

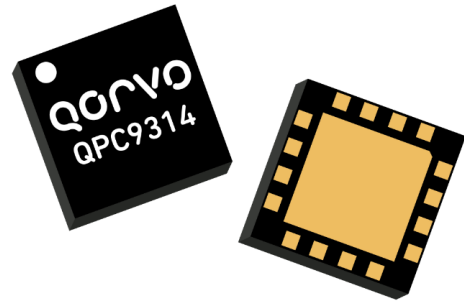
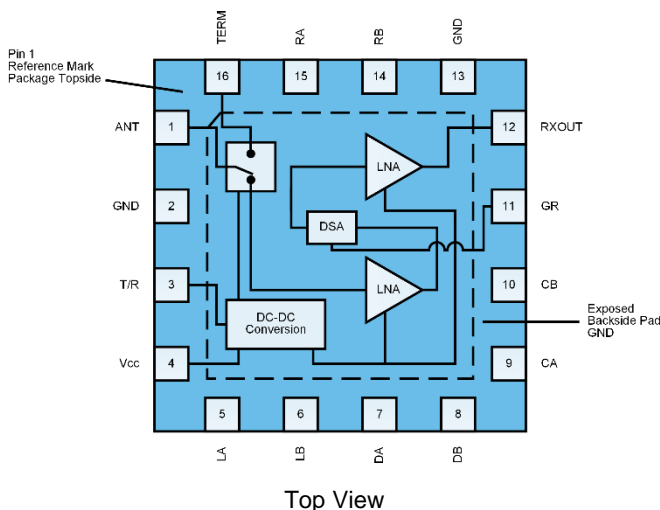
Product Overview

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 _{CC}	+6 V
RF at ANT (Tx Mode) ⁽¹⁾	+47.2 dBm
RF at ANT (Tx Mode) ⁽²⁾	+44.2 dBm
RF at ANT (Tx Mode) ⁽³⁾	+46.0 dBm
RF at ANT (Rx Mode) ⁽²⁾	+20 dBm

Notes:

1. 10s, 8 dB PAR, 88% duty cycle, +100°C, 1CH LTE
2. Indefinitely, 8 dB PAR, 88% duty cycle, +100°C, 1CH LTE
3. 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 _{CC}	+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 _{CASE}	-40		+105	°C
T _J for >10 ⁶ hours MTTF ⁽⁴⁾			+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

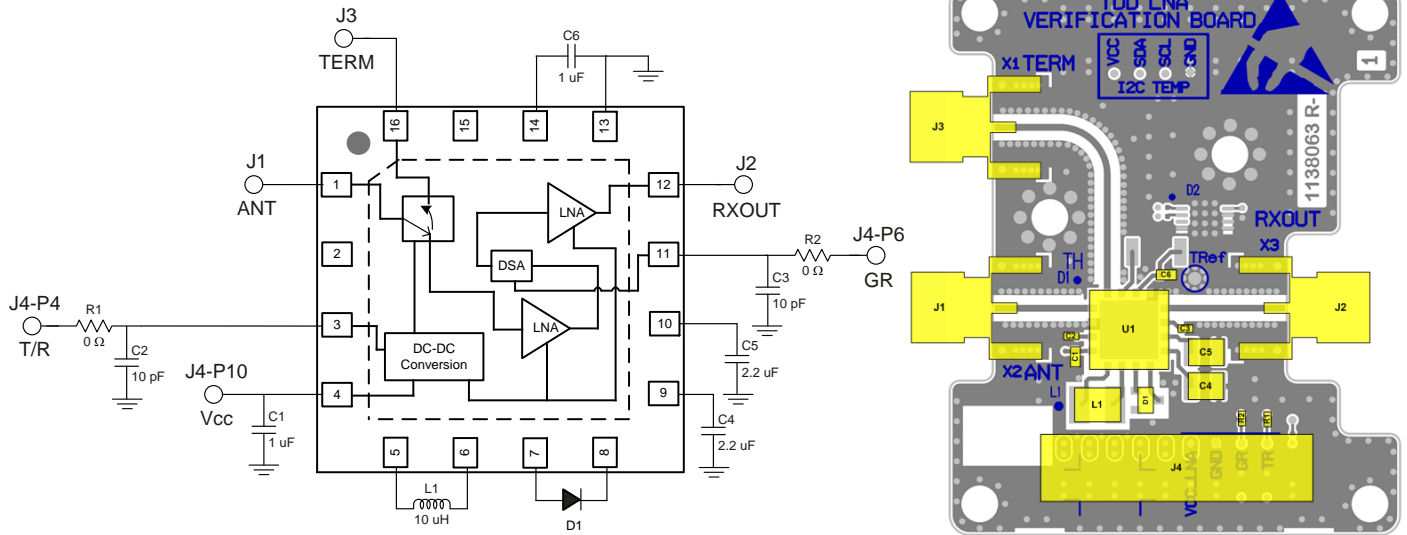
Test conditions unless otherwise noted: V_{CC} = +5.0 V, Temp. = +25 °C, 50 Ω system

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 ⁽⁵⁾	Rx Mode at Rx out with Pin = -49dBm ⁽⁶⁾		-85		dBc
Out of Band Emissions ⁽⁷⁾	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)

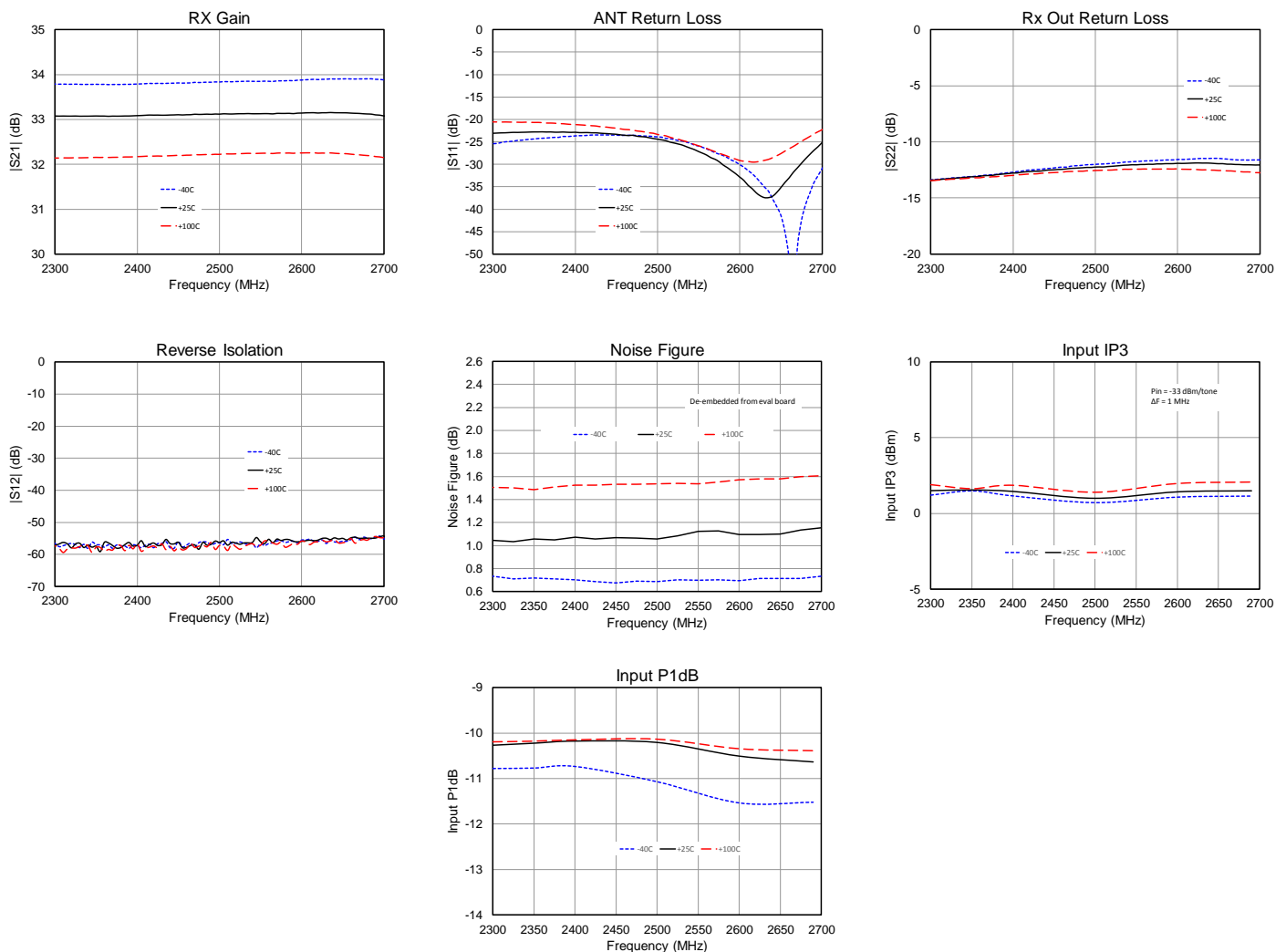
Parameter	Conditions ⁽¹⁾	Typical Value			Units
Frequency		2300	2500	2700	MHz
Gain		33	33	33	dB
Input IP3	Pin = -33 dBm/tone, Δf=1 MHz	+1.5	+1.0	+1.5	dBm
Input P1dB		-10.2	-10.2	-10.7	dBm
Noise Figure	De-embedded from Evaluation board PCB	1.1	1.1	1.2	dB
Return Loss	ANT port	20	20	20	dB
Return Loss	Rx 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)

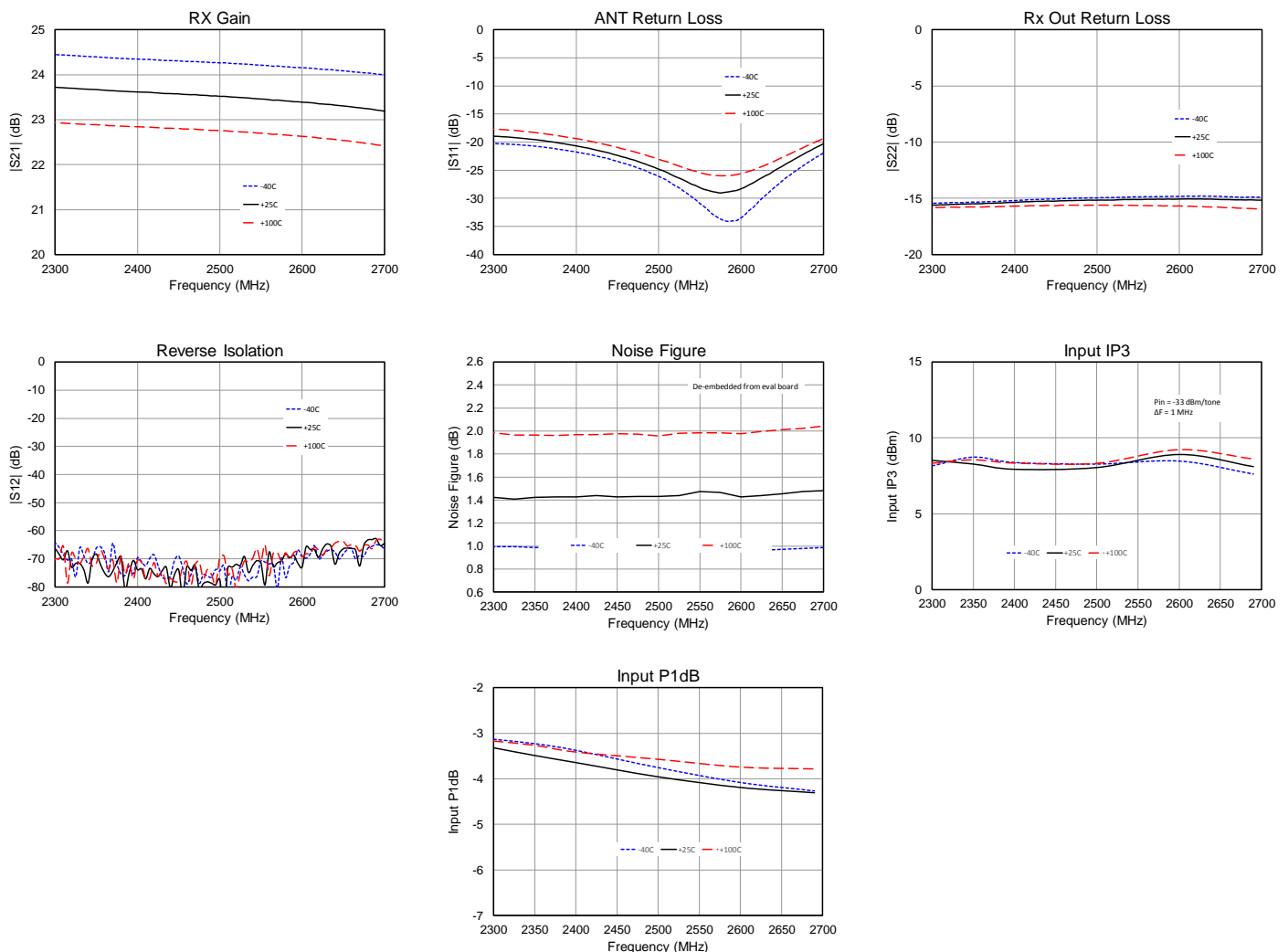
Parameter	Conditions ⁽¹⁾	Typical Value			Units
Frequency		2300	2500	2700	MHz
Gain		23.7	23.5	23.2	dB
Input IP3	Pin = -33 dBm/tone, Δf=1 MHz	+7.8	+7.7	+7.7	dBm
Input P1dB		-3.3	-4.0	-4.3	dBm
Noise Figure	De-embedded from Evaluation board PCB	1.4	1.4	1.5	dB
Return Loss	ANT port	19	20	20	dB
Return Loss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

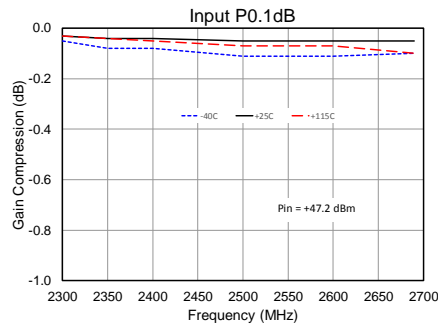
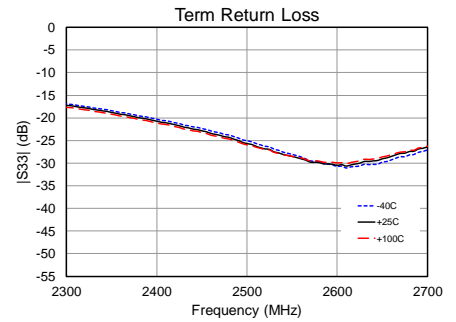
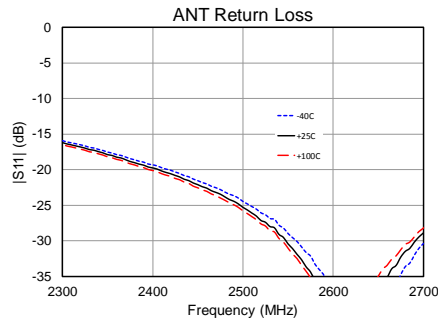
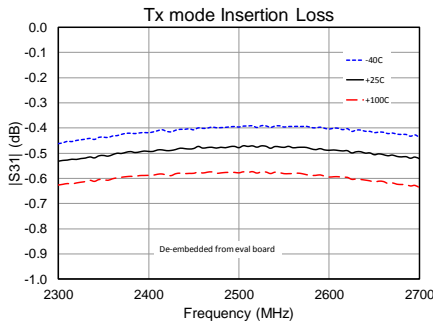
Parameter	Conditions ⁽¹⁾	Typical Value			Units
Frequency		2300	2500	2700	MHz
Insertion Loss	De-embedded from Evaluation board PCB	0.5	0.5	0.5	dB
Input Compression	Pin = +47.2 dBm	0.05	0.07	0.07	dB
Return Loss	ANT port	16	20	20	dB
Return Loss	TERM port	17	20	20	dB

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.

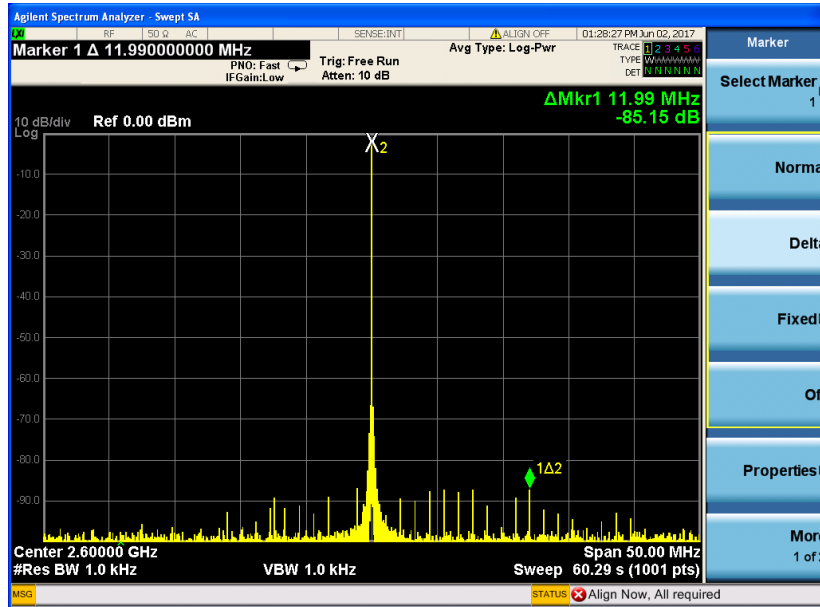


Application Circuit for Reduced Spurious

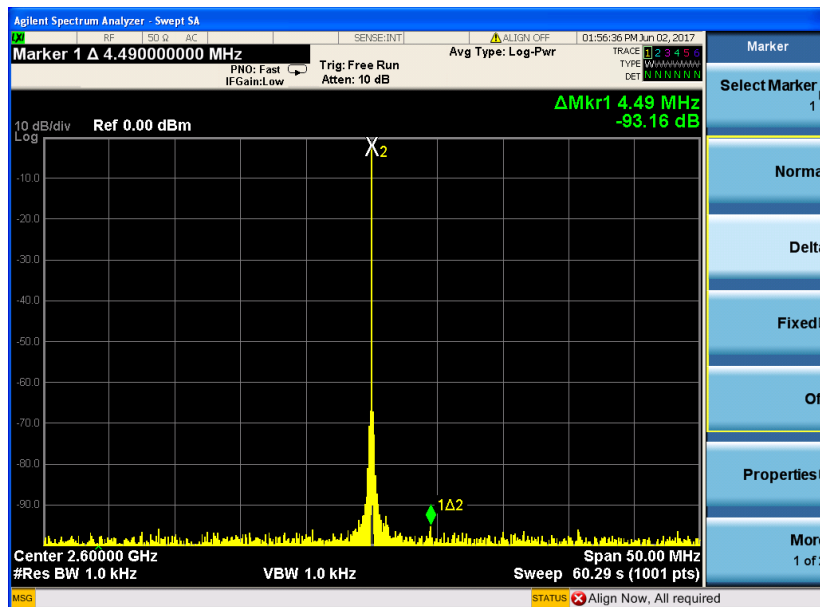
This section describes an alternative way to route the DC-DC converter signals for further improvement of in-band spurious emissions.

Spurious Performance – Modified PCB

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

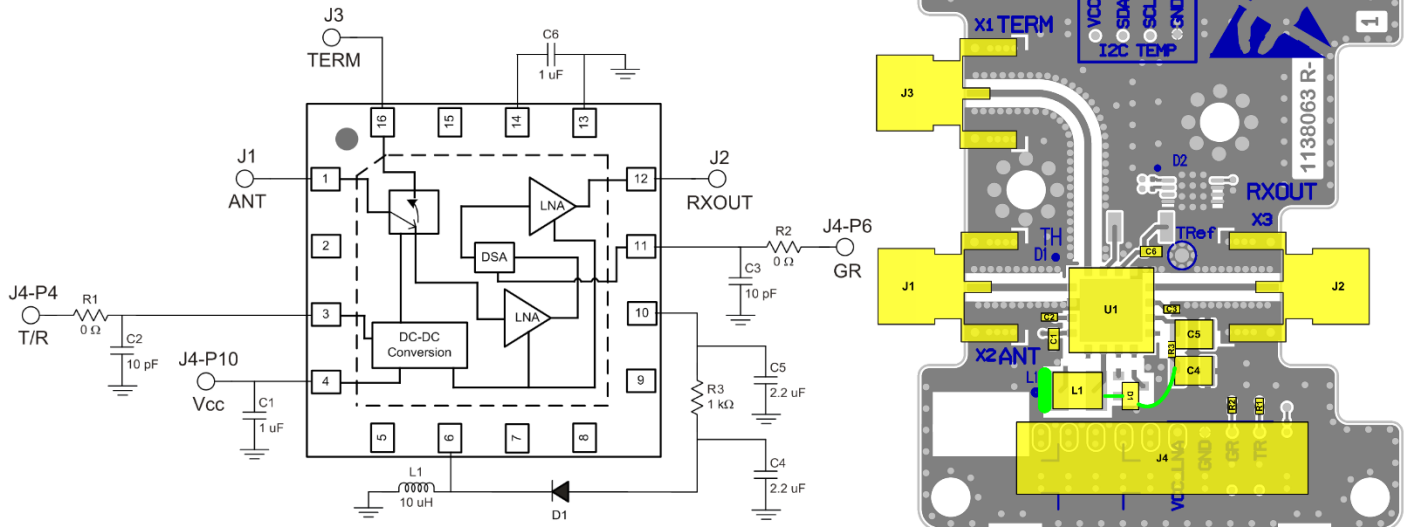


Original PCB Configuration



Modified PCB Configuration

Application Circuit Schematic and Layout – Modified PCB

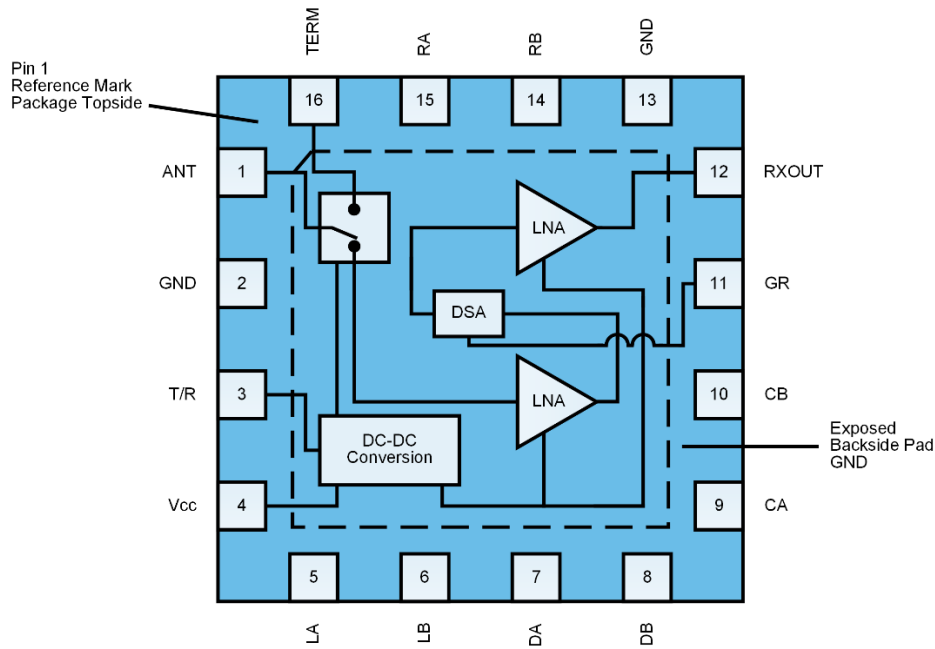


Note:
R3 is the only additional component. All other parts are same as unmodified Evaluation Board

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

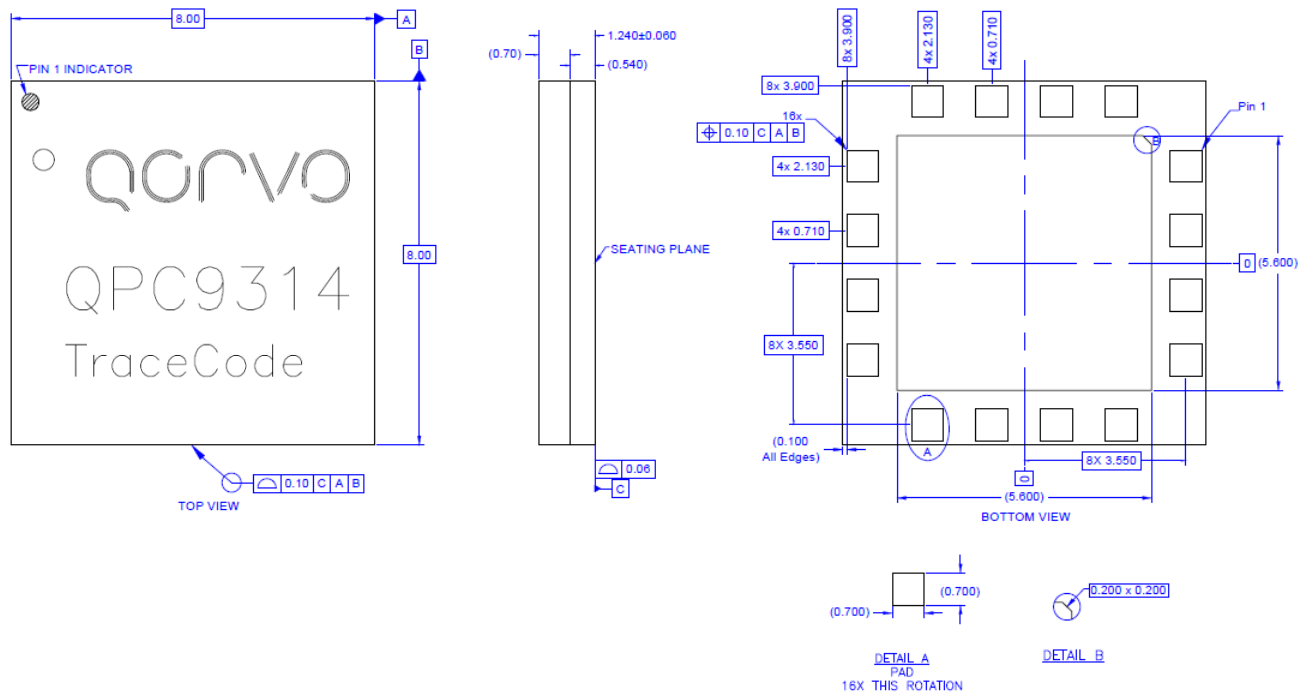


Top View

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 _{cc}	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.