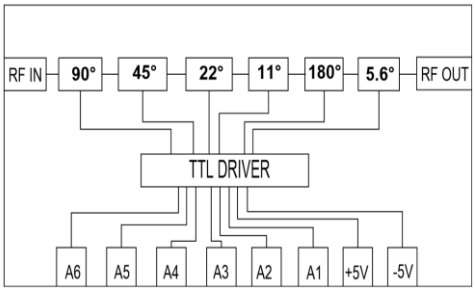
8.5-11.0 GHz 6-Bit Digital Phase Shifter

Features

- **Frequency Range: 8.5 – 11.0GHz**
- **RMS Error < 3 deg**
- **Insertion Loss 7dB (mid-band)**
- **Return Loss >10dB**
- **Integral TTL Driver**
- **Chip Size:4.5mm x 2.2mm x 0.1mm**

Functional Diagram



Typical Applications

- Radar
- Military & Space
- Instrumentation

Description

The ASL2013 is a 6-bit digital phase shifter MMIC designed to operate over a frequency band of 8.5-11.0 GHz. The phase shifter features a low RMS phase error of less than 3deg over the operating range. The mid-band insertion loss is 7 dB and varies within ± 1dB over the entire frequency range and over the 64 phase states. The input /output ports are well matched to 50 Ohms with return losses better than 10dB. The integrated TTL compatible drivers provide a convenient digital interface for 6-bit control. The chip operates with +5V and -5V DC supply voltages with a very low current.

Absolute Maximum Ratings[1]

Parameter	Absolute Maximum	Units
RF Input Power	26	dBm
Positive Supply Voltage	+6	V
Negative Supply Voltage	-6	V
Control Voltage	-0.5 to +5.5	V
Operating Temperature	-55 to +85	ºC
Storage Temperature	-65 to +150	ºC

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

Electrical Specifications @ T_A = 25 ºC, Z_o =50Ω

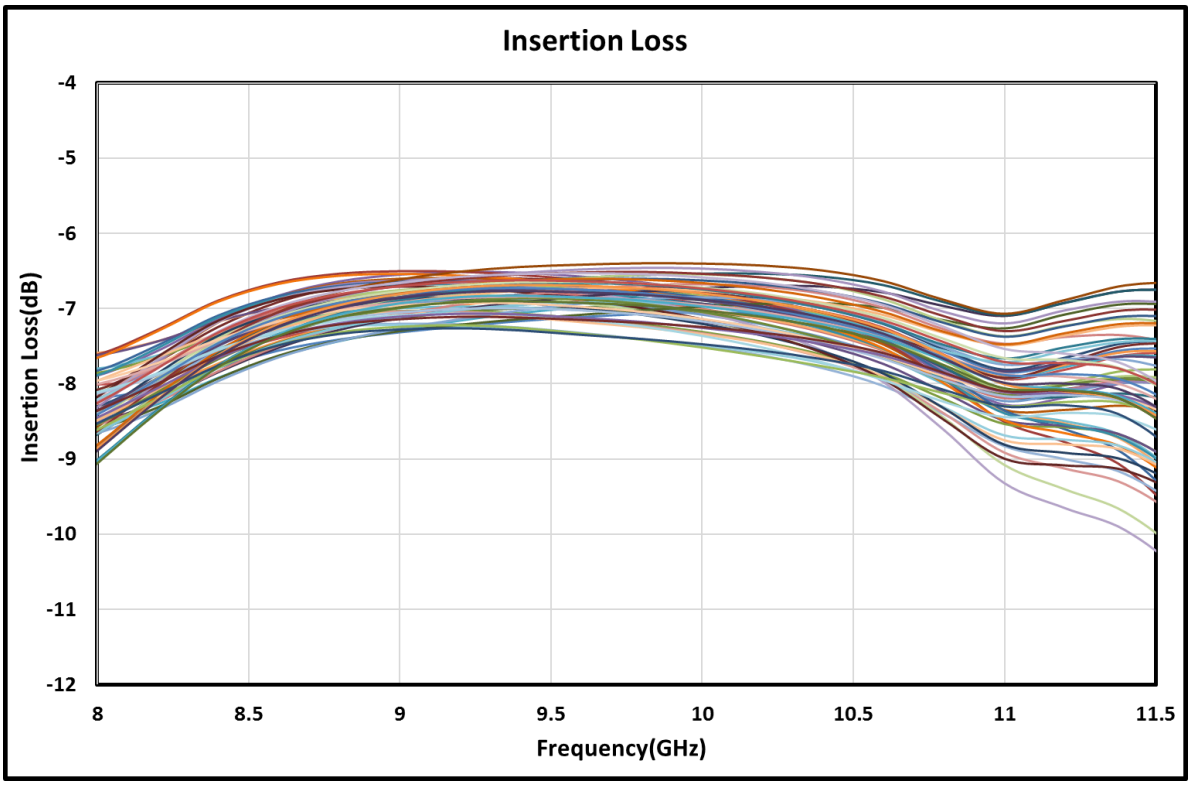
Parameter	Min.	Typ.	Max.	Units
Frequency Range		8.5-11.0		GHz
Phase Shift		0-360 in 64 steps		deg
Insertion Loss	6.5	7.5	9	dB
RMS Amplitude Error	0.2	0.3	0.8	dB
Peak Phase Shift Error		±10		deg
RMS Phase Shift Error	1.4	2	3	Deg
Input Return Loss	10	12	--	dB
Output Return Loss	10	12	--	dB
P1dB @ Input	18	18	18	dBm
DC Supply		+5/-5		V
Control Voltages		TTL compatible		
ON		+3.5 to +5 V		V
OFF		0 to +0.5 V		V

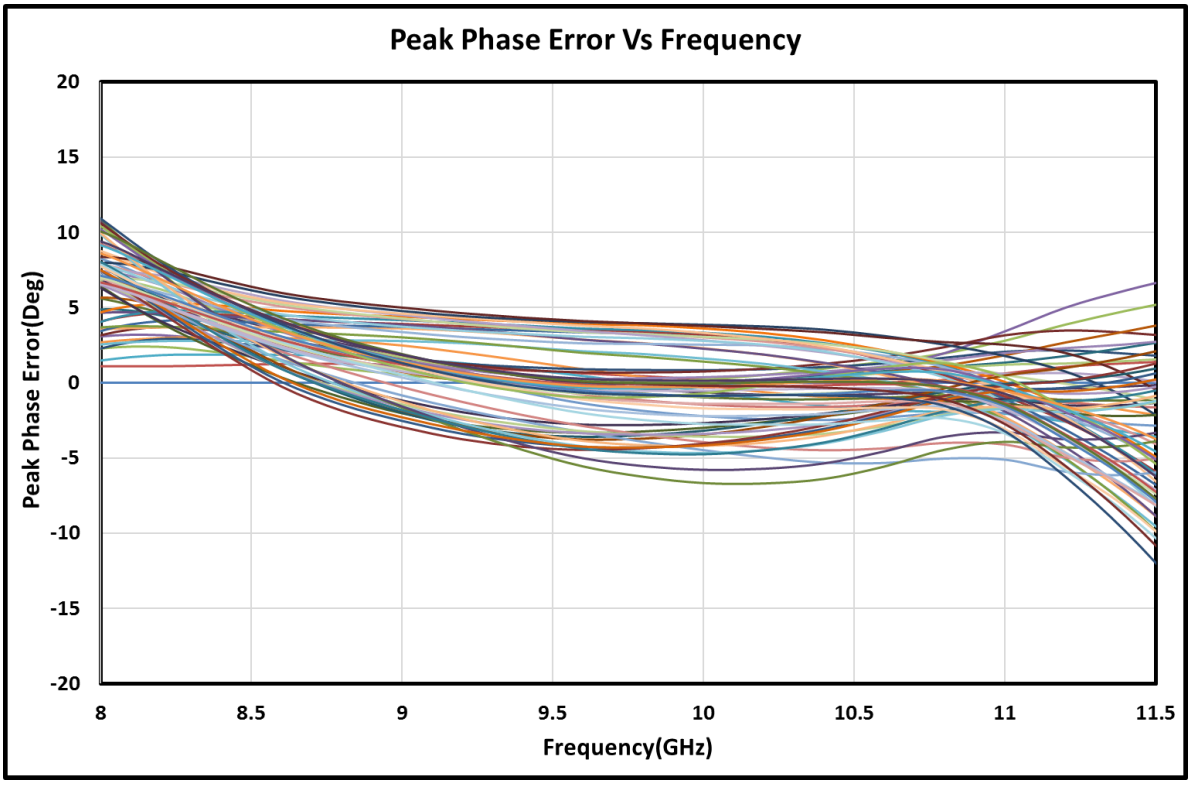
Note:

1. The above-mentioned electrical specifications are measured On-Wafer.
2. Current consumption on +5V is ~7mA & -5V is ~6mA.

On Wafer data

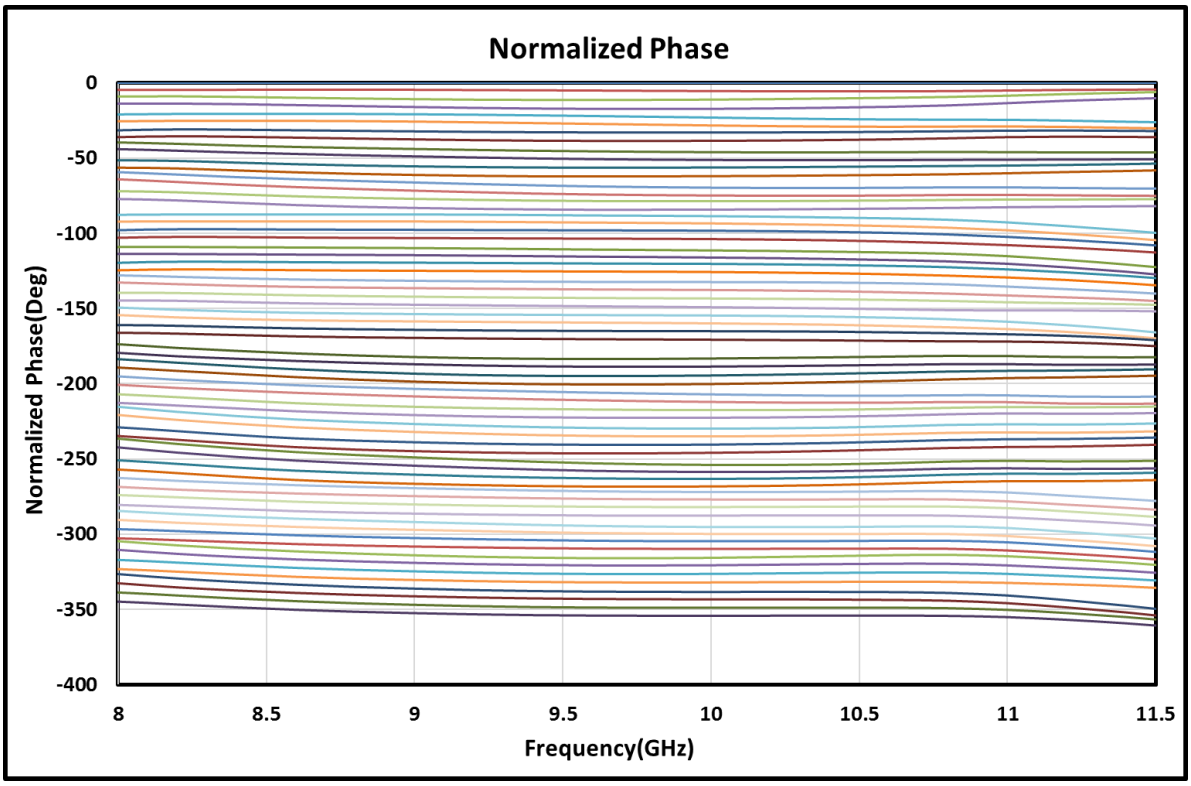
Driver Bias +5V, -5V; Control Voltage 0/+5V; T_A = 25 ^oC

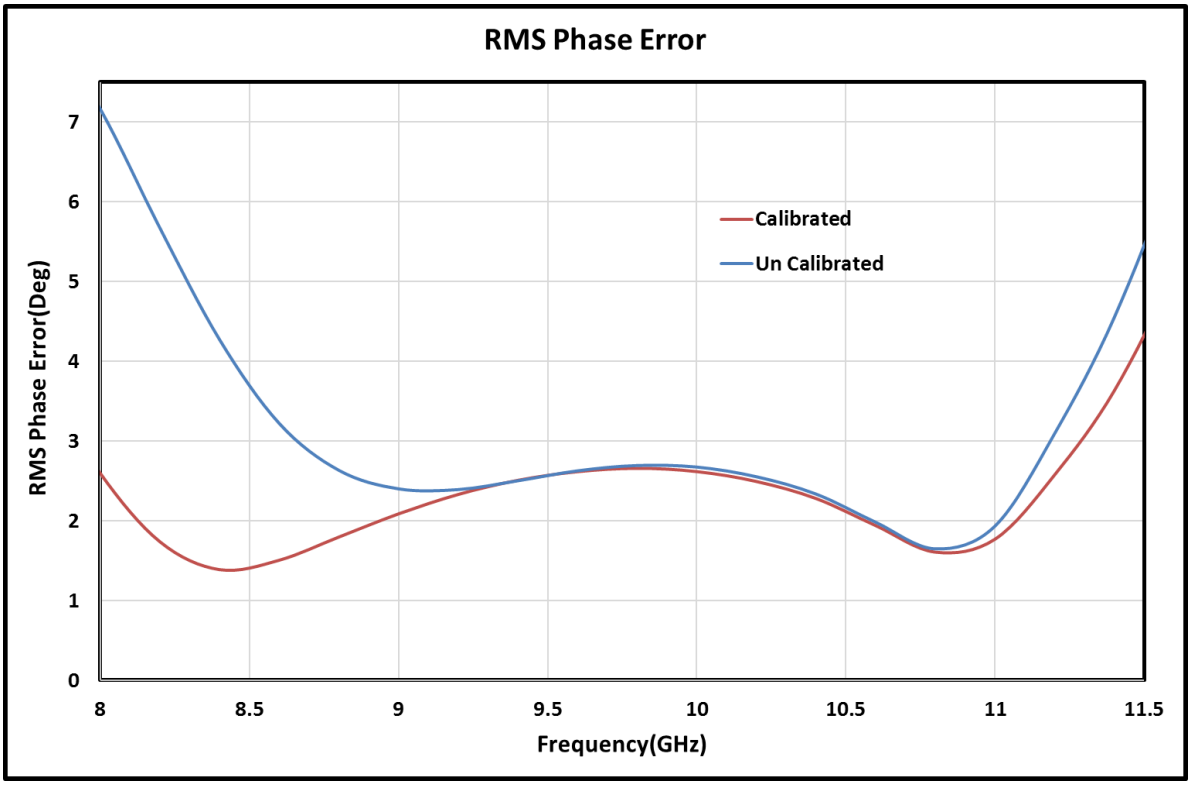




On Wafer data

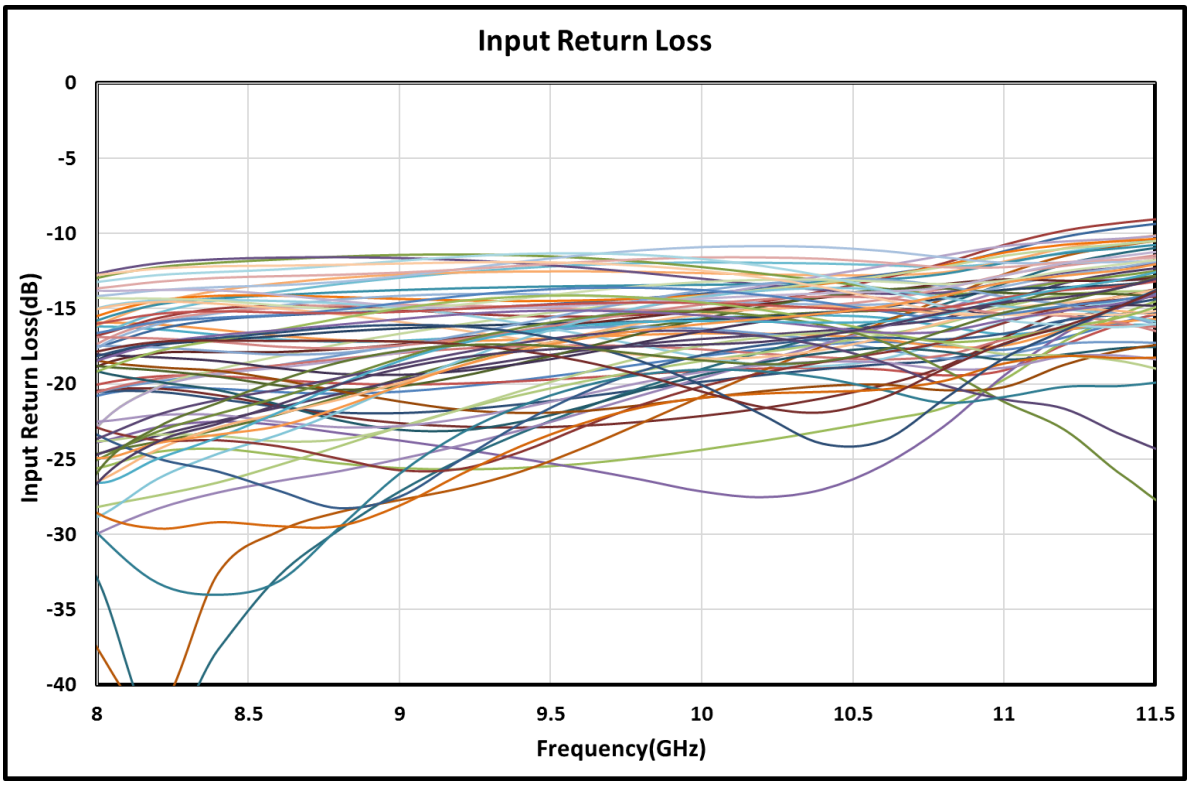
Driver Bias +5V, -5V; Control Voltage 0/+5V; T_A = 25 ^oC

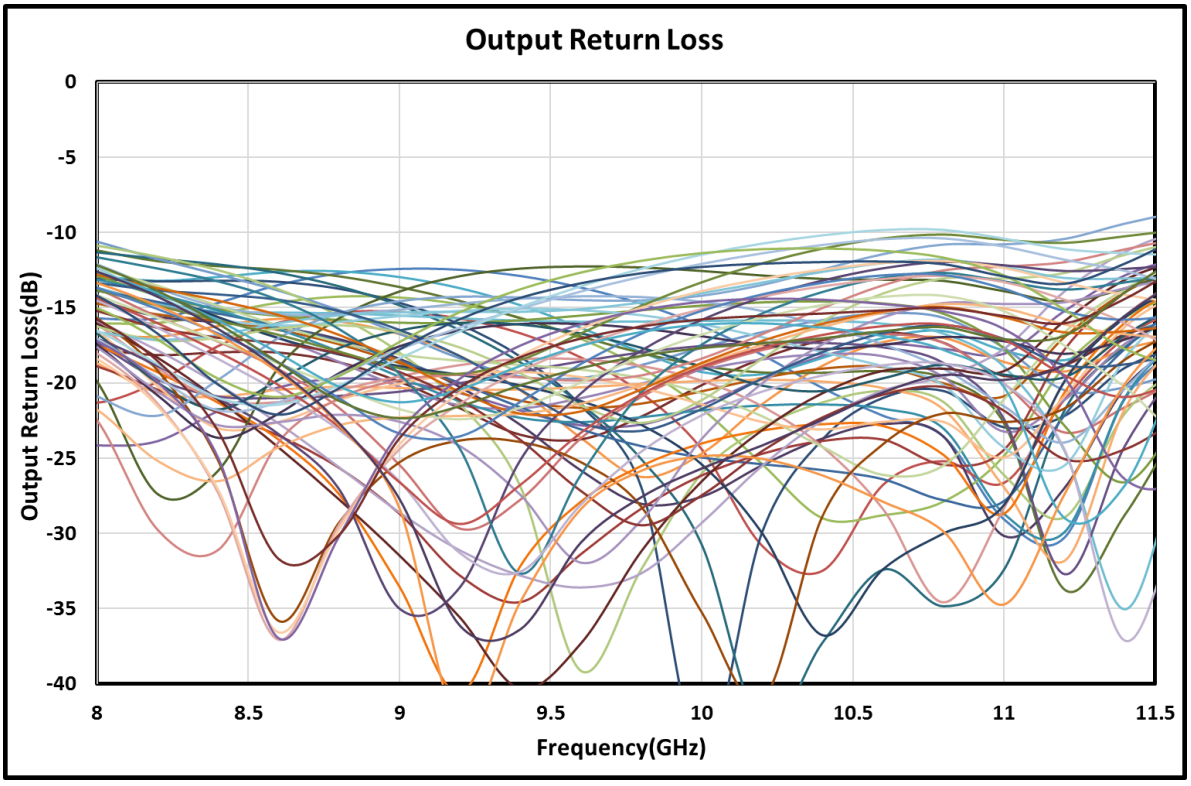




On Wafer data

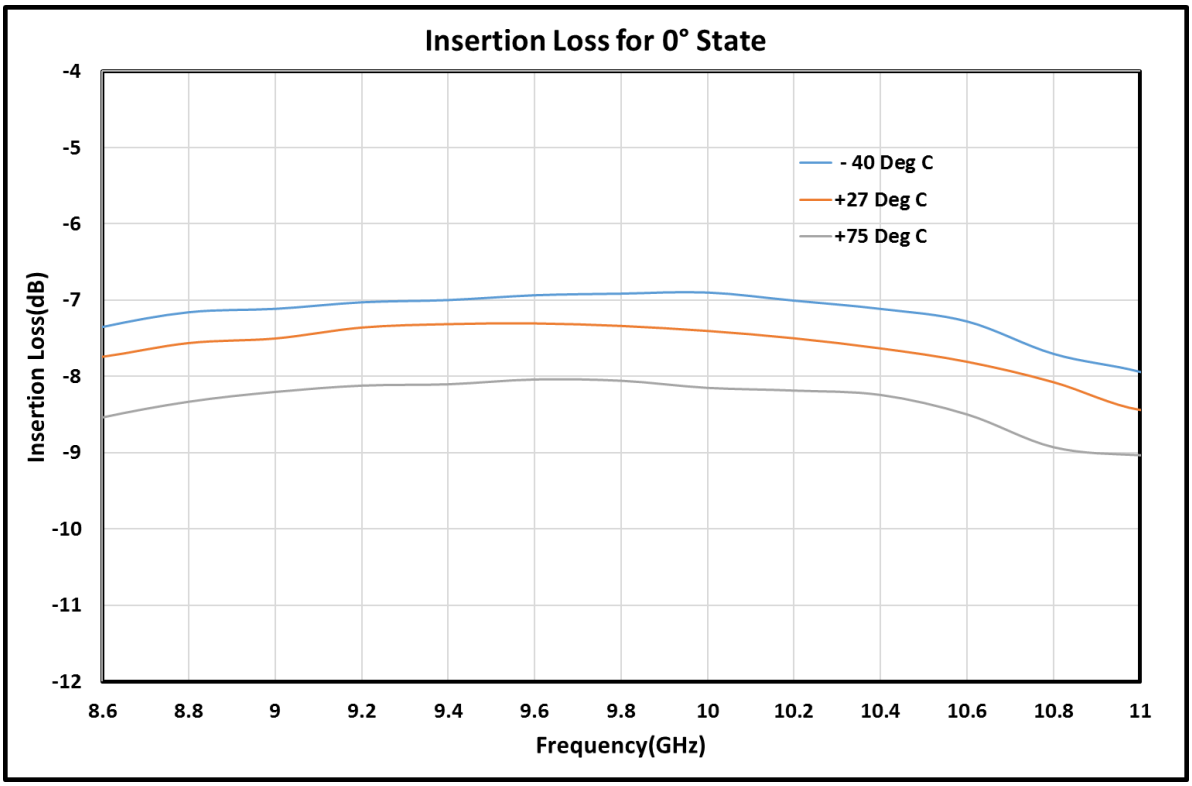
Driver Bias +5V, -5V; Control Voltage 0/+5V; T_A = 25 ^oC

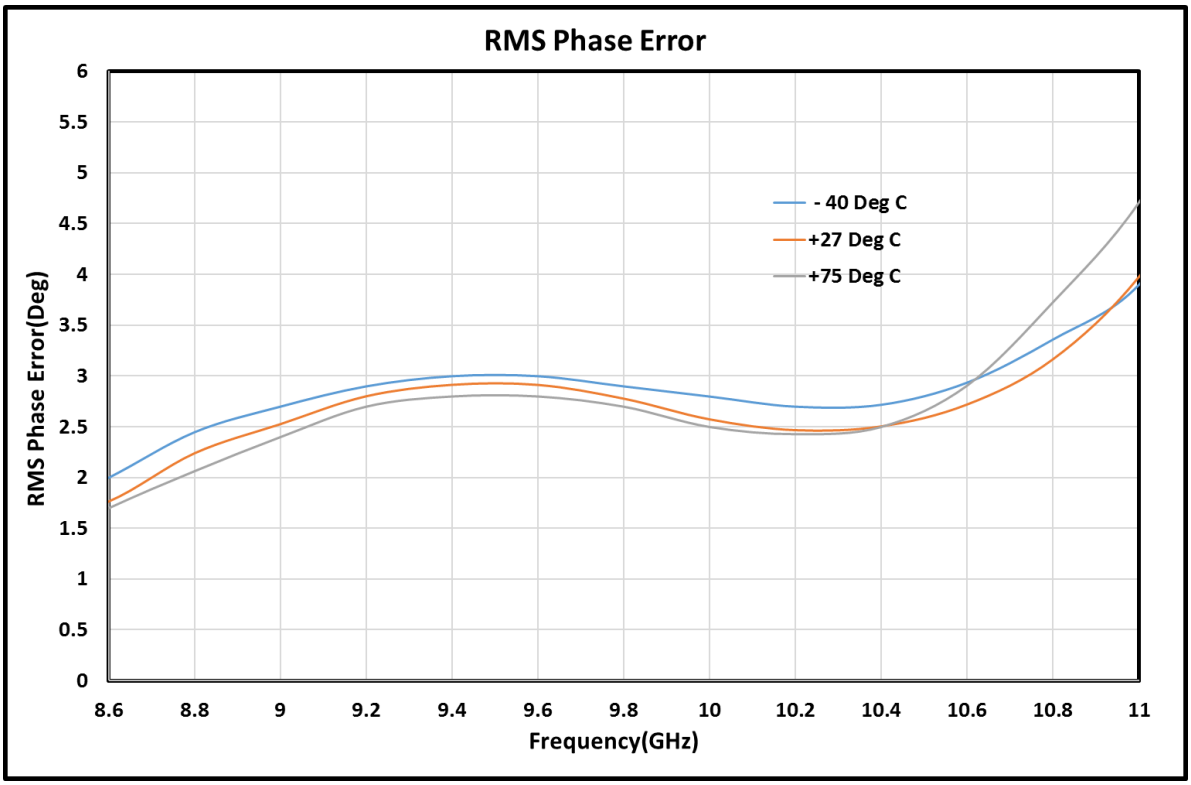




Test Fixture data over temperature

Driver Bias +5V, -5V; Control Voltage 0/+5V; T_A = 25 ^oC





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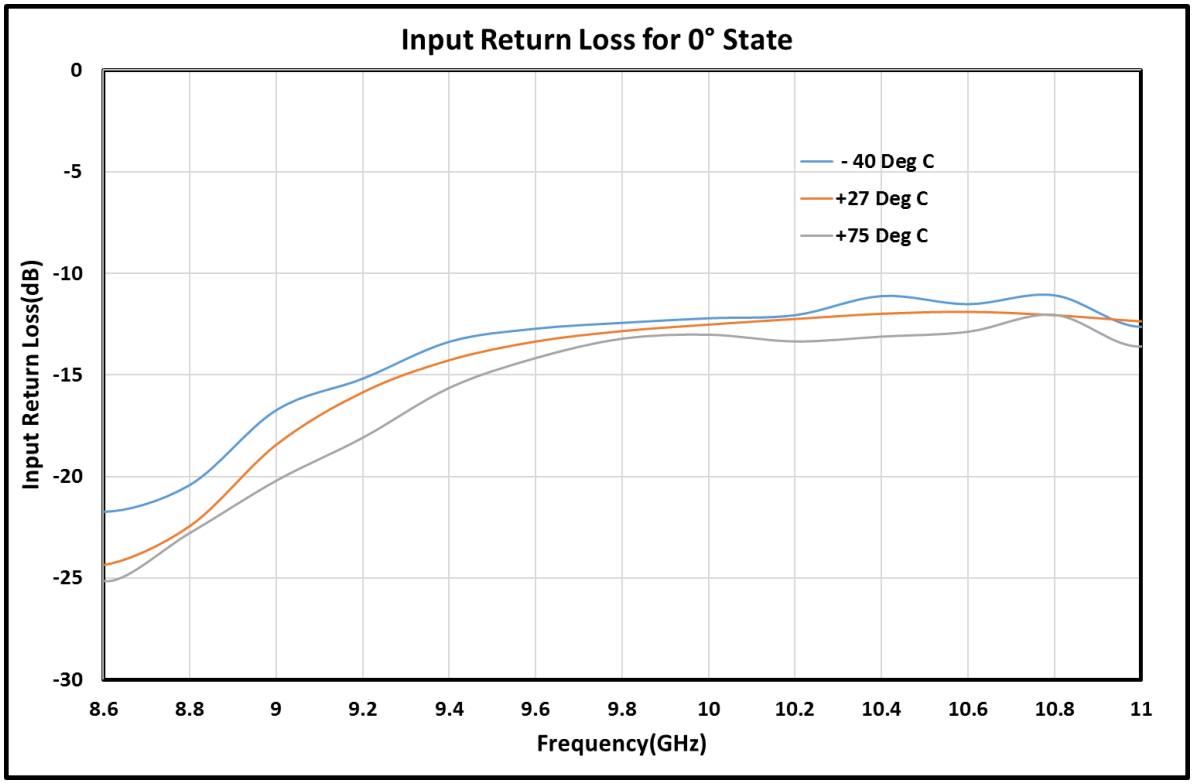
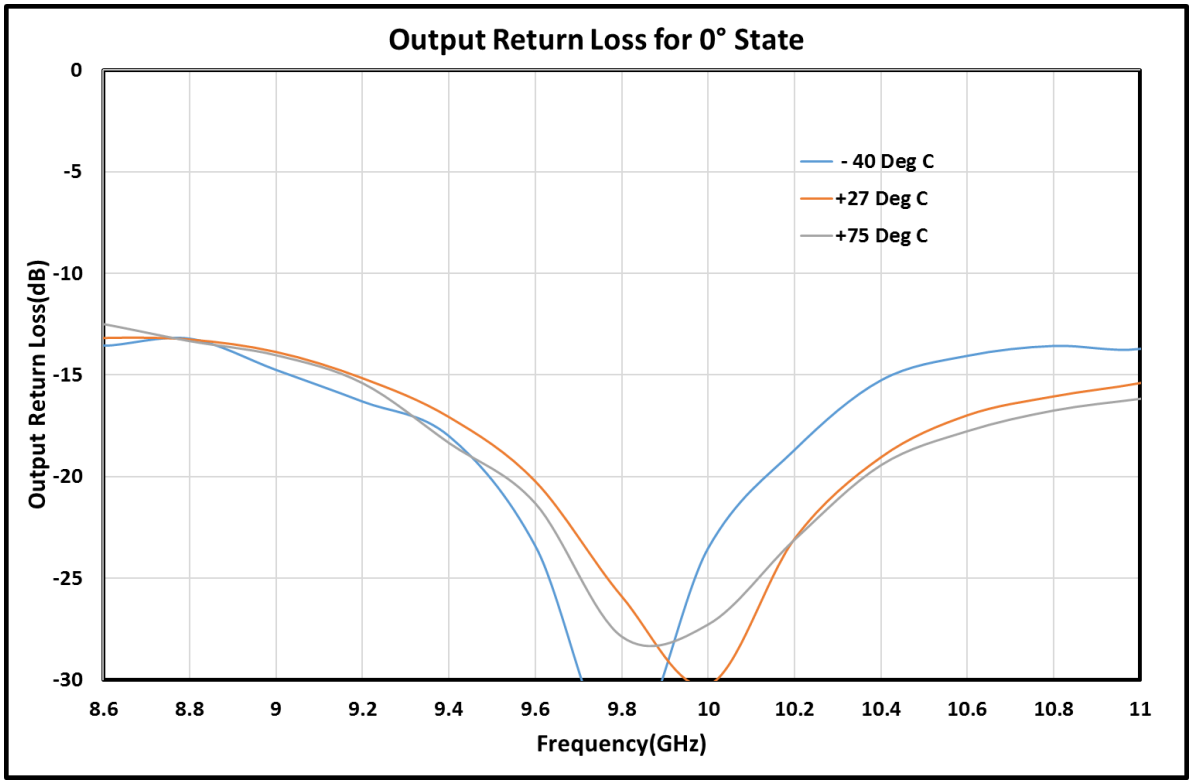




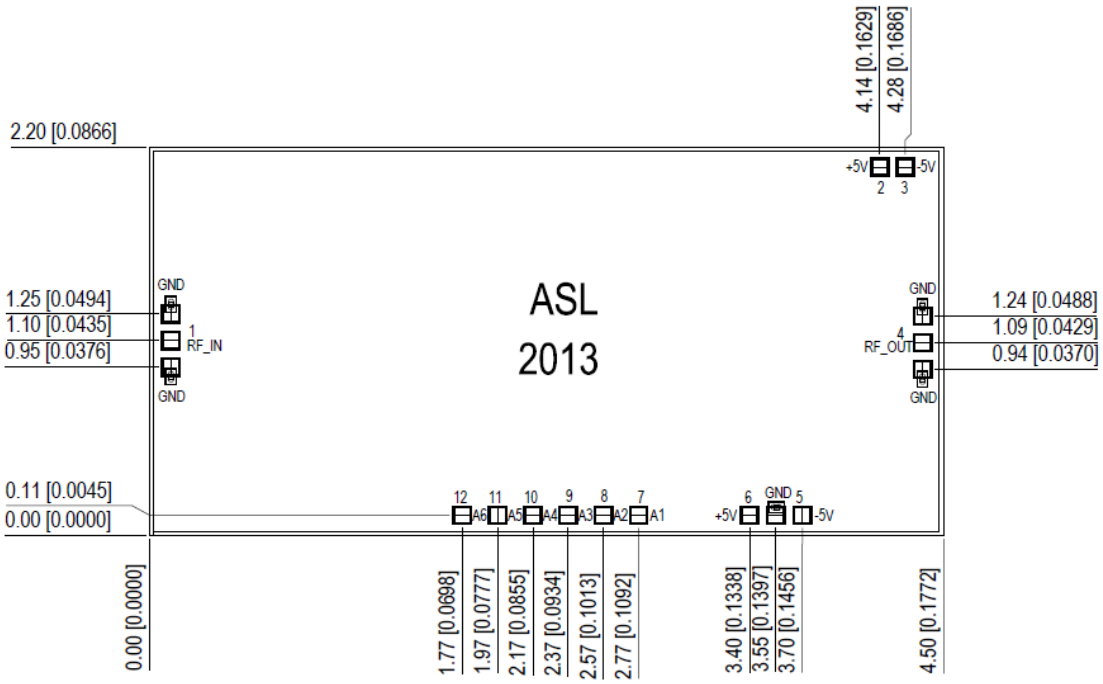
Truth Table

S.No.	Phase Shift	180Deg	90Deg	45Deg	22.5Deg	11.25Deg	5.625Deg
		A6	A5	A4	A3	A2	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	180Deg	90Deg	45Deg	22.5Deg	11.25Deg	5.625Deg
		A6	A5	A4	A3	A2	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



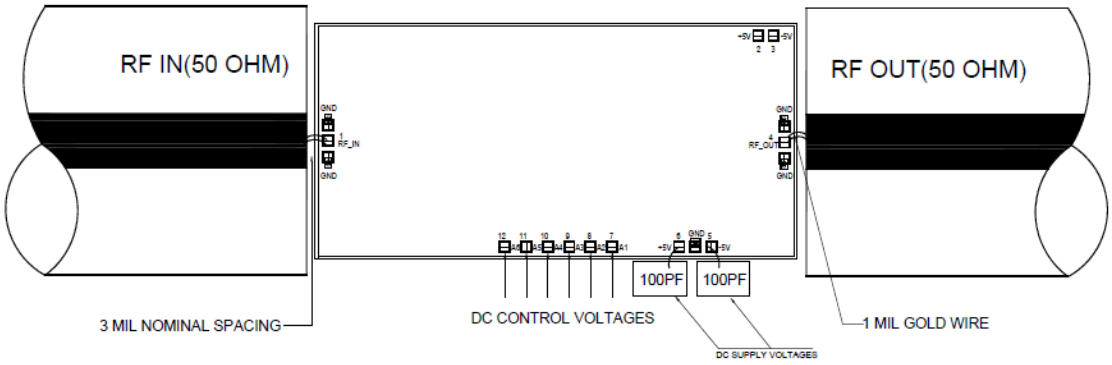
Units: millimetres (inches)

Note:

1. All RF and DC bond pads are 100µm x 100µm in size.
2. Pad no. 1 : RF In
3. Pad no. 2, 6* : +5 V
4. Pad no. 3, 5* : -5 V
5. Pad no. 4 : RF Out
6. Pad no. 7 to 12 : A1 to A6 (Control bits from LSB to MSB)

*Pad no 5 & 6 are optional DC power supply bond Pads.

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 flux less 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