Open TX
2.2

Getting Started

Contents

Introduction

There are two ways of programming **OpenTX**. Either the transmitter can be used working through the various screens, or **OpenTX Companion** can be downloaded to a Mac or PC and a model programmed on the computer screen and then transferred to the transmitter using a USB cable. Neither method is mutually exclusive, both can be mixed and matched. Programmed model setups can be transferred back to the computer to be used in **OpenTX Companion**. Which method is the easiest? Using the transmitter there is only one system to learn, but that system is undoubtedly complex with many different pages of menus, some with 30-40 lines of features. The programming is basically done by using the 6 buttons on the transmitter and combinations of short and long presses. Using the computer more of the features can be seen at once, and by using a mouse, editing is far simpler, as is switching between screens. The **Companion** also allows much copying and pasting, and undoubtedly is far easier for entering text for model names, etc.

A very useful feature of **OpenTX Companion** is the simulator which is an integral part of the program. The simulator allows a model setup to be tested and see just what effect there is on the servo outputs. An interesting feature of the simulator is the ability to also show the transmitter screen, and use the mouse to press the appropriate transmitter buttons. Using this, the transmitter menu pages can be quickly related to the **OpenTX Companion** in order to make changes on the transmitter.

To start using **OpenTX Companion**, go to this website **http://www.open-tx.org/downloads**, and select the latest version of **OpenTX 2.2** version 2.2.x down at the bottom of the screen. Ignore earlier versions of **OpenTX**. Download the latest 2.2 **Companion** version, and install it. **OpenTX** versions are delivered as sets of major and minor releases. Major releases represent big steps with lots of feature changes and new functionality, which require changes in the way model data is stored and thus breaks compatibility with the previous one. Minor releases will fix bugs, correct functionality that needs changes, add new functionality that doesn't require breaking compatibility, or remove features that are deemed no longer necessary or useful. There is a simple numbering system for the various software releases. For instance, with version 2.2.1, 2.2 is the latest major release, where important changes have been made to the software, and the "1" following is the latest minor update.

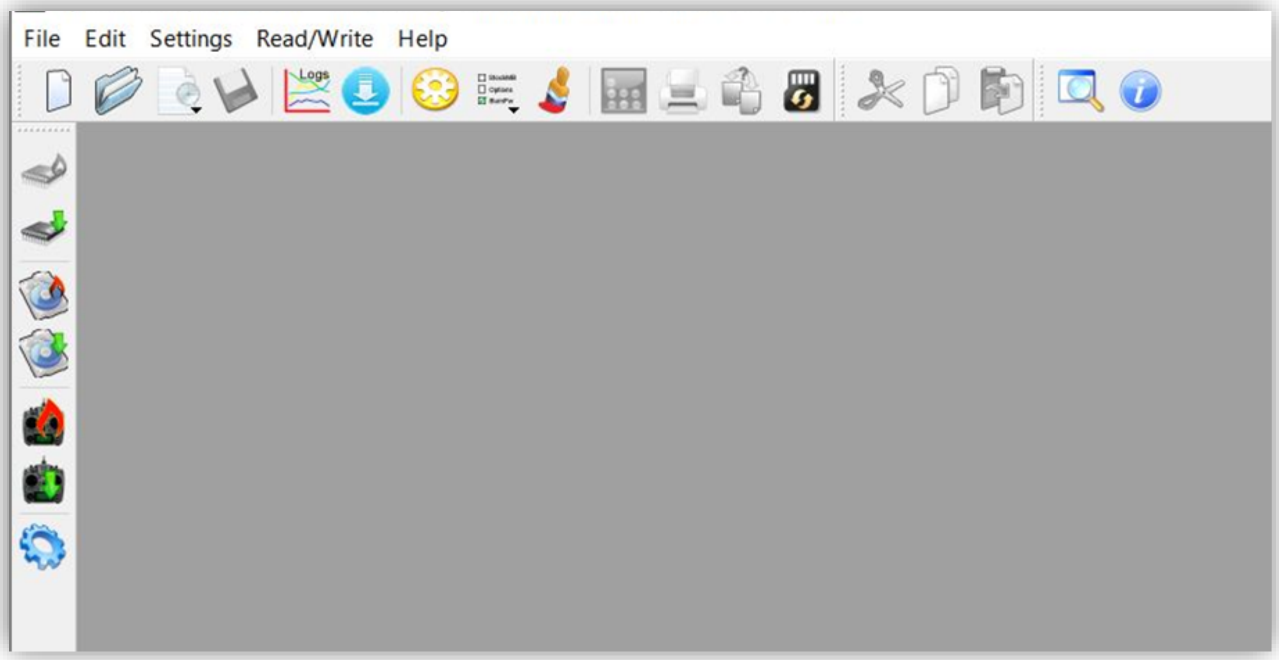
The first thing to learn with **OpenTX** is that it differs from the majority of mainstream radios by its programming philosophy. Owners of Multiplex radios will however feel at home very quickly, as the principles are very similar. Most common radios offer a choice between a limited set of predefined usage scenarios (airplane, glider, helicopter), a number of functions that are commonly used with such models (delta, flaperon, camber, butterfly, etc.), and have fixed assignations (i.e. sticks always control their respective channels), **OpenTX** offers a blank canvas on which you will build your setup: the **Mixes** window. This approach ensures maximum flexibility because whatever you do you will never have to work around what the radio expects you to do. For some model types, the usual predefined functions can allow setting up a model in seconds (just enable a function), but for others you'll spend hours trying to get around its limitations. With **OpenTX** it might take a little longer at the beginning to set up a seemingly simple model, but a complicated one won't take much more time. As there is no existing function you can just turn on, it will require basic understanding of how your model is supposed to work, and what you want each control surface to do.

There are two golden rules for **OpenTX**:

- ✪ We have all become used to the setting conventions provided by our preferred transmitter manufacturer, and because this is what we are used to, we take this as the norm, and assume this is the way it must be done. **OpenTX** allows one to discard these preconceived views and adopt a much more flexible approach to settings and switch assignments to meet individual requirements.
- ✪ There is no single right way of doing anything on **OpenTX**, the same effect can often be achieved in a variety of ways. At times though, some ways are definitely better.

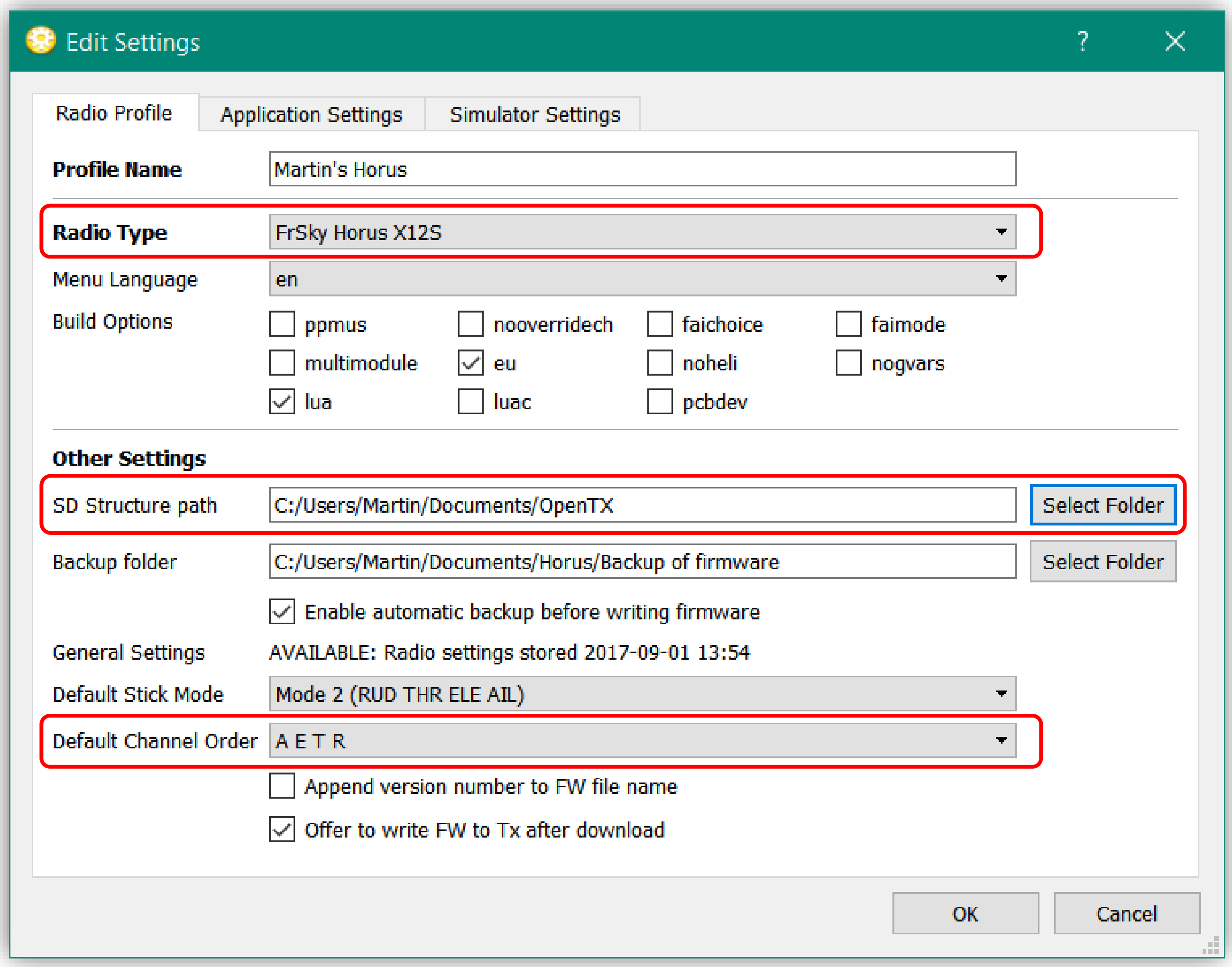
The Main OpenTX Companion Screen

Once **OpenTX** is installed and run you will get a screen which looks like the screenshot below.



Holding the mouse pointer over each icon will show what each icon does. Please note there are different themes available for this screen. Here we will leave it as the “classical” theme as it provides the clearest icons for these screen shots.

First we need to tell the program which transmitter we will be using. Select the **Settings** icon, the round yellow icon shown left. Select the transmitter you already have or are planning to buy. Here I have selected the Horus 12S.



Profile Name Martin's Horus

Radio Type FrSky Horus X12S

Menu Language en

Build Options
□ ppmus □ nooverridech □ faichoice □ faimode
□ multimodule ☑ eu □ noheli □ nogvars
☑ lua □ luac □ pcbdev

Other Settings

SD Structure path C:/Users/Martin/Documents/OpenTX Select Folder

Backup folder C:/Users/Martin/Documents/Horus/Backup of firmware Select Folder

☑ Enable automatic backup before writing firmware

General Settings AVAILABLE: Radio settings stored 2017-09-01 13:54

Default Stick Mode Mode 2 (RUD THR ELE AIL)

Default Channel Order A E T R

□ Append version number to FW file name

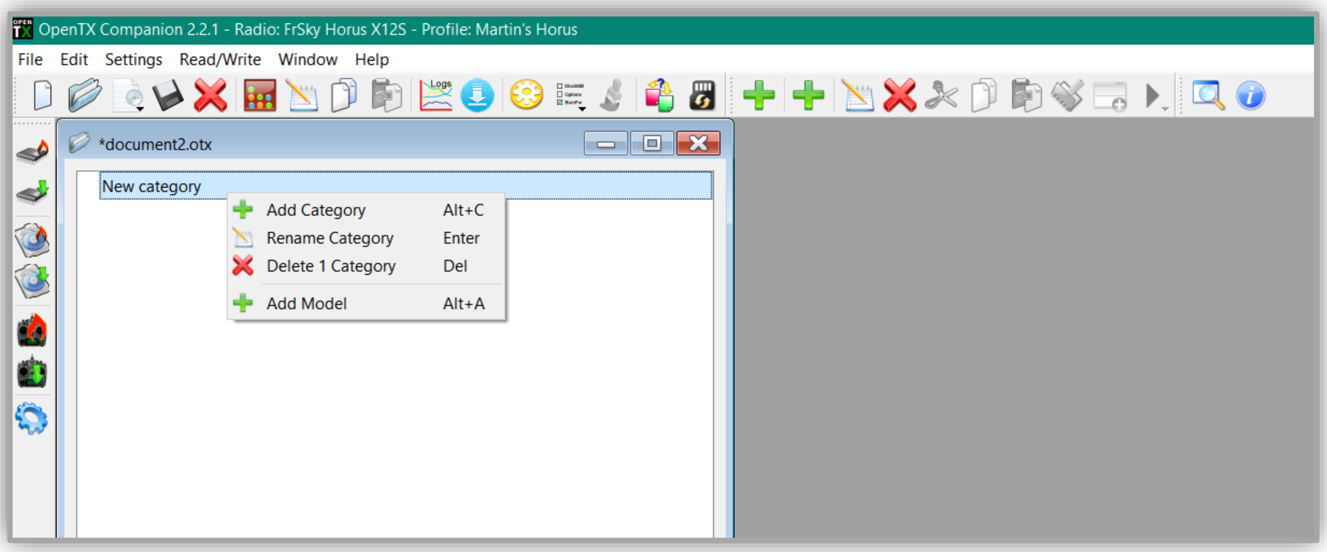
☑ Offer to write FW to Tx after download

Next you will need to select a folder on the computer where a copy of the transmitter's SD card files are held. If you click on **Select Folder**, the program will allow you to search for where the folder is located. If no folder exists, you will need to create one. Now go back to the OpenTX downloads page, and right at the bottom download the SD card contents for **OpenTX 2.2.x**. It will ask you which transmitter version you require. It needs to be the same as you have selected above. This download will need extracting and putting into the folder you have selected.

Notice down at the bottom of the window the default channel order is set. Other radio manufacturers have their own default order of channels. This is usually printed on the receiver. Manufacturers all tend to do different things and have a different order. Here is the first occasion when we begin to see how **OpenTX** is different, and why one needs to leave one's pre-conceived ideas behind. **You** have the choice of which order. In reality it matters little. However, for those of us that like things neat and tidy, there may be good reason for a particular order. I normally fly planes, and tend to use channel 1 for throttle, and channel 4 for aileron because I almost invariably use individual aileron servos for each aileron and assign channel 5 for the second servo. Well, I think it is logical! Again with the flexibility of **OpenTX**, it makes sense to use individual aileron servos. The latest small servos are not only cheap but very powerful, and with the low cost of 8 channel receivers, we might as well use these channels. Individual aileron servos allow for all sorts of extra functions to be added such as flaperons, or differential, or some fascinating mixes. Everything else on the screen can be ignored for now, so click OK.

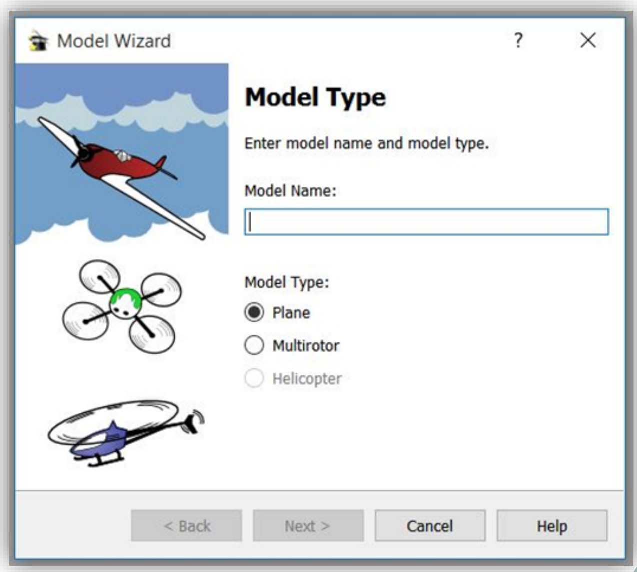
The Model Wizard

Back on the main **OpenTX** screen, click on **File** and then select **New**, and the models window will open:



For the time being ignore the **New Category** box at the top which allows one to group models into categories on the **Companion** and on some transmitters. Incidentally **OpenTX** will store up to 60 models; enough for most of us, and by using the **Companion**, a copy of these can (and should) be stored on the computer, just in case! Right click on the **New Category** box and another window will open up. Go to **Add Model** and the **Model Wizard** will start which provides a simple way of setting up a new model.

First enter a model name, and then you have the option of selecting either a plane or a multirotor. Sadly, the helicopter is greyed out because at the time of writing nobody has developed a



Model Type

Enter model name and model type.

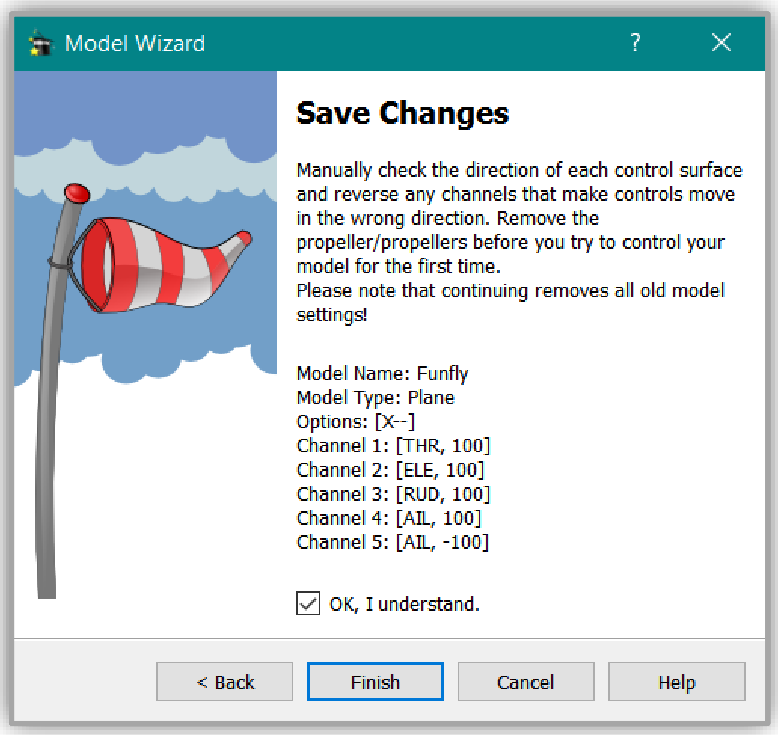
Model Name:

Model Type:
● Plane
○ Multirotor
○ Helicopter

model wizard for a helicopter, though **OpenTX** works well with helicopters. Try selecting **Plane**. Then follow through the various steps to create your plane. At this stage select a basic wing, select ailerons controlled by two channels, ignore such things as flaps and airbrakes, and go for a standard tail configuration. These can be changed later by right clicking on the model name in the model window and selecting model wizard again. You might think it a bit odd that the program asks you which channel to use for the controls. As mentioned above, conventional radios assign channels automatically. **FrSky** receivers do not, and the receiver ports are not labelled throttle, rudder etc., but simply 1 to 8. At this stage it might appear an added complication, but in reality it adds more versatility. Do be aware, however, that the stabilised **FrSky** receivers do have pre-assigned functions, which somewhat upsets my simple choice of channels explained above!

Here you can see the final screen of the model wizard set for a basic plane with two servos controlling the ailerons.

Once you have worked through the model wizard, your new model is programmed, and the program can be transferred to your transmitter. How to do this is covered later in this documentation. Be assured, however, it is a simple process, and almost foolproof. It is perhaps worth mentioning at this stage that when building a new model, if one uses a digital servo tester, one can set the mid point of each servo accurately to give a neutral control surface, and then set the maximum throws before the receiver is ever connected. However, more of this later.



Save Changes

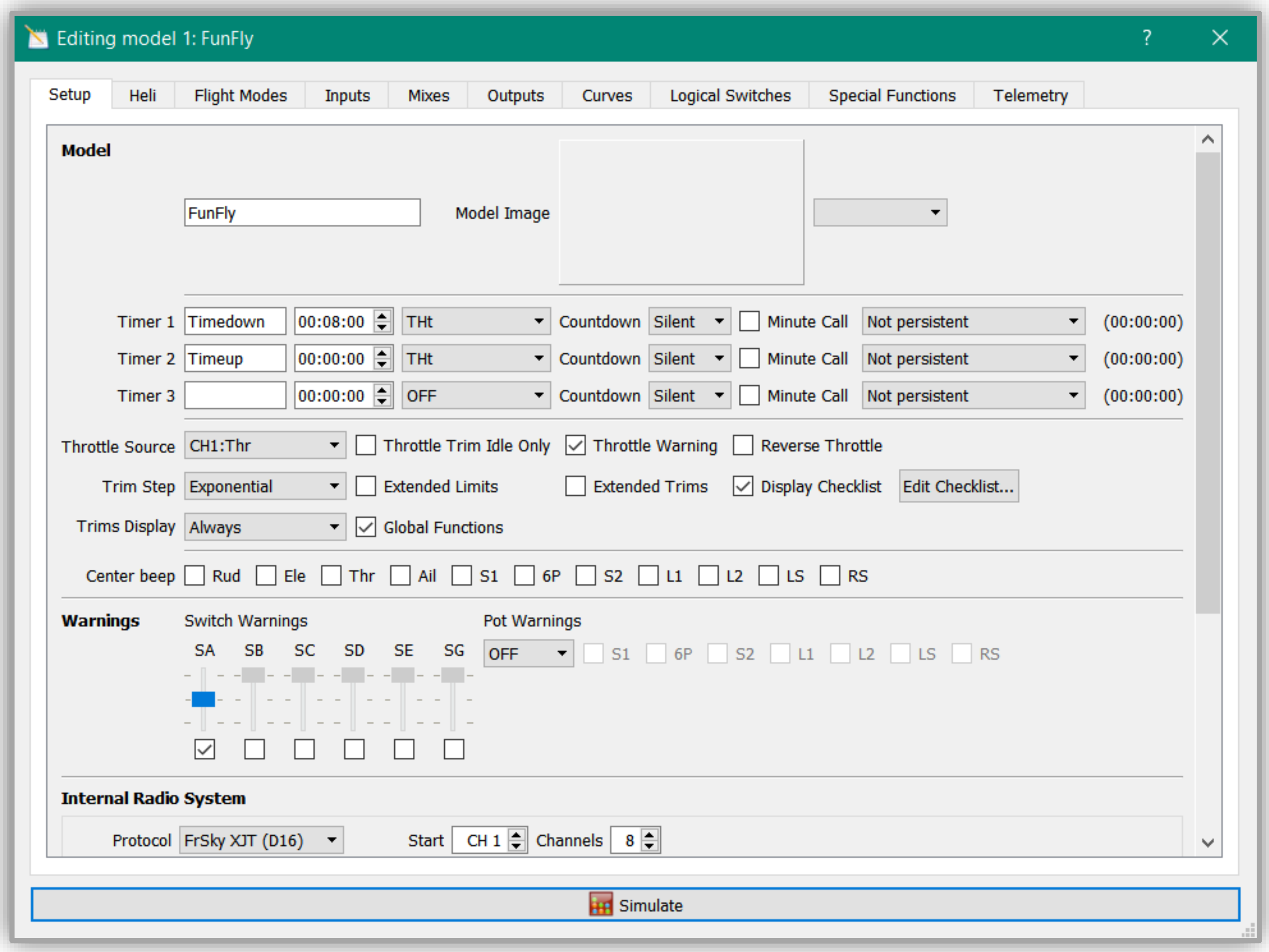
Manually check the direction of each control surface and reverse any channels that make controls move in the wrong direction. Remove the propeller/propellers before you try to control your model for the first time.
Please note that continuing removes all old model settings!

Model Name: Funfly
Model Type: Plane
Options: [X--]
Channel 1: [THR, 100]
Channel 2: [ELE, 100]
Channel 3: [RUD, 100]
Channel 4: [AIL, 100]
Channel 5: [AIL, -100]

☑ OK, I understand.

The Editing Screen

It is useful to first check the operation of your model setup before transfer. Double click on your first model setup and a new, more complex window opens up. This is the main **OpenTX** editing window – well you must have been thinking there is more to the program that that already described! Clicking through the tabs at the top of this window reveal a plethora of options most of which probably mean very little at this stage. You will see some settings entered in **Inputs** and **Mixes** Later we will delve into each of these tabs in more detail showing how to add extra features which will make **OpenTX** really come alive and show the full potential of the system.



Model

FunFly — Model Image

Timer 1: Timedown, 00:08:00, THt, Countdown Silent, □ Minute Call, Not persistent (00:00:00)

Timer 2: Timeup, 00:00:00, THt, Countdown Silent, □ Minute Call, Not persistent (00:00:00)

Timer 3: 00:00:00, OFF, Countdown Silent, □ Minute Call, Not persistent (00:00:00)

Throttle Source: CH1:Thr □ Throttle Trim Idle Only ☑ Throttle Warning □ Reverse Throttle

Trim Step: Exponential □ Extended Limits □ Extended Trims ☑ Display Checklist Edit Checklist...

Trims Display: Always ☑ Global Functions

Center beep □ Rud □ Ele □ Thr □ Ail □ S1 □ 6P □ S2 □ L1 □ L2 □ LS □ RS

Warnings

Switch Warnings: SA SB SC SD SE SG

☑ □ □ □ □ □

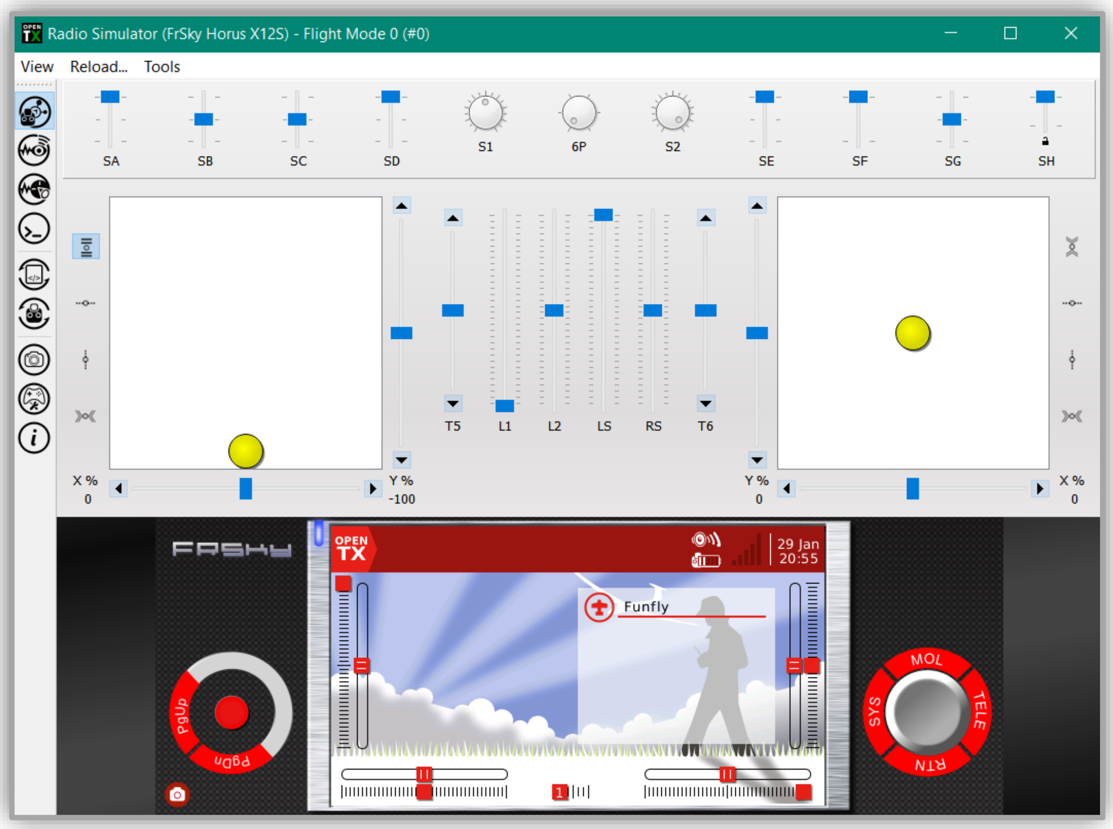
Pot Warnings: OFF □ S1 □ 6P □ S2 □ L1 □ L2 □ LS □ RS

Internal Radio System

Protocol: FrSky XJT (D16) Start: CH 1 Channels: 8

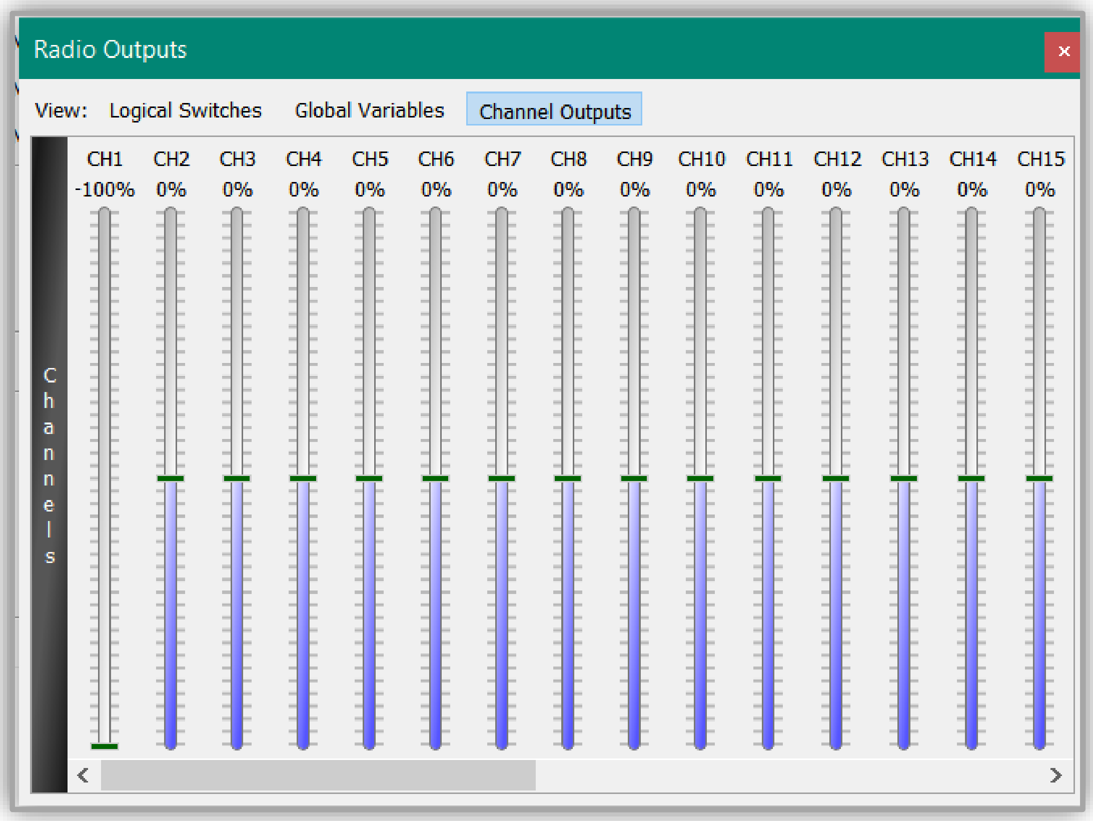
The Simulator

In the meantime, simply click on the **Simulate** box at the bottom of the editing window shown on the previous page. In version 2.2 of **OpenTX**, the Simulator has been greatly enhanced:



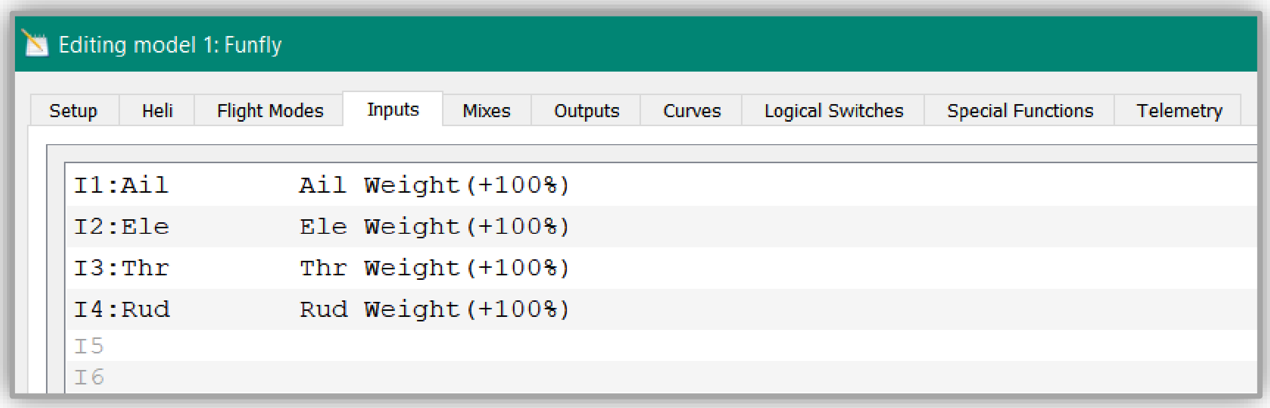
The simulator looks complicated with the switches at the top, the joysticks, sliders and trims in the middle, and a graphic of the transmitter display at the bottom. The yellow dots are the joysticks which can be moved by clicking the mouse on the yellow dot and then with the mouse button still pressed moving the yellow dot. Above are the various switches available. These will change depending on the model of transmitter selected.

At the top left of the simulator screen is a column of icons. Click on the top one, and another window will appear. This shows the radio outputs. At this stage it is better to reduce the size of the simulator so that both windows can be seen on the screen at once. Now by moving the joysticks the channel outputs can be seen moving. As we assigned two channels to the ailerons, on the simulator you will see channels 4 and 5 moving in opposite directions. Later we will be able to see how adding exponential, limits or reversing servos will alter the amount or direction the servos can travel for a given joystick movement.



The Inputs Window

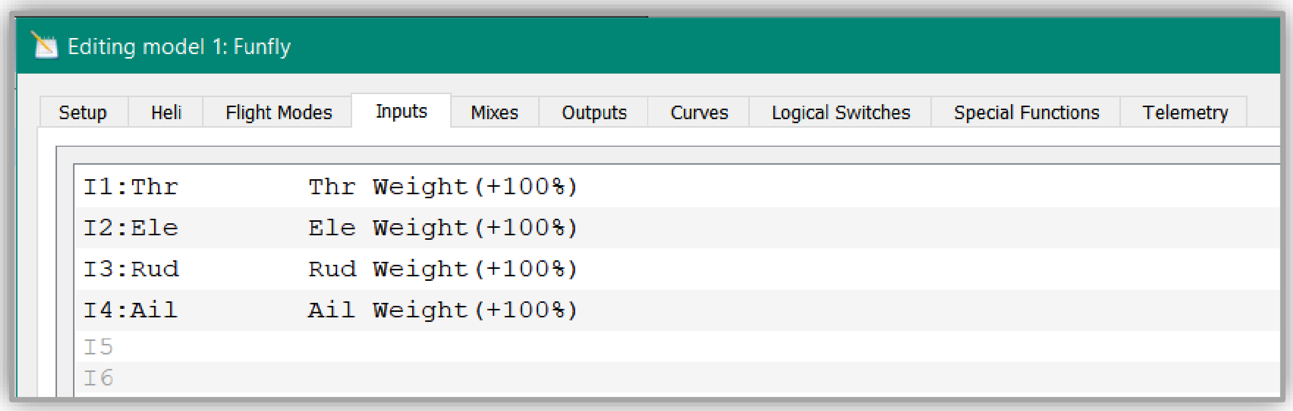
Next we can look in detail how the wizard set our plane up. With the model editing window open, click on the **Inputs** tab:



```
I1:Ail          Ail Weight(+100%)
I2:Ele          Ele Weight(+100%)
I3:Thr          Thr Weight(+100%)
I4:Rud          Rud Weight(+100%)
I5
I6
```

On the left we have 4 inputs. These relate to the transmitter sticks and appear in the order set on the **General Settings** window where we entered the transmitter type. The inputs are labelled [I1] to [I4] and this screen links them to the four main joystick controls, throttle, elevator, rudder and aileron. It is possible to have up to 32 inputs using either pots, switches, trims and even timers.

We have this peculiar feature of “weights”. Essentially this is how far the servo will travel for a given maximum stick position, and is key to the whole operation of **OpenTX**. All your transmitter is ever doing is reading the joystick and switch positions, manipulating those values in a defined way and then telling each servo how far to move and in which direction. If the weight was set at 50% then

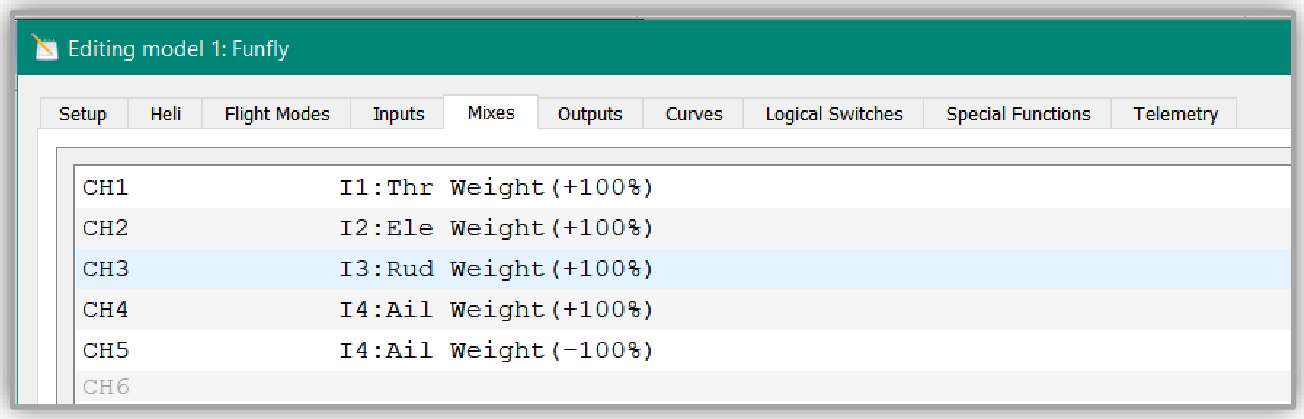


```
I1:Thr        Thr  Weight(+100%)
I2:Ele        Ele  Weight(+100%)
I3:Rud        Rud  Weight(+100%)
I4:Ail        Ail  Weight(+100%)
I5
I6
```

the servo arm would rotate only half as far compared to a weight of 100%. A minus sign in front reverses the servo travel. At this point it is worth pointing out that different makes of transmitter will move a servo a different amount for a full stick movement, and some have a slightly different centre point. The **Inputs** screen assigns individual sticks to actual inputs.

The Mixes Window

The keen-eyed will have spotted that there is just one aileron programmed, yet we asked for two. It could have been included here, though it is handled in the next window, the **Mixes** window for reasons you will better understand later. Selecting now the **Mixes** tab, this screen links the inputs to outputs and handles all the mixing of the various functions. It is the programming heart of **OpenTX.**

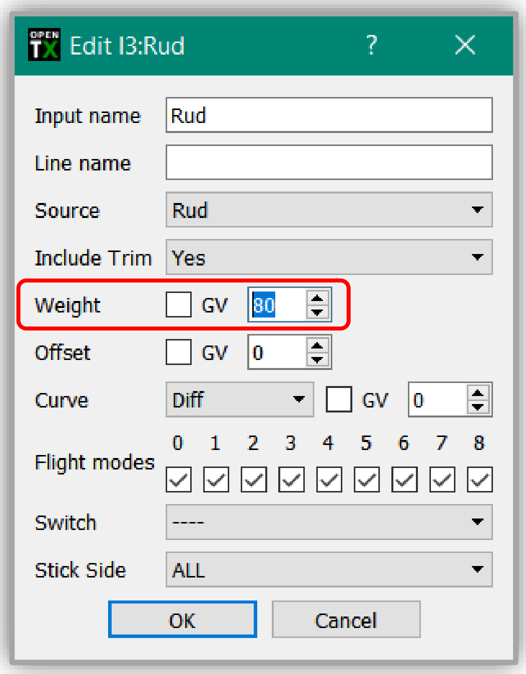


```
CH1           I1:Thr Weight(+100%)
CH2           I2:Ele Weight(+100%)
CH3           I3:Rud Weight(+100%)
CH4           I4:Ail Weight(+100%)
CH5           I4:Ail Weight(-100%)
CH6
```

Channels 1-4 are straightforward but channel 5 now takes **[I4]** again and links it to channel 5 also. This gives us the dual aileron servo function. However, this time it inverts the servo travel using a minus weight -100%. Thus when you use the simulator, you will see the servo travel for channels 4 and 5 going in opposite directions. Often 2 wing servos actually reverse the final movement to the aileron by linking to opposite sides of the servo arm. In this situation one would keep both channel 4 and channel 5 weights positive; in much the same manner as using a servo “Y” lead. **OpenTX** gives you the flexibility.

Editing a Model

How do the weights on the **Mixes** window compare to the weights on the **Inputs** window? **OpenTX** combines the two, so if both weights are set at 100%, then the servo travel will be 100%, if either weight is set at 80% then the overall servo travel will be 80%. However, if both weights are set at 80% then the resulting servo travel will be just 64% (80% of 80%). The beauty of **OpenTX Companion** is that you can experiment on screen, and try the simulator to see the effect. To change the weighting value simply double click on the appropriate line and a new small window will open up. Try it with the rudder on the **Inputs** window first. This is a particularly powerful window which allows all sorts of useful functions to be added and changed. Most are not needed at this stage. All we need to do is change the weight line to 80 and close the box. Now check on the simulator what happens to the rudder.

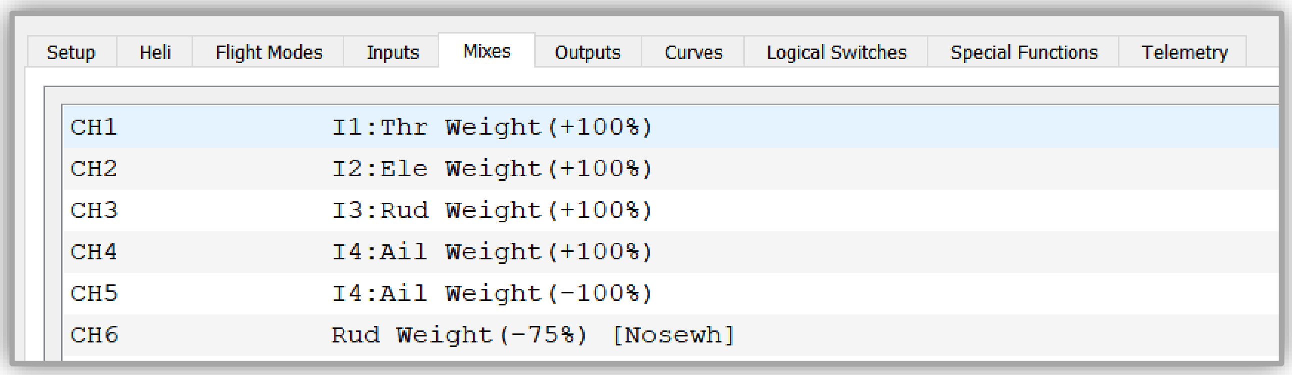


Edit I3:Rud

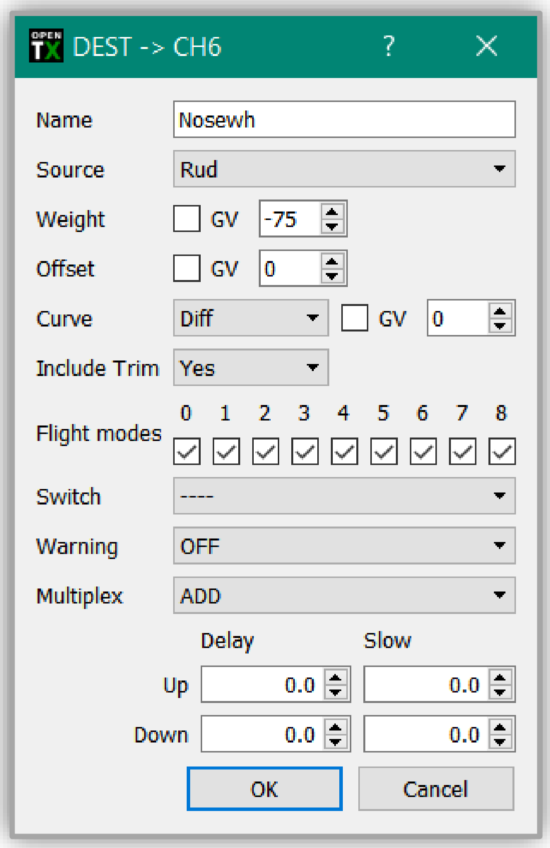
Input name: Rud
Line name:
Source: Rud
Include Trim: Yes
Weight: □ GV 80
Offset: □ GV 0
Curve: Diff □ GV 0
Flight modes: 0 ☑ 1 ☑ 2 ☑ 3 ☑ 4 ☑ 5 ☑ 6 ☑ 7 ☑ 8 ☑
Switch: ----
Stick Side: ALL

Next move back to the **Mixes** window and similarly open up the rudder window. This window is slightly more complex, but again we simply change the weight to 80 and test on the simulator again. Now the servo should only travel between -64 and +64. Similarly, you can change the -100% weight in channel 5 to +100% and see the effect on the servo travel so both aileron servos move in the same direction.

Having got this far, adding new functions is straightforward. With our 8 channel receiver, it is often also better to use a separate servo to drive a nose wheel. Having a separate servo gives us the flexibility to reverse direction if needed and alter the travel. This also keeps linkages simpler but then there is the complication of mixing back at the transmitter. Use channel 6 for a nose wheel servo. In this example we will set our servo to reduce the travel to 75%, and in the opposite direction, -75%. Right click on channel 6 in the **Mixes** window to open up a new options window, and select **Edit** (an alternative to double clicking as we did above) and then add the line shown in the **Mixes** window on the next page.



```
CH1          I1:Thr Weight(+100%)
CH2          I2:Ele Weight(+100%)
CH3          I3:Rud Weight(+100%)
CH4          I4:Ail Weight(+100%)
CH5          I4:Ail Weight(-100%)
CH6          Rud Weight(-75%) [Nosewh]
```



DEST -> CH6

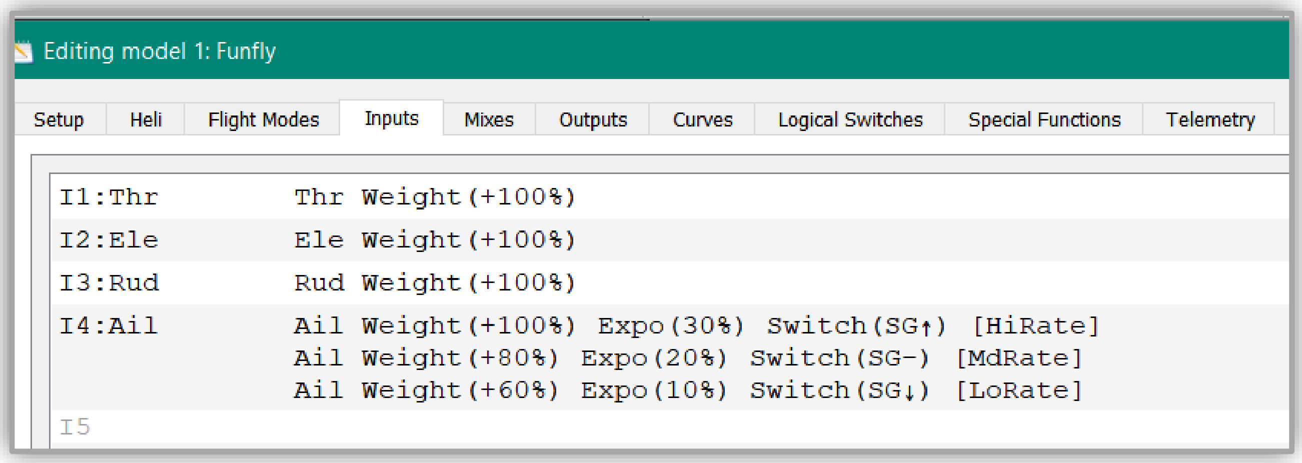
Name	Nosewh
Source	Rud
Weight	□ GV -75
Offset	□ GV 0
Curve	Diff □ GV 0
Include Trim	Yes
Flight modes	0 ☑ 1 ☑ 2 ☑ 3 ☑ 4 ☑ 5 ☑ 6 ☑ 7 ☑ 8 ☑
Switch	----
Warning	OFF
Multiplex	ADD

	Delay	Slow
Up	0.0	0.0
Down	0.0	0.0

Notice **CH06** uses the **Rud** source, not the **[I3]Rud** source which is also available. This means that the source is the actual rudder joystick, not input 3 defined on the **Inputs** window. Why do this? It just means that if you change the weight of the rudder input on the **Inputs** window it will not affect the nosewheel as we did previously. You can test this out using the simulator. As has already been said, there are many ways of doing things on **OpenTX.** Much is down to personal preference.

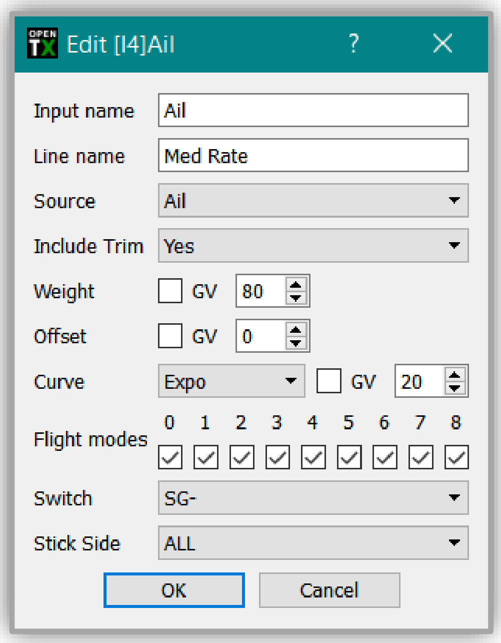
It is useful to also give your function a clear name. After programming several models, and returning to edit this one some months later, you will be glad you made the function of each line very clear. The **Include Trim** feature is a way of linking or unlinking the rudder trim to this control. It is debatable whether we would need trim for a nosewheel. The trim is more relevant to rudder operation in the air. However, you have the choice.

One common requirement is to add aileron and elevator rates, and perhaps add some expo too. Switches on the Frsky transmitter range are labelled **SA** to **SH**, and basically any switch can be assigned to any task. To show how it works we will assign switch **G** to the aileron rates, and seeing as we have a three position switch we might as well add triple rates. We could add rates using either the **Mixes** window or the **Inputs** window, but it is easier to do this on the **Inputs** window as we only have to enter everything once. Otherwise on the **Mixes** window we would have to enter the same things for each aileron line. Down at the flying field where one wants to use the transmitter screen to, say, edit the rates, this becomes far easier and there is less risk of accidentally setting each aileron differently. Right click on the line **[I4] Ail** and select **Add** to add a new line or **Edit** to change the existing one. The flexibility is there to copy an existing line and just change the relevant parts.



```
I1:Thr          Thr Weight(+100%)
I2:Ele          Ele Weight(+100%)
I3:Rud          Rud Weight(+100%)
I4:Ail          Ail Weight(+100%) Expo(30%) Switch(SG↑) [HiRate]
                Ail Weight(+80%) Expo(20%) Switch(SG-) [MdRate]
                Ail Weight(+60%) Expo(10%) Switch(SG↓) [LoRate]
I5
```

With the line editing window open, when one clicks on the switch box, a drop-down box with a number of options come up. Some of these are switch options, other options will be covered later in this section, or in later sections. The switches are designated with a symbol after them. **SG↑** means switch **G** is in the up position, **SG–** means switch **G** is in the mid position and **SG↓** means switch **G** is in the down position. An exclamation mark before the switch inverts the operation. This is one to watch, it is easy to accidentally select this and wonder why things don't work as they should! Also **OpenTX** works down the list of commands in order. As set out above the rates and expo work as expected on the simulator. You will find the three positions for **SG** at the top of the simulator window with a blue button. As with the joystick it is moved by clicking and holding on the blue button and dragging it down.

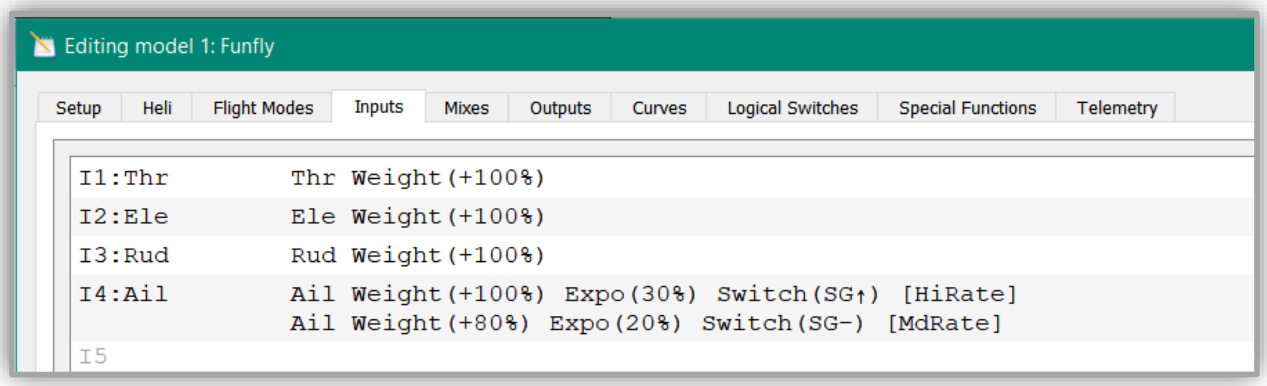


Input name: Ail
Line name: Med Rate
Source: Ail
Include Trim: Yes
Weight: □ GV 80
Offset: □ GV 0
Curve: Expo □ GV 20
Flight modes: 0 ☑ 1 ☑ 2 ☑ 3 ☑ 4 ☑ 5 ☑ 6 ☑ 7 ☑ 8 ☑
Switch: SG-
Stick Side: ALL

However, try editing **I4:Ail** so that the first line reads:

Ail Weight (+100%) Expo (30%) [Hi Rate]

The rates no longer work, because this altered line now states that in all conditions make weight 100% and expo 30%. **OpenTX** thus ignores the other two lines. Try altering the aileron input lines to now read the following so that you just have 2 rate settings and check the operation using the simulator.

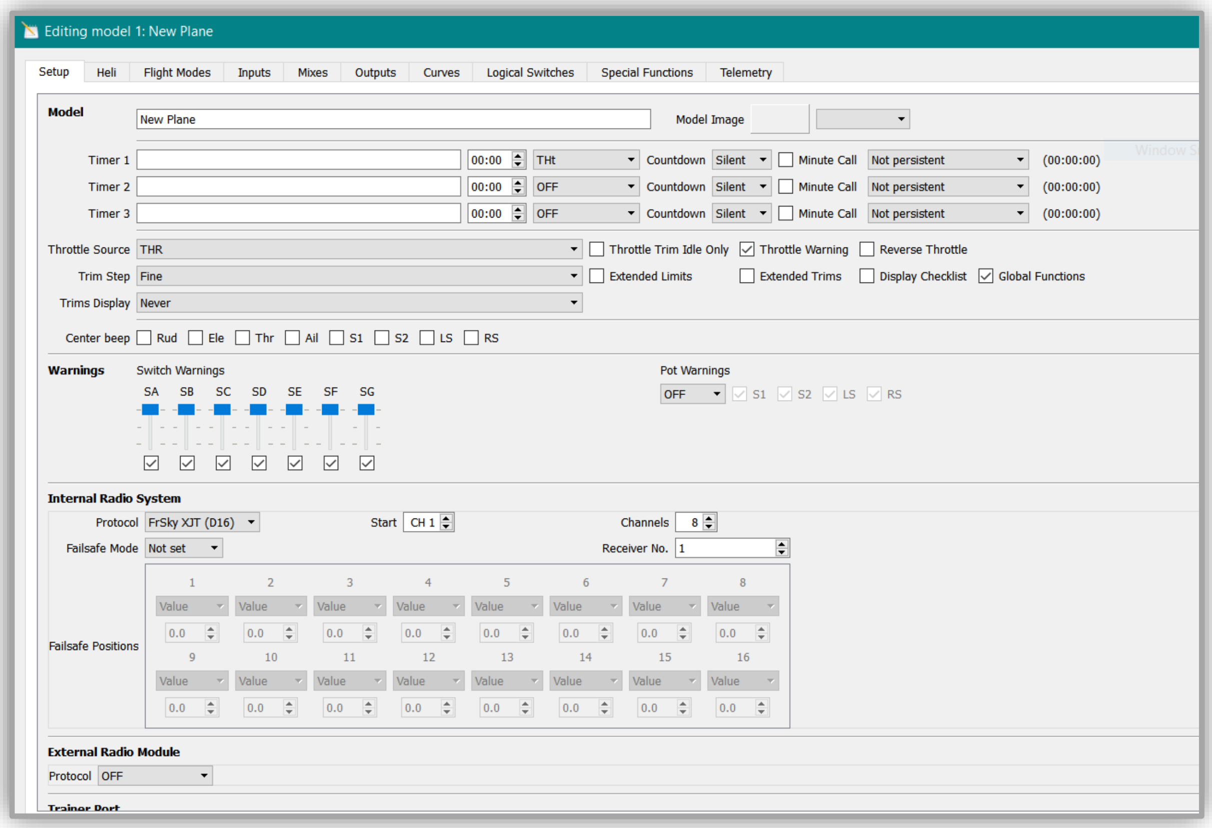


```
I1:Thr        Thr Weight(+100%)
I2:Ele        Ele Weight(+100%)
I3:Rud        Rud Weight(+100%)
I4:Ail        Ail Weight(+100%) Expo(30%) Switch(SG↑) [HiRate]
              Ail Weight(+80%) Expo(20%) Switch(SG-) [MdRate]
I5
```

Can you see what has happened? If **SG** is in the down position, both the lines for the aileron are ignored, and effectively there is no aileron control. **OpenTX** does need to be used with some care, and this is why the **Companion** is so useful, it is very easy to check for mistakes using the simulator. However, it quickly becomes second nature to program in a way that avoids these errors.

The Setup Window

Hopefully by now, the **OpenTX** approach is beginning to make some sense. Do remember that further detail on some functions can be found in the later sections. Next we will look at how to set up a new basic model using the **OpenTX Companion**, and prepare it for its maiden flight. The example will be a fairly basic model with a motor, a single aileron servo, and a traditional rudder and elevator. We will add a throttle timer. This basic plane can be set up using the **OpenTX Companion Wizard**, and the **Editing** Window opened:



Editing model 1: New Plane

Model New Plane   Model Image

Timer 1   00:00   THt   Countdown   Silent   □ Minute Call   Not persistent   (00:00:00)
Timer 2   00:00   OFF   Countdown   Silent   □ Minute Call   Not persistent   (00:00:00)
Timer 3   00:00   OFF   Countdown   Silent   □ Minute Call   Not persistent   (00:00:00)

Throttle Source THR   □ Throttle Trim Idle Only   ☑ Throttle Warning   □ Reverse Throttle
Trim Step Fine   □ Extended Limits   □ Extended Trims   □ Display Checklist   ☑ Global Functions
Trims Display Never

Center beep □ Rud □ Ele □ Thr □ Ail □ S1 □ S2 □ LS □ RS

Warnings   Switch Warnings   SA ☑ SB ☑ SC ☑ SD ☑ SE ☑ SF ☑ SG ☑
Pot Warnings OFF ☑ S1 ☑ S2 ☑ LS ☑ RS

Internal Radio System
Protocol FrSky XJT (D16)   Start CH 1   Channels 8
Failsafe Mode Not set   Receiver No. 1

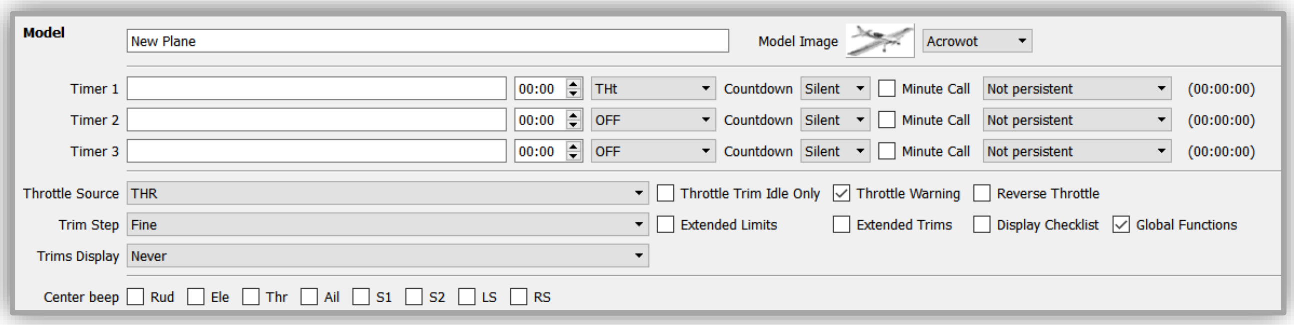
Failsafe Positions

1	2	3	4	5	6	7	8
Value	Value	Value	Value	Value	Value	Value	Value
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	10	11	12	13	14	15	16
Value	Value	Value	Value	Value	Value	Value	Value
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

External Radio Module
Protocol OFF

Trainer Port

This is the basic **Setup** window created once the Wizard has finished. You need to either right click on the model in the model window and select edit, or double click on the model to open this window up. I've called the plane "New Plane", sorry if it's not very imaginative! One can add a small picture of one's plane. **OpenTX** provides a whole file of them, with more being added all the time, and, of course, you can create your own. These pictures, and the sounds, will only show if you have downloaded the contents of the SD card to your computer.



Model New Plane   Model Image Acrowot

Timer 1   00:00   THt   Countdown   Silent   □ Minute Call   Not persistent   (00:00:00)
Timer 2   00:00   OFF   Countdown   Silent   □ Minute Call   Not persistent   (00:00:00)
Timer 3   00:00   OFF   Countdown   Silent   □ Minute Call   Not persistent   (00:00:00)

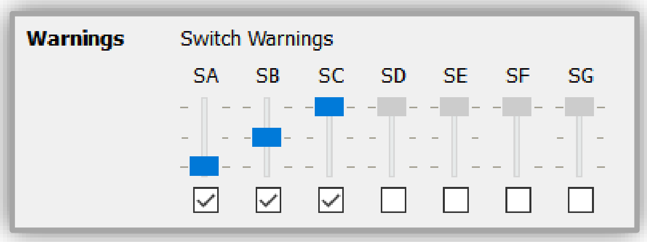
Throttle Source THR   □ Throttle Trim Idle Only   ☑ Throttle Warning   □ Reverse Throttle
Trim Step Fine   □ Extended Limits   □ Extended Trims   □ Display Checklist   ☑ Global Functions
Trims Display Never

Center beep □ Rud □ Ele □ Thr □ Ail □ S1 □ S2 □ LS □ RS

This next part of the screen shows various model settings, including the timer options. The timer options are very flexible, **Timer 1** will have been set to **THt** by the wizard, **Timer 2** and **Timer 3** are off. This means that **Timer 1** will start first time the throttle is opened. Other options include **THs** runs when the throttle is not at idle, **TH%** counts up as a percentage of the full stick range and **ABS** counts up all the time. If value is set to 00.00, the timer will count up from 0, if not, the timer will count down from a preset value entered in minutes and seconds. Countdown will give announcements several times during the last minute, whereas minute call will beep/say the time every full minute. **Persistent**, if ticked, means the value is stored when the radio is powered off and later switched on again. This is useful if one takes a number of short flights without refuelling or changing the battery.

The trim step is a useful function. Here one can set how the trims behave for a new model. **Exponential** is a useful option, together with a very novel feature which is covered later. For electric models, the throttle warning is very useful as it warns if the joystick is not fully down when switching on or changing models. Similarly, the reverse throttle may be of value to Futaba owners, as those sets reverse the throttle, awkward for electric flyers. It is not advisable to use extended limits to be able to move servos more than 100%. The normal servo travel with **OpenTX** is greater than, say, Spektrum gear and is equivalent to their setup with 25% extended trims. Some modern servos do very odd things when moved outside their normal operating range.

The next set of boxes are switch warnings. Basically a warning will be given when the transmitter is switched on if the ticked switches are not in the positions selected. This is very useful for some functions, say like a throttle disable switch. However, it can simply be a nuisance for non-critical or unused switches so they do need to be set correctly.

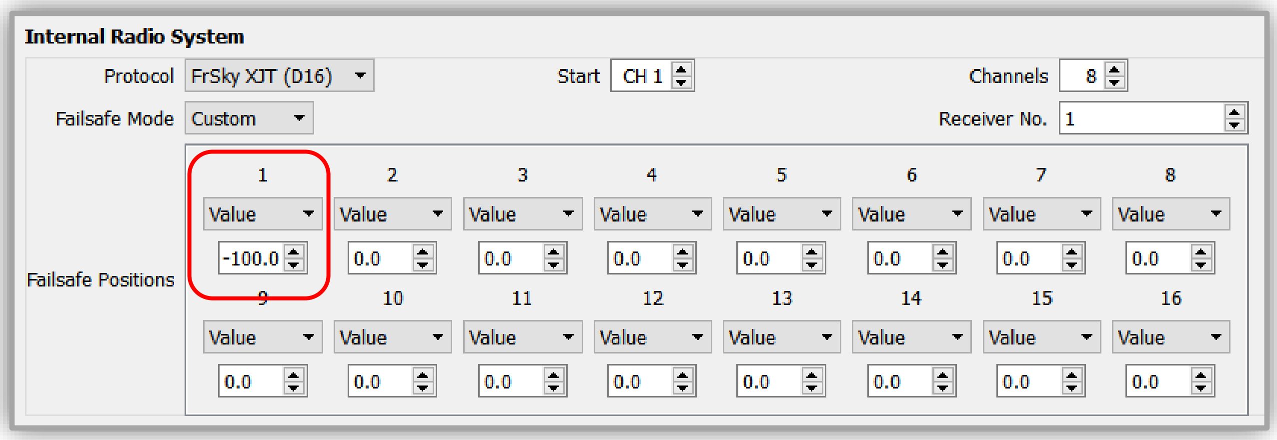


Warnings

Switch Warnings

SA	SB	SC	SD	SE	SF	SG
☑	☑	☑	□	□	□	□

The box below looks complicated. Essentially one first sets it for the type of FrSky receiver being used. With the latest range, X8R, X6R and X4R, the **XJT D(16)** protocol is used. This relates to the FrSky bit of the firmware which takes the **OpenTX** outputs, and transmits the signal to the plane. Other protocols are available, however for most one needs a specific module to be inserted in the bay at the back for this to work.



Internal Radio System

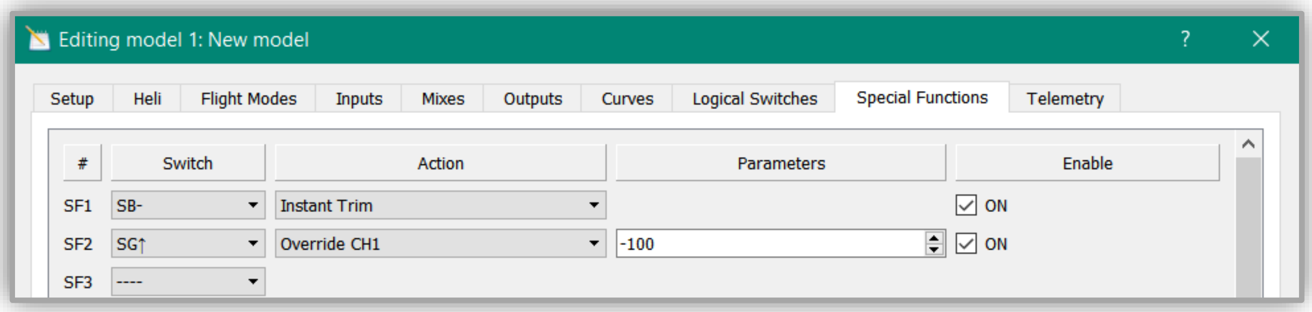
Protocol: FrSky XJT (D16)
Start: CH 1
Channels: 8
Failsafe Mode: Custom
Receiver No.: 1

Failsafe Positions

1	2	3	4	5	6	7	8
Value	Value	Value	Value	Value	Value	Value	Value
-100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Value	Value	Value	Value	Value	Value	Value	Value
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

It is best for each receiver to have its own number. A very important feature of any radio today is the failsafe mode. Here the throttle is set to -100 which is off, and the other control surfaces to neutral. Obviously one can set these to one's preferred failsafe setting. If one does not set failsafe, a warning will come up on the transmitter every time that model is selected. This is a really simple and effective way to set the failsafe and can be done before or after one binds a receiver. It should be noted that values set here are not affected by any weighting given later. Failsafe can also be set in the more conventional way by pressing the F/S button on the receiver.

Next we shall move to an entirely new window, the **Special Functions** window. It is here we can create some of the magical effects which really make **OpenTX** so special. As this is a new plane, and we are somewhat worried about the maiden flight, we can either have a fellow flyer standing beside the transmitter ready to move the trims in response to one's frantic appeals for more left aileron trim, or we can program a special function to very simply do the job.

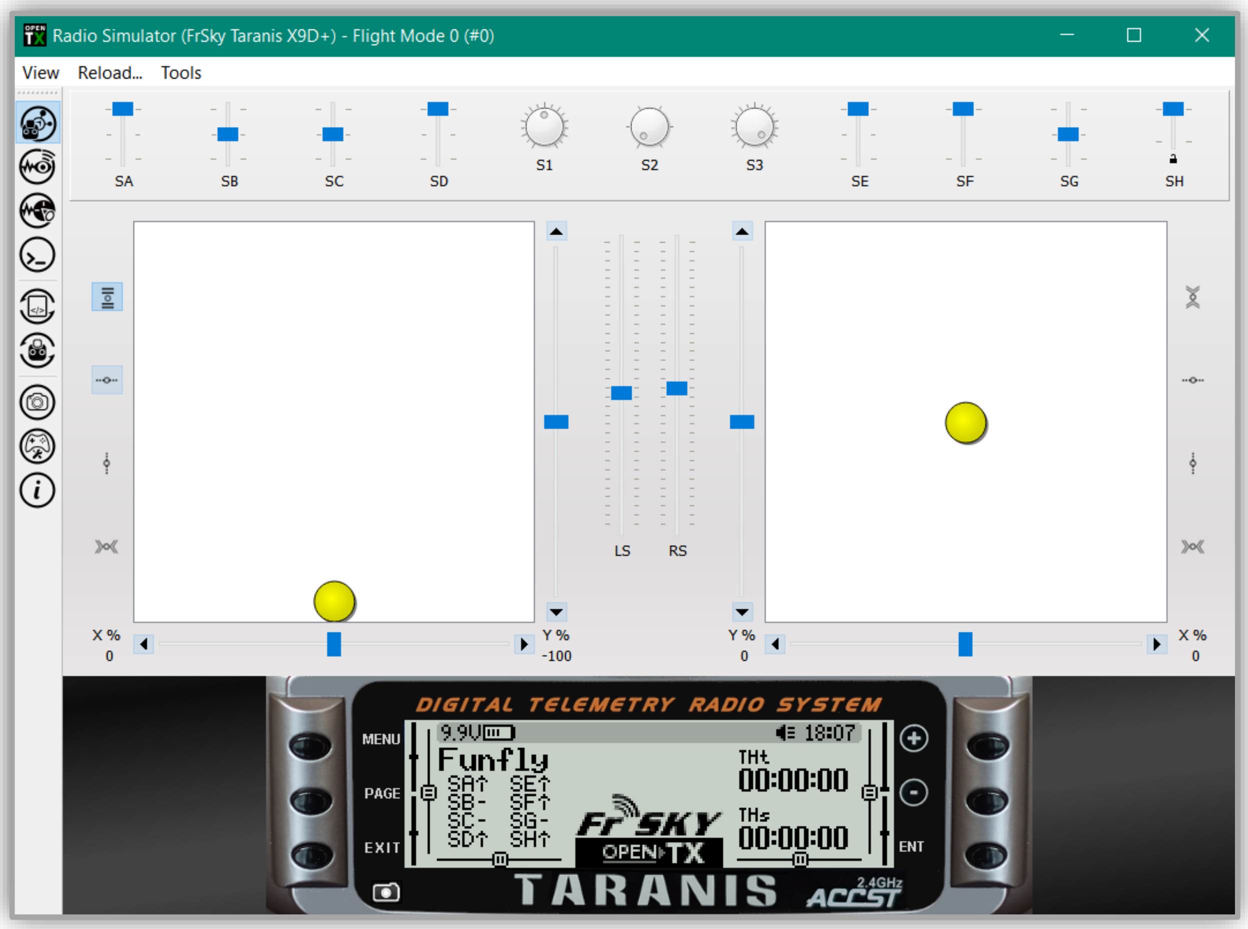


#	Switch	Action	Parameters	Enable
SF1	SB-	Instant Trim		☑ ON
SF2	SG↑	Override CH1	-100	☑ ON
SF3	----			

Here **SF1** sets switch **B** to instantly trim the model. Thus on the maiden flight you may well be having to hold quite a lot of aileron and elevator in to get level flight. Keep the model flying level, then flick switch **B** and this will set the trims to the current joystick positions. You still have the option of using the normal trims as well. Switch **B** is perhaps the best switch for a mode 2 flyer, however, any unused switch can be used. Once the maiden flight is over, the plane trimmed and the hands have stopped shaking then it is just a matter of scrolling through the transmitter menu to the **Special Functions** screen, and unchecking the **ON** box to disable this function so that it is not accidentally activated again.

SF2 programs switch **G** in the up position to override whatever position channel 1, the throttle joystick, is in and give it a value of -100. In this case -100 will turn the throttle completely off. Here we have a simple switch setting to disable the throttle for electric flyers to prevent the motor starting by accidentally knocking the joystick.

You can test both of these functions out using the simulator. To test the instant trim, you will need to click the **Hold X** box and the **Hold Y** box to stop the joystick self-centring while you move switch **G**. Later we will look at how we can add a sound warning when the throttle is enabled.

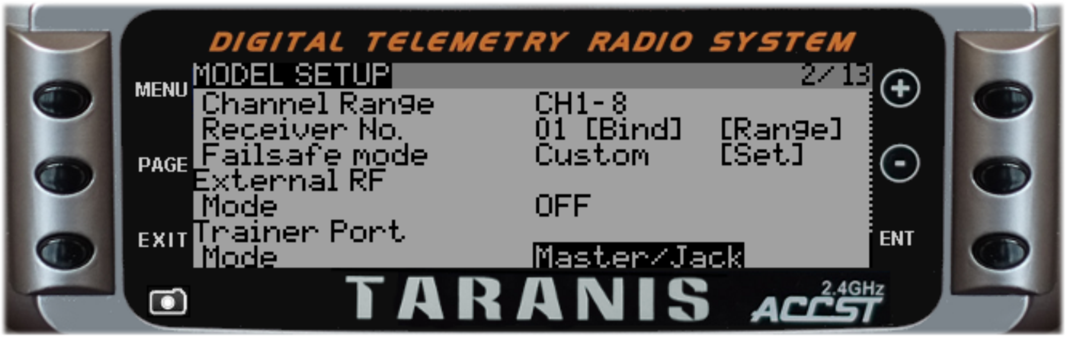


Now go back to the first editing window on the **OpenTX Companion** editing window, **Setup**, and click on the simulator. Below the joystick representation we see a simulation of the Taranis transmitter screen. (Different screens will come up depending on the transmitter selected earlier.) There are six buttons, three each side, and clicking on them operates the screen in exactly the same way as pressing the actual buttons on the transmitter. Basically the buttons all operate on a system of short or long presses. **EXIT** leaves that particular element, and when you get to a particular feature you want to edit, press **ENT**, (short for enter). The up and down buttons scroll up and down a menu or change a value. Menus will scroll round, so when you get to the bottom of a menu pressing down again will bring you back to the top. This is particularly useful when you know the item you want is near the bottom of a menu.

A long press on the **MENU** button takes one to the transmitter setup screens, nine in total. You get the next page of the menu by a short press on the page button. A long press takes you back. This sequence of menus equates to the menus seen in **General Settings**. Press the **EXIT** button to return to the main screen of the simulator.

A short press on the **MENU** button brings up the first of 13 screens which allows one to change models. This is quick and easy to do in the field. Pressing **PAGE** brings up screen 2. The screen number can be seen at the top right hand corner. Screen 2 corresponds to the Setup tab on the **Companion** editor. One only has to scroll through this screen a few times to realise how much easier it is to use the **Companion** than the transmitter for setting up. There are 2 features at the bottom of this screen not found on the **Companion**:

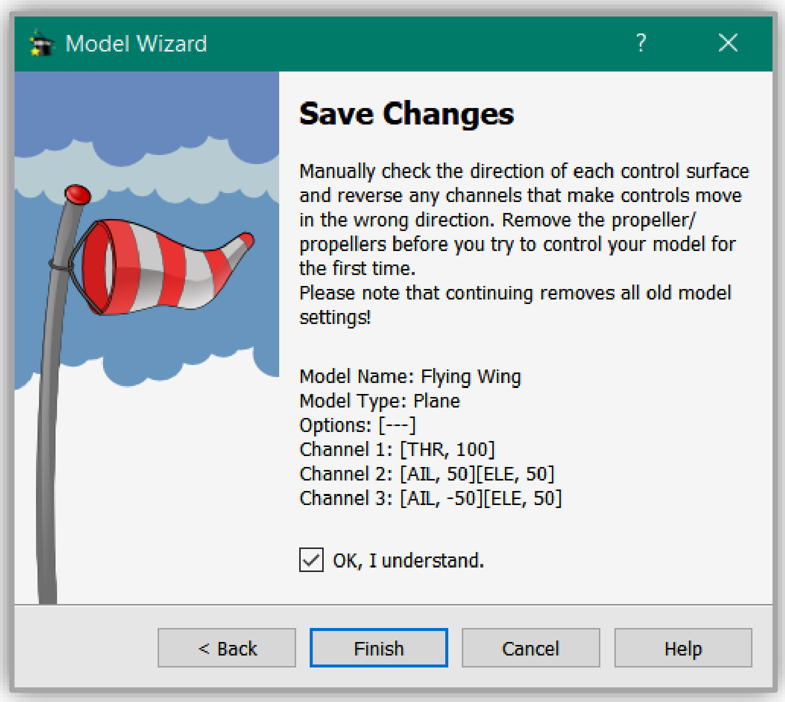
They are **Bind** and **Range**. **Bind** is used to bind a new receiver, and **Range** performs the field range test. The latter is great to use because you actually get to see (and hear) the signal strength seen by the receiver, so no faffing about waggling sticks needed. In reality expect to walk a long way! Incidentally, if you click on the failsafe mode **Set** tab, and then press **ENT**, another screen will pop up showing the current failsafe settings. Remember we set just the throttle to be off earlier.



```
MODEL SETUP                         2/13
 Channel Range        CH1-8
 Receiver No.         01 [Bind]  [Range]
 Failsafe mode        Custom     [Set]
External RF
 Mode                 OFF
Trainer Port
 Mode                 Master/Jack
```

Going Beyond Basics

Let's develop what we have learned so far to show that once we have begun to understand how **OpenTX** works, it is very easily adaptable for different models and for advanced features. This is when **OpenTX** really begins to challenge that nagging feeling of, "What's the point, this is too complicated for me, bring back my basic 35Mhz radio". To start, consider that new flying wing with an electric motor and just two servos to control elevons. Using the Wizard, we can quickly program such a system with no rudder. Channel 1 output is set to throttle, and channels 2 and 3 outputs are set to elevons.



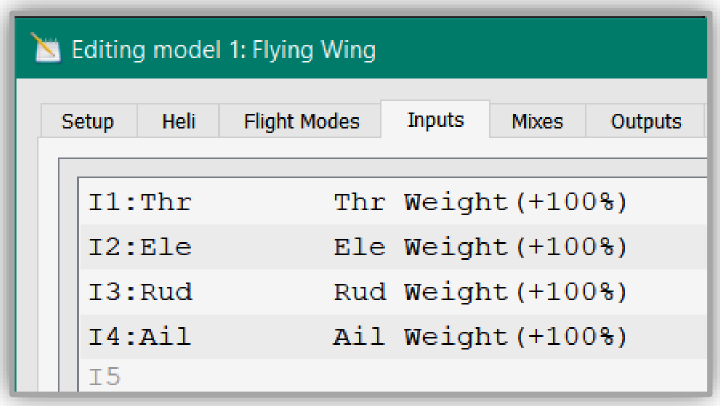
Save Changes

Manually check the direction of each control surface and reverse any channels that make controls move in the wrong direction. Remove the propeller/propellers before you try to control your model for the first time.
Please note that continuing removes all old model settings!

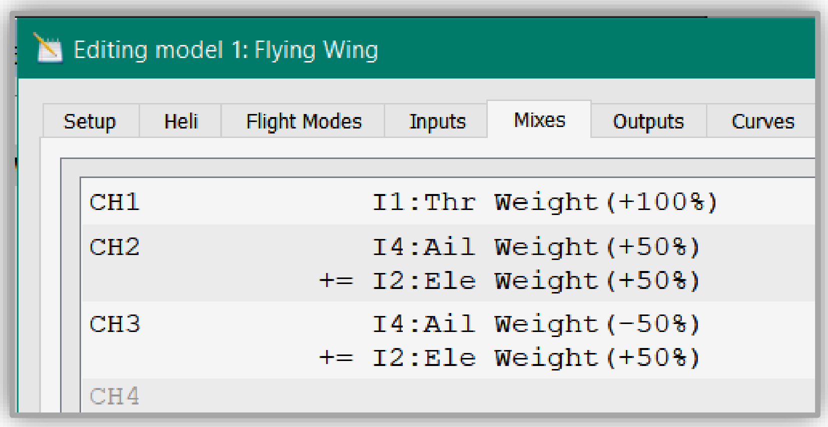
Model Name: Flying Wing
Model Type: Plane
Options: [---]
Channel 1: [THR, 100]
Channel 2: [AIL, 50][ELE, 50]
Channel 3: [AIL, -50][ELE, 50]

☑ OK, I understand.

The **Inputs** window looks like this. The order of the 4 inputs is how they were identified up on the **Setup** page. Although we are not using the rudder it still shows here; not sure why. It's not really needed and could be deleted.



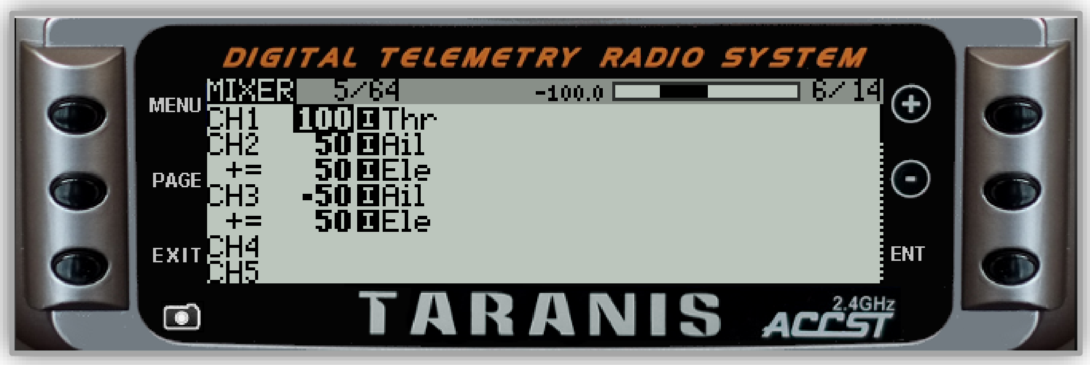
```
I1:Thr          Thr  Weight(+100%)
I2:Ele          Ele  Weight(+100%)
I3:Rud          Rud  Weight(+100%)
I4:Ail          Ail  Weight(+100%)
I5
```



```
CH1             I1:Thr Weight(+100%)
CH2             I4:Ail Weight(+50%)
             += I2:Ele Weight(+50%)
CH3             I4:Ail Weight(-50%)
             += I2:Ele Weight(+50%)
CH4
```

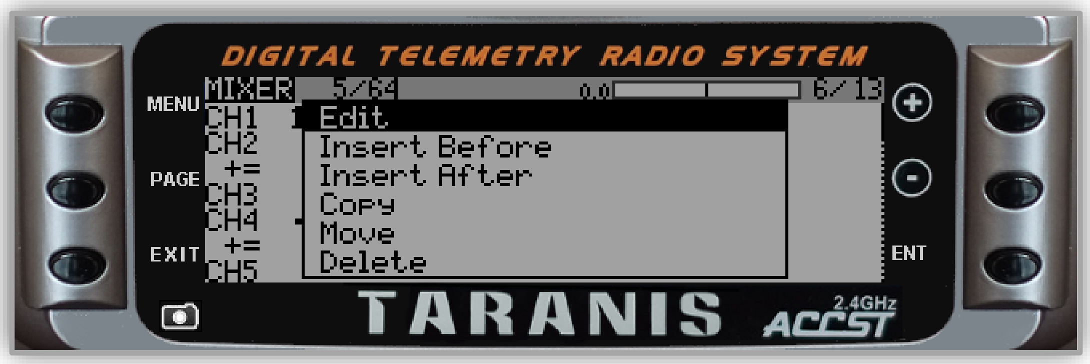
The **Mixes** window shows how the elevons are created from these inputs. Channel 2 output adds the aileron input and the elevator input both at 50% of their weight, so the maximum combined weight is 100%. Channel 4 though is set with a negative aileron weight to give an opposite movement of the servo. The more observant of you might realise that while the Wizard follows the normal channel order on the **Inputs** page, the **Mixes** page puts the **output** order as specified in the Wizard. This simple flying wing setup really demonstrates the power of **OpenTX**. Yes, there is a steep learning curve to understand the logic of the system, but then that logic can be applied very easily to much more complex models. In reality when one asked for elevons on any transmitter, this is exactly the mixing that goes on, though we are probably not aware of what is happening.

The simulator shows the various servo movements. If, on its test flight our flying wing proved to be a bit tame on the elevator, but very twitchy on ailerons, the weights can be adjusted to give more elevator movement and less aileron movement but keeping the total possible throw the same. Using the simulator, we can practice altering these weights on the transmitter. Sadly, though it does not change the values in the model script, though it will show on the **Outputs** window of the simulator. Once you leave the simulator these settings will be lost. It is useful to get this experience to be fully familiar with changing settings down at the field. Try altering the aileron weight to 40%. A short press of the **MENU** key brings up the **Model Selection** menu. Short presses of the **PAGE** button will then move forward through the various pages. Remember that a long press of the **PAGE** button will move back a page. Page 6 brings up the **Mixer** window:

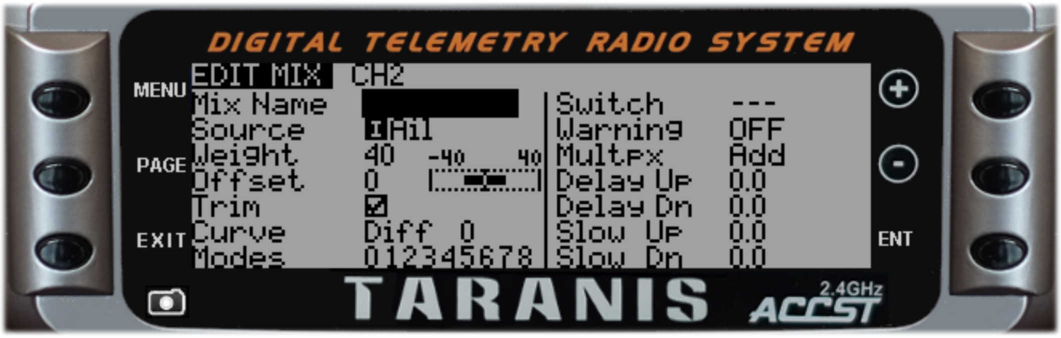


```
MIXER   5/64        -100.0           6/14
CH1   100 I Thr
CH2    50 I Ail
  +=   50 I Ele
CH3   -50 I Ail
  +=   50 I Ele
CH4
CH5
```

Then use the ⊕ and ⊖ buttons to move down to **CH2**, and after a long press of the **ENT** key, the following menu will appear:



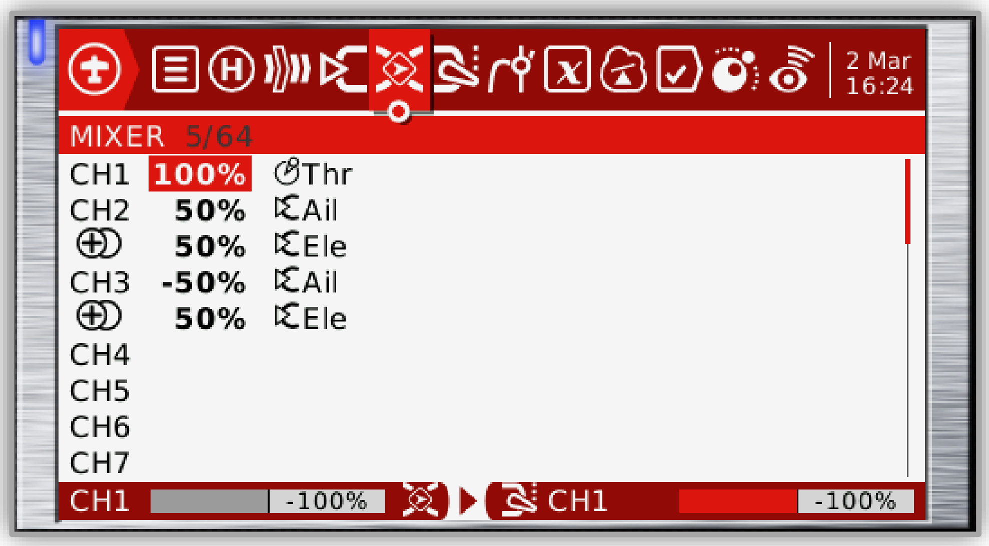
These are the same options as offered on the **Companion**. We want to edit the settings, so with **Edit** highlighted, press **ENT**.



```
EDIT MIX  CH2
Mix Name                      | Switch     ---
Source    I Ail               | Warning    OFF
Weight    40      -40      40 | Multpx     Add
Offset    0                   | Delay Up   0.0
Trim      ☑                   | Delay Dn   0.0
Curve     Diff  0             | Slow Up    0.0
Modes     012345678           | Slow Dn    0.0
```

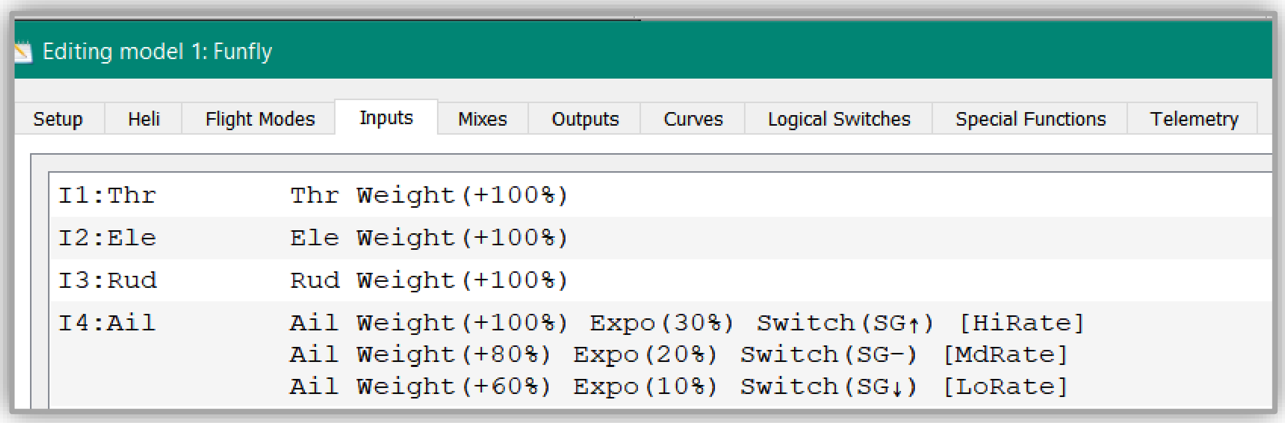
Again we get the same options that are available with the **Companion**. Scrolling down to the weight line with the ⊕ and ⊖ and pressing **Ent** will allow the weight to be changed to 40%. Repeated presses of the **EXIT** button will return to the main screen. By using the outputs screen, the aileron action can be tested. Remember, we only changed one aileron, so both ailerons will move differing amounts.

On the Horus, the procedure is exactly the same, however the screen is slightly different. The sign for the input is now shown as: ⋉ and the page is now page 5.



```
MIXER  5/64
CH1  100%  Thr
CH2   50%  Ail
      50%  Ele
CH3  -50%  Ail
      50%  Ele
CH4
CH5
CH6
CH7
CH1  -100%  ▶  CH1  -100%
```

One aspect of **OpenTX** coupled with the Taranis and Horus transmitters is its ability to play sounds. While I know sound may annoy some flyers, the information and feedback provided by this system is enormously useful. If there are major grumbles about the sound one can always use a single earpiece plugged into the headphone socket. Earlier we saw how to add triple aileron rates:

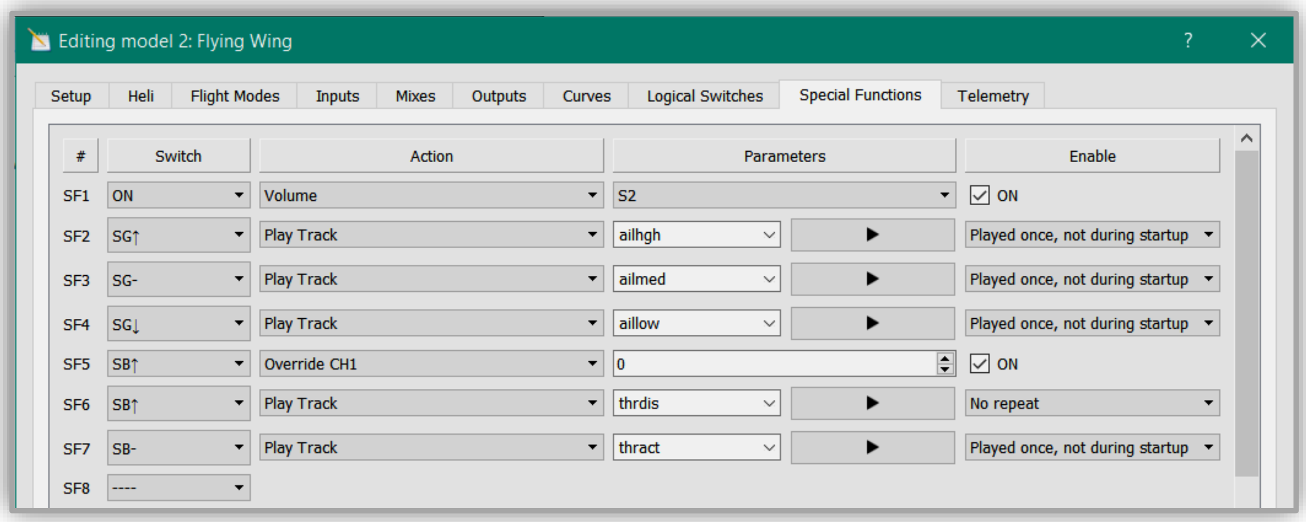


Editing model 1: Funfly

```
I1:Thr        Thr Weight(+100%)
I2:Ele        Ele Weight(+100%)
I3:Rud        Rud Weight(+100%)
I4:Ail        Ail Weight(+100%) Expo(30%) Switch(SG↑) [HiRate]
              Ail Weight(+80%) Expo(20%) Switch(SG-) [MdRate]
              Ail Weight(+60%) Expo(10%) Switch(SG↓) [LoRate]
```

With so many switches on the transmitter, it makes sense to have audible feedback. It is very reassuring to know one has changed the right switch without having to look down at the transmitter. Sound is added on the **Special Functions** screen. We can also program one of the four sliders to act as a volume control.

This screen shows a number of special functions assigned.



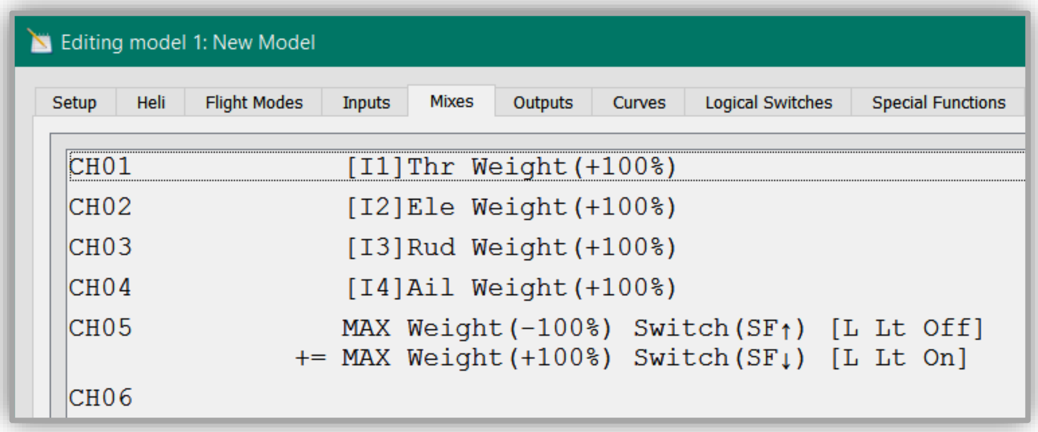
Editing model 2: Flying Wing

#	Switch	Action	Parameters		Enable
SF1	ON	Volume	S2		☑ ON
SF2	SG↑	Play Track	ailhgh	▶	Played once, not during startup
SF3	SG-	Play Track	ailmed	▶	Played once, not during startup
SF4	SG↓	Play Track	aillow	▶	Played once, not during startup
SF5	SB↑	Override CH1	0		☑ ON
SF6	SB↑	Play Track	thrdis	▶	No repeat
SF7	SB-	Play Track	thract	▶	Played once, not during startup
SF8	----				

One is allowed up to 64 special functions for each model. **SF1** is programmed to use the rotary knob **S2** as a volume control. **SF2**, **3** and **4** are programmed to play the appropriate voice message for each aileron rates switch position. If the file location of the SD card files on the computer is correctly identified on the **Setup** screen, then the list of available phrases will scroll down in the **Parameters** box. (This example uses the “Amber” sound file.) Each sound can be tested out. More phrases can be added by recording one’s own using a microphone or using text-to-speech software (See the “How To” section). Earlier we saw the simple function added to switch **B** to disable the throttle. This is function **SF5**. We can add speech feedback to this switch too with “throttle disabled”, or “throttle active”. If one would prefer, there are phrases to say “engine disabled” or “engine off” or “engine on”.

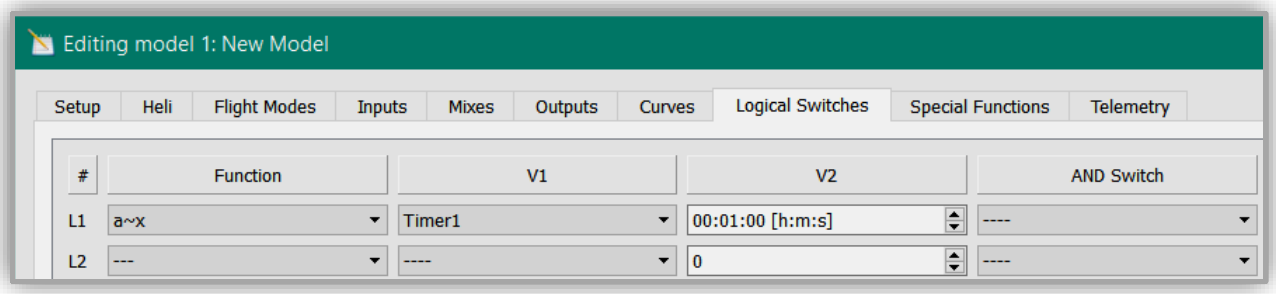
A further use of the sound feature is linked to the extensive, but very inexpensive telemetry options available. One can get **OpenTX** to automatically read out telemetry values when either certain conditions are met, or when a switch is enabled, however more on this later in the series.

Next, a quick look at two of the more advanced options on **OpenTX**. The first is **Logical Switches**. Essentially these logical switches allow us to develop our own rules, which, if the condition is met, will have some outcome. Just to give a simple example, your favourite scale model has working landing lights which you would like to use every time you come in to land. Easy with **OpenTX**, simply assign a switch, say switch **F**, and link it to an output, say channel 5. On the mixes screen it would look like this:



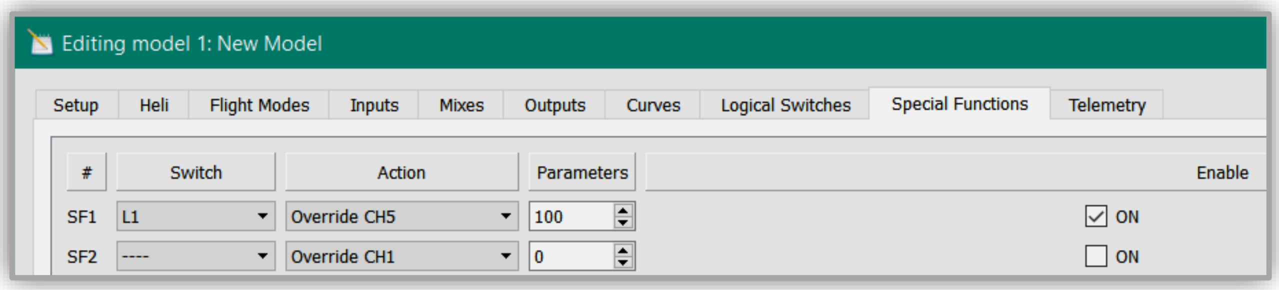
```
CH01          [I1]Thr Weight(+100%)
CH02          [I2]Ele Weight(+100%)
CH03          [I3]Rud Weight(+100%)
CH04          [I4]Ail Weight(+100%)
CH05          MAX Weight(-100%) Switch(SF↑) [L Lt Off]
           += MAX Weight(+100%) Switch(SF↓) [L Lt On]
CH06
```

This is a somewhat inelegant procedure. In the long list of sources is the value **MAX**, which sets the weight to 100%. However, our electronic switch in the plane expects a minimum value to switch off and a maximum value to switch on. Therefore, the two position switch is set to a weight of -100% in the off position, and +100% in the on position. But we're not satisfied with that. We also want the switch to come on automatically just before we land. Here we could tap into the timer we are using on the transmitter and when the countdown has reached one minute put the lights on for us. This is where the logical switches come in.



#	Function	V1	V2	AND Switch
L1	a~x	Timer1	00:01:00 [h:m:s]	----
L2	---	----	0	----

Add the line above to program logical switch **L1**, and then in the **Special Functions** window add a line to program Channel 5 output. Remember to tick the **ON** box. This makes the special function operate immediately when logical switch is true.

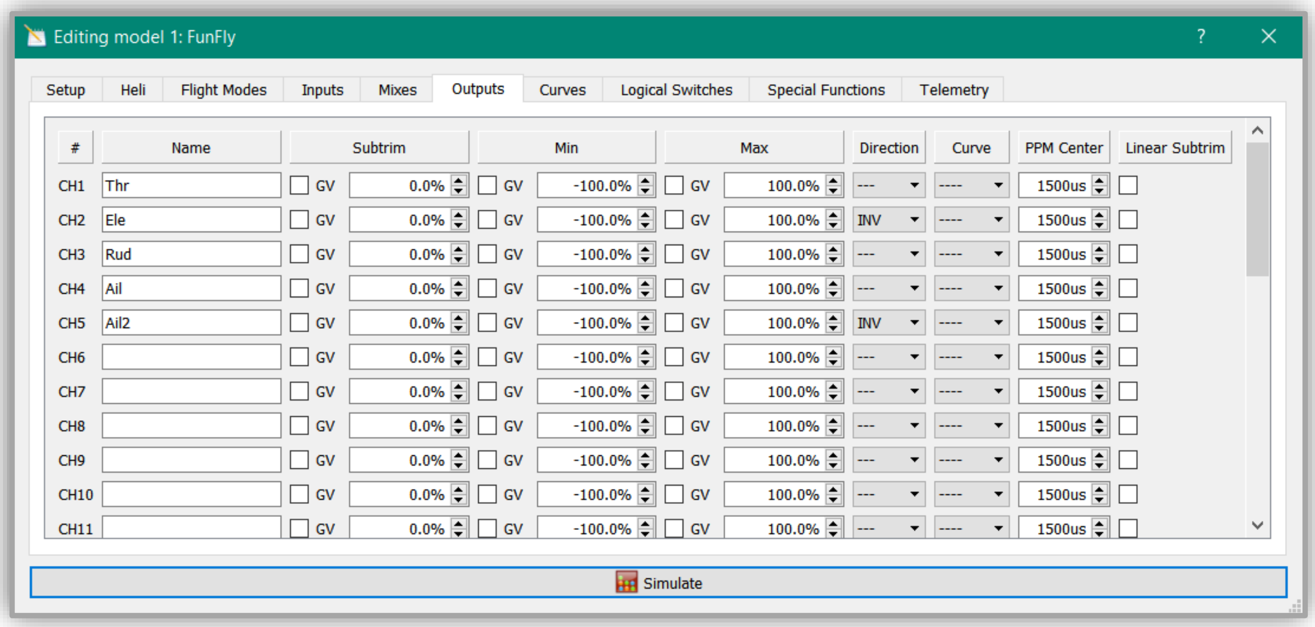


#	Switch	Action	Parameters	Enable
SF1	L1	Override CH5	100	☑ ON
SF2	----	Override CH1	0	□ ON

Check in the **Setup** window, that a throttle timer has been set using **THt**, and the time set (1 minute 30 seconds is sensible for this demonstration), and open the simulator. As the throttle, by default, opens at mid-point on the simulator, the timer will start straight away. After half a minute, channel 5 will suddenly switch fully on and the **L1** box will show green. There are all sorts of applications for logical switches such as putting delays into bomb doors, or sequencing landing gear.

Going back to the **Logical Switches** screen, there are a list of functions in the scroll down box. The basic ones are **a=x** or **a~x**, meaning in the first case, **a**, or **V1** equals **x** or **V2**, so when **V1** and **V2** are equal, the logical switch will go active. The **~** sign means “roughly equal”. It is sometimes better to use this roughly equal as occasionally **OpenTX** might never see the exact value of **x**, especially when looking at joystick values; computers are picky, precise machines. It should be noted however, that the **~** can be very imprecise when used with such things as time. If you want something to happen at an exact time, then use the **=**. We also have **a<x**, and **a>x**, a is less than **x** and a is greater than **x**. **|a|** means that **a** is converted to a positive value. **a=b** compares two sources directly without having to specify a value. Edge is quite interesting as it can be used to say get a momentary switch to do different things depending on how long the switch is pressed. It takes some experimenting though. The **AND** switch allows another condition to be added, **Duration** is the time the condition remains active, and **Delay** sets the time before the condition starts. Going back to our throttle disable system, we could enhance this and use the logical switches to ensure that the motor was enabled only if both the throttle was off and switch **SB** is on.

Finally, a quick mention of the **Outputs** screen. Generally, this is only useful for a quick way of reversing servos, or perhaps for setting servo travel limits and centres to suit other makes of radio gear if changing a receiver over to the FrSky Taranis system. Even then it is far better to spend some time to check and reset all the control surfaces to suit the new radio, and, if it is an electric plane, then naturally with the propeller removed! See the later sections for a more in-depth understanding of the **Outputs** screen.



#	Name		Subtrim		Min		Max	Direction	Curve	PPM Center	Linear Subtrim
CH1	Thr	□ GV	0.0%	□ GV	-100.0%	□ GV	100.0%	---	----	1500us	□
CH2	Ele	□ GV	0.0%	□ GV	-100.0%	□ GV	100.0%	INV	----	1500us	□
CH3	Rud	□ GV	0.0%	□ GV	-100.0%	□ GV	100.0%	---	----	1500us	□
CH4	Ail	□ GV	0.0%	□ GV	-100.0%	□ GV	100.0%	---	----	1500us	□
CH5	Ail2	□ GV	0.0%	□ GV	-100.0%	□ GV	100.0%	INV	----	1500us	□
CH6		□ GV	0.0%	□ GV	-100.0%	□ GV	100.0%	---	----	1500us	□
CH7		□ GV	0.0%	□ GV	-100.0%	□ GV	100.0%	---	----	1500us	□
CH8		□ GV	0.0%	□ GV	-100.0%	□ GV	100.0%	---	----	1500us	□
CH9		□ GV	0.0%	□ GV	-100.0%	□ GV	100.0%	---	----	1500us	□
CH10		□ GV	0.0%	□ GV	-100.0%	□ GV	100.0%	---	----	1500us	□
CH11		□ GV	0.0%	□ GV	-100.0%	□ GV	100.0%	---	----	1500us	□