RFFM4203

3.0V TO 5.0V, 2.4GHz TO 2.5GHz 802.11b/g/n/ac WiFi FRONT END MODULE

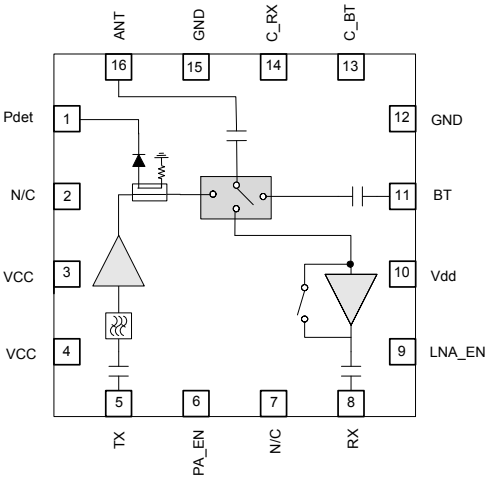
Package: Laminate, 16-pin, 3mm x 3mm x 1.05mm

Features

- Integrated 2.4GHz to 2.5GHz b/g/n/ac Amplifier, LNA with Bypass Mode, SP3T Switch, and Power Detector Coupler
- Single Supply Voltage 3.0V to 5V
- P_{OUT} = 21.5dBm, 5V <3% Dynamic EVM
- P_{OUT} = 19dBm, 3.3V <3% Dynamic EVM

Applications

- IEEE802.11b/g/n/ac WiFi Applications
- 2.4GHz to 2.5GHz ISM Band Solutions
- Portable Battery-Powered Equipment
- WiFi Access Points, Gateways, and Set Top Boxes



Functional Block Diagram

Product Description

The RFFM4203 provides a complete integrated solution in a single front end module (FEM) for WiFi 802.11b/g/n/ac 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 RFFM4203 integrates a 2.4GHz to 2.5GHz 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 1.05mm, 16-pin package. This module meets or exceeds the RF front end needs of IEEE 802.11b/g/n/ac WiFi RF systems.

Ordering Information

RFFM4203SB	5-Piece sample bag
RFFM4203SQ	25-Piece sample bag
RFFM4203SR	100-Piece reel
RFFM4203TR7	2500-Piece reel
RFFM4203PCK-410	RFFM4203 Eval 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	

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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 Case Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C
Maximum Tx Input Power into 50Ω Load	+10	dBm
Maximum Rx Input Power for both High Gain and Bypass Modes (No Damage)	+10	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.

RFMD Green: RoHS compliant per EU Directive 2011/65/EU, 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.

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Typical Conditions 3.3V					Temperature = -10°C to +70°C, V_{CC} = 3.3V, PA_EN = high, P_{OUT} = 19dBm using a IEEE802.11n MCS7 waveform unless otherwise noted.
Tx Performance - 11g/n/ac					Compliance with standard 802.11g/n/ac
Frequency	2412		2484	MHz	
802.11n Output Power	18.5	19		dBm	802.11n HT20 and HT40 MCS7 at 25°C
11n Dynamic EVM		2.5	3	%	
		-32	-30.5	dB	
802.11ac Output Power	16.5	17		dBm	802.11ac HT40 MCS9 at 25°C
11ac Dynamic EVM			1.8	%	
			-35	dB	
Tx Performance - Spectral Mask					
802.11n Output Power		21		dBm	802.11n HT20 and HT40 MCS7 at 25°C
802.11b Output Power		24		dBm	Meet 802.11b DSSS 1Mbps Spectral Mask
General Tx Performance					
Second Harmonic		-24	-20	dBm/MHz	At P_{OUT} = 19dBm
Third Harmonic		-50	-42	dBm/MHz	
Gain	25	27	29	dB	
Gain Variation Over Temp	-2		+2	dB	
Power Detect Voltage	0.11	0.125	.014	V	RF = off
	0.7	0.8	0.9	V	At rated P_{OUT}
Power Detect Accuracy	-2.0		+2.0	dB	Into 3:1 VSWR load at 25°C
Input Return Loss - Tx_in pin		-13	-10	dB	In specified frequency band
Output Return Loss at ANT pin		-15	-10	dB	
Operating Current		210	230	mA	At rated P_{OUT} 19dBm
		195	215	mA	At rated P_{OUT} 17dBm
Quiescent Current		170		mA	Nominal conditions; no RF applied
Leakage Current		2	10	µA	V_{CC} = 3.3V, PA_EN = low, C_RX = low, LNA_EN = low
Power Added Efficiency		10.5		%	Nominal conditions
Power Supply - V_{CC}	3.0	3.3	3.6	V	
$V_{CONTROL}$ High (PA_EN, C_RX, C_BT, LNA_EN)	2.8	3	V_{CC}	V	
$V_{CONTROL}$ Low (PA_EN, C_RX, C_BT, LNA_EN)	0		0.2	V	

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Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Typical Conditions 3.3V (continued)					Temperature = -10°C to +70°C, V_{CC} = 3.3V, PA_EN = high, P_{OUT} = 19dBm using a IEEE802.11n MCS7 waveform unless otherwise noted.
Turn-on time from PA_EN edge			500	ns	Output stable to within 90% of final gain
Turn-off time from PA_EN edge			500	ns	
Stability	-25		24	dBm	No spurs above -47dBm into 4:1 VSWR
CW P1dB	26	27		dBm	Tx mode in 50% Duty Cycle
Rx Performance					Temperature = -10°C to +70°C, V_{DD} = 3.3V, C_RX = high, LNA_EN = high
Gain	11	13	15	dB	
NF		2.3	3	dB	In specified frequency band
RX Port Return Loss			-9.6	dB	
ANT Port Return Loss			-4	dB	
Input IP3	4	8		dBm	
Input P1dB	-6	-2		dBm	
I_{DD}		10	15	mA	
LNA_EN Control Current		30	50	µA	
Rx Bypass Mode					Temperature = -10°C to +70°C, V_{DD} = 3.3V, C_RX = high, LNA_EN = low
Insertion Loss	-8.5	-7.5	-6.5	dB	
RX Port Return Loss			-9.6	dB	
ANT Port Return Loss			-4	dB	
Input IP3	4	8		dB	
Input P1dB	-6	-2		dBm	
Typical Conditions 5.0V					Temperature = -10°C to +70°C, V_{CC} = 5.0V, PA_EN = high, P_{OUT} = 21.5dBm using a IEEE802.11n MCS7 waveform unless otherwise noted.
Tx Performance - 11g/n/ac					Compliance with standard 802.11g/n/ac
Frequency	2412		2484	MHz	
802.11n Output Power	21	21.5		dBm	802.11n HT20 and HT40 MCS7 at 25°C
11n Dynamic EVM		2.5	3	%	
		-32	-30.5	dB	
802.11ac Output Power	17	18		dBm	802.11ac HT40 MCS9 at 25°C
11ac Dynamic EVM			1.8	%	
			-35	dB	
Tx Performance - Spectral Mask					
802.11n output power		22		dBm	802.11n HT20 and HT40 MCS7 at 25°C
802.11b output power		26		dBm	Meet 802.11b DSSS 1Mbps spectral mask

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
Typical Conditions 5.0V (continued)					Temperature = -10°C to +70°C, V_{CC} = 5.0V, PA_EN = high, P_{OUT} = 21.5dBm using a IEEE802.11n MCS7 waveform unless otherwise noted.
General Tx Performance					
Second Harmonic		-20	-18	dBm/MHz	P_{OUT} = 21.5dBm
Third Harmonic		-43	-38	dBm/MHz	
Gain	25	27	29	dB	
Gain variation over Temp	-2		+2	dB	
Power Detect Voltage	0.14	0.16	0.18	V	P_{OUT} = 0dBm and also when RF = off
Power Detect Accuracy	-2		+2	dB	Into 3:1 VSWR load at 25°C
Power Detect Voltage	0.95	1.05	1.20	V	P_{OUT} = 21.5dBm
Input Return Loss - Tx_in pin		-13	-10	dB	In specified frequency band
Output Return Loss at ANT pin		-15	-10	dB	
Operating Current		260	290	mA	At rated 11n P_{OUT}
		230	260	mA	At rated P_{OUT} 19dBm
Quiescent Current		190		mA	Nominal conditions; no RF applied
Leakage Current		2	10	µA	V_{CC} = 5V, PA_EN = low, C_RX = low, LNA_EN = low at 25°C
$V_{CONTROL}$ High (PA_EN, C_BT, C_RX, LNA_EN)	2.8	2.9	5.0	V	
$V_{CONTROL}$ Low (PA_EN, C_BT, C_RX, LNA_EN)	0		0.2	V	
Turn-on time from PA_EN edge			500	ns	Output stable to within 90% of final gain
Turn-off time from PA_EN edge			500	ns	
Stability	-25		24	dBm	No spurs above -47dBm into 4:1 VSWR
CW P1dB	28.5	29.5		dBm	Tx mode in 50% duty cycle
Rx Performance					Temperature = -10°C to +70°C, V_{DD} = 5.0V, C_RX = high, LNA_EN = high
Gain	11.5	14	16	dB	
NF		2.3	3.0	dB	In specified frequency band
RX Port Return Loss			-9.6	dB	
ANT Port Return Loss			-4	dB	
Input IP3	4	8		dBm	
Input P1dB	-6	-2		dBm	
I_{DD}		10	20	mA	
LNA_EN Control Current		30	50	µA	
Rx Bypass Mode					Temperature = -10°C to +70°C, V_{DD} = 5.0V, C_RX = high, LNA_EN = low
Insertion Loss	-8.5	-7.5	-6.5	dB	
RX Port Return Loss			-9.6	dB	
ANT Port Return Loss			-4	dB	
Input IP3	4	8		dB	
Input P1dB	-6	-2		dBm	

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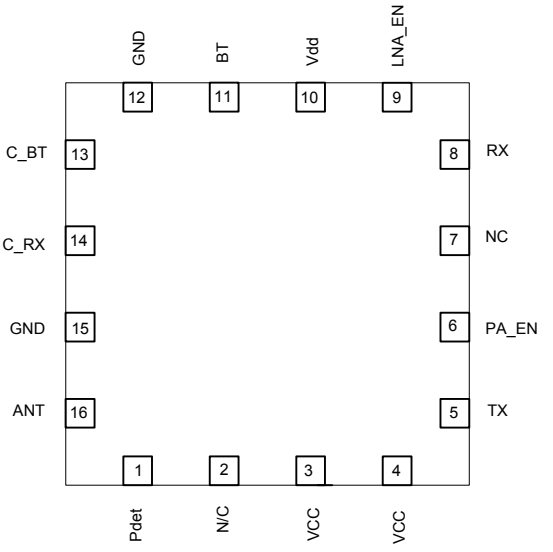
Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
General Performance 3.3V and 5.0V					
Control Current					
C_RX and C_BT Current		0.5	1	µA	
PA_EN Current		30	50	µA	
Switch Control Speed			200	ns	
PA_EN Control Impedance		5.2		MΩ	
LNA_EN Control Impedance		7.4		MΩ	
C_RX Control Impedance		27		MΩ	
C_BT Control Impedance		27		MΩ	
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
Thermal Resistance					
R_{TH_I}		46		°C/W	
Junction Temperature T_J		170		°C	MTTF > 30 years
Maximum Input Power			12	dBm	Into 50Ω, V_{CC} = 3.3V, 25°C
Maximum Input Power			12	dBm	6:1 VSWR, V_{CC} = 3.3V, 25°C
Maximum Input Power			5	dBm	10:1 VSWR, V_{CC} = 3.3V, 25°C
Bluetooth (Both 3.3V and 5.0V)					Temperature = -10°C to +70°C, V_{DD} = 3.3V, 5.0V, C_BT = high, unless otherwise noted.
Input/Output Power	25	30		dBm	
Insertion Loss		0.7	0.9	dB	
BT Port Return Loss			-9.6	dB	
ANT Port Return Loss			-9.6	dB	
Isolation					
ANT-BT; Tx Mode		18		dB	PA_EN = High, C_BT = Low, C_RX = Low, LNA_EN = Low
ANT-BT; Rx Gain Mode		25		dB	PA_EN = Low, C_BT = Low,C_RX = High, LNA_EN = High
ANT-BT; Rx Bypass Mode		20		dB	PA_EN = Low, C_BT = Low, C_RX = High, LNA_EN = Low
ANT-RX; Tx Mode		35		dB	PA_EN = High, C_BT = Low, C_RX = Low, LNA_EN = Low
ANT-RX; BT Mode		25		dB	PA_EN = Low, C_BT = High, C_RX = Low, LNA_EN = Low
ANT Port Return Loss			-9.6	dB	

Switch Logic Control

Operating Mode	PA_EN	LNA_EN	C_RX	C_BT
Standby	Low	Low	Low	Low
802.11b/g/n/ Tx	High	Low	Low	Low
802.11b/g/n/ Rx Gain	Low	High	High	Low
802.11b/g/n/ Rx Bypass	Low	Low	High	Low
BT Rx/ Tx	Low	Low	Low	High

Note: High = 2.8V to V_{CC}, Low = 0V to 0.2V.

Pin Out



Pin Names and Description

Pin	Name	Description
1	PDET	Power detector voltage for Tx section. PDET voltage varies with output power. May need external decoupling 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 802.11b/g/n PA. Input is matched to 50Ω and DC block is provided internally.
6	PA_EN	Control voltage for the PA and Tx switch. See truth table for proper settings.
7	NC	No connect pin.
8	RX	RF output port for the 802.11b/g/n 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. 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 internally.
12	GND	Ground connection.
13	C_BT	Bluetooth® switch control pin. See Truth Table for proper level.
14	C_RX	Receive switch control pin. See Switch Truth Table for proper level.
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, i.e., PCB vias under the device are recommended.

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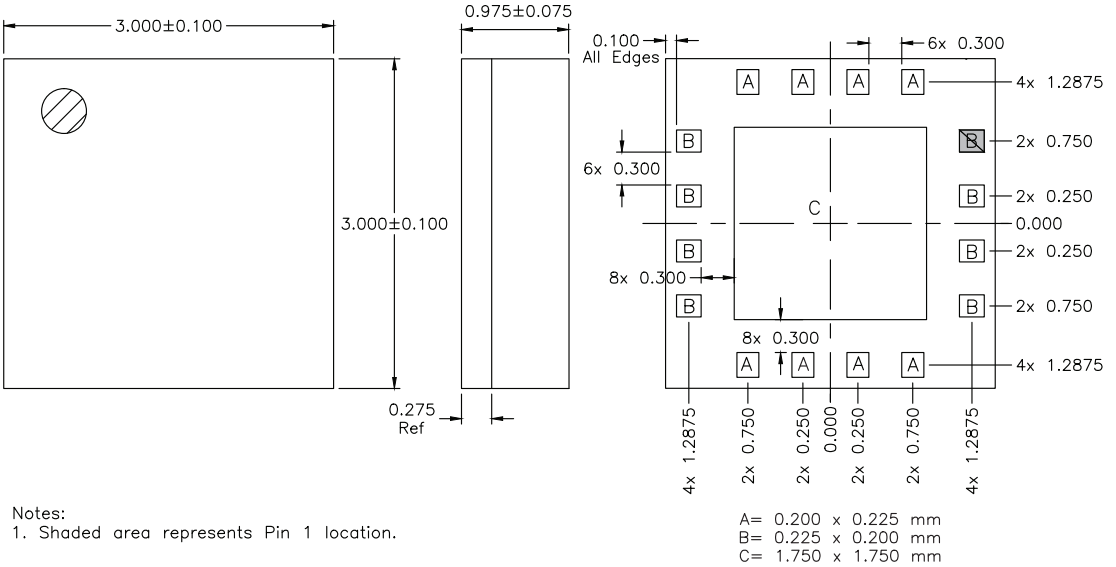
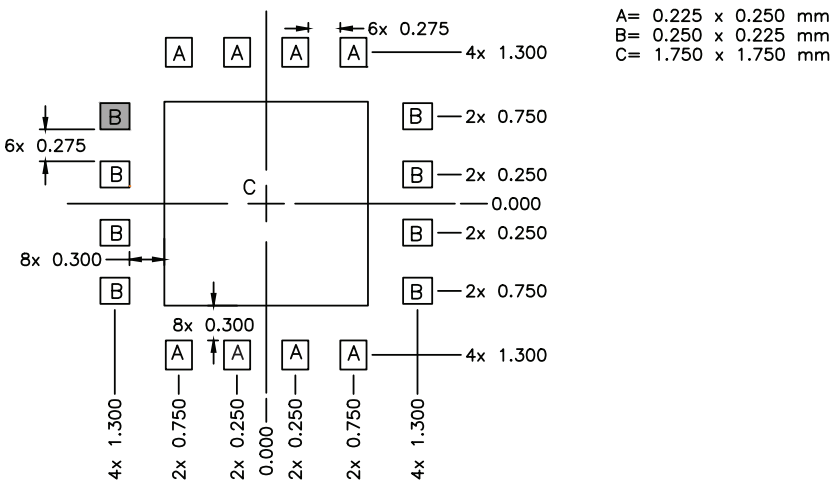
Package Drawing



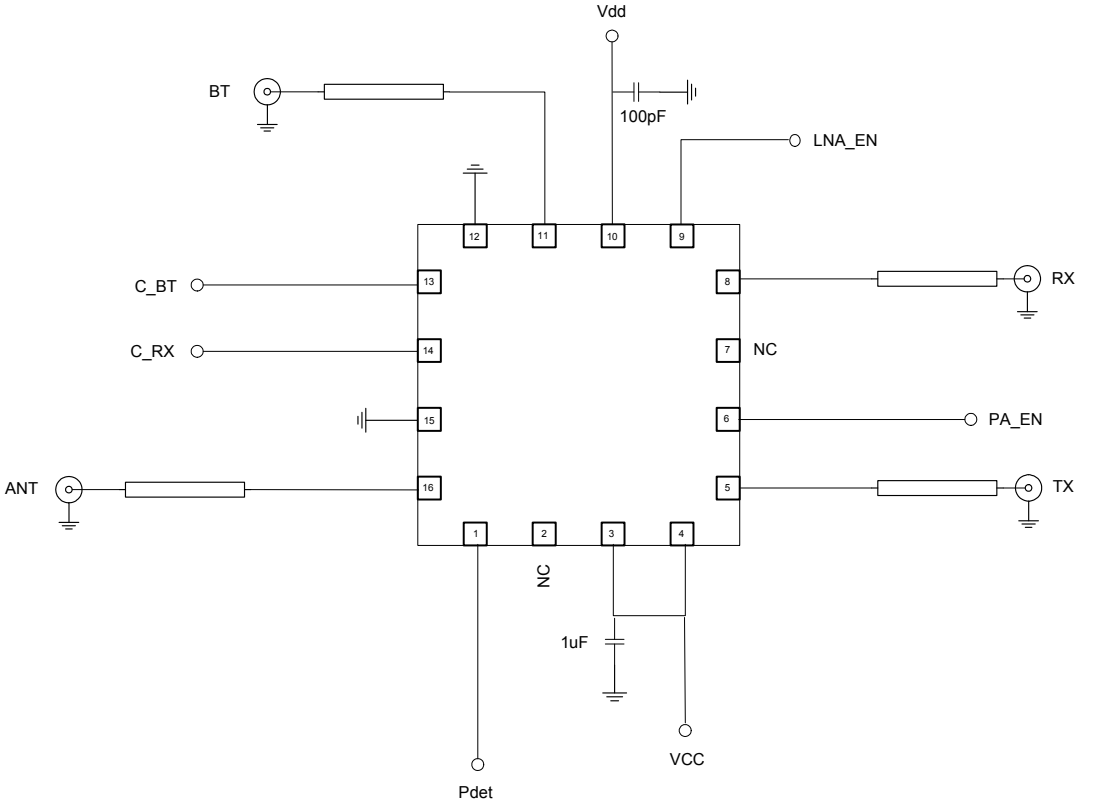
Notes:
1. Shaded area represents Pin 1 location.

RFFM4203 PCB Footprint and Stencil Recommendations



Notes:
1. Shaded area represents Pin 1 location.
2. Example of the number and size of vias can be found on the RFMD evaluation board layout.

Applications Schematic



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