DATA SHEET

RFX2402E: CMOS 2.4GHz Transmit / Receive WLAN RFeIC

Applications

- 802.11b/g/n/ac multimedia applications
- 802.11b/g/n/ac embedded applications
- 802.11b/g/n/ac mobile platforms
- 802.11b/g/n/ac NIC PC card
- Other 2.4 GHz ISM radios
- 802.11b/g/n/ac access point

Features

- 2.4 GHz ISM, single chip, single-die RF front-end IC
- Separate TX and RX transceiver port and single antenna port
- 2.4 GHz power amplifier with low-pass harmonic filter
- Low-noise amplifier
- Transmit/receive switch circuitry
- High transmit signal linearity meeting standards for OFDM and CCK modulation
- Integrated power detector for transmit power monitor and control
- Compatible with low voltage (1.2 V) CMOS control logic or levels up to VDD
- ESD protection circuitry on all ports
- DC decoupled RF ports
- Internal RF decoupling on all VDD bias pins
- Low noise figure for receive channels
- High-power capability for received signals
- Very low DC power consumption
- Full on-chip matching and decoupling circuitry
- Minimal external components required
- 50-Ω input/output matching
- Market-proven CMOS technology
- Small QFN 16-lead (3 x 3 x 0.55 mm) package with exposed ground pad (MSL1, 260 °C per JEDEC J-STD-020)

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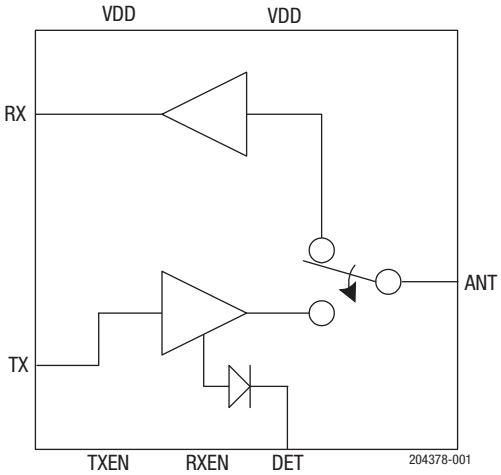

Figure 1. RFX2402E Block Diagram

Description

The RFX2402E is a fully integrated, single-chip, single-die RF front-end integrated circuit (RFeIC) that incorporates all the RF functionality needed for today's wireless communications.

The RFX2402E architecture integrates the PA, LNA, transmit and receive switching circuitry, the associated matching network, and a harmonic filter all in a CMOS single-chip device.

This RFeIC is designed for use in 802.11b/g/n/ac applications operating at 2.4 GHz. Combining superior performance, high sensitivity and efficiency, low noise, small form factor, and low cost, the RFX2402E is the ideal solution for single antenna applications, and the ideal building block for MIMO applications.

The RFX2402E has simple and low-voltage CMOS control logic, and requires minimal external components for system implementation. The PA power detector circuit is also integrated.

A functional block diagram is shown in Figure 1. The pin configuration and package are shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.

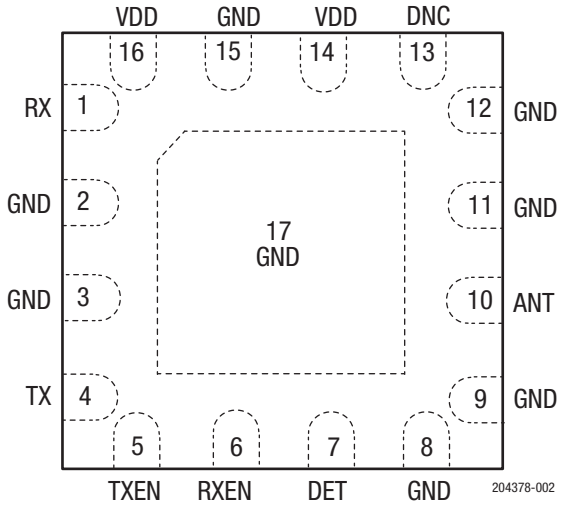

Figure 2. RFX2402E Pinout
(Top View)

Table 1. RFX2402E Signal Descriptions

Pin	Name	Description	Pin	Name	Description
1	RX	Received RF signal from the LNA to the transceiver; DC dhorted to GND	9	GND	Ground (must be connected to ground in the application circuit)
2	GND	Ground (must be connected to ground in the application circuit)	10	ANT	Antenna port RF signal from the PA or RF signal applied to the LNA; DC shorted to GND
3	GND	Ground (must be connected to ground in the application circuit)	11	GND	Ground (must be connected to ground in the application circuit)
4	TX	Transmitted RF signal from the transceiver to the PA: DC shorted to GND	12	GND	Ground (must be connected to ground in the application circuit)
5	TXEN	CMOS input to enable the PA	13	DNC	Reserved pin, do not connect in the application circuit
6	RXEN	CMOS input to enable the LNA	14	VDD	Alternate supply pin, internally connected to pin 16
7	DET	Analog voltage proportional to the PA power output	15	GND	Ground (must be connected to ground in the application circuit)
8	GND	Ground (must be connected to ground in the application circuit)	16	VDD	Voltage supply connection

Electrical and Mechanical Specifications

The absolute maximum ratings of the RFX2402E are provided in Table 2. The recommended operating conditions are specified in Table 3.

The electrical specifications are provided in Table 4. Figure 3 provides a control signal diagram. The state of the RFX2402E is determined by the logic provided in Table 5.

Table 2. RFX2402E Absolute Maximum Ratings[1]

Parameter	Conditions	Minimum	Maximum	Units
DC VDD voltage supply	All VDD pins	0	4.5	V
DC control pin voltage	Through 1 kΩ resistor	0	3.6	V
DC VDD current consumption	Through VDD pins when TX is ON		350	mA
DC control pin current consumption			1	µA
TX RF input power	All operating modes		+10	dBm
ANT RF input power	When RX is "ON"		+5	dBm
Junction temperature			150	°C
Storage ambient temperature	No RF and DC voltages applied Appropriate care required according to JEDEC standards	-50	+150	ºC

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. RFX2402E Recommended Operating Conditions[1]

Parameter	Conditions	Min	Typ	Max	Units
DC VDD voltage supply	All VDD pins	2.7	3.3	3.6	V
Control voltage high[1]	Through 1 kΩ resistor	1.2			V
Control voltage low				0.3	V
DC control pin current consumption			1		uA
DC shutdown current	All control lines low		2		uA
PA turn on/off time			0.5		usec
LNA turn on/off time			0.8		usec
Shutdown and ON state switching time			0.5		usec
Operating ambient temperature	Note 2	-40		+125	ºC
θja			35		ºC/W

1 If control voltage can exceed 1.8 V, a 1 kΩ - 10 kΩ series resistor is recommended for the application circuit on each control line.

2 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.

Table 4. RFX2402E Electrical Specifications[1] (V_{DD} = 3.3 V, T_A = 25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Frequency range	f	All RF pins terminated by 50 Ω	2.4		2.5	GHz
Transmit Mode						
Output P1dB		CW		+24		dBm
Linear output power 802.11b		1 Mbps CCK, Mask Compliance		+21		dBm
Linear output power 802.11n		54 Mbps OFDM, EVM < -33dB at ANT		+17		dBm
Linear output power 802.11g		54 Mbps OFDM, EVM < -30 dB at ANT		+18		dBm
Large-signal power gain in all modes		P_{OUT} = +18 dBm		28		dB
Small-signal power gain in all modes		P_{OUT} = 0 dBm		28.5		dB
TX quiescent current		No RF applied		80		mA
TX linear current		P_{OUT} = +18 dBm		140		mA
Power detector voltage output		P_{OUT} = +5 to +20 dBm		0.25-1.6		V
Second harmonic (CW)		P_{OUT} = +20 dBm, CW at ANT pin		-30		dBc
Third harmonic (CW)		P_{OUT} = +20dBm, CW at ANT pin		n35		dBc
Modulated second harmonic		P_{OUT} = +20 dBm, 802.11n HT40		-26		dBm/MHz
Modulated third harmonic		P_{OUT} = +20 dBm, 802.11n HT40		-30		dBm/MHz
Input return loss				-10		dB
Output return loss				-12		dB
Input output impedance single-ended				50		Ω
TX leakage to RX port		P_{OUT} = +20 dBm at ANT		-7		dBm
Receive Mode						
Gain				11		dB
Noise figure				3		dB
Input return loss				-12		dB
Output return loss				-10		dB
Rf port impedance				50		Ω
Rx quiescent current		No RF applied		9		mA
Input p_{1db}				-5		dBm

[1] Performance is guaranteed only under the conditions listed in this table.

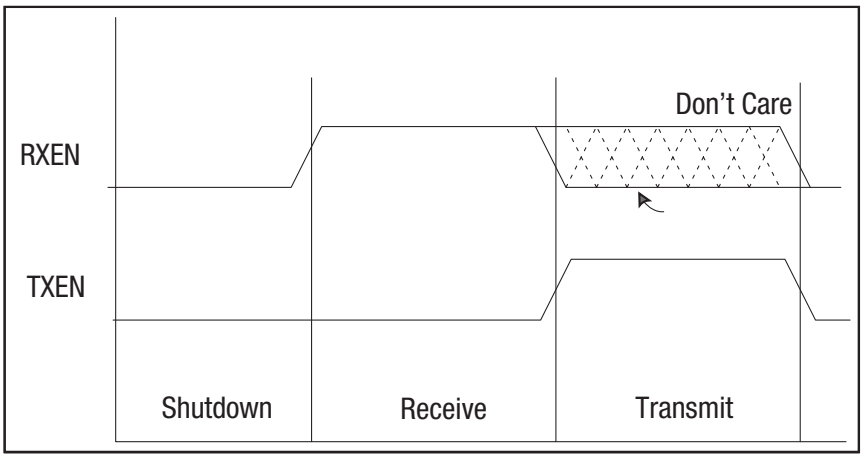

Figure 3. RFX2402E Control Signal Diagram

Table 5. RFX2402E Control Logic[1]

Operating Conditions	TXEN	RXEN
Shutdown	0	0
RX active	0	1
TX active	1	x

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 "0" can be applied

Package Dimensions

The PCB layout footprint for the RFX2402E is shown in Figure 4. Typical part markings are shown in Figure 5. Package dimensions are shown in Figure 6, and tape and reel dimensions are provided in Figure 7.

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 RFX2402E 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.

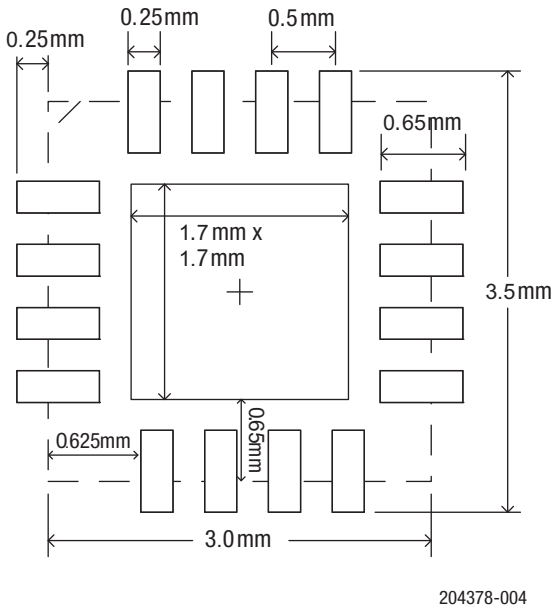

Figure 4. RFX2402E PCB Layout Footprint (Top View)

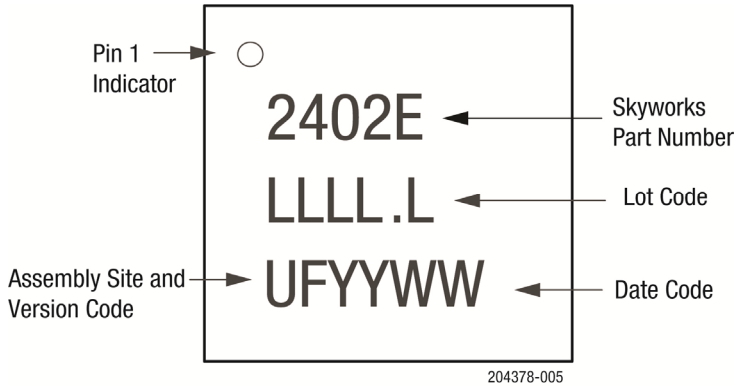

Figure 5. Typical Part Markings (Top View)

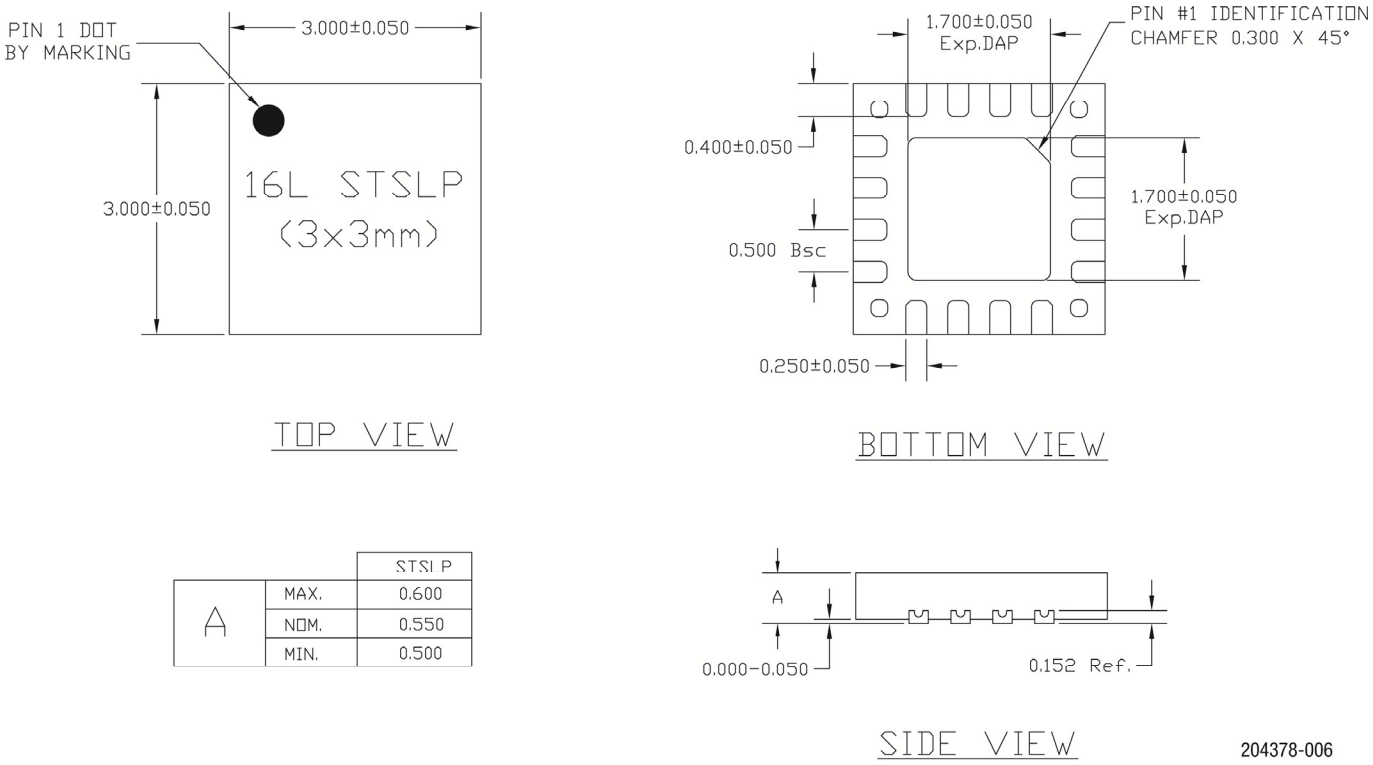

Figure 6. RFX2402E Package Dimensions

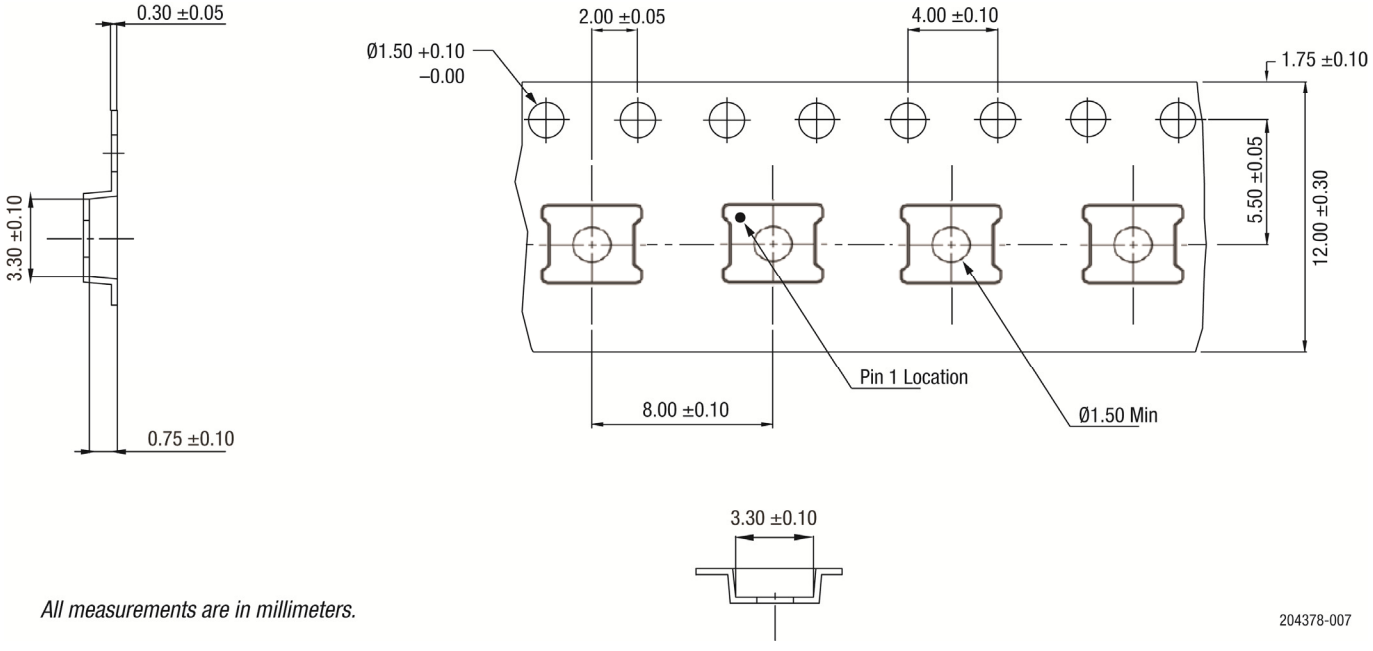

Figure 7. RFX2402E Tape and Reel Dimensions

Ordering Information

Part Number	Product Description	Evaluation Board Part Number
RFX2402E	CMOS 2.4 GHz Transmit / Receive WLAN RFeIC	RFX2402E-EK1

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