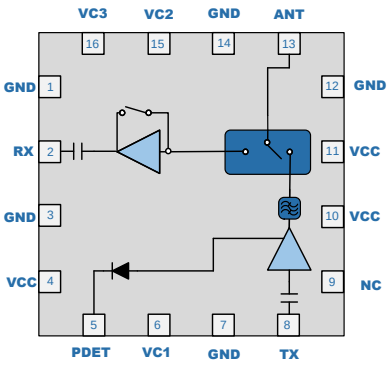
RFFM8515

4.9GHz to 5.85GHz 802.11a/n/ac WiFi Front End Module

The RFFM8515 provides a complete integrated solution in a single front end module (FEM) for WiFi 802.11a/n/ac systems. The ultra-small form factor and integrated matching minimizes layout area in the customer's application and greatly reduces the number of external components. This simplifies the total front end solution by reducing the bill of materials, system footprint, and manufacturing cost. The RFFM8515 integrates a 5GHz power amplifier (PA), single pole double throw switch (SP2T), LNA with bypass, and a power detector coupler for improved accuracy. The device is provided in a 2.3mm x 2.3mm x 0.33mm, 16-pin QFN package.



Functional Block Diagram



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

Features

- P_{OUT} = +17.0dBm at 3.3V, 802.11ac 80MHz MCS9 256QAM at 1.8% Dynamic EVM Compliance
- P_{OUT} = +19dBm at 3.3V, 802.11ac 80MHz MCS0 at Spectral Mask Compliance
- Input and Output Matched to 50Ω
- Integrated 5GHz PA, SP2T Switch, LNA, and PDET
- Low Height Package, Suited for Module and Chip On Board (CoB) designs
- Supports low power mode for improved efficiency

Applications

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

Ordering Information

RFFM8515SB	Standard 5-piece sample bag
RFFM8515SQ	Standard 25-piece sample bag
RFFM8515SR	Standard 100-piece on 7 inch diameter reel
RFFM8515TR7	Standard 2500-piece on 7 inch diameter reel
RFFM8515PCK-410	Fully assembled evaluation board w/ 5 pc bag

RF Micro Devices Inc. 7628 Thorndike Road, Greensboro, NC 27409-9421
For sales or technical support, contact RFMD at +1.336.678.5570 or customerservice@rfmd.com.

DS20160429

RF MICRO DEVICES® and RFMD® are trademarks of RFMD, LLC. BLUETOOTH is a trademark owned by Bluetooth SIG, Inc., U.S.A. and licensed for use by RFMD. All other trade names, trademarks, and registered trademarks are the property of their respective owners. ©2013, RF Micro Devices, Inc.

Absolute Maximum Ratings

Parameter	Rating	Unit
DC Supply Voltage (No RF Applied)	6	V
PA Enable Voltage	-0.5 to 5	V_{DC}
DC Supply Current	500	mA
Operating Temperature Range	-40 to +85	ºC
Storage Temperature	-40 to +150	ºC
Maximum TX Input Power into 50Ω Load for 11a/n (No Damage)	+10	dBm
LNA On Maximum RX input power (No damage)	+5	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		
Compliance					**802.11a, 802.11n, 802.11ac**
Operating Frequency	5.18		5.825	GHz	
Extended Frequency	4.9		5.925	GHz	
Operating Temperature	-40		85	ºC	
Power Supply V_{CC}	3.0	3.3	4.2	V	
Extended V_{CC}	3		4.8	V	
Control Voltage-high	2.8	3.1	V_{CC}	V	VC1, VC2, VC3
Control Voltage-low		0	0.2	V	
Transmit (TX-ANT) TX High Power Mode					**T = 25°C, V_{CC} = 3.3V, 50% Duty Cycle unless otherwise noted**
HT80 / HT40 Output Power	16.0	17.0		dBm	T= 25°C, V_{CC}= 3.3V
80MHz /40MHz 802.11ac - Dynamic EVM		1.5	1.8	%	
		-36.5	-35.0	dB	
HT80 / HT40 Output Power	15.0	16.0		dBm	T= -10°C to +70°C, V_{CC}=3.3V
80MHz / 40MHz 802.11ac - Dynamic EVM		1.5	1.8	%	
		-36.5	-35.0	dB	
HT20 Output Power	17.0	18.0		dBm	T= 25°C, V_{CC}= 3.3V
20MHz 802.11n - Dynamic EVM		2.5	3	%	
		-32	-30.5	dB	
HT20 Output Power	16.0	17.0		dBm	T= -10°C to +70°C, V_{CC}=3.3V
20MHz 802.11n - Dynamic EVM		2.5	3	%	
		-32	-30.5	dB	
20MHz 802.11n - Spectral Mask Power		21		dBm	T= 25°C, V_{CC}= 3.3V
40MHz / 80 MHz 802.11 ac Spectral Mask Power		19		dBm	
TX Port Return Loss	10	20		dB	
ANT Port Return Loss	10	15		dB	
Large Signal Gain		28	32	dB	T = 25°C, V_{CC} = 3.3V
	24	28			T= -10°C to +70°C, V_{CC}=3.3V
Gain flatness over any 80MHz BW	-0.5		0.5	dB	

The information in this publication is believed to be accurate. However, no responsibility is assumed by RF Micro Devices, Inc. ("RFMD") for its use, nor for any infringement of patents or other rights of third parties resulting from its use. No license is granted by implication or otherwise under any patent or patent rights of RFMD. RFMD reserves the right to change component circuitry, recommended application circuitry and specifications at any time without prior notice.

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
Transmit (TX-ANT) TX High Power Mode (continued)					**T = 25°C, V_{CC} = 3.3V, 50% Duty Cycle unless otherwise noted**
Gain flatness across band	-1		1	dB	
Operating Current		170	215	mA	P_{OUT} = +16.0dBm, T = 25°C, V_{CC} = 3.3V
		180	220	mA	P_{OUT} = +17.0dBm, T = 25°C, V_{CC} = 3.3V
		230		mA	P_{OUT} = +21dBm, T = 25°C, V_{CC} = 3.3V
Quiescent current		140	175	mA	RF=Off, V_{CC} = 3.3V
Second Harmonic		-30	-20	dBm/MHz	P_{OUT} = +21dBm, T = 25°C, V_{CC} = 3.3V, using a standard IEEE802.11 11a, 6Mbps waveform.
Third Harmonic		-45	-35	dBm/MHz	
Power Detector Voltage		0.25		V	P_{OUT} = 0dBm
		0.76		V	P_{OUT} = +16dBm
		0.97		V	P_{OUT} = +21dBm
Variation from 0-360° load pull	-1.5		1.5	dB	3:1 VSWR
ANT-RX Isolation (TX Mode-TX enabled and maximum power)	27			dB	
Transmit (TX-ANT) TX Low Power Mode					**T= 25°C, V_{CC}= 3.3V, 50% Duty Cycle unless otherwise noted**
HT80 / HT40 Output Power	10	11		dBm	T = 25°C, V_{CC} = 3.3V
80MHZ 802.11ac Dynamic EVM		1.5	1.8	%	
		-36.5	-35.0	dB	
HT20 Output Power	12	13		dBm	T = 25°C, V_{CC} = 3.3V
20MHz 802.11n Dynamic EVM		2.5	3	%	
		-32.0	-30.5	dB	
TX Performance – Spectral Mask				dBm	
20 MHz 802.11n / ac Output Power		15		dBm	T = 25°C, V_{CC} = 3.3V
40MHz / 80 MHz 802.11 ac Spectral Mask Power		13		dBm	
Operating Current		120	170	mA	P_{OUT}= 10dBm
		130	180	mA	P_{OUT}= 12dBm
		145	195	mA	Pout =15dBm
Large Signal Gain	24	27		dB	P_{OUT}= 10dBm, T = 25°C, V_{CC} = 3.3V
Gain flatness over any 80MHz BW	-0.5		0.5	dB	
Power Detector Voltage		0.25		V	P_{OUT} = 0dBm
		0.53		V	P_{OUT} = +10dBm
		0.73		V	P_{OUT} = +15dBm
Receive (ANT-RX)-RX Gain Mode					**T = +25°C, V_{CC} = 3.3V, unless otherwise noted**
Gain	11	14		dB	T = 25°C, V_{CC} = 3.3V
	10	14			T= -10°C to +70°C, V_{CC}=3.0 to 4.2V
Gain flatness over any 80MHz BW	-0.25		0.25	dB	
Gain flatness across band	-0.75		0.75	dB	
Noise Figure		2.5	3.0	dB	
Rx Port Return Loss	9	15		dB	
ANT Port Return Loss	6	10		dB	
Input P1dB	-6	-3		dBm	
Current Consumption		10	17	mA	T = 25°C, V_{CC} = 3.3V

The information in this publication is believed to be accurate. However, no responsibility is assumed by RF Micro Devices, Inc. ("RFMD") for its use, nor for any infringement of patents or other rights of third parties resulting from its use. No license is granted by implication or otherwise under any patent or patent rights of RFMD. RFMD reserves the right to change component circuitry, recommended application circuitry and specifications at any time without prior notice.

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
LNA Turn On Time		400	600	nS	

Receive (ANT-RX)- RX Bypass Mode					**T = +25°C, V_{CC} = 3.3V, unless otherwise noted**
LNA Bypass Current		2	10	µA	
Nominal Insertion Loss		6	10	dB	T = 25°C, V_{CC} = 3.3V
RX Port Return Loss	10	15		dB	
ANT Port Return Loss	10	15		dB	
Input P1dB	20	23		dBm	T = 25°C, V_{CC} = 3.3V
General Specifications					
Control Line Impedance-VC1		75		kΩ	
Control Line Impedance-VC2		78		kΩ	
Control Line Impedance-VC3		27		MΩ	
Control Line VC1 Current- Nominal	0	0.5	1	mA	T = 25°C, V_{CC} = 3.3V RF OFF
Control Line VC2 Current- Nominal	0	0.1	1	mA	T = 25°C, V_{CC} = 3.3V RF OFF
Control Line VC3 Current- Nominal	0	0.1	1	mA	T = 25°C, V_{CC} = 3.3V RF OFF
Switching Speed		100	500	ns	
ESD – Human Body Model		1000		V	
ESD – Charge Device Model		1000		V	
PA Turn-on Time		200	500	ns	10% to 90%
FEM Leakage Current		2	15		VCC=4.8V, RF = Off
PA Stability		+20	+22	dBm	No spurious above -41.25dBm/MHz up to 4:1 VSWR
Ruggedness			12	dBm	6:1 VSWR, V_{CC} = 3.3V, 25°C; No damage
			5	dBm	10:1 VSWR, V_{CC} = 3.3V, 25°C; No damage
			10:1	VSWR	At typical operating conditions; No damage

Switch Control Logic Truth Table

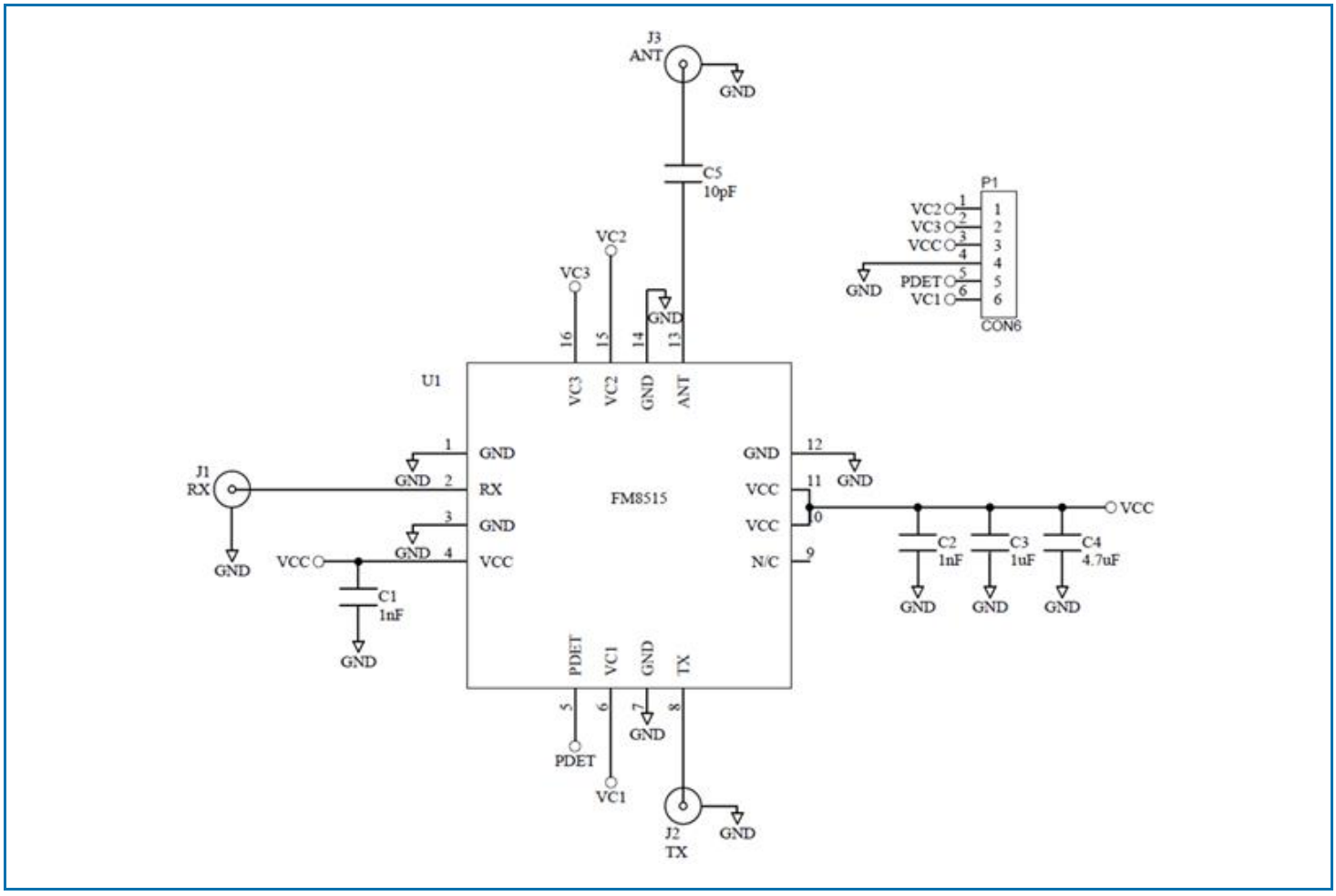
Operating Mode	VC1	VC2	VC3
Standby	Low	Low	Low
802.11a/n/ac TX High Power Mode	High	Low	High
802.11a/n/ac TX Low Power Mode	High	Low	Low
802.11a/n/ac RX Gain	Low	High	Low
802.11a/n/ac RX Bypass	Low	High	High

Notes:

- High = 2.8 to V_{CC}. Low = 0V to 0.2V

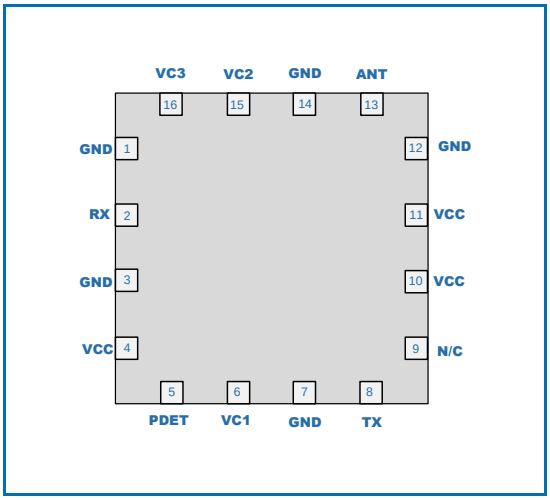
The information in this publication is believed to be accurate. However, no responsibility is assumed by RF Micro Devices, Inc. ("RFMD") for its use, nor for any infringement of patents or other rights of third parties resulting from its use. No license is granted by implication or otherwise under any patent or patent rights of RFMD. RFMD reserves the right to change component circuitry, recommended application circuitry and specifications at any time without prior notice.

Applications Schematic

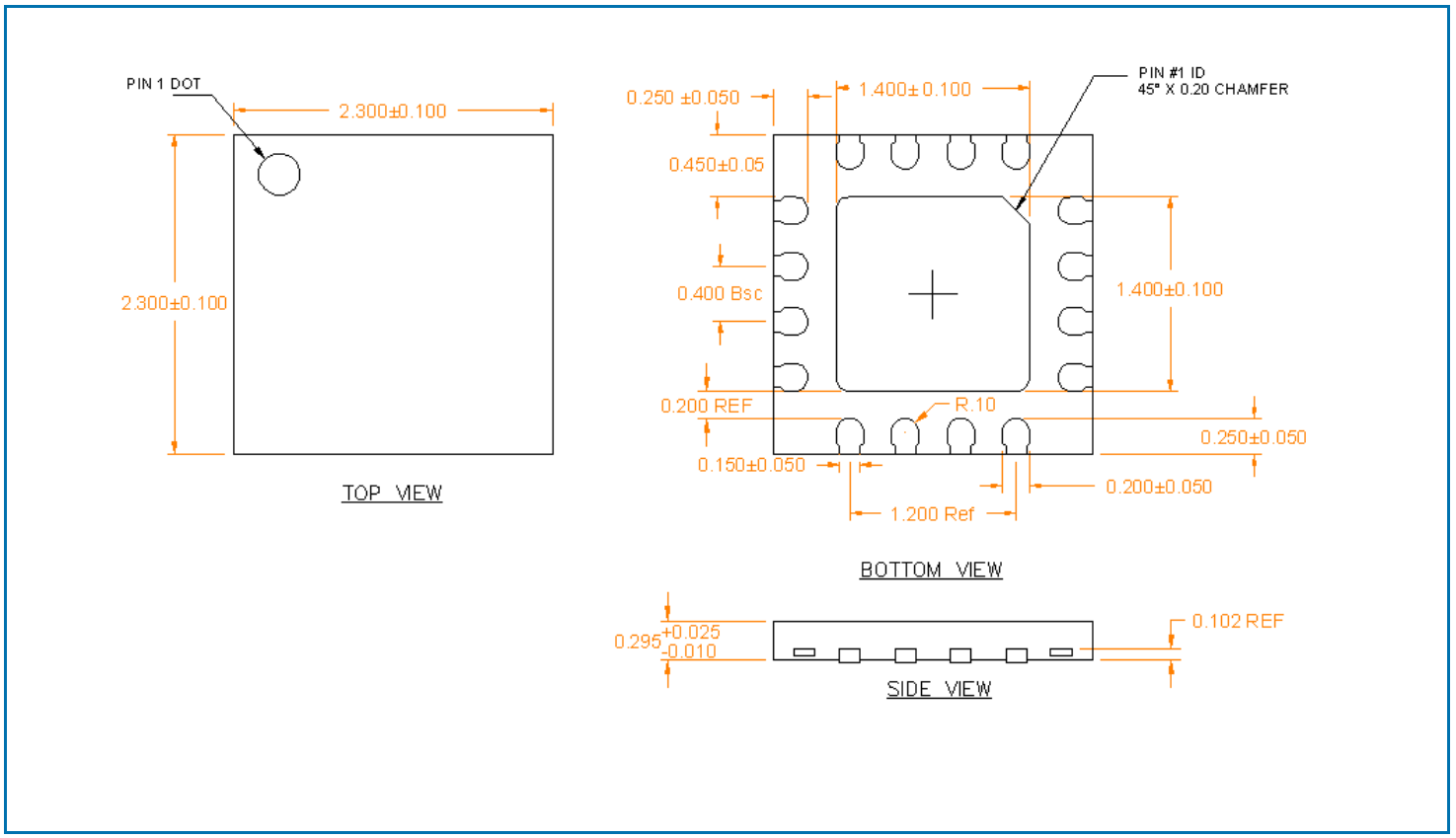


The information in this publication is believed to be accurate. However, no responsibility is assumed by RF Micro Devices, Inc. ("RFMD") for its use, nor for any infringement of patents or other rights of third parties resulting from its use. No license is granted by implication or otherwise under any patent or patent rights of RFMD. RFMD reserves the right to change component circuitry, recommended application circuitry and specifications at any time without prior notice.

Pin Out

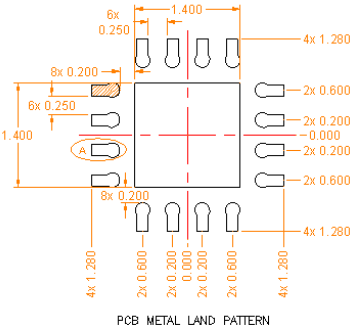


Package Drawing

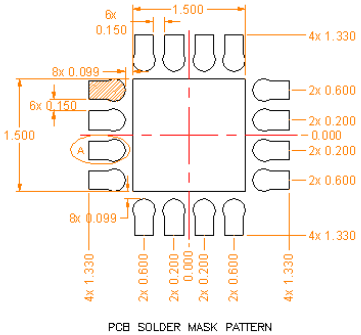


The information in this publication is believed to be accurate. However, no responsibility is assumed by RF Micro Devices, Inc. ("RFMD") for its use, nor for any infringement of patents or other rights of third parties resulting from its use. No license is granted by implication or otherwise under any patent or patent rights of RFMD. RFMD reserves the right to change component circuitry, recommended application circuitry and specifications at any time without prior notice.

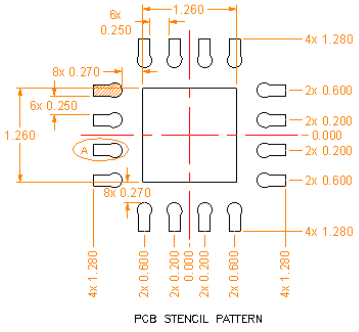
PCB Patterns



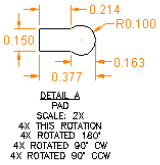
PCB METAL LAND PATTERN

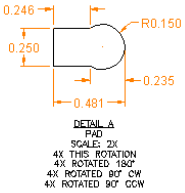


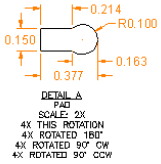
PCB SOLDER MASK PATTERN



PCB STENCIL 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.

The information in this publication is believed to be accurate. However, no responsibility is assumed by RF Micro Devices, Inc. ("RFMD") for its use, nor for any infringement of patents or other rights of third parties resulting from its use. No license is granted by implication or otherwise under any patent or patent rights of RFMD. RFMD reserves the right to change component circuitry, recommended application circuitry and specifications at any time without prior notice.

Pin Names and Descriptions

Pin	Name	Description
1	GND	This pin is not connected internally and can be left floating or connected to ground.
2	RX	RF output port for the 802.11a/n LNA. This port is matched to 50Ω and DC blocked internally
3	GND	This pin is not connected internally and can be left floating or connected to ground.
4	VCC	Supply voltage for the LNA and PA Regulator. See applications schematic for biasing and bypassing components.
5	PDET	Power detector voltage for the TX path. May need external series R/shunt C to adjust voltage level and to filter RF noise
6	VC1	Control Logic Pin - Refer to Logic Table
7	GND	This pin is not connected internally and can be left floating or connected to ground.
8	TX	RF input port for the 802.11a/n PA. Input is matched to 50Ω and DC blocked internally
9	N/C	This pin is not connected internally and can be left floating or connected to ground.
10	VCC	Supply voltage for the first and second stage of the PA. See applications schematic for biasing and bypassing components.
11	VCC	Supply voltage for the final stage of the PA. See applications schematic for biasing and bypassing components.
12	GND	This pin is not connected internally and can be left floating or connected to ground.
13	ANT	RF bidirectional antenna port matched to 50Ω and external DC block is required
14	GND	This pin is not connected internally and can be left floating or connected to ground.
15	VC2	Control Logic Pin - Refer to Logic Table
16	VC3	Control Logic Pin - Refer to Logic Table
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.

The information in this publication is believed to be accurate. However, no responsibility is assumed by RF Micro Devices, Inc. ("RFMD") for its use, nor for any infringement of patents or other rights of third parties resulting from its use. No license is granted by implication or otherwise under any patent or patent rights of RFMD. RFMD reserves the right to change component circuitry, recommended application circuitry and specifications at any time without prior notice.