X20 and Ethos
User Manual

Table of Contents

System Setup

The System setup menu is used to configure those parts of the radio system's hardware that are common to all models, and is accessed by selecting the Gear tab along the bottom of the screen. Conversely, model specific setup is performed in the Model menu, which is accessed by selecting the Airplane tab along the bottom of the screen.

Please note that the settings to determine whether the internal or external RF module is used are model specific, so these are handled in the 'RF system' section of the Model menu.

Overview

Model Select

The Model Select option is used to create, select, add, clone, or delete models.

File Manager

The File Manager is for managing files and for access to flash firmware to the TD-ISRM, external S.Port, OTA and external modules.

Alerts

Configuration of system sound, vibration and battery alerts.

Date & Time

Configuration of the system clock and time display options.

Display

For configuring the menu style, system language, and LCD Display attributes such as brightness and backlight.

Sound & Vibr

Configuration of sound and vibration options and the vario options.

Battery

Configuration of battery management settings.

Hardware

This section allows checking of the hardware physical input devices, and analogs and gyro calibration. It also allows the switch type definitions to be changed.

Sticks

Configuration of the Stick Mode, and the default channel order. The 4 stick controls can also be renamed.

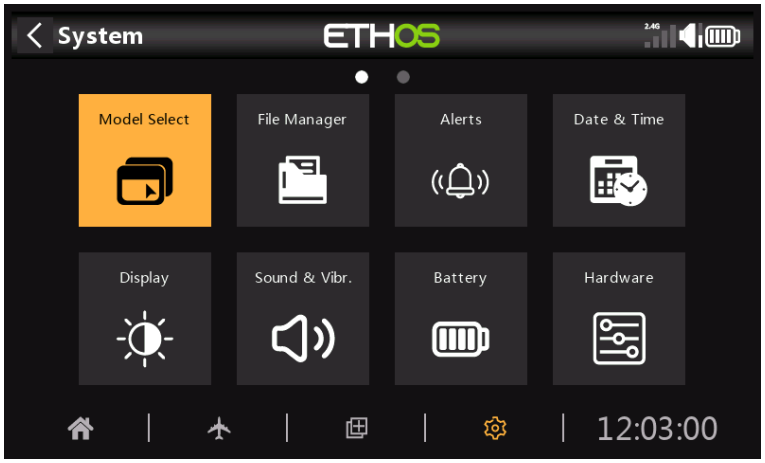
Wireless

Configuration of the Bluetooth module.

Info

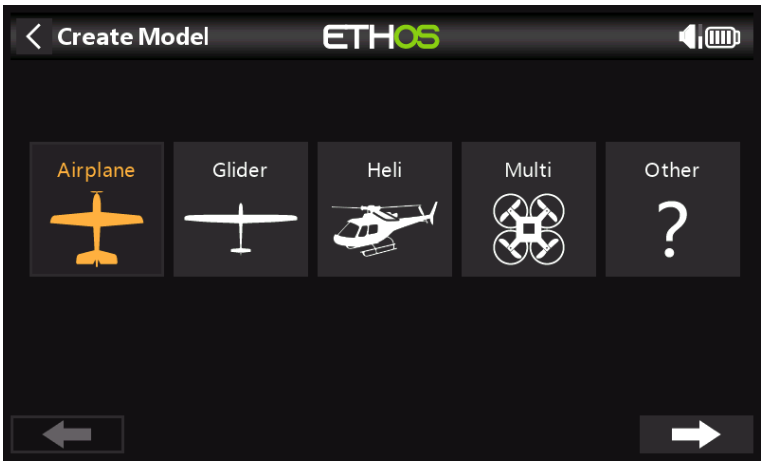
System information for firmware version, gimbals types and RF modules.

Model Select



The Model Select option is accessed by selecting 'Model select' from the System menu. It is used to Select the Current Model, Add a New Model, or Clone or Delete it.

Adding a New Model



The first time you tap on Model Select (or at first startup) you are advised that there are no models, and the Model Creation Wizard is started automatically. Choose the category of model you wish to create, and follow the prompts.

There are wizards for:

- Airplane
- Glider
- Helicopter
- Multirotor
- Other

Created models will be shown in groups based on the model categories.

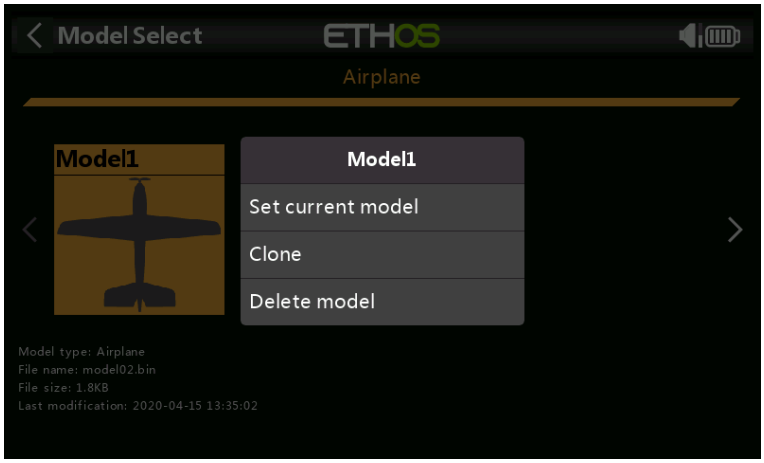
Example: Airplane Wizard

The Airplane wizard assists you with the basic setup for a fixed wing model. It takes you through a number of steps to configure the basic setup of the model, allowing you to choose the number of motors/engines, ailerons, flaps, type of tail (e.g. traditional with elevator and rudder. Finally is asks you to name your model and optionally link an image of it.

Selecting a Model

Tap on 'Model select' to bring up a list of your models. Detailed info of the model is shown below the icon: the model type, name, model file size and the last modification time stamp.

Tap on a model to select it, then tap on it again to bring up the model management menu.



Model Management Menu

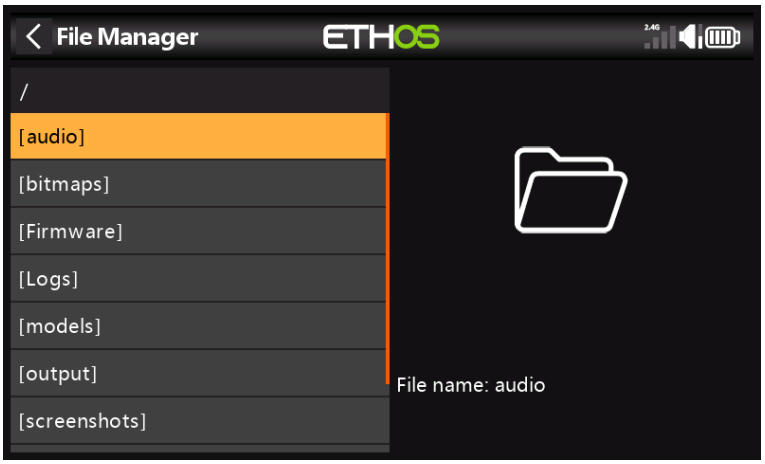
The model management menu allows you to make the selected model the current model.

You can also Clone the model, which will duplicate the model. Alternatively, you can Delete the model. Note that the Delete option only appears if the selected model is not the current model.

File Manager

The File Manager is for managing files and access to flash firmware to the TD-ISRM, external S.Port, OTA and external modules.

Note that when updating the system firmware, the files in the flash drive and SD card may also need updating.



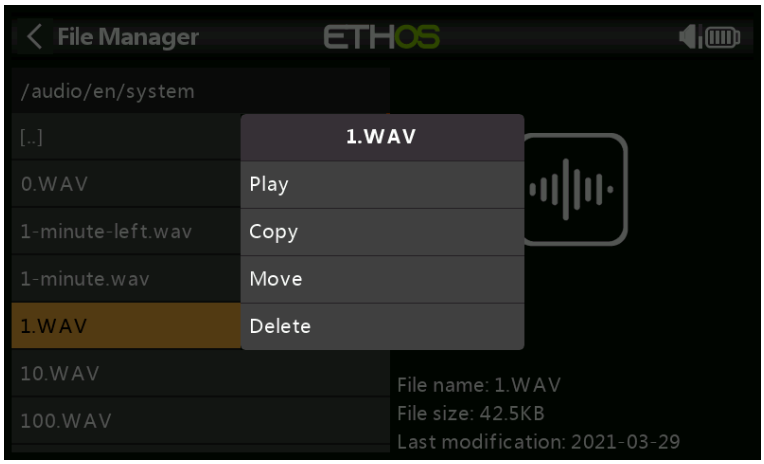
Tap on File Manager to open the file explorer. The top level of folders are:

audio/

This folder is for user sound files, which can be played by the 'Play track' Special Function. Refer to the Model / Special Functions section.

USB drive path: SD Card (drive letter)/audio/
also
USB drive path: SD Card (drive letter)/audio/en/system (system sound files)

Tap on the [audio] folder to view the folder contents.



Tap on a WAV file, and select the Play option to listen to it.

The files may also be copied, moved or deleted.

bitmaps/

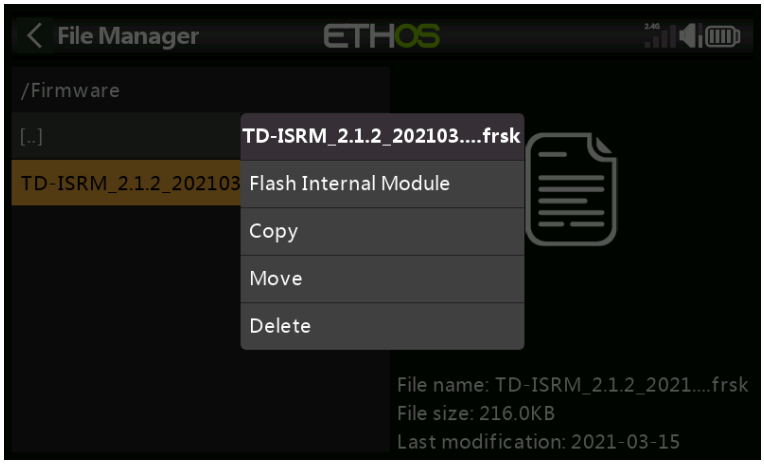
user/

This folder is for user model images. Image size for the main X20 screen is 300x280 and 180x166 for the X10)

USB drive path: SD Card (drive letter)/bitmaps/user/

Firmware

Firmware updates for the X20 Internal TD-ISRM RF module, external modules and other devices like receivers etc. are stored here. They can then be flashed from here via external S.Port or OTA (Over The Air). The new firmware must be copied to the Firmware folder after placing the X20 in boot-loader mode and connecting to a PC via USB.



Tap on the Firmware folder to view the firmware files that have been copied to this folder. Then tap on the Flash option in the popup dialog.

The files may also be copied, moved or deleted.

Logs

Date logs are stored here.

USB drive path: SD Card (drive letter)/Logs/

models/

The radio stores model files here. These files cannot be edited by the user, but may be backed up or shared from here.

USB drive path: SD Card (drive letter)/models/

output/

USB drive path:

screenshots/

Screenshots created by the Screenshot Special Function are stored here. Refer to the Model / Special Functions section.

USB drive path: SD Card (drive letter)/screenshots/

System Volume Information

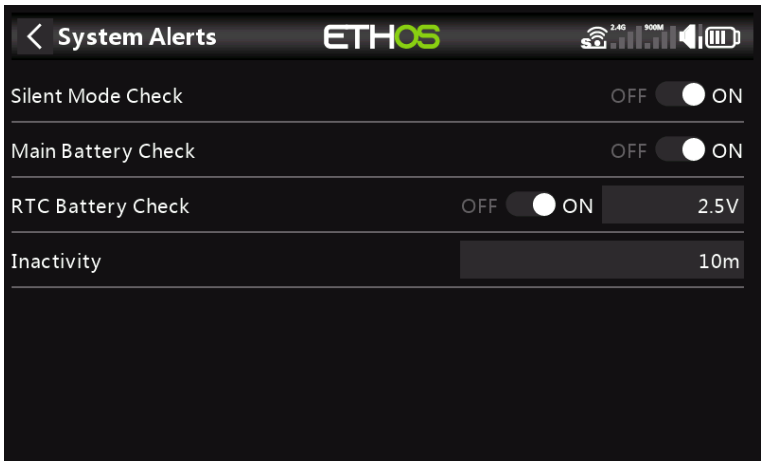
For system use only.

radio.bin

This file is created by the X20 system when first used and stores system settings. It must be deleted when the firmware update file firmware.bin is stored in the root folder of the SD card.

USB drive path: SD Card (drive letter)/radio.bin
USB drive path: SD Card (drive letter)/firmware.bin

Alerts



The System Alerts are:

Silent Mode Check

A Silent Mode Alert will be given at startup when Silent Mode Check is ON and the Audio Mode has been set to Silent in System / Sound & Vibr.

Main Battery Check

A speech 'Radio Battery is Low' Alert will be given when Main Battery Check is ON and the main radio battery is below the threshold set in the 'Low voltage' parameter in System / Battery.

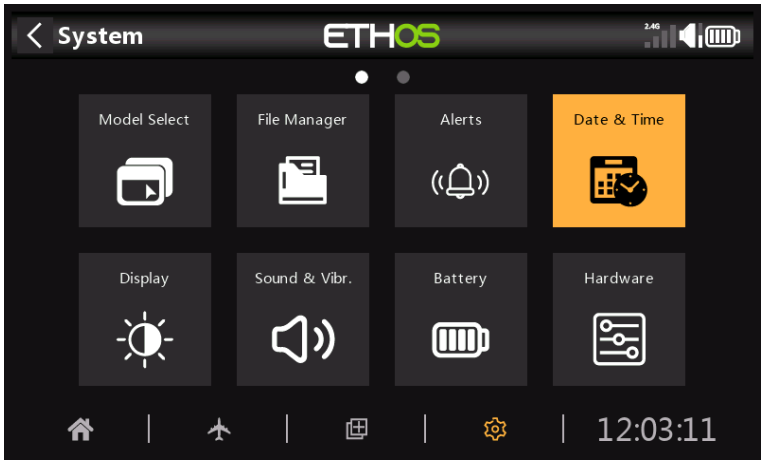
RTC Battery Check

A speech 'RTC Battery is Low' Alert will be given when RTC Battery Check is ON and the RTC coin battery is below the threshold set in the 'RTC voltage' parameter in System / Battery. The default is 2.9V.

Inactivity

A speech 'No Activity for a Long Time' Alert will be given when the radio has not been used for longer than the 'Inactivity' time. The default is 10 minutes.

Date and Time



The Date and Time settings are:

24 Hour time

The clock displays in 24 hour format when enabled.

Display seconds

The clock will display seconds when enabled.

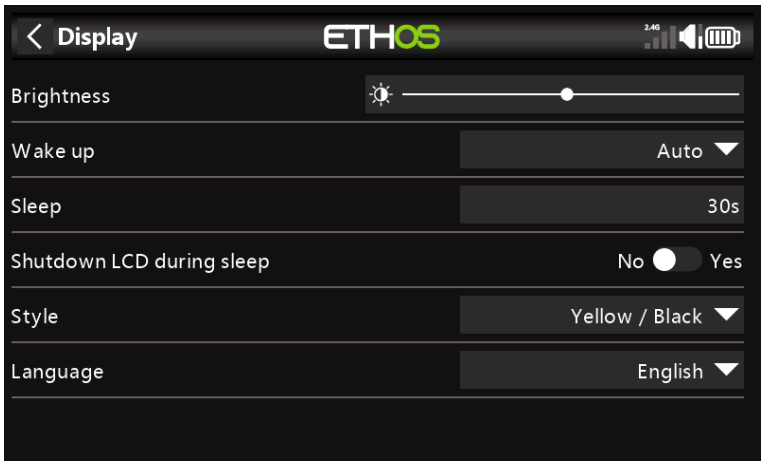
Date

Should to the current date. This is used in the logs.

Time

Should to the current time. This is used in the logs.

Display

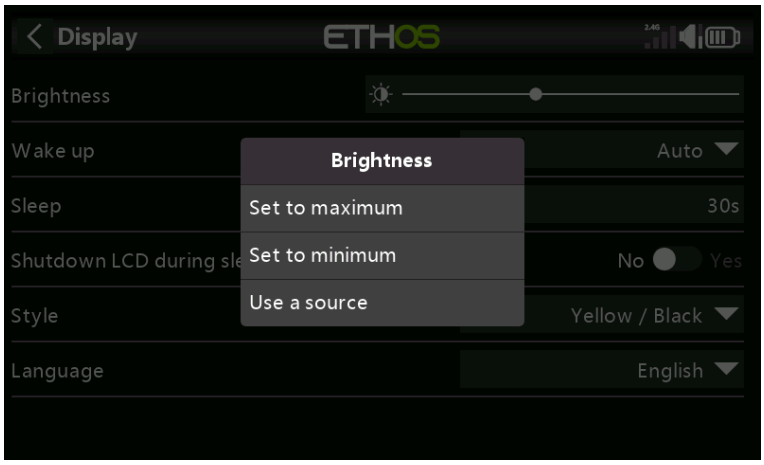


The LCD Display attributes can be configured here:

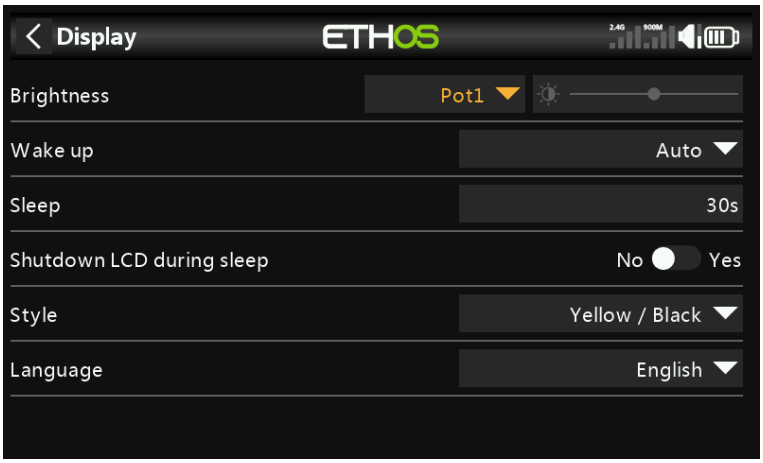
Brightness

Use the slider to control the screen brightness, from left to right to set brightness from dark to bright.

Pot Option

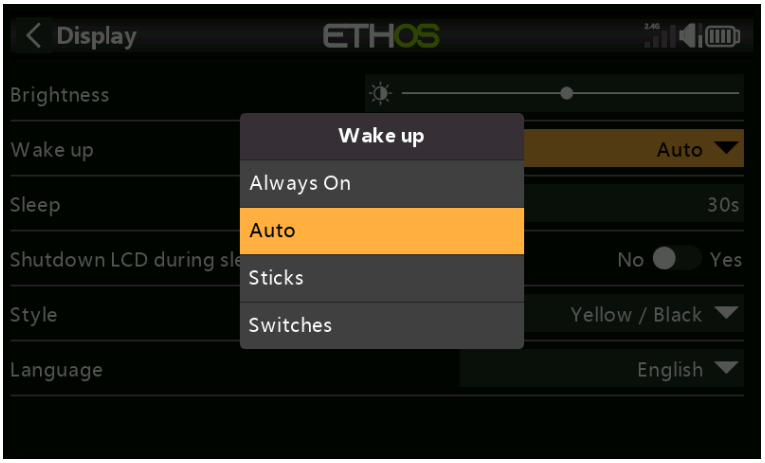


Long press on ENT when the bar is selected to bring up a dialog to set brightness to maximum or minimum, or to select a pot to use as brightness control.



The above example shows brightness being controlled via Pot 1.

Wake up



The screen backlight can be woken from the sleep state in accordance with one of the following options:

Auto

Backlight turns on when touching the screen or operating any control or button.

Sticks

Backlight does not turn on when switches are operated.

Switches

Backlight does not turn on when sticks or analogs are operated.

Sleep

The length of inactivity before the backlight is turned off.

Shutdown LCD during sleeping

When enabled the LCD will go totally dark (not visible) during sleep mode, otherwise the LCD will still have some brightness so the display remains visible.

Style

There are currently three menu color themes or styles available:

- Yellow/Black
- Orange/Black
- Black/White

Further themes will be made available with the evolution of ETHOS.

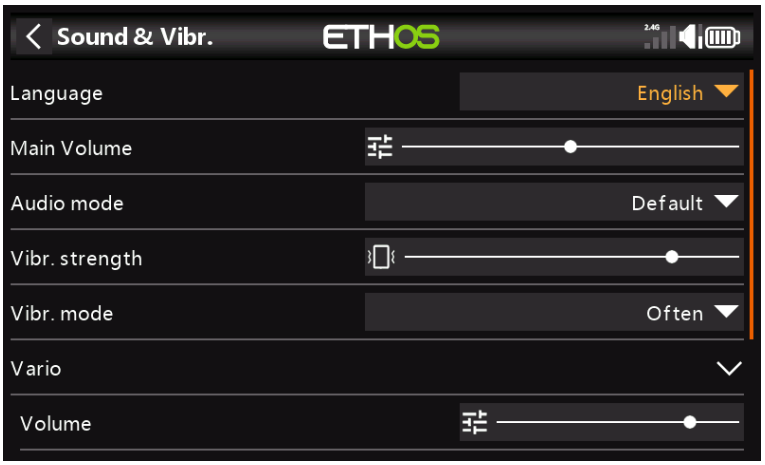
Language

The following languages are supported for the display menus:

- cn
- cz
- de
- en
- fr

Ensure that you have installed the corresponding voice pack in your SD card to ensure the appropriate voice output.

Sound & Vibr



The Sound & Vibrations settings are:

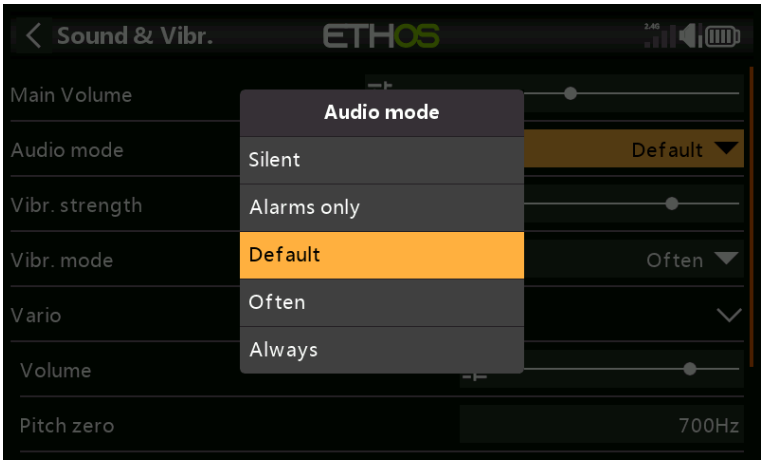
Language

Supported languages are Chinese, Czech, German, English and French.

Main Volume

Use the slider to control the audio volume. Long press ENT allows a pot to be used. Beeps during adjustment assist in judging the volume.

Audio Mode



Silent

No audio. Note that there will be an Alert given at startup if the Silent Mode Check in System / Alerts is ON.

Alarms only

Only Alarms will be output on audio.

Default

TBA

Often

TBA

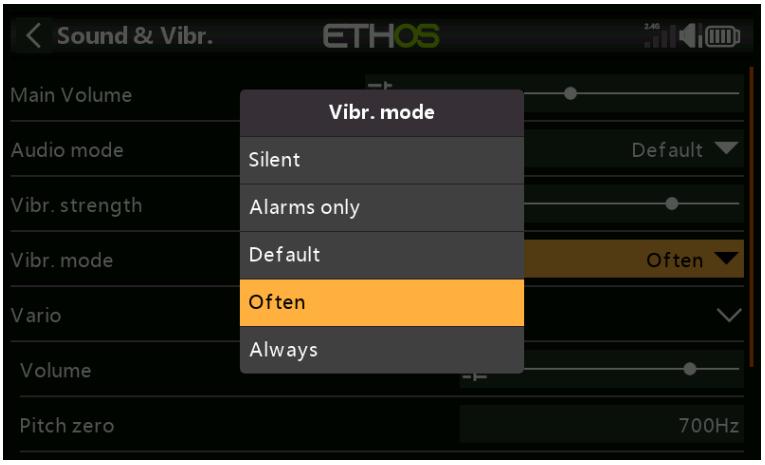
Always

There will also be beeps when the menu is navigated.

Vibr Strength

Use the slider to control the haptic vibration strength.

Vibr. Mode



Similar to Audio Mode above.

Vario

Volume

The relative volume of the vario tone.

Pitch zero

The tone pitch when the climb rate is zero.

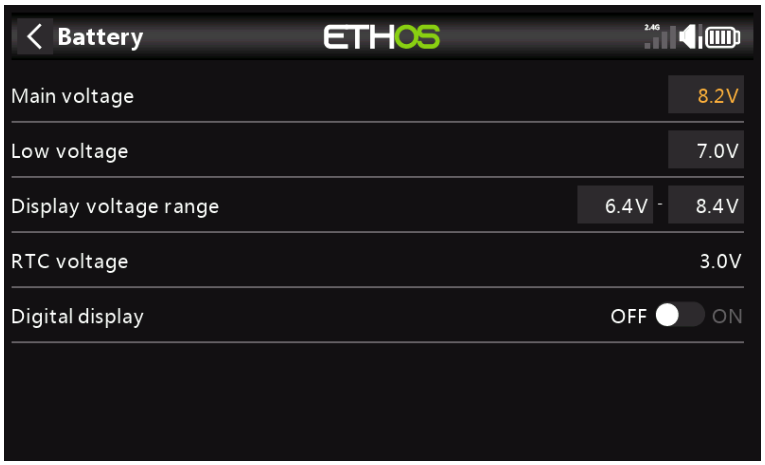
Pitch max

The tone pitch at maximum climb rate.

Repeat

The delay between beeps at pitch zero.

Battery



The Battery section is for calibrating the radio batteries and setting the alarm thresholds.

Main Voltage

This is the nominal battery voltage. The default is 8.4V for a charged 2 cell lithium battery.

Low Voltage

This is the alarm threshold voltage. The default is 7V.

A speech 'Radio Battery is Low' Alert will be given when Main Battery Check is ON in System / Alerts and the main radio battery is below the threshold set here.

Display voltage range

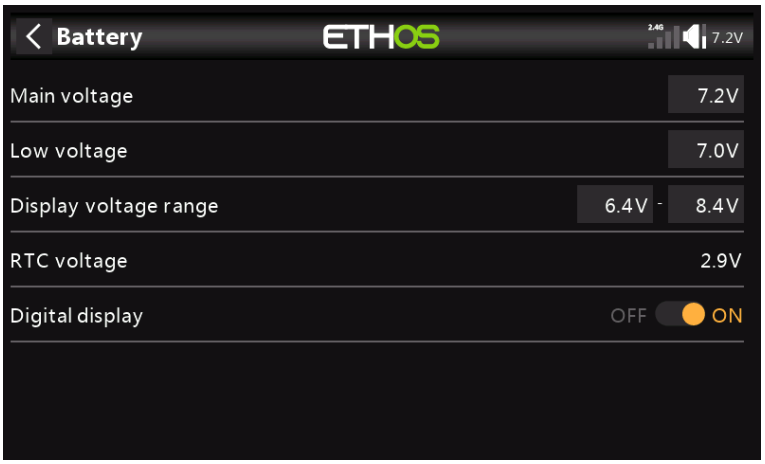
These settings set the range of the graphical battery display in the top right of the screen. The default range limits for the built-in LiIon battery are 6.4 and 8.4V. Many pilots increase the bottom sensing voltage to trigger the low TX voltage alert earlier and prevent over discharging their TX battery.

If the battery is changed to a different type, then the limits must be set appropriately.

RTC voltage

Shows the voltage of RTC (Real Time Clock) battery in the radio. The voltage is 3.0v for a new battery. If the voltage is below 2.7v please replace the battery inside the radio to ensure the clock runs properly.

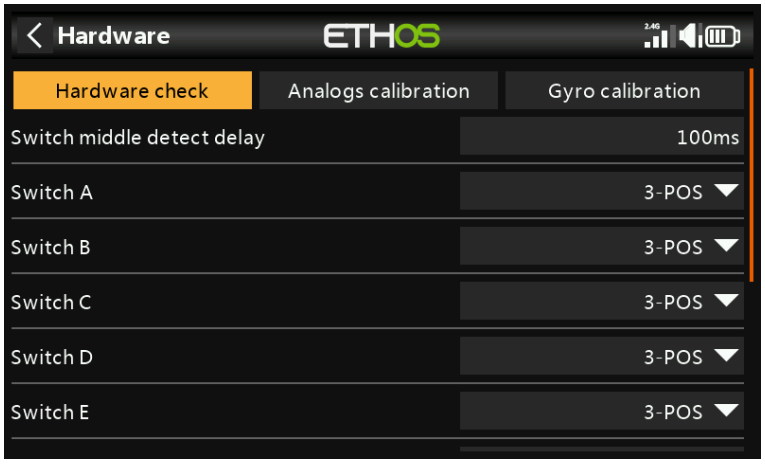
Digital display

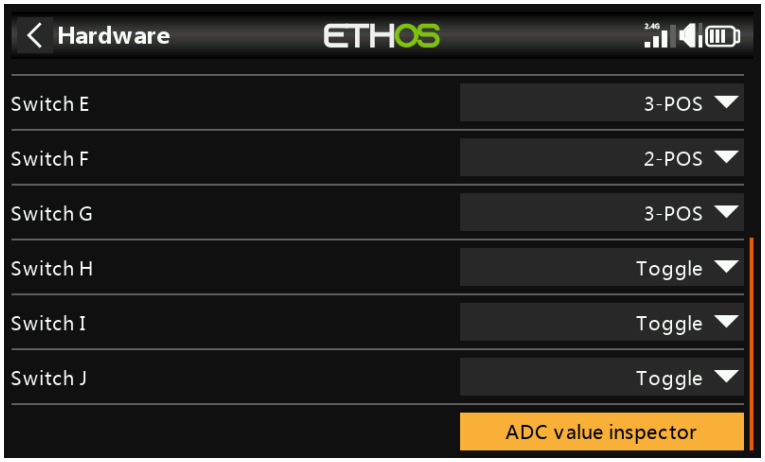


If enabled the battery charge status icon in the top right of the screen will be replaced by the digital voltage. It can also briefly be turned on to read the actual battery voltage.

Hardware

The Hardware section is used to test all inputs, perform analog and gyro calibration, and set switch types.





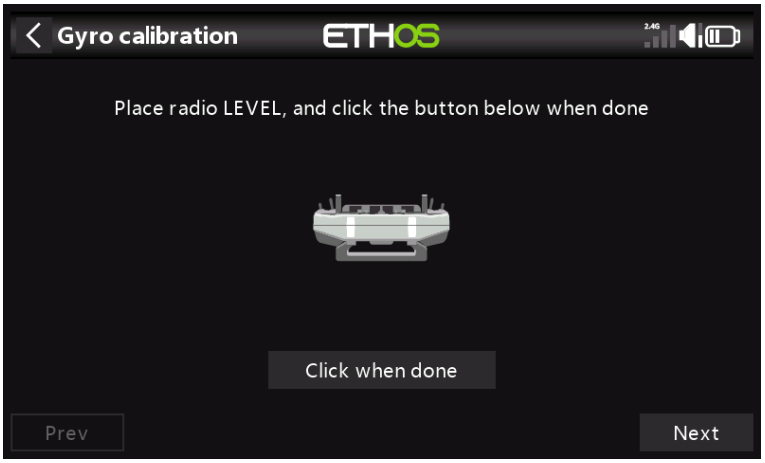
Hardware check

The Hardware check allows all the inputs to be checked for operation.

Analogs calibration

Analogs calibration is be performed so that the radio knows exactly where the centers and limits of each gimbal, pot, and slider are. It is automatically run at initial startup or after a firmware upgrade. It should be repeated after replacement of a gimbal, pot or slider.

Gyro calibration

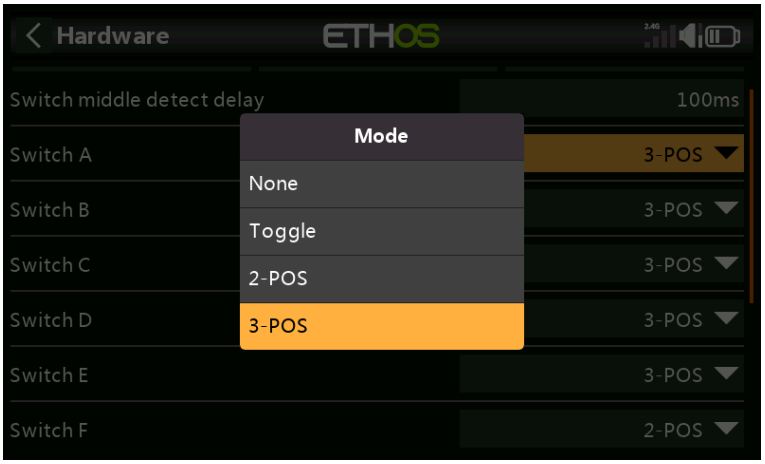


Gyro calibration can be performed so that the gyro sensor outputs respond correctly to tilting the radio. For example, the radio 'level' position would be the angle at which you normally hold the radio.

Switch middle detect delay

This setting ensures that the switch middle position on three way switches is not detected when the switch is flipped from the up to the down position in one movement, and vice versa. It should only be detected when the switch stops in the middle position.

Switch A to Switch J



Each switch may be defined as:

- None
- Toggle (momentary)
- 2 POS
- 3 POS

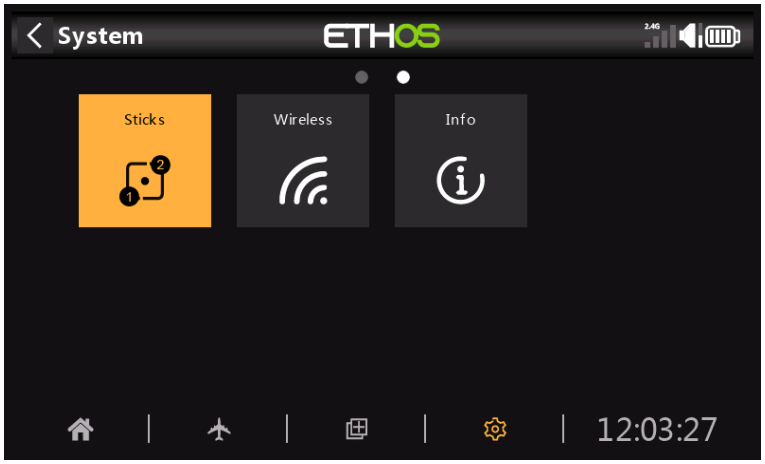
This allows for switches to be swapped over, for example the toggle switch H could be swapped over with the 2 position switch F. Note that it may no be possible to replace a toggle or 2 position with a 3 position switch if the radio wiring does not allow for it.

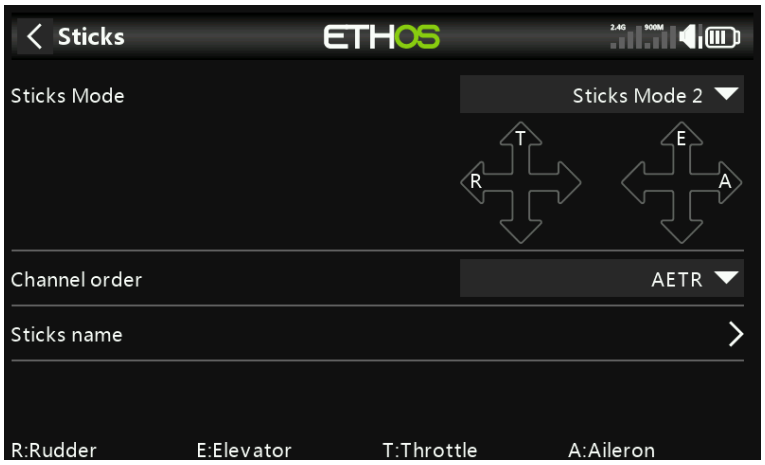
ADC value inspector

Shows the analog to digital conversion (ADC) values for the analog inputs read by the CPU.

1. Left stick horizontal
2. Left stick vertical
3. Right stick vertical
4. Right stick horizontal
5. Pot 1
6. Pot 2
7. Middle slider
8. Left slider
9. Right slider

Sticks





Select your preferred stick mode. Mode 1 has throttle and aileron on the right stick, and elevator and rudder on the left. Mode 2 has throttle and rudder on the left stick, and aileron and elevator on the right.

Channel Order

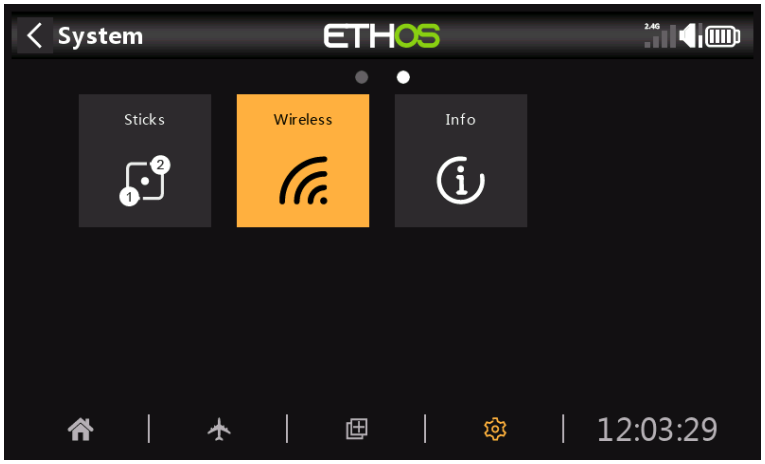
The Channel Order defines the order in which the four stick inputs are inserted into the mixer when a new model is created by the wizards. The default order is AETR. If there are more than one of each type of surface, they will be grouped. For example, for 2 ailerons the channel order will be AAETR.

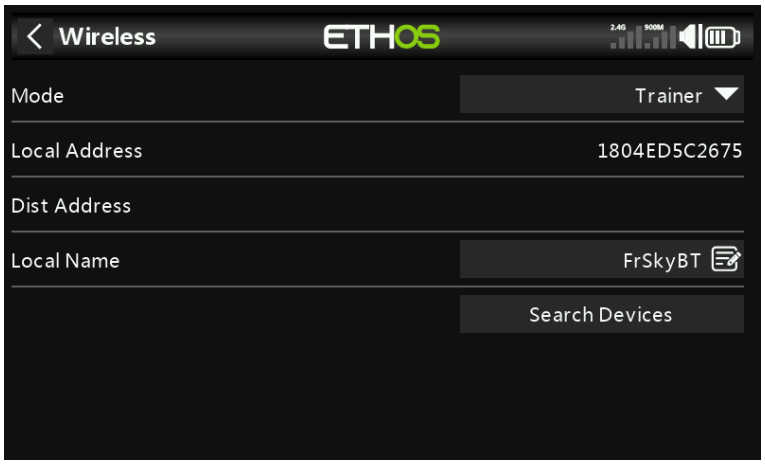
When using FrSky stabilized receivers, you may still need to reassign channels to achieve the AETR channel order required.

Sticks name

By default the sticks are named as listed above for the industry standard stick modes. They may be renamed as desired.

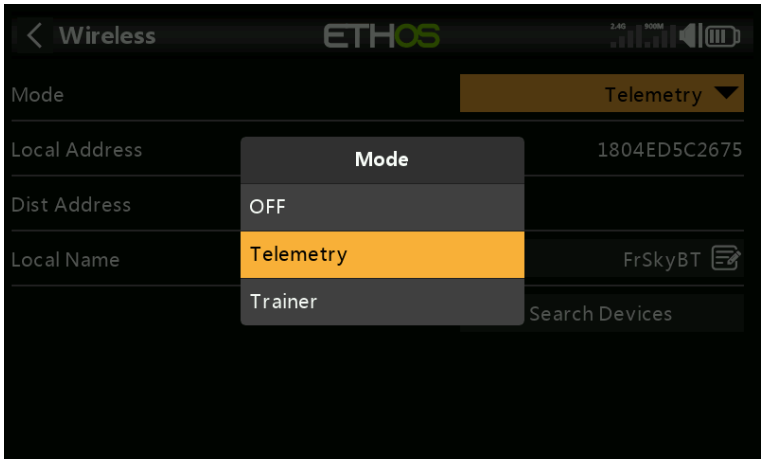
Wireless





The X20 Bluetooth module can work in either Telemetry or Trainer modes.

Mode



Telemetry

In Telemetry Mode the radio can work with the FrSky FreeLink App to display telemetry data on your mobile phone. The App can also be used to configure FrSky devices like the stabilized receivers.

Trainer

In Trainer Mode, the radio can be operated in Master or Slave mode to achieve the trainer function wirelessly. Refer to the Model / Wireless section to configure the radio as Master or Slave for the currently selected model.

Local Address

This is the local Bluetooth address of the radio.

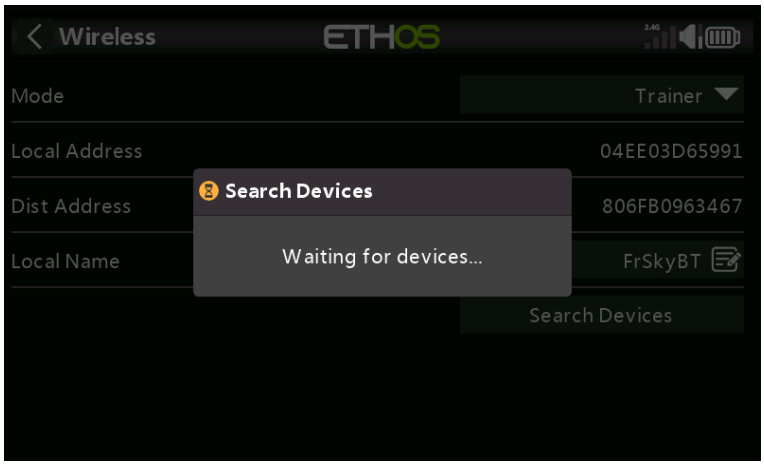
Dist Address

Once a Bluetooth device has been found and linked, the remote device's Bluetooth address is displayed here.

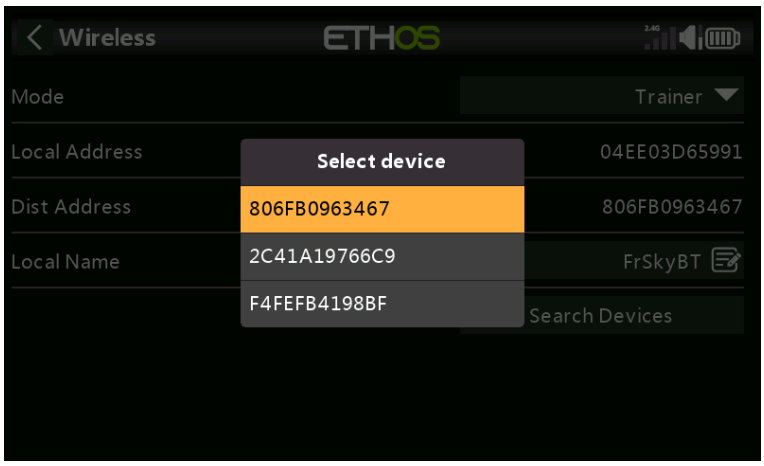
Local Name

This is the local BT name that will be displayed in devices being connected. The default name is FrSkyBT, but may be edited here.

Search Devices

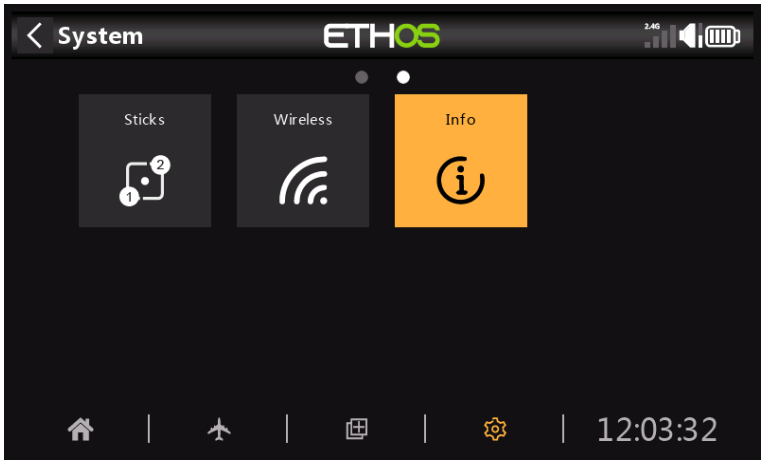


Tap on 'Search Devices' to put the radio into BT search mode.

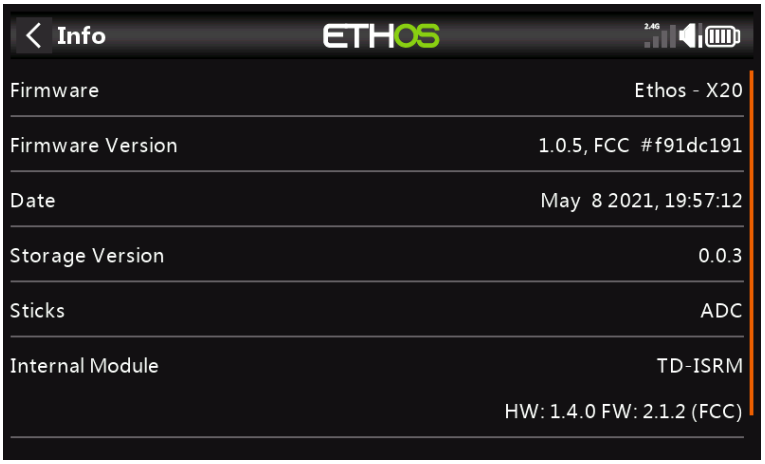


Found devices are listed in a popup dialog with a request to select a device. Select the BT address that matches the radio to be used as training mate.

Info



The Info page displays system firmware information, gimbals type, internal module firmware version, ACCESS receiver firmware and external module information.



Firmware

Ethos firmware, and radio type (X20).

Firmware Version

Current firmware version and type, e.g. FCC, LBT, or Flex.

Date

Current date and time.

Storage version

Currently at 0.0.3

Sticks

The gimbal Hall sensor version installed. ADC is for analog.

Internal Module

Details of the internal RF module, including hardware and firmware versions.

External Module

Details of the external RF module (if fitted), including hardware and firmware versions if ACCESS protocol.

Model Setup

The Model setup menu is used to configure each model's specific setup. It is accessed by selecting the Airplane tab along the bottom of the Home screen. Conversely, settings that are common to all models are performed in the System menu, which is accessed by selecting the Gear tab instead (please refer to the System section).

Overview

Edit Model

The 'Edit model' option is used to edit the basic parameters for the model as set up by the wizard, and is mainly used to edit the model name or picture.

Flight Modes

Flight modes allow models to be set up for switch selectable specific tasks or flight behavior. For example, gliders may be set up to have flight modes such as Launch, Cruise, Speed and Thermal. Power planes may have flight modes for Normal flying, Take Off and Landing. Helicopters have modes such as Normal for spool up and take off/landing, Idle Up 1 for aerobatic flying, and Idle Up 2 for perhaps 3D.

Mixer

The Mixer section is where the model's control functions are configured. It allows any of the many sources of input to be combined as desired and mapped to any of the output channels.

This section also allows the source to be conditioned by defining weights/rates and offsets, adding curves (eg Expo). The mix can be made subject to a switch and/or flight modes, and a slow function to be added.

Outputs

The Outputs section is the interface between the setup "logic" and the real world with servos, linkages and control surfaces as well as actuators and transducers. In the Mixer we have set up what we want our different controls to do. This section allows these pure logical outputs to be adapted to the mechanical characteristics of the model. This is where we configure minimum and maximum throws, servo or channel reverse, and adjust the servo or channel center point or add an offset using subtrim. We can also define a curve to correct any real world response issues. For example, a curve can be used to ensure that left and right flaps track accurately.

Timers

The Timers section is used to configure the three available timers.

Trims

The Trims section allows you to configure the Trim Mode, disable trims, or enable Extended Trims or Independent Trims for each of the 4 control sticks.
The Trim Mode configures the granularity of the trim switch steps, from Fine to Coarse to Exponential, or to disable trims. The normal trims range is +/- 25%, but Extended Trims enables the full range. If you are using Flight Modes, then Independent Trims enables the relevant trim to be independent for each flight mode, instead of being common across flight modes.

RF System

This section is used to configure the Owner Registration ID, and the internal and/or external RF modules.

The Owner Registration ID is an 8 character ID that contains a unique random code, which can be changed if desired. This ID becomes the Owner Registration ID when registering a receiver. Enter the same code in the Owner ID field of your other transmitters you want to use the Smart Share feature with them. This must be done before creating the model you want to use it on.

Telemetry

Telemetry is used for passing information from the model back to the RC pilot. This information can be quite extensive, and includes RSSI (receiver signal strength) and Link Quality, various voltages and currents, and any other sensor outputs such as GPS position, altitude, etc.

Note that the telemetry screens are set up as main views in the Configure Screens section.

Checklist

The Checklist section is used to define startup alerts for things like initial throttle position, whether failsafe is configured, pot and slider positions, and initial switch positions.

Logic Switches

Logic switches are user programmed virtual switches. They aren’t physical switches that you flip from one position to another, however they can be used as program triggers in the same way as any physical switch. They are turned on and off by evaluating the conditions of the programming. They may use a variety of inputs such as physical switches, other logical switches, and other sources such as telemetry values, channel values, timer values, or Global Variables. They can even use values returned by a LUA model script.

Special Functions

This is where switches can be used to trigger special functions such as trainer mode, soundtrack playback, speech output of variables, data logging etc. Special Functions are used to configure model specific functions.

Curves

Custom curves can be used in input formatting, in the mixers or in the outputs. There are 100 curves available, and can be of several types (between 2 and 21 point, with either fixed or user-definable x-coordinates).

In the Mixer a typical application is using an Expo curve to soften the response around mid-stick. A curve may also be used to smooth a flap to elevator compensation mix so that the aircraft does not 'balloon up' when flaps are applied.

In the Outputs a balancing curve may be used to ensure accurate tracking of the left and right flaps.

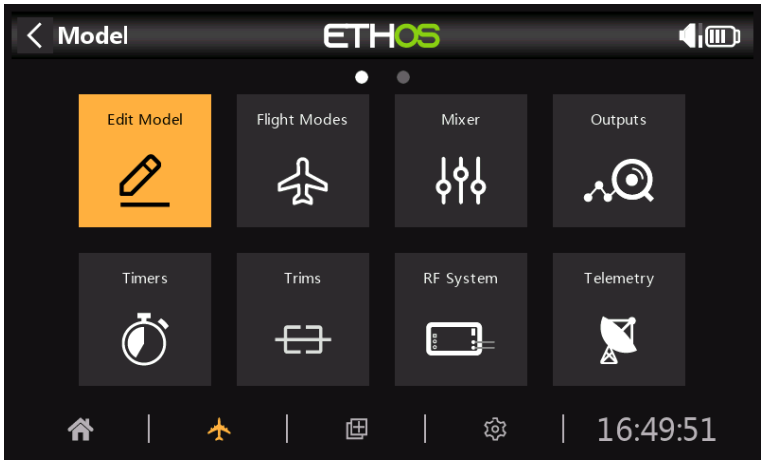
Trainer

The Trainer section is used to set the radio as a Master or Slave in a trainer setup. The trainer link can be via Bluetooth or a cable.

Device Config

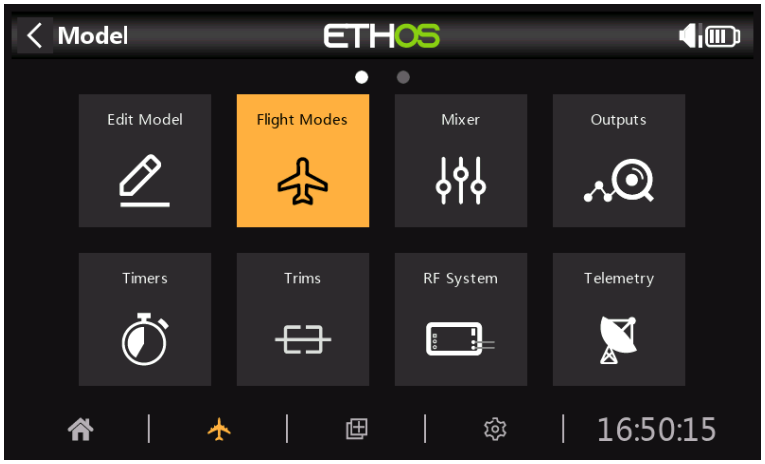
Device Config contains tools for configuring devices like sensors, receivers, the gas suite, servos and video transmitters.

Edit model



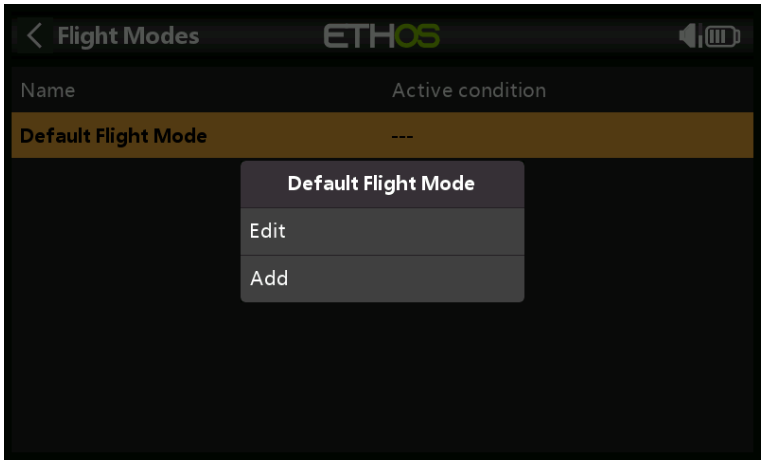
The 'Edit model' option is used to edit the basic parameters for the model as set up by the wizard. The model can be renamed, or the picture assigned or changed. Changing any of the channel configurations, will cause all mixers to be reset.

Flight Modes

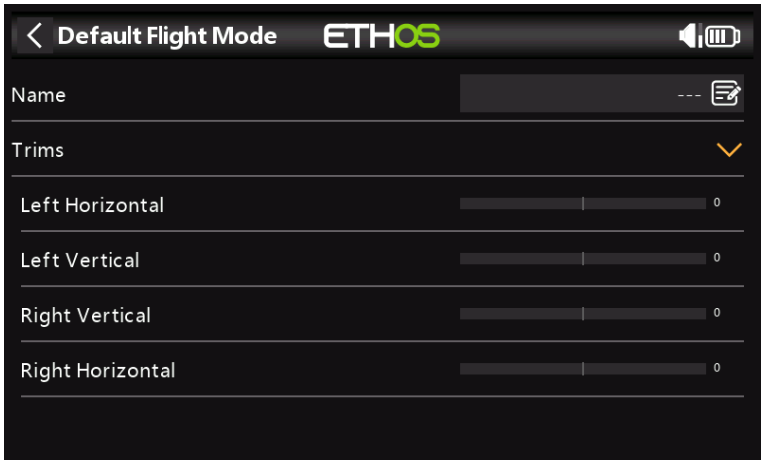


Flight modes bring incredible flexibility to a model setup, because they allow models to be set up for switch selectable specific tasks or flight behavior. For example, gliders may be set up to have switch selectable modes such as Launch, Cruise, Speed and Thermal. Power planes may have flight modes for Normal precision flying, Take Off, and Landing with either half or full flaps deployed. Helicopters have modes such as Normal for spool up and take off/landing, Idle Up 1 for aerobatic flying, and Idle Up 2 for perhaps 3D.

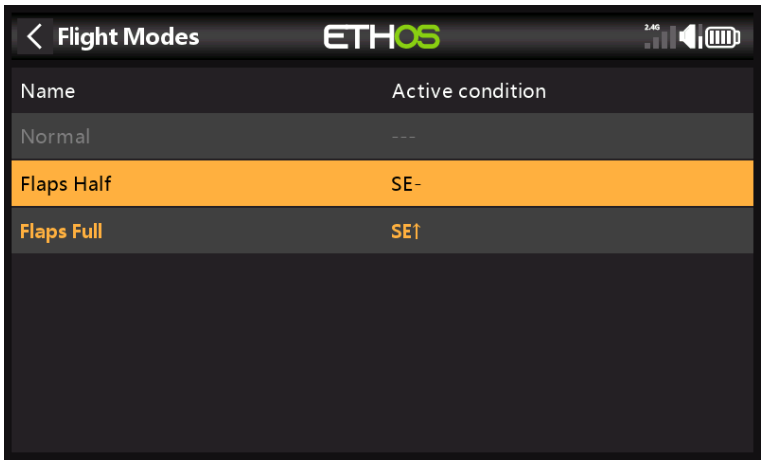
Flight modes remove much of the switching and trimming burden from the pilot.
The great power of flight modes is that they support independent trims and mixer Variables, and can also be used to enable Mixer lines. Together, these features allow for great flexibility. Please refer to the Tutorial section to see examples of these features applied.



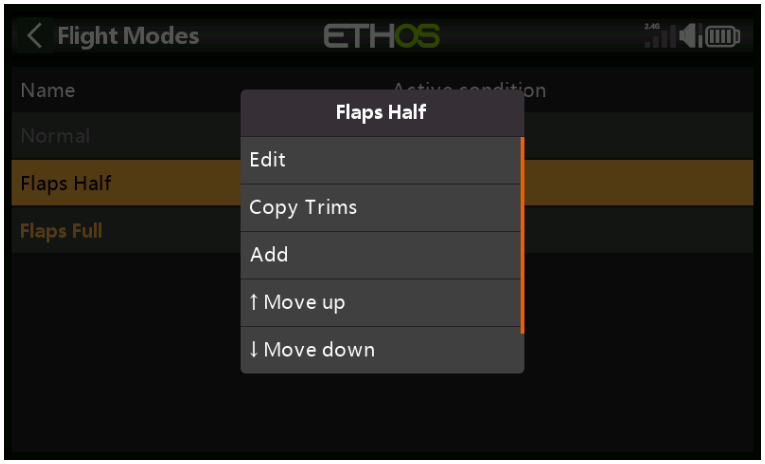
There are no default flight modes defined. Tap on the default flight mode, and select Edit if you wish to rename it, otherwise select Add to define a new flight mode.



You can name each flight mode, and define its active condition, which can be a switch or button position, a function or logic switch, or a trim position. Note that the default flight mode does not have an active condition parameter, because this is the flight mode that is always active when no other flight mode is active. The first flight mode that has its switch ON is the active one.



Once programed the flight mode selections are displayed in the mixers. Up to 100 flight modes can be programmed. Like most functions in ETHOS the user can program descriptive text Flight Mode names such as Cruise, Speed, Thermal or Normal, Take Off, Landing.



Flight Mode Management

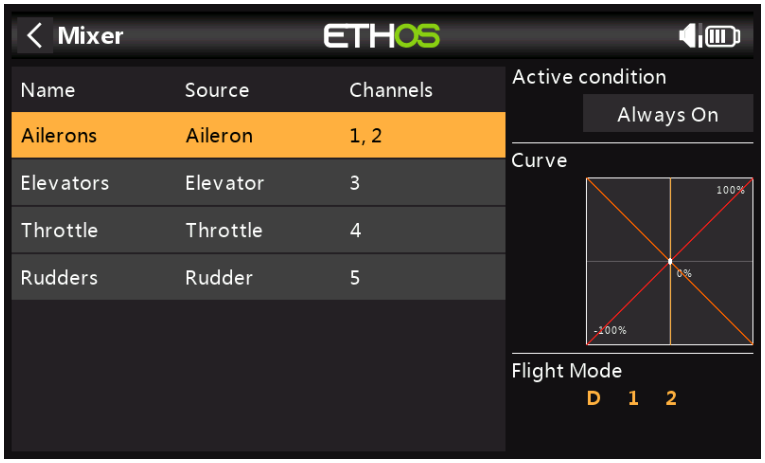
Tap on a flight mode to bring up a menu which allows you to edit, copy trims, add a new flight mode or delete flight modes. You can use the 'Move up' and 'Move down' options to change the priority of a flight mode, bearing in mind that the first flight mode that that the priority of flight modes is in ascending order, and the first one that has its switch ON is the active one.

Mixer

The Mixer function forms the heart of the radio. This is where the model's control functions are configured. The Mixer section allows any of the many sources of input to be combined as desired and mapped to any of the output channels. Ethos has 100 mixer channels available for programming your model. Normally the lowest numbered channels will be assigned to the servos, because the channel numbers map directly to the channels in the receiver. The X20 Internal RF (Radio Frequency) module has up to 24 output channels available.

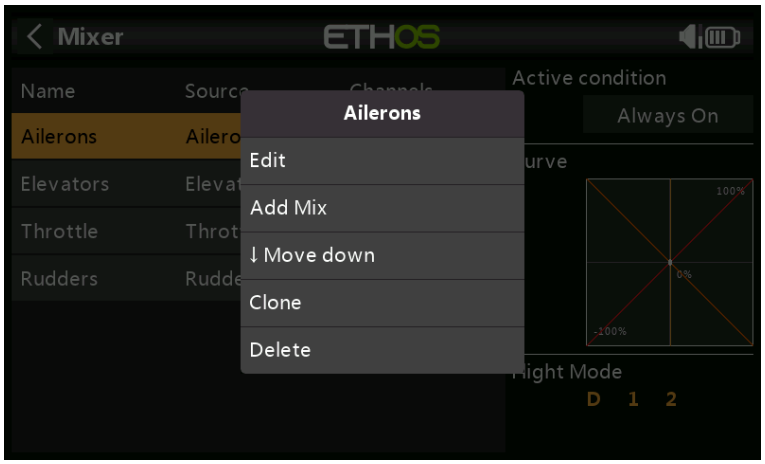
The upper mixer channels can be used as 'virtual channels' in more advanced programming, or as real channels using multiple RF modules (Internal + External) and SBus. The channel order is a matter of personal preference or convention, or it may be dictated by the receiver. We will use AETR for our example.

This section also allows the source to be conditioned by defining weights/rates and offsets, and adding curves (eg Expo). The mix can be made subject to a switch and/or flight modes, and a slow function to be added. (Note that Delays are implemented in the Logic Switches because they are related to switches.) The mixer includes contextual help text that dynamically changes as mixer options are touched. Up to 100 mixer lines may be defined.



If your model was created using one of the model creation wizards in the 'Model select' function in the System menu, the base mixer lines will be shown when you tap on the 'Mixer'.

In addition, the most common predefined mixes can be added as well as free mixes that are user configurable.

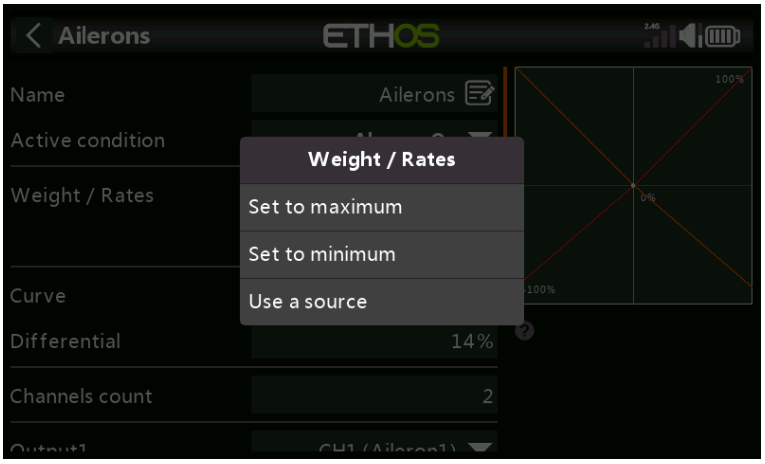


There is one mix line for each control/mix and a graphic display for that mix. To edit a mixer line, touch the mixer and touch again for the popup menu, then select Edit.

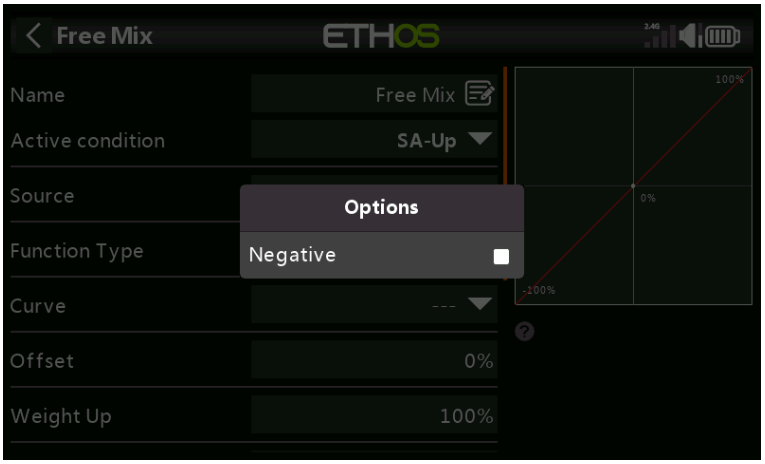
Please note that inactive mixer lines are shown greyed out, to assist in debugging.

Options feature

Ethos has a very powerful 'Options' feature. Almost anywhere a value is expected, a long press of the Enter key will bring up an Options dialog.



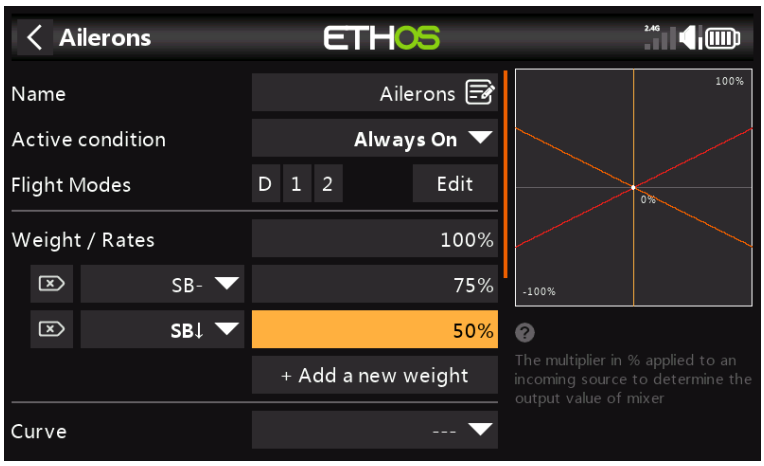
The Options dialog shows which parameter is being configured. In this example you have the choice of setting the Weight/Rates to maximum or minimum, or to use a source. Using a source like a Pot would allow the Weight/Rates to be adjusted in flight.



In this example, the Options dialog allows a switch position to be negated or inverted. For example instead of being active when switch SA is up, it would be active when switch SA is NOT up, i.e. in either the mid or down positions.

Aileron, Elevator, Rudder Mixer

We will use the Ailerons as an example, but the Elevator and Rudder mixes are very similar.



Name

Ailerons has been filled in as the default name, but it can be changed.

Active Condition

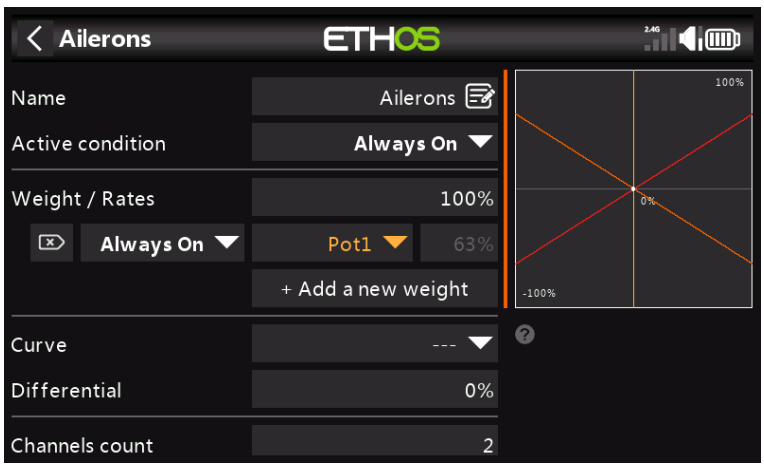
The default active condition is 'Always On', which is appropriate for Ailerons. It may be made conditional by choosing from switch or button positions, function switches, logic switches or trim positions.

Flight Modes

If any flight modes have been defined, the mix can be made conditional to one or more flight modes. Click on 'Edit' and check the boxes for the flight modes in which this mixer line must be active.

Weight / Rates

Multiple rates can be defined, subject to a switch position, function switch, logic switch, trim position or flight mode. A line is added for each rate. The default rate (i.e. first rates line) is active when none of the other rates are active. There is a small cross inside an arrow on the left of defined rates that can be used to delete a rates line. In the example above three rates have been set up on switch SA.

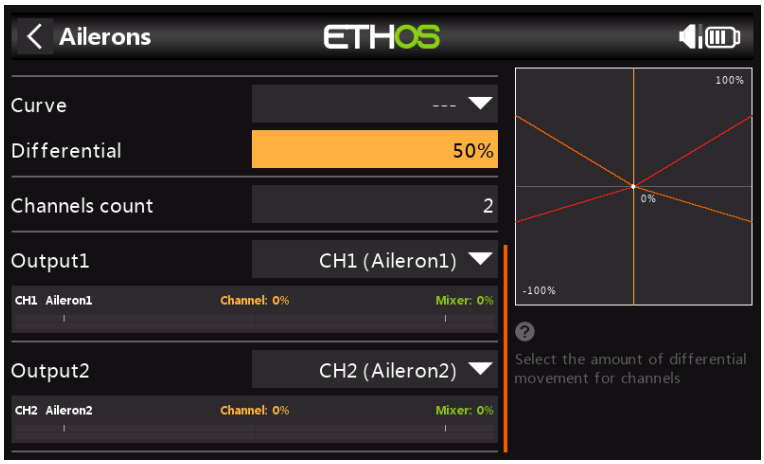


In this example a long press on Enter brought up the dialog to select a source instead of the default fixed value, in this case Pot1 was selected. The graph on the right shows that the pot is at 63%, so this would be the weight for the Aileron Rates, but adjustable in flight.

Curve

A standard curve option is Expo, which by default has a value of 0, which means the response is linear (i.e. no curve). A positive value will soften the response around 0, while a negative value will sharpen the response.

Any previously defined curve may also be selected. The mixer output will then modified by this curve. Alternatively, a new curve may be added.



Differential

On Ailerons differential (typically more up aileron travel than down) is utilized to reduce adverse yaw and to improve turning/ handling characteristics. A positive value will result in the ailerons having less downward travel, as can be seen in the graph above. (Default = 0. Range -100 to +100).

Channels Count

Channel count defines how many Output channels are allocated. In this example two ailerons were configured in the model creation wizard.

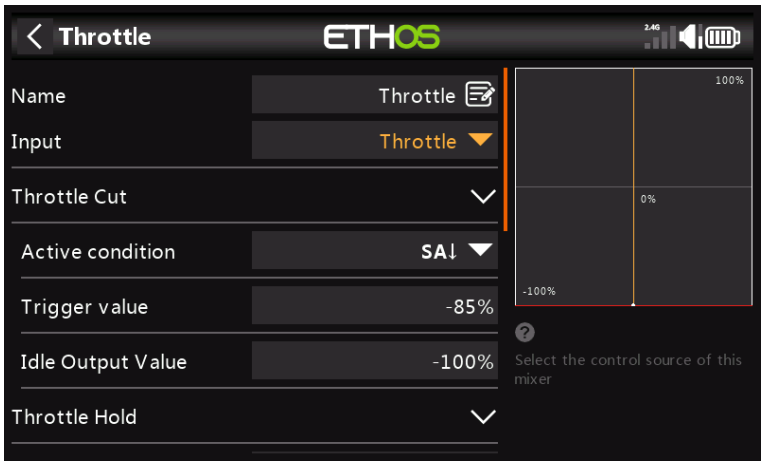
Output1, Output2

The model creation wizard assigned channels 1 and 2 to the ailerons, because the default channel order in the System – Sticks menu was set to AETR, i.e. ailerons, elevator, throttle, rudder.

The default can be altered if required, but care must be exercised to assess any other impacts to making a change here.

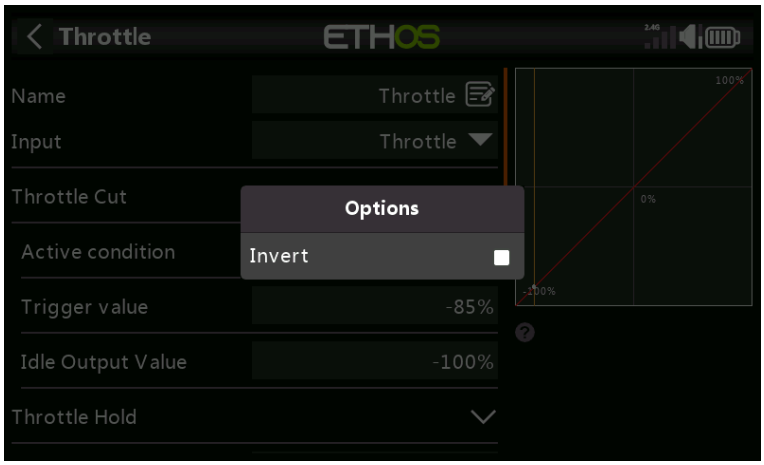
Throttle Mixer

The Throttle mixer has parameters for managing Throttle Cut and Throttle Hold. Throttle Cut, together with Low Position Trim, is used for managing the throttle and idle settings on glow or gas powered models. Throttle Hold is commonly used on electric models.



Input

The source for the Throttle mix can be selected here. It defaults to the Throttle stick, but can be changed to an analog, switch, trim, channel, gyro axis, trainer channel, timer or special value.



Note that the Throttle input may be inverted. Long press ENT and select Invert from the popup dialog.

Throttle Cut

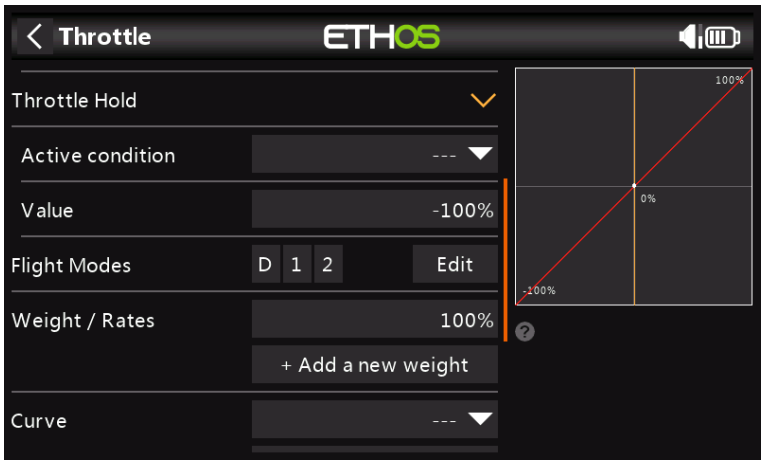
Note that the Throttle Cut function interacts with the Low Position Trim setting (see below).

Active Condition

The active condition may be chosen from switch or button positions, function switches, logic switches or trim positions.

Trigger Value

The Trigger Value is chosen so that once the throttle stick goes below the Trigger value then the Idle Output Value will be output on the throttle channel. For example, using the defaults, once the throttle stick value drops below -85%, the throttle channel output will be switched to the Idle Output Value of -100%.



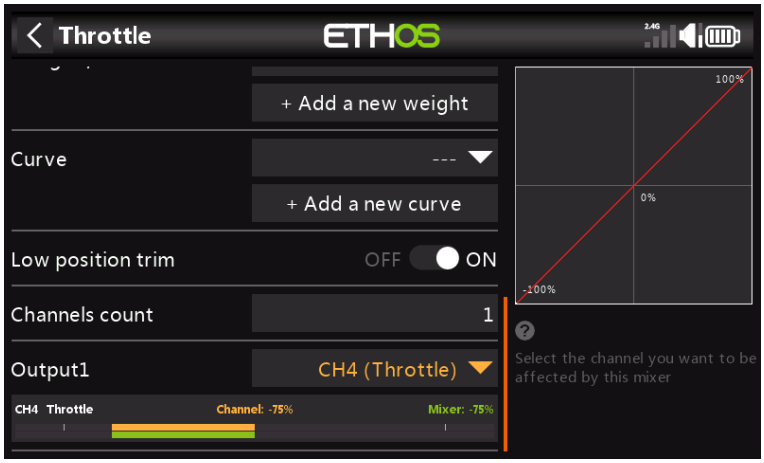
Throttle Hold

Active Condition

The active condition may be chosen from switch or button positions, function switches, logic switches or trim positions.

Value

Once the throttle hold function goes active, the Value setting will be output on the throttle channel. On electric powered models, the throttle hold value is normally -100%.

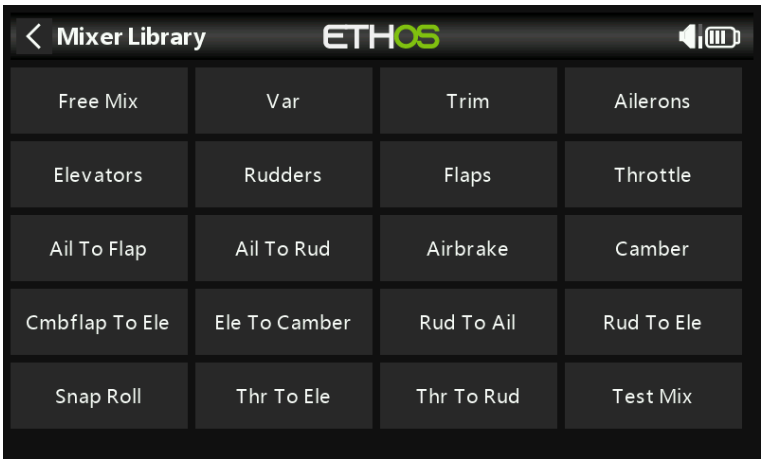


Low Position Trim

For glow and gas we use 'Low position trim' to adjust the idle speed. The idle speed can vary depending on the weather, etc., so having a way to adjust the idle speed without impacting the full throttle position is important.

If 'Low position trim' is enabled, the throttle channel goes to an idle position of -75% when the throttle stick is at the low position (please refer to the channel bar display at the bottom of the screenshot above). The throttle trim lever can then be used to adjust the idle speed between -100% and -50%. Throttle Cut can then be configured to cut the engine with a switch.

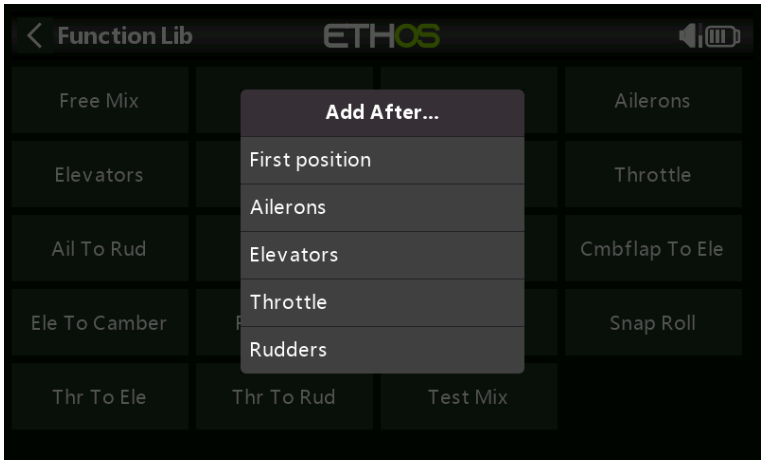
Predefined Mixes



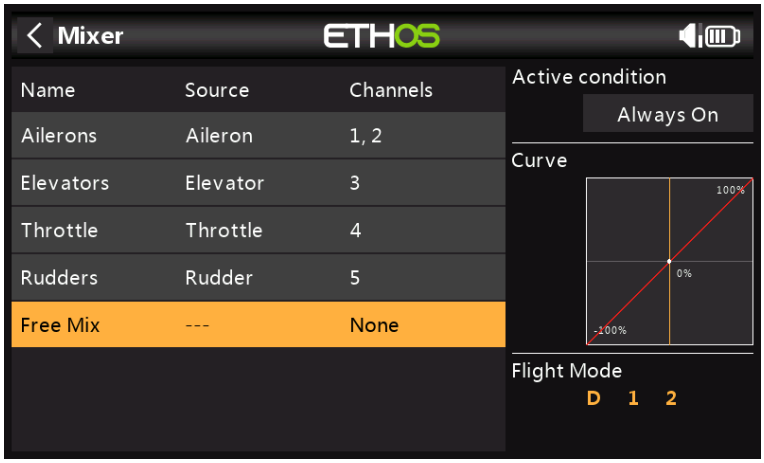
Free Mix

The Mixer function can best be described by making use of a Free Mix, which we will add to the above mixes for illustration purposes. Tap on any Mixer line, and select 'Add Mix' from the popup menu to add a new mixer line.

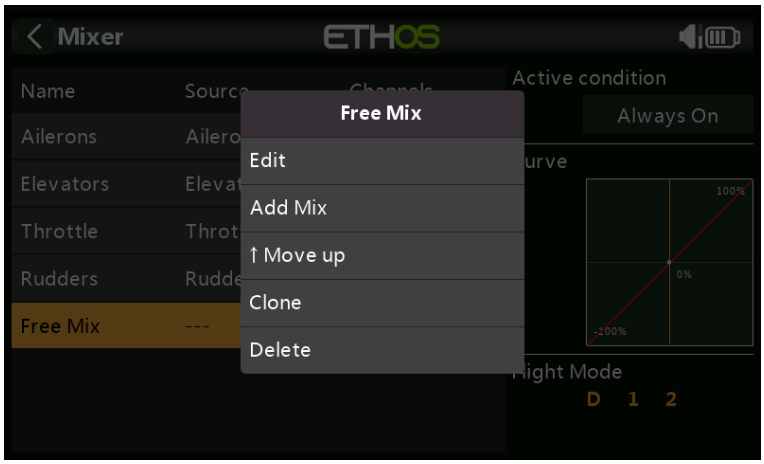
Select Free Mix from the list of available predefined mixes in the Mixer Library.



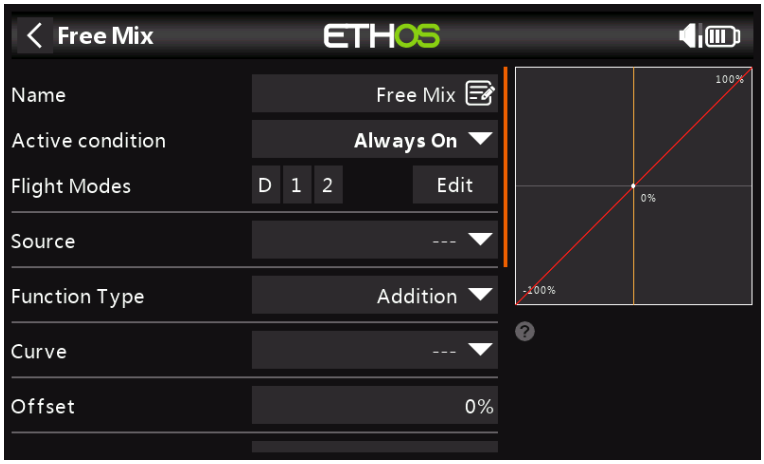
Next the position for the new mixer line must be chosen, in this example after 'Rudders'.



Tap on 'Free Mix' to bring up the edit sub-menu.



Select Edit to open a new screen showing the detailed parameters for the 'Free Mix'. The graph display on the right will display the mixer output, and the effect of any setting changes that are made.



Name

A descriptive name can be entered for the Free Mix.

Active Condition

The default active condition is 'Always On'. It may be made conditional by choosing from switch or button positions, function switches, logic switches or trim positions.

Flight Modes

If any flight modes have been defined, the mix can be made conditional to one or more flight modes. Click on 'Edit' and check the boxes for the flight modes in which this mixer line must be active.

Source

The source or input to this mix can be chosen from:
a) analog inputs such as the sticks, pots and sliders
b) the toggle switches or buttons
c) any defined logic switches
d) the trim switches
e) any defined channels
f) a gyro axis
g) a trainer channel
h) a timer
i) a telemetry sensor
j) a 'special' value, i.e. minimum, maximum or 0

The mixer line will take the value of the source at any instant as its input.

Function Type

The Function Type defines how the current mixer line interacts with the others on the same channel. There are three function types:

Addition

The output of this mixer line will be added to any other mixer lines on the same output channel.

Multiply

The output of this mixer line will be multiplied with the result of any other mixer lines on the same output channel.

Replace

The output of this mixer line will replace the result of any other mixer lines on the same output channel.

The combination of these operations allows the creation of complex mathematical operations.

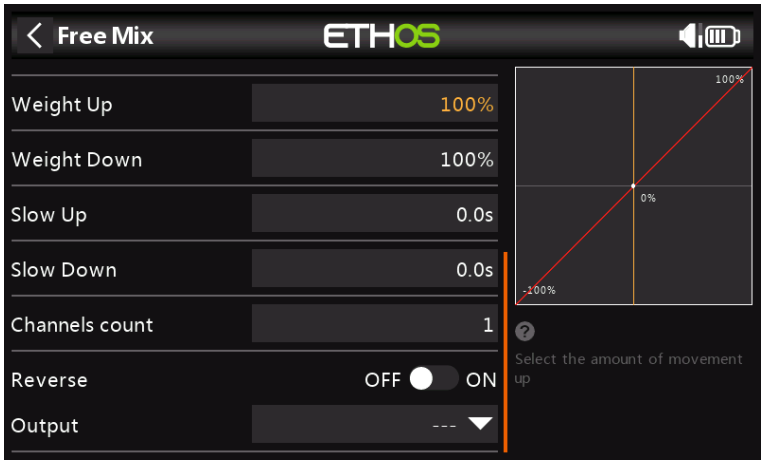
Curve

A standard curve option is Expo, which by default has a value of 0, which means the response is linear (i.e. no curve). A positive value will soften the response around 0, while a negative value will sharpen the response.

Any previously defined curve may also be selected. The mixer output will then modified by this curve. Alternatively, a new curve may be added.

Offset

Offset will shift the mixer output up or down by the offset value entered here. Negative values are allowed.



Weight Up

The mixer output in the positive direction will be scaled by the weight value entered here. Negative values are allowed.

Weight Down

Similarly, the mixer output in the negative direction will be scaled by the weight value entered here.

Slow Up/Down

Response of the output can be slowed down with regard to the input change. Slow could for example be used to slow retracts that are actuated by a normal proportional servo. The value is time in seconds that the output will take to cover the -100 to +100% range.

Channels Count

Channel count defines how many Output channels are allocated.

Reverse

The output of this mixer line can be reversed or inverted by enabling this option. Please note that servo reversal should be done under Outputs. This option is for getting the logic of the mixing right.

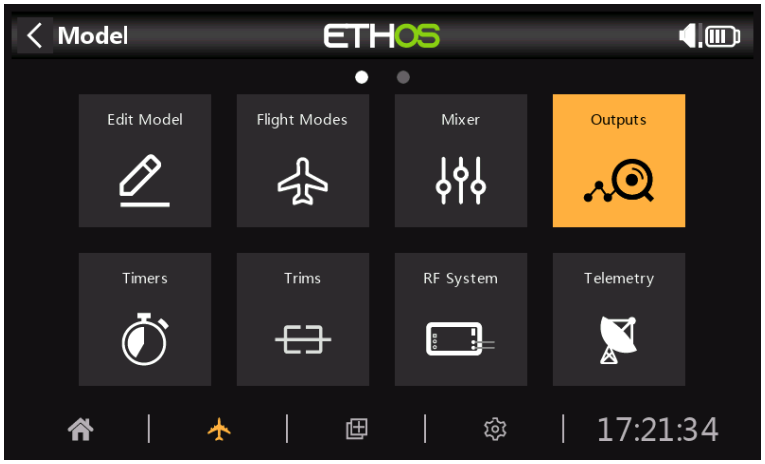
Output

Any channel can be selected to receive the output from this mixer line. If the Channels Count above is greater than one, then a channel must be configured for each Output.

Other Pre-defined Mixes

<< this section to be added >>

Outputs



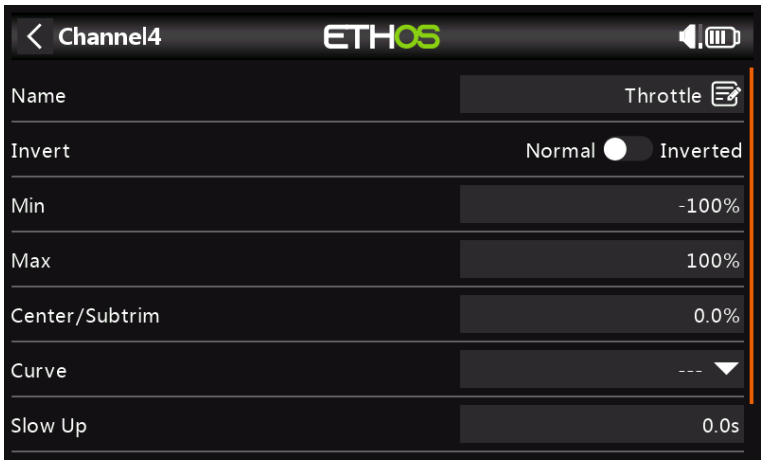
The Outputs section is the interface between the setup "logic" and the real world with servos, linkages and control surfaces as well as actuators and transducers. In the Mixer we have set up what we want our different controls to do. This section allows these pure logical outputs to be adapted to the mechanical characteristics of the model. This is where we configure minimum and maximum throws, servo or channel reverse, and adjust the servo or channel center point or add an offset using subtrim. We can also define a curve to correct any real world response issues. For example, a curve can be used to ensure that left and right flaps track accurately. The various channels are outputs, for example CH1 corresponds to servo plug #1 on your receiver (with the default protocol settings).

The Outputs screen shows two bar graphs for each channel. The lower green bar shows the value of the mixer for the channel, while the upper orange shows the actual value (in both % and µS terms) of the Output after the Outputs processing, which is what is sent to the receiver. In the example above you can see that both the mixer and output values for CH4 Throttle are at -100%.

Note: For quick access to this monitor screen, a long press of the enter key from the Mixer screen and Flight Modes screens will jump to the Outputs.

Outputs Setup

Tap on the Output channel to be edited or reviewed.



Name

The name can be edited.

Invert

Will Invert the channel output, typically to reverse servo direction.

Min/Max

The Channel min and max settings are 'hard' limits, i.e. they will never be overridden. They should be set to avoid mechanical binding. Note that they serve as gain or 'end point' settings, so reducing these limits will reduce throw rather than induce clipping. Note that the limits default to +/- 100%, but may be increased here to +/- 150%.

Center and Subtrim

Used to introduce an offset on the output, typically used to center a servo arm.

Curve

Allows you to select an Expo or custom curve to condition the output. The popup allows to to either select an existing curve, or to add a new curve. After configuring the curve, an Edit button is added so that you can edit the curve easily.

Curves are a quicker and more flexible way of configuring the center and min/max limits of the outputs, and you get a nice graphic. Use a 3-point curve for most outputs, but use a 5-point curve for things such as the second aileron and flap, so you can synchronize the travel at 5 points. When using a curve it is good practice to leave Min, Max and Subtrim at their 'pass thru' values of -100, 100 and 0 respectively (or -150, 150 and 0 if using extended limits).

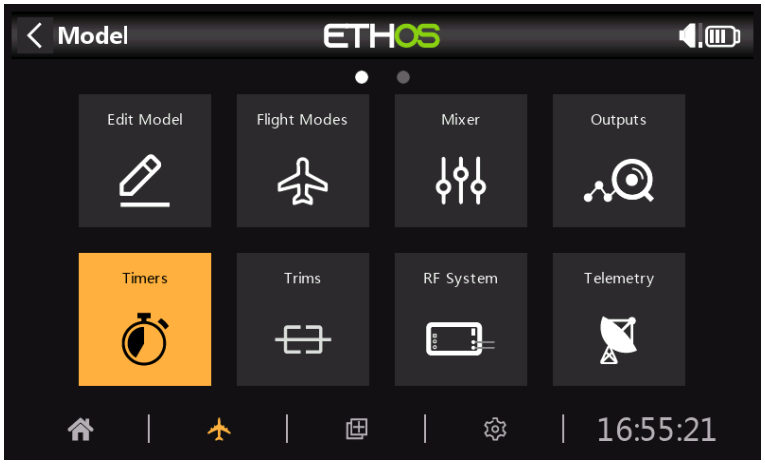
Slow Up/Down

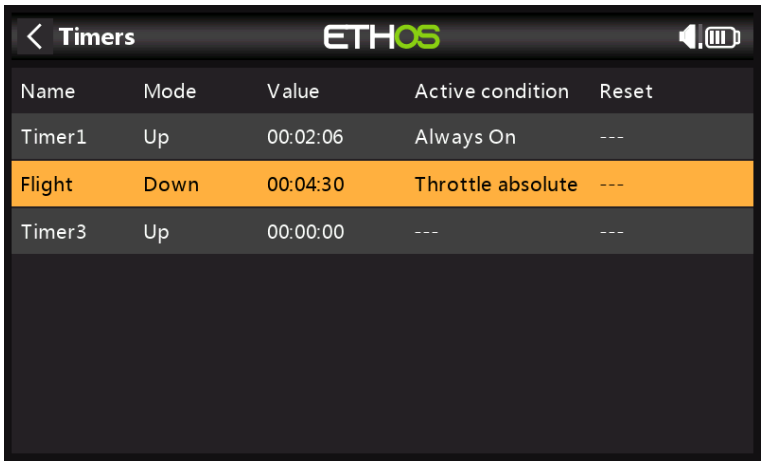
Response of the output can be slowed down with regard to the input change. Slow could for example be used to slow retracts that are actuated by a normal proportional servo. The value is time in seconds that the output will take to cover the -100 to +100% range.

Delay

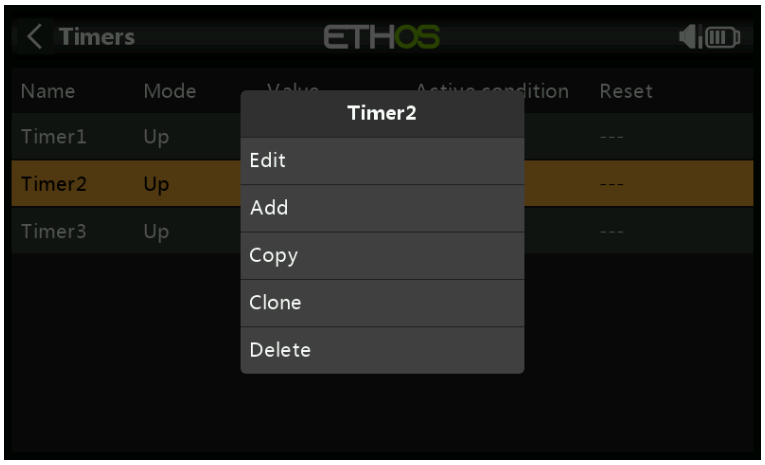
Please note that a delay function is available under Logic Switches.

Timers

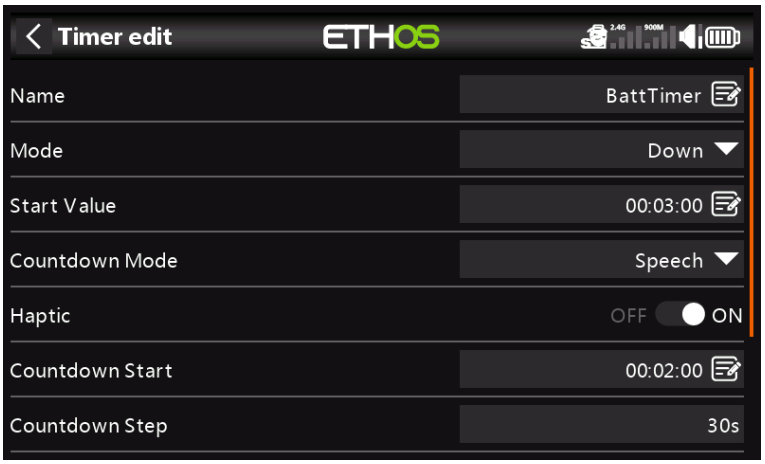




There are 3 fully programmable timers that can count either up or down.



Touching any timer line brings up a popup with options to edit that timer, add a new timer, copy/paste or clone or delete a timer.



Name

Allows the timer to be named.

Mode

The timer can count Up or Down.

Alarm/Start Value

If the timer has been set to count Up, the next parameter sets the Alarm Value at which the timer triggers the configured alerts.

If the timer has been set to count Down, the next parameter sets the Start Value from which the timer counts down. When it reaches zero, it triggers the configured alerts.

Countdown Mode

This setting determines whether the countdown alert is mute, or a beep or spoken value.

Haptic

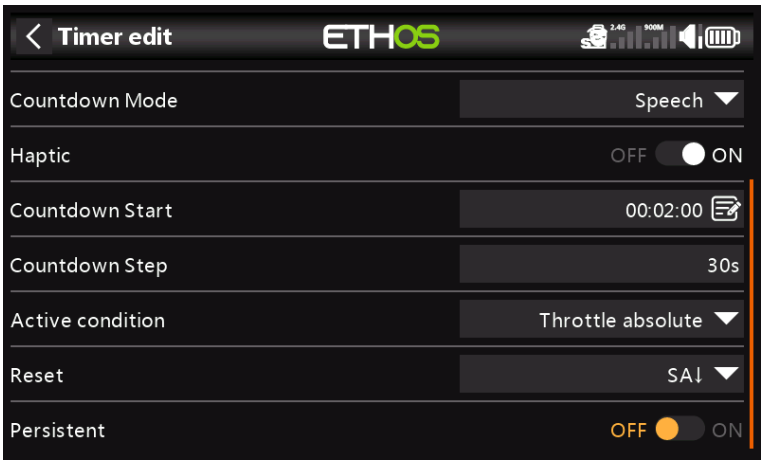
Enables haptic feedback to signal that the timer has elapsed.

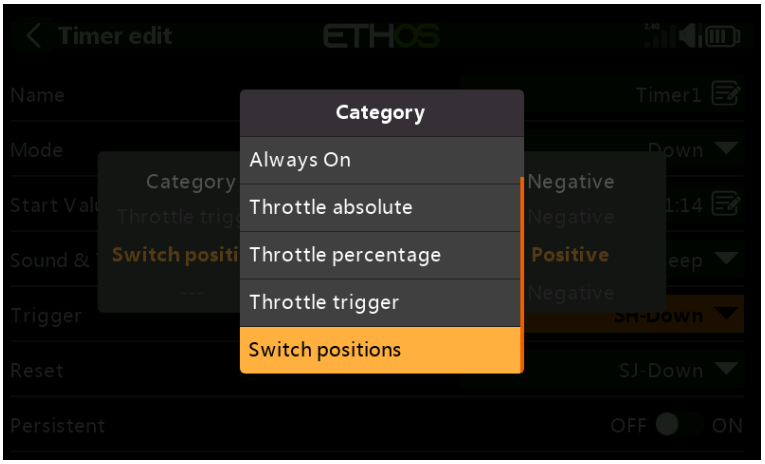
Countdown Start

The timer value from which the countdown alerts start.

Countdown Step

The interval at which countdown alerts are made.





Active Condition

The active condition parameter which determines when the timer is running has the following options:

Always On

Always On counts all the time.

Throttle Absolute

The timer runs whenever the throttle stick isn't at idle.

Throttle Percentage

The timer counts up/down as a percentage of the full stick range.

Throttle Trigger

Throttle Trigger starts the timer the first time throttle is advanced,

Switch Positions

The timer may also be enabled by a switch position.

Logic Switch Positions

The timer may also be enabled by a logic switch.

Reset

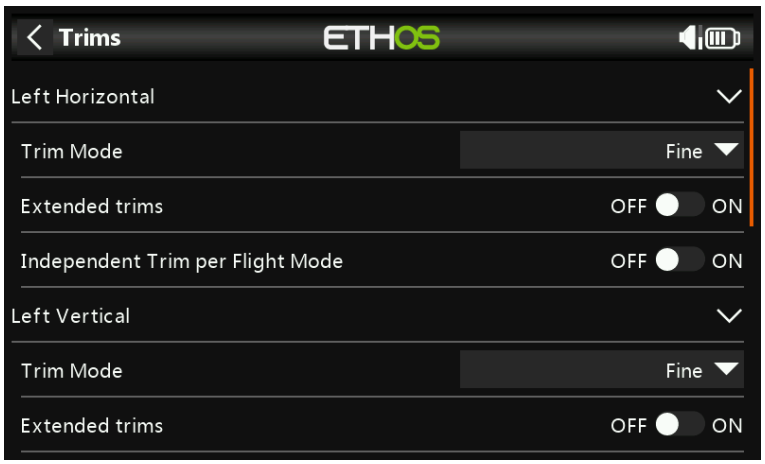
The timer can be reset by switch positions, function switches, logic switches or trim switch positions. Not that the timer will be held in reset while the Reset condition is valid.

Persistent

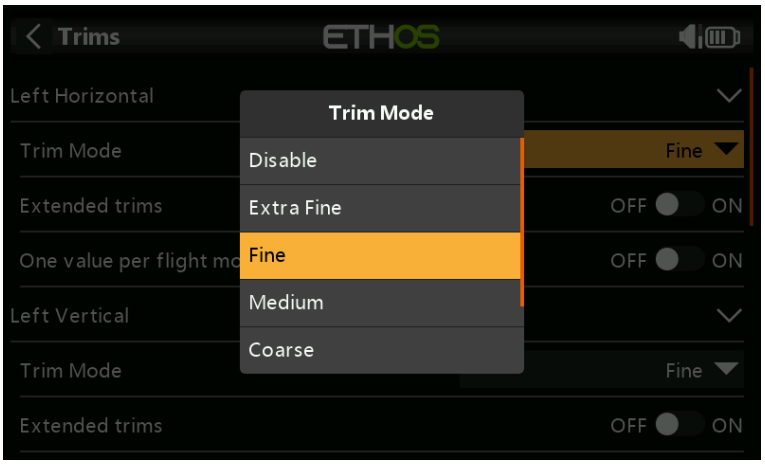
Turning Persistent to On allows storing the timer value in memory when the radio is powered off or the model is changed, and will be reloaded next time the model is used.

Trims

The Trims section allows you to configure the Trim Mode (i.e. trim step size), enable Extended Trims or Independent Trims for each of the 4 control sticks. It also allows Cross Trims to be configured.



There are four sets of Trims settings, one set for each stick. For example, you can have independent elevator trims per flight mode, while leaving the aileron and rudder trims as common or combined.



Trim Mode

The Trim Mode allows trims to be disabled, or to configure the granularity of the trim switch steps, from Extra Fine through Medium to Coarse, or Exponential. The Exponential setting gives fine steps near the center, and coarse steps further out. Custom allows the trim step to be specified.

Extended Trims

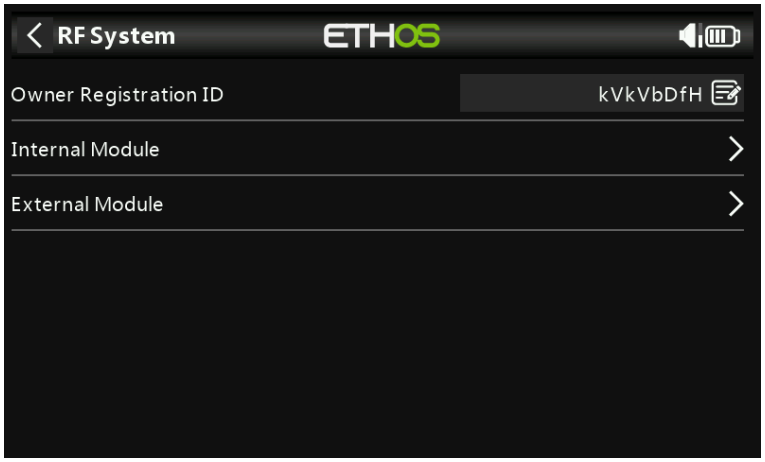
Extended trims allows trims to cover the full stick range instead of +/- 25%. Care must be taken with this option, as holding the trim tabs for too long might add so much trim as to make your model unflyable.

Independent Trim per Flight Mode

If you are using Flight Modes, then this setting enables the relevant trim to be independent for each flight mode, instead of being common to all flight modes.

RF System

This section is used to configure the Owner Registration ID, and the internal and/or external RF modules.



Owner Registration ID

The Owner Registration ID is an 8 character ID that contains a unique random code, which can be changed if desired. This ID becomes the Owner Registration ID when registering a receiver (see below). Enter the same code in the Owner ID field of your other transmitters you want to use the Smart Share feature with them. This must be done before creating the model you want to use it on.

Internal Module

Overview

The X20 TD-ISRM internal RF module is a new design that provides tandem 2.4GHz and 900MHz RF paths. It can operate in 3 modes, i.e. ACCESS, ACCST D16 (see below) or TD MODE (see further below).

ACCESS Mode

In ACCESS mode the 2.4G and 900M RF paths work in tandem with one set of ACCESS controls. There can be three 2.4G receivers registered and bound or three 900M receivers registered and bound or a combination of 2.4G and 900M for a total of three receivers.

In ACCESS mode with a combination of 2.4G and 900M receivers the telemetry for the 2.4G and 900M RF links are active at the same time. The sensors are identified in telemetry as 2.4G or 900M.

There is a new ETHOS telemetry receiver source feature named RX. RX provides the receiver number of the active receiver sending telemetry. RX is available in telemetry like any other sensor for real time display, Logic Switches, Special Functions and data logging.

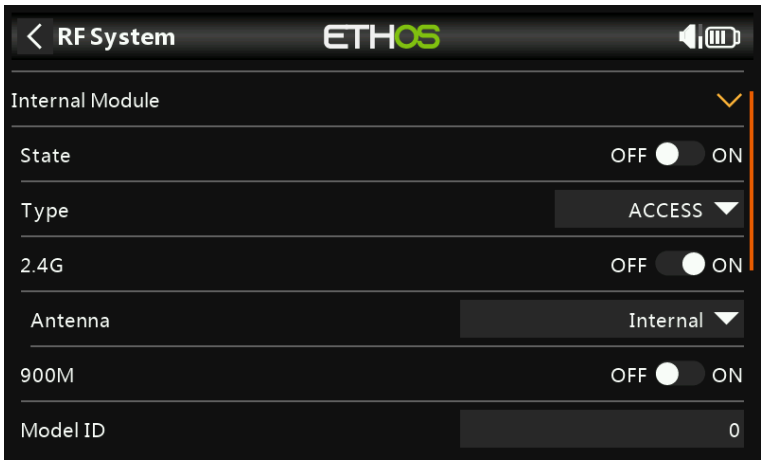
ACCST D16 Mode

In ACCST D16 the TD-ISRM becomes a single 2.4G RF path.

TD Mode

In TD Mode the TD-ISRM is in a low latency long range mode using the 2.4G and 900M RF links in Tandem to work with the new Tandem receivers. At the time of writing Tandem receivers are not available yet.

Please see the following sections for configuration details.

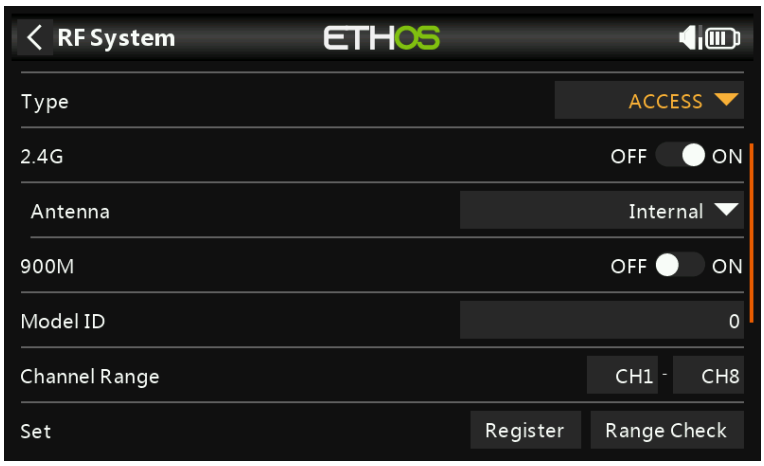


State

The Internal Module can be On or Off.

Type

Transmission mode of the internal RF module. The X20/X20S models operate on the 2.4GHz and/or the 900MHz band. The ACCESS and TD (Tandem) modes can operate on both the 2.4GHz and/or the 900MHz band simultaneously (or individually), while the ACCST D16 operates only on the 2.4GHz band. The Mode must match the type supported by the receiver or the model will not bind! After a Mode change, carefully check model operation (especially Failsafe!) and fully verify that all receiver channels are functioning as intended.



Type: ACCESS

ACCESS changes the way receivers are bound and connected with the transmitter. The process is broken into two phases. The first phase is registering the receiver to the radio or radios it is to be used with. Registration only needs to be performed once between each receiver / transmitter pair. Once registered, a receiver can be bound and re-bound wirelessly with any of the radios it is registered with, without using the bind button on the receiver.

Having selected the ACCESS mode, the following parameters must be set up:

2.4G

Enable or disable the 2.4G RF module.

Select Internal or External (on ANT1 connector) Antenna. Although the RF stage has built-in protection, it is good practice to ensure that an external antenna has been fitted before selecting the External antenna.

900M

Enable or disable the 900M RF module.

Antenna: Select Internal or External (on ANT2 connector) Antenna. Although the RF stage has built-in protection, it is good practice to ensure that an external antenna has been fitted before selecting the External antenna.

Power: Select the RF Power desired between 10, 25, 100, 200, 500mW.

In ACCESS mode the 2.4g and 900m RF paths work in tandem with one set of ACCESS controls. There can be three 2.4G receivers registered and bound or three 900M receivers registered and bound or a combination of 2.4G and 900M for a total of three receivers.

Model ID

When you create a new model, the default Model ID is 0. However, you should change this to a unique number.

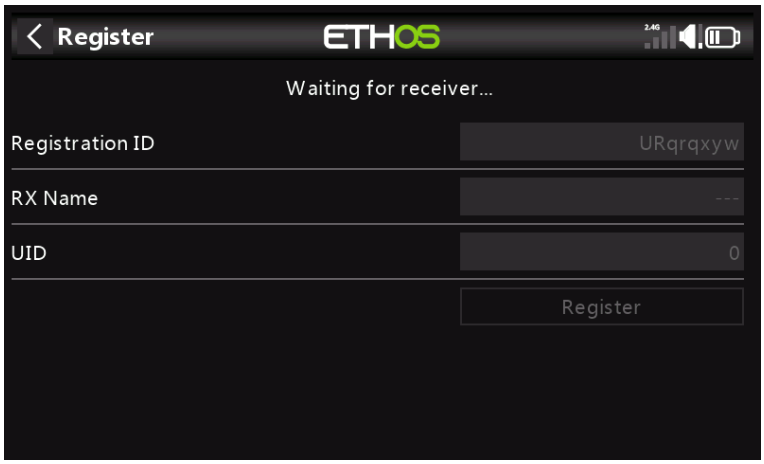
Channel Range:

Since ACCESS supports 24 channels, you normally choose Ch1-8, Ch9-16 or Ch17-24 for the receiver being set up.

Phase One: Registration

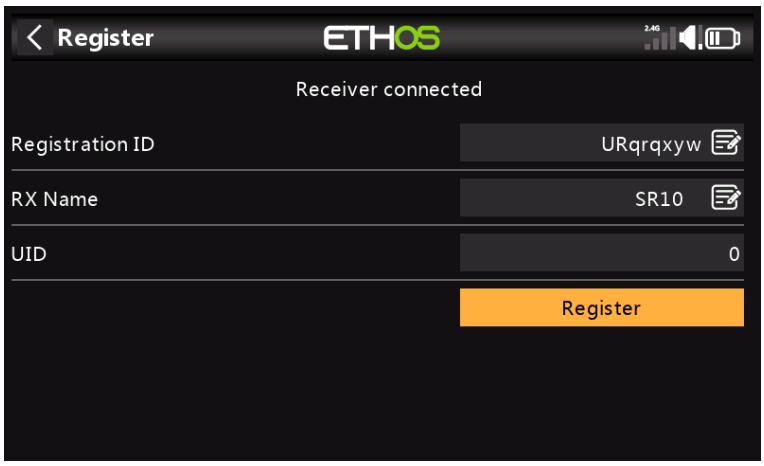
Set:

1. Initiate the registration process by selecting [Register].



A message box with 'Waiting....' will pop up with a repeating ‘Register’ voice alert.

2. While holding down the bind button, power up the receiver, and wait for the red & green LEDs to become active.

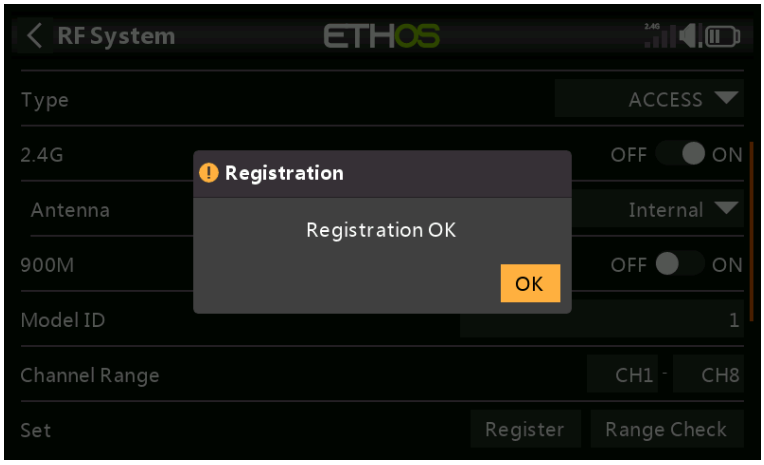


The 'Waiting...' message changes to ‘Receiver Connected’, and Rx Name field will be filled in automatically.

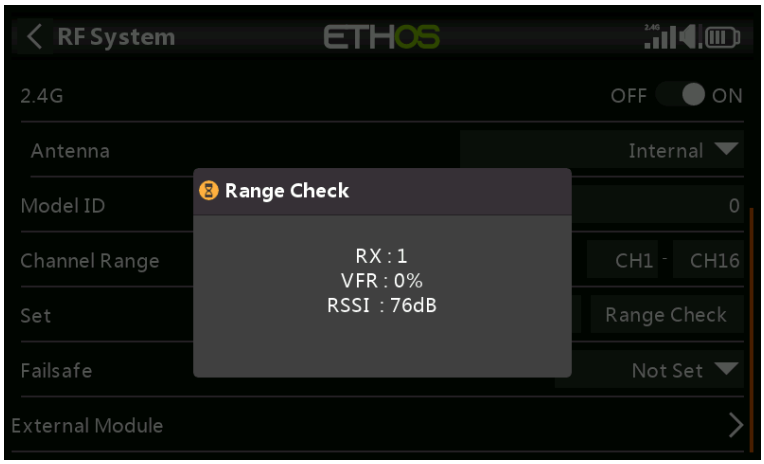
3. At this stage the Reg. ID and UID can be set:
   - Reg. ID: The Registration ID is at owner or transmitter level. This should be a unique code for your X20/X20S and transmitters to be used with Smart Share. It defaults to the value in the Owner Registration ID setting described above at the start of this section, but can be edited here. If two radios have the same ID you can move receivers (with the same Receiver No for a given model) between them by simply using the power on bind process.
   - RX Name: Filled in automatically, but the name can be changed if desired. This can be useful if you are using more than one receiver and need to remember for example that RX4R1 is for Ch1-8 or RX4R2 is for Ch9-16 or RX4R3 is for Ch17-24 when rebinding later. A name for the receiver can be entered here.
   - The UID defaults to 0 for Ch1-8. When more than one receiver is to be used in the same model, the UID should be changed to 1 for Ch9-16, or 2 for Ch17-24. Please note that this UID cannot be read back from the receiver, so it is a good idea to label the receiver.

4. Press [Register] to complete. A dialog box pops up with 'Registration ok'. Press [OK] to continue.

5. Turn the receiver off. It is now ready for binding.



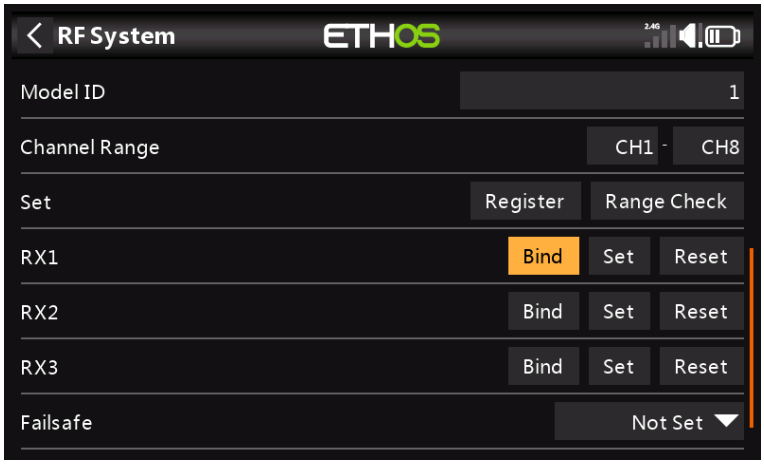
Range



A range check should be done at the field when the model is ready to fly.

Range check is activated by selecting 'Range'. A voice alert will announce 'Range Check' every few seconds to confirm that you are in range check mode. A popup will display the Receiver Number, and the VFR% and RSSI values to evaluate how reception quality is behaving. When the Range Check is active, it reduces transmitter power by a factor of 900, which reduces the range by a factor of 30. Under ideal conditions, with both the radio and receiver at 1m above the ground, you should only get a critical alarm at about 30m apart.

Please refer to the Telemetry section for a discussion on VFR and RSSI values.



At this point the receiver is registered, but it still needs to be bound to the transmitter to be used.

Phase 2 – Binding, and Module Options

Receiver binding enables a registered receiver to be bound to one of the transmitters it has been registered with in phase 1, and will then respond to that transmitter until re-bound to another transmitter. Be certain to perform a range check before flying the model.

Receiver No: Confirm the receiver number the model is to operate under. Receiver matching is still as important as it was before ACCESS. The receiver number defines the behavior of the receiver lock function (aka: Receiver Match). This number is sent to the receiver, which will only respond to the number it was bound to. By default this is the number of the model's slot when it is created. It can however be changed manually, and will not change if a model is moved or copied. If manual setting or a copy/move operation results in 2 or more models on the radio having the same number, a warning pop-up will show up. It is then up to the user to determine if this is the desired behavior or not and change if required.

Bind

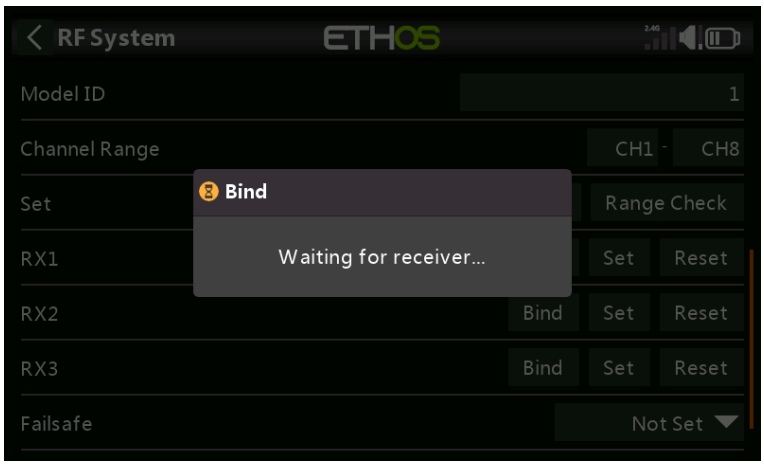
Warning – Very Important

Do not perform the binding operation with an electric motor connected or an internal combustion engine running.

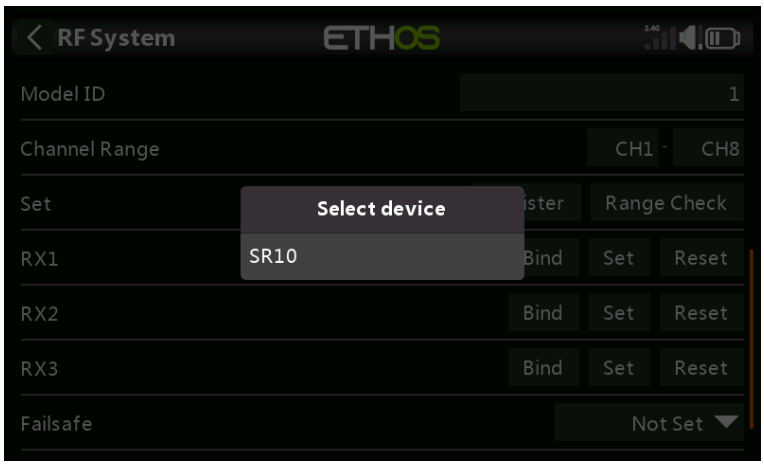
1. Turn the receiver power off.

2. Confirm that you are in ACCESS mode.

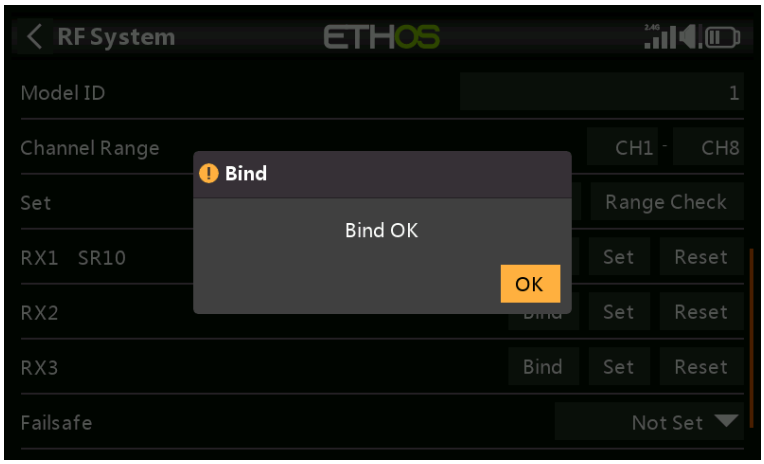
3. Receiver 1 [Bind]: Initiate the binding process by selecting [Bind]. A voice alert will announce 'Bind' every few seconds to confirm that you are in bind mode. A popup will display 'Waiting for receiver….'.



4. Power up the receiver without touching the F/S bind button. A message box will pop up 'Select device' and the name of the receiver you have just powered on.



5. Scroll to the receiver name and select it. A message box will pop up indicating that binding was successful.

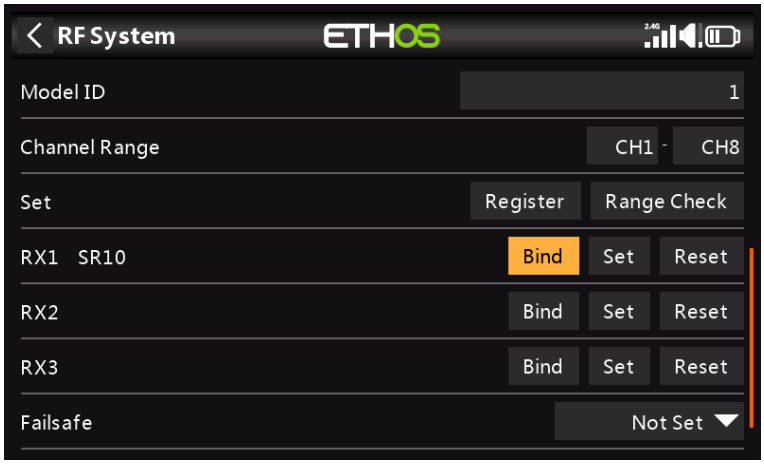


6. Turn off both the transmitter and the receiver.

7. Turn the transmitter on and then the receiver. If the Green LED on the receiver is on, and the Red LED is off, the receiver is linked to the transmitter. The receiver/transmitter module binding will not have to be repeated, unless one of the two is replaced.

The receiver will only be controlled (without being affected by other transmitters) by the transmitter it is bound to.

The receiver selected will now show for RX1 the name next to it:



The receiver is now ready for use.

Repeat for Receiver 2 and 3 if applicable.

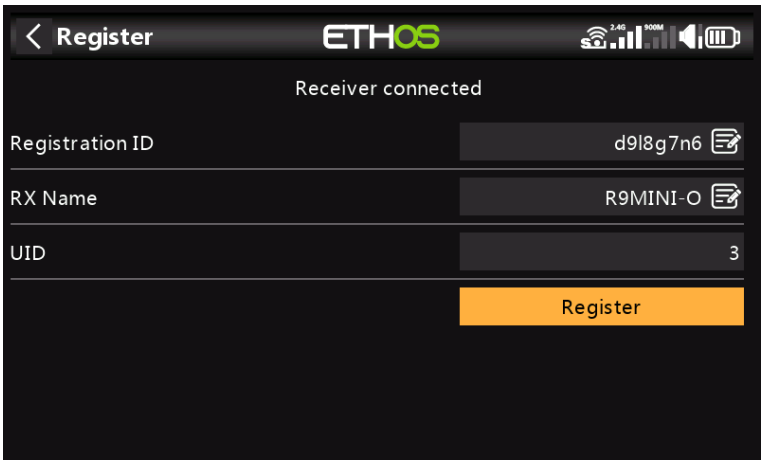
Refer also to the Telemetry section for a discussion on RSSI.

Adding a Redundant Receiver

A second receiver may be bound to each of RX1, 2 or 3 to provide redundancy in case of reception problems. Either a 2.4G or 900M receiver may be the backup for redundancy. Our example below shows a 900M receiver being added.

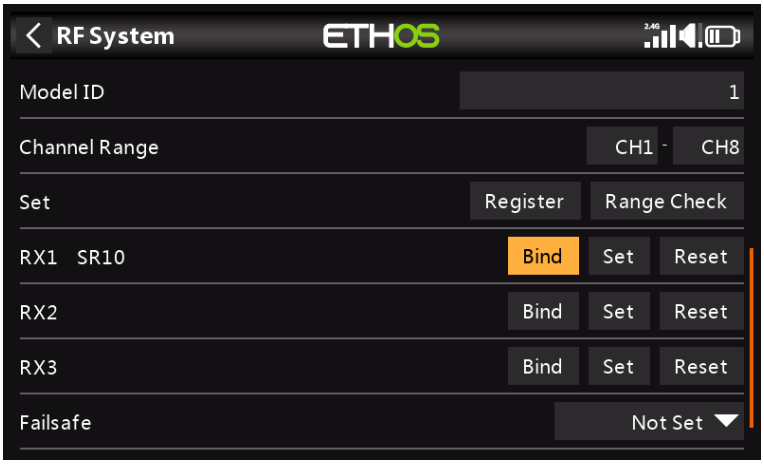
1. Connect the SBUS Out port of the redundant receiver to the SBUS IN port of the main receiver.

2. Power up the receivers (the redundant receiver can be powered via the SBUS cable.



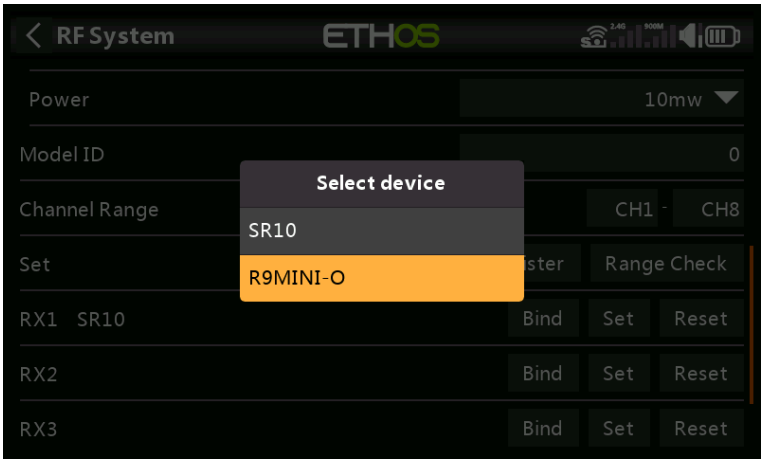
3. Register the new receiver.

4. Switch off the receivers.

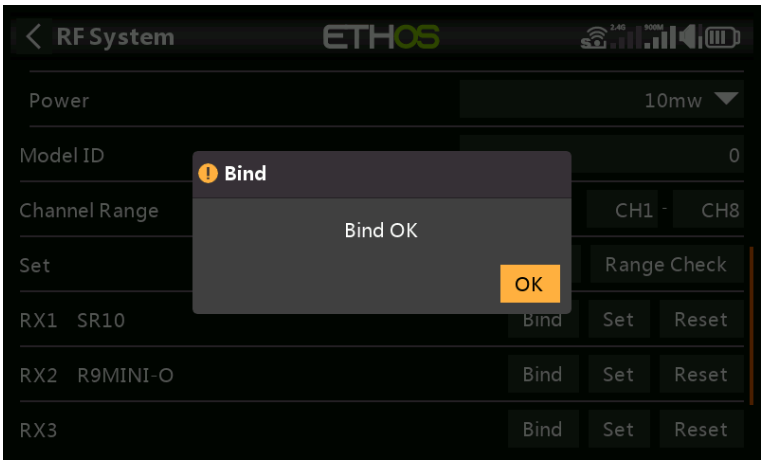


5. Tap 'Bind' on the same line as your main receiver.

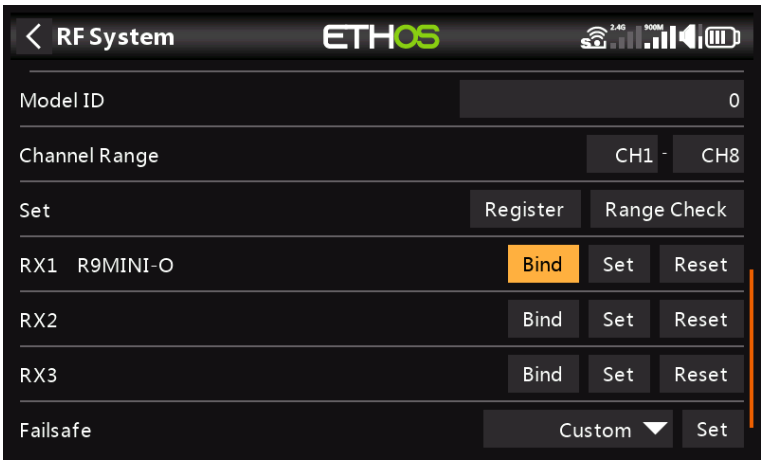
6. Power up the receivers.



7. Select the R9 redundant receiver.

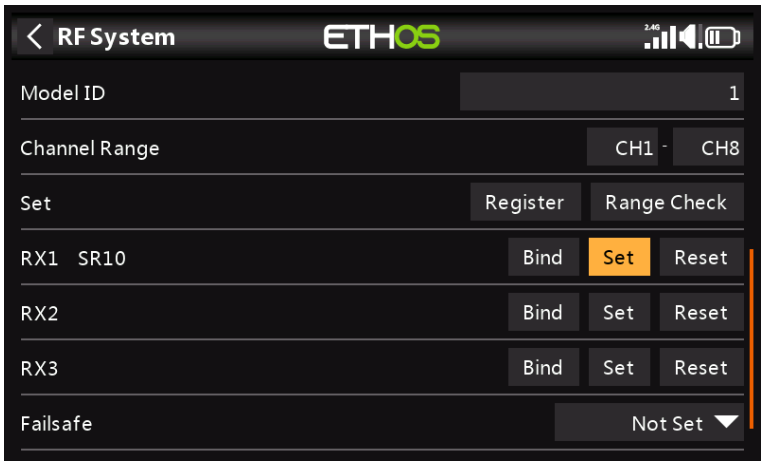


8. Tap on OK. Ensure that the Green LED on the redundant receiver is ON. The redundant receiver is now bound.

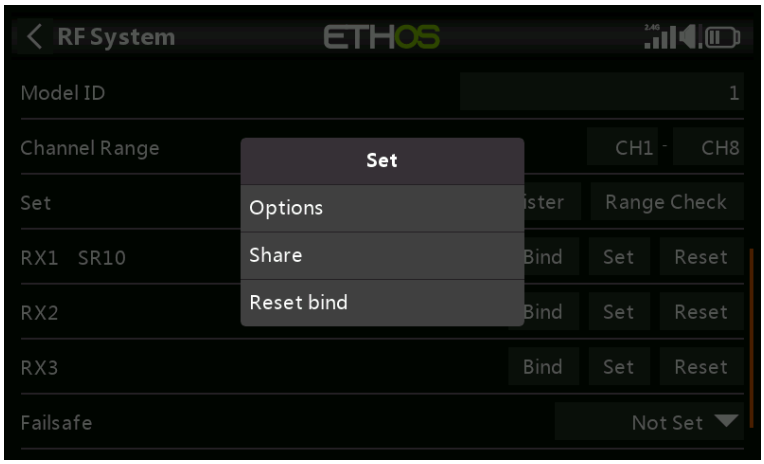


9. Both receivers will now be listed against for RX1 (or whichever receiver you are making redundant).

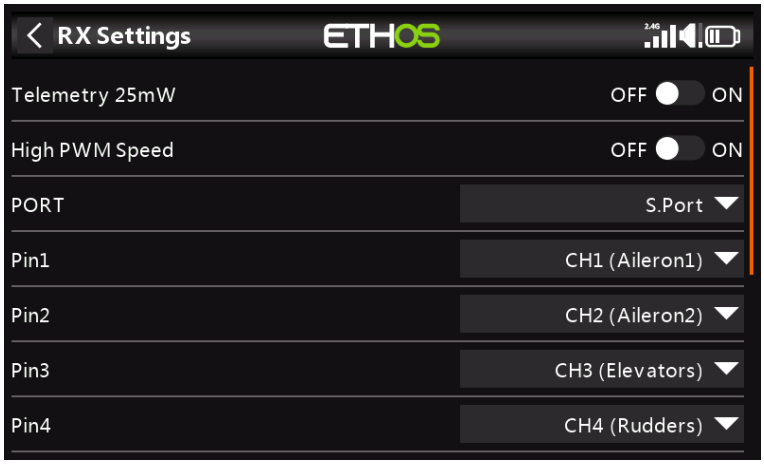
Set – Receiver Options



Tap the Set button next to Receiver 1, 2 or 3, and to bring up Receiver Options:



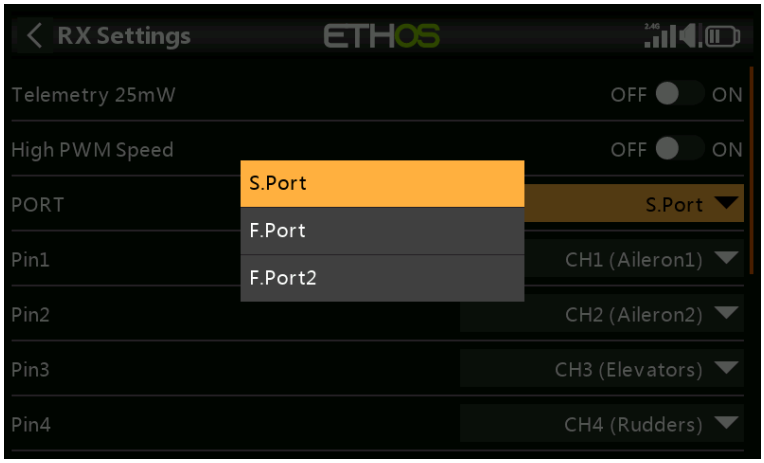
Tap on Options:



Options

Telemetry 25mW: Checkbox to limit telemetry power to 25mW (normally 100mW), possibly required if for example servos experience interference from RF being sent close to them.

High PWM Speed: Checkbox to enable a 7ms PWM update rate (vs 20ms standard). Ensure that your servos can handle this update rate.



Port: Allows selection of the SmartPort on the receiver to use either S.Port, F.Port or the F.Port2 protocol. The F.Port protocol was developed with the Betaflight team to integrate the separate SBUS and S.Port signals. F.Port 2.0 also enables one Host device to communicate with several Slave devices on the same line.

The receiver Options dialog also gives the ability to Remap channels to the receiver pins.

Share

The Share feature provides the ability to move the receiver to another ACCESS radio having a different Owner Registration ID. When the Share option is tapped, the receiver green LED turns off.

On target radio B, navigate to the RF System section and Receiver(n) and select Bind. Note that the Share process skips the Registration step on Radio B, because the Owner Registration ID is transferred from radio A. The receiver name from the source radio pops up. Select the name, the receiver will bind and its LED will go green.

A 'Bind successful' message will pop up.

Tap on OK. Radio B now controls the receiver. The receiver will remain bound to this radio until you choose to change it.

Press the EXIT button on Radio A to stop the Share process.

The receiver can be moved back to radio A by rebinding it to radio A.

Note: You do not need to use 'Share' if all your radios are using the same Owner ID / registration number. You can simply put the radio you want to use in bind mode, turn on the receiver, select the receiver in the radio and it will bind with that radio. You can switch to another radio the same way. It is best to keep the model receiver numbers the same when copying the models.

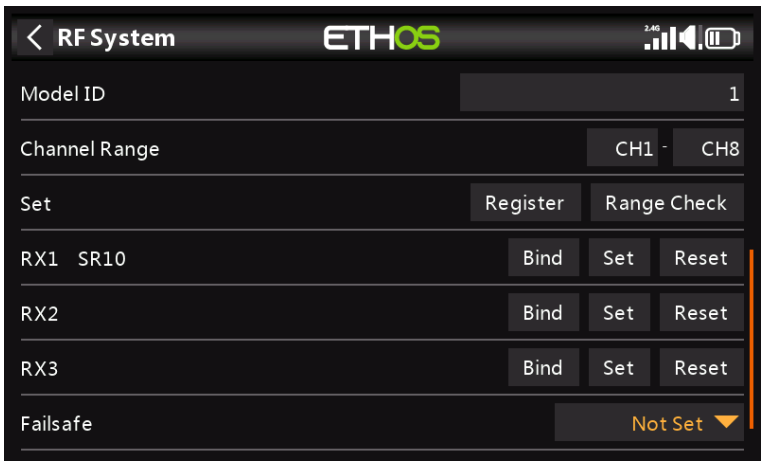
Reset bind

If you change your mind about sharing a model, select 'Reset bind' to clean up and restore your bind. Power cycle the receiver, and it will be bound to your transmitter.

Reset – Receiver

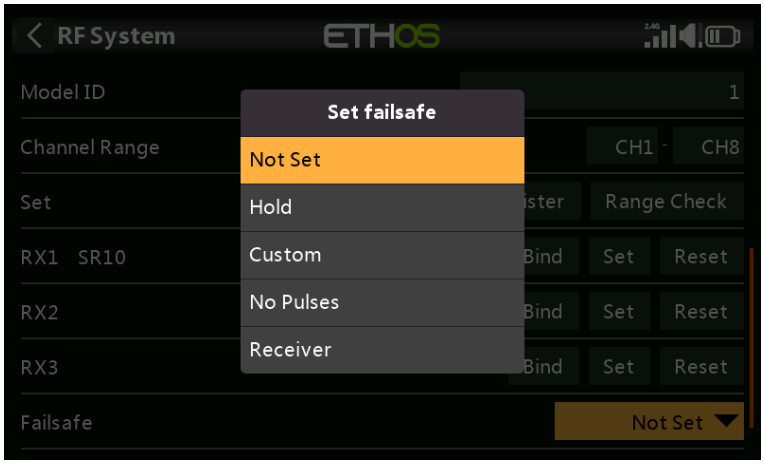
Tap on the Reset button to Reset the receiver back to factory settings and clear the UID. The receiver is unregistered with X20.

Set Failsafe



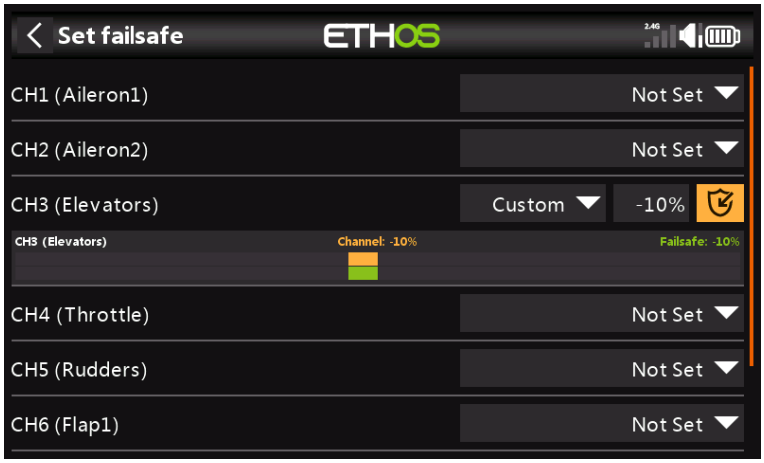
The Failsafe mode determines what happens at the receiver when the transmitter signal is lost.

Tap on the drop-down box to see the failsafe options:



Hold

Hold will maintain the last received positions.



Custom

Custom allows moving the servos to custom predefined positions. The position for each channel can be defined separately. Each channel has the options of Not Set, Hold, Custom or No Pulses. If Custom is selected, the channel value is displayed. If the set icon with an arrow is tapped, the current value of the channel is used. Alternatively, a fixed value for that channel can be entered by tapping on the value.

No Pulses

No Pulses turns off pulses (for use with flight controllers having return-to-home GPS on loss of signal).

Receiver

Choosing "Receiver" on X series or later receivers allows failsafe to be set in the receiver.

Warning: Be sure to test the chosen Failsafe settings carefully.

Type: ACCST D16

Mode ACCST D16 is for the ACCST 16ch two-way full duplex transmission, also known as the "X"-mode. For use with the legacy “X” series receivers.

2.4G

ACCST D16 operates on 2.4G, so the 2.4G RF section is on by default.

Antenna

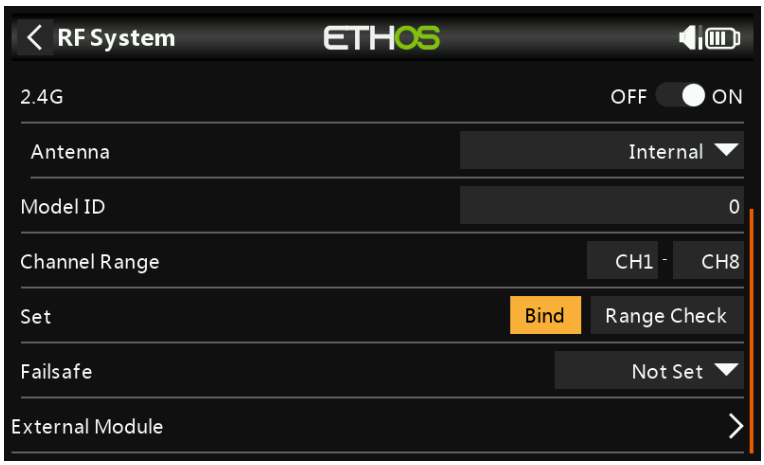
Select Internal or External (on ANT1 connector) Antenna. Although the RF stage has built-in protection, it is good practice to ensure that an external antenna has been fitted before selecting the External antenna.

Model ID

When you create a new model, the Model ID is automatically allocated. However, you should change this.to a unique number. The Model ID defines the behavior of the receiver lock function (aka: Receiver Match). This number is sent to the receiver, which will only respond to the number it was bound to. By default this is the number of the model's slot when it is created. It can however be changed manually, and will not change if a model is moved or copied.

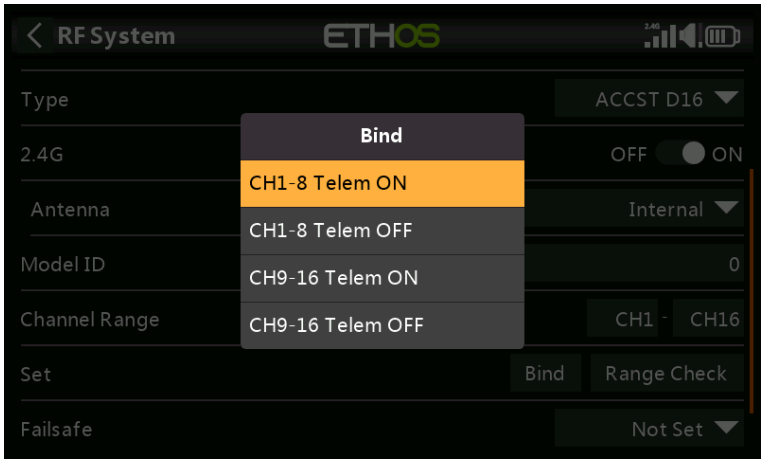
Channel Range

Choice of which of the radio's internal channels are actually transmitted over the air. In D16 mode you can choose between 8 channels with data sent every 9ms, and 16 channels with data sent every 18ms.

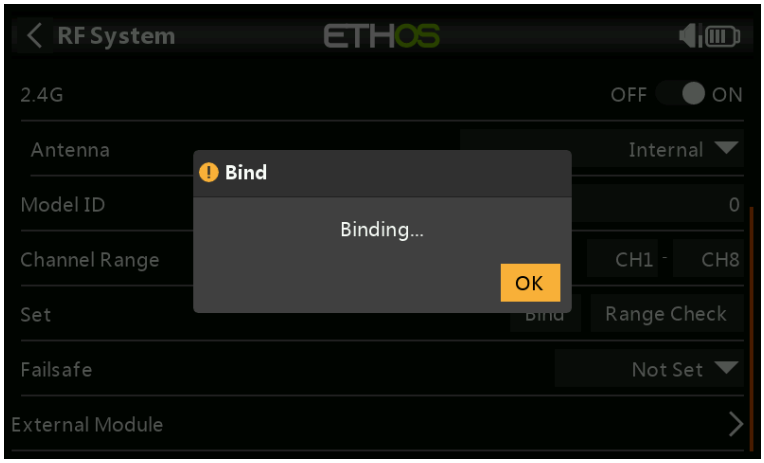


Bind

1. Initiate the binding process by selecting [Bind]. A voice alert will announce 'Bind' every few seconds to confirm that you are in bind mode. In D16 mode a pop-up menu will open during bind to allow selection of the operation mode of the receiver. The options refer to the PWM outputs, and apply to receivers that support choosing between these 4 options using jumpers. Ensure that the receiver and RF module firmware support this option. If not, a regular bind takes place.



There are 4 modes with the combinations of Telemetry on/off and channel 1-8 or 9-16. This is useful when using two receivers for redundancy or to connect more than 8 servos using two receivers.



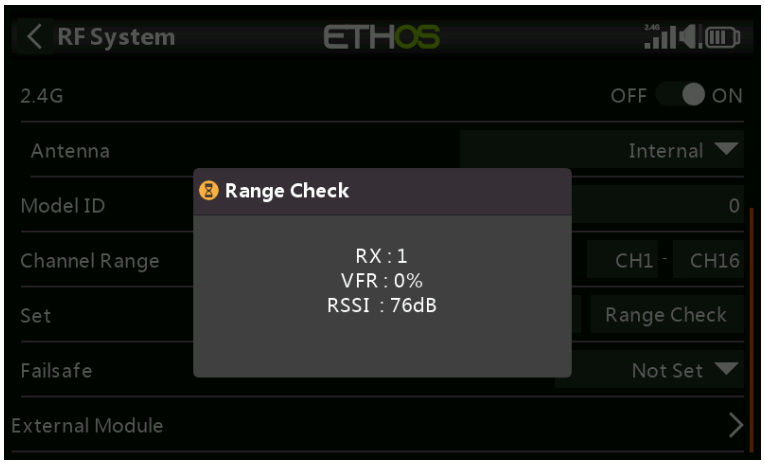
2. Power up the receiver, putting it into bind mode as per the receiver instructions. (Generally done by holding down the Failsafe button on the receiver during power up.)

3. The Red and Green LEDs will come on. The Green LED will go off, and the Red LED will flash when the binding process is completed.

4. Tap OK on the transmitter to end the Bind process, and power cycle the receiver.

5. If the Green LED on the receiver is on, and the Red LED is off, the receiver is linked to the transmitter. The receiver/transmitter module binding will not have to be repeated, unless one of the two is replaced. The receiver will only be controlled (without being affected by other transmitters) by the transmitter it is bound to.

Warnings – Very Important
Do not perform the binding operation with an electric motor connected or an internal combustion engine running.



Range

A range check should be done at the field when the model is ready to fly.

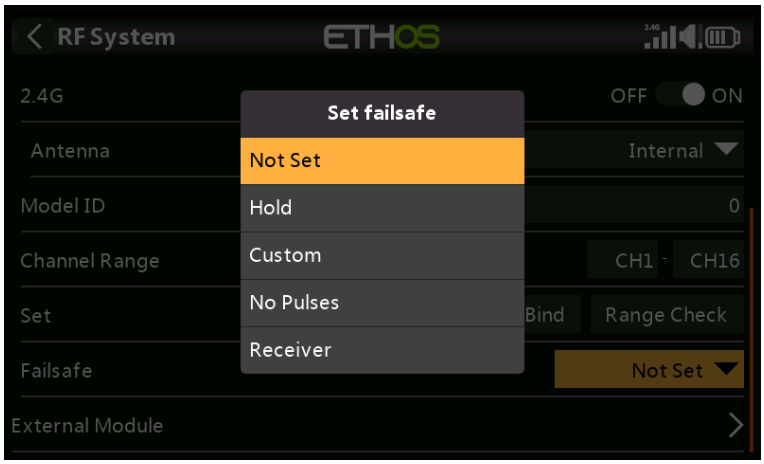
Range check is activated by selecting 'Range'. A voice alert will announce 'Range Check' every few seconds to confirm that you are in range check mode. A popup will display the Receiver Number, and the VFR% and RSSI values to evaluate how reception quality is behaving. When the Range Check is active, it reduces transmitter power by a factor of 900, which reduces the range by a factor of 30. Under ideal conditions, with both the radio and receiver at 1m above the ground, you should only get a critical alarm at about 30m apart.

Please refer to the Telemetry section for a discussion on VFR and RSSI values.

Set Failsafe

The Failsafe mode determines what happens at the receiver when the transmitter signal is lost.

Tap on the drop-down box to see the failsafe options:



Hold

Hold will maintain the last received positions.

Custom

Custom allows moving the servos to custom predefined positions. The position for each channel can be defined separately. Each channel has the options of Not Set, Hold, Custom or No Pulses. If Custom is selected, a fixed value for that channel can be entered.

No Pulses

No Pulses turns off pulses (for use with flight controllers having return-to-home GPS on loss of signal).

Receiver

Choosing "Receiver" on X series or later receivers allows failsafe to be set in the receiver.

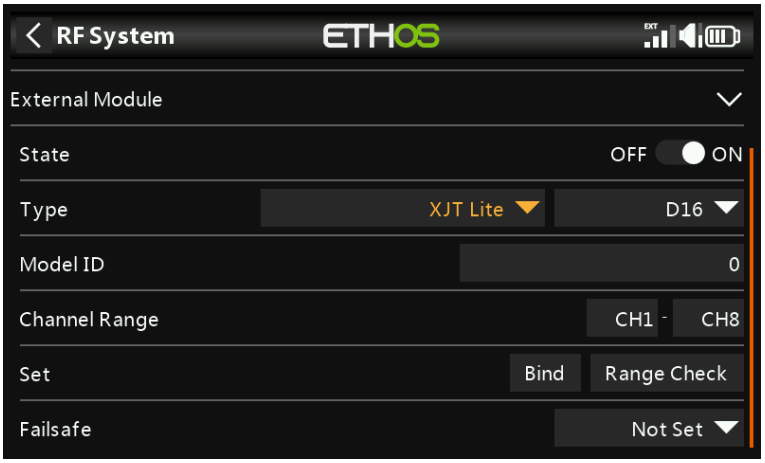
Warning: Be sure to test the chosen Failsafe settings carefully.

Type: TD Mode

<< to be completed when Tandem receivers are ready >>

External Module

Currently the following external modules are supported: XJT Lite, R9M Lite, R9M Lite Access, R9M Lite Pro Access and PPM.
The External module can operate in 3 modes, i.e. ACCESS, ACCST D16 or TD MODE. Please see the following sections for configuration details.



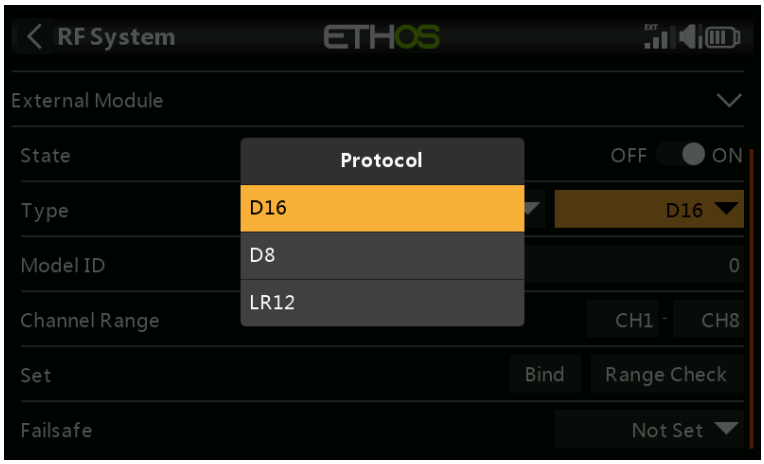
State

The Internal Module can be On or Off.

Type

XJT Lite

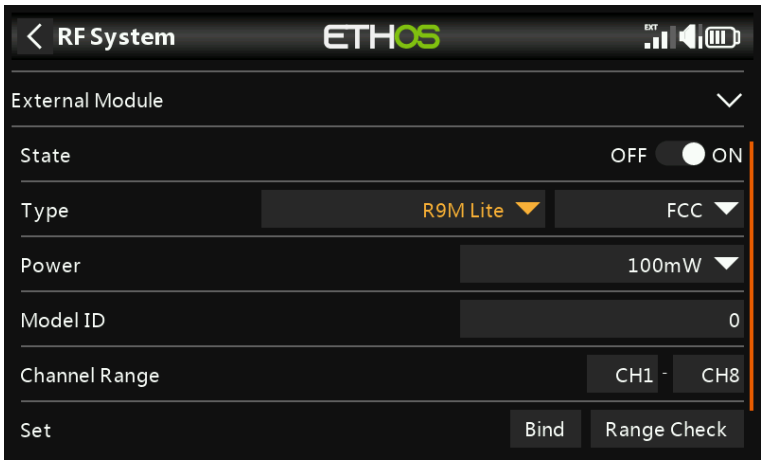
Protocol



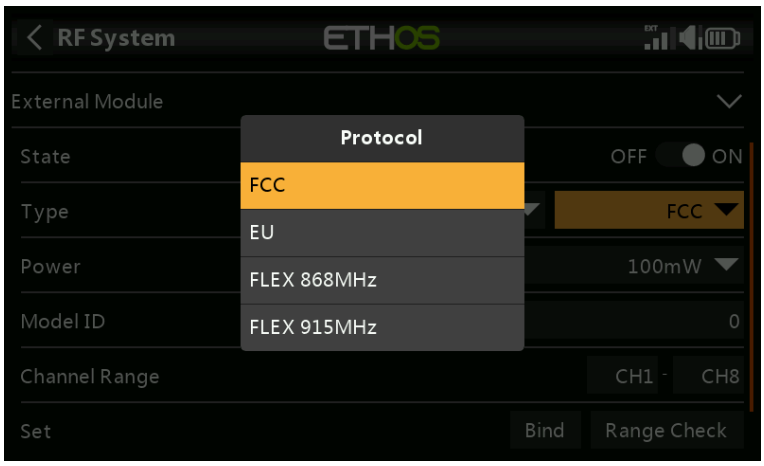
The XJT Lite can operate in D16 (up to 16 channels), D8 (up to 8 channels) or LR12 (up to 12 channels) modes.

Type

R9M Lite



○



Protocol

The R9M Lite can operate in the following modes:

Mode	RF Operating Frequency	RF Power
FCC	915MHz	100mW (with telemetry)
EU	868MHz	25mW (with telemetry) / 100mW (without telemetry)
FLEX 868MHz	Adjustable	100mW (with telemetry)
FLEX 915MHz	Adjustable	100mW (with telemetry)

Type

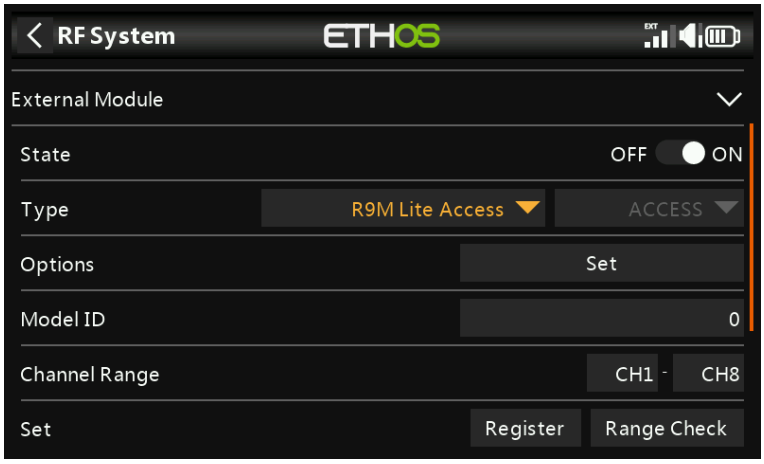
R9M Lite ACCESS

Protocol

The R9M Lite ACCESS operates in ACCESS mode.

Type

R9M Lite Pro ACCESS



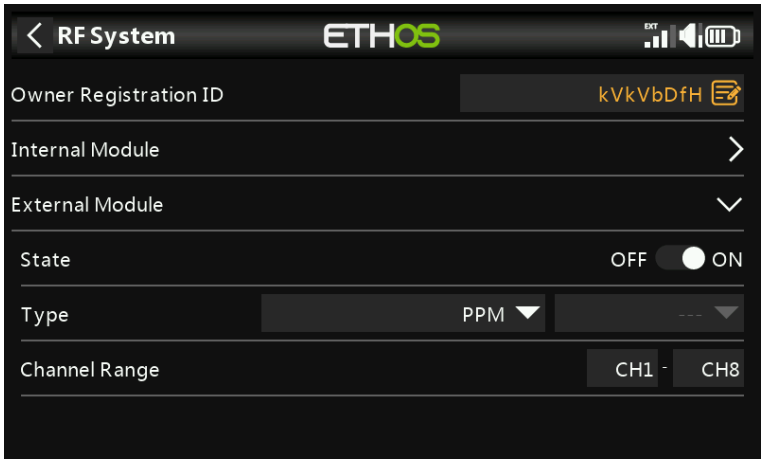
Protocol

The R9M Lite Pro ACCESS operates in ACCESS mode.

Mode	RF Operating Frequency	RF Power
Non-LBT	915MHz	10mW / 100mW / 500mW / 100mW~1W (Self-adaptive)
LBT	868MHz	Telemetry mode (25mW) / Non-Telemetry mode (200mW / 500mW)

Type

PPM



The External RF Module can operate in PPM mode.

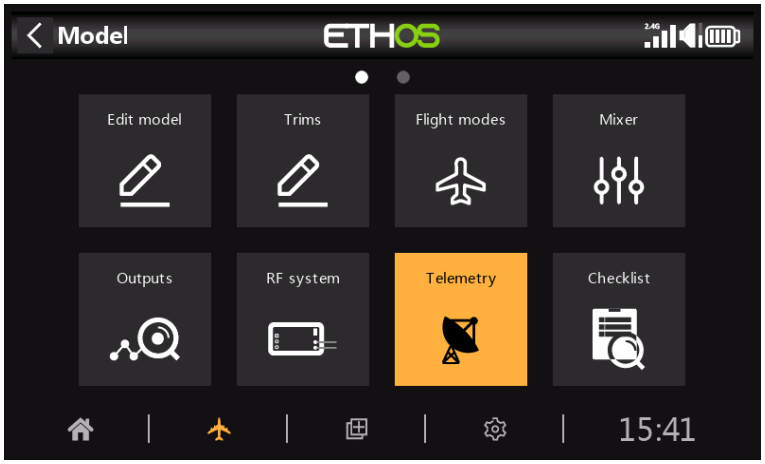
Channels Range

Bind/Range

Set Failsafe

These settings are similar to those for the Internal RF Module, so please refer to the relevant sections above for configuration details.

Telemetry



FrSky offers a very comprehensive telemetry system. The power of telemetry has lifted the RC hobby to a whole new level, and allows much more sophistication and a much richer modeling experience.

Smart Port telemetry

FrSky's series of sensors are a hub-less design. Smart Port (S.Port) telemetry devices are daisy chained together in any sequence and plugged into the Smart Port connection on compatible X and S and later series receivers. The receiver can achieve full duplex (2-way) high speed communication with many compatible devices through this connection with little or no manual set up. This results in less clutter and gives you the freedom to design the system you need, not what a hub will allow.

Key features:

Each value received via telemetry is treated as a separate sensor, that has its own properties such as

- the sensor value
- the S.Port Data ID and Physical ID number
- the name of the sensor (editable)
- the unit of measurement
- the decimal precision
- option to log to the SD card

The sensor also keeps track of its min/max value.

More than one of the same sensor type can be connected, but the Physical ID must be changed (using the FrSky SBUS servo changer SCC) to ensure that each sensor in the smart port chain has a unique ID. Examples are a sensor for each cell in a 2 x 6S Lipo, or monitoring individual motor currents in a multi-motor model.

The same sensor can be duplicated, for example with different units, or for use in calculations such as absolute altitude, altitude above starting point, etc.

Each sensor can be individually reset with a special function, so for example you can reset your altitude offset to your starting point without losing all the other min/max values.

With FrSky sensors, once set up, they are auto-discovered whenever the complete system is powered up. However, when initially installed, they must be manually 'discovered' in order for the system to recognize them.

Telemetry Sensors can be

- played in voice announcements
- used in logical switches
- used in Inputs for proportional actions
- displayed in custom telemetry screens
- seen directly on the telemetry setup page without having to configure a custom telemetry screen

Displays are updated as data is received, and loss of sensor communication is detected.

Access Telemetry

Single receiver telemetry with ACCESS works in the same way as before.

Multi receiver telemetry

ACCESS offers Trio Control, which allows one transmitter to control the channels and/or telemetry for up to 3 receivers per model. You no longer need to use the STK tools for setup, and Smart Port also allows the use of third-party input/output devices with pass-through mode.

ACCESS will automatically switch to the next receiver if the RF link to a receiver is lost. The switching order is Receiver 1, then 2, then 3.

The most common application would be using S.Port, by daisy chaining the S.Port sensor chain to all 3 receivers, which should be sharing a common power supply.

- Register and bind the receivers (refer to Model Setup).
- Connect the sensor and receiver Smart Ports in a daisy chain fashion.
- Discover new sensors (refer to Telemetry Setup), and test carefully that Smart Port switching is working correctly.

Note that on the transmitter there will only be one telemetry entry for RSSI and RxBat, but these values will dynamically come from the receiver that is currently handling the telemetry.
Simultaneous telemetry from three receivers will come later. Further developments are expected in this area.

Sensor Types:

1. Internal Sensors

FrSky radios and receivers have built-in telemetry functions to monitor the strength of the signal being received by the model.

RSSI

Receiver Signal Strength Indicator (RSSI): A value transmitted by the receiver in your model to your transmitter that indicates how strong the signal is that is being received by the model. Warnings can be set up to warn you when it drops below a minimum value, indicating that you’re in danger of flying out of range. Factors affecting the signal quality include external interference, excessive distance, badly oriented or damaged antennas etc.

It is not an absolute measurement, but a number that indicates the ratio of the signal to some initial "good" value. The number is relative, but can give an indication that the model may be approaching the range limit for control of the airplane.

The operating range of, for example, the X8R is about 1.45 – 2km under normal operating conditions.

ACCESS

The default alarms for ACCESS are 35 for 'RSSI Low' and 32 for 'RSSI Critical'. Loss of control will happen when the RSSI drops to around 28.

These numbers are on a dB logarithmic scale, which means that the value drops by 6 every time the distance to the receiver is doubled. Close to the transmitter the RSSI reading is close to 100. At a distance of 125m, the reading should be about 50, and drop by 6 to 44 at 250m, to 38 at 500m, and to 32 at 1km. At this point there will be about another 500m to spare because 32 is still 4 above the loss of signal value of 28, which equates to a range factor of about 1.5 (if it had been 6db, it would have been double, so 4db is about 1.5 times).

ACCST

The default alarms for ACCESS are 35 for 'RSSI Low' and 32 for 'RSSI Critical', while for ACCST they are 45 and 42 respectively. Loss of control will happen when the RSSI drops to around 28 for ACCESS and 38 for ACCST.

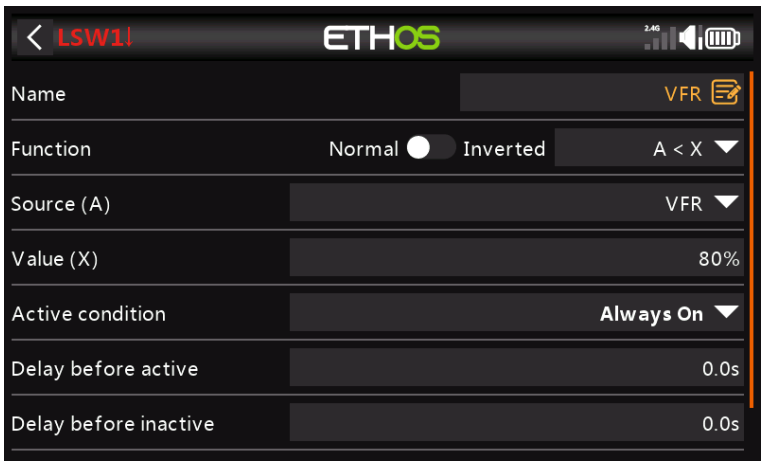
These numbers are on a dB logarithmic scale, which means that the value drops by 6 every time the distance to the receiver is doubled. Close to the transmitter the RSSI reading is close to 100. At a distance of 125m, the reading should be about 60, and drop by 6 to 54 at 250m, to 48 at 500m, and to 42 at 1km. At this point there will be about another 500m to spare because 42 is still 4 above the loss of signal value of 38, which equates to a range factor of about 1.5 (if it had been 6db, it would have been double, so 4db is about 1.5 times).

The warning for when telemetry is lost completely is announced as 'Telemetry Lost'. Be aware that further alarms will NOT sound, because the telemetry link has failed, and the radio can no longer warn you of an RSSI or any other alarm condition. In this situation it is wise to turn back to investigate the problem.

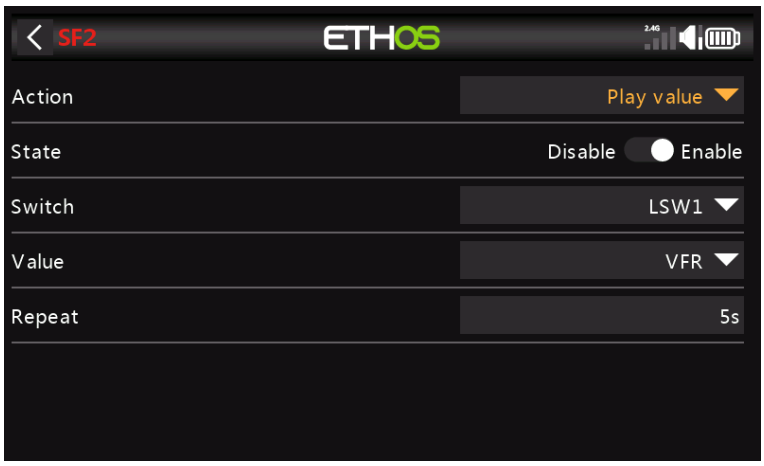
Note that when the radio and receiver are too close (less than 1m) the receiver may be swamped causing spurious alarms, resulting in an annoying "Telemetry Lost" - "Telemetry Recovered" alarm loop.

VFR%

Prior to ACCESS V2.1, RSSI was based on a combination of received signal strength and lost frame rate. Lost frames have now been removed from the RSSI calculation, and added as a new sensor VFR% (Valid Frame Rate) to provide a measure of Link Quality. At this stage there is no built in alert for VFR%, but you can easily set one up as follows:
a) Set a Logical Switch to become True when VFR drops below say 80% (please refer to the Logic Switches section):



b) Then create a Special Function to play the VFR value when the Logical Switch is True (please refer to the Special Functions section):



RxBatt

Another standard internal sensor is the receiver battery voltage.

ADC2

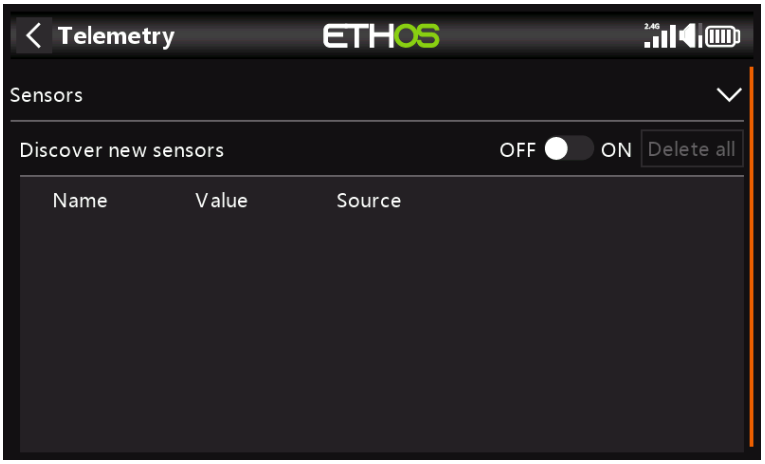
Some receivers support a second analog voltage input, which is available in telemetry as sensor ADC2.

2. 'External' Sensors

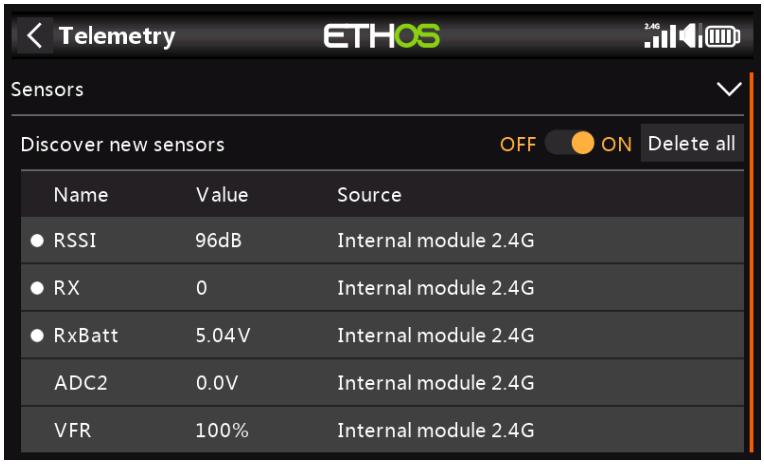
The current FrSky telemetry system makes use of FrSky Smart Port sensors. The X and S and later series of telemetry enabled receivers have the Smart Port interface. Multiple Smart Port sensors can be daisy chained together, making the system easy to implement. Most receivers also have either one or both A1/A2 analog input ports, which are useful for monitoring battery voltages, etc.

Telemetry Settings

Discover and edit sensor options including data logging. When the sensors are discovered they have an individual description for 2.4G or 900M so the sensor values can be used throughout the system. Up to 100 sensors are supported.



Sensors



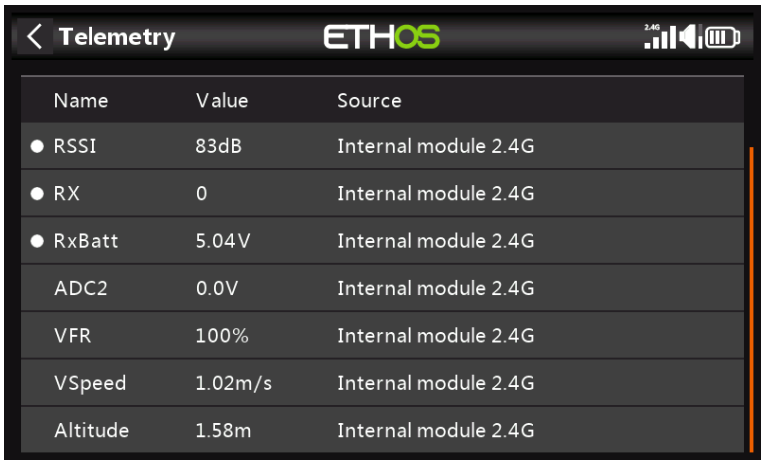
Discover new sensors:

Once the sensors have been connected, and the radio and receiver have been bound and are powered up, enable 'Discover new sensors' to discover new sensors available. A flashing dot in the left column indicates sensor data being received, or the value shows in red if no data is being received. Up to 100 sensors are supported.

During discovery the screen will be automatically populated with all the sensors found.

The above example screen shows an SR10 Pro receiver's 'internal' sensors, which are:

1. RSSI (Receiver Signal Strength Indicator) on line 1,
2. RX: There is a new ETHOS telemetry receiver source feature named RX. RX provides the receiver number of the active receiver sending telemetry. RX is available in telemetry like any other sensor for real time display, Logic Switches, Special Functions and data logging.
3. RxBatt, the receiver battery voltage measurement on line 3,
4. ADC2, the receiver analog voltage input on line 4, and
5. VFR, the Valid Frame Rate percentage on line 4.



6 VSpeed, the Vertical Speed from a FrSky High Precision Vario (FVAS-02H) on line 6, and
7 Altitude, and Altitude from the same sensor.

Note that the minimum and maximum values are also defined for each parameter, even though they are not displayed on the sensor list. For example, when Altitude is defined, Altitude- and Altitude+ for the minimum and maximum altitude also become available.

Sensor discovery must be done for every model.

Stop Discovery:

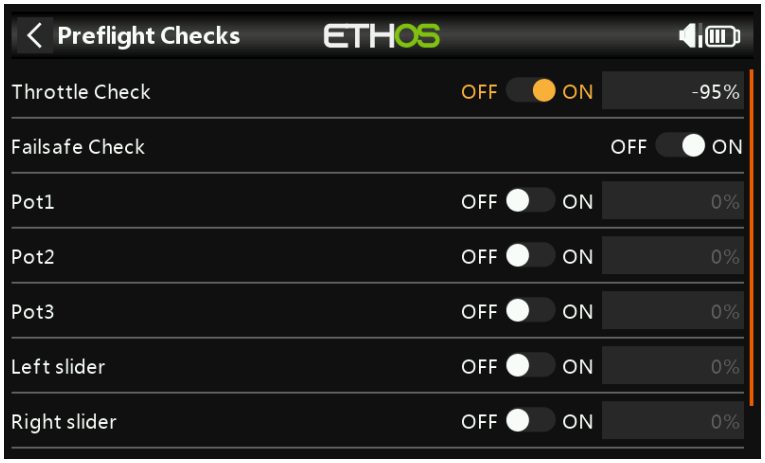
Move the 'Discover new sensors' switch to Off to stop discovery once the sensors have been discovered.

Delete all sensors:

This option will delete all sensors so you can start again.

Checklist

The Checklist function provides for a set of Preflight Checks. This is a group of safety features that take effect when powering up the radio and/or loading a model from the model list.



Throttle State

When enabled, it will warn you if the throttle stick is above the value set in it's parameter.

Failsafe Check

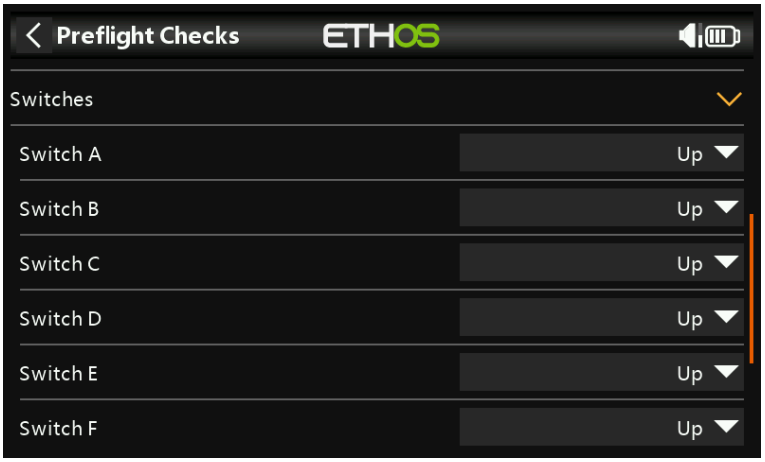
When enabled, it will warn you if Failsafe has not been set for the current model. It is highly advisable to leave this enabled!

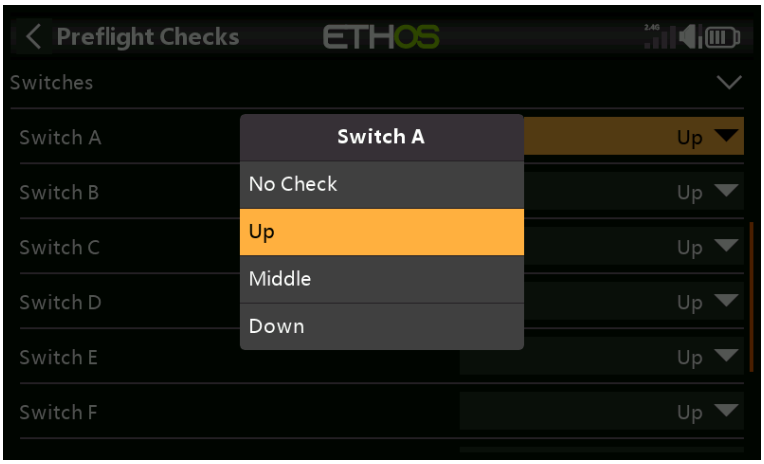
Pot1/2/3

Defines whether the radio requests the pots to be in predefined positions at startup. The desired pot values can be entered for each pot.

Left/Right Slider

The same applies for the slider controls.

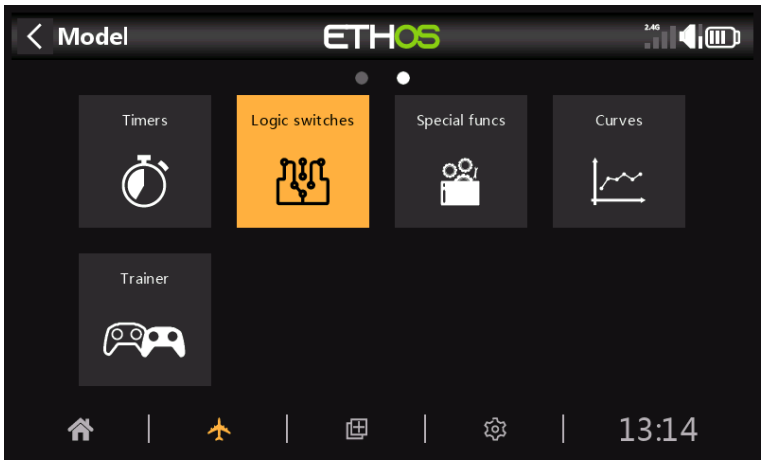




Switches

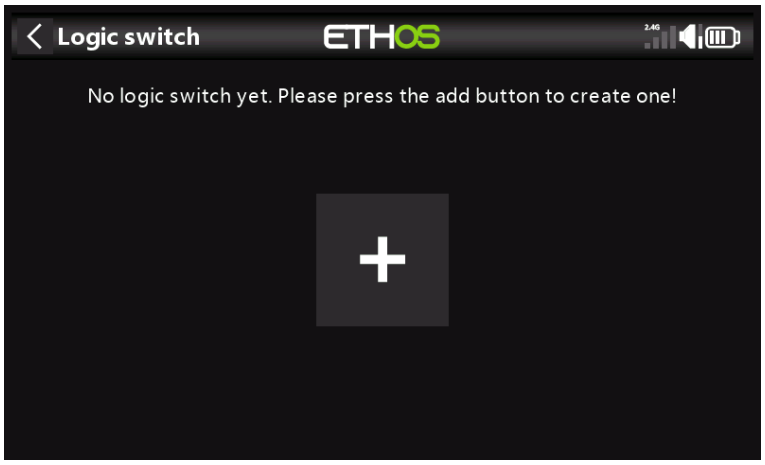
For each switch, you can define whether the radio requests that switches to be in the desired predefined positions. The options are shown above.

Logic Switches

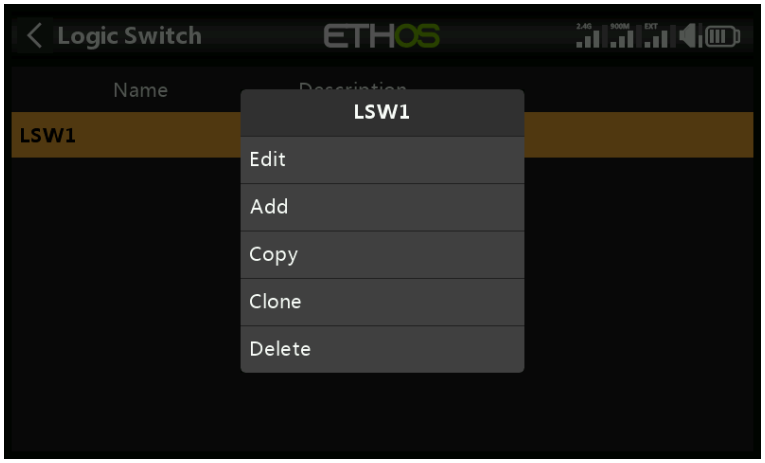


Logical switches are user programmed virtual switches. They aren't physical switches that you flip from one position to another, however they can be used as program triggers in the same way as any physical switch. They are turned on and off (in logical terms they become True or False) by evaluating the input conditions against the programming for the logical switch. They may use a variety of inputs such as physical controls and switches, other logical switches, and other sources such as telemetry values, mixer values, timer values, gyro and trainer channels. They can even use values returned by a LUA model script.

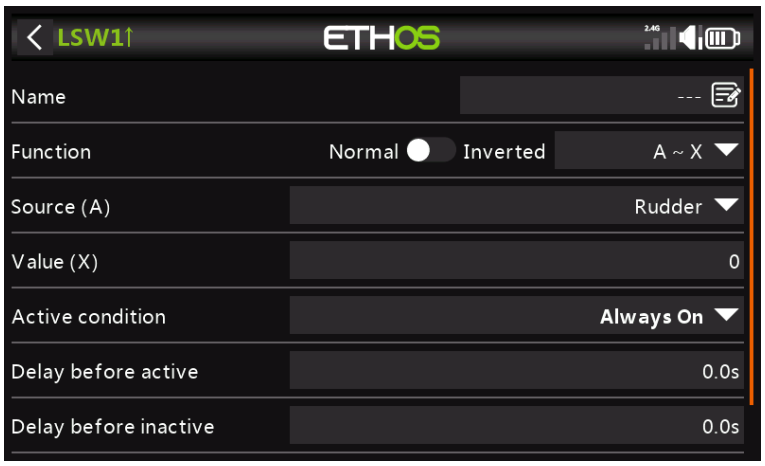
Up to 100 Logic Switches are supported.



There are no default Logic Switches. Tap on the '+' button to add a Logic Switch.



Once Logic Switches have been defined, tapping on one will bring up the above popup menu, allowing you to edit, add, copy/paste, clone or delete that switch.



Name

Allows the Logic Switch to be named.

Function

The functions available are listed below. Please note that all functions may have normal or inverted outputs. Please also refer to the shared parameters section following the function descriptions below.

A ~ X

The condition is True if the value of the selected source 'A' is approximately equal (within about 10%) to 'X', a user defined value.

In most cases, it is better to use the approximately equals function rather than the 'exactly' equals function.

A = X

The condition is True if the value of the selected source 'A' is 'exactly' equal to 'X', a user defined value.

Care must be taken when using the 'exactly' equals function. For example, when testing if a voltage is equal to a setting of 8.4V, the actual telemetry reading may jump from 8.5V to 8.35V, so the condition is never met and the Logical Switch will never turn on.

A > X

The condition is True if the value of the selected source 'A' is greater than 'X', a user defined value.

A < X

The condition is True if the value of the selected source 'A' is less than 'X', a user defined value.

|A| > X

The condition is True if the absolute value of the selected source 'A' is greater than 'X', a user defined value. (Absolute means disregarding whether 'A' is positive or negative, and just using the value.)

|A| < X

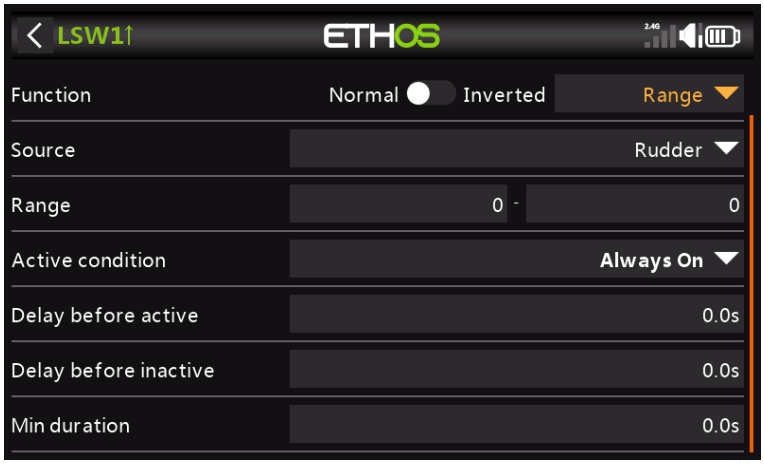
The condition is True if the absolute value of the selected source 'A' is less than 'X', a user defined value. (Absolute means disregarding whether 'A' is positive or negative, and just using the value.)

Δ > X

The condition is True if the change in value 'd' (i.e. delta) of the selected source 'A' is greater than or equal to 'X', a user defined value.

|Δ| > X

The condition is True if the absolute value of the change '|d|' in the selected source 'A' is greater than or equal to 'X', a user defined value. (Absolute means disregarding whether 'A' is positive or negative.)

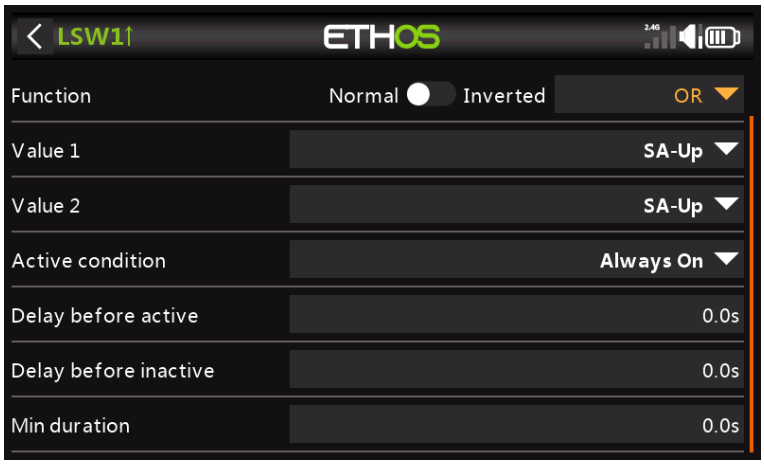


Range

The condition is True if the value of the selected source 'A' is within the range specified.

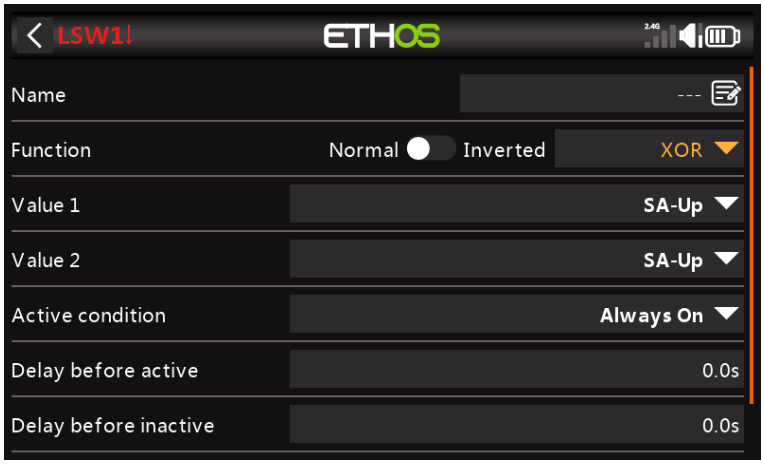
AND

The condition is True if both the sources selected in Value 1 and Value 2 are true (i.e. ON).



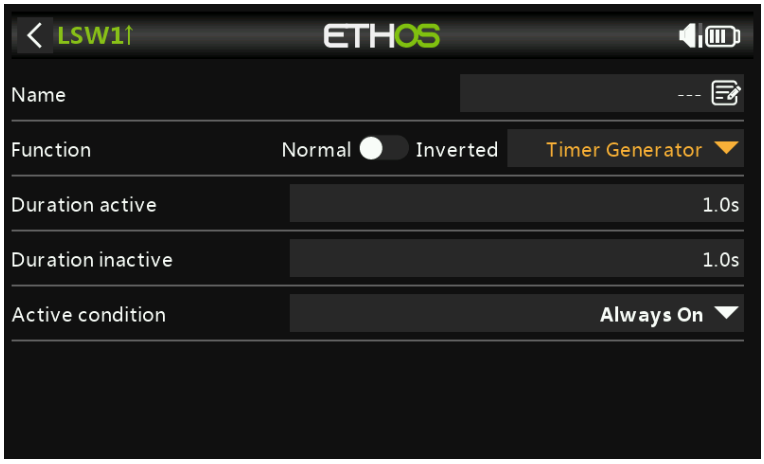
OR

The condition is True if either of the sources selected in Value 1 and Value 2 is true (i.e. ON).



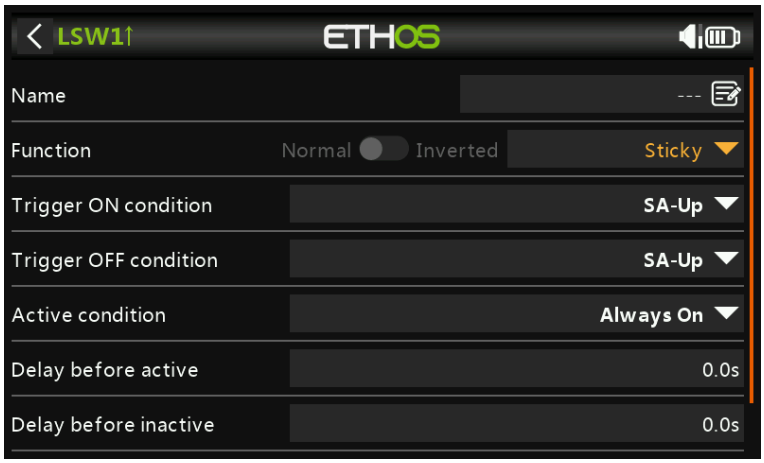
XOR (Exclusive OR)

The condition is True if either the Value 1 source or the Value 2 source is true (i.e. ON) but not both.



Timer Generator

The Logical Switch toggles on and off continuously. It switches on for time 'Duration Active', and off for time 'Duration Inactive'.



Sticky

The Sticky function is latched on (i.e becomes True) when the'Trigger ON condition' switches from False to True, and holds its value until it is forced to False when the 'Trigger OFF condition' switches from False to True. This can be gated by the optional 'Active Condition' parameter. This means that if the 'Active Condition' is True, then the Logical Switch output follows the Sticky function's condition. However, if the 'Active Condition' is False, then the Logical Switch output is also held False.
Note that the Sticky function continues to operate, even if its output is gated by the 'Active Condition' switch. As soon as the 'Active Condition' switch condition becomes True again, the Sticky function's condition is switched through to the Logic Switch output.

Edge

Active Condition

Edge is a momentary switch that becomes True for a moment when triggered by its first 'Active Condition' source.

During

During: is in two parts [t1:t2]; t1 is the Minimum and t2 the Maximum duration for the 'Active Condition'. The logical switch becomes True only after the trigger 'Active Condition' has been True for at least t1 AND is released before t2.

Logic Switches – Shared Parameters

The Logic Switches all have a number of shared parameters:

Active Condition

The Logic Switches can be gated by the optional 'Active Condition' parameter. This means that if the 'Active Condition' is True, then the Logical Switch output follows the Function's condition. However, if the 'Active Condition' is False, then the Logical Switch output is also held False.
Note that the Sticky function continues to operate, even if its output is gated by the 'Active Condition' switch. As soon as the 'Active Condition' switch condition becomes True again, the Function's condition is switched through to the Logic Switch output.

Delay before active

This value determines the time for which the Logic Switch conditions have to be True before the Logic Switch output becomes True.

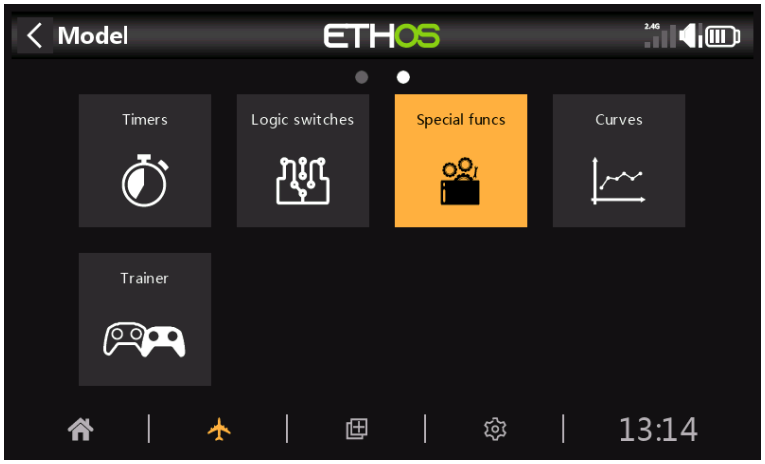
Delay before inactive

Similarly, this value determines the time for which the Logic Switch conditions have to be False before the Logic Switch output becomes False.

Min Duration

Once the Logic Switch becomes True, it will remain True for the duration specified.

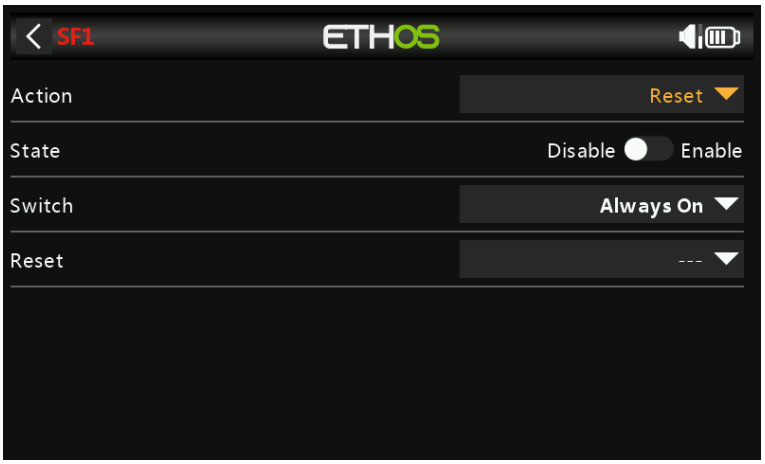
Special Functions



Special Functions can be configured to play values, play sounds, etc. Up to 100 Special Functions supported.

Currently the following Special Functions are supported:

- Reset
- Screenshot
- Set failsafe
- Play track
- Play value
- Haptic
- Write logs



Action: Reset

State

Enable or disable this Special Function.

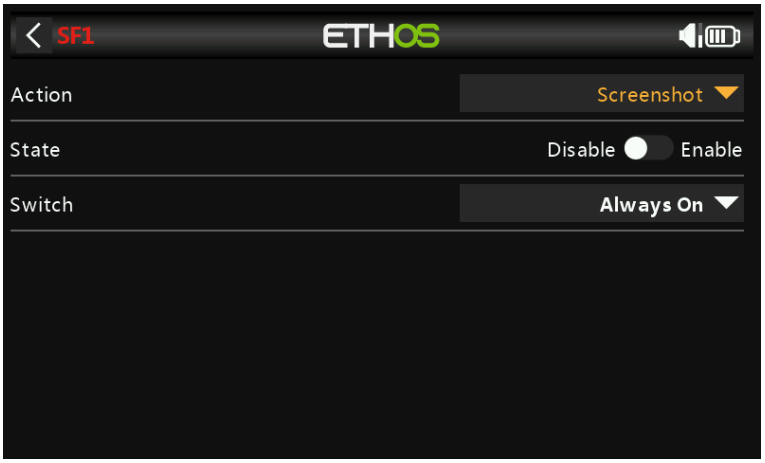
Switch

The Special Function may be Always On, or activated by switch positions, function switches, logic switches, trim positions or flight modes.

To select the inverse of for example switch SG-up, if you long press Enter on the switch name and select the Negative check box in the popup the switch value will changes to ! SG-up. This means the Special Function will be active when switch SG is not in the up position.

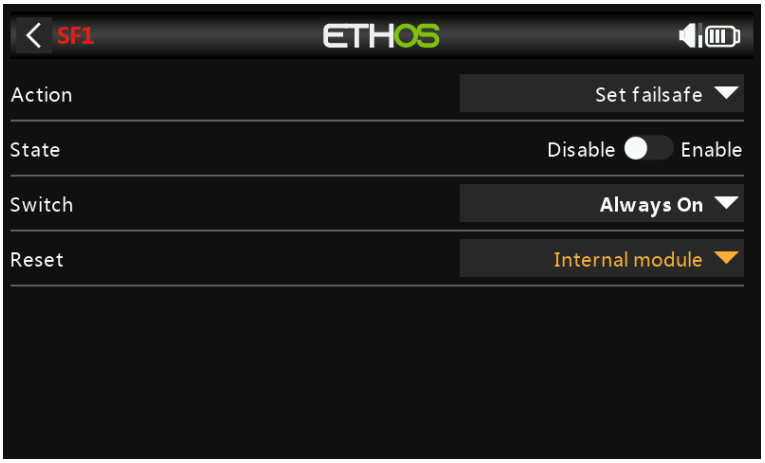
Reset

The following categories may be reset:
- Flight data: resets both telemetry and timers
- All timers: resets all 3 timers
- Whole telemetry: resets all telemetry values.



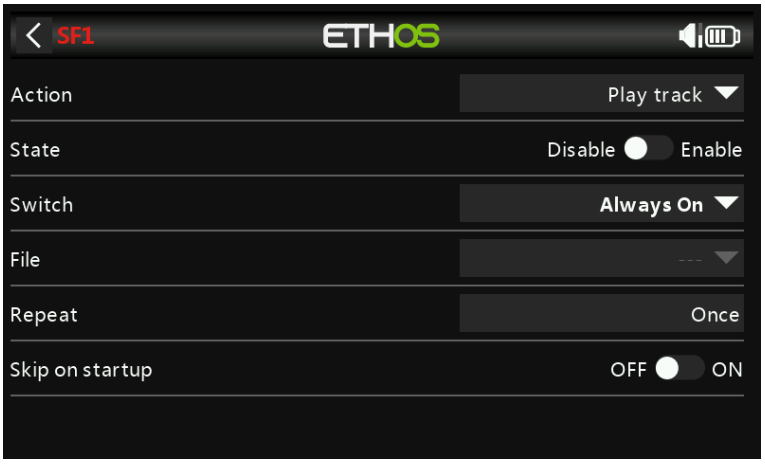
Action: Screenshot

Will save a screenshot into the location:
SD Card (drive letter)/screenshots/



Action: Set failsafe

At the time of writing, this Special Function is still under construction.



Action: Play track

State

Enable or disable this Special Function.

Switch

The Special Function may be Always On, or activated by switch positions, function switches, logic switches, trim positions or flight modes.

File

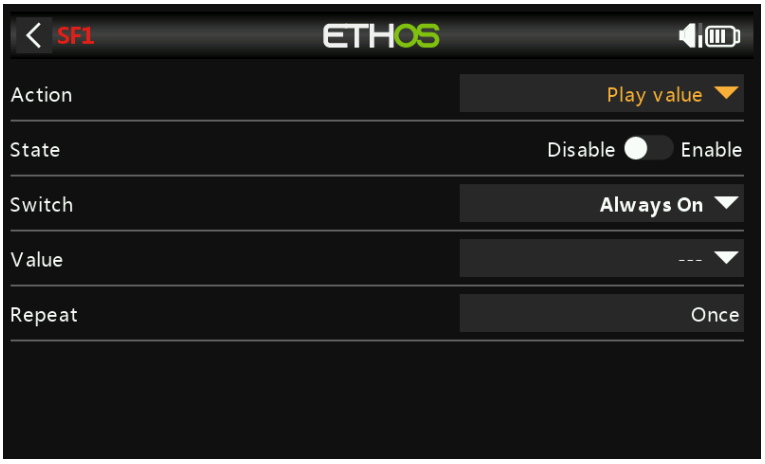
Select the wav file to be played. The file should be located in:
SD Card (drive letter)/audio/

Repeat

The value may be played once, or repeated at the frequency entered here.

Skip on startup

If enabled, the file will not be played on startup.



Action: Play value

State

Enable or disable this Special Function.

Switch

The Special Function may be Always On, or activated by switch positions, function switches, logic switches, trim positions or flight modes.

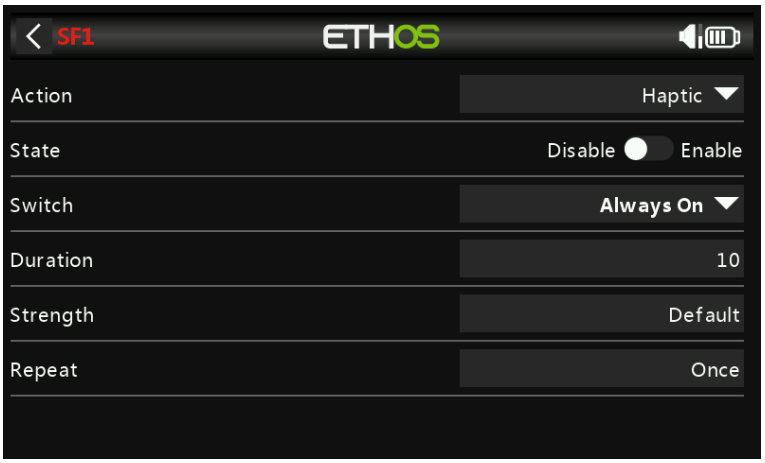
Value

Select the source whose value is to be played. The source may be from any of the following:

- Analogs, i.e. sticks, pots or sliders
- Switches
- Logic Switches
- Trims
- Channels
- Gyro
- Trainer
- Timers
- Telemetry

Repeat

The value may be played once, or repeated at the frequency entered here.



Action: Haptic

This Special Function assigns haptic vibration

State

Enable or disable this Special Function.

Switch

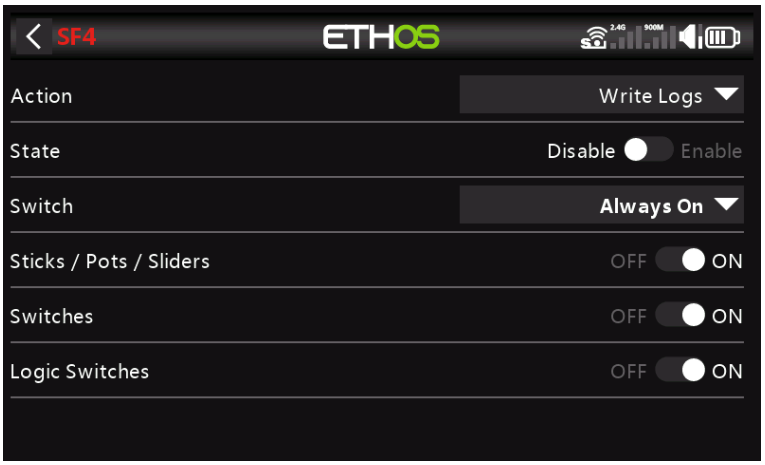
The Special Function may be Always On, or activated by switch positions, function switches, logic switches, trim positions or flight modes.

Duration

Sets the duration in seconds.

Strength

Select the strength of the haptic vibration, between 1 and 10. The default is 5.



Action: Write Logs

State

Enable or disable this Special Function.

Switch

The Special Function may be Always On, or activated by switch positions, function switches, logic switches, trim positions or flight modes.

Sticks/Pots/Sliders

Enables logging of Sticks/Pots/Sliders.

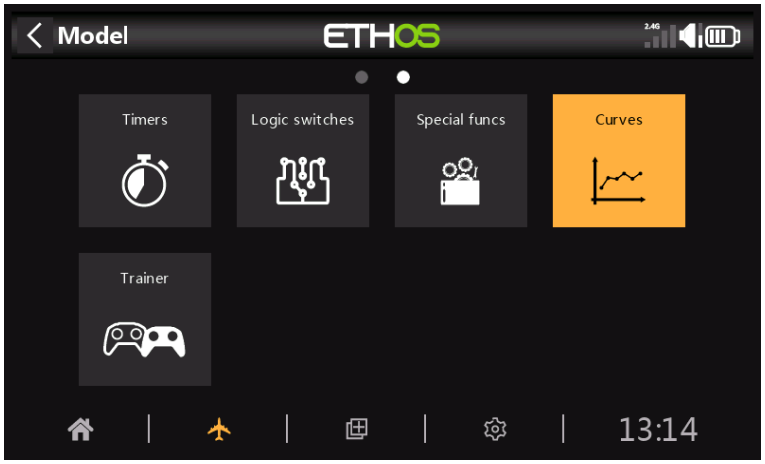
Switches

Enables logging of Switches.

Logic Switches

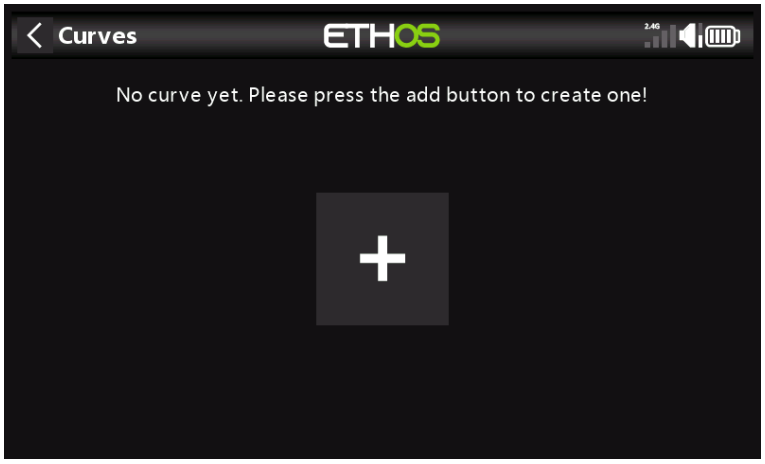
Enables logging of Logic Switches.

Curves

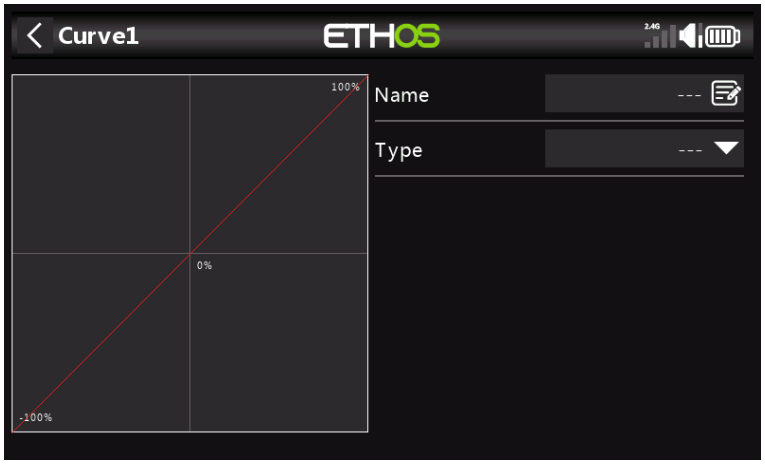


Curves may be used to modify the control response in the Mixers or Outputs. While the standard Expo curve is available directly in those sections, this section is used to define any custom curves that may be required. The 'Add curve' function may also be reached from the Mixer and Outputs edit screens directly.

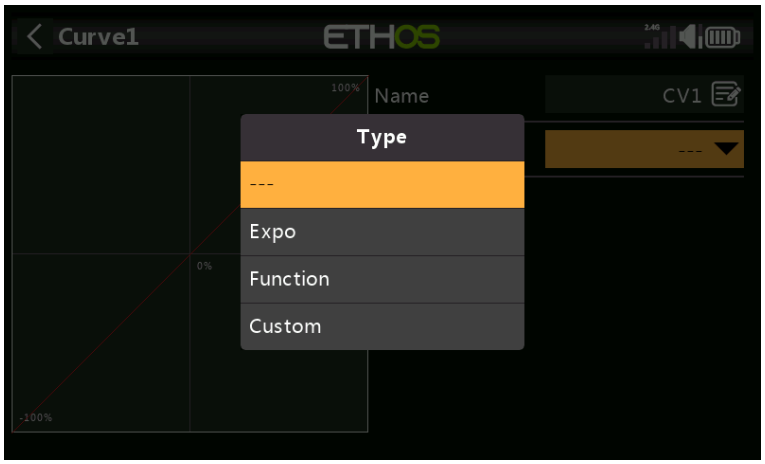
There are 100 curves available.



There are no default curves (except Expo which is built in). Tap on the '+' button to add a new curve.



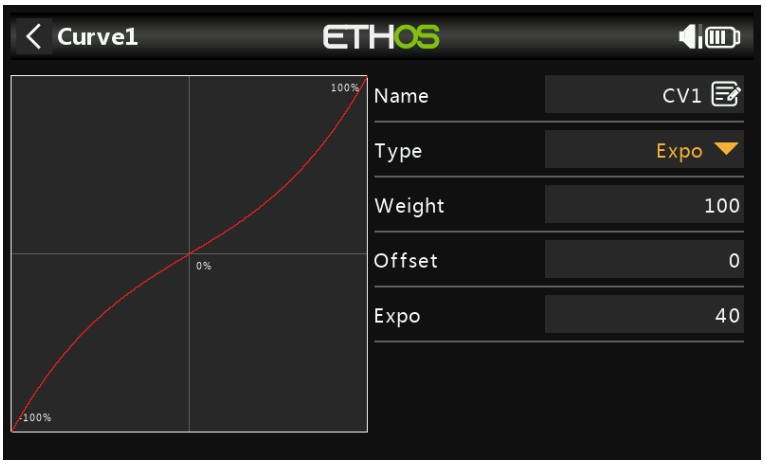
The initial screen allows you to name your curve, and to select the curve type.



The available curve types are:

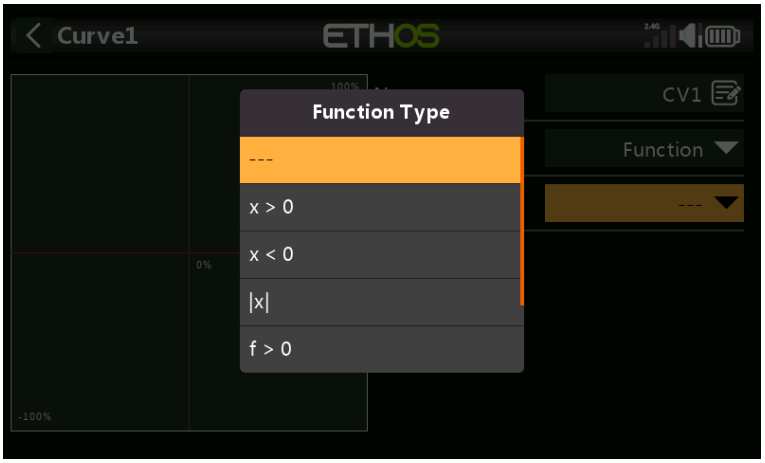
Expo

The default exponential curve has value of 40.

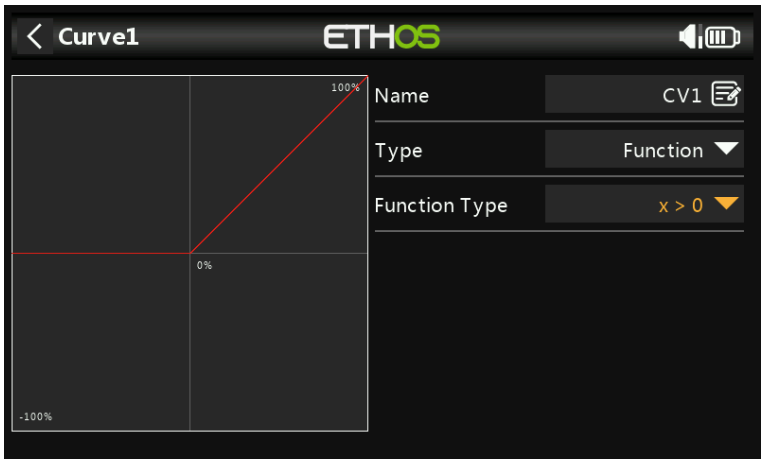


A positive value will soften the response around 0, while a negative value will sharpen the response around 0. Softening the response around mid stick helps to avoid over controlling the model, especially for beginners.

Function

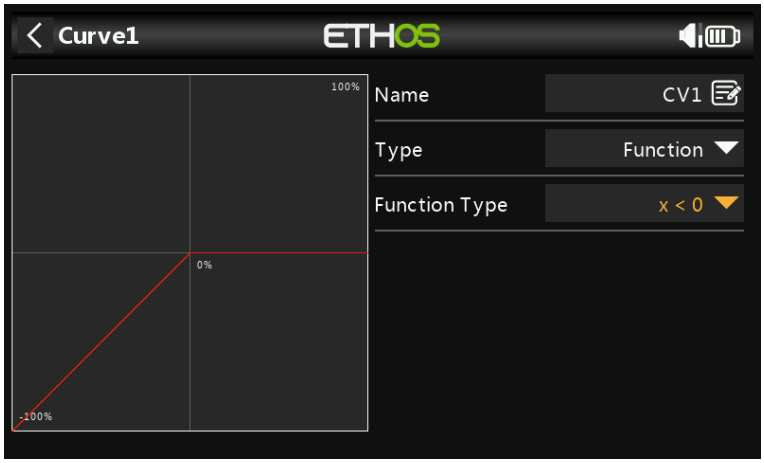


The following mathematical function curves are available:



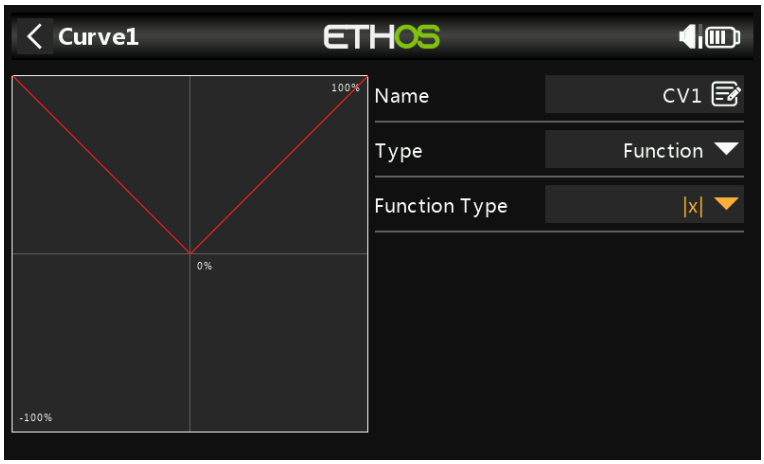
x > 0

If the source value is positive, then the curve output follows the source.
If the source value is negative, then the curve output is 0.



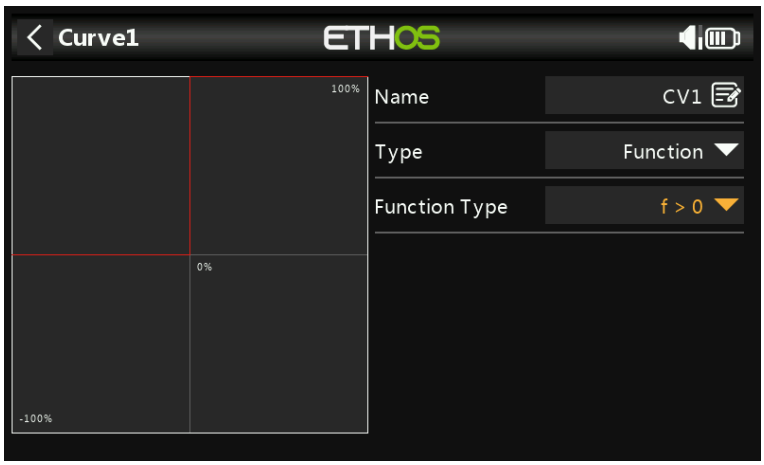
x < 0

If the source value is negative, then the curve output follows the source.
If the source value is positive, then the curve output is 0.



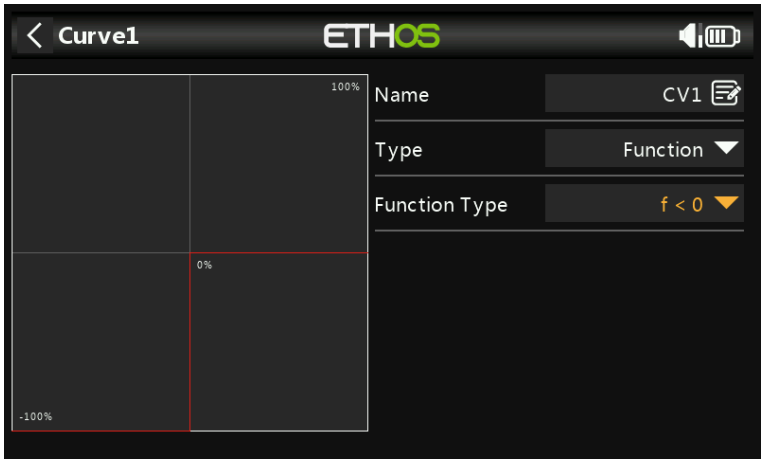
|x|

The curve output follows the source, but is always positive (also called 'absolute value').



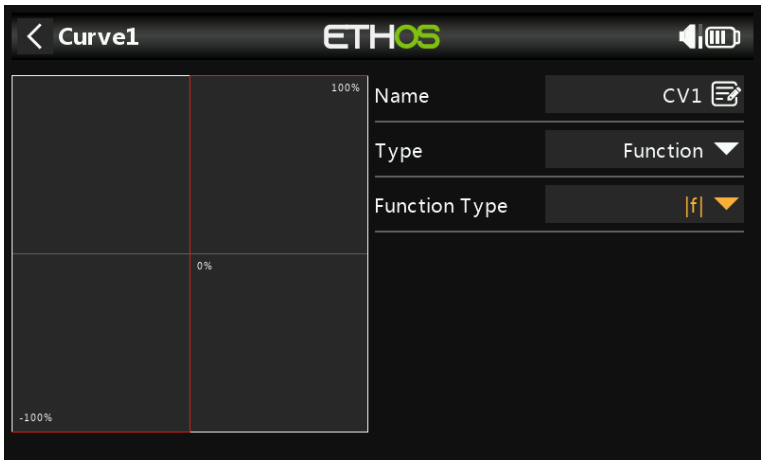
f > 0

If the source value is negative, then the curve output is 0.
If the source value is positive, then the curve output is 100%.



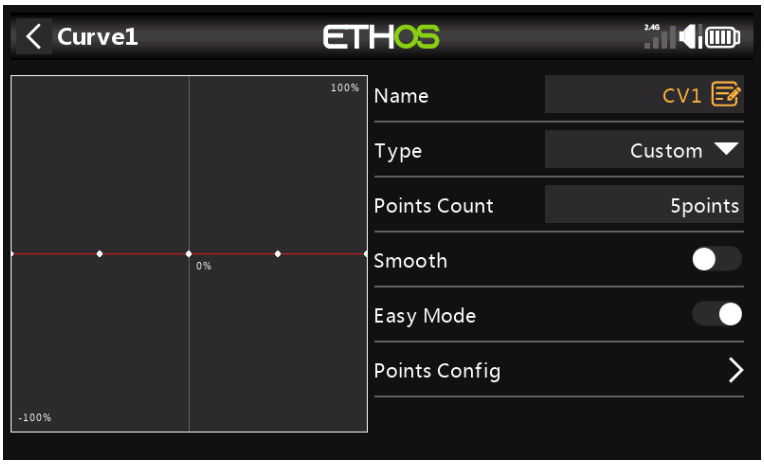
f < 0

If the source value is negative, then the curve output is -100%.
If the source value is positive, then the curve output is 0.



If the source value is negative, then the curve output is -100%.
If the source value is positive, then the curve output is +100%.

Custom

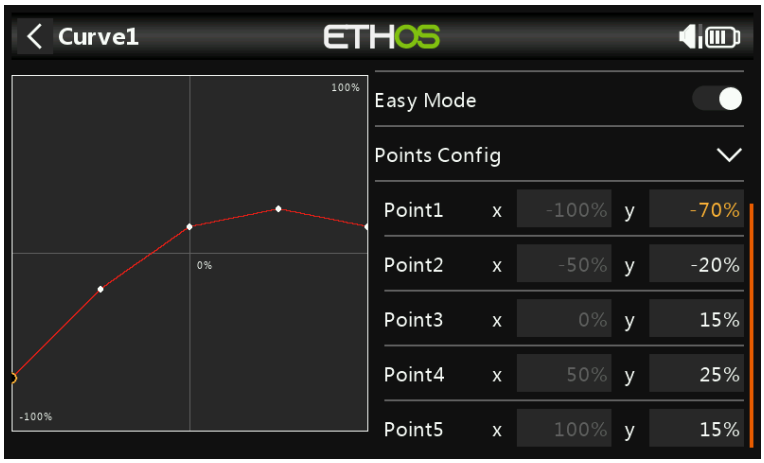


Points Count

The default custom curve has 5 points. You may have up to 21 points on your curve.

Smooth

If enabled a smooth curve is created through all points.

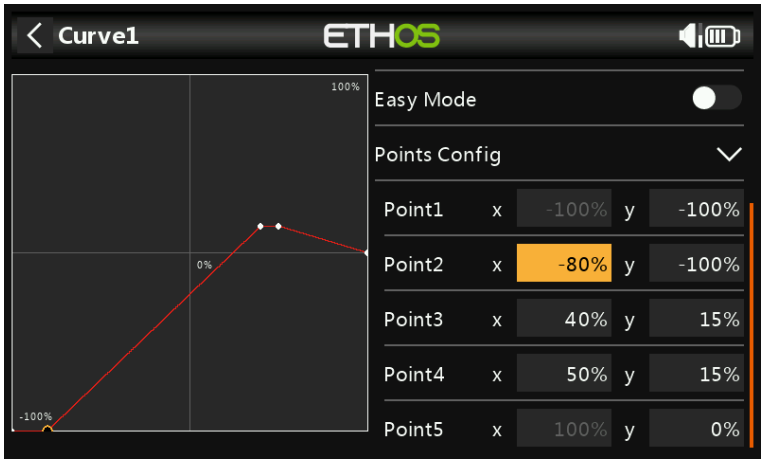


Easy Mode = On

Easy mode has equidistant fixed values on the X axis, and only allows the Y coordinates for the curve to be programmed.

Points Config

With Easy Mode On, the Y coordinates may be configured (see example above).



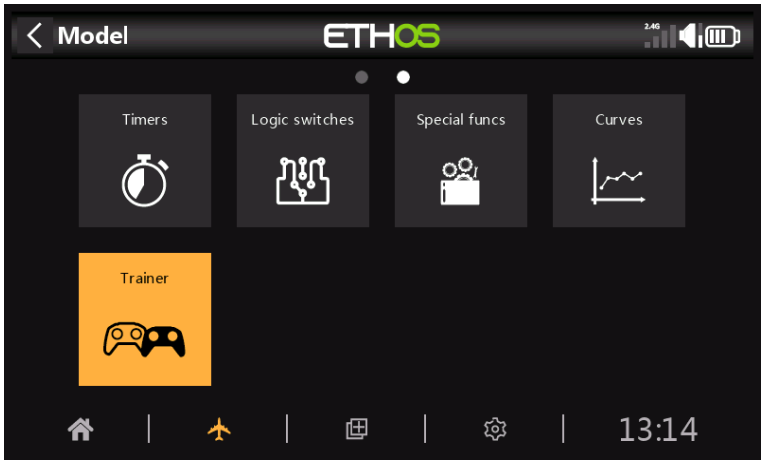
Easy Mode = Off

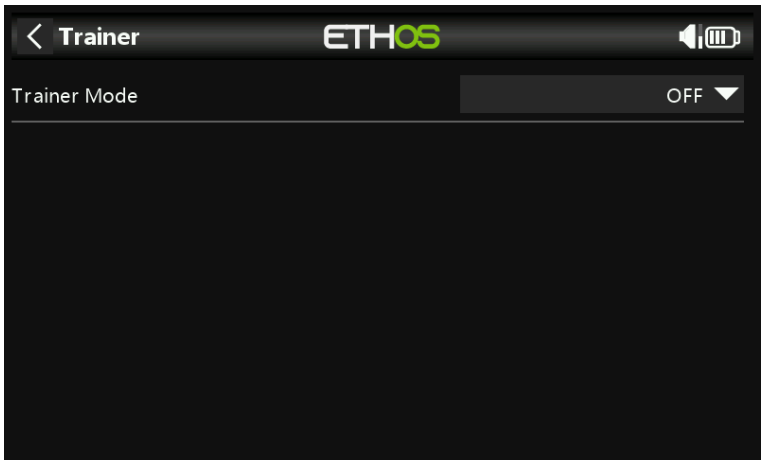
Easy mode has equidistant fixed values on the X axis, and only allows the Y coordinates for the curve to be programmed.

Points Config

With Easy Mode Off, both the X and Y coordinates may be configured, (see example above). Note that the -100% and +100% X coordinates for the curve end-points cannot be edited, because the curve must cover the full signal range.

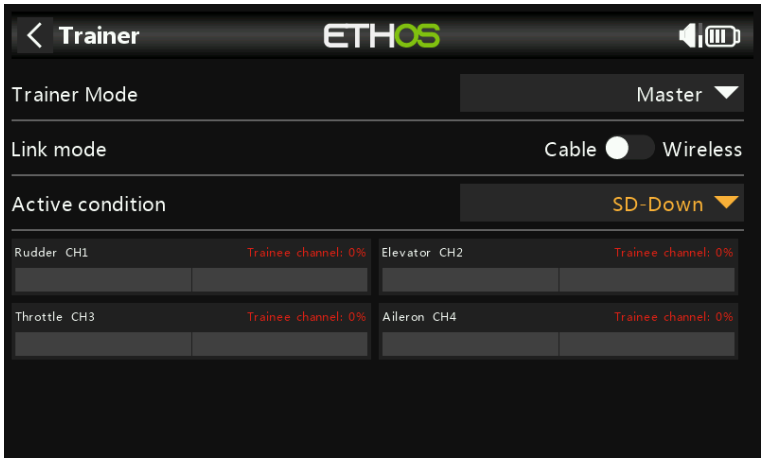
Trainer





The Trainer function is off by default.

Trainer Mode = Master



Link Mode

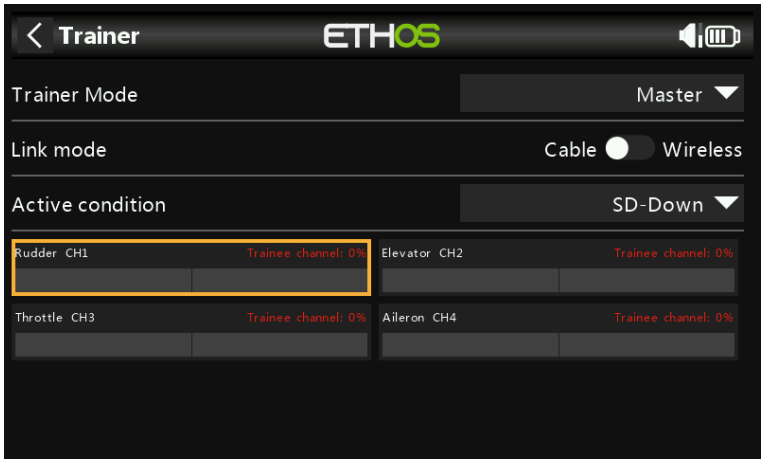
The trainer link can be either via cable or wireless (BT). At the time of writing, the wireless option has not been implemented. The cable should be a 3.5mm mono audio lead.

Active Condition

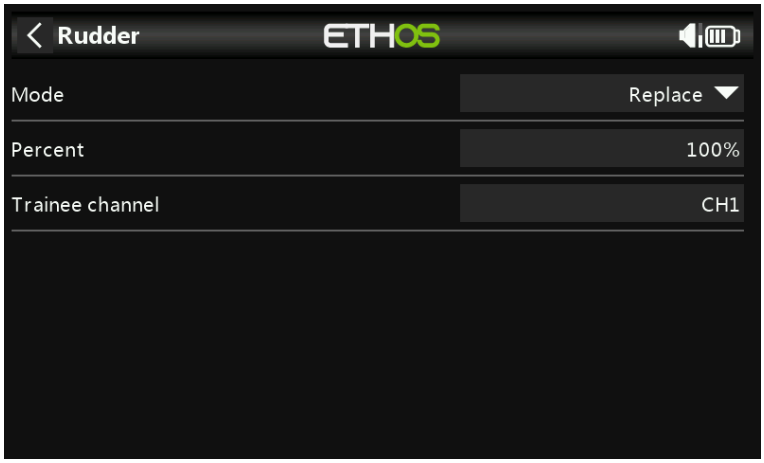
Control of the model can be transferred to the student radio by a switch or button, a function switch, logic switch, trim position, or flight mode.

Trainer Channels

The 4 main controls are transferred from the student radio to the master radio when the 'Active Condition' set above is active.



Tap on each channel to configure it individually:



Mode

OFF: disables the channel for trainer use.

Add: selects additive mode, where both master and slave signals are added so both teacher and student can act upon the function.

Replace: replaces the master radio's control with the student's, so the student has full control while the 'Active Condition' is active. This is the normal mode of use.

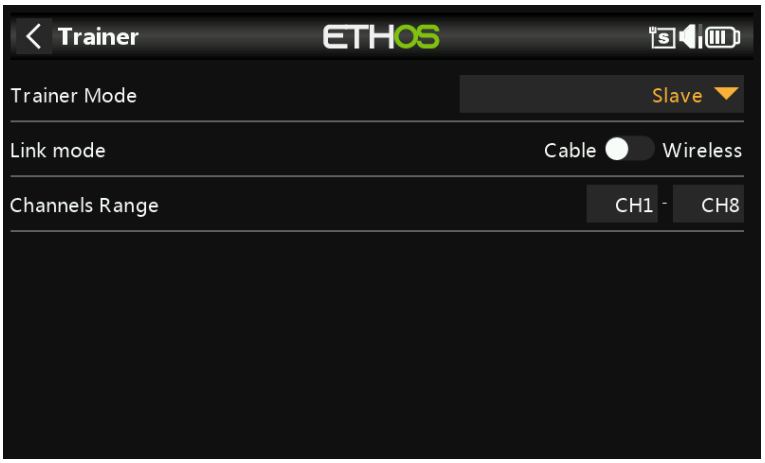
Percent

Normally set to 100%, but can be used to scale the Slave input.

Trainee Channel

Maps the slave radio's channel to the corresponding function.

Trainer Mode = Slave



Link Mode

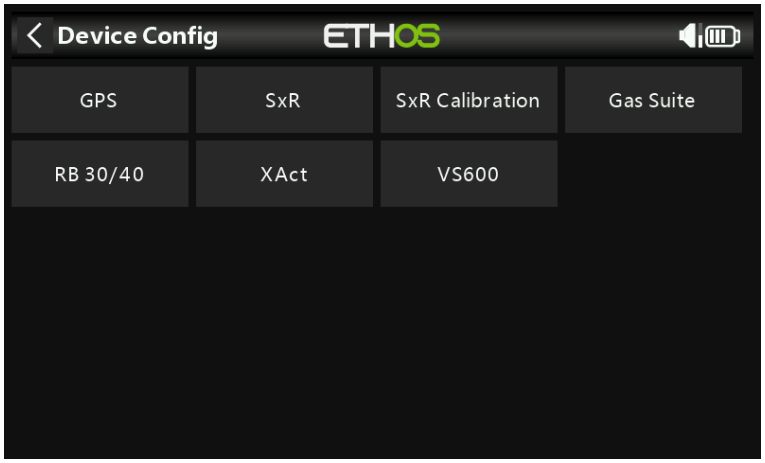
The trainer link can be either via cable or wireless (BT). At the time of writing, the wireless option has not been implemented. The cable should be a 3.5mm mono audio lead.

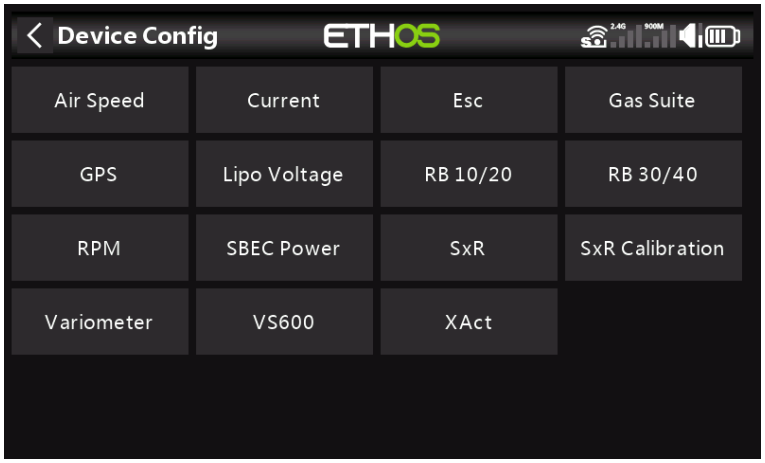
Channels Range

Selects which channels are transferred to the master radio.

Device Config

Device Config contains tools for configuring devices like sensors, receivers, the gas suite, servos and video transmitters.





The following devices are currently supported:

- Airspeed
- Current
- Esc
- Gas Suite
- GPS
- Lipo Voltage
- RB 10/20
- RB 30/40
- RPM
- SBEC Power
- SXR
- SxR Calibration
- Variometer
- VS600 video transmitter
- XAct servos

Please refer to the device's manual for further details.

Programming Tutorials

This section describes some programming examples for a number of models, preceded by a basic radio setup section covering the basic settings needed for any model.

- Initial radio setup example
- Basic Power Model example
- Simple 4ch Glider example
- Basic Wing example

Although these examples may appear to be for specific model types, they are merely a vehicle for explaining the Ethos way of programming. It would be useful to actually program these models on the radio, and observe the outputs on the monitor screen as the inputs are manipulated. Once these concepts and the process are understood, you should be able to adapt these examples to your model.

Initial radio setup example

This introductory section describes the initial steps in setting up the radio itself, before programming any specific models. Once completed, any of the programming examples in the following sections can be followed.

Note: These examples are not 'cookbook' in nature. They assume that the user has a basic understanding of the vocabulary of radio control models, and is familiar with navigating the Ethos menu structure. If, at any time, you are confused, please review previous sections of this manual for a refresher. In particular, please refer to the Menu Navigation section to familiarize yourself with the radio's user interface, so that you can find the setup page you need easily.

Step 1. Charge the radio and flight batteries.

Please refer to the battery charging section and charge the radio battery using those guidelines. Also charge the flight battery(ies) to be used, using a charger suitable for the battery type(s), observing all safety precautions, especially when using Lithium batteries.

Step 2. Calibrate the hardware.

Ensure that you have performed the hardware calibration during initial startup of the radio, to confirm that the radio knows exactly where the centers and limits of each gimbal, pot, and slider are. It should also be re-done whenever the firmware is upgraded. Please refer to the System \ Calibration section of this manual for instructions on doing this.

Step 3. Perform the Radio System setup.

The radio System Setup is used to configure those parts of the radio system’s hardware that are common to all models. It differs from the 'Model Setup' functions which configure the model specific settings for each model.

Please read the System Setup section to familiarize yourself with all the settings in this section.

Many settings can (at least initially) be left at their defaults, but the following should be reviewed:

Date & Time

Set the current time and date.

Sticks

Sticks Mode

Select your preferred stick mode. Mode 1 has throttle and aileron on the right stick, and elevator and rudder on the left. Mode 2 has throttle and rudder on the left stick, and aileron and elevator on the right.
Note: Mode 2 is the default.
Warning: If you upgrade the firmware, check that the Sticks Mode is as expected! If you fly a different mode to Mode 2, previous model profiles do not work as expected. This is the first setting to check! CAUTION! If a model is configured for Mode 2 and the TX for Mode 1, it is possible to have the motor for electric models start when the receiver is turned on.

Channel Order

The default channel order for Ethos is AETR (i.e. Aileron, Elevator, Throttle, Rudder). You may prefer to set the default channel order to the order you are accustomed to. TAER is the default for Spektrum/JR, and AETR is the default for Futaba/Hitec. This setting defines the order in which the four stick inputs are inserted when a new model is created. They can of course be changed later.

Note that AETR is the required order if you want to use any of the FrSky stabilized receivers.

Battery

Review your radio battery's specification and configure the 'Main voltage', 'Low voltage' and 'Display voltage range' as described in the System / Battery section of this manual.

Owner Registration ID

The Owner Registration ID is used with ACCESS systems. This ID becomes the Registration ID when registering a receiver. Enter the same code in the Owner Registration ID field of your other transmitters you want to use the Smart Share feature with. Refer to the Model Setup / RF System section of this manual (although it is configured in the Model Setup section, the Owner Registration ID will be used for each new model and can be considered a System setting. Please note also that the Owner Registration ID can be changed for a particular receiver during the registration process).

Units

Please note that in Ethos telemetry units are configured on a per sensor basis. There is no global Metric or Imperial setting.

Basic Fixed Wing Airplane example

This simple fixed wing airplane example covers the configuration of a model having a motor, 2 ailerons (and optionally retracts and 2 flaps) and has a servo for each surface.

Step 1. Confirm System settings

Begin by following the 'Initial radio setup example' above, which is used to configure those parts of the radio system's hardware that are common to all models. For this example we are using the default AETR (Aileron, Elevator, Throttle, Rudder) channel order.

Use the RF System function to register (if your receiver is ACCESS) and bind your receiver in preparation for configuring the model.

Step 2. Identify the servos/channels required

The Mixer function forms the heart of the radio. It allows any of the many sources of input to be combined as desired and mapped to any of the output channels. Ethos has 100 mixer channels available for programming your model. Normally the lowest numbered channels will be assigned to the servos, because the channel numbers map directly to the channels in the receiver. The X20 Internal RF (Radio Frequency) module has up to 24 output channels available.

The upper mixer channels can be used as 'virtual channels' in more advanced programming, or as real channels using multiple RF modules (Internal + External) and SBus. The channel order is a matter of personal preference or convention, or it may be dictated by the receiver. We will use AETR for our example.

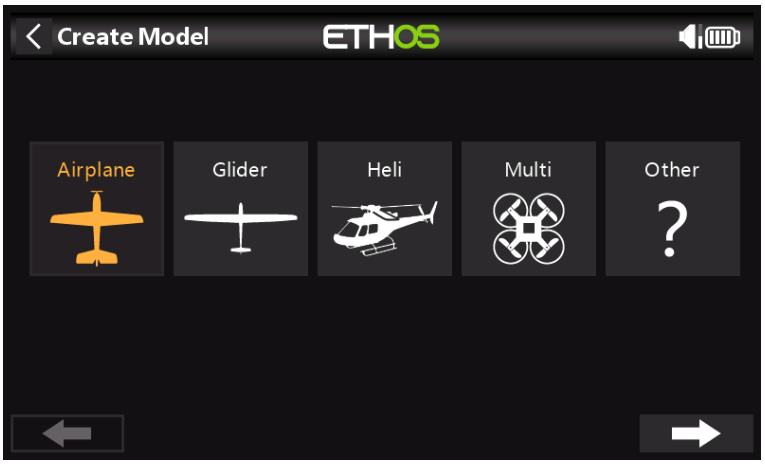
Our airplane example has the following servos/channels:
1 motor
2 ailerons
2 flaps
1 Elevator
1 Rudder

We will also add retracts later.

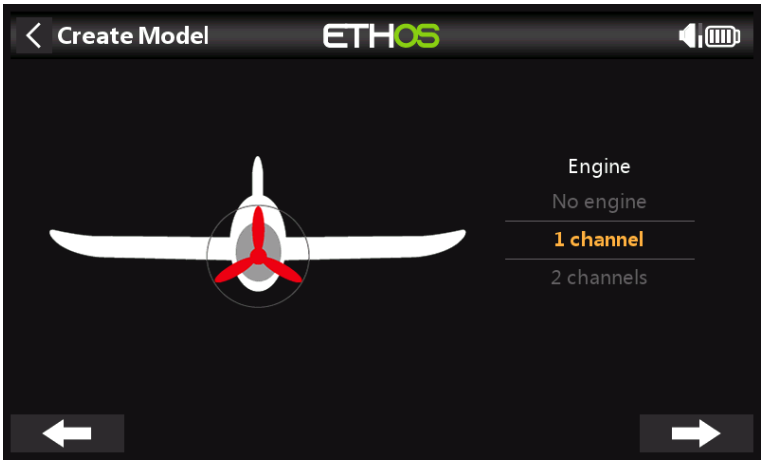
Step 3. Create a new model.

Refer to the System Setup / Model Select section to create your new model. Also refer to the Menu Navigation section to familiarize yourself with the radio's user interface, so that you can find the functions you need easily.

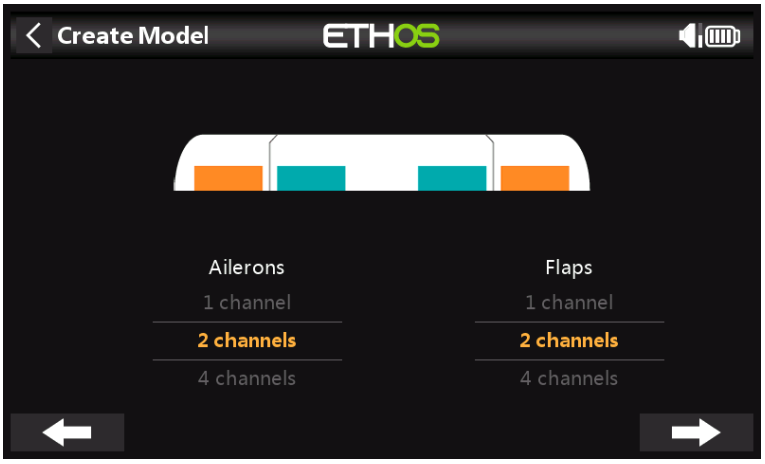
Tap on the System tab (Gear Icon), and select the Model Select function. Then tap on the '+' symbol, which will present you with a choice of model creation wizards, i.e. Airplane, Glider, Heli, Multirotor or Other. The wizard takes your selections and creates the Mixer lines needed to implement the functionality required.



For our example, tap on the Airplane icon to start the model creation wizard.

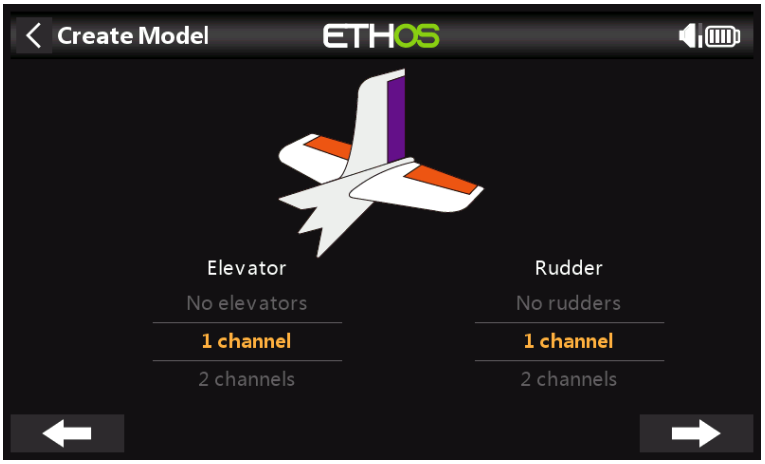


Accept the default of 1 channel for the motor.

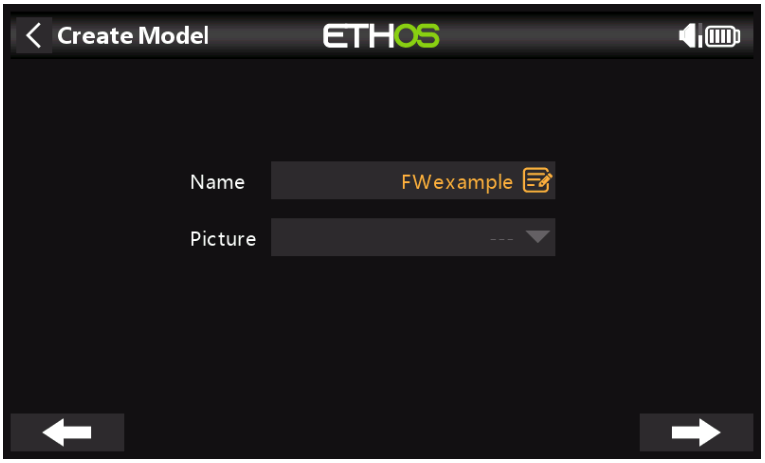


Accept the default 2 channels for Ailerons, and select 2 channels for Flaps.

Accept the default Traditional Tail (which has Elevator and Rudder).



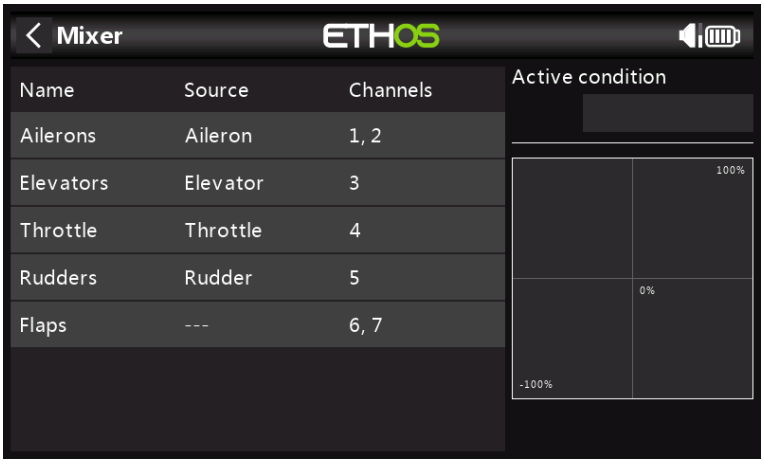
Accept the default 1 channel for Elevator and 1 channel for Rudder.



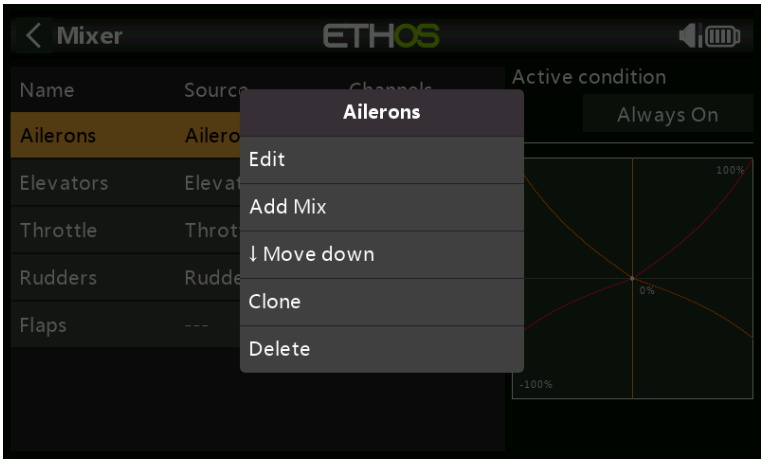
We will name the model 'FWexample', and follow the wizard to the end which results in the 'FWexample' model being created in the Airplane group. It will also be made the active model, so we can continue to configure its features.

Step 4. Review and configure the mixes

Tap on the Mixer icon to review the mixes created by the Airplane wizard.

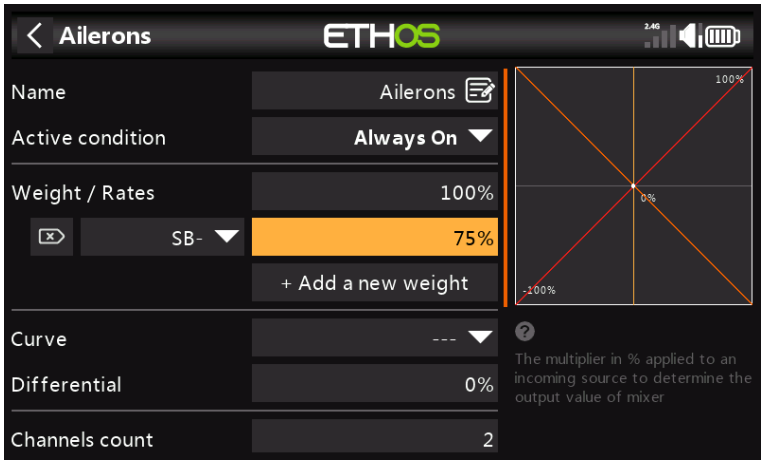


The wizard has created two Ailerons on channels 1 and 2, followed by the Elevator, Throttle, Rudder and Flaps channels.



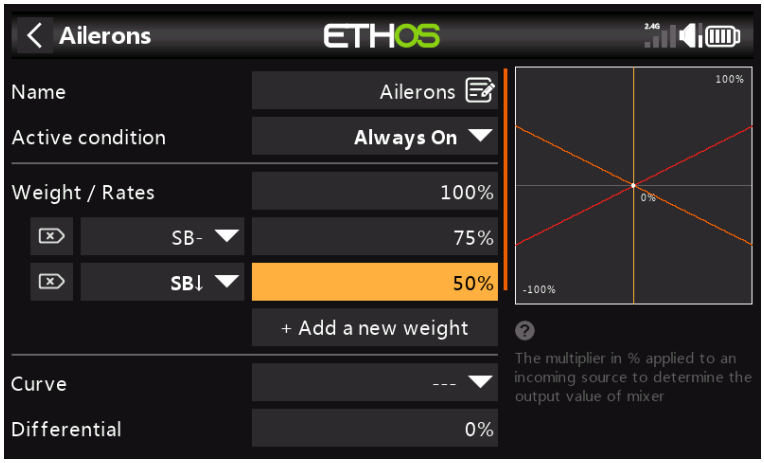
Ailerons

To review the Aileron mix, tap on the Ailerons line and select Edit from the popup menu.

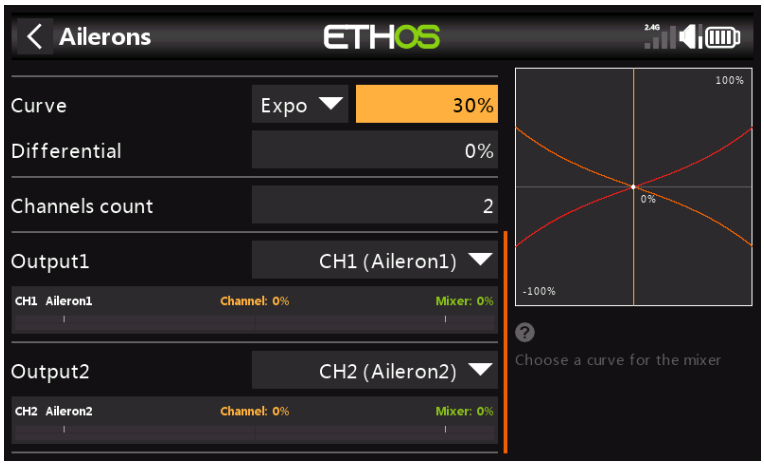


Weight/Rates

It is a good idea to set up Rates on your model, especially if you have not flown it before. Rates set the ratio of the stick movement to channel movement. For example, for sport flying you normally want fairly modest throws on the control surfaces, so you may want to reduce the travel to say 50%. On the other hand, for 3D flying you want as much travel as you can get, i.e. 100%. In the screenshot above a Rate of 75% has been set for switch SB in the mid position. The vertical axis in the graph on the right shows that only 75% of throw is available.

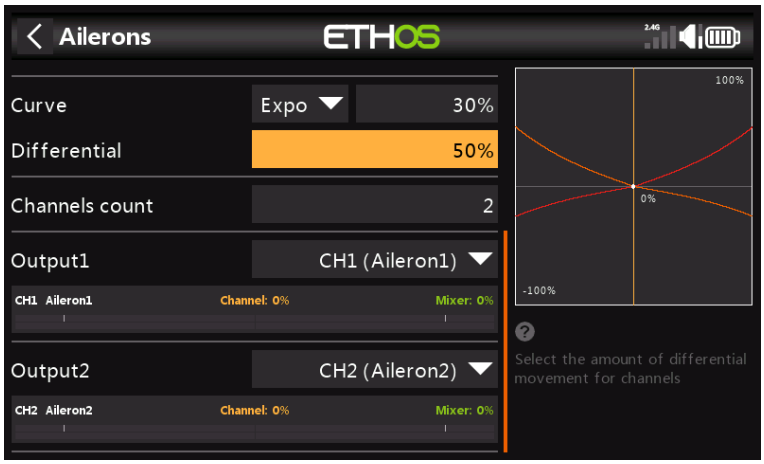


Click on 'Add a new weight', and set up a 50% Rate for switch SB in the down position. The vertical axis in the graph on the right now shows that only 50% of throw is available in this switch position.

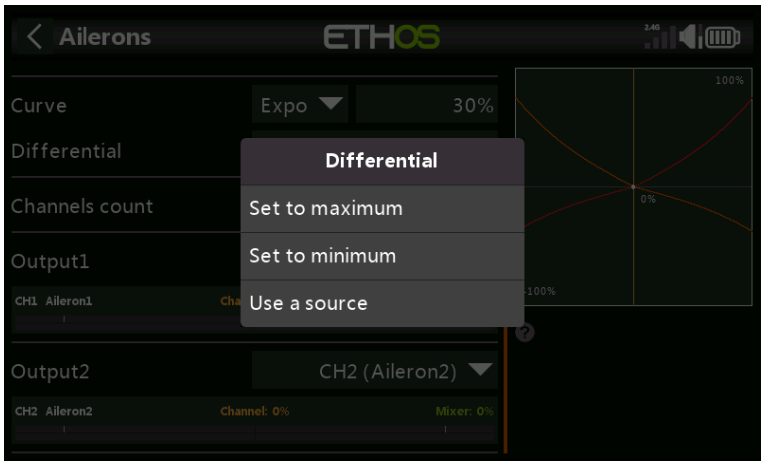


Expo

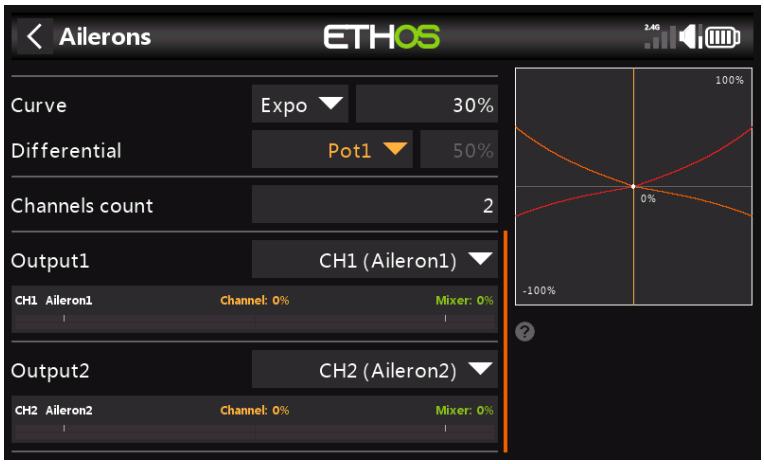
In the Rates examples above you can see that the output response is linear. To avoid the response being too twitchy at the stick centers, you can use an Expo curve to reduce the control surface movement at center stick and to increase it as the stick moves further from center. For this example we have set the Expo to 30%, and the graph now shows a curved response which is flatter at stick center.



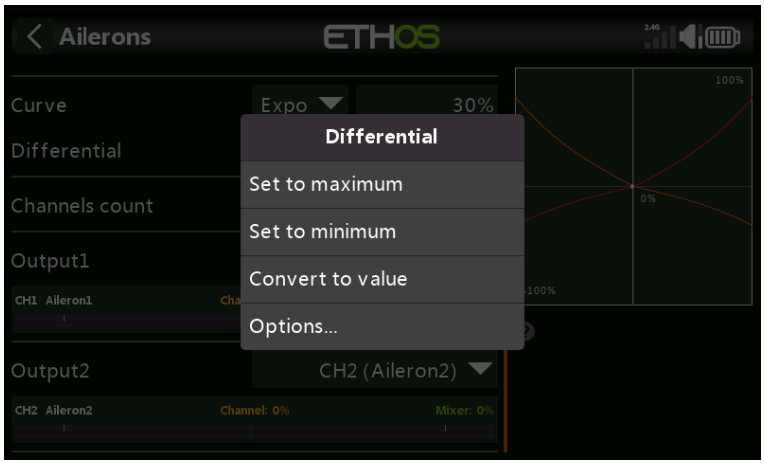
For Ailerons there is another special setting called Differential. If the left and right ailerons move up or down by the same amount, the downward moving aileron will cause more drag than the upward moving aileron, causing the wing to yaw in the opposite direction to the turn. This is known as adverse yaw. To reduce this a positive value in the Differential setting will result in less downward aileron movement, as can be seen in the graph. This will reduce adverse yaw and improve turning/ handling characteristics. A common aileron differential setting is 50%.



However, you can assign the differential to a pot, allowing your to optimize the value in flight. Long press Enter to bring up the Options dialog, and select 'Use a source'.

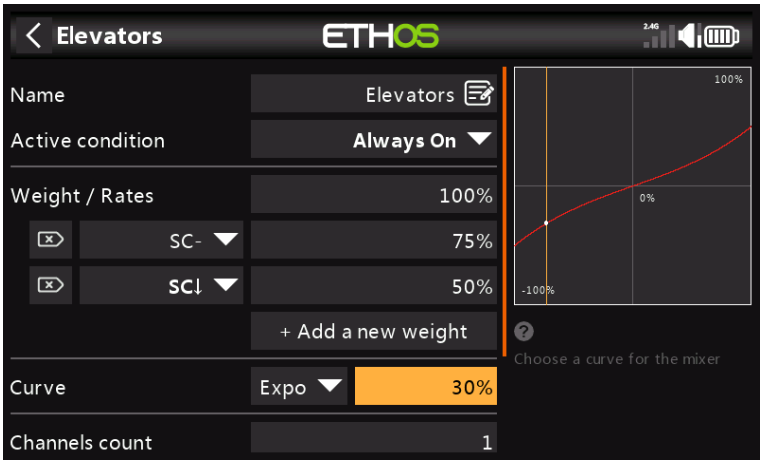


Choose Pot1 from the sources list. You can see the effect of Pot1 in the graph on the right.



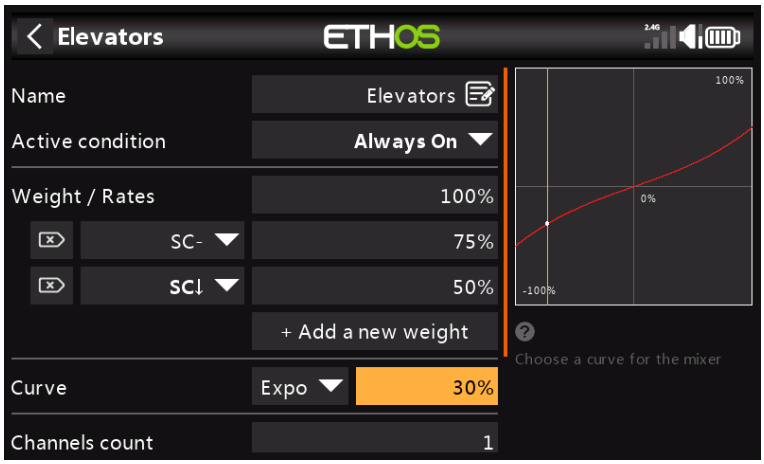
After optimizing aileron differential in flight, you can easily make the pot value your permanent setting. Long press Enter to bring up the Options dialog, and select 'Convert to value'.

Elevator



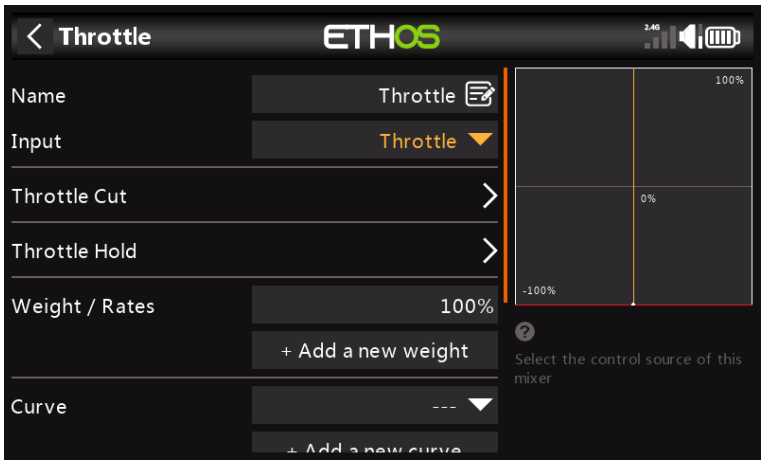
In a similar way to the Ailerons, we can set up triple rates for the Elevator on switch SC, and add 30% Expo.

Rudder



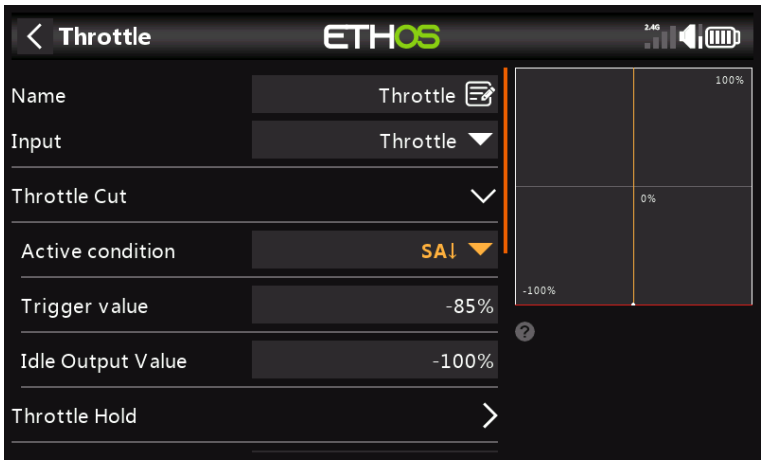
Once again, in a similar way to the Ailerons, we can set up triple rates for the Rudder on switch SD, and add 30% Expo.

Throttle



For the throttle we will leave the Input on the throttle stick. We do not need rates or expo, but we do need a safety switch so that the motor will not start unexpectedly. This is extremely important, because model engines and motors can cause serious injury or death.

Throttle Cut



Throttle Cut provides a throttle safety latching mechanism. Once the Active Condition has been satisfied in our example with switch SA in the down position, the throttle

output will be held at -100% once the throttle value falls below -85%. (Compare the first graph above with the second.)

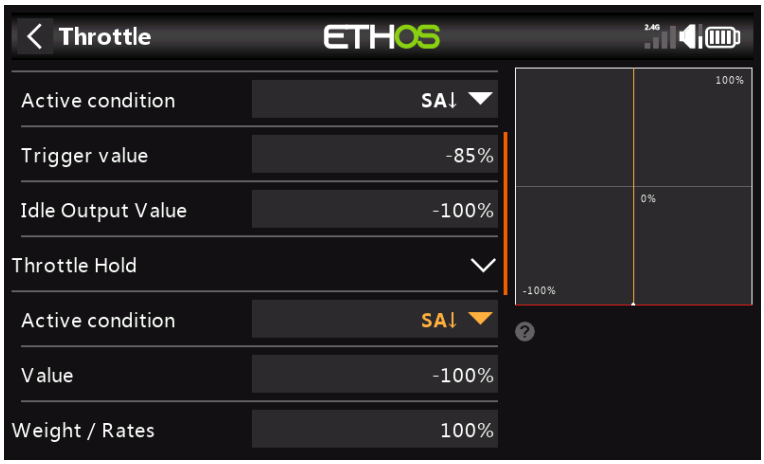
Once the Active Condition has been removed (i.e. switch SA not in the down position), the throttle stick or control must be brought down below -85% before it can be increased. This avoids the motor unexpectedly starting at a high throttle position when Throttle Cut on switch SA is released.

Low Position Trim

For glow and gas we use 'Low position trim' to adjust the idle speed. The idle speed can vary depending on the weather, etc., so having a way to adjust the idle speed without impacting the full throttle position is important.

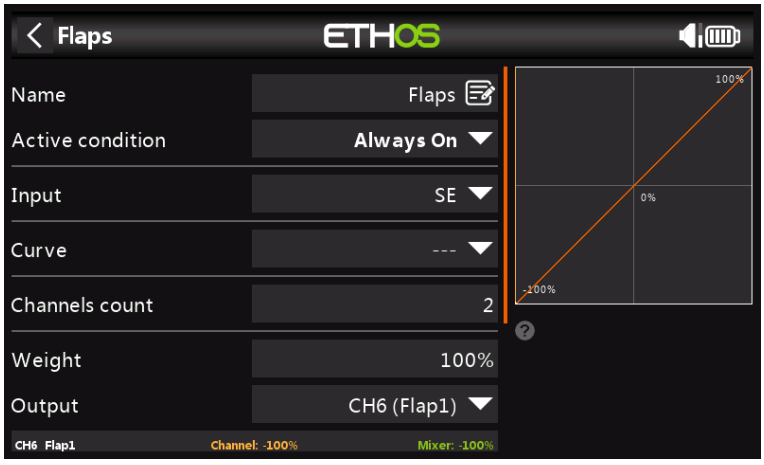
If 'Low position trim' is enabled, the throttle channel goes to an idle position of -75% when the throttle stick is at the low position. The throttle trim lever can then be used to adjust the idle speed between -100% and -50%. Throttle Cut can then be configured to cut the engine with a switch.

Throttle Hold



Throttle Hold is used to cut the motor in an emergency from any throttle position. When the Throttle Hold Active condition is met, the throttle output is instantly reduced to -100% (or the value entered). As can be seen in the graph above, the throttle output has been cut to -100% even though the throttle stick is above the half way mark.)

Flaps



In this example we assign the flaps to switch SE, and increase both output channel weights to 100%.

Step 5. Configure the Outputs

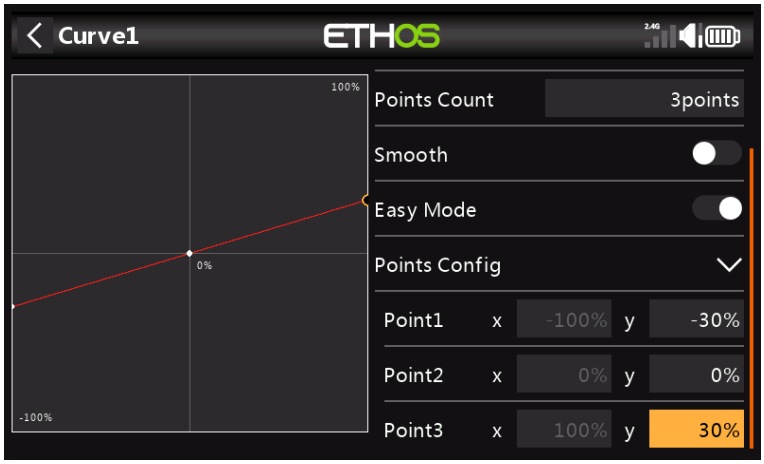
The Outputs section is the interface between the setup "logic" and the real world with servos, linkages and control surfaces, and motors or engines. So far we have set up the logic for what we want each control to do. Now, we can adapt that to the mechanical characteristics of the model. The various channels are outputs, for example CH1 corresponds to servo plug #1 on your receiver.

Tap on the Outputs icon to configure the Outputs.

Tap on an Output channel to configure it.

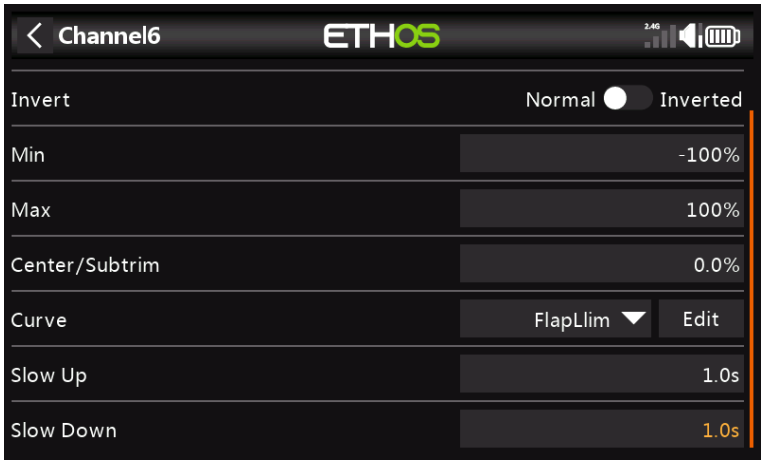
Example 1: Aileron1

The servo or channel limits can be configured with the Min and Max settings, but an easy way is to use a curve. In this example we have defined a curve 'AilLlim' and assigned it to the Aileron1 (left aileron) channel.



It is a good idea to use +/- 30% initially, and then adjust the curve to suit the servo and linkages with the model powered up. This ensures that the servo will not be driven beyond its mechanical limits, which would overload the servo and lead to failure. The curve midpoint is edited to achieve the surface neutral position.

Example 2: Flap1



In a similar way the Flap1 channel can have a 'Flap1Llim' curve assigned to it. In addition, Slow Up and Slow Down could be set to 1 second, so that the flaps move to the new position slowly.

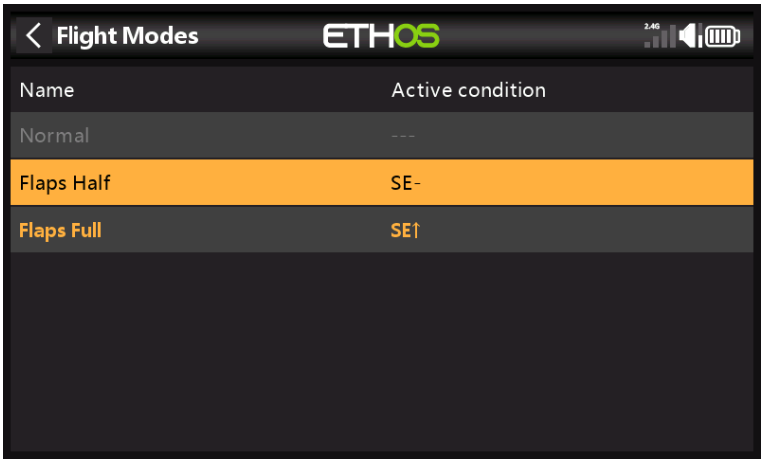
Note that Flaps normally require a large amount of down deflection for effective braking. To achieve this large downward deflection, you can sacrifice some of the upward deflection when making the linkages. This means that the Flaps will be in a half down position at servo center. The three points of the curve are adjusted to achieve the desired flap up, flap half, and flap full positions.

Step 6. Introduction to Flight Modes

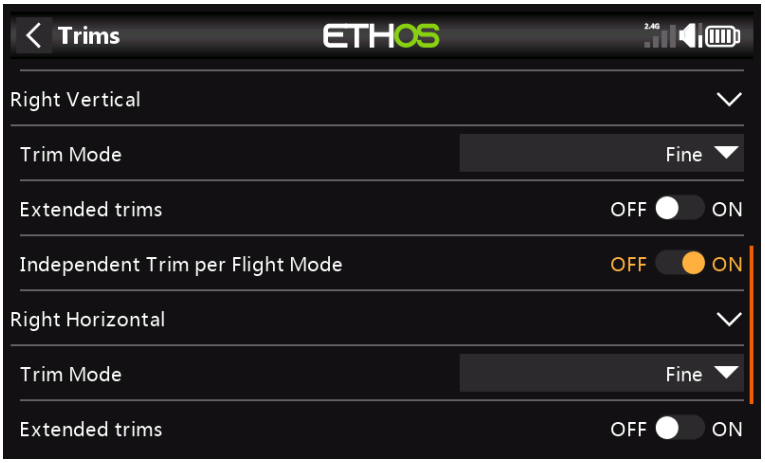
Flight Modes are a great way to configure a model for different tasks. For example, a glider may have flight modes for tasks such as Cruise, Speed, Thermal, Launch and Land. Each flight mode can remember its own trim settings, so once you have trimmed the glider to fly well in each mode, you no longer have to keep changing your trims during flight as you change tasks. The flight mode switch becomes a bit like changing gears in a car. Flight modes are sometimes called 'Conditions' in other firmware.

For simplicity, this example only shows setting up flight modes for Normal, Flaps Half and Flaps Full.

There are 100 flight modes including the default mode available for use. The first flight mode that has its Active Condition ON is the active one. When none has its Active Condition ON, the default mode is active. This explains why the default mode does not have a switch selection option.



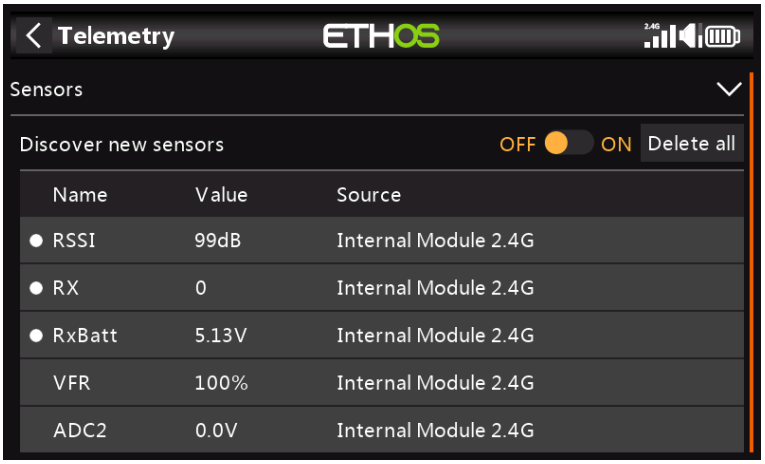
For our example we have configured the default flight mode as Normal, and added two additional flight modes named Flaps Half (switch SE-mid) and Flaps Full (switch SE-Up).



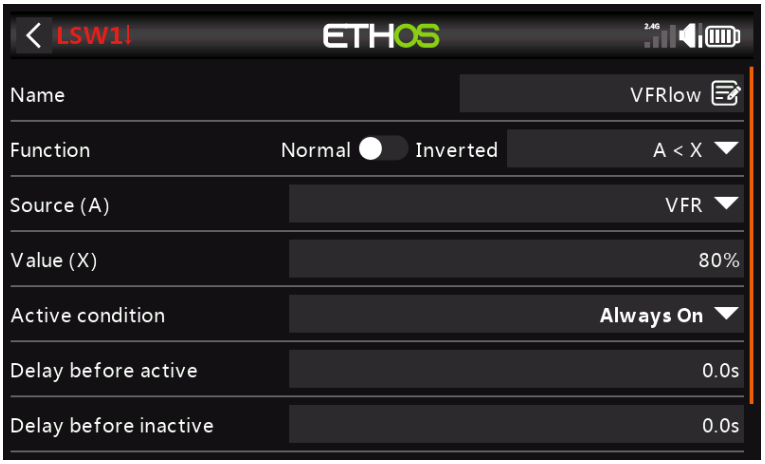
Next we go the Trims section, and change the Right Vertical stick (which is the Elevator in Sticks Mode 2) to have Independent Trims per Flight Mode. This then allows you to have independent elevator compensation for the two flap settings. The Elevator Trim Switch will automatically switching between the settings as you operate the flaps on switch SE.

Step 7. Add a VFR alert

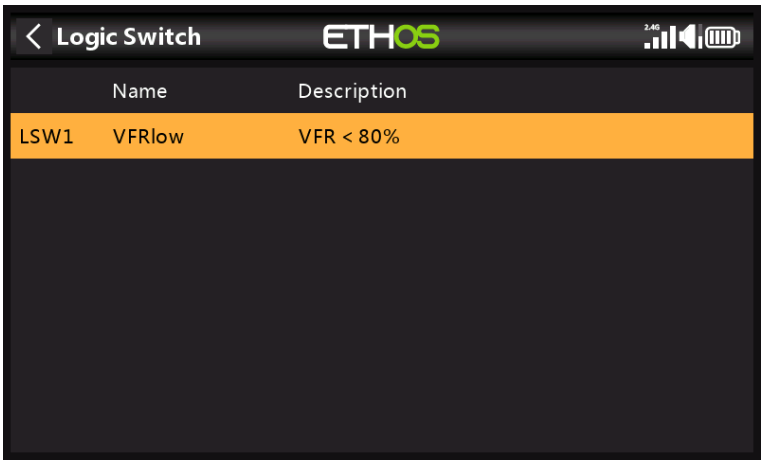
The Valid Frame Rate sensor has been introduced with ACCESS, and provides a measure of Link Quality, where 100% is perfect. At this stage there is no built in alert for VFR%, but you can easily set one up as follows:



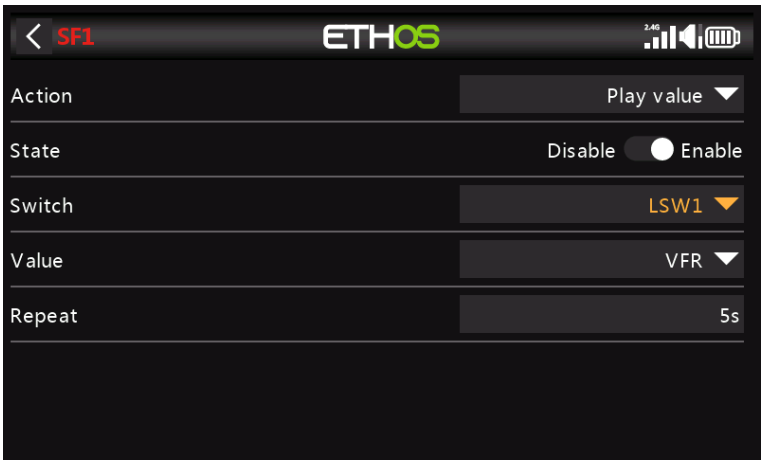
a) Enable the 'Discover new sensors' option in Model / Telemetry. You should see sensors similar to the example above, including VFR.



b) Tap on the '+' in Model / Logical Switches to add a Logical Switch.
c) Configure the Logical Switch to become True when VFR drops below say 80%.

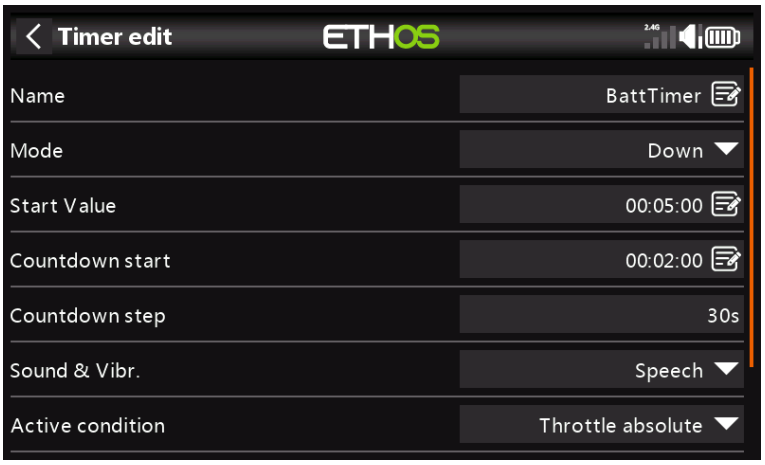


d) The completed Logical Switch is shown above.

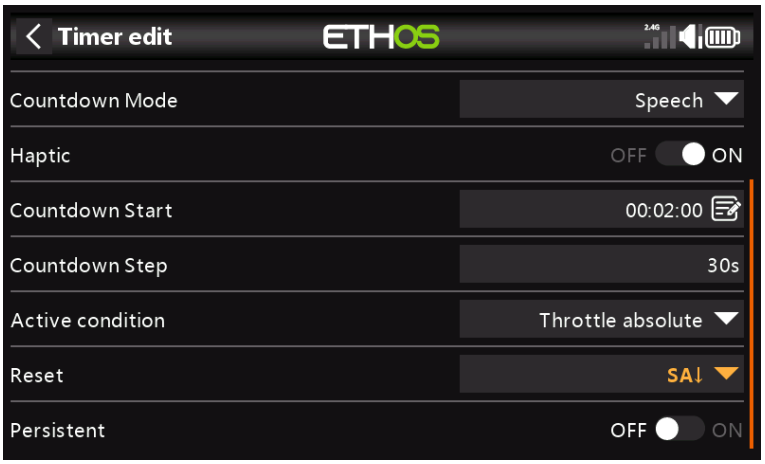


e) Tap on the '+' in Model / Special Functions to add a Special Function to speak the value of VFR% every 5 seconds when its value drops below the threshold of 80% set up in the logical switch above.

Step 8. Set up a LiPo battery timer



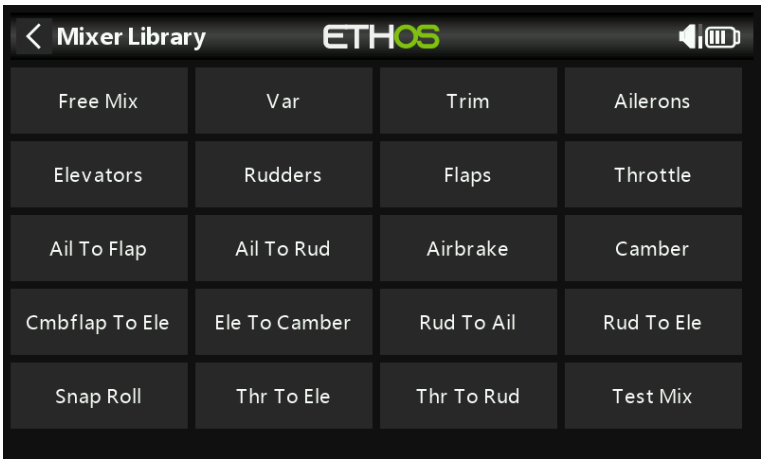
Tap on Timer 1 in the Model / Timers section, and select Edit. In this example we are configuring a Down counting timer, with a Start Value of 5 minutes. The countdown will start at 2 minutes, and will be called out via speech at 30 second intervals and then every second from 10 seconds remaining. The timer will run whenever the throttle is not idle (throttle absolute option), provided it is not being held in reset.



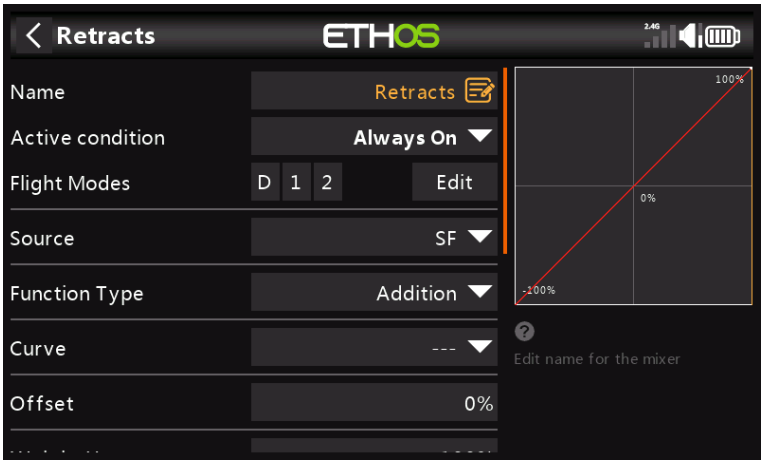
In the example the timer is reset by switch SA-down, which is our throttle hold switch. It is not persistent, so it will also be reset at power on.

This setup can be used to warn you when it is time to land, with the start value chosen so that approximately 30% of battery capacity remains. LiPo type batteries do not tolerate being over-discharged.

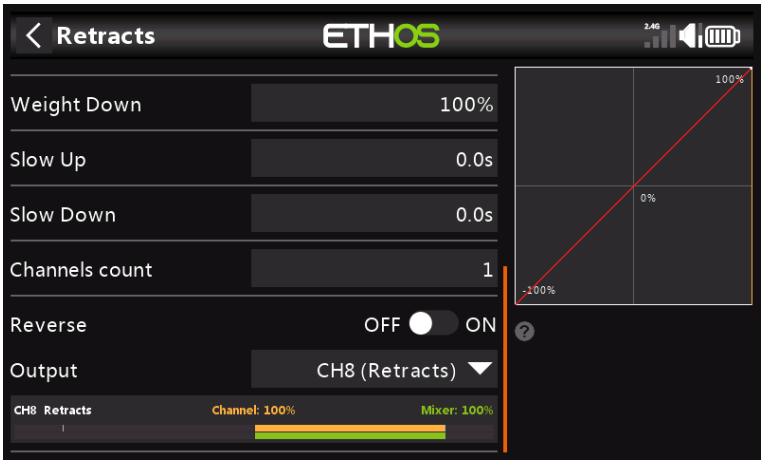
Step 9. Add a mix for retracts



Tap on a mixer line and select 'Add Mix' from the popup menu. This will open the Mixer Library. Select 'Free Mix'.



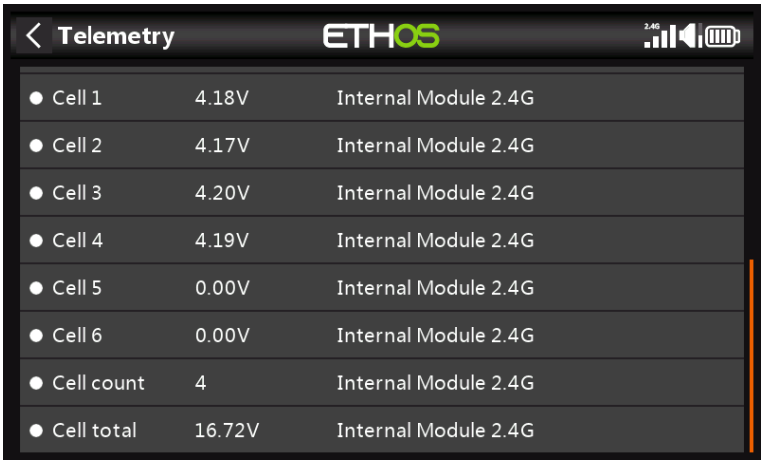
For this example name the Free Mix as 'Retracts'. The mix can always be on, and the Source can be switch SF.



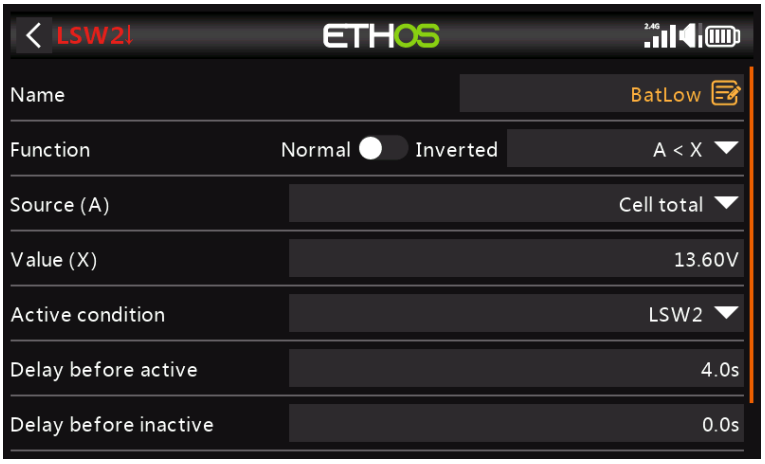
The lower half of the Free Mix settings shows that channel 8 has been allocated to the retracts.

Option 1: Set up a low battery voltage warning

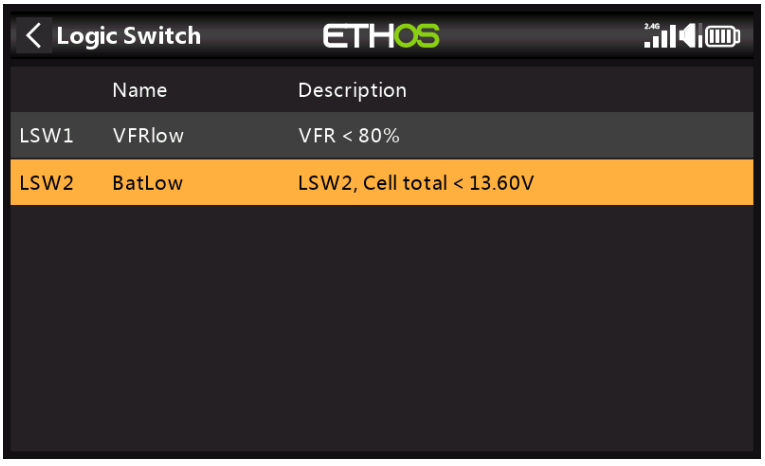
In this age of telemetry, a better battery management approach is to monitor the battery voltage under load, and raise an alert when the voltage drops below the chosen threshold. For this a battery voltage sensor such as the FrSky FLVSS can be used.



Connect the FLVSS to your receiver via an S.Port cable, and enable the 'Discover new sensors' option in Model / Telemetry. The additional sensors are shown in the example above. The sensor of interest is 'Cell total'.



Add a new Logical Switch to monitor the 'Cell total' voltage, and become True/Active when the 'Cell total' voltage remains below 3.4 per cell for 4 seconds. In the example a 4S LiPo is being monitored, so the threshold is set to 3.4 x 4 = 13.6V. A threshold of 3.4V under load will recover to around 3.7V when no longer under load.



The completed Logical Switch for battery low is shown above.

Add a Special Function to speak the value of 'Cell total' every 5 seconds when its value drops below the threshold of 3.4V per cell for 4 seconds as set up in the logical switch above.

Further refinements to low battery warnings:

1. Lowest cell voltage

Use a sensor providing the lowest cell voltage, instead of the pack voltage. The lowest cell voltage is a vital parameter when using high cell count LiPos, because a failing cell is unlikely to be detected by merely monitoring the pack voltage. For example, a 6S LiPo has a nominal voltage of 25.2V, so if one cell only has a 50% voltage (I.e. it drops by 2.1V) then the pack will simply look like slightly discharged.

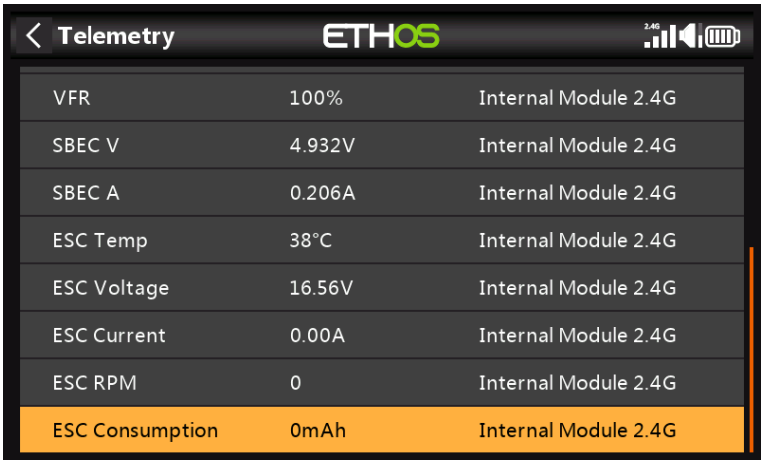
This capability is under development for ETHOS. This manual will be updated when the feature becomes available.

2. Energy consumed

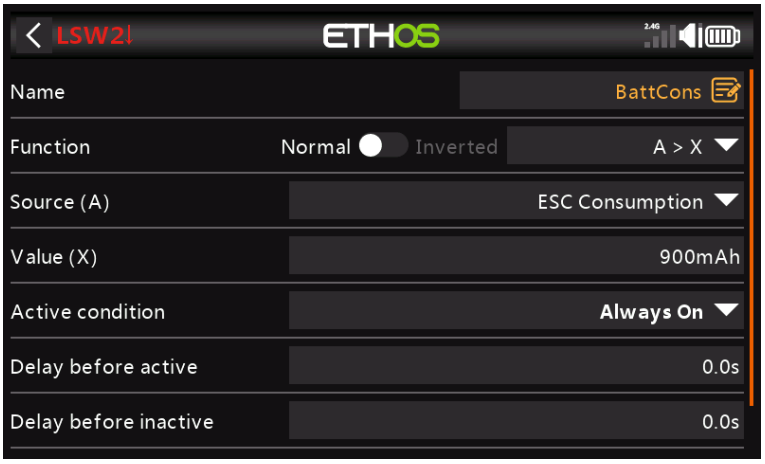
The best method of all is to measure the mAh consumed, so that the remaining battery capacity can be calculated. The FrSky Neuron series of ESCs offer this capability. Please refer to the next section.

Option 2: Set up a battery capacity warning

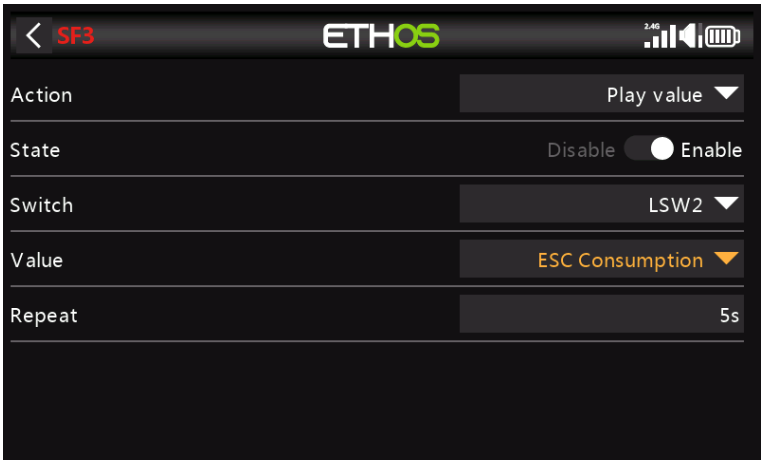
As mentioned in Option 1 above, the best method of battery monitoring is to measure the energy or mAh consumed, so that the remaining battery capacity can be calculated. The FrSky Neuron series of ESCs offer this capability.



Connect the telemetry port of the Neuron ESC to your receiver via an S.Port cable, and enable the 'Discover new sensors' option in Model / Telemetry. The additional sensors are shown in the example above. The sensor of interest is 'ESC Consumption'.



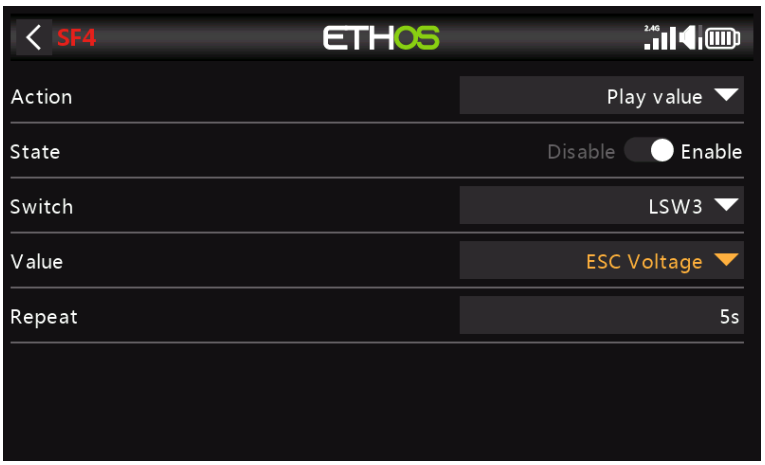
Add a new Logical Switch to monitor the 'ESC Consumption', and become True/Active when the consumption exceeds say 900mAh, or a convenient fraction of the battery capacity, allowing sufficient capacity to land and still have about 30% left.



Add a Special Function to speak the value of 'ESC Consumption', i.e. the total mAh consumed, which will be just over 900 mAh in our example.

As an additional safeguard, we can also set up an alert for battery voltage using the Neuron 'ESC Voltage' sensor.

Add a new Logical Switch to monitor the 'ESC Voltage', and to become True/Active when the 'ESC Voltage' voltage remains below 3.4 per cell for 4 seconds. In the example a 4S LiPo is being monitored, so the threshold is set to 3.4 x 4 = 13.6V. A threshold of 3.4V under load will recover to around 3.7V when no longer under load.

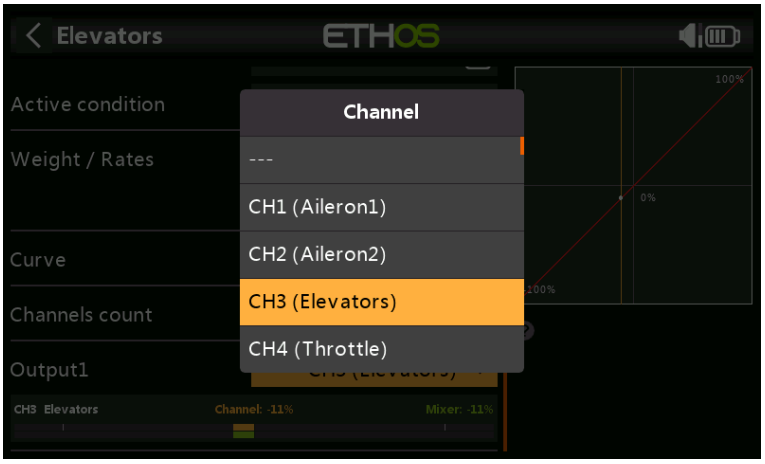


Now add a Special Function to speak the value of 'ESC Voltage' every 5 seconds when its value drops below the threshold of 3.4V per cell for 4 seconds as set up in the logical switch above.

Option 3: Adapt model for SR8/SR10

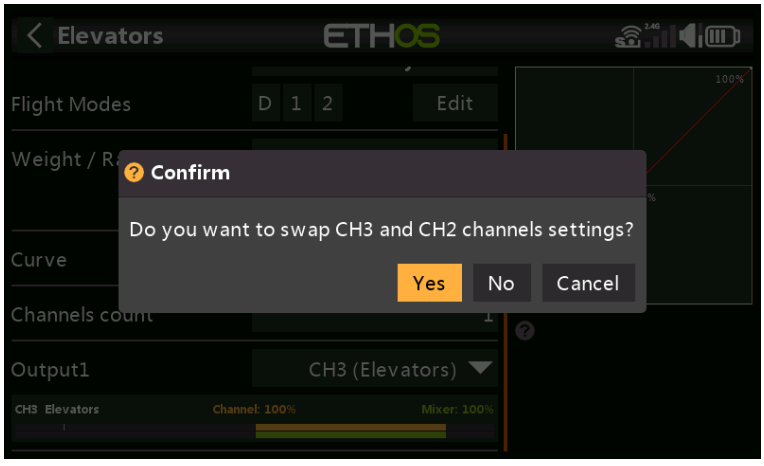
The wizards use the default channel order of AETR as defined in System / Sticks. However, for models with more than one surface for ailerons, elevator, rudder, flaps etc the wizard will group these surfaces. In our FWexample model the wizard created the channels as AAETRFF. The FrSky stabilized receivers have a defined channel order AETRAE as follows:

CH1 Aileron (Left)
CH2 Elevator
CH3 Throttle
CH4 Rudder
CH5 Aileron2 (Right)
CH6 Elevator2



1. Swap CH3 (Elevators) and CH2 (Aileron2)

a) Go to Model / Mixers, and tap on CH3 (Elevators) to highlight it.
b) Tap again, and select Edit from the popup dialog.
c) Scroll down to Output1, and tap on CH3, then select CH2 (see above example)



d) Say Yes to swap CH3 and CH2 channels settings.
e) You will now have Elevator on CH2, and Aileron2 on CH3.

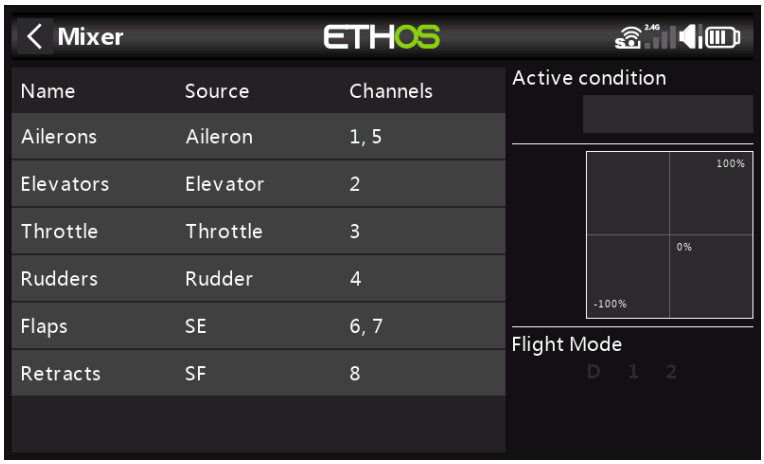
2. Swap CH4 (Throttle) and CH3 (Aileron2)

a) Tap on CH4 (Throttle) to highlight it.
b) Tap again, and select Edit from the popup dialog.
c) Scroll down to Output1, and tap on CH4, then select CH3 (Aileron2).
d) Say Yes to swap CH4 and CH3 channels settings.
e) You will now have Throttle on CH3, and Aileron2 on CH4.

3. Swap CH5 (Rudders) and CH3 (Aileron2)

a) Tap on CH5 (Rudders) to highlight it.
b) Tap again, and select Edit from the popup dialog.
c) Scroll down to Output1, and tap on CH5, then select CH4 (Aileron2).
d) Say Yes to swap CH4 and CH3 channels settings.
e) You will now have Rudder on CH4, and Aileron2 on CH5.

4. Confirm new channel order



As can be seen in the above example, the channels are now in the correct order for SX8 and SX10:

CH1 Aileron (Left)
CH2 Elevator
CH3 Throttle
CH4 Rudder
CH5 Aileron2 (Right)
CH6 Flap1 (Left)
CH7 Flap2 (Right)
CH8 Retracts.