ROYAL evo

TUTORIAL

Written by James "Joedy" Drulia © 2004

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ROYALevo 9/12 Tutorial

MULTIPLEX®
Modellsport GmbH & Co. KG

GB

This addendum to the ROYALevo 9/12 Manual was written by Joedy Drulia.

We, MULTIPLEX, thank the author and the translators for their encouragement and hope, it will enable you as a user to make even better use of the features of your ROYALevo 9/12.

Please send comments, questions or suggestions directly to the author or the translators.

D

Diese Ergänzung zum Handbuch der ROYAL evo 9/12 wurde von Joedy Drulia verfasst. Die deutsche Übersetzung haben Karl Schuster und Frank Eisenkrämer gemacht.

Wir, MULTIPLEX, danken dem Autor und den Übersetzern für ihr Engagement und hoffen, dass Sie als Anwender mit diesem Tutorial die Möglichkeiten Ihrer ROYALevo 9/12 noch besser nutzen können.

Mit Kommentaren, Fragen oder Anregungen wenden Sie sich bitte direkt an den Autor oder die Übersetzer.

F

Ce supplément au manuel de la ROYALevo 9/12 a été créé par Joedy Drulia et traduit en Français par Christian Grandejean.

Nous, MULTIPLEX, remercions l'auteur et les traducteurs pour leur engagement et espérons que vous pouvez encore mieux utiliser les possibilités de votre ROYALevo 9/12.

Avec toutes commentaires, questions et propositions adressez-vous directement ver l'auteur ou les traducteurs svp.

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1. INTRODUCTION

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This tutorial is primarily catered to new Multiplex EVO pilots who have recently converted to the Multiplex EVO or who are currently in the process of upgrading to an EVO with a background working with and programming Asian-based radios (AR).

The tutorial also assumes that the reader has read the manual. The reader should be comfortable entering information into the EVO and should be reasonably adept in using the input keys as well as the digi-adjuster keys for data input.

1.1 WIDGETS, CONTROLS, CHANNELS, MIXERS

First and foremost the new Multiplex user should immediately endeavor to become acclimated with the specific terminology used in this tutorial as well as within the Multiplex community in general.

The author recommends using Mike Shellim's approach to the following unique Multiplex vocabulary terms:

Widget : Sticks, switches, buttons, and sliders. On the EVO, the trim buttons, the digi-adjusters and the menu buttons near the bottom of the transmitter case are **NOT** considered a widget.

Control : What the function of the widget is. Initially, a widget doesn't do anything on Multiplex radios. The pilot must instruct the EVO as to what the effect that the widget will have.

Channel : Servo input signal. For this tutorial, you cannot have more servos in a plane than you have channels. The RE9 has nine and the RE12 has twelve.

Mixer : A miniature list of up to five control inputs that can each provide a control signal to a servo. Servos only have one physical plug end. Mixers allow for more than one control input to command a servo to move. Mixers will be addressed in detail in a later lesson. Mixers are not physical elements, but are created and stored in the EVO software.

1.2 THE MULTIPLEX PROGRAMMING CONCEPT

For a new user of the EVO, the MPX logic sequence can be very confusing at first. It is helpful to keep in mind the following programming logic sequence:

WIDGET ← CONTROL ← MIXER (OPTIONAL) ← SERVO

This is best understood as, "The servo is assigned to the Mixer, which is assigned to a control, which is then assigned to a widget."

With MPX, none of the widgets are established as controls initially. The widgets don't and won't do anything when the EVO is taken right out of the retail box. The actual data streams to the servos (which are the controls), however, already exists within the transmitter, but since they're not yet assigned to a widget, to a new MPX user it appears that there are no functions on the EVO!

Mixers can be pre-made by Multiplex or can be a custom made that the pilot can create. Mixers will be discussed in detail later in this tutorial.

The idea that widgets don't do anything right out of the box is a major hurdle to overcome when converting from an Asian radio brand to a Multiplex brand radio.

On an AR, the widget (the switch) that commands the flaps is already established to a control (activating the flap servo). This widget is permanently wired to a channel that sends a signal to the flap servo. Because the widget and the channel are permanently connected, none of the attributes such as the widget, control, or channel can be changed on an AR. The flap widget on an AR will always be a flap widget - it cannot be set to effect another servo or control such as a landing gear, tow release or wheel brake. This applies to the other pre-wired widgets on the ARs as well.

With an AR, since the widget and the channel are already hardwired for you from the factory, it is common practice to refer to a "flap channel" or a "spoiler channel." This is a practice that can no longer continue since it will cause the reader a lot of grief when attempting to understand the MPX approach.

With the MPX radios there are no connections between the widgets, controls and servos.

There is, however, a software connection that can be established within the MPX transmitter. In fact, this ability is the pivotal concept that allows the MPX radios such a tremendous amount of flexibility and programming power.

“So, how do these connections become established on the EVO?”

The pilot establishes these connections. The pilot decides which widget should effect which control and then established which servo receives that control signal. With MPX, the pilot will no longer need to plug specific servos into specific slots in the receiver - MPX allows the pilot to determine which control signal goes to which output on the receiver.

So, now that we have an understanding of the MPX logic, should the next step be to jump right in and begin programming the EVO?

No.

Before the pilot begins to program the EVO, they should spend a moment to consider the plane, their preferred flying style, and the specific controls that will be needed for the plane. They should also consider which widgets that they would like to use and how they should be utilized (always "ON" or switched off or on a slider?)

2. INITIAL CONSIDERATIONS

So, there the EVO sits on the workbench just out of the package. Perhaps the pilot has already read the manual, but perhaps they just charged the EVO up and turned it on and started playing around with the widgets and menu buttons.

"Ugh?" they may have wondered. "Where is the dual-rate switch? Doesn't this thing have a crow switch? How about a simple landing gear switch?"

These are probably all valid first impressions if the pilot is transitioning from an Asian radio (AR) to the EVO.

Notice that all of the widgets on the EVO are designated with a letter. One slider, for example, is labeled as "E" and the other is designated with an "F". Other switches and buttons have their own letter designations.

There is a valid reason for this approach by MPX. Since the widgets are not assigned to a control or to a function from the factory, assigning a generic letter code to each widget allows a way to indicate a particular widget to the EVO by referencing the letter code.

Also, take this time now to consider whether the pilot will be installing the short, medium or long buttoned axis sticks. Install that set that is most comfortable. Although the long sticks are for finger tip flying, they feature extra buttons that can be used later to control features or to turn on and off certain functions.

So, are the readers now ready to begin setting up the EVO?

No.

It's now time to put some thought into how the pilot likes to fly and what type of ship the pilot will be programming into the EVO.

For this example, we will be using the Omega 1.8E that is an ARF composite glider that has ailerons, v-tail and proportional motor controls. This is a plane is representative of many hot liners. The reader should keep in mind, however, that many of the steps that will be illustrated in this tutorial can be used to work with other planes.

2.1 PLANNING THE MODEL

Before commencing the EVO programming, it will be necessary to consider the following items:

- **How many servos will be installed in this plane?**
- **Are non-flying functions such as a landing gear switches or a timer functions needed?**
- **Should certain functions be designated as "Always on" or "Switched on"?**
- **Which widgets should be used and which widgets should remain dormant?**
- **Should more than one control movement affect a servo?**

The plane example used in this tutorial has a total of four servos, one each for the ailerons and one each for the v-tail surfaces. Although there will be no servo controlling the motor, there will be an ESC which will be considered a "servo" since it will require a data stream from one of EVO's channels in order to operate.

This means that there will be at least five essential control channels necessary for flight.

This satisfies the first of the pre-programming questions.

Next, since there will not be a landing gear, this function will not be needed. A tow release function will not be needed as well. However, a timer function that will keep track of the motor run time will be a nice feature. Since the author doesn't want to fool with a switch to turn the timer on or off, the timer should start and remaining running only when the throttle is turned on automatically.

Dual-rates on the aileron, rudder and elevator controls will be needed. This to be turned on and off with a switch.

Rudder should be added with ailerons for coordinated turns. This should be switched on and off with a widget as well.

Aileron differential will possibly be needed in case the Omega experiences adverse yaw when ailerons are used. This should always on, but there needs to be a way to adjust and fine tune the amount of differential compensation while flying the plane.

A spoileron and flaperon function will be needed that will be set on a slider for camber and reflex settings. This widget will work as a set-and-forget slider to adjust the reflex setting for penetration flight and the camber setting for thermal flight.

Another control will be spoilerons and this will be assigned to the left axis stick. This will be used for landing purposes.

2.2 PLANNING THE TRANSMITTER

We've determined which control functions should be used on the plane, but now it's time to decide which widgets should be programmed. The pilot can pick any widget to have any function, but some things are pretty obvious - assigning the elevator control to a two position switch would not be very beneficial. The three main flying functions (elevator, rudder and ailerons) will be assigned on the axis sticks working in mode two. The right control stick will control elevator and ailerons and the left stick will control the rudder.

If the reader has not set ratcheting on the left stick and disabled the spring tensions in the up and down motions, this is ok. The EVO will work fine without this being set, but if the reader would like their EVO to resemble the feel of most Mode 2 factory set transmitters, change the settings of the left stick to be ratcheting in the forward and back motion. The spring tension can also be disabled in the forward and back widget motion. By doing this, the reader can use the left stick as a throttle control or as a landing control for flaps, spoilers or crow functions.

For the throttle functions, the "E" widget will be used. When it's all the way towards the bottom of the transmitter, the motor should be off.

The "L" three-position switch will be used for dual rates since this will allow for two “on” positions for dual rates. One in the upper and another dual rate setting the lower position with the center position being utilized for no dual rate setting (full high-rates.)

The aileron differential should be set to a switch as well. The "I" widget will be used since it's close to the aileron control widget and will be easy to locate by fingers.

The reflex/camber function will be put on the "F" slider. Center detent will be no reflex or camber.

The spoiler function will be assigned to the left axis stick.

Observant readers will note here that three widgets have been assigned to control the spoilerons: the right axis stick, the "F" slider and the left axis stick.

Consider this: the aileron servos should to respond to the aileron widget (the right axis stick), to the reflex/camber ("F" slider) widget so that they both go up and down together and they should also respond to the left axis stick which will be the spoileron landing control.

But, here's the problem: The left and right aileron servos have only one physical plug ending each. We could plug the left aileron servo into a slot on the receiver that is commanding the left aileron signal, but then, how can we get the signals coming from the "F" slider and the left axis stick to the left and right ailerons? With only one plug ending, we can only get one channel signal to the servo!

“How can we work around this?”

The answer is to establish a mixer.

Recall the definition of a mixer that was given earlier.

Mixer :

A miniature list of up to five control inputs that can each provide a control signal to a servo. Servos only have one physical plug end. Mixers allow for more than one control input to command a servo to move.

Our solution is to make a mixer that will accept the widget movement instructions from the "F" slider (reflex control), the left axis stick (spoileron landing control) and from the right axis stick (aileron control). The mixer does not "mix" up these signals, but it will send a signal to the aileron servos whenever one, two or all three of these widgets are moved. With a mixer, whenever a signal is encountered from any of the control inputs, a signal will be sent to the servo that is assigned to the mixer. How much the aileron servos will move, their directions of travel and their limits of travel as a result of getting signals from the mixer will all be set by the pilot.

This mixer must be created before proceeding further. Greater discussion of the MPX mixer concept is necessary as well.

3. MIXING

For new users of the MPX EVO and especially if they are upgrading from an Asian radio (AR), the MPX concept of mixing is probably one of the most difficult concepts to understand at first.

So far, it has been decided which widgets to use for flying the plane. It has also been discovered that since the servos on the aileron only have one physical plug connector, that by plugging it into a receiver port, it would be impossible to send more than one channel signal to the servo.

This is anticipated to be a problem since it will be necessary to have a reflex/camber slider control, a spoileron control on the left axis and the standard aileron controls on the right axis stick. All of these widgets are to send a signal to the aileron servos when the pilot moves them.

A mixer will be necessary in order to accomplish this.

3.1 MIXER OVERVIEW

Mixer definitions (the name of the mixer, the control inputs to the mixer, whether they're always on or switched, and the description of the assigned servo's movement) are considered global. This simply means that the definitions are not created when the model is created in the EVO. If this were the case, the pilot would have to create each mixer from scratch every time they set up a new model.

The Multiplex approach to mixers allows the pilot to save time while programming future models after initially creating their unique mixers.

So, while it may seem strange at first to not be able to make a mixer while you are programming your specific plane into the EVO, keep in mind that by creating the mixer under the SETUP menu, it will become available to other planes. So while the pilot may initially create the mixer for one plane, the mixer can later be used on another plane. This saves a lot of time and programming steps.

So, how many mixer definitions can be saved? On the EVO, there can be up to 14. The first five mixers are made courtesy of Multiplex to assist users who don't want to create from scratch commonly used control scenarios. These are things such as v-tail, delta wings and flap landing mixers. There is also a specialized elevator mixer that was created with spoiler, flap and throttle compensation. There is also a specialized aileron mixer which was created by Multiplex with spoiler, flap and elevator compensation in mind.

Consider this: if a mixer is created (such as the one that will soon be created for the Omega) suppose that while the servo travel functions work fine with this plane. But at a later time when we assign this mixer to another similar glider, the mixer while it causes the servos to move properly in the correct directions has way too much to too little servo travel? Do we need to create another mixer?

The answer reveals that the question was a trick question!

Keep in mind that while a mixer does list the particular controls that will effect a specific servo and describes how that servo will travel when the control's widget is moved (symmetrical, symmetrical with dead zone, single sided with offset, single sided with dead zone or single sided with curve), the mixer does not contain any specific definitions that provide travel volumes or provide travel distances for a servo when it is defined.

"When creating a mixer, the pilot only establishes a frame work, but no specific servo travel distances?"

The answer is yes.

While the newly created mixer will be created as a global element, the travel values of each control listed in the mixer will be modified only once the mixer has been assigned to a model.

This is a good programming approach since by only establishing the controls (or the framework) that will affect a servo in the mixer definition and not the corresponding servo travels of the controls listed in the mixer, it allows us to create "generic" (or global) mixers which can be tweaked and modified when assigned to other planes. Consider that while you may use one mixer with more than one plane, the servo travel limits for each plane will be probably be different.

MPX mixing logic is set up to account for this.

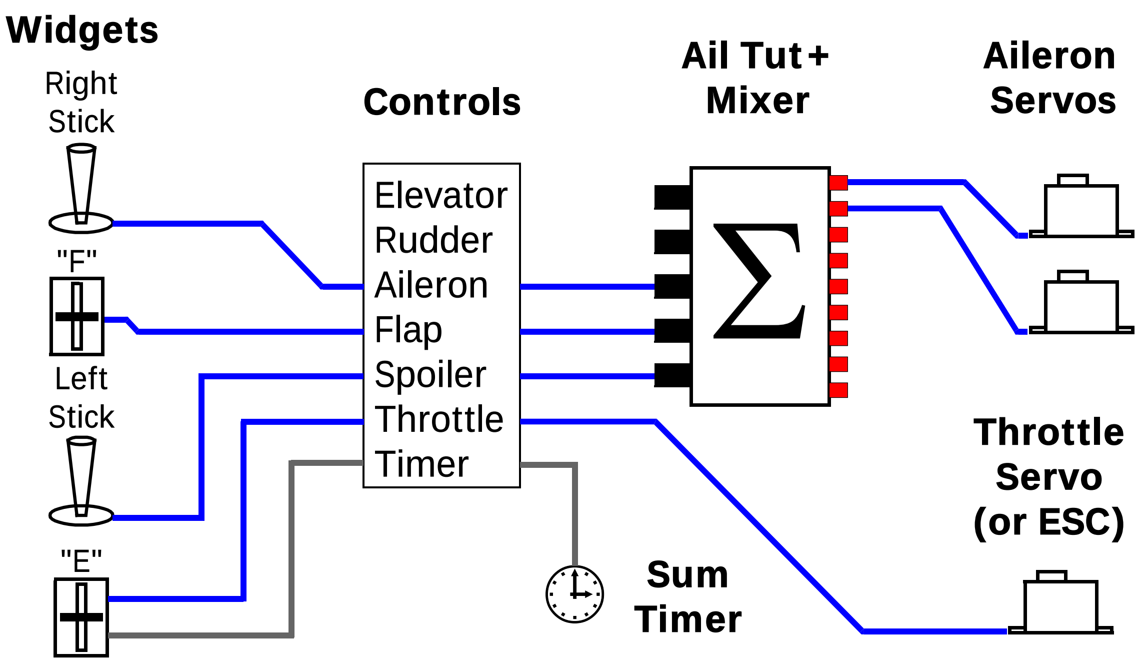
The following illustration shows how the aileron servos (which have only one physical plug ending) are able to receive servo data signals from more than one control. (The Elevator and Rudder widgets are omitted for clarity.) The mixer named "Ail Tut+" (which will later be created in this tutorial) will accept signals from the aileron, flap and spoiler controls. When any one of these controls sends a signal into the "Ail-Tut+" mixer, a corresponding servo signal will be sent to all of the servos attached to the mixer. Observe that the MPX mixer concept is not a slave/master technique. Each control input into the mixer is independent of the other controls also entering into the mixer. When one, two, or all controls are activated, the mixer will send a signal to the servos attached to it. The pilot establishes the levels of signals that are sent to the servos by adjusting the servo output values within the mixer itself. So for example, while the right axis stick widget might be set to give 100% of aileron servo movement the, the "F" slider widget could be set to give only 20% of aileron servo movement.

The pilot establishes the blue lines by making assignments in the EVO. The red-colored squares on the "Ail Tut+" mixer indicate that up to nine servos can be connected to the mixer. On an EVO12, there would be 12 red-colored squares shown. If the pilot had a need to add additional aileron servos (for a large scale plane, perhaps), the additional aileron servos could be plugged into the “Ail Tut+” mixer. As a result, all of the aileron servos would move the same. (The pilot needs not to be concerned about making the left and right aileron servos move in opposite directions; the EVO figures out this by itself.) Observe the choice of widgets and the blue lines that connect the widgets to the controls. The pilot also establishes which widgets to use as well as which control that the widget should be assigned to.

The Throttle control has been assigned to the “E” slider widget in this illustration. The throttle servo (or ESC) is assigned directly to the Throttle control and not to a mixer. The “E” slider will be able to control the throttle servo/ESC without a problem, but this is the only widget that will be able to send any signals to this servo.

Observe how the “E” slider is controlling the throttle as well as the Sum Timer. On the EVO, a widget can be used for multiple functions. This will be demonstrated in detail later in the tutorial.

Observe also that there are still two remaining control input slots into the “Ail Tut+” mixer if the pilot decided that additional controls should also effect the aileron servos.



The following diagram shows how one mixer definition can be applied to multiple planes.

The two example planes shown are very different. One is a jet with a v-tail, flap, aileron and throttle controls. The other example is a sailplane with v-tail, flap, aileron, and spoiler controls.

Although each plane has different servo travel distances established within the mixer menu, they both are utilizing the “V-Tail+” default mixer definition that comes pre-programmed within the EVO from the factory.

Notice how some controls are not utilized such as the Spoiler control on the V-Tail Jet and the Throttle control on the V-Tail Sailplane and are thus are dashed out to instruct the EVO to ignore these specific controls.

There is no limit as to the number of times that a servo can be assigned to a defined mixer. In fact, in this example, there are a total of four servos that are taking advantage of the default "V-Tail+" mixer; each plane has two v-tail servos that are assigned to the "V-Tail+" mixer.

As more planes are programmed into the EVO and take advantage of the default "V-Tail+" MPX mixer, the servos of these additional planes can be assigned to the "V-Tail+" mixer. Since the mixers in the EVO are global, they are accessible to all models. Within the setup of each plane, up to nine servos on an EVO9 (and up to 12 servos on an EVO12) can be assigned to this mixer.

On the left side of the diagram in the "Global Mixer Definitions" columns, the reader will notice that there are no specific servo travel distances listed or shown. Travel distances are not entered until a servo as been assigned to the mixer, and then within the plane's Mixer menu.

Observe also that the first five default mixers from MPX are shown in the Global Mixer Definition column as well as a custom mixer named "CROWflap+". This custom made mixer was created for flap servos on a sailplane for Crow or Butterfly flight function. This custom mixer contains an additional piece of information that is not observed within the first five MPX-defined mixers; the "CROWflap+" mixer contains a listing in the middle column titled as "Mix 1".

The Mix 1, Mix 2 and Mix 3 functions will be explained in detail in a future chapter.

For the time being, however, take a moment to commit to memory that global mixer ***definitions*** do not contain specific servo travel distance information.

Specific servo travel distances can be entered only once a servo has been assigned to a mixer. This is done on a per model basis.

Global Mixer Definitions

Name	Elevator+
1 Elevator	----
2 Spoiler	----
3 Flap	----
4 Thr -Tr	----
5 -------	----

Name	V-Tail+
1 Elevator	----
2 Rudder	----
3 Spoiler	----
4 Flap	----
5 Thr -Tr	----

Name	Delta+
1 Aileron	----
2 Elevator	----
3 Thr -Tr	----
4 --------	----
5 --------	----

Name	Aileron+
1 Aileron	----
2 Spoiler	----
3 Flap	----
4 Ele -Tr	----
5 --------	----

Name	Flap+
1 Flap	----
2 Spoiler	----
3 Aileron	----
4 Ele -Tr	----
5 --------	----

Name	CROWflp+
1 Flap	- - -
2 Aileron	Mix 1
3 Spoiler	Mix 1
4 Brake	Mix 1
5 -------	-----

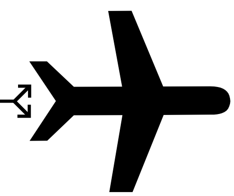
A total of 14 mixers can be created and stored in the EVO memory.

Mixer Menu

V-Tail+

		Trv	Trv
1	Elevator	-90%	100%
2	Rudder	-90%	100%
3	Spoiler	----	----
4	Flap	-20%	20%
5	Thr -Tr	OFF	-25%

Both V-Tail Servos Assigned to Mixer



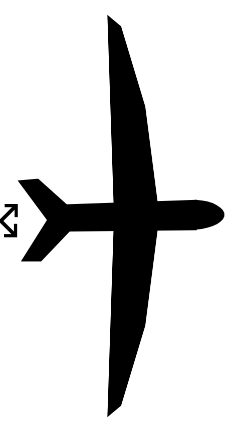
V-Tail Jet

Mixer Menu

V-Tail+

		Trv	Trv
1	Elevator	-80%	100%
2	Rudder	-100%	100%
3	Spoiler	30%	85%
4	Flap	-30%	30%
5	Thr -Tr	----	----

Both V-Tail Servos Assigned to Mixer



V-Tail Sailplane

Some additional things to keep in mind concerning mixers are:

- There can be a maximum of five controls inputting a signal to a specific servo.

- The pilot can have a mixer that only has one control input to a mixer, but if this is the case, it is not necessary to even have a mixer. Instead just assign the control to the servo - no mixer would be necessary in this case. For practical purposes, consider that mixers by nature should contain at least two or more control inputs. The EVO doesn't care, however, if the pilot establishes only one control input to a mixer. The end result will be that the pilot will be using one of the 14 mixer slots for something that is unnecessary.

- Mixers can have up to eight characters in the mixer name. The pilot is not constrained in any fashion as to the schematic or naming conventions of the mixers. It would be wise to develop a habit of mixer naming patterns that is easy to see and recognize. The typical MPX mixer naming schematic is to list the specific servo that will be plugged into the mixer (for example, "Aileron") and then to add a "+" symbol ("Aileron+") to indicate that the mixer does more than just send aileron control signals to the servo - it sends additional control signals from other widgets. This is a simple way of designating a mixer.

- It is **highly** recommended by Multiplex, other MPX users and this tutorial to **not** play with the mixer definitions of the first five mixers that are provided by Multiplex in the SETUP-Mixer Def. menu. You can open them up, look at them, write down their control inputs, note their mixer options symbol and then use that information to create a duplicate mixer that is custom made. This way, experimentation can be later deleted without affecting the functionality of your pre-defined MPX mixers.

3.2 CREATING A MIXER

With this overview of MPX mixers in mind, create the mixer that will be needed for the Omega 1.8E.

STEP ONE

Turn on the EVO and navigate to any of the main screens. Hit the SETUP button near the bottom of the transmitter. Select "Mixer def." On the "Define mixer" menu, the first five pre-made by MPX mixers listed. Slot 6 should say "<<MIX6>>". (If the reader has already built another other mixer in slot 6, use the next available free slot.) Go ahead and select slot 6.

STEP TWO

The next screen shown is the "Define mixer" menu. The name will be blank and all five of the control inputs will have dashes shown since no controls have yet to be assigned to the mixer.

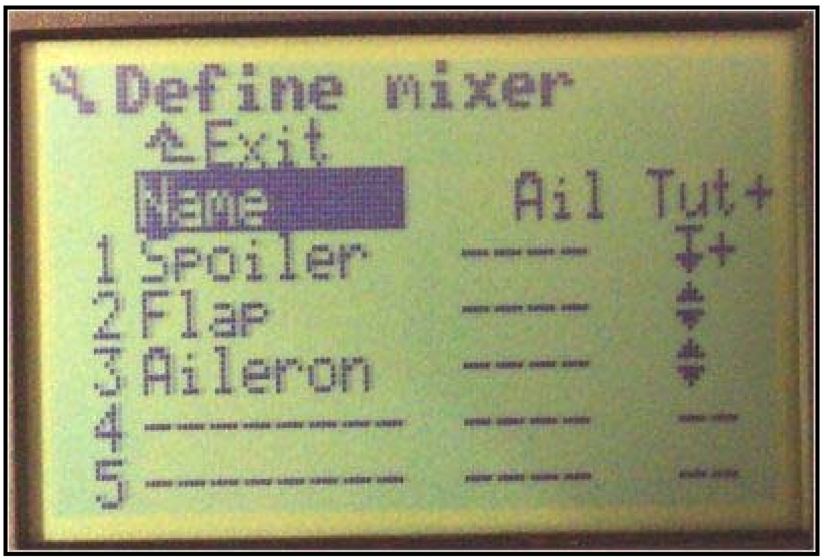
Select the name field and enter the name of this mixer. Name this mixer as, "Ail Tut+". Hit the enter key to confirm the mixer name.

STEP THREE

Now, program the mixer with control inputs. Select the first line and input the "Spoiler" control. The next column will remain as four dashes which means that the spoiler input will always be fed into the mixer - it will not be switched on or off with a switch. The mixer option symbol will be set as "single-sided linear with offset." The full action of the left axis stick should begin to move the spoilerons as soon as it is moved from its full down position. Otherwise, without an offset designated, the left axis stick (although it is being physically moved by the pilot from the bottom-most down position) will not begin to transmit a signal to the aileron servos until it reaches the center point of the left axis movement.

Input number two will be set as "Flap", always on (four dashes in the second column) and the symbol will be symmetrical.

Input number three will be set as "Aileron", always on (four dashes in the second column) and the symbol will be symmetrical.



This is how the mixer should appear on the "Define mixer" menu.

Be sure to save the changes when prompted by the EVO when exiting this screen

Under the "Define mixer" main menu, the readers will see the newly created mixer "Ail Tut+" listed in slot number 6.

4. PROGRAMMING

It may not seem that a lot of progress has been made thus far in getting ready to program the EVO for the plane, but believe it or not, most of the hard work is already past!

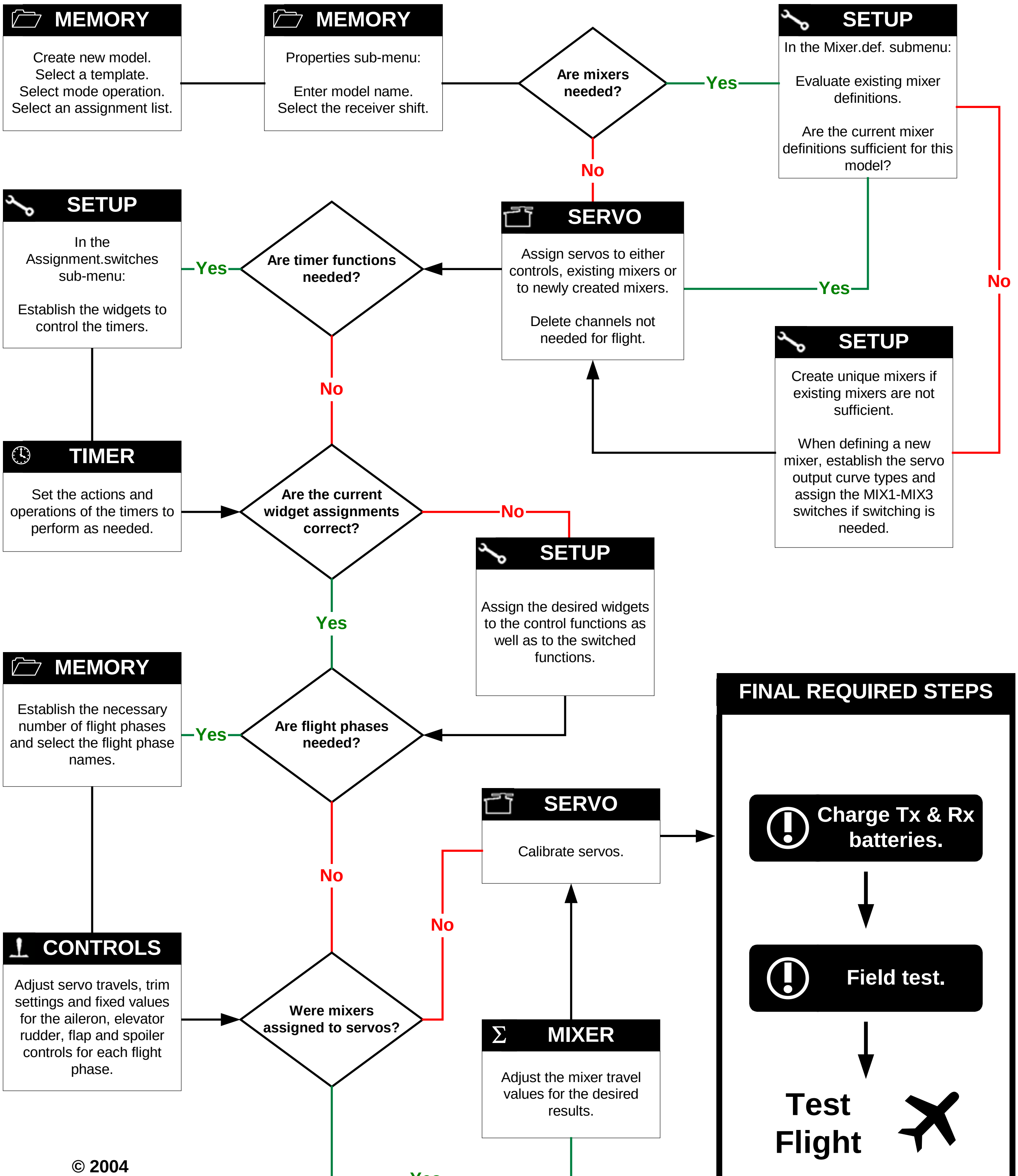
It has already been determined which flight functions that the plane will have as well as how those functions should be set (such as switched or always on.) It has also been decided which widgets will effect specific functions or controls. A unique mixer named “Ail Tut+” has been created that provides for a reflex/camber function, a spoileron function and the typical aileron functions that will all effect the aileron servos.

4.1 EVO PROGRAMMING FLOW CHART

The following flowchart will provide the reader with a visual guide to assist in following the tutorial and for future reference when programming additional planes into the EVO.

The dark highlighted areas above the squares correspond to the menus that are accessed by pressing the buttons near the bottom of the transmitter case.

EVO Model Programming



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James "Joedy" Drulia

4.2 EVO PROGRAMMING MENU CHART

The following EVO programming menu chart will provide the reader with a visual guide to assist in following the tutorial and for future reference when programming additional planes into the EVO.

The dark highlighted areas above the squares correspond to the menus that are accessed by pressing the buttons near the bottom of the transmitter case.

For menu items that are not listed or shown in detail, see the EVO manual for instructions.

EVO Programming Menus

software ver.1.26

SETUP

Transmitter
- Trim graphics, Sounds, Battery alarm, Battery charge, Contrast — (global attribute)
- Check throttle — (can be adjusted separately per model)
- Check RF — (global attribute)

Mixer def.
- Existing mixers — (global attribute)
- <<New mixer>>
  - 1. Control Mix1-3
  - 2. Control Mix1-3 −
  - 3. Control Mix1-3
  - 4. Control Mix1-3 +
  - 5. Control Mix1-3

Assignment
- Mode — (per model)
- Assignment
  - Name
  - Controls, Switches — (global attribute)

Training, User — (see EVO Manual)

CONTROLS

Dynamic Menu
Only controls assigned to model are displayed

Elevator / Rudder / Aileron

Trim	(per flight phase)	%
Step		0.5 / 1.5 / 2.5 / 3.5%
D/R	(digi-adjuster)	0 — 100%
Trvl	(per flight phase) (digi-adjuster)	0 — 100%
Expo	(digi-adjuster)	-100% — 100%

Throttle

T. cut	⊥*
Idle	%
Step	0.5 / 1.5 / 2.5 /3.5%
Slow	0.1 — 4.0 seconds

Spoiler / Flap

Run time	(digi-adjuster)	0.1 — 4.0 seconds
Fixed val.	(per flight phase) (digi-adjuster)	-100% — 100%

Contr.switch — (per model)

⊥	-100% — 100%
E	-100% — 100%
F	-100% — 100%

MEMORY

Select Model, Copy Model, Erase Model — (see EVO Manual)

Flight Phases (names vary) — (per model)
- NORMAL
- SPEED1 x ⊥*
- THERMAL1
- LANDING

Properties
- Template, Mode, Assignment, Name — (per model)

New Model
- Memory Nr.
- Template
- Servo conf.
- Mode
- Assignment
- OK

MIXER

Combi.Switch — (per model)
- Combi.switch ⊥
- Aileron > Rudder 2 — 200%
- Aileron < Rudder -2 — -200%

Aileron differential
- Mode ON / OFF / Spoiler+ (selection affects all flight phases)
- Diff. % — (per flight phase) (digi-adjuster)

Mixers (must be assigned to a servo to appear)
- Mixer Name

	trv	trv	
Control	OFF	%	⊥
Control	%	%	⊥*
Control	%	%	⊥
Control	%	%	⊥
Control	%	%	

SERVO

Calibrate
- 1. Control — (per model)
  - Calbri.Control
  - REV/CLR #
  - P1 %
  - P2 %
  - P3 %
  - P4 %
  - P5 %
- 2. ....

Assignment
- 1. Control MPX/UNI 2/3/5P — (per model)
- 2. ....

Monitor
- Percentage — Graphical view (information only)

Test Run
- Control — Control Name
- Time — 0.1 — 4.0 seconds

TIMER

Timer (information only) (global attribute)

Model
- Time 00:00:00 — (per model)

Slot
- Time 00:00:00
- Alarm 00:00:00
- Difference 00:00:00
- Switch ⊥*
- — (per model)

Slot
- As above

Sum
- As above

Interval
- As above

Symbol Legend

- (book) See EVO Manual for detailed instructions
- (airplane) Can be adjusted separately per model
- ⊥ ⊥* ⊥ Widget symbol representation
- (pages) Can be adjusted separately per flight phase
- (starburst) Can be assigned to a digi-adjuster
- (globe) Global attribute
- 2. .... Additional controls are available for this menu, but are not displayed in this guide
- (i) Provides information only
- % Indicates a value that is programmed by the pilot

4.3 CREATE A NEW MODEL

STEP ONE

From any of the main screens, press the Memory button near the bottom of the transmitter. Highlight "New Model" and press enter. On the new model menu the "Memory nr." number will automatically assigned by the EVO. The pilot is not allowed to change this. The reader's individual "Memory nr" value may be different. On the next line, select the "Basic" template. (The "BASIC" template is already built for a plane with one servo per aileron surface, one servo per rudder, one servo per elevator and a motor control. The Omega is pretty close to this setup, but a v-tail will be used instead. Under the "Assignment" pick "Glider+". (Note that the user must pick from one of the existing three assignment lists that are provided by Multiplex. There are also two empty assignment lists that customized by pilots for future use.) An assignment list is just a pre-set list of what widgets will be set to effect which function. Don't fret over these choices, since their default assignments can and will be changed anyway.

Before continuing, it is prudent to have a discussion about EVO Templates since this causes much confusion to new EVO pilots.

Let's put the concept of templates into perspective by comparing it with the "Universal" base type in the Profi 4000. (The Profi does not have "templates". It has something called "base types" which are essentially the same thing as the EVO "templates".)

When programming the 4000 using the UNIVERSAL base type, the user has to enter every minute detail and step. For example, servomixes (akin to custom, user-created EVO mixers) must be set, servo assignments must be established, each widget action must be set, and servo travel values must be adjusted. Initially, programming a 4000 using the UNIVERSAL approach is a very labor-intensive endeavor when compared with the EVO. (Note, there are techniques to speed this process up on the 4000, however.)

Multiplex recognized that a majority of their users really don't want all of the extra efforts associated with programming a plane from complete scratch. In fact, most of us really would just rather pick a plane type and then tweak the initial MPX (Multiplex) settings to our preferences.

However, when MPX designed the EVO, they did not make a facility for programming a plane from the ground up with absolutely NO initial starting values (like the Profi 4000 UNIVERSAL base type offers.) Instead, MPX programmed the EVO to offer a list of 6 fixed-wing and 2 predefined helicopter initial templates. One of these templates must be selected by the pilot in order to start programming on the EVO.

Being forced to pick a pre-defined template when programming the EVO is not a limitation since any of the parameters of the initial template settings can (and should) be changed. MPX advises us about templates in their manual on page 78 when it says:

Quote:
The values defined by the template serve as starting points, and have to be adjusted to suit your model. All the settings and definitions can be altered at any time and changed in any way you wish

While you can (and should) change the initial settings of any chosen template when programming your ship, you cannot save these changes permanently to the EVO in the form of a "TEMPLATE" file. You can try: program a plane using the ACRO template, make some changes and then program another plane using the same ACRO template. All of the initial changes that you made on the first plane do not regress to the ACRO template settings and thus, the second plane starts out with the same initial configuration that the first plane did.

Keep in mind that templates are not assignment lists. In fact when you see the phrase "assignment list", you should insert the phrase "**WIDGET** assignment list" in your ears! You can assign a servo, you can assign a template and you can assign values, but although the word "assign" is being used, a "**WIDGET** assignment list" is something very different.

WIDGET assignment lists are different entities. There are five of them that you have access to. The first three are made for you courtesy of Multiplex. Their values can be changed, but the changes will be global and will affect all models already programmed using that specific **WIDGET** assignment list.

On page 90 of the English EVO manual:

Note: Predefined WIDGET assignment lists

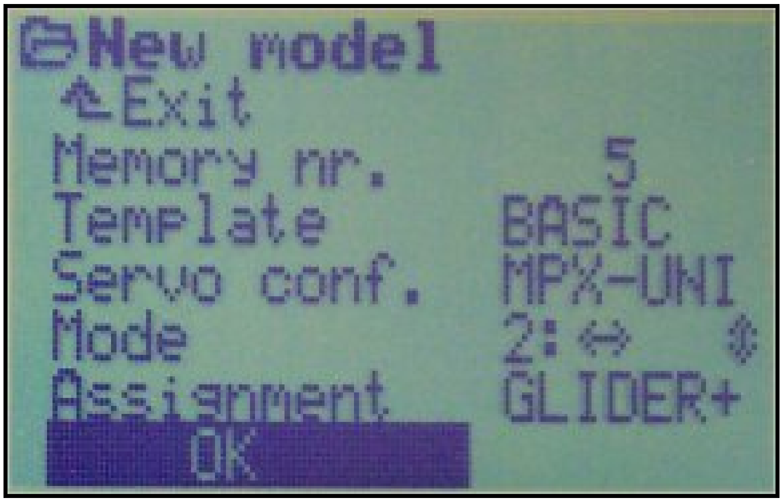
3 of the 5 [WIDGET] assignment lists contain default assignment data. This can be changed at any time to suit your own requirements. However, please note that we cannot guarantee that the template will work 100% correctly if you change the standard mixers and subsequently create a new model using a model template which includes the assigned [user MODIFIED] "standard mixers".

This warning also applies to changes made to the first three **[WIDGET]** assignment lists.

Select the Mode as "2". Keep in mind that this tutorial was written assuming that the pilot will be flying in Mode 2.

The "Servo conf." option allows the pilot to instruct the EVO to use Multiplex servo timing pulse or the Universal servo timing pulse. The specifics of the servo timing are beyond the scope of this tutorial. All servos being used in the North American market are set to use the universal mode of servo timing.

Be sure to highlight the "OK" at the bottom of the screen and then press ENTER to create the model.

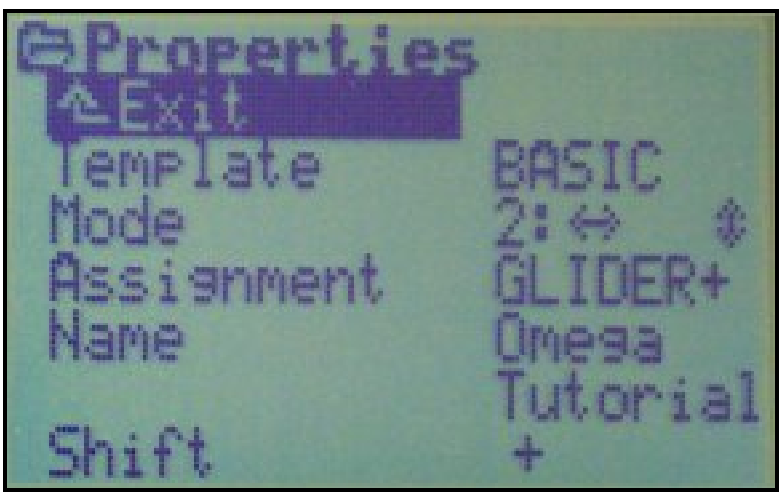


The "OK" option is highlighted. Press ENTER to confirm.

STEP TWO

After hitting ENTER, the EVO will immediately navigate back to the "Memory" menu. Now personalize this new model by selecting "Properties". On the "Properties" menu, notice that the template is set as "BASIC". This cannot be changed now - it is permanently established. The assignment list can be changed, however. Set the mode to number "2". Highlight the name and change it to "Omega Tutorial" (there are two lines available for establishing the model name - it's easier to set the "Omega" part on the top line and the "Tutorial" part on the lower name line.)

At the bottom of this screen, you can change the shift from "+" to "-" depending on the brand of receiver that you will be using in your plane. *Note that this step only applies to the North American MPX market.*



Receiver shift selecting is only needed in the North American market.

Save the changes and the EVO will navigate back to the "Memory" menu automatically.

STEP THREE

This step is not necessary, but if the reader selects the "Select model" menu, they will see a screen showing the "Omega Tutorial x" listed in the "Select model" menu. The "x" simply means that the Omega is currently selected as our model.

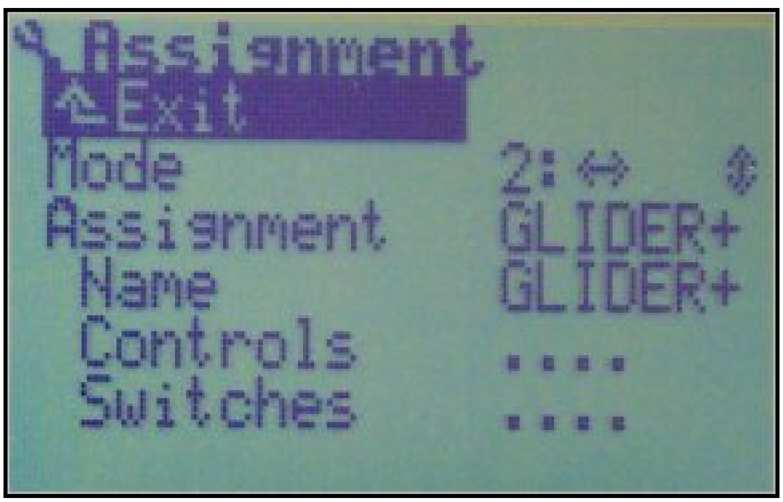
Navigate back to a main screen.

4.4 ASSIGN THE WIDGETS AND CONTROLS

STEP FOUR

Select the "Setup" button at the bottom of the transmitter. It's now time to instruct the EVO as to which widgets will be controlling which functions. At the "Setup" menu, select "Assignment."

On the "Assignment" menu, notice that the mode is already set as well as the assignment of "GLIDER+". The EVO has carried all of these choices over for us.



The "Assignment" sub menu within the main "Setup" menu.

Scroll down to the "Controls ...." field and hit ENTER.

Remember that assignment list (GLIDER+) that was chosen before? On the "Assign. Controls" menu, observe the listing of the controls and their corresponding widgets that the EVO established when we selected the "GLIDER+" assignment list. These can be changed easily. In fact, do that now, but before, let's have a side discussion about the concept of Assignment lists on the EVO.

Let's suppose for the sake of discussion, that the EVO only had the ability to configure the widgets in one, single configuration.

In the workshop, you would sit down and program all of the widgets on the EVO to fly your parkflyers in a way that best suits your flying style and preferences.

Suppose that you are wealthy enough to purchase four additional EVO transmitters.

Since (only in this hypothetical scenario), each of your EVO transmitters can only have a single widget configuration:

- The second EVO's widgets will be configured to fly sailplanes.
- The third EVO's widgets will be configured to fly 3D pattern planes.
- The fourth EVO's widgets will be configured to fly helicopters.
- The fifth EVO's widgets will be configured to fly electric RES gliders.

Once finished, five different EVO transmitters will have been programmed and will now available for flight. Hopefully, the readers will have wisely labeled each EVO transmitter as to which plane type it was configured for.

If you pick up a sailplane and grab the sailplane-configured EVO and go out to fly in your custom airfield (remember, you're rich in this scenario), there won't be a problem; all of the widgets will operate as you anticipate and expect them to.

But what happens if you accidentally take the wrong EVO? Suppose that you accidentally take the parkflyer configured EVO when you go out to fly your sailplane.

The parkflyer configured EVO will have been configured with a throttle widget and perhaps a Throttle-Cut function as well. It may or may not have been configured with motor brake widget and it may (or may not) have been configured with a landing gear widget. All of these widget settings depend on choices that were made when the parkflyer configured EVO was being configured.

Nevertheless, when you attempt to use the parkflyer configured EVO with the sailplane, what happens when you engage the throttle widget? The sailplane doesn't even have a motor, so while the EVO is sending out invisible commands instructing the throttle to engage, nothing appears to move on the sailplane. In this case, no harm would be done to the sailplane.

Some unexpected things could occur when you attempt to use the parkflyer configured EVO with the sailplane, however! Perhaps when widget "N" is enabled (which could be configured to change the Flight Phase on the parkflyer version of the EVO transmitter, but could have a very different function on the sailplane configured EVO) suddenly causes the little sailplane pilot figurine to be violently propelled into the air as a result of enabling his miniature cockpit ejection seat? (Remember, we're rich in this scenario - we can afford to "save" our pilot in such an extravagant fashion.)

The whole point to this farcical narrative is that EVO assignment lists are an analogy to those five separate, specially configured EVO radios. While you can make modifications to the widgets of any one of these five EVO transmitters, any and all changes that you make to the widget assignments may affect other planes when you use a specific configured EVO radio for an incorrect plane type. Some of the effects may not be of significance (such as enabling the throttle widget on the parkflyer configured EVO when flying the sailplane) and other effects may be very significant (such as ejecting the sailplane pilot when using the parkflyer EVO while flying the sailplane.)

Now, here's the great news! You don't need to purchase 5 different EVO transmitters in order to take advantage of the possibility of offering 5 different sets of widget configurations - just use the Assignment Lists function on the EVO.

Assignment lists offer a convenient way to customize the EVO to be configured for specific plane types without having to manually program each widget every time a new plane is programmed into the EVO. When programming a new plane into the EVO, the pilot needs to only create a plane-specific Assignment List one time. When a new plane is added into the EVO, the pilot can merely assign a previously created Assignment List to the model and all of the widgets will automatically be configured.

With this powerful programming ability however, a great burden of responsibility is placed on the pilot to be prudent when creating assignment lists and to be mindful when selecting a correct assignment list when programming a new plane into the EVO.

STEP FIVE

Select the "Throttle" control and press ENTER. (Press ENTER again to move past the warning screen that the EVO presents.) Since the motor control should be on the "E" slider, slide the "E" slider around until you see a letter "E" in the second column. Leave the "E" slider in the downward position since this will later be our "no-throttle" position for motor control channel.

Select the "Spoiler" control and move the left axis stick all the way down. This will be the "no spoilerons" position for this widget.

Select the "Flap/RPM" control and set it to the "F" slider, but leave the "F" slider in the center detent position. This will later be the "no reflex/camber" setting for this widget.

The arrows point to the "ON" position of the control widget. The asterisk symbol is shown indicating that the left axis widget (which has been selected to command the Spoiler control) is physically resting in the "On" position. In this screenshot, the left axis stick is currently all the way down.

Since no other controls are needed such as landing gear, tow release, brake, gyro and so fourth, proceed to the next step.

STEP SIX

At the "Assignment" menu, select the "Switches ..." listing. At this screen notice that the EVO has gone ahead and set the dual rates function for aileron, elevator and rudder on the on the "L" switch. This is ok, since this just happens to be the initial widget that was decided to install these functions onto. The "CombiSwitch" is what is used by the EVO for aileron and rudder coupling. Change it to the "I" widget since it was decided earlier that this function's widget was to be close to the aileron axis widget. Be sure to move the "I" down and leave it there since this will tell the EVO that the "On" position will be in the down position. (This can be changed later if it should be ON in the opposite position.)

Make sure that all switches below the "CombiSwitch" are turned off (they should all be set to dashes.)

4.5 ASSIGN SERVOS

STEP SEVEN

The controls for this model have been set and the widgets have been assigned. It's now time to assign the servos.

Navigate to a main screen and press the "Servo" button near the bottom of the transmitter. On the "Servo" menu, select the "Assignment ..." listing.

On the "Servo. Assign" menu, notice that the servos have already been assigned to the receiver slots. The first seven slots have been assigned by the EVO. They are:

```
Aileron
ELEVATOR+
Rudder
Throttle
Aileron
Spoiler
Spoiler
```

Since it won't be necessary for this plane to have two separate servos for the spoiler function, delete slots 6 and 7 now.

Currently in slots 1 and 5 are aileron controls. If the reader were to proceed with the model set up and not change this control assignment, while the right axis stick would control the ailerons properly, no signals from the "F" widget and the left axis stick could be sent to the aileron servos. The only way to send more than one control signal to a servo is to assign the servos to a mixer.

But wait, where can we find such a mixer that will send aileron, flap and spoiler signals to the aileron servos?

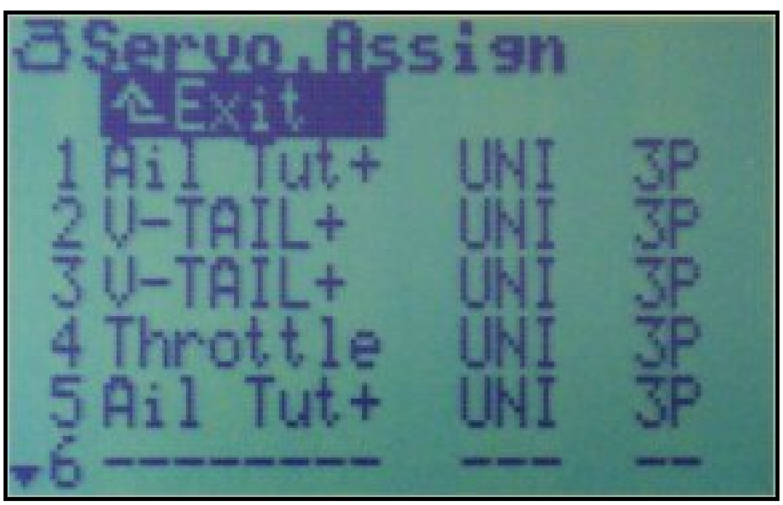
Hey, wasn't one created earlier? Yes!

Change slots 1 and 5 to the "Ail Tut+" mixer that was created earlier.

Since it was also determined that Omega would have a v-tail, change slot 2 ("Elevator+") and slot 3 ("Rudder") both to the mixer "V-tail+".

"Wait," you say. "Where did this mixer come from? We didn't make it!"

That's correct. This is one of the pre-made mixers from Multiplex. It will save time (from needing to create a v-tail mixer from scratch) and will keep the reader from using one of the 8 remaining mixer slots in their EVO.



The final "Servo.Assign" screen should now look like this.

Leave the second column to "UNI" and the third column to "3P" for all slots 1 through 5.

The remaining throttle control does not need to be changed. Leave it as it is.

STEP EIGHT

Now that the servos have been assigned to mixers, the pilot is now able to adjust the travel values of the servos assigned to the mixer.

Navigate to a main screen and press the "Mixer" button at the bottom of the transmitter.

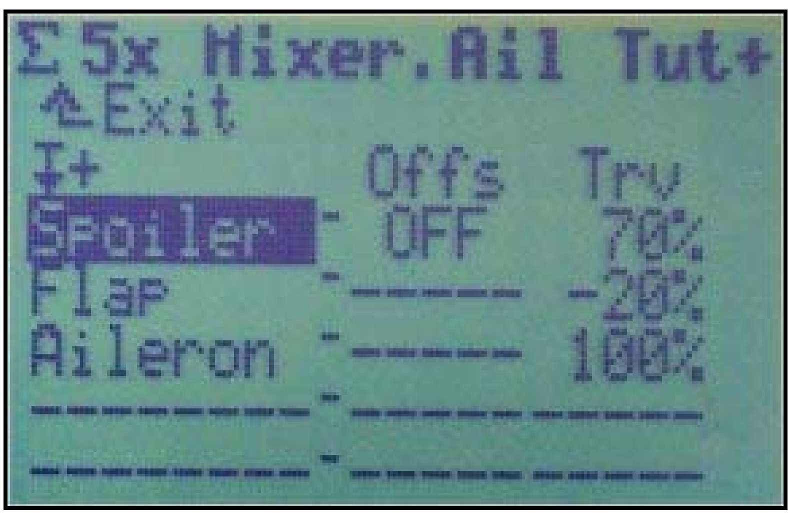
On the "Mixer" menu, only the mixers that have been assigned to the servos in this model will be displayed. "CombiSwitch" and "Ail. Diff" will always be listed at this screen before any other mixers. This is set by Multiplex and cannot be changed. The reader does not have to use these features, just keep in mind that they cannot ever be eliminated from this screen.

The mixer "Ail Tut+" will be listed on this screen. Select it now.

On the "5x Mixer.Ail. Tut+" screen, observe that spoiler, flap and aileron control inputs are all set to "OFF". Keep in mind that these are all controls that will cause the aileron servos to move.

Since it is not likely that the spoileron function should move the aileron surfaces to their ends of travel, input 70% in the third column. The "Flap" control (remember that for this model setup, it will be used as a reflex/camber slider on the "F" widget and not as a standard flap surface) should have only about 20% of movement. You will notice that there is only one input field for the "Flap" and this is because we initially set the "Flap" input in the mixer to be symmetrical. Only one input field means that the travels will go 20% above the center detent on the "F" slider and 20% below the center detent on the "F" slider. *Notice that in the screenshot example, the "20%" has been set to "-20%". This is to reverse the direction of the servo travels when the "F" widget is moved. The reader will have to set their own setting as necessary.*

The "Aileron" should be set to 100%. We want the aileron surfaces to move 100% of their throws when the aileron widget (the right axis stick) is moved left and right.



The "Ail Tut+" mixer travel settings.

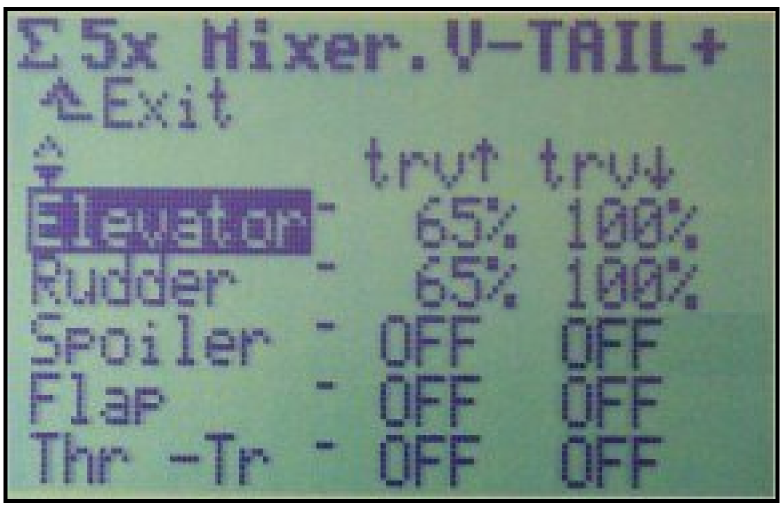
Now, it's time to set the servo travels for the v-tail surfaces. Select the "V-TAIL+" mixer next.

On the "5x Mixer.V-TAIL+" screen, notice that all of the servo travel values have dashes in them.

For the Elevator control, set the "trv {up}" value to 65% and the "trv {down}" value to 100%.

For the Rudder control, set these up and down travel values exactly the same as on the Elevator control row. The Spoiler, Flap and Thr -tr values should all remain in the "OFF" state. The spoiler, flap and throttle (without trim) widget movement should not affect the v-tail servos.

The reason for setting the elevator and rudder servo travel values differently is to demonstrate for the purposes of this tutorial, that you can have different servo travels for a control when used in a mixer. By instructing the EVO to have more down travel than up travel, we are essentially creating a v-tail differential action. Be sure to note that Multiplex created the V-TAIL+ mixer up to have asymmetrical travel distances on the elevator and rudder controls (from the neutral axis stick point.)



The "V-Tail+" mixer travel settings.

Exit this screen and navigate back to one of the main screens.

4.6 ALERT – ERRONEOUS INITIAL FLAP VALUE

All Royal EVO users are indebted to Harry Curzon for discovering and posting this information.

There appears to be a software oversight on the behalf of Multiplex. This isn't really a software malfunction, but if the readers don't anticipate it and account for it, it will cause them to believe that their EVO is malfunctioning.

This is from Harry's posting at the www.rcgroups.com Multiplex Royal EVO thread:

I believe there is a minor error in a default value for new models.

Problem:	*New models default to the flap control having a fixed value of 20% instead of being set to OFF.*
Solution:	*Every time you create a new model, the first thing to do is go to controls, flap, and set the fixed value to OFF.*
What is a fixed value?	*A fixed value is a set amount of travel that overrides the control switch/slider. The flap control will generate a travel value of 20% (or whatever value you alter it to) and ignore your movement of the flap control widget.*
Why have them?	*There is a fixed value for each flight phase. This is useful for example to set a defined landing phase flap, a defined launch phase flap, a defined speed phase reflex, but if set to OFF in the cruise phase then control is returned to the switch/slider for you to set as you see fit.*
What's the problem?	*1. Assign your flap servos direct to the flap control, as you might with a scale power model. The flaps will go to 20% and refuse to move no matter what you do with the flap switch/slider. If you are not familiar with MPX and the features it has, this is going to cause you frustration as you try to solve it.* *2. Assign servos to a mixer that has flap as an input and it will generate false servo neutrals, the neutral being the fixed value multiplied by the flap mixer value. Also, when you move the flap control widget, nothing will happen to the flaps, ailerons or elevator trim offset since the flap control is sending its fixed value and ignoring the switch/slider. The servos will respond to the other controls. However because the servo is already offset from its center by some amount, it will reach either the Txs signal limit or the servo's mechanical limit earlier than expected in one direction of rotation. The servo may stop moving before you have reached the end of the control stick movement in that direction. This problem will not arise if you assign servos to a mixer that has flap as an input but where the flap value is set to OFF in the mixer since the flap control's fixed value does not get into the mixer.*
The Solution:	*Press the "Control" button at the bottom of the transmitter. On the "Control" menu, select the "Flap ...." control. On the "Flap.NORMAL" menu, you will see that the "Fixed value" has been set by default to be 20%. Change this to "OFF".* *You will need to do this step manually for each new plane that you set up unless Multiplex releases a software patch that addresses this issue.*

4.7 CHECKING INPUTS

Let's see how the EVO is responding now. You will not need a plane in front of you to evaluate your progress; let's use the servo monitoring function built into the EVO for evaluating our results.

Press the "Servo" button at the bottom of the transmitter and select the "Monitor" option.

With the "E" slider all the way down, observe that servo 4 (throttle) moves up and down when the slider is moved.

Switch the "I" widget to the up position (off). Move the right axis stick (aileron widget) left and right and observe servos 1 and 5 move in opposite directions. Flip the "I" widget down and continue moving the aileron widget and observe the screen. Now, rudder is added with our aileron input. Keep in mind this plane is using a v-tail and both v-tail servos will move when rudder is input. In fact, observe this action now - move the left aix stick (rudder widget) left and right and watch servos 2 and 3 move. Notice here that there is a different amount of servo travel in the v-tail servos when the rudder or elevator widget is moved to their extreme ends of travel. This is a result of the settings that was programmed into the V-TAIL+ mixer.

Now, observe the reflex/camber slider "F" in action. Slide this slider down towards the bottom of the transmitter case and observe that channels 1 and 5 (the aileron servos) go upwards. “Wait a minute,” the reader wonders. “They both are moving upwards? Doesn't it make more sense for them to go "down" when the "F" widget is moved "down"?” The author agrees, but how can this be changed?

Navigate back to the mixer screen by pressing the "Mixer" button at the bottom of the transmitter. Select "Ail Tut+" from the menu. In the "trv" value for the flap, highlight it and press the **REV/CLR** button at the bottom of the transmitter. This will automatically change the "20%" value to a "-20%". This is a shortcut and saves a little time from having to manually dial in the opposite number from the "20%" position.

Navigate back to the servo monitor screen and move the "F" slider. The aileron servos 1 and 5 will now move downwards in concert together when the "F" widget is slid down towards the bottom of the transmitter case.

This was very easy to do, indeed.

Also observe how the left axis stick (spoileron function) will move both of the aileron servos upward when the stick is moved up. If the reader’s spoiler widget action shows it working in reverse (the servos go "down" when the stick is raised from the bottom position), just change the servo direction as shown with the previous "F" widget (reflex/camber control).

Since dual rate were another one of the initial requirements for this plane, establish the dual rates now.

4.8 DUAL RATES

From any of the main screens, press the CONTROL button near the bottom of the transmitter. Keep in mind that this menu is considered "dynamic" by MPX. This simply means that the user will not see all of the controls that the EVO is able to support listed on this screen. If that were the case, we would have to navigate among listings such as "L. gear, Tow hook, Brake, Gyro, Mixture, AUX1, AUX2" even if the current plane isn't using these controls.

The Control menu will show only the controls that have been assigned to the current model. This reduces the amount of screen clutter.

A widget for the dual rate control has already been established. This is widget "L". Keep in mind that this widget is a three-position switch. For the purposes of this tutorial, the upper (near the top of the transmitter case) position will be a dual-rate off, the bottom ("L" switch towards the bottom of the transmitter case) position will be a dual-rate on and the last middle position will be considered an "OFF" position. Keep in mind that the position listed on the readers' EVO as "ON" could be set the other way. *(The "ON" position of a widget is dependent on how they were initially set up. If the reader had the "L" widget in the down position when they pressed ENTER to confirm the dual-rates choice, the "ON" position would be established as down.)* If the reader needs to change their widget's ON setting, navigate back to the "Setup" menu by pressing the SETUP button near the bottom of the transmitter. Then move to the "Assignment" sub-menu and from there to the "Switches ...." sub-menu. Change the dual rate setting by highlighting the listing, moving the "L" widget and leaving it in the bottom (towards the bottom of the transmitter case) position. The EVO considers how the widget is positioned when the user presses the ENTER button and considers that widget's position as "ON". In fact, the EVO will display a small graphical arrow near the right of the widget letter on this screen. The arrow will always "point" to the "ON" position for that widget.

Is there any benefit for having the "ON" widget switch in the down position? As far as the EVO is concerned, it does not care one way or the other. However, the author likes to set his dual-rates switch using a mnemonic device:

"Pull the switch DOWN to turn DOWN the control rates."

Back at the main "Controls" menu, observe that the Aileron, Elevator, Rudder, Throttle, Spoiler, Flap and Contr. switch controls are listed. Go ahead and select the Aileron control.

On the next screen, notice the specific settings listed for the aileron control. There will be a trim percentage, a step value for the trim buttons, a "D/R" for the dual rates, a travel and an exponential field displayed. To change the dual rates settings, simply highlight the field and dial in a lower number. Select 50% for this tutorial.

Exit the aileron control menu and change the values of the dual rates for the rudder and the elevator controls using the same procedure that was used for altering the aileron control. Set both the rudder and the elevator to have a dual rate of 50% as well.

Once done, navigate back to any of the main screens.

Now, it's time to observe the progress so far.

Press the SERVO button near the bottom of the transmitter and select the Monitor option on the Servo menu.

With the "L" widget in the top position, move around the aileron, elevator and rudder widgets to the extremes of their motions and observe their ranges of travels on the bar graph. Now, pull the "L" switch in the downward position and observe how the aileron, elevator and rudder travels have now been cut in half. This is a reflection that our dual rates (which were set to 50% for all of theses controls) is now limiting the travels for these controls by 50%.

5. DIGI-ADJUSTERS

How does the reader know that 50% is enough (or not enough) dual rates for these items? Suppose that after launching the plane, while although the rudder control has too much travel with 50% of dual rates, perhaps the elevator is hyper sensitive even WITH the dual rates set at 50%. Now, the pilot will be forced to land the wildly controllable model (hopefully, safely and without damage), adjust the dual rate settings, hope and pray that they are close to the optimum settings and launch again. This process will need to be repeated as necessary.

The EVO offers a much easier and safer way to solve this issue. They are called digi-adjusters and can be used to alter just about any numerical value input - even **while** flying the model!

This is a perfect scenario and application for the digi-adjusters (DA). In fact, just for the fun of it, assign the rudder and the elevator dual rates on the two DAs. This way, once launching the plane, the digi-adjusters will be able to alter the amount of dual rates on the elevator and the rudder control by simply turning the DAs. Make it easy to remember which of the two DAs will be affecting the elevator or rudder dual rate by establishing the right DA as the elevator dual rate adjuster and the left DA as the rudder dual rate adjuster. If this assignment is forgotten, this will be all right since the EVO will display our choices on the main screens for quick reference.

5.1 ASSIGNING A DIGI-ADJUSTER

Navigate to any of the main screens. Press the CONTROL button near the bottom of the transmitter.

Highlight the rudder control and select enter. Notice that this was the same screen that was accessed when the value for the dual rates was modified earlier.

Highlight the dual rate field (which currently displays "50%" as the value.) Instead of selecting a new numerical value, press the DIGI-ADJUSTER button at the bottom of the transmitter. The "50%" displayed temporarily disappear and a symbol of a circle with a plus sign will now appear in its place. Now, since the dual rate for the function is to be assigned to the left DA, depress and hold down the left DA at the top of the transmitter. While holding down the left DA, a "<" symbol will appear next to the circle with plus sign symbol. This is the EVO confirming the choice of the left DA. Release the left DA and the last numerical figure that was set when the rudder CONTROL screen was opened will be displayed. In this case, it was 50% and "50%" will remain displayed in the D/R field.

Navigate back to the CONTROL menu by pressing the CONTROL button near the bottom of the transmitter. Select the elevator control this time.

Highlight the dual rate field, which currently contains "50%" as the value. Instead of selecting a new numerical value, press the DIGI-ADJUSTER button at the bottom of the transmitter. The "50%" display will temporarily disappear and a symbol of a circle with a plus sign will now appear in its place. Now, since the elevator dual rate function is to be assigned to the right DA, depress and hold down the right DA at the top of the transmitter. As the DA is held down, a ">" symbol will appear next to the circle with plus sign symbol. This is the EVO confirming the choice of the right DA. Release the right DA and you will see the last numerical figure that was set when the rudder control screen was accessed. The elevator dual rate control will also show "50%" since this was the previous dual rate number that had been set.

Exit this screen and navigate back to any of the main screens. Observe that "<Rudd D-R" on the top left and "Elev D-R>" on the top right of the main screens. Displayed between these two listings at the top of the screen will be either a locked or unlocked padlock symbol.

If the symbol appears to be 'unlocked', press the digi-adjuster key at the bottom of the transmitter until it shows a locked symbol.

Now, turn the left DA either clockwise or counterclockwise. The screen display will show a large "50%" momentarily and then return to the previous screen. Try the right DA, it will also show a "50%" momentarily. *(Note, that if you are at the battery management screen, the screen will not change when you turn the DAs.)*

What the EVO is saying is that the DAs have been locked (indicated by the locked padlock symbol) and when the DAs are turned, the values currently set in the dual rates fields are not being altered.

This is designed to prevent the pilot from accidentally changing the settings while in flight.

Now, unlock the DAs and change the settings. Press the digi-adjuster button at the bottom of the transmitter. Observe that the center padlock symbol change into an 'unlocked' padlock symbol.

Turn the left DA and observe the screen. Now, the numbers will change either up or now depending on which direction that the left DA is rotated - clock or counterclockwise. Pretend that about 75% of dual rate on the rudder is needed. Adjust the left DA until "75%" is displayed on the screen. Keep in mind that in a real situation, the pilot would be currently in flight and the feedback from the plane would be instantaneous. The proper amount of dual rates could be easily set and verified while in flight.

Change the elevator dual rate now. Pretend that only 25% of dual rates is needed after observing the plane while in flight. Turn the right DA until "25%" is displayed.

Now that the dual rates have been tweaked to perfection, lock the settings in place. Press the digi-adjuster button near the bottom of the transmitter.

These choices are now locked again. Turning either DA will no longer change the dual rate settings.

The pilot can observe these results in two ways. The first is to go servo monitor screen and observe the servo travels in the bar graph and the other is to go to the CONTROLS menu and select either the rudder or the elevator control. The pilot will see that the dual-rate numbers for both the rudder and elevator are now showing what was dialed in with the DAs .

The author would like to point out with the EVO and its DAs is that the pilot is not limited to only using them for adjusting dual rates. They could, for example, be set up to adjust the amount of rudder to aileron compensation. In fact, just about any input field that will accept a number can be set to one of the DAs for in-flight adjustment and fine tuning.

5.2 HOW TO ERASE THE DIGI-ADJUSTOR ASSIGNMENT

If there is a need to erase a DA assignment, do the following:

STEP ONE

Navigate to any of the main screens except the battery management screen. Press and hold down the DA whose assignment that should be erased.

STEP TWO

While holding down the DA, press the "REV/CLR" button at the bottom of the transmitter.

The DA assignment will be erased and the main screens will reflect the erased assignment.

6. TIMERS

Another one of the initial requirements for this plane setup is timer functions.

Initially, since the Omega is a motorized glider, it was decided that a timer function would be established that would keep track of the motor run time. This function could be used to determine how long the motor had been running during the flying session.

But after some consideration, the author has decided that having only a motor run timer would not give us a full idea of the flights with this plane.

Suppose that the pilot also wanted to know how long they were able to thermal the Omega after shutting down the motor? And also, suppose that the pilot wanted like to set up a count down timer so that they could practice timed landings for the local club contests?

With the EVO, all of these scenarios are possible.

Since it must be decided which widget shall control the timer functions, consider which of the remaining widgets that could be used.*(The author is assuming that the readers have not yet installed the long axis sticks with the additional buttons and will not consider these buttons as candidates for timer widget assignments. This will eliminate these two button choices only for the purposes of this tutorial. If the readers have installed the long axis sticks, they will be able to use the buttons on the long axis sticks for timer functions once they learn how to establish the timer widget and program the timer functions.)*

6.1 MOTOR RUN TIMER

Ok, consider the timer scenario again. The author would like to have a widget that will allow him to record the amount of motor run time. This would be handy for several reasons. The first would be an immediate direct feedback for the amount of motor run time that will be displayed on the main timer screen. The pilot could use this information to determine how long that the motor has run for the purposes of practicing for limited motor run (LMR) contests. It could also be used as a very rough (and inaccurate) "fuel gauge" for the motor battery. The pilot would have to carefully note over a period of time roughly how many minutes (or even seconds) of motor run time with a particular motor battery before the ESC cuts off the motor power for this to be of any benefit, though.

WARNING!

This is not a science, nor is it a reliable way to calculate your remaining total flying time if you are using the motor battery to also provide power for the servos (which is how I will be flying my Omega.) This technique is mentioned as a way of gathering a sense of the duration of motor drain. The actual remaining motor battery capacity will be dependent on many factors such as mechanically or unsynchronized stalled servos, battery wear and tear and other electronic failures. Use your own proven methods and techniques for calculating motor battery endurance.

So, which widget should be used for the motor run timer? There are several spare widgets to pick from. If a switch widget is used, the pilot will need to manually turn it on when the motor is started and turn it off when the throttle slider "E" is slid back down. By using one of the buttons mounted on the side of the transmitter case (widgets "H" and "M"), the pilot could set either one to be the widget that starts and stops the timer.

These widgets are different than the switch widgets in that they can be set to be momentarily operated (stays on while the pilot holds it down) or push ON/OFF operated (push one time for "ON" and the function will remain on until the button is pressed again for "OFF".)

But there is one major drawback to these buttons - it requires a vigilant effort on the part of the pilot to always turn the timer on and off as the "E" widget (the throttle control) is slid on and off. Otherwise, the timer results will not be an accurate assessment of the true motor run time.

Wouldn't this particular situation be better served by having the throttle widget ("E") itself be used as a switch for the motor run timer in addition to serving as a throttle control? This way, by merely turning the motor on or off, the motor run timer will automatically be controlled by the EVO! This would be another workload item that the pilot would not need to worry about and the EVO would be happy to do. It will also ensure that the timer results for the motor run time could not be inaccurate due to pilot error. When the "E" slider is slid up, the timer starts. When it is slid down, the timer stops.

In fact, this is a better solution; set this now.

6.2 THE SUM TIMER

STEP ONE

Before proceeding, establish a widget for the motor run timer.

Press the SETUP button at the bottom of the transmitter case. On the next menu, select the "Assignment" option. On the next screen, select the "Switches ." option. On the "Assign.Switches" menu, scroll down until a listing for "Sum" is shown. (There will be a small mathematical SUM symbol displayed in front of the word "Sum" displayed on the screen.) Select this listing (press ENTER to pass the warning screen) and then move the "E" slider. Leave the "E" slider in the up position. The "Sum" listing will now show a letter "E" to indicate that the "E" widget will be used to control the sum timer as well as an up arrow icon to indicate that the on position will be as the "E" widget is slid upwards.

The "Sum" timer allows the pilot to start and stop the timer with a widget while the total amount of time never resets back to zero - the timer continually "sums" up the total amount of time while the widget remains in the "ON" position. In the case of the motor run timer, this is exactly what is needed.

STEP TWO

Now that the "E" widget has been established for the sum timer, program it to work properly. Navigate back to any of the main screens, and press the TIMER button at the bottom of the transmitter. On the next screen, you will see a listing containing:

Model ...
Slot ...
Sum ...
Interval ...

Select the sum timer. On the "Sum" menu, you will see a display for the Time and the Alarm. Slide the "E" widget in the up position and observe the sum timer clock value increment upward. Slide the "E" widget back down to turn off the sum timer. Select and highlight the "Time" field and press the REV/CLR button at the bottom of the transmitter. The sum time value will now be reset back to zero.

The "Alarm" field will not be used in this tutorial. The Alarm field allows the pilot to set a specified amount of time and the EVO will count down from that specific amount of time and then produce an alarm. This has valuable functions (such as dialing in 30 seconds for LMR timing functions), but for the purpose of this tutorial, the Sum timer should count only upwards without producing an alarm.

STEP THREE

Navigate back to any of the main screens and enable the Timer main screen. In the center of the screen observe the "sum" timer displayed. Also displayed to the right of the sum timer clock is the corresponding widget that turns the sum timer on and off. Go ahead and turn the "E" slider up and observe the sum timer begin to count up. Slide the throttle control back down and see the sum timer stop. The sum timer will continue to count up until it is either disabled by removing the "sum" timer assignment in the "Assignment.Switches" menu or if the sum timer is reset.

Notice carefully that while the "E" slider widget is moved upward, that until the widget passes the halfway mark, the sum timer does not actually turn on. This could mean that the motor could run slowly without increasing the timer. Change this so that when the "E" slider is moved from its lowest position, it will immediately trigger the sum timer to start.

Press the CONTROL button at the bottom of the transmitter case. Scroll down until you see a listing labeled, "Control.switch". Go ahead and select it. On the "Contr.switch" menu, you will see three listings: an axis stick symbol, "E" and "F" widgets. Select the "E" widget and change the number to "-99%".

What this means is that the trigger point for the "E" widget will be at the -99% point below the center detent. If we set it to be -100% and move the "E" slider down as far as it will go, the slider will not be able to control the sum timer since it cannot go below "-100%" mechanically. In case the readers are curious, they can leave it set on "-100%" and navigate back to the main timer screen. With the "E" slider all the way down, the sum timer will continue to run. In fact, no amount of moving the "E" slider will turn it off. Go back and change this setting to "-99%". Navigate back to the timer screen and now observe the action of the "E" slider. It will now trigger the sum timer when it receives even one click of the slider ratchet as it is moved from its lowest position.

Now that the sum timer has been set up, establish a timer that will record the total amount of flight time- from takeoff to landing.

6.3 THE SLOT TIMER

Use the "H" widget to turn this function on and off. "Why use the "H" widget?" the readers ask. Truthfully, there is no valid reason to use it or another widget; it's just a widget that the author happened to choose.

Press the SETUP button at the bottom of the transmitter and then select the "Assignment" option. On the next screen, select the "Switches …" listing. Scroll down the menu and select "Slot". Once you hit ENTER to pass the warning screen, press the "H" widget. Press the "H" widget repeatedly and observe the symbol listed to the right of the letter H on the screen change from a momentary symbol (which looks like a little hat) to an ON/OFF symbol (which looks like a poorly written letter `s'.) Be sure to establish the action of the "H" widget as ON/OFF. Press ENTER to confirm the selection.

Navigate back to the main Timer screen and observe that there are now **two** sets of timers displayed. A new one has now appeared on top of the sum timer. Press the "H" widget and observe the top line. The slot timer begin to count up until the "H" widget is depressed again. This will be used to record our total flight time.

To clear the slot timer, follow the same procedure that was used for resetting the sum timer. For the purposes of this tutorial, the "Alarm" field that appears on the Slot menu will not be utilized.

6.4 THE COUNT-DOWN TIMER

Now, set the last timer function which will be used to practice count-down timer landing skills.

Please note that this tutorial will be using a truly unrealistic number of 30 seconds for illustration purposes only.

Normally in a real-world setting, the pilot would use a number of several minutes, but since the author does not want the readers to sit mindlessly by while the EVO counts down from 5, 10 or whichever amount of minutes, this tutorial will use a few seconds as an example for demonstration purposes only.

Set the widget that will be used for the count down timer. Since the tutorial hasn't utilized a switch widget for a timer function as an example so far, use the "N" widget.

Navigate to any of the main screens and press the SETUP button at the bottom of the transmitter then select "Assignment" from the menu. Select "Switches …" on the next menu. Scroll down the "Assign.Switches" menu until a listing for "Interval" is displayed. Go ahead and select this. Press ENTER to pass the warning screen. When the Interval field is highlighted, move the "N" widget. Leave the "N" widget in the down position since this will be our "ON" setting.

It is now necessary program 30 seconds into the count down timer. Exit this menu and navigate back to any of the main screens. Now, press the TIMER button at the bottom of the transmitter. Select the "Interval ..." listing. On the next screen, highlight the "Alarm" field and program 30 seconds of time.

If the "N" widget is currently in the down ("ON") position as soon as the reader inputs 30 seconds into the Alarm field, they will see the "Time" field listed above the "Alarm" field begin to count down from 30 seconds.

Exit this screen and navigate back to the main Timer screen. Push the "N" into the up (towards the top of the transmitter case) position, then pull it down and observe the timer clock shown on the bottom of the Timer screen. It will immediately change to 30 seconds and begin to count down. If the reader moves the "N" widget up and back down again, it will reset the count down timer to 30 seconds.

Once the interval timer has been started, and while the "N" widget remains "ON" (the down position in this case) during the count down process, the interval timer will continue to reset itself automatically back to 30 seconds once the interval timer reaches zero and will repeat the cycle indefinitely.

If you reset the "N" widget by moving it up, down and then leaving it in the up position, when the interval timer reaches zero from the 30 seconds, it will not reset itself back to 30 seconds and start the countdown process all over again. It will instead commence counting from zero upwards until it hits 4 hours and 30 minutes. This allows the pilot to turn on the interval timer only occasionally without being forced to hear the alarm beep over and over again as the interval timer cycles automatically from the count down start (which in this case has been set to 30 seconds.)

The readers can reset their sum and the slot timers back to zero and play with the widgets to see the effect of moving the timer widgets.

Keep in mind, that the readers can change any of the widgets assigned to the timers if they prefer different widgets. They can also make use of the buttons on the long axis sticks if they have been installed.

The SLOT Timer is set to widget "H". The "H" widget has been established to work as either ON or OFF and not in a momentary fashion.

7. FLIGHT PHASES

With the exception of calibrating the servos (which can only occur while the pilot has a plane in front of them), the progress in the EVO programming is now sufficient for flight. Servo calibration will not be covered in this tutorial. The EVO manual does a good job of listing the steps involved in servo calibration.

Flight Phases (FPs) are not required for flight, but are additional tools that can be used to reduce the amount of pilot workload.

So, what are flight phases?

The FP feature on the EVO allows the pilot to assign a specific set of parameters such as servo travel limits, trim settings and specific pre-set servo settings to a widget. With FPs, the pilot can establish a particular flying setup and transition to that setup at the flick or push of a widget. The pilot can also use FPs as another means of establishing multiple dual rates since each FP can have different limits of servo travel ranges.

But still, why bother with FPs?

FPs are very similar to a feature on some automobiles known as driver settings. When a different driver takes control of the automobile, they will adjust the seat to the proper height, adjust the side and rear view mirrors to the proper setting, establish certain environmental temperature controls and perhaps, set certain stations on the radio. When the next driver assumes control, all of these steps must be manually changed again to suit the next driver. With the driver settings feature, all of these particular settings are recorded at the press of a button and saved for future reference. When a new driver sits in the automobile, they merely press their settings button and the mirrors, seat position, temperature controls and radio settings are all automatically set to that driver's preferences.

FPs work very much the same way. Of course, the pilot can manually change each of the widgets on their EVO while changing plane settings for a new flying style, but FPs make it much easier to do this. FPs greatly reduces the amount of pilot workload if there is a need for certain control settings during flight.

Some examples of FPs are:

A "Launch" FP for a glider

The flaps and ailerons would all travel down for increased camber during the winch or highstart launch. The control travels on the elevator control would be reduced to minimize over controlling and thereby minimize airframe stressing.

A "Landing" FP

This FP would pre-set the flap servo settings, give spoileron (crow) on the ailerons and pre-set the elevator servo for compensation.

There are a total of four flight phase settings on the EVO. The tutorial will be establishing four FPs. The "NORMAL" FP will be used when there should be full servo travel limits and no servo pre set positions. Once the readers understand FPs, they will be able to set up their own FPs for their own fleet.

7.1 FLIGHT PHASE NAMES

The FPs have names that are already established and set by MPX. They are as follows:

NORMAL
START1
START2
THERMAL1
THERMAL2
SPEED1
SPEED2
CRUISE
LANDING
AUTOROT
HOVER
3D
ACRO

Be sure to note that these names are not flight phases in themselves, but instead are simply names that the pilot chooses. By themselves, they do nothing but to help you identify which set of servo settings are currently being used. The pilot will choose a name from the above list and then modify the servo settings that will be used when the particular flight phase has been activated.

Can the pilot choose the "CRUISE" FP listing, set the appropriate flap, aileron and elevator travels and pre-sets and use that “CRUISE” FP for landing functions? Yes. The FP name is nothing more than a name that helps the pilot recognize and identify specific servo settings.

Suppose that the pilot would rather have a FP whose name is a little more representative of what the FP is being used for? For example, suppose that the pilot would like to have a pre-set for launching discus-launched gliders called, "DLG LNCH"? Can they simply rename one of the above FPs?

Unfortunately, with the EVO 1.26 software release and below, this is not an implemented feature. Please write to MPX and to HitechUSA and request that this feature be added on future software releases. *[This is one of the few complaints that the author has with his EVO.]*

For the purposes of this tutorial, four flight phases will be set up. The main phase will be selected as "NORMAL" and will feature full servo travels and no servo presets. FPs 1, 2 and 3 will be selected as, "START1, CRUISE, LANDING". This will cover about most of the flying situations. The "NORMAL" FP (which incidentally will be numbered 4 on the Fight Phase menu) will be considered the Main Phase and will override any of the other phases when enacted. This, as it will later be demonstrated, will allow for immediate access to the main phase in the event of a need to immediately exit another phase and gain full servo travels.

To reduce possible confusion while the readers establish and work with FPs, the tutorial is going to undo some of the previous EVO programming. Specifically, it will be removing the dual-rate setting and the dual-rate widget. It will also be deleting the digi-adjuster assignments.

The tutorial is not deleting these programming functions to enable the FPs to work correctly; it is deleting them since there can be come potential confusion which can result by misinterpreting the servo movement results if these previously established widgets were to be accidentally enabled.

Go ahead and delete the digi-adjuster (DA) assignments. From any of the main screens, press and hold down the right DA and while holding down this DA, press the REV/CLR button at the bottom of the transmitter case. Erase the left DA assignment by following the above steps.

Now, change the dual rate setting for the aileron, elevator and the rudder. Hit the CONTROL button at the bottom of the transmitter and select "Aileron ...". On the next screen, change the "D/R" setting back to 100%. Exit this screen and do the same thing for the elevator and the rudder "D/R" fields.

Now, remove the widget that was set for the dual rates. This was widget "L". Navigate back to any of the main screens and press the SETUP button at the bottom of the transmitter. On the next screen, select "Assignment ...." On the next "Assignment" screen, select "Switches ...." On the "Assign.Switches" screen, select the "DR-ai" listing, hit ENTER to bypass the warning screen and then press the REV/CLR button at the bottom of the transmitter to clear the setting from **"<L"** to **"---"**. Do the same thing for the "DR-el" and the "DR-ru" listings, erasing both of their widget assignment from **"<L"** back to **"---"** (unassigned).

7.2 Flight Phase Selection

Pause for a moment to consider which widgets that can be used for the FPs. By choosing a three-position widget, the pilot can gain access to three of the four flight phases all on one switch. They would then need only to choose one additional widget to active the main phase.

The "L" widget has just been freed from being used as the dual-rate control and can be re-used for the FP assignment, but since this tutorial will later re-activate the "L" widget for the dual-rates function, do not choose this widget.

The "O" three-position switch is not being utilized for any function. FPs 1, 2 and 3 can be assigned to this widget. Widget "M" (which is the button underneath the "O" widget) would make a good choice of the Main Phase widget. This puts all of the FPs widgets on one side of the transmitter.

On the EVO, the Main Phase will always override any other phase settings. This will allow the pilots to quickly exit any particular phase for any reason. It will also assist the pilot in preventing any unintentional phase setting activation.

Set the flight phases now.

7.3 FLIGHT PHASE DEFINITION

STEP ONE

Since FPs are unique to each model, they are accessed through the Memory menu. Press the MEMORY button near the bottom of the transmitter. On the Memory menu, select the "Flight phase ...." listing. On the Flight phase menu, select listing number one and change it to "START1" and press ENTER.

Phases 2, 3, and 4 will be crossed out with a dashed line through them. If no flight phases are ever set up, the EVO will consider that the first phase (listed in the number 1 row) is the only flight phase and will cross out the other phases automatically.

Select the second field listing and press the REV/CLR button at the bottom of the transmitter. This will remove the crossed out line over the phase name in the second row. Change this phase name to "CRUISE" and press ENTER.

Following the procedure listed above, change the phase names for the third listing to "LANDING" and for the fourth listing to "NORMAL".

Exit this menu back to any of the main screens.

STEP TWO

Now that the names of the FPs have been established, it's time to establish the widgets that will control these flight phases. Keep in mind that the EVO mandates that phases 1, 2, and 3 to be on one widget, but it considers the "Main Phase" to be a separate function. The “Main Phase” can be assigned to another widget. The pilot can choose to use as many or few FPs as they wish, but any phase set up as the "Main phase" will always override any other FPs.

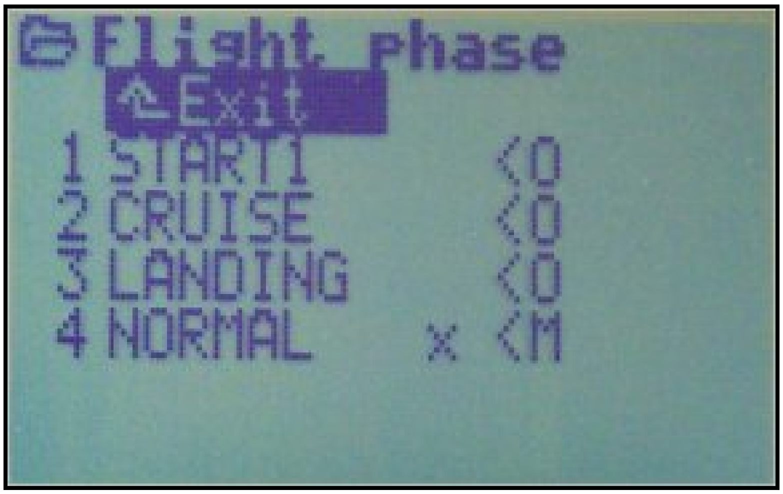
Press the SETUP button at the bottom of the transmitter. Select the "Assignment ...." listing on the Setup menu. On the next menu named "Assignment" select the "Switches ...." listing. On the "Assign.Switches" menu, scroll down the list until "Main phase" is displayed and select it. Hit the ENTER key to pass the warning screen. Press the "M" widget button to assign the main phase to this widget. Be sure to set the "M" widget button action as ON/OFF (which is indicated by a small symbol to the right of the second column that looks something like a poorly written letter 's'.) The button action is changed by repeatedly pressing the "M" widget while remaining in the second column in the Main phase listing. Hit ENTER to confirm the widget assignment.

Below the Main phase listing is the "Phases 1-3" listing. Select this, press ENTER to bypass the warning screen and assign the "O" three-position widget by moving it around. Leave the "O" widget in the uppermost vertical position and press ENTER to confirm the choice.

STEP THREE

Now, observe the progress thus far. Navigate back to any of the main screens and press the MEMORY button at the bottom of the transmitter. Select the "Flight phase ...." listing and press ENTER.

On the "Flight phase" menu, observe that the widgets that are now assigned to each flight phase are displayed to the right of the phase name. Phases 1, 2 and 3 display a "<O" and phase number 4 ("NORMAL") shows a "<M" next to its name.



The "NORMAL" Flight Phase is currently active in this screenshot. The "M" widget enables the "NORMAL" Flight Phase.

Press the "M" widget a few times and observe a small letter 'x' jump from the fourth line to another line above it. The small 'x' indicates which phase is currently activated. Press the "M" widget until the 'x' displayed to the right of the forth phase, the "NORMAL" phase.

Move the "O" three-position widget and observe how the 'x' will not move from the "NORMAL" phase listing. This is indicative of the operation of the "M" widget which stays ON until pressed again for OFF as well as indicative that while the main phase (the fourth phase, named "NORMAL" in this case) is active, no other phases can be activated.

Press the "M" widget one more time which will turn off the "Main Phase".

Now, move the three-position "O" widget and observe how the small 'x' will move from phase to phase as the widget is moved among its three positions. If the "M" widget is pressed again, the phase will revert back to the fourth listing which is the main phase.

Navigate back to the main screens and enable the Flight Phases main screen.

Activate the "M" and "O" widgets and the names of the FPs displayed on the screen will change accordingly. Remember, while the main phase is active (the "NORMAL" phase in this case), no other phases will be allowed to activate.

7.4 FLIGHT PHASE FUNCTIONS

Now it's time to decide on the servo actions of each phase.

For the NORMAL phase, 100% of servo travels and no pre-set trim settings should be set.

For the LANDING phase, the flaps should be set to go down as well as the servo travels on the ailerons and elevator should be reduced. This will help to reduce over control during landing.

For the CRUISE1 phase, the servo travels for the ailerons, rudder and elevator should be reduced further to prevent over controlling.

Go ahead and set the individual FPs now.

7.5 Setting the Flight Phase Settings

Press the CONTROL button at the bottom of the transmitter and then select "Aileron ...." on the Control menu.

On the next screen, the aileron controls are displayed. If the "O" widget is changed, the corresponding FP will be displayed on the top of the screen. Set the "O" widget to LANDING phase by moving it to the lowest vertical position. Notice that is a small number displayed to the right side of the "Trim" and the "Trvl" fields. This number corresponds to the FP number. The LANDING FP was established as the third FP. When the "O" widget is moved to its lowest position, a small number '3' will be displayed to the right of the "Trim" and the "Trvl" fields.

Reduce the "Trvl" field for the ailerons to 75%. Leave the "Trim" field to "0.0%".

Exit this screen and now select the "Elevator ...." listing on the Control menu. Reduce the "Trvl" field to 75% as well.

Set the travel field for the rudder to 75% by using the above steps.

Exit this screen and now select the "Flap ...." listing on the Control menu. The Flap control (as well as the spoiler control) will not look the same as the aileron and the elevator control screens. This control will have a "Run time" value as well as a "Fixed value". Select the "Fixed value" field and change the listing from "OFF" to 100%. Be sure that there is a small number '3' displayed to the right of the "Fixed value" field. If there is another number shown, move the "O" widget to its lowest position. If there is a small number '4' displayed, then the Main Phase has been activated. Press the "M" widget to turn it off.

Exit back to the main Flight Phase screen.

The LANDING FP has now been established. Move the "O" widget to the LANDING phase and press the "M" widget to change to the NORMAL phase.

Go to the servo monitor screen by pressing the SERVO button at the bottom of the transmitter and then selecting the "Monitor ...." listing.

Move the axis sticks around and observe that the servo travels have 100% of the travel motions (or at least as much motion as the current mixers allow for.) Currently the NORMAL FP is enabled. The default settings are already at 100% for this phase (as well as any other phases.) Since 100% servo travel was decided for the NORMAL phase, there are no further steps needed for the NORMAL FP.

Move left axis stick all the way down and then move the "F" widget to the centered position on the detent.

Press the "M" widget to turn off the NORMAL FP. Since the "O" widget is in its lowest position, the FP will change to LANDING FP. Observe how the first and fifth servos go down in conjunction. This reflects the "Fixed value" field that was changed from "OFF" to "100%". Go ahead and move the "F" widget which is the flaps control widget. Notice how the first and fifth servos will not move with the "F" widget motion any longer. This demonstrates that a fixed value amount will always override the widget that controls the flaps or the spoilers. Notice also that the aileron control travels have been limited.

Press the "M" widget again to change back into the NORMAL FP. Observe how the first and fifth servos will slowly transition back to neutral settings. This reflects the EVO's programming which allows for a gradual transition change from one phase to the next without abrupt servo movements.

Enable the LANDING FP once again. Why do the first and fifth servos not go all the way down? Wasn't the "Fixed value" field for the Flap control set to 100%? The answer is in the "Ail Tut+" mixer values. Press the MIXER button at the bottom of the transmitter and then select "Ail Tut+ ...." on the Mixer menu. The travel limit for the Flap was previously to "-20%". If greater flaperon travel distance is desired, change the "-20%" value to a lower number such as "-50%". Go ahead and change the Flap value in the “Ail Tut+” mixer now.

Go back to the servo monitor screen and observe the travel limits of the first and fifth servos. With the LANDING FP activated, the ailerons will travel together downward much more now (the results of the lower fixed value number that was input.) Keep in mind, though, that the "F" widget, which commands the flap control, will also have a greater travel effect for camber/reflex now.

Observe also that the left axis stick (which happens to be the spoiler widget in this tutorial) will continue to effect the first and fifth servos (the ailerons) even though the fixed value for the flaps has been set. This is also because of the mixer "Ail Tut+" which is set to provide "70%" of spoileron travel. The spoiler control has not been altered with a fixed value. If the CONTROL button is pressed at the bottom of the transmitter and then "Spoiler ...." is selected, the spoiler control for all four FPs will indicate a fixed value of "OFF".

The other FPs settings can now be established. Following the above procedures change the travel settings for the ailerons, elevator and rudder to the following travel limits:

```
START1 Trvl=80%  (FP numbered 1)
CRUISE Trvl=25%  (FP numbered 2)
NORMAL Trvl=100% (FP numbered 4)
```

Once the FPs have been set with their appropriate travels, observe their responses in the servo monitor screen. Enable each FP, move the widgets and see what the effects of the servo travels are.

"Are FPs a form of dual rates?"

Yes.

Each FP can be altered to have different amounts of travel, which is what a dual rate function does. Although this lesson has demonstrated how to change the servo travels in the different phases, the official dual rate field has not been utilized.

The Dual Rate setting is universal across all flight phases. Press the CONTROL button at the bottom of the transmitter case and then select the "Aileron ...." listing on the next screen. Set the D/R field to "50%." Exit this screen and then select "Elevator ...." on the Control menu. Change the dual rate for the elevator to 50%. Change the dual rate on the rudder control to "50%" as well.

Earlier in this tutorial lesson, the dual rate widget assignment was deleted. Re-establish this again. Select the SETUP button at the bottom of the transmitter. Select the "Assignment ...." listing and then select the "Switches ...." listing on the Assignment menu. Select the "DR-ail" listing, press ENTER to pass the warning screen and then move the "L" widget towards the bottom of the transmitter case. Press ENTER to confirm. Assign the "DR-el" and the "DR-ru" fields to the "L" widget as well. Sure that the "L" widget is shown as "ON" when it is in the lowest position. (There will be a small arrow pointing down to the right of the "<L" displayed on the screen.)

Go back to the servo monitor screen. Push the "L" widget into the OFF position. Enable the NORMAL FP. Move the axis sticks and observe that the servo travels move to 100% of their range. Move the "L" widget to the ON position and observe the servo travels. They have been reduced to 50%. Enable the FP number one ("START1"). With the "L" in the ON position (dual rates enabled) observe the motion of the servo travels. The servo travels have now been reduced to 40%. This is a result of reducing the original 80% of servo travel in the START1 FP by 50%, which results in 40%. While the dual rates "L" widget is ON, the travel rates in all of the FPs will be reduced by 50% (except for the fixed values in the LANDING phase.)

This has effectively allowed for a total of eight dual rate settings. In the START1 FP, the travels are from 80% without the dual-rate "L" widget set, to 40% with it on. The CRUISE FP has 25% of servo without the dual-rate "L" widget turned on and 14% with it on. The LANDING FP has 75% travel without the "L" widget on and 36% of travel with the dual-rate switch on. The NORMAL FP has 100% of travel with the dual-rates widget in the OFF position and 50% of travel with the dual-rates turned on.

Of course, this does not consider the fact that the travel limits of the aileron, elevator and the rudder in each flight phase can be assigned to one of the digi-adjuster buttons for even more flexibility and adjustment if needed.

8. THE MIX 1, MIX 2, MIX 3 FUNCTION

While the term "mixer" is loosely used within the remote control community, a Multiplex mixer stands apart from what many of the Asian based radios label as a 'mixer'. Be sure to re-read the mixer chapter in this tutorial if there are any doubts as to the concepts and the workings of Multiplex mixers.

Earlier in this tutorial, a specialized mixer was created named “Ail Tut+”. The controls in this mixer are spoiler, flap and aileron. The flap control (the “F” widget), the spoiler control (the left axis widget) and the aileron control (the right axis widget) were established to remain always ON.

Since the sample plane being programmed into the EVO in this tutorial features a v-tail, the elevator and rudder servos were assigned to a mixer that came from Multiplex already programmed into the EVO. This mixer is named “V-TAIL+”. The control inputs in this mixer were set to the following settings:

V-Tail+		
Elevator	65%	100%
Rudder	65%	100%
Spoiler	OFF	OFF
Flap	OFF	OFF
Thr –Tr	OFF	OFF

For the sake of the tutorial, it will be assumed that a test flight has already occurred and it was determined that automatic elevator compensation will reduce the pilot workload when spoilerons are deployed.

Look again at the mixer named, “V-TAIL+”. Although the mixer has been established (by Multiplex) to have a spoiler control input, in this tutorial lesson the spoiler control has been set to “OFF”.

The spoiler control can be modified so that when the spoiler widget (the left axis stick) is engaged, it will cause the v-tail servos to provide up elevator compensation. Simply press the MIXER button at the bottom of the transmitter, select the “V-TAIL+…” listing and change the spoiler control to have the following inputs:

V-Tail+		
Elevator	65%	100%
Rudder	65%	100%
Spoiler	OFF	–20%
Flap	OFF	OFF
Thr –Tr	OFF	OFF

This is a quick and easy solution to providing Elevator->Spoiler Compensation (EPC). Go ahead and view the results on the servo monitor screen. Move the left axis stick and observe how elevator control will be added when the spoiler control is now moved to the end of its travel.

Suppose, however, that the pilot does not want a particular control inputting into a mixer at all times? Suppose that the pilot would like to be able to turn the EPC on and off simply by flipping a switch? Is there a way to accomplish this?

Yes.

This is the purpose of the Mix1, Mix2 and Mix3 switches.

"Wait a minute, where are these switches? They are not on the EVO transmitter case!" the reader asks.

That is true. The MIX1-3 switches are a form of software switch that can be assigned to turn on and off individual control inputs into a mixer.

Let's make the EPC switchable.

STEP ONE

The "J" three-position widget will be used to turn on and off the EPC. It will be ON in its lowest vertical position.

Ordinarily it is HIGHLY recommended that the EVO user not modify the MPX provided mixers, but for the purpose of this tutorial, the "V-TAIL+" mixer will receive a slight alteration which can be reversed without harm. If you are uncomfortable with mixers and do not trust your understanding and ability to perform this modification, it is suggested that you simply read this chapter and not perform the modification of the "V-TAIL+" mixer on your EVO. Failure to perform the modification correctly can result in your v-tailed models operating incorrectly.

Press the SETUP button at the bottom of the transmitter. Select the "Mixer def" listing and then the V-TAIL+ mixer on the Define.mixer screen. Highlight the spoiler control in the middle column, change the **"----"** to **"Mix1"**. Do not change the servo output type symbol in the rightmost column! Press ENTER to confirm the change to the mixer.

Add only the "Mix1" switch to the Spoiler control!

STEP TWO

Establish the "J" widget to the Mix1 function.

Press the SETUP button at the bottom of the transmitter and then select "Assignment". Select the "Switches .." listing on the Assignment menu.

Scroll down and highlight the "Mix-1" listing and press ENTER. Press ENTER again to pass the warning screen. Move the "J" widget to assign it to the Mix-1 field and leave it in its lowest position to indicate to the EVO that this is the "ON" position.

STEP THREE

Navigate back to any of the main screens and press the MIXER button at the button of the transmitter. Select the "V-TAIL+ .." listing.

Now there will be a letter 'j' displayed to the right of the spoiler control listing in the "V-TAIL+" mixer screen. This indicates that the spoiler control input into the mixer is now switchable. It will only be allowed to feed in a signal into the "V-TAIL+" mixer when the "J" widget is in the "ON" position.

Go to the servo monitor screen and observe the action of the v-tail servos when the spoiler control is engaged with the "J" widget in the "ON" position as well as what happens to these servos when the "J" widget is switched to either the middle position or to its uppermost vertical position.

EPC has now been added and its action has been changed from always ON to selectable ON and OFF action.

But I thought that this was supposed to reduce the pilot workload? Can't the EPC be engaged automatically when the spoiler control is input – without the need to flip a separate switch?

Yes.

Earlier in the tutorial (in the Timers chapter) the motor run timer was assigned to the throttle widget so that the timer would start and stop automatically when the motor was turned on and off. The EPC function can work in a similar fashion to reduce pilot workload.

Press the SETUP button at the bottom of the transmitter case. Select “Assignment ..” and then “Switches ..” Scroll back down to the “Mix-1” listing and select it. Press ENTER to pass the warning screen. Move the left axis widget and leave it in its uppermost position to indicate to the EVO that this is the ON position. The “J” widget assignment will be automatically erased when this is done.

Exit this screen and go to the servo monitor screen and observe the servo actions when the spoiler control is engaged. EPC will automatically kick in when the left axis stick is moved upwards and the “J” widget will no longer have any effect to the EPC.

Notice that in this screenshot, channel 4 (the motor control) has been moved to its lowest vertical position. The left axis widget (spoiler control) when move to it’s top vertical position raises both aileron surfaces upwards and also causes the v-tail surfaces to move downward.

The specific point during which the left axis stick begins to move the v-tail servos can be set lower or higher. To do this, press the CONTROL button at the bottom of the transmitter and scroll down to the bottom of the list and then select “Contr.switch ..” The first listing on the “Contr.switch” menu can be modified to change the “trigger point” of the left axis stick. This will be pilot-dependent and no one setting will be appropriate for all pilots.

The Mix2 & Mix3 are simply two more switches that can be used to select two additional control inputs that can selectively switched on or off. These additional MIX switches can be used in other mixers and are not required to all be used within only one mixer.

9. Advanced Mixer Concepts

The EVO has only one official dual-rate (DR) utility. With flight phases (FPs), however, the control travels of the elevator, rudder and aileron controls can be individually limited; this results in essentially of up to four possible "dual-rate" settings on these controls.

If the official dual-rate facility is enabled as well as the four FPs (with their own individual sets of travel limits), the pilot is able to gain access to a total of up to eight different dual rate settings on one model.

Suppose there is a scenario where the pilot does not want to use FPs, but would still like to have different servo actions when a certain set of flight parameters occurs?

For this scenario, it will be assumed that the pilot would like to have three different elevator dual rates. The pilot also does not want to use FPs.

STEP ONE

Create a new model. Use the BASIC Template and set the Assignment to POWER.

On the model Properties screen, name the model "Crazy Plane" and set the Assignment listing to POWER.

STEP TWO

Create a new mixer named "Elev#". The mixer should be set up as shown.

Add the Mix1, Mix2 and Mix3 switches as shown.

Is it permitted to have the same controls listed multiple times in a mixer?

Yes. The rationale will be demonstrated shortly.

STEP THREE

Go to the servo assignment screen and replace the mixer "ELEVATOR+" on servo numbered 2 with the "Elev#" mixer that was just created.

STEP FOUR

Now that a servo has been assigned to the "Elev#" mixer, the servo travels can now be set. Set the servo travels in the mixer menu to the following:

```
Elev#

Elevator ----  100%
Elevator ----  50%
Elevator ----  25%
```

STEP FIVE

When the "Elev#" mixer was defined, each line in the mixer was set to elevator control with symmetrical output curves, however, each of the controls listed will be switched with the MIX1, MIX2 and MIX3 switches.

Establish a widget to control these switches. In the SETUP-ASSIGNMENT-SWITCHES menu, set Mix-1 to the "G" 3 position switch with the ON position towards the top of the transmitter. Set Mix-2 to be also on the "G" widget, but the ON position should be in the lower position. Set MIX3 to the "I" widget with the ON position to be in the lower position.

Go to the servo monitor screen. Set the "I" widget to the OFF position. Set the "G" widget to the up position. Move the elevator control (the right axis stick) and observe that the elevator has 100% of travel. Move the "G" widget in the lowest position and observe that the elevator travel is now only 50%. The "G" widget is currently triggering the MIX2 switch which has been set to activate one of the control inputs from a mixer. In this case, it is activating one of the elevator controls in the "Elev#" mixer, which has been set to have only 50% of servo travel.

Move the "G" widget to the center position and then move the "I" widget to the ON position (down). Observe the elevator servo travel. It has been reduced to 25% which reflects the MIX3 switch which has been assigned to the third elevator control input in the "Elev#" mixer.

Move the "G" widget to the ON (down) position and set the "I" widget to the ON (down) position and observe the results of the elevator servo travel. The resulting travel values will now be 75% which is a reflection of the 50% from MIX2 and the 25% from MIX3. Since both MIX2 and MIX3 are set to the on position, their resulting travels are added up to 75%.

This is a nifty trick to be able to extract additional dual rates by using a mixer and the MIX1-3 switches without using the official dual rate function or flight phases.

Keep in mind that the reader is not limited to using the MIX1, MIX2 and MIX3 switches only one time. You can create a new mixer for the rudder with three inputs and assign one rudder control to MIX1, another rudder control to MIX2 and the third rudder control to MIX3 in the mixer definition screen. Replace the rudder servo assignment with this newly created rudder mixer and set the travel values like the "Elev#" mixer shown above. The end result will be elevator AND rudder dual rates when the "G" and "I" widgets are turned on.

An important note!

The middle position on a three-position switch means, "Neither UP or DOWN." Since widget "G" in the up position means that MIX1 switch is ON and widget "G" in the down position means that MIX2 is on, if widget "G" is in the center, neither one of them are on. If the "I" widget is also set to OFF (in the up position), there will be no elevator servo travel!

This is not a malfunction, but rather a demonstration of one of the few limitations of the Royal EVO. With the Profi 4000, each position of a three position switch can be set as "ON".

An even more important note!

Although you can establish a mixer with multiple rudder and elevator control inputs to create a dual rate function, due to the Multiplex aileron sequencing rule, applying multiple aileron inputs into a mixer to effect a dual rate function on the ailerons will cause the ailerons on the plane to work improperly.

Aileron servos are required to be listed in a Left-Right-Left-Right order fashion so that the EVO will know which aileron is the on the port side and which aileron is on the starboard side. When two aileron controls are listed in a mixer in the aim of allowing for a dual rate function, the EVO counts the occurrence of the second aileron control listed in the mixer as a "right" servo and thereby sends a "left" aileron servo data to the next servo utilizing the mixer. In this case "left" aileron signal will be sent to the right physical aileron servo! To the EVO, it is following the L-R-L-R aileron rule, however both the left and right **physical** aileron servos on the plane will only be receiving "left" aileron servo data signals. This will cause the ailerons on the plane to act like spoilerons and flaperons.

Mixers are powerful programming tools and they are not limited to only providing mixing function outputs to servos. They can also be used as another form of dual rates if the pilot needs additional functionality on their EVO.

10. PROGRAMMING FULL-HOUSE SAILPLANES

This chapter is credited to Geir Wilkran and is used with his generous permission. The author has modified the narration for clarity and has performed formatting alterations for readability.

This chapter provides the readers with a detailed set of instructions for programming a full-house sailplane. Full-house sailplanes typically have the following functions: Elevator, Aileron, Flap, Rudder. Some full-house sailplanes also have a separate spoiler control surface, but the example plane that Mr. Wilkran is proposing in this chapter uses the aileron surfaces as spoilerons for the spoiler channel; there are no separate spoiler flying surfaces on his example full-house sailplane.

10.1 PROGRAMMING OVERVIEW

This full-house sailplane setup assumes that the Elevator and Aileron controls are located on the right stick widget (in mode 2 operation). The Rudder and Spoiler controls are located on the left stick widget. The Flap control is located on the “E” slider widget. The Flap control will be used for small amounts of camber and reflex while in flight.

The aileron surfaces should act as flaperons during full trailing edge flap settings and as spoilerons during crow braking.

The flap surfaces should act as full span ailerons as well as act as conventional flaps.

The elevator surface should compensate when crow braking is enabled.

The “N” widget should switch between allowing the spoiler widget to effect either full span flaps (flap and aileron travel downward together) or crow brake (flap surfaces go down and aileron surfaces go up).

The “I” widget should turn aileron-rudder coupling on and off.

10.2 CREATE A CUSTOM ASSIGNMENT LIST

First, set up a custom assignment list and define the mixers that are needed. Once hese mixers and assignment list have been programmed, they will be considered global and can be used with other sailplanes.

Begin by setting up a custom list of widget-to-control assignments.

Go to the main menu "Setup" and select "Assignment". In the "Assignment" screen move down to "Assignment" and select it (by pressing the digi-adjusters or the ENTER key). Use the digi-adjusters (or up/down keys) to select one of the two empty assignment lists, which will show up in the display as "4...." and "5....". Change the name of the assignment to something meaningful.

Navigate to the "Controls" listing and select it. Highlight the "Spoiler" listing and select it. Select the widget that will act as the Spoiler control by moving the left stick widget up and down. Leave the stick in a forward position to set stick travel value from forward as negative to backward as positive, and then press ENTER to confirm. This will navigate back to the “Controls” list. Move down to "Flaps/RPM" and select it. Move the “E” slider widget and leave it in an upward position before pressing the ENTER key.

Exit the "Assign Controls" screen.

Back in the "Assignment" screen, select "Switches". Move down to "CombiSwitch" (aileron-rudder combination) and select the “I” widget. Leave the “I” widget in the downward position as the “ON” position and press ENTER to confirm.

Move down to "Mix-1" in the list and select the “N” widget with upwards as being the “ON” position. Move down to "Mix-2" and select the same “N” widget, but this time with downward as being the “ON” position. The Mix-1 and Mix-2 switches will allow the pilot to change between crow brake and full span flaps. This will be demonstrated later in the chapter.

This custom global assignment list is now complete and can now be used with additional models.

10.3 CREATE THE MIXERS

For setting up our full house glider, three different mixers will be needed: one to manage the aileron servos, another to manage the flap servos, and one to manage the elevator servos. These mixers will be named as, AILERONx, FLAPx, and ELEVATRx.

AILERONx mixer:

Press the "Setup" button at the bottom of the transmitter and select "Mixer def". In the "Define mixer" screen scroll down the list and select an unused entry. In the next screen change the name to "AILERONx". This is the mixer that will be used to effect the aileron servos, so it must now be decided which controls should cause the aileron servos to move. In the “Programming Overview” chapter, it was determined that the aileron servos should move when the following events occur:

- **When the aileron widget is enabled, the aileron servos should move.**
- **When the flap widget is enabled, the aileron servos should move for camber and reflex adjustments.**

- **When the “N” widget is forward in the Mix1 position, the ailerons should move as spoilerons when crow braking is enabled by the spoiler widget.**

- **When the “N” widget is downward in the Mix2 position, the ailerons should move as flaperons for full trailing edge flaps.**

Define the aileron mixer as shown below:

```
AILERONx

1. Aileron   ----
2. Flap      ----
3. Spoiler   Mix1
4. Spoiler   Mix2
5. -------   ----   ---
```

In the AILERONx mixer, line 1 receives the Aileron control as an input. The aileron servos should move equally up and down in response to the aileron widget, so the symmetrical output option is chosen. Since the symmetrical output option forces the servo to travel equally above and below the neutral servo position, when the aileron servo travel adjustments are later programmed into the mixer, only one value will need to be entered. However, the asymmetrical output option could have been chosen in order to allow fine tuning the specific upward and downward travel distance of the aileron surfaces. Is this how aileron differential is programmed? No, aileron differential is a parameter that is adjusted with a separate function on the EVO and not by the use of mixers. This will later be demonstrated.

Line 2 receives Flap as an input. The flap control is set with an **a**symmetrical output option. With this option, separate values for the upward and for the downward movement of the aileron surfaces can be programmed when the flap widget is enabled. These travel values will be used to fine tune the amount of aileron surface travel when camber or reflex is enabled with the “E” slider widget.

Line 3 receives Spoiler as an input **only** when the Mix1 switch is in the “ON” position. (When the “N” widget is in the upward position.) The Mix1 switch will toggle the crow brake function in response to the Spoiler widget. When the Mix1 switch is set to “ON”, the ailerons should move in one direction only (upwards), so the single-sided with offset option is chosen. The offset option allows the entire physical movement of the left axis stick (the spoiler widget) from full up position (0% or neutral) to full down position (+100%) to be utilized to deploy the ailerons as spoilerons.

Line 4 also receives Spoiler as an input, but only when the **Mix2** switch is in the “ON” position (when the “N” widget is in the downward position.) When the **Mix2** switch is set to the “ON” position, it will cause the ailerons to move as flaperons in response to the Spoiler widget. This will be used in conjunction with the flap surfaces to allow the pilot to set full trailing edge flaps.

Line 5 is not used and is left empty.

FLAPx mixer:

Press the "Setup" button at the bottom of the transmitter and select "Mixer def". In the "Define mixer" screen scroll down the list and select an unused entry. In the next screen change the name to "FLAPx". This is the mixer that will be used to effect the flap servos, so it must be decided now which controls should cause the flap servos to move. In the “Programming Overview” chapter, it was determined that the flap servos should move when the following events occur:

- **When the flap control is enabled (the “E” slider widget), the flap servos should move a small amount of up for reflex and a small amount of down for camber.**
- **When the spoiler widget is enabled, the flap servos should move down as far as possible.**
- **When the aileron widget is moved, the flap servos should work in conjunction with the aileron servos for full span aileron function.**

Define the mixer as shown below:

```
FLAPx

1. Flap      ----
2. Spoiler   ----   +
3. Aileron   ----
4. -------   ----   ---
5. -------   ----   ---
```

Line 1 receives flap as an input. An asymmetrical output option is selected so that the upward and downward movement distance of the flap servos can be adjusted as needed.

Line 2 receives spoiler as an input. The spoiler widget should cause the flap servos to move only in one direction. The output option is chosen as single-sided with offset in order to allow the full physical movement of the spoiler widget to be utilized.

Line 3 receives aileron as an input. An asymmetrical output option is selected so that the upward and downward movement of the flap servos can be adjusted to match the aileron surfaces for full span ailerons.

Lines 4 and 5 are unused and are left empty.

ELEVATRx mixer:

Press the "Setup" button at the bottom of the transmitter and select "Mixer def". In the "Define mixer" screen scroll down the list and select an unused entry. In the next screen change the name to "ELEVATRx". This is the mixer that will be used to effect the elevator servo, so it must now be decided which controls should cause the elevator servo to move. In the “Programming Overview” chapter, it was determined that the elevator servo should move when the following events occur:

- **When the elevator widget is enabled, the elevator servo should move.**
- **When the spoiler widget is enabled, the elevator servo should move in order to provide compensation.**

Define the mixer as shown below:

```
ELEVATRx

1. Elevator  ----
2. Spoiler   ----
3. -------   ----   ---
4. -------   ----   ---
5. -------   ----   ---
```

Line 1 receives Elevator as an input. An asymmetrical output option is selected so that the upward and downward movement of the elevator servos can be adjusted as needed.

Line 2 receives Spoiler as an input. This input is used for elevator compensation when Spoilers are deployed.

Lines 3, 4, and 5 are unused and are left empty.

10.4 CREATE THE MODEL

Now that the mixers have been created, the model can now be created. Press the MEMORY button near the bottom of the transmitter and then select "New model". In the "New model" screen select "4 FLAPS" as the Template. Select "2" (Rudder on left stick, Elevator and Aileron on right stick) as the Mode selection. For the Assignment list selection, choose the custom assignment list that was made earlier. Finally, select "OK" and press ENTER.

Press the CONTROLS button near the bottom of the transmitter and then select "Fixed value," Make sure that the parameter "Fixed value" is set to OFF for the flap and spoiler control.

Press the SERVO button near the bottom of the transmitter and then select "Assignment". Assign the AILERONx mixer to the two channels that will be used for the ailerons. (Remember that that left wing should be on a lower channel number than the right wing in order to observe the aileron sequencing rule.)

Assign the FLAPx mixer to the two channels that will be used for flaps. Remember that that left flap should be on a lower channel number than the right flap in order to comply with the sequencing rule. The two flap channels should be on higher numbered channels than the two aileron channels.

Assign the ELEVATRx mixer to the channels that will be used for elevator.

Assign the Rudder control to the channel that will be used for rudder. The rudder control will not need a mixer.

10.5 ADJUST THE MIXER VALUES

Press the MIXER button near the bottom of the transmitter and then select the AILERONx mixer. Enter the following travel values as shown below.

```
AILERONx

Aileron     ----  100%
Flap        100%  100%
Spoiler     OFF   -100% Mix1
Spoiler     OFF   100%  Mix2
```

Press the MIXER button near the bottom of the transmitter and then select the FLAPx mixer. Enter the following travel values as shown below.

```
FLAPx

Flap        100%  100%
Spoiler     OFF   100%
Aileron     OFF   -30%
```

Press the MIXER button near the bottom of the transmitter and then select the ELEVATRx mixer. Enter the following travel values as shown below.

```
ELEVATRx

Elevator    100%  100%
Spoiler     OFF   0%
```

By ensuring that all of the channels will receive full output from each control, it will be easier to adjust the mechanical servo linkages and flying surfaces.

10.6 SERVO CALIBRATION

Press the SERVO button near the bottom of the transmitter and then select "Calibrate". Select each channel and make sure that both end points of the servo curve (P1 and P5) are set to -/+100% value. Check that each control surface on the model is moving in the correct direction. If any servo needs to be reversed, select that channel in the SERVO menu, highlight the “REV/TRM” field and then press the REV/CLR button at the bottom of the transmitter to invert the curve.

For each servo, adjust the mechanical linkage so that the full servo movement is used when moving the control surface to its maximum needed deflection. (This may require adjusting the clevises on the servo arms and control horns.) Even after completing this, there may still be some servos that will attempt to move more that the mechanical linkage and control surface will allow for. If this is the case, select the corresponding channel on the SERVO menu and adjust the end points (P1 and P5) on the servo curve so that under no circumstance will the servo move further than the mechanical linkage allows for.

The flap servos will require some special attention in order to synchronize them with the aileron servos. The flap surfaces need to move only a few degrees upward travel for reflex. However, the flaps should also move as much down as possible for braking. Therefore it is desirable to preserve as much physical servo movement as possible for moving the flaps downward. Turn on the receiver. Move the spoiler stick to neutral (full forward). Move the flap slider (the “E” widget) full forward, so that both flap servos (and surfaces) move to their upward ends of travel, and hold it there while turning off the receiver. (This will cause the servos to “freeze” into place.) Adjust the mechanical servo linkages for the flaps so that the flap surfaces are set to their maximum required reflex position. Turn the receiver on again, and set the flap slider to neutral. The flap servos will now move to the servo neutral positions, but the flap surfaces will physically be below the neutral point. Press the MIXER button, go into the FLAPx mixer, select the Spoiler input, and adjust the Offs parameter so that the flap surfaces are at neutral when spoiler, aileron and flap widgets are at their neutral positions.

Go through each mixer (AILERONx, FLAPx, and ELEVATRx) and readjust the mixer travel values as needed for the model.

The Flap control should produce only a small amount of flap surface movement (5-10 degrees) for reflex and camber settings. Within both mixers AILERONx and FLAPx, adjust the amount of flap control travel so that the flap surfaces move in response to the Flap widget (the "E" slider) in the amounts that are needed for the model.

Press the MIXER button at the bottom of the transmitter and then select the "CombiSwitch" listing. The Rudder-Aileron coupling for coordinated turns can be set up here. This can be set so that either Ailerons or Rudder is considered master. *(See section 15.1 in the manual.)* Within the customer assignment list that was created, the "I" widget has been programmed to turn Aileron-Rudder combination ON and OFF.

Press the MIXER button at the bottom of the transmitter and then select the "Ail.Diff" listing. The "Mode" parameter can be set to +SPOILER. *(See section 15.2 in the manual.)* In this example setup, much of the aileron movement will be used in crow braking and in full span flaps when deploying the Spoiler widget. Less aileron movement is remains for the Aileron control when Spoilers are fully deployed, and this will cause degraded aileron response for the plane when using spoilers. When the mode is set to +SPOILER, aileron differential will be gradually reduced as Spoilers are progressively deployed. This will enable better aileron response when deploying spoilers.

10.7 Refinement Possibilities

The following discussion are variations of other possibilities and refinements to the prior example setup. There are other alternative EVO programming approaches that are possible, but are not discussed below.

10.7.1 Alternative Elevator Compensation Possibilities

When the ELEVATRx mixer was defined, the Spoiler input was set with the "Single-sided with offset" output option. This option gives linear output to the elevator from the first moment of spoiler deployment.

Perhaps this is not desired. Suppose that very little elevator compensation should occur at the beginning of spoiler deployment, but more elevator compensation should occur after the spoiler has passed a certain point? In this case, a "Single-sided with curve" output option could be chosen instead. This will provide a two-point curve for adjusting the elevator compensation rate instead of a straight linear elevator compensation.

Or perhaps instead, no elevator compensation at all is desired until a given amount of spoiler is deployed? In this case, a "Single-sided with dead zone" output option could be chosen. This will allow the pilot to specify at which point during the spoiler deployment that elevator compensation should begin.

10.7.2 Alternative Reflex/Camber Possibilities

The flap control (which was assigned to the "E" slider widget) was programmed to enable small adjustments of reflex and camber for penetration or thermal situations.

For the fingers to find the “E” slider and moving it to the correct position, is sometimes not as easy and quick as could be desired. In some situations, it is better to flip a switch to set the flaps in speed, thermal, or normal positions. This could be obtained by reassigning the flap control to a switch widget, for example to the 3-position “L” widget (reflex in upper position, neutral in middle position, and camber in lower position).

However, if he pilot desires, they can leave the control assignment as it is and use the forward and backward position of the “L” widget to quickly set reflex and camber while at the same time have the “E” widget action slaved to the middle position of the “L” widget. In another words, when the “L” widget is set to either reflex or camber, the “E” slider will have not effect. When the “L” widget is in the center position, the “E” slider will continue to allow the pilot to manually specify the amount of reflex or camber to effect.

This will be done using a combination of Flight Phases and fixed values.

Press the SETUP button at the bottom of the transmitter and then select "Assignment". Select "Switches", scroll down to "Phases 1-3" and select it. Move the “L” widget to select it, and leave it in the forward position for Phase 1 before pressing ENTER to confirm the choice.

Press the MEMORY button at the bottom of the transmitter and then select "Flight phases". Navigate to the second line listed as Phase 2, select it (by pressing the digi-adjuster or the ENER key) and change the name in the second line to "NORMAL" and press ENTER.

Navigate to the Phase 3 line and change the name to "THERMAL1". Make sure the “L” widget is in the forward position. This will select Phase 1 which is the phase that already contains the previous settings. An "x" will appear on the display to indicate this.

Navigate back to the Phase 1 (line 1), select it and change the name to "SPEED1" and press ENTER. The marker will now move to the "x" after the name of the phase. Use the digi-adjuster (or up/down keys) to copy Phase 1 to Phase 2 (in the display a "c" will show behind the phase that will be copied to). Copy Phase 1 to Phase 3 as well. Now, all of the previous settings have been copied to these two new phases.

Press the CONTROL button at the bottom of the transmitter case and select "Flap". Move the “L” widget to the upward position to enable the "Speed1" phase (phase 1). Set the "Fixed value" to the required amount of reflex for this Flight Phase.

Move the “L” widget to the lower position to select "Thermal1" phase (phase 3), and set the "Fixed value" to the required amount of camber for the Flight Phase.

Move the “L” widget to the middle position and ensure that the "Fixed value" is OFF in the "Normal" phase. This will enable the “E” widget to continue to work as it did before in the "Normal" phase. *(Remember, even if the pilot chooses not to use Flight Phases, the EVO considers that the “Normal” Flight Phase is enabled by default.)*

One thing to be aware is that when you set fixed values the resulting output will be limited to the maximum values set for that control in each mixer. For example, if in the FLAPx mixer the travel values for Flap were set 25% upward travel and 30% downward travel and a fixed value is set for Flap to -100% (up), the actual output from the mixer will only be -25% (the maximum value in the mixer setup).

11. PROGRAMMING ELECTRIC RES SAILPLANES

On electric gliders, it is often beneficial to have a programming set up that allows the left axis stick to control both the ESC (throttle) as well as the spoiler. During the launch stage or during motor power-on, the left axis stick is used as a typical throttle control widget. However, by programming the left axis stick to also control the spoiler function, it reduces the pilot workload since it will not be necessary to utilize another slider widget or switch to enable the spoilers.

This EVO programming scenario will have one widget that will be used to control two independent servos, but not at the same time. Clearly, the spoilers and the throttle should not both enable at the same time!

These two functions on the left axis stick will be switched by the position of widget "O" which is a three-position widget on the left side of the transmitter, although any other three-position switch widget could be utilized instead.

The top-most vertical position of the "O" widget will be for throttle control and the bottom-most position will be for spoiler control. The middle position will be for nether control and thus, will effectively be used as a "master kill switch" to prevent accidental spoiler or throttle inputs during flight. This will be beneficial when the glider is very far away and it will be impossible to quickly notice if the spoilers or the throttle have been accidentally turned on.

In addition to the selectable function of the left axis stick, different rates of elevator to throttle and elevator to spoiler coupling will be added to further reduce the pilot workload while in flight.

One last reduction of the pilot workload will be to combine the rudder control onto the right axis stick for single-stick flying.

This setup will reduce the pilot workload to only three widgets, but will still allow the full range of control for the RES-Electric sailplane.

11.1 PROGRAMMING SOLUTION

The solution to this programming setup is rather unorthodox and goes against some conventional EVO programming guidelines, but it works well and further demonstrates that the EVO can be configured to work in a variety of ways with a little bit of thinking outside of the box.

The answer to this programming set up is to use three custom made mixers and a combination of the Mix1 and Mix2 software switches.

This solution also avoids having to use a Flight Phase (FP) assigned to a switch widget, and thus, frees this tool for additional functions if the pilot determines later that a FP would be of benefit.

11.2 Unique Mixers that are Needed

There will be three custom mixers that will be needed. Create these mixers as shown below in the Mixer definition menu.

```
RES-Eele

Elevator    ----
Throttle    Mix1  −
Spoiler     Mix2  −
```

```
RES-Ethr

Throttle    Mix1  +
```

```
RES-Espl

Spoiler     Mix2  +
```

Conventional EVO programming specifies that if there is only a single control listed in a mixer, a mixer is not necessary; the pilot would just assign the control to a widget.

But in this case, assigning the spoiler or the throttle control directly to a widget will not allow the pilot to attach a “Mix1” or “Mix2” software switch to the control. This is why the last two unorthodox mixer definitions are necessary.

11.3 Control Widget Assignments

Assign both the throttle control and the spoiler control to the left axis stick. Be sure that the left axis stick remains in the down position when selecting **ENTER** to confirm your selection.

11.4 Switch Widget Assignment

Assign the “O” widget in the up-most position as “Mix1” in the bottom-most position as “Mix2”.

11.5 SERVO ASSIGNMENTS

Assign the elevator servo to the **"RES-Eele"** mixer.

Assign the throttle servo (the ESC) to the **"RES-Ethr"** mixer.

Assign the spoiler servo to the **"RES-Espl"** mixer.

11.6 MIXER TRAVEL SETTINGS

As a starting point, set the servo travels within each mixer to the following settings:

```
RES-Eele

Elevator  ----    100%
Throttle  15%     25%
Spoiler   30%     50%
```

```
RES-Ethr

Throttle  -100%   100%
```

```
RES-Espl

Spoiler   -100%   100%
```

11.7 MIXER RESULTS AND EXPLANATIONS

Because the throttle control is set to the "Mix1" software switch, the left stick will only enable the throttle when the "O" widget is moved to its upper-most vertical position. The spoiler servo will not move at this time since it is programmed to move only when the "Mix2" software switch is enabled (which is when the "O" widget is set in its lowest-most position.)

When the "Mix2" switch position is enabled, the left axis stick will control the spoiler only.

The elevator compensation for throttle and spoiler is handled within the "RES-Eele" mixer.

11.7.1 THROTTLE > ELEVATOR COMPENSATION EXPLAINED

Throttle	15%	25%

Because this input was originally defined as "single-sided linear with dead zone" when the mixer was created, it allows the pilot to determine at what point should the elevator servo begin to move when the throttle control (the left axis stick) is moved from it's lowest position of no throttle to its highest position of full throttle.

Consider this, in an electric glider and especially at low throttle speeds it may not be necessary or even desirable to have the elevator servo attempt to compensate. At higher throttle settings, it may be very necessary to have the elevator compensate the effects of the higher throttle setting.

What the above mixer line is saying is that as the throttle control (the left axis stick) is being moved from its lowest position of 0% travel until it reaches a point 15% along its total travel, don't add any elevator compensation. This is what the term "dead zone" refers to when setting mixer options in the mixer definition stage. In this example, the dead zone (of which there will be no elevator signal sent to the elevator servo) is from 0%-15% when the throttle (the left axis stick) is moved.

Once the 15% point is passed on the throttle control however, the mixer is instructing the elevator to add a maximum 25% of travel in a linear fashion.

If immediate elevator compensation is desired from the instant that the throttle control widget is moved, change the RES-Eele mixer to the following:

```
RES-Ethr

Throttle  Off     100%
```

This setting will give elevator compensation as soon as the throttle widget is advanced.

11.7.2 SPOILER > ELEVATOR COMPENSATION EXPLAINED

Spoiler	**30%**	**50%**

Because this mixer input line also was originally defined as "single-sided linear with dead zone" when the mixer was created, it allows the pilot to determine at what point should the elevator servo begin to move when the spoiler control (the left axis stick) is moved from it's lowest position of no spoiler to its highest position of full spoiler.

Remember, that the left axis stick is being used for BOTH the spoiler control as well as the throttle control. The position of the widget "O" determines which control is being enabled as the left axis stick is moved.

In this example, because the elevator doesn't need to compensate much when the spoiler is initially deployed, the dead zone is set to 30%. As the spoiler is deployed in flight, the elevator will not attempt to compensate until the spoiler control (the left axis stick) passes beyond the 30% trigger point in the widget movement travel.

Once this occurs, the mixer is instructing the elevator servo to move up to 50% (in a linear fashion) of its travel to compensate for the full spoiler deployment.

This means basically, that full spoiler is going to drop the glider like a rock and much more elevator compensation will be necessary to maintain the flight path, but lesser amounts of spoiler deployment (less than 30% spoiler deployment in this example) will not need to have any elevator compensation. In this example, the dead zone for elevator compensation when the spoiler control is enabled is from 0% to 30%.

This gives elevator compensation when the spoiler is opened.

11.8 AILERON > RUDDER COUPLING

Assign the ailerons to rudder coupling to one of the digi-adjusters (DA) for fine tuning in flight and for quickly setting pilot preferences. In the Mixer menu, select the "Combi…" listing. Under the Combi screen, make sure that the Aileron > Rudder option is displayed and press the Digi-Adjuster button at the bottom of the transmitter. Press either the left or the right DA as desired. The coupling rate can now be adjusted while in flight. Be sure that a widget has been assigned to the Combi function and that it is currently positioned to the "On" position.

11.8.1 AUTOMATIC AILERON > RUDDER COUPLING USING A MIXER

Another way to eliminate pilot workload is to create a custom mixer for the rudder servo that has the following settings:

```
Ail>Rud+

Rudder      ----  ⇕
Aileron     ----  ⇕
```

The travel distances for this mixer should be set to the following:

```
Ail>Rud+

Rudder    ----    100%
Aileron   ----    100%
```

Assign the rudder servo to the "Ail>Rud+" mixer.

This will cause the aileron control (the right stick on a mode 2 setting in the EVO) to make the rudder servo move. Because the aileron control input is set to be always on within the mixer definition, the pilot will not need to be concerned about flipping a widget to enable coupled aileron > rudder flight.

The EVO will still allow the aileron control within the Ail>Rud+ mixer to be assigned to one of the DA for fine tuning in flight. Highlight the 100% value for the Aileron control in the Ail>Rud+ mixer screen, press the digi-adjuster button at the bottom of the transmitter and then press either one of the DA buttons at the top of the transmitter.

Note:

The numerical values in the mixers in this chapter are purely for instructional purposes only and each plane will need to be adjusted individually to suit pilot and plane preferences.

12. PROGRAMMING COLLECTIVE PITCH HELICOPTERS

This chapter is credited to Flemming Friche Rodler (RCGroups.com screen alias "Rcfun") and Christian Grandjean (RCGroups.com screen alias "Tamely") and is used with their generous permission. The graphics, illustrations and screenshots are credited to them as well.

The author has modified the narration for clarity and has performed formatting alterations for readability.

12.1 PROGRAMMING OVERVIEW

This chapter focuses on many of the aspects needed for setting up a helicopter on the EVO. The chapter is intended to be as general as possible and will guide the readers in setting up helicopters with both mechanical mixing and CCPM control of the swash plate. In the case of setting up a CCPM helicopter the focus of the tutorial will be limited to 120º CCPM control of the swash plate. The tutorial will also explain how to set up a gyro and a governor. In particular, a Futaba GY401 gyro and a Throttle Jockey Pro governor from Model Avionics and a GV-1 governor from Futaba will be used as examples.

The reasons behind choosing this setup are many: a 120º CCPM is a popular CCPM configuration used on many helicopters, the GY401 is a capable, popular and common gyro, (many other gyros work in the same way) and both the Throttle Jockey Pro (TJPro) and the Futaba GV-1 are popular governors. There are some challenges to setting the TJPro and the GV-1 up on the EVO, especially the first time. Even though the equipment examples that are used in this tutorial are specific to the Futaba GY401 gyro, the Model Avionics TJPro and the Futaba GV-1 governor, much of the information presented can be used with similar products of other brands. This tutorial will address these challenges and describe how to overcome them.

THROTTLE RACHETING:

For helicopter use it is strongly recommended by the author to disable throttle/collective stick racheting. (See the EVO manual section 7.4.6 for instructions on how to do this.) With the racheting set, it can be difficult to adjust the collective for hover. Instead, it is recommended to enable spring tension. Do not set it too soft. A harder tension will make rudder inputs easier to perform without accidental changing the collective. Experiment to find the best tension for your preferences.

12.2 PROGRAMMING SOLUTION

For the purpose of the chapter, the author will use the same assignment of the widgets as described under the HELIccpm and the HELImech template (they are the same) in section 12.11 and 12.12 in the EVO manual with the following exceptions:

- Widget slider E will not be used to control the gyro. Instead, a fixed gyro gain value will be set up that can be changed with each flight phase. Since the value of slider E cannot be stored and it is the same for all flight phases, this method is a better way to set gyro gain. In the case that in-flight adjustments are needed, the gyro gain can be assigned to a digi-adjuster.

- Widget O will be assigned to control the governor so that the Throttle Jockey Pro's or the GV-1's ability to change the head speed from the transmitter can be utilized. Assigning this function to the O widget will allow for altering the head speed as flight phases are chosen.

- If the autorotation flight phase is selected (to be controlled by widget I), the governor should be disabled.

! WARNING !

Do not turn on the receiver until the tutorial calls for it!

It is very easy to accidentally stall the servos – especially those connected to the swash plate – before the helicopter has been setup. Stalling a servo might damage the helicopter or the servo.

12.3 Creating a New Model

Before proceeding, create a new model.

Place all of the switch widgets in the UP position.

Press the Memory button near the bottom of the transmitter. Using either the digi adjusters or the UP/DOWN arrow buttons select the “New Model” menu.

Change the template to “HELIccpm” if a CCPM helicopter is being programmed (or to “HELImech” otherwise).

Change the Assignment List to “HELI”. The EVO has five available Assignment Lists. Assignment Lists informs the EVO which widgets do what function. Widgets can be set to enable a control function or to enable a switch function. The first three Assignment Lists are programmed by default from Multiplex. For the purposes of this tutorial, the HELI assignment list will be used. The following chart shows the readers how the HELI assignment list is configured. It can also be used as a reference chart if the readers elect to create a new assignment list from any of the two spare assignment list slots (which are labelled by default as, “4….” and “5….” from Multiplex.)

CONTROLS				**SWITCHES**			
Assignment List Number	**3.**	**4.**	**5.**	Assignment List Number	**3.**	**4.**	**5.**
Name	**HELI**	**4 . . .**	**5 . . .**	Name	**HELI**	**4 . . .**	**5 . . .**
Throttle	- - -			Dual/Rate – Aileron	L ↓		
Spoiler				Dual/Rate – Elevator	L ↓		
Flap/RPM	- - -			Dual/Rate – Rudder	L ↓		
Speed L.	- - -			CS/DTC	**N** ↓		
Hook Towing	- - -			Throttle Cut	**H** ⎍		
Brake	- - -			Slot	- - -		
Gyroscope	E ↑			Σ Sum	F ↑		
Mixture	- - -			Interval	- - -		
AUX1	- - -			Mix-1	- - -		
AUX2	- - -			Mix-2	- - -		
Collective (Minimum) *	↓			Mix-3	- - -		
Throttle Lim (Minimum) *	F ↓			Teacher	- - -		
				Main Phase Autorotation	I ↓		
				Phases 1-3	O ↑		

Set the mode to the preferred flying mode.

Set the Servo to either MPX-UNI or MPX-MPX depending on the type of servos that are being used. See **“Chapter 4.3 Create a New Model”** for further information about servo configuration.

Select OK and press the Enter button to create the new model.

From the Memory menu select "Properties". From this menu change the "Name" setting to reflect the name of the helicopter.

These screenshots show example setups from the EVO transmitter.

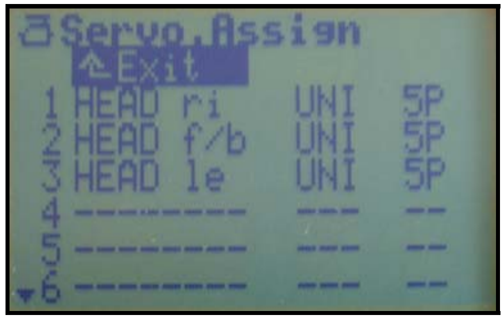
This example shows that the pilot is setting up a new CCPM helicopter using the predefined Assignment List named, "HELI".

This example shows that the name of the model is, "Sceadu Evo 50".

The following steps will describe how to set up a 120º CCPM helicopter. If a helicopter with a mechanical mixed swash plate is being programmed instead, skip to the next section.

12.4 CCPM SERVO ASSIGNMENT

Now that a new model has been created, it is time to assign servos to the receiver outputs. For the purpose of this tutorial, use the following servo to channel assignments:



Assign the first three servos as shown above.

To set the servos according to above table press the Servo menu button and select the Assignment menu. Within this menu select channel 1 using the digi-adjuster and press Enter once. Scroll through the assignment options until it reads, **"Head ri".** Press Enter twice and use the digi-adjuster to select a 5P curve. Press Enter once again to return to channel select. Then repeat the procedure for the two other channels. Later in the tutorial, more servos will be assigned for the governor and Gyro. At this time, however, leave all of the other servo assignments blank. This will allow the readers to safely power up their receivers when the time comes to calibrate the servos.

Note: if the readers' helicopters are using 4 servo 90º CCPM systems, it is necessary to also assign Head 4 to a channel during this step of the tutorial.

NOTE:

The author recommends that swash plate servos be assigned to consecutive positions on the receiver when programming a CCPM helicopter. Having the servo output signals assigned in a sequential pattern allows the pilot to program the swash plate servos while preventing interaction.

12.5 MECH SERVO ASSIGNMENT

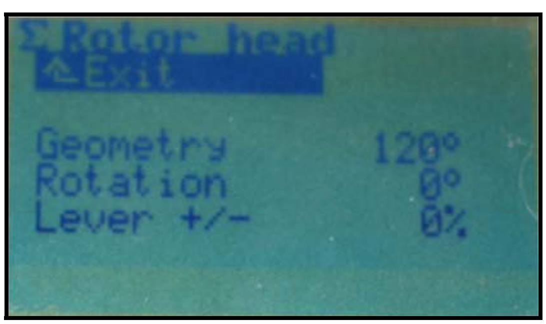
Now that a new model has been created, it is time to assign servos to the receiver outputs. For the purpose of this tutorial, use the following servo to channel assignments:

Channel	Servo	# of points
1	Aileron	2
2	Elevator	2
3	Collect.	2

To set the servos according to above table press the Servo menu button and select the Assignment menu. Within this menu select channel 1 using the digi-adjuster and press Enter once. Scroll through the assignment options until it reads, "Aileron." Press Enter twice and use the digi-adjuster to select a 2P curve. Press Enter once again to return to channel select. Then repeat the procedure for the two remaining channels. Later in the tutorial, more servos will be assigned to channels for the governor and the gyro. However, at this time set all other channel assignments to blank. This will allow safe power up of the receiver when the time comes to calibrate the servos.

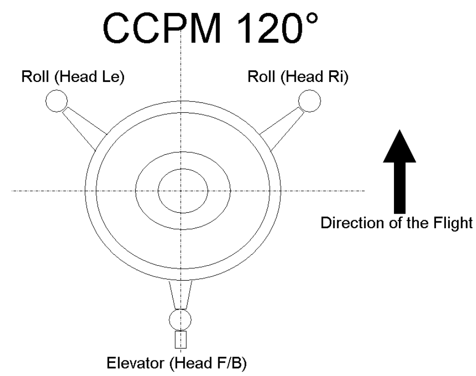
12.6 SETTING UP THE SWASH ROTOR HEAD MIXER (CCPM)

Now that the swash plate servos have been assigned the "Rotor head" mixer appears in the Mixer menu. Press the Mixer button to enter the Mixer menu and select the "Rotor head" mixer. The procedure for setting up the three parameters "Geometry", "Rotation" and "Lever +/-" is very well documented in the EVO manual on page 100-101. For the purposes of this tutorial, the "Geometry" will be se to 120° and the two other parameters to 0° and 0% as shown below.

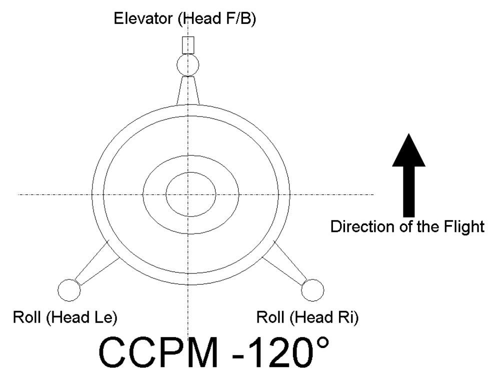


Rotor head mixer

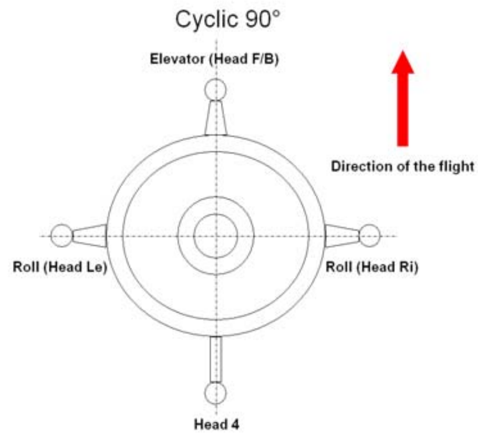
This corresponds to a 120° CCPM setup where the anti rotation pin is pointing forwards and the servos are connected to the swash plate at the 10, 2 and 6 o'clock positions. If they are connected to the 12, 4 and 8 o'clock positions, the Geometry parameter should be set to negative (–120°).



This CCPM configuration should have a +120° geometry parameter.



This CCPM configuration should have a –120° geometry parameter.



This CCPM configuration should have a -90° geometry parameter.

Before calibrating the servos and adjusting servo travel, verify that the "Rotor head" mixer and the servo travel direction are set up correctly. The following steps will help the reader to verify a correct setup and help to diagnosis and correct any problems. It is assumed that a swash plate that rises will result in increased pitch, a swash plate that tilts left will make the helicopter move left and swash plate that tilts forward will move the helicopter forward. These assumptions apply for both 120° and 90° swash plate configurations.

STEP 1: COLLECTIVE PITCH MOVEMENT.

Center all sticks and turn on the receiver.

Carefully move the Throttle axis stick up and down a bit while being careful not to move the swash plate beyond its mechanical limits, which will stall the servos. The swash plate should stay level and move up and down with the throttle stick. For most helicopters the swash should travel upwards when the throttle stick is moved up and should move down when the throttle stick is moved down. (Some helicopters have the movement of the swash plate reversed, so consult your helicopter manual for the proper movement direction of the swash plate and the action of the Throttle axis stick.)

Observe the movement of the swash plate when moving the throttle axis stick:

Swash plate rises:

Perfect. Move onto **"Step 2: Elevator Movement".**

Swash plate lowers or tilts:

Identify the servos connected to the swash plate that move downward. These servos must be reversed. To do this, press the SERVO menu button and select "Calibrate" using the digi-adjusters. Highlight and select the incorrectly moving servo. Select the REV/TRM parameter. Reverse the travel direction by pressing the REV/CLR button. Repeat this step for all the servos that move in the incorrect direction.

STEP 2: ELEVATOR MOVEMENT.

Move the cyclic stick forward taking care not to bind any servos and observe how the swash plate moves:

The swash plate tilts forward:

Perfect. Move on to **"Step 3: Aileron Movement".**

The swash plate tilts aft:

Navigate to the "Rotor Head" mixer and reverse the geometry by pressing the REV/CLR button.

STEP 3: AILERON MOVEMENT.

Move the cyclic stick to the left and observe the how the swash plate moves:

The swash plate tilts to the left:

Aileron movement setup is complete.

The swash plate tilts to the right:

Navigate to the "Rotor Head" mixer and reverse the geometry by pressing the REV/CLR button.

12.7 SETTING UP THE SWASH PLATE TRAVEL (CCPM)

After making sure the swash plate is set up correctly, programming the swash plate travel is a very important next step to ensure that no servos bind or stall. Binding servos (especially high torque servos often found on helicopters) can damage them beyond repair quickly.

There are two important goals that need to be accomplished during setup of the CCPM controlled swash plate. They are:

- ***Ensuring that the swash plate cannot be driven past its mechanical limits.***
- ***Ensuring that the swash plate moves perpendicular to the main mast when applying collective.***

Before proceeding, make sure that the active flight phase is set to "Hover".

Also, ensure that the links from servos to the swash plate and that the links from the swash plate to the rotor head are set up mechanically correct before continuing. Refer to the owner's helicopter manual for specific information relating to this issue. The author cannot stress enough how important a correct mechanical setup is on a CCPM helicopter for proper flight performance. Please take the time and effort needed to complete this step. If the readers are novices to CCPM helicopters, please seek the help of an experienced CCPM helicopter pilot.

It is outside the scope of this tutorial to describe how to properly set up the mechanical links to the swash plate and to the rotor head.

STEP 1: LIMIT THE SWASH PLATE TRAVEL TO PREVENT BINDING

There are two ways to limit the swash plate travel.

Servo Calibration Menu

The servo calibration menu can be used to limit the servo end points. However, since these limits are hard limits that cannot be exceeded when multiple inputs are mixed together, this method poses a problem: if the pilot limits the servo end points so that the swash plate cannot move past its up and down mechanical limit (pitch), they will not be able to add cyclic inputs when the swash plate is at its lower and upper programmed limits. This is because the servo necessary to tilt the swash plate would have been limited by the programmed end points. If the pilot attempts to address this issue by increasing the programmed servo end points to allow for more cyclic input, the swash plate could be forced too far up and down.

In addition, modifying the servo end points will not help to prevent over driving the swash plate when using cyclic inputs while the swash plate is near the center of the main mast. Adjusting the servo end points should not be the sole effort used to limit the swash plate travel.

Initially the servo end points will be left at ±100% for all three swash plate servos and the swash plate will be limited by adjusting the Trvl parameters. After the Trvl and Collective control parameters have been set, the tutorial will explain how to adjust the servo end points in order to achieve more precise programming of collective pitch (which requires readjusting the Collective control parameters). If the readers do not need this level of precision, they can skip this last part of the swash plate limiting procedure.

Aileron, Elevator and Collective Control

The other way to limit swash plate travel is to use the travel values for the Elevator cyclic control, the Aileron cyclic control and the Collective Pitch control (which governs the pitch curve.) This is accomplished by:

Center the collective stick. Use the servo monitor to make sure it is perfectly centered. The pitch should now be zero and the swash plate should be perfectly level. If this is not the case, alter the mechanical setup to make it so.

Press the CONTROL menu button and select Aileron. Scroll down to Trvl and press Enter to select it. Set it to 0%. Move the cyclic axis stick all the way to the left and hold it there. Now, increase the Trvl value until binding begins to occur. Decrease the travel slightly to eliminate the binding. Ensure that there is no binding when the cyclic axis stick is moved all the way to the right. If the Trvl parameter reaches 100% and there is no binding, adjustments to the mechanical setup is necessary if more cyclic is desired.

Press the CONTROL menu button and select Elevator. Scroll down to Trvl and press Enter to select it. Set it to 0%. Move the elevator axis stick all the way to the bottom and hold it there. Now, increase the Trvl value until binding begins to occur. Decrease the travel slightly to eliminate the binding. Ensure that there is no binding when the elevator axis stick is moved all the way to the top.

Now that the Trvl parameters have been calibrated so as to prevent binding when the cyclic is deflected either fully to the left and to the right and fully to the fore and to the aft, it is necessary to make further adjustments in order to prevent binding when the cyclic stick is moved toward the corners.

Slowly try to move the cyclic stick toward any of the corners. If binding occurs before the axis stick reaches the corner, release the stick. Navigate to the Aileron control menu and reduce “Trvl” by a few percent. Reduce the “Trvl” of the Elevator control by the same amount in the Elevator control menu. Attempt to move the cyclic stick to the corner again. Repeat adjusting the value of the two “Trvl” parameters for both Aileron and Elevator until the cyclic stick can be moved to any corner without binding. This is the maximum available aileron and elevator movement.

Now, select the Collect. sub menu from the Controls menu. Set P1, P2, P3, P4, P5 and P6 to zero percent. Select P1 and move the collective stick all the way down. While pushing the cyclic stick to one of its corners, begin decreasing the P1 number (towards –100%) until binding is observed then increase it towards zero until the binding stops. This is the maximum negative pitch setting.

Before completing the adjustment of P1 check that the cyclic stick can be moved to any corner with no binding occurring.

While still in the Collect. sub menu, select P6. Move the collective stick all the way up and start increasing the P6 value (towards 100%) until binding is observed then decrease it slightly to reduce binding. This is the maximum possible positive pitch.

After adjusting the value for P6, check that the cyclic stick can be moved to any corner without binding.

Fill in P2, P3, P4 and P5 values to achieve the desired pitch curve.

The pitch curve points from P1 to P6 and the cyclic TRVL parameters can be changed to any desired value as long as they do not exceed the negative/positive values programmed in the above prior steps.

NOTE 1:

When the reader later learns how to set up flight phases, they will need to set travel values for cyclic and collective curves for the new phases. To do this, simply enter your desired curve for the new flight phases. Be sure not to exceed the maximum negative and positive values that are encountered during the above steps.

NOTE 2:

The readers might encounter a situation where there is more positive than negative pitch. If these travels should be equal, it will be necessary to change the mechanical setup. This can typically be accomplished by reducing the length of the links from the bell cranks (or servo if they are connected directly to the swash plate) and increasing the length of the links of the rods above the swash plate. Check your helicopter manual for specifics.

Also, if the readers are not satisfied with their pitch range or cyclic travel, it will be necessary to alter their mechanical setups.

Be sure to recheck the swash plate travels every time that any mechanical adjustments are made directly or indirectly to the swash plate!

Using Servo Calibration End Points to Fine Tune Swash Plate Limits:

Suppose that the P1 and P6 points of the readers' pitch curve were found to be -50% and +50% after following the above steps. The collective (pitch) movement of the swash plate (at full collective stick deflection) could then be adjusted from zero pitch to maximum pitch in 50 incrementing steps. If, on the other hand, the P1 and P5 points were found to be ±70%, it would allow for the same adjustment using 70 steps. Hence, the latter allows for a more precise adjustment of the pitch curve.

If this extra precision is desired by the readers (at the burden of an increased setup effort) read on. Otherwise, proceed to **Step 2: Ensure a perpendicular swash plate.**

With the swash plate travel limited as described above (by using the Trvl parameter for Aileron and Elevator and the Collect. curve for collective), navigate to the servo calibration menu by pressing the SERVO menu button and select "Calibration". In turn, select each of the three swash plate servo assignments and reduce end points P1 and P5 (toward 0%) by an equal amount, say 10% - 20% for example. Also, adjust P2 and P3 of each curve to ensure a straight line.

Move the collective stick through its movement range and observe that the swash plate will not move as far as before. This is because of the change to the servo calibration curves. Therefore, redo the above procedure for setting the Collect. control parameters so that maximum collective travel again is achieved. Note that when the re-adjustments are completed the P1 and P6 points of the Collect. control curve have increased. Repeat readjusting first the servo calibration end points (always an equal amount for all 3 servos) and then P1 and P6 of the Colllect. control parameters until satisfied. Always check that the cyclic movement is not decreased when the collective stick is up or down. If this is the case the servo end points have been reduced too far.

Do not bother readjusting the "Trvl" parameters for aileron an elevator after having modified the servo calibration end points; they will not have changed. The reason for this is that the values for these parameters where found while the collective stick was at center. The calibration end points are not reached when the swash plate is at the center of its travel range.

Note that the values of P1 and P6 in the Collect. control menu cannot reach 100%. If they do it is not possible to add cyclic movement at minimum and maximum pitch because of the servo end point limits.

STEP 2: ENSURE A PERPENDICULAR SWASH PLATE.

Ideally, if the linkages are set correctly and he servos are behaving the same there will be no need to calibrate the servos. For a CCPM setup, it is recommend that quality digital servos (like the Futaba 9252) be utilized. If the servos are not identical in their speed and their amounts of movement traveled for a given input, there will likely be interaction when applying pitch or cyclic (the helicopter might move slightly to the left when more pitch is applied, for example.)

After adjusting the mechanical setup as accurately as possible, there might still be a need to perform the following calibrations:

Perpendicular linkages:

When setting up the linkages to the servos, locate a hole on the servo horn that will allow the push rods to be perpendicular to the servo arm when the servo and the swash plate are at neutral positions. Use the servo arm and hole that allows for the closest perpendicular orientation of the linkages, then use the sub trim facility to make them perfect.

To do this, press the SERVO menu button and select Calibration. Then select the servo that is being trimmed. Highlight the REV/TRM parameter and then press ENTER. Now make the servo arm and push rod perpendicular to each other using the digi adjuster. When satisfied, press ENTER to store the value. If it is necessary to adjust these value amounts by more that a few percent, check the mechanical setups. Ideally, these values should be zero, but it might be impossible in practice.

When all of the axis sticks are centered (use the servo monitor to verify this), the swash plate should be perfectly level. If it is not, adjust the linkages until it is.

Calibrate servos:

Move the collective stick all the way down. Now slowly move the cyclic stick up a small amount and pause. At every pause verify that the swash plate is still level. If it is not, then calibrate the servos to level it again.

To do this, press the SERVO menu button and select Calibrate. Find out which servo(s) need adjustment (up/down) to level the swash. Adjust as few servos as possible. Select the servo assignment. Note where the stipulated line is in the graph. Now adjust the point(s) near this line to level the swash plate.

Note that the P3 should never be adjusted! Remember, the helicopter is set up mechanically to have a level swash plate at center stick.

After checking that the swash is level at all collective stick locations, move the collective stick all the way down.

Quickly move the collective stick up and observe the behaviour of the swash plate while it moves. It should stay perfectly level while moving up quickly.

If the servos travel at different speeds, it will be necessary to obtain servos that are synchronized. Some digital servos can be programmed for this function.

WARNING!

The EVO manual suggests a different way of calibrating the servos on page 80. It recommends to enter servo calibration and then to select one of the Head assignments. Then, for each point P1, P2, P3, P4 and P5 select them and press the ASSIGN button. This will result in all 3 swash plate servos moving to that point. This point can then be adjusted to level the swash plate. The author does not recommend this procedure instead of the method described above. The readers might risk forcing the servos to a position where they bind since the servos are not restricted to the Trvl adjustments when using the ASSIGN button.

12.8 Setting Up the Swash Plate Travel (Mech)

After making the servo assignments, setting up the swash plate travel is a very important step in order to prevent the servos from binding. Binding servos, especially high torque servos often found on helicopters, can fry them quickly.

There are three important goals that need to be accomplished during setup of a mechanical swash plate. They are:

- Ensuring that the servos move in the correct direction.
- Ensuring that the swash plate cannot be driven past its mechanical limits.
- Ensuring that the swash plate is perpendicular (level) to the main mast.

The following assumptions are presumed: a rising swash plate will result in increased pitch, the helicopter will move left when the swash plate tilts left and the helicopter will move forward when the swash plate tilts forward.

Before proceeding, make sure that the active flight phase is set to Hover. Also, be sure that the links from servos to the swash plate and from the swash plate to the rotor head are set up mechanically correct before continuing. Refer to your helicopter manual. Please take the time and effort needed. If you are new to helicopters please seek help by an experience pilot as it is outside the scope of this tutorial to describe how to accomplish this task (not to mention the different ways of doing this depending on the helicopter in question).

STEP 1: LIMIT SWASH PLATE TRAVEL TO PREVENT BINDING

This step will accomplish two tasks: ensuring that the servos move in the correct direction and the limiting the servo travel to prevent binding.

If the swash plate moves in a different axis during the following tests (for example, the swash plate moves left and right when the collective stick is moved up or down) an error has been made either to the servo assignments or to the order that the servos are plugged into the receiver.

Center all sticks and turn on the receiver.

Press the SERVO menu button and select Calibrate using the digi-adjusters. At the calibration menu, select Aileron. Select P1 and set it to 0%. Then press the digi-adjuster assignment button (located at the lower left corner of the EVO transmitter case) to make the servo move to the position of P1. Now, decrease the value slowly (towards –100%). If the swash plate tilts to the left, continue decreasing the value to the point where binding barely begins to occur. Then increase it back a bit to eliminate the binding. If, instead, the swash plate tilts to the right, reset the value to 0% and start increasing the travel (towards 100%) so that it now starts to tilt towards the left. Keep increasing this value until binding is observed, then decrease the value a bit to stop the binding.

Once satisfied that the correct settings have been made, select P5 and press the digi-adjuster assignment button. Now, set the travel value in the opposite direction as P1. Keep increasing (or decreasing) the value until binding begins to occur. Reduce the amount of travel by a few percent to eliminate the binding.

Ideally, the P1 and P5 positions should be the same value. If not, recheck the mechanical linkages controlling the aileron movement (otherwise differential travel between left and right will be introduced.)

Now it is time to calibrate the elevator movement. This procedure is identical to the procedure described for aileron movement. In the calibration menu select Elevator. When P1 is selected the adjustment should be made such that the swash plate tilts aft. Likewise the swash plate should tilt forward when adjusting P5.

Now that the servos have been calibrated so as to prevent binding when the cyclic is deflected either fully to the left or right as well as fully to the fore or aft positions, it is necessary to make further adjustments in order to prevent binding when the cyclic stick is moved toward the corners.

Slowly move the cyclic stick toward any of the corners. If binding occurs before the corner is reached release the stick. Navigate to the Aileron calibration menu and reduce the P1 and the P5 by a few percent numbers. Do the same thing for P1 and P5 in the Elevator calibration menu.

Once this is completed, attempt to move the cyclic stick to the corners again. Repeat adjusting P1 and P5 for both Aileron and Elevator until the cyclic stick can be moved to any corner without binding.

Finally, the collective servo must be adjusted. Before proceeding, go to the Collective control by pressing the CONTROL menu button. From the control menu select Collective using the digi-adjusters. Select P1 and set it to –100%. Select P6 and set it to +100%. This will ensure that when the collective servo end points are set that the end points can actually be reached by moving the collective stick all the way down or all the way up. It is beneficial to record these settings so that they can be reset afterwards.

To set the end points for the collective servo, select “Collect.” from the servo calibration menu. Set P1 and P5 to 0%. Pull the collective stick all the way down and start by selecting P1. While pushing the cyclic stick to one of its corners, begin decreasing P1. If the swash plate moves upwards instead of downwards, increase P1 instead of decreasing it. Keep adjusting P1 until binding just occurs. Before completing the adjustment of P1 check that the cyclic stick can be moved to any corner with no binding occurring.

Move the collective stick all the way up and select P5. Again move the cyclic stick to one of its corners and begin adjusting P5 in the opposite direction of P1. Continue adjusting this value until binding just occurs. After adjusting the value for P5, check that the cyclic stick can be moved to any corner without binding.

The readers might desire a situation where there is more positive than negative pitch. If these travels should be equal, it will be necessary to change the mechanical setup.

If the readers are also not satisfied with their pitch range or cyclic travel, it will be necessary to alter the mechanical setup.

Refer to the helicopter manual for specifics.

STEP 2: CALIBRATE THE SERVOS

Ideally, this step should not be necessary with a correct mechanical setup. However, in practice it might turn out that a small amount of servo adjustment is needed (for example, if it proves to be impossible to locate a position on the servo control horn that allows for perfect alignment of the control horn and push rod.) Please be aware that the ability to calibrate the servos from the transmitter is no excuse for obtaining the best mechanical setup possible.

To adjust a slight mismatch in the angle between the servo horn and the push rod when the sticks are at neutral, press the SERVO menu button and then select “Calibrate” using the digi-adjusters. Assuming that the Aileron servo requires adjustment, select “Aileron” from the calibration menu. At the Aileron calibration menu, select REV/TRM. Adjust the REV/TRM parameter up or down as needed to correct the mismatch. Only a few percent should be needed.

The elevator and collective servo can be adjusted similarly. If adjustment of the collective servo is needed, be sure to center the collective stick first (use the servo monitor by pressing the SERVO menu button then select Monitor using the digi-adjusters.) After selecting the servo monitor menu, turn one of the digi-adjusters clockwise to show the servo percentages instead of the bar graph. The collective channel should show 0%.

After calibrating the servos be sure to recheck for binding at the axis stick limits.

12.9 AILERON, ELEVATOR AND RUDDER CONTROL MENU

The aileron, elevator and rudder control are used to program trim step increments, set dual rate settings, limit travel for flight phases and to program the expo setting.

When programming a CCPM helicopter, remember not to exceed the maximum Trvl values for aileron and elevator as determined in the section titled, **“Setting up the Swash Rotor Head Mixer (CCPM)”** in the tutorial.

Remember also that the rudder “Trvl” value typically does not limit the travel of the rudder servo. Instead it controls the pivot rate. Rudder servo travel is typically programmed through the gyro.

Finally it is important to remember that “Trim” and “Trvl” parameters must be programmed for each flight phase that is enabled.

12.10 COLLECTIVE CONTROL

There are a few things to remember about the collective control. First if the readers are not familiar in setting up pitch curves, please seek the help of an experienced helicopter pilot.

A curve must be set up for each enabled flight phase.

When programming a CCPM helicopter, do not exceed the minimum value for parameter P1 and the maximum value for P6 as determined earlier in the tutorial

12.11 THROTTLE CONTROL

A throttle servo must be assigned to a channel. To do this, press the SERVO menu button and then select Assignment using the digi-adjusters. Assign channel 4 to “Throttle” as shown in the table below. *(Note that the table shows the assignment for a CCPM helicopter. For a mechanical setup, channels 1, 2 and 3 are assigned differently as described previously in the tutorial.)*

Channel	Servo	# of points
1	Head Ri	5
2	Head f/b	5
3	Head Le	5
4	Throttle	2

Ensure that the active flight phase is set to Hover. Widget O and I and N should be moved to the UP position and slider widget F is moved all the way up. Press the CONTROL menu button and select “Throttle” by using the digi-adjusters. Set the throttle curve to a straight line by setting P1, P2, P3, P4 and P5 to 0%, 25%, 50%, 75%, and 100% respectively then set Min. to 0%.

Press the SERVO menu button and select “Monitor” using the digi-adjuster. After selecting the monitor turn one of the digi-adjusters clockwise to display the percentage (%) monitor view. Place the collective stick exactly at the middle position. The servo monitor will display 0% for channel 4 when this axis stick is centered precisely.

Verify also that the engine carburettor is exactly halfway open at this time. If it is not then reset the throttle linkage.

Press the SERVO menu button and select “Calibrate” using the digi-adjusters then scroll down and select Throttle. Begin calibrating by selecting P1 and set it to 0%, then press the digi-adjuster assignment button located at the bottom of the EVO transmitter case. Decrease P1 towards –100% and observe what happens with the throttle on the carburettor. If it starts to close, continue decreasing P1 until the throttle linkage starts to bind slightly. Then move P1 in the opposite direction until the binding stops. If the throttle, on the other hand, starts to open when the P1 value is decreased, increase P1 towards 100% and continue until the point of where binding occurs. Then reduce the P1 value to eliminate binding.

Now select P5, set it to 0% and press the digi-adjuster assignment button. Start moving the value P5 in the opposite direction as the value of P1. Stop when binding occurs. Then reduce the P5 value a little to eliminate binding.

Now that both end points have been calibrated they should ideally have the same value but with opposite signs. If this is not the case, adjusting the throttle linkage will be necessary. If the end points are not equal, differential throttle will be the result. Take the time to achieve a good setup. If the linkage is changed go back and start over with the calibration.

Finally set the throttle curve so that it will provide a constant main rotor head speed for the pitch curve that has been chosen (press the CONTROL menu button and select "Throttle using the digi-adjusters, then modify P1 to P5). If needed get an experienced helicopter pilot to help. Even if a governor is used it is a good idea to have a reasonable underlying throttle curve in case the governor should decide to turn off. (For example, if the magnet falls off during flight.)

When the auto rotation flight mode is activated (when widget I is in the down position) only a horizontal curve can be set. This curve must be set such that the clutch disengages power to the rotor head yet high enough to provide a safe idle. When using a governor like the TJPro the idle setting should be low enough so the governor disengages.

The savvy EVO helicopter pilot might consider placing the throttle before the rotor head assignments in the servo assignment list - especially if not using a governor.

This way the throttle servo will receive its new position slightly before any pitch change (about 3ms before).

12.12 THROTTLE LIMITER, MIN. PARAMETER AND DIRECT THROTTLE

Use the default widget N to control whether the transmitter is in throttle limiter mode (UP) or in direct throttle mode (DOWN).

Throttle limiter

When the throttle limiter mode is active, widget F acts as a limiter on the maximum allowed throttle. If, for example, the widget is placed in the middle, the throttle will be controlled with the throttle curve until the throttle curve reaches an output of 50% (which might not be at center stick.) An illustration of this can be seen by pressing the CONTROL menu button and selecting "Throttle" using the digi-adjusters. Place widget F in the middle position and observe the horizontal dotted line going out from the throttle curve showing the limit. Move widget F up and down and notice the effect on the throttle curve.

The idea behind the throttle limiter is that moving widget F all the way down will allow for safe starting of the engine and movement to the flight line with the engine running at idle. If the collective stick is accidentally bumped while walking to the flight line nothing will happen as the throttle is limited. When ready to fly place the collective stick down and move widget F all the way up.

Min. parameter

Move widget F all the way down. Select the "Min." parameter (in the throttle control menu) and increase it from 0% to to 10%. Observe that a full horizontal line will begin to move upwards. The throttle limiter cannot be forced below the value of minimum neither by moving widget F nor by moving the collective stick down. The Min. parameter is used to establish the engine idle setting. This setting is the same for all flight phases. Programming a proper Min. parameter will prevent the engine from dying when using the throttle limiter (widget F) or the collective stick. Even if P1 (or any of the other points on the curve) is set below the Min. parameter the throttle will not move below the value of Min. The Min. parameter has no effect in the auto rotation flight phase (widget I in the DOWN position). It is recommended to program Min. to the same value as the setting used for setting idle speed in the auto rotation flight phase.

The trim setting is relative to the Min. value. For example, if the trim is increased so that throttle servo output is increased by 5% when the collective stick is all the way down and the Min. is then set to 10%, the throttle servo output will then be increased by a total of 25% (5% from trim and 20% from Min. if servo curve point P1 and P5 are set to –100% and 100%. Remember 10% of a 200% range is 20%).

Direct Throttle

To activate direct throttle, move widget N in the DOWN position. The throttle is now controlled by widget F independently of the collective stick. To verify, either look at the servo monitor in the SERVO menu or the throttle sub menu in the CONTROL menu. The throttle cannot be reduced below the Min. parameter when using direct throttle.

Direct throttle is useful for testing the engine without changing the pitch. By moving the collective down the helicopter will be loaded with negative pitch while the engine can be spooled up using widget F.

! WARNING !

DO NOT enter direct throttle when widget F is not all the way down. You risk the engine jumping to full throttle immediately!

Be extremely careful when spooling the engine up on the ground - even if loading it with a negative pitch. A wind gust might tumble the helicopter around when the head speed is high.

How to Disable Direct Throttle

Direct throttle can be disabled thereby permanently enabling the throttle limiter. Having the Direct throttle disabled allows the pilot to fly without concern as to whether the transmitter is in throttle limiter or direct throttle mode. To do this, press the CONTROL menu button and select "Assignment" using the digi-adjusters. Scroll down and select "Switches". From the switches sub menu scroll down and select "CombiSwitch" (or "CS/DTC" if the readers are using EVO firmware version 1.40). The transmitter will display a warning. Bypass the warning notice by pressing Enter. Press the REV/CLR button to clear the line then press Enter to complete disabling direct throttle. Direct throttle can be enabled again by selecting "CombiSwitch" and pressing Enter to ignore the warning and then select widget N. Leave widget N in the DOWN position when confirming the selection. This will enable throttle limit when widget N is in the UP position while direct throttle is enabled when N is in the DOWN position.

Note that the throttle limiter function can also be disabled (which will disable direct throttle also) by reassigning widget F in the assignment of controls in the SETUP menu.

12.13 Control Switch Control and Timers

For examples on using the Contr. switch control and how to set up timers, see "Chapter 6 Timers" in this tutorial.

By default the widget F slider is set to control the Sum timer. This is a reasonable setup since most helicopters will run at a fixed head speed (thereby consuming fuel) independently on the collective stick. It will therefore normally only idle when either the throttle limiter is lowered (widget N) or the auto rotation flight phase is enabled. If the reader makes it a practice (a good safe practice) to always use the throttle limiter when starting the engine and carrying the helicopter to the flight line, the Sum timer will give a good representation of engine run time.

12.14 Setting up the Gyro (GY401)

This section explains how to use the Gyro mixer. For the purposes of this tutorial, a Futaba GY401 Gyro will be used as an example. However, the information presented is general enough that it can be applied to any brand of gyro.

NOTE

Make sure the transmitter is in the "Hover" flight phase by putting the widget O and I in the up position!

Do not turn on the receiver before the instructions call for it. This is to avoid the binding of the rudder servo.

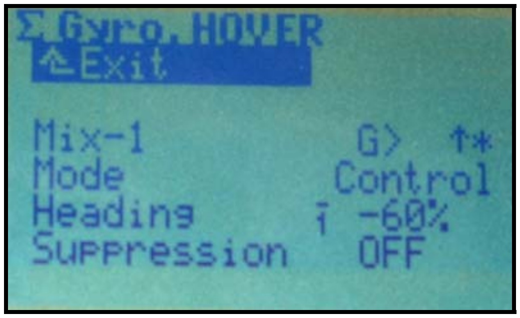
This section assumes that the reader's gyro can be controlled remotely. These types of gyros have two leads that plug into the receiver. One is used to control how fast the helicopter should turn (or the tail rotor speed on some micro helicopters) and the other is used to set the gyro gain remotely from the transmitter

If the reader's gyro cannot be controlled remotely by a transmitter (it only has one servo lead), they can skip this section. For these types of gyros, simply plug the gyro lead into the transmitter and assign it to the TAIL channel. Then set the gyro gain on the gyro, which is typically accomplished by adjusting a small POT on the gyro itself.

First, assign the gyro to the correct channels. Press the Servo menu button and select the Assignment menu. Assign channel 5 and 6 to TAIL and Gyro respectively. The servo assignment list should now look like:

Channel	Servo	# of points
1	Head Ri	5
2	Head f/b	5
3	Head Le	5
4	Throttle	2
5	TAIL	2
6	Gyro	2

Once the TAIL and Gyro have been assigned in the SERVO menu, the Gyro mixer will appear in the MIXER menu. Push the MIXER menu button and select the Gyro mixer. The Gyro mixer will look like the figure shown below.



Gyro mixer

The top line of the Gyro mixer indicates that this is the gyro mixer and that the flight phase called Hover is enabled. Below the top line are four lines with information and settings. The first line is for information only and cannot be changed from within the mixer. It informs the pilot that the Mix-1 software switch controls the Gyro mixer and that it is currently assigned to widget G which is turned ON by moving it to the up position and which happens to be currently in the ON position which is shown by the displayed asterisk. *(The reader is encouraged to read the chapter titled “The Mix 1, Mix 2, Mix 3 Function” in this tutorial for further information concerning these software switches.)* The Gyro mixer allows two different gyro settings for each flight mode. With four possible flight modes this allows for a total of up to 8 different Gyro settings.

The following steps show how to set up the Gyro mixer. It is assumed that the mixer is being set up to control a Futaba GY401 gyro and that it is desired for the gyro to be programmed to heading hold.

STEP 1: SETTING THE MODE PARAMETER

Scroll down to the Mode line using the digi-adjusters and then depress the digi-adjuster. Try using the digi-adjusters to cycle through the three different settings. This parameter can have: Control, Heading and Damping.

Control: In this mode, the Heading parameter is ignored. Instead, the Gyro is controlled by the control Gyro that (by default) is assigned to the slider widget E. This is not a very useful feature for helicopters. If the pilot wants to adjust the gyro it is always possible to assign heading/damping parameter to a digi-adjuster. This way any on-the-fly changes will be saved.

Heading: This mode is used when the Helicopter (or fixed wing airplane) is equipped with a heading hold gyro (which is also known as a "Heading Lock" gyro.) However, it can also be used to control normal gyros. In the case of setting up a GY401, set the Mode to Heading.

Damping: This mode is intended for fixed wing models and helicopters equipped with a normal Gyro (non heading hold). This mode is not really needed since these types of gyros can also be controlled when the Mode is set to Heading (see below).

STEP 2: SETTING THE HEADING/DAMPNING (GAIN PARAMETER.)

Assign the Mix-1 software switch to widget G by pressing the SETUP menu button at the bottom of the EVO case and then select "Assignments" and then the "Switches" sub-menu. Scroll down the list until Mix-1 is highlighted and press the ENTER key to confirm. Bypass the warning message by pressing the ENTER again. Toggle the G widget and leave it in the UP position when pressing the ENTER button to confirm the widget selection.

Navigate to the Gyro mixer by pressing the main MIXER button at the bottom of the EVO case.

Scroll down to the third line (labelled either Heading or Damping) and press ENTER. Set the parameter to a negative value and observe that the parameter now reads Heading. Set it to a positive value and observe that the parameter name changes from Heading to Damping. This is because most heading-hold gyros can be used in either heading hold or in normal (also called rate) mode.

Start by setting the value to –40% (heading). The heading/damping parameter controls the gain of the Gyro. In case of heading hold, a large negative number means high heading hold gain and a small negative number means a low heading hold gain.

There are two schools of thought on setting the Gyro gain:

- Keep increasing the gain until the tail starts to wag then decrease it slightly. This will insure maximum holding power but will likely wear out the tail servo more quickly.

- Start with a low programmed heading hold value (fx -40%). If the tail does not hold well during flight or if it is sluggish in coming to a complete stop after turning the tail quickly, increase the gain.

As mentioned previously, the EVO allows two heading hold settings per flight phase. Move the G widget to the middle or the down position and observe how the Heading parameter changes. Set the second value to +40% for now so that the gyro can be changed into normal mode when servo end points are calibrated in step 5 below.

Later it will be set to the same value as the first so to prevent any surprises should the G widget inadvertently set to the wrong position when taking or off or when flying the helicopter. When the readers gain more experience, this value can be set to personal preference.

Notice the small number "1" displayed after the heading/damping parameter. This indicates that values for this parameter can be set differently for each flight phase. Also note the hyphen above the small number "1" displayed which means that this parameter value can be assigned to one of the two digi-adjusters for in-flight adjusting. Later in this chapter, the reader will need to return to the Gyro mixer setup screen and program different gain values for each of the flight phases as desired.

A note regarding the rudder trim:

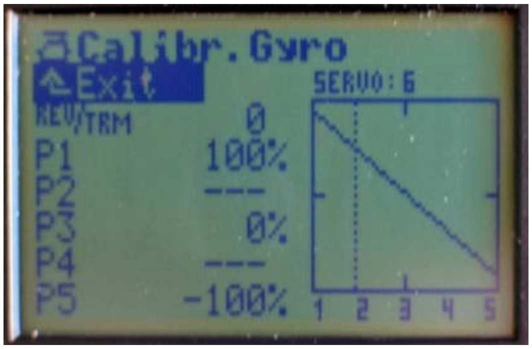
When the mode parameter is set to Heading, the gyro can be set to work in either heading hold or damping by setting the heading/damping parameter to either a negative or positive value. When set to Heading (a negative value) the rudder (yaw) trim is switched off. Instead the trim button works on a separate trim memory to allow minor adjustment needed in case of temperature drift. This trim setting can be viewed on the trim bars in status displays. The trim parameter shown on the rudder control screen will not show the setting of this secondary trim setting. Instead it shows the setting used if the gyro mixer was set to damping.

STEP 3: SETTING THE SUPPRESSION PARAMETER

This parameter is ignored when the gyro mixer heading/damping parameter is in the heading state (negative value). It is primarily used for normal (rate) gyros. The purpose of this parameter is well explained in the EVO manual in section 15.3.3 on page 99. For the purposes of this tutorial, set it to OFF.

STEP 4: SETTING CORRECT "SERVO" DIRECTION

The EVO uses a negative value for the heading/damping parameter to indicate that it operates in the heading hold state and a positive value to indicate it is in the damping state. This will result in a negative "servo" position being output on the channel that has Gyro assigned to it. Navigate to the servo calibration menu by pressing the SERVO menu button and select Calibrate using the digi-adjusters. From the Calibrate menu select the Gyro. Note that curve will go from –100 to +100. Check the gyro manual to see whether it requires a positive or negative output in order to be set to heading hold. In the case of the Futaba GY401 gyro, the channel output needs to be 0 to+100 in order to put it into heading hold. A value of –100 to 0 will set it to normal (rate) mode. This means that it might be necessary to reverse the direction of the curve. Select the REV/TRM parameter using the digi-adjuster and then press the REV/TRM bottom located at the bottom of the transmitter to reverse the curve if this is the case (as it is on the Futaba GY401 gyro).



Gy401 gyro calibration screenshot

STEP 5: LIMITING THE RUDDER SERVO TRAVEL

The Futaba GY401 gyro must always be turned on while in heading hold mode. Ensure that the flight phase is set to Hover and that widget G is in the UP position. Center both the rudder stick and rudder trim and turn on the receiver. While the gyro initializes, the helicopter must be held perfectly still (this normally takes a few seconds for the GY401). The LED on the gyro should light constantly when it is ready.

Put the gyro into normal mode by moving widget G to the MIDDLE or DOWN position. Observe that the light on the GY401 turns off. Now slowly move the rudder stick left and right and observe if the rudder servo starts to bind. Adjust the LIMIT setting on the gyro (on the GY401 it is a small POT in on gyro casing) so that the rudder linkage will not bind when the rudder stick is moved to both extremes. Do not set this limit too low or else gyro performance will suffer. (This step might involve a change in the mechanical setup. The reader is advised to seek help if inexperienced and unsure of how to accomplish this.) Once this is set, the gyro will not drive the servo past these limits.

Note that the servo limits are set on the gyro and not the transmitter. In other words, changing the servo end points for the rudder channel have no effect on how far the gyro will drive the servo. The transmitter servo end points for the rudder channel on the other hand control how fast a pivot rate can be achieved. It is suggested to leave the servo end points for the rudder calibration curve at ±100 and control rudder sensitivity through the Trvl, D/R and Expo parameters in the rudder control menu.

After the gyro limit has been adjusted, go to the Gyro mixer menu by pressing the MIXER menu button and select "Gyro" using the digi-adjusters. Place widget G in the DOWN position and change the heading/damping parameter to –40%. This will set the gyro gain to the same value for all positions of widget G.

STEP 6: TESTING THE GYRO

Now is also the time to check that the gyro works correctly. Turn on the transmitter if its not already on and then turn on the receiver. Make sure the helicopter is sitting perfectly still while the gyro calibrates (it takes a few seconds for the GY401). The LED on the gyro should light constantly when it is ready. Now push the tail rapidly to the right. Observe how the gyro adjusts the tail blade pitch. Make sure the blades will push the tail back toward the left when the tail is rotating. For good measure make a similar check pushing the tail rapidly to the left. If the direction is wrong you need to reverse the gyro direction. On some gyros (like the GY401) there is a small switch on the gyro that allows you to do this. On the reader's particular gyro, there might be a display with menus on the gyro for setting this. If there is no way to set the direction, attempt to install the gyro upside down.

Now that the gyro direction is set correctly, try moving the rudder stick to the left. Check that the tail blade pitch changes so as to move the tail to the right (thereby moving the nose of the helicopter to the left). If this is the case the gyro setup is completed. If instead the tail will not move to the right go to the servo calibrate screen and select the TAIL and reverse the curve.

A note on the TAIL compensation mixer:

The Tail compensation mixer (revo mix) is used to increase the performance of non heading hold gyros. There is an elaborate explanation in the manual in Section 12.3 step 9 on page 81 and in Section 15.4 on page 99.

If the readers are using a heading hold gyro, the tail compensation mixer must be turned off. To do this press the Mixer menu button and select the mixer labelled, "TAIL.HOVER." Alter this mixer as shown in the screenshot below:

Tail compensation has been turned off

The last parameter shows the collective stick position.

12.15 PROGRAMMING THE THROTTLE JOCKEY PRO GOVERNOR

From the transmitter's point of view, all gyros work similar independently of brand or type. The transmitter controls governors in a similar fashion as well. However, how they are calibrated varies a great deal. This section focuses on setting up the Throttle Jockey Pro (TJPro) Governor. However, the information presented is general enough that it can be applied to any brand of governor.

It is assumed that the readers have installed the TJPro correctly and have read the manual section about calibration. It is furthermore assumed that the throttle and AUX wires from the TJPro are plugged into receiver on channels 4 and 7 respectively.

The following criteria will be used when programming the governor:

1. The main rotor RPM will change according to the chosen flight phase (which will be set to widget O by default).

2. When the flight phase "AUTOROT" is selected (by the position of the I widget), the GV-1 governor will be turned OFF.

3. If a given widget (for example G) is in the UP position, then the governor will work as described above, but if the given widget is in the DOWN position, the governor will be turned off. *(This will be addressed at the end of the this chapter. Since it is quite involved and therefore not for everyone. This description is placed in a separate section called Advanced Throttle Jockey Pro setup.)*

Setting up a Throttle Jockey Pro (TJPro) governor on the EVO is easy once the process is understood, but can be quite hard to figure out if the readers have never done so before.

At first it seems obvious to use the RPM control to control the governor, which can be set to a different fixed value for each flight phase. This is exactly what is needed to control the TJPro. However, when changing flight phases the transition from the fixed value for the first flight phase to the next fixed value of the second flight phase is slowed down on the RPM control. This makes it impossible to get the TJPro to enter its calibration state. According to the EVO manual, it should be possible to adjust the run time from 0s – 4s for the RPM control but it is not possible. Instead, it seems to be fixed around 1 second. I think this is a bug since run time can be set for spoiler and flap controls.

Instead of the RPM control, the AUX1 control will be used in order to set up the governor.

! Warning !

Poor adjustment of the helicopter engine when used with a governor can destroy the motor! This is because the governor will attempt to maintain the engine speed, even if the engine cannot maintain it. This might lead to significant overheating!

STEP 1: CHANNEL ASSIGNMENT.

First it is necessary to assign the AUX1 control to a channel. (The Throttle control was assigned to channel 4 previously in this chapter.). Enter the servo menu and select assignment. Ensure that the assignment list looks like:

Channel	Servo	# of points
1	Head Ri	5
2	Head f/b	5
3	Head Le	5
4	Throttle	2
5	TAIL	2
6	Gyro	2
7	AUX1	3

STEP 2: ASSIGN WIDGET O TO THE AUX CONTROL.

Since the head speed should be controllable when changing flight phase, assign the AUX1 control to the same widget that enables the flight phases (the default is widget O). Press the SETUP button and select the Assignment option using the digi-adjusters. From the Assignment menu select Controls. Scroll down until AUX1 is highlighted and press the digi-adjuster. Press ENTER to bypass the warning screen displayed on the EVO. Toggle the O widget and leave it in the up position and then press the ENTER button to confirm the widget selection. The assignment is now complete.

STEP 3: PREPARING GOVERNOR CALIBRATION.

During throttle setup, the throttle servo was calibrated properly and the servo direction was set correctly.

Now, set the flight phase to "Hover" (widget O and I in up position). Then press the CONTROL button and select throttle using the digi-adjusters. Set the curve to be linear going from 0 to 100 and ensure that the Min. parameter is set to 0%. (Take a note of the existing values before changing them so they can be reset after calibration). This ensures that the governor will be calibrated correctly to the high and low throttle points.

Press the SERVO menu button and select Calibrate. Scroll down to assignment 7 AUX and select it. Set the calibration points to –80%, 0% and +80% respectively. According to the TJPro manual these should be set to –100% to 100%. However, this does not work for the EVO. It is presumed this has to do with the fact that Multiplex uses slightly different pulse widths and that while JR and Futaba have servo ranges up 150% and 140% respectively the EVO have up to 110%.

STEP 4: GOVERNOR CALIBRATION.

The transmitter is now ready to calibrate the TJPro. Use the following procedure:

Turn on the transmitter and place the throttle stick all the way down, center the throttle trim and then turn on the receiver. Toggle the O widget DOWN and UP two times within 2 seconds from turning on the power. The TJPro should now show a green flashing LED. If not, then repeat the procedure. If it still won't enter calibration, try toggling the EVO O widget switch faster or slower.

Notice

Since only the first flight phase has been programmed the EVO will beep a warning when the O widget is moved. The beeping can be avoided if the other flight phases are set up. The warning serves as a notice to advise the pilot that they are attempting to enable a flight phase, which has not yet been programmed.

Press the SERVO menu button and select Monitor using the digi-adjusters. Turn the digi-adjuster clock wise to show the servo percentage values. Note that output 4 is at the value that was set during throttle servo calibration earlier in this chapter. If not, place the throttle axis stick at the low position, center throttle trim, turn off the receiver and restart calibration.

Now, move the throttle stick all the way up (verify that output is equal to the value you set up during throttle servo calibration). Then move the stick all the way down again.

If the readers are using a high speed super servo, move the stick all the way up again (the led will turn orange). A super servo is a servo capable of running at high frame rates (250 frames/second or more). A fast digital servo is a servo turning 60º in less than 0.1 seconds. An example of such a servo is the Futaba 9253.

Exit calibration by toggling the O switch twice again. The LED will stop flashing to indicate that calibration has been completed.

! WARNING !

Enabling the super servo mode of the Throttle Jockey Pro with a servo not designed for high frame rates will most likely lead to servo failure – possibly while in flight!

STEP 5: VERIFYING CORRECT CALIBRATION.

It is now time to verify that the TJPro has been calibrated correctly.

Select the Hover flight mode (widget O and I up). While still in the servo monitor mode, verify that the all the LEDs on the TJPro are off with the throttle stick in the low position.

Raise the throttle stick slowly until you see a steady green (orange if using a super servo) LED come on at around –50%.

Now raise the throttle stick so the steady green/orange LED is on. Then press the SERVO menu button and select Calibrate. Scroll down to AUX1 and select it. Select point 1 and slowly adjust it toward 0% while monitoring the TJPro LED. The LED should stay on until about –5% value is reached.

Keep increasing the value of point 1. The LED should stay off until a value of about +5% is reached, whereupon the LED should turn on again. Keep increasing the value slowly until a value of +80% is reached. The LED should stay on all the way from around +5% to +80%

If all the above efforts succeed, the TJPro has been calibrated correctly. If not, try recalibrating it again.

STEP 7: RESET THROTTLE CONTROL CURVE.

After calibration it is necessary to change the throttle curve back to what it was before calibration. Go ahead and complete this step.

STEP 8: SETTING HEAD SPEEDS FOR EACH FLIGHT PHASE.

Setting the head speed of the TJPro is now very simple. Press the SERVO menu button and select Calibrate using the digi-adjusters. Scroll down to AUX1 and select it. Note the vertical dotted line displayed on the screen. Try the 3 positions of the widget O and observe that this line moves from P1 to P2 and to P3 when the widget is in the up, middle and down position respectively. To set the head speed for a flight phase, simply select P1 (for the Hover flight phase) and adjust the value. Start low (ex 10-15%) and keep increasing it until the desired head speed is reached. Use an optical tachometer to determine head speed. *(On the author's machine, a head speed of about 1600 RPM is observed when P1 is set to 28% with an engine to rotor head gearing of 1:8.7.)*

Do not increase the value above the value used for calibration (80% if the tutorial has been followed).

Now, set the head speed for the other flight phases (2 and 3). If the readers want the TJPro to be deactivated for any of the 3 normal flight phases, simply set the corresponding P1-P3 value to 0%.

One of the programming criteria for the TJPro was that is should not be active when activating the auto rotation flight phase (which is activated using widget I by default.) Unfortunately, the control of the TJPro was established on the O widget. Fortunately, however, the TJPro will automatically turn off whenever the throttle is below 25%. Press the CONTROL menu button and select Throttle. Place widget I in the down position to enter the auto rotation flight phase. Make sure that the throttle settings are set below 25% (this might be lower if throttle servo end points where set lower than ±100% during throttle servo calibration). Verify that the TJPro is disabled by moving the throttle stick all the way up and observe that the LED is off.

It is strongly suggested that the readers start their engines in either the auto rotation flight phase or use the throttle limiter to keep the TJPro (and throttle stick) disengaged while starting the engine and carrying the helicopter safely to the flight line.

! WARNING !

Be careful when adjusting the head speed, especially if the helicopter is running while on the ground! It is recommend to use a little bit of negative pitch to prevent the helicopter from tumbling. Afterwards, fine-tune the head speed during the first test flights.

NOTE

The TJPro will first engage when the head speed is close to the desired head speed set from the transmitter. Therefore, it is necessary to have a throttle curve that will bring the rotor RPM up to this speed.

It might be possible to use a value closer to ±100% than ±80% when calibrating the TJPro. This will allow slightly higher precision when setting the head speed. If ±80% used for calibration with a 1:8.7 gearing, the head speed increases about 15-20 RPM for each 1% increase in P1, P2 or P3.

The author has used values ±85%, ±90% and ±95% when calibrating. The TJPro will enter calibration mode fine, but when testing that it has been calibrated properly the TJPro turned off when values between -6% and +3% were used. When using ±80% when calibrating this interval becomes symmetric.

FINAL GOVERNOR NOTES

When breaking in a new engine it is recommended to disable governor function. During break in, the engine will be running very rich which might make throttle response appear sluggish. This is OK for initially hovering, but will make it very hard for the governor to control the head speed. It might also cause the governor to start hunting. It is advisable to have spent some time setting up a reasonable throttle curve before engaging the governor. Should the governor magnet suddenly decide to rapidly depart the helicopter, most governors will simply turn off and pass the transmitter throttle signal directly to the servo. With no proper underlying curve this might lead to disaster. Also in case of the TJPro governor, the curve is needed because the TJPro will not engage unless the rotor RPM reaches the desired speed. Also the TJPro actually looks at the throttle channel value in order to predict how to control the throttle.

12.16 PROGRAMMING THE FUTABA GV-1 GOVERNOR

This chapter describes the installation of a FUTABA GV-1 governor that is another common and popular governor. This chapter will further assist the readers in programming their helicopters by offering specific information to this brand of governor.

The implementation of the FUTABA GV-1 governor on the EVO is not difficult. The author stresses, however, that the proper installation of a governor and its subsequent actions can only be reliably assured if the engine has been properly broken in and the carburettor has been properly tuned.

This chapter will not discuss the technical issues relating to the mechanics that allow governors to work, nor will it discuss the proper installation of the governor itself. The author assumes that the pilot has successfully performed these steps and has a firm understanding of the operation of helicopter governors.

For the purposes of this chapter the following operating criteria of the GV-1 will be programmed.

- The main rotor RPM will change according to the chosen flight phase (which will be set to widget **"O"** by default).
- When the flight phase **"AUTOROT"** is selected (by the position of the **"I"** widget position), the GV-1 governor will be turned OFF.
- If a given widget (for example, widget **"J"**) is in the UP position the governor will work as described above, but if the given widget is in the DOWN position, the governor will be turned off

Warning

Poor adjustment of the helicopter engine when used with a governor can destroy the motor! This is because the governor will attempt to maintain the flight mode, even if the engine is unable to achieve it. This might lead to significant overheating!

NOTE

It is important to have the helicopter be able to fly without the governor if the governor were to fail while in flight (due to malfunction or due to losing the sensor magnet, for example). The readers should ensure that this is possible before proceeding.

STEP 1: ASSIGN THE SERVOS

Assign the servos in the main SERVO menu as shown below.

Besides the throttle channel, two channels will be necessary in order to control the GV-1. These channels will be **AUX1** and **AUX2** that will control the entries **"AUX Rpm"** and **"AUX (on/off) (m-trim)"** on the governor.

The table below shows the servo assignments as well as the numbers of calibration points. Set the servo pulse to UNI for the throttle, AUX1 and AUX2 and to MPX (if Multiplex servos are being utilized).

Channel	Servo	# of points
1	Head Ri	5
2	Head f/b	5
3	Head Le	5
4	Throttle	5
5	Rot.Tail	2
6	Gyro	3
7	AUX1	3
8	AUX2	2

(Assigning AUX2 to a channel is only necessary if following step 8 below.)

STEP 2: CONNECTING THE GOVERNOR

It is important that the throttle control servo is of good quality since the GV1 will continuously control this servo like a gyro controls a tail rotor servo. The throttle linkage must be reliable, direct, and without play.

1. Connect "CH 3 (THRO)" on the governor to channel 4 on the receiver.
2. Connect “AUX (RPM)" on the governor to channel 7 on the receiver.
3. Connect "AUX (on/off) (m-trim)" on the governor to channel 8 on the receiver. *(This connection is only necessary if the reader chooses to follow step 8 below.)*

The AUX(on/off)(m-trim) input on the GV-1 provides for one of two functions:

One: It provides for deactivating the governor using a switch widget

OR

Two: If the carburetor is equipped with a mixture adjustment, this function can be utilized for in-flight control of the mixture setting.

There are two ways to implement that the ON/OFF function of the GV-1 governor can be controlled from the transmitter.

The first way is to assign the ON/OFF function to a switch widget. The second way is to assign the GV-1 ON/OFF function to the proportional Throttle widget.

STEP 3: ASSIGN THE "AUX (RPM)” WIDGET

Since the rotor RPM should alter with the selection of the flight phase, the AUX1 control will be assigned to the same widget as the Flight Phase widget. Press the SETUP button at the bottom of the EVO case and then select “Controls” from the menu. In the next menu, select the “Assign.controls” listing. Scroll down the list until AUX1 is highlighted then press enter. Bypass the warning and assign the AUX1 control to the O widget by toggling it. Be sure to leave the O widget in the UP position when pressing the ENTER key to confirm this selection.

STEP 4: ADJUSTING THE GV-1

It is necessary to program the GV-1 to recognize the Idle, High and the Stop (engine cut) position of the throttle servo travel so that the GV-1 never exceeds these values.

Set the flight phase to “Hover” (widget O and I in the UP position). Then press the CONTROL button and select throttle using the digi-adjusters. Set the curve to be linear going from 0 to 100 and ensure that the Min. parameter is set to 0%. (Take a note of the existing values before changing them so they can be reset after calibration). This ensures that the governor will be calibrated correctly to the high and low throttle points. Also make sure that the throttle curve for the auto rotation flight phase is set at the throttle idle position.

Now it is time to program the throttle limits into the GV-1:

1. Navigate to the “Limit Set” screen on the GV-1 by pressing the FUNC+ or the FUNC- buttons.

2. Move the I widget to the DOWN position (idle setting) and press the Data+ or the Data- on the GV-1. The “Idle” display will cease flashing indicating that the GV-1 has memorized the idle position.

3. Move widget I back to the UP position and move the Throttle widget all the way up and then press the Data+ or the Data- on the GV-1. The “High” display will cease flashing indicating that the GV-1 has memorized the high position.

4. Move the Throttle widget all the way down (engine cut) position and then press the Data+ or the Data- on the GV-1. The “Stop” display will cease flashing indicating that the GV-1 has memorized the engine cut position.

After setting the GV-1 parameters go to the control menu and set the throttle curve back to its original setting.

STEP 5: PROGRAMMING THE GEAR REDUCTION RATIO INTO THE GV-1

It is necessary to program the proper gear ratio into GV-1 governor to ensure that the correct number of revolutions per flight phase is maintained. Generally this ratio is provided in the assembly/construction literature included with the helicopter.

If this information is not provided, the readers can calculate the proper ratio by using the following formula:

$$\frac{\textbf{Number of teeth on the main rotor gear}}{\textbf{Number of teeth on the motor pinion}} = \textbf{Gear Ratio}$$

If the reader’s helicopter is comprised of more than one gear ratio reduction, the final gear ratio can be determined by the following formula:

1st Gear Ratio multiplied by 2nd Gear Ratio = Gear Ratio

Now that the proper gear ratios have been obtained or calculated, program this value into the GV-1 governor by pressing the FUNC+ or the FUNC- button until the Roto Gear Ratio screen (the **"GRt"**) is displayed. Enter the proper gear ratio number by pressing the Data+ or the Data- buttons on the GV-1.

STEP 6: PROGRAMMING THE GV-1 SPEED SETTINGS PER FLIGHT PHASE

The main rotor RPM must be programmed into the GV-1 based on the flight phase currently chosen.

Move the O widget to the UP position and navigate to the "Speed Set Up" screen on the GV-1. Program the GV-1 speed setting by using the Data+ or the Data- buttons.

Repeat this step for the MIDDLE and the DOWN positions of the O widget to program the speed settings for the other flight phases.

STEP 7: DISABLING THE GV-1 DURING AUTOROTATION

Navigate to the CONTROL main menu and select Throttle. Toggle the I widget to the "AUTOROT" flight phase by moving it to its DOWN position. Verify that P1 to P5 are set to a value below 15%. Do not change the values of P1 to P5 as these where used to calibrate the GV-1 during step 4.

If it turns out that an idle setting of more than 15% throttle is needed to maintain a good idle this method of disengaging the GV-1 during auto rotation cannot be used. In this case assign the on/off function to widget I instead of widget J during step 8

Navigate to the "StSw" menu on the GV-1 by pressing the FUNC+ or the FUNC- buttons and make sure it is set to "on/off" using the DATA+ or DATA- button. This will ensure that the GV-1 disengages during auto rotation.

STEP 8: DISABLING THE GV-1 USING A SWITCH WIDGET

Having the ability to turn the governor on or off using a widget allows for easy testing of the underlying throttle curves. This task will be accomplished by using the AUX2 control to manage the **"**AUX (on/off) (m-trim)**"** function of the GV-1.

Press the SETUP button at the bottom of the EVO case and then select "Controls" from the menu. In the next menu, select the "Assign.controls" listing. Scroll down the list and highlight AUX2 and press Enter. Bypass the warning by pressing Enter once more. Then assign AUX2 by toggling the J widget. Be sure to leave the J widget in the DOWN position when pressing the ENTER key to confirm the selection.

To program the GV-1 to recognize the position of the J widget to disable the GV-1, navigate to the "SWPt" screen on the GV-1 by pressing the FUNC+ or the FUNC- buttons. Move the J widget to the DOWN position and observe the GV-1 screen display either "SWPt ON" or "SWPt OFF". Press the Data+ or the Data- buttons on the GV-1 until the display reads "SWPt OFF". Now move the J widget to the UP position and verify that the display changes to "SWPt ON".

The GV-1 mixture trim function cannot be used when the GV-1 is setup to use a switch to control its on/off state. Navigate to the "MTrm" screen on the GV-1 using the FUNC+ or FUNC- button. If needed use the DATA+ or DATA- button so that the GV-1 will display INH for this function. Also navigate to the "MxMD" screen and verify that it is set to "Gov".

Note if the reader's prefer the on/off operation of the GV-1 can be linked to the I widget instead of the J widget. This will allow it to turn the GV-1 off during auto rotation even if the idle throttle setting is set above 15%. However, by doing so the readers will not be able to control the on/off state of the GV-1 using a separate widget.

STEP 9: TESTING CORRECT OPERATION

After the Evo and the GV-1 has been setup the reader should test that the GV-1 is working as intended.

Using the FUNC+ or FUNC- buttons on the GV-1 navigate to the "rpm" screen. Verify that the GV-1 displays the desired head speed for all enabled flight phases by toggling widget O to its three possible positions.

On the GV-1 navigate to the "SWcd" screen, which displays the governor on/off status. This display should read OFF when either the I or the J widget is in the DOWN position. Otherwise it should read ON (assuming that the throttle curve does not fall below 15% when using flight phase 1-3).

Note that the GV-1 will only engage when the following is satisfied:

1. The head speed is running at least 70% from the set speed AND

2. The throttle output is at least 20%.

After the GV-1 has engaged it will disengage whenever the throttle falls below 15% or the on/off widget is set to the off position.

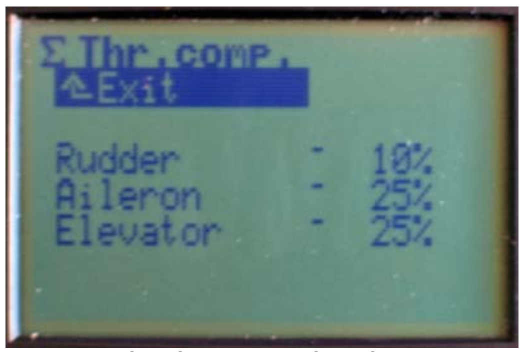
It is strongly suggested that the readers start their engine in either the auto rotation flight phase or use the throttle limiter to keep the GV-1 (and throttle stick) disengaged while starting the engine and carrying the helicopter safely to the flight line.

FINAL GOVERNOR NOTES

When breaking in a new engine it is recommended to disable governor function. During break in, the engine will be running very rich which might make throttle response appear sluggish. This is OK for initially hovering, but will make it very hard for the governor to control the head speed. It might also cause the governor to start hunting. It is advisable to have spent some time setting up a reasonable throttle curve before engaging the governor. Should the governor magnet suddenly decide to rapidly depart the helicopter, most governors will simply turn off and pass the transmitter throttle signal directly to the servo. With no proper underlying curve this might lead to disaster. Also in case of the GV-1 governor, the curve is needed because the GV-1 will not engage unless the rotor RPM reaches 70% of the desired speed.

12.17 THROTTLE COMPENSATION MIXER

The throttle compensation mixer is a useful tool in case the readers are not using a governor. For collective pitch helicopters, a constant head and tail rotor speed is desired. Collective (pitch), cyclic and tail rotor inputs made by the pilot all affect the load that the engine sees and therefore will effect the speed of the rotors. The throttle compensation mixer is used to compensate for cyclic and tail rotor inputs by increasing the throttle in proportion to these inputs (the collective inputs are compensated for by setting an appropriate throttle curve). The figure below shows how a throttle compensation mixer might look like:



Throttle compensation mixer

Following is an explanation of each of the three mixer parameters. For all parameters it is suggested to start with a value around 10-20%. However, actual test flying is necessary in order to find the best settings of the parameters. Remember that these parameters can be assigned to the digi-adjusters for in-flight adjustments. See the next section for more information about this.

Rudder: This parameter is used to compensate for inputs that increase or decrease the tail rotor blade pitch. An input that increases the pitch requires an increase in throttle while an input that decreases the blade pitch requires a decrease in throttle. This parameter can be set from –100% to 100%. Whether the readers use a positive or negative value for this parameter depends on how the tail rotor on their helicopter turns in relation to the direction of the main rotor.

Aileron: This parameter compensates for left/right cyclic inputs. Both left and right inputs require an increase in throttle to keep the rotor speeds constant. This parameter can be set to values between 0% to 100%.

Elevator: This parameter compensates for for/aft cyclic inputs. Both fore and aft inputs require an increase in throttle to keep the rotor speeds constant. This parameter can be set to values from 0% to 100%.

The way these parameters affect the throttle is best illustrated with an example. (The best values for this mixer are found by trial and error while flying.) The following table shows example values for the relevant controls, mixers and servo calibration settings. (These values might not be realistic but they are meant to serve as an example.):

	Control settings				Mixer settings	Servo
	Trim	**D/R**	**Trvl**	**Expo**	**Thr.comp.**	**Calibration curve**
Aileron	0%	100%	100%	0%	20%	-50-50
Elevator	0%	100%	100%	0%	20%	-50-50
Rudder	0%	100%	50%	0%	10%	-50-50
Throttle	Curve: 0-25-50-75-100				N/A	-100-0-50

Example 1:

If the cyclic stick is push all the way left or right (elevator) 10% will be add to the throttle output if the throttle stick is above mid stick. Below mid stick 20% will be added to the throttle output. This output is achieved as follows: first the Trim, D/R, Trvl and Expo settings determine a control curve for elevator and secondly, the stick position acts as input to this curve producing an output value for the elevator control (also used as input to the elevator servo calibration curve). This elevator output value (which in this case is 100%) is then modified by the Throttle compensation mixer thereby giving a value of 20%. This value is then added to the input value for the throttle servo calibration curve. With the throttle stick above mid stick this result in a value of 10 since the throttle curve is linear from 0-50%. Below mid stick the throttle curve goes from –100% to 0%. Therefore, 20% will be added to the throttle output.

Example 2:

If the cyclic stick is put in any of the corners, 20% will be added if the throttle stick is above half stick. If the cyclic stock is place below the half stick position a 40% will be added.

12.18 USING THE DIGI-ADJUSTERS TO FINE TUNE

For an explanation of why and how to use the digi-adjusters for in-flight adjustments see chapter five of this tutorial.

The list below offers some suggestion of what can be adjusted by the digi-adjusters while in flight. Note that the parameters controlling the TJPro governor head speed setting cannot be assigned to a digi-adjuster. This is because the settings for the 3 flight phases are controlled by adjusting the "servo" curve for the AUX1 assignment.

The list below provides some (but not all) possibilities for parameters that can be assigned to a digi-adjuster:

- Gyro gain
- Aileron/Elevator Expo
- Aileron/Elevator D/R
- Throttle compensation mixer parameters (Aileron, Elevator, Rudder).

12.19 FLIGHT PHASES

For a detailed discussion of Flight Phases, see chapter seven of this tutorial.

The following checklist indicates what controls and mixers must be set up for each flight phase. Use this as reference when programming flight phases.

Controls	**Aileron:** Trim and Trvl.
	Elevator: Trim and Trvl.
	Rudder: Trim and Trvl.
	Collective: curve.
	Throttle: curve.
Mixers	**Gyro:** Heading/Damping (for both positions of widget G).
	Tail rotor compensation (revo mix): Coll.+, Coll.-, Yaw diff. and Offset. *Only if not using a Heading hold gyro.*

Before the helicopter is ready to fly it is STRONGLY recommended to setup both the Hover flight phase (widget O and I in the up position) and the Autorotation flight phase (widget I in the down position).

12.20 ADVANCED THROTTLE JOCKEY PRO SETUP.

The section titled, “Programming the Throttle Jockey Pro Governor” explained how to set up the Throttle Jockey Pro governor using the AUX1 control. By assigning the AUX1 control to the widget controlling the flight phases, the TJPro can be set up to alter the head speed when the flight phase is changed.

However, it is not possible to turn the TJPro on or off with another widget. This could be useful if one wants to test the underlying throttle curves. This section will show how to set the TJPro up to work as follows:

1. Head speed will change with flight phase 1-3 using widget O.
2. Govenor control will be turned off in flight phase 4 (Auto rotation – default switch I)
3. If widget G is in the up position the TJPro will work as per point 1 or 2 and if G is in the middle or down position the TJPro will be disabled.

This involves using the "Gyro" mixer to control the TJPro. Since the Gyro mixer won't be available for setting up a gyro the section will also show how to program a gyro using the AUX1 control.

Remember that when the gyro parameter "Mode" is set to Heading (or Damping) the gyro mixer allows for two different gyro settings for each flight mode. Since the output of the gyro mixer is simply a constant value on the channel that has "Gyro" assigned to it (when suppression is off), the readers can take advantage of this in order to achieve the above govenor setup.

It is recommended to read section "Programming the Governor (Throttle Jockey Pro)" before proceeding with the following procedure. However, some of the text from that section has been repeated here for completeness.

STEP 1: CHANNEL ASSIGNMENT.

Press the SERVO menu button and select "Assignment" using the digi adjusters. From the assignment menu select the channel where the TJPro AUX wire is plugged into (channel 7 if the tutorial has been followed) and assign it to "Gyro". Press Enter until the last parameter is high lighted and set it to 2P and press Enter. Exit the the assignment menu by pressing the SERVO menu button and select "Calibrate" using the digi adjuster. Select the channel that was just assigned to Gyro. Set P1 to -100% and P5 to 100%. Exit the calibration menu.

STEP 2: PREPARING FOR CALIBRATION.

If the TJPro has been calibrated previously skip to step 4.

Press the MIXER menu button and select "Gyro" using the digi adjusters. Select the "Mode" parameter and change it to "Heading".

Place widget O, I and G in the up position. Using the digi adjusters set parameter "Heading/Damping" to +80% (the parameter name will show Damping). Then set widget G in the middle or down position. Again select the "Heading/Damping" parameter and set it to –80% (the paramete name will show Heading). Set the "Supression" parameter to off.

Press the CONTROL button and select "Throttle" using the digi-adjusters. Set the curve to be linear going from 0 to 100 and make sure that the Min. parameter is 0%. (Take a note of the existing values before changing them so they can be reset after calibration). This ensures that the governor will be calibrated correctly to the high and low throttle points.

STEP 3: CALIBRATION.

Turn on the transmitter and place the throttle stick all the way down and set widget O, I and G in the up position, then turn on the receiver. Toggle the G widget DOWN and UP two times within 2 seconds from turning on the power. The TJPro should now show a green flashing LED. If not, then repeat the procedure. If it still won't enter calibration, try toggling the G widget switch faster or slower.

Press the SERVO menu button and select Monitor using the digi-adjusters. Turn the digi-adjuster clock wise to show the servo percentage values. Note that output 4 is at the value that was set during throttle servo calibration earlier in this chapter. If not, place the throttle axis stick at the low position, center throttle trim, turn off the receiver and restart calibration.

Now, move the throttle stick all the way up (verify that the output is equal to the value set up during throttle servo calibration). Then move the stick all the way down again.

If the readers are using a high-speed super servo, move the stick all the way up again (the led turns orange). A super servo is a servo capable of running at high frame rates (250 frames/second or more). A fast digital servo is a servo turning 60º in less than 0.1 seconds. One example of a servo that is both a super servo and fast is the Futaba 9253 servo.

Exit calibration by toggling the G switch twice again. The LED will stop flashing indicating calibration has been completed.

! WARNING !

Enabling the super servo mode of the Throttle Jockey Pro with a servo not designed for high frame rates will most likely lead to servo failure – possibly during flight!

STEP 4: VERIFYING CALIBRATION.

It is now time to verify that the TJPro has been calibrated correctly.

Select the Hover flight mode (widget O and I up) and place widget G in the up position. While still in the servo monitor mode, verify that all the LEDs on the TJPro are off with the throttle stick in the low position.

Raise the throttle stick slowly until a steady green (orange if using a super servo) LED comes on at around –50% (assuming that throttle servo end points are ±100%).

Now raise the throttle stick so the steady green/orange LED is on. Then press the MIXER menu button and select Gyro. Select the Heading/Dampning parameter and slowly adjust it toward 0% while monitoring the TJPro LED. The LED should stay on until about 5% value is reached.

Keep deceasing the value (the parameter name changes when going from positive to negative). The LED should stay off until a value of about -5% is reached, whereupon the LED should turn on again. Keep decreasing the value slowly until a value of -80% is reached. The LED should stay on all the way from around -5% to -80%

If all the above efforts succeed, the TJPro has been calibrated correctly. If not, try recalibrating it again.

STEP 5: RESETTING THROTTLE CURVE.

After calibration it is necessary to change the throttle curve back to what it was before calibration. Go ahead and complete this step.

STEP 6: SETTING THE HEAD SPEED.

Setting the head speed of the TJPro is now very simple. Place widget G in the up position and select the flight phase for which the head speed shall be set. Press the MIXER menu button and select "Gyro" using the digi-adjusters. The head speed for the active flight phase is simply set by changing the value of the Heading/Damping parameter. Start low (for example, 10-15%) and keep increasing it until the desired head speed is reached. Use an optical tachometer to determine head speed. *(On the author's machine, a head speed of about 1600 RPM is observed when P1 is set to 28% with an engine to rotor head gearing of 1:8.7).*

Now, set the head speed for the other flight phases (2 and 3). For the auto rotation flight phase set the Heading/Damping parameter to 0%.

Put widget G in the middle or down position. Go through flight phase 1-4 and set the Heading/Damping parameter to 0%. This will ensure that the TJPro is disabled whenever widget G is in the middle or down position.

Make sure that the tail compensation mixer in the MIXER menu is turned off.

! WARNING !

Take care when adjusting the head speed. Especially if the helicopter is standing on the ground. The author adjusts head speed approximately with the helicopter on the ground using a bit of negative pitch to keep the helicopter from tumbling. Then the head speed is fine tuned during a few test flights.

NOTE

The TJPro will first engage when the head speed is close to the desired head speed set from the transmitter. Therefore, it is necessary to have a throttle curve that will bring the rotor RPM up to this speed.

It might be possible to use a value closer to ±100% than ±80% when calibrating the TJPro. This will allow slightly higher precision when setting the head speed. If ±80% used for calibration with a 1:8.7 gearing, the head speed increases about 15-20 RPM for each 1% increase in P1, P2 or P3.

The author has used values ±85%, ±90% and ±95% when calibrating. The TJPro will enter calibration mode fine, but when testing that it has been calibrated properly the TJPro turned off when values between -6% and +3% were used. When using ±80% when calibrating this interval becomes symmetric.

FINAL GOVERNOR NOTES

When breaking in a new engine it is recommended to disable governor function. During break in, the engine will be running very rich which might make throttle response appear sluggish. This is OK for initially hovering, but will make it very hard for the governor to control the head speed. It might also cause the governor to start hunting. It is advisable to have spent some time setting up a reasonable throttle curve before engaging the governor. Should the governor magnet suddenly decide to rapidly depart the helicopter, most governors will simply turn off and pass the transmitter throttle signal directly to the servo. With no proper underlying curve this might lead to disaster. Also in case of the TJPro governor, the curve is needed because the TJPro will not engage unless the rotor RPM reaches the desired speed. Also the TJPro actually looks at the throttle channel value in order to predict how to control the throttle.

STEP 7: SETTING UP A GYRO (GY401) USING AUX1.

This step presumes that the readers are familiar with section "Setting Up the Gyro (GY401)". Since the gyro mixer won't be used to control the gyro, the tail compensation mixer (revo-mix) cannot be used. It is therefore necessary to use a heading hold gyro for the best results.

First the AUX1 control needs to be assigned to a widget. Press the SETUP menu botton and select "Assignment" using the digi adjusters. From the assignment menu select "Controls" and scroll down until AUX1 is high lighted and select it. A warning will appear.

Ignore it by pressing Enter. Wiggle the O widget and place it in the up position. Press Enter again to confirm the selection.

Navigate to the SERVO menu and select “Assignment”. Find the channel that has the gyro control wire plugged into it and assign it to AUX1 also set the assignment to use a 3P curve. Go to the servo calibration menu and select AUX1.

While in the calibration menu try wiggle the O widget and note how the vertical dotted line moves between P1, P2 and P3. Setting the gyro gain for a given flight phase (1-3) is simply done by selecting the flight phase with widget O and then change the value of the correspong point (P1, P2 or P3) on the servo calibration curve. Setting the point to a postive value will set the GY401 to heading hold while setting it to a negative value will put the gyro in rate mode (remember that the tail compensation mixer cannot be used).

Note the gyro gain of the auto rotation flight phase cannot be changed. When switching to this phase the gyro gain will remain the same as it was, i.g., if changing to auto rotation from flight phase 2 the gyro gain will be the same as when flying in flight phase 2.

The drawback of using AUX1 to control the gyro is that the gyro gain can no longer be changed using widget G (i.e., it is not possible to use two different gain settings for each flight phase). Also the tail compensation mixer cannot be used. This should not be a problem when using a heading hold gyro.

13. PROGRAMMING ELECTRIC FIXED PITCH HELICOPTERS

This chapter is credited to Flemming Friche Rodler and is used with his generous permission.

The author has modified the narration for clarity and has performed formatting alterations for readability.

An electric fixed pitch helicopter like the Piccolo or the Hummingbird can be programmed quite easily into the EVO. Much of the following information presented in this chapter is similar to the contents of the previous chapter. Therefore, this material will be presented in a brief format.

STEP 1: CREATING A NEW MODEL.

Press the Memory button near the bottom of the transmitter. Using either the digi adjusters or the UP/DOWN arrow buttons select the “New Model” menu listing.

Change the Template to “HELImech” and the Assignment List to “HELI”. See the previous chapter for a detail explanation of assignment lists.

Set the mode to your preferred flying mode.

Set the Servo to either MPX-UNI or MPX-MPX depending on the type of servo used.

Select OK and press the Enter button to create the new model.

From the Memory menu select “Properties”. From this menu change the “Name” setting to reflect the name of the helicopter.

STEP 2: CHANNEL ASSIGNMENT.

Press the SERVO menu button and select Assignment using the digi adjusters. Using the digi adjusters set the channel assignment as follows:

Channel	Servo	# of points
1	Throttle	2
2	Aileron	2
3	Elevator	2
4	TAIL	2
5	Gyro	2

If the reader finds it more convenient to plug the servo leads into the receiver in a different order the assignment should reflect that order.

STEP 3: CALIBRATING AND LIMITING AILERON AND ELEVATOR.

On many micro helicopters the servos are glued onto the frame of the helicopter and the control rods going from the servo to the swash plate have a fixed length. Even if great care is taken it can be difficult to align and glue the servo such that the swash plate is perfectly level. The first part of calibration takes care of this problem.

Press the CONTROL menu button and select Aileron using the digi adjusters. Verify that the “D/R” and “Trvl” parameters are both set to 100%. Exit and do the same for Elevator.

Press the SERVO menu button and select Calibrate. From the calibration menu choose Aileron. Looking from behind the helicopter verify that the swash plate is perfectly level. If not select the “REV/TRM” parameter and adjust up or down to level the swash plate. Try to align the servo so that a minimum of sub trim is necessary.

Now look at the swash plate from the side of the helicopter. If it is not level select Elevator from the servo calibration menu and use the sub trim to level the swash plate.

Now that the swash plate is level it is time to set the correct servo direction and limit the servo travel to prevent binding when the cyclic sticks are placed at the extremes.

From the servo calibration menu select Aileron. Set both P1 and P5 to 0% then select P1 and press the ASSIGN button. The servo moves to P1. Using the digi adjuster decrease P1 toward –100%. If the swash plate tilts to the left continue decreasing P1 until binding starts to occur then increase P1 slightly to stop the binding. If on the other hand the servo starts to tilt to the right set P1 back to 0% and start increasing P1 toward 100%. Continue until binding occurs then decrease P1 slightly to stop the binding.

After setting P1 select P5 and press the ASSIGN button. Adjust P5 in the opposite direction as P1 until binding occurs. Then roll P5 back a bit to stop the binding. Ideally P1 and P5 should now be the same value but with opposite sign (it might be different if the REV/TRM is not zero).

Now do the same for Elevator. When Adjusting P1 the swash plate should tilt aft.

The servos to swash plate have now been set so that they will not bind when the cyclic stick is moved either left/right or up/down. However, binding might still occur when moving the stick toward one of the corners. To prevent this form for binding move the stick slowly toward a corner. If binding occurs stop and go to the servo calibration menus and reduce P1 and P5 of both Aileron and Elevator by a few percent (adjust all points by equal amounts). Move the stick towards the corners again and ensure that no binding is occurring. Continue reducing P1 and P5 until the axis stick can be moved all the way to all four corners without binding.

STEP 4: SETTING THE THROTTLE COMPENSATION MIXER.

For information about setting up a throttle compensation mixer, refer to the section titled, “Throttle Compensation Mixer”.

STEP 5: SETTING UP THE GYRO.

For information about setting up a gyro, refer to the section titled, “Setting up the Gyro (GY401)”.

STEP 6: THE THROTTLE CURVE.

A good starting point for the throttle curve for a fixed pitch helicopter like the Piccolo or Hummingbird is a straight line. Press the CONTROL menu button and select Throttle and set P1 to P5 as 0%, 25%, 50%, 75% and 100% respectively. Remember to set Min. to 0%.

Some ESC’s (speed controllers) have a soft start that will spool the motor up slowly whenever it has stopped. This might pose a problem if the stick is placed all the way down during a fast descent. Raising the stick at the bottom of the descent might lead to a crash if the motor does not spool up quickly enough. To prevent the motor from stopping when the stick is all the way down, increase the Min. parameter until the motor runs continuously at low speed. Personally the author prefers to be able to stop the engine by lowering the stick in case of a crash. If Min. is set to keep the motor running a low throttle stick at least enter the auto rotation flight phase and set the throttle curve to 0%. In case of a crash quickly flip the auto rotation widget to stop the engine.

STEP 7: FLIGHT PHASES.

For a simple fixed pitch helicopter there really are no need for flight phases. However, they can be set up if desired. Remember to adjust the gyro mixer for each enabled flight phase. Also the throttle curve, aileron and elevator Trvl and Trim must be set for each flight phase.

STEP 8: TRIM ADJUSTMENTS.

For some reason the Throttle Compensation mixer is affected by the aileron, elevator and rudder trim settings. If an extended amount of trim is needed, this might result in a situation where the motor will not stop spinning when the throttle stick is all the way back.

There are two main reasons why trim might be needed during flight. First the swash plate might not be perfectly level and secondly the helicopter might not be correctly balanced. On many of the micro helicopters the battery is held in place by rubber bands. Sometimes this will not allow for a consistent placement of the battery which might result in the center of gravity moving around slightly from flight to flight.

If the readers find that the helicopter consistently wanders off in the same direction attempt to balance the helicopter (which can be hard to do accurately on a small lightweight helicopter) or use the sub trim feature as described during step 3. Adjusting the “REV/TRM “ parameter instead of using the trim buttons will prevent the trimming to affect the throttle compensation mixer.

14. Example Scenarios

As the tutorial has demonstrated, the EVO is a very flexible and powerful transmitter. The below listed scenarios and their necessary mixers will allow the reader to realize the possibilities and strengths of utilizing MPX mixers.

14.1 Selectable Crow (Butterfly) Braking

The pilot would like to have a full house glider to have crow braking enabled when the spoiler control is activated. Enabling the Crow function should be handled with a switch widget, which will allow the pilot to switch from full Crow to flaps-only landing setups.

Controls	**Widgets**
Flap control	“F” slider
Spoiler control	Left axis stick
Aileron control	Right axis stick
Crow control	“N” switch as “MIX1”

Two custom mixers will be needed. The **“FLAPCROW”** mixer will be for the flap servos and the **“AIL-CROW”** mixer will have the aileron servos assigned to it.

Define the mixers in the Setup – Mixer def menu to the following:

FLAPCROW		**AIL-CROW**	
Flap	**----**	**Flap**	**----**
Spoiler	**----**	**Spoiler**	**Mix1**
		Aileron	**---**

Set the mixer values in the mixer menu to the following settings:

FLAPCROW			AIL-CROW		
Flap	30%	10%	Flap	30%	10%
Spoiler	OFF	100%	Spoiler	OFF	-70% MIX1
			Aileron	---	100%

Comments:

Since the "F" slider is sending the same amount of servo travel to both the flap servos and to the aileron servos, it will allow for full wingspan camber and reflex. At the neutral point of the "F" slider, the flap and aileron surfaces will be at their neutral positions.

The spoiler control is always set to command the flap servos to move up to 100% of their travels. The output curve is **single-sided, linear with dead zone** which will allow the spoiler widget to be in the all the way up or down position resulting in a neutral position for the flaps.

When the "MIX1" switch is enabled (the "N" widget), moving the spoiler control will cause the ailerons to travel upward to about –70% of their travel limits. With the "MIX1" switch off, the spoiler control will not affect the ailerons.

The aileron control will affect the aileron servos up to 100% of their travel distances.

14.2 RUDDER COMPENSATION WITH THROTTLE TRAVEL

The pilot would like to have the EVO automatically add a small amount of rudder to compensate for torque forces during rolling takeoffs. Since the pilot does not want this compensation to always remain on, it should be selectable.

Controls	**Widgets**
Throttle control	Left axis stick (vertically)
Rudder control	Left axis stick (horizontally)
R/T compensation	“N” switch as “MIX1”

Only one mixer will have to be made. The rudder servo will be assigned to it.

```
Rud/Thr+

Rudder     ----
Throttle   Mix1
```

```
Rud/Thr+

Rudder    ----   100%
Throttle  -10%   OFF   MIX1
```

Comments:

The rudder control will affect the rudder servo at all times to 100% of its travel distances.

When the “N” widget is in the ON position, advancing the throttle will move the rudder 10% of its travel distance only to one side. When the “N” widget is in the OFF position, there will be no rudder/throttle compensation.

The throttle setting in the mixer may need to be reversed depending on servo installation.

By setting the control switch setting, the rudder servo can be set to give compensation at only high ends of throttle travel such as 90%, for example.

14.3 A Discus-Launch Momentary Rudder Preset

A pilot would like to have a momentary rudder compensation for launching discus-launched gliders. The pilot does not want to use a Flight Phase for this.

Controls	**Widgets**
Tow Rel. control	"M" widget (momentary action)
Rudder control	Left axis stick (horizontally)

Only one mixer will be needed. The rudder servo(s) will be assigned to it.

```
RUD-DLG+

Rudder    ----
Tow Rel.  ----
```

```
RUD-DLG+

Rudder    ----   100%
Tow Rel.  OFF    (-)10%
```

Comments:

The rudder control will affect the rudder servo at all times to 100% of its travel distances.

While the "M" widget is held down, it will enable the Tow Release control, which is set in the above mixer to provide 10% of rudder travel in one direction. The pilot may need to adjust this setting depending on how the rudder servos are installed.

This mixer demonstrates taking advantage of a control that is not being utilized for mixing purposes.

14.4 AUTOMATIC ELEVATOR COMPENSATION WITH THROTTLE AND SPOILER DEPLOYMENT

The pilot desires to program the EVO to automatically give elevator compensation when the throttle and the spoiler controls are deployed.

Controls	**Widgets**
Throttle control	Left axis stick (vertically)
Spoiler control	“E” slider widget
Elevator control	Right axis stick (vertically)

In this scenario, the elevator surface on the model should move when three events occur:

1) ***When the elevator widget is moved, the elevator servo should move.***
2) ***When the throttle widget is moved, the elevator servo should compensate.***
3) ***When the spoiler widget is moved, the elevator servo should compensate.***

Since this scenario has three data streams that must somehow reach the elevator servo and by the fact that there is only one physical plug ending on the elevator servo, a MPX mixer is needed in order to get all three data streams to the elevator servo.

Only one mixer will be to be created. The elevator servo will be assigned to it.

```
EScomps+

Elevator   ----
Throttle   ----
Spoiler    ----
```

```
EScomps+

Elevator   ----  100%
Throttle   ----  25%
Spoiler    ----  15%
```

(The Throttle and Spoiler values may need to be converted to a negative number depending on how the servos are installed in the plane.)

Comments:

When the elevator widget is moved, the elevator servo will travel to its 100% position from BOTH sides of the center position. This is because its movement action was set in the mixer definition as being symmetrical.

When the Throttle widget is moved, the elevator servo will only move 25% of its total travel from the center position in one direction only. This is because its movement action was set in the mixer definition as single-sided with dead zone.

When the Spoiler widget is moved, the elevator servo will only move 15% of its total travel from the center position in one direction only. Again, this is a result of the servo action being set as single-sided with dead zone during the mixer definition stage.

14.5 Automatic Rudder Dual Rate When Flaperons Are Deployed Past A Certain Point

The pilot desires to fly a DLG on a single stick, but notices that when flaperons are deployed steeply, the control of DLG begins to diminish. In order to add greater control authority, it is necessary to use greater amounts of rudder travel. Instead of a separate rudder control dual rate, this programming solution allows for an automatic rudder dual rate that is triggered by the flaperon setting.

This idea is credited to Mark Drela, but the instructions are the authors'.

This example plane is a DLG with Flaperons and separate elevator and rudder servos. Note that this scenario is also using a rudder pre-set activated by the Tow Release control which is assigned to the "M" button.

Create the following mixers:

(Use these names or create your own)

```
dlgAIL+

Aileron  ----
Flap     ----
```

```
dlgRUD+

Rudder      ----
Aileron     Mix1
Aileron     Mix1
Tow Rel.    ----
```

```
dlgELE+

Elevator    ----
Flap        ----
```

Assign the following widget controls:

Controls	**Widgets**
Flap/RPM control	Left Axis Stick (“ON” is down)
Tow Rel. control	M Button

Assign the following widget switches:

Switches	**Widgets**
Mix-1	Left Axis Stick (“ON” is down)
Combi.Switch	“I” widget (“ON” is upwards)

Set the control switch point on the left axis stick to “ON” at –65% of travel. The control switch point is accessed by pressing the CONTROL button at the bottom of the transmitter case and then selecting the “Contr. Switch” listing, which is the last item listed on the menu.

Access the MIXER Menu and set the travel for the CombiSwitch to 15%.

Set the travels for the dlgELE+ and the dlgAIL+ to the settings that are needed for your model.

On the dlgRUD+ mixer, use the initial following settings:

dlgRUD+		
Rudder	**----**	**100%**
Aileron	**----**	**30%**
Aileron	**----**	**-30%**
Tow Rel.	**20%**	**OFF**

The reader will most likely need to adjust these initial settings for their models.

Comments:

The CombiSwitch function can take care of the ordinary rudder coupling on the right axis stick, but the dlgRUD+ mixer will allow for a dynamic alternate coupling rate of the rudder control.

The greater rudder travel setting in the dlgRUD+ mixer (30% as compared to the 15% that was set with the Combi.switch setting) will only happen when the Mix1 switch has been enabled.

The Mix1 one switch was assigned to the left axis stick, but since this widget isn't a switch (it's really just a plain old slider), the EVO needs to be told at what point should the slider "switch" on or off. This was done by entering a value for the Control Switch.

In this example, the Control Switch "trigger point" was set to –65%.

The flaps are also set to this same widget (the left axis stick). When the stick is pulled down, the ailerons will act like flaperons. This is a result of the flap control being listed in the dlgAIL+ mixer.

When the travel distance of the left axis stick triggers the control switch (passes the –65% travel point), the Mix1 controls listed in the dlgRUD+ definition are turned "ON".

In this case, it means that the rudder travel will be changing from 15% (the amount that was set to the CombiSwitch setting) to 30% and –30% which is the amount of travel that was entered into the eleRUD+ mixer setting.

Note that the Combi.switch is still transmitting the 15% value, but since the dlgAIL+ mixer is sending a greater travel instruction, the end result is that the 15% signal from the Combi.switch is not observed on the plane.

The negative number (-30%) in the dlgAIL+ mixer will allow for symmetrical rudder travel since the rudder servo center point is considered "zero", positive and negative travel values will allow the rudder servo to move left and right from the servo center position.

This gives an automatic increase in the amount of rudder travel when the flaperons are lowered past a certain point, which in turn will give a greater amount of control authority while still allowing for single stick flying on the right axis stick.

Mark Drela's additional comments:

The real reason for the two Aileron inputs to dlgRUD+ mixer is so that the rudder movement due to aileron stick remains symmetrical even if a non-zero Ail.Diff value is programmed, since the alternating 30% and -30% aileron inputs combine into a net symmetrical 60% input. Also, the 15% CombiSwitch setting adds to this and it's not "overridden".

But this may be moot. I have since found a simpler way to do this. In the dlgRUD+ mixer, instead of:

dlgRUD+			dlgRUD+		
Rudder	----	100%	Rudder	----	100%
Aileron	----	30%	Aileron -TR	----	60%
Aileron	----	-30%	Tow Rel	20%	OFF
Tow Rel	20%	OFF			

The Ail -Tr input is not affected by the Ail.Diff gizmo, so the rudder deflection is always symmetrical.

14.6 SNAP FLAPS

The pilot desires to have the flaps assist with the elevator control to allow the plane to respond more forcefully to elevator input. This is commonly known as Snap Flaps (SF).

Since minor adjustments of the elevator control should not cause the flaps to move, it is necessary to establish a range of elevator control that do not cause the flaps to move until this range is exceeded. When the specified elevator travel range has been exceeded, the flaps will move in conjunction with the elevator servo(s) to intensify the elevator control response.

Snap flaps are commonly used for aerobatic maneuvers and to assist in racing events where quick turns are necessary.

The pilot desires to be able to turn the SF facility on an off with the selection of a switch widget.

This scenario also assumes that the pilot's plane features separate flap and aileron flying surfaces for added complexity and demonstration purposes only.

Create the following mixers:

(Use these names or create your own)

```
sfFLAP+

Flap       ----
Elevator   Mix1
```

```
sfAIL+

Aileron    ----
Elevator   Mix1
```

Assign the following widget controls:

Controls	**Widgets**
Flap	Left Axis Stick (“ON” is down)
Elevator	Right Axis Stick (Mode 2 operation)
Aileron	Right Axis Stick (Mode 2 operation)

Assign the following widget switches:

Switches	**Widgets**
Mix-1	“I” widget (“ON” is down)

Assign the sfFLAP+ mixer to the flap servos.

Assign the sfAIL+ to the aileron servos.

Use these initial following travel values for the following mixers:

sfFLAP+		
Flap	**----**	**100%**
Elevator	**33%**	**30%**

sfAIL+		
Aileron	**----**	**100%**
Elevator	**33%**	**30%**

The reader will likely need to adjust these initial settings for their models.

Comments:

The flap servos will respond when the flap widget (the left axis stick in the scenario) is moved. The flap servos will also respond when the elevator widget is moved, but since the elevator servo was programmed with a symmetrical with dead zone curve when the mixers sfFLAP+ and sfAIL+ were created, the elevator widget will only effect the flaps and the ailerons when two events occur:

1. **When the Mix1 switch (the “I” widget) is “ON”**
2. **When the dead band zone of 33% is exceeded**

The initial elevator compensation has been set to a maximum of 30% of travel. This value will need be adjusted differently as the pilot determines.

Another possible benefit of using a SF function is to use it in conjunction with a specific Flight Phase. This will benefit the pilot in that the FP name displayed on the screen will notify the pilot that the SF function has been enabled.

To do this, simply assign the Flight Phase to the same widget as the Mix1 switch. An example could be to assign the “SPEED1” Flight Phase to the “I” widget with the “ON” position being downwards as well as assign the Mix1 switch to the “I” widget with the “ON” position being downwards.

The end result would be that the Snap Flaps would only be turned “ON” when the SPEED1 Flight Phase is enabled (the “I” widget is moved downwards.)

14.7 SNAP ROLL

The idea and general programming approach for this scenario is credited to Harry Curzon, but the instructions are the author's.

The pilot desires to have a facility that allows for snap rolls with the activation of a widget. The example plane used in this scenario has a total of four flying surfaces – elevator, rudder, left aileron and right aileron.

In this scenario, it will be assumed that the pilot desires to have the two button widgets "M" and "H" automatically move the ailerons to a pre-set position for counterclockwise and clockwise axial rolls. These widgets will be set for momentary action. When released, the ailerons will return to neutral position automatically.

To further add and demonstrate additional abilities of the EVO, the pilot should have access to three different snap roll "rates" while flying. One snap roll rate will provide only 25% of aileron travel and the other two should provide 50% and 75% roll "rates" respectively. The f Snap Roll "rates" will be determined by the position of a three-position widget.

This programming approach takes advantage of the following capabilities of the EVO – fixed values, flight phases and the software switches Mix1-Mix2.

On the EVO, the flap and spoiler controls are capable of fixed values. Fixed values are a way of automatically moving the flaps or spoiler surfaces to a pre-set position irregardless of the position of a widget that has been assigned to control the flaps or the spoilers. Fixed values also have the added benefit of being assignable to multiple flight phases with different fixed values.

The drawback to using fixed values, though, is that they cannot be assigned to a widget or controlled by a widget. However, by utilizing flight phases (which **can** be assigned to a widget) and the ability to link fixed values to a specific flight phase, the EVO provides the pilot with a crafty work around for this limitation.

While this example plane does not have spoiler flying surfaces and will not require a widget to be assigned to the spoiler, a data stream from the spoiler channel can still be generated by the EVO. To do this, two custom mixers will be created that will allow the ailerons to receive instructions from a spoiler channel that will not have a widget assigned to it or, furthermore, even have a spoiler surface on the plane! Instead, a flight phase will be programmed to generate a spoiler signal through the use of the fixed values property.

Two mixers will be needed for this example.

Create the following mixers:

(Use these names or create your own)

```
LsnpROLL

Aileron     ----
Spoiler     Mix1
Spoiler     Mix2
```

```
RsnpROLL

Aileron     ----
Spoiler     Mix1
Spoiler     Mix2
```

If your assigned template has the spoiler control assigned to a widget, delete this assignment now. A spoiler widget will not be necessary for this scenario and may cause confusion if inadvertently activated.

Assign the following widget controls:

Controls	**Widgets**
Rudder	Left Axis Stick
Elevator	Right Axis Stick (Mode 2)
Aileron	Right Axis Stick (Mode 2)

Assign the following widget switches:

Switches	**Widgets**
Mix-1	“M” widget (momentary action)
Mix-2	“H” widget (momentary action)
Phase 1	“J” widget (upwards for “ON”)
Phase 2	“J” widget (center for “ON”)
Phase 3	“J” widget (downwards for “ON”)
Main Phase	“I” widget (downwards for “ON”)

Select “SPEED1” for the flight phase (FP) number 1, “SPEED2” for FP number 2, “3D” for FP number 3 and “NORMAL” for FP number 4.

Press the CONTROLS button at the bottom of the transmitter. Navigate to the spoiler control and change the fixed value for FP number 1 to 25%. For FP number 2, change the value to 50% and for FP number 3, change the value to 100%. The “Normal” FP (phase numbered 4) will **not** have fixed value for the spoiler, so the fixed value should be set to “OFF.”

Assign the LsnpROLL mixer to the left aileron servo through the SERVO menu.

Assign the RsnpROLL mixer to the right aileron servo through the SERVO menu.

Enter these values for the mixers in the MIXER menu.

```
LsnpROLL

Aileron   ----  100%
Spoiler   ----  100%  Mix1
Spoiler   ----  -100% Mix2
```

```
RsnpROLL

Aileron   ----  100%
Spoiler   ----  -100% Mix1
Spoiler   ----  100%  Mix2
```

Comments:

When the “I” widget is downwards to the “ON” position, the aileron servos will respond to the right axis widget at all times up to 100% of their programmed travel distances.

Because the LsnpROLL and the RsnpROLL mixers list the spoiler control as an input, the ailerons will also respond when the spoiler control is activated.

Although there is no widget assigned to the spoiler control nor is there a spoiler surface on the plane, the EVO can still produce a spoiler control data stream by using the fixed value facility.

Since a fixed value for the spoilers has been entered for the “SPEED1”, “SPEED2”, and “3D” flight phases, a spoiler control data stream is generated when these phases are activated.

When the “I” widget is moved upwards, the Main Phase (“NORMAL” FP) is turned off, which allows the “J” three position widget to enable the “SPEED1”, “SPEED2” or the “3D” FP.

The spoiler data stream for the FP “SPEED1”, “SPEED2” and “3D” have been set to 25%, 50% and 100% respectively.

When one of these FPs is activated by the “J” three position widget, a 25%, 50% or 100% spoiler data stream is generated.

The LsnpROLL and the RsnpROLL mixers instruct the aileron servos to move when two events occur – when the aileron widget is moved and when either the Mix1 or the Mix2 switch is enabled.

1. **When the Mix1 switch is depressed and held down (the “M” widget), the LsnpROLL and the RsnpROLL mixer instructs that either 100% or –100% of the spoiler fixed value should be sent to the aileron servo. The amount of fixed value of the spoiler channel is determined by the position of the “J” widget. When the “J” widget is upwards, 25% of spoiler input will effect the aileron servos. When the “J” widget is in the center position, 50% of the spoiler input will effect the aileron servos and when the “J” widget is in the downward position, 100% of spoiler input will effect the aileron servos.**

2. **When the Mix2 switch is depressed and held down, the LsnpROLL and the RsnpROLL mixer instructs that either 100% or –100% of the fixed value should be sent to the aileron servo. (The negative number “reverses” the direction of the aileron servo for an opposite roll effect.) The amount of fixed value of the spoiler channel is determined by the position of the “J” widget as described above.**

When neither the Mix1 nor the Mix2 software switch is activated (neither “M” nor “H” widgets are depressed), the only widget that will command the aileron servos is the aileron control (right axis widget).

It is important to note that two mixers are necessary to obtain the proper operation of the aileron servos. This is not due to a conflict with the aileron sequencing rule, but due to the nature of how the EVO considers the spoiler channel.

If only one mixer is created and used, when the spoiler control is enabled by the use of either the “M” or the “H” widgets, both aileron surfaces will move as spoilerons or as flaperons. By using two separate mixers for the left and the right aileron servos, the direction of each spoiler input into each mixer can be adjusted for proper aileron action.

If the aileron travel results are backwards, then alter the spoiler values in the LsnpROLL mixer from positive to negative. Do the same for the RsnpROLL mixer.

Some pilots may elect to simplify this scenario by assigning the “J” widget to also be the Mix1 and Mix2 switches in upward and downward positions. The center position can be set to the “NORMAL” flight phase. This will reduce some pilot workload, but it will also eliminate the multiple snap roll “rates” option.

Note that ailerons are not the only surfaces that can be assigned to a snap roll function. The elevator and rudder control can be assigned to custom mixers that make use of the spoiler or the flap control fixed value property in conjunction with flight phases. This opens the possibility of specific “snap” surface settings that the pilot desires for certain maneuvers. This allows for a pre-set snap setting for ailerons, elevator and rudder if desired.

Another possible refinement is to assign the Mix1 switch to the momentary button on the long axis stick (KTa). This would allow pilots to perform a single-direction snap roll without needing to remove their fingers from the long axis stick. The opposite snap roll direction (Mix2) could be assigned to the other button on the long axis stick, KSw. Although this widget cannot be set to momentary action, it can still be utilized for snap functions if the pilot desires.

14.8 SERVO SEQUENCING

The idea and general programming approach for this scenario is credited to Harry Curzon, but the instructions are the author's.

On complex retract setups that are activated with multiple servos, it is often necessary to perform a specific sequence of servo movement in order to enable proper coordination of the retract servo and the door servo. On some scale gliders this is also necessary; the servo which propels the up and go power pylon must be coordinated with the servo that drives the doors. Failure to do this can cause stalled servos or may possibly cause damage to these units.

This scenario takes advantage of the EVO's ability to modify individual servo movement even if these servos are programmed to the same control widget. In another words, one servo will respond with one type of movement action while the other servo will respond to the same widget with a different movement action.

The servos will be programmed to perform the following sequence when the landing gear widget is moved: the door servo will open the bay door, the retract servo deploys the landing wheel, door servo closes once the landing wheel is in place. When the landing gear widget is moved again, the same pattern will occur in opposite sequence.

This type of servo sequencing does not require the use of a mixer.

Note that this scenario is using only one servo for the retract and one servo for the bay door which simplifies the scenario for clarification purposes. On an actual landing gear setup, additional landing gear servos could be added as needed.

Assign the following widget control:

Controls	**Widgets**
L. gear	"N" switch widget

Enter the servo menu by pressing the SERVO button near the bottom of the transmitter case. Assign the retract servo as well as the door servo to the L.gear control. Be sure that the 5 point servo curve has been set for each of these servos on the far right side of the screen.

Enter the CONTROLS main menu by pressing the CONTROL button near the bottom of the EVO case. Select the L. gear control and change the Run Time to 4 seconds. Since the L.gear control has been set to have five points of adjustment, there will be four positions between these points. Each of these positions corresponds to one of the four seconds of servo time travel.

Navigate to the Servo Calibration menu by pressing the SERVO button near the bottom of the EVO case.

In the Servo Calibration menu, select the servo that will be assigned to the retract and press ENTER.

Adjust the servo travel points as shown in the screen shot.

Exit this screen back to the Servo Calibration menu, select the servo that will be assigned to the bay door and press ENTER.

Adjust the servo travel points as shown in Figure 1.

Exit this screen back to the Servo Calibration menu, select the servo that will be assigned to the bay door and press ENTER.

Adjust the servo travel points as shown in Figure 2.

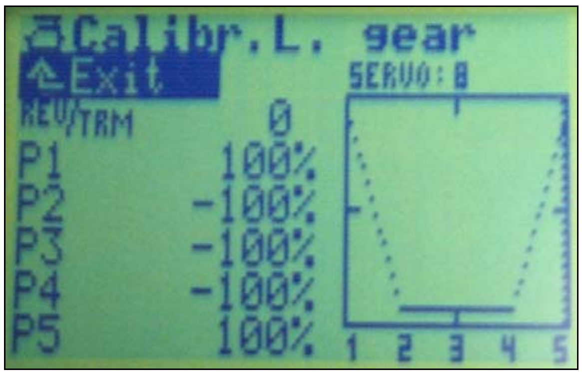


Figure 1

Landing bay door servo

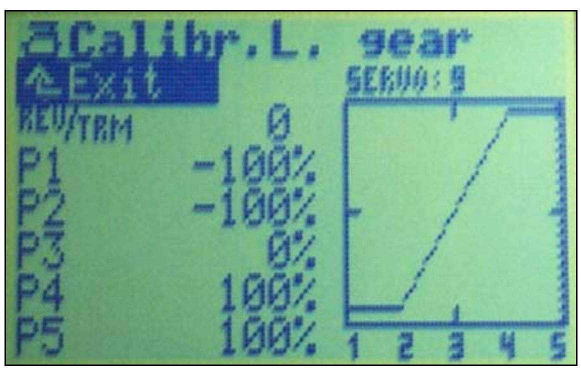


Figure 2

Retract servo

Readers Note:

These curves may need to be reversed depending on the action of your door or retract servo. This will vary based on actual servo installation in the plane.

When the “N” widget is moved and the L. gear control has been enabled, there are four distinct seconds involved with these servos.

Second One

This occurs between points 1 and 2. During this time, the door servo moves to its opposite end of travel – it travels from it 100% position to its –100% position. The retract servo does not move; it remains in its 100% position during this second.

Second Two

This occurs between points 2 and 3. During this second, the retract servo begins to move the landing wheel down into place. It does not move the landing wheel to the full down position during this time – the landing wheel moves only to the zero point position. The door servo has been instructed to remain “open” by staying at the –100% position.

Second Three

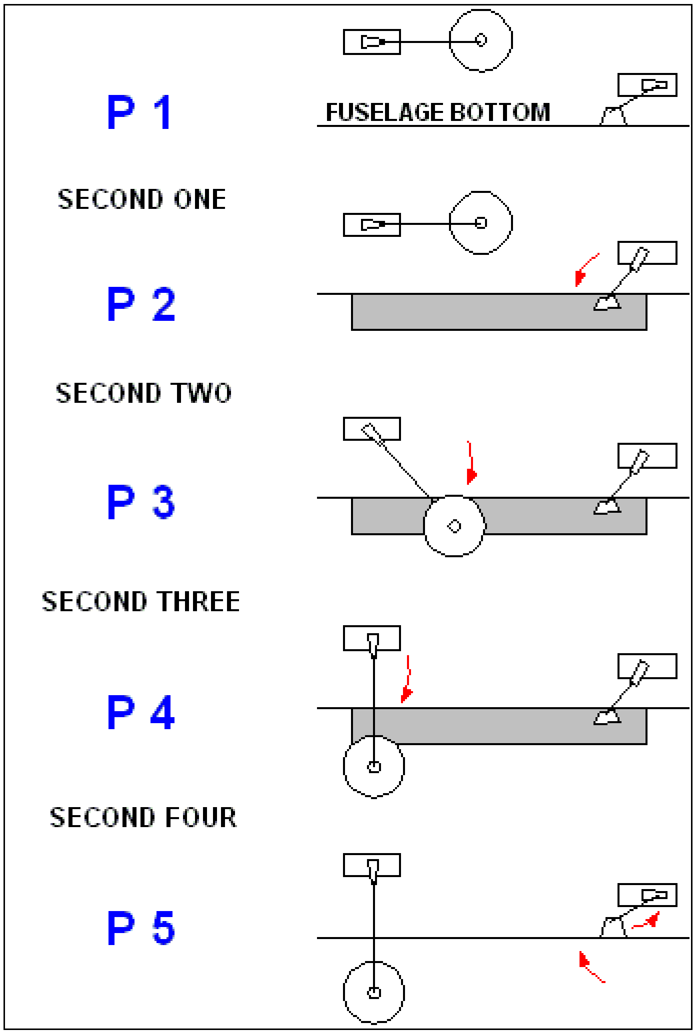
This occurs between points 3 and 4. During this second, the retract servo continues moving the landing wheel down until it is in the full down position. The landing gear has been given two full seconds to deploy. This occurs starting at second number two and ending at second number three. The door servo has been instructed to remain “open” by staying at the –100% position during this second.

Second Four

This occurs between points 4 and 5. During this second, the door servo is instructed to return back to the 100% position which closes the bay door. The retract servo has been instructed to remain at the position of 100% which means that the wheel stays locked down.

When the “N” widget is moved back to its original position, the above sequence happens in opposite order; the bay door opens, the wheel is raised and then the bay door closes.

The diagram on the following page indicates the five points of the servo calibrations, the corresponding four seconds of servo travel and illustrate the mechanical actions that occur during each of these four seconds.



Landing gear servo sequencing.

Comments

In many cases this scenario will still work with a more traditional, non-proportional retract servo. Some retract servos, however, are triggered to begin movement only when the signal from the transmitter passes the mid point. This would equate to a servo position of 0% in the EVO's servo calibration screen. In this case the retract servo would not be travelling when the signal is going from P2 to P4, or from P4 to P2, but only from P3 to P4 and P3 to P2. This still gives it one "spare" second to move the gear at least out of the way of the door so in most cases a non-proportional retract servo will still work unless it is so heavily stressed that it moves very slowly.

If the servo synchronization is too close when raising or lowering the wheel, alter the points of the retract servo's curve to gain the necessary clearance. This can make the retract servo move at the later end of the gear lowering stage but at the earlier end of the gear raising sequence, which is when it is slower and more likely to get in the door's way.

14.9 Automatic Crow (Butterfly) Deployment

The pilot desires to be able to automatically deploy crow (butterfly) braking on a full house glider by using only the flap widget; no other widget should need to be altered to enable the crow function. In this example, the left axis stick will be used as the flap widget. The full upwards position will be neutral settings on the aileron surfaces.

The crow function should not start until a specific point is passed during the flap widget downward travel motion. The flap widget should cause the ailerons to move down like flaperons for camber adjustment until a specific programmed switching point is passed. When the switching point is passed, the ailerons should automatically travel from downward motion to upward motion and continue providing crow as the left axis stick continues to move downward.

This scenario takes advantage of the EVO's ability to assign multiple software switches to the same widget. In this scenario, Mix-1 and Mix-2 software switches will be assigned to the left axis stick. In addition, a control switch will also be assigned to the left axis stick. This control switch will determine which part of the left axis stick travel is considered the Mix-1 area and which part of the travel is considered the Mix-2 area.

Since the aileron servos in this scenario will be commanded to move from the Aileron widget as well as the Flap widget, a mixer will be needed.

In addition, another mixer will be needed for the flap control.

Create the following mixers:

(Use these names or create your own)

```
CrwFlp+

Aileron    ----
Flap       Mix1  +
Flap       Mix2  +
```

```
FlapCrv+

Flap       Mix1  +
Flap       Mix2  +
```

Assign the following widget controls:

Controls	**Widgets**
Flap/RPM	Left Axis Stick ("ON" is up)
Elevator	Right Axis Stick (Mode 2 operation)
Aileron	Right Axis Stick (Mode 2 operation)

Assign the following widget switches:

Switches	**Widgets**
Mix-1	Left Axis Stick ("ON" is up)
Mix-2	Left Axis Stick ("ON" is down)

Enter the CONTROLS menu and select the Contr.Switch listing.

On the Contr.Switch main menu, select the axis stick icon listing and set the switch setting to -55%. This instructs the EVO that a switched function will occur at -55% of the travel of the left axis stick.

In the SERVO ASSIGNMENT menu, assign the CrwFlp+ mixer to the aileron servos.

Use these initial following travel values for the following mixers:

AilCROW+		
Aileron	**----**	**100%**
Flap	**OFF**	**-80%**
Flap	**OFF**	**50%**

```
FlpCrv+

Flap        OFF   -100%
Flap        OFF   -100%
```

Comments:

The flap control has been given an offset value of –100% when it is in the top-most position. By using a mixer, the EVO is instructed that when either Mix-1 or the Mix-2 switch is enabled, the flap widget should be offset. This allows the left axis stick to be a neutral position when fully in the upwards position.

It is necessary to have the FlpCrv+ mixer in order to be able to instruct the EVO that while the Mix-1 and the Mix-2 switches are enabled, that each of these mixes should expect an offset value from the flap control of –100%. By not doing this, the EVO will see two different values from the flap widget when changing from Mix-1 state to the Mix-2 state.

The aileron servos will move when a flap command is issued as a result of the CrwFlp+ mixer. As the flap widget is moved from the top position (the –100% value), it will move the aileron servos to their –80% value. The flap widget is currently in the Mix-1 position.

The control switch position has been programmed to occur at –55% of the downward travel value of the left axis stick.

When this position is passed, it triggers the Mix-2 software switch.

When the Mix-2 software switch has been enabled, the aileron servos immediately move to the 50% position as programmed in the CrwFlp+ mixer values. Since this number is a positive number and since the flap widget is currently in a negative number range, the Mix-2 software switch forces the aileron servos to reverse direction and position in response to the left axis stick at this point. The aileron servos will continue to move upwards with additional downward travel of the left axis stick.

The FlpCrv+ mixer is necessary to prevent the EVO from “seeing” two different flap curves when the Mix-1 or the Mix-2 software switch is enabled. By eliminating this mixer, the aileron servos will momentarily jump to an incorrect position if the flap curves are different.

Keep in mind that the aileron servos will have some limitation in movement when responding to crow. This is because of the offset that is assigned to the flap widget as well as the two areas of physical movement for the Mix-1 and Mix-2 positions on the left axis stick. This can be altered by adjusting the control switch position as well as the travel values within the CrwFlp+ mixer to suit a specific model.

14.10 DLG PRE-SET WITH TAPERING REFLEX ACTION

The pilot desires to have a DLG (discus launched glider) pre-set that provides an elevator and rudder pre-set as well as an automatic, smooth transition from reflexed ailerons to normal ailerons. A reflex pre-set on the ailerons is typically used during the launch phase to alter the profile of the airfoil in order to improve penetration and launch height.

This gradual transition from reflexed ailerons to neutral ailerons assists the launch by smoothing the transition from vertical flight to horizontal flight. This also assists the pilots during HLG competitions by reducing the pilot workload associated with immediate catch and launch rounds. Programming the reflex setting onto the DLG pre-set widget also prevents the pilot from forgetting to turn off the reflex setting while in flight.

What is unique about this scenario is the requirement that the rudder and the elevator pre-sets move immediately with the press or release of one of the side button widgets, but the ailerons transition to and from reflex gradually in response to the same widget. At all times, however, the aileron widget and the flaperon widget should operate the aileron servos normally and without delay.

This scenario assumes that a four-servo discus launched glider is used. Flying surfaces are elevator, rudder and ailerons functioning as flaperons and spoilerons.

Create the following mixers:

(Use these names or create your own)

```
Rudd%

Rudder      ----
L. gear     ----
```

```
Elev%

Elevator    ----
L. gear     ----
```

```
Ail%

Aileron     ----
Flap        ----  +
Spoiler     ----  +
```


Assign the following widget controls:

Controls	Widgets
Flap	Left Axis Stick (“ON” is down)
Elevator	Right Axis Stick (Mode 2 operation)
Aileron	Right Axis Stick (Mode 2 operation)
Spoiler	“M” Widget
L. gear	“M” Widget

No switch widgets will be needed for this scenario.

Assign the Rudd% mixer to the rudder servo.

Assign the Elev% mixer to the elevator servo.

Assign the Ail% mixer to the aileron servos.

In the CONTROLS menu, select the spoiler control and change the run time value to 4.0 seconds.

The flap control as well as the L. gear run time value should be left in their default run time settings of 0.0 seconds.

In the main MIXER menu, use these initial following travel values for the following mixers:

Rudd%

Rudder	----	100%
L. gear	OFF	30%

Elev%

Elevator	----	100%
L. gear	OFF	30%

Ail%

Aileron	----	100%
Flap	OFF	-70%
Spoiler	OFF	50%

Reader Note:

The reader will likely need to adjust these initial settings for their specific models since they have been greatly exaggerated for demonstration purposes only.

Numerical values may also need to be reverse if servos move in the incorrect directions.

Comments:

Because the “M” side button widget has been assigned to the L. gear channel and because the Rudd% and the Elev% mixers have L. gear listed as a control input, when the L. gear is enabled (the “M” button is pressed and held down), the elevator and the rudder servo move the amount of travel that has been programmed into the mixers (30%). If any of these servos move in the incorrect direction, then adjust the travel value to an negative number as needed for proper direction.

L. gear is one of the controls in the EVO that has the ability to be slowed, but the L. gear control has not been slowed in this scenario, so the elevator and rudder pre-sets occur immediately when the “M” widget is pressed down.

Because the “M” side button widget has also been assigned to the spoiler channel and because the Ail% mixer has spoiler listed as a control input, when the spoiler channel is enabled (the “M” button is pressed and held down), the aileron servos will both move into reflex positions in the amount of travel as specified in the mixer (50%). If these servos move in the incorrect direction, then adjust the travel value to an negative number as needed for proper direction.

The spoiler channel is also a channel that has the ability to be slowed. The spoiler channel has been slowed to 4.0 seconds in this scenario.

Because the spoiler channel has been programmed to move slowly, its input into the Ail% mixer is entered slowly by the EVO when the spoiler control (the “M” widget) is pressed and held down. The aileron servos will move into reflex position, but will take four seconds to reach their final positions since this was the value that was programmed for the spoiler run time.

The aileron servos will also move when the flap channel is activated since flap was programmed as an input into the Ail% mixer.

The flap channel is also a channel that has the ability to be slowed, but in this scenario the flap channel has not been slowed down; its run time was left at 0.0 seconds.

The left axis stick is the widget that controls the flap channel. When it is moved, the ailerons will operate as flaperons without delay.

The aileron servos are set to respond when the right axis stick is moved at all times and without delay. This allows for aileron control while the “M” widget is pressed down or when the left axis stick has effected flaperons.

Notice that there are no physical spoiler or flap servos in this scenario. This scenario takes advantage of the EVO's ability to utilize a data stream from a control even if the plane does not have a physical servo for these controls. The EVO in turn uses these "slowed" data streams to affect other servos by the use of a mixer.

14.11 How to "Assign" a Digi-Adjuster To A Control

Although the Digi-Adjusters (DA) can be used to alter numerical values in many places on the EVO (even while flying), they cannot be assigned directly to a control.

However, by using the fixed value properties of either the spoiler or the flap controls which can be assigned to one of the DAs, a mixer can be made that will enable any channel to be moved directly from the DAs.'

This scenario assumes that either the flap or the spoiler channel is not being used in the plane.

Create the following mixer:

```
DA+Rud+

Rudder      ----  ↕
Spoiler     ----  ↕
```

Assign the DA+Rud+ mixer to the rudder servo.

In the MIXER main menu adjust the DA+Rud+ mixer to these initial values:

```
DA+Rud+

Rudder      ----  100%
Spoiler     ----  100%
```

In the CONTROLS menu, select the spoiler control and assign the fixed value field to the right DA by highlighting the numerical value, pressing the DA button at the bottom of the transmitter and then pressing the right DA.

Comments

Since the DAs can be used to adjust fixed values and since the channel whose fixed value is being altered is listed as an input into the mixer (the spoiler channel), the rudder servo in this example will move when the DA is turned

Some drawbacks to using this method are that a free spoiler or flap channel must be available, the DAs don't have a mechanic stop like a conventional slider and the DA click "steps" cannot be adjusted for greater or lesser servo travel as a result of the DA being turned.

This scenario may limited feasible applications due to the limitations listed above.

14.12 SELECTABLE "THROTTLE-CUT"

This scenario is credited to Steve (RCGroups.com alias "GlowFly"), but the instructions are the author's.

On internal-combustion (IC) RC planes, it is helpful to have a programming setup that allows for a throttle cut function to enable only when the throttle widget is in the idle motor position. This is beneficial since it eliminates the possibility of killing the throttle by inadvertently enabling a widget while in flight.

The programming challenge of this scenario is that it requires that the throttle cut widget to work only when the throttle widget is in the idle motor run position. When the throttle is enabled at any other settings, pressing the throttle cut widget should have no effect. (Note that this programming scenario is similar to programming with logical switches that are available on the Multiplex Profi 4000.)

The EVO features an official "Throttle-Cut" facility that will cut the throttle signal, but the EVO will enable this to occur at any point during the throttle widget travel. This may be a desirable action for an electric model since the electric motor can be restarted remotely without complications. With an IC motor, however, shutting the engine down during flight could have disastrous results. This scenario allows the pilot to kill the motor only once the plane has safely landed and the pilot throttled back to the idle setting. This scenario also increases safety by preventing an accidental motor shut off while in active flight.

This programming setup takes advantage of a Mix1-3 software switch, a control switch and a custom made mixer. Typically, the Mix1-3 software switches are used to "turn on" or a enable specific control within a mixer. What makes this programming scenario unique is that the Mix1-3 software switches will be used to "turn off" or disable a specific control within a mixer. This will be accomplished by using a spare control to input a negative numerical input value or a value that will negate (or "turn off") a specific control input into a mixer.

One mixer will be needed for this scenario.

Create the following mixer:

(Use this name or create your own)

```
TH/KS+

Throttle    ----
Mixture     Mix1    +
```

Assign the following widget controls:

Controls	**Widgets**
Throttle	Left Axis Stick ("ON" is down)
Mixture	Left press button "H"

Assign the following widget switches:

Switches	**Widgets**
Mix-1	Left Axis Stick ("ON" is down)
Throttle-Cut	----

! Important Note !

The assignment of the official Throttle-Cut function must be erased (blanked out) to allow this scenario to function properly.

In the SERVO main menu, assign the TH/KS+ mixer to the throttle servo.

In the CONTROLS main menu, select the Control Switch listing and set the switching point on the left axis stick to –100%.

In the MIXER main menu, use these initial following travel values for the mixer:

TH/KS+		
Throttle	**----**	**100%**
Mixture	**OFF**	**-100%**

Comments:

The full down position of the left axis stick will equal –70% of actual throttle servo travel. This is because the EVO by default programs in a trim value of -30% on the lower end of throttle servo travel. This allows the pilot to enable the full down position of the throttle widget while allowing the trim buttons to adjust and fine tune the idle setting.

A value of -100% from a widget to the throttle servo will shut down the motor completely.

The Mixture control was assigned to the left widget button "H" and programmed to a momentary action. When this widget is pressed and held down, the Mixture control is enabled. This will send a value of –100% to the throttle servo through the TH/KS+ mixer.

When the TH/KS+ mixer was defined (created), the Mixture control was programmed with a Mix1 software switch. The Mixture control input into the TH/KS+ mixer (-100%) will only be permitted when:

1) The "H" widget is pressed and held down (the Mixture control initiated)

2) The Mix1 software switch has been enabled

The Mix1 software switch was set to the left axis stick. For the EVO to know when to "turn on or turn off" the Mix1 software switch when assigned to a proportional control such as the left axis stick, a Control Switch value must be programmed. The control switch point (or the physical position where the left axis stick will "turn on or off" the Mix1 software switch) was set to a value of –100% in the main CONTROLS menu.

A Control Switch value of –100% means that the Mix1 software switch will only enable when the left axis stick is in the full down position. At any physical position above this position of the left axis stick, the Mix1 software switch will not be enabled. Since the Mixture control input into the TH/KS+ mixer can only occur when the Mix1 software switch has been enabled, at any physical position above the control switching point, pressing the side button "H" widget will have no effect.

14.13 Selectable Snap-Roll

This scenario is credited to Steve (RCGroups.com alias "GlowFly"), but the instructions are the author's. All screenshots in this chapter are credited to Steve and are used with his permission.

The pilot desires to have a snap-roll facility programmed to a side widget button. The direction of the roll (clockwise or counterclockwise) will be determined by the position of a two-position widget. This scenario is different from an earlier scenario in this tutorial that called for both of the momentary side button widgets to be used as snap-roll facilities. In this scenario, only one of the side buttons is utilized thereby freeing the remaining side button widget for other functions.

In this scenario, the snap roll function will trigger movement of the aileron servos, the rudder servo and the elevator servo. While the snap roll button is pressed and held down, these servos will remain at their programmed snap roll positions. Flying a plane using this technique will be a matter of properly timing the commencement and ending of the rolling movement with the widget depressing and releasing.

Three mixers will be needed for this scenario. Two of these mixers will be the default mixers that come pre-programmed into the EVO from the factory: AILERON+ and ELEVATR+. The third mixer will need to be created from scratch. Since the default mixers AILERON+ and ELEVATR+ are only being given additional functions, this addition will not affect preexisting models that use these mixers.

> **Note**
>
> **If the readers feel uncomfortable modifying existing mixers for this scenario, they should make a new mixer with duplicate control inputs as the AILERON+ and ELEVATR+ default mixers and utilize these newly created mixers instead.**

Modify the ELEVATR+ mixer by adding the **AUX1** control in row number five. In the center column, enable the software Mix2 switch. In the right column, select the asymmetrical servo output curve.

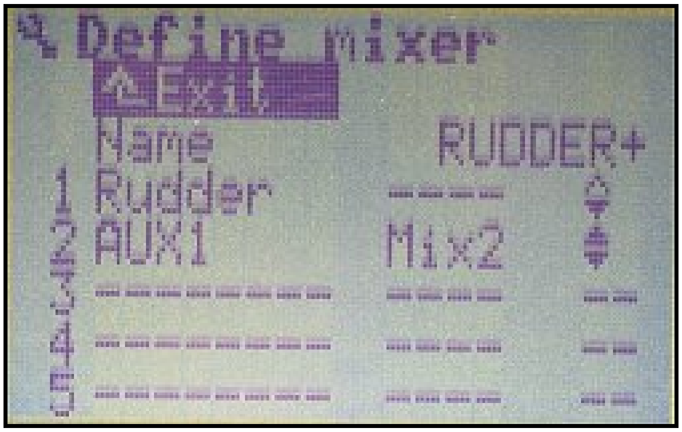
The fifth row reflects that the AUX1 control is now an input into the ELEVATR+ mixer. It also shows that the AUX1 control input has the Mix2 software switch assigned to it.

Modify the AILERON+ mixer by adding the **AUX1** control in row number five. In the center column, enable the software Mix2 switch. In the right column, select the symmetrical servo output curve.

The fifth row reflects that the AUX1 control is now an input into the AILERON+ mixer. It also shows that the AUX1 control input has the Mix2 software switch assigned to it.

Since the EVO does not come pre-programmed with a rudder mixer from the factory, one will need to be made from scratch. Create the following RUDDER+ mixer in the SETUP menu with Rudder listed as an control input, always on (indicated by the four dashes in the middle column) and with the asymmetrical servo output curve selected in the right column.

In the second row, the AUX1 control input should be selected with the middle column being set to the software Mix2 switch and the right column being programmed as a symmetrical servo curve output.

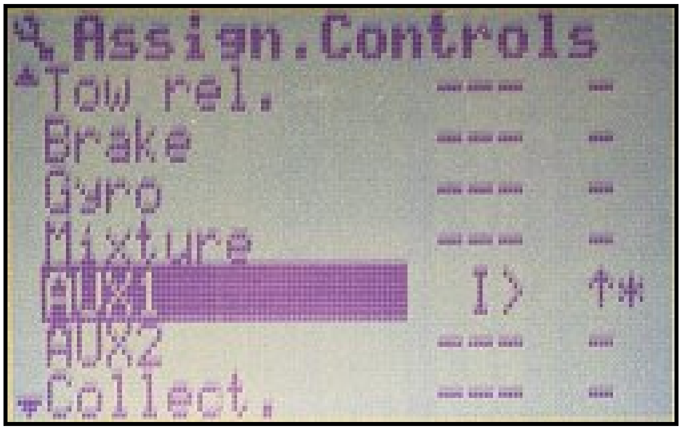


Completed RUDDER+ mixer shown. Rows 3 through 5 are left blank.

Another mixer will be needed for this scenario. One mixer will be programmed for the left aileron and another will be programmed for the right mixer. It is necessary to have two separate mixers in order to allow the ailerons to move in their proper directions.

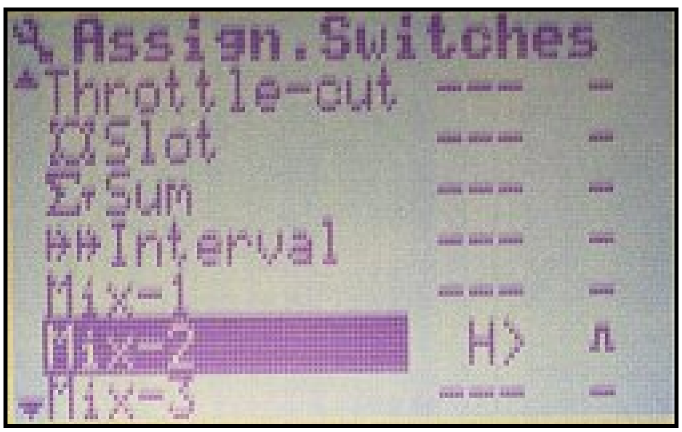
Completed RUDDER+ mixer shown. Rows 3 through 5 are left blank.

Now that the mixers have been programmed, assign the widgets to their desired functions. In the SETUP menu, assign the AUX1 control to the "I" two-position widget as shown in the following screenshot.



The "UP" arrows points to the "ON" position. The asterisk indicates that the "I" widget is currently resting in the "ON" position.

In the SETUP menu, assign the Mix2 software switch control to the “H” side button widget as shown in the following screenshot. The action of the “H” widget should be set to momentary as indicated by the “top hat” symbol in the right column. Depress the “H” widget repeatedly to change its action from momentary to press on - stay on action.

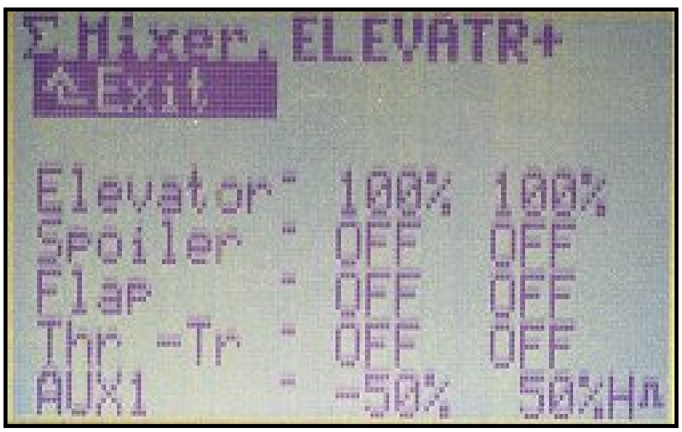


The "Top Hat" symbol in the third column indicates that the "H" widget button is programmed to work in a momentary fashion.

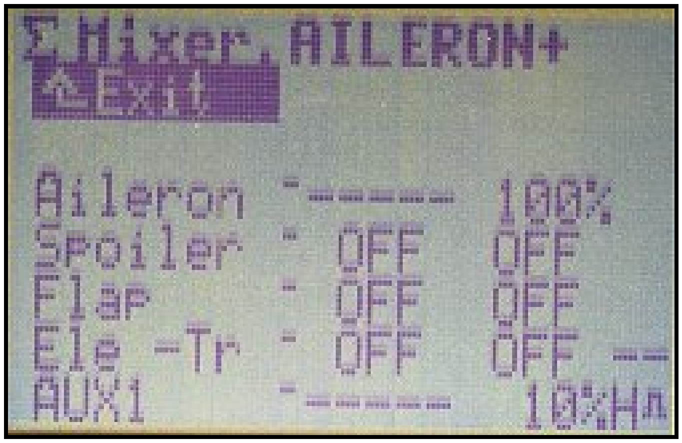
In the main SERVO menu, assign the AILERON+, ELEVATR+ and RUDDER+ mixers to their appropriate outputs as needed. Note that the reader’s own servo assignment screen may differ based on their individual model setup.

All servos should be set initially to three points of servo adjustment ("3P") unless later determined that five points of servo adjustment are needed to effect proper servo calibration and travels.

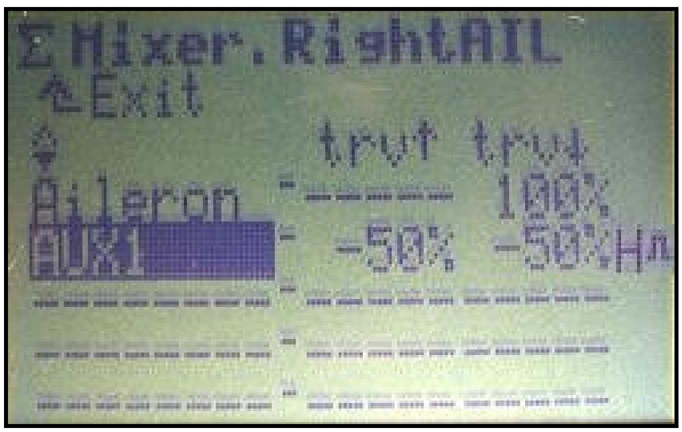
Now that the servos have been assigned to their mixers, the travel values within the mixers can now be set. Enter the main MIXER menu and input the following settings as a starting point. These values will need to be adjusted to suit each model as necessary for the desired amount of control surface travel.



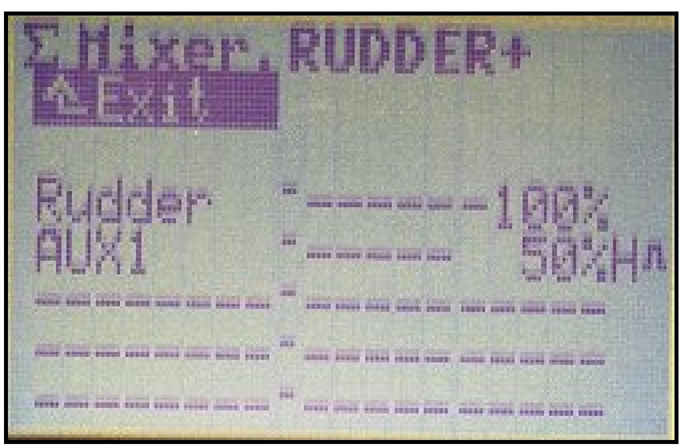
These values will need to be adjusted and fine tuned for individual models and should be considered as starting points only.



These values will need to be adjusted and fine tuned for individual models and should be considered as starting points only.



These values will need to be adjusted and fine tuned for individual models and should be considered as starting points only.



These values will need to be adjusted and fine tuned for individual models and should be considered as starting points only.

Comments:

Because the aileron, elevator and rudder servos utilize a mixer that has the AUX1 control listed as an input, these servos will move when the AUX1 widget has been enabled. The AUX1 control was assigned to the “I” two-position widget. When a control is assigned to a two-position widget, the servo travel values that are possible when the widget is in one position or another are –100% and +100% respectively.

The AILERON+, ELEVATR+, RightAIL and the RUDDER+ mixers were also programmed with a Mix2 software switch that was added to the AUX1 control input. The Mix2 software switch that has been assigned to AUX1 control input within these mixers allows that control input to be enabled or disabled

The Mix2 software switch was assigned to the “H” side button widget. This widget action was set to be momentary in action, so it is only considered to be “ON” when it pressed and held down. When it is not pressed and held down, the AUX1 control input into the AILERON+, ELEVATR+ and RUDDER+ mixers is disabled and as a result, the servos will not move when the "I" widget is moved from one position to another.

The AUX1 control input into the AILERON+, ELEVATR+, RightAIL and the RUDDER+ mixers will only occur when the Mix2 switch (the "H" side button widget) has been enabled (pressed and held down.)

So while the “I” widget constantly sends either a –100% signal or a +100% signal (depending on whether it is UP or DOWN) into the AILERON+, ELEVATR+, RightAIL and the RUDDER+ mixers, this signal will only be allowed to pass to these mixers if the Mix2 software switch is enabled.

When the “I” widget is in the UP position and the “H” widget pressed and held down, the aileron, elevator and rudder servos will move to the values that where programmed into the AUX1 listing within the AILERON+, ELEVATR+, RightAIL and RUDDER+ mixers.

When the “I” position is moved to the DOWN position, these travel values will be reversed and thus will cause these servos to move these same amounts, but in opposite directions. The travel travels are reversed since one position of the "I" widget is considered +100% of servo travel and the opposite position of the "I" widget is considered -100% of servo travel. In the case of the AILERON+ mixer, the AUX1 control input was programmed with a value of 10%. This means that only ten percent of the current value of the "I" widget (either +100% or -100% depending on the position of the "I" widget) is sent to the aileron servo. In the case of the RUDDER+ and the RightAIL mixer, only 50% of the current value of the "I" widget is sent to the rudder servo.

The end result is either clockwise or counterclockwise snap rolls depending on the position of the "I" widget and on when the "H" is pressed in held down.

Note: Changing the AUX1 control inputs into all of the mixers as asymmetrical will allow for fine adjustment in both directions if control linkages or plane settings require such adjustments for proper travels.

14.14 AUTOMATIC COMBINED SINGLE-STICK FLYING

There are two facilities that can offer a RES (Rudder-Elevator-Spoiler) pilot the ability to fly on a single axis stick when using a Mode 2 axis stick configuration.

Typically, many U.S. pilots desire to have the rudder and elevator coupled on the right axis stick when flying two or three channel gliders to reduce pilot workload during flight.

One solution is to use the Combi.switch function which will couple the rudder to the movement of the aileron widget. After assigning a widget to the Combi.switch switch in the SETUP.Assignment.switches menu and then programming a value for combined action field in the Mixers.Combi.switch menu, the coupling rate can be adjusted to individual pilot preference.

Another solution is to utilize a mixer assigned to the rudder servo which lists aileron as a control input. After assigning this mixer to the rudder servo and then adjusting the aileron control travel values in this mixer in the MIXER menu, the rudder servo will respond as desired when the aileron control on the right axis stick is moved.

A simpler and more elegant solution, however, is to change the mode assignment on the EVO.

There are several different mode configurations that are offered on the EVO. In this specific example, Mode 4 provides for the rudder and the elevator controls on the right axis stick while the left axis stick has the spoiler and aileron control assigned to it.

By changing the Mode assignment in the MEMORY.Properties menu to Mode 4, the rudder and the elevator widgets will automatically be assigned to the right stick.

The corresponding rudder trim will also relocate underneath the right axis stick as well as the aileron trim tabs which will be relocated underneath the left axis stick.

Changing the mode assignment is not a global assignment and will not affect other models stored in the EVO. This allows the pilot to have multiple planes stored in the EVO each with a different mode assignment if desired.

The benefit of changing the mode assignment is that it allows for coupling to be automatic and thus, there will be no need to utilize the Combi.switch function or to utilize a mixer in order to effect combined flight on one axis stick.

The drawback to using this solution (although for a RES glider, it may not be considered a drawback) is that the combined coupling will not be able to be turned ON and OFF by using a widget. By using this solution, the coupling will always be on.

14.15 SELECTABLE EXPO RATES

This scenario is credited to Eric Gold, however significant modifications to this scenario were made by the author. All instructions in this scenario are the author's as well.

While the EVO is a powerful transmitter, there are a few drawbacks to the EVO that have not been addressed within the 1.26 version firmware.

One of the most glaring omissions from the current EVO firmware is the lack of selectable Expo. While the EVO does offer an expo setting for the rudder, elevator and aileron controls, the expo setting can not been turned on or off while in flight without utilizing one of the DAs.

However, by using the powerful abilities of mixers, a form of expo can be artificially created without resorting to utilizing the official expo feature or by assigning the official Expo function to one of the DAs.

In this scenario, the pilot desires to have a selectable expo setting on the elevator control which will be turned ON and OFF by the position of a two-position widget.

One mixer will be needed for this scenario.

Create the following mixer:

(Use this name or create your own)

```
ELE+expo

Elevator    ----
Elevator    Mix1
Elevator    Mix2
```

Assign the following widget switches:

Switches	**Widgets**
Mix-1	"I" widget ("ON" is down)
Mix-2	"I" widget ("ON" is up)

In the main SERVO menu, assign a servo to the ELE+expo mixer.

Once a servo has been assigned to the ELE+expo mixer, the travel values within this mixer can be adjusted.

Enter these initial travel settings as shown below in the main MIXER menu.

```
ELE+expo

1. Elevator   ----   10%
2. Elevator   50%    100%
3. Elevator   OFF    100%
4. --------   ----   ---
5. --------   ----   ---
```

In the main CONTROLS menu within the Elevator control submenu, ensure that the official expo setting is set to zero.

The travel settings for the elevator servo can easily be observed in the servo monitor screen. For specific and accurate feedback, change the servo monitor screen from graphical display to numeric display by turning one of the DAs while viewing the graphical servo monitor screen.

The "I" widget will now enable an artificial expo rate. When the "I" widget is in the up position, an expo rate will be observed when the elevator widget is moved. When the "I" widget is on the down position, no expo rates will be observed when the elevator widget is moved.

Comments:

This scenario illustrates the powerful abilities of Multiplex mixers. It is helpful to study in detail what is occurring within this mixer when the elevator widget is moved in order to understand how this mixer provides an artificial expo function.

The ELE+expo mixer instructs the elevator servo to move when three events happen.

The first event when the elevator servo will move is whenever the elevator widget is moved. The elevator servo will move to a maximum of 10% symmetrically from the neutral position. This situation is considered always "ON" and does not depend on the position of any additional widgets.

The second event when the elevator servo will move is when the Mix-2 switch is enabled (the "I" widget is in the down position). This input is listed in line three of the ELE+expo mixer. This input was programmed with a symmetrical with dead zone servo output curve when the mixer was defined (created). The dead zone is programmed to be OFF, with a total travel output of 100%. When the Mix-2 switch is enabled, the elevator widget will move the elevator servo with no delay and no expo.

The third event when the elevator servo will move is when the Mix-1 switch is enabled (the "I" widget is in the up position). This input is listed in line two of the ELE+expo mixer. This input was programmed with a symmetrical with dead zone servo output curve when the mixer was defined (created). The dead zone is programmed to be 50%, with a total travel output of 100%.

When the Mix-1 switch is enabled (the "I" widget is in the up position), it instructs the elevator servo not to move until the dead zone of 50% is passed. Once either the positive or the negative 50% position of the elevator stick is passed, the elevator servo will begin to move up to the 100% of travel.

The artificial expo works because the first line of the ELE+expo mixer instructs that the elevator widget should move the elevator servo up to 10% of travel **at all times** - irregardless of whether the Mix-1 or the Mix-2 switch has been enabled. So while the second line of the ELE+expo input is programmed with a dead zone of travel and the dead zone of travel is set to 50%, the elevator will move when the elevator stick happens to be at any position within the dead zone of 50% due to the first line of the mixer.

The EVO is processing two elevator inputs at any given time in this scenario. The first input is from the first line of the ELE+expo mixer and the second input is from either line 2 or line 3 of the ELE+expo mixer depending on whether the Mix-1 or the Mix-2 switch is enabled (whether the "I" widget is in the up or down position.)

Additional Comments:

The above settings allow for an artificial expo rate without resorting to the official expo setting within the CONTROLS menu of the elevator control. The output, however, is not curved as a true expo facility would be. This artificial expo scenario has somewhat of a "linear" expo due to the symmetrical with dead band servo output curve in the third line of the ELE+expo mixer that has the Mix-2 software switch assigned to it.

If the pilot desires the effects of the elevator widget to be more curved and thus, more like a true expo, a small amount of official expo can be set to the elevator control.

This setting is entered in the main CONTROLS menu under the elevator sub menu. At the bottom of the CONTROLS.Elevator menu is the official Expo setting. By adding a small amount of Expo value, the elevator widget will provide a smoother expo transition when the elevator servo is moved.

Keep in mind, however, that this will cause the elevator widget to effect a small amount of expo even when the Mix-2 (the "I" widget is up and no artificial expo is selected) is moved. This is because of the limitations of the official Expo function within the 1.26 firmware; remember, the official Expo function cannot be turned ON or OFF when in active flight without resorting to utilizing one of the DAs.

The amount and intensity of the artificial expo that is effected by using this scenario can be adjusted per model and pilot preference within the ELE+expo mixer. Without resorting to utilizing the official expo setting, it is likely that a little experimentation will result in an artificial expo settings that is acceptable.

14.16 TWIN TURBINE ENGINES

The idea and general programming approach for this scenario is credited to Harry Curzon, but the instructions are the author's.

The pilot desires to have a programming setup that allows for two turbine engines to respond to a single throttle widget. What is unique in this scenario is that when starting up the engines, each turbine engine must be started separately by the movement of two separate sliders. Once the engines have been spooled up, they should both respond to a single throttle widget for flight functions.

One mixer will be needed for this scenario.

(Use this name or create your own)

```
rTRBINE%

Throttle    Mix1    +
Aux1        Mix2    +
```

Assign the following widget controls:

Controls	**Widgets**
Throttle	Left Axis Stick ("ON" is down)
Aux1	"E" Slider ("ON" is down)

Assign the following widget switches:

Switches	**Widgets**
Mix-1	"I" widget ("ON" is up)
Mix-2	"I" widget ("ON" is down)

In the SERVO ASSIGNMENT menu, assign the left turbine engine to the throttle control and assign the right turbine engine to the rTRBINE% mixer.

Use these initial following travel values for the following mixers in the main MIXER menu:

```
rTRBINE%

Throttle    OFF   100%
AUX1        OFF   100%
```

Comments:

The left turbine engine will always respond to the action of the throttle widget (left axis stick) regardless of the movement of the "I" widget.

The right turbine will respond to the actions of either the Throttle control or the Aux1 control.

For the right turbine engine, both of these control inputs into the rTRBINE% mixer have been programmed with the Mix1 and Mix2 software switches. Since these software switches have been assigned to a two position widget in opposite positions, either the Throttle control or the Aux1 control will be enabled at any given time, but they can never be enabled at the same time.

This allows the "E" slider to control the right turbine only when the "I" widget is in the Mix2 position (which is in the down position.)

When the "I" widget is in the up position, the right turbine engine will respond to the throttle control (the left axis stick) in conjunction with the left turbine engine.

Note that the position of the "I" widget enables the "E" slider to control the right turbine engine. If greater security from accidental movement of the "I" widget while in flight is desired, the Mix2 software switch could be assigned to a momentary button such as the long axis stick top "Kta" momentary button or one of the side button widgets "H" or "M". This will force the pilot to actively hold down the Mix2 software switch widget while spooling up the right turbine engine.

A miniature push-to-make widget could be installed into one of the spare expansion wells "P" and "K" which would also provide for a way to do this.

14.17 SELECTABLE SMOKE ACTION

The pilot has an on-board smoke system that should only be enabled in certain situations.

These requirements are:

- If widget "N" is OFF, then no smoke regardless of throttle setting.
- If widget "N" is ON, the smoke is off between zero throttle and 1/4 throttle.
- If greater than 1/4 throttle is given, then smoke servo is enabled.

Assign the following widget controls:

Controls	**Widgets**
Throttle	Left Axis Stick ("ON" is down)
Aux1	Widget "N". ON is down.

Assign the following widget switches:

Switches	**Widgets**
Mix-1	Left Axis Stick ("ON" is down)

One mixer will be needed for this scenario.

(Use this name or create your own)

SMOKE+		
Aux1	**Mix1**	+

The smoke servo will have to have a mixer assigned to it despite only having one control input into the mixer. This is because it is necessary to add the Mix1 software switch to the control input (Aux1, in this example). Mix1-Mix3 software switches can only be added within mixers.

Set the control switch of throttle widget. The ON position should be around the 40% position.

Comments:

Here's the data flow logic of what the EVO processes in this scenario.

1) If the "N" widget is in the UP position, the no smoke. This turns off the Aux1 control.

2) If the "N" widget is in the DOWN position, then enable the Aux1 control.

3) The smoke servo is tied to a mixer that allows for Aux1 control to enter into it, but most importantly, **ONLY IF** the Mix1 switch is ON

4) Movement of the throttle stick below 40% does not turn on the Mix1 switch due to the setting of the control switch point. When the throttle widget is moved to any position below the 40% mark, the Mix1 will not be turned on and as a result, no signals will be sent to the Aux1 control and no smoke will result.

5) Moving the throttle widget past the control switch point of 40% as well as ensuring that the "N" widget is in the DOWN position ("on"), then smoke (Aux1) is enabled and generated.

The same concept applies to the glow requirement and you can have both of these requirements programmed at the same time on your plane.

14.18 PROGRAMMING PLANK-STYLE WINGS

This scenario is credited to Dave Kirk and is used with his generous permission. The author has modified the scenario for readability.

Plank style flying wings present a unique challenge to radio transmitters in that the elevon servos must travel in different amounts in response from the elevator widget as well as the aileron widget. In addition, plank style flying wings are extremely pitch sensitive in regards to trimming.

However, the digital trim function on the EVO can cause less trim travel to be made available since the end points of servo travel are not altered. On tail-less plank style wings, drastic trim changes may be necessary for inverted flight or changing flight conditions. Having less trim amounts in "reserve" can possibly lead to crash on these types of planes.

Create a new model and assign two servos to the default Delta+ mixer.

Once these servos have been assigned, immediately enter into the SERVO.Calibrate menu and adjust the travel values for the elevator control and the aileron control as needed for the plank style flying wing. It is presumed that there are only two elevon servos and that they are identical in their make and mechanical set up.

Press the main MIXER button at the bottom of the EVO case and use these initial following travel values for the Delta+ mixer:

```
Delta+

Aileron     OFF   100%
Elev        30%   30%
Thr –TR     ----  ----
```

Ideally either Aileron or Elevator should be set to 100% because these servos were 'Calibrated' potential full travel in the previous step. If the pilot finds that he has too much travel when it comes to flight-testing, this is the menu where less travel should be adjusted.

For the various kinds of tailless aircraft, the required roll and pitch travels are different and it is in this menu these value are programmed. Combat type wings need less Elevator than Aileron and plank style wings need extremely small Elevator travel in relation to the Aileron.

These types of setups (large travels for one input and very small for another) can lead to problems if the servo setup doesn't follow this top down approach (See Note below).

Note

Trim is based upon the travel setup in the **Mixer** menu **NOT** the travel setup in the Controls menu!

For example, if the readers have set 30% travel for Elevator in the DELTA+ Mixer, further reduced the travel to 30% of the Elevator in the Controls menu and then applied 30% trim, the end result would be **NO** Elevator movement.

If the readers reduce the Control travel below the max trim value, they will in get control reversal.

This is not a bug in the Evo software. Trim must be applied to the Mixer value in order for trims to make sense when switching flight phases.

To change the Flight Phase travel on the plank style wing, navigate to the Elevator Control menu and setup specific travels for each of the Flight Phases that are desired.

Following this top down approach to servo setup eliminates potential problems with very small servo travels but should be regardless of model type.

15. SELF-MADE EXPANSION SWITCHES

Warning!

Although some pilots have taken the liberty of declaring the author to be an "EVO Guru", bear in mind that the author is not an expert on Multiplex hardware, nor does he claim that the following information will not cause any damage directly or indirectly to the readers, their planes, their EVO or to other persons.

The reader is advised to use sound judgment when modifying their EVO transmitters and to forward any specific questions or concerns to Multiplex-USA or to Multiplex-DE.

Use this information at your own risk!

This chapter concerns making additional switches for the Multiplex EVO expansion wells "P" and "K". These self-made switch assemblies will also work with the Multiplex Profi 4000 transmitters, but the appropriate servo plug ending must be used instead.

There are a variety of manufacturers that make compatible expansion switches that are nearly the same dimensions. The brand that the author found on a genuine MPX OEM expansion switch was the brand that was chosen by Multiplex when they assembled their own "Multiplex Brand" expansion switches. Keep in mind, however, that the current switch brands that MPX chooses is probably based on marketing and mass volume sales deals. (This is plainly in evidence by the different brand of switches that have been installed on the author's own Profi 4000.)

In the printed Mouser catalog (www.mouser.com) on page 924, the reader will find a whole sheet devoted to "C&K" Miniature Toggle Switches. "C&K" is the name of the specific company brand. "Miniature Toggle Switches" is the name of the general switch category. These switches are offered as two or three position switches with short, medium and long actuators ("sticks") as well as with flat, non-slip actuators and locking actuators. The locking actuator sounds like an ideal candidate for a "Master" switch that could be assigned to the throttle cut function. There are also momentary, spring-like action, switches that could be used for a launch phase. Momentary action switches will spring back to the center position or opposite position automatically when released.

Sample SPDT miniature toggle switch

Three position switches will fit in these wells, but the center position will not be recognized by the EVO. The EVO manual specifically says that these wells are for 2 position switches only.

The “Contact Form” that Mouser lists in their catalog and on their web site is SPDT (Single Pole, Dual Throw). SPDT switches are needed for these expansion wells.

Listings in the Mouser catalog as such **“(On)-On"** means that this is a two position switch and that one of the positions is spring loaded. The parenthesis indicates a momentary action.

The dimensions for this switch casing is (in mm) .270 wide x .5 long x .350 tall (not counting the solder terminals).

Be sure to order a threaded bushing. A threaded neck will be needed to install the switch onto the EVO mounting plate with the supplied mounting nut. Naturally, the soldered bushing variety won’t work on the plastic EVO casing.

Please note that there are about 100 C&K toggle switches listed on page 924 of the printer Mouser catalog. If you are interested in seeing the other possible varieties, contact Mouser and request one of their free 1200+ pages printed catalog. The author has ordered from Mouser and has found their service to be good and prompt.

The Mouser web page and printed catalog do not show them, but there are plastic colored switch stick sleeves available from C&K. Contact Mouser for availability or for a comparable product that will fit the C&K brand switches.

At the Mouser.com web site, the readers can download the PDF literature from C&K which has additional information about these switches that is not shown on the Mouser web site.

15.1 EXAMPLE PART NUMBERS

Here are some specific Mouser part numbers to get the readers started in assembling their own expansion switch assemblies. Keep in mind that "Actuators" are what Mouser considers the movable "stick" portion of the switch.

Standard Actuators		
Mouser part		
611-7101-054	On-On	SPDT
611-7108-001	On-(On)	SPDT

Short Actuators		
Mouser part		
611-7101-063	On-On	SPDT

Long Actuators		
Mouser part		
611-7101-041	On-On	SPDT

Flattened, Anti-Rotation Actuators		
Mouser part		
611-7101-022	On-On	SPDT
611-7108-021	On-(On)	SPDT

Locking Actuators (only tall size available)		
Mouser part		
611-7101-031	On-On	SPDT

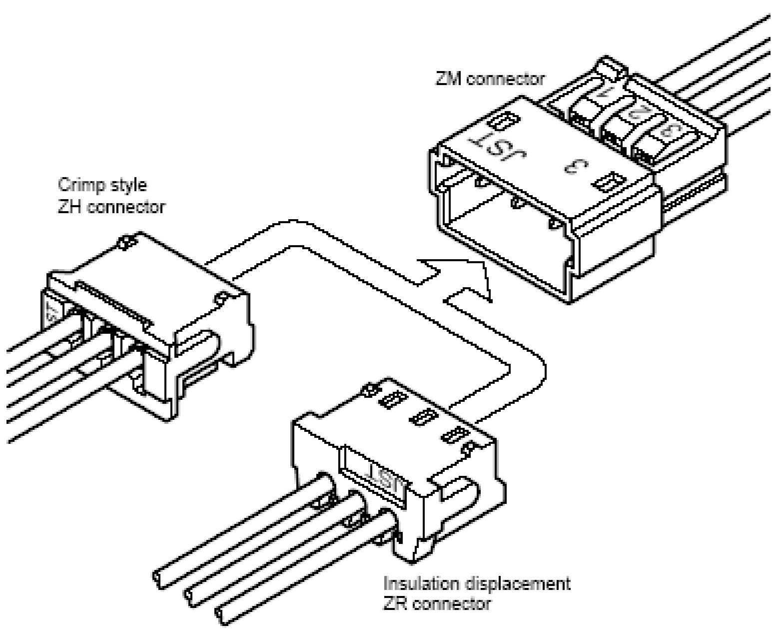
In case the readers are wondering if the "P" and "K" wells on the EVO will accept a proportional control, the answer is officially "No" directly from Multiplex-Germany. This has been confirmed by the attempts to add a 5K slider to these ports; it doesn't work. These ports will only switch on or off even with a proportional slider installed.

15.2 SWITCH ASSEMBLY PLUG CONNECTORS

The small connectors that fit into the "P" and "K" wells are manufactured by **JST**. They are marketed under the **ZH Series** micro connector name. Volz uses the **ZH Series** connectors on their servos under the guise of being "VMS® Microconnector System" brand connectors, but this just a marketing ploy! These connectors are made by **JST** and are used in a multitude of electronic products.

The link to the **JST** PDF spec sheet is:

http://www.jst-mfg.com/pdfE/eZM.pdf



JST schematic showing the available ZH connector variations

Keep in mind that without a crimping tool (which costs around 300 dollars US), it will be easier and cheaper to purchase a pre-connected **ZH Series** pigtail from Maxx Products or an electronics supplier such as DigiKey.

Multiplex has likely chosen this small connector for their preassembled OEM expansion switches since the small **JST ZH Series** connector will fit through the "P" and "K" expansion well holes without requiring any unsoldering by the pilot.

Making an expansion switch is just a matter of soldering on a **ZH Series** pigtail directly to the toggle switch terminals and plugging in the **ZH Series** connector into the EVO main board **JST** slot.

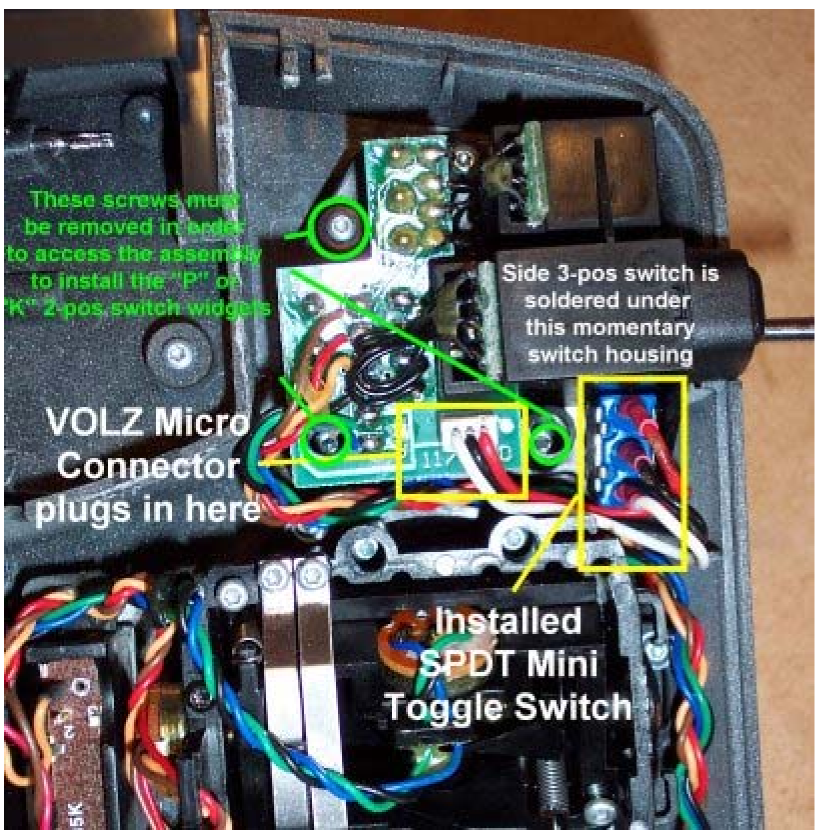
With a Male **ZH Series** pigtail from Maxx Products and a mini toggle switch from Mouser or DigiKey, the costs of the self-made expansion well switches are about 5 dollars (US) each.

This is a cheaper alternative than ordering Multiplex OEM expansion switches.

15.3 ADDITIONAL PHOTOGRAPHS

The following photographs show a completed self-installed two-position switch widget that the author installed in the "P" well on his EVO. The widget installed in these photographs was purchased from a local Radio Shack, but is identical to the items offered by Mouser and other major electronics parts suppliers.

Note that the bag on the left does not come with two switches nor does it come with the red caps. These were just items that the author placed in the bag so that he would not lose them.



Rear view showing an installed widget in the "P" expansion well.

A flat actuator 2-pos switch widget was installed in the "P" well. Since the actuator was too thick, it had to be filed down in order to fit through well.

Rubber cap added to the actuator to improve tactile feel and appearance.

16. ORIGINAL MULTIPLEX MIXER DEFINITIONS

The original factory-established settings of the mixers that come pre-programmed into the EVO are shown below.

If the reader has accidentally erased or modified the original mixers to where they no longer work as designed, the original mixer settings are shown below and can be manually returned to their original state.

16.1 ELEVATOR+

```
Elevator+

Elevator ----
Spoiler  ----
Flap     ----
Thr -Tr  ----
```

16.2 V-TAIL+

```
V-Tail+

Elevator ----
Rudder   ----
Spoiler  ----
Flap     ----
Thr -Tr  ----
```

16.3 DELTA+

```
Delta+

Aileron  ----
Elevator ----
Thr -Tr  ----   –
```

16.4 AILERON+

```
Aileron+

Aileron  ----
Spoiler  ----   +
Flap     ----
Ele -Tr  ----
```

16.5 FLAP+

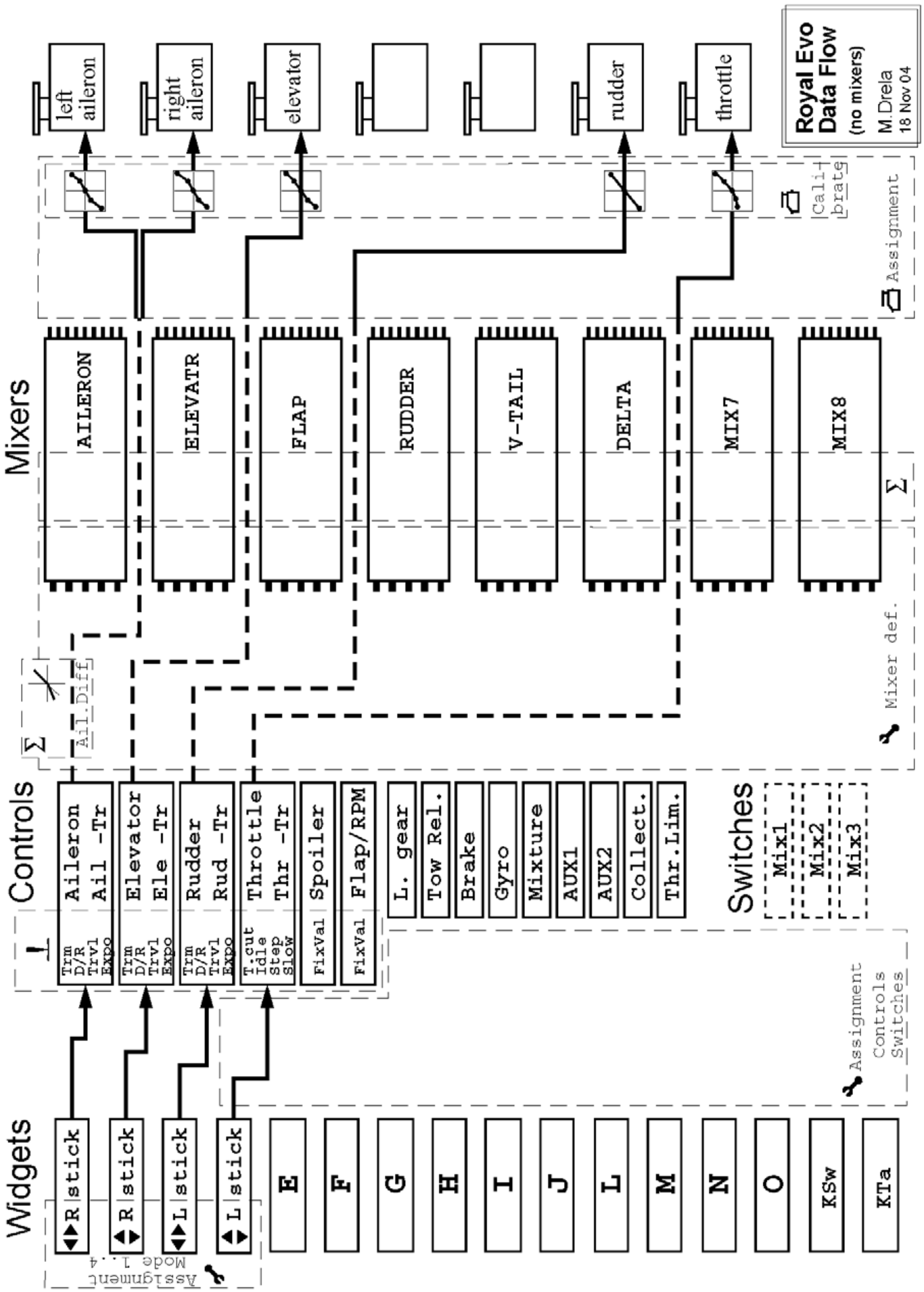
```
Flap+

Flap     ----
Spoiler  ----   +
Aileron  ----
Ele -Tr  ----
```

17. EVO DATA FLOW CHARTS

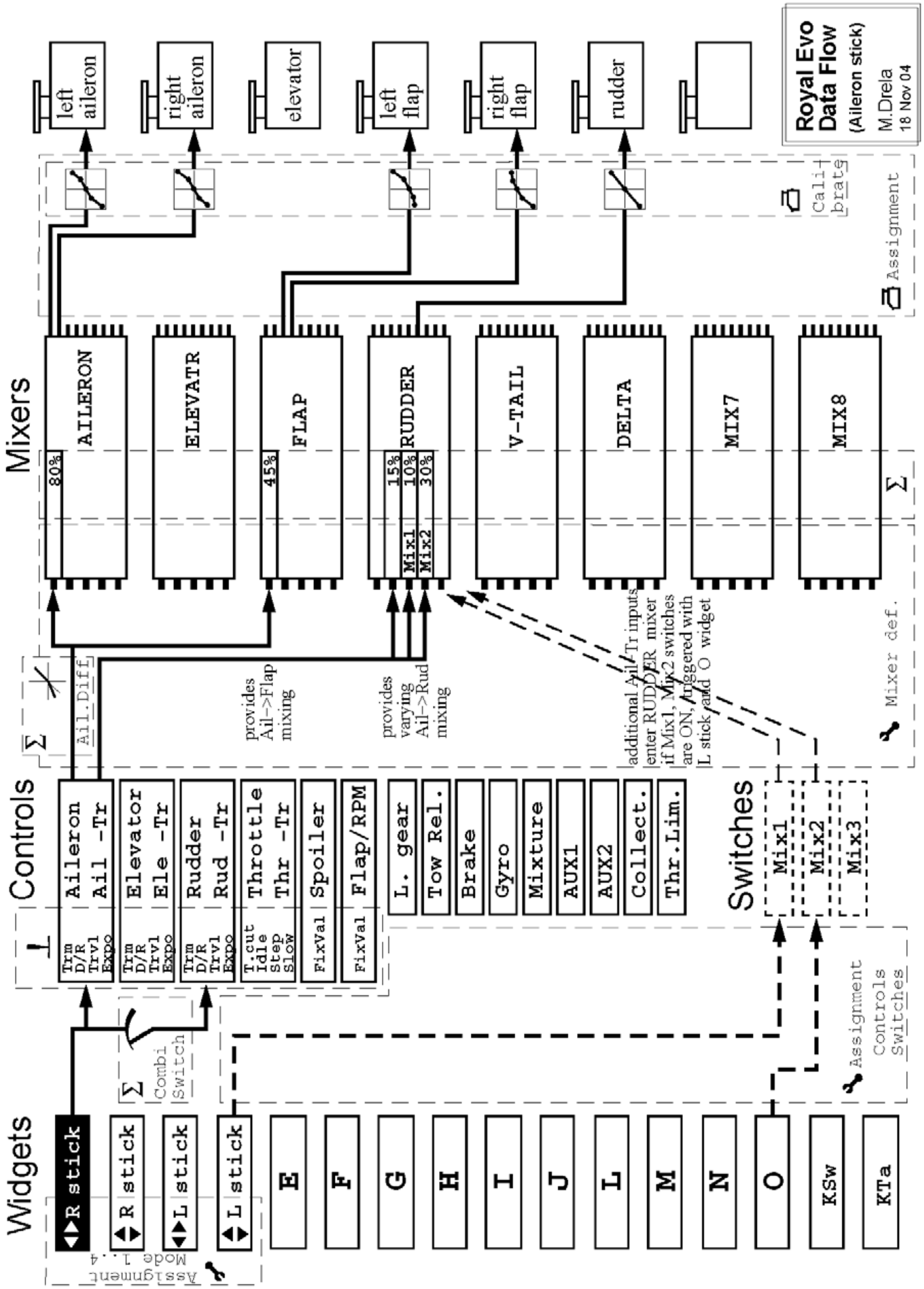
The following charts have been created by Mark Drela and have been included with the EVO Tutorial with his kind permission.

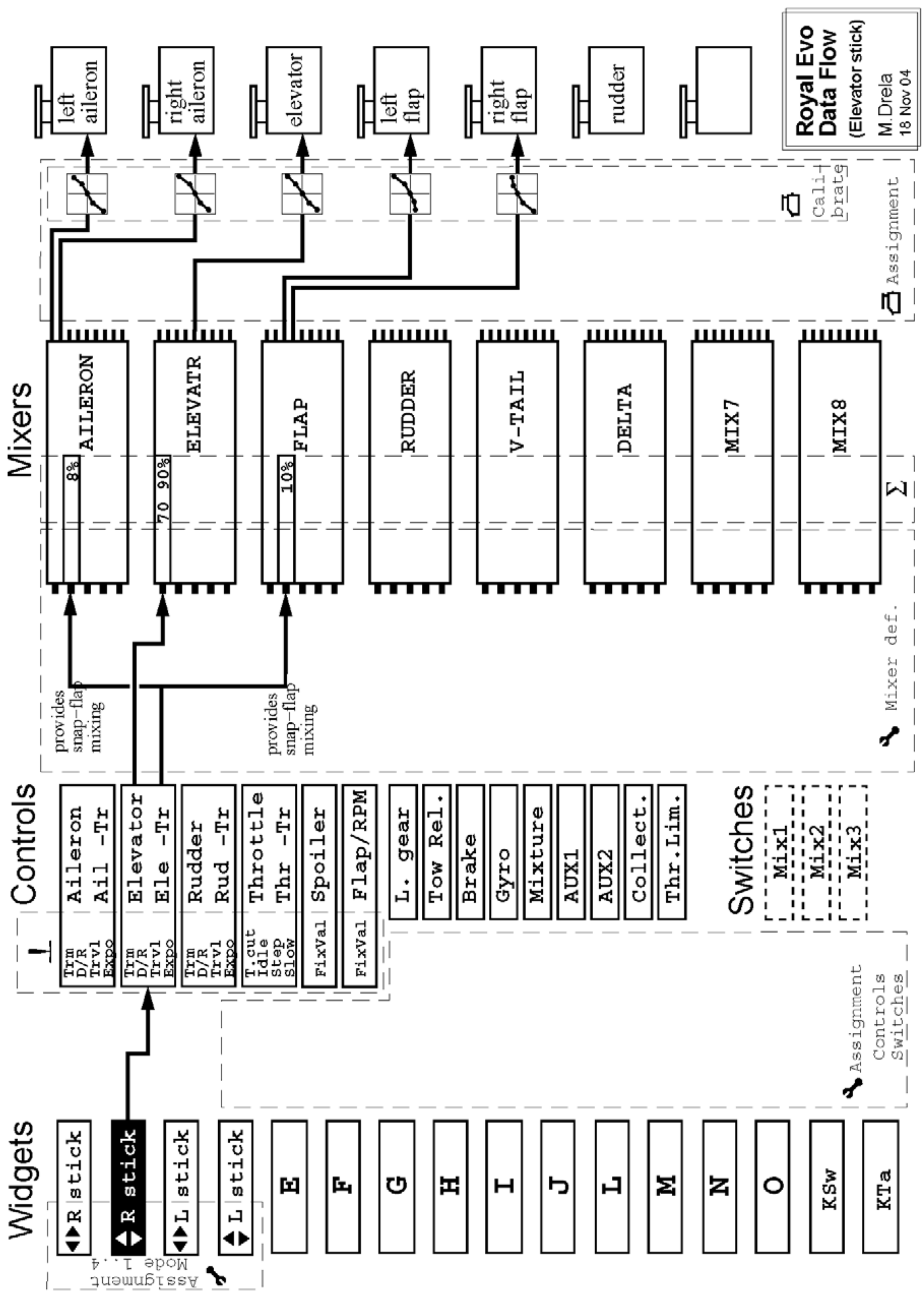
These charts offer the pilot a visual presentation of the data flow process that occurs within the EVO from the widget movements to the resulting movements of the servos. The plane scenario that these charts are representing is a full-house sailplane, but the data process that are illustrated within the schematics applies to all plane types in the EVO.

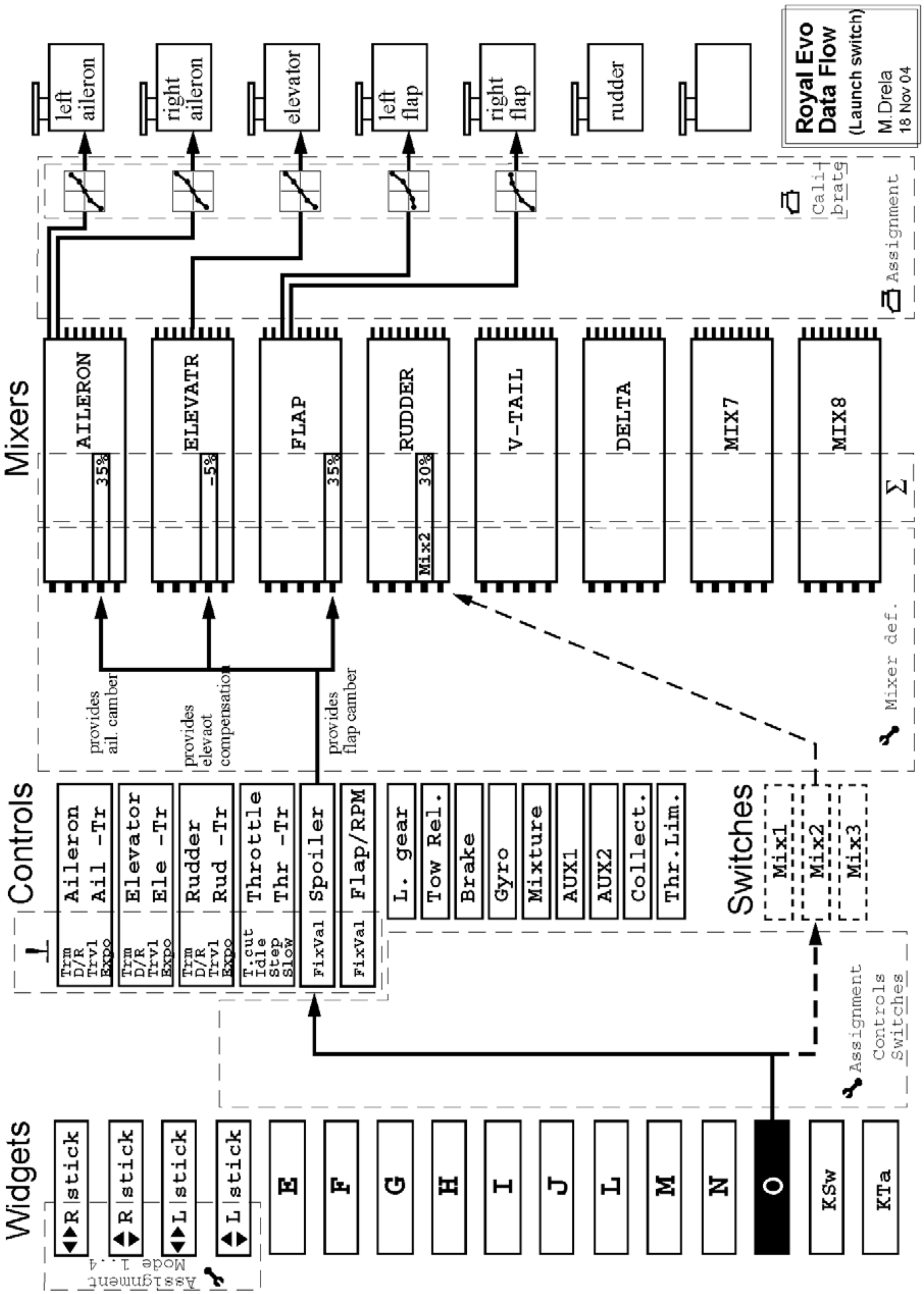
In addition, Mark has also provided a "blank" Data Flow Process chart that the readers can utilize to better help them to visualize and understand the EVO data process flow when programming their own EVO radios.

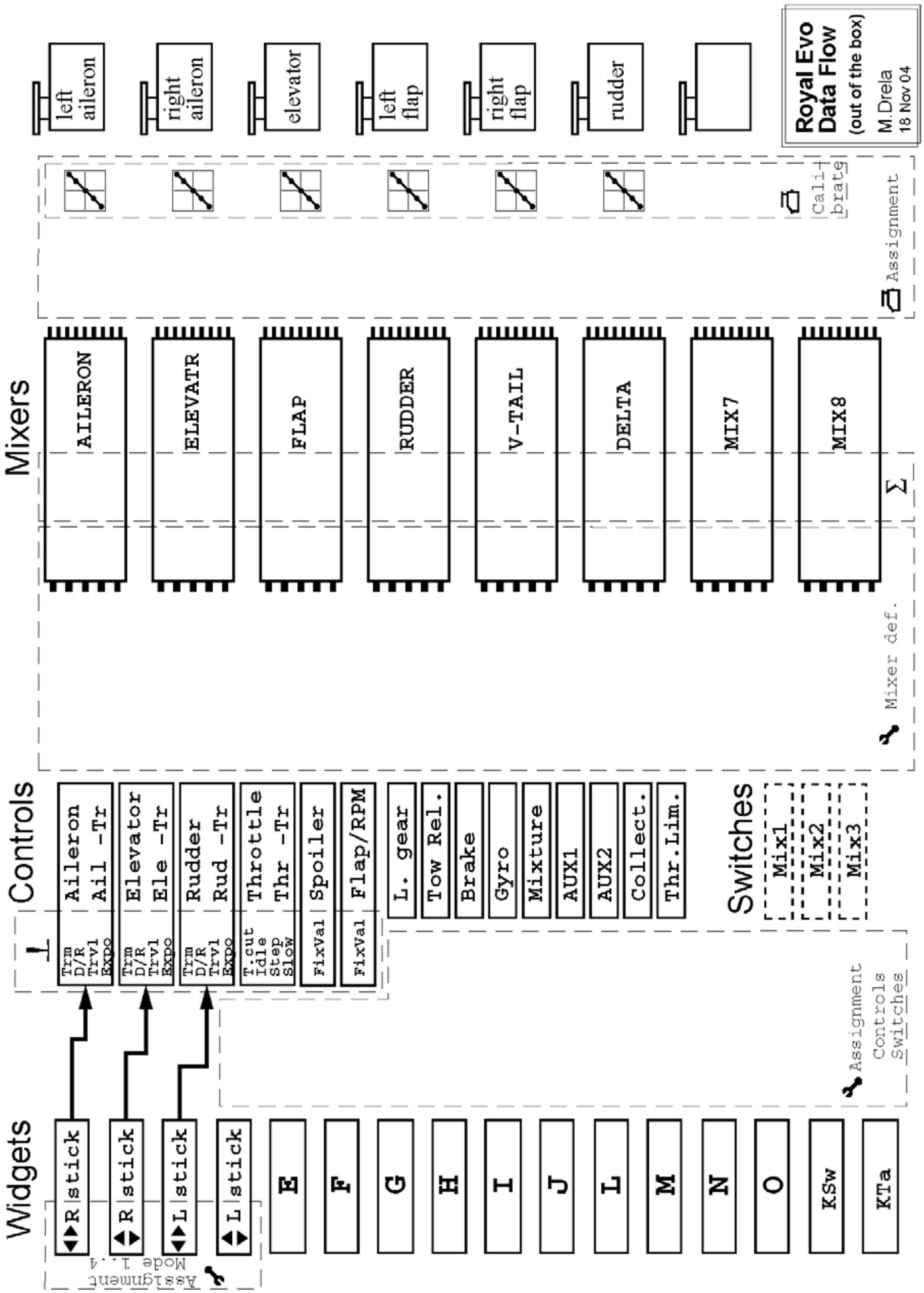


Royal Evo Data Flow
(no mixers)
M.Drela
18 Nov 04
Widgets
R stick
R stick
L stick
L stick
E
F
G
H
I
J
L
M
N
O
KSw
KTa
Assignment
Mode 1..4
Assignment
Controls
Switches
Controls
Aileron Ail -Tr
Elevator Ele -Tr
Rudder Rud -Tr
Throttle Thr -Tr
Spoiler
Flap/RPM
Trm D/R Trvl Expo
T.cut Idle Step Slow
FixVal
L. gear
Tow Rel.
Brake
Gyro
Mixture
AUX1
AUX2
Collect.
Thr.Lim.
Switches
Mix1
Mix2
Mix3
Ail.Diff
Mixer def.
Mixers
AILERON
ELEVATR
FLAP
RUDDER
V-TAIL
DELTA
MIX7
MIX8
Assignment
Cali-brate
left aileron
right aileron
elevator
rudder
throttle


Royal Evo Data Flow
(Aileron stick)
M.Drela
18 Nov 04
Widgets
R stick
R stick
L stick
L stick
E
F
G
H
I
J
L
M
N
O
KSw
KTa
Assignment
Mode 1..4
Combi Switch
Controls
Aileron
Ail -Tr
Elevator
Ele -Tr
Rudder
Rud -Tr
Throttle
Thr -Tr
Spoiler
Flap/RPM
L. gear
Tow Rel.
Brake
Gyro
Mixture
AUX1
AUX2
Collect.
Thr.Lim.
Trm
D/R
Trvl
Expo
T.cut
Idle
Step
Slow
FixVal
Assignment
Controls
Switches
Switches
Mix1
Mix2
Mix3
Ail.Diff
provides Ail->Flap mixing
provides varying Ail->Rud mixing
additional Ail-Tr inputs enter RUDDER mixer if Mix1, Mix2 switches are ON, triggered with L stick and O widget
Mixer def.
Mixers
AILERON
ELEVATR
FLAP
RUDDER
V-TAIL
DELTA
MIX7
MIX8
80%
45%
15%
10%
30%
Mix1
Mix2
Assignment
Cali-brate
left aileron
right aileron
elevator
left flap
right flap
rudder


Royal Evo Data Flow
(Elevator stick)
M.Drela
18 Nov 04
Widgets
R stick
R stick
L stick
L stick
E
F
G
H
I
J
L
M
N
O
KSw
KTa
Assignment
Mode 1..4
Controls
Trm D/R Trvl Expo
Aileron Ail -Tr
Elevator Ele -Tr
Rudder Rud -Tr
T.cut Idle Step Slow
Throttle Thr -Tr
FixVal
Spoiler
Flap/RPM
L. gear
Tow Rel.
Brake
Gyro
Mixture
AUX1
AUX2
Collect.
Thr.Lim.
Switches
Mix1
Mix2
Mix3
Assignment
Controls
Switches
Mixers
provides snap-flap mixing
AILERON
8%
ELEVATR
70 90%
FLAP
10%
RUDDER
V-TAIL
DELTA
MIX7
MIX8
Mixer def.
Σ
Assignment
Cali-brate
left aileron
right aileron
elevator
left flap
right flap
rudder


Royal Evo
Data Flow
(Launch switch)
M.Drela
18 Nov 04
Widgets
R stick
R stick
L stick
L stick
Assignment
Mode 1..4
E
F
G
H
I
J
L
M
N
O
KSw
KTa
Controls
Trm
D/R
Trvl
Expo
Aileron
Ail -Tr
Elevator
Ele -Tr
Rudder
Rud -Tr
T.cut
Idle
Step
Slow
Throttle
Thr -Tr
FixVal
Spoiler
FixVal
Flap/RPM
L. gear
Tow Rel.
Brake
Gyro
Mixture
AUX1
AUX2
Collect.
Thr.Lim.
Switches
Mix1
Mix2
Mix3
Assignment
Controls
Switches
provides
ail. camber
provides
elevaot
compensation
provides
flap camber
Mixer def.
Mixers
AILERON
35%
ELEVATR
-5%
FLAP
35%
RUDDER
30%
Mix2
V-TAIL
DELTA
MIX7
MIX8
Σ
Assignment
Cali-
brate
left
aileron
right
aileron
elevator
left
flap
right
flap
rudder


Royal Evo Data Flow
(out of the box)
M.Drela
18 Nov 04
left aileron
right aileron
elevator
left flap
right flap
rudder
Cali-brate
Assignment
Mixers
AILERON
ELEVATR
FLAP
RUDDER
V-TAIL
DELTA
MIX7
MIX8
Σ
Mixer def.
Controls
Aileron
Ail -Tr
Elevator
Ele -Tr
Rudder
Rud -Tr
Throttle
Thr -Tr
Spoiler
Flap/RPM
Trm
D/R
Trvl
Expo
T.cut
Idle
Step
Slow
FixVal
L. gear
Tow Rel.
Brake
Gyro
Mixture
AUX1
AUX2
Collect.
Thr.Lim.
Switches
Mix1
Mix2
Mix3
Assignment
Controls
Switches
Widgets
R stick
R stick
L stick
L stick
E
F
G
H
I
J
L
M
N
O
KSw
KTa
Assignment
Mode 1..4

18. REVISION HISTORY

18.1 UPDATE "A"

Modified:	EVO Programming Flowchart	p.15
Corrected:	Various spelling and grammar errors	

18.2 UPDATE "B"

Added:	Full-House sailplane setup guide	p.51
Added:	EVO Menu Hierarchy Chart	p.17
Added:	Scenario - Snap Roll	p.78
Added:	Scenario – Snap Flaps	p.75
Corrected:	Minor layout revisions	

18.3 UPDATE "C"

Added:	Mark Drela's Comments	p.76
Added:	Scenario – Servo Sequencing	p.83
Added:	Scenario – Auto. Crow Deployment	p.87
Added:	Scenario - DLG Pre-Set With Tapering Reflex Action	p.90
Added:	Scenario - How to "Assign" A Digi-Adjuster To A Control	p.94
Added:	Revision History Chapter	p.96
Added:	Reader Feedback	p.99
Corrected:	Minor layout revisions	

18.4 UPDATE "D"

Added:	Scenario –	Selectable "Throttle-Cut"	p.95
Added:	Scenario –	Selectable Snap Roll	p.98

18.5 UPDATE "E"

Added:	Scenario -	Automatic Combined Single-Stick flying	P.104

18.6 UPDATE "F"

Added:	Scenario -	Selectable Expo Rates	p.111
Added:	Chapter -	Self-Made Expansion Switches	p.115

18.7 UPDATE "G"

Corrected:	Duplicate	"Selectable Snap Roll" scenario deleted	
Corrected:	Scenario -	"Selectable Snap Roll" Additional aileron mixer required	p.98
Corrected:	Scenario –	Selectable Throttle Cut	p.98
Added:	Scenario - Selectable Smoke Action		P.112
Added:	Additional photographs added to Self-Made Expansion Switches		p.118
Added:	Scenario -	Twin Turbine Engines	p.110
Added:	Charts - EVO Data Flow Charts		P.122

18.8 UPDATE "J"

Added:	EVO Template discussion	P.19
Added:	Assignment List discussion	P.23
Added:	Helicopter programming content	P.71
Added:	Scenario	
	Programming plank-style wings	P.172
Corrected:	Switch Assembly Plug Connectors	P.177
	Clarification on JST plug types	
	for expansion switches.	
Corrected:	Programming Full House Sailplanes	
	FLAPx mixer Spoiler symbol changed	P.58
Corrected:	Programming Full House Sailplanes	
	Servo Calibration step deleted	
	and a new method added to correct	
	flap travel in the MIXER menu	P.61

19. ACKNOWLEDGEMENTS AND CREDITS

I would like to thank the following individuals for their valuable time and input into this tutorial.

Harry Curzon for his prompt, expert answers and guidance to all Multiplex users as well as to the author himself. Without Harry's generous time and effort to proofread this tutorial, there would have been many errors and oversights.

Geir Wilkran for his valuable full-house sailplane guide.

Bill Glover for his steady and persistent assistance to all Multiplex users. Bill, like Harry, spends valuable time generously assisting new Multiplex pilots in their programming questions.

Mark Drela for posting and providing a DLG preset mixer method using the momentary side buttons as well as offering his data flow charts.

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Dave Kirk for offering his Plank Style flying wing programming solution.

To all of the individuals who wrote to say that this tutorial either convinced them to purchase an EVO or that the tutorial allowed them to fully enjoy and understand the possibilities of their EVO.

To all of the individuals who wrote personal notes thanking me for this tutorial.

Fly Multiplex!

Joedy Drulia

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20. Reader Feedback

I would like to congratulate Joedy on his effort, and the speed with which he has understood the EVO so well that he has been able to write the tutorial now published by HitecUSA. If you look at the main EVO thread, it was only last October that Joedy was asking how the EVO worked, and on 16th Oct was the first time that he actually got his hands on a borrowed EVO. An excellent achievement in such a short time.

Joedy, I now officially welcome you into the hallowed halls of "Multiplex Gurus" !!

I am a new EVO owner and have been struggling through the manual! Your tutorial has been absolutely magnificent in giving me a clearer understanding of what the radio is capable. It is fair to say that without the assistance of the tutorial I may never have appreciated half of what the radio has to offer. Your document is very readable and easy to understand.

Thank you very much for all the hard work and expertise that you (and Harry, Bill and others) have put into this most helpful tutorial.

Just to say – fantastic. More power to your pencil!

I would just like to say a big thanks for your excellent tutorial on setting up an EVO transmitter. Having recently purchased an EVO 12 and after over 30 years getting to know the Futaba way of doing things, I was really struggling!! … A quick search of the net lead me to your excellent work and as luck would have it I was trying to set up exactly the same model as you used in tutorial, the only difference being I have air brakes as well. I have to admit until I read your work I was thinking my new purchase was a big mistake and I should have gone for another Futaba set. I am a modeller from the UK and have been involved in many aspects of our marvelous hobby, including model jets and more latterly electric models. Thanks again for your help.

Your tutorial gets better every post. I hope you can finish it by the weekend. I am leaving for Florida to fly in the Tangerine contest Monday and plan to print out the tutorial so I can study it in my spare time.

Joedy if anybody has earned a gratuity it's you. Sorry I don't have any spare Multiplex stuff to send you, and you probably don't want the old Airtronics stuff. Do you have a favorite brand of beer?

Thanks Joedy for the great tutorial. I am sure it will come in handy once I get an EVO.

Thanks a big one Joedy. If it wasn't for you I would have sold this radio. I am really starting to like it now.

Thanks a million! Just printed and read your tutorial….I got my EVO 4 months ago and had my share of difficulties adopting the MPX way of thinking. However, I have managed to set up one 3-D, two fun flyers and an electric helicopter without too many problems. Just a minute ago I managed to get the elev. compensation for crow to work linearly with the spoilerons/flaps input. The first try with the 2.8 Silent Dream took me 4.52hrs to get to obey. My Robbe Eolo [took] only 4min. I guess I should reset the radio and start all over now that there is this excellent guide available

The tutorial is great, I've learned a lot from it.

Excellent. Your work and level of explanation is just excellent !

Well done !!!!! I think Multiplex should add this tutorial to each radio they sell.

Great job Joedy!! I'm beginning to understand the functional theory behind the RE12!

I haven't received my EVO 9 yet but have started reading the manual. The situations brought up in the tutorial are excellent

I just got my EVO 9 a few days ago, read the manual and tutorial. The tutorial helped me a lot, I would struggle much more without it. Thanks a lot.

Thank you for all of the time and effort that you put into the tutorial. I do not have my radio but have just ordered one and I now see what all of the excitement is about. The manual was OK but you do not see all of the opportunities until you read the tutorial. What an eye opener to the wonderful world of EVO as compared to the world of AR. This is my first step up into the world of a real computer radio. I have a Futaba 7AU and a Hitech Flash 5X and there is no comparison. All of my Futaba's (3 ea) are going on sale. I will keep the 5X just for a back up.

Again, thank you for opening up my eyes to what a real computer radio can do. Now all I need is for the radio to show up. The wait will be worth it though.

Thank you!!! This tutorial is awesome

Great for you, HiTec, Multiplex and EVO users everywhere.

YES!!!! Finally the Tutorial is in my printer! Thanks Joedy (and Hitec), I thought I was gonna go nuts while waiting. First the wait for the radio, then as soon as the radio materialized, the tutorial was gone! But, now all is great again.

Gents (all the tutorial contributors), well done! I downloaded the manual [tutorial] this morning and it is an excellent piece of work. You deserve credit for not going the greedy route and trying to sell the booklet as, has happened with other transmitter guides!

A "friend " informed me about the EVO. Now I have to rethink my entire system, away from Fut. 9C. Overwhelming info.. but certainly appreciated and much more than what I got with Futaba. Thank you sir. I have lots of reading to do.

Just had a quick look at the tutorial Joedy and I really appreciate just how much work must have gone into it. It seems very clear and I think that Multiplex could have spent a little bit more space in their manual with data flow and process diagrams to get across the essential concepts. Do you have a job writing manuals? If not I think that Multiplex owe you a couple of receivers at the very least.

BTW, my compliments to the tutorial, great stuff!

I'd like to commend you on your open attitude as well as on the effort you have put into the tutorial. I think that it has turned out that the "right" person (you) has authored the basic work of the tutorial and become the most qualified to edit it as a "living" document as it is amended and added to. Many people would have had an ego problem and become quite possessive of the work, but even though you have done the major portion of the work, you have still incorporated valuable additions from other people (and given them proper credit), and are still willing to include contributions from others that will add additional value as well.

Your open attitude is sort of like the Linux operating system where anyone can, and does, add value to it as time goes on resulting in one heckuva powerful piece of work. Keep it up.

I have an EVO on the way. You have done a great job with the tutorial.

By the way , thank you Joedy for that wonderful tutorial. It helped me tremendously!

Thanks Joedy for the excellent work.

Greetings from Finland, Europe. I just wanted to thank you for your great Royal EVO tutorial! It really helped me a lot.

Excellent! Now to get hold of a radio!