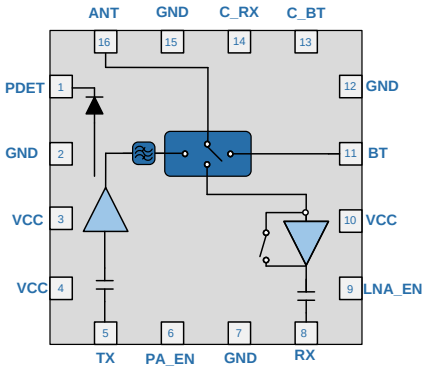
RFFM8205

2.4GHz to 2.5GHz 802.11b/g/n/ac WiFi Front End Module

The RFFM8205 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 manufacturing cost. The RFFM8205 integrates a 2.5GHz power amplifier (PA), a low noise amplifier (LNA) with bypass mode, a power detector coupler for improved accuracy, an SP3T switch, and some filtering for harmonic rejection. The device is provided in a 2.5mm x 2.5mm x 0.40mm 16-pin QFN package. This module meets or exceeds the RF front end needs of IEEE 802.11b/g/n/ac WiFi RF systems.



Functional Block Diagram

Package: QFN, 16-pin,
2.5mm x 2.5mm x 0.40mm

Features

- P_{OUT} = +20dBm 802.11n 64QAM MCS7 20MHz BW at 3.0% (-30.0dB) Dynamic EVM Compliance
- P_{OUT} = +18.0dBm 802.11ac 256QAM MCS9 40MHz BW at 1.8% (-35.0dB) Dynamic EVM Compliance
- P_{OUT} = +22dBm 802.11b at Spectral Mask Compliance
- Input and Output Matched to 50Ω High Level of Integration
- Supports Wide Voltage Supply Range
- Able to Meet Demands of Evolving WiFi Market

Applications

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

Ordering Information

RFFM8205SB	Standard 5-pieces sample bag
RFFM8205SQ	Standard 25-piece sample bag
RFFM8205SR	Standard 200-piece sample bag
RFFM8205TR7	Standard 2500-piece sample bag
RFFM8205PCK-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.

DS130930

Absolute Maximum Ratings

Parameter	Rating	Unit
DC Supply Voltage (No RF Applied)	6	V
PA Enable Voltage	-0.5 to 5	VDC
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 for 11b/g/n/ac (No Damage)	+12	dBm
Maximum RX Input Power (No Damage)	+12	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					**802.11b, 802.11g, 802.11n, 802.11ac**
Operating Frequency	2.412		2.484	GHz	
Operating Temperature	-10		70	ºC	
Extended Operating Temperature	-40		85	ºC	Functional with reduced performance
Power Supply V_{CC}	3.2	3.6	4.6	V	
Extended V_{CC}	3		4.8		Functional with reduced performance
Control Voltage - High	2.8		V_{CC}	V	PA_EN, CRX, CBT, LNA_EN
Control Voltage - Low		0	0.2	V	
Transmit (TX-ANT)					**T= -10ºC to +70ºC, V_{CC} = 3.0V to 4.2V, 50% duty cycle unless otherwise noted**
HT40 Output Power	17.5	18.0		dBm	T = 25ºC, V_{CC} = 3.6V
Dynamic EVM - HT40		1.5	1.8	%	
		-36.5	-35.0	dB	
HT40 Output Power	15.5	16.0		dBm	T = -10ºC to 70ºC, V_{CC} = 3.0V to 4.2V
Dynamic EVM - HT40		1.5	1.8	%	
		-36.5	-35.0	dB	
HT20 Output Power		20.0		dBm	T=25ºC, V_{CC} = 3.6V
Dynamic EVM - HT20		2.5	3.0	%	
		-32.0	-30.0	dB	
HT20 Output Power		17.5		dBm	T = -10ºC to 70ºC, V_{CC} = 3.0V to 4.2V
Dynamic EVM - HT20		2.5	3.0	%	
		-32.0	-30.5	dB	
HT20 Output Power		18.0		dBm	T=25ºC, V_{CC} = 3.6V
Dynamic EVM - HT20		1.5	1.8	%	
		-36.5	-35.0	dB	
HT20 Output Power	15.5	16.0		dBm	T = -10ºC to 70ºC, V_{CC} = 3.0V to 4.2V
Dynamic EVM - HT20		1.5	1.8	%	
		-36.5	-35.0	dB	

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
Transmit (TX-ANT) (continued)					**T= -10ºC to +70ºC, V_{CC} = 3.0V to 4.2V, 50% duty cycle unless otherwise noted**
Spectral Mask HT20/HT40 Output Power	20.5	21		dBm	T=25ºC, V_{CC} = 3.6V
TX Port Return Loss	15	22		dB	
ANT Port Return Loss	10	17		dB	
Large Signal Gain	23.5	26	30	dB	T = 25ºC, V_{CC} = 3.6V
	22.5	26	31	dB	T = -10ºC, to +70ºC, V_{CC} = 3.2V to 4.6V
Gain Flatness - 20MHz Channel	-0.25	0	0.25	dB	
Gain Flatness - Across Band	-1	0	1	dB	
Operating Current		225		mA	P_{OUT} = 18dBm , T=25ºC, V_{CC} = 3.6V
		240		mA	P_{OUT} = 20dBm , T=25ºC, V_{CC} = 3.6V
		235		mA	P_{OUT} = 16dBm, T = -10ºC to 70ºC, V_{CC} = 3.0V to 4.2V
Quiescent Current		175		mA	T = 25ºC, V_{CC} = 3.6V
PA_EN Current		40	80	µA	
Second Harmonic		-10	-5	dBm/MHz	P_{OUT} = 22dBm, T = -10ºC to 70ºC, V_{CC} = 3.0V to 4.2V,Measured with a standard IEEE802.11b, 1Mbps waveform
Third Harmonic		-28	-25	dBm/MHz	
Power Detector Voltage	0	0.05	0.1	V	P_{OUT} = 0dBm (No RF)
	0.25	0.35	0.5	V	P_{OUT} = 18.0dBm (see evaluation board schematic)
	0.5	0.6	0.8	V	P_{OUT} = 22dBm (see evaluation board schematic)
Variation from 0-360 load pull	-1.5		1.5	dB	3:1 VSWR
ANT-RX Isolation	30	32	35	dB	FEM is operating in TX mode
Receive (ANT-RX)-LNA On					**T= -10ºC to +70ºC, V_{CC} = 3.0V to 4.2V unless otherwise noted**
Gain (S21)	9	10.5	12	dB	T = 25ºC, V_{CC} = 3.6V
	8	10.5	13	dB	T = -10ºC to 70ºC, V_{CC} = 3.2V to 4.2V
RX Gain Flatness over any 20MHz BW	-0.25		0.25	dB	
Gain flatness across band	-1		1	dB	
Noise Figure		2.5	3	dB	T = 25ºC, V_{CC} = 3.6V
		2.5	3.7	dB	T = -10ºC to 70ºC, V_{CC} = 3.2V to 4.2V
Rx Port Return Loss	10	12	20	dB	
ANT Port Return Loss	3	4	10	dB	
Current Consumption	7.5	10	13.5	mA	T = 25ºC, V_{CC} = 3.6V
	7	10	14.5	mA	T = -10ºC to 70ºC, V_{CC} = 3.0V to 4.2V
LNA_EN Control Current	30	200	500	µA	
LNA Turn On Time		200	500	nS	
Receive (ANT-RX)-Bypass Mode					**T= -10ºC to +70ºC, V_{CC} = 3.0V to 4.2V unless otherwise noted**
Insertion Loss		6	8	dB	T = 25ºC, V_{CC} = 3.6V
	4	6	9	dB	T = -10ºC to 70ºC, V_{CC} = 3.0V to 4.2V
RX Port Return Loss	10	14	25	dB	
ANT Port Return Loss	10	12	25	dB	
Input P1dB	20	27	30	dBm	

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
Bluetooth TX/RX					**T= -10ºC to +70ºC, V_{CC} = 3.0V to 4.2V unless otherwise noted**
Nominal Input P1dB	23	25		dBm	T = 25ºC, V_{CC} = 3.6V
Insertion Loss	0.3	0.8	1.1	dB	
BT Port Return Loss	10	18	30	dB	
ANT Port Return Loss	10	18	30	dB	
General Specifications					
Leakage Current		0.5	10	µA	V_{CC} = 4.8V, RF OFF, All control lines floating
Control Line Impedance - PA_EN		187		KΩ	
Control Line Impedance - LNA_EN		228		KΩ	
Control Line Impedance - C_RX		27		MΩ	
Control Line Impedance - C_BT		27		MΩ	
Switch Control Current-High - Each Line		5	60	µA	
Switch Control Current-Low - Each Line		0.5	10	µA	
Switching Speed		100	500	ns	
ESD - Human Body Model		1000		V	
ESD - Charge Device Model		1000		V	
PA +TX Switch Turn-on Time		200	500	ns	10% to 90%
PA Stability					No spurious above -41.25dBm/MHz
Maximum Input Power			12	dBm	Into 50Ω, V_{CC} = 3.3V, 25°C
			12	dBm	6:1 VSWR, V_{CC} = 3.3V, 25°C
			5	dBm	10:1 VSWR, V_{CC} = 3.3V, 25°C
Ruggedness			10:1	VSWR	At typical operating conditions
Transmit (TX-ANT) – 5V					
HT20 Output Power		20		dBm	T = 25°C; V_{CC} = 5V
Dynamic EVM - HT20		1.5	1.8	%	
		-36.5	-35.0	dB	
HT20 Output Power		21		dBm	T = 25°C; V_{CC} = 5V
Dynamic EVM - HT20		2.5	3	%	
		-32.0	-30	dB	
HT40 Output Power		19.5		dBm	T = 25°C; V_{CC} = 5V
Dynamic EVM - HT40		1.5	1.8	%	
		-36.5	-35.0	dB	
HT20, HT40 Operating Current	200	250	290	mA	P_{OUT} =20dBm ; T = 25°C; V_{CC} = 5V
HT20 Operating Current	210	250	320	mA	P_{OUT} = 21dBm ; T = 25°C; V_{CC} = 5V
Quiescent Current	170	190	250	mA	T = 25°C V_{CC} = 5V
Gain (S21)	24	26	30	dB	
Receive (ANT-RX) – LNA On-5V					
Gain (S21)	9	10.5	12	dB	T = 25°C V_{CC} = 5V
Noise Figure	2	2.5	3	dB	
Rx Port Return Loss	10	12	25	dB	
ANT Port Return Loss	3	4	10	dB	

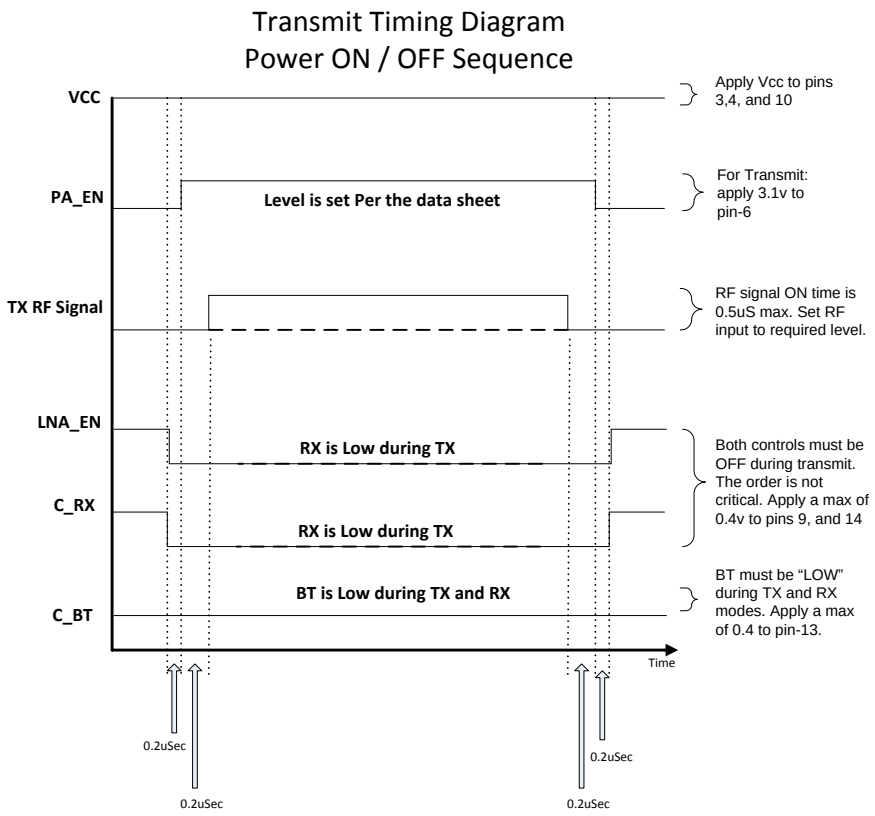
Switch Control Logic Truth Table

Operating Mode	PA_EN	LNA_EN	C_RX	C_BT
Standby	Low	Low	Low	Low
802.11b/g/n/ac TX High Power	High	Low	Low	Low
802.11b/g/n/ac RX Gain	Low	High	High	Low
802.11b/g/n/ac RX Bypass	Low	Low	High	Low
BT RX/TX	Low	Low	Low	High

Notes:

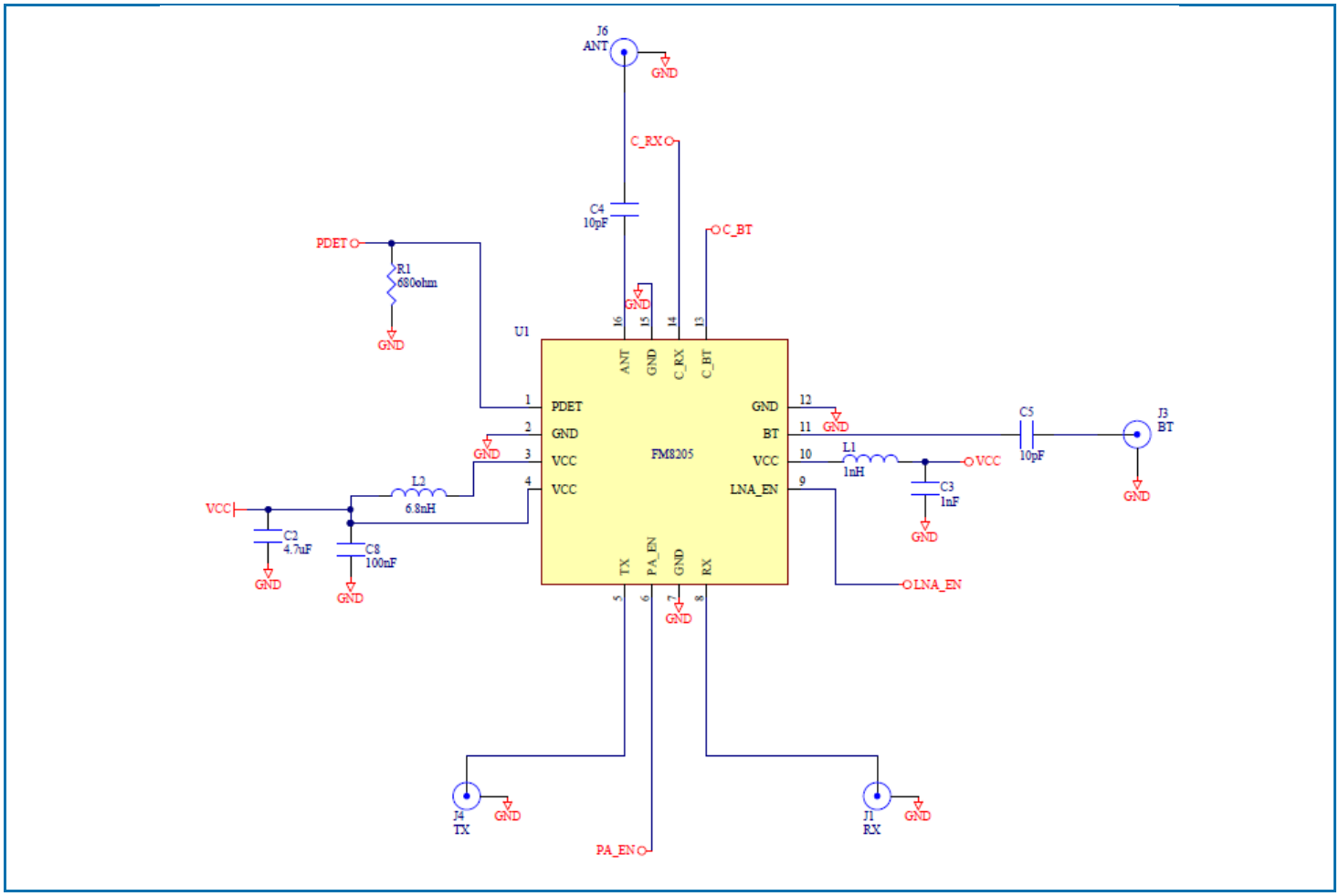
- PA_EN and TX switch control are tied together internally.
- High = 2.8 to V_{CC}. Low = 0V to 0.2V.

Timing Diagram

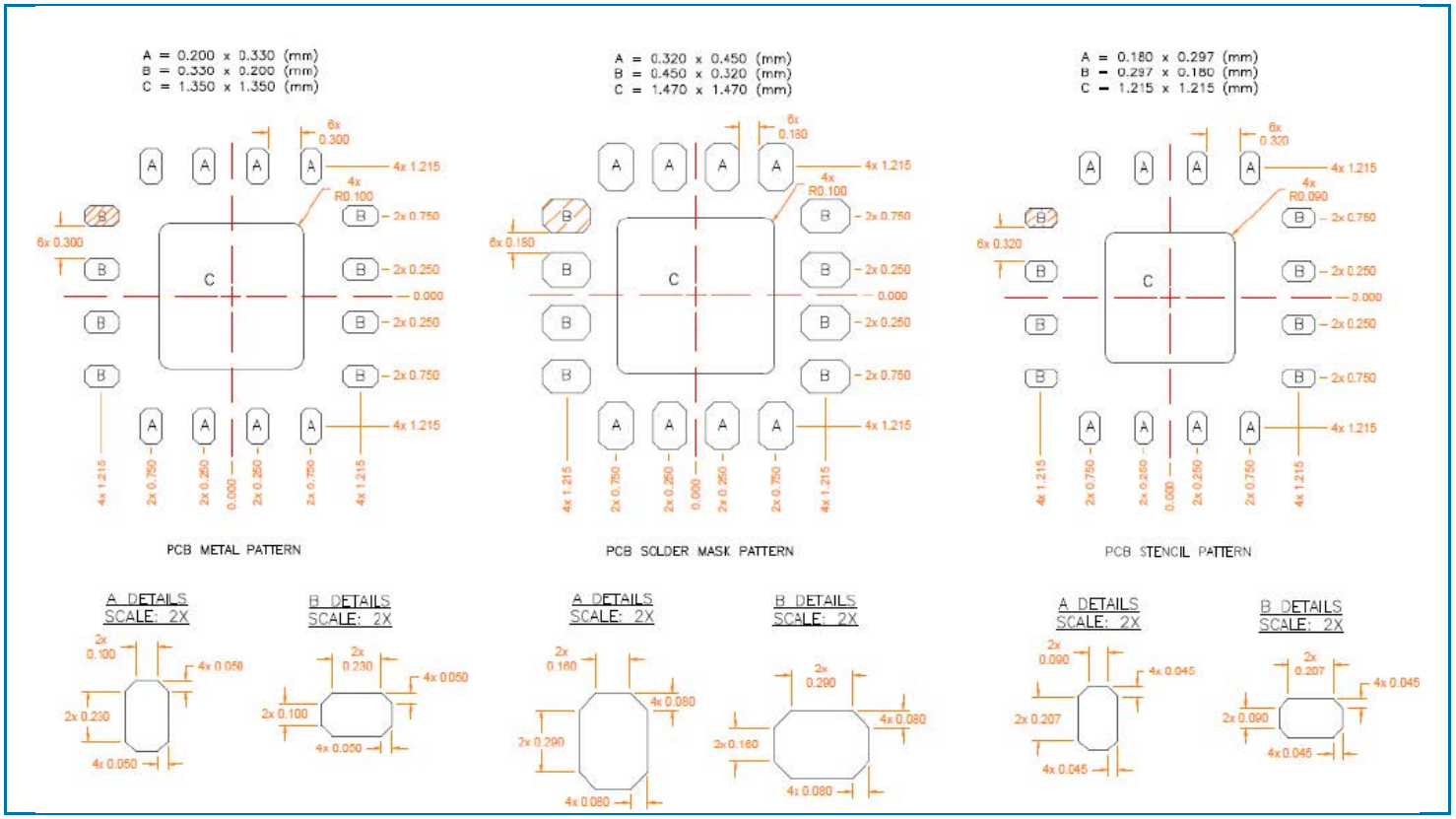


Note1: RF Signal for each specific mode is applied after the DC bias is applied
Note2: Total ON/OFF time includes from 10% of control switching to 90% of RF power
Note3: Listed values on diagram are typical. The maximum is 0.5us for each mode

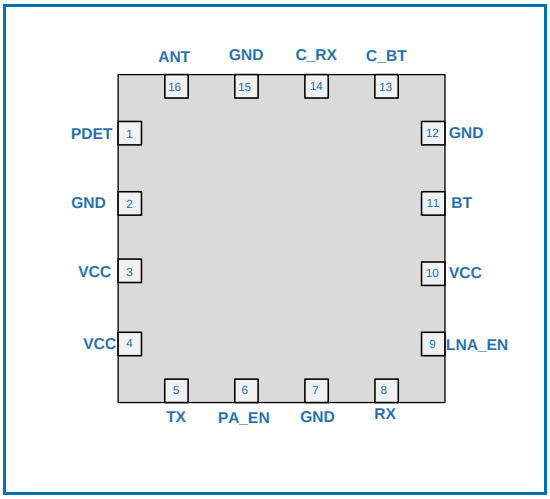
Applications Schematic



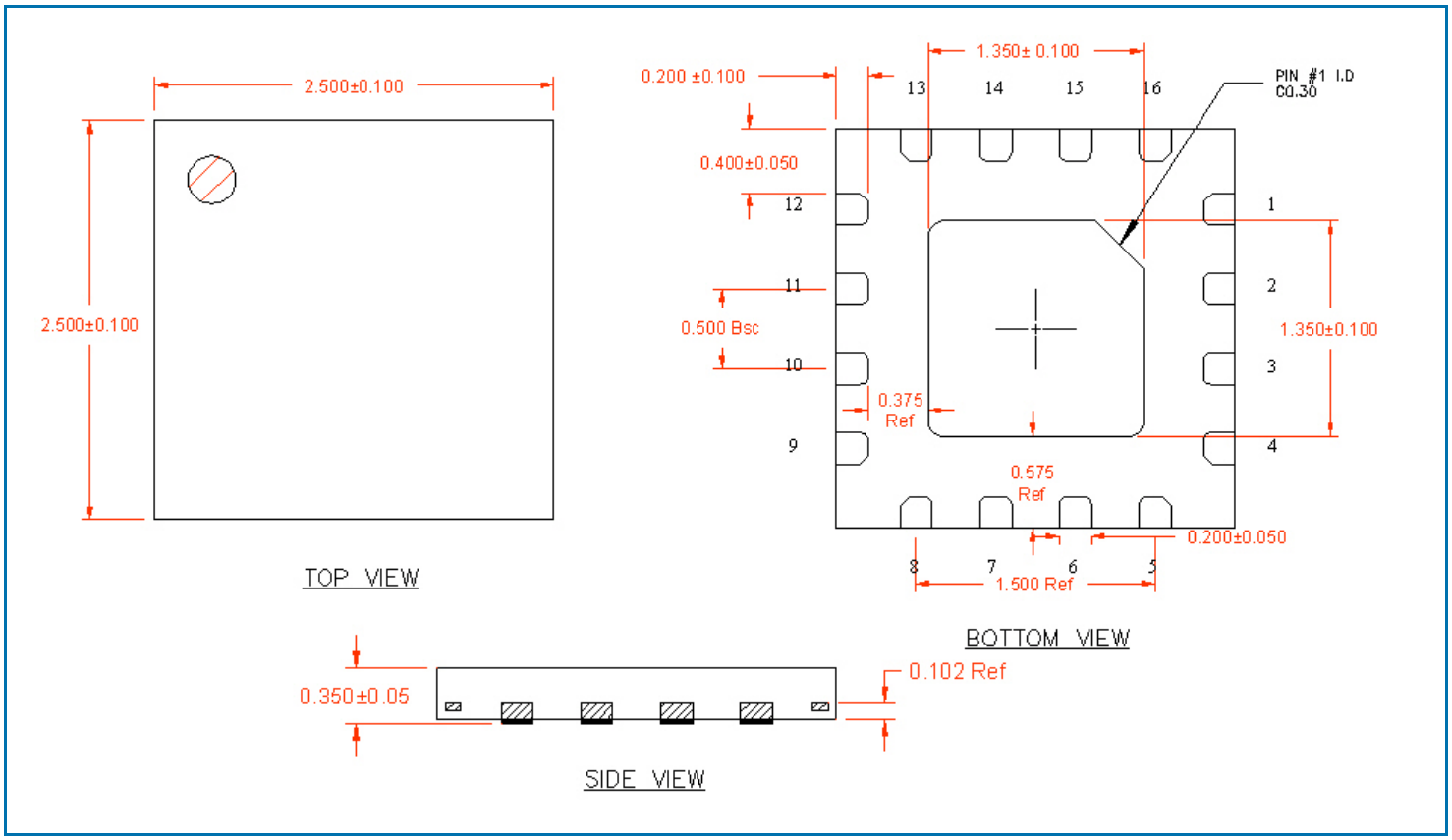
PCB Patterns



Pin Out



Package Drawing



Notes:
1. Shaded area represents Pin 1 location

Pin Names and Descriptions

Pin	Name	Description
1	PDET	Power detector voltage for the TX path. May need external series R/shunt C to adjust voltage level and to filter RF noise.
2	GND	This pin is not connected internally and can be left floating or connected to ground.
3	VCC	Supply voltage for the output stage of the PA. See applications schematic for biasing and bypassing components.
4	VCC	Supply voltage for the first stage of 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. This pin is DC blocked internally.
6	PA_EN	Bias voltage for the PA. This pin also controls the TX switch of the SP3T. See truth table for proper settings.
7	GND	This pin is not connected internally and can be left floating or connected to ground.
8	RX	RF output port for the 802.11b/g/n LNA. Port is matched to 50Ω. This pin is DC blocked 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	VCC	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. An external DC block is required.
12	GND	This pin is not connected internally and can be left floating or connected to ground.
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	This pin is not connected internally and can be left floating or connected to ground.
16	ANT	RF bidirectional antenna port matched to 50Ω. An external DC block is required.
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.