EC-01 Specification

Version V1.0

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Formulation / Revision / Abolition of CV

Version	Date	Formulation / Revision	Make	Verify
V1.0	2021.05.24	First development	Nannan Yuan	Ning Guan

CONTENT

1. Product overview

EC-01 is a NB module developed by Ai-Thinker. The main chip scheme adopted by the NB part is EC616S. The chip has an ultra-highly integrated NB-IoT SoC, supports ultra-low power consumption, and fully supports the 3GPP Rel14 NB-IoT standard. It is an ultra-high cost-effective NB-IoT chip.

It has the following characteristics：

- Integrated RF transceiver, PA, RF filter, antenna switch and power management.
- Excellent communication performance and stability in various wireless environments.
- Excellent power consumption performance in various modes (PSM, DRX, eDRX, connected state).
- Unique MCU mode, providing lower working current and shorter wake-up time.

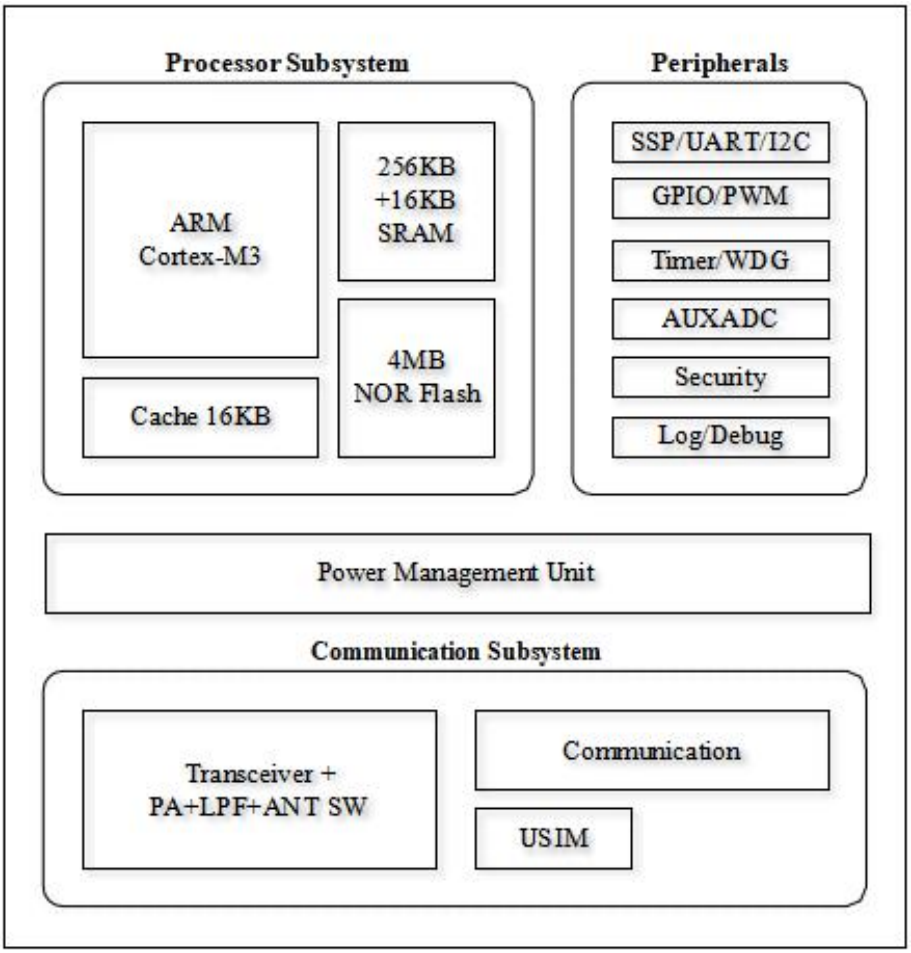

Figure 1 Chip architecture diagram

1.1. Features

- CPU：
  - ✓ Cortex-M3，support MPU
  - ✓ Configurable CPU frequency, up to 204MHz
  - ✓ 8-channel DMA
- Memory：
  - ✓ 4MB on-chip NOR flash
  - ✓ 272KB on-wafer SRAM, divided into 256KB and 16KB
  - ✓ 16KB instruction cache
- System：

- ✓ Flexible configuration support 1.8/2.8/3.3V IO
- ✓ Clock source: 26MHz TCXO or DCXO, 32.768KHz crystal oscillator
- ✓ 1 external wake-up source (interrupt)
- ✓ Unique MCU mode, in this mode, the internal RC oscillator is used as the clock, and the power consumption is lower
- ✓ LOG port, UNILOG
- ✓ Debug port, SWD
- ■ Peripherals：
- ✓ 16 GPIO
- ✓ 3 UART, 2 SSP, 2 I2C
- ✓ 6 PWM, 6 Timers，6 GPIO counter,1 WDG
- ✓ 32KHz RTC timer
- ✓ USIM, support Esim
- ✓ LPUART
- ✓ 4-channel 12-bit AUXADC
- ✓ Temperature Sensor
- ✓ Battery voltage monitoring
- ■ Low power consumption：
- ✓ Unique low-power architecture, 4-level sleep mode
- ✓ PSM: 800nA
- ✓ DRX (2.56s): typical value 110uA
- ✓ RX: typical value10mA
- ✓ TX: typical value24mA
- ■ Communication：
- ✓ Totally support 3GPP R14 NB-IoT
- ✓ Category NB2, 2-HARQ
- ✓ Multi-tone NPUSCH
- ✓ Anchor and non-anchor carrier

- ✓ In-band same/different PCI, guardband, standalone
- ✓ Multi-carrier paging, NPRACH
- ✓ Positioning: OTDOA & ECID
- ✓ ROHC, RAI, multiple-DRB, RRC connection re-establish
- ✓ SC-PTM (need SW upgrade)

■ RF：

- ✓ Support frequency band: 3, 5, 8
- ✓ Chip integrated PA, support APT function
- ✓ Chip integrated RF transceiver filter and antenna switch
- ✓ Power level 3

■ Safety：

- ✓ Hardware encryption and decryption module(AES, SHA)
- ✓ Secure boot
- ✓ flash encryption
- ✓ True random number generator

■ Application：

- ✓ Support open-CPU
- ✓ The software complies with the CMSIS architecture
- ✓ Support mainstream cloud services
- ✓ IPv4, IPv6 and non-IP
- ✓ UDP, TCP
- ✓ DTLS, TLS, SSL
- ✓ MQTT, CoAP, HTTP(S)
- ✓ LWM2M
- ✓ Support FOTA

■ Voltage range：

- ✓ 3.3V to 4.5V

2. Main parameters

List 1 Main parameter description

Model	EC-01
Package	SMD-54
Size	19.2*18.8*2.8(±0.2)MM
Antenna	External antenna
Spectrum range	Band3,Band5,Band8
Operating temperature	-40 ℃ ~ 85 ℃
Storage environment	-40 ℃ ~ 125 ℃ , < 90%RH
Power supply range	Voltage 3.3V ~ 4.5V, current ＞500mA
Support interface	SSP/UART/I2C/PWM/ADC/GPIO
Serial port rate	Support 110 ~ 4608000 bps, default 9600 bps
Safety	AES/SHA
Flash	4MB NOR Flash

2.1. Electrical parameters

EC-01 module is electrostatic sensitive equipment, special precautions need to be taken when handling.

Figure 2 ESD Anti-static

2.2. Electrical characteristics

List 2 Electrical characteristics table

Parameter		Condition	Min	Typical	Max	Unit
Voltage		VDD	3.3	3.3	4.5	V
I/O	V_{IL}/V_{IH}	-	-0.3/0.75VIO	-	0.25VIO/4.5	V
	V_{OL}/V_{OH}	-	N/0.8VIO	-	0.1VIO/N	V
	I_{MAX}	-	-	-	24	mA

2.3. NB RF performance

List 3 NB RF performance`

Band	Channel	1 Tone@11(15KHz)				12 Tone(15KHz)			
		Pout (dBm)	EVM RMS (%)	SEM Margin (dB)	ACLR Max (dBc)	Pout (dBm)	EVM RMS (%)	SEM Margin (dB)	ACLR Max (dBc)
3	1201	22.5	0.9	4.9	-39.5	20.5	7	6	-40.8
	1575	22.5	0.9	3.8	-39	20.5	7	6	-41
	1949	22.5	0.9	4	-39	20.5	7	5	-40.5
5	2401	22.6	0.9	8	-42	20.4	7	7	-43

	2525	22.6	0.9	9	-42	20.4	6	6	-42.5
	2649	22.6	0.9	8	-42	20.4	7	7	-42.8
8	3451	22.5	0.9	7.5	-42.5	20.5	6	4	-42.5
	3625	22.5	0.9	8.5	-42	20.4	6	3.5	-41
	3799	22.5	0.9	5	-42	20.4	7	4.5	-40.5

2.4. Power consumption

The following power consumption data is based on a 3.3V power supply, an ambient temperature of 25°C, and measured using an internal voltage regulator.

List 4 Power consumption table

Mode	Min	Average	Max	Unit
Connect_Tx_23dBm_1Tone(Band3 Channel 1575 1842.5MHz)	-	120	240	mA
Connect_Tx_23dBm_1Tone(Band5 Channel 2525 881.5MHz)	-	110	226	mA
Connect_Tx_23dBm_1Tone(Band8 Channel 2625 942.5MHz)	-	108	215	mA
Connect_Rx_Band3	-	10	40	mA
Connect_Rx_Band5	-	16	46	mA
Connect_Rx_Band8	-	10	40	mA
DRX (2.56s)	-		110	μA
PSM	-		<1	μA

3. Dimensions

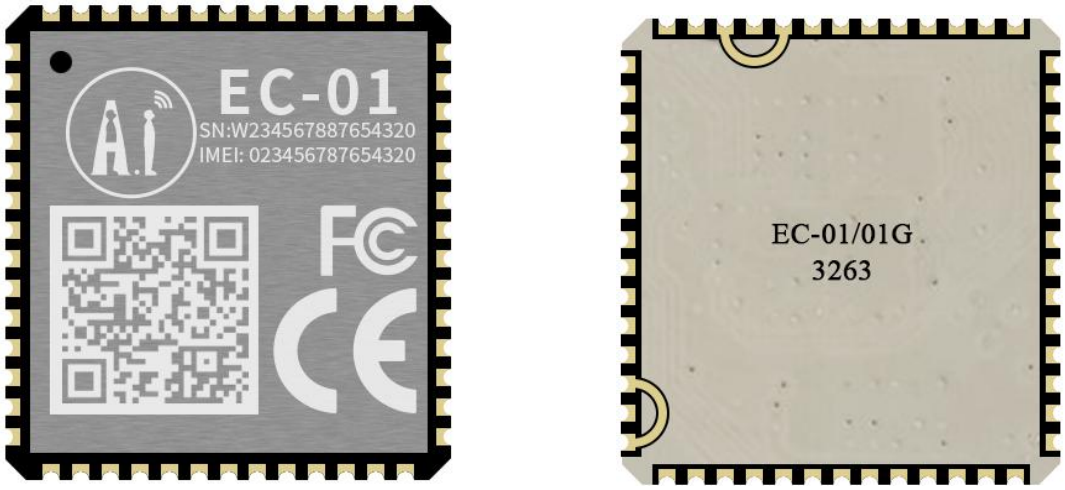

Image 3 EC-01 Appearance(The picture and silk screen are for reference only, the actual product shall prevail）

Note: The two-dimensional code of the shielding cover is the SN/IMEI number of the product

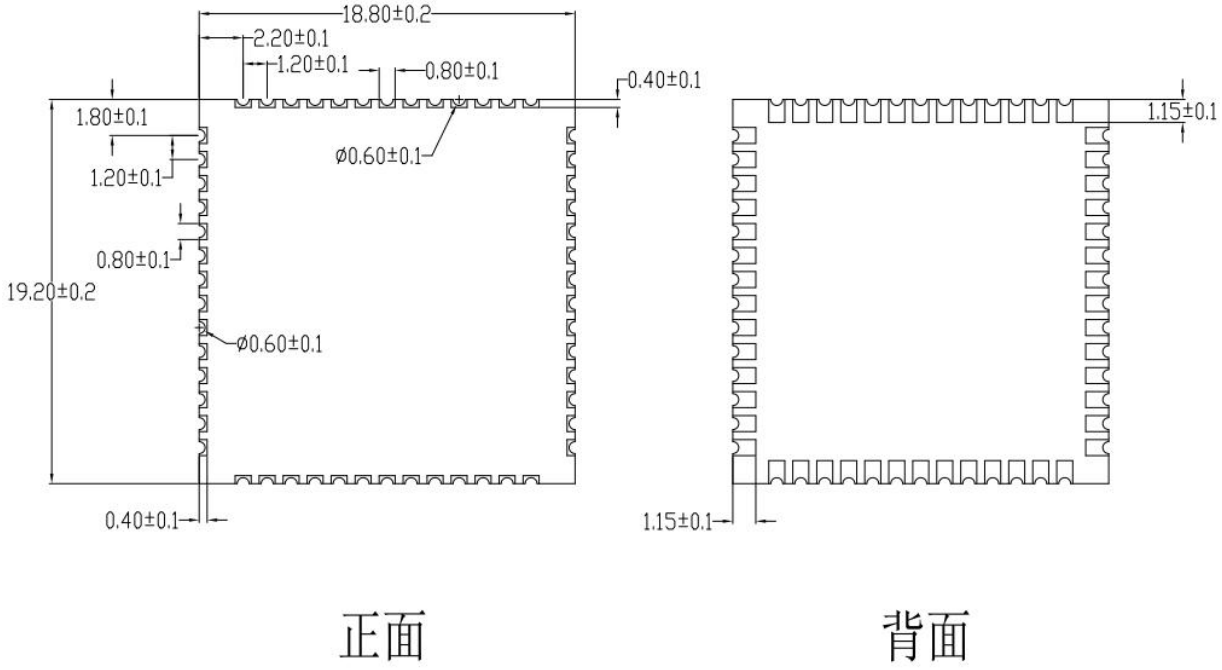

Figure 4 Module size

4. PIN definition

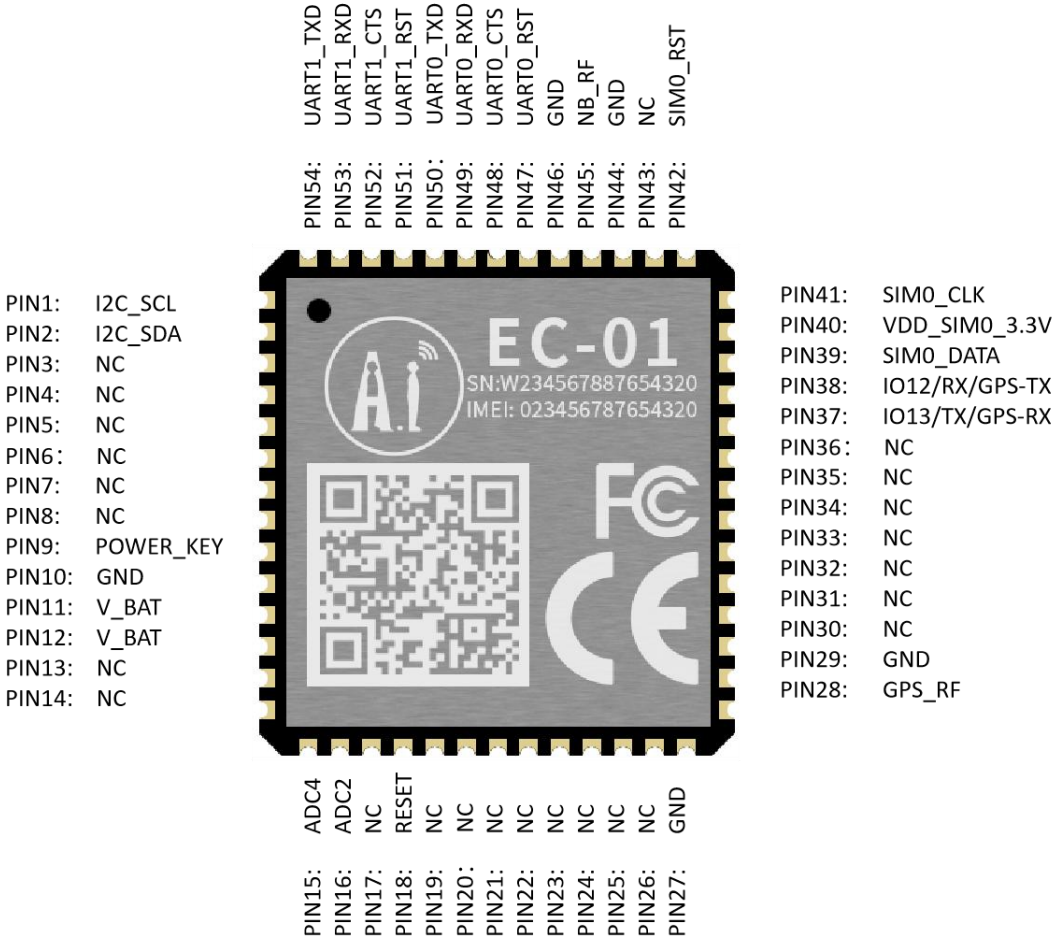

Figure 5 EC-01 PIN diagram(The picture and silk screen are for reference only, the actual product shall prevail)

The EC-01 module has a total of 54 interfaces. As shown in the pin diagram, the pin function definition table is the interface definition.

List 5 Pin function definition table

No.	Name	Function description
1	I2C_SCL	GPIO3

2	I2C_SDA	GPIO2
3-8	NC	Empty feet
9	POWER_KEY	WAKEUP
10	GND	Grounded
11	V_BAT	Power input
12	V_BAT	Power input
13-14	NC	Empty feet
15	ADC4	ADC Channel AIO4
16	ADC2	ADC Channel AIO2
17	NC	Empty feet
18	RESET	RESETn
19-26	NC	Empty feet
27	GND	Grounded
28	NC	Because EC-01 does not have GPS, the PIN pin is NC
29	GND	Grounded
30-36	NC	Empty feet
37	IO13/TX	UART1_TXD
38	IO12/RX	UART1_RXD
39	SIM0_DATA	USIM_UIO/SIM card IO
40	VDD_SIM0_3.3V	VO_LDOSIM Output of LDO SIM 1.8V/3.3V
41	SIM0_CLK	USIM_UCLK/SIM card clock
42	SIM0_RST	USIM_URSTn/SIM card reset

43	NC	Empty feet
44	GND	Grounded
45	NB_RF	NB RF port
46	GND	Grounded
47	UART0_RST	GPIO6/UART0_RSTn
48	UART0_CTS	GPIO7/UART0_CTSn
49	UART0_RXD	GPIO8/UART0_RXD
50	UART0_TXD	GPIO9/UART0_TXD
51	UART1_RST	GPIO10/UART1_RSTn
52	UART1_CTS	GPIO11/UART1_CTSn
53	UART1_RXD	GPIO14/UART1_RXD
54	UART1_TXD	GPIO15/UART1_TXD

5. Schematic diagram

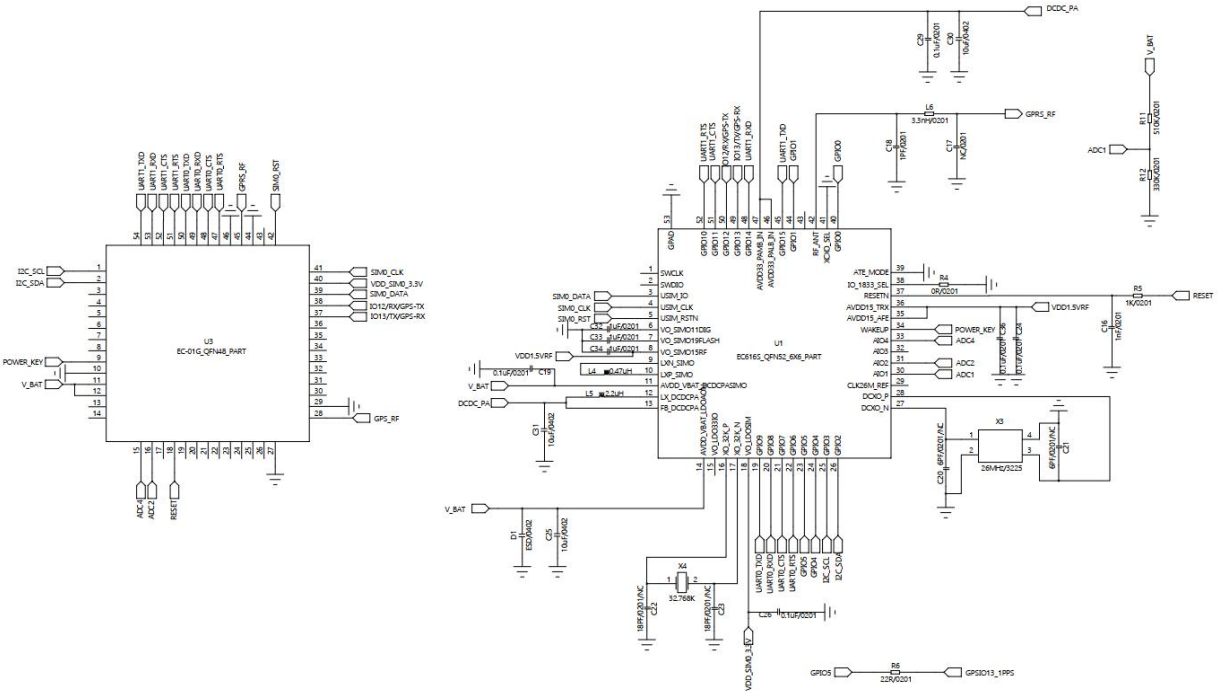

Figure 6 Module schematic

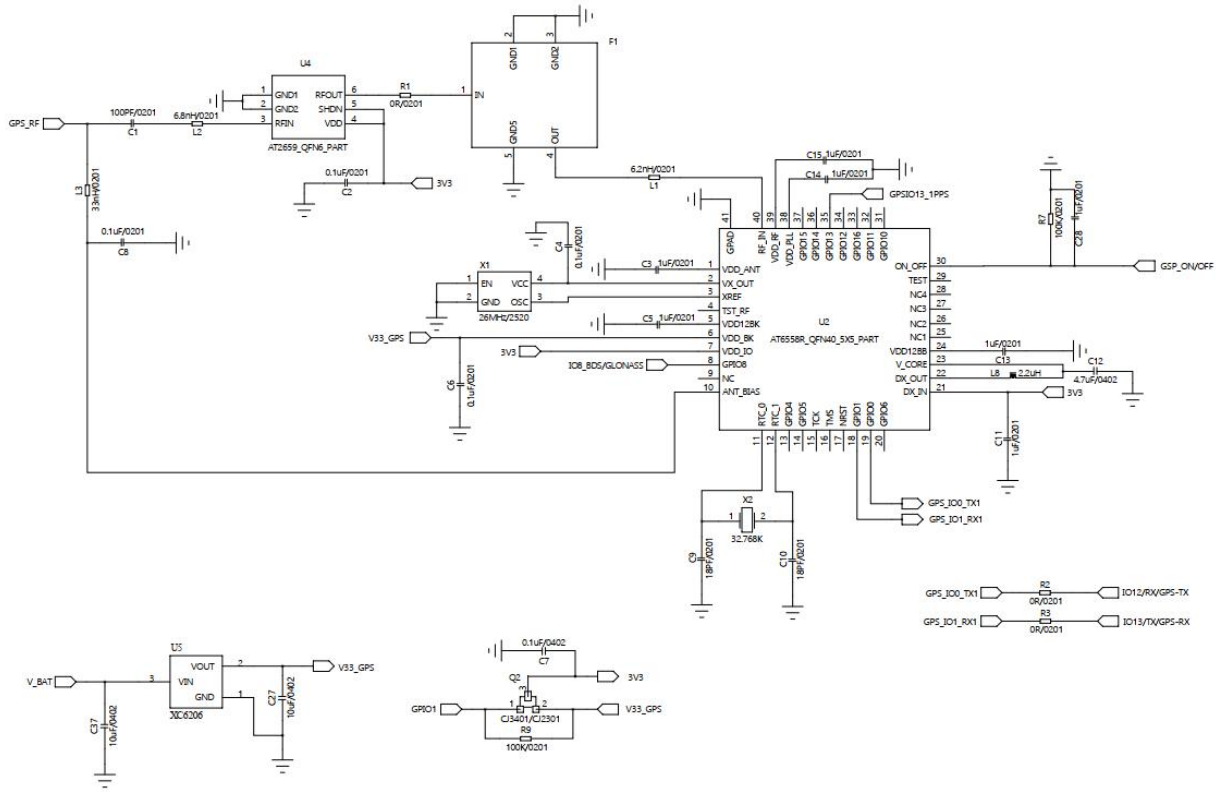

Figure 7 GPS chip related design reference schematic diagram

6. Design guide

6.1. Application circuit

It is recommended to add an anti-static protection IC to the power input.

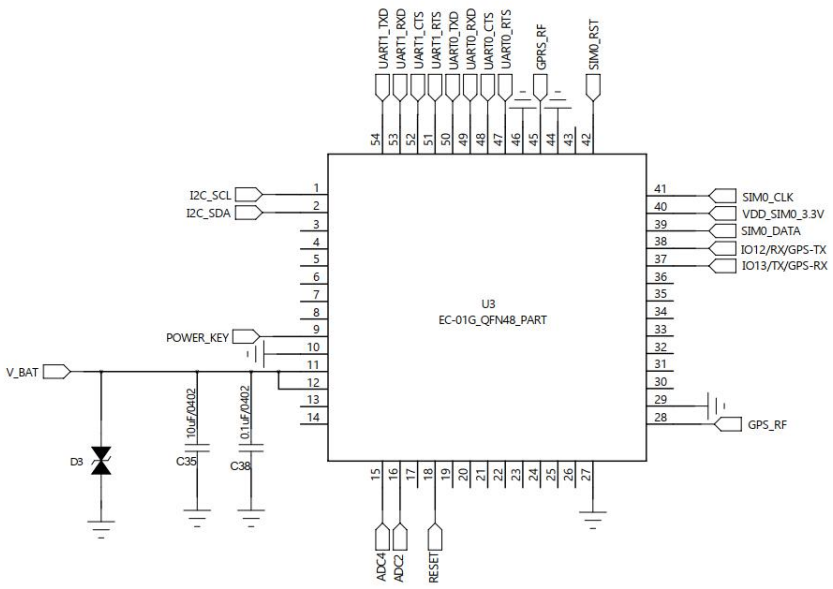

Figure 8 Application circuit schematic

6.2. Power supply

- Recommended 3.3V-4.5V voltage, peak current above 500mA
- It is recommended to use LDO for power supply; if using DC-DC, it is recommended that the ripple be controlled within 50mV.

- For the DC-DC power supply circuit, it is recommended to reserve a place for the dynamic response capacitor to optimize the output ripple when the load changes greatly.
- It is recommended to add ESD devices for the 3.3V-4.5V power interface.

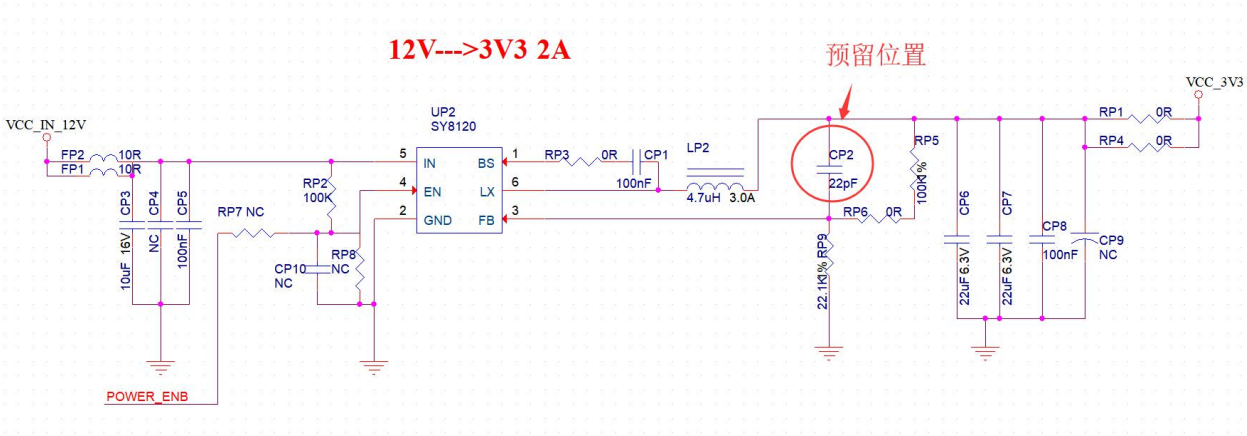

Figure 9 Recommended power supply circuit

7. Reflow soldering curve

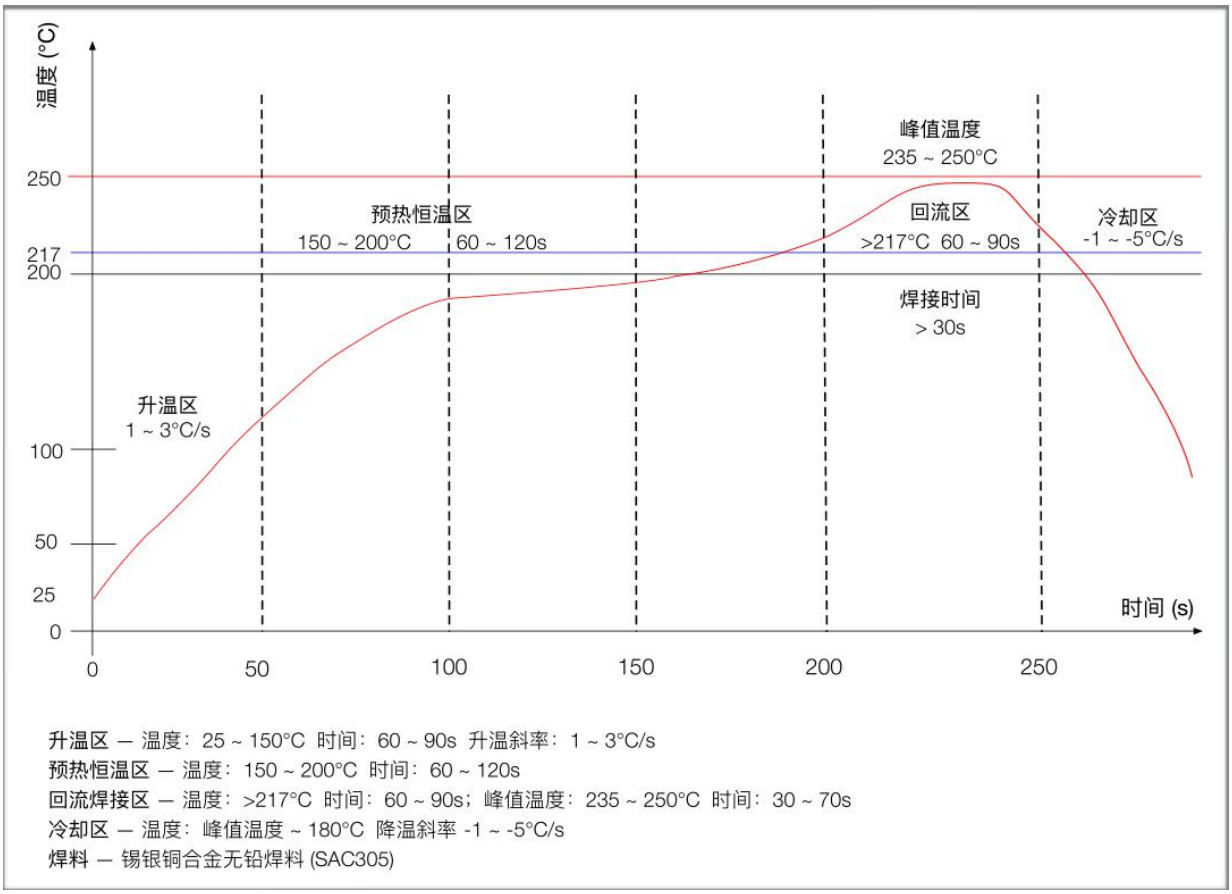

Figure 10 Reflow soldering curve

8. Packaging

As shown in the figure below, the default packaging of EC-01 is taping.

Figure **11** **tape package**

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