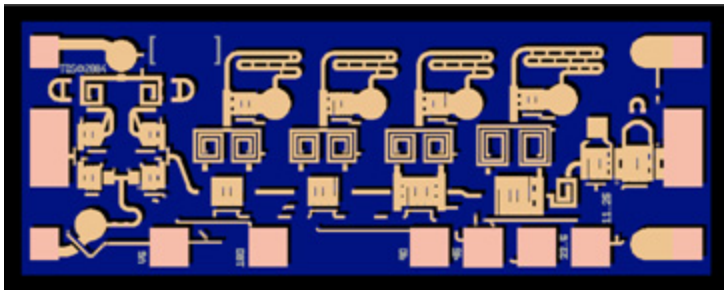
TriQuint SEMICONDUCTOR

Product Data Sheet
August 5, 2008

35 GHz 5-Bit Phase Shifter

TGP2102



Key Features and Performance

- Frequency Range: 32 - 37 GHz
- 7dB Nominal Insertion Loss
- 3.5deg RMS Phase Error @ 35GHz
- 0.4dB RMS Amp. Error @ 35GHz
- Negative Control Voltage
- Single-Ended Logic
- 0.25µm pHEMT 3MI Technology
- Chip dimensions:
  1.88 x 0.75 x 0.1 mm
  (0.074 x 0.030 x 0.004 inches)

Primary Applications

- Military Radar
- Transmit / Receive

Description

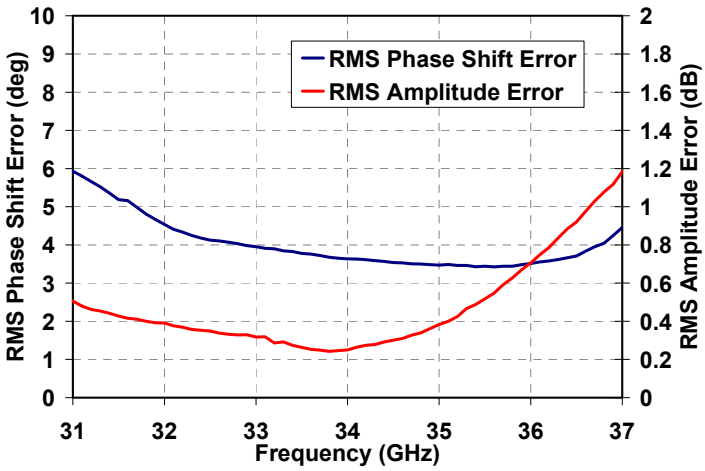
The TriQuint TGP2102 is a 5-bit digital phase shifter MMIC design using TriQuint's proven 0.25µm power pHEMT process to support a variety of Ka-Band phased array applications including military radar.

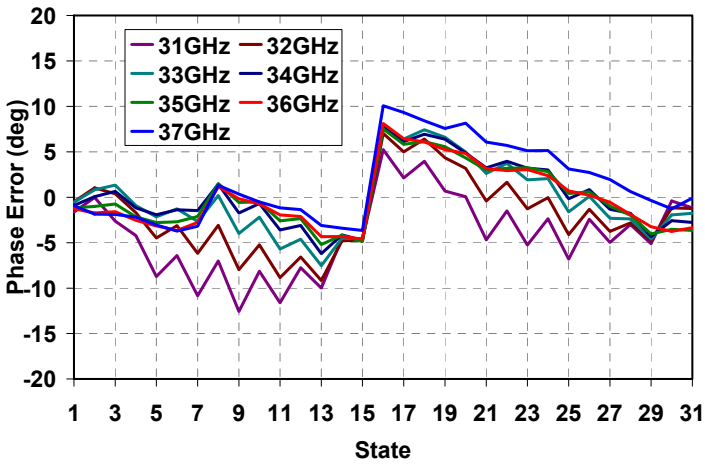
The 5-bit design utilizes a compact topology that achieves a 1.41mm^2 die area and high performance.

The TGP2102 provides a 5-bit digital phase shift function with a nominal 7dB insertion loss and 5° RMS phase shift error over a bandwidth of 32-37GHz.

The TGP2102 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.

Preliminary Measured Performance





Note: Datasheet is subject to change without notice.

TABLE I
MAXIMUM RATINGS

Symbol	Parameter	Value	Notes
V_C	Control Voltage Range	-8V to 0V	1/ 2/
I_D	Control Supply Current	1 mA	1/ 2/
P_{IN}	Input Continuous Wave Power	20 dBm	1/ 2/
P_D	Power Dissipation	0.1 W	1/ 2/
T_{CH}	Operating Channel Temperature	150 ^{0}C	3/
T_M	Mounting Temperature (30 Seconds)	320 ^{0}C	
T_{STG}	Storage Temperature	-65 to 150 ^{0}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 at a package base temperature of 70°C

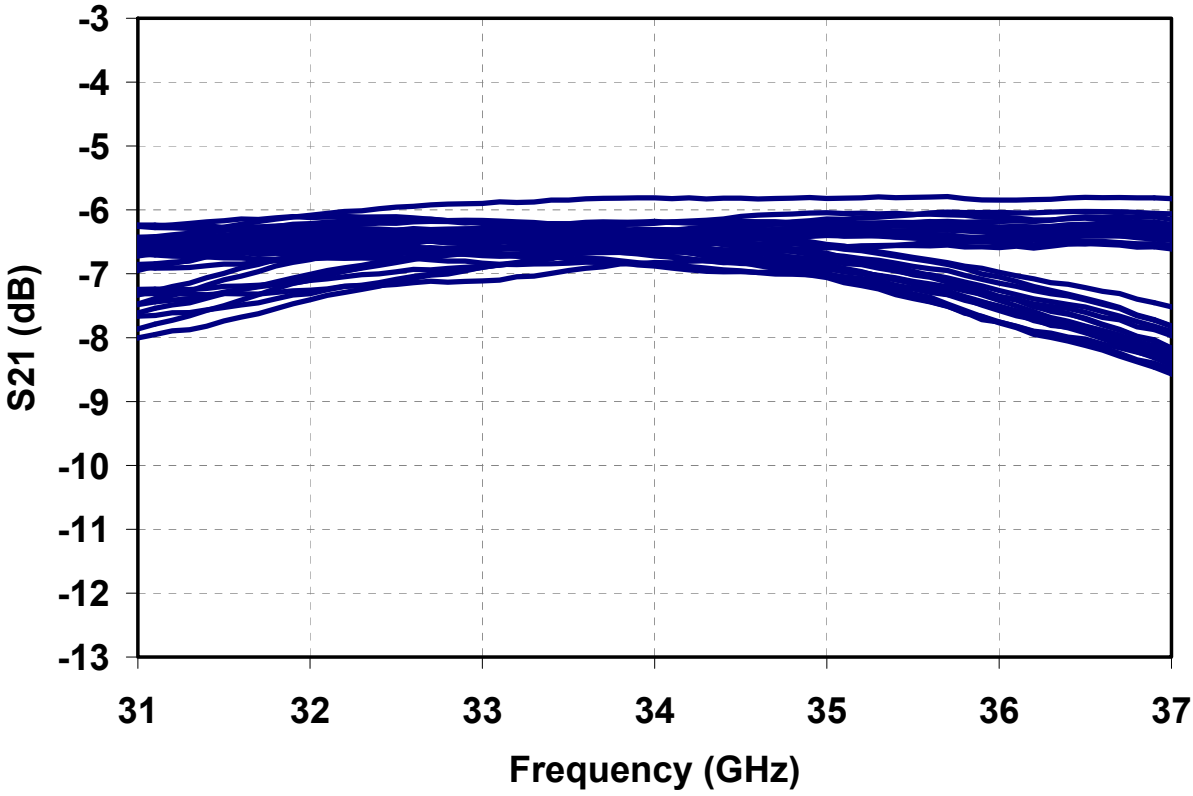
3/ Junction operating temperature will directly affect the device median time to failure (MTTF). For maximum life, it is recommended that junction temperatures be maintained at the lowest possible levels.

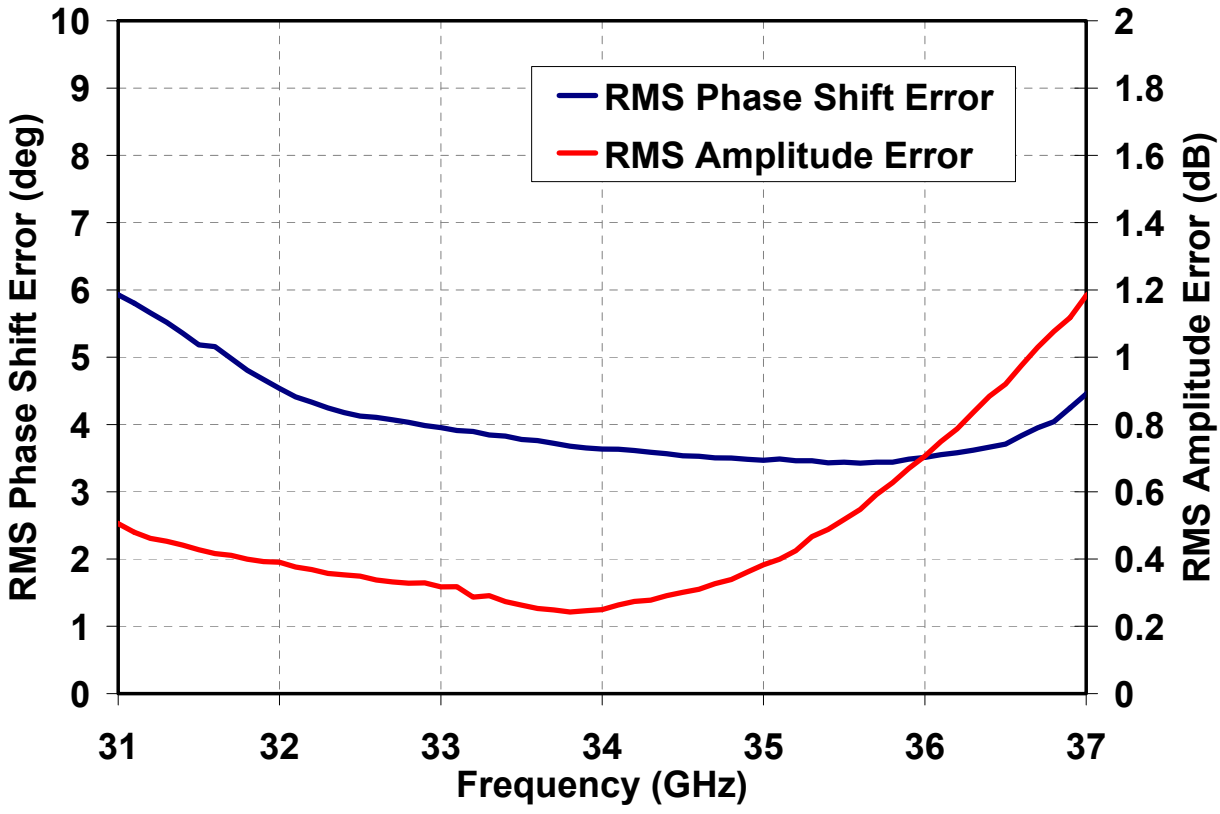
TABLE II
RF CHARACTERIZATION TABLE
(T_A = 25°C, Nominal)
(V_C = -5V)

Parameter	Test Conditions	Typ	Units	Notes
Insertion Loss	32 – 37GHz	7	dB	
Peak Amplitude Error	32 – 37GHz	1	dB	
RMS Amplitude Error	32 – 37GHz	0.7	dB	
Peak Phase Shift Error	32 – 37GHz	5	deg	
RMS Phase Shift Error	32 – 37GHz	4	deg	
Input Return Loss	32 – 37GHz	14	dB	
Output Return Loss	32 – 37GHz	7	dB	

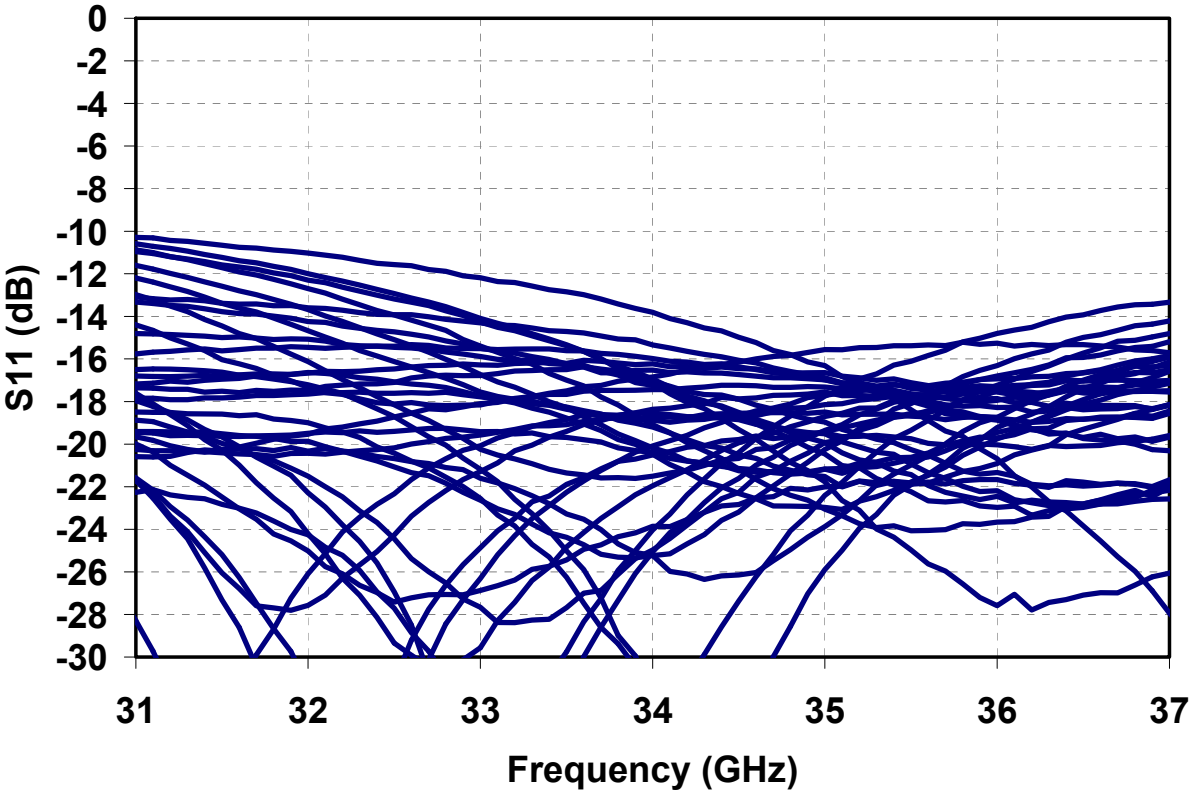
Note: Table II Lists the RF Characteristics of typical devices as determined by fixtured measurements.

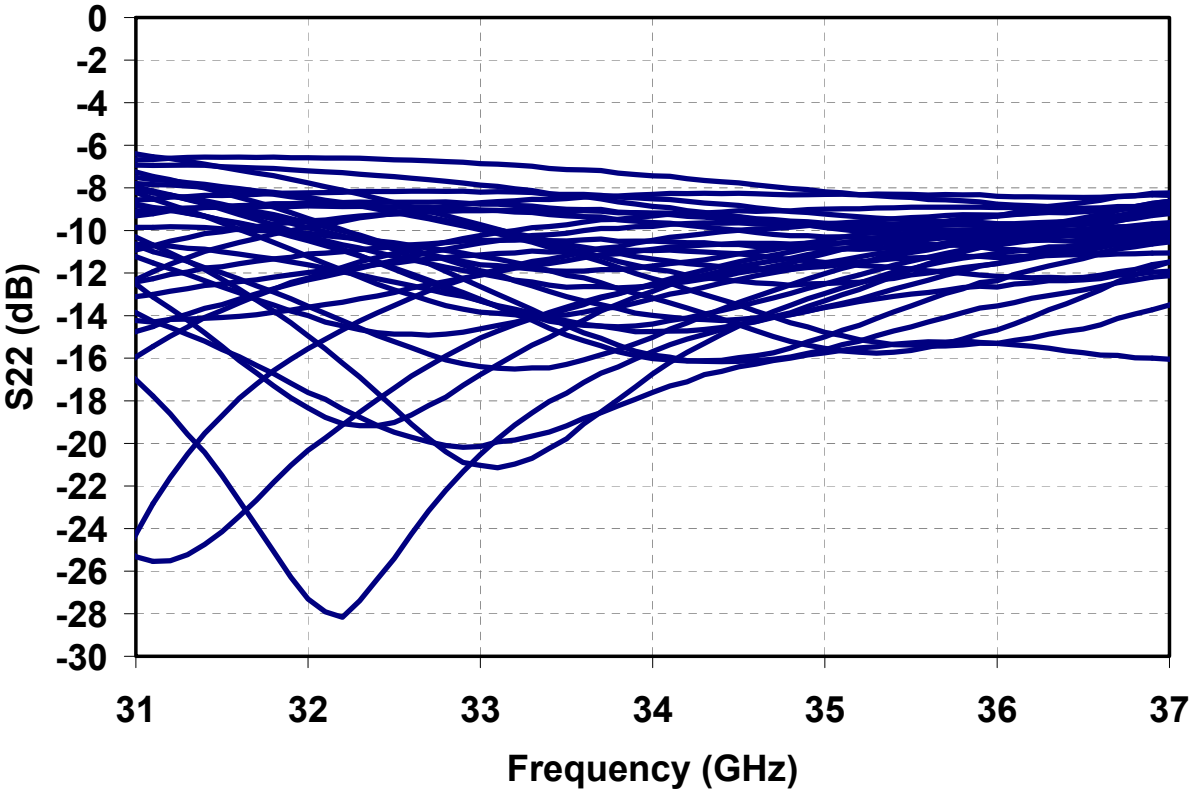
Preliminary Measured Data



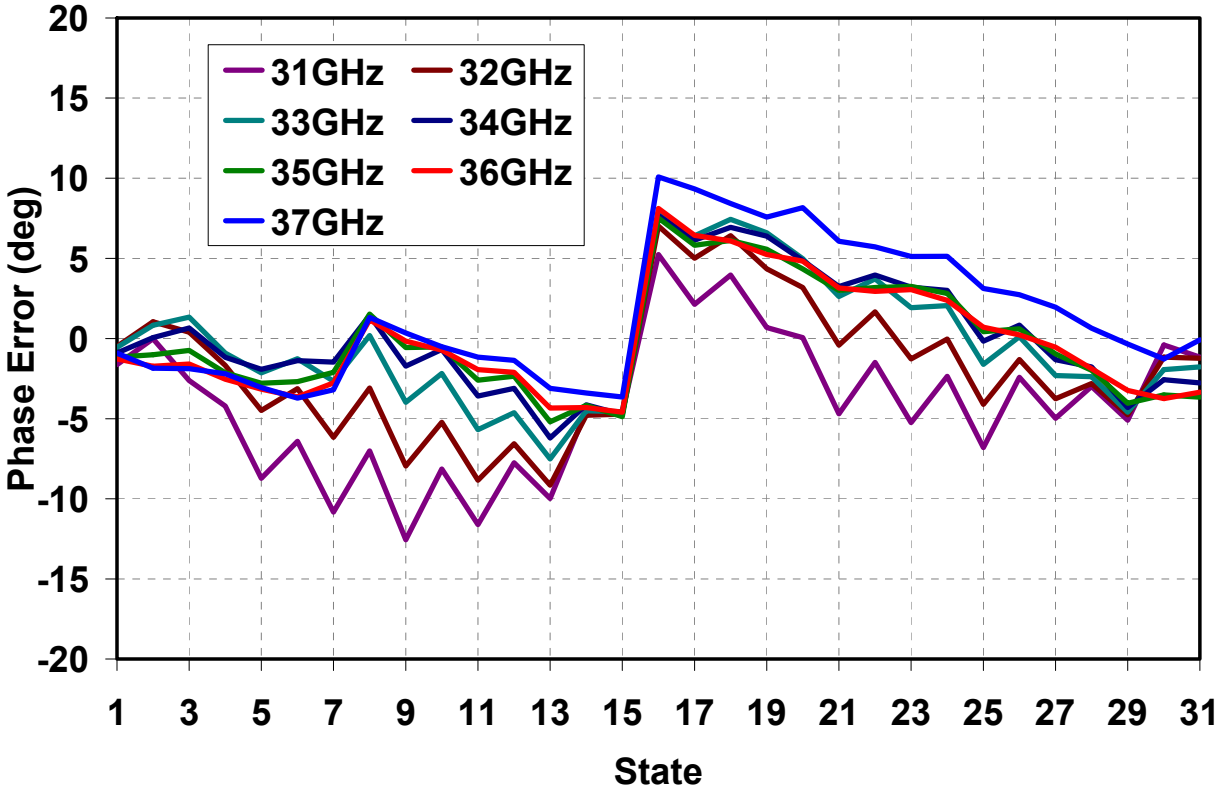


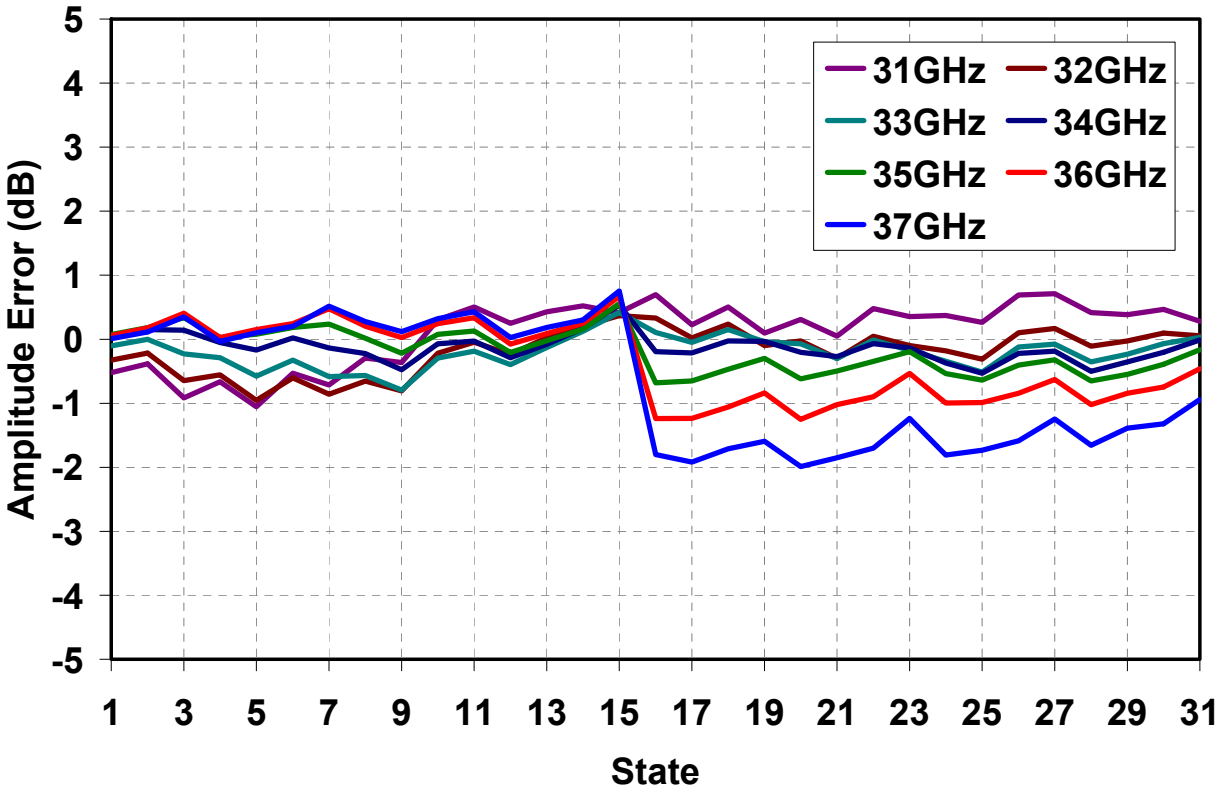
Preliminary Measured Data





Preliminary Measured Data

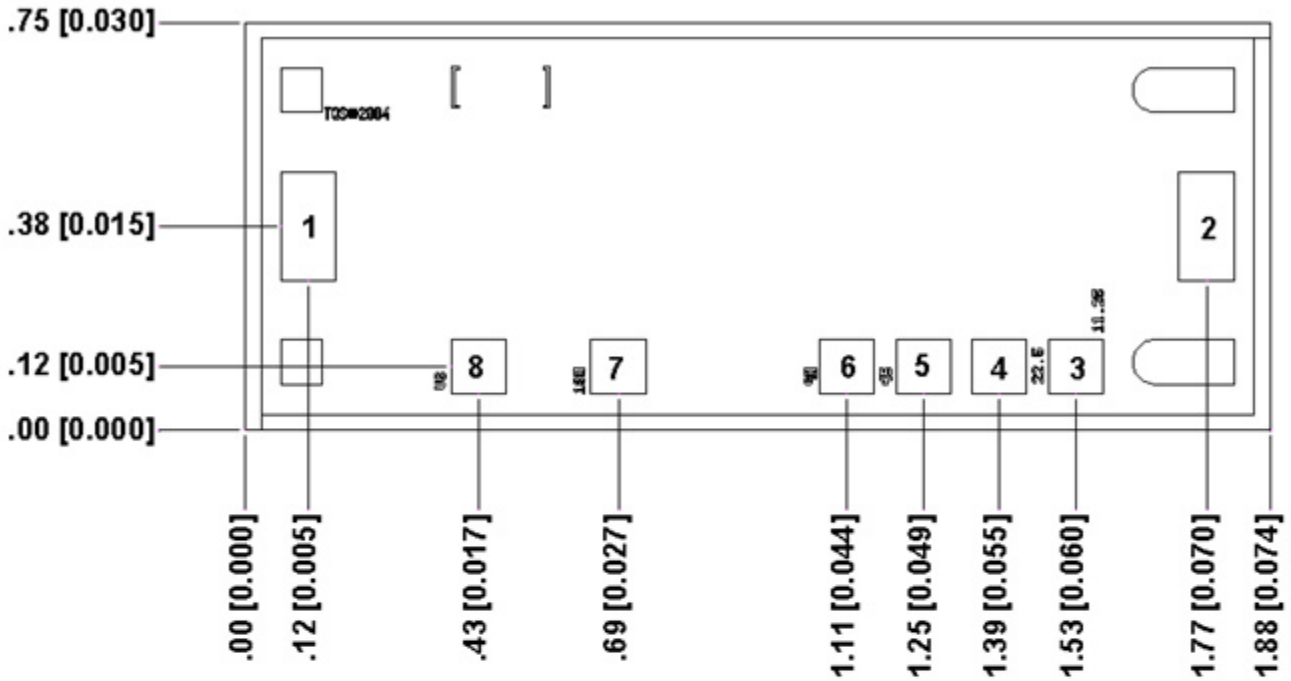




State Table

State	V-Supply	V-11.25	V-22.5	V-45	V-90	V-180	Phase Shift
0	-5V	0V	0V	0V	0V	0V	Reference
1	-5V	-5V	0V	0V	0V	0V	11.25°
2	-5V	0V	-5V	0V	0V	0V	22.5°
3	-5V	-5V	-5V	0V	0V	0V	33.75°
4	-5V	0V	0V	-5V	0V	0V	45°
5	-5V	-5V	0V	-5V	0V	0V	56.25°
6	-5V	0V	-5V	-5V	0V	0V	67.5°
7	-5V	-5V	-5V	-5V	0V	0V	78.75°
8	-5V	0V	0V	0V	-5V	0V	90°
9	-5V	-5V	0V	0V	-5V	0V	101.25°
10	-5V	0V	-5V	0V	-5V	0V	112.5°
11	-5V	-5V	-5V	0V	-5V	0V	123.75°
12	-5V	0V	0V	-5V	-5V	0V	135°
13	-5V	-5V	0V	-5V	-5V	0V	146.25°
14	-5V	0V	-5V	-5V	-5V	0V	157.5°
15	-5V	-5V	-5V	-5V	-5V	0V	168.75°
16	-5V	0V	0V	0V	0V	-5V	180°
17	-5V	-5V	0V	0V	0V	-5V	191.25°
18	-5V	0V	-5V	0V	0V	-5V	202.5°
19	-5V	-5V	-5V	0V	0V	-5V	213.75°
20	-5V	0V	0V	-5V	0V	-5V	225°
21	-5V	-5V	0V	-5V	0V	-5V	236.25°
22	-5V	0V	-5V	-5V	0V	-5V	247.5°
23	-5V	-5V	-5V	-5V	0V	-5V	258.75°
24	-5V	0V	0V	0V	-5V	-5V	270°
25	-5V	-5V	0V	0V	-5V	-5V	281.25°
26	-5V	0V	-5V	0V	-5V	-5V	292.5°
27	-5V	-5V	-5V	0V	-5V	-5V	303.75°
28	-5V	0V	0V	-5V	-5V	-5V	315°
29	-5V	-5V	0V	-5V	-5V	-5V	326.25°
30	-5V	0V	-5V	-5V	-5V	-5V	337.5°
31	-5V	-5V	-5V	-5V	-5V	-5V	348.75°

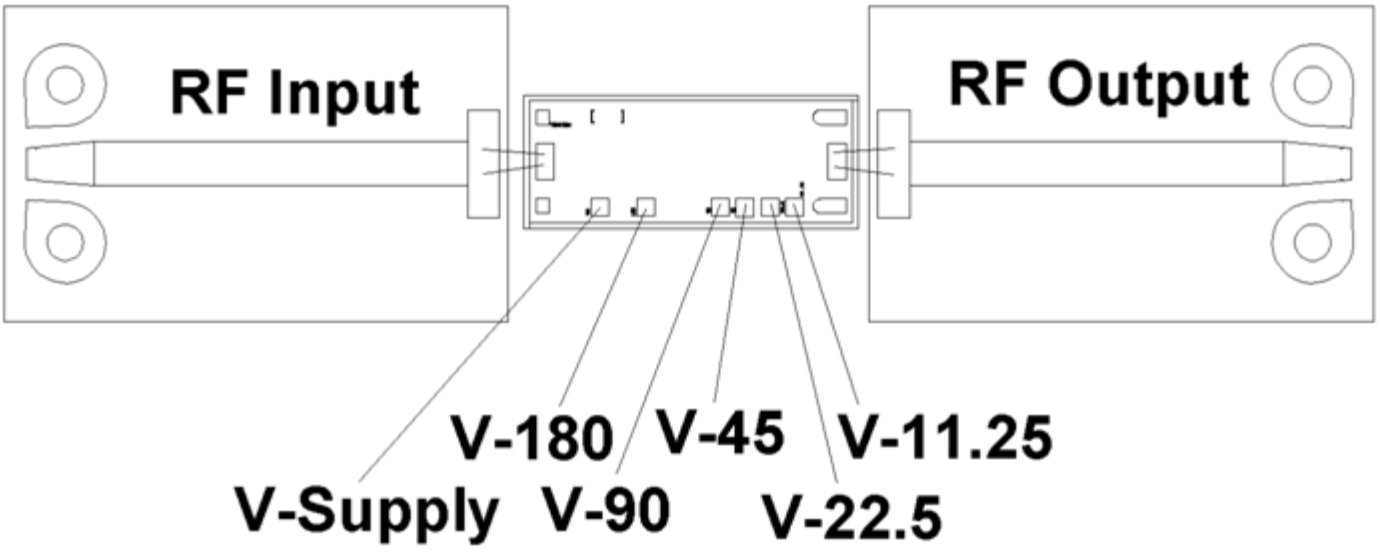
Mechanical Drawing



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	0.10 x 0.20	[0.004 x 0.008]
Bond Pad #2	RF Output	0.10 x 0.20	[0.004 x 0.008]
Bond Pad #3	V-11.25 (ON V=-5V)	0.10 x 0.10	[0.004 x 0.004]
Bond Pad #4	V-22.5 (ON V=-5V)	0.10 x 0.10	[0.004 x 0.004]
Bond Pad #5	V-45 (ON V=-5V)	0.10 x 0.10	[0.004 x 0.004]
Bond Pad #6	V-90 (ON V=-5V)	0.10 x 0.10	[0.004 x 0.004]
Bond Pad #7	V-180 (ON V=-5V)	0.10 x 0.10	[0.004 x 0.004]
Bond Pad #8	V-Supply (-5V)	0.10 x 0.10	[0.004 x 0.004]

Chip Assembly & Bonding Diagram



- Devices were tested with 500Ω resistors in series with control lines
- Input and output stubs are 0.007" x 0.024" 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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