

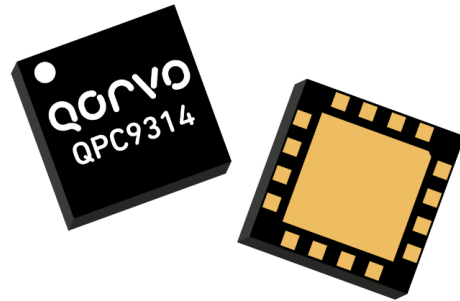
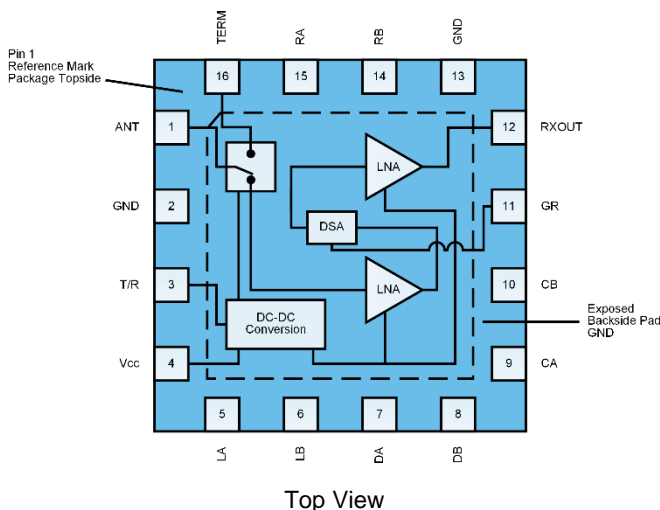
### Product Overview

The Qorvo® QPC9314 is a highly integrated front-end module targeted for TDD macro or picocell base stations. The LNA switch module integrates RF functional blocks such as a pin-diode based high power switch capable of handling up to 52 W with an LTE signal (8 dB PAR) along with two LNA stages, and a 1-bit DSA to provide a high and low gain mode. Further integration is also implemented where the pin diode driver and dc-dc converter circuits are implemented inside the module to enable only the need for an external 5 V power supply. The control voltage for the switch and gain control. mode is with 3.3 V logic.

The QPC9314 can be utilized across the 2.3-2.7 GHz range to provide 1.2 dB noise figure for operation in the receive mode and 0.5 dB insertion loss in the transmit mode. The LNAs utilize Qorvo’s high performance E-pHEMT process while the switch allows for power levels up to 330 W peak power to be routed to an external load termination.

The QPC9314 is packaged in a RoHS-compliant, compact 8x8 mm surface-mount leadless package. The switch LNA module is targeted for wireless infrastructure applications configured for TDD-based architectures.

### Functional Block Diagram



16 Pin 8 mm x 8 mm leadless SMT Package

### Key Features

- 2.3-2.7 GHz frequency range
- Integrates a high power switch, two LNA stages, a 1-bit DSA, pin diode driver circuits, and dc converter
- Ideal for TDD systems with an isolator
- Only requires a 5 V supply with 3.3 V logic Ctrl.
- Max RF Input power: 52 W Pavg (8 dB PAR)
- 33 or 24 dB gain (Rx high and Rx low gain mode)
- 1.2 dB noise figure
- +33 dBm OIP3 (Rx mode)
- 0.65 dB Insertion Loss (Tx mode)
- Compact package size, 8x8 mm

### Applications

- Wireless Infrastructure
- Macro or picocell base stations
- TDD-based architectures

### Ordering Information

| Part No.    | Description            |
|-------------|------------------------|
| QPC9314TR13 | 2500 pcs on a 13" reel |
| QPC9314SR   | 100 pcs on a 7" reel   |
| QPC9314EV/B | Evaluation board       |

## Absolute Maximum Ratings

| Parameter                          | Rating        |
|------------------------------------|---------------|
| Storage Temperature                | -50 to 150 °C |
| Max Operating Temperature          | +115 °C       |
| V <sub>CC</sub>                    | +6 V          |
| RF at ANT (Tx Mode) <sup>(1)</sup> | +47.2 dBm     |
| RF at ANT (Tx Mode) <sup>(2)</sup> | +44.2 dBm     |
| RF at ANT (Tx Mode) <sup>(3)</sup> | +46.0 dBm     |
| RF at ANT (Rx Mode) <sup>(2)</sup> | +20 dBm       |

Notes:

- 10s, 8 dB PAR, 88% duty cycle, +100°C, 1CH LTE
- Indefinitely, 8 dB PAR, 88% duty cycle, +100°C, 1CH LTE
- 20s, 8 dB PAR, 80% duty cycle, +100°C, 1CH LTE

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

## Recommended Operating Conditions

| Parameter   | Min   | Typ | Max   | Units |
|---|-------|-----|-------|-------|
| V <sub>CC</sub>   | +4.75 | +5  | +5.25 | V     |
| T/R Mode Low Voltage  | 0     |     | 0.8   | V     |
| T/R Mode High Voltage   | 2.0   |     | 3.6   | V     |
| T <sub>CASE</sub>   | -40   |     | +105  | °C    |
| T <sub>J</sub> for >10 <sup>6</sup> hours MTTF <sup>(4)</sup> |       |     | +190  | °C    |

Notes:

4. For Rx Mode operation

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

## Electrical Specifications

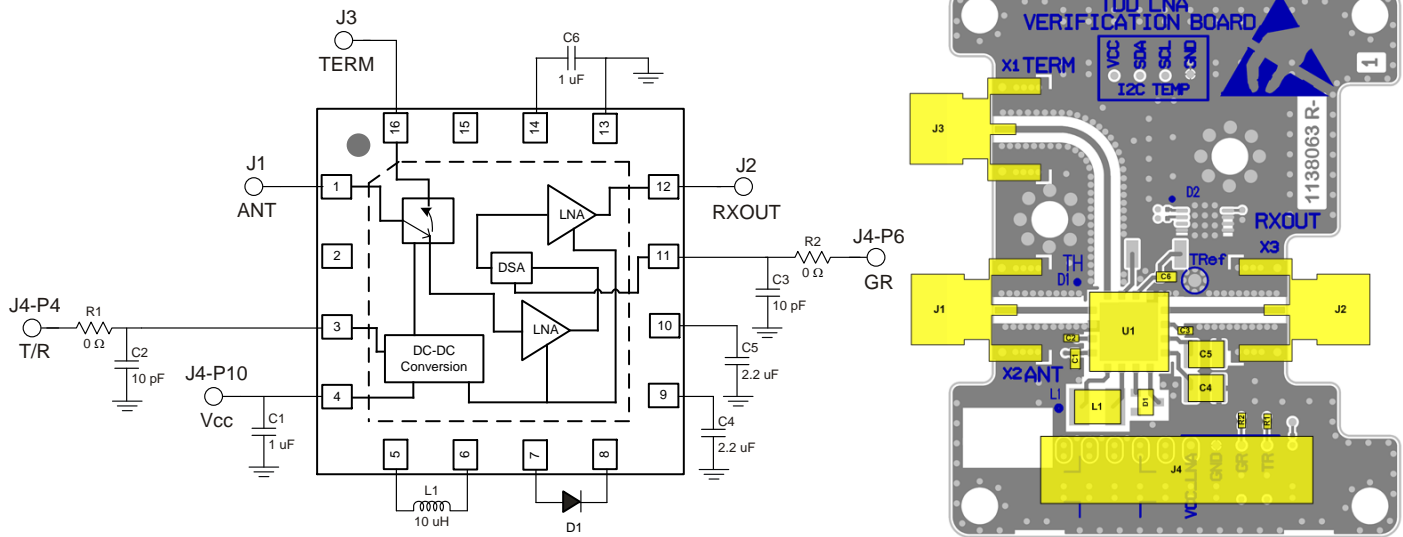
Test conditions unless otherwise noted: V<sub>CC</sub> = +5.0 V, Temp. = +25 °C, 50 Ω system

| Parameter                                | Conditions   | Min  | Typ  | Max  | Units |
|--|--|------|------|------|-------|
| Operational Frequency Range              |  | 2300 |      | 2700 | MHz   |
| Test Frequency                           |  |      | 2595 |      | MHz   |
| Gain                                     | Rx mode, high gain mode                            | 31   | 33   |      | dB    |
|  | Rx mode, low gain mode                             | 22   | 24   |      | dB    |
| Gain Flatness                            | Rx mode, 2.3-2.4 GHz or 2.5-2.7 GHz                |      | 0.4  |      | dB    |
| Noise Figure                             | Rx mode, high gain mode                            |      | 1.2  | 1.4  | dB    |
|  | Rx mode, low gain mode                             |      | 1.5  | 1.7  | dB    |
| Input IP3                                | Rx mode, high gain mode                            | -3.0 | 1.0  |      | dBm   |
|  | Rx mode, low gain mode                             |      | 8    |      | dBm   |
| Input P1dB                               | Rx mode, high gain mode                            |      | -10  |      | dBm   |
|  | Rx mode, low gain mode                             |      | -4   |      | dBm   |
| Input Return Loss                        | Rx mode, ANT port                                  | 16   | 20   |      | dB    |
| Output Return Loss                       | Rx mode, high gain mode, Rx Out port               |      | 13   |      | dB    |
| Reverse Isolation                        | Rx mode  |      | 55   |      | dB    |
| Insertion Loss                           | Tx mode  |      | 0.5  | 1.0  | dB    |
| Input P0.1dB                             | Tx mode  |      | 47.6 |      | dBm   |
| Return Loss                              | Tx mode, ANT and TERM ports                        |      | 15   |      | dB    |
| Operating Current                        | Rx mode  |      | 250  | 300  | mA    |
|  | Tx mode  |      | 140  | 180  | mA    |
| Switching Time (ANT to Rx Out)           | 50% of CTL to 10% / 90% of RF Output               |      | 1.1  |      | uS    |
| In Band Spurious Emission <sup>(5)</sup> | Rx Mode at Rx out with Pin = -49dBm <sup>(6)</sup> |      | -85  |      | dBc   |
| Out of Band Emissions <sup>(7)</sup>     | Rx Mode at Rx out from DC to 12275MHz              |      | -59  |      | dBm   |
| Thermal Resistance                       | Rx mode  |      |      | 30   | °C/W  |
|  | Tx mode  |      |      | 22   | °C/W  |

Notes:

5. Pin is a CW signal swept from 2.3 to 2.7GHz. Spec refers to any spurious mixing product that occurs from 2.3 to 2.7GHz.
6. Recommend to follow Qorvo EVB layout for lowest spur level any deviation can increase spur level.
7. Measure Pout with IBW = 4.5Mhz over frequency range with no input power applied.

## Application Circuit Schematic and Layout



## Bill of Material

| Ref Des | Value  | Description                            | Manuf.  | Part Number       |
|---------|--------|--|---------|-------------------|
| n/a     | n/a    | Printed Circuit Board                  |         |                   |
| U1      | n/a    | High Power Switch LNA Module           | Qorvo   | QPC9314           |
| R1, R2  | 0 Ω    | Resistor, Chip, 0402, 5%               | Various |                   |
| C1, C6  | 1 uF   | Capacitor, Chip, 0603, 20%, X7R        | Various |                   |
| C2, C3  | 10 pF  | Capacitor, Chip, 0402, NPO/COG, 5%     | Various |                   |
| C4, C5  | 2.2 uF | Capacitor, Chip, 1210, 100 V, 10%, X7R | Various |                   |
| D1      | n/a    | Diode 200 V 200 mA SOT23               | Various |                   |
| L1      | 10 uH  | Inductor, Power, 10 uH, 20%, 0.84 A    | TDK     | VLCF4020T-100MR85 |

## Logic Table

| Parameter | High        | Low          |
|-----------|-------------|--------------|
| T/R       | Rx Mode     | Tx Mode      |
| GR        | Rx Low Gain | Rx High Gain |

## Typical Performance – Rx Mode (High Gain)

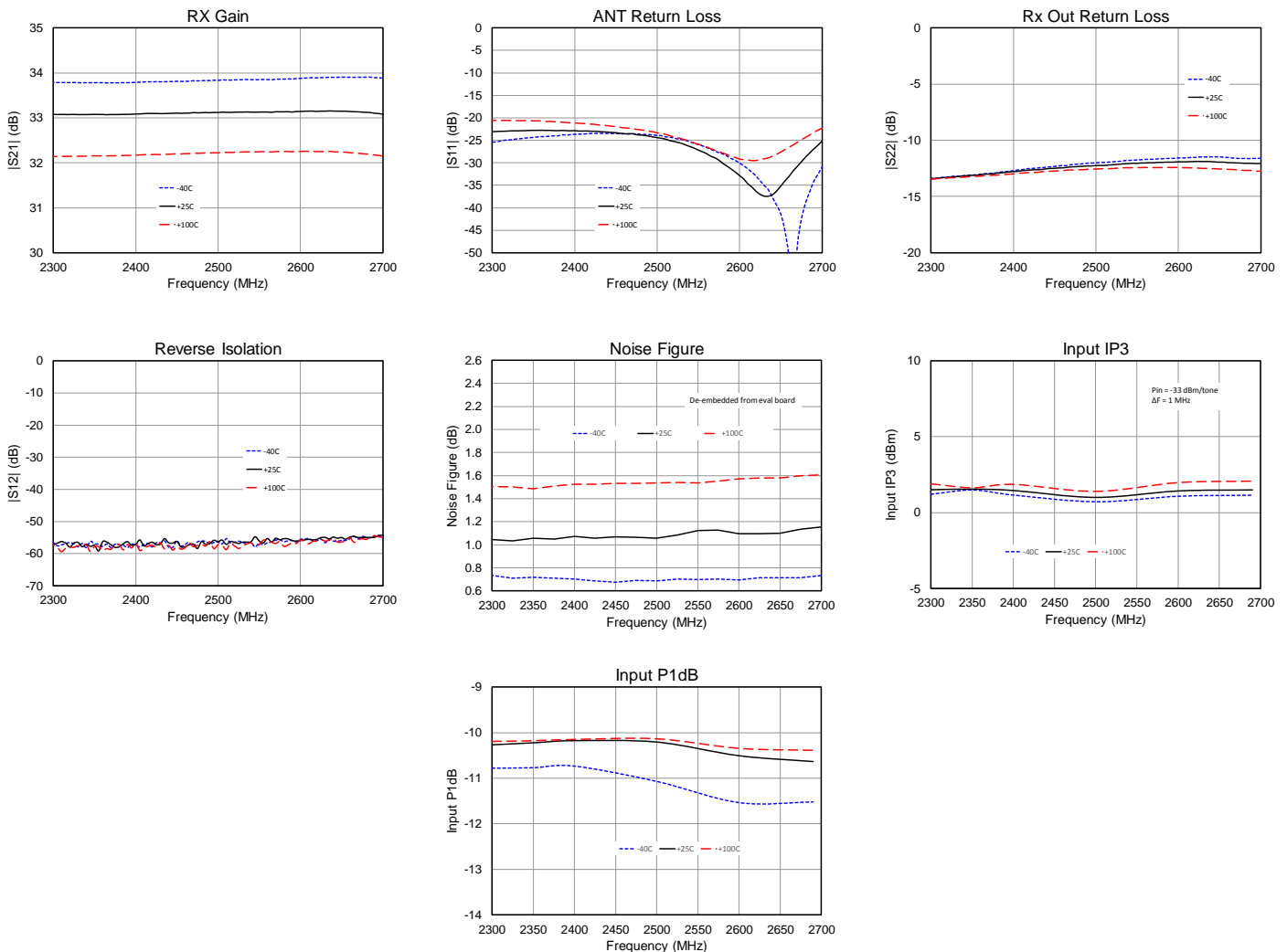
| Parameter         | Conditions <sup>(1)</sup>             | Typical Value |       |       | Units |
|-------------------|---------------------------------------|---------------|-------|-------|-------|
| Frequency         |                                       | 2300          | 2500  | 2700  | MHz   |
| Gain              |                                       | 33            | 33    | 33    | dB    |
| Input IP3         | Pin = -33 dBm/tone, Δf=1 MHz          | +1.5          | +1.0  | +1.5  | dBm   |
| Input P1dB        |                                       | -10.2         | -10.2 | -10.7 | dBm   |
| Noise Figure      | De-embedded from Evaluation board PCB | 1.1           | 1.1   | 1.2   | dB    |
| Return Loss       | ANT port                              | 20            | 20    | 20    | dB    |
| Return Loss       | Rx Out port                           | 13            | 12    | 12    | dB    |
| Reverse Isolation | Rx Out to ANT port                    | 56            | 55    | 54    | dB    |

**Notes:**

1. Test conditions unless otherwise noted:  $V_{CC} = +5.0\text{ V}$ ,  $T/R = 3\text{ V}$ ,  $GR = 0\text{ V}$ ,  $Temp. = +25\text{ }^\circ\text{C}$

## Performance Plots – Rx Mode (High Gain)

Test conditions unless otherwise noted:  $V_{CC} = +5.0\text{ V}$ ,  $T/R = 3\text{ V}$ ,  $GR = 0\text{ V}$ ;  $Temp. = +25\text{ }^\circ\text{C}$



## Typical Performance – Rx Mode (Low Gain)

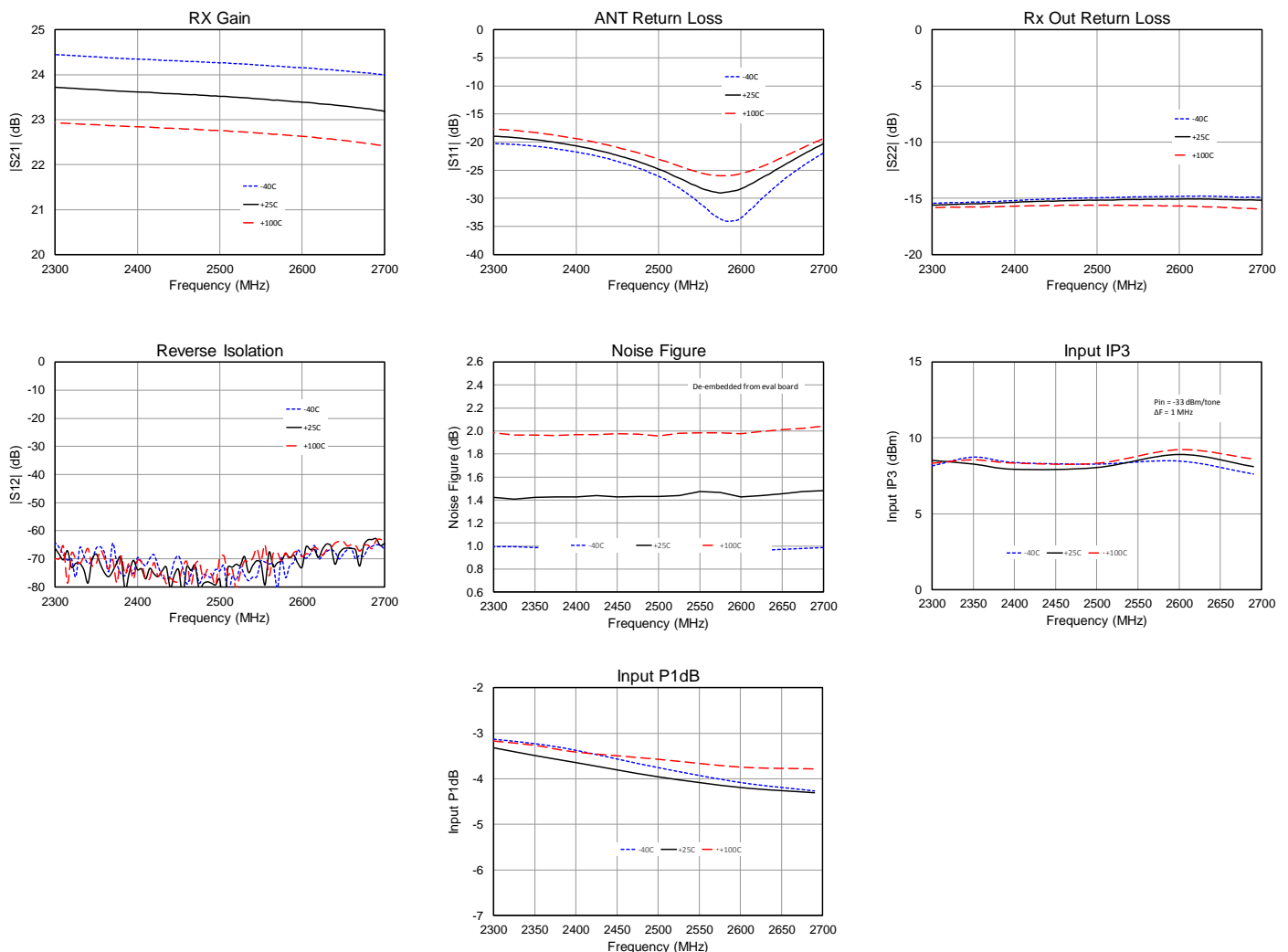
| Parameter         | Conditions <sup>(1)</sup>             | Typical Value |      |      | Units |
|-------------------|---------------------------------------|---------------|------|------|-------|
| Frequency         |                                       | 2300          | 2500 | 2700 | MHz   |
| Gain              |                                       | 23.7          | 23.5 | 23.2 | dB    |
| Input IP3         | Pin = -33 dBm/tone, Δf=1 MHz          | +7.8          | +7.7 | +7.7 | dBm   |
| Input P1dB        |                                       | -3.3          | -4.0 | -4.3 | dBm   |
| Noise Figure      | De-embedded from Evaluation board PCB | 1.4           | 1.4  | 1.5  | dB    |
| Return Loss       | ANT port                              | 19            | 20   | 20   | dB    |
| Return Loss       | Rx Out port                           | 15            | 15   | 15   | dB    |
| Reverse Isolation | Rx Out to ANT port                    | 65            | 70   | 62   | dB    |

**Notes:**

- Test conditions unless otherwise noted:  $V_{CC} = +5.0\text{ V}$ ,  $T/R = 3\text{ V}$ ,  $GR = 3\text{ V}$ ,  $Temp. = +25\text{ }^{\circ}\text{C}$

## Performance Plots – Rx Mode (Low Gain)

Test conditions unless otherwise noted:  $V_{CC} = +5.0\text{ V}$ ,  $T/R = 3\text{ V}$ ,  $GR = 3\text{ V}$ ;  $Temp. = +25\text{ }^{\circ}\text{C}$



## Typical Performance – Tx Mode

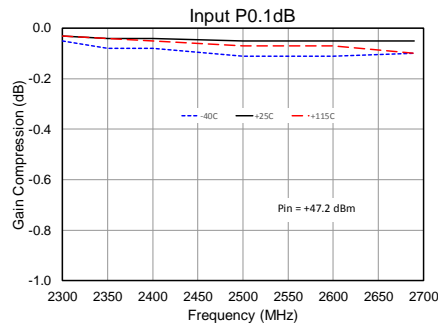
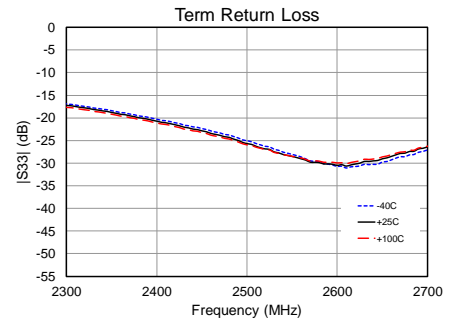
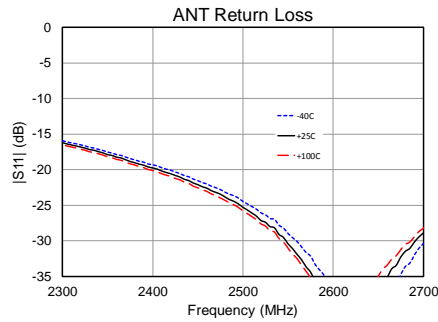
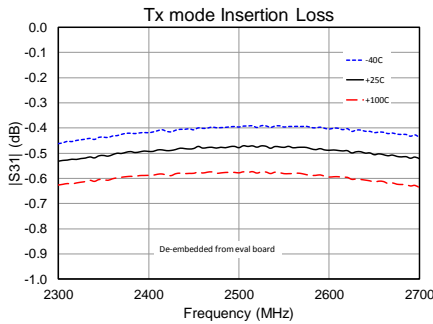
| Parameter         | Conditions <sup>(1)</sup>             | Typical Value |      |      | Units |
|-------------------|---------------------------------------|---------------|------|------|-------|
| Frequency         |                                       | 2300          | 2500 | 2700 | MHz   |
| Insertion Loss    | De-embedded from Evaluation board PCB | 0.5           | 0.5  | 0.5  | dB    |
| Input Compression | Pin = +47.2 dBm                       | 0.05          | 0.07 | 0.07 | dB    |
| Return Loss       | ANT port                              | 16            | 20   | 20   | dB    |
| Return Loss       | TERM port                             | 17            | 20   | 20   | dB    |

Notes:

1. Test conditions unless otherwise noted:  $V_{CC} = +5.0\text{ V}$ ,  $T/R = 0\text{ V}$ ,  $GR = 0\text{ V}$ , Temp. = +25 °C

## Performance Plots – Tx Mode

Test conditions unless otherwise noted:  $V_{CC} = +5.0\text{ V}$ ,  $T/R = 0\text{ V}$ ,  $GR = 0\text{ V}$ ; Temp. = +25 °C. Evaluation board PCB loss = 0.3dB.

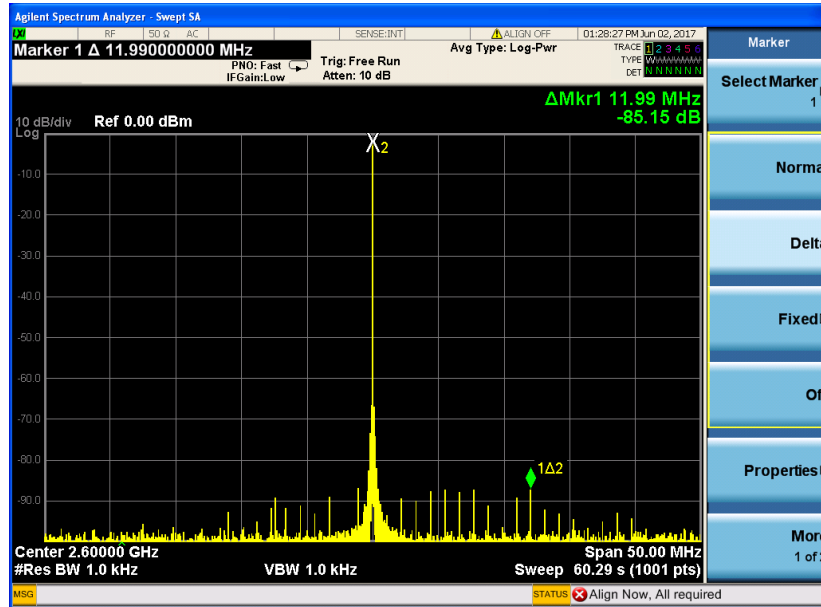


## Application Circuit for Reduced Spurious

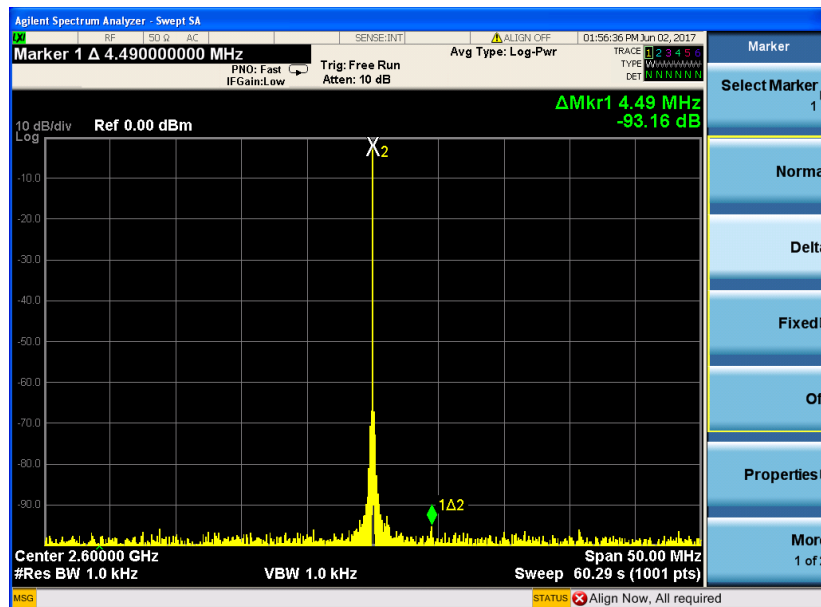
This section describes an alternative way to route the DC-DC converter signals for further improvement of in-band spurious emissions.

### Spurious Performance – Modified PCB

Test conditions unless otherwise noted:  $V_{CC} = +5.0\text{ V}$ ,  $T/R = 0\text{ V}$ ,  $R_{Fin} = -35\text{ dBm CW}$ ;  $Temp. = +25\text{ }^\circ\text{C}$

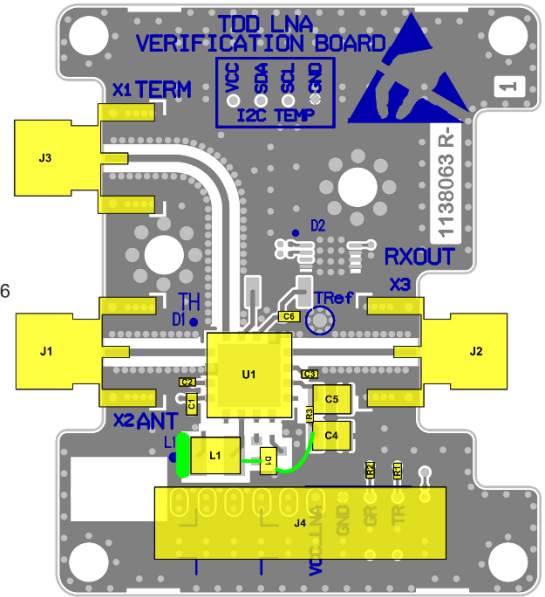
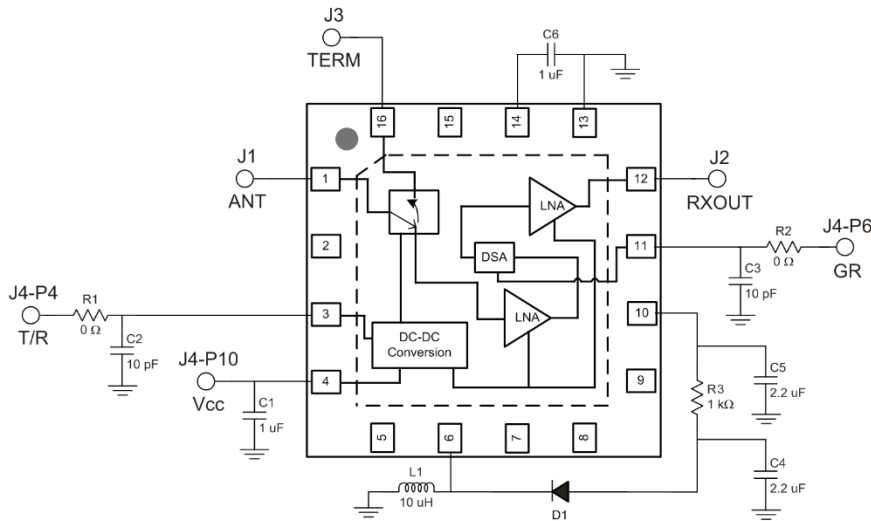


Original PCB Configuration



Modified PCB Configuration

**Application Circuit Schematic and Layout – Modified PCB**



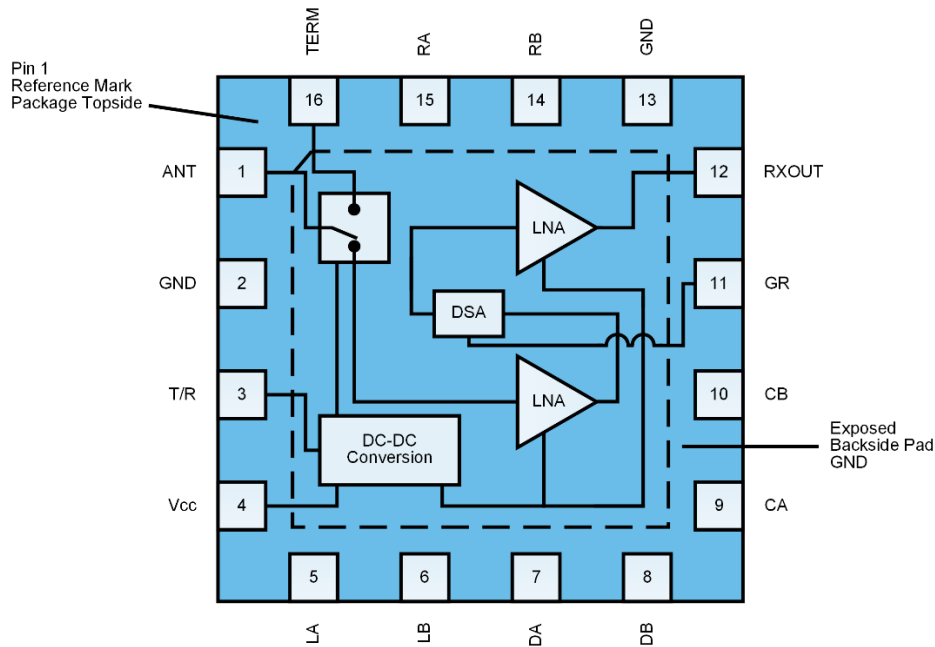
Note:  
R3 is the only additional component. All other parts are same as unmodified Evaluation Board

**Bill of Material – Modified PCB**

| Ref Des | Value  | Description                            | Manuf.  | Part Number       |
|---------|--------|--|---------|-------------------|
| n/a     | n/a    | Printed Circuit Board                  |         |                   |
| U1      | n/a    | High Power Switch LNA Module           | Qorvo   | QPB9325           |
| R1, R2  | 0 Ω    | Resistor, Chip, 0402, 5%               | Various |                   |
| C1, C6  | 1 uF   | Capacitor, Chip, 0603, 20%, X7R        | Various |                   |
| C2, C3  | 10 pF  | Capacitor, Chip, 0402, NPO/COG, 5%     | Various |                   |
| C4, C5  | 2.2 uF | Capacitor, Chip, 1210, 100 V, 10%, X7R | Various |                   |
| D1      | n/a    | Diode 200 V 200 mA SOT23               | Various |                   |
| L1      | 10 uH  | Inductor, Power, 10 uH, 20%, 0.84 A    | TDK     | VLCF4020T-100MR85 |
| R3      | 1 kΩ   | Resistor, Chip, 0402, 5%               | Various |                   |



## Pin Configuration and Description

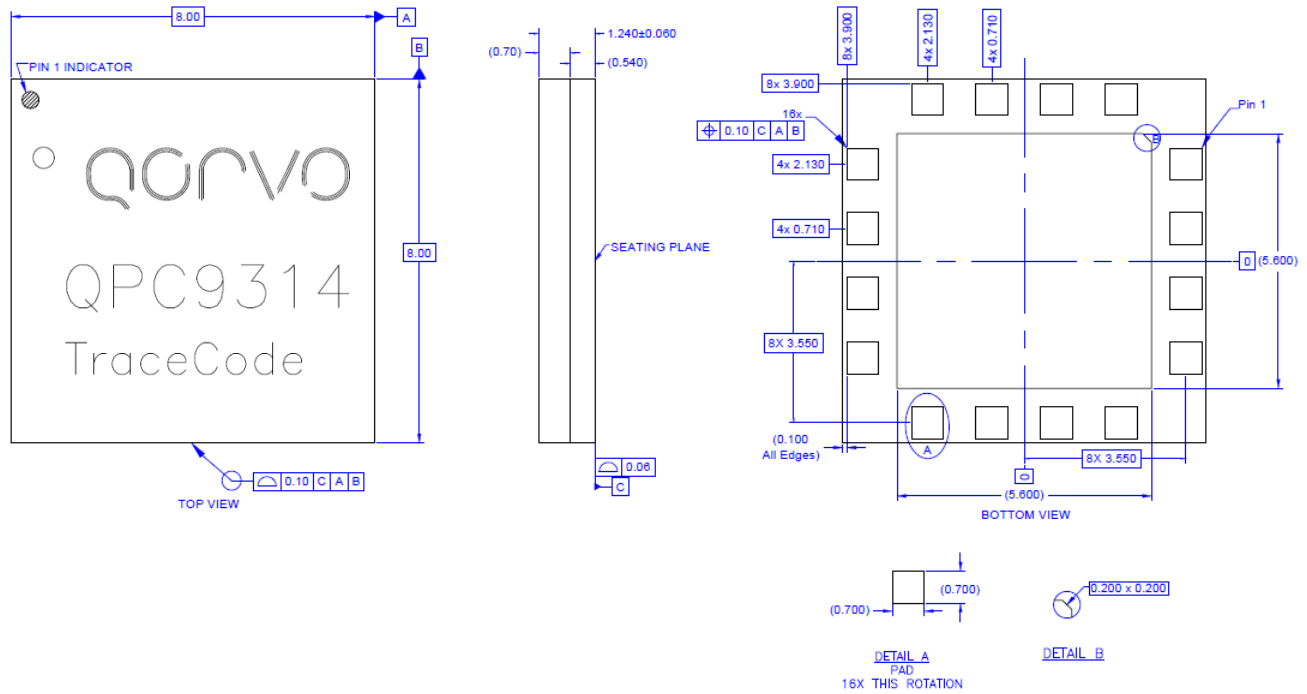


Top View

| Pin No.       | Label           | Description  |
|---------------|-----------------|--|
| 1             | ANT             | RF antenna input/output port 50 ohms.  |
| 2, 13, 14, 15 | NC              | No Connection.   |
| 3             | T/R             | Switch Control, Tx mode Low state, Rx mode High state.   |
| 4             | V <sub>cc</sub> | DC Power Supply Voltage.   |
| 5             | LA              | External inductor connection for internal power supply.  |
| 6             | LB              | External inductor connection for internal power supply.  |
| 7             | DA              | External diode anode connection for internal power supply.   |
| 8             | DB              | External diode cathode connection for internal power supply.   |
| 9             | CA              | External bypass capacitor connection.  |
| 10            | CB              | External bypass capacitor connection.  |
| 11            | GR              | Rx mode Gain control, High = Low gain mode, Low = High gain mode.  |
| 12            | Rx OUT          | RF LNA output port 50 ohms.  |
| 16            | TERM            | RF termination port 50 ohms.   |
| Backside Pad  | GND             | Ground connection. The back side of the package should be connected to the ground plan though as short of a connection as possible. PCB via holes under the device are required. |

## Package Marking and Dimensions

Marking: Part number – QPC9314  
 Trace Code – Assigned by assembly sub-contractor



- Notes:
1. All dimensions are in microns. 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 1C | 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 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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[RFFM8250](#) [RFFM6500](#) [RFFM8204](#) [RF6514](#) [RFFM4204](#) [RF6599](#) [RF6569](#) [RFFM4501F](#) [RFFM6907](#) [RFFM6403](#)  
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[RFFM4501FTR7](#) [RFFM8250BTR7](#) [RFFM8250TR7](#) [RFFM6500TR13](#) [RFFM8202TR7](#) [RF6505TR13](#) [RFFM6204TR7](#)  
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[RFFM6201SR](#) [RF6514TR7](#) [RFFM3482QSR](#) [RFFM4501FSR](#) [RFFM4211TR7](#) [RFFM4200SR](#) [RF6569SR](#)  
[RFFM4503TR7](#) [RFFM4503SR](#) [RFFM4204SR](#) [RFFM4501ESR](#) [RFFM5765QSR](#) [RFFM4555SR](#) [RF6575SR](#)  
[RFFM6204SR](#) [RFFM6403SR](#) [RFFM8500QSR](#) [RFFM6406SR](#) [RFFM8250QSR](#) [RFFM8250QTR7](#) [RFFM8500SR](#)  
[RFFM8550SR](#) [RFFM8202SR](#) [RFFM8504SR](#) [RFFM6907SR](#) [RFFM8209SR](#) [RFFM8204SR](#) [RFFM8511SR](#)  
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