

RFFM8502

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

The RFFM8502 provides a complete integrated solution in a single front end module (FEM) for WiFi 802.11a/n systems. The ultra-small form factor and integrated matching minimizes the 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 manufacturability cost. The RFFM8502 integrates a 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 2.5mm x 2.5mm x 0.45mm, 16-pin QFN package. This module meets or exceeds the RF front end needs of IEEE 802.11a/n WiFi RF systems.



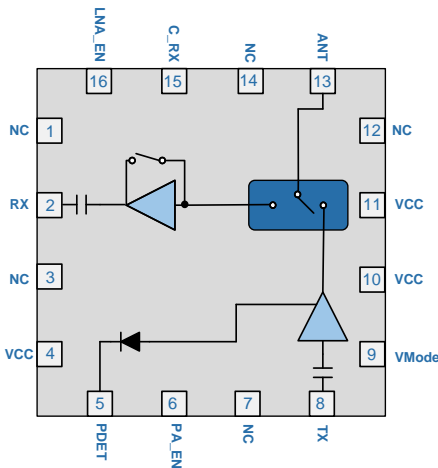
Package: QFN, 16-pin,
2.5mm x 2.5mm x 0.45mm

Features

- $P_{OUT} = 17.5\text{dBm}$, 11a, OFDM at 2.5% EVM
- Voltage Range 3.0V to 4.8V
- Input and Output Matched to 50Ω
- Integrated 5GHz PA, SP2T, Switch, LNA, and PDET
- Low Height Package, Suited for SiP and CoB Designs

Applications

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



Functional Block Diagram

Ordering Information

RFFM8502SB	Standard 5-piece sample bag
RFFM8502SQ	Standard 25-piece sample bag
RFFM8502SR	Standard 100-pieces reel
RFFM8502TR7	Standard 2500-piece reel
RFFM8502PCK-410	Fully assembled eval board w/ 5-piece sample bag

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
Storage Temperature	-40 to +150	°C
Maximum TX Input Power into 50Ω Load for 11a/n (No Damage)	+10	dBm
Maximum RX input power for both LNA_EN mode and bypass mode (No damage)	+10	dBm
Moisture Sensitivity	MSL1	



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
Operating Frequency	5.18		5.825	GHz	
Extended Frequency	4.9		5.15	GHz	Functional with derated performance
Extended Operating Temperature	-40	25	+85	°C	
Power Supply V_{CC}	3	3.3	4.35	V	Recommended Operating Voltage Range
Extended V_{CC}	3	3.3	4.8	V	Functional with derated performance
Control Voltage - high	2.8		VCC	V	PA_EN, CRX, LNA_EN, Vmode
Control Voltage - low	0		0.2	V	
Transmit (TX-ANT) High Power Mode					802.11a/n $P_{OUT} = 17\text{dBm}$, $T = 25^\circ\text{C}$, $V_{CC} = 3.3\text{V}$, PA_EN = High, LNA_EN = Low, C_RX = Low, Vmode = Low Freq = 5.18GHz to 5.825GHz unless otherwise noted
802.11a/n Output Power	17	17.5		dBm	$T = 25^\circ\text{C}$
Dynamic EVM - Nominal		2.5	3	%	$T = 25^\circ\text{C}$, $P_{OUT} = 17\text{dBm}$
		-32	-30.5	dB	
802.11a/n Output Power	14	15.5		dBm	$T = -40^\circ\text{C}$ to $+85^\circ\text{C}$; $V_{CC} = 3.0\text{V}$ to 4.8V
Dynamic EVM		2.5	3	%	
		-32	-30.5	dB	
TX Port Return Loss	10	12		dB	$T = -40^\circ\text{C}$ to $+85^\circ\text{C}$; $V_{CC} = 3.0\text{V}$ to 4.8V
ANT Port Return Loss	10	12		dB	
Nominal Gain	25	30		dB	$T = 25^\circ\text{C}$, $V_{CC} = 3.3\text{V}$
Gain	22	30		dB	$T = -40^\circ\text{C}$ to $+85^\circ\text{C}$; $V_{CC} = 3.0\text{V}$ to 4.8V
Nominal Operating Current		225	250	mA	$P_{OUT} = 17\text{dBm}$, $T = 25^\circ\text{C}$, $V_{CC} = 3.3\text{V}$
Operating Current		225	285	mA	$T = -40^\circ\text{C}$ to $+85^\circ\text{C}$; $V_{CC} = 3.0\text{V}$ to 4.8V
Quiescent Current		160	220	mA	
PA_EN Current	0	20	50	μA	
Leakage Current	0	2	10	μA	$V_{CC} = 4.8\text{V}$, RF OFF

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
Transmit (TX-ANT) High Power Mode (continued)					802.11a/n P_{OUT} = 17dBm, T = 25°C, V_{CC} = 3.3V, PA_EN = High, LNA_EN = Low, C_RX = Low, Vmode = Low, Freq = 5.18GHz to 5.825GHz unless otherwise noted
Second Harmonic		-35	-30	dBm/MHz	T= -40°C to +85°C; V _{CC} =3.0V to 4.8V
Third Harmonic		-50	-41	dBm/MHz	
Power Detector Voltage	0.3		0.45	V	T= -40°C to +85°C; V _{CC} =3.0V to 4.8V, P _{OUT} = 0dBm
	0.6		0.9	V	T= -40°C to +85°C; V _{CC} =3.0V to 4.8V, P _{OUT} = 20dBm
Transmit (TX-ANT) Low Power Mode					802.11a/n P_{OUT} = 8dBm, T = 25°C, V_{CC} = 3.3V, PA_EN = High, LNA_EN = Low, C_RX = Low, Vmode = High, Freq = 5.18GHz to 5.825GHz unless otherwise noted
Dynamic EVM - Nominal		2.5	3	%	T = 25°C, V _{CC} = 3.3V, P _{OUT} = 8dBm
		-32	-30.5	dB	
Dynamic EVM		2.5	3	%	T= -40°C to +85°C; V _{CC} =3.0V to 4.8V, P _{OUT} = 6dBm
		-32	-30.5	dB	
Operating Current		125	160	mA	
Vmode Control Line Current			500	µA	
Receive (ANT-RX) – LNA On					T = 25°C, V_{CC} = 3.3V, LNA_EN = High, C_RX = High, Vmode = Low, PA_EN = Low
Nominal Gain	8	12.5	17	dB	T = 25°C, V _{CC} = 3.3V
Gain	6	13	18	dB	T= -40°C to +85°C; V _{CC} =3.0V to 4.8V
NF - Nominal		2.5	3	dB	T = 25°C, V _{CC} = 3.3V
Noise Figure			4.5	dB	T= -40°C to +85°C; V _{CC} =3.0V to 4.8V
Rx Port Return Loss	5	10		dB	
ANT Port Return Loss	5	10		dB	
Input IP3	3	5		dBm	
Input P1dB	-5	0		dBm	
I _{DD}		15	21	mA	T = 25°C, V _{CC} = 3.3V
		16	22	mA	T= -40°C to +85°C; V _{CC} =3.0V to 4.8V
LNA_EN Control Current		30	100	µA	
LNA Turn On Time		200	500	nS	
Receive (ANT-RX) – Bypass Mode					T = 25°C, V_{CC} = 3.3V, LNA_EN = Low, C_RX = High, Vmode = Low, PA_EN = Low
Insertion Loss	5	8	13	dB	T= -40°C to +85°C; V _{CC} =3.0V to 4.8V
	6	8	12	dB	T = 25°C, V _{CC} = 3.3V
Rx Port Return Loss	8	10		dB	T= -40°C to +85°C; V _{CC} =3.0V to 4.8V
ANT Port Return Loss	5	10		dB	
Input IP3	15	20		dBm	
Input P1dB	5	10		dBm	

Parameter	Specification			Unit	Condition
	Min	Typ	Max		
General Specifications					
Switch Control Current-High-Each Line		5	60	μA	
Switch Control Current-Low Each Line		0.1	1	μA	
Switching Speed		100		nS	
ESD		1000		V	
PA Turn-on Time		200	500	nS	10% to 90%

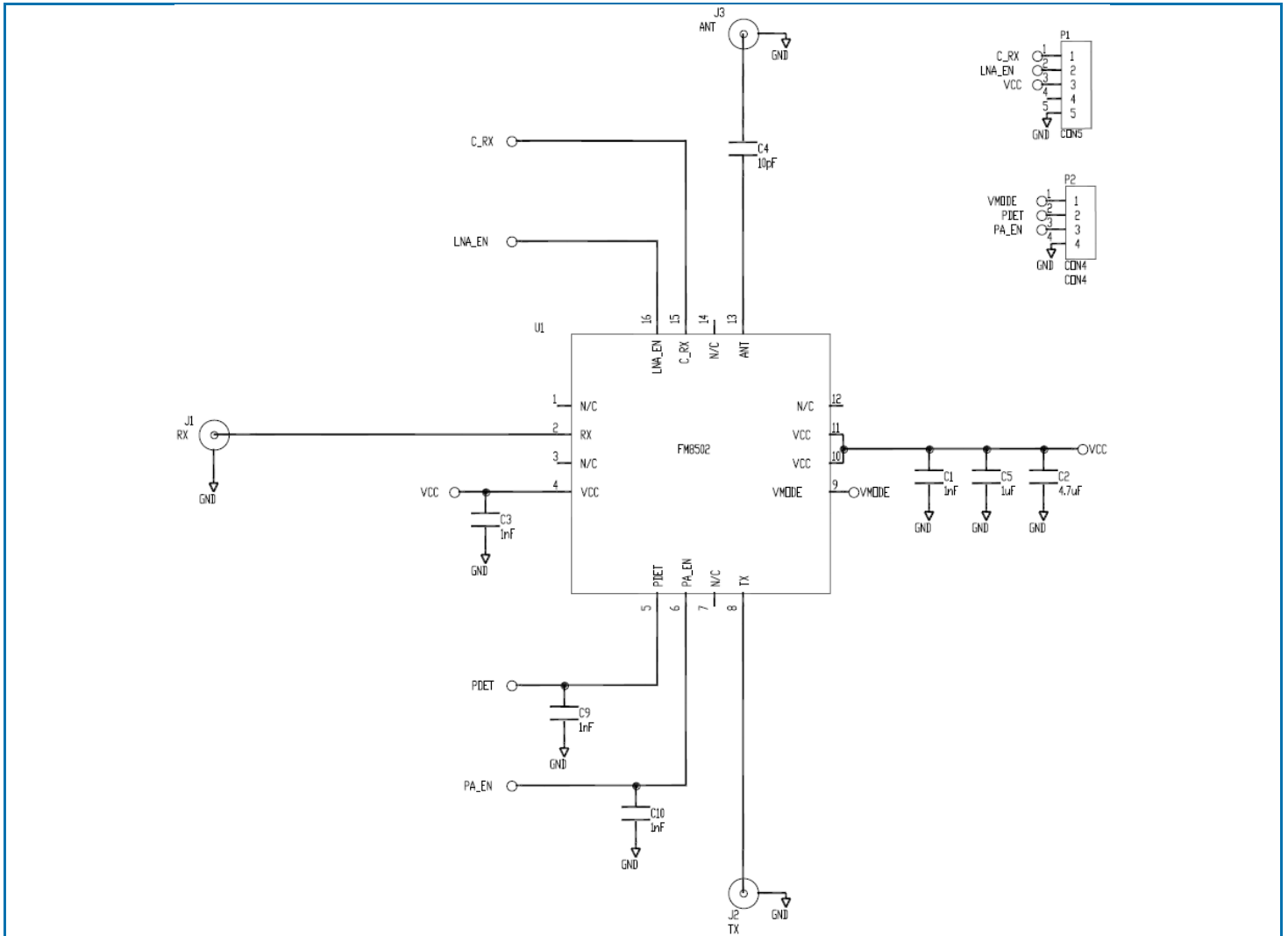
Switch Control Logic Truth Table

Operating Mode	PA_EN	LNA_EN	C_RX	Vmode
Standby	Low	Low	Low	Low
802.11a/n TX High Power	High	Low	Low	Low
802.11a/n TX Low Power	High	Low	Low	High
802.11a/n RX Gain	Low	High	High	Low
802.11a/n RX Bypass	Low	Low	High	Low

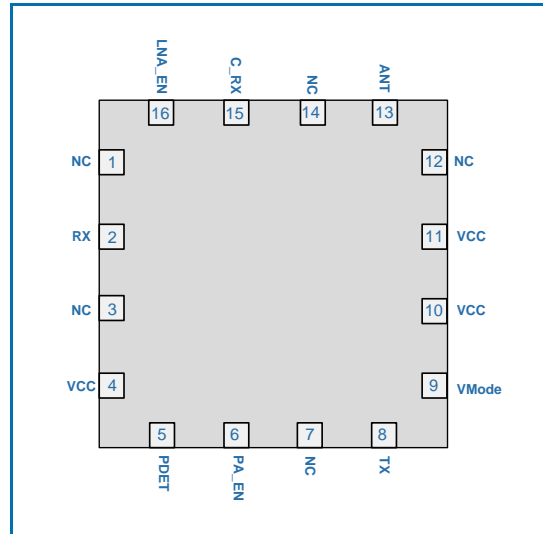
Note:

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

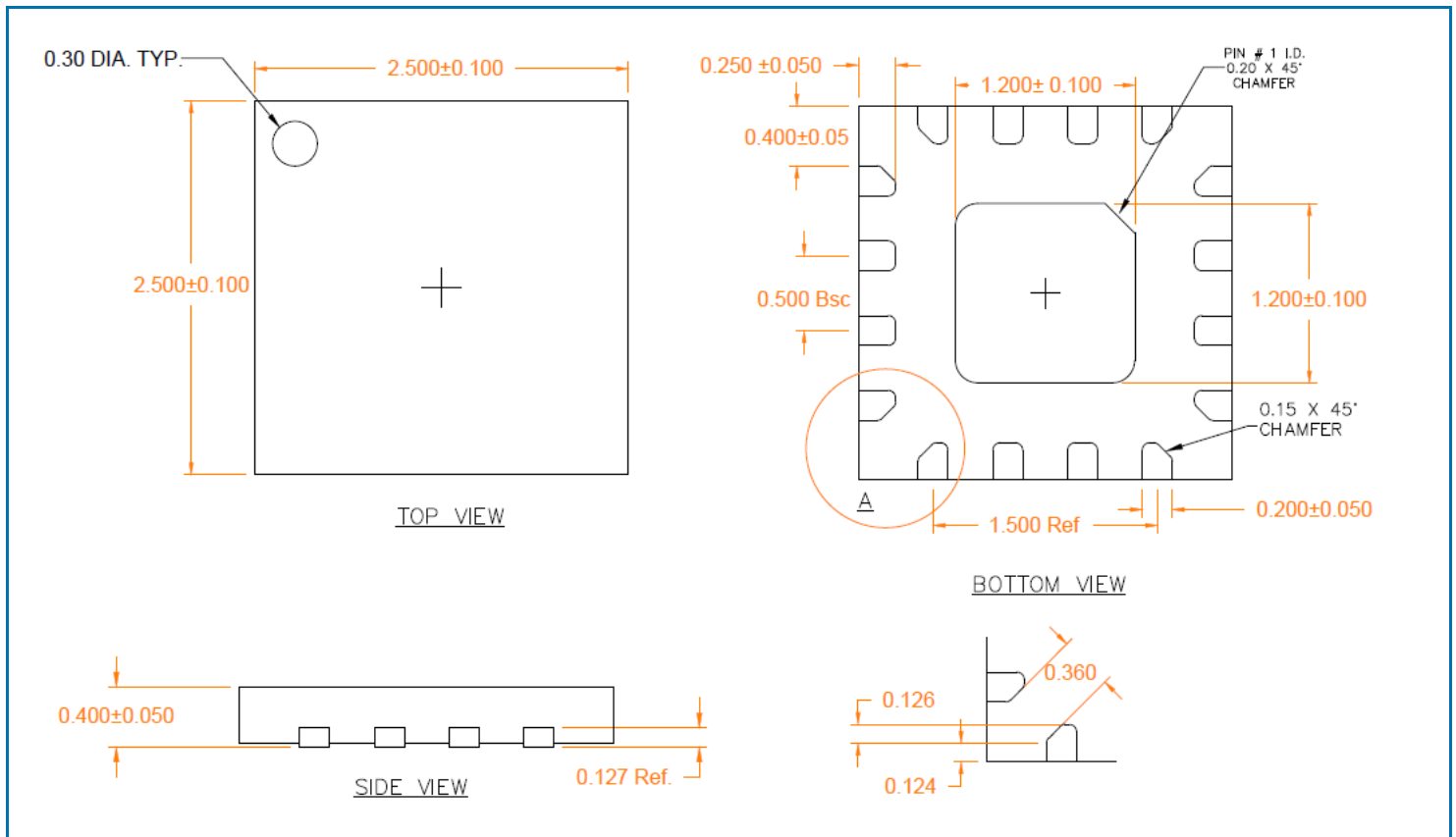
Evaluation Board Schematic



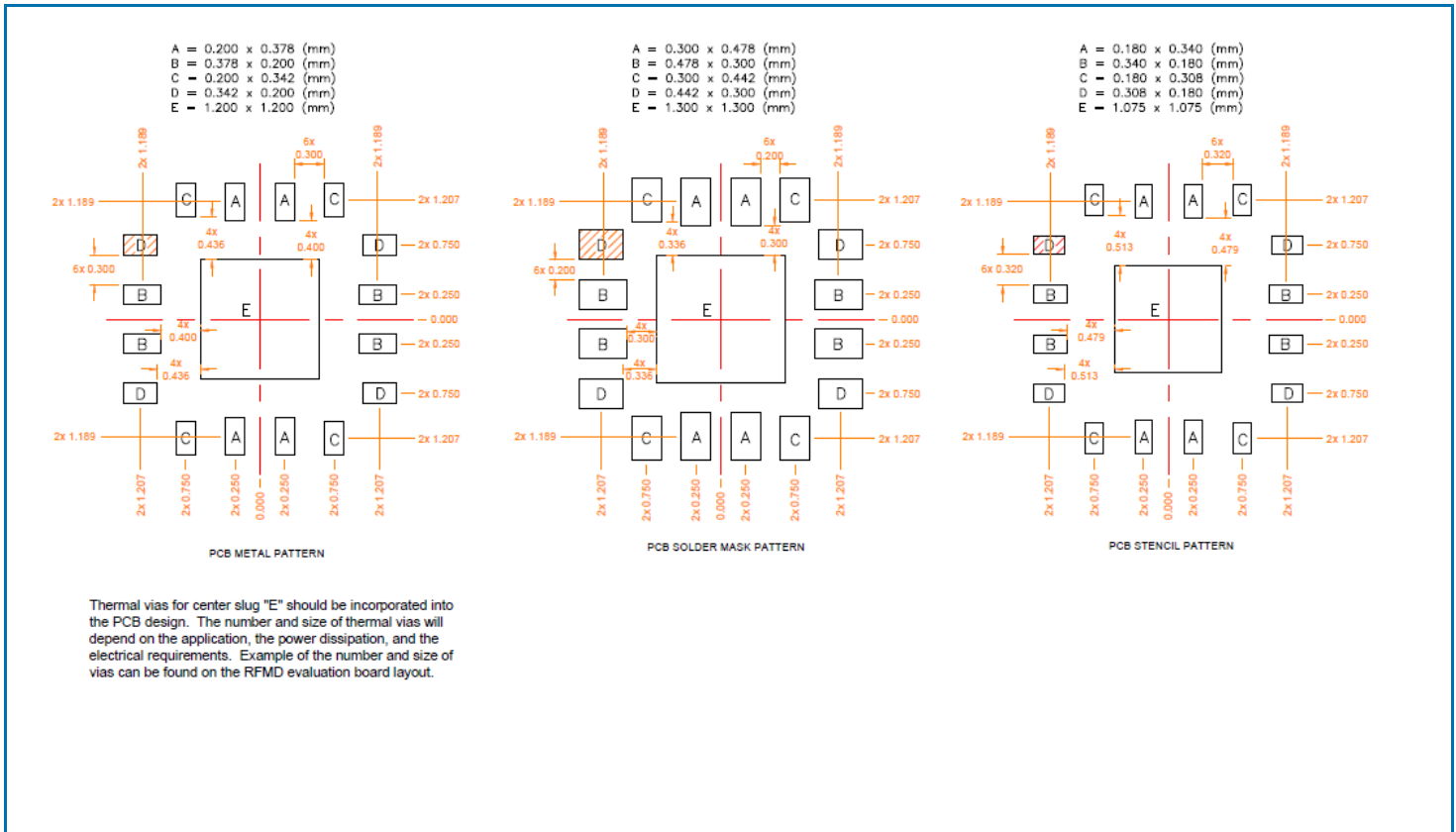
Pin Out



Package Drawing



PCB Patterns



Note: Shaded area represents Pin 1 location

Pin Names and Descriptions

Pin	Name	Description
1	NC*	No Connect. 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	NC*	No Connect. 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	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 blocked internally.
9	Vmode	High/Low power mode control signal. Vmode can be low or floating for nominal conditions (high power mode). Applying 2.8V or greater to this pin enables low power mode.
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	NC*	No Connect. This pin is not connected internally and can be left floating or connected to ground.
13	ANT	RF bidirectional antenna port matched to 50Ω. An external DC block is required.
14	NC*	Not internally connected. This pin can be left floating or grounded.
15	C_RX	Receive switch control pin. See switch truth table for proper level.
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.

*It is recommended to ground all NC pins.