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RFFM8200

2.4GHz TO 2.5GHz 802.11b/g/n WiFi FRONT END MODULE

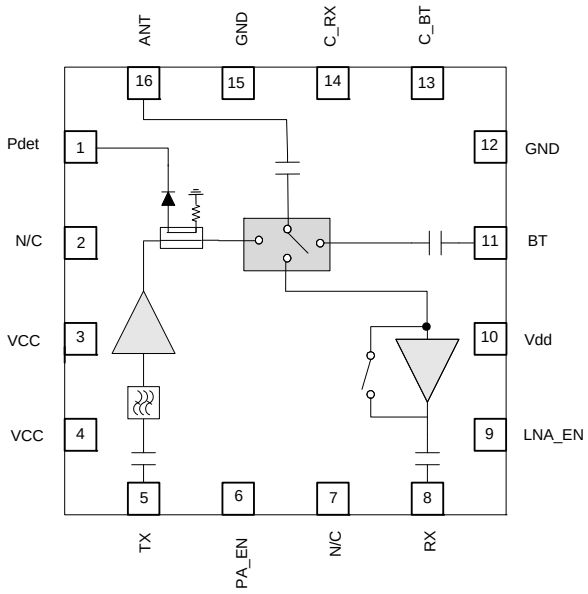
Package Style: Laminate, 16-pin, 3mm x 3mm x 1.05mm

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} = 18dBm, 2.5% Dynamic EVM
- 11b P_{OUT} = 21dBm, 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

☐ GaAs HBT	☐ SiGe BiCMOS	☑ GaAs pHEMT	☐ GaN HEMT
☐ GaAs MESFET	☐ Si BiCMOS	☐ Si CMOS	☐ BiFET HBT
☑ InGaP HBT	☐ SiGe HBT	☐ Si BJT	☐ LDMOS

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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.

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_{CC} = 3.3V to 4.2V; PA_EN = V_{CTRL} = V_{CC} -0.2V; P_{OUT}=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_{CC}
OFF		0.00	0.20	V	PA OFF
Dynamic EVM		2	2.5	%	Temp = 25°C
		2	2.5	%	P_{OUT} = 17dBm
Adjacent Channel Power					
ACP1		-36	-33	dBc	P_{OUT} = 23dBm, 1Mbps; 100% Duty Cycle; +/- 11MHz Offset from carrier
ACP2		-56	-52	dBc	P_{OUT} = 23dBm, 1Mbps; 100% Duty Cycle; +/- 22MHz Offset from carrier
Gain	24	26.5	28	dB	V_{CC} = 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_{CC} = 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_{CC} = 3.3V

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Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
2.4GHz Transmit Parameters (continued)					
Power Detector					
Voltage at P_{OUT} = 0dBm	0	0.15	0.2	V	V_{CC} = 3.3V
Voltage at P_{OUT} = 18dBm	0.6	0.7	0.8	V	V_{CC} = 3.3V
Voltage Target at 23dBm P_{OUT}	1.2	1.35	1.5	V	V_{CC} = 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_{CC}		195	210	mA	V_{CC} = 3.3V; Temp = 25°C
		200	230	mA	
Quiescent Current		160	200	mA	"RF OFF"
FEM Leakage Current		2	10	µA	V_{CC} = 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_{OUT} = 17dBm, 54Mbps OFDM Modulation, 64QAM, RBW = 1MHz, VBW = 100kHz, V_{CC} = 3.3V; Temp=25°C
			-41.25	dBm/MHz	P_{OUT} = 20dBm, 11Mbps CCK Modulation, RBW = 1MHz, VBW = 100kHz, V_{CC} = 3.3V; Temp=25°C
Harmonics					11b modulation, 1Mbps, BW = 1MHz; P_{OUT} = 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_{CC} = 3.3V to 4.2V; LNA_EN = V_{CTRL}= V_{CC} -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_{DD} tied to V_{BATT} at all times
LNA Current		8	13	mA	
Gain					
Receive	11	13	15	dB	LNA ON; V_{CC} = 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_{CC}=3.3V to 4.2V; V_{CTRL}= V_{CC} -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_{CC}
Switch Control Current		10	100	µA	Per control line
Enable Control Current		60	100	µA	PA_EN, LNA_EN, Over V_{CC}, 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

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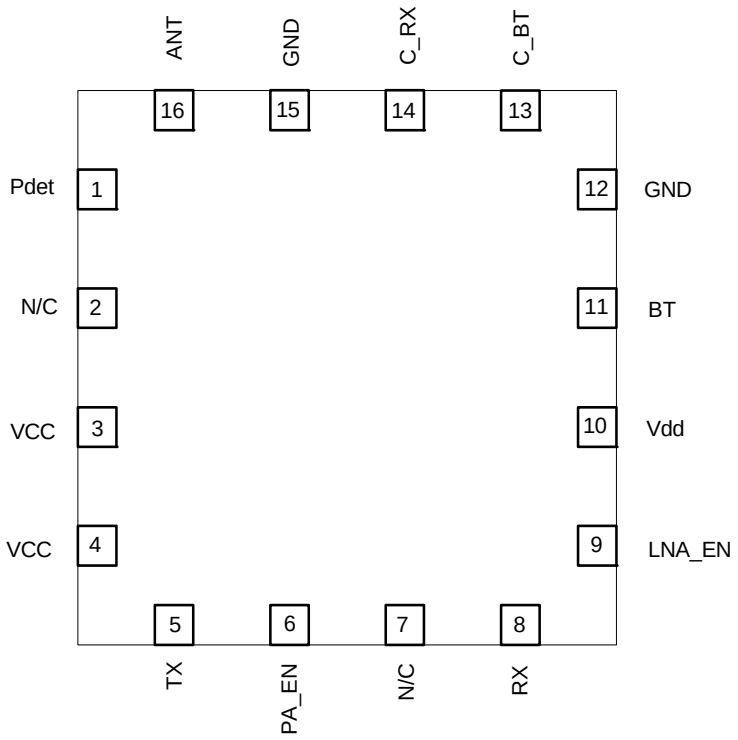
RFFM8200 Control Logic

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



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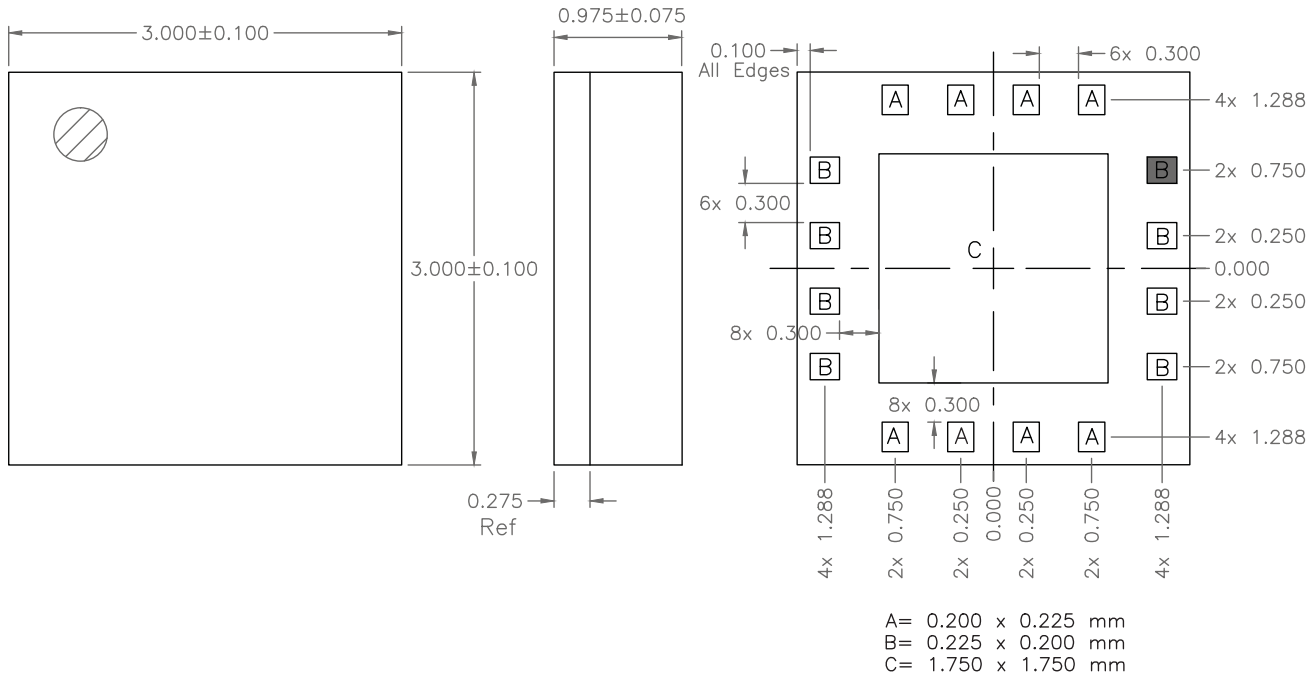
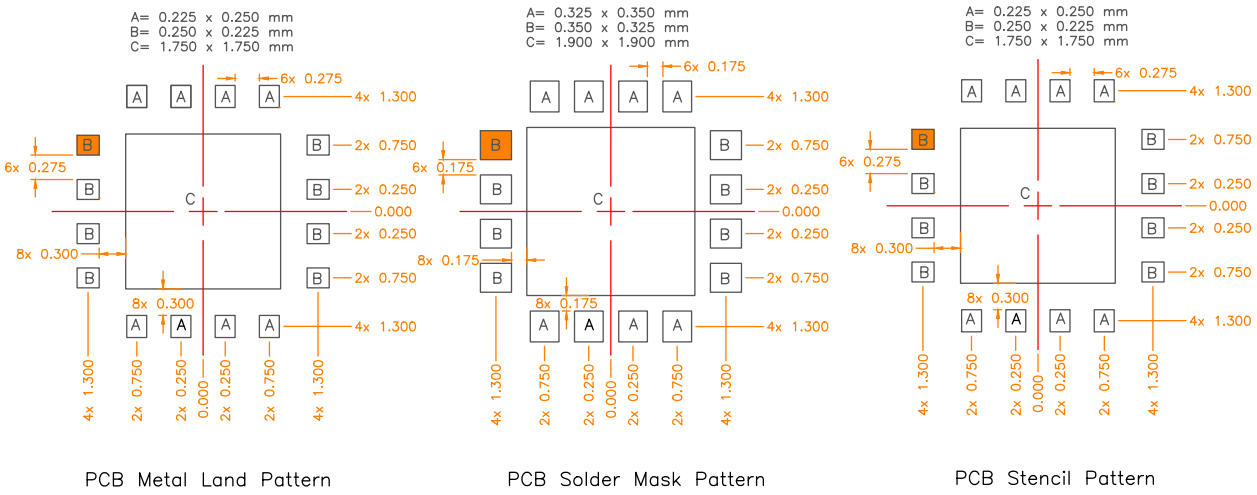
Package Drawing



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).

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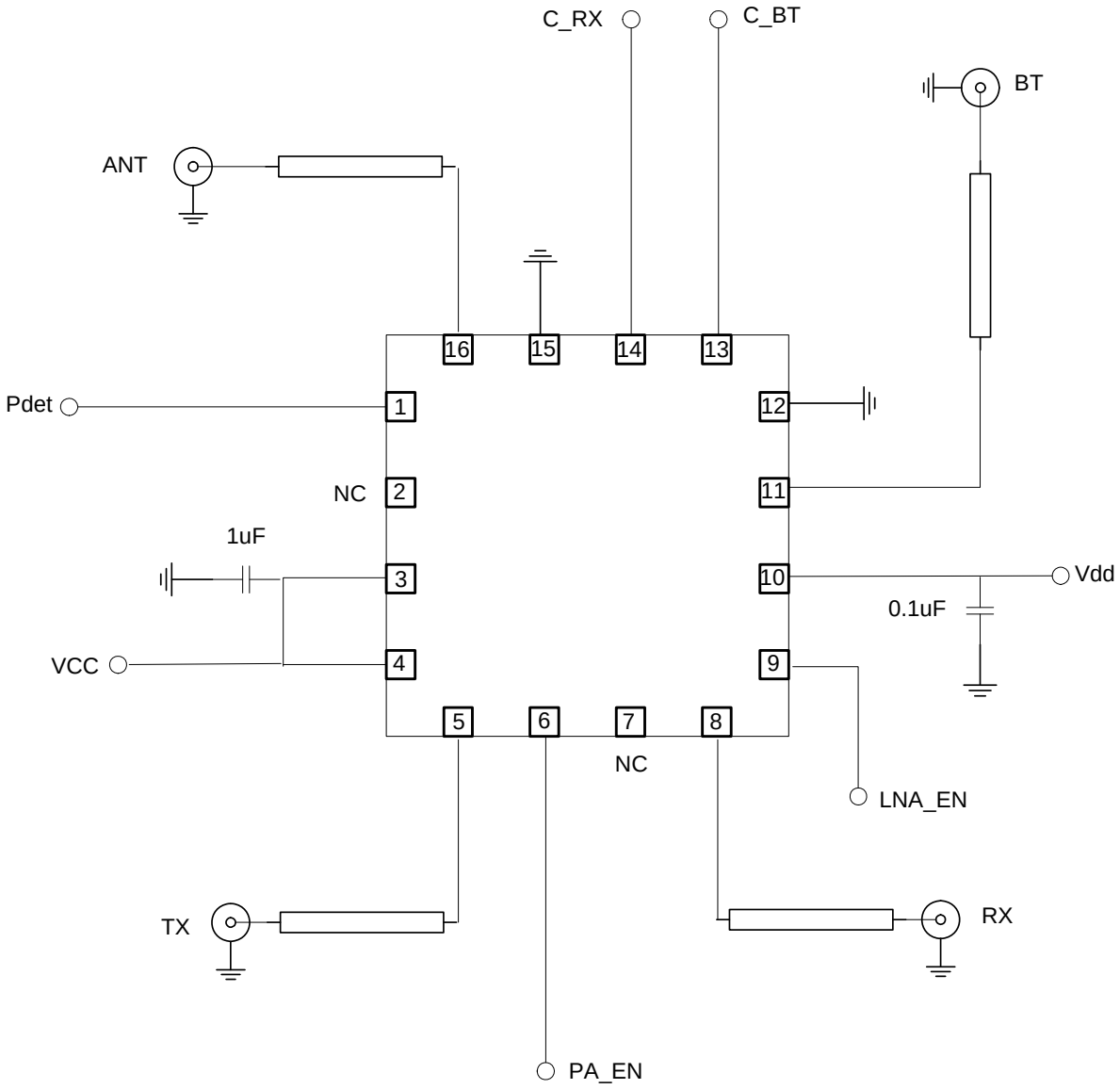
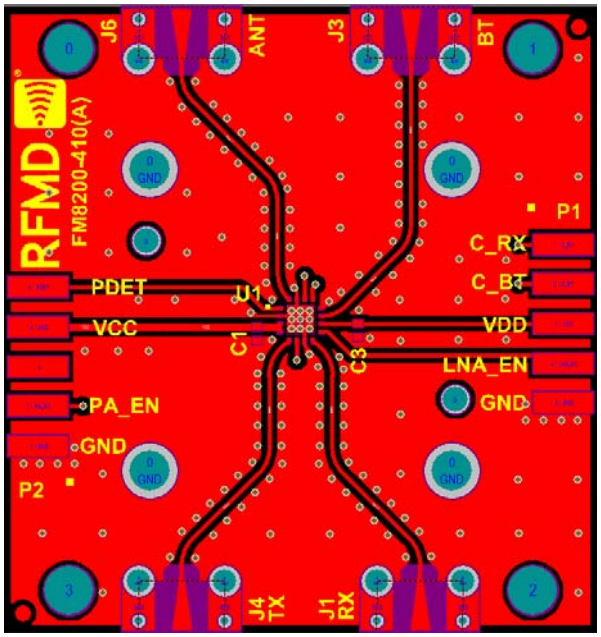
Applications Schematic



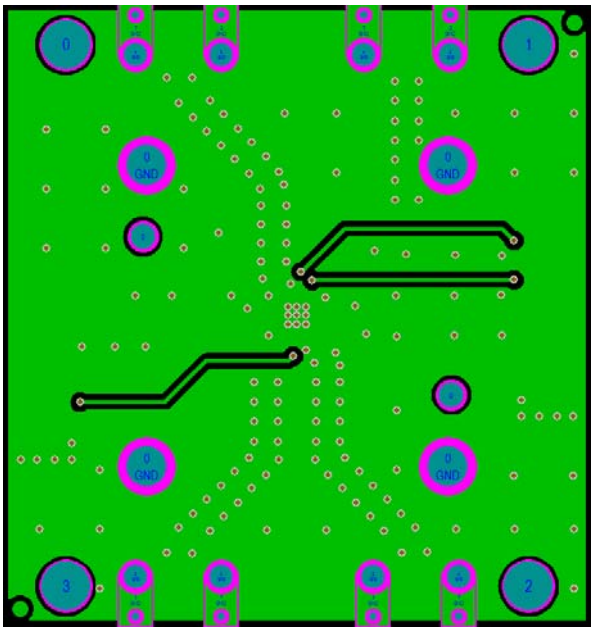
Note: Pins 2, 7, 12 and 15 are not connected internally. These pins can be left floating or grounded. It is recommended to follow RFMD evaluation board layout.

Evaluation Board Layers

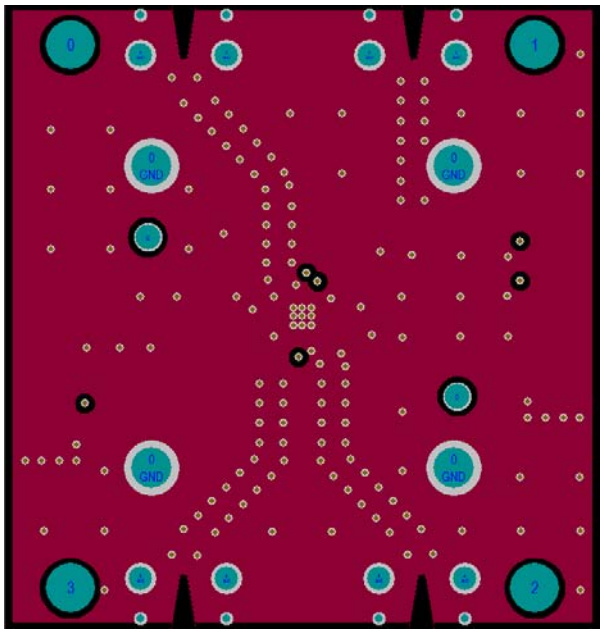
Top



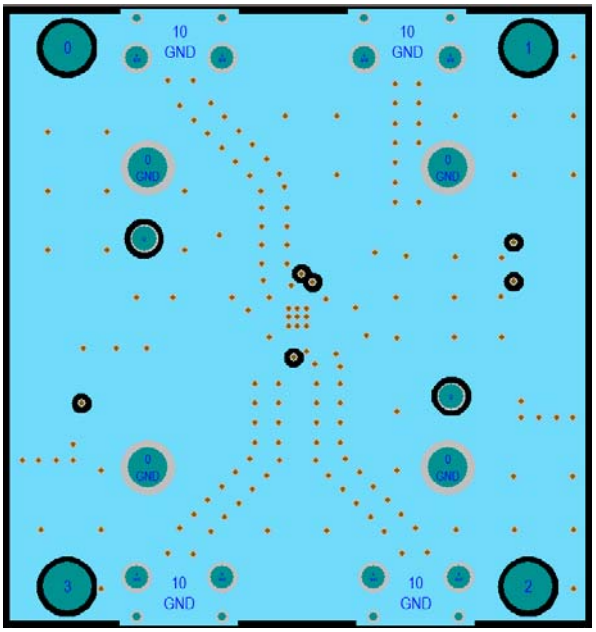
Bottom



Mid Layer1



Mid Layer2



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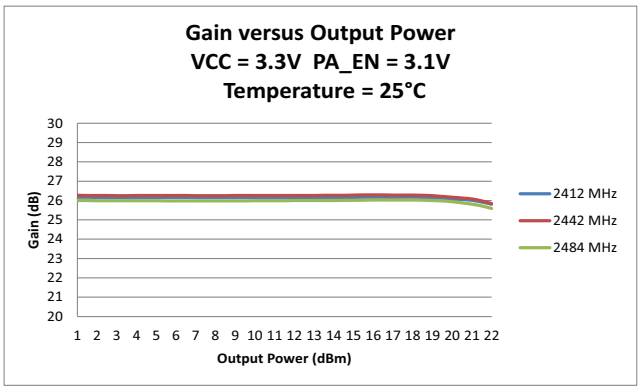
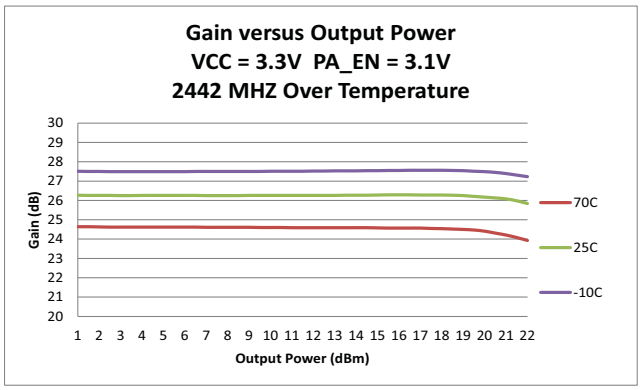
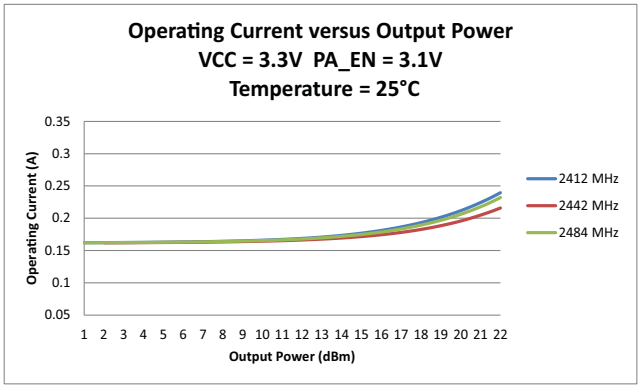
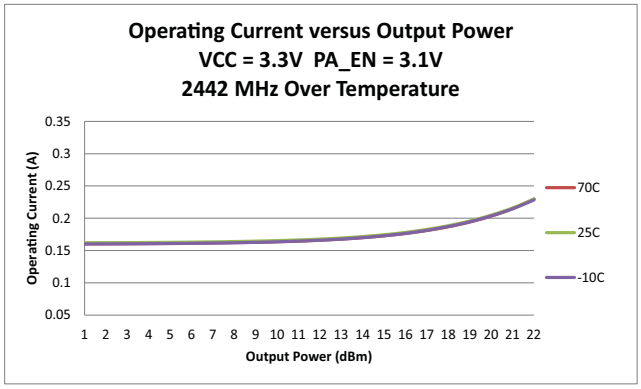
RFFM8200 Transmit Performance Plots

802.11n MCS7 HT20 Performance Plots



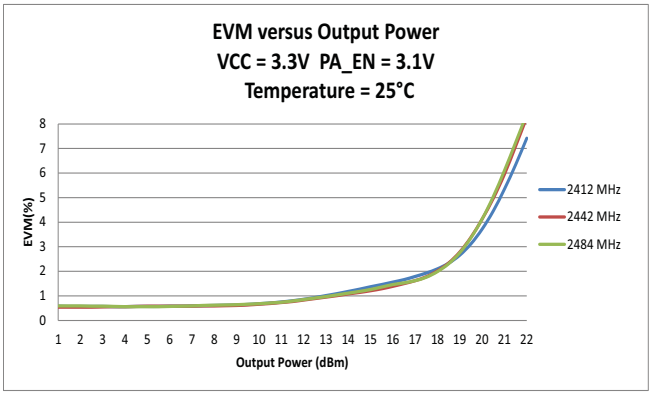


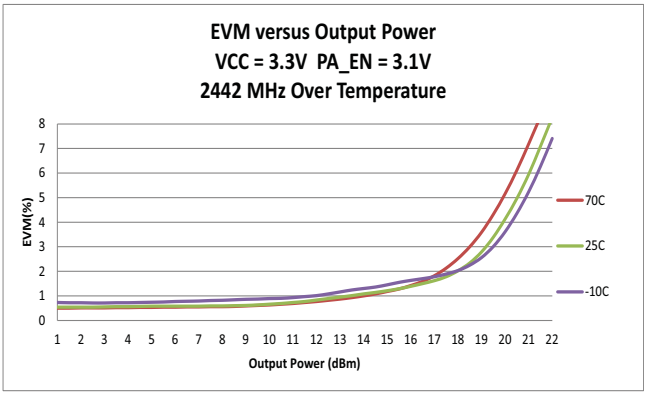


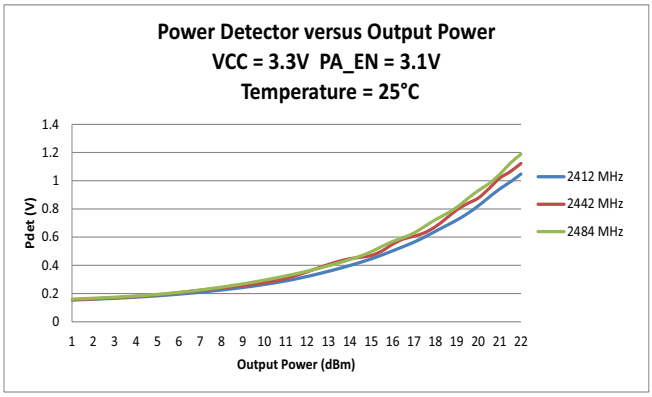


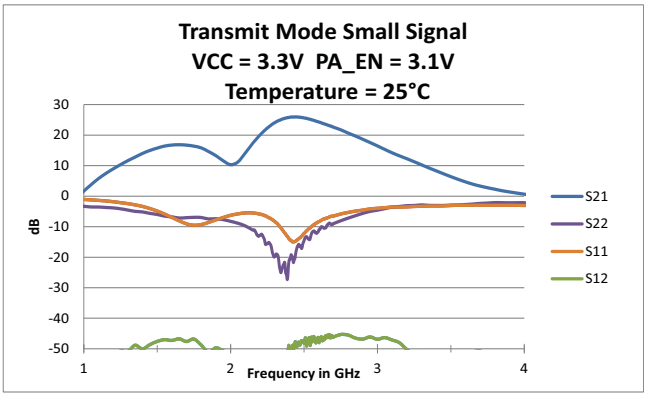
RFFM8200 Transmit Performance Plots

802.11n MCS7 HT20 Performance Plots









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RFFM8200 Receive and Bluetooth Performance Plots