

Quick Start Guide

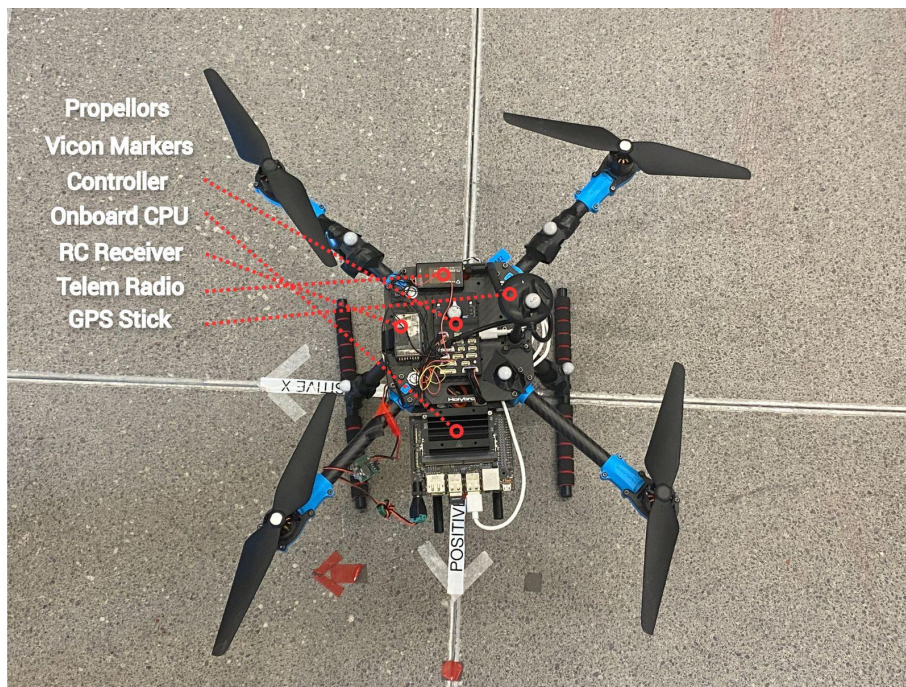
Please **read** and **become familiar** with the steps in this guide in its **entirety** for the first flight to ensure a safe flight with no crashes. Failing to do so is a safety hazard, and no one should try to use this repo without doing so.

Pre-flight

(Assuming that all requirements are met in the setup-guide)

Safety Check 1: Hardware Safety Check

- ☐ Make sure all hardware components are on the drone, specified below



- ☐ Make sure all wires on the drones are well away from the propellers
- ☐ Make sure the propellers and other components are firmly attached

Prior to Drone Power-up:

- ☐ Make sure all computer devices are connected to TP-Link_ROB498
- ☐ Turn on the Vicon System and place the drone at the centre of the room, facing towards the far wall
 - ☐ Confirm the Vicon Computer can detect the Drone's Markers on the Vicon Computer
- ☐ Turn on the Ground Control Station (GCS) and plug a telemetry radio into the GCS

GCS refers to the computer from which the drone is monitored and missions are sent.

Power on checklist:

- ☐ MAKE SURE KILL SWITCH IS ON AND DRONE IS DISARMED on the RC controller

- ☐ Set the throttle (left joystick) to zero (bottom) and turn on RC controller
 - ☐ Check battery level of remote control - > larger than 7.5 V
- ☐ Confirm the Onboard Computer is disconnected from the controller's USB port
- ☐ Put on kevlar gloves and glasses and go to drone and plug battery in
- ☐ Check for GPS light is blue, X8R RC receiver is solid green, and telemetry receiver is flashing red
- ☐ Make sure the kill switch and arm switches, as well as the drone itself, are working by quickly executing the following steps in order (READ FIRST THEN EXECUTE)
 - ☐ turning off the kill switch
 - ☐ setting throttle to zero
 - ☐ arming the drone
 - ☐ letting the propellers spin
 - ☐ disarm the drone
 - ☐ and killing the drone in that succession
 - ☐ Disarm/Arm is Left switch Down/Up
 - ☐ Kill/Unkill is Right Switch Up/Down

Position Lock Software Commands:

Open 5 terminals and run the setup scripts below (in ssh terminal, run only the last 3 scripts immediately after ssh into the onboard computer):

Sourcing:

- source ~/ros2-vicon-receiver/vicon_receiver/install/setup.bash
- source ~/ROS2_ViconDroneCtrl/flight_controller_ws/install/setup.bash
- source ~/px4_ros_com_ros2/install/setup.bash
- source ~/ros2_decawave/install/setup.bash

Terminal 1: Run QGC App

- run in terminal 1: ~/Downloads/QGroundControl.AppImage
- When QGC opens:
 - Check battery level of drone (QGC) -> larger than 16.4 V
 - Check MPC_THR_HOVER in parameters, and set it to 18%

Terminal 2: Run position publisher from GCS to Onboard Computer

- run in terminal 2: ros2 launch vicon_position_bridge graphing_launch.py

Terminal 3 (ssh): ssh into Onboard and create MicroRTPS Agent/Client Bridge

- run in terminal 3: ssh rob498@10.42.0.132
- Once ssh is successful, connect the drone's offboard computer and controller via the USB cable and run setup scripts.
- In QGC App, click on the Q icon in the top-left corner, and open Analyse Tools
- Go to MAVLink Console, and in the console, type in the following command

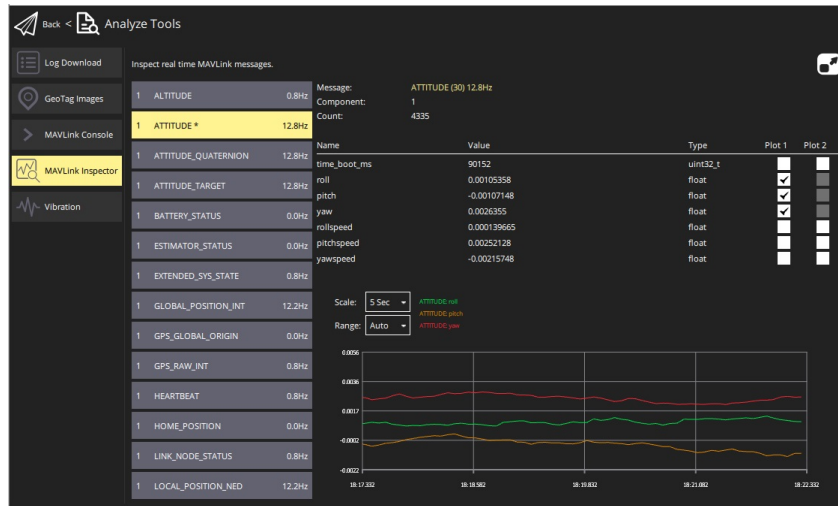
- micrortps_client start -d /dev/ttyACM0 -b 57600
- run in ssh terminal 3: micrortps_agent start -d /dev/ttyACM0 -b 57600

Terminal 4 (ssh): ssh into Onboard and receive position messages from GCS

- run in terminal 4: ssh rob498@10.42.0.132
- run in ssh terminal 4: ros2 run vicon_position_bridge pose_sub

Safety Check 2: Position Lock Safety Check

Checking if QGC is taking in the Position Lock:



- If all nodes run successfully at this point, the drone should show in analyse tools on QGC that it is accepting the vicon's position lock, as shown above.

Quick Sanity Check (Recommended if someone has confirmed the pipeline is working):

- If the drone is placed in the centre of the room facing the far wall, the drone's orientation and position should be as follows
- Position Sanity Check (Under Local Position NED): $x = 0$, $y = 0$, $z = -0.26$
- Rotation Sanity Check (Under Attitude): $\text{roll} = 0$, $\text{pitch} = 0$, $\text{yaw} = 1.6$
 - Compass in the main screen on QGC should be pointing east.

Full Sanity Check (Recommended if this is first time flying):

- Position Sanity Check (Under Local Position NED):
 - When moving the drone positive Z (in vicon), Z position should become more negative
 - When moving the drone in positive X (in vicon), X position should become more positive
 - When moving the drone in positive Y (in vicon), Y position should become more negative
- Rotation Sanity Check (Under Attitude):
 - When Drone is facing towards positive x, heading should be pointing north

- Rolling to the Drone's right should give positive Roll
- Yawing to the Drone's right should give positive Yaw
- Pitching to the Drone's front should give negative Pitch

Offboard Control Software Commands:

Terminal 5 (ssh): keyboard controller

- Disable the drone's kill switch
- Before executing the next step, please read ahead and ensure to familiarise with all the remaining steps, as flight will require full attention to the drone.
- Run the following command in terminal 5 and arm the drone at the same time:
 - `ros2 launch control_launch.py`

During-flight

An important safety warning:

DO NOT STOP ANY OF ROS2 NODES WHEN THE DRONE IS ARMED AND FLYING IN OFFBOARD MODE.

- *This will cause the drone to exit offboard mode and potentially crash, so if any of the nodes are not running or have crashed, land or kill the drone immediately*

The three lists below will concern the `command_launch` node, takeoff, and landing:

Command Launch Node:

- The `control_launch` node should be the terminal the user is seeing when flying, as it prints messages containing the following information, portrayed by the example below:
 - `[command_control-2] KEY: z`
 - the last keybind is z
 - `[command_control-2] REACHED/MODE:False True`
 - First False - it has not reached the setpoint,
 - Second True - it currently is in manual mode
 - `[command_control-2] POSE:0.0 0.0 0.0`
 - The current position of the drone is at (0, 0, 0)
 - `[command_control-2] SET:0.0 0.0 -0.25`
 - The current target position setpoint of the drone is at (0, 0, -0.25)
- Keep in mind that the height of the drone's position is negative. Therefore -4 in the z position actually means 4 metres above the ground.
- Additionally, the drone's body height is around -0.25 metres, so therefore -0.25 is actually "ground-level"

- When the control_launch node is running, the GCS keyboard will be sensitive and can be used to control the drone. The controls are as follows:
 - Manual:

- w: Forward, (East, Neg Y)	i: Up
- a: Left, (North, Pos X)	j: Yaw - Counter Clockwise
- s: Back, (West, Pos Y)	k: Down
- d: Right, (South, Neg X)	l: Yaw - Clockwise
 - ---
 - Autonomous
 - c: Control Mode/Hold
 - **x: Failsafe Land**
 - **(will not activate when the drone is 15 cm above ground)**
 - r: Land (Return)
 - f: Float (Hover 20cm)
 - q: Square Loop
 - e: Circle Loop
 - h: Helix Loop
 - t: Linear Setpoints
 - y: Continuous Setpoints
- When the drone is in flight, users may choose to run an autonomous mission to manually control the drone.
 - Running an autonomous mission requires the drone to be at the takeoff point
 - For running autonomous missions, pressing any one of the autonomous missions buttons once will start the mission
 - However, pressing any of the manual control buttons during flight will make it go back to manual control.
 - Users may use the terminal to see the drone's current setpoint to adjust the current setpoint manually.
 - The drone should not be flying outside of the yellow square or higher than 4 metres in the air.

TakeOff:

- When the drone is initially armed by the control_launch node and the RC joystick controller, **it will disarm** quickly if it does not take off.
 - If this does occur, disarm the arm switch, kill the kill switch, and shut down the command_control ROS2 launch file and restart from the step prior to the During Flight section.
- Therefore, as soon as the drone is armed, please either immediately start an autonomous mission, or manually raise the drone's using the manual controls to

increase the height of the current setpoint to 20 cm above ground (use keys i and k)

Landing:

- Before Landing the drone, be sure to manually lower the drone's height to lower than 15 cm off the ground.
- When landing, be sure to press 'X', or whatever the kill switch keybind is. This should kill the drone and stop it from landing.
 - **As per the safety warning, DO NOT KILL THE COMMAND_CONTROL NODE BEFORE DISARMING/KILLING THE DRONE FIRST.**
- Lastly, after confirming the drone has been killed, disarm the disarm switch and kill the kill switch

Post-flight

Prior to entering the flight space:

- ☐ Make sure the propellers are no longer spinning
- ☐ Make sure the drone is disarmed and the kill-switch is on
- ☐ Stop the following running pipeline components:
 - ☐ Can keep the vicon client running
 - ☐ Stop all nodes running on the Onboard
- ☐ Shut-down the nano from the SSH

Inside the flight space:

- ☐ 1 person put on kevlar gloves and glasses and go to drone
- ☐ Unplug the battery

Cleaning up:

- ☐ Turn off the vicon client on the GCS
- ☐ Turn off the vicon system with remote
- ☐ Turn off the RC controller for the drone.