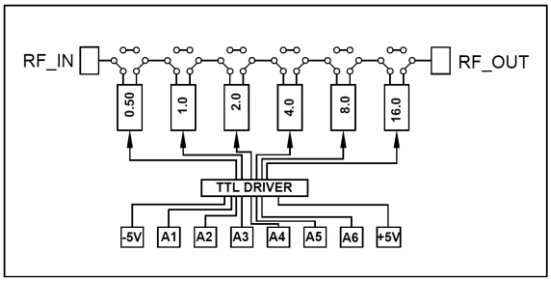
DC – 20GHz 6 BIT DIGITAL ATTENUATOR

Features

- **Frequency Range: DC - 20GHz**
- **Low Insertion Loss: 5dB(Max)**
- **Max. Attenuation of 31.5dB**
- **RMS Amplitude Error: 1dB**
- **Input & Output Return Loss: 12dB**
- **Die Size:3.3mm × 2.2mm × 0.1mm**

Functional Diagram



Typical Applications

- Radar
- Military & Space
- Instrumentation

Description

The ASL 3013 is a high performance MMIC 6-bit Digital Attenuator offering an attenuation range of 31.5dB in steps 0.5dB. The attenuator bit values are 0.5(LSB), 1, 2, 4, 8 and 16dB (MSB) for a total attenuation of 31.5dB. The attenuator features an RMS error of less than 1dB over all 64 states with a maximum insertion loss of 5dB. The attenuator provides an integral TTL driver facilitating a 6-bit digital control. 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

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

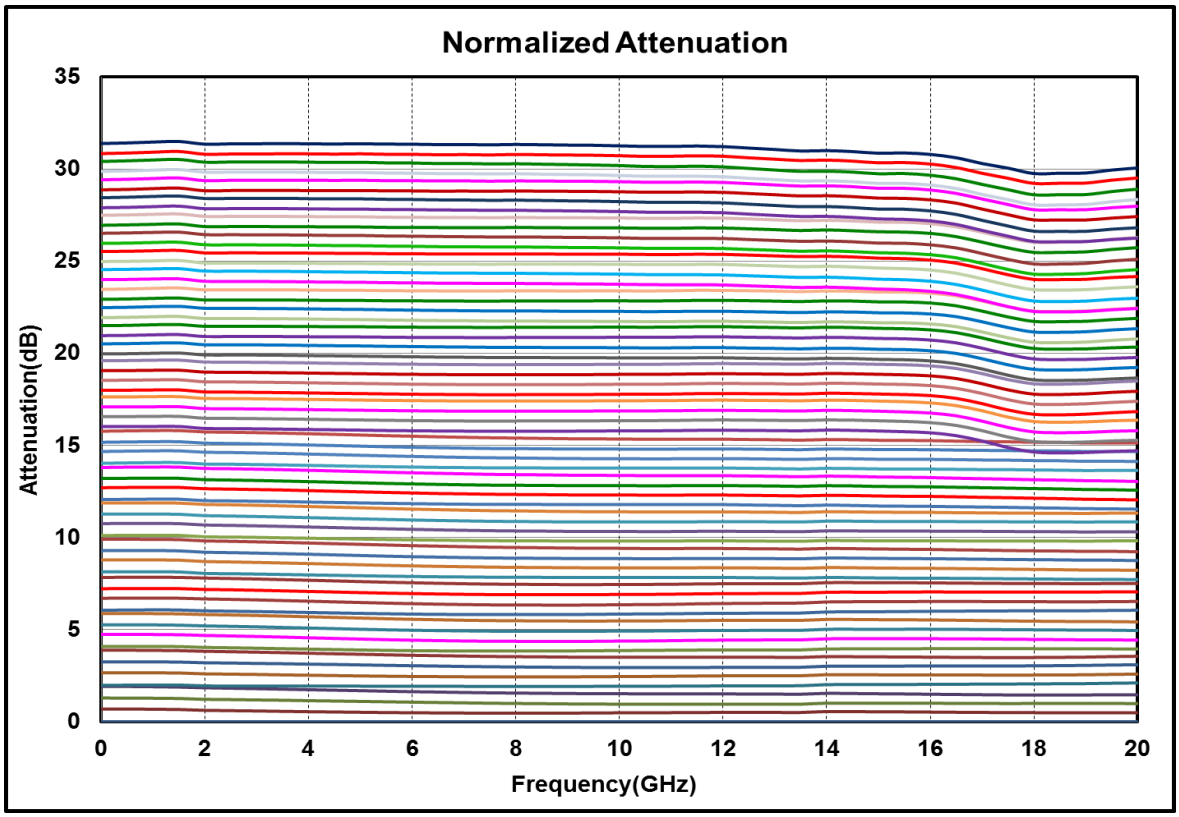
Parameter	Typical Values	Units
Frequency Range	DC - 20	GHz
Insertion Loss	5	dB
Attenuation Range	31.5	dB
Attenuation Accuracy 0.5 – 15.5dB States 16 – 31.5dB States	 ±0.3 ±0.3 + 5% of Attn. Setting.	dB
RMS Amplitude Error 0 – 16GHz 16 – 20GHz	 0.3 1	dB
Input Return Loss	15	dB
Output Return Loss	15	dB
Insertion Phase	0 to 40	Deg
DC Bias Voltages	+5 , - 5	V
Control Voltages	0 / +5	V

Note:

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

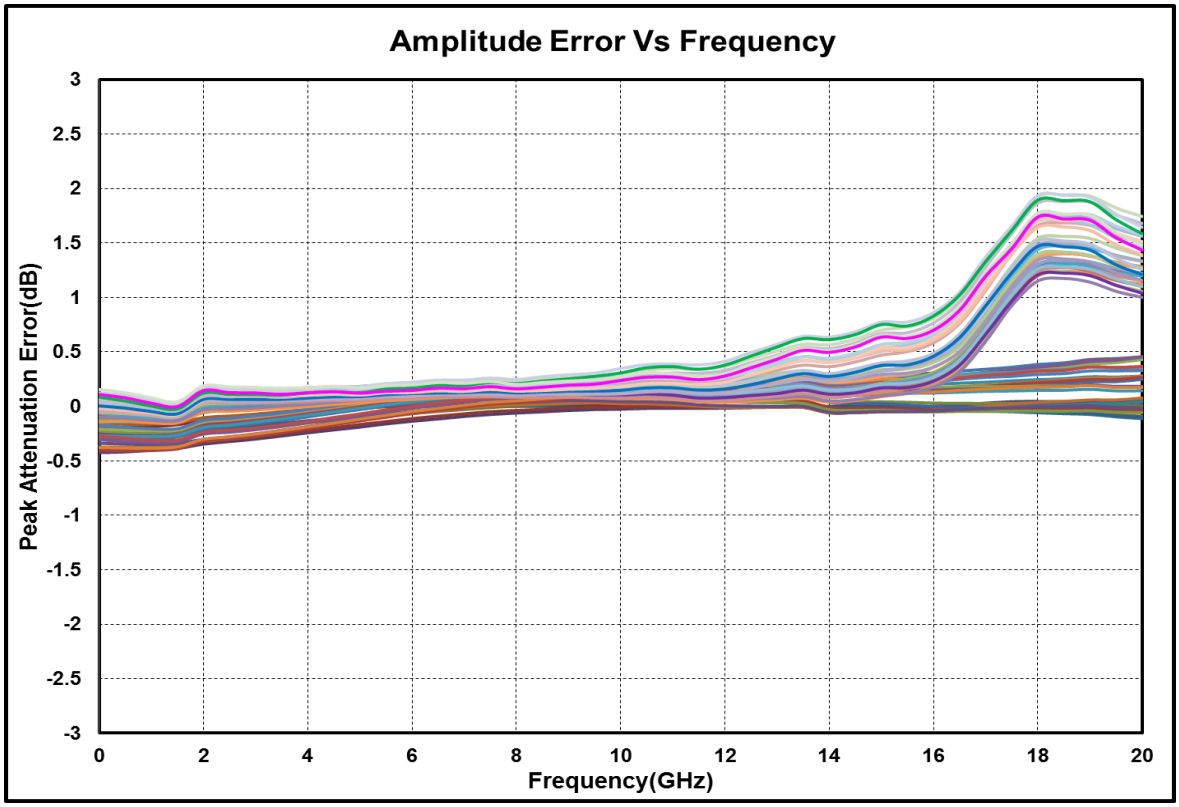
On Wafer data

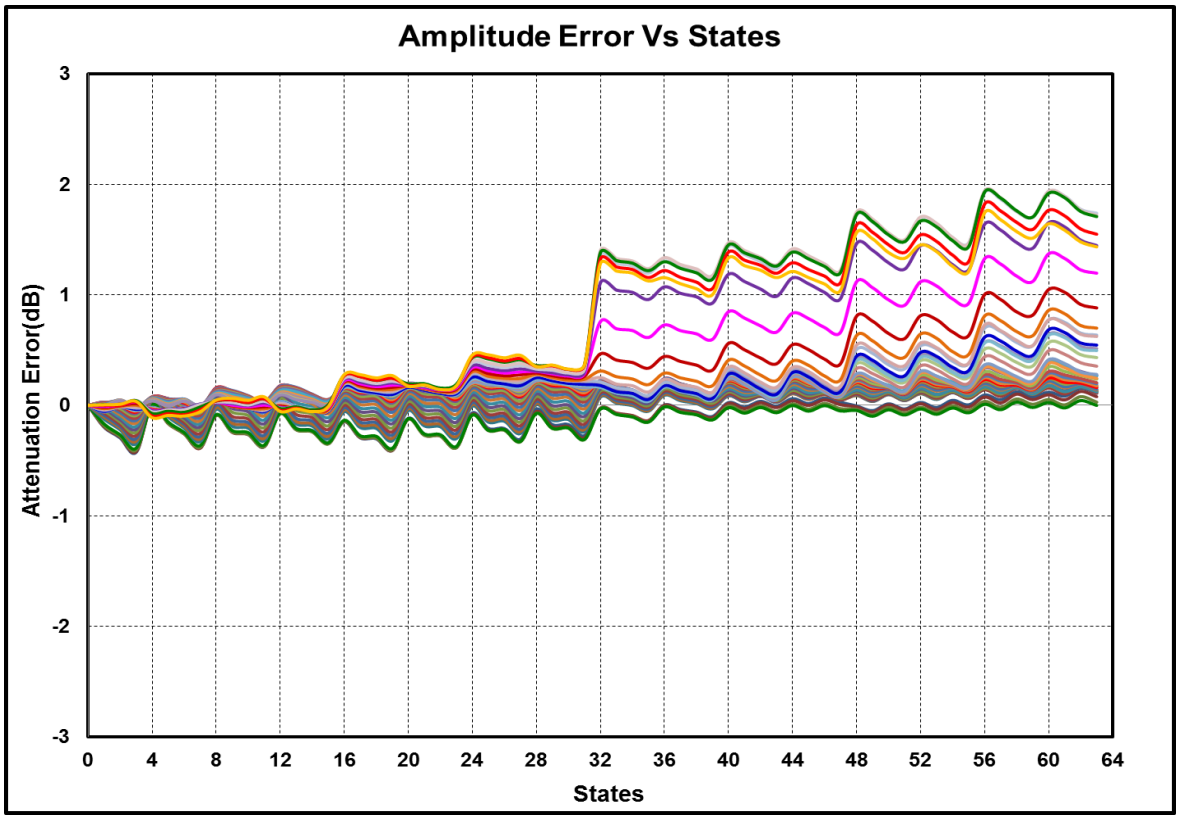
Driver Bias +5V, -5V; Control Voltage 0/+5V; T_A = 25 °C



On Wafer data

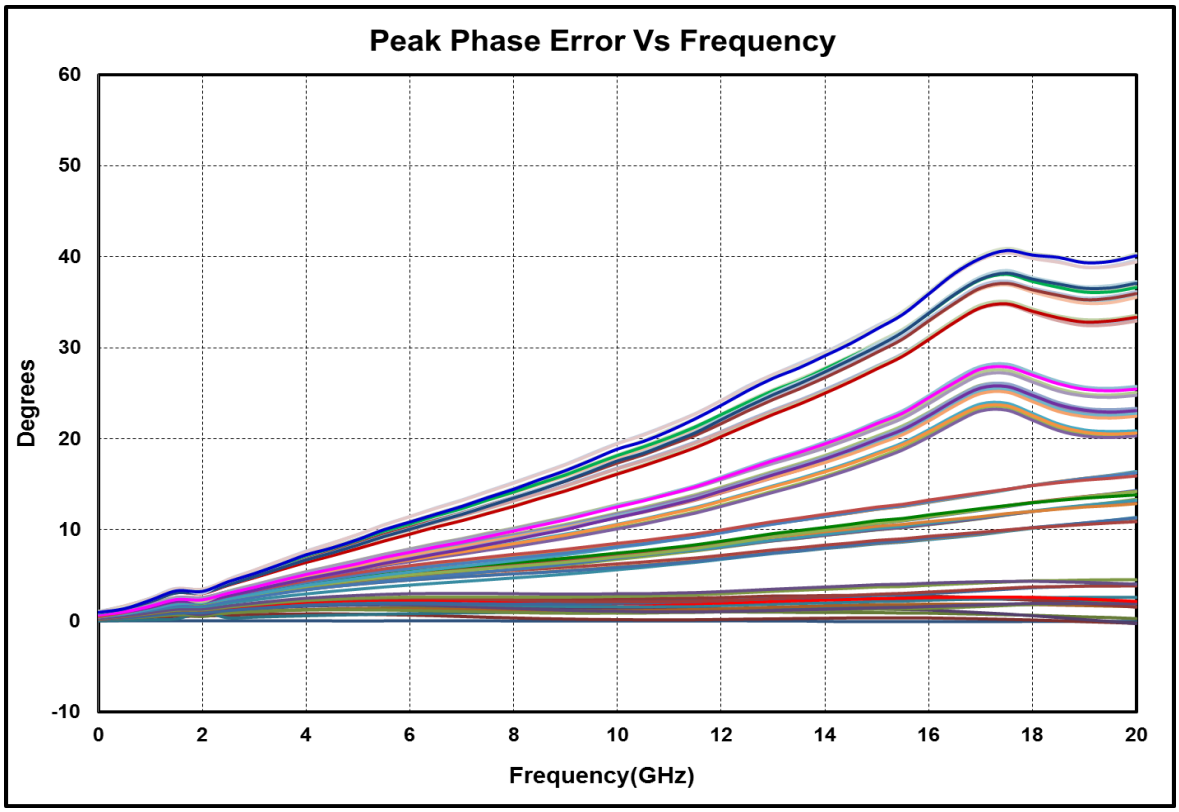
Driver Bias +5V, -5V; Control Voltage 0/+5V; T_A = 25 °C

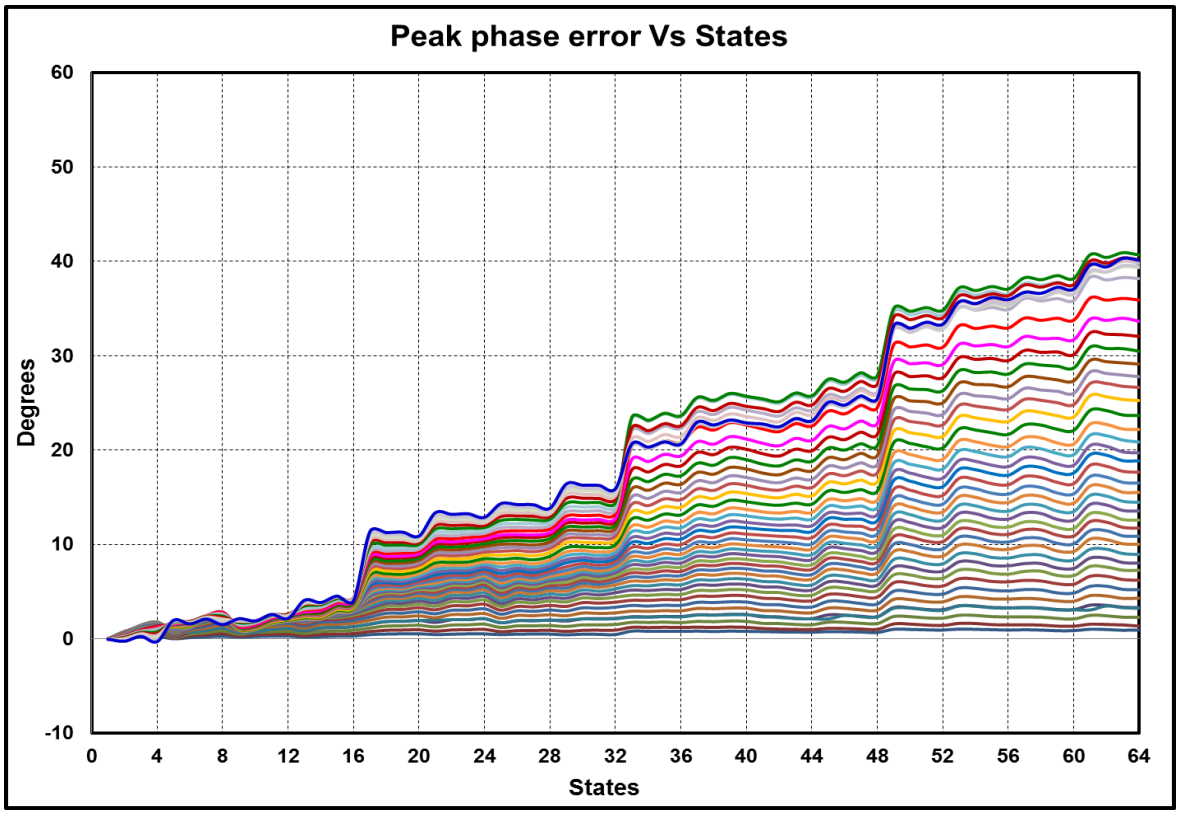




On Wafer data

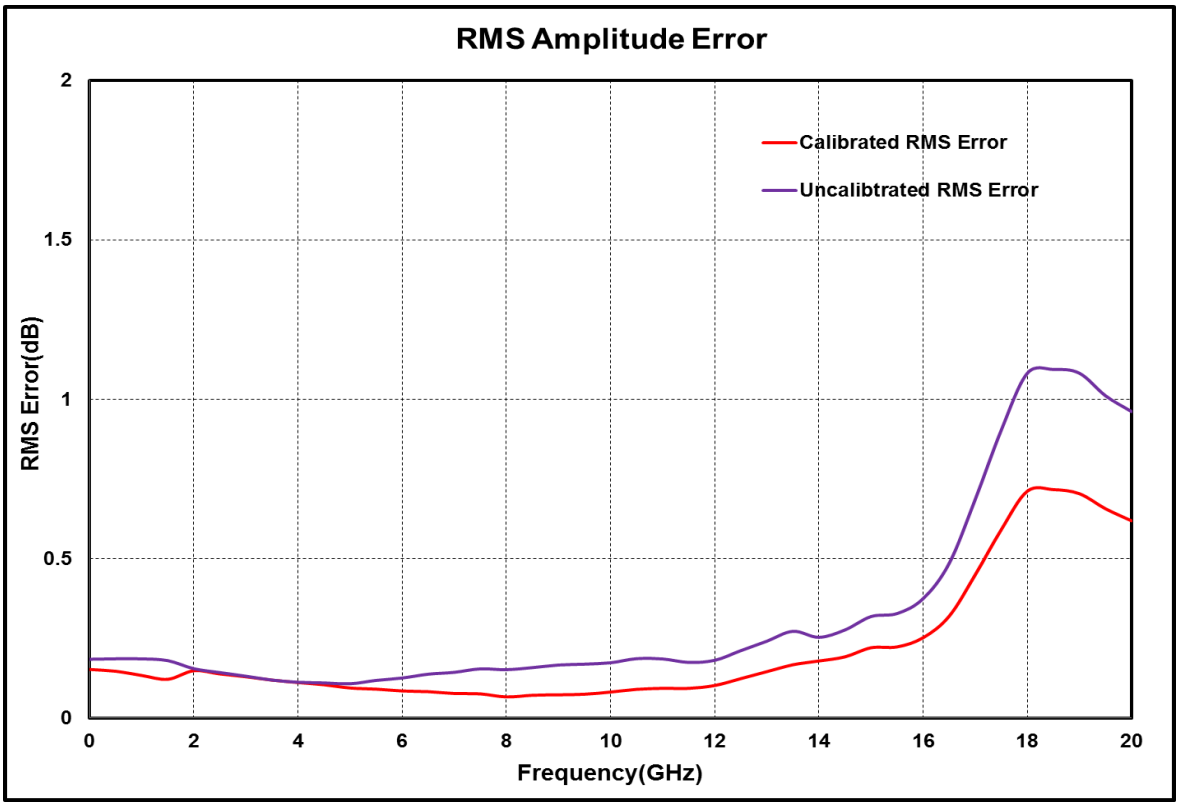
Driver Bias +5V, -5V; Control Voltage 0/+5V; T_A = 25 °C





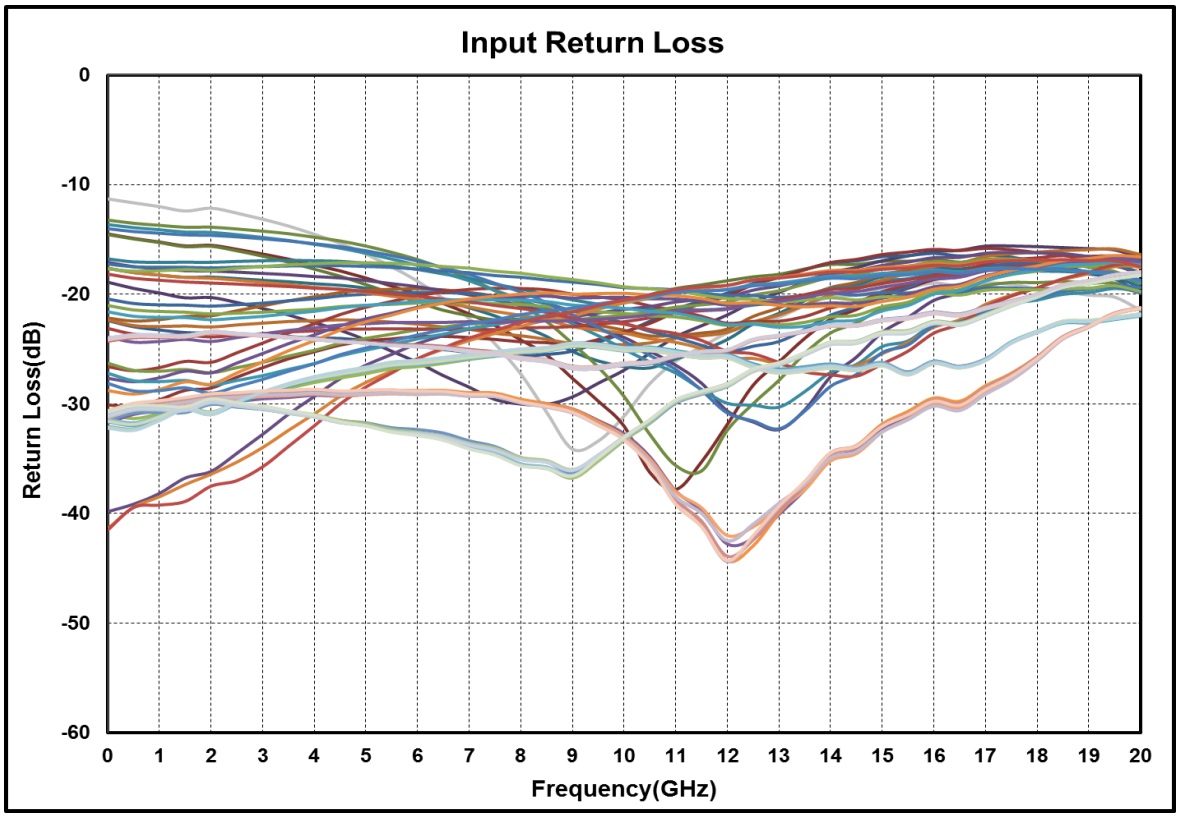
On Wafer data

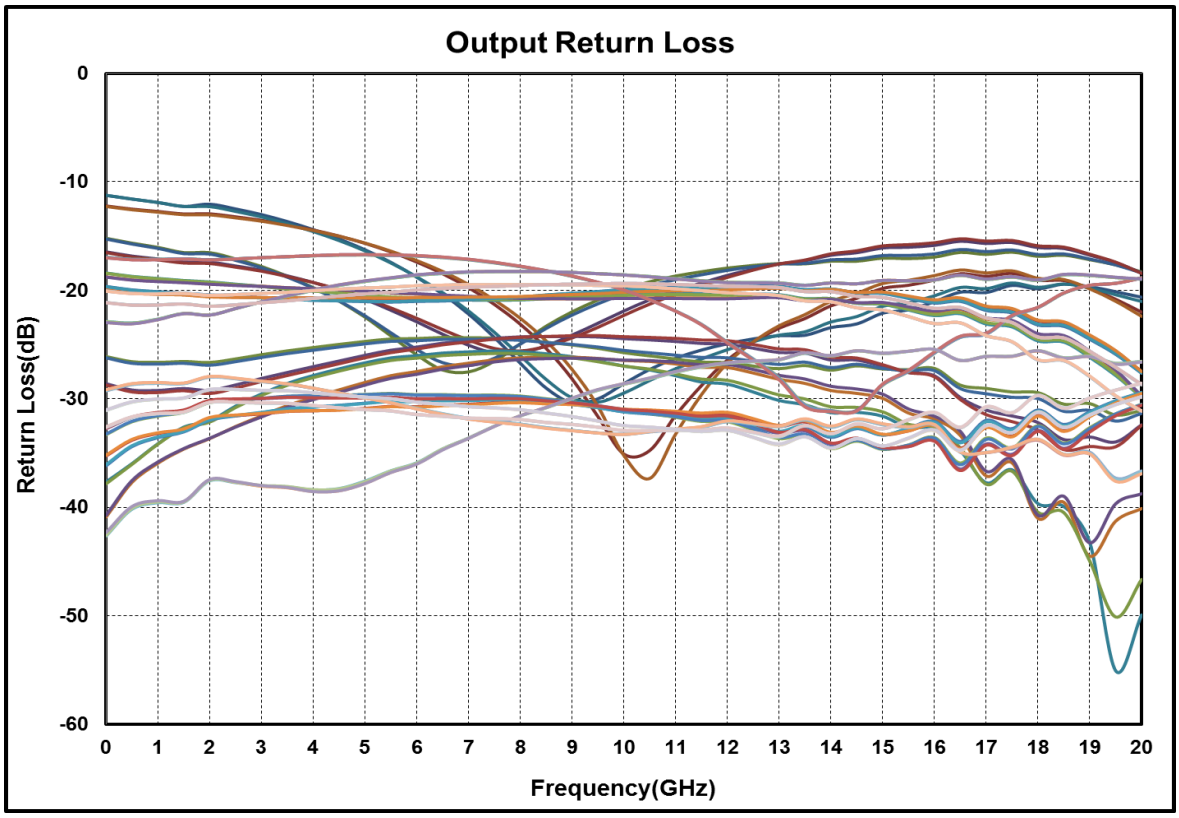
Driver Bias +5V, -5V; Control Voltage 0/+5V; T_A = 25 °C



On Wafer data

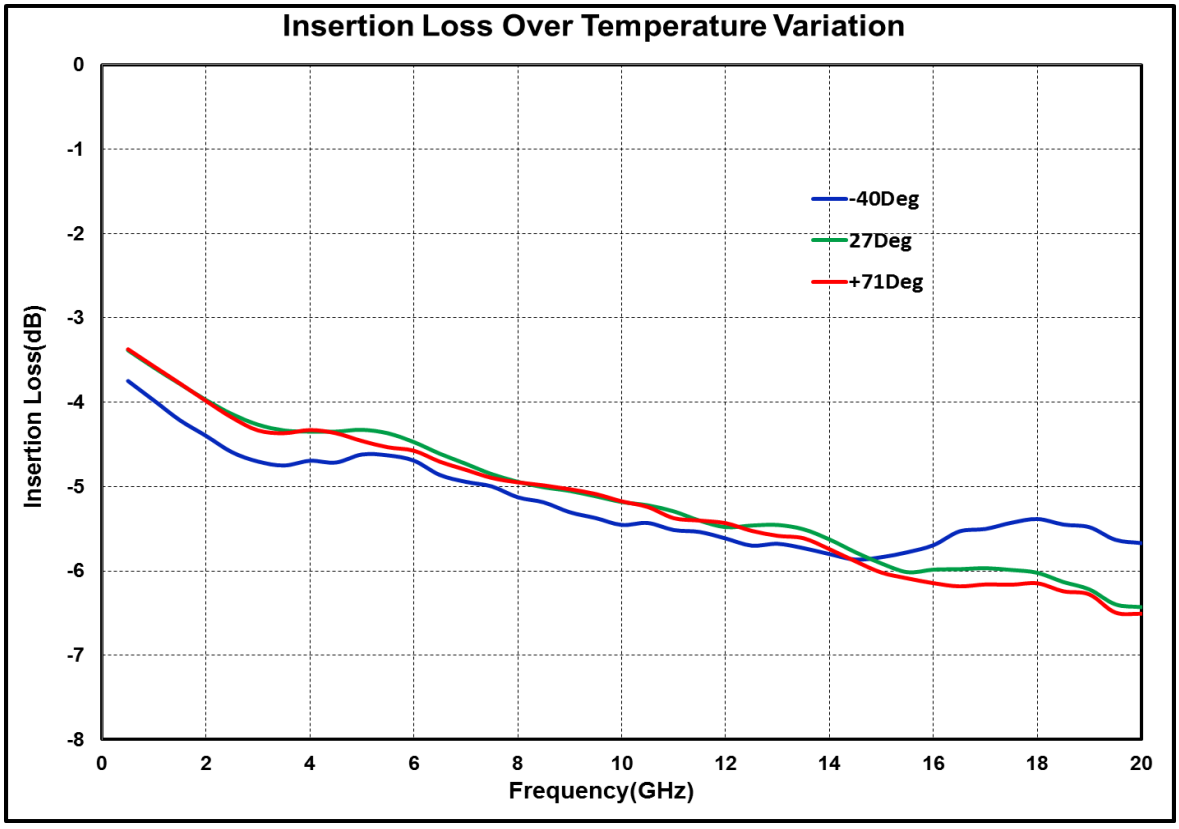
Driver Bias +5V, -5V; Control Voltage 0/+5V; T_A = 25 °C

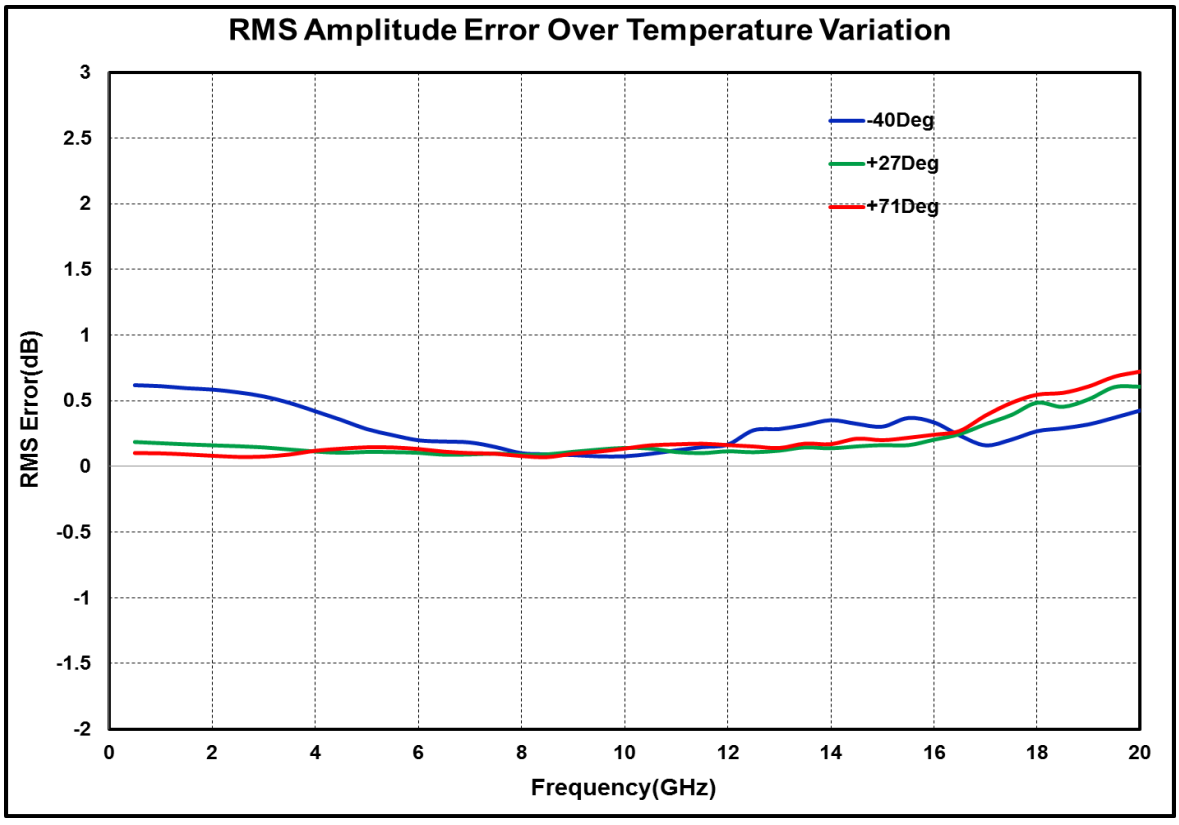




Test Fixture data over temperature

Driver Bias +5V, -5V; Control Voltage 0/+5V; T_A = 25 °C





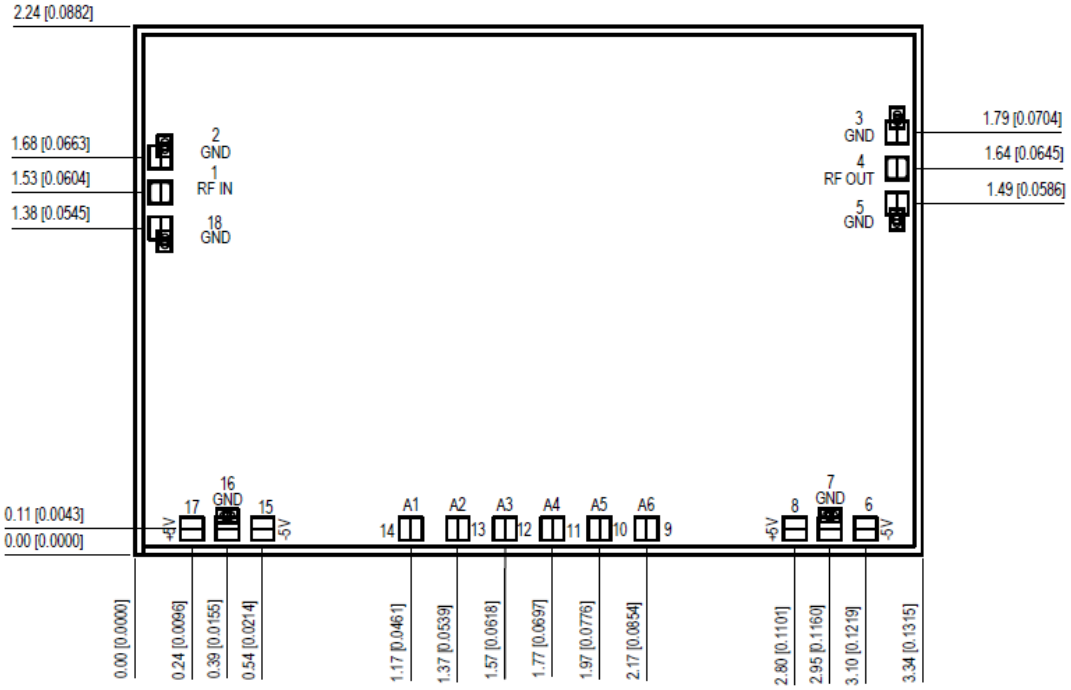
Truth Table

S.No.	Attenuation (dB)	TTL Control (1 = 3 to 5 V, 0 = 0 to 0.5 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

Truth Table

S.No.	Attenuation (dB)	TTL Control (1 = 3 to 5 V, 0 = 0 to 0.5 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

Mechanical Characteristics



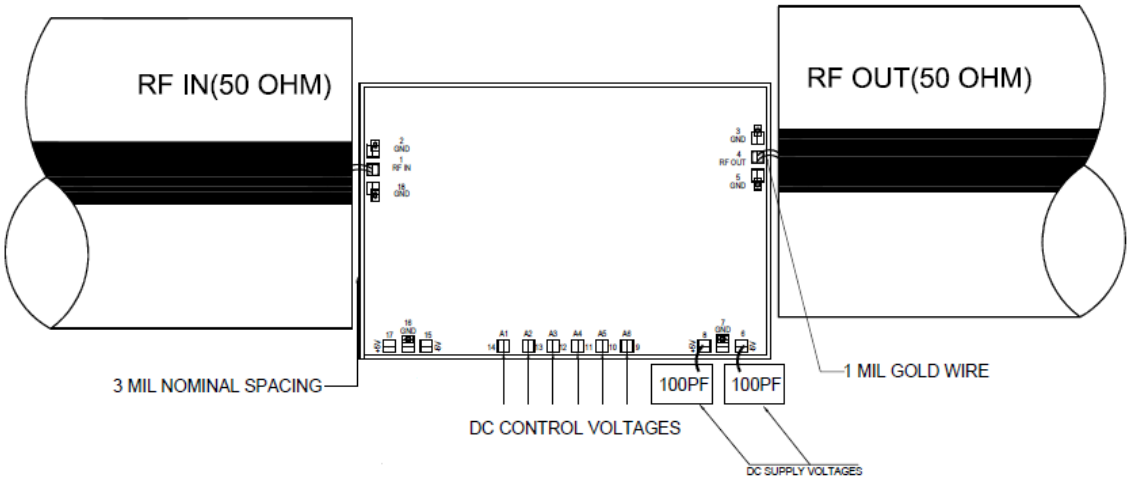
Units: millimetres (inches)

Note:

1. All RF and DC bond pads are 100µm x 100µm in size.
2. Pad no. 1 : RF In
3. Pad no. 6, 15* : -5 V
4. Pad no. 8, 17* : +5 V
5. Pad no. 4 : RF Out
6. Pad no. 9 to 14 : A6 to A1 (Control bits from LSB to MSB)
7. Pad no. 2,3,5,7,16 & 18 : GND (Ground)

*Pad no 15 & 17 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