QPD0005

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

Product Overview

The QPD0005 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 8.7 W at +48 V operation.

Lead free and RoHS compliant.

6 Pin 4.5 x 4.0 mm DFN Package

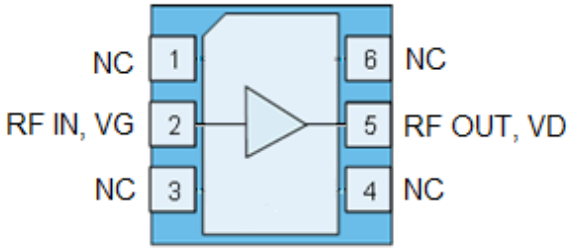
Key Features

- Operating Frequency Range: 2.5 – 5.0 GHz
- Operating Drain Voltage: +48 V
- Maximum Output Power (P_{SAT}): 8.7 W (1)
- Maximum Drain Efficiency: 72.9% (1)
- Efficiency-Tuned P3dB Gain: 18.8 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 Number	Description
QPD0005SR	Short Reel – 100 Pieces
QPD0005TR13	13” Reel – 2500 Pieces
QPD0005EVB01	3.4 – 3.6 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, Pulse CW	+34 dBm
VSWR Mismatch, P1dB Pulse (10% 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 device may reduce device reliability.

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Gate Voltage (V_G)	−3.0	−2.6	−2.3	V
Drain Voltage (V_D)		+48		V
Quiescent Drain Current (I_{DQ})		12		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			12.0		mA
Gain	P_{OUT} = 24 dBm	16.8	19.2		dB
Peak Output Power	P_{OUT} = 30 dBm, 10 dB PAR signal	36.3	37.8		dBm
Drain Efficiency	P_{OUT} = 24 dBm	13.0	15.9		%
Adjacent Power Ratio	P_{OUT} = 24 dBm		-39.0	-30.0	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} = 12 mA, T = +25°C, 1x20 MHz LTE signal with 8 dB PAR at 3600 MHz on a production test fixture.

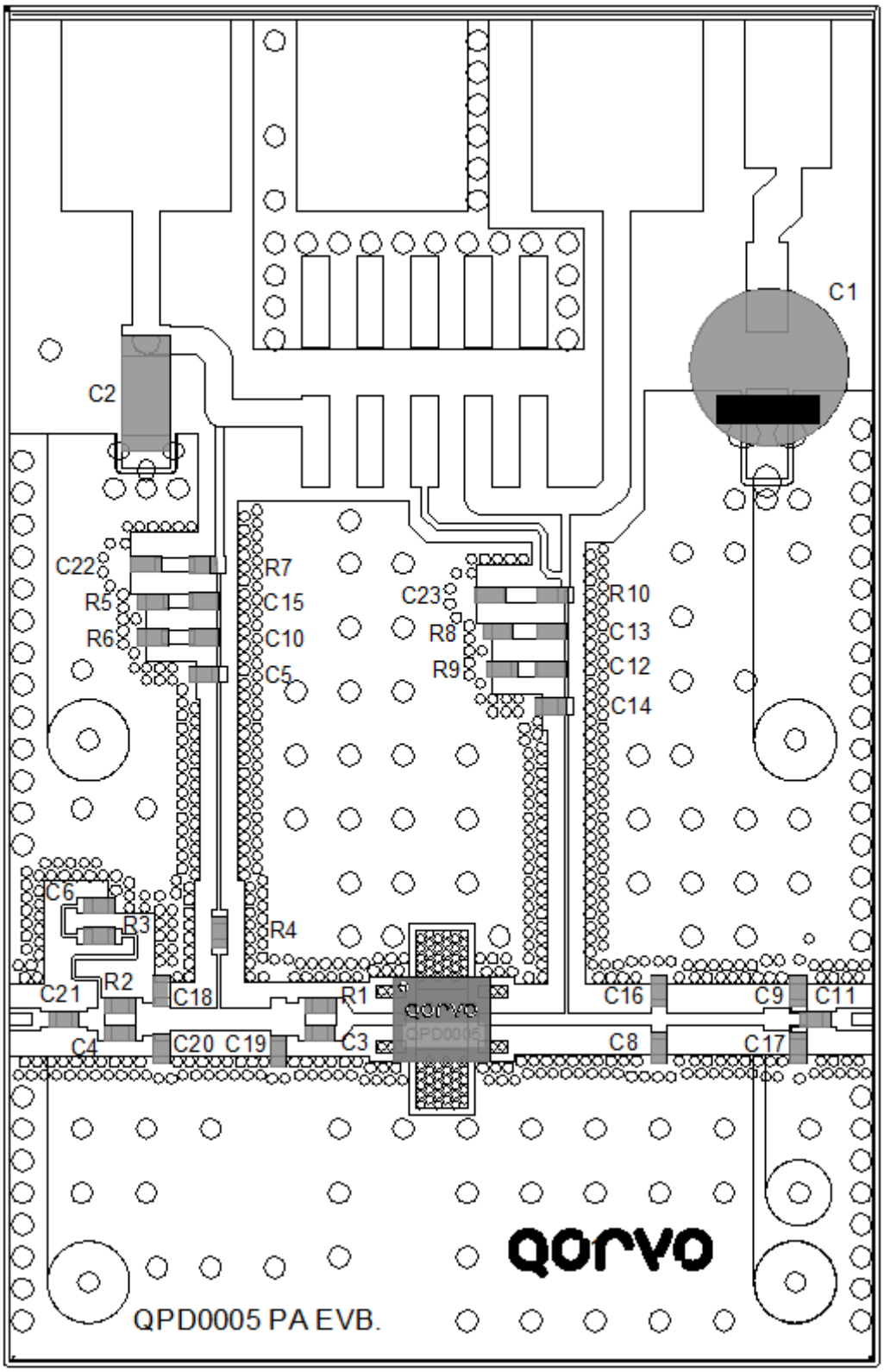
Thermal Information

Parameter	Conditions	Values	Units
Thermal Resistance, Peak IR Surface Temperature at Average Power (θ_{JC})	T_{CASE} = +85°C, T_{CH} = 116°C CW: P_{DISS} = 2.1 W, P_{OUT} = 0.2 W	14.7	°C/W
Thermal Resistance, Peak IR Surface Temperature at Average Power (θ_{JC})	T_{CASE} = +85°C, T_{CH} = 124°C CW: P_{DISS} = 2.6 W, P_{OUT} = 1.2 W	14.9	°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

QPD0005EVB01 Layout – 3400 – 3600 MHz Reference Design

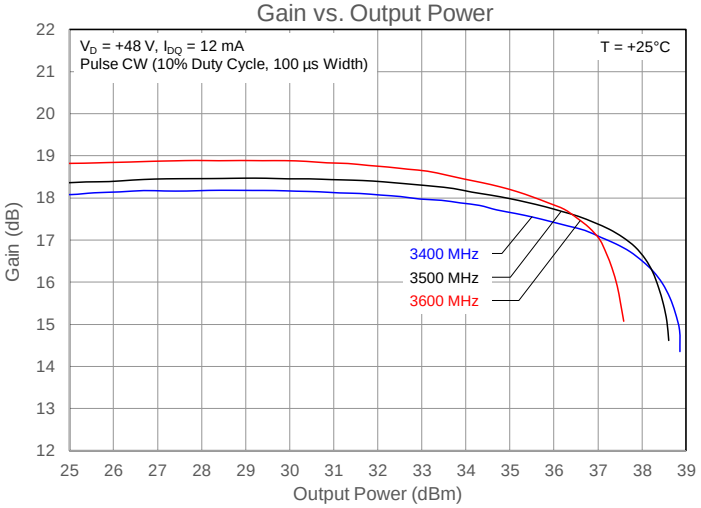


QPD0005EVB01 Bill of Materials – 3400 – 3600 MHz Reference Design

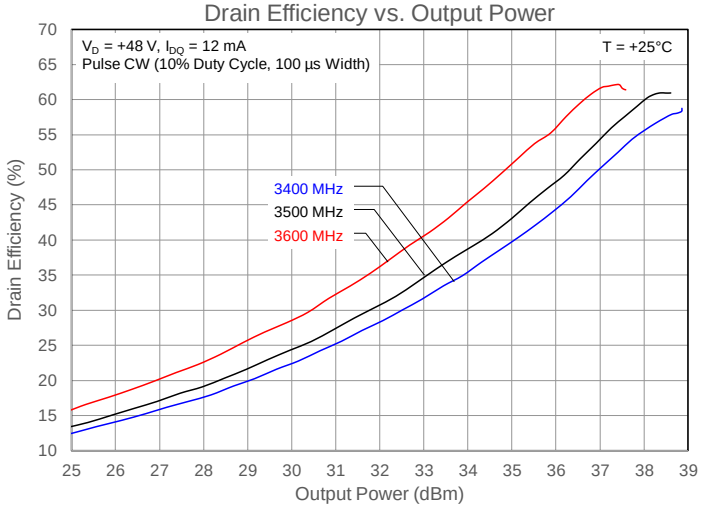
Reference Des.	Value	Description	Manuf.	Part Number
C1	33 µF	Capacitor, 33 µF, ±20%, 80 V	Panasonic	EEEFK1K330P
C2	10 µF	Capacitor, 10 µF, ±10%, 16 V, Tantalum	AVX	TPSC106K016R0500
C3, C19	1.5 pF	Capacitor, 1.5 pF, ±0.1 pF, 250 V, 0603	ATC	600S1R5AT250X
C4	4.7 pF	Capacitor, 4.7 pF, ±0.1 pF, 250 V, 0603	ATC	600S4R7AT250X
C5, C6, C11, C14, C21	10 pF	Capacitor, 10 pF, ±1%, 250 V, 0603	ATC	600S100FT250X
C8, C16	0.9 pF	Capacitor, 0.9 pF, ±0.05 pF, 250 V, 0603	ATC	600S0R9AT250X
C9, C17	0.6 pF	Capacitor, 0.6 pF, ±0.05 pF, 250 V, 0603	ATC	600S0R6AT250X
C10, C12	56 pF	Capacitor, 56 pF, ±1%, 250 V, 0603	ATC	600S560FT250X
C13, C15	1000 pF	Capacitor, 1000 pF, ±5%, 200 V, X7R, 0603	AVX	06032C102JAT2A
C18, C20	0.5 pF	Capacitor, 0.5 pF, ±0.05 pF, 250 V, 0805	ATC	600S0R5AT250X
C22, C23	0.1 µF	Capacitor, 0.1 µF, ±10%, 100 V, X7R, 0805	AVX	08051C104JAT2A
R1	150 Ω	Resistor, 150 Ω, ±1%, 1/10 W, 50 V, Thick Film, 0603	Kamaya	RMC1/16K1500FTP
R2	51.1 Ω	Resistor, 51.1 Ω, ±1%, 1/10 W, Thick Film, 0603	Cal-Chip	RM06F51R1CT
R3, R6, R9	5.1 Ω	Resistor, 5.1 Ω, ±1%, 1/10 W, Thick Film, 0603	Samsung	RC1608F5R1CS
R4	10 Ω	Resistor, 10 Ω, ±1%, 1/10 W, Thick Film, 0603	Kamaya	RMC1/16K10R0FTP
R5, R8	33 Ω	Resistor, 33 Ω, ±5%, 1/10 W, Thick Film, 0603	KOA Speer	RK73B1JTTD330J
R7, R10	1 Ω	Resistor, 1 Ω, ±1%, 1/10 W, Thick Film, 0603	Samsung	RC1608F1R0CS
Q1	-	Transistor, 8 W, 48 V, 4x4.5 mm, GaN	Qorvo	QPD0005
J4 (not pictured)	-	2.4 mm Pitch, 10 Way, ST SM Shrouded Header	Samtech	TSSH-105-01-L-DV
J5, J6 (not pictured)	-	SMA Panel Mount Jack 4-Hole, 26 GHz	Gigalane	PSF-S00-000

QPD0005EVB01 Performance Plots – 3400 – 3600 MHz Reference Design

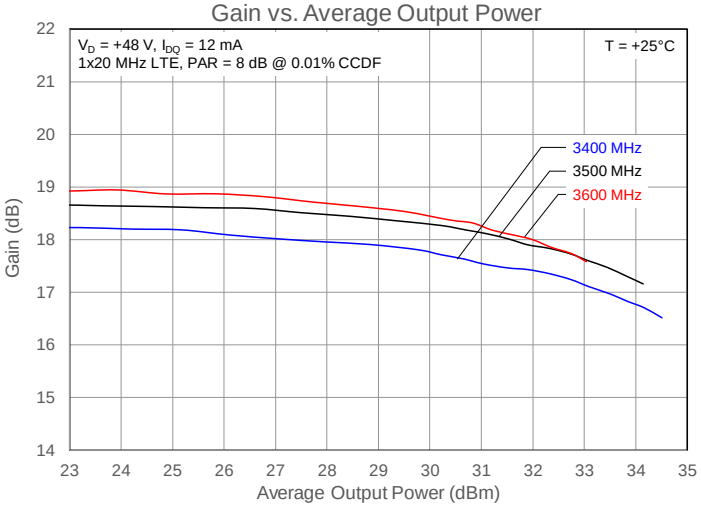
Gain vs. Output Power



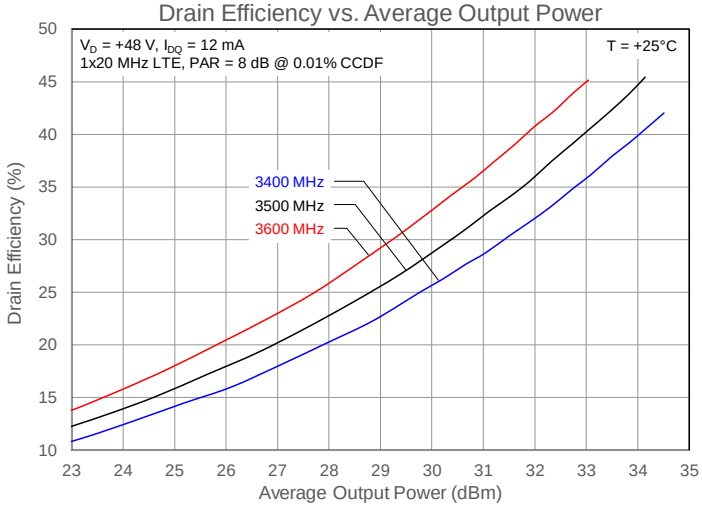
Drain Efficiency vs. Output Power



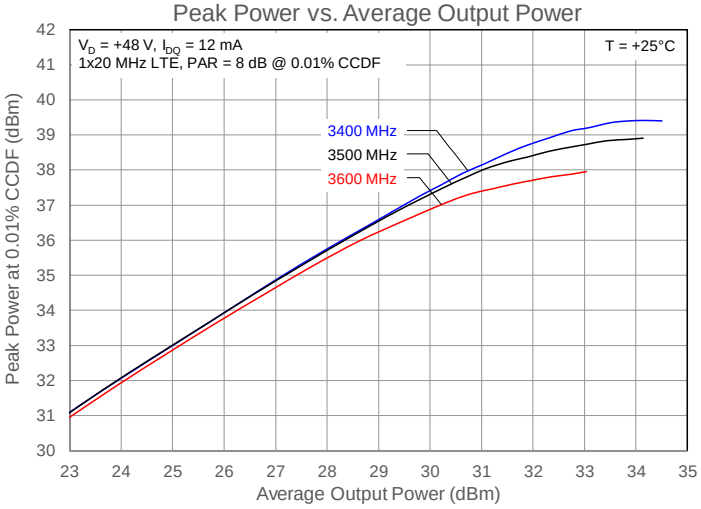
Gain vs. Average Output Power



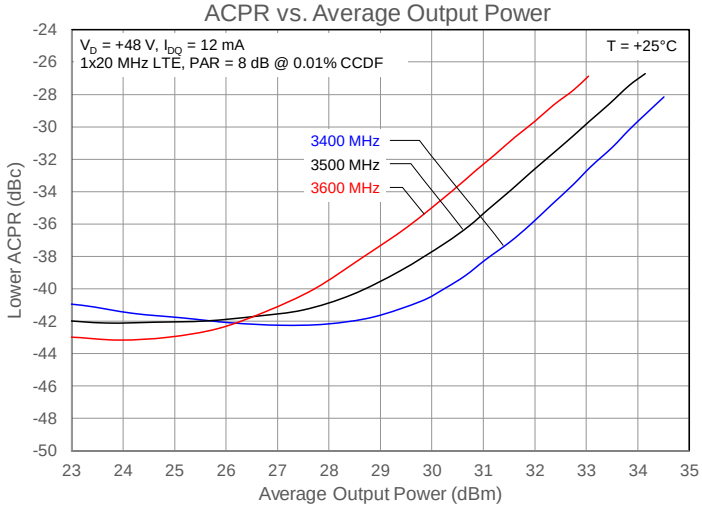
Drain Efficiency vs. Average Output Power



Peak Power vs. Average Output Power

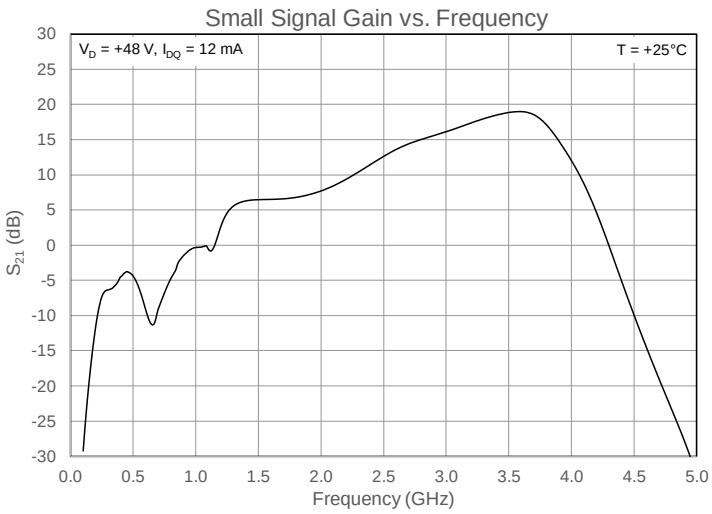


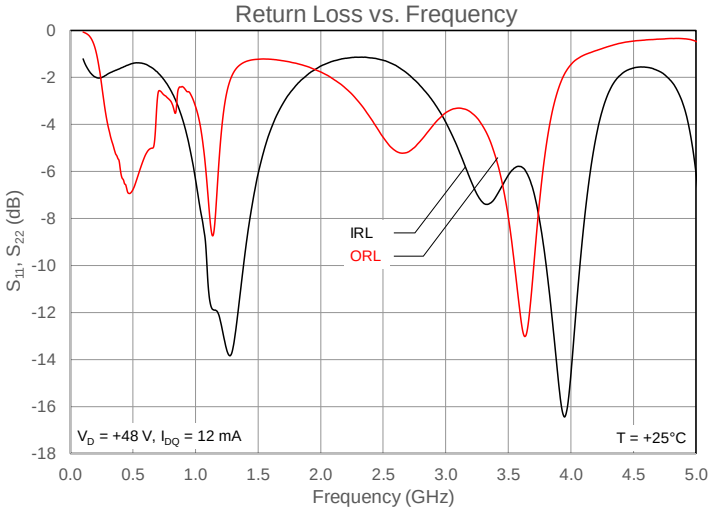
ACPR vs. Average Output Power



Test conditions unless otherwise noted: V_D = +48 V, I_{DQ} = 12 mA, T = +25°C on a reference design fixture tuned for 3400 – 3600 MHz.

QPD0005EVB01 Performance Plots – 3400 – 3600 MHz Reference Design





Test conditions unless otherwise noted: V_D = +48 V, I_{DQ} = 12 mA, T = +25°C on a reference design fixture tuned for 3400 – 3600 MHz.

Power-Matched Load Pull Performance

Frequency (MHz)	Source Impedance (Ω)	Load Impedance (Ω)	P3dB (dBm)	Drain Efficiency (%)	G3dB (dB)
2500	6.06 + j15.31	44.35 + j36.16	39.6	66.0	20.8
2700	6.08 + j14.51	43.46 + j38.18	39.4	67.0	20.2
3400	8.28 + j9.45	29.23 + j27.82	39.3	64.6	17.7
3600	8.12 + j6.04	29.25 + j27.82	39.4	64.4	17.4
4800	5.68 – j6.54	17.45 + j10.20	39.0	63.9	16.1
5000	5.73 – j8.75	16.93 + j5.44	39.0	60.5	15.4

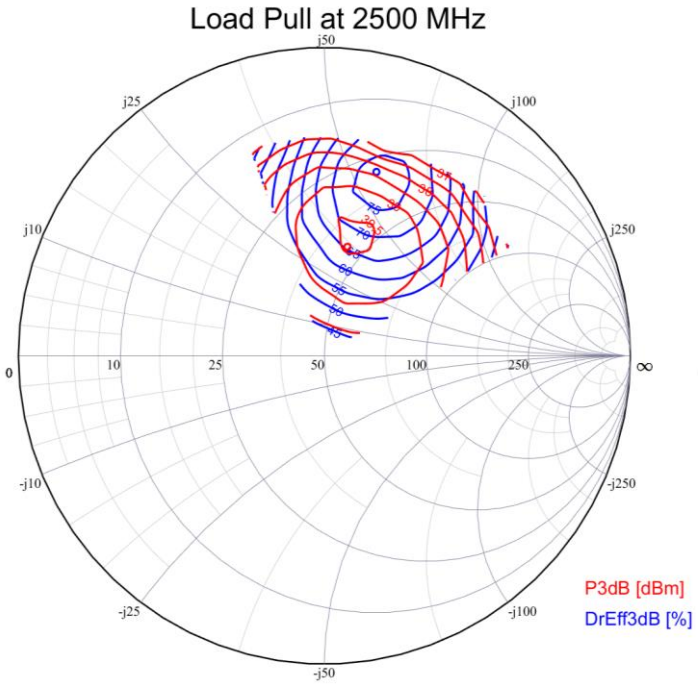
Test conditions unless otherwise noted: V_D = +48 V, I_{DQ} = 12 mA, T = +25°C, Pulse CW (10% duty cycle, 100 µs width).

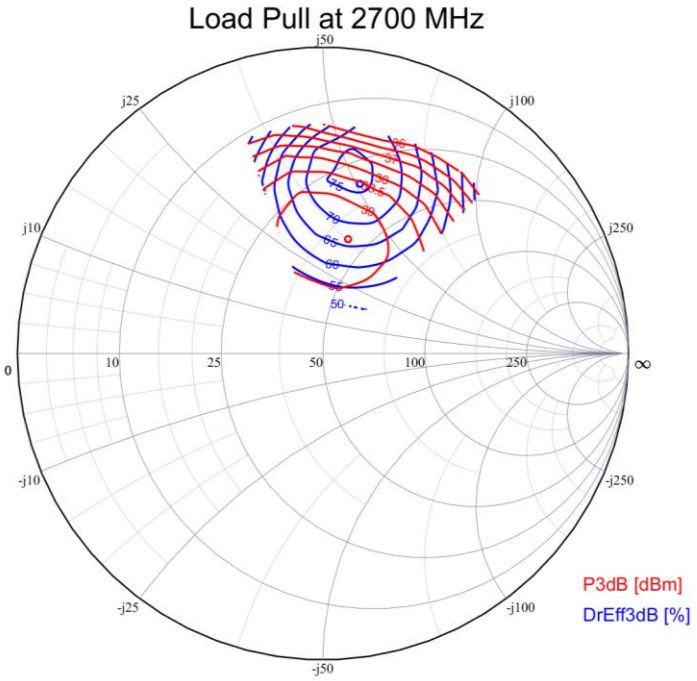
Efficiency-Matched Load Pull Performance

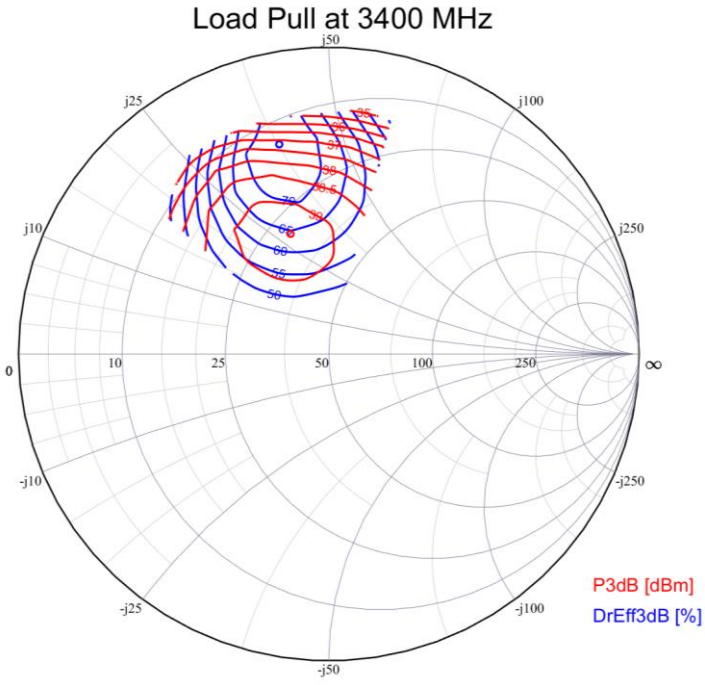
Frequency (MHz)	Source Impedance (Ω)	Load Impedance (Ω)	P3dB (dBm)	Drain Efficiency (%)	G3dB (dB)
2500	6.06 + j15.31	28.95 + j56.78	38.4	77.7	23.0
2700	6.08 + j14.51	31.57 + j51.40	38.6	76.3	21.3
3400	8.28 + j9.45	14.04 + j37.77	37.3	74.4	18.5
3600	8.12 + j6.04	12.48 + j32.24	37.6	72.9	18.8
4800	5.68 – j6.54	9.78 + j16.20	37.3	71.5	17.1
5000	5.73 – j8.75	5.88 + j12.07	36.2	71.0	17.0

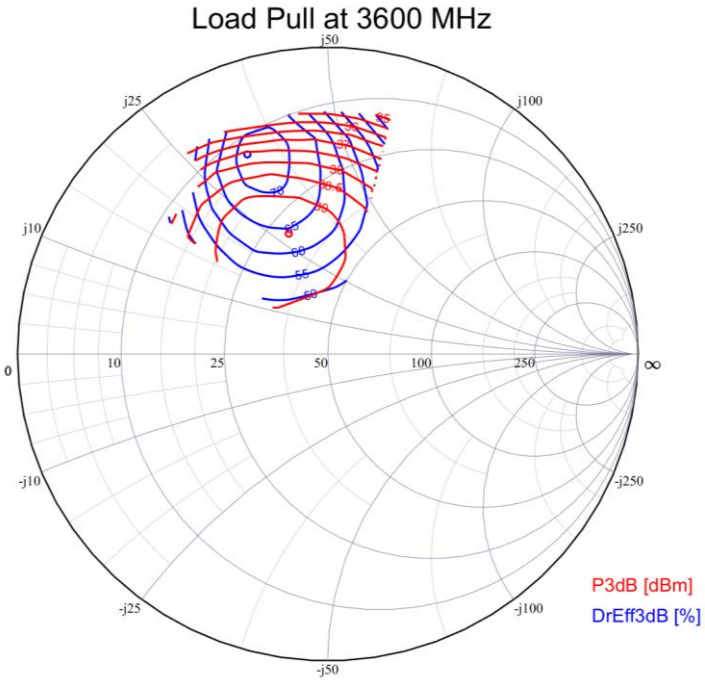
Test conditions unless otherwise noted: V_D = +48 V, I_{DQ} = 12 mA, T = +25°C, Pulse CW (10% duty cycle, 100 µs width).

Load Pull Contours









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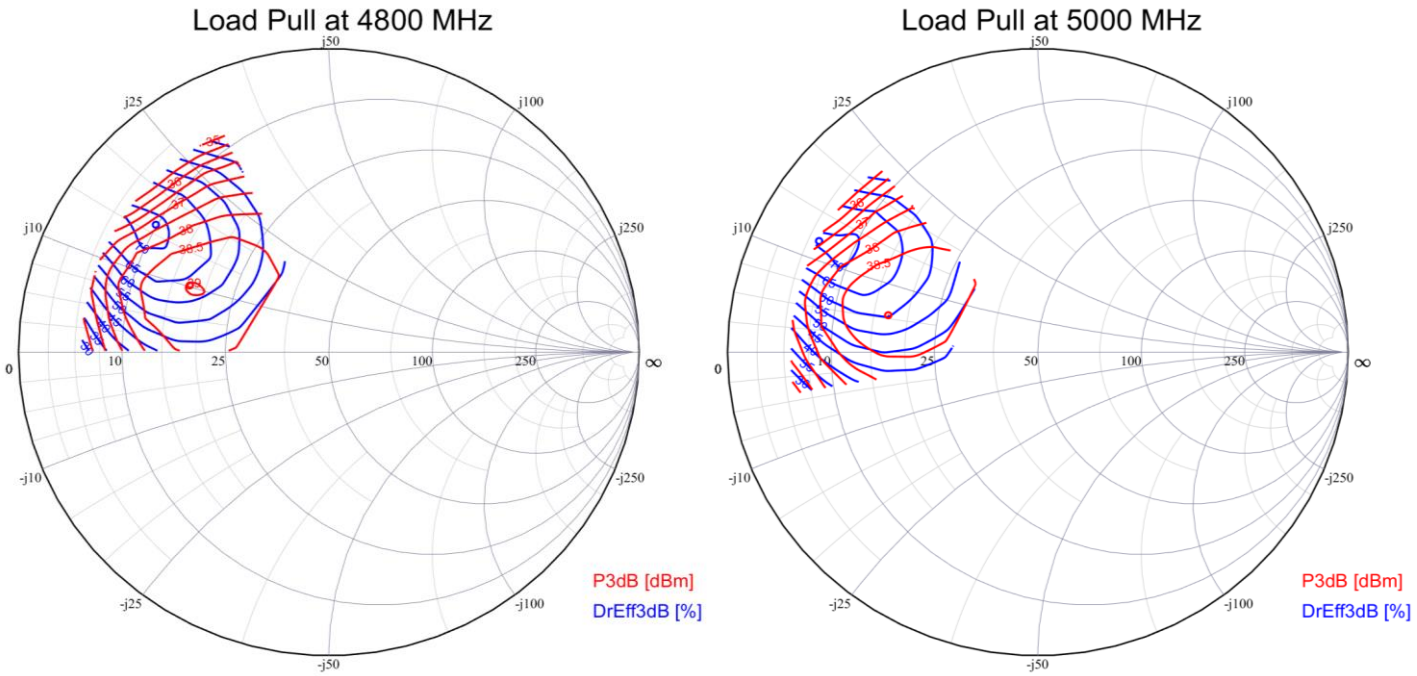
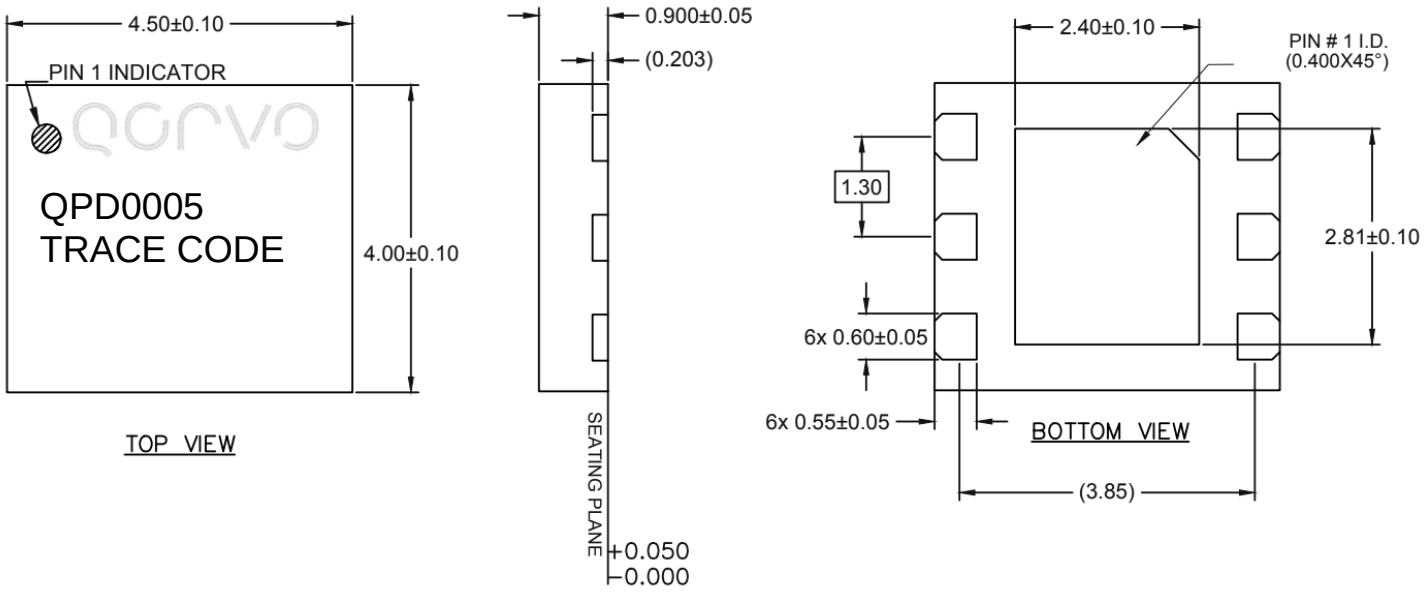
Load Pull Contours



Test Conditions unless otherwise noted: V_D = +48 V, I_{DQ} = 12 mA, T = +25°C, Pulse CW (10% duty cycle, 100 µs width).

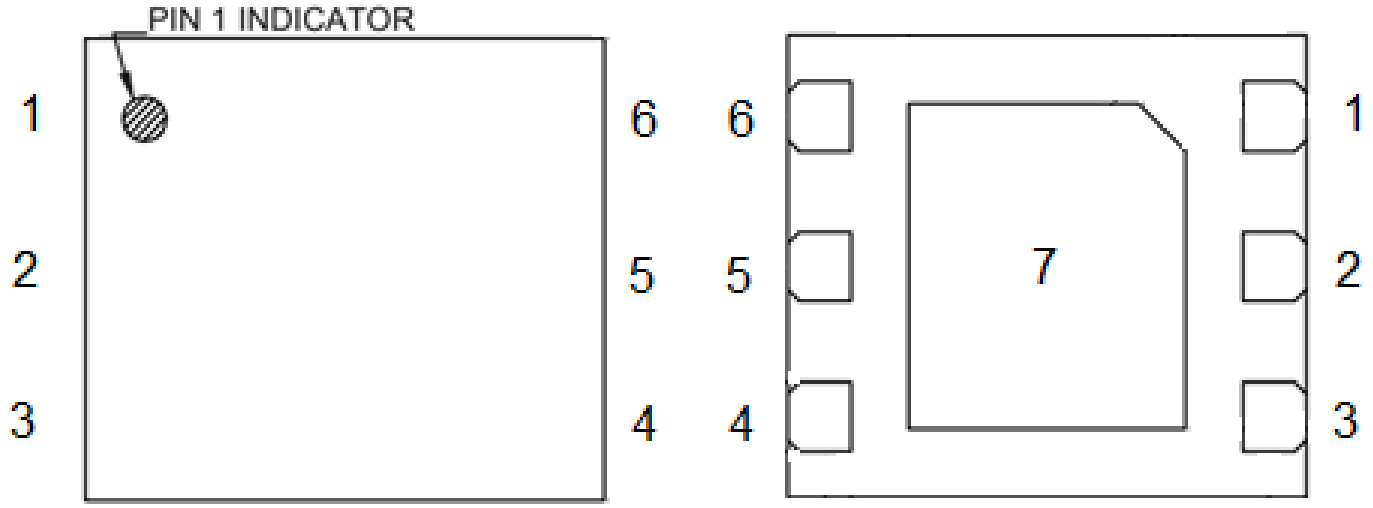
Package Marking and Dimensions

Marking: Qorvo Logo
Part Number – QPD0005
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.

Pin Configuration and Description



Top View Bottom View

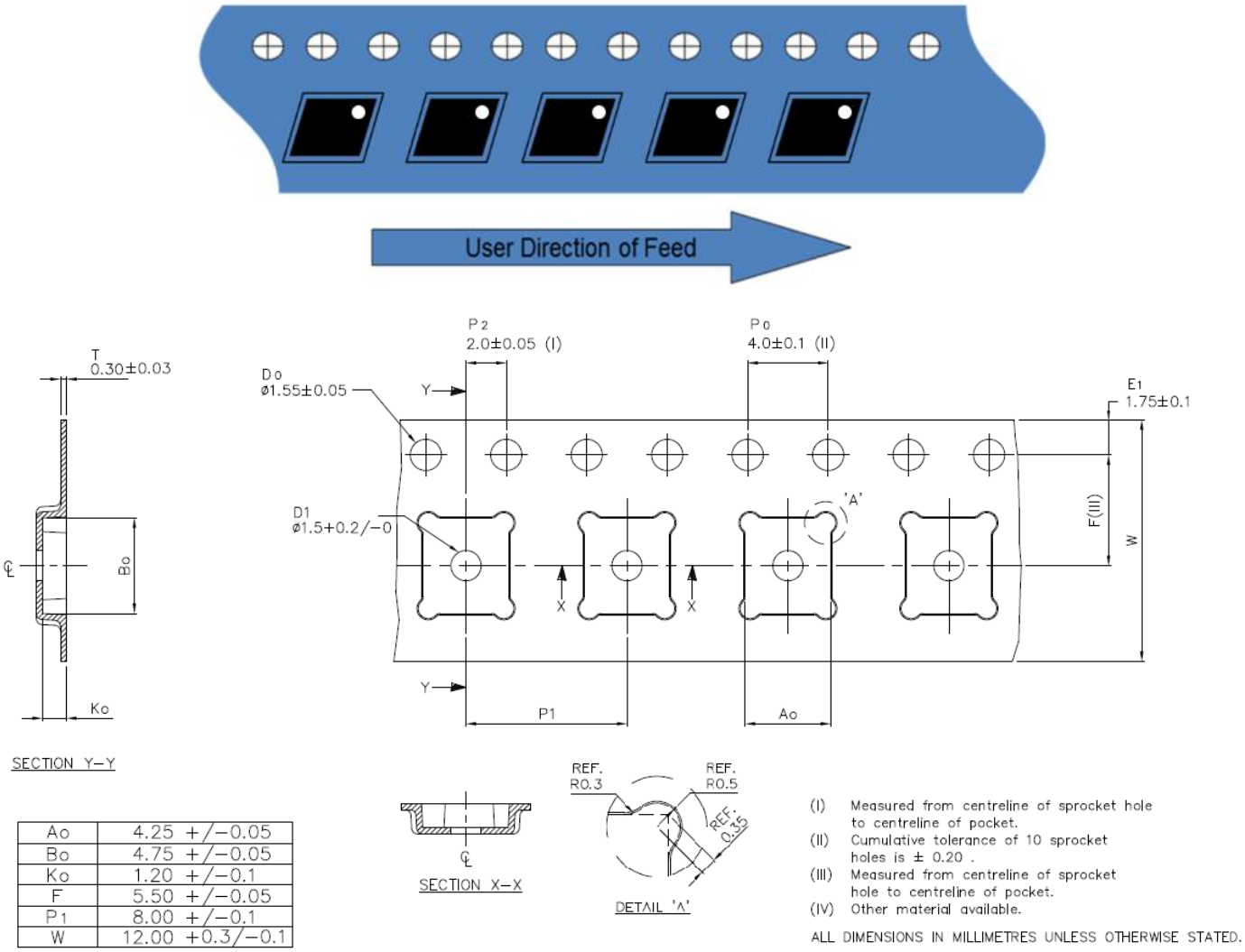
Pin Number	Label	Description
1	NC	No Connect
2	RF IN, VG	RF Input, Gate Bias
3	NC	No Connect
4	NC	No Connect
5	RF OUT, VD	RF Output, Drain Bias
6	NC	No Connect
7 (Backside Paddle)	GND	Ground

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 = 12 mA. (Typically, V_G = −2.6 V.) 4. Turn ON RF.	1. Turn OFF RF. 2. Adjust V_G to −5 V. 3. Turn OFF V_D. 4. Wait two (2) seconds to allow drain capacitors to discharge. 5. Turn OFF V_G.

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.

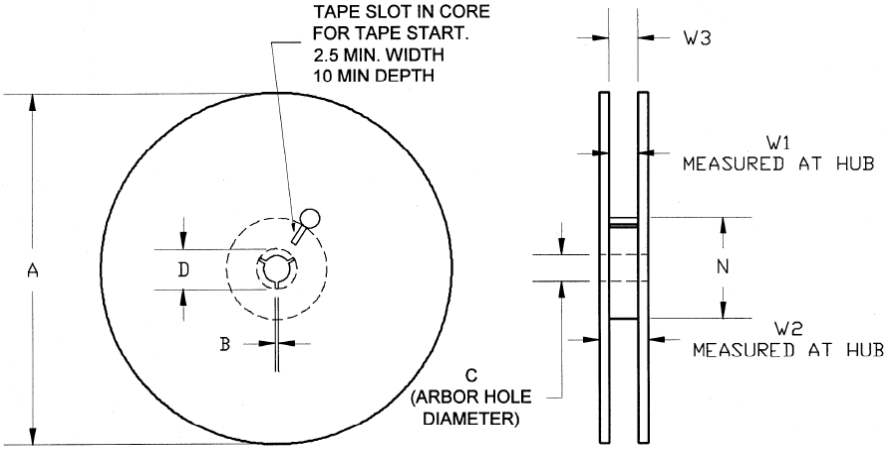


Ao	4.25 +/−0.05
Bo	4.75 +/−0.05
Ko	1.20 +/−0.1
F	5.50 +/−0.05
P1	8.00 +/−0.1
W	12.00 +0.3/−0.1

Feature	Measure	Symbol	Size (in)	Size (mm)
Cavity	Length	A0	0.167	4.25
	Width	B0	0.187	4.75
	Depth	K0	0.047	1.20
	Pitch	P1	0.315	8.00
Centerline Distance	Cavity to Perforation - Length Direction	P2	0.079	2.00
	Cavity to Perforation - Width Direction	F	0.217	5.50
Cover Tape	Width	C	0.362	9.2
Carrier Tape	Width	W	0.472	12.00

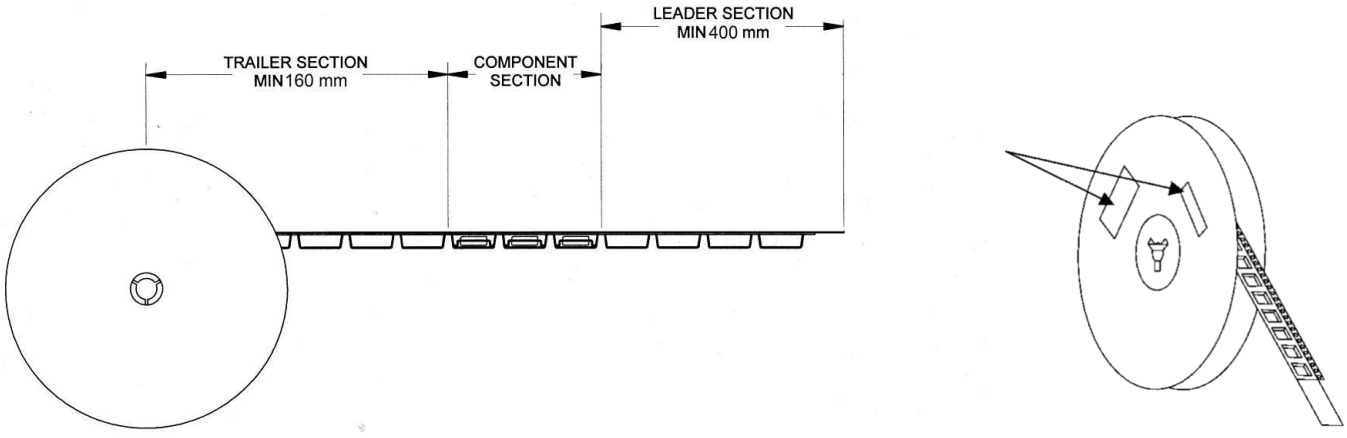
Tape and Reel Information – Reel Dimensions

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.



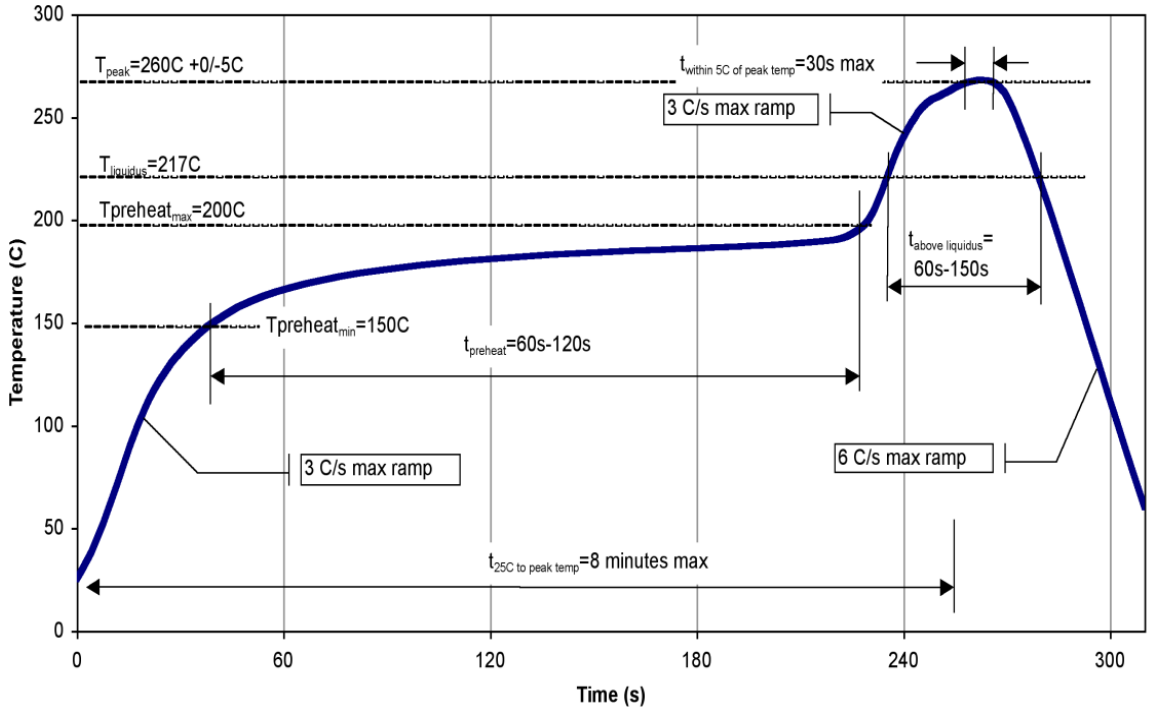
Feature	Measure	Symbol	Size (in)	Size (mm)
Flange	Diameter	A	12.992	330.0
	Thickness	W2	0.717	18.2
	Space Between Flange	W1	0.504	12.8
Hub	Outer Diameter	N	4.016	102.0
	Arbor Hole Diameter	C	0.512	13.0
	Key Slit Width	B	0.079	2.0
	Key Slit Diameter	D	0.787	20.0

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.
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 1A (250 V)	ANSI/ESDA/JEDEC Standard JS-001
ESD – Charged Device Model (CDM)	Class C2A (500 V)	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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