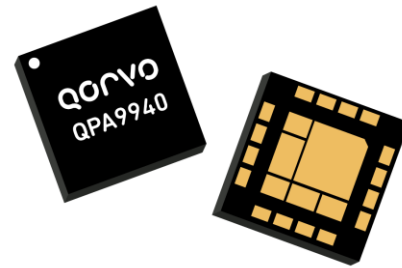


### Product Overview

The QPA9940 is a high-efficiency, linearizable power amplifier targeting Band 40 small-cell wireless infrastructure systems. Using InGaP/GaAs HBT technology, the product delivers high efficiency of 31% at +28dBm average output power while providing excellent DPD linearized ACPR of -50 dBc for signal bandwidths of up to 100MHz.

The QPA9940 is housed in a 5x5mm SMT package. It is pin-to-pin compatible to QPA9901, QPA9903 and QPA9908 (high-efficiency small cell PA).

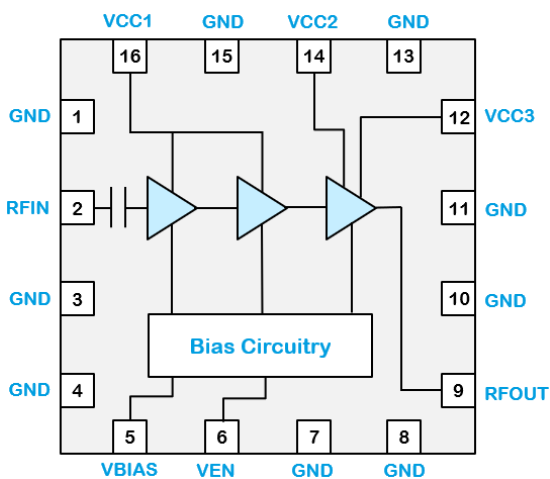


16 Pad 5 x 5 mm Package

### Key Features

- 2300 – 2400 MHz
- 34.5 dB Gain
- Over 36 dBm P3dB
- 31% PAE at +28 dBm power output
- -50 dBc ACPR DPD Linearized at +28 dBm Power Output with 5-carrier signal
- 1.8V Logic Compatible PA ON/OFF Control
- On Chip ESD Protection
- 5 x 5 mm Package

### Functional Block Diagram



Top View

### Applications

- 4G/5G Small-cell BTS
- 5G M-MIMO
- Repeaters / DAS
- Mobile Infrastructure
- General Purpose Wireless

### Ordering Information

Part No.	Description
QPA9940TR13	2500pcs on 13" reel
QPA9940EVB-01	2300-2400 MHz EVB

## Absolute Maximum Ratings

Parameter	Rating
Storage Temperature	-55 to +125 °C
RF Input Power, Pulsed CW, 50 Ω <sup>(1)</sup>	+10 dBm
Device Voltage (V <sub>CC</sub> )	+5.5 V

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.

1. 2300-2400 MHz, Pulsed CW, 10% duty cycle, 100us period

## Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Device Voltage (V <sub>CC</sub> )	+4.75	+5	+5.25	V
T <sub>CASE</sub>	-40		+105	°C
T <sub>j</sub> for >10 <sup>6</sup> hours MTTF			+175	°C

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		2300		2400	MHz
Test Frequency			2350		MHz
Gain <sup>(2)</sup>	At +28dBm P <sub>out</sub> and room temperature	32	34.5		dB
Input Return Loss			-17		dB
Output Return Loss			-15		dB
Output P <sub>3dB</sub>	10 μs pulse width, 10% duty cycle	35.1	+36		dBm
Power Added Efficiency <sup>(2)</sup>	P <sub>out</sub> = +28 dBm	28.1	31		%
ACPR (Uncorrected) <sup>(2)</sup>	P <sub>out</sub> = +28 dBm		-31	-28.4	dBc
ACPR (Uncorrected) <sup>(3)</sup>	P <sub>out</sub> = +28 dBm		-29		dBc
ACPR (Corrected) <sup>(3)</sup>	P <sub>out</sub> = +28 dBm		-50		dBc
Quiescent Current, I <sub>CC</sub>	Pins 12, 14 and 16		100		mA
Total Operating Current	Pin 5, 12, 14 and 16, P <sub>out</sub> = +28 dBm		406		mA
Thermal Resistance, θ <sub>JC</sub>	Junction to case		23.3		°C/W
V <sub>EN</sub> High		1.17	1.8	V <sub>CC</sub>	V
V <sub>EN</sub> Low		0	0	0.63	V
2nd Harmonic	P <sub>out</sub> = +28 dBm		-40		dBc
3rd Harmonic	P <sub>out</sub> = +28 dBm		-54		dBc
Turn-on time	Measured from 50% PA enable voltage level to 90% of RF amplitude		0.5		us

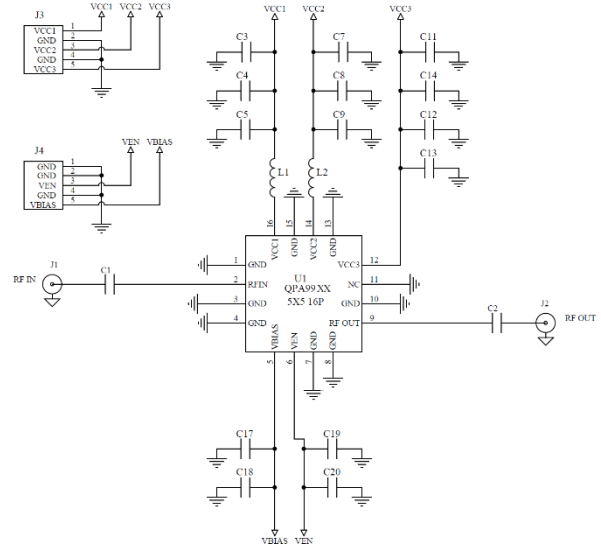
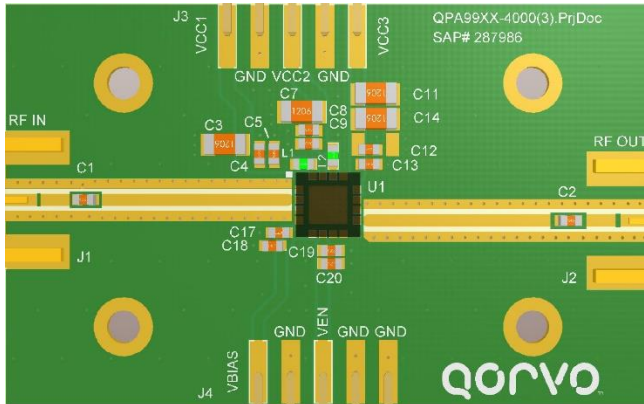
Notes:

1. Test conditions unless otherwise noted: All V<sub>CC</sub> & V<sub>BIAS</sub> = +5.0 V, V<sub>EN</sub> = +1.8 V, Temp = +25 °C, 50 Ω system.
2. LTE, 20 MHz E-UTRA Test Mode 1.1 or 3.1, PAR = 8.5 dB at 0.01% probability.
3. LTE, 20 MHz x 5 E-UTRA Test Mode 1.1 or 3.1, PAR = 8.5 dB at 0.01% probability.

## Power Amplifier Enable Logic Table

Parameter	High	Low
V <sub>EN</sub>	Power Amplifier ON	Power Amplifier OFF

### QPA9940 EVB Layout and Schematic



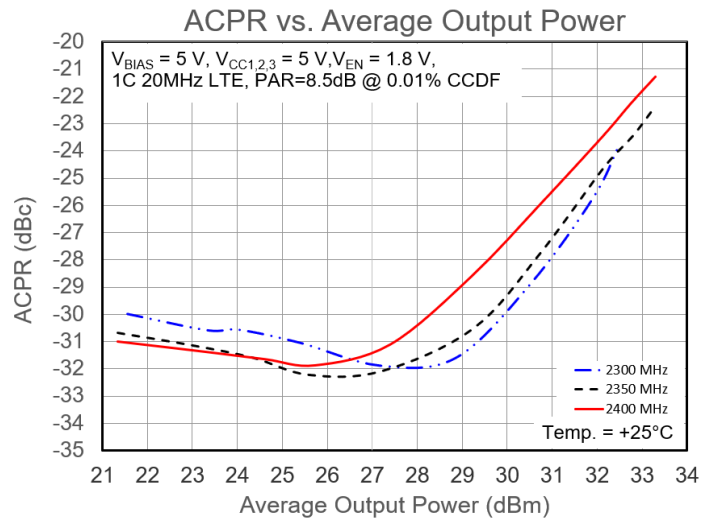
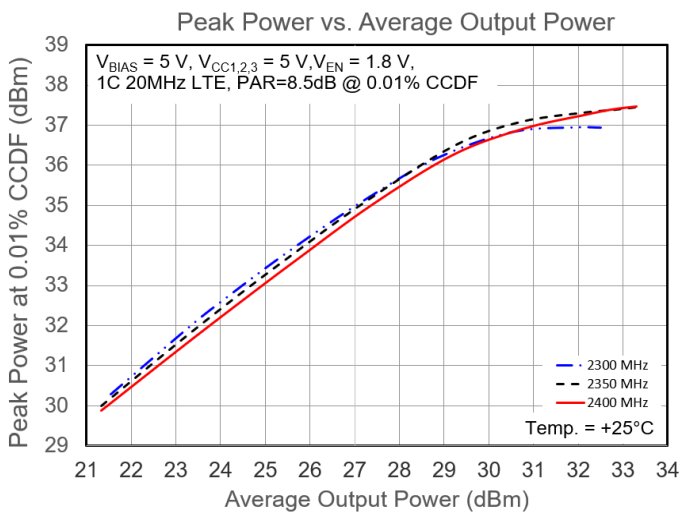
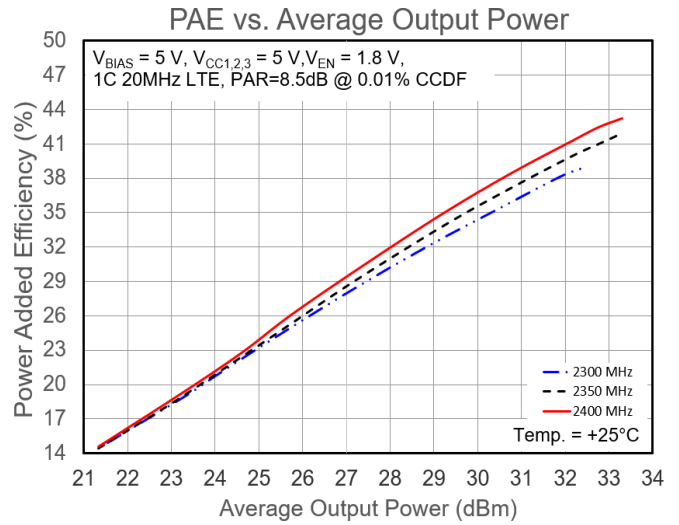
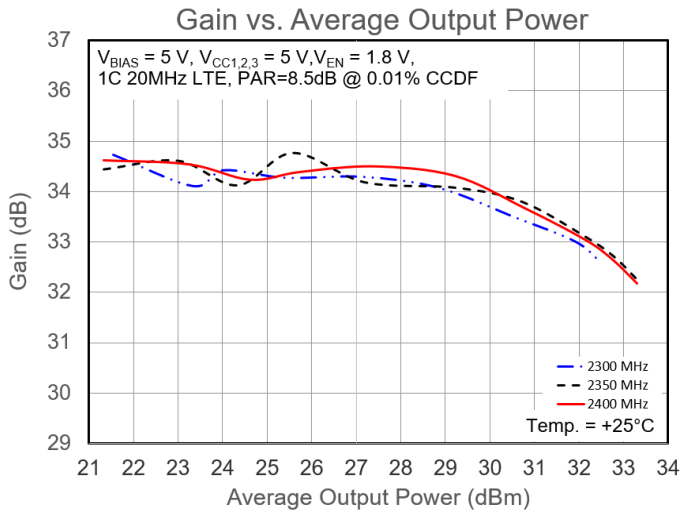
**Notes:**

1. See Evaluation Board PCB Information for material and stack up.

### Bill of Materials – QPA9940EVB-01

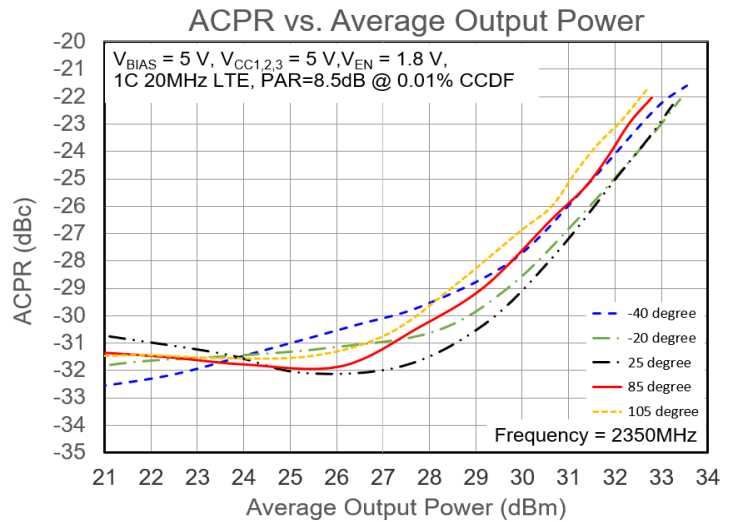
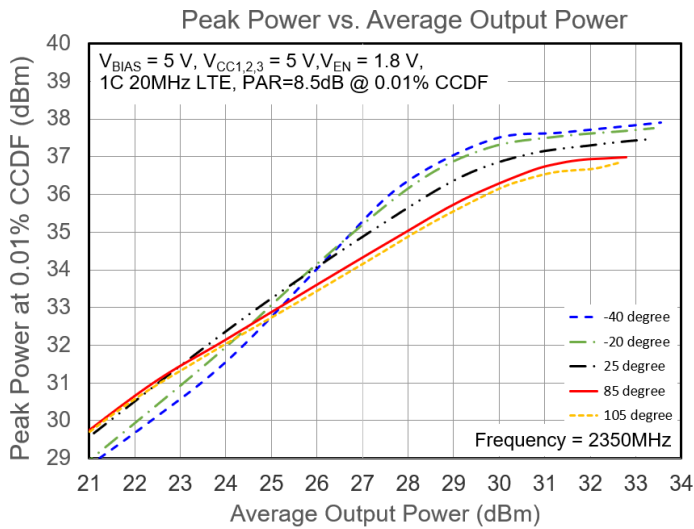
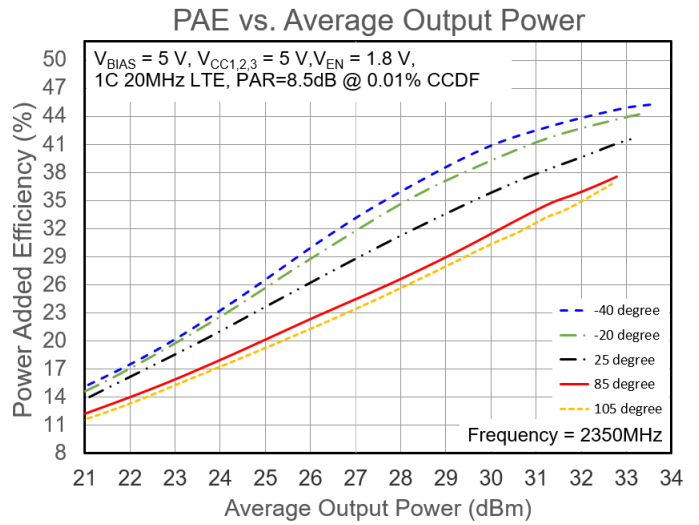
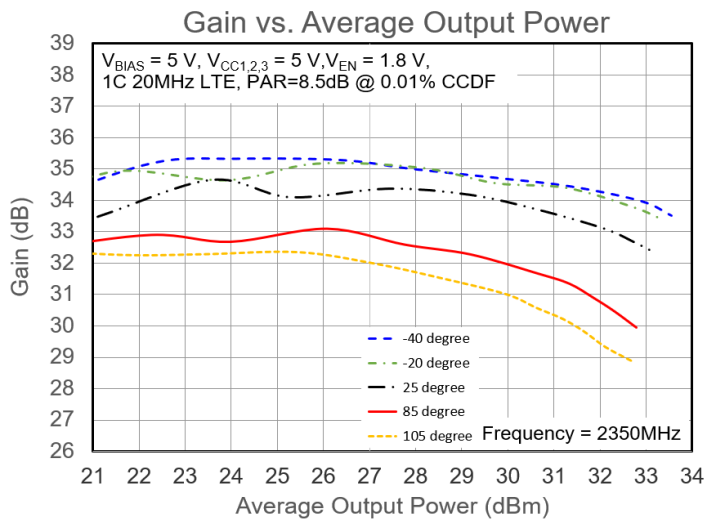
Reference Des.	Value	Description	Manuf.	Part Number
U1	-	Amplifier, QPA9940 2300-2400MHz, High-Efficiency	Qorvo	QPA9940
C1, C2	100 pF	CAP,100 pF, 0603, 5%, 50V, C0G	various	
C5, C9, C13, C17, C19	1000 pF	CAP,1000 pF, 0603, 5%, 50V, C0G	various	
C4, C8, C12, C18, C20	0.1 μF	CAP,0.1 μF, 0603, 10%, 50V, X7R	various	
C3, C7, C14	10 μF	CAP, 10 μF, 1206, 25V	various	
L1, L2	0 Ω	RES 0 Ω, 0603, 1/16W, Chip	various	
J1, J2	-	CONN. RF. SMA. F. STRT. Edge Mount	various	
J3, J4	-	Connector, 5 Pin	various	

**Performance Plots - LTE**



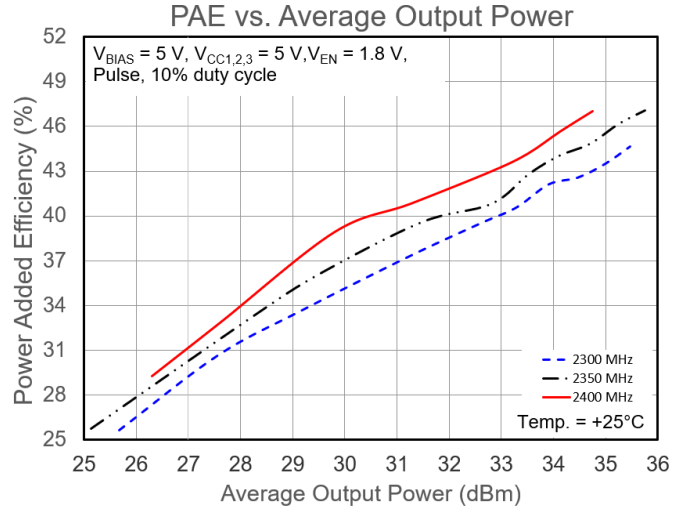
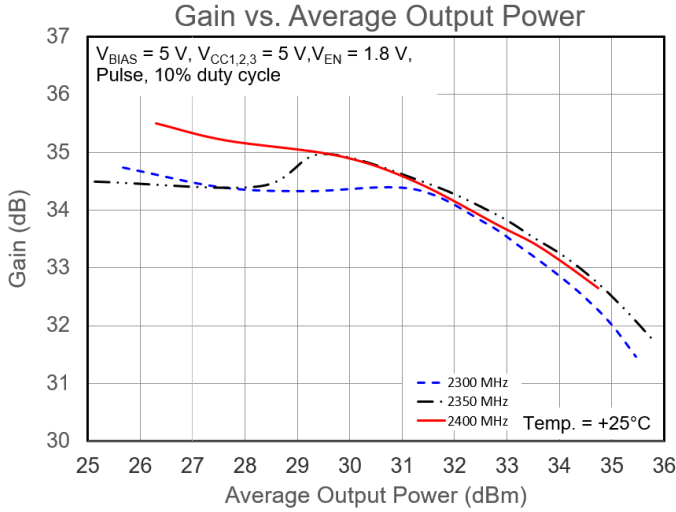
Test conditions unless otherwise noted:  $V_{BIAS} = 5\text{ V}, V_{CC1,2,3} = 5\text{ V}, V_{EN} = 1.8\text{ V}, T = +25^\circ\text{C}$ , tested using a single-carrier, 20 MHz LTE signal with 8.5 dB PAR at 0.01% CCDF on a reference design fixture.

Performance Plots - LTE

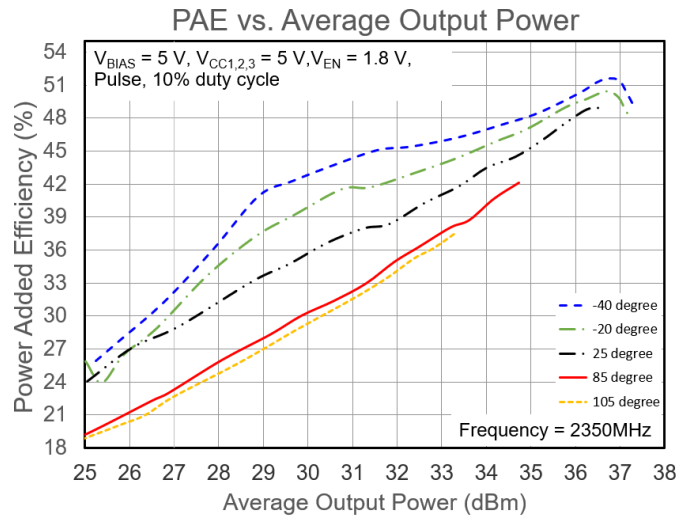
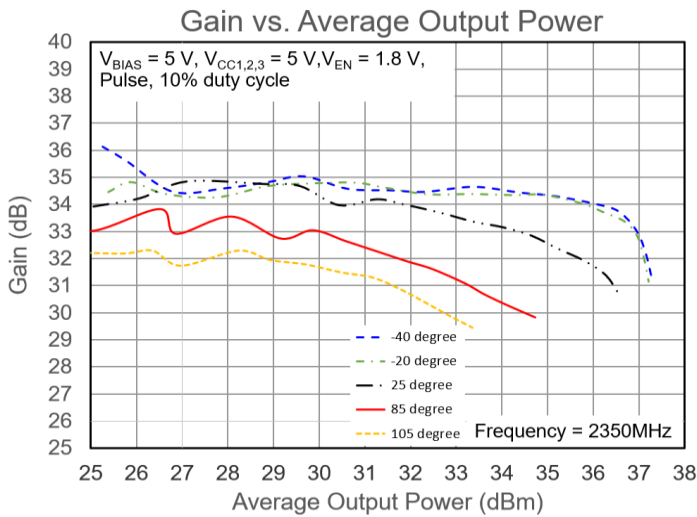


Test conditions unless otherwise noted:  $V_{BIAS} = 5\text{ V}, V_{CC1,2,3} = 5\text{ V}, V_{EN} = 1.8\text{ V},$  tested at 2350 MHz using a single-carrier, 20 MHz LTE signal with 8.5 dB PAR at 0.01% CCDF on a reference design fixture.

Performance Plots - Pulse

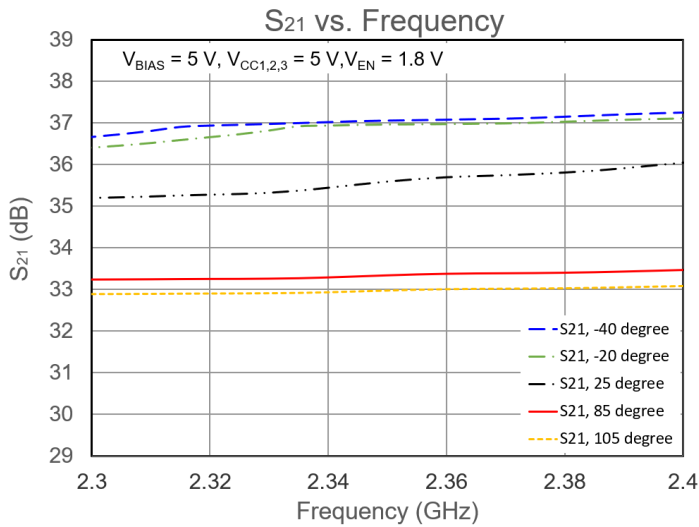
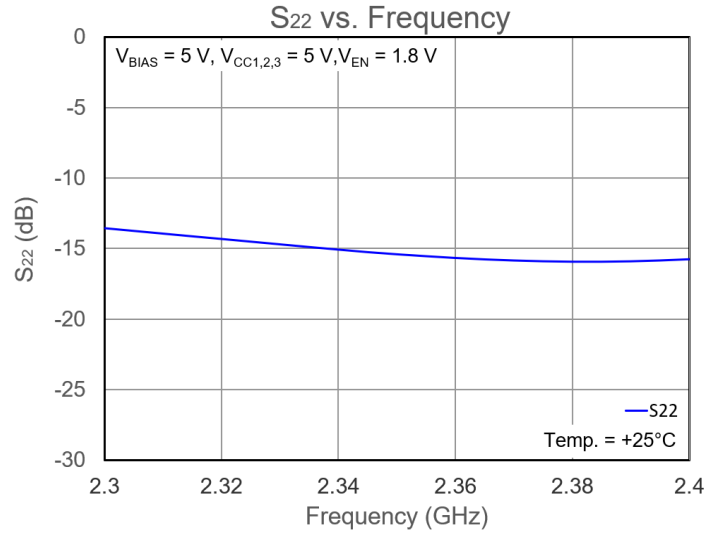
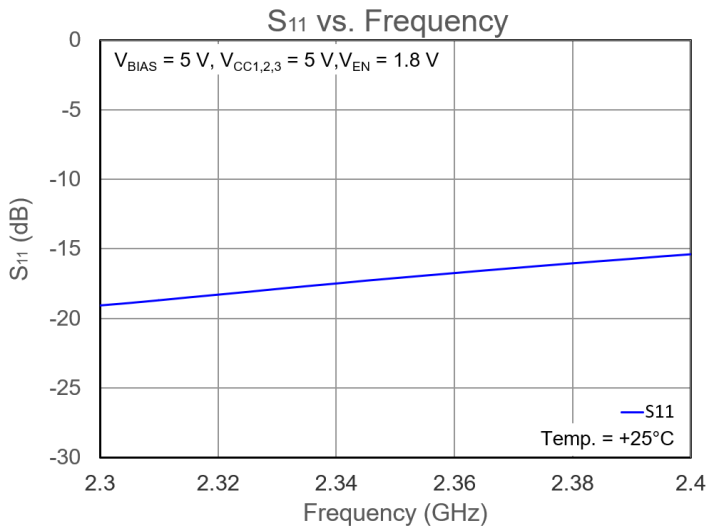


Test conditions unless otherwise noted:  $V_{BIAS} = 5\text{ V}, V_{CC1,2,3} = 5\text{ V}, V_{EN} = 1.8\text{ V}, T = +25^\circ\text{C}$ , tested using a pulse signal, 10% duty cycle.



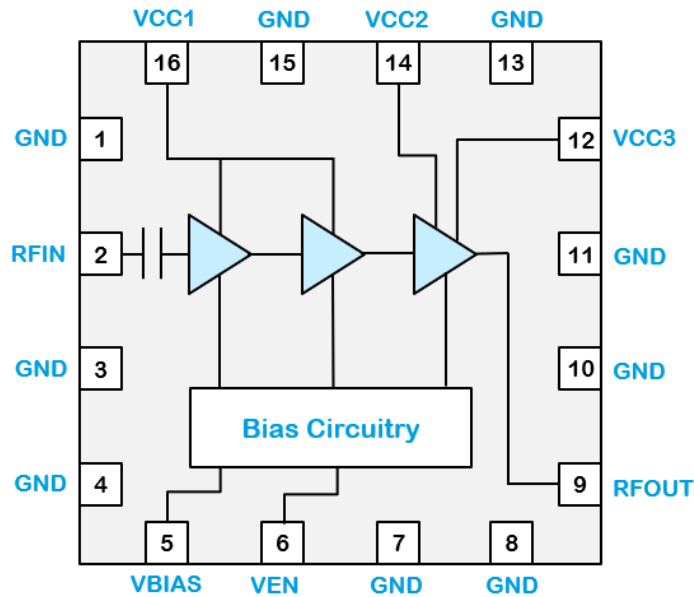
Test conditions unless otherwise noted:  $V_{BIAS} = 5\text{ V}, V_{CC1,2,3} = 5\text{ V}, V_{EN} = 1.8\text{ V}$ , tested at 2350 MHz using a pulse signal, 10% duty cycle.

Performance Plots – S-parameters



Test conditions unless otherwise noted:  $V_{BIAS} = 5\text{ V}, V_{CC1,2,3} = 5\text{ V}, V_{EN} = 1.8\text{ V}$ .

## Pad Configuration and Description



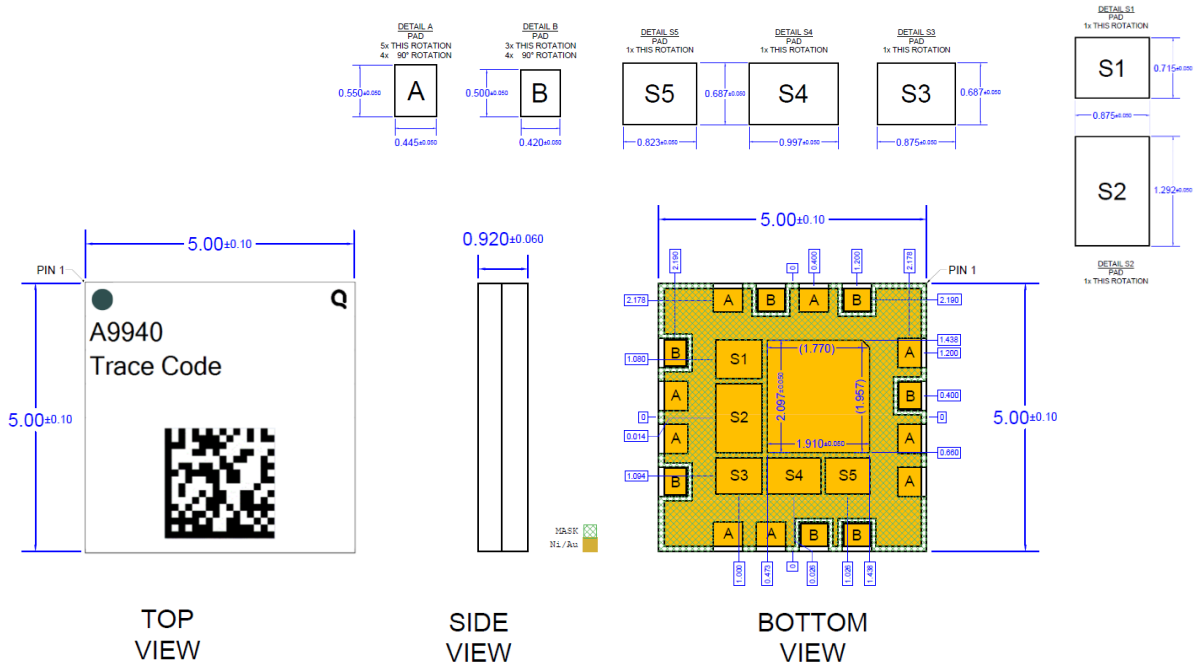
Top View

Pad No.	Label	Description
1, 3, 4, 7, 8, 10, 11, 13, 15	GND	Ground connection.
2	RF <sub>IN</sub>	RF input, internally matched to 50Ω and DC blocked.
5	V <sub>BIAS</sub>	Bias circuit supply voltage
6	V <sub>EN</sub>	Amplifier enable voltage (regulated internally)
9	RF <sub>OUT</sub>	RF output, internally matched to 50Ω and DC shorted. External DC blocking capacitor required
12	V <sub>CC3</sub>	Supply voltage for the various amplifier stages
14	V <sub>CC2</sub>	Supply voltage for the various amplifier stages
16	V <sub>CC1</sub>	Driver stage supply voltage
Backside Paddle	GND	Ground connection. The back side of the package should be connected to the ground plane through as short of a connection as possible. PCB via holes under the device are recommended.



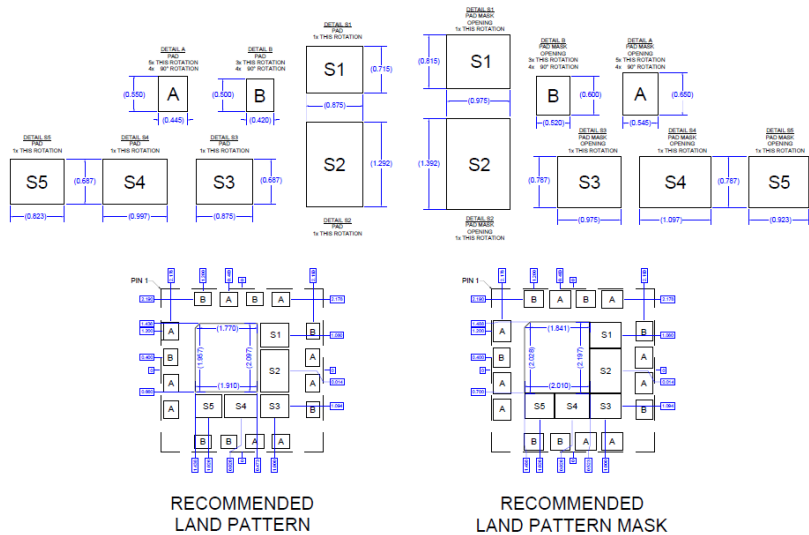
### Package Marking and Dimensions

Marking: Pin 1 Indicator and Qorvo Logo  
 Part Number – QPA9940  
 Trace Code – XXXXXX Up to 8 Characters to be Assigned by sub-Contractor



- Notes:
1. All dimensions are in millimeters. Angles are in degrees.
  2. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.
  3. Contact plating: ENEPIG

### PCB Mounting Pattern

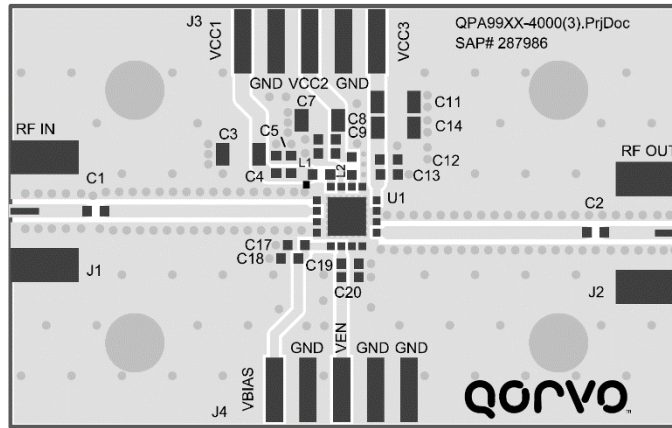


**Evaluation Board PCB Information**

**PC Board Layout**

Layer	Name	Material	Thickness	Constant
1	Top Overlay			
2	Top Solder	Solder Resist	0.40 mil	3.5
3	Top Layer	Copper	1.40 mil	
4	Dielectric1	RO4350	20.00 mil	3.48
5	Bottom Layer	Copper	1.40 mil	

Total thickness: 23.2mill

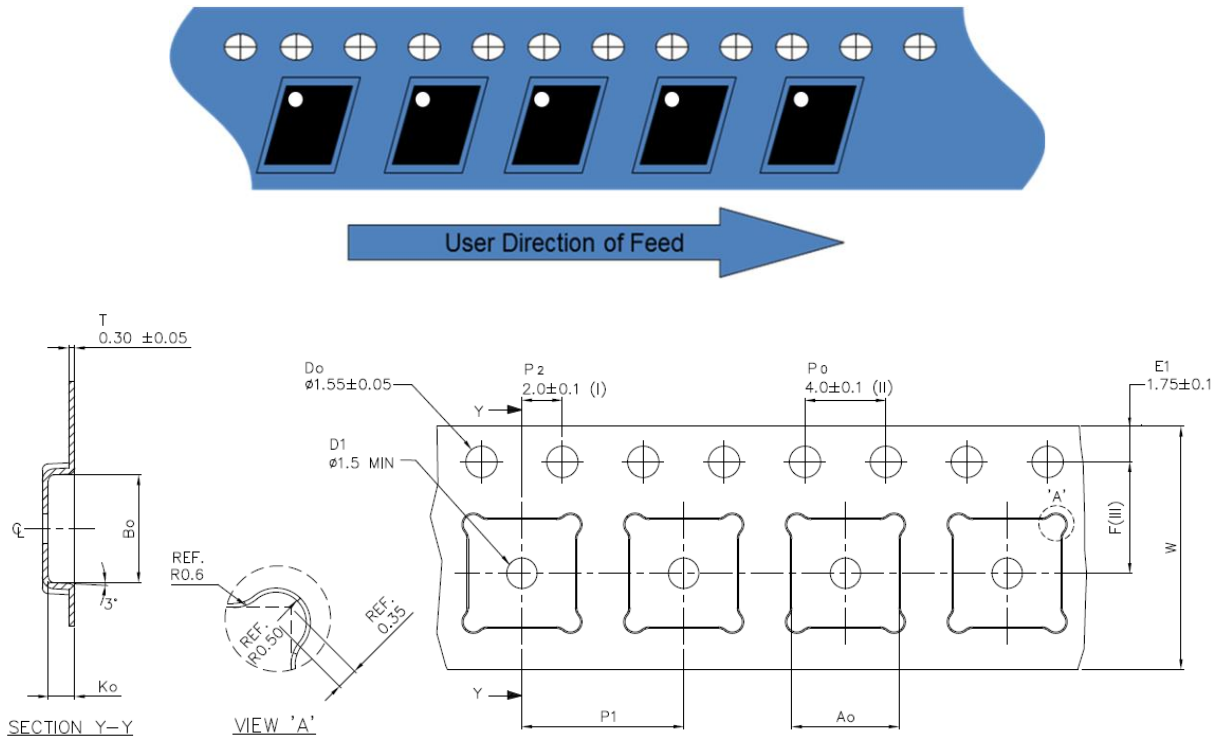


Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Use 1 oz. copper minimum for top and bottom layer metal.
3. Via holes are required under the backside paddle of this device for proper RF/DC grounding and thermal dissipation. We recommend a 0.35mm (#80/.0135") diameter bit for drilling via holes and a final plated thru diameter of 0.25 mm (0.10").
4. Ensure good package backside paddle solder attach for reliable operation and best electrical performance.

**Tape and Reel Information – Carrier and Cover Tape Dimensions**

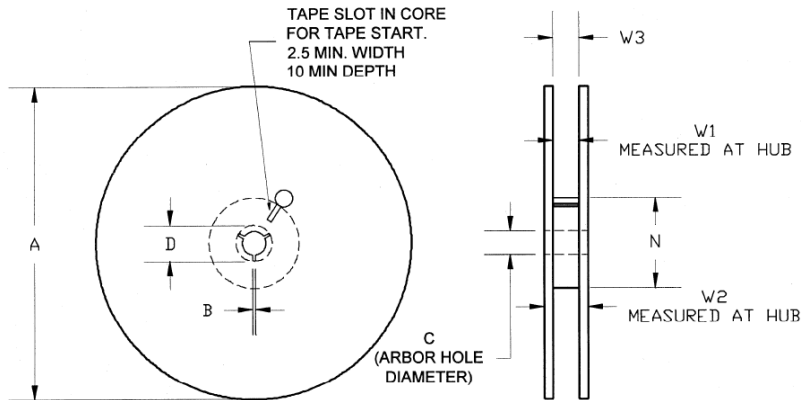
Tape and reel specifications for this part are also available on the Qorvo website.  
 Standard T/R size = 2500 pieces on a 13" reel.



Feature	Measure	Symbol	Size (in)	Size (mm)
Cavity	Length	A0	0.209	5.3
	Width	B0	0.209	5.3
	Depth	K0	0.051	1.3
	Pitch	P1	0.315	8.0
Centerline Distance	Cavity to Perforation - Length Direction	P2	0.079	2.0
	Cavity to Perforation - Width Direction	F	0.217	5.5
Cover Tape	Width	C	0.362	9.2
Carrier Tape	Width	W	0.472	12

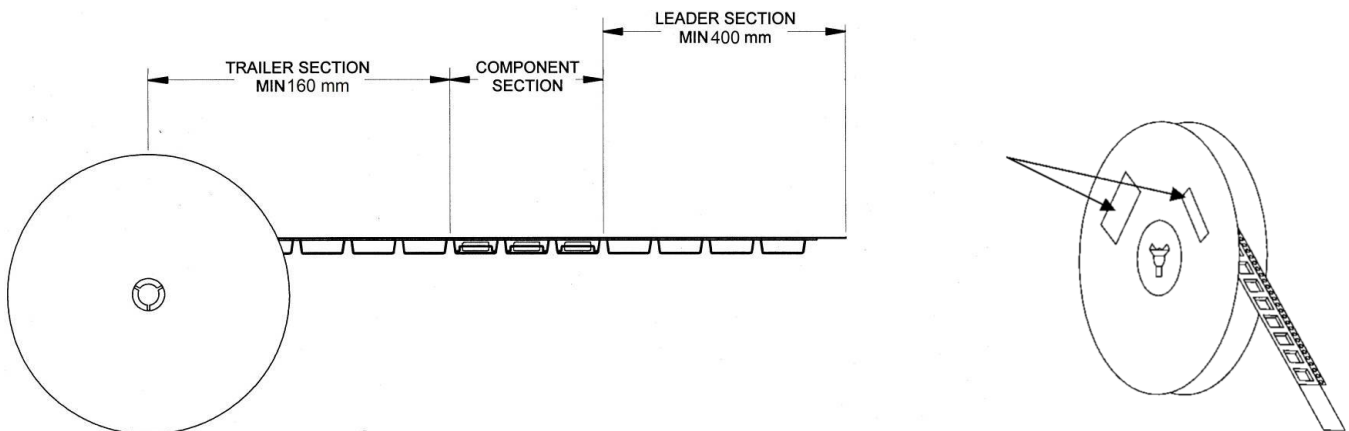
**Tape and Reel Information – Reel Dimensions**

Packaging reels are used to prevent damage to devices during shipping and storage, loaded carrier tape is typically wound onto a plastic take-up reel. The reel size is 13" diameter. The reels are made from high-impact injection-molded polystyrene (HIPS), which offers mechanical and ESD protection to packaged devices.



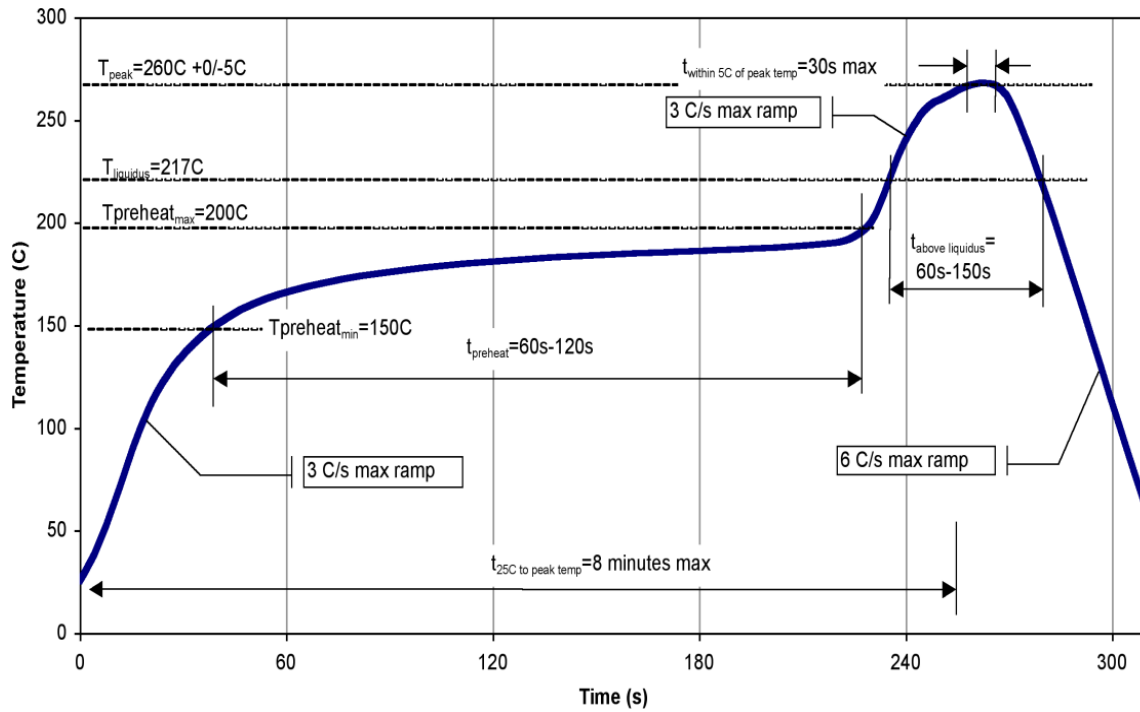
Feature	Measure	Symbol	Size (in)	Size (mm)
Flange	Diameter	A	12.992	330.00
	Thickness	W2	0.717	18.20
	Space Between Flange	W1	0.504	12.80
Hub	Outer Diameter	N	4.016	102.00
	Arbor Hole Diameter	C	0.512	13.00
	Key Slit Width	B	0.079	2.00
	Key Slit Diameter	D	0.795	20.2

**Tape and Reel Information – Tape Length and Label Placement**



- Notes:
1. Empty part cavities at the trailing and leading ends are sealed with cover tape. See EIA 481-1-A.
  2. Labels are placed on the flange opposite the sprockets in the carrier tape.

Recommended Solder Temperature Profile



## 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: ENEPIG

## 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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