

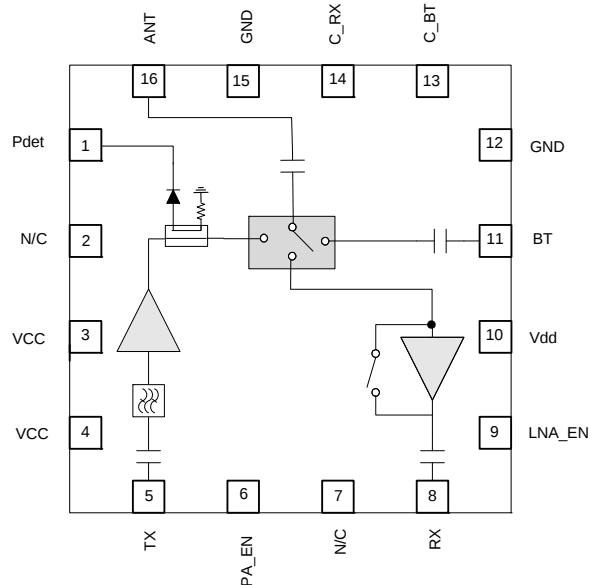


### Features

- Integrated 2.5GHz b/g/n Amplifier, LNA with Bypass Mode, SP3T Switch, and Power Detector Coupler
- Single Supply Voltage 3.0V to 4.8V
- 11n  $P_{OUT} = 18\text{dBm}$ , 2.5% Dynamic EVM
- 11b  $P_{OUT} = 21\text{dBm}$ , Meeting Spectral Mask

### Applications

- Cellular Handsets
- Mobile Devices
- Tablets
- Consumer Electronics
- Gaming
- Netbooks and Notebooks
- TV, Monitors, and Video
- Smart Energy AMI



Functional Block Diagram

### Product Description

The RFFM8200 provides a complete integrated solution in a single Front End Module (FEM) for WiFi 802.11b/g/n and Bluetooth® systems. The ultra small form factor and integrated matching greatly reduces the number of external components and layout area in the customer application. This simplifies the total Front End solution by reducing the bill of materials, system footprint, and manufacturability cost. The RFFM8200 integrates a 2.4GHz Power Amplifier (PA), Low Noise Amplifier (LNA) with bypass mode, power detector coupler for improved accuracy, and some filtering for harmonic rejection. The device is provided in a 3mm x 3mm x 1.0mm, 16-pin package. This module meets or exceeds the RF Front End needs of IEEE 802.11b/g/n WiFi RF systems.

### Ordering Information

|                 |                                                   |
|-----------------|---------------------------------------------------|
| RFFM8200SB      | Standard 5 pieces sample bag                      |
| RFFM8200        | Standard 25 pieces sample bag                     |
| RFFM8200SR      | Standard 100 pieces reel                          |
| RFFM8200TR7     | Standard 2500 pieces reel                         |
| RFFM8200PCK-410 | Fully assembled evaluation board with 5-piece bag |

### Optimum Technology Matching® Applied

|                                               |                                      |                                                |                                    |
|-----------------------------------------------|--------------------------------------|------------------------------------------------|------------------------------------|
| <input type="checkbox"/> GaAs HBT             | <input type="checkbox"/> SiGe BiCMOS | <input checked="" type="checkbox"/> GaAs pHEMT | <input type="checkbox"/> GaN HEMT  |
| <input type="checkbox"/> GaAs MESFET          | <input type="checkbox"/> Si BiCMOS   | <input type="checkbox"/> Si CMOS               | <input type="checkbox"/> BiFET HBT |
| <input checked="" type="checkbox"/> InGaP HBT | <input type="checkbox"/> SiGe HBT    | <input type="checkbox"/> Si BJT                | <input type="checkbox"/> LDMOS     |

## Absolute Maximum Ratings

| Parameter                                                    | Rating      | Unit |
|--------------------------------------------------------------|-------------|------|
| DC Supply Voltage (Continuous with No Damage)                | 5.4         | V    |
| DC Supply Current                                            | 500         | mA   |
| Operating Ambient Temperature                                | -40 to +85  | °C   |
| Storage Temperature                                          | -40 to +150 | °C   |
| Maximum TX Input Power into 50Ω Load for 11b/g/n (No Damage) | +5          | dBm  |
| Maximum RX Input Power into 50Ω Load(No Damage)              | +5          | dBm  |
| Moisture Sensitivity                                         | MSL3        |      |



**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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| Parameter                  | Specification |      |       | Unit | Condition                                                                                                                                                                                                                         |
|----------------------------|---------------|------|-------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            | Min.          | Typ. | Max.  |      |                                                                                                                                                                                                                                   |
| 2.4GHz Transmit Parameters |               |      |       |      |                                                                                                                                                                                                                                   |
| Compliance                 |               |      |       |      | IEEE802.11b/g/n, FCC CFG 15.247, .205, .209, EN, and JDEC                                                                                                                                                                         |
| Nominal Conditions         |               |      |       |      | V <sub>CC</sub> = 3.3V to 4.2V; PA_EN = V <sub>CTRL</sub> = V <sub>CC</sub> -0.2V; P <sub>OUT</sub> =18dBm; Duty Cycle=50%; Temp= -10 °C to +70 °C; Freq = 2412MHz to 2484MHz; Modulation 11n MCS7 20MHz, Unless noted otherwise. |
| Operating Frequency Range  | 2.412         |      | 2.484 | GHz  |                                                                                                                                                                                                                                   |
| Power Supply               | 3.0           | 3.3  | 4.8   | V    | Voltage Supply Operating Range                                                                                                                                                                                                    |
| PA_EN Voltage              |               |      |       |      |                                                                                                                                                                                                                                   |
| ON                         | 2.8           | 3.1  | 4.8   | V    | PA ON, Control voltage not to exceed V <sub>CC</sub>                                                                                                                                                                              |
| OFF                        |               | 0.00 | 0.20  | V    | PA OFF                                                                                                                                                                                                                            |
| Dynamic EVM                |               | 2    | 2.5   | %    | Temp = 25 °C                                                                                                                                                                                                                      |
|                            |               | 2    | 2.5   | %    | P <sub>OUT</sub> = 17dBm                                                                                                                                                                                                          |
| Adjacent Channel Power     |               |      |       |      |                                                                                                                                                                                                                                   |
| ACP1                       |               | -36  | -33   | dBc  | P <sub>OUT</sub> = 23dBm, 1Mbps; 100% Duty Cycle; +/- 11MHz Offset from carrier                                                                                                                                                   |
| ACP2                       |               | -56  | -52   | dBc  | P <sub>OUT</sub> = 23dBm, 1Mbps; 100% Duty Cycle; +/- 22MHz Offset from carrier                                                                                                                                                   |
| Gain                       | 24            | 26.5 | 28    | dB   | V <sub>CC</sub> = 3.3v; Temp=25 °C                                                                                                                                                                                                |
|                            | 23            | 26.5 | 29    | dB   |                                                                                                                                                                                                                                   |
| Gain Flatness              |               |      |       |      | At rated power and a given supply voltage                                                                                                                                                                                         |
| Channel 20MHz BW           | -0.25         |      | 0.25  | dB   | V <sub>CC</sub> = 3.3V; 100% Duty Cycle; Temp=25 °C                                                                                                                                                                               |
| Channel 40MHz BW           | -0.5          |      | 0.5   | dB   |                                                                                                                                                                                                                                   |
| Frequency 100MHz BW        | -1            |      | 1     | dB   |                                                                                                                                                                                                                                   |
| Out of Band Rejection      |               | 8    |       | dBc  | 2110 to 2170MHz; CW Signal; Temp=25 °C; V <sub>CC</sub> = 3.3V                                                                                                                                                                    |

| Parameter                                                                  | Specification |      |        | Unit    | Condition                                                                                                             |
|----------------------------------------------------------------------------|---------------|------|--------|---------|-----------------------------------------------------------------------------------------------------------------------|
|                                                                            | Min.          | Typ. | Max.   |         |                                                                                                                       |
| 2.4GHz Transmit Parameters (continued)                                     |               |      |        |         |                                                                                                                       |
| Power Detector                                                             |               |      |        |         |                                                                                                                       |
| Voltage at P <sub>OUT</sub> = 0dBm                                         | 0             | 0.15 | 0.2    | V       | V <sub>CC</sub> = 3.3V                                                                                                |
| Voltage at P <sub>OUT</sub> = 18dBm                                        | 0.6           | 0.7  | 0.8    | V       | V <sub>CC</sub> = 3.3V                                                                                                |
| Voltage Target at 23dBm P <sub>OUT</sub>                                   | 1.2           | 1.35 | 1.5    | V       | V <sub>CC</sub> = 3.3V                                                                                                |
| Variation Over Phase                                                       | -1.5          |      | 1.5    | dB      | up to 3:1 VSWR; 0 to 360° load pull; Temp=25 °C                                                                       |
| Current Consumption                                                        |               |      |        |         |                                                                                                                       |
| I <sub>CC</sub>                                                            |               | 195  | 210    | mA      | V <sub>CC</sub> = 3.3V; Temp = 25 °C                                                                                  |
|                                                                            |               | 200  | 230    | mA      |                                                                                                                       |
| Quiescent Current                                                          |               | 160  | 200    | mA      | “RF OFF”                                                                                                              |
| FEM Leakage Current                                                        |               | 2    | 10     | μA      | V <sub>CC</sub> = 4.8V, RF OFF                                                                                        |
| Input Port Return Loss                                                     | 9.6           | 12   |        | dB      |                                                                                                                       |
| Output Port Return Loss                                                    | 10            | 15   |        | dB      |                                                                                                                       |
| Ruggedness                                                                 |               |      |        |         | No Damage Conditions: max operating voltage, max input power, max temperature                                         |
| Output VSWR                                                                |               |      | 10:1   |         | All phase angles, no spurious or oscillations                                                                         |
| Input Power                                                                |               |      | 0      | dBm     |                                                                                                                       |
| Stability                                                                  |               |      |        |         | PA must be stable from 0dBm to 21dBm. CW Signal, No spurs above -41.25dBm for non-harmonic related signals.           |
| Output VSWR                                                                | 4:1           |      |        |         | All phase angles, no spurious or oscillations                                                                         |
| Out-of-Band Emissions 2310MHz to 2390MHz and 2483.5MHz to 2500MHz (note 1) |               |      | -41.25 | dBm/MHz | P <sub>OUT</sub> = 17dBm, 54Mbps OFDM Modulation, 64QAM, RBW = 1MHz, VBW = 100kHz, V <sub>CC</sub> = 3.3V; Temp=25 °C |
|                                                                            |               |      | -41.25 | dBm/MHz | P <sub>OUT</sub> = 20dBm, 11Mbps CCK Modulation, RBW = 1MHz, VBW = 100kHz, V <sub>CC</sub> = 3.3V; Temp=25 °C         |
| Harmonics                                                                  |               |      |        |         | 11b modulation, 1Mbps, BW = 1MHz; P <sub>OUT</sub> = 21.5dBm                                                          |
| Second                                                                     |               |      | -15    | dBm     | 4.80GHz to 5.00GHz                                                                                                    |
| Third                                                                      |               | -45  | -30    | dBm     | 7.20GHz to 7.50GHz                                                                                                    |
| Noise Power                                                                |               |      |        |         |                                                                                                                       |
| at 2170MHz                                                                 |               | -134 |        | dBm/Hz  | Temp=25 °C                                                                                                            |
| Turn-on/off Time                                                           |               | 200  | 600    | nS      | Output from 10% to 90% of final gain                                                                                  |

Note 1: The output power for channels 1 and 11 may be reduced to meet FCC restricted band requirements.

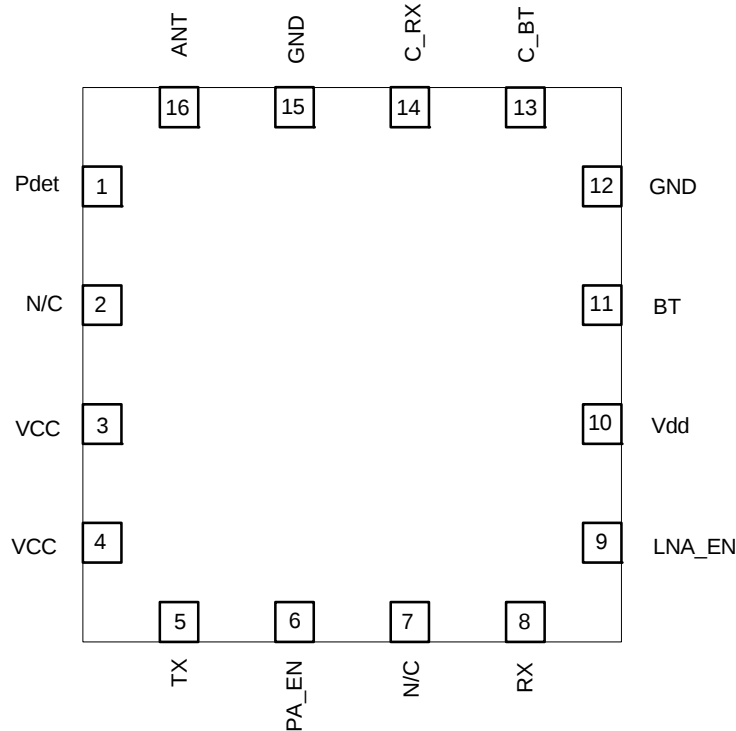
| Parameter                  | Specification |      |       | Unit | Condition                                                                                                                                                                 |
|----------------------------|---------------|------|-------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            | Min.          | Typ. | Max.  |      |                                                                                                                                                                           |
| 2.4GHz Receive Parameters  |               |      |       |      |                                                                                                                                                                           |
| Compliance                 |               |      |       |      | IEEE802.11b/g/n, FCC CFG 15.247,,205,,209, EN, and JDEC                                                                                                                   |
| Nominal Conditions         |               |      |       |      | V <sub>CC</sub> = 3.3V to 4.2V; LNA_EN = V <sub>CTRL</sub> = V <sub>CC</sub> -0.2V; Temp= -10 °C to +70 °C; Freq = 2412MHz to 2484MHz; CW Signal; Unless noted otherwise. |
| Frequency Range            | 2.412         |      | 2.484 | GHz  |                                                                                                                                                                           |
| LNA Voltage Supply         | 3.0           | 3.3  | 4.8   | V    | LNA V <sub>DD</sub> tied to V <sub>BATT</sub> at all times                                                                                                                |
| LNA Current                |               | 8    | 13    | mA   |                                                                                                                                                                           |
| Gain                       |               |      |       |      |                                                                                                                                                                           |
| Receive                    | 11            | 13   | 15    | dB   | LNA ON; V <sub>CC</sub> = 3.3V; Temp= 25 °C                                                                                                                               |
|                            | 10.5          | 13   | 15.5  | dB   |                                                                                                                                                                           |
| Bypass Mode                | -12           | -10  | -8    | dB   | LNA OFF; C_RX = High                                                                                                                                                      |
| Noise Figure               |               | 2    | 3     | dB   | LNA ON                                                                                                                                                                    |
| Input IP3                  | 3             | 5    |       | dBm  | Temp=25 °C                                                                                                                                                                |
| Input P1dB                 | -10           | -5   |       | dBm  |                                                                                                                                                                           |
| Output Return Loss         | 8.5           |      |       | dB   |                                                                                                                                                                           |
| Input Return Loss          | 4             | 5    |       | dB   |                                                                                                                                                                           |
| Bluetooth TX/RX Parameters |               |      |       |      |                                                                                                                                                                           |
| Nominal Conditions         |               |      |       |      | V <sub>CC</sub> =3.3V to 4.2V; V <sub>CTRL</sub> = V <sub>CC</sub> -0.2V; Temp= -10 °C to +70 °C; Freq = 2412MHz to 2484MHz; CW Signal; Unless noted otherwise.           |
| Frequency                  | 2.412         |      | 2.484 | GHz  |                                                                                                                                                                           |
| Insertion Loss             |               | 0.9  | 1.2   | dB   |                                                                                                                                                                           |
| Input/Output Return Loss   | 9.6           |      |       | dB   | Switch in Bluetooth Mode                                                                                                                                                  |
| Input P1dB                 | 25            | 30   |       | dBm  |                                                                                                                                                                           |
| Other Requirements         |               |      |       |      |                                                                                                                                                                           |
| Isolation                  |               |      |       |      |                                                                                                                                                                           |
| TX to RX                   | 30            | 35   |       | dB   | In Tx Mode (measured from ANT to RX port)                                                                                                                                 |
| BT to RX                   | 25            | 27   |       | dB   | In BT Mode (measured from ANT to RX port)                                                                                                                                 |
| TX to BT                   | 15            | 18   |       | dB   | In Tx Mode (measured from ANT to BT port)                                                                                                                                 |
| RX to BT                   | 18            | 25   |       | dB   | In Rx High Gain Mode (measured from ANT to BT port)                                                                                                                       |
| RX to BT (Bypass mode)     | 18            | 20   |       | dB   | In Rx Bypass Mode (measured from ANT to BT port)                                                                                                                          |
| Switch Control Voltage     |               |      |       |      | C_RX, C_BT, LNA_EN, and PA_EN control lines                                                                                                                               |
| Low                        |               | 0    | 0.2   | V    |                                                                                                                                                                           |
| High                       | 2.8           | 3.1  | 4.8   | V    | Not to exceed V <sub>CC</sub>                                                                                                                                             |
| Switch Control Current     |               | 10   | 100   | μA   | Per control line                                                                                                                                                          |
| Enable Control Current     |               | 60   | 100   | μA   | PA_EN, LNA_EN, Over V <sub>CC</sub> , Frequency and Temperature                                                                                                           |
| Switch Control Speed       |               |      | 100   | nsec |                                                                                                                                                                           |
| ESD                        |               |      |       |      |                                                                                                                                                                           |
| Human Body Model           | 500           |      |       | V    | EIA/JESD22-114A RF pins                                                                                                                                                   |
|                            | 1000          |      |       | V    | EIA/JESD22-114A DC pins                                                                                                                                                   |
| Charge Device Model        | 250           |      |       | V    | JESD22-C101C all pins                                                                                                                                                     |

## RFFM8200 Control Logic

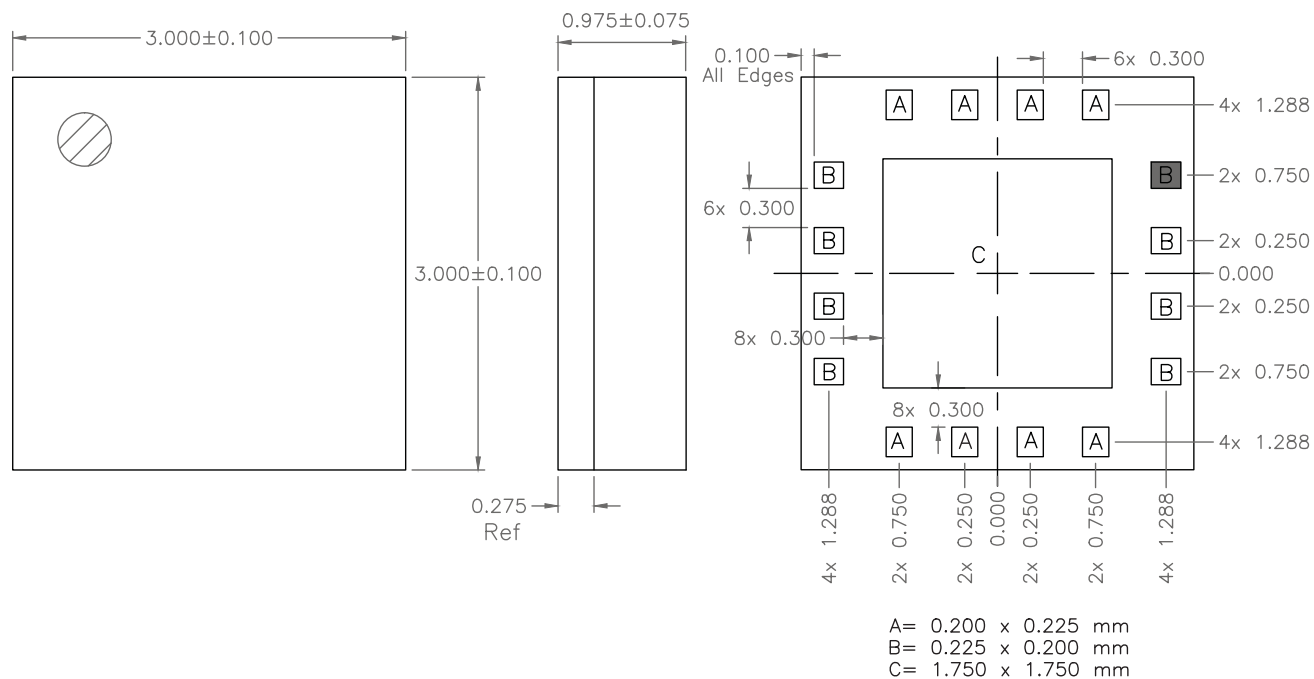
| Operating Mode | PA_EN | LNA_EN | C_RX | C_BT |
|----------------|-------|--------|------|------|
| Transmit       | High  | Low    | Low  | Low  |
| Receive        | Low   | High   | High | Low  |
| Bypass         | Low   | Low    | High | Low  |
| Bluetooth      | Low   | Low    | Low  | High |
| Standby        | Low   | Low    | Low  | Low  |

| Pin      | Function | Description                                                                                                                                             |
|----------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | PDET     | Power detector voltage for TX section. PDET voltage varies with output power. May need external capacitor for noise decoupling.                         |
| 2        | NC       | No connect pin.                                                                                                                                         |
| 3        | VCC      | Supply voltage for the PA. See applications schematic for biasing and bypassing components.                                                             |
| 4        | VCC      | Supply voltage for the PA. See applications schematic for biasing and bypassing components.                                                             |
| 5        | TX       | RF input port for the PA. Input is matched to 50Ω and DC block is provided internally.                                                                  |
| 6        | PA_EN    | Control voltage for the PA bias circuit. See Control Logic table for proper settings.                                                                   |
| 7        | NC       | No connect pin.                                                                                                                                         |
| 8        | RX       | RF output port for the LNA. Input is matched to 50Ω and DC block is provided internally.                                                                |
| 9        | LNA_EN   | Control voltage for the LNA. When this pin is set to a LOW logic state, the bypass mode is enabled.                                                     |
| 10       | VDD      | Supply voltage for the LNA and regulator. See applications schematic for biasing and bypassing components.                                              |
| 11       | BT       | RF Bidirectional port for Bluetooth. Input is matched to 50Ω and DC block is provided.                                                                  |
| 12       | GND      | Ground connection.                                                                                                                                      |
| 13       | C_BT     | Bluetooth switch control pin. See Control Logic table for proper settings.                                                                              |
| 14       | C_RX     | Receive switch control pin. See Control Logic table for proper settings.                                                                                |
| 15       | GND      | Ground connection.                                                                                                                                      |
| 16       | ANT      | RF bidirectional antenna port matched to 50Ω and DC block is provided internally.                                                                       |
| 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. |

Pin Out



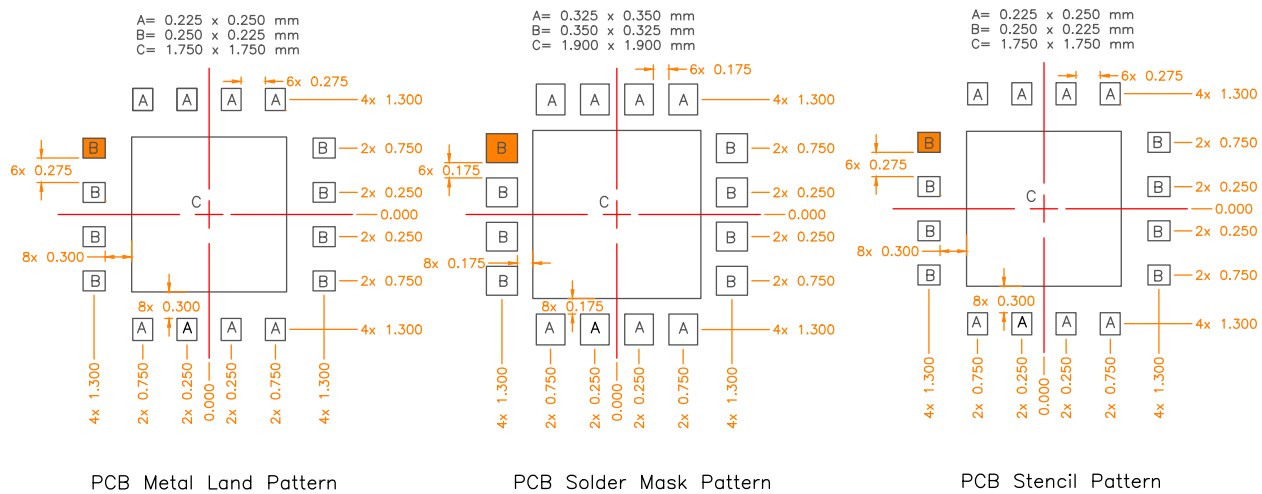
## Package Drawing



### Notes:

1. Shaded area represents Pin 1 location

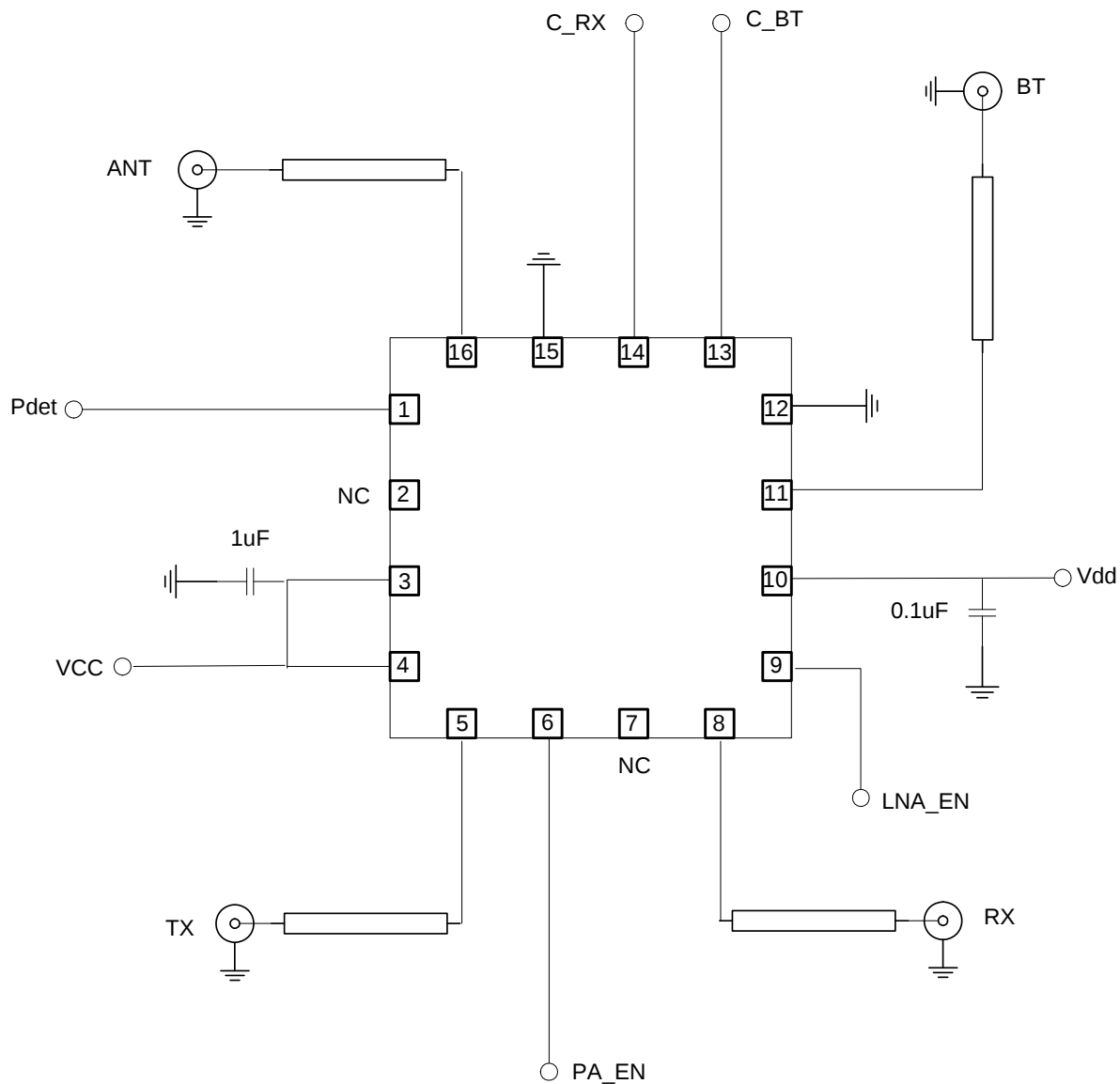
## RFFM8200 PCB Footprint and Stencil Recommendations



### Notes:

1. Shaded area represents Pin 1 location
2. Thermal vias for center slug "C" should be incorporated into the PCB design. The number and size of thermal vias will depend on the application, power dissipation and electrical requirements. Example of the number and size of vias can be found on the RFMD evaluation board layout (gerber files are available upon request).

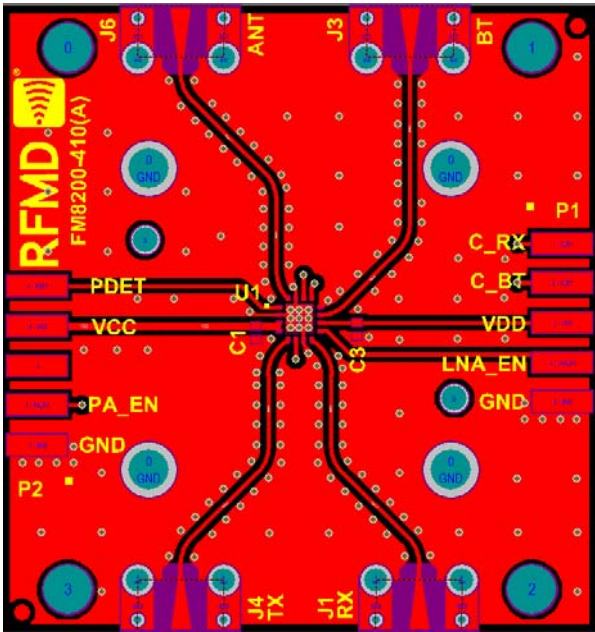
## Applications Schematic



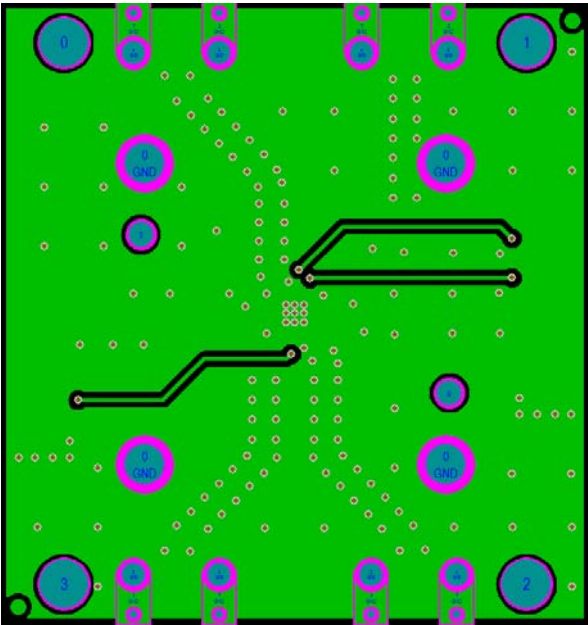
Note: Pins 2, 7, 12 and 15 are not connected internally. These pins can be left floating or grounded. It is recommended to follow RFMD evaluation board layout.

Evaluation Board Layers

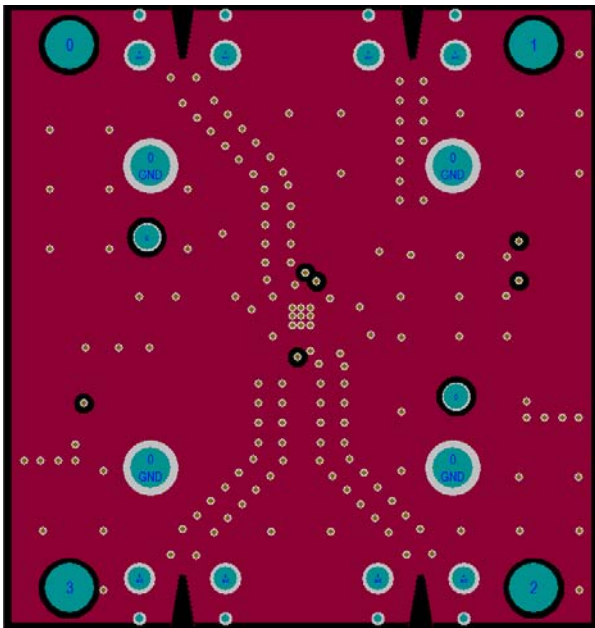
Top



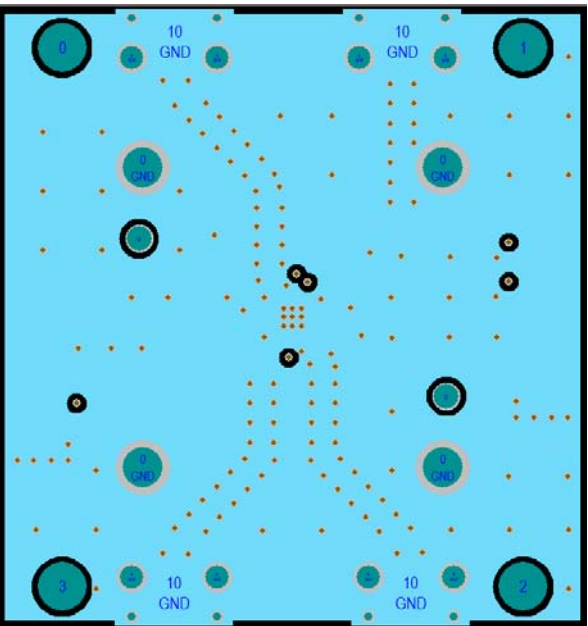
Bottom



Mid Layer1

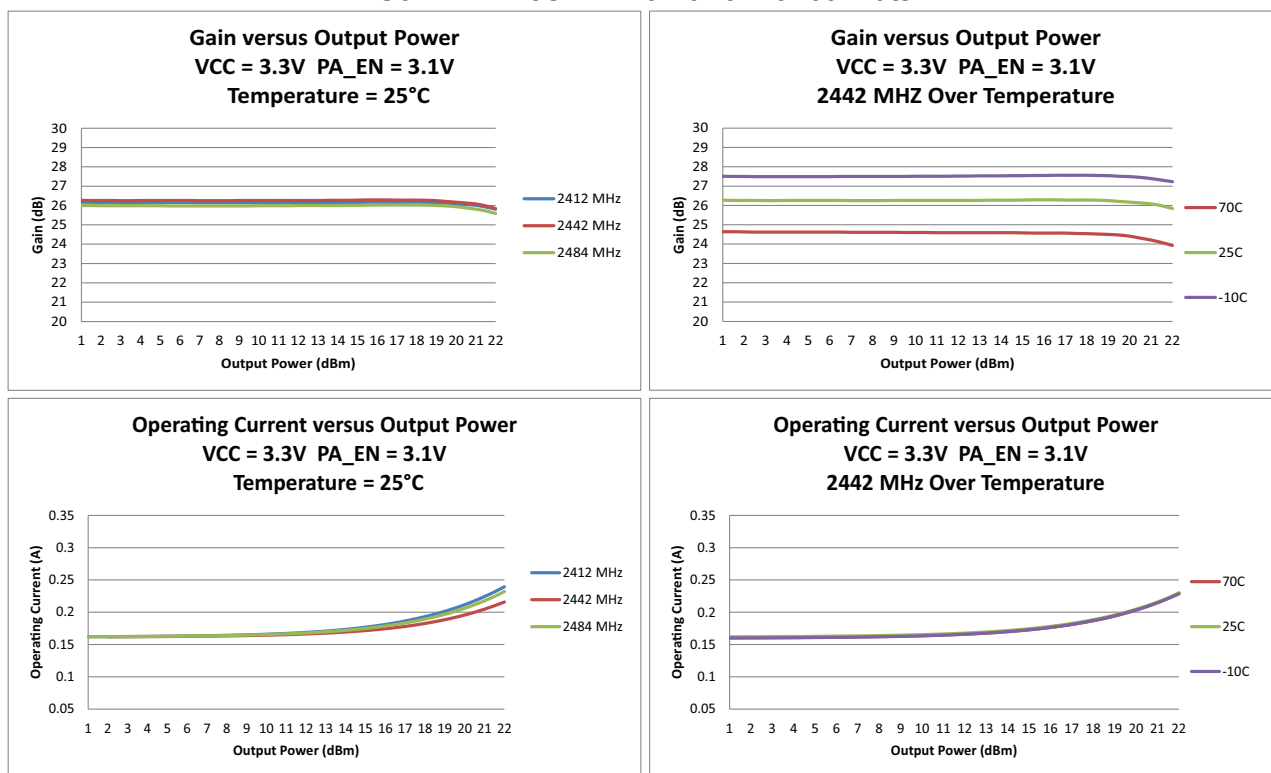


Mid Layer2

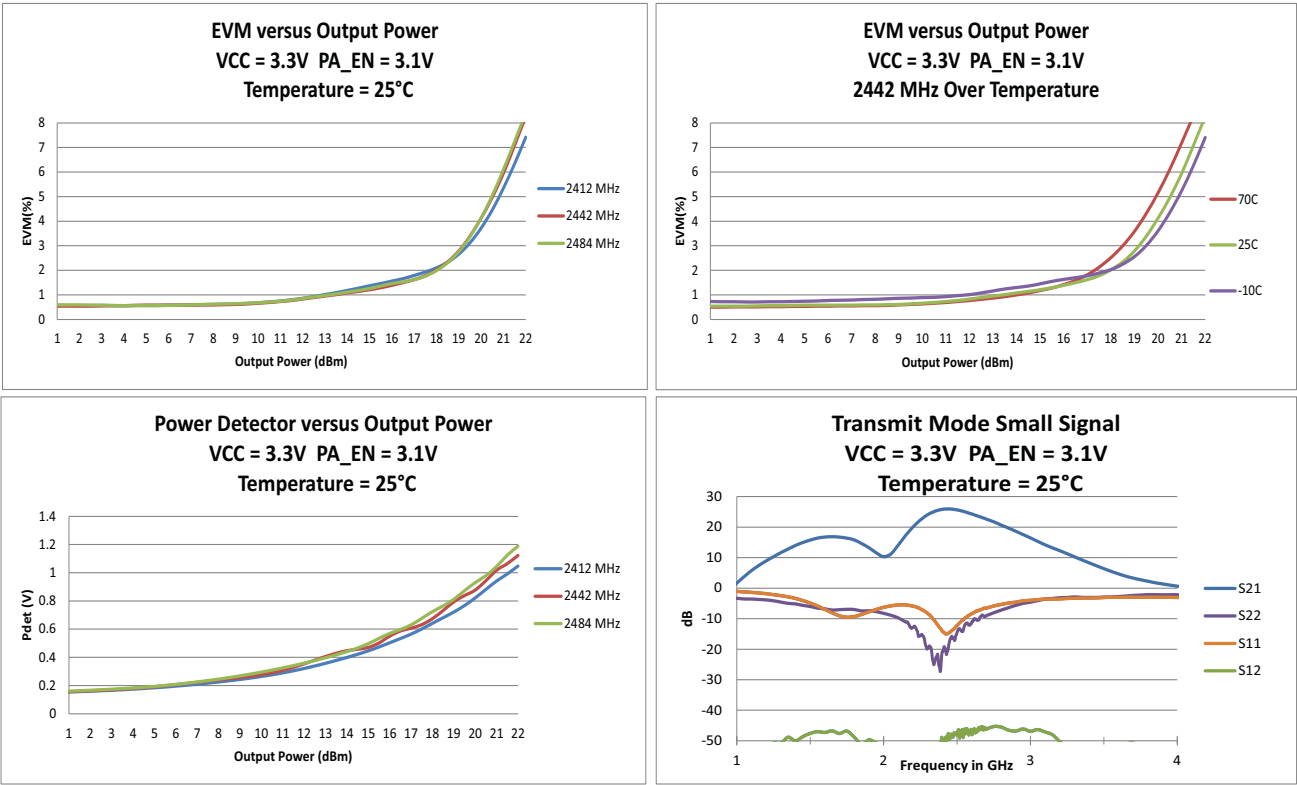


## RFFM8200 Transmit Performance Plots

### 802.11n MCS7 HT20 Performance Plots



RFFM8200 Transmit Performance Plots  
802.11n MCS7 HT20 Performance Plots



## RFFM8200 Receive and Bluetooth Performance Plots

