# TGA2760-SM

## 10 – 11.7 GHz Power Amplifier

## Product Overview

Qorvo's TGA2760-SM is a packaged X-band high power amplifier utilizing Qorvo's production GaAs pHEMT and GaN processes. The TGA2760-SM operates from 10 – 11.7 GHz and typically provides 16W saturated power with power-added efficiency of 36% and large signal gain 30 dB. Third-order intermodulation is better than -30 dBc at 3 dB backed off from Psat. Along with the higher performance, an additional feature is an integrated power detector allowing the user to accurately monitor the output power of the unit.

The TGA2760-SM is packaged in a small air-cavity surface mount package and matched to 50 ohms with integrated DC blocking capacitors on both RF I/O ports simplifying system integration.

Lead-free and RoHS compliant.

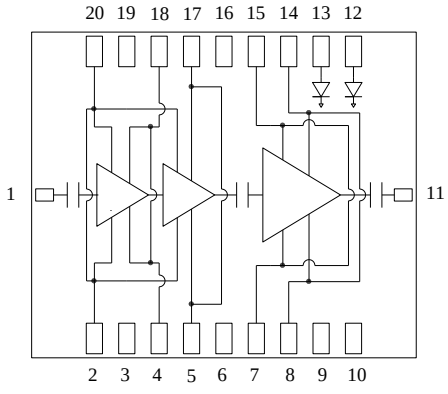

20-Lead 8.0 x 10.0 x 2 mm Package

## Key Features

- Frequency Range: 10 – 11.7 GHz
- Power: +42 dBm Psat
- Gain: 33 dB
- Integrated Power Detector
- Bias: $V_{D1} = V_{D2} = +7$ V, $I_{D1} + I_{D2} = 1000$ mA, $V_{D3} = +28$ V, $I_{D3} = 260$ mA
- Package Dimensions: 8.0 x 10.0 x 2 mm

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

## Functional Block Diagram




Top View

## Applications

- Point-to-Point Radio

## Ordering Information

| Part No. | Description |
|---|---|
| TGA2760-SM | 10 – 11.7 GHz Power Amplifier |
| TGA2760-SM-T/R | 500 pieces on a 7" reel (standard) |
| TGA2760-SM EVB | Evaluation Board |

## Absolute Maximum Ratings

| Parameter | Rating |
|---|---|
| Drain Voltage, $V_{D1}$, $V_{D2}$ | +9 V |
| Drain Voltage, $V_{D3}$ | +32 V |
| Drain Current, $I_{D1}$ + $I_{D2}$ | 3850 mA |
| Drain Current, $I_{D3}$ | 2000 mA |
| Power Dissipation, Driver Stages, $P_{DISS}$ | 14.8 W |
| Power Dissipation, Final Stage, $P_{DISS}$ | 28.8 W |
| RF Input Power, CW, 50 Ω, T = 25 °C | +29 dBm |
| Mounting Temperature (30 Seconds) | 260 °C |
| Storage Temperature | −40 to 150 °C |

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability.

## Recommended Operating Conditions

| Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|
| Operating Temp. Range | −40 | +25 | +85 | °C |
| $V_{D1}$, $V_{D2}$ | | +7 | | V |
| $V_{D3}$ | | +28 | | V |
| $I_{D1}$ + $I_{D2}$ | | 1000 | | mA |
| $I_{D3}$ | | 260 | | mA |
| $V_{G12}$ | | −0.7 | | V |
| $V_{G3}$ | | −2.6 | | V |
| $I_{D1}$ + $I_{D2}$ drive (at +39 dBm Pout) | | 1018 | | mA |
| $I_{D3}$ drive (at +39 dBm Pout) | | 930 | | mA |

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

## Electrical Specifications

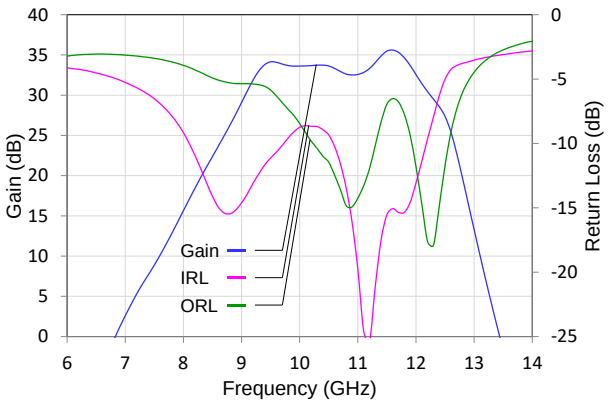
| Parameter | Conditions (1) | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| RF Frequency Range | | 10 | | 11.7 | GHz |
| Small Signal Gain | | 27 | 33 | | dB |
| Input Return Loss, IRL | | | 8 | | dB |
| Output Return Loss, ORL | | | 8 | | dB |
| Output Power at Pin = +12 dBm | | +39.5 | +42 | | dBm |
| Power Added Efficiency | | | 36 | | % |
| Output Third Order Intercept, TOI @ 30 dBm/Tone | | | +52 | | dBm |
| Gain Temperature Coefficient | | | −0.05 | | dB / °C |
| Power Temperature Coefficient | | | −0.01 | | dBm / °C |

Notes:
1. Test conditions unless otherwise noted: $V_{D1} = V_{D2} = +7$ V, $I_{D1} + I_{D2} = 1000$ mA, $V_{G1} = V_{G2} = -0.7$ V, $V_{D3-} = +28$ V, $I_{D3} = 260$ mA, $V_{G3} = -2.6$ V, Temp = +25 °C, $Z_0 = 50$ Ω

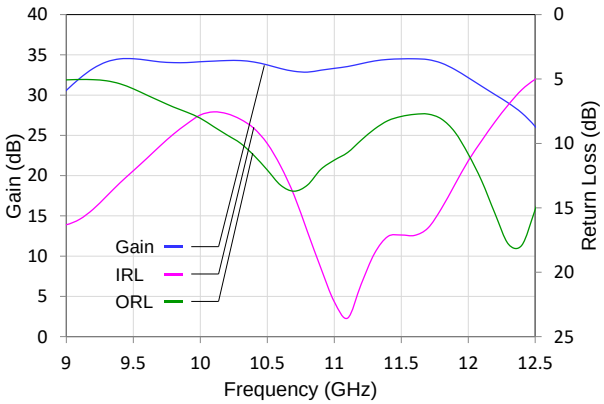
## Performance Plots

Test conditions unless otherwise noted: $V_{D1} = V_{D2} = +7$ V, $I_{D1} + I_{D2} = 1000$ mA, $V_{G1} = V_{G2} = -0.7$ V, $V_{D3-} = +28$ V, $I_{D3} = 260$ mA, $V_{G3} = -2.6$ V, Temp = +25 °C, $Z_0 = 50\ \Omega$

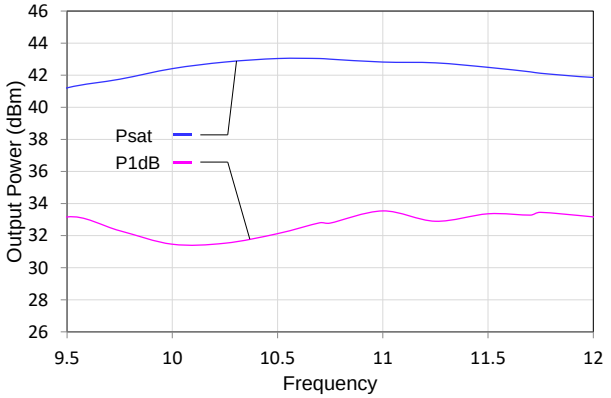
S-Parameter vs. Frequency



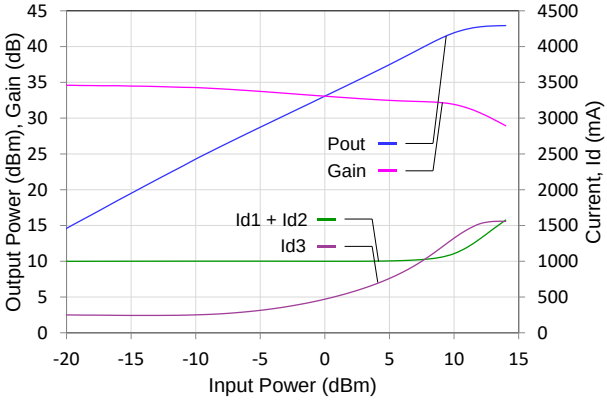

S-Parameter vs. Frequency




Output Power vs. Frequency

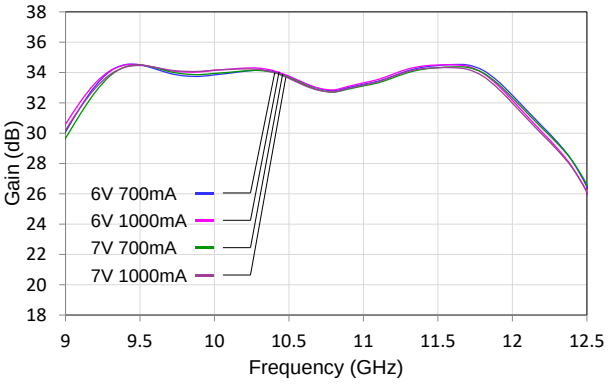



Pout, Gain, Id vs. Pin @ 10.5 GHz



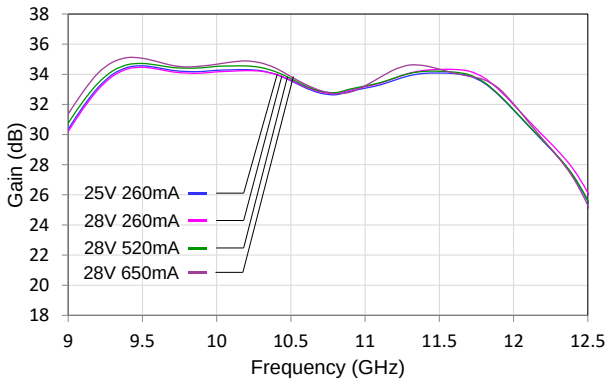

Gain vs. Frequency vs. Bias (Vd1 and Vd2)

Vd3 = 28 V, Id3 = 260 mA, Vg3 = -2.6 V Typical




Gain vs. Frequency vs. Bias (Vd3)

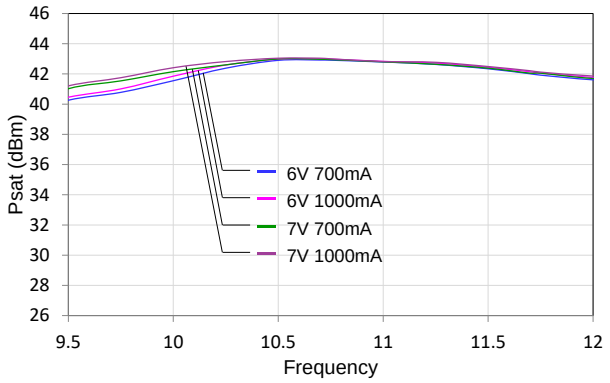
Vd1 = Vd2 = 7 V, Id1 + Id2 = 1000 mA, Vg12 = -0.7 V Typical



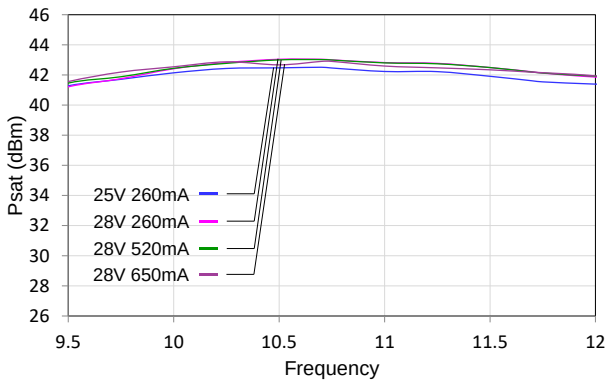
## Performance Plots

Test conditions unless otherwise noted: $V_{D1} = V_{D2} = +7$ V, $I_{D1} + I_{D2} = 1000$ mA, $V_{G1} = V_{G2} = -0.7$ V, $V_{D3} = +28$ V, $I_{D3} = 260$ mA, $V_{G3} = -2.6$ V, Temp = +25 °C, $Z_0 = 50\ \Omega$

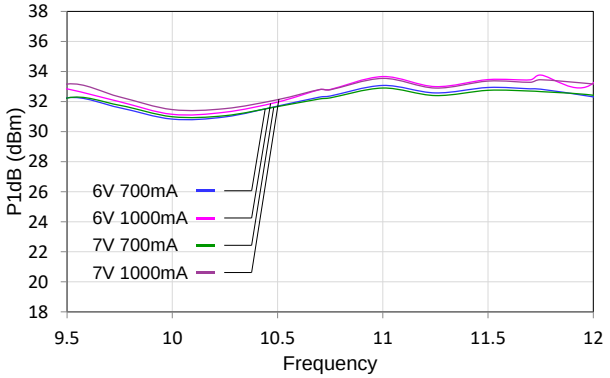
Psat vs. Frequency vs. Bias (Vd1 and Vd2)
Vd3 = 28 V, Id3 = 260 mA, Vg3 = -2.6 V Typical



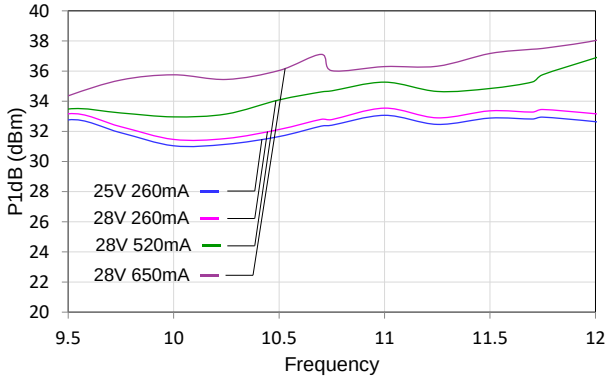

Psat vs. Frequency vs. Bias (Vd3)
Vd1 = Vd2 = 7 V, Id1 + Id2 = 1000 mA, Vg12 = -0.7 V Typical



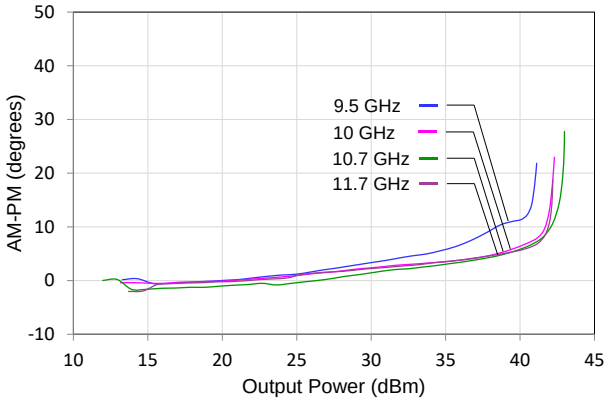

P1dB vs. Frequency vs. Bias (Vd1 and Vd2)
Vd3 = 28 V, Id3 = 260 mA, Vg3 = -2.6 V Typical



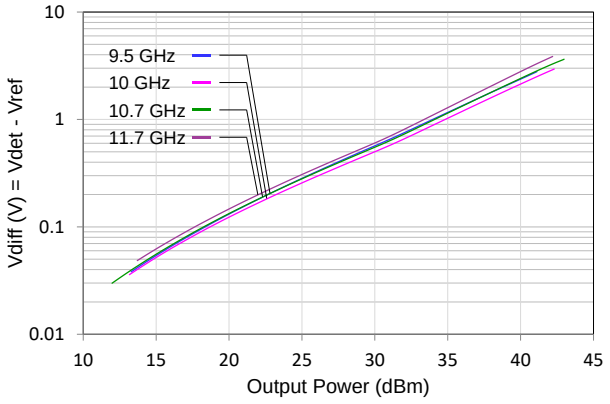

P1dB vs. Frequency vs. Bias (Vd3)
Vd1 = Vd2 = 7 V, Id1 + Id2 = 1000 mA, Vg12 = -0.7 V Typical




AM-PM vs. Pout vs. Frequency



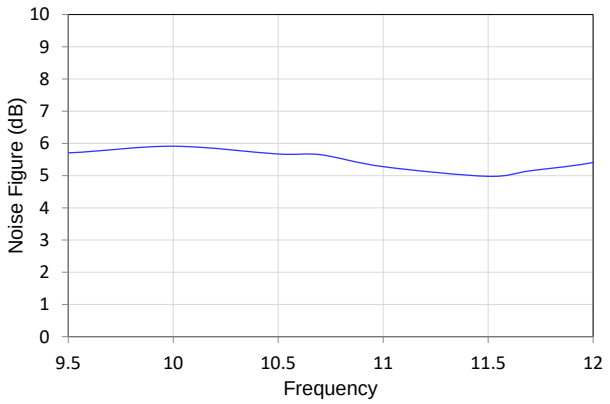

Power Detector vs. Pout vs. Frequency



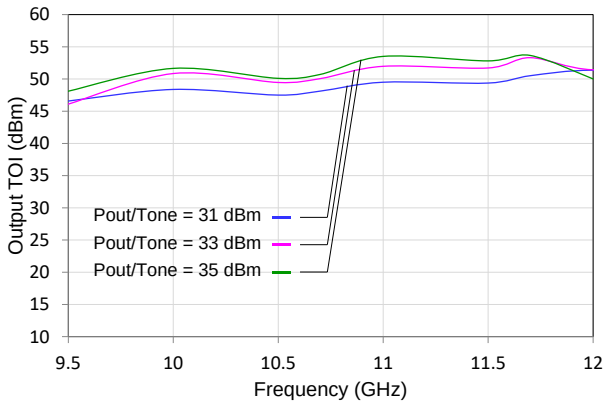
## Performance Plots

Test conditions unless otherwise noted: $V_{D1} = V_{D2} = +7$ V, $I_{D1} + I_{D2} = 1000$ mA, $V_{G1} = V_{G2} = -0.7$ V, $V_{D3} = +28$ V, $I_{D3} = 260$ mA, $V_{G3} = -2.6$ V, Temp = +25 °C, $Z_0 = 50$ Ω

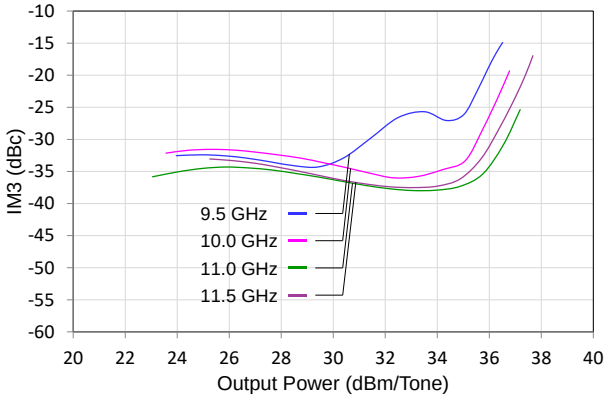
Noise Figure vs. Frequency



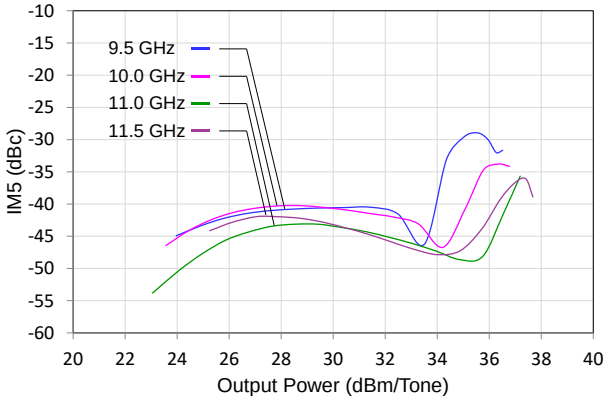

TOI vs. Frequency vs. Pout/Tone




IM3 vs. Pout/Tone vs. Frequency

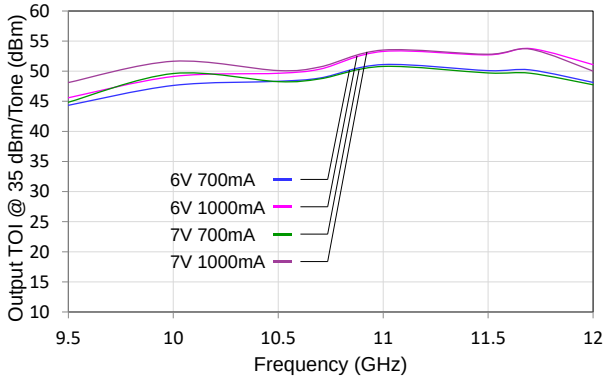



IM5 vs. Pout/Tone vs. Frequency



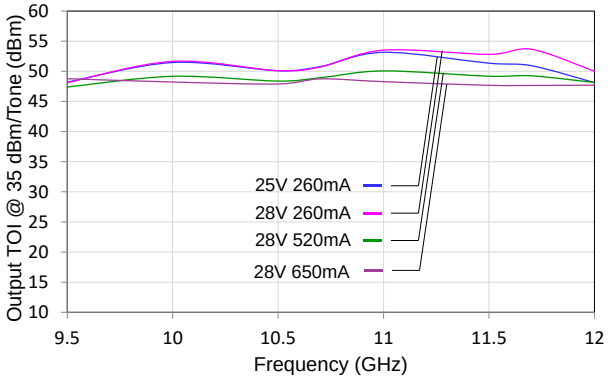

TOI vs. Frequency vs. Bias (Vd1 and Vd2)

Vd3 = 28 V, Id3 = 260 mA, Vg3 = -2.6 V Typical




TOI vs. Frequency vs. Bias (Vd3)

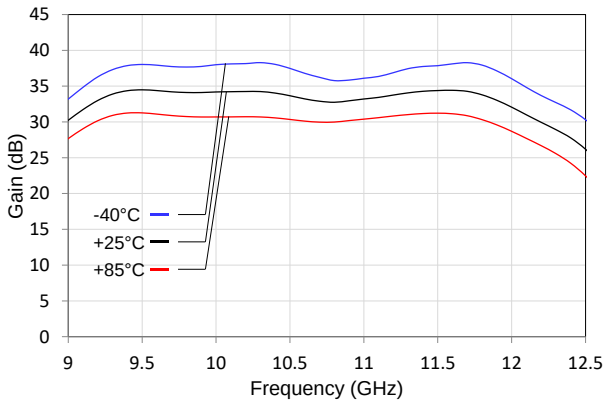
Vd1 = Vd2 = 7 V, Id1 + Id2 = 1000 mA, Vg12 = -0.7 V Typical



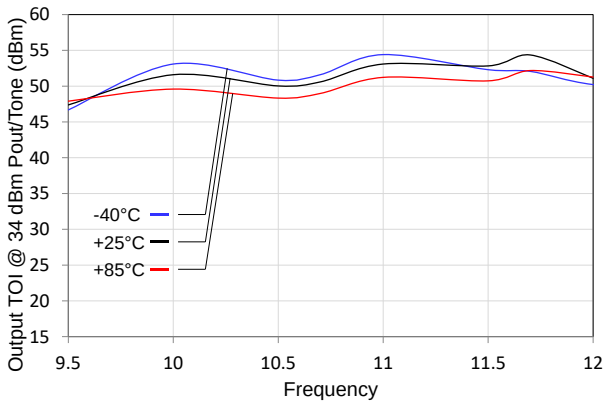
## Performance Plots

Test conditions unless otherwise noted: $V_{D1} = V_{D2} = +7$ V, $I_{D1} + I_{D2} = 1000$ mA, $V_{G1} = V_{G2} = -0.7$ V, $V_{D3} = +28$ V, $I_{D3} = 260$ mA, $V_{G3} = -2.6$ V, Temp = +25 °C, $Z_0 = 50$ Ω

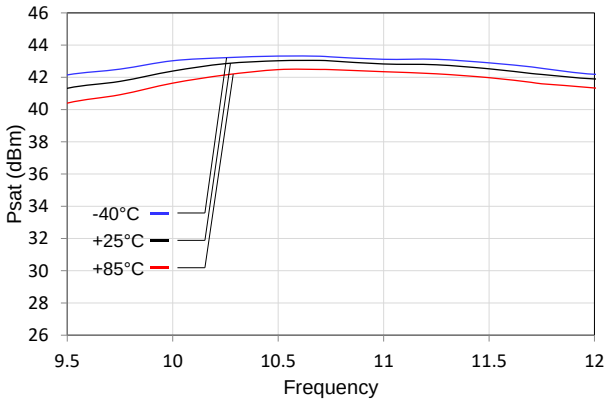
Gain vs. Frequency vs. Temperature



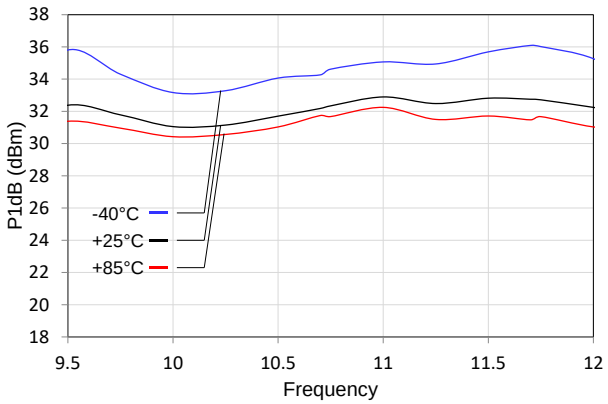

TOI vs. Frequency vs. Temperature



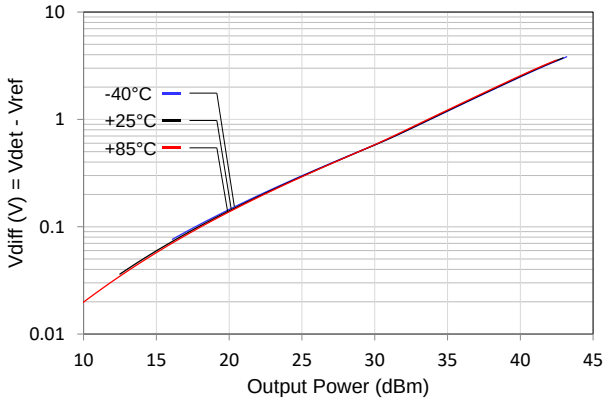

Psat vs. Frequency vs. Temperature




P1dB vs. Frequency vs. Temperature




Power Detector vs. Pout vs. Temperature



## Thermal and Reliability Information (GaAs Driver Stage)

| Parameter | Test Conditions | Value | Units |
|---|---|---|---|
| Thermal Resistance ($\theta_{JC}$) (1) | CW<br>$T_{base}$ = +85 °C, $V_{D\ Driver}$ = +7 V, $I_{D\ Driver}$ = 1000 mA, $P_{DISS}$ = 7.0 W | 8.14 | ºC/W |
| Channel Temperature, $T_{CH}$ | | 142 | °C |
| Median Lifetime ($T_M$) | | $2.0 \times 10^6$ | Hrs |
| Thermal Resistance ($\theta_{JC}$) (1) | CW<br>$T_{base}$ = +85 °C, $V_{D\ Driver}$ = +7 V, $I_{D\ Driver}$ = 1018 mA, $P_{OUT}$ = +39 dBm, $P_{DISS}$ = 7.1 W | 8.17 | ºC/W |
| Channel Temperature, $T_{CH}$ (Under RF) | | 143 | °C |
| Median Lifetime ($T_M$) | | $1.8 \times 10^6$ | Hrs |

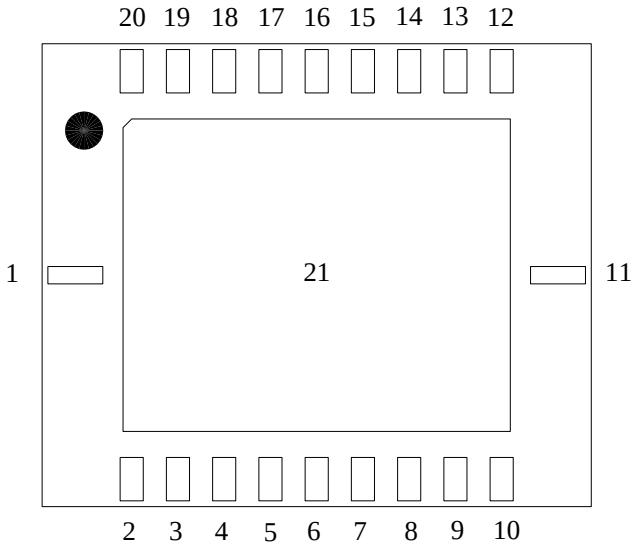
Notes:
1. Thermal resistance measured at back of package.

## Thermal and Reliability Information (GaN Final Stage)

| Parameter | Test Conditions | Value | Units |
|---|---|---|---|
| Thermal Resistance ($\theta_{JC}$) [1] | CW<br>$T_{base}$ = +85 °C, $V_{D\ Driver}$ = +28 V, $I_{D\ Final}$ = 260 mA, $P_{DISS}$ = 7.3 W | 3.42 | ºC/W |
| Channel Temperature, $T_{CH}$ [2] | | 110 | °C |
| Thermal Resistance ($\theta_{JC}$) [1] | CW<br>$T_{base}$ = +85 °C, $V_{D\ Driver}$ = +28 V, $I_{D\ Final}$ = 930 mA, $P_{OUT}$ = +39 dBm, $P_{DISS}$ = 18 W | 3.44 | ºC/W |
| Channel Temperature, $T_{CH}$ (Under RF) [2] | | 147 | °C |

Notes:
1. Thermal resistance measured at back of package.
2. IR scan equivalent. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

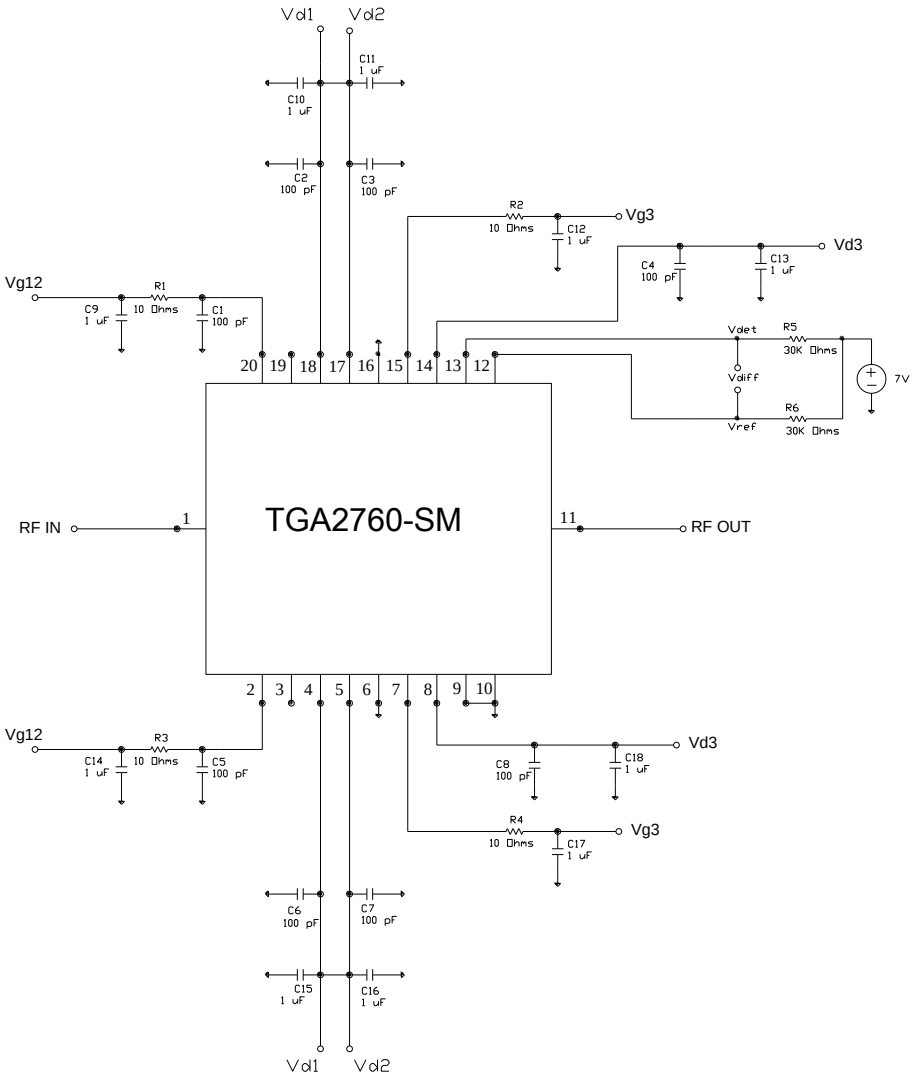
## Pin Configuration and Description




Top View

| Pad No. | Label | Description |
|---|---|---|
| 1 | RF IN | RF Input, matched to 50 Ω, AC Coupled. |
| 2, 20 | $V_{G12}$ | Gate voltage. Bias network is required; can be biased from either pin, and non-biased pin can be left open; see Application Circuit on page 10 as an example. |
| 3, 6, 9, 10, 16, 19 | NC | No internal connection; can be grounded on PCB. |
| 4, 18 | $V_{D1}$ | Drain voltage. Bias network is required; see Application Circuit on page 10 as an example. |
| 5, 17 | $V_{D2}$ | Drain voltage. Bias network is required; see Application Circuit on page 10 as an example. |
| 7, 15 | $V_{G3}$ | Gate voltage. Bias network is required; can be biased from either pin, and non-biased pin can be left opened; see Application Circuit on page 10 as an example. |
| 8, 14 | $V_{D3}$ | Drain voltage. Bias network is required; see Application Circuit on page 10 as an example. |
| 11 | RF OUT | RF Output, matched to 50 ohms, AC Coupled. |
| 12 | $V_{REF}$ | Reference diode output voltage. |
| 13 | $V_{DET}$ | Detector diode output voltage. Varies with RF output power. |
| 21 | GND | Backside Paddle. Multiple vias should be employed to minimize inductance and thermal resistance; see Mounting Configuration on page 13 for suggested footprint. |

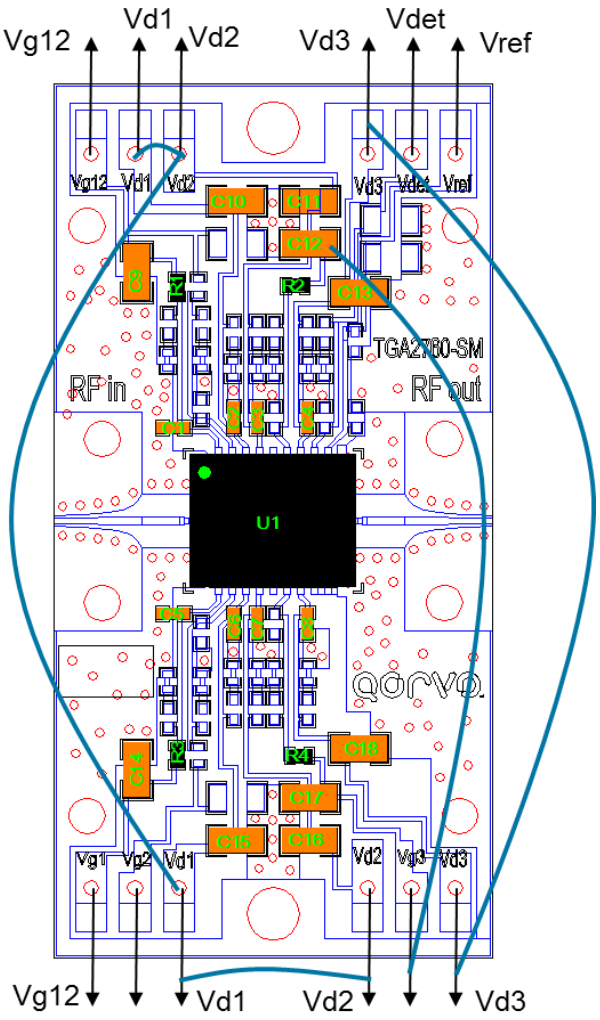
## Application Circuit




$V_{G12}$ can be biased from either side, and the non-biased side can be left open.
$V_{D1}$, $V_{D2}$, $V_{D3}$, must be biased from both sides.

| Bias-up Procedure | Bias-down Procedure |
|---|---|
| $V_{G12}$ set to −1.5 V | Turn off RF signal |
| $V_{G3}$ set to −3.5 V | Reduce $V_{G12}$ to −1.5 V. Ensure $I_D$ ~ 0 mA |
| $V_{D1}$, $V_{D2}$ set to +7 V | Reduce $V_{G3}$ to −3.5 V. Ensure $I_D$ ~ 0 mA |
| $V_{D3}$ sets to +28 V | Turn $V_{D1}$, $V_{D2}$, $V_{D3}$ to 0 V |
| Adjust $V_{G12}$ more positive until quiescent $I_D$ is 1000 mA. This will be ~ $V_G$ = −0.7 V typical | Turn $V_{G12}$, $V_{G3}$ to 0 V |
| Adjust $V_{G3}$ more positive until quiescent $I_D$ is 260 mA. This will be ~ $V_G$ = −2.6 V typical | |
| Apply RF signal | |

## Application Evaluation Board



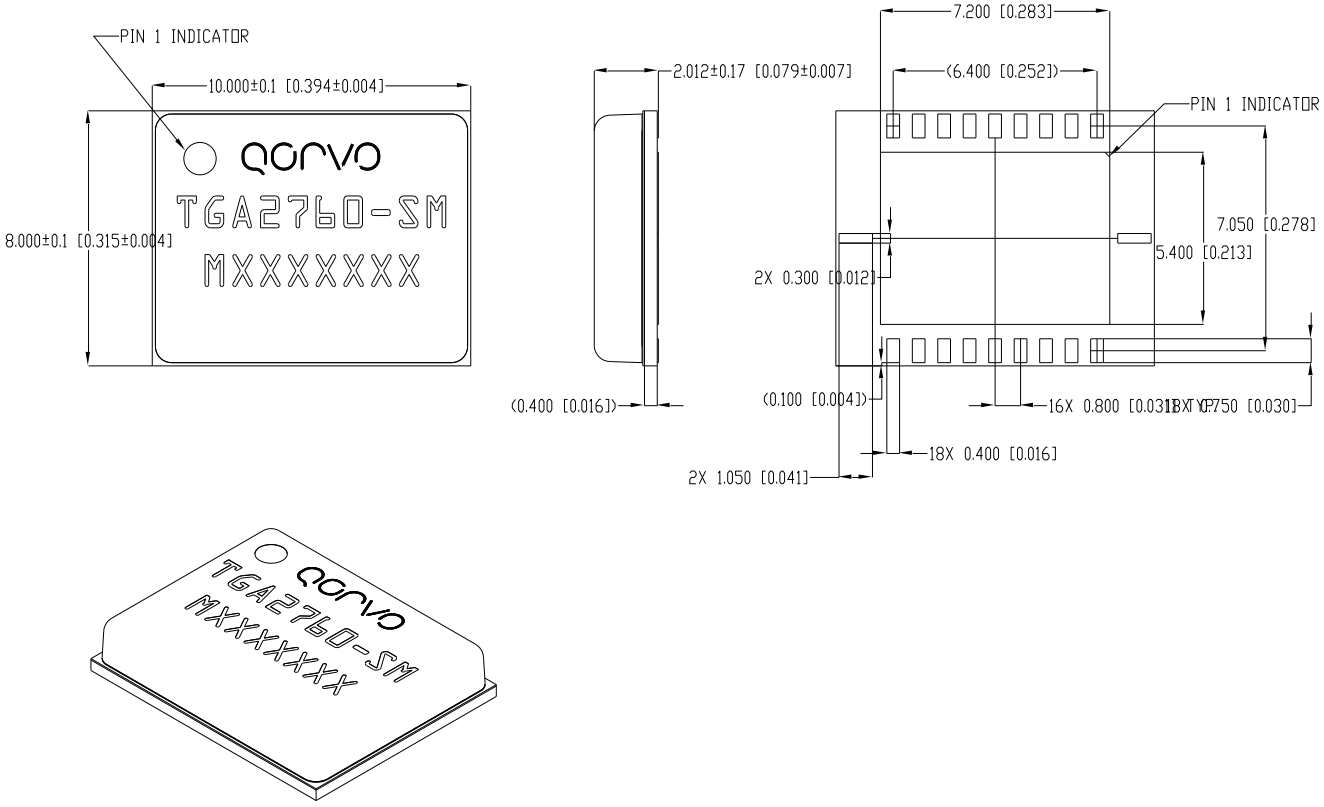

1. Board Material is RO4003 0.008” thickness with ½ oz. copper cladding

## Bill of Material

| Reference Des. | Value | Description | Manuf. | Part Number |
|---|---|---|---|---|
| n/a | n/a | Printed Circuit Board | Qorvo | |
| C1 – C8 | 100 pF | Cap, 0402, +50 V, 5%, COG | various | |
| C9 – C18 | 1 µF | Cap, 0603, +50 V, 5%, X5R | various | |
| R1 – R4 | 10 Ω | Res, 0402, 1/16W, 5%, SMD | various | |
| U1 | | 9.5 – 12 GHz Power Amplifier | Qorvo | TGA2760-SM |

## Package Marking and Dimensions

Marking: Part Number – TGA2760-SM
Lot Code – MXXXXXXX




Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. This package is lead-free/RoHS-compliant with an embedded heat spreader, and the plating material on the leads is NiAu. It is compatible with both lead-free (maximum 260 °C reflow temperature) and tin-lead (maximum 245 °C reflow temperature) soldering processes.

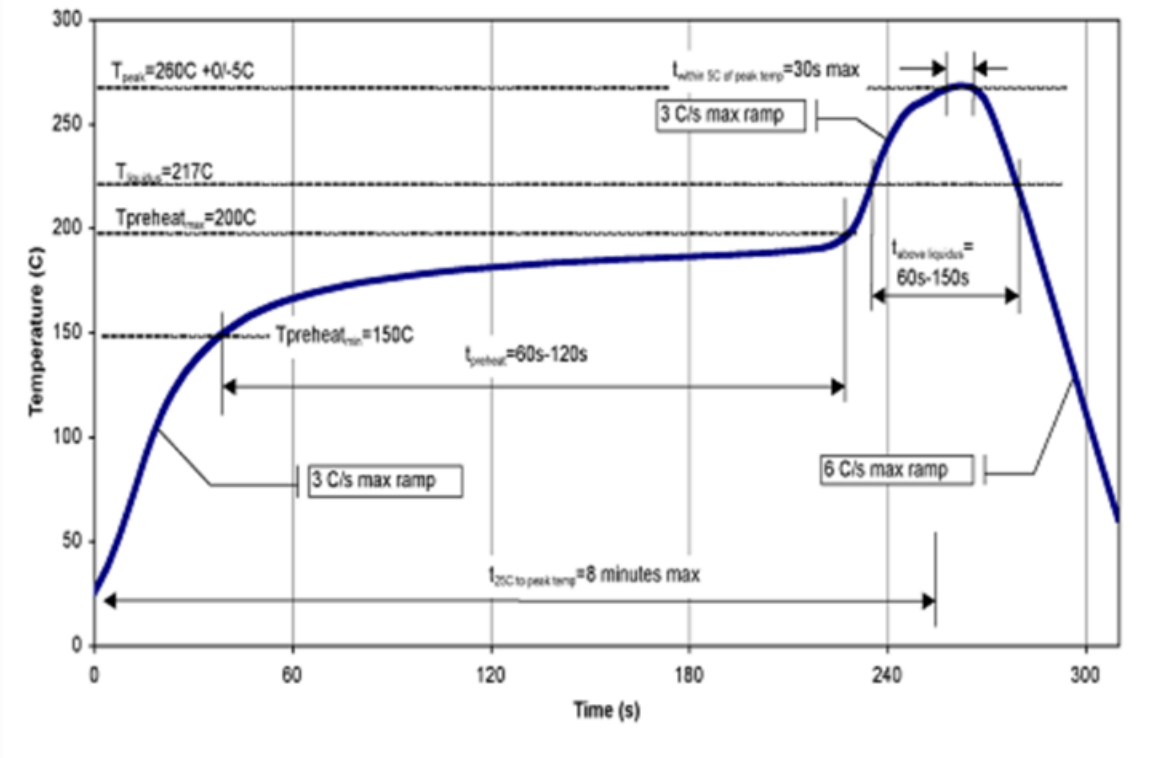
## Assembly Notes

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.

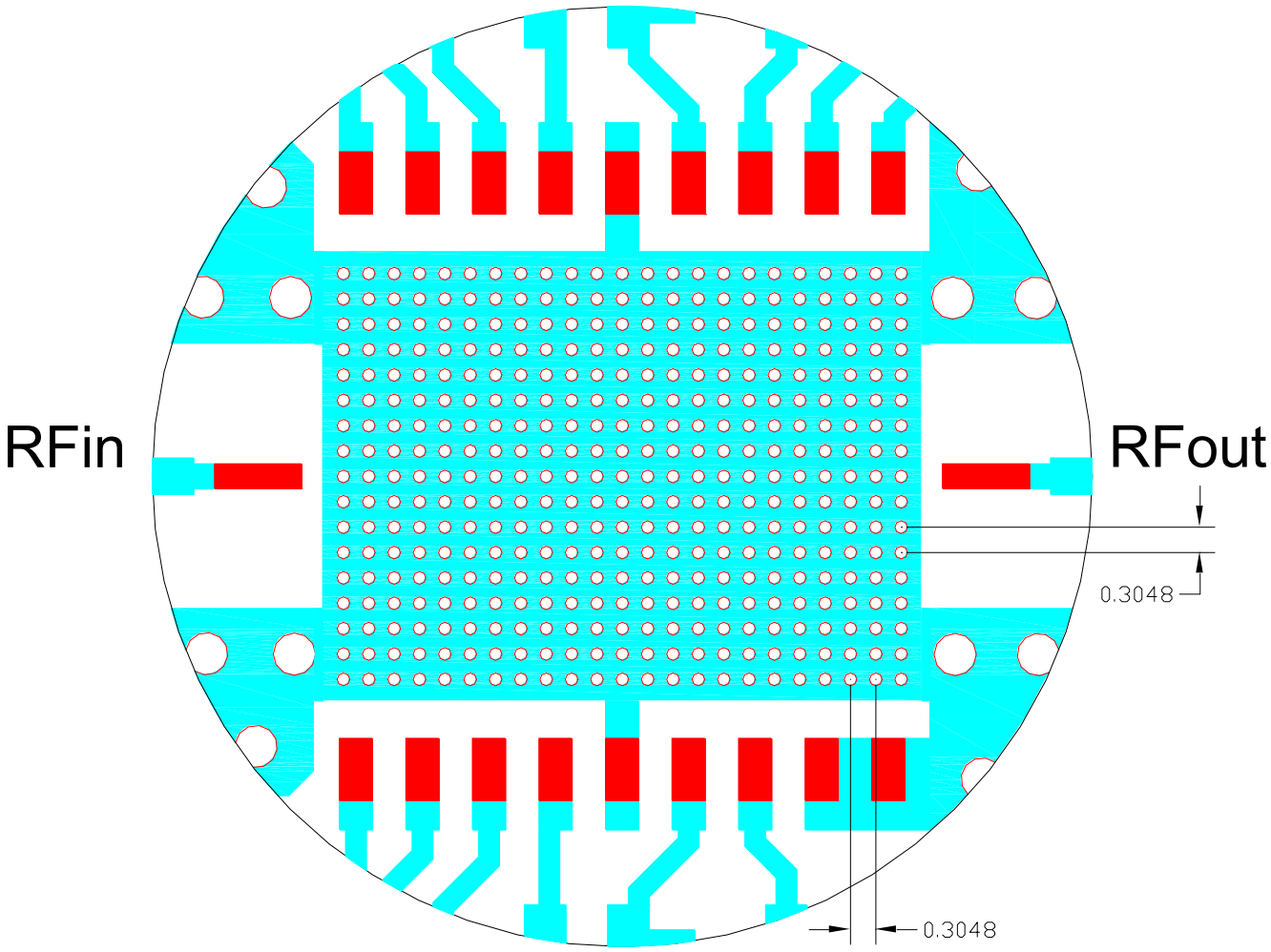
Contact plating: Ni-Au.

Solder rework not recommended.



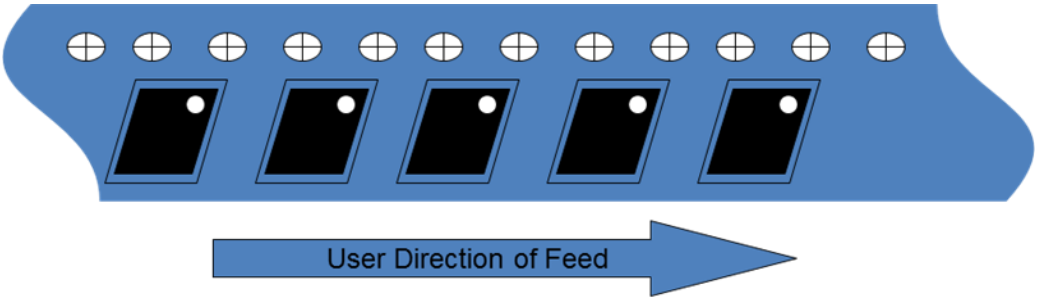

Recommended Soldering Temperature Profile

## PCB Mounting Pattern

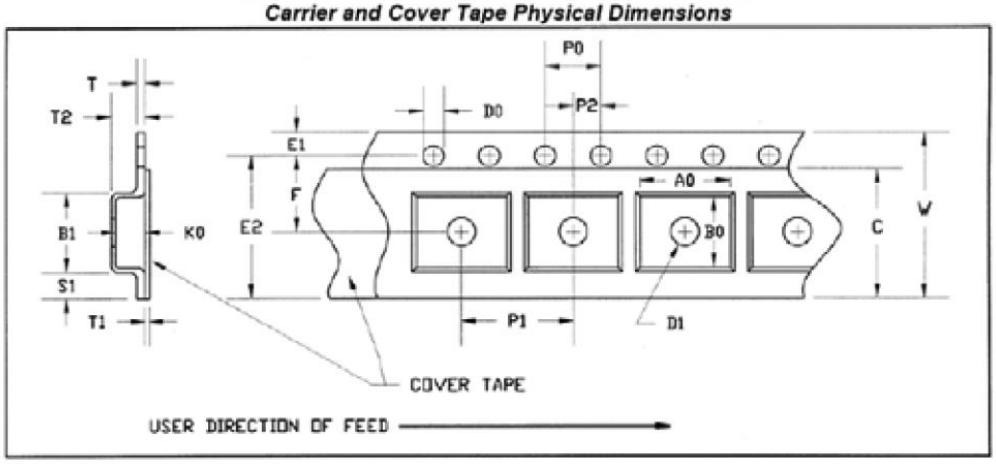



Notes:
1. The pad pattern shown has been developed and tested for optimized assembly at Qorvo. The PCB land pattern has been developed to accommodate lead and package tolerances. Since surface mount processes vary from company to company, careful process development is recommended.
2. Ground vias are critical for the proper performance of this device. Vias should have a final plated thru diameter of .1524 mm (.006").
3. For best thermal performance, vias under the ground paddle should be copper filled.

## Tape and Reel Information




*Carrier and Cover Tape Physical Dimensions*




| Feature | Measure | Symbol | Size (in) | Size (mm) |
|---|---|---|---|---|
| Cavity | Length | A0 | 0.331 | 8.4 |
| | Width | B0 | 0.409 | 10.4 |
| | Depth | K0 | 0.094 | 2.4 |
| | Pitch | P1 | 0.472 | 12.0 |
| Centerline Distance | Cavity to Perforation - Length Direction | P2 | 0.331 | 8.4 |
| | Cavity to Perforation - Width Direction | F | 0.409 | 10.4 |
| Cover Tape | Width | C | 0.472 | 12.0 |
| Carrier Tape | Width | W | 0.945 | 24.0 |