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INSTALLATION AND OPERATION

USER MANUAL

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UB4B0M

GPS/BDS/GLONASS/Galileo
All-constellation All-frequency
Compact High Precision Board

Revision History

Version	Revision History	Date
Ver. 2.0	Release	Jun. 2019
R3.0	Add the related description to clarify the VCC restrictions and LED indicators	Aug. 2019
R3.1	Update Copyright time	Apr. 2020
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R4.1	Modify the note of EVENT in Table 2-2	July 2021

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Foreword

The User Manual offers you information in hardware features, installation and use, and performance indicators of UNICORECOMM UB4B0M.

Note: This manual is a generic version. Please refer to the corresponding chapter of the manual according to the configuration of the purchased product for more information concerning the usage requirement of CORS, RTK and Heading.

Target Readers
The User Manual is targeted for the technicians with certain knowledge about GNSS Receiver but not for the general readers.

CONTENTS

1. Overview

UB4B0M is a new generation compact RTK board based on NebulasII high performance and high accuracy GNSS SoC. It supports signals including BDS B1I/B2I/B3I/B1C/B2a, GPS L1/L2/L5, GLONASS L1/L2 and Galileo E1/E5a/E5b. UB4B0M features classic small size, supports chip-level multi-path mitigation, and delivers millimeter-level carrier phase observations and centimeter-level RTK positioning. UB4B0M is particularly suitable for surveying and mapping, high-precision positioning and navigation application.

UB4B0M adopts UNICORECOMM's new generation all-system multi-core high-precision SoC - NebulasII. The chip is based on the mature core technology of Nebulas baseband chip, supports 432 channels, and integrates a 600MHz ARM processor and a special high-speed floating-point processor, yielding stronger satellite navigation signal process ability. Making full use of the high-performance data sharing ability and the super simplified real-time operation system, UB4B0M optimizes the multi-dimensional RTK matrix pipeline computing, which considerably enhances the RTK process ability and realizes the multi-system multi-frequency RTK calculating (more than 32 satellites).

The newly designed tri-band RTK engine of UB4B0M can process observation data from multiple frequencies of BDS, GPS, GLONASS and Galileo, which can significantly improve the RTK initialization speed, measurement accuracy and reliability in harsh signal environment like urban areas and shade of trees, and realize long-baseline centimeter-level RTK positioning.

Figure 1-1 UB4B0M All-constellation All-frequency Compact High Precision Board

1.1 Key Features

- Supporting BDS B1I/B2I/B3I/B1C/B2a, GPS L1/L2/L5, GLONASS L1/L2, Galileo E1/E5a/E5b, etc.

- Millimeter-level carrier-phase observation data

- Centimeter-level high-precision RTK positioning

- Hardware size compatible with the mainstream GNSS OEM boards on the market

- NebulasII-based new generation multi-system multi-frequency high-performance SoC

- Supporting single-system independent positioning and multi-system integrated positioning as well as BDS/GPS/GLONASS/Galileo independent PVT output

- Supporting advanced multi-path mitigation

- Supporting 3 serial ports and 1 1PPS

1.2 Technical Index

Table 1-1: Performance

Channels	432 channels, based on NebulasII	Cold Start	< 25 s
Frequency	BDS B1I/B2I/B3I/B1C*/B2a* GPS L1/L2/L5 GLONASS L1/L2 Galileo E1/E5a/E5b QZSS L1/L2/L5	Re-acquisition	< 1 s
Single Point Positioning (RMS)	Horizontal: 1.5 m Vertical: 2.5 m	RTK Initialization Time	< 5 s (Typical)
		Initialization Reliability	> 99.9%
DGPS (RMS)	Horizontal: 0.4 m Vertical: 0.8 m	Differential Data	RTCM 3.0/3.2/3.3
RTK (RMS)	Horizontal: 1 cm + 1 ppm Vertical: 1.5 cm+1 ppm	Data Format	NMEA-0183 Unicore
Observation Accuracy (RMS)	BDS GPS GLONASS Galileo	Data Update Rate	20 Hz
		Positioning Update Rate	20 Hz
B1/L1 C/A/E1 Code	10 cm 10 cm 10 cm 10 cm	Time Accuracy (RMS)	20 ns
B1/L1/E1 Carrier Phase	1mm 1 mm 1 mm 1 mm	Velocity Accuracy (RMS)	0.03 m/s

B2/L2P(Y)/L2C/E5b Code	10 cm 10 cm 10 cm 10 cm	**Power Consumption**	1.8W (Typical)
B2/L2P(Y)/L2C/E5b Carrier Phase	1 mm 1 mm 1 mm 1 mm		
B3/L5/E5a Code	10 cm 10 cm 10 cm		
B3/L5/E5a Carrier Phase	1 mm 1 mm 1 mm		

Note: The part marked with * is optional
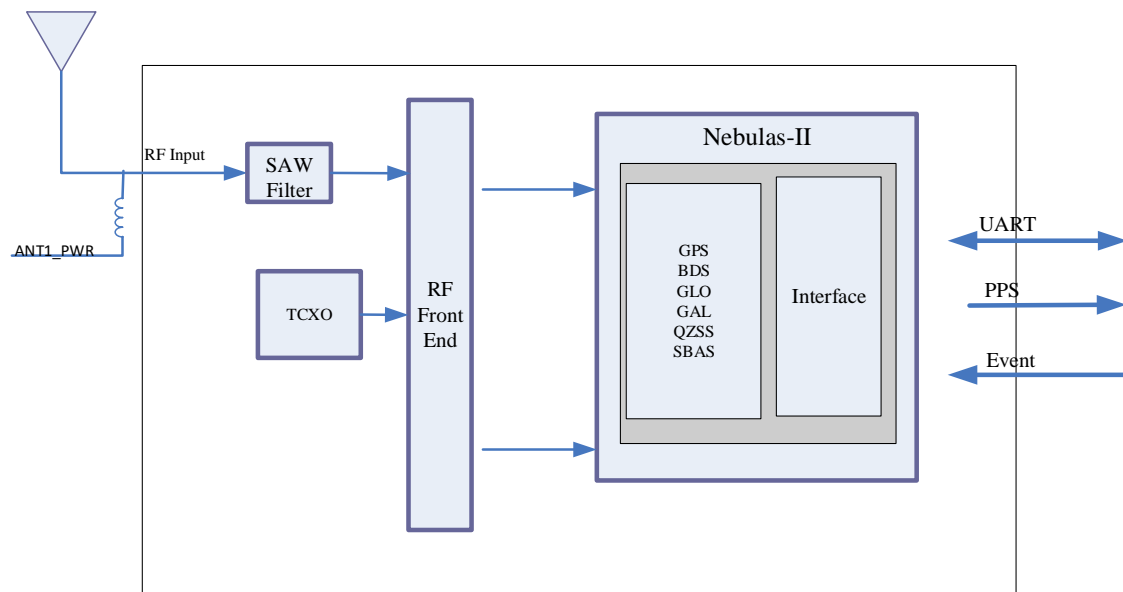
1.3 Board Overview

Figure 1-2 UB4B0M Structure Diagram

1. RF Part

The receiver gets filtered and enhanced GNSS signal from the antenna via a coaxial cable. The RF part converts RF input signal into IF signal, and converts IF analog signal into digital signal which NebulasII (UC4C0) digital processing requires.

2. NebulasII SoC (UC4C0)

The UB4B0M incorporates the processing from the NebulasII SoC—UNICORECOMM's new generation high precision GNSS SoC with 55 nm low power design, which supports 432 channels and is equipped with a built-in UNICORECOMM's new generation baseband engine. The chip integrates a 600 MHz ARM processor and a special high-speed floating-point processor as well as a special anti-interference unit. A single NebulasII SoC can complete high-precision baseband processing and RTK positioning and heading calculation.

3. 1PPS

UB4B0M provides 1 PPS signal with adjustable pulse width and polarity.
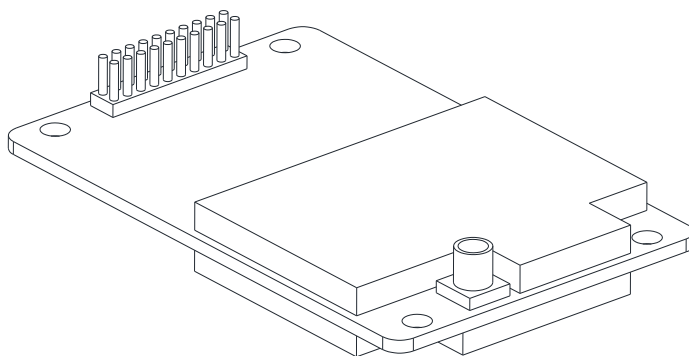
4. Event

UB4B0M provides 1 Event Mark Input signal with adjustable pulse width and polarity.

2. Hardware Composition

2.1 Mechanical Dimension

Table 2-1 Mechanical Dimension

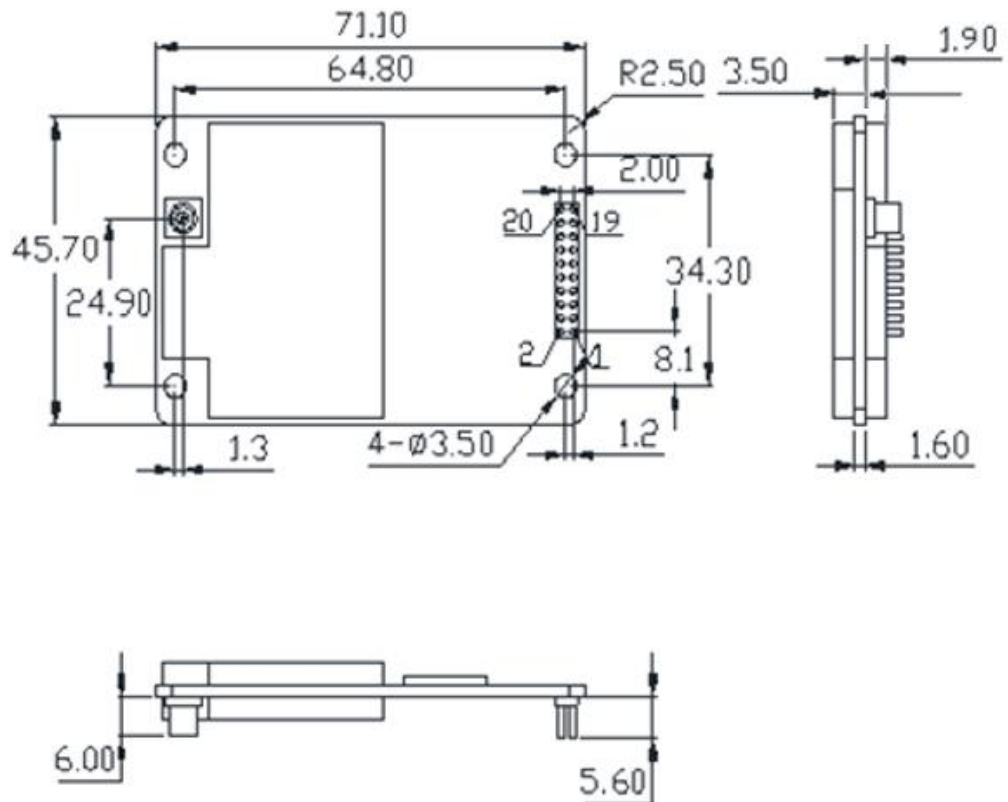| Parameter	Value (mm)	Tolerance
Length	71.1	-0.2 mm, +0.5 mm
Width	45.7	±0.2 mm
Height (PCB)	1.6	±10%
RF Connector	6.00	±0.2 mm
Shield	1.9	±0.2 mm
Pin Distance	5.6	±0.2 mm

Figure 2-1 Mechanical Structure Drawing

2.2 Interface and Pin Definition

Apart from the antenna RF interface, UB4B0M provides the following 20 Pin SAMTEC dual-row pins. The pin distance: 2.0 mm; pin length: 4.0 mm; base thickness: 1.5 mm.
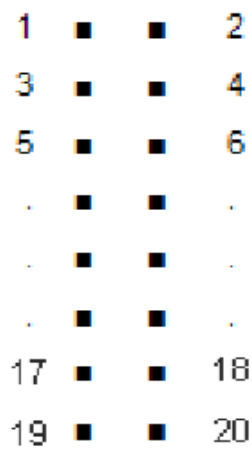

Figure 2-2 Pinout

5

2.3 Pin Function

Table 2-2 Pin Definition

No	Signal	Type	Description	Note
1	RSV		Reserved	Reserved
2	3.3V	PWR	Power input	3.3 V~5 V（+5%/-3%）
3	Reserved		Reserved	Reserved
4	RXD3	I	COM3 Receive data	LVTTL Level
5	RESETIN	I	Reset-input	Low level effective, duration >5 ms
6	Reserved	O	Reserved	Reserved
7	EVENT	I	Event input	
8	RSV		Reserved	Reserved
9	TXD3	O	COM3 Send data	LVTTL Level
10	GND	PWR	DGND&GND	
11	TXD1	O	COM1 Send data	LVTTL Level
12	RXD1	I	COM1 Receive data	LVTTL Level
13	GND	PWR	DGND&GND	
14	TXD2	O	COM2 Send data	LVTTL Level
15	RXD2	I	COM2 Receive data	LVTTL Level
16	GND	PWR	DGND&GND	
17	PV	O	Position validity indication	High level effective. If LED indicators are needed, please connect this pin to the positive pole of the LED diode.
18	GND	PWR	DGND&GND	
19	PPS	O	Time mark output	LVTTL Level
20	RSV		Reserved	Reserved

2.4 Electrical Specification

Table 2-3 Absolute Maximum Rating

Parameter	Symbol	Minimum	Maximum	Unit
VCC	Vcc	-0.3	5.5	V
Input Pin Voltage	Vin	-0.3	3.6	V
VCC Maximum Ripple	Vrpp	0	50	mV
Input Pin Voltage (all the other pins in addition to the mentioned ones)	Vin	-0.3	3.6	V
RF Input Power Consumption of Antenna	ANT_IN input power		+15	dBm
Maximum Bearable ESD Stress Level	VESD (HBM)		±2000	V

2.5 Operational Conditions

Table 2-4 Operational Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Unit	Condition
VCC	Vcc	3.2	3.3	5.0	V	
Power-on Impulse Current*	Iccp			10	A	Vcc=3.3 V
Input Pin Low Level	Vin_low_1	-0.3		0.9	V	
Input Pin High Level	Vin_high_1	2.4		3.6	V	
Output Pin Low Level	Vout_low	0		0.45	V	Iout=4 mA
Output Pin High Level	Vout_high	2.85		3.3	V	Iout=4 mA
Optimum Input Gain	Gant	20		36	dB	
Power Consumption	P		1.8	1.9	W	

Note: Since the product has capacitors inside, inrush current will occur during power-on. Evaluate in the actual environment in order to check the effect of the supply voltage drop due to the inrush current.

2.6 Physical Characteristics

Table 2-5 Physical Characteristics

Size	46 ×71 ×13 mm
Weight	28 g
Temperature	Operating Temperature: -40℃～+85℃
	Storage Temperature: -55℃～+95℃
Humidity	95% non-condensation
I/O Interface	2×10 Pin
Antenna Interface	1×MCX
Vibration	GJB150.16-2009, MIL-STD-810
Shock	GJB150.18-2009, MIL-STD-810

3. Hardware Integration Guide

3.1 Design Notes

For the normal operation of UB4B0M, the following signals need to be connected correctly:

- The module's VCC should be monotonic when powered on, the initial level should be lower than 0.4V, and the undershoot and ringing should be guaranteed

to be within 5% VCC

- Use VCC pin to provide reliable power source and earth all GND pin of the board

- MMCX interface provides 4.6 ± 0.2 V feed, and notice 50Ω impedance matching for the circuit. When no antenna is connected to the port of antenna in the module, which means there is no load, use a multimeter to test and the voltage supply is DC 4.8 V ~ 5.4 V. When the RF port of the module is connected with the antenna and the working current is 30~100 mA at normal temperature, the antenna feed is DC 4.6 V ± 0.2 V.

- Make sure the output of serial port 1. Users need to use this serial port to receive the positioning data and to update the software

In order to acquire satisfactory performance, the following points should also be particularly noticed:

- Power supply: Satisfactory performance cannot be achieved without a stable and low-ripple power source. The peak value of the ripple voltage should not exceed 50mVpp. In addition to adopting LDO to guarantee uninterruptible power supply, the following points should also be taken into consideration:

  - Widen power supply wires or use split copper pour surface to transmit current
  - Try to place LDO close to the board
  - Power supply wires should not pass through any high power and high inductance devices such as magnetic coils

- UART interface ensures that the corresponding signal and baud rate of the main device are consistent with those of UB4B0M.

- Antenna wires should be as short and smooth as possible; avoid sharp angle and pay attention to impedance matching.

- Avoid wiring right beneath UB4B0M.

- Keep the board away as far as possible from any high temperature airflow.

3.2 Notes for Pin

Table 3-1 Notes for Pin

	Pin	I/O	Description	Note
Power Supply	VCC	Power source	Power supply	Stable, uninterruptible, and low-ripple power; the peak value of ripple voltage should not exceed 50mVpp.
	MCX	Power source	Antenna power supply	Active antennas supply power at a corresponding voltage. When no antenna is connected to the port of antenna in the module, which means there is no load, use a multimeter to test and the voltage supply is DC4.8 V ~ 5.4 V. When the RF port of the module is connected with the antenna and the working current is 30~100 mA at normal temperature, the antenna feed is DC4.6 V ± 0.2 V.
	GND	Power source	Ground	Ground all GND signals of the board, preferably with a larger area of copper pour.
UART	TXD1	O	Send from Serial Port 1	Output by Serial Port 1; leave vacant if not necessary.
	RXD1	I	Receive by Serial Port 1	Input by Serial Port 1; leave vacant if not necessary.
	TXD2	O	Send from Serial Port 2	Output by Serial Port 2; leave vacant if not necessary.
	RXD2	I	Receive by Serial Port 2	Input by Serial Port 2; leave vacant if not necessary.
	TXD3	O	Send from Serial Port 3	Output by Serial Port 3; leave vacant if not necessary.
	RXD3	I	Receive by Serial Port 3	Input by Serial Port 3; leave vacant if not necessary.

3.3 Antenna

Antenna input MCX interface of UB4B0M provides an antenna feed of 4.6 ± 0.2 V. When no antenna is connected to the port of antenna in the module, which means there is no load, use a multimeter to test and the voltage supply is DC4.8 V ~ 5.4 V. When the RF port of the module is connected with the antenna and the working current is 30~100 mA at normal temperature, the antenna feed is DC4.6 V ± 0.2 V. When adopting active antennas, pay attention to the 50Ω impedance matching for the antennas.
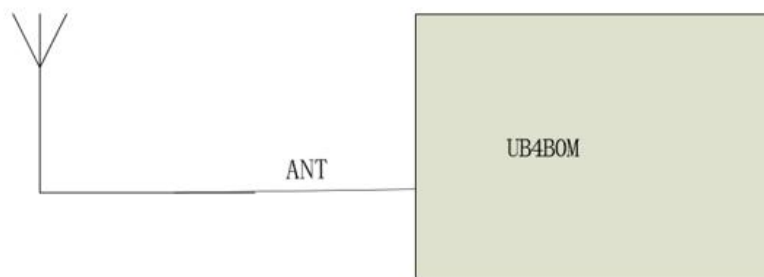
Figure 3-1 UB4B0M Antenna Connection Diagram

4. Connection and Setting

4.1 Electrostatic Protection

Many components on UB4B0M are vulnerable to electrostatic damage, which will then affect IC circuits and other components. Please take the following electrostatic protection measures before opening the anti-static blister box:

- Electrostatic discharge (ESD) may damage components. Please operate the board on the anti-static work table and at the same time wear an anti-static wristband and use conductive foam pads. If no anti-static bench is available, please wear an anti-static wristband and connect it to the metal part of the machine for anti-static protection.

- When plugging or unplugging the board, please do not touch the components on the board directly.

After taking out the board, please check the components carefully for obvious loose or damage.

4.2 Installation Guide

UB4B0M is delivered in the form of board, allowing users to assemble it flexibly according to application scenarios and market needs. The following figure shows a typical UB4B0M installation method using a set of evaluation kit (EVK). Users can also, in the same way, use other receiver casings to install.
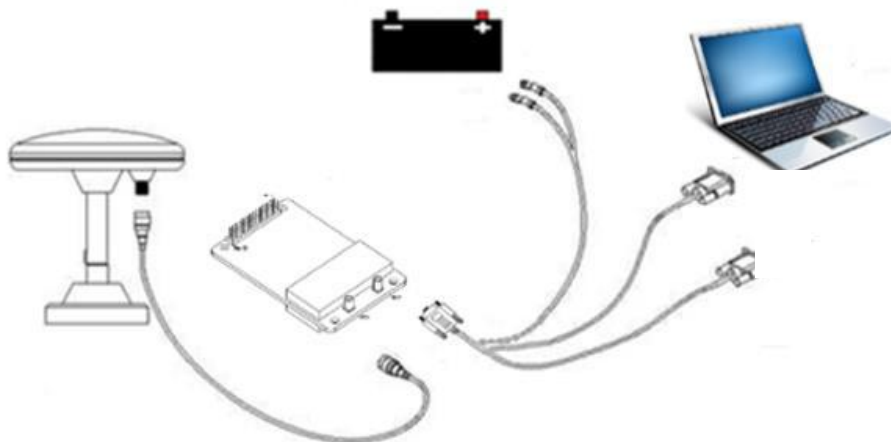
Figure 4-1 UB4B0M Installation Diagram

To ensure efficient installation, please prepare the following tools before installing the board:

- UB4B0M board and EVK

- User manual

- Command manual

- UPrecise display and control software

- Qualified antennas

- MCX antennas and connecting cables

- Desktop or laptop (Win7 and above) with serial ports, installed relevant serial driver and UPrecise software

Step 1. For the UB4B0M EVK users, align UB4B0M positioning holes and pins with EVK.

Note: If the EVK connector hole is 24-pin, connect the middle 24 pins of the board with the connector). EVK provides power supply and standard communication interface to the board to communicate with peripheral devices (such as PC, CAN and USB devices, etc.)

Step 2. Select a GNSS antenna with appropriate gain, and set it in a stable and open area. Connect the antenna with the board through coaxial radio frequency cable. When the antenna is installed, the MCX antenna interface on UB4B0M corresponds to the antenna signal interface.
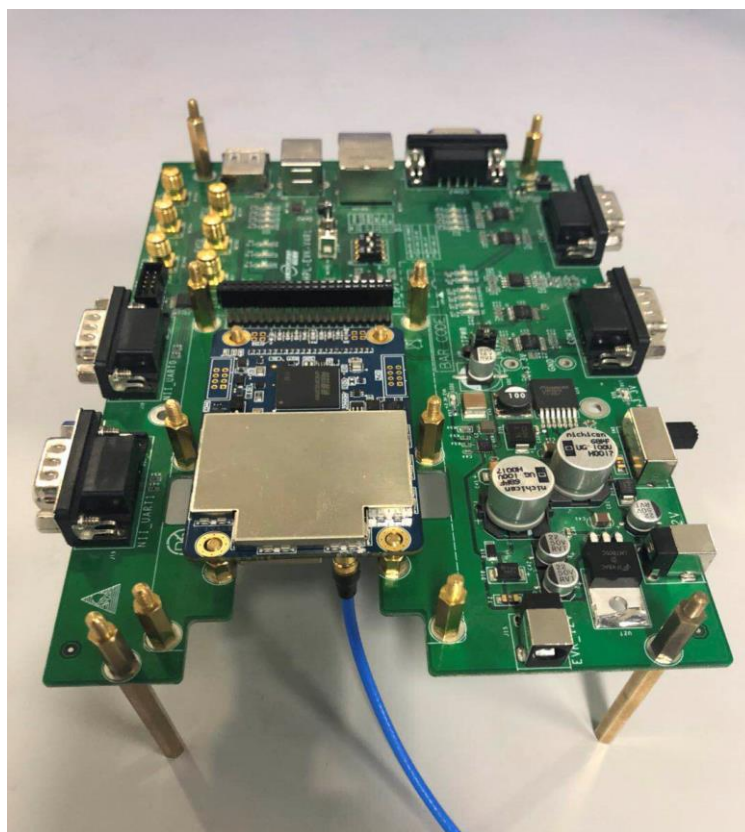
11

Figure 4-2 UB4B0M Connecting to Antenna RF Wires

Note: The RF connector on the board is MMCX; please select the appropriate cable according to the packaging. The input signal gain of the antenna connector should be within 25 to 36dB. Plug and unplug the MCX RF head vertically and the time of this operation is limited. Improper plugging or unplugging will lead to damage to the RF head or MCX male connector head.

Step 3. Connect the PC to EVK through serial ports.

Step 4. Connect a 12V adapter to the EVK power source, and switch on to power UB4B0M.
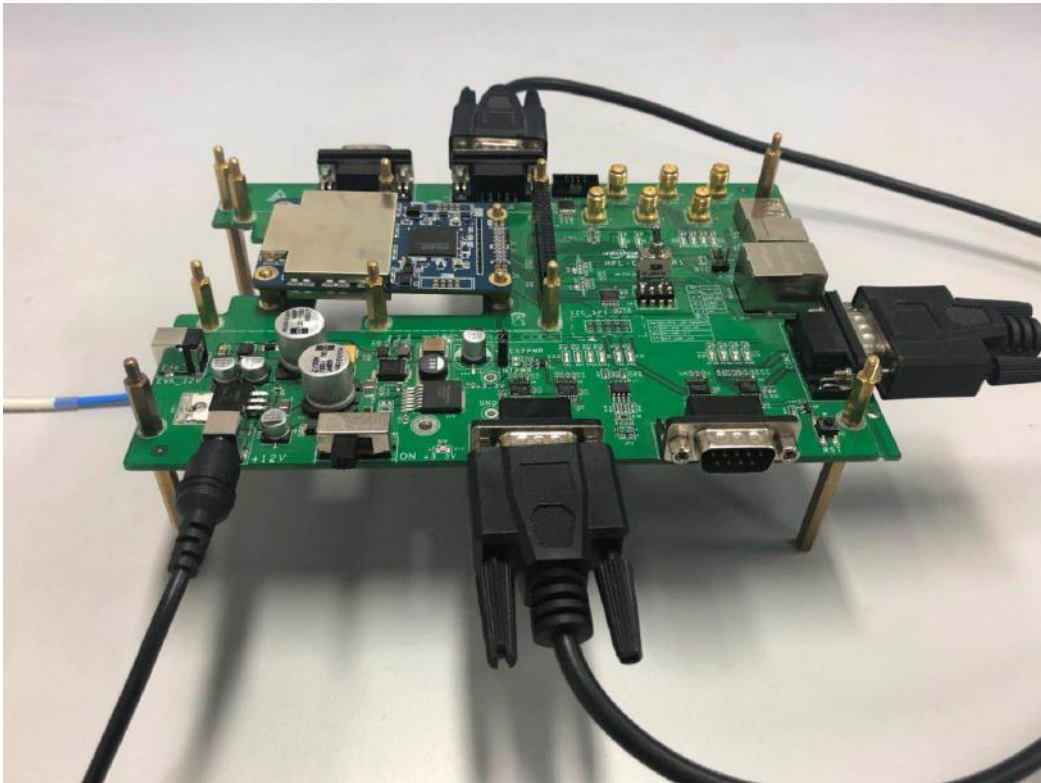
Figure 4-3 UB4B0M Power on EVK

Step 5. Start the UPRECISE control software on PC and connect to the receiver through the software.

Step 6. Operate the receiver via UPRECISE and record the relevant data.

4.3 Power on

The supply voltage of UB4B0M is 3.3 V, and the supply terminal voltage of EVK is 12 V. After powered on, the receiver starts up and can quickly establish communication.

4.4 Setting and Output

The satellite display and control software UPRECISE provides a graphical interface so that users can set up the receiver conveniently and be aware of the receiver status and required information rapidly.
UPrecise possesses the following basic functions:

● Connecting the receiver and configuring the baud rate, etc.

● Displaying the preliminary position of satellite, PRN, and Signal/Noise Ratio in the graphical window (Constellation View)

● The trajectory window displaying the present and historical points, as well as the

13

position velocity and time (Trajectory View)

● Graphic interface for data logging and sending commands to the receiver (Logging Control View)

● Console window for sending commands to the receiver (Console View)

● Sending commands to the receiver

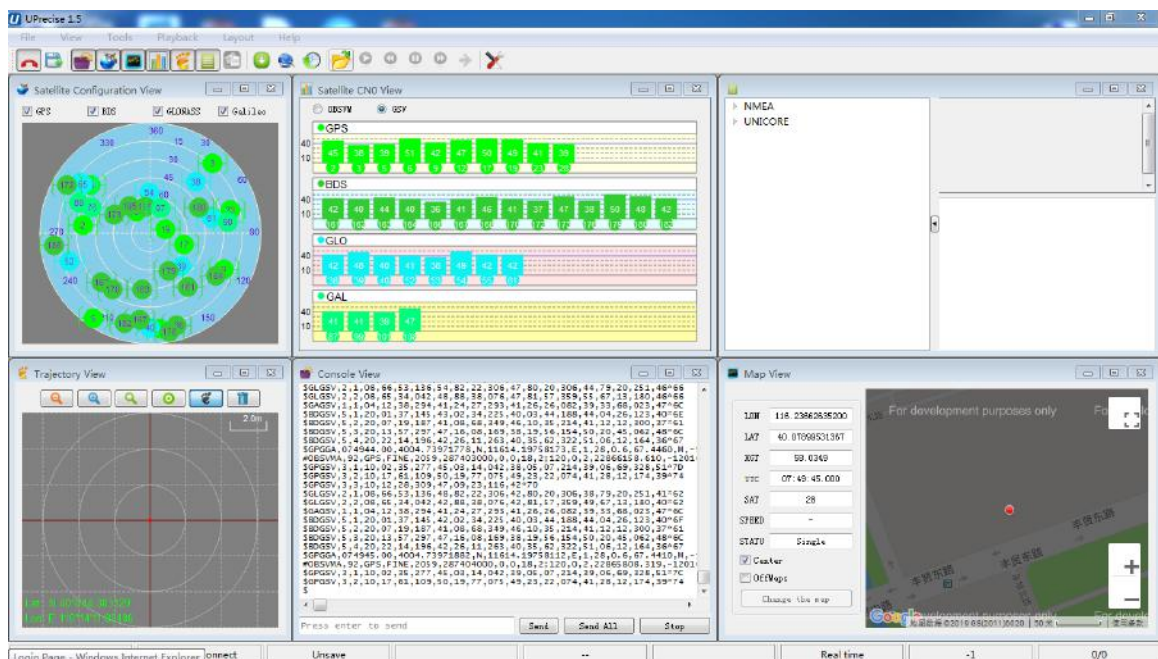● Displaying the track point

● Upgrading the firmware

● TTFF test

Figure 4-4 UPrecise Interface

4.4.1 Operation Steps

Step 1. Follow 4.2 Installation Guide to connect the power source, antenna to the board, and turn on the EVK switch

Step 2. Click file - > connect the serial port, and set the baud rate; the default baud rate of UB4B0M is 115200bps
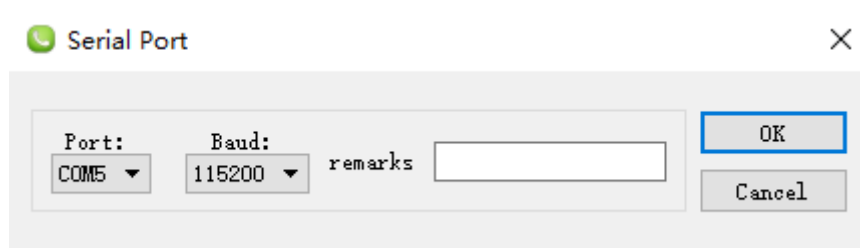

Figure 4-5 Connect the Serial Port

Step 3. Click the receiver settings button to configure the NMEA message output. It is recommended to configure GPGGA, GPGSV, and other messages.
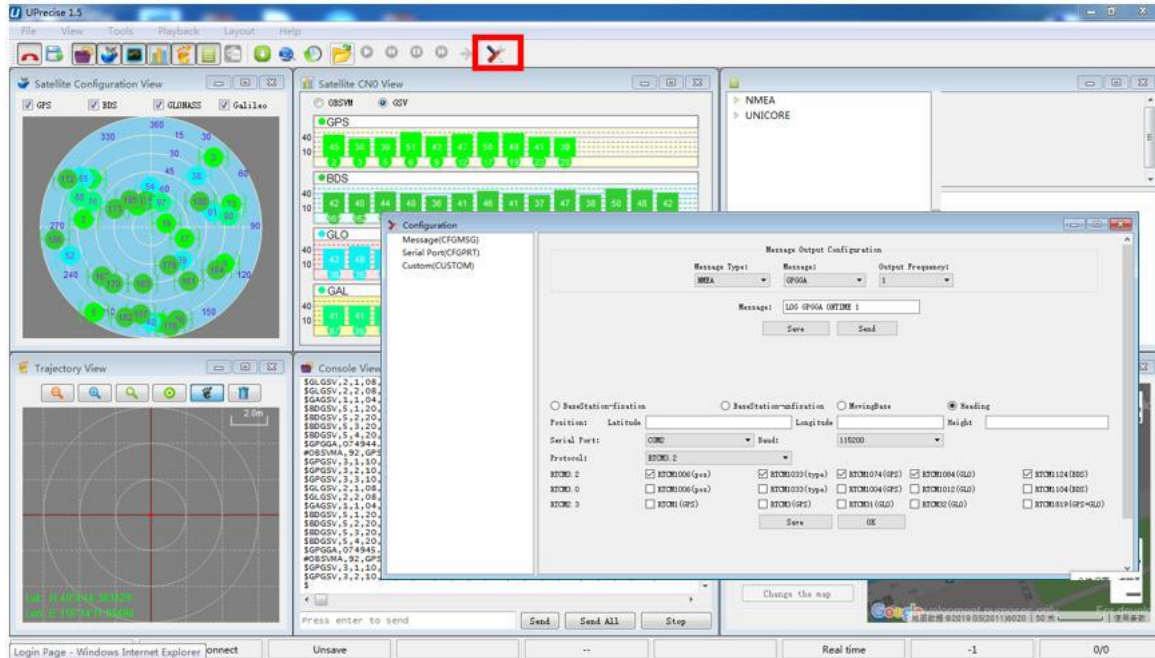

Figure 4-6 NMEA Data Output

Step 4. Click the receiver settings button, configure the NMEA message output, and click send. It is recommended to configure GPGGA, GPGSV, and other messages.

Step 5. In the data session window, click "Send all Message" to complete all the NMEA message output (update rate 1Hz). Right click in the data session window to adjust: output log font size, stop / resume log output, or clear log content, etc.

Step 6. Use various views of UPrecise to configure or input commands as required.

5. LED Indicators

Three LED indicators are installed on UB4B0M board to indicate the basic working status of the board, which includes:

No	Color	Status	Instruction	Remark
1	Red	On	Power on	
2		Off	Power off	
3	Green	On	PV indicator, RTK FIX is enabled	
4		Off	PV indicator, RTK FIX is disabled	
5	Yellow	On	Single point positioning is enabled	
6		Off	Single point positioning is disabled	

6. Common Commands Setup

UB4B0M supports simplified ASCII format. Simplified ASCII format without checksum bits makes it easier for users to enter commands. All commands consist of a command header and configuration parameters (if the parameter part is empty, the command has only one header), and the header field contains the command name or message header.

UB4B0M is simple and easy to use, and the common commands are shown in the following table:

Table 6-1 Common Commands

Command	Description
freset	Restore factory settings
version	Query version number
config	Query the serial port status of receiver
mask BDS	Mask (disable) tracking of Beidou satellite system. BDS, GPS, GLONASS and Galileo can be disabled separately.
unmask BDS	Unmask (enable) tracking of Beidou satellite system. BDS, GPS, GLONASS and Galileo can be enabled separately. By default, all satellite systems are tracked.
config com1 115200	Set com1 baud rate as 115200 Com1, com2 and com3 can be set respectively as any one of 9600, 19200, 38400, 57600, 115200, 230400, and 460800
unlog	Disable all output of the current serial port
saveconfig	Save settings
mode base time 60 1.5 2.5	The reference point coordinates are automatically generated 60 seconds after positioning or when the horizontal accuracy is better than 1.5m or the elevation accuracy is better than 2.5 m. After power off and restart, the new reference point coordinates will be calculated and generated again.
mode base lat Lon height	Manually set the reference point coordinates as: lat, lon, height (the coordinates do not change after the power off and restart) e.g. lat=40.07898324818, lon=116.23660197714, height=60.4265 Note: The longitude and latitude coordinates can be obtained through the bestpos command. If it is the southern latitude, lat value is negative; if it is the western longitude, lon value is negative.
mode base	Set as base station
mode movingbase	Set as moving base station
mode rover	Rover mode by default (The command can switch the receiver from the base station mode to rover station mode)

Command	Description
rtcm1033 comx 10 rtcm1006 comx 10 rtcm1074 comx 1 rtcm1124 comx 1 rtcm1084 comx 1 rtcm1094 comx 1	The base station mode is set as COMX, ICOMX, NCOMX to send a differential message. COMX can be appointed as anyone of COM1, COM2, and COM3;
NMEA0183 Output Statement	
gpgga comx 1	Set the output frequency of GGA message as 1 Hz Message type and update rate can be set flexibly: 1, 0.5, 0.2 and 0.1 correspond to output frequency 1Hz, 2Hz, 5Hz and 10Hz respectively; different types include GGA, RMC, ZDA, VTG, NTR
gphdt comx 1	Output the course information of current time HDT Course types include: HDT, TRA

6.1 Base Station Setting

RTK base station (fixed base station) is to install the receiver antenna at a fixed position and it will not move during the whole process. At the same time, the precise coordinates of the known measuring station and the received satellite information are directly or after being processed sent to the receiver of the rover station (pending position) in real time. The rover station receives the satellite observations as well as information from the base station to conduct the RTK positioning calculation and realize centimeter-level or millimeter-level positioning.

Table 6-2 Base Station Mode shows the commands entered the receiver when precise coordinates are known.

Table 6-2 Base Station Mode

No	Command	Specification
1	mode base 40.078983248 116.23660197760.42	Set as base station, longitude, latitude, and elevation
2	rtcm1006 com2 10	RTK base station antenna reference point coordinates (including antenna height)
3	rtcm1033 com2 10	Receiver and antenna specification
4	rtcm1074 com2 1	GPS differential message
5	rtcm1124 com2 1	BDS differential message
6	rtcm1084 com2 1	GLO differential message
7	rtcm1094 com2 1	Galileo differential message

No	Command	Specification
8	saveconfig	Save settings

Self-optimizing setting base station refers that there is no precise coordinate at the point where the base station is set up. The receiver can be set to self-position within a certain period at the installation point to get the average value, which can be set as the coordinates of the base station. Commands are shown in **Table 6-3: Self-optimizing Setting Base Station.**

Table 6-3: Self-optimizing Setting Base Station

No	Command	Specification
1	mode base time 60 1.5 2.5	The receiver conducts independent positioning for 60s, or when the standard deviation of horizontal positioning <=1.5m and the standard deviation of elevation positioning <=2.5m, the average value of horizontal positioning and the average value of elevation positioning are taken as the coordinate value of the base station.
2	rtcm1006 com2 10	RTK base station antenna reference point coordinates (including antenna height)
3	rtcm1033 com2 10	Receiver and antenna specification
4	rtcm1074 com2 1	GPS differential message
5	rtcm1124 com2 1	BDS differential message
6	rtcm1084 com2 1	GLO differential message
7	rtcm1094 com2 1	Galileo differential message
8	saveconfig	Save settings

6.2 Rover Station Setting

RTK rover station (mobile station) receives the differential correction information of the base station in real time, and at the same time, it receives the satellite signal for RTK positioning calculation, realizing RTK high-precision positioning. The receiver can adaptively identify the ports and formats of RTCM data input. Common commands of the RTK rover station are:

MODE ROVER
GNGGA 1
SAVECONFIG

6.3 Mobile Base Station Setting

The mobile base station is different from the RTK base station, which is a fixed station with known and precise coordinates. The mobile base station is in a state of motion, and at the same time, the received satellite information is directly or after being processed sent to

the receiver (pending point) of the rover station in real time. The receiver receives the satellite observation value and the information of the mobile base station for relative positioning to determine the location of the rover station relative to the mobile base station. Common commands for configuring mobile base stations are shown in **Table 6-4: Mobile Base Station Mode.**

Table 6-4 Mobile Base Station Mode

No	Command	Specification
1	mode movingbase	Set as mobile base station
2	rtcm1006 com2 1	Mobile base station antenna reference point coordinates (including antenna height)
3	rtcm1033 com2 1	Receiver and antenna specification
4	rtcm1074 com2 1	GPS differential message
5	rtcm1124 com2 1	BDS differential message
6	rtcm1084 com2 1	GLO differential message
7	rtcm1094 com2 1	Galileo differential message
8	saveconfig	Save settings

7. Firmware Update

The firmware of UB4B0M is updated using UPrecise software. In the UPrecise interface, click as follows: "Advanced" -> "Firmware Update".
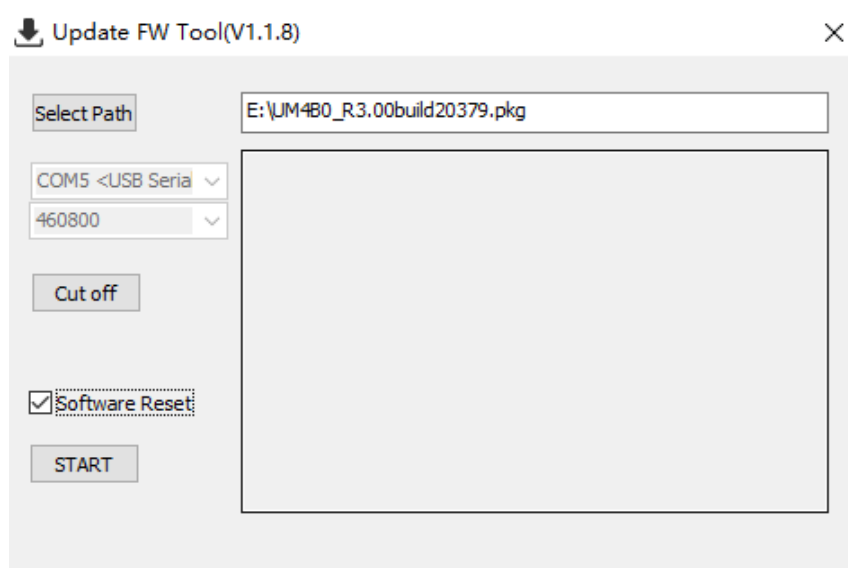

Figure 7-1 Update Interface

Click "Select Path", select the file location of UB4B0M PKG and then click "START" (Ignore the software reset option).
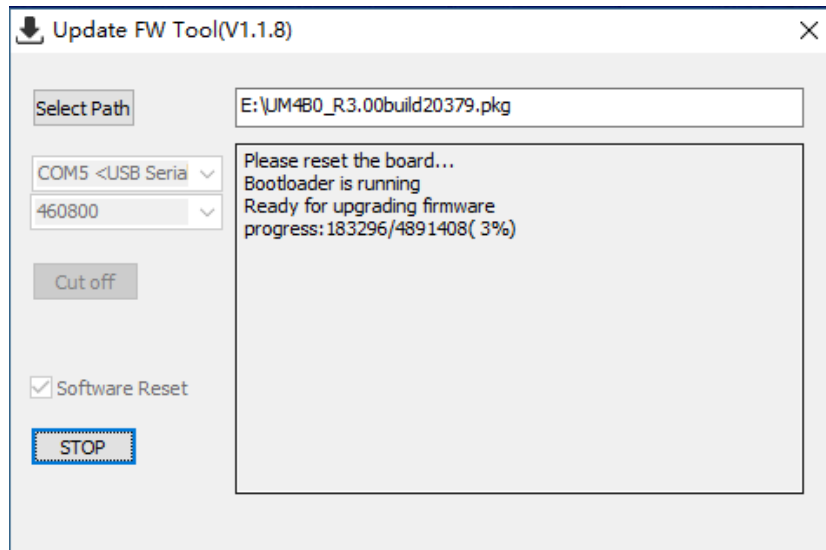
Figure 7-2 Update Steps

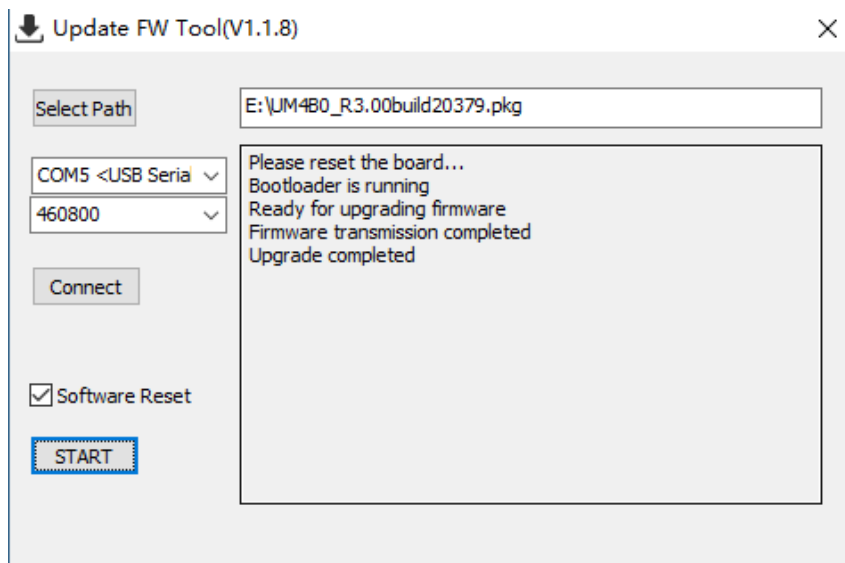Wait for the progress bar to complete 100%, and the upgrade time will be counted (usually less than 5 minutes).

Figure 7-3 Update Steps

When using a serial port to upgrade, please use serial port 1 of the board.

8. Packaging

UB4B0M boards are packed in cartons, 100 UB4B0M boards per carton.

Table 8-1 Packaging

Project	Description
1	10 boxes per carton
2	10 anti-static packages per box
3	1 UB4B0M per package

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