

## Product Description

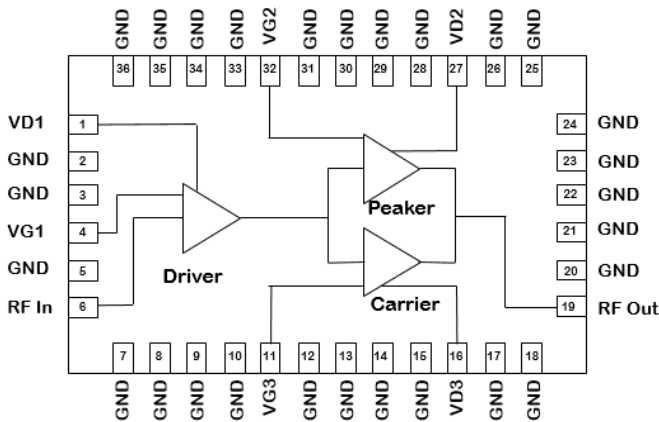
The QPA3503 is an integrated 2-stage Power Amplifier Module designed for massive MIMO applications with 3 W RMS at the device output covering frequency range from 3.4 to 3.6 GHz.

The module is 50  $\Omega$  input and output and requires minimal external components. The module is also compact and offers a much smaller footprint than traditional discrete component solutions.

The QPA3503 incorporates a Doherty final stage delivering high power added efficiency for the entire module at 3 W average power.

RoHS compliant.

## Functional Block Diagram



36 Pin 6x10 mm Plastic Package

## Product Features

- Operating Frequency Range: 3.4 - 3.6 GHz
- Operating Drain Voltage: +28 V
- 50  $\Omega$  Input / Output
- Integrated Doherty Final Stage
- Gain at 3 W avg.: 32 dB
- Power Added Efficiency at 3 W avg.: 33%
- 6x10 mm Plastic Surface Mount Package

## Applications

- 5G Massive MIMO
- W-CDMA / LTE
- Macrocell Base Station Driver
- Microcell Base Station
- Small Cell Final Stage
- Active Antenna
- General Purpose Applications

## Ordering Information

Part No.	Description
QPA3503SB	Sample Bag – 5 Pieces
QPA3503SR	Short Reel – 100 Pieces
QPA3503TR13	13" Reel – 2500 Pieces
QPA3503EVB01	Tested 3.4-3.6 GHz EVB

### Absolute Maximum Ratings<sup>2</sup>

Parameter	Range / Value	Units
Breakdown Voltage, $BV_{DG}$	120	V
Gate Voltage ( $V_{G1,2,3}$ )	-7 to +2	V
Drain Voltage ( $V_{D1,2,3}$ )	+40	V
RF Input Power <sup>(1)</sup>	+25	dBm
VSWR Mismatch, P3dB Pulse (10 % duty cycle, 100 $\mu$ width), $T = 25^\circ\text{C}$	10:1	
Storage Temperature	-65 to +150	$^\circ\text{C}$

1. Tested at 3.5 GHz,  $T = +25^\circ\text{C}$ , single-carrier, 20 MHz LTE signal with 7.8 dB PAR @ 0.01% CCDF.
2. Operation of this device outside the parameter ranges given above may cause permanent damage.

### Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Gate Voltage ( $V_{G1}$ )		-2.6		V
Gate Voltage ( $V_{G2}$ )		-4.5		V
Gate Voltage ( $V_{G3}$ )		-2.6		V
Drain Voltage ( $V_{D1,2,3}$ )		+28		V
Quiescent Current ( $I_{DQ1}$ )		50		mA
Quiescent Current ( $I_{DQ3}$ )		75		mA

Electrical performance is measured under conditions noted in the electrical specifications table. Specifications are not guaranteed over all recommended operating conditions.

### Electrical Specifications

Parameter	Conditions	Min	Typ	Max	Units
Frequency Range		3.4		3.6	GHz
Driver Quiescent Current			50		mA
Carrier Quiescent Current			75		mA
Gain	$P_{AVG} = 34.8$ dBm		32		dB
P3dB	3 dB PAR compression		44		dBm
Power Added Efficiency	$P_{AVG} = 34.8$ dBm		33		%
Raw ACLR	$P_{AVG} = 34.8$ dBm		-28		dBc

Test conditions unless otherwise noted:  $V_{D1,2,3} = +28$  V,  $I_{DQ1} = 50$  mA,  $I_{DQ3} = 75$  mA,  $V_{G2} = -4.5$  V,  $T = +25^\circ\text{C}$ , single-carrier, 20 MHz LTE signal with 7.8 dB PAR @ 0.01% CCDF, de-embedded from EVB measurements.

### Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Peak IR Surface Thermal Resistance at Average Power ( $\theta_{JC}$ )	$T_{CASE} = +85^\circ\text{C}$ , $T_{CH} = 101^\circ\text{C}$ CW: $P_{DISS} = 6.1$ W, $P_{OUT} = 3$ W	2.6	$^\circ\text{C}/\text{W}$

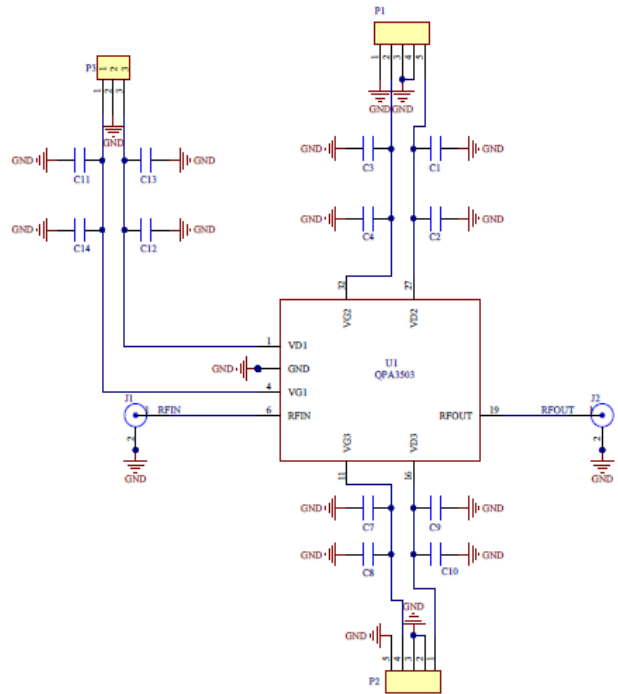
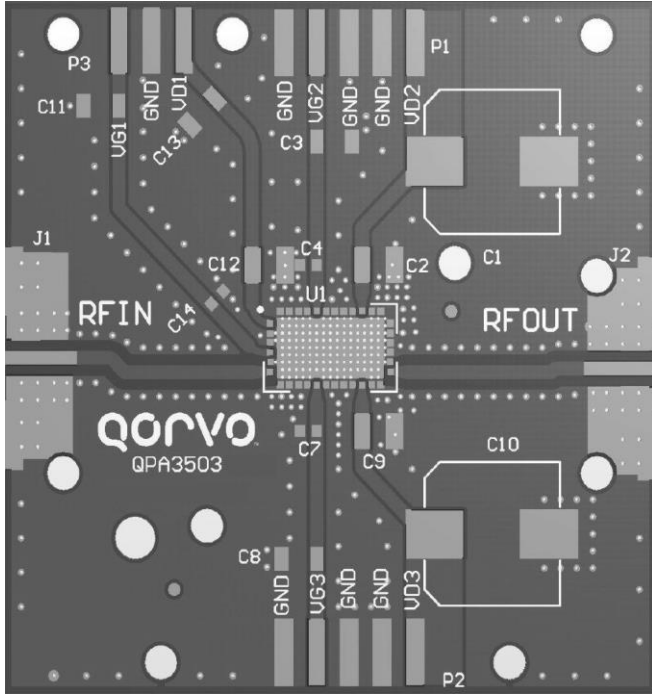
Notes:

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

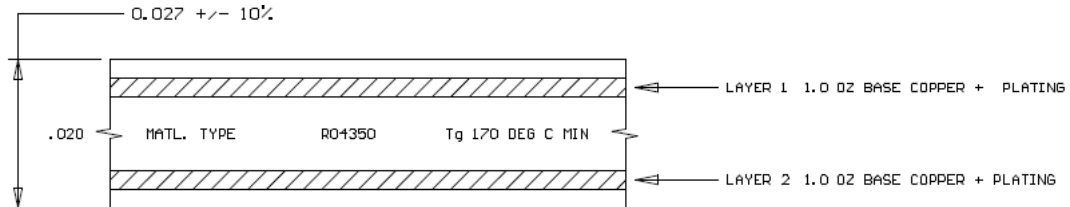
### QPA3503 3.4 – 3.6 GHz Reference Design

EVB Layout

EVB Schematic



PCB Stackup and Material



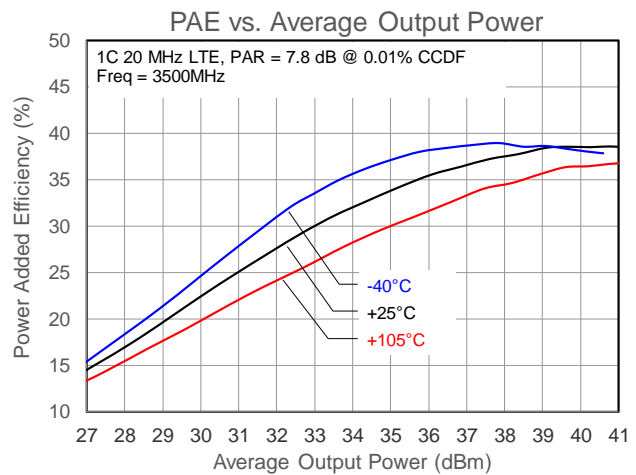
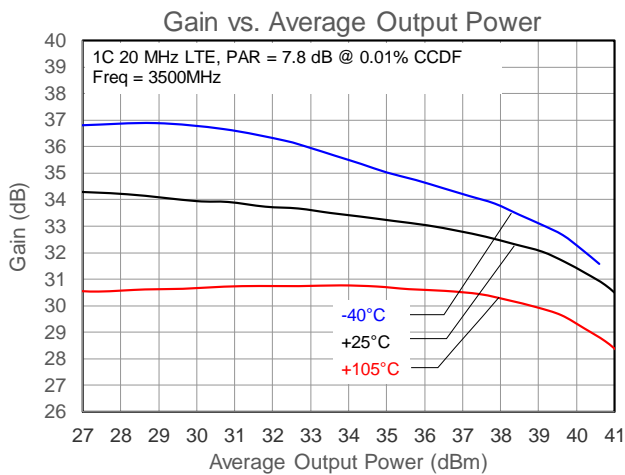
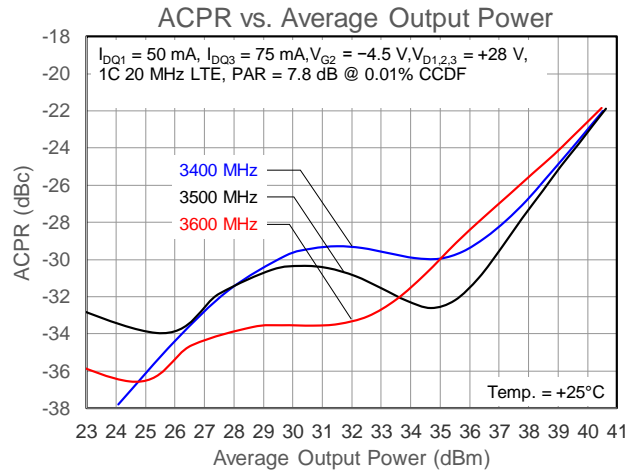
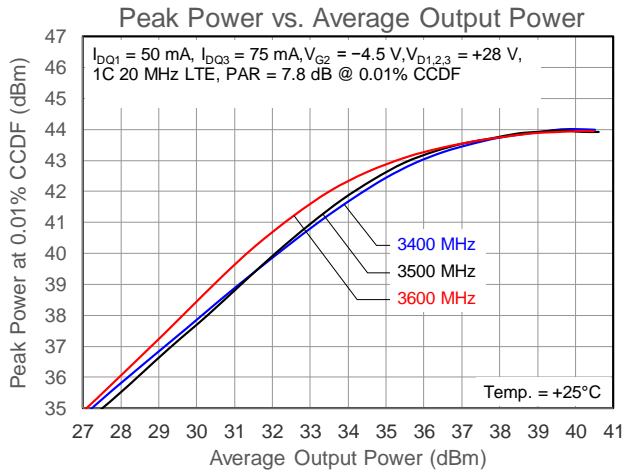
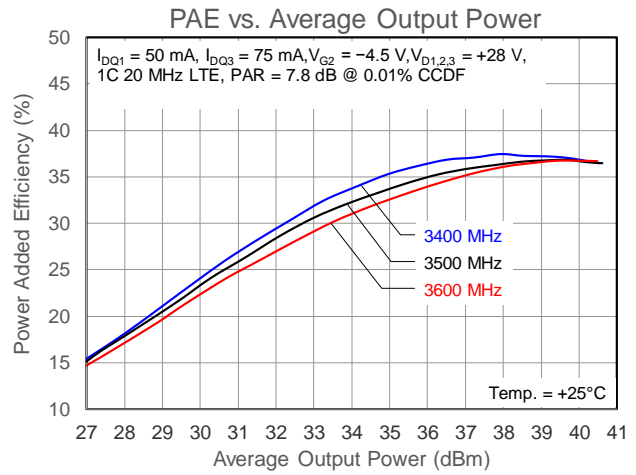
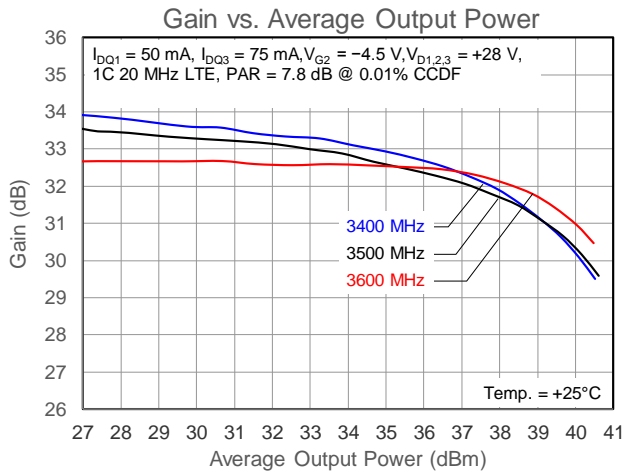
**Notes:**

1. All dimensions are in inches.
2. PCB is soldered on a 2 inch by 2 inch copper base plate with 0.25 inch thickness.

### Bill of Materials – QPA3503 3.5 GHz Evaluation Board

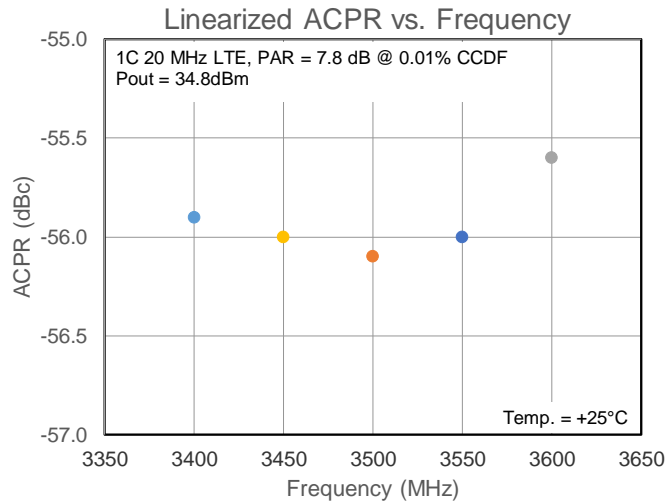
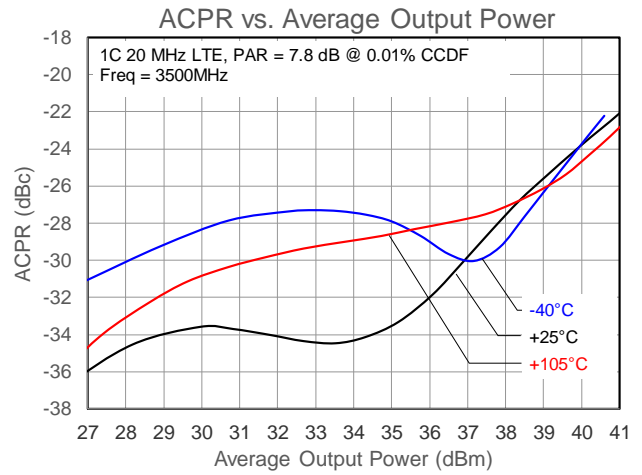
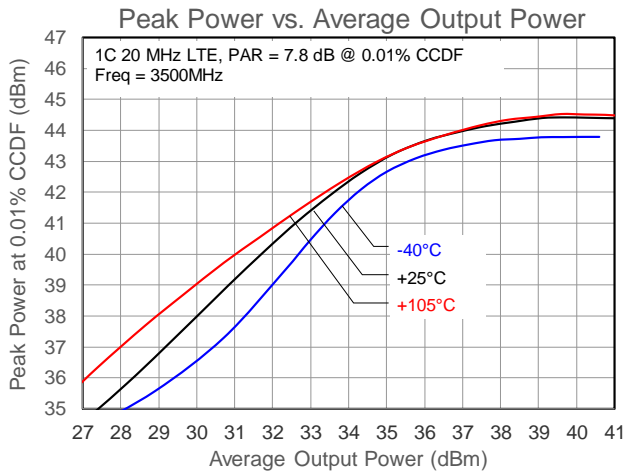
Reference Des.	Value	Description	Manuf.	Part No.
C1, C10	220 $\mu$ F	Capacitor, 220 $\mu$ F, electrolytic 50 V	Panasonic	EEEFK1H221P
C4, C7, C14	22,000 pF	Capacitor, 22,000 pF, 10%, 50 V, X7R, 0603	Murata	GRM188R71H223KA01D
C3, C8, C11, C13	4.7 $\mu$ F	Capacitor, 4.7 $\mu$ F, 10%, 50 V, X7R, 1206	Murata	GRM31CR71H475KA12L
C2, C9, C12	10 $\mu$ F	Capacitor, 10 $\mu$ F, 10%, 50 V, X7R, 1210	Murata	GRM32ER71H106KA
J1, J2		Connector, SMA, 4-Hole Panel Mount Jack	Gigalane	PAF-S00-000
P1, P2		Connector, HDR, ST, PLRZD, 5-Pin, 0.100"	ITW Pancon	MPSS100-5-C
P3		Connector, HDR, ST, 3-PIN, T/H	Molex	22-28-4033
U1		3W 3.5GHz PA Module	Qorvo	QPA3503

### Performance Plots



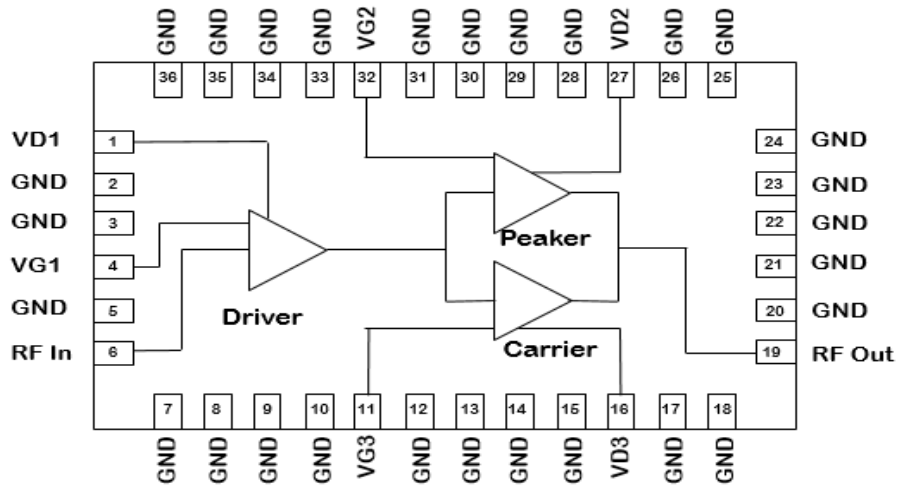
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**Performance Plots**



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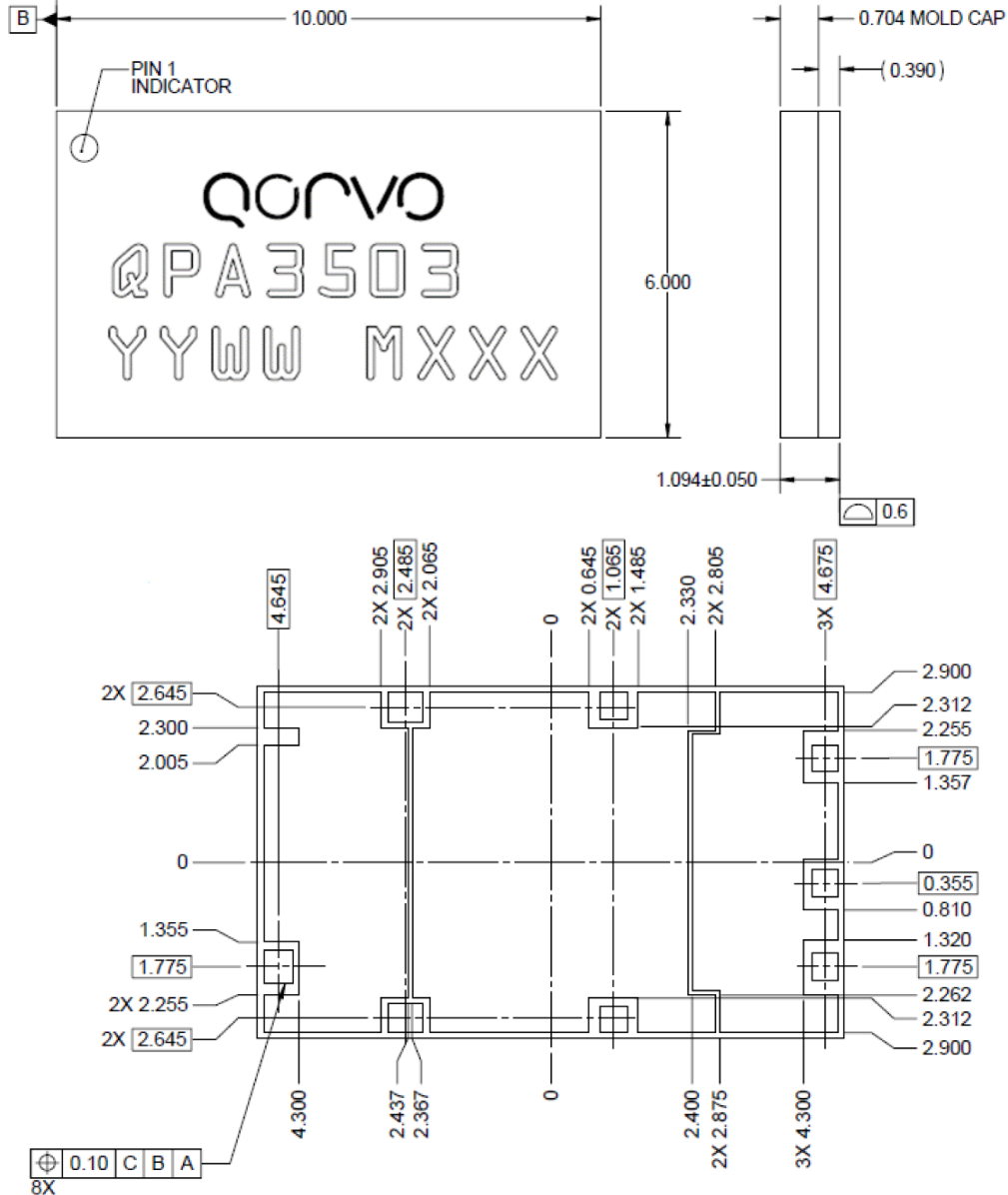
## Pin Configuration and Description



Pin No.	Label	Description
1	VD1	Driver Amplifier, Drain Bias
4	VG1	Driver Amplifier, Gate Bias
6	RF IN	RF Input
11	VG3	Carrier Amplifier, Gate Bias
16	VD3	Carrier Amplifier, Drain Bias
19	RF OUT	RF Output
27	VD2	Peaking Amplifier, Drain Bias
32	VG2	Peaking Amplifier, Gate Bias
2-3, 5, 7-10, 12-15, 17-18, 20-26, 28-31, 33-36	GND	Internal Grounding, recommend connecting to Epad ground
EPAD	GND	DC/RF Ground. Must be soldered to EVB ground plane over array of vias for thermal and RF performance. Solder voids under EPAD will result in excessive junction temperatures causing permanent damage.

## Package Marking and Dimensions

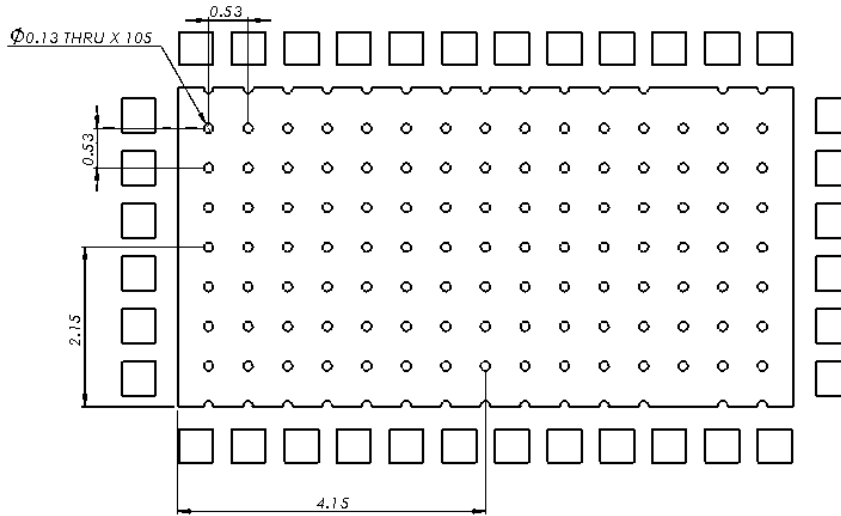
Marking: Qorvo Logo  
 Part Number – QPA3503  
 Date Code – YYWW  
 Batch Code – MXXX



### Notes:

1. General tolerance is  $\pm 0.100$ .
2. All dimensions are in mm. Angles are in degrees.
3. Material:  
 Package Base: Laminate  
 Package Lid: Mold
4. Exposed metallization is NiPdAu plated. Au thickness is 0.095  $\mu\text{m}$ .
5. Part is mold sealed.

**Mounting Footprint Pattern**

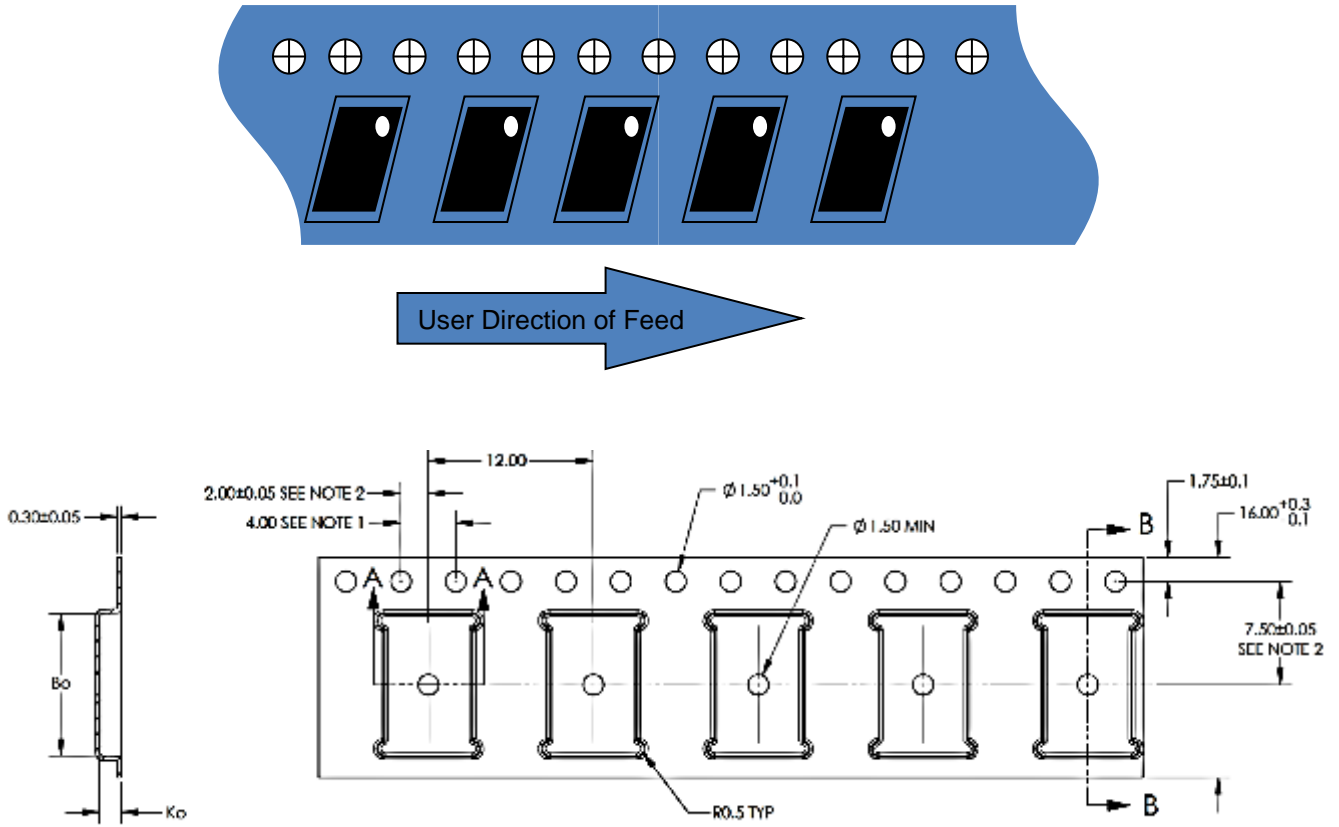


**Notes:**

1. All dimensions are in mm. Angles are in degrees.
2. Vias are required under the backside paddle of this device for proper RF/DC grounding and thermal dissipation. ALL vias are PTH to ground.
3. Ensure good package backside paddle solder attach for reliable operation and best electrical performance.



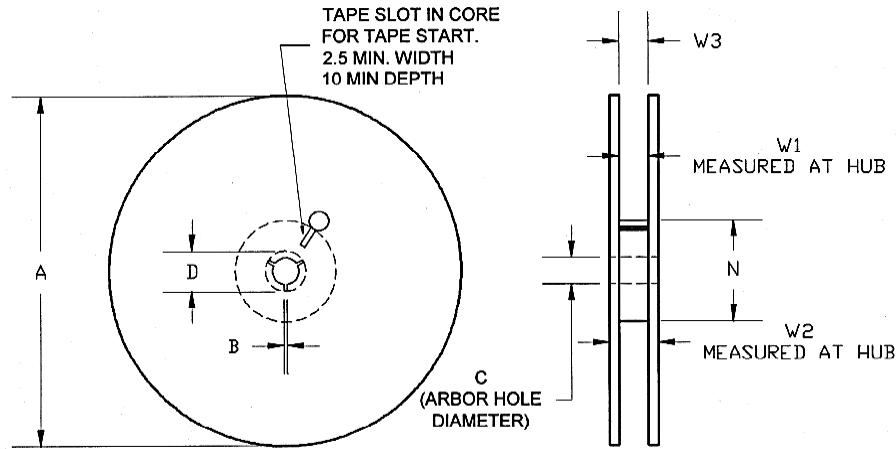
**Tape and Reel Information – Carrier and Cover Tape Dimensions**



Feature	Measure	Symbol	Size (in)	Size (mm)
Cavity	Length	A0	0.248	6.30
	Width	B0	0.406	10.3
	Depth	K0	0.061	1.55
	Pitch	P1	0.472	12.0
Centerline Distance	Cavity to Perforation – Length Direction	P2	0.079	2.00
	Cavity to Perforation – Width Direction	F	0.295	7.5
Cover Tape	Width	C	0.524	13.3
Carrier Tape	Width	W	0.630	16.0

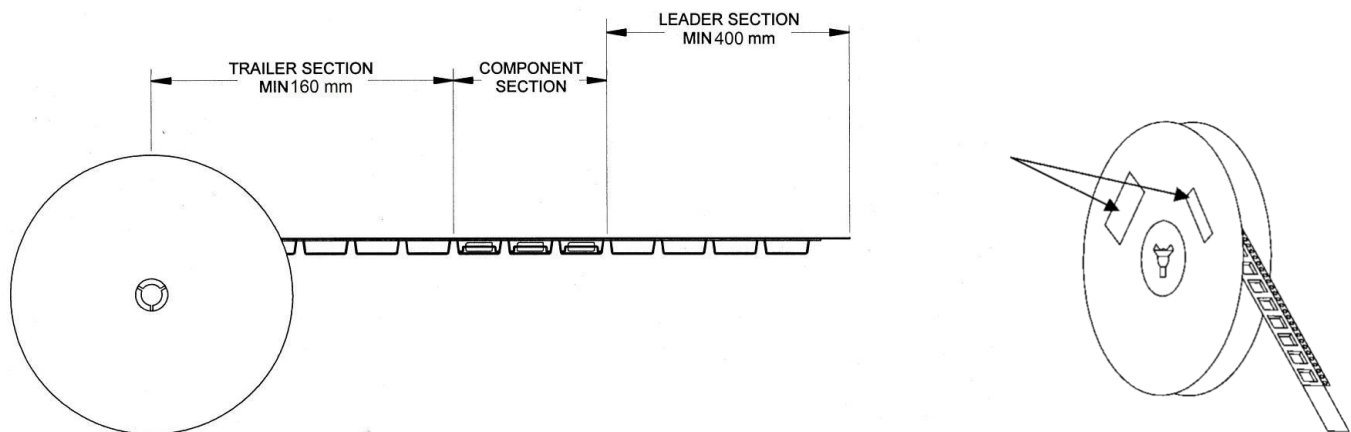
## Tape and Reel Information – Reel Dimensions

Standard T/R size = 2500 pieces on a 13" reel.



Feature	Measure	Symbol	Size (in)	Size (mm)
Flange	Diameter	A	12.992	330.0
	Thickness	W2	0.874	22.2
	Space Between Flange	W1	0.661	16.8
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 481-1-A.
2. Labels are placed on the flange opposite the sprockets in the carrier tape.

## 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 – 260°C Convection Reflow	MSL3	IPC/JEDEC Standard J-STD-020



## Solderability

Compatible with both lead-free (260°C maximum reflow temperature) soldering processes. Package lead plating is NiPdAu. Au thickness is 0.095 µm.

## RoHS Compliance

This product is compliant with the 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, and information about Qorvo:

**Web:** [www.qorvo.com](http://www.qorvo.com)      **Tel:** 1-844-890-8163  
**Email:** [info-sales@qorvo.com](mailto:info-sales@qorvo.com)

For technical questions and application information:

**Email:** [BTSAApplications@qorvo.com](mailto:BTSAApplications@qorvo.com)

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### Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: [info@moschip.ru](mailto:info@moschip.ru)

Skype отдела продаж:

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