

# Analog Devices Welcomes Hittite Microwave Corporation

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## 22.5° MMIC 4-BIT DIGITAL PHASE SHIFTER MODULE, 8 - 12 GHz



### Features

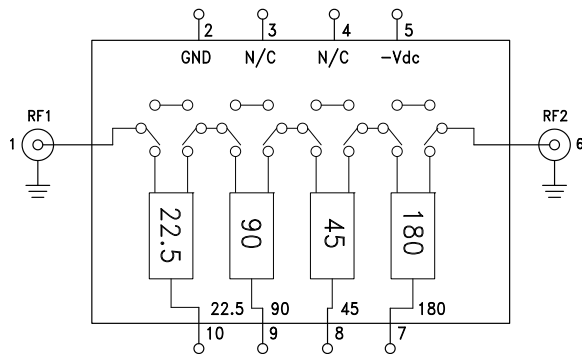
- Low RMS Phase Error: 6°
- Low Insertion Loss: 7 dB
- Excellent Flatness
- 360° Coverage, LSB = 22.5°
- Hermetically Sealed Module
- Field Replaceable SMA Female Connectors

### Typical Applications

The HMC-C055 is ideal for:

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

### Functional Diagram



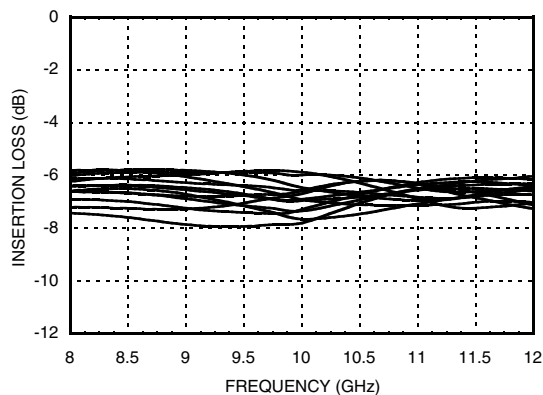
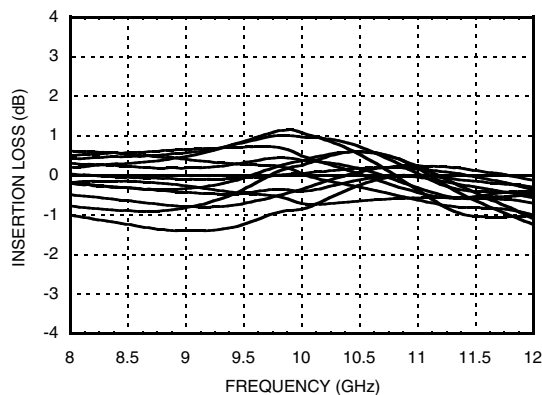
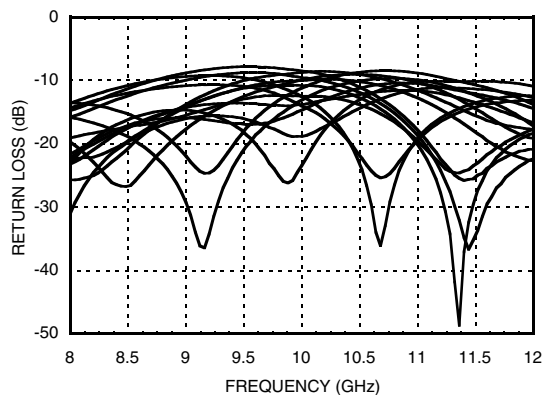
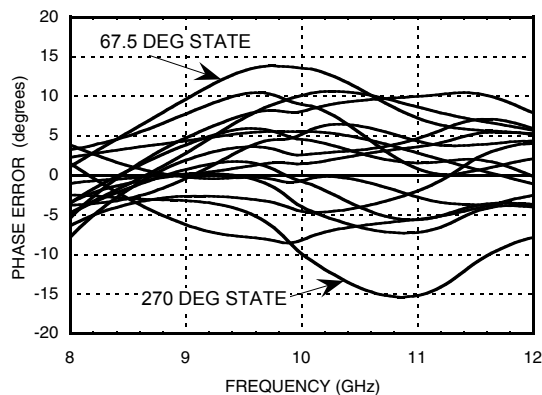
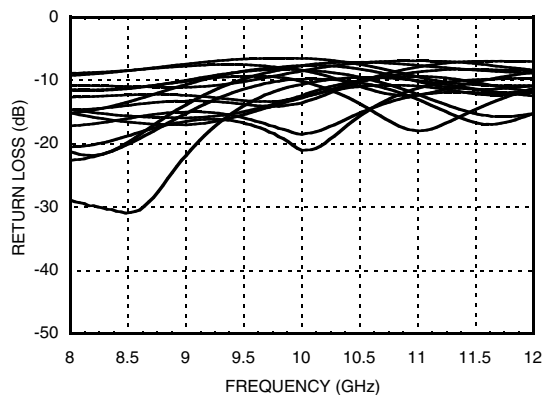
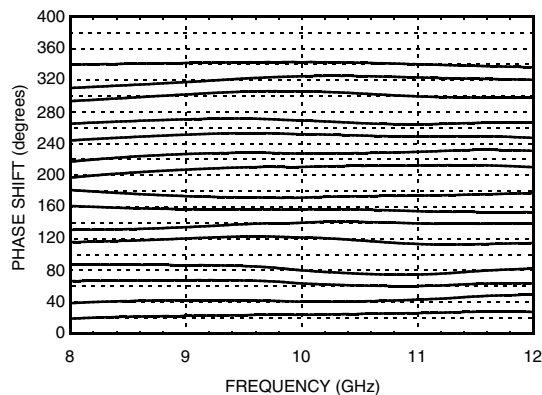
### General Description

The HMC-C055 is a 4-bit digital phase shifter which is rated from 8 to 12 GHz, providing 0 to 360 degrees of monotonic phase coverage, with a LSB of 22.5 degrees. The HMC-C055 features a very low RMS phase error of 6 degrees and a low insertion loss variation of  $\pm 1$  dB across all phase states. This high accuracy phase shifter requires a single DC voltage of -5V and is internally matched to 50 Ohms. The package is a hermetically sealed module that can utilize field replaceable SMA connectors or be used as a drop-in module.

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

Parameter	Min.	Typ.	Max.	Units
Frequency Range	8		12	GHz
Insertion Loss*		7	8.5	dB
Input Return Loss*		10		dB
Output Return Loss*		8		dB
Phase Error*		$\pm 10$	$\pm 17$	deg
RMS Phase Error		6		deg
Gain Variation*		$\pm 1$		dB
Input Power for 1 dB Compression		24		dBm
Input Third Order Intercept		38		dBm
Control Voltage Current		2.5		mA

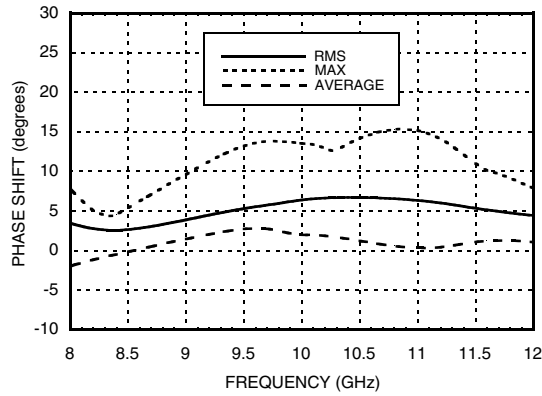
\*Note: All States Shown

**22.5° MMIC 4-BIT DIGITAL  
PHASE SHIFTER MODULE, 8 - 12 GHz**
**Insertion Loss, All States**

**Normalized Loss, All States**

**Input Return Loss, All States**

**Phase Error, All States**

**Output Return Loss, All States**

**Relative Phase Shift, All States**


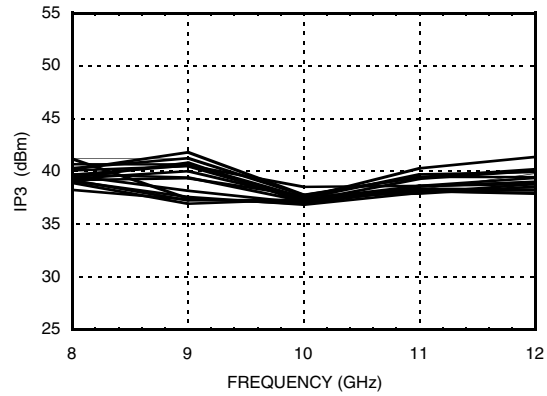


## 22.5° MMIC 4-BIT DIGITAL PHASE SHIFTER MODULE, 8 - 12 GHz

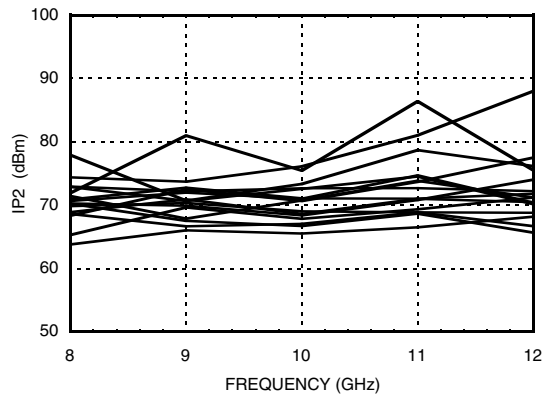
**Relative Phase Shift, RMS, Average, Max, All States**



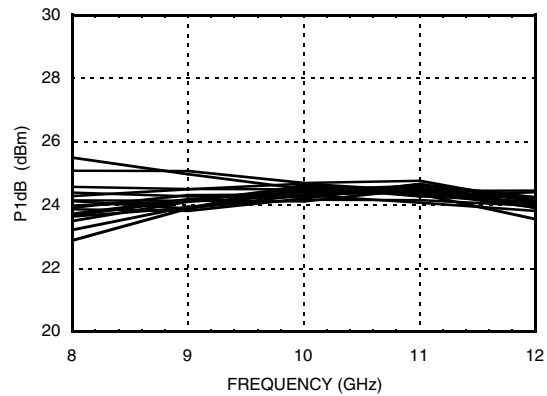
**Input IP3, All States**



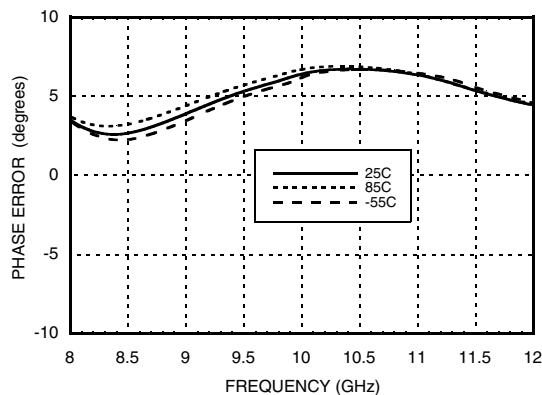
**Input IP2, All States**



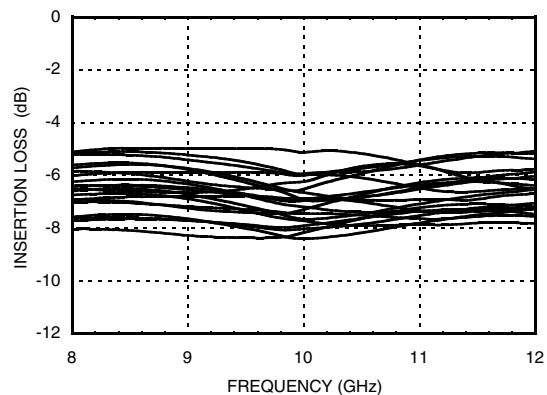
**Input P1dB, All States**



**RMS Phase Error vs. Temperature**



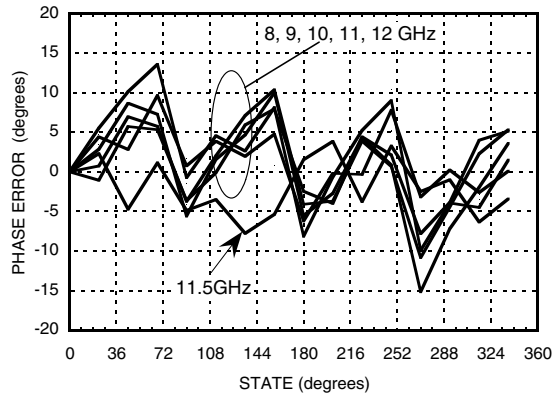
**Insertion Loss vs. Temperature All States**





## 22.5° MMIC 4-BIT DIGITAL PHASE SHIFTER MODULE, 8 - 12 GHz

### Phase Error vs. State



### Absolute Maximum Ratings

Input Power (RF1, RF2) (8-12 GHz)	+27 dBm (T= +85 °C)
Channel Temperature (Tc)	150 °C
Supply Voltage (-Vdc)	-5.5V
Control Voltage	5.5V
Storage Temperature	-65 to +150 °C
Operating Temperature	-40 to +85 °C

### Truth Table

Control Voltage Input				Phase Shift (Degree) RFIN - RFOUT
22.5	45	90	180	
0	0	0	0	Reference
1	0	0	0	22.5
0	1	0	0	45
0	0	1	0	90
0	0	0	1	180
1	1	1	1	337.5

Any combination of the above states will provide a phase shift approximately equal to the sum of the bits selected.

### Control Voltage

State	Bias Condition
Low (0)	0V
High (1)	+5V

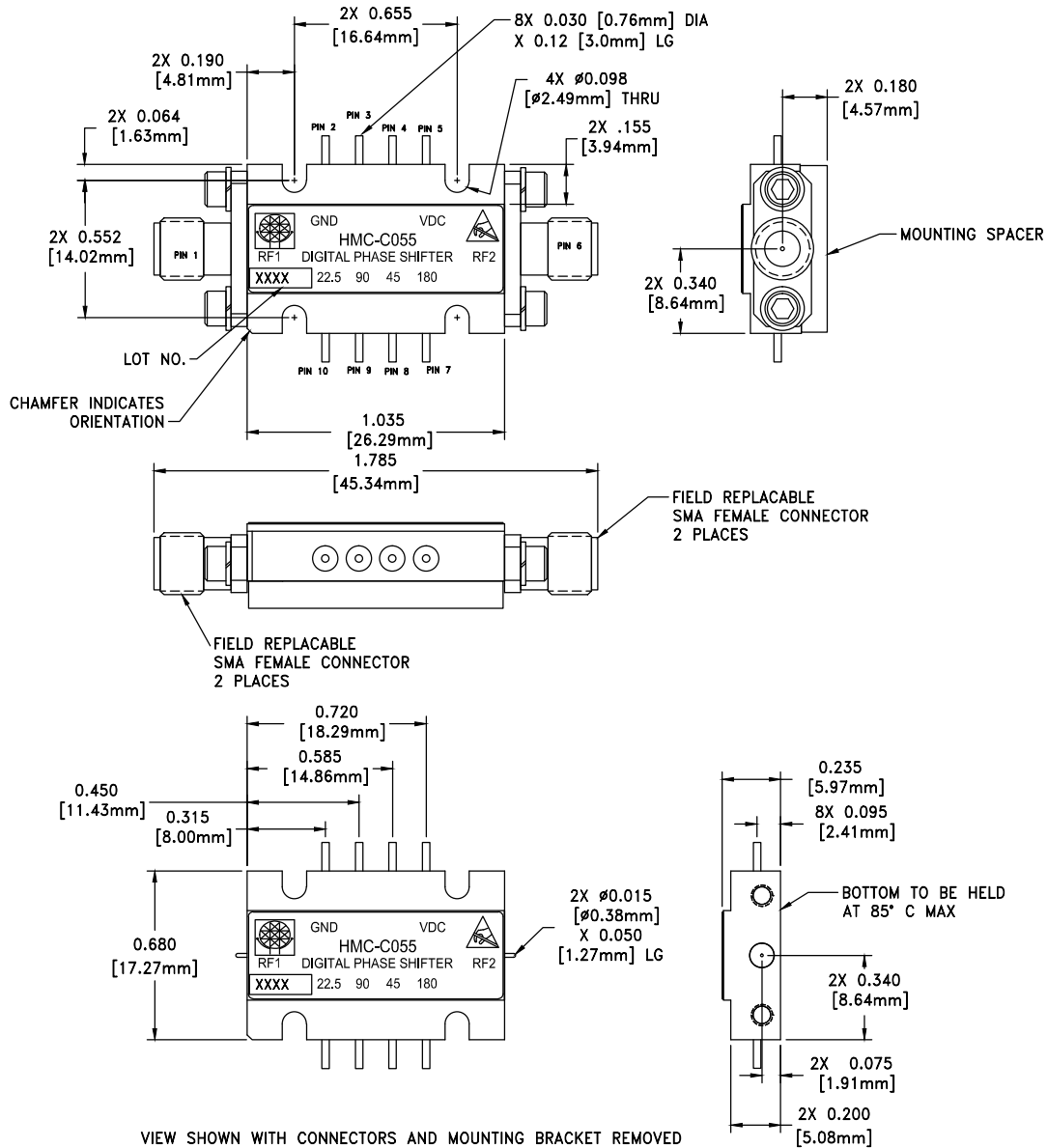


**ELECTROSTATIC SENSITIVE DEVICE  
OBSERVE HANDLING PRECAUTIONS**



**22.5° MMIC 4-BIT DIGITAL PHASE SHIFTER MODULE, 8 - 12 GHz**

**Outline Drawing**



VIEW SHOWN WITH CONNECTORS AND MOUNTING BRACKET REMOVED

**Package Information**

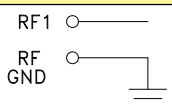

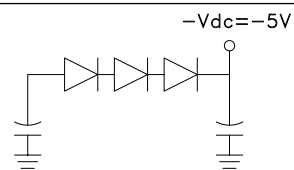
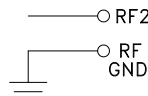
Package Type	C-6
Package Weight [1]	17.4 gms [2]
Spacer Weight	3 gms [2]

[1] Includes the connectors  
 [2] ±1 gms Tolerance

- NOTES:**
1. PACKAGE, LEADS, COVER MATERIAL: KOVAR™
  2. PLATING: ELECTROLYTIC GOLD 50 MICROINCHES MIN., OVER ELECTROLYTIC NICKEL 75 MICROINCHES MIN
  3. MOUNTING SPACER: NICKEL PLATED ALUMINUM
  4. ALL DIMENSIONS ARE IN INCHES [MILLIMETERS]
  5. TOLERANCES ±0.010 [0.25] UNLESS OTHERWISE SPECIFIED
  6. FIELD REPLACEABLE SMA CONNECTORS TENSOLITE 5602 - 5CCSF OR EQUIVALENT
  7. TO MOUNT MODULE TO SYSTEM PLATFORM REPLACE 0 -80 HARDWARE WITH DESIRED MOUNTING SCREWS

PHASE SHIFTERS


**22.5° MMIC 4-BIT DIGITAL  
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**Pin Descriptions**

Pin Number	Function	Description	Interface Schematic
1	RF1 & RF Ground	RF input connector, coaxial female, field replaceable. This pin is AC coupled and matched to 50 Ohms.	
2	GND	This pin must be connected to RF/DC ground.	
3, 4	N/C	The pins are not connected internally; however, all data shown herein was measured with these pins connected to RF/DC ground externally.	
5	-Vdc	-5V DC Voltage	
6	RF2 & RF Ground	RF input connector, coaxial female, field replaceable. This pin is AC coupled and matched to 50 Ohms.	
7 - 10	180, 45, 90, 22.5	Control voltage input. See truth table and control voltage tables.	