



RFFM8228P

Wi-Fi Front End Module

Product Overview

The Qorvo® RFFM8228P is an integrated front end module (FEM) designed for Wi-Fi 802.11a/n/ac systems. The compact form factor and integrated matching minimizes layout area in the application.

Performance is focused on a balance of efficiency versus linear power that increases the range and throughput of connections. Control lines are reduced to a two pin scheme.

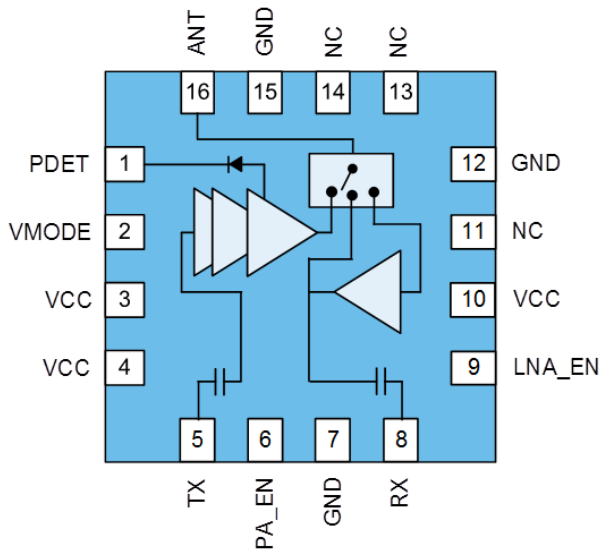
Integrated die level filtering for 2nd and 3rd harmonics are included.

The RFFM8228P integrates a 2.4 GHz power amplifier (PA), single pole three throw switch (SP3T) and low noise amplifier (LNA) into a single device.



16 Pin 2.3x2.3 mm QFN Package

Functional Block Diagram



Top View

Key Features

- 2412 – 2484 MHz
- P_{OUT} = +17.5dBm MCS8/9 VHT40 -35dB Dynamic EVM
- P_{OUT} = +19dBm MCS7 HT20/40 -30dB Dynamic EVM
- P_{OUT} = +20dBm 802.11g -28dB Dynamic EVM
- P_{OUT} = +23dBm 802.11b Spectral Mask Compliance
- Optimized for +3.3 V Operation
- Low Power Mode Enabled
- 28 dB Tx Gain
- 2.4 dB Noise Figure
- 15 dB Rx Gain & 1.5 dB Bypass Loss
- Integrated DC Power Detector

Applications

- Access Points
- Wireless Routers
- Residential Gateways
- Set-Top Boxes
- Customer Premise Equipment
- Internet of Things

Ordering Information

Part Number	Description
RFFM8228PSB	Sample bag with 5 pieces
RFFM8228PSQ	Sample bag with 25 pieces
RFFM8228PSR	7" reel with 100 pieces
RFFM8228PTR7	7" reel with 2,500 pieces
RFFM8228PTR13	13" reel with 10,000 pieces
RFFM8228PPCK410	Assembled Evaluation Board + 5 pcs

Absolute Maximum Ratings

Parameter	Conditions	Rating
DC Supply Voltage		-0.5 to +6 V
Control Voltage		-0.5 to +V _{CC} V
Storage Temperature		-40 to 150 °C
Junction Temperature	MTTF > 0.7 x10 ⁶ hours MTTF > 1.0 x10 ⁶ hours	160 °C 150 °C
RF Input Power at TX_IN	Into 50 Ω Load for 802.11b/g/n/ac (No Damage), Transmit Mode	+12 dBm
RF Input Power at ANT	(No Damage), Receive LNA On Mode	+5 dBm
RF Input Power at ANT	(No Damage), Receive Bypass Mode	+25 dBm

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.

Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Units
Operating Frequency	2412		2484	MHz
Device Voltage (V _{CC} & V _{DD})	+3	+3.3	+4.2	V
Control Voltage – High (PA_EN, LNA_EN & VMODE)	+2.8	+2.95	V _{CC}	V
Control Voltage – Low (PA_EN & LNA_EN & VMODE)	0		+0.2	V
T _{OPERATING} *	-40		+85	°C

Electrical specifications are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions. * T_{OPERATING} is temperature at package ground.

Electrical Specifications

Parameter	Conditions	Min.	Typ.	Max.	Units
TRANSMIT (TX-ANT) HIGH POWER	Unless otherwise noted: V_{CC}=3.3V, T=+25°C, PA_EN=High, LNA_EN=Low				
11ac VHT20/40 Output Power	MCS8/9 256QAM	17.5	18		dBm
Dynamic EVM				-35	dB
11n HT20/40 Output Power	MCS7 64QAM	18	19		dBm
				-30	dB
11g Output Power	OFDM 54Mbps	19	20		dBm
Dynamic EVM				-28	dB
Margin to HT20 Spectral Mask	P _{OUT} = +21 dBm, 11n MCS0		4	0	dBc
Margin to 802.11b Spectral Mask	P _{OUT} = +23 dBm, DSSS 1 Mbps		3	0	dBc
Gain		27	28		dB
Gain Flatness	Across any 40 MHz Channel	-0.25		+0.25	dB
TX Port Return Loss			15		dB
ANT Port Return Loss			15		dB
Quiescent Current	RF Off		120	150	mA
Operating Current	P _{OUT} = +17.5 dBm		190	210	mA
	P _{OUT} = +23 dBm		290	315	mA



RFFM8228P

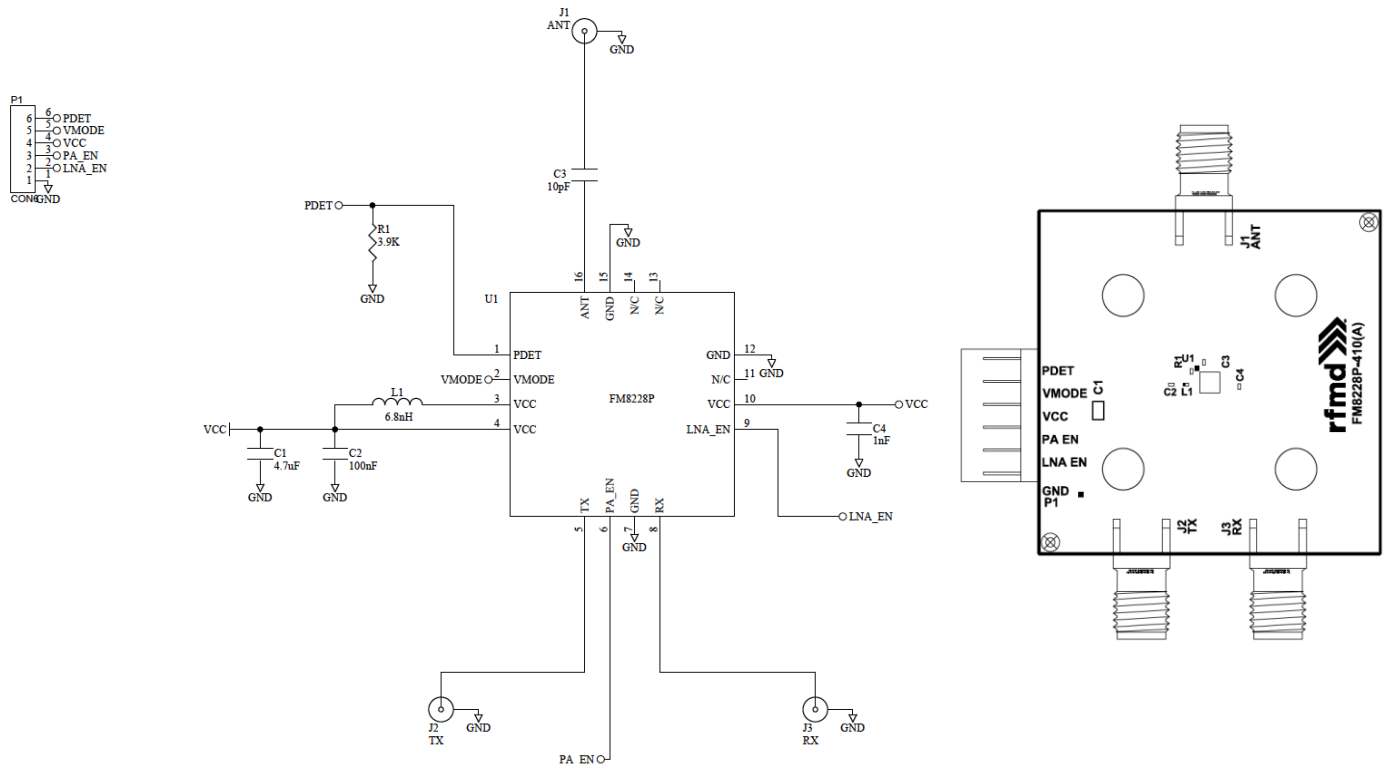
Wi-Fi Front End Module

Parameter	Conditions	Min.	Typ.	Max.	Units
2 nd Harmonics	P _{OUT} = +23 dBm 802.11b 1 Mbps		-15	-13	dBm/MHz
3 rd Harmonics	P _{OUT} = +23 dBm 802.11b 1 Mbps		-35	-32	dBm/MHz
ANT-RX Isolation		35	40		dB
DC Power Detect Voltage	RF Off		0.15		V
	P _{OUT} = +19 dBm		0.55		V
	P _{OUT} = +23dBm		0.80		V
TRANSMIT (ANT-RX) LOW POWER	Unless otherwise noted: V_{CC}=3.3V, T=+25°C, PA_EN=High, LNA_EN=High				
11ac VHT20/40 Output Power	MCS8/9 256QAM	9	11		dBm
Dynamic EVM				-35	dB
Gain			27		dB
Gain Flatness		-0.25		+0.25	dB
TX Port Return Loss			10		dB
ANT Port Return Loss			15		dB
Operating Current	P _{OUT} = +11 dBm		125		mA
	P _{OUT} = +17.5 dBm		175		mA
RECEIVE (ANT-RX) LNA ON MODE	Unless otherwise noted: V_{CC}=3.3V, T=+25°C, PA_EN=Low, LNA_EN=High				
Gain		14	15		dB
Gain Flatness Across any 40 MHz Channel		-0.25		+0.25	dB
Noise Figure			2.4	2.7	dB
RX Port Return Loss			10		dB
ANT Port Return Loss			15		dB
Input P _{1dB}		-8	-6		dBm
Input IP3			+5		dBm
Rx Operating Current			9		mA
RECEIVE (ANT-RX) BYPASS MODE	Unless otherwise noted: V_{CC}=3.3V, T=+25°C, PA_EN=Low, LNA_EN=Low				
Bypass Loss			1.5	2	dB
Loss Flatness Across any 40 MHz Channel		-0.1		+0.1	dB
RX Port Return Loss			12		dB
ANT Port Return Loss			20		dB
Input P _{1dB}		+16	+18		dBm
Input IP3			+30		dBm
GENERAL SPECIFICATIONS	Unless otherwise noted: V_{CC}=3.3V, T=+25°C				
FEM Leakage Current			5	10	μA
PA_EN Control Current - High			300	500	μA
LNA_EN Control Current - High			60	100	μA
TX Output P _{1dB}	CW		+27		dBm
Ramp ON/OFF Time	10<->90% Ref from Control Voltage to RF Power		200		nS
PA Stability - Output VSWR	CW No Spurious above -41.25dBm/MHz		4:1		
Output Power Range		0		25	dBm
Thermal Resistance, θ _{JC}	Junction to case, MCS0 P _{OUT}		45		°C/W

Logic Truth Table

Mode	PA_EN	LNA_EN
Transmit – High Power	High	Low
Transmit – Low Power	High	High
LNA On	Low	High
Bypass	Low	Low

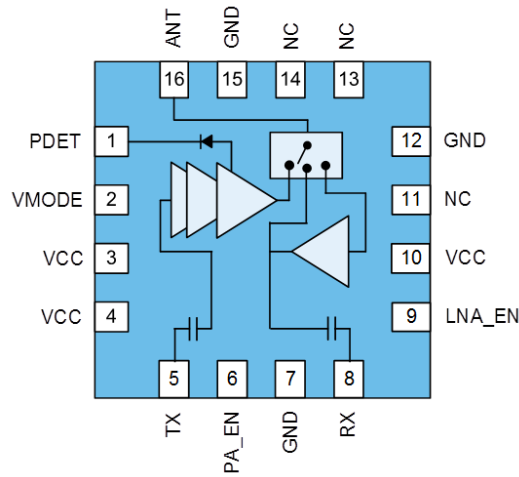
Evaluation Board Schematic and Layout



Bill of Material

Ref. Des.	Value	Description	Manuf.	Part number
-	-	Printed Circuit Board		
U1	-	2.4GHz Wi-Fi Front End Module	Qorvo	RFFM8228P
C4	1000 pF	Capacitor, Chip, 10%, 25V, X7R, 0201	Samsung E-M	CL03B102KA3NMMC
C1	4.7 μ F	Capacitor, Chip, +80%/-20%, 10V, Y5V, 0805	Taiyo Yuden	CE LMK212 F475ZG-T
C3	10 pF	Capacitor, Chip, +/-0.5pF, 25V, C0G, 0201		
C2	0.1 μ F	Capacitor, Chip, 10%, 6.3V, X5R, 0201		
R1	3.9K Ω	Resistor, Chip, 5%, 1/20W, 0201	Kamaya, Inc	RMC1/20-392JPA15
L1	1.8 nH	Inductor, Chip, 5%, M/L, 0201	Taiyo Yuden	LG HK 0603 6N8J-T

Pin Configuration and Description

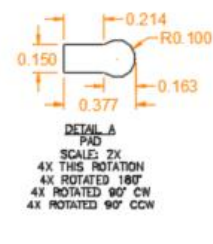
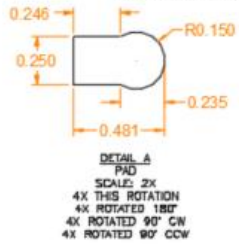
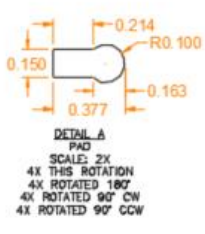
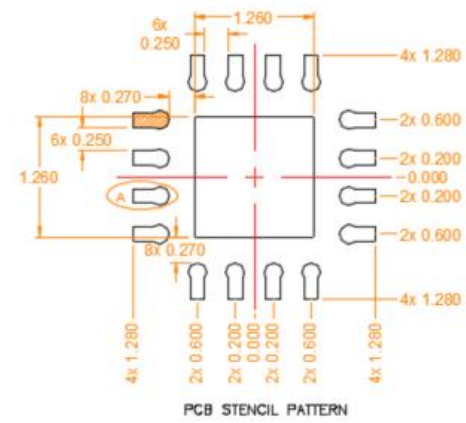
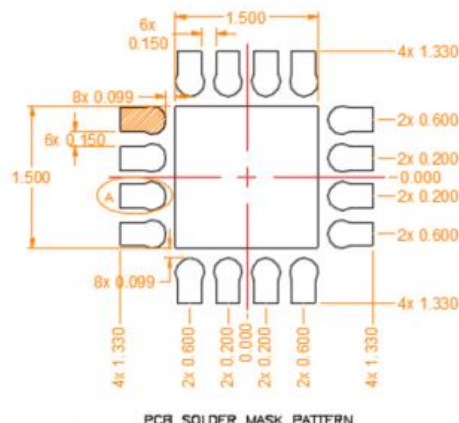
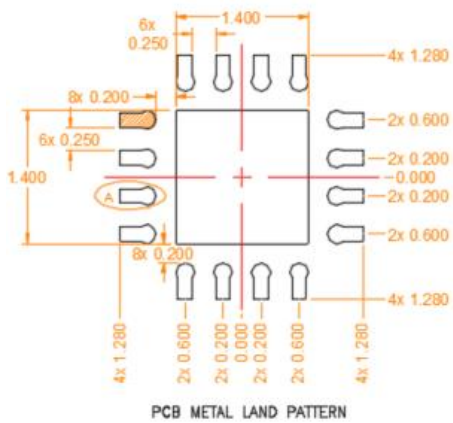
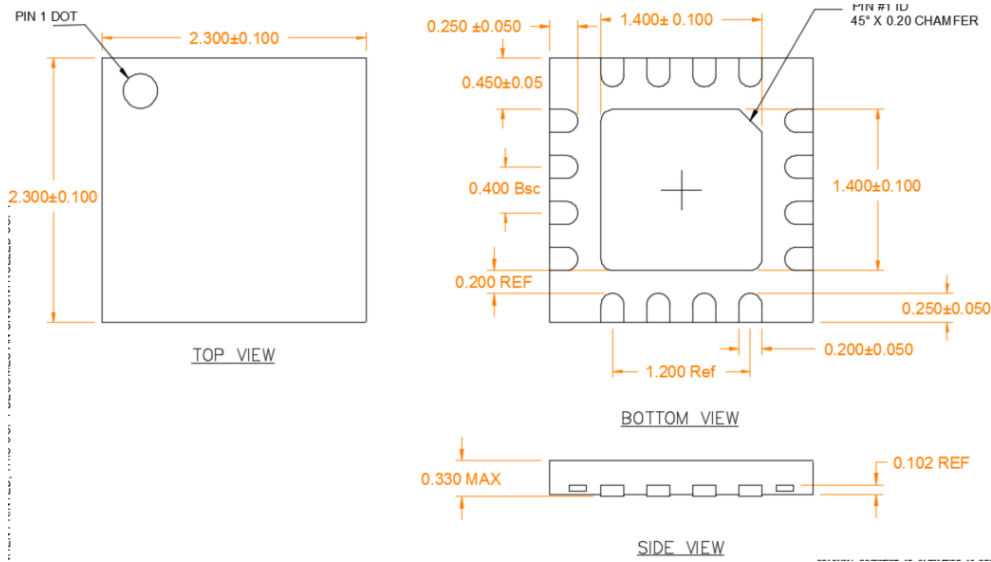


Top View

Pin Number	Label	Description
1	PDET	DC power detector. Provides an output voltage proportional to the RF output power level
2	VMODE	High/low power mode control voltage. It may be left floating for nominal conditions in high power mode. Applying 2.8V or greater enables low power mode.
3	VCC	1 st and 2 nd stage supply voltage
4	VCC	3 rd stage supply voltage
5	TX	RF input. Internally matched to 50 Ω and DC Blocked.
6	PA_EN	Input enable bias voltage (Regulated internally)
7	GND	Ground connection.
8	RX	RF output from the low noise amplifier or bypass. Internally matched to 50 Ω and DC blocked.
9	LNA_EN	LNA enable bias voltage
10	VCC	LNA and regulator supply voltage
11	NC	No electrical connection. It may be left floating or connected to ground.
12	GND	Ground connection.
13	NC	No electrical connection. It may be left floating or connected to ground.
14	NC	No electrical connection. It may be left floating or connected to ground.
15	GND	Ground connection.
16	ANT	RF bi-directional antenna port. Internally matched to 50 Ω . An external DC block is required.
Backside Paddle	GND	RF/DC ground. Use recommended via pattern to minimize inductance and thermal resistance. See PCB Mounting Pattern for suggested footprint.

Mechanical Information

Dimensions and PCB Mounting Pattern



Thermal vias for center slug 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.

Notes:

1. All dimensions are in millimeters. Angles are in degrees.
2. Dimension and tolerance formats conform to ASME Y14.5-2009.
3. The terminal #1 identifier and terminal numbering conform to JESD 95-1 SPP-012.

Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1B	ANSI/ESD/JEDEC JS-001
ESD – Charged Device Model (CDM)	Class C3	JESD22-C101
MSL – Moisture Sensitivity Level	Level 2	IPC/JEDEC J-STD-020



Caution!

ESD sensitive device

Solderability

Compatible with both lead-free (260 °C max. reflow temperature) and tin/lead (245 °C max. reflow temperature) soldering processes.

Package lead plating: Electrolytic plated Au over Ni

RoHS Compliance

This part is compliant with the 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment), as amended by Directive 2015/863/EU.

This product also has the following attributes:

- Lead free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C₁₅H₁₂Br₄O₂) Free
- SVHC Free



Contact Information

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