The FrSky Q X7(S) and Companion Programming Guide

A guide to programming a model using the FrSky Taranis Q X7(S)
and OpenTx Companion

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DISCLAIMER

This document is for guidance only, it is the readers responsibility to understand the programming process and the effect on the model, and to thoroughly test the model operation before flight.

This document is not a complete, comprehensive or thorough guide to using the Q X7(S) nor OpenTx Companion.

The operating software (firmware or FW) for the Q X7(S) and Companion is available in many versions. The versions used in this document are listed in Chapter 3. No consideration has been given to any other versions of either FrSky or OpenTx software, nor any models other than those discussed in this document.

No responsibility is accepted for any harm to persons or damage to property, howsoever caused, arising from the use of this document.

1 Introduction

This document provides a practical guide to setting up the Q X7(S) for three types of model glider, using a combination of the Q X7(S) and OpenTx Companion. Before any programming is undertaken, the necessary supporting elements are introduced and the software elements of the Q X7(S) are explained. This document shows one way to set up models on the Q X7(S).

Note that the as-bought Q X7(S) contains proprietary FrSky software. The OpenTx team state "For Taranis users: Please note that your radio has been delivered with a firmware that is customised and exclusive to FrSky, and is not part of the OpenTX team's offerings and development cycle. It is supposed to be used on its own, exclusively on the radio (no companion), and is supported directly by FrSky which means that should something not work or any feature request should be expressed directly to them. It is stable and suitable for most usage cases, and is the preferred version that most Taranis owners should likely be using. Switching to the OpenTX team's releases and using tools like companion should be considered an "advanced" usage scenario…". http://www.open-tx.org/downloads

This document primarily uses a Q X7(S) with OpenTx software installed but much of the content is applicable to the Q X7(S) programming.

The first model programmed is a simple rudder / elevator model used primarily to introduce, and then examine, the various aspects of the programming. Next, a delta wing model is developed. Using Companion and the delta wing as a base-line, an in-depth look at each of the main tabs, INPUTS, MIXES and OUTPUTS, is used to explain how to build the programme.

The next stage is to add common capabilities found on conventional radio control transmitters, such as differential, exponential and rates. To complete the task, the delta wing model programme is uploaded to the Q X7(S) and tested on the model.

The third model, a 4-servo wing sport model, is a development of the rudder / elevator model, and incorporates crow brakes and camber control. Programme development is along the same lines as for the delta wing.

With this programme uploaded to the Q X7(S), the model is 'fine-tuning' to adapt the Companion settings to suit the model itself. In doing so, some enhancements to the programming are applied to make the settings more flexible, less error prone and more readable.

The Appendices provide further detail on aspects pf programming the Q X7(S), such as programming the switches, tidying a programme, binding receivers, the use of Global Variables and more.

1.1 Notes

1. the term 'transmitter' also refers to the Q X7(S).
2. the term 'Companion' refers to the OpenTx Companion programme.
4. A few internet sources:
   a) In Youtube videos, Painless360 is particularly useful.
   b) OpenTx manual and more: http://rcdiy.ca
   c) a Companion guide at http://rcdiy.ca/introduction-to-opentx-companion/
   d) Other OpenTx manuals are at https://opentx.gitbooks.io/manual-for-opentx-2-2/
   and OpenTx University http://open-txu.org/

2 Common Notation in this Document

2.1 Words

The following words have a specific meaning within this document.

Channel:	a route whereby an INPUT gets to the OUTPUT (NOT the servo)
Control surface	a model control surface - ailerons, rudder elevator etc
ENT	press the transmitters ENT button. May be short or long press.
Function	Combined signals to provide a channel output, eg mixing to provide elevator compensation for a power model.
Line:	a line in a model programme
Long press	press, hold and release the indicated button
Model file:	the set of Companion model files identified as *.otx
Model Software	the programme for a specific model.
Operator	in a Line, something that modifies the output of the Line.
Press	press and release the indicated button (a short press)
Processed	a Line acted on by one or more operators.
Scroll	rotating the right–hand 'ENT' rotary button to increase / decrease a value.
Servo:	the physical device, not part of Companion software.
Surface	see control surface.
Tab	In Companion, a set of programming facilities (eg, Mixing = MIXES tab)
Toggle	for a switch, either one of two positions. For a programming selection, to switch between two sets of options.
Value	a number or symbol used in a Line

The Companion model file typically has many 'tabs'. In this document they are capitalised, eg 'Mixes' is shown as MIXES. Note the equivalent screen in the Q X7(S) is called MIXER.

2.2 Switch Positions

Switch positions are shown symbolically. A three-position switch has an up, middle and down position: UP shown as SA↑ MIDDLE shown as SA— and DOWN shown as SA↓
Another version of position selection is to only use one position, eg !SA↓.

See Appendix A1 for a review of switch operations and a programming example for each type.

2.3 Mouse Clicks

The normal mouse 'left button click' or the 'double left button click' is referred to as 'Click'. The different usage is determined by the menu context, as for Windows applications.

Stepping through several menu or screens is identified by the '>' symbol. For example, to open a Companion model file requires the following steps:
Left click on 'File, Left Click on 'Open', Double left click on file name'
This now becomes: Click 'File' > 'Open' > 'File Name'.

2.4 Companion Simulator Servo display.

To view servo outputs as bar graph:
Open Companion > Open model file > click on 'Simulate' > click on top menu bar 'View' > click on 'Radio Outputs'. (or press F2 key). The 'PAGE' key on the Q X7(S) can be used to select percent channel display at the same time.

3 Q X7(S) – Hardware and Software

3.1 Radio Hardware

Equipment used for this text were as follows:

1. Transmitter: Q X7(S), with EU/LBT software (as bought), but see Para. 3.2.1.
   Stick Mode 2, with Throttle, Aileron, Elevator, Rudder (TAER) configuration.
   External FrSky JR (DJT) radio module initially fitted, but see Para 3.2.2.
2. OpenTx Companion V2.2.
3. Receivers: FrSky 'D' series, 'X' series

3.2 Q X7(S) Software

There are two software elements to the Q X7(S) - the operating software (or firmware) and the transmitter module software. A third, independent, software element is the model programme, generated either in the Q X7(S) or in Companion and uploaded to the Q X7(S).

3.2.1 EU Compatibility

In the Companion guide at Para 1.1.4.c, referring to the Transmitter Profile – Build Options, it states "eu – Removes D8 and LR12 Frsky protocols that are illegal in Europe after Jan 1st, 2015". This is the implementation of the EU Listen Before Talk (EU/LBT) protocol.

3.2.2 The Operating Software (Firmware)

The as-bought EU/LBT software need not be changed if the only receivers to be used are the D16 (X) type etc. This firmware is not compatible with the older 'D' series receivers. See Para 6.1.1 for changing the Companion build options.

See Appendix 9 for other build options and to upload alternate firmware

3.2.3 Internal XJT Transmitter Module

This module is used with the OpenTx v2.2 firmware above, and is compatible with FrSky 'D' series receivers (see 3.2.2). See Appendix A3 for the binding procedures.

3.3 The Model Software

This is the actual programming that operates the model. Models may be programmed using the Q X7(S) itself, or the Companion software, or both. In Companion, the programming is written and simulated on a PC, then uploaded via USB to the transmitter. In Companion, one or models are held in a 'Model file' (*.otx), and there can be many Model files. See Appendix A5 for how to up/download Model files.

See Chapter 4 for a detailed explanation of common settings available.

4 Q X7(S) - Common Programming Operations

The Q X7(S) menus are reflected in Companion. This Chapter describes a method to access a selection of the available options used in the programming of the transmitter.

4.1 Model Selection

From the MODEL screen:

Press MENU. The MODEL SEL screen is shown
The default model has an * in front of its name and its number is highlighted.
Scroll down to the required model, the number will highlight
Press ENT. A menu with SELECT MODEL highlighted is displayed.
Press ENT to select that model.
Press EXIT as required to return to the MODEL screen.

WARNING Depending on the individual model set-up, if a switch or other alert is set, warnings will appear in the screen, the on/off button light will turn red and NO SIGNAL TRANSMISSION will occur until all warnings are cleared.

4.2 Radio Element Edit of Q X7(S)

This screen refers to the transmitter functions, such as mode, alarms and such. The Q X7(S) radio element is found in the RADIO SETUP screen on the transmitter

From the MODEL screen:

Long press MENU. The RADIO SETUP screen (1/9) is displayed.
Scroll to select the required option to edit.
Press EXIT as required to return to the MODEL screen

4.3 Radio Element Edit of Model

This screen refers to the model functions, the operation of timers, switch warnings and – importantly - the transmitter module settings. The model radio element is found in the SETUP screen on the transmitter.

From the MODEL screen:

Press MENU and then PAGE. The SETUP screen (2/13) is displayed.
Scroll to select the required option to edit.

Press EXIT as required to return to the MODEL screen

4.4 Model Element Edit

The model element is found in the SETUP, INPUTS, MIXES etc. screens.

From the MODEL screen:

Press MENU and then PAGE. The SETUP screen (2/13) is displayed
Press PAGE as required until the desired screen is shown.

Press EXIT as required to return to the MODEL screen

4.4.1 Value or Symbol Edit

Navigate to the required screen.

Scroll to the required value, which is highlighted.
Press ENT and the line is highlighted.
Long press ENT, EDIT appears on a menu.
Press EDIT, the setup screen appears and scroll to the desired value.
To switch between a number or a symbol, or vice-versa, long press ENT.

In either selection, the value flashes and may be adjusted by scrolling.
Press ENT to accept the value, the highlight is steady.
Press EXIT as required to leave the screen

4.4.2 Line Add

At the selected screen, a new line, ready for editing, is added by:
Select the line/channel number by scrolling
Press ENT to show the line edit screen. Scroll and edit the options as required.
Press EXIT as required to leave the screen.

4.4.3 Line Delete

Select the line/channel number by scrolling. The first value is highlighted.
Long press ENT to show a menu, scroll down to DELETE and press DELETE.
Press EXIT as required to leave the screen

4.4.4 Line Insert

A line may be inserted before or after the selected line.
Navigate to the line to be added to
Long press ENT to show a menu and scroll to the desired option.
The line edit screen appears. Scroll and edit the options as required.
Press EXIT as required to leave the screen

4.5 Servo Direction

The servo direction may be reversed for correct operation. See Para. 14.2 for more detail.

4.6 Subtrim

A corrective trim may be added to a control surface via Subtrim'. See Para. 14.3 for more detail.

4.7 Programming the Q X7(S) - Notes

1. The above descriptions are but one method of using the transmitter to edit its various screens.

2. For the Q X7(S), labels are three characters, and the displays on screen are compact to the point of cryptic. In some cases, an option available in Companion is not visible at the Q X7(S). This makes it far easier to set a model initially in Companion, but more practical to fine-tune the model using the Q X7(S).

4.7.1 Observing the Effect of Changing a Value

With the Q X7(S) and the model switched on, in most cases, the changes to values made can be observed directly on the model control surfaces, providing a convenient method of fine-tuning the settings.

4.7.2 Warning: Regarding Editing on the Q X7(S)

1. Care needs to be taken when editing values on the Q X7(S) to edit the correct function.

2. Similarly, if a value gets inadvertently assigned to another stick or pot (when selecting a symbol), this could damage a servo by exceeding its travel, or the surface hinge.

3. Scrolling too quickly will make the value jump quickly - to a much higher or lower value. Rotate the scroll gently.

5 Companion - Common Programming Operations

Companion offers an alternate method of programming the Q X7(S). The use of the 'Simulate' option allows provides visualising the different output responses for a given programme.

5.1 WARNING: To Prevent Servo or Model Damage

Companion has no knowledge of your transmitter stick and pot calibration. To get this information into Companion, do the following:

- **set up the radio section – Chapter 4:**
- **calibrate the Q X7(S) sticks and pots - Appendix A4:**
- **download the Q X7(S) data to Companion and save the file – Appendix A5):**
- **Use this Model file (or a copy) to edit models:**
- **After editing, upload this Model file to the Q X7(S).**

Failure to do this may cause damage to servos or the model.

5.2 Download and Customise Companion

http://rcdiy.ca/introduction-to-opentx-companion/ provides a comprehensive guide to downloading and setting up Companion. Many of the options may be ignored for now, but note the 'eu; tick box as Para 3.2.2.

5.3 Open an Existing Model File

Open Companion, click on 'File' > 'Open' and double click on a file name from the list (*.otx file). The Model file appears in Companion main window with the default model in **bold**.

5.4 Save a Model File

In Companion, click on the blue bar at the top of the Model file. Click on 'File' > 'Save ' to save with the same name, or 'save as' to save with a different name.

5.5 Copy Model Files

It is possible copy a complete model from one Companion *.otx file to another, as described in Appendix A6.

5.6 Copy Programming Lines Within a Model file

It is possible to copy lines from one channel to another within a tab, eg MIXES.

Right click on the line that is to be copied and click 'Copy' from drop down menu.
Move the cursor to the required line, right click, then click 'Paste' from drop down menu.
Repeat as required.

Close and save both Model files when finished.

5.7 Copy Programming Lines Between Models

It is also possible to copy lines from one model to another. To copy the programme lines:

Open Companion, and open both *.otx files. Companion shows both files in its window.
Open each model and navigate to the required screen.
Right click on the line to be copied and click on 'Copy' from the drop down menu.
Move the cursor to the destination, right click and click 'Paste' from drop down menu.
Repeat as required.

Close and save both Model files when finished.

6 Companion - Model Software, Radio

This section outlines the radio elements of a model to be uploaded into the Q X7(S). Note that, for a new model, the radio elements are already set up from Chapter 3, but some aspects, such as internal or external transmitter module, may be changed for each model.

6.1 Basic Radio Setup

Open Companion and Click on Settings > Settings.

6.1.1 Radio Profile – Build Options

The Build Options select operating system options. Note that changing these alone does not change the operating system software, that is a three-part operation, see Appendix 9.

For a full description of the various 'tick-box' options see:
http://rcdiy.ca/introduction-to-opentx-companion/ > Transmitter Profile (Build Options).

For example tick 'noheli' box removes HELI page from Q X7(S) screens, tick 'sqt5font' enables a 'blockier' font on the Q X7(S) screen.

6.1.2 Default Stick Mode

Selected by a drop down box. Typical settings are Mode 1 or Mode 2.

6.1.3 Default Channel Order

Set by a drop down box. Most (every?) combination is available, but one common scheme is Ch1 = Throttle, Ch 2 = Aileron, Ch3 = Elevator, Ch 4 -= Rudder
This is abbreviated to 'TAER'. The remaining options follow a variation of this format.
Click OK to finish.

Both stick mode and Channel Order can be changed in other places (See 'More Radio Setup', next), and the 'MIXES' section allows reassignment of channels, see Appendix 7.

6.2 More Radio Setup

Open Companion and a model file. Click on 'File' > 'Edit Radio Settings'. The default SETUP tab is part of the Q X7(S) RADIO SETUP page).

6.2.1 The Global Function and Trainer tab

Not discussed here

6.2.2 The Calibration tab

The values in this table are from the Q X7(S) download, see Para. 5.1and Appendix A4.

When finished, click "Store Calib. and hw settings to selected profile" and close the window.

6.3 Even More Radio Setup

Each model can have its own radio settings. In either the Q X7(S) or Companion, select a model. The SETUP tab shows the available options for that model. Here the model is named, the radio module is selected (internal or external), timers and alarms for default switch positions, and more.

7 Values, their Types and Uses

Values, as described above, warrant discussion before finally getting into the model programming, as generally they will determine the amount of travel a servo will produce. They are also responsible for the amounts (as a percentage) of a signal mixed with another signal.

Values may be a positive or negative number or a symbol that represent a number. Generally, a number is used, and this is sufficient for most applications. In some cases it may be advantageous to use symbols. Symbols include Global Variables and Logical Switches, but there are many other options,

7.1 Value Sources

A value may be fixed, variable or calculated. The switch provides a fixed value, and a pot can provide a variable value. Other sources of variable values are those calculated via a function. A value may also come from Global Variables, Logical Switches or be calculated.

7.2 Selecting a Value Source

In Companion, the signal source is usually accessed by editing the line, then selecting the desired value from the 'Source' drop-down box.

Setting a value using the Q X7(S) is more problematic because of the limited screen size and the ability to press the wrong button. Using the transmitter, the value is selected by navigating to the appropriate screen, scrolling to the required value, and pressing ENT. When the value is selected, scrolling increases or decreases the numeric value. If the ENT is a long press, symbols are shown. Again, scroll to select the required symbol.

7.3 Numbers

This is the most common type of value. Numbers are easily readable in the programming. Values normally range from +100% to –100% but up to + / -500% is available.

In use, a function may require several signals in a MIXER. The use of a number will makes the amount of each mix obvious.

Numbers become less desirable, from a practical point (at the field), when the same numbers appear in several places to implement a single function, such as aileron differential. With a 2-aileron model, each aileron has differential added, with the same number, (one number may be negative but the same value) to set the amount of differential. In this instance, there are two places where the value is to be changed to maintain the correct operation. This is relatively simple at the computer, but error prone using the transmitter at the field.

More complex mixes may use the same (or its negative value) many times. Now there are many places with this value, and each needs changing to change the function correctly.

Now it may be advantageous to use other forms of numbers, ie a symbol.

7.4 Symbols

Symbols are an alternate, textual method of representing a number. The numeric value of the symbol depends on the symbol source and may be fixed (a constant), variable (changing, eg sticks) or dependent on the output of a function (eg Logical Switches, Special Functions).

7.4.1 Fixed Values

These symbols hold a known, fixed value. For example, a three-way switch has three symbols, each with an equivalent numeric value:

Symbol	Position	Numeric value
SA↑	UP	-100%,
SA—	MID	0
SA↓	DOWN	+100%

7.4.2 Offsets and Signal 'Weight'

The symmetrical numeric value range of switches may cause unexpected outputs, see the programming of Camber Change, Para 16.6.4. Here, both the Offsets are the same value to produce an up–going and a down-going camber change.

Example – both Offsets at +25% gives one aileron up, one down:
SA↑ value is -100%, -100% * +25% = -25%.
SA↓ value is +100%, +100% * +25% = +25%.

7.4.3 Variable Values

These are typically between +100% and –100% but larger values may be used. Variable inputs may be from a stick or pot.

7.4.4 User Set Symbols

Global Variables (GV) provides the user with a method of substituting a number with a symbol. To create a GV the user first enters a label (ie creates a symbol) and then inserts the numeric value for that GV. Each time the GV label is 'seen' in a line, it is replaced by the numeric value. See Appendix A2 for more detail on GVs.

7.4.5 Other Symbols

Symbols may also represent signal sources from the programming perspective. These include the sticks, pots, Global Functions, Logical Switches and more. Each of these has a particular use, and some may be interlinked, but they all provide a method to replace a numeric value.

7.4.6 The Difference Between I2:Thr And Thr

Normally the stick etc. signals are processed by INPUTS. MIXES then uses the INPUTS-processed signals. However, MIXES can also use inputs directly. So, in MIXES, the throttle channel from INPUTS becomes:
"CH1 I2:Thrl Weight (+100%)" where I2 is the INPUTS-processed throttle signal.
While the stick direct input is:
"CH1 Thr Weight (+100%)" where 'Thr' is the direct stick signal (ie no 'I2':).

Note that there is no need to use throttle input in INPUTS if it only used directly in MIXES. If the signal requires processing before MIXES, then use INPUTS to do this.

7.5 Summary

Numbers and symbols each have a place in the programming of a model. There are advantages and limitations to the use of each, and caution should be used when choosing the type of value to use.

8 A New Rudder / Elevator Model

Companion contains a wizard to create a model with a specific set-up. By following the menu-style selections, a basic programme is developed. The user then modifies the programme to suit their individual needs. This Chapter shows how to create a simple model with the Companion wizard. The main tabs and programme lines used by Companion are then examined.

8.1 Using the Wizard to Create a Model

For this example, a rudder / elevator glider model is created. With Companion open, click on 'File' > 'New'. Double click under 'NAME' in an empty space, and a wizard window will open, Fig.8.1a.

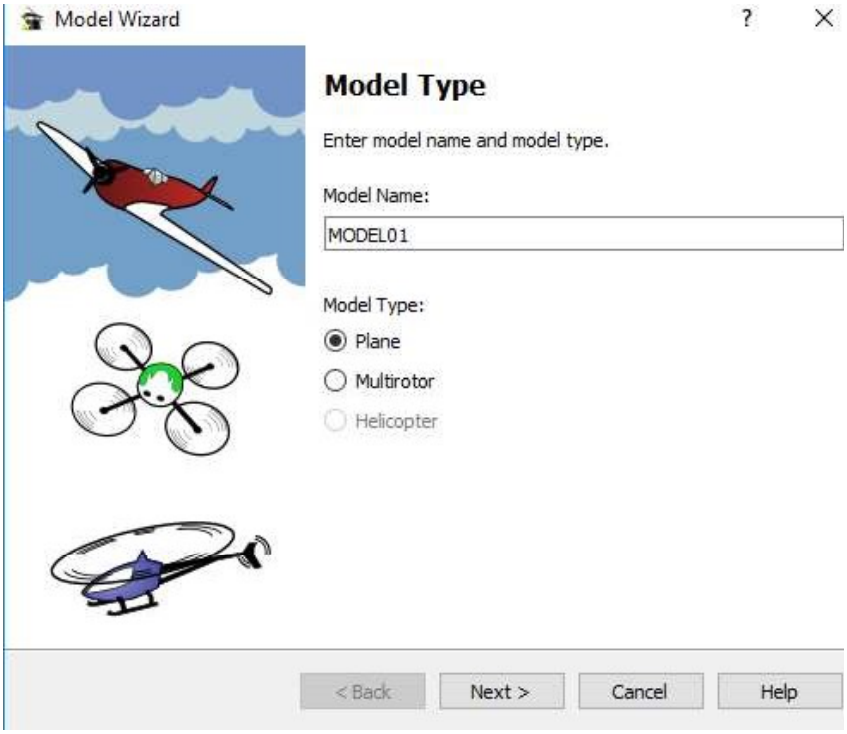

Figure 8.1a - New Model Wizard

Click on Next to move through the menus. Choose No to throttle, accept the throttle, wing, aileron options etc. Select 'Elevator and Rudder' as tail type, and choose their respective channels. At the 'Save changes' screen, tick the box' OK, I understand' and click 'Finish'. The Companion window now shows MODEL01 at Index 01.

8.2 Examine the Model via the Tabs

Double click on the model name and a window 'Editing Model 1:MODEL01' appears with the SETUP tab open Fig. 8.2a. The box labelled 'Model' contains the current model name ie MODEL01. Change this to the model name, eg 'Phoenix'. In SETUP tab, timers can be set, the sticks can be set to beep at their centre position and warnings can be set for switch positions. The remainder are the internal and external Radio Module and the trainer port. These radio settings will become this models radio settings.

For now, leave all settings as they are.

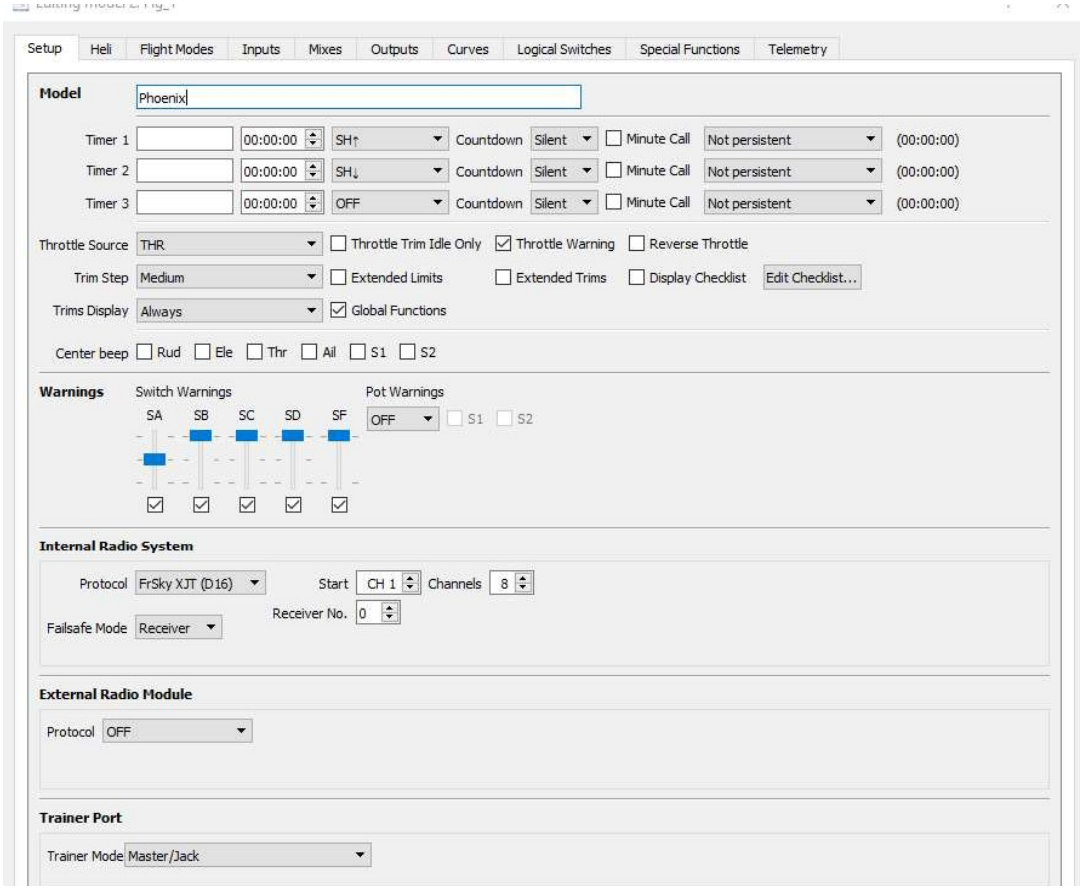

Figure 8.2a - New Model 'SETUP' tab

8.3 INPUTS tab

The INPUTS tab is shown in Fig. 8.3a.

Figure 8.3a - Model 'INPUTS' tab

Note that, on the INPUTS tab:

1. the inputs are allocated channels as per the 'Default Channel Order, Para 7.1.3.
   In this case Throttle, Ailerons, Elevator and Rudder.
2. each line starts with the Ix:label format.
   Ix is the channel number and the three letters are the Input Name.
2. Next is a three letter label identifying the signal source.
   Channel 2 is Ail = ailerons.
3. followed by the channel 'Weight', in this case +100%.
   The weight refers to how much signal is passed onto MIXES tab. In this case, +100% means all of the signal. –100% means the signal in inverted.

8.4 MIXES tab

The MIXES tab is shown at Fig. 8.4a.

Figure 8.4a - Model 'MIXES' tab

Note that, on the MIXES tab:

1. The channels (elevator and Rudder) are allocated as per the wizard choices.
   In this case elevator on CH3 and Rudder on CH4.
2. each line starts with the CHx label format.
   CHx is the channel number
3. next, each line has the Ix:label format.
   The Ix identifies the source being from INPUTS, here I3 or I4.
   The three letters are the Source Name.
4. followed by the channel 'Weight', in this case +100%.
   The Weight refers to how much signal is passed onto OUTPUTS tab. In this case, 100% means all of the signal. –100% means the signal is inverted.

8.5 OUTPUTS Tab

The OUTPUTS tab (Fig. 8.5a) has only 'Subtrim', 'Min', 'Max' and 'Direction' of interest here.

1. Subtrim provides an offset to the servo shaft position to compensate for mechanical discrepancies in the setting up of the control runs.
2. Max and Min set the travel limits of the servo arm, allowing a restricted travel at the control surface (equivalent to 'end travel' in conventional transmitters).
5. Direction reverses the servo travel.

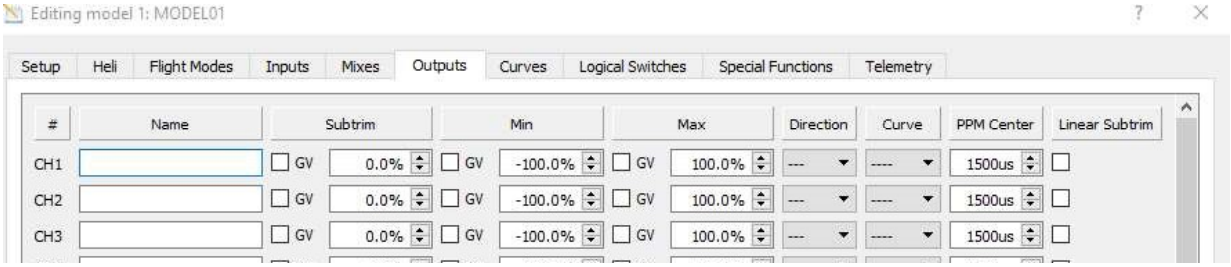

Figure 8.5a - Model 'OUTPUTS' tab

This set-up is now the basis of a 2-channel 'trainer' type glider. All new models developed in Companion follow this format, with differences in the tabs to accommodate the requirements of the new model.

This model is later developed into a 4-servo wing glider by adding, for example, camber control and crow braking. Refer to Chapters 16 to 18.

Before that, a delta wing model is created and developed into a working model programme to illustrate many common programming techniques.

9 A New Delta Wing Model

The wizard is used to create a delta wing model. These models use the elevator and aileron signals mixed together, generally at 1:1 ratio. Once the wizard is complete the user then modifies the programme to suit their individual needs. The methods used are shown in Chapters 10, 11 and 12, before completing the programme in Chapter 13.

9.1 Create a New Model

Open the Companion New Model wizard. Change model name to Wildthing. Choose 'No throttle', then 'Flying Wing / Delta wing'. Next allocate the receiver channels for the aileron and elevator. Choose NO to rudder and leave 'Model Options' clear. At the 'Save changes' screen, tick the box' OK, I understand' and click 'Finish'. The Companion window now shows 'Wildthing' at the Index number used.

9.2 The Model Programme

Double click on the model name and a window 'Editing Model x:Wildthing' appears with the SETUP tab open. This, except for the model name, is identical to that generated in Chapter 8.

Click on the INPUTS tab, and again, the contents are identical to that of Fig. 8.3a
Jumping ahead, the contents of the OUTPUTS tab is also identical to Fig. 8.5a

The MIXES tab at Fig. 9.2a shows some interesting features:

1. CH2, aileron, has some elevator mixed in (added, as shown by the '+=')
2. CH3, elevator, has some aileron mixed in (added, as shown by the '+=')
3. The mix ratio is 1:1, but at 50%, not 100%.

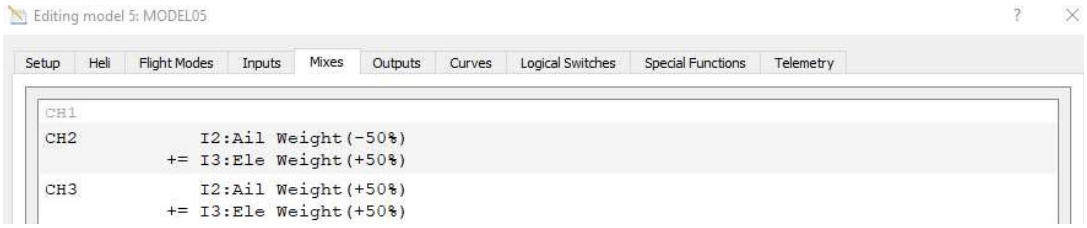

Figure 9.2a - Delta Wing MIXES Tab

Aileron and elevator move correctly to create the delta control. The 50% mix may seem to limit the control surface movement, but takes account of the 'stick-in-the-corner' effect. Fig. 9.2b shows the outputs with the elevator stick fully up - the output is –50%, as expected, as are the aileron outputs. However, if the stick is pushed into a corner, ie, full up elevator and full left aileron, as Fig. 9.2c, the CH3 output is now -100% because both channels are added together.

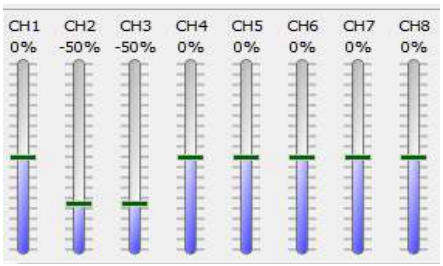

Figure 9.2b – Full Up Elevator

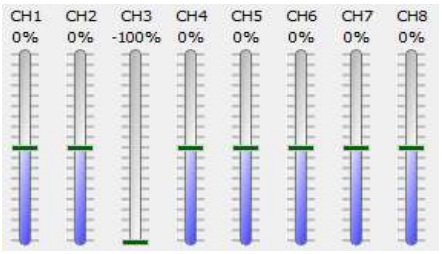

Figure 9.2c – Full Up Elevator, Left Aileron

10 Companion - Model Software, INPUTS

The INPUTS tab collects stick, potentiometer, switch and other input signals. In addition, INPUTS multiplies each input by a Weight (sensitivity), and therefore can set a Rate. Exponential settings are also added in INPUTS.

The results of INPUTS are sent to the MIXES section.

10.1 Basic Input Sources

The INPUTS tab of Fig. 8.3a is repeated in Fig. 10.1a, below. This set-up takes each of the four stick inputs and produces a linear, full-scale output that is passed onto the MIXER section. Note the line order is the TAER sequence of the Para 6.1.3, 'Default Channel Order'.

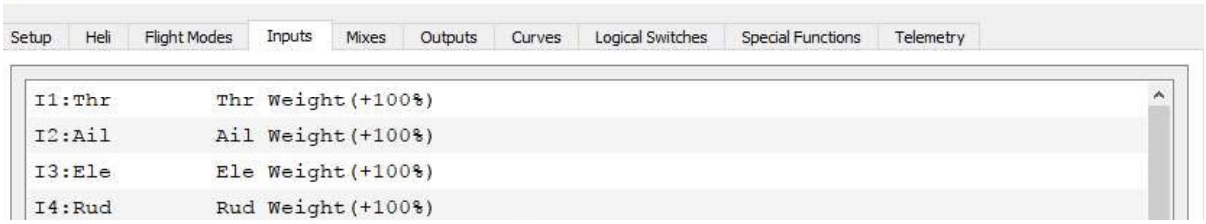

Figure 10.1a - INPUT Sources

It is best practice to keep the 'Weight (+100%)' line as the last, or only, line of any input, for each channel - irrespective of any lines preceding it. In operation, the programme will exit when all lines are processed. If no such line exists, there will be an unknown condition. A trivial example - using a three-way switch with only two switch positions specified, eg UP and DOWN. If the switch is set to MID position there is no 'TRUE' (valid) line for that input and the result is undefined. Adding this line last creates a catch-all state for the input.

10.2 Add, Delete or Move Lines

To add or delete a line generally follows the familiar Windows format of left or right click and then select an option from the drop-down box. Data is entered via a tick-box selection, a value or other selection options.

10.2.1 Add a Programming Line

Double click on the empty line, or right-click > 'Add'. Then set the required labels, source, curve and so on. Click OK to enter the line.

10.2.2 Delete a Programming Line

A line is deleted by right-click > 'Delete' > 'OK'.

10.2.3 Copy, Paste or Move Programme Line

A line is copied, pasted or moved by right-click > 'copy/paste/move' > 'OK'

10.3 Edit Lines

A line is edited by double clicking on the line, or right-click > 'Edit'. This action brings up a window with many options. The relevant options may be numbers, Global Variables, and so on. The inputs to this window are described below:

Input name A three-character label appears to the left of the line describing the input source.

Line name A six-character label appears at the end of the line, describing line function.
Source This is the actual input selector. Options include sticks. Pots, etc. In the MIXES tab, the source may also be the input processed by INPUTS.
Include trim Carries trim settings from other sources, such as Flight Modes. Leave as 'Yes'
Weight Multiplier (%) applied to the input signal.
Offset Used to specify offsets to most inputs.
Curve Differential, exponential, user-created curves or a function-generated curve may be applied.
Flight mode Flight Mode 0 is the default, but there are eight other flight modes available. Note that all Flight Mode boxes are ticked by default, Fig 8.3.1a.
Switch Selects which switch, at which position, activates the programming line.
Stick side An input may be set up to operate on only one side of a stick input.

10.3.1 Edit Lines – Set Rates

Rates are set by altering the Weight of the input. Fig 10.3.1a shows the Ail (CH2) line being edited to give 50% aileron by switch D in the mid-position. This line means a stick input of -100% to +100 becomes –50% to +50% sent to the MIXES section.

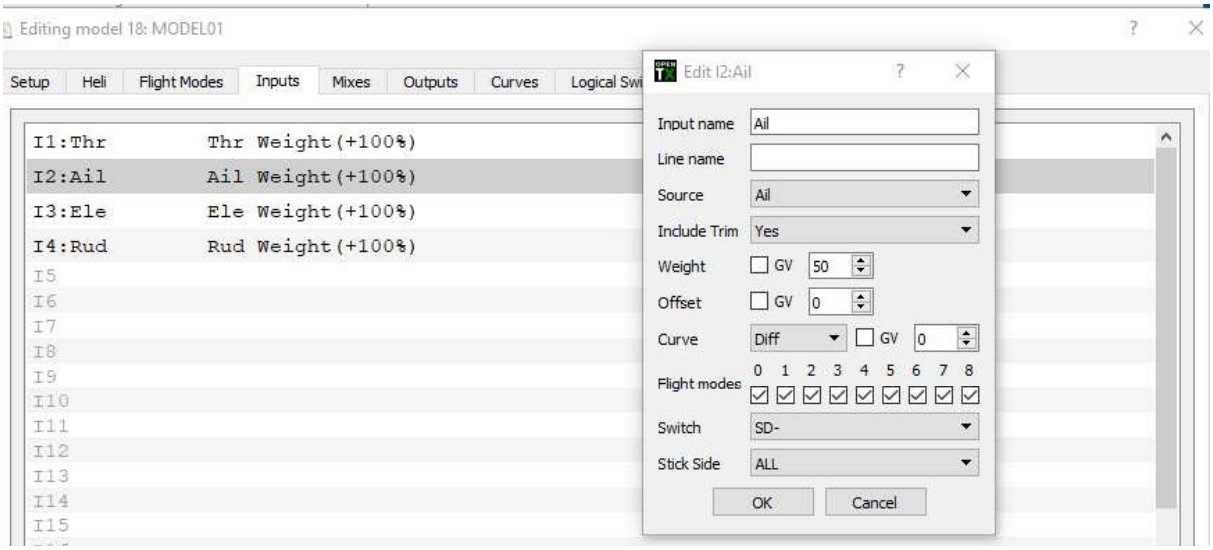

Figure 10.3.1a - Use Switch D to Set Rates

Click Ok and the Ail line is now as Fig. 10.3.1b.

Figure 10.3.1b - Rates on Aileron with Switch D at Mid-Position

To complete the three rate positions, two additional lines have to be added to the ailerons and the elevator.

Once all the lines are added, the programming is as Fig. 10.3.1c. In this example both aileron and elevator rates are selected by one switch (SD), but each channel could have a separate switch Note the 'catch-all' line on I2 and I3.

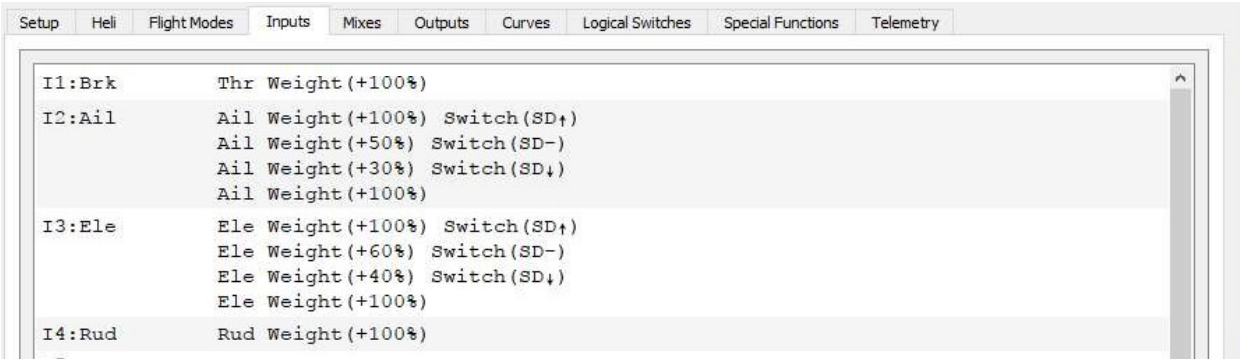

Figure 10.3.1c – Three Level Rates Using Switch D

A switch position determines which line is used for the input, and each line has a different Rate value. For example, Switch D Down gives the ailerons a Rate (Weight) of 30%.

10.3.2 Edit Lines – Set Exponential

Exponential is added by editing the line, selecting Expo from the 'Curve' drop down box, and entering a value in the adjacent box. In Fig 10.3.2a the ailerons are 10%, the elevator is 20%.

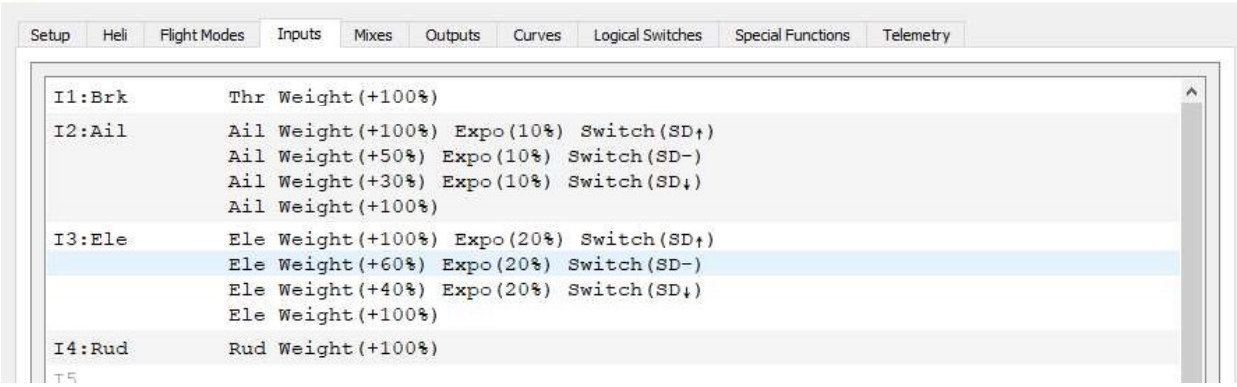

Figure 10.3.2a – Channels with Rates and Exponential

11 Companion - Model Software, MIXES

The MIXER is where channels are assigned to outputs, and other channel signals are combined (mixed) to create the complete channel signal. The results of MIXES is sent onto the OUTPUTS section.

11.1 Basic Input Sources

Generally, MIXES gets its source signals from INPUTS. MIXES may, however, also get inputs direct from sticks or other sources, see Para. 7.4.6.

The INPUTS of Fig. 9.2a are used directly in the MIXES tab. Fig. 11.1a shows the MIXES tab for the delta / elevon model of Para. 9.2a.

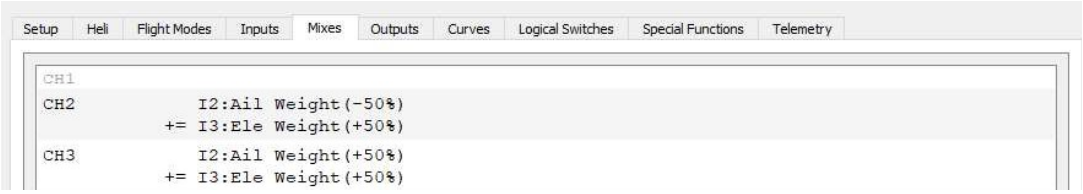

Figure 11.1a – Delta MIXES Tab

11.2 Editing MIXES Lines

See Para. 4.4 and Para. 10.2 for these operations in MIXES. Note that MIXES has the same options, but with the addition of:

Warning	Select OFF, 1 beep, 2 beep or 3 beep. Not discussed here.
Multiplex	Default ADD. MULTIPLY and REPLACE, are not discussed here.
Delay	The delay before the mix takes effect.
Slow	Provides a slow transition from one control surface position to the next.

And the deletion of:

Line name

11.3 Edit Lines – Set Differential

Differential is added by editing the line, selecting Diff from the 'Curve' drop down box, and entering a value in the adjacent box. In Fig 11.3a and 11.3b the ailerons are given 30% differential.

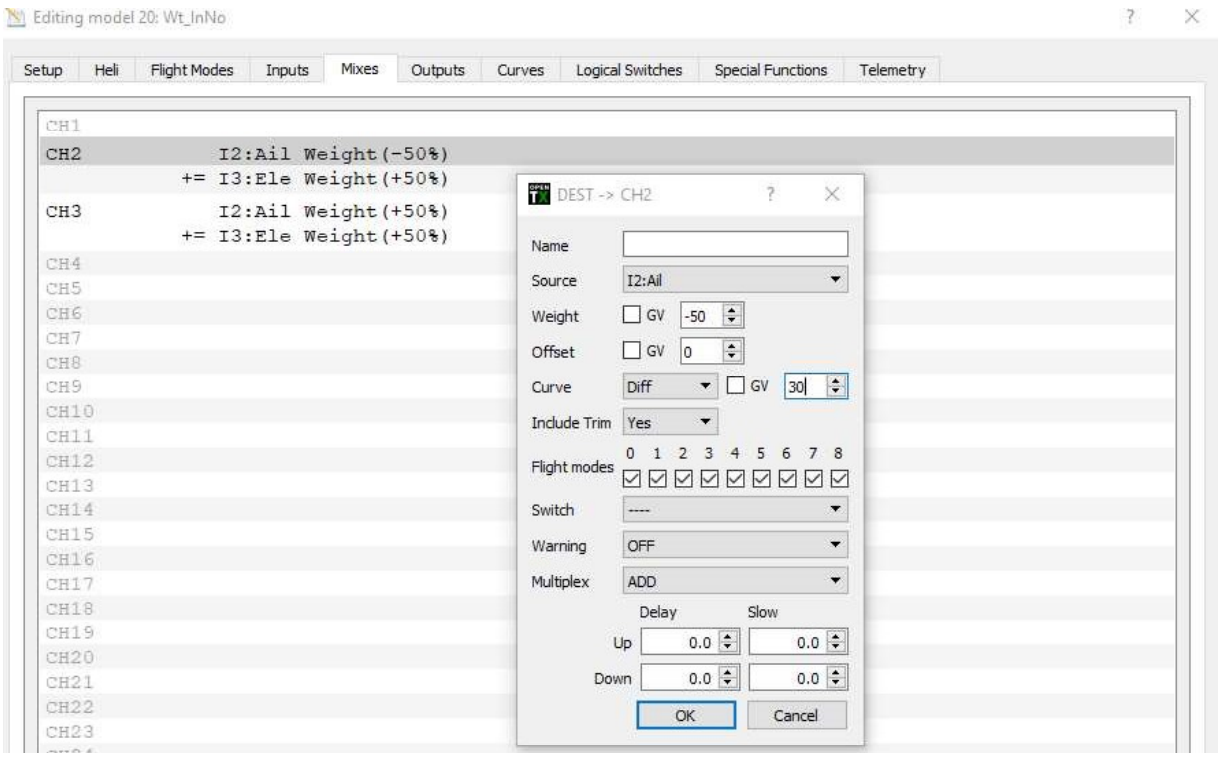

Figure 11.3a – Set Differential

Fig.11.3b shows the completed MIXES tab for differential.

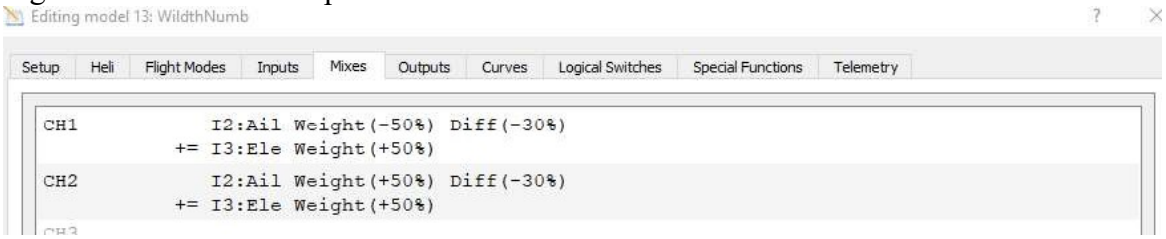

Figure 11.3b – Differential Complete

12 Companion - Model Software, OUTPUTS

The OUTPUTS tab allows many options such as name the channel, set travel limits and subtrims, direction (reverse) and additional curves.

12.1 Subtrims

These allow the control surface to be fine tuned into a desired position to compensate for minor mechanical linkage discrepancies. Note that the mechanical link should be as accurate as possible before using subtrims.

12.2 Max and Min

These set the farthest travel points of the servo (end-point adjustment). Useful for a fixed servo travel such as hatch or doors.

12.3 Servo Reverse

This is done from the 'Direction' tab. Click on the down arrow for the output, and click on '---' (default, normal) or 'INV' to reverse the servo.

12.4 Output scaling.

One of the outcomes of mixing several inputs is that the final output value can exceed 100%. This is captured by Companion, which limits the servo travel to +/- 100%. In itself this is good, but it does mean that a servo may not provide the travel expected as it reaches full travel too soon, and travel in the opposite direction may be insufficient. There are discussions on the internet explaining this event.

13 The Wildthing Programme

Continuing on from the model developed in Chapter 9, rates, exponential and differential are added to enhance the models flying envelope and to suit pilot preferences.

The description for these changes has been given in the preceding chapters, so they are only outlined her (with reference back to the relevant paragraph). The main decision for the programmer is choosing the switch for the purpose.

13.1 Rates

Rates are added in the INPUTS tab. A Rate is a modified Weight value, effectively changing the control surface movement. Normally they are associated with a 2-way or 3-way switch.

See Appendix A1 for techniques for programme switches and Para 10.3.1 for programming Rates.

13.2 Exponential

Exponential is added in the INPUTS tab. Exponential is generally used to 'soften' (reduce) the stick sensitivity around the stick neutral point while keeping full deflection at the stick extremes. Exponential is usually a single, fixed value, not applied by a switch.

See Para 10.3.2 to add exponential. The completed INPUTS tab is shown at Fig. 13.2a.

Figure 13.2a - Wildthing INPUTS tab

13.3 Differential

Differential is added in the MIXES tab. Differential is generally used to correct 'adverse yaw' created when the down aileron produces more drag than the up aileron. Differential is usually a single, fixed value, not applied by a switch.

See Para 11.3 o add differential. The completed MIXES tab is shown at Fig. 13.3a

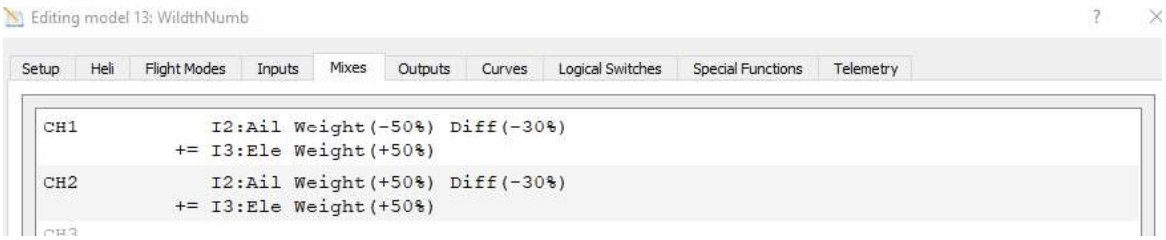

Figure 13.3a - Wildthing MIXES Tab

14 Using the Q X7(S) to Control the Wildthing

Up to this point the channel direction and travel has been displayed on the RADIO SIMULATOR or RADIO OUTPUT in Companion. While it accurately reflects the channel outputs of the software, it cannot account for the model in terms of servo installation, servo travel and direction relative to the control surface, the length of the servo arm and so on for a real model. Equally, the differential and exponential have to have 'real' numbers included, but these are only a best-guess.

WARNING
Due to the unpredictable nature of the servo travel and direction, it is advisable to disconnect the servo linkages.

14.1 The Model Software

Open Companion and the Model file. Upload this file to the transmitter as described in Appendix A5.

The opening screen (Model screen) shows the selected model. In this case all trims are at zero, all sticks (except channel 8) are at neutral. See Fig. 13.1a.

Figure 13.1a - Q X7(S) Model Screen

Review the model as now set in the Q X7(S). With the correct model selected (ie Wildthing), press the 'Menu' (three bars on left button) then 'Page' buttons. This brings up the model 'SETUP' screen, Fig. 13.2b

Figure 13.1b - Q X7(S) SETUP Screen

.
Press ENT, then scroll down the menu to ensure that all settings are as expected, particularly the radio sections. If all is well, press EXIT as required to return to the model main screen.

Ensure all sticks, trims and subtrims are centred / zeroed.

If the receiver is not already bound, do so now.

On switching the model on, the ailerons and elevators may not move in the expected direction. To get the surfaces working correctly is a matter of deduction, and may involve changing the servo connections at the receiver.

14.2 Tuning Servo Direction

One of the errors for the servo movement may be the direction of rotation of the servo. To reverse a servo, do the following:

Navigate from the MODEL SETUP screen by repeatedly press the 'PAGE' button to advance to page 7/13. OUTPUTS.
CH1 should be highlighted. Scroll to the required channel.
Press ENT and a menu pops up. Press ENT again to select the EDIT option.
Scroll down to the DIRECTION option and press ENT. The display shows 'INV'.
Press EXIT twice to return to OUTPUTS.
Scroll down to CH2 and repeat. .

14.3 Tuning Reflex - Subtrim

Once the surfaces are working correctly, it is necessary to add reflex, ie a slight upward deflection to the control surfaces. This is set in SUBTRIM, within OUTPUTS.

Navigate from the SETUP screen by repeatedly press the 'PAGE' button to advance to page 7/13. OUTPUTS.
CH1 should be highlighted. If not, scroll to this channel.
Long press ENT and a menu appears. Press ENT to select the EDIT.
Scroll down to SUBTRIM to highlight the option. Press ENT and the option flashes.
Observing the control surfaces, scroll to set the desired amount of reflex.
When finished, press ENT. The value stops flashing.
Press 'Exit' repeatedly to return to the OUTPUTS page.
Repeat for channel 2 as required.

Note, on the OUTPUTS page, the subtrim value is now in the first numeric value after the channel identifier and the value in the top line is now offset from the default 1500uS. Using 'PPM Centre' to re-centre the 1500uS pulse width will also re-centre the servo, and also the control surface.

Press EXIT repeatedly to return to the MODEL screen.

14.4 Tuning Rates

To set a rate value, the rates switch must be in the correct position for the line being edited, ie the value is in bold, and care is taken when selecting values – see Para 5.7.2 – Warnings.

Navigate from the SETUP screen by repeatedly press PAGE to advance to page 5/13. INPUTS.
For each switch position:
Set the switch to the rate being set.
Scroll to the required channel.

In that channel the first value is highlighted and in **bold** text. If not, move the rate switch to the relevant position (Up, Mid, Down).
Long press ENT and a menu appears. Press ENT to select EDIT.
Scroll down to 'WEIGHT' to highlight the option. Press ENT and the option flashes.
Observe the control surfaces and scroll to set the desired Rate for the switch position.
When finished, press ENT and the value stops flashing.
Press EXIT twice to return to INPUTS screen.

Press EXIT to return to OUTPUTS, and then to the MODEL screen.

14.5 Tuning Differential

Differential is usually set so the up-going surface moves further than the down-going surface. If differential is added, then it is added to both aileron signals, at the same value.

Navigate from the SETUP screen by repeatedly press the 'PAGE' button to advance to page 6/13. MIXER.
Scroll down to the line to be edited
Long press ENT and a menu appears. Press ENT to select EDIT.
Scroll to the value adjacent to 'Diff', it will highlight.
Press ENT and the value flashes. **Warning** – a long press on the value will select a different set of values e.g. Global Variable presets. Long press again to return to numbers.
Observing the control surfaces, scroll to set the desired amount for the differential.
Press ENT to accept the change.
Press EXIT as required to return to the MIXES page
Repeat the above for the other aileron input, using the same differential value.
Press EXIT as required to return to the model screen.

14.6 Tuning Exponential

This is best done while on the field. The menu navigation is the same as Rates, but selecting the 'Expo' value instead.

14.7 Notes to Programming

1. The tuning for Rates and Expo above requires changing several values in the transmitter menus. An alternate, (better) method involves Global Variables. These are explained in detail in Appendix A2, and the programming process is described in Chapter 15.

2. When the model settings are satisfactory, then it is good practice to download the Model file to Companion for safe keeping.

14.8 TIPs for Programming

1. When trims have been applied, they can be easily transferred to the 'subtrim' field of OUTPUTS. Navigate to OUTPUTS, scroll down to channel 32 and a message appears below 'Trims to Subtrims >'. Long press ENT and the trims will be copied to the subtrims and the trims will return to zero. This can also be done per channel by scrolling to the channel, press ENT, scroll to 'Cpy trim > subtrim' but the trims are not zeroed.

2. During the tuning process it may be easier to make the required changes in Companion. Download the Model file as usual. But do not remove the USB lead. Make the changes as required, and upload the model file. Disconnect the USB lead.

15 Using Global Values in the Wildthing

The use of GVs for the Wildthing programming is included here as the delta wing has relatively simple programming, and so the use of GVs is fairly easy to follow. Please read Appendix A2 regarding the use and warnings applicable to GVs.

The Wildthing programming shown in Chapter 13 is adapted for GVs. This change involves setting up the GVs in the FLIGHT MODES tab and then editing the relevant line(s) in INPUTS and MIXES to change the numeric value for a GV.

15.1 Setting GVs in FLIGHT MODES for the Wildthing

GVs are not set up by default, so they require setting up. The GVs, located in FLIGHT MODES, are labelled and a value added, as shown in Fig. 15.1a. The choice of label is arbitrary, but should be meaningful for later reference. The values entered are a best-guess, usually based on previous experience.

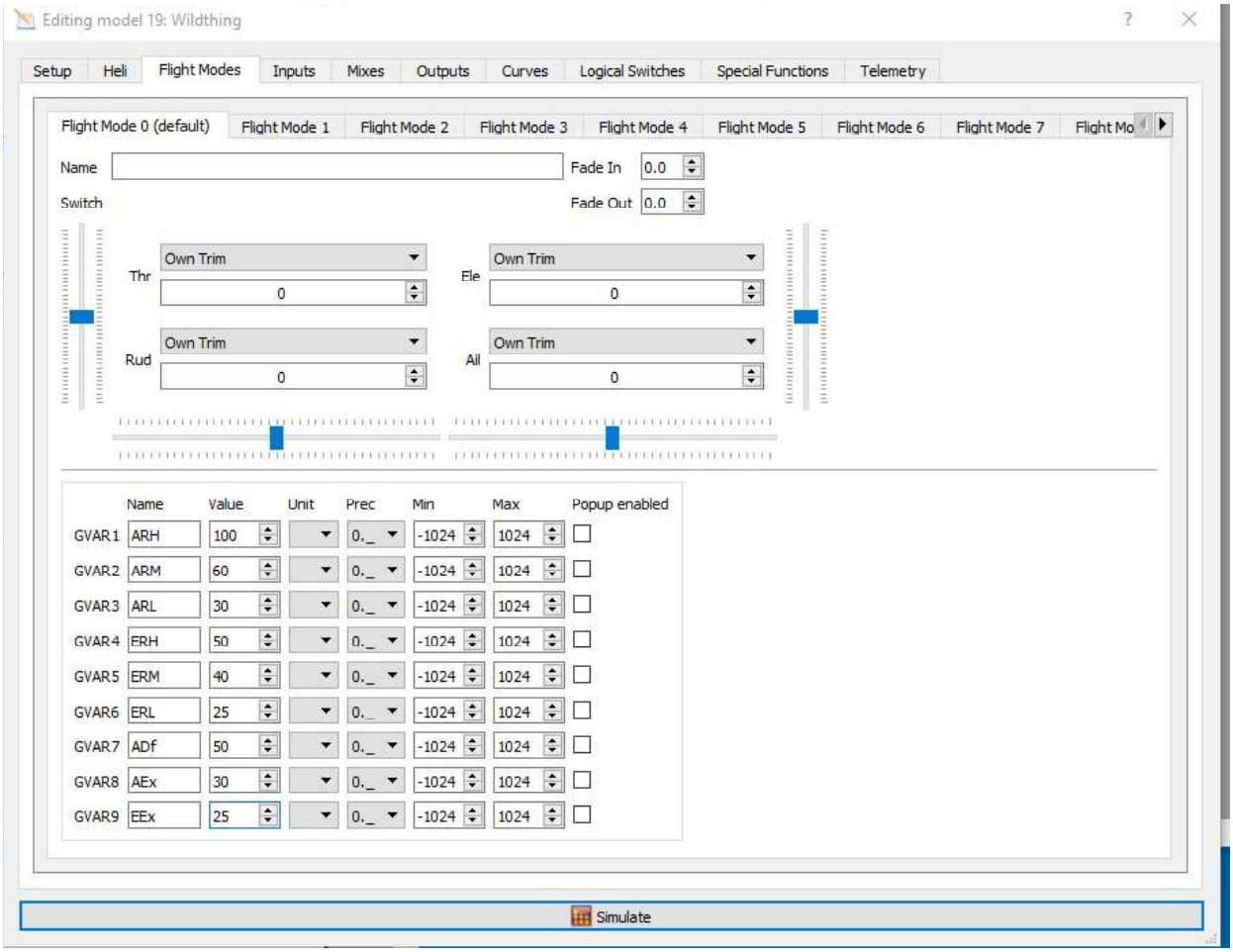

Figure 15.1a – Setting GVs

For this model, all nine GVs are used. If a GV were preferred in a different channel operation, then a GV would have to be allocated from an existing value. Many modellers only use two values of rates, so one of each aileron and elevator rate GVs are obvious candidates for reassignment, implemented by either a two way switch (SF) or a three way switch as described in Appendix A1).

Note: ensure that the boxes (Thr, Ail, Ele, Rud) in the top section of the screen are set to 'Own trim'. Sometimes these appear as 'Trim disabled'. This gives rise to an error message in the transmitter screen and should be corrected.

15.2 Setting GVs in INPUTS for the Wildthing

Following the details in Appendix A2, the values of the INPUTS are changed for GVs. In this case the label 'ARH' refers to Aileron Rate High, 'AEx' refers to aileron Exponential and so on.

The modified programme for INPUTS is shown in Fig. 15.2a.

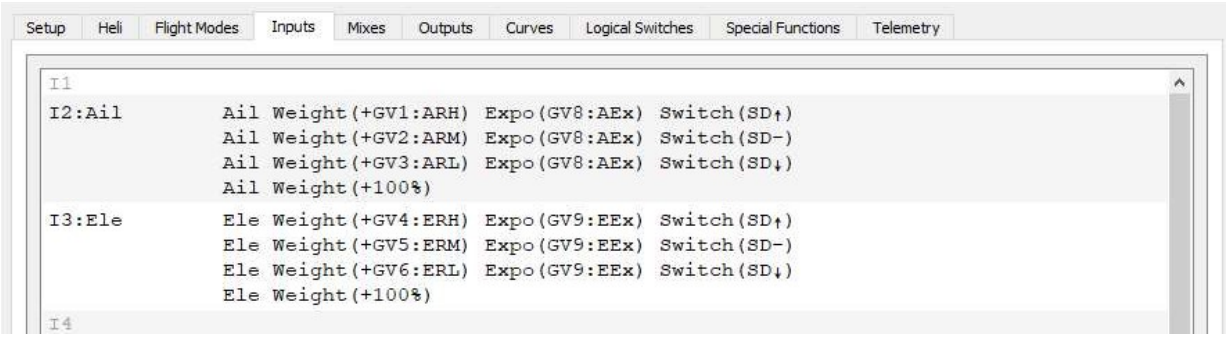

Figure 15.2a – GVs in INPUTS

The three rates are separate for aileron (ARH, ARM and ARL) and elevator (ERH, ERM and ERL) respectively, but the three exponential settings are the same within the aileron (AEx) and elevator (EEx) inputs.

15.3 Setting GVs in MIXES for the Wildthing

The same process is used for MIXES, and the modified programming is shown in Fig. 15.3a

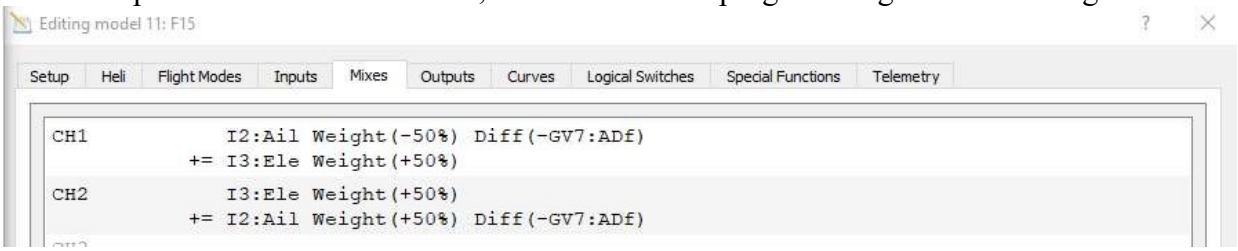

Figure 15.3a – GVs in MIXES

The only change regarding GVs here is both channels of aileron use the negative GV (-GV) to provide the negative differential.

15.4 Using and Changing the GVs at the Field

Navigate to MODEL SETUP > FLIGHT MODES (Page 4/13) and scroll to FM0 if it is not highlighted.
Press ENT to select FM0.

Scroll down to locate and edit the GV value.
Press EXIT repeatedly to return to the FLIGHT MODES page.

16 Model Software – the 4-Servo Wing Sport Model

This section walks through the programming of a four-servo wing glider with a cross (or T) tail, in this case, the Alex XL. Following on from the programming concepts of the Wildthing, setting this model uses much of the same techniques, and so is somewhat familiar. Bear in mind there are many ways to implement a particular model function in either Companion or the Q X7(S), and this is but one approach.

The throttle is used to provide proportional braking (the throttle stick is normally UP), with ailerons and flaps combined to provide 'crow' brakes while elevator mixing compensates for the flap pitch change. In the following examples, the brakes are always active. A switch may be allocated to inhibit the brake action (but not implemented here).

The ailerons and elevator have (independent) rate settings operated by a three-position switch set to give two values of rates. High rate is provided at Up position, low rates in Mid and Down positions.

The ailerons and elevator channels have (independent) exponential.

Note: all numeric values are for demonstration purposes only, the actual settings will be 'tuned' later in 'tune-up' Chapter 17, when the programming is tested on the model.

16.1 Convert to V-tail

To convert the tail to 'V' configuration, use the delta wing mix, but use elevator and rudder.

16.2 Convert to Electric Launch

To add electric launch, a switch or pot will have to be allocated because the brakes use the throttle stick. Alternately, the flaps could be allocated a pot, and the motor is controlled by the throttle stick.

16.3 Convert Channel Order

It is possible to reassign channels to different outputs, for example, to match a different transmitter channel order. This is briefly explained in Appendix A7.

16.4 Add Pot Signal to Channel

The output from a pot (S1 or S2) may be added to a channel to provide, say, trimming while in flight. This option must be applied with great care, see Appendix A8 for a brief explanation.

16.5 INPUTS

The INPUTS tab is very similar to the delta wing INPUTS page, Fig 13.2a, shown at Fig. 16.5a.

The throttle input is now used for crow (butterfly) braking (it is renamed 'Brk') and the switched rates are set for two values, not three.

Figure 16.5a – The INPUTS Tab

16.6 MIXES

MIXES tab is where most of the programming is done. The following paragraphs develop the programme but, as with the Wildthing, the description for these changes has been given in the preceding chapters, so they are only outlined here (with reference back to the relevant paragraph).

Again, the main decision for the programmer is choosing the switch(es) for the purpose.

16.6.1 The Basic MIXES Tab

Fig. 16.6.1a shows the initial programming for the two ailerons. CH2 is the left aileron, CH7 is the right. The input for both is the INPUTS processed signal I2, with NEGATIVE differential added to CH7. The full-left aileron channel outputs are indicated in Fig. 16.6.1b.

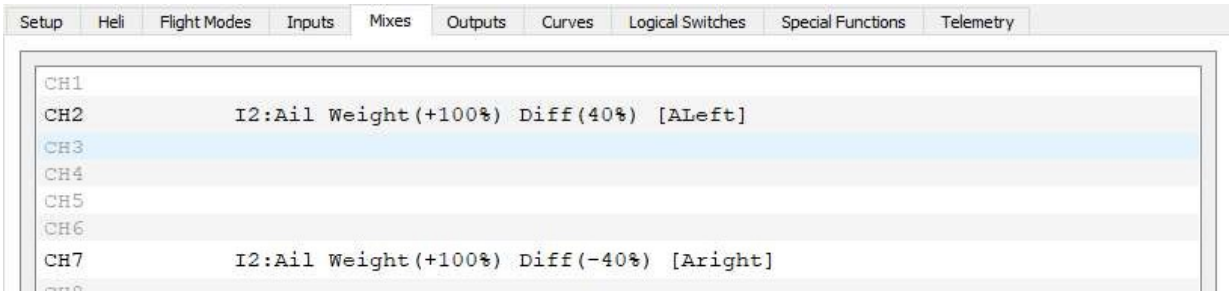

Figure 16.6.1a - Ailerons Added

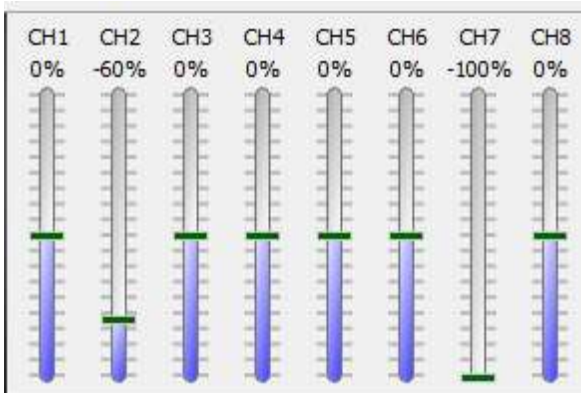

Figure 16.6.1b - Full Left Aileron with Differential

16.6.2 Crow (Butterfly) Braking

The throttle stick input to provide a proportionally progressive drooping of the flaps, coupled with the ailerons rising slightly and elevator down compensation to offset the flap pitch effect. The throttle stick is renamed to Brk, and usually set at the top position, with more braking applied as the stick moves down.

The elevator compensation in CH3 is by using a fraction of the throttle. Doing this alone gives an offset to the elevator, as the throttle stick is usually at the top position, ie +100% travel. Adding in an offset of opposite polarity but the same value as the Weight re-centres the channel output.

First, the flaps are added. This simply requires the Brake signal added to CH5 and CH6. Next, rhe rudder is added at CH4.

The Crow ailerons are next. A small part of the throttle signal is added to the ailerons, to provide rising ailerons for the crow brakes. The full brake programming is shown in Fig 16.6.2a, the channel outputs are at Figs 16.6.2b and 16.6.2c.

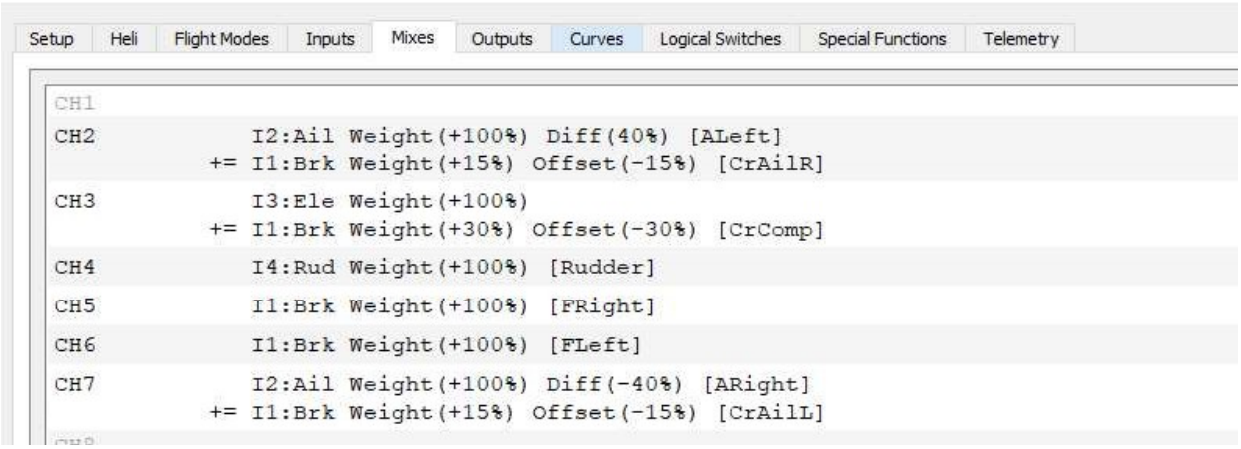

Figure 16.6.2a - Crow Brakes Complete

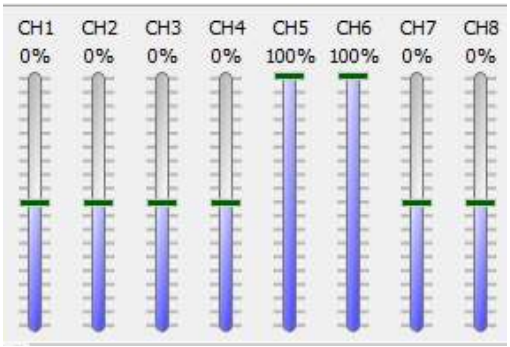

Figure 16.6.2b Normal Flight Mode

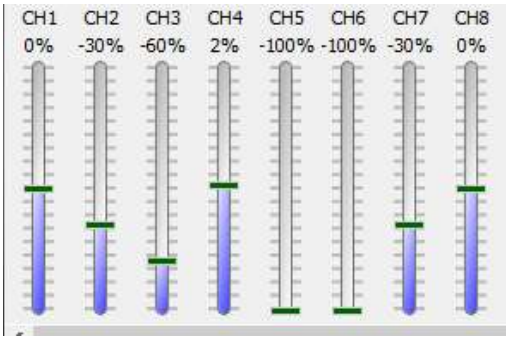

Figure 16.6.2c – Full Crow

16.6.3 Flaps as Ailerons

To use flaps with the ailerons, some aileron input is added to the neutral position flap settings of CH5 and CH6. Upward flap movement for camber and crow settings requires adding in an offset of opposite polarity but the same value as the Weight re-centres the channel output.

Fig 16.6.3a shows the MIXER for aileron and flap roll control with offsets to provide servo movement at each brake stick extreme.

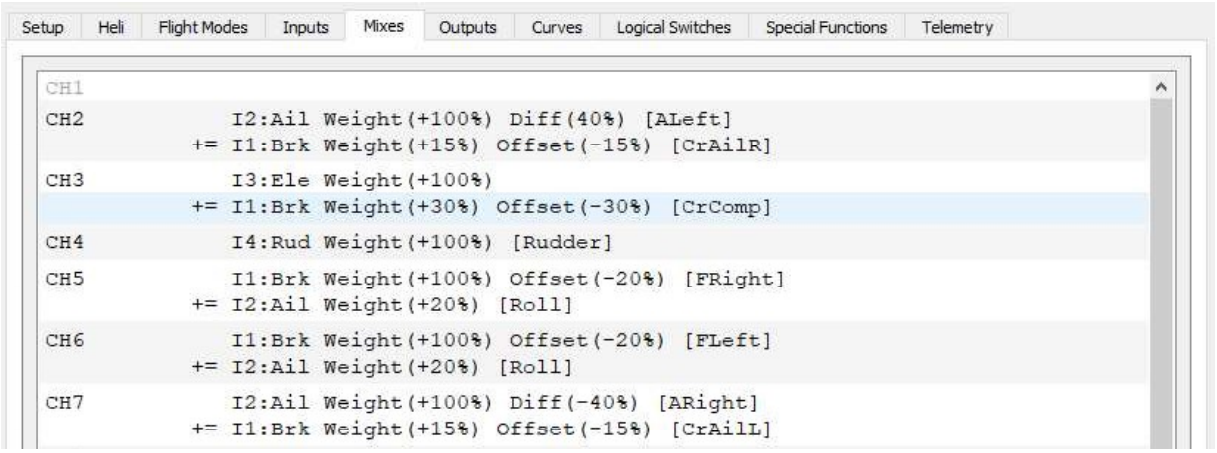

Figure 16.6.3a – The Roll Programme

Figs 16.6.3b, c and d demonstrate the combined aileron and flap movements. Normal flying positions are shown in (b), and both aileron extremes and flap positions are shown in (c) and (d).

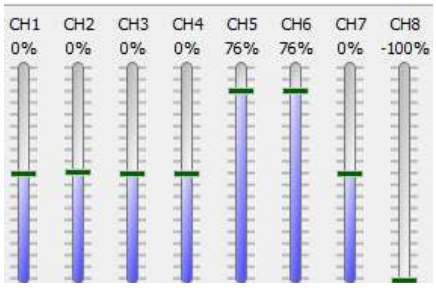

Figure 16.6.3b - Normal Flight Mode

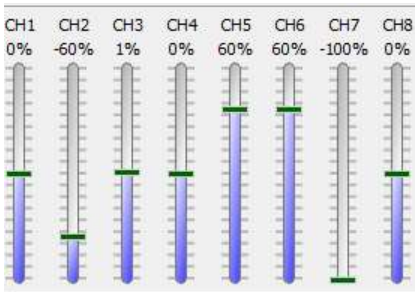

Figure 16.6.3c - Full Left Aileron

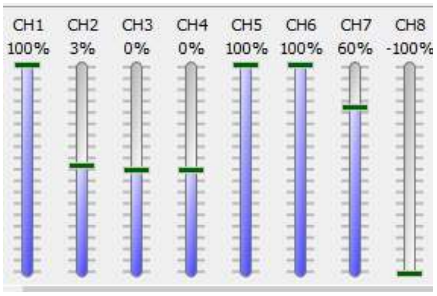

Figure 16.6.3d – Full Right Aileron

16.6.4 Camber Change

For thermal soaring, changing the airfoil camber of the airfoil may be advantageous. In this example, camber change is set by a three-way switch, to provide speed, cruise and thermal settings. This requires that the flaps are offset by a small amount (already done for the Alex programming).

To implement the camber change, both ailerons and flaps have a small, fixed, offset applied to raise or lower the ailerons and flaps a small amount. SA is used, with 'Weight' of the SA position added to the aileron channel. Fig. 16.6.4a shows the programming, Figs. 16.6.4b, c and d demonstrate the surface movements.

Note an oddity when using switch up and down with offsets:
SA↑ value is -100%, -100% * +25% = -25%.
SA↓ value is +100%, +100% * +25% = +25%.
SA↑ value is -100%, -100% * -25% = +25%.
SA↓ value is +100%, +100% * -25% = -25%.

Therefore the offset has to have the correct sign (plus or minus) to achieve the desired direction.

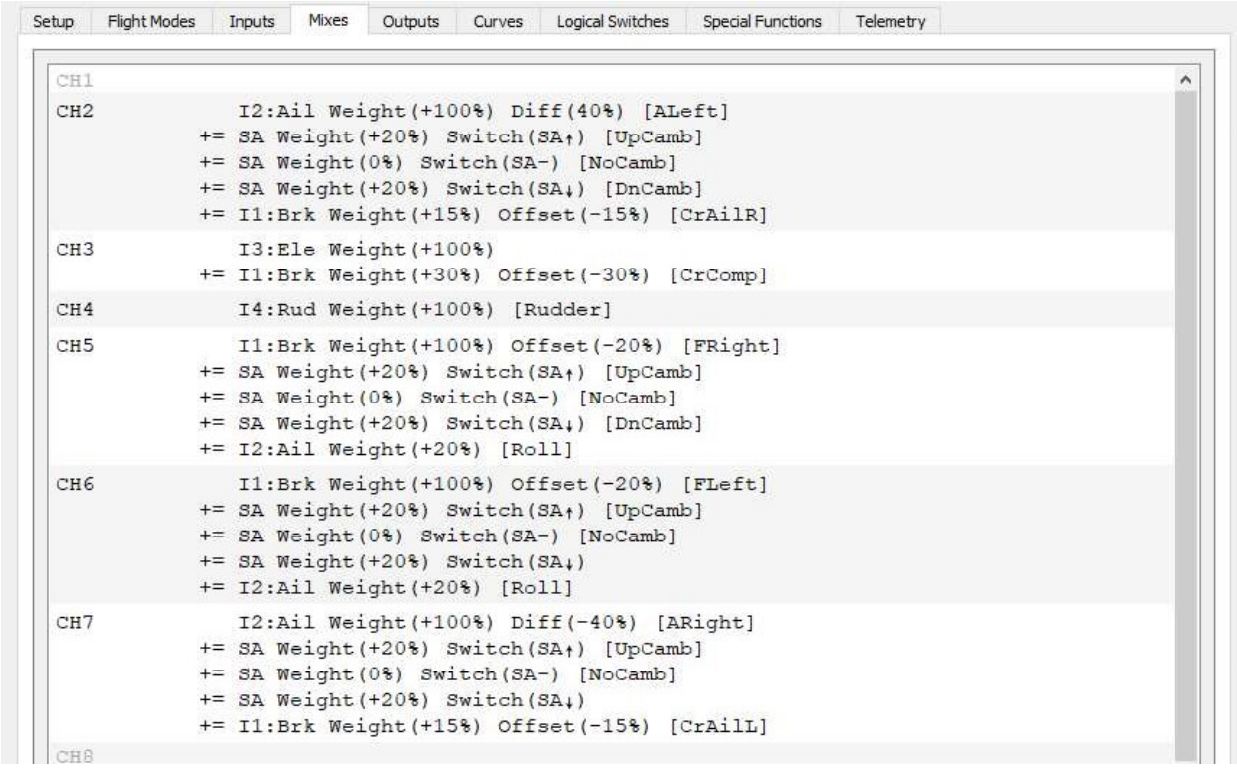

Figure 16.6.4a – Add Camber – the Full Programme

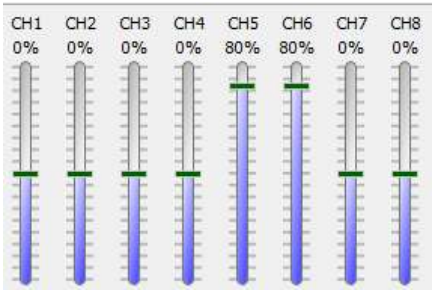

Figure 16.6.4b - Camber Normal (SA Mid-position)

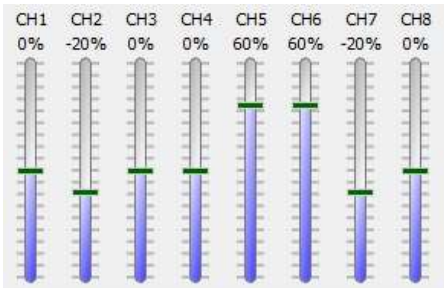

Figure 16.6.4c - Camber Positive (SA Up)

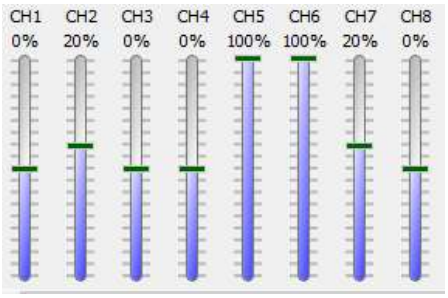

Figure 16.6.4d - Camber Negative (SA Down)

17 Using the Q X7(S) to Control the Alex

The detail for changing settings is essentially the same as for the delta wing model at Chapter 14. The following is a suggested sequence to set the control surfaces in a logical manner.

WARNING

1. Due to the unpredictable nature of the servo travel and direction, it is advisable to disconnect the servo linkages.

2. All the programming values used here are all a best-guess, but offsets and some mixes were deliberately exaggerated so the effect is easily visible in the simulation..

3. There has been no effort to calculate the servo travel for inputs that are mixed. Therefore a servo may run out of travel due to excessive offsets or too great a mix value. A suitable setting could be found by calculation (see internet discussions) or by trial and error.

17.1 A Suggested sequence:

1. Set transmitter switches to mid position to set no camber and low rates. Centre sticks and trims.
2. Switch on the transmitter and then the model.
3. Correct servo direction as required. Change only the primary surfaces ie rudder, elevator, aileron and flaps, ignore the camber, aileron/flap and brake mix effects.
4. Connect the ailerons, rudder and elevator at their neutral position, and mechanically set the neutral position.
5. Set the throttle stick to the top (censure the servo movement is not stressing the hinges)
6. Connect the flaps mechanically
7. Move the throttle stick down slightly to account for camber and crow later.
8. Move the camber switch to up. All wing surfaces should travel up. Depending on the physical construction of the flap hinge, flap up travel may be limited. The flaps will travel less than the ailerons.
9. Move the camber switch to down, all wing surfaces should move down. Again, flap travel is less then the aileron.
10. Return camber switch to centre.
11. Move the aileron stick. Change aileron/flap mix to make flaps move in the same direction as each aileron.
12. Ensure aileron differential is correct (down aileron moves less than up aileron).
13. Slowly move the brake stick down and observe the elevator movement. Adjust the direction of the compensation to suit the model. See Para 16.2.
14. Each aileron should move up as the stick goes down. See Para 16.2. To retain aileron control during brake operation, keep the aileron up travel quite small. .
15. Check the surface movements are all correct. For flaps, this required altering the INPUTS CH1 line to be: I1:Brk Thr Weight(+50%) Offset (50%).
16. Restore the flap stick to the up position and reset the linkages.
17. Move the rate switch to the down position. The aileron and elevator surfaces should have the same travel as before. Move the rate switch to the up position. The aileron and elevator surfaces should now have a larger travel. The rates switch effect may be reversed, depending on preference

Set the exponential at the field, depending on preference or flying style.

17.2 Setting Elevator and Aileron Brake Mixes

Setting the amounts of elevator compensation and rising ailerons while the brakes are applied can be tricky, as these both rely on a combination of a Weight and an equal, but opposite, Offset. This is not easy to so, and is greatly simplified by setting a Global Variable because they have both a positive, and an equal negative, value. Two (separate) Global Values are used for elevator and aileron compensation when using brakes.

Adding the Global Variables is the same as for setting the Wildthing GVs, and see Appendix A2 for detail.

17.3 Setting GVs in FLIGHT MODES for the Alex

The first step is to add the GVs in the FLIGHT MODES tab. In Fig. 17.1a the two labels, CrA (for Crow Ailerons) and CrE (for Crow Elevator). Each is assigned a value. The values here are from the downloaded Alex setting, not the original Companion file.

The third GV is for the differential, not yet implemented.

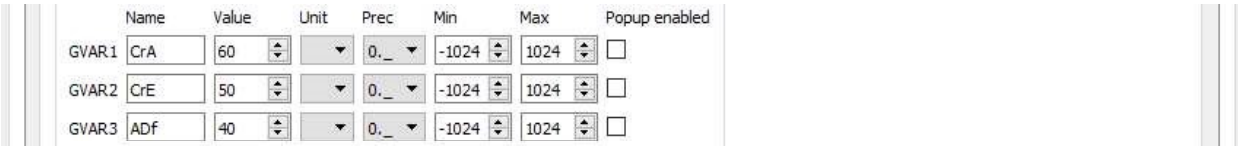

Figure 17.1a – The GVs added

Next, the GVs are allocated in place of their respective numbers, Fig. 18.1b.

Figure 17.1b – The GVs added to MIXES

TIP: See Para. 14.8 for programming tips.

TIP: See Appendix 8 for de-cluttering the programme.

A1 Programming 2 and 3 Way Switches

The Q X7(S) has four 3-way switches (SA, SB, SC and SD), one 2-way, biased switch (SH) and one 2-way switch (SF).

If, say, it is desired that the elevator and ailerons have 2 different rate settings, and both have a separate toggle switch, then the transmitter cannot fulfil this requirement directly.

There are several methods available to solve this problem, and some are described below. There are also additional entries in MIXES to demonstrate the MAX operator and the use of –100% as an offset.

SH is a two-way biased switch, and used here for the models Lost Model Alarm. With the switch at rest, the channel output goes to -100%, and when operated, the signal goes to +100%.

Note 1: there is no zero value for SH.

Note 2: When using switches, there is no need to set them in INPUTS as they are a direct input to MIXES unless they require processing first eg reduce the proportion of the signal for a mix.

A1.1 Switches Programming

Some programming techniques for the various switch types are shown in the MIXES page of Fig A1.1a.

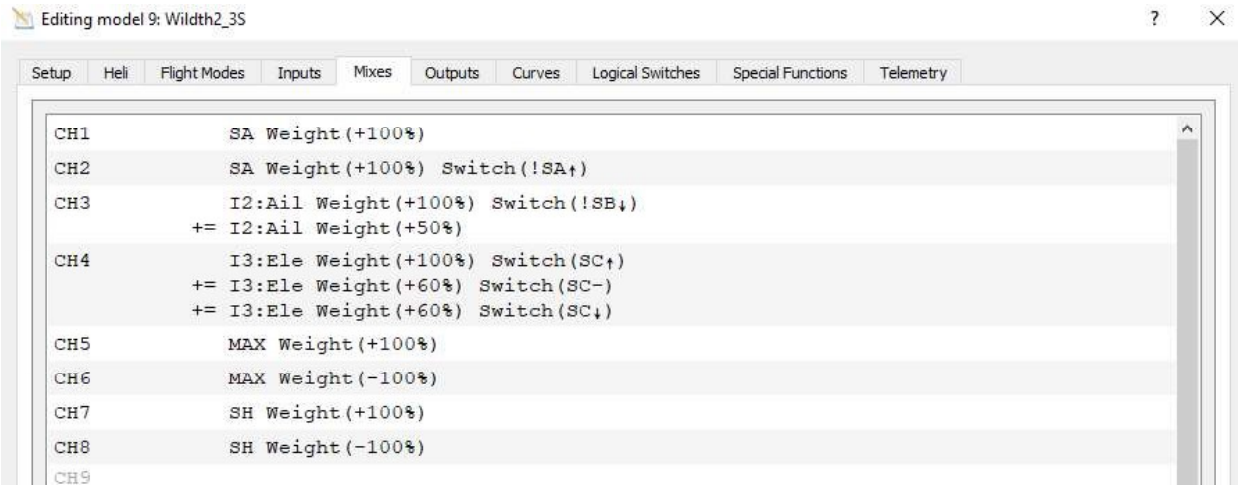

Figure A1.1a – Switch MIXES Page

A1.2 Channel Outputs

The following output diagrams show the various outputs with the varying switch positions.

A1.2.1 CH1 and CH2 – SA and !SA↑

CH1 has a direct input from SA with 100% weight and no other operator.
CH2 has a direct input fom SA, with 100% weight, but controlled by the "!SA↑" operator.

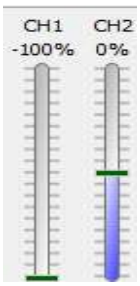

Figure A1.2.1a – SA Up

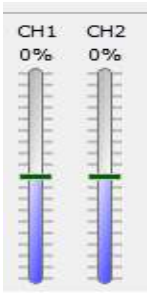

Figure A1.2.1b – SA Mid

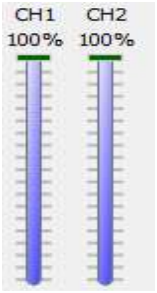

Figure A1.2.1c – SA Down

CH1 output follows SA position, UP = -100%, Mid -= 0, and Down = +100%.

CH2 output is Mid-position until the switch is Down, ie **!SA↑**.

Therefore, CH1, a direct input, 3-way switch will provide a three-position output of -100%, 0% and +100%.

The CH2 "!SA↑" operator leaves CH2 output in the **Mid position** in both the up and Mid switch positions, but goes to 100% when the switch is Down.

A1.2.2 CH3 – 3-way Switch as 2-Way Switch (SB↓)

CH3 is the INPUTS aileron stick channel, set up for 2-way switch operation using SB↓. When SB is not active, the rates are set to -50% (Figs show left aileron)

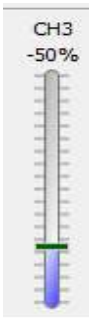

Figure A1.2.2a – SB Up

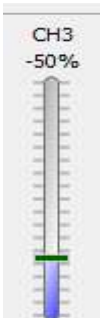

Figure A1.2.2b – SB Mid

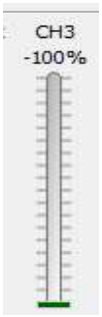

Figure A1.2.2c – SB Down

CH3 shows a decreased, rated, travel for both SB Up and Mid positions (60% travel). When SB is Down, the aileron moves to full travel (the +100% Weight).

The CH3 "SB↓" operator leaves CH3 output low-rated in both the Up and Mid switch positions, but goes to High Rates (-100%) when the switch is down. Note the figures are full left aileron, full right aileron are the reverse outputs.

A1.2.3 CH4 – 3-Way Switch as 2-Way Switch (SC↑, SC-- and SC↓)

CH4 programming is the simplest to understand, and, for the sake of the extra line, much more readable than the "!SB↓" style. SC is a 3-way switch but with two programme lines the same, creating the same effect as a 2-position switch.

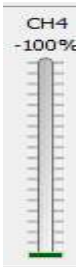

Figure A1.2.3a – SC Up

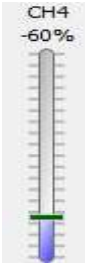

Figure A1.2.3b – SC Mid

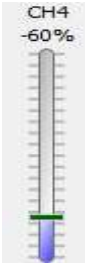

Figure A1.2.3c – SC Down

SC Up shows full up elevator ie +100%. SC Mid and SC Down show the same rate output for both switch positions.

The CH4 SC↑ operator leaves CH4 at 100% only in the Up position. Switch positions SC-- and SC↓ both give the rated (60%) output. Note the Figures show full up elevator, full down elevator are the reverse outputs.

A1.2.4 CH5 and CH6, MAX +100% and –100%

CH 5 and CH6 show the effect of the MAX operator, which is a fixed value of 100%.

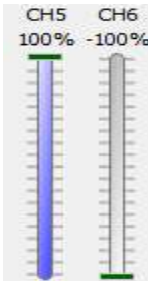

Figure A1.2.4a MAX

CH5 shows the MAX operator without an operator
CH 6 shows MAX with an offset to invert (reverse) the channel output.

A1.2.5 CH7 and CH8, SH +100% and –100%

CH7 is the biased switch SH output
CH8 is the biased switch SH with an offset to invert (reverse) the channel output

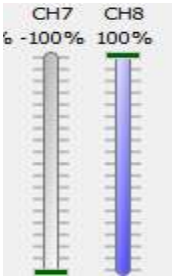

Figure A1.2.5a – SH Up

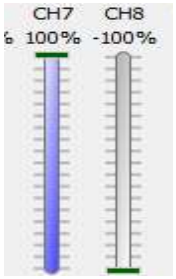

Figure A1.2.5b – SC Down

The CH7 SH Up leaves Channel 7 output at +100%. CH8 is at +100% because of the –100% weight applied to that switch position. SH is a biased switch. Biased means that the lever is spring-loaded, normally at the rest position. When the switch is operated, unless the lever is held in place, the lever will return to its rest position.

A2 Global Variables (and Flight Modes)

Global variables (GV) are numbers represented by a text label. They may be used anywhere a number is used in the programming. They are found in the 'Flight Modes' tab as GVAR1 to GVAR9.

There is one other GV that contains a specific value, MAX, which represents 100%.

A2.1 Limitations of GVs

There are only nine GVs available in the Q X7(S). Because of this limitation, use GVs economically – but note that creating a GV will also create a GV with an equal, negative, value. Thus a GV labelled ABC of value +10 will also create a GV of –10. See Fig. 2.3.2c, CH2, last line for an example. Note that a GV may be re-used by replacing the GV with its numeric value in the programme.

GV labels are limited to three characters. This makes it easy to misinterpret a GV label, particularly on the Q X7(S) screen, and also if the programming of the model is changed at a later date.

Once labelled, that label applies to GVs across all Flight Modes although a different value may be selected per flight mode. Flight Modes are not discussed further.

A2.2 Warnings Applicable to the Use of Gvs

Care must be taken to make the use function-specific. Say a GV has a value of 30, initially chosen for aileron differential. Because of the limited number of GVs, and 30 is a suitable value, this GV is used for elevator expo as well. If, for example, the aileron differential is altered on the field by changing the GV to 60, then every instance of this particular GV will change – including the elevator expo - to the new value of 60.

A2.3 Programming with GVs

GVs are located in the FLIGHT MODES (FM) tab. As an aside, Flight Mode 0 is the default flight mode, and no further action need be taken if other FMs are not used.

GVs are particularly useful where a number appears multiple times in related functions, such as where a programme line contains a positive and an equal, negative, value.

An example may be crow ailerons, where the 'Brk' signal is added to aileron channels 2 and 7 (last line of CH2 and CH7 in Fig. 16.6.4a), to raise the aileron during braking. Each ;Brk' line has a Weight (+15%) and a negative Offset (-15%). Here, a GV is useful as several locations may be set simultaneously by one GV (because each GV also has its complementary negative, –GV).

A GV is selected by ticking the GV box, then selecting the required GV from the adjacent drop-down menu. Positive GVs are down, negative GVs are up the menu. See Fig. A2.3.2c

The process of substituting GVs for numbers is described below.

A2.3.1 Set up GVs in FLIGHT MODES

Open Companion and a Model file, and select a model to modify.
Click on the Flight Modes page
Click on the next empty GVAR location and enter a 3 letter identity. Make this label meaningful for future reference.
Click on the adjacent 'Value' box and enter the value to be used.

The result is shown in Fig. A2.3.1a.

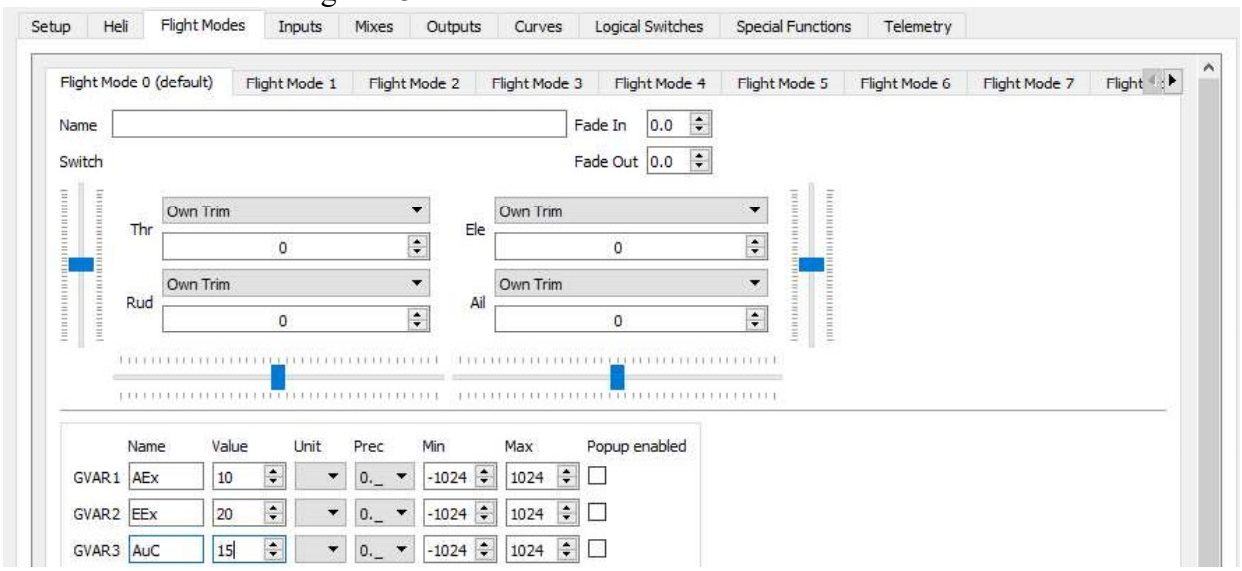

Figure A2.3.1a – FLIGHT MODES Tab

A2.3.2 Set up GVs in the Programming

Now the GVs will appear as selectable options for 'Weight' and 'Offset' when editing a line. Instead of entering a numeric value, tick the 'GV' box and choose the correct GV (there are both positive and negative GVs for the same label) from the drop-down list, Fig A2.3.2a.

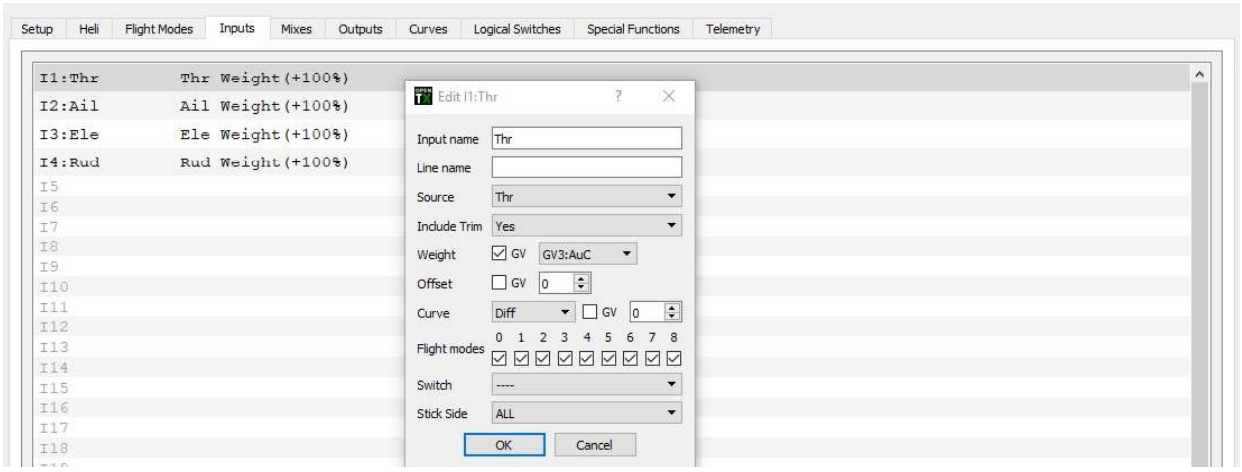

Figure A2.3.2a – Channel 1 with GV 'AuC' chosen

And the resulting CH1 line with ‘AuC’ as the Weight, Fig. 2.3.2b.

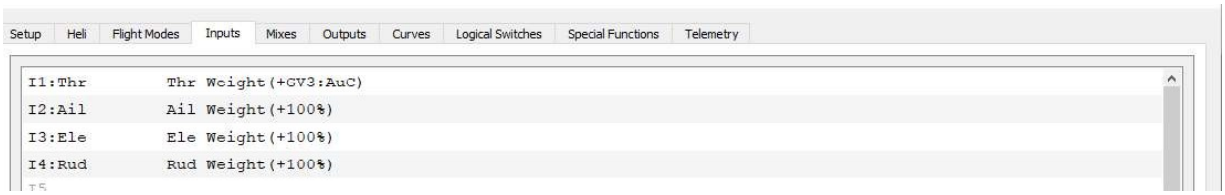

Figure A2.3.2b – GV in Place of Value.

Fig 2.3.2c demonstrates the results of using GVs in model airplane programming.

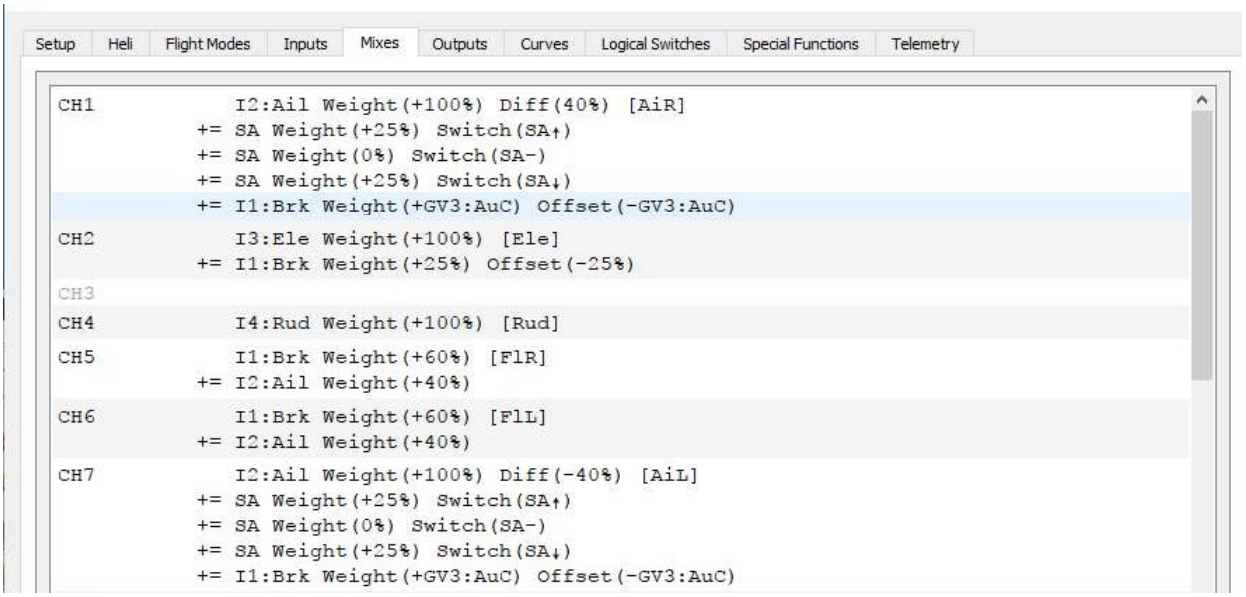

Figure A2.3.2c - GV used In Place of the Same Numeric Value at Four Locations.

Similarly, most values in the INPUTS or MIXER may be replaced by GVs, but each channel or function should have a separate GV to avoid the issues outline in A2.2.

A2.4 Recovering or Re-using GVs

Once the aircraft is set to fly as required, then a Gv may be replaced by the numeric value of that GV. For example, if the pilot wishes to experiment with different camber settings after initial test flights confirm the rates are correct, then the rate gvs can be reassigned to the camber function.

A2.5 Flying with GVs

GVs are useful at the field because they allow the setting of a servo position from one location (FLIGHT MODES), not each occurrence in the programme.

Navigate to MODEL SETUP > FLIGHT MODES (Page 4/13) and scroll to FM0.
Press the ENT to select FM0.
Scroll down to locate and edit the various GV entries. These are the same values as set by Companion.

A3 Bind X8R, D8R, V8FR Receivers and Range Check

Using the Q X7(S) with the original internal transmitter software and the OpenTx V2.2 radio software, the X8R (EU/LBT), V8FR (non-telemetry) and the D8R (telemetry) receivers have been bound to the Q X7(S), as described below.

A3.1 Bind X8R:

On Q X7(S): Navigate to SETUP > scroll to 'Internal RF' > 'Mode'.
Press ENT > scroll to 'D16' > press ENT.
Set Channel range as required: (leave channel range as 1–16.)
Scroll to 'RxNum' > scroll to select receiver number, eg '00'
Ensure 'External RF' is 'OFF'
Scroll to 'Receiver' > 'BND' > press ENT.
At menu, scroll to select option required and press ENT, 'Bnd' will flash.
On X8R:
Press the F/S button while applying power. Green LED on, Red LED flashing
Power off receiver
On Q X7(S) Press ENT on Q X7(S), 'Bnd' will highlight steady.
On X8R: Power on receiver. Green LED will flicker rapidly and servos operate

A3.2 Bind D8R:

On Q X7(S): Navigate to SETUP > scroll to 'Internal RF' > 'Mode' > press ENT
Scroll to 'D8' > press ENT.
Ensure 'External RF' is 'OFF'
Scroll to 'Receiver' and 'Bnd' > press ENT.
On D8R: Power on receiver. The red LED will flash.
Power off receiver
On Q X7(S): Press ENT on Q X7(S), 'Bnd' will highlight steady.
On D8R: Power on receiver and servos should operate correctly.

A3.3 Bind V8FR:

On Q X7(S): Navigate to SETUP > scroll to 'Internal RF' > 'Mode' > press ENT.
Scroll to 'D8' > press ENT.
Ensure 'External RF' is 'OFF'
Scroll to 'Receiver' > BND > press ENT.
On V8FR: Add shorting link between Channel 1 and Channel 2 signal pins
Power on receiver. The red LED will flash.
Power off receiver.
On Q X7(S): Press ENT on Q X7(S), 'BND; will highlight steady.
On V8FR: Remove shorting link. Reconnect servos if necessary and servos operate.

A3.4 V8R4:

Of two receivers tried, neither would bind.

A3.5 Range Check

In all cases, after binding, and before each flight, perform a range test as specified by the receiver manufacturer.

A4 Q X7(S) Calibration and Companion

OpenTx Companion requires some setting up before Model files are uploaded to the Q X7(S). Predominately, these are the radio module settings and the Q X7(S) stick and pot calibration.

WARNING
Failure to set the transmitter module and its protocol, and calibrate the Q X7(S) sticks and pots may result in a burnt-out servo, and / or damage to the model.

A4.1 Using Companion with the Q X7(S)

When first used, Companion does not know anything about the Q X7(S). Therefore, calibration and radio settings for the transmitter need to be set within Companion before any uploads take place. This is achieved by a) setting the Q X7(S) radio settings to a known state, b) calibrating the sticks and c) downloading and saving the Q X7(S) Model file to Companion. As noted previously, individual models may be set for different radio module set-ups, but the calibration settings remain constant.

A4.2 Set Up and Calibrating the Q X7(S)

1. To set up Radio section:
   See Para. 5.2 and 5.3 to set up the radio elements of the Q X7(S).
2. To calibration the Q X7(S):
   Long press ENT, repeatedly press PAGE to reach CALIBRATION (9/9)
   Press ENT
   Centre the sticks and pots (pot knob marker to top position).
   Press ENT.
   Move sticks and pots through their full travel.
   When done, centre S2 at detent. To centre S1, adjust S1 so the S1 bar graph matches the S2 bar graph.
   Set throttle stick at TOP
   Press ENT to save setting in Q X7(S).
   Press EXIT twice to return to Model screen
3. Download Q X7(S) model memory to Companion see Appendix A5).
4. Use ‘save as’ option to rename and save Model file.
5. Use the file saved in step 3 (or a copy) for all model development.

Note the Model file may be copied and renamed, so these settings are copied to the new file - there is no need to repeat this process for a new Model file.

Now, all model uploads from Companion from this model file will retain the correct settings.

A4.3 FrSky software vs. OpenTx

After setting up a simple model on Companion, the expo and rates data were being corrupted when the model files were uploaded, they were being set to 125% at the Q X7(S).

OpenTx 2.2 was uploaded to the transmitter, with the attendant SD card files. This seems to cure the issue.

A5 Upload and Download Model Files

Up or downloading Model files to/from the transmitter to the PC is via USB cable.

A5.1 To upload, a Model file to the Q X7(S)

Open Companion and the required Model file. At the transmitter, hold both lower trim buttons towards the centre of the transmitter and BRIEFLY press and release the power button. Release the trim buttons. The transmitter screen shows three options. Ensure the 'Write firmware' option is highlighted.

Open the flap at the base of the Q X7(S) and connect a suitable USB lead to the connector. The Q X7(S) screen shows 'USB connected'

Click on the Companion screen on the PC. Either:
click on the icon (top left side). Hovering over this icon shows the caption 'Write Model and Settings to Radio'. Click on the icon.
OR
select 'Read/Write' tin the top menu list, then click on 'Write Model and Settings to Radio'. Click on this line.

In either case, tick the box 'Check firmware for compatibility' then click 'Write to Tx'.

A progress bar appears, and after short while disappears. Remove the USB lead from the Q X7(S) and use the scroll wheel on the Q X7(S) to select 'Exit', then press ENT. The transmitter reverts to normal operation.

Note that if a switch or other alert is set, warnings will appear in the Q X7(S) screen, and NO SIGNAL TRANSMISSION will occur until all warnings are cleared. Once cleared the default model name will appear on the Q X7(S) screen and the radio-control link to the model is active.

A5.2 Download a Model file to Companion

At the Q X7(S), hold both lower trim buttons towards the centre of the transmitter and BRIEFLY press and release the power button. Release the trim buttons. Open the flap at the base of the Q X7(S) and connect a suitable USB lead to the connector. The Q X7(S) screen shows 'USB connected'

Open Companion on the PC. Either: click on the icon (second down, top left side). Hovering over this icon shows the caption 'Read Models and Settings from Radio'. Click on the icon.
OR
select 'Read/Write' tin the top menu list, then click on 'Read Models and Settings from Radio'. Click on this line.

A progress bar appears, and after short while disappears. Remove the USB lead from the Q X7(S), scroll to 'Exit' and press ENT. The transmitter will now revert to normal operation.

Companion now has a Model file named 'document1.otx'. Click on File > Save as and give the file an appropriate name. Then click 'Save'.

A6 Copying Models To and From Model Files

If there are model files in Companion that are not on the transmitter, for example, from a downloaded *.otx file, do one of the following:

A6.1 Using Two Copies of Companion

Open the original Companion Model file (file 1)
Open a new copy of Companion
Open the source Model file (file 2)
Copy model files from file 2 to file 1.
Save file 1
Upload new Model file (file 1) to transmitter
Close both copies of Companion

A6.2 Copy Files Using Windows

Open the folder that contains the *.otx file and copy this file into the OpenTx Companion folder, rename if required. Open Companion and open the destination Model file (where the *.otx file is to be placed). Then open the Model file to copy from. Both Model files are now open in Companion.

In the source Model file, right click > 'Copy 1 model'. Move the cursor to the model line in the destination Model file, right click > 'Paste 1 model'. Click on 'File' > Save' to keep the changes.

Ensure the new model goes into the existing Model file to retain the stick calibrations and transmitter module settings.

A7 MIXES - Reassigning Channels

The following demonstrates some features of MIXES. Here, MIXES is used to reassign channels, from the Q X7(S) default TAER stick configuration to that of a Futaba transmitter.

A7.1 INPUTS

The INPUTS tab of Fig. 7.1a shows a straightforward programme for throttle, aileron, elevator and rudder, (TAER) in that order.

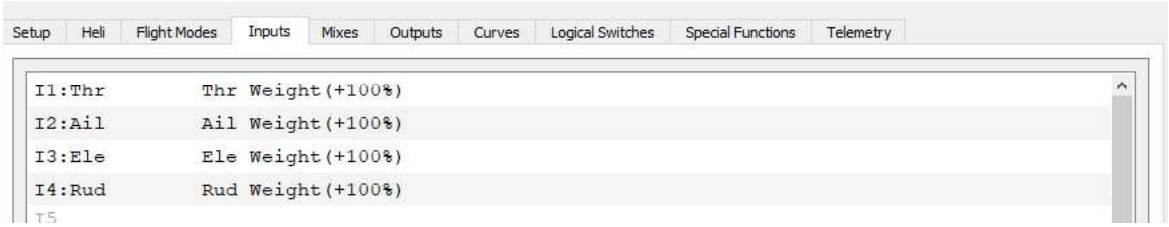

Figure A7.1a – Basic INPUTS Tab

A7.2 MIXES and Channel Reassignment

A simple MIXES tab, Fig. 7.2a, is for a two-aileron model. Using the INPUTS of Fig. A7.1a, the various sources from INPUTS are rearranged.

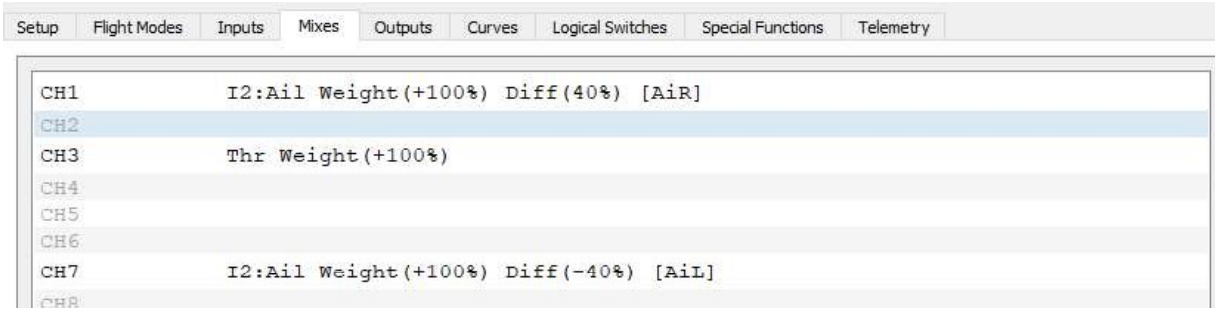

Figure A7.2a – MIXES with Reassigned Channels

A7.2.1 Reassigning a Channel, Input Source from INPUTS

CH1 shows that the INPUTS Channel 2 (aileron) has been reassigned to CH1. The symbol I2 is the aileron stick, processed by INPUTS.

A7.2.2 Reassigning a Channel, Input Source from a Stick

CH3, shows the INPUTS channel 1 (throttle) reassigned to CH3. Note the line source is 'Thr' not I1. Now the source of CH3 is the stick itself, not the stick signal processed by INPUTS.

A7.2.3 Adding a Channel - Right Aileron

CH7 is the other aileron signal. It is also driven by I2. Thus aileron 2 is on channel 7.

A8 Tidying a Programming

With the Q X7(S) loaded with the programme of Fig. 16.6.4a the model was set up. When completed, the programme was downloaded to Companion, and examined for common programme lines. Having repeated groups of the same lines, particularly in MIXES tab, makes the programming cumbersome and means that values for the same function appear in many places. De-cluttering, in this context, simply means taking out these groups of (identical) repeated lines and replacing them with one line. Of course, one copy of these lines is kept to maintain the function.

Doing this makes the programming easier to read, and reduces to potential for error when editing, as the values are located in one area, and there are fewer to change

A8.1 De-clutter the Programming – Grouping Lines

The downloaded programme, after setting up the model, is shown in Fig. A8.1a.

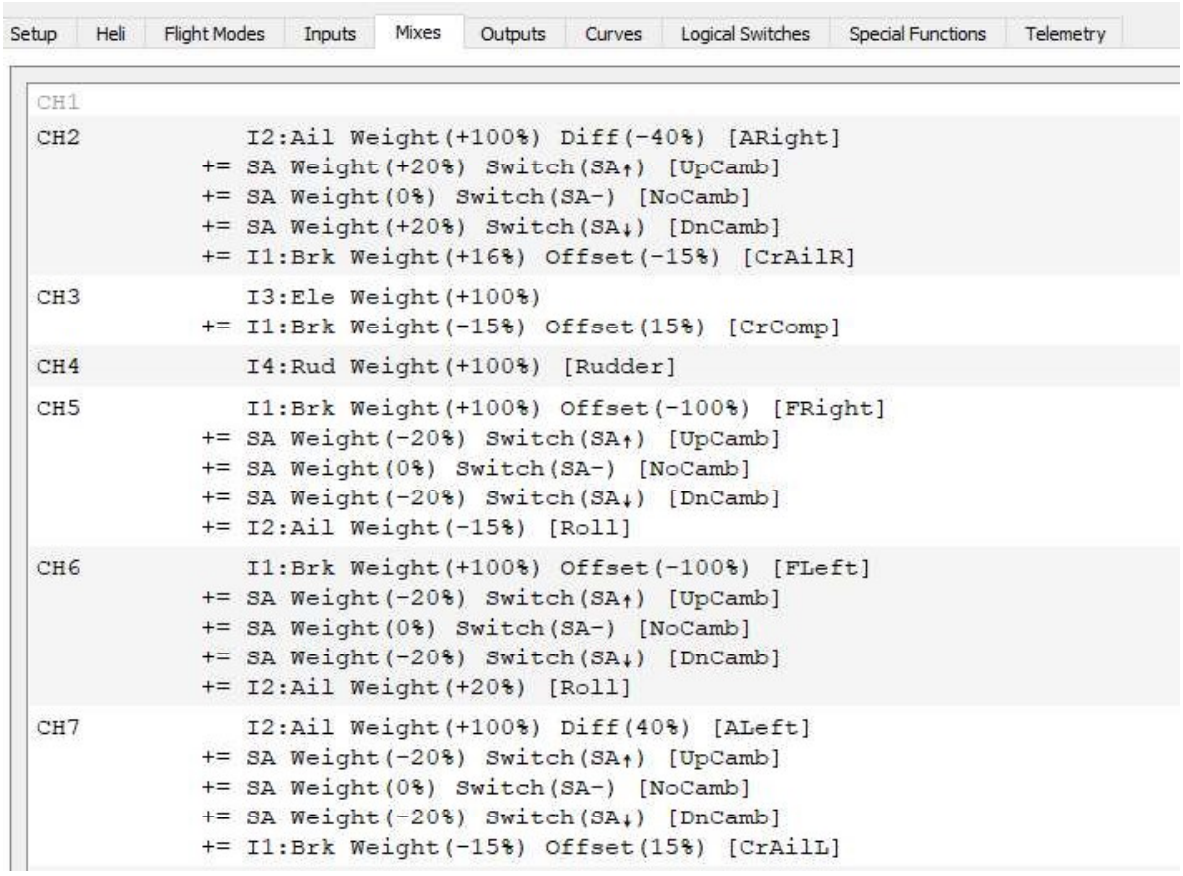

Figure A8.1a – The Alex Programme after Testing.

Examining Fig, A8.1a shows there are three repeated groups of lines, Fig.A8.1b. Note there are three sets of lines, not four, because CH2, the other aileron, is reversed to CH5, 6 and 7.

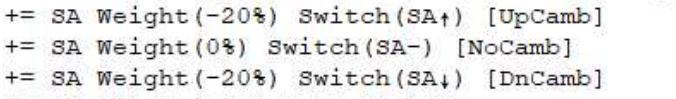

Figure A8.1b - Repeated lines

A8.2 De-Clutter the Programme - Implementation

Copy one set of the duplicates to, say, CH12 (ie, the lines of Fig. A8.1b now appear in CH12). Then include CH12 as a mix into the channels where these lines have been removed. The final implementation, subject to trimming the settings in flight) is shown at Fig. A8.2a.

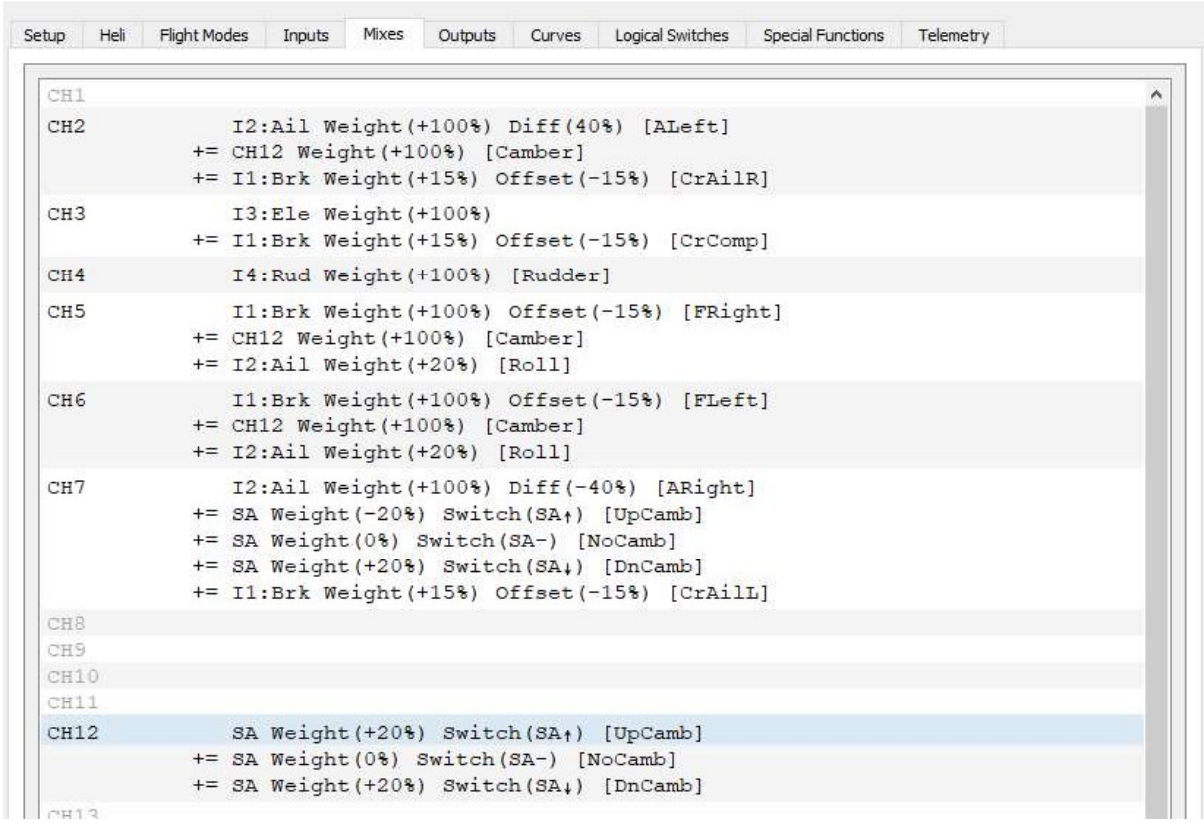

Figure A8.2a – Final Alex Programme

WARNING:

1. While a useful way to reduce the number of lines, care should be taken not to group lines that appear to be the same, but apply to different functions.

2. When editing values, say on the field, care must be taken to modify the functionally-related lines (here, CH2) of programming to match the values in the modified lines of CH12.

TIP: Consider the use of Global Variables to simplify the programme changes at the field, as all the values are kept in one place.

A9 Select Options and Reload Firmware (Operating Software)

When using Companion to set the Build Options (Settings > Settings) it is necessary to:

1. select the required options;
2. download the correct file to match the choices;
3. upload the file to the transmitter.

1. Set the required Build Options:
   a. Select the options. For example,
      to remove the HELI screen, tick the 'noheli' box
      to select non-eu (eg for D8 receivers), clear the 'eu' tick-box.
   b. Click OK to close the window.

2. Download the correct operating system file
   c. Click File > Download > Download firmware.
      a window will open with "opentx-x7-noheli-en.bin" in the name line.
   d. Select a destination to save the file and click Save
   e. Click OK to close the window.

3. Upload new firmware to the Q X7(S);
   a. Set Q X7(S) in download mode and connect USB lead.
   b. Open Companion. Click on Read/Write (top menu) > 'Write Firmware to Radio'
   c. In the 'Flash Firmware' window, click 'Load'
   d. Navigate to where file (opentx-x7-noheli-en.bin) is located
   e. Highlight file > click 'Open'
   f. In 'Flash Firmware' window, click 'Write to Tx'
   g. Wait for green bar and 'Flashing done' message. Click 'Close'
   h. Remove USB lead, scroll to 'Exit > click ENT.

A9.1 Example OpenTx File Structure on PC

It is convenient to keep all the OpenTx files in one folder. The Radio Profile page holds the Build Options, the path to the SD card, backup folder and any splash screen files.

An example file structure, held in folder OpenTx, may be as Fig. 9.1a. In the example, the Model files (.otx) are stored here as well.

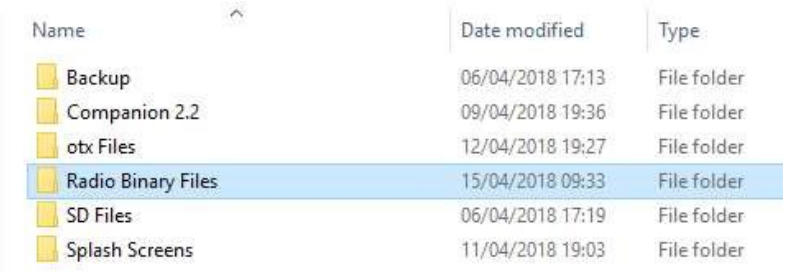

Figure 9.1a – Example OpenTx File Structure on a PC