LOCOSYS

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RTK-M100 Series User's Manual

Document history

Version	Date	Updates
1.0	September 10, 2019	Creation.

Contents

1. Introduction

RTK-M100 product series are affordable dual-frequency multi-constellation RTK devices that provide centimeter-accurate GNSS measurements. RTK-M100 product series include RTK-M100, RTK-M100R, RTK-M101 and RTK-M101R. All of them can work in different modes: rover, base station or remote sensor (i.e. remote GNSS raw data collector). There are three communication interfaces, including Ethernet, 4G/LTE and LoRa. Through these built-in communication functions, the product as a rover can receive data from NTRIP caster or the remote broadcasting base station, and as a base station can transmit data to NTRIP caster or broadcast data to the rovers. There are USB and UART interface for local communication with the external host.

RTK-M100 product series have not only 64M bytes on-board flash memory for saving up to 7 days of RTK position data, but also a micro SD interface to log RTK position data and GNSS raw data for post processing. In addition, light weight and low power consumption make RTK-M100 product series easy to use outdoors.

2. Feature

- Centimeter-accurate RTK
- Support dual-frequency GPS, BEIDOU, GALILEO and QZSS.
- Up to 5Hz RTK position or 5Hz RTK heading.
- Up to 2Hz simultaneous RTK position and heading
- Built-in Ethernet function.
- Built-in global 4G modem.
- Built-in LoRa radio.
- Switchable among rover, base station and remote sensor.
- Internal memory and micro SD interface.
- Light weight and low power consumption.

Model name	Ethernet	4G/LTE	LoRa	RTK position	RTK heading	RTK position and heading
RTK-M100	Yes	Yes	No	Yes	No	No
RTK-M100R	Yes	Yes	Yes	Yes	No	No
RTK-M101	Yes	Yes	No	Yes	Yes	Yes
RTK-M101R	Yes	Yes	Yes	Yes	Yes	Yes

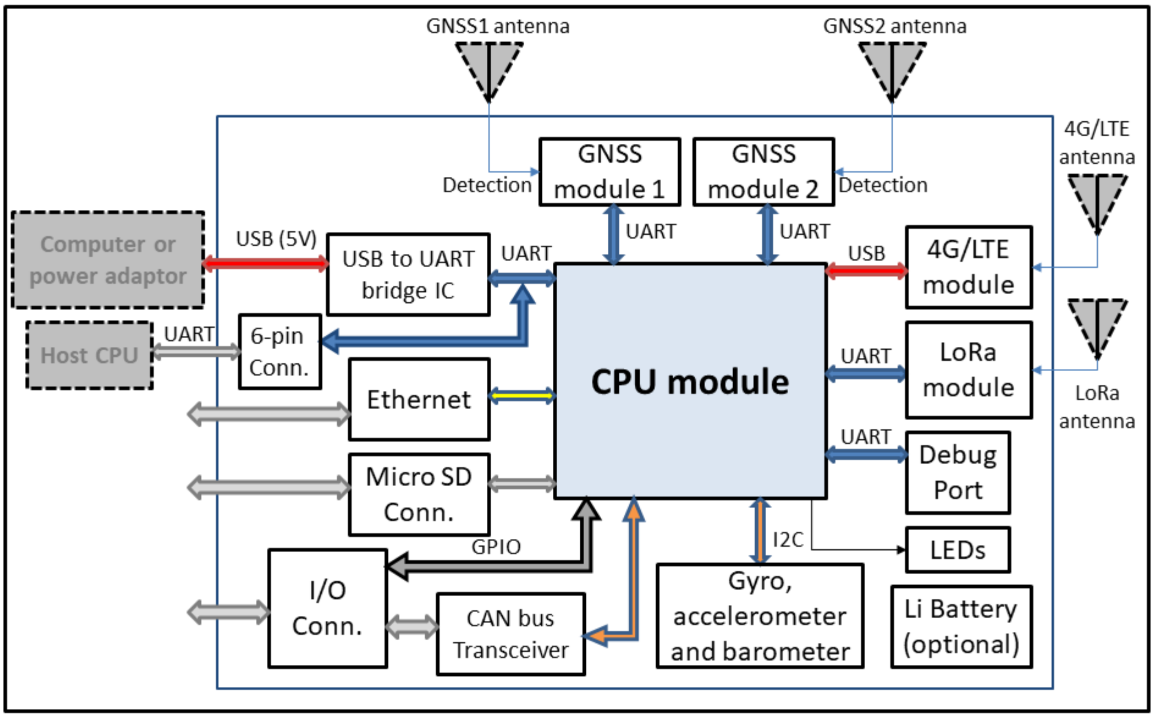
3. Application

- Precision agriculture

- Environmental and structural monitoring
- Unmanned aerial vehicle (UAV)
- Land survey, 3D mapping and aerial photography
- Robots and smart machines

4. Hardware description

4.1. Block diagram



The blocks with the dashed outline are not included in the product. GNSS module 2 is only included in RTK-M101 and RTK-M101R. LoRa module is only included in RTK-M100R and RTK-M101R.

4.2. Ethernet connector

The product does not support the hot plug of Ethernet. If Ethernet is going to be used, please insert Ethernet cable before turning on the power of the product.

4.3. Mini USB connector

The product is powered through Mini USB connector. PC's USB port, 5V power bank or 5V/1A adaptor can power the product. Mini USB connector is also used for communication with PC's software tool RTKFox. The optional internal battery of the product is charged through Mini USB connector, too.

4.4. Micro SD connector

The product supports hot plug of micro SD card with FAT32, exFAT or NTFS file system. The user can save RTK position data and GNSS raw data to micro SD card for post processing.

4.5. I/O connector

The 8-position I/O connector of the product is compatible with Hirose's DF13 series. The pin description of the connector is in the following.

Pin 1: CANL, CAN Low-Level Voltage I/O.

Pin 2: CANH, CAN High-Level Voltage I/O.

Pin 3: GND, ground.

Pin 4: IO_PWR, power input for IO pin 1 ~ 4. Input voltage range is 3.3V ~ 5.5V.

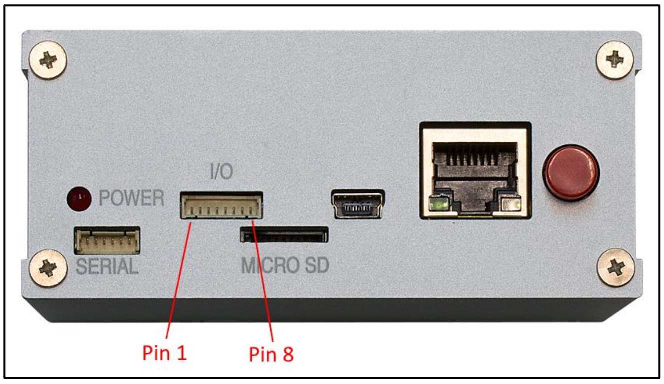
Pin 5: IO_01, general purpose IO pin 1. Logic level is based on the voltage of IO_PWR.

Pin 6: IO_02, general purpose IO pin 2. Logic level is based on the voltage of IO_PWR.

Pin 7: IO_03, general purpose IO pin 3. Logic level is based on the voltage of IO_PWR.

Pin 8: IO_PWM, general purpose IO pin 4. Logic level is based on the voltage of IO_PWR.

Note: If LoRa module is included, IO_01 is reserved for controlling LoRa module.



4.6. Serial port connector

The external host CPU can communicate with the product through the serial port. The protocol is 115200-8-N-1 (115200 baud, 8 data bits, no parity, 1 stop bit). The 6-position connector of the serial port is compatible with Hirose's DF13 series. The pin description of the connector is in the following.

Pin 1: NC, not connected.

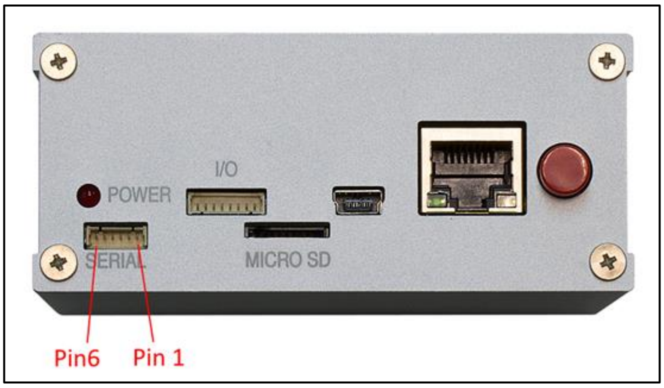
Pin 2: TX, transmit data to the external device. (3.3V)

Pin 3: RX, receive data from the external device. (3.3V)

Pin 4: NC, not connected.

Pin 5: PPS, pulse per second.

Pin 6: GND, ground.



TX and RX signals of the serial port and USB-UART bridge IC connect to the same UART port of the product's internal CPU module. If both serial port and Mini USB connector are connected, the serial port will dominate the communication with the internal CPU module.

4.7. RF connectors of GNSS1 and GNSS2

The product supplies the dedicated 3.3V power to the external GNSS antennas through RF connectors of GNSS1 and GNSS2. It has built-in antenna short circuit protection. The product can detect GNSS antenna connection status. If GNSS antenna is not properly connected, green LED will be always on.

4.8. RF connector of 4G/LTE

Connect 4G/LTE antenna before turning on the power of the product. If the product successfully registers to the network of the telecom provider, the yellow LED will blink once every second.

4.9. RF connector of LoRa

LoRa antenna must be connected before turning on the power of the product. Note that power on the product without LoRa antenna may damage the product.

4.10. LED

The product has three LEDs. The colors are red, yellow and green. Detail description is in the following table.

LED		Description
Red	Blink (on/off: 500ms)	The product is working.
Yellow	Blink (on/off: 500ms)	Successfully register to the network of the telecom provider through 4G/LTE.
	Blink (on/off: 250ms)	Not register to the network of the telecom provider through 4G/LTE

Green	Always on	GNSS antenna is not properly connected.
	Blink (on/off: 100ms)	Data log function has been enabled, but fails to detect the micro SD card or internal flash memory is full.
	Blink (on/off: 300ms)	• Rover mode: RTK fix is not available. • Base station mode: Survey-In is not complete.
	Blink (on/off: 500ms)	• Rover mode: RTK fix. • Base station mode: Survey-In is complete.

5. Installation of SIM card

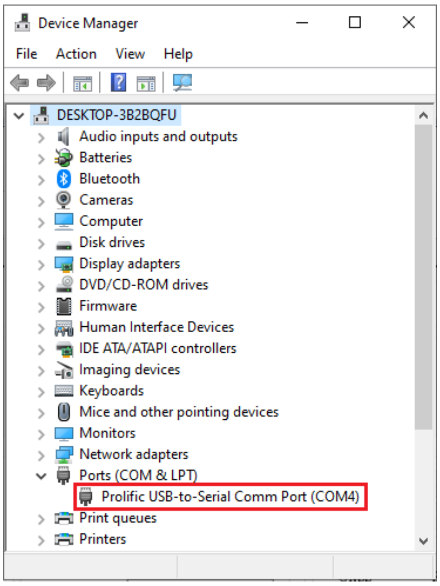
First, power off the product and confirm the red LED is off. Then remove 8 screws of the product and pull out the PCB board. The SIM card holder is on the bottom side of the PCB board shown as below picture. Prepare a micro SIM card with no PIN lock, and insert into SIM card holder. Then put PCB board back into the metal box of the product and tighten the screws. Now SIM card is installed.

6. Getting started

1. Install USB driver for MS Windows. It can be downloaded at http://www.prolific.com.tw/UserFiles/files/PL2303_Prolific_DriverInstaller_v1200.zip.
2. If Ethernet is going to be used, plug in Ethernet cable before power on the product.
3. If 4G/LTE is going to be used, insert a micro SIM card with no PIN lock as described in the section 5. Attach 4G/LTE antenna.
4. If LoRa module is included (RTK-M100R, RTK-101R), attach LoRa antenna before power on the product.
5. Attach GNSS antenna to GNSS1 connector. If RTK heading is needed, connect the second GNSS antenna to GNSS2 connector. GNSS antenna connected to GNSS1 connector represents

the position of RTK solution. The direction from GNSS2 antenna to GNSS1 antenna represents the heading of RTK solution.

6. Connect Mini USB cable to the product and the computer. A COM port will be enumerated in the Device Manager of MS Windows.

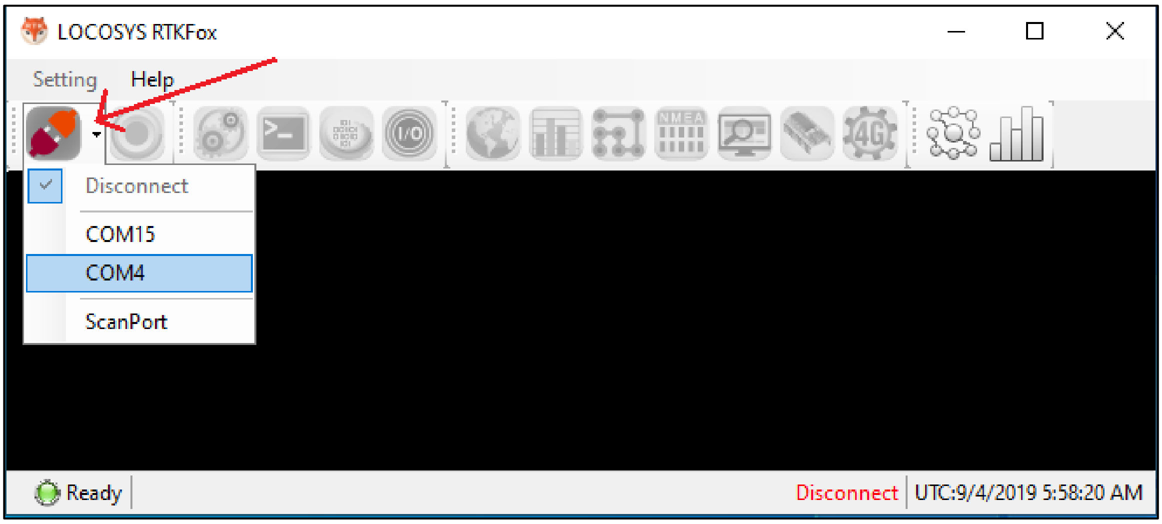


7. Press the red button to power on the product. The red LED of the product will be on immediately. Wait for up to 1 minute until the red LED blinks. The product starts and ready for control.

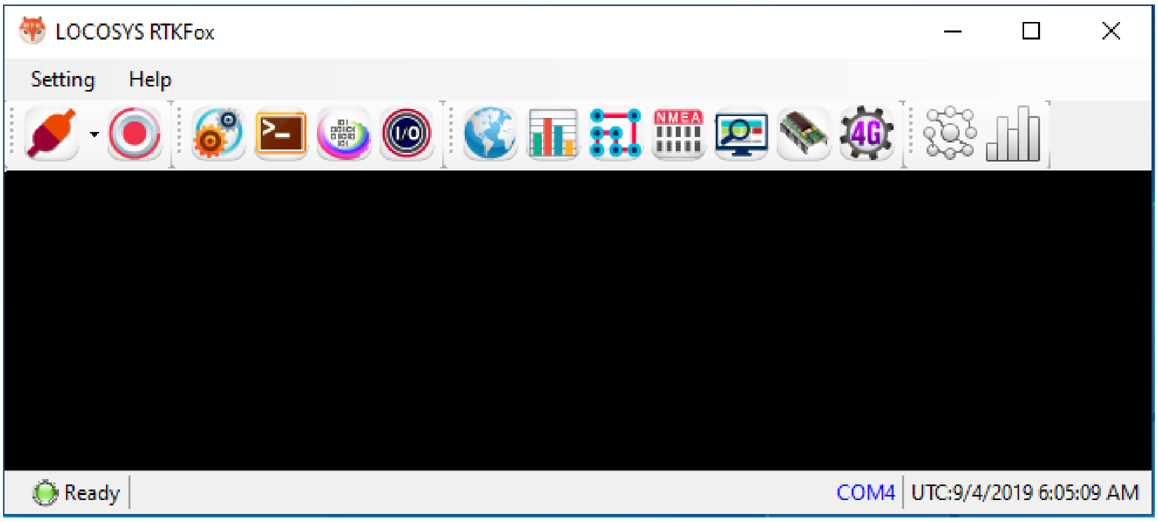
8. Now you can run PC software tool RTKFox to evaluate the product.

7. Configuration examples

RTK-M100 product series can work in three different modes, including rover, base station and sensor mode. The user can use PC software tool RTKFox to configure. After finishing the steps in section 6, RTKFox starts as below. Select COM port that the product is connected.

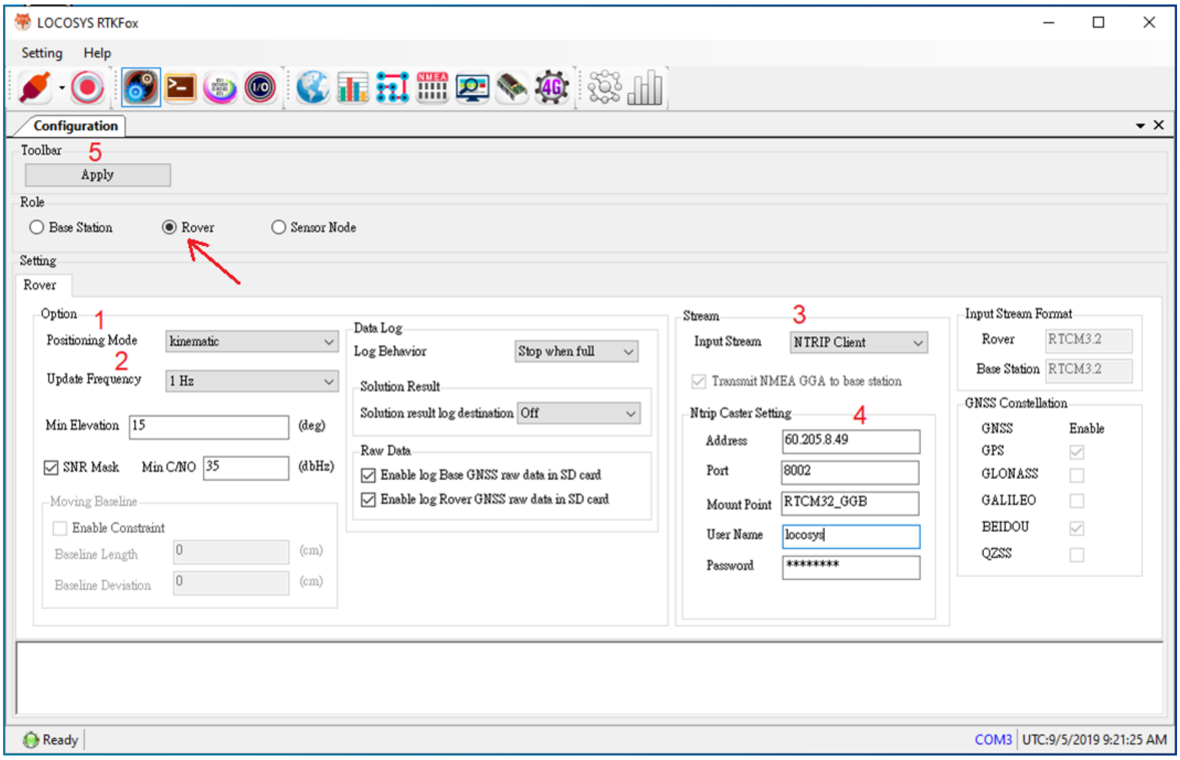


If RTKFox connects to the product successfully, all buttons are enabled as below.



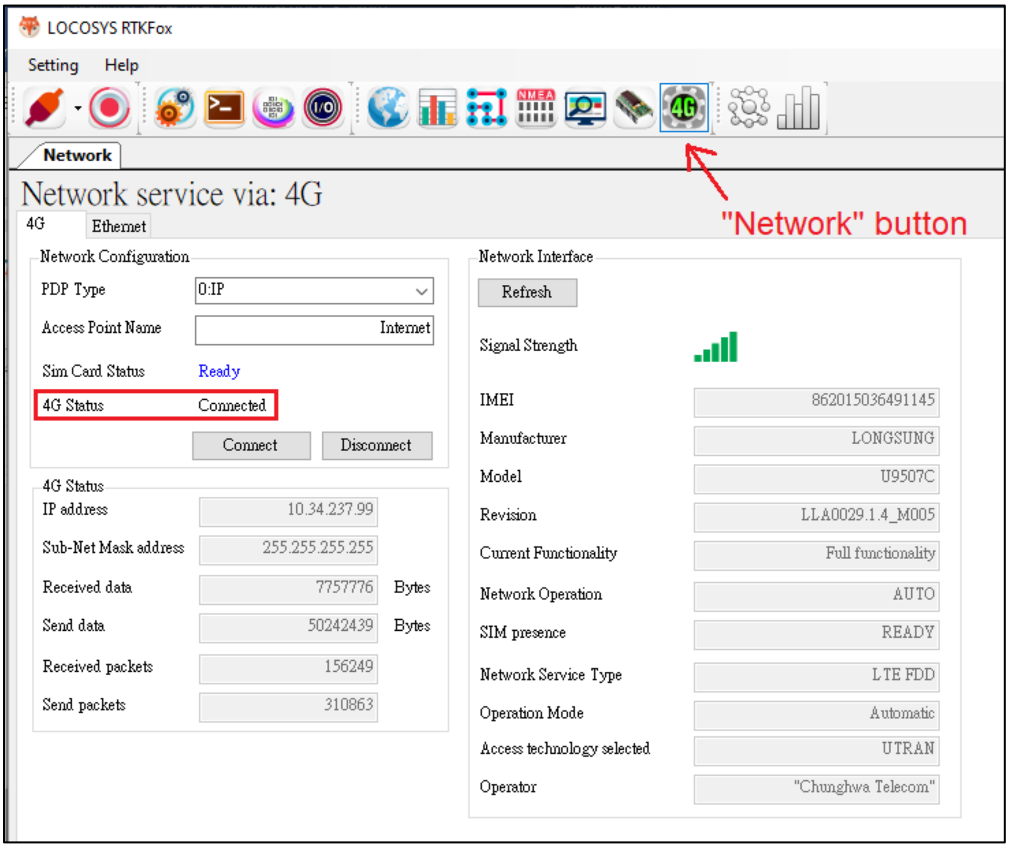
7.1. Configuration example of the rover

Click the radio button of "Rover" to show the setting page as below picture.

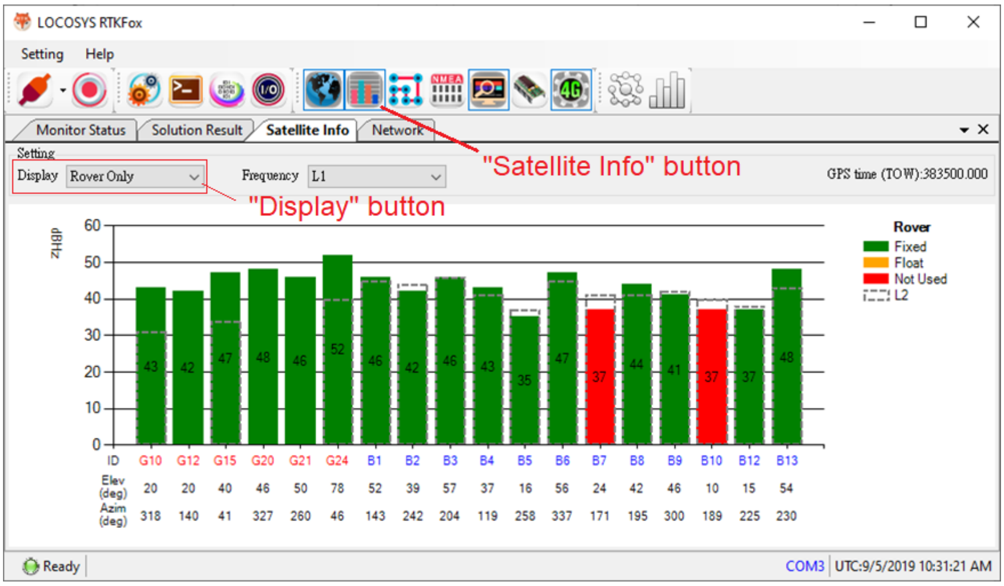


9. Click the selection "Position Mode". There are three options. The option "kinematic" is for RTK position. The option "Moving baseline" is for RTK heading. The option "kinematic + moving baseline" is for simultaneous RTK position and RTK heading.
10. Click the selection of "Update Frequency" to set the update rate of RTK.
11. Click the selection "Input Stream". There are two options. The option "LoRa" is for receiving data broadcasted from the base station through LoRa radio. The option "NTRIP Client" is for receiving data from NTRIP caster.

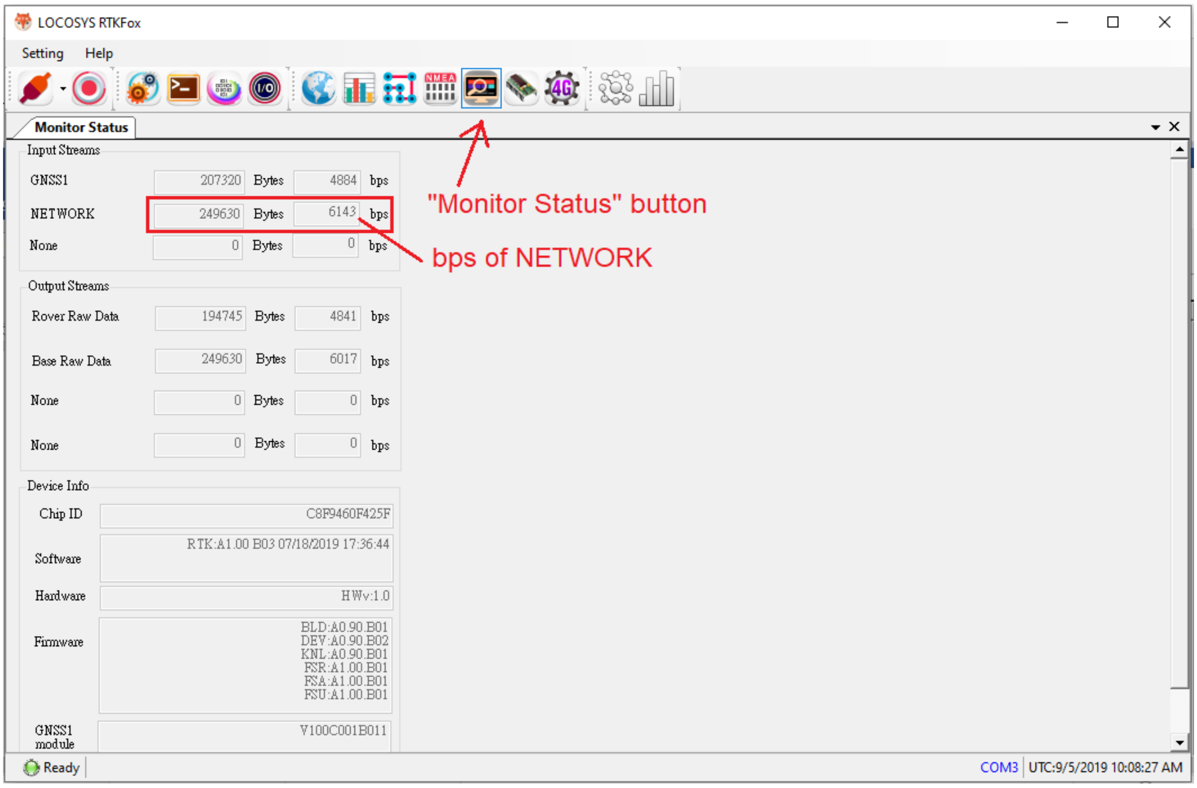
12. Input the settings of NTRIP Caster.
13. Click the button "Apply" to take effect. The settings will be saved in the internal flash memory.
14. Check 4G/LTE connection by clicking "Network" button. If the product registers to the network of the telecom provider, it will show "Connected" as below picture.



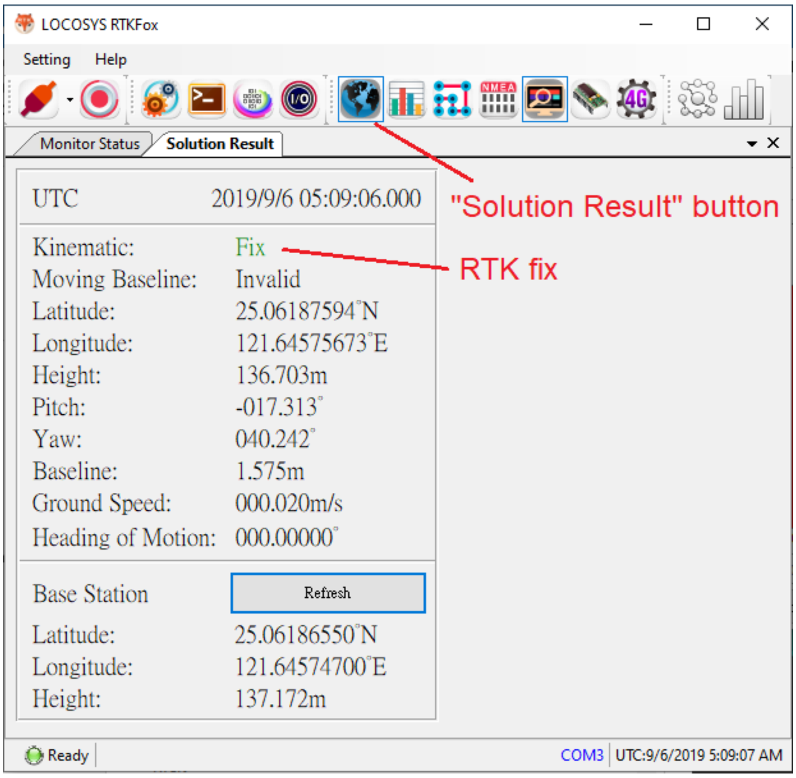
15. Click "Satellite Info" button to check the received GNSS signal strength. Most signals should be higher than 40. If you want to see satellite information from the reference/base station, you can click "Display" button and select "Rover & Base".



16. Click "Monitor Status" button. If "bps of NETWORK" varies, the connection to NTRIP Caster is established and the correction data for RTK is received.

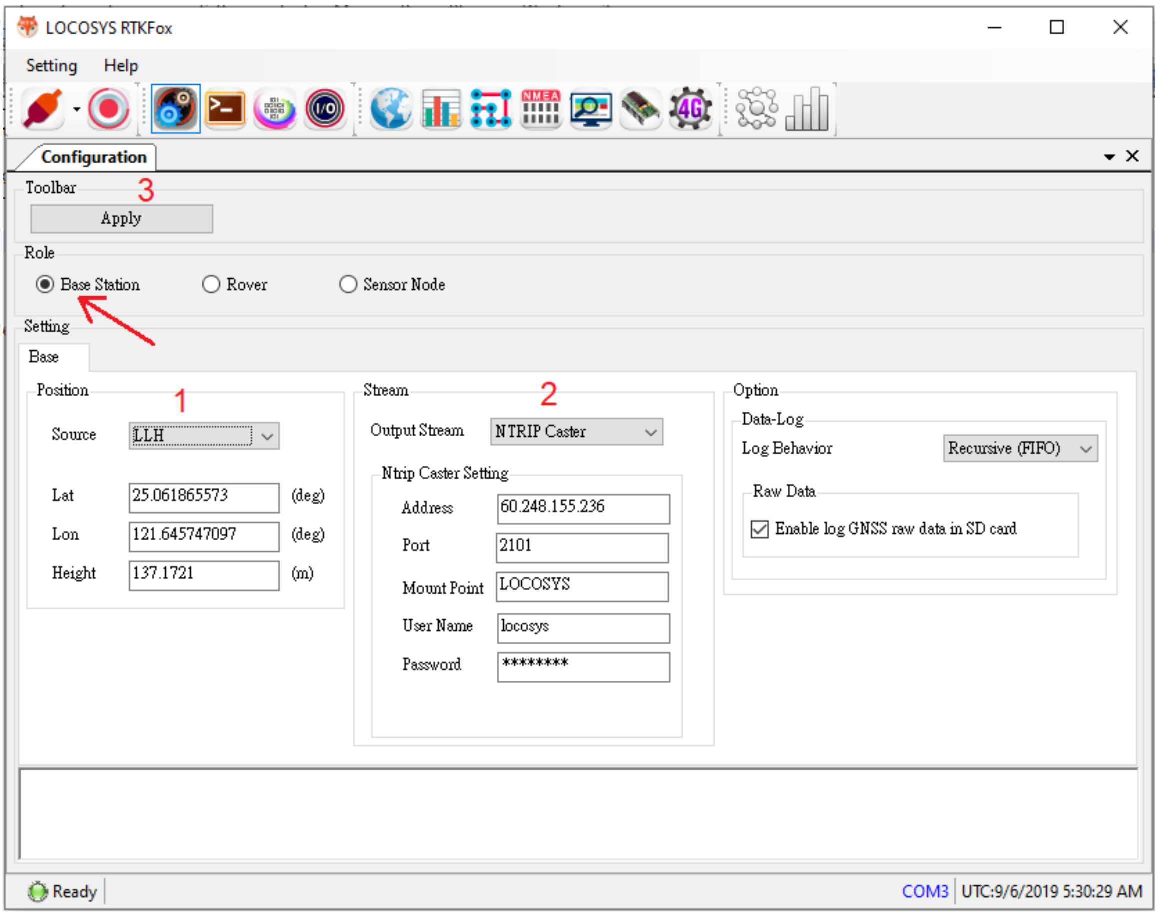


17. Click "Solution Result" button. You can see RTK fix or not and the other information of RTK position.



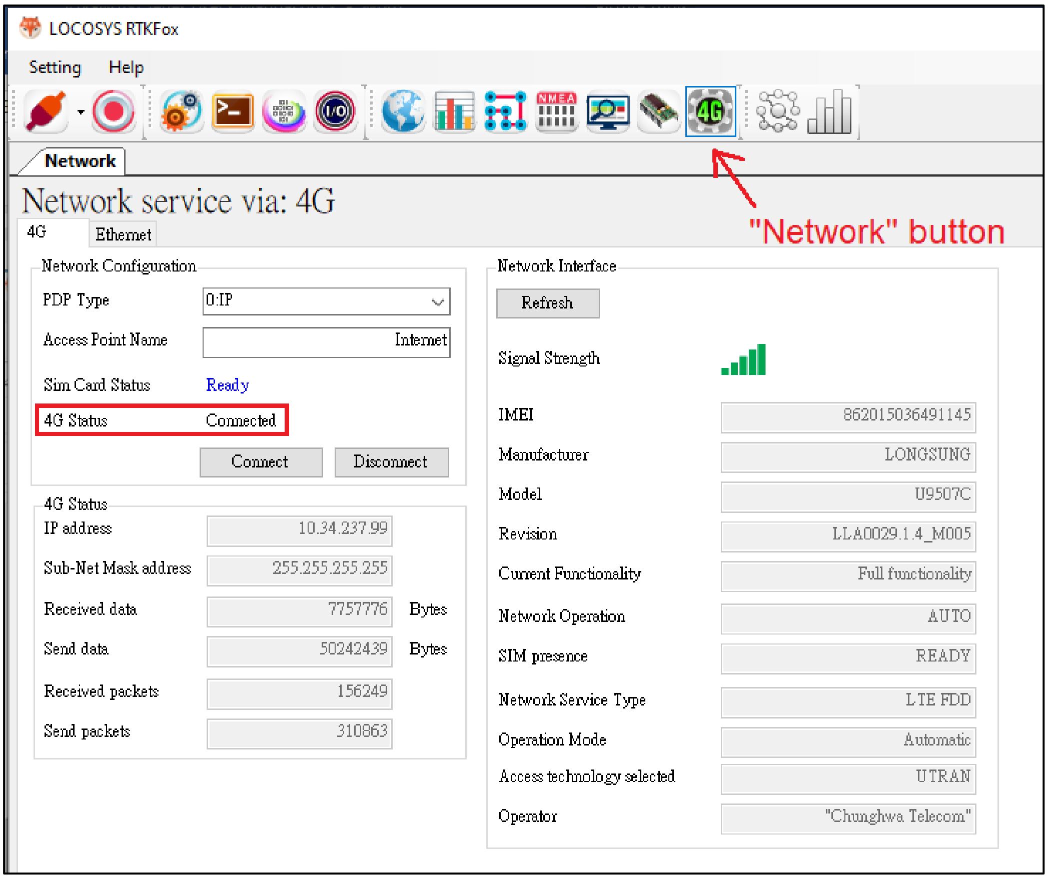
7.2. Configuration example of the base station

Click the radio button of "Base Station" to show the setting page as below picture.

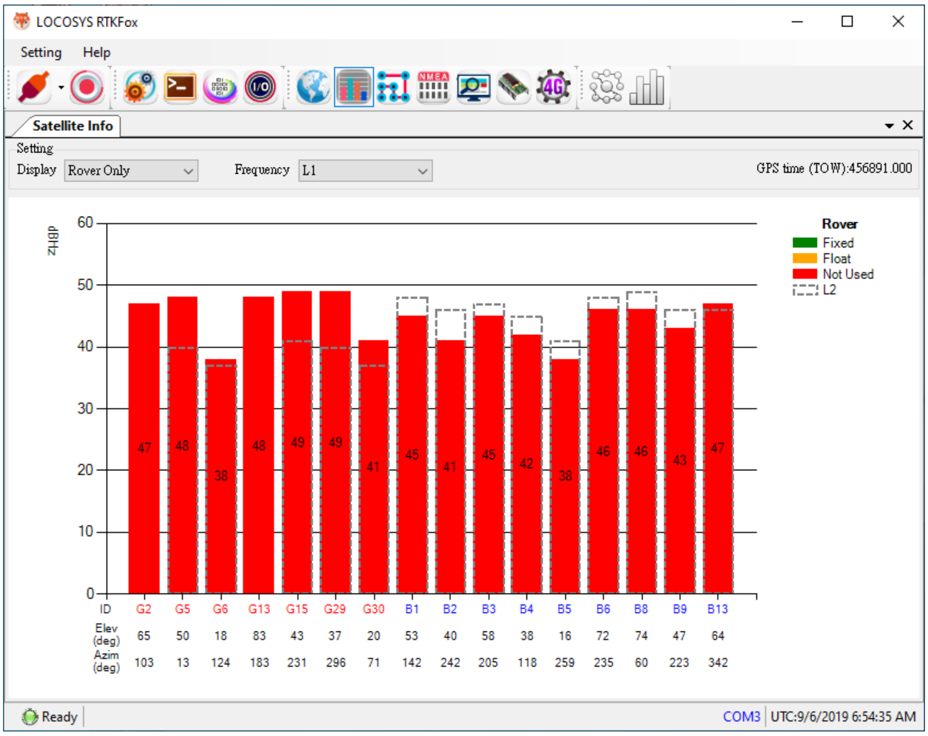


1. If the position of the product is known, select "LLH" and input its latitude, longitude and height. If the position is unknown, select "Survey In" to let the product get its own position that accuracy is 2 ~ 5 meters depending on the received GNSS satellite signals.
2. If the product is going to join a NTRIP caster through 4G/Ethernet network, select "NTRIP Caster" and input its settings. If the product is going to broadcast data through LoRa radio, select "LoRa" and input its settings.
3. Click the button "Apply" to take effect. The settings will be saved in the internal flash memory.

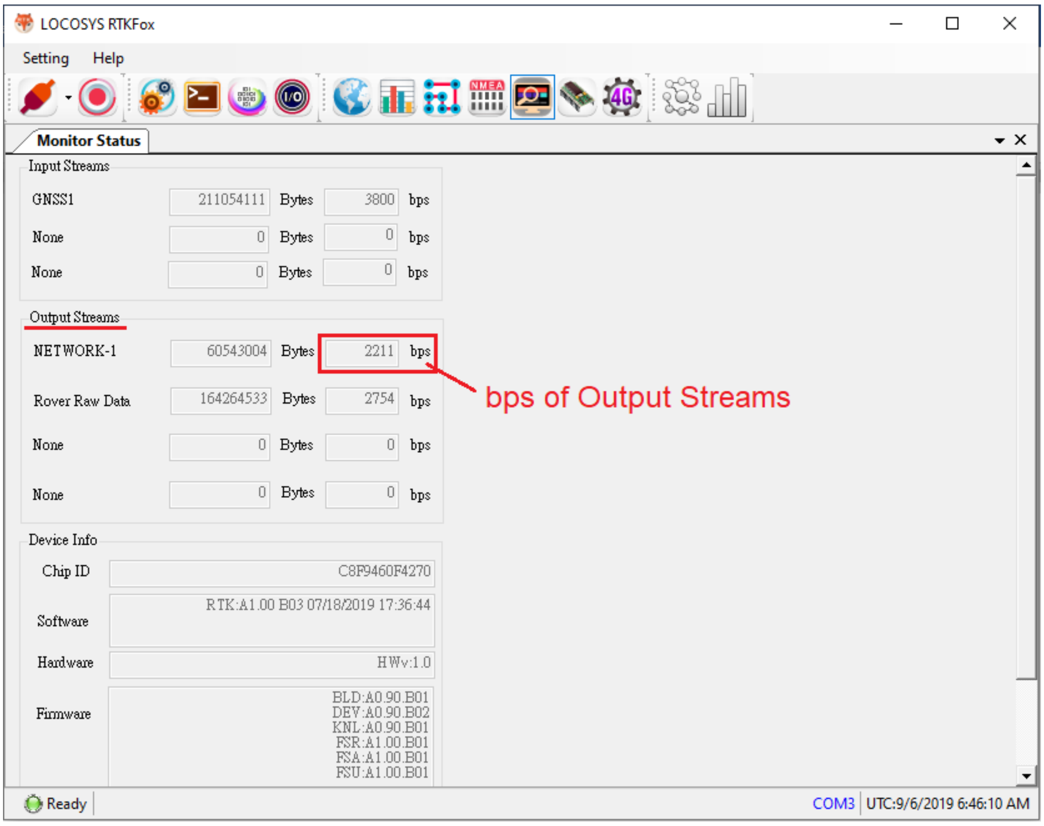
4. Check 4G/LTE connection by clicking "Network" button. If the product registers to the network of the telecom provider, it will show "Connected" as below picture.



5. Click "Satellite Info" button to check the received GNSS signal strength. Most signals should be higher than 40.



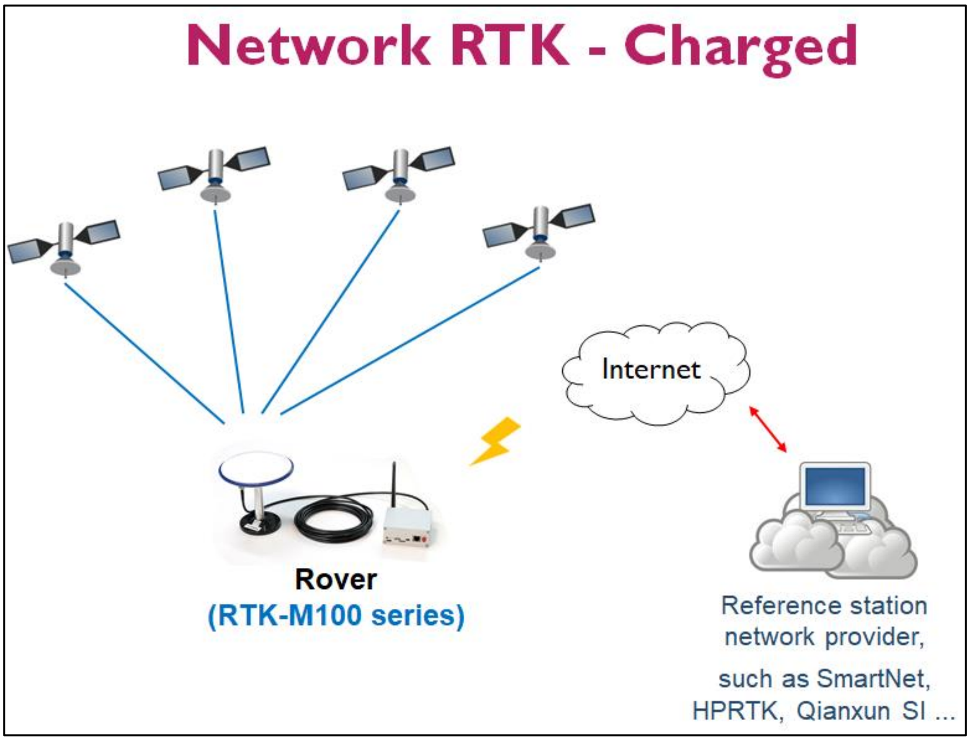
6. Click "Monitor Status" button. If "bps of Output Streams" varies, the data is successfully transmitting to NTRIP Caster.



7. The configuration of the base station is done.

8. RTK network

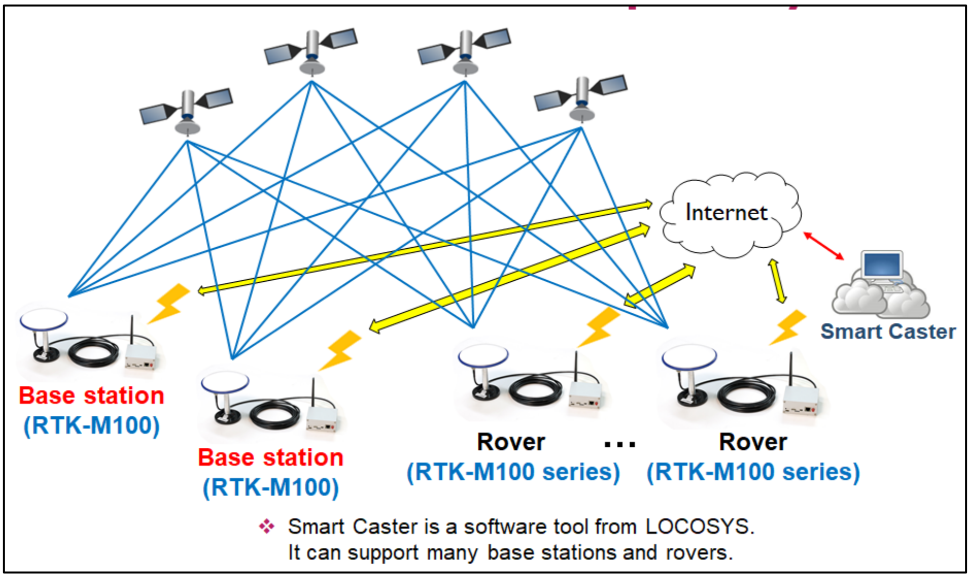
Most countries have Continuously Operating Reference Stations (CORS) operated by the government or enterprises. The standard protocol called NTRIP is adopted to access these RTK differential corrections. RTK-M100 product series have 4G/LTE modem and support NTRIP that can access these corrections to achieve centimeter RTK accuracy.



One of the benefits to use these corrections from the providers is the user does not need to purchase and manage the base stations himself. But in order to use these corrections, the registration, service charge and telecom charge are required.

8.1. Proprietary RTK network

LOCOSYS has the software tool “Smart Caster” that can form a proprietary RTK network with many base stations and many rovers. It receives RTK corrections from each base station and sends to the rovers with the corrections from the nearest base station. For more information of “Smart Caster”, please contact us.



8.2. RTK over LoRa radio

Even the proprietary RTK network described in section 8.1, the telecom charge is required because of 4G/LTE mobile communication. Is there a way for RTK application without telecom charge? Yes. We can use LoRa radio instead of 4G/LTE communication. A base station with known position broadcasts its RTK corrections by LoRa radio. Many rovers within the coverage of LoRa radio can receive RTK corrections.

Using LoRa radio can have only one base station in the service area. It is hard to form RTK network that has several base stations. However, it is useful and economic RTK application for the small farm, driving school and amusement park.