



AS01-ML01S User Manual

2.4G, 1mw RF Transceiver of PCB Antenna Port Based on nRF24L01P

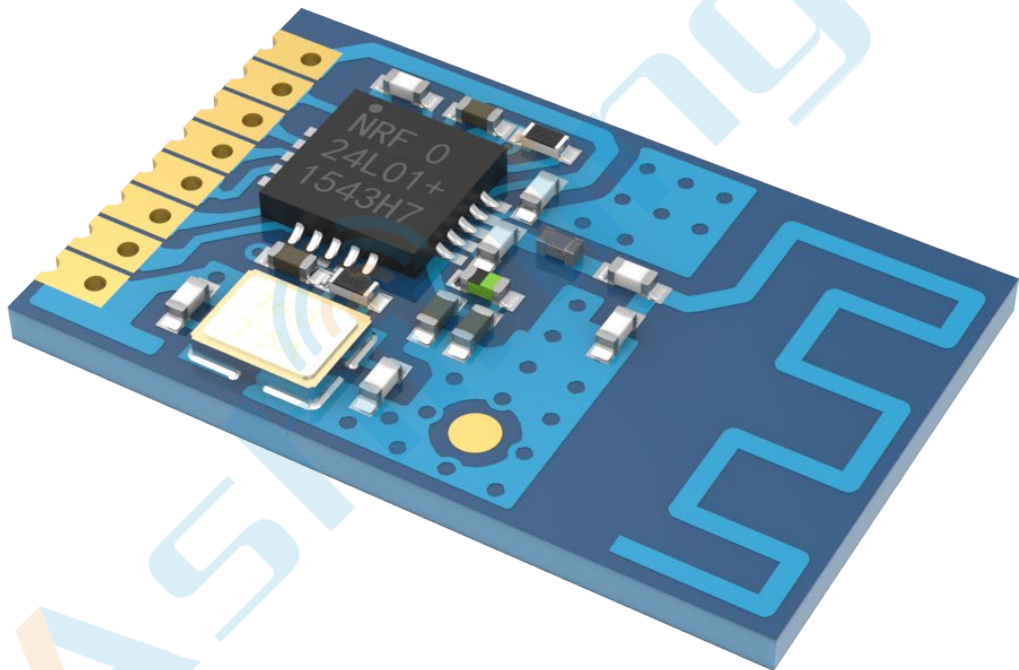


Table of Content

| | |
|---|----|
| 1. Product Overview | 3 |
| 2. Product Features..... | 3 |
| 3. Series Products | 4 |
| 4. Electrical Parameters | 4 |
| 5. Module Functions..... | 5 |
| 5.1 Recommended Connection Diagram..... | 5 |
| 5.2 Pin Definition | 6 |
| 5.3 Pin Function..... | 6 |
| 6. Package Information | 9 |
| 6.1 Machine Size (unit: mm)..... | 9 |
| 6.2 Reference Pad Design (unit: mm) | 9 |
| 7. Package Manner..... | 10 |
| 7.1 Electrostatic Bag Package | 10 |

1. Product Overview

AS01-ML01S is a 1mW industrial wireless data transceiver with high speed and high stability, operates at ISM band 2.4GHz~2.4835GHz (default 2.4GHz). The module uses original nRF24L01P from Nordic. It comes with high-performance PCB antenna and accurate impedance matching. It features enough power, good spectral properties, small harmonic wave, small cross talk and super small volume. Some of the devices meet military grade standard.

2. Product Features

- Comes with PCB antenna, transmission distance up to 0.12km ^[1]
- Super low power consumption, the lowest power consumption is about 0.9uA
- Operation frequency 2.4-2.4835GHz, a total of 126 channels
 - Frequency adjustable, 1MHz stepping
 - GFSK modulation
- 3 FIFO levels
 - Transmission length: 1-32 bytes each data packet
 - Receiving length: 1-32 bytes each data packet
 - Automatically resend mechanism
 - Support data transmission of 6 channels
- Communication interface
 - Hardware SPI interface of 4-Pin
 - 4Mbps data speed is recommended, Max speed is up to 10Mbps.
- Multiple levels of airspeed
 - 3 levels of air speed are optional: ^[2] 250Kbps, 1Mbps, 2Mbps
- 4 power levels adjustable, the max power is about 0dBm ^[3]
- 4 operation modes ^[4]
 - Power down
 - Standby
 - Send
 - Receive
- supply voltage range
 - 1.8V-3.6VDC
- Transmitting current
 - When the transmitting power is 0dBm, the transmitting current is tested as 150mA
- Receiving sensibility
 - -82dBm (data speed 2Mbps)
 - -85dBm (data speed 1Mbps)
 - -94dBm (data speed 250Kbps)
- Ultra-small volume, in-line package
 - 12 * 19mm
 - Module weight is about 0.5g

Remarks:

- 1) Open, sunny, no obstacles; The max power, height 2m, data speed 250Kbps
- 2) The airspeed is higher, the distance is closer; The airspeed is lower, distance is longer
- 3) For transmitting power, please see chip manual of nRF24L01P
- 4) For four operation modes, please see chip manual nRF24L01P

3. Series Products

Table 3-1 Brief Specification of AS01-ML01S

| Model Number | Carrier Frequency (Hz) | IC | Package | Size (mm) | Max Transmit Power (dBm) | Range (km) | Antenna type |
|--|------------------------|---------------|---------|-----------|--------------------------|------------|--------------|
| AS01-ML01S | 2.4G~2.4835G | nRF24L01P | SMD | 12 * 19 | 0 | 0.12 | PCB |
| AS01-ML01D | 2.4G~2.4835G | nRF24L01P | DIP | 12.5 * 22 | 0 | 0.12 | PCB |
| AS01-ML01DC | 2.4G~2.4835G | nRF24L01P | DIP | 13.2 * 30 | 0 | 0.12 | PCB |
| AS01-ML01PX | 2.4G~2.4835G | nRF24L01P | SMD | 12 * 19 | 0 | 0.2 | IPEX |
| AS01-ML01DP2 | 2.4G~2.4835G | nRF24L01P +PA | DIP | 17 * 33.5 | 20 | 1.8 | SMA-K |
| AS01-ML01DP3 | 2.4G~2.4835G | nRF24L01P +PA | DIP | 15 * 27 | 20 | 1.5 | SMA-K |
| AS01-ML01DP5 | 2.4G~2.4835G | nRF24L01P +PA | DIP | 18 * 33.3 | 20 | 2.0 | SMA-K |
| AS01-ML01DP6 | 2.4G~2.4835G | nRF24L01P +PA | DIP | 16.5 * 30 | 20 | 1.2 | PCB |
| AS01-SPIPX | 2.4G~2.4835G | nRF24L01P +PA | SMD | 13 * 19 | 20 | 2.0 | IPEX |
| AS01-SP2 | 2.4G~2.4835G | nRF24L01P +PA | SMD | 13 * 25 | 20 | 1.2 | PCB/IPEX |
| ASU1-SA | 2.4G~2.4835G | nRF24LU1P | DIP | 14.4*47.5 | 0 | 0.1 | PCB |
| ★Above model numbers of the AS01 series can communicate★ | | | | | | | |

4. Electrical Parameters

Table 4-1 Electrical Parameters of AS01-ML01S

Test Condition: Tc=25°C, VCC=3.3V

| Parameter | Parameter Name | Description | Min Value | Typical Value | Max Value | Unit |
|-----------|-------------------------------------|--|-----------|---------------|-----------|------|
| Voltage | Supply voltage ^[1] | | 1.8 | | 3.6 | VDC |
| | Communication level | The communication level is generally smaller than the supply voltage, and VCC in 0.7*VCC refers to the supply voltage. | 0.3*VCC | | 0.7*VCC | V |
| Current | Transmitting current ^[2] | | | 19.6 | | mA |
| | Receiving current | CE=1 | | 18.9 | | mA |
| | Turn off current | nRF24L01P set as power down mode, CE is low level. | | 0.9 | | uA |
| | Operating frequency | Adjustable, 1MHz stepping | 2.4 | | 2.525 | GHz |
| | Transmitting power | 4 chip powers are available, Max 0dBm, about 1mW | | 0 | | dBm |

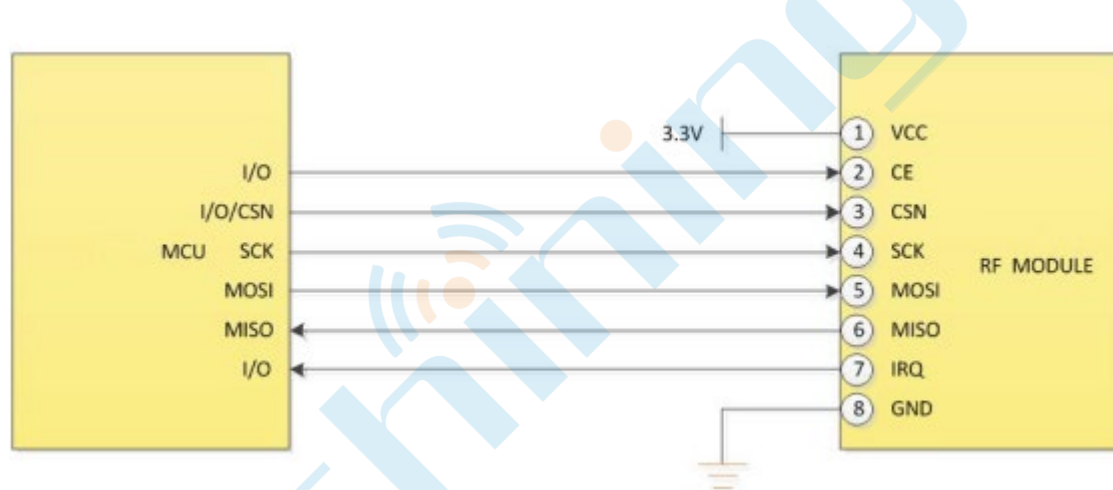
| | | | | | | |
|-----------------------|-----------------------|--|------|------|------|-----|
| RF Parameters | Receiving sensitivity | -94dBm@250kbps, receive sensitivity is detailed in the chip manual | | -94 | | dBm |
| | Air speed | 3 air speeds are available (250Kbps, 1Mbps, 2Mbps) | 250K | 250K | 2M | bps |
| Operation Environment | Operating temperature | Industrial grade | -40 | | +85 | °C |
| | Operating humidity | Relative humidity, no condensation | 10% | | 90% | |
| | Storage temperature | | -40 | | +125 | °C |

Remarks:

- 1) The modular has an onboard 3.3V regulator

5. Module Functions

5.1 Recommended Connection Diagram



0-1 Recommended Connection Diagram

Explanation:

1. High level CE is valid. When the module writes the register, it must first be set to power-down mode. It is recommended to connect CE to the IO port of the micro-controller.
2. IRQ is recommended to connect the external interrupt of the micro-controller. Alternatively, the SPI query mode can be used to obtain the interrupt status.
3. The nRF24L01P technical manual requires that the high-level time of the CE pin is greater than 10us to start data transmission. However, in order to make the same code compatible with our AS01 series modules with PA and LNA, it is recommended to change CE to high level after setting the SPI operation. After the completion of the transmission, continue to maintain a high level of 1ms, and then lower the CE.

5.2 Pin Definition

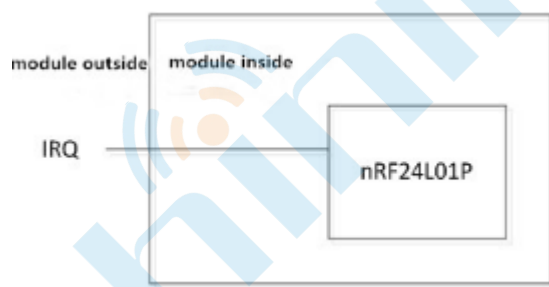
Table 5-1 Pin Definition of AS01-ML01S

| Pin No. | Pin Name | Pin Direction | Pin Description |
|---------|----------|---------------|--|
| 1 | VCC | | Power supply, range 1.8~3.6V, recommend 3.3V, it is recommended to add ceramic filter capacitors externally. |
| 2 | CE | input | Module control pin, please see nRF24L01P Datasheet for details |
| 3 | CSN | input | Module chip select pin, used to start an SPI communication |
| 4 | SCK | input | Module SPI bus clock |
| 5 | MOSI | input | Module SPI Data Input Pin |
| 6 | MISO | output | Module SPI Data Output Pin |
| 7 | IRQ | output | Module interrupt signal output, valid in low communication level |
| 8 | GND | | Ground, connect to power reference ground |

*See the nRF24L01P data sheet for pin definitions, software drivers, and communication protocols of the module. *

5.3 Pin Function

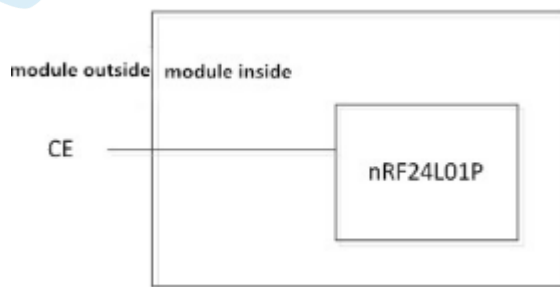
5.3.1 Function of IRQ Pin



Picture 0-2 IRQ Local Connection Diagram

IRQ is the interrupt mapping pin, low level is valid, and the specific interrupt signal represented is in the nRF24L01P chip manual

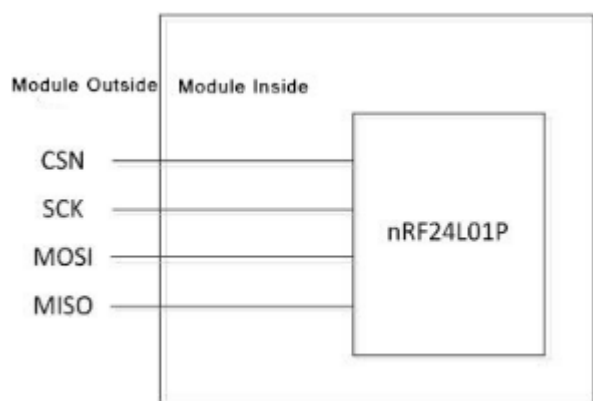
5.3.2 Function of CE Pin



Picture 0-3 CE Local Connection Diagram

The module control pin, the module's transmit mode (TXD) and receive mode (RXD) are determined by this pin. See the nRF24L01P chip manual for details.

5.3.3 Function of SPI pin

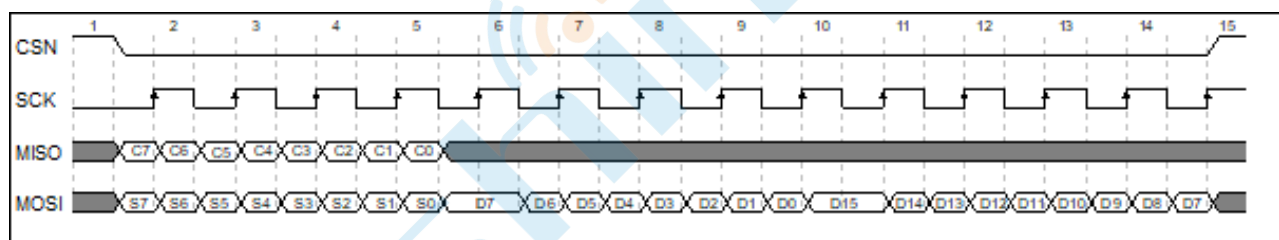


Picture 5-4 SPI Local Connection Diagram

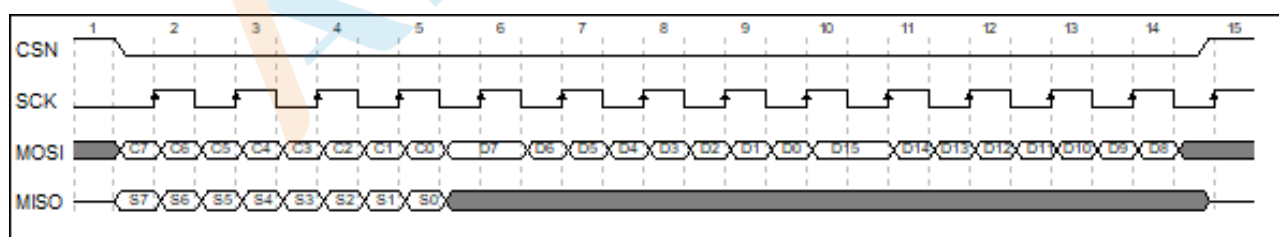
The SPI Sequence Diagram is as follows:

Table 5-2

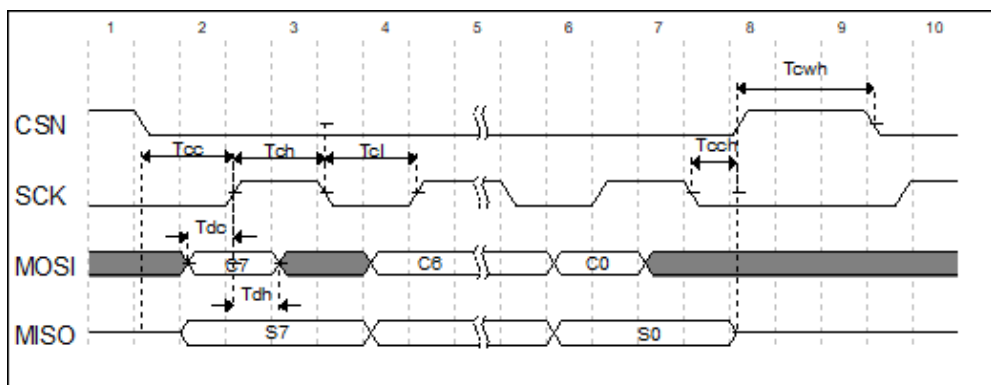
| abbr | Description |
|------|---------------------|
| Cn | SPI command bit |
| Sn | Status register bit |
| Dn | Data bit |



Picture 5-5 Sequence Diagram of SPI Read Operation



Picture 5-6 Sequence Diagram of SPI Write Operation



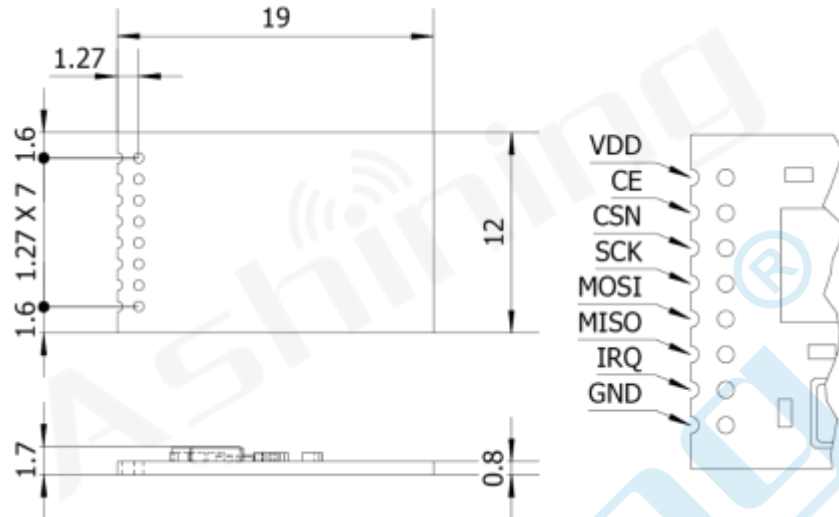
Picture 5-7 SPI Sequence Diagram of Parameters

Table 5-3

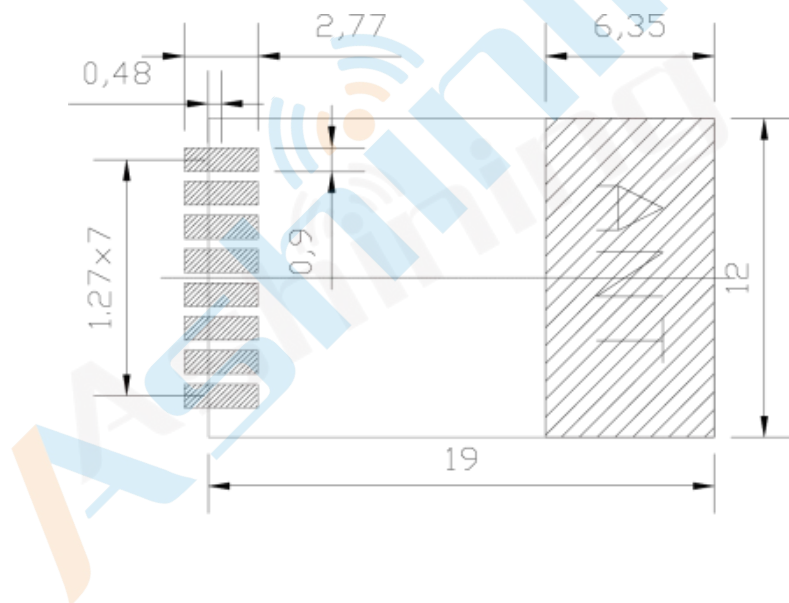
| Parameters Symbols | Description | Min | Max | Unit |
|--------------------|---------------------------|-----|-----|------|
| T_{cc} | Chip select clock setting | 2 | | ns |
| T_{ch} | Clock high level time | 40 | | ns |
| T_{cl} | Clock low level time | 40 | | ns |
| T_{cch} | The selection time lasts | 2 | | ns |
| T_{cwh} | Chip selection idle time | 50 | | ns |
| T_{dc} | Data initialization clock | 2 | | ns |
| T_{dh} | Data duration | 2 | | ns |

6. Package Information

6.1 Machine Size (unit: mm)

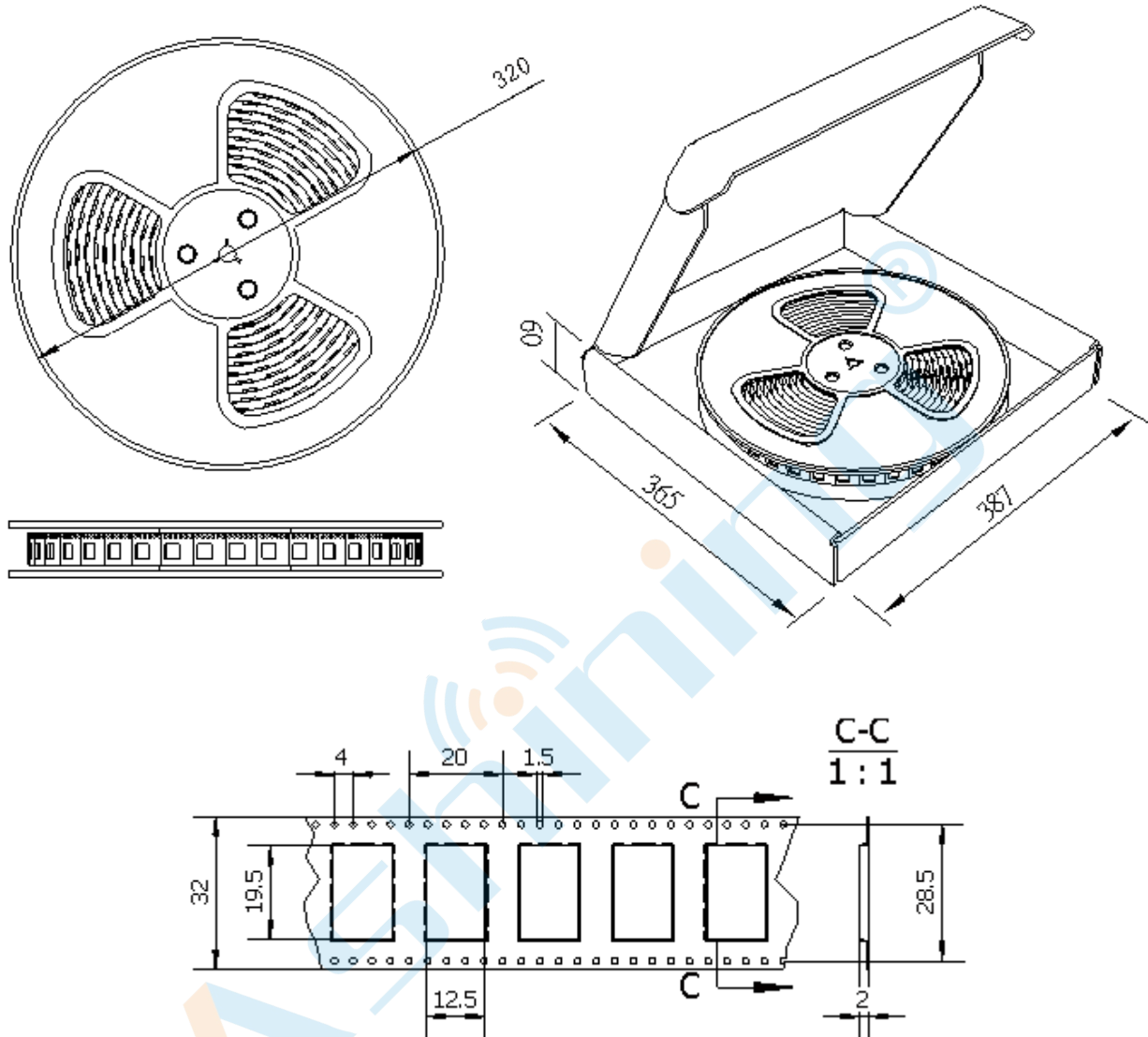


6.2 Reference Pad Design (unit: mm)



7. Package Manner

7.1 Electrostatic Bag Package



Important Remarks and Disclaimers

As the hardware and software of the product continue to improve, this manual may be subject to change, and the final version of the manual shall prevail.

Users of this product need to pay attention to the product dynamics on the official website, so that users can get the latest information of this product in time.

The pictures and diagrams used in this manual to explain the functions of this product are for reference only.

The measured data in this specification are all measured by our company at room temperature for reference only. Please refer to the actual measurement for details.

Chengdu Ashining Technology Co., Ltd. reserves the right of final interpretation and modification of all contents in this manual

FCC Statement

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This modular has been tested and found to comply with part 15 requirements for Modular Approval.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Radiated Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment meets the SAR threshold exclusion set forth in KDB 447498 and therefore can be used in mobile/portable configurations. The antenna used for this transmitter must not transmit simultaneously with any other antenna or transmitter, except in accordance with FCC multi-transmitter product procedures. Users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

The OEM integrator is still responsible for testing their end-user end-product for any additional compliance requirements required with this modular installed.

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01r01

2.2 List of applicable FCC rules

CFR 47 FCC Part 15 Subpart C has been investigated. It is applicable to the modular transmitter

2.3 Specific Operational Use Conditions - Antenna Placement Within the Host Platform

The module is tested for standalone mixed portable/mobile RF exposure use condition.

- The transmitter module may not be co-located with any other transmitter or antenna. In the event that these conditions cannot be met (for example co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

2.4 Limited Module Procedures

Not applicable

2.5 Trace Antenna Designs

Not applicable

2.6 RF Exposure Considerations

This equipment meets the SAR threshold exclusion set forth in KDB 447498 and therefore can be used in mobile/portable configurations.

2.7 Antenna Type and Gain

The PCB antenna have been certified for use with this module.

Only antennas of the same type with equal or lower gain may also be used with this module. Other types of antennas and/or higher gain antennas may require the additional authorization for operation.

2.8 End Product Labelling Compliance Information

When the module is installed in the host device, the FCC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily removed. If not, a second label must be placed on the outside of the final device that contains the following text: "Contains FCC ID: **2AL6KBL-M8800DS1**". The FCC ID can be used only when all FCC compliance requirements are met.

2.9 Information on Test Modes and Additional Testing Requirements

This transmitter is tested in a standalone mobile RF exposure condition and any co-located or simultaneous transmission with other transmitter(s) class II permissive change re-evaluation or new FCC authorization.

Host manufacturer installed this modular with single modular approval should perform the test of radiated emission and spurious emission according to FCC part 15C, 15.209, 15.207 requirement, only if the test result comply with FCC part 15C, 15.209, 15.207 requirement, then the host can be sold legally.

2.10 Additional testing, Part 15 Subpart B Disclaimer

This transmitter modular is tested as a subsystem and its certification does not cover the FCC Part 15 Subpart B rules requirement applicable to the final host. The final host will still need to be reassessed for compliance to this portion of rules requirements if applicable.

As long as all conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this modular installed.

2.11 Manual Information to The End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The host integrator must follow the integration instructions provided in this document and ensure that the composite system end product complies with the requirements by a technical assessment or evaluation to the rules and to KDB Publication 996369.

The host integrator installing this module into their product must ensure that the final composite product complies with the requirements by a technical assessment or evaluation to the rules, including the transmitter operation and should refer to guidance in KDB Publication 996369.

OEM/Host Manufacturer Responsibilities

OEM/Host manufacturers are ultimately responsible for the compliance of the Host and Module. The final product must be reassessed against all the essential requirements of the FCC rule such as FCC Part 15 Subpart B before it can be placed on the US market. This includes reassessing the transmitter module for compliance with the Radio and RF Exposure essential requirements of the FCC rules.

2.12 How to Make Changes - Important Note

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.