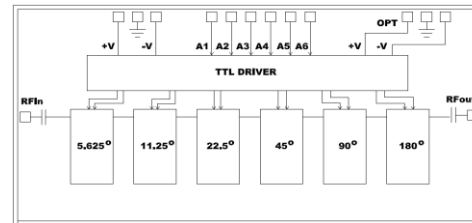


3.0- 4.0 GHz 6-Bit Digital Phase Shifter

Features

- ◆ Frequency Range: 3 to 4 GHz
- ◆ Low RMS Phase Error ~ 2 deg.
- ◆ 6 dB Maximum Insertion Loss
- ◆ TTL Control Inputs
- ◆ 21 dBm Input P1dB
- ◆ Chip Size : 4.5 mm x 2.2 mm x 0.1 mm

Functional diagram



Typical Applications

- ◆ Military & Space
- ◆ Radar

Description

The ASL2002 is a 6-bit digital phase shifter MMIC designed to work from 3 to 4 GHz. The phase shifter features a low RMS phase error of less than 2.0 deg over the entire operating band. The insertion loss is 6 dB maximum and varies within ± 0.5 dB over the band and the 64 phase states. The phase shifter has an input P1 dB of 21 dBm at +7V & -7V supply Voltages and is capable of handling up to 1 Watt of input power. 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 0.5 μ m InGaAs pHEMT technology

Absolute Maximum Ratings⁽¹⁾

Parameter	Absolute Maximum	Units
RF Input Power	30	dBm
Positive Supply Voltage	+8	V
Negative Supply Voltage	-8	V
Control Voltage		
ON	+6	V
OFF	-0.5	V
Operating Temperature	-55 to +85	°C
Storage Temperature	-55 to +120	°C

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

Electrical Specifications @ $T_A = 25\text{ }^\circ\text{C}$, $Z_o = 50\ \Omega$

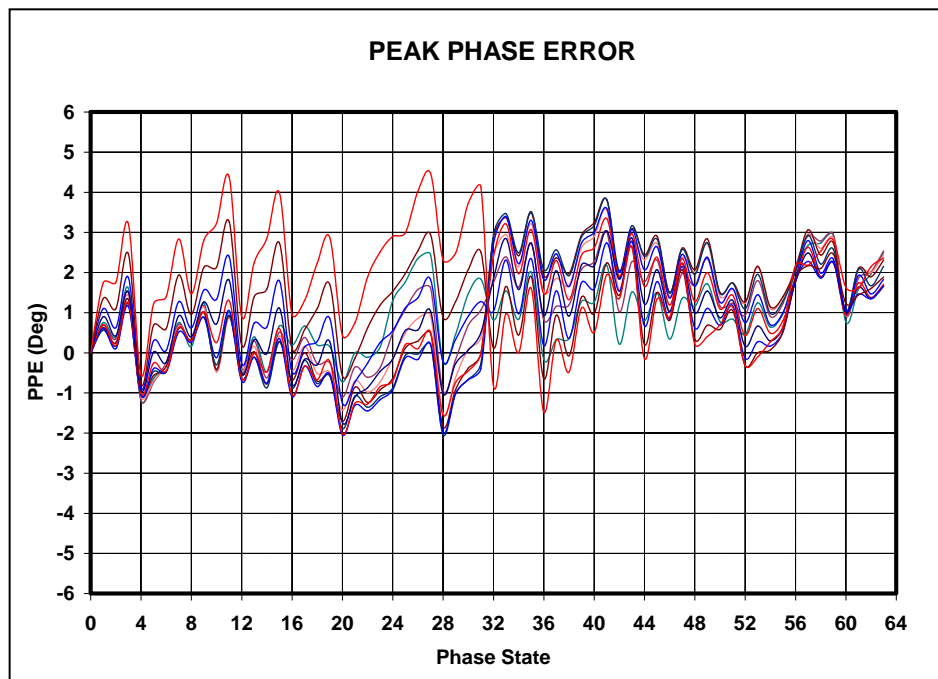
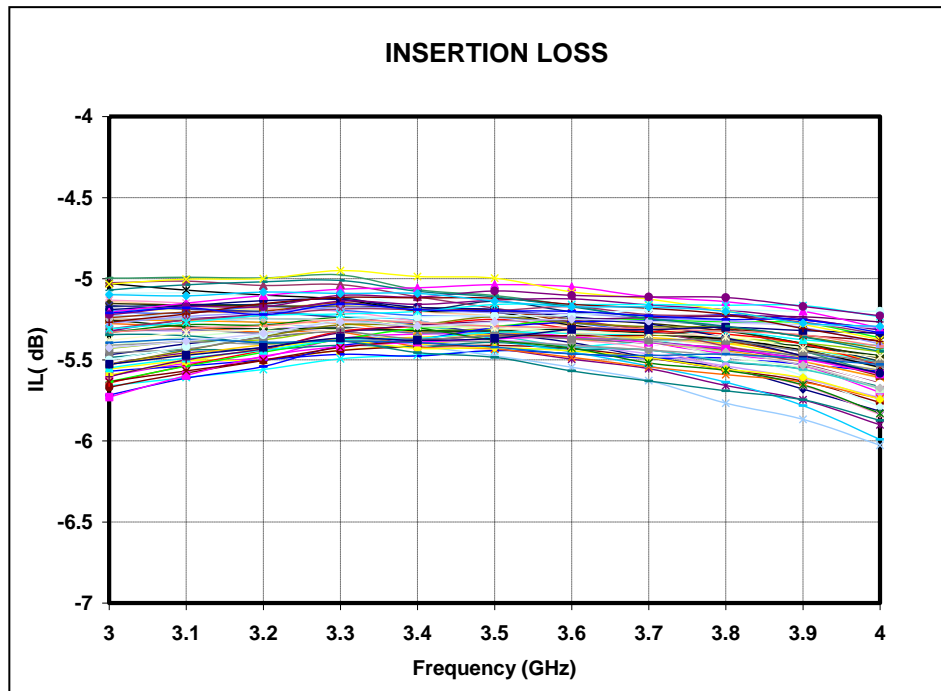
Parameter	Value	Units
Bandwidth	3 to 4	GHz
Phase Shift	0 – 360 in 64 steps	deg
Insertion Loss ¹	5.5	dB
Peak Amplitude Error	±0.5	dB
Peak Phase Shift Error	-2 to +4.5	deg
RMS Phase Shift Error (max.)	2.2	deg
Input Return loss ²	-9	dB (max)
Output Return Loss ²	-10	dB (max)
P1 dB @ Input ³	+ 21	dBm
DC Supply Voltages	+5, -5	V
DC Supply Current ⁴	11	mA
DC Control Voltage		
ON	+5	V
OFF	0	V

Note:

1. Averaged over all the 64 phase states
2. Measured over all the 64 phase states
3. Measured over prime phase states – 0, 5.625, 11.25, 22.5, 45, 90 and 180 degrees.
4. Positive supply draws 7mA, negative supply draws 3mA.

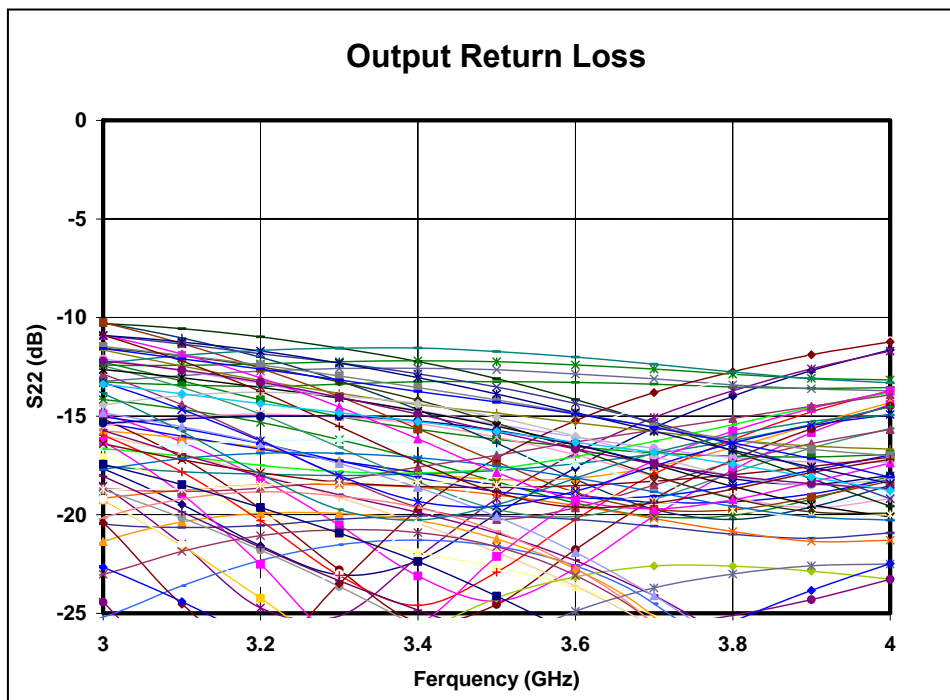
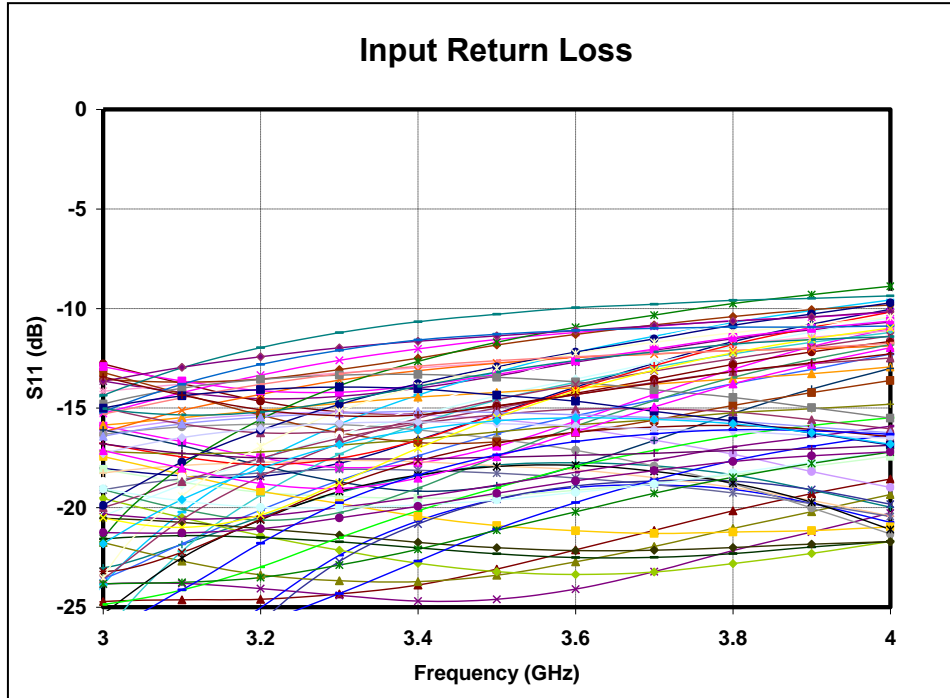
Test fixture data

$T_A = 25\text{ }^\circ\text{C}$, $Z_0 = 50\Omega$



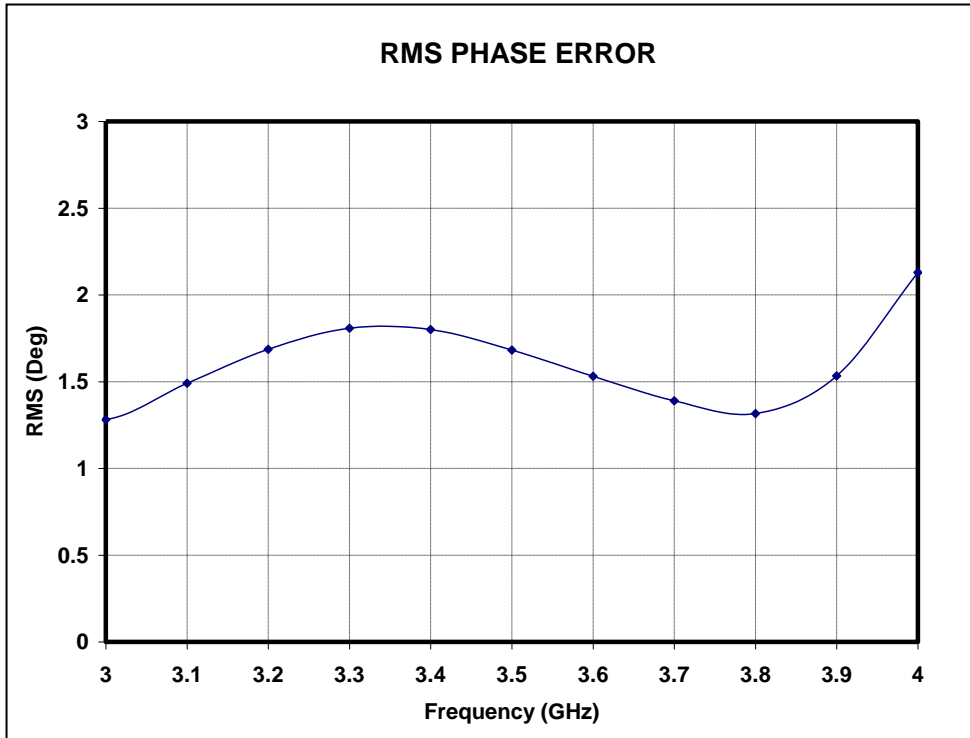
Test fixture data

$T_A = 25\text{ }^\circ\text{C}$, $Z_0 = 50\Omega$



Test fixture data

$T_A = 25\text{ }^\circ\text{C}$, $Z_0 = 50\Omega$



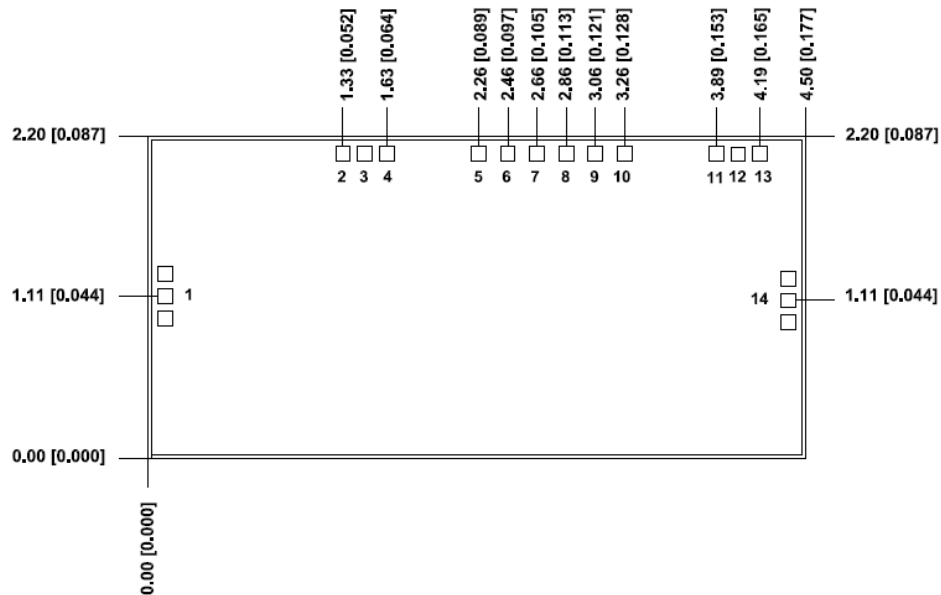
Truth Table

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



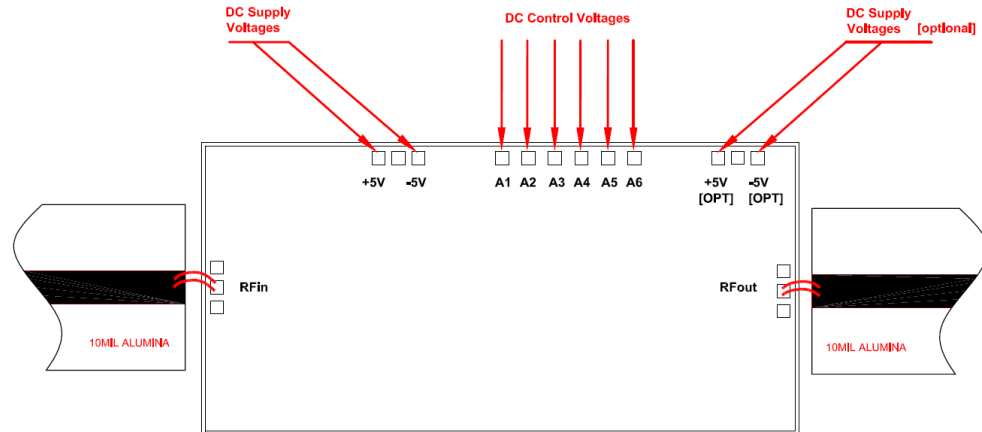
Units: millimeters (inches)

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

PAD DESIGNATIONS

Pad No.	Function	Pad No.	Function
1	RF INPUT	8	CTRL BIT – 4 (45°)
2	+Vcc (+5V)	9	CTRL BIT – 5 (90°)
3	GND	10	CTRL BIT – 6 (180°)
4	-Vcc (-5V)	11	+Vcc (Optional)
5	CTRL BIT – 1 (5.625°)	12	GND
6	CTRL BIT – 2 (11.25°)	13	-Vcc (Optional)
7	CTRL BIT – 3 (22.5°)	14	RF OUTPUT

Recommended Assembly Diagram



Note:

1. It is recommended to use series resistors $\sim 100\text{-}500\ \Omega$ at all the control inputs
2. DC Supply Pads are given on both sides of the Control Input Pads. Either of the pads can be used.
3. For giving +Vcc and -Vcc supplies, 100 pF capacitor should be used as a bypass as close to the chip as possible.

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 - 200 μm length of wedge bonds is advised. Single Ball bonds of 250-300 μm 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

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