

RFFM8850P

Dualband 2.4GHz and 5.0GHz 802.11b/g/n/a/ac Wi-Fi® Switch + LNA Front End Module

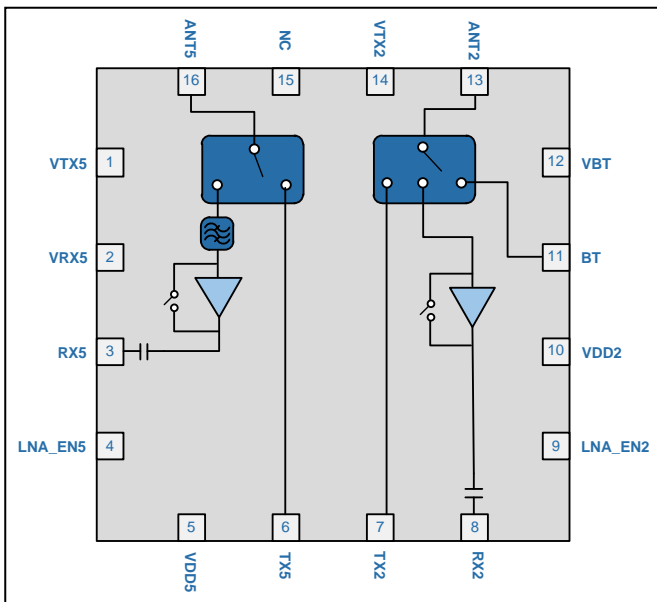
The RFFM8850P provides a complete dualband integrated Switch + LNA solution in a single Front End Module (FEM) for Wi-Fi® 802.11b/g/n/a/ac and Bluetooth® systems. The ultra-small form factor and integrated matching greatly reduces the number of external components and layout area. The RFFM8850P integrates a 2.4GHz SP3T Transmit/Receive Switch, a 5.0GHz SP2T Transmit/Receive Switch, a 2.4GHz Low Noise Amplifier with bypass mode, and a 5.0GHz Low Noise Amplifier with bypass mode.



Package: QFN, 16-pin,
2.3mm x 2.3mm x 0.33mm

Features

- Dualband 2.4GHz & 5.0GHz Wi-Fi® SW+LNA FEM
- 2.4GHz SP3T T/R Switch with Bluetooth® Support
- 2.4GHz LNA with Bypass Mode
- 5.0GHz SP2T T/R Switch
- 5.0GHz LNA with Bypass Mode
- All Input and Output Ports Matched to 50Ω
- Wide Voltage Supply Range
- Supports Wi-Fi® chipsets with Integrated Power Amplifier (iPA)
- Small Package for Chip on Board Designs
- Low Profile Package for Module Designs



Functional Block Diagram

Ordering Information

| | |
|------------------|---|
| RFFM8850PSB | Standard 5-piece sample bag |
| RFFM8850PSQ | Standard 25-piece sample bag |
| RFFM8850PSR | Standard 100-piece reel |
| RFFM8850PTR7 | Standard 2500-piece reel |
| RFFM8850PPCK-410 | Fully assembled evaluation board w/ 5-piece bag |

Applications

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

Absolute Maximum Ratings

| Parameter | Rating | Unit |
|---|-------------|------|
| DC Supply Voltage (No RF Applied) | 6 | V |
| DC Supply Current | 100 | mA |
| Operating Case Temperature | -40 to +85 | °C |
| Storage Temperature | -40 to +150 | °C |
| Maximum TX Input Power into 50Ω Load for 11b/g/n/ac (No Damage) 2.4GHz and 5.0GHz | +30 | dBm |
| Maximum RX Input Power (No Damage) | +12 | dBm |
| Bypass Mode Maximum RX input power (No damage) | +25 | dBm |
| Moisture Sensitivity | MSL2 | |



Caution! ESD sensitive device.



RFMD Green: RoHS status based on EU Directive 2011/65/EU (at time of this document revision), halogen free per IEC 61249-2-21, < 1000ppm each of antimony trioxide in polymeric materials and red phosphorus as a flame retardant, and <2% antimony in solder.

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.

Nominal Operating Parameters

| Parameter | Specification | | | Unit | Condition |
|--|---------------|------|-------|------|--|
| | Min | Typ | Max | | |
| General Specifications | | | | | |
| Operating Frequency | 2.412 | | 2.484 | GHz | 2.4GHz Band |
| Operating Frequency | 5.18 | | 5.825 | GHz | 5.0GHz Band |
| Extended Frequency | 4.9 | | 5.925 | GHz | 5.0GHz Band |
| Operating Temperature | -40 | 25 | 85 | °C | |
| Power Supply - VDD2,VDD5 | 3.0 | 3.6 | 5.0 | V | |
| 2G Control Voltage-High | 2.8 | 3.1 | VDD2 | V | VTX2, LNA-EN2, and VBT should not exceed VDD2 |
| 2G Control Voltage-Low | | 0 | 0.2 | V | |
| 5G Control Voltage-High | 2.8 | 3.1 | VDD5 | V | VTX5, LNA-EN5, and VRX5 should not exceed VDD5 |
| 5G Control Voltage-Low | | 0 | 0.2 | V | |
| ESD – Human Body Model | | | 1000 | V | |
| ESD – Charge Device Model | | | 1000 | V | |
| Transmit (TX2-ANT2) | | | | | |
| 2.4GHz Band, V_{DD2} = 3.6V, unless otherwise noted | | | | | |
| Insertion Loss | | 0.6 | 1.2 | dB | T = 25°C, V _{DD2} = 3.6V |
| TX Port Return Loss | 12 | 20 | | dB | |
| ANT Port Return Loss | 12 | 20 | | dB | |
| Nominal Input P0.1dB | 27 | 30 | | dBm | T = 25°C, V _{DD2} = 3.6V |
| ANT-RX Isolation | 28 | 35 | | dB | TX Mode enabled and at maximum power |
| Receive (ANT2-RX2)-LNA On | | | | | |
| 2.4GHz Band, V_{DD2} = 3.6V, unless otherwise noted | | | | | |
| Gain (S21) | 12 | 14 | 17 | dB | T = 25°C, V _{DD2} = 3.6V |
| | 11 | 14 | 18 | dB | T = -40 to +85°C, V _{DD2} = 3.0V to 5V |
| Gain Flatness over any 20MHz BW | -1 | | +1 | dB | |
| Gain Flatness across band | -1 | | +1 | dB | |
| Noise Figure - Nominal | 1.8 | 2.2 | 2.7 | dB | T = 25°C, V _{DD2} = 3.6V |
| Noise Figure | 1.3 | 2.5 | 3.1 | dB | T = -40 to +85°C, V _{DD2} = 3.0 to 5.0V, F = 2400 - 2500MHZ |
| RX2 Port Return Loss | 10 | 15 | 25 | dB | |
| ANT2 Port Return Loss - Nominal | 5 | 8 | 10 | dB | T = 25°C, V _{DD2} = 3.6V |
| ANT2 Port Return Loss | 4 | 7.5 | 12 | dB | All Conditions |
| Input P1dB - Nominal | -8 | -6.5 | | dBm | T = 25°C, V _{DD2} = 3.6V |
| Current Consumption -Nominal | 6 | 9 | 13 | mA | T = 25°C, V _{DD2} = 3.6V |

| Parameter | Specification | | | Unit | Condition |
|--|---------------|-----|------|------|--|
| | Min | Typ | Max | | |
| Receive (ANT2-RX2)-LNA On | | | | | 2.4GHz Band, V_{DD2} = 3.6V, unless otherwise noted |
| LNA_EN2 Control Current | | 50 | 100 | μA | |
| LNA Turn On Time | | 200 | 500 | nS | |
| Receive (ANT2-RX2)-LNA Bypass Mode | | | | | 2.4GHz Band, V_{DD2} = 3.6V, unless otherwise noted |
| Insertion Loss - Nominal | 4 | 5 | 7 | dB | T = 25°C, V _{DD2} = 3.6V |
| RX Port Return Loss - Nominal | 10 | 12 | 20 | dB | |
| ANT Port Return Loss - Nominal | 10 | 15 | 20 | dB | |
| Input P1dB | +17 | +21 | | dBm | |
| Bluetooth TX/RX Mode | | | | | 2.4GHz Band, V_{DD2} = 3.6, unless otherwise noted |
| Input P0.1dB | +24 | +28 | +32 | dBm | T = 25°C, V _{DD2} = 3.6V |
| Insertion Loss | 0.3 | 0.6 | 1.3 | dB | |
| BT Port Return Loss | 12 | 18 | | dB | |
| ANT2 Port Return Loss | 12 | 18 | | dB | |
| Control Line Specifications | | | | | 2.4GHz Band, V_{DD2} = 3.6, unless otherwise noted |
| Control Line Impedance – VTX2 | | 40 | | MΩ | |
| Control Line Impedance – LNAEN2 | | 66 | | KΩ | |
| Control Line Impedance - VBT | | 40 | | MΩ | |
| Leakage Current – VDD2 | | 0.2 | 10 | μA | |
| 2G Switch Control Current-High-Each Line | | 5 | 100 | μA | |
| 2G Switch Control Current-Low-Each Line | | 0.5 | 1 | μA | |
| Switching Speed | | 100 | 500 | ns | |
| Transmit (TX5-ANT5) | | | | | 5.0GHz Band, V_{DD5} = 3.6V, unless otherwise noted |
| Insertion Loss - Nominal | 0.2 | 0.8 | 1.8 | dB | T = 25°C, V _{DD5} = 3.6V |
| TX5 Port Return Loss - Nominal | 12 | 25 | | dB | |
| ANT5 Port Return Loss - Nominal | 12 | 25 | | dB | |
| Input P0.1dB - Nominal | 28 | 30 | 31.5 | dBm | T = 25°C, V _{DD5} = 3.6V |
| Max Linear Input power (<1% EVM) - Nominal | 20 | 23 | 25 | dBm | T = 25°C, V _{DD5} = 3.6V |
| Max Linear Input power (<1% EVM) - Over VT | 19 | 21 | 25 | dBm | All Conditions |
| ANT5-RX5 Isolation | 28 | 35 | | dB | TX Mode enabled and at maximum power |
| Receive (ANT5-RX5)-LNA On | | | | | 5.0GHz Band, V_{DD5} = 3.6V, unless otherwise noted |
| Gain - Nominal | 10 | 14 | 15 | dB | T = 25°C, V _{DD5} = 3.6V |
| Gain | 9 | 13 | 18 | dB | All conditions |
| Gain flatness over any 80MHz BW | -0.5 | | +0.5 | dB | |
| Gain flatness across band | -1 | | +1 | dB | T = 25°C, V _{DD5} = 3.6V |
| Noise Figure-Nominal | | 2.3 | 3 | dB | |
| Noise Figure | | 2.5 | 3.5 | | T = -40 to +85°C, V _{DD5} = 3.0 to 5.0V |
| Rx5 Port Return Loss - Nominal | 8 | 12 | | dB | |
| ANT5 Port Return Loss - Nominal | 5 | 8 | | dB | |
| Nominal Input P1dB | -7.5 | -5 | | dBm | T = 25°C, V _{DD5} = 3.6V |
| Current Consumption | 6 | 10 | 13 | mA | |
| LNA_EN5 Control Current | 50 | 140 | 200 | μA | |
| LNA Turn On Time | | 400 | 600 | nS | |

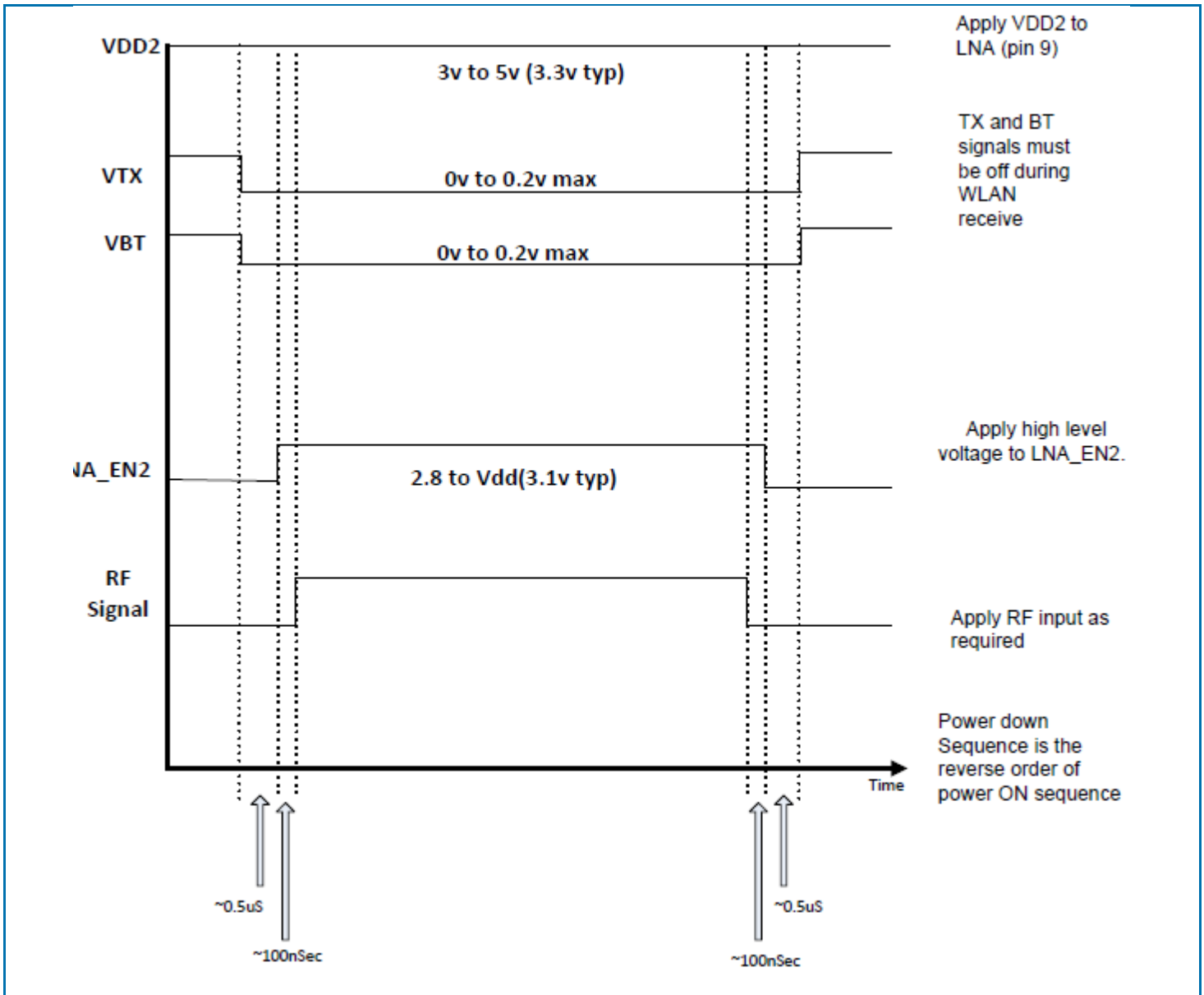
| Parameter | Specification | | | Unit | Condition |
|--|---------------|-----|-----|------|--|
| | Min | Typ | Max | | |
| Receive (ANT5-RX5)-Bypass Mode | | | | | 5.0GHz Band, V_{DD5} = 3.6V, unless otherwise noted |
| Insertion Loss - Nominal | 5 | 7 | 12 | dB | T = 25°C, V _{DD5} = 3.6V |
| RX5 Port Return Loss | 10 | 15 | | dB | |
| ANT5 Port Return Loss | 12 | 20 | | dB | |
| Input P1dB | +18 | +21 | | dBm | T = 25°C, V _{DD5} = 3.6V |
| Control Line Specifications | | | | | 5.0GHz Band, V_{DD5} = 3.6V, unless otherwise noted |
| VDD5 Leakage Current - Nominal | 0 | 0.2 | 10 | uA | |
| Control Line Impedance – VTX5 | | 40 | | MΩ | |
| Control Line Impedance – LNA_EN5 | | 66 | | kΩ | |
| Control Line Impedance – VRX5 | | 40 | | MΩ | |
| Leakage Current – VDD5 | | 0.2 | 10 | μA | |
| 5G Switch Control Current – High - Each Line | | 5 | 100 | μA | |
| 5G Switch Control Current – Low - Each Line | | 0.5 | 1 | μA | T = 25°C, V _{DD5} = 3.6V |
| Switching Speed | | 100 | 500 | ns | |
| Isolation | | | | | V_{DD2} = 3.6V and V_{DD5} = 3.6V, unless otherwise noted |
| ANT5 to RX5 | | 25 | | dB | |
| ANT2 to RX2 | | 25 | | dB | |
| ANT5 to ANT2 | | 40 | | dB | |

Switch Control Logic Truth Table

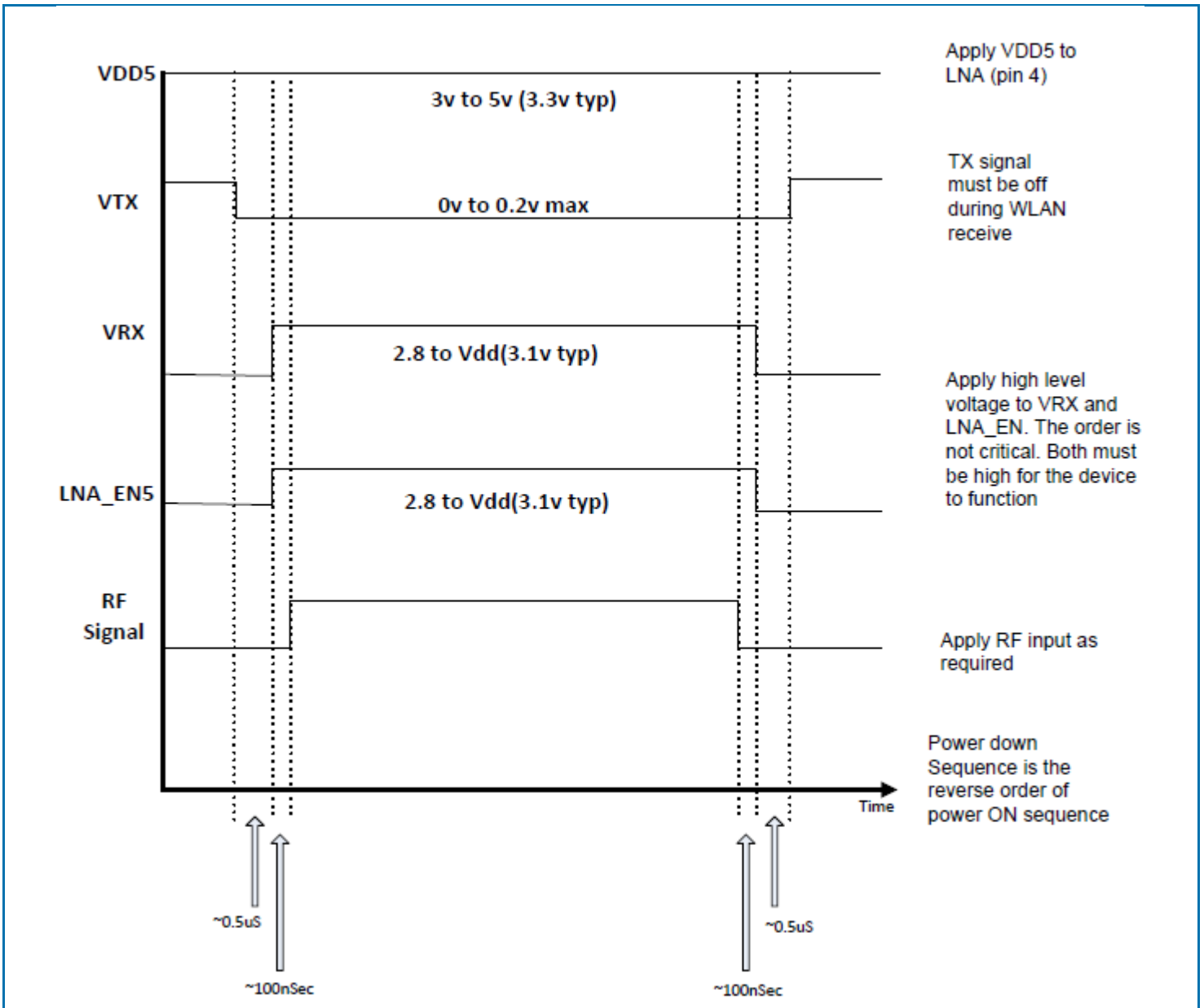
| Operating Mode | VTX2 | LNAEN2 | VBT | VTX5 | LNAEN5 | VRX5 |
|---------------------------------|------|--------|------|------|--------|------|
| 802.11b/g/n Rx Bypass - Standby | Low | Low | Low | | | |
| 802.11b/g/n TX2 Mode | High | Low | Low | | | |
| 802.11b/g/n RX2 Gain Mode | Low | High | Low | | | |
| BT TX | Low | Low | High | | | |
| 5.0 GHz Standby Mode | | | | Low | Low | Low |
| 802.11a/n/ac TX5 Mode | | | | High | Low | Low |
| 802.11a/n/ac RX5 Gain Mode | | | | Low | High | High |
| 802.11a/n/ac RX5 Bypass Mode | | | | Low | Low | High |

Note: 2G: High = 2.8 to V_{DD2}, Low = 0V to 0.2V, and 5G: High = 2.8 to V_{DD5}, Low = 0V to 0.2V.

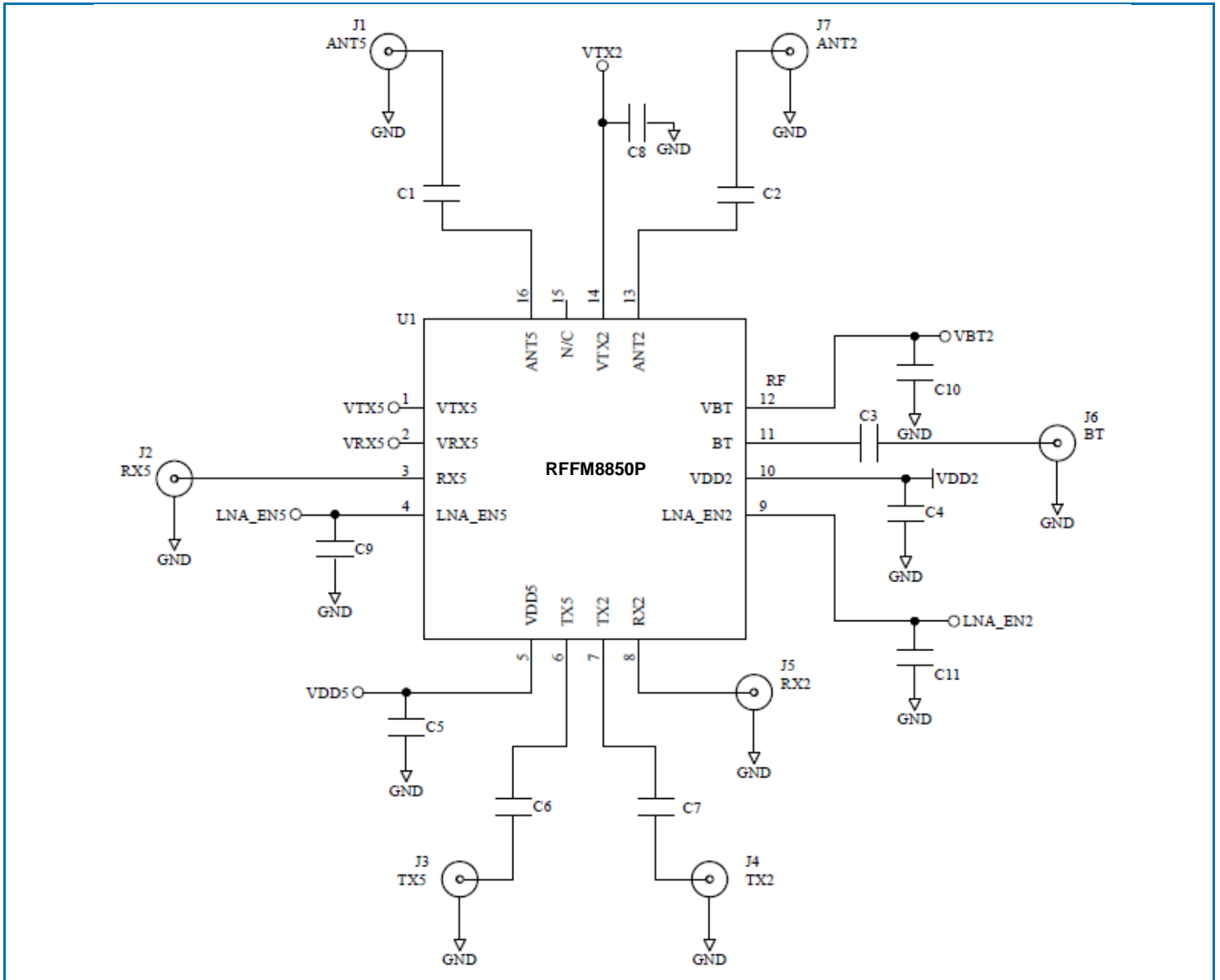
Timing Diagram 2.4GHz Control



Timing Diagram 5.0GHz Control

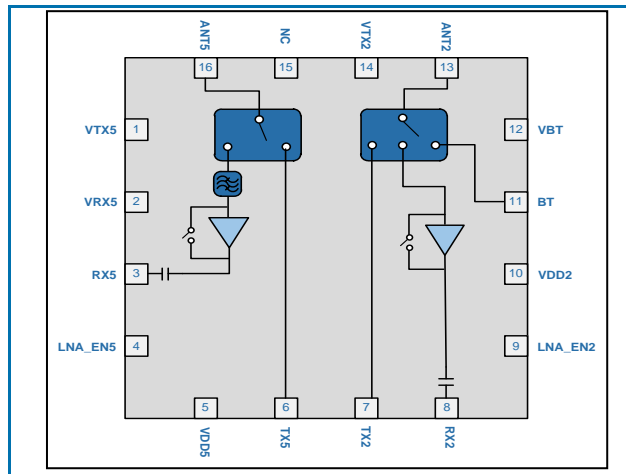


Applications Schematic

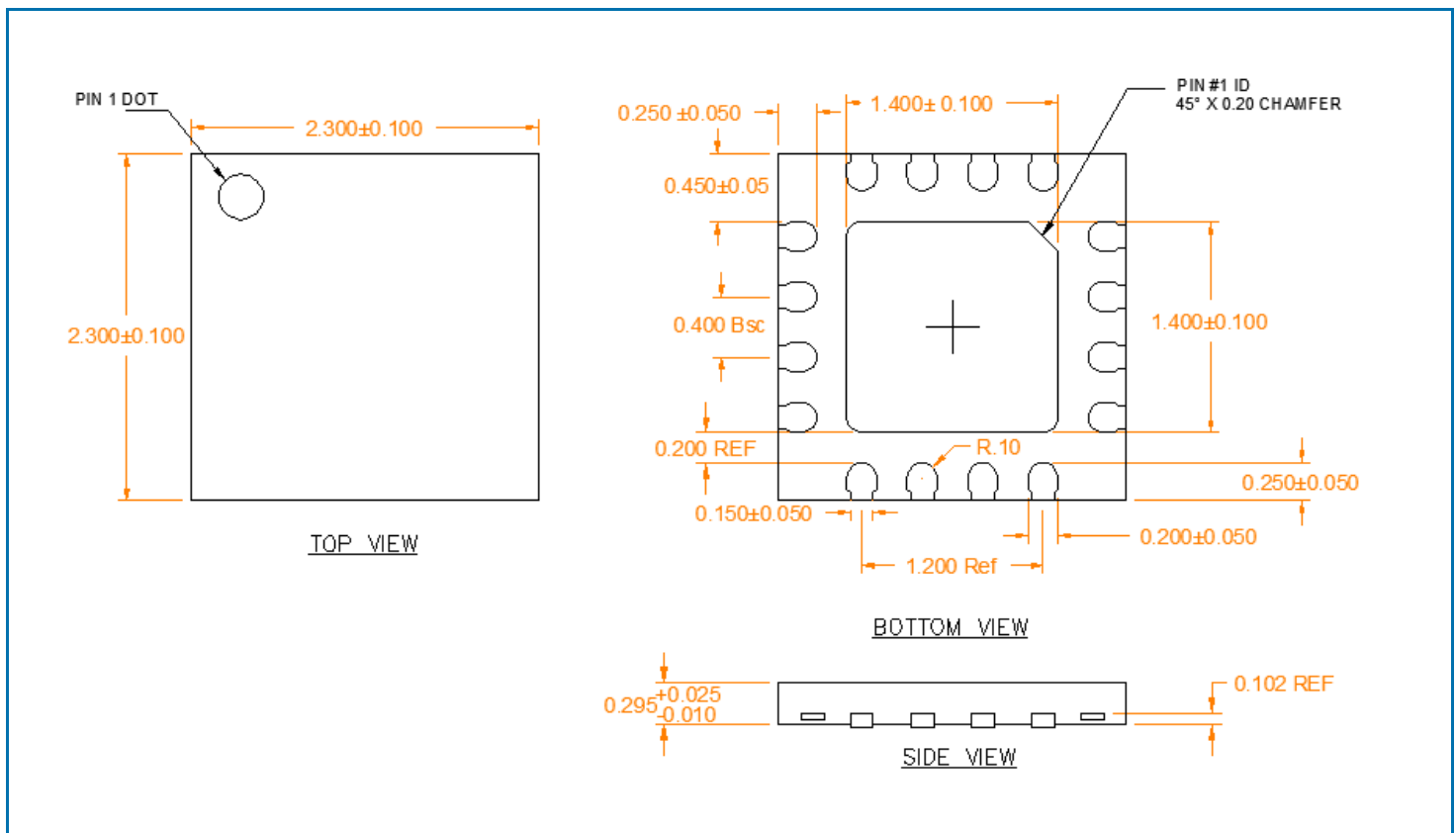


*Note If PIN 11 (BT) is not used then that port should be left open.

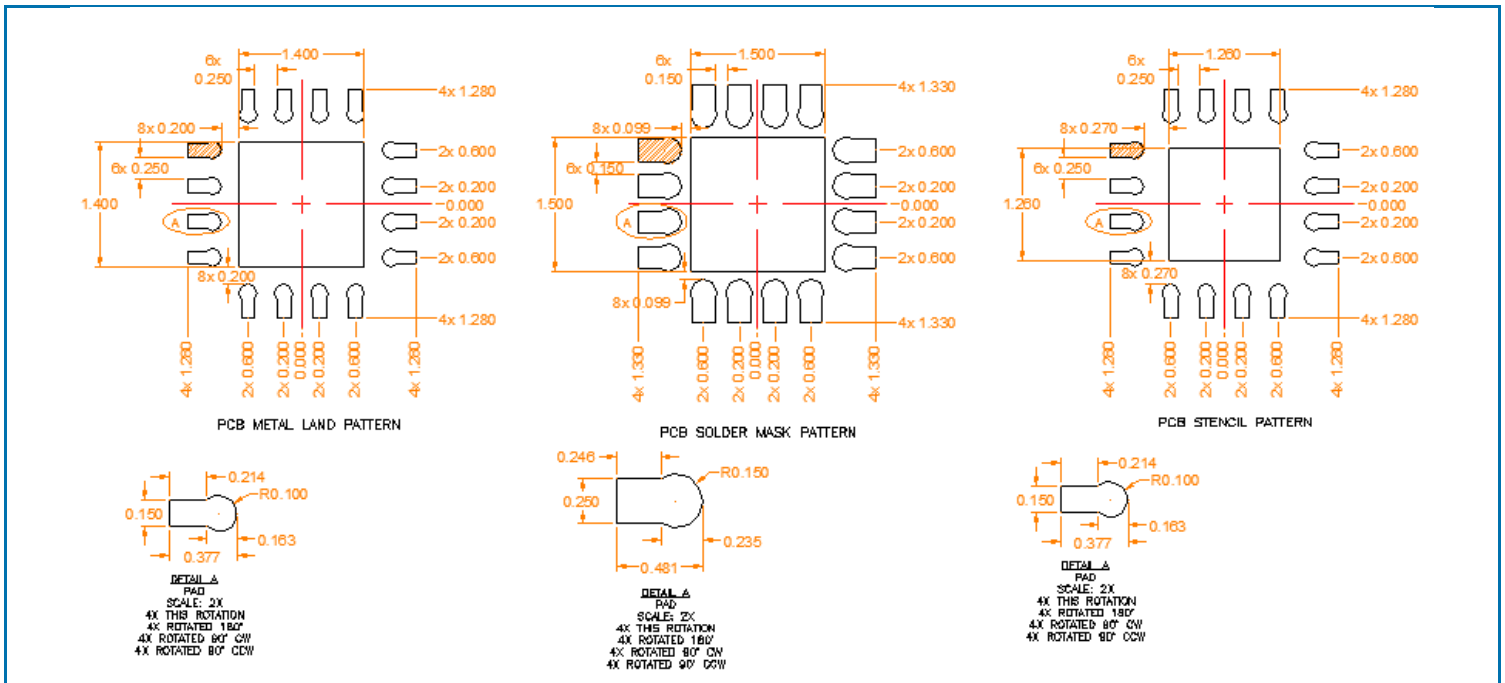
Pin Out



Package Drawing



PCB Patterns



Note:

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)

Pin Names and Descriptions

| Pin | Name | Description |
|----------|---------|---|
| 1 | VTX5 | 5 GHz TX switch control voltage. Refer to logic table for proper settings |
| 2 | VRX5 | 5 GHz RX switch control voltage. Refer to logic table for proper settings |
| 3 | RX5 | RF output port for the 5 GHz LNA. This port is matched to 50Ω and DC blocked internally |
| 4 | LNA_EN5 | 5 GHz LNA enable voltage. Refer to logic table for proper settings |
| 5 | VDD5 | Supply voltage for the 5 GHz LNA. See applications schematic for biasing and bypassing components. |
| 6 | TX5 | RF input port for the TX throw of the 5 GHz T/R switch. An external DC block is required |
| 7 | TX2 | RF input port for the TX throw of the 2.4 GHz T/R switch. An external DC block is required |
| 8 | RX2 | RF output port for the 2.4 GHz LNA. This port is matched to 50Ω and DC blocked internally |
| 9 | LNA_EN2 | 2.4 GHz LNA enable voltage. Refer to logic table for proper settings |
| 10 | VDD2 | Supply voltage for the 2.4 GHz LNA. See applications schematic for biasing and bypassing components. |
| 11 | BT | RF bidirectional port for Bluetooth®. Input is matched to 50Ω. An external DC block is required |
| 12 | VBT | Bluetooth® switch control pin. See truth table for proper level. |
| 13 | ANT2 | 2.4 GHz RF bidirectional antenna port matched to 50Ω. An external DC block is required. |
| 14 | VTX2 | 2.4 GHz TX switch control voltage. Refer to logic table for proper settings |
| 15 | NC | This pin is not connected internally and can be left floating or connected to ground. |
| 16 | ANT5 | 5 GHz RF bidirectional antenna port matched to 50Ω. An external DC block is required. |
| Pkg Base | GND | Ground connection. The backside of the package should be connected to the ground plane through a short path, i.e., PCB vias under the device are recommended. |

*Note If PIN 11 (BT) is not used then that port should be left open.