

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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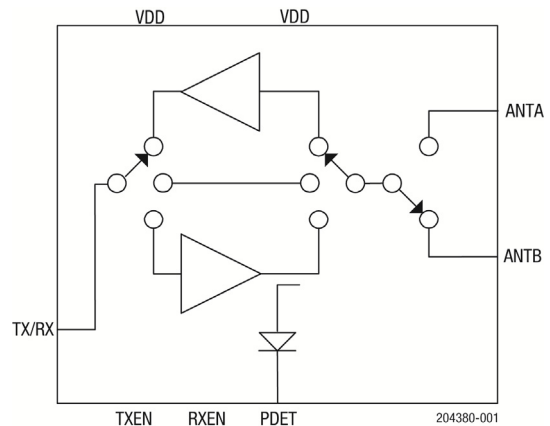


Figure 1. RFX2411N Block Diagram

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.

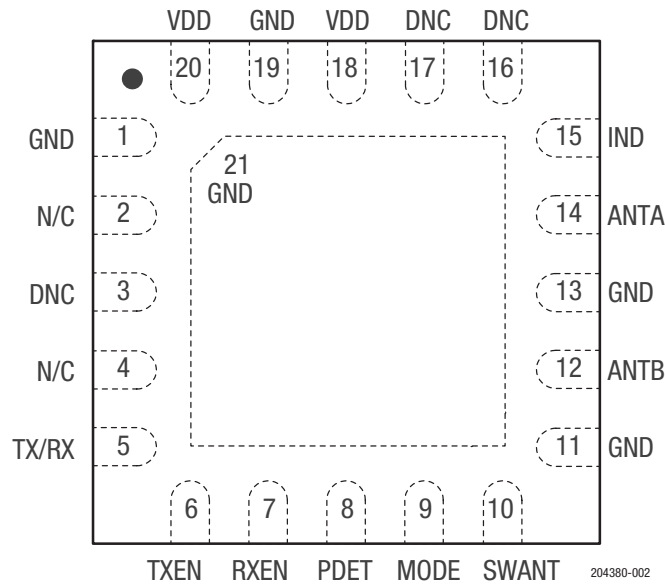


Figure 2. RFX2411N Pinout (Top View)

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 Ratings¹

| 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 |

¹ 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 Conditions¹

| Parameter | Conditions | Min | Typ | Max | Units |
|--|---------------------------|------------------|-----|------|-------|
| DC VDD voltage supply | All VDD pins | 2.0 ¹ | 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 ² | | -40 | | +125 | °C |
| θ _{ja} ² | | | 35 | | °C/W |

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

² For operation above +85 °C, use the θ_{ja} as guidance for system design to assure the junction temperature will not exceed the maximum of +150 °C. A major contributor to θ_{ja} is the PCB. The above θ_{ja} 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 nd - 5 th) | 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 Logic¹

| 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 |

¹ "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.

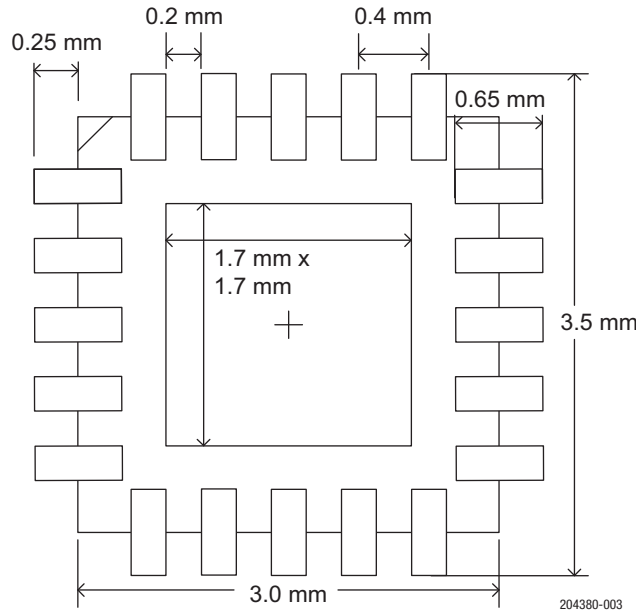


Figure 3. RFX2411N Typical Part Marking

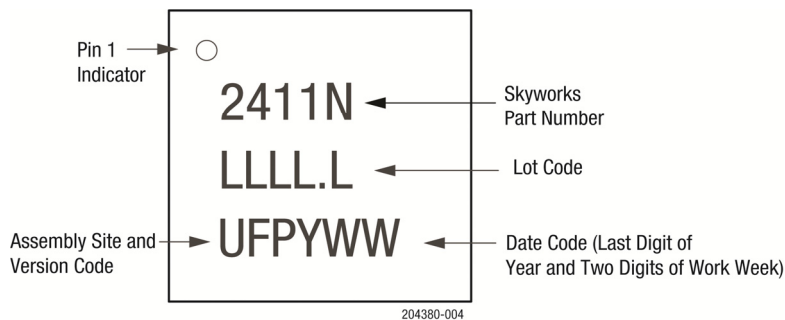
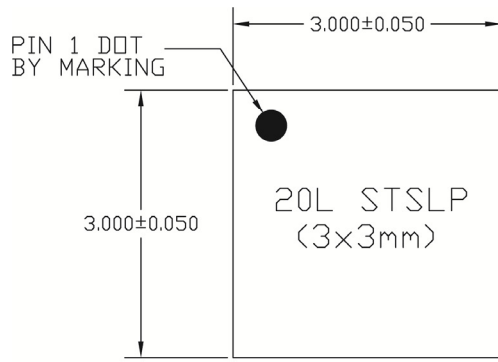
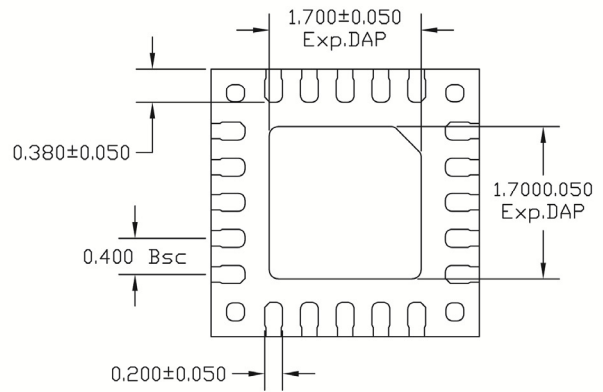


Figure 4. Typical Part Markings (Top View)

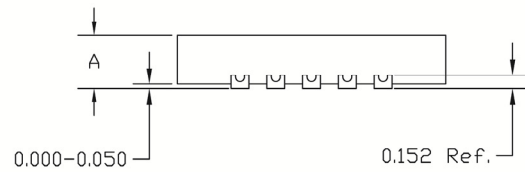


TOP VIEW



BOTTOM VIEW

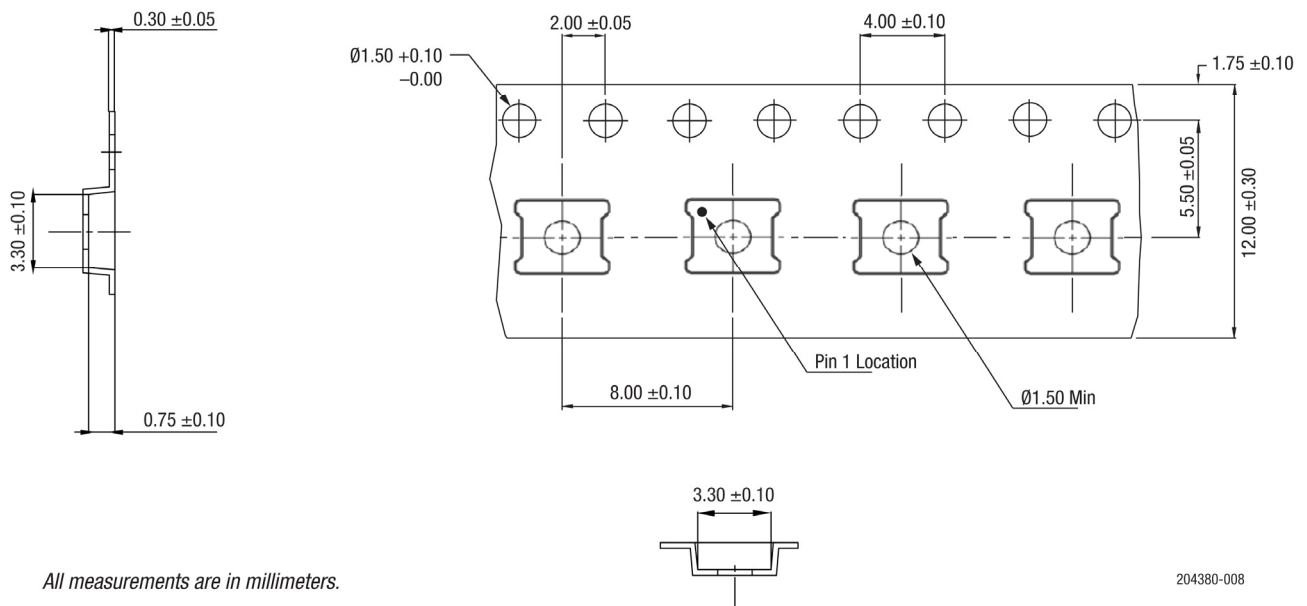
| | | |
|---|------|-------|
| | | STSLP |
| A | MAX. | 0.600 |
| | NOM. | 0.550 |
| | MIN. | 0.500 |



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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