



# QPA4563A

## DC – 3500 MHz Cascadable SiGe HBT Amplifier

### Product Overview

The QPA4563A is a high performance SiGe HBT MMIC amplifier. A Darlington configuration provides high FT and excellent thermal performance. The heterojunction increases breakdown voltage and minimizes leakage current between junctions. Cancellation of emitter junction non-linearities results in higher suppression of intermodulation products.

The QPA4563A may be operated from a variety of supply voltages by using a voltage dropping resistor. Two DC-blocking capacitors, bypass capacitors and an optional RF choke complete the circuit required for operation of this internally matched 50 ohm device.

The QPA4563A is assembled in an industry standard SOT-363 package that is lead-free and RoHS-compliant.

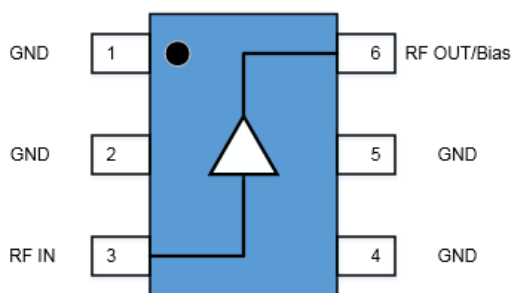


6 Lead SOT-363 Package

### Key Features

- DC to 3500 MHz Operation
- Single Positive Voltage Supply
- Gain: 20.4 dB at 1950 MHz
- Output IP3: +29.4 dBm typical at 1950 MHz
- Noise Figure: 2.5 dB Typical at 1950 MHz
- Robust 1000 V Class 1C HBM ESD Rating
- Lead-free/RoHS-compliant SOT-363 Package

### Functional Block Diagram



Top View

### Applications

- Cellular, PCS, GSM, UMTS
- PA Driver Amplifier
- IF/RF Buffer Amplifier
- Wireless Data, Satellite

### Ordering Information

| Part No.       | Description                          |
|----------------|--------------------------------------|
| QPA4563ASQ     | 25 Piece Sample Bag                  |
| QPA4563ASR     | 100 Pieces on 7" Reel                |
| QPA4563ATR7    | 3000 pieces on a 7" reel             |
| QPA4563APCK401 | 850 MHz, EVB with 5 Piece Sample Bag |

## Absolute Maximum Ratings

| Parameter                            | Rating         |
|--------------------------------------|----------------|
| Storage Temp                         | –55 to +150 °C |
| Device Voltage ( $V_D$ )             | +5 V           |
| Device Current ( $I_D$ )             | 90 mA          |
| RF Input Power ( $Z_L = 50 \Omega$ ) | +18 dBm        |

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.

Bias Conditions should also satisfy the following expression:

$$I_D \times V_D < (T_{JUNCTION} - T_{LEAD}) / R_{TH}$$

## Recommended Operating Conditions

| Parameter                      | Min | Typ | Max  | Units |
|--------------------------------|-----|-----|------|-------|
| Operating Temperature          | –40 |     | +105 | °C    |
| Junction Temperature ( $T_J$ ) |     |     | +125 | °C    |

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

## Electrical Specifications

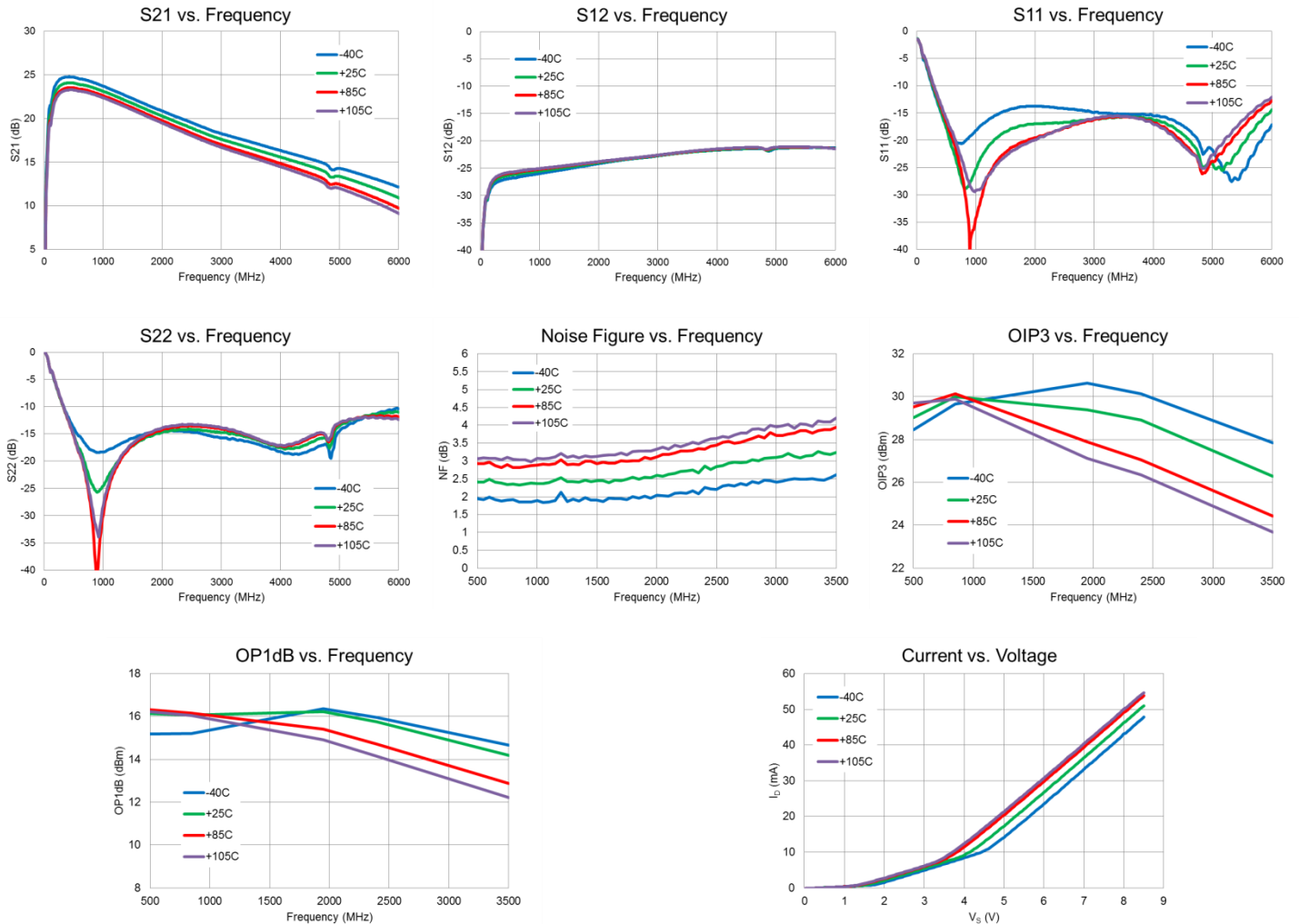
| Parameter                       | Conditions | Min | Typ   | Max | Units |
|---------------------------------|------------|-----|-------|-----|-------|
| Small Signal Gain               | 850 MHz    |     | 23.5  |     | dB    |
|                                 | 1950 MHz   |     | 20.4  |     |       |
|                                 | 2400 MHz   |     | 19.2  |     |       |
| Output Power at 1dB Compression | 850 MHz    |     | +16.0 |     | dBm   |
|                                 | 1950 MHz   |     | +16.2 |     |       |
|                                 | 2400 MHz   |     | +15.8 |     |       |
| Output Third Intercept Point    | 850 MHz    |     | +30.0 |     | dBm   |
|                                 | 1950 MHz   |     | +29.4 |     |       |
|                                 | 2400 MHz   |     | +28.9 |     |       |
| Input Return Loss,  S11         | 850 MHz    |     | 28.7  |     | dB    |
|                                 | 1950 MHz   |     | 17.1  |     |       |
|                                 | 2400 MHz   |     | 16.9  |     |       |
| Output Return Loss,  S22        | 850 MHz    |     | 25.0  |     | dB    |
|                                 | 1950 MHz   |     | 14.9  |     |       |
|                                 | 2400 MHz   |     | 14.2  |     |       |
| Reverse Isolation,  S12         | 850 MHz    |     | 25.8  |     | dB    |
|                                 | 1950 MHz   |     | 24.1  |     |       |
|                                 | 2400 MHz   |     | 23.5  |     |       |
| Noise Figure                    | 850 MHz    |     | 2.3   |     | dB    |
|                                 | 1950 MHz   |     | 2.5   |     |       |
|                                 | 2400 MHz   |     | 2.8   |     |       |
| Device Operating Voltage        |            |     | +3.5  |     | V     |
| Device Operating Current        |            |     | 45    |     | mA    |
| Thermal Resistance              |            |     | 124   |     | °C/W  |

Notes:

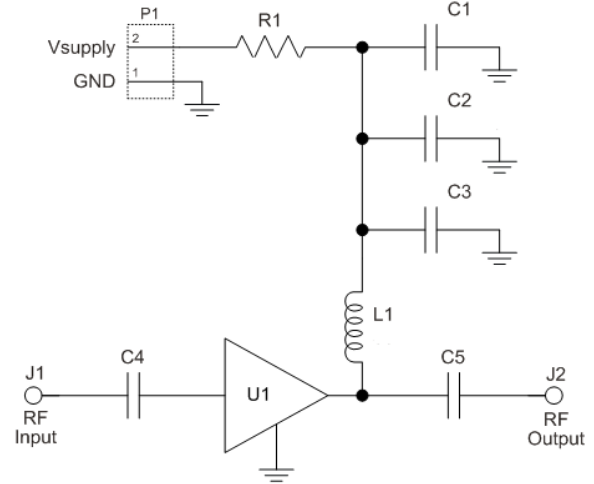
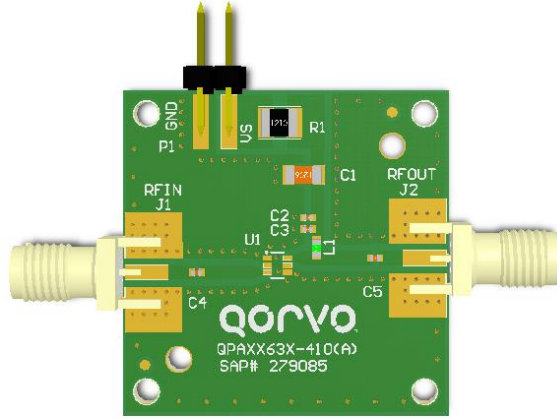
- Test conditions unless otherwise noted:  $V_S = +8$  V,  $R_{BIAS} = 100 \Omega$ ,  $V_D = +3.5$  V,  $I_D = 45$  mA Typ., OIP3 Tone Spacing = 1 MHz,  $P_{OUT}/tone = -10$  dBm,  $T_{LEAD} = +25^\circ\text{C}$ ,  $Z_S = Z_L = 50 \Omega$

## Performance Plots – 850 MHz Application Circuit

Test conditions unless otherwise noted:  $V_S = +8\text{ V}$ ,  $R_{BIAS} = 100\ \Omega$ ,  $I_D = 45\text{ mA Typ}$



## Evaluation Board and Schematic – 850 MHz Application Circuit



## Bill of Material – 850 MHz Application Circuit

| Reference | Value   | Description                              | Manufacturer                 | Part Number        |
|-----------|---------|------------------------------------------|------------------------------|--------------------|
| n/a       | n/a     | PCB                                      | Qorvo                        | QPAXX63X-410(A)    |
| U1        | n/a     | HBT MMIC Amplifier                       | Qorvo                        | QPA4563A           |
| C1        | 1 uF    | CAP, 10%, 25V, X7R, 1206                 | Murata Electronics           | GRM31MR71E105KA01L |
| C2        | 1000 pF | CAP, 10%, 50V, X7R, 0402                 | Murata Electronics           | GRM155R71H102KA01D |
| C3        | 68 pF   | CAP, 5%, 50V, C0G, 0402                  | Murata Electronics           | GRM1555C1H680JA01D |
| C4, C5    | 100 pF  | CAP, 5%, 50V, C0G, 0402                  | Murata Electronics           | GRM1555C1H101JA01D |
| R1        | 100 Ω   | RES, 5%, 1/2W, 1210                      | Panasonic Industrial Devices | ERJ-14YJ101U       |
| L1        | 33 nH   | IND, 5%, M/L, 0603                       | Murata Electronics           | LL1608-FSL33NJ     |
| J1, J2    | n/a     | CONN, SMA, EL, FLT, 0.068" SPE-000318    | Amphenol RF Asia Corp        | 901-10426          |
| P1        | n/a     | CONN, HDR, ST, 1x2, 0.100", Hi-temp, T/H | Samtec Inc                   | HTSW-102-07-G-S    |

## Component Values for Specific Frequencies

| Reference Designator | 500 MHz | 850 MHz | 1950 MHz | 2400 MHz | 3500 MHz |
|----------------------|---------|---------|----------|----------|----------|
| C4, C5               | 220 pF  | 100 pF  | 68 pF    | 56 pF    | 39 pF    |
| C3                   | 100 pF  | 68 pF   | 22 pF    | 22 pF    | 15 pF    |
| L1                   | 68 nH   | 33 nH   | 22 nH    | 18 nH    | 15 nH    |

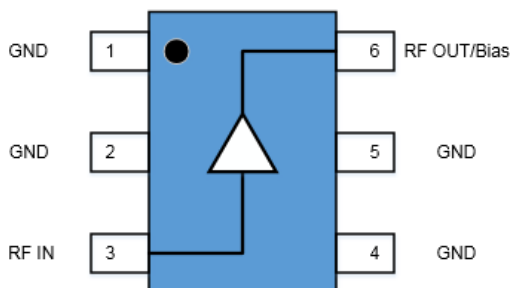
## Bias Resistor Values for Specific Supply Voltages

| Reference Designator                      | V <sub>S</sub> =+6 V | V <sub>S</sub> =+8 V | V <sub>S</sub> =+10 V | V <sub>S</sub> =+12 V |
|-------------------------------------------|----------------------|----------------------|-----------------------|-----------------------|
| R1 ( R <sub>BIAS</sub> ) <sup>(1,2)</sup> | 51 Ω                 | 100 Ω                | 150 Ω                 | 180 Ω                 |

Notes:

1. Bias resistor improves current stability over temperature
2. Bias Resistance =  $R_{BIAS} + R_{LDC} = (V_S - V_D) / I_D$

## Pin Configuration and Description

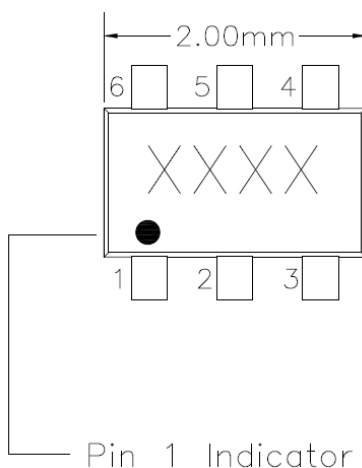


Top View

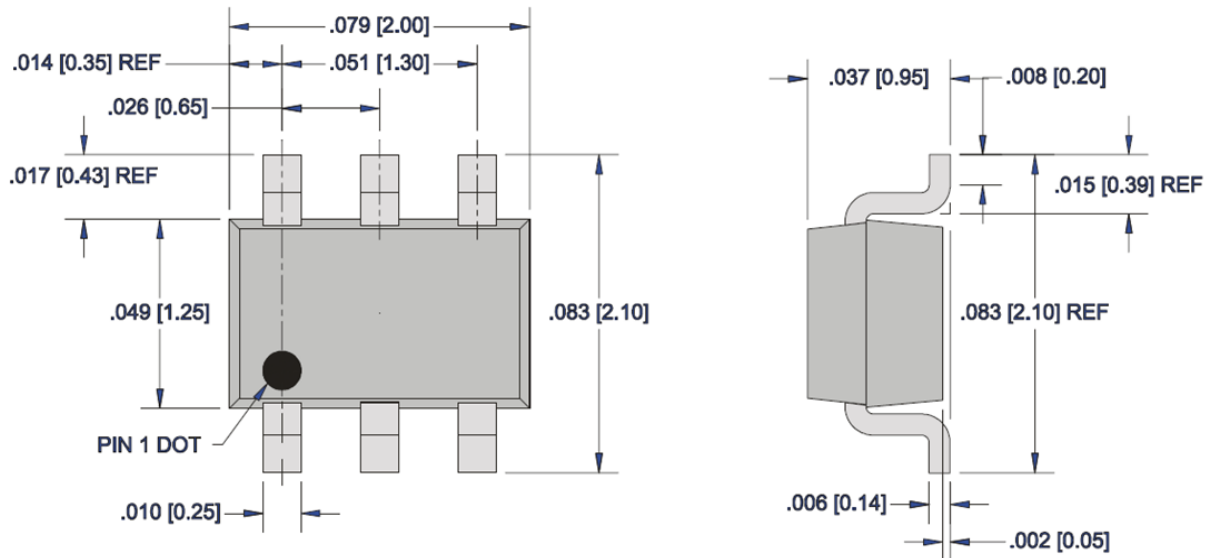
| Pad No.    | Label                   | Description                                                                                                                                                               |
|------------|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1, 2, 4, 5 | GND                     | Connection to ground. Use via holes in PCB for best performance to reduce lead inductance as close to ground leads as possible                                            |
| 3          | RF <sub>IN</sub>        | RF Input Pin. DC voltage is present on this pin therefore this pin requires the use of an external DC blocking capacitor chosen for the frequency of operation.           |
| 6          | RF <sub>OUT</sub> /Bias | RF Output and Bias Pin. DC voltage is present on this pin therefore this pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. |

## Package Marking

XXXX is an Alpha-numeric trace code.



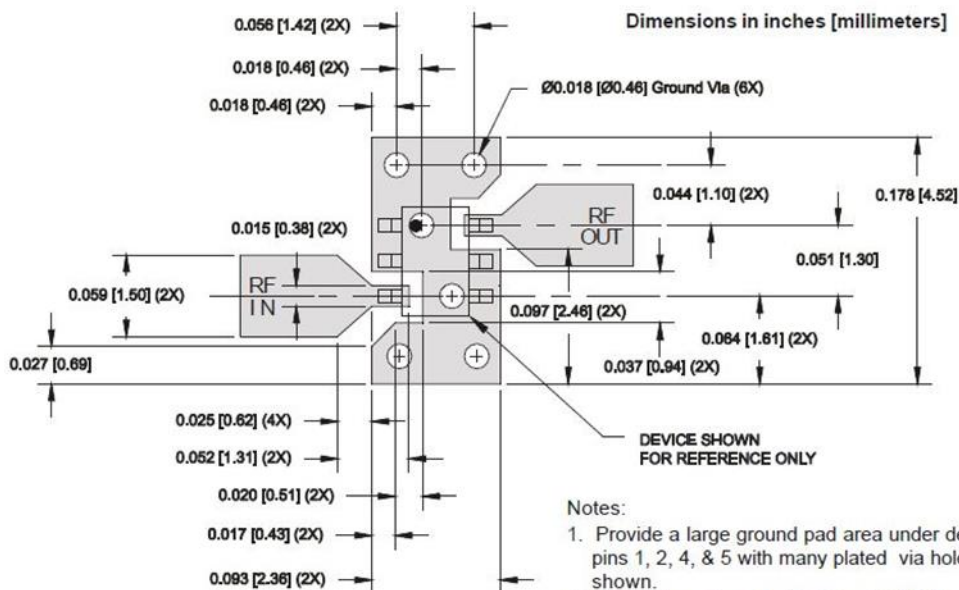
## Package Dimensions



### Notes:

1. All dimensions are in inches (millimeters). Angles are in degrees.
2. Dimension and tolerance formats conform to ASME Y14.5-2009.

## PCB Mounting Pattern



### Notes:

1. Provide a large ground pad area under device pins 1, 2, 4, & 5 with many plated via holes as shown.
2. Dimensions given for 50 Ohm RF I/O lines are for 31 mil thick Getek. Scale accordingly for different board thicknesses and dielectric constants.
3. We recommend 1 or 2 ounce copper. Measurements for this data sheet were made on a 31 mil thick Getek with 1 ounce copper on both sides.

## Handling Precautions

| Parameter                        | Rating   | Standard                 |
|----------------------------------|----------|--------------------------|
| ESD – Human Body Model (HBM)     | Class 1C | ESDA / JEDEC JS-001-2014 |
| ESD – Charged Device Model (CDM) | Class C3 | ESDA / JEDEC JS-002-2014 |
| MSL – Moisture Sensitivity Level | Level 1  | IPC/JEDEC J-STD-020      |



Caution!  
ESD-Sensitive Device

## Solderability

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

Solder profiles available upon request.

Contact plating: Matte Sn

## 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)

For technical questions and application information: **Email:** [sicapplications.engineering@qorvo.com](mailto:sicapplications.engineering@qorvo.com)

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Тел: +7 (812) 336 43 04 (многоканальный)

Email: [org@lifeelectronics.ru](mailto:org@lifeelectronics.ru)

[www.lifeelectronics.ru](http://www.lifeelectronics.ru)