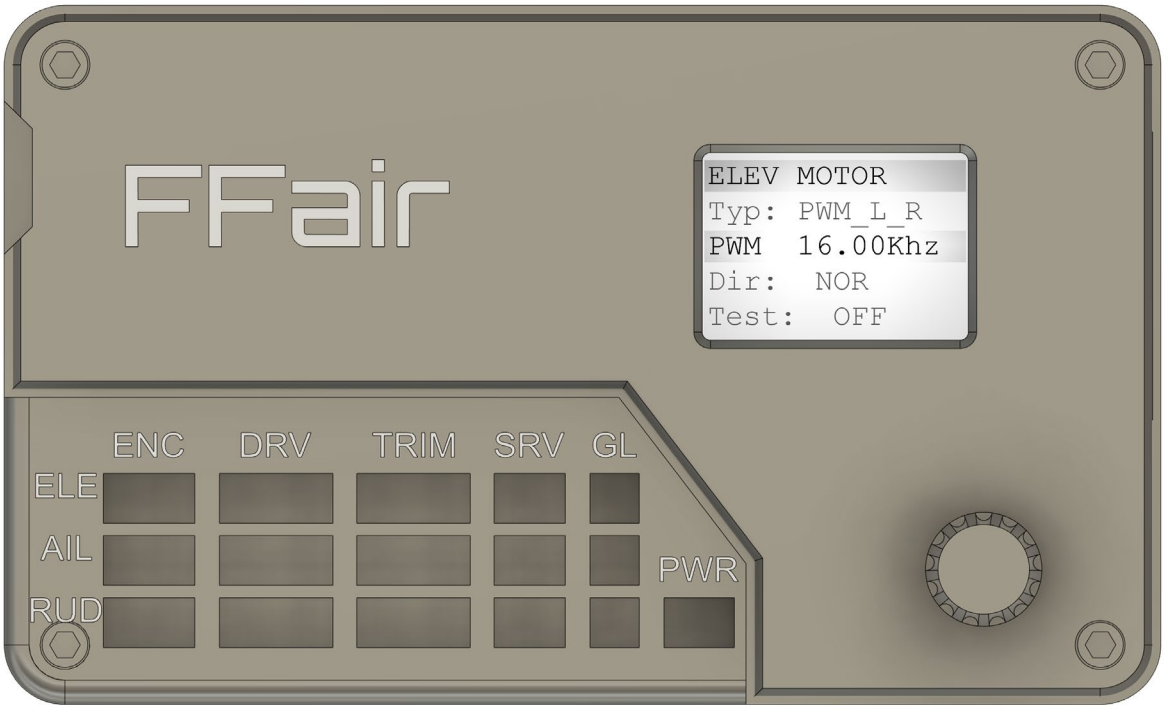


FFair system

SETUP GUIDE

Content

1.- BASIC HARDWARE CONFIGURATION GUIDE.

1. If you want to configure the system from scratch, it is advisable to reset the profile.

PROFILE -> Reset -> Reset profile

2. DISCONNECT POWER FROM THE MOTORS.

3. Connect the USB cable to the FFair box.

4. Activate the axes on which you want to have control (e.g. for yoke without pedals):

AXES CONTROL->ELEV CONTROL -> CONTROL->JOY

AXES CONTROL->AIL CONTROL -> CONTROL-> JOY

AXES CONTROL->RUD CONTROL -> CONTROL->OFF

5. Activate the axes that you want to configure the forces (e.g. for yoke without pedals):

AXES FORCES->ELEV FORCES -> FORCES->ON

AXES FORCES->AIL FORCES -> FORCES->ON

AXES FORCES->RUD FORCES -> FORCES->OFF

6. Perform a manual calibration of the controls:

CALIBRATE -> Type -> MANUAL

CALIBRATE -> Calibrate

The control unit will tell you that (only for the axis you activated in AXES CONTROL):

- Push the yoke, and put the ailerons and pedals to the left and press OK.
- Pull the Yoke, and set the ailerons and pedals to the right, and press OK.
- Set all controls to neutral, and press OK.

With this, the encoders should already be calibrated.

At this point it is advisable to save the values:

PROFILE -> Save -> save profile will save the data in the selected profile. It is possible to save 3 different profiles.

7. To check the correct functioning of the Encoders:

H/W SETUP -> ENCODERS -> ELEV.ENCODER It must have been configured only with manual calibration. You can check this as the numbers should move as you move each axis, and show the direction while it is moving, or show that it is still when the yoke is not touched.

Repeat for each axis you activated.

- For gear ratios about **1:3 to 1:6**, **FULL mode** is recommended
- For **1:1 gear ratios** (which is generally not recommended), it may be necessary to set the **encoder mode** to **HALF** or **QUARTER**.

If Encoder Mode changes, you need to perform a manual calibration again and save profile.

8. To set up the Motors:

H/W SETUP -> MOTORS -> ELEV. MOTOR: and select the type of motor driver installed.

- Cytron 30A: PWM_L_R
- BTS7960: PWM1_PWM2_ENB

H/W SETUP -> MOTORS -> ELEV. MOTOR -> PWM and select 20khz. Lower this value only if the installed motor driver does not support such high frequencies. Both Cytron and BTS7960 work well at 20Khz.

Now you have to check that the polarity of the motor is correct, to do this:

H/W SETUP -> MOTORS -> ELEV. MOTOR -> POWER: lower it up to 20%, to avoid surprises.

H/W SETUP -> MOTORS -> ELEV. MOTOR -> Exp: 0%.

Connect the motor power cables.

Press:

H/W SETUP -> MOTORS -> ELEV. MOTOR -> Test

You should feel a force trying to centre the yoke to its centre point. If so, the polarity is correct.

If when you move the yoke, you feel forces pulling the yoke towards the ends, then the polarity is reversed. Change the value of:

H/W SETUP -> MOTORS -> -> ELEV. MOTOR -> Dir: swap the Norm/Rev value.

Check that the forces now tend to center the shaft at the midpoint.

Now that the direction of the forces is correct, set up

H/W SETUP -> MOTORS -> ELEV. MOTOR -> POWER: increase the value until the force you feel at the extremes of the travel range is the maximum desired. This will be the maximum force the system will use for this axis.

H/W SETUP -> MOTORS -> ELEV. MOTOR -> Exp: increase the value with positive percentages until the dead zone of the shaft at its midpoint is small or zero. The control, wherever you leave it, should always go to its neutral in the same place. If it does not always centre on the same spot, gradually increase the Exp value. If it always goes to the same spot and you have to use a lot of force to start moving the yoke, reduce the Exp value.

Repeat the motor configuration for the other active axes.

Remember to save the values:

PROFILE -> Save -> save profile

9. Configuring PIDs

Correctly configuring the PIDs is necessary both for the autocalibration when the system is started and for the correct operation of the autopilot commands.

Start with the following values:

Force:	80%	The maximum percentage of force the system will use.
Disengage:	80%	What force must be exerted against the movement to detect the buffers.
Time Disengage:	500ms	How long (in milliseconds) the PID must try to bring the yoke to the desired position before the PID is deactivated.
Speed:	5 secs	Speed at which the PID test will move. This way you can test at different speeds and check that it is stable at all of them.
kp	40	PID Proportional Component
ki	0	PID Integral Component
kd	0	PID Derivative Component

It is advisable to do the TEST with these values. Once the TEST has been started, they can be varied in real time until a smooth and precise movement is achieved throughout the travel. By applying a force with the

hands in the opposite direction to the movement, the PID will be deactivated depending on the values set in Disengage and Time Disengage.

Information on the theory of operation of PIDs can be found on the internet:

https://es.wikipedia.org/wiki/Controlador_PID

https://en.wikipedia.org/wiki/Proportional%E2%80%93integral%E2%80%93derivative_controller

Repeat the PID calibration process for the other active axes.

Remember to save the values:

PROFILE -> Save -> save profile

10. Autocalibration.

Once the PIDs of the active axes have been set correctly, and after having achieved a smooth yoke movement in the PID tests, you can use the automatic calibration of the system.

CALIBRATE -> Type -> AUTO

CALIBRATE -> Calibrate

The system will move the active axes of the system to self-calibrate. It will do this every time the USB cable is connected. **Power to the motors must always be active before connecting the USB cable**.

11. Save the configuration

PROFILE -> Save -> save profile will save the data in the selected profile. It is possible to save 3 different profiles.

From this moment on, the system will auto-calibrate itself every time the control unit is started. Remember that the power supply of the motors must be connected before connecting the USB.

2.- AXES CONTROL.

FFair allows you to control up to three control axes.

- Elevator
- Ailerons
- Rudder

Each of them can be activated and deactivated in the following ways

AXES CONTROL -> ELEV CONTROL -> CONTROL -> OFF/Data/Joystick

AXES CONTROL-> AIL CONTROL -> CONTROL -> OFF/Data/Joystick

AXES CONTROL -> RUD CONTROL -> CONTROL -> OFF/Data/Joystick

*Data Mode is currently disabled. Joystick mode must be used.

2.1.-CONTROL:

- OFF: disables axis control. The simulator will not receive data from FFair.
- Data: FFair directly injects axis values into XPlane/MSFS variables. Nothing needs to be configured in XPlane/MSFS. This is the recommended method for XPlane default aircraft and addons that use these same variables.
- JOYSTICK: FFair simulates a joystick axis. In Xplane, you have to configure this Joystick axis and assign the joystick to control elevator, ailerons or rudder. Some addons need this mode to work properly, as they are not compatible with the standard simulator variables. An example of this is the Airfoillabs C172. Activating Joystick mode will work correctly.

2.2.- DUAL RATE:

Accepts Values between 50% and 200%.

100% makes the movement of the physical yoke equal to that of the simulator. A 100% maximum deflection will correspond to 100% deflection in the simulator.

Lower values of 100% lower the amount of movement in the simulator.

Higher values of 100% increase it.

A value of 100% is recommended.

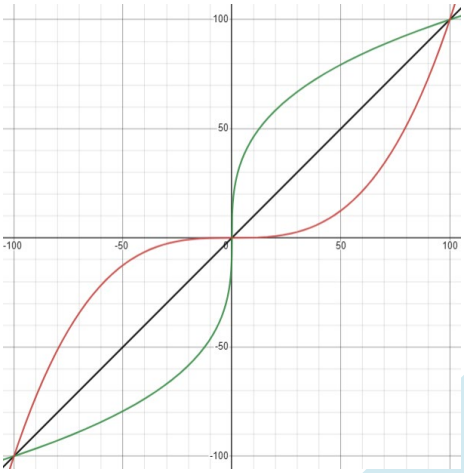
2.3.- EXP:

Accepts values from -100% to 100%.

Positive values make the control more authoritative in the centre (see green curve).

Negative values soften the control around the centre (see red curve).

0% exponential makes the command fully linear (see black line).



3.- AXES FORCES.

This menu configures the intensity and type of forces that will be felt on each axis. It is very important to have the motors correctly configured before using these settings. Go to the basic hardware configuration guide and configure the direction, intensity and exponential curve of the force of the motors. These values affect the rest of the settings in this menu.

3.1.- FORCES

ON/OFF toggles the forces on and off for the selected axis.

3.2.- SPRING:

This parameter should be used in two situations:

1.- you want the yoke to behave like a normal mechanical joystick with springs. What this parameter does is to simulate a spring that centres the joystick.

2.- the yoke/pedal mechanics are not well balanced and this imbalance shifts the axis somewhere when the whole system is disconnected. For example, pedals that go all the way to the right or left when there is no power. With this parameter you can introduce a centring/centring force to balance this force, so that you can leave the axle static in any position.

3.3.- EXP.SPRING:

Introduces a positive or negative exponential factor to the previous spring value, to achieve any of the objectives 1 and/or 2 described above.

3.4.- DAMPER

Exercises a damping type force. It is a dynamic force, offering resistance the faster the yoke moves.

Positive values increase resistance to movement. Negative values facilitate movement.

Values from 0 to 20% are common.

This force does not depend on the flight simulator.

To set it up you should imagine that you are in a stationary aircraft, and try to get the feel of the controls that simulates the hardware of the real aircraft.

3.5.- FRICTION

Exerts a frictional force on the stick. It is a constant force that mimics the hardness of the yoke.

Positive values offer resistance to movement

Negative values facilitate movement. Think of it like power steering in a car.

3.6.- SPRING GROUND

For Rudder axis only. Simulates the centring of the steering wheel when the aircraft is rolling on the ground. This force increases from 0 when the aircraft is stationary, to the set parameter when we reach the "at speed" speed (see below).

3.7.- FRICTION GROUND

Only for the Rudder axis. Simulates the frictional drag force that is generated at the steering wheel when the aircraft is on the ground. The friction ground force is at its maximum when the speed is 0. It decreases to 0 when the “at speed” is reached.

3.8.- AT SPEED

For rudder axis only. Speed at which the spring ground force is maximum, and the friction ground force reaches 0.

3.9.- AERO

This force attempts to bring the control to its central neutral position, and depends on the aerodynamic effects of the simulator. The higher the airspeed, the greater the centring force on the control.

3.10.- AT SPEED

This is the airspeed at which you will feel 100% of the Aero-like force. If the value is 0, then the force will be constant. Like a conventional joystick.

In general, you should enter here a value close to the maximum airspeed of the aircraft.

3.11.- AERO EXP

The centring force can be calibrated exponentially. This allows different types of aircraft to be simulated.

A negative exponential force mimics an aerodynamic force against the control surfaces of the aircraft.

Negative values mimic small cable-driven aircraft.

0 or positive values mimic hydraulic controls of larger aircraft.

3.12.- PROP WASH

The force applied to the control surface by the jet of air propelling the propeller over the control surfaces.

In flight, this force is virtually negligible.

But when stationary on the ground, and with the engine at full power, the air will hit the control surfaces trying to centre the control.

Typical example of a Cessna 172. The propwash will affect the elevator and rudder, but will not affect the ailerons, as they are far from the propeller-induced air jet.

3.13.- WEIGHT

Only the elevator is affected.

The weight of the control surface itself, causes it to try to lower the yoke when the aircraft is stationary. Once the engine is started, this force can be counteracted by the propwash and, in flight, by the Spring-type aerodynamic force.

3.14.- AT SPEED

Airspeed (either aerodynamic or due to propwash), at which the weight of the elevator disappears.

4.- EFFECTS OF FORCES

Effects are non-constant forces, due to different types of simulator events, such as shock or vibration.

4.1.- EFFECTS

0 a 100%. Regulates the force intensity of the effects. Affects all of the following effects.

4.2.- STALL FORCE

0 a 100%. Regulates the intensity of the vibration due to stall of the aircraft.

4.3.- STALL Hz

The frequency in Hz at which the control will vibrate when the aircraft is in a stall state.

Typical values are 5 to 20 hz

4.4.- GROUND FORCE

This force induces vibrations produced as the aircraft rolls along the ground.

FFair takes into account all the different ground surfaces in the simulator, and depending on the type of surface and the taxiing speed, more or less vibrations/shock will be felt in frequency and intensity.

It is not the same to taxi on a tarmac runway as it is to taxi on a dirt runway, or to land off the runway in a field. FFair takes these things into account.

You should increase the force the smaller and more sensitive the simulated aircraft is. You will feel the bumps in the ground much more if you are in a cessna152 than if you are in an airbus320.

4.5.- LOW RPM FORCE

The strength of the vibrations you will feel due to the engine turning. This force is the force you will feel when the engine revolutions per minute are at the "LOW RPM" parameter.

4.6.- LOW RPM

Sets the number of rpm at which the LOW RPM FORCE force will be felt. It is recommended to use the value that the engine has when idling.

4.7.- HIGH RPM FORCE

The strength of the vibrations that you will feel due to the engine turning. This force is the force you will feel when the engine revolutions per minute are at the "HIGH RPM" parameter.

4.8.- HIGH RPM

Sets the number of rpm at which the force of the LOW RPM FORCE will be felt. I recommend setting a value similar to the rpm when the engine is at maximum power and revolutions.

4.9.- RPM DIVIDER

Divide the rpm by this coefficient to make the calculations.

In piston aircraft it is recommended to use 1.

On turbines it may be necessary to use different coefficients to achieve the desired rpm feel.

4.10.- ON AIR% IS THE PERCENTAGE OF THE FORCE OF ALL THE AIR

This is the percentage of force of all the above events, when the aircraft is in the air.

When the aircraft is in the air, the forces of the effects are lowered because it has no fixed point of attachment to something (the ground).

Using a value of 100%, the forces will be the same as when the aircraft is on the ground.

Values of 10-30% give good results.

5.- TRIM

In this menu we can adjust the behaviour of the trims for each axis. Force feedback systems allow the trims to be configured so that they behave as in real aviation.

In a conventional joystick, the neutral of the control will always be with the lever in the centre of the travel, as there is a spring that takes it to this place.

In real aviation, the trim allows the aerodynamic neutral of the control surface to be varied. Therefore, when we move the trims, we are varying the point where the aerodynamic pressure wants to take the control.

This is possible to mimic with a force feedback system, and FFair is ready for it.

5.1.- CONTROL

OFF: disables the trim function for this axis. The simulator configuration will be used to operate the trims.

FORCE: The encoder, buttons or potentiometer connected to FFair will be used, which will vary the aerodynamic neutral within the yoke/pedal travel. The simulator trim will indicate zero. But the yoke neutral will be out of phase with the centre of travel, so the controller will be continuously sending a slight deflection to the simulator. This is the most realistic way to trim the aircraft. The correct process will be to move the yoke until the aircraft has the desired trajectory. Operate the trim buttons, encoder or potentiometer until you notice that there is no pressure on the yoke. At this point the plane will be trimmed. This method is recommended for small aircraft that do not have an autopilot.

SIM: The buttons, encoder or potentiometer connected to FFair will be used, which will move the simulator trim as usual in the simulator. Recommended for airliners.

HYBRID: It is a mixture of the previous ones. Moving the trim will move the simulator trim, but it will also move the axis in FFair. This method is recommended for small aircraft where Autopilot following can be removed.

It is recommended to use SIM mode while adjusting all the simulator parameters, such as AP following, forces. And once everything is calibrated, experiment with Force/Hybrid modes.

5.2.- INPUT

BUTTONS: the trim will work with two buttons (or with a momentary ON - OFF - momentary ON switch). See the hardware assembly section for the correct connection of these buttons.

POT: the trim works with a potentiometer. We recommend a quality potentiometer, 5 or 10 turns, linear, 5 or 10kohm resistance. See hardware assembly section for the correct connection.

ENCODER: The trim will operate with the rotation of a pulse encoder (12 to 24 pulses per revolution type).

5.3.- BUTTONS SPEED:

Speed at which the trim moves when the buttons are pressed. This is the time it takes for the trim to travel through its full range. Between 2 and 20 seconds. Approximately 10 seconds is recommended.

5.4.- POT SETUP:

In this menu you can calibrate the pot.

Under "Current" you see the current value of the pot.

Move the wheel to full up, and look at the value in "current". Place this value in the "Set UP" line.

Move the wheel to full down, and look at the value under "current". Place this value on the "Set DOWN" line.

5.5.- ENC STEPS

In case you use a pulse encoder for the trim, put here the total number of steps/pulses/clicks you want to have during the whole trim range.

Example: If an encoder has 16 clicks per revolution, and you want the trim to have a total range of 5 full turns, put here a value of 16 x 5 = 80 steps.

5.6.- DIRECTION

Norm/rev. If the trim acts backwards in the system, we can change the connection of the buttons, the wiring of the pot, or simply and easiest of all, change this parameter.

5.7.- FORCE:

0 a 100%. This is the total percentage of the force that we want the trim force and trim Hybrid modes to apply to the yoke. Values of 30% are a good starting point.

5.8.- SERVO

FFair incorporates a Trim indicator system. This can be operated by a servo.

To use it, a 5v power supply needs to be connected to the FFair power connector (second pin). See hardware connection section for more information.

The servo can be adjusted in 3 positions Min/Middle/Max.

Use the test in this menu to set different values in "Value" to know which values should be set to Min/Middle/Max.

5.9.- PWM

FFair can also use galvanometer type Trim indicators. These must be galvanometers whose idle state (zero volts) causes the needle to go all the way to one side. They cannot be used if in the 0 volt state the needle marks the middle of the scale.

To use these indicators, we will have to supply voltage (5 to 24V) to the power connector (third pin). See hardware connection section for more information.

The galvanometer can be adjusted in 3 positions Min/Middle/Max.

Use the test in this menu to set different values in "Value" to know which values should be set to off/Min/Middle/Max.

OFF is the position that the needle will have when there is no voltage on the aircraft master bus.

Min/Middle/Max are the values for minimum, neutral and maximum trim travel.

6.- AUTOPILOT

FFair has a system for tracking the movement of the simulator yoke/joystick when the aircraft autopilot is engaged. It can be activated or deactivated independently for each main axis, and each trim axis.

If the function is enabled, and the aircraft autopilot is active, FFair will move the controls trying to follow the movements made by the simulator controls.

It is very important to have the PIDs of each axis perfectly configured for the controls to move correctly. If the PIDs are not set correctly, the yoke movements may be erratic, and the autopilot will disengage.

The autopilot will disengage, if we force our hands in the opposite direction to the movement of the yoke.

Elevator Axis (Elev Axi): If **enabled**, the elevator axis will follow the movements commanded by the autopilot in the simulator. This allows the yoke to move in response to autopilot-induced pitch changes, enhancing realism.

Elevator Trim (Elev Trim): If **enabled**, FFair's trim value will update according to the trim adjustments made by the autopilot in the simulator. Behavior based on trim input type:

- **If using buttons or an encoder for trim**: The trim value will remain unchanged when the autopilot is disconnected, preserving the last position set by the autopilot.
- **If using a potentiometer for trim**: The trim position cannot be retained when the autopilot is disengaged, as the potentiometer physically sets the trim position. The only way to maintain trim adjustments in this case is by using a motorized trim system.

The same functions and behaviours also apply to the **aileron** and **rudder** axes.

AP/d

When this option is pressed, it sends a joystick press to windows. You have to configure the simulator so that this joystick press disables the autopilot. Go to the control assignment, find the option to disable autopilot, and assign the event that is sent when you press the "AP/d" option.

- In X-Plane assign the push button to "**Disconnect autopilot and interrupt pitch trim servo**".
- In MSFS, assign the push button to "**SET AUTOPILOT DISENGAGE**".

7.- PROFILE

7.1.- PROFILE

Displays the currently active profile.

7.2.- SAVE

Saves the current configuration, in the active profile.

7.3.- COPY PROFILE TO:

Copies the current configuration, to the selected profile.

7.4.- RESET

Resets the current profile to factory defaults. This profile must be reconfigured from scratch.

7.5.- RESET ALL

Sets all profiles to factory defaults.

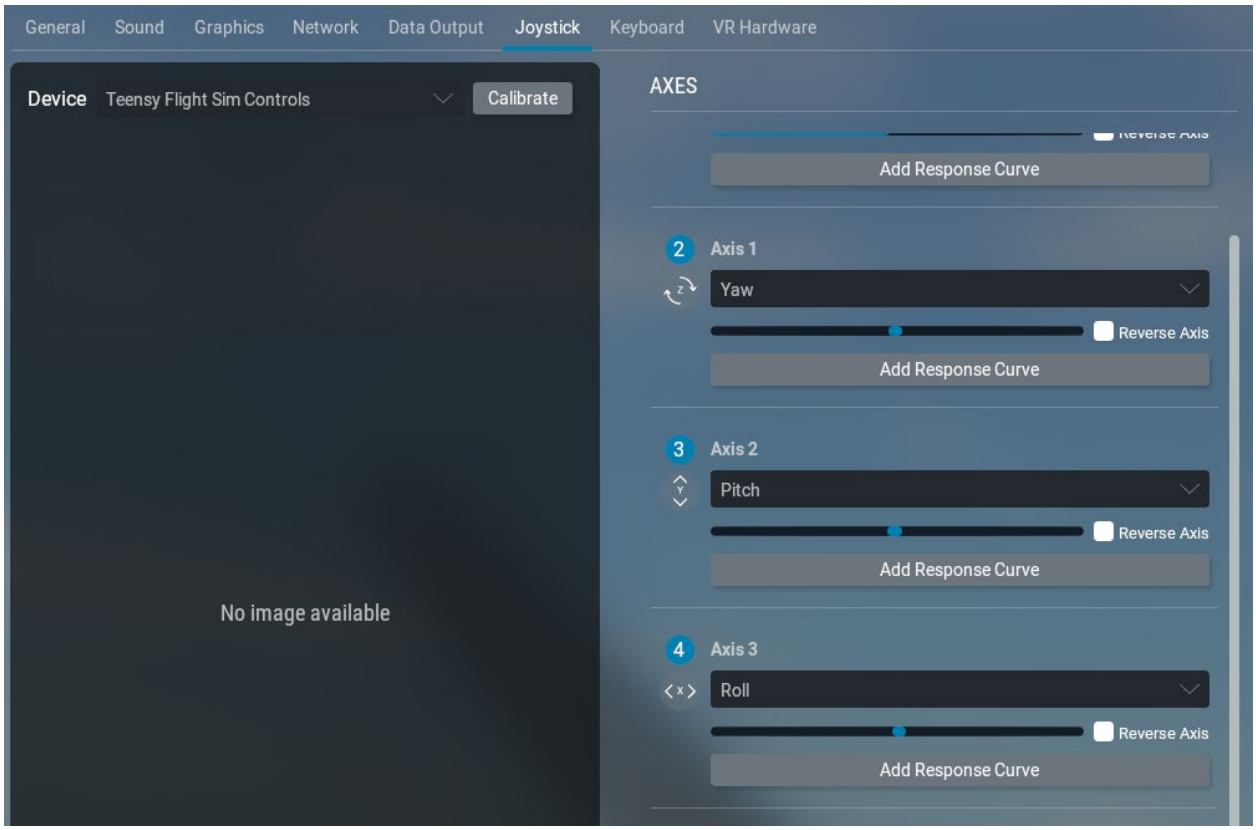
8.- X-PLANE SETUP

1.- Install the plugin that allows FFair data exchange with X-Plane. It can be found at: https://www.pjrc.com/teensy/td_flightsim.html

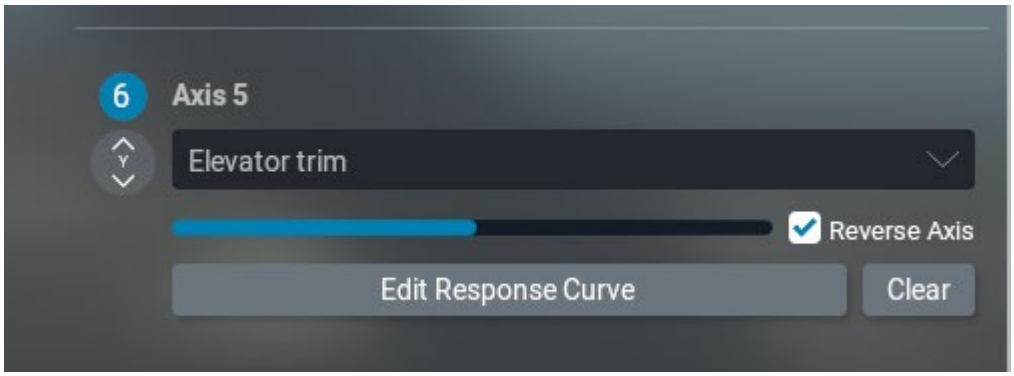
2.- Start X-plane. When you are in an active flight in X-Plane, FFair will show a "*" after X-Plane in the first line of the menu, indicating that communication is established with X-Plane.

3.- With an active flight, go to Controls, and configure the new Device which will appear with the name "Teensy Flight Sim Controls".

4.- Assign the yoke axes to the functions. Yaw (rudder), Pitch (elevator), and Roll (ailerons).



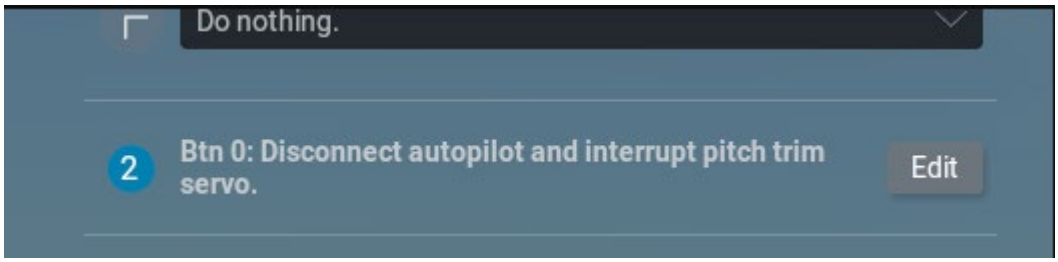
5.- Assign the trims you are using. The trims will be seen in X-Plane as axes, regardless of whether you have FFair configured as buttons, pots, or encoders. In all three options, FFair ends up sending a trim axis to X-Plane.



6.- Calibrate the device as a joystick. This should only be done the first time. It will ask you to move the controls and trims from side to side and centre them. To do this, follow these tips:

- put the FFair trims in FFair in SIM mode, so that there is no interference between trims and axes.
- You will be prompted to move all the axes to their ends, and then centre them. To make sure you have the axes centred, go into FFair in the calibrate menu and set all axes to values close to 0. To centre the trim axes, go into FFair in the "trim show" menu, and set the trims so that they are as close to 0 as possible. Once you have done this in both menus, confirm to X-Plane the centred position of the axes.

7.- Finally, assign the joystick button that is detected by X-Plane when you press the AP/d (autopilot disconnect) option in the FFair menu. Assign the function "Disconnect autopilot and interrupt pitch trim servo".



This command will be sent by FFair to X-Plane when you force your hands on the yoke in the opposite direction to the movement the Autopilot Following wants to make.

9.- MSFS 2020/2024 SETUP

1. Install FSUIPC

Download and install FSUIPC (registered version required) from the official website. This software acts as a bridge between MSFS and external hardware, allowing communication with the force feedback system.

2. Copy the LUA Script

Once FSUIPC is installed, locate the FSUIPC installation folder (by default, C:\FSUIPC).
Copy the “ffairlink.lua” script directly into the C:\FSUIPC folder.
This script is responsible for handling the data exchange between MSFS and the central unit.

3. Identify the COM Port of the Teensy Board

To enable communication between FSUIPC and the central unit, you need to identify the COM port assigned to the Teensy microcontroller:
Open Device Manager in Windows (Win + X → "Device Manager").
Look under "Ports (COM & LPT)" and find Teensy (it should be listed as "USB Serial Device (COMX)").
Note down the COM port number (e.g., COM5).

4. Edit the LUA Script to Set the Correct COM Port

Open the FFairLink.lua script using a text editor (e.g., Notepad).
Locate the line that sets the port_number variable. It should look like this:

port_number = 10 -- put your ffair com port here.

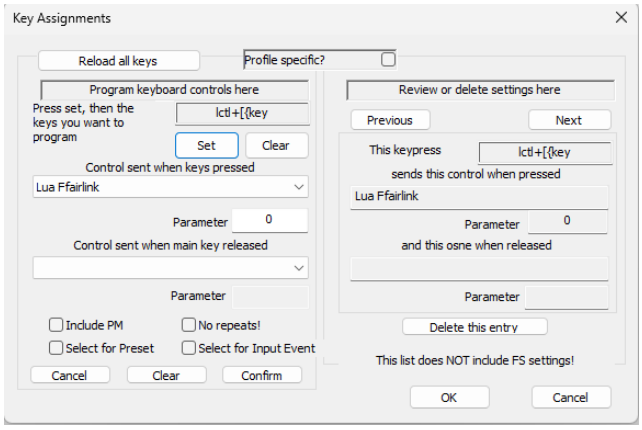
Replace 10 with the actual COM port number you found in Device Manager (e.g., if the Teensy is assigned to COM5, update the line as follows):

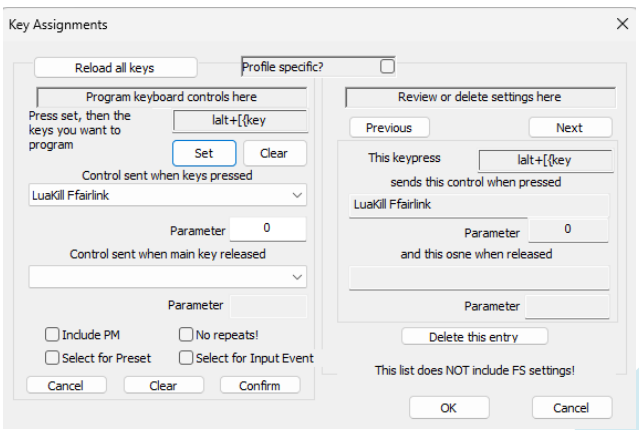
port_number = 5 -- put your ffair com port here.

Save the file.

5. Assign a Button or Shortcut to Start/Stop the LUA Script

To manually start and stop the LUA script within FSUIPC:
Open FSUIPC settings from within MSFS.
Go to the Key/Button Assignments section.
Assign a key or button to launch and stop the FFairLink.lua script. (choose the shortcut you want) to run the lua script... and to kill it... (optional)



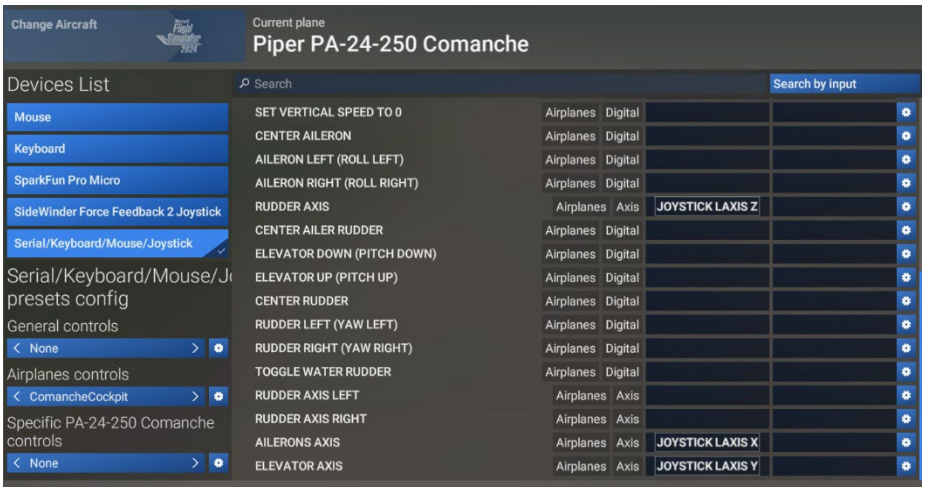


6. Confirm Connection – Check for "*" on the Central Unit

Once the LUA script is running, the central unit should display a **MSFS*** instead **MSFS** symbol on its screen. This indicates that it is successfully receiving data from MSFS via FSUIPC. It only happens in an active flight.

7. Assign the Elevator, Aileron, and Rudder Axes in MSFS

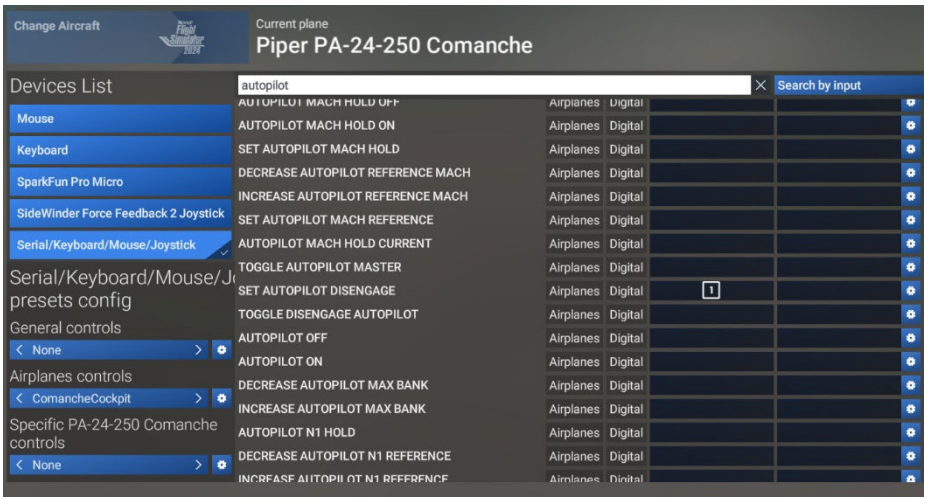
Now that communication is set up, you need to configure the force feedback system as a joystick device in MSFS:



Open MSFS Controls Settings.
Find your central unit under connected controllers. You will see a "Serial + Keyboard + Mouse + Joystick" device.
Assign the following axes:
Elevator → Pitch control
Aileron → Roll control
Rudder → Yaw control

8. Assign the Autopilot Disconnect Button

To ensure that force feedback and manual control work seamlessly with the autopilot, you need to assign the Autopilot Disengage function in MSFS. Follow these steps:



Open MSFS Controls Settings.
In the search bar, type "SET AUTOPILOT DISENGAGE".
Select the function "SET AUTOPILOT DISENGAGE" from the results.
Press the AP Disconnect button on your hardware.
This button is sent from the FFair central unit when pressing AUTOPILOT → AP/D Push.
Click "Validate" or "Confirm" to save the assignment.

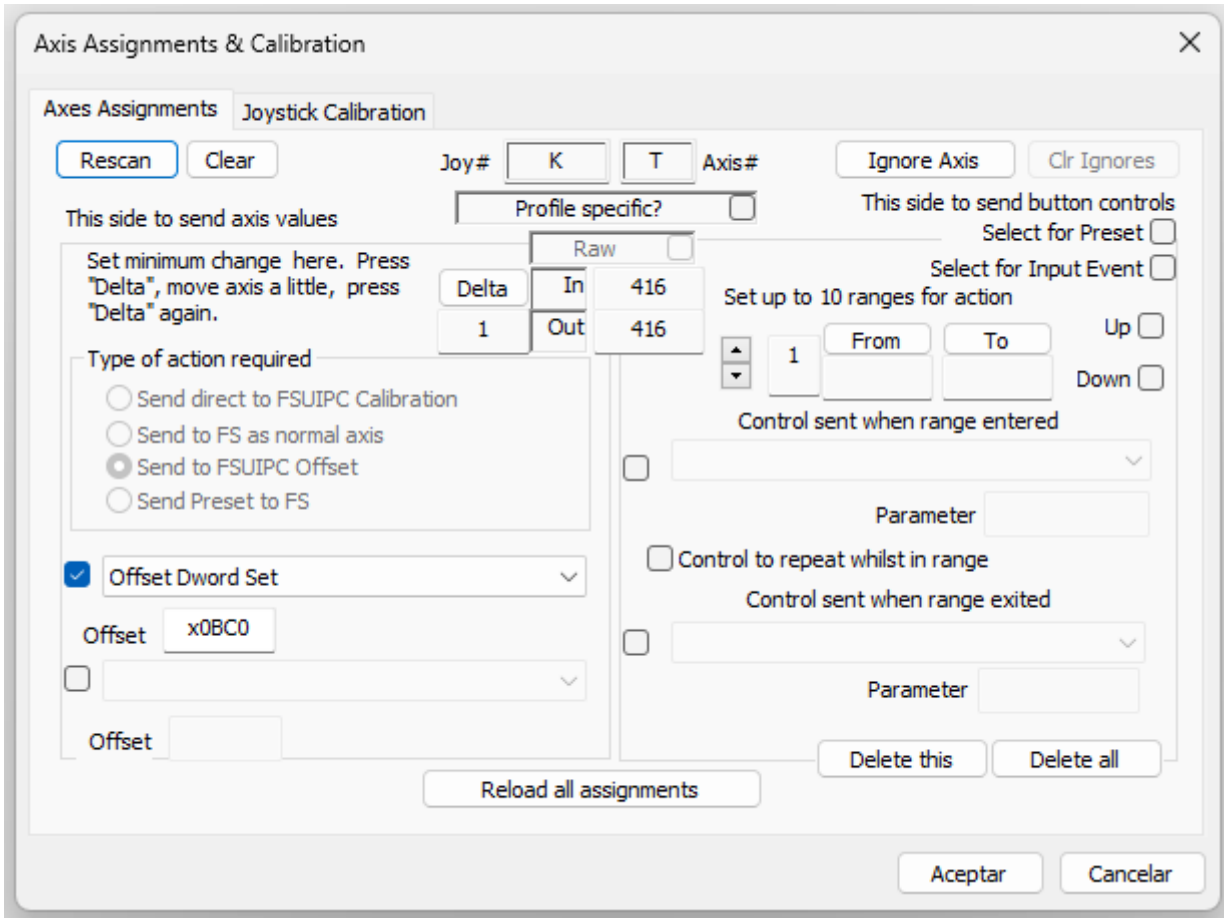
9. Assign Trim Axes in FSUIPC (Including Offsets)

For proper trim control, you need to assign the trim axes directly in FSUIPC using specific offsets. These offsets allow FSUIPC to communicate trim data between MSFS and the force feedback system.

Steps to Assign Trim Axes in FSUIPC

- Open FSUIPC and go to the Axis Assignment tab.
- Move the trim wheel (or trim controls) to detect its input.
- Select "Send direct to FSUIPC Calibration" instead of sending to MSFS.
- Assign the trim axes using the following FSUIPC Offsets:

use x0BC0 for elevator trim
use x0C02 for aileron trim, if needed.
and x0C04 for rudder trim, if needed.



10.- FIRMWARE UPDATE

Updates are required to fix bugs, add new features, or change firmware between simulators. Firmware beginning with X are for use with X-Plane. Firmware starting with M are for use with Microsoft Flight Simulator or prepar3d.

1.- Download Teensy Loader from https://www.pjrc.com/teensy/loader.html

2.- Start the program.

3.- Click on Open HEX file and select the new firmware file.

4.- Click on the letter "I" of the "FFair" logo on the control unit. This point on the housing is flexible and just below it is the teensy button to load the new firmware.

5.- Once the firmware is loaded, FFair will restart, and the version number will appear on the home screen.

11.- FACTORY RESET

11.1 Resetting FFair to Factory Defaults

If FFair is working normally but you want to reset all data to factory values—either to start fresh or because an update recommends it—follow these steps:

- Navigate to **"Profile -> Reset all?"**
- Confirm the reset. This will erase all stored settings and restore FFair to its original configuration.

11.2 Display Calibration (If FFair Shows No Data on Screen)

If the FFair display does not show any data, you need to perform a display calibration:

- **Unplug the USB cable** from the device.
- **Press and hold down the encoder**.
- **While holding the encoder, reconnect the USB cable**.
- **Continue holding the encoder while the display flashes**. Do not release it until you see the message **"RELEASE WHEN YOU CAN READ THIS"**
- Release the button. At this point, the display is calibrated enough to be readable.
- The screen will then show **"PUSH 5 TIMES TO RESET ALL"** and **"WAIT FOR EXIT"**
- Simply wait for the process to finish.
- Once completed, go to **"H/W SETUP -> DISPLAY"** to fine-tune **BIAS** and **CONTRAST** settings as needed.

11.3 Full Reset: Display Calibration + Factory Reset

If you want/need to both **calibrate the display and reset all data to factory defaults**, follow these steps:

- **Unplug the USB cable** from the device.
- **Press and hold down the encoder**.
- **While holding the encoder, reconnect the USB cable**.
- **Continue holding the encoder while the display flashes**. Do not release it until you see the message: **"RELEASE WHEN YOU CAN READ THIS"**
- Release the button. At this point, the display is calibrated enough to be readable.
- **Press the encoder 5 times** as instructed on the screen.
- This will trigger a **total memory reset** of all profiles. The screen will display **"MEMORY HAS BEEN RESET".** If this message does not appear, unplug the USB and try again.
- Once completed, go to **"H/W SETUP -> DISPLAY"** to fine-tune **BIAS** and **CONTRAST** settings as needed.