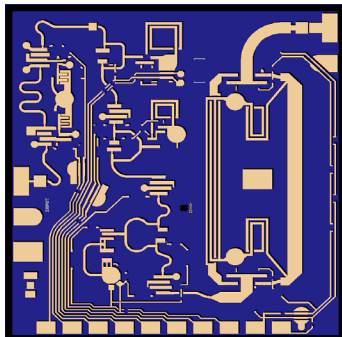


8.5 - 11 GHz 6-bit Phase Shifter



Key Features and Performance

- Frequency Range: 8.5 - 11 GHz
- 5dB Nominal Insertion Loss
- 2deg RMS Phase Error @ 9.5GHz
- 0.2dB RMS Amp. Error @ 9.5GHz
- Negative Control Voltage
- 0.5 μ m MESFET Technology
- Chip dimensions:
3.25 x 3.48 x 0.15 mm
(0.128 x 0.137 x 0.006 inches)

Primary Applications

- Military Radar
- Transmit / Receive

Description

The TriQuint TGP2103 is a 6-bit digital phase shifter MMIC design using TriQuint's proven 0.5 μ m MESFET process. The TGP2103 will support a variety of X-Band phased array applications including military radar.

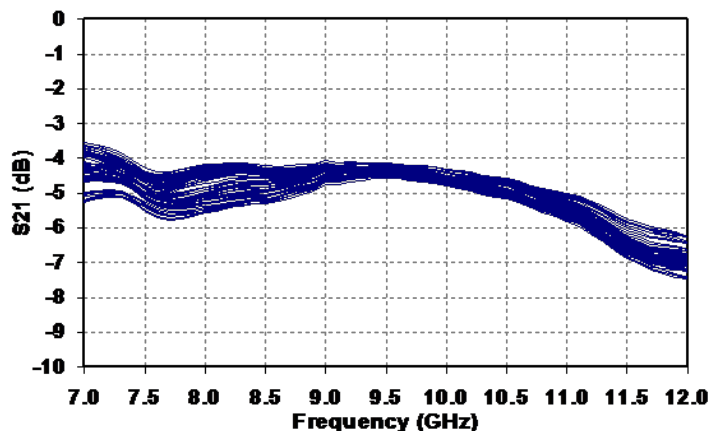
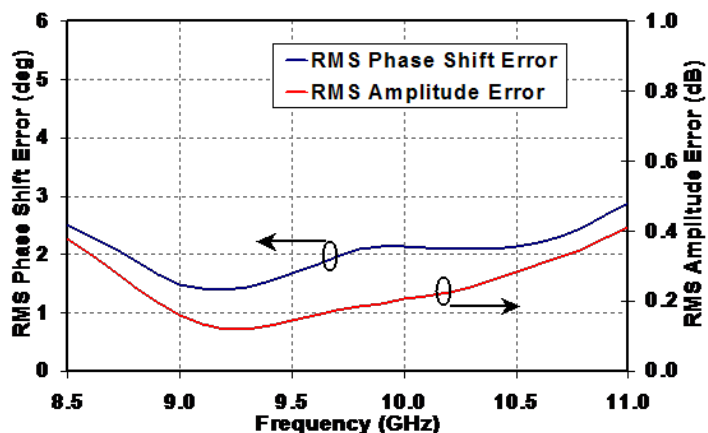
The 6-bit design utilizes a compact topology that achieves a 11.31mm² die area and high performance.

The TGP2103 provides a 6-bit digital phase shift function with a nominal 5dB insertion loss and 2° RMS phase shift error over a bandwidth of 8.5-11GHz.

The TGP2103 requires a minimum of off-chip components and operates with a -5V control voltage. Each device is RF tested on-wafer to ensure performance compliance. The device is available in chip form.

Lead-Free and RoHS compliant

Measured Performance



Datasheet subject to change without notice

**TABLE I
MAXIMUM RATINGS**

Symbol	Parameter	Value	Notes
V _C	Control Voltage Range	-8V to 0V	<u>1/</u> <u>2/</u>
I _C	Control Supply Current	1 mA	<u>1/</u> <u>2/</u>
P _{IN}	Input Continuous Wave Power	20 dBm	<u>1/</u> <u>2/</u>
P _D	Power Dissipation	0.1 W	<u>1/</u> <u>2/</u>
T _{CH}	Operating Channel Temperature	200 °C	<u>3/</u>
	Mounting Temperature (30 Seconds)	320 °C	
T _{STG}	Storage Temperature	-65 to 150 °C	

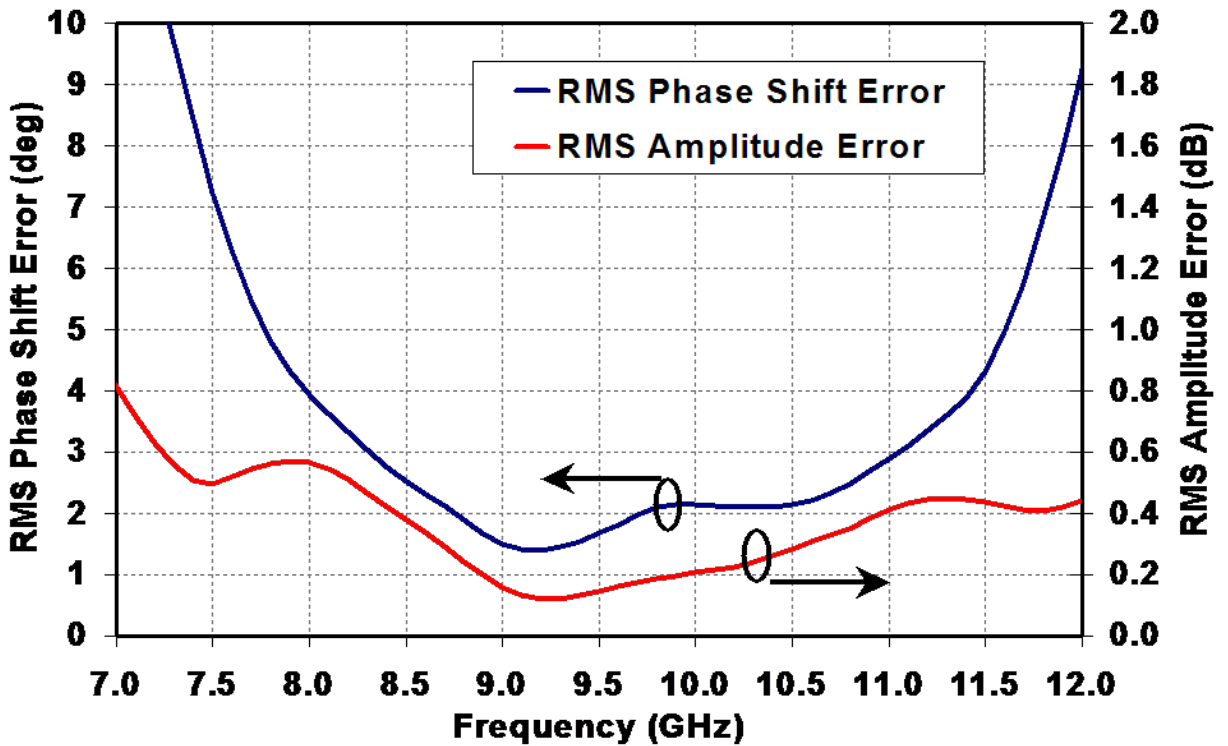
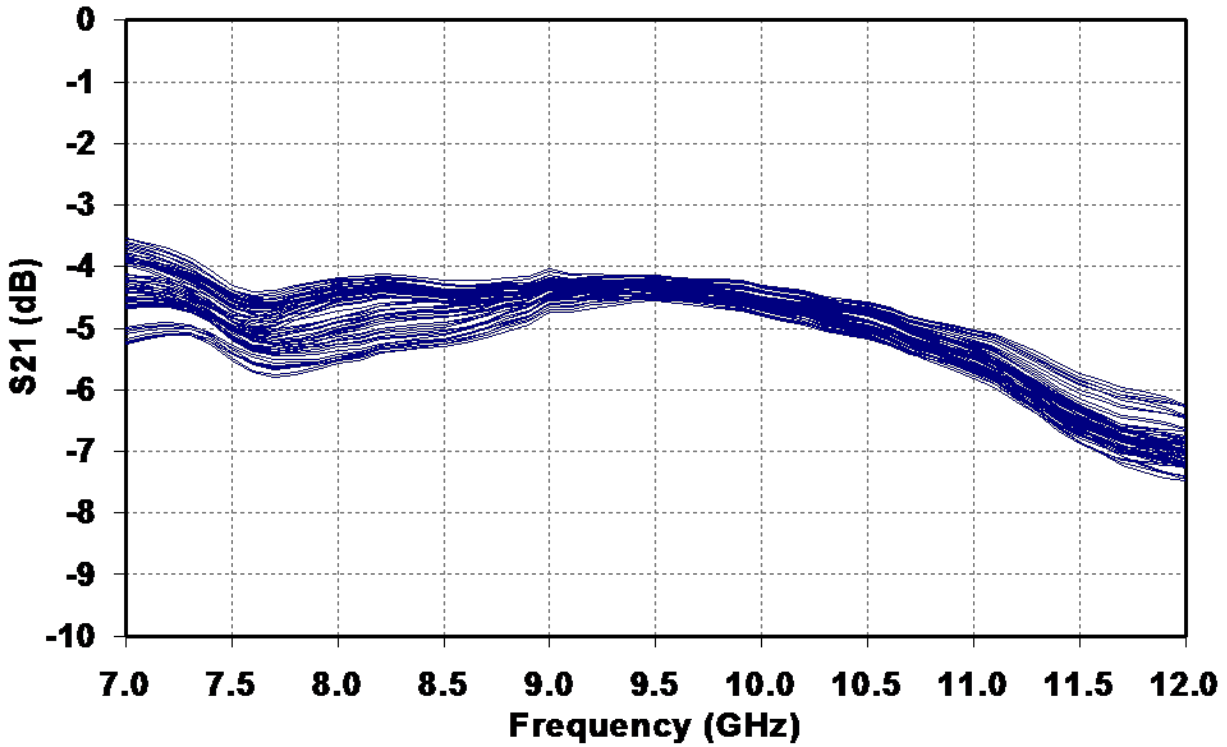
- 1/ These ratings represent the maximum operable values for this device
- 2/ Combinations of supply voltage, supply current, input power, and output power shall not exceed P_D
- 3/ Junction operating temperature will directly affect the device median time to failure (T_m). For maximum life, it is recommended that junction temperatures be maintained at the lowest possible levels.

**TABLE II
RF CHARACTERIZATION TABLE
(T_A = 25°C, Nominal)
(V_C = -5V)**

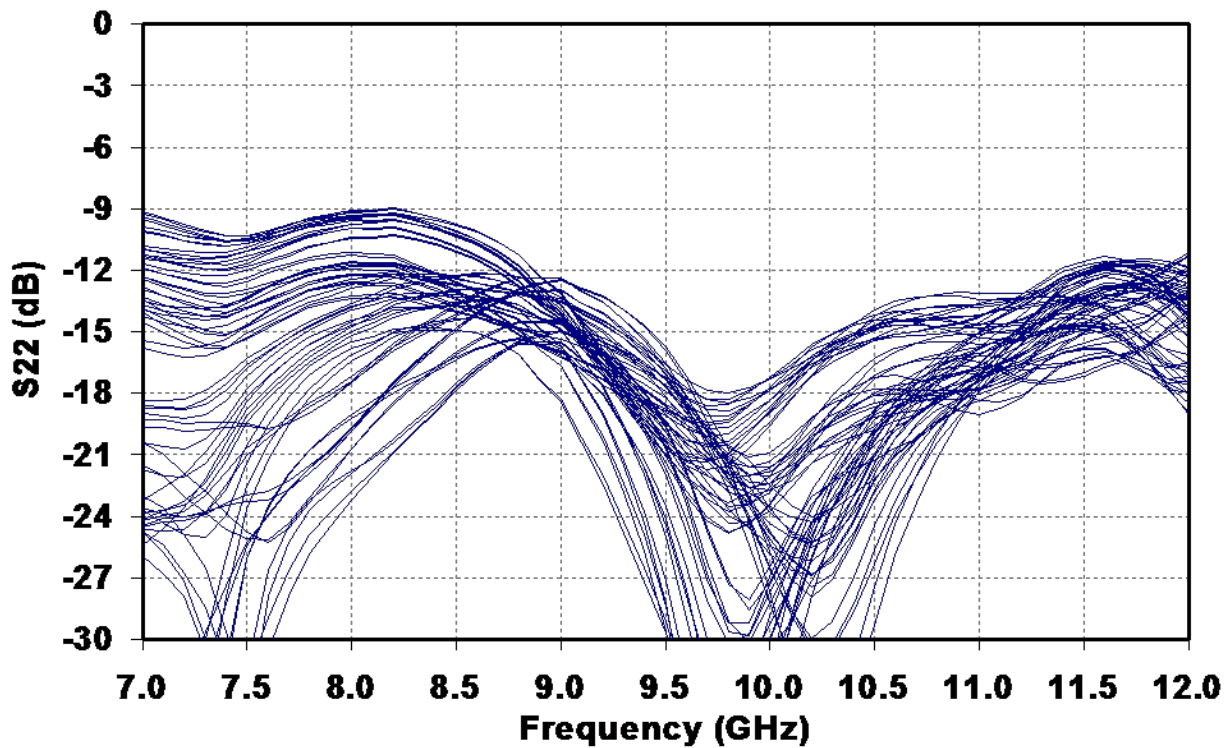
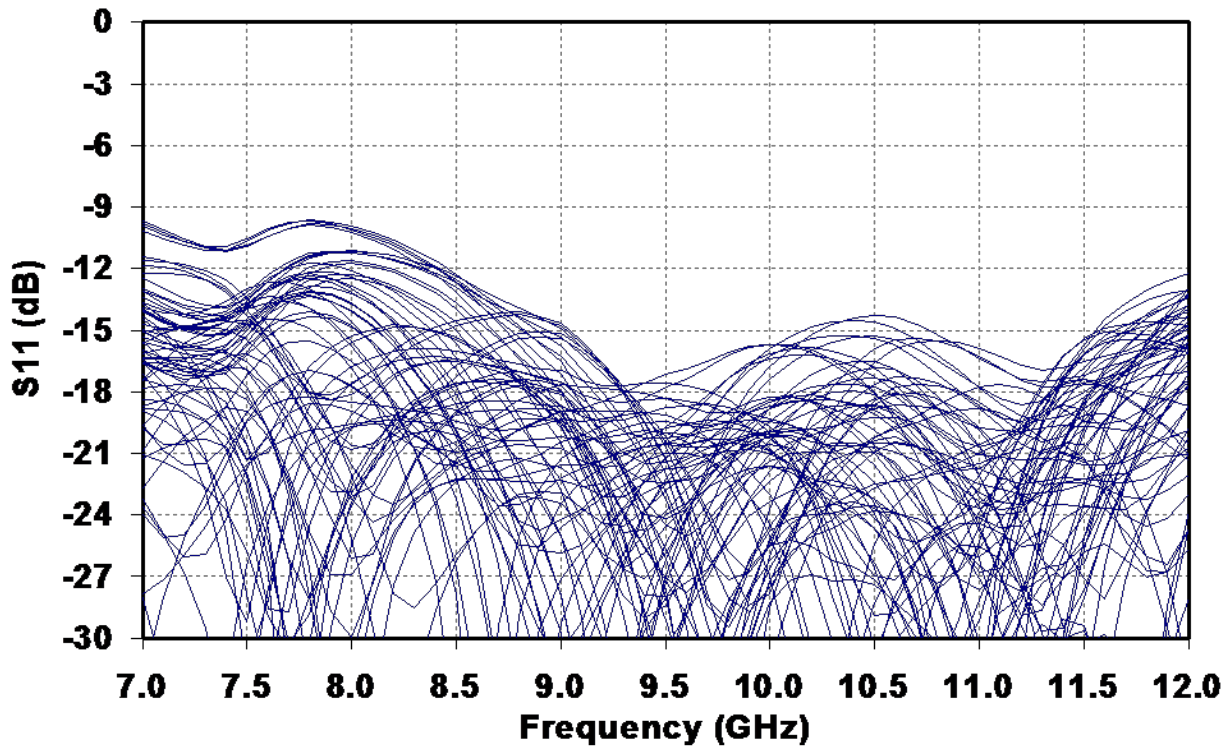
Parameter	Test Conditions	Typ	Units	Notes
Insertion Loss	8.5 – 11GHz	5	dB	
Peak Amplitude Error	8.5 – 11GHz	0.5	dB	
RMS Amplitude Error	8.5 – 11GHz	0.2	dB	
Peak Phase Shift Error	8.5 – 11GHz	3	deg	
RMS Phase Shift Error	8.5 – 11GHz	2	deg	
Input Return Loss	8.5 – 11GHz	15	dB	
Output Return Loss	8.5 – 11GHz	12	dB	

Note: Table II Lists the RF Characteristics of typical devices as determined by fixtured measurements.

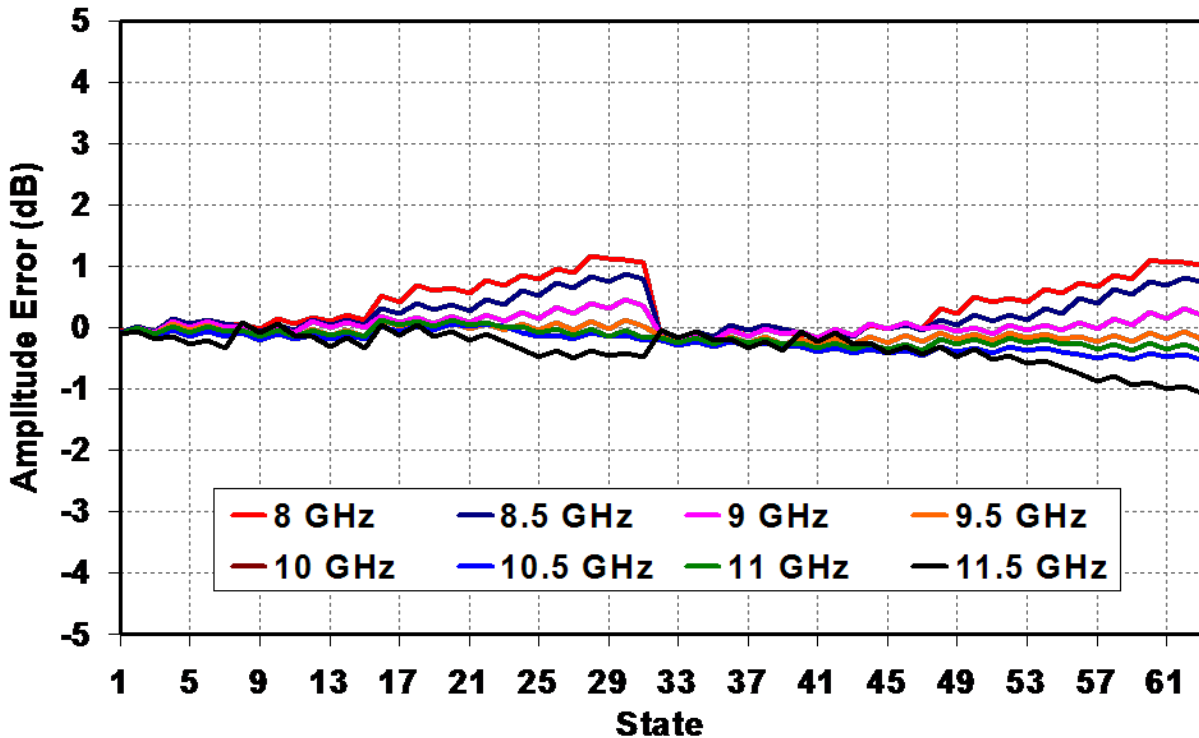
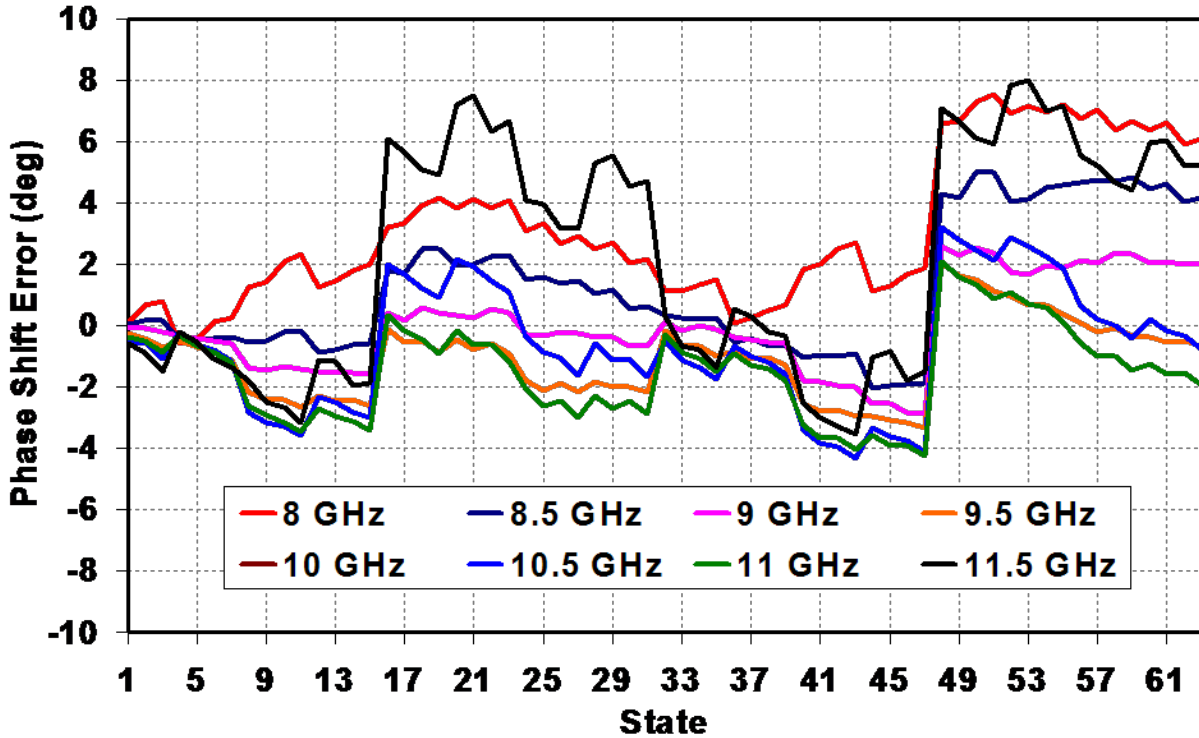
Preliminary Measured Data



Preliminary Measured Data



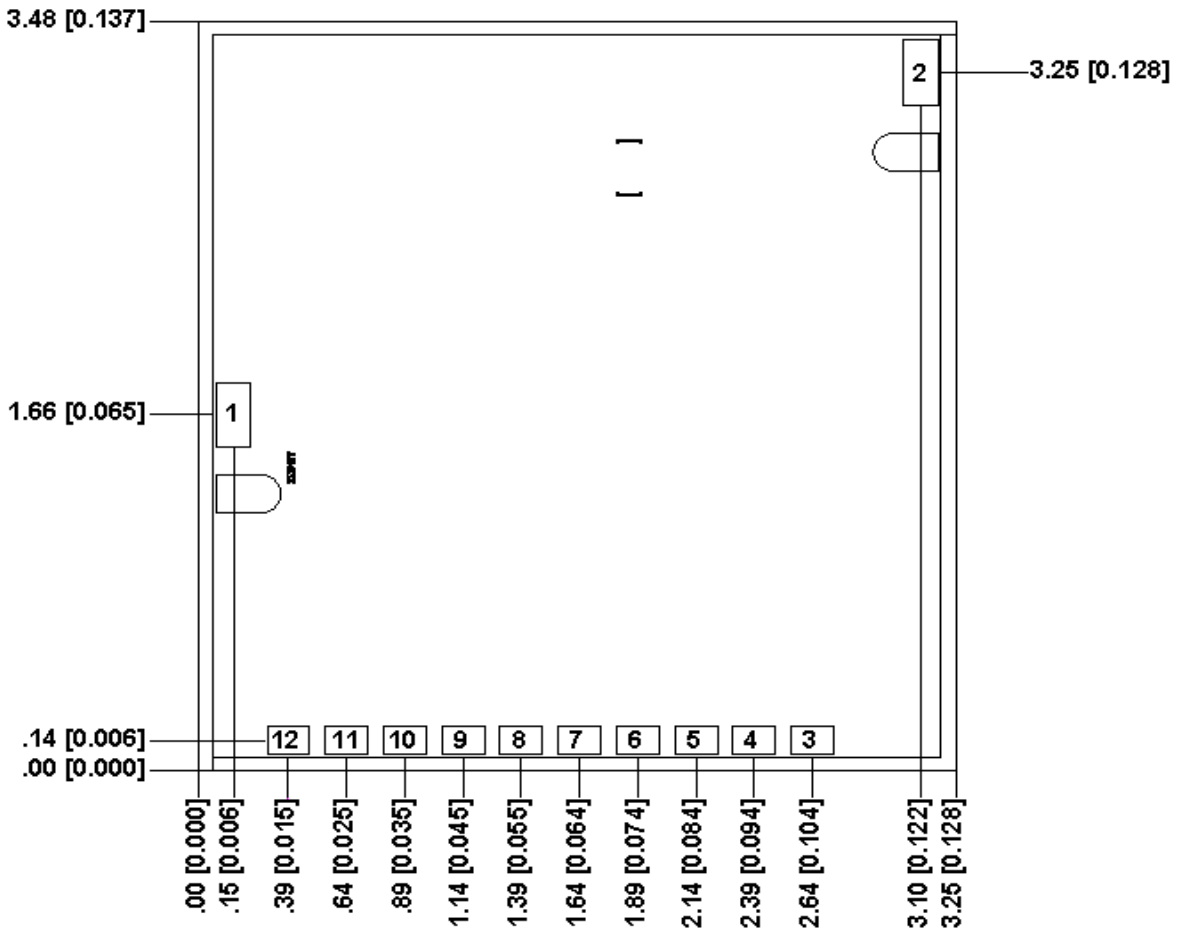
Preliminary Measured Data



State Table

State	V-5.625	V-11.25	V-22.5A	V-22.5B	V-45A	V-45B	V-90A	V-90B	V-180A	V-180B	Phase Shift
0	0V	0V	0V	-5V	-5V	0V	-5V	0V	-5V	0V	Reference
1	-5V	0V	0V	-5V	-5V	0V	-5V	0V	-5V	0V	5.625°
2	0V	-5V	0V	-5V	-5V	0V	-5V	0V	-5V	0V	11.25°
3	-5V	-5V	0V	-5V	-5V	0V	-5V	0V	-5V	0V	16.875°
4	0V	0V	-5V	0V	-5V	0V	-5V	0V	-5V	0V	22.5°
5	-5V	0V	-5V	0V	-5V	0V	-5V	0V	-5V	0V	28.125°
6	0V	-5V	-5V	0V	-5V	0V	-5V	0V	-5V	0V	33.75°
7	-5V	-5V	-5V	0V	-5V	0V	-5V	0V	-5V	0V	39.375°
8	0V	0V	0V	-5V	0V	-5V	-5V	0V	-5V	0V	45°
9	-5V	0V	0V	-5V	0V	-5V	-5V	0V	-5V	0V	50.625°
10	0V	-5V	0V	-5V	0V	-5V	-5V	0V	-5V	0V	56.25°
11	-5V	-5V	0V	-5V	0V	-5V	-5V	0V	-5V	0V	61.875°
12	0V	0V	-5V	0V	0V	-5V	-5V	0V	-5V	0V	67.5°
13	-5V	0V	-5V	0V	0V	-5V	-5V	0V	-5V	0V	73.125°
14	0V	-5V	-5V	0V	0V	-5V	-5V	0V	-5V	0V	78.75°
15	-5V	-5V	-5V	0V	0V	-5V	-5V	0V	-5V	0V	84.375°
16	0V	0V	0V	-5V	-5V	0V	0V	-5V	-5V	0V	90°
17	-5V	0V	0V	-5V	-5V	0V	0V	-5V	-5V	0V	95.625°
18	0V	-5V	0V	-5V	-5V	0V	0V	-5V	-5V	0V	101.25°
19	-5V	-5V	0V	-5V	-5V	0V	0V	-5V	-5V	0V	106.875°
20	0V	0V	-5V	0V	-5V	0V	0V	-5V	-5V	0V	112.5°
21	-5V	0V	-5V	0V	-5V	0V	0V	-5V	-5V	0V	118.125°
22	0V	-5V	-5V	0V	-5V	0V	0V	-5V	-5V	0V	123.75°
23	-5V	-5V	-5V	0V	-5V	0V	0V	-5V	-5V	0V	129.375°
24	0V	0V	0V	-5V	0V	-5V	0V	-5V	-5V	0V	135°
25	-5V	0V	0V	-5V	0V	-5V	0V	-5V	-5V	0V	140.625°
26	0V	-5V	0V	-5V	0V	-5V	0V	-5V	-5V	0V	146.25°
27	-5V	-5V	0V	-5V	0V	-5V	0V	-5V	-5V	0V	151.875°
28	0V	0V	-5V	0V	0V	-5V	0V	-5V	-5V	0V	157.5°
29	-5V	0V	-5V	0V	0V	-5V	0V	-5V	-5V	0V	163.125°
30	0V	-5V	-5V	0V	0V	-5V	0V	-5V	-5V	0V	168.75°
31	-5V	-5V	-5V	0V	0V	-5V	0V	-5V	-5V	0V	174.375°
32	0V	0V	0V	-5V	-5V	0V	-5V	0V	0V	-5V	180°
33	-5V	0V	0V	-5V	-5V	0V	-5V	0V	0V	-5V	185.625°
34	0V	-5V	0V	-5V	-5V	0V	-5V	0V	0V	-5V	191.25°
35	-5V	-5V	0V	-5V	-5V	0V	-5V	0V	0V	-5V	196.875°
36	0V	0V	-5V	0V	-5V	0V	-5V	0V	0V	-5V	202.5°
37	-5V	0V	-5V	0V	-5V	0V	-5V	0V	0V	-5V	208.125°
38	0V	-5V	-5V	0V	-5V	0V	-5V	0V	0V	-5V	213.75°
39	-5V	-5V	-5V	0V	-5V	0V	-5V	0V	0V	-5V	219.375°
40	0V	0V	0V	-5V	0V	-5V	-5V	0V	0V	-5V	225°
41	-5V	0V	0V	-5V	0V	-5V	-5V	0V	0V	-5V	230.625°
42	0V	-5V	0V	-5V	0V	-5V	-5V	0V	0V	-5V	236.25°
43	-5V	-5V	0V	-5V	0V	-5V	-5V	0V	0V	-5V	241.875°
44	0V	0V	-5V	0V	0V	-5V	-5V	0V	0V	-5V	247.5°
45	-5V	0V	-5V	0V	0V	-5V	-5V	0V	0V	-5V	253.125°
46	0V	-5V	-5V	0V	0V	-5V	-5V	0V	0V	-5V	258.75°
47	-5V	-5V	-5V	0V	0V	-5V	-5V	0V	0V	-5V	264.375°
48	0V	0V	0V	-5V	-5V	0V	0V	-5V	0V	-5V	270°
49	-5V	0V	0V	-5V	-5V	0V	0V	-5V	0V	-5V	275.625°
50	0V	-5V	0V	-5V	-5V	0V	0V	-5V	0V	-5V	281.25°
51	-5V	-5V	0V	-5V	-5V	0V	0V	-5V	0V	-5V	286.875°
52	0V	0V	-5V	0V	-5V	0V	0V	-5V	0V	-5V	292.5°
53	-5V	0V	-5V	0V	-5V	0V	0V	-5V	0V	-5V	298.125°
54	0V	-5V	-5V	0V	-5V	0V	0V	-5V	0V	-5V	303.75°
55	-5V	-5V	-5V	0V	-5V	0V	0V	-5V	0V	-5V	309.375°
56	0V	0V	0V	-5V	0V	-5V	0V	-5V	0V	-5V	315°
57	-5V	0V	0V	-5V	0V	-5V	0V	-5V	0V	-5V	320.625°
58	0V	-5V	0V	-5V	0V	-5V	0V	-5V	0V	-5V	326.25°
59	-5V	-5V	0V	-5V	0V	-5V	0V	-5V	0V	-5V	331.875°
60	0V	0V	-5V	0V	0V	-5V	0V	-5V	0V	-5V	337.5°
61	-5V	0V	-5V	0V	0V	-5V	0V	-5V	0V	-5V	343.125°
62	0V	-5V	-5V	0V	0V	-5V	0V	-5V	0V	-5V	348.75°
63	-5V	-5V	-5V	0V	0V	-5V	0V	-5V	0V	-5V	354.375°

Mechanical Drawing



Units: millimeters [inches]

Thickness: 0.10 [0.004] (reference only)

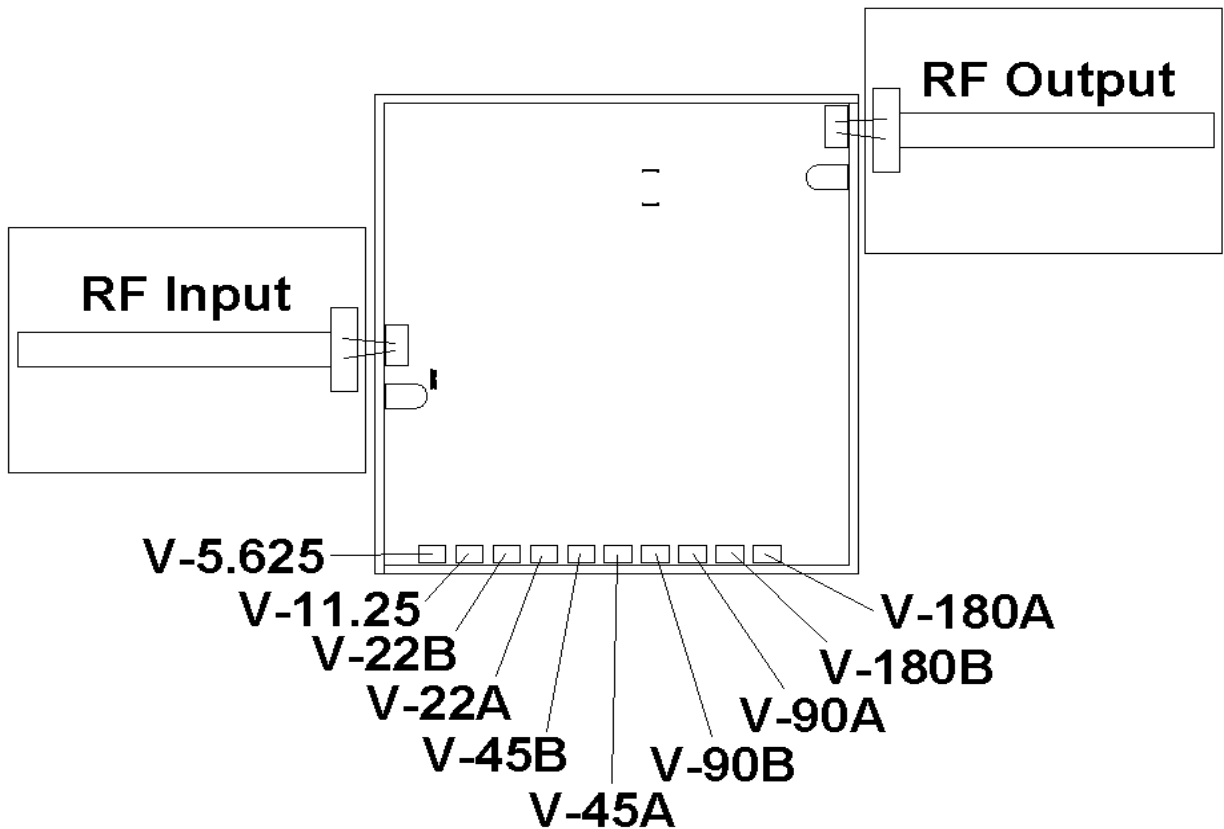
Chip edge to bond pad dimensions are shown to center of bond pads.

Chip size tolerance: ± 0.05 [0.002]

RF ground through backside

Bond Pad #1	RF Input	0.15 x 0.30	[0.006 x 0.012]
Bond Pad #2	RF Output	0.15 x 0.30	[0.006 x 0.012]
Bond Pad #3	V-180A (ON V=0V)	0.18 x 0.13	[0.007 x 0.005]
Bond Pad #4	V-180B (ON V=-5V)	0.18 x 0.13	[0.007 x 0.005]
Bond Pad #5	V-90A (ON V=0V)	0.18 x 0.13	[0.007 x 0.005]
Bond Pad #6	V-90B (ON V=-5V)	0.18 x 0.13	[0.007 x 0.005]
Bond Pad #7	V-45A (ON V=0V)	0.18 x 0.13	[0.007 x 0.005]
Bond Pad #8	V-45B (ON V=-5V)	0.18 x 0.13	[0.007 x 0.005]
Bond Pad #9	V-22A (ON V=-5V)	0.18 x 0.13	[0.007 x 0.005]
Bond Pad #10	V-22B (ON V=0V)	0.18 x 0.13	[0.007 x 0.005]
Bond Pad #11	V-11.25 (ON V=-5V)	0.18 x 0.13	[0.007 x 0.005]
Bond Pad #12	V-5.625 (ON V=-5V)	0.18 x 0.13	[0.007 x 0.005]

Chip Assembly & Bonding Diagram



- Devices were tested with 500Ω resistors in series with control lines
- Input and output stubs are 0.010" x 0.025" on 0.010" alumina substrate

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

Assembly Process Notes

Reflow process assembly notes:

- Use AuSn (80/20) solder with limited exposure to temperatures at or above 300°C. (30 seconds maximum)
- An alloy station or conveyor furnace with reducing atmosphere should be used.
- No fluxes should be utilized.
- Coefficient of thermal expansion matching is critical for long-term reliability.
- Devices must be stored in a dry nitrogen atmosphere.

Component placement and adhesive attachment assembly notes:

- Vacuum pencils and/or vacuum collets are the preferred method of pick up.
- Air bridges must be avoided during placement.
- The force impact is critical during auto placement.
- Organic attachment can be used in low-power applications.
- Curing should be done in a convection oven; proper exhaust is a safety concern.
- Microwave or radiant curing should not be used because of differential heating.
- Coefficient of thermal expansion matching is critical.

Interconnect process assembly notes:

- Thermosonic ball bonding is the preferred interconnect technique.
- Force, time, and ultrasonics are critical parameters.
- Aluminum wire should not be used.
- Maximum stage temperature is 200°C.

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