



INSTALLATION AND OPERATION

## USER MANUAL

[WWW.UNICORE.COM](http://WWW.UNICORE.COM)

# UM220-INS

## Multi-GNSS Integrated Navigation and Positioning Module

Copyright© 2009-2024, Unicore Communications, Inc.  
Data subject to change without notice.



## Revision History

Version	Revision History	Date
R1	Initial Edition	Feb. 2020
R1.1	SNRSTAT: update the description of InstallState	Jun. 2020
R1.2	1.2 Key Features: add and refine the specification	Aug. 2020
R1.3	Add parameters in section 1.2 4.1: add module usage notes	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 4.3	Nov. 2021
R1.7	If hot start is not used, connect V_BCKP to VCC. GNSS chip qualified according to AEC-Q100. Revise the VSWR in section 2.2	Nov. 2022
R1.8	Modify the description of antenna power supply; Add Chapter 4.2 Power Supply Requirements	Apr. 2023
R1.9	Update the TTFF and velocity accuracy	Jan. 2024
R1.10	Update Unicore's logo	May 2024

## Legal right notice

This manual provides information and details on the products of Unicore Communication, Inc. ("Unicore") referred to herein.

All rights, title and interest to this document and the information such as data, designs, layouts contained in this manual are fully reserved, including but not limited to the copyrights, patents, trademarks and other proprietary rights as relevant governing laws may grant, and such rights may evolve and be approved, registered or granted from the whole information aforesaid or any part(s) of it or any combination of those parts.

Unicore holds the trademarks of "和芯星通", "UNICORECOMM", "Unicore" and other trade name, trademark, icon, logo, brand name and/or service mark of Unicore products or their product serial referred to in this manual (collectively "Unicore Trademarks").

This manual or any part of it, shall not be deemed as, either expressly, implied, by estoppel or any other form, the granting or transferring of Unicore rights and/or interests (including but not limited to the aforementioned trademark rights), in whole or in part.

### **Disclaimer**

The information contained in this manual is provided "as is" and is believed to be true and correct at the time of its publication or revision. This manual does not represent, and in any case, shall not be construed as a commitments or warranty on the part of Unicore with respect to the fitness for a particular purpose/use, the accuracy, reliability and correctness of the information contained herein.

Information, such as product specifications, descriptions, features and user guide in this manual, are subject to change by Unicore at any time without prior notice, which may not be completely consistent with such information of the specific product you purchase.

Should you purchase our product and encounter any inconsistency, please contact us or our local authorized distributor for the most up-to-date version of this manual along with any addenda or corrigenda.



# Foreword

This document describes the information of the hardware, installation, specification and the use of Unicore UM220-INS series products.

## **Audience**

This document is intended to present an overview of Unicore UM220-INS series products. The audience is expected to possess the expertise on GNSS receivers.

## Contents

<b>1</b>	<b>Introduction .....</b>	<b>1</b>
1.1	Product Description .....	1
1.2	Key Features .....	2
1.3	Interfaces .....	4
<b>2</b>	<b>System Installation.....</b>	<b>6</b>
2.1	Prerequisites .....	6
2.2	System Installation .....	7
<b>3</b>	<b>Technical Specifications .....</b>	<b>8</b>
3.1	Electrical Specifications .....	8
3.2	Operating Conditions .....	8
3.3	Dimensions .....	9
3.4	Pin Definition (Top View) .....	10
3.5	PCB Packaging.....	11
<b>4</b>	<b>Hardware Design .....</b>	<b>12</b>
4.1	Design in Considerations.....	12
4.2	Power Supply Requirements .....	13
4.2.1	<i>Main Supply (VCC).....</i>	<i>13</i>
4.2.2	<i>Backup Supply (V_BCKP) .....</i>	<i>13</i>
4.3	Antenna.....	14
4.4	Reset .....	14
4.5	Serial Port.....	15
4.6	Odometer Connection.....	15
4.7	System Coordinates.....	16
4.8	Installation of the Module.....	17
4.8.1	<i>Installation Instructions .....</i>	<i>17</i>
4.8.2	<i>Installation Angle Definition.....</i>	<i>17</i>
4.8.3	<i>Installation Options of the Module .....</i>	<i>18</i>
4.8.4	<i>Reference Messages .....</i>	<i>18</i>
4.8.5	<i>Module Calibration and Notes .....</i>	<i>21</i>
<b>5</b>	<b>Disassembly .....</b>	<b>22</b>
<b>6</b>	<b>Package.....</b>	<b>22</b>
6.1	Product Labeling.....	22
6.2	Package Description.....	22
<b>7</b>	<b>Clean.....</b>	<b>23</b>
<b>8</b>	<b>Reflow Soldering .....</b>	<b>24</b>

# 1 Introduction

## 1.1 Product Description

UM220-INS series products (including UM220-INS NL, UM220-INS NF) are GNSS+MEMS integrated positioning modules designed for automotive navigation based on Unicore's low power and high performance GNSS SoC - UFirebird (UC6226). With the built-in six axis MEMS and the support of multi-system joint positioning or single system standalone positioning, UM220-INS series products can output GNSS+MEMS integrated positioning results continuously even in tunnels and underground garages.

The GNSS chip in the UM220-INS module is qualified according to AEC-Q100, and the production process complies with IATF 16949.



Figure 1-1 UM220-INS Series Modules (left side: UM220-INS NL, right side: UM220-INS NF)

Variant	Grade		System*					Interface		Data Update Rate*
	Professional	Automotive	GPS	BDS*	GLONASS*	Galileo	QZSS	UART1	UART2	
UM220-INS NL	•		•	•	•	•	•	•	•	1Hz
UM220-INS NF		•	•	•	•	•	•	•	•	1Hz

UM220-INS series modules support multiple positioning modes including joint positioning and standalone positioning:

- GPS L1+SBAS+QZSS
- GPS+GLONASS+Galileo+SBAS+QZSS
- GPS+BDS+Galileo+SBAS+QZSS (default mode)
- BDS

※ QZSS and SBAS are only available when GPS is enabled.

- 
1. The BDS system cannot run in parallel with the GLONASS system.
  2. The default data update rate of the module is 1Hz, which can be configured to 10Hz.
- 

## 1.2 Key Features

Power	
Voltage	+3.0V~3.6V VDC
Power Consumption <sup>1</sup>	90mW
RF Input	
Frequency	1559~1605MHz
Input VSWR	≤2.5
Input Impedance	50Ω
Antenna Gain	15~30dB
Physical Characteristics	
Dimension	16.0mm*12.2mm*2.6mm
Environment	
Operating Temperature	-40°C ~ +85°C
Storage Temperature	-45°C ~ +90°C
Input/ Output Data Interface	
UART	UART*2, LVTTTL. Baud Rate: 4800~460800bps
GNSS Performance	
Frequency	BDS B1: 1561.098MHz GPS L1: 1575.42MHz GLONASS L1: 1602+0.5625*k (MHz) Galileo E1: 1575.42MHz

---

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

		GPS+GLO+GA	GPS+BD+GA			
TTFF (Time to First Fix)	Cold Start	28s	28s			
	Hot Start	1s	1s			
	Reacquisition	1s	1s			
	AGNSS	5s	5s			
Positioning Accuracy <sup>2</sup>		GPS+GLO+GA	GPS+BD+GA			
		2m	2m			
Velocity Accuracy (RMS)		GPS+GLO+GA	GPS+BD+GA			
		0.1m/s	0.1m/s			
Sensitivity		GPS+GLO+GA	GPS+BD+GA	BD	GPS	GLO
	Tracking	-161dBm	-161dBm	-159dBm	-161dBm	-158dBm
	Acquisition	-147dBm	-147dBm	-144dBm	-147dBm	-142dBm
	Hot Start	-154dBm	-154dBm	-149dBm	-154dBm	-148dBm
	Reacquisition	-157dBm	-157dBm	-156dBm	-157dBm	-153dBm
DR Position Error		typ. 3 % of distance travelled without GNSS				
Frequency of Time Pulse Signal		1Hz				
Maximum Navigation Rate (Measurement Rate)		10Hz				
Navigation Latency		100ms nominal				
Maximum Sensor Measurement Message Output Rate		10Hz				
Accuracy of Time Pulse Signal		RMS 30ns (GPS+BD) 99% 50ns (GPS+BD)				
Data Output <sup>3</sup>		NMEA 0183, Unicore Protocol				
Operational Limits		Dynamics ≤ 4g Altitude 50000m Velocity 515m/s				

<sup>2</sup> CEP, 50%

<sup>3</sup> User configurable. See *UFirebird\_INS Products Protocol Specification* for more details.



## 1.3 Interfaces

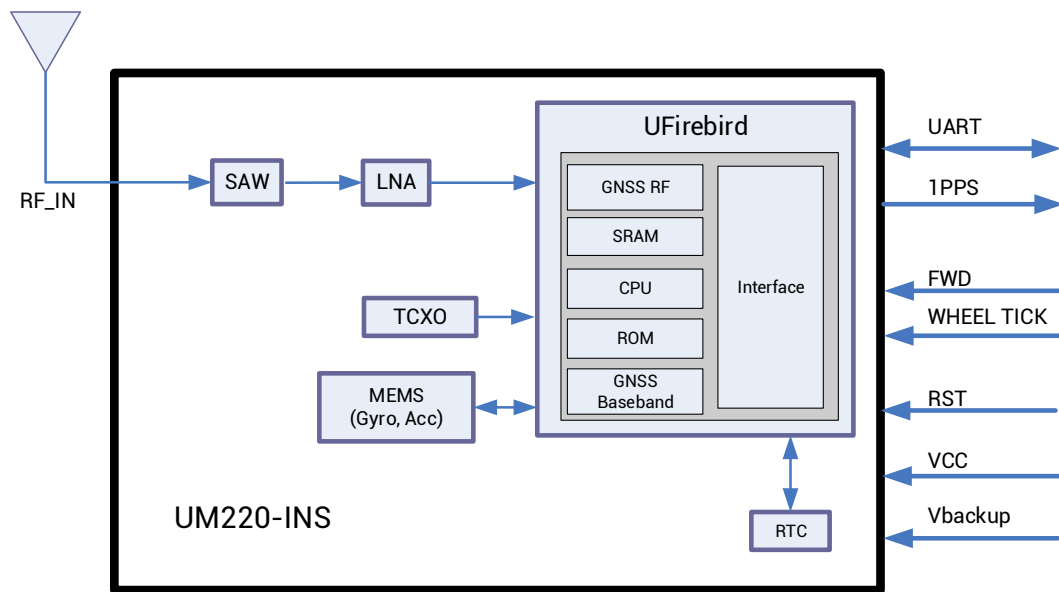


Figure 1-2 UM220-INS Series Modules Block Diagram

### UART

UM220-INS series modules support two configurable UART ports. COM1 is the main serial port, which supports data transfer and firmware upgrade, the signal input/output is LVTTTL. The default baud rate varies according to the version of firmware, and the baud rate can be configured up to 460800bps<sup>4</sup>. **Ensure that COM1 is connected to a PC or an external processor for firmware upgrades.**

COM2 only supports data transfer, and can't be used for firmware upgrade.

### Odometer (FWD/WHEELTICK)

UM220-INS series modules have two pins for odometer signal input—FWD for direction signal input and WHEELTICK for speed pulse input, which are useful for improving the module's positioning accuracy.

### MEMS

UM220-INS series modules integrate a six-axis MEMS, including a three-axis gyro and a three-axis accelerometer on board. MEMS provides information on the carrier's attitude and speed changes, which are combined with GNSS to perform an integrated navigation calculation. This combination ensures better positioning performance than standalone GNSS, providing continuous and uninterrupted positioning, especially in the conditions

<sup>4</sup> See *UFirebird\_INS Products Protocol Specification* for more details.



with poor signals, such as in tunnels, underground garages and urban canyons.

## **1PPS**

UM220-INS series modules output 1PPS with adjustable pulse width and polarity.

1PPS is not for timing application.

## **nReset**

Low voltage valid, and the active time is required to last at least 10ms.

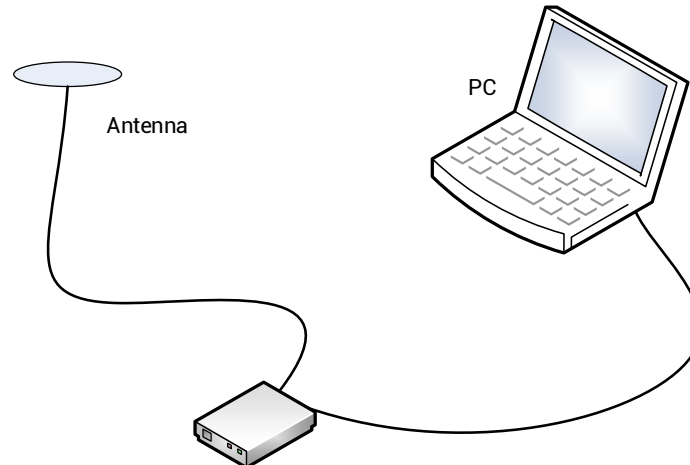
## 2 System Installation

### 2.1 Prerequisites

UM220-INS series modules are Electrostatic Sensitive Devices (ESD) and must be installed with special precautions when handling. Improper operation can result in damage to components.

- Perform 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 should be performed on an antistatic workbench, using an antistatic wristband and a conductive foam pad. If the antistatic workbench is not available, wear an antistatic wrist strap and connect the other end to a metal frame to play an anti-static role.
- Hold the edge of the module, and DO NOT touch any components of the module.
- Please check carefully whether the module is obviously loose or damaged. Please contact us or the local dealer for any problems.

Figure 2-1 shows the typical installation of UM220-INS series modules with Evaluation Kit.



**Figure 2-1 Typical Installation of UM220-INS Series Modules**

Please check the contents of the package carefully after receiving the UM220-INS series modules.

- UM220-INS EVK suite (with AC Adapter)
- UM220-INS Series Module User Manual
- Unicore uSTAR application package
- Qualified antenna supporting GPS L1 and BDS B1/GLONASS L1



- Straight through serial cable and USB cable
- PC or Laptop with serial ports (Windows 7 and above)

---

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

---

## 2.2 System Installation

Perform the steps below to install the module:

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-INS evaluation kit.

Step 3: Use the GNSS antenna with appropriate gain and fix it in the non-blocking area; use the appropriate cable to connect the antenna to UM220-INS EVK.

Step 4: Connect the PC to the EVK serial port through the serial cable or USB cable.

Step 5: Open the uSTAR software on the PC.

Step 6: Configure the receiver through uSTAR to display constellations view, log messages, receiver status, etc.

## 3 Technical Specifications

### 3.1 Electrical Specifications

#### Absolute Maximum Ratings

Item	Min	Max	Unit	Description
Power Supply (VCC)	-0.5	3.6	V	Main power
Backup Voltage (V_BCKP)	-0.5	3.6	V	Backup power supply for RTC
Digital IO (RXD1, RXD2) <sup>5</sup>	-0.5	3.6	V	Voltage of the digital signal pins
RF_IN	-	+3	dBm	Max input power of antenna
Storage Temperature T <sub>STG</sub>	-45	90	°C	Storage temperature
SMT Reflow Temperature T <sub>SLDR</sub>	-	+260	°C	Soldering temperature

### 3.2 Operating Conditions

Item	Pin	Min.	Typical Value	Max.	Unit	Condition
Power Supply (VCC)	Vcc	3.0	3.3	3.6	V	
Ripple Voltage	Vp-p			50	mV	
Peak Current	Iccp			52	mA	Vcc=3.0 V
Tracking Average Current	I <sub>ACQ</sub>	28	30	32	mA	Vcc=3.0V
LOW Level Input Voltage	V <sub>IL</sub>	-0.3		0.2*Vcc	V	
High Level Input Voltage	V <sub>IH</sub>	0.7*Vcc		Vcc+0.3	V	
LOW Level Output Voltage	V <sub>OL</sub>	0		0.4	V	I <sub>out</sub> = -2 mA
High Level Output Voltage	V <sub>OH</sub>	Vcc-0.4		Vcc	V	I <sub>out</sub> =2 mA
Antenna Gain <sup>6</sup>	G <sub>ANT</sub>	15	20	30	dB	
Noise Figure	NF		1.9		dB	
Operating Temperature	T <sub>OPR</sub>	-40		+85	°C	

<sup>5</sup> Including nRESET, TIMEPULSE, WHELTICK, TXD2, RXD2, FWD, TXD1, RXD1

<sup>6</sup> The antenna gain range refers to the gain range of the preamplifier before RF\_IN of the module.

### 3.3 Dimensions

Symbol	Min (mm)	Typical (mm)	Max (mm)
A	15.9	16.0	16.5
B	12	12.2	12.4
C	2.4	2.6	2.8
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	0.9	1.0	1.1
K	0.7	0.8	0.9
N	0.4	0.5	0.6
M	0.8	0.9	1.0

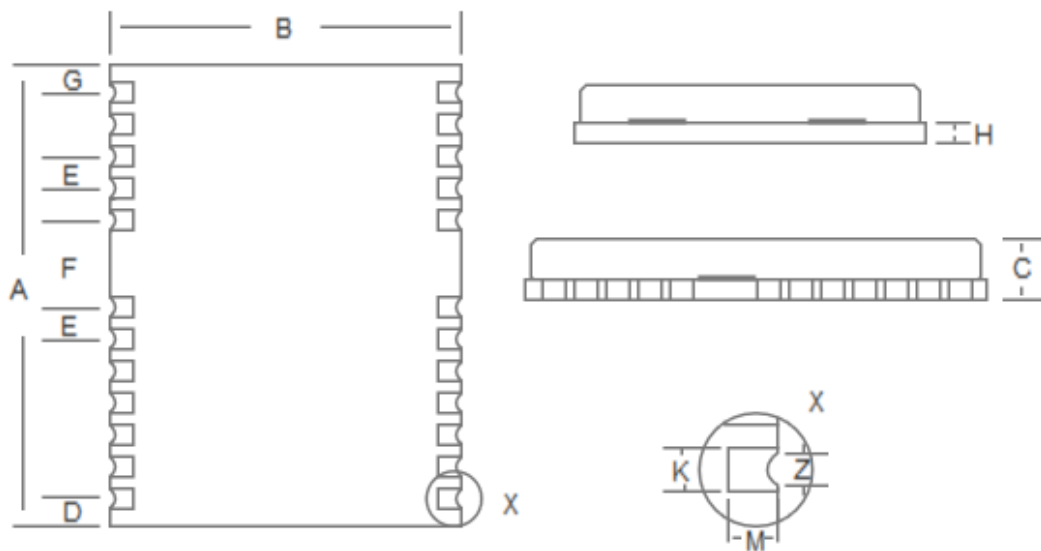


Figure 3-1 Mechanical Layout

### 3.4 Pin Definition (Top View)

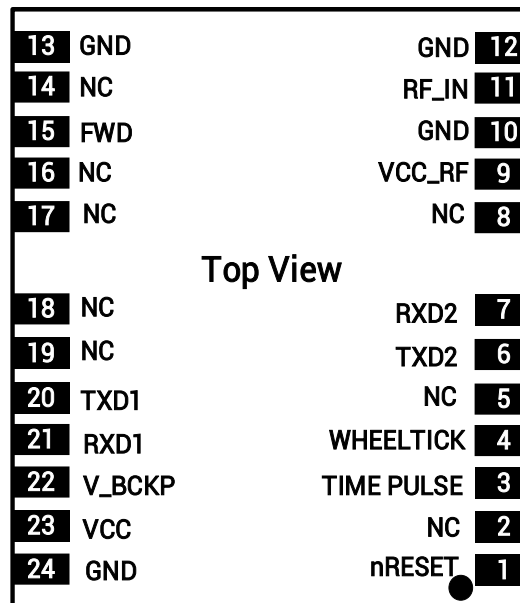
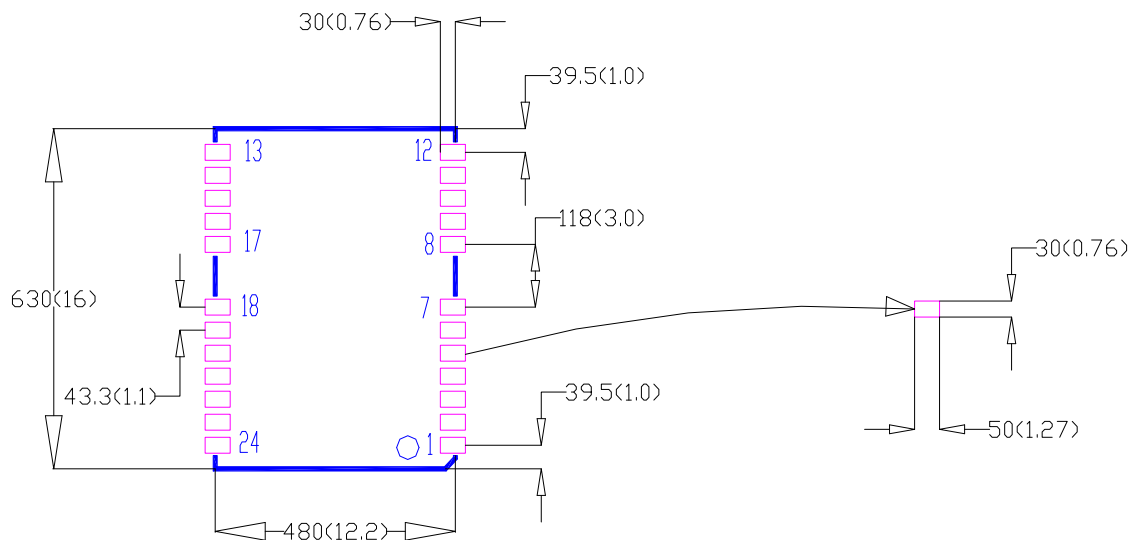


Figure 3-2 Pin Assignment

Pin No	Name	I/O	Electrical Level	Description
1	nRESET	I	LVTTL	Reset Low active, leave it floating if not in use
2	NC	-	-	Reserved
3	TIMEPULSE	O	LVTTL	Time pulse (1PPS)
4	WHEELTICK	I	LVTTL	Odometer speed pulse, leave it floating if not in use. It is strongly recommended to use; the maximum acceptable pulse frequency is 5KHz, and the minimum pulse width is greater than 100μs. <b>Note: Incorrect signals of the odometer will lead to serious problems in the use of the product. Please make sure the signal is correct.</b>
5	NC	-	-	Reserved
6	TXD2	O	LVTTL	UART 2-TX
7	RXD2	I	LVTTL	UART 2-RX
8	NC	-	-	Reserved
9	VCC_RF	O		Antenna feed output
10	GND	-	-	Ground
11	RF_IN	I	-	GNSS signal input
12	GND	-	-	Ground
13	GND	-	-	Ground
14	NC	-	-	Reserved

Pin No	Name	I/O	Electrical Level	Description
15	FWD	I	LVTTL	Odometer direction input, leave it floating if not in use. It is strongly recommended to use. High level=forward Low level=backward <b>Note: Incorrect signals of the odometer will lead to serious problems in the use of the product. Please make sure the signal is correct.</b>
16	NC	-	-	Reserved
17	NC	-	-	Reserved
18	NC	-	-	Reserved
19	NC	-	-	Reserved
20	TXD1	O	LVTTL	UART 1-TX
21	RXD1	I	LVTTL	UART 1-RX
22	V_BCKP	I	1.65V~3.6V	Backup voltage supply, necessary for hot start. If you do not use hot start, connect V_BCKP to VCC. Do NOT connect it to ground or leave it floating.
23	VCC	-	3.0V~3.6 V	Supply voltage
24	GND	-	-	Ground

### 3.5 PCB Packaging



**Figure 3-3 UM220-INS Series Modules Recommended PCB Packaging (unit: mil, in brackets: mm)**

In the design of PCB solder, make sure the area below the UM220-INS series modules are fully covered with solder layer.



## 4 Hardware Design

### 4.1 Design in Considerations

It's required to connect the following signals correctly to make UM220-INS series modules work properly.

When the module is not powered on, it is necessary to ensure that the power supply and all GPIOs are in a high impedance state or a low level to avoid abnormal operation of the module caused by power leakage.

If serial port 2 and pulse per second (1PPS) are used, a 1K $\Omega$  resistor must be connected in series at TXD2 and a 4.7K $\Omega$  resistor must be connected in series at the pulse per second (1PPS). The resistance can be adjusted slightly according to actual application to achieve better effect.

- Connect all the GND pins to ground.
- Provide reliable power to the VCC pin.
- Connect RF\_IN signal to the antenna, and make sure the 50  $\Omega$  impedance match on the circuit.
- Ensure COM1 is connected to a PC or an external processor. Users can use this serial port to receive position data. COM1 is also used for firmware upgrades.

Pay attention to the following items in the design to obtain good performance:

- Power supply: Stable and low ripple power is necessary for good performance.
  - Use LDO to ensure the purity of power supply.
  - Place LDO to the module as close as possible in layout.
  - Widen the power circuit wiring or use copper pour surface to transmit current.
  - Avoid wiring through any high-power or high inductance devices such as magnetic coils.
  - Make sure the peak to peak voltage ripple does not exceed 50mV.
- UART interfaces: ensure that the signals and baud rate of the main equipment are consistent with that of UM220-INS series modules.
- Antenna interface: make sure the antenna impedance matching, and the circuit is short and smooth; try to avoid acute angle.
- Try to avoid circuits below UM220-INS series modules.
- This module is a temperature sensitive device and rapid temperature changes 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 Power Supply Requirements

### 4.2.1 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.

### 4.2.2 Backup Supply (V\_BCKP)

When using hot start, 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 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.

## 4.3 Antenna

If the UM220-INS series modules use an active antenna, supply power 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.

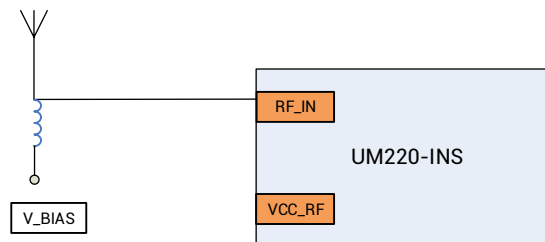


Figure 4-1 UM220-INS Active Antenna Solution

If the UM220-INS series modules use a passive antenna, connect the antenna to the RF\_IN directly. It should be noted that compared to an active antenna, the use of a passive antenna may cause a decrease in GNSS performance.

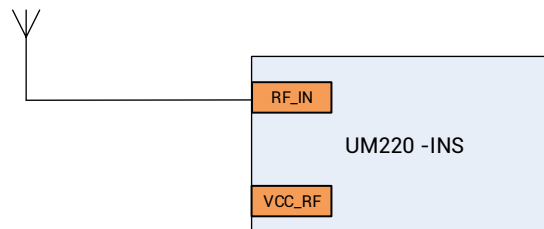


Figure 4-2 UM220-INS Passive Antenna Solution

## 4.4 Reset

If the reset pin nRESET of the UM220-INS 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.

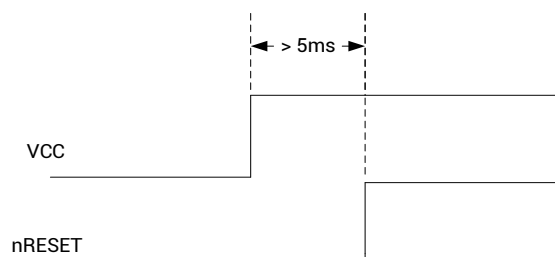


Figure 4-3 UM220-INS Reset Requirement

## 4.5 Serial Port

The serial ports of UM220-INS series modules are of LVTTTL level; use a RS232 converter for the PC connection.

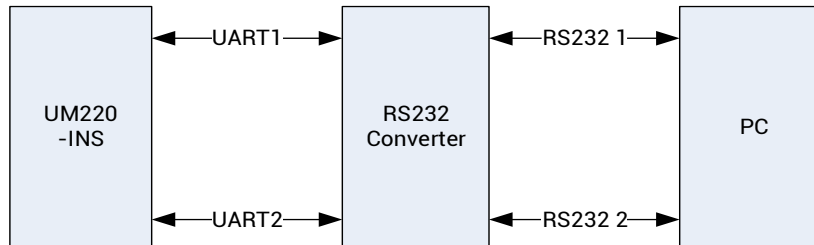


Figure 4-4 Connect COM to PC

## 4.6 Odometer Connection

UM220-INS series modules support direction (FWD) and velocity pulse (WHEELTICK) signals connecting with odometer. The accuracy of module positioning trajectory could be enhanced if the module obtains effective direction and velocity pulse signals.

The odometer signal of vehicles is generally 12V, and the signal quality is poor. Therefore, signal filtering, optocoupler isolation and level conversion are required before transferring the vehicle odometer signals to the UM220-INS module for use.

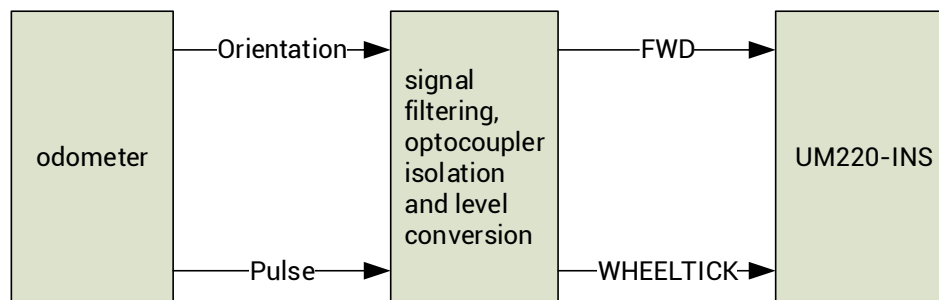


Figure 4-5 Odometer Connection

## 4.7 System Coordinates

The coordinate system of UM220-INS series modules must be consistent with that of the vehicle, otherwise you must perform the related configuration following the CFGROTAT command in the corresponding protocol manual.

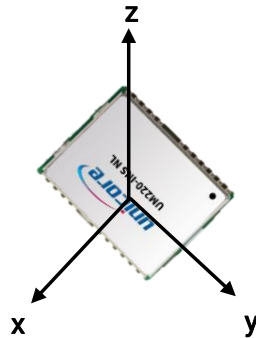


Figure 4-6 Module Coordinate System

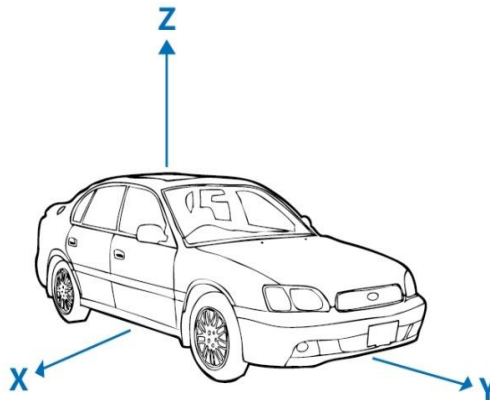


Figure 4-7 Car Coordinate System

- 
1. The normal direction of the module's shield is z axis, the long axis is y and the short axis is x.
  2. The coordinate system of the module must be consistent with the vehicle's, which means: x-axis and X-axis are parallel in the same direction, y-axis and Y-axis are parallel in the same direction, and z-axis and Z-axis are parallel in the same direction.
-

## 4.8 Installation of the Module

UM220-INS series modules must be rigidly connected to the vehicle body and firmly fixed.

- 
1. The antenna should be installed with the front facing up as much as possible and firmly fixed; ensure that the elevation angle of the environment where the antenna is located is greater than  $15^\circ$  and the space is unobstructed.
  2. In the environment where the antenna is located, ensure that there is no strong interference source within the frequency of  $1568 \pm 20$  MHz.
- 

### 4.8.1 Installation Instructions

The UM220-INS series modules must be firmly connected to the vehicle to prevent any offsets or vibrations between the module and the vehicle. UM220-INS series modules should not be installed in the suspension part (or elastic part) of the vehicle. When the vehicle is moving, any change of the vehicle coordinate system will seriously affect the UM220-INS module and prevent it from working normally.

### 4.8.2 Installation Angle Definition

The vehicle coordinate system is XYZ, and the module coordinate system is xyz, as shown in Figure 4-6 and Figure 4-7. The module's installation angle — angleX, angleY and angleZ — are defined as below:

1. Align the initial state of xyz coordinate system with that of XYZ coordinate system
2. Rotate  $\gamma$  angle of the module along the z axis
3. Rotate  $\alpha$  angle of the module along the new x axis
4. Rotate  $\beta$  angle of the module along the new y axis
5. The module is now in the same state as the actual installation, with that, angleX= $\alpha$ , angleY= $\beta$ , angleZ= $\gamma$

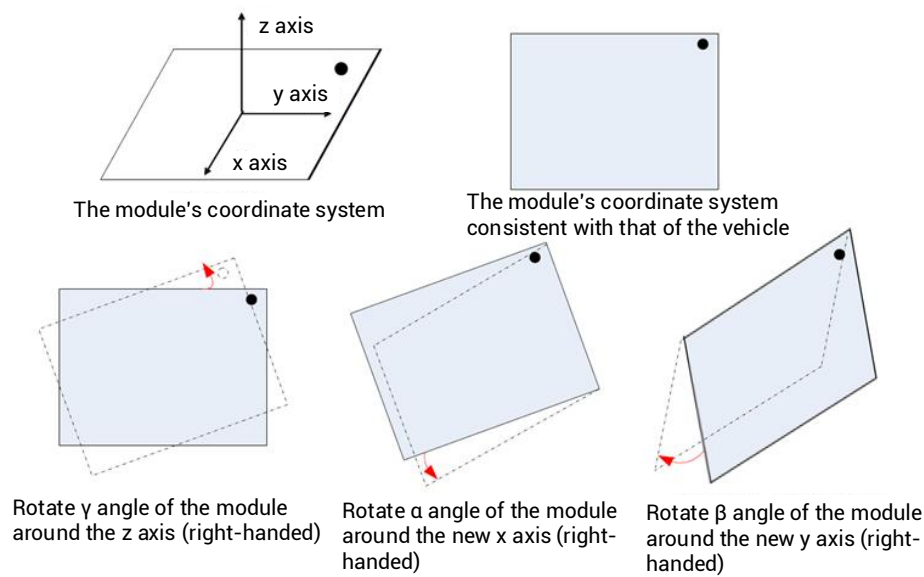


Figure 4-8 Rotation Diagram of the Module

### 4.8.3 Installation Options of the Module

- **Free Installation (Default Mode)**

UM220-INS series modules integrate a three-axis gyroscope and a three-axis accelerometer, with a built-in self-calibration algorithm, which supports the free installation of the module with respect to any installation angle of the vehicle coordinate system, such as, the completely horizontal installation, inclined installation at a certain angle, and flip installation.

- **Fixed Installation**

According to the installation angle definition, the accurate installation angle is manually configured into the module. This installation method takes a short calibration time. When configuring the installation angle manually, the maximum angle error is limited to  $\pm 5$  degrees.

### 4.8.4 Reference Messages

#### 1. CFGROTAT

**Message format:** \$ CFGROTAT,angleX,angleY,angleZ,mode

**Description:** Set or output the installation angle of the module with respect to the vehicle coordinate system.

**Parameters:**

- ◆ angleX, angleY and angleZ are defined in section 4.8.2, with the unit of 0.01°
- ◆ mode, which stands for the installation angle configuration mode:
  - 0 – General installation mode, the input value of the installation angle is relatively coarse (within 10deg)
  - 2 – Automatic installation mode, no need to input the installation angle, only need calibration.

**Remark:**

- 1) Choose 2 for free installation mode and 0 for fixed installation mode.
- 2) Input the actual installation angles including angleX, angleY, and angleZ into the module. After the configuration is completed, save the configuration to the flash through the CFGSAVE command, otherwise it needs to be identified again at the next boot.
- 3) Any configuration on the INS will cause the module to be re-initialized during normal operation or after power-off and restart, and the previously completed or ongoing calibration operations will be reset.

**2. SNRSTAT**

**Message format:** \$SNRSTAT,insstatus,odostatus,InstallState,Mapstat

**Description:** Output initial status (applicable for both fixed installation mode and free installation mode)

**Parameters:**

- ◆ insstatus: Initial status of INS
  - 1: IMU device failure
  - 0: Disabled
  - 1: Initialization starts
  - 2: The installation angle is known
  - 3: Initialization is completed
- ◆ odostatus: Odometer initialization status
  - 1: Odometer device failure
  - 0: Disabled



- 1: Initialize the scale factor
- 2: The scale factor initialization is completed
- 3: The scale factor calibration is completed

◆ InstallState:

- 1: IMU device failure, unable to estimate the installation angle
- 0: In the progress of the calibration
- 1: The current quality of satellite information is insufficient and better satellite conditions are required
- 2: The current motion of the vehicle is insufficient and acceleration is required
- 3: The current speed of the vehicle is too low and it's required to be increased.

◆ Mapstat:

- 2: MAP information is abnormal
- 1: No serial port is configured to enter MAP information
- 0: No MAP messages are received by the serial port or the MAP message is timeout
- 1: MAP information is received but not applied to the integrated navigation
- 2: MAP information is received and applied to the integrated navigation

### Fully Free Installation Test

1. Install the module completely freely
2. Input the command \$CFGROTAT,0,0,0,2 (no configuration is required for the factory mode)
3. Input the command \$CFGSAVE (no configuration is required for the factory mode)
4. The process of self-calibration should satisfy above conditions of parking, satellite quality, vehicle motion, etc. Confirm whether the self-calibration is completed using the \$SNRSTAT command, and when the insstatus becomes 3, the self-calibration is completed.
5. Make sure the self-calibration is completed before entering the road with poor satellite quality.
6. If the function of hot start in underground garages is needed, V\_BCKP requires to be powered continuously.

## 4.8.5 Module Calibration and Notes

### ● Self-Calibration

After the installation of the UM220-INS series modules, the self-calibration is required to ensure the accuracy of the module output. In the process of the self-calibration, the module estimates installation status parameters and sensor parameters. The module is in GNSS navigation mode before the self-calibration is completed, and is in GNSS + INS integrated navigation mode after the self-calibration is completed.

### ● Conditions of Completing Self-Calibration

- The self-calibration is triggered after power on, stop the car for more than three minutes;
- Good satellite visibility is required during the process of the self-calibration (the number of visible satellites is not less than six, and CNO is above 30dB); the better the satellite observation quality is, the faster the calibration will be.
- It's required to make 90-degree turns for more than five times while the vehicle is running normally (this step is unnecessary for fixed installation mode).
- Keep the forward driving speed above 36 km/h on the premise of normal driving. The more times of acceleration (it's recommended to drive at the acceleration greater than  $0.5\text{m/s}^2$  for no less than 10 times) and the longer the driving time is, the faster the calibration will be.

After the first alignment of inertial navigation (insstatus 3), it is still necessary to drive for about 15 minutes in the normal open environment to train the inertial navigation device adequately. If the vehicle enters a complex environment such as a tunnel and garage immediately after the first alignment, the navigation accuracy may be slightly worse.

### Notes:

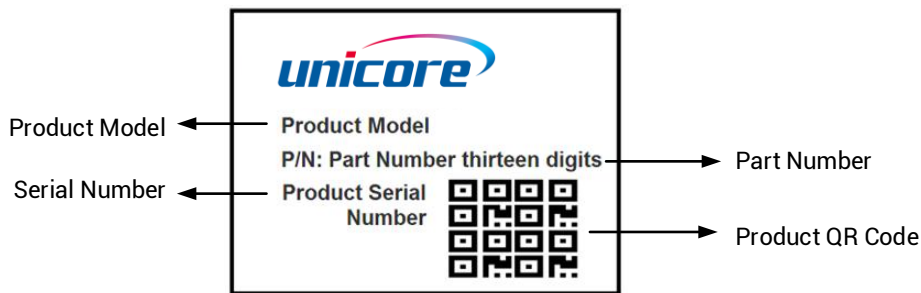
- The normal use of the module only requires only one self-calibration process.
- After the INS module is calibrated, it can be moved only after the power is completely cut off, including the main power VCC and the backup power V\_BCKP.

## 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 (for example, using a hot air gun to blow the module off), which may lead to module damage.

## 6 Package

### 6.1 Product Labeling



### 6.2 Package Description

The UM220-INS series modules use carrier tape and reel (suitable for mainstream surface mount devices), packaged in vacuum-sealed aluminum foil antistatic bags, with a desiccant inside to prevent moisture. When using reflow soldering process to solder modules, please strictly comply with IPC standard to conduct humidity control on the 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" External Diameter: 330mm, Internal Diameter: 100mm, Width: 24mm Thickness: 2.0mm
Carrier Tape	Space between: 20mm

UM220-INS series modules are rated at MSL level 3, refer to the relevant IPC/JEDEC standards for baking requirements. Please access to the website [www.jedec.org](http://www.jedec.org) to see the details.

The shelf life of UM220-INS series modules is one year.

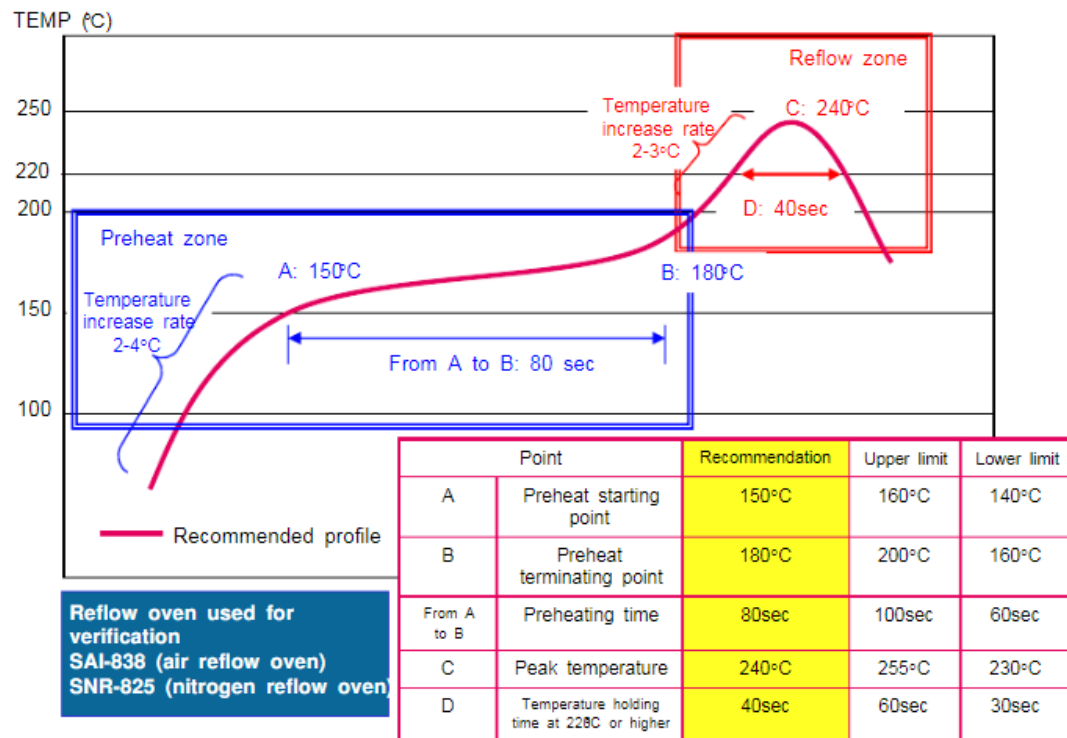
## 7 Clean

DO NOT use alcohol or other organic solvents to clean, otherwise it 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 only be soldered once.



**Figure 8-1 Reflow Soldering Temperature 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](mailto:info@unicorecomm.com)



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