CMOS RF Front-End IC for 2.4GHz Zigbee/ISM Transmit/Receive

General Description

The EC2401C is a fully integrated, single-chip RF Front-end IC which incorporates all the RF functionality needed for IEEE 802.15.4/ZigBee, wireless sensor network, and any other wireless systems in the 2.4GHz ISM band. The EC2401C integrates the PA, LNA Transmit and Receive switching circuitry in one CMOS single-chip device.

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, EC2401C is the perfect solution for applications requiring extended range and bandwidth. EC2401C has simple and low-voltage CMOS control logic, and requires minimal external components for system implementation.

The EC2401C is available in QFN3×3-16 package.

Features

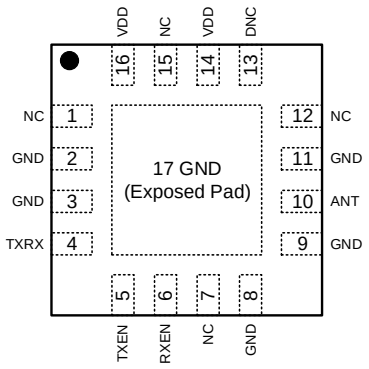
2.4 GHz high-power single-chip, single-die RF front-end IC
Single-ended 50 Ω input and output ports
Integrated PA with up to +22 dBm output power
Integrated LNA with 3.0 dB noise figure
Transmit/receive switch circuitry
ESD protection circuitry on all ports
DC decoupled RF ports
Full on-chip matching and decoupling circuitry
Market proven CMOS technology
QFN16 (3 × 3 × 0.75 mm) package with exposed ground pad

Applications

ZigBee Extended Range Devices
Home and Industrial Automation
ZigBee Smart Power
RF4CE Remote Control
Portable Information Application
Mobile and Battery ZigBee Systems

Pin Description

TOP VIEW

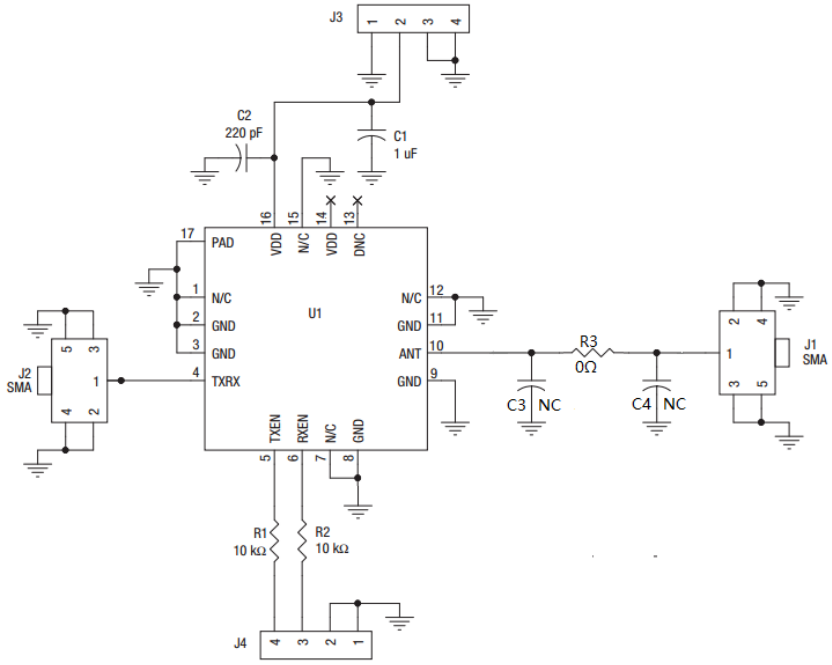


QFN16-3×3

Marking Information

Device	Marking	Package	Shipping
EC2401C	2401C Y XX	QFN3*3-16	5000
Marking Indication: Y: Year XX: Week			

Typical Application Circuit

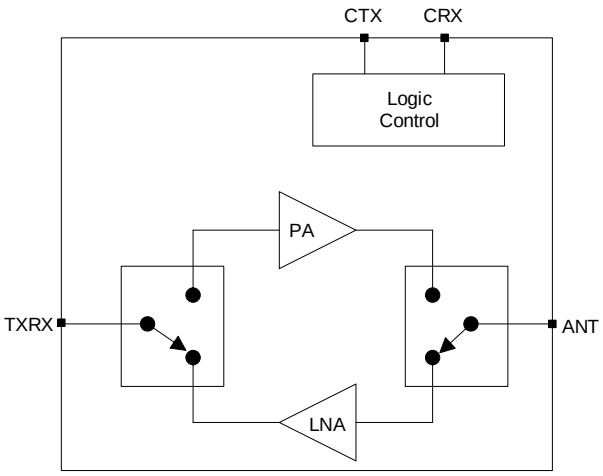


Typical Application Circuit

Pin Description

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

Functional Block Diagram



Absolute Maximum Ratings (1) (2)

Item	Min	Max	Unit
Supply Voltage VDD	0	4	V
DC Control Voltage (3)	0	3.6	V
DC VDD Current Consumption (4)		350	mA
Sleep Current Consumption		0.5	μA
RF Input Power		5	dBm
ESD (HBM)		4000	V
Operating Ambient Temperature	-40	85	°C
Maximum junction temperature		150	°C
Storage temperature, T_{stg}	–40	150	°C
Lead Temperature (Soldering, 10sec.)		260	°C

Note (1): Exceeding these ratings may damage the device.

Note (2): The device is not guaranteed to function outside of its operating conditions.

Note (3): Through 1kΩ resistor

Note (4): Through VDD pins when TXEN is on

ESD Ratings

Item	Description	Value	Unit
$V_{(ESD-HBM)}$	Human Body Model (HBM) ANSI/ESDA/JEDEC JS-001-2014 Classification, Class: 2	2000	V

Recommended Operating Conditions

Item	Min	Max	Unit
Supply voltage VDD (1)	3.0	3.6	V
Control voltage "high" (2)	1.2	VDD	V
Control voltage "low" (2)	0	0.3	V
Operating junction temperature (3)	–40	125	°C
Operating temperature range	-40	85	°C

Note (1): All VDD Pins.

Note (2): Through 1kΩ resistor

Note (3): All limits specified at room temperature (T_A = 25°C) unless otherwise specified. All room temperature limits are 100% production tested. All limits at temperature extremes are ensured through correlation using standard Statistical Quality Control (SQC) methods. All limits are used to calculate Average Outgoing Quality Level (AOQL).

Thermal Information

Item	Description	Value	Unit
$R_{\theta JA}$	Junction-to-ambient thermal resistance (1)(2)	43.4	°C/W
θ_{JCtop}	Junction-to-case (top) thermal resistance	45.6	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	15	°C/W
ψ_{JT}	Junction-to-top characterization parameter	0.6	°C/W
ψ_{JB}	Junction-to-board characterization parameter	15	°C/W
θ_{JCbot}	Junction-to-case (bottom) thermal resistance	3.3	°C/W

Note (1): The package thermal impedance is calculated in accordance to JESD 51-7.

Note (2): Thermal Resistances were simulated on a 4-layer, JEDEC board

Electrical Characteristics

VDD=3.3V, T_A = 25°C, Frequency=2.4GHz-2.5GHz, unless otherwise noted.

Parameter	Specification Typical Value	Unit	Condition
TX			
Quiescent Current	22	mA	
Gain	23	dB	
Saturated Output Power	+22	dBm	
Output Current	95	mA	Pout=20 dBm at ANT
Input Return Loss	-12	dB	
Output Return Loss	-6	dB	
Input / output impedance	50	Ohm	Single-ended
Second Harmonic	-10	dBm/MHz	Pout=20 dBm at ANT
Third Harmonic	-15	dBm/MHz	Pout=20 dBm at ANT
Load VSWR for stability	6:1	N/A	Pout= +20 dBm
Load VSWR for ruggedness	No damage	N/A	Pout=+20 dBm
RX			
Small-Signal Gain	13	dB	
Noise Figure	3.0	dB	
Input P1dB	-4	dBm	
Input Return Loss	-12	dB	
Output Return Loss	-12	dB	
Quiescent Current	9	mA	

Control Logic

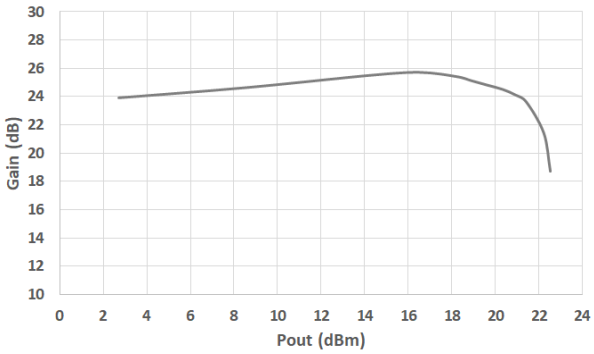
Mode	TXEN	RXEN
TX active	1	X
RX active	0	1
Shutdown	0	0

Typical Performance Characteristics

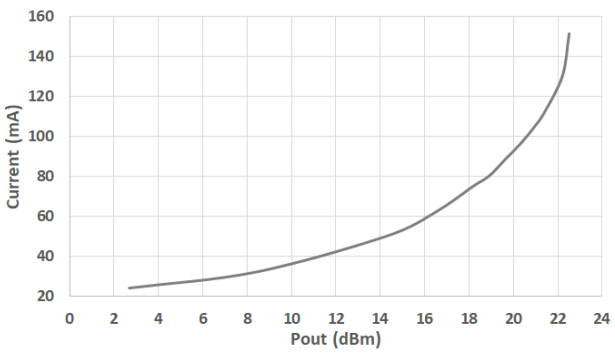
Note (1): Performance waveforms are tested on the evaluation board.

Note (2): T_A = +25ºC, unless otherwise noted.

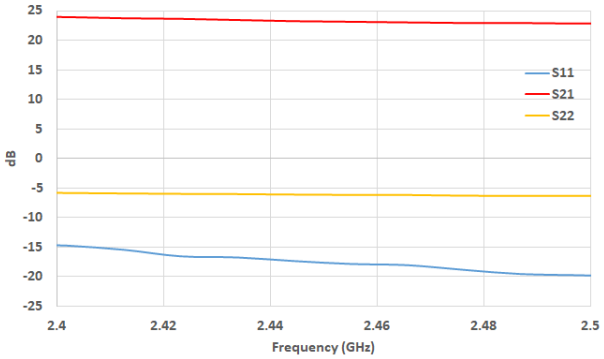
Measured TX Gain



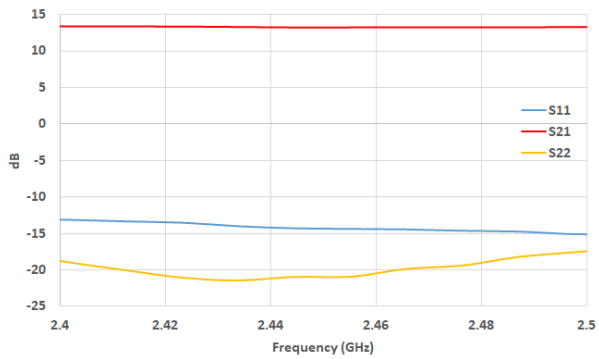
Measured TX Current



TX S Parameters



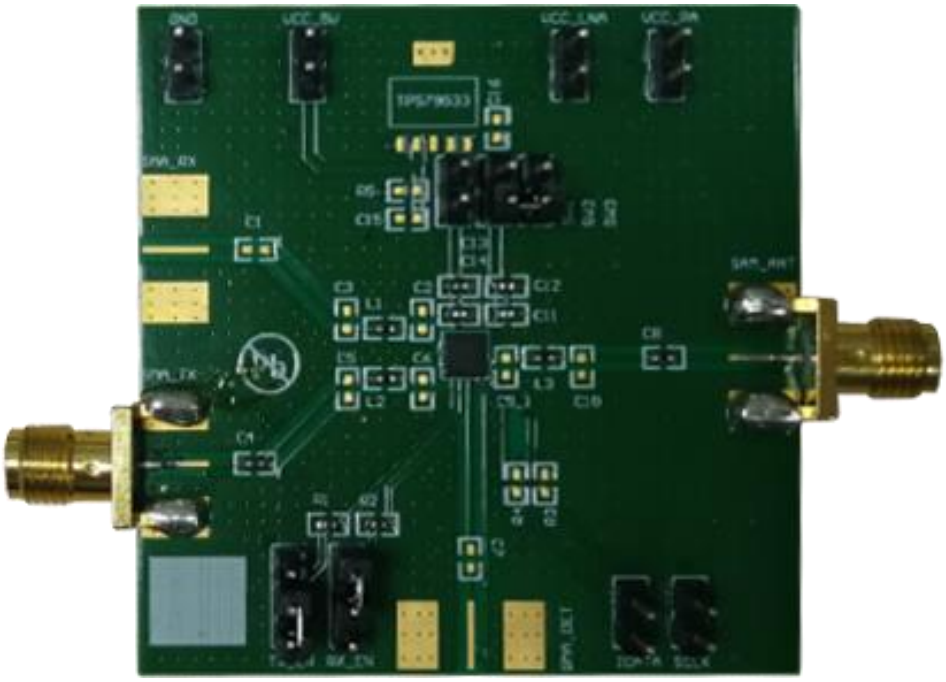
RX S Parameters



Applications Information

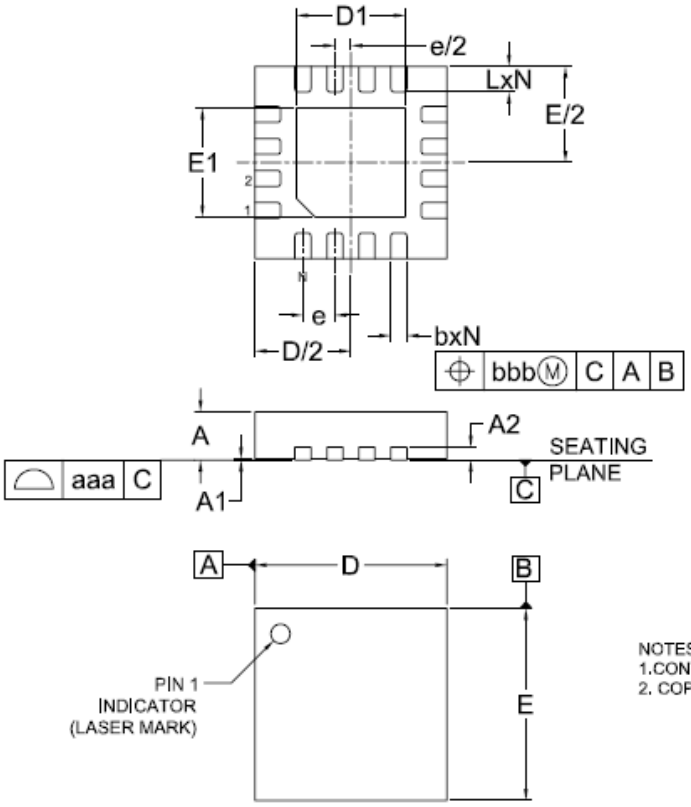
1. TXRX and ANT cannot accept DC voltages.
2. TXRX and ANT require 50 Ω impedance match from 2.4GHz to 2.5GHz working frequency.

Evaluation Board Description



Packaging Information

QFN3×3-16 Outline Dimensions



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	TYP	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A2		0.20	
b	0.18	0.25	0.30
D	2.90	3.00	3.10
D1	1.55	1.70	1.80
E	2.90	3.00	3.10
E1	1.55	1.70	1.80
e		0.5BSC	
L	0.30	0.40	0.50
N		16	
aaa		0.08	
bbb		0.10	

NOTES:
1.CONTROLLING DIMENSIONS ARE IN MILLIMETERS(ANGLES IN DEGREES).
2. COPLANARITY APPLIES TO THE EXPOSED PAD AS THE TERMINALS.