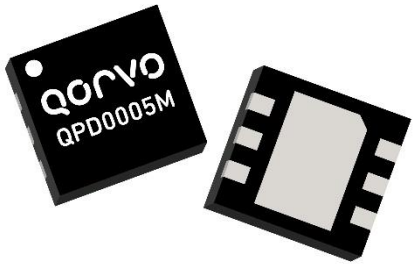
QPD0005M

8 W, 48 V, 2.5 – 5.0 GHz, GaN RF Transistor

Product Overview

The QPD0005M is a single-path discrete GaN on SiC HEMT in a plastic overmold DFN package which operates from 2.5 to 5.0 GHz. It is a single-stage, unmatched transistor capable of delivering P_{SAT} of 8 W at +48 V operation.

Lead free and RoHS compliant.



6 Pin 4.5 x 4.0 mm DFN Package

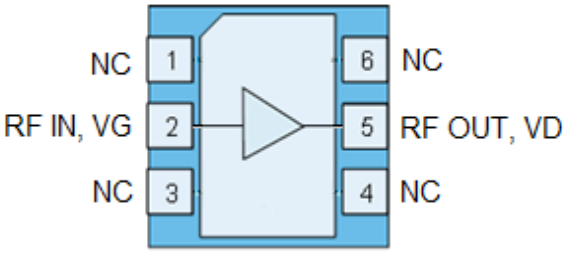
Key Features

- Operating Frequency Range: 2.5 – 5.0 GHz
- Operating Drain Voltage: +48 V
- Maximum Output Power (P_{SAT}): 39.1 dBm (1)
- Maximum Drain Efficiency: 71.4% (1)
- Efficiency-Tuned P3dB Gain: 17.8 dB (1)
- 4.5 x 4.0 mm DFN Package

Notes:

1. Load pull at 3.6 GHz

Functional Block Diagram



Applications

- WCDMA / LTE
- Macrocell Base Station
- Microcell Base Station
- Small Cell
- Active Antenna
- 5G Massive MIMO
- General Purpose Applications

Ordering Information

Part No.	Description
QPD0005MSR	Short Reel – 100 Pieces
QPD0005MEVB1	3.4 – 3.6 GHz Evaluation Board
QPD0005MEVB02	3.2 – 3.8 GHz Evaluation Board
QPD0005MEVB03	3.7 – 4.0 GHz Evaluation Board
QPD0005MEVB04	2.5 – 2.7 GHz Evaluation Board

Absolute Maximum Ratings

Parameter	Rating
Breakdown Voltage (BV_{DG})	+165 V
Gate Voltage Range (V_G)	−7 to +2 V
Drain Voltage (V_D)	+55 V
Peak RF Input Power, CW Pulsed	+28.4 dBm
VSWR Mismatch, P1dB Pulse (20% Duty Cycle, 100 µs Width), T = +25°C	10:1
Storage Temperature	−65 to +150°C

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_G)		−2.6		V
Drain Voltage (V_D)		+48		V
Quiescent Drain Current (I_{DQ})		20		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		3400		3600	MHz
Quiescent Drain Current (I_{DQ})			20.0		mA
Gain	P_{OUT} = 24 dBm	16.0	17.9		dB
Peak Output Power	P_{OUT} = 30 dBm, 10 dB PAR signal	36.3	37.8		dBm
Drain Efficiency	P_{OUT} = 24 dBm	12.1	13.3		%
Adjacent Power Ratio	P_{OUT} = 24 dBm		−35.0	−31.4	dBc
Gate Leakage	V_D = +48 V, V_G = −7 V	−0.6			mA

Test conditions unless otherwise noted: V_D = +48 V, I_{DQ} = 20 mA, T = +25°C, 1x20 MHz LTE signal with 8 dB PAR at 3600 MHz on a production test fixture.

Thermal Information

Parameter	Conditions	Values	Units
Thermal Resistance, Peak IR Surface Temperature at Average Power (θ_{JC})	T_{CASE} = +85°C, T_{CH} = 105°C CW: P_{DISS} = 1.1 W, P_{OUT} = 0.3 W	17.3	°C/W

Notes:

1. Thermal resistance is measured to package backside.
2. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

Power-Matched Load Pull Performance

Frequency (MHz)	Source Impedance (Ω)	Load Impedance (Ω)	P3dB (dBm)	Drain Efficiency (%)	G3dB (dB)
2500	9.2 + j8.0	36.4 + j32.7	39.2	62.9	18.7
2600	9.1 + j8.2	36.2 + j40.2	39.2	69.4	19.4
2700	9.2 + j8.1	33.1 + j36.1	39.2	66.0	19.0
3400	9.3 + j0.3	34.5 + j23.2	38.9	58.7	16.7
3500	9.4 – j0.9	30.4 + j29.2	39.1	65.0	16.7
3600	9.2 – j2.2	29.0 + j22.5	39.1	59.8	16.3

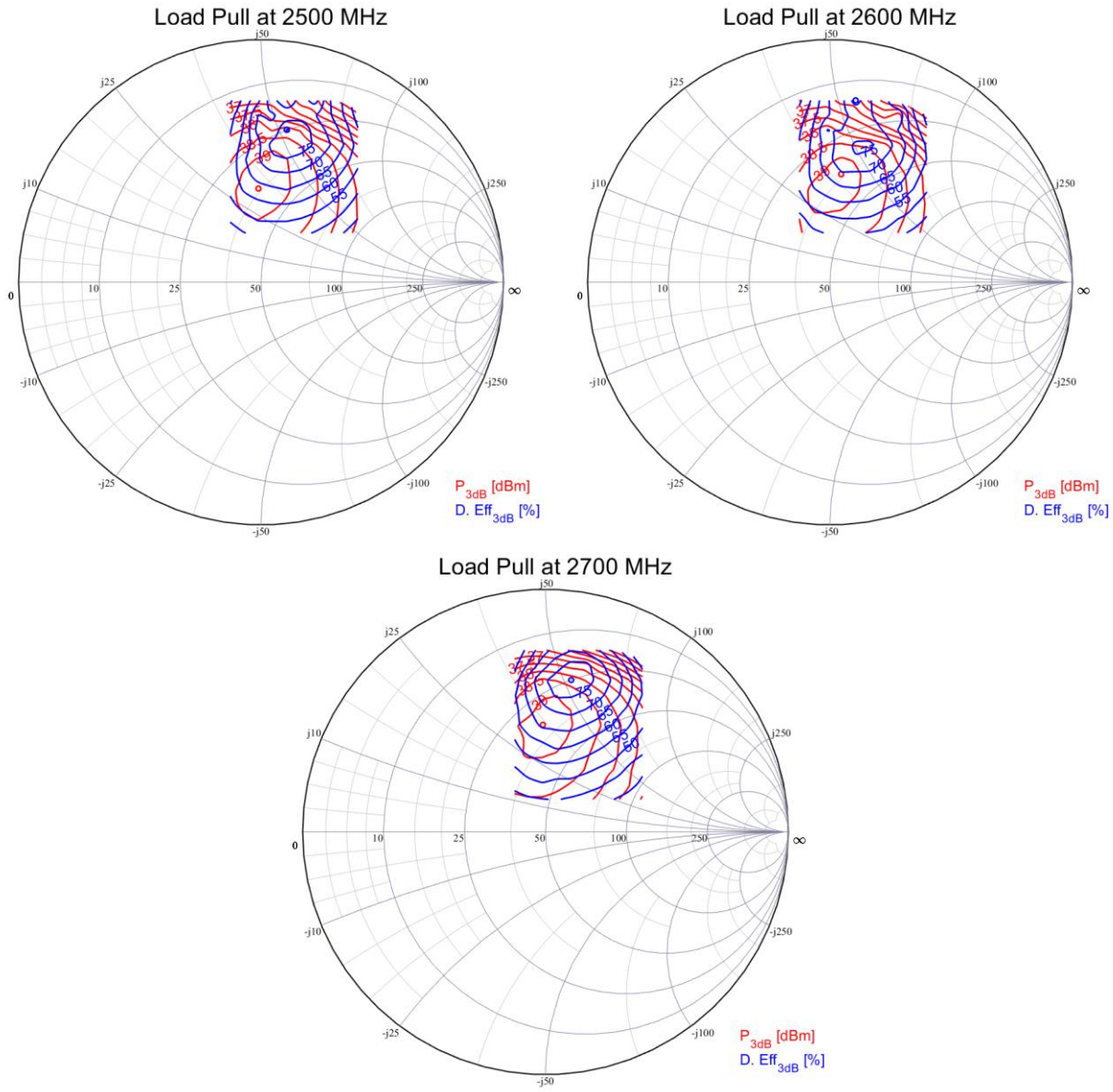
Test conditions unless otherwise noted: V_D = +48 V, I_{DQ} = 20 mA, T = +25°C, Pulse CW (10% duty cycle, 100 µs width).

Efficiency-Matched Load Pull Performance

Frequency (MHz)	Source Impedance (Ω)	Load Impedance (Ω)	P3dB (dBm)	Drain Efficiency (%)	G3dB (dB)
2500	9.2 + j8.0	24.9 + j52.6	38.2	80.4	20.6
2600	9.1 + j8.2	15.6 + j55	36.3	77.7	21.0
2700	9.2 + j8.1	25 + j52.6	38.3	78.5	20.1
3400	9.3 + j0.3	14.7 + j41.2	36.7	72.0	18.3
3500	9.4 – j0.9	19.4 + j43.6	37.3	73.0	17.7
3600	9.2 – j2.2	15.3 + j40.2	36.9	71.4	17.8

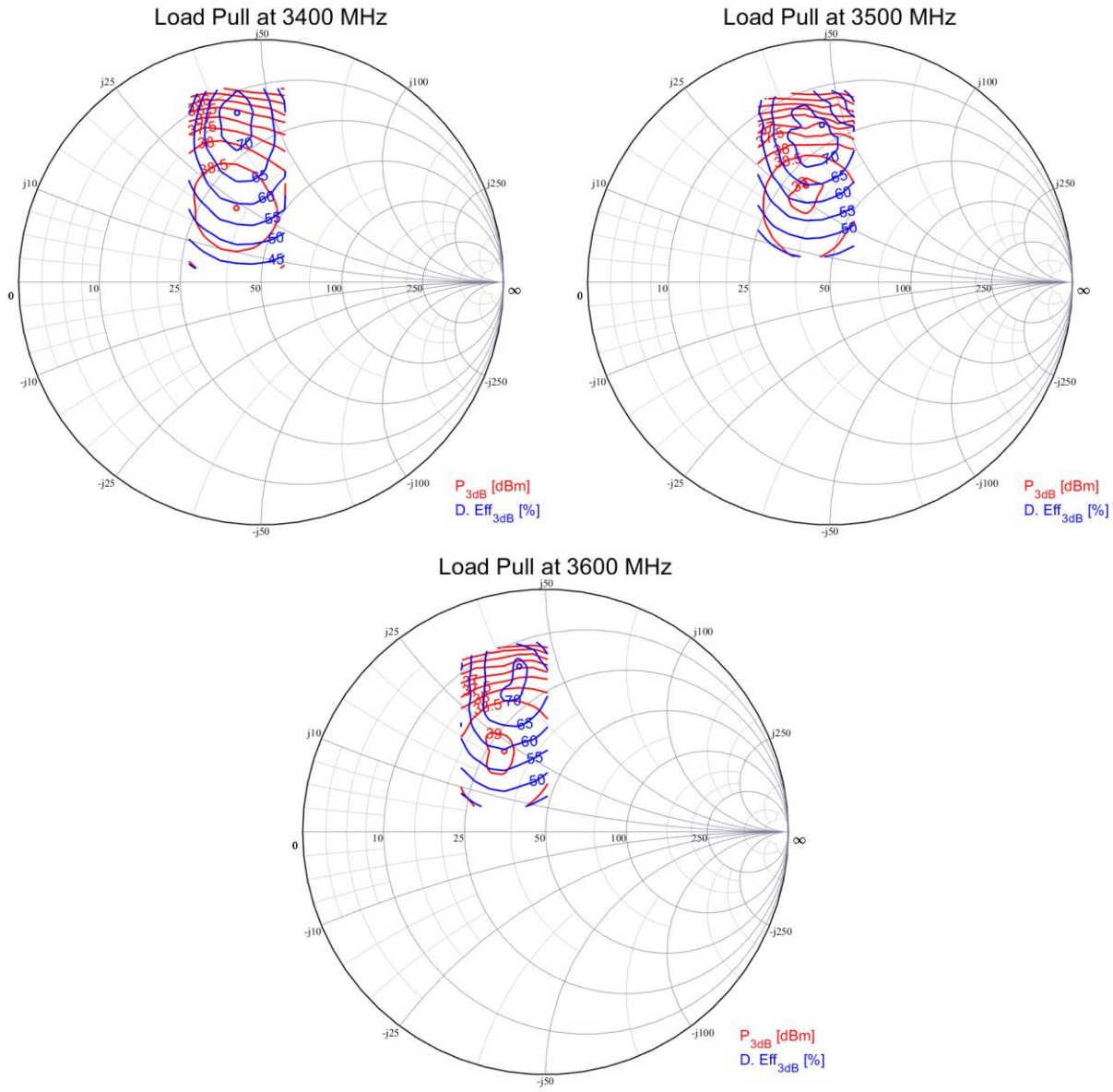
Test conditions unless otherwise noted: V_D = +48 V, I_{DQ} = 20 mA, T = +25°C, Pulse CW (10% duty cycle, 100 µs width).

Load Pull Contours



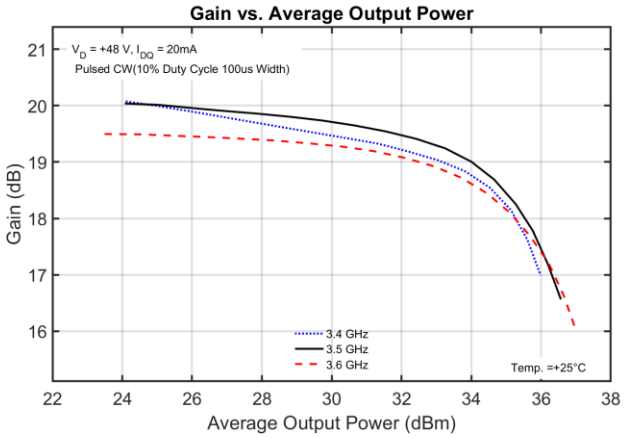
Test Conditions unless otherwise noted: V_D = +48 V, I_{DQ} = 20 mA, T = +25°C, Pulse CW (10% duty cycle, 100 µs width).

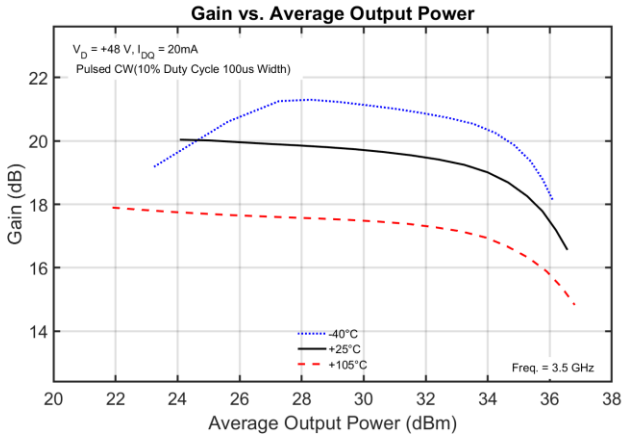
Load Pull Contours

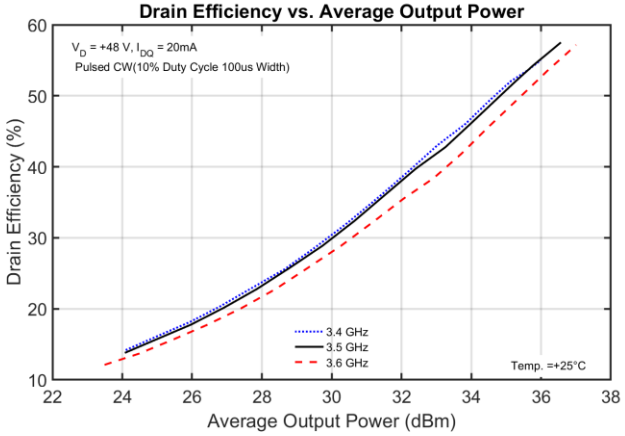


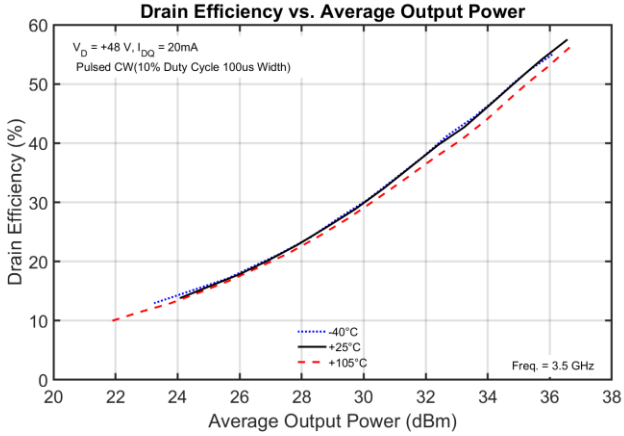
Test Conditions unless otherwise noted: V_D = +48 V, I_{DQ} = 20 mA, T = +25°C, Pulse CW (10% duty cycle, 100 µs width).

QPD0005EVB1 Performance Plots – 3400 – 3600 MHz Reference Design



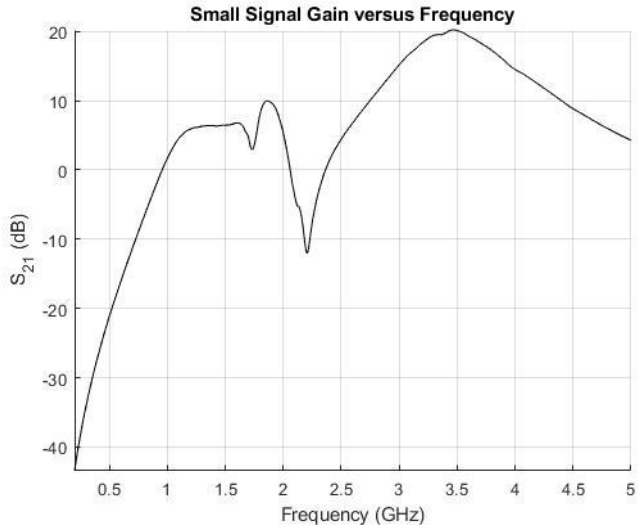


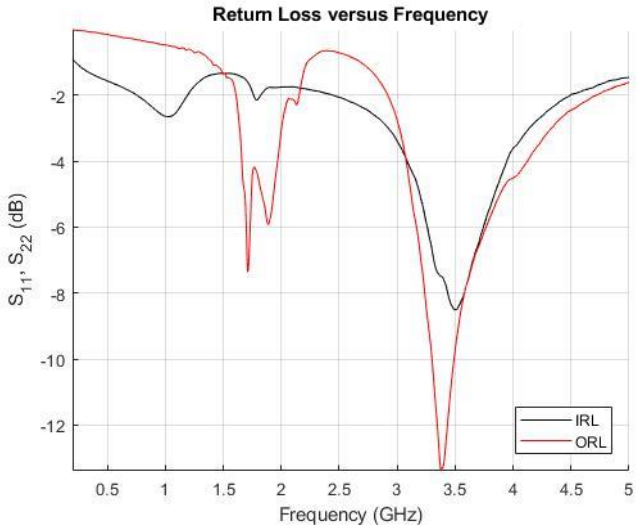




Test conditions unless otherwise noted: V_D = +48 V, I_{DQ} = 20 mA, on a reference design fixture tuned for 3400 – 3600 MHz.

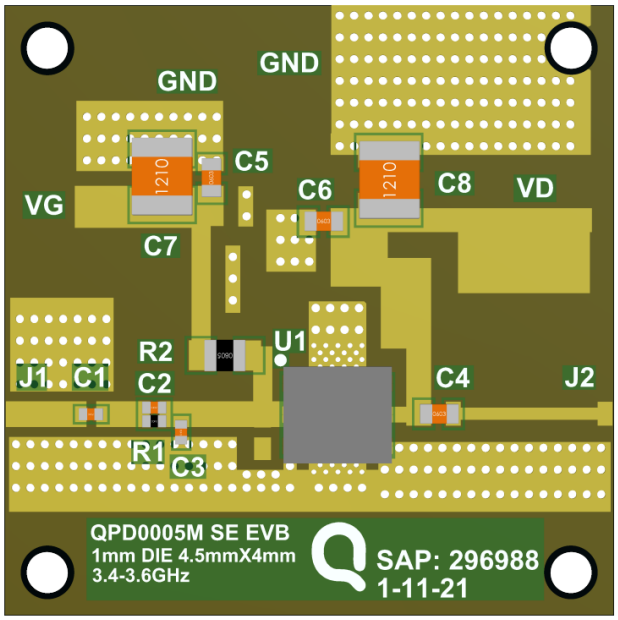
QPD0005EVB1 Performance Plots – 3400 – 3600 MHz Reference Design





Test conditions unless otherwise noted: V_D = +48 V, I_{DQ} = 20 mA, T = +25°C on a reference design fixture tuned for 3400 – 3600 MHz.

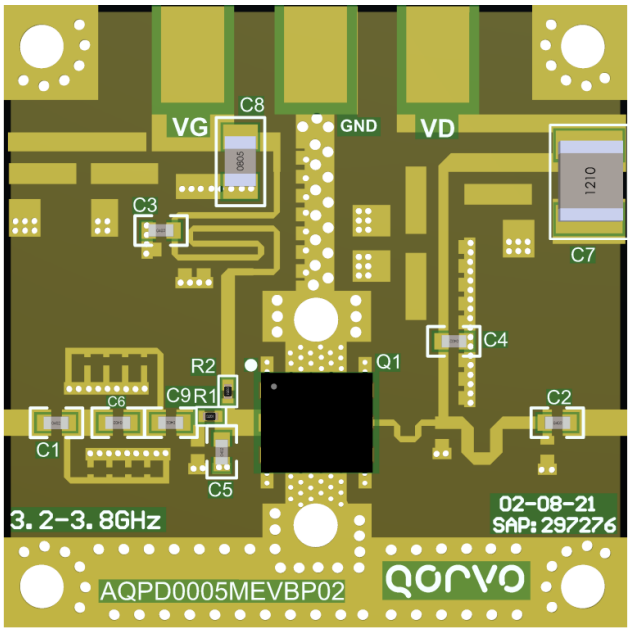
QPD0005MEVB1 Layout – 3.4 – 3.6 GHz Reference Design



QPD0005MEVB1 Bill of Materials – 3.4 – 3.6 GHz Reference Design

Reference Des.	Value	Description	Manuf.	Part Number
U1	-	Transistor, 8 W, 48 V, 4x4.5 mm, GaN	Qorvo	QPD0005M
C1	2.4 pF	Capacitor, 2.4pF, ±0.1pF, 200V, C0G, HI-Q, 0402	AVX	600L2R4BT200T
C2	0.9 pF	Capacitor, 0.9pF, ±0.05pF, 200V, HI-Q, 0402	AVX	600L0R9AT200T
C3	0.7 pF	Capacitor, 0.7pF, ±0.05pF, 200V, HI-Q, 0402	AVX	600L0R7AT200T
C4	6.8 pF	Capacitor, 6.8pF, +/-0.1pF, 250V, HI-Q, 0603	AVX	600S6R8BT250T
C5	8.2 pF	Capacitor, 8.2pF, +/-0.1pF, 250V, HI-Q, 0603	AVX	600S8R2BT250XT
C6	3.9 pF	Capacitor, 3.9pF, +/-0.1pF, 250V, HI-Q, 0603	AVX	600S3R9BT250XT
C7, C8	10 uF	Capacitor, 10uF, 10%, 100V, X7S, 1210	Murata	GRM32EC72A106KE05L
R1	243 Ω	Resistor, 243 Ohm, 1%, 1/10W, 0402	Kamaya	RMC1/16SK2430FTH
R2	10 Ω	Resistor, 10 Ohm, 5%, 37W, 0805	International Manufacturing Service	ND3-0805WA10R0J
J1, J2	-	SMA Panel Mount Jack 4-Hole, 26 GHz	Gigalane	PSF-S00-000

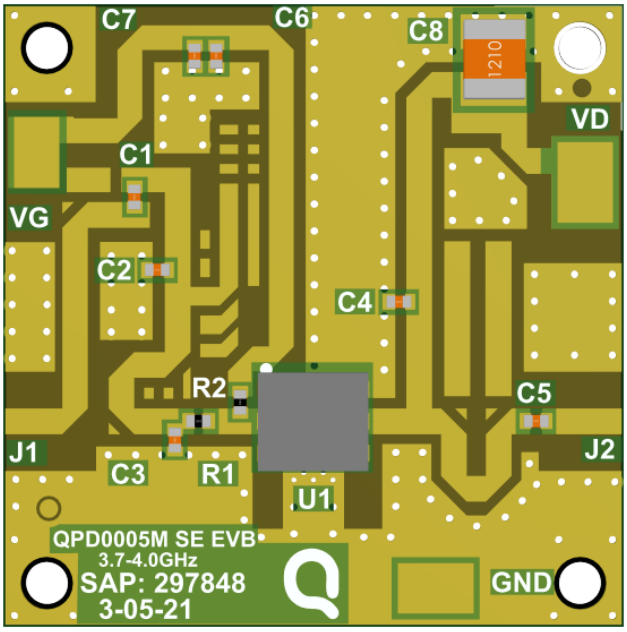
QPD0005MEVB02 Layout – 3.2 – 3.8 GHz Reference Design



QPD0005MEVB02 Bill of Materials – 3.2 – 3.8 GHz Reference Design

Reference Des.	Value	Description	Manuf.	Part Number
U1	-	Transistor, 8 W, 48 V, 4x4.5 mm, GaN	Qorvo	QPD0005M
C1, C6	4.3 pF	Capacitor, 4.3pF, ±0.1pF, 200V, C0G, HI-Q, 0402	Murata	GQM1555C2D4R3BB01D
C2	0.6 pF	Capacitor, 0.9pF, ±0.05pF, 200V, HI-Q, 0402	Murata	GQM1555C2DR60BB01
C3, C4	3.3 pF	Capacitor, 3.3pF, ±0.1pF, 200V, C0G, HI-Q, 0402	Murata	GQM1555C2D3R3BB01
C5	1.3 pF	Capacitor, 1.3pF, +/-0.1pF, 200V, HI-Q, 0402	Murata	GQM1555C2D1R3BB01D
C7	10 uF	Capacitor, 10uF, 10%, 100V, X7S, 1210	Murata	GRM32EC72A106KE05L
C8	1.0 uF	Capacitor, 1.0uF, 20%, 100V, X7S, 0805	TDK	C2012X7S2A105M125AB
C9	0.8 pF	Capacitor, 0.8pF, +/-0.05pF 200V, C0G, HI-Q, 0402	Murata	GQM1555C2DR80WB01D
R1	5.1 Ω	Resistor, 5.1 Ohm, 1%, 1/10W, 0402	Kamaya	RMC1/16SK5R10FTH
R2	10 Ω	Resistor, 10 Ohm, 5%, 1/20W, 0201	Kamaya	RMC1/20-100JPA15
J1, J2	-	SMA Panel Mount Jack 4-Hole, 26 GHz	Gigalane	PSF-S00-000

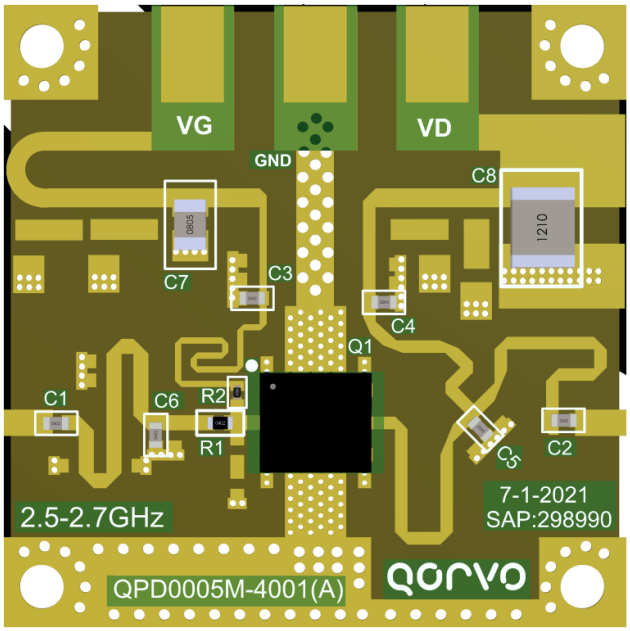
QPD0005MEVB03 Layout – 3.7 – 4.0 GHz Reference Design



QPD0005MEVB03 Bill of Materials – 3.7 – 4.0 GHz Reference Design

Reference Des.	Value	Description	Manuf.	Part Number
U1	-	Transistor, 8 W, 48 V, 4x4.5 mm, GaN	Qorvo	QPD0005M
C1	3.0 pF	Capacitor, 3.0pF, ±0.1pF, 200V, HI-Q, 0402	Murata	GQM1555C2D3R0BB01D
C2	0.6 pF	Capacitor, 0.6pF, ±0.1pF, 200V, HI-Q, 0402	Murata	GQM1555C2DR60BB01D
C3	1.2 pF	Capacitor, 1.2pF, ±0.1pF, 200V, HI-Q, 0402	Murata	GQM1555C2D1R2BB01D
C4, C5, C6	7.5 pF	Capacitor, 7.5pF, +/-0.1pF, 200V, HI-Q, 0402	Murata	GQM1555C2D7R5BB01D
C7	1.0 uF	Capacitor, 1.0uF, 10%, 6.3V, X7R, 0402	Murata	GRM155R70J105KA12D
C8	10 uF	Capacitor, 10uF, 10%, 100V, X7S, 1210	Murata	GRM32EC72A106KE05L
R1	2.4 Ω	Resistor, 2.4 Ohm, 5%, 1/16W, 0402	Kamaya	RMC1/16S-2R4JTH
R2	5.1 Ω	Resistor, 5.1 Ohm, 1%, 1/10W, 0402	Kamaya	RMC1/16SK5R10FTH
J1, J2	-	SMA Panel Mount Jack 4-Hole, 26 GHz	Gigalane	PSF-S00-000

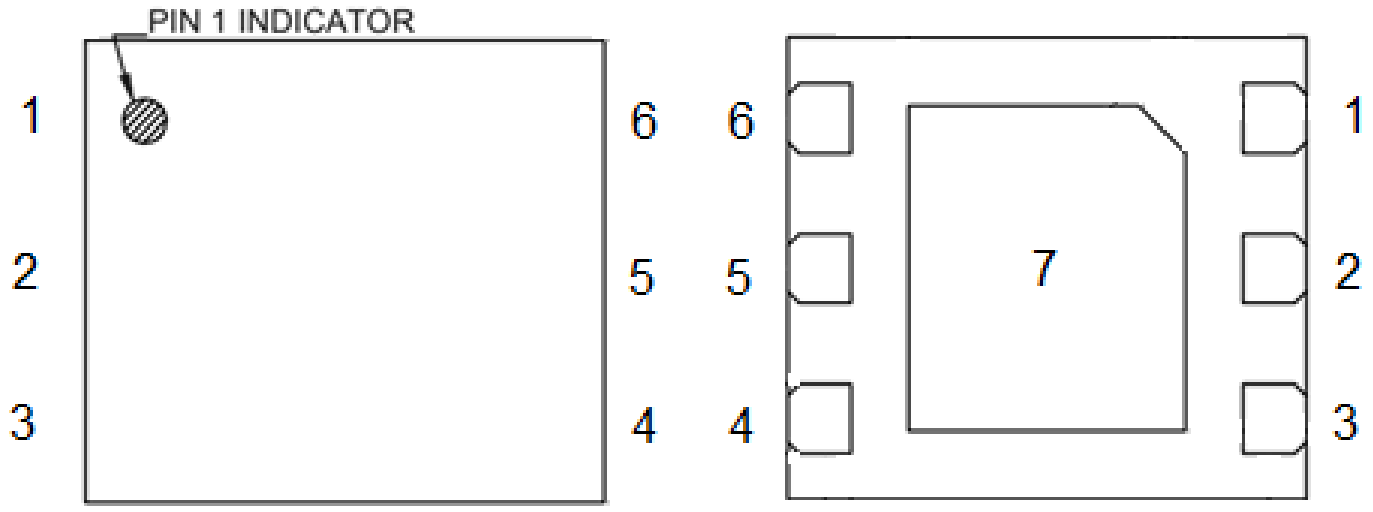
QPD0005MEVB04 Layout – 2.5 – 2.7 GHz Reference Design



QPD0005MEVB04 Bill of Materials – 2.5 – 2.7 GHz Reference Design

Reference Des.	Value	Description	Manuf.	Part Number
U1	-	Transistor, 8 W, 48 V, 4x4.5 mm, GaN	Qorvo	QPD0005M
C1	2.2 pF	Capacitor, 2.2pF, ±0.1pF, 50V, HI-Q, 0402	Murata	GJM1555C1H2R2BB01D
C2	1.0 pF	Capacitor, 1.0pF, ±0.05pF, 200V, HI-Q, 0402	Murata	GQM1555C2D1R0WB01D
C3, C4	4.7 pF	Capacitor, 4.7pF, ±0.1pF, 200V, HI-Q, 0402	Murata	GQM1555C2D4R7BB01D
C5	2.7 pF	Capacitor, 2.7pF, +/-0.1pF, 200V, HI-Q, 0402	AVX	600L2R7BT200T
C6	2.0 pF	Capacitor, 2.0pF, +/-0.25pF, 50V, HI-Q, 0402	Murata	GJM1555C1H2R0CB01D
C7	1.0 uF	Capacitor, 1.0uF, 20%, 100V, X7S, 0805	TDK	C2012X7S2A105M125AB
C8	10 uF	Capacitor, 10uF, 10%, 100V, X7S, 1210	Murata	GRM32EC72A106KE05L
R1	5.1 Ω	Resistor, 243 Ohm, 1%, 1/10W, 0402	Kamaya	RMC1/16SK2430FTH
R2	10 Ω	Resistor, 10 Ohm, 5%, 1/20W, 0201	Kamaya	RMC1/20-100JPA15
J1, J2	-	SMA Panel Mount Jack 4-Hole, 26 GHz	Gigalane	PSF-S00-000

Pin Configuration and Description



Bottom View

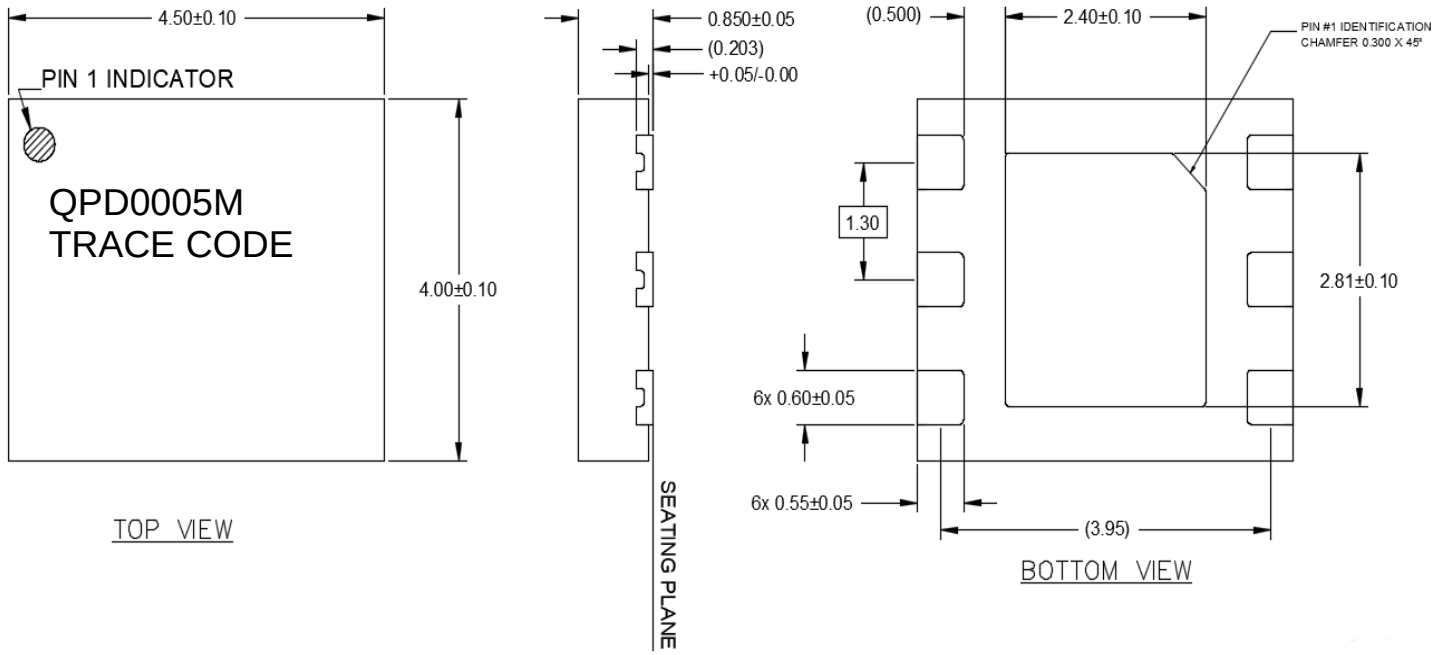
Pin No.	Label	Description
1	GND	No Connect
2	RF IN, VG	RF Input, Gate Bias
3	NC	No Connect
4	NC	No Connect
5	RF OUT, VD	RF Output, Drain Bias
6	NC	No Connect
7 (Backside Paddle)	GND	Ground

Biasing Procedure

Bias On	Bias Off
1. Turn ON V_G to −4 V. 2. Turn ON V_D to +48 V. 3. Slowly adjust V_G until I_D = 20 mA. (Typically, V_G = −2.6 V.) 4. Turn ON RF.	1. Turn OFF RF. 2. Adjust V_G to −4 V. 3. Turn OFF V_D. 4. Wait two (2) seconds to allow drain capacitors to discharge. 5. Turn OFF V_G.

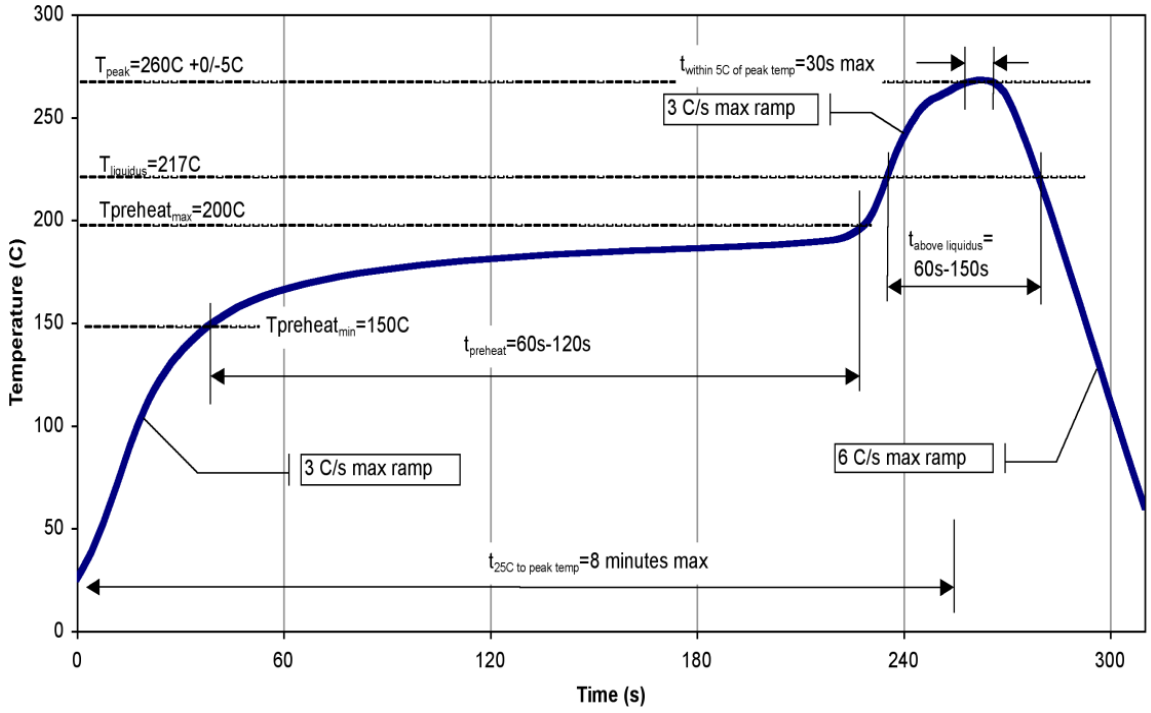
Package Marking and Dimensions

Marking: Qorvo Logo
Part Number – QPD0005M
Trace Code – To be assigned by subcontractor.



Notes:
1. All dimensions are in millimeters. Angles are in degrees.
2. General tolerance is ±0.05 unless otherwise shown.
3. Part is overmold encapsulated.
4. Contact plating is NiPdAu. Au thickness is 0.00254 to 0.01501 µm.

Recommended Solder Temperature Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1B (500V)	ANSI/ESDA/JEDEC Standard JS-001
ESD – Charged Device Model (CDM)	Class C2a (500V)	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 ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free

Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

Web: www.qorvo.com **Tel: 1-844-890-8163**

Email: customer.support@qorvo.com

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