

### Product Overview

The QPD0050 is a wide band plastic over-molded QFN discrete power amplifier. The device is a single stage unmatched power amplifier transistor.

The QPD0050 can be used in Doherty architecture for the final stage of a base station power amplifier for small cell, microcell, and active antenna systems. The QPD0050 can also be used as a driver in a macrocell base station power amplifier.

The wide bandwidth of the QPD0050 makes it suitable for many different applications from DC to 3.6 GHz. QPD0050 can deliver  $P_{SAT}$  of 79.4 W at +48 V operation at 2.1 GHz.

Lead-free and ROHS compliant.



6 Pin 6.6 x 7.7 mm DFN Package

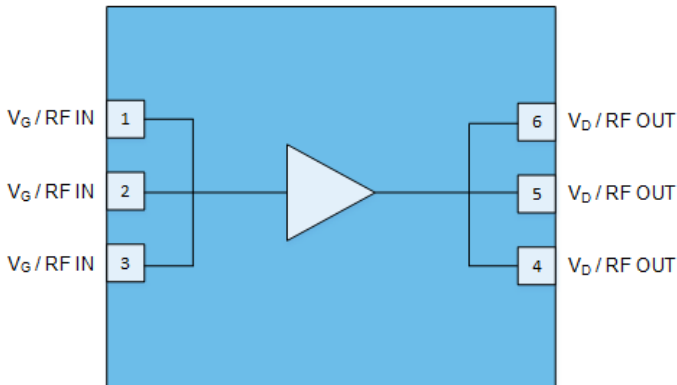
### Key Features

- Operating Frequency Range: DC to 3.6 GHz
- Operating Drain Voltage: +48 V
- Maximum Output Power ( $P_{SAT}$ ): 79.4 W <sup>(1)</sup>
- Maximum Drain Efficiency: 77.9% <sup>(1)</sup>
- Efficiency-Tuned P3dB Gain: 19.4 dB <sup>(1)</sup>
- Surface Mount Plastic Package

Notes:

1. Load pull performance at 2.1 GHz.

### Functional Block Diagram



### Applications

- W-CDMA / LTE
- Macrocell Base Station Driver
- Microcell Base Station
- Small Cell Final Stage
- Active Antenna
- General Purpose Applications

### Ordering Information

Part Number	Description
QPD0050SR	Short Reel – 100 Pieces
QPD0050TR7	7" Reel – 500 Pieces
QPD0050PCB4B01	2110 – 2170 MHz Evaluation Board

## Absolute Maximum Ratings

Parameter	Rating
Breakdown Voltage (BV <sub>DG</sub> )	+165 V
Gate Voltage Range (V <sub>G</sub> )	-7 to +2 V
Drain Voltage (V <sub>D</sub> )	+55 V
Peak RF Input Power	35 dBm
VSWR Mismatch, P1dB Pulse (20% Duty Cycle, 100 μs Width), T = +25°C	10:1

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.

## Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Gate Voltage (V <sub>G</sub> )		-2.7		V
Drain Voltage (V <sub>D</sub> )		+48		V
Quiescent Drain Current (I <sub>DQ</sub> )		130		mA

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

## Electrical Specifications

Parameter	Conditions	Min	Typ	Max	Units
Operational Frequency Range		2110		2170	MHz
Quiescent Drain Current (I <sub>DQ</sub> )			130		mA
Gain	3 dB Compression	17.5	19.5		dB
Power (P <sub>SAT</sub> )	3 dB Compression	46.5	47.7		dBm
Drain Efficiency	3 dB Compression	60.0	72.7		%
Gate Leakage	V <sub>g</sub> = -3.8V, V <sub>d</sub> = +10V	-11.6			mA

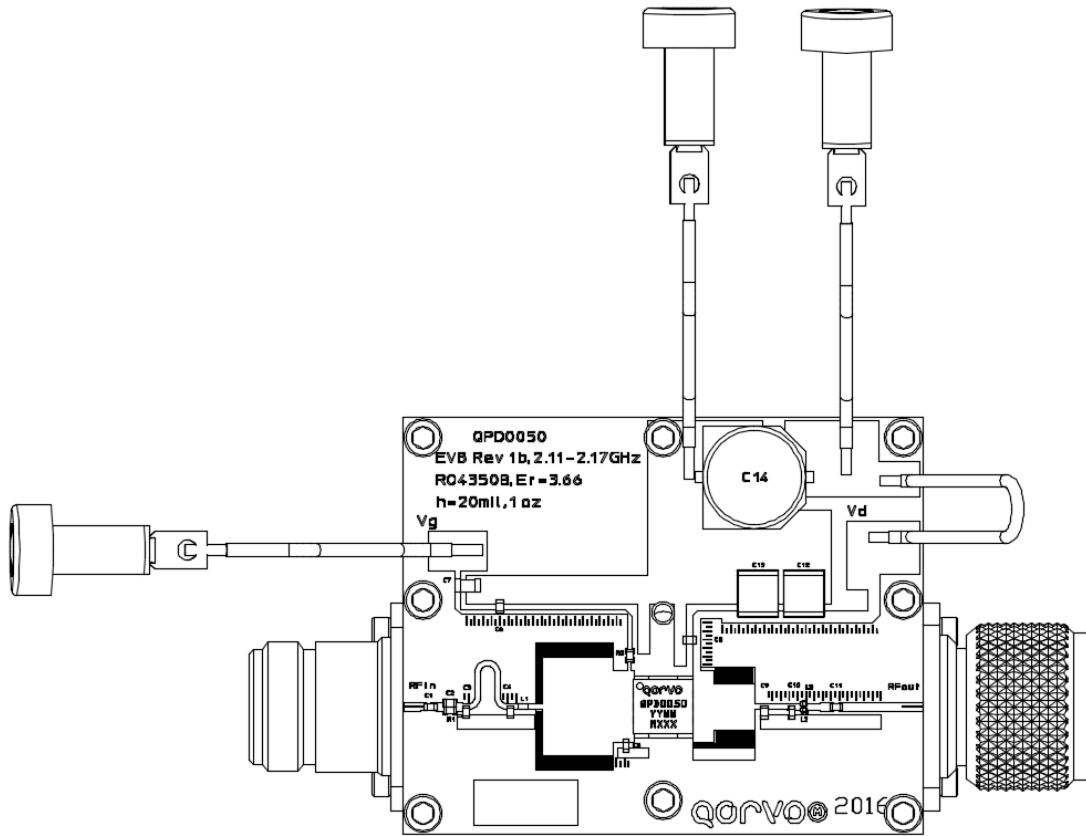
Test conditions unless otherwise noted: V<sub>D</sub> = +48 V, I<sub>DQ</sub> = 130 mA, T = +25°C, Pulse signal (20% Duty Cycle, 100 μs Width) at 2140 MHz on a Class AB single-ended reference design tuned for 2110-2170 MHz.

## Thermal Information

Parameter	Conditions	Values	Units
Doherty Thermal Resistance, Peak IR Surface Temperature at Average Power (θ <sub>JC</sub> ) <sup>(1) (2)</sup>	T <sub>CASE</sub> = +105°C, T <sub>CH</sub> = 113°C CW: P <sub>DISS</sub> = 8.5 W, P <sub>OUT</sub> = 12.7 W	0.9	°C/W
Device Thermal Resistance, Peak IR Surface Temperature at Average Power (θ <sub>JC</sub> )	T <sub>CASE</sub> = +105°C, T <sub>CH</sub> = 122°C CW: P <sub>DISS</sub> = 13.4 W, P <sub>OUT</sub> = 3.5 W	1.3	°C/W

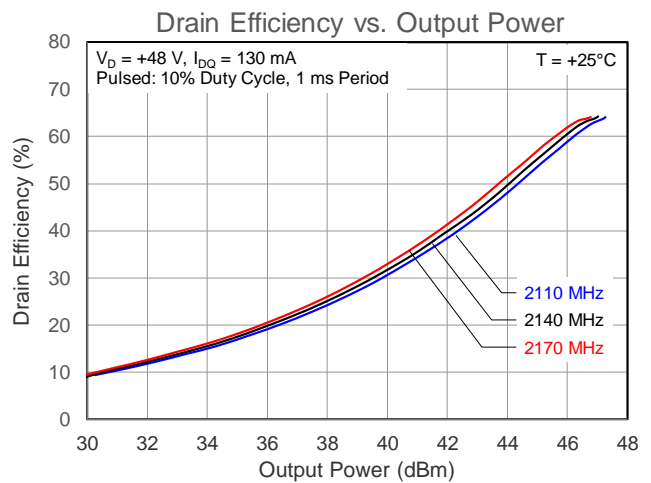
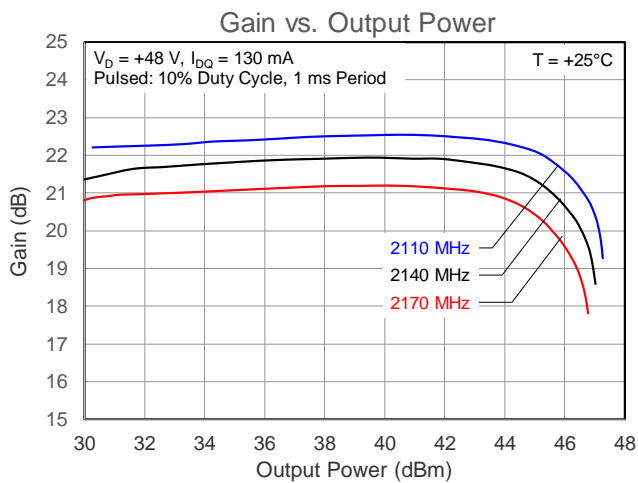
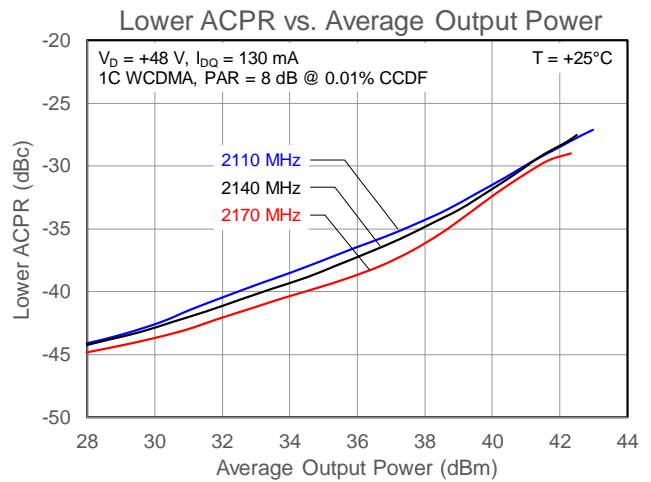
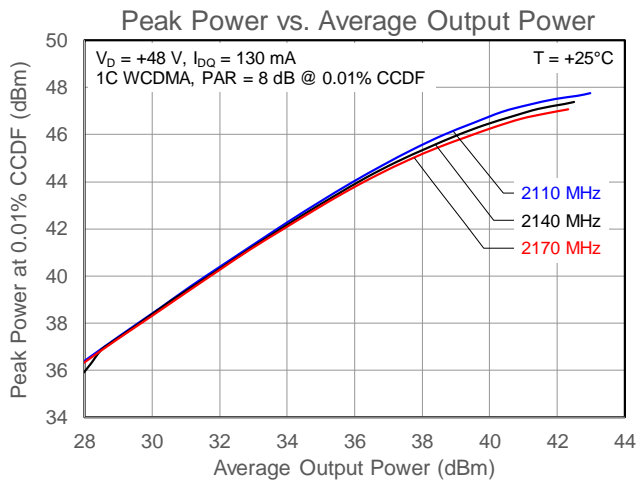
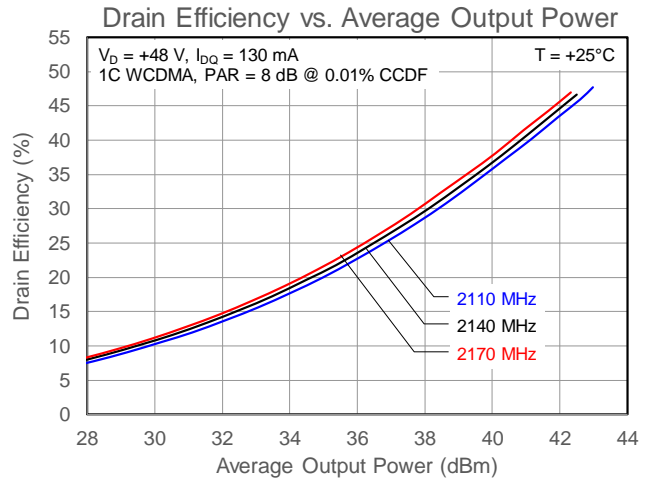
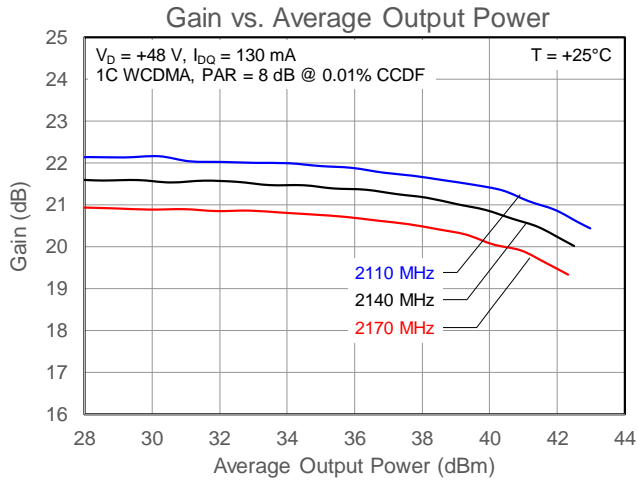
Notes:

1. Based on expected carrier amplifier efficiency of Doherty.
2. P<sub>OUT</sub> assumes 20% peaking amplifier contribution of total average Doherty rated power.
3. Thermal resistance is measured to package backside.
4. Refer to the following document: [GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates](#)

**QPD0050PCB4B01 Layout – 2110 – 2170 MHz Reference Design**

**QPD0050PCB4B01 Bill of Materials**

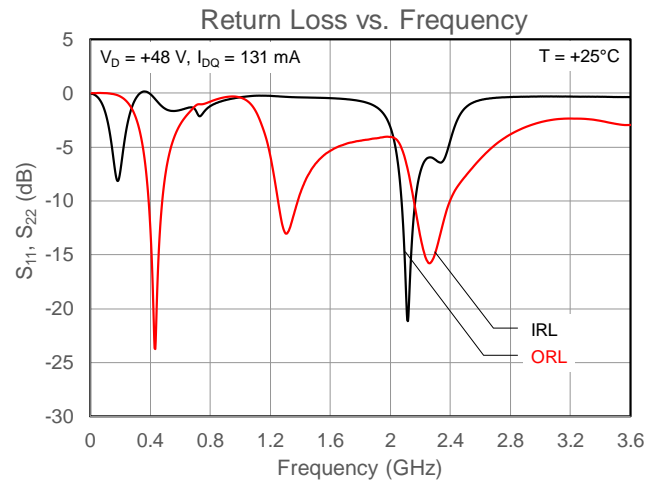
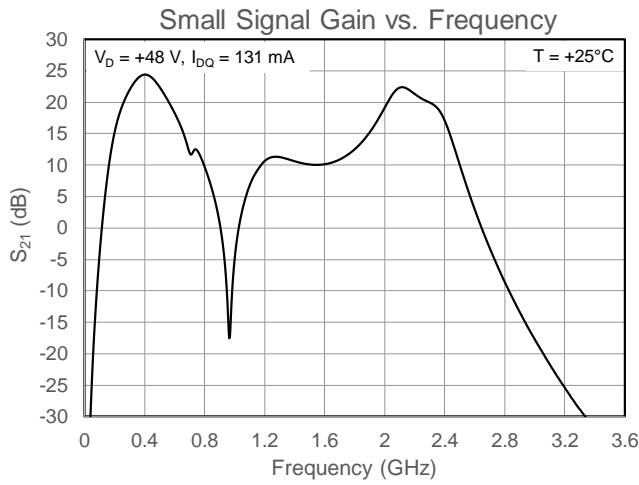
Reference Des.	Value	Description	Manufacturer	Part Number
C1, C2, C6, C8, C11	18 pF	Capacitor, 18 pF, $\pm 1\%$ , 250 V, C0G, 0603	ATC	600S180FT250XT
C3	2 pF	Capacitor, 2 pF, $\pm 0.05$ pF, 250 V, C0G, 0603	ATC	600S2R0AT250X
C4	1.6 pF	Capacitor, 1.6 pF, $\pm 0.05$ pF, 250 V, HI-Q, 0603	ATC	600S1R6AT250XT
C5	2.4 pF	Capacitor, 2.4 pF, $\pm 0.1$ pF, 250 V, C0G, 0603	ATC	600S2R4BT250XT
C7	4.7 $\mu$ F	Capacitor, 4.7 $\mu$ F, 50 V, X7R, 1206	Kemet	C1206C475K5RACTU
C9	2.7 pF	Capacitor, 2.7 pF, $\pm 0.1$ pF, 250 V, HI-Q, 0603	ATC	600S2R7BW250XT
C10	1.5 pF	Capacitor, 1.5 pF, 250 V, 0603	ATC	600S1R5GT250XT
C12, C13	10 $\mu$ F	Capacitor, 10 $\mu$ F, 20%, 100 V, X7S, 2220	TDK	C5750X7S2A106M230KB
C14	100 $\mu$ F	Capacitor, 100 $\mu$ F, 20%, 100 V, Electrolytic	Vishay	MAL215099907E3
L1	4.3 nH	Inductor, 4.3 nH, $\pm 5\%$ , 0.7 A, 0402	Coilcraft	0402CS-4N3XJL
L2, L3 (In Parallel)	0.67 nH	Inductor, 0.67 nH, $\pm 10\%$ , 1.6 A, WW, 0302	Coilcraft	0302CS-N67XKLW
R1	1 $\Omega$	Resistor, 1 $\Omega$ , 0603	Vishay	CRCW06031R00JNEA
R2	10 $\Omega$	Resistor, 10 $\Omega$ , 0603	Vishay	CRCW060310R0

Performance Plots



Test conditions unless otherwise noted:  $V_D = +48\text{ V}$ ,  $I_{DQ} = 130\text{ mA}$ ,  $T = +25^\circ\text{C}$ , on a 2110 – 2170 MHz reference design fixture.

Performance Plots



Test conditions unless otherwise noted:  $V_D = +48\text{ V}$ ,  $I_{DQ} = 130\text{ mA}$ ,  $T = +25^\circ\text{C}$ , on a 2110 – 2170 MHz reference design fixture.

## Power-Matched Load Pull Performance

Frequency (MHz)	Source Impedance ( $\Omega$ )	Load Impedance ( $\Omega$ )	P3dB (dBm)	Drain Efficiency (%)	G3dB (dB)
1800	1.5 – j1.6	5.9 + j3.1	48.8	68.7	20.1
1900	1.5 – j2.3	5.7 + j1.9	48.9	64.9	19.3
2100	1.7 – j3.6	5.6 + j0.9	49.0	64.2	18.0
2200	1.6 – j3.9	5.8 + j1.2	49.1	65.5	17.9
2600	1.9 – j5.7	4.5 – j0.5	48.9	62.2	16.5
3500	2.6 – j8.8	3.8 – j4.8	48.5	53.7	13.5

Test conditions unless otherwise noted:  $V_D = +48$  V,  $I_{DQ} = 130$  mA,  $T = +25^\circ\text{C}$ , Pulse (10% Duty Cycle, 100  $\mu\text{s}$  Width).

## Efficiency-Matched Load Pull Performance

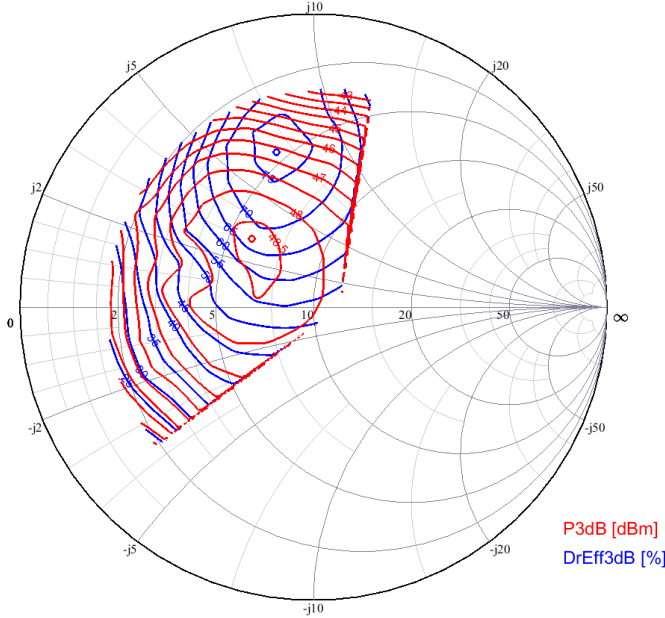
Frequency (MHz)	Source Impedance ( $\Omega$ )	Load Impedance ( $\Omega$ )	P3dB (dBm)	Drain Efficiency (%)	G3dB (dB)
1800	1.5 – j1.6	4.6 + j6.8	46.7	77.1	20.9
1900	1.5 – j1.6	4.3 + j5.7	47.1	77.4	20.5
2100	1.7 – j3.6	3.6 + j5.2	46.6	77.9	19.4
2200	1.6 – j3.9	3.7 + j5.2	46.9	76.3	19.1
2600	1.9 – j5.7	2.9 + j2.2	47.1	73.8	17.5
3500	2.6 – j8.8	1.8 – j2.4	46.5	66.7	14.7

Test conditions unless otherwise noted:  $V_D = +48$  V,  $I_{DQ} = 130$  mA,  $T = +25^\circ\text{C}$ , Pulse (10% Duty Cycle, 100  $\mu\text{s}$  Width).

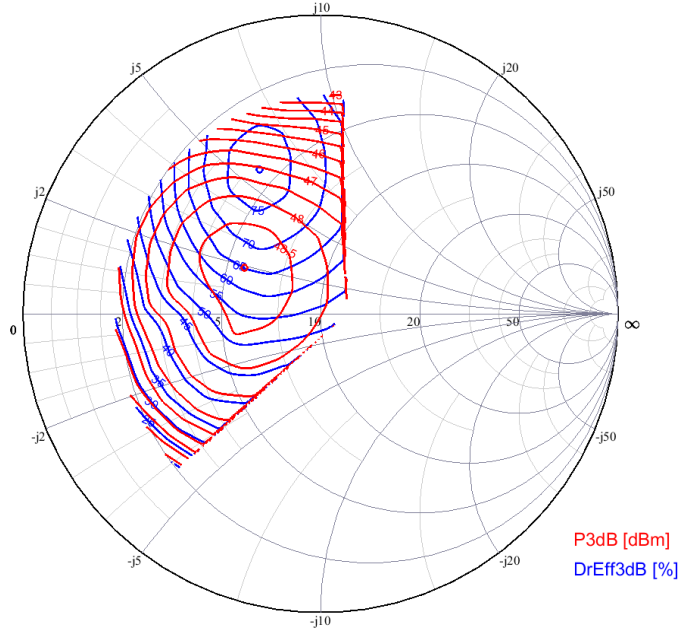
**Load Pull Contours**

Test Conditions unless otherwise noted:  $V_D = +48\text{ V}$ ,  $I_{BQ} = 130\text{ mA}$ ,  $T = +25^\circ\text{C}$ , Pulse (10% Duty Cycle, 100  $\mu\text{s}$  Width).

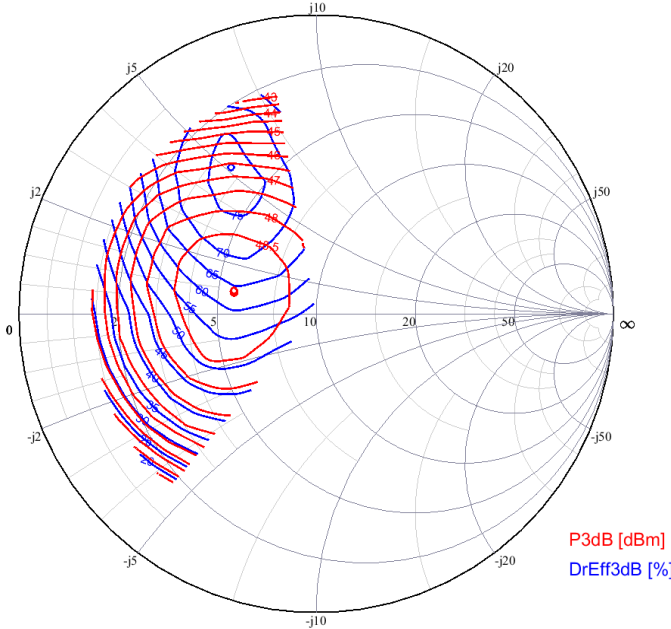
Load Pull at 1.8 GHz



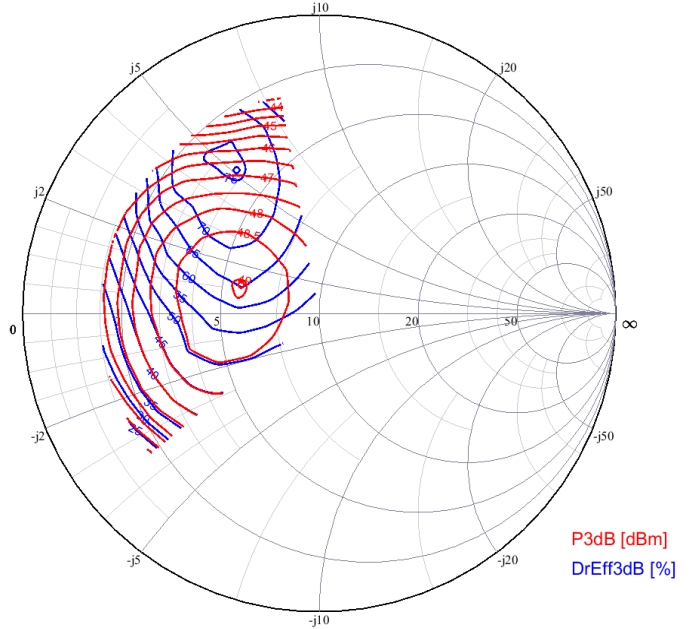
Load Pull at 1.9 GHz



Load Pull at 2.1 GHz

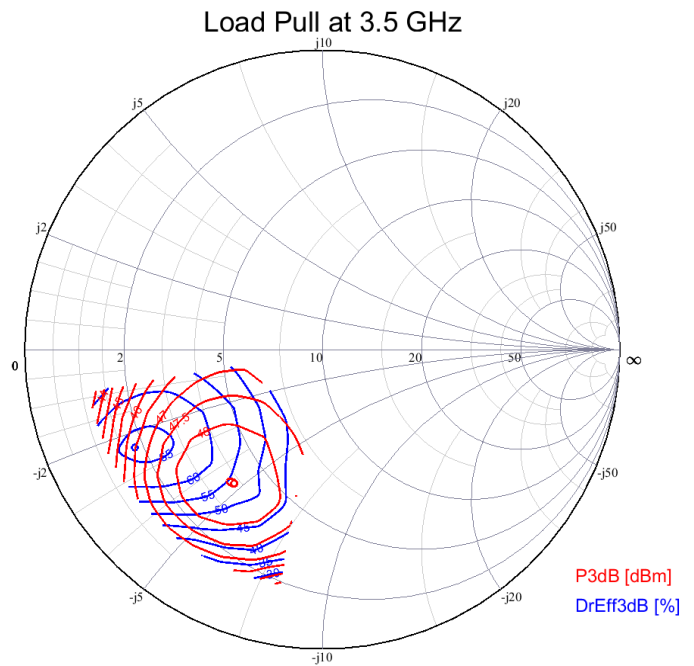
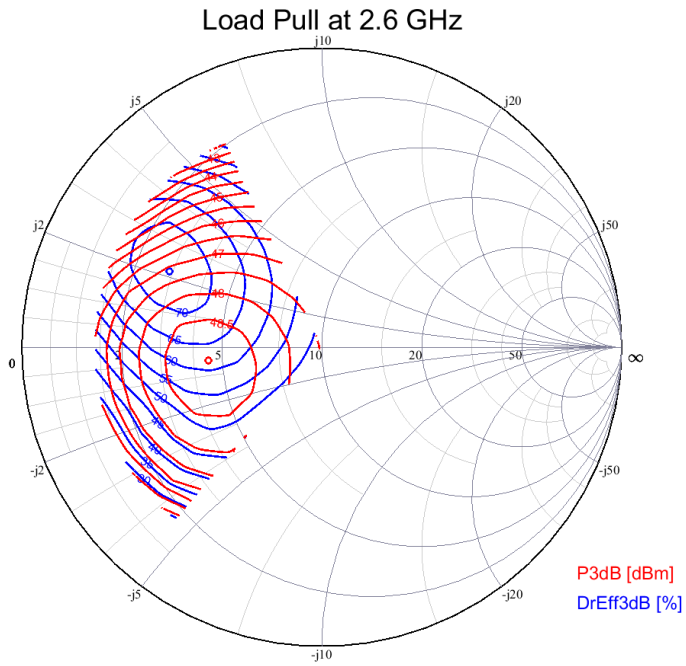


Load Pull at 2.2 GHz



**Load Pull Contours**

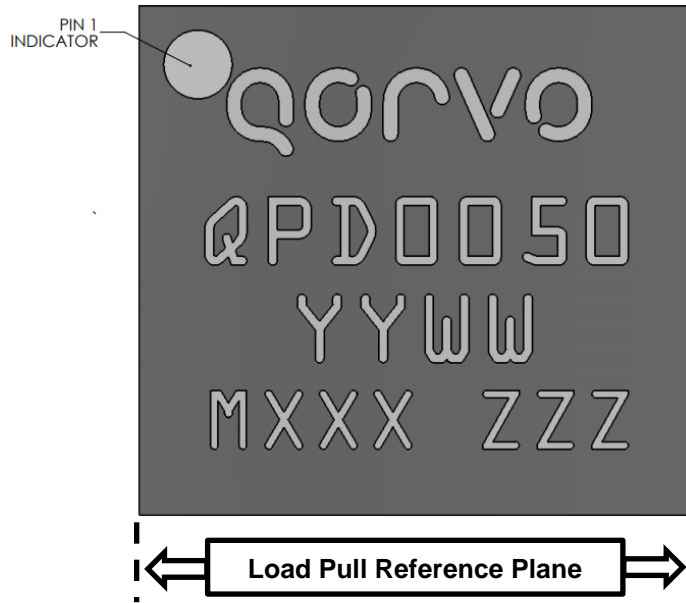
Test Conditions unless otherwise noted:  $V_D = +48\text{ V}$ ,  $I_{BQ} = 130\text{ mA}$ ,  $T = +25^\circ\text{C}$ , Pulse (10% Duty Cycle, 100  $\mu\text{s}$  Width).



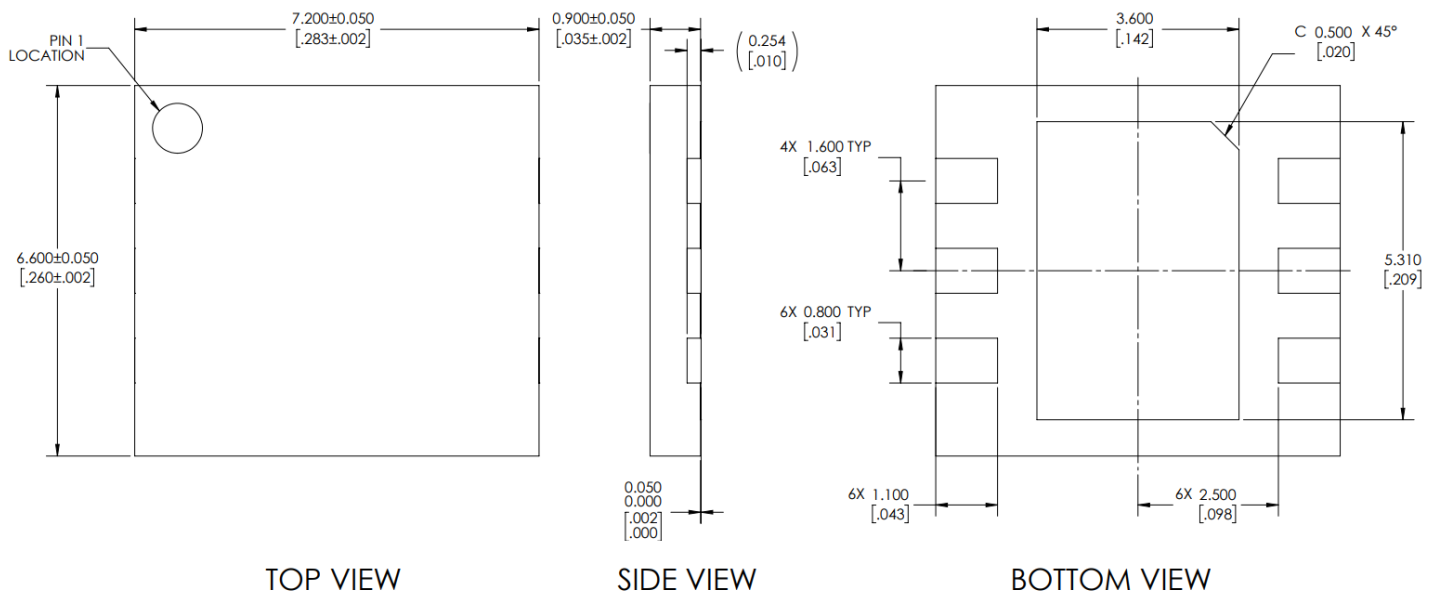


**Package Markings**

Marking: Qorvo Logo  
 Part Number – QPD0050  
 Date Code – YYWW  
 Lot Code – MXXX  
 Serial Number – ZZZ



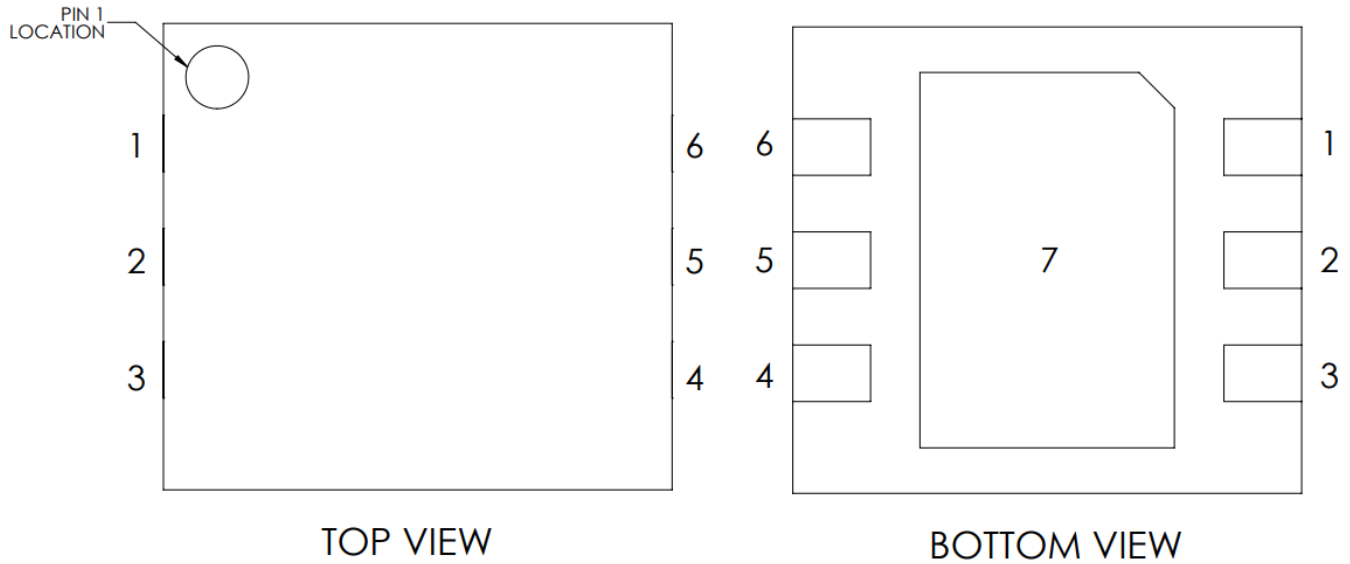
**Package Dimensions**



**Notes:**

1. Dimensions are in millimeters [inches]. Angles are in degrees.
2. Part is overmold encapsulated.
3. Contact plating is NiPdAu. Au thickness is 0.00254 to 0.01501 μm.

## Pin Configuration and Description

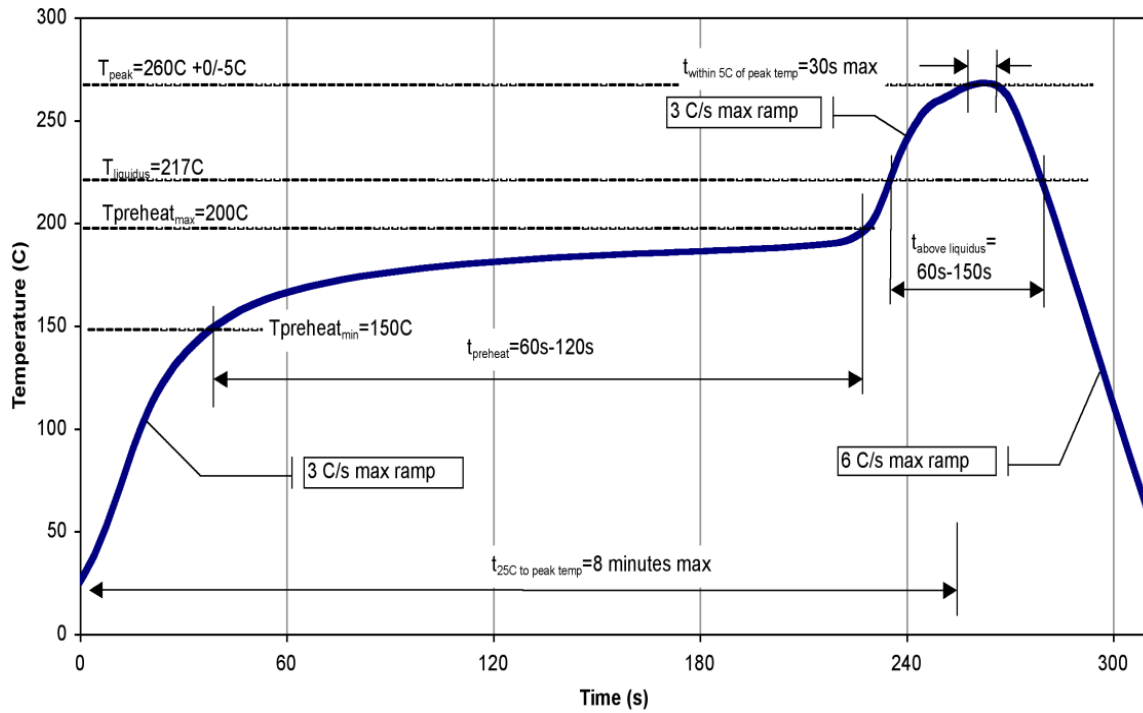


Pin No.	Label	Description
1, 2, 3	RF IN, $V_G$	RF Input, Gate Bias
4, 5, 6	RF OUT, $V_D$	RF Output, Drain Bias
7 (Backside Paddle)	RF/DC GND	RF/DC Ground

## Bias Procedure

Bias On	Bias Off
<ol style="list-style-type: none"> <li>1. Turn ON <math>V_G</math> to <math>-4</math> V.</li> <li>2. Turn ON <math>V_D</math> to <math>+48</math> V.</li> <li>3. Slowly adjust <math>V_G</math> until <math>I_D</math> is set to 130 mA. (Typically, <math>V_G = -2.7</math> V.)</li> <li>4. Turn ON RF.</li> </ol>	<ol style="list-style-type: none"> <li>1. Turn OFF RF.</li> <li>2. Adjust <math>V_G</math> to <math>-5</math> V.</li> <li>3. Turn OFF <math>V_D</math>.</li> <li>4. Wait two (2) seconds to allow drain capacitor to discharge.</li> <li>5. Turn off <math>V_G</math>.</li> </ol>

Recommended Solder Temperature Profile



## Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1A	ANSI/ESDA/JEDEC Standard JS-001
ESD – Charged Device Model (CDM)	Class C3	ANSI/ESDA/JEDEC Standard JS-002
MSL – Moisture Sensitivity Level	Level 3	IPC/JEDEC Standard J-STD-020



Caution!  
ESD-Sensitive Device

## Solderability

Compatible with lead-free (260°C max. reflow temp.) soldering processes.

Package lead plating is NiPdAu. Au thickness is 0.00254 to 0.01501 µm.

## 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:

- Lead Free
- 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)

## Important Notice

The information contained herein is believed to be reliable; however, Qorvo makes no warranties regarding the information contained herein and assumes no responsibility or liability whatsoever for the use of the information contained herein. All information contained herein is subject to change without notice. Customers should obtain and verify the latest relevant information before placing orders for Qorvo products. The information contained herein or any use of such information does not grant, explicitly or implicitly, to any party any patent rights, licenses, or any other intellectual property rights, whether with regard to such information itself or anything described by such information. **THIS INFORMATION DOES NOT CONSTITUTE A WARRANTY WITH RESPECT TO THE PRODUCTS DESCRIBED HEREIN, AND QORVO HEREBY DISCLAIMS ANY AND ALL WARRANTIES WITH RESPECT TO SUCH PRODUCTS WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

Without limiting the generality of the foregoing, Qorvo products are not warranted or authorized for use as critical components in medical, life-saving, or life-sustaining applications, or other applications where a failure would reasonably be expected to cause severe personal injury or death.

Copyright 2020 © Qorvo, Inc. | Qorvo is a registered trademark of Qorvo, Inc.