



# EC-01F-Kit Specification

Version V2.0.1

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## Resumed

| Version | Date       | Develop/revise content                                                                                          | Formulate | check and approve |
|---------|------------|-----------------------------------------------------------------------------------------------------------------|-----------|-------------------|
| V1.0.0  | 2021.09.08 | For the first time, formulate                                                                                   | JieWei    | Hong Xu           |
| V2.0.1  | 2021.09.24 | Modify indicator description, and replace the dimensions diagram, schematic diagram, and specification template | JieWei    | Hong Xu           |
|         |            |                                                                                                                 |           |                   |
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## Catalog

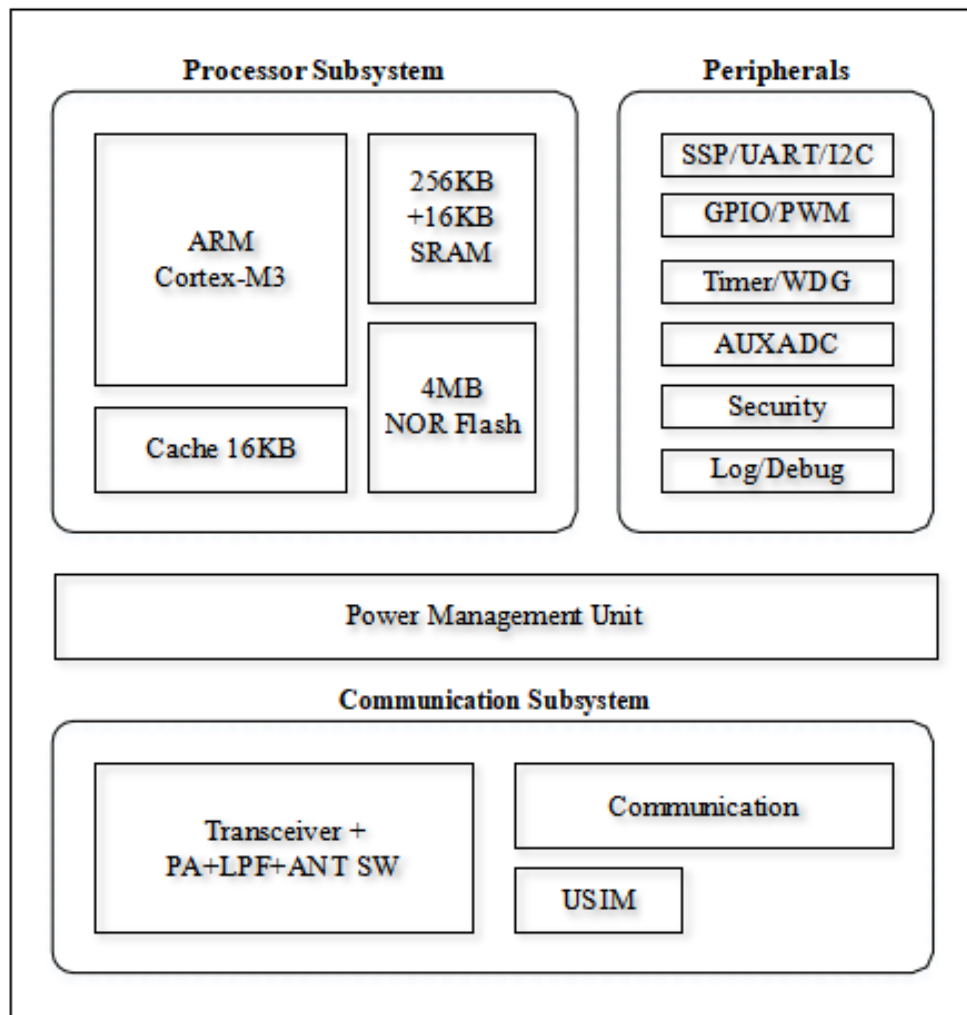
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## 1. Product Overview

EC-01F-Kit It is an NB-IoT development board developed by Ai-Thinker. The main chip scheme used in the NB-IoT part is EC616S. The ultra-integrated NB-IoT SoC development board supports ultra-low power consumption and fully supports the 3GPP Rel14 NB-IoT standard, making it an ultra-cost-effective NB-IoT chip.

It has the following characteristics (NB-IoT) :

- Are integrated with RF transceivers, PA, RF filters, antenna switches, and power management.
- Excellent communication performance and stability in a variety of wireless environments.
- Excellent power performance in various modes (PSM, DRX, eDRX, connected mode).
- Unique MCU mode, providing lower operating current and shorter wake up time.



**Figure 1 EC616S chip architecture diagram**

## 1.1. Character

- Processor:
  - ✓ Cortex-M3, Support MPU
  - ✓ Configurable CPU frequency, Max 204MHz
  - ✓ 8-Channel DMA
- Storer:
  - ✓ 4MB NOR Flash on chip
  - ✓ 272KB WIW SRAM, divided into 256KB and 16KB
  - ✓ 16KB instruct 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, internal RC oscillator as the clock, lower power consumption
- ✓ LOG □, UNILOG
- ✓ Debug port,SWD
- Peripheral
  - ✓ 8 GPIO(Include TX0\RX0 AND TX1\RX1)
  - ✓ 2 UART,2 I2C
  - ✓ 5 PWM
  - ✓ 4 Channel12-bit AUXADC
  - ✓ 1 SIM Booth
- Low power consumption:
  - ✓ Unique low power architecture, level 4 sleep mode
  - ✓ PSM: 800nA
  - ✓ DRX (2.56s): typical value 110uA
  - ✓ RX:typical value 10mA
  - ✓ TX:typical value 24mA
- Communication:
  - ✓ Fully 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)
- Radio frequency:
  - ✓ Support the spectrum: Band3、 Band5、 Band8
  - ✓ chip integrates PA and supports 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
  - ✓ software conforms to the CMSIS architecture
  - ✓ Supports mainstream cloud services
  - ✓ IPv4, IPv6 and non-IP
  - ✓ UDP, TCP
  - ✓ DTLS, TLS, SSL
  - ✓ MQTT, CoAP, HTTP(S)
  - ✓ LWM2M
  - ✓ Support FOTA
- Power supply voltage: support 5V Micro USB or 3.3V pin supply

## 2. Main parameters

**Table 1 Main parameters**

|                                |                                          |
|--------------------------------|------------------------------------------|
| <b>Development board Model</b> | EC-01F-Kit                               |
| <b>Adaptive pattern</b>        | EC-01F                                   |
| <b>Packaging</b>               | DIP-14 (2.54Spacing standard row needle) |
| <b>Size</b>                    | 33.9*28.4*13(±0.2)mm                     |
| • <b>Antenna form</b>          | NB:External SMA antenna                  |
| <b>Spectral Range</b>          | Band3,Band5,Band8                        |
| • <b>Working</b>               | -40 °C ~ 85 °C                           |
| • <b>Storage</b>               | -40 °C ~ 125 °C , < 90%RH                |
| <b>Supply district</b>         | 5V Micro USB or pin 3.3V power supply    |
| <b>Support interface</b>       | UART/I2C/PWM/ADC/GPIO                    |

|                                 |                                                                                                                                        |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| <b>IO quantity</b>              | 8(contain TX0\RX0 TX1\RX1)                                                                                                             |
| <b>Series Rate</b>              | Support 110 ~ 4608000 bps , Default9600 bps                                                                                            |
| <b>Bluetooth</b>                | Nonsupport                                                                                                                             |
| <b>Security</b>                 | AES/SHA                                                                                                                                |
| <b>Flash</b>                    | 4MB NOR Flash                                                                                                                          |
| <b>Module Power Consumption</b> | Sleep mode(PSM): 0.9uA (Single Module)<br>Standby mode(DRX): 120uA (Single Module)<br>Full load mode (TX: 23Bm) :240mA (Single Module) |

## 2.1. Power supply selection

You can power the EC-01F-Kit in either of the following ways:

- Micro-USB Interface power supply (default)
- 3V3 and GND Fixing pin power supply

Suggest to use the first power supply mode: Micro-USB port.

## 2.2. Electrostatic requirements

EC-01F-Kit is electrostatic sensitive equipment and special precautions should be taken when handling them.



**Figure 2 ESD preventive measures**



## 2.3. Electrical characteristics

**Table 2 Electrical characteristics**

| parameter                  |                 | condition | minimum                  | typical value | maximum                  | unit |
|----------------------------|-----------------|-----------|--------------------------|---------------|--------------------------|------|
| supply voltage (Micro-USB) |                 | VDD       | 4.75                     | 5             | 5.3                      | V    |
| I/O                        | $V_{IL}/V_{IH}$ | -         | -0.3/0.75V <sub>IO</sub> | -             | 0.25V <sub>IO</sub> /4.5 | V    |
|                            | $V_{OL}/V_{OH}$ | -         | N/0.8V <sub>IO</sub>     | -             | 0.1V <sub>IO</sub> /N    | V    |
|                            | $I_{MAX}$       | -         | -                        | -             | 24                       | mA   |

## 2.4. NB-IoT Rf performance

**Table 3 NB-IoT RF performance table**

| 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          |

## 2.5. Module power consumption

The following power consumption figures are based on a 3.3V power supply, ambient temperature at 25°C, and using an internal voltage regulator.

**Table 4 Module power consumption table**

| Model                                                   | minimum | average value | maximum | Unit |
|---------------------------------------------------------|---------|---------------|---------|------|
| Connect_Tx_23dBm_1Tone(Band3<br>Channel 1575 1842.5MHz) | -       | 120           | 240     | mA   |
| Connect_Tx_23dBm_1Tone(Band5<br>Channel 2525 881.5MHz)  | -       | 110           | 226     | mA   |
| Connect_Tx_23dBm_1Tone(Band8<br>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. External Dimensions

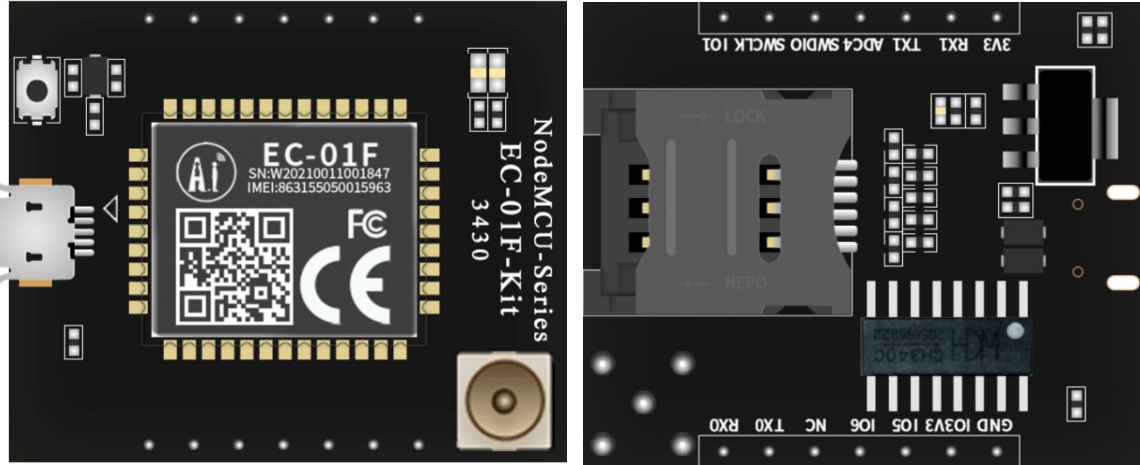


Figure 3 Appearance of development board (picture and silkscreen are for reference only, subject to the real object)

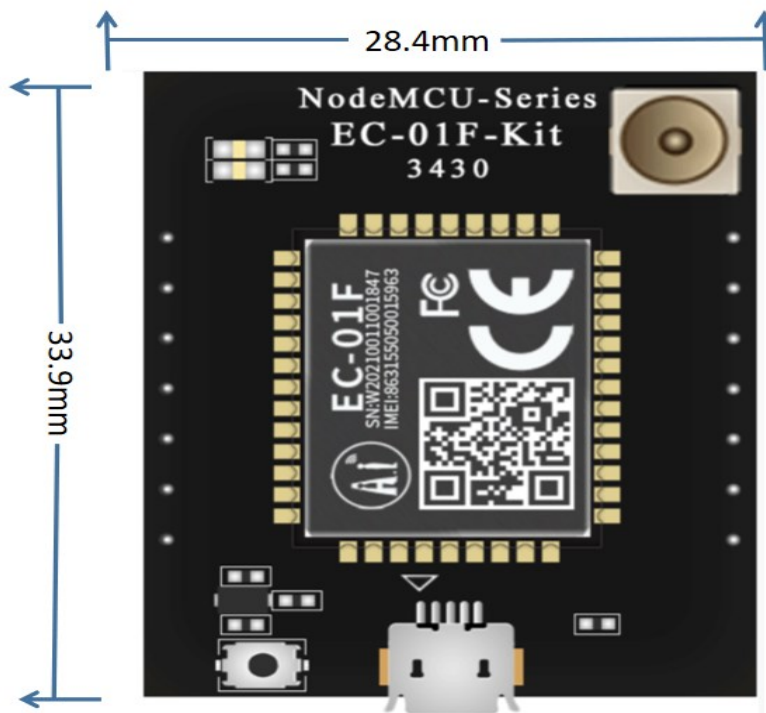


Figure 4 Development board size diagram

## 4. Description of Indicators and Buttons

EC-01F-Kit there are two indicators, the indicators are NB indicator and LINK indicator. A key is drawn as the "RST" key, as shown below:

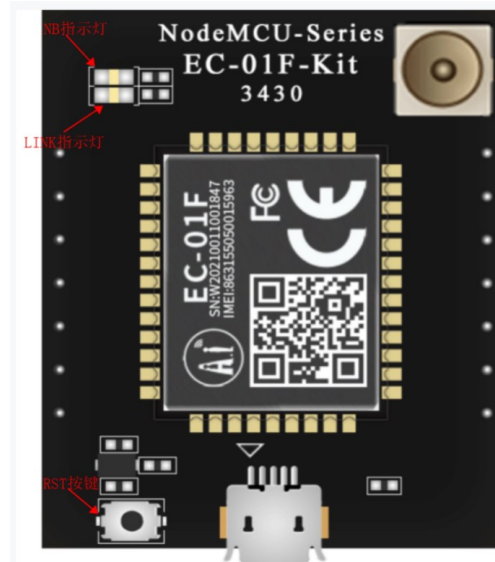
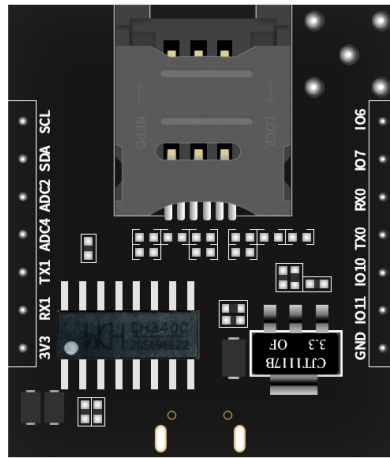


Figure 5 positions of indicators and buttons on the EC-01F-Kit

Table 5 Indicator status and button functions

| Indicator light or button                    | Network state                             | LED status or Button Function                          | Remark                                                                                                                                    |
|----------------------------------------------|-------------------------------------------|--------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| “NB” Indicator<br>(Network status indicator) | Connected                                 | 1s Flashing once                                       | Turn on the indicator mode<br>(AT+ECLEDM ODE=1)                                                                                           |
|                                              | Search the Internet                       | 0.5s Flashing once<br>(quick flashing)                 |                                                                                                                                           |
|                                              | The network is disconnected or hibernated | Extinguish                                             |                                                                                                                                           |
| “LINK” Indicator                             | Failed to connect to server               | Extinguish                                             | The use of the “LINK” indicator must be configured with the AT+MODULETYPE=0 command after each power-on or reset of the development board |
|                                              | Connected Server                          | Steady on (when connecting to the TCP server and ID=0) |                                                                                                                                           |
| RST Key                                      | /                                         | Resetting Key                                          | /                                                                                                                                         |

## 5. Pin definition



**Figure 6 Schematic diagram of development board pins (bottom view)**

EC-01F-KitA total of 14 interfaces are connected, such as pin schematic diagram, pin function definition table is the interface definition.

**Table 6 Pin function definition table**

| Foot sequence | Name  | Function Declaration          |
|---------------|-------|-------------------------------|
| 1             | 3V3   | 3.3V power supply             |
| 2             | RX1   | GPIO14/UART1_RXD              |
| 3             | TX1   | GPIO15/UART1_TXD              |
| 4             | ADC4  | ADC Channel AIO4              |
| 5             | SWDIO | SWDIO/Serial Wire Debug Data  |
| 6             | SWCLK | SWCLK/Serial Wire Debug Clock |
| 7             | IO1   | GPIO1                         |
| 8             | RX0   | GPIO8/UART0_RXD               |
| 9             | TX0   | GPIO9/UART0_TXD               |
| 10            | NC    | NC                            |
| 11            | IO6   | GPIO6/UART0_RSTn              |
| 12            | IO5   | GPIO5                         |
| 13            | IO3V3 | IO3V3                         |
| 14            | GND   | Ground Connection             |

## 6. Schematic diagram

EC-01-Kit and EC-01G-Kit share a schematic.

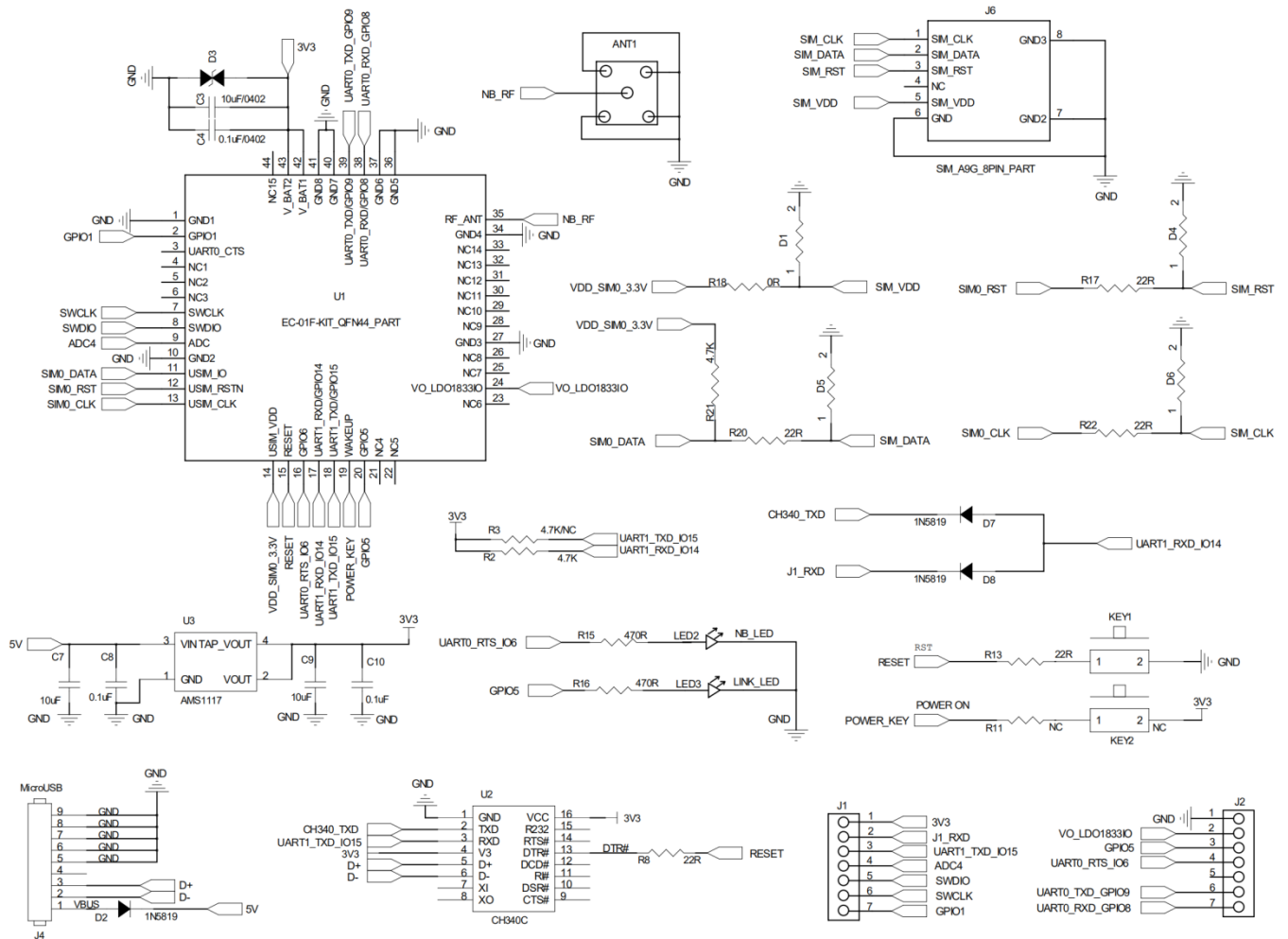


Figure 7 Schematic diagram of development board

## 7. Product Model

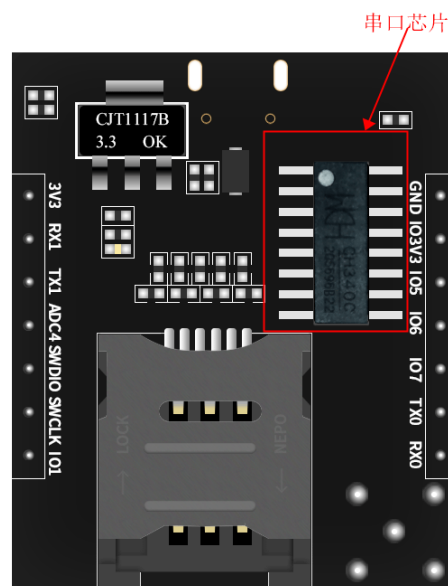
Table 7 Product model table

| Product Model                                                                                                  | Power Supply            | Pin TX1 and RX1    | Package | Size                      | GPS |
|----------------------------------------------------------------------------------------------------------------|-------------------------|--------------------|---------|---------------------------|-----|
| EC-01 Module                                                                                                   | 3.3V ~ 4.5V,<br>I>500mA | /                  | SMD-54  | 19.2*18.8*2.8<br>(±0.2)MM | No  |
| EC-01G Module                                                                                                  | 3.3V ~ 4.5V,<br>I>500mA | /                  | SMD-54  | 19.2*18.8*2.8<br>(±0.2)MM | Yes |
| EC-01F Module                                                                                                  | 3.3V ~ 4.5V,<br>I>500mA | /                  | SMD-44  | 17.7*15.8*2.8<br>(±0.2)MM | No  |
| EC-01-Kit_V1.0 Development Board                                                                               | 5V,<br>I>500mA          | Access not support | DIP-14  | 37.6*32.5<br>(±0.2) mm    | No  |
| EC-01G-Kit_V1.0 Development Board                                                                              | 5V,<br>I>500mA          | Access not support | DIP-14  | 37.6*32.5<br>(±0.2) mm    | Yes |
| EC-01F-Kit_V1.0 Development Board                                                                              | 5V,<br>I>500mA          | Access not support | DIP-14  | 33.9*28.4*13<br>(±0.2)mm  | No  |
| EC-01-Kit_V2.0 Development Board                                                                               | 5V,<br>I>500mA          | Support access     | DIP-14  | 37.6*32.5<br>(±0.2) mm    | No  |
| EC-01G-Kit_V2.0 Development Board                                                                              | 5V,<br>I>500mA          | Support access     | DIP-14  | 37.6*32.5<br>(±0.2) mm    | Yes |
| EC-01F-Kit_V2.0 Development Board                                                                              | 5V,<br>I>500mA          | Support access     | DIP-14  | 33.9*28.4*13<br>(±0.2)mm  | No  |
| Product Information: <a href="https://docs.ai-thinker.com/nb_module">https://docs.ai-thinker.com/nb_module</a> |                         |                    |         |                           |     |

## 8. Product Notes

EC-01F-Kit V1.0 version of the onboard micro-USB port and TX1, RX1 can only use one of the two for communication and recording, When the serial port chip as shown in Figure 8 exists, only onboard micro-USB port can be used for communication and recording. If you want to use TX1 and RX1 pin row for communication and burning need to remove the serial chip, In this case, the micro-USB port does not support communication and burning. Ec-01f-kit V2.0 Micro-USB port, TX1 and RX1 can be used for communication at the same time.

Figure 9 shows the differences between EC-01F-KIT V1.0 and EC-01F-Kit V2.0.



**Figure 8 schematic diagram of serial port chip**



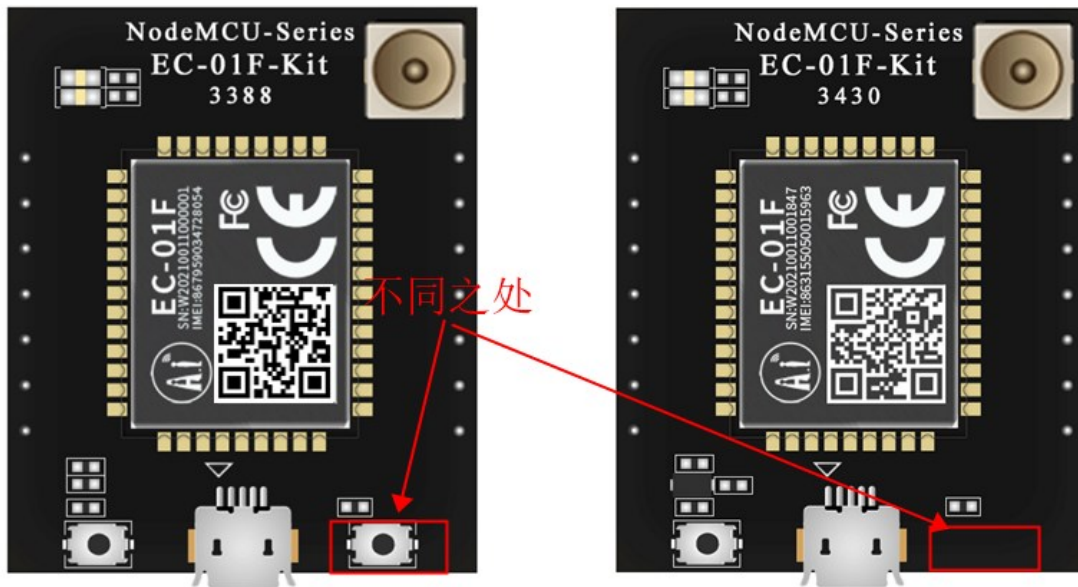


Figure 9 Difference between EC-01F-Kit V1.0(left) and EC-01F-Kit V2.0(right)

## 9. Product packaging information

EC-01F-Kit development board is packed in electrostatic bag, 1pcs/bag. As shown below:



Figure 10 Packing diagram of an ESD bag

## 10. Contact us

Official website: <https://www.ai-thinker.com>

Develop Wiki: <https://docs.ai-thinker.com>

Official forum: <http://bbs.ai-thinker.com>

Sample purchase: <https://aithinker.tmall.com>

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