# QPA3503

## 3 W, 28 V, 3.4 – 3.6 GHz GaN PA Module

## Product Description

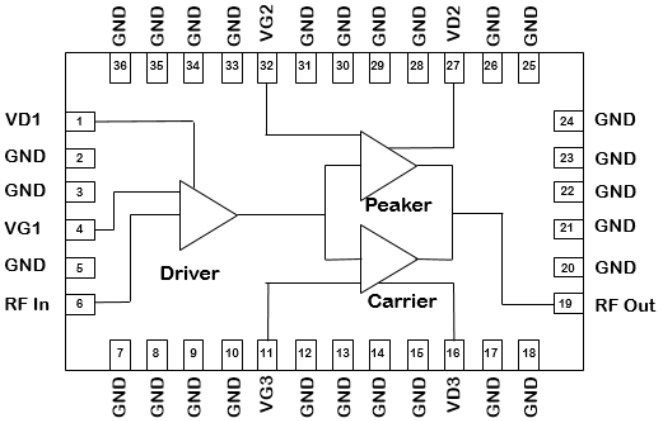
The QPA3503 is an integrated 2-stage Power Amplifier Module designed for massive MIMO applications with 3 W RMS at the device output covering frequency range from 3.4 to 3.6 GHz.

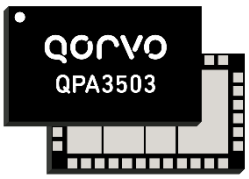
The module is 50 Ω input and output and requires minimal external components. The module is also compact and offers a much smaller footprint than traditional discrete component solutions.

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 Ω 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[2]

| 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 (1) | +25 | dBm |
| VSWR Mismatch, P3dB Pulse (10 % duty cycle, 100 µ width), T = 25 °C | 10:1 | |
| Storage Temperature | −65 to +150 | °C |

1. Tested at 3.5 GHZ, T = +25°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°C, single-carrier, 20 MHz LTE signal with 7.8 dB PAR @ 0.01% CCDF, de-embedded from EVB measurements.

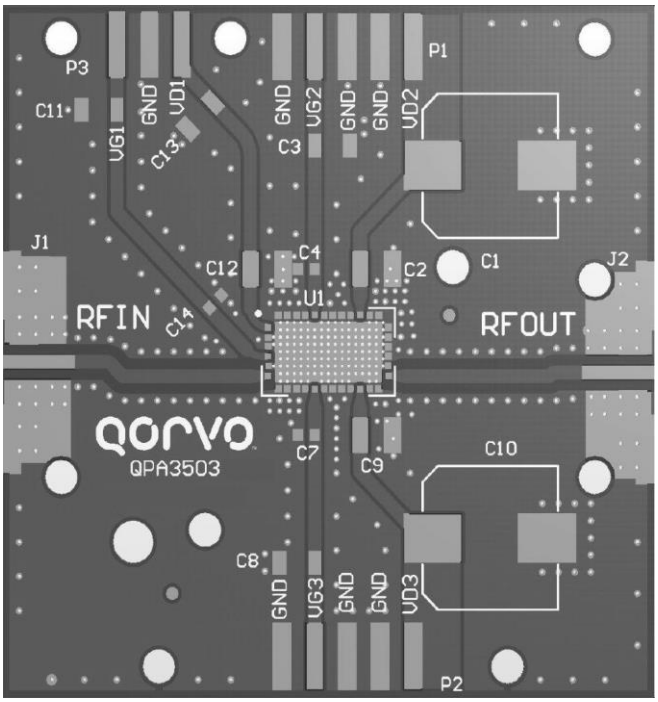
## Thermal and Reliability Information

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

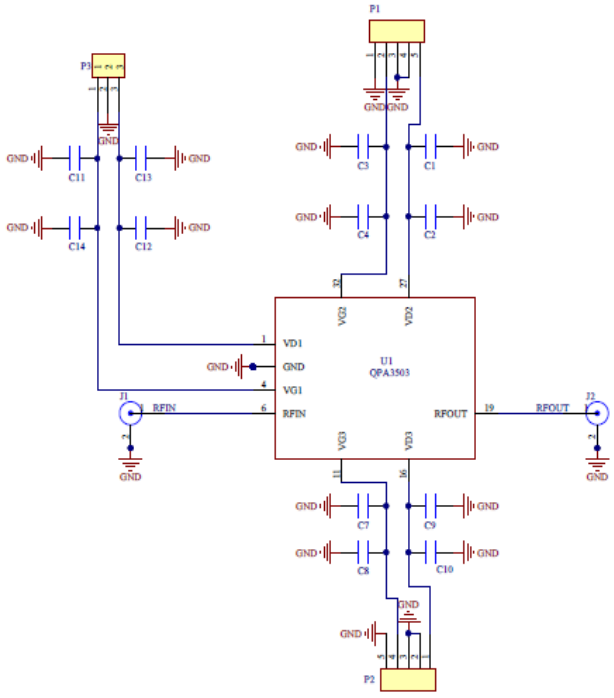
Notes:
1. Thermal resistance measured to package backside.
2. Based on expected carrier amplifier efficiency of Doherty.
3. $P_{OUT}$ assumes 20% peaking amplifier contribution of total average Doherty rated power.
4. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance,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

## QPA3503 3.4 – 3.6 GHz Reference Design

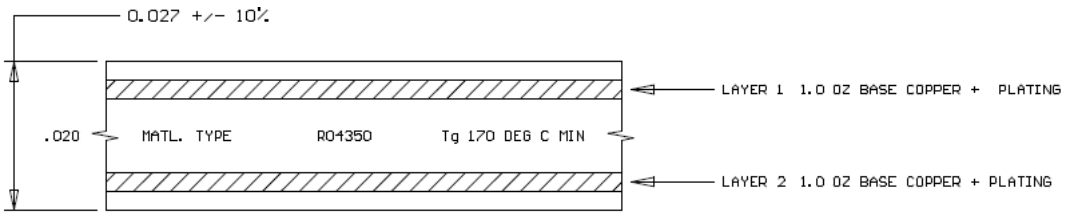
EVB Layout




EVB Schematic




PCB Stackup and Material

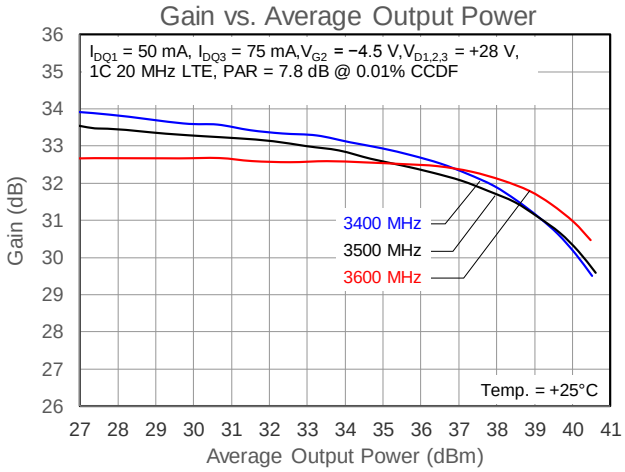


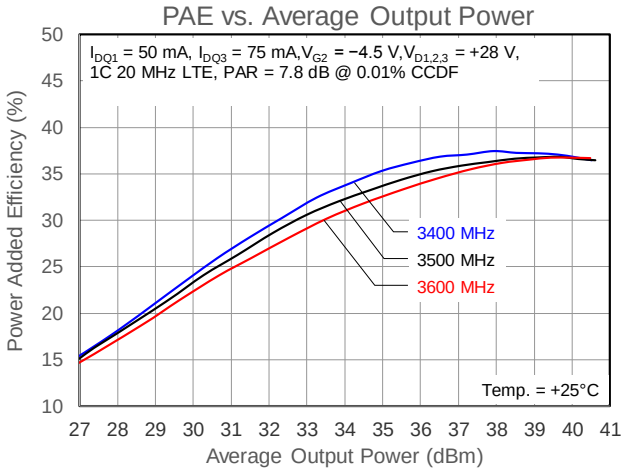

Notes:
1. All dimensions are in inches.
2. PCB is soldered on a 2 inch by 2 inch copper base plate with 0.25 inch thickness.

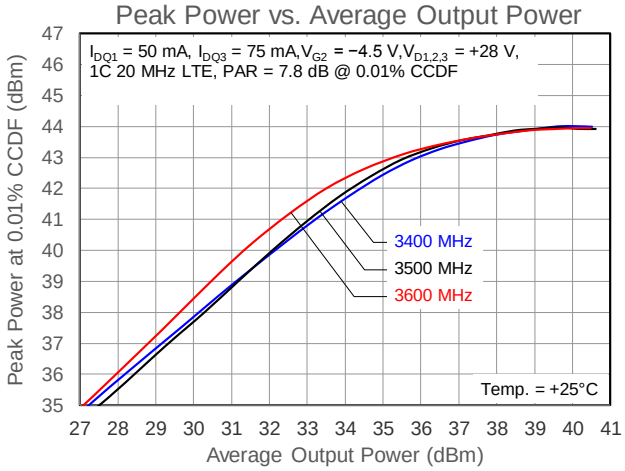
## Bill of Materials – QPA3503 3.5 GHz Evaluation Board

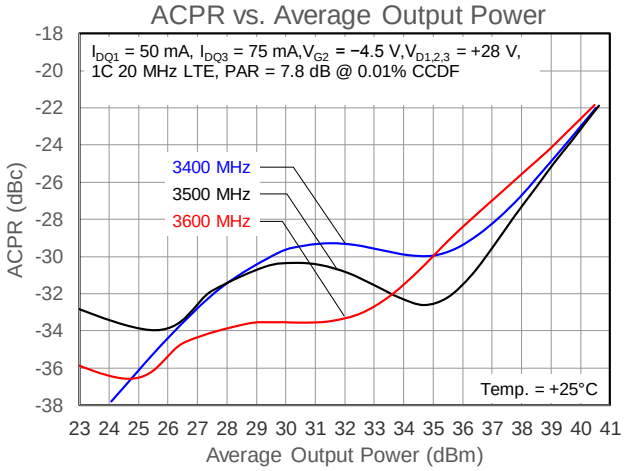
| Reference Des. | Value | Description | Manuf. | Part No. |
|---|---|---|---|---|
| C1, C10 | 220 µF | Capacitor, 220 µF, electrolytic 50 V | Panasonic | EEEFK1H221P |
| C4, C7, C14 | 22,000 pF | Capacitor, 22,000 pF, 10%, 50 V, X7R, 0603 | Murata | GRM188R71H223KA01D |
| C3, C8, C11, C13 | 4.7 µF | Capacitor, 4.7 µF, 10%, 50 V, X7R, 1206 | Murata | GRM31CR71H475KA12L |
| C2, C9, C12 | 10 µF | Capacitor, 10 µF, 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 |

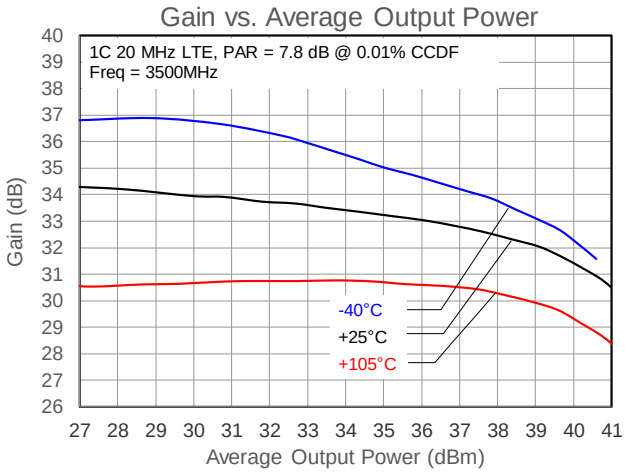
## Performance Plots

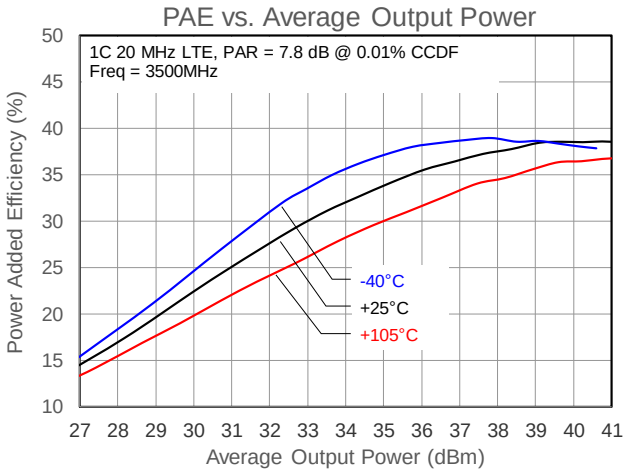


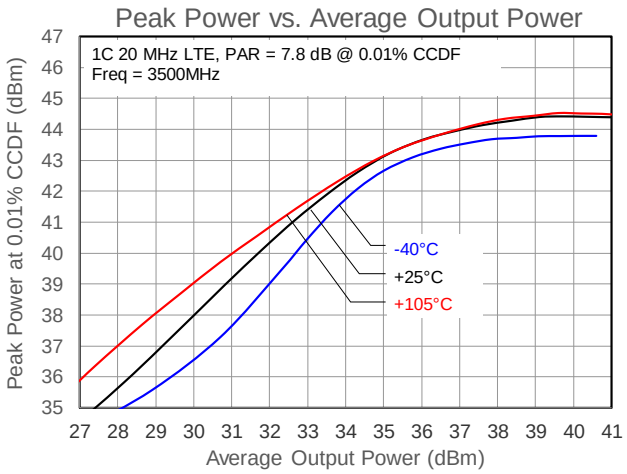



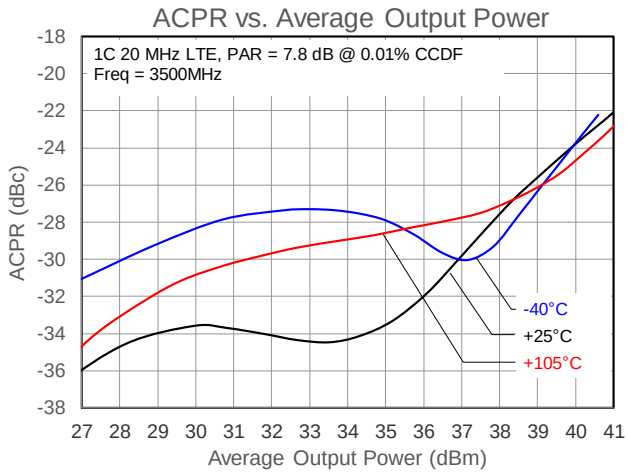



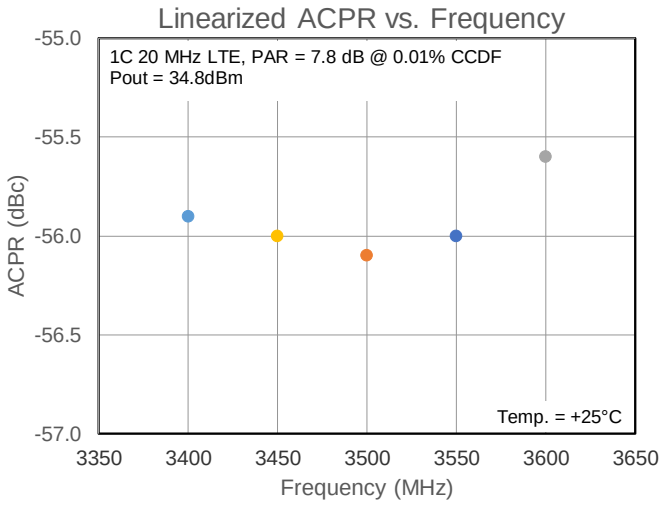




Test conditions unless otherwise noted: $V_{D1,2,3}$ = +28 V, $I_{DQ1}$ = 50 mA, $I_{DQ3}$ = 75 mA, $V_{G2}$ = −4.5 V, T = +25°C, single-carrier, 20 MHz LTE signal with 7.8 dB PAR @ 0.01% CCDF, de-embedded from EVB measurements.

## Performance Plots

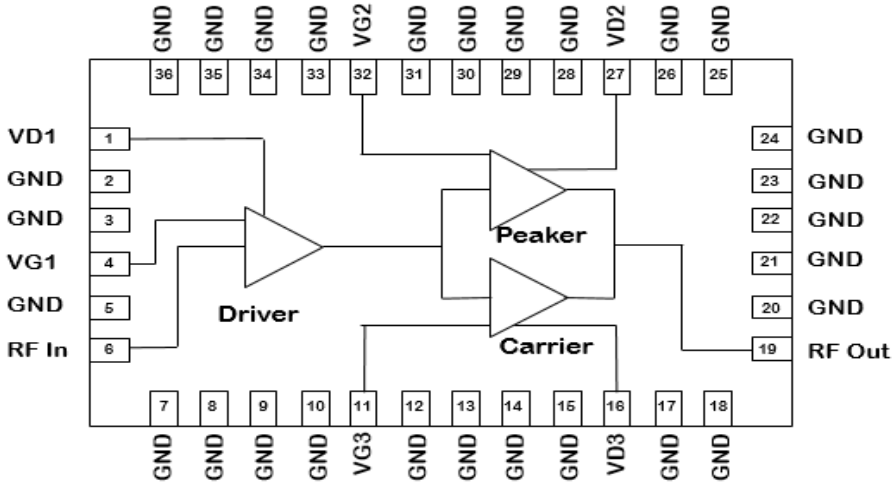



Test conditions unless otherwise noted: $V_{D1,2,3}$ = +28 V, $I_{DQ1}$ = 50 mA, $I_{DQ3}$ = 75 mA, $V_{G2}$ = −4.5 V, T = +25°C, single-carrier, 20 MHz LTE signal with 7.8 dB PAR @ 0.01% CCDF, de-embedded from EVB measurements.

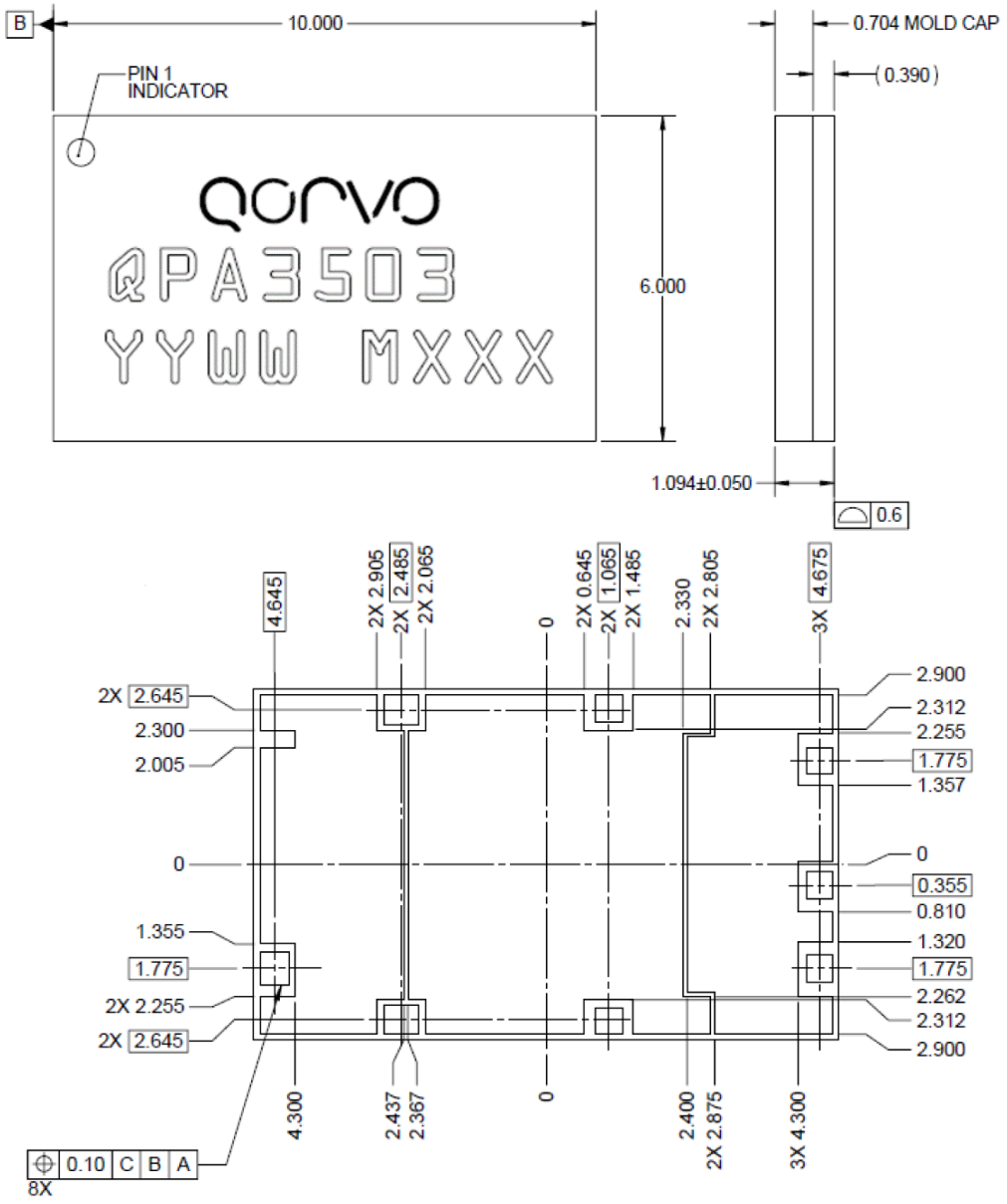
## Pin Configuration and Description




| 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

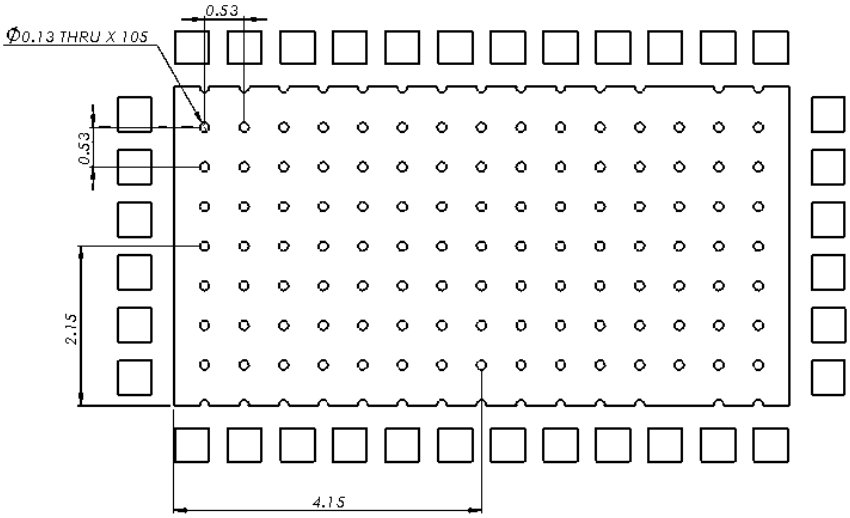
Marking: Qorvo Logo
Part Number – QPA3503
Date Code – YYWW
Batch Code – MXXX




Notes:

1. General tolerance is ±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 µm.
5. Part is mold sealed.

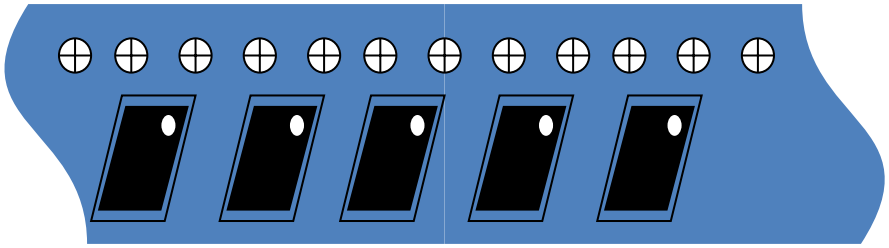
## Mounting Footprint Pattern

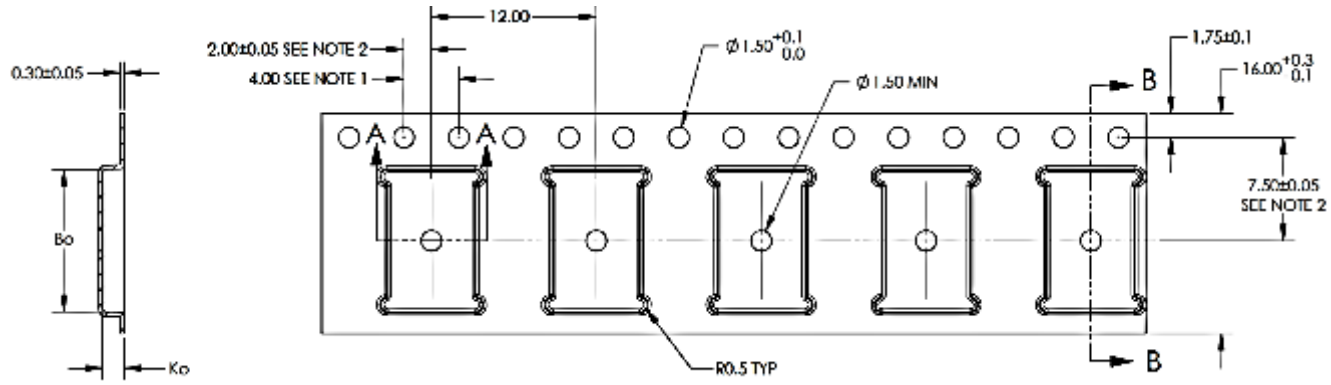



Notes:

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

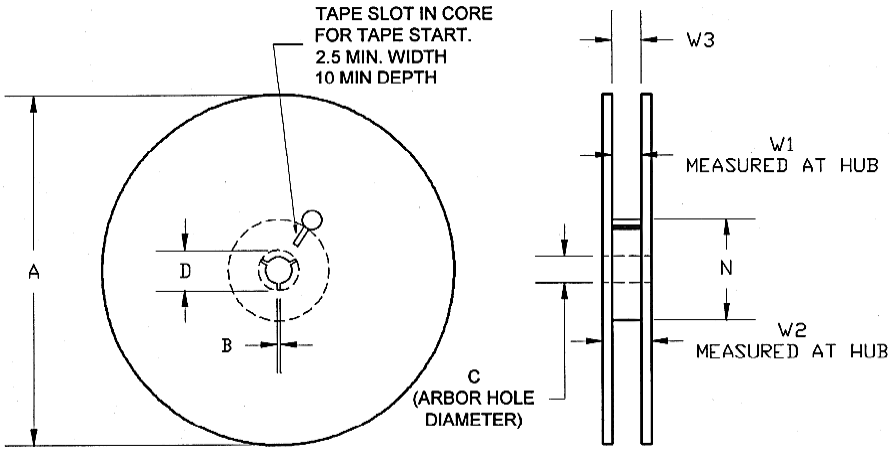





| Feature | Measure | Symbol | Size (in) | Size (mm) |
|---|---|---|---|---|
| Cavity | Length | A0 | 0.248 | 6.30 |
| | Width | B0 | 0.406 | 10.3 |
| | Depth | K0 | 0.061 | 1.55 |
| | Pitch | P1 | 0.472 | 12.0 |
| Centerline Distance | Cavity to Perforation – Length Direction | P2 | 0.079 | 2.00 |
| | 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 |

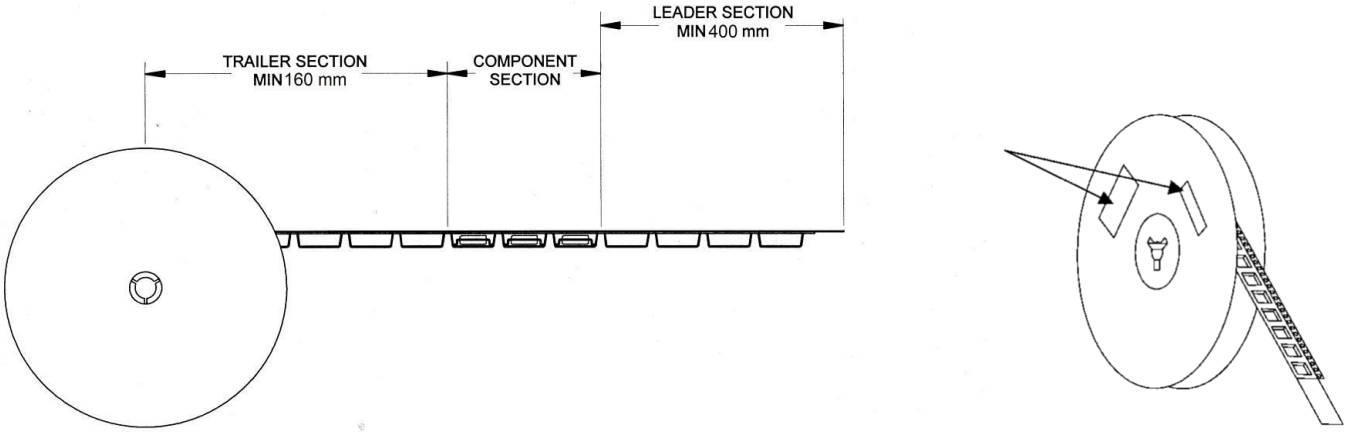
## Tape and Reel Information – Reel Dimensions

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 |

Caution!
ESD-Sensitive Device

## 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 ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free

## Contact Information

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

**Web:** www.qorvo.com **Tel:** 1-844-890-8163
**Email:** info-sales@qorvo.com

For technical questions and application information:

**Email:** BTSApplications@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 2018 © Qorvo, Inc. | Qorvo is a registered trademark of Qorvo, Inc.

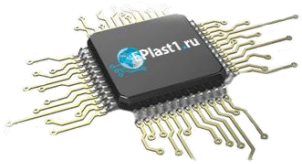
Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.




**Как с нами связаться**

**Телефон:** 8 (812) 309 58 32 (многоканальный)
**Факс:** 8 (812) 320-02-42
**Электронная почта:** org@eplast1.ru
**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.