

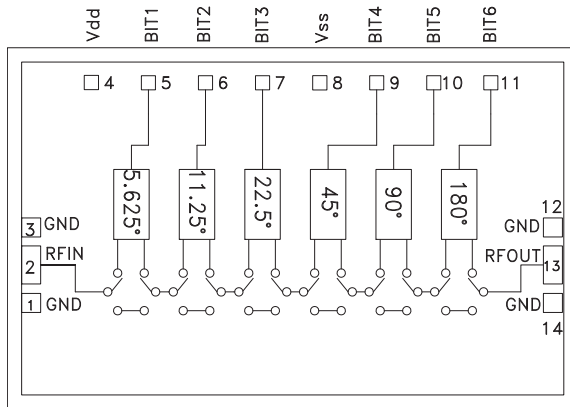
## GaAs MMIC 6-BIT DIGITAL PHASE SHIFTER, 9 - 12.5 GHz

### Typical Applications

The HMC642 is ideal for:

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

### Functional Diagram



### Features

- Low RMS Phase Error: 2.5°
- Low Insertion Loss: 6.5 dB
- High Linearity: +41 dBm
- Positive Control Voltage
- 360° Coverage, LSB = 5.625°
- Die Size: 3.25 x 1.9 x 0.1 mm

### General Description

The HMC642 is a 6-bit digital phase shifter die which is rated from 9 to 12.5 GHz, providing 360 degrees of phase coverage, with a LSB of 5.625 degrees. The HMC642 features very low RMS phase error of 2.5 degrees and extremely low insertion loss variation of  $\pm 0.25$  dB across all phase states. This high accuracy phase shifter is controlled with positive control logic of 0/+5V, and is internally matched to 50 Ohms with no external components.

### Electrical Specifications, $T_A = +25^\circ \text{C}$ , Vee = -5V, Vdd = +5V, Control Voltage = 0/+5V, 50 Ohm System

Parameter	Min.	Typ.	Max.	Units
Frequency Range	9		12.5	GHz
Insertion Loss*		6.5	8.5	dB
Input Return Loss*		13		dB
Output Return Loss*		12		dB
Phase Error*		$\pm 5$	+15 / -8	deg
RMS Phase Error		2.5		deg
Insertion Loss Variation*		$\pm 0.25$		dB
Input Power for 1 dB Compression		28		dBm
Input Third Order Intercept		41		dBm
Control Voltage Current		<250		$\mu\text{A}$
Bias Control Current		<12		mA

\*Note: Major States Shown

**GaAs MMIC 6-BIT DIGITAL  
PHASE SHIFTER, 9 - 12.5 GHz**

**Insertion Loss, Major States Only**



**Normalized Loss, Major States Only**



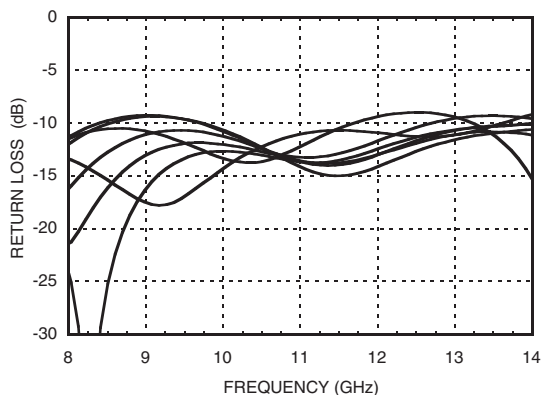
**Input Return Loss, Major States Only**



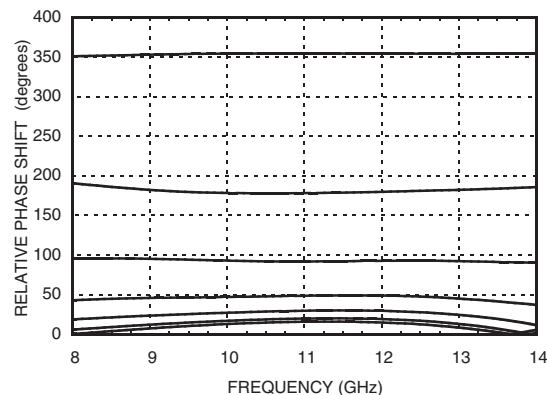
**Phase Error, Major States Only**



**Output Return Loss, Major States Only**



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

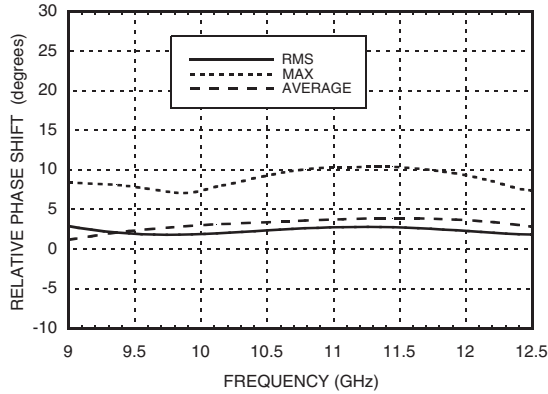


Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

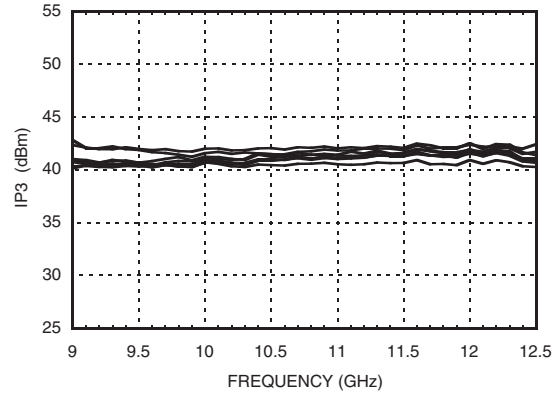
For price, delivery, and to place orders: Analog Devices, Inc., One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106 Phone: 781-329-4700 • Order online at [www.analog.com](http://www.analog.com) Application Support: Phone: 1-800-ANALOG-D

**GaAs MMIC 6-BIT DIGITAL  
PHASE SHIFTER, 9 - 12.5 GHz**

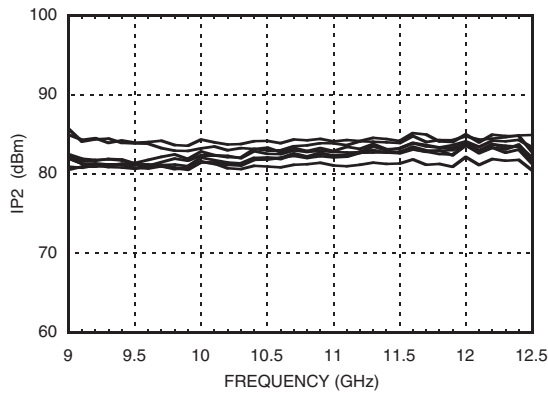
**Relative Phase Shift,  
RMS, Average, Max, All States**



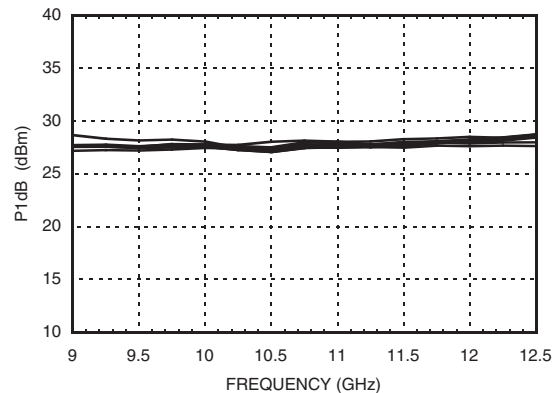
**Input IP3, Major States Only**



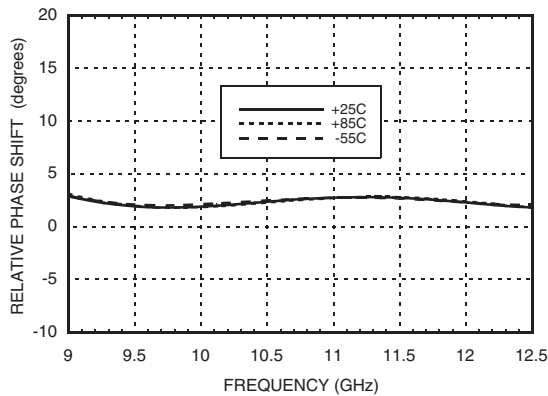
**Input IP2, Major States Only**



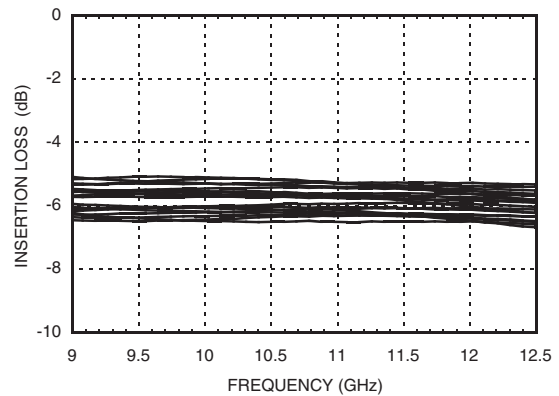
**Input P1dB, Major States Only**



**RMS Phase Error vs. Temperature**



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

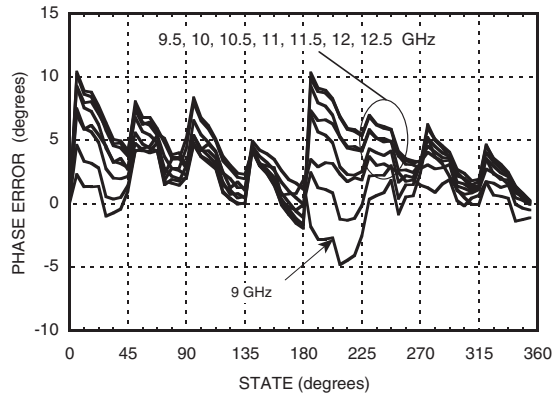


Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

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](http://www.analog.com) Application Support: Phone: 1-800-ANALOG-D

## GaAs MMIC 6-BIT DIGITAL PHASE SHIFTER, 9 - 12.5 GHz

### Phase Error vs. State



### Absolute Maximum Ratings

Input Power (RFIN)	30 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 die bottom)	60 °C/W
Storage Temperature	-65 to +150 °C
Operating Temperature	-55 to +85 °C



**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


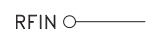

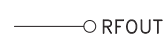
### Bias Voltage & Current

Vdd	Idd
5.0	5.6mA
Vss	Iss
-5.0	5.6mA

### Control Voltage

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

### Pad Descriptions

Pad Number	Function	Description	Interface Schematic
1, 3, 12, 14	GND	These pads and die bottom must be connected to RF/DC ground.	
2	RFIN	This port is DC coupled and matched to 50 Ohms.	
4	Vdd	Voltage supply.	
5 - 7, 9 - 11	BIT1, BIT2, BIT3, BIT4, BIT5, BIT6	Control Input. See truth table and control voltage tables.	
8	Vss	Voltage supply.	
13	RFOUT	This port is DC coupled and matched to 50 Ohms.	

Information furnished by Analog Devices is believed to be accurate and reliable. However, no responsibility is assumed by Analog Devices for its use, nor for any infringements of patents or other rights of third parties that may result from its use. Specifications subject to change without notice. No license is granted by implication or otherwise under any patent or patent rights of Analog Devices. Trademarks and registered trademarks are the property of their respective owners.

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](http://www.analog.com)  
Application Support: Phone: 1-800-ANALOG-D

**GaAs MMIC 6-BIT DIGITAL  
PHASE SHIFTER, 9 - 12.5 GHz**

**Outline Drawing**



**Die Packaging Information** [1]

Standard	Alternate
GP-1 (Gel Pack)	[2]

[1] Refer to the "Packaging Information" section for die packaging dimensions.

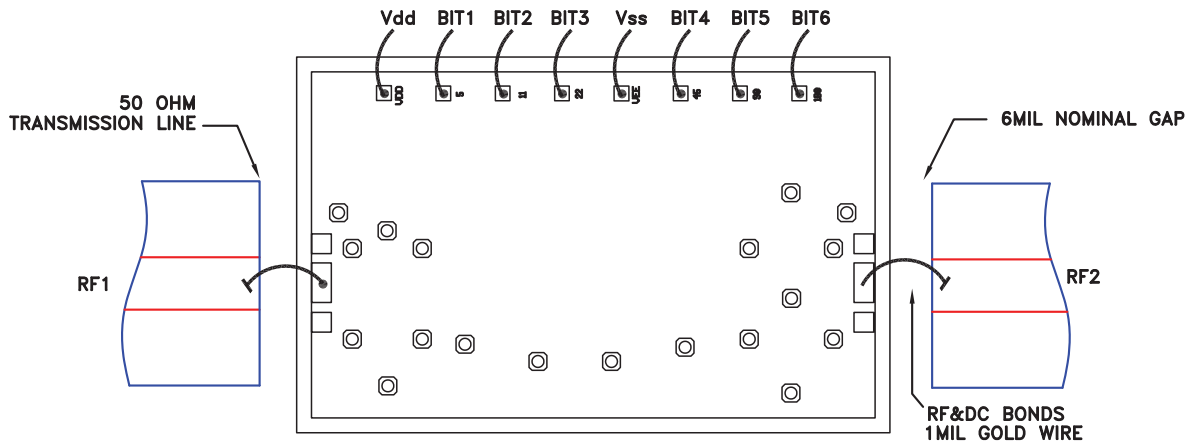
[2] For alternate packaging information contact Hittite Microwave Corporation.

NOTES:

1. ALL DIMENSIONS IN INCHES (MILLIMETERS)
2. DIE THICKNESS IS 0.004
3. BACKSIDE METALLIZATION: GOLD
4. BACKSIDE METAL IS GROUND
5. BOND PADS METALLIZATION: GOLD
6. OVERALL DIE SIZE  $\pm 0.002$

## GaAs MMIC 6-BIT DIGITAL PHASE SHIFTER, 9 - 12.5 GHz

### Assembly Diagram



### Handling Precautions

Follow these precautions to avoid permanent damage.

**Storage:** All bare die are placed in either Waffle or Gel based ESD protective containers, and then sealed in an ESD protective bag for shipment. Once the sealed ESD protective bag has been opened, all die should be stored in a dry nitrogen environment.

**Cleanliness:** Handle the chips in a clean environment. DO NOT attempt to clean the chip using liquid cleaning systems.

**Static Sensitivity:** Follow ESD precautions to protect against  $\pm 250V$  ESD strikes.

**Transients:** Suppress instrument and bias supply transients while bias is applied. Use shielded signal and bias cables to minimize inductive pick-up.

**General Handling:** Handle the chip along the edges with a vacuum collet or with a sharp pair of bent tweezers. The surface of the chip has fragile air bridges and should not be touched with vacuum collet, tweezers, or fingers.

### Mounting

The chip is back-metallized and can be die mounted with electrically conductive epoxy. The mounting surface should be clean and flat.

**Epoxy Die Attach:** Apply a minimum amount of epoxy to the mounting surface so that a thin epoxy fillet is observed around the perimeter of the chip once it is placed into position. Cure epoxy per the manufacturer's schedule.

### Wire Bonding

Ball or wedge bond with 0.025mm (1 mil) diameter pure gold wire. Thermosonic wirebonding with a nominal stage temperature of 150 deg. C and a ball bonding force of 40 to 50 grams or wedge bonding force of 18 to 22 grams is recommended. Use the minimum level of ultrasonic energy to achieve reliable wirebonds. Wirebonds should be started on the chip and terminated on the package or substrate. All bonds should be as short as possible <0.31mm (12 mils).



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.