

Applications

- Wireless Infrastructure
- LTE / WCDMA / CDMA / EDGE
- PtP IF Gain Control
- General Purpose Wireless

Product Features

- Integrates Amp + VVA + Amp functionality
- 500–2700 MHz Bandwidth
- 38 dB Gain (max gain setting)
- 4.0 dB Noise Figure
- +16 dBm P1dB
- +29 dBm OIP3
- +5V Supply Voltage
- Low Current

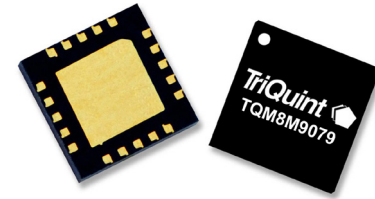
General Description

The TQM8M9079 is an analog controlled variable gain amplifier (VGA) which operates from 500 to 2700 MHz. The VGA is able to provide broadband performance with +29 dBm OIP3 and +16 dBm P1dB over a wide frequency range while only consuming 95 mA current.

The TQM8M9079 integrates two broadband gain blocks with a voltage variable attenuator. The three stages are individually accessible via package I/O contacts. This permits full flexibility to insert other components or filters between the stages.

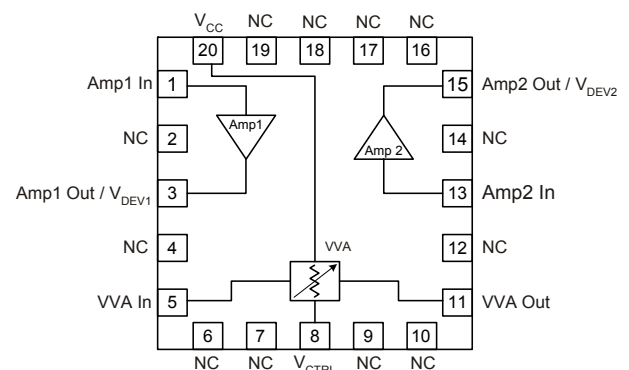
The TQM8M9079 is packaged in a RoHS-compliant, compact 5x5 mm surface-mount leadless package. Superior thermal design allows the product to have a minimum MTTF rating of 1000 years at a mounting temperature of +85° C.

The TQM8M9079 is targeted for use in wireless infrastructure, IF gain control in point-to-point applications, and for general purpose wireless.



20-pin 5x5 mm Leadless Package

Functional Block Diagram



Pin Configuration

| Pin No. | Symbol |
|---|-----------------------|
| 1 | Amp1 In |
| 2, 4, 6, 7, 9, 10, 12, 14, 16, 17, 18, 19 | NC (No Connect) |
| 3 | Amp1 Out / V_{DEV1} |
| 5 | VVA In |
| 8 | V_{CTRL} |
| 11 | VVA Out |
| 13 | Amp2 In |
| 15 | Amp2 Out / V_{DEV2} |
| 20 | Vcc |
| Backside Paddle | GND |

Ordering Information

| Part No. | Description |
|---------------|-------------------------------|
| TQM8M9079 | Variable Gain Amplifier |
| TQM8M9079-PCB | 500–2700 MHz Evaluation Board |

Standard T/R size = 2500 pieces on a 13" reel

Absolute Maximum Ratings

| Parameter | Rating |
|------------------------------------|--------------|
| Storage Temperature | -65 to 150°C |
| RF Input Power, CW, 50Ω, T = 25°C | +24 dBm |
| Amplifier Voltage ($V_{DEV1,2}$) | +4.5 V |
| Control Voltage (V_{CTRL}) | +6 V |

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

Recommended Operating Conditions

| Parameter | Min | Typ | Max | Units |
|--------------------------------|-----|-----|-----|-------|
| Control Voltage (V_{CTRL}) | 0.5 | | 5 | V |
| Operating Temp. Range | -40 | | +85 | °C |
| T_J (for $>10^6$ hours MTTF) | | | 170 | °C |

Electrical specifications are measured under test conditions as described or noted. Electrical specifications are not guaranteed over all recommended operating conditions.

Electrical Specifications

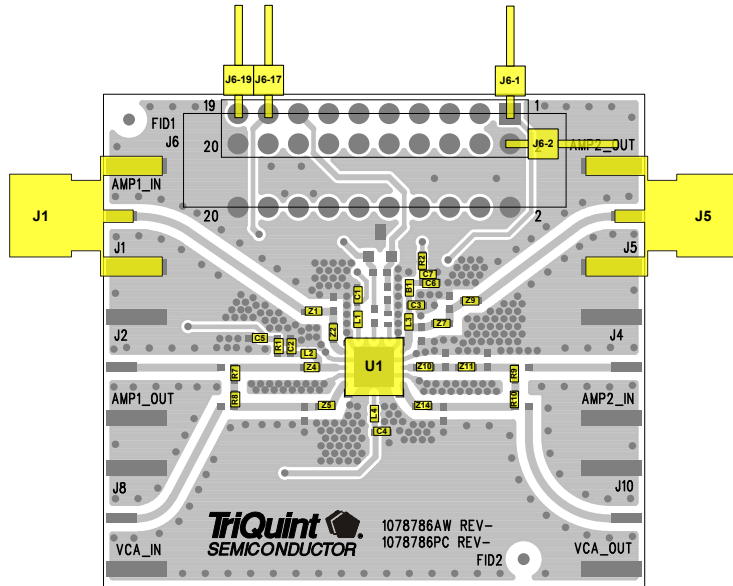
Test conditions unless otherwise noted: $V_{CC}=+5V$, $R_{BIAS}=24\Omega$, Maximum gain setting, Temp.=+25°C

| Parameter | Conditions | Min | Typ | Max | Units |
|-----------------------------------|-----------------------------------|-----|------|------|-------|
| Operational Frequency Range | | 500 | | 2700 | MHz |
| Test Frequency | | | 2140 | | MHz |
| Gain | | 35 | 38 | | dB |
| Gain Variation Range | Note 1 | 25 | 30 | | dB |
| Input Return Loss | | | 11 | | dB |
| Output Return Loss | | | 20 | | dB |
| Output IP3 | Pout=0 dBm/tone, $\Delta f=1$ MHz | +25 | +29 | | dBm |
| Output P1dB | | | +16 | | dBm |
| Noise Figure | | | 4.0 | | dB |
| Amplifier Current | Note 2 | 77 | 95 | 117 | mA |
| VVA Current (Pin 8) | Note 3 | | 3.6 | | mA |
| Thermal Resistance, θ_{JC} | Junction to backside paddle | | | 61 | °C/W |

Notes:

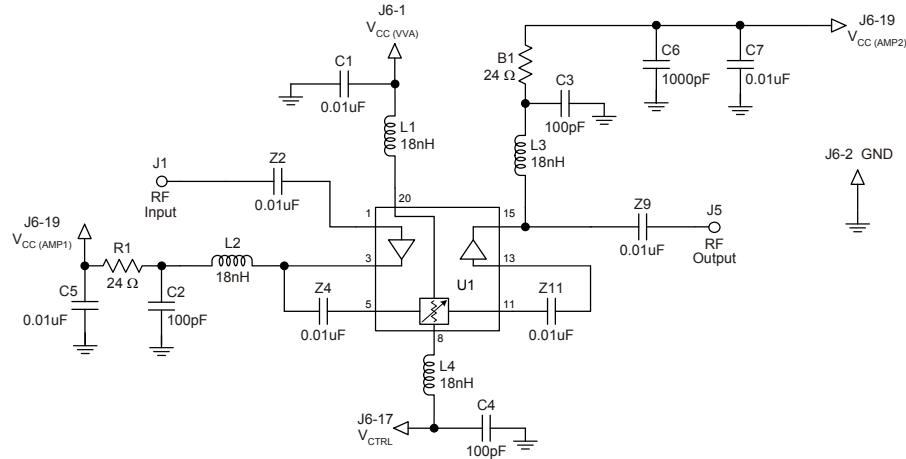
1. The Gain variation range is measured as the difference in gain with $V_{CTRL} = 5$ V and $V_{CTRL} = 0$ V.
2. Amp1 current (pin 3) and Amp2 current (pin 15) are typically 47.5 mA in each
3. VVA typical current is < 1 mA for min attenuation and 3.6 mA for max attenuation

TQM8M9079-PCB Evaluation Board (500–2700 MHz)



Notes:

1. See Evaluation Board PCB Information section for material and stack-up.
2. 0 Ω jumpers are not shown on the schematic and may be replaced with copper trace in the target application layout.



Bill of Material – TQM8M9079-PCB

| Reference Des. | Value | Description | Manuf. | Part Number |
|---|---------|------------------------------------|-----------|---------------|
| N/A | N/A | Printed Circuit Board | TriQuint | 1078786 |
| U1 | n/a | Variable Gain Amplifier | TriQuint | TQM8M9079 |
| B1, R1 | 24 Ω | Res., Chip, 0402, 5%, 1/16W | various | |
| L1, L2, L3, L4 | 18 nH | Inductor, 0402, 5%, 3.1 GHz SRF | CoilCraft | 0402CS-18NXJL |
| R2, R7, R8, R9, R10, Z1, Z5, Z7, Z10, Z14 | 0 Ω | Res., Chip, 0402, 5%, 1/16W | various | |
| C1, C5, C7, Z2, Z4, Z9, Z11 | 0.01 uF | Res., Chip, 0402, 5%, 1/16W | various | |
| C2, C3, C4, | 100 pF | Cap., Chip, 0402, 5%, 50V, NPO/COG | various | |
| C6 | 1000 pF | Cap., Chip, 0402, 10%, 50V, X5R | various | |
| Z8 | 0.5 pF | Cap., Chip, 0402, 5%, 50V, NPO/COG | various | |

Typical Performance – TQM8M9079-PCB

Test conditions unless otherwise noted: $V_{CC} = +5\text{ V}$, $R_{BIAS} = 24\Omega$, Maximum Gain Setting, Temp = 25°C

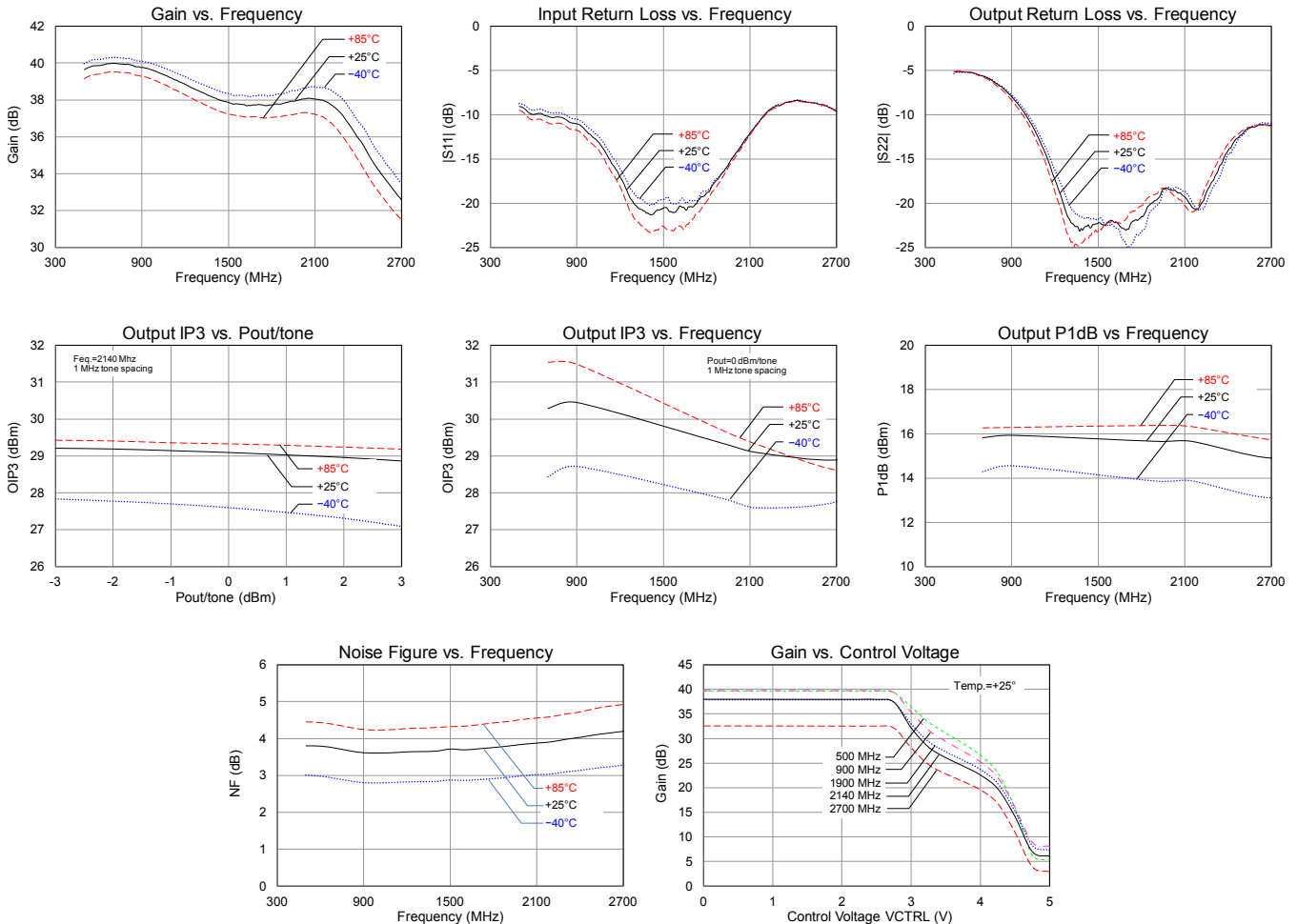
| Parameter | Typical Value | | | | | Units |
|-----------------------|---------------|-------|-------|-------|-------|-------|
| Frequency | 500 | 900 | 1900 | 2140 | 2700 | MHz |
| Gain | 39.6 | 39.8 | 37.9 | 38.0 | 32.6 | dB |
| Input Return Loss | 9.1 | 11.0 | 16.7 | 11.2 | 9.6 | dB |
| Output Return Loss | 5.1 | 8.0 | 19.7 | 20.2 | 11.2 | dB |
| Output IP3 (note 1) | +30.3 | +30.4 | +29.4 | +29.1 | +28.9 | dBm |
| Output P1dB | +15.8 | +15.9 | +15.7 | +15.7 | +14.9 | dBm |
| Noise Figure (note 2) | 4.0 | 3.9 | 4.0 | 4.1 | 4.3 | dB |

Notes:

1. IIP3 measured with two tones at an input power of +0 dBm / tone separated by 1 MHz.
2. Evaluation board PCB losses de-embedded.

Performance Plots – TQM8M9079-PCB

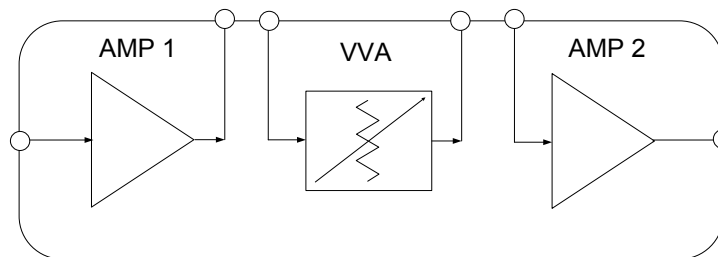
Test conditions unless otherwise noted: $V_{CC} = +5\text{V}$, $R_{BIAS} = 24\Omega$, Maximum Gain Setting, 50 Ω system.



Detailed Device Description

The TQM8M9079 is a 50 Ω internally matched analog controlled variable gain amplifier (VGA) which operates from 500 to 2700 MHz. The amplifier module features the integration of a general purpose amplifier with high dynamic range, a voltage variable attenuator (VVA), along with another general purpose amplifier as shown in the functional diagram below. The VGA is able to provide broadband performance with +29 dBm OIP3 and +16 dBm P1dB over a wide frequency range while only consuming 95 mA current. The three stages are individually accessible via package I/O contacts. This permits full flexibility to insert other components or filters between the stages.

Functional Schematic Diagram



AMP1 / AMP2

AMP1 and AMP2 are general purpose high dynamic range in VGA module. The two amplifiers in the VGA are identical and provide 20.3 dB gain, +15.7 dBm P1dB, +29.4 dBm OIP3 at 1.9 GHz while only drawing 45 mA current per amplifier. The amplifiers are unconditionally stable at the pins of the module. External DC blocks are required that prevent the flow of direct current without affecting the RF signal through the main transmission line path.

VVA (Voltage Variable Attenuator)

The VVA offers 31 dB of attenuation range while providing high linearity (+45 IIP3) over the entire attenuation range. The external voltage source, V_{CTRL} pin provides different analog voltages that set different attenuation states in the module. 4.5Vctl represents the lowest attenuation state. As the voltage is decreased, the attenuation will increase. It provides 2.6 dB insertion loss while drawing 2 mA supply current at 5V supply voltage. The typical control current is around 4 mA. VVA is symmetric; therefore, either pin (pin7 or pin 10) can be as RF input or output. VVA input and output ports are DC blocked internally to the module.

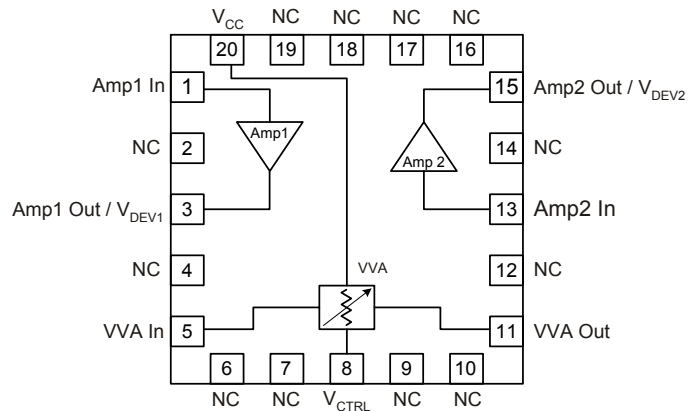
Chain Analysis Table

This table provides the typical performance of individual stages in the module as well as overall module performance. Frequency = 1900 MHz.

| Parameter | AMP1 | VVA | AMP2 | Overall Module | Units |
|-----------|------|------|------|----------------|-------|
| Gain | 20.3 | -2.6 | 20.3 | 38 | dB |
| NF | 3.9 | 2.6 | 3.9 | 4.0 | dB |
| OIP3 | 29.4 | 42 | 29.4 | 29.4 | dBm |
| P1dB | 15.7 | 22 | 15.7 | 15.7 | dBm |
| Icc | 45 | 6.0* | 45 | 96 | mA |

Note: * 2mA V_{CC} + 4 mA V_{CTRL}

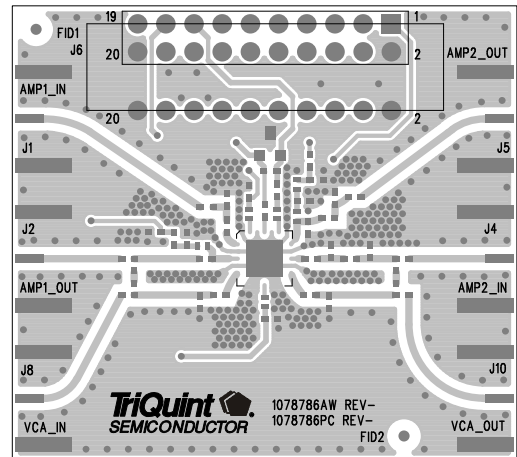
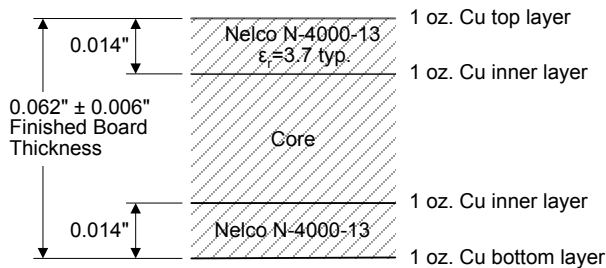
Pin Configuration and Description



| Pin No. | Symbol | Description |
|---|----------------------------|---|
| 1 | Amp1 In | RF input (Amp1). DC blocking capacitor required. |
| 2, 4, 6, 7, 9, 10, 12, 14, 16, 17, 18, 19 | NC (No Connect) | No electrical connection. Land pads should be provided for PCB mounting integrity. |
| 3 | Amp1 Out/V _{DEV1} | RF output / DC bias (Amp1), Bias resistor required (R _{BIAS}) |
| 5 | VVA In | RF input (VVA). DC blocking capacitor required. |
| 8 | V _{CTRL} | Analog input for voltage controlled amplifier |
| 11 | VVA Out | RF output (VVA). DC blocking capacitor required. |
| 13 | Amp2 In | RF input (Amp2). DC blocking capacitor required. |
| 15 | Amp2 Out/V _{DEV2} | RF output / DC bias (Amp2), Bias resistor required (R _{BIAS}) |
| 20 | V _{CC} | DC supply for voltage variable attenuator. |
| Backside Paddle | RF/DC GND | RF/DC Ground. Follow recommended via pattern and ensure good solder attach for best thermal and electrical performance. |

Evaluation Board PCB Information

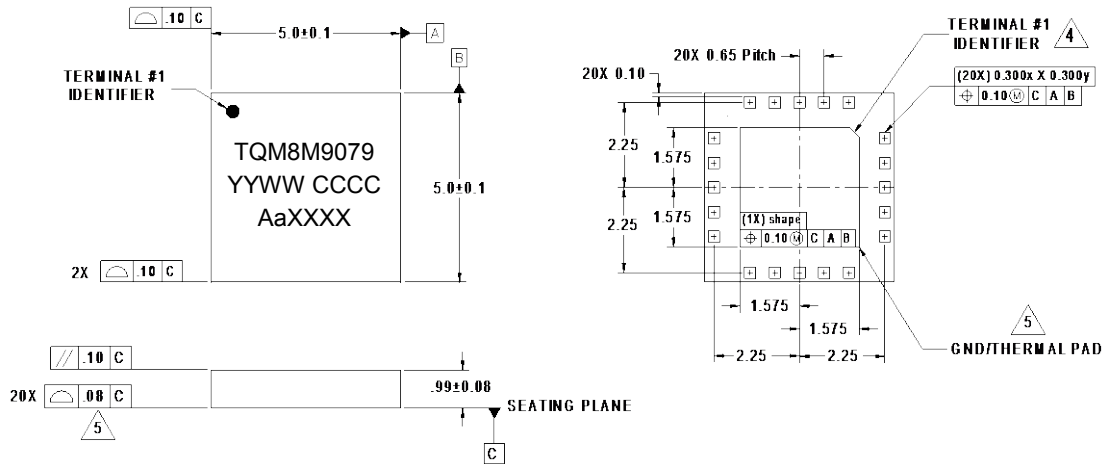
TriQuint PCB 1078786 Material and Stack-up



Mechanical Information

Package Marking and Dimensions

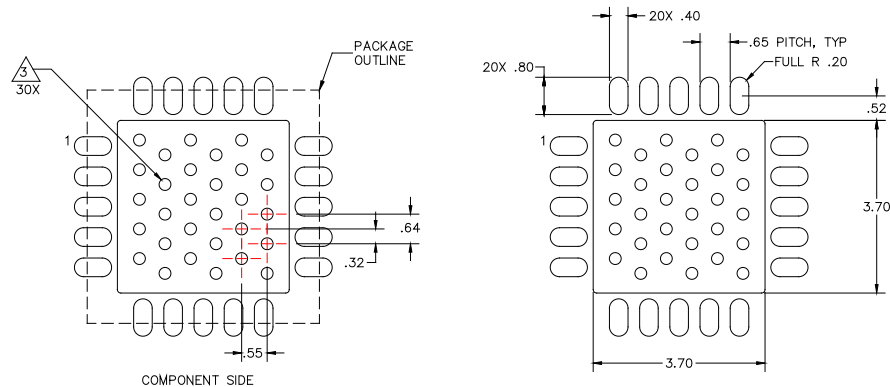
Marking: Part number – TQM8M9079
 Year, week, country code – YYWW CCCC
 Assembly code – AaXXXX



Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Except where noted, this part outline conforms to JEDEC standard MO-270, Issue B (Variation DAE) for extra thin profile, fine pitch, internal stacking module (ISM).
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.
5. Co-planarity applies to the exposed ground/thermal pad as well as the contact pins.

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. We recommend a 0.35 mm (#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.

Product Compliance Information

ESD Sensitivity Ratings



Caution! ESD-Sensitive Device

ESD Rating: Class 1B
Value: ≥ 500 V to < 1000 V
Test: Human Body Model (HBM)
Standard: JEDEC Standard JESD22-A114

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

MSL Rating

MSL Rating: Level 3
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: Electrolytic plated Au over Ni

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:

- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($\text{C}_{15}\text{H}_{12}\text{Br}_4\text{O}_2$) Free
- PFOS Free
- SVHC Free

Contact Information

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