MAPS-010165-DIE

Digital Phase Shifter
6-Bit, 3.5 - 6.0 GHz

Rev. V1

Features

- 6 Bit Digital Phase Shifter
- 360° Coverage with LSB = 5.6°
- Low DC Power Consumption
- Minimal Attenuation Variation over Phase Shift Range
- 50 Ω Impedance
- EAR99
- RoHS* Compliant

Description

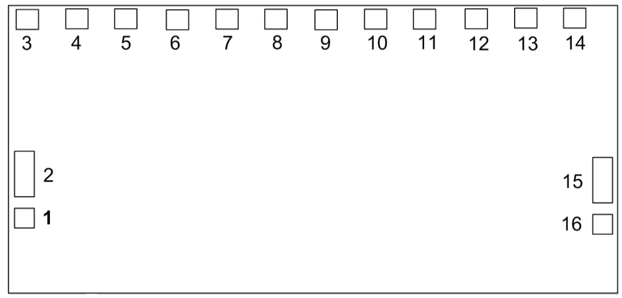
The MAPS-010165-DIE is a GaAs pHEMT 6-bit digital phase shifter. Step size is 5.6° providing phase shift from 0° to 360° in 5.6° steps. This design has been optimized to minimize variation in attenuation over the phase shift range.

The MAPS-010165-DIE is ideally suited for use where high phase accuracy with minimum loss variation over the phase shift range are required. Typical applications include communications antennas and phased array radars.

Ordering Information

Part Number	Package
MAPS-010165-DIE	50 piece Gel Pak

Functional Schematic



Pad Configuration[1]

Pad #	Name	Function
1, 16	GND	Ground
2	RF_{IN}	RF Input
3	A1	5.6° Control
4	B1	5.6° Control
5	A2	11.2° Control
6	B2	11.2° Control
7	A3	22.5° Control
8	B3	22.5° Control
9	A4	45° Control
10	B4	45° Control
11	A5	90° Control
12	B5	90° Control
13	A6	180° Control
14	B6	180° Control
15	RF_{OUT}	RF Output

1. The backside of the die must be connected to RF, DC, and thermal ground.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

Electrical Specifications: Freq. = 3.5 - 6.0 GHz, T_A = 25°C, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss	Any Phase State 3.5 GHz 6.0 GHz	dB	—	4.9 5.8	6.5 7.0
Attenuation Variation	Across All Phase States	dB	—	± 0.8	—
RMS Attenuation Error [2]	All Values Relative to Insertion Loss at Reference Phase	dB	—	0.4	—
RMS Phase Error [2]	All Values Relative to Reference Phase	deg.	—	4	—
Phase Relative to Reference Loss State	5.6° Bit 11.2° Bit 22.5° Bit 45° Bit 90° Bit 180° Bit Sum of All Bits	deg.	—	4.7 10.5 23 42.5 90 182 352	—
VSWR	RF IN RF OUT	Ratio	—	1.5:1 1.5:1	—
1 dB Compression	Reference State	dBm	—	27	—
Input IP3	Two-tone inputs up to 5 dBm	dBm	—	40	—
T_{RISE}, T_{FALL}	10% to 90% RF, 90% to 10% RF	ns	—	50	—
V_L V_H	LOW-level input voltage HIGH-level input voltage	V	—	-5 0	—

2. RMS is calculated across all 63 amplitude or phase states relative to the amplitude or phase in the 0° phase state at a given frequency.

Truth Table[3]

A1	B1	A2	B2	A3	B3	A4	B4	A5	B5	A6	B6	Phase Shift
V_L	V_H	V_L	V_H	V_L	V_H	V_L	V_H	V_L	V_H	V_L	V_H	Reference Phase
V_H	V_L	V_L	V_H	V_L	V_H	V_L	V_H	V_L	V_H	V_L	V_H	5.6°
V_L	V_H	V_H	V_L	V_L	V_H	V_L	V_H	V_L	V_H	V_L	V_H	11.2°
V_L	V_H	V_L	V_H	V_H	V_L	V_L	V_H	V_L	V_H	V_L	V_H	22.5°
V_L	V_H	V_L	V_H	V_L	V_H	V_H	V_L	V_L	V_H	V_L	V_H	45°
V_L	V_H	V_L	V_H	V_L	V_H	V_L	V_H	V_H	V_L	V_L	V_H	90°
V_L	V_H	V_L	V_H	V_L	V_H	V_L	V_H	V_L	V_H	V_H	V_L	180°
V_H	V_L	V_H	V_L	V_H	V_L	V_H	V_L	V_H	V_L	V_H	V_L	354.4°

3. V_L = -5 V, V_H = 0 V.

Absolute Maximum Ratings[4,5]

Parameter	Absolute Maximum
Input Power 3.5 - 6.0 GHz	27 dBm
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C

4. Exceeding any one or combination of these limits may cause permanent damage to this device.
5. MACOM does not recommend sustained operation near these survivability limits.

Handling Procedures

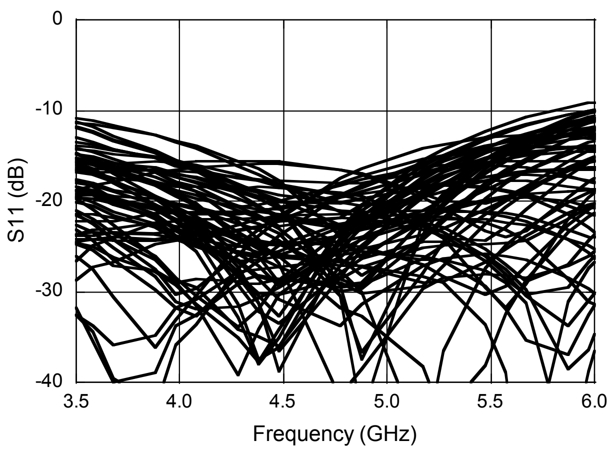
Please observe the following precautions to avoid damage:

Static Sensitivity

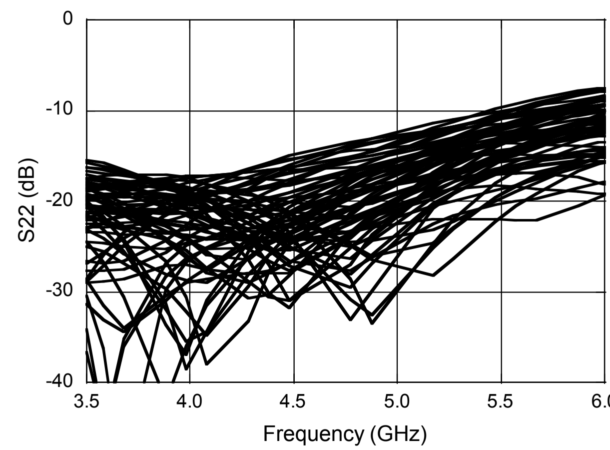
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

Typical Performance Curves

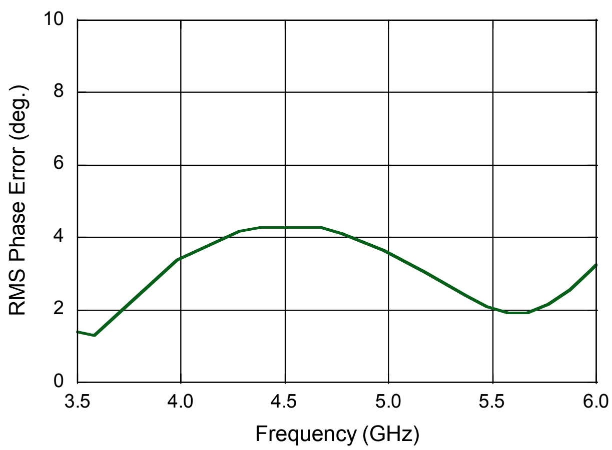
RF$_{IN}$ Return Loss vs. Frequency (All States)



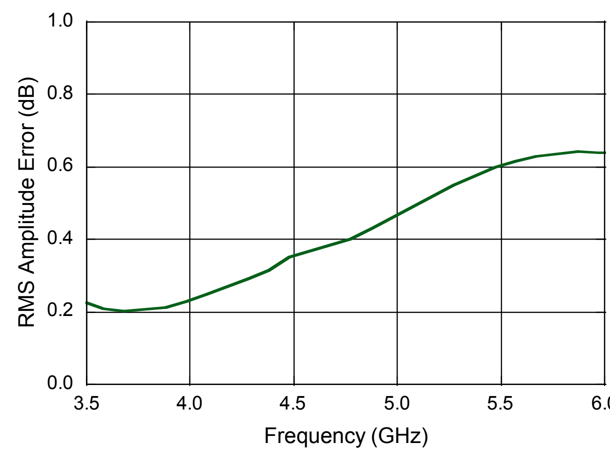
RF$_{OUT}$ Return Loss vs. Frequency (All States)



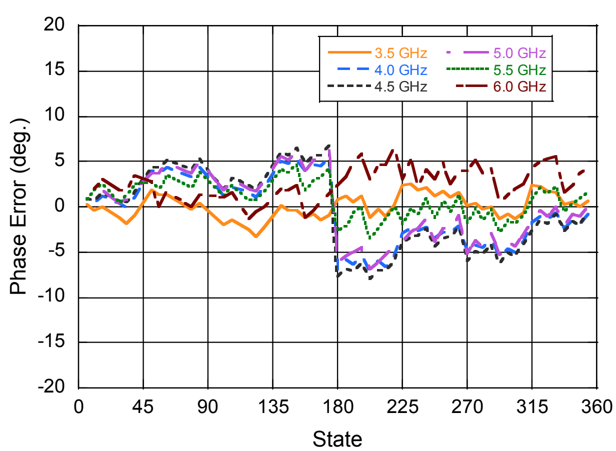
Mean RMS Phase Error vs. Frequency



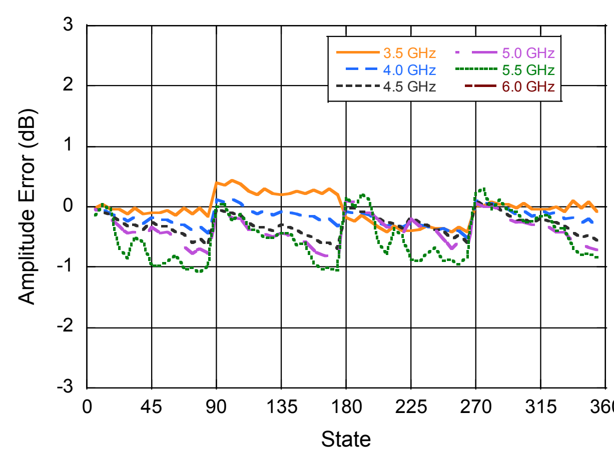
Mean RMS Amplitude Error vs. Frequency



Phase Error vs. State

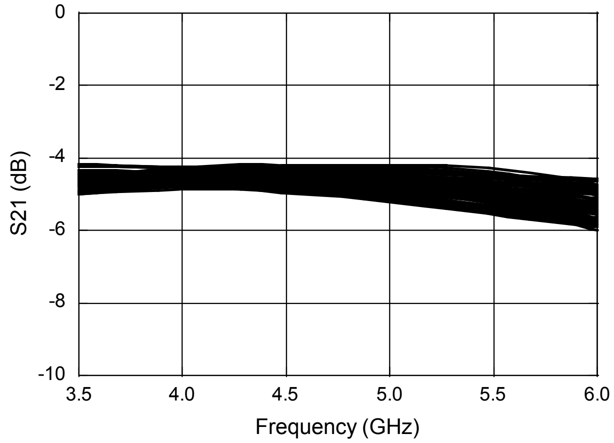


Amplitude Error vs. State

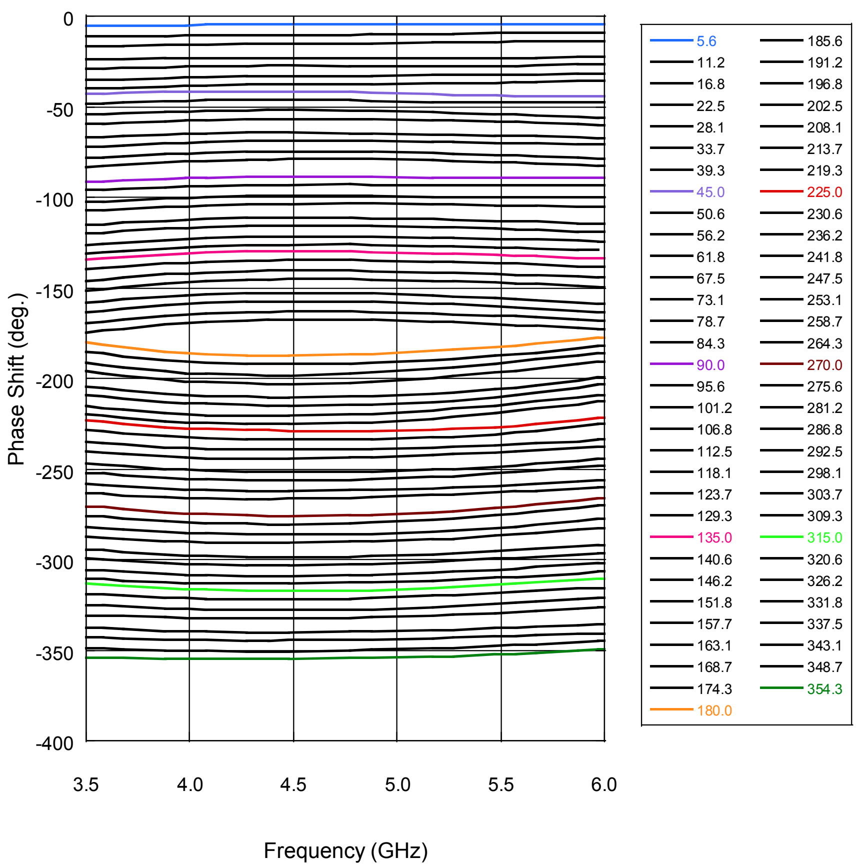


Typical Performance Curves

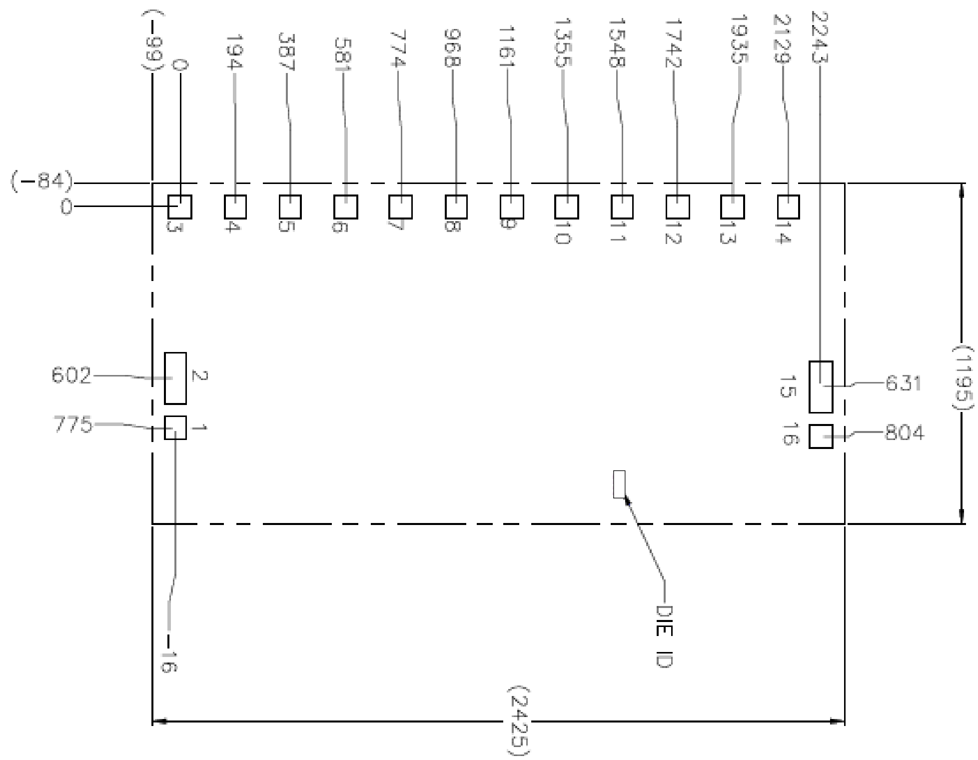
Amplitude Variation vs. Phase State



Phase Shift vs. Frequency (All States)



Outline Drawing [6,7,8,9]



6. Unless otherwise specified, all dimensions are um with a tolerance of ±5 µm.
7. Die thickness is 100 ±10 µm.
8. Bond pad/backside metallization: Gold.
9. Die size reflects uncut dimensions. Saw or laser kerf reduces die size by ~25 µm each dimension.