INSTALLATION AND OPERATION

USER MANUAL

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UB9A0

All-Constellation Multi-Frequency High-Precision Board

Foreword

Applicability

This document describes the information of the hardware, specification and the use of Unicore UB9A0 board.

Target Readers

This document applies to technicians who possess the expertise on GNSS receivers.

Statement

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Revision History

Version	Revision History	Date
R1.0	First release.	Jun. 2024
R1.1	1. Updated **1.3 Technical Specifications**, including: - Changing the description used to describe **Data Update**, - Adding information to the footnote of the data in **Data Update**. 2. Changed the requirement for the NC type pins and updated several pin descriptions in **2.2 Pin Definition**. 3. Changed the expression "all-frequency" to "multi-frequency".	Sept. 2024
R1.2	1. Added L6E to the QZSS constellation. 2. Updated the descriptions in **1.2 Key Features**. 3. Updated the following information in **1.3 Technical Specifications**: - Changed **Time Pulse Accuracy (RMS)** from 20ns to 5ns. - Added BINEX to **Data Format**. - Changed the "50 Hz (RTK)" to "50 Hz" in **Data Update** .	Mar. 2025
R1.3	1. Deleted "+1ppm" of the DGPS (RMS) accuracy data. 2. Updated vibration and shock test standards to GB/T 28046.3, ISO 16750-3.	Dec. 2025

Product Introduction

1.1 Product Descriptions

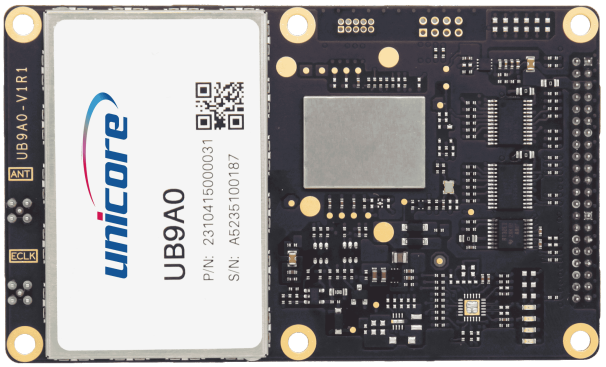
UB9A0 is an all-constellation multi-frequency high-precision OEM board developed by Unicore, designed for positioning scenarios, including surveying and mapping, CORS stations, portable base stations, seismic monitoring and global monitoring stations.

The UB9A0 board is developed based on NebulasIV, an RF-baseband and high-precision algorithm integrated GNSS SoC. For more information on the chipset, see 1.4 Block Diagram.

UB9A0 has a size of 100 mm × 60 mm × 11.4 mm, which is compatible with mainstream GNSS OEM boards on the market. UB9A0 has various types of interfaces for different purposes. For details on the interfaces, see 1.3 Technical Specifications.

UB9A0 supports the frequencies as follows:

- BDS: B1I, B2I, B3I, B1C, B2a, B2b
- GPS: L1C/A, L1C, L2P(Y), L2C, L5
- GLONASS: G1, G2, G3
- Galileo: E1, E5a , E5b, E6
- QZSS: L1C/A, L1C, L2C, L5, L6E
- NavIC: L5
- SBAS: L1C/A
- LBAND



1.2 Key Features

UB9A0 supports the following enhanced features:

- Highly reliable, stable and resilient in challenging environments,
- Single-constellation standalone positioning and multi-constellation joint positioning,
- Advanced multi-path mitigation and low elevation angle tracking,
- Outputs of carrier-phase observations with millimeter-level accuracy,
- Outputs of centimeter-level RTK positioning data,
- UART, Ethernet, 1PPS, EVENT and external clock input,
- Antenna feed and detection capability that activates the board protection mechanism in case of an antenna short circuit.
- Precise Point Positioning (PPP) calculation.

1.3 Technical Specifications

Basic Information	
Channels	1408 channels, based on NebulasIV
Constellations	BDS/GPS/GLONASS/Galileo/QZSS/NavIC
Frequencies	BDS: B1I, B2I, B3I, B1C, B2a, B2b[1]
	GPS: L1C/A, L1C, L2P(Y), L2C, L5
	GLONASS: G1, G2, G3
	Galileo: E1C, E5a, E5b, E6
	QZSS: L1C/A, L1C, L2C, L5, L6E
	NavIC: L5
	SBAS: L1C/A
	LBAND
Power	
Main Voltage	+3.2 V ~ +3.6 V DC

Backup Voltage	+2.2 V ~ +3.6 V DC			
Ripple Voltage	50 mV_{pp} (max.)			
Power Consumption	800 mW (typ.)			
Performance				
Single Point Positioning (RMS)	1.5 m (Horizontal)			
	2.5 m (Vertical)			
SBAS (RMS)	0.8 m (Horizontal)			
	0.8 m (Vertical)			
DGPS (RMS)	0.4 m (Horizontal)			
	0.8 m (Vertical)			
RTK (RMS)	0.8 cm + 1ppm (Horizontal)			
	1.5 cm + 1ppm (Vertical)			
PPP (RMS)[2]	5 cm (Horizontal)			
	10 cm (Vertical)			
Observation Accuracy (RMS)	**BDS**	**GPS**	**GLONASS**	**Galileo**
B1I/B1C/L1C/L1C/A/G1/E1 Pseudorange	10 cm	10 cm	10 cm	10 cm
B1I/B1C/L1C/L1C/A/G1/E1 Carrier Phase	1 mm	1 mm	1 mm	1 mm
B3I/L2P(Y)/L2C/G2/E6 Pseudorange	10 cm	10 cm	10 cm	10 cm
B3I/L2P(Y)/L2C/G2/E6 Carrier Phase	1 mm	1 mm	1 mm	1 mm
B2I/B2a/B2b/L5/G3/E5a/E5b Pseudorange	10 cm	10 cm	10 cm	10 cm
B2I/B2a/B2b/L5/G3/E5a/E5b Carrier Phase	1 mm	1 mm	1 mm	1 mm
Time Pulse Accuracy (RMS)	5 ns			

Velocity Accuracy (RMS)	0.03 m/s	
Sensitivity[3]	-148 dBm (Acquisition), -160 dBm (Tracking)	
TTFF	Hot Start: < 4 s	
	Cold Start: < 12 s	
	Reacquisition: <1 s (Unlock ≤ 30s)	
	Reacquisition: <2 s (30 s < Unlock < 90s)	
Initialization Time	< 5 s (typ.)	
Initialization Reliability	> 99.9% (typ.)	
Data Update	1 Hz, 2 Hz, 5 Hz, 10 Hz, 20 Hz, 50 Hz	
	Supporting up to 50 Hz raw measurements and RTK/PVT output.[4]	
Differential Data	RTCM 3.x RTCM 2.x MSM	
Data Format	NMEA0183 Unicore BINEX	
Physical Specifications		
Dimensions	100 mm × 60 mm × 11.4 mm	
RF Input		
Input impedance	50 Ω	
Antenna Gain	20 db to 40 db	
Interfaces		
2 × UART (LV-TTL)	1 × EX-CLOCK，10 M/20 M	1 × RTK_STAT
1 × UART (RS-232)	1 × 1PPS	1 × ERR_STAT
1 × LAN，10 M/100 M	1 × EVENT	1 × PVT_STAT
Environmental Specifications		

Operating Temperature	-40 °C to +85 °C
Storage Temperature	-55 °C to +95 °C
Humidity	95% No condensation
Vibration	GB/T 28046.3, ISO 16750-3
Shock	GB/T 28046.3, ISO 16750-3

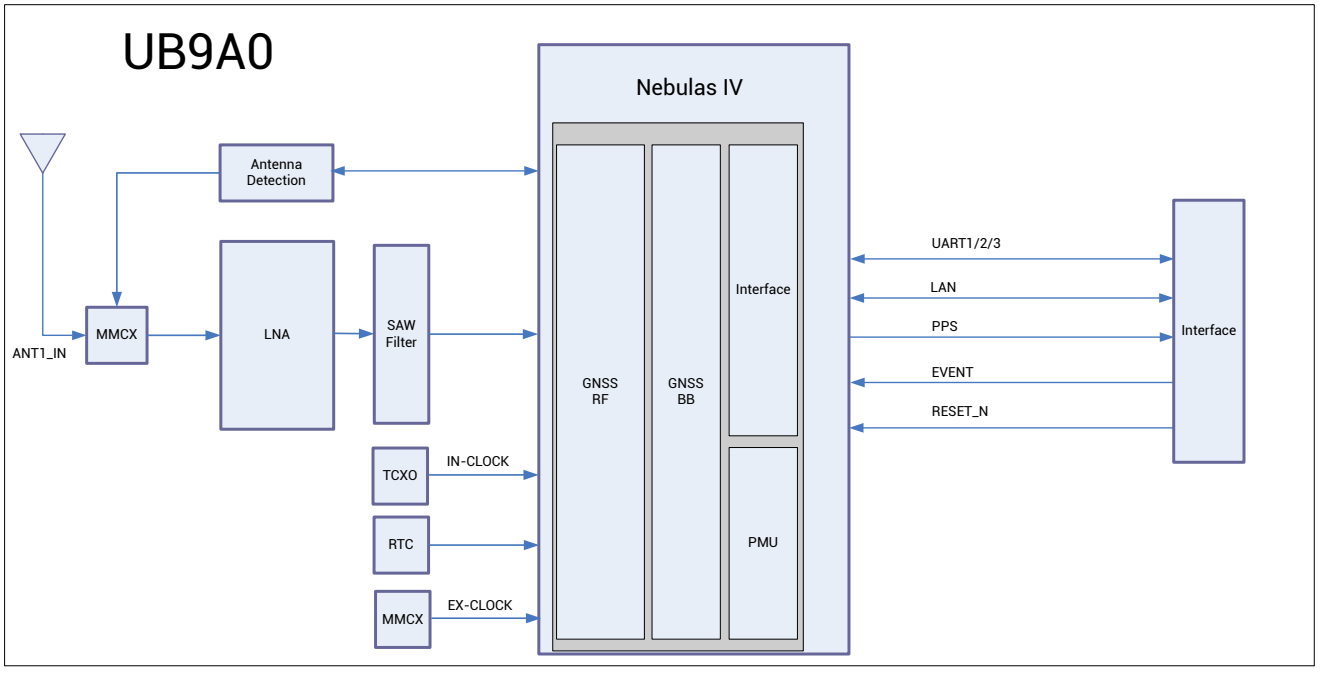
[1]. Due to the reason of signal system, it is recommended to cancle the selection of B2b when using TEQC. ↩

[2]. After 20 minutes of convergence under open sky without jamming. ↩

[3]. Rover mode. ↩

[4]. ONCHANGED trigger is recommended to output the ephemeris information. Ethernet is recommended to transmit raw measurements at 50 Hz to avoid data loss. ↩

1.4 Block Diagram



(1) RF Part

The receiver gets filtered and enhanced GNSS signals from the antenna via a coaxial cable. The RF part converts the RF input signals into the IF signals, and converts IF analog signals into digital signals required for NebulasIV^{TM} chip.

(2) NebulasIV SoC

NebulasIV is Unicore's new generation high precision GNSS SoC with 22 nm low power consumption design, supporting all constellations, multiple frequencies and 1408 super channels. NebulasIV integrates a dual-core CPU, a high-speed floating point processor and an RTK co-processor, which can fulfill the high precision baseband processing and RTK positioning independently.

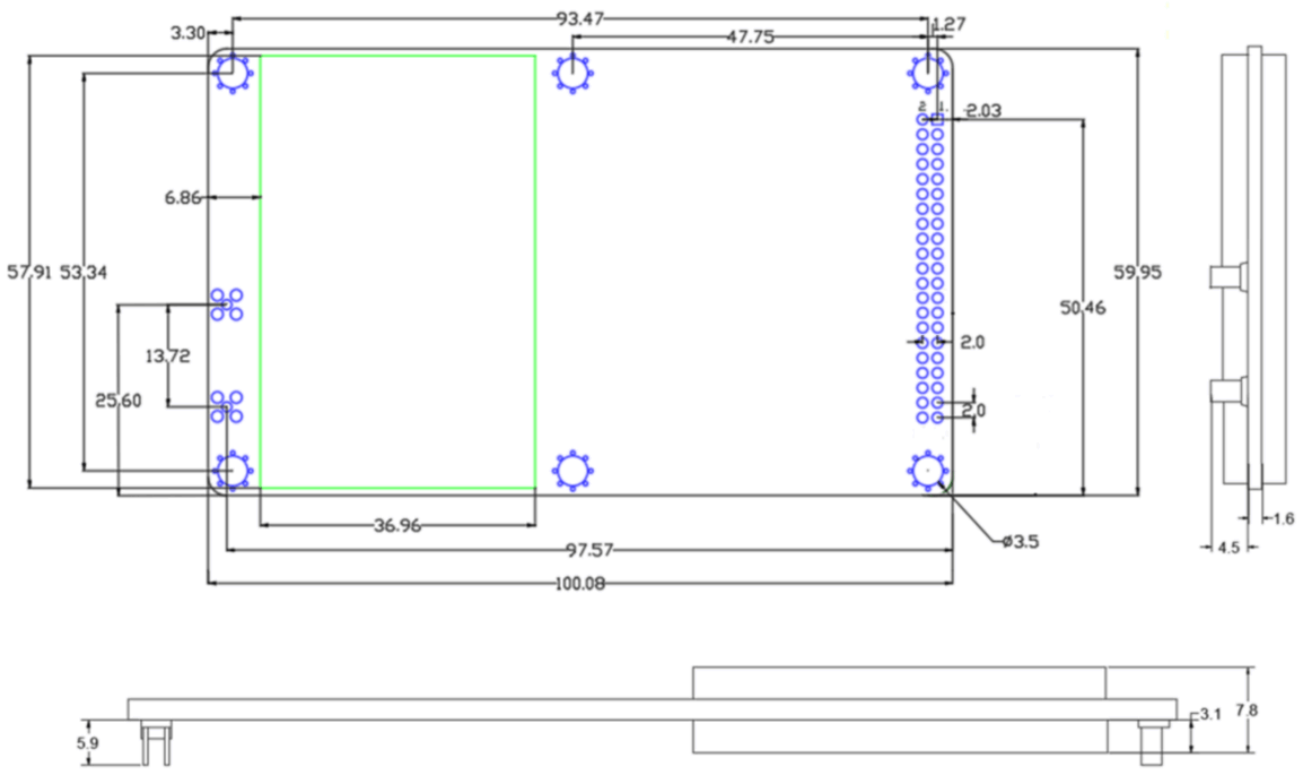
(3) External Interfaces

UB9A0 has the following external interfaces:

- UART
- Ethernet
- PPS
- EVENT
- RESET_N

Hardware Introduction

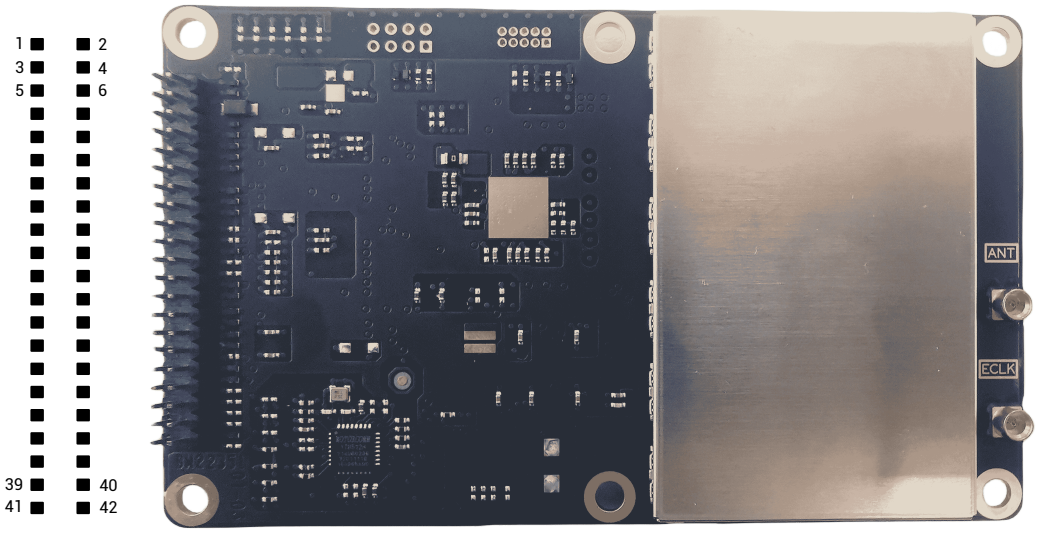
2.1 Dimensions



Parameters	Values	Tolerance
Length	100 mm	-0.2 mm + 0.5 mm
Width	60 mm	±0.2 mm
Height (PCB)	1.6 mm	±10%
RF Connector	4.5 mm	±0.2 mm
Shield	3.1 mm	±0.2 mm
Pin Height	5.9 mm	±0.2 mm

2.2 Pin Definition

UB9A0 provides dual-row 2 x 21 pins (2.0 mm pitch) as the main interface.



No.	Pins	I/O	Descriptions
1	GND	GND	Ground
2	RTK_STAT	O	RTK positioning indicator, active high, high level for RTK fixed solution, low level for other positioning status or no positioning.
3	NC	-	No connection inside. Leave floating.
4	PPS	Pulse	Pulse per second, with adjustable pulse width and polarity LVTTL
5	VCC	Power	Power supply +3.2 V to +3.6 V
6	VCC	Power	Power supply +3.2 V to +3.6 V
7	RXD3	I	COM3 input LVTTL
8	EVENT	I	Event input, with adjustable frequency and polarity. LVTTL
9	ERR_STAT	O	Error status: active high, high level when failing self-test, low level when passing self-test.

No.	Pins	I/O	Descriptions
10	PVT_STAT	O	PVT status: active high, high level when positioning, low level when not positioning.
11	NC	-	No connection inside. Leave floating.
12	RSTN	I	Reset. LVTTL, active low, Duration time > 5 ms
13	NC	-	No connection inside. Leave floating.
14	RXD2	I	COM2 input, LVTTL
15	NC	-	No connection inside. Leave floating.
16	TXD2	O	COM2 output, LVTTL
17	NC	-	No connection inside. Leave floating.
18	RXD1	I	COM1 input, RS-232
19	TXD3	O	COM3 output, LVTTL
20	TXD1	O	COM1 output, RS-232
21	NC	-	No connection inside. Leave floating.
22	NC	-	No connection inside. Leave floating.
23	GND	GND	Ground
24	GND	GND	Ground

No.	Pins	I/O	Descriptions
25	RSV	-	Reserved. Leave floating.
26	RSV	-	Reserved. Leave floating.
27	ETH_RX_N	I	Ethernet input, negative signal of a differential pair, Connecting to RD-
28	ETH_RX_P	I	Ethernet input, positive signal of a differential pair, Connecting to RD+
29	RSV	RSV	Reserved. Leave floating.
30	ETH_TX_P	O	Ethernet output, positive signal of a differential pair, Connecting to TD+
31	ETH_TX_N	O	Ethernet output, negative signal of a differential pair, Connecting to TD-
32	RSV	RSV	Reserved. Leave floating.
33	ETH_LED1	O	Blinking. 10 Mbps connection
34	ETH_LED2	O	Blinking. 100 Mbps connection
35	GND	GND	Ground
36	NC	-	No connection inside. Leave floating.
37	RSV	-	Reserved. Leave floating.
38	RSV	-	Reserved. Leave floating.
39	V_BCKP/GND	POWER/GND	External backup power, Level requirement: 2.2 V to 3.6 V, If you do not use the hot start function, leave the pin floating, or connect it to ground.

No.	Pins	I/O	Descriptions
40	RSV	-	Reserved. Leave floating.
41	RSV	-	Reserved. Leave floating.
42	GND	GND	Ground

UB9A0 has the following external interfaces:

- Antenna interface: MMCX interface to receive the GNSS antenna signals. It can also feed the antenna as well.
- External clock interface: MMCX interface to receive the external clock signal. It does not support hot plugging.

For more information about the above interfaces, see 2.3 Electrical Specifications.

2.3 Electrical Specifications

This section introduces the electrical specifications for UB9A0.

2.3.1 Absolute Maximum Ratings

Parameters	Symbols	Min.	Max.	Unit
Power Supply (VCC)	VCC	-0.3	3.6	V
Voltage Input (TTL)	TTL-V_{in}	-0.3	3.6	V
Voltage Input (RS232)	RS232-V_{in}	-25	25	V
Antenna Feed Current	ICC_RF	/	100	mA
RF Input Power of Antenna	ANT_IN input power	/	+15	dBm
Storage Temperature	T_{stg}	-55	95	°C

2.3.2 Operating Conditions

Parameters	Symbols	Min.	Typ.	Max.	Unit	Conditions
Power Supply (VCC)[1]	VCC	3.2	3.3	3.6	V	/
Maximum Ripple Voltage	V_{rpp}	0	/	50	mV	/
Working Current[2]	I_{opr}	/	242	/	mA	VCC=3.3 V
Antenna Feed Current	ICC_RF	/	50	/	mA	/
Operating Temperature	T_{opr}	-40	/	85	°C	/
Power Consumption	P	/	800	/	mW	/

[1]. The voltage range of VCC (3.2 V to 3.6 V) has already included the ripple voltage.

[2]. Since the product has capacitors inside, inrush current occurs during power-on. You should evaluate in the actual environment in order to check the effect of the supply voltage drop caused by inrush current in the system.

2.3.3 IO Threshold

(1) LVTTL Threshold

Parameters	Symbols	Min.	Max.	Unit	Conditions
Low Level Input Voltage	V_{in_low}	0	0.6	V	/
High Level Input Voltage	V_{in_high}	VCC * 0.7	VCC + 0.2	V	/
Low Level Output Voltage	V_{out_low}	0	0.45	V	I_{out} = 2 mA
High Level Output Voltage	V_{out_high}	VCC - 0.45	VCC	V	I_{out} = 2 mA

(2) RS232 Threshold

Parameters	Symbols	Min.	Typ.	Max.	Unit
Direct Input Threshold Voltage	VIT+	/	1.5	2.4	V
Inverse Input Threshold Voltage	VIT-	0.6	1.2	/	V

Parameters	Symbols	Min.	Typ.	Max.	Unit
High Level Output Voltage	VOH	5	5.5	/	V
Low Level Output Voltage	VOL	-5	-5.4	/	V

2.3.4 RF Input

Parameters	Symbols	Min.	Typ.	Max.	Unit	Conditions
Optimum Input Gain	G_{ant}	20	30	40	dB	/
GNSS Antenna Power Supply	ANT_PWR	4.0	/	5.1	V	<100 mA

2.3.5 External Clock Input

Parameters	Descriptions
External clock input	Frequency: 10 MHz/20 MHz V_{p-p}: 1.5 V to 3.3 V; recommended: 2.5 V Frequency Stability: max ± 0.5 ppm Waveform: Sine wave

Hardware Design

3.1 Power-on Requirements

To ensure the normal work of UB9A0, please follow the requirements for power-on below:

VCC

- 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.
- Power-on time interval: The time interval between the power-off (VCC < 0.4 V) and the next power-on must be larger than 500 ms.

V_BCKP

- 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.
- Power-on time interval: The time interval between the power-off (V_BCKP < 0.4 V) and the next power-on must be larger than 500 ms.

Installation and Test

4.1 Prerequisites

You can use Unicore's EVK to test the functionality and performance of UB9A0. Make sure that you have:

- High-precision products EVK, including:
  - power adapter
  - RF cable
  - serial cable
  - bottom test board
- **UPrecise**, the evaluation software
- **Unicore Reference Commands Manual For N4 High Precision Products**.

> **Tip**
> Please keep the packing box and antistatic box for storage and handling.

4.2 ESD Protection

Many components on UB9A0 are Static Sensitive Devices (SSD). Therefore, it is necessary to provide ESD protection for IC circuits and other SSD.

Please follow the ESD precautions and procedures below:

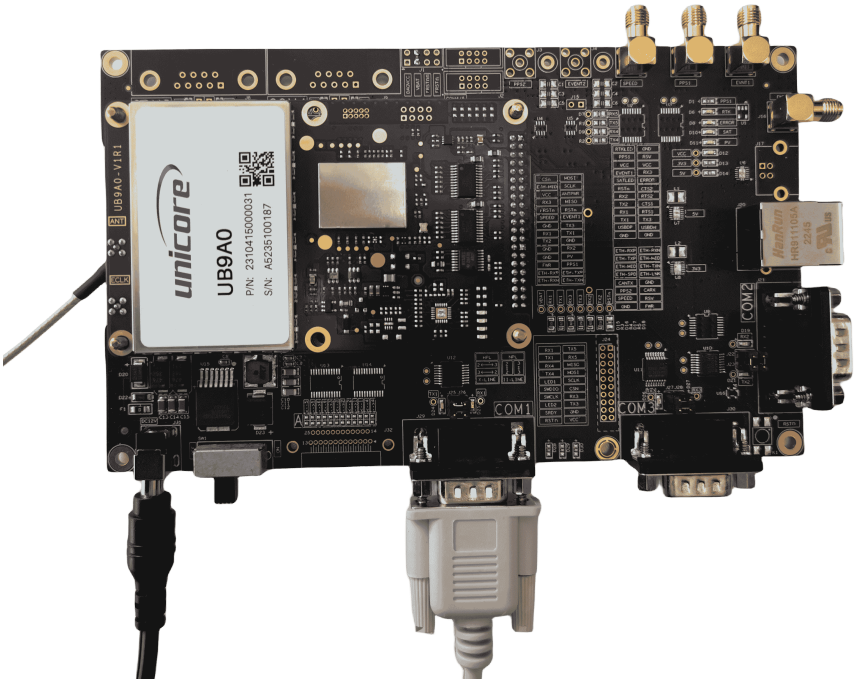
- Electrostatic discharge (ESD) may cause damage to the device. All operations mentioned in this chapter should be carried out on an antistatic workbench using an antistatic wrist strap and conductive foam pad. If there is no antistatic workbench, wear an antistatic wrist strap and connect the strap to a metal frame to avoid electrostatic damages.
- Hold the edge of the evaluation board, and do NOT touch the components directly.
- Carefully check the board to make sure that there is no apparent loose or damaged components. If you have any questions, please contact Unicore or the local distributors.

4.3 Installation

UB9A0 is delivered as a board which can be used and installed flexibly according to your applications. Here introduces the installation on the evaluation kit from Unicore to test its functionality and performance. For more information about the kit, see *High Precision Products Evaluation Kit User Manual*.

To install UB9A0 on the EVK, conduct the following steps:

1. Ensure adequate antistatic measures, such as wearing a grounded antistatic wrist strap and using a grounded workbench, etc.
2. Install UB9A0 on the EVK bottom board by aligning the dual-row pins to the pinholes. The bottom board supplies power to UB9A0.



3. Select a GNSS antenna with appropriate gain, fix it in a stable, interference-free, and non-occluded area, and use the appropriate cable to connect the antenna with UB9A0 ANT interface.

> **Note**
> The RF connector on the board is MMCX, please select the appropriate cable. The signal gain to the RF connector should be better within 25 dB to 35 dB. The Antenna connector provides 5V DC antenna feed by default configuration.

4. Connect one end of the serial port cable to the COM1 on the EVK, and connect the other end of the cable to the computer if your computer has RS232 ports; otherwise, you need a RS232 to USB cable to connect to the computer.

> **Tip**
> Z-TEK RS232 to USB cable is recommended.

5. Do **Step 4** again to connect other serial ports with the computer as per your need; besides, UB9A0 supports the Ethernet connection.
6. If necessary, connect the PPS and EVENT interfaces.
7. Connect the power adapter to the power supply interface on the EVK and plug the power adapter into the power outlet.
8. Turn the power supply switch to the right to start the UB9A0.
9. Start **UPrecise**. Select the serial port and baud rate to connect the receiver, then **UPrecise** shows the constellation, message, receiver status, etc. Refer to *UPrecise User Manual* for more details.

> **Note**
>
> If the board has not been in use for a long time, or the distance between the last location and the current location is above 1000 km, a slower fix may occur. In that case, please use the FRESET command to clear the older ephemeris and almanac information (this command will also clear the configurations). After the FRESET command is executed, the board will be reset, and it will take 15 minutes to collect new ephemeris and almanac information.

Firmware Upgrade

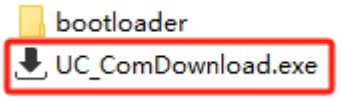
5.1 Firmware Upgrade

Two options are supported for upgrading UB9A0:

- Using the UPrecise software to upgrade. For more information, see *UPrecise User Manual*.
- Using **UC_ComDownload** to upgrade.

To upgrade UB9A0 using **UC_ComDownload**, follow the steps below:

1. Connect UB9A0 to a computer.
2. Double click **UC_ComDownload.exe** to run.



3. Click **Select Path** to select the pkg file for upgrading.

   The path of the upgrade file is displayed in the file path box on the right.

   > **Note**
   > Using the valid pkg file provided by Unicore is necessary for upgrading.

4. Select the serial port used on the computer and set the baud rate.
5. **[Optional]**

   Click **Software Reset** to have an automatic restart.

   > **Note**
   > Manual restart can also be conducted in **Step 7**.

6. **[Optional]**

   Click **Support Multi Uarts** when you use UART2 or UART3 to upgrade.

7. Depending on whether **Step 5** has been conducted, choose from the two options below:
   - **When Step 5 is NOT conducted**, click **START** and when a prompt to reset the chipset is displayed, manually restart UB9A0 .
   - **When Step 5 is conducted**, click **START**.

   After either of the options is chosen, the status view on the right displays the upgrade progress. When the upgrading is done, the occupied serial port is released. UB9A0 is ready for use.

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