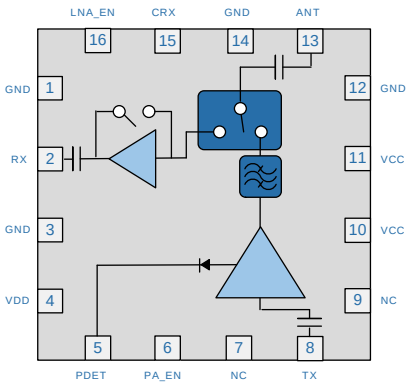
RFMD + TriQuint = Qorvo

RFFM4503

4.9GHz to 5.85GHz 802.11a/n/ac Wi-Fi Front End Module

The RFFM4503 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 RFFM4503 integrates a 5GHz power amplifier (PA), single pole two throw switch (SP2T) and an LNA with bypass. 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

Ordering Information

RFFM4503SB	Standard 5-piece sample bag
RFFM4503SQ	Standard 25-piece sample bag
RFFM4503SR	Standard 100-piece reel
RFFM4503TR7	Standard 2500-piece reel
RFFM4503PCK-410	Fully assemble evaluation board w/ 5-piece bag

Package: Laminate, 16-pin, 3.0mm x 3.0mm x 1.0mm

Features

- 3.3V – 4.2V Operation
- P_{OUT} = +18.0dBm at 3.3V, 802.11ac MCS9 HT80 at 1.8% Dynamic EVM Compliance
- P_{OUT} = +20.0dBm at 3.3V, MCS0 HT20, HT40, and HT80 at Spectral Mask Compliance
- P_{OUT} = +20.0dBm at 4.2V, 802.11ac MCS9 HT80 at 1.8% Dynamic EVM Compliance
- P_{OUT} = +22.0dBm at 4.2V, MCS0 HT20, HT40, and HT80 at Spectral Mask Compliance
- High performance FEM in Small Package
- Input and Output Matched to 50Ω

  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

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		5.850	GHz	
Extended Frequency	4.900		5.150	GHz	Functional with reduced performance
Operating Temperature Range	-40		+85	ºC	
Power Supply V_{CC}	3.0	3.3	4.2	V	
Control Voltage-High	2.8	3.1	V_{CC}	V	For 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 - 5.85 GHz PA_EN = High, LNA_EN = Low, CRX = Low Unless otherwise noted**
802.11ac MCS9 HT80 Output Power	16.5	17.5		dBm	T = 25ºC, V_{CC} = 3.3V, 5.15GHz – 5.85GHz
802.11ac MCS9 Dynamic EVM Compliance		1.5	1.8	%	
		-36.5	-35.0	dB	
802.11ac MCS7 HT20 Output Power	18.0	19.0		dBm	T = 25ºC, V_{CC} = 3.3V, 5.15GHz – 5.85GHz
802.11ac MCS7 Dynamic EVM Compliance		2.5	3.0	%	
		-32.0	-30.5	dB	
802.11ac MCS0 Output Power Spectral Mask Compliance		21.0		dBm	T = 25ºC, V_{CC} = 3.3V, HT20
		20.0		dBm	T = 25ºC, V_{CC} = 3.3V, HT40, HT80
Large Signal Gain	27.5	29.5		dB	T = 25ºC, V_{CC} = 3.3V
	25.0	26.5		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	9	15		dB	
ANT Port Return Loss	15	20		dB	

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
Transmit (TX-ANT) (continued)					**V_{CC} = 3.3V, T = +25ºC *f* = 5.15GHz - 5.85 GHz PA_EN = High, LNA_EN = Low, CRX = Low Unless otherwise noted**
Operating Current		260		mA	P_{OUT} = 18.0dBm, 802.11ac MCS9 HT80 T = 25ºC, V_{CC} = 3.3V
		315		mA	P_{OUT} = 21.0dBm, 802.11ac MCS0 HT20 T = 25ºC, V_{CC} = 3.3V
Second Harmonic		-38	-30	dBm/MHz	P_{OUT} = 20dBm, measured with a standard 802.11a 6Mbps waveform
Third Harmonic		-40	-35	dBm/MHz	
Power Detector Voltage	0.25	0.30	0.35	V	P_{OUT} = 0dBm
	0.55	0.65	0.75	V	P_{OUT} = 17.0dBm, 802.11ac MCS9 HT80
	0.60	0.70	0.75	V	P_{OUT} = 18.0dBm, 802.11ac MCS9 HT80
	0.7	0.80	0.9	V	P_{OUT} = 21.0dBm, 802.11ac MCS0 HT20
Transmit (TX-ANT)					**V_{CC} = 4.2V, T = +25ºC *f* = 5.15GHz - 5.85 GHz PA_EN = High, LNA_EN = Low, CRX = Low Unless otherwise noted**
802.11ac MCS9 HT80 Output Power	17.0	18.0		dBm	T = 25ºC, V_{CC} = 4.2V, 5.15GHz – 5.47GHz
	19.0	20.0		dBm	T = 25ºC, V_{CC} = 4.2V, 5.47GHz – 5.85GHz
802.11ac MCS9 Dynamic EVM Compliance		1.5	1.8	%	
		-36.5	-35.0	dB	
802.11ac MCS7 HT20 Output Power	19.0	20.0		dBm	T = 25ºC, V_{CC} = 4.2V, 5.15GHz – 5.47GHz
	20.0	21.0		dBm	T = 25ºC, V_{CC} = 4.2V, 5.47GHz – 5.85GHz
802.11ac MCS7 Dynamic EVM Compliance		2.5	3.0	%	
		-32.0	-30.5	dB	
802.11ac MCS0 Output Power Spectral Mask Compliance		23.0		dBm	T = 25ºC, V_{CC} = 4.2V, HT20
		22.0		dBm	T = 25ºC, V_{CC} = 4.2V, HT40, HT80
Large Signal Gain	27.5	29.5		dB	T = 25ºC, V_{CC} = 4.2V
	25.0	26.5		dB	T = 85ºC, V_{CC} = 4.2V
Gain Flatness Over Full Frequency band	-1.5		1.5	dB	T = 25ºC, V_{CC} = 4.2V
TX Port Return Loss	9	15		dB	
ANT Port Return Loss	15	20		dB	
Quiescent Current		180		mA	T = 25ºC, V_{CC} = 4.2V, RF= OFF
Operating Current		280		mA	P_{OUT} = 20.0dBm, 802.11ac MCS9 HT80 T = 25ºC, V_{CC} = 4.2V
		350		mA	P_{OUT} = 23.0dBm, 802.11ac MCS0 HT20 T = 25ºC, V_{CC} = 4.2V
Second Harmonic		-38	-30	dBm/MHz	P_{OUT} = 23dBm, measured with a standard 802.11a 6Mbps waveform
Third Harmonic		-40	-30	dBm/MHz	
Power Detector Voltage		0.30		V	P_{OUT} = 0dBm
		0.65		V	P_{OUT} = 17.5dBm, 802.11ac MCS9 HT80
		0.75		V	P_{OUT} = 19.5dBm, 802.11ac MCS9 HT80
		0.85		V	P_{OUT} = 23.0dBm, 802.11ac MCS0 HT20

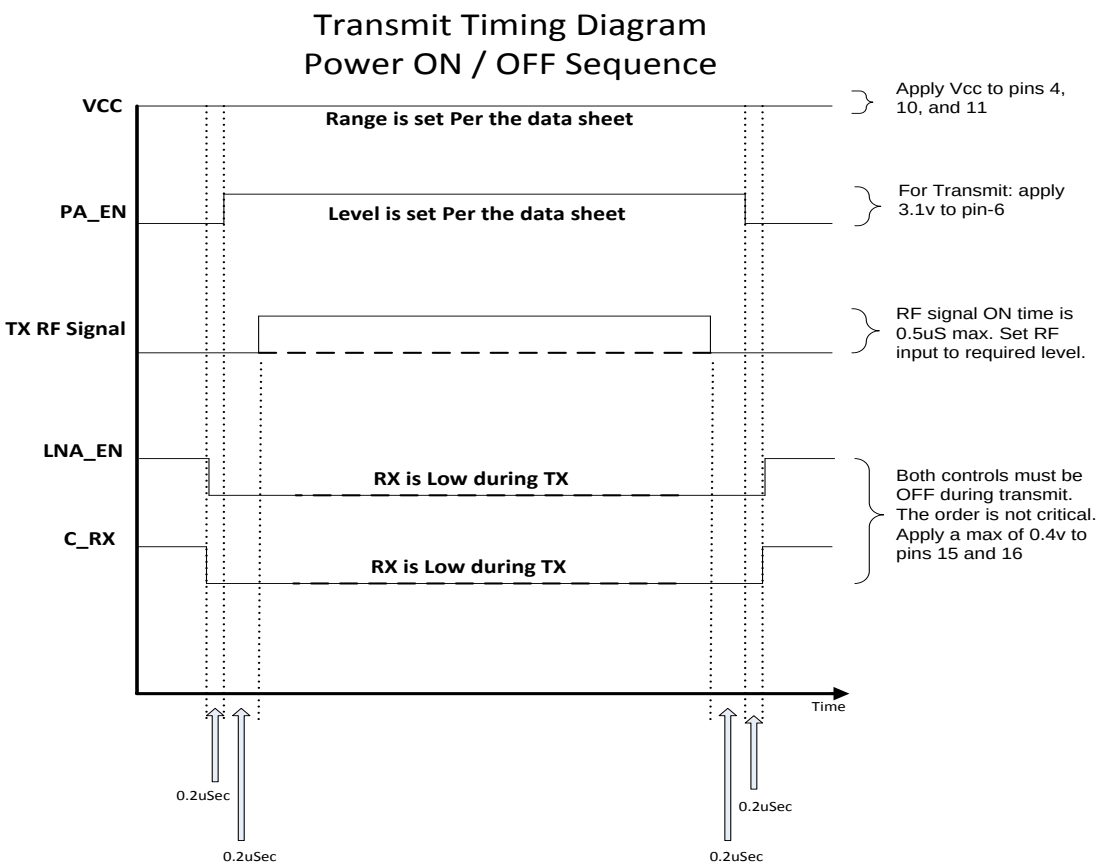
Parameter	Specification			Unit	Condition
	Min	Typ	Max		
Receive (ANT-RX) LNA On Mode					**V_{CC} = 3.3V to 4.2V, T = +25ºC *f* = 5.15GHz - 5.85 GHz PA_EN = Low, LNA_EN = High, CRX =High Unless otherwise noted**
Gain	10.0	12.0		dB	
Noise Figure		2.5	3.0	dB	
RX Port Return Loss	10	15		dB	
ANT Port Return Loss	9	12		dB	
Input P_{1dB}		-3.0		dBm	
RX Operating Current		12	20	mA	
Receive (ANT-RX) LNA Bypass Mode					**V_{CC} = 3.3V to 4.2V, T = +25ºC *f* = 5.15GHz - 5.85 GHz PA_EN = Low, LNA_EN = Low, CRX = High Unless otherwise noted**
Bypass Loss	5	7		dB	
RX Port Return Loss	8	12		dB	
ANT Port Return Loss	10	15		dB	
Input P_{1dB}		20		dBm	
General Specifications					**V_{CC} = 3.3V to 4.2V**
Isolation ANT-RX: Transmit Mode	23	28		dB	PA_EN = High, LNA_EN = Low, CRX = Low
Isolation ANT-TX: LNA On Mode		20		dB	PA_EN = Low, LNA_EN = High, CRX = High
Isolation ANT-TX: LNA Bypass Mode		20		dB	PA_EN = Low, LNA_EN = Low, CRX = High
PA_EN Control Current		70		uA	
LNA_EN Control Current		130		uA	
CRX Control Current		5		uA	
FEM Leakage Current		2	15	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
Optional Isolation Mode	High	Low	High

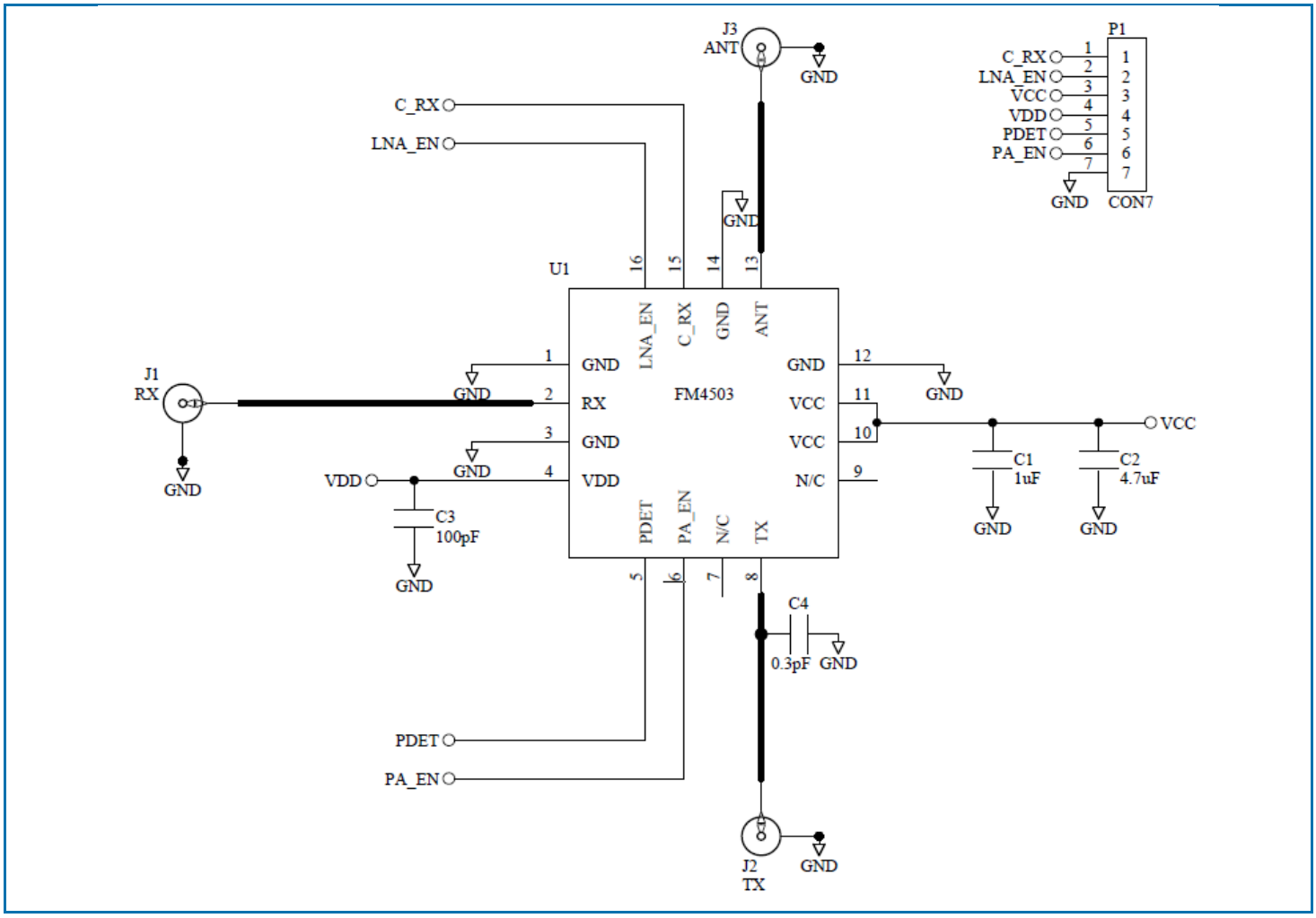
Notes:
- PA_EN and TX switch control lines are tied together internally.
- High = 2.8 to VCC.
- Low = 0V to 0.2V.

Timing Diagrams

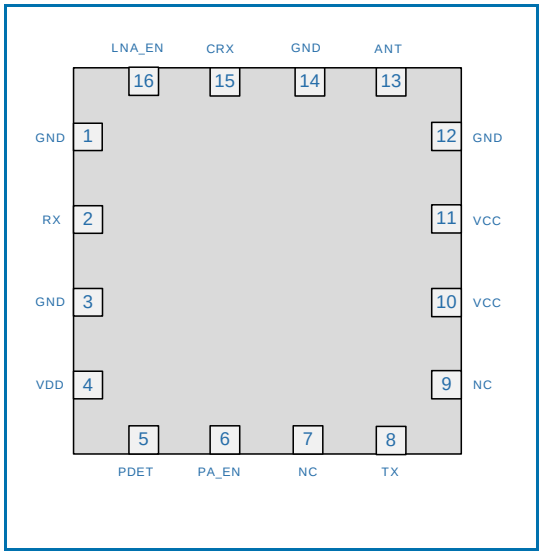


Note1: RF Signal for each specific mode is applied after the DC bias is applied
Note2: Total ON/OFF time includes from 10% of control switching to 90% of RF power
Note3: Listed values on diagram are typical. The maximum is 0.5us for each mode

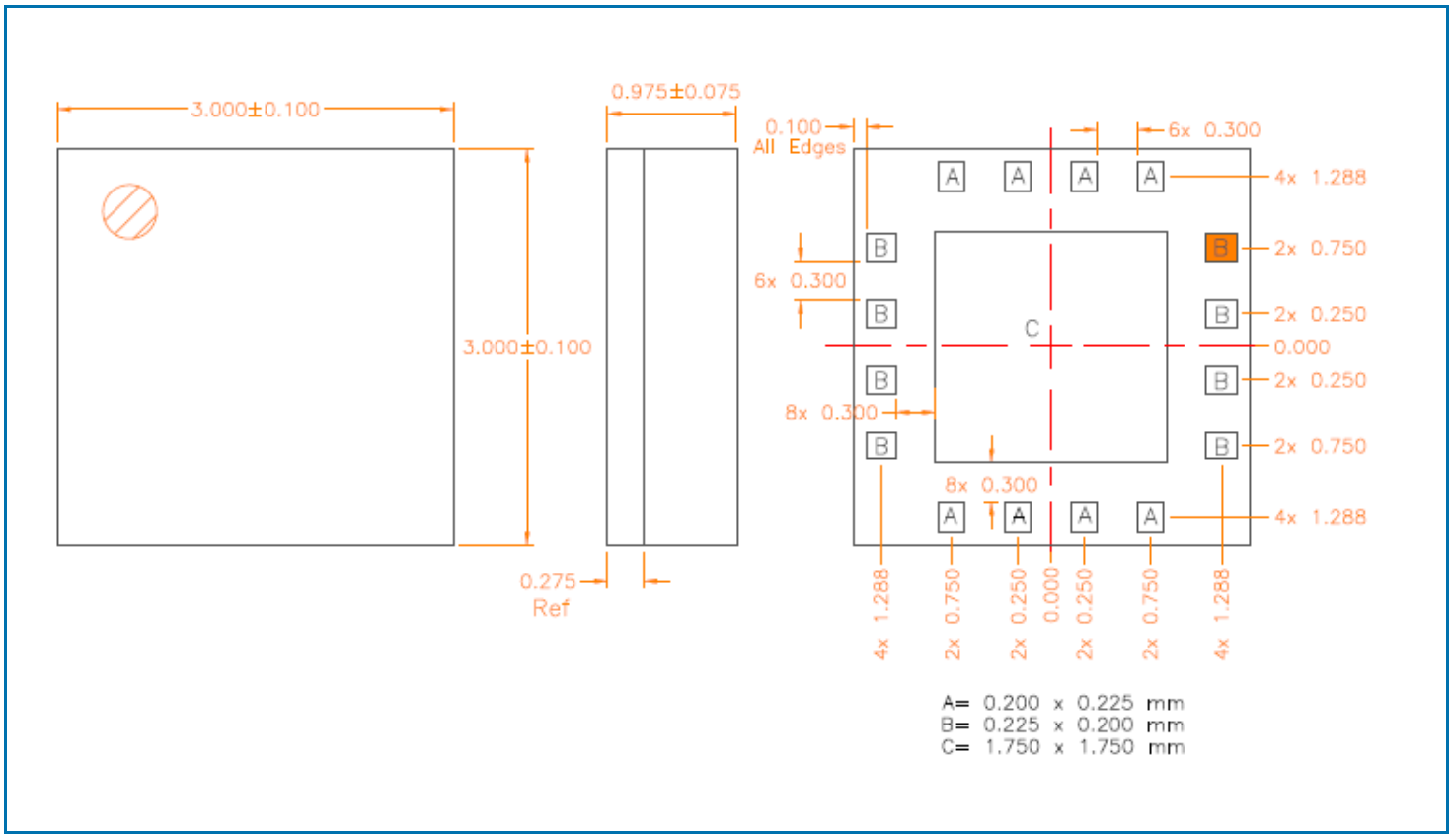
Applications Schematic



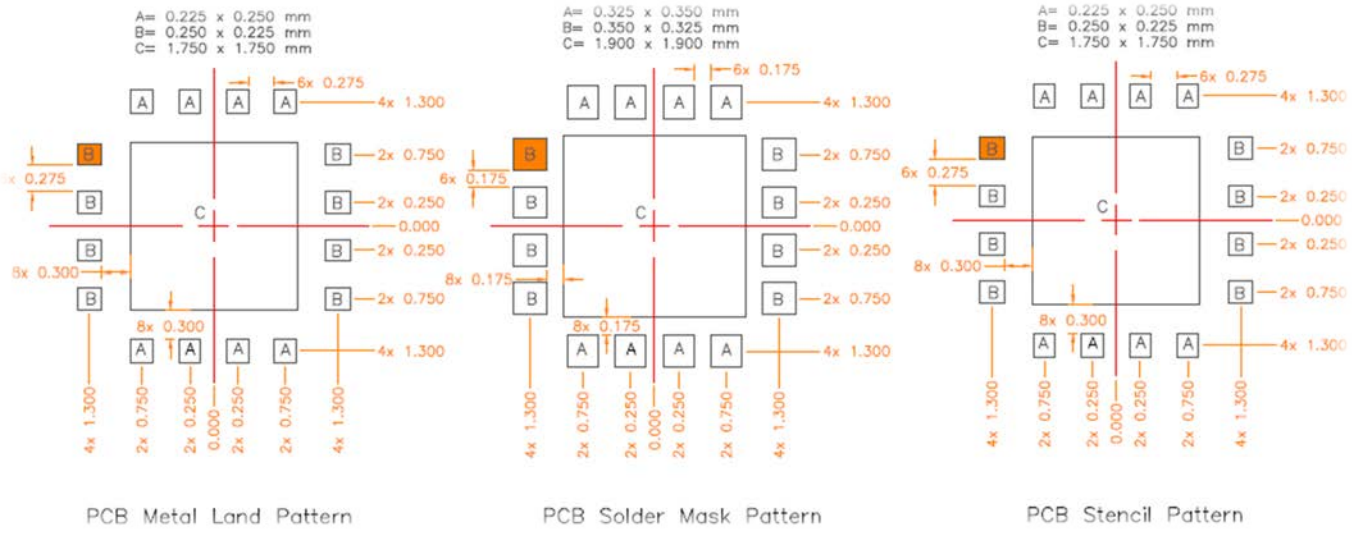
Pin Out



Package Drawing



PCB Patterns



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 blocked 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	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	NC	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 bi-directional antenna port matched to 50Ω. An internal DC block is integrated in device.
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.