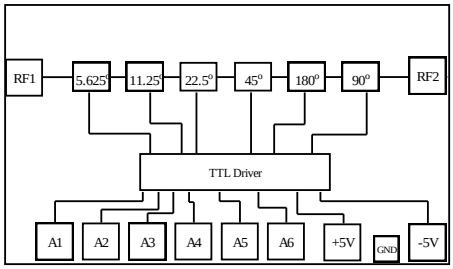
16 – 19 GHz 6-Bit Digital Phase Shifter

Features

- Frequency Range: 16 to 19 GHz
- Low RMS Error: 3.5 deg (Typ.)
- Low RMS Amplitude Error < 0.9 dB
- Peak Phase Error ± 8 Deg (Typ.)
- 10 dB Typ. Insertion Loss
- TTL Control Inputs
- Chip Size: 4.5 mm x 2.2 mm x 0.1 mm

Functional Diagram



Typical Applications

- Radar
- Military & Space
- Instrumentation

Description

The Aelius ALS2014 is a 6-bit digital phase shifter MMIC designed to operate over a frequency band of 16 -19 GHz. The phase shifter features a low RMS phase error of 3.5 deg (Typ.). The insertion loss is 10 dB typical and varies within ± 1.2 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 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	23	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[2] @ T_A = 25 °C , Z_o = 50 Ω

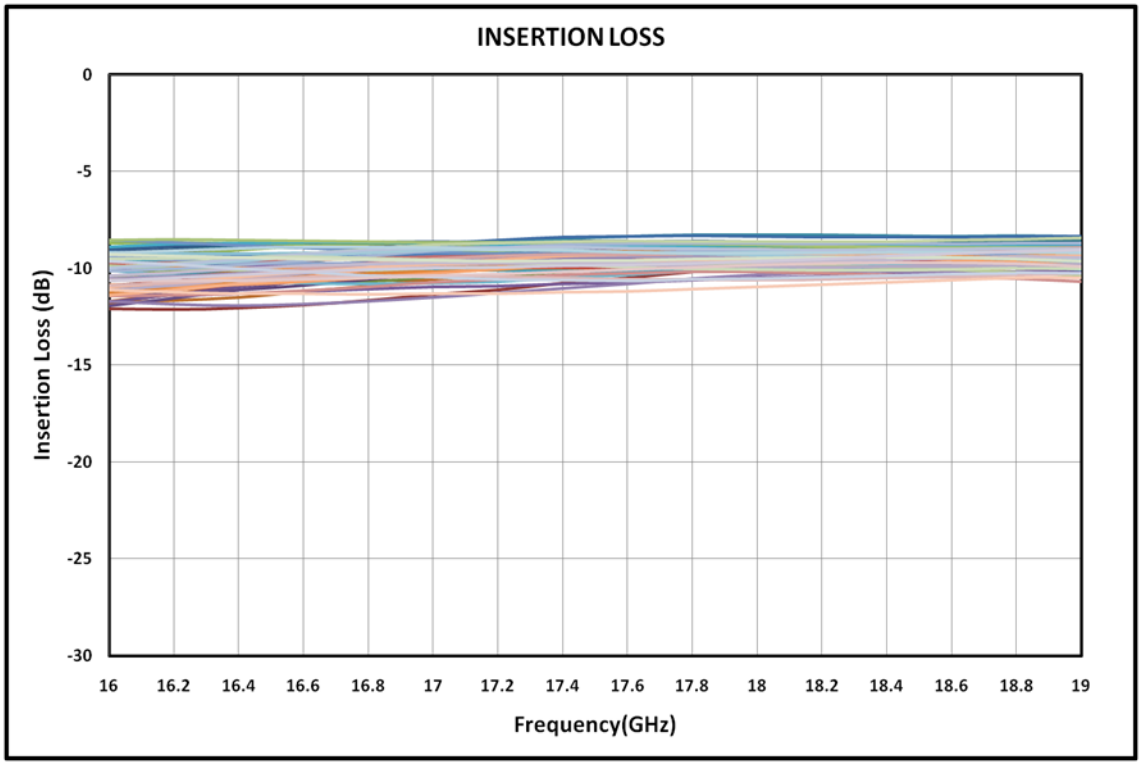
Parameter	Minimum	Typical	Maximum	Units
Frequency Range	16 - 19	16 – 19	16 – 19	GHz
Phase Shift	0-360 in 64 steps	0-360 in 64 steps	0-360 in 64 steps	deg
Insertion Loss	-11.5	-10	-8	dB
Insertion Loss Variation	-	± 1.2	-	dB
Peak Phase Error	-	± 8	-	deg
RMS phase Error	2.4	3.5	4.5	deg
RMS Amplitude Error	0.5	0.7	0.9	dB
Input Return Loss	-27	- 10	-6	dB
Output Return Loss	-32	- 10	-6	dB
DC Bias Voltages	-	+5, -5	-	V
DC Supply Current	-	11	-	mA
Control Voltage	-	0 / +3.5	-	V

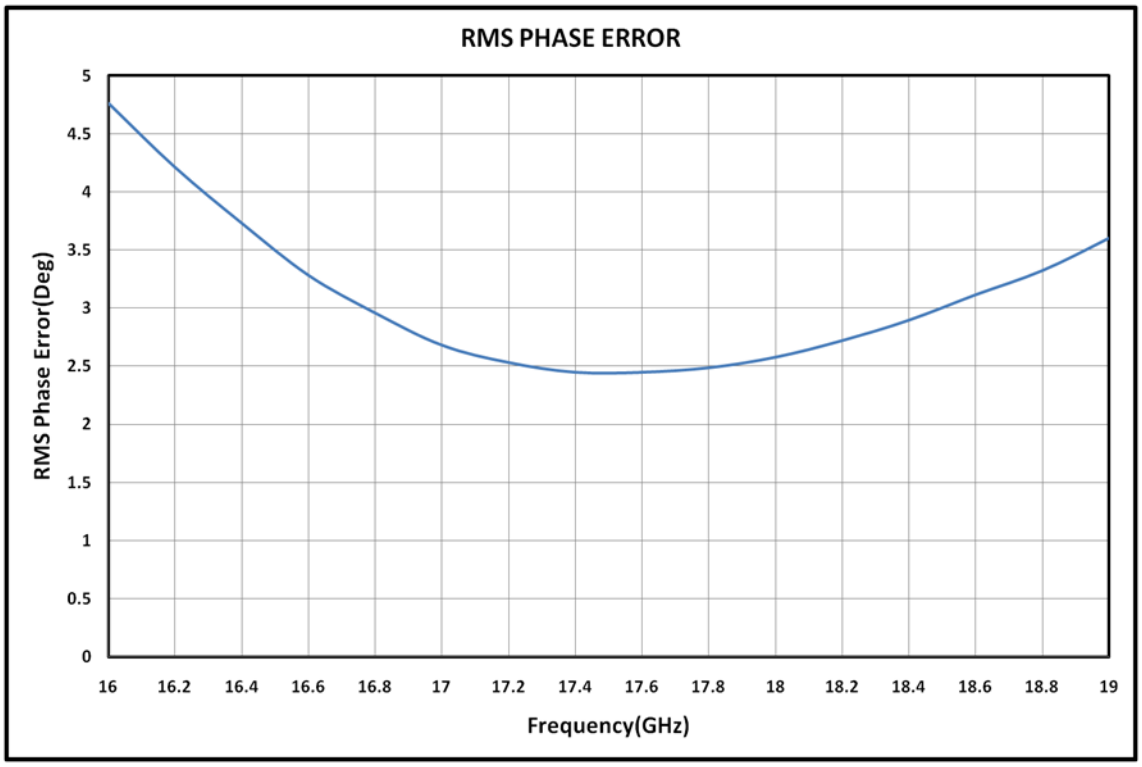
Note:

2. The above mentioned electrical specifications are measured in text fixture.

Text Fixture Data

T_A = 25 °C





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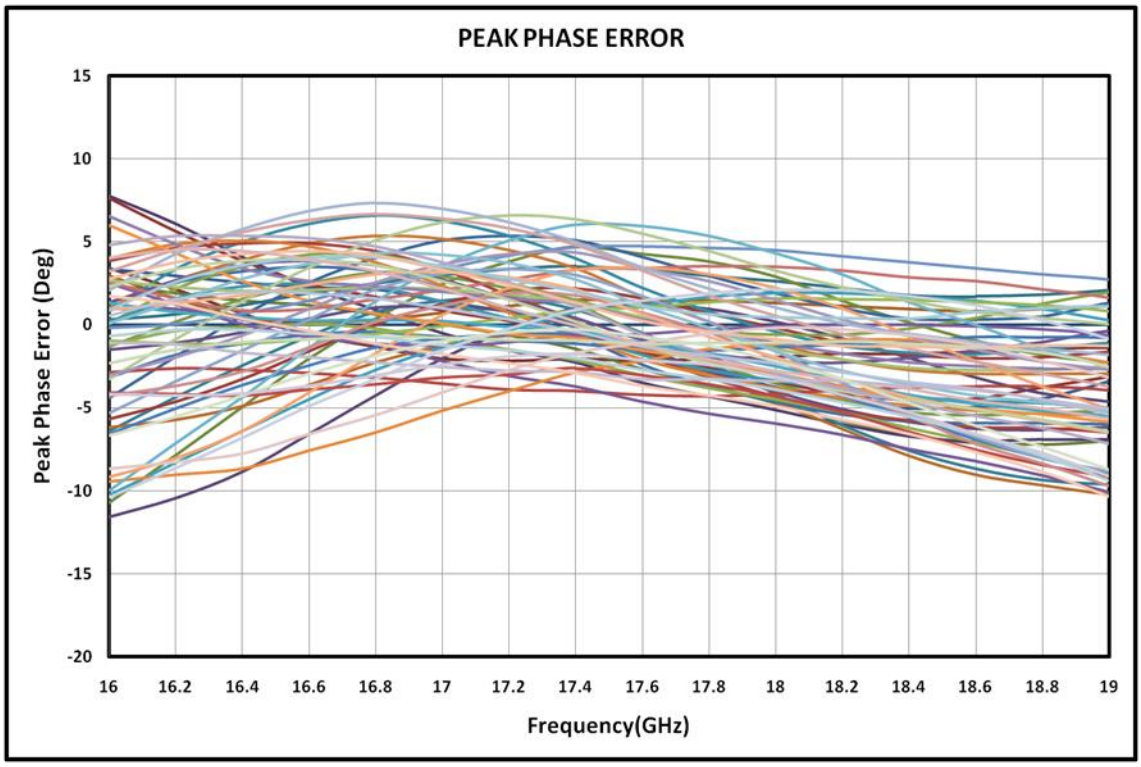

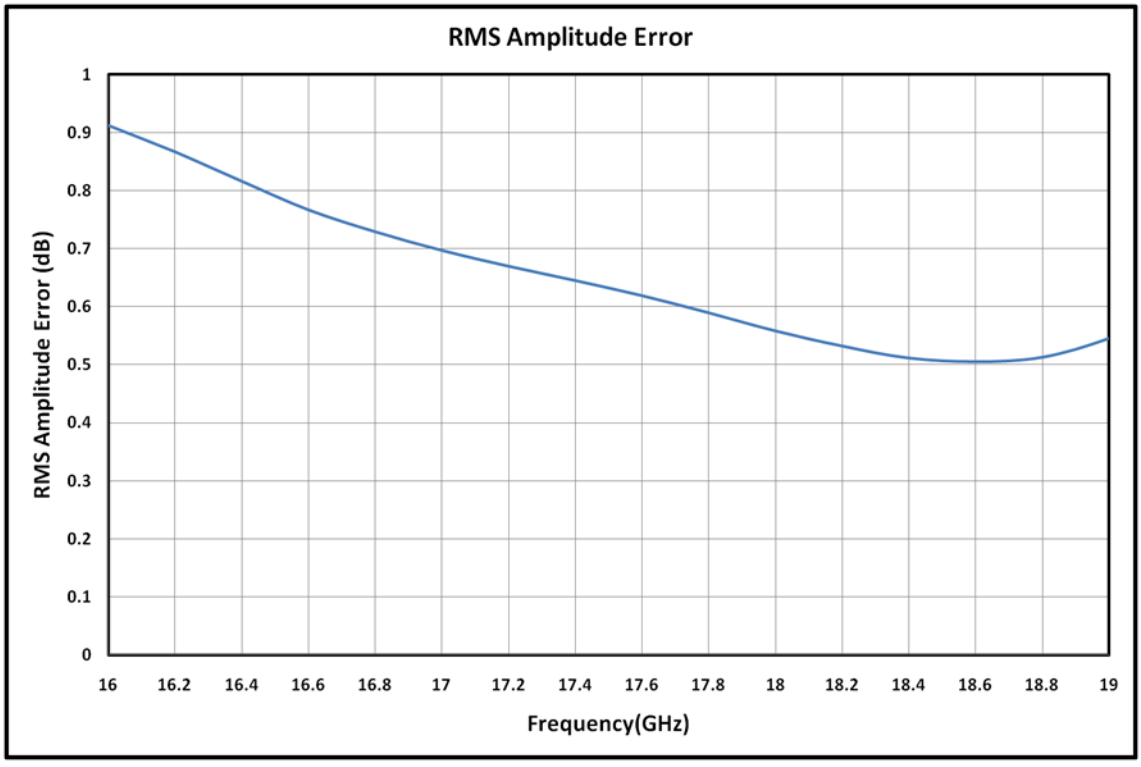

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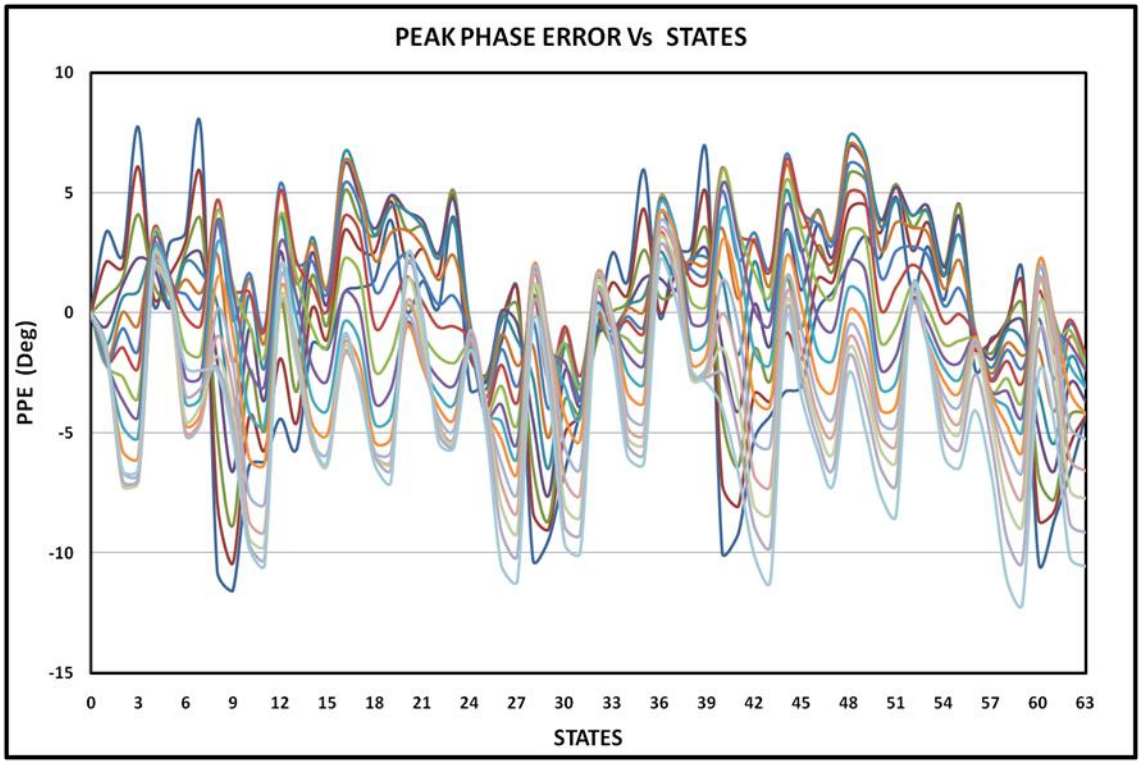

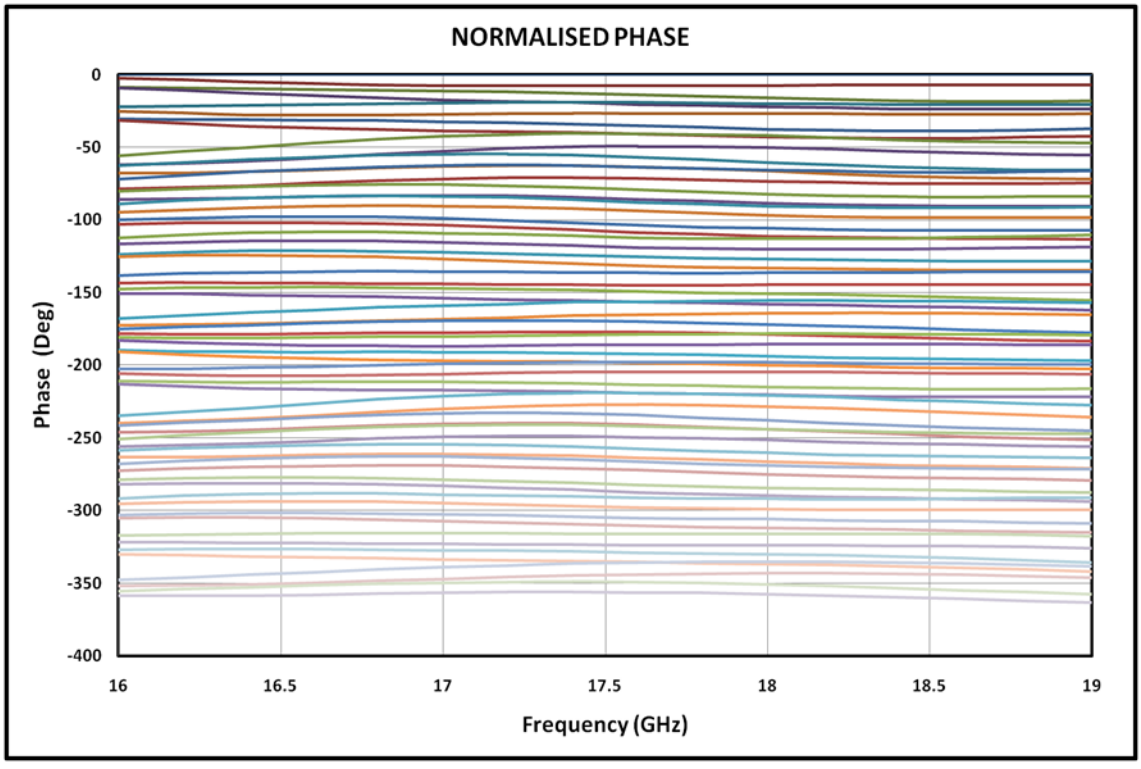

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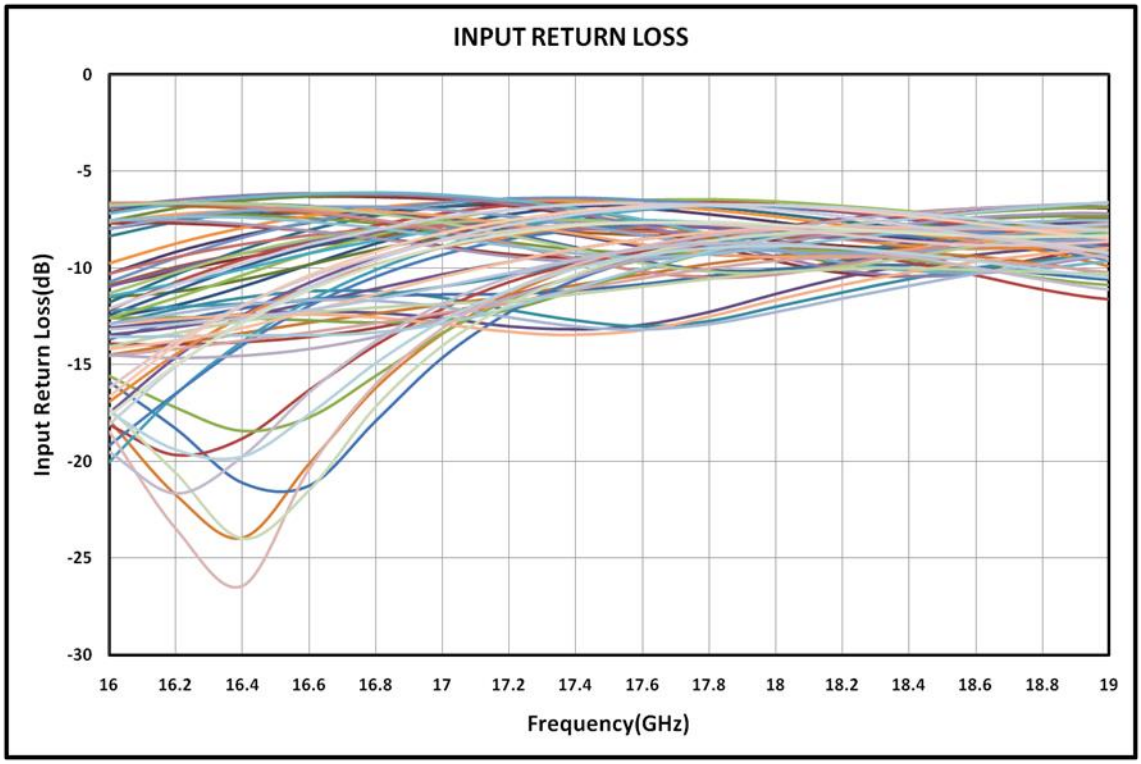
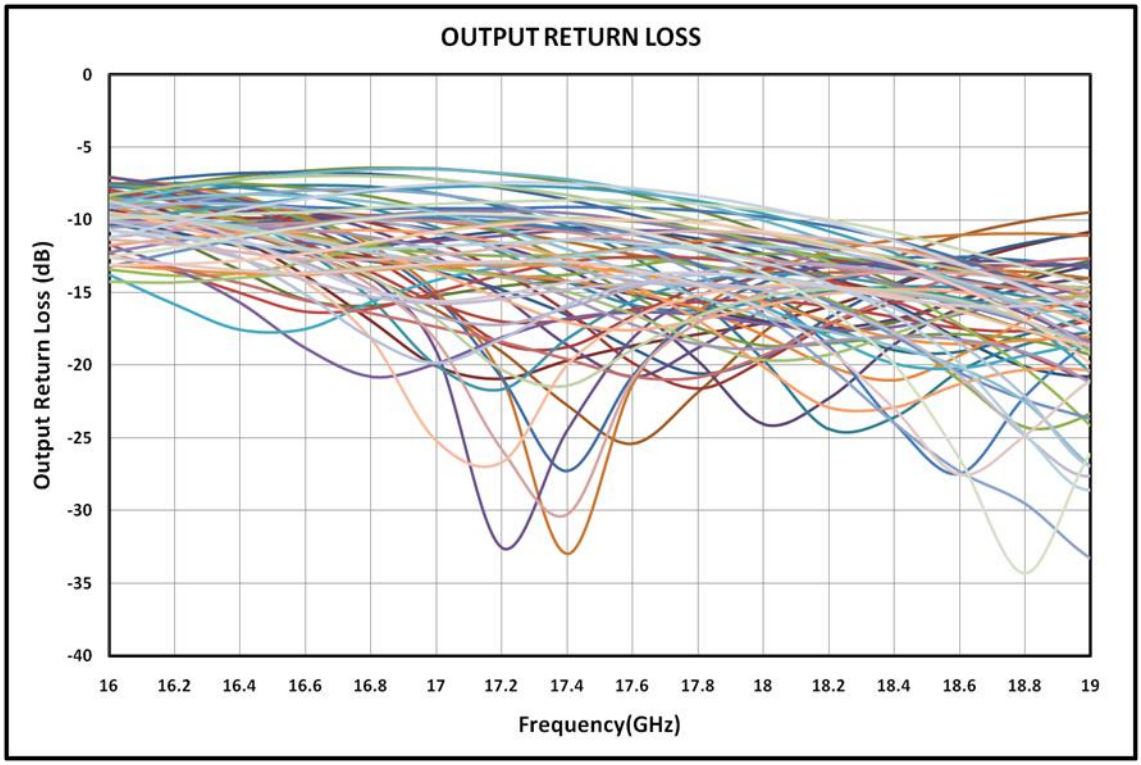




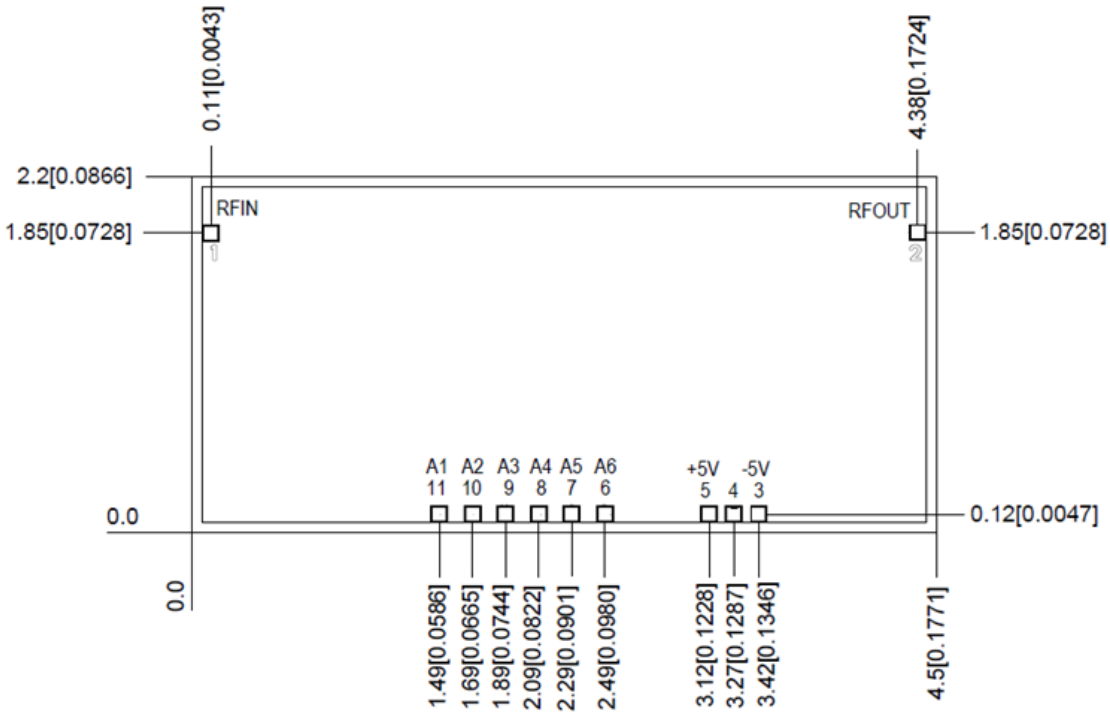
Truth Table

State	Phase Shift	180 deg	90 deg	45 deg	22.5 deg	11.25 deg	5.625 deg
		A6	A5	A4	A3	A2	A1
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	180 deg	90 deg	45 deg	22.5 deg	11.25 deg	5.625 deg
		A6	A5	A4	A3	A2	A1
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



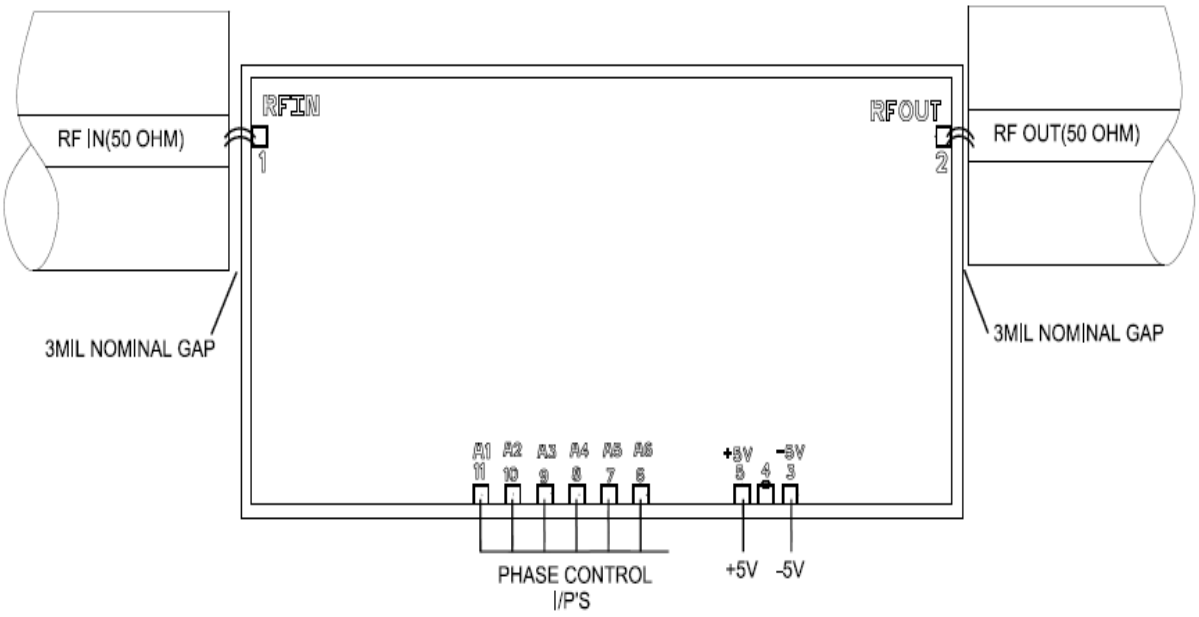
Units: millimeters (inches)

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

Note:

1. Pad No. 1 : RF IN
2. Pad No. 2 : RF OUT
3. Pad No. 3 : -5V
4. Pad No. 4 : GND
5. Pad No. 5 : +5V
6. Pad No's 6 to 11: A6 to A1 Phase Controls

Recommended Assembly Diagram



Note:

1. 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

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