



INSTALLATION AND OPERATION

**USER MANUAL**

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# UM761 Series

**Multi-GNSS Single-Frequency  
Integrated Positioning Module**

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# Foreword

## About This Document

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This document describes the information of the hardware, installation, specification and the use of Unicore UM761 series modules.

### Target Readers

This document is intended for technical personnel familiar with GNSS receivers.

## Statement

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# Revision History

Version	Revision History	Date
R1.0	First release.	Mar. 2026

## Document Status

Releases	Status Descriptions	Current Status
Primary	This is a pre-release version with target specifications that are subject to revision.	
Alpha release	This is an alpha release version, which has been preliminarily tested and verified. The content may undergo minor modifications based on user feedback and further testing.	
Production release	The document contains the complete and final specifications.	√

# 1 Introduction

## 1.1 Overview

UM761 series modules are GNSS + IMU integrated positioning and navigation modules independently developed by Unicore Communications. Based on the multi-constellation, single-frequency and high-performance GNSS SoC – UFirebird IV (UC7510 series), and with the built-in six-axis inertial measurement unit, the modules support multi-constellation single-frequency joint positioning, and can directly output GNSS + IMU integrated positioning results, which ensures continuous positioning even in tunnels and underground garages.

The manufacturing process of the UM761 series modules is in line with IATF 16949 and the GNSS chip inside the automotive-grade module (UM761A) conforms to the requirements of AEC-Q100.



Figure 1-1 UM761 Series Modules

Table 1-1 UM761 Series Modules Overview

Main Model		UM761A	UM761
Sub-model		02	02
Operating Temperature	-40°C ~+85°C	●	●
	-40°C~+105°C		
Grade	Professional		●
	Automotive	●	
System	GPS	●	●
	BDS	●	●
	GLONASS	●	●
	Galileo	●	●
	QZSS	●	●

Main Model		UM761A	UM761
	SBAS	●	●
Interface	UART	●	●
Data Update Rate		1Hz/ 5Hz/ 10Hz	1Hz/ 5Hz/ 10Hz

## 1.2 Key Specifications

Table 1-2 Key Specifications

Power	
Voltage	+2.7 V ~ 3.6 V DC
Power Consumption	Tracking: 66 mA @ 3.3 V
	Acquisition: 75 mA @ 3.3 V
RF Input	
Constellations	GPS/GLONASS/BDS/Galileo/QZSS
Standing Wave Ratio	≤ 2.5
Input Impedance	50 Ω
Antenna Gain	15 dB ~ 30 dB
Physical Characteristics	
Dimensions	16.0 mm × 12.2 mm × 2.4 mm
Weight	0.94 g ± 0.05 g
Environmental Specifications	
Operating Temperature	-40 °C ~ +85 °C
Storage Temperature	-45 °C ~ +90 °C
Vibration	JEDEC JESD22-B103
Shock	JEDEC JESD22-B103
Input/Output Data Interface	
UART x 1	LVTTL level, supported baud rate: 9600 ~ 921600 bps
GNSS Performance	

Frequencies	GPS: L1 C/A
	GLONASS: G1
	BDS: B1I, B1C <sup>1</sup>
	Galileo: E1B/C
	QZSS: L1C/A, L1S, L1C/B <sup>2</sup>
	SBAS: L1C/A <sup>3</sup>
Time to First Fix	Cold Start: 26 s
	Hot Start: 1 s
	Reacquisition: 1 s
	AGNSS <sup>4</sup> : 3 s
Horizontal Positioning Accuracy (CEP95)	1.5 m
Velocity Accuracy <sup>5</sup>	0.05 m/s
INS Positioning Error without GNSS	ADR: < 2% of distance traveled (without GNSS for 120 s)
	UDR: < 5% of distance traveled (without GNSS for 120 s)
Sensitivity (GNSS)	Tracking: -165 dBm
	Cold Start: -148 dBm
	Hot Start <sup>6</sup> : -156 dBm
	Reacquisition: -160 dBm
Data Update Rate	GNSS only or GNSS + INS: 1 Hz / 5 Hz / 10 Hz
	IMU raw data output: 50 Hz /100 Hz
1PPS Accuracy (RMS)	20 ns
Data Format	NMEA 0183, Unicore Protocol

<sup>1</sup> B1C is supported by specific firmware.

<sup>2</sup> L1C/B is supported by specific firmware.

- <sup>3</sup> SBAS is supported by specific firmware.
- <sup>4</sup> Timely injection of assistance data.
- <sup>5</sup> 95% at 30 m/s for dynamic operation, open sky.
- <sup>6</sup> Main power disconnected.

## 1.3 Interfaces

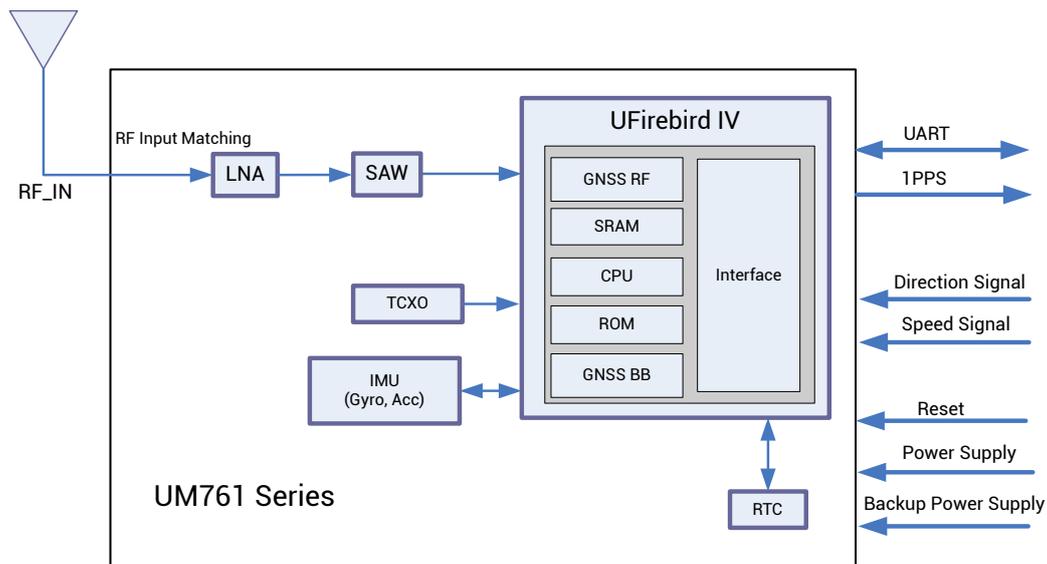


Figure 1-2 UM761 Series Modules Block Diagram

### UART

UM761 series modules provide one UART for data transfer and firmware upgrade, and the signal input/output voltage level is LVTTTL. The baud rate can be configured by users<sup>1</sup>, and the maximum is 921600 bps. Ensure that the UART is connected to a PC or an external processor for firmware upgrade.

### IMU

UM761 series modules integrate a six-axis IMU, including a three-axis gyro and a three-axis accelerometer. The IMU provides information of attitude and speed changes, which are combined with GNSS data to perform integrated navigation solution. The combination of GNSS and IMU ensures better positioning performance than standalone GNSS, providing continuous and uninterrupted positioning, especially in the conditions with poor signals, such as tunnels, underground garages and urban canyons.

### 1PPS



UM761 series modules output 1PPS with adjustable pulse width and polarity.

1PPS cannot be used for timing application.

#### **nRESET**

Active LOW. The active time shall be no less than 10 ms.



<sup>1</sup> For more information, see *UFirebird IV Protocol Specification*.

## 2 Product Installation

### 2.1 Preparations

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UM761 series modules are Electrostatic Sensitive Devices (ESD) and must be installed with special precautions when handling. Please take the following protective measures before opening the anti-static plastic box.

1. Follow the steps in the [Hardware Installation](#) in the correct order.
2. Electrostatic discharge (ESD) may cause damage to the device. All operations mentioned in this chapter shall be performed on an antistatic workbench, using an antistatic wristband and a conductive foam pad. If the antistatic workbench is unavailable, wear an antistatic wristband and connect the other end to a metal frame to play the anti-static role.
3. Hold the edge of the module, and DO NOT touch any components of the module.
4. Please check carefully whether the module is obviously loose or damaged. If there are any problems, please contact Unicore or the local dealer.

The following figure shows the typical installation of UM761 series evaluation kit (EVK).

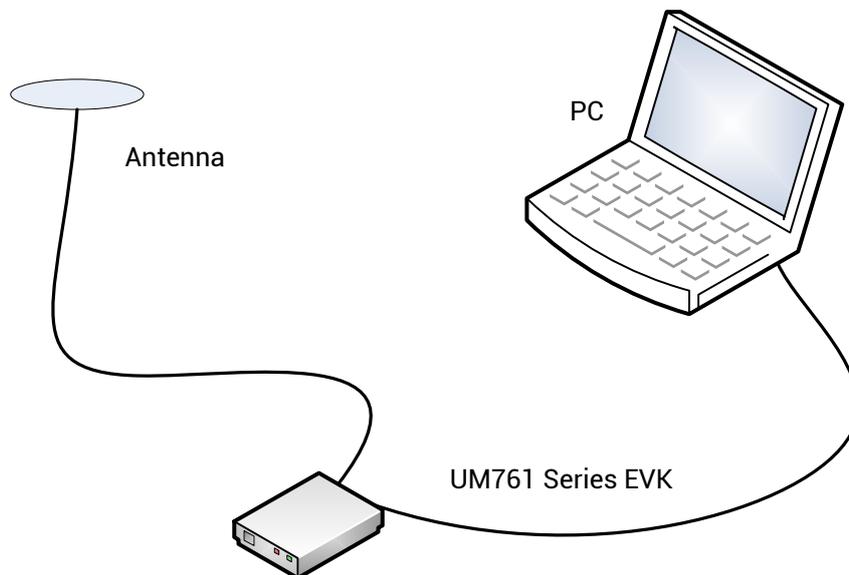


Figure 2-1 Typical Installation of the UM761 Series EVK

Please prepare the following items before installing the UM761 series modules.



- UM761 series EVK, including
  - An evaluation box with UM761 or UM761A module inside
  - Accessory GNSS antenna
  - USB cable with Type-C interface for data transfer and power supply
- PC or laptop with USB ports (Windows 7 and above)
- Unicore UPrecise software
- UM761 series User Manual

**Note:** Please keep the packing box and anti-static plastic box for storage and handling.

## 2.2 Hardware Installation

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After the above preparations, please follow the steps below to install the module, only for satellite navigation test.

1. Make sure to take adequate anti-static measures, such as wearing an anti-static wristband and grounding the workbench.
2. Open the package box and take out the UM761 series evaluation kit.
3. Use the GNSS antenna in the evaluation kit or use a GNSS antenna with appropriate gain (the GNSS frequencies supported by the antenna shall be in line with that of the module) and fix it in a non-blocking area; connect the antenna to the ANT port on the evaluation box.
4. Connect the evaluation box to a PC through the USB Type-C cable.
5. Open the UPrecise software on the PC.
6. Control the receiver through UPrecise to view the constellations, data stream, tracking status, map, etc. For more information, please refer to *UPrecise\_User Manual*.

## 2.3 Installation Instructions

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The UM761 series modules must be firmly connected to the vehicle to prevent any offsets or vibrations between the module and the vehicle. UM761 series modules shall not be installed in the suspension part of the vehicle (elastic part). When the vehicle is moving, any change of position relative to the vehicle's coordinate system will seriously affect the UM761 series modules and prevent them from working normally.

**Note:**

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° and the space is unobstructed.

Ensure that there is no strong interference within the frequency of  $1568 \pm 20$  MHz in the environment where the antenna is located.

### 2.3.1 Installation Angle

The vehicle's coordinate system is XYZ, and the module's coordinate system is xyz, as shown in [Coordinate System of the Module](#) and [Coordinate System of the Vehicle](#). 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 around the z axis
3. Rotate  $\alpha$  angle of the module around the new x axis
4. Rotate  $\beta$  angle of the module around the new y axis
5. The module is now in the same state as the actual installation, with that, angleX= $\alpha$ , angleY= $\beta$ , angleZ= $\gamma$

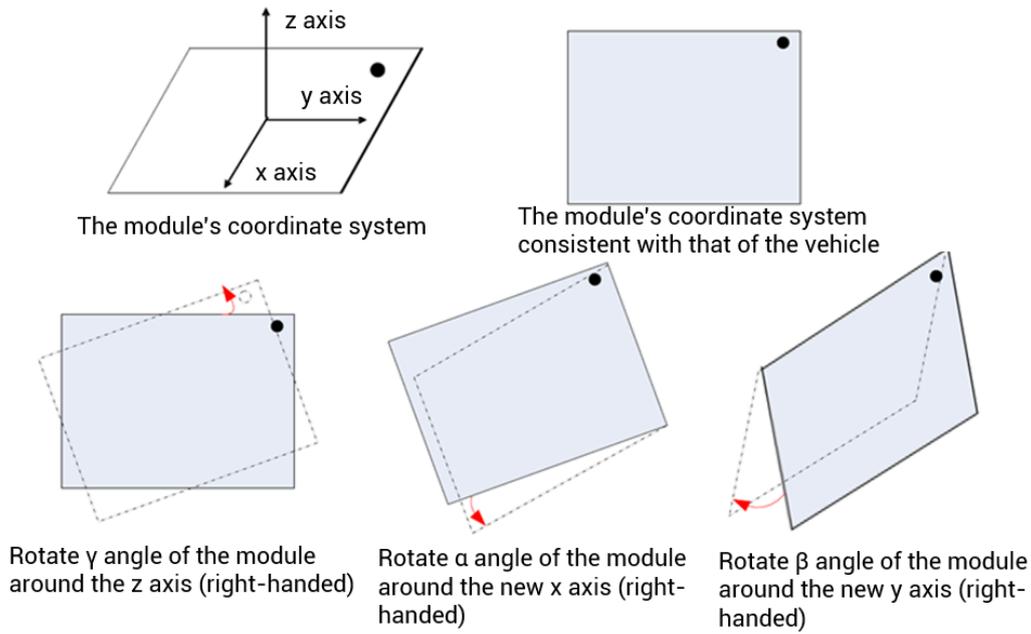


Figure 2-2 Coordinate System of the Module

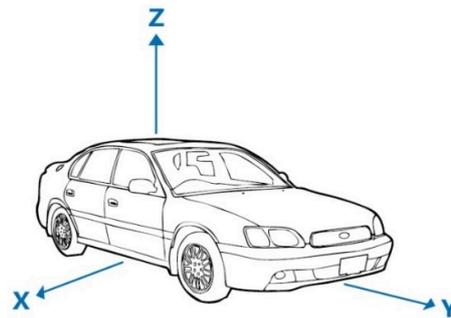


Figure 2-3 Coordinate System of the Vehicle

**Note:** The coordinate system of the module must be consistent with that of the vehicle, 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.

## 2.3.2 Installation Mode

### Free Installation (Default Mode)

UM761 series modules integrate a three-axis gyroscope and a three-axis accelerometer, with built-in self-calibration algorithm, supporting free installation of the module at any angle relative to the vehicle's coordinate system, such as completely horizontal installation, inclined installation at a certain angle, and flip installation.

### Fixed Installation

This mode allows users to input the accurate installation angle into the module according to the description of the [Installation Angle](#). Compared to the free installation, this installation mode takes a shorter calibration time. When configuring the installation angle, the maximum error shall be within  $\pm 5$  degrees.

## 2.3.3 Reference Messages

### CFGROTAT

**Message format:** `§CFGROTAT,angleX,angleY,angleZ,mode`

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

**Parameters:**

- angleX, angleY and angleZ are defined in [Installation Angle](#), with the unit of  $0.01^\circ$
- mode stands for the installation mode:
  - 0 – General installation mode, the input value of the installation angle is relatively coarse (within 10 degrees)
  - 2 – Automatic installation mode, no need to input the installation angle, only calibration is required.

**Notes:**

1. Choose 0 for fixed installation mode and 2 for free 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 using 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.

### SNRSTAT (or SNRSTATEX)<sup>1</sup>

**Message format:**

```
§SNRSTAT,insstatus,odostatus,InstallState,Mapstat  
§SNRSTATEX,insstatus,odostatus,InstallState,mapstat,gyrState,gyrCaliCnt
```

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

**Parameters:**



- insstatus: INS Initialization status
  - 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: Installation angle estimation status
  - 1: IMU device failure, unable to estimate the installation angle
  - 0: Calibration in progress
  - 1: The current quality of satellite information is insufficient and better satellite conditions are required
  - 2: The current vehicle motion is insufficient and acceleration is required
  - 3: The current speed of the vehicle is too low and it's required to be increased.
- Mapstat: Map information status
  - 1: No serial port is configured to enter MAP information
  - 2: The MAP information is abnormal
  - 0: No MAP message is 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
- gyrstat: Gyroscope calibration status
  - 0: Gyroscope multiplicative errors not calibrated
  - 1: Gyroscope multiplicative errors being estimated during installation angle alignment
  - 2: Gyroscope multiplicative errors calibrated
- gyrCaliCnt: Number of nodes involved in gyroscope multiplicative error estimation

### 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 the conditions of parking, satellite quality, vehicle motion, etc. mentioned in [Module Calibration and Notes](#). Confirm whether the self-calibration is completed using the `$$SNRSTAT` (or `$$SNRSTATEX`) 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 hot start is needed in underground garages, please continuously power the `V_BCKP`.

## 2.3.4 Module Calibration and Notes

### Self-Calibration

After the installation of the UM761 series modules, wait for the module to complete self-calibration in order to ensure the accuracy of the module output. In the process of self-calibration, the module estimates the installation status parameters and sensor parameters. Before the self-calibration is completed, the module is in GNSS navigation mode; after the self-calibration is completed, the module enters into GNSS + INS integrated navigation mode.

### Conditions of Completing Self-Calibration

- After power-on and the start of self-calibration, it's recommended to keep the vehicle stationary for more than 3 minutes.
- Maintain good satellite visibility during self-calibration (with at least 6 visible satellites and CNO above 30 dB). Better satellite observations will lead to faster calibration.
- Execute at least five 90-degree turns during normal driving (not required for fixed installation). For best calibration results, cover varied turning scenarios as shown in [Maneuvering Conditions for INS Calibration](#).
- Accelerate during straight-line driving and maintain a speed above 36km/h. More frequent acceleration cycles (with acceleration  $> 0.5 \text{ m/s}^2$  for at least 10 times) and longer periods of high-speed driving will lead to faster calibration.

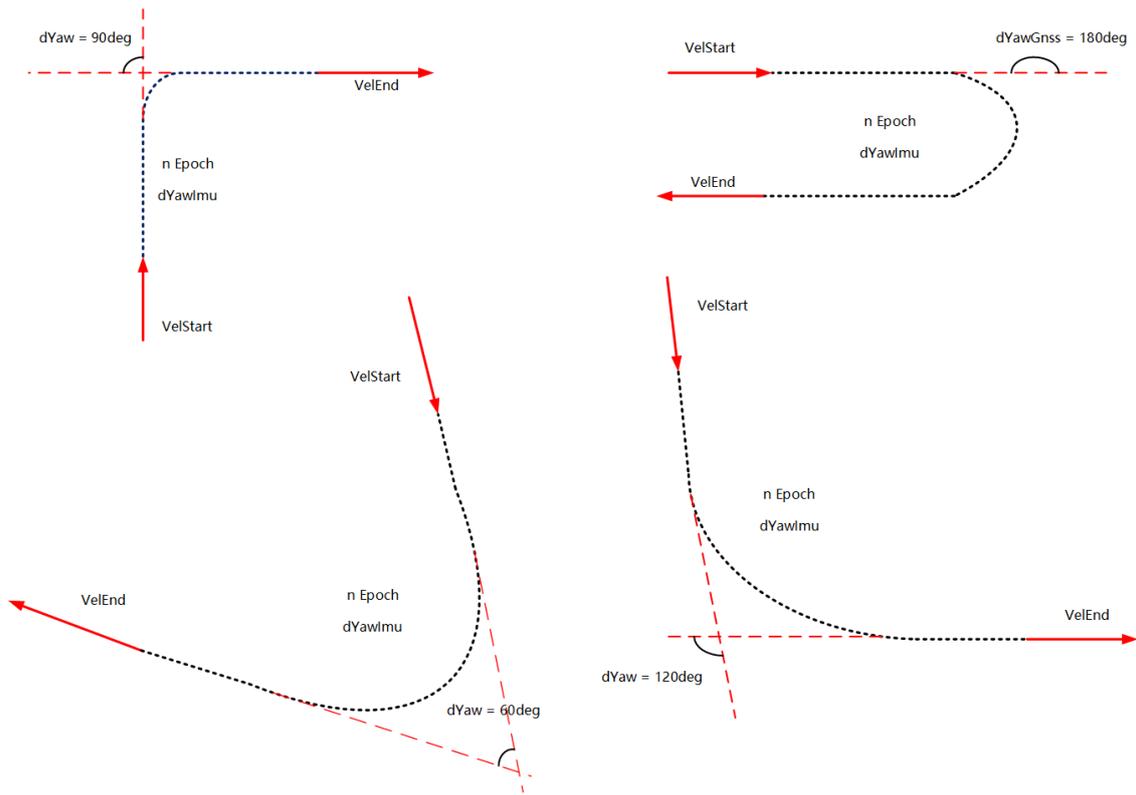


Figure 2-4 Maneuvering Conditions for INS Calibration

After the first calibration (insstatus 3), it is still necessary to drive for about 15 minutes in open environments to train the IMU adequately. Otherwise, the navigation accuracy may be slightly worse if the vehicle enters a complex environment such as a tunnel and garage immediately after the first calibration.

**Notes:**

1. The normal use of the module only requires one self-calibration process.
2. 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.

<sup>1</sup> It is recommended to use SNRSTATEX instead of SNRSTAT. As an extended version of SNRSTAT, SNRSTATEX fully retains all original fields while adding two new fields – gyrState and gyrCaliCnt – thereby providing more comprehensive information.

## 3 Technical Specifications

### 3.1 Electrical Specifications

#### 3.1.1 Absolute Maximum Ratings

Table 3-1 Absolute Maximum Ratings

Item	Min.	Max.	Unit	Description
Power Supply Voltage (VCC)	-0.5	3.6	V	Main power supply
Backup Voltage (V_BCKP)	-0.5	3.6	V	Backup power supply for RTC
Digital IO Voltage	-0.5	3.6	V	Voltage at digital IO pins
Antenna Input Power (RF_IN)	/	+3	dBm	Maximum input power of antenna

#### 3.1.2 Operational Conditions

Table 3-2 Operational Conditions

Item	Symbol	Min.	Typ.	Max.	Unit	Condition
Power Supply Voltage	VCC	2.7	3.3	3.6	V	/
Ripple Voltage	V <sub>p-p</sub>	/	/	50	mV	/
Tracking Average Current	I <sub>ACQ</sub>	51	66	84	mA	VCC=3.3 V
Low Level Input Voltage	V <sub>IL</sub>	0	/	0.2×VCC	V	/
High Level Input Voltage	V <sub>IH</sub>	0.8×VCC	/	3.6	V	/
Low Level Output Voltage	V <sub>OL</sub>	0	/	0.4	V	I <sub>out</sub> =-5 mA
High Level Output Voltage	V <sub>OH</sub>	VCC-0.55	/	VCC	V	I <sub>out</sub> =5 mA
Antenna Gain	G <sub>ANT</sub>	15	20	30	dB	/

Item	Symbol	Min.	Typ.	Max.	Unit	Condition
Backup Voltage	V_BCKP	1.7	/	3.6	V	/
RTC Time Keeping Current	I_BCKP	/	6	10	μA	/

## 3.2 Dimensions

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The dimensions of UM761 series modules are as follows:

Table 3-3 Dimensions

Parameter	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 (Outer edge of the stamp hole)	0.7	0.8	0.9
N (Inner edge of the stamp hole)	0.4	0.5	0.6
M	0.8	0.9	1.0

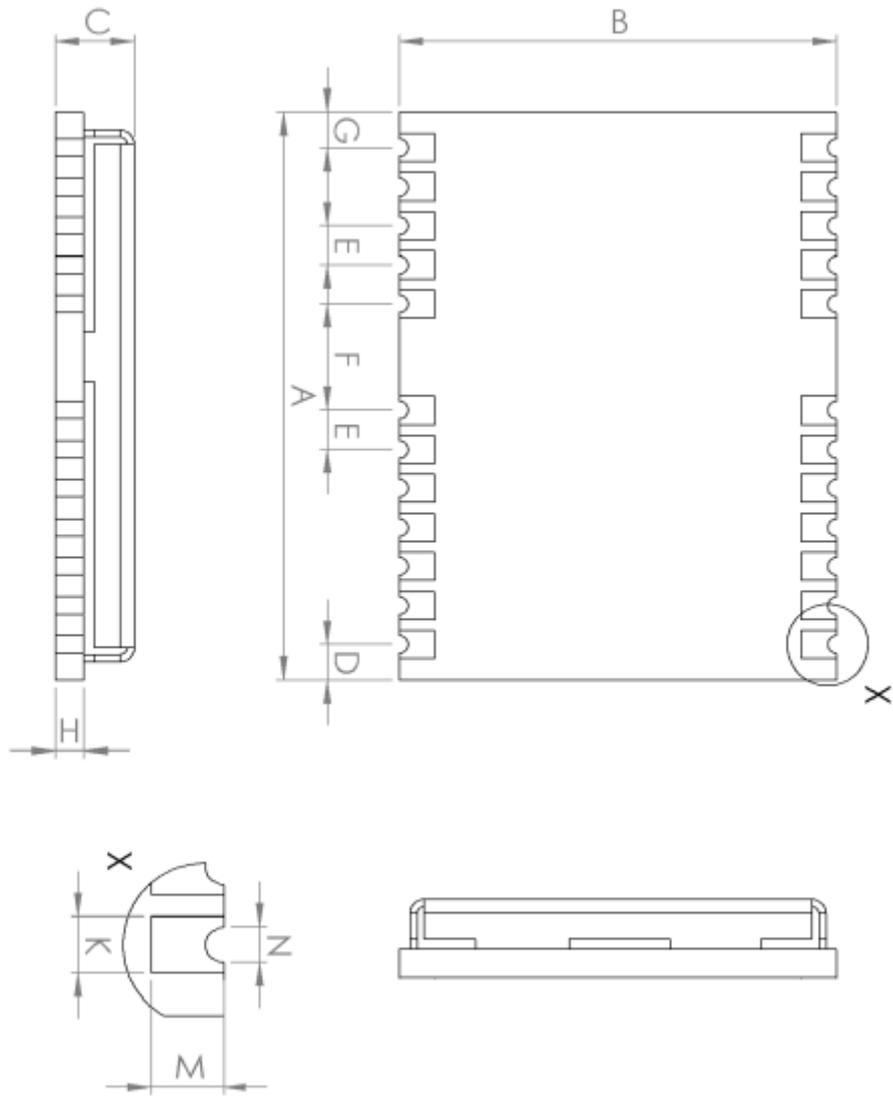


Figure 3-1 Mechanical Layout

### 3.3 Pin Definition



Figure 3-2 Pin Assignment

Table 3-4 Pin Definition

Pin No.	Name	I/O	Electrical Level	Description
1	nRESET	I	LVTTL	Reset pin, active low. Keep it floating if not used.
2	NC	/	/	Do not connect
3	TIMEPULSE	O	LVTTL	Pulse per second (1PPS)
4	WHEELTICK	I	LVTTL	Odometer speed pulse input. Keep it floating if not used. It is strongly recommended to use this pin. The maximum pulse frequency is 10 KHz, and the minimum pulse width is greater than 100 $\mu$ s. <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	/	/	Do not connect
6	NC	/	/	Do not connect
7	NC	/	/	Do not connect
8	nRESET	I	LVTTL	Reset pin, active low.

Pin No.	Name	I/O	Electrical Level	Description
				Keep it floating if not used.
9	VCC_RF	O	/	Antenna feed output. Recommended to use an external power supply rather than the VCC_RF pin. <sup>1</sup>
10	GND	/	/	Ground
11	RF_IN	I	/	GNSS signal input
12	GND	/	/	Ground
13	GND	/	/	Ground
14	LNA_EN	O	LVTTL	Enable external LNA; high level by default
15	DIR	I	LVTTL	Odometer direction input. Keep it floating if not used. It is strongly recommended to use. High level = forward Low level = reverse <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	/	/	Do not connect
17	NC	/	/	Do not connect
18	NC	/	/	Do not connect
19	NC	/	/	Do not connect
20	TXD1	O	LVTTL	UART TXD signal
21	RXD1	I	LVTTL	UART RXD signal
22	V_BCKP	I	1.7 V ~ 3.6 V	Backup voltage supply, used for hot start. If you do not use hot start, connect V_BCKP to VCC. Do NOT leave it floating or connect it to ground.
23	VCC	I	2.7 V ~ 3.6 V	Main supply voltage
24	GND	/	/	Ground

<sup>1</sup> If the antenna's power supply and the module's main power supply (VCC) use the same power rail, the ESD, surge and overvoltage introduced at the antenna will be directly applied to 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.

## 3.4 Recommended Footprint on the PCB

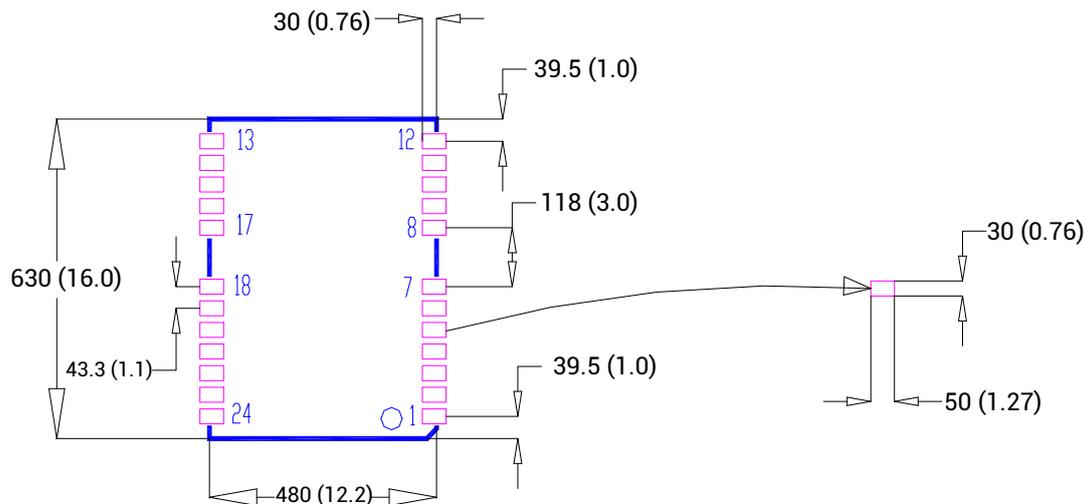


Figure 3-3 Recommended Footprint (unit: mil, in brackets: mm)

**Note:** When designing PCB solder mask, ensure that the area under the UM761 series module is completely coated with solder mask.

## 3.5 Power Supply Requirements

### 3.5.1 Main Supply (VCC)

The voltage range of VCC is 2.7 V ~ 3.6 V.

**Notes:**

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



- The time interval between the power-off of VCC ( $< 0.4$  V) to the next power-on is recommended to be larger than 500 ms.

### 3.5.2 Backup Supply (V\_BCKP)

When using hot start, it is necessary to supply backup power to the module.

The voltage range of V\_BCKP is 1.7 V ~ 3.6 V.

#### Notes:

- The initial level of V\_BCKP when power-on shall be less than 0.4 V.
- The power-on ramp of V\_BCKP shall be monotonic, without plateaus.
- The undershoot and ringing of V\_BCKP when power-on shall be within 5% of V\_BCKP.
- The power-on waveform of V\_BCKP rising from 10% to 90% shall be within 100  $\mu$ s ~ 10 ms.
- The time interval between the power-off of 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 shall be connected to VCC or connected to backup power.



## 4 Reliability Tests and Approvals

The UM761 series modules meet international standards in terms of reliability testing and environmental protection. For detailed information, please refer to the table [Reliability Tests and Approvals](#).

Table 4-1 Reliability Tests and Approvals

Qualification Types		UM761A	UM761
Reliability Tests	JESD47, GB/T2423		√
	AEC-Q104 (Grade3)	√	
Approvals	RoHS	√	√
	REACH	√	√
	CE	√	√
	FCC	√	√
Manufacturing	IATF 16949	√	√
Moisture Sensitivity Level	MSL	MSL 3	MSL 3
ESD	HBM	±2000V	±2000V
	CDM	±500V	±500V

## 5 Package

### 5.1 Label Description

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Figure 5-1 Label Description

### 5.2 Ordering Information

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Table 5-1 Ordering Information

Main Model	Sub-Model	Description
UM761A	02	Automotive grade single-frequency GNSS+IMU module, operating temperature: -40°C ~+85°C, supporting firmware upgrade, 16.0 mm x 12.2 mm, 500 pieces/reel
UM761	02	Industrial grade single-frequency GNSS+IMU module, operating temperature: -40°C ~+85°C, supporting firmware upgrade, 16.0 mm x 12.2 mm, 500 pieces/reel

### 5.3 Package Description

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The UM761 series modules are packaged in carrier tape and reel (suitable for mainstream surface mount devices), in vacuum-sealed aluminum foil antistatic bags, with desiccant inside to prevent moisture. When using reflow soldering process to solder the modules, please strictly comply with the IPC standards to conduct temperature and humidity control. As the packaging materials such as the carrier tape can only withstand the temperature of 55 degrees Celsius, the modules shall be removed from the package during baking.



Figure 5-2 UM761 Series Modules Package

Table 5-2 Package Description

Item	Description
Number of Modules	500 pieces/reel
Reel Size	Tray: 13" External diameter: 330 mm Internal diameter: 100 mm Width: 24 mm Thickness: 2.0 mm
Carrier Tape	Space between (center-to-center distance): 20 mm

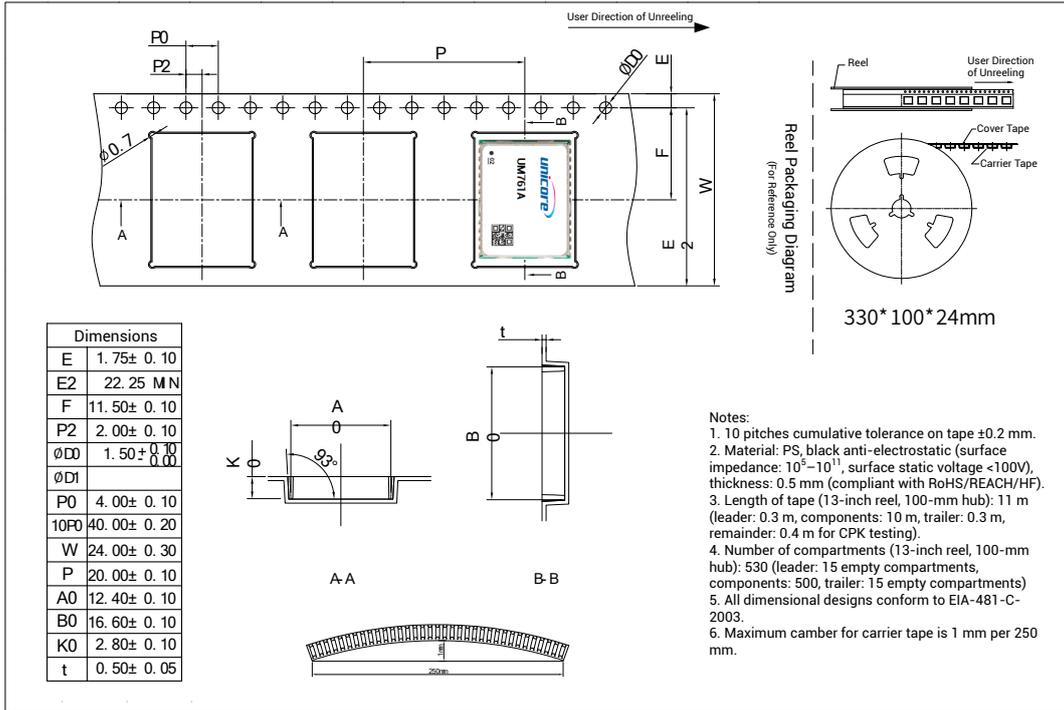


Figure 5-3 UM761 Reel Package Diagram

UM761 series modules are rated at MSL level 3. Please refer to the relevant IPC/JEDEC standards for baking requirements. Users may access to the website [www.jedec.org](http://www.jedec.org) to get more information.

The shelf life of UM761 series modules packaged in vacuum-sealed aluminum foil antistatic bags is one year.



## 6 Clean

DO NOT use alcohol or other organic solvents to clean, which may cause the soldering flux residues flooding into the shielding cover, resulting in mildew or other problems.

# 7 Reflow Soldering

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

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

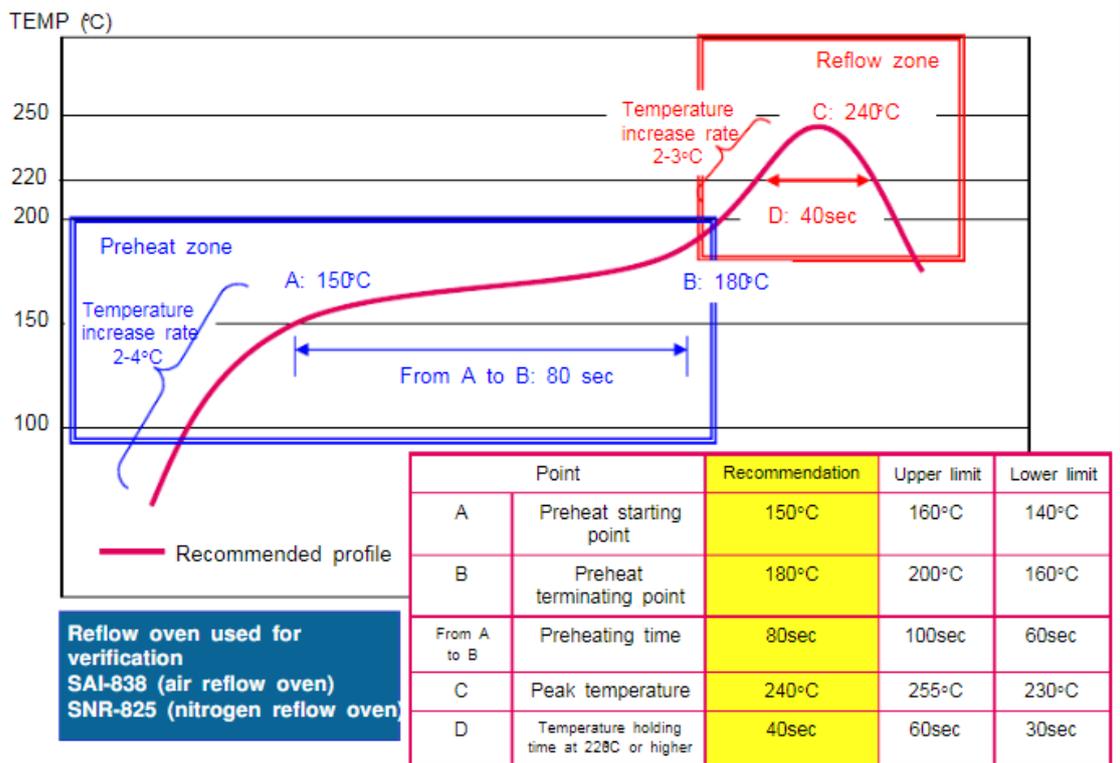


Figure 7-1 Reflow Soldering Temperature Curve

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

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