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Product Specification

2.4GHz LOW POWER CONSUMPTION BT Module

Project Name	**2.4GHz LOW POWER CONSUMPTION BT Module**
Model NO	**FN-CC2541**
Customer	
Customer's Part NO	

Approved: SYMEN SONG	Check: Jim Hu	Prepared: SJ LI

Feedback of customer's Confirmation

We accept the specification after Confirmed

Customer name	Customer signature	Confirmation Date

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0. Revision History

REV NO	Date	Modifications	Approved	Draft
Rev1.0	May.8th,2014		SYMEN SONG	SJ LI

1. Introduction

FN-CC2541 is 2.4GHz Bluetooth low power system on chip (SoC), support 250kbps, 500kbps, 1Mbps and 2Mbps data rate, with connecting budget excellent, but the front end the application, the output power can be programmed into the 0dBm, receiving 1Mbps with a sensitivity of -94dBm, mainly used in the 2.4GHz Bluetooth low energy system, personal 2.4GHz system, man-machine interface such as a keyboard, mouse, and remote control etc., sports and leisure equipment, mobile phone accessories and consumer electronics.

RFX2401

1.1 Overview

The block diagram for the module is shown in Figure 1. The modules can be roughly divided into one of three categories: CPU-related modules; modules related to power, test, and clock distribution; and radio-related modules.

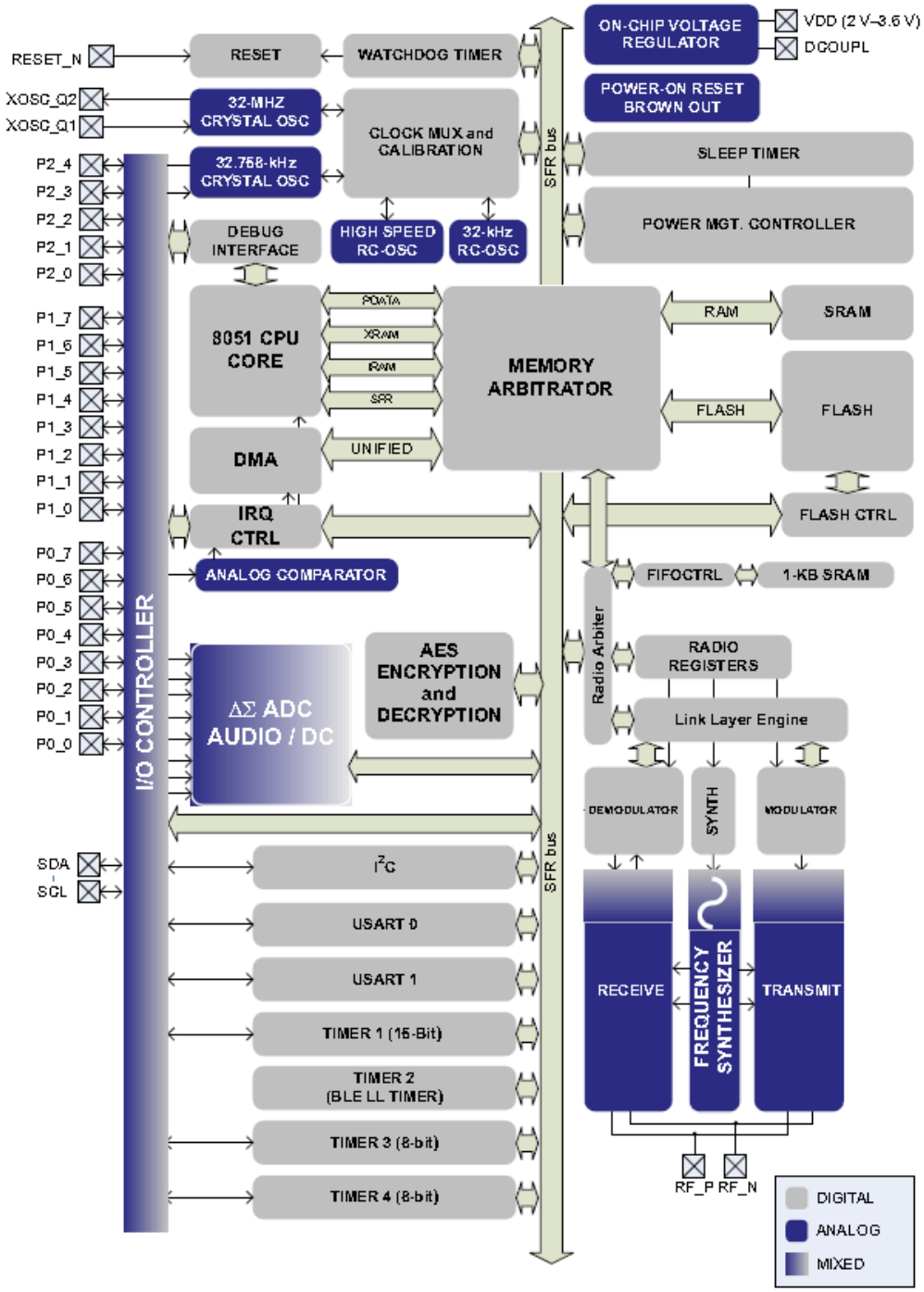


Figure 1. Block Diagram

1.2 ELECTRICAL CHARACTERISTICS

Measured on Texas Instruments CC2541 EM reference design with TA = 25°C and VDD = 3 V, 1 Mbps, GFSK, 250-kHz deviation, Bluetooth low energy mode, and 0.1% BER

PARAMETER	TEST CONDITIONS	MIN TYP MAX	UNIT
Core current consumption	RX mode, standard mode, no peripherals active, low MCU activity	17.9	mA
	RX mode, high-gain mode, no peripherals active, low MCU activity	20.2	
	TX mode, –20 dBm output power, no peripherals active, low MCU activity	16.8	
	TX mode, 0 dBm output power, no peripherals active, low MCU activity	18.2	
	Power mode 1. Digital regulator on; 16-MHz RCOSC and 32-MHz crystal oscillator off;	270	µA

	32.768-kHz XOSC, POR, BOD and sleep timer active; RAM and register retention		
	Power mode 2. Digital regulator off;16-MHz RCOSC and 32- MHz crystal oscillator off; 32.768-kHz XOSC, POR, and sleep timer active; RAM and register retention	1	
	Power mode 3.Digital regulator off;no clocks;POR active; RAM and register retention	0.5	
	Low MCU activity: 32-MHz XOSC running. No radio or peripherals. Limited flash access, no RAM access.	6.7	mA
Peripheral current consumption (Adds to core current Icore for each peripheral unit activated)	Timer 1. Timer running, 32-MHz XOSC used	90	μA
	Timer 2. Timer running, 32-MHz XOSC used	90	
	Timer 3. Timer running, 32-MHz XOSC used	60	
	Timer 4. Timer running, 32-MHz XOSC used	70	
	Sleep timer, including 32.753-kHz RCOSC	0.6	
	ADC, when converting	1.2	mA

1.3 GENERAL CHARACTERISTICS

Measured on Texas Instruments CC2541 EM reference design with TA = 25°C and VDD = 3 V

PARAMETER	TEST CONDITIONS	MIN TYP MAX	UNIT
WAKE-UP AND TIMING			
Power mode 1 → Active	Digital regulator on, 16-MHz RCOSC and 32-MHz crystal oscillator off. Start-up of 16-MHz RCOSC	4	μs
Power mode 2 or 3 → Active	Digital regulator off, 16-MHz RCOSC and 32-MHz crystal oscillator off. Start-up of regulator and 16-MHz RCOSC	120	μs
Active → TX or RX	Crystal ESR = 16 Ω. Initially running on 16-MHz RCOSC, with 32-MHz XOSC OFF	500	μs
	With 32-MHz XOSC initially on	180	μs
RX/TX turnaround	Proprietary auto mode	130	μs
	BLE mode	150	
RADIO PART			
RF frequency range	Programmable in 1-MHz steps	2379 2496	MHz
Data rate and modulation format	2 Mbps, GFSK, 500-kHz deviation 2 Mbps, GFSK, 320-kHz deviation 1 Mbps, GFSK, 250-kHz deviation Data rate and modulation format 1 Mbps, GFSK, 160-kHz deviation 500 kbps, MSK 250 kbps, GFSK, 160-kHz deviation 250 kbps, MSK		

1.4 RF RECEIVE SECTION

Measured on Texas Instruments CC2541 EM reference design with TA = 25°C, VDD = 3 V, fc = 2440 MHz

PARAMETER	TEST CONDITIONS	MIN TYP MAX	UNIT

2 Mbps, GFSK, 500-kHz Deviation, 0.1% BER			
Receiver sensitivity		-90	dBm
Saturation	BER < 0.1%	-1	dBm
Co-channel rejection	Wanted signal at –67 dBm	-9	dB
In-band blocking rejection	±2 MHz offset, 0.1% BER, wanted signal –67 dBm	-2	dB
	±4 MHz offset, 0.1% BER, wanted signal –67 dBm	36	
	±6 MHz or greater offset, 0.1% BER, wanted signal –67 dBm	41	
Frequency error tolerance(1	Including both initial tolerance and drift. Sensitivity better than –67dBm, 250 byte payload. BER 0.1%	–300 300	kHz
Symbol rate error tolerance(2)	Maximum packet length. Sensitivity better than–67dBm, 250 byte payload. BER 0.1%	–120 120	ppm
2 Mbps, GFSK, 320-kHz Deviation, 0.1% BER			
Receiver sensitivity		-86	dBm
Saturation	BER < 0.1%	-7	dBm
Co-channel rejection	Wanted signal at –67 dBm	-12	dB
In-band blocking rejection	±2 MHz offset, 0.1% BER, wanted signal –67 dBm	-1	dB
	±4 MHz offset, 0.1% BER, wanted signal –67 dBm	34	
	±6 MHz or greater offset, 0.1% BER, wanted signal –67 dBm	39	
Frequency error tolerance(1	Including both initial tolerance and drift. Sensitivity better than –67dBm, 250 byte payload. BER 0.1%	–300 300	kHz
Symbol rate error tolerance(2)	Maximum packet length. Sensitivity better than–67dBm, 250 byte payload. BER 0.1%	–120 120	ppm
1 Mbps, GFSK, 250-kHz Deviation, *Bluetooth* low energy Mode, 0.1% BER			
Receiver sensitivity(3) (4)	High-gain mode	-94	dBm
	Standard mode	-88	
Saturation(4)	BER < 0.1%	5	dBm
Co-channel rejection	Wanted signal at –67 dBm	-6	dB
In-band blocking rejection	±1 MHz offset, 0.1% BER, wanted signal –67 dBm	-2	dB
	±2 MHz offset, 0.1% BER, wanted signal –67 dBm	26	
	±3 MHz offset, 0.1% BER, wanted signal –67 dBm	34	
	>6 MHz offset, 0.1% BER, wanted signal –67 dBm	33	
Out-of-band blocking rejection(4)	Minimum interferer level < 2 GHz (Wanted signal –67 dBm)	-21	dBm
	Minimum interferer level [2 GHz, 3 GHz] (Wanted signal –67 dBm)	-25	
	Minimum interferer level > 3 GHz (Wanted signal –67 dBm)	-7	
Intermodulation(4)	Minimum interferer level	-36	dBm

Frequency error tolerance(1	Including both initial tolerance and drift. Sensitivity better than –67dBm, 250 byte payload. BER 0.1%	–250	250	kHz
Symbol rate error tolerance(2)	Maximum packet length. Sensitivity better than–67dBm, 250 byte payload. BER 0.1%	–80	80	ppm
1 Mbps, GFSK, 160-kHz Deviation, 0.1% BER				
Receiver sensitivity(7)		-91		dBm
Saturation	BER < 0.1%	0		dBm
Co-channel rejection	Wanted signal 10 dB above sensitivity level	-9		dB
In-band blocking rejection	±1 MHz offset, 0.1% BER, wanted signal –67 dBm	2		dB
	±2 MHz offset, 0.1% BER, wanted signal –67 dBm	24		
	±3 MHz offset, 0.1% BER, wanted signal –67 dBm	27		
	>6 MHz offset, 0.1% BER, wanted signal –67 dBm	32		
Frequency error tolerance(1	Including both initial tolerance and drift. Sensitivity better than –67dBm, 250 byte payload. BER 0.1%	–200	200	kHz
Symbol rate error tolerance(2)	Maximum packet length. Sensitivity better than–67dBm, 250 byte payload. BER 0.1%	–80	80	ppm
500 kbps, MSK, 0.1% BER				
Receiver sensitivity(7)		-99		dBm
Saturation	BER < 0.1%	0		dBm
Co-channel rejection	Wanted signal at –67 dBm	-5		dB
In-band blocking rejection	±1-MHz offset, 0.1% BER, wanted signal –67 dBm	20		dB
	±2-MHz offset, 0.1% BER, wanted signal –67 dBm	27		
	>2-MHz offset, 0.1% BER, wanted signal –67 dBm	28		
Frequency error tolerance(1	Including both initial tolerance and drift. Sensitivity better than –67dBm, 250 byte payload. BER 0.1%	–150	150	kHz
Symbol rate error tolerance	Maximum packet length. Sensitivity better than–67dBm, 250 byte payload. BER 0.1%	–80	80	ppm
250 kbps, GFSK, 160 kHz Deviation, 0.1% BER				
Receiver sensitivity (8)		-98		dBm
Saturation	BER < 0.1%	0		dBm
Co-channel rejection	Wanted signal at –67 dBm	-3		dB
In-band blocking rejection	±1-MHz offset, 0.1% BER, wanted signal –67 dBm	23		dB
	±2-MHz offset, 0.1% BER, wanted signal –67 dBm	28		
	>2-MHz offset, 0.1% BER, wanted signal –67 dBm	29		
Frequency error tolerance(9)	Including both initial tolerance and drift. Sensitivity better than –67dBm, 250 byte payload. BER 0.1%	–150	150	kHz
Symbol rate error tolerance(10)	Maximum packet length. Sensitivity better than–67dBm, 250 byte payload. BER 0.1%	–80	80	ppm
250 kbps, MSK, 0.1% BER				

Receiver sensitivity (11)		-99	dBm
Saturation	BER < 0.1%	0	dBm
Co-channel rejection	Wanted signal at –67 dBm	-5	dB
In-band blocking rejection	±1-MHz offset, 0.1% BER, wanted signal –67 dBm	20	dB
	±2-MHz offset, 0.1% BER, wanted signal –67 dBm	29	
	>2-MHz offset, 0.1% BER, wanted signal –67 dBm	30	
Frequency error tolerance	Including both initial tolerance and drift. Sensitivity better than –67dBm, 250 byte payload. BER 0.1%	–150 150	kHz
Symbol rate error tolerance	Maximum packet length. Sensitivity better than–67dBm, 250 byte payload. BER 0.1%	–80 80	ppm
ALL RATES/FORMATS			
Spurious emission in RX.Conducted measurement	f < 1 GHz	-67	dBm
Spurious emission in RX.Conducted measurement	f > 1 GHz	-57	dBm

(1) Difference between center frequency of the received RF signal and local oscillator frequency
(2) Difference between incoming symbol rate and the internally generated symbol rate
(3) The receiver sensitivity setting is programmable using a TI BLE stack vendor-specific API command. The default value is standard mode.
(4) Results based on standard-gain mode.
(5) Difference between center frequency of the received RF signal and local oscillator frequency
(6) Difference between incoming symbol rate and the internally generated symbol rate
(7) Results based on high-gain mode.
(8) Results based on standard-gain mode.
(9) Difference between center frequency of the received RF signal and local oscillator frequency
(10) Difference between incoming symbol rate and the internally generated symbol rate
(11) Results based on high-gain mode.

1.5 RF TRANSMIT SECTION

Measured on Texas Instruments CC2541 EM reference design with TA = 25°C, VDD = 3 V and fc = 2440 MHz

PARAMETER	TEST CONDITIONS	MIN TYP MAX	UNIT
Output power	Delivered to a single-ended 50-Ω load through a balun using maximum recommended output power setting	8	dBm
	Delivered to a single-ended 50-Ω load through a balun using minimum recommended output power setting	-20	
Programmable output power range	Delivered to a single-ended 50-Ω load through a balun using minimum recommended output power setting	20	dB
Spurious emission conducted measurement	f < 1 GHz	-52	dBm
	f > 1 GHz	-48	
	Suitable for systems targeting compliance with worldwide radio-frequency regulations ETSI EN 300 328 and EN 300 440 Class 2 (Europe), FCC CFR47 Part 15 (US), and ARIB STD-T66 (Japan)		
Optimum load impedance	Differential impedance as seen from the RF port (RF_P and RF_N) toward the antenna	70 +/-30	Ω

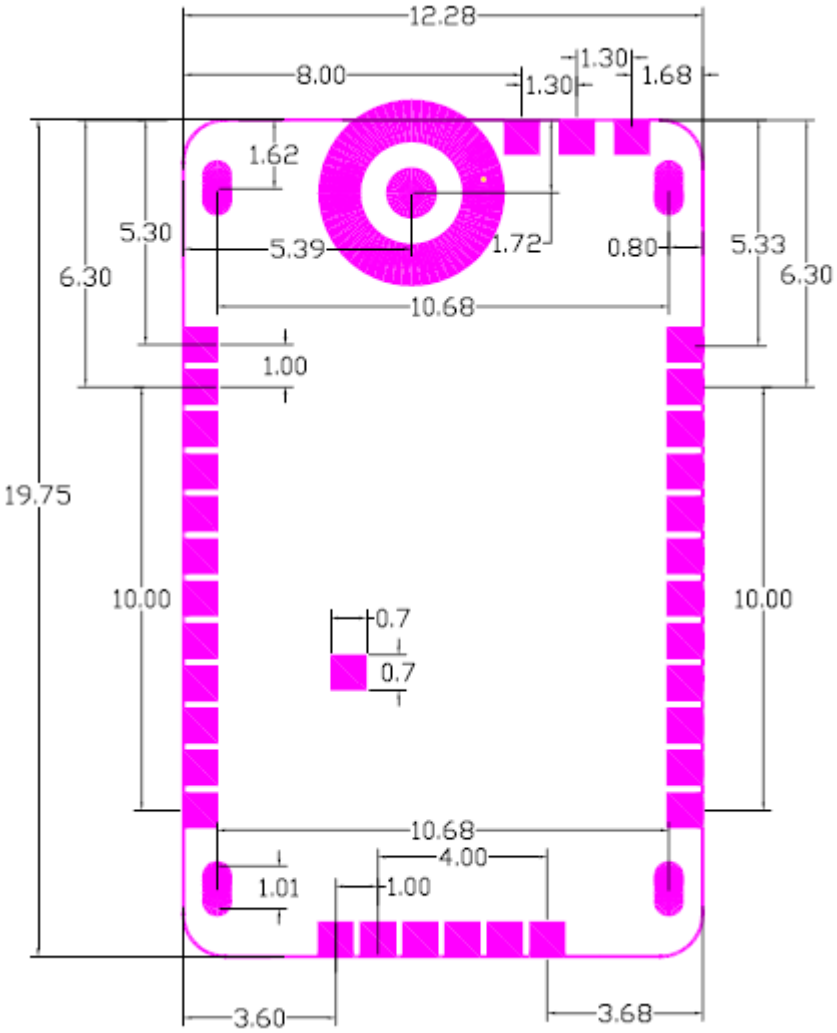
1.6 RECOMMENDED OPERATING CONDITIONS

over operating free-air temperature range (unless otherwise noted)

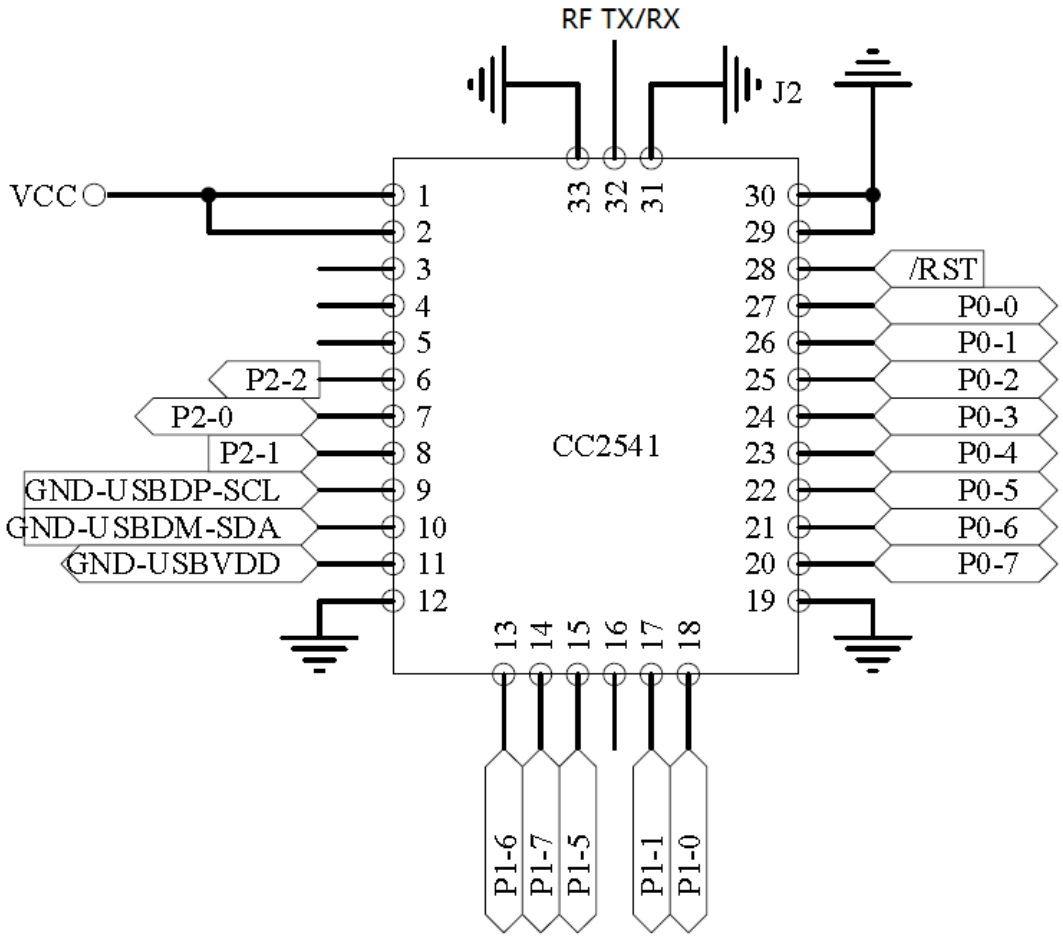
	MIN	NOM	MAX	UNIT
Operating ambient temperature range, TA	–30		70	°C
Operating supply voltage	2		3.6	V

2. Mechanical Specification

2.1 Outline Drawing



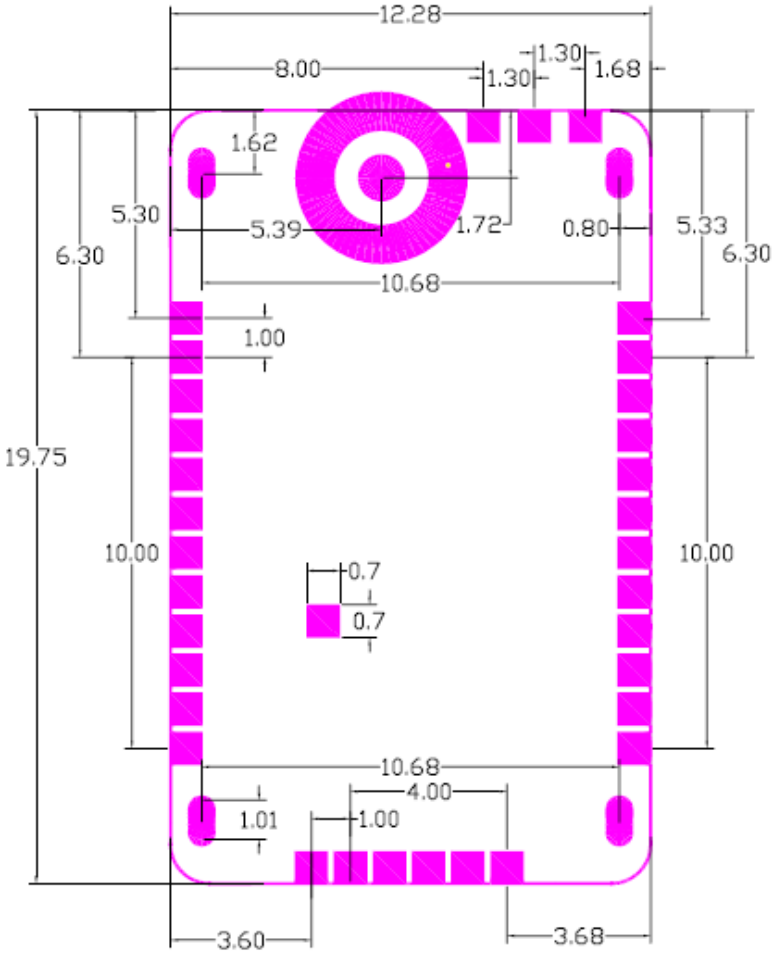
2.2 Connector Pin Definition



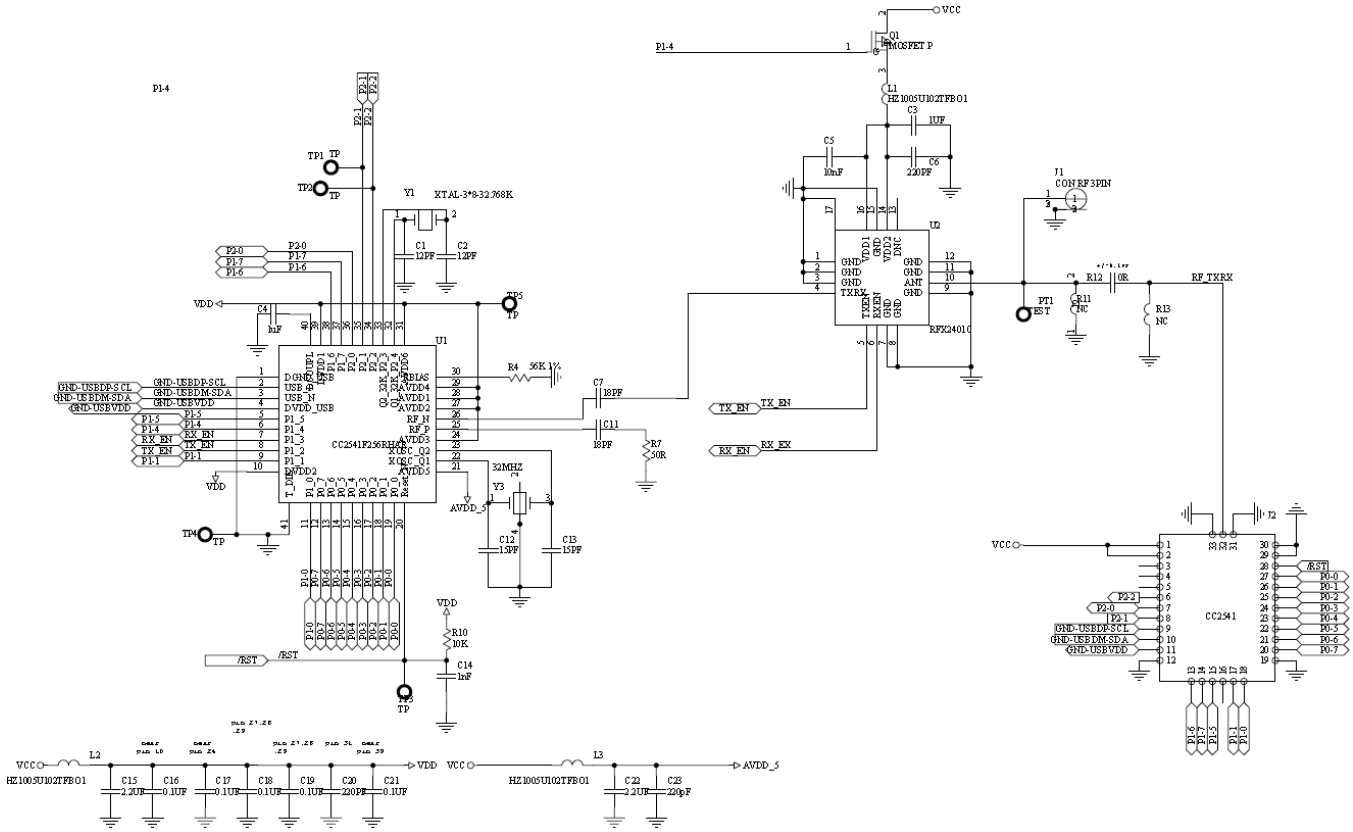
Pin #	Name	Description
1	VCC	2-3.6V
2	VCC	2-3.6V
3	NC	NOP
4	NC	NOP
5	NC	NOP
6	P2-2	
7	P2-0	
8	P2-1	
9	GND	USBDP-SCL
10	GND	USBDM-SDA
11	GND	USBVDD
12	GND	GND
13	P1-6	

14	P1-7	
15	P1-5	
16	NC	NOP
17	P1-1	
18	P1-0	
19	GND	GND
20	P0-7	
21	P0-6	
22	P0-5	
23	P0-4	
24	P0-3	
25	P0-2	
26	P0-1	
27	P0-0	
28	RST	RESET
29	GND	GND
30	GND	GND
31	GND	J2
32	TX/RX	RF TX/RX
33	GND	GND

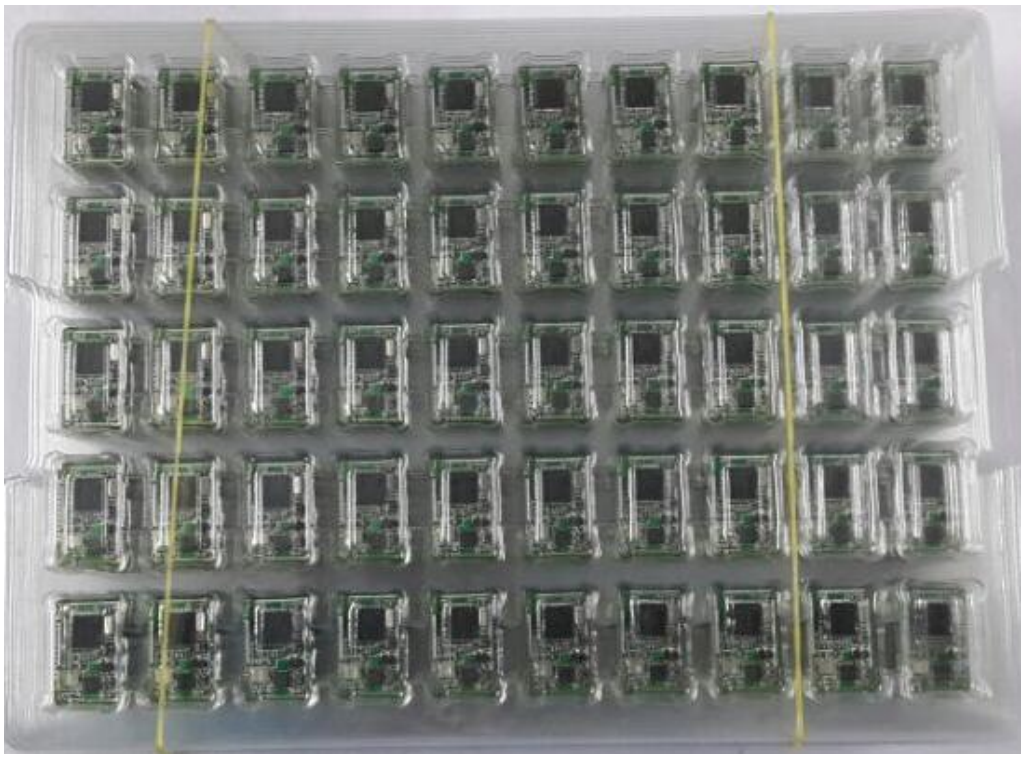
2.3 Layout reference



2.4 Layout Connection diagram



3 Package
3.1 blister packaging



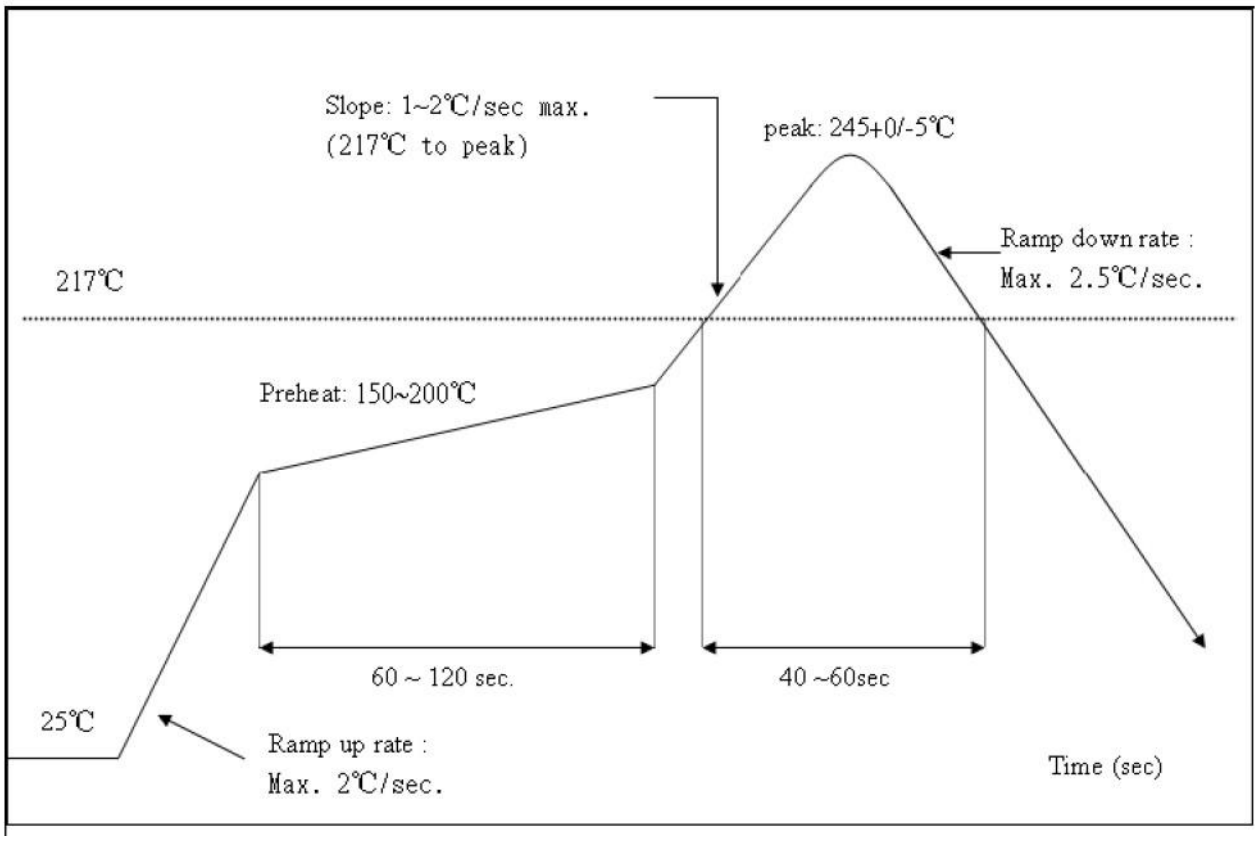
Vacuum packaging

A piece of 50 PCS (500 pcs/bag)

4 User's Manual

4.1 Recommended Reflow Profile

Referred to IPC/JEDEC standard.
Peak Temperature : <250°C
Number of Times : ≤2 times



4.2 Patch the modules installed before the notice:

Module installed note:
1. Please press 1 : 1 and then expand outward proportion to 0.7 mm, 0.12 mm thickness When open a stencil
2. Take and use the module, please insure the electrostatic protective measures.
3. Reflow soldering temperature should be according to the customer the main size of the products, such as the temperature set at 250 + 5 ℃ for the MID motherboard.

About the module packaging, storage and use of matters needing attention are as follows:
1. The module of the vacuum packing: 1). Shelf life: 8 months, storage environment conditions: temperature in: < 40 ℃, relative humidity: < 90% r.h.
2. The module vacuum packing once opened, time limit of the assembly:
Card: 1) check the humidity display value should be less than 30% (in blue), such as: 30% ~ 40% (pink), or greater than 40% (red) the module have been moisture absorption.
2.) factory environmental temperature humidity control: ≦ 30% ℃, ≦ 60% r.h..
3). Once opened, the workshop the preservation of life for 168 hours.
3. Once opened, such as when not used up within 168 hours:
1). The module must be again to remove the module moisture absorption.
2). The baking temperature: 125 ℃, 8 hours.
3.) after baking, put the right amount of desiccant to seal packages.