

TQP3M9038

High Linearity LNA Gain Block



Applications

- Repeaters
- Mobile Infrastructure
- Defense/Aerospace
- LTE / WCDMA / EDGE / CDMA
- General Purpose Wireless
- IF amplifier, RF driver amplifier

Product Features

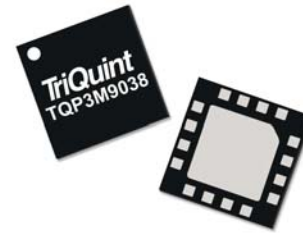
- 50–4000 MHz Operating Range
- Flat gain (14.7 ± 0.3 dB) from 50 to 3500 MHz
- +39.5 dBm Output IP3
- 2 dB Noise Figure at 1900 MHz
- 50 Ω gain block; No RF matching required
- Unconditionally stable
- +5V Single Supply, 85 mA Current
- 3x3mm 16 pin QFN plastic package

General Description

The TQP3M9038 is a cascadable, high linearity gain block amplifier in a low-cost surface-mount package. At a frequency of 1900 MHz, the amplifier typically provides 15 dB gain, +40 dBm OIP3, and 2 dB Noise Figure while only drawing 85 mA current. The device is housed in a lead-free/green /RoHS-compliant QFN Package.

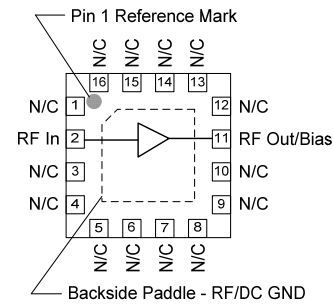
The TQP3M9038 has the benefit of having excellent gain flatness across a broad range of frequencies. The low noise figure and high linearity performance allows the device to be used in both receiver and transmitter chains for high performance systems. The amplifier is internally matched using a high performance E-pHEMT process and only requires an external RF choke and blocking/bypass capacitors for operation from a single +5V supply. The internal active bias circuit also enables stable operation over bias and temperature variations.

The TQP3M9038 covers the 50–4000 MHz frequency band and is targeted for wireless infrastructure or other applications requiring high linearity and/or low noise figure.



3x3 mm 16 Pin QFN Package

Functional Block Diagram



Pin Configuration

| Pin No. | Symbol |
|-----------------|-------------|
| 2 | RF IN |
| 11 | RF OUT/BIAS |
| All other pins | N/C |
| Backside paddle | RF/DC GND |

Ordering Information

| Part No. | Description |
|------------------|-------------------------------|
| TQP3M9038 | High Linearity LNA Gain Block |
| TQP3M9038-PCB_IF | 50–500 MHz Eval. Board |
| TQP3M9038-PCB_RF | 500–4000 MHz Eval. Board |

Standard T/R size = 2500 pieces on a 7" reel.

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Absolute Maximum Ratings

| Parameter | Rating |
|-----------------------------------|---------------|
| Storage Temperature | -65 to +150°C |
| Supply Voltage (V _{DD}) | +7 V |
| RF Input Power, CW, 50Ω, T = 25°C | +23 dBm |
| Reverse Device Voltage | -0.3 V |

Operation of this device outside the parameter ranges given above may cause permanent damage.

Recommended Operating Conditions

| Parameter | Min | Typ | Max | Units |
|--|-------|-----|-------|-------|
| Supply Voltage (V _{DD}) | +4.75 | +5 | +5.25 | V |
| T _{CASE} | -40 | | +85 | °C |
| T _J (for >10 ⁶ hours MTTF) | | | 190 | °C |

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

Electrical Specifications

Test conditions unless otherwise noted: V_{DD} = +5V, Temp = +25°C, 50 Ω system

| Parameter | Conditions | Min | Typ | Max | Units |
|-------------------------------------|---|-------|-------|------|-------|
| Operational Frequency Range | | 50 | | 4000 | MHz |
| Test Frequency | | | 1900 | | MHz |
| Gain | | 13 | 14.9 | 16 | dB |
| Input Return Loss | | | 21 | | dB |
| Output Return Loss | | | 23 | | dB |
| Noise Figure | | | 2 | | dB |
| Output P1dB | | | +21.6 | | dBm |
| Output IP3 | P _{out} =+4 dBm/tone, Δf=1 MHz | +35.5 | +39.5 | | dBm |
| Current, I _{DD} | | | 85 | 100 | μA |
| Thermal Resistance, θ _{jc} | Channel to case | | | 36.6 | °C/W |

Device Characterization Data

S-Parameters

Test conditions unless otherwise noted: V_{DD}=+5 V, I_{DD}=85 mA (typ.), Temp=+25°C, 50 Ohm system

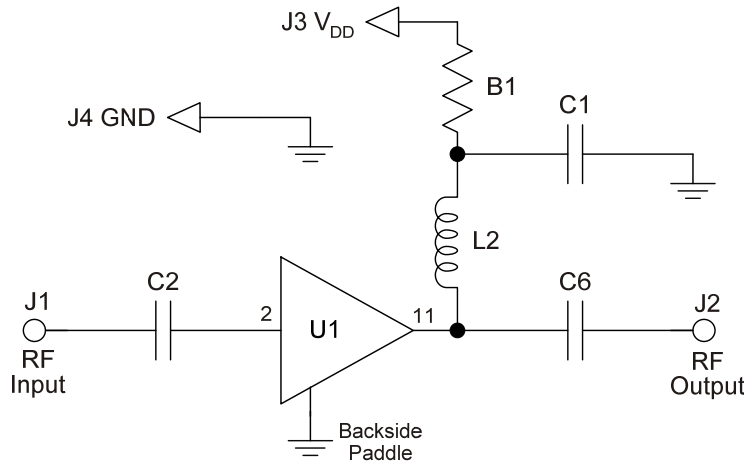
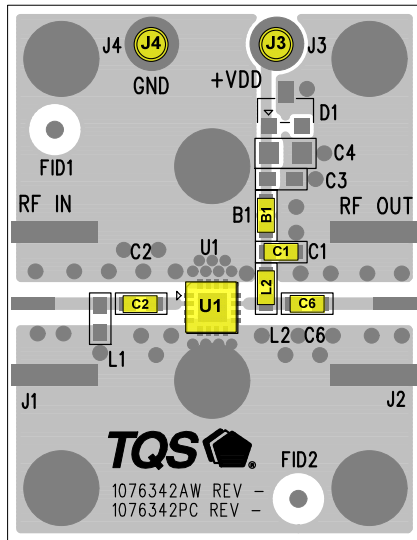
| Freq (MHz) | S11 (dB) | S11 (ang) | S21 (dB) | S21 (ang) | S12 (dB) | S12 (ang) | S22 (dB) | S22 (ang) |
|------------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|
| 10 | -12.2 | -61.9 | 17.7 | 167.0 | -20.6 | 12.1 | -17.9 | -94.7 |
| 20 | -13.5 | -39.4 | 17.2 | 169.7 | -20.4 | 10.0 | -17.5 | -52.1 |
| 50 | -15.9 | -50.9 | 16.4 | 168.8 | -19.6 | 6.6 | -20.1 | -79.8 |
| 100 | -20.7 | -73.2 | 15.9 | 167.6 | -19.1 | 1.7 | -22.8 | -112.9 |
| 200 | -25.5 | -85.5 | 15.5 | 163.8 | -18.9 | -4.6 | -24.8 | -144.3 |
| 500 | -28.6 | -91.1 | 15.4 | 146.9 | -18.8 | -18.2 | -27.2 | -177.2 |
| 900 | -27.0 | -99.7 | 15.3 | 122.7 | -19.0 | -34.2 | -29.8 | 175.9 |
| 1000 | -26.3 | -101.9 | 15.3 | 116.5 | -19.0 | -38.2 | -30.7 | 179.6 |
| 1500 | -23.4 | -117.6 | 15.2 | 85.5 | -19.3 | -58.3 | -28.7 | -137.4 |
| 1900 | -21.9 | -130.7 | 15.1 | 66.6 | -19.5 | -70.6 | -24.6 | -131.1 |
| 2000 | -21.4 | -136.1 | 15.1 | 60.2 | -19.6 | -74.8 | -23.5 | -131.5 |
| 2500 | -21.0 | -141.8 | 15.1 | 53.9 | -19.7 | -79.0 | -22.4 | -132.7 |
| 3000 | -20.6 | -147.7 | 15.0 | 47.5 | -19.8 | -83.2 | -21.4 | -134.4 |
| 3500 | -18.8 | -174.7 | 15.0 | 21.3 | -20.1 | -100.5 | -18.1 | -143.2 |
| 4000 | -17.9 | 170.3 | 15.0 | 7.9 | -20.3 | -109.3 | -16.6 | -149.0 |

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TQP3M9038-PCB_(RF / IF) Evaluation Board



Notes:

1. See Evaluation Board PCB Information section for material and stack-up.
2. Package pins 3 through 9 and 13 through 16 are grounded for PCB mounting integrity and optimal isolation.
3. B1 (0 Ω jumper) may be replaced with copper trace in the target application layout.
4. The recommended component values are dependent upon the frequency of operation.
5. All components are 0603 size unless stated on the schematic.

Bill of Material - TQP3M9038-PCB_(RF / IF)

| Reference Designation | TQP3M9038-PCB_IF 50–500 MHz | TQP3M9038-PCB_RF 500–4000 MHz |
|-----------------------|--------------------------------|----------------------------------|
| Q1 | TQP3M9038 | |
| C2, C6 | 1000 pF | 100 pF |
| C1 | 0.01 uF | 0.01 uF |
| L2 | 330 nH | 68 nH |
| L1, D1, C3, C4 | Do Not Place | |
| B1 | 0 Ω | |

Performance may be further optimized at frequency of interest by using recommended component values given below.

| Reference Designation | 500 MHz | 2000 MHz | 2500 MHz | 3500 MHz |
|-----------------------|---------|----------|----------|----------|
| C2, C6 | 100 pF | 22 pF | 22 pF | 22 pF |
| L2 | 82 nH | 22 nH | 18 nH | 15 nH |

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Typical Performance - TQP3M9038-PCB_RF

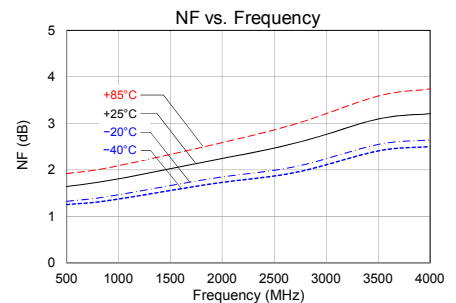
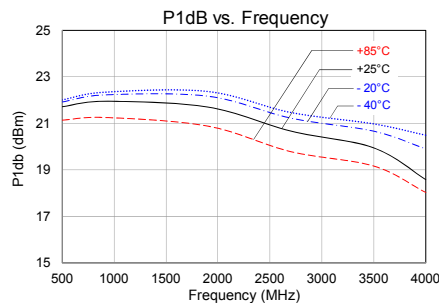
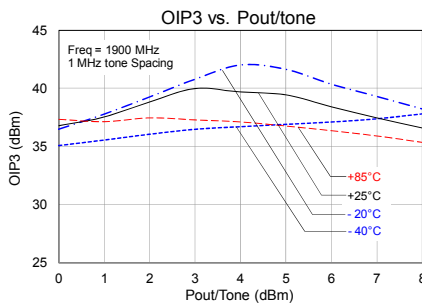
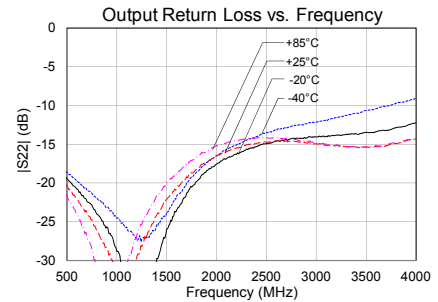
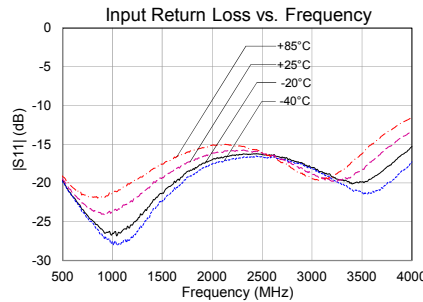
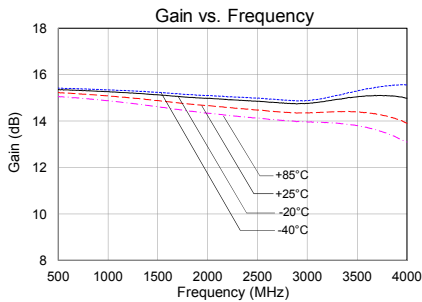
Test conditions unless otherwise noted: $V_{DD} = +5V$, $I_{DD} = +85\text{ mA (typ.)}$, $Temp = +25^{\circ}C$

| Parameter | Typical Performance | | | | | | Units |
|-----------------------------|---------------------|-------|-------|-------|-------|-------|-------|
| Frequency | 500 | 900 | 1900 | 2700 | 3500 | 4000 | MHz |
| Gain | 15.2 | 15.1 | 14.9 | 14.5 | 14.5 | 14.5 | dB |
| Input Return Loss | -19.2 | -24.0 | -20.9 | -13.7 | -14.5 | -16.1 | dB |
| Output Return Loss | -17.9 | -20.0 | -22.6 | -12.8 | -11.3 | -12.0 | dB |
| Output P1dB | +21.7 | +21.9 | +21.6 | +20.6 | +19.8 | +18.5 | dBm |
| OIP3 ⁽¹⁾ | +41.1 | +41.4 | +39.5 | +38.0 | +35.3 | +32.3 | dBm |
| Noise Figure ⁽²⁾ | 1.7 | 1.8 | 1.9 | 2.2 | 2.8 | 3.0 | dB |

Notes:

- OIP3 measured with two tones at an output power of +4 dBm / tone separated by 1 MHz.
- Noise figure data shown in the table above includes board losses of 0.1dB @ 2000 MHz.

Performance Plots - TQP3M9038-PCB_RF



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Typical Performance - TQP3M9038-PCB_IF

Test conditions unless otherwise noted: $V_{DD} = +5V$, $I_{DD} = +85 \text{ mA (typ.)}$, $Temp = +25^\circ C$

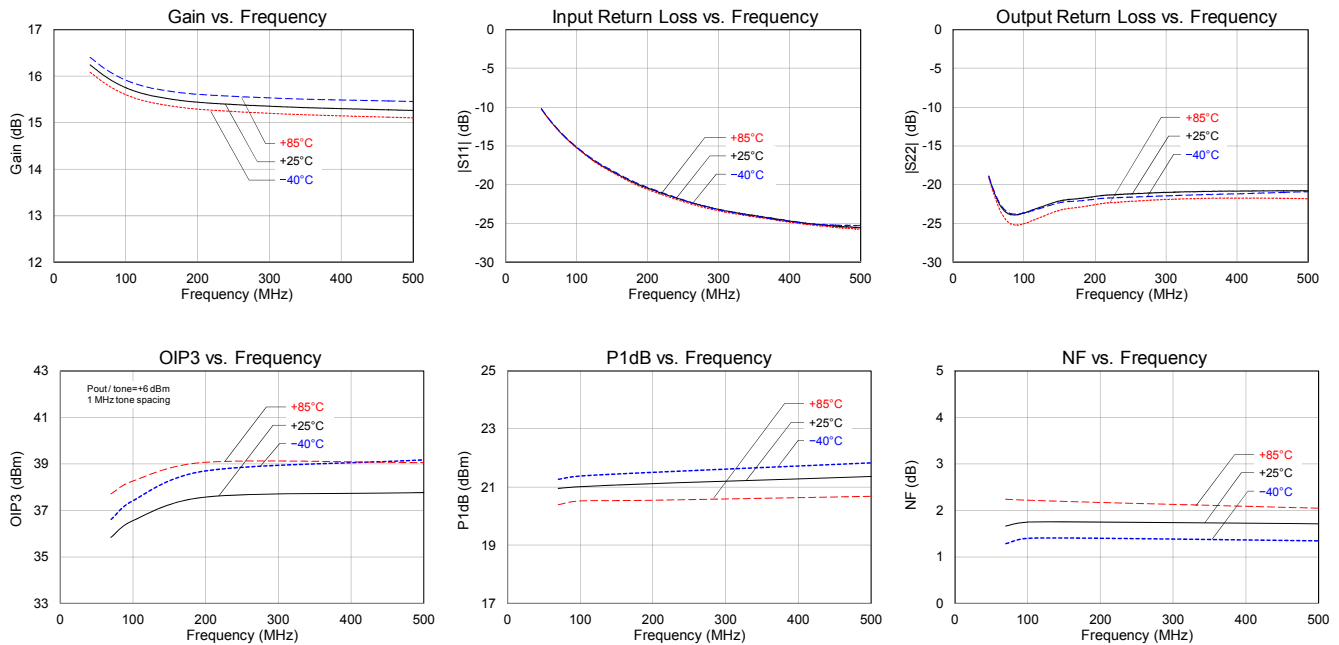
| Parameter | Typical Performance | | | | Units |
|-----------------------------|---------------------|-------|-------|-------|-------|
| Frequency | 70 | 100 | 200 | 500 | MHz |
| Gain | 15.9 | 15.7 | 15.4 | 15.2 | dB |
| Input Return Loss | -12.3 | -15.0 | -20.4 | -26.4 | dB |
| Output Return Loss | -23.0 | -24.5 | -22.4 | -21.4 | dB |
| Output P1dB | +20.9 | +21.0 | +21.0 | +21.3 | dBm |
| OIP3 ⁽¹⁾ | +39.5 | +39.7 | +40.7 | +40.0 | dBm |
| Noise Figure ⁽²⁾ | 1.65 | 1.75 | 1.75 | 1.70 | dB |

Notes:

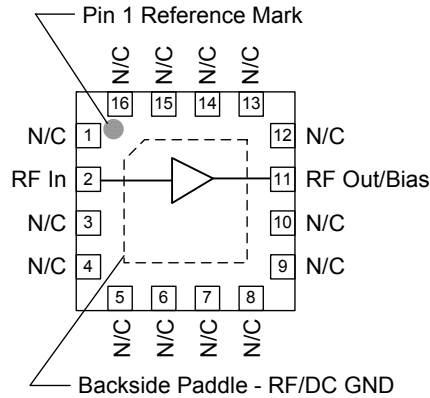
- OIP3 measured with two tones at an output power of +6 dBm / tone separated by 1 MHz.
- Noise figure data shown in the table above includes board losses.

Performance Plots - TQP3M9038-PCB_IF

Test conditions unless otherwise noted: $V_{DD} = +5V$, $I_{DD} = +85 \text{ mA (typ.)}$,



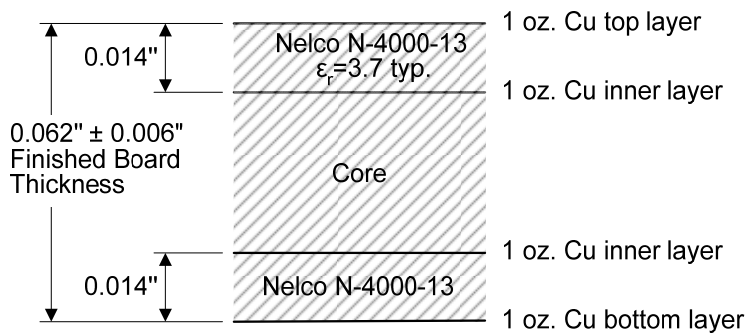
Pin Configuration and Description



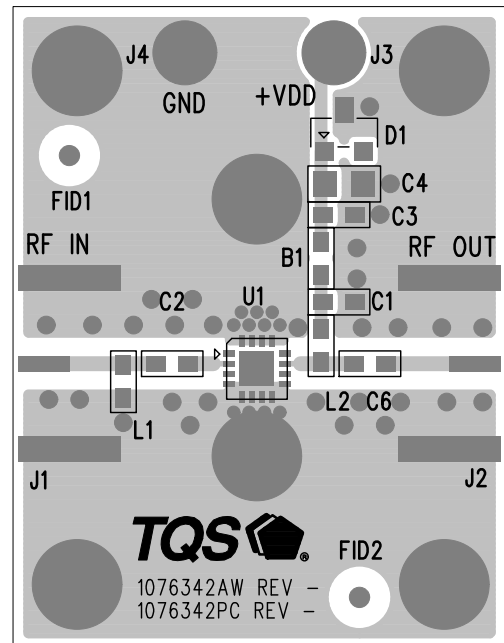
| Pin No. | Symbol | Description |
|-----------------|-------------------|--|
| 2 | RF IN | RF input, matched to 50 ohms. External DC Block is required. |
| 11 | RF OUT DC BIAS | RF output, matched to 50 ohms. Bias voltage and external DC Block are required. |
| All other pins | N/C | No electrical connection. Provide grounded land pads for PCB mounting |
| Backside paddle | RF/DC GND | RF/DC ground. Use recommended via pattern to minimize inductance and thermal resistance; see PCB Mounting Pattern for suggested footprint. |

Evaluation Board PCB Information

TriQuint PCB 1076342 Material and Stack-up



50 ohm line dimensions: width = .031", spacing = .035



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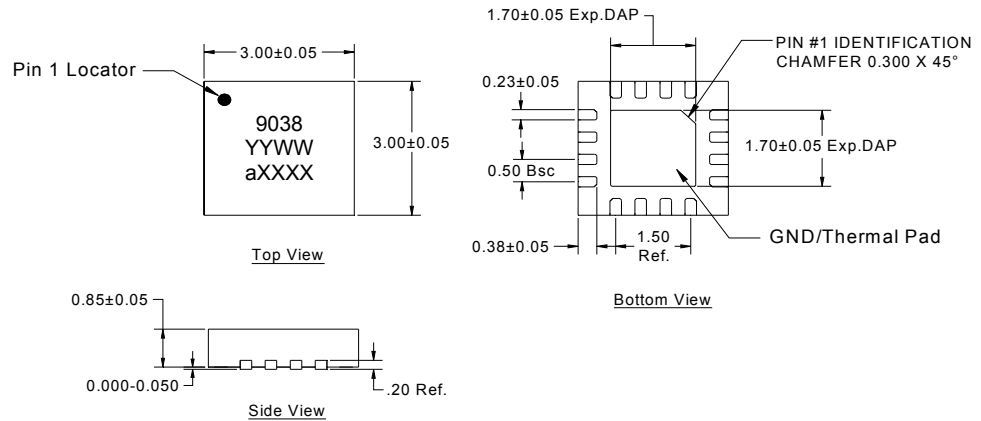
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Mechanical Information

Package Marking and Dimensions

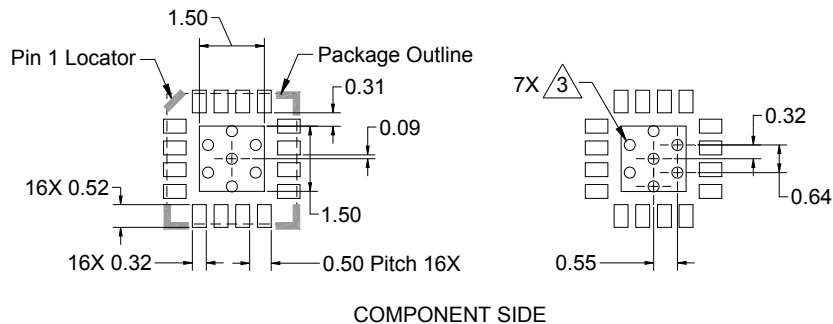
Marking: Part number – 9038
 Date Code – YYWW
 Assembly Code – aXXXX



NOTES:

1. All dimensions are in millimeters. Angles are in degrees.
2. Except where noted, this part outline conforms to JEDEC standard MO-220, Issue E (Variation VGGC) for thermally enhanced plastic very thin fine pitch quad flat no lead package (QFN).
3. Dimension and tolerance formats conform to ASME Y14.4M-1994.
4. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

PCB Mounting Pattern



NOTES:

1. All dimensions are in millimeters. Angles are in degrees.
2. Use 1 oz. copper minimum for top and bottom layer metal.
3. Vias are required under the backside paddle of this device for proper RF/DC grounding and thermal dissipation. We recommend a 0.35mm (#80/.0135") diameter bit for drilling via holes and a final plated thru diameter of 0.25 mm (0.10").
4. Ensure good package backside paddle solder attach for reliable operation and best electrical performance.

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Product Compliance Information

ESD Sensitivity Ratings



Caution! ESD-Sensitive Device

ESD Rating: Class 1A
Value: Passes ≥ 250 V to < 500 V
Test: Human Body Model (HBM)
Standard: JEDEC Standard JESD22-A114

ESD Rating: Class IV
Value: Passes ≥ 1000 V min.
Test: Charged Device Model (CDM)
Standard: JEDEC Standard JESD22-C101

MSL Rating

MSL Rating: Level 1
Test: 260°C convection reflow
Standard: JEDEC Standard IPC/JEDEC J-STD-020

Solderability

Compatible with both lead-free (260°C max. reflow temperature) and tin/lead (245°C max. reflow temperature) soldering processes.

Package contact plating: Annealed Matte Tin

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 (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free

Contact Information

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