



# TQP9418

## High Linearity 0.5 W Small Cell PA

### Product Overview

The TQP9418 is a high-linearity two-stage power amplifier in a low-cost surface-mount package with on-chip bias control and temperature compensation circuits, suitable for small cell base station applications.

TQP9418 provides 30 dB gain and +27 dBm linear power over the 1805 – 1880 MHz frequency range. The amplifier is able to achieve –48 dBc ACLR at +27 dBm output power using 20 MHz LTE signal.

The TQP9418 integrates two high performance amplifier stages onto a module to allow for a compact system design and requires very few external components for operation. The amplifier is bias adjustable allowing the amplifier's power consumption to be optimized. The TQP9418 is available in a 7 x 7 mm surface mount package.

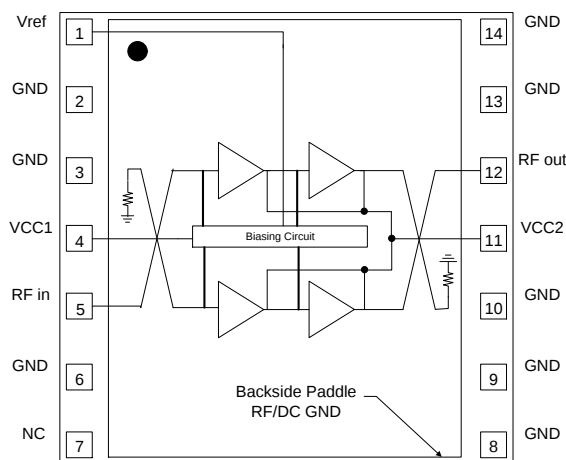


7 mm x 7 mm leadless SMT Package

### Key Features

- 1.805 – 1.88 GHz Frequency Range
- Fully Integrated, 2 Stage Power Amplifier
- Internally Matched 50  $\Omega$  Input/Output
- –48 dBc ACLR at  $P_{avg}$  = +27 dBm
- 31 dB Gain
- 14.5% PAE at +27 dBm
- 420 mA Quiescent Current
- On-chip Bias Control and Temp. Comp. Circuit

### Functional Block Diagram



Top View

### Applications

- Small Cell / Picocell
- Enterprise Femtocell
- Customer Premises Equipment (CPE)
- Data Cards and Terminals
- Distributed Antenna Systems (DAS)
- Booster Amps, Repeaters

### Ordering Information

| Part No.                                      | Description                        |
|-----------------------------------------------|------------------------------------|
| TQP9418                                       | High Linearity 0.5 W Small Cell PA |
| TQP9418-PCB                                   | 1805 – 1880 MHz Evaluation board   |
| Standard T/R size = 2500 pieces on a 13" reel |                                    |

## Absolute Maximum Ratings

| Parameter                       | Rating         |
|---------------------------------|----------------|
| Storage Temperature             | -55 to +150 °C |
| Supply Voltage ( $V_{CC}$ )     | +6 V           |
| $V_{ref}$                       | +3.5 V         |
| RF Input Power, CW, 50Ω, T=25°C | +13 dBm        |
| Tj at T <sub>CASE</sub> = 125°C | +205°C         |

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

## Recommended Operating Conditions

| Parameter                   | Min   | Typ   | Max   | Units |
|-----------------------------|-------|-------|-------|-------|
| $V_{CC1}, V_{CC2}$          | +3.6  | +4.5  | +5.25 | V     |
| $V_{ref}$                   | +2.75 | +2.85 | +2.95 | V     |
| T <sub>CASE</sub>           | -40   |       | +85   | °C    |
| Tj at T <sub>CASE</sub> max |       |       | +165  | °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:  $V_{CC1} = V_{CC2} = +4.5$  V,  $V_{ref} = +2.85$  V, Temp= +25 °C

| Parameter                                       | Conditions                                                   | Min  | Typ   | Max  | Units |
|-------------------------------------------------|--------------------------------------------------------------|------|-------|------|-------|
| Operational Frequency Range                     |                                                              | 1805 |       | 1880 | MHz   |
| Test Frequency                                  |                                                              |      | 1840  |      | MHz   |
| Gain                                            |                                                              | 28   | 31    | 34   | dB    |
| Input Return Loss                               |                                                              | 15   | 20    |      | dB    |
| Output Return Loss                              |                                                              | 15   | 25    |      | dB    |
| P1dB                                            |                                                              |      | 36    |      | dBm   |
| ACLR                                            | P <sub>OUT</sub> = +27 dBm, 20 MHz LTE E-TM1.1, 9.5 dB PAR   |      | -48   | -45  | dBc   |
| ACLR                                            | P <sub>OUT</sub> = +27 dBm, 2X20 MHz LTE E-TM1.1, 9.5dB PAR  |      | -41   |      | dBc   |
| ACLR                                            | P <sub>OUT</sub> = +27 dBm, 15 MHz LTE E-TM1.1, 9.5dB PAR    |      | -50   |      | dBc   |
| ACLR                                            | P <sub>OUT</sub> = +27 dBm, 10 MHz LTE E-TM1.1, 9.5dB PAR    |      | -49   |      | dBc   |
| ACLR                                            | P <sub>OUT</sub> = +27 dBm, 5 MHz LTE E-TM1.1, 9.5dB PAR     |      | -47.5 |      | dBc   |
| Power Added Efficiency                          | P <sub>OUT</sub> = +27 dBm, 20 MHz LTE E-TM1.1, 9.5 dB PAR   | 13   | 14.5  |      | %     |
| Quiescent Current, I <sub>CQ</sub> <sup>1</sup> | $V_{CC1} + V_{CC2}$                                          | 330  | 420   | 510  | mA    |
| Leakage Current                                 | $V_{CC} = +4.5$ V, $V_{ref} = 0$ V                           |      | 13    | 19.5 | μA    |
| Reference Current, I <sub>ref</sub>             | Temp = -40°C to +85°C, $V_{ref} = +2.85$ V                   |      | 3     | 10   | mA    |
| Operational Current, I <sub>CC</sub>            | P <sub>out</sub> = +27 dBm                                   |      | 680   | 920  | mA    |
| Switching Speed                                 | Rise time (10%-90%)                                          |      | 670   |      | ns    |
|                                                 | Fall time (90%-10%)                                          |      | 1205  |      | ns    |
| Spurious Output Level                           | P <sub>out</sub> ≤ +27dBm, In & Out of band load VSWR ≤ 10:1 |      | -60   |      | dBc   |
| VSWR survivability                              | No permanent degradation or failure                          | 10:1 |       |      | -     |
| Harmonics                                       | 2F <sub>0</sub> (P <sub>out</sub> = 27 dBm), CW signal       |      | -42   | -37  | dBc   |
|                                                 | 3F <sub>0</sub> (P <sub>out</sub> = 27 dBm), CW signal       |      | -58   | -53  | dBc   |
|                                                 | 4F <sub>0</sub> (P <sub>out</sub> = 27 dBm), CW signal       |      | -68   | -63  | dBc   |
| Thermal Resistance, θ <sub>jc</sub>             | Module (junction to case)                                    |      |       | 18.5 | °C/W  |

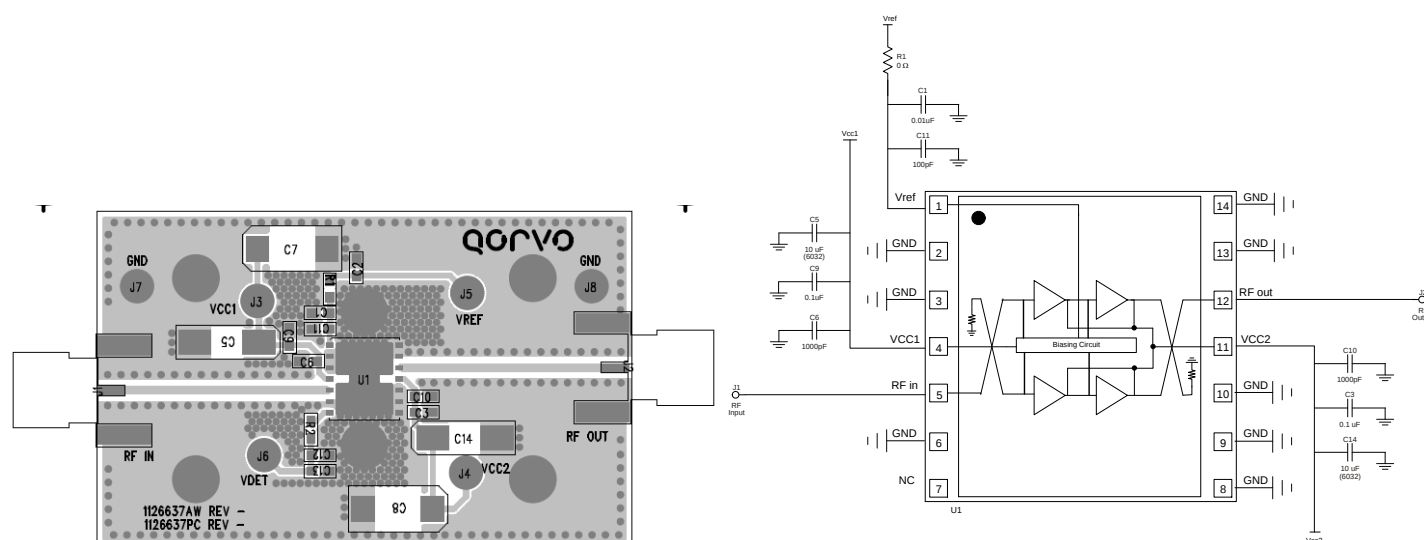
Notes:

- Current through Vcc1 does not vary with power. Vcc1 provides the bias voltage to the current mirror circuit along with Vref to set the bias point for the whole amplifier.

| Parameter | Conditions                                                | -40°C | +25°C | +85°C | Units |
|-----------|-----------------------------------------------------------|-------|-------|-------|-------|
| Gain      | Small Signal                                              | 33    | 31.3  | 29.6  | dB    |
| ACLR      | P <sub>OUT</sub> = +27 dBm, 20 MHz LTE E-TM1.1, 9.5dB PAR | -51   | -49   | -47   | dBc   |
| PAE       | P <sub>OUT</sub> = +27 dBm, 20 MHz LTE E-TM1.1, 9.5dB PAR | 15.5  | 14.5  | 13.5  | %     |
| P1dB      |                                                           | +35.6 | +36   | +35.8 | dBm   |

Test Frequency = 1840MHz

## TQP9421 Application Circuit Schematic and Layout



## Bill of Material - TQP9421 Evaluation Board

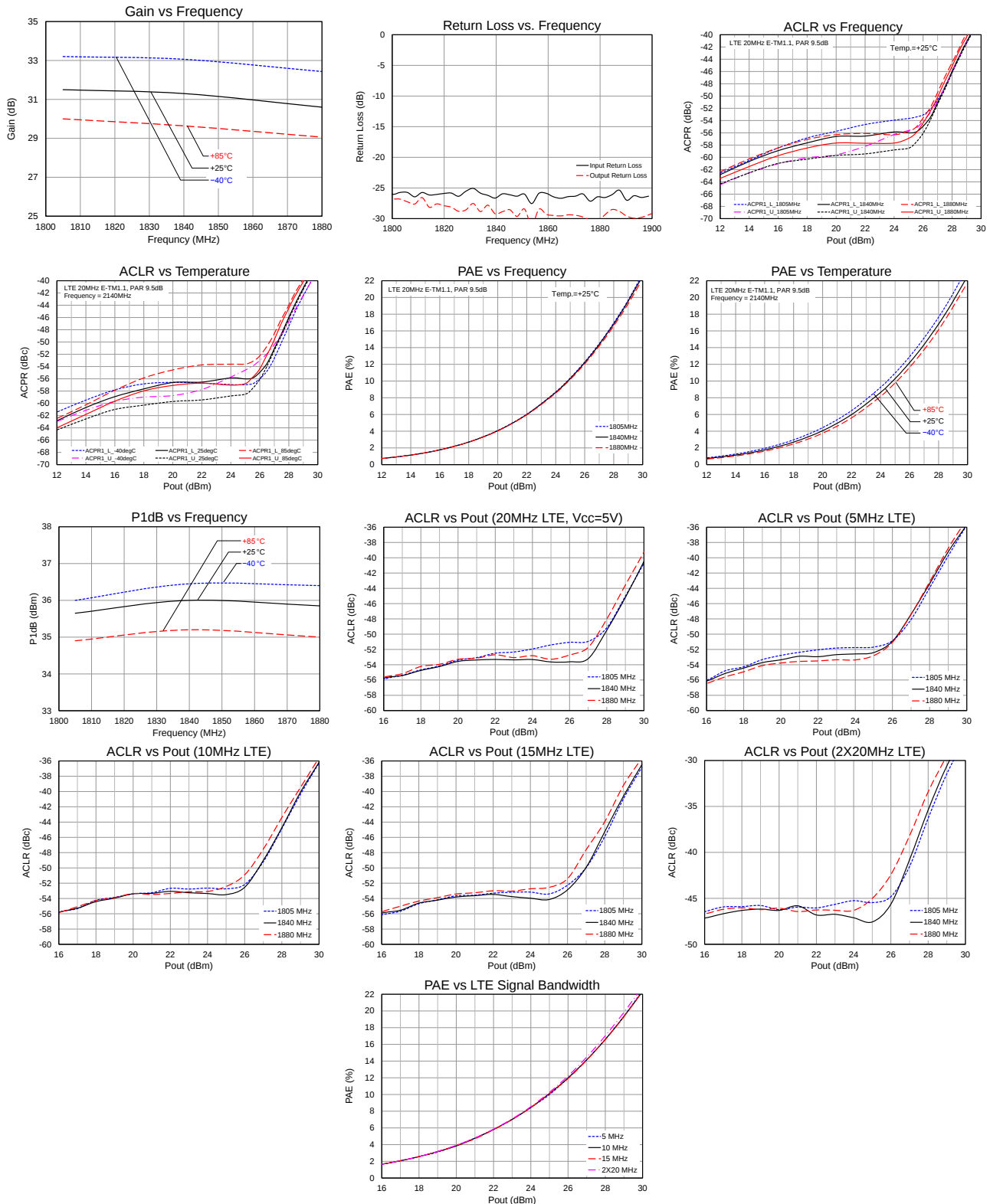
| Ref Des | Value        | Description                           | Manuf.  | Part Number |
|---------|--------------|---------------------------------------|---------|-------------|
| n/a     | n/a          | Printed Circuit Board                 | Qorvo   |             |
| U1      | n/a          | High Linearity 0.5 W Power Amplifier  | Qorvo   | TQP9418     |
| R1      | 0 $\Omega$   | Resistor, Chip, 0603, 5%              | various |             |
| C1      | 0.01 $\mu$ F | Capacitor, Chip, 0603, 5%             | various |             |
| C11     | 100 pF       | Capacitor, Chip, 0603, 5%             | various |             |
| C3, C9  | 0.1 $\mu$ F  | Capacitor, Chip, 0603, 5%             | various |             |
| C5, C14 | 10 $\mu$ F   | Capacitor , Chip, 6032, 10%, Tantalum | various |             |
| C6, C10 | 1000 pF      | Capacitor , Chip, 0603, NPO/COG, 5%   | various |             |

**Vcc1=Vcc2=4.5V, Pout=27dBm, Signal PAR=9.5dB**

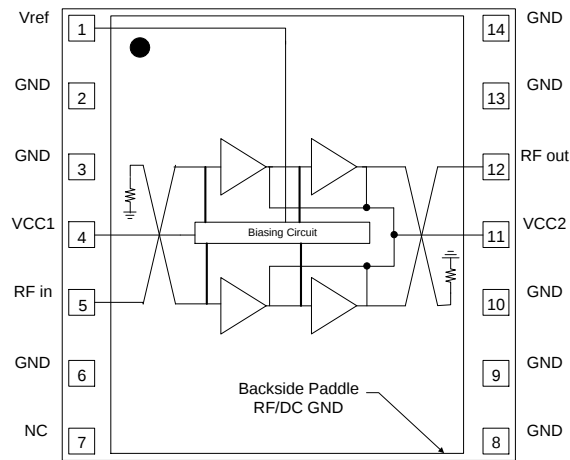
| LTE signal BW | 5MHz  | 10MHz | 15MHz | 20MHz | 2X20MHz | Units |
|---------------|-------|-------|-------|-------|---------|-------|
| ACLR1-Low     | -47.4 | -49.0 | -49.9 | -51.0 | -40.8   | dBc   |
| ACLR1-high    | -50.0 | -49.8 | -50.1 | -51.2 | -42.5   | dBc   |

## Performance Plots

Test conditions unless otherwise noted:  $V_{CC1} = V_{CC2} = +4.5V$ ,  $V_{ref} = +2.85V$ , Temp. = +25 °C



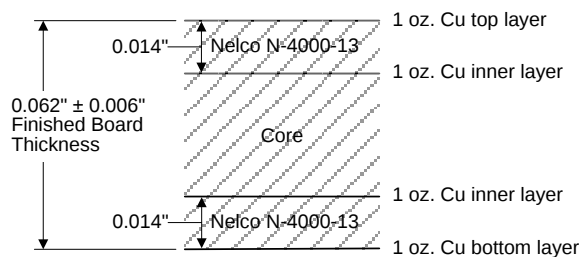
## Pin Configuration and Description



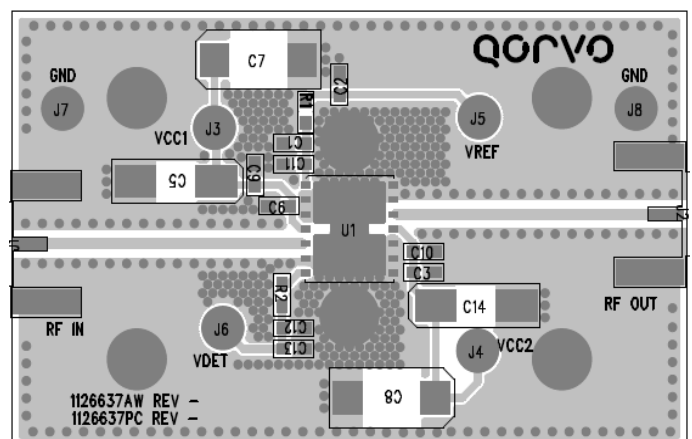
| Pin No.                   | Label     | Description                                                                     |
|---------------------------|-----------|---------------------------------------------------------------------------------|
| 1                         | Vref      | Provides reference voltage for internal active biasing circuit                  |
| 2, 3, 6, 8, 9, 10, 13, 14 | GND       | RF and DC ground.                                                               |
| 4                         | VCC1      | Bias voltage for current mirror in combination with Vref to set the bias point. |
| 5                         | RFin      | RF input pin. The DC is internally blocked at this pin.                         |
| 7                         | NC        | No internal connection. Can be left open or grounded for mounting integrity.    |
| 11                        | VCC2      | Supply to all stages.                                                           |
| 12                        | RFout     | RF output pin. The DC is internally blocked at this pin.                        |
| Backside Paddle           | RF/DC GND | RF/DC ground. See PCB Mounting Pattern for suggested footprint.                 |

## Evaluation Board PCB Information

### Qorvo PCB 1126637 Material and Stack-up



50 ohm line dimensions: width = .028\"  
spacing = .028\".

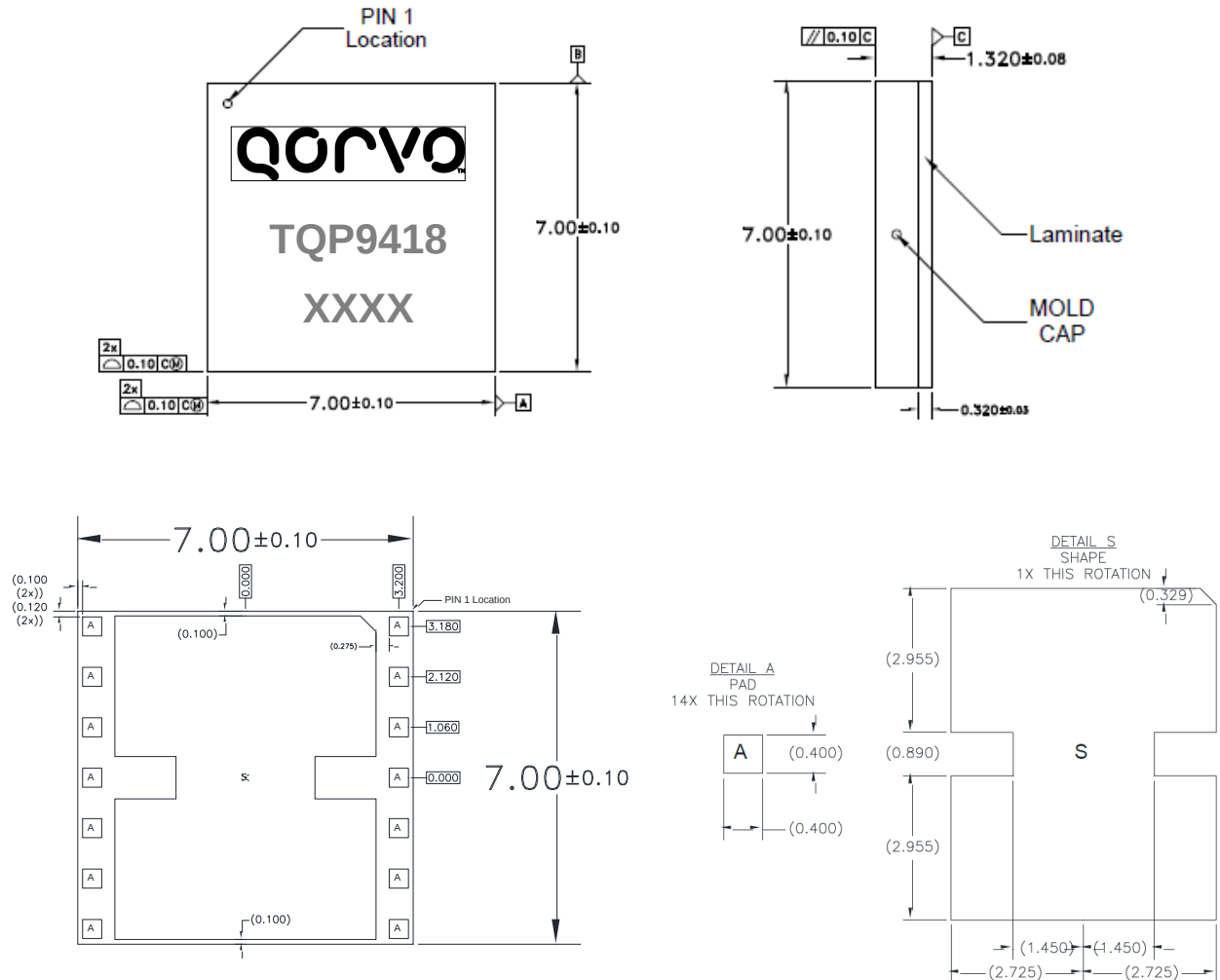


## Mechanical Information

### Package Marking and Dimensions

Marking: Part number – TQP9418

Trace code – XXXX

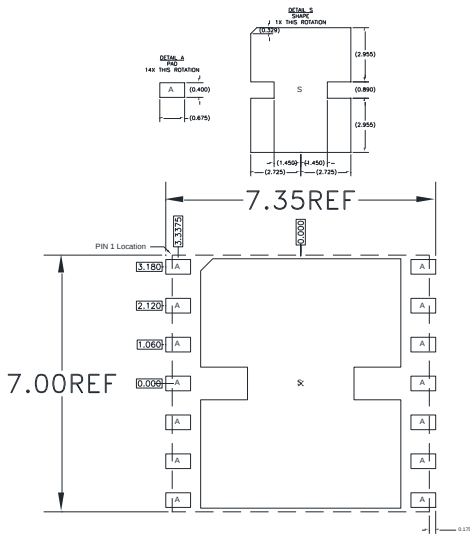


#### Notes:

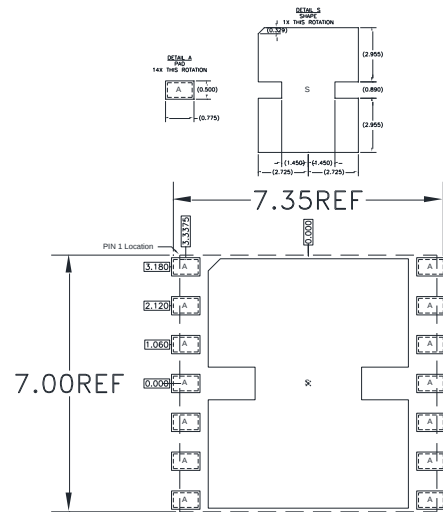
1. All dimensions are in millimeters. Angles are in degrees.
2. Dimension and tolerance formats conform to ASME Y14.4M-1994.
3. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

## PCB Mounting Pattern

Recommend PCB land-pad pattern metallization (Top View)



## RECOMMENDED LAND PATTERN



## RECOMMENDED LAND PATTERN MASK

Notes:

1. A heat sink underneath the area of the PCB for the mounted device is strictly required for proper thermal operation. Damage to the device can occur without the use of one.
2. Ground / thermal vias are critical for the proper performance of this device. Vias should use a .35mm (#80 / .0135") diameter drill and have a final plated thru diameter of .25 mm (.010").
3. Add as much copper as possible to inner and outer layers near the part to ensure optimal thermal performance.

## Handling Precautions

| Parameter                        | Rating   | Standard                 |
|----------------------------------|----------|--------------------------|
| ESD – Human Body Model (HBM)     | Class 2  | ESDA / JEDEC JS-001-2012 |
| ESD – Charged Device Model (CDM) | Class C3 | JEDEC JESD22-C101F       |
| 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 temp.) and tin/lead (245°C max. reflow temp.) soldering processes.  
 Solder profiles available upon request.

Contact plating: Electrolytic plated Au over Ni

## 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:

- Product uses RoHS Exemption 7c-I to meet RoHS Compliance requirements.
- 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
- PFOS Free
- SVHC Free

## Contact Information

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

**Web:** [www.qorvo.com](http://www.qorvo.com)

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

**Email:** [customer.support@qorvo.com](mailto:customer.support@qorvo.com)

For technical questions and application information:

**Email:** [appsupport@qorvo.com](mailto:appsupport@qorvo.com)

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