# TGA4544-SM

## 26 – 31 GHz 1 Watt Power Amplifier

## Product Overview

The Qorvo TGA4544-SM is a Ka-Band Power Amplifier with integrated power detector. The TGA4544-SM operates from 26 – 31 GHz and is designed using Qorvo's power pHEMT production process.

The TGA4544-SM typically provides 32 dBm of saturated output power with small signal gain of 23 dB. Third Order Intercept is 41 dBm at 20 dBm SCL.

The TGA4544-SM is available in a low-cost, surface mount 26 lead 5x5 ACQFN package and is ideally suited for Point-to-Point Radio.

Lead-free and RoHS compliant

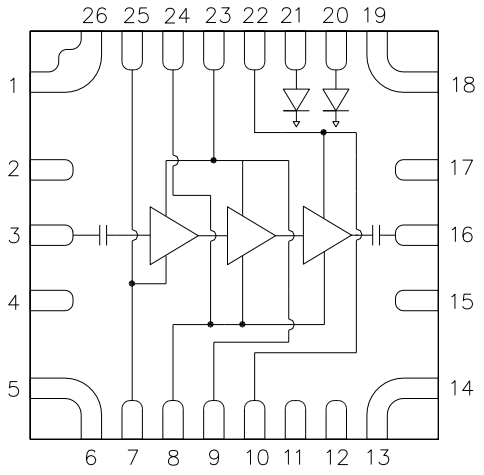

26 Lead 5 x 5 mm ACQFN package

## Key Features

- Frequency Range: 26 – 31 GHz
- Power: 32 dBm Psat, 31 dBm P1dB
- Gain: 23 dB
- TOI: 41 dBm at 20 dBm/tone
- Integrated Power Detector
- Bias: Vd = 6 V, Idq = 1100 mA, Vg = -0.55 V Typical
- Package Dimensions: 5.0 x 5.0 x 1.3 mm

*Performance is typical across frequency. Please reference electrical specification table and data plots for more details.*

## Functional Block Diagram




## Applications

- Point-to-Point Radio
- Ka-band Sat-Com

## Ordering Information

| Part No. | Description |
|---|---|
| TGA4544-SM | 26 – 31 GHz 1W Power Amplifier |
| TGA4544-SM-T/R | 200 pieces on a 7" reel (standard) |
| TGA4544-SMEVB | Evaluation Board for TGA4544-SM |

## Absolute Maximum Ratings

| Parameter | Value / Range |
|---|---|
| Drain Voltage ($V_D$) | 6.5 V |
| Gate Voltage Range ($V_G$) | -3.5 V to 0 V |
| Drain to Gate Voltage, $V_D$ - $V_G$ | 10 V |
| Drain Current ($I_D$) | 2.5 A |
| Gate Current ($I_G$) | -7 to +52 mA |
| Power Dissipation ($P_{DISS}$), $T_{BASE}$ = 85°C | 16.2 W |
| Input Power ($P_{IN}$), 50 Ω, $V_D$ = 6 V, $I_{DQ}$ = 1.1 A, 25 °C | 25 dBm |
| Channel Temperature, $T_{CH}$ | 200 °C |
| Mounting Temperature (30 sec) | 260 °C |
| Storage Temperature | -55 to +155 °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 | Typ. | Max | Units |
|---|---|---|---|---|
| Drain Voltage ($V_D$) | | +6 | | V |
| Drain Current, Quiescent ($I_{DQ}$) | | 1.1 | | A |
| Drain Current, RF ($I_{D\_Drive}$) | | 1.7 | | A |
| Gate Voltage Typ. Range ($V_G$) | −0.3 to −0.75 | | | V |
| Gate Current, RF ($I_{G\_Drive}$) | | 15 | | mA |
| Input Power at $P_{SAT}$ ($P_{IN}$) | -40 °C, -14 dBm | | | dBm |
| | +25 °C, -15 dBm | | | |
| | +85 °C, -16 dBm | | | |
| Operating Temp. Range ($T_{BASE}$) | −40 | | +85 | °C |

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

## Electrical Specifications

| Parameter | Conditions (1) (2) | Min | Typ. | Max | Units |
|---|---|---|---|---|---|
| Operational Frequency Range | | 26 | | 31 | GHz |
| Output Power at Saturation, $P_{SAT}$ | $P_{IN}$ = 15 dBm | | 32 | | dBm |
| Output Power at 1 dB Gain Compression, $P_{1dB}$ | | | 31 | | dBm |
| Small Signal Gain, S21 | | | 23 | | dB |
| Input Return Loss, IRL | CW | | 8 | | dB |
| Output Return Loss, ORL | CW | | 10 | | dB |
| Output TOI | $P_{OUT/TONE}$ = 20 dBm | | 41 | | dBm |
| $P_{SAT}$ Temperature Coefficient | $T_{DIFF}$ = −40 °C to +85 °C; $P_{IN}$ = 15 dBm | | -0.01 | | dBm/°C |
| S21 Temperature Coefficient | $T_{DIFF}$ = −40 °C to +85 °C | | -0.03 | | dB/°C |

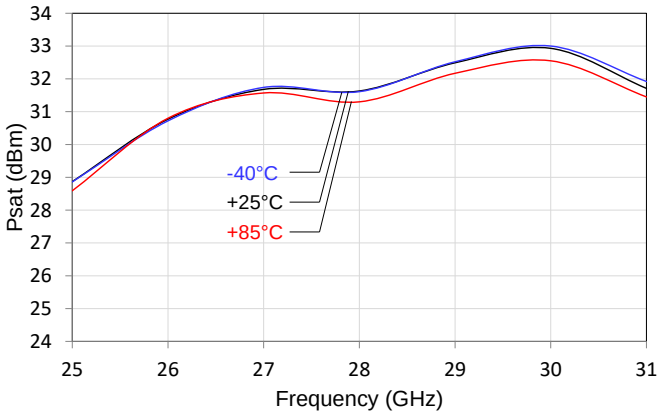
Notes:

1. Test conditions unless otherwise noted: Pulsed RF, $V_D$ = +6 V, $I_{DQ}$ = 1.1 A, $V_G$ = -0.55 V +/- typical, $T_{BASE}$ = +25 °C, $Z_0$ = 50 Ω
2. $T_{BASE}$ is back side of TGA4544-SM

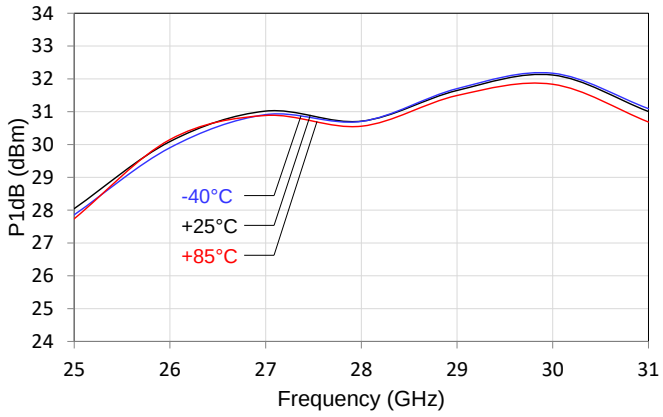
## Performance Plots – Large Signal

Test conditions, unless otherwise noted: $V_D$ = 6 V, $I_{DQ}$ = 1.1 A, $P_{IN}$ = 15 dBm, $T_{BASE}$ = +25 °C

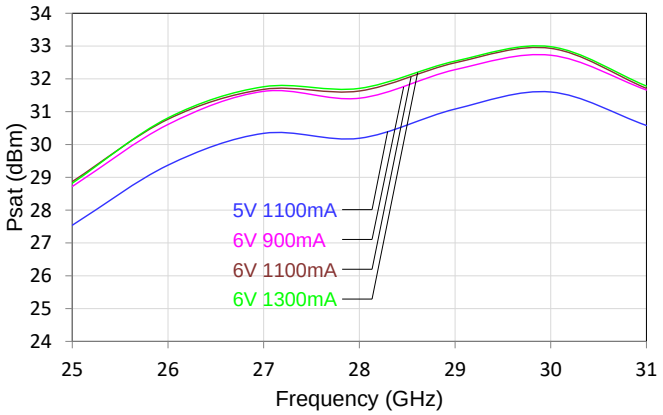
Psat vs. Frequency vs. Temperature
Vd = 6V, Id = 1100mA, Vg = -0.58V Typical



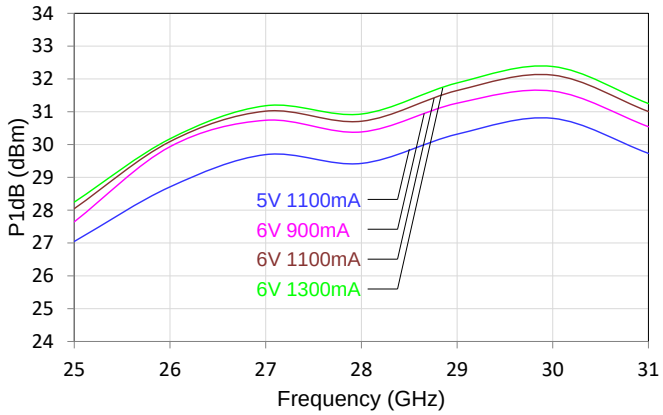

P1dB vs. Frequency vs. Temperature
Vd = 6V, Id = 1100mA, Vg = -0.58V Typical



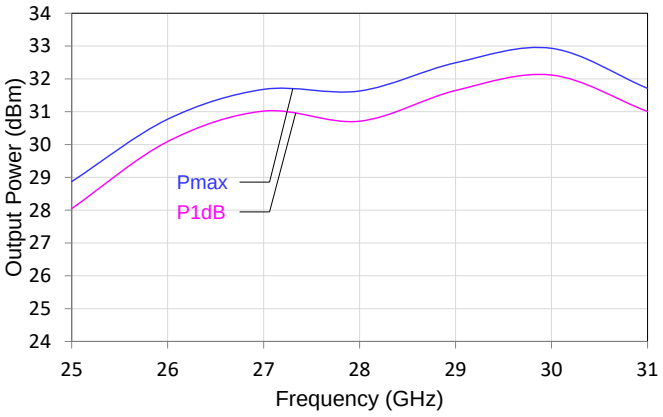

Psat vs. Frequency vs. Bias
Vd = 5 - 6 V, Id = 900 - 1300 mA, Vg = -0.58V Typical



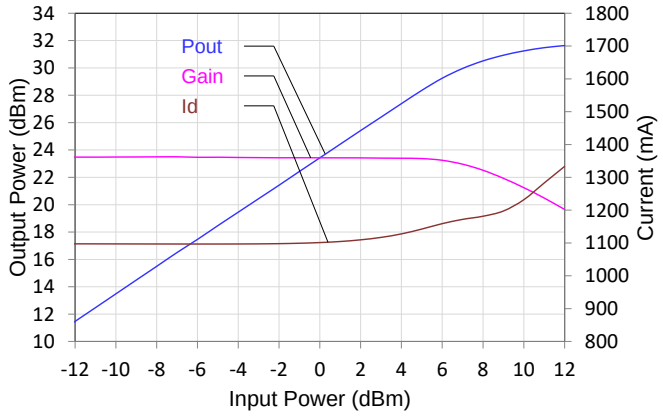

P1dB vs. Frequency vs. Bias
Vd = 5 - 6 V, Id = 900 - 1300 mA, Vg = -0.58V Typical




Output Power vs. Frequency
Vd = 6 V, Id = 1100 mA, Vg = -0.58V Typical



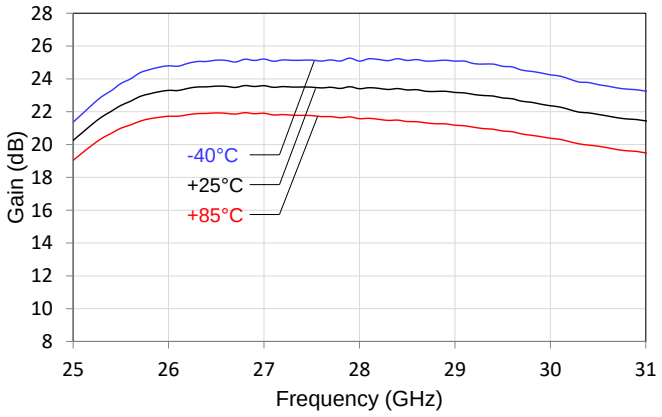

Pout, Gain, Id vs. Pin @ 28GHz
Vd = 6 V, Id = 1100 mA, Vg = -0.58V Typical



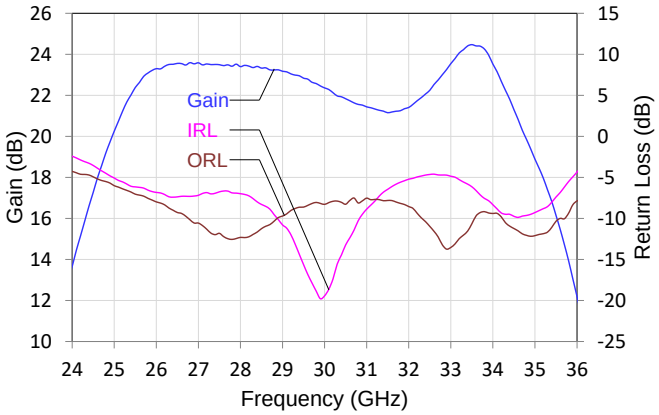
## Performance Plots – Small Signal

Test conditions, unless otherwise noted: $V_D$ = 6 V, $I_{DQ}$ = 1.1 A, $T_{BASE}$ = +25 °C

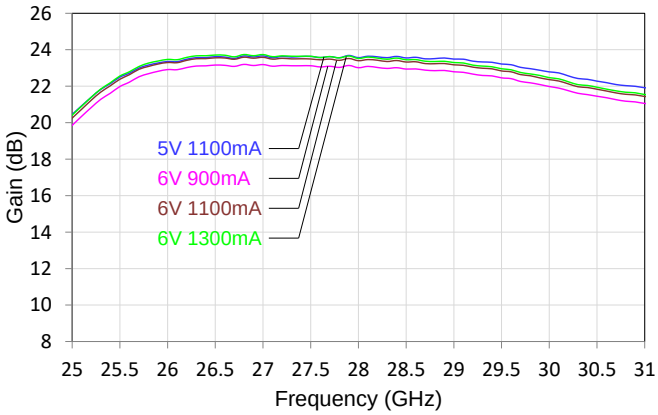
Gain vs. Frequency vs. Temperature
Vd = 6V, Id = 1100mA, Vg = -0.58V Typical




S-Parameters vs. Frequency
Vd = 6 V, Id = 1100 mA, Vg = -0.58 V Typical, +25°C



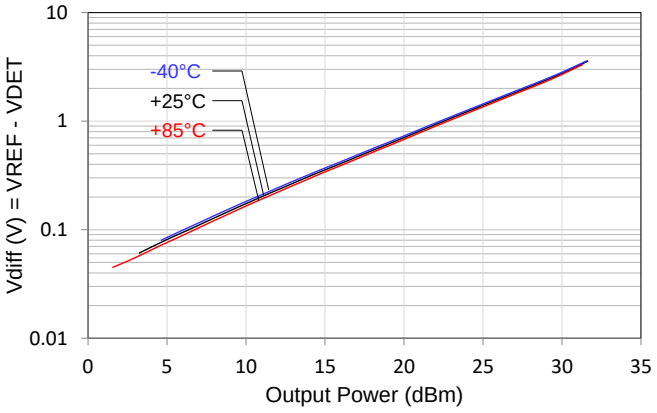

Gain vs. Frequency vs. Bias
Vd = 5 - 6 V, Id = 900 - 1300 mA, Vg = -0.58V Typical



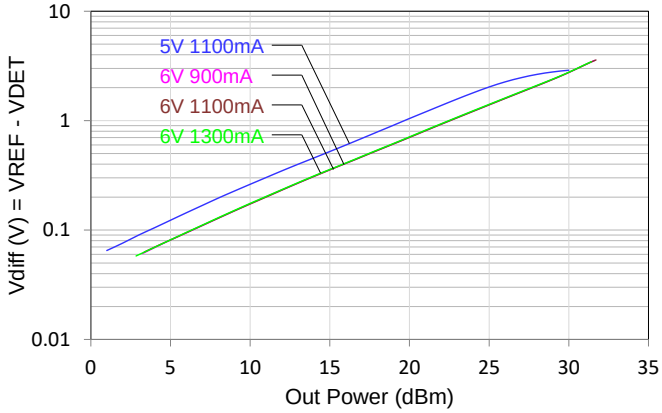
## Performance Plots – Other

Test conditions, unless otherwise noted: $V_D$ = 6 V, $I_{DQ}$ = 1.1 A, $T_{BASE}$ = +25 °C

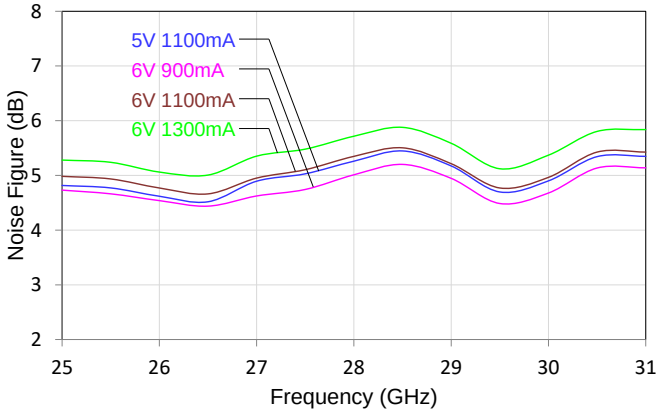
Power Detector vs. Pout vs. Temperature
Vd = 6V, Id = 1100mA, Vg = -0.58V Typical




Power Detector vs. Pout vs. Bias @ 28GHz
Vd = 5 - 6 V, Id = 900 - 1300 mA, Vg = -0.58V Typical



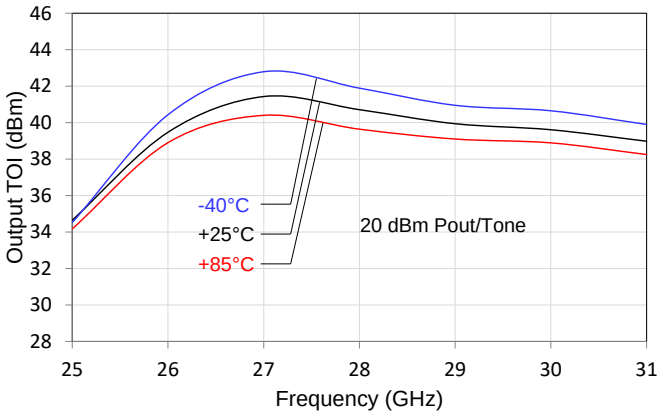

Noise vs. Frequency vs. Bias
Vd = 5 - 6 V, Id = 900 - 1300 mA, Vg = -0.58V Typical



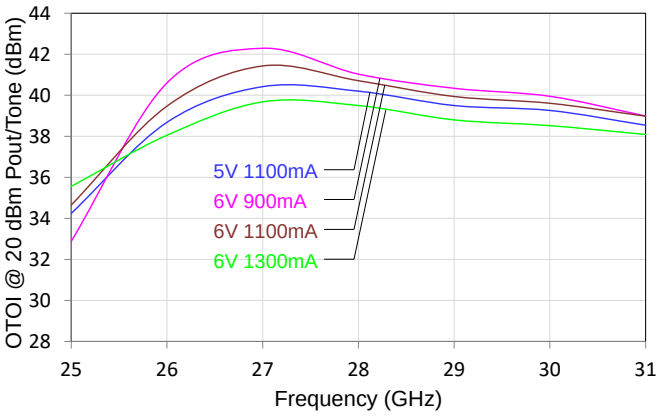
## Performance Plots – Linearity

Test conditions, unless otherwise noted: $V_D$ = 6 V, $I_{DQ}$ = 1.1 A, $T_{BASE}$ = +25 °C

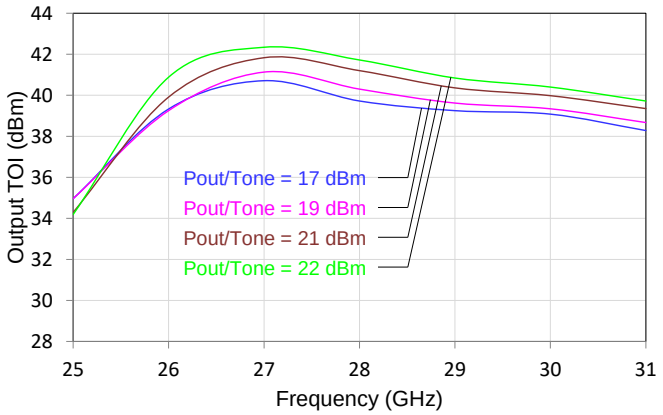
Output TOI vs. Frequency vs. Temperature
Vd = 6V, Id = 1100mA, Vg = -0.58V Typical



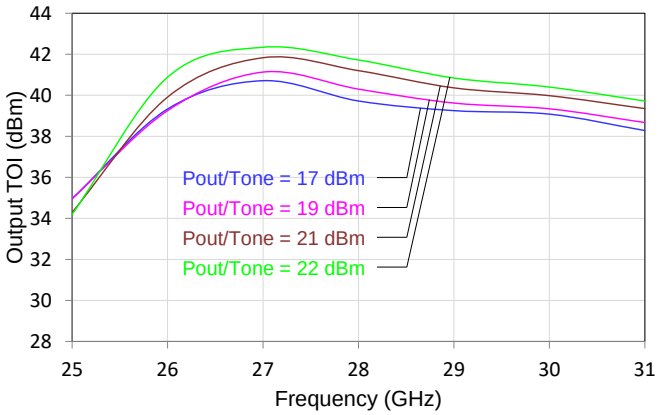

Output TOI vs. Frequency vs. Bias
Vd = 5 - 6 V, Id = 900 - 1300 mA, Vg = -0.58V Typical




Output TOI vs. Frequency
Vd = 6 V, Id = 1100 mA, Vg = -0.58V Typical, 25°C



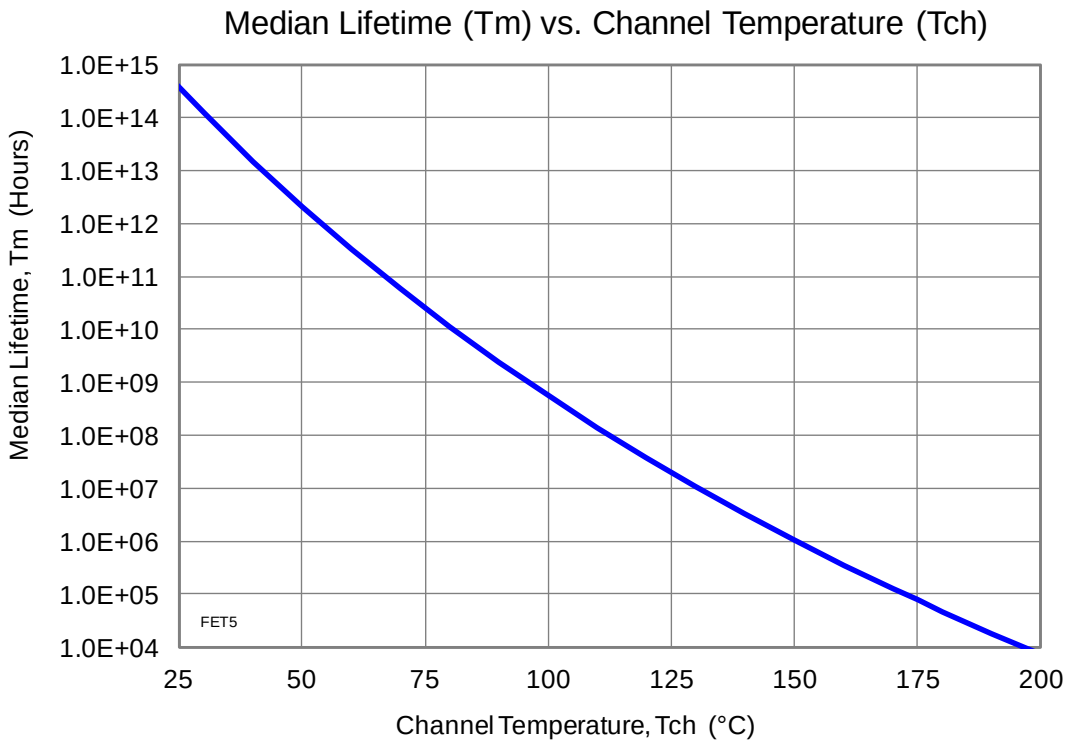

Output TOI vs. Frequency
Vd = 6 V, Id = 1100 mA, Vg = -0.58V Typical, 25°C



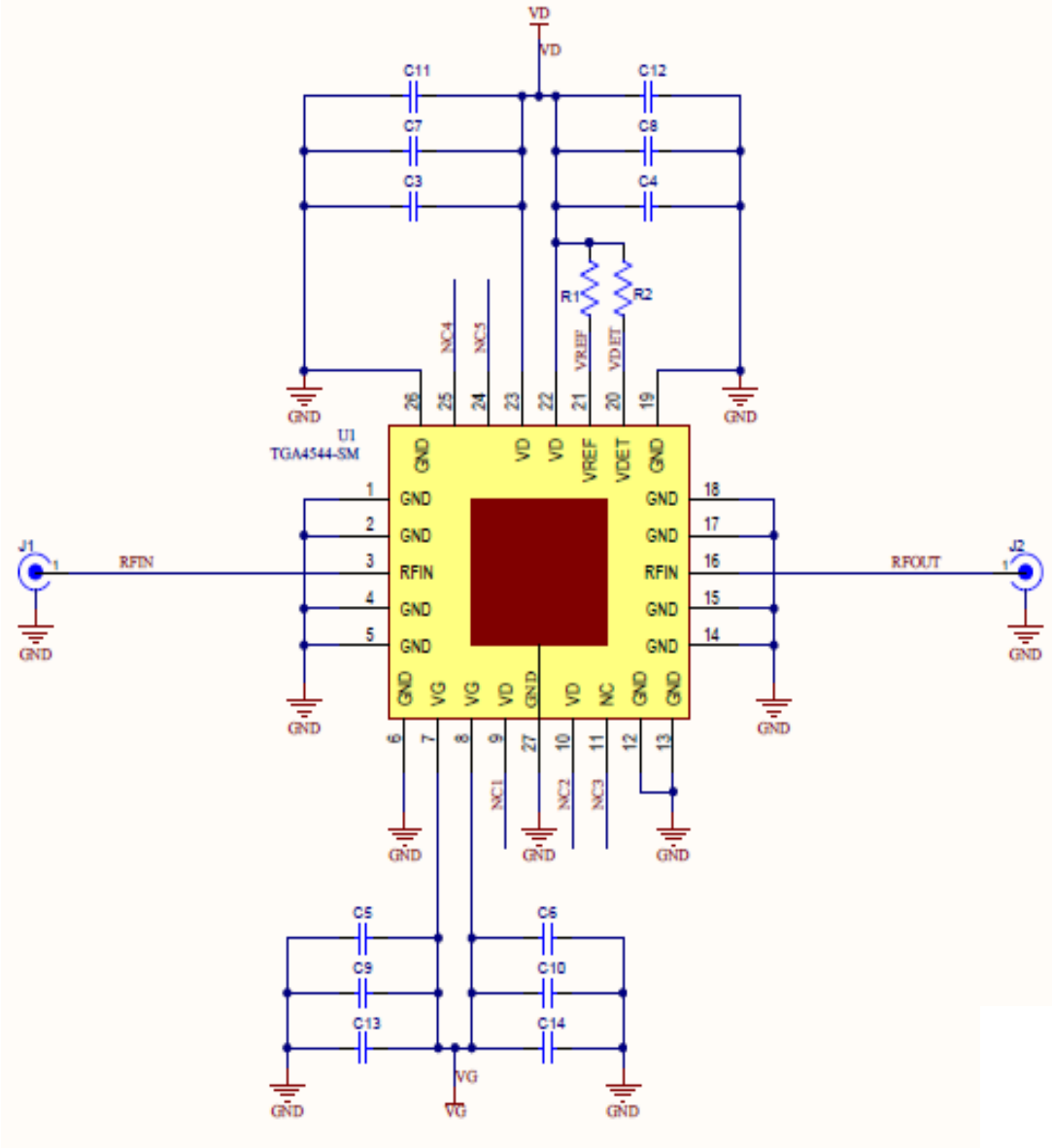
## Thermal and Reliability Information

| Parameter | Test Conditions | Value | Units |
|---|---|---|---|
| Thermal Resistance ($\theta_{JC}$) (1) | $T_{base}$ = 85 °C, $V_D$ = 6 V, $I_{DQ}$ = 1.1 A, $P_{DISS}$ = 6.6 W, No RF (quiescent DC operation) | 10 | ºC/W |
| Channel Temperature, $T_{CH}$ (Under RF) (2) | | 151 | °C |
| Thermal Resistance ($\theta_{JC}$) (1) | $T_{base}$ = 85 °C, $V_D$ = 6 V, $I_{DQ}$ = 1.1 A, Freq = 31 GHz, $I_{D\_Drive}$ = 1.65 A, $P_{IN}$ = 16 dBm, $P_{OUT}$ = 31.7 dBm, $P_{DISS}$ = 8.4 W | 10 | ºC/W |
| Channel Temperature, $T_{CH}$ (Under RF) (2) | | 170 | °C |

Notes:
1. Thermal resistance determined to the back of package, $T_{BASE}$ (85 °C)



## Applications Circuit




Vd, Vg can be biased from either side (top or bottom)

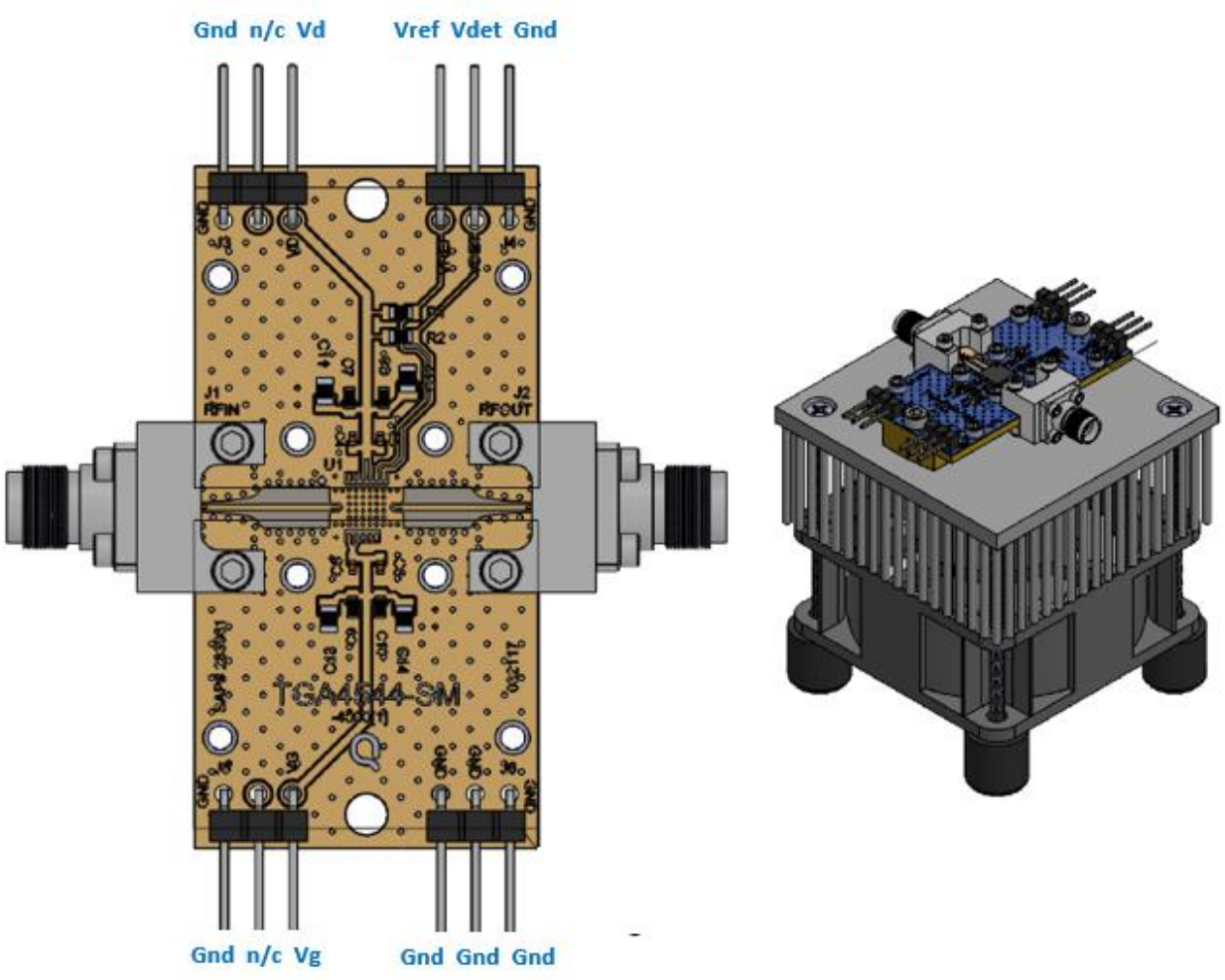
## Bias-Up Procedure

1. Set $I_D$ limit to 2 A, $I_G$ limit to 20 mA
2. Set $V_G$ to −1.5 V
3. Set $V_D$ +6 V
4. Adjust $V_G$ more positive until $I_{DQ}$ = 1.1 A
5. Apply RF signal

## Bias-Down Procedure

1. Turn off RF signal
2. Reduce $V_G$ to −1.5 V. Ensure $I_{DQ}$ ~ 0 mA
4. Set $V_D$ to 0 V
5. Turn off $V_D$ supply
6. Turn off $V_G$ supply

## Evaluation Board (EVB) Layout

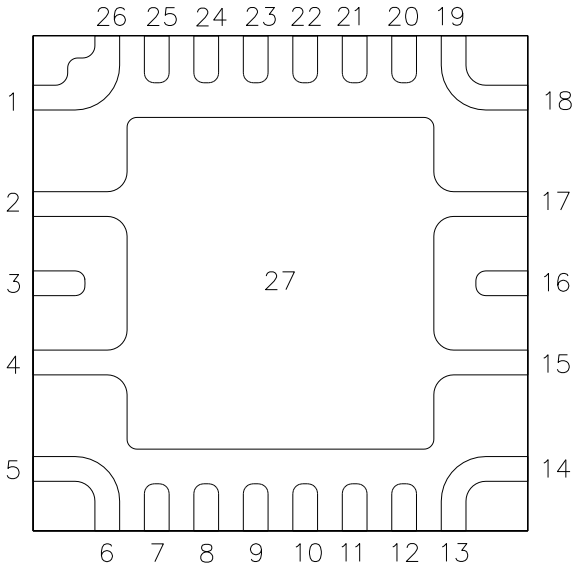



PCB board material is Rogers Corp. 4003 0.008" thickness with ½ oz copper cladding.
For further technical information, refer to the TGA4544-SM Product Information page

## Bill of Materials

| Reference Des. | Value | Description | Manuf. | Part Number |
|---|---|---|---|---|
| U1 | | 26-31 GHz 1 W Power Amplifier | Qorvo | TGA4544-SM |
| C3 – C6 | 100 pF | CAP, 100pF, 5%, 50 V, COG, 0402 | Various | |
| C7 – C10 | 1 uF | CAP, 1 uF, 10%, 50 V, X7R, 0603 | Various | |
| C11 – C14 | 10 µF | CAP, 10 uF, 20%, 25 V, STD, 0803 | Various | |
| R1, R2 | 47.5k Ω | RES, 47.5k, 1%, 1/10W, 0603 | Various | |

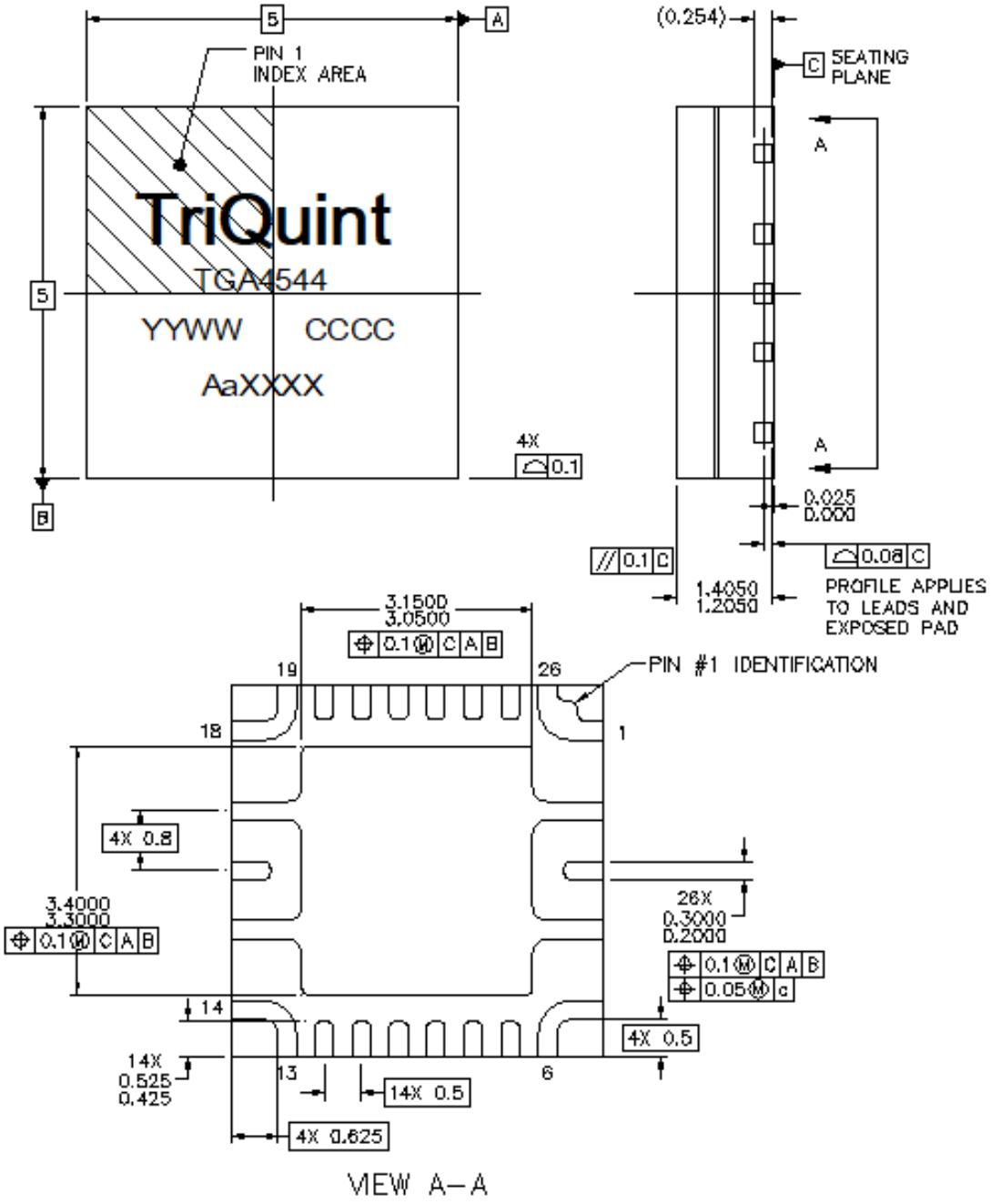
## Pin Description




| Pin No. | Label | Description |
|---|---|---|
| 1, 5, 6, 13 14, 18, 19, 26 | GND | Must be connected to Ground |
| 2, 4, 15, 17 | GND | Backside paddle. Multiple vias should be employed to minimize inductance and thermal resistance; see 'PCB Mounting Pattern' on page 12 for suggested footprint |
| 3 | RF IN | RF input; DC blocked, matched to 50 ohms |
| 7, 25 | VG1 | Stage 1 gate voltage (1) |
| 8, 24 | VG23 | Stage 2 and 3 gate voltage (1) |
| 9, 23 | VD12 | Stage 1 and 2 drain voltage (1) |
| 10, 22 | VD3 | Stage 3 drain voltage (1) |
| 11 | NC | No internal connection; recommend to be grounded on the PCB |
| 12 | GND | Internally connected to GND; recommend to be grounded on the PCB |
| 16 | RF OUT | RF output; DC blocked, matched to 50 ohms |
| 20 | VDET | Detector diode output voltage. Varies with RF output power |
| 21 | VREF | Reference diode output voltage |

(1) Bias bypass network is required; see 'Application Circuit' on page 8 as an example.

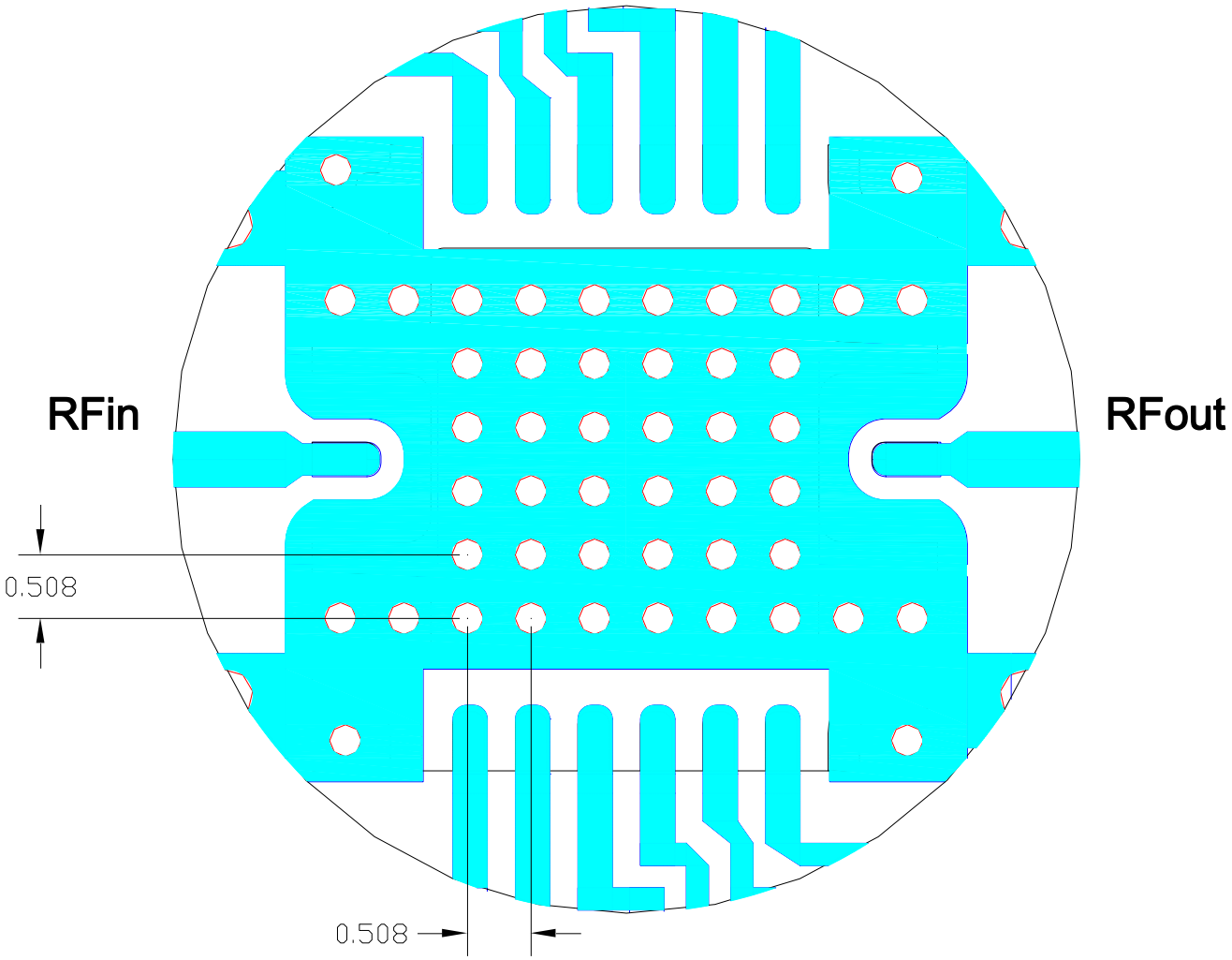
## Mechanical Information




The TGA4544-SM will be marked with the “YYWW” 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, the “CCCC” is the country code, the “Aa” is the vendor, and the “XXXX” is the last 4 digit of lot number.

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 process.

## PCB Mounting Pattern

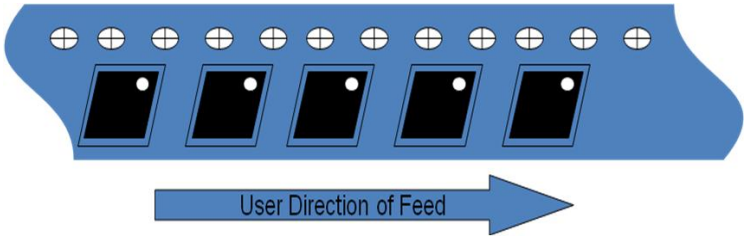



Notes:

1. 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.
2. Ground vias are critical for the proper performance of this device. Vias have a final plated thru diameter of .25 mm (.010”).

## Tape and Reel

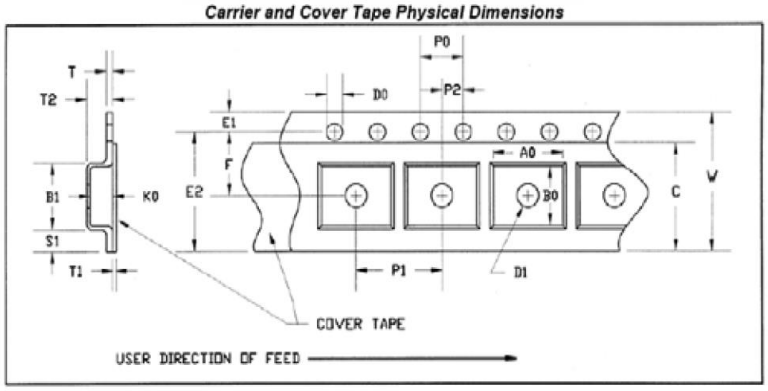
Standard T/R size = 200 pieces on a 7” reel
Vendor: Tek-Pak P/N QFN0500x0500F-L500




## CARRIER AND COVER TAPE DIMENSIONS

| Part | Feature | Symbol | Size (in) | Size (mm) |
|---|---|---|---|---|
| Cavity | Length | A0 | 0.209 | 5.3 |
| | Width | B0 | 0.209 | 5.3 |
| | Depth | K0 | 0.064 | 1.65 |
| | Pitch | P1 | 0.315 | 8.00 |
| Cover Tape | Width | C | 0.362 | 9.2 |
| Carrier Tape | Width | W | 0.472 | 12.00 |

*Carrier and Cover Tape Physical Dimensions*



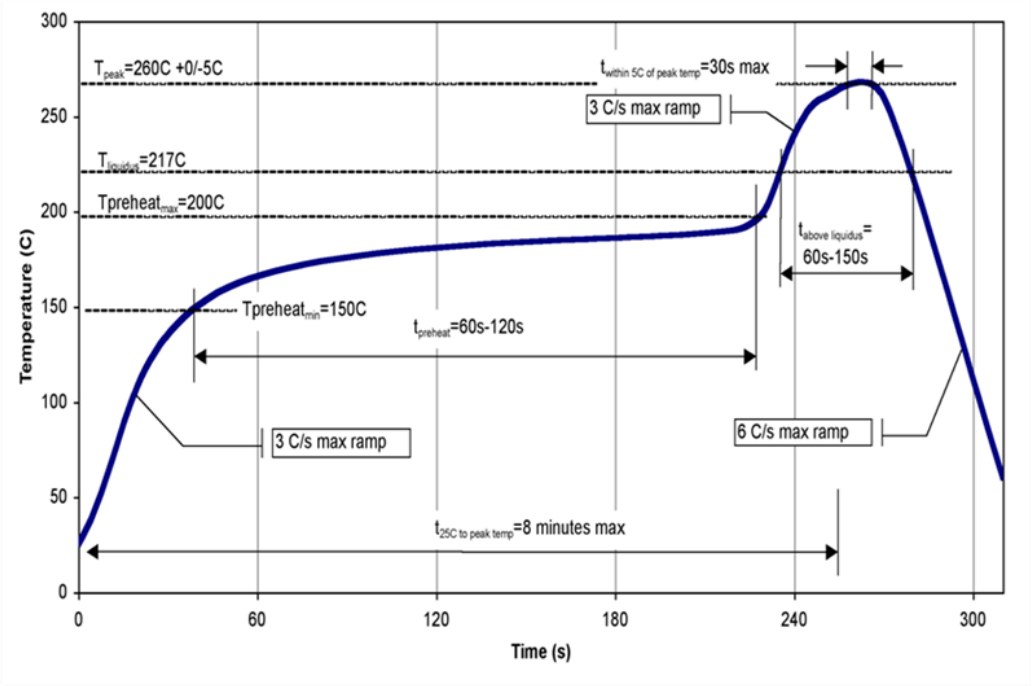
## Assembly Notes

Compatible with lead-free soldering processes with 260°C peak reflow temperature.

This package is air-cavity and non-hermetic, and therefore cannot be subjected to aqueous washing. The use of no-clean solder to avoid washing after soldering is highly recommended.

Contact plating: NiPdAu

Solder rework not recommended



## Handling Precautions

| Parameter | Rating | Standard |
|---|---|---|
| ESD – Human Body Model (HBM) | 1A | ESDA / JEDEC JS-001-2012 |
| MSL – Convection Reflow 260 °C | 3 | JEDEC standard IPC/JEDEC J-STD-020 |

Caution!

ESD-Sensitive Device

## RoHS Compliance

This product is compliant with the 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment), as amended by Directive 2015/863/EU. 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
- SVHC Free

## Contact Information

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

**Tel: 1-844-890-8163**

**Web: www.qorvo.com**

**Email: customer.support@qorvo.com**

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