

DATA SHEET

# RFX2411N: 2.4 GHz Transmit / Receive Booster with Diversity Switch for IoT / BLE / Zigbee®

## Applications

- Extended range devices
- Zigbee, ANT+, Thread, Bluetooth, BLE, RF4CE
- Smart energy / metering / lighting / remote control
- Home and industrial automation
- Custom 2.4 GHz radio systems
- Mobile and battery systems

## Features

- Single-chip, single-die CMOS IC
- Transmit/receive switch circuitry
- Antenna diversity switch circuitry
- TX power amplifier or bypass
- RX low-noise amplifier or bypass
- Linearity in compliance with standards for OQPSK, DQPSK, and 8DPSK modulations
- Integrated power detector for transmit power monitor and control
- CMOS control logic
- ESD protection circuitry on all pins
- RF ports do not carry DC voltage
- Internal RF decoupling on VDD bias pins
- Very low DC power consumption
- Operation up to 125 °C ambient temperature
- Full on-chip matching and decoupling circuitry
- Minimal external components required
- 50 Ω input/output matching
- Market-proven CMOS technology
- Small QFN (20-lead, 3.0 x 3.0 x 0.55 mm) package with exposed ground pad



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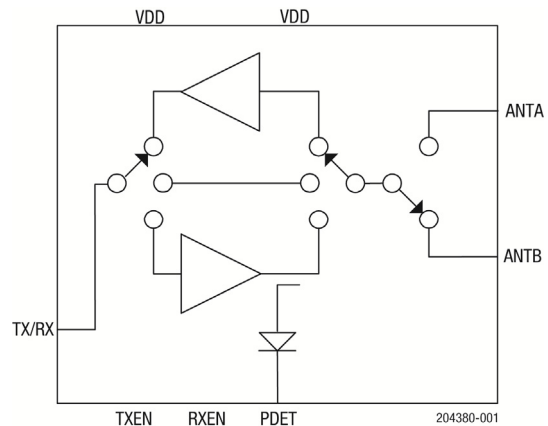
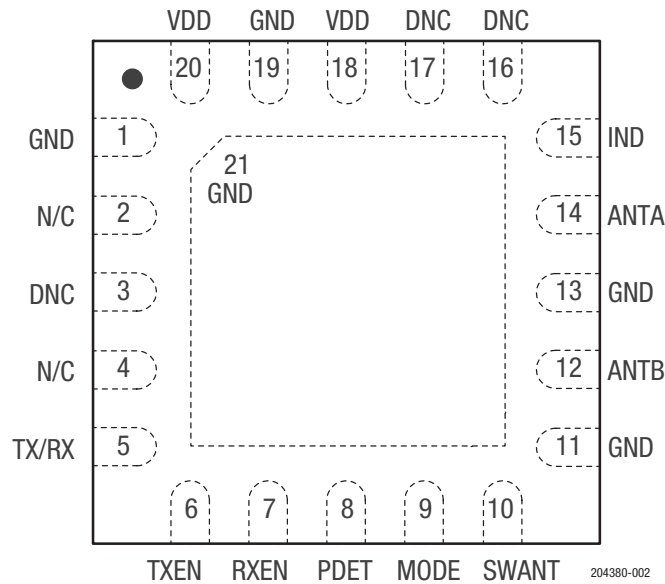


Figure 1. RFX2411N Block Diagram

## Description

The RFX2411N is a fully integrated, single-chip, single-die RFeIC® (RF front-end integrated circuit) that incorporates all the RF functionality needed for wireless Zigbee / smart energy applications. The RFX2411N architecture integrates TX / RX and diversity switching circuitry with PA, LNA, and the associated matching networks with harmonic reduction in a CMOS single-chip device. The device also includes a bypass mode to provide maximum flexibility for system implementations.

The RFX2411N is designed for the 2.4 GHz ISM band and supports Bluetooth / BT EDR / BLE, 802.15.4, Zigbee, ANT, and Thread. The RFX2411N is the perfect solution for applications requiring extended range and bandwidth, such as home and industrial automation, smart energy/smart metering, and RF4CE. RFX2411N interfaces seamlessly with low-voltage CMOS control logic, requires minimal external components, and provides an integrated PA power detector circuit. The superior performance, high sensitivity, high efficiency, low noise, small form factor, low power consumption and low cost make the RFX2411N an ideal and application-friendly solution.



**Figure 2. RFX2411N Pinout (Top View)**

**Table 1. RFX2411N Signal Descriptions**

Pin	Name	Description	Pin	Name	Description
1, 11, 13, 19, 21	GND	Ground (must be connected to ground in the application circuit)	10	SWant	CMOS input to select antenna for diversity
2, 4	N/C	No internal connection	12	ANTB	RF signal from the PA or RF signal applied to the LNA; DC shorted to ground
5	TXRX	RF signal to/from the transceiver: DC shorted to GND	14	ANTA	RF signal from the PA or RF signal applied to the LNA; DC shorted to ground
6	TXEN	CMOS input to control TX enable	15	IND	Inductor to GND
7	RXEN	CMOS input to control RX enable	3, 16, 17	DNC	Reserved (do not connect in the application circuit)
8	PDET	Analog voltage proportional to the PA power output	18, 20	VDD	Voltage supply connection
9	MODE	CMOS input to control mode of operation			

## Electrical and Mechanical Specifications

The absolute maximum ratings of the RFX2411N are provided in Table 2. The recommended operating conditions are specified in Table 3.

The electrical specifications are provided in Tables 4, 5, and 6. The state of the RFX2411N is determined by the logic provided in Table 7.

**Table 2. RFX2411N Absolute Maximum Ratings<sup>1</sup>**

Parameter	Conditions	Minimum	Maximum	Units
DC VDD voltage supply	VDD pins, standby mode	0	4.5	V
DC control pin voltage		0	3.6	V
DC VDD current consumption	Through VDD pins when TX is ON		350	mA
TX RF input power			+5	dBm
LNA RF input power	At active ANT port in RX LNA mode		+5	dBm
Bypass RF input power	At any RF port in bypass mode		+16	dBm
Junction temperature			+150	°C
Storage ambient temperature	No RF and DC voltages applied Appropriate care required according to JEDEC Standards	-50	+150	°C
Electrostatic discharge: Charged Device Model (CDM) Human Body Model (HBM)	All pins		1000 3750	V V

<sup>1</sup> Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device. All maximum RF input power ratings assume 50 Ω terminal impedance.

**ESD HANDLING:** *Although this device is designed to be as robust as possible, electrostatic discharge (ESD) can damage this device. This device must be protected at all times from ESD when handling or transporting. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD handling precautions should be used at all times.*

**Table 3. RFX2411N Recommended Operating Conditions<sup>1</sup>**

Parameter	Conditions	Min	Typ	Max	Units
DC VDD voltage supply	All VDD pins	2.0 <sup>1</sup>	3.3	3.6	V
Control voltage high	RXEN, TXEN, and MODE pins	1.2		VDD	V
Control voltage low	RXEN, TXEN, and MODE pins	0		0.3	V
DC control pin current consumption			300		nA
DC shutdown current			300		nA
PA turn-on/turn-off time				1	µsec
LNA turn on/turn-off time				1	µsec
Antenna switch time				1	µsec
Operating ambient temperature <sup>2</sup>		-40		+125	°C
θja <sup>2</sup>			35		°C/W

<sup>1</sup> At VDD < 3.3 V, the RFX2411N will provide a reduced maximum TX output power.

<sup>2</sup> For operation above +85 °C, use the θja as guidance for system design to assure the junction temperature will not exceed the maximum of +150 °C. A major contributor to θja is the PCB. The above θja value is based on the EVB with multiple vias under the paddle.

**Table 4. RFX2411N PA Transmit Mode Electrical Characteristics (VDD = 3.3 V, TXEN = High, Mode = Low, TA = +25°C, Unless Otherwise Specified)**

Parameter	Test Condition	Min	Typ	Max	Units
Operating frequency band	All RF pins terminated by 50 Ω	2.4		2.5	GHz
Saturated output power			+21		dBm
Small-signal gain			25		dB
Harmonics (2 <sup>nd</sup> - 5 <sup>th</sup> )	POUT ≤ +20 dBm; see application note for proper selection of pin 15 IND		-18	-12	dBm/MHz
Total supply current	POUT = +20 dBm		90		mA
TX quiescent current	TX mode		20		mA
Input return loss			-10		dB
Output return loss			-10		dB
Power detector voltage	POUT = +5 to +20 dbm, 10 kΩ load	100		800	mV
Input/output impedance single-ended			50		Ω
Load VSWR for stability (POUT = +20 dBm)	All non-harmonically related spurs < -53 dBm/MHz		6:1		
Load VSWR for ruggedness (POUT = +20 dBm)	No damage		10:1		

**Table 5. RFX2411N LNA Receive Mode Electrical Characteristics (VDD = 3.3 V, RXEN = High, TXEN/Mode = Low, TA = +25°C, Unless Otherwise Specified)**

Parameter	Test Condition	Min	Typ	Max	Units
Operating frequency band	All RF pins terminated by 50 Ω	2.4		2.5	GHz
Gain			12		dB
Noise figure			2.5		dB
Input P1dB			-8		dBm
RX quiescent current			8		mA
RF port impedance	At TXRX and ANT pins		50		Ω
Input return loss	At ANT pin		-10		dB
Output return loss	At TXRX pin		-10		dB

**Table 6. RFX2411N Bidirectional Bypass Mode Electrical Characteristics (VDD = 3.3 V, Mode = High, TA = +25°C, Unless Otherwise Specified)**

Parameter	Test Condition	Min	Typ	Max	Units
Operating frequency		2.4		2.5	GHz
Insertion loss			5		dB
Input P1dB	At ANTA or ANTB	12			dBm
Current consumption	Mode = 2.0 V, TX, RX = 0 V		700		nA

**Table 7. RFX2411N Control Logic<sup>1</sup>**

Mode of Operation	TXEN	RXEN	MODE	SWant
Shutdown	0	0	0	
PA transmit mode	1	0	0	
	1	1	0	
LNA receive mode	0	1	0	
Bypass mode (bidirectional)	any	any	1	
ANTA port enabled				1
ANTB port enabled				0

<sup>1</sup> "1" denotes high voltage state (> 1.2 V)  
 "0" denotes low voltage stage (< 0.3 V) at control pins  
 "X" denotes do not care: either 1 or 2 without change

### Package Dimensions

The PCB layout footprint for the RFX2411N is shown in Figure 3. The typical part marking is shown in Figure 4. Package dimensions are shown in Figure 5. Tape and reel dimensions are provided in Figure 6.

### Package and Handling Information

Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

The RFX2411N is rated to Moisture Sensitivity Level 1 (MSL1) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *Solder Reflow Information*, document number 200164.

Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.

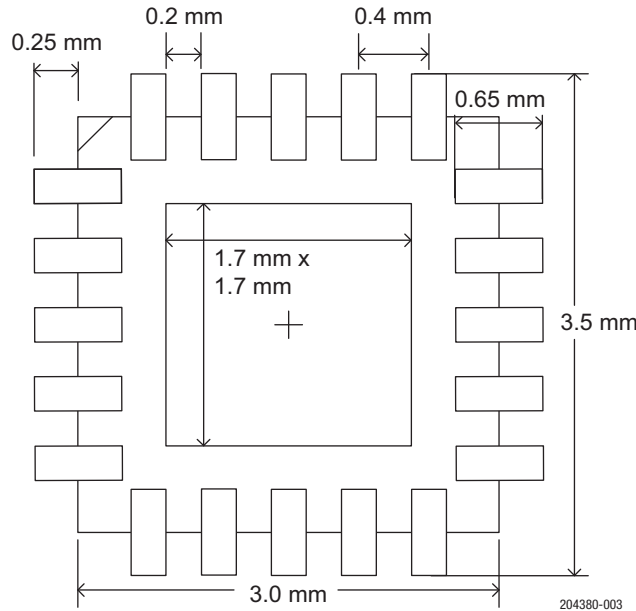


Figure 3. RFX2411N Typical Part Marking

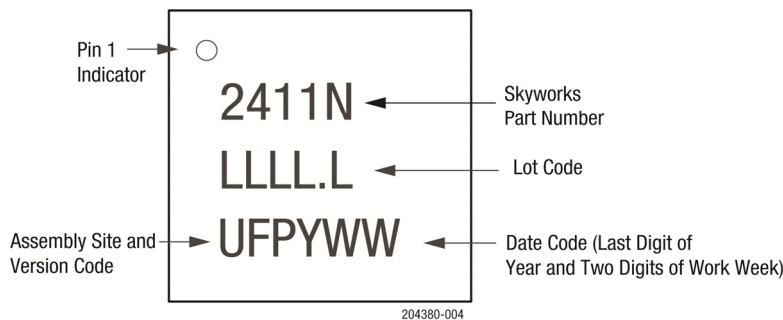
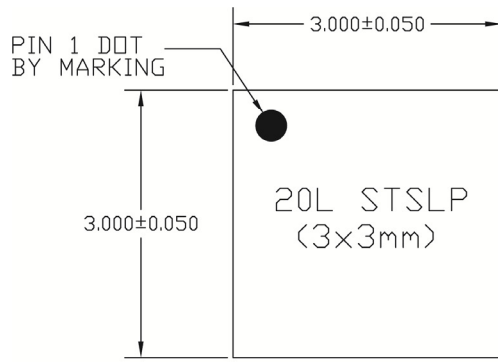
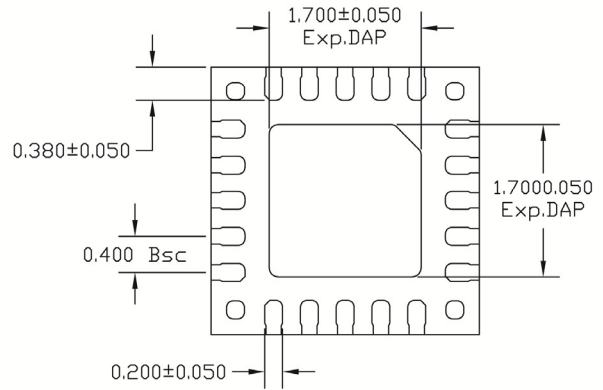


Figure 4. Typical Part Markings (Top View)

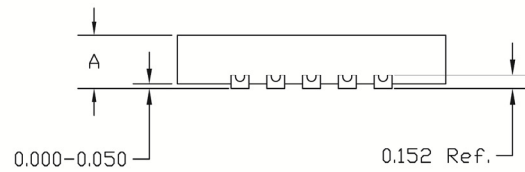


TOP VIEW



BOTTOM VIEW

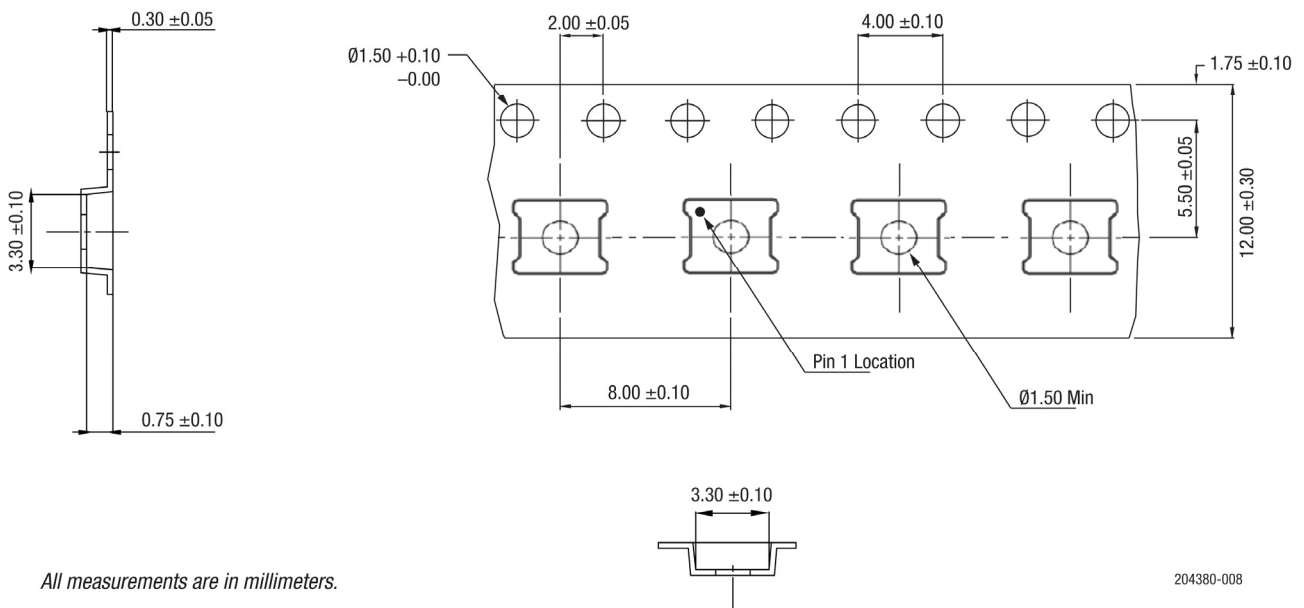
		STSLP
A	MAX.	0.600
	NOM.	0.550
	MIN.	0.500



SIDE VIEW

204380-005

Figure 5. RFX2411N Package Dimensions



All measurements are in millimeters.

204380-008

Figure 6. RFX2411N Tape and Reel Dimensions

## Ordering Information

Part Number	Product Description	Evaluation Board Part Number
RFX2411N	2.4 GHz TX / RX Booster with Diversity Switch for IoT / BLE / Zigbee	RFX2411N-EK1

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