



INSTALLATION AND OPERATION

USER MANUAL

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UM761 Series

Multi-GNSS Single-Frequency
Integrated Positioning Module

Revision History

Version	Revision History	Date
P1.0.0	Draft	May. 2024
P1.0.1	Added the industrial grade module UM761	Sept. 2024
P1.0.2	Updated the input and output voltages in section 3.2	Dec. 2024
P1.0.3	- Updated the Low Level Input Voltage, Low Level Output Voltage, and High Level Output Voltage in 3.2 Operational Conditions. - Galileo E1 modified to "E1B/C", QZSS L1 modified to "L1C/A, L1S", and SBAS "L1C/A" added. - Added 3.3 Dimensions. - Added 3.5 Recommended Footprint on the PCB. - Added Figure 4-3 UM761 Reel Package Diagram.	Apr. 2025
P1.0.4	Updated the hot start sensitivity.	Oct. 2025

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.	

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Foreword

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

Document Structure

1. Introduction
2. Product Installation
3. Technical Specifications
4. Package
5. Clean
6. Reflow Soldering

PRELIMINARY

Contents

1	Introduction	1
1.1	Overview.....	1
1.2	Key Specifications	2
1.3	Interfaces	3
2	Product Installation	4
2.1	Preparations.....	4
2.2	Installation of the EVK	5
2.3	Installation of the Module.....	6
3	Technical Specifications	11
3.1	Electrical Specifications	11
3.2	Operational Conditions	11
3.3	Dimensions	11
3.4	Pin Definition.....	13
3.5	Recommended Footprint on the PCB	15
3.6	Power Supply Requirements	15
4	Package.....	16
4.1	Label Description	16
4.2	Ordering Information	16
4.3	Package Description.....	17
5	Clean.....	18
6	Reflow Soldering	18

1 Introduction

1.1 Overview

UM761 series modules are GNSS + MEMS 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 + MEMS 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 (Left: Automotive; Right: Industrial)

Main Model	Sub-Model	Operating Temperature		Grade		System						Interface	Data Update Rate
		-40°C ~ +85°C	-40°C ~ +105°C	Professional	Automotive	GPS	BDS	GLONASS	Galileo	QZSS	SBAS	UART	
UM761A	02	•			•	•	•	•	•	•	•	•	1Hz/ 5Hz/ 10Hz
UM761	02	•		•		•	•	•	•	•	•	•	1Hz/ 5Hz/ 10Hz

1.2 Key Specifications

Power		
Voltage	+2.7 V~3.6 V DC	
Power Consumption	Tracking: 45 mA @ 3.3 V Acquisition: 50 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	
Environmental Specifications		
Vibration	JEDEC JESD22-B103	
Shock	JEDEC JESD22-B103	
Input/ Output Data Interface		
UART x 1	LVTTTL level Supported baud rate: 115200 ~ 460800 bps	
GNSS Performance		
Frequencies	GPS: L1 C/A GLONASS: G1 BDS: B1I, B1C Galileo: E1B/C QZSS: L1C/A, L1S SBAS: L1C/A	
Time to First Fix (TTFF)	Cold Start	26 s
	Hot Start	1 s
	Reacquisition	1 s
	AGNSS	1 s
Horizontal Positioning Accuracy	1.5 m CEP (with SBAS)	

Velocity Accuracy (RMS) ¹	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)
GNSS	
Sensitivity	Tracking -165 dBm
	Cold Start -148 dBm
	Hot Start -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

1.3 Interfaces

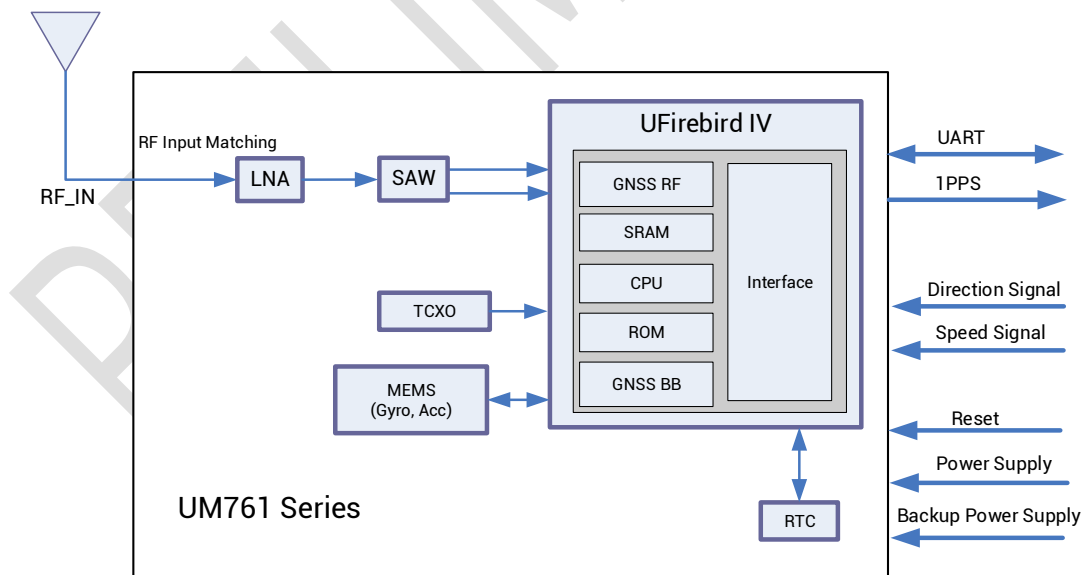


Figure 1-2 UM761 Series Modules Block Diagram

¹ 68% at 30 m/s for dynamic operation, open sky

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 users², and the maximum is 460800 bps. Ensure that the UART is connected to a PC or an external processor for firmware upgrade.

MEMS

UM761 series modules integrate a six-axis MEMS, including a three-axis gyro and a three-axis accelerator. The MEMS provides information of attitude and speed changes, which are combined with GNSS data to perform integrated navigation solution. The combination of GNSS and MEMS 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 is not for timing application.

nRESET

Active LOW, and the active time shall be no less than 10 ms.

2 Product Installation

2.1 Preparations

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 section 2.2 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.

² For more information, see *UFirebird IV Protocol Specification*.

- 4) Please check carefully whether the module is obviously loose or damaged. If there are any problems, please contact Unicore or the local dealer.

Figure 2-1 shows the typical installation of UM761 series evaluation kit (EVK).

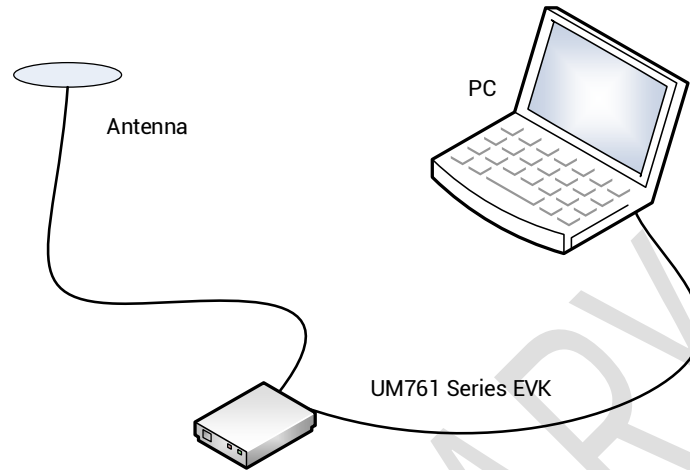


Figure 2-1 Typical Installation of UM761 Series EVK

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*

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

2.2 Installation of the EVK

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

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

Step 2: Open the package box and take out the UM761 series evaluation kit.

Step 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.

Step 4: Connect the evaluation box to a PC through the USB Type-C cable.

Step 5: Open the UPrecise software on the PC.

Step 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 of the Module

UM761 series modules must be rigidly connected to the vehicle body and firmly fixed.

-
- ☞ 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 ± 20 MHz in the environment where the antenna is located.
-

2.3.1 Installation Instructions

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.

2.3.2 Installation Angle

The vehicle's coordinate system is XYZ, and the module's coordinate system is xyz, as shown in Figure 2-2 and Figure 2-3. 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 γ angle of the module around the z axis
3. Rotate α angle of the module around the new x axis
4. Rotate β 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= α , angleY= β , angleZ= γ

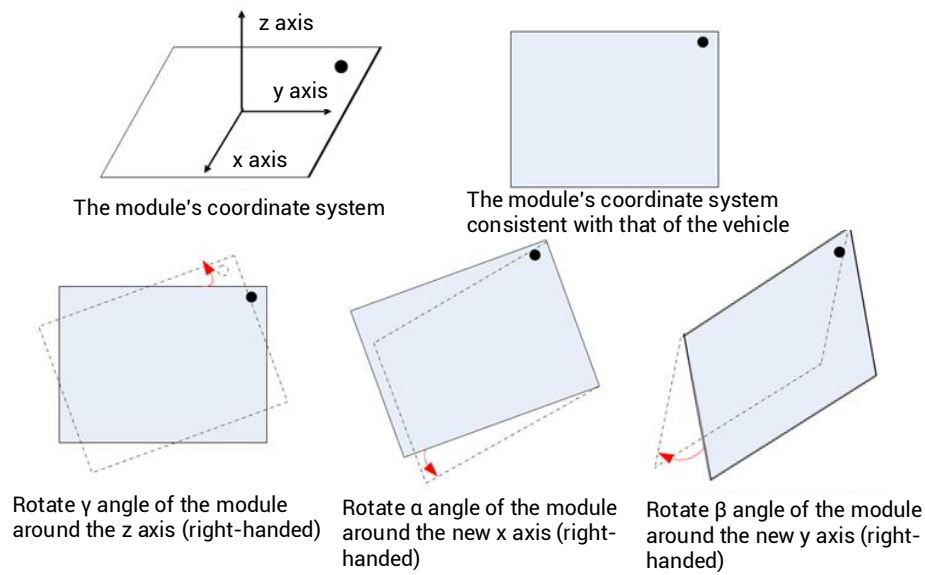


Figure 2-2 Coordinate System of the Module

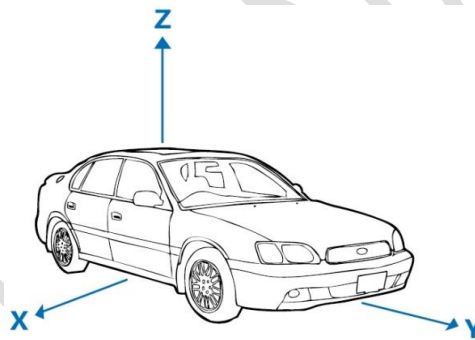


Figure 2-3 Coordinate System of the Vehicle

☞ 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.

2.3.3 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 installation 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 definition in section 2.3.2. Compared to the free installation, this installation mode takes a shorter calibration time. When configuring the installation angle, the maximum error shall be within ± 5 degrees.

2.3.4 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's coordinate system.

Parameters:

- ◆ angleX, angleY and angleZ are defined in section 2.3.2, with the unit of 0.01°
- ◆ 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.

2. SNRSTAT

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

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

Parameters:

- ◆ insstatus: Initialization status of INS
 - 1: IMU device failure
 - 0: Disabled
 - 1: Initialization starts
 - 2: The installation angle is known

3: Initialization is completed

◆ odostatus: Initialization status of odometer

-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: 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:

-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

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 section 2.3.5. 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 hot start is needed in underground garages, please continuously power the V_BCKP.

2.3.5 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

- The self-calibration is triggered after power on. It's required to stop the car for more than three minutes.
- Good satellite visibility is required during the process of self-calibration (the number of visible satellites is not less than six, and CNO is above 30 dB). 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 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 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 alignment.

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.

3 Technical Specifications

3.1 Electrical Specifications

Absolute Maximum Ratings

Item	Min.	Typ.	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
RTC Time Keeping		10		μA	
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

3.2 Operational Conditions

Item	Symbol	Min.	Typ.	Max.	Unit	Condition
Power Supply Voltage	VCC	2.7	3.3	3.6	V	
Ripple Voltage	V _{p-p}			50	mV	
Tracking Average Current	I _{ACQ}		45		mA	VCC=3.3 V
Low Level Input Voltage	V _{IL}	0		0.2×VCC	V	
High Level Input Voltage	V _{IH}	0.8×VCC		3.6	V	
Low Level Output Voltage	V _{OL}	0		0.4	V	I _{out} = -5 mA
High Level Output Voltage	V _{OH}	VCC-0.55		VCC	V	I _{out} =5 mA
Antenna Gain	G _{ANT}	15	20	30	dB	

3.3 Dimensions

The dimensions of UM761 series modules are as follows:

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

Parameter	Min (mm)	Typical (mm)	Max (mm)
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

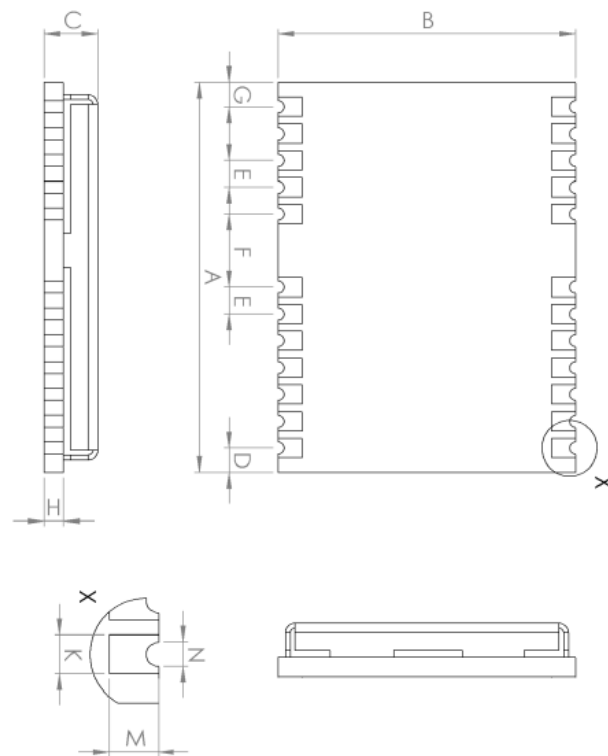


Figure 3-1 Mechanical Layout

3.4 Pin Definition

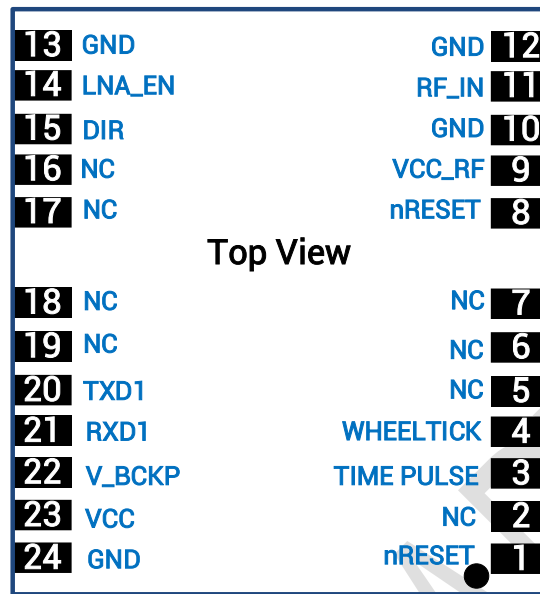


Figure 3-2 Pin Assignment

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 5K Hz, and the minimum pulse width is greater than 100 μ s. Note: Incorrect signals of the odometer will lead to serious problems in the use of the product. Please make sure the signal is correct.
5	NC	—	—	Do not connect
6	NC	—	—	Do not connect
7	NC	—	—	Do not connect
8	nRESET	I	LVTTL	Reset pin, active low. Keep it floating if not used.

Pin No.	Name	I/O	Electrical Level	Description
9	VCC_RF	O		Antenna feed output. It is recommended to use an external power supply rather than the VCC_RF pin to feed the antenna. ³
10	GND	—	—	Ground
11	RF_IN	I	—	GNSS signal input
12	GND	—	—	Ground
13	GND	—	—	Ground
14	LNA_EN	O	—	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 Note: Incorrect signals of the odometer will lead to serious problems in the use of the product. Please make sure the signal is correct.
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	2.0 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

³ If the antenna's power supply and the module's main power supply (VCC) use the same power rail, the ESD, surge and overvoltage generated 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.

3.5 Recommended Footprint on the PCB

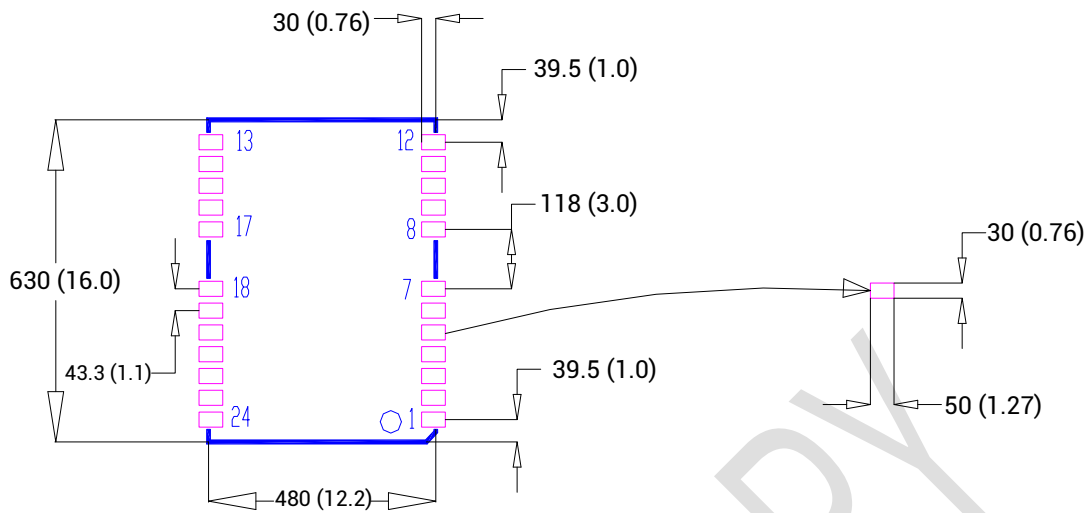


Figure 3-3 Recommended Footprint (unit: mil, in brackets: mm)

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

3.6 Power Supply Requirements

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 μ 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.

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 μ 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 Package

4.1 Label Description

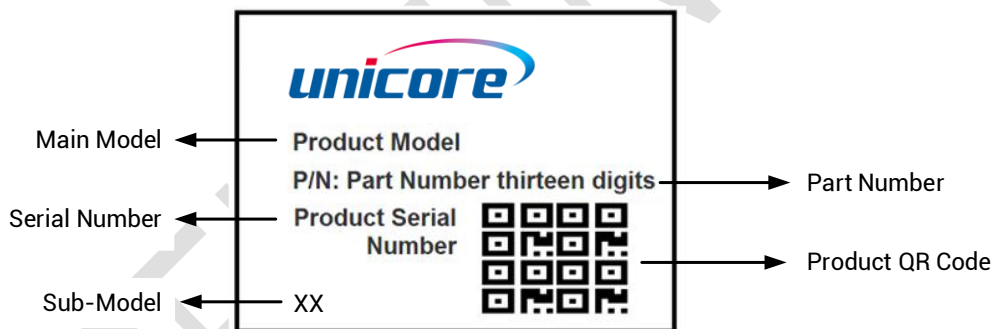


Figure 4-1 Label Description

4.2 Ordering Information

Table 4-1 Ordering Information

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

4.3 Package Description

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 standard 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 4-2 UM761 Series Modules Package

Table 4-2 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

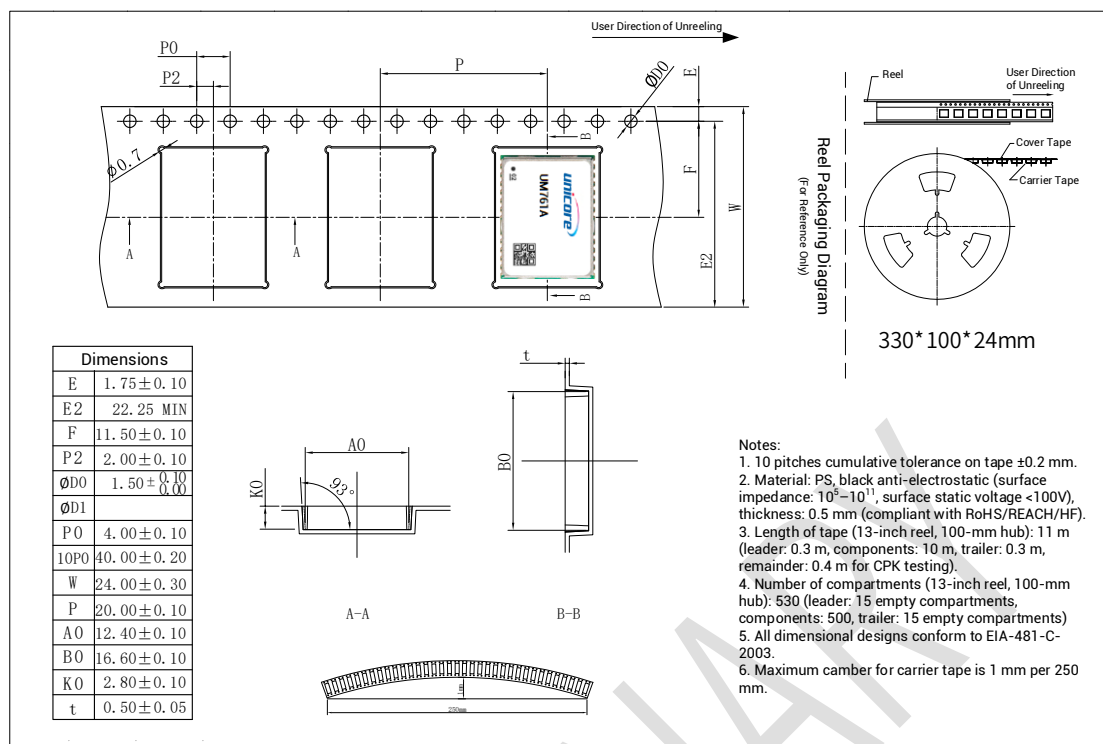


Figure 4-3 UM761 Reel Package Diagram

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 to get more information.

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

5 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.

6 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 Figure 6-1 below (M705-GRN360 is recommended for solder paste).

Note: The module can be soldered only once.

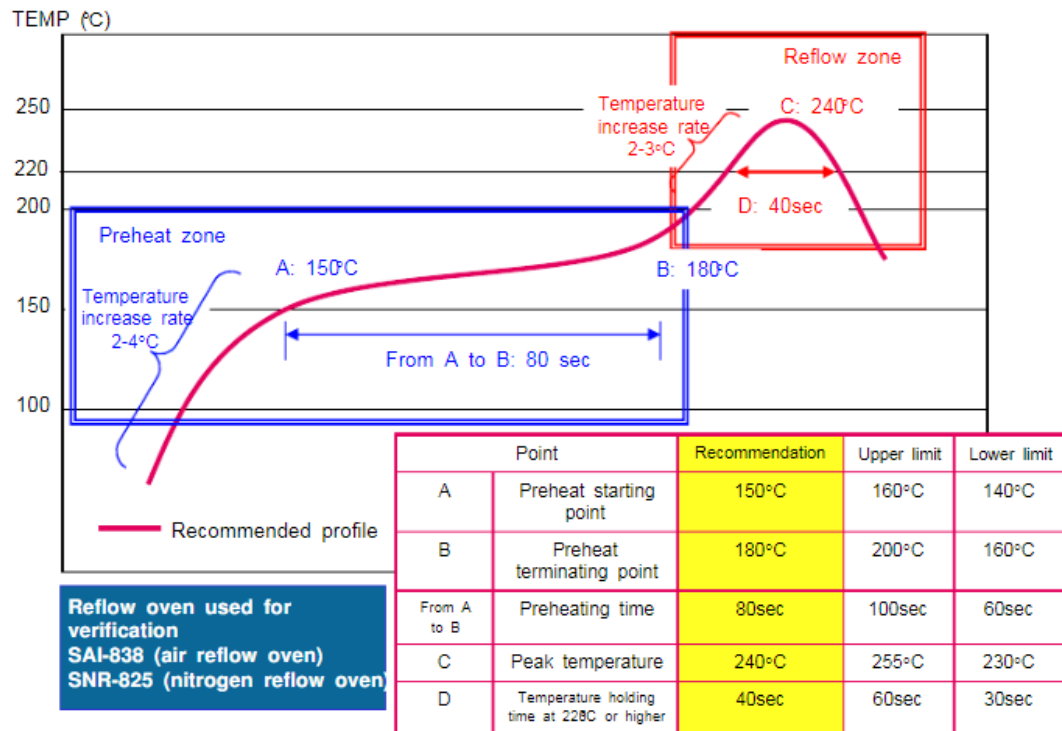


Figure 6-1 Reflow Soldering Temperature Curve

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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