

# **ROPPOR Server v1.0**

## **Start Guide**

Chemessen, Inc.



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ChemEssen Inc. is a software company. We are only responsible for the development and supply of swarm drone software and does not actually operate drone aircraft. The hardware related to parts and equipment, etc. and data such as mobile communication networks provided by us is only one example of testing the products of various manufacturers and the services of mobile carriers and confirming their integration with our software, and the durability of each hardware and mobile communication network.

It does not guarantee the stability, the function for a specific purpose, etc.

The user is solely responsible for the selection, interlocking, and operation results of all hardware and mobile communication networks outside the scope of the software.

Please select the hardware and mobile communication network that suits your purpose using the free trial version, which is provided unlimitedly regardless of the duration and number of drones, and be sure to verify its function, durability, stability, and malfunction. In addition, it is necessary to check and comply with the relevant laws and regulations of the country when drones are actually operated.

In addition to the software, the civil and criminal liability for all unforeseen circumstances and illegal operation including errors, malfunctions, accidents, human damages and property damages that may occur during interlock and operation of the drone body, parts, equipment, and mobile communication network selected by the user lies with the user, not with ChemEssen, Inc.



## About This Manual

This manual only provides the basic information to use the product and it was written since the download file has been constructed. There may be technical errors, editing errors, or omitted details. Content, composition, etc. of the manual may change without notice in advance upon improvement of performance and functions.

Please refer to the website for reporting error during use of ROPPOR Swarm Drone Software, suggestions, usage conversion for commercial purpose, technical support, individual training service, request for special flight authorization through subscription user conversion for lifting night flight restriction, altitude limit, and distance limit, and designation of number of operational drones, etc.

Description of Symbols (Legend)

### ※ References and Checklist



#### Caution and Things to Note



#### Restrictions and Warning

Things to understand before using the ROPPOR platform

Please read and understand the contents of the following documents before using the ROPPOR platform.

0. Preparation Process for ROPPOR Server Software
1. Configuration Guide for ROPPOR Swarm Drone Connection
2. Configuration Guide for ROPPOR RTK Connection
3. Installation Guide of ROPPOR Server Software
4. Installation Guide of Smart Device Application Software
5. Function Specifications of ROPPOR Server Ground Control Software



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## 1. Product Overview

### 1-1. Introduction

ROPPOR is a swarm drone software platform that can control multiple drones through a single computer. There is no limitation to the control distance since it is based on mobile communication network. Information collected by multiple drones are checked in real-time and saved automatically.

ROPPOR Server Swarm Drone Ground Control Software is installed on the ground control operation PCs at each regional flight site and integrated control center with video wall, connect to multiple swarm drones through servers, and control integrated multiple swarm drones real-time at the site and control center. Multiple drones may arrive at the way point at different times, but the departure time of the way point is synchronized, reducing the risk of collision between drones and resulting in aligned flight. Even in unexpected situations such as the loss of a drone or computer malfunction, the video information is safely and automatically stored in the server.

### 1-2. Basics Required for Product Operation

ROPPOR platform is a software platform that can control multiple swarm drones through a mobile communication network with dual security of security and user authentication and it features Pixhawk based flight controller (FC) and the companion computer Raspberry Pi with Smart Device Application Software (SDAS).

Therefore, you should prepare Pixhawk based flight controller, companion computer, LTE communication module, etc. for configuration of the drone connection with the ROPPOR platform.

※ **Please refer to the Configuration Guide for ROPPOR Swarm Drone Connection for more detail.**



## 2. Rules for Safe Operation

Please understand the following before using the product, and use the product according to the guide.

### 2-1. Environmental Concerns

- 1) Only fly in an authorized area within the country.
- 2) Only fly outdoors where GPS signal is effective when using this product.
- 3) Fly in an environment without electromagnetic wave and radio wave interference.
- 4) Only fly in ordinary weather conditions.
- 5) Check mobile communication received signal strength indicator (RSSI) in the flight area and avoid the communication-shadow area.
- 6) Secure a sufficient safety distance from the flight station where the drone will take-off and land.

### 2-2. Pre-flight Check

- 1) Check that ROPPOR has been updated to the most recent version.
- 2) Check the mobile communication received signal strength indicator (RSSI) in the flight area.
- 3) Check that the batteries have been charged sufficiently for all operating equipment such as the drone, controller, operation PC, mobile communication equipment, etc.
- 4) Check if there is any issue with the drone to be operated in the drone messages tab on ROPPOR screen.
- 5) Check the drone is ready to fly through configuration check in pre-flight.
- 6) Check for any collision between the drones, obstacles, etc. on the flight path.
- 7) Plan the flight after checking the manual flight with the remote controller (RC) before flight using ROPPOR.

### 2-3. Control

- 1) Check if the pilot is exhibiting any symptoms such as alcohol consumption, drug use, anesthesia, dizziness, fatigue, sickness, or any other physical or mental state that may hinder the capability of safely operating the drone.
- 2) Land the drone at a safe location for check when there is a warning for insufficient battery

or other flight related matters.

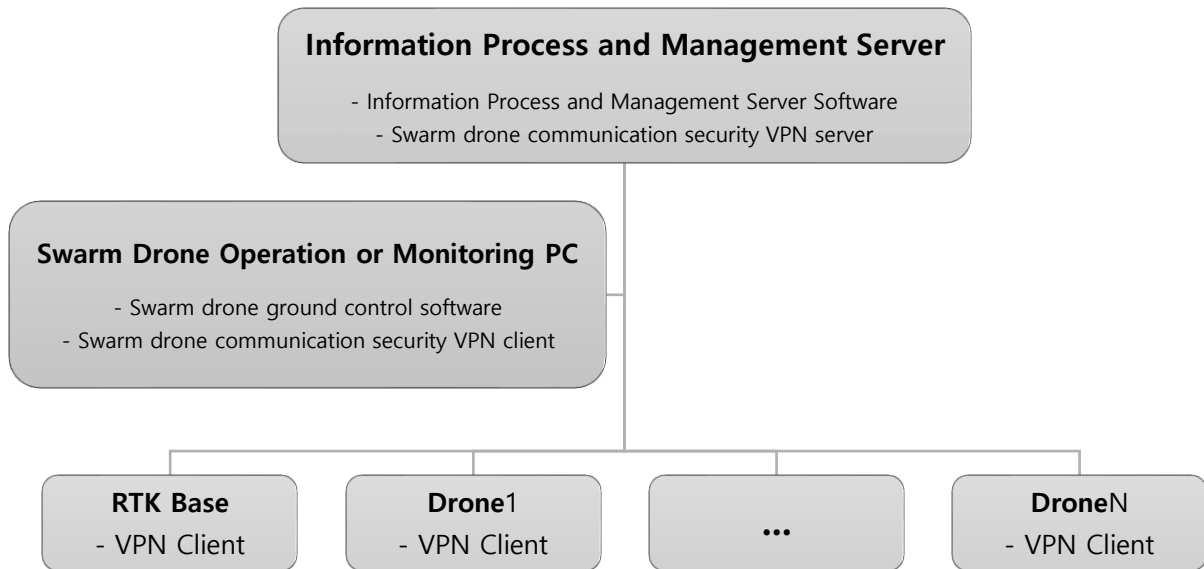
- 3) Always take caution and observe the status of the drone during flight.
- 4) Do not depend only on the flight path configured by the user or the ROPPOR system. Assess the situation appropriately to control the drone, and manually avoid the obstacles in a timely manner.
- 5) Warning messages, etc. on the system just supports the user so the user must directly take action for such instances.
- 6) This product features a flight pre-planned by the user, so user's cognitive abilities and decision making are very important.



### 3. ROPPOR Flight Preparation

This section explains the system configuration diagram for ROPPOR operation, overall composition of the ground station necessary for flight, and test flight for safe operation in phases.

#### 3-1 ROPPOR Server System Configuration Diagram



**Figure # 1 ROPPOR Server System Configuration Diagram**

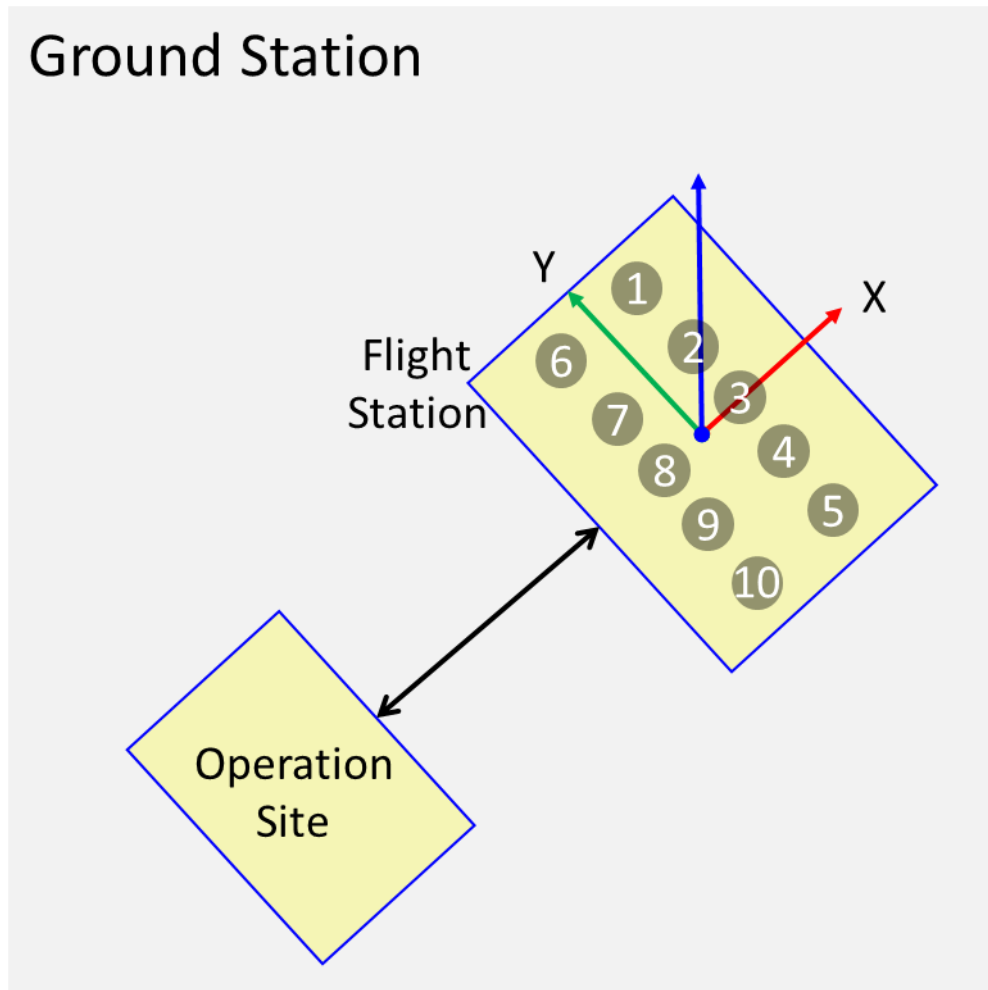
ROPPOR Server uses server PC for secure information process and management and also VPN for communication and security. Thus, Information Process and Management Server PC (hereinafter referred to as Server PC) and Swarm Drone Operation or Monitoring PC (hereinafter referred to as operation PC) are required. VPN client on the operation PC and VPN client on the RTK base and drone are constructed for communication and security even on shared IP through the VPN server of the Server PC. Therefore, the following steps of preparation are required for the use of the ROPPOR.

- 1) Launch VPN server, information process and management server software and NGINX on server PC
- 2) Launch VPN client on operation or monitoring (video wall etc.) PC
- 3) Launch ROPPOR installed on operation PC
- 4) Supply power to operational drone





### 3-2. Ground Station



**Figure # 2 Ground Station**

The ground station is divided into operation site and flight station. The operation site should have equipment necessary for operation such as the operation PC installed, and be able to monitor the takeoff/landing of the drone. Therefore, Secure sufficient distance from the flight station and choose a safe location where takeoff and landing of the drones can be visually confirmed for the operation site. Also, make preparations for immediate use of controllers for quick action upon emergencies. You need proper equipment to continuously supply power to the devices that use electricity such as the operation PC, mobile communication devices, etc. during the operation. Flight station should be assigned for safe takeoff and landing of the drone (consistent gaps and direction). Select a wide open space without obstacles against collision into the drones during takeoff and landing, and a location where the drones can be placed with enough space and suitable for designed performance formation for the performance.



1) Software Preparation for Operation

Prepare the operation software as follows to use the swarm drone ground control software.

1-1) Launch VPN server on the Server PC and click [Connect].

※ Please refer to the “Installation Guide for ROPPOR Server Software” document for the VPN server installation.

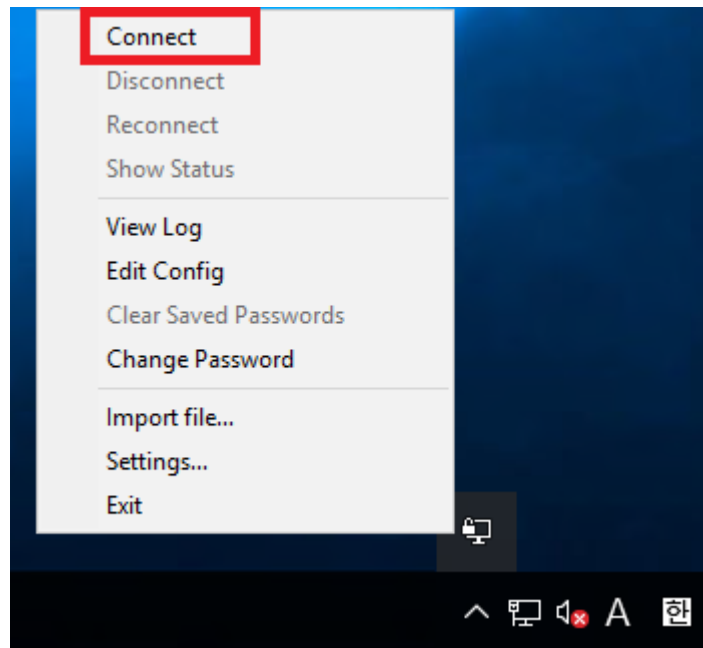


Figure # 3 VPN Connection

1-2) After connecting, check the server connection and assigned IP.

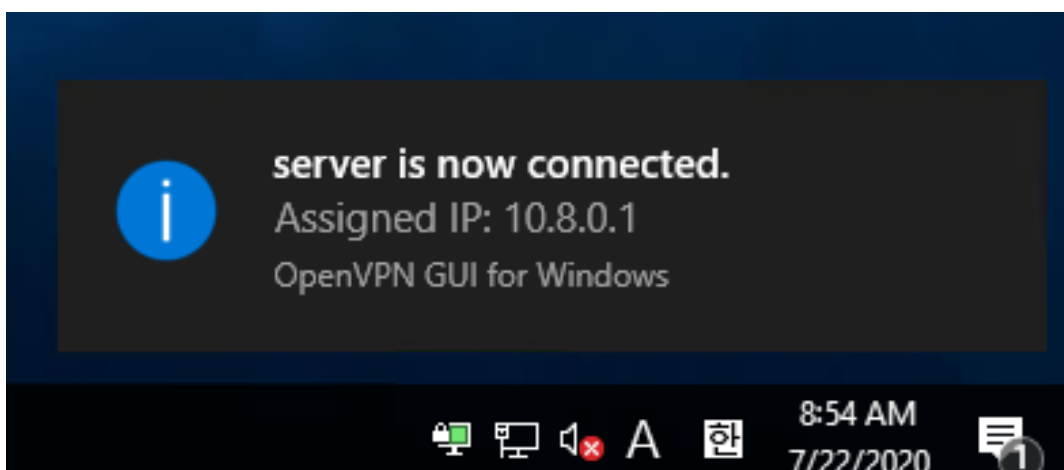


Figure # 4 VPN – Server Connection Check

※ IP of server PC is fixed at “10.8.0.1”

1-3) Launch VPN client on the operation or monitoring PC, click [Connect], and check client



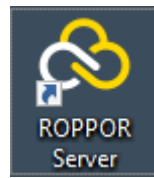
connection and assigned IP.



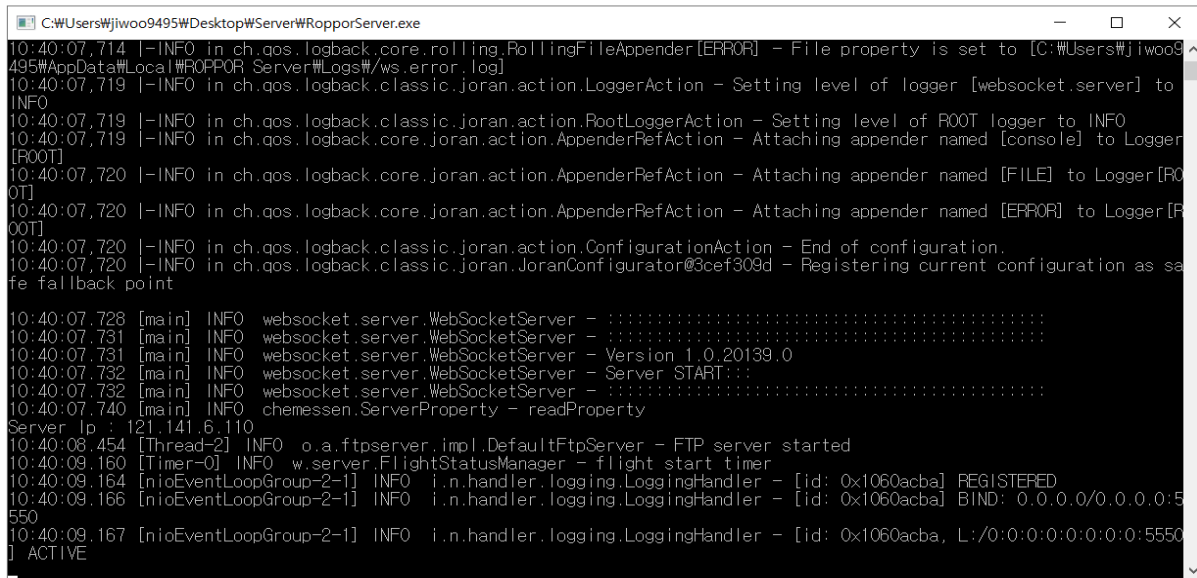
**Figure # 5 VPN Client Connection Check**

※ VPN client IP for the operation PC, RTK base, and drones are automatically assigned once connected to the VPN server.

1-4) Click the shortcut icon for “ROPPOR Server” installed on the desktop of the server PC or the Windows Start menu to launch the information processing and management server software (hereinafter referred to as “ROPPOR Server”).



**Figure # 6 ROPPOR Server Shortcut Icon**

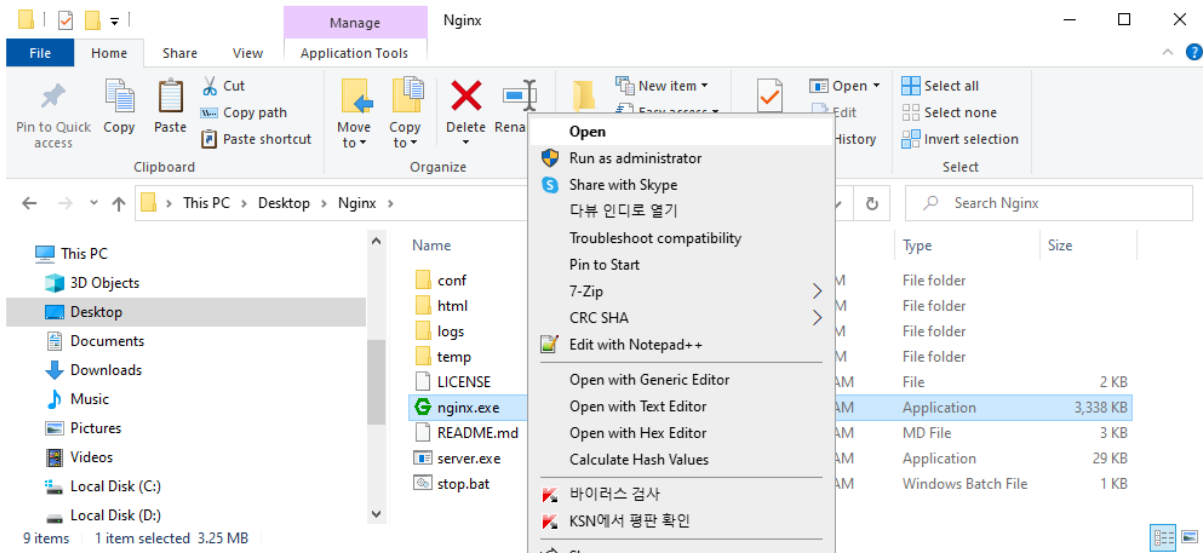


**Figure # 7 ROPPOR Server Launch Screen**

※ Do not click the ROPPOR Server launch screen when the server is in operation. The process stops running when clicked; If clicked, press [Enter] to operate again.

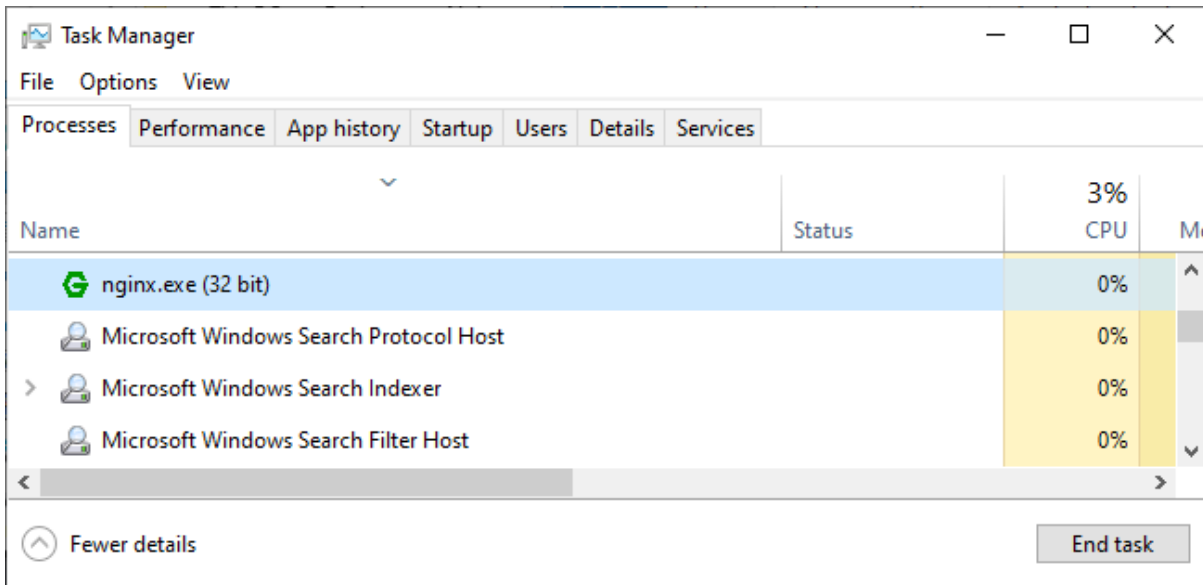


### 1-5) NGINX Execute on Server



**Figure # 8 nginx.exe – Open**

1-6) Click [Ctrl + Shift + ESC] and launch [Task Manager] and check [nginx.exe (32 bit)] background process running on [Task Manager > Processes] tab.



**Figure # 9 Task Manager – nginx.exe Check**



1-7) Launch ROPPOR installed on the operation or monitoring PC.



Figure # 10 ROPPOR Icon

1-8) After Launch ROPPOR, click the Environment Settings Icon on the top right side.

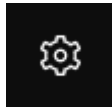


Figure # 11 Environment Settings Icon

1-9) Check the information of Main Server.

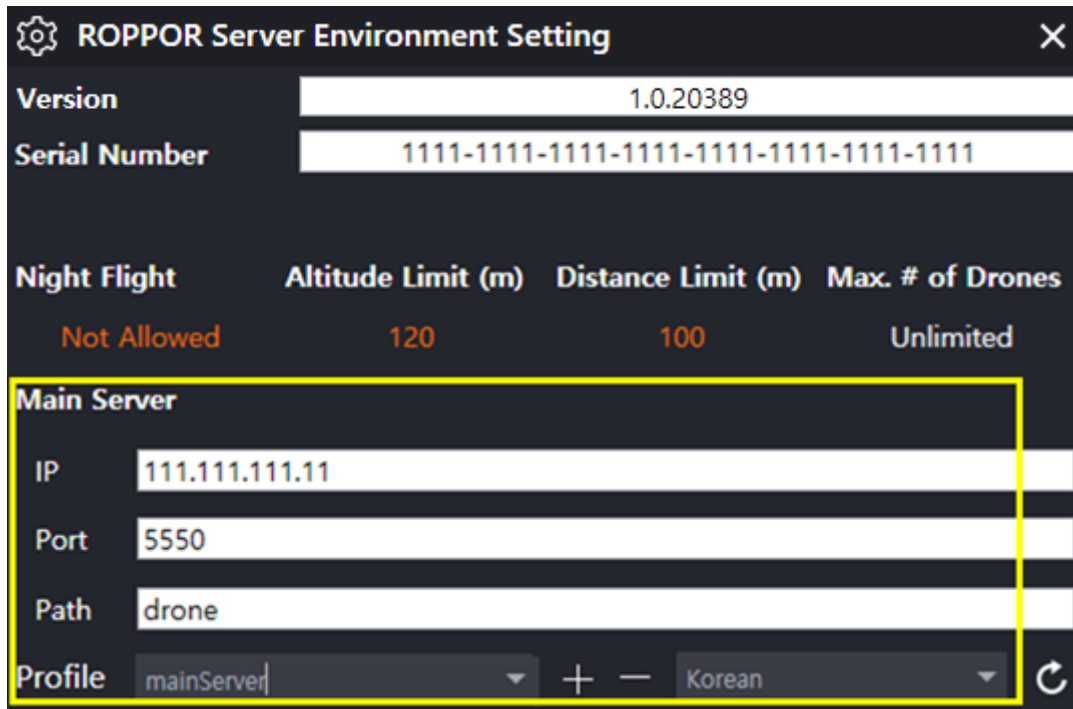


Figure # 12 ROPPOR – Environment Settings

※ Please refer to the Installation Guide for ROPPOR Server Software and Function Specifications of ROPPOR Server Ground Control Software for more detailed installation and execution method.

**!** Connection with ROPPOR does not take place if you supply power to the drone without preparing the operation software on server PC

## 2) RTK Base Preparation (Option)

ROPPOR support the RTK technology which is more improved than GPS for a precise flight.

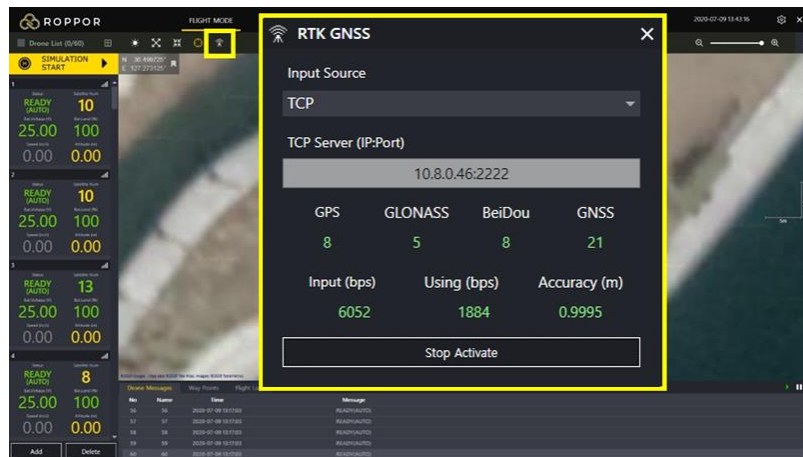
※ Please refer to the **Configuration Guide for ROPPOR RTK Connection** for more detailed installation and execution method.

After preliminary preparation, RTK base should be installed at a location without radio wave and satellite reception interference within the ground station.

※ Provided by U-blox : [1](#) / [2](#)



**Figure # 13 RTK Base Installation**



**Figure # 14 ROPPOR – RTK GNSS Check**

Turn on the power for RTK base with ROPPOR launched, and check the reception status on RTK GNSS window. Before flight, check for accuracy (unit in meters) converge below the configured value, rapid change/decrease in number of effective receiving satellites, etc. for the RTK base device.

★ When you use the LTE device over a long period of time with the SIRIUS RTK BASE power, power may shut down.



### 3-3. Test Flight

Preliminary test for flight, etc. along with drone configuration check are required before the swarm flight.

Preliminary test is conducted for each drone and it is carried out in phases of pre-flight check, drone assignment, controller check flight, and ROPPOR check flight.

#### 1) Pre-flight Check and Drone Assignment

Check the drone and operating equipment according to the user check regulations for the flight.

※ **Ardupilot provision** : <https://ardupilot.org/copter/docs/checklist.html>

Prepare the drone as follows for the flight test when there is no error as a result of the check.

1-1) Assign 1 drone at the center of the flight station. Then supply power to the drone.

1-2) Check the drone status and RTK reception status on ROPPOR screen.

#### 2) Controller Check Flight

Check for any issues in drone activity and basic flight through the controller through the following steps.

2-1) Check that the drone flight ready status in loiter mode, arm, and takeoff with the controller.

2-2) Elevate to a certain level of altitude (within 3m approximately) after takeoff, and check that the drone is hovering still.

2-3) Check that other modes aside from the loiter mode can be switched and applied through the controller.

**!** If the mode of the drone cannot be changed through the controller, control transfer (ROPPOR -> Controller) may not be possible in case of emergencies. You must check.

**!** Control transfer : ROPPOR flight is switched into guided mode aside from RTL (Return To Launch) and LAND functions. Therefore, the drone will not react even if the controller wheel is moved during ROPPOR flight (Guided mode) since the controller does not have control. Transfer or withdrawal of drone control for the controller during ROPPOR flight, you must switch to a different flight mode from the guided mode. After switching to another flight mode, control is transferred to the controller and all pre-planned flights are canceled. If the



power of the controller for the drone is off or if the throttle of the controller is below neutral level (50%), caution is required for the drone may crash.

★ Switching the mode with the controller when multiple drones bound to a single controller during ROPPOR flight to transfer control is very dangerous since multiple drones are being controlled together.

2-4) Fly at user's discretion and according to flight check regulations to check if the control is effective.

2-5) When there are any issues while performing the steps above, the drone must be checked hardware configuration or setting.

✂ Ardupilot provision : <https://ardupilot.org/copter/docs/common-when-problems-arise.html>

### 3) ROPPOR Check Flight

Check for any issues in command execution and **configuration** through the functions on the dashboard of the ROPPOR. Select the **drone** and proceed as follows.

! Proceed as you observe the drone with the controller prepared since it is a ROPPOR flight, not a controller flight.



Figure # 15 ROPPOR - Dashboard





3-1) Check if the drone can arm by clicking [ARM] on the dashboard window.



Figure # 16 ROPPOR – Dashboard - ARM

3-2) Check if the drone can disarm by clicking [DISARM] on the dashboard window.



Figure # 17 ROPPOR – Dashboard - DISARM

3-3) Configure the altitude on the dashboard, and click [TAKEOFF] to check that the drone takes off and hovers.

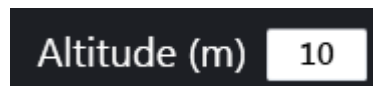


Figure # 18 ROPPOR – Dashboard - Altitude



Figure # 19 ROPPOR Art – Dashboard – TAKE OFF

3-4) Check if the drone can land by clicking [LAND] on the dashboard window.



Figure # 20 ROPPOR – Dashboard - LAND

3-5) Check if the drone control can be transferred to the controller by clicking [LOITER] on the dashboard window.



Figure # 21 ROPPOR – Dashboard - LOITER

**!** The throttle should be positioned at neutral (50%) with the controller power on for the drone.



★ Do not use when the controller power is off or control for the drone is unprepared.

3-6) Check if the drone control can return to launch location by clicking [RTL] on the dashboard window. (Return To Launch)



Figure # 22 ROPPOR – Dashboard – RTL

3-7) Click [BRAKE] on the dashboard window to check if safety measures can be taken after stopping the flight, switching the mode again, and landing.

ex) [RTL] execution -> [RTL] operation -> [BRAKE] execution -> [RTL] stop -> Controller mode switch -> Land

It suspends all control including the controller for the selected drones and the pilot can directly switch modes, and take other safety measures when issues such as drone position breakaway occur.



Figure # 23 ROPPOR Art – Dashboard – BRAKE



## 4. ROPPOR Flight

Once you have completed the preliminary checking and preparation, we recommend learning how to use and practice swarm flight and studying methods for safe operation. Operation may become more familiar as more flights are performed but users should always establish their own principles and check the drone and equipment carefully. Caution is required before, during, and after flight.

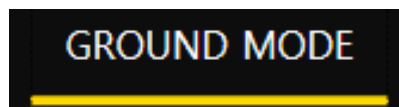
### 4-1. Editing and Planning Paths

You can edit paths for ROPPOR's swarm drones as planned in [GROUND MODE].

※ **For more information on basic map control and path editing, see the Function Specifications of ROPPOR Server Ground Control Software.**

You can edit and plan paths as in the following:

- 1) Click [GROUND MODE] on top of the ROPPOR screen.



**Figure # 24 ROPPOR – GROUND MODE**

- 2) Select drones at READY status whose flight paths will be edited.



**Figure # 25 ROPPOR – GROUND MODE – Select Drones**



3) According to the flight plan, select all or individual drones, specify locations of way points, enter altitude value to edit paths.

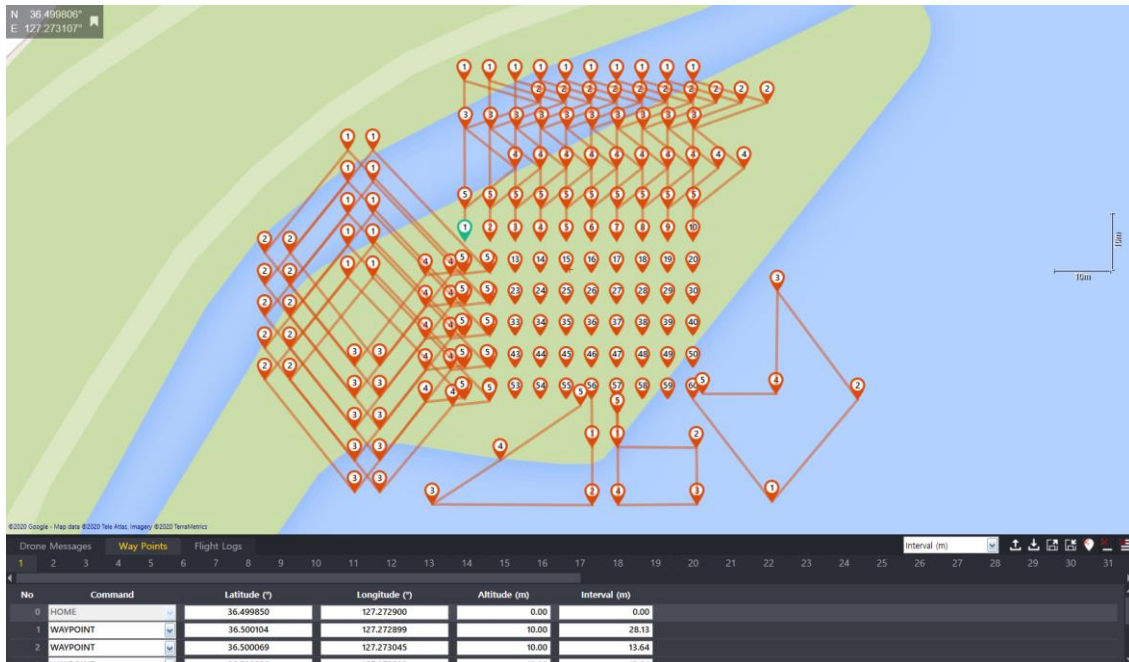


Figure # 26 ROPPOR – GROUND MODE– Edit paths

- ★ When planning a flight of multiple drones, make plans in order to prevent drones from crossing each other on their flight paths or colliding with each other due to overlapping location of the way point with the same sequence.
- ! After flight to the final destination, the drone is automatically switched to RTL (Return to Launch), returns to the departure location and lands.
- ★ Therefore, when planning a swarm flight of two or more drones, make sure to set the final destination as the initial departure location in order for drones to safely and vertically land on the departure location in RTL.

4) When a path has been edited in [GROUND MODE] according to the user’s plan, upload the path and download it to make it available for monitoring in flight mode.



Figure # 27 ROPPOR – GROUND MODE – Upload/Download

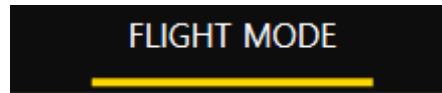
- ★ Do not start a flight without uploading. Please note that flight follows the path previously uploaded.



#### 4-2. Path Confirm and Flight

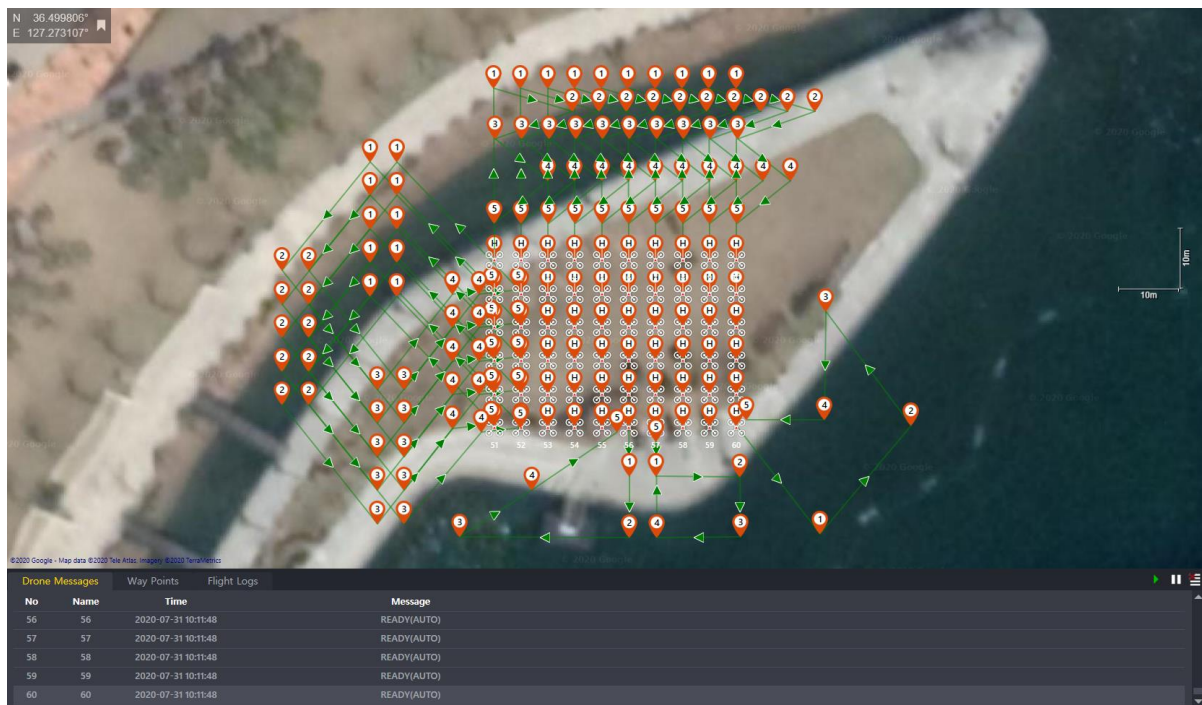
With ROPPOR's swarm drones, you can download in [GROUND MODE] the path previously uploaded and view it in [FLIGHT MODE]. Proceed as follows for flight.

1) Click [FLIGHT MODE] on top of the ROPPOR home screen.



**Figure # 28 ROPPOR – FLIGHT MODE**

2) Check and confirm the uploaded and downloaded paths.



**Figure # 29 ROPPOR – FLIGHT MODE – Check and confirm paths**



3) Select drones with flight plans on the dashboard.

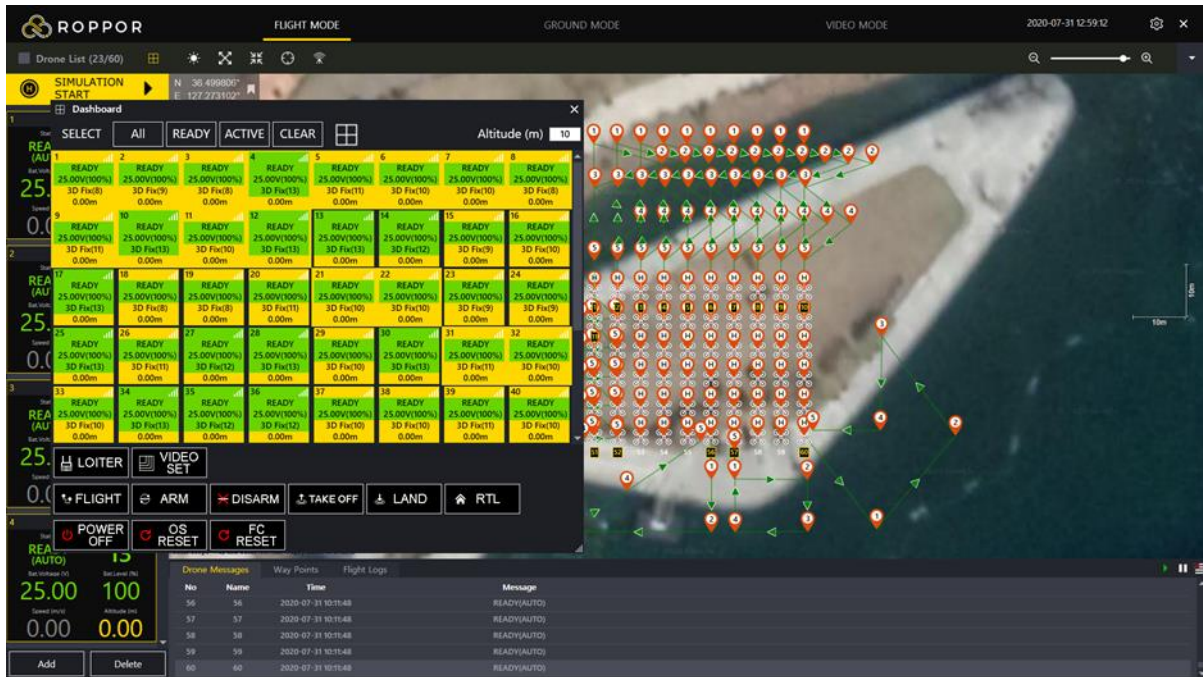


Figure # 30 ROPPOR – FLIGHT MODE/Dashboard – Select and check drones

**!** Check the selected drones again through Dashboard, Drone List, or map.

4) After going over all of the previous steps again, launch [FLIGHT] of Dashboard window to check swarm flight.



Figure # 31 ROPPOR – Dashboard - FLIGHT

**!** Prior to flight, prepare the controller for immediate use, and during flight, continuously monitor the drone condition and pay constant attention until the flight is completed.