

**REXENSE** 瑞瀛

802.15.4/ZigBee Module Datasheet

REX3L

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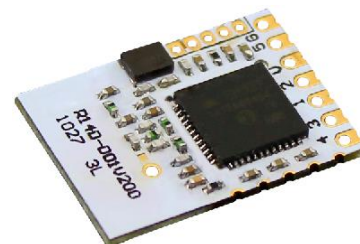
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# 1. Introduction

## 1.1 Summary

REX3L is an ultra-compact, low-power, high-sensitivity 2.4 GHz IEEE 802.15.4/ZigBee module based on the innovative Rexense's hardware platform. It is designed for wireless sensing, control and data acquisition applications. And this module has a specialized firmware for LED lights, support grouping, timing, scene mode, wireless updating for firmware, parameter setting. RexBee modules eliminate the need for costly and time-consuming RF development, and shorten time to market for a wide range of wireless applications.



## 1.2 Applications

RexBee module is compatible with robust IEEE 802.15.4/ZigBee stack that supports a self-healing, self-organizing mesh network, while optimizing network traffic and minimizing power consumption. Rexense offers two stack configurations: Custom and Transparent. Custom software can be provided to support reliable, scalable, and secure wireless applications running on RexBee modules. Transparent software allows programming of the module via serial AT-command interface.

The applications include, but are not limited to:

- Building automation & monitoring
  - Lighting controls, ZLL, Zigbee light link
  - Wireless smoke and CO detectors
  - Structural integrity monitoring
- HVAC monitoring & control
- Inventory management
- Environmental monitoring
- Security
- Water metering
- Industrial monitoring
  - Machinery condition and performance monitoring
  - Monitoring of plant system parameters such as temperature, pressure, flow, tank level, humidity, vibration, etc.
- Automated meter reading (AMR)
- LED light control

## 1.3 Key Features

- Size : 20.4\*14.8\*1.8mm
- High RX sensitivity : -99dBm
- Outperforming link budget: 107dB
- Wide Communication Distance : 200m ( visual range )
- Output power: 8dBm
- Very low power consumption
  - Sleep mode : <2.0μA
  - RX mode : 29mA
  - TX mode : 36mA@3dBm; 45mA@8dBm
- Ample memory resources:
  - EM357-i : 192K bytes Flash ; 12K bytes RAM
- Wide range of interfaces (both analog and digital):
  - 7 pcs GPIO
  - 4 pcs PWM input interface
  - 1 line ADC channel
  - 1 USART interface
  - According to IEEE 802.15.4
  - 2.4G free working frequency
  - Support API interface and AT command
  - Comply with ZLL protocol
  - Support PTI interface
  - Support USART bootloader

## 1.4 Advantages

- Small physical footprint and low profile for optimum fit in even the smallest of devices
- Best-in-class RF link range
- Extended battery life
- Easy prototyping with 2-layer PCB
- Ample memory for user software application
- Mesh networking capability
- Easy-to-use low cost Evaluation Kit
- Worldwide license-free operation
- Support RexBee and ZLL protocol

## 1.5 Abbreviations and Acronyms

ADC	Analog-to -Digital Converter
API	Application Programming Interface
DC	Direct Current
DTR	Data Terminal Ready
DIP	Dual In-line package
EEPROM	Electrically Erasable Programmable Read-Only Memory
ESD	Electrostatic Discharge
GPIO	General Purpose Input/Output
HAL	Hardware Abstraction Layer
HVAC	Heating, Ventilating and Air Conditioning
HW	Hardware
TWI	Inter-Integrated Circuit
IEEE	Institute of Electrical and Electronics Engineers
IRQ	Interrupt Request
ISM	Industrial, Scientific and Medical radio band
JTAG	Digital interface for debugging of embedded device, also known as IEEE 1149.1 standard interface
MAC	Medium Access Control layer
MCU	Microcontroller Unit. In this document it also means the processor, which is the core of ZigBee module
NWK	Network layer
OEM	Original Equipment Manufacturer
OTA	Over-The-Air upgrade
PCB	Printed Circuit Board
PER	Package Error Ratio
PHY	Physical layer
RAM	Random Access Memory
RF	Radio Frequency
RTS/CTS	Request to Send/ Clear to Send
RX	Receiver
SMA	Surface Mount Assembly
SPI	Serial Peripheral Interface
SW	Software
TX	Transmitter
UART	Universal Asynchronous Receiver/Transmitter

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USART	Universal Synchronous/Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
ZDK	ZigBee Development Kit
ZigBeePRO	Wireless networking standards targeted at low-power applications
802.15.4	The IEEE 802.15.4-2003 standard applicable to low-rate wireless PAN

## 1.6 Related Documents

[1] IEEE Std 802.15.4-2003 IEEE Standard for Information technology - Part 15.4 Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low-Rate Wireless Personal Area Networks (LR-WPANs)

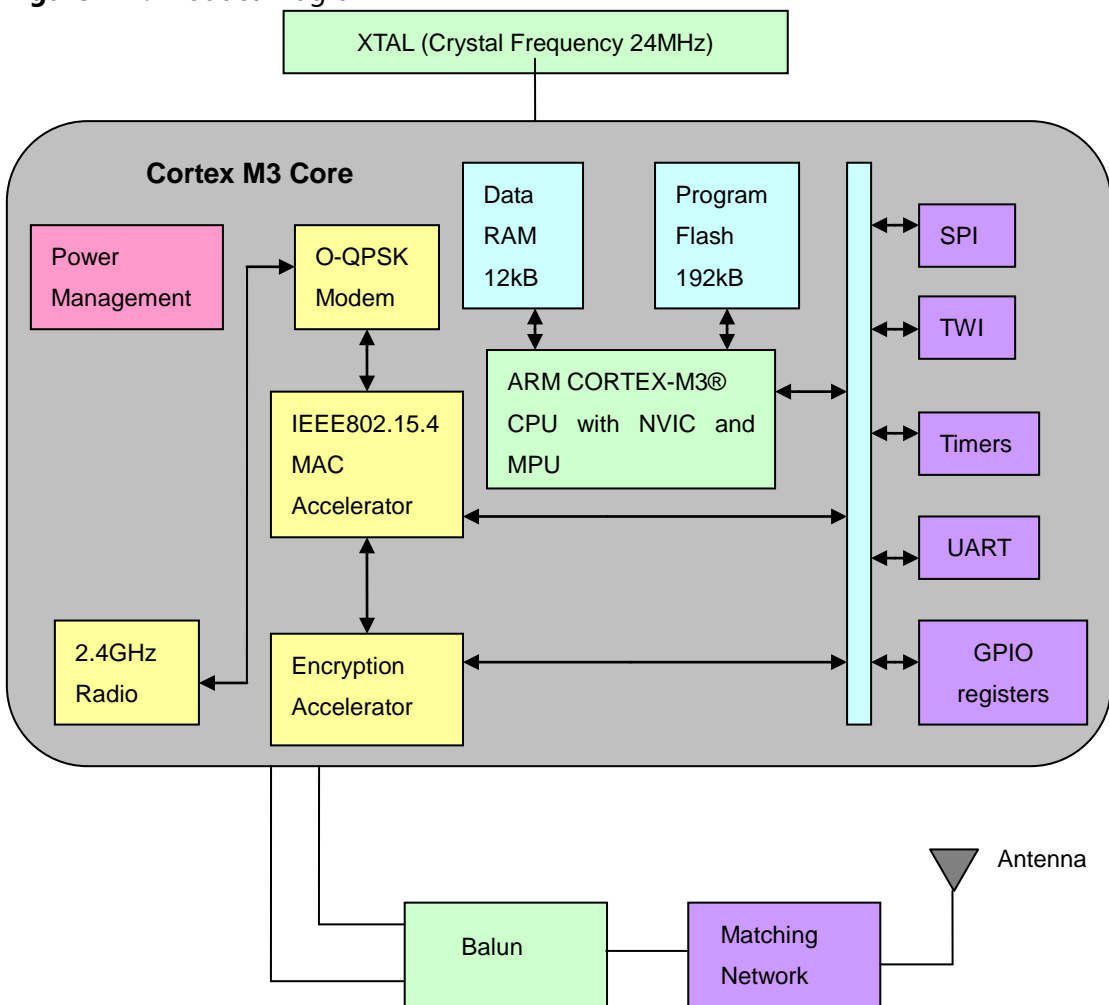
[2] ZigBee Specification. ZigBee Document 053474r17, October 19, 2007

## 2. Product Overview

### 2.1 Overview

REX3L is a low-power, high-sensitivity IEEE 802.15.4/ ZigBee-compliant module. This multi-functional state-of-art module occupies ultra-small space, which is comparable to a typical size of a single chip. Based on a solid combination of Rexense's latest MCU Wireless hardware platform, RexBee module offers superior radio performance, ultra-low power consumption, and exceptional ease of integration.

**Figure 2-1.** Product Diagram



REX3L RexBee module complies with the FCC (Part 15), IC and ETSI (CE) rules applicable to the



devices radiating in uncontrolled environment.

REX3L RexBee module fully satisfies the requirements of the “Directive 2002/95/EC of the European Parliament and the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment” (RoHS).

To jumpstart evaluation and development, Rexense also offers a complete set of evaluation and development tools. The ZigBee Development Kit comes with everything you need to develop and test your own applications.

## 3. Specifications

### 3.1. Electrical Characteristics

#### 3.1.1. Maximum Sustain Index

**Table 3-1.** Absolute Maximum Ratings

Parameters	MIN	MAX
Power supply voltage range ( VCC )	2.1V	3.6V
Pin working voltage range ( Except ADC )	-0.3V	VCC+0.3V
ADC pin working voltage range	-0.3V	2.0V
Max driving circuit data of all I/O on chips		40 mA
Maximum RX level		+15 dBm

**Note:**

Absolute Maximum Ratings are the values beyond which damage to the module may occur.

#### 3.1.2. Testing condition

**Table 3-2.** testing condition (unless otherwise stated ), VCC = 3.3V, Temp = 25°C

Parameter	Range	Unit
Supply Voltage, VCC	2.1 to 3.6	V
Current Consumption: RX mode	29	mA

Current Consumption: TX mode ( @3dBm )	36	mA
Current Consumption: TX mode ( @8dBm )	45	mA
Sleeping current	<2.0	μA
Transmitting power	-32 to +8	dBm

### 3.1.3. RF Characteristic

Table 3-3. RF characteristic

Parameter	Testing Condition	Range	Unit
Frequency Band		2400~2483.5	MHz
Numbers of frequency band		16	
Channel Number		0B~1A	Hex
Channel Spacing		5	MHz
Transmitter Power		-32 to +8	dBm
Receiver Sensitivity	Loss rate ≤1%	-99	dBm
Maximum transmission speed		250	kbps
Nominal Impedance of RX and TX	For unbalanced output	50	Ω

### 3.1.4. Microcontroller Characteristics

Table 3-4. Microcontroller Characteristics

Parameter	Condition	Range	Unit
On-chip Flash Memory size		192K	bytes
On-chip RAM size		12K	bytes
Operation Frequency		24	MHz

### 3.1.5. Module Interfaces characteristics

Table 3-5. Module Interfaces characteristics

Parameter	Condition	Range	Unit
UART Maximum Baud Rate		230400	bps
ADC Resolution/ Conversion Time	Half-duplex mode	12/4096	Bits/μs

ADC Input Resistance		>1	MΩ
ADC Reference Voltage (VREF)		1.2	V
ADC Input Voltage		0 - VREF	V
I2C Maximum Clock		400	kHz
GPIO Output Voltage (Logic 0)	-8/ 4 mA	0 ~ 0.18*VCC	V
GPIO Output Voltage (Logic 1)	-8/ 4 mA	0.82*VCC ~ VCC	V
Real time clock frequency		32.768	kHz

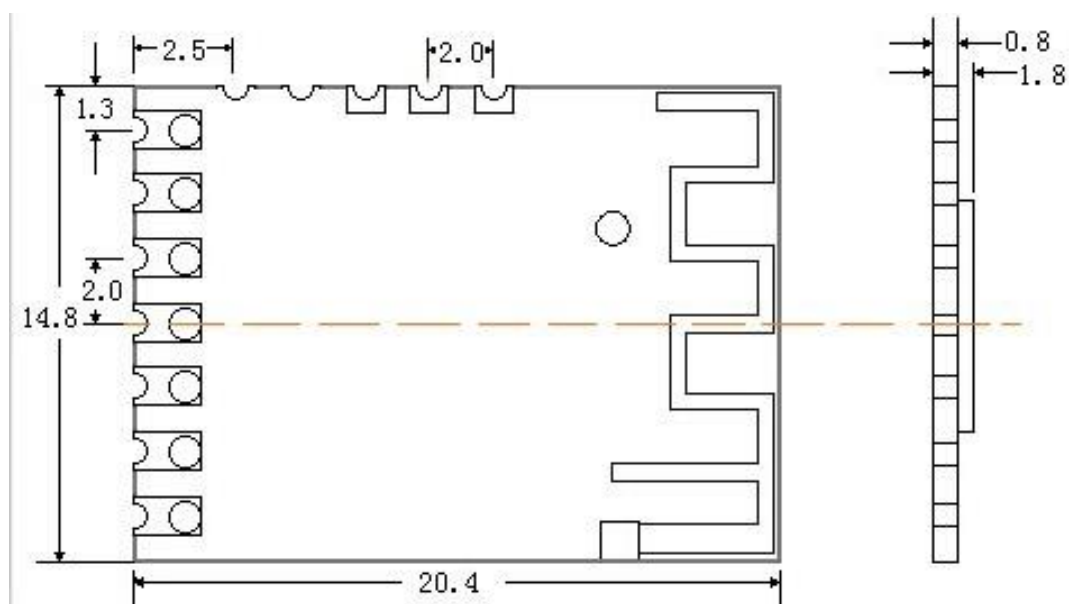
## 3.2. Physical/Environmental Characteristics

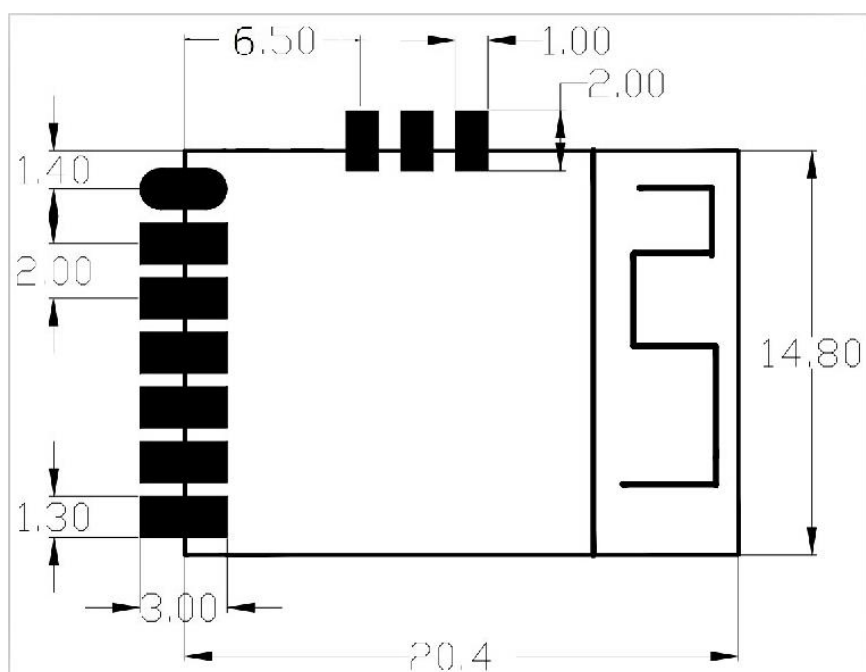
Table 3-6. Physical/Environmental Characteristics

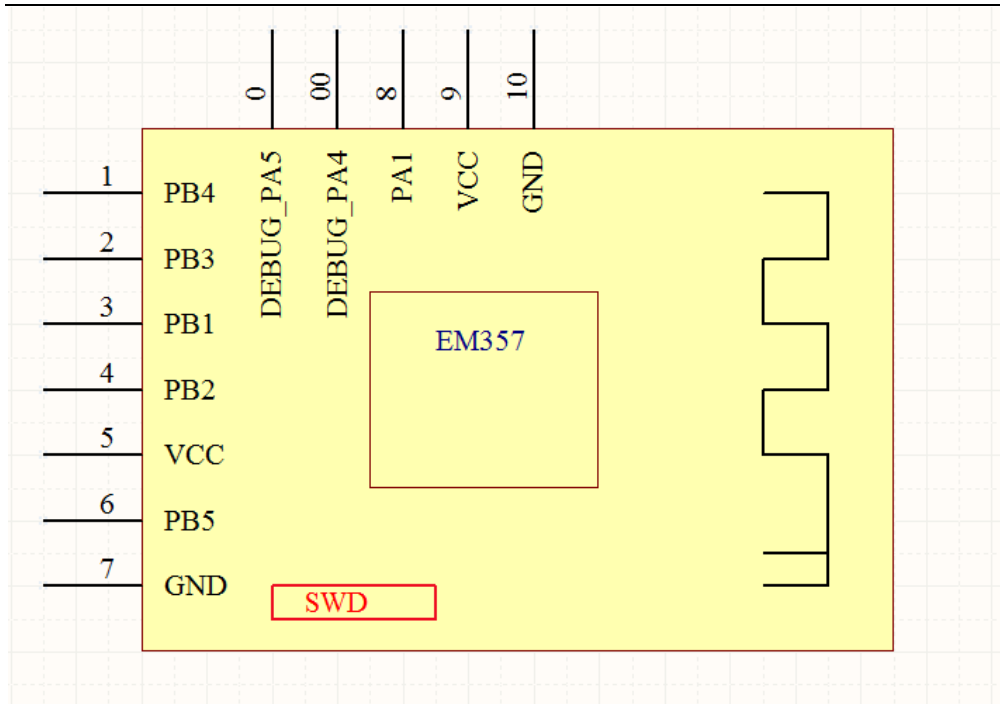
Parameter	Value	Remark
Size	20.4*14.8*1.8mm	
Weithgt	1.0g	
Operating Temperature Range	-40°C to +125°C	
Operating Relative Humidity Range	<95%	

## 3.3. Pin Configuration

Picture3-7. External dimension drawing (mm)



**Picture3-8. Packaging(mm)****Picture 3-9. Pin Configuration**



**Table 3-10.** Pin descriptions

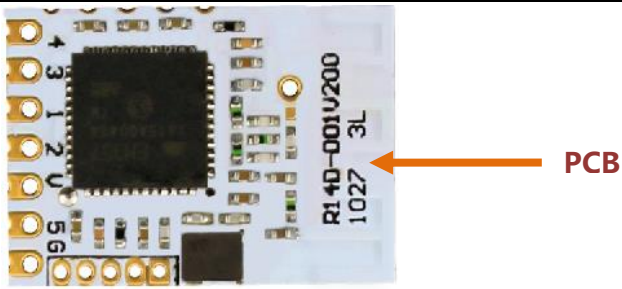
模块引脚编号	QFN48封装引脚编号	引脚信号	方向	引脚说明
1	20	PB4	I/O	Digital I/O
		PWM1	O	PWM Output Pin1
2	19	PB3	I/O	Digital I/O
		PWM2	I	PWM Output Pin2
3	30	PB1	I/O	Digital I/O
		TXD	O	UART TXD
		PWM3	O	PWM Output Pin3
4	31	PB2	I/O	Digital I/O
		RXD	I	UART RXD
		PWM4	O	PWM Output Pin4
5		3.3V	I	DC3.3V supply
6	43	PB5	I/O	Digital I/O

模块引脚编号	QFN48封装引脚编号	引脚信号	方向	引脚说明
		ADC0	Analog	ADC Input 0. Enable analog function with GPIO_PBCFGH[7:4]
7		GND	-	Ground
8	22	PA1	I/O	Digital I/O
		SC2SDA	I/O	TWI data of Serial Controller 2 Either disable timer output in TIM2_CCER or enable remap with TIM2_OR[6] Select TWI with SC2_MODE Select alternate open-drain output function with GPIO_PACFGL[7:4]
		SC2MISO	O	SPI slave data out of Serial Controller 2 Either disable timer output in TIM2_CCER or enable remap with TIM2_OR[6] Enable slave with SC2_SPICFG[4] Select SPI with SC2_MODE Select alternate output function with GPIO_PACFGL[7:4]
			I	SPI master data in of Serial Controller 2 Enable slave with SC2_SPICFG[4] Select SPI with SC2_MODE
9		3.3V	I	DC3.3V supply
10		GND	-	Ground
0	27	PA5	I/O	Digital I/O
		ADC5	Analog	ADC Input 5. Select analog function with GPIO_PACFGH[7:4].
		PTI_DATA	O	Data signal of Packet Trace Interface (PTI). Disable trace interface in ARM core. Select alternate output function with GPIO_PACFGH[7:4].
		nBOOTM ODE	I	Embedded serial bootloader activation out of reset. Signal is active during and immediately after a reset on NRST.
		TRACEDA TA3	O	Synchronous CPU trace data bit 3. Select 4-wire synchronous trace interface in ARM core. Enable trace interface in ARM core. Select alternate output function with GPIO_PACFGH[7:4]
00	26	PA4	I/O	Digital I/O
		ADC4	Analog	ADC Input 4. Select analog function with GPIO_PACFGH[3:0].
		PTI_EN	O	Frame signal of Packet Trace Interface (PTI). Disable trace interface in ARM core. Select alternate output function with GPIO_PACFGH[3:0].
		TRACEDA TA2	O	Synchronous CPU trace data bit 2. Select 4-wire synchronous trace interface in ARM core. Enable trace interface in ARM core. Select alternate output function with GPIO_PACFGH[3:0].

### 3.4. Antenna Specifications

REX3L has two antennas, PCB antenna as following

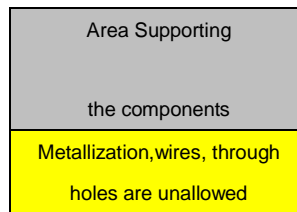
Picture 3-11. PCB antenna



Notification :

- Don't integrate the module into device which has metal shell.
- Don't put metal thing close to the PCB antenna.
- Don't put module close to some electrical products which may influence the communication channel.

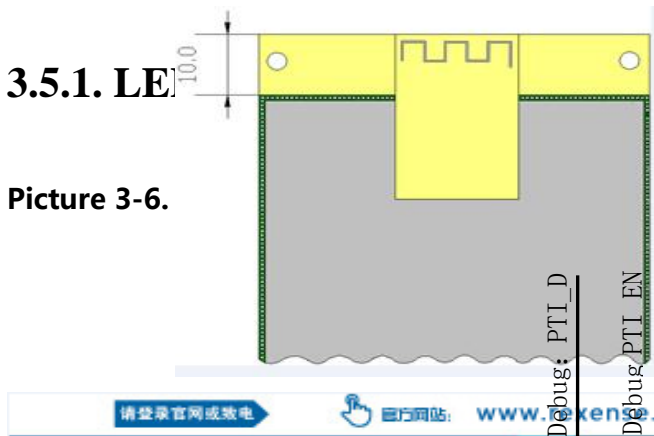
Picture 3-12. PCB antenna location drawing



The design of the electrical board should prevent microwave field from interior PCB material. High-frequency electromagnetic wave can penetrate the PCB board, that will cause the radiation from the PCB edge, it may changing antenna mode.

To eliminate this kind of influence, a metallized grounding hole should be embraced on PCB edge.

### 3.5. Reference design for circuit



Picture 3-6.

请登录官网或致电 官方网站: [www.rexense.cn](http://www.rexense.cn) 小时服务热线: 86-571-85395623

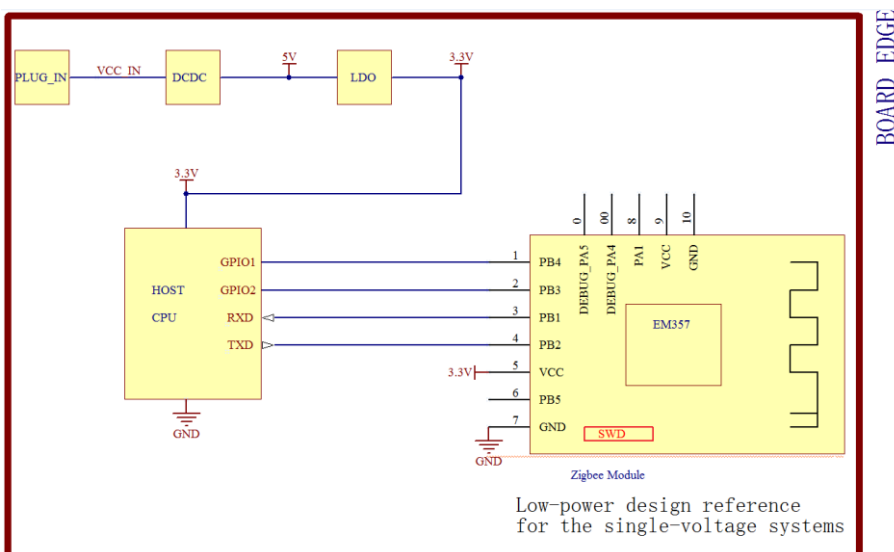
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Reuse: PWM\_1, R ,RTS

PB4	PA5	PA4	PA1	VCC	GND
-----	-----	-----	-----	-----	-----

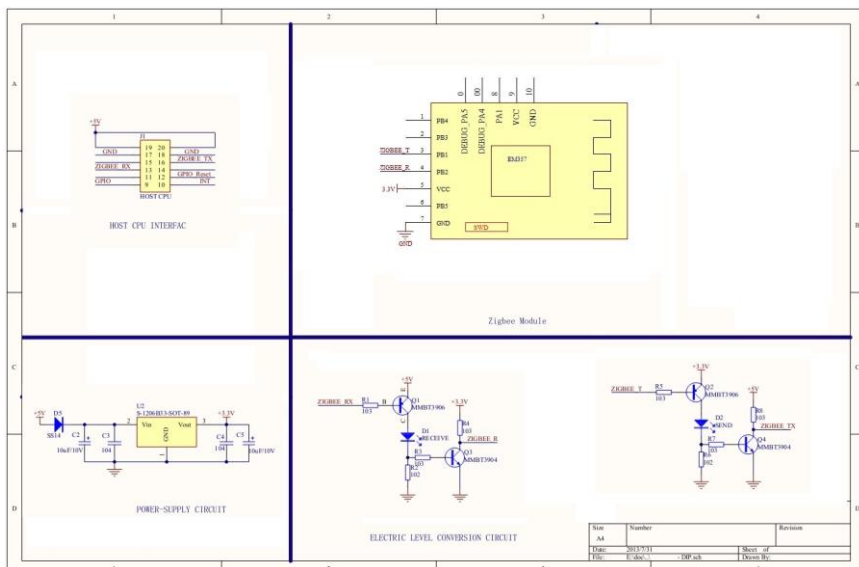
### 3.5.2. Be used for common application

System voltage is 3.3V power supplied





System voltage is 5.0V power supplied



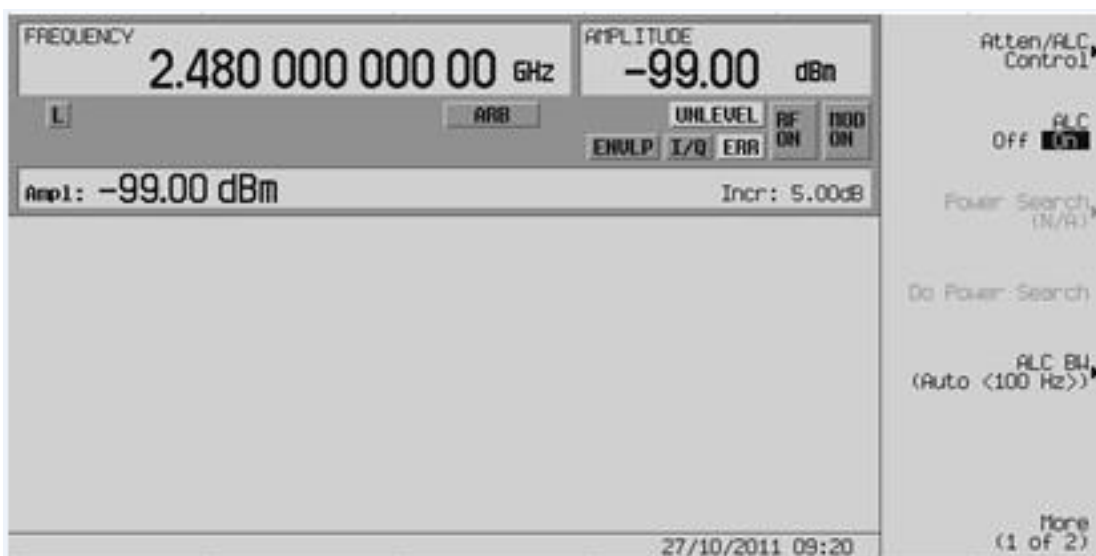
### 3.6. Module Program and Interface debugging Instruction

Module has SWD debugging interface, which can be connected to J-Link, it can debug the program and download the firmware. Please see following SWD connections.

Please refer picture 3-6

### 3.7 Test Result of RF Performance

Picture 3-7. RX sensitivity



Picture 3-8. TX power diagram



Picture 3-9. Debugging TX power diagram



## 4. Ordering Information

### Manufacturer

REX 3 L 57 B  
 REX=REXENSE

### Serial

3=Zigbee serial ( Cortex™-M3 Core )

### Package type

D=DIP

S=SMD

U=Ultra-compact

L=especially for LED

### Chip type

51=EM351

57=EM357 ( Default )

64=STM32W108CBU64

### Antenna

U=U.FL connector

B=PCB antenna ( Default )

L=L antenna

P=Pin can be used

S=SMA antenna

H=Spring antenna

## 5. Contact Us

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