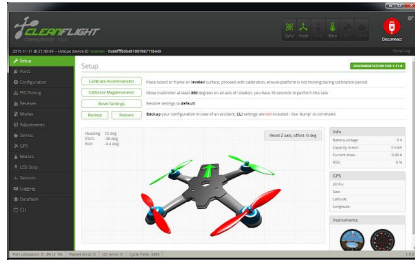
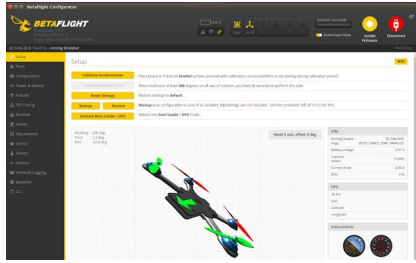


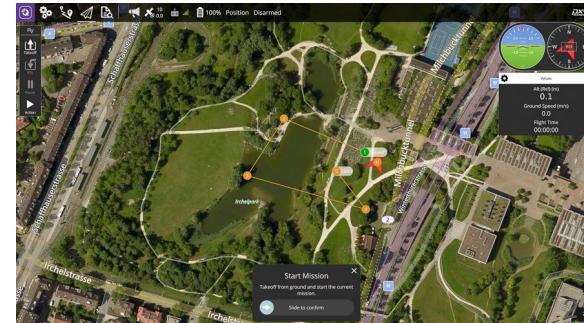
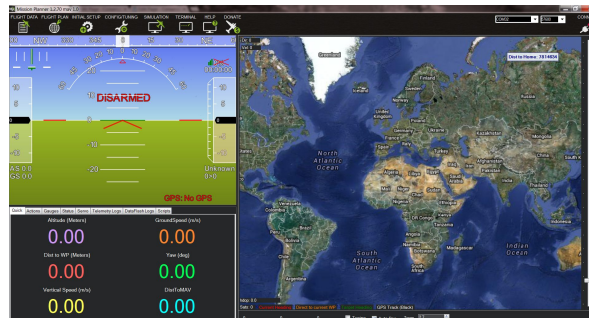
Ground Control Station (GCS)

- Ground Control Stations (GCS) are **ground-based** hardware and software that allow UAV operators to communicate, control, and configure a drone
- **Configuration** parameters are set for normal drone operation or autonomous operation





Proprietary - DJI, Naza, etc.



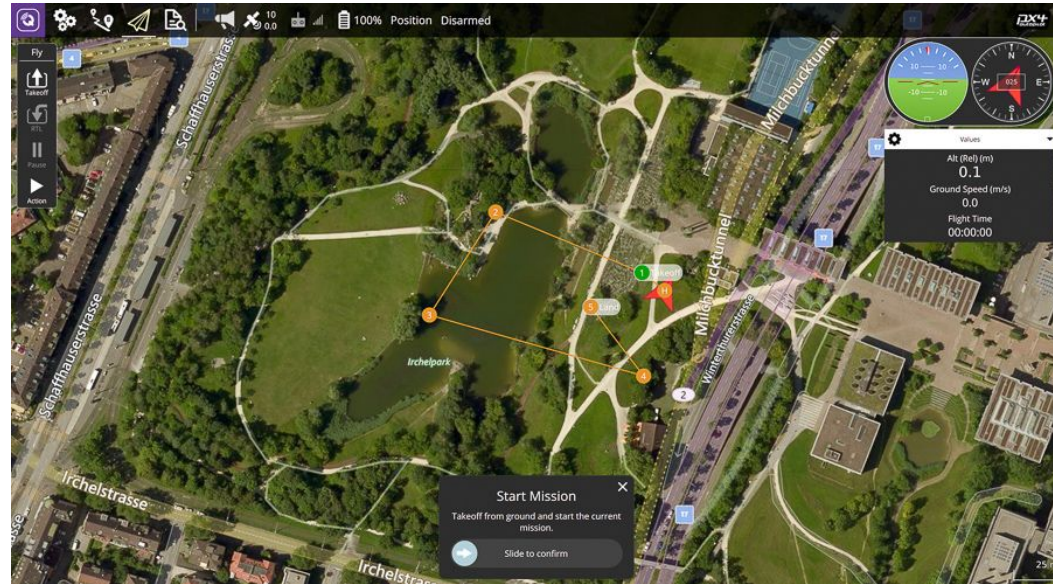
QGroundControl



<http://qgroundcontrol.com/>

Key features:

- Open Source Software
- PX4 and ArduPilot firmware
- Multirotor, fixed wing
- Windows, Mac, Linux, Android



QGroundControl

Back < Vehicle Setup

Summary

Below you will find a summary of the settings for your vehicle. To the left are the setup menus for each component.

Airframe	Sensors	Radio	Flight Modes	Power
System ID: 1	Compass 0: Ready	Roll: 1	Mode switch: Channel 8	Battery Full: 4,050
Airframe type: Quadrotor x	Compass 1: Ready	Pitch: 2	Flight Mode 1: Stabilized	Battery Empty: 3,300
Vehicle: Generic Quadcopter	Gyro: Ready	Yaw: 4	Flight Mode 2: Unassigned	Number of Cells: 4
Firmware Version: 1.11.3	Accelerometer: Ready	Throttle: 3	Flight Mode 3: Unassigned	
Custom Fw. Ver.: 0.0.0		Aux1: 12	Flight Mode 4: Position	
		Aux2: 7	Flight Mode 5: Unassigned	
			Flight Mode 6: Mission	

Step 1 Step 2 Step 3 Step 4 Step 5

Safety	Camera
Low Battery Failsafe: Warning	Trigger interface: Generic PWM (IR trigge...
RC Loss Failsafe: Return mode	Trigger mode: Time based, on command
RC Loss Timeout: 1.0 s	AUX pins: 56
Data Link Loss Failsafe: Disabled	
RTL, Then: Land immediately	

Step 6 Step 7









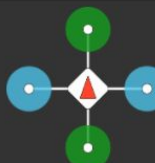
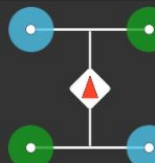
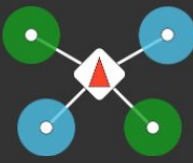

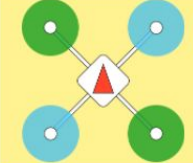
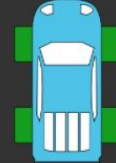






Parameters ← Step 8

1. Airframe configuration
2. Calibrate sensors (compass, gyro, accel)
3. RC remote radio channels
4. Flight modes
5. Power, ESC
6. Motors
7. Safety features
8. Custom parameters (safety switch, OSD, etc.)

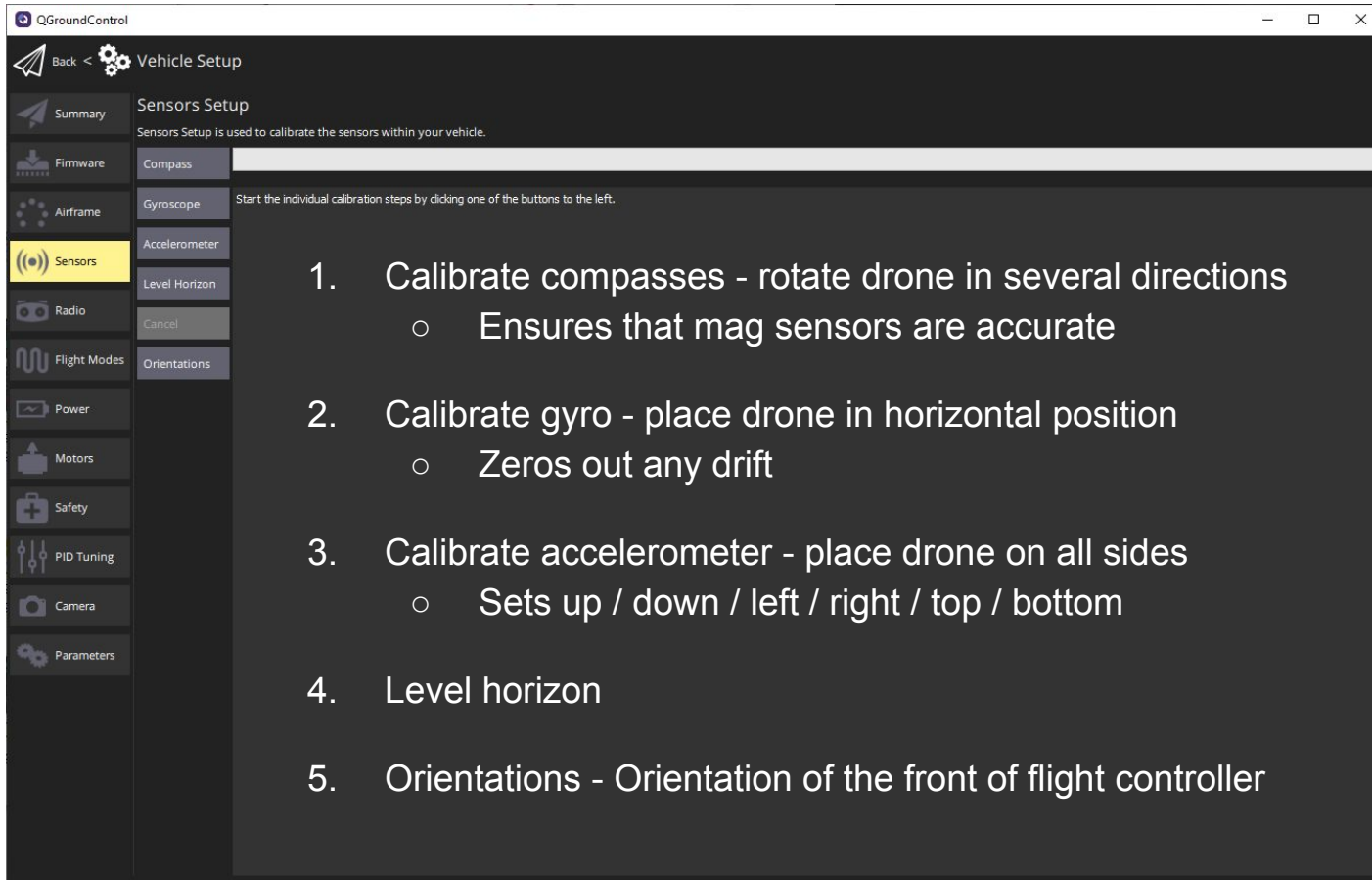
Step 1 - Airframe

QGroundControl Vehicle Setup


Summary
Firmware
Airframe
Sensors
Radio
Flight Modes
Power
Motors
Safety
PID Tuning
Camera
Parameters

Helicopter	Hexarotor +	Hexarotor Coaxial	Hexarotor x	Octo Coax Wide	Octorotor +
					
Blade 130X	Generic Hexarotor + geometry	Generic Hexarotor coaxial geometry	Generic Hexarotor x geometry	Steadidrone MAVRIK	Generic Octorotor + geometry
Octorotor Coaxial	Octorotor x	Plane A-Tail	Plane V-Tail	Quadrotor +	Quadrotor H
					
Generic 10" Octo coaxial geometry	Generic Octorotor X geometry	Applied Aeronautics Albatross	X-UAV Mini Talon	Generic 10" Quad + geometry	Reaper 500 Quad
Quadrotor Wide	Quadrotor asymmetric	Quadrotor x	Rover	Simulation (Copter)	Simulation (Plane)
					
Team Blacksheep Discovery	Spedix S250AQ	Generic Quadcopter	Generic Ground Vehicle	HIL Quadcopter X	HILStar (XPlane)
Simulation (VTOL)	Standard Plane	Standard VTOL	Tilt-Quad	Tricopter Y+	Tricopter Y-
					

Step 2 - Sensors



QGroundControl

Back <  Vehicle Setup

Summary Sensors Setup

Sensors Setup is used to calibrate the sensors within your vehicle.

Firmware Compass

Airframe Gyroscope Start the individual calibration steps by clicking one of the buttons to the left.

Sensors Accelerometer

Radio Level Horizon

Flight Modes Cancel

Power Orientations

Motors

Safety

PID Tuning

Camera

Parameters

1. Calibrate compasses - rotate drone in several directions
 - Ensures that mag sensors are accurate
2. Calibrate gyro - place drone in horizontal position
 - Zeros out any drift
3. Calibrate accelerometer - place drone on all sides
 - Sets up / down / left / right / top / bottom
4. Level horizon
5. Orientations - Orientation of the front of flight controller

Step 3 - Radio

QGroundControl

Back < Vehicle Setup

Summary **Radio Setup**

Radio Setup is used to calibrate your transmitter. It also assign channels for Roll, Pitch, Yaw and Throttle vehicle control as well as determining whether they are reversed.

Attitude Controls

Roll

Pitch

Yaw

Throttle

Mode 1 Mode 2

Channel Monitor

1 2

3 4

5 6

7 8

9 10

11 12

13 14

15 16

17 18

Additional Radio setup:

AUX1 Passthrough RC channel AUX2 Passthrough RC channel

PARAM1 tuning channel PARAM2 tuning channel

PARAM3 tuning channel

Spektrum Bind Copy Trims

Calibrate

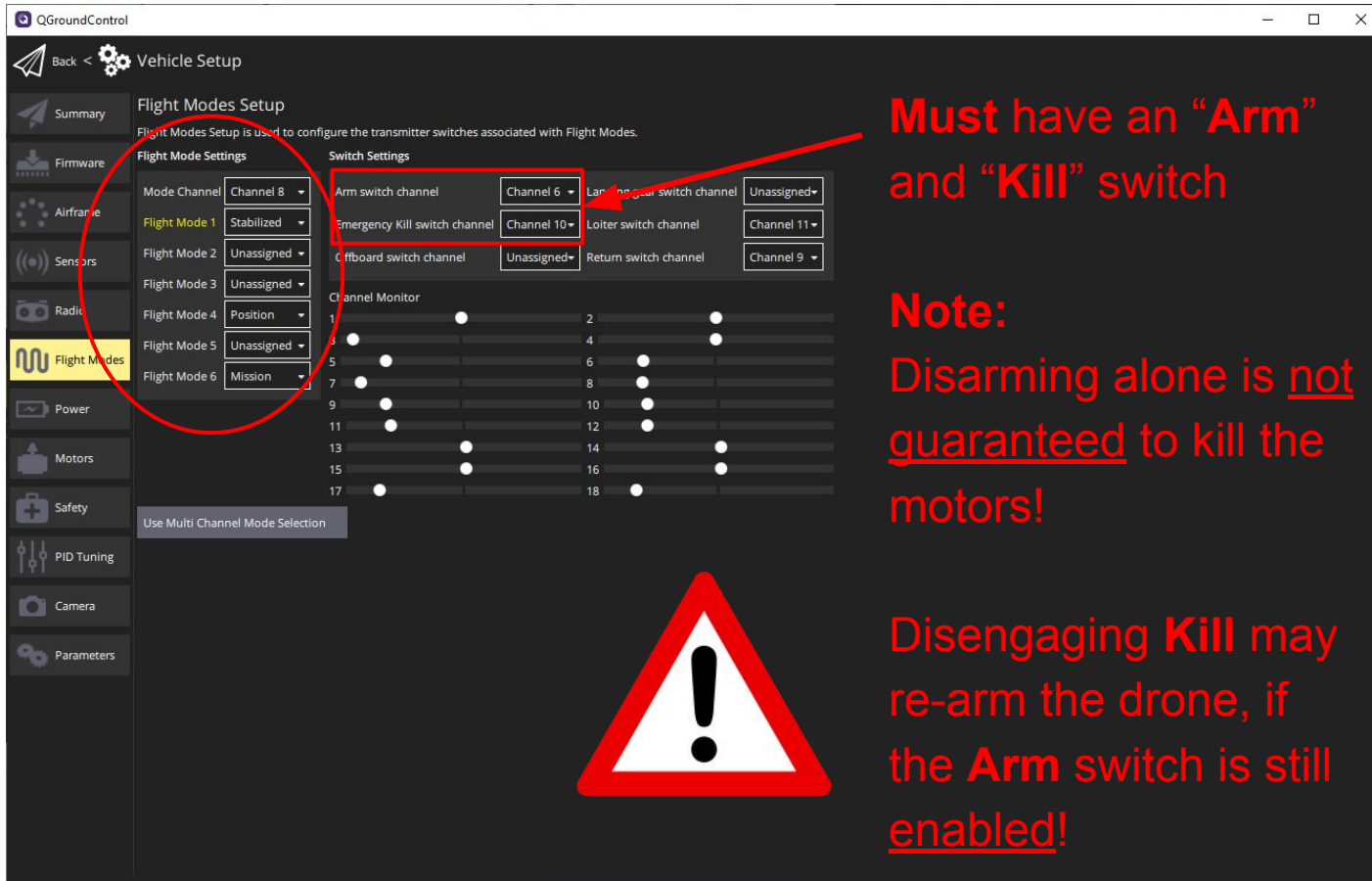
Skipped Cancel

Calibrate RC remote end points

Ensures channels used are recognized

Sets the first 2 auxiliary outputs to control servos or other actuators

Step 4 - Flight Modes



QGroundControl

Back < Vehicle Setup

Summary

Flight Modes Setup is used to configure the transmitter switches associated with Flight Modes.

Firmware

Airframe

Sensors

Radio

Flight Modes

Power

Motors

Safety

PID Tuning

Camera

Parameters

Flight Modes Setup

Flight Mode Settings

Switch Settings

Mode Channel Channel 8

Flight Mode 1 Stabilized

Flight Mode 2 Unassigned

Flight Mode 3 Unassigned

Flight Mode 4 Position

Flight Mode 5 Unassigned

Flight Mode 6 Mission

Arm switch channel Channel 6

Emergency Kill switch channel Channel 10

Loiter switch channel Channel 11

Return switch channel Channel 9

Channel Monitor


1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	
16																	
17																	
18																	

Use Multi Channel Mode Selection

Must have an "Arm" and "Kill" switch

Note: Disarming alone is not guaranteed to kill the motors!

Disengaging **Kill** may re-arm the drone, if the **Arm** switch is still enabled!



Step 4 - Flight Modes

QGroundControl Vehicle Setup

Flight Modes Setup

Flight Mode Settings

Mode Channel	Mode	Arm switch channel	Landing gear switch channel
Channel 8	Stabilized	Channel 6	Unassigned
Flight Mode 1	Stabilized	Emergency Kill switch channel	Loiter switch channel
Flight Mode 2	Unassigned	Channel 10	Channel 11
Flight Mode 3	Unassigned	Clipboard switch channel	Return switch channel
Flight Mode 4	Position	Unassigned	Channel 9
Flight Mode 5	Unassigned		
Flight Mode 6	Mission		

Switch Settings

Channel Monitor

Channel	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	●																	
2		●																
3			●															
4				●														
5					●													
6						●												
7							●											
8								●										
9									●									
10										●								
11											●							
12												●						
13													●					
14														●				
15															●			
16																●		
17																	●	
18																		●

Use Multi Channel Mode Selection

Acro Mode ("Flight Mode Settings")

Stabilization

Step 4 - Flight Modes

QGroundControl

Back < Vehicle Setup

Summary | Firmware | Airframe | Sensors | Radio | Flight Modes | Power | Actuators | Safety | PID Tuning | Flight Behavior | Camera | Parameters

Search: Show modified only

COM_LKDOWN_TKO	3.000 s	Timeout for detecting a failure after takeoff
MC_ACRO_EXPO	0.69	Acro mode Expo factor for Roll and Pitch
MC_ACRO_EXPO_Y	0.69	Acro mode Expo factor for Yaw
MC_ACRO_P_MAX	720.0 deg/s	Max acro pitch rate
MC_ACRO_R_MAX	720.0 deg/s	Max acro roll rate
MC_ACRO_SUPEXPO	0.70	Acro mode SuperExpo factor for Roll and Pitch
MC_ACRO_SUPEXPOY	0.70	Acro mode SuperExpo factor for Yaw
MC_ACRO_Y_MAX	540.0 deg/s	Max acro yaw rate
MC_BAT_SCALE_EN	Disabled	Battery power level scaler
MC_PITCHRATE_MAX	220.0 deg/s	Max pitch rate
MC_ROLLRATE_MAX	220.0 deg/s	Max roll rate
RC_MAP_ACRO_SW	Unassigned	Acro switch channel (deprecated)

Acro Mode

Stabilization

Setting "Acro" mode in Parameters is deprecated in versions 4.3.x

Step 5 - Power, and ESCs

Make sure to indicate number of cells in battery

Power & Battery

Step 5 - Power, and ESCs

QGroundControl

Back < Vehicle Setup

Summary | **Power Setup**

Power Setup is used to setup battery parameters as well as advanced settings for propellers.

Battery 1

Source	Power Module		Battery Max: 0.0 V
Number of Cells (in Series)	0		Battery Min: 0.0 V
Empty Voltage (per cell)	3.50 V		
Full Voltage (per cell)	4.05 V		

Show Advanced Settings

Battery 2

Source: Disabled

ESC PWM Minimum and Maximum Calibration

WARNING: Propellers must be removed from vehicle prior to performing ESC calibration. You must use USB connection for this operation.

Calibrate

Show UAVCAN Settings

UAVCAN Bus Configuration

Sensors Automatic Change required restart

UAVCAN Motor Index and Direction Assignment

WARNING: Propellers must be removed from vehicle prior to performing UAVCAN ESC configuration. ESC parameters will only be accessible in the editor after assignment. Start the process, then turn each motor into its turn direction, in the order of their motor indices.

Start Assignment

Stop Assignment

Summary

Firmware

Airframe

Sensors

Radio

Flight Modes

Power

Motors

Safety

PID Tuning

Flight Behavior

Camera

Parameters

Calibrate ESCs only is PWM

If DShot, no need to calibrate

Step 6 - Motors (and Other Actuators)

Actuators Config

Geometry: Multirotor

Motors: 4

	Bidirectional	Stew Rate	Position X	Position Y	Position Z	Direction CCW Axis	
Motor 1:	<input type="checkbox"/>	0.00	3.28	3.28	0.00	<input checked="" type="checkbox"/>	Upwards ▾
Motor 2:	<input type="checkbox"/>	0.00	-3.28	-3.28	0.00	<input checked="" type="checkbox"/>	Upwards ▾
Motor 3:	<input type="checkbox"/>	0.00	3.28	-3.28	0.00	<input type="checkbox"/>	Upwards ▾
Motor 4:	<input type="checkbox"/>	0.00	-3.28	3.28	0.00	<input type="checkbox"/>	Upwards ▾

Actuator Testing

Propellers are removed - Enable sliders

All Motors: Motor 1, Motor 2, Motor 3, Motor 4, RC AUX 1, RC AUX 2

Set Spin Direction 1, Set Spin Direction 2

Actuator Outputs

PWM MAIN | UAVCAN

Identify & Assign Motors

MAIN 1-4: DShot600

Function: Rev Range (for Servos)

MAIN 1: Motor 2

MAIN 2: Motor 3

MAIN 3: Motor 4

MAIN 4: Motor 1

MAIN 5-6: PWM 50 Hz

	Function	Disarmed	Minimum	Maximum	Failsafe	Rev Range (for Servos)
MAIN 5:	RC AUX 1	1000	1000	2000	-1	<input type="checkbox"/>
MAIN 6:	RC AUX 2	1000	1000	2000	-1	<input type="checkbox"/>

MAIN 7-10: PWM 400 Hz

	Function	Disarmed	Minimum	Maximum	Failsafe	Rev Range (for Servos)
MAIN 7:	Disabled	1000	1000	2000	-1	<input type="checkbox"/>
MAIN 8:	Disabled	1000	1000	2000	-1	<input type="checkbox"/>
MAIN 9:	Disabled	1000	1000	2000	-1	<input type="checkbox"/>
MAIN 10:	Disabled	1000	1000	2000	-1	<input type="checkbox"/>

PWM Main

Advanced

Identify motors

Use DShot 600 / 1200, if supported
Otherwise use 400 Hz

Make sure ALL propellers are removed

Optional: Motor spin directions can be set here

Step 6 - Motors (and Other Actuators)

Actuators Config
Geometry: Multirotor

Motors: 4

	Bidirectional	Stew Rate	Position X	Position Y	Position Z	Direction CCW Axis	
Motor 1:	<input type="checkbox"/>	0.00	3.28	3.28	0.00	<input checked="" type="checkbox"/>	Upwards ▾
Motor 2:	<input type="checkbox"/>	0.00	-3.28	-3.28	0.00	<input checked="" type="checkbox"/>	Upwards ▾
Motor 3:	<input type="checkbox"/>	0.00	3.28	-3.28	0.00	<input type="checkbox"/>	Upwards ▾
Motor 4:	<input type="checkbox"/>	0.00	-3.28	3.28	0.00	<input type="checkbox"/>	Upwards ▾

Actuator Testing

Propellers are removed - Enable sliders

RC AUX 1, RC AUX 2

Actuator Outputs

PWM MAIN | UAVCAN

Identify & Assign Motors

MAIN 1-4: DShot600

	Function	Rev Range (for Servos)
MAIN 1:	Motor 2	<input type="checkbox"/>
MAIN 2:	Motor 3	<input type="checkbox"/>
MAIN 3:	Motor 4	<input type="checkbox"/>
MAIN 4:	Motor 1	<input type="checkbox"/>

MAIN 5-6: PWM 50 Hz

	Function	Disarmed	Minimum	Maximum	Failsafe	Rev Range (for Servos)
MAIN 5:	RC AUX 1	1000	1000	2000	-1	<input type="checkbox"/>
MAIN 6:	RC AUX 2	1000	1000	2000	-1	<input type="checkbox"/>

MAIN 7-10: PWM 400 Hz

	Function	Disarmed	Minimum	Maximum	Failsafe	Rev Range (for Servos)
MAIN 7:	Disabled	1000	1000	2000	-1	<input type="checkbox"/>
MAIN 8:	Disabled	1000	1000	2000	-1	<input type="checkbox"/>
MAIN 9:	Disabled	1000	1000	2000	-1	<input type="checkbox"/>
MAIN 10:	Disabled	1000	1000	2000	-1	<input type="checkbox"/>

Annotations:

- PWM Main
- Advanced
- 50 Hz for hobby servos
- Identify servos and enable (Aux. channels)

Step 6 - Motors (and Other Actuators)

The screenshot shows the QGroundControl interface for vehicle setup. The 'Actuators' tab is selected in the left sidebar. The 'Geometry: Multirotor' section shows 4 motors. The 'Actuator Outputs' section shows PWM AUX outputs for AUX 1-4, AUX 5-6, and AUX 7-8. A red box highlights the 'Actuator Testing' section, which includes a checkbox for 'Propellers are removed - Enable sliders' and sliders for 'All Motors', 'Motor 1', 'Motor 2', 'Motor 3', 'Motor 4', 'RC AUX 1', and 'RC AUX 2'. A red arrow points from the text 'Make sure ALL propellers are removed' to the 'Propellers are removed' checkbox.

Make sure ALL propellers are removed

Function	Disarmed	Minimum	Maximum	Rev Range (for Servos)
AUX 1: RC AUX 1	1000	1000	2000	<input type="checkbox"/>
AUX 2: RC AUX 2	1000	1000	2000	<input type="checkbox"/>
AUX 3: Disabled	1000	1000	2000	<input type="checkbox"/>
AUX 4: Disabled	1000	1000	2000	<input type="checkbox"/>
AUX 5: Disabled	1000	1000	2000	<input type="checkbox"/>
AUX 6: Disabled	1000	1000	2000	<input type="checkbox"/>
AUX 7: Disabled	1000	1000	2000	<input type="checkbox"/>
AUX 8: Disabled	1000	1000	2000	<input type="checkbox"/>

Step 7 - Safety

QGroundControl

Back < Vehicle Setup

Summary

Firmware

Airframe

Sensors

Radio

Flight Modes

Power

Motors

Safety

PID Tuning

Camera

Parameters

Geofence Failsafe Trigger

Action on breach:

Max Radius: m

Max Altitude: m

Return To Launch Settings

Climb to altitude of: m

Return to launch, then:

Land immediately

Loiter and do not land

Loiter and land after specified time

Loiter Time: s

Loiter Altitude: m

Land Mode Settings

Landing Descent Rate: m/s

Disarm After: s

Vehicle Telemetry Logging

Telemetry logging to vehicle storage:

Geofence behavior

Return To Launch behavior

Step 8 - Safety Switch, Pre-Arm

QGroundControl Vehicle Setup

Summary Search: Clear Show modified only

Parameter	Value	Description
CBRK_AIRSPD_CHK	0	Circuit breaker for airspeed sensor
CBRK_BUZZER	0	Circuit breaker for disabling buzzer
CBRK_ENGINEFAIL	284953	Circuit breaker for engine failure detection
CBRK_ELIGHTTFRM1	131212	Circuit breaker for flight termination
CBRK_IO_SAFETY	0	Circuit breaker for IO safety
CBRK_RATE_CTRL	0	Circuit breaker for rate controller output
CBRK_SUPPLY_CHK	0	Circuit breaker for power supply check
CBRK_USB_CHK	0	Circuit breaker for USB link check
CBRK_VEL_POSERR	0	Circuit breaker for position error check
CBRK_YTOLARMING	0	Circuit breaker for arming in fixed-wing mode check
COM_POSCTL_NAVL	Altitude/Manual	Assun Position control navigation loss response
COM_POWER_COUNT	1	Required number of redundant power modules
FD_FAIL_P	60 deg	FailureDetector Max Pitch
FD_FAIL_R	60 deg	FailureDetector Max Roll

QGroundControl Vehicle Setup

Summary Search: Clear Show modified only

Parameter	Value	Description
COM_POSCTL_NAVL	Altitude/Manual	Assun Position control navigation loss response
COM_POS_FS_DELAY	1 s	Loss of position failsafe activation delay
COM_POS_FS_EPH	5,000 m	Horizontal position error threshold
COM_POS_FS_EPV	10,000 m	Vertical position error threshold
COM_POS_FS_GAIN	10	Loss of position probation gain factor
COM_POS_FS_PROB	30 s	Loss of position probation delay at takeoff
COM_POWER_COUNT	1	Required number of redundant power modules
COM_PREARM_MODE	Always	Condition to enter prearmed mode

CBRK_IO_SAFETY = 0
COM_PREARM_MODE = ALWAYS

Safety switch ACTIVE

Servos / RC_MAP_AUX channels always active

CBRK_IO_SAFETY = 0
COM_PREARM_MODE = Safety Button

Safety switch ACTIVE

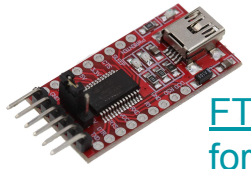
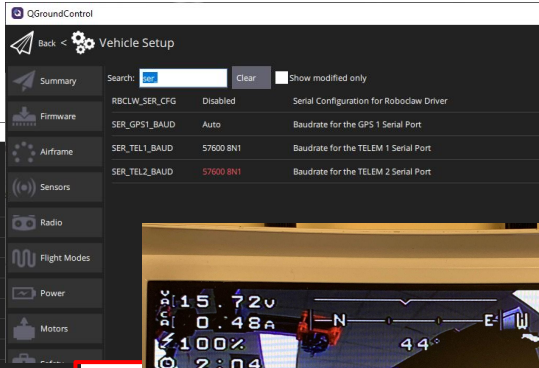
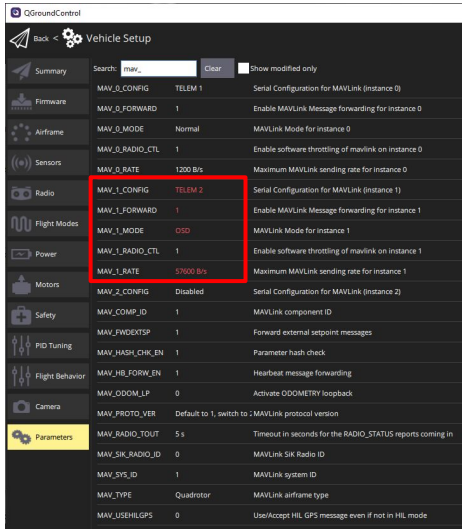
Servos / RC_MAP_AUX channels active only after
Safety switch is pressed

CBRK_IO_SAFETY = 22027
COM_PREARM_MODE = ALWAYS / DISABLED

No Safety Switch

Servos / RC_MAP_AUX channels always active

Step 8 - OSD



FTDI to USB for config



OSD

Configuration App

<https://code.google.com/archive/p/arducam-osd/downloads>

Configure Telemetry port 2

- MAV_1_CONFIG = TELEM 2
- MAV_1_FORWARD = 1
- MAV_1_MODE = OSD
- MAV_1_RATE = 57600 B/s

Reboot vehicle to access next parameter

- SER_TEL2_BAUD = 57600 8N1

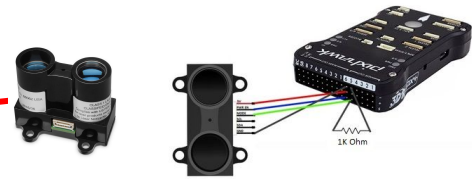
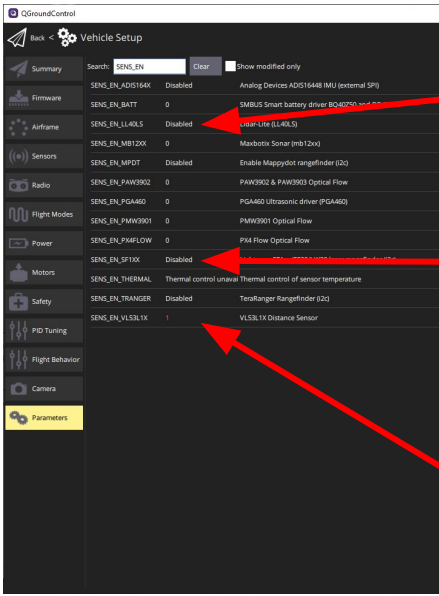
Configure Telemetry port 3

- MAV_2_CONFIG = TELEM 3
- MAV_2_FORWARD = 1
- MAV_2_MODE = OSD
- MAV_2_RATE = 57600 B/s

Reboot vehicle to access next parameter

- SER_TEL3_BAUD = 57600 8N1

Step 8 - Parameters (Range finders, Optical flow)



Lidar Lite



LightWare SF1X/SF02/LW20 Lidar



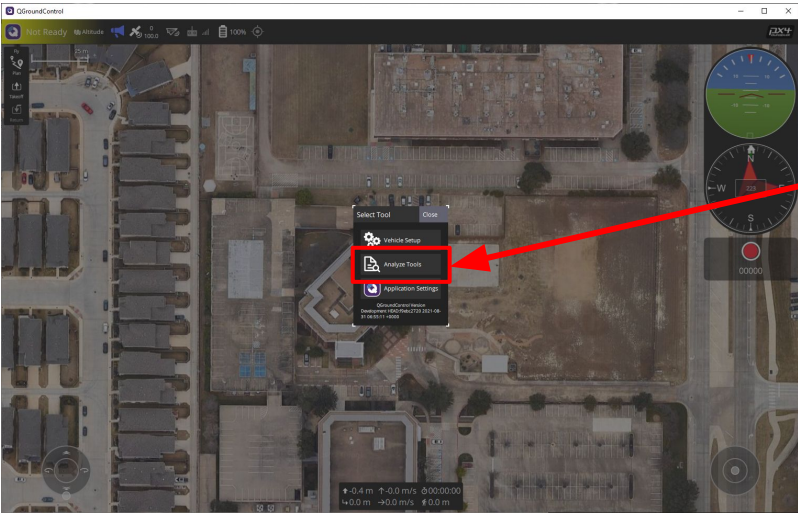
VL53L1X Lidar



SENS_EN_XXXXX set to "1"

- SENS_EN_VL53L1X
- SENS_EN_LL40LS
- SENS_EN_SF1XX
- ...and others

Step 8 - Parameters (Range finders, Optical Flow)

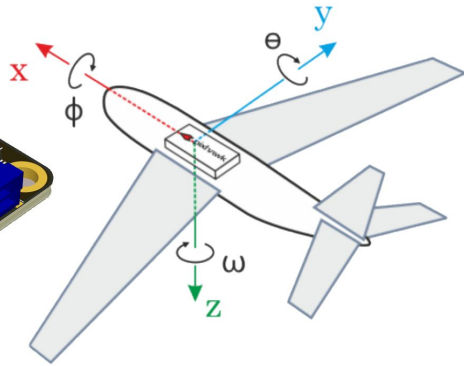
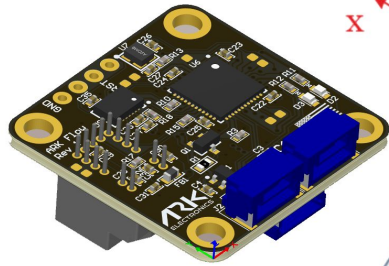


The screenshot shows the 'Analyze Tools' window in GDMUinCenter. It displays a list of parameters and their values, with 'DISTANCE_SENSOR' highlighted in yellow. Below the list is a graph showing data over time.

Message	Component	Value	Type	Plot 1	Plot 2
1 ALTITUDE	0.214	1	uint32_t		
1 ALTITUDE_TARGET	12.914	9	uint16_t		
1 ATTITUDE	1.214	0	uint16_t		
1 ATTITUDE_TARGET	1.214	0	uint16_t		
1 DISTANCE_SENSOR	0.814	49400	uint32_t		
1 ESTIMATOR_STATUS	0.814	0	uint16_t		
1 EXTENDED_SYS_STATE	0.214	20	uint16_t		
1 GPS_RAW_DATA	0.214	0	float		
1 HEARTBEAT	1.014	0, 0, 0, 0	float		
1 LINK_MODE_STATUS	0.214	0	uint8_t		
1 PING	0.014	0	uint8_t		
1 POSITION_TARGET_LOCAL_NED	1.014	0, 0, 0, 0	float		
1 SERVO_OUTPUT_RAW	0.214	0, 0, 0, 0	float		
1 STATUS_TEXT	0.014	0	uint8_t		
1 SYS_STATUS	0.214	0	uint8_t		
1 VFR_MOLD	3.814	0	uint8_t		
1 VIBRATION	0.014	0, 0, 0, 0	float		

The graph below the table shows a single data series for 'DISTANCE_SENSOR' over time. The y-axis is labeled 'Scale' and ranges from 0 to 200. The x-axis is labeled 'Range' and ranges from 18:42:20 to 18:42:30. The data series shows a constant value of approximately 49400.

Step 8 - Parameters (Range finder, **Optical flow**)

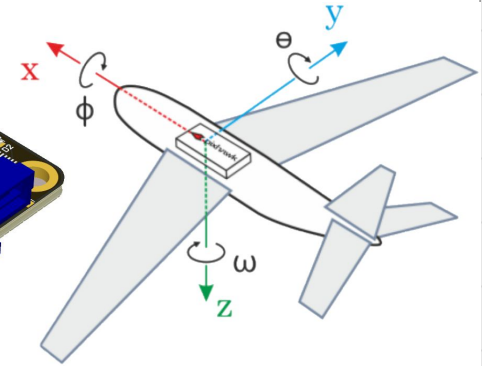
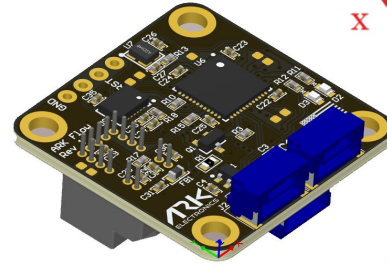


[ARK Flow - ARK Electronics](#)

Step 8 - Distance Sensors (Range finder, **Optical flow**)

QGroundControl [parameters for the ARK Flow](#)

UAVCAN_ENABLE	2 (reboot required to detect CAN sensors)
EKF2_OF_CTRL	enable
EKF2_GPS_CTRL	0
UAVCAN_SUB_FLOW	enable
UAVCAN_SUB_RNG	enable
EKF2_RNG_A_HMAX	10 m (32.8 ft)
EKF2_RNG_QLTY_T	0.2 s
UAVCAN_RNG_MIN	0.08 m (0.26 ft)
UAVCAN_RNG_MAX	30 m (98.4 ft)
SENS_FLOW_MINHGHT	0.08 ft (0.26 ft)
SENS_FLOW_MAXHGHT	25 m (82 ft)
SENS_FLOW_MAXR	7.4
EKF2_OF_POS_X, EKF2_OF_POS_Y, EKF2_OF_POS_Z	Set X, Y, Z positions of the optical flow focal point in the body frame (refer to diagram for +/-)



Step 8 - Distance Sensors (Range finder, Optical flow)

Check the distances to make sure the optical flow sensor is functioning correctly. Values *may* be in meters or centimeters.

The image displays two side-by-side screenshots of the QGroundControl MAVLink Inspector interface. The left screenshot shows the 'OPTICAL_FLOW_RAD (106)' message with a table of fields. The right screenshot shows the 'DISTANCE_SENSOR (132)' message with a table of fields. Red annotations include a box around the 'QGroundControl' title bar, a box around the 'MAVLink Inspector' icon, a red arrow pointing from the 'MAVLink Inspector' icon to the 'DISTANCE_SENSOR' message, and red circles around the 'distance' field in the left screenshot and the 'current_distance' field in the right screenshot.

Left Screenshot: OPTICAL_FLOW_RAD (106)

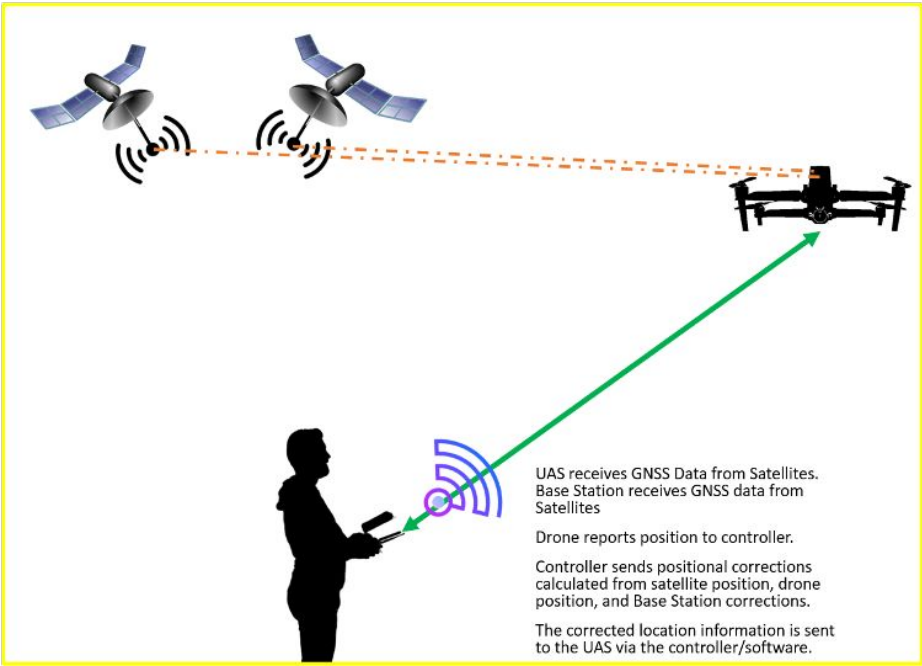
Name	Value	Type	Plot 1	Plot 2
time_usec	86551213	uint64_t	<input type="checkbox"/>	<input type="checkbox"/>
sensor_id	0	uint8_t	<input type="checkbox"/>	<input type="checkbox"/>
integration_time_us	15872	uint32_t	<input type="checkbox"/>	<input type="checkbox"/>
integrated_x	0	float	<input type="checkbox"/>	<input type="checkbox"/>
integrated_y	0	float	<input type="checkbox"/>	<input type="checkbox"/>
integrated_xgyro	-3.0648e-05	float	<input type="checkbox"/>	<input type="checkbox"/>
integrated_ygyro	1.5323e-05	float	<input type="checkbox"/>	<input type="checkbox"/>
integrated_zgyro	nan	float	<input type="checkbox"/>	<input type="checkbox"/>
temperature	0	int16_t	<input type="checkbox"/>	<input type="checkbox"/>
quality	149	uint8_t	<input type="checkbox"/>	<input type="checkbox"/>
time_delta_distance_us	0	uint32_t	<input type="checkbox"/>	<input type="checkbox"/>
distance	0.632813	float	<input type="checkbox"/>	<input type="checkbox"/>

Right Screenshot: DISTANCE_SENSOR (132)

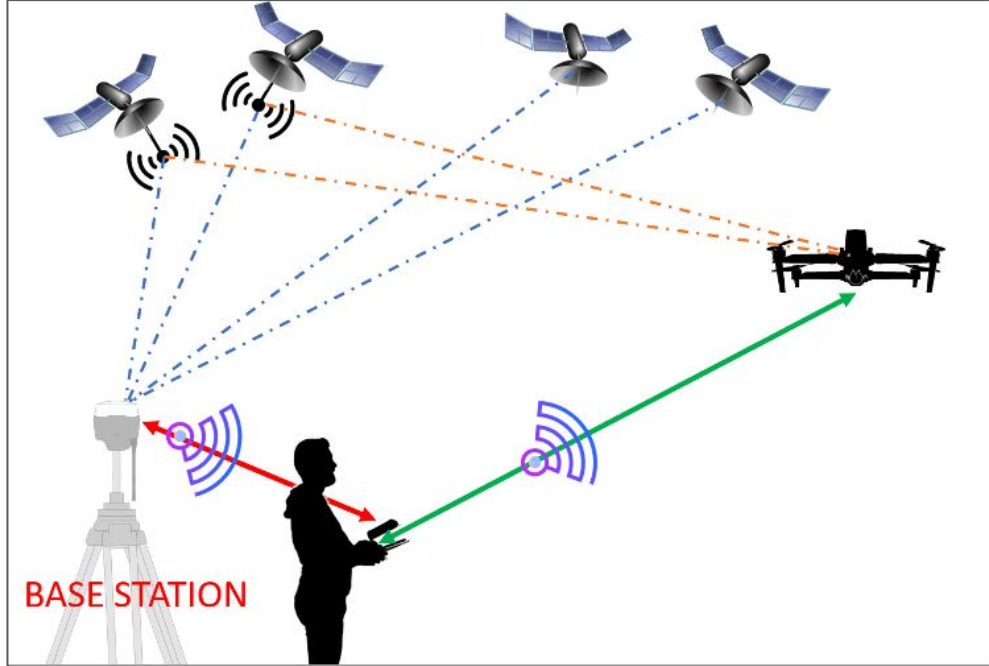
Name	Value	Type	Plot 1	Plot 2
time_elapsed_ms	108109	uint32_t	<input type="checkbox"/>	<input type="checkbox"/>
min_distance	7	uint16_t	<input type="checkbox"/>	<input type="checkbox"/>
max_distance	2999	uint16_t	<input type="checkbox"/>	<input type="checkbox"/>
current_distance	63	uint16_t	<input type="checkbox"/>	<input type="checkbox"/>
type	0	uint8_t	<input type="checkbox"/>	<input type="checkbox"/>
id	0	uint8_t	<input type="checkbox"/>	<input type="checkbox"/>
orientation	25	uint8_t	<input type="checkbox"/>	<input type="checkbox"/>
covariance	0	uint8_t	<input type="checkbox"/>	<input type="checkbox"/>
horizontal_fov	0	float	<input type="checkbox"/>	<input type="checkbox"/>
vertical_fov	0	float	<input type="checkbox"/>	<input type="checkbox"/>
quaternion	0, 0, 0, 0	float	<input type="checkbox"/>	<input type="checkbox"/>
signal_quality	0	uint8_t	<input type="checkbox"/>	<input type="checkbox"/>

GPS & TELEMETRY

HOW A NON-RTK AIRCRAFT CAPTURES AERIAL POSITION
(2 - 3 m accuracy)

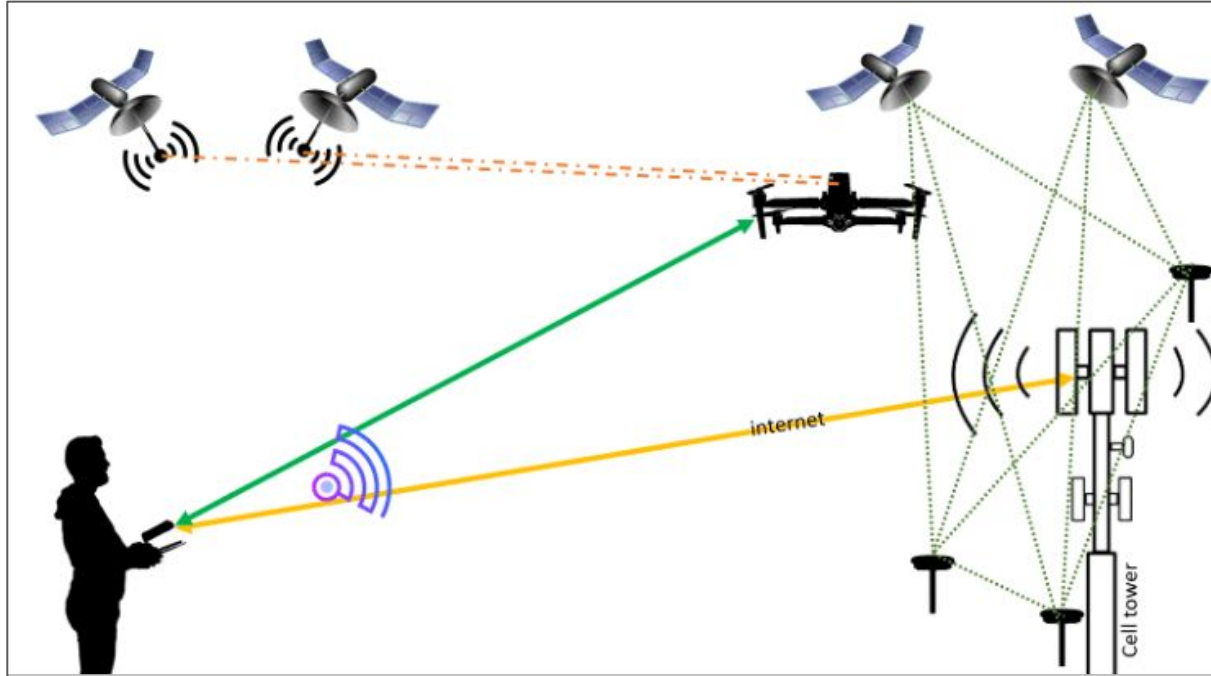


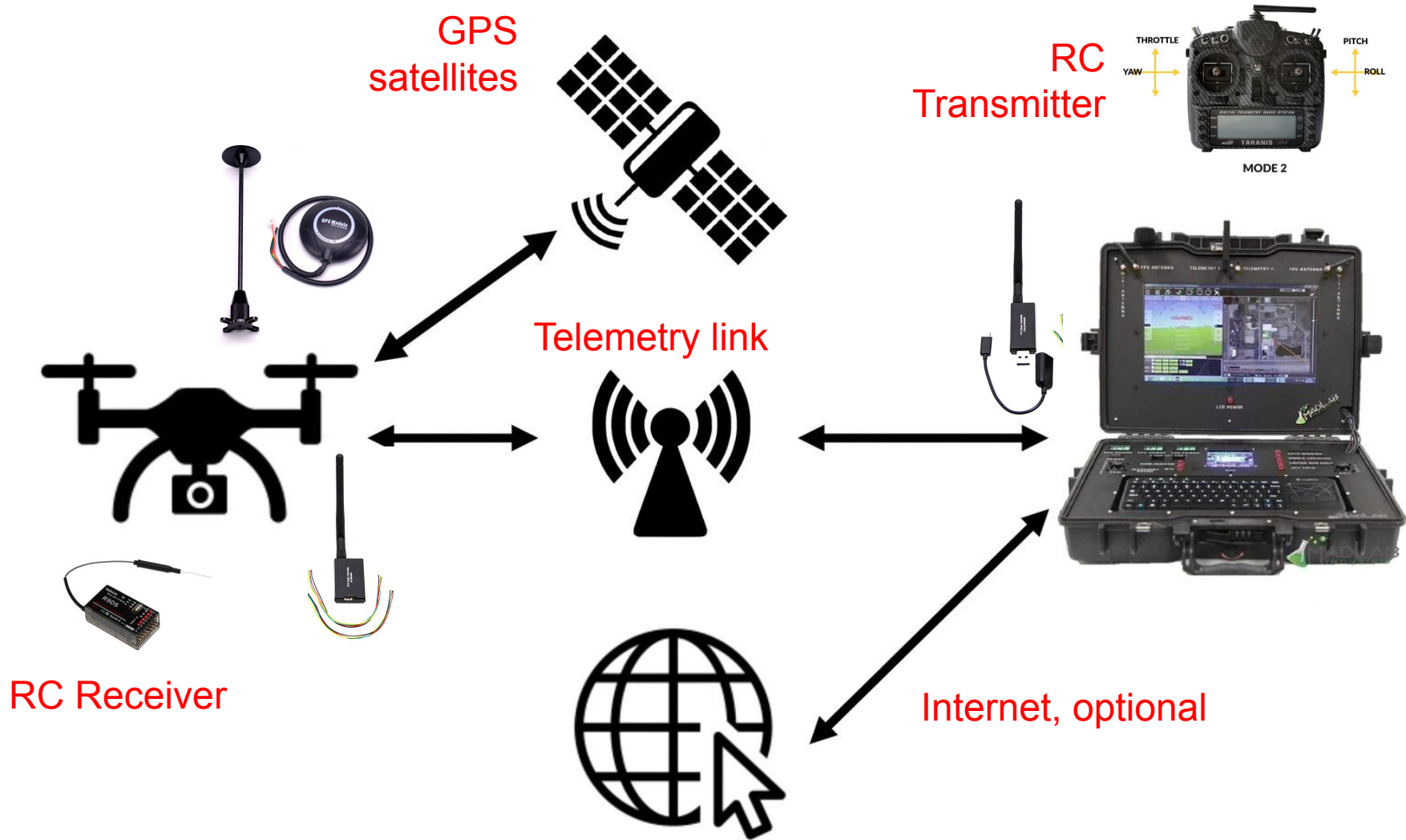
HOW AN RTK-CAPABLE AIRCRAFT CAPTURES POSITION with a BASE STATION
(cm accuracy)



Reference: <https://dronelife.com/2022/03/20/rtk-and-drone-mapping-do-you-need-it-is-it-worth-it/>

HOW AN RTK AIRCRAFT DETERMINES POSITION with NTRIP





GPS & TELEMETRY

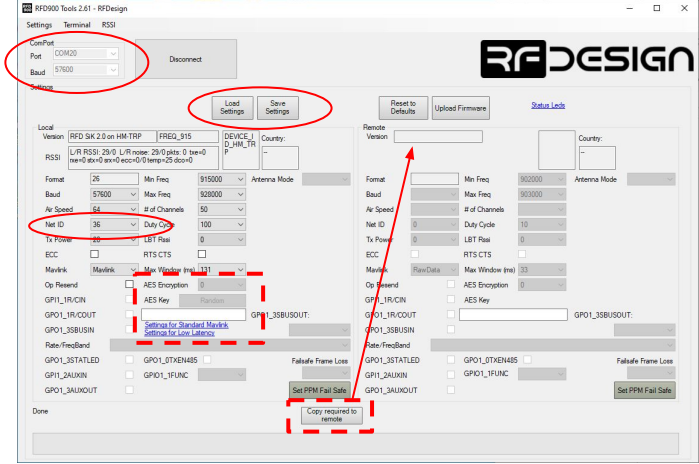
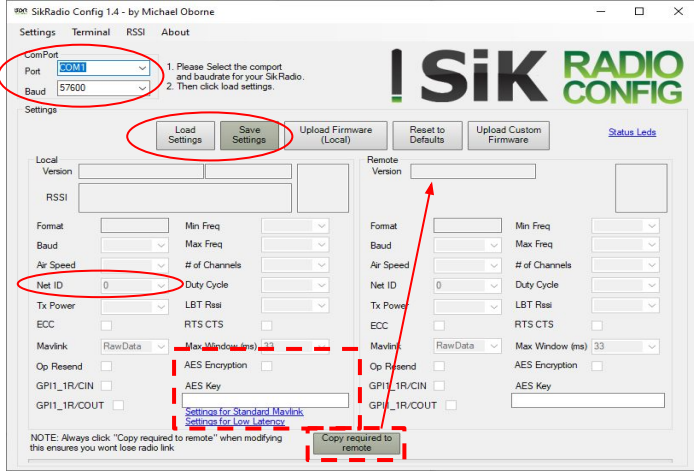
Telemetry frequency

- 915 Mhz (US)
- 433 Mhz (Europe)

Configure **Net ID** for your telemetry module

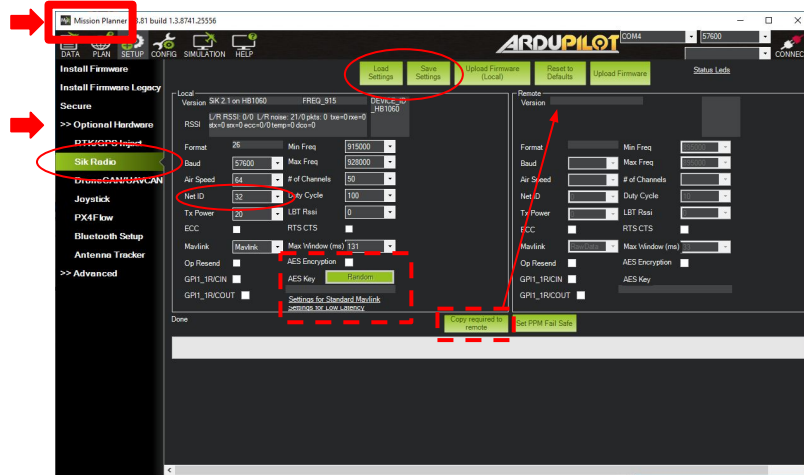
- Use modem AT commands
 - https://docs.px4.io/main/en/data_links/sik_radio.html
- Use the Radio Configuration tool
 - <http://vps.oborne.me/3drradioconfig.zip>
 - <https://files.rfdesign.com.au/>
 - <https://files.rfdesign.com.au/Files/tools/RFDTools-V2.61.zip>
 - Mission Planner GCS (<https://ardupilot.org/planner/>)





<http://vps.oborne.me/3drradioconfig.zip>

<https://files.rfdesign.com.au/Files/tools/RFDTools-V2.61.zip>



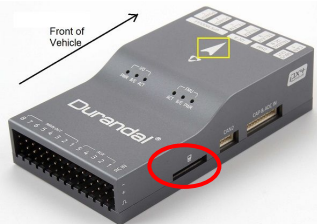
<https://ardupilot.org/planner/>

OPTIONAL - Telemetry Logs & Post Flight Analysis



Telemetry Logging (The Black Box)

- **Flight control logs** are stored on the SD Card of the Pixhawk FC, or
- Logs can be downloaded using QGroundControl: [Analyze View > Log Download](#).

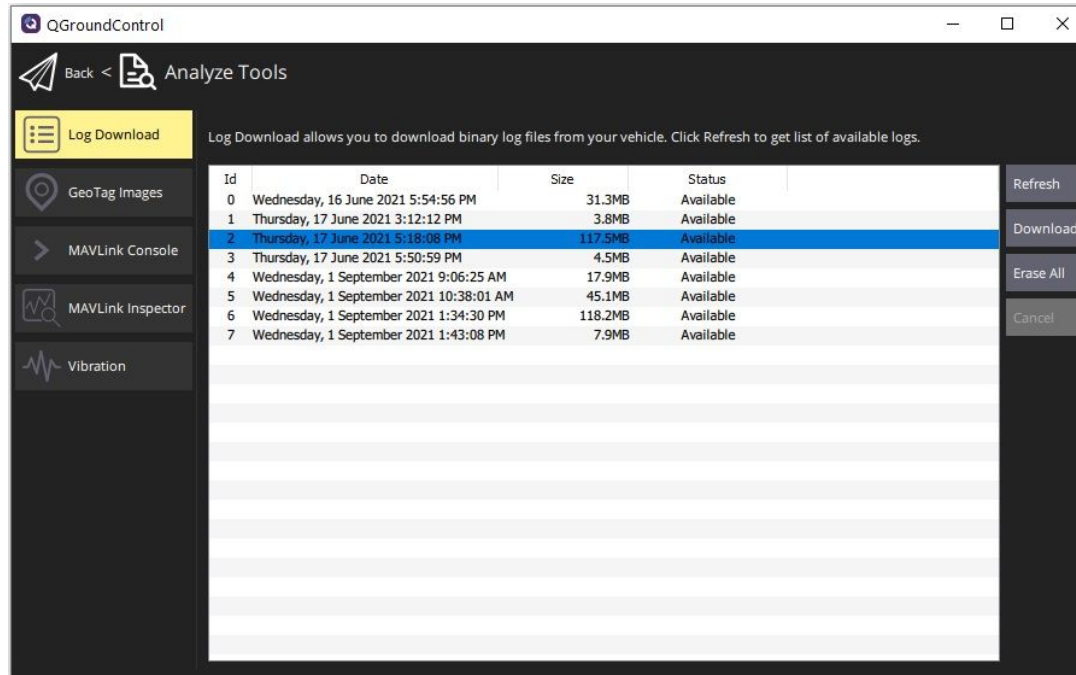


Id	Date	Size	Status
0	Wednesday, 16 June 2021 5:54:56 PM	31.3MB	Available
1	Thursday, 17 June 2021 3:12:12 PM	3.8MB	Available
2	Thursday, 17 June 2021 5:18:08 PM	117.5MB	Available
3	Thursday, 17 June 2021 5:50:59 PM	4.5MB	Available
4	Wednesday, 1 September 2021 9:06:25 AM	17.9MB	Available
5	Wednesday, 1 September 2021 10:38:01 AM	45.1MB	Available
6	Wednesday, 1 September 2021 1:34:30 PM	118.2MB	Available
7	Wednesday, 1 September 2021 1:43:08 PM	7.9MB	Available

The screenshot also shows a sidebar with navigation options: GeoTag Images, MAVLink Console, MAVLink Inspector, and Vibration. On the right side of the table, there are buttons for 'Refresh', 'Download', 'Erase All', and 'Cancel'.

Analysing The Logs

- Upload the log file to the online Flight Review tool (<http://logs.px4.io>)
- After upload you'll emailed a link to the analysis page for the log



The screenshot shows the QGroundControl interface with the 'Log Download' tool selected. The tool provides a list of available log files from a vehicle. The table below shows the details of these logs:

Id	Date	Size	Status
0	Wednesday, 16 June 2021 5:54:56 PM	31.3MB	Available
1	Thursday, 17 June 2021 3:12:12 PM	3.8MB	Available
2	Thursday, 17 June 2021 5:18:08 PM	117.5MB	Available
3	Thursday, 17 June 2021 5:50:59 PM	4.5MB	Available
4	Wednesday, 1 September 2021 9:06:25 AM	17.9MB	Available
5	Wednesday, 1 September 2021 10:38:01 AM	45.1MB	Available
6	Wednesday, 1 September 2021 1:34:30 PM	118.2MB	Available
7	Wednesday, 1 September 2021 1:43:08 PM	7.9MB	Available

On the right side of the table, there are four buttons: 'Refresh', 'Download', 'Erase All', and 'Cancel'. The 'Log Download' tool also includes a sidebar with other features like 'GeoTag Images', 'MAVLink Console', 'MAVLink Inspector', and 'Vibration'.

- **Flight control logs** are stored on the SD Card of the Pixhawk FC, or
- Logs can be downloaded using QGroundControl: [Analyze View > Log Download](#)
- Telemetry, flight path to analyze performance, flight mishaps, or other incidents

