



# QPF4530

## Wi-Fi Front End Module

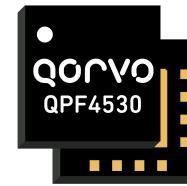
### Product Overview

The Qorvo® QPF4530 is an integrated front end module (FEM) designed for Wi-Fi 802.11ax systems. The compact form factor and integrated matching minimizes layout area in the application.

Performance is focused on optimizing the PA for a 3.3V supply voltage that conserves power consumption while maintaining the highest linear output power and leading edge throughput. Receive path matches the optimal technologies to maximize Rx sensitivity through noise figure performance that is consistent over a wider variety of conditions.

The receive path is pinned out so external filtering can be added in the optimal position. Integrated die level filtering for 2nd and 3rd harmonics as well as 2.4 GHz rejection for DBDC operation are included. A DC power detector which has voltage output provides feedback for close loop applications.

The QPF4530 integrates a 5 GHz power amplifier (PA), regulator, single pole two throw switch (SP2T) and bypassable low noise amplifier (LNA) into a single device

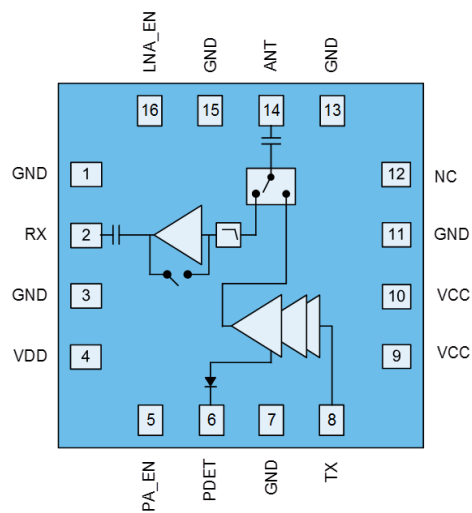


16 Pin 3x3 mm QFN Package

### Key Features

- 5150 – 5925 MHz
- $P_{OUT} = +15\text{dBm}$  MCS11 HE80 -43dB Dynamic EVM
- $P_{OUT} = +18\text{dBm}$  MCS9 VHT80 -35dB Dynamic EVM
- $P_{OUT} = +19\text{dBm}$  MCS7 HT20/40 -30dB Dynamic EVM
- $P_{OUT} = +21\text{dBm}$  MCS0 HT20 Spectral Mask Compliance
- Optimized for +3.3 V Operation
- 0.5W Power Consumption at  $P_{OUT} +17\text{dBm}$
- 30 dB Tx Gain
- 2 dB Noise Figure
- 15 dB Rx Gain & 7 dB Bypass Loss
- 37 dB 2.4 GHz Rejection on Rx Path
- Integrated DC Power Detector

### Functional Block Diagram



Top View

### Applications

- Access Points
- Wireless Routers
- Client Equipment
- Customer Premise Equipment
- Internet of Things

### Ordering Information

| Part Number    | Description                |
|----------------|----------------------------|
| QPF4530SB      | Sample bag with 5 pieces   |
| QPF4530SQ      | Sample bag with 25 pieces  |
| QPF4530SR      | 7" reel with 100 pieces    |
| QPF4530TR13-5K | 13" reel with 5,000 pieces |
| QPF4530PCK-01  | Assembled Evaluation Board |

## Absolute Maximum Ratings

| Parameter             | Conditions                                                           | Rating           |
|-----------------------|----------------------------------------------------------------------|------------------|
| DC Supply Voltage     |                                                                      | -0.5 to +6 V     |
| Control Voltage       | PA_EN & LNA_EN                                                       | -0.5 to +6 V     |
| Storage Temperature   |                                                                      | -40 to 150 °C    |
| Junction Temperature  | MTTF > 1.5x10 <sup>6</sup> hours<br>MTTF > 1.0x10 <sup>6</sup> hours | 160 °C<br>170 °C |
| RF Input Power at TX  | Into 50 Ω Load for 802.11a/n/ac/ax (No Damage), Transmit Mode        | +10 dBm          |
| RF Input Power at ANT | (No Damage), Receive LNA On Mode                                     | +10 dBm          |
| RF Input Power at ANT | (No Damage), Receive Bypass Mode                                     | +25 dBm          |

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. This is an InGaP device designed for high duty cycle applications with T<sub>j</sub>>30 °C over ambient.

## Recommended Operating Conditions

| Parameter                                           | Min. | Typ. | Max.            | Units |
|-----------------------------------------------------|------|------|-----------------|-------|
| Operating Frequency                                 | 5150 |      | 5850            | MHz   |
| Extended Operating Frequency                        | 4900 |      | 5925            | MHz   |
| Device Voltage (V <sub>CC</sub> & V <sub>DD</sub> ) | +3   | +3.3 | +3.6            | V     |
| Control Voltage – High                              | +1.7 | +3   | V <sub>CC</sub> | V     |
| Control Voltage - Low                               | 0    |      | +0.4            | V     |
| T <sub>OPERATING</sub> *                            | -40  |      | +85             | °C    |

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions. \* T<sub>OPERATING</sub> is temperature at package ground.

## Electrical Specifications

| Parameter                     | Conditions                                                                          | Min.  | Typ. | Max.  | Units |
|-------------------------------|-------------------------------------------------------------------------------------|-------|------|-------|-------|
| <b>Transmit (TX-ANT) Mode</b> | <b>Unless otherwise noted: V<sub>CC</sub>=3.3V, T=+25°C, PA_EN=High, LNA_EN=Low</b> |       |      |       |       |
| 11ax HE80 Output Power        | MCS11 1024QAM                                                                       |       | 15   |       | dBm   |
| Dynamic EVM                   |                                                                                     |       |      | -43   | dB    |
| 11ax HE80 Output Power        | MCS11 1024QAM                                                                       |       | 16   |       | dBm   |
| Dynamic EVM                   |                                                                                     |       |      | -40   | dB    |
| 11ac VHT80 Output Power       | MCS9 256QAM                                                                         | 16.5  | 18   |       | dBm   |
| Dynamic EVM                   |                                                                                     |       |      | -35   | dB    |
| 11n HT20/40 Output Power      | MCS7 64QAM                                                                          | 17.5  | 19   |       | dBm   |
| Dynamic EVM                   |                                                                                     |       |      | -30   | dB    |
| Margin to VHT80 Spectral Mask | P <sub>OUT</sub> = +19.5 dBm, 11ac MCS0                                             |       | 3    |       | dBc   |
| Margin to HT20 Spectral Mask  | P <sub>OUT</sub> = +21 dBm, 11n MCS0                                                |       | 3    |       | dBc   |
| Gain                          |                                                                                     | 29    | 30   |       | dB    |
| Gain Flatness                 | Across any 80 MHz Channel                                                           | -0.25 |      | +0.25 | dB    |
| Out of Band Gain              | f = 3300-3800MHz                                                                    |       |      | -5    | dB    |
|                               | f > 7000MHz                                                                         |       |      | 15    | dB    |
| TX Port Return Loss           |                                                                                     | 7     | 14   |       | dB    |

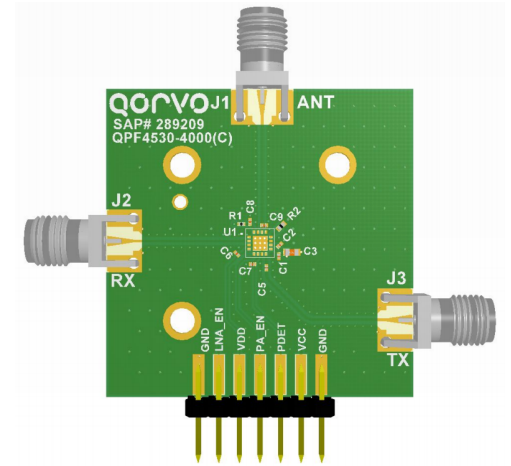
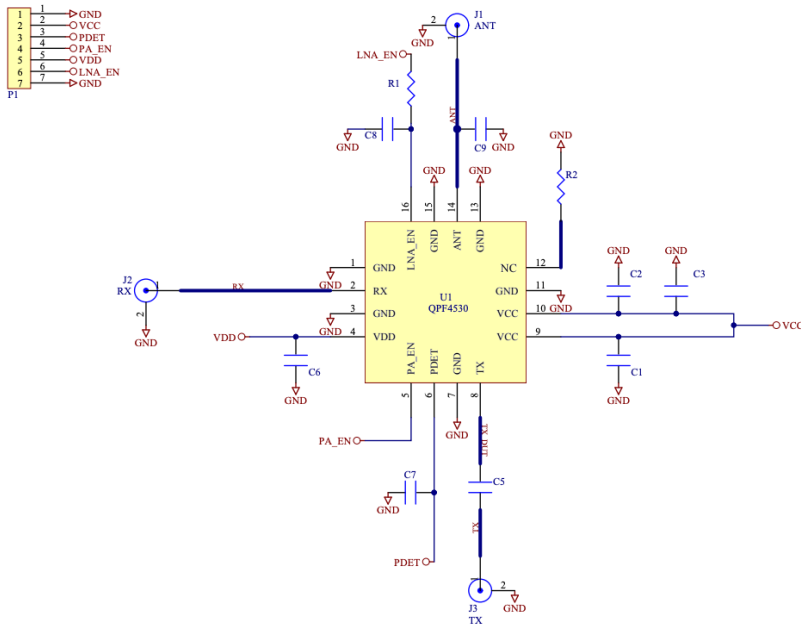
| Parameter                               | Conditions                                | Min.                                                                                | Typ. | Max.  | Units   |
|-----------------------------------------|-------------------------------------------|-------------------------------------------------------------------------------------|------|-------|---------|
| ANT Port Return Loss                    |                                           | 7                                                                                   | 15   |       | dB      |
| Quiescent Current                       | RF Off                                    |                                                                                     | 95   |       | mA      |
| Operating Current                       | P <sub>OUT</sub> = +15 dBm                |                                                                                     | 135  | 150   | mA      |
|                                         | P <sub>OUT</sub> = +18 dBm                |                                                                                     | 155  | 175   |         |
|                                         | P <sub>OUT</sub> = +21 dBm                |                                                                                     | 195  | 215   |         |
| 2 <sup>nd</sup> Harmonics               | P <sub>OUT</sub> = +21 dBm 802.11a 6 MBps |                                                                                     | -35  | -30   | dBm/MHz |
| 3 <sup>rd</sup> Harmonics               | P <sub>OUT</sub> = +21 dBm 802.11a 6 MBps |                                                                                     | -40  | -35   | dBm/MHz |
| ANT-RX Isolation                        |                                           |                                                                                     | 40   |       | dB      |
| DC Power Detect Voltage                 | RF Off                                    |                                                                                     | 0.25 |       | V       |
|                                         | P <sub>OUT</sub> = +15 dBm                |                                                                                     | 0.46 |       | V       |
|                                         | P <sub>OUT</sub> = +18 dBm                |                                                                                     | 0.58 |       | V       |
|                                         | P <sub>OUT</sub> = +21 dBm                |                                                                                     | 0.75 |       | V       |
| <b>RECEIVE (ANT-RX) LNA ON MODE</b>     |                                           | <b>Unless otherwise noted: V<sub>CC</sub>=3.3V, T=+25°C, PA_EN=Low, LNA_EN=High</b> |      |       |         |
| Gain                                    |                                           | 13.5                                                                                | 15   |       | dB      |
| Gain Flatness Across any 80 MHz Channel |                                           | -0.25                                                                               |      | +0.25 | dB      |
| Out of Band Gain                        | f = 2400-2500 MHz                         |                                                                                     | -37  |       | dB      |
| Noise Figure                            |                                           |                                                                                     | 2    | 2.2   | dB      |
| RX Port Return Loss                     |                                           | 7                                                                                   | 13   |       | dB      |
| ANT Port Return Loss                    |                                           | 6                                                                                   | 9    |       | dB      |
| Input P <sub>1dB</sub>                  |                                           |                                                                                     | -5   |       | dBm     |
| Input IP3                               |                                           |                                                                                     | +9   |       | dBm     |
| Rx Operating Current                    |                                           |                                                                                     | 17   |       | mA      |
| <b>RECEIVE (ANT-RX) BYPASS MODE</b>     |                                           | <b>Unless otherwise noted: V<sub>CC</sub>=3.3V, T=+25°C, PA_EN=Low, LNA_EN=Low</b>  |      |       |         |
| Bypass Loss                             |                                           |                                                                                     | 7    |       | dB      |
| Loss Flatness Across any 80 MHz Channel |                                           | -0.15                                                                               |      | +0.15 | dB      |
| Out of Band Gain                        | f = 2400-2500 MHz                         |                                                                                     | -32  |       | dB      |
| RX Port Return Loss                     |                                           | 10                                                                                  | 12   |       | dB      |
| ANT Port Return Loss                    |                                           | 6                                                                                   | 8    |       | dB      |
| Input P <sub>1dB</sub>                  |                                           |                                                                                     | +20  |       | dBm     |
| Input IP3                               |                                           |                                                                                     | +40  |       | dBm     |
| <b>GENERAL SPECIFICATIONS</b>           |                                           | <b>Unless otherwise noted: V<sub>CC</sub>=3.3V, T=+25°C</b>                         |      |       |         |
| Control Current - High                  |                                           |                                                                                     | 30   |       | μA      |
| Control Current - Low                   |                                           |                                                                                     | 5    |       | μA      |
| Switching Time                          | Transmit to LNA On or Bypass Mode         |                                                                                     |      | 500   | nS      |
|                                         | LNA On to Bypass Mode                     |                                                                                     |      | 200   | nS      |
|                                         | Bypass to LNA On Mode                     |                                                                                     |      | 200   | nS      |
|                                         | LNA On or Bypass to Transmit Mode         |                                                                                     |      | 500   | nS      |
| TX Output P <sub>1dB</sub>              | CW                                        |                                                                                     | +27  |       | dBm     |
| PA Stability - Output VSWR              | CW No Spurious above -41.25dBm/MHz        |                                                                                     | 4:1  |       |         |
| Output Power Range                      |                                           | 0                                                                                   |      | 21    | dBm     |
| Thermal Resistance, θ <sub>Jc</sub>     | Junction to case                          |                                                                                     | 49   |       | °C/W    |



Logic Truth Table

| Mode     | PA_EN | LNA_EN |
|----------|-------|--------|
| Bypass   | Low   | Low    |
| Transmit | High  | Low    |
| LNA On   | Low   | High   |
| Not Used | High  | High   |

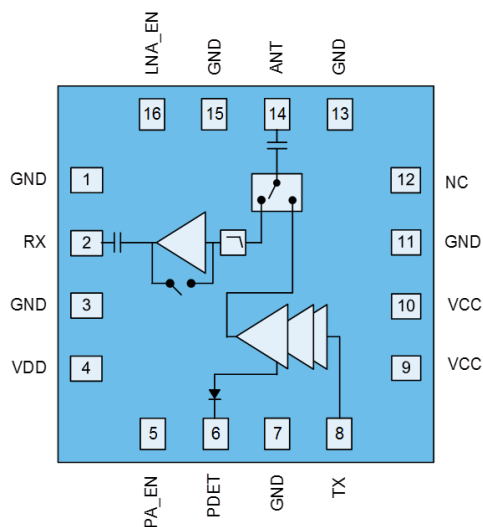
## Evaluation Board Schematic and Layout



## Bill of Material

| Ref. Des. | Value   | Description                                | Manuf.        | Part number        |
|-----------|---------|--------------------------------------------|---------------|--------------------|
| -         | -       | Printed Circuit Board                      |               |                    |
| U1        | -       | 5GHz Wi-Fi Front End Module                | Qorvo         | QPF4530            |
| C9        | 0.1 pF  | Capacitor, Chip, +/-0.05pF, 25V, C0G, 0201 | Murata        | GRM0335C1ER10WA01D |
| C3        | 4.7 µF  | Capacitor, Chip, 10%, 6.3V, X5R, 0603      | Murata        | GRM188R60J475KE19D |
| C6, C8    | 1000 pF | Capacitor, Chip, 10%, 16V, X7R, 0201       |               |                    |
| C1        | 100 pF  | Capacitor, Chip, 5%, 25V, C0G, 0201        |               |                    |
| C5        | 10 pF   | Capacitor, Chip, +/-0.05pF, 25V, C0G, 0201 |               |                    |
| C2        | 150 pF  | Capacitor, Chip, 10%, 16V, X7R, 0201       |               |                    |
| R1        | 0 Ω     | Resistor, Chip, 5%, 1/20W, 0201            | Kamaya        | RMC1/20JPPA15      |
| R2        | 49.9 Ω  | Resistor, Chip, 1%, 1/10W, 0402            | Panasonic IDS | ERJ-2RKF49R9X      |
| C7        | -       | Do Not Install                             |               |                    |

## Pin Configuration and Description

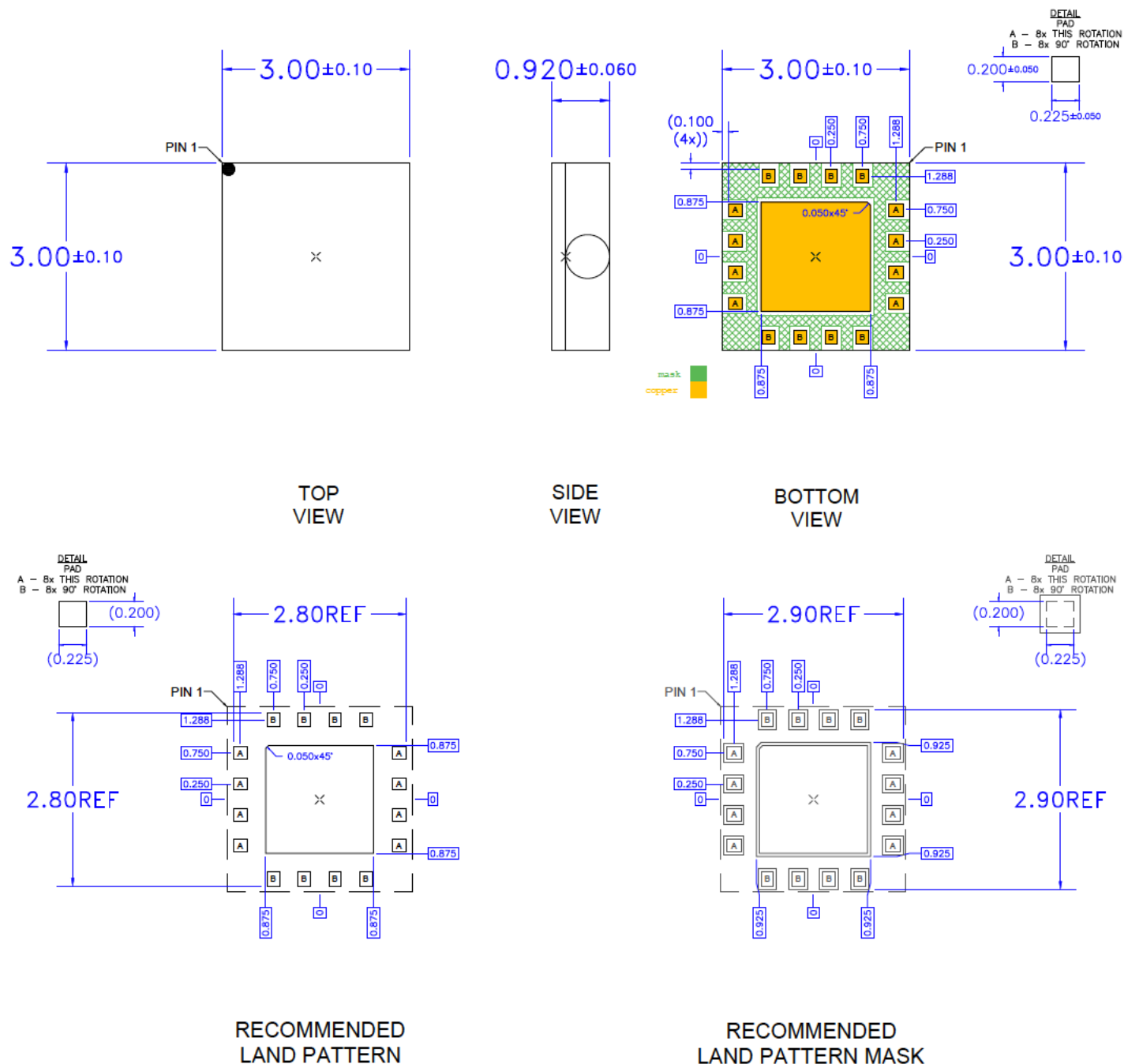


Top View

| Pin Number      | Label  | Description                                                                                                                                                          |
|-----------------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1               | GND    | Ground connection.                                                                                                                                                   |
| 2               | RX     | RF output from the low noise amplifier. Internally matched to 50 $\Omega$ and DC blocked.                                                                            |
| 3               | GND    | Ground connection.                                                                                                                                                   |
| 4               | VDD    | LNA & regulator supply voltage.                                                                                                                                      |
| 5               | PA_EN  | Control pin.                                                                                                                                                         |
| 6               | PDET   | DC power detector. Provides an output voltage proportional to the RF output power level                                                                              |
| 7               | GND    | Ground connection.                                                                                                                                                   |
| 8               | TX     | RF input. Internally matched to 50 $\Omega$ and DC shorted. No DC leakage from this pin. If DC is present on the trace to TX, then a series DC block is recommended. |
| 9               | VCC    | Supply voltage                                                                                                                                                       |
| 10              | VCC    | Supply voltage                                                                                                                                                       |
| 11              | GND    | Ground connection.                                                                                                                                                   |
| 12              | NC     | RF power detector. Provides an RF output proportional to the RF output power level. This pin must be terminated with 50 $\Omega$ when not used.                      |
| 13              | GND    | Ground connection.                                                                                                                                                   |
| 14              | ANT    | RF bi-directional antenna port. Internally matched to 50 $\Omega$ and DC blocked.                                                                                    |
| 15              | GND    | Ground connection.                                                                                                                                                   |
| 16              | LNA_EN | Control pin.                                                                                                                                                         |
| Backside Paddle | GND    | RF/DC ground. Use recommended via pattern to minimize inductance and thermal resistance. See PCB Mounting Pattern for suggested footprint.                           |

## Mechanical Information

### Dimensions and PCB Mounting Pattern



#### Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Dimension and tolerance formats conform to ASME Y14.4M-1994.
3. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

## Handling Precautions

| Parameter                        | Rating          | Standard              |
|----------------------------------|-----------------|-----------------------|
| ESD – Human Body Model (HBM)     | Class 1B (500V) | ANSI/ESD/JEDEC JS-001 |
| ESD – Charged Device Model (CDM) | Class C3 (1kV)  | JESD22-C101           |
| MSL – Moisture Sensitivity Level | Level 3         | IPC/JEDEC J-STD-020   |



Caution!

ESD sensitive device

## Solderability

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

Package lead plating: Electroless Ni/Electroless Pd/Immersion Au (ENEPIG)

## RoHS Compliance

This part 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<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) Free
- SVHC Free



## Contact Information

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

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