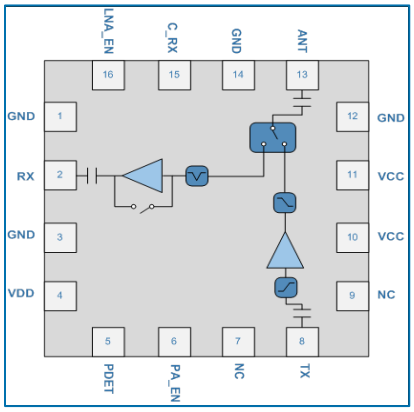
RFFM4551

4.9GHz to 5.925GHz 802.11a/n/ac Wi-Fi Front End Module

The RFFM4551 provides a complete integrated solution in a single front end module (FEM) for Wi-Fi 802.11a/n/ac systems. The ultra-small factor and integrated matching minimizes layout area in the customer's application and greatly reduces the number of external components. Performance is focused on linear output power under a number of conditions including duty cycle and packet length while balancing power consumption needs of leading edge device platforms. This simplifies the total front end solution by reducing the bill of materials, system footprint, and manufacturing cost.

The RFFM4551 integrates a 5GHz power amplifier (PA), single pole two throw switch (SP2T) and an LNA with bypass. Also this FEM includes integrated 2nd and 3rd Harmonic filters and integrated out of band rejection filters. The device is provided in a 3.0mm x 3.0mm x 1.0mm, 16-pin laminate package. This module meets or exceeds the RF front end needs of IEEE 802.11a/n/ac Wi-Fi RF systems.



Functional Block Diagram

Package: Laminate, 16-pin, 3.0mm x 3.0mm x 0.975mm

Features

- 3.3V Operation
- P_{OUT} = +17.0dBm at 3.3V, 802.11ac MCS9 HT80 at 1.8% Dynamic EVM Compliance
- P_{OUT} = +18.0dBm at 3.3V, 802.11n MCS7 HT20/40 at 3.0% Dynamic EVM Compliance
- P_{OUT} = +19.0dBm at 3.3V, MCS0 HT20, HT40, and HT80 at Spectral Mask Compliance
- Integrated 2nd and 3rd Harmonic filters & Integrated out of band rejection filters.
- Integrated RX notch filter @ 2.5GHz for DBDC operation.
- Integrated 5GHz PA, SP2T, LNA with Bypass and Power Detector Coupler.

Applications

- Customer Premise Equipment
- Set-Top Boxes
- Netbooks/Notebooks
- Mobile Routers/Access Points
- Data Cards
- TV/Monitors/Video

Ordering Information

RFFM4551SB	Standard 5-piece sample bag
RFFM4551SQ	Standard 25-piece sample bag
RFFM4551SR	Standard 100-piece reel
RFFM4551TR7	Standard 2500-piece reel
RFFM4551PCK-410	Fully assembled evaluation board w/5 piece 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.

DS150211

Absolute Maximum Ratings

Parameter	Rating	Unit
DC Supply Voltage	-0.5 to +5.5	V_{DC}
PA Enable Voltage	-0.5 to 5	V_{DC}
Operating Temperature Range	-40 to +85	ºC
Storage Temperature	-40 to +150	ºC
Maximum TX Input Power into 50Ω Load for 802.11a/n/ac (No Damage)	+5	dBm
Moisture Sensitivity	MSL3	

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		
Parameter					
Operating Frequency	5.150		5.9250	GHz	
Extended Frequency	4.900		5.150	GHz	
Operating Temperature Range	-40		+85	ºC	
Power Supply V_{CC}	3.0	3.3	3.6	V	
Control Voltage-High	2.8	3.1	V_{CC}	V	PA_EN, LNA_EN, CRX control-lines
Control Voltage-Low		0	0.2	V	
Package Size	2.9 x 2.9 x 0.9	3.0 x 3.0 x 0.975	3.1 x 3.1 x 1.05	mm	Length x Width x Height
Transmit (TX-ANT)					**V_{CC} = 3.3V, T = +25ºC *f* = 5.15GHz - 5.925 GHz PA_EN = High, LNA_EN = Low, CRX = Low Unless otherwise noted**
802.11ac MCS9 HT80 Output Power	16.0	17.0		dBm	T = 25ºC, V_{CC} = 3.3V, 5.15GHz – 5.925GHz
Dynamic EVM Compliance		1.5	1.8	%	
		-36.5	-35.0	dB	
802.11n MCS7 HT20 /40 Output Power	17.0	18.0		dBm	T = 25ºC, V_{CC} = 3.3V, 5.15GHz – 5.925GHz
Dynamic EVM Compliance		2.5	3.0	%	
		-32.0	-30.5	dB	
Output Power Spectral Mask Compliance		21.0		dBm	T = 25ºC, V_{CC} = 3.3V, HT20
		19.0		dBm	T = 25ºC, V_{CC} = 3.3V, HT40, HT80
Large Signal Gain	29	31		dB	T = 25ºC, V_{CC} = 3.3V, 5.25GHz – 5.925GHz
	27.5	30			T = 25ºC, V_{CC} = 3.3V, 5.15GHz – 5.25GHz
	26	29		dB	T = 85ºC, V_{CC} = 3.3V
Gain Flatness Over Full Frequency band	-1.5		1.5	dB	T = 25ºC, V_{CC} = 3.3V
TX Port Return Loss	8	15		dB	
ANT Port Return Loss		20		dB	

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
Transmit (TX-ANT) (continued)					**V_{CC} = 3.3V, T = +25ºC *f* = 5.15GHz - 5.925 GHz PA_EN = High, LNA_EN = Low, CRX = Low Unless otherwise noted**
Operating Current		260		mA	P_{OUT} = 17.0dBm, 802.11ac MCS9 HT80 T = 25ºC, V_{CC} = 3.3V
		290		mA	P_{OUT} = 18.0dBm, 802.11ac MCS7 HT20/40 T = 25ºC, V_{CC} = 3.3V
		330		mA	P_{OUT} = 21.0dBm, 802.11n MCS0 HT20 T = 25ºC, V_{CC} = 3.3V
Quiescent Current		200		mA	RF=Off, T = 25ºC, V_{CC} = 3.3V
Second Harmonic		-40	-35	dBm/MHz	P_{OUT} = 21dBm, measured with a standard 802.11a 6Mbps waveform, Frequency 5.15 to 5.29GHz
		-47	-40	dBm/MHz	P_{OUT} = 21dBm, measured with a standard 802.11a 6Mbps waveform, Frequency 5.30 to 5.925GHz
Third Harmonic		-55	-50	dBm/MHz	P_{OUT} = 21dBm, measured with a standard 802.11a 6Mbps waveform across full frequency band.
Out Of Band Gain		-10	-5	dB	@ 3.2 to 3.9GHz
		19	22	dB	@ 7GHz
		0	5	dB	@1.60 to 1.95 GHz
Power Detector Voltage		0.30		V	P_{OUT} = 0dBm, RF OFF
		0.75		V	P_{OUT} = 17.0dBm, 802.11ac MCS9 HT80
		0.85		V	P_{OUT} = 18.0dBm, 802.11ac MCS9 HT80
		1.0		V	P_{OUT} = 21.0dBm, 802.11ac MCS0 HT20
Isolation ANT-RX: Transmit Mode		20		dB	PA_EN = High, LNA_EN = Low, CRX = Low
Receive (ANT-RX) LNA On Mode					**V_{CC} = 3.3V, T = +25ºC *f* = 5.15GHz - 5.925 GHz PA_EN = Low, LNA_EN = High, CRX =High Unless otherwise noted**
Gain	11	14		dB	
Noise Figure		2.5	3.3	dB	
RX Port Return Loss	8	12		dB	
ANT Port Return Loss	5	12		dB	
Input P_{1dB}		-5		dBm	
RX Operating Current		12	20	mA	
Out of Band rejection		15		dB	@ 2.4 to 2.5GHz
Receive (ANT-RX) LNA Bypass Mode					**V_{CC} = 3.3V, T = +25ºC *f* = 5.15GHz - 5.925 GHz PA_EN = Low, LNA_EN = Low, CRX = High Unless otherwise noted**
Bypass Loss	8	6	5	dB	
RX Port Return Loss	10	15		dB	
ANT Port Return Loss	10	12		dB	
Input P_{1dB}		20		dBm	
Out of Band rejection		15		dB	@ 2.4 to 2.5GHz
General Specifications					**V_{CC} = 3.3V, T = +25ºC**
LNA_EN Control Current		150		uA	
CRX Control Current		1		uA	

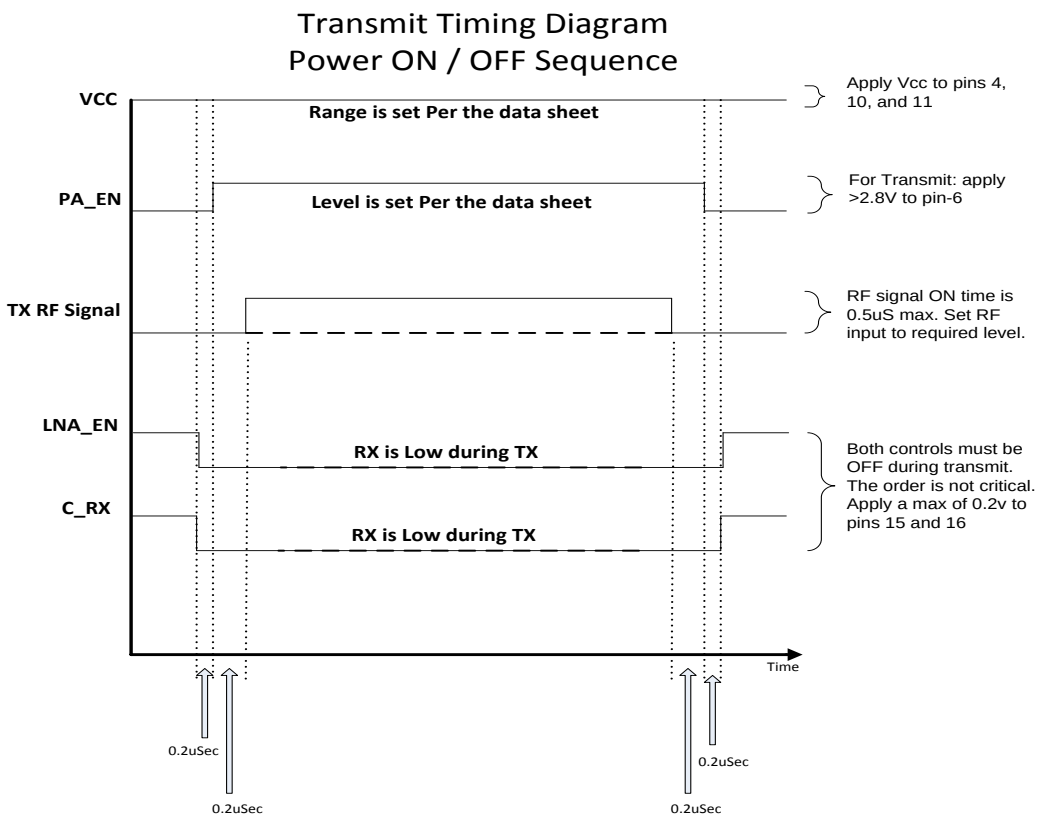
Parameter	Specification			Unit	Condition
	Min	Typ	Max		
General Specifications					V_{CC} = 3.3V, T = +25ºC
PA_EN Control Current		30		uA	
FEM Leakage Current		8		uA	Standby Mode (RF Off) PA_EN = Low, LNA_EN = Low, CRX = Low
Control Lines Switching Speed			100	nS	
ESD – Human Body Model	500			V	
ESD – Charge Device Model	500			V	
PA Turn-on Time		200	500	nS	10% to 90%
PA Stability @ Pout		22		dBm	Unconditional into 4:1 VSWR, No spurious above -41.25dBm/MHz

Switch Control Logic Table

Operating Mode	PA_EN	LNA_EN	CRX
Standby	Low	Low	Low
802.11a/n/ac TX (Transmit Mode)	High	Low	Low
802.11a/n/ac RX Gain (LNA On Mode)	Low	High	High
802.11a/n/ac RX Bypass (LNA Bypass Mode)	Low	Low	High

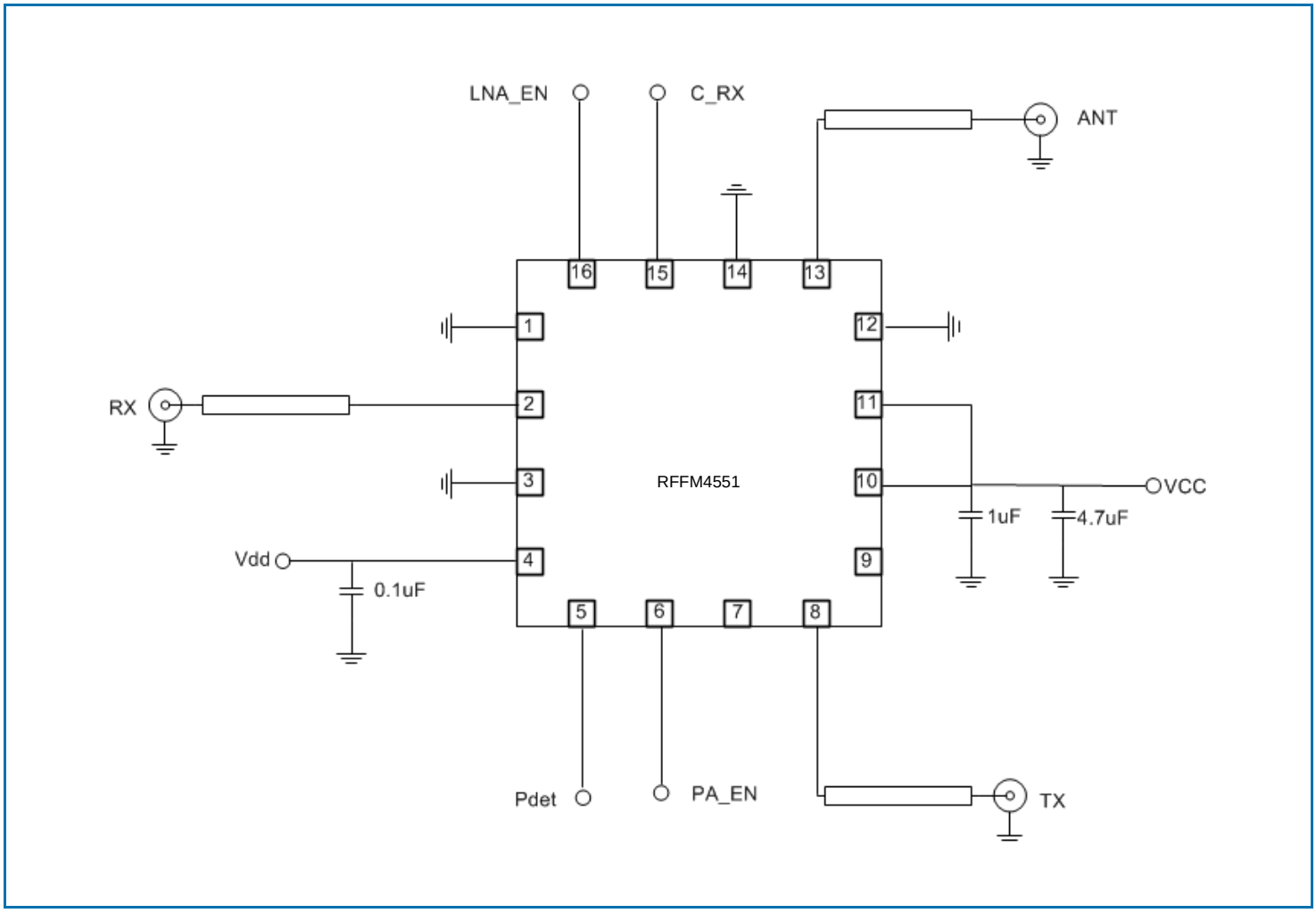
Notes:
- PA_EN and TX switch control lines are tied together internally.
- High = 2.8 to VCC.
- Low = 0V to 0.2V.

Timing Diagrams

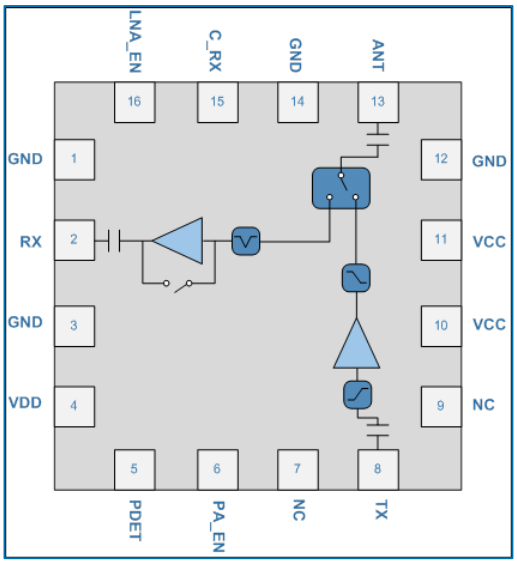


Note1: RF Signal for each specific mode is applied after the DC bias is applied
Note2: Total ON/OFF time includes from 10% of control switching to 90% of RF power
Note3: Listed values on diagram are typical. The maximum is 0.5us for each mode

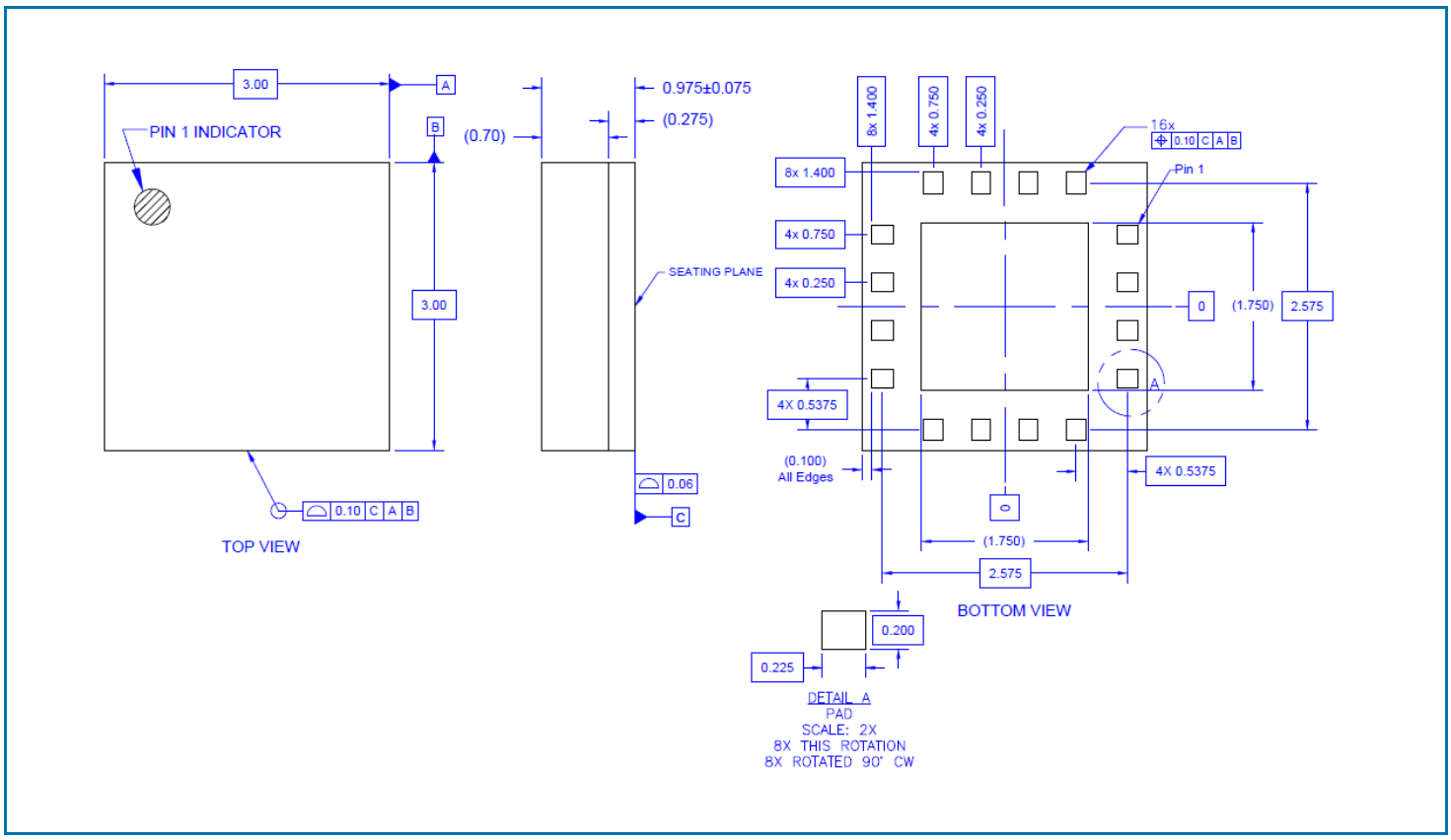
Evaluation Board Schematic



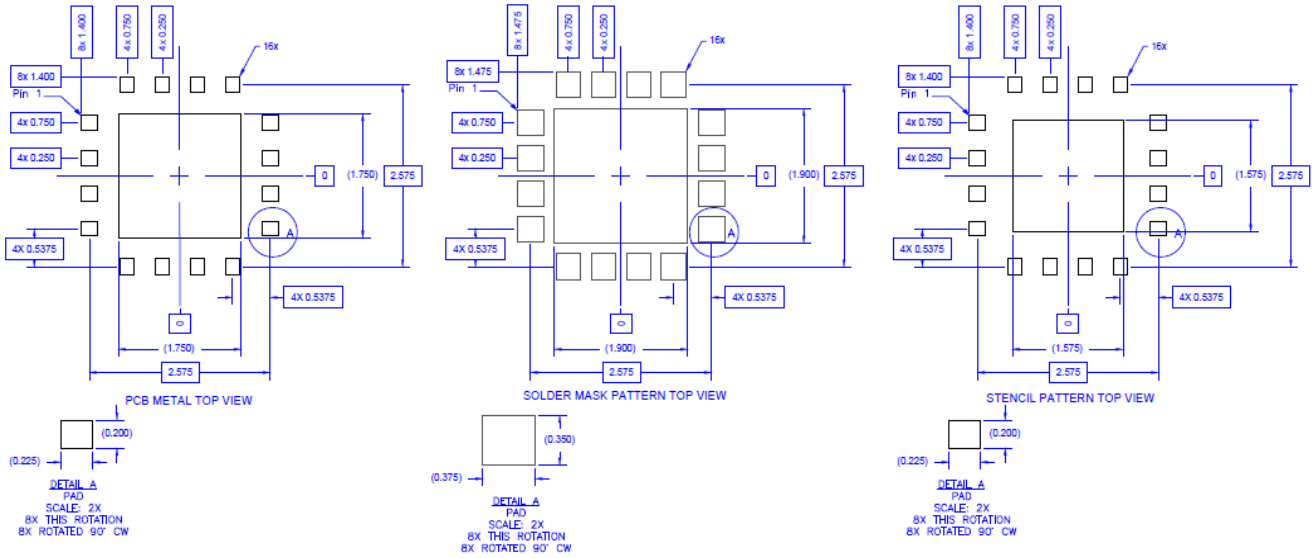
Pin Out



Package Outline Drawing



PCB Pattern



Pin Names and Descriptions

Pin	Name	Description
1	GND	Ground connection
2	RX	RF output port for the 802.11a/n/ac LNA. This port is matched to 50Ω and DC block is provided internally.
3	GND	Ground connection
4	VDD	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	PA_EN	Control voltage for the PA and TX switch. See truth table for proper settings.
7	NC	No Connect. 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 block is provided internally.
9	NC	No Connect. This pin is not connected internally and can be left floating or connected to ground.
10	VCC	Supply voltage for the PA. See applications schematic for biasing and bypassing components.
11	VCC	Supply voltage for the PA. See applications schematic for biasing and bypassing components.
12	GND	Ground connection
13	ANT	RF bidirectional antenna port matched to 50Ω and DC block is provided internally.
14	GND	Ground connection
15	CRX	Receive switch control pin. See truth table
16	LNA_EN	Control voltage for the LNA. When this pin is set to a low logic state, the bypass mode is enabled.
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.