REYAX
TECHNOLOGY CORPORATION, LTD

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RYUW122_DK

Positioning Development Kit
User Guide

RYUW122_DK Overview

To help developers quickly adopt and implement UWB positioning applications, we have launched the RYUW122 Positioning Development Kit. This development kit offers a complete UWB hardware and software positioning solution, enabling developers to rapidly apply it in real-world environments.

The kit integrates a four-anchor positioning architecture centered around the RYUW122_ANCHOR1, paired with the RYUW122_Lite as the mobile tag device. It also provides anchor side example firmware for STM32 MCU, source code for a Windows® C# user interface application, as well as supporting power supplies and cables. This allows users to conduct testing, integration, and development in the shortest possible time.

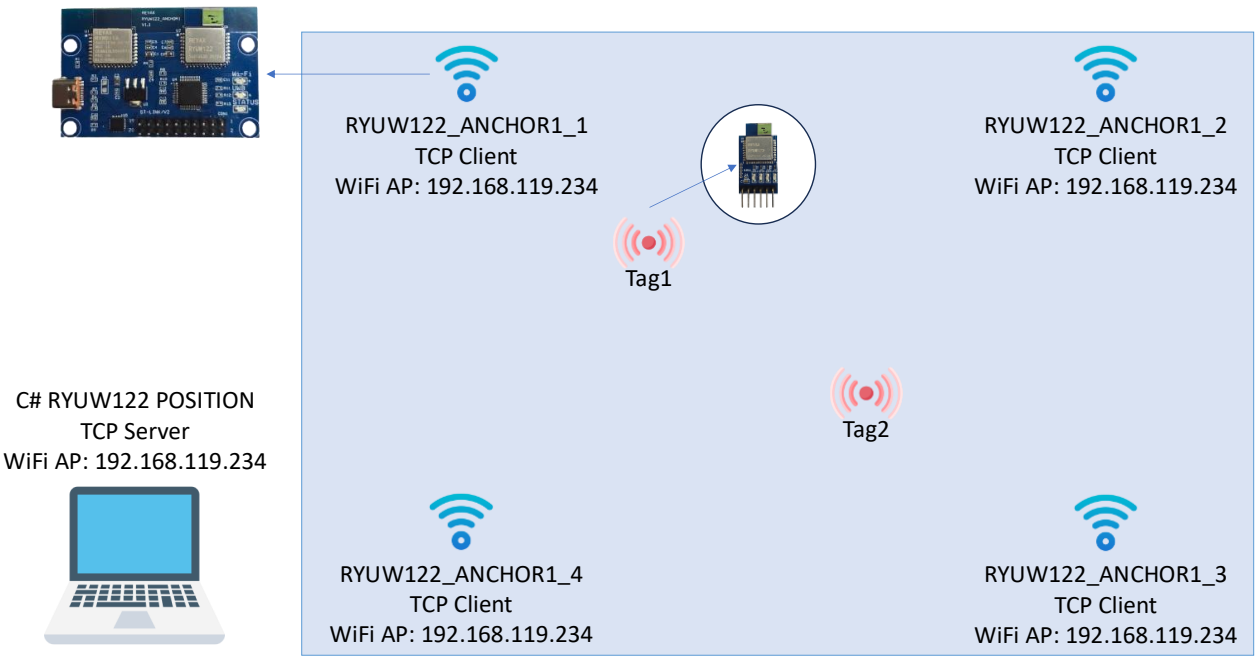
Contents of the Kit

Item	Model Name	Quantity	Function Description
1	RYUW122_ANCHOR1 	4	UWB Anchor with Wi-Fi Connection
2	TYPE-C CABLE 	4	Provides DC Power Supply for RYUW122_ANCHOR1
3	RYUW122_Lite 	2	TAG
4	RYLS135 	2	Setting and providing power to RYUW122_Lite
5	USB Flash Drive	1	Contains RYUW122_ANCHOR1 STM32 MCU firmware source code and positioning software Windows® C# source code

System architecture description

The system uses a four-point Anchor deployment architecture and establishes a TCP communication connection between the Anchor and the Windows® C# via Wi-Fi®.

The following is a description of the roles of each component:



1. RYUW122_ANCHOR1（Anchor）：

   Four Anchor nodes (RYUW122_ANCHOR1_1, RYUW122_ANCHOR1_2, RYUW122_ANCHOR1_3, RYUW122_ANCHOR1_4) are fixedly installed at the four corners of the positioning space. Each node has a built-in STM32 MCU, supports Wi-Fi transmission, is responsible for receiving Tag feedback and transmitting distance information to the host Windows® C# through TCP.

2. RYUW122_Lite（Tag）：

   As a mobile device, it moves freely in the positioning space. When the Anchor sends a distance measurement command, the Tag will respond with a UWB signal for distance measurement.

3. Windows® C# GUI：

   Establish a TCP Server, connect to four Anchors, control each Anchor to start distance measurement in sequence, and aggregate the returned data for positioning calculation and display coordinates.

Operation steps

Please follow the steps below to complete system installation and startup to begin UWB positioning tests:

1. **Prepare the Windows® C# TCP Server.**
   Launch the Windows® C# positioning interface software, start the TCP Server, and wait for the Anchor devices to connect.

2. **Configure the UWB of RYUW122_ANCHOR1.**
   Use UART and configuration commands to set each RYUW122_ANCHOR1 device to Anchor mode and assign a unique Anchor Address (Anchor1 to Anchor4).

3. **Configure the Wi-Fi of RYUW122_ANCHOR1.**
   Set the Wi-Fi AP SSID, password, and the IP and port of the TCP Server to ensure the Anchor can connect properly to the Windows® C# software.

4. **Complete the setup for all four RYUW122_ANCHOR1 devices.**
   Configure UWB and Wi-Fi AP settings for each of the four Anchors one by one, and record their corresponding physical locations.

5. **Configure the RYUW122_Lite for Tag mode.**
   Use RYLS135 to set the module to Tag mode so it can respond to ranging commands sent by the Anchors.

6. **Connect RYUW122_ANCHOR1 to C# TCP Server.**
   Power on and connect the Anchors to the Windows® C# software in the sequence Anchor1 → Anchor2 → Anchor3 → Anchor4. The system will automatically map each Anchor ID based on the order of connection.

7. **Start the positioning function.**
   After all Anchors are successfully connected and the coordinates of the four positioning points are set, click the "TagPosition" button in the C# software. The system will automatically poll the Anchors for distance measurements and perform coordinate calculations.

1. Prepare the Windows® C# TCP Server.

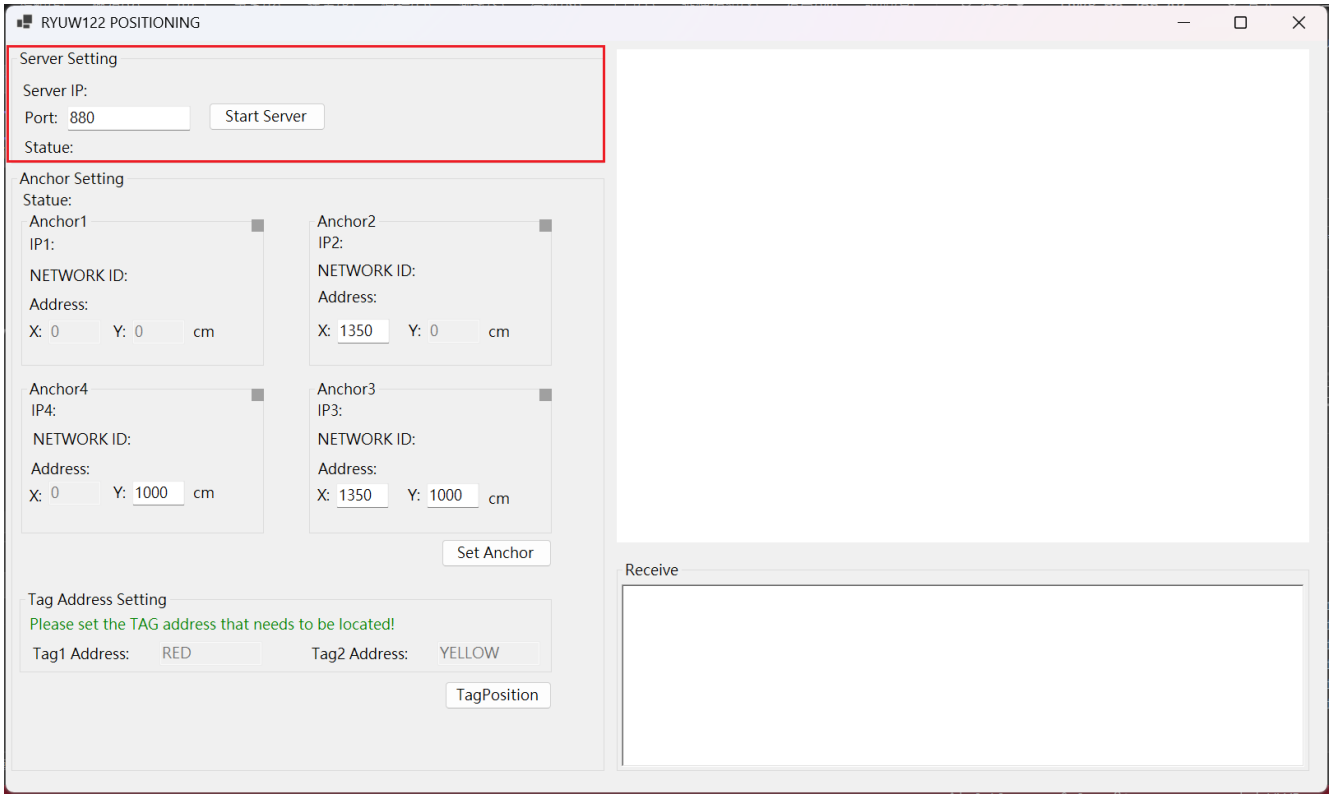
Please follow the steps below to set up a TCP Server on your computer for Anchor device connections:

[1] **Connect the computer to the Wi-Fi AP.**

Make sure the computer is successfully connected to the Wi-Fi Access Point used by the RYUW122_ANCHOR1 (e.g., REYAX 192.168.119.234) to establish TCP communication.

[2] **Run the C# RYUW122 POSITIONING software.**

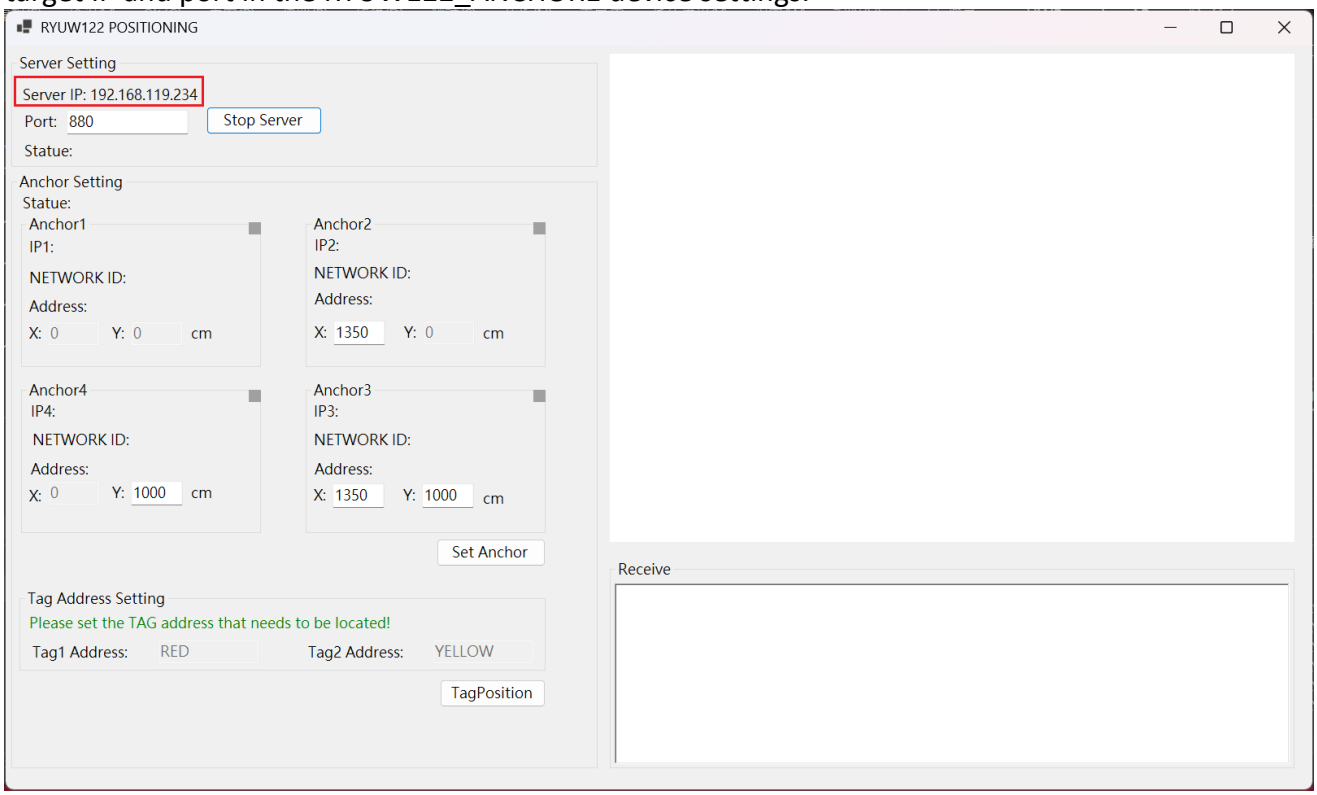
Launch the provided Windows® C# user interface program, set the desired TCP port, and then click the Start Server button.



[3] **Start the server and display the IP address.**

Once the server is successfully started, the interface will automatically display the current IP

address of the computer. Please note this IP address (e.g., 192.168.119.234) and enter the correct target IP and port in the RYUW122_ANCHOR1 device settings.



2. Configure the UWB of RYUW122_ANCHOR1

RYUW122_ANCHOR1 is a UWB Anchor, which integrates RYWB116 Wi-Fi module and RYUW122 UWB module, and is controlled by STM32 MCU, Please refer to the following link for more details: https://reyax.com/products/RYUW122_ANCHOR1

The related software can be developed and tested based on the STM32 RYUW122_ANCHOR1 firmware source code provided in the USB Flash Drive.

Circuit diagrams can be downloaded from the REYAX website or USB Flash Drive.

[1]Serial Port Software Operation Guide

The following steps demonstrate how to send initialization and configuration commands using Docklight® software https://docklight.de/

After powering on the RYUW122_ANCHOR1, launch Docklight®, select the corresponding COM port, and set the UART parameters to 115200 baud rate, 8-N-1 (8 data bits, no parity, 1 stop bit).

[2]Command Format Notes

Except for the RYWB116 initialization commands (0x1C, 0x55, 0x31), which are in pure HEX format, all other text-based commands must end with \r\n (Carriage Return + Line Feed).

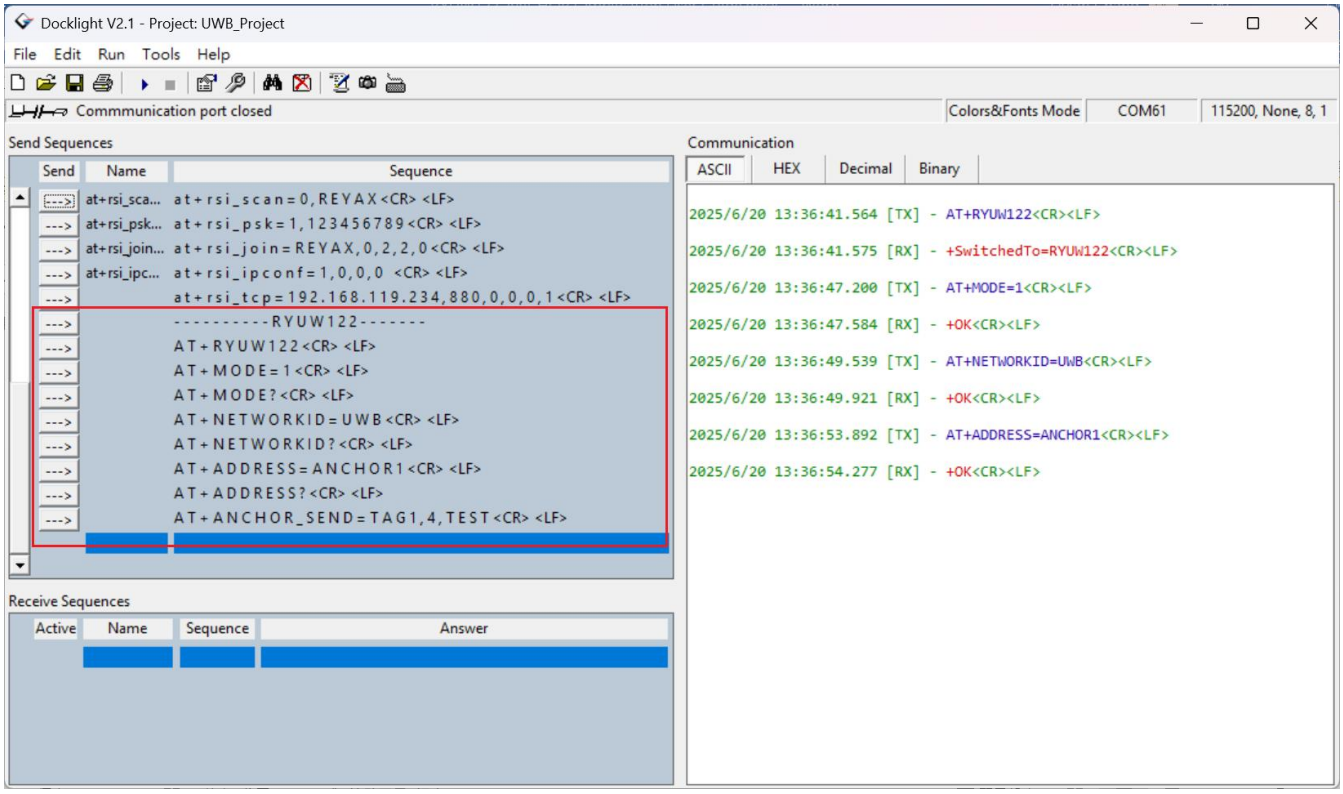
Example: When sending AT+RYUW122, the actual content should be: AT+RYUW122\r\n

[3] Configure UWB Functionality

Before proceeding with further configuration, please use the AT+RYUW122 command to switch control to the UWB module. This enables the use of RYUW122-specific commands. The following commands configure the device role as an Anchor and set related parameters.

Enter the commands in the following order (each must end with \r\n):

AT+RYUW122
AT+MODE=1
AT+NETWORKID=UWB
AT+ADDRESS=ANCHOR1



*RYUW122 is the UWB module used in the RYUW122_ANCHOR1. For the detailed command set, please refer to the following link for more details:
https://reyax.com/products/RYUW122

3. Configure the Wi-Fi of RYUW122_ANCHOR1

Before controlling the RYWB116 module, please use the AT+RYWB116 command to switch the MCU UART control to the Wi-Fi module. Once completed, proceed with the initialization process.

[1]Use AT+RYWB116 to switch to Wi-Fi and initialize.

After powering on the module, use Docklight to set the required UART baud rate (default is 115200), then send the initialization commands in the following sequence (in hexadecimal format):

(1) Send 0x1C
(2) Wait for the module to return an acknowledgment character
(3) Send 0x55
(4) Wait for the module to respond
(5) Send 0x31 (to complete initialization)
(6) Wait for the module to respond with “Loading Done”

Note:
This initialization process must be performed by sending accurate HEX format commands. Each step should only proceed after receiving the module’s response, otherwise initialization may fail.

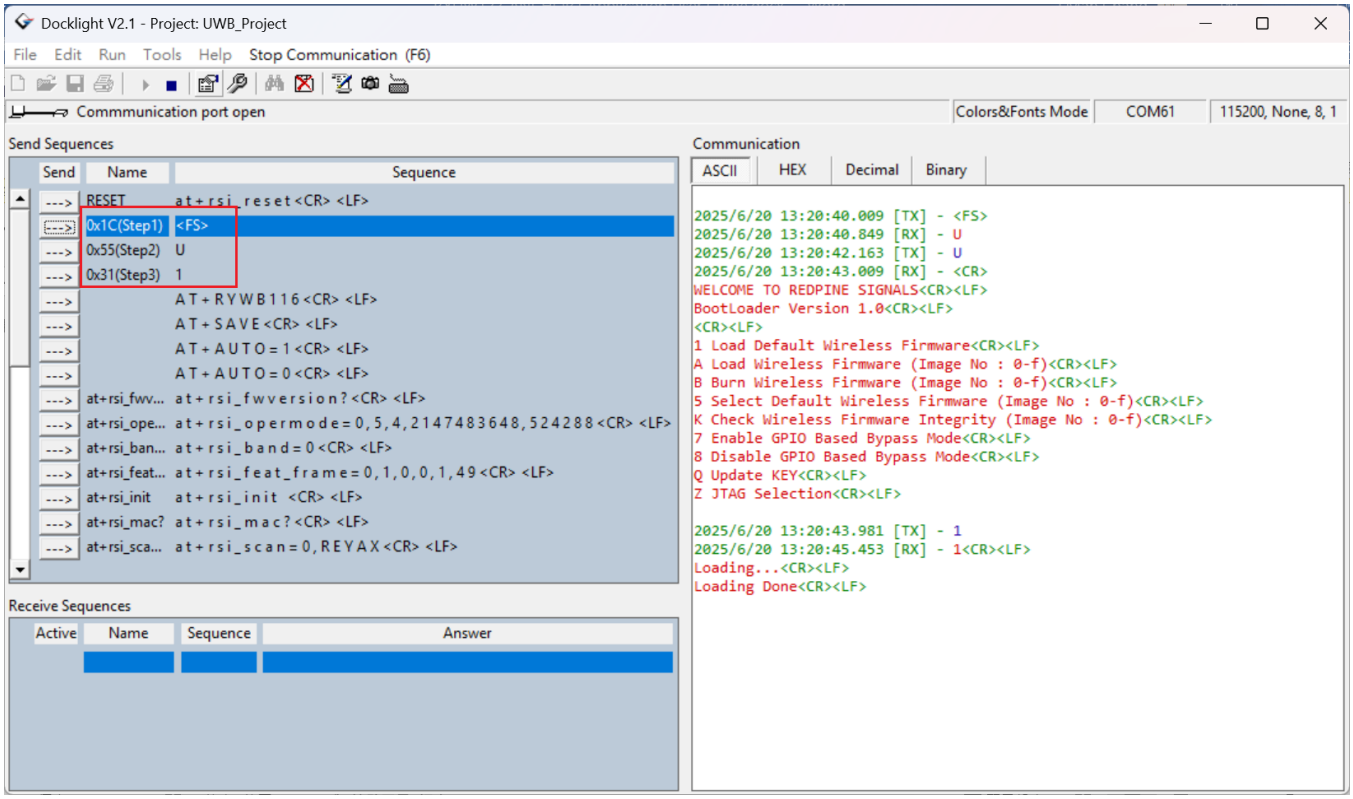
Docklight Log:

```
2025/6/20 11:37:53.822 [TX] - AT+RYWB116<CR><LF>

2025/6/20 11:37:53.832 [RX] - +SwitchedTo=RYWB116<CR><LF>

2025/6/20 11:37:55.150 [TX] - <FS>_
2025/6/20 11:37:55.991 [RX] - U
2025/6/20 11:37:56.728 [TX] - U
2025/6/20 11:37:57.574 [RX] - <CR>
WELCOME TO REDPINE SIGNALS<CR><LF>
BootLoader Version 1.0<CR><LF>
<CR><LF>
1 Load Default Wireless Firmware<CR><LF>
A Load Wireless Firmware (Image No : 0-f)<CR><LF>
B Burn Wireless Firmware (Image No : 0-f)<CR><LF>
5 Select Default Wireless Firmware (Image No : 0-f)<CR><LF>
K Check Wireless Firmware Integrity (Image No : 0-f)<CR><LF>
7 Enable GPIO Based Bypass Mode<CR><LF>
8 Disable GPIO Based Bypass Mode<CR><LF>
Q Update KEY<CR><LF>
Z JTAG Selection<CR><LF>

2025/6/20 11:37:58.613 [TX] - 1
2025/6/20 11:38:00.085 [RX] - 1<CR><LF>
Loading...<CR><LF>
Loading Done<CR><LF>
```



[2] Wi-Fi AP Mode Configuration

After completing the HEX initialization and firmware loading, please enter the following AT commands in sequence to configure the RYWB116 module's mode and basic parameters.

The command input sequence is as follows:

(1) at+rsi_opermode=0,5,4,2147483648,524288

(2) at+rsi_band=0

(3) at+rsi_feat_frame=0,1,0,0,1,49

(4) at+rsi_init

Docklight Log:

2025/6/20 11:38:47.975 [TX] - at+rsi_opermode=0,5,4,2147483648,524288<CR><LF>

2025/6/20 11:38:48.797 [RX] - OK<CR><LF>

2025/6/20 11:38:49.993 [TX] - at+rsi_band=0<CR><LF>

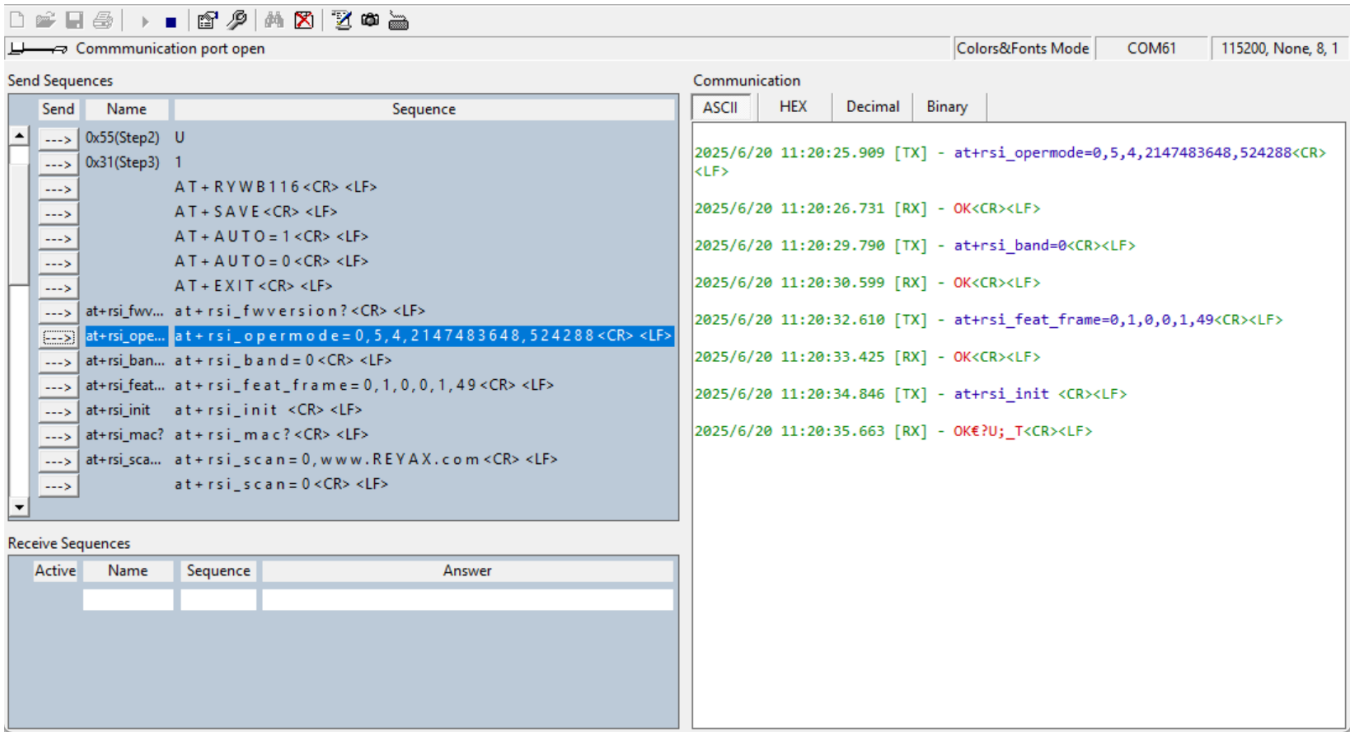
2025/6/20 11:38:50.802 [RX] - OK<CR><LF>

2025/6/20 11:38:51.900 [TX] - at+rsi_feat_frame=0,1,0,0,1,49<CR><LF>

2025/6/20 11:38:52.713 [RX] - OK<CR><LF>

2025/6/20 11:38:53.583 [TX] - at+rsi_init <CR><LF>

2025/6/20 11:38:54.400 [RX] - OK€?U;_T<CR><LF>



[3] AP Scanning and Connection Command Sequence

After completing the basic Wi-Fi module configuration, follow the steps below to scan for wireless networks, connect to an access point, and establish a TCP connection (e.g., Wi-Fi AP REYAX: 192.168.119.234).

Command input sequence:
(5) at+rsi_scan=0,<your ssid>
(6) at+rsi_psk=1,<your password>
(7) at+rsi_join=<your ssid>,0,2,2,0
(8) at+rsi_ipconf=1,0,0,0
(9) at+rsi_tcp=<your server ip>,<your port>,0,0,0,1

Docklight Log:

2025/6/20 11:33:06.306 [TX] - at+rsi_scan=0,REYAX<CR><LF>

2025/6/20 11:33:08.226 [RX] - OK<SOH>_<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<VT>
<STX>_(<SOH>_REYAX<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>
▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NU
L>▯<NUL>▯<NUL>▯<LF>
%<CR>
<EOT>_?c<NUL>▯<NUL>▯<CR><LF>

2025/6/20 11:33:10.386 [TX] - at+rsi_psk=1,123456789<CR><LF>

2025/6/20 11:33:11.196 [RX] - OK<CR><LF>

2025/6/20 11:33:12.731 [TX] - at+rsi_join=REYAX,0,2,2,0<CR><LF>

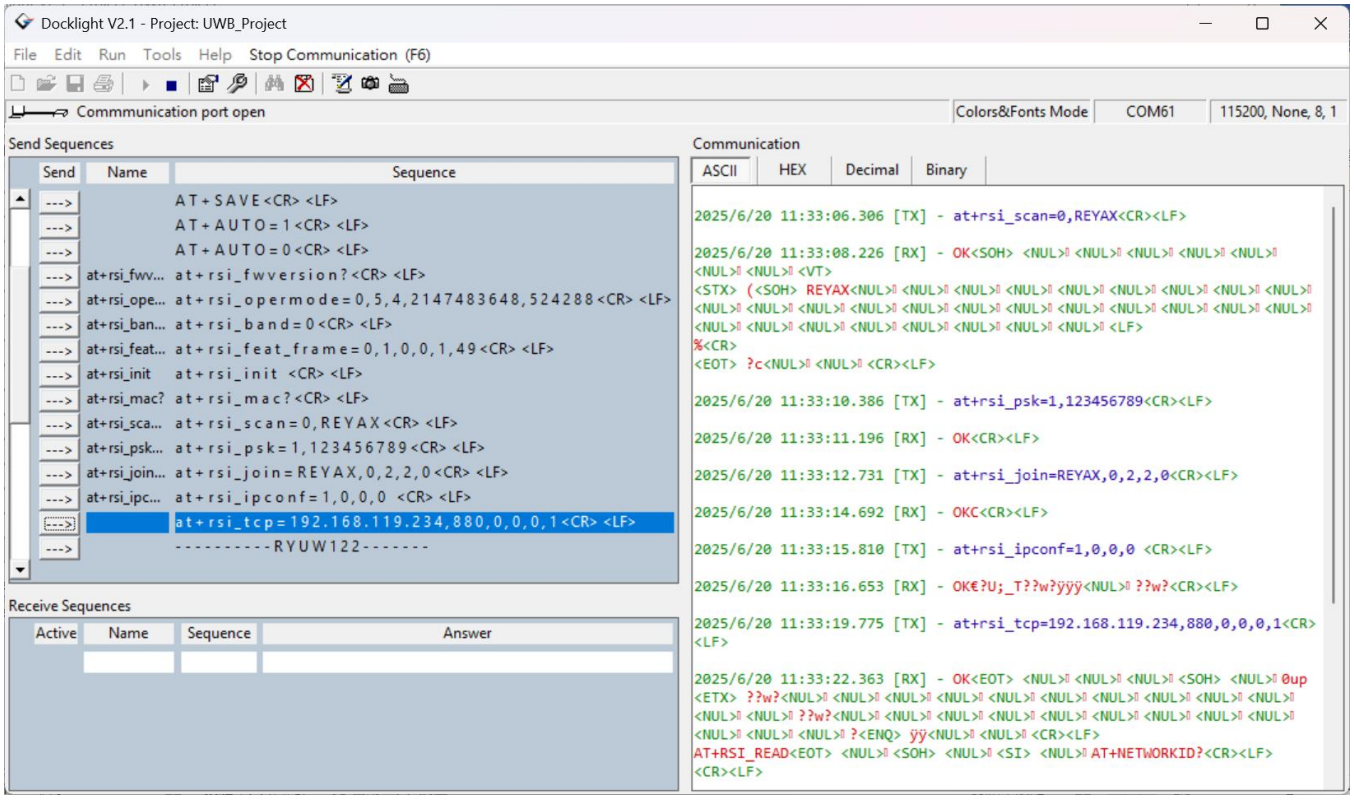
2025/6/20 11:33:14.692 [RX] - OKC<CR><LF>

2025/6/20 11:33:15.810 [TX] - at+rsi_ipconf=1,0,0,0 <CR><LF>

2025/6/20 11:33:16.653 [RX] - OK€?U;_T??w?ÿÿÿ<NUL>▯??w?<CR><LF>

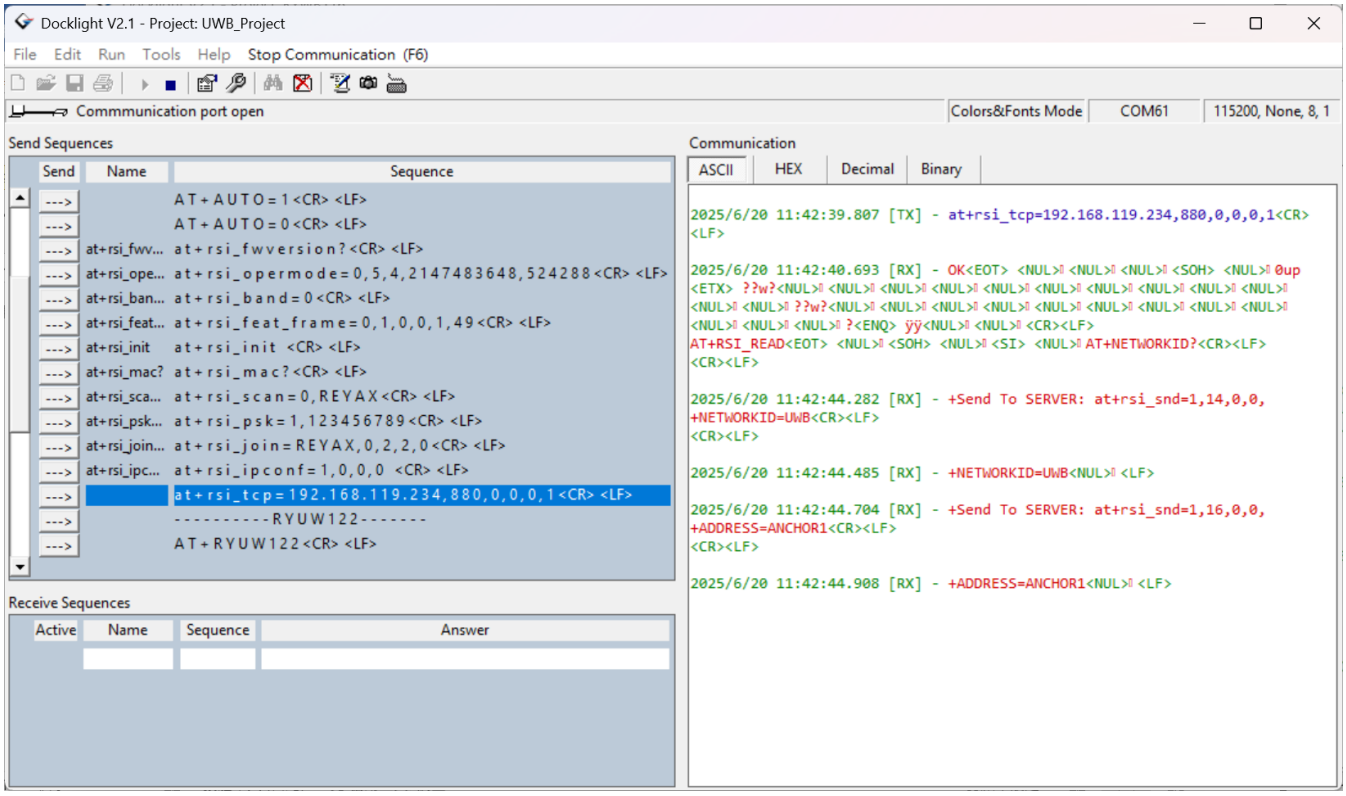
2025/6/20 11:33:19.775 [TX] - at+rsi_tcp=192.168.119.234,880,0,0,0,1<CR><LF>

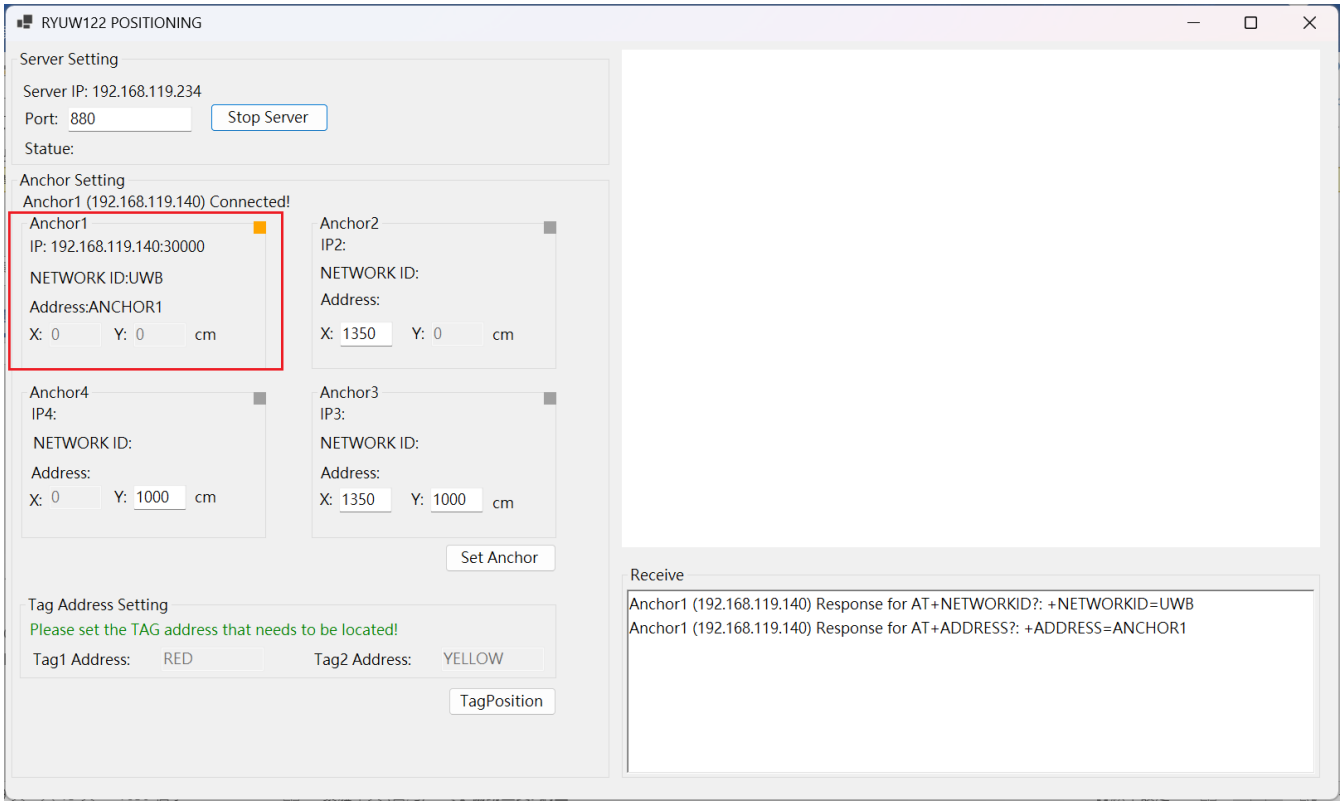
2025/6/20 11:33:22.363 [RX] -
OK<EOT>_<NUL>▯<NUL>▯<NUL>▯<SOH>_<NUL>▯0up<ETX>_??w?<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<
NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯??w?<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<NUL>▯<
NUL>▯<NUL>▯<NUL>▯<NUL>▯?<ENQ>_ÿ <NUL>▯<NUL>▯<CR><LF>
AT+RSI_READ<EOT>_<NUL>▯<SOH>_<NUL>▯<SI>_<NUL>▯AT+NETWORKID?<CR><LF>
<CR><LF>



[4] Automatic Identification After Connecting to the Server

Once the RYUW122_ANCHOR1 successfully connects to the TCP server, the module will automatically send its configured **NETWORK ID** (e.g., *UWB*) and **ADDRESS** (e.g., *ANCHOR1*). This information will be displayed in real time on the server interface, allowing users to easily verify the connection status and identity of each anchor node.





[5] Save Configuration Parameters

After confirming that the module has successfully connected, use the command AT+SAVE to write the current configuration parameters to flash memory. This ensures the settings will be automatically loaded on the next power-up, avoiding the need for reconfiguration.

Docklight Log:

```
2025/6/20 13:09:14.255 [TX] - AT+SAVE<CR><LF>

2025/6/20 13:09:14.512 [RX] - +Save OK<CR><LF>
```

[6] Enable Auto-Connect Function

You can enable or disable the Wi-Fi module's auto-connect function using the following commands:
(1) Enable auto-connect: AT+AUTO=1
(2) Disable auto-connect: AT+AUTO=0

Usage Instructions:

After completing the configuration and resetting the Wi-Fi module (at+rsi_reset), enabling the auto-connect feature (AT+AUTO=1) allows the module to automatically connect using the previously saved parameters (make sure to run AT+SAVE first). Each time the module is powered on, it will automatically attempt to connect to the previously saved network, eliminating the need for manual reconnection.

Auto-Connect Status Messages:

When auto-connect is enabled, the Wi-Fi module will return the following prompts during the connection process to help users monitor the connection status:

- Auto-connect start: WiFi Auto CFG Start...
- Auto-connect complete: WiFi Auto CFG Done.

Docklight Log:

```
2025/6/20 13:15:50.205 [TX] - AT+SAVE<CR><LF>

2025/6/20 13:15:50.463 [RX] - +Save OK<CR><LF>

2025/6/20 13:15:52.196 [TX] - at+rsi_reset<CR><LF>

2025/6/20 13:15:55.203 [RX] - +RESET<CR><LF>

2025/6/20 13:15:55.613 [RX] - +READY<CR><LF>

2025/6/20 13:15:59.818 [TX] - AT+AUTO=1<CR><LF>

2025/6/20 13:15:59.830 [RX] - <CR><LF>

2025/6/20 13:16:00.077 [RX] - +Save OK<CR><LF>
+OK<CR><LF>

2025/6/20 13:16:01.078 [RX] - WiFi Auto CFG Start...<CR><LF>
```

2025/6/20 13:16:01.820 [RX] - WiFi init...<CR><LF>

2025/6/20 13:16:02.052 [RX] - WiFi SCAN...<CR><LF>

2025/6/20 13:16:03.223 [RX] - WiFi JOIN...<CR><LF>

2025/6/20 13:16:07.657 [RX] - WiFi Connect TCP...<CR><LF>

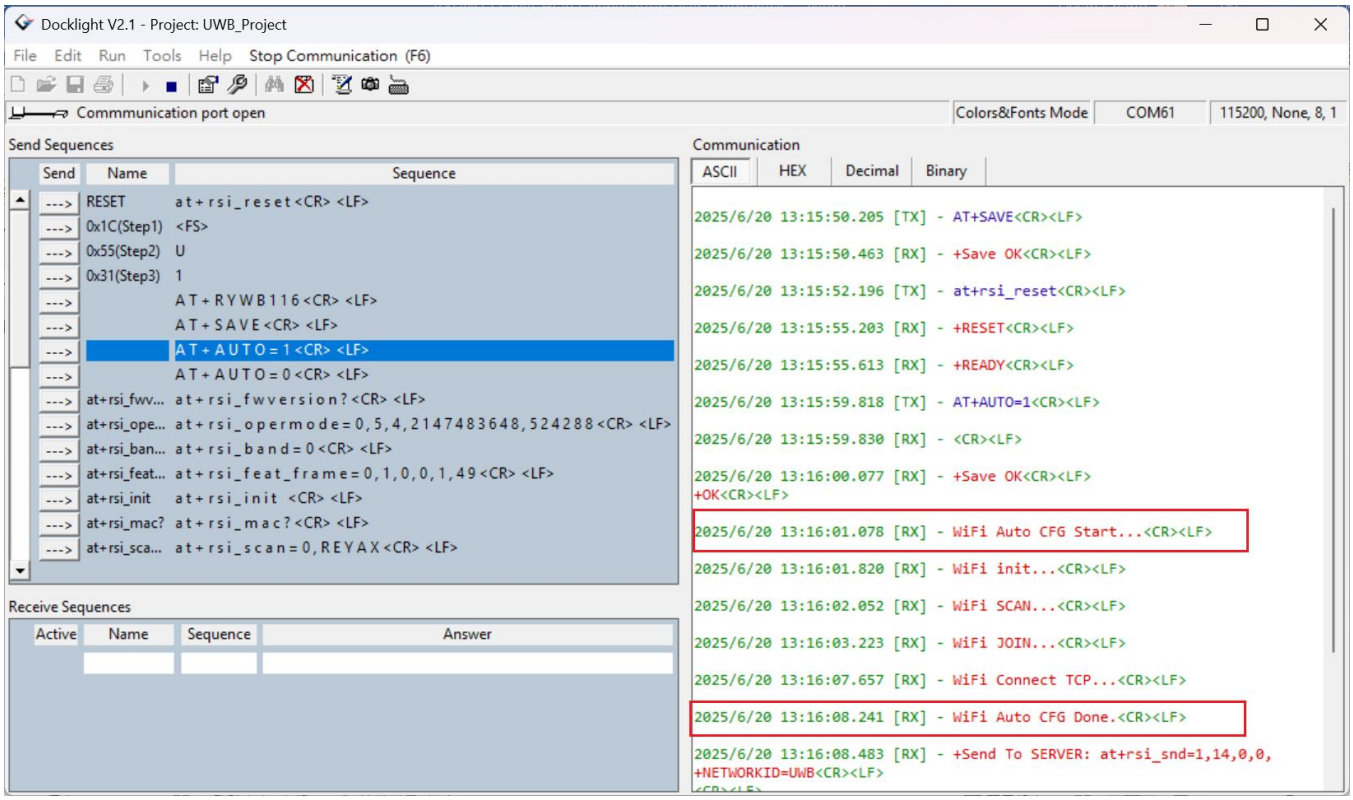
2025/6/20 13:16:08.241 [RX] - WiFi Auto CFG Done.<CR><LF>

2025/6/20 13:16:08.483 [RX] - +Send To SERVER: at+rsi_snd=1,14,0,0,+NETWORKID=UWB<CR><LF>
<CR><LF>

2025/6/20 13:16:08.687 [RX] - +NETWORKID=UWB<NUL>▯<LF>

2025/6/20 13:16:08.906 [RX] - +Send To SERVER: at+rsi_snd=1,16,0,0,+ADDRESS=ANCHOR1<CR><LF>
<CR><LF>

2025/6/20 13:16:09.110 [RX] - +ADDRESS=ANCHOR1<NUL>▯<LF>



5. Configure the RYUW122_Lite for Tag mode.

Please refer to the document to use RYLS135 connection and set RYUW122_LITE as the tag mode:

https://reyax.com//products/RYUW122

https://reyax.com//products/RYUW122_Lite

Operating Procedure

After powering on the RYUW122_LITE, open Docklight, select the corresponding COM port, and set the UART baud rate to 115200.

Then, enter the following AT commands in sequence to complete the Tag mode configuration:

(1) AT+MODE=0

(2) AT+NETWORKID=UWB

(3) AT+ADDRESS=RED

(4) AT+TAG_SEND=4,TEST

Docklight Log:

2025/6/20 14:12:36.185 [TX] - AT+MODE=0<CR><LF>

2025/6/20 14:12:36.357 [RX] - +OK<CR><LF>

2025/6/20 14:12:37.090 [TX] - AT+NETWORKID=UWB<CR><LF>

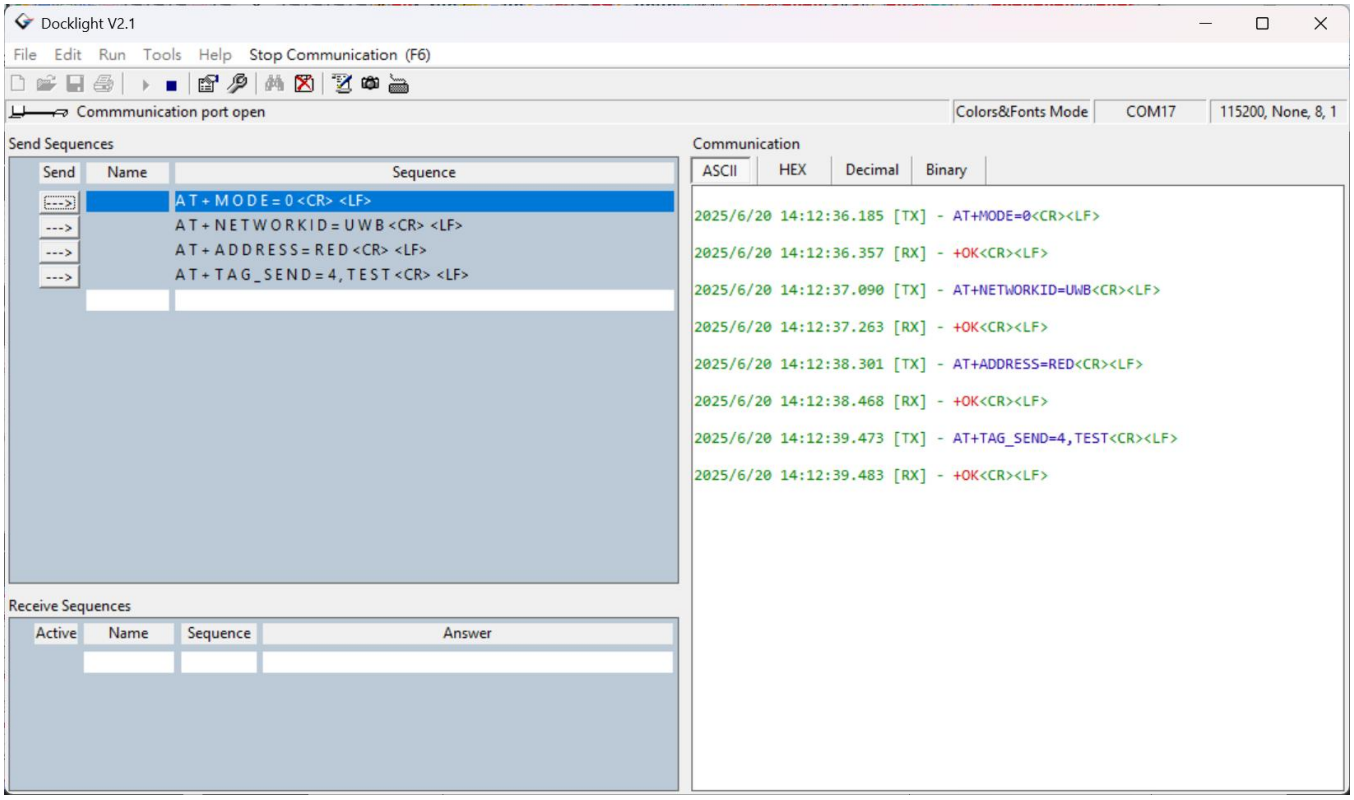
2025/6/20 14:12:37.263 [RX] - +OK<CR><LF>

2025/6/20 14:12:38.301 [TX] - AT+ADDRESS=RED<CR><LF>

2025/6/20 14:12:38.468 [RX] - +OK<CR><LF>

2025/6/20 14:12:39.473 [TX] - AT+TAG_SEND=4,TEST<CR><LF>

2025/6/20 14:12:39.483 [RX] - +OK<CR><LF>



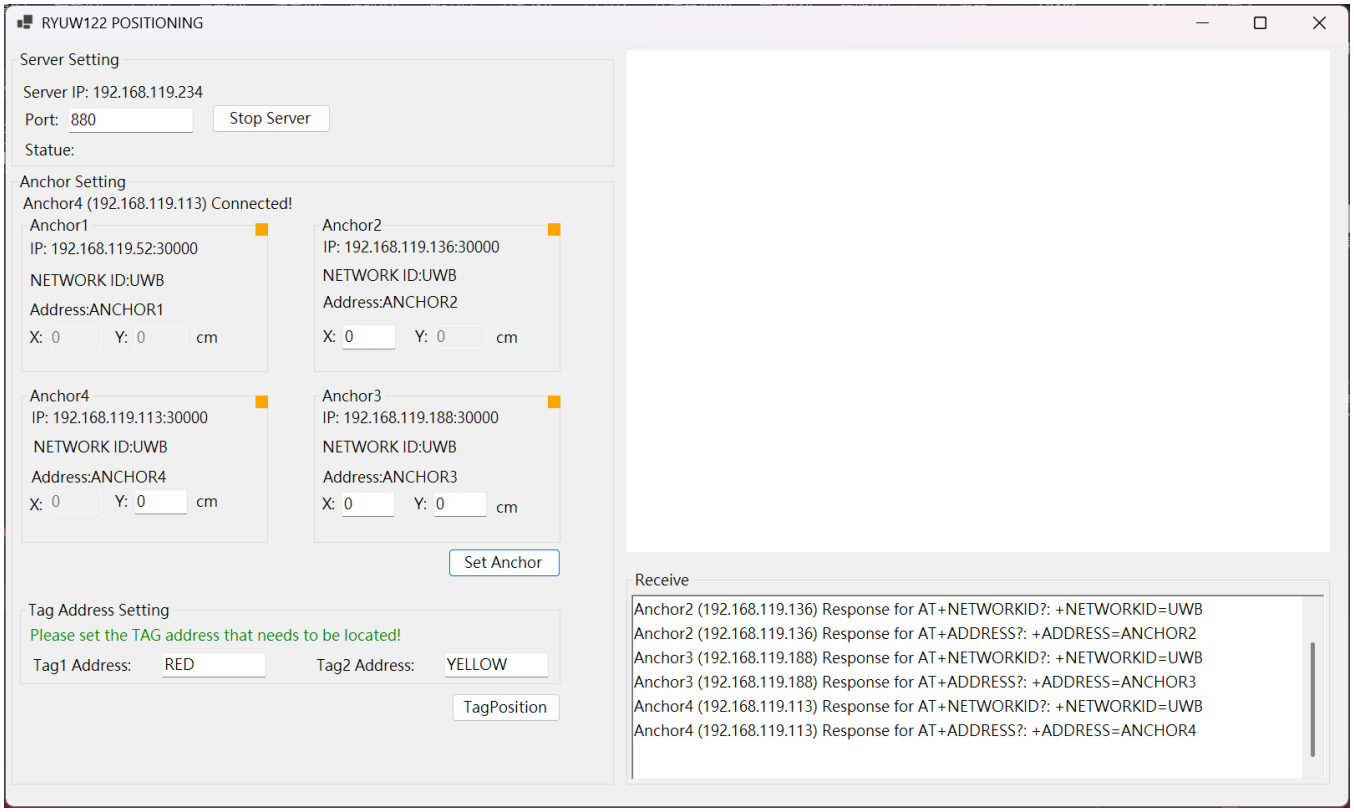
6. Connect RYUW122_ANCHOR1 to C# TCP Server.

[1]Please connect the four RYUW122_ANCHOR1 devices to the TCP server in sequence.

Once the connections are successful, the server interface will display:

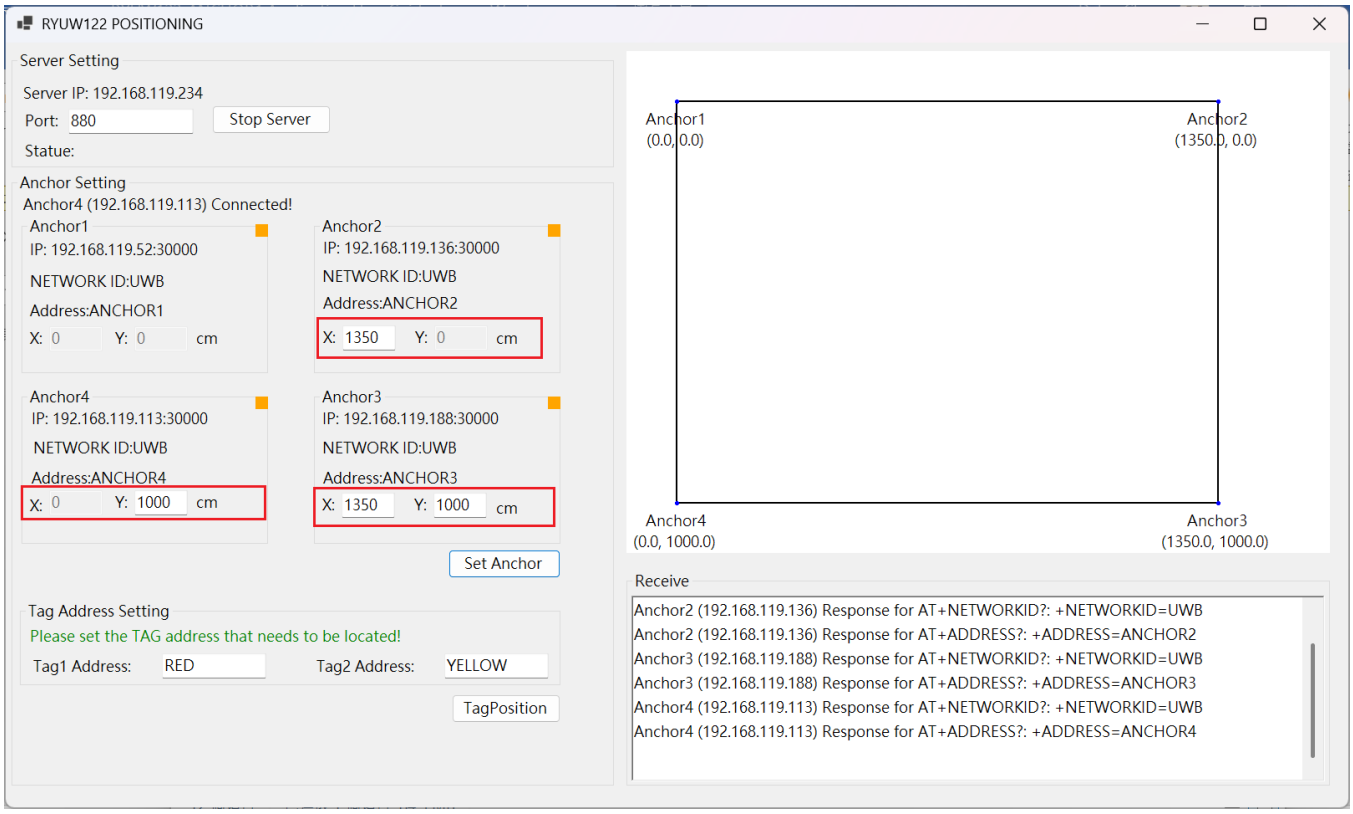
- The IP address of each Anchor device
- The NETWORK ID returned by the Anchor (e.g., **UWB**)
- The ADDRESS of the Anchor (e.g., **ANCHOR1**, **ANCHOR2**, etc.)

This information helps users verify that all Anchor nodes are properly connected and correctly identified.



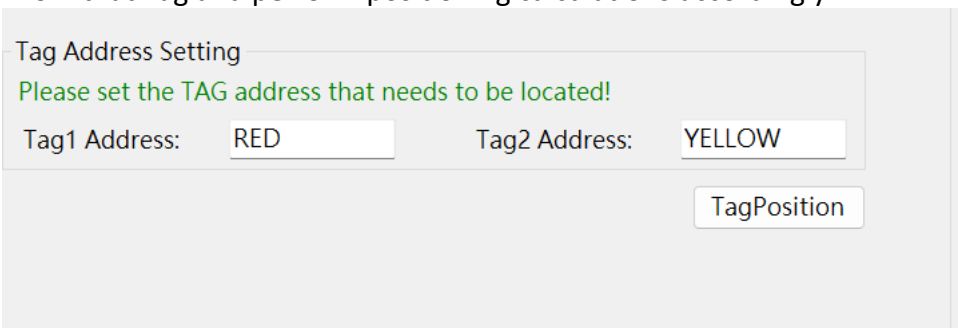
[2] Set Anchor Coordinates

- Enter the XY plane coordinates for the four Anchor nodes.
- Click the **Set Anchor** button on the interface.
- The configured coordinates of the four Anchors will be displayed on the right side of the screen for easy verification and adjustment.



[3] Set the TAG Address of the Target to Receive

Enter the TAG Address you wish to track (e.g., **RED**) in the interface. The system will only receive distance data from that Tag and perform positioning calculations accordingly.

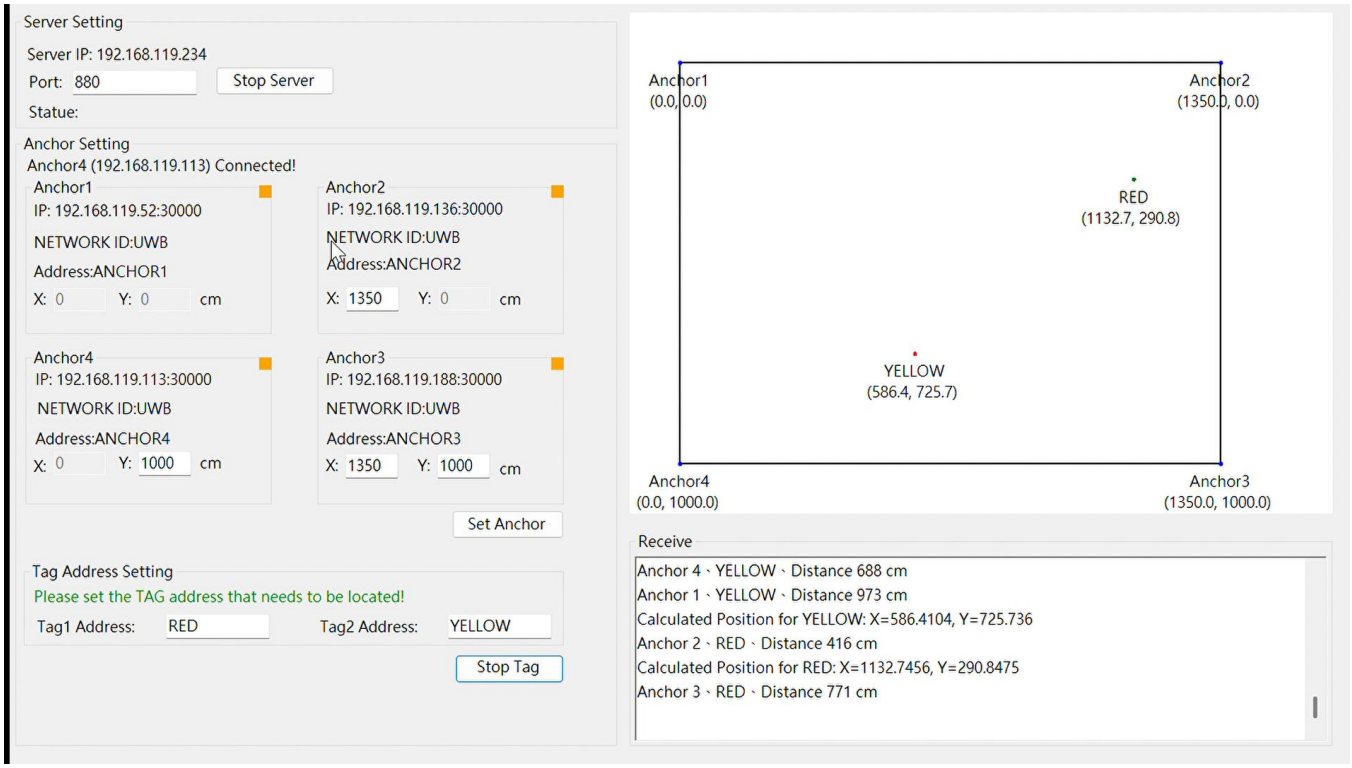


7. Start the positioning function.

[1] After clicking the TagPosition button, the system will begin to:

- Sequentially control the four Anchor nodes to send ranging commands to the specified Tag
- Receive distance data from all four Anchors
- Perform coordinate calculations and display the positioning result in real time on the right side of the screen

Please ensure that all Anchors and the specified Tag are properly connected; otherwise, positioning accuracy may be affected, or coordinates may not be displayed.



The demo video shown can be found at the following link:

https://drive.google.com/file/d/1TEHAn2-OCoVNocdL8bi1Km-acrew7pjD/view