

AT-R2

User Manual



Disclaimer

Thank you for purchasing AT-R2 GNSS Receiver. (Hereinafter referred to as the "Product".) Please read this disclaimer carefully before using the product. Use of this product signifies your agreement to this disclaimer. Please use the product strictly in accordance with the instructions and be sure to heed the precautions. Zhangzhou 3Rtablet Technology Co., Ltd. is not responsible for damage or injury caused directly or indirectly by improper use, sale or installation (including, but not limited to, the use of non-specified accessories).

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Precautions

Please read the following precautions carefully before using this product.

1. Comply with local laws and regulations when using AT-R2 GNSS receiver in the appropriate frequency bands.
2. Do not bend or fold the cable excessively.
3. Ensure that AT-R2 is mounted and positioned as horizontally as possible.
4. During use or testing, the antenna of AT-R2 should be placed as far as possible in an open area with no tall buildings or trees within 20 meters.
5. Connect the unit strictly according to the instructions in the manual. Make sure the connector holes are aligned and inserted vertically.
6. Do not change the cables. Changing the cables without checking the cable definitions may damage the unit or affect the operation of the unit.
7. Please note the power supply requirements of the unit (Voltage Range: 6-36V).
8. Please do not disassemble this product yourself as this will invalidate the warranty.
9. Do not use the GNSS receiver in adverse weather conditions such as typhoons, storms and thunderstorms.

1. Introduction

AT-R2 is a high performance multi-frequency RTK receiver with Bluetooth and RS232 interfaces. It acts as a GNSS receiver receiving RTCM3.x messages from the base station or using network CORS service data to provide centimetre accuracy positioning results. It can be custom configured to output a wide range of standard NMEA message format statements and development protocols are provided to allow users to carry out secondary development.

1.1. Product Highlight

➤ Full Constellations Tracking

Using GPS, Glonass, Galileo and Beidou to provide robust data, while maintaining centimeter-level positioning level.

➤ Multi RTK Calibration Data Source

Support networking access to CORS server by tablet or built-in radio to obtain differential data.

➤ Built-in High-performance IMU (Optional)

Built-in high-performance multi-array 9-axis IMU with real-time EKF algorithm, full attitude solution and real-time zero offset compensation.

➤ Rich Data Interfaces

Support various communication methods, including data transmission via both BT 5.2 and RS232. Additionally, support customization service for interfaces such as CAN bus.

➤ Reliability

With IP66&IP67 rating and UV protection, ensure high performance, accuracy and durability even in complicated and harsh environments.

➤ Ultra Compact Design

The internal integrated wireless receiving module is compatible with major radio protocols and can adapt to most radio base stations in the market.

1.2. Products & Accessories

AT-R2



Power Adaptor
(Optional)



Extension Cable
(Optional)



Whipping Antenna
(Optional)

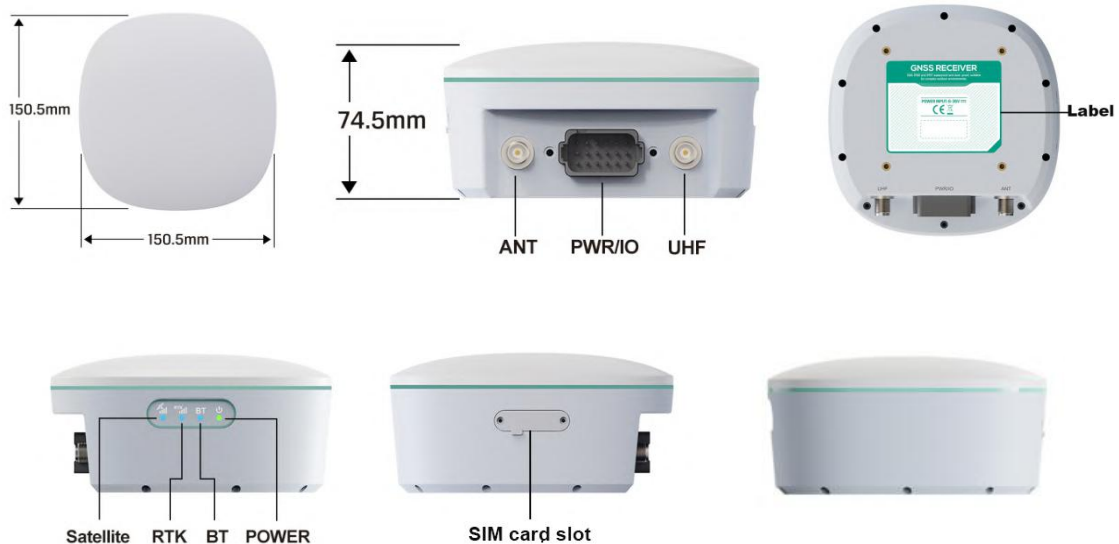


Vesa Fixed Bracket
(Optional)



1.3. Parts of the Device

The appearance of AT-R2 is shown below:



ANT: Reserved interface, temporarily unavailable.

PWR/IO: Interfaces for power supply and expansion functions such as serial ports.

UHF: Radio antenna interface for connecting an external radio antenna.

Label: Displays host serial number, Bluetooth ID and device parameters, etc.

Satellite: Satellite indicator light to indicate the star search status of the device.

RTK: RTK indicator light to indicate the status of the unit's RTK differential signal reception and RTK fixed.

BT: Bluetooth indicator light to indicate the Bluetooth connection status of the device.

POWER: Power indicator light to indicate the operating status of the device.

SIM card slot: Reserved function, temporarily unavailable.

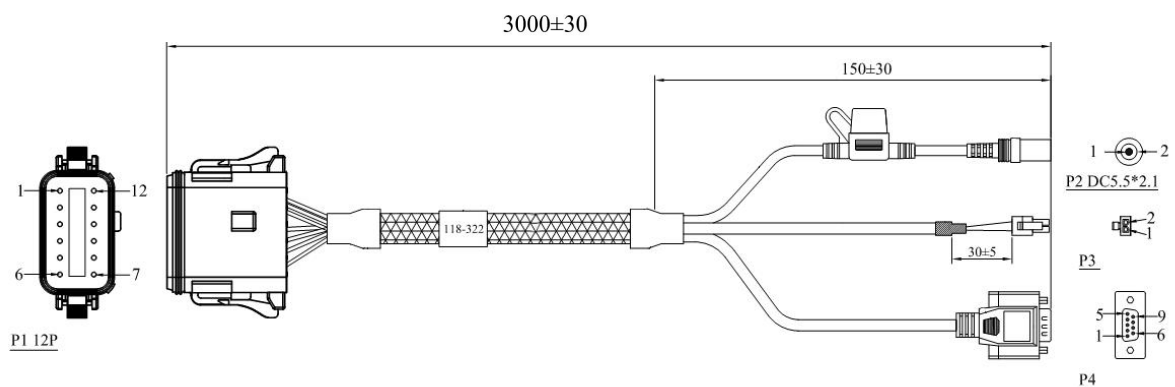
1.4. Specifications

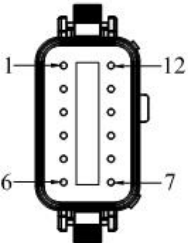
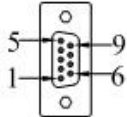
SATELLITES TRACKING	Constellations	GPS; L1C/A, L1C, L2P (Y), L2C, L5 BDS; B1I, B2I, B3I, B1C, B2a, B2b GLONASS: L1, L2 Galileo: E1, E5a, E5b, E6 QZSS: L1, L2, L5, L6
	Channels	1408
ACCURACY	Standalone Position(RMS)	Horizontally: 1.5 m
		Vertically: 2.5 m
	DGPS(RMS)	Horizontally: 0.4 m
		Vertically: 0.8 m
	RTK (RMS)	Horizontally: 2.5cm+1ppm
		Vertically: 3cm+1ppm
		Initialization reliability >99.9%
	PPP(RMS) (coming soon)	Horizontally: 5cm
		Vertically: 10cm
TIME TO FIRST FIX	Cold Start	<30 s
	Hot Start	<4 s
DATA FORMAT	Data Update Rate	Position Data Update Rate: 1~10Hz
	Data Output Format	NMEA-0183
SENSOR FUSION(OPTIONAL)	IMU	Three axis accelerometer, three axis gyro, three axis magnetometer(Compass).
	IMU Accuracy	Pitch & Roll: 0.2 deg, Heading: 2 deg
UHF CORRECTIONS RECEIVE(OPTIONAL)	Sensitivity	Over -115dBm , 9600bps
	Frequency	410-470MHz
	UHF Protocol	HUACE(9600bps, 19200bps) SOUTH(9600bps) TRIMATLK(9600bps) TRANSEOT(9600bps) TRIMMARK3(19200bps)
	Air Communication	9600bps, 19200bps

	Rate	
	Distance	1-5KM (typical)
USER INTERACTION	Indicator Light	Power Light, BT Light, RTK Light, Satellite Light.
COMMUNICATION	BT	BLE 5.2
	IO Ports	RS232(default baud rate of serial port: 460800); CANBUS (Customizable)
POWER	PWR-IN	6-36V DC
	Power Consumption	1.5W
CONNECTOR	M12	M12 for data communication and power in
	TNC	x1 for UHF Radio
ENVIRONMENTAL	Operating Temperature	-31°F ~ 167°F (-30°C ~ +70°C)
	Storage Temperature	-40°F ~ 176°F (-40°C ~ +80°C)
	Protection Rating	IP66 and IP67
	Shock and Vibration	MIL-STD-810G
PHYSICAL DIMENSIONS	Installation	75mm VESA Mounting
		Strong Magnetic Attraction(Standard)
	Weight	623.5g
	Dimension	150.5*150.5*74.5mm

2. Use the GNSS Receiver

2.1. Extension Cable Definition



No.	Description				
P1 	Pin	1	2	3	4
	Define	DC+	DC-	CAN_L	CAN_H
	Pin	5	6	7	
	Define	RS232-TX	RS232-RX	GND	
P2(Power) 	Pin	1		2	
	Define	DC+		DC-	
P3(Can Bus) 	Pin	1		2	
	Define	CAN_H		CAN_L	
P4(RS232) 	Pin	2		3	
	Define	RS232-RX		RS232-TX	
				GND	

2.2. Indicator Light Description

Table 1 Indicator Light Status Description

	Icon	Color	Status	Definition
① Satellite		Blue	Flash	Searching for satellites
			On	Satellites Search Success
			Off	Device Shutdown
② RTK Statement		Blue	Flash	Radio is receiving differential data.
			On	RTK Fixed
			Off	No Fix/Device Shutdown
③ Bluetooth		Blue	Flash	Bluetooth Pending
			On	Bluetooth Connected
			Off	Device Shutdown

④ Power		Green	On	Device Start-up
			Off	Device Shutdown

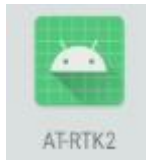
2.3. Instructions for Using the Software

Preparation:

1. A mobile Android device with Bluetooth function or serial port function.
2. AT-R2 software installation package.

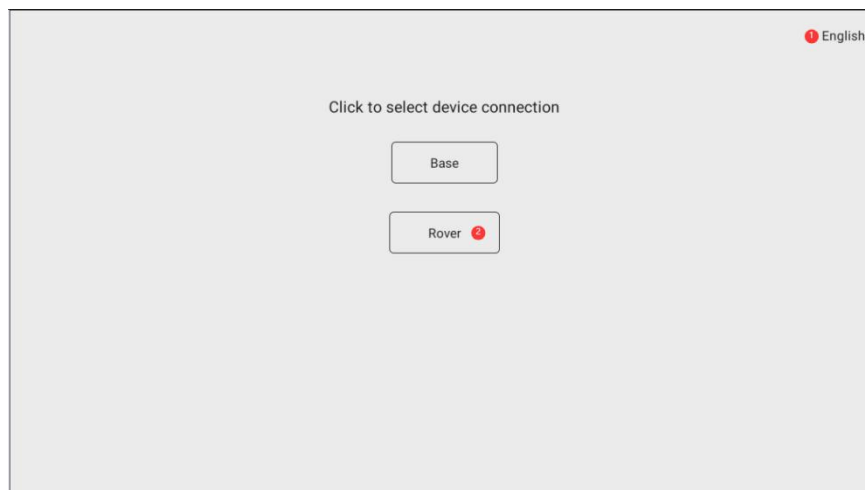
2.3.1. Install “AT-RTK2” APP

Install the "AT-RTK2" software on the mobile terminal, the software icon is as follows:



2.3.2. Connecting AT-R2 via Bluetooth

After AT-R2 is turned on, the Bluetooth indicator will spark at 1Hz, indicating that the Bluetooth of AT-R2 enters the state of pending connection, open the software, the interface is as follows.



Main Interface of “AT-RTK2”

- ① Available in English and Chinese, English as default.
- ② Click “Rover” to enter the interface as shown below:

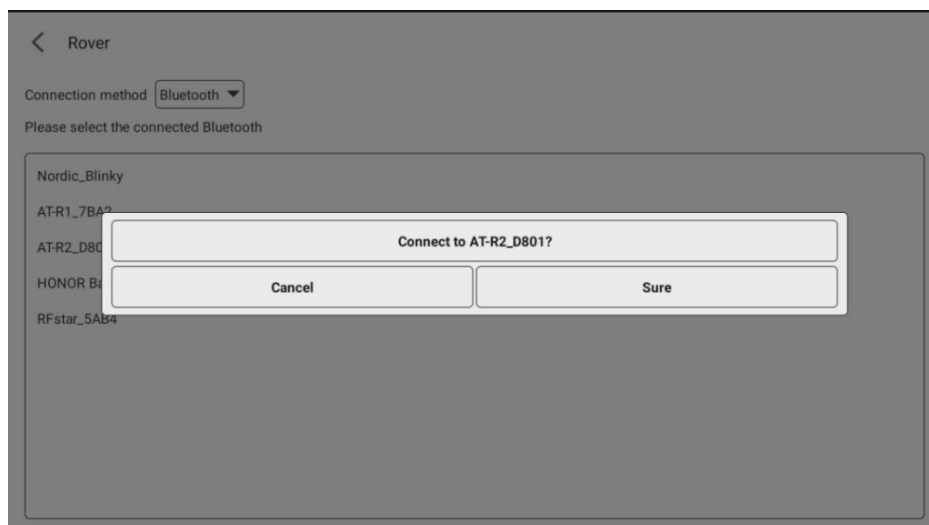


Interface of Searching Bluetooth

① There are two types of connection methods, Bluetooth and serial port, the default connection method is Bluetooth. For serial port connection instructions please refer to 2.3.3. Connecting the AT-R2 via serial port.

② Find the Bluetooth name of the GNSS Receiver. Bluetooth name format: AT-R2_XXXX. (XXXX is the last four digits of the Bluetooth MAC address.)

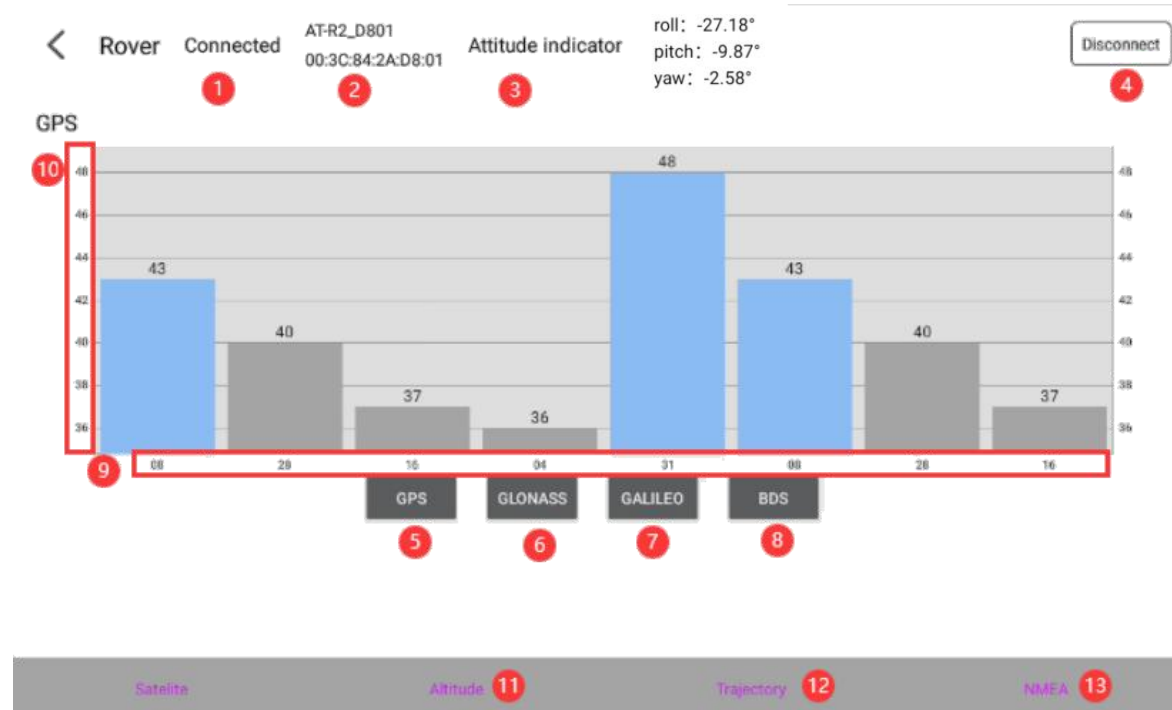
The corresponding Bluetooth name of the device is printed on the back label on the bottom of AT-R2.



Interface of the Bluetooth Connection

2.3.2.1. Satellites

The satellite page displays the search satellite status of the device, including individual satellite numbers for each of the four satellite systems and signal-to-noise ratio information.



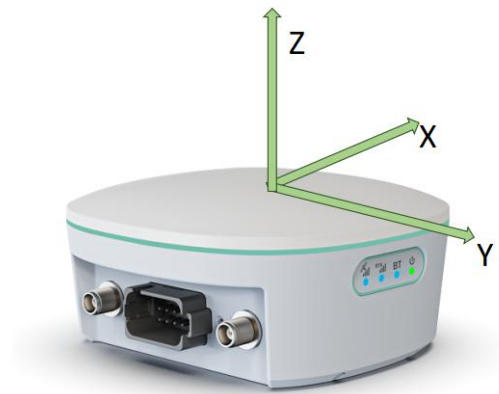
Main Interface of successful connection to GNSS Receiver via Bluetooth

- ① Display the connection status of Bluetooth.
- ② Display the connected GNSS receiver Bluetooth name and Bluetooth Mac address.
- ③ Display the GNSS receiver attitude meter data. (Attitude meter function is optional.)

Roll: Detecting the roll angle of the device in the Y-axis, when the roll angle is positive, the device is tilted to the left; when the roll angle is negative, the device is tilted to the right, the value range is -180°~180°.

Pitch: Detecting the pitch angle of the device in the X-axis, when the pitch angle is positive, the device is tilted upwards; when the pitch angle is negative, the device is tilted downwards (head downwards), the value range is -90°~90°.

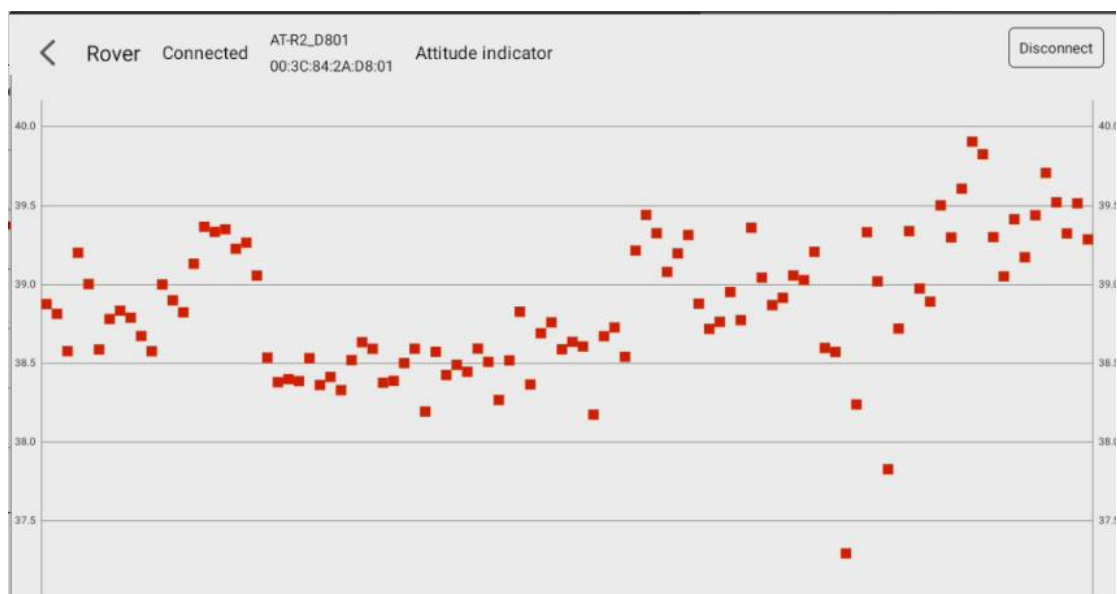
Yaw: Detecting the rotation angle (heading angle) of the device in the vertical direction (Z-axis), every time the device is switched on, the heading angle is reset to 0. When the heading angle is negative, the device rotates clockwise horizontally; when the heading angle is positive, the device rotates counterclockwise horizontally, the value range is -180°~ 180°.



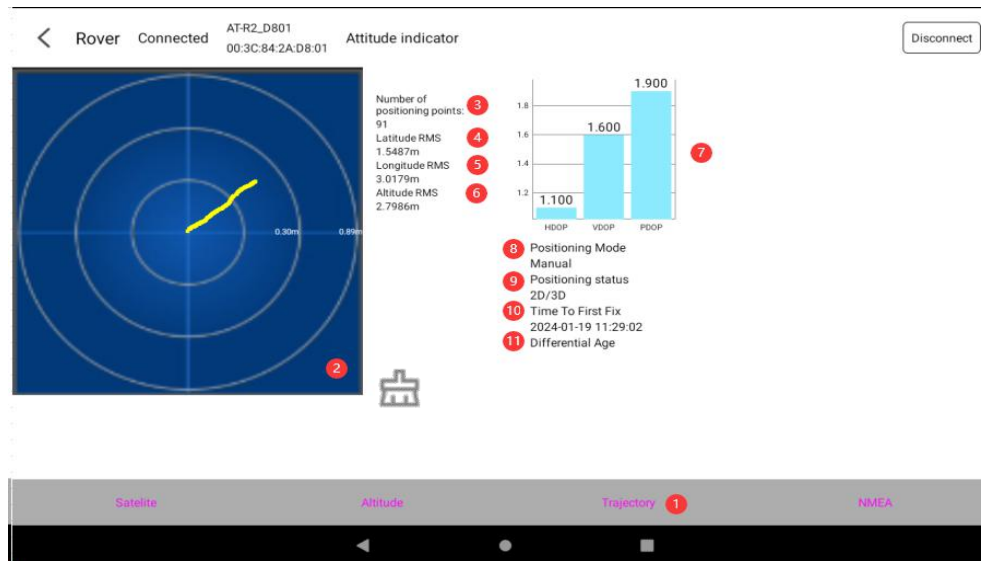
- ④ Click to disconnect the software from the GNSS receiver Bluetooth connection.
- ⑤ The satellite signal-to-noise ratio of the GPS system is displayed first by default.
- ⑥ Press the button to switch to the GLONASS satellite system and view the GLONASS satellite signal-to-noise ratio.
- ⑦ Press the button to switch to the GALILEO satellite system and view the GALILEO satellite signal-to-noise ratio.
- ⑧ Press the button to switch to the BDS satellite system and view the BDS satellite signal-to-noise ratio.
- ⑨ The horizontal coordinate shows the satellite number of the current satellite system.
- ⑩ The vertical coordinate is the signal-to-noise ratio for each satellite. (Columns are shown in blue for signal-to-noise values of 40 dB or more, and in grey for values less than or equal to 40 dB.)
- ⑪ Switch to "Altitude" page.
- ⑫ Switch to "Trajectory" page.
- ⑬ Switch to "NMEA" page.

2.3.2.2. Altitude

The altitude page displays the receiver's altitude data in meters, as shown below:



2.3.2.3. Trajectory



① Click “Trajectory” to check the positioning status of the receiver.

② Trajectory Dispersion Map: the radius of the trajectory map is automatically adjusted according to the deviation distance of the positioning point, the first positioning point is the reference point (i.e. the centre of the circle), and the rest of the points are calculated from the offset longitude and latitude positions relative to the first reference point.

③ Number of Location Points: Count the number of positioning points based on the number of GGA positioning statements.

④ Longitude RMS: Longitude Standard Deviation

⑤ Latitude RMS: Latitude Standard Deviation

⑥ Altitude RMS: Altitude Standard Deviation

RMS: Pseudo-distance standard deviation for positioning calculations. (Parsed by BestPosa statement.)

⑦ The accuracy factor reflects the fact that the better the distribution of satellites in the sky, the higher the accuracy of positioning.(The smaller the value, the higher the accuracy).

PDOP(Position Dilution of Precision): Three-dimensional positional accuracy factor.

HDOP(Horizontal Dilution Of Precision): Horizontal position accuracy factor.

VDOP (Vertical Dilution of Precision): Vertical component accuracy factor.

⑧ Positioning modes: Automatic and manual positioning modes. Automatic switching between 2D/3D modes; manual forced operation in 2D or 3D mode. (3D is generally defined as positioning with at least 4 satellites or more and 2D is generally defined as positioning with 3 satellites.)

⑨ Positioning Status: single point (2D/3D), differential (DGPS), RTK fixed, RTK float, etc.

⑩ First positioning time: The moment when the device detects the first positioning point.

⑪ Differential Age: The average age of the most recent differential correction used by the device, in seconds, null for non-differential positioning. The main reason why the differential age

is constantly refreshed is that it is constantly being corrected and adjusted to cope with multiple changes and sources of error in the environment, and the differential age maintained at 2.0 represents excellent communication with the base station radio. For example, if the value stays at 5.0, it means that there is a delay in communication, and it is necessary to check whether the radio antenna is blocked or not, but it doesn't affect the RTK accuracy; however, if the value is increasing, it is necessary to check whether the base station is working normally or not, and whether there is any obstruction affecting the positioning in the environment in which the base station is located, and to check the protocol and baud rate of the communication radio. If the device is disconnected from the RTK differential data source from the RTK fixed state, the value of the differential age period will gradually increase until after 180s, the device positioning state will change from RTK fixed to single point positioning .

Click the Clear button “” to empty all position point data on the trajectory map.

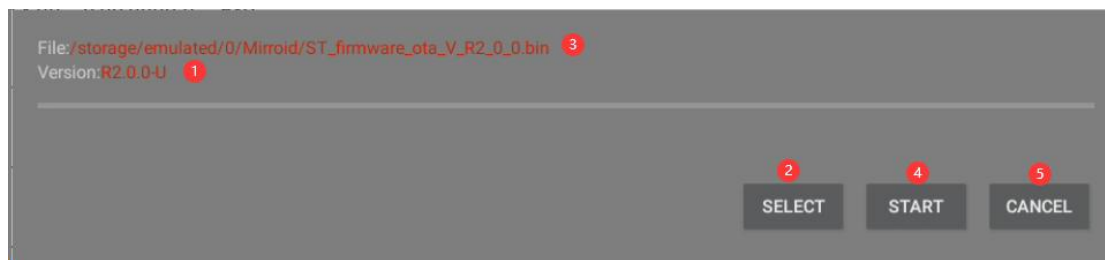
2.3.2.4. NMEA



① Click the "NMEA" button in the menu bar at the bottom of the main interface of the software.

- ② NMEA data receiving interface.
- ③ Stop the data scrolling in the NMEA interface.
- ④ Save NMEA data to a local memory.
- ⑤ Instantly clear all data in the current NMEA interface.
- ⑥ OTA firmware upgrade button. Please refer to the [OTA Upgrade Instruction](#) for details.
- ⑦ Setting button, please refer to [Setting Instruction](#) for details.

(1) OTA Upgrade Instruction



- ① Displays the current firmware version of the device.
- ② Click "SELECT" to select the OTA upgrade file. (The upgrade file needs to be copied to the local path of the device first, and it is not possible to upgrade the upgrade file stored in the path of a USB stick or other external memory.)
- ③ Displays the path where the selected OTA upgrade file is stored.
- ④ Click "START" to start upgrading, the upgrade is complete when the green progress bar is read and the window shows SUCCESS. (During the process of upgrading the firmware, all the indicators will spark at a frequency of 1HZ.)



The Interface of OTA Upgrade Succeed

- ⑤ Interrupt the OTA firmware upgrade or exit the OTA firmware upgrade page.

If the upgrade is canceled during the upgrade process, the device is still in the OTA upgrade mode, and the firmware version number will be displayed as Rx.x.x-T, which requires the user to re-upgrade or reboot the device for normal use.



(2) Setting Instruction

A. Setting GNSS Receiver

① Select NMEA statement types such as GGA, GSV, GSA, VTG, RMC, ZDA, GLL, GST, HDT TRA and so on.

② Select the output frequency for the current NMEA statement type. (1Hz, 2Hz, 5Hz, 10Hz are supported).

③ Click "Send" (Sends a command to the positioning module to set the instruction to be output at xHz.* After the device is shut down, the changed configuration will not be saved.)

④ Checkbox to stop output of all NMEA statements.

⑤ Click Send to send a command to the positioning module setting to stop outputting all NMEA statements; when clicking Send without ticking the previous checkbox, the device outputs the BestPosa statement. (*After the device is shut down, all changed configurations will not be saved.)

⑥ Click "SaveALL" button to save all the configurations sent by the user to Flash, the tablet can save the last configuration after power off and on again.

B. Setting Data Link

① Set UHF Uart Baud Rate,default value is 38400, which is not recommended to modify.

② Air Communication Rate (4800, 9600, 19200 for option.)

③ UHF Communication Protocol: supports TRIMTALK, TRIMMK3, TT450S, TRANSEOT, SOUTH, SATEL.)

④ Transmitting Power(H: high power, L: low power)

⑤ UHF Working Channel: Select the channel used by the radio. (Channel 00 as default.)

⑥ Save all configurations of the radio to Flash. (After the device is shut down, the changed configuration will be saved.)

⑦ Channel Name: Manually fill in channel XX (XX:00-47)

⑧ Sending Frequency: Manually fill in the sending frequency of channel XX (the value ranges is from 410.00000 to 470.00000, retaining at least one decimal but not more than 5 decimals.)

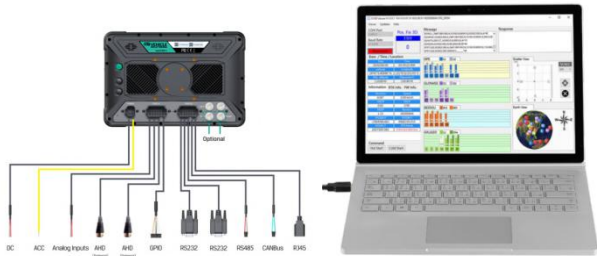
⑨ Receiving Frequency: Manually fill in the receiving frequency of channel XX (the value ranges is from 410.00000 to 470.00000, retaining at least one decimal but not more than 5 decimals.)

Note:

- To realize mutual communication between the receiver and the radio station of the base station, it is necessary to ensure that the air baud rate of the radio station, the radio protocol and the radio communication frequency (the sending frequency of the base station = the receiving frequency of the mobile station) are consistent, and all three factors are indispensable, otherwise the two parties cannot communicate normally.
- The radio station can resume data transmission only after exiting the configuration page.

2.3.3. Connecting the Serial Port of AT-R2

Prepare the following items as an example:

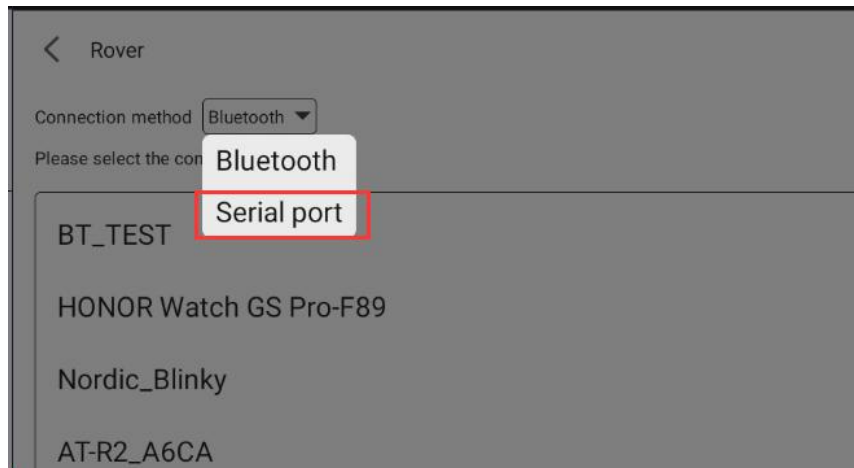
AT-R2	AT-R2 Power Adaptor	AT-R2 Extension Cable
		
USB-RS232 Cable	Android Terminal with RS232/PC (1 of 2)	
		

Connect the extension cable to the AT-R2 connector, then use the power adaptor to power AT-R2.

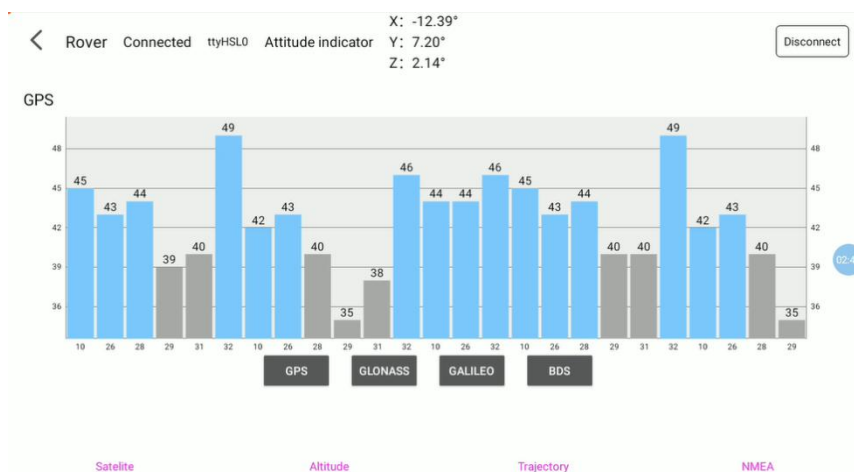
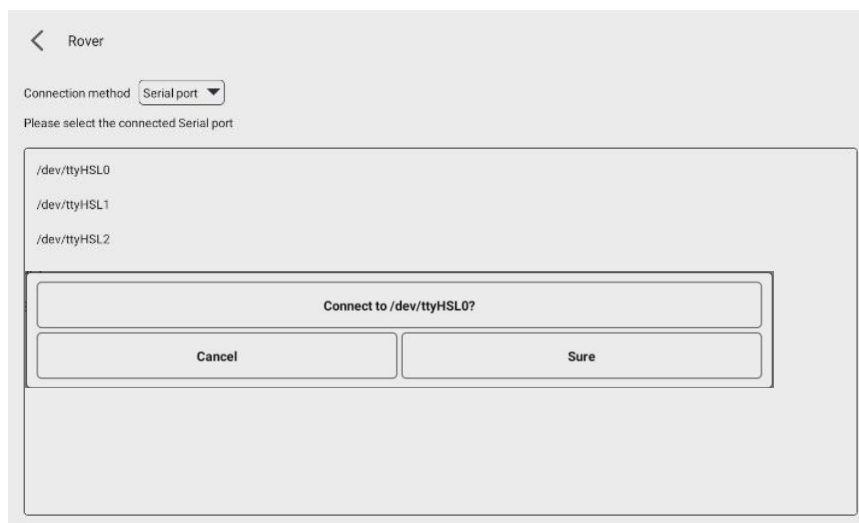
1. Use the DB9 connector of the extension cable to connect the PC via a USB to serial port cable
2. Connect directly to Android devices with serial ports using DB9 connectors with expansion cables

Below are the instructions for connecting with an Android terminal with a serial port:

After installing the "AT-R2" software on the Android terminal, select the serial port connection method.



Then connect according to the serial node of the Android terminal. Take ttyHSL0 as an example:



Note that the default serial port baud rate for Android software is 460800. When AT-R2 is connected to the PC, please set the baud rate of the computer software to 460800 for normal communication.

(1) OTA Upgrade Instruction

The same as the OTA Upgrade Instruction via Bluetooth

(2) GNSS Receiving Setting Instruction

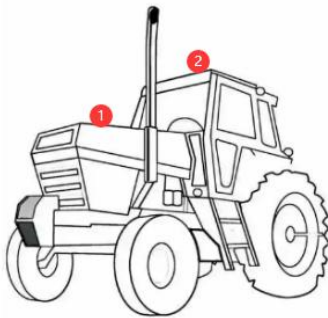
The same as the GNSS Receiving Setting Instruction via Bluetooth

(3) Radio Setting Instruction

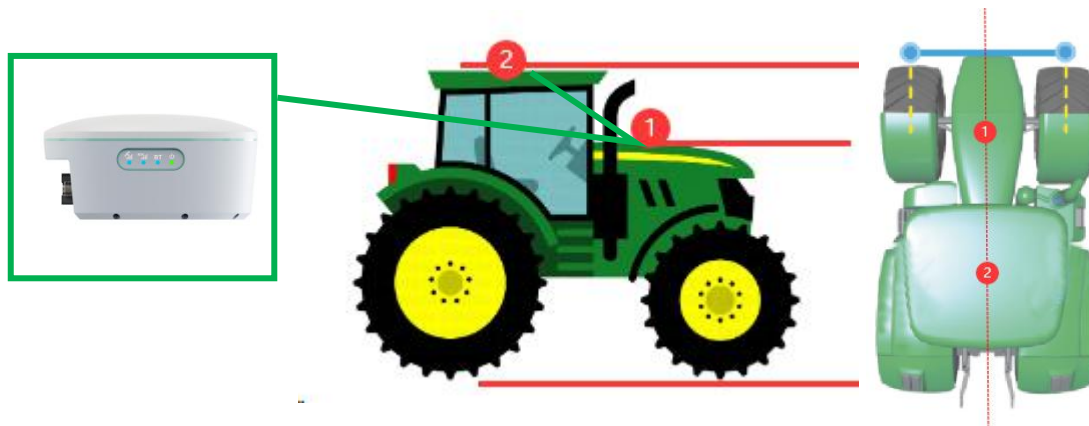
The same as the Radio Setting Instruction via Bluetooth

2.4. Installation

- A. AT-R2 has a strong magnetic magnet on the bottom as standard, which can be securely attached to the roof or bonnet position of the vehicle.



- B. The unit should be mounted as central and horizontal to the vehicle as possible, with the AT-R2 connector facing the rear of the vehicle.



FCC Caution:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction.