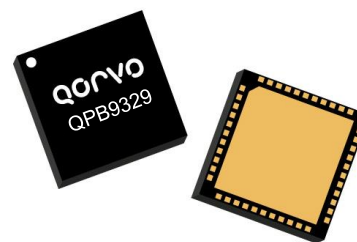




The QPB9329 is a highly integrated front-end module targeted for TDD base stations. The switch LNA module integrates a two-stage LNA and a high power switch in a dual channel configuration. The second stage LNA has a bypass mode. Power down and bypass capability for the LNAs can be controlled with control pins on the module.

The QPB9329 can be utilized across the 3.8 – 5.0 GHz range to provide 1.8 dB noise figure for operation in the receive mode and 1.0 dB insertion loss in the transmit mode at 4.5 GHz. The LNAs utilize Qorvo's high performance E-PHEMT process while the SOI technology based switch supports input RF power signals of up to 5W average power assuming 8 dB PAR. The product only needs a +5V supply to operate the high-power switch and the LNAs.

The QPB9329 is packaged in a RoHS-compliant, compact 7 mm x 7 mm surface-mount leadless package. The switch LNA module is targeted for wireless infrastructure applications configured for TDD-based MIMO architectures. The module can be used for next generation 5G or pre-5G solutions or small cell base-station applications.

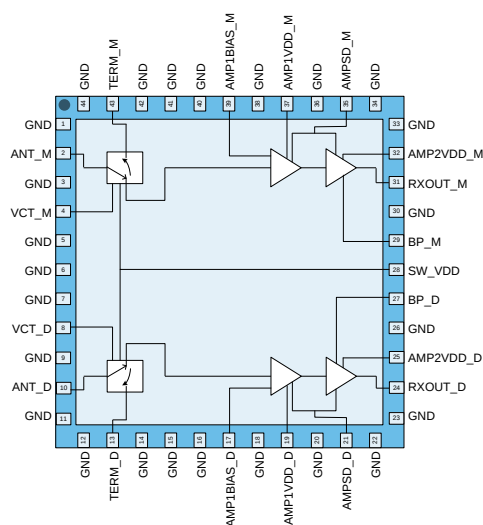


44 Pin 7 mm x 7 mm leadless SMT Package

## Key Features

- 3.8–5.0 GHz Frequency Range
- Dual Channel
- Second LNA has bypass mode
- Max RF Input power: 5W  $P_{avg}$  (8 dB PAR), TX mode
- 31.5 dB Gain (Rx mode, High Gain state)
- 16.5 dB Gain (RX mode, Low Gain state)
- +33 dBm OIP3 (Rx mode, High gain state)
- +33.5 dBm OIP3 (Rx mode, Low Gain state)
- 1.8V TTL logic compatibility
- 3–5V operation for switch and LNAs
- Compact package size, 7x7 mm

## Functional Block Diagram



Top View

## Applications

- Wireless Infrastructure
- Small cell BTS
- Pre-5G / 5G Massive MIMO systems
- TDD-based architectures

## Ordering Information

| Part No.     | Description            |
|--------------|------------------------|
| QPB9329EVB01 | Evaluation Board       |
| QPB9329TR13  | 2500 pcs on a 13" reel |

## Absolute Maximum Ratings

| Parameter                                        | Rating        |
|--------------------------------------------------|---------------|
| Storage Temperature                              | -65 to 150 °C |
| Supply Voltage (Pins 17, 19, 25, 32, 37, 39)     | +7 V          |
| Rx mode ANT Input Power (Pavg, 8 dB PAR)         | 27 dBm        |
| Tx mode ANT Input Power (Pavg, 8 dB PAR), <10sec | 39 dBm        |

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

## Recommended Operating Conditions

| Parameter                      | Min | Typ | Max   | Units |
|--------------------------------|-----|-----|-------|-------|
| LNA Voltage                    | +3  | +5  | +5.25 | V     |
| Switch V <sub>DD</sub>         | +3  | +5  | +5.5  | V     |
| T <sub>CASE</sub>              | -40 |     | +105  | °C    |
| Tj at max Tcase <sup>(1)</sup> |     |     | +136  | °C    |
| Tj at max Tcase <sup>(2)</sup> |     |     | +125  | °C    |

Notes:

1. For RX Mode operation
2. For TX Mode operation with 5W Pavg power in.

Electrical specifications are measured at specified test conditions.

Specifications are not guaranteed over all recommended operating conditions.

## Electrical Specifications

| Parameter                                             | Conditions <sup>(1)</sup>                                | Min   | Typ   | Max             | Units |
|-------------------------------------------------------|----------------------------------------------------------|-------|-------|-----------------|-------|
| Operational Frequency Range                           |                                                          | 3800  |       | 5000            | MHz   |
| Test Frequency                                        |                                                          |       | 4500  |                 | MHz   |
| Gain <sup>(2)</sup>                                   | Rx mode, High Gain state                                 |       | 31.5  |                 | dB    |
| Gain <sup>(2)</sup>                                   | RX mode, Low Gain state                                  |       | 16.5  |                 | dB    |
| Gain Flatness                                         | Rx mode, Any 100 MHz BW within band                      |       | 0.8   |                 | dB    |
| Noise Figure <sup>(2)</sup>                           | Rx mode                                                  |       | 1.8   |                 | dB    |
| Output IP3                                            | Rx mode, High Gain state<br>Pout/tone = +3dBm, Δf = 1MHz |       | +33   |                 | dBm   |
|                                                       | Rx mode, Low Gain state<br>Pout/tone = +3dBm, Δf = 1MHz  |       | +33.5 |                 | dBm   |
| OP1dB <sup>(2)</sup>                                  | RX mode, High Gain state                                 |       | +16.5 |                 | dBm   |
|                                                       | RX mode, Low Gain state                                  |       | +18   |                 | dBm   |
| Insertion Loss <sup>(2)</sup>                         | Tx mode                                                  |       | 1.1   |                 | dB    |
| Input Return Loss                                     | RX mode                                                  |       | 10    |                 | dB    |
| Output Return Loss                                    | RX mode                                                  |       | 10    |                 | dB    |
| Return Loss                                           | TX mode                                                  |       | 17    |                 | dB    |
| Switch Isolation                                      | ANT to TX in RX mode                                     |       | >25   |                 | dB    |
| Switch Isolation                                      | ANT to RX in TX mode                                     |       | >60   |                 | dB    |
| Channel Isolation                                     | ANT M/D to RX D/M                                        |       | >40   |                 | dB    |
| Channel Isolation                                     | TX-TX or RX-RX                                           |       | >40   |                 | dB    |
| Power handling (Pavg)                                 | TX mode, 8 dB PAR                                        | 5     |       |                 | W     |
| LNA Supply Voltage                                    |                                                          |       | +5    |                 | V     |
| LNA Current                                           | Rx mode, High gain state, Per channel                    |       | 120   |                 | mA    |
| LNA Current                                           | Rx mode, Low gain state, Per channel                     |       | 60    |                 | mA    |
| LNA Shutdown Current                                  | Per channel                                              |       | 6     |                 | mA    |
| LNA and Switch Control Voltage (Pins 4,8,21,27,29,35) | V <sub>low</sub>                                         | 0     |       | +0.63           | V     |
|                                                       | V <sub>high</sub>                                        | +1.17 |       | V <sub>DD</sub> | V     |
| Switch Current                                        | Tx mode                                                  |       | <0.5  |                 | mA    |
| Switch switching time                                 | ANT-TX rise time                                         |       | 890   |                 | ns    |
|                                                       | ANT-TX fall time                                         |       | 780   |                 | ns    |
|                                                       | ANT-RX rise time                                         |       | 980   |                 | ns    |
|                                                       | ANT-RX fall time                                         |       | 610   |                 | ns    |
| Thermal Resistance                                    | Tx Mode                                                  |       |       | 22.7            | °C/W  |
|                                                       | Rx High Gain Mode                                        |       |       | 23              | °C/W  |

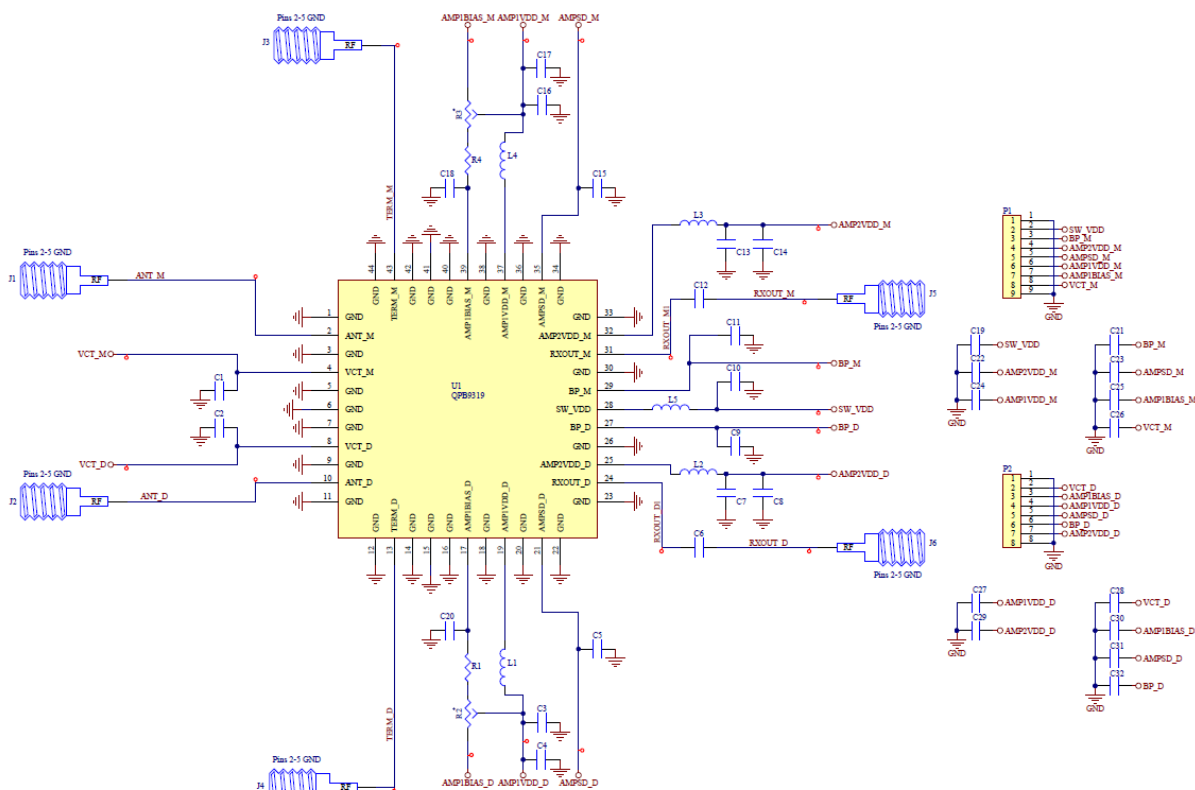
Notes:

1. Test conditions unless otherwise noted: Temp = +25 °C, 50 Ω system.
2. Trace loss de-embedded.

## Control bits settings for Switch state and Rx path gain mode.

|                           | VCT (switch control)<br>Pins 4 & 8 (J7 & J8 on EVB) | AMPSD<br>Pins 21 & 35 (J14 & J11 on EVB) | BP<br>Pins 27 & 29 (J16 & J18) |
|---------------------------|-----------------------------------------------------|------------------------------------------|--------------------------------|
| RX mode (high gain state) | 0                                                   | 0                                        | 0                              |
| RX mode (low gain state)  | 0                                                   | 0                                        | 1                              |
| TX mode                   | 1                                                   | 1                                        | 0                              |

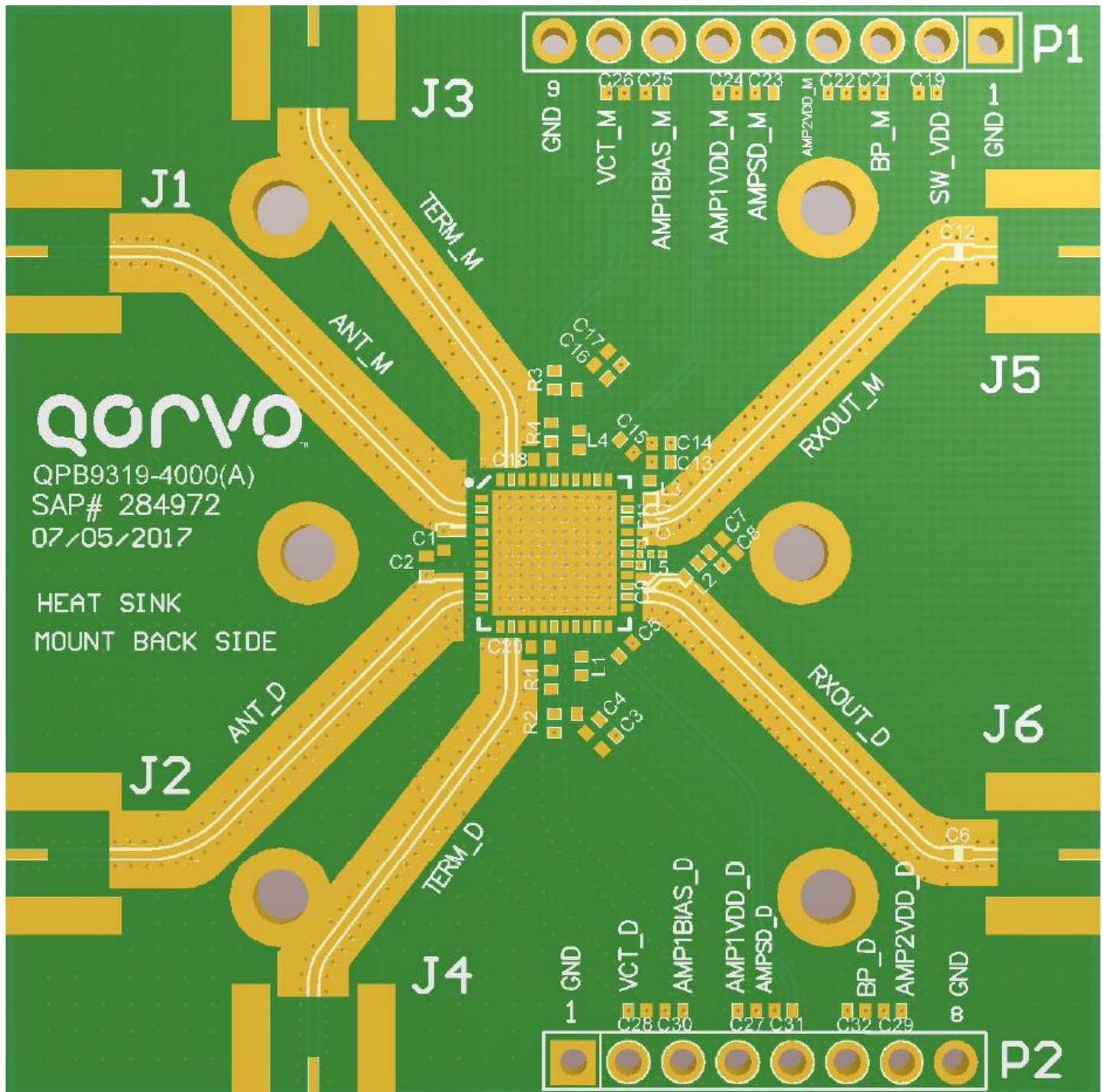
## Evaluation Board Schematic



## Bill of Material – Evaluation Board

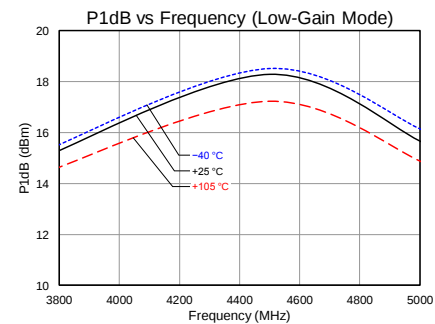
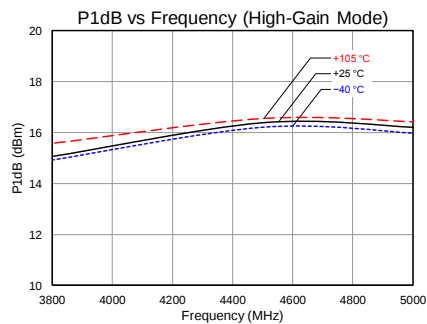
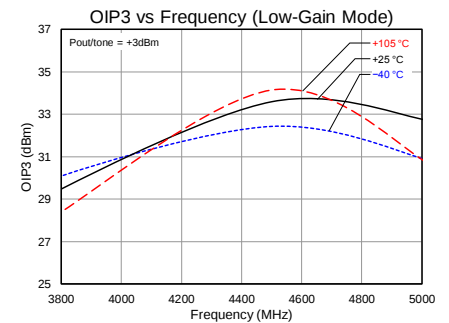
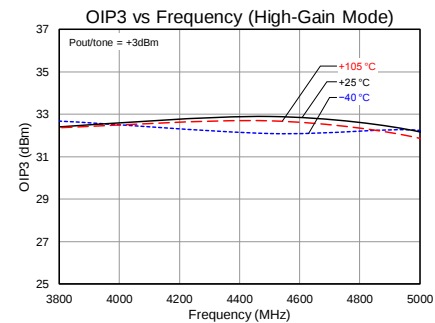
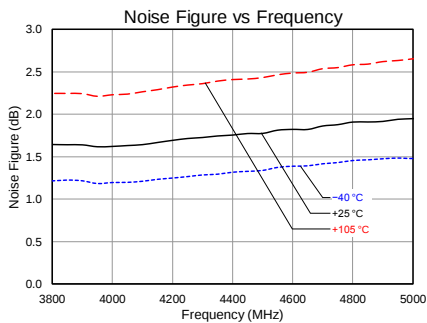
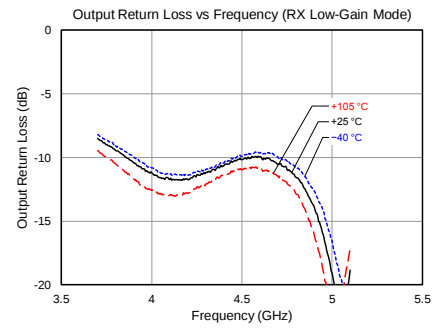
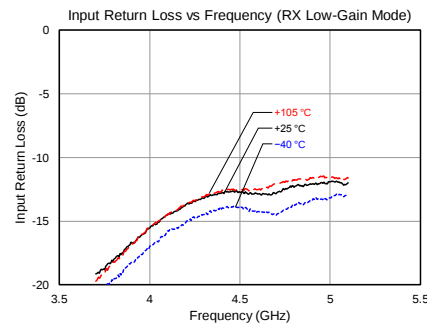
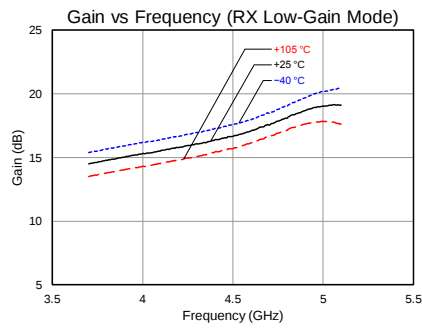
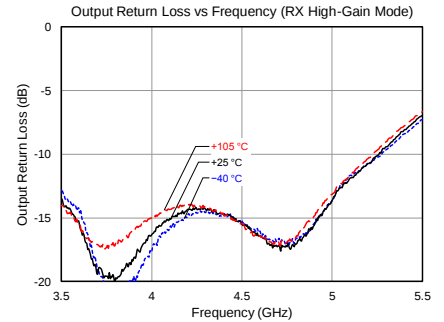
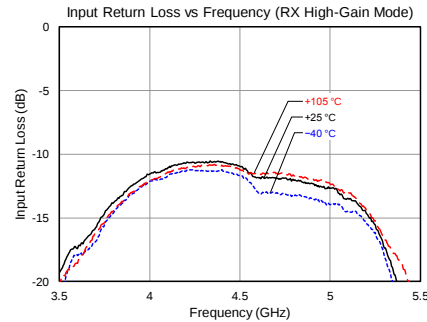
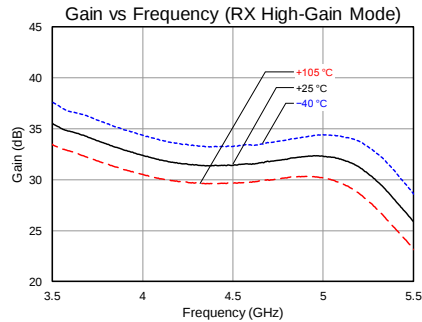
| Reference Des.                             | Value   | Description                    | Manuf.    | Part Number        |
|--------------------------------------------|---------|--------------------------------|-----------|--------------------|
| U1                                         | N/A     | Dual-Channel Switch-LNA Module | Qorvo     | QPB9329            |
| PCB                                        | n/a     | PCB, QPB9329                   |           |                    |
| C6,C12                                     | 8.2 pF  | CAP, 5%, 50V, C0G, 0402        | MURATA    | GRM1555C1H8R2CA01D |
| C22,C24,C27,C29                            | 0.1 uF  | CAP, 10%, 10V, X7R, 0402       | TAIYO     | LMK105B7104KV-F    |
| C9,C11                                     | 1000 pF | CAP, 10%, 16V, X7R, 0201       | AVX       | 0201YC102KAT2A     |
| C1,C2,C4,C5,C7,C13,C15,C16,C18,C20,C21,C32 | 1000 pF | CAP, 10%, 25V, STD, 0402       | TDK       | C1005X7R1E102K     |
| C3,C8,C14,C17                              | 1 uF    | CAP, 10%, 6.3V, X7R, 0402      | MURATA    | GRM155R70J105KA12D |
| C10                                        | 0.01 uF | CAP, 10%, 6.3V, X7R, 0201      | MURATA    | GRM033R70J103KA01D |
| R2,R3                                      | 0 Ω     | RES, 5%, 1/10W, 0402           | Kamaya    | RMCI1/16SJPTH      |
| R1,R4                                      | 5.1K Ω  | RES, 5%, 1/16W, 0402           | KOA Speer | RK73B1ETTP512J     |
| L2,L3                                      | 7.5 nH  | IND, 3%, W/W, 0402             | MURATA    | LQW15AN7N5G80D     |
| L1,L4                                      | 3.9 nH  | IND, +/-0.1nH, W/W, 0402       | MURATA    | LQW15AN3N9B00D     |
| L5                                         | 7.5 nH  | IND, 3%, T/F, 0201             | MURATA    | LQP03TG7N5H02D     |

## Evaluation Board Layout



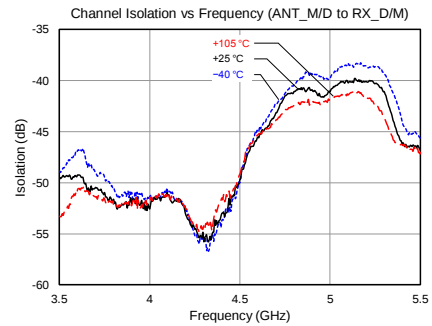
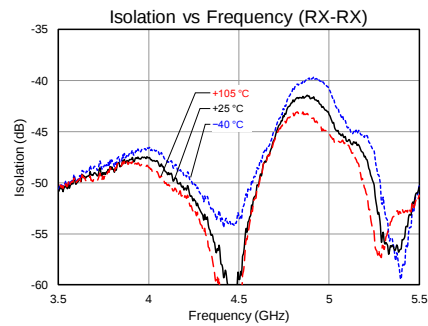
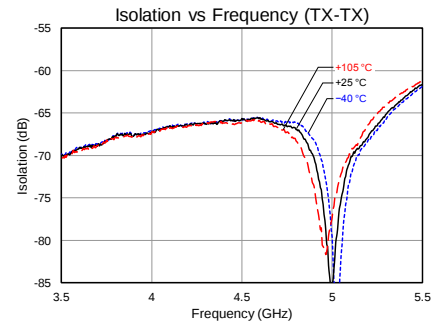
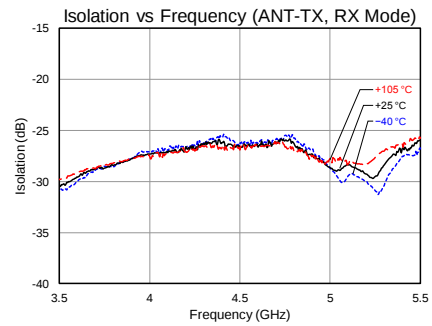
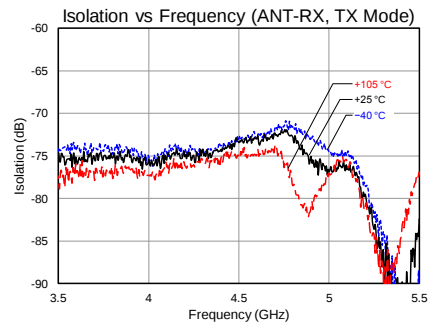
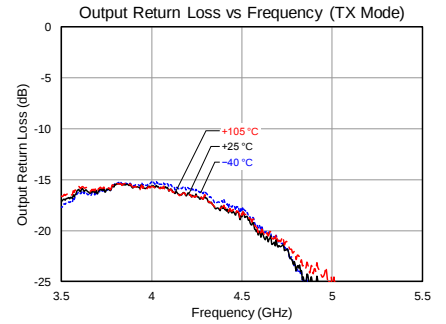
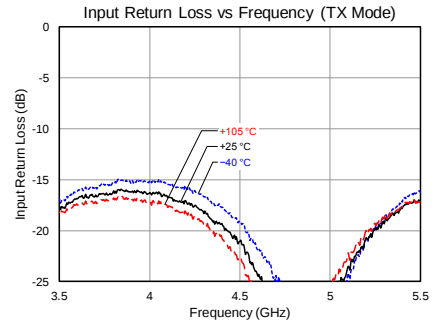
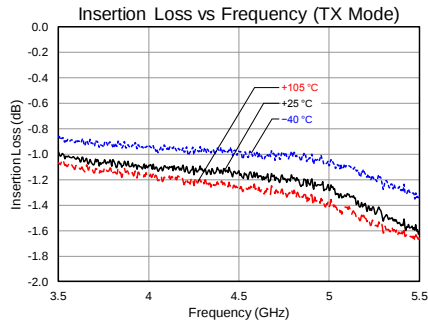
## Performance Plots

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

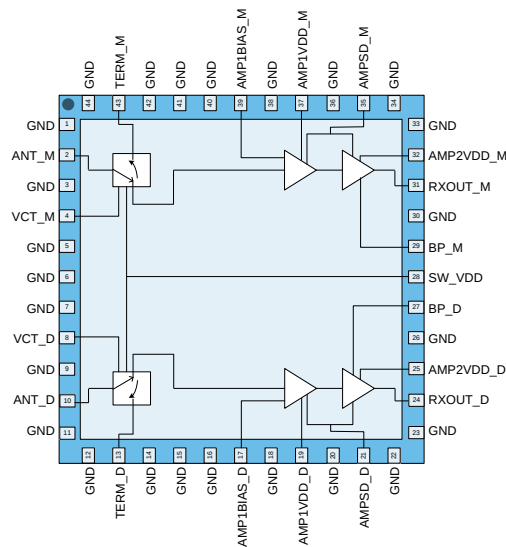


## Performance Plots Contd.

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



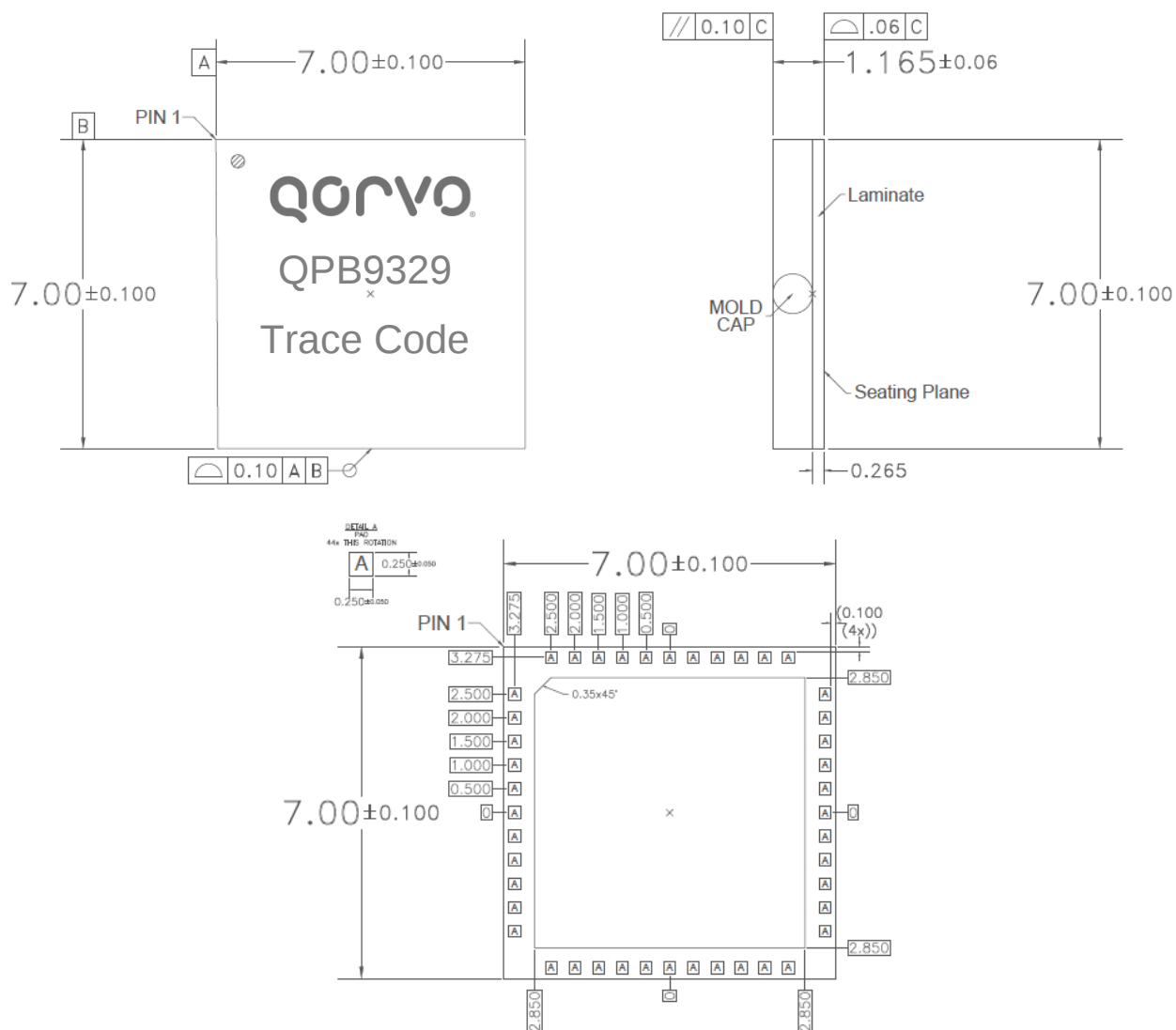
## Pin Configuration and Description



Top View

| Pin No.                                                                                      | Label      | Description                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1, 3, 5, 6, 7, 9, 11, 12, 14, 15, 16, 18, 20, 22, 23, 26, 30, 33, 34, 36, 38, 40, 41, 42, 44 | GND        | RF/DC ground connection. Recommended to be grounded on PCB to help with isolation and good mounting integrity.                                                                      |
| 2                                                                                            | ANT_M      | Main channel Antenna port of switch.                                                                                                                                                |
| 4                                                                                            | VCT_M      | Main channel switch control voltage.                                                                                                                                                |
| 8                                                                                            | VCT_D      | Diversity channel switch control voltage.                                                                                                                                           |
| 10                                                                                           | ANT_D      | Diversity channel Antenna port of switch.                                                                                                                                           |
| 13                                                                                           | TERM_D     | Diversity channel TX or termination port of switch. Switch set to ANT-TERM path can handle 5W average power provided there is a good 50 Ohm load.                                   |
| 17                                                                                           | AMP1BIAS_D | Diversity channel RX path first LNA bias control pin. External series resistor at this pin tied to VDD sets the bias point. Value of resistor can be varied to change current draw. |
| 19                                                                                           | AMP1VDD_D  | Diversity channel RX path first LNA supply voltage pin. External choke and bypass caps needed.                                                                                      |
| 21                                                                                           | AMPSD_D    | Diversity channel RX path control voltage to turn OFF both AMPs.                                                                                                                    |
| 24                                                                                           | RXOUT_D    | Diversity channel RX path RF output port. External DC block needed.                                                                                                                 |
| 25                                                                                           | AMP2VDD_D  | Diversity channel RX path second LNA supply voltage. External choke and bypass caps needed.                                                                                         |
| 27                                                                                           | BP_D       | Diversity channel RX path control voltage to switch second AMP to bypass mode.                                                                                                      |
| 28                                                                                           | SW_VDD     | Switch DC supply voltage for both channels. External bypass caps recommended.                                                                                                       |
| 29                                                                                           | BP_M       | Main channel RX path control voltage to switch second AMP to bypass mode.                                                                                                           |
| 31                                                                                           | RXOUT_M    | Main channel RX path RF output port. External DC block needed.                                                                                                                      |
| 32                                                                                           | AMP2VDD_M  | Main channel RX path second LNA supply voltage. External choke and bypass caps needed.                                                                                              |
| 35                                                                                           | AMPSD_M    | Main channel RX path control voltage to turn OFF both AMPs.                                                                                                                         |
| 37                                                                                           | AMP1VDD_M  | Main channel RX path first LNA supply voltage pin. External choke and bypass caps needed.                                                                                           |
| 39                                                                                           | AMP1BIAS_M | Main channel RX path first LNA bias control pin. External series resistor at this pin tied to VDD sets the bias point. Value of resistor can be varied to change current draw.      |
| 43                                                                                           | TERM_M     | Main channel TX or termination port of switch. Switch set to ANT-TERM path can handle 5W average power provided there is a good 50 Ohm load.                                        |
| Backside Pad                                                                                 | GND        | Ground connection. PCB vias under the device are required. Refer 'PCB Mounting Pattern' on pg. 7.                                                                                   |

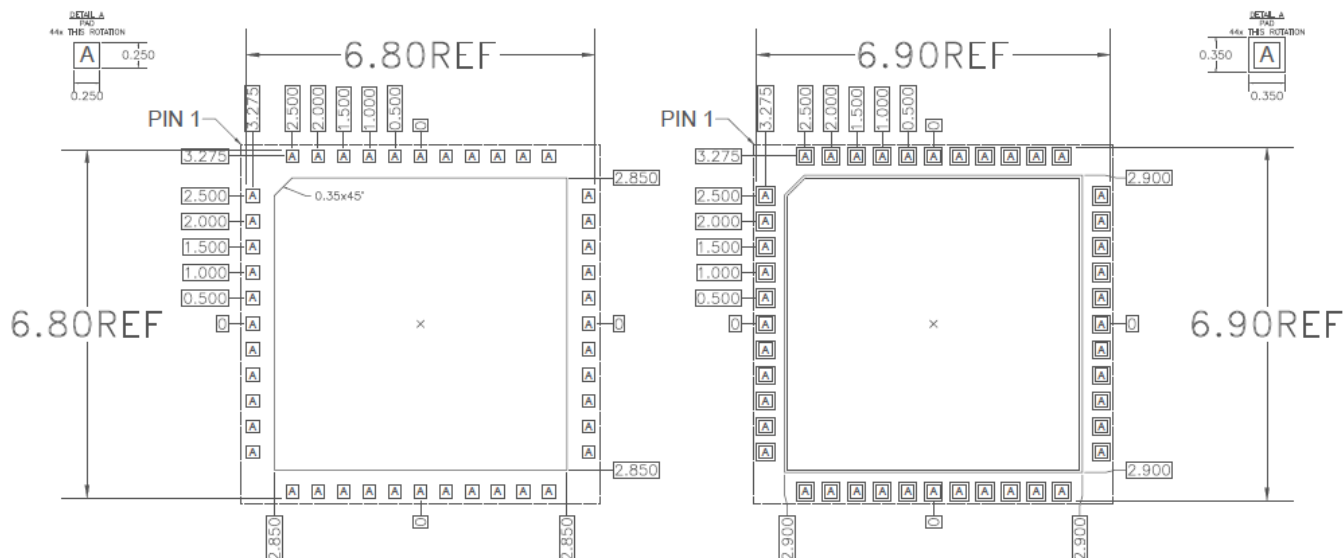
## Package Marking and Dimensions



### Notes:

1. All dimensions are in mm. 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



### Notes:

1. A heat sink underneath the area of the PCB for the mounted device is recommended for proper thermal operation.
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)     | TBD     | ESDA / JEDEC JS-001-2012 |
| ESD – Charged Device Model (CDM) | TBD     | 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: NiPdAu

## 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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