

## MavLink support in Pitlab&Zbig FPV System

### Functionality

OSD can work with MavLink-enabled flight controller (FC), using MavLink1.0/2.0 protocol and presenting data from FC on OSD screen and sending data in telemetry stream (encoded in video signal). OSD can present data collected directly by OSD (e.g from GPS or current sensor) or received from flight controller. If both data exists, data from FC has higher priority and overrides data collected by OSD itself (e.g motor battery voltage information from FC send via MavLink message overrides voltage measurement made directly by OSD board).

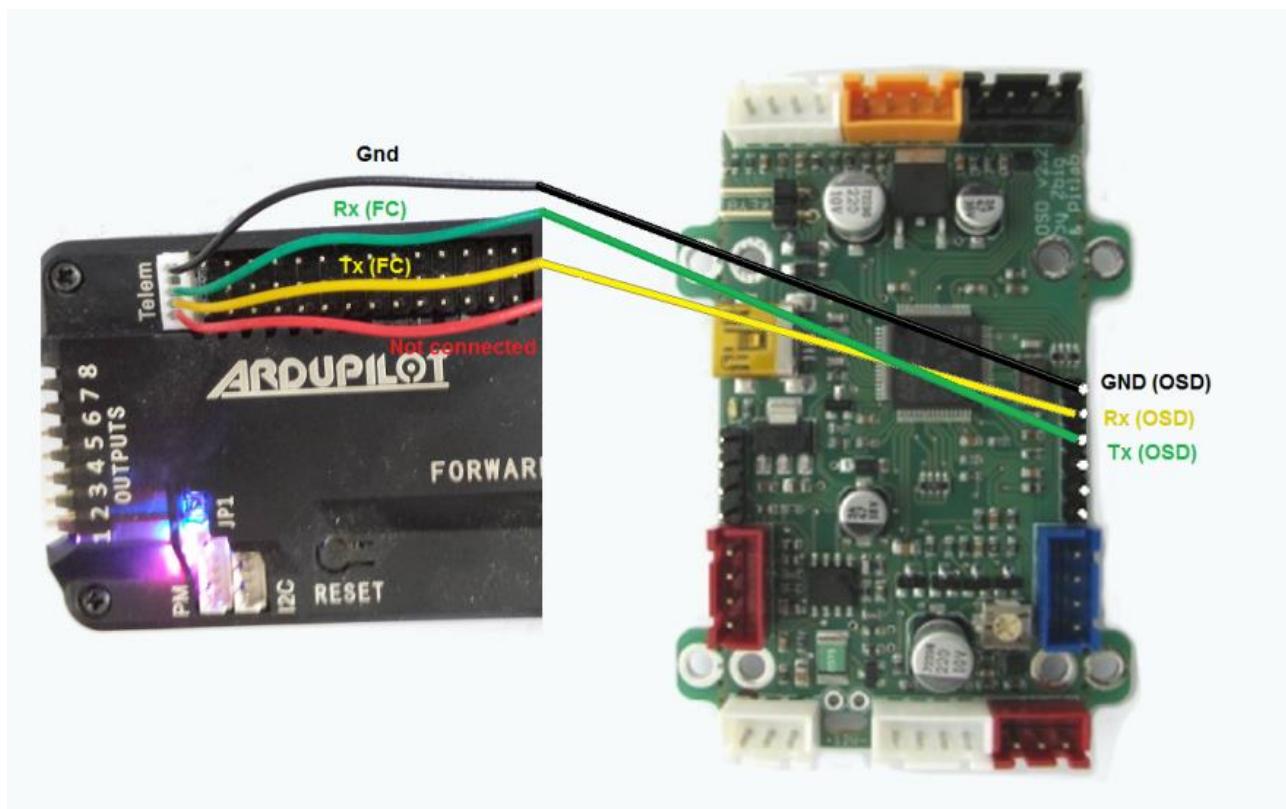
OSD presents waypoints from FC and allows to select waypoint and that way forces FC to start mission from this waypoint. OSD shows waypoints from FC in OSD menu->Mission.

OSD can configure some parameters of flight controller (e.g. PIDs, fence, battery parameters) directly from OSD menu, reducing need of on-line connection with Ground Control Station and PC computer on airfield.

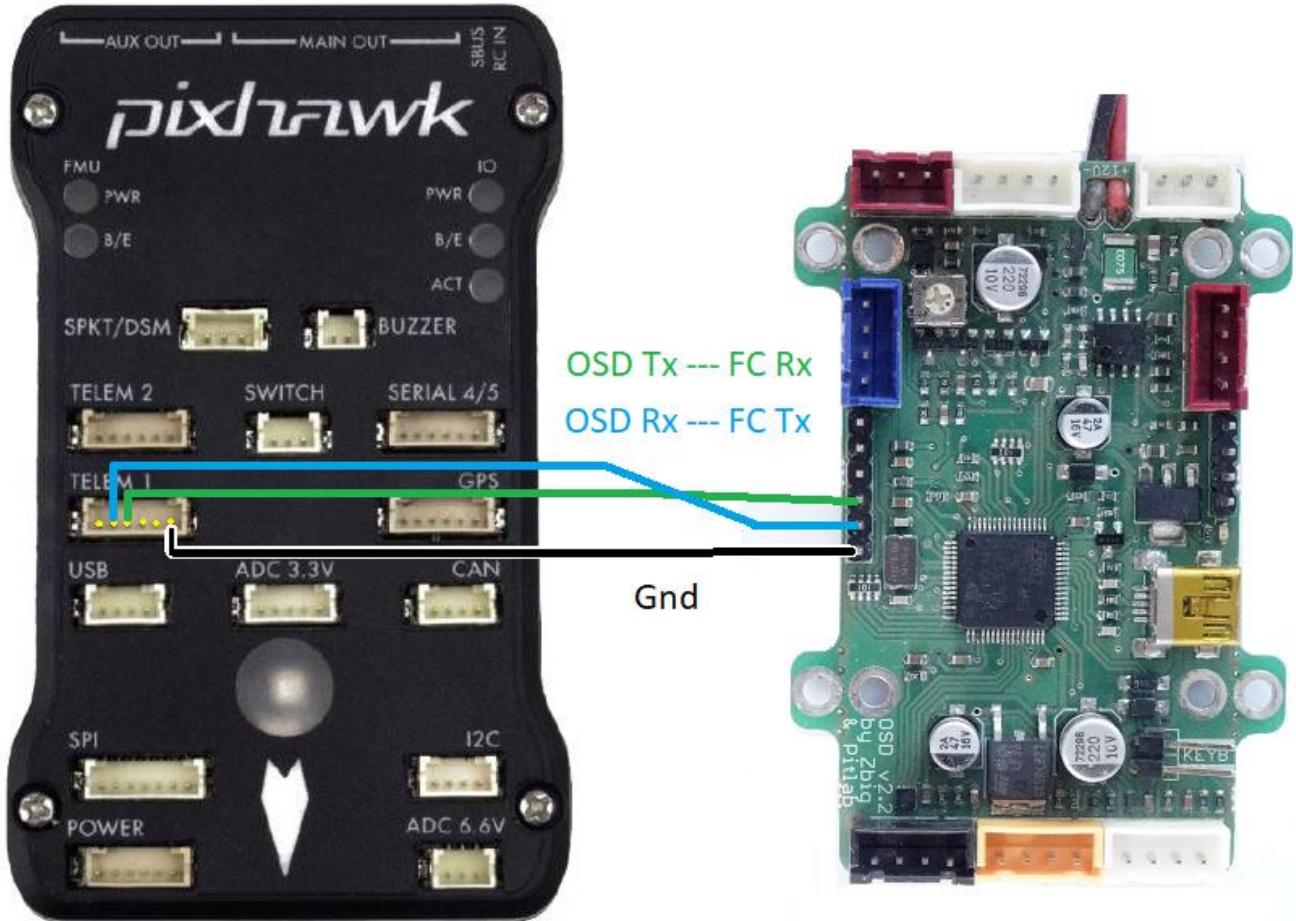
### Connections

OSD should be connected to flight controller's telemetry port. This connection uses USART (RS232 TTL) protocol.

Connect APM and OSD with 3 wires (GND, Tx, Rx) as follows:



To connect Pixhawk use its spare telemetry port, and connect OSD as follows:



OSD works with fixed transmission parameters: 8 bit data, 1 bit stop, no parity, and default 57600 bps. Transmission speed can be set to 19200, 38400 or 57600 bps using FPV\_manager application (page OSD->settings, in **MavLink USART** box).

FPV Device Manager ver. 2.62rc2 (C) Zbig&Pitlab

OSD   Autopilot   Ground Station   PitLab

<b>Firmware</b>	Temperature sensor Temp. °C: 18 Calibration: -8  Save	Menu RC input <input checked="" type="radio"/> MavLink RC channel: 8 Close menu after (sec): 3  Save	USER AI2 Input <ul style="list-style-type: none"> <li><input checked="" type="radio"/> = scale * (ADC + Offset)</li> <li><input type="radio"/> = scale * sqrt(ADC + offset)</li> <li><input type="radio"/> = scale * (PulseL + offset)</li> <li><input type="radio"/> = scale * (PulseL + offset)</li> <li><input type="radio"/> = scale * (Period + offset)</li> <li><input type="radio"/> = scale * (Freq + offset)</li> <li><input type="radio"/> = scale * (Duty + offset)</li> </ul> Scale: 0,0140 Offset: -17 Units: °C Pulse tick (us): 1  Save
<b>Layout</b>	Callsign  Save	Telemetry encryption Telemetry ID: 0  Save	
<b>Map</b>	Current sensor Current A: 9,4 Calibration: 333  Save	Odometer and flight time Kilometers: 2470 46 h 18 min  Save	
<b>Routes</b>	Mavlink UART Speed bps: 57600  Save		
<b>Settings</b>			
<b>Simulator</b>			

## Configuration

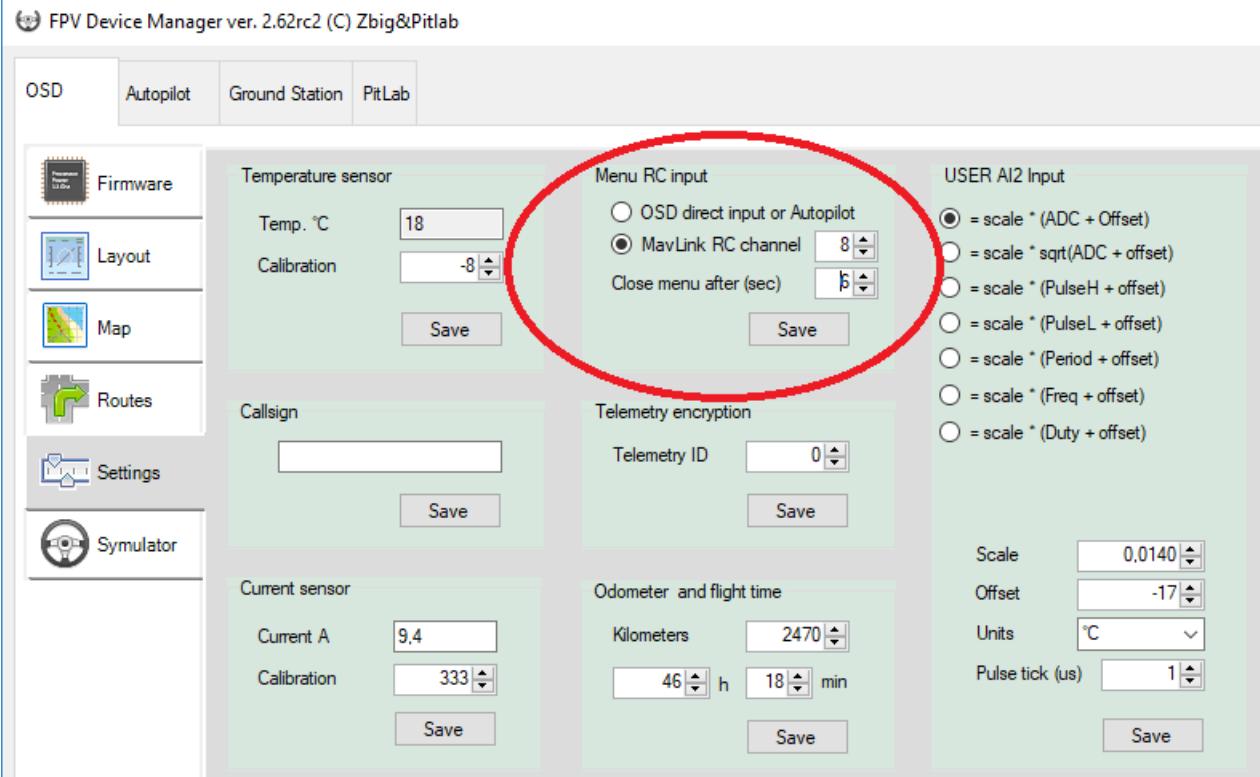
OSD do not need special configuration to work with other flight controller.

OSD sends request to FC and configures refresh rate of required messages: 10Hz for artificial horizon (pitch/roll), and 2Hz for other data (RC channels, GPS data, current/voltage etc). These rates are necessary for smooth display of information.

*NOTE: OSD sends heartbeat message with System ID 90 and Component ID 8.*

## OSD menu operation

OSD menu can be operated with 3-position switch on RC transmitter using spare RC channel. User may connect RC signal directly to OSD board or select free channel from RC controller. Configuration will be made in FPV\_manager.exe on page OSD->settings.



## Supported messages

OSD requests and processes only selected messages set described below. Other messages from FC will be ignored. It is recommended to disable any unnecessary messages from FC to reduce OSD processor load.

### MAVLINK\_MSG\_ID\_HEARTBEAT

Monitors status of flight controller and its connection

### MAVLINK\_MSG\_ID\_SYS\_STATUS

OSD monitors and displays error status of all enabled sensors. In case any enabled sensor is not healthy OSD will show periodically E:xxxx message in autopilot mode field (where xxxx is the symbolic name of the sensor)

OSD displays voltage, current and discharge level from this message as motor (main power) battery parameters.

### MAVLINK\_MSG\_ID\_GPS\_RAW\_INT

When this message is present, OSD will ignore GPS connected to OSD board and will take all positioning data from this message.

### MAVLINK\_MSG\_ID\_VFR\_HUD

This message provides following information:

- Altitude,
- Vertical speed (variometer)
- Airspeed

- Throttle position (for RC input channel monitor)

### **MAVLINK\_MSG\_ID\_ATTITUDE**

This message provides data for artificial horizon (pitch and roll) and heading (may replace course from GPS as external course source).

For fast horizon response this message may be send with up to 25Hz update rate.

### **MAVLINK\_MSG\_ID\_RC\_CHANNELS**

This message provides information about up to 12 RC channels and RSSI signal level. This information can be used in RC monitor fields.

### **MAVLINK\_MSG\_ID\_RC\_CHANNELS\_RAW**

This message provides information about up to 8 RC channels and RSSI signal level.

This message may be used as alternative to MAVLINK\_MSG\_ID\_RC\_CHANNELS message.

### **MAVLINK\_MSG\_ID\_WIND**

This message provides information about wind speed and direction. This information overrides internal Wind Assistant data.

### **MAVLINK\_MSG\_ID\_SCALED\_PRESSURE**

This message provides internal FC sensor (board) temperature (for OSD temperature field).

### **OTHER MESSAGES**

In addition to above message set OSD may send to FC requests for other messages and then receive other messages (response) from FC.

### **Firmware and compatibility**

MavLink-enabled firmware is fully compatible with latest OSD board version 2.3. If firmware is flashed to previous boards OSD will inform about incompatibility during startup.

In case of incompatible board please flash previous, official firmware 2.60 available from Pitlab website.

## **Working with external flight controller**

This supplement focuses on the OSD menu items MISSION, FLIGHT CONTROLLER and BASIC TUNING in the FLIGHT CONTROLLER Sub Menu. See the general Pitlabs OSD manual for detailed information on other OSD Main Menu items.

Mission Planner GCS note: In the connections boxes, upper right of the ArduPilot GUI, once a connection is made, an additional object is presented, labeled: "COMxx OSD 90". This is the mavlink connection to the OSD. If selected, the GUI only gets the OSD layout number. Select the other listing for the FC on that COM port.

Arducopter flight modes are available for change from the OSD Main Menu. Flight Controller actions are also available.

```
‣Exit
Store base
Mission
Set FC mode
Flight controller
Layout
Runways
Power battery alarm 5.2Ah/20.5V
OSD battery alarm 10.0V
System status
Service
```

Also note full Pixhawk (or other FC) status is available on the OSD Main Menu item SYSTEM STATUS page.

```
Gyroscope:          OK
Accelerometer:     OK
Magnetometer:      OK
Magnetometer Z:    ---
Abs. pressure:     OK
Dif. pressure:     ---
GPS:               OK
Safety Switch:     OFF
Battery:           OK
RC Receiver:       OK
Z/Altitude:        OK
Geo Fence:         ---
AHRS system:       OK
Optical Flow:      ---
Vision Pos.:       ---
Laser Pos.:        OK
Logging:           Unhealthy
```

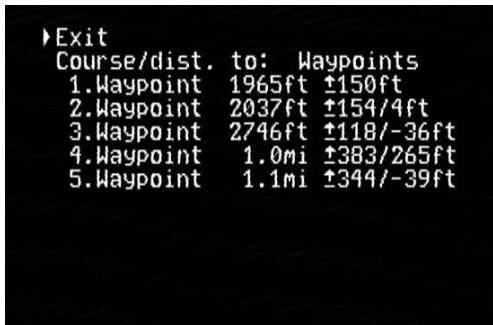
## Manual Waypoint Navigation:

From the Main Menu, select MISSION:

```
‣Exit
Store base
Mission
Set FC mode
Flight controller
Layout
Runways
Power battery alarm 5.2Ah/20.5V
OSD battery alarm 10.0V
System status
Service
```

NOTE: when selecting MISSION from the menu, the waypoint/command list will populate from the FC.

- Select Course/Dist. to: WAYPOINTS (toggles between waypoint and base when selected with radio switch)



Waypoint information is presented as follows:

- Number 1 Waypoint will show distance from home/present position, azimuth, Waypoint elevation relative to home elevation. The number to the right of " / " is the altitude difference between Waypoints

(note the small underlined arrow to the left of the waypoint elevation depicts the Waypoint as above, at the same elevation or below the home point).

Subsequent Waypoint information lines present distance, azimuth from the preceding Waypoint.

- Select a WAYPOINT for navigation(Menu closes upon selection)
- Select a Layout with the OSD horizon item and include Waypoints in the item properties

The selected Waypoint is now displayed with box around number and alternating with single or double chevrons indicating if the waypoint is below, level with or above present altitude. If the waypoint is within 10m/33ft of present altitude, only the waypoint number will be indicated. A single chevron alternating with the waypoint number indicates the waypoint is more than 10m/33ft above or below the present altitude. If a double chevron is alternating with waypoint number, the waypoint is more than 50m/164ft above or below the present altitude.

Note, the chevrons also give the pilot a sense of terrain. If a pilot has programmed a Waypoint on top of a hill and the air frame is below the hill elevation and the Waypoint icon is not flashing up chevrons, then the Waypoint has been programmed too low and the air frame will fly into the hillside.

If Distance and Navigation Mode items have been included in an OSD Layout, Base will be displayed in the Navigation Mode display item and distance will alternate between Base distance and last mission Waypoint. Base distance is annotated with a " / " and the Waypoint by a flag symbol.

Note: Only the active Waypoint is displayed on OSD screen

## Automatic Navigation:

Flying mission requires previously loaded "mission" by Mission Planner or other GCS.

The first method to begin Automatic Navigation from the main OSD Menu is to select FC Mode, then AUTO.

-Select AUTO



(Menu closes upon selection)

If the air frame is armed and the takeoff command set, the air frame will take off and begin the mission.

If in flight, the air frame will now track to the first Waypoint(not a command point) from present position and continue the mission from that point, using the waypoint parameters set in GCS.

#### **"Mini Missions" within Overall Mission**

A new feature of OSD is the ability select and activate "mini missions" within the overall Mission structure. No new or additional commands are used beyond the normal Arducopter Flight Plan commands.

The Main Menu item Mission lists all the Waypoints and commands of a Mission Planner created mission. OSD presents a convenient method for selecting a flight segment from within the whole mission, using the "DO\_JUMP" command.

When creating a mission, the pilot may want to create flight segments within a larger mission structure. These flight segments - mini missions, are easily constructed in the Mission Planner Flight Planning framework. By building the mission in this manner, the flight segments are readily accessible individually and the pilot does not have to rely on a phone app or notebook to load and send the air frame the new mission.

On the flight Plan page, start constructing the mission with the idea of how many flight segments would be used in the overall mission. Create that number of DO\_JUMP commands, i.e., 3 flight segments in the example below, create 3 commands. The pilot will return to them later to designate which Waypoints to jump to in order to start that flight segment.

From that point build the first( or main ) mission and commands. The last Waypoint or command of that flight segment should be Land, RTL or Loiter Unlimited. Land will command the air frame to land at the selected point and disarm the air frame. RTL will return the air frame to the takeoff point and disarm after landing. Both will stop the overall mission at that point. Using Loiter unlimited will leave the air frame hovering at the designated point and altitude for further pilot input.

Continue to create Waypoints and commands for the next segment, using the segment ending commands last. Do this for the 3 segments.

Once the pilot is satisfied with the overall mission structure, return to the initial DO\_JUMP commands and designate the Waypoint AFTER the segment ending command as the start of the new flight segment. In the below example of 3 flight segments, the first DO\_JUMP command will have Waypoint #4 as the Waypoint to "jump" to, to start that flight segment. Select the subsequent Waypoints(#6 and #10) for starting a segment and enter them next to the appropriate DO\_JUMP command.

```
›Exit
Course/dist. to: Base
<Next>
1. Jump #4
2. Jump #6
3. Jump #10
4. Loit turn +1279ft, ±147ft
5. RTL
6. Waypoint +1148ft, ±249ft
7. Spline +1072ft, ±249ft
8. Waypoint +124ft, ±29ft
9. Land +82ft, ±0ft
```

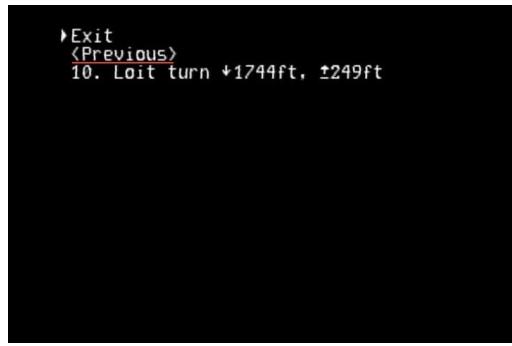
Now the pilot has an easy method of selecting a flight segment since the JUMP commands are at the top of the Mission menu list and the pilot does not have to scroll through what could be a long waypoint list.

NOTE: If the pilot is starting any mini mission from a non AUTO Flight Mode except the primary or first one, the AUTO Options field in Flight Controller|AUTO Option item MUST be set to RESUME MISSION. If left in Restart Mission any mini mission JUMP command will be ignored and the overall mission will be restarted at the first Waypoint. If a JUMP command is invoked while the flight controller is in AUTO, then the JUMP command will activate.

Tip: The best technique is to leave the AUTO Options item in Resume Mission. That way, any command selected on the Mission list will activate. The pilot can always invoke a Restart Mission( from the beginning) by selecting the first Waypoint of the overall mission.

Also note that if there are more than 9 Waypoints or commands, there will be additional pages.

```
›Exit
Course/dist. to: Base
<Next>
1. Jump #4
2. Jump #6
3. Jump #10
4. Loit turn +1279ft, ±147ft
5. RTL
6. Waypoint +1148ft, ±249ft
7. Spline +1072ft, ±249ft
8. Waypoint +124ft, ±29ft
9. Land +82ft, ±0ft
```



## Other Flight Controller Options:

### FLT Controller Sub Menu

```
→Exit
Trigger camera
Set altitude
Fence: Enabled
Arm
Basic tuning
Preflight reboot
AUTO option: Resume mission
```

### Trigger Camera

Shutter release for appropriate camera mounted to the air frame (Menu closes upon selection)

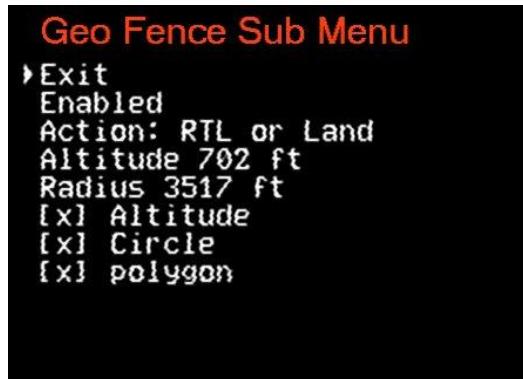
### Set Altitude

```
→Exit
150 ft
300 ft
500 ft
700 ft
1000 ft
1500 ft
2000 ft
2500 ft
3000 ft
3500 ft
```

Selects enroute altitude (Menu closes upon selection)

### Fence: (Enabled/Disabled)

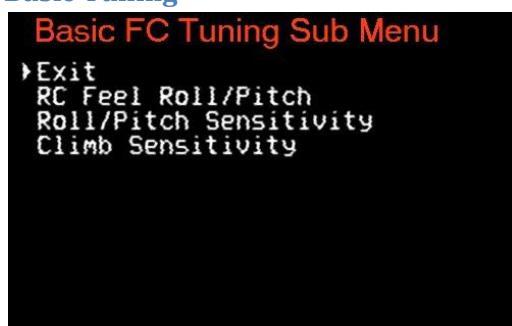
This item allows the pilot to enable or disable the Geo Fence, change the action when the fence is encountered, set altitude and radius parameters and individually enable/disable altitude, circle or a polygon fence if one programmed in the FC.



### Arm

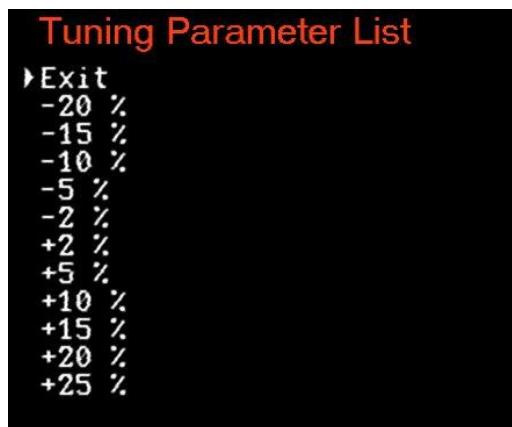
Arms air frame (Menu closes upon selection and appropriate tones are heard from FC)

### Basic Tuning



This item allows the pilot to modify the tuning parameters.

All three items have the same numeric list

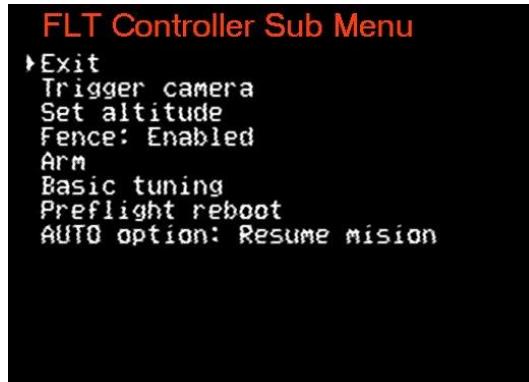


OSD will retain these changes and are percentage changes in total. If the FC has different values for pitch and roll, those are preserved with the OSD values layered over them.

### Preflight Reboot

**This option is only visible in the sub menu IF the air frame is disarmed.**

## AUTO Option



There are two AUTO options: Restart Mission and Resume Mission

When the pilot is presented with the sub menu, AUTO option will always list the last state of the option. In the above image, it is Resume Mission.

To change the option, select AUTO option and toggle it active with the designated radio switch.

Restart Mission is the same as AUTO FC mode where the air frame will restart the mission from the first Waypoint, with the additional step of invoking AUTO FC mode after selecting Restart Mission.

Resume Mission will command the air frame to join the mission at the next Waypoint past where the flight was interrupted. Example: mission has proceeded past Waypoint #4 ("reached command #x" will be seen in OSD) and is interrupted. The mission will resume at Waypoint #5.

Note: Both options require the pilot to then invoke AUTO FC Mode from the Main Menu.

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