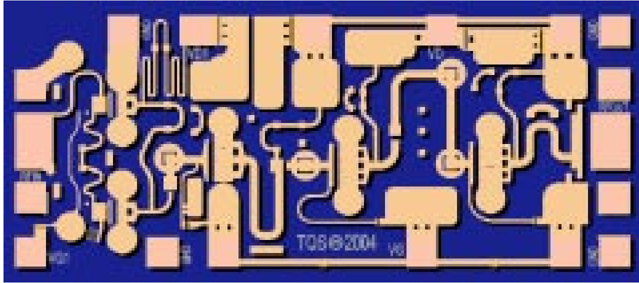
17 - 43GHz MPA/Multiplier

TGA4040



Key Features

- Frequency: 17 - 43 GHz
- 25 dB Nominal Gain @ Mid-band
- 22 dBm Nominal Output P1dB
- 2x and 3x Multiplier Function
- 0.15 um 3MI pHEMT Technology
- Chip Dimensions 1.72 x 0.76 x 0.10 mm (0.068 x 0.030 x 0.004 in)

Primary Applications

- Point-to-point radio
- EW
- Instrumentation
- Frequency Multiplier

Product Description

The TriQuint TG4040 is a Medium Power Amplifier and Multiplier for a wide band of 17 – 43GHz applications. The part is designed using TriQuint's 0.15um power pHEMT production process.

The TGA4040 provides a nominal 25 dB small signal gain with 22 dBm output power @ 1 dB gain compression. For 2x and 3x Multiplier Function, TGA4040 provides 15 dBm typical of Output Power @ 9 dBm Pin.

The part is ideally suited for applications such as Point-to-Point Radio, EW, Instrumentation and frequency multipliers.

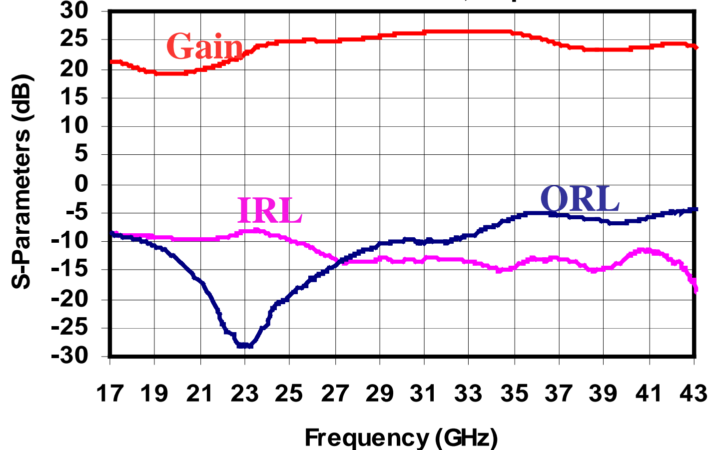
The TGA4040 is 100% DC and RF tested on-wafer to ensure performance compliance.

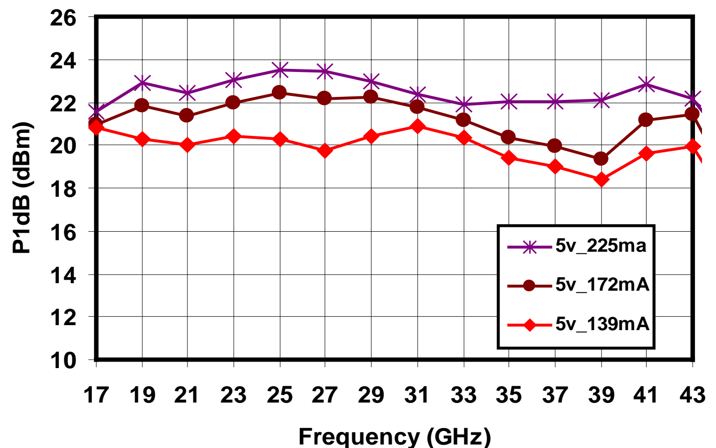
The TGA4040 has a protective surface passivation layer providing environmental robustness.

Lead-Free & RoHS compliant.

Amplifier Performance

Bias Conditions: Vd = 5 V, Idq = 139 mA





Note: Devices is early in the characterization process prior to finalizing all electrical specifications. Specifications are subject to change without notice

TABLE I
MAXIMUM RATINGS 1/

SYMBOL	PARAMETER	VALUE	NOTES
Vd	Drain Voltage	6 V	2/
Vg	Gate Voltage Range	-2 TO 0 V	
Id	Drain Current	TBD	2/ 3/
$\lvert Ig \rvert$	Gate Current	7 mA	3/
P_{IN}	Input Continuous Wave Power	20 dBm	
P_D	Power Dissipation	See note 4/	2/
T_{CH}	Operating Channel Temperature	150 ^{0}C	5/
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 exceec P_D.

3/ Total current for the entire MMIC.

4/ For a median life time of 1E+6 hrs, Power dissipation is limited to:

$$P_D(max) = (150\ ^0C - T_{BASE}\ ^0C) / 66.7\ (^0C/W)$$

Where T_{BASE} is the base plate temperature.

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

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TABLE II
ELECTRICAL CHARACTERISTICS
(Ta = 25 ^{0}C Nominal)

PARAMETER	Amplifier	2x Multiplier	3x Multiplier	UNITS
Frequency Range	17 - 43	9 - 22	6 - 12	GHz
Drain Voltage, Vd1*	-	-	1	V
Drain Voltage, Vd*	5	5	5	V
Total Drain Current*	139	120	160	mA
Gate Voltage, Vg1*	-0.65	-1.1	-0.6	V
Gate Voltage, Vg*		-0.65		V
Small Signal Gain, S21	25	-	-	dB
Input Return Loss, S11	12	-	-	dB
Output Return Loss, S22	8	-	-	dB
Output Power @ 1dB Gain compression, P1dB 5V @ 139mA 5V @ 225mA	 20 22	-	-	dBm
Output TOI	28	-	-	dBm
Output Power @ Pin = 9dBm	-	15	15	dBm
Gain Temperature Coefficient	-0.04	-	-	dB/^{0}C

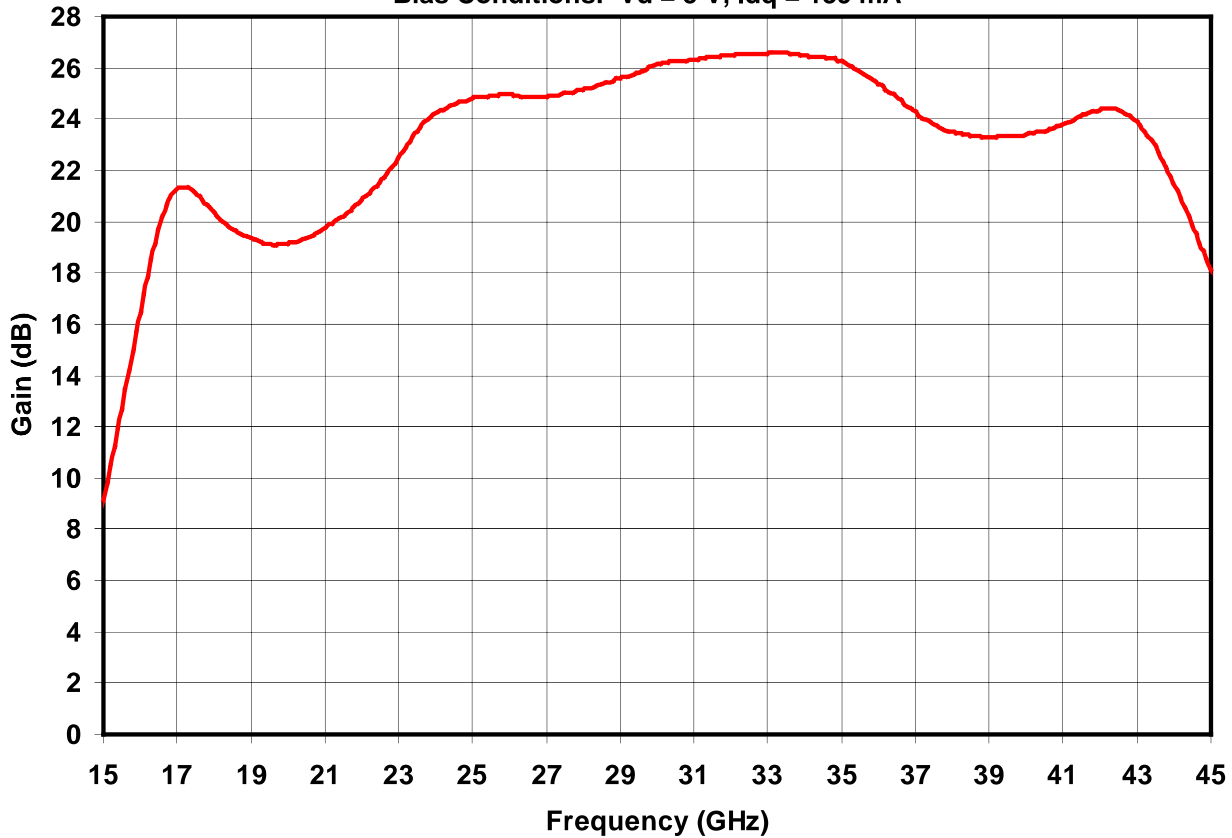
* See bias plan on page 8 for amplifier and 2x multiplier, page 9 for 3x multiplier

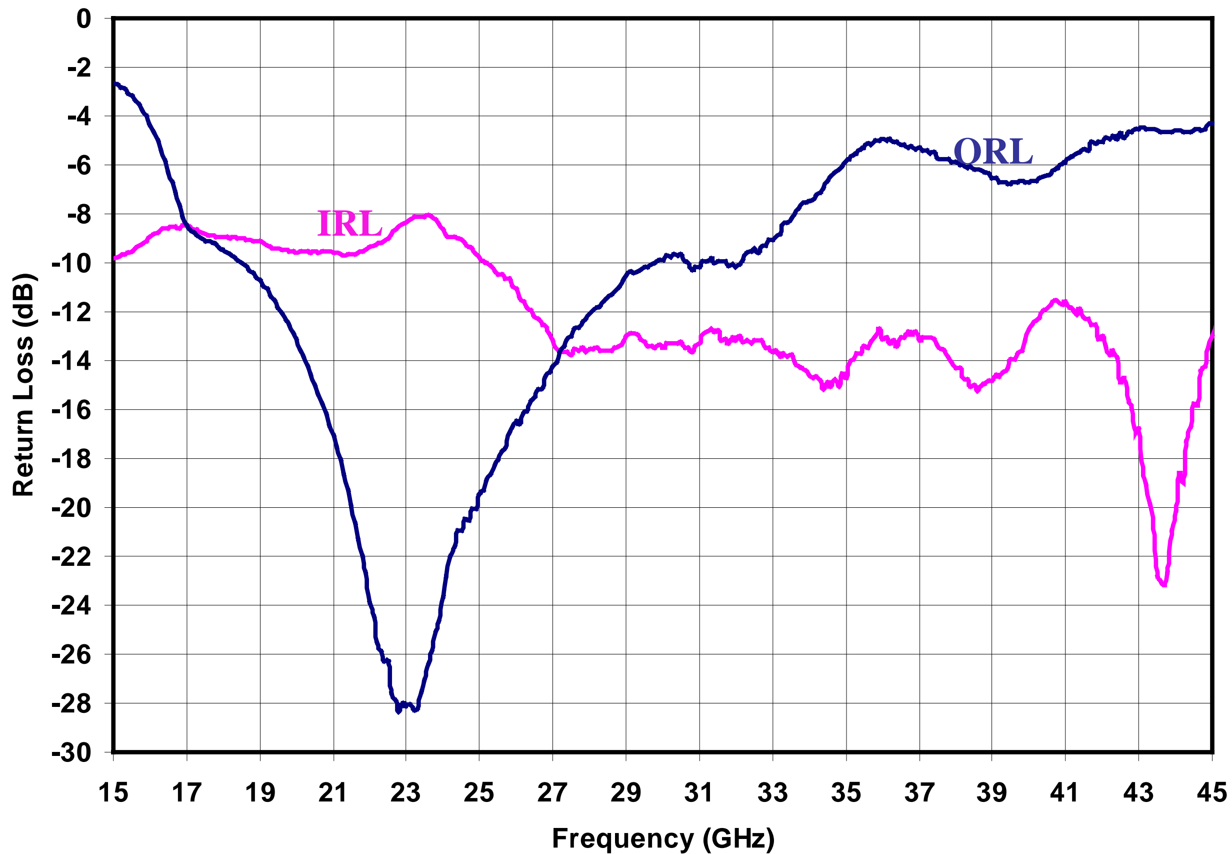
TABLE III
THERMAL INFORMATION

PARAMETER	TEST CONDITIONS	T_{CH} (^oC)	θ_{JC} (°C/W)	T_M (HRS)
θ_{JC} Thermal Resistance (channel to Case)	Vd = 5 V Id = 139 mA Pdiss = 0.69 W	116	66.7	2.4E+7

Note: Assumes eutectic attach using 1.5 mil 80/20 AuSn mounted to a 20 mil CuMo Carrier at 70°C baseplate temperature. Worst case condition with no RF applied, 100% of DC power is dissipated.

Measured Amplifier Data





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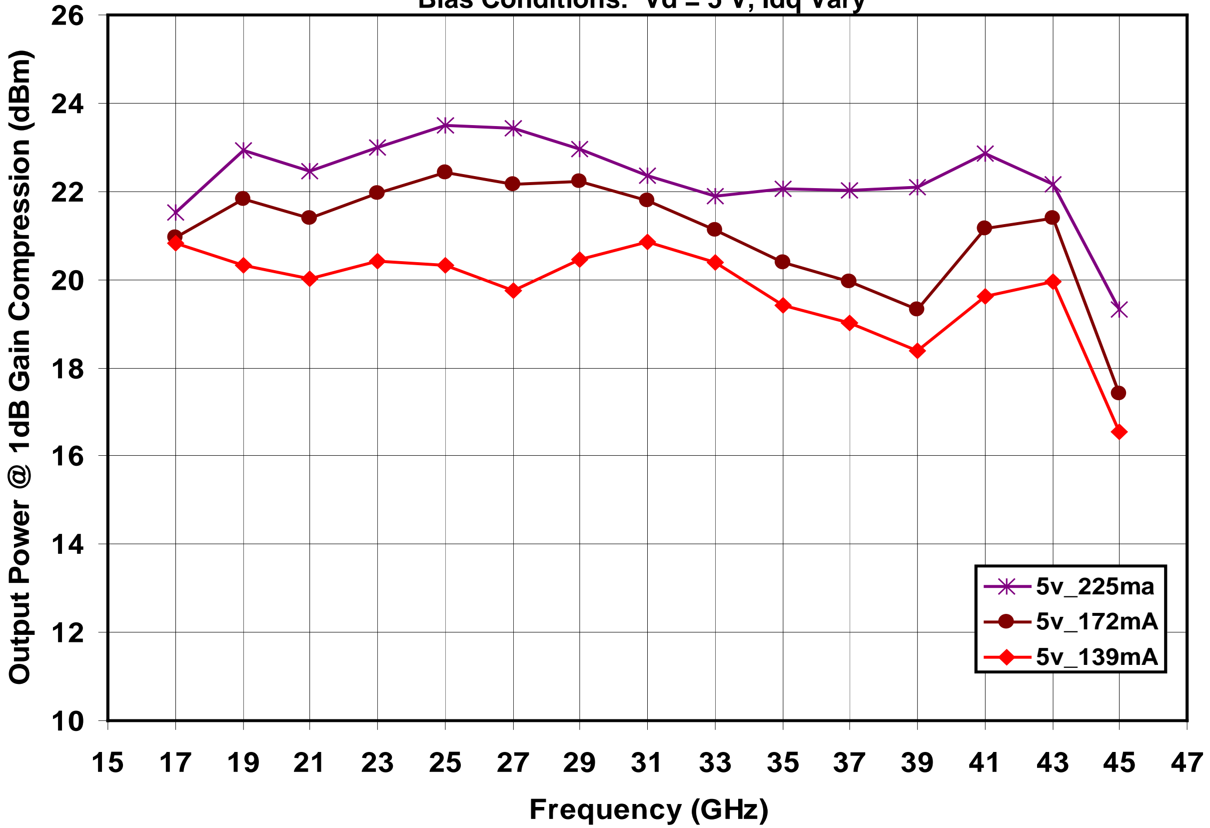
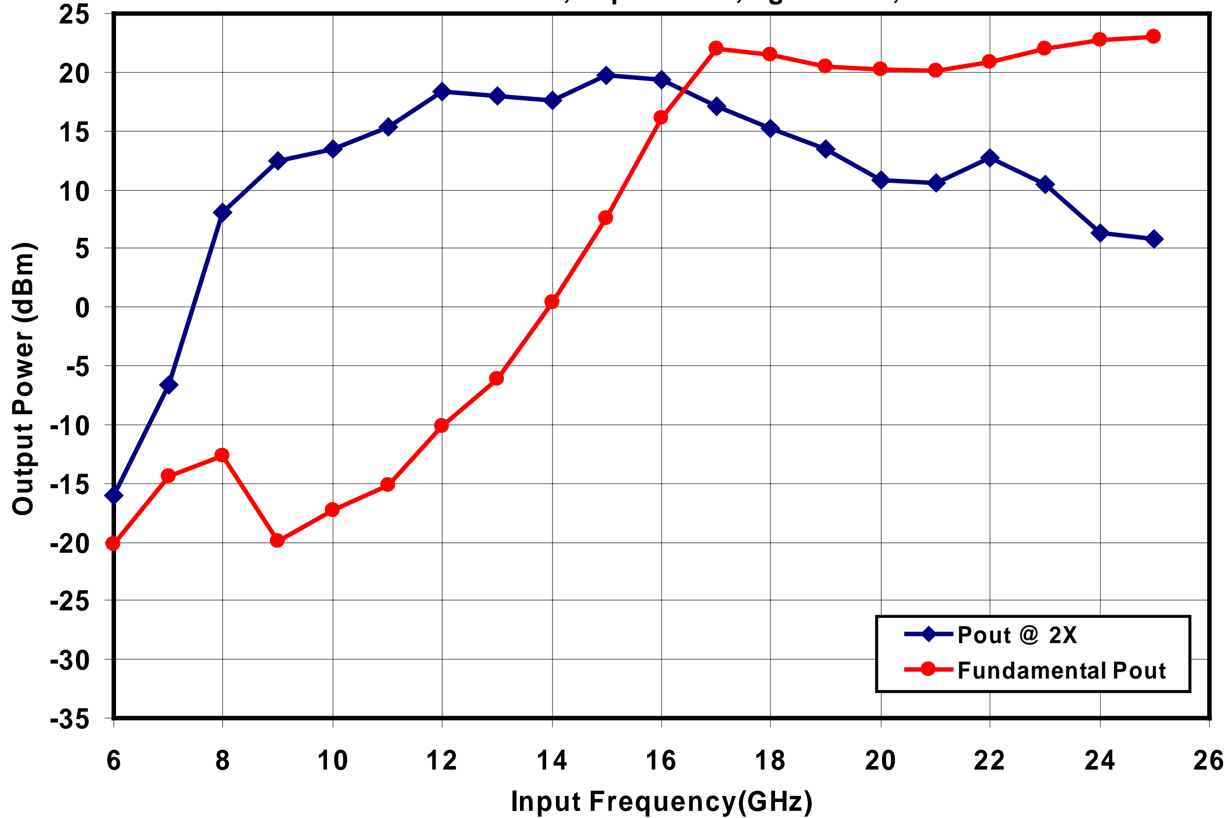
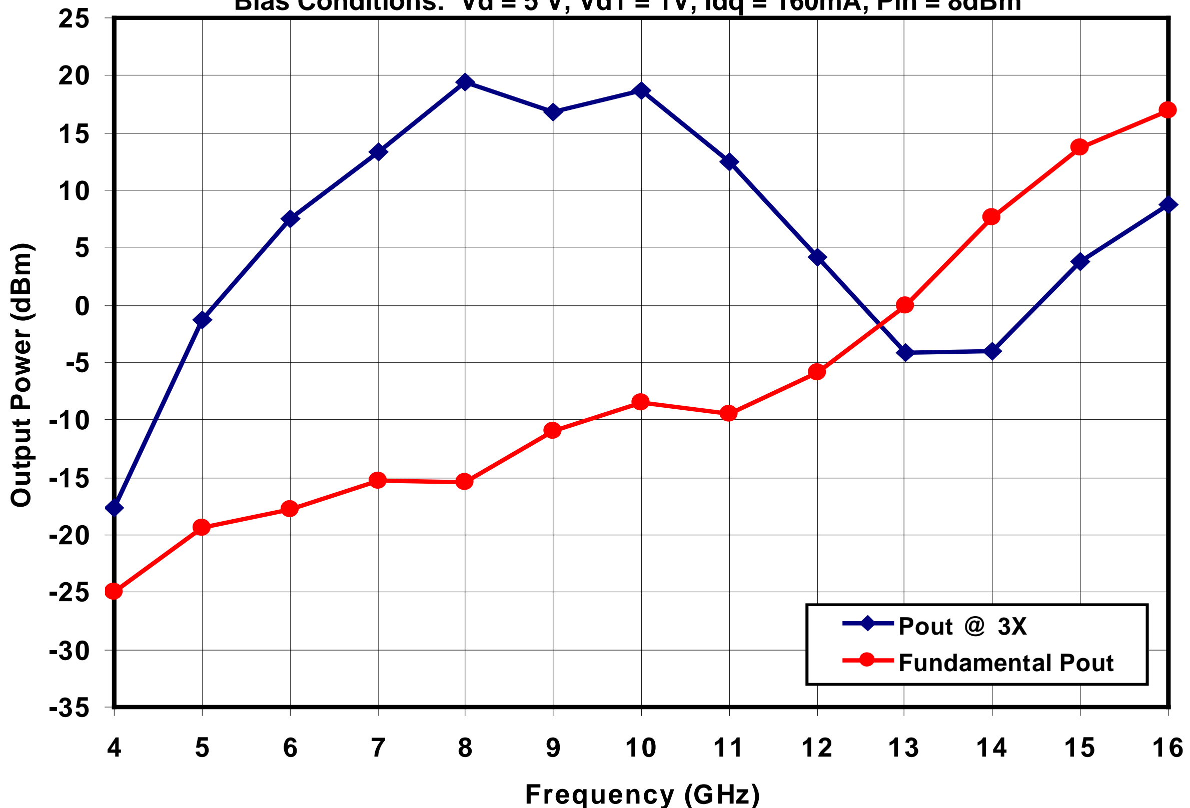
Measured Amplifier Data



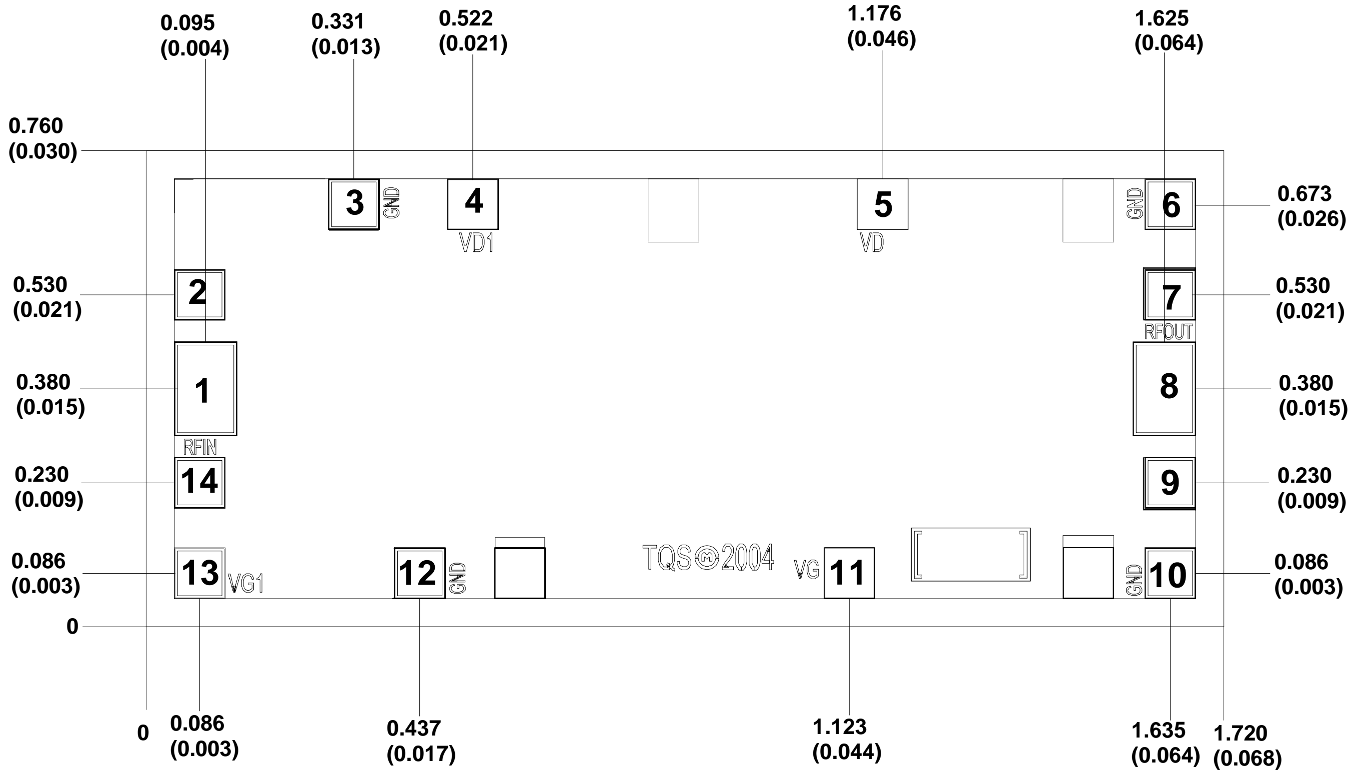
Measured 2X Multiplier Data



Measured 3X Multiplier Data



Mechanical Drawing



Units: millimeters (inches)
Thickness: 0.100 (0.004)
Chip edge to bond pad dimensions are shown to center of bond pad
Chip size tolerance: +/- 0.051 (0.002)
GND is back side of MMIC

Bond pad #1:	(RF In)	0.100 x 0.150 (0.004 x 0.006)
Bond pad #2, #3, #6, #7, #9, #10, #12, #14:	(GND)	0.081 x 0.081 (0.003 x 0.003)
Bond pad #4:	(Vd1)	0.081 x 0.081 (0.003 x 0.003)
Bond pad #5:	(Vd)	0.081 x 0.081 (0.003 x 0.003)
Bond pad #8:	(RF Out)	0.100 x 0.150 (0.004 x 0.006)
Bond pad #11:	(Vg)	0.081 x 0.081 (0.003 x 0.003)
Bond pad #13:	(Vg1)	0.081 x 0.081 (0.003 x 0.003)

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

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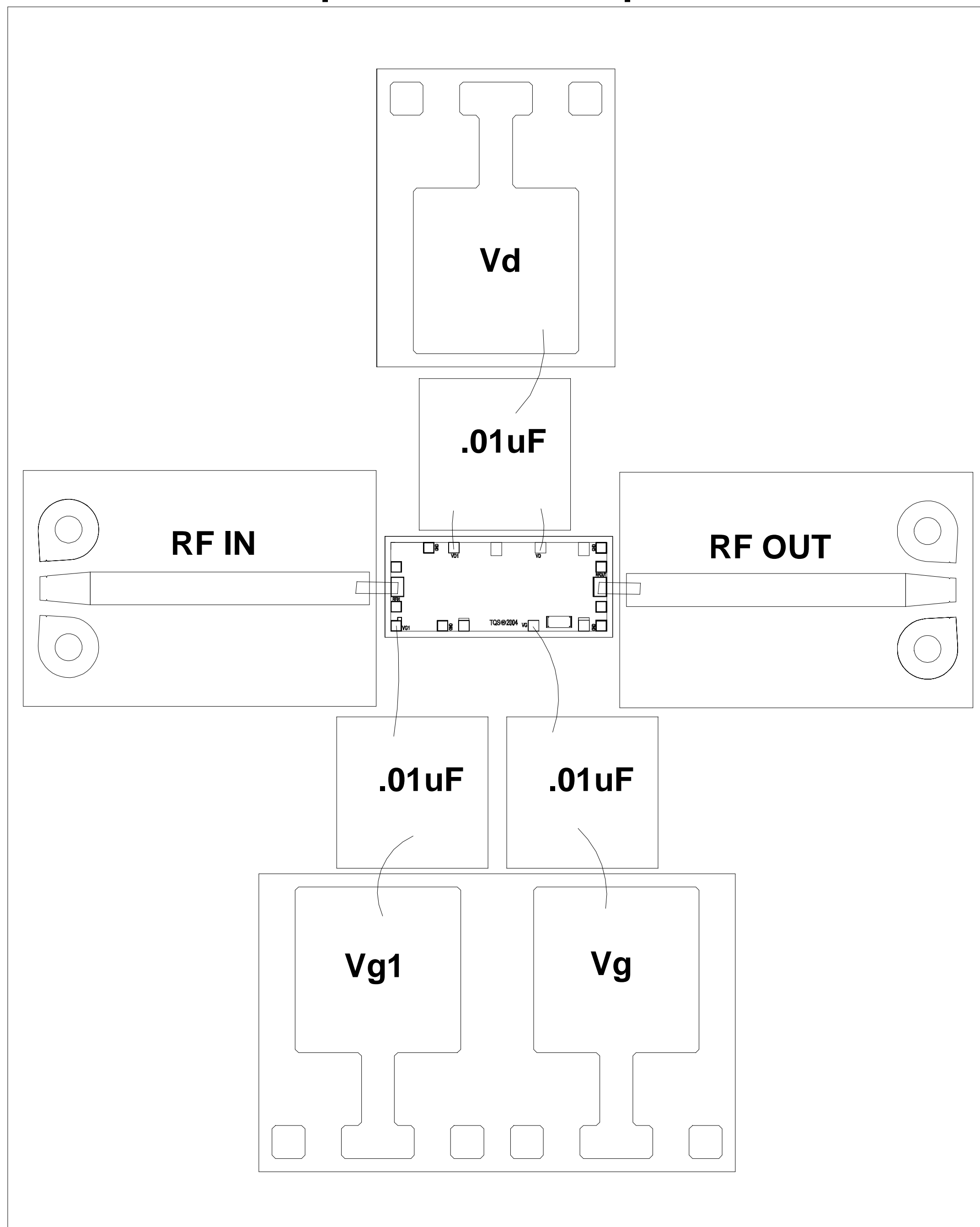
Recommended Chip Assembly Diagram
Amplifier & 2x Multiplier



Amplifier
Set Vd = 5.0V
Vary (Vg + Vg1) to achieve Id = 139mA

2x Multiplier
Set Vd = 5.0V
Set Vg1 = -1.1V
Vary Vg to achieve Id = 120mA

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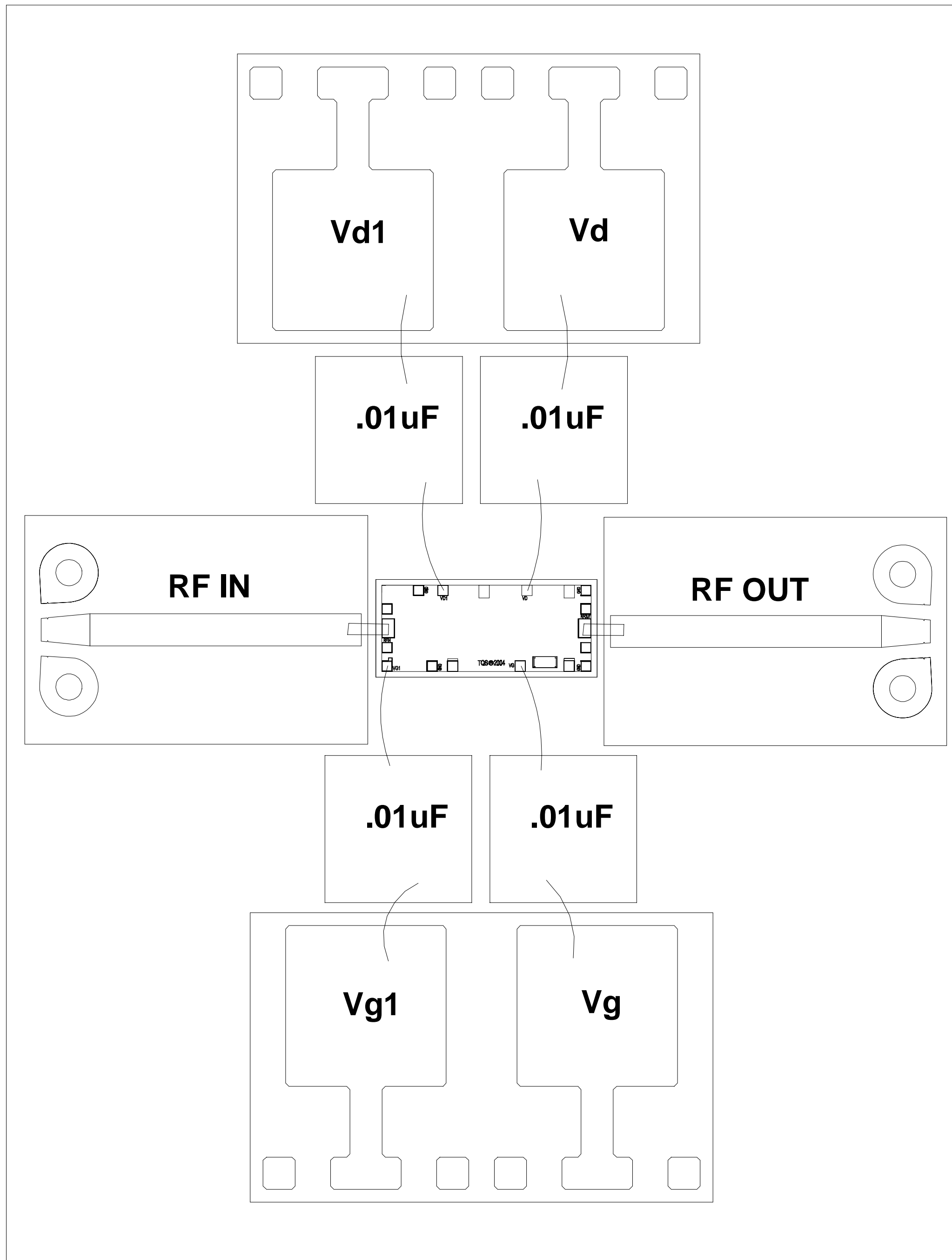
Recommended Chip Assembly Diagram
3x Multiplier



<u>3x Multiplier</u>
Set Vd = 5.0V
Set Vd1 = 1.0V
Vary (Vg + Vg1) to achieve(Id + Id1) = 160mA

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 300^0C (30 seconds max).
- 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 200^0C.

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