



# QPF4219

## Wi-Fi Front End Module

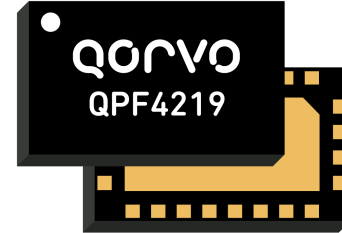
### Product Overview

The Qorvo® QPF4219 is an integrated front end module (FEM) designed for Wi-Fi 5 (802.11ac) systems. The compact form factor and integrated matching minimizes layout area in the application.

Performance is focused on optimizing the PA for a 5V supply voltage that conserves power consumption while maintaining the highest linear output power and leading edge throughput. Receive path matches the optimal technologies to maximize Rx sensitivity through noise figure performance that is consistent over a wider variety of conditions.

The receive path is pinned out so external filtering can be added in the optimal position. Integrated die level filtering for 2nd and 3rd harmonics as well as 5 GHz rejection for DBDC operation are included.

The QPF4219 integrates a 2.4 GHz power amplifier (PA), regulator, single pole two throw switch (SP2T), bypassable low noise amplifier (LNA) and DC power detector into a single device.

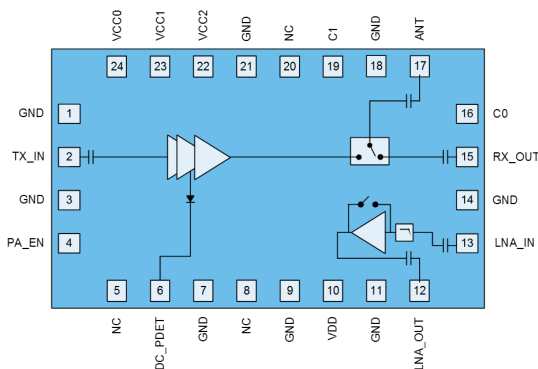


24 Pin 5x3 mm Laminate Package

### Key Features

- 2400-2500 MHz
- P<sub>OUT</sub> = +24.5 dBm MCS8/9 VHT40 -35 dB Dynamic EVM
- P<sub>OUT</sub> = +25.5 dBm MCS7 HT20/40 -30 dB Dynamic EVM
- P<sub>OUT</sub> = +26.5 dBm MCS0 HT20 Spectral Mask Compliance
- P<sub>OUT</sub> = +28 dBm 802.11b Spectral Mask Compliance
- Optimized for +5 V Operation
- 33 dB Tx Gain
- 1.9 dB Noise Figure
- 15.5 dB Rx Gain & 7 dB Bypass Loss
- 15 dB 5 GHz Rejection on Rx Path
- Integrated DC Power Detector

### Functional Block Diagram



Top View

### Applications

- Access Points
- Wireless Routers
- Residential Gateways
- Customer Premise Equipment
- Internet of Things

### Ordering Information

| Part Number    | Description                |
|----------------|----------------------------|
| QPF4219SB      | Sample bag with 5 pieces   |
| QPF4219SQ      | Sample bag with 25 pieces  |
| QPF4219SR      | 7" reel with 100 pieces    |
| QPF4219TR13-5K | 13" reel with 5,000 pieces |
| QPF4219EVB-01  | Assembled Evaluation Board |



**Absolute Maximum Ratings**

| Parameter               | Conditions   | Rating           |
|-------------------------|--|------------------|
| DC Supply Voltage       |  | -0.5 to +6 V     |
| Control Voltage         |  | -0.5 to $V_{CC}$ |
| Storage Temperature     |  | -40 to 150 °C    |
| Junction Temperature    | MTTF > 30.30x10 <sup>6</sup> hours                           | 190 °C           |
|                         | MTTF > 2.02x10 <sup>6</sup> hours                            | 210 °C           |
|                         | MTTF > 1.03x10 <sup>6</sup> hours                            | 218 °C           |
| RF Input Power at TX_IN | Into 50 Ω Load for 802.11b/g/n/ac (No Damage), Transmit Mode | +12 dBm          |
| RF Input Power at ANT   | (No Damage), Receive LNA On Mode                             | +10 dBm          |
| RF Input Power at ANT   | (No Damage), Receive Bypass Mode                             | +25 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.

**Recommended Operating Conditions**

| Parameter                               | Min.  | Typ. | Max.  | Units |
|---|-------|------|-------|-------|
| Operating Frequency                     | 2412  |      | 2484  | MHz   |
| Extended Operating Frequency            | 2400  |      | 2500  | MHz   |
| Device Voltage ( $V_{CC}$ & $V_{DD}$ )  | +4.75 | +5   | +5.25 | V     |
| Extended Device Voltage                 | +3.15 |      | +5.25 | V     |
| Control Voltage – High (PA_EN, C0 & C1) | +1.6  | +1.8 | +3.6  | V     |
| Control Voltage – Low (PA_EN, C0 & C1)  | 0     |      | +0.4  | V     |
| T <sub>OPERATING</sub> *                | -40   |      | +85   | °C    |

Electrical specifications are measured at specified test conditions. Extended Parameters have degraded performance but operational. Specifications are not guaranteed over all recommended operating conditions. T<sub>OPERATING</sub>\* is temperature at the package ground.

**Electrical Specifications**

| Parameter                                    | Conditions   | Min.  | Typ. | Max.  | Units |
|--|--|-------|------|-------|-------|
| <b>Transmit (TX_IN-ANT) Mode</b>             | <b>Unless otherwise noted: <math>V_{CC/DD}=5V</math>, <math>T=+25^{\circ}C</math>, PA_EN=High, C0=Low, C1=High</b> |       |      |       |       |
| Wi-Fi 5 VHT40 Output Power<br>Dynamic EVM    | MCS8/9 1024QAM 11ac  |       | 22   |       | dBm   |
|  |  |       |      | -40   | dB    |
| Wi-Fi 5 VHT20/40 Output Power<br>Dynamic EVM | MCS8/9 256QAM 11ac   | 23    | 24.5 |       | dBm   |
|  |  |       |      | -35   | dB    |
| Wi-Fi 4 HT20/40 Output Power<br>Dynamic EVM  | MCS7 64QAM 11n   | 24    | 25.5 |       | dBm   |
|  |  |       |      | -30   | dB    |
| Margin to HT20 Spectral Mask                 | P <sub>OUT</sub> = +26.5 dBm, 11n MCS0   | 0     | 3    |       | dBc   |
| Margin to 11b Spectral Mask                  | P <sub>OUT</sub> = +28 dBm, 11b 1Mbps DSSS   | 0     | 3    |       | dBc   |
| Gain   |  | 31    | 33   |       | dB    |
| Gain Flatness                                | Across any 40 MHz Channel  | -0.25 |      | +0.25 | dB    |



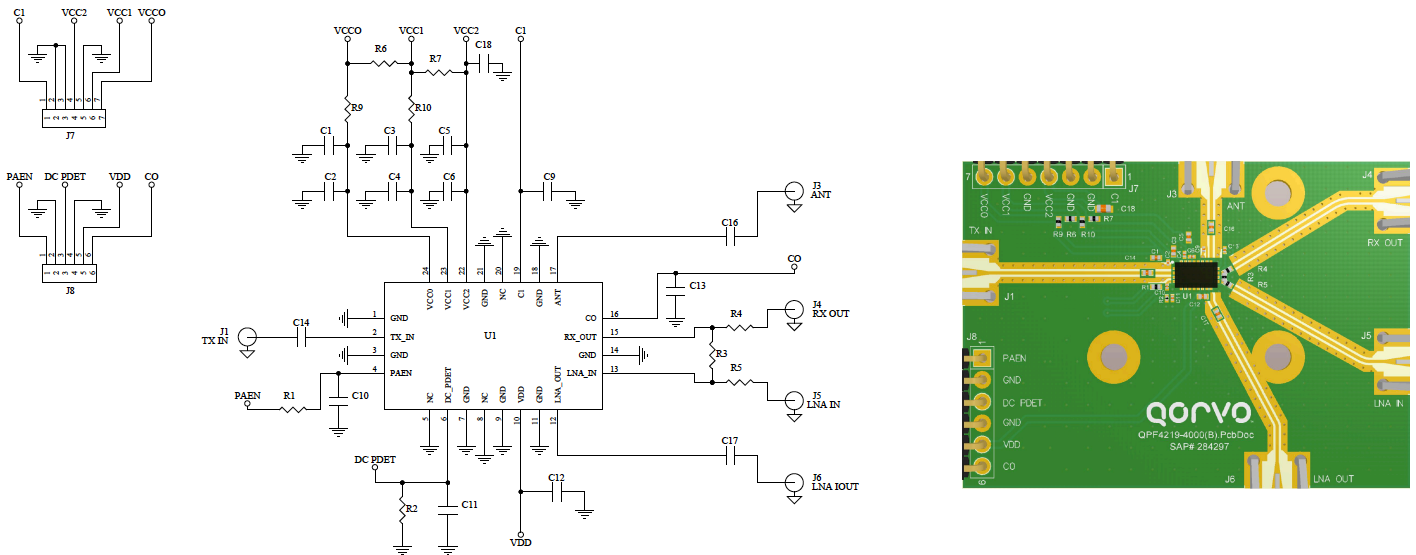
# QPF4219 Wi-Fi Front End Module

| Parameter                                | Conditions   | Min.  | Typ.  | Max.  | Units   |
|--|--|-------|-------|-------|---------|
| TX_IN Port Return Loss                   |  | 10    | 14    |       | dB      |
| ANT Port Return Loss                     |  | 10    | 12    |       | dB      |
| Quiescent Current                        | RF Off   |       | 220   | 255   | mA      |
| Operating Current                        | P <sub>OUT</sub> = +24.5 dBm   |       | 360   | 390   | mA      |
|  | P <sub>OUT</sub> = +26.5 dBm   |       | 395   | 450   | mA      |
|  | P <sub>OUT</sub> = +28 dBm   |       | 510   | 550   | mA      |
| 2 <sup>nd</sup> Harmonics                | P <sub>OUT</sub> = +28 dBm 802.11b 1 Mbps  |       | -35   | -30   | dBm/MHz |
| 3 <sup>rd</sup> Harmonics                | P <sub>OUT</sub> = +28 dBm 802.11b 1 Mbps  |       | -55   | -50   | dBm/MHz |
| ANT-LNA_OUT Isolation                    |  |       | 50    |       | dB      |
| DC Power Detect Voltage                  | RF Off   |       | 0.24  |       | V       |
|  | P <sub>OUT</sub> = +24.5 dBm   |       | 0.57  |       | V       |
|  | P <sub>OUT</sub> = +26.5 dBm   |       | 0.64  |       | V       |
|  | P <sub>OUT</sub> = +28 dBm   |       | 0.79  |       | V       |
| <b>RECEIVE (ANT-LNA_OUT) LNA ON MODE</b> | <b>Unless otherwise noted: V<sub>CC/DD</sub>=5V, T=+25°C, PA_EN=Low, C0=High, C1=Low<br/>Only through path between RX_OUT and LNA_IN</b>   |       |       |       |         |
| Gain                                     |  |       | 15.5  |       | dB      |
| Gain Flatness                            | Across any 40 MHz Channel  | -0.25 |       | +0.25 | dB      |
| Out of Band Gain                         | f = 5000-6000 MHz  |       | -15   |       | dB      |
| Noise Figure                             |  |       | 1.9   | 2.1   | dB      |
| LNA_OUT Port Return Loss                 |  | 15    | 20    |       | dB      |
| ANT Port Return Loss                     |  | 10    | 12    |       | dB      |
| Input P <sub>1dB</sub>                   |  |       | -5    |       | dBm     |
| Input IP3                                |  |       | +10   |       | dBm     |
| Rx Operating Current                     |  |       | 18    | 26    | mA      |
| <b>RECEIVE (ANT-LNA_OUT) BYPASS MODE</b> | <b>Unless otherwise noted: V<sub>CC/DD</sub>=5V, T=+25°C, PA_EN=Low, C0=High, C1=High,<br/>Only through path between RX_OUT and LNA_IN</b> |       |       |       |         |
| Bypass Loss                              | Across any 40 MHz Channel  |       | 7     |       | dB      |
| Loss Flatness                            |  | -0.25 |       | +0.25 | dB      |
| Out of Band Gain                         | f = 5000-6000 MHz  |       | -22   |       | dB      |
| LNA_OUT Port Return Loss                 |  | 9     | 12    |       | dB      |
| ANT Port Return Loss                     |  | 9     | 12    |       | dB      |
| Input P <sub>1dB</sub>                   |  |       | +27   |       | dBm     |
| Input IP3                                |  |       | +41   |       | dBm     |
| <b>GENERAL SPECIFICATIONS</b>            | <b>Unless otherwise noted: V<sub>CC/DD</sub>=5V, T=+25°C,<br/>Switching Time Power Accuracy +/-1dB</b>                                     |       |       |       |         |
| Control Current - High                   |  |       |       | 1     | μA      |
| Control Current - Low                    |  |       |       | 100   | nA      |
| TX Output P <sub>1dB</sub>               | CW   |       | +32.5 |       | dBm     |
| Switching Time                           | Transmit to LNA On or Bypass Mode  |       |       | 400   | nS      |
|  | LNA On to Bypass Mode  |       |       | 200   | nS      |
|  | Bypass to LNA On Mode  |       |       | 200   | nS      |
|  | LNA On or Bypass to Transmit Mode  |       |       | 400   | nS      |
| PA Stability - Output VSWR               | CW No Spurious above -41.25dBm/MHz   |       | 4:1   |       |         |
| Output Power Range                       |  | 0     |       | 28    | dBm     |
| Thermal Resistance, θ <sub>Jc</sub>      | Junction to case   |       | 31    |       | °C/W    |

## Logic Truth Table

| Mode          | PA_EN            | C0   | C1   |
|---------------|------------------|------|------|
| Transmit      | High             | Low  | High |
| LNA On        | Low              | High | Low  |
| Bypass        | Low              | High | High |
| All Off       | Low              | Low  | Low  |
| Not Supported | All Other States |      |      |

## Evaluation Board Schematic and Layout



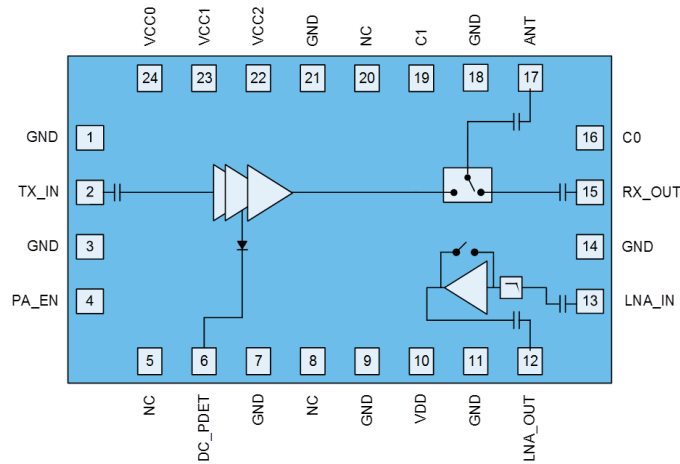
## Bill of Material

| Ref. Des.                | Value        | Description                           | Manuf.      | Part number         |
|--------------------------|--------------|---------------------------------------|-------------|---------------------|
| -                        | -            | Printed Circuit Board                 |             |                     |
| U1                       | -            | 2.4GHz Wi-Fi Front End Module         | Qorvo       | QPF4219             |
| C12                      | 0.1 $\mu$ F  | Capacitor, Chip, 10%, 10V, X5R, 0402  | Taiyo Yuden | RM LMK105 BJ104KV-F |
| C14, C16, C17            | 100 pF       | Capacitor, Chip, 5%, 50V, C0G, 0402   | Murata      | GRM1555C1H101JA01D  |
| C1, C3, C5               | 2.2 $\mu$ F  | Capacitor, Chip, 20%, 6.3V, X5R, 0402 | Murata      | GRM155R60J225ME15D  |
| C9, C10, C13             | 100 pF       | Capacitor, Chip, 5%, 25V, C0G, 0201   |             |                     |
| C2, C4, C6               | 0.1 $\mu$ F  | Capacitor, Chip, 10%, 16V, X5R, 0201  |             |                     |
| R1, R3, R9, R10          | 0 $\Omega$   | Resistor, Chip, 5%, 1/10W, 0402       | Kamaya      | RMC1/16SJPTH        |
| R2                       | 27K $\Omega$ | Resistor, Chip, 5%, 1/16W, 0201       | Kamaya      | RMC1/20-273JPA15    |
| C11, C18, R4, R5, R6, R7 | -            | Do Not Install                        |             |                     |

**Notes:**

1. R6 and R7 are not installed on EVB so VCC0, VCC1 & VCC2 should be tied to a single supply.

## Pin Configuration and Description

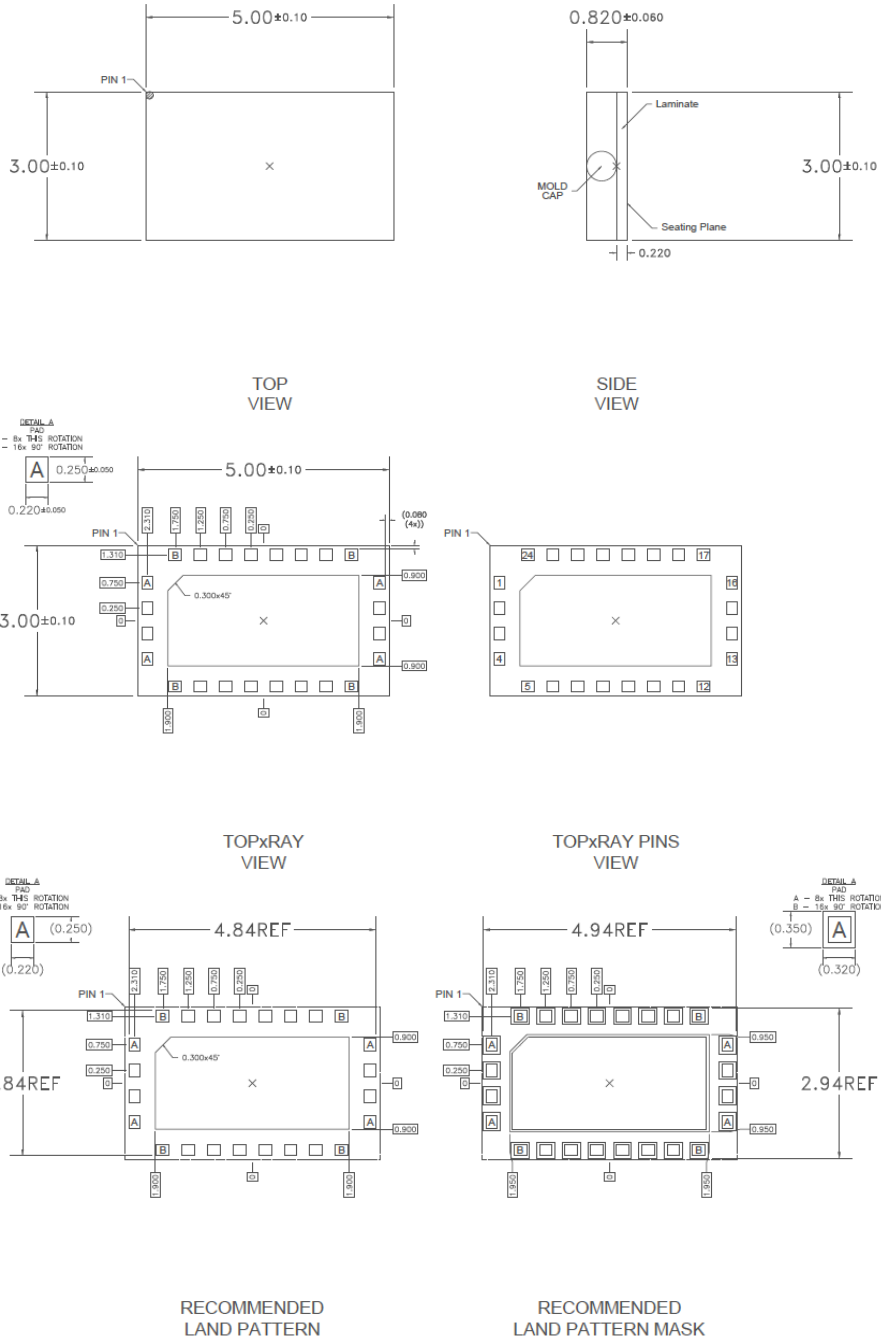


*Top View*

| Pin Number      | Label   | Description  |
|-----------------|---------|--|
| 1               | GND     | No electrical connection. Recommend connect to ground.   |
| 2               | TX_IN   | RF input. Internally matched to 50 $\Omega$ and DC blocked.  |
| 3               | GND     | No electrical connection. Recommend connect to ground.   |
| 4               | PA_EN   | Control pin.   |
| 5               | NC      | No electrical connection.  |
| 6               | DC_PDET | DC power detector. Provides an output voltage proportional to the RF output power level  |
| 7               | GND     | Ground connection.   |
| 8               | NC      | No electrical connection. Recommend connect to ground.   |
| 9               | GND     | No electrical connection. Recommend connect to ground.   |
| 10              | VDD     | Supply voltage.  |
| 11              | GND     | Ground connection.   |
| 12              | LNA_OUT | RF output from the low noise amplifier. Internally matched to 50 $\Omega$ and DC blocked.  |
| 13              | LNA_IN  | RF input to the low noise amplifier. Internally matched to 50 $\Omega$ and DC blocked.   |
| 14              | GND     | No electrical connection. Recommended connect to Ground.   |
| 15              | RX_OUT  | RF output from the RX branch of the T/R switch. Internally matched to 50 $\Omega$ and DC blocked.  |
| 16              | C0      | Control pin.   |
| 17              | ANT     | RF bi-directional antenna port. Internally matched to 50 $\Omega$ and DC blocked.  |
| 18              | GND     | No electrical connection. Recommended connect to Ground.   |
| 19              | C1      | Control pin.   |
| 20              | NC      | No electrical connection. Recommend connect to ground.   |
| 21              | GND     | Ground connection.   |
| 22              | VCC2    | Supply voltage   |
| 23              | VCC1    | Supply voltage   |
| 24              | VCC0    | Supply voltage   |
| Backside Paddle | GND     | RF/DC ground. Use recommended via pattern to minimize inductance and thermal resistance. See PCB Mounting Pattern for suggested footprint. |

Mechanical Information

Dimensions and PCB Mounting Pattern



Notes:

2. All dimensions are in millimeters. Angles are in degrees.
3. Dimension and tolerance formats conform to ASME Y14.4M-1994.
4. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

## Handling Precautions

| Parameter                        | Rating          | Standard              |
|----------------------------------|-----------------|-----------------------|
| ESD – Human Body Model (HBM)     | Class 1B (500V) | ANSI/ESD/JEDEC JS-001 |
| ESD – Charged Device Model (CDM) | Class C3 (1kV)  | ANSI/ESD/JEDEC JS-002 |
| MSL – Moisture Sensitivity Level | Level 3         | IPC/JEDEC J-STD-020   |



Caution!

ESD sensitive device

## Solderability

Compatible with both lead-free (260 °C max. reflow temperature) and tin/lead (245 °C max. reflow temperature) soldering processes.

Package lead plating: Electrolytic plated Au over Ni

## RoHS Compliance

This part 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:

- 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
- SVHC Free



## Contact Information

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

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