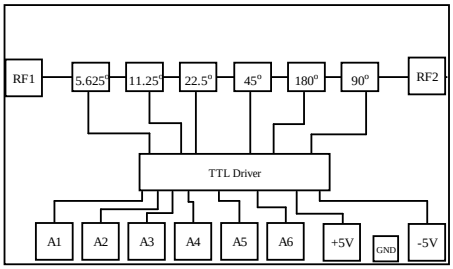
5 – 6 GHz 6-Bit Digital Phase Shifter

Features

- **Frequency Range: 5 to 6 GHz**
- **RMS Error ~ 3.5 deg.**
- **6 dB Insertion Loss**
- **Low Insertion loss Variation**
- **Excellent I/O return losses**
- **TTL Compatible**
- **0.5-um InGaAs pHEMT Technology**
- **Chip Size : 4.5mm x 2.2 mm x 0.1 mm**

Functional Diagram



Typical Applications

- **Radar**
- **Military & Space**
- **Instrumentation**

Description

The AMT 2231041 is a 6-bit digital phase shifter MMIC designed to operate over a frequency band of 5-6 GHz. The phase shifter features a low RMS phase error of less than 3.5 deg over the entire operating band. The midband insertion loss is 6 dB and varies within ± 1.0 dB over the band and the 64 phase states. The input /output ports are well matched to 50 Ohms. The integrated TTL compatible drivers provide a 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 0.5µm InGaAs pHEMT technology.

Absolute Maximum Ratings (1)

Parameter	Absolute Maximum	Units
RF Input Power	25	dBm
Positive Supply Voltage	+6	V
Negative Supply Voltage	-6	V
Control Voltage ON OFF	 +5 to +5.5 -0.5 to 0	 V V
Operating Temperature	-40 to +85	ºC
Storage Temperature	-65 to +150	ºC

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

Electrical Specifications [1] @ T_A = 25 °C, Z_o =50 Ω

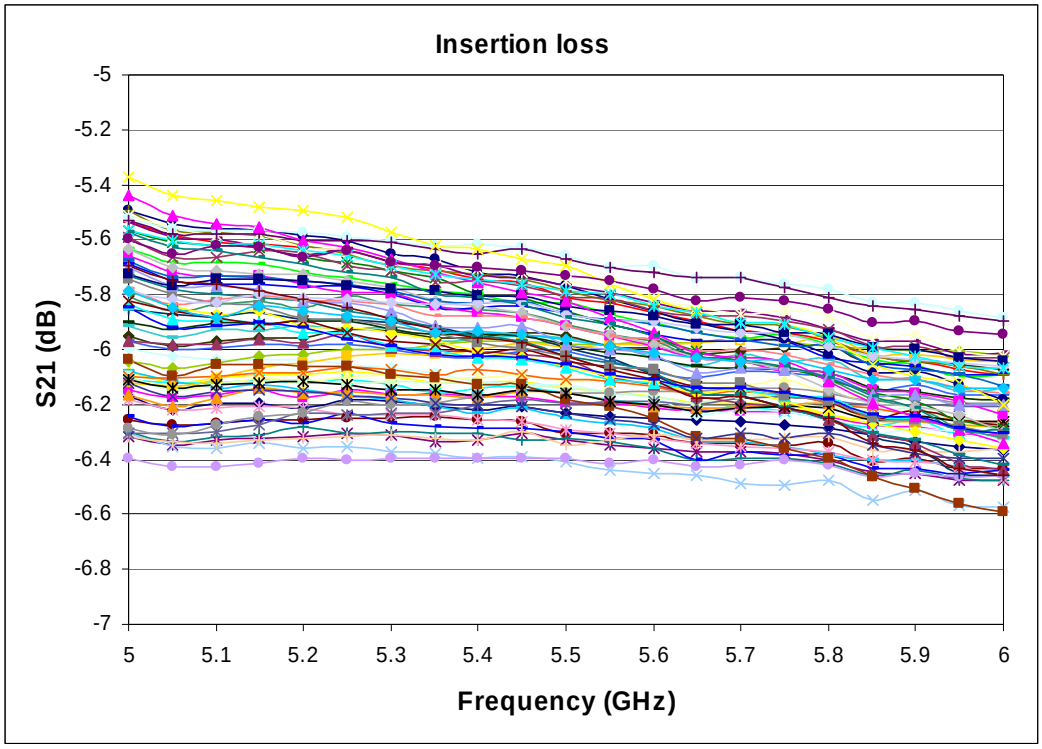
Parameter	Value	Units
Frequency	5.0 – 6.5	GHz
Phase Shift	0-360 in 64 steps	deg
Insertion Loss (Typ.)	6	dB
Insertion Loss Variation	± 0.5	dB
Peak Phase Error	-9 to +6	deg
RMS Error	< 3.5	deg
Port1 Return Loss	12	dB
Port2 Return Loss	12	dB
Pin for 1dB gain compression	20	dBm
DC Supply	+5/6, -5/3	V/mA
Control Voltage	0 / +5	V

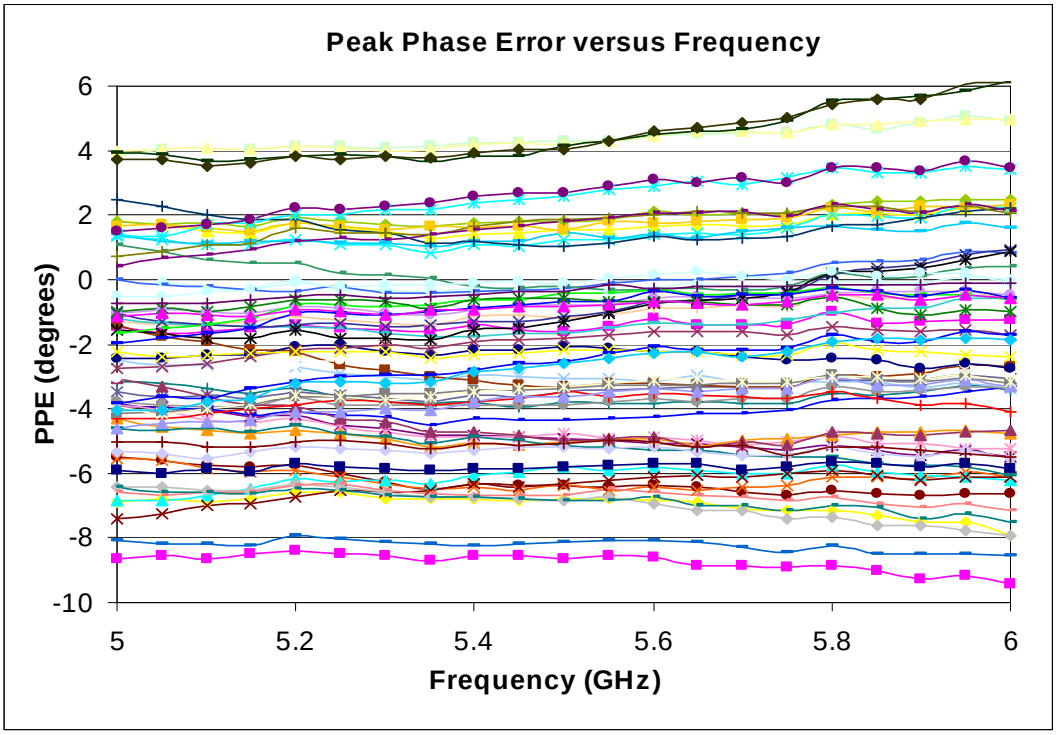
Note:

1. The above mentioned electrical specifications are measured On-Wafer.

On Wafer data

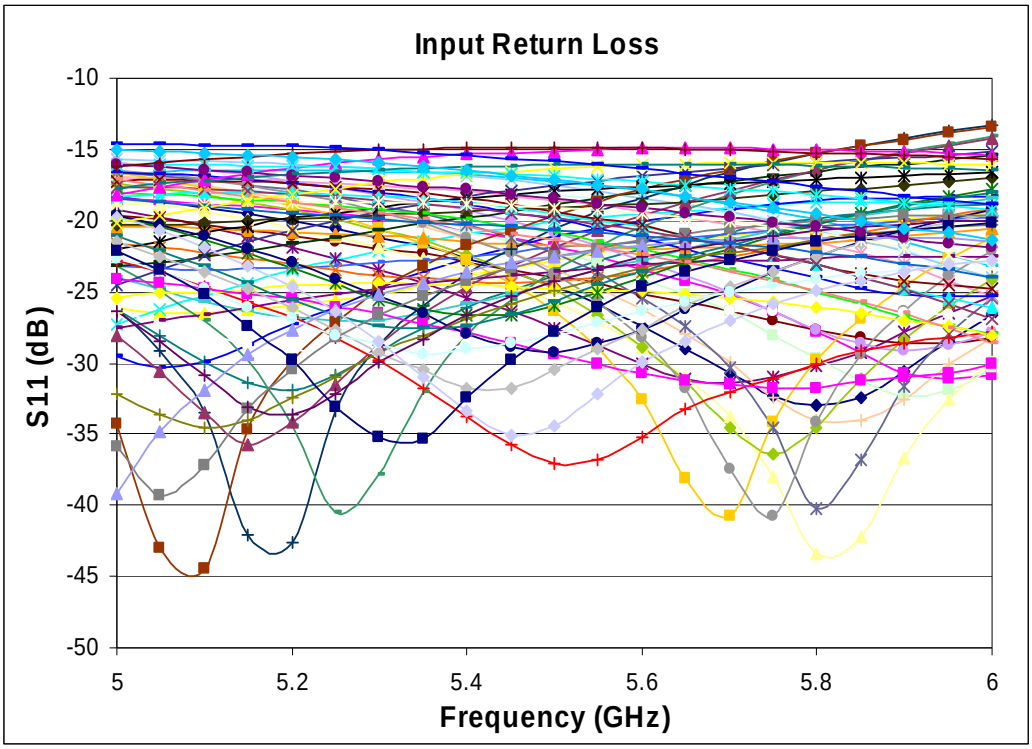
$T_A = 25\ ^oC$

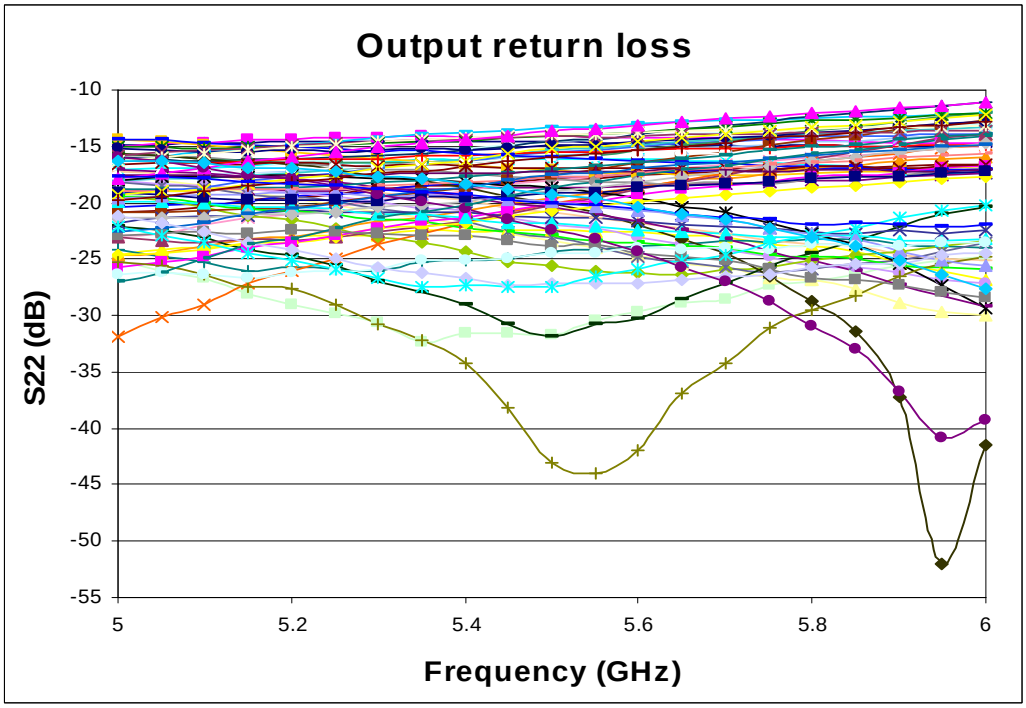




On Wafer data

$T_A = 25\ ^oC$





On Wafer data

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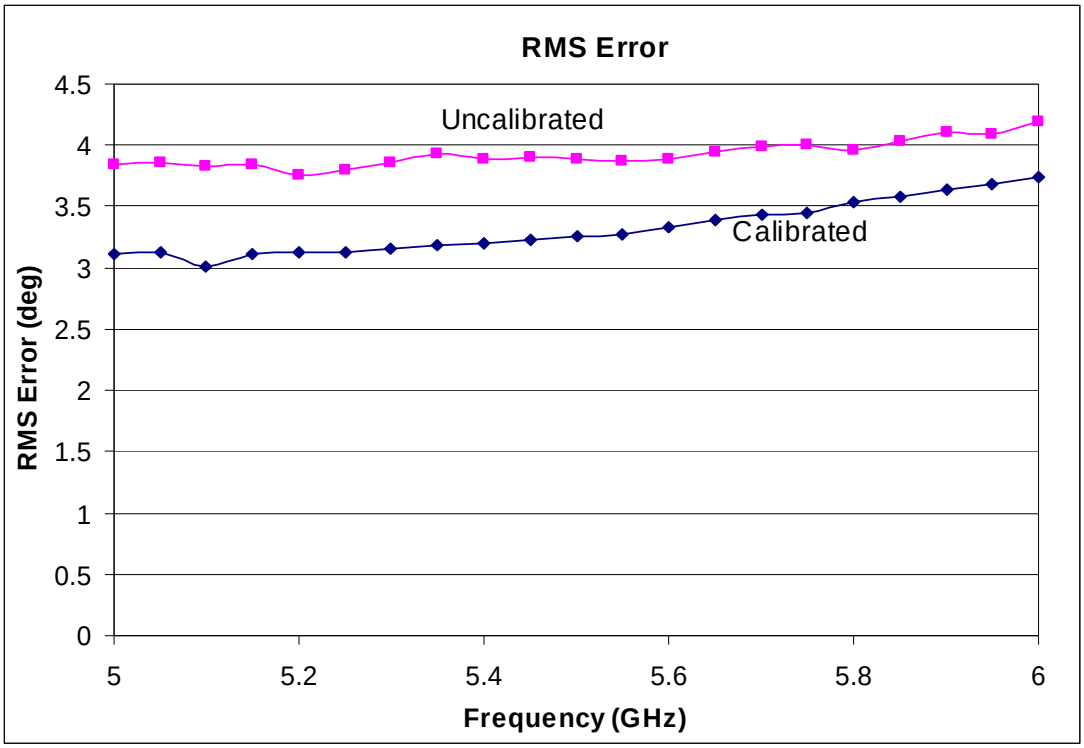


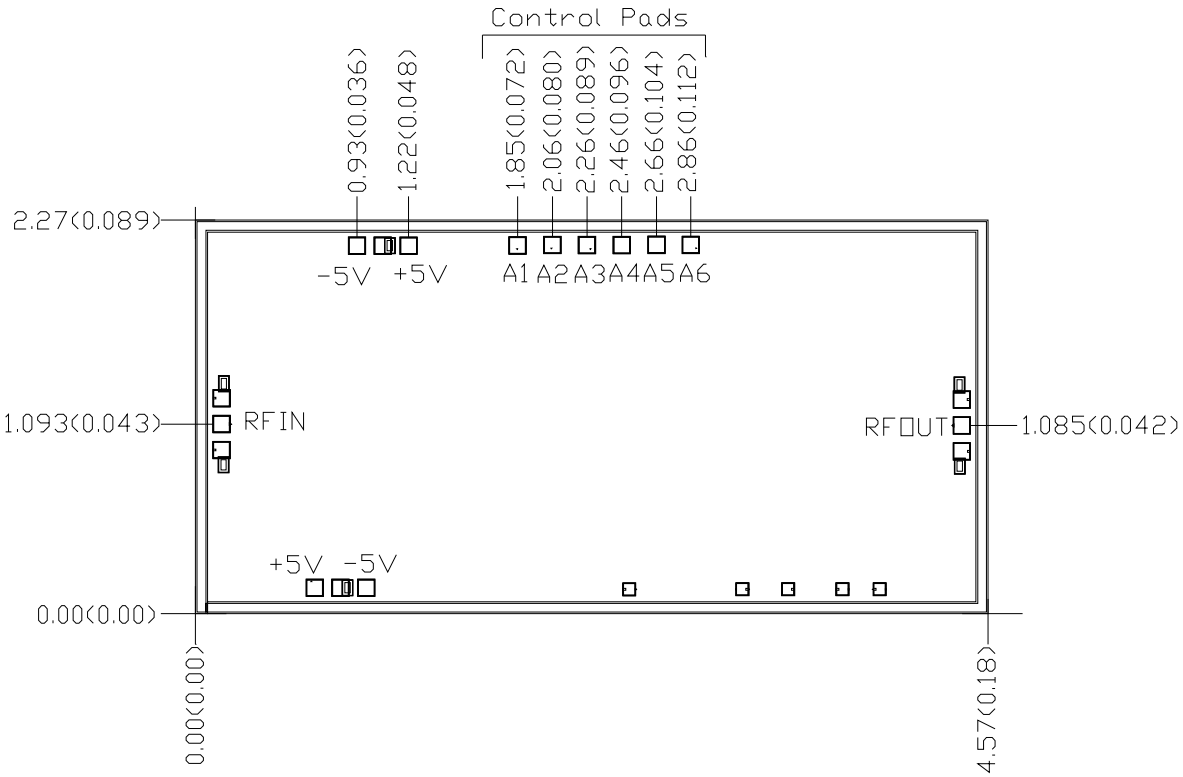
Truth Table

State	Phase Shift (deg.)	TTL Control (1 = 3.5 to 5 V, 0 = 0 to 0.5 V)					
		A6 (180)	A5 (90)	A4 (45)	A3 (22.5)	A2 (11.25)	A1 (5.625)
0	0	0	0	0	0	0	0
1	5.625	0	0	0	0	0	1
2	11.25	0	0	0	0	1	0
3	16.875	0	0	0	0	1	1
4	22.5	0	0	0	1	0	0
5	28.125	0	0	0	1	0	1
6	33.75	0	0	0	1	1	0
7	39.375	0	0	0	1	1	1
8	45	0	0	1	0	0	0
9	50.625	0	0	1	0	0	1
10	56.25	0	0	1	0	1	0
11	61.875	0	0	1	0	1	1
12	67.5	0	0	1	1	0	0
13	73.125	0	0	1	1	0	1
14	78.75	0	0	1	1	1	0
15	84.375	0	0	1	1	1	1
16	90	0	1	0	0	0	0
17	95.625	0	1	0	0	0	1
18	101.25	0	1	0	0	1	0
19	106.875	0	1	0	0	1	1
20	112.5	0	1	0	1	0	0
21	118.125	0	1	0	1	0	1
22	123.75	0	1	0	1	1	0
23	129.375	0	1	0	1	1	1
24	135	0	1	1	0	0	0
25	140.625	0	1	1	0	0	1
26	146.25	0	1	1	0	1	0
27	151.875	0	1	1	0	1	1
28	157.5	0	1	1	1	0	0
29	163.125	0	1	1	1	0	1
30	168.75	0	1	1	1	1	0
31	174.375	0	1	1	1	1	1
32	180	1	0	0	0	0	0
33	185.625	1	0	0	0	0	1
34	191.25	1	0	0	0	1	0
35	196.875	1	0	0	0	1	1

Truth Table

State	Phase Shift (deg.)	TTL Control (1 = 3.5 to 5 V, 0 = 0 to 0.5 V)					
		A6 (180)	A5 (90)	A4 (45)	A3 (22.5)	A2 (11.25)	A1 (5.625)
36	202.5	1	0	0	1	0	0
37	208.125	1	0	0	1	0	1
38	213.75	1	0	0	1	1	0
39	219.375	1	0	0	1	1	1
40	225	1	0	1	0	0	0
41	230.625	1	0	1	0	0	1
42	236.25	1	0	1	0	1	0
43	241.875	1	0	1	0	1	1
44	247.5	1	0	1	1	0	0
45	253.125	1	0	1	1	0	1
46	258.75	1	0	1	1	1	0
47	264.375	1	0	1	1	1	1
48	270	1	1	0	0	0	0
49	275.625	1	1	0	0	0	1
50	281.25	1	1	0	0	1	0
51	286.875	1	1	0	0	1	1
52	292.5	1	1	0	1	0	0
53	298.125	1	1	0	1	0	1
54	303.75	1	1	0	1	1	0
55	309.375	1	1	0	1	1	1
56	315	1	1	1	0	0	0
57	320.625	1	1	1	0	0	1
58	326.25	1	1	1	0	1	0
59	331.875	1	1	1	0	1	1
60	337.5	1	1	1	1	0	0
61	343.125	1	1	1	1	0	1
62	348.75	1	1	1	1	1	0
63	354.375	1	1	1	1	1	1

Mechanical Characteristics

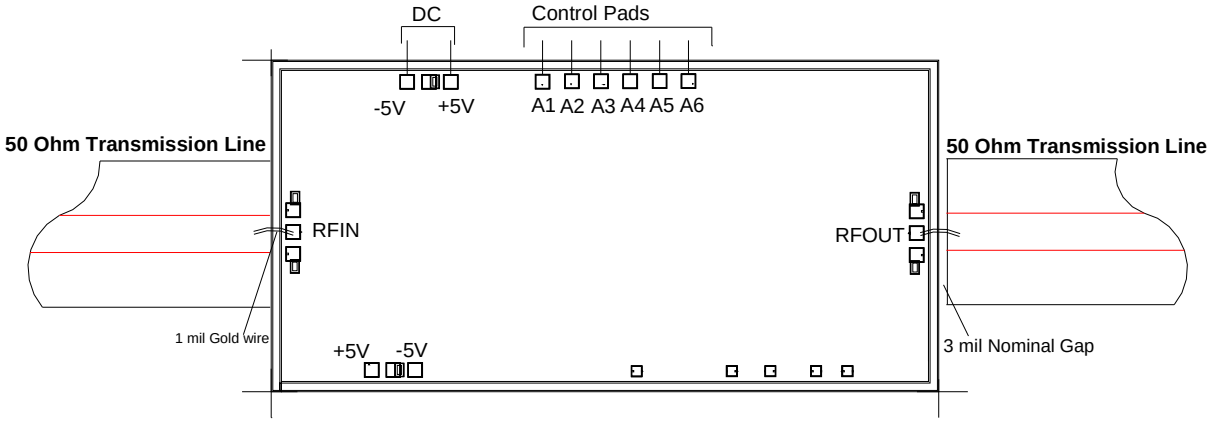


Units: millimeters (inches)

Note:

1. All RF and DC bond pads are 100µm x 100µm

Recommended Assembly Diagram



Note :

1. Two 1 mil (0.0254mm) bond wires of minimum length should be used for RF input and output.
2. The RF input & output ports are DC coupled.

Die attach: For Epoxy attachment, use of a two-component conductive epoxy is recommended. An epoxy fillet should be visible around the total die periphery. If Eutectic attachment is preferred, use of fluxless AuSn (80/20) 1-2 mil thick preform solder is recommended. Use of AuGe preform should be strictly avoided.

Wire bonding: For DC pad connections use either ball or wedge bonds. For best RF performance, use of 150 - 200µm length of wedge bonds is advised. Single Ball bonds of 250-300µm though acceptable, may cause a deviation in RF performance.

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