

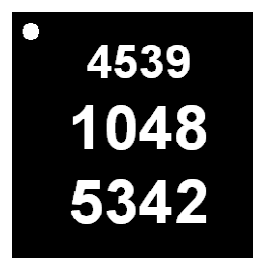
TGA4539-SM

Ka-Band 1 Watt Power Amplifier



Applications

- Point-to-Point Radio
- Ka-Band VSAT Ground Terminal
- Point-to-Multipoint Communications

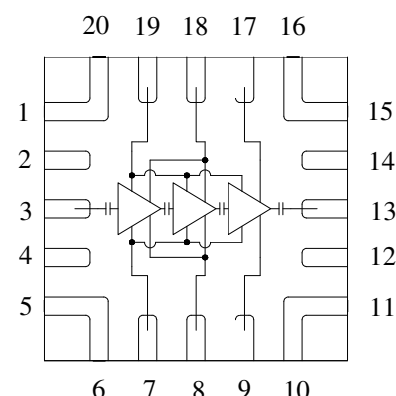


QFN 5x5 mm 20L

Product Features

- Frequency Range: 28 – 30 GHz
- Power: 30.5 dBm Psat, 30 dBm P1dB
- Gain: 20 dB
- Bias: $V_d = 6\text{ V}$, $I_{dq} = 420\text{ mA}$, $V_g = -0.59\text{ V}$ Typical
- Package Dimensions: 5.0 x 5.0 x 1.3 mm

Functional Block Diagram



General Description

The TriQuint TGA4539-SM is a Ka-Band 1 Watt Power Amplifier. The TGA4539-SM operates from 28 – 30 GHz and is designed using TriQuint's power pHEMT production process.

The TGA4539-SM typically provides 30.5 dBm of saturated output power with small signal gain of 20 dB.

The TGA4539-SM is available in a low-cost, surface mount 20 lead 5x5 mm QFN package and is ideally suited for Point-to-Point Radio, Point-to-Multipoint and VSAT communications.

Lead-free and RoHS compliant

Evaluation Boards are available upon request.

Pin Configuration

| Pin # | Symbol |
|---|-----------------|
| 1, 2, 4, 5, 6, 10, 11, 12, 14, 15, 16, 20 | N/C |
| 3 | RF IN |
| 7, 19 | V_g |
| 8 | $V_{d1,2_Bot}$ |
| 9 | V_{d3_Bot} |
| 13 | RF OUT |
| 17 | V_{d3_Top} |
| 18 | $V_{d1,2_Top}$ |

Ordering Information

| Part No. | ECCN | Description |
|------------|-------------|-------------------------|
| TGA4539-SM | 3A001.b.2.c | Ka-Band Power Amplifier |

Standard T/R size = 500 pieces on a 7" reel.

Specifications

Absolute Maximum Ratings

| Parameter | Rating |
|-----------------------------------|---------------|
| Drain Voltage, Vd | +8 V |
| Gate Voltage, Vg | -5 to 0 V |
| Drain to Gate Voltage, Vd – Vg | 12 V |
| Drain Current, Id | 984 mA |
| Gate Current, Ig | 35 mA |
| Power Dissipation, Pdiss | 6.9 W |
| RF Input Power, CW, T = 25°C | 22 dBm |
| Channel Temperature, Tch | 200 °C |
| Mounting Temperature (30 Seconds) | 260 °C |
| Storage Temperature | -40 to 150 °C |

Operation of this device outside the parameter ranges given above may cause permanent damage. These are stress ratings only, and functional operation of the device at these conditions is not implied.

Recommended Operating Conditions

| Parameter | Min | Typical | Max | Units |
|--|-----|---------|-----|-------|
| Vd | | 6 | | V |
| Idq | | 420 | | mA |
| Id_drive (Under RF Drive, Constant Vg) | | 800 | | mA |
| Vg | | -0.59 | | V |

Electrical specifications are measured at specified test conditions.
Specifications are not guaranteed over all recommended operating conditions.

Electrical Specifications

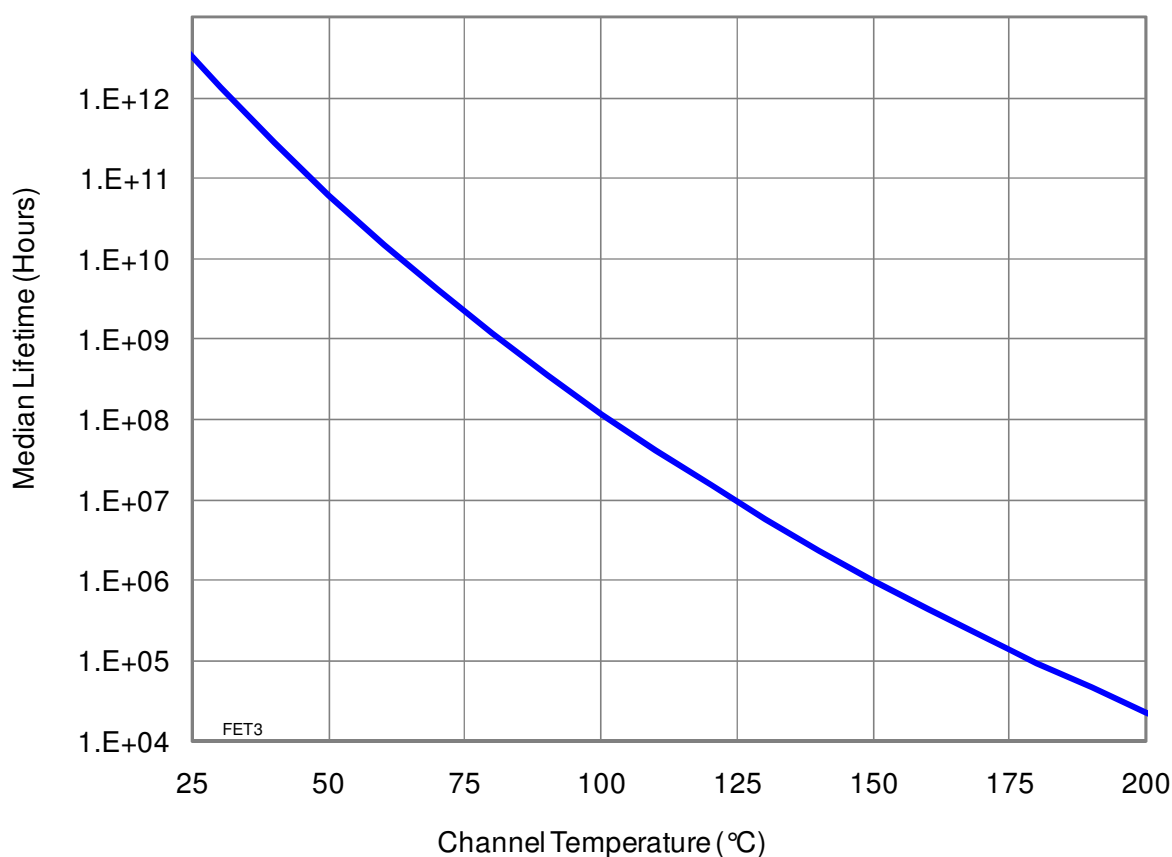
Test conditions unless otherwise noted: 25°C, Vd = 6 V, Idq = 420 mA, Vg = -0.59 V Typical.

| Parameter | Min | Typical | Max | Units |
|-------------------------------------|------|---------|-----|-------|
| Operational Frequency Range | 28 | | 30 | GHz |
| Gain | 15.5 | 20 | | dB |
| Input Return Loss | | 15 | | dB |
| Output Return Loss | | 10 | | dB |
| Output Power @ Saturation | 29.5 | 30.5 | | dBm |
| Output Power @ 1dB Gain Compression | | 30 | | dBm |
| Output TOI @ 26 dBm Pout/tone | | 33 | | dBm |
| Gain Temperature Coefficient | | -0.06 | | dB/°C |
| Power Temperature Coefficient | | -0.02 | | dB/°C |

Specifications (cont.)

Thermal and Reliability Information

| Parameter | Condition | Rating |
|--|--|------------------------------------|
| Thermal Resistance, θ_{JC} , measured to back of package | Tbase = 70 °C | θ_{JC} = 21.9 °C/W |
| Channel Temperature (Tch), and Median Lifetime (Tm) | Tbase = 70 °C, Vd = 6 V, Idq = 420 mA, Pdiss = 2.52 W | Tch = 125 °C Tm = 1.0 E+7 Hours |
| Channel Temperature (Tch), and Median Lifetime (Tm) Under RF Drive | Tbase = 70 °C, Vd = 6 V, Id = 800 mA, Pout = 30.5 dBm, Pdiss = 3.8 W | Tch = 153 °C Tm = 9.6 E+5 Hours |

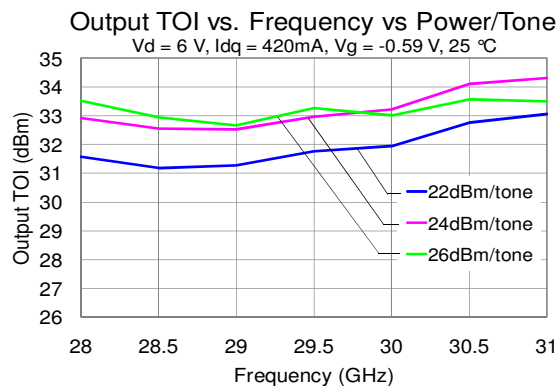
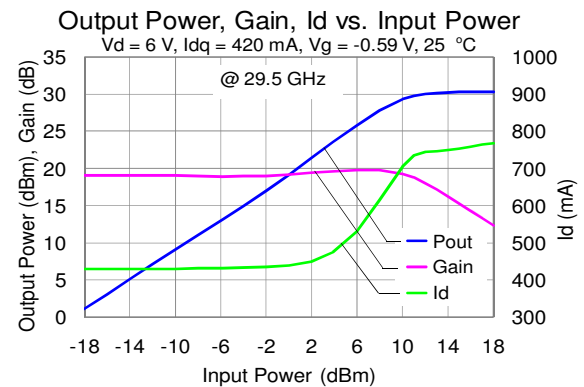
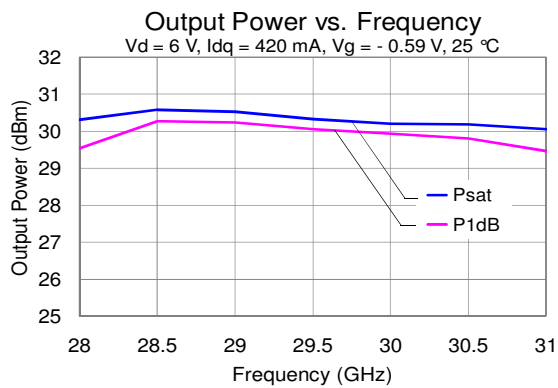
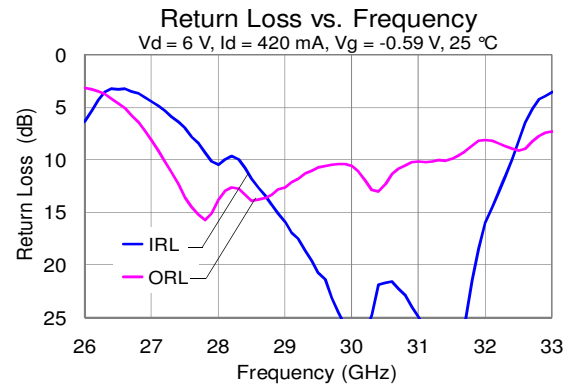
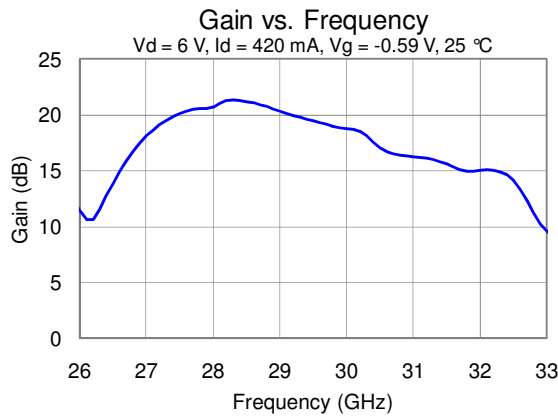


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Typical Performance

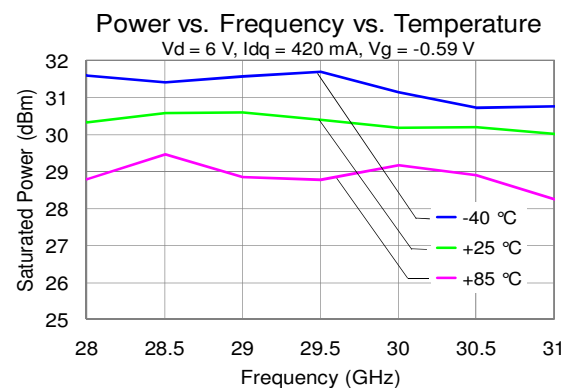
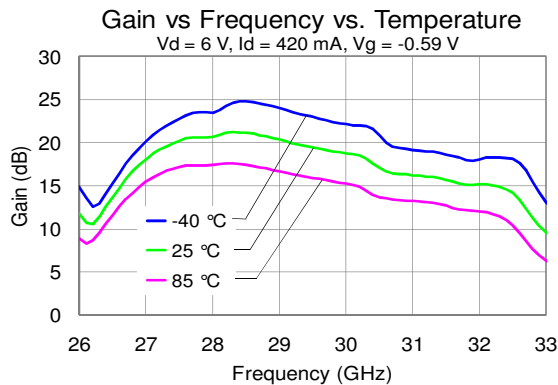
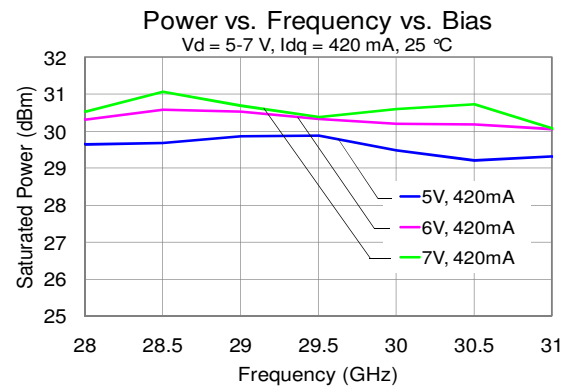
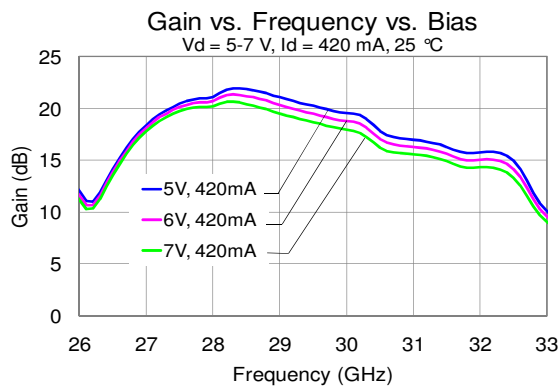
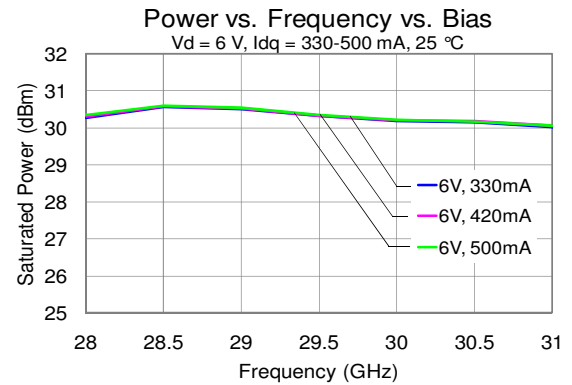
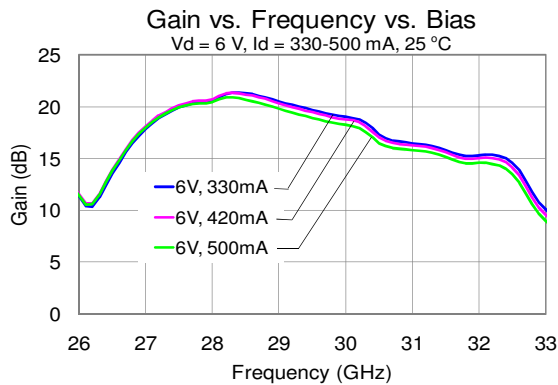


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Typical Performance (cont.)



Device Characterization Data

Load Pull Data

RF performance of the TGA4539-SM is optimum when placed in the impedance environment specified below. These impedances are NOT the impedances of the device; they are the impedances presented to the device via an RF circuit or load pull system. Z_{LOAD} is the load impedance presented at pin 13. For load pull contours, refer to the [TGA4539-SM Product Information](#) page.

The power data points shown below were measured in a load pull system. The power data points shown in ‘Typical Performance’ were measured using the input and output structures shown in ‘PC Board Tuning Layout’ and can vary from the load pull measurements.

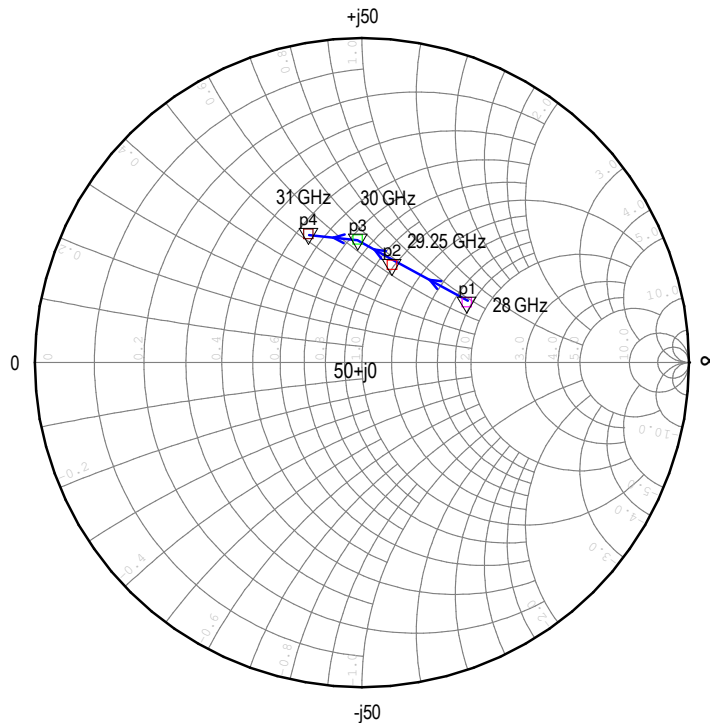
Test Conditions:

Input power for load pull: +16 dBm.

$V_d = 6.0$ V, $I_{dq} = 420$ mA, 25°C

Z_{SOURCE} for load pull: $50 + j0$

| Freq (GHz) | Γ_{LOAD} | $Z_{LOAD} (\Omega)$ | Output Power (dBm) |
|------------|----------------------|---------------------|--------------------|
| 28.0 | Mag=0.371 Ang=30.1° | $86.5 + j37.5$ | 30.97 |
| 29.25 | Mag=0.339 Ang=79.2° | $44.8 + j33.8$ | 30.66 |
| 30.0 | Mag=0.375 Ang=91.1° | $37.2 + j32.5$ | 30.29 |
| 31.0 | Mag=0.429 Ang=112.4° | $27.0 + j26.3$ | 30.06 |

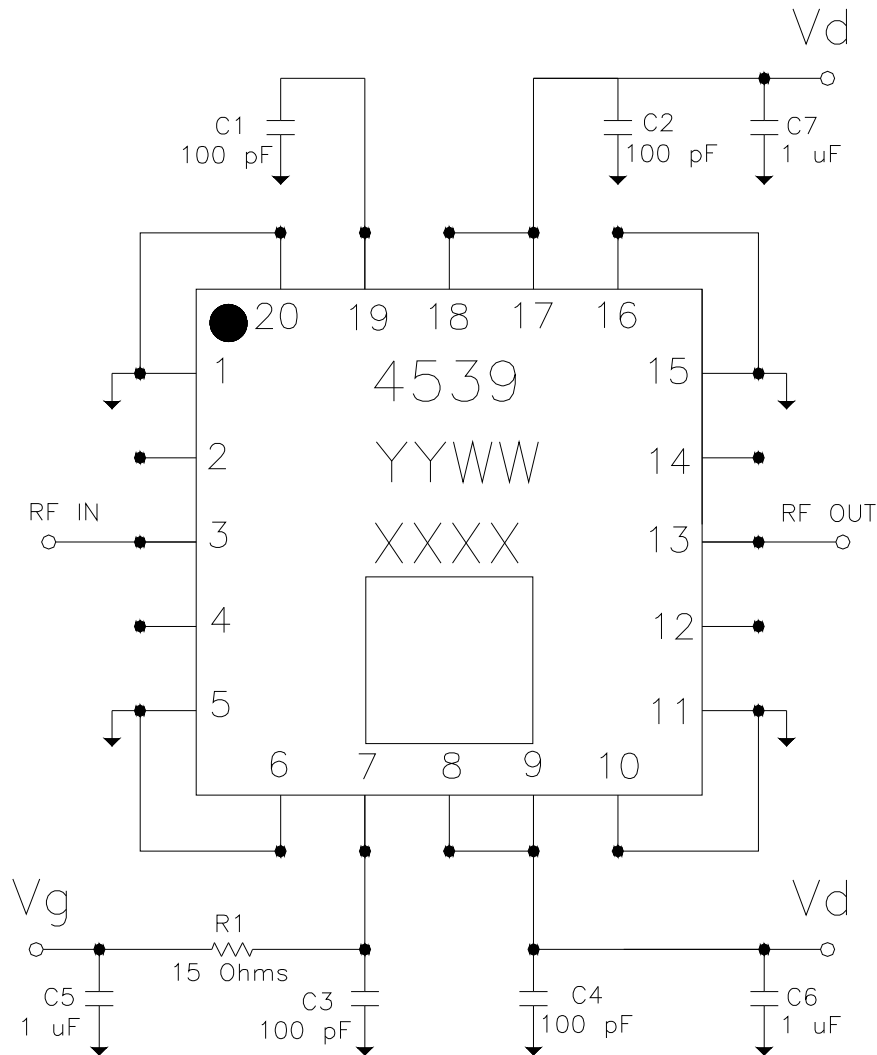


TGA4539-SM

Ka-Band 1 Watt Power Amplifier



Application Circuit



Vg can be biased from either side (pin 7 or pin 19)
Vd must be biased from both side (pins 8, 9, 17, 18)

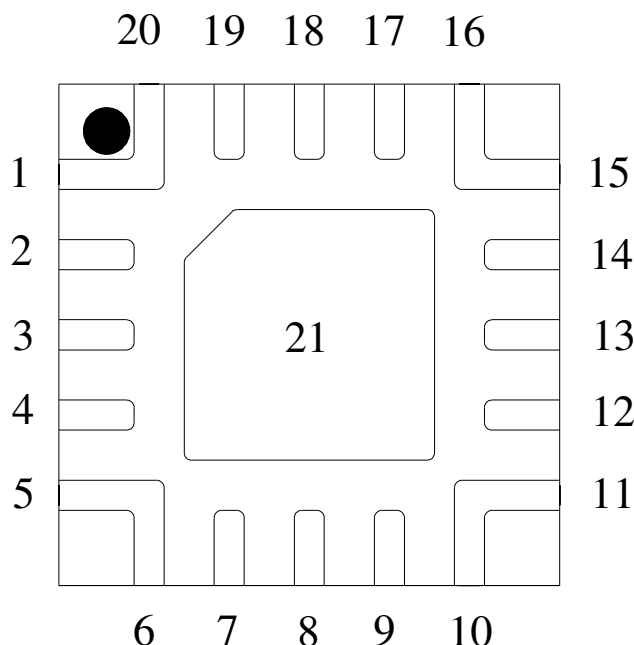
Bias-up Procedure

Turn Vg to -1.5 V
Turn Vd to +6 V
Adjust Vg more positive until quiescent Id is 420 mA.
This will be ~ Vg = -0.59 V typical
Apply RF signal

Bias-down Procedure

Turn off RF signal
Reduce Vg to -1.5V. Ensure Id ~ 0 mA
Turn Vd to 0 V
Turn Vg to 0 V

Pin Description



| Pin | Symbol | Description |
|-----------------------------|--|---|
| 1, 5, 6, 10, 11, 15, 16, 20 | N/C | Internally connected to 21; must be grounded on PCB. |
| 2, 4, 12, 14 | N/C | No internal connection; open on PCB for best performance. |
| 3 | RF IN | Input, matched to 50 ohms. |
| 7, 19 | V _g | Gate voltage. See Note 1 |
| 13 | RF OUT | Output, matched to 50 ohms. |
| 8, 18 | V _{d12_Bot} V _{d12_Top} | Drain voltage for 1 st and 2 nd Stage. See Note 2 |
| 9, 17 | V _{d3_Bot} V _{d3_Top} | Drain voltage for 3 rd Stage. See Note 2 |
| 21 | GND | Backside Paddle. Multiple vias should be employed to minimize inductance and thermal resistance; see Mounting Configuration on page 12 for suggested footprint. |

Notes:

1. Bias network is required; can be biased from either side (pin 7 or pin 19); see Application Circuit on page 7 as an example.
2. Bias network is required; must be biased from both side (pins 8, 9, 17, 18); see Application Circuit on page 7 as an example.

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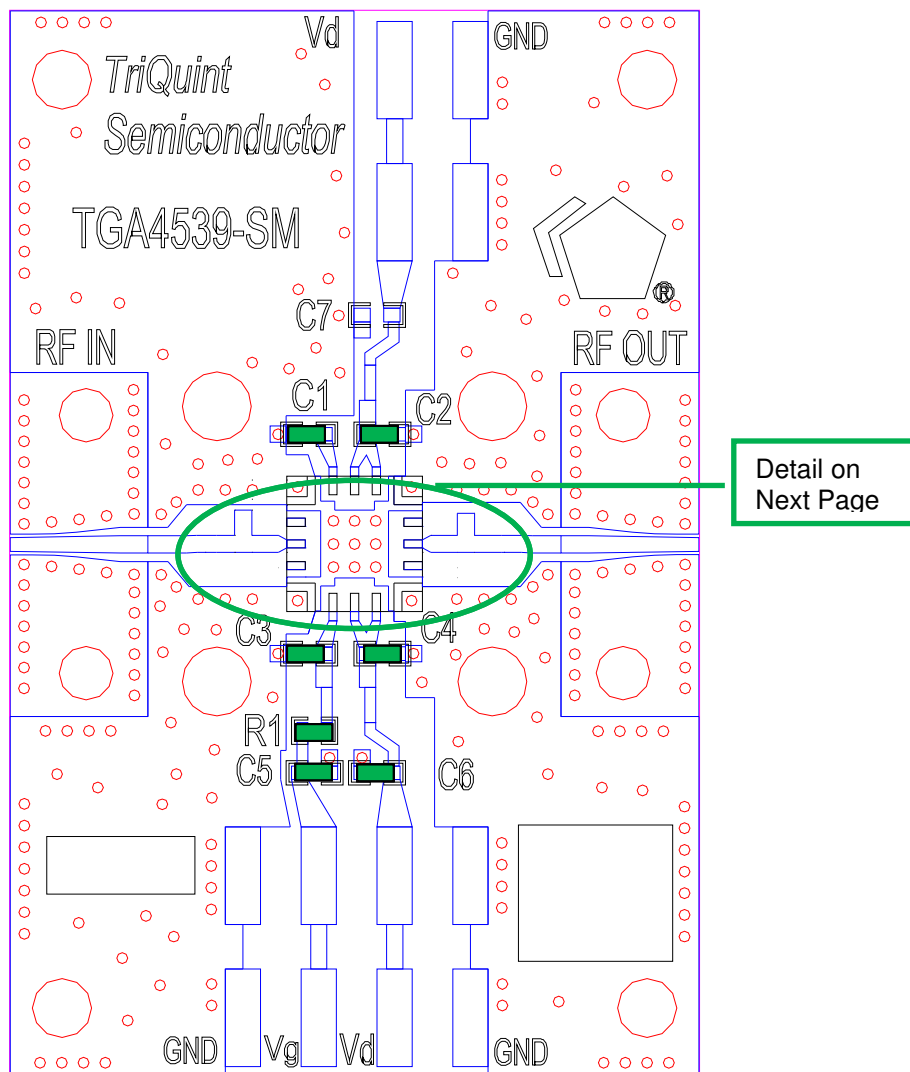
Applications Information

PC Board Layout

Top RF layer is 0.010" thick Rogers RO3203, $\epsilon_r = 3.02$. Metal layers are 0.5-oz copper.

The pad pattern shown has been developed and tested for optimized assembly at TriQuint Semiconductor. The PCB land pattern has been developed to accommodate lead and package tolerances. Since surface mount processes vary from company to company, careful process development is recommended.

For further technical information, refer to the [TGA4539-SM](#) Product Information page.



TGA4539-SM

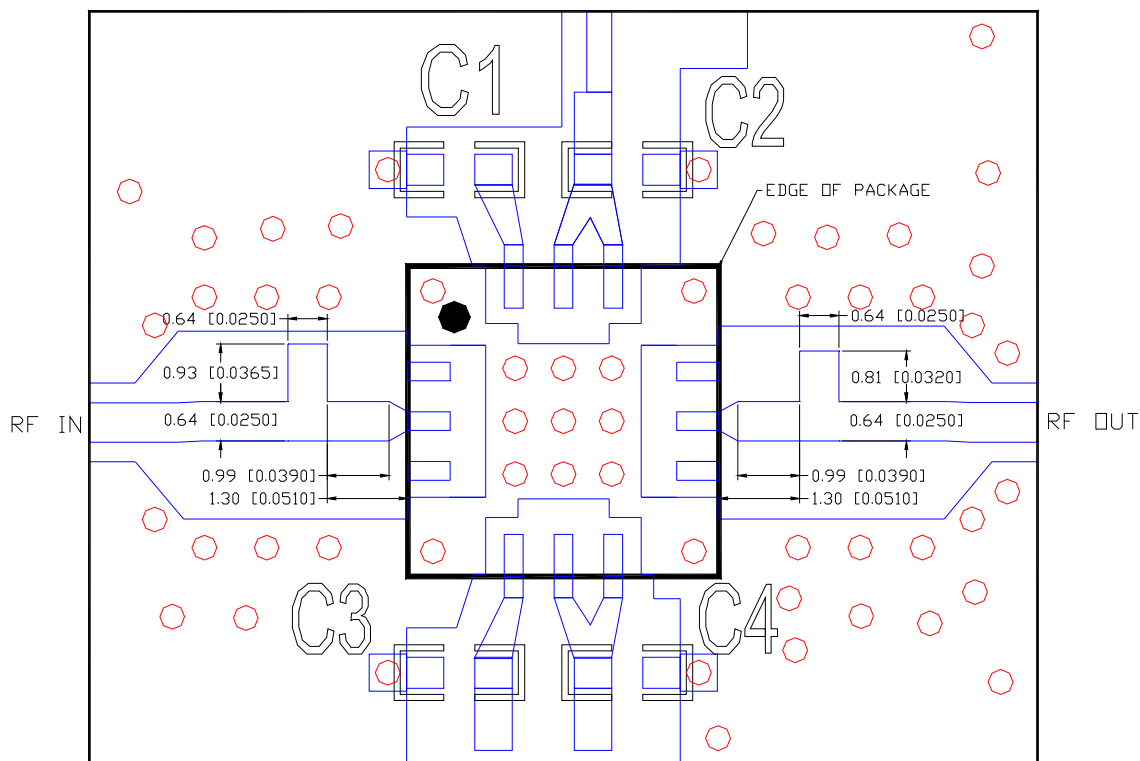
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Applications Information (cont.)

Bill of Material

| Ref Des | Value | Description | Manufacturer | Part Number |
|------------|---------|---------------------------|--------------|-------------|
| C1- C4 | 100 pF | Cap, 0402, 50 V, 5%, COG | Various | |
| C5, C6, C7 | 1 uF | Cap, 0603, 25 V, 10%, X5R | Various | |
| R1 | 15 Ohms | Res, 0402, 0.1 W, SMD | Various | |

PC Board Tuning Layout



Dimensions are in millimeters [inches].

All performance data in this data sheet was measured using the transmission line tuning elements shown at pins 3 (RF In) and pin 13 (RF Out). These transmission line dimension apply to transmission lines on 0.010" thick Rogers RO3203, $\epsilon_r = 3.02$.

TGA4539-SM

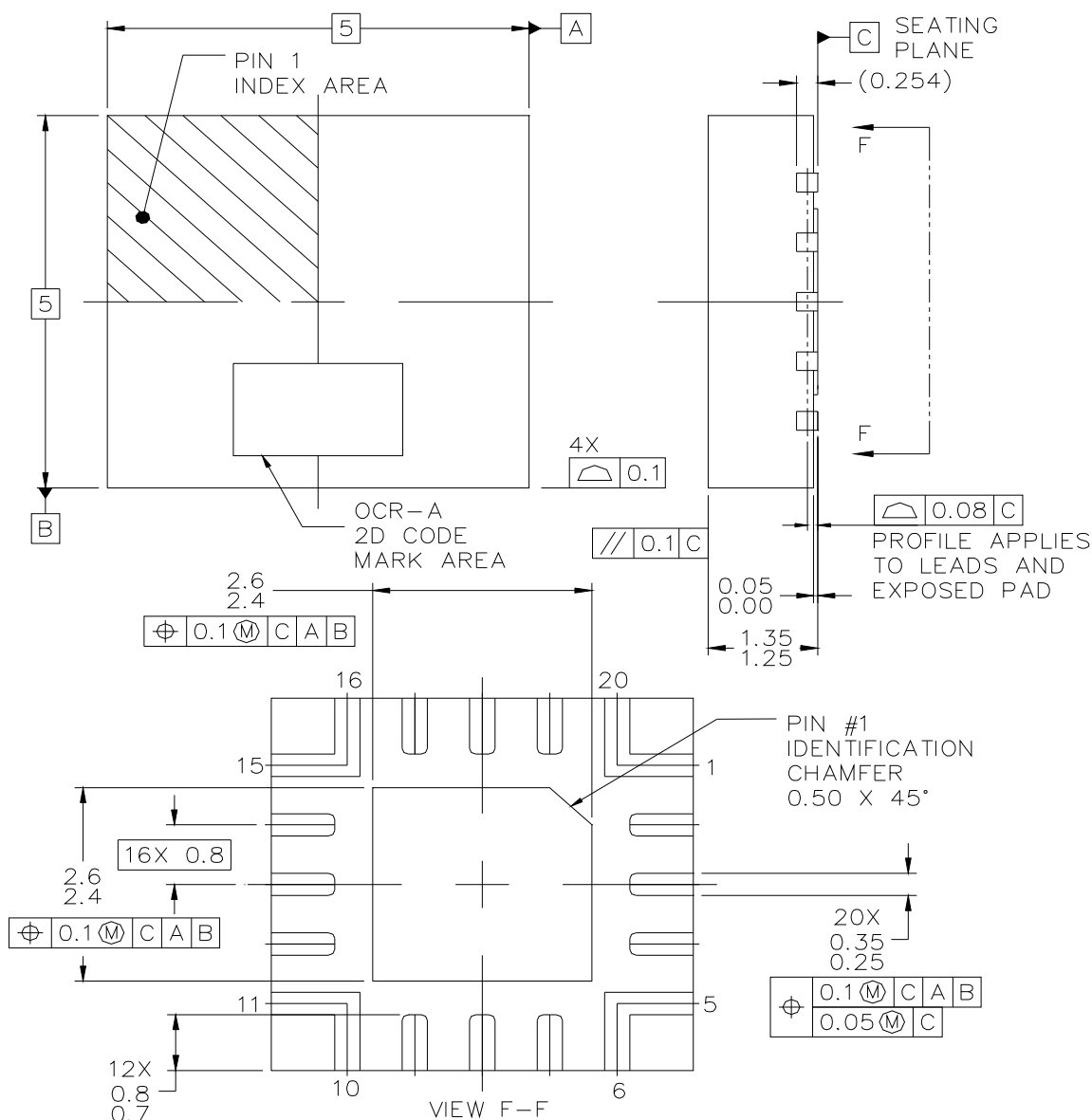
Ka-Band 1 Watt Power Amplifier



Mechanical Information

Package Information and Dimensions

All dimensions are in millimeters.



The TGA4539-SM will be marked with the “4539” designator and a lot code marked below the part designator. The “YY” represents the last two digits of the year the part was manufactured, the “WW” is the work week, and the “XXXX” is an auto-generated number. The OCR-A 2D Code has four rows and is the ‘XXXX’ number, one digit per row.

This package is lead-free/RoHS-compliant with a copper alloy base (CDA194), and the plating material on the leads is NiPdAu. It is compatible with lead-free (maximum 260 °C reflow temperature) soldering processes.

Mechanical Information (cont.)

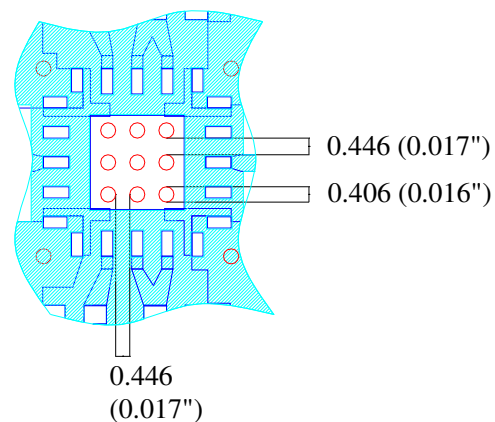
Mounting Configuration

All dimensions are in millimeters (inches).

Note:

Ground / thermal vias are critical for the proper performance of this device.

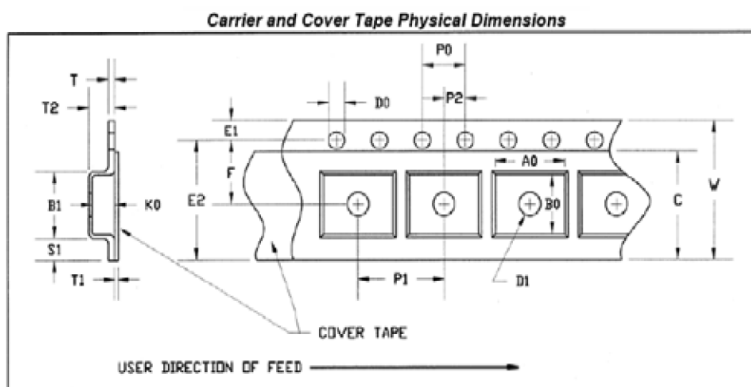
Vias have a final plated thru diameter of 0.406 mm (0.016").



Tape and Reel Information

Tape and reel specifications for this part are also available on the TriQuint website in the “Application Notes” section.

Standard T/R size = 500 pieces on a 7 x 0.5” reel.



CARRIER AND COVER TAPE DIMENSIONS

| Part | Feature | Symbol | Size (in) | Size (mm) |
|-----------------------------|--|--------|-----------|-----------|
| Cavity | Length | A0 | 0.207 | 5.25 |
| | Width | B0 | 0.207 | 5.25 |
| | Depth | K0 | 0.043 | 1.80 |
| | Pitch | P1 | 0.315 | 8.00 |
| Distance Between Centerline | Cavity to Perforation Length Direction | P2 | 0.079 | 2.00 |
| | Cavity to Perforation Width Direction | F | 0.217 | 5.50 |
| Cover Tape | Width | C | 0.374 | 9.50 |
| Carrier Tape | Width | W | 0.472 | 12.00 |

Product Compliance Information

ESD Information



Caution! ESD-Sensitive Device

ESD Rating: 1A
Value: Passes ≥ 250 V min.
Test: Human Body Model (HBM)
Standard: JEDEC Standard JESD22-A114

MSL Rating

Level MSL1 at +260 °C convection reflow
The part is rated Moisture Sensitivity Level MSL1 at 260°C per JEDEC standard IPC/JEDEC J-STD-020.

Solderability

Compatible with lead-free soldering processes, 260° maximum reflow temperature.

Package lead plating: NiPdAu

The use of no-clean solder to avoid washing after soldering is recommended.

This package is not compatible with solder containing lead.

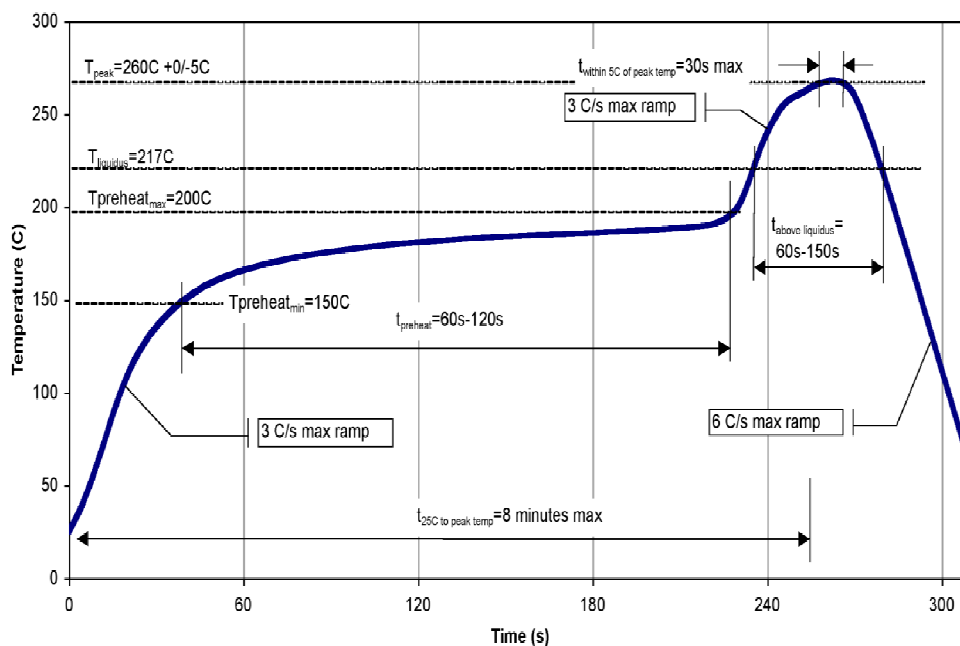
RoHS Compliance

This part is compliant with EU 2002/95/EC RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free

Recommended Soldering Temperature Profile



TGA4539-SM

Ka-Band 1 Watt Power Amplifier



Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations, and information about TriQuint:

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For technical questions and application information:

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