

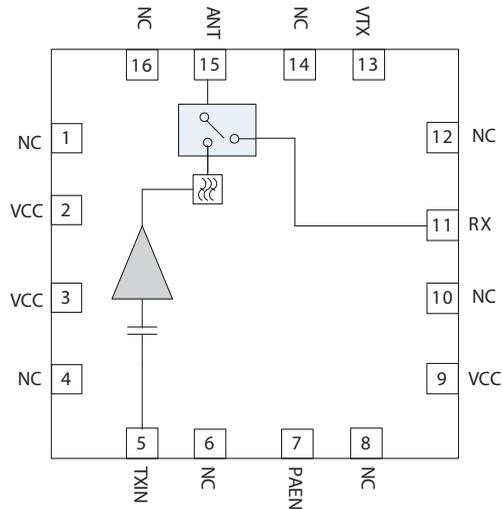


**Features**

- Small Size
- High Performance FEM
- Excellent Linearity
- Input and Output Matched to 50Ω
- P<sub>OUT</sub> = 17.5dBm, 11ac, 80MHz MCS9 at -36dB (1.5%) EVM
- Integrated 5GHz PA and SP2T Switch
- Low Height Package, Suited for SiP and CoB Designs

**Applications**

- Cellular Handsets
- Mobile Devices
- Tablets
- Consumer Electronics
- Gaming
- Netbooks/Notebooks
- TV/Monitors/Video



Functional Block Diagram

**Product Description**

The RFFM8504 provides a complete integrated solution in a single front end module (FEM) for 4.9GHz to 5.85GHz WiFi 802.11a/n/ac systems. The ultra-small form factor and integrated matching minimizes the layout area in the customer's application and greatly reduces the number of external components. This simplifies the total front end solution by reducing the bill of materials, system footprint, and manufacturability cost. The RFFM8504 integrates a power amplifier (PA) and single-pole double-throw switch (SP2T). The device is provided in a 2.5mm x 2.5mm x 0.45mm, 16-pin QFN package. This module meets or exceeds the RF front end needs of IEEE 802.11a/n/ac WiFi RF systems.

**Ordering Information**

|                 |   |
|-----------------|---|
| RFFM8504SQ      | Standard 25-piece sample bag                      |
| RFFM8504SR      | Standard 100-piece reel                           |
| RFFM8504TR7     | Standard 2500-piece reel                          |
| RFFM8504PCK-410 | Fully assembled evaluation board with 5-piece bag |

## Absolute Maximum Ratings

| Parameter  | Rating       | Unit            |
|--|--------------|-----------------|
| DC Supply Voltage  | -0.5 to +5.4 | V <sub>DC</sub> |
| PA Enable Voltage  | -0.5 to 5    | V <sub>DC</sub> |
| DC Supply Current  | 500          | mA              |
| Maximum Tx and Rx Input Power into 50Ω Load for 11a/n/ac (No Damage) | +12          | dBm             |
| Storage Temperature  | -40 to +150  | °C              |
| Moisture Sensitivity   | MSL1         |                 |



**Caution!** ESD sensitive device.

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. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

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65/EURFMD Green: RoHS compliant per EU Directive 2011/65/EU, halogen free per IEC 61249-2-21, < 1000 ppm each of antimony trioxide in polymeric materials and red phosphorus as a flame retardant, and <2% antimony in solder.

| Parameter                                     | Specification |      |      | Unit | Condition   |
|---|---------------|------|------|------|---|
|   | Min.          | Typ. | Max. |      |   |
| <b>Compliance: 802.11a, 802.11n, 802.11ac</b> |               |      |      |      | 4.9GHz to 5.85GHz Only  |
| Operating Frequency                           | 5.15          |      | 5.85 | GHz  |   |
| Extended Frequency                            | 4.9           |      | 5.15 | GHz  | Functional with derated performance   |
| Input and Output Port Impedance               |               | 50   |      | Ω    |   |
| Operating Temperature                         | -30           |      | +85  | °C   |   |
| Power Supply V <sub>CC</sub>                  | 3             | 3.6  | 4.2  | V    |   |
| Switch Control Voltage - VTX High             | 2.75          | 2.9  | 4.2  | V    | TX switch On at high control voltage  |
| Switch Control Voltage - VTX Low              |               | 0.1  | 0.4  | V    | RX switch On with low control voltage   |
| PA_Enable High                                | 2.75          | 2.9  | 4.2  | V    | PA in "On" state  |
| PA_Enable Low                                 |               | 0.1  | 0.4  | V    | PA in "Off" state, Do not leave floating  |
| <b>Transmit (TX-ANT) Mode</b>                 |               |      |      |      | V <sub>CC</sub> = 3.6V; VTX = High, Temperature = 25 °C; Unless otherwise noted |
| Gain (5.15GHz to 5.85GHz)                     | 25.5          | 29   |      | dB   |   |
| 20MHz Output Power*                           |               | 19   |      | dBm  | 802.11ac HT20 MCS7  |
| 11ac 20MHz Dynamic EVM                        |               | -33  | -30  | dB   |   |
|   |               | 2.2  | 3.2  | %    |   |
| 40MHz Output Power*                           |               | 18   |      | dBm  | 802.11ac VHT40 MCS9   |
| 11ac 40MHz Dynamic EVM                        |               | -36  | -35  | dB   |   |
|   |               | 1.5  | 1.8  | %    |   |
| 80MHz Output Power*                           |               | 17   |      | dBm  | 802.11ac VHT80 MCS9   |
| 11ac 80MHz Dynamic EVM                        |               | -36  | -35  | dB   |   |
|   |               | 1.5  | 1.8  | %    |   |
| 80MHz Output Power*                           |               | 13.5 |      | dBm  | 802.11ac VHT80 MCS9   |
| 11ac 80MHz Dynamic EVM                        |               | -40  |      | dB   |   |
|   |               | 1.0  |      | %    |   |
| Spectral Mask 20MHz Output Power*             |               | 22   |      | dBm  | 802.11ac HT20 with 3dB margin   |
| Spectral Mask 40MHz Output Power*             |               | 21   |      | dBm  | 802.11ac VHT40 with 3dB margin  |
| Spectral Mask 80MHz Output Power*             |               | 20   |      | dBm  | 802.11ac VHT80 with 3dB margin  |
| Operating Current - Nominal                   |               | 270  | 310  | mA   | P <sub>OUT</sub> = 19dBm  |

\* For 4900MHz to 5150MHz, P<sub>OUT</sub> is degraded by 1dB

| Parameter                            | Specification |      |      | Unit | Condition   |
|--------------------------------------|---------------|------|------|------|---|
|                                      | Min.          | Typ. | Max. |      |   |
| Second Harmonic                      |               |      | -40  | dBm  | Fundamental frequency is between 4900MHz and 5850MHz; RF P <sub>OUT</sub> = 19dBm; measured in 1MHz resolution bandwidth (FCC limit max = -30dBm) |
| Third Harmonic                       |               |      | -40  | dBm  |   |
| PA Selectivity/Out of Band Gain      |               |      |      |      |   |
| 30MHz to 2900MHz                     |               | -6   |      | dB   |   |
| 3600MHz to 4400MHz                   |               | 19   |      | dB   |   |
| 7250MHz to 7750MHz                   |               | 20   |      | dB   |   |
| Tx Port Return Loss                  | 10            | 12   |      | dB   |   |
| ANT Port Return Loss                 | 12            | 15   |      | dB   |   |
| Noise Figure                         |               |      | 6    | dB   |   |
| <b>Receive (ANT-RX) Receive Data</b> |               |      |      |      | V <sub>CC</sub> = 3.6V; VTX = Low, Temperature = 25 °C; Unless otherwise noted  |
| Insertion Loss                       |               | 0.9  |      | dB   |   |
| RX Port Return Loss                  | 12            | 15   |      | dB   |   |
| ANT Port Return Loss                 | 12            | 15   |      | dB   |   |
| TX - RX Isolation                    | 21            |      |      | dB   |   |
| <b>General Specifications</b>        |               |      |      |      |   |
| Switch Control Current - High        |               |      | 2    | µA   |   |
| Switch Control Current - Low         |               |      | 0.1  | µA   | Do not leave floating   |
| PAEN Current - All Conditions        |               | 30   |      | µA   |   |
| FEM Leakage - Nominal                |               | 4    | 10   | µA   | RF = Off; PAEN = Low; VTX = Low   |
| Turn-On time from PA_EN edge         |               |      | 300  | ns   | Output stable within 90% of final gain  |
| Turn-Off time from PA_EN edge        |               |      | 300  | ns   | Output stable within 90% of final gain  |
| Switching Speed                      |               |      | 200  | ns   |   |
| ESD - Human Body Model               | 1000          |      |      | V    | EIA/JESD22-114A all pins  |
| ESD - Charge Device Model            | 1000          |      |      | V    | EIA/JESD22-101C all pins  |

## PA Mode of Operation

| PA Mode | PAEN |
|---------|------|
| Enable  | High |
| Disable | Low  |

## Switch Mode of Operation

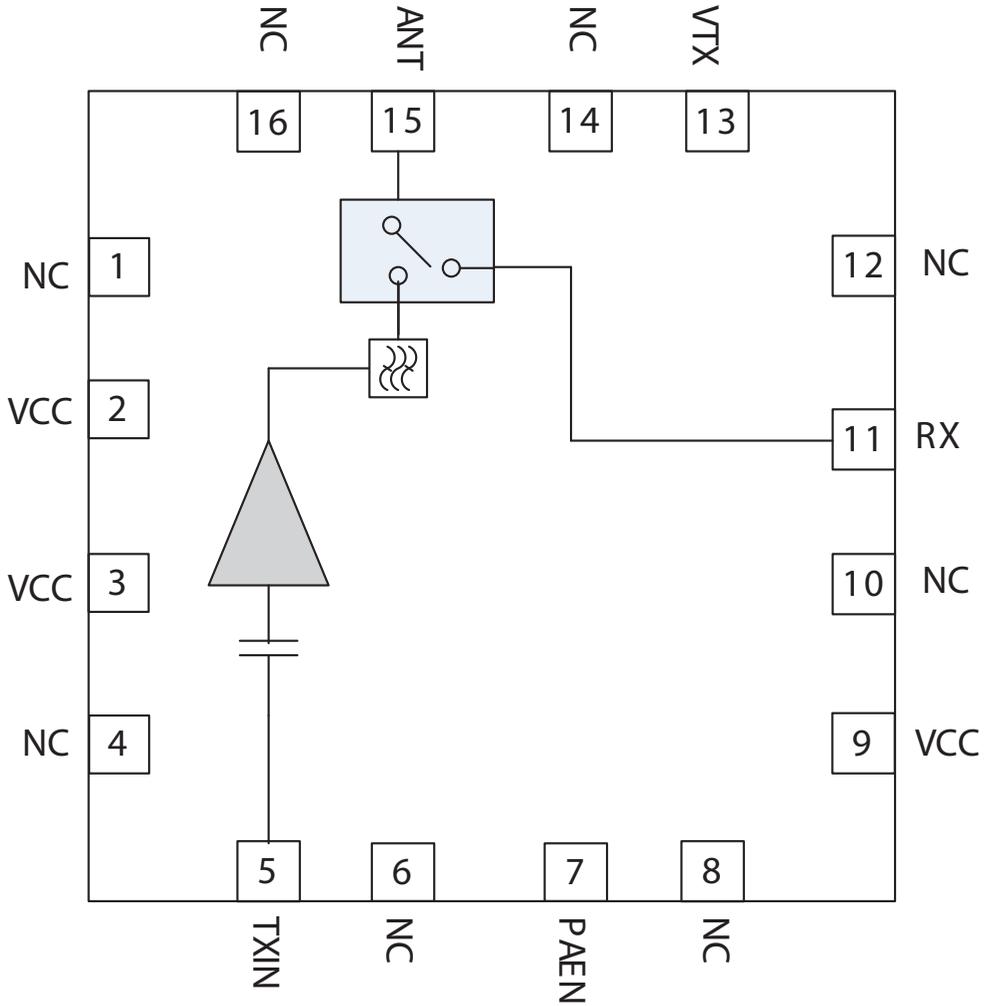
| Switch Mode | VTX  |
|-------------|------|
| Transmit    | High |
| Receive     | Low  |

## Pin Descriptions

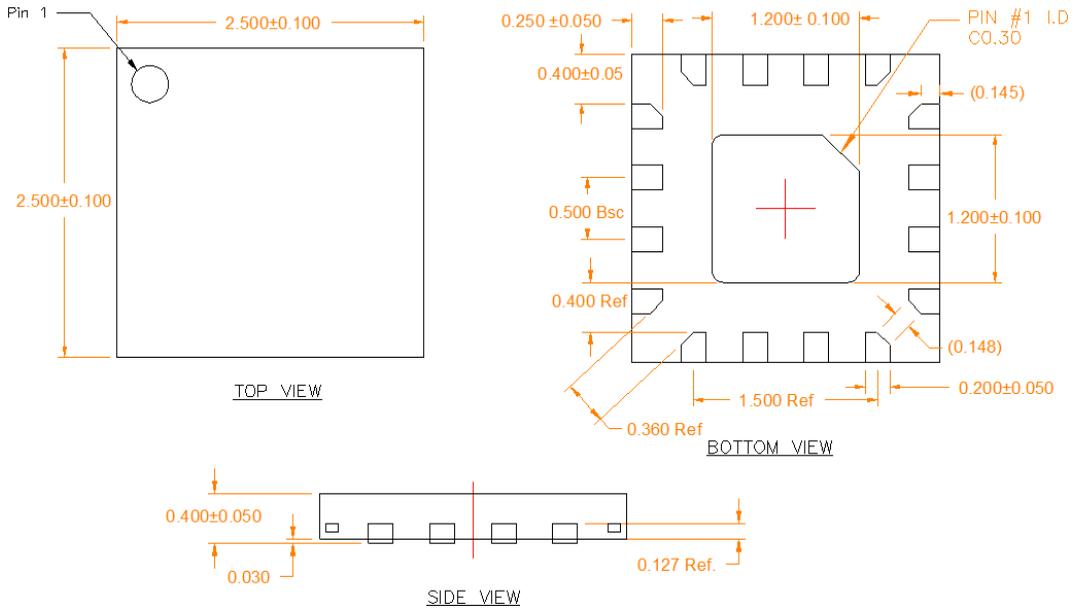
| Pin      | Name | Description   |
|----------|------|---|
| 1        | NC*  | No Connect. This pin is not connected internally. It can be left floating or connected to ground.   |
| 2        | VCC  | Supply voltage for the PA. See applications schematic for biasing and bypassing components.   |
| 3        | VCC  | Supply voltage for the PA. See applications schematic for biasing and bypassing components.   |
| 4        | NC*  | No Connect. This pin is not connected internally. It can be left floating or connected to ground.   |
| 5        | TXIN | RF input port for the 802.11a/n PA. Input is matched to 50Ω. Internally DC blocked.   |
| 6        | NC*  | No Connect. This pin is not connected internally. It can be left floating or connected to ground.   |
| 7        | PAEN | Control voltage for the PA. High PAEN enables the PA and Low PAEN disables the PA (see switch logic tables).  |
| 8        | NC*  | No Connect. This pin is not connected internally. It can be left floating or connected to ground.   |
| 9        | VCC  | Supply voltage for the PA. See applications schematic for biasing and bypassing components.   |
| 10       | NC*  | No Connect. This pin is not connected internally. It can be left floating or connected to ground.   |
| 11       | RX   | Receive (Rx) 50Ω output pin.  |
| 12       | NC*  | No Connect. This pin is not connected internally. It can be left floating or connected to ground.   |
| 13       | VTX  | Switch control voltage. High control voltage turns on the Tx path and low control voltage turns on the Rx path (see switch logic tables).               |
| 14       | NC*  | No Connect. This pin is not connected internally. It can be left floating or connected to ground.   |
| 15       | ANT  | RF bidirectional antenna port matched to 50Ω.   |
| 16       | NC*  | No Connect. This pin is not connected internally. It can be left floating or connected to ground.   |
| Pkg Base | GND  | Ground connection. The backside of the package should be connected to the ground plane through a short path; PCB vias under the device are recommended. |

\* It is recommended to ground all NC pins.

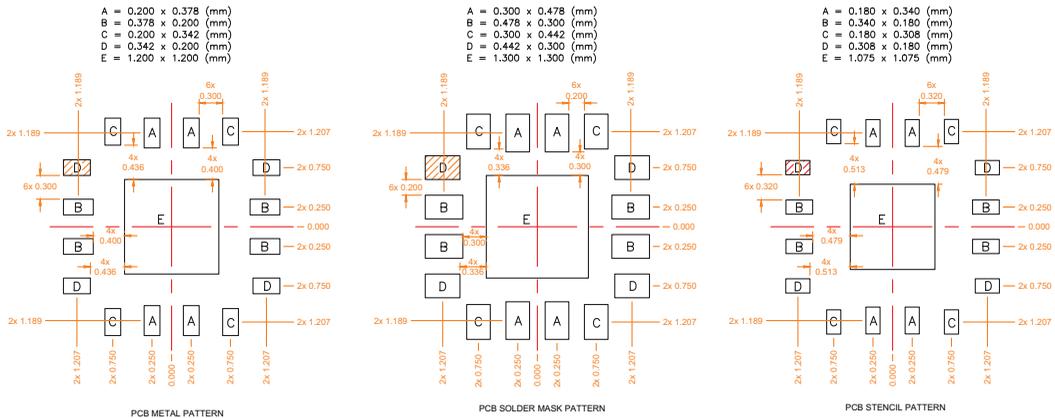
**Detailed Functional Block Diagram**



## Package Drawing



## PCB Patterns



Thermal vias for center slug "E" should be incorporated into the PCB design. The number and size of thermal vias will depend on the application, the power dissipation, and the electrical requirements. Example of the number and size of vias can be found on the RFMD evaluation board layout.

Shaded are represents Pin 1 location.

**Evaluation Board Schematic**

