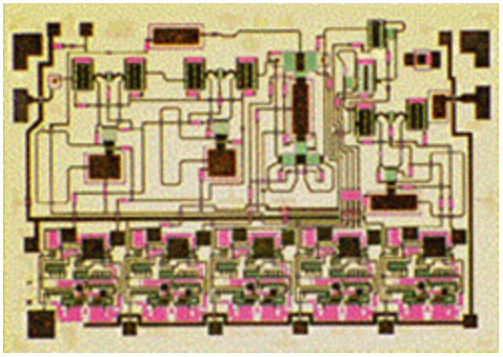
6 - 18 GHz Phase Shifter

TGP6336



Key Features and Performance

- 6 to 18 GHz Frequency Range
- 5-Bit Phase Shifter
- On-Chip CMOS-Compatible Drivers
- 9 dB Typical Insertion Loss at Midband
- 2:1 Typical Input SWR: 2.6:1 Typical Output SWR
- 3.6 x 2.5 x 0.1mm (0.140 x 0.100 x 0.004 in.)

Description

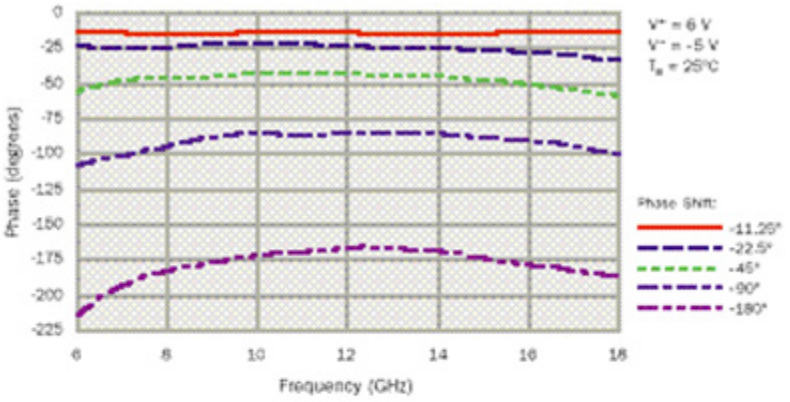
The TriQuint TGP6336 is a GaAs MMIC 5-bit phase shifter which operates from 6 to 18 GHz. Phase can be shifted from 0 to 348.75 degrees in 11.25 degree steps. Control bias voltages are 0 and 5 V. The insertion loss is typically 9 dB.

The TGP6336 features on-chip CMOS-compatible drivers. The FET based phase shifter offers wide band performance and small size for use in T/R modules for EW applications.

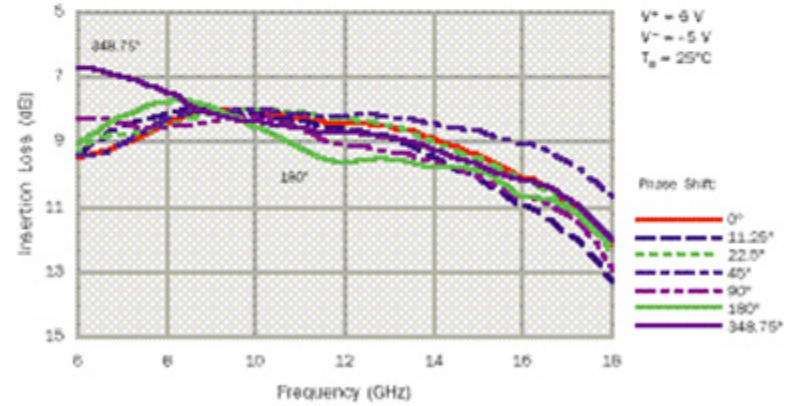
Bond pad and backside metallization is gold plated for compatibility with eutectic alloy attach methods as well as thermocompression and thermosonic wire-bonding processes. Ground is provided to the circuitry through vias to the backside metallization.

Note: Datasheet is subject to change without notice.

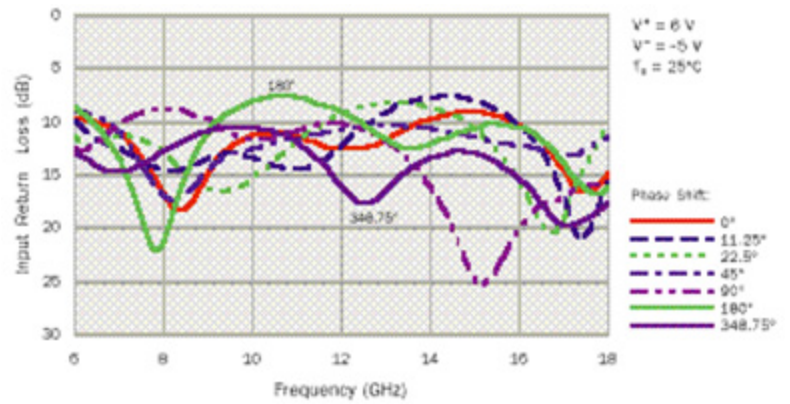
TYPICAL RELATIVE PHASE



TYPICAL INSERTION LOSS



TYPICAL INPUT RETURN LOSS



TYPICAL OUTPUT RETURN LOSS

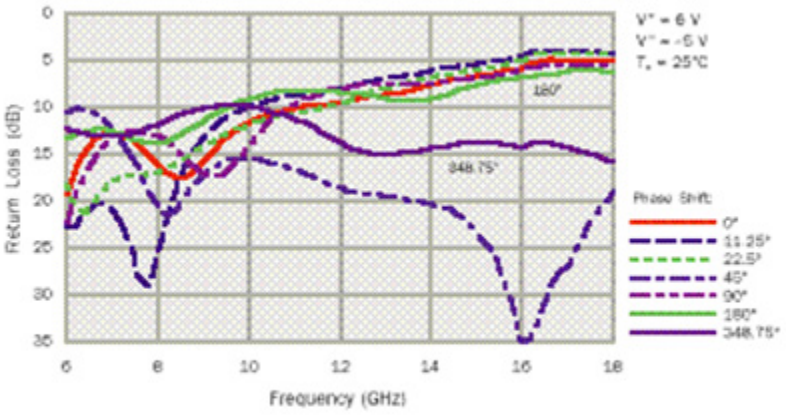


TABLE I
MAXIMUM RATINGS

SYMBOL	PARAMETER 1/	VALUE	NOTES
V^+	Positive Supply Voltage	8 V	
$V^+ - V^{--}$	Positive Supply Voltage Range	0 V to 12 V	
V^{--}	Negative Supply Voltage Range	0 V to -6 V	
P_{IN}	Input Continuous Wave Power	1 W	
	Control Voltage Range,	0 V to V^+	2/
T_{CH}	Operating Channel Temperature	150 °C	3/, 4/
T_{STG}	Storage Temperature	-65 to 150 °C	
T_M	Mounting Temperature (30 seconds)	320 °C	

1/ These ratings represent the maximum values for this device. Stresses beyond those listed under “Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “On-Wafer RF Probe” is not implied. Exposure to maximum rated conditions for extended periods may affect device reliability.

2/ Control Voltage Range, SHF90, SHF180, SHF11.25, SHF22.5, SHF45

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

4/ These ratings apply over channel temperature range T_{CH} (unless otherwise noted).

TABLE II
ON-WAFER RF PROBE CHARACTERISTICS
(T_A = 25 °C ± 5°C)
V^+ = 5.75 V, V^- = -5 V

Symbol	Parameter	Test Condition	Limit			Units
			Min	Typ	Max	
IL	Insertion Loss	F = 6.4 – 7.9 GHz	-10	-7	---	dB
IRL	Input Return Loss	F = 6.4 – 7.9 GHz	---	-13	-7.4	dB
ORL	Output Return Loss	F = 6.4 – 7.9 GHz	---	-11	-7.4	dB
POW	Total Modulation Power	F = 6.4 – 7.9 GHz	---		-12	dBc
PHS11	Phase for 11°	F = 6.4 – 7.9 GHz	5	13	22	degrees
PHS22	Phase for 22°	F = 6.4 – 7.9 GHz	10	23	40	degrees
PHS45	Phase for 45°	F = 6.4 – 7.9 GHz	30	55	65	degrees
PHS90	Phase for 90°	F = 6.4 – 7.9 GHz	70	107	120	degrees
PHS180	Phase for 180°	F = 6.4 – 7.9 GHz	160	214	220	degrees

BIAS TRUTH TABLE

RELATIVE PHASE SHIFT (degrees)	SHF 180 (Bond pad #10)	SHF 90 Bond pad #11	SHF 45 (Bond pad #7)	SHF 22.5 (Bond pad #8)	SHF 11.25 (Bond pad #9)
0.00	5	5	5	5	5
-11.25	5	5	5	5	0
-22.50	5	5	5	0	5
-33.75	5	5	5	0	0
-45.00	5	5	0	5	5
-56.25	5	5	0	5	0
-67.50	5	5	0	0	5
-78.75	5	5	0	0	0
-90.00	5	0	5	5	5
-101.25	5	0	5	5	0
-112.50	5	0	5	0	5
-123.75	5	0	5	0	0
-135.00	5	0	0	5	5
-146.25	5	0	0	5	0
-157.50	5	0	0	0	5
-168.75	5	0	0	0	0
-180.00	0	5	5	5	5
-191.25	0	5	5	5	0
-202.50	0	5	5	0	5
-213.75	0	5	5	0	0
-225.00	0	5	0	5	5
-236.25	0	5	0	5	0
-247.50	0	5	0	0	5
-258.75	0	5	0	0	0
-270.00	0	0	5	5	5
-281.25	0	0	5	5	0
-292.50	0	0	5	0	5
-303.75	0	0	5	0	0
-315.00	0	0	0	5	5
-326.25	0	0	0	5	0
-337.50	0	0	0	0	5
-348.75	0	0	0	0	0

V+ = 6 V, V- = -5 V, T_A = 25°C

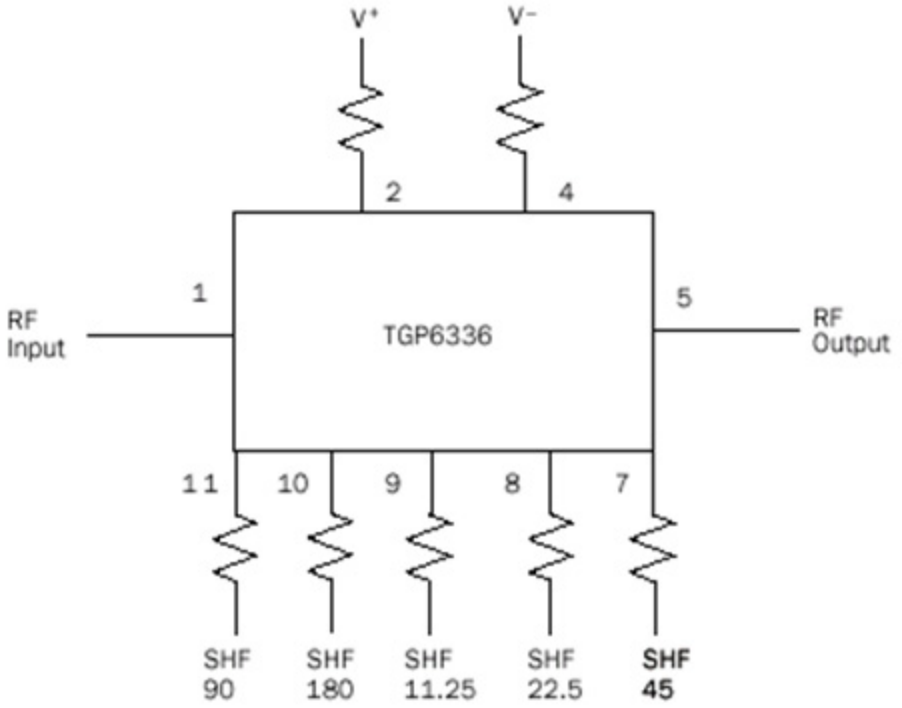
RF CHARACTERISTICS

PARAMETER		TEST CONDITIONS	TYP	UNIT
IL	Insertion loss (all states)	f = 6 - 18 GHz	9	dB
SWR(in)	Input standing w ave ratio	f = 6 - 18 GHz (all states)	2.0:1	-
SWR(out)	Output standing w ave ratio	f = 6 - 18 GHz (all states)	2.6:1	-
P_{1dB}(in)	Input pow er at 1–dB gain compression	see next table		

PHASE SHIFT (degrees)	TYPICAL RELATIVE PHASE SHIFT			TYPICAL INPUT POWER at 1–dB GAIN COMPRESSION at MIDBAND(dBm)
	at 6GHz (degrees)	at 12GHz (degrees)	at 18GHz (degrees)	
-11.25	-13±2	-13.5±2	13±4	26
-22.5	-23±2	-23±2	32±4	27
-45	-55±4	-43±3	58±7	26
-90	-107±5	-84±7	99±8	25
-180	-214±4	-165±8	186±16	25
-348.75	-416±8	-326±9	380±11	25

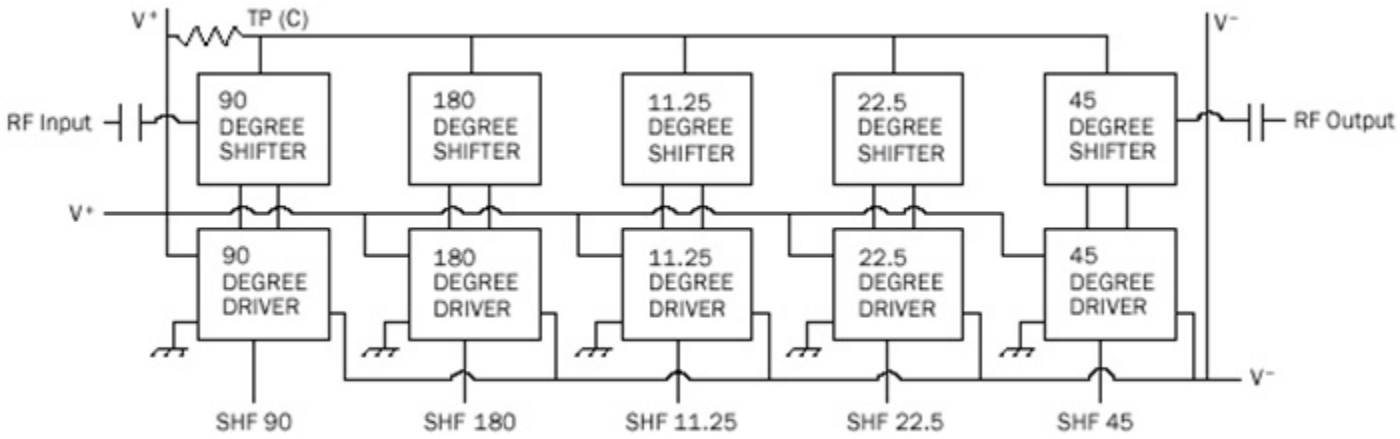
V+ = 6 V, V- = -5 V, T_A = 25°C

RECOMMENDED BIAS NETWORK



All bias resistors have a nominal value of 25-Ohms.
RF connections: Bond one 1-mil diameter, 20 to 25-mil-length gold bond wires at both RF Input and RF Output for optimum RF performance.
Close placement of external components is essential for resonant-free performance.
Refer to TriQuint's Gallium Arsenide Products Designers' Information on our website under Application Information.

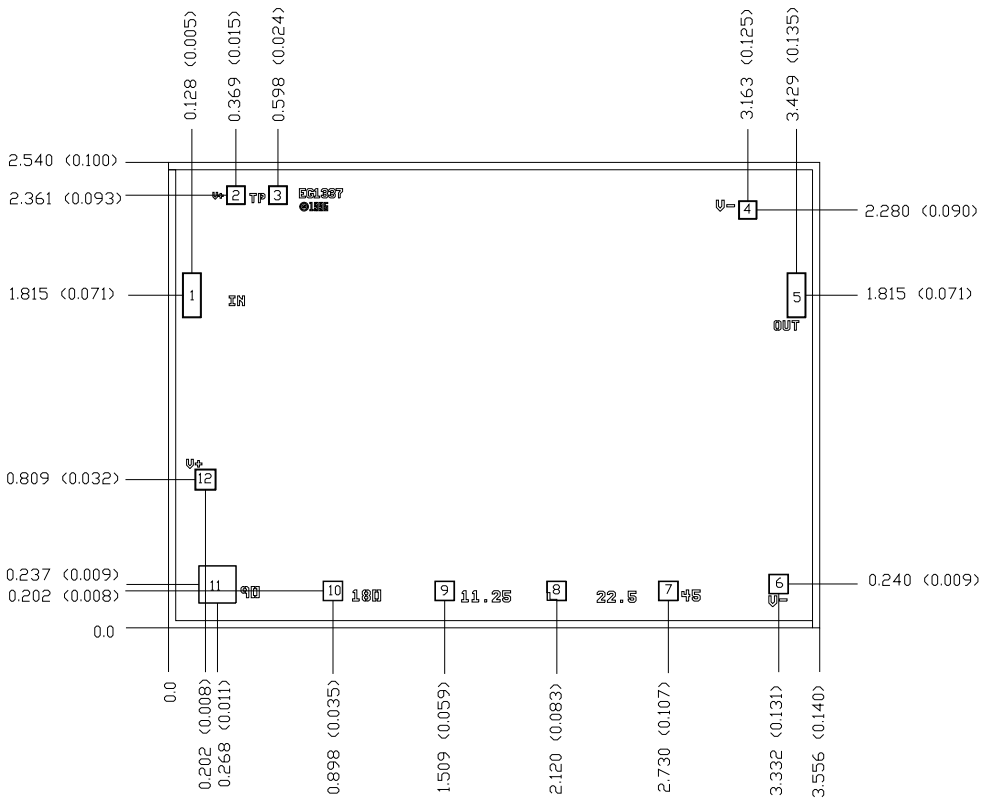
FUNCTIONAL BLOCK DIAGRAM



Control voltage inputs should be 0.0 to 0.3 V for logic “0”
and 4.5 to 5.3 V for logic “1”

V^+ and V^- should be held to +/-0.3 V tolerances

MECHANICAL DRAWING



Units: millimeters (inches)
Thickness: 0.100 (0.004) (reference only)
Chip edge to bond pad dimensions are shown to center of bond pad
Chip size: +/- 0.0508 (0.002)

GND IS BACKSIDE OF MMIC

Bond pad #1 (RF Input)	0.098 x 0.240 (0.004 x 0.009)
Bond pad #2 (V+)	0.098 x 0.098 (0.004 x 0.004)
Bond pad #3	0.098 x 0.098 (0.004 x 0.004)
Bond pad #4 (V-)	0.096 x 0.096 (0.004 x 0.004)
Bond pad #5 (RF Output)	0.098 x 0.240 (0.004 x 0.009)
Bond pad #6 (V-)	0.103 x 0.103 (0.004 x 0.004)
Bond pad #7 (SHF 45)	0.103 x 0.103 (0.004 x 0.004)
Bond pad #8 (SHF 22.5)	0.103 x 0.103 (0.004 x 0.004)
Bond pad #9 (SHF 11.25)	0.103 x 0.103 (0.004 x 0.004)
Bond pad #10 (SHF 180)	0.103 x 0.103 (0.004 x 0.004)
Bond pad #11 (SHF 90)	0.203 x 0.203 (0.008 x 0.008)
Bond pad #12 (V+)	0.110 x 0.110 (0.004 x 0.004)

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 for 30 sec
- 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.
- Discrete FET devices with small pad sizes should be bonded with 0.0007-inch wire.
- Maximum stage temperature is 200 °C.

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