DATA SHEET

RFX2401C: 2.4 GHz ZigBee®/ISM Front-End Module

Applications

- ZigBee extended range devices
- ZigBee smart power
- Wireless sound and audio systems
- Home and industrial automation
- Wireless sensor networks
- Custom 2.4 GHz radio systems

Features

- 2.4 GHz ZigBee high-power single-chip, single-die RF front-end IC
- Single-ended 50 Ω input and output ports
- Integrated PA with up to +22 dBm output power
- Integrated LNA with 2.5 dB noise figure
- Transmit/receive switch circuitry
- High transmit signal linearity meeting standards for OQPSK modulation
- Low voltage (1.2 V) CMOS control logic
- ESD protection circuitry on all ports
- DC decoupled RF ports
- Full on-chip matching and decoupling circuitry
- Market proven CMOS technology
- Small QFN, 16-pin (3 x 3 x 0.55 mm) package with exposed ground pad (MSL1, 260 °C per JEDEC J-STD-020)

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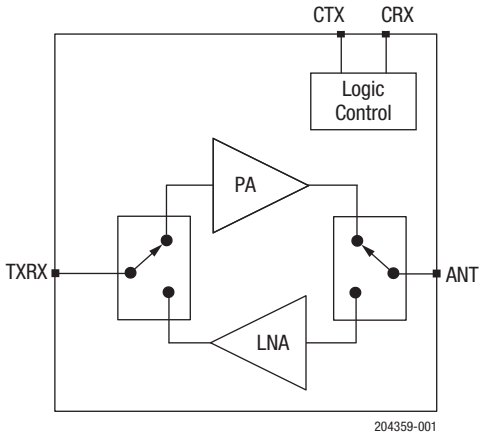


Figure 1. RFX2401C Block Diagram

Description

The RFX2401C is a fully integrated front-end module that incorporates all the RF functionality needed for IEEE 802.15.4/ZigBee, wireless sensor network, and any other wireless systems in the 2.4 GHz ISM band. The RFX2401C architecture integrates the PA, LNA, transmit and receive switching circuitry, and the associated matching network, all in a single package.

Typical high-power applications include home and industrial automation, smart power, and RF4CE among others. Combining superior performance, high sensitivity and efficiency, low noise, small form factor, and low cost, the RFX2401C is the perfect solution for applications requiring extended range and bandwidth. RFX2401C has simple and low-voltage CMOS control logic, and a wide operating supply voltage range.

The device is provided in a compact, 16-pin 3 x 3 mm Quad Flat No-Lead (QFN) package. 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.

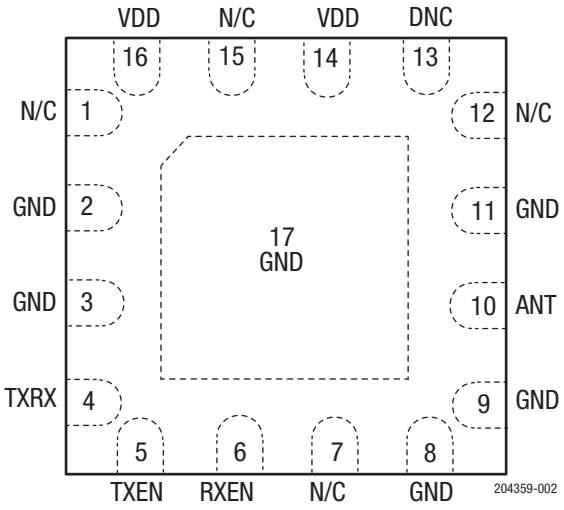


Figure 2. RFX2401C Pinout
(Top View)

Table 1. RFX2401C Signal Descriptions

Pin	Name	Description	Pin	Name	Description
1	N/C	Not connected internally	9	GND	Ground
2	GND	Ground	10	ANT	Connect to 50 Ω antenna (DC shorted to GND)
3	GND	Ground	11	GND	Ground
4	TXRX	RF signal to/from the transceiver (DC shorted to GND)	12	N/C	Not connected internally
5	TXEN	CMOS input to control TX enable	13	DNC	Do not connect
6	RXEN	CMOS input to control RX enable	14	VDD	Alternate supply pin, internally connected to pin 16
7	N/C	Not connected internally	15	N/C	Not connected internally
8	GND	Ground	16	VDD	Voltage supply connection

Electrical and Mechanical Specifications

The absolute maximum ratings of the RFX2401C are provided in Table 2. The recommended operating conditions are specified in Table 3.

The electrical specifications are provided in Tables 4 and 5. The state of the RFX2401C is determined by the logic provided in Table 6.

Table 2. RFX2401C Absolute Maximum Ratings[1]

Parameter	Conditions	Minimum	Maximum	Units
DC VDD voltage supply		0	4.0	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		+5	dBm
ANT RF input power	When RX is "ON"		+5	dBm
Junction temperature			150	°C
Storage ambient temperature	No RF and DC voltages applied	-50	+150	ºC
Electrostatic discharge: Human Body Model (HBM)			3250	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. RFX2401C Recommended Operating Conditions[1]

Parameter	Conditions	Min	Typ	Max	Units
DC VDD voltage supply	All VDD pins	2.0	3.3	3.6	V
Control voltage "high"	Through 1 kΩ resistor	1.2		VDD	V
Control voltage "low"		0		0.3	V
Operating ambient temperature	Note 2	-40		+125	ºC
θja			35		ºC/W

1 During production test, devices will be tested at 5 V.

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.

Table 4. RFX2401C Electrical Specifications[1] (V_{DD} = 3.3 V, All Unused Ports Terminated with 50 Ω, T_A = 25 °C, Unless Otherwise Noted)

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
Frequency range	f		2.4		2.525	GHz
Transmit Mode						
Saturated output power				+22		dBm
Small-signal gain			21.5	25	26.5	dB
Second harmonic		P_{OUT} = +20 dBm, IEEE 802.15.4 OQPSK modulation signal		–10		dBm/MHz
Third harmonic		P_{OUT} = +20 dBm, IEEE 802.15.4 OQPSK modulation signal		–20		dBm/MHz
Input return loss				–10		dB
Output return loss				–6		dB
Input / output impedance single-ended				50		Ω
TX quiescent current		No RF applied		17		mA
TX high-power current		P_{OUT} = +20 dBm		90		mA
Load VSWR for stability (P_{OUT} = +20 dBm)		All non-harmonically related spurs less than –43 dBm/MHz		6:1		N/A
Load VSWR for ruggedness (P_{OUT} = +20 dBm)		No damage		10:1		N/A
Receive Mode						
Gain				12		dB
Noise figure				2.5		dB
Input return loss				–10		dB
Output return loss				–12		dB
Rf port impedance				50		Ω
Rx quiescent current		No RF applied		8		mA
Input p_{1db}		At ANT pin		–8		dBm

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

Table 5. RFX2401C Standby Mode Technical Parameters

Parameter	Symbol	Test Condition	Min	Typ	Max	Units
DC shutdown current					1	µA
TXRX-ANT insertion loss (S21)		Pin < -20 dBm		–50		dB
ANT-TXRX insertion loss (S21)				–50		dB
Return loss (S11)		From TXRX port		–1.5		dB
Transmit-receive switching time				800		nsec
Shutdown and “ON” State switching time				800		nsec

Table 6. RFX2401C Control Logic[1]

Mode	TXEN	RXEN
TX active	1	x
RX active	0	1
Shutdown	0	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 "0" can be applied

Application Schematic Board Description

A suggested RFX2401C FEM application schematic diagram is shown in Figure 3. A schematic of the Evaluation Board is shown in Figure 4.

Circuit Design Considerations

The following design considerations are general in nature and must be followed regardless of final use or configuration:

- Paths to ground should be made as short as possible.
- If the transceiver TXRX port has DC present, use a capacitor to block this voltage from reaching the RFX2401C.
- The ground pad of the RFX2401C has special electrical and thermal grounding requirements. This pad is the main thermal conduit for heat dissipation. Because the circuit board acts as the heat sink, it must shunt as much heat as possible from the device.

  Multiple vias to the grounding layer are required.Use thermal vias to assure efficient heat dissipation.
- Locate the bypass capacitors as close as possible to the ground pad. Use two ground vias.
- The VDD (pin 14) is an optional VDD pin, internally connected to pin 16.
- The N/C pins 1, 7, 12, and 15 may be left open or connected to GND.
- If the antenna circuits have DC present, use a capacitor to block this voltage from reaching the RFX2401C.

NOTE: *A poor connection between the ground pad and ground increases junction temperature (TJ), which reduces the life of the device..*

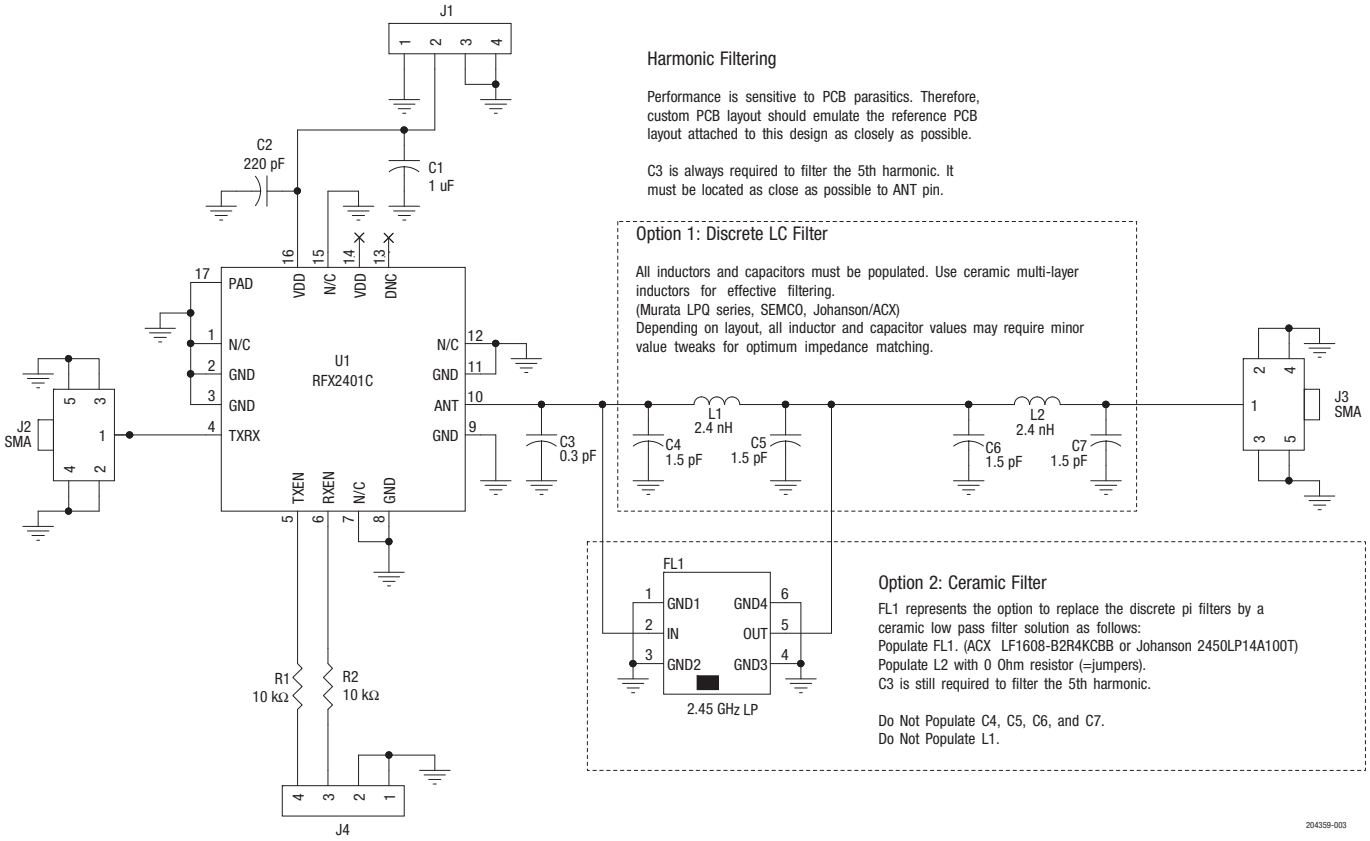


Figure 3. RFX2401C Application Schematic

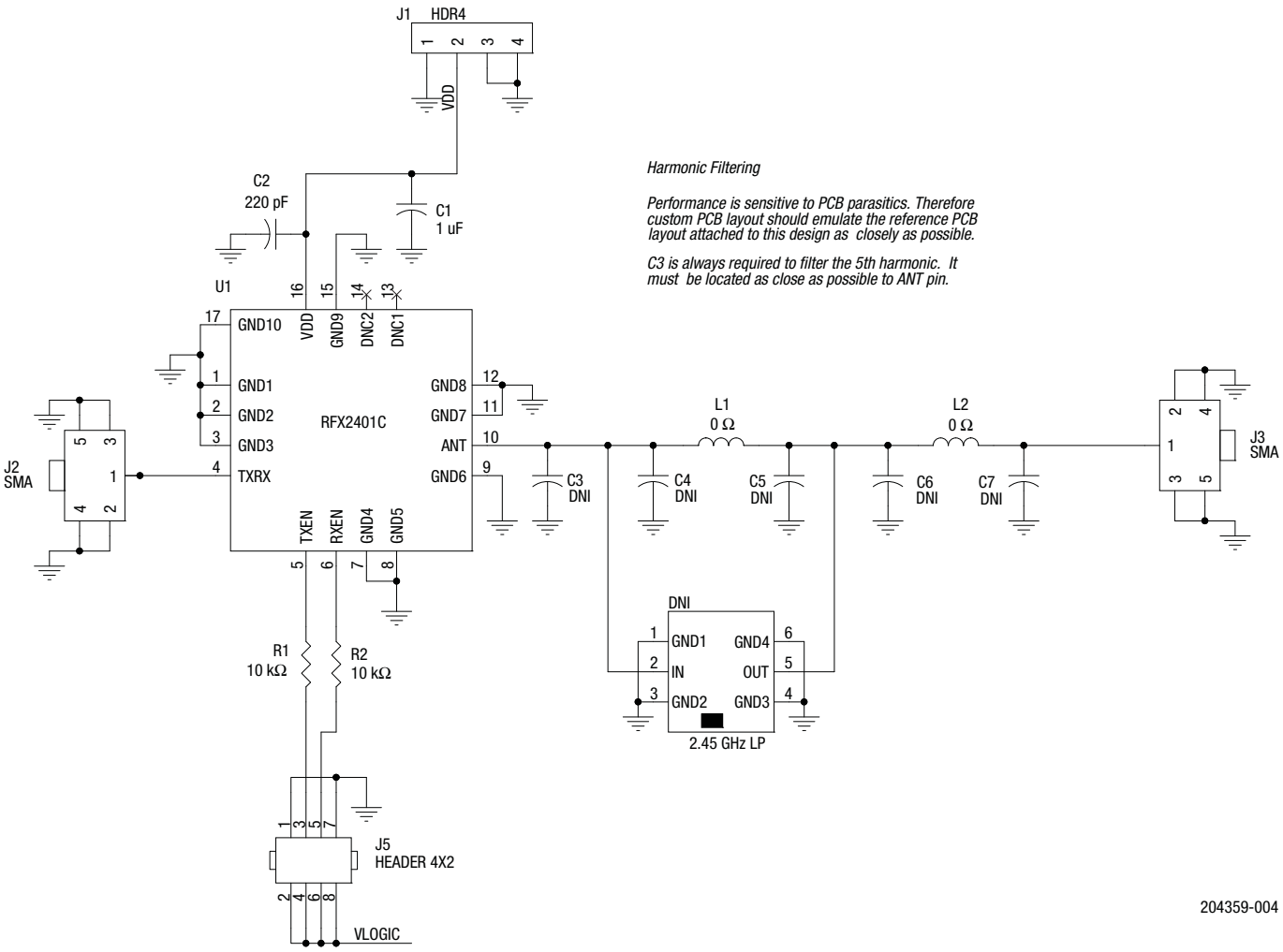


Figure 4. RFX2401C Evaluation Board Schematic

Package Dimensions

The PCB layout footprint for the RFX2401C is shown in Figure 5. Typical part markings are shown in Figure 6. Package dimensions are shown in Figure 7, and tape and reel dimensions are provided in Figure 8.

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 RFX2401C 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.

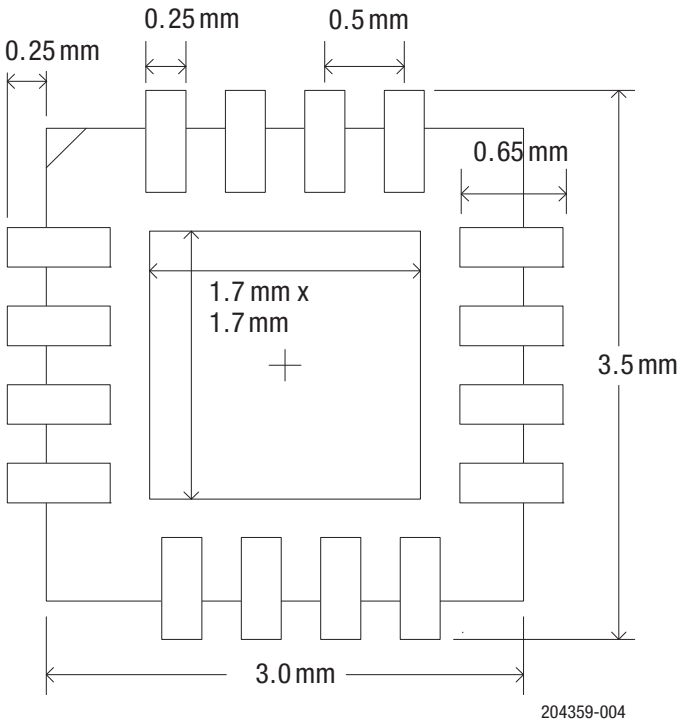


Figure 5. RFX2401C PCB Layout Footprint (Top View)

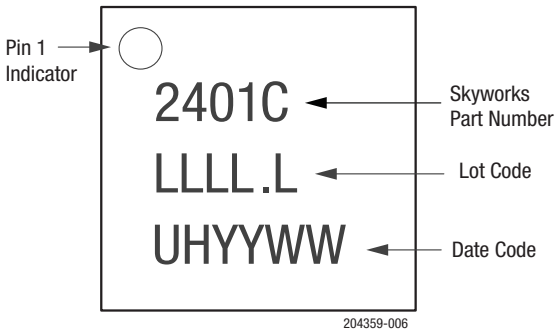
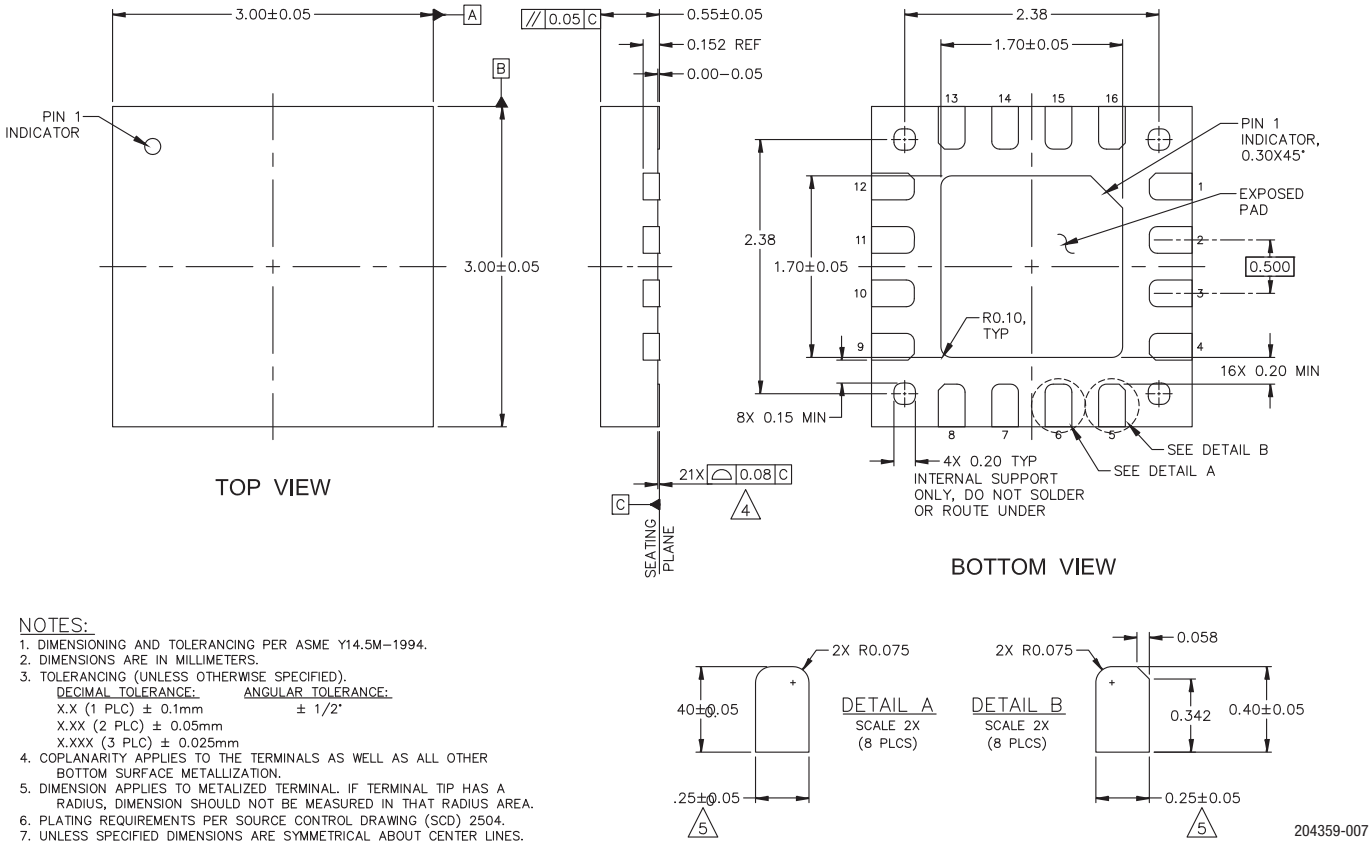


Figure 6. Typical Part Markings (Top View)



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994.
2. DIMENSIONS ARE IN MILLIMETERS.
3. TOLERANCING (UNLESS OTHERWISE SPECIFIED).

DECIMAL TOLERANCE:	ANGULAR TOLERANCE:
X.X (1 PLC) ± 0.1mm	± 1/2°
X.XX (2 PLC) ± 0.05mm	
X.XXX (3 PLC) ± 0.025mm	

4. COPLANARITY APPLIES TO THE TERMINALS AS WELL AS ALL OTHER BOTTOM SURFACE METALLIZATION.
5. DIMENSION APPLIES TO METALIZED TERMINAL. IF TERMINAL TIP HAS A RADIUS, DIMENSION SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
6. PLATING REQUIREMENTS PER SOURCE CONTROL DRAWING (SCD) 2504.
7. UNLESS SPECIFIED DIMENSIONS ARE SYMMETRICAL ABOUT CENTER LINES.

Figure 7. RFX2401C Package Dimensions

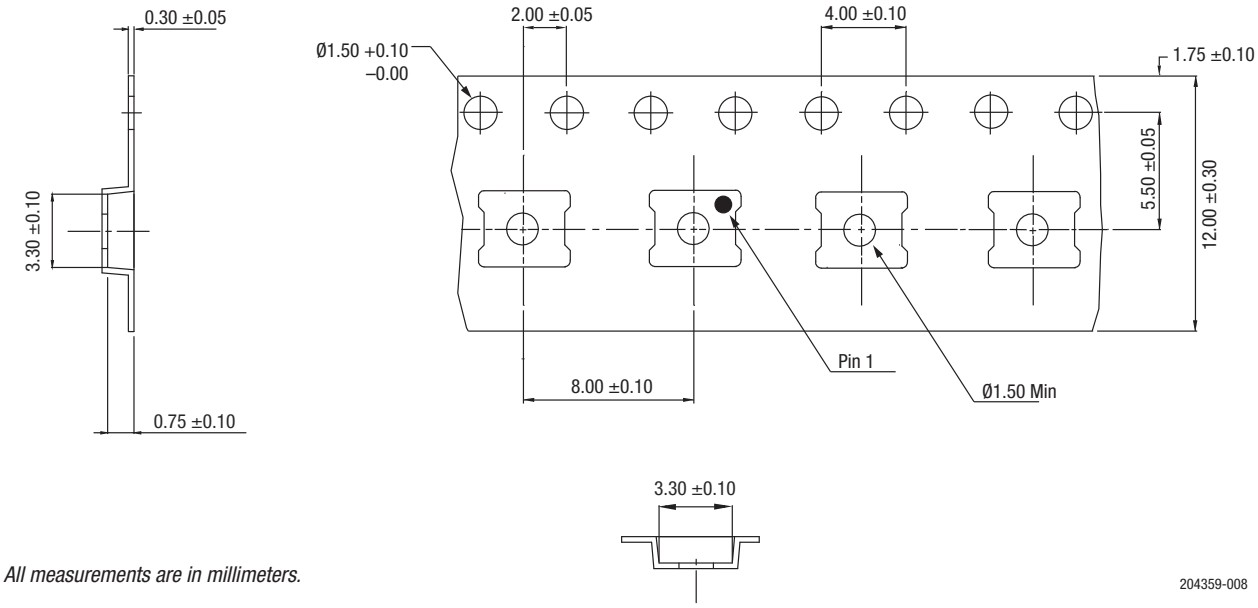


Figure 8. RFX2401C Tape and Reel Dimensions

Ordering Information

Model Name	Manufacturing Part Number	Evaluation Board Part Number
RFX2401C: 2.4 GHz ZigBee/ISM Front-End Module	RFX2401C	RFX2401C-EK1

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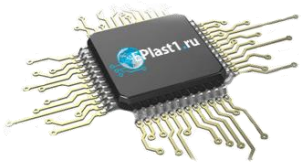
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

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