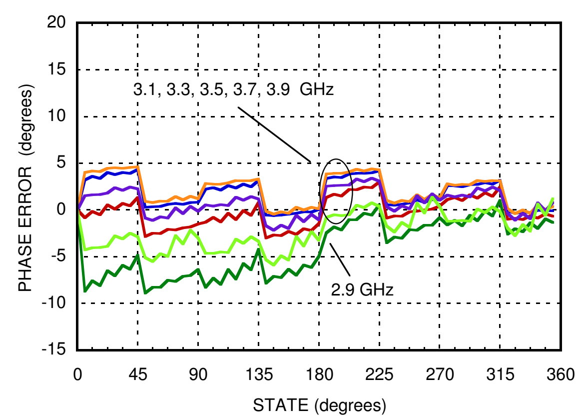
RMS Phase Error vs. Temperature



Insertion Loss vs. Temperature, Major States Only



Phase Error vs. State



GaAs MMIC 6-BIT DIGITAL PHASE SHIFTER, 2.9 - 3.9 GHz

Absolute Maximum Ratings

Input Power (RFIN)	33 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)	120 °C/W
Storage Temperature	-65 to +150 °C
Operating Temperature	-40 to +85 °C
ESD Sensitivity	Class1A Passed 250V

ELECTROSTATIC SENSITIVE DEVICE
OBSERVE HANDLING PRECAUTIONS

Bias Voltage & Current

Vdd	Idd
5.0	5.2mA
Vss	Iss
-5.0	5.2mA

Control Voltage

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

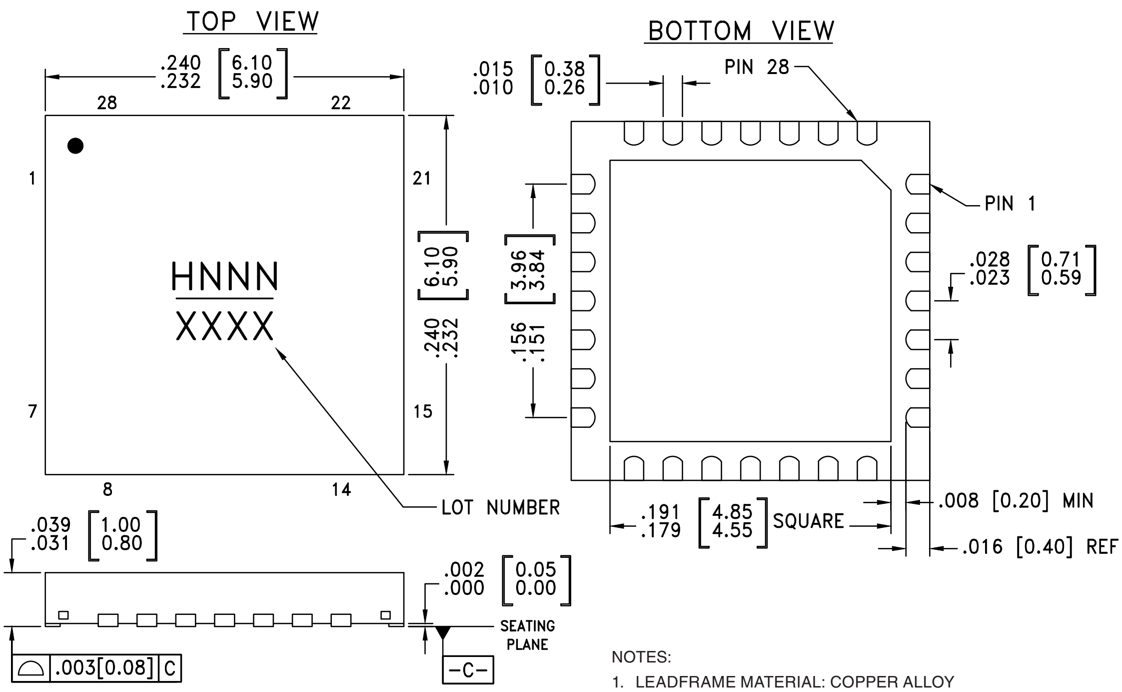
Truth Table

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

Outline Drawing



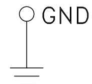
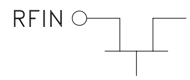
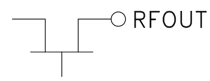
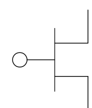
NOTES:
1. LEADFRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS].
3. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.15mm PER SIDE.
4. DIMENSION DOES NOT INCLUDE MOLDFLASH OF 0.25mm PER SIDE.
5. ALL GROUND LEADS MUST BE SOLDERED TO PCB RF GROUND.
6. CLASSIFIED AS MOISTURE SENSITIVITY LEVEL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

Package Information

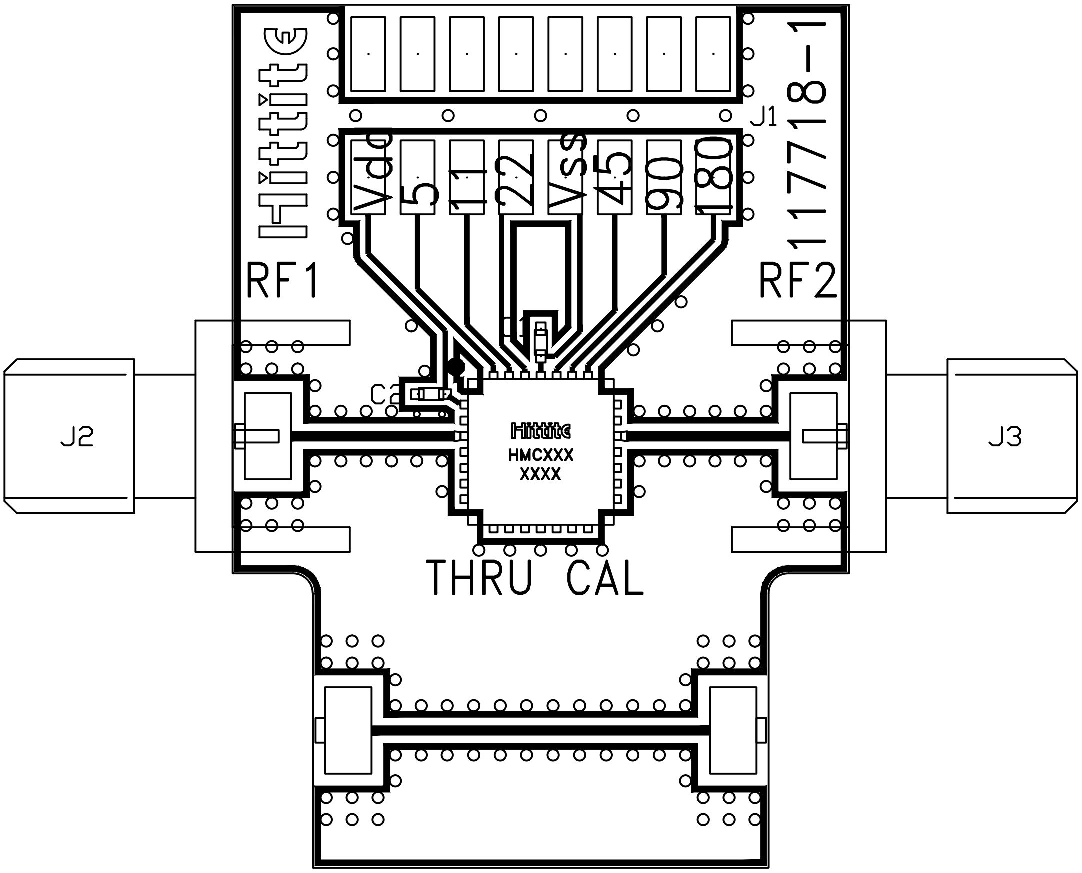
Part Number	Package Body Material	Lead Finish	MSL Rating	Package Marking [2]
HMC648ALP6E	RoHS-compliant Low Stress Injection Molded Plastic	100% matte Sn	MSL3 [1]	H648A XXXX

[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	N/C	The pins are not connected internally; however, all data shown herein was measured with these pins connected to RF/DC ground externally.	
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.	

Evaluation PCB



List of Materials for Evaluation PCB 117720 [1][3]

Item	Description
J1 - J2	PCB Mount SMA RF Connector
J3	Header 2mm, 16 Pin
C1, C2	1000pF Capacitor, 0402 Pkg.
U1	HMC648ALP6E 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 Analog Devices upon request.

PRODUCT TYPE - SMT

Notes: