



INSTALLATION AND OPERATION

## USER MANUAL

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# UM220-IV NL

## Industry Grade Multi-GNSS Positioning Module

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## Revision History

| Version                    | Revision   | Date      |
|----------------------------|--|-----------|
| Ver. 1.0.0 Primary         | UM220-IV NL User manual Primary.   | Dec.2017  |
| Ver. 1.0.1 Alpha release   | The Pin definition and performance parameters have been updated.                               | Jun.2018  |
| Ver. 1.0.2 Beta release    | Updated size parameters  | Aug.2018  |
| Ver. 1.0.3 Product release | Update product label instruction   | May.2019  |
| R1.1                       | 1.2: Delete the GLONASS frequency<br>6.2: Add shelf life                                       | Sep. 2019 |
| R1.2                       | Chapter 6.2: revise the MSL instructions   | Jan. 2020 |
| R1.3                       | Add the footnote to elaborate CEP  | Oct. 2020 |
| R1.4                       | Add the description of SMT stencil   | Jun. 2021 |
| R1.5                       | Update power supply VCC and V_BCKP   | Aug. 2021 |
| R1.6                       | Add notes in Section 4.4   | Nov. 2021 |
| R1.7                       | If hot start is not used, connect V_BCKP to VCC.<br>Revise the VSWR in section 1.2             | Nov. 2022 |
| R1.8                       | Optimize the description of antenna power supply;<br>Add Chapter 4.3 Power Supply Requirements | Apr. 2023 |
| R1.9                       | Modify the description of "order code" to "sub-model"  | Jan. 2024 |

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## Foreword

This document offers you information in the features of the hardware, the installation, specification and use of Unicore UM220-IV NL product.

### Reader it applies to

This document is applied to the technicians who know GNSS Receiver to some extent but not to the general readers.

### Structure of the file

This document includes the followings:

Introduction: Briefly explaining the functions, performances and structure of the product

Installation: Contains the list of the product package and the details of product installation

Technical Specification: Offering technical specifications of the product

Hardware Design: Offering the information of hardware design

Disassembly: Instructions of how to remove the module

Package: Product label and package information

Clean: Dos and don'ts for cleaning the module

Reflow soldering: Offering temperature information about reflow soldering

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# 1 Introduction

## 1.1 Overview

Unicore UM220-IV NL is a multi-system GNSS positioning module. Based on the low power and high performance GNSS SoC-UFirebird, the module supports GPS L1 +BDS B1 dual system joint positioning and single system standalone positioning, as well as the QZSS signal. The module supports AGNSS, which can reduce the positioning time with the help of assisted data service when connected to network.

UM220-IV NL is compact in size, with SMT pads, and supports fully automatic integration of standard pick-and-place and reflow soldering, especially suitable for low cost and low power consumption fields.



Figure 1-1 UM220-IV NL Module

| Main Model  | Sub-model | PN           | Standard     |            | System |     |         |      | Interface |       | Data updating rate |
|-------------|-----------|--------------|--------------|------------|--------|-----|---------|------|-----------|-------|--------------------|
|             |           |              | Professional | Automotive | GPS    | BDS | GLONASS | QZSS | UART1     | UART2 |                    |
| UM220-IV NL | GB        | 080101016200 | ●            |            | ●      | ●   |         | ●    | ●         | ●     | 1Hz                |

 Note: The sub-model (GB) is displayed in the lower left corner of the module.

## 1.2 Key Features

| Power                             |  |
|-----------------------------------|--|
| Voltage                           | +3.0~3.6 VDC   |
| Power consumption <sup>1</sup>    | 50mW   |
| RF Input                          |  |
| Input VSWR                        | ≤2.5   |
| Input impedance                   | 50Ω  |
| Antenna gain                      | 15~30dB  |
| Physical Characteristics          |  |
| Dimension                         | 16.0*12.2*2.4mm  |
| Weight                            | 0.8g   |
| Environment                       |  |
| Operating Temperature             | -40°C ~ +85°C  |
| Storage Temperature               | -45°C ~ +90°C  |
| RoHS                              | Compliant  |
| Input/ Output Data Interface      |  |
| UART                              | 2 UART, LVTTTL. Baud rate 4800~115200bps   |
| GNSS Performance                  |  |
| Frequency                         | BDS B1: 1561.098MHz<br>GPS L1: 1575.42MHz  |
| TTF                               | Cold Start: 28s<br>Hot Start: 1s<br>Reacquisition: 1s<br>AGNSS <sup>2</sup> : 4s |
| Positioning accuracy <sup>3</sup> | 2.0m (Dual system Horizontal, Open sky)<br>3.5m (Dual system vertical, Open sky) |
| Velocity accuracy (RMS)           | 0.1m/s (Dual system Horizontal, Open sky)  |

<sup>1</sup> Continuous positioning, typical value

<sup>2</sup> Timely input of assistance data

<sup>3</sup> CEP, 50%

|                          | GN                          | BDS     | GPS     |         |
|--------------------------|-----------------------------|---------|---------|---------|
| Sensitivity <sup>4</sup> | Tracking                    | -160dBm | -159dBm | -160dBm |
|                          | Acquisition                 | -147dBm | -146dBm | -147dBm |
|                          | Hot Start                   | -151dBm | -150dBm | -151dBm |
|                          | Reacquisition               | -158dBm | -157dBm | -158dBm |
| 1PPS (RMS) <sup>5</sup>  | 20ns                        |         |         |         |
| Data update rate         | 1Hz                         |         |         |         |
| Data Output <sup>6</sup> | NMEA 0183, Unicore Protocol |         |         |         |

### 1.3 Interface

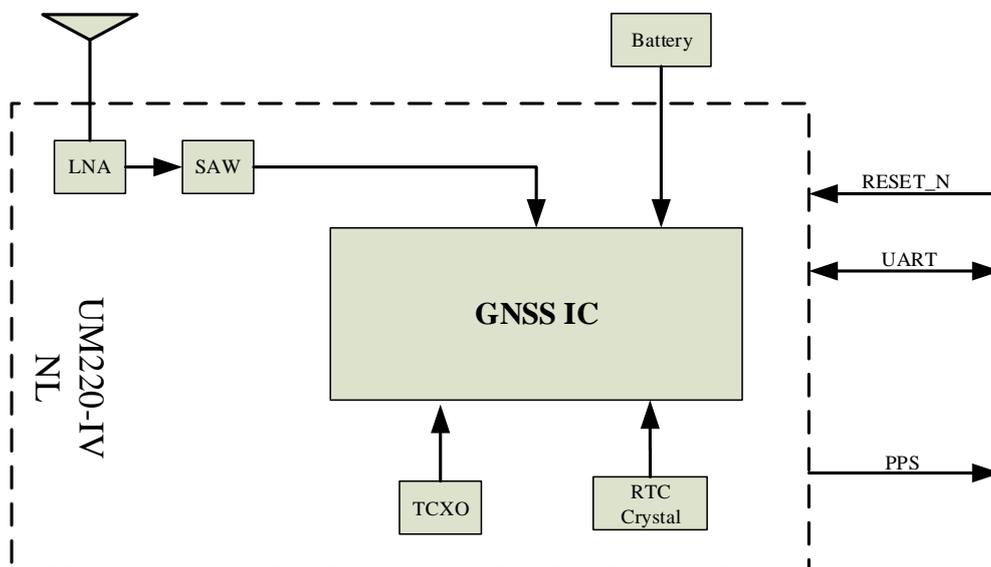


Figure 1-2 Structure Chart

#### UART

UM220-IV NL module COM1 is the primary serial port, which supports data transfer and firmware upgrade. The signal input/output level is LVTTTL. The default baud rate varies according to the version of firmware, and the baud rate can be configured up to 115200bps<sup>7</sup>. During design, please ensure that COM1 is connected to a PC or an external processor for firmware upgrades.

COM2 only supports data transfer, and cannot be used for firmware upgrade purpose. It

<sup>4</sup> When C/N0 is 41 db

<sup>5</sup> 1 hour statistics, timing is not recommended.

<sup>6,7</sup> Can be configured by users, refer to *UFirebird\_Standard Positioning Products Protocol Specification* for details

is reserved for future use.

## 1PPS

UM220-IV NL outputs 1PPS with adjustable pulse width and polarity.

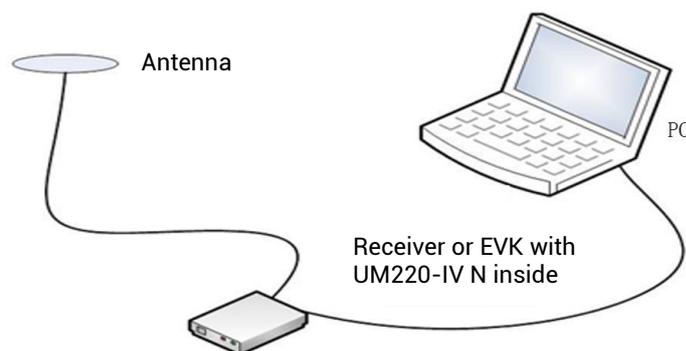
## 2 Product Installation

### 2.1 Installation Preparation

UM220-IV NL Modules are Electrostatic Sensitive Devices and require special precautions when handling:

- Follow the steps in section 2.2 in the correct order
- Electrostatic discharge (ESD) may cause damage to the device. All operations mentioned in this chapter shall be carried out on an antistatic workbench, wearing an antistatic wrist strap and using a conductive foam pad. If antistatic workbench is not available, wear an antistatic wrist strap and connect the other end to a metal frame to play a role in anti-static protection.
- Hold the edge of the module, not in direct contact with the components
- Please check carefully whether the module has obviously loose or damaged components. If you have any questions, please contact us or your local dealer.

Figure 2-1 shows the typical installation of UM220-IV NL EVK suites



**Figure 2-1 Typical Installation**

Please check the contents of the package carefully after receiving the package of UM220-IV NL:

- UM220-IV NL EVK suite (with AC Adapter)
- UM220-IV NL User manual
- uSTAR application package



- Qualified antenna
- Antenna connection cable
- Direct serial cable
- PC or Laptop with serial ports (Windows 2000/xp/win7)

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 Please keep the box and anti-static plastic bags for storage and handling

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## 2.2 Hardware Installation

After the above preparation is complete, follow the steps below to install:

Step 1: Make sure to take full anti-static measures, such as wearing an anti-static wrist strap and grounding the workbench.

Step 2: Open the UM220-IV NL evaluation kit.

Step 3: Select the GNSS antenna with appropriate gain, fix it in the non-block area, using the appropriate cable to connect the antenna with UM220 EVK.

Step 4: Connect the PC to the EVK serial port through the straight-through serial cable.

Step 5: Power the evaluation board and initialize the UM220-IV NL.

Step 6: Open the uSTAR.

Step 7: Control the receiver through uSTAR to display constellations view, log messages, and receiver status.

## 3 Technical Specifications

### 3.1 Electrical Specifications

#### Absolute Maximum Rating

| Item                | Symbol                          | Min  | Max      | Unit | Condition |
|---------------------|---------------------------------|------|----------|------|-----------|
| Power Supply (VCC)  | Vcc                             | -0.5 | 3.6      | V    |           |
| VCC Ripple          | Vrpp                            |      | 50       | mV   |           |
| Digital IO          | Vin                             | -0.5 | Vcc +0.2 | V    |           |
| Storage Temperature | Tstg                            | -45  | 90       | °C   |           |
| MSL                 | □Level 1 □Level 2 ■Level 3 □TBD |      |          |      |           |

### 3.2 Operation Condition

| Item                      | Symbol    | Min     | Typical | Max | Unit | Condition    |
|---------------------------|-----------|---------|---------|-----|------|--------------|
| Power Supply (Vcc)        | Vcc       | 3.0     | 3.3     | 3.6 | V    |              |
| Peak Current              | Iccp      |         |         | 28  | mA   | Vcc = 3.0 V  |
| Tracking Average Current  | Iacc      | 15      | 17      | 19  | mA   | Vcc = 3.0V   |
| Low Level Input Voltage   | Vin_low   |         |         | 0.7 | V    |              |
| High Level Input Voltage  | Vin_high  | 1.2     |         |     | V    |              |
| Low Level Output Voltage  | Vout_low  |         |         | 0.4 | V    | Iout = -8 mA |
| High Level Output Voltage | Vout_high | Vcc-0.4 |         |     | V    | Iout = 8 mA  |
| Antenna Gain              | Gant      | 15      |         | 30  | dB   |              |
| Noise Figure              | Nftot     |         | 2       |     | dB   |              |
| Operating Temperature     | Topr      | -40     |         | 85  | °C   |              |

### 3.3 Dimensions

| Symbol               | Min (mm) | Typical (mm) | Max (mm) |
|----------------------|----------|--------------|----------|
| A                    | 15.9     | 16.0         | 16.5     |
| B                    | 12.05    | 12.2         | 12.35    |
| C                    | 2.2      | 2.4          | 2.6      |
| D                    | 0.9      | 1.0          | 1.3      |
| E                    | 1.0      | 1.1          | 1.2      |
| F                    | 2.9      | 3.0          | 3.1      |
| G                    | 0.9      | 1.0          | 1.3      |
| H                    | 0.7      | 0.8          | 0.9      |
| K (Outside the hole) | 0.7      | 0.8          | 0.9      |
| N (Inside the hole)  | 0.4      | 0.5          | 0.6      |
| M                    | 0.8      | 0.9          | 1.0      |

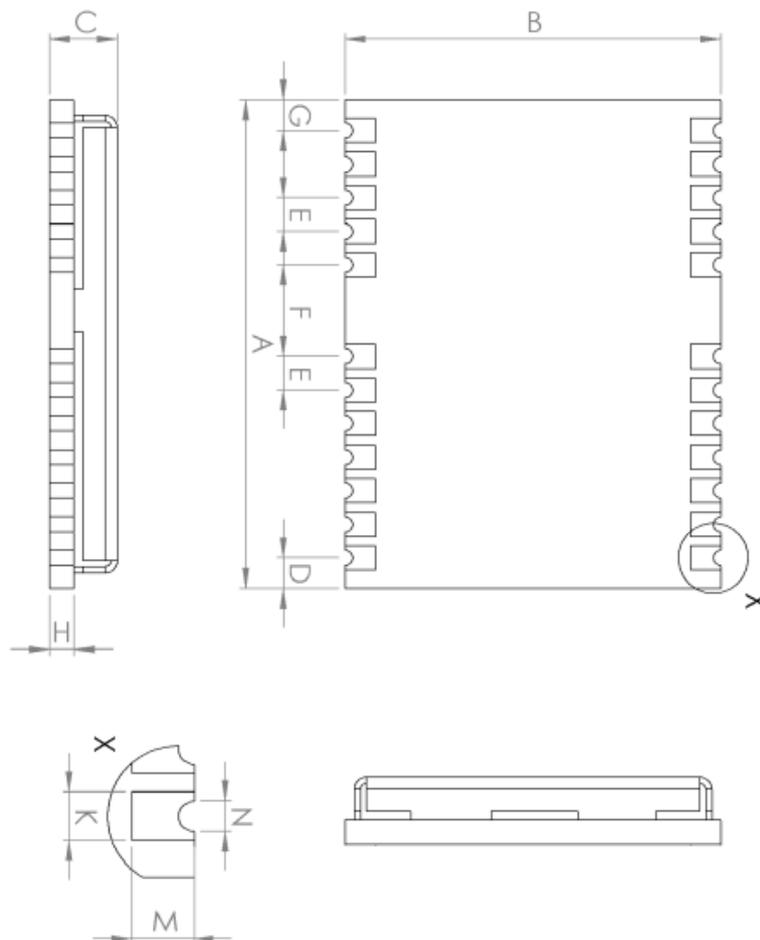


Figure 3-1 Mechanical Layout

### 3.4 Pin Definition (Top View)

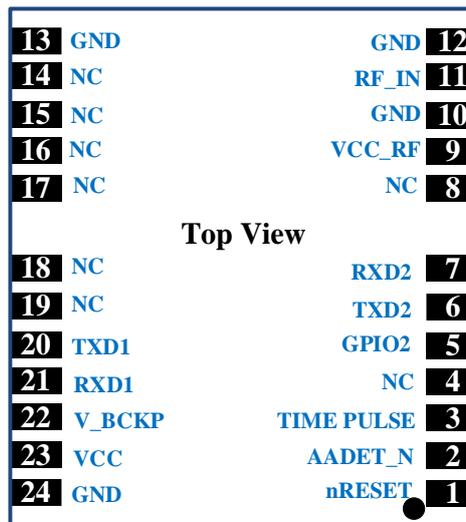
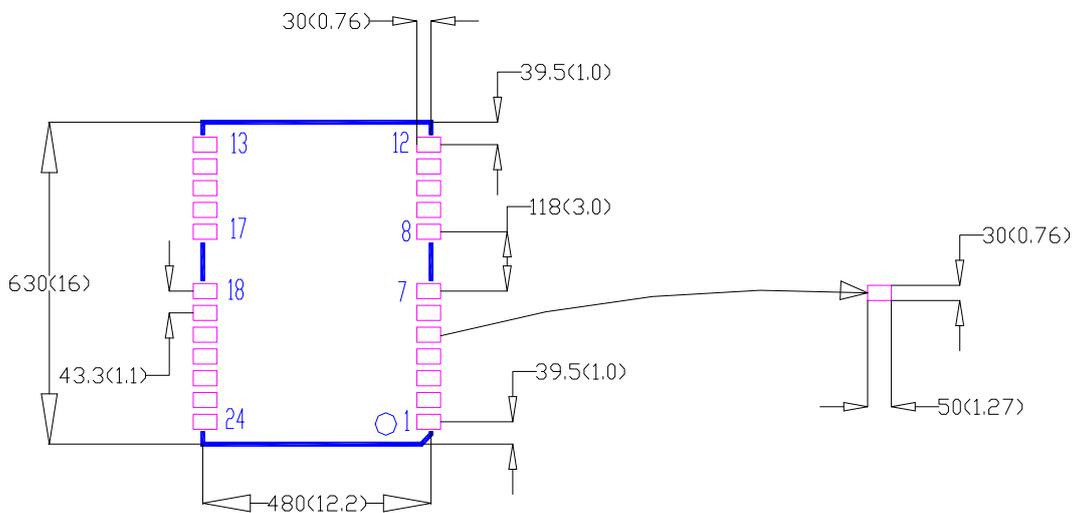


Figure 3-2 UM220-IV NL Top View

| No | Name      | I/O | Electrical level | Description  |
|----|-----------|-----|------------------|--|
| 1  | nRESET    | I   | LVTTL            | For reset, Low level active, if you do not use the pin, please leave it floating |
| 2  | AADET_N   | I   | LVTTL            | Antenna detection  |
| 3  | TIMEPULSE | O   | LVTTL            | Time pulse (1PPS)  |
| 4  | NC        | I   | LVTTL            | Reserve  |
| 5  | GPIO2     | I   | LVTTL            | Antenna detection  |
| 6  | TXD2      | O   | LVTTL            | UART 2-TX  |
| 7  | RXD2      | I   | LVTTL            | UART 2-RX  |
| 8  | NC        |     |                  | Reserve  |
| 9  | VCC_RF    | O   | =VCC             | Output voltage RF section  |
| 10 | GND       | —   |                  | Ground   |
| 11 | RF_IN     | I   |                  | GNSS signal input (BDS B1+GPS L1)  |
| 12 | GND       | —   |                  | Ground   |
| 13 | GND       | —   |                  | Ground   |
| 14 | NC        |     |                  | Reserve  |
| 15 | NC        |     |                  | Reserve  |
| 16 | NC        |     |                  | Reserve  |
| 17 | NC        |     |                  | Reserve  |
| 18 | NC        | I/O | LVTTL            | Reserve  |
| 19 | NC        | I/O | LVTTL            | Reserve  |
| 20 | TXD1      | O   | LVTTL            | UART 1-TX  |
| 21 | RXD1      | I   | LVTTL            | UART 1-RX  |

| No | Name   | I/O | Electrical level | Description   |
|----|--------|-----|------------------|---|
| 22 | V_BCKP | I   | 1.65V~3.6V       | Backup voltage supply<br>If you do not use the hot start function, connect V_BCKP to VCC. Do NOT connect it to ground or leave it floating. |
| 23 | VCC    | —   | 3.0V~3.6 V       | Main power  |
| 24 | GND    | —   |                  | Ground  |

### 3.5 PCB Packaging



**Figure 3-3 UM220-IV NL Recommended PCB Packaging (unit: mil, in brackets: mm)**

In the design of PCB solder, make sure that the area under the UM220-IV NL module is fully covered with solder mask.

## 4 Hardware Design

### 4.1 Design in Considerations

To ensure that UM220-IV NL works properly, please pay attention to the following:

- Recommended to connect 1 K $\Omega$  resistance at RX serial ports, and 33  $\Omega$  or 1 K $\Omega$  resistance at TX serial ports; other necessary PIOs require 4.7 K $\Omega$  resistance connected in series at the pin. The resistance can be adjusted slightly according to the application to achieve better effect.
- Connect all the GND pins to ground.
- Connect the RF\_IN signal to the antenna, and the line should keep 50 $\Omega$  impedance matching.
- Ensure COM1 is connected to a PC or an external processor. Users can use this serial port to receive position data. COM1 is also necessary for firmware upgrades.

In order to obtain good performance, special concern should be paid during the design :

- Power supply: Stable and low ripple power is necessary for good performance. Make sure the peak to peak voltage ripple does not exceed 50mV.
  - Using LDO to ensure the purity of power supply
  - Try to place LDO close to the module in layout
  - Widening the power circuit or use copper pour surface to transmit current
  - Avoid wiring through any high-power or high inductance devices such as magnetic coils
- UART interfaces: Ensure that the signals and baud rate of the main equipment match that of the UM220-IV NL module
- Antenna interface: Make sure the antenna impedance matching, and the circuit is short and smooth; try to avoid acute angles
- Antenna position: In order to ensure a good signal-to-noise ratio, the antenna is required to be well isolated from any electromagnetic radiation source, especially the electromagnetic radiation in the frequency range of 1559 ~ 1607MHz
- Try to avoid circuits below UM220-IV NL
- This module is a temperature sensitive device and dramatic changes in temperature will result in reduced performance, so keep it as far away from any



high-temperature air and high-power heating devices as possible.

## 4.2 Avoid Power Leakage

When the module is not powered on, if there is data input at the input ports (including RXD and GPIO), it will cause power leakage on the VCC. When the leakage voltage is higher than 1.6 V, it may cause failure of starting up when the module is powered on.

### Solution:

When the module is not powered on, make sure that the IO ports connected to the module is in a high-resistance state or a low level to avoid power leakage. You can also connect a 1K $\Omega$  resistor at the RX ports and a 33 $\Omega$  or 1K $\Omega$  resistor at the TX ports, and connect a 4.7K $\Omega$  resistor at other necessary PIOs.

## 4.3 Power Supply Requirements

### 4.3.1 Main Supply (VCC)

The voltage range of VCC is 3.0 V ~ 3.6 V.

#### Notes:

- The VCC initial level when power-on should be less than 0.4 V.
- The VCC ramp when power-on should be monotonic, without plateaus.
- The voltages of undershoot and ringing should be within 5% VCC.
- VCC power-on waveform: The time interval from 10% rising to 90% must be within 100  $\mu$ s ~ 10 ms.
- Power-on time interval: The time interval between the power-off (VCC < 0.4 V) to the next power-on is recommended to be larger than 500 ms.

### 4.3.2 Backup Supply (V\_BCKP)

If the hot start function is needed, users should supply backup power to the module. The voltage range of V\_BCKP is 1.65 V ~ 3.6 V.

#### Notes:

- The V\_BCKP initial level when power-on should be less than 0.4 V.
- The V\_BCKP ramp when power-on should be monotonic, without plateaus.
- The voltages of undershoot and ringing should be within 5% V\_BCKP.
- V\_BCKP power-on waveform: The time interval from 10% rising to 90% must be within 100  $\mu$ s ~ 10 ms.

- Power-on time interval: The time interval between the power-off ( $V_{BCKP} < 0.4\text{ V}$ ) to the next power-on is recommended to be larger than 500 ms.
- The  $V_{BCKP}$  pin cannot be floating or connected to ground. When  $V_{BCKP}$  is not used, it should be connected to VCC or connected to backup power.

## 4.4 Antenna

If the UM220-IV NL uses an active antenna, the bias voltage  $V_{BIAS}$  is supplied to the antenna through a feed inductor. It's recommended to use an independent power as  $V_{BIAS}$  to supply the antenna.

---

☞ If the antenna power supply and the module's main supply VCC use the same power rail, the ESD, surge and overvoltage from the antenna will have an effect on VCC, which may cause damage to the module. Therefore, it's recommended to design an independent power rail for the antenna to reduce the possibility of damage to the module.

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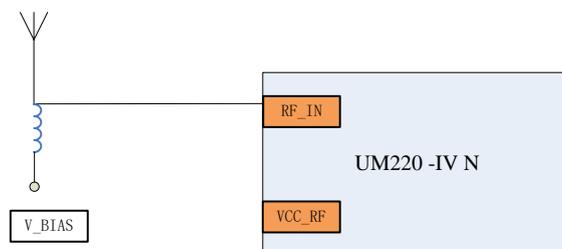


Figure 4-1 UM220-IV NL Active Antenna Solution

If UM220-IV NL uses a passive antenna, the antenna can be directly connected to the RF\_IN pin. It should be noted that the use of a passive antenna may cause a decrease in GNSS performance compared to an active antenna.

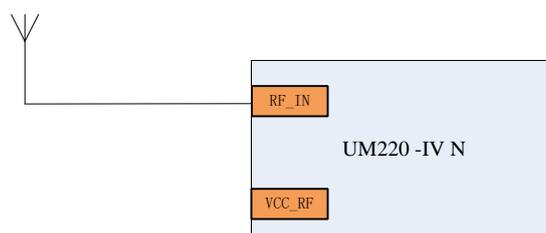


Figure 4-2 UM220-IV NL Passive Antenna Solution

## 4.5 Reset

If the reset pin nRESET of UM220-IV NL module needs to be used, the following timing requirements must be met between the nRESET and the power supply VCC. During normal operation of the module, pulling down the nRESET pin over 5 ms can also reset the module.

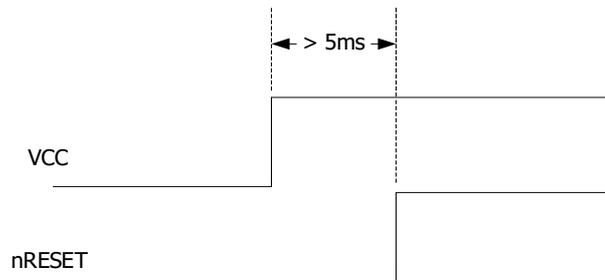


Figure 4-3 UM220-IV NL Reset Requirement

## 4.6 Serial Port

UM220-IV NL has two LVTTL serial port. For PC connection, please use a RS232 voltage level converter.

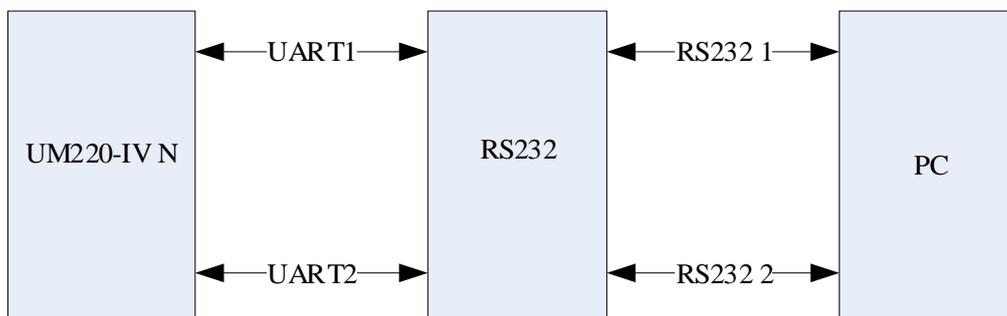


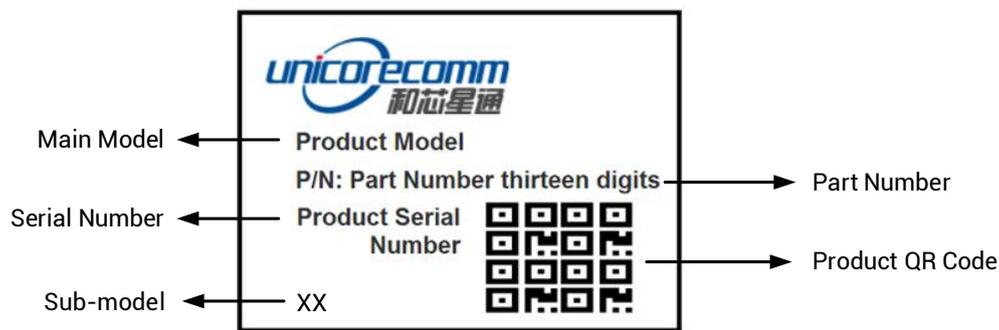
Figure 4-4 Connect COM to PC

## 5 Disassembly

When it is necessary to remove the module, it is recommended to melt the soldering tin of the pins on both sides of the module with an electric soldering iron and remove the module with tweezers. Do not use other means to remove the module (such as using a hot air gun to blow module), which may otherwise lead to module damage.

## 6 Package

### 6.1 Product Label Description



### 6.2 Package Description

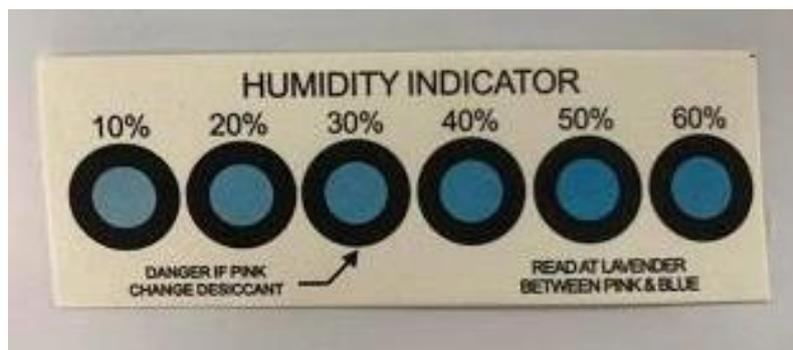
The UM220-IV NL module is packaged in vacuum sealed aluminum foil anti-static bags with desiccant and moisture-proof agent. When using reflow welding process to weld modules, please strictly comply with IPC standard to conduct humidity control on modules. As packaging materials such as the carrier tape can only withstand the temperature of 65 degrees Celsius, modules shall be removed from the package during baking.



**Figure 6-1 Module Package**

| Item         | Description   |
|--------------|---|
| Module       | 500 pcs/reel  |
| Reel size    | Tray: 13"<br>External diameter 330mm, internal diameter 100mm, wide 24mm, thickness 2.0mm |
| Carrier tape | Space between: 20mm   |

Check the humidity indicator card before soldering. The 30% indication is blue for normal conditions, as shown in figure 6-2. Bake modules firstly before soldering if the 30% indication turns pink, as shown in figure 6-3. The UM220-IV NL modules are rated at MSL level 3. For more MSL information, please refer to [www.jedec.org](http://www.jedec.org).



**Figure 6-2 the 30% indication is blue**

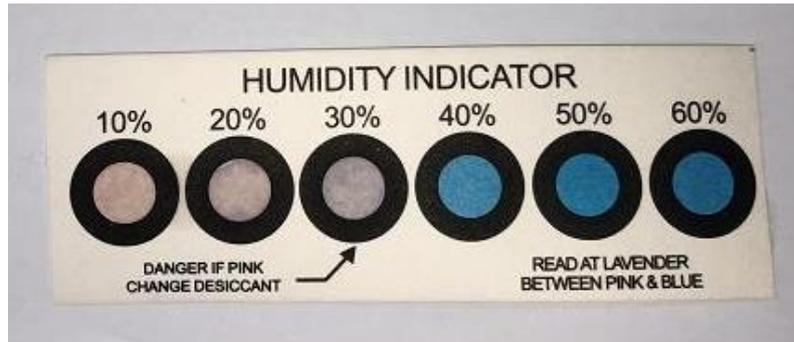


Figure 6-3 the 30% indication is pink

The shelf life of UM220-IV NL is one year.

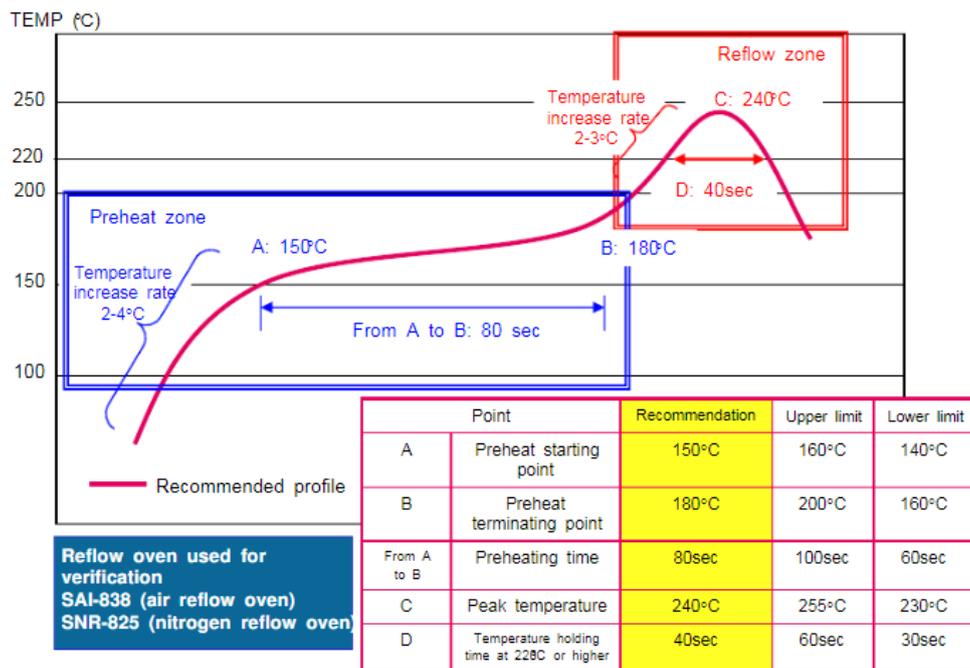
## 7 Clean

Do not use alcohol or other organic solvents to clean, which may lead to soldering flux residues flooding into the shielding shell, causing mildew and other problems.

## 8 Reflow Soldering

In order to avoid device falling off, the module should be placed on the top of the main board during soldering. Reflow soldering temperature curve is recommended as shown in figure 8-1 below (M705-GRN360 is recommended for solder paste).

**Note: The module can be soldered only once.**



**Figure 8-1 Reflow Soldering Line**

**Note:** The apertures in the stencil need to meet the customer's own design requirements and inspection specifications. The thickness of the stencil should be above 0.15mm, and 0.18mm is recommended.

和芯星通科技（北京）有限公司

**Unicore Communications, Inc.**

北京市海淀区丰贤东路 7 号北斗星通大厦三层  
F3, No.7, Fengxian East Road, Haidian, Beijing, P.R.China,  
100094

[www.unicore.com](http://www.unicore.com)

Phone: 86-10-69939800

Fax: 86-10-69939888

info@unicorecomm.com



[www.unicore.com](http://www.unicore.com)