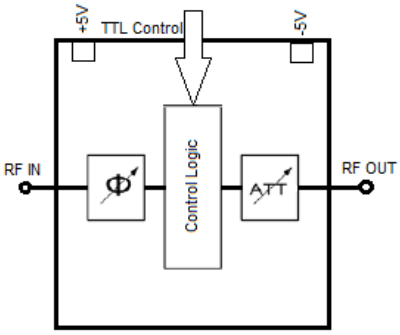
6-Bit X-Band Passive Core Chip

Features

- **Frequency Range: 7.0-9.0 GHz**
- **Phase shift range: 0-360^0 (Step 5.625^0)**
- **Attenuation Range: 31.5dB (Step 0.5dB)**
- **Insertion Loss: 12 dB (Typ)**
- **Low RMS Phase Error: < 4 deg (Typ)**
- **Low RMS Amplitude Error: 0.8dB**
- **Input & Output Return Loss: 10dB**
- **Parallel Data Input**
- **Chip Size:3.5mm×4.0mm×0.1mm**

Functional Diagram



Typical Applications

- **Radar**
- **Telecommunication**
- **Instrumentation**

Description

The ASL6002 is a high performance GaAs MMIC T/R 6-bit Core Chip operating in X-Band. It includes a 6-bit phase shifter, 6-bit attenuator and TTL compatible parallel interface. The ASL6002 has a nominal phase shifting range of 0-360^0 and attenuation setting range of 31.5dB. This chip features RMS Phase error of less than 4^0 and RMS Amplitude error of less than 1dB over all 64 states with an insertion loss of 12 dB. The input /output ports are well matched to 50 Ohms with return losses better than 10dB. The driver operates on +5/-5V voltages with minimal DC power consumption.

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

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

Parameter	Typical Values	Units
Frequency Range	7.0-9.0	GHz
Insertion Loss	12	dB
Phase Range	0-360	0
Phase shift Step	5.625	0
RMS Phase Error	4	0
Phase variation with attenuation setting(max)	+5 to -10	0
Attenuation Range	31.5	dB
Attenuator Step	0.5	dB
RMS Attenuation Error	0.8	dB
Attenuation Variation with phase setting(max)	0 to -2	dB
Input Return Loss	10	dB
Output Return Loss	10	dB
Positive Supply Voltage	5	V
Negative Supply Voltage	-5	V
Control Voltage low level	0	V
Control Voltage high level	+3.3/+5	V

Note:

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

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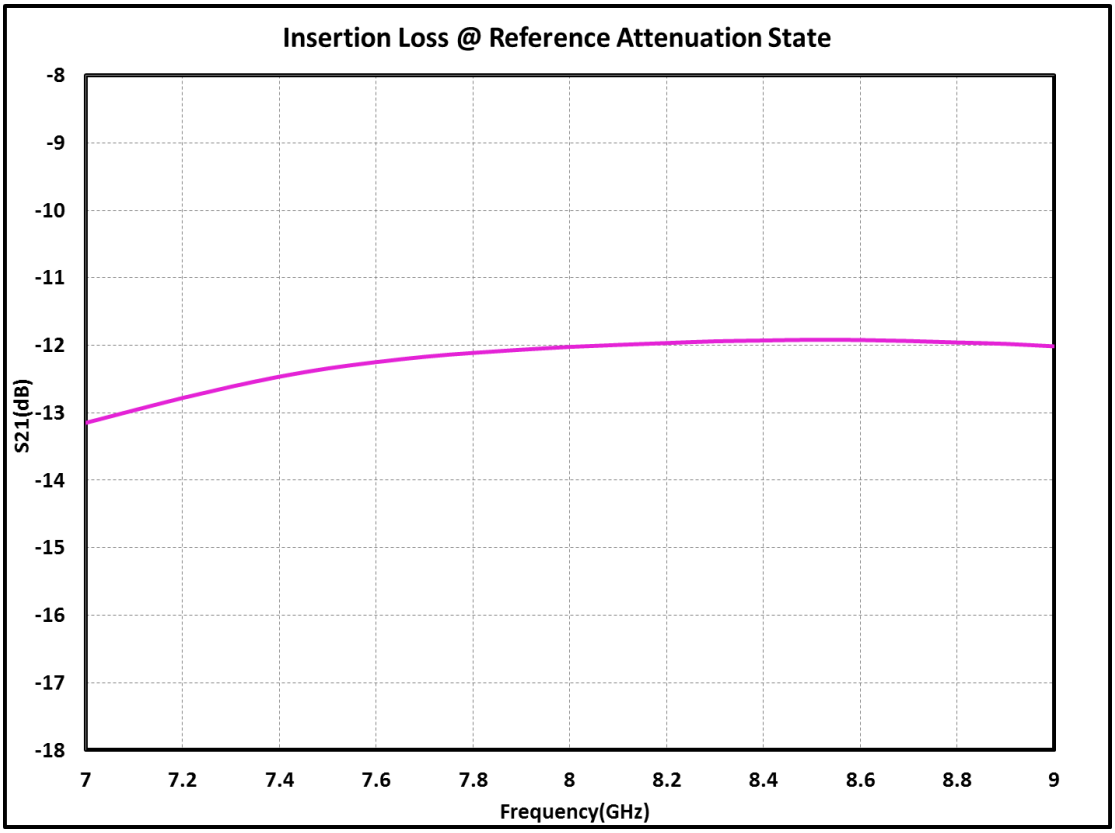
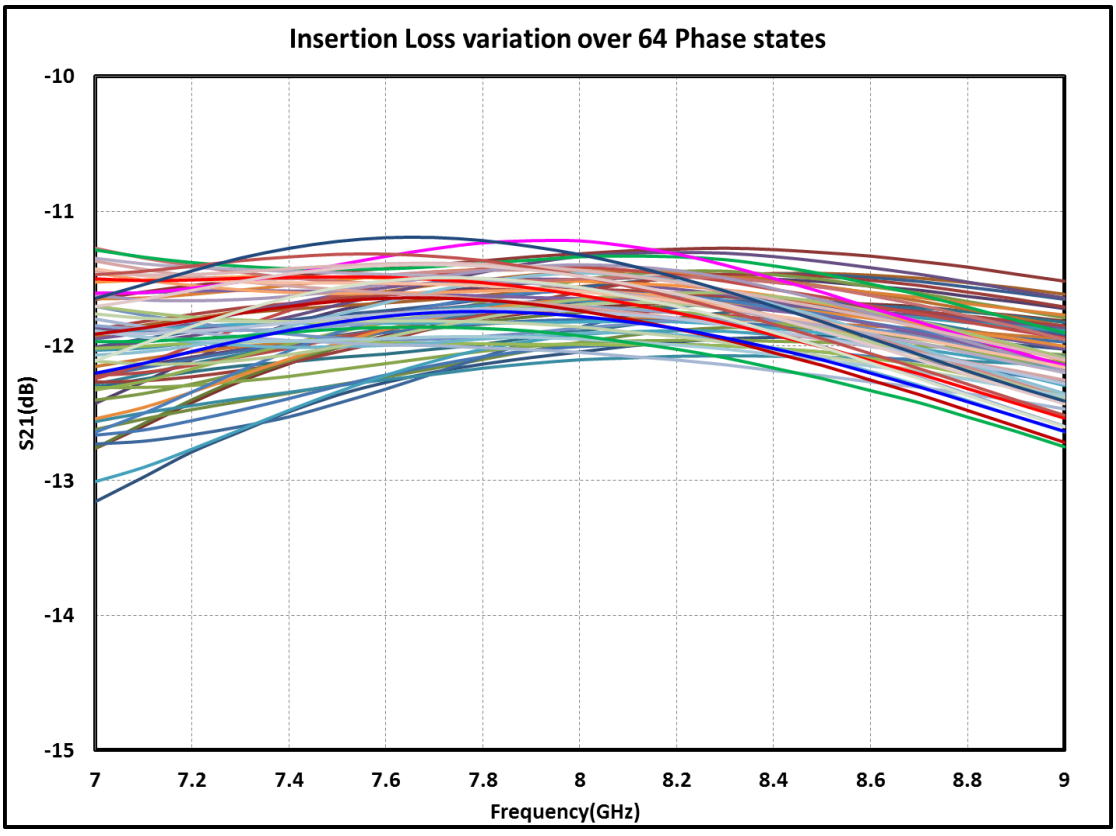
On Wafer data

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





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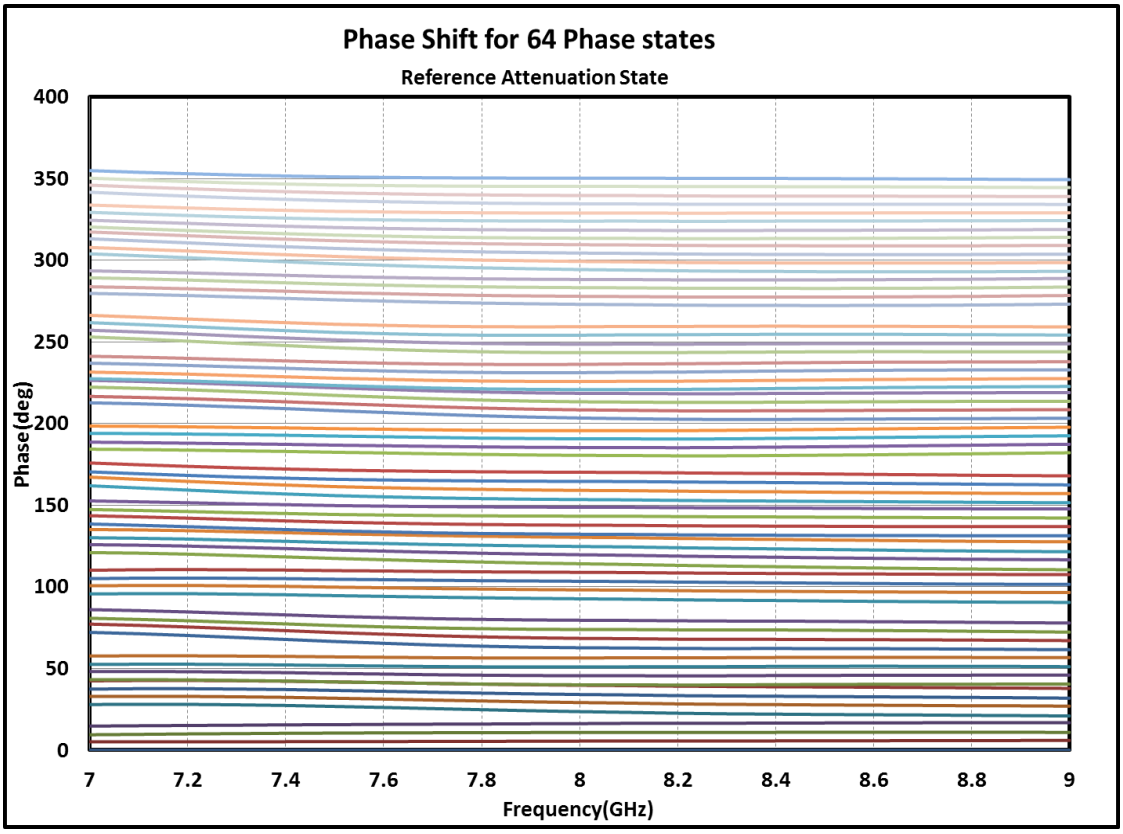

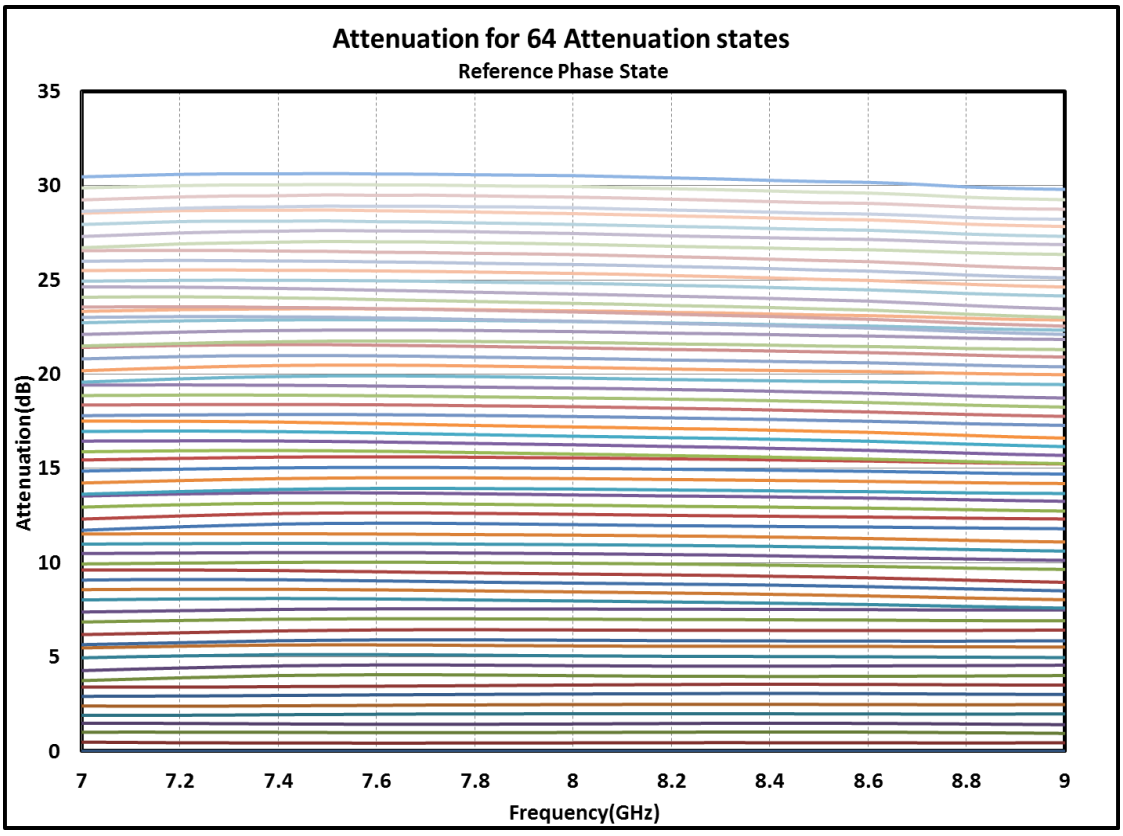

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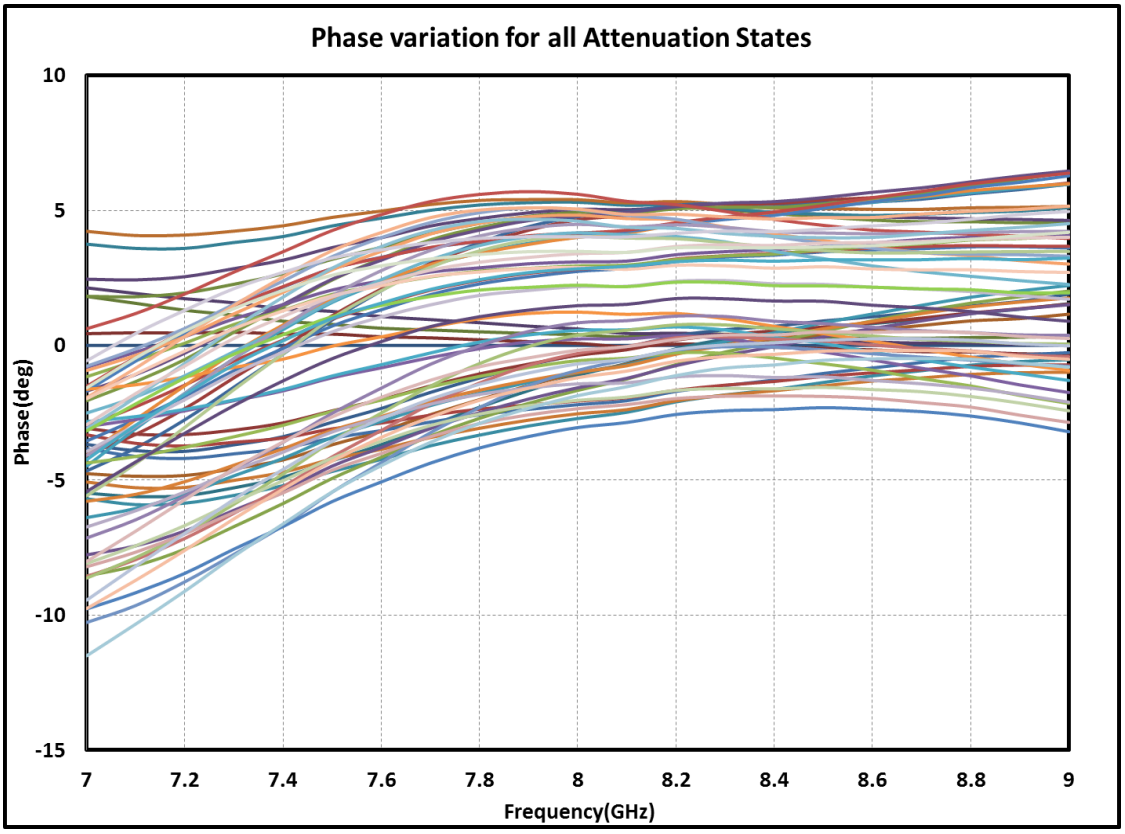

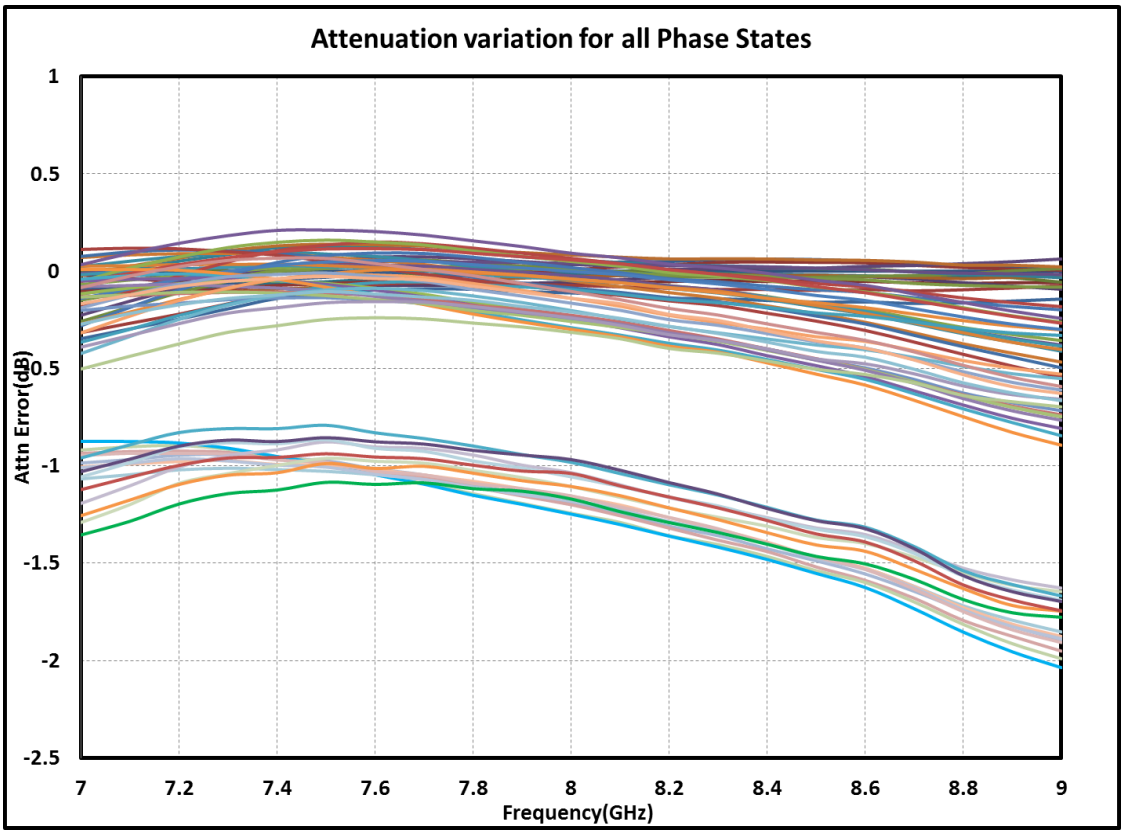

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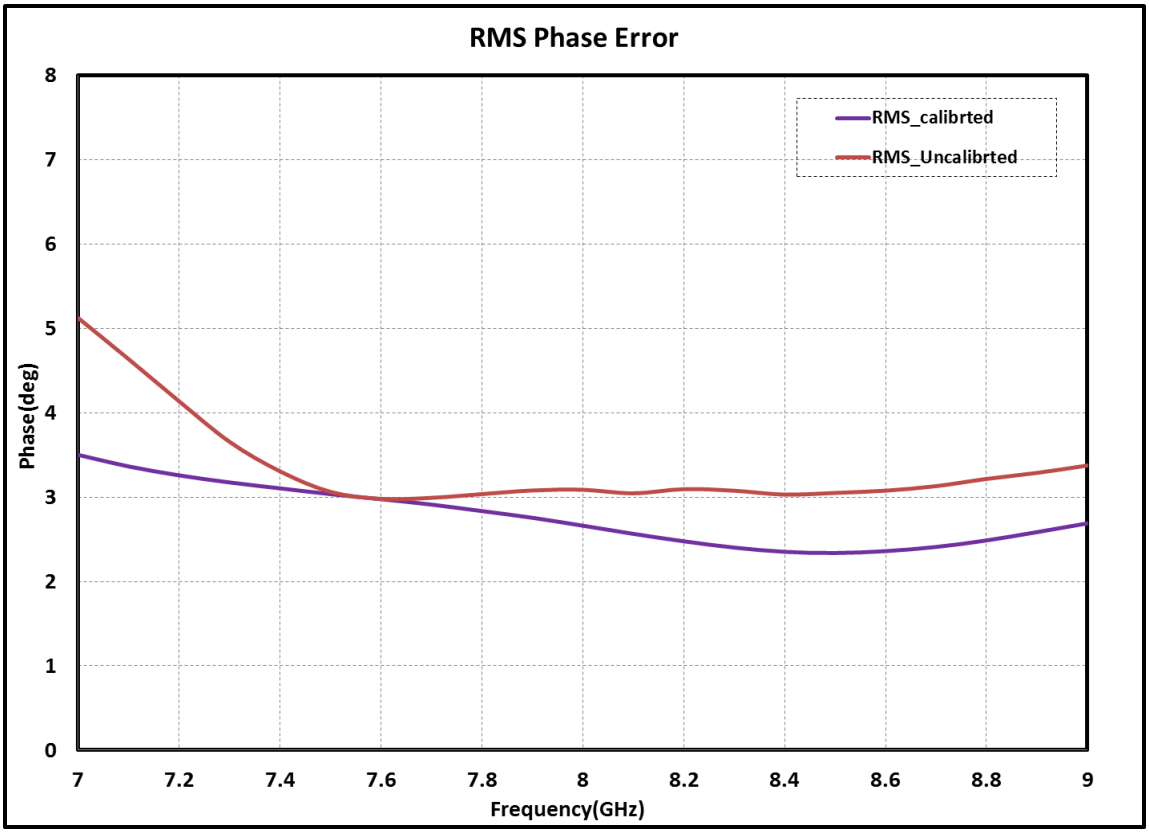
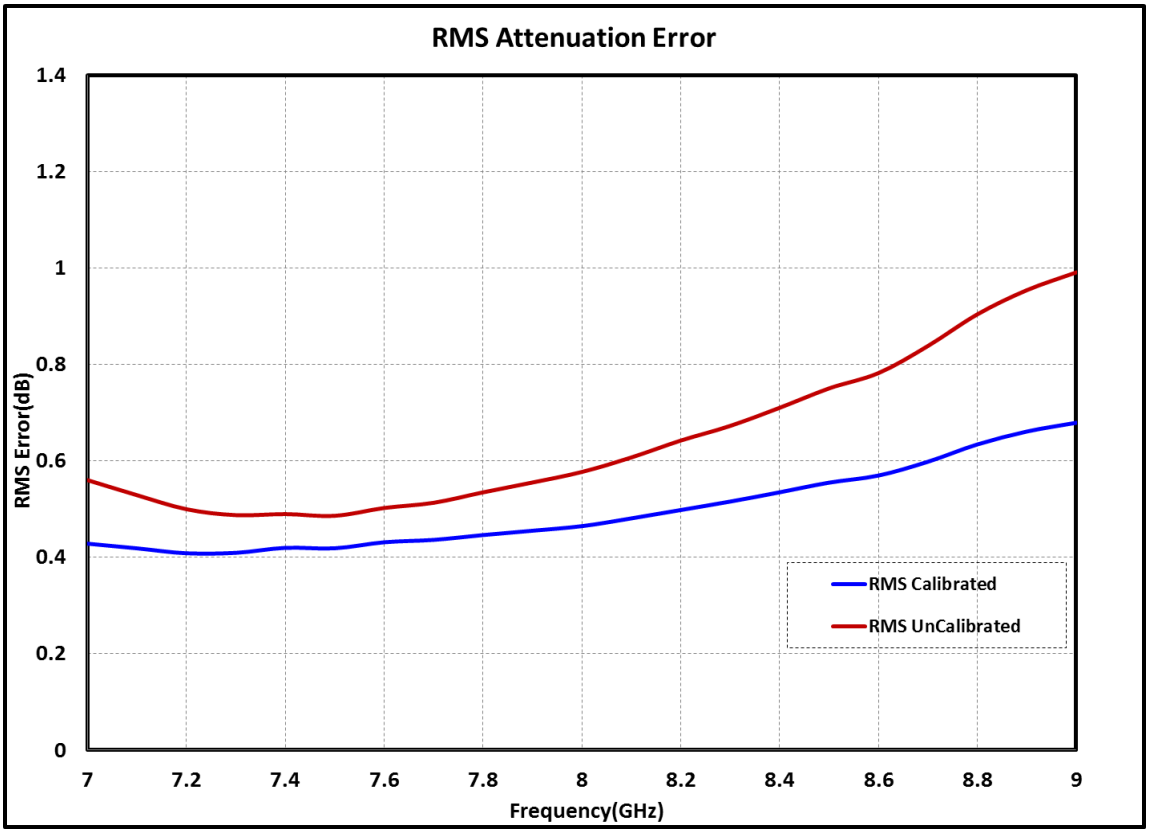
Driver Bias +5V, -5V; Control Voltage 0/+5V; T_A = 25 ^oC





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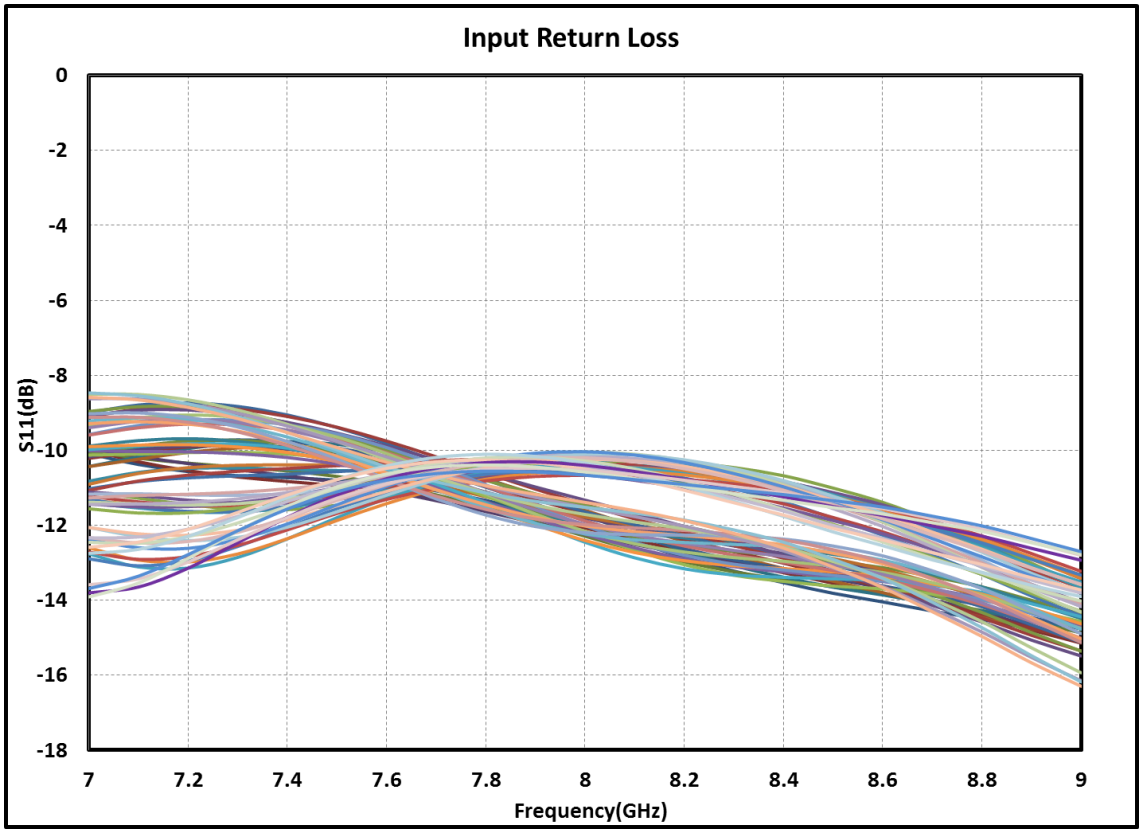
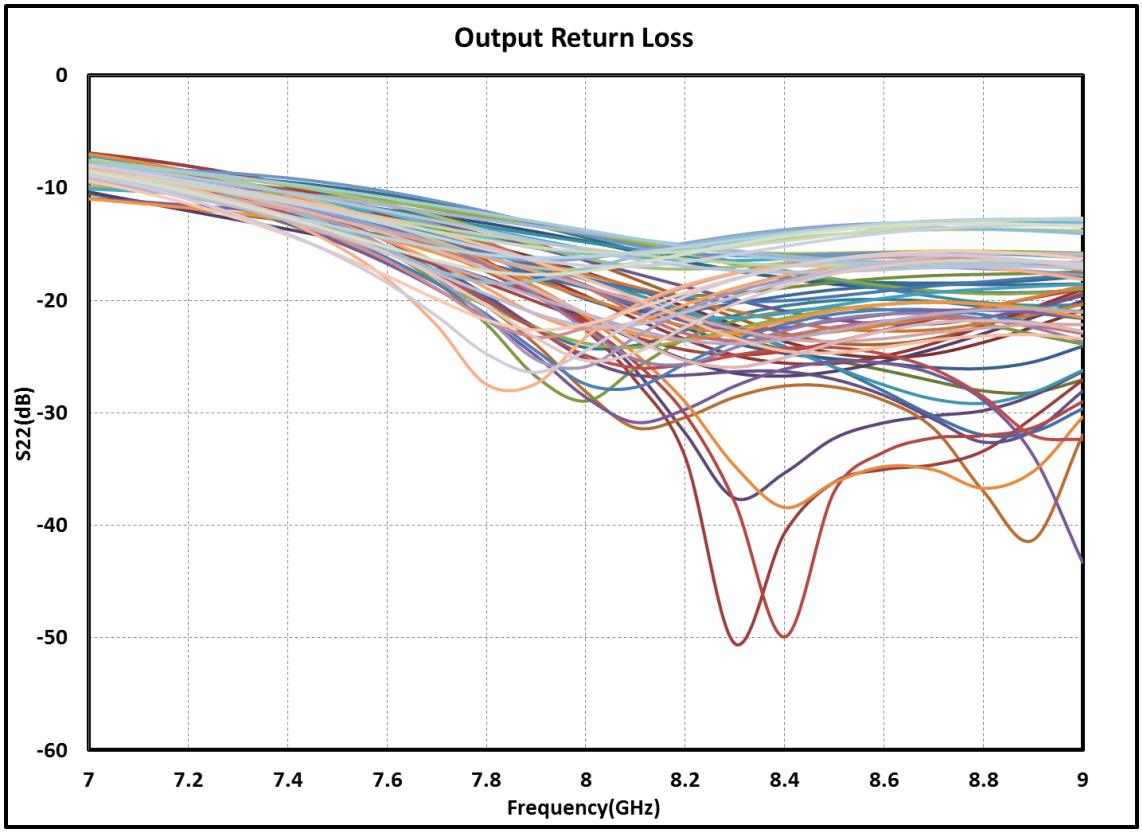
On Wafer data

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





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Phase shifter Truth Table

S.No.	Phase Shift	180Deg	90Deg	45Deg	22.5Deg	11.25Deg	5.625Deg
		P6	P5	P4	P3	P2	P1
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

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S.No.	Phase Shift	180Deg	90Deg	45Deg	22.5Deg	11.25Deg	5.625Deg
		P6	P5	P4	P3	P2	P1
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

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Attenuator Truth Table

S.No.	Attenuation (dB)	TTL Control (1 = 3 to 5 V, 0 = 0 to 0.2 V)					
		A6 (16)	A5 (8)	A4(4)	A3 (2)	A2(1)	A1 (0.5)
1	0	0	0	0	0	0	0
2	0.5	0	0	0	0	0	1
3	1	0	0	0	0	1	0
4	1.5	0	0	0	0	1	1
5	2	0	0	0	1	0	0
6	2.5	0	0	0	1	0	1
7	3	0	0	0	1	1	0
8	3.5	0	0	0	1	1	1
9	4	0	0	1	0	0	0
10	4.5	0	0	1	0	0	1
11	5	0	0	1	0	1	0
12	5.5	0	0	1	0	1	1
13	6	0	0	1	1	0	0
14	6.5	0	0	1	1	0	1
15	7	0	0	1	1	1	0
16	7.5	0	0	1	1	1	1
17	8	0	1	0	0	0	0
18	8.5	0	1	0	0	0	1
19	9	0	1	0	0	1	0
20	9.5	0	1	0	0	1	1
21	10	0	1	0	1	0	0
22	10.5	0	1	0	1	0	1
23	11	0	1	0	1	1	0
24	11.5	0	1	0	1	1	1
25	12	0	1	1	0	0	0
26	12.5	0	1	1	0	0	1
27	13	0	1	1	0	1	0
28	13.5	0	1	1	0	1	1
29	14	0	1	1	1	0	0
30	14.5	0	1	1	1	0	1
31	15	0	1	1	1	1	0
32	15.5	0	1	1	1	1	1
33	16	1	0	0	0	0	0
34	16.5	1	0	0	0	0	1
35	17	1	0	0	0	1	0
36	17.5	1	0	0	0	1	1

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S.No.	Attenuation (dB)	TTL Control (1 = 3 to 5 V, 0 = 0 to 0.2 V)					
		A6 (16)	A5 (8)	A4(4)	A3 (2)	A2(1)	A1 (0.5)
37	18.0	1	0	0	1	0	0
38	18.5	1	0	0	1	0	1
39	19	1	0	0	1	1	0
40	19.5	1	0	0	1	1	1
41	20	1	0	1	0	0	0
42	20.5	1	0	1	0	0	1
43	21	1	0	1	0	1	0
44	21.5	1	0	1	0	1	1
45	22	1	0	1	1	0	0
46	22.5	1	0	1	1	0	1
47	23	1	0	1	1	1	0
48	23.5	1	0	1	1	1	1
49	24	1	1	0	0	0	0
50	24.5	1	1	0	0	0	1
51	25	1	1	0	0	1	0
52	25.5	1	1	0	0	1	1
53	26	1	1	0	1	0	0
54	26.5	1	1	0	1	0	1
55	27	1	1	0	1	1	0
56	27.5	1	1	0	1	1	1
57	28	1	1	1	0	0	0
58	28.5	1	1	1	0	0	1
59	29	1	1	1	0	1	0
60	29.5	1	1	1	0	1	1
61	30	1	1	1	1	0	0
62	30.5	1	1	1	1	0	1
63	31	1	1	1	1	1	0
64	31.5	1	1	1	1	1	1

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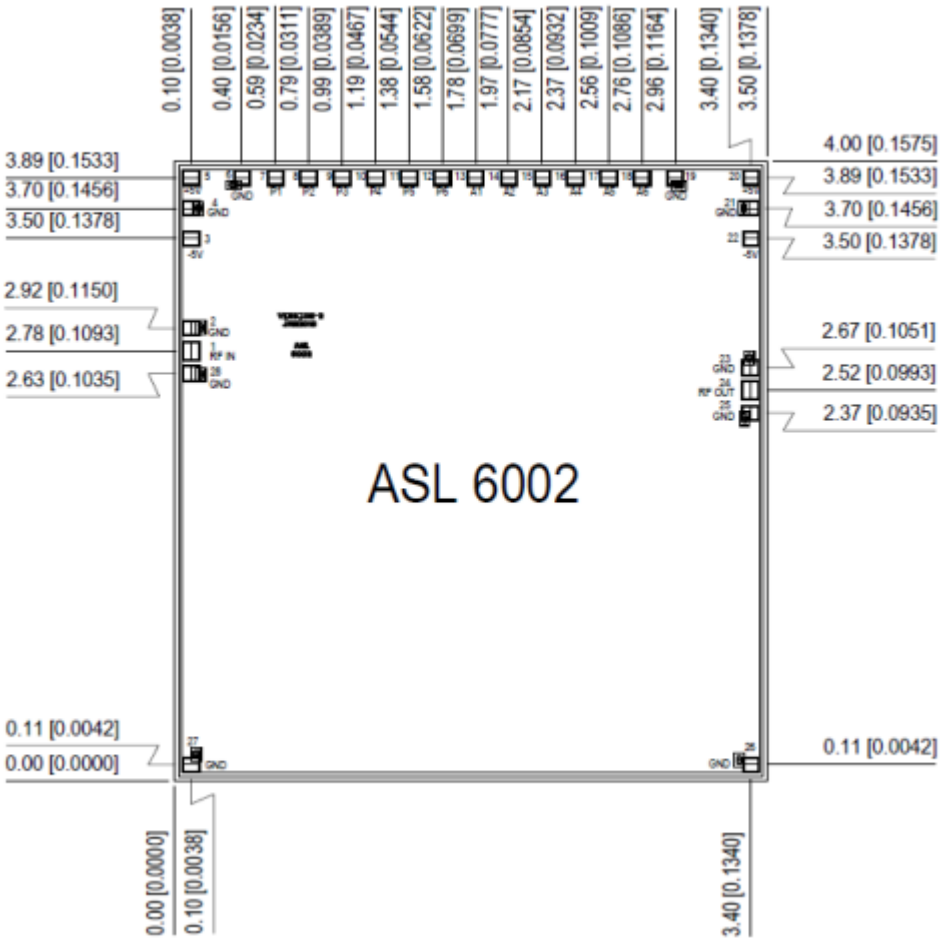
Mechanical Characteristics



Units: millimetres (inches)

Chip size	: 3.5 x 4.0mm
DC and Control Pads size	: 100 x 100µm
RF Pads (1, 24) size	: 125 x 100µm
Chip Thickness	: 100µm

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Bond Pad Designations:

Pad Number	Pad Name	Description
1	RF IN	RF Input
3	-5V	Negative Supply Voltage
5	+5V	Positive Supply Voltage
7	P1	Control of 5.625^0 phase shifter bit
8	P2	Control of 11.25^0 phase shifter bit
9	P3	Control of 22.5^0 phase shifter bit
10	P4	Control of 45^0 phase shifter bit
11	P5	Control of 90^0 phase shifter bit
12	P6	Control of 180^0 phase shifter bit
13	A1	Control of 0.5dB attenuator bit
14	A2	Control of 1.0dB attenuator bit
15	A3	Control of 2.0dB attenuator bit
16	A4	Control of 4.0dB attenuator bit
17	A5	Control of 8.0dB attenuator bit
18	A6	Control of 16.0dB attenuator bit
20	+5V	Optional Positive Supply Voltage
22	-5V	Optional Negative Supply Voltage
24	RF OUT	RF Output
2,4,6,19,21,23,25,26,27 & 28	GND	Ground pads

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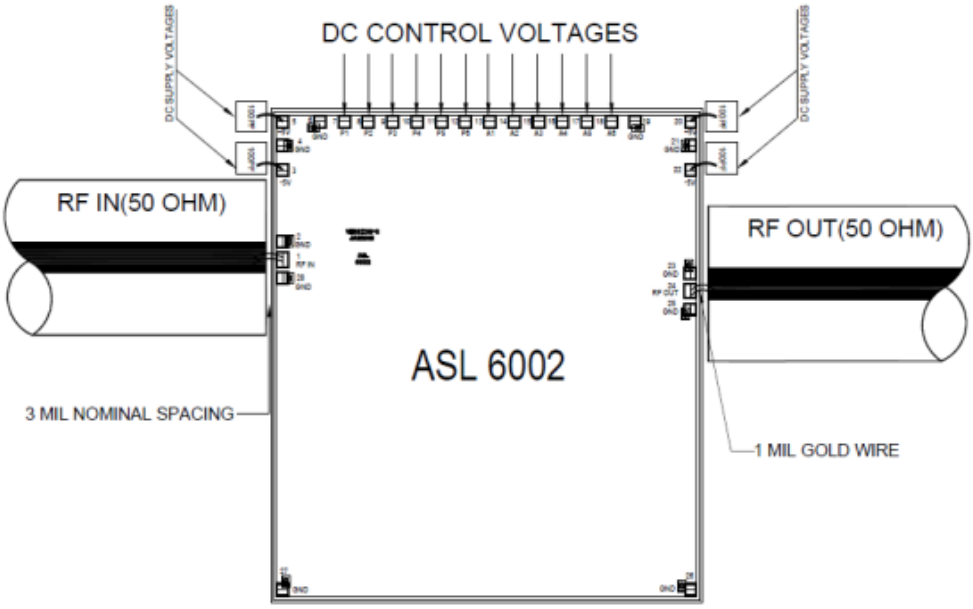
Recommended Assembly Diagram:



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 decoupled on-chip.
3. Input and output 50 ohm lines are preferably on 5mil or 10mil RT Duroid substrate.

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

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