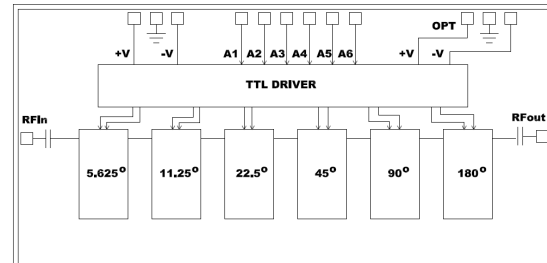


## 3.0 – 4.0 GHz 6-Bit Digital Phase Shifter

### Features

- ◆ Frequency Range: 3 to 4 GHz
- ◆ Low RMS Phase Error ~ 2°
- ◆ 6 dB Maximum Insertion Loss
- ◆ TTL Control Inputs
- ◆ 21 dBm Input P1dB
- ◆ Hermetically Sealed Package
- ◆ Small form factor : 22 mm x19mm x14mm

Functional diagram



### Typical Applications

- ◆ Military & Space
- ◆ Radar
- ◆ Test and Measurement

### Description

The AMT2221013P is a 6-bit digital phase shifter MMIC in a hermetically sealed package designed to work from 3 to 4 GHz. The phase shifter features a low RMS phase error of less than 1.8 deg over the entire operating band. The insertion loss is 6 dB maximum and varies within  $\pm 0.5$  dB over the band and the 64 phase states. The phase shifter has an input P1 dB of 21 dBm at +7V & -7V supply Voltages and is capable of handling up to 1 Watt of input power. The input /output ports are well matched to 50 Ohms. The integrated TTL compatible drivers provide convenient digital interface for 6-bit control. The chip operates with +5V and -5V DC supply at a very low current. The MMIC die is fabricated using a robust 0.5 $\mu$ m InGaAs pHEMT technology.

### Absolute Maximum Ratings<sup>(1)</sup>

Parameter	Absolute Maximum	Units
RF Input Power	30	dBm
Positive Supply Voltage	+8	V
Negative Supply Voltage	-8	V
Control Voltage		
ON	+6	V
OFF	-0.5	V
Operating Temperature	-55 to +85	°C
Storage Temperature	-65 to +120	°C

1. Operation beyond these limits may cause permanent damage to the component

**Electrical Specifications @  $T_A = 25\text{ }^\circ\text{C}$ ,  $Z_o = 50\text{ }\Omega$** 

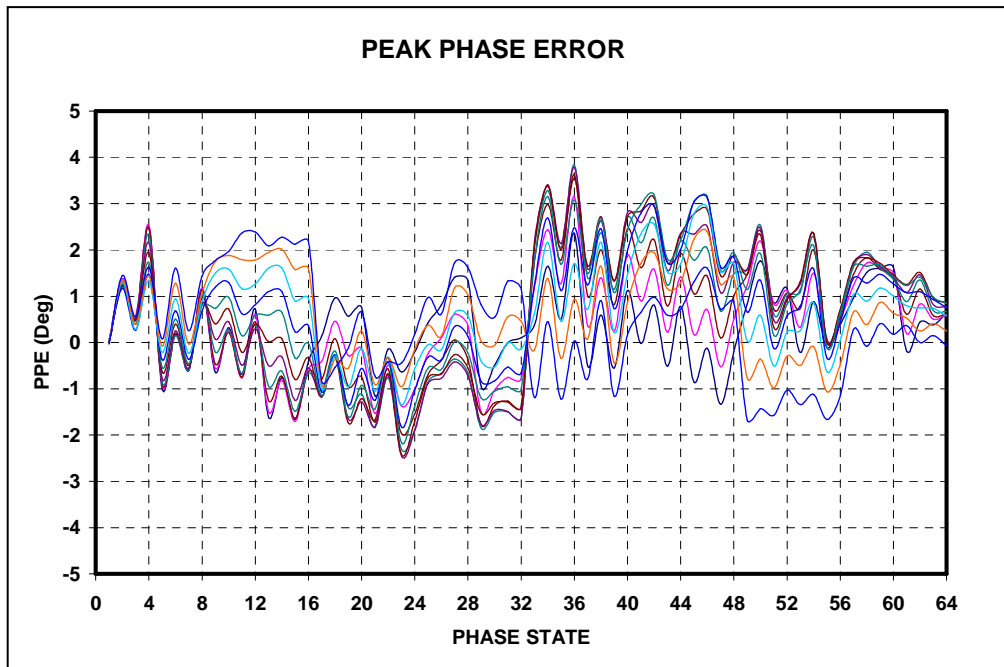
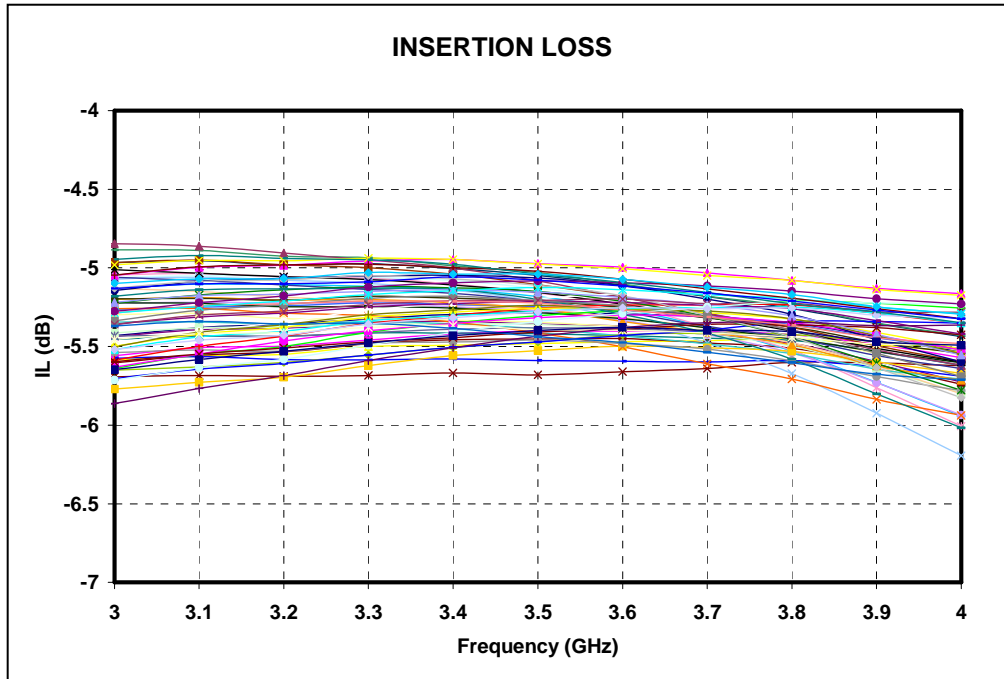
Parameter	Value	Units
Frequency Range	3 to 4	GHz
Phase Shift	0 – 360 in 64 steps	deg
Insertion Loss <sup>1</sup>	5.5	dB
Peak Amplitude Error	±0.6	dB
Peak Phase Shift Error	-3.5 to +5	deg
RMS Phase Shift Error	2	deg
Input Return loss <sup>2</sup>	-10	dB (max)
Output Return Loss <sup>2</sup>	-12	dB (max)
P1 dB @ Input <sup>3</sup>	+ 21	dBm
DC Supply Voltages	+5, -5	V
DC Supply Current <sup>4</sup>	11	mA
DC Control Voltage		
ON	+5	V
OFF	0	V

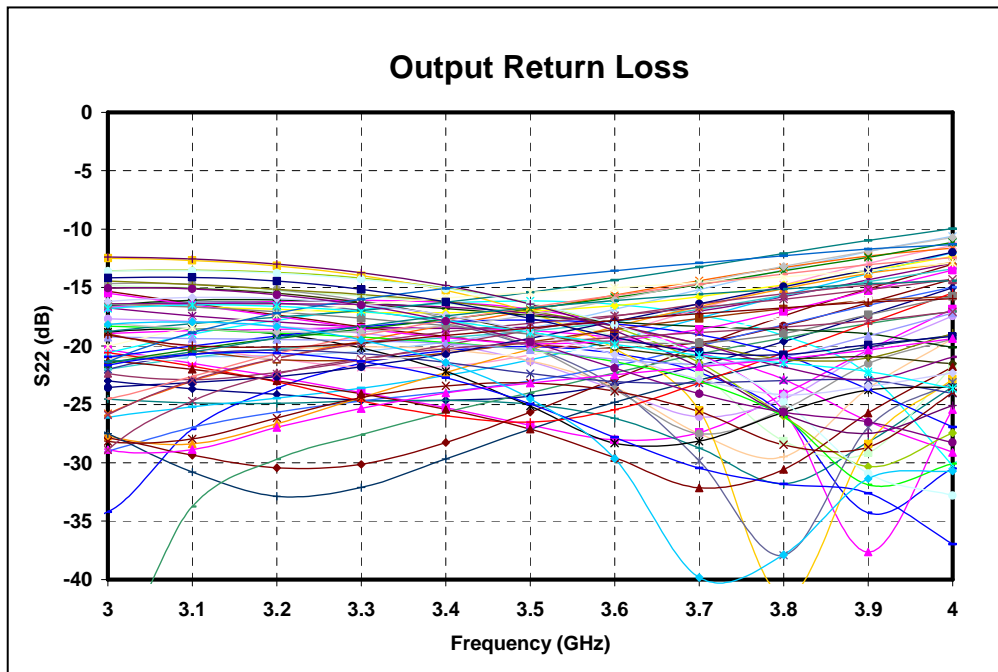
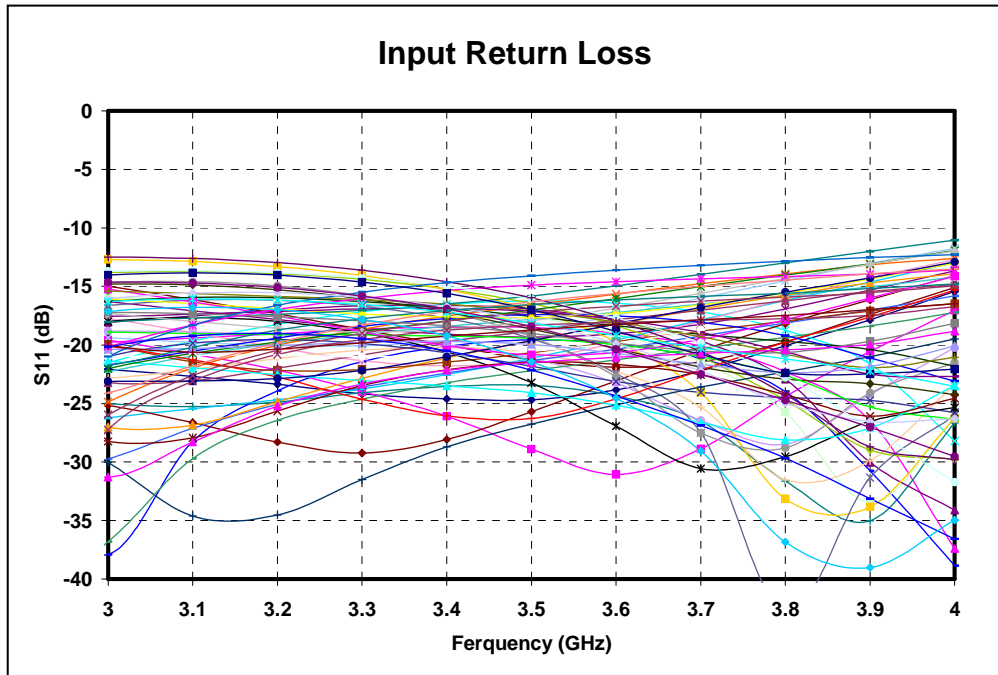
**Note:**

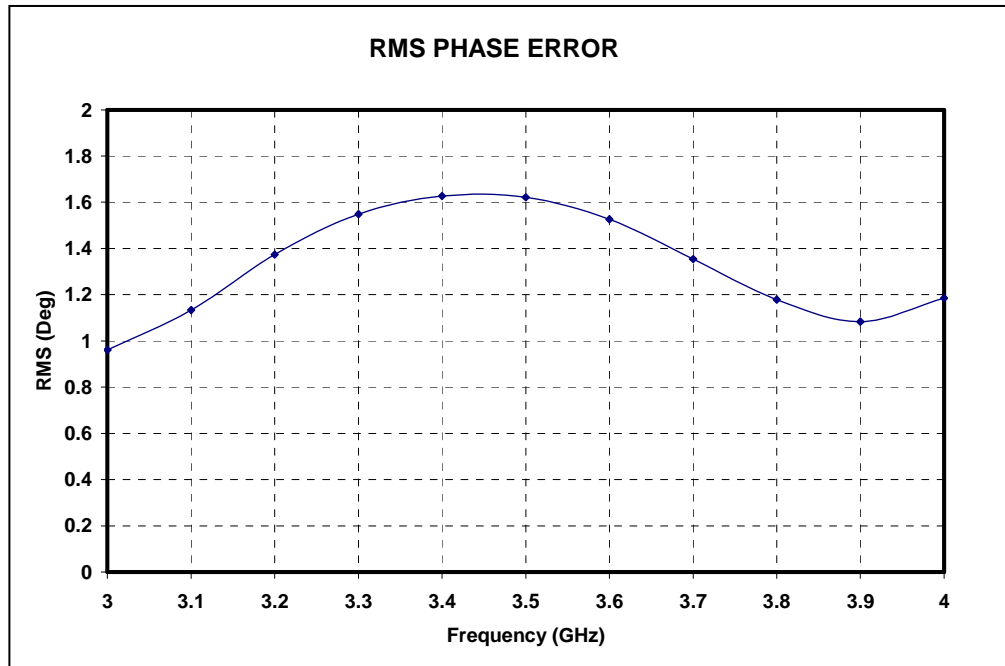
1. Averaged over all the 64 phase states
2. Measured over all the 64 phase states
3. Measured over prime phase states – 0, 5.625, 11.25, 22.5, 45, 90 and 180 degrees.
4. Positive supply draws 7mA, negative supply draws 3mA.

**Test fixture data**

$T_A = 25^\circ\text{C}$ ,  $Z_0 = 50\Omega$



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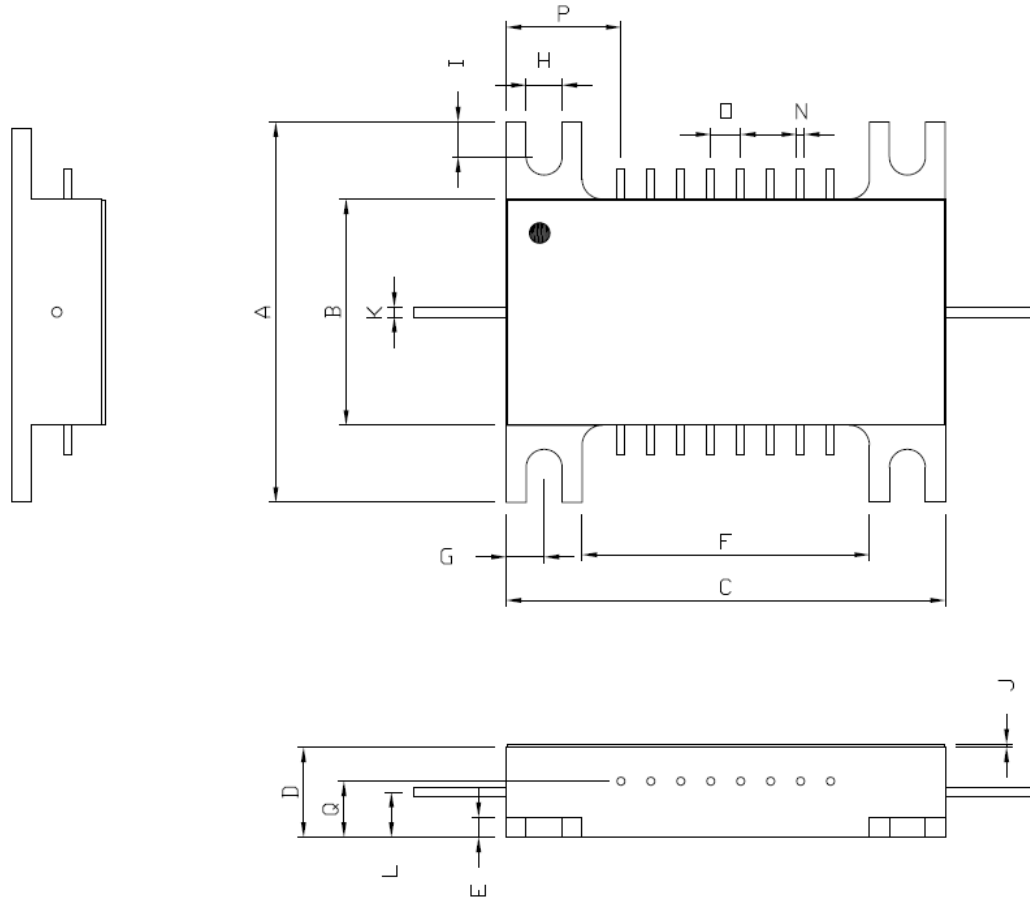
**Truth Table**

S.No.	Phase Shift	TTL Control ( 1 = 3.5 to 5 V, 0 = 0 to 0.5 V )					
		180Deg (A6)	90Deg (A5)	45Deg (A4)	22.5Deg (A3)	11.25Deg (A2)	5.625Deg (A1)
1	0	0	0	0	0	0	0
2	5.625	0	0	0	0	0	1
3	11.25	0	0	0	0	1	0
4	16.875	0	0	0	0	1	1
5	22.5	0	0	0	1	0	0
6	28.125	0	0	0	1	0	1
7	33.75	0	0	0	1	1	0
8	39.375	0	0	0	1	1	1
9	45	0	0	1	0	0	0
10	50.625	0	0	1	0	0	1
11	56.25	0	0	1	0	1	0
12	61.875	0	0	1	0	1	1
13	67.5	0	0	1	1	0	0
14	73.125	0	0	1	1	0	1
15	78.75	0	0	1	1	1	0
16	84.375	0	0	1	1	1	1
17	90	0	1	0	0	0	0
18	95.625	0	1	0	0	0	1
19	101.25	0	1	0	0	1	0
20	106.875	0	1	0	0	1	1
21	112.5	0	1	0	1	0	0
22	118.125	0	1	0	1	0	1
23	123.75	0	1	0	1	1	0
24	129.375	0	1	0	1	1	1
25	135	0	1	1	0	0	0
26	140.625	0	1	1	0	0	1
27	146.25	0	1	1	0	1	0
28	151.875	0	1	1	0	1	1
29	157.5	0	1	1	1	0	0
30	163.125	0	1	1	1	0	1
31	168.75	0	1	1	1	1	0
32	174.375	0	1	1	1	1	1
33	180	1	0	0	0	0	0
34	185.625	1	0	0	0	0	1
35	191.25	1	0	0	0	1	0
36	196.875	1	0	0	0	1	1

**Truth Table**

S.No.	Phase Shift	TTL Control ( 1 = 3.5 to 5 V, 0 = 0 to 0.5 V )					
		180Deg (A6)	90Deg (A5)	45Deg (A4)	22.5Deg (A3)	11.25Deg (A2)	5.625Deg (A1)
37	202.5	1	0	0	1	0	0
38	208.125	1	0	0	1	0	1
39	213.75	1	0	0	1	1	0
40	219.375	1	0	0	1	1	1
41	225	1	0	1	0	0	0
42	230.625	1	0	1	0	0	1
43	236.25	1	0	1	0	1	0
44	241.875	1	0	1	0	1	1
45	247.5	1	0	1	1	0	0
46	253.125	1	0	1	1	0	1
47	258.75	1	0	1	1	1	0
48	264.375	1	0	1	1	1	1
49	270	1	1	0	0	0	0
50	275.625	1	1	0	0	0	1
51	281.25	1	1	0	0	1	0
52	286.875	1	1	0	0	1	1
53	292.5	1	1	0	1	0	0
54	298.125	1	1	0	1	0	1
55	303.75	1	1	0	1	1	0
56	309.375	1	1	0	1	1	1
57	315	1	1	1	0	0	0
58	320.625	1	1	1	0	0	1
59	326.25	1	1	1	0	1	0
60	331.875	1	1	1	0	1	1
61	337.5	1	1	1	1	0	0
62	343.125	1	1	1	1	0	1
63	348.75	1	1	1	1	1	0
64	354.375	1	1	1	1	1	1

## Mechanical Characteristics



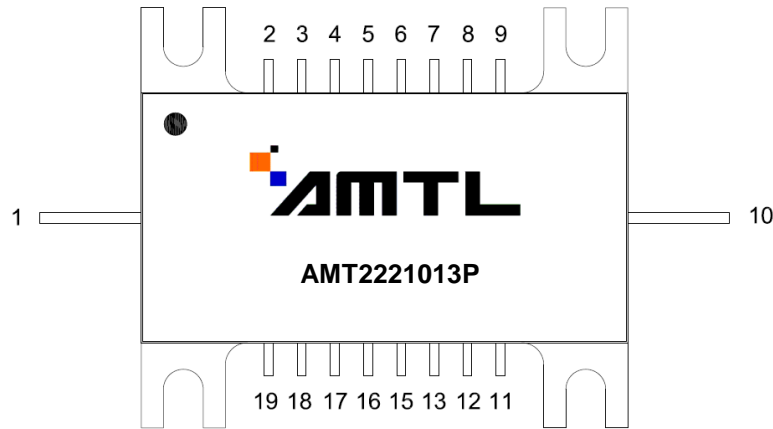
DIMENSION	MILLIMETER	INCHES	DIMENSION	MILLIMETER	INCHES
<b>A</b>	<b>19.00</b>	0.748	I	1.00	0.039
<b>B</b>	11.30	0.445	J	0.16	0.066
<b>C</b>	<b>22.00</b>	0.866	K <sup>1</sup>	0.50	0.020
<b>D</b>	<b>14.40</b>	0.570	L	2.25	0.089
<b>E</b>	1.90	0.075	M	0.40	0.016
<b>F</b>	1.80	0.710	N <sup>2</sup>	1.50	0.059
<b>G</b>	1.75	0.070	O	5.75	0.226
<b>H</b>	4.50	0.177	P	2.80	0.110

**Note:**

1. RF PIN Diameter, PIN Length- 4.6 mm (0.181 inches)
2. DC/Control PIN Diameter, PIN Length- 1.5 mm (0.059 inches)



## PIN number Designation



PIN No.	Function	PIN No.	Function
1	RF INPUT	11	NC
2	CTRL BIT – 1 (5.625°)	12	NC
3	CTRL BIT – 2 (11.25°)	13	NC
4	CTRL BIT – 3 (22.5°)	14	NC
5	CTRL BIT – 4 (45°)	15	NC
6	CTRL BIT – 5 (90°)	16	NC
7	CTRL BIT – 6 (180°)	17	NC
8	+Vcc (+5V)	18	NC
9	-Vcc (-5V)	19	NC
10	RF OUTPUT		

**Note:**

- All Control Inputs were given through 500 Ohms series Resistors



***GaAs MMIC devices are susceptible to Electrostatic discharge. Proper precautions should be observed during handling, assembly & testing***

All information and Specifications are subject to change without prior notice