

Taranis for DLG Pilots.

For Version 2.0.19

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1 Introduction

This guide is intended for DLG pilots who after using traditional radios with preset programming, are considering or have obtained a Taranis for DLG use. The purpose is to try to simplify the use of the Taranis specifically for DLG use. It is not a goal to figure out all the different things you can do with a Taranis, nor the multiple ways to get this done, just the typical setup. Note that there are multiple ways to accomplish the same thing with Taranis. The author is not suggesting that the way described here is THE way to do it, but it is A way to do it.

But what about Companion? Isn't there this cool program to do all the setup on your computer? Yes there is but I won't be using it till we get to the end. Why? Because you don't carry a laptop with you onto the flying field. Most people don't take a laptop to the field (I do, but I load a lot of setups for people and this saves me time.). All you usually have with you at the field is the transmitter. So if you learn to setup with the transmitter, you will know how to make adjustments in the field. Later if you use companion to copy models and try to new things out, you will still know how to adjust it in the field. If we start with companion and you never map the companion screens to the actual transmitter screens, you will be helpless to make adjustments in the field.

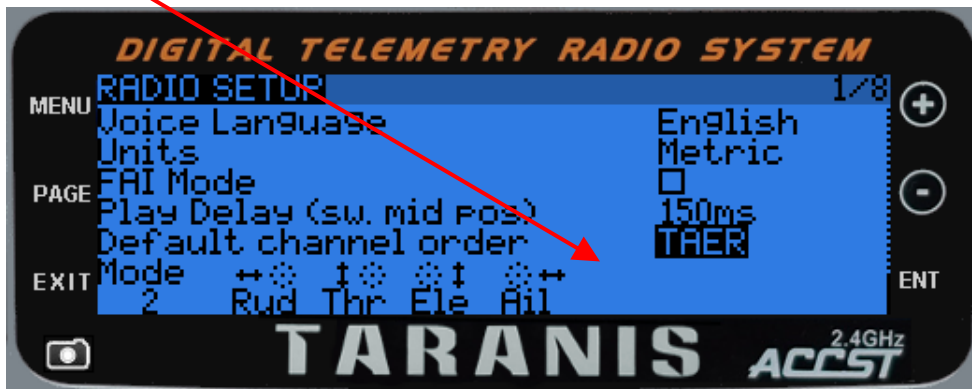
1.1 Fundamental Taranis Concepts

A little background can go a long way in being able to use the Taranis at the field. It is possible to download a Taranis setup for DLG and get it to work on the bench only to be frustrated at the field by not knowing how to make what would seem to be a simple adjustment on the field during a contest prep window. This guide will attempt to provide enough background for the setup and why each choice was made. This is so the pilot will know which setting affects what output so that the adjustments can be made in the field.

Taranis Basics:

- There are no preset "setups", you build a setup from raw materials.
- Mixers are not just for special functions
- Flight modes are helpful and have priority.
- "Virtual" switches
- "Condition" switches
- "Sticky" switches
- "Edge" switches
- Inputs and outputs
- "Special" functions

Note : this guide assumes that the transmitter has been configured for JR signal order, that is TAER. You can make this setting in the Radio Setup screen (long hold on the Menu button):



Some basic ideas

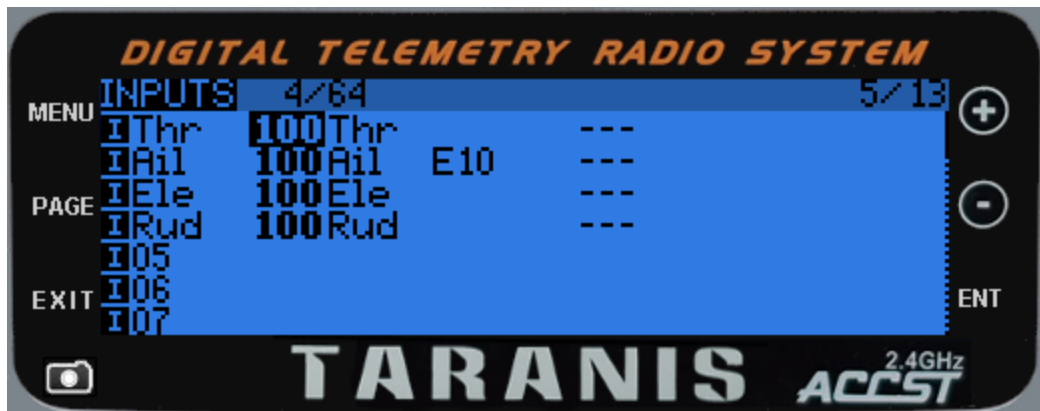
1.2 Simple 2 Channel Model

To get our feet wet and get past the initial shock of using a new paradigm, let's first set up a basic 2 channel sailplane. The basic thing you need to know is that on Taranis you have to connect things together yourself. This is challenging at first because on a traditional radio you already have the basic four channel model already set up. But this ease of set up has its downside in that it is limiting. For example you can't choose what channels the servos plug into the receiver, or which stick to use. For this example let's decide that you want to use the right (aileron stick) for rudder, but have the rudder channel be channel 4 on your receiver, because you may add ailerons later and don't want to have to rewire the plane. Right off the bat, with a traditional radio what I just described is complicated because a traditional radio wants ailerons on channel 2 (JR). So some trick or mixer must be employed, but not with Taranis.

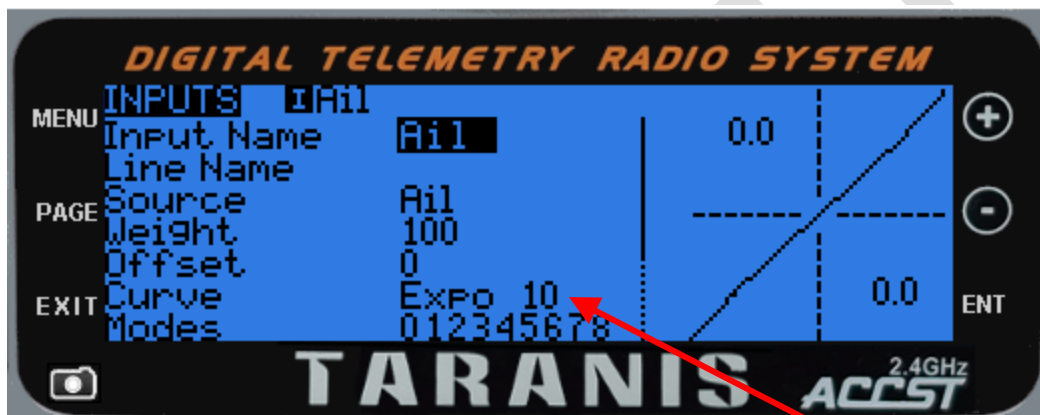
Let's set this up the Taranis. On Taranis, setup of a channel is the result of asking a few questions then filling in the blanks.

- What control do I want to use?
- Do I want expo/dual rate on that channel?
- What channel on the model do I want to connect this to?
- What kind of motion do I want when the stick moves for this channel?
- Do I need to adjust the servo centering or throw differences?

Let's start with rudder. (*What control do I want to use? Do I want expo/dual rate on that channel?*) First I want to use the aileron stick for rudder, and I want a little expo (say 10%). So I go to the inputs screen and select the aileron input:

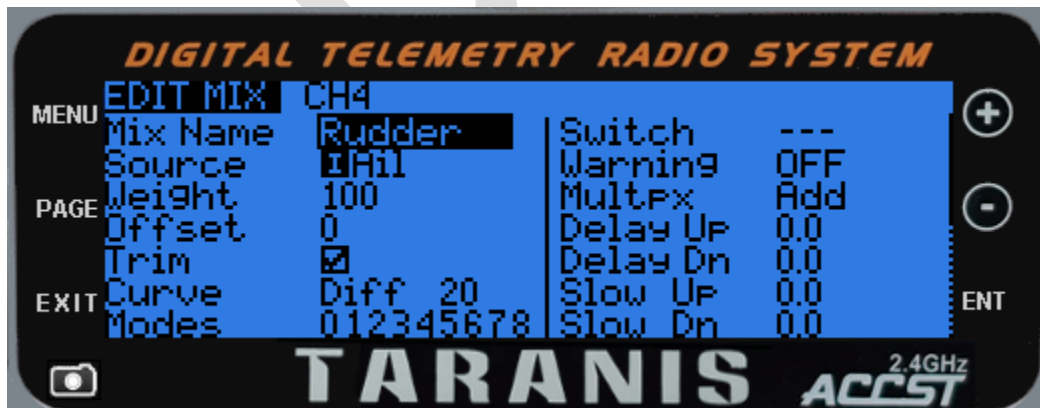


Use the “+/-” key to scroll down to the aileron line, hold down the enter key and get to the mixer for this channel:



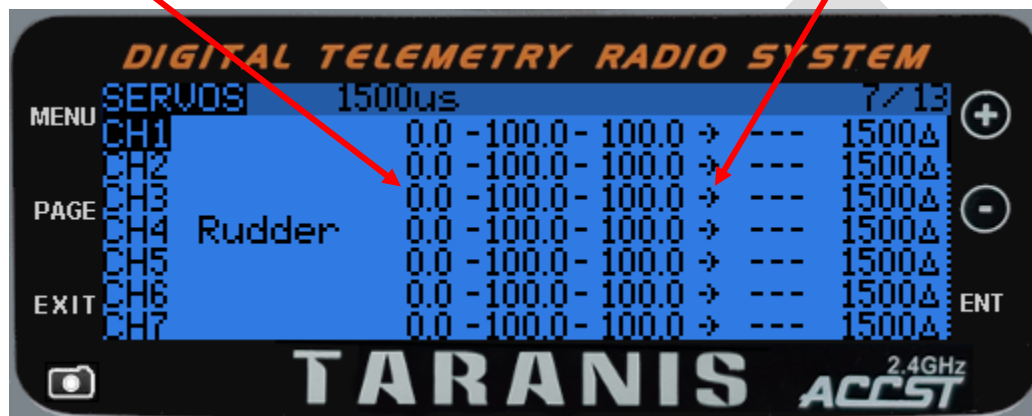
Edit the mixer. We leave the weight at 100%, we set the expo to 10%. So now the aileron stick always outputs an exponential amount of “signal” compared to the linear stick movement. This is what we do if we want a “universal” expo feel for the ailerons all the time.

Now we hook this aileron “signal” to the channel we want. (*What channel on the model do I want to connect this to? What kind of motion do I want when the stick moves for this channel?*) Go to the mixers screen, scroll down to the rudder channels (4 if you set your model up to JR signal order TAER) and hold the enter key to edit the mixer.



We chose the source for this mixer of IAI, this is the “expo’d” aileron signal we built in the inputs. We make sure that the trim box is checked, because we do want aileron trim. We name the mixer “Rudder” to remind us that this is really the rudder channel. We set the “weight” or how much the rudder moves corresponding to the stick at 100%. Finally we set the diff to 20% because we didn’t quite get the rudder horn over the hinge line and we need a little more throw one way versus the other. (Note that this might be -20% if the diff needs to be the other way). We make this work for all flight modes 0-8 (we aren’t using them right now).

We now go to the servo screen. (*Do I need to adjust the servo centering or throw differences?*) If we need to change the servo direction we do it here. We can change the subtrim here as well. For now we don’t need anything else.



You can change throws on this screen as well. This is where you set the traditional “end points” for a channel, which is the mechanical limits the servo is allowed to move. Once you set mechanical limits here you won’t have to adjust them again. We are now done with rudder.

We repeat this procedure for elevator.

The model setup is complete.

That wasn’t so bad, now was it? We just had to decide what stick moved what servo and by what amount. We didn’t have to fight the radio to “trick” it to use the rudder channel with the aileron stick, we simply hooked up the input we wanted to the channel we wanted. This is the Taranis (OpenTx) way.

Now of course, a 4 channel DLG with flaperons is going to be more complicated than this so you will need to be a little patient in the sections that follow. Take your time, hopefully it will be worth it and you will be able to set up your model exactly the way you want.

Note: The following few pages are a discussion about some basic concepts, not a hands-on experience with the radio. I feel like this discussion is important because it is a few concepts that just didn’t exist in old style radios. So I think it is good to talk about the ideas without getting bogged down in the actual hands on part of programming. Be patient as eventually it all comes together, but I think you will be better off with an understanding of what’s going on.

2 Logical Switch Basics and Flight Modes

Flight modes are familiar to most fliers. The Taranis has 9. Importantly they have a priority. Flight mode 0 is selected when none of the other modes is selected. I don't use that one¹. Flight mode 1 takes priority over modes 2 through 8. This means if you assign a switch to flight mode 1 and turn that switch on, flight mode 1 will always be selected, even if the switches that turn on the other flight modes are also on. If 1 isn't selected and 2 is, then it takes priority over 3 to 8, etc. This is useful for DLG because you can use flight mode 1 for launch/rotate and flight mode 2 for zoom/climb and they will always override the other flight modes. Handily you can disable flaps for these two modes in clever ways and never launch with flaps down. I'll get into how to select flight modes after the discussion about logical switches. This is because the logical switches are useful for picking flight modes.

2.1 Logical Switches

The first concept for traditional users is the idea of a "virtual" switch. Radios used to have only real mechanical switches. You moved a mechanical thing and it made the radio do something. In Taranis you can have a "pretend" or "virtual" switch. These are called logical switches. A logical switch can be turned on or off like a real switch but the thing that turns it on or off doesn't have to be a mechanical switch. For example the throttle/flap stick being above 90% can make a logical switch turn on. Conversely the throttle being below 90% can turn that same logical switch off. The conditions that can turn a logical switch on or off can be a real switch, some condition like throttle and more stuff. The more stuff includes things like moving a stick such as the elevator up or down by a certain amount, or if the throttle or any other control is roughly in a given position. The opposite of these can be used as well. For example a logical switch can be set if the throttle is NOT roughly in a certain position. The fact that you are in a certain flight mode can also set or clear a logical switch.

Another important concept is that a logical switch can be set when a switch/condition changes position, rather than when it's in a position. This is an important idea. A logical switch can be set very briefly when the throttle passes through 90%. It may only be set for a short time. This is useful in sensing when you are changing from one thing to another. An example. You can have a logical switch that is on when the throttle is above 90% and off when it is below 90%. As long as the throttle is above 90% the logical switch is on. In contrast you can have a logical switch that turns on only when the throttle moves from <90 to >90. This is called an edge switch. Note that in this example the switch briefly sets when the throttle goes from below 90 to above 90, but does nothing when the throttle moves from above 90 to below 90. This may not seem immediately useful, but it is, as will be shown later on. One of the main uses for an "edge" switch is detecting when you let go of the spring loaded launch switch.

To extend this idea, a logical switch can turn ON or OFF not only by a single thing changing but a combination of things changing. For example you can have a logical switch turn on when the throttle is below 90 AND when the flight mode is not launch, for example.

Summary: Logical switches are not real switches but can do the same thing as a real switch. A logical switch can be turned "on" or "off" by a real switch, by the position of a control, by a flight mode being

¹ I don't use it because I can't "select" it. It only is the default if nothing else is selected. This makes it a little tricky to use. And since there are 8 other flight modes this is enough to not have to putz with flight mode 0.

set, or logical combinations of these things. A logical switch can be set by the change of one control from one place to another (the edge between two things as it were).

2.2 Sticky Logical Switch

A sticky switch is a simple idea. It's basically a logical switch that gets turned on by one control, and turned off by another control. The sticky switch stays on until the "off" control turns it off, even if you release the switch or function that turned it "on". To make a silly example a sticky logical switch could be turned on with the spring loaded switch (that can be then let go of) that later gets turned off when you pull full right rudder. Let's use a DLG example to solve a common problem. During a quick turn you want to land with the flaps down, make the catch and then relaunch with the flaps up. Most pilots use a spring loaded switch to do this. Also you really don't want the flaps to come down when you let go of the spring loaded switch for the zoom portion of the launch either. What is needed is a "logical" (and turns out "sticky") switch that gets turned on when you pull the spring loaded switch (and doesn't get turned off when you release the spring loaded switch; it gets "stuck" on, hence a "sticky" switch) and gets turned off when you do something at the top of the climb, like moving the flap stick for example. This logical switch can be used to select flight modes that disable the flaps, for example.

2.3 Launch Example

Let me take the flight modes and logical switches and describe the first piece of the DLG program for Taranis.

The setup is to use the spring loaded switch being pulled to select flight mode 1 (call this Launch). This has its own set of camber, rudder, elevator and aileron trim, and can have its own dual rates/throws if so desired. We also make another flight mode called "zoom" and make it flight mode 2. We create a sticky switch that gets set when the launch mode switch is pulled using the edge function. So when we pull the switch we select launch and we set this sticky switch. We choose flight mode zoom with this sticky switch. So when we pull the launch switch we get launch and zoom selected, but launch is higher priority and so we get launch. When we release the spring loaded switch, the sticky switch is still stuck on, set so we get zoom. For convenience we will make zoom have the same trim, camber, etc. as our speed mode. So however the model is trimmed for speed also becomes our trim for zoom, except we disable the flaps.

The sticky switch gets turned off whenever the flap stick is over 90%. So if the flap stick is up when we launch we get launch, then speed mode, because the stick switch is cleared immediately after it has been set by the launch switch. On the other hand, if the flap stick is low, as in a quick turn, the zoom mode with flaps disabled stays on until we bring the flap stick up. No launching with flaps down.

Note that the zoom mode doesn't have a real switch assigned to it. It is set when the spring loaded switch is first pulled (edge of spring switch), stays set if the flaps are low (sticky), then clears when the flap stick is pulled up. No real switch needed.

3 Flight Modes

3.1 Basic Flight Modes – Version One

To continue and flesh out our flight modes we want speed, cruise and thermal in addition to launch and zoom, so we end up with these flight modes : launch, zoom, speed, cruise and thermal. These modes are selected by the following things:

- FM1: Launch – Pulling and holding the spring switch (Switch F on Taranis, abbreviated SF↓ with a down arrow).
- FM2: Zoom – Set by stick logical switch Logical 1 (L1 in taranis speak)
L1 is set by the edge of SF↓ (in Taranis speak edge:SF↓)
L1 is cleared by flap stick being > 90% (in Taranis speak thr>90) (we put this on logical switch 2 or L2, so L1 is set edge:SF↓ and cleared by L2.)
- FM3:Speed Set by 3 position switch being down (away) (SE↑)
- FM4:Cruise set by 3 position switch in the middle (SE→)
- FM4:Thermal set by 3 position switch up (close)(SE↓)

There is a problem you say? Yep it's possible to rotate, have the flaps up, clear out zoom then accidentally be in thermal or cruise mode during climb. How to prevent this?

The solution is to add a little more logic to stop us from making a mistake. We don't clear the zoom mode out until we have the flaps up and we pushover at the top. We just need to move the 3-pos switch during climb to where we want it at pushover. So the modified flight modes are:

- FM1: Launch – Pulling and holding the spring switch (Switch F on Taranis, abbreviated SF↓ with a down arrow).
- FM2: Zoom – Set by stick logical switch Logical 1 (L1 in taranis speak), cleared by L4.
- FM3:Speed Set by 3 position switch being down (away) (SE↑)
- FM4:Cruise set by 3 position switch in the middle (SE→)
- FM4:Thermal set by 3 position switch up (close)(SE↓)
- L1 is the edge of spring switch (SF↓)
- L2 is a logical switch that is true when the elevator is moved more than say 10% (either way).
- L3 is a logical switch that is true when flaps > 90 AND when L2 is on.
- L4 is a sticky that is set by L1 and cleared by L3.

Note that FM3,4 and 5 only come into play if FM2 and FM1 are not selected due to flight mode priority.

So given this setup here are the launch choices:

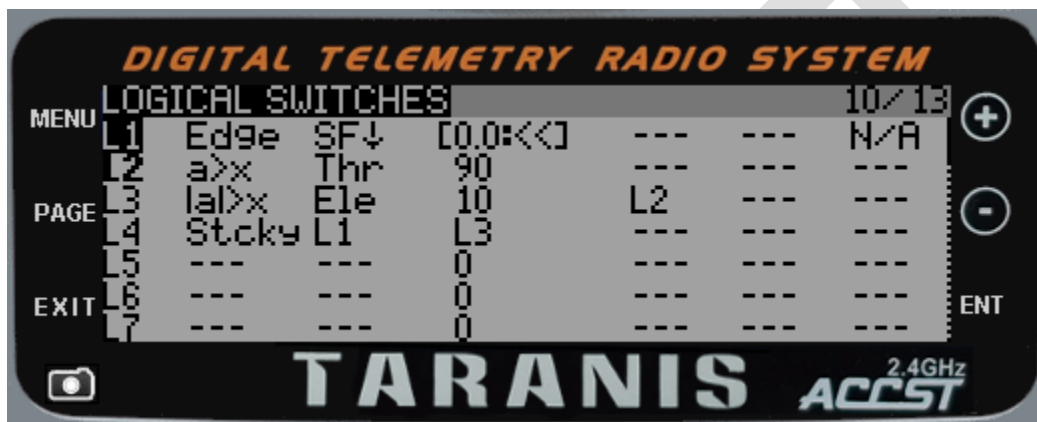
Flaps	3-Pos	Effect
Up	Speed	Pull the launch, release to zoom mode, pushover in speed mode.
Up	Cruise	Pull the launch, release to zoom mode, pushover into cruise
Up	Thermal	Pull the launch, release to zoo, pushover to thermal

Down	Doesn't matter	Launch, release to zoom, pushover stays in zoom/speed with flaps up, finally pull flaps up and bump the elevator to go into whatever mode the 3 position switch is in.
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Ok so now we have the idea for flight modes. Let's program the radio to do this now.

Turn on the Taranis. Hit the menu key. Hold down the enter key, then choose select model. Page over to the "Flight Modes" screen. Use +/- to go down to FM1. Hit enter and Edit the name to be "launch". Hit exit then navigate to the --- spot. Hit enter then pull the SF switch. Before letting go, hit enter. Hit exit and put the names Zoom, Speed, Cruise and Thermal in for FM2,3,4 and 5 respectively.

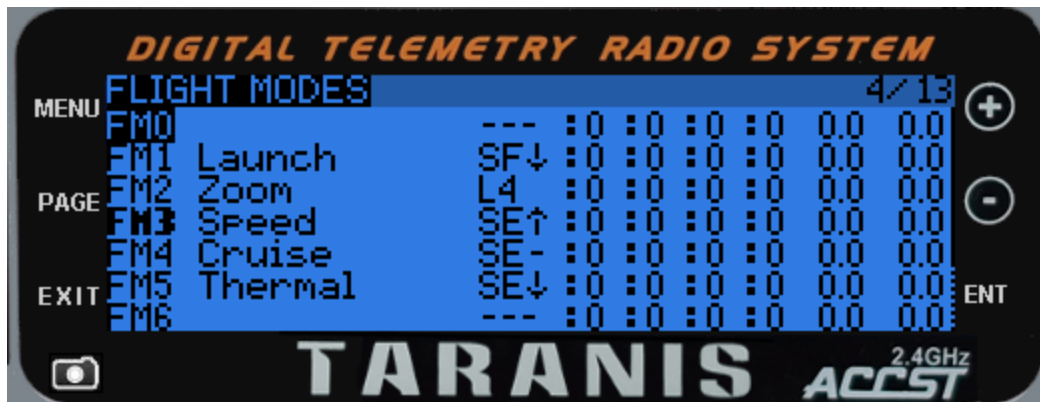
Use page to get to the logical switches screen. Setup these logical switches:



The explanation is that L1 is an edge switch that works on the pulling of SF↓. The 0.0:<< stuff just means do it right now and don't wait for something else or any delays. L2 says turn on when the throttle stick (Thr) is greater than 90%, that is, close to the top. L3 say go true when the elevator is moved more that 10% up or down (|a| is absolute value so it says that "a" or elevator in this case can be less than -10 or greater than +10 and this switch will go true if L2 is also true (L2 is in the AND column for L3). Finally L4 is a sticky that gets set when L1 is true (we pulled on launch) and is turned off when L3 is true. Basically L4 comes on when we pull the launch switch and goes off when we move the elevator when the flap stick is up.

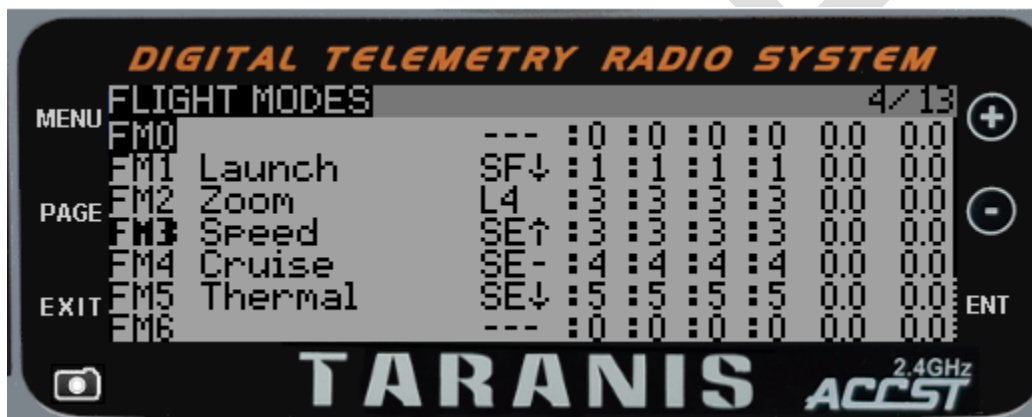
NOTE: Make sure you chose "Thr" and "Ele" instead "IThr" and "IEle" as the latter ones include the trim, which we don't want for these functions. We don't want elevator trim for example, to be clearing out zoom mode too early. We just want to know when the stick moves.

Now page back to the flight mode page and make this setup:



Now hit exit and play. Pulling SF will make launch get selected. Releasing will select zoom. Moving the elevator will unselect zoom and select whatever the 3 position switch is set to. Try pulling the flaps low and simulating a launch. See that you have to pull the flap stick back up and move the elevator so there is no way to launch with flaps down.

Finally let's make sure that whatever trim you have in speed is also the trim for zoom. Navigate to the flight mode screen and set the trim choices to this:



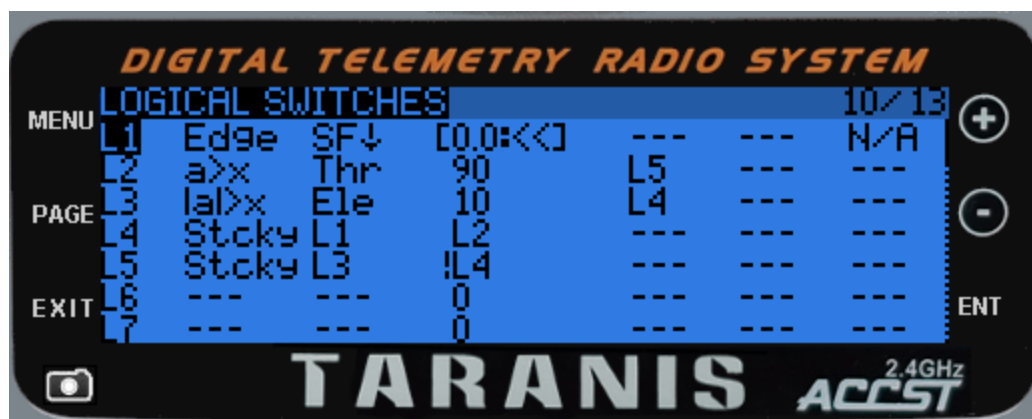
The explanation is that Launch has its own unique trims, as does Speed, Cruise and Thermal. But zoom just uses whatever trims are set for speed mode. Why not just use speed instead of zoom? Because as we will see Zoom will have the flaps disabled, and speed won't. This is how we stop the flaps from ever being down on launch/zoom.

If you don't like the method used to clear zoom out, or want different switches you should know enough now to pick what you like.

At this point we have the basic flight modes set up. Now we need to decide how we want the controls to move in each flight mode.

3.2 More Sophisticated Launch Mode

The flight modes above have one feature that I don't like, namely that you have to move the elevator again if you pushover before moving the flaps up. So this slight change fixes that problem:



Here is the explanation.

- L1 sets on the pull of SF as before. This also sets sticky L4 (Zoom). L1 enables launch.
- L3 sets when you move the elevator and sticky L4 is set. Basically L3 sets when you move the elevator (the |a|>x Ele>10 part) in zoom mode (the L4 part).
- L5 is sticky that remembers that you moved the elevator during zoom mode (we made this in L3). It clears when zoom mode (L4) clears. (The symbol !L4 says I want when L4 is off (that's the ! part) to be the action that clears this sticky.) In other words L5 gets set when we move the elevator in zoom mode, and gets cleared when we exit zoom mode.)
- L2 gets set when the throttle is above 90% and the elevator got moved during zoom mode (remembered in L5).
- L4 selects zoom mode. It sets on L1 (pull of launch switch) and clears on L2 being set. In plain language L4 (zoom) gets set when we pull the launch switch and gets cleared when we pull the flaps up then pushover, or pushover then pull the flaps up.

So L4 gets set on launch, and gets cleared when you move the elevator and pull the flaps up in either order. So now it doesn't matter if you move the flaps up before or after pushover, whichever is last will turn zoom mode off.

I think you will agree that this is a pretty handy trick for DLG launching that includes quick turns. No more launching with the flaps down, or in the wrong camber setting for zoom.

4 Mixers

Mixers are the heart of the radio. This is where you get to pick what control makes what servo move. Unlike mixers in a traditional radio that ADD some extra motion to already existing function, in Taranis you make the channel with the mixer in the first place. Using a mixer is pretty straightforward. You basically ask a few questions and then fill in the normal fields.

1. What channel do I want to work with? Let's choose rudder on channel 4. Yes you can pick any channel to any function with any receiver. So we will eventually in the radio go to channel 4 and add a mixer there.

2. What do I want to use to make this channel move? In this example we want rudder to move with the rudder stick. So we choose the source for the mixer to be the rudder stick. We also choose to include the rudder trim for this mixer because we do want rudder trim to work.
3. How much and in what way do I want the servo to move? There are couple of controls we want, one is the actual amount of throw we want when we want to move the rudder. This is not endpoint adjustment. Think of it kinda like dual rate. This is especially true for ailerons when we want the ailerons to move only a little bit for aileron, but a lot for flaps. We don't want to reduce the overall throw endpoint, just the effect when the ailerons are used.
4. When do I want the channel to move? You can have one mixer for all flight modes, or selected flight modes, or when a switch is flipped.

Before we dive completely into the mixers we should talk about curves.

5 Curves

Curves are a generic term for making a control move other than in a straight line. Most modelers are used to curves. What most modelers aren't used to is the use of curves most anywhere. Let me illustrate this with a few pictures.

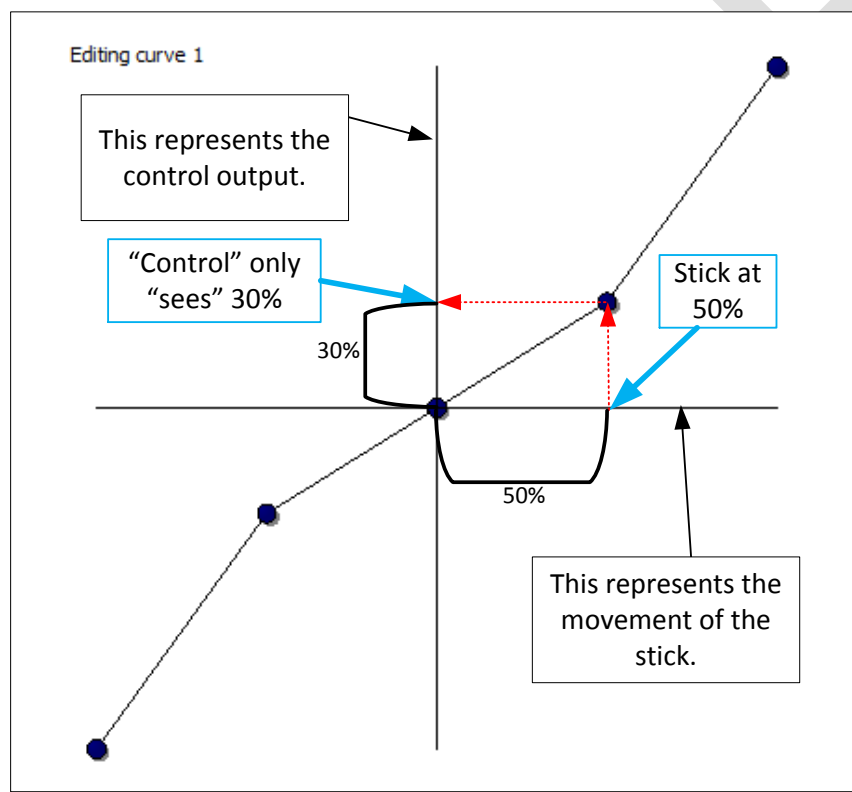


Figure 1 Curve showing Expo at 50% stick

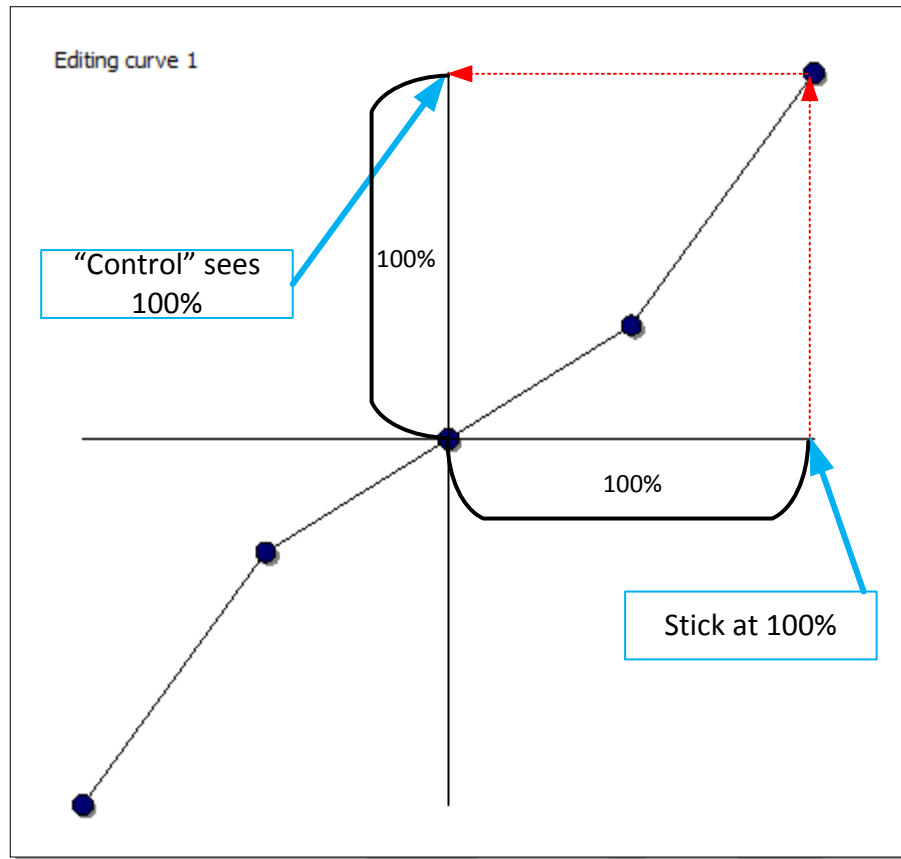


Figure 2 Curve showing expo with stick at 100%

The horizontal axis on the graph represents the stick input motion, which is basically always linear. The vertical axis shows the effect of the stick motion on the “output”. The output could be the servo but it might be the input to another mixer, so we will say output, instead of servo. The plotted line shows the mapping from the input, the stick, to the output for any point on the stick motion. To determine what the output is we find a point on the horizontal axis corresponding to a stick input position, go up to the plotted curve till we hit it, then we go horizontally to the vertical axis to find the output. The two cases show the output when the stick is at 50%, showing that we only get 30% output, and at 100% stick input when we get 100% control output. In practical terms this means that we have a less sensitive control from center to 50% stick, then from there on the control is more sensitive.

Now we can make these curves manually with the curve editor, or the radio can supply one automatically if we chose. Expo is one such automatic curve and it looks similar to the one I made manually shown above.

We can apply a curve, whether it is made manually, or supplied by the radio, like expo, to the stick input. For example let’s apply expo to the stick input. This means that for the initial stick motion the (internal) output to the rest of the radio is reduced. We can make this happen across all flight modes, so let’s assume that is true for now. Next we connect this input, that is the expo’d aileron, into the mixer for left aileron. Suppose we need differential to trim the plane out? No problem we apply a curve to the aileron mixer input from the aileron stick. Now the left aileron is a combination of soft center from the stick curve and the differential applied to the mixer. We do the right aileron the same way.

Let's consider another case of the manually created curve as shown below.

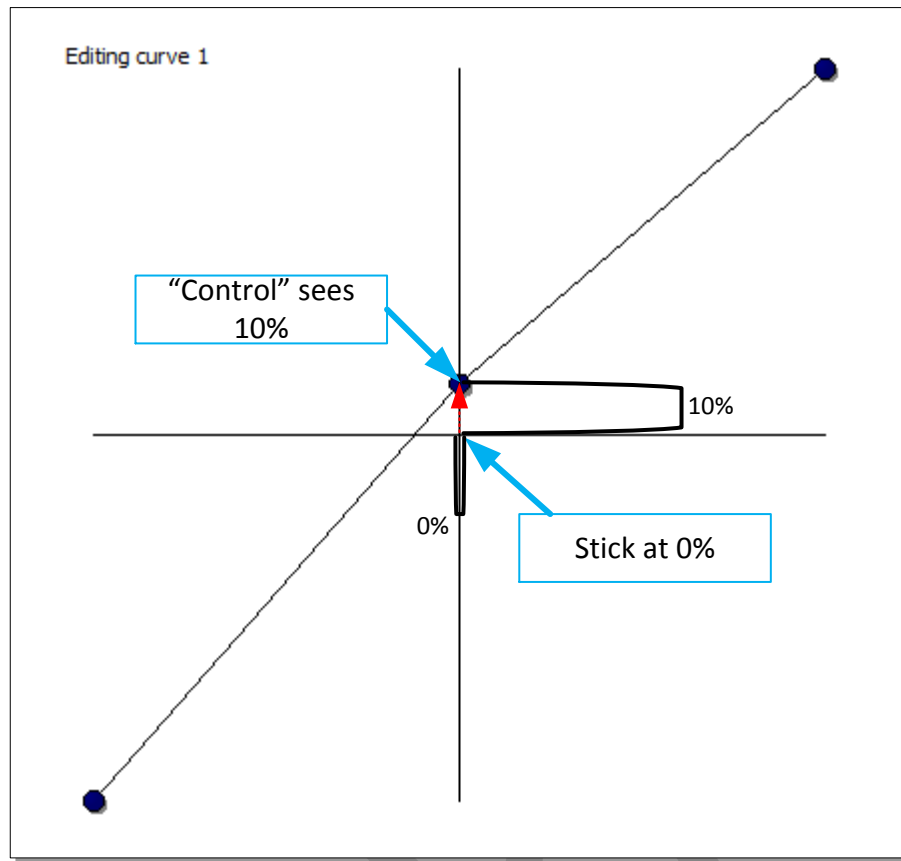


Figure 3 Curve with center offset

This is a simple linear curve, basically the output tracks the input, except with one substantial difference. When the input is centered, whatever the input is, the output will have +10% position. There are a few cases where you want this kind of non-center-matches-center behavior, but one special case of matching the aileron servos.

We will come back to the curve ability after we do some basic mixing.

Ok, a quick summary.

- We use flight modes to control when certain controls are disabled. Mostly this is for launch and zoom to make sure the flaps and camber are set correctly for launch/QT.
- We use a stick curve to do any expo, etc to get the feel right on the controls.
- We use a mixer curve to solve differential, etc.
- We use a servo output curve to neutralize all the mechanical differences in the ailerons so the mixing is much easier to set up.

6 Aileron Setup

Let's go end to end on the aileron channel as an example.

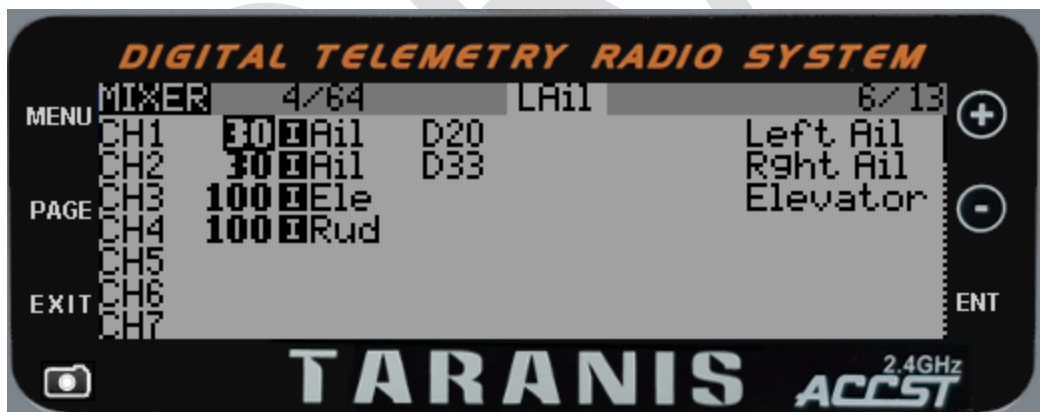
First we select the input. Go to this screen



By going to the inputs screen. Go down to the aileron line and hold the enter key. Set the aileron input as shown. We have chosen 15% expo on all flight modes.

If you need to change the aileron expo, this is the place to do it.

Next let's hook this input up to one of the servo channels. Navigate to this screen:



Go to the first line and hold the enter key. Get to this screen.

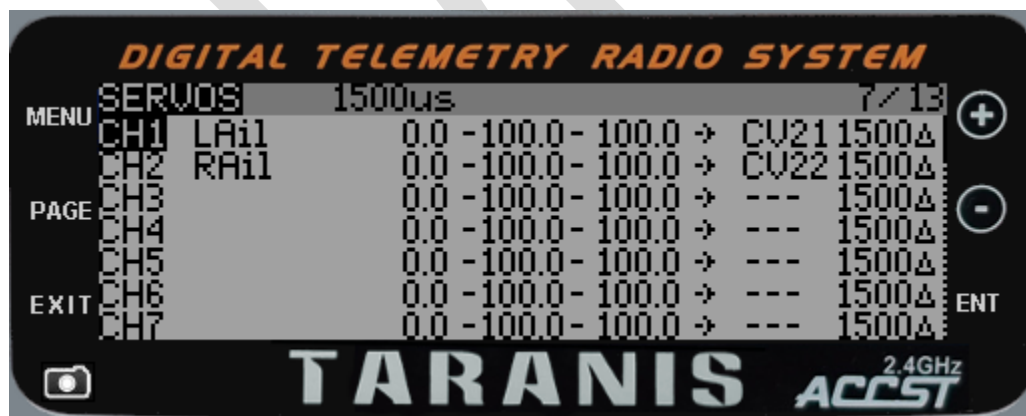


Set the mixer up as shown. By way of explanation we are naming this the left aileron channel. The input to the mixer is the aileron stick (that has expo applied to it). We are using a weight of 30%. This means that when we move full stick on the aileron we only get 30% of the servo movement. This is what we want so we have leftover endpoint for flaps. We include the trim because we like having aileron trim. We also apply 20% diff to this motion, i.e. more up than down. Note that you may have to do -20% depending on your servo throw. We've picked this amount of diff and throw for all flight modes.

Now repeat for the right aileron channel. Note that the weight may have to be -30 and the diff may have to be +/- 20 depending on servo reversing.²

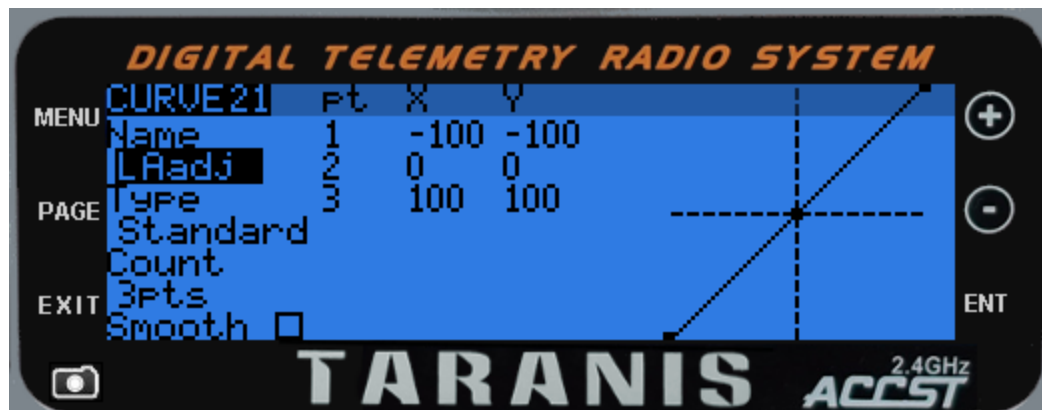
If you need to change the aileron sensitivity or aileron differential, this is the place to do it. Note that you have to make changes to both left and right aileron channels.

Finally we go to where the servos are connected to this mixer and make final adjustments. Navigate to the servo screen.



² Note that in Taranis fashion there are more ways to do this. You could make the weight on the Aileron input 30% and this mixer weighted 30%, but then this would be the maximum aileron throw in any mode. Later on I will show how to have a different aileron sensitivity (and differential if you want) in each flight mode (automatic dual rates if you like) if desired, so I'm doing it this way for now.

Edit CH1 that we have chosen for left aileron. Select curve 21 (CV21) for left aileron. Select CV22 for right aileron. Move over to CV21, hold enter and edit this curve like so:



This is a simple three point OUTPUT curve on the servo. Right now it assumes that the servos, horns and other mechanicals are perfectly matched. Later on we will use these curves to fix the mechanicals when we add flaps in.

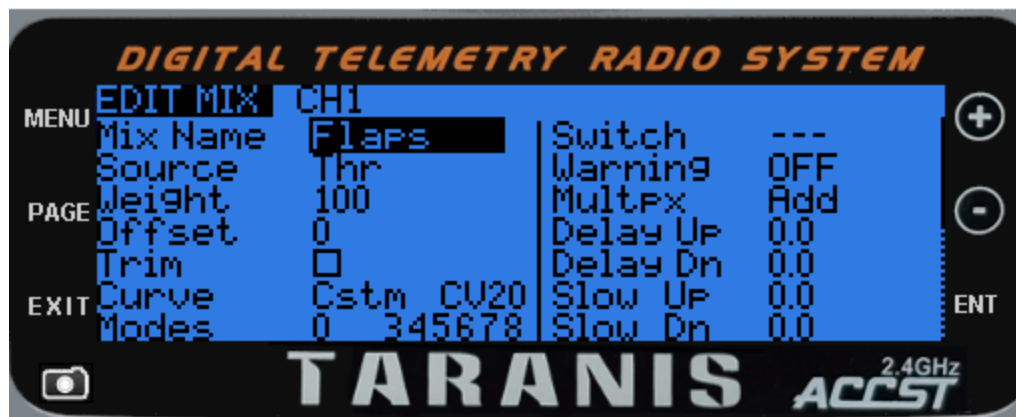
NOTE I set my planes up such that when the servos are centered on the ailerons, the ailerons are down about 15° (10-12mm). This setup procedure assumes that. You will not get full mechanical advantage from your servos if you set them up with the servos centered and the ailerons in line with the wing and there is nothing the transmitter can do to fix that. I strongly suggest that you make the aileron pushrods so that the servos are centered and the ailerons are down about 15°.

After the three setups shown above the ailerons should be moving on your plane and you should have five flight modes. You may have to reverse a servo (SERVOS screen, the little →), or change the weight or diff from positive to negative (MIXERS individual mixes) to get things moving the right way.

7 Adding Flaps

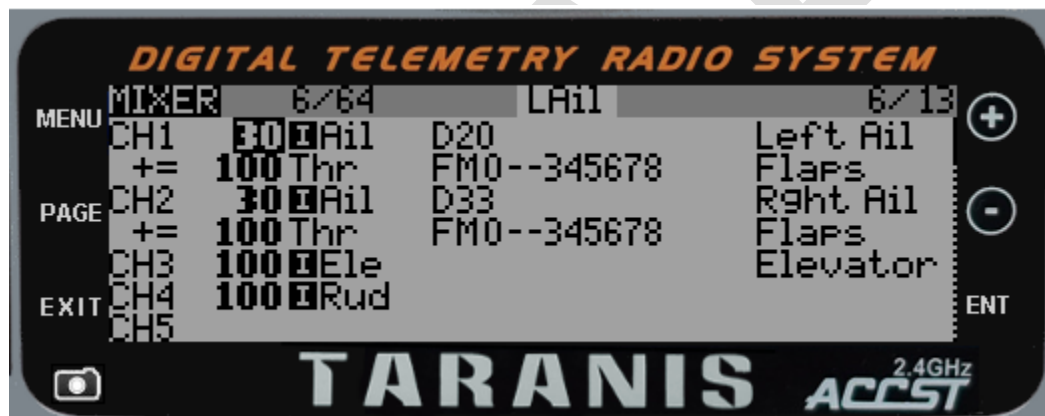
Now we want to add flaps to our ailerons for brakes. We've already mentioned that we don't want flaps during launch and zoom, but we want them for speed (FM3), cruise (FM4) and thermal (FM5). We choose the throttle stick for flaps.

We do this with the mixer. We have already mixed the aileron stick into the left and right aileron, now we mix the throttle stick into the left and right aileron. Navigate to the mixer screen, select left aileron and hold down enter, then pick "add". Setup the added mixer this way:



The explanation is that we are making a mixer that adds throttle into the left aileron, with 100% weighting, no trim (unchecked) and here is the important part, only for flight modes 3,4 and 5 (also 0,6,7,8 but we aren't using them). Also we are using curve 20 to mix the throttle to left aileron, more on this in a second.

Go back and make the same mix applied to the right aileron. When you get done the mixer screen will look like this:

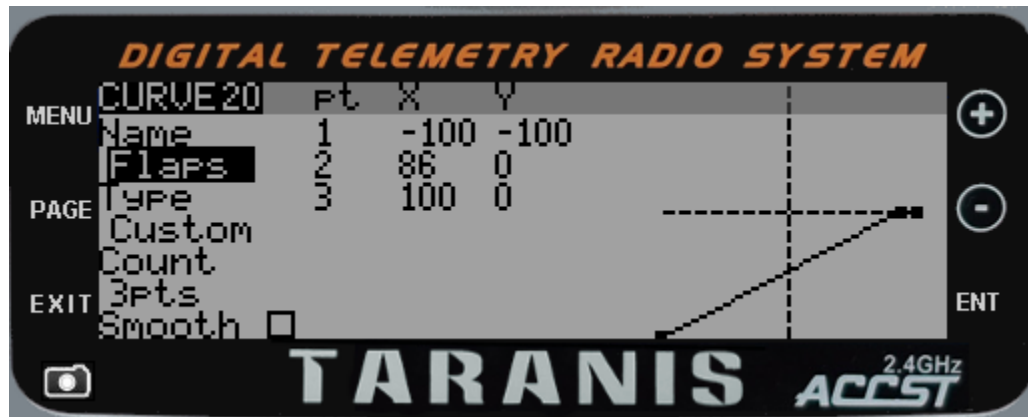


And it will alternate like this.



So the explanation is that CH1 is aileron and is composed of the Aileron (with expo) function is mixed in 20% differential and 30% throw, combined with 100% of throttle using curve 20. Same for right aileron. (Note that if one of the flaps moves the wrong way you may have to change the mix weight to -100% instead of +100%.

Now let's take a look at curve 20.



This curve is a 3 point curve with custom points. This means you can move where the mixer points are. In this case I moved the middle point to about 90% point. Above that point the mix is 0, below that point it slopes down. The effect is that when the throttle is between 86% and 100% the flaps don't move, below that they start down. This means you have a little wiggle room to the stick at the top when using rudder without accidentally putting some flap in. If you don't like this then you can move the point all the way to 100% or use a 2 point curve. If you want the flaps to start down slowly then get faster with more flap stick you can use a 5 or 7 point curve and make them come down in any way you want. Both flaps will come down exactly the same because you took my advice and fixed the mechanical matching on the servos with the output mixers, right? If you didn't now is the time to do that. Go play with the flaps going up and down and adjust Curve 21 and 22 until the flaps going down are exactly matched all through the travel.

Handy tip, make curve 20 go to +100 initially so the flaps go up and down both. Then adjust the mechanicals with the output curves 21/22 so the throws in the ailerons are matched everywhere, then reset the mixer to how it's shown here. Make sure you use the curve to fix any centering difference rather than subtrim as this is cleaner. Then when you actually move the ailerons like ailerons they will both move exactly the same way. And later when we add camber adjustment the ailerons will stay in sync.

Go play with the setup and see that you can pull flaps down, pull the launch switch and they will go back up, release the launch switch and they stay up, move the flap stick to the top and bump the elevator and now you are in speed, cruise or thermal and the flaps work again, ready for another quick turn.

8 Fixing Mechanical Mismatch on Flaperons

But suppose we now move the controls and see that there are centering and throw differences in the mechanical setup? The old way was to putz around with throw, sub trim and end point. There is another way to do this. First a little diagram to show how curves and mixers work together.

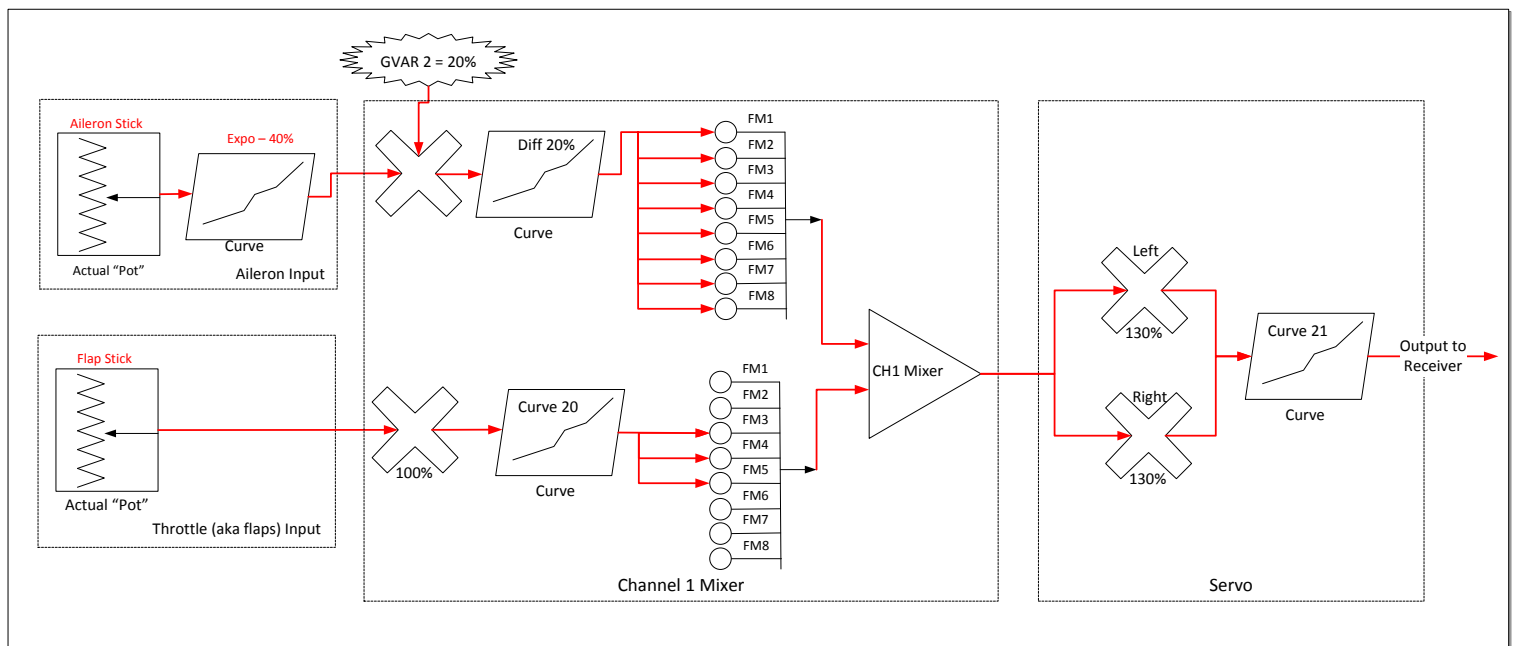


Figure 4 Graphical Mixer Setup For Aileron

Let's take some time to describe what this picture represents.

The flow is from left to right. On the left are the things that the pilot manipulates, the physical controls. On the right is the output to the receiver, the final commanded servo position. Everything in between is how we want the servo to move in response to the controls and current radio conditions (aka flight modes, launch etc.). The red lines and labels are things we chose to connect in the radio. This is our setup. The black figures are things the radio already does, the basic building blocks if you will.

Starting on the left we have the aileron stick. We chose (we didn't have to) to use expo on our aileron input that works for all flight modes. So we applied expo to the aileron input, in the input screen, in the setup for this aileron. We used the radio's built in expo curve function to do this and set the amount of expo to 40%. Now when the aileron stick is moved we get an exponential output from the input screen.

The flap stick is also selected on the input screen. We don't apply any curve or throw reductions to it, just let it output.

Next we want to reduce the aileron throw, and only the aileron's portion of this, to 20%. We accomplish this by using the mixing input scaling set to 20%, but it's not a fixed 20%, it's whatever the GVAR2 value is set to. And this can change for each flight mode if we want a different sensitivity for each one. I don't show the different values for different flight modes, but they are there behind the scenes.

Also, we want the aileron's function to have differential, more up than down aileron (just our example). So we use the built in radio differential curve to apply more up aileron than down in the mixer.

Finally we make sure that this aileron function is hooked up in all flight modes.

Note that if you wanted the ailerons to NOT have expo for one flight mode we would create another "input" that only outputs during the flight mode we wanted and connect it to the mixer only for that flight mode and you would see two "rows" of input/mixing input. The current mixer would be disconnected for the flight mode where we didn't want expo.

For flaps we want the flaps to follow a curve so that for the first 10% nothing happens, then the flaps move linearly from there. We did this with curve number 20, so we apply curve 20 to the flap input to the mixer. Note that we only hook this up for flight modes 3, 4 and 5, so the flaps don't work in launch and zoom.

Next the signal goes to the servo screen. Here we set the actual servo endpoints and apply a curve to the output. This curve is linear right now, but we are about to use it. First some servo stuff.

Most servos respond to a pulse that is about 1500 microseconds long and varies from about 1000 microseconds to 2000 microseconds. About 1500 is considered "centered". So the radio also kinda assumes that 1500 is the center for the servos. It also assumes this is the "center" for mixing as well. The problem is that if the transmitter assumes 1500 as a center and the servo assumes 1500 as a center but the mechanical pushrod is the wrong length, especially compared to the mechanical length of the other aileron pushrod, everyone will think that things are centered, except the physical ailerons won't be at the same place.

Also if you happen to have gotten one horn longer than the other when the radio is outputting 2000 (or 1000 depending on direction) microseconds for full flap to both servos, one flap will be further down than the other. In old school radios we had to play with sub-trims, end-points, mixes, offsets and all kinds of other things to make this all work out. But what we really need is a magic box that lets the radio output 1500 and have the control surface be centered. That magic box is the output curve on the servo screen.

We use all the mixing in the radio to compute where we want the control surface to be, then we use the magic box to warp the signal to match the mechanical setup. In this way when we change our mixing to do something different we don't screw up our mechanical correction adjustment.

Look back at the curves section at the curve with a center offset. If we use this curve as the servo output curve we can adjust where the actual servo position is, when the mixers are telling us 1500 microseconds, aka "centered". Also we can adjust the endpoints of the servo when the mixer is commanding one end (2000 microseconds) or the other (1000 microseconds).

This is a very powerful feature as once it is setup properly, you can adjust the mixing to suit the flying and we never screw up the centers or endpoints ever again.

How do we use this? The first thing to do is go to the servo screen. Note that if you scroll down the servos, the display shows you what is being output to the servo. Select a flight mode where the flaps

work. Now adjust the flap stick until the left and right servos read about 1500³. If your ailerons are the same, then great, move on to the next step.

If the ailerons are not in the same position, edit one of the output curves. Change the center value until they match. That's it. From now on when the radio calls for the ailerons to be centered, no matter what mode we are in, they will be centered.

Now pull full flaps. One aileron will likely be lower than the other. Go into that input curve and reduce the end of the curve until the ailerons match at full flap. Now the ailerons should match from centered to full flap when you pull the stick. Now do the up direction to full reflex. Again reduce the higher one with the curve endpoint (not the center!) until they match. Now the ailerons should match across all flight modes and conditions. Now if we change expo, dual rates, elevator to flap mixing, whatever, the ailerons will always move in a matching manner.

Note: I will use the output curve to set the center (1500 microsecond position) trim due to temperature changes (like first thing in the morning on contest day) so the mixing stays clean.

Now this might seem overly complicated at first, but in reality it is simple because you have a direct control over each part of the problem. The expo doesn't mess up the differential, the differential doesn't mess up the expo, and the servo mechanical matching doesn't mess up anything. They are all independent.

Handy Tip

So here is a handy tip. When I first set up a new airplane I bind it to a model called "trim". Trim has all the servos centered and the flap stick disabled. I make all the pushrods and cables using the model trim so that everything is as centered as possible.

Next I bind to the actual model that I will be using that also has all the trims and camber settings set to zero. Then I use the output mixers on the aileron channels to match the ailerons. From then on, all the mixing is pretty clean and doesn't have to allow for mechanical difference in the aileron throw and centering.

9 Finishing Up Elevator and Rudder

We have now completed the following setup:

³ Note that if you RE-doing this step, FIRST go into the curves and set the center point back to zero. This is because the servo screen shows exactly what is going to the servo, not what the mixer is outputting.

- 5 flight modes with flap lockout on launch and zoom.
- Ailerons matched through their full throw.
- 15% expo aileron, with 20% differential mixed to both ailerons.
- Flap stick mixed for flaps with deadband at the top.

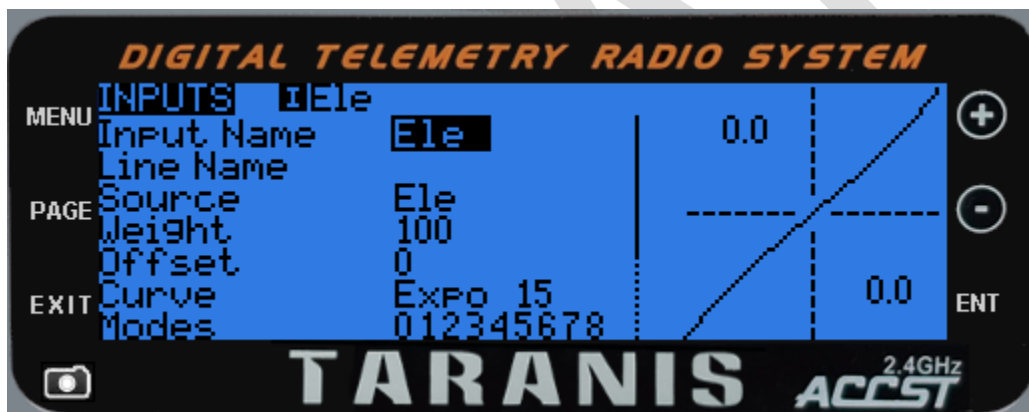
What's left?

- Elevator and rudder, basic motions
- Camber adjustments
- Elevator to flap mixing for snap flap
- Flap to elevator mixing for landing
- Aileron to rudder mix

After we do this we will pretty much have a basic DLG setup done and we can talk about more advanced stuff. If you followed the aileron setup and the flap mixing most likely you can get the basic elevator and rudder stuff done, but I'll go through it anyway. Then we will do snap flap and flap to elevator, etc.

These are pretty easy if you've kept up to this point. We basically want to mix the elevator stick (let's put in some expo) to the elevator channel. Likewise we want to mix the rudder stick to the rudder.

Navigate to the input screen and move down to the elevator. Hold down the enter key and setup the input mixer like this:



This will give 15% expo to the elevator across all flight modes. Weight is 100%.

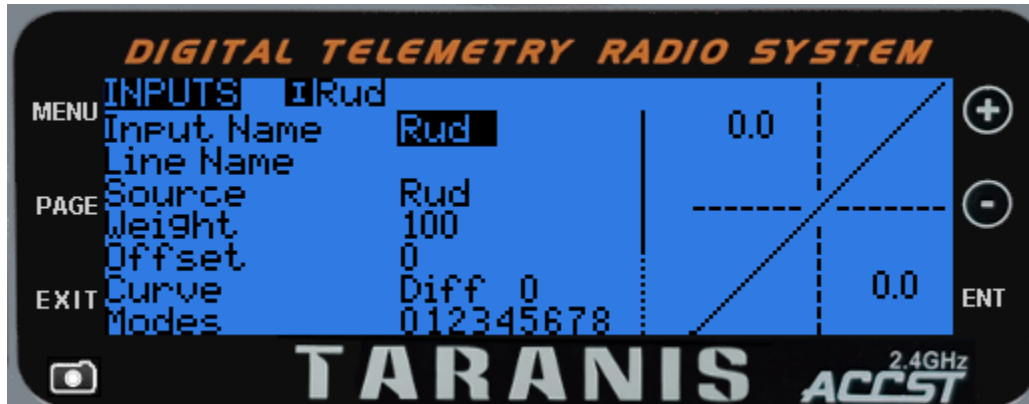
Now go to the mixer screen and open up the elevator line.



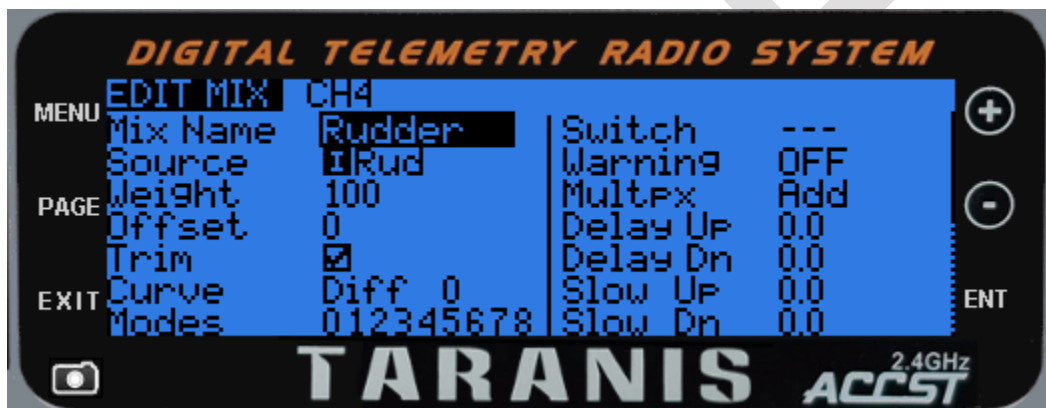
This gives a little differential so that you get more down than up for pushover. You may have to change the diff to +20 if your elevator moves the other way.

The setup for rudder is similar but with no expo and no differential:

The input screen.



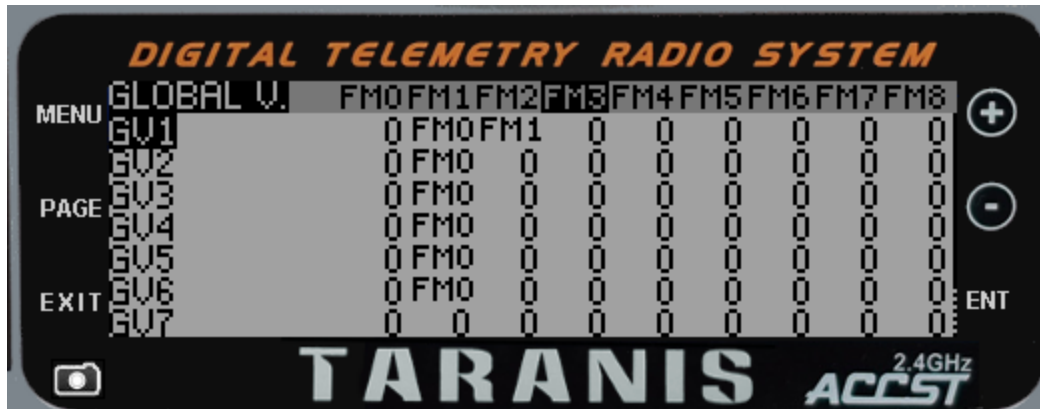
The mixer screen.



At this point we should have a working model with ailerons, rudder elevator and flaps. If you followed the setup hint the ailerons will be down about 15°. Let's fix this next. For that we need to learn about GVars.

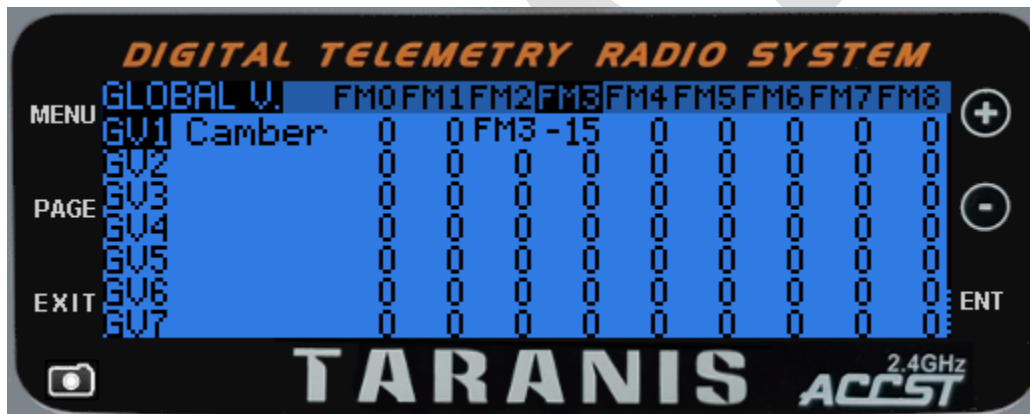
10 Global Variables (GVARS)

GVars are simple idea. They are basically a whole set of trim pots. Here is a sample.

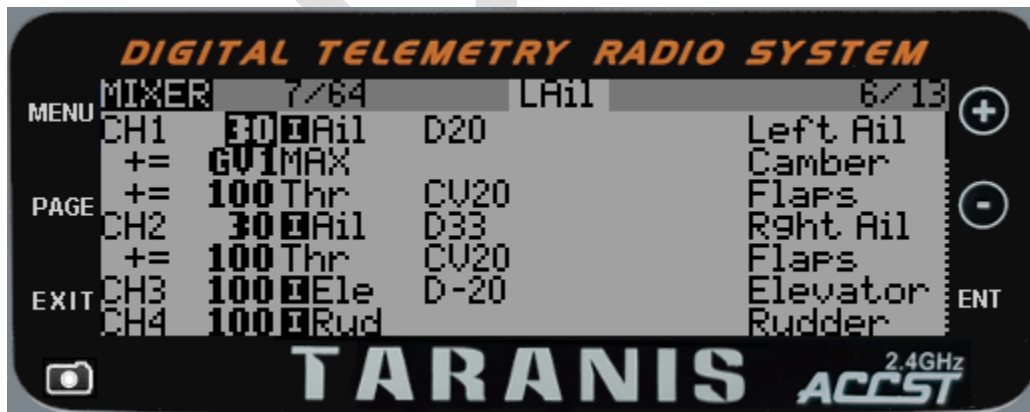


There a couple of things to note. One is you can name each line. The other is that there is a trim pot for each flight mode for each line. The value for FM0 is always a value. The value for the trim pot columns can be a real number or they can use the value from another flight mode in the same line.

How are these useful? Let's take a relevant example. We want our zoom camber and our speed camber to be the same. So for speed camber we are going to use GVAR1 (GV1) for FM3. So we don't have to adjust the camber for zoom as well each time, we make the camber for FM2 be the same as FM3. It looks like this now.



But we have to make this trim pot connected to the ailerons somehow and we do that with the mixers. Navigate to the mixer screen and add a mixer line to the left aileron (hold enter and do "insert after":



Edit this mixer to this setting:



So this is a little subtle. We're not using the GV1 to be the mix input, we are using it to be the weight in the mixer. The input to the mixer is just MAX, or 100%.

This makes the camber -15 in speed and zoom mode which should hopefully move your ailerons up to the clean position. If not adjust the value +/- until you have the desired camber value for zoom and speed. Note now that when you pull and release the launch switch the camber will go to the same camber as speed. When you pushover and move the flap stick up the camber should remain the same.

Add this mixer line to the right aileron as well. (You can copy it). You might have to make the weight – GV1 (minus) to get the direction right, for one or the other of the aileron channels.

Now go set the basic camber for the other flight modes to suit yourself.

So now we have a basic camber position for all flight modes, and zoom tracks speed for camber. However adjusting these values while flying is difficult. So let's add a trimmer so that we can make small adjustments to the camber in each mode.

Back to the mixers and add a mixer to each aileron that mixes throttle trim to each aileron with only a 20% weight. It will look like this.



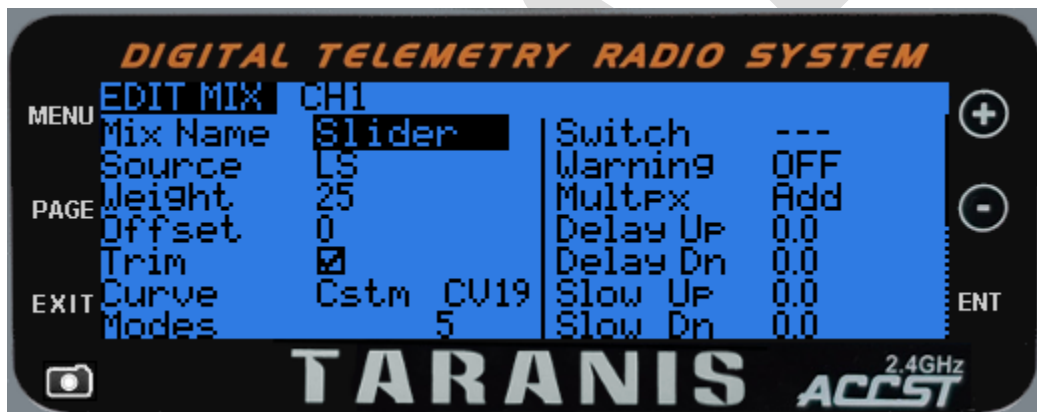
And this.



Ok we now have a rough camber adjustment and an inflight tweak adjustment. How about a slider for thermal mode?

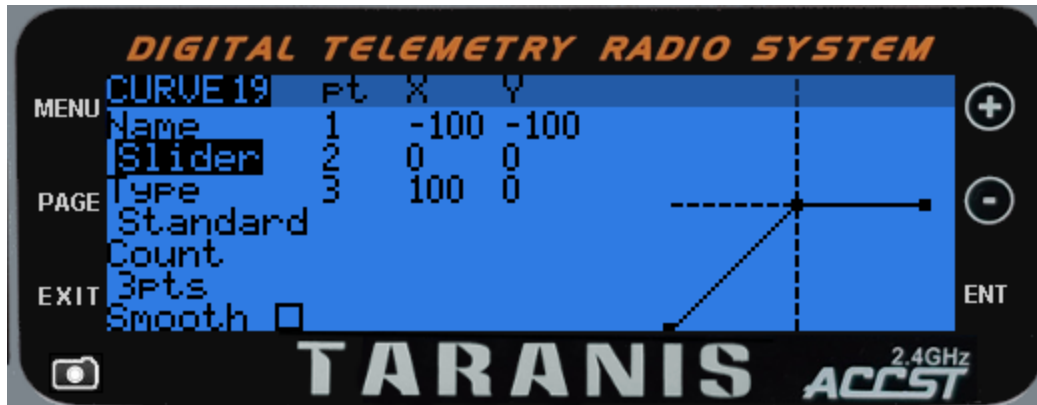
Add another mixer to ailerons. This time we will use the left slider (LS) as the input, with 25% weight and make the slider dead above half just as an example. Here is the procedure:

Add the mixer to left aileron and edit the mixer.



The explanation is that this is the slider mixer into the left aileron. The input is the left slider with a weight of 25%, and importantly we use curve 19 to adjust the mix. Very importantly we have made this mix ONLY work in flight mode 5 (thermal). So in other modes the slider will have no effect.

Curve 19 looks like this:



This curve make sure that the slider does nothing above the detent (so it's easy to know that it's not in play) and only starts adding camber below the detent (and only in FM5).

Current Configuration

So at this point we have the following DLG setup completed (and hopefully you understand how to adjust everything thus far).

- 5 flight modes with flap lockout on launch and zoom.
- Ailerons matched through their full throw.
- 15% expo aileron, with 20% differential mixed to both ailerons.
- Flap stick mixed for flaps with deadband at the top.
- Elevator with expo and differential for more down throw than up.
- Rudder.
- Rough camber adjustment with a GVAR.
- Camber trimmer using the throttle trimmer.
- A slider (LS) for adding camber in thermal that only works below the detent.

We're getting close to the end for a basic setup. What's left?:

- Flaps to elevator mixing for landing
- Elevator to flap mixing for snap flap
- Aileron to rudder

At this point we could go ahead and add the flap to elevator, elevator to flap, and aileron to rudder. For elevator to flap, you would add a mix to each aileron, use elevator for input and pick a mix percentage and which flight modes you want. Flap to elevator would be similar, but adding a mixer to the elevator channel and using the flap stick as input, also using only the flight modes you want (likely speed, cruise and thermal).

But by now it must be getting tedious to keep doing something to the left aileron, then the right aileron and making things the same. So let's make this easier.

11 Virtual Camber Channel

I'm going to assume that you matched the servo movement on the ailerons by now, or else this part might be frustrating. Once you get the servos moving the same it turns out that all the "functional" mixing is pretty non-fidgety. That is, you don't have to go round and round with throws, endpoints, and such like traditional radios to get everything to move right. So once this is setup correctly we can make a simplification.

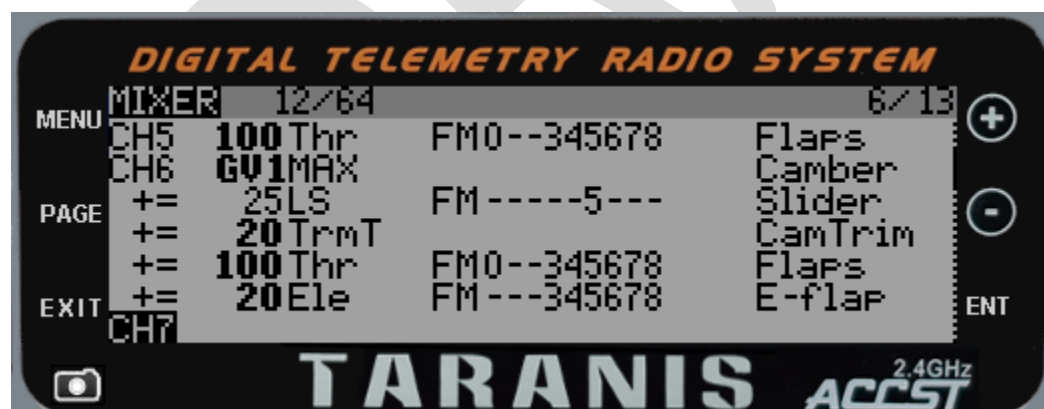
Just like logical switches, the Taranis can have virtual or logical channel. This is a named channel in the radio that doesn't really do anything on your receiver. For example if you pick channel 9, and you only have an 8 channel receiver (or channel 5 and a 4 channel receiver), there is nowhere for this channel output to go. But the good news is that we can use this channel as an input to any of the mixers just like any other real physical control.

The gist of what we will do is to make a virtual channel called the camber channel. The camber channel will combine flaps, rough camber trim, fine camber trim, camber slider and elevator to flap mixing. The output of this channel will be what total camber we are asking for at any moment. We will then take this camber channel and mix it with the left and right aileron.

Why not add the aileron to this "camber" channel? Because all the camber adjustments move the ailerons together, but the aileron input moves the ailerons in an opposite manner, so it would be impossible to mix a "camber+aileron" function to each aileron because we would want to reverse only the aileron portion of the combined value and not the camber portion. Hence we leave the aileron to channel 1 and 2 mix in place as is, and just add in the camber mix to each channel (likely with a negative value on one channel or the other to get things in the right direction).

To do this, do the following:

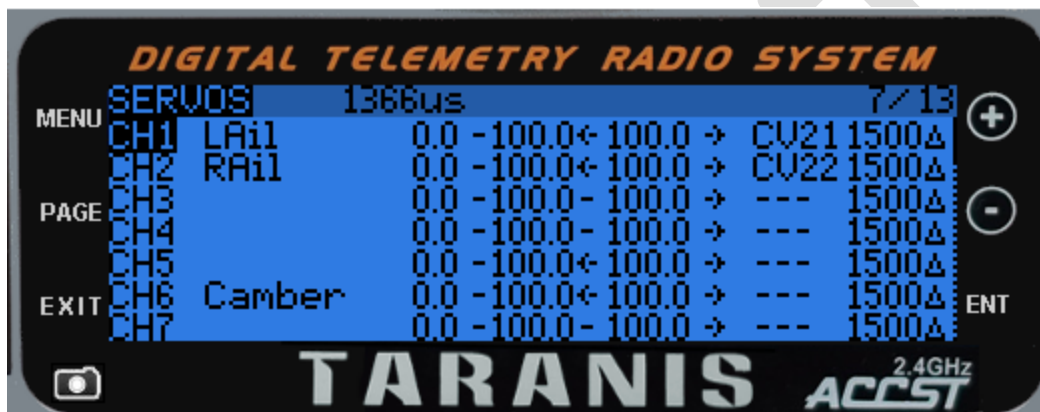
Go to the mixer screen and move all the additional mixes, that is everything except the aileron stick input, to channel 6. We will use channel 6 as our "virtual" camber channel.



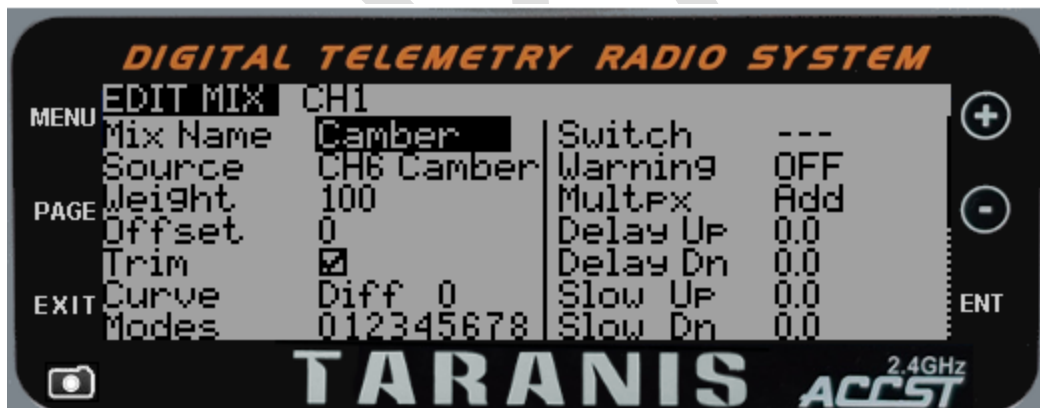
Remove the additional mixer from left and right aileron. Add a mixer to left and right aileron that mixes channel 6 to left and right aileron. You may have to change the weight negative on one or the other depending on the servo install.



Go to the servo screen and name channel 6 “camber” so it’s easy to keep up with.



Back to the mixer screen, the mix of channel 6 to aileron looks like:



This mixes the “virtual” channel 6 to the aileron. We use 100% mixing in all flight modes. Note that this doesn’t mean the flaps work in all flight modes because we only mix the flaps into channel 6 for some of the flight modes. It does mean that the rough and fine camber trim works in all flight modes.

Now go back and add another mixer to channel 6 for flap to elevator.



This mixer adds in the elevator stick to flaps, only in flight modes 3,4, and 5 (speed, cruise and thermal), and does not include the trim. We don't include the trim because we don't want our elevator trim to adjust our camber trim, we keep them separate. But when we move the elevator we get some additional camber or reflex on top of the trimmed camber position. We turn this off for launch and zoom as we don't want little corrections on the elevator to change our camber trim for zoom. The weight is set to 20; this is something you will need to adjust to suit your taste.

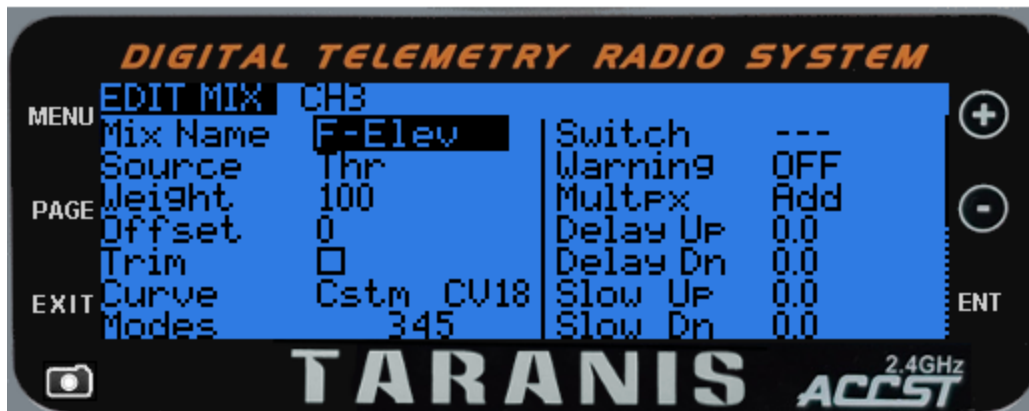
Finally, let's add some flap to elevator compensation and aileron to rudder.

For flap to elevator, we simply add the flap stick to the elevator with a mixer for flight modes where flap stick is active. We use a curve to provide the same deadband we have for flaps coming down.

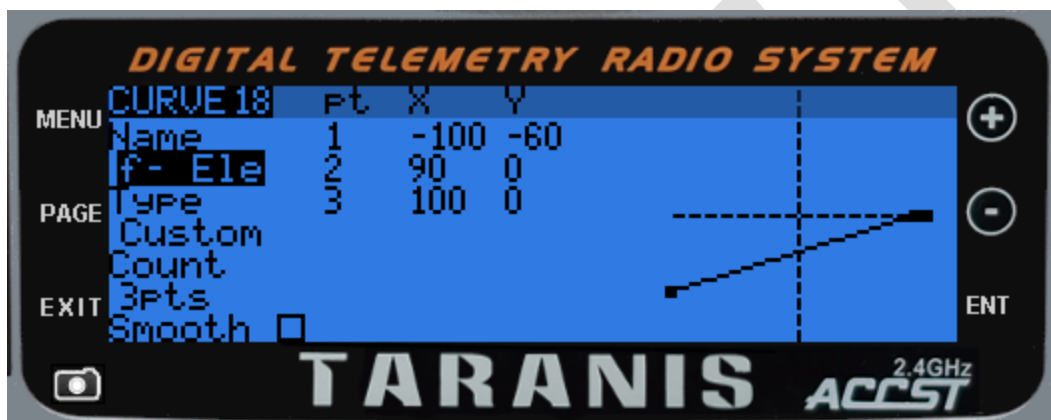
The main mixer page:



The mixer itself:

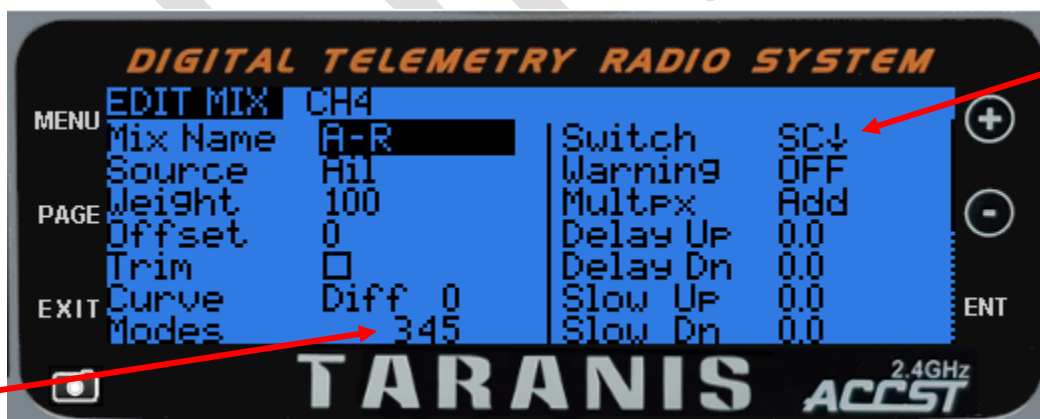


Note that here we only pick speed, cruise and thermal (3,4 and 5). The weight is 100% but we mix through curve 18. Curve 18 matches the flap stick to aileron mix with the same deadband at the top.



Finally the aileron to rudder mix if you want it (I don't, I fly the rudder manually).

Add a mixer to the rudder that looks like this:



The important things to note are that we are mixing the aileron Stick to rudder. We are not mixing the trim in, just the stick motion. We only do this for flight modes 3,4 and 5 (speed, cruise and thermal) AND only when switch C is in the down (closest to the pilot) position. So we can choose when this comes on, only in flight modes 3, 4 and 5.

12 Complete Model

So here is what we have so far:

- 5 flight modes with flap lockout on launch and zoom.
- Flap lockout released on elevator bump with flap stick returned to top or elevator bump followed by flap stick to top.
- Ailerons matched through their full throw.
- 15% expo aileron, with 20% differential mixed to both ailerons.
- Flap stick mixed for flaps with deadband at the top.
- Elevator with expo and differential for more down throw than up.
- Rudder.
- Rough camber adjustment with a GVAR.
- Camber trimmer using the throttle trimmer.
- A slider (LS) for adding camber in thermal that only works below the detent.
- Flap to elevator mixing for landing, in flight modes speed, cruise and thermal.
- Elevator to Flap for additional camber with elevator (aka “snap flap”), in flight modes speed, cruise and thermal.
- Aileron to rudder mixing, in flight modes speed, cruise and thermal, and switchable with switch C.

At this point we basically have a full DLG setup for flying the model.

We can make this more convenient so all the adjustments are on one page by using the GVARs. We will do this in the advanced section. But for now this will get you a flyable airplane with adjustments.

Hopefully, since we went through all the setup manually and explained the reason for each setting you will be able to make modifications to suit your own preferences. But you should have a basic idea of how things are done and where to make the correct adjustment on your model.

A summary of where all the adjustments could be made for this setup:

Function	Adjust	Screen
Aileron Expo	Input mix, aileron channel, expo amount	Inputs
Aileron Sensitivity	left/Right aileron mixers, weight	Mixers
Aileron Diff	Left/Right aileron mixers, diff amount	Mixers
Elevator Throw	Elevator mixer, weight	Mixers
Elevator Diff	Elevator mixer, diff amount	Mixers
Aileron Throw/Centering matching	Servo output curves, curve adjustment curve 21 and 22	Servo

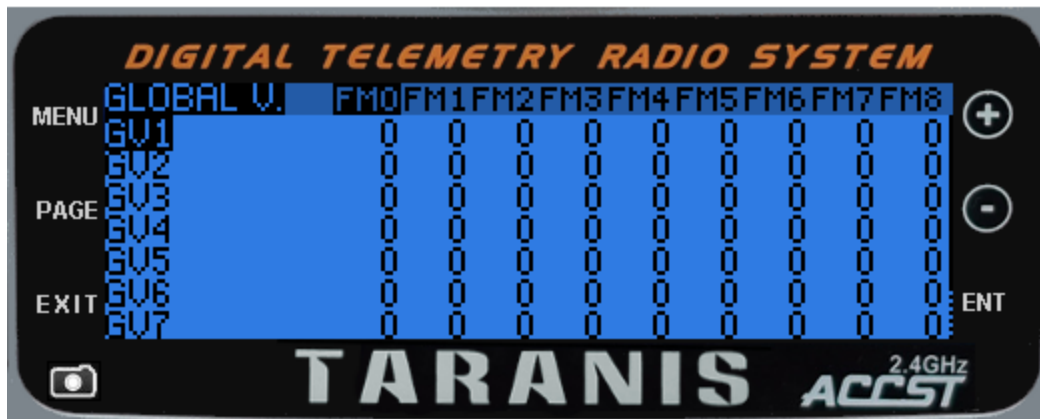
"Nominal" Camber settings	GVARs, GVAR1 for each flight mode	GVARs
Camber Trimmer sensitivity	Channel 6, camber mixer, Throttle trim weight	Mixers
Flap engagement point	Channel 6, camber mixer, flap mixer, and then edit the curve. (Curve 20)	Mixers or directly to Curves(20)
Camber slider sensitivity	Channel 6, camber mixer, and then the curve. (Curve 19).	Mixers or directly to Curves(19)
Elevator to flap mix	Camber mixer, adjust the weight on the elevator to flap mix.	Mixers
Flap to elevator	Elevator mixer, edit the flap input and then go edit the curve.	Mixers or directly to Curves(18)
Aileron to Rudder mix	Rudder mixer, adjust the weight on the aileron mix.	Mixers
Servo moves the wrong way	Servos screen, toggle the direction on the little arrow.	Servos
Flap motion is backwards	Change weighting from plus to minus or minus to plus on the aileron mixer.	Mixers
Camber trim moves backwards	Change weight from plus to minus or minus to plus on channel 6, camber mixer for throttle trim input.	Mixers
Slider works backwards	Change weight on channel 6 mixer, or edit the curve to go up instead of down.	Mixers

13 Advanced Setup

13.1 Using GVAR for adjustments

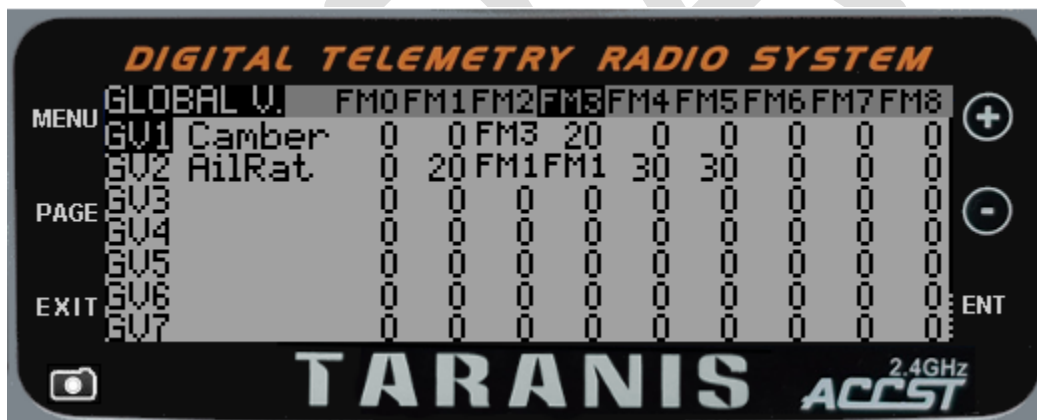
It would be convenient if we could put all the adjustments all on one screen. In fact we can, using the GVARs. In this section we will modify the setup slightly to put most if not all the adjustments on the GVAR screen. The gist of what is going to take place is that we are going to do is replace all the hard numbers (like 15% weight, and 20% weight) with GVARs. Then we will name the GVAR line to remind us what that line is adjusting.

As a reminder here is the blank GVAR screen.

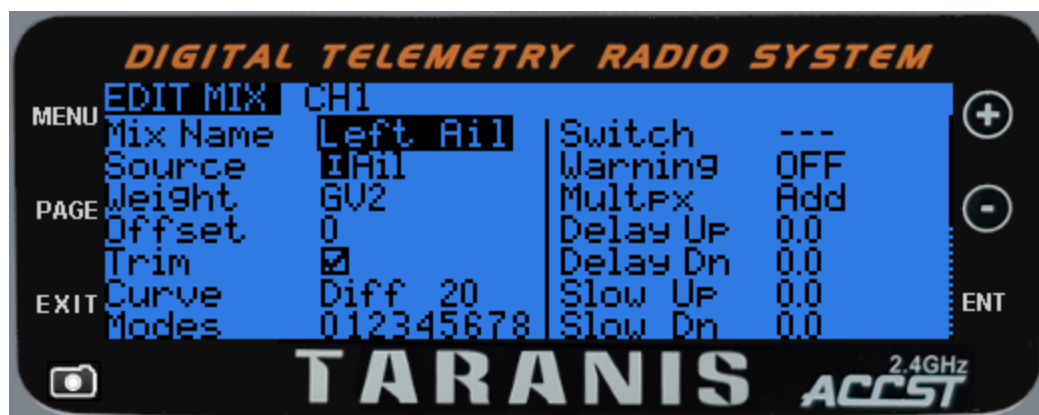


The Global Variables (GVARS) is basically a set of virtual pots. There are 81 of them. The 9 rows represent 9 different sets of pots. Each “row” can be referenced by the mixers or other things instead of an actual value. Additionally certain actions can change the value. For example you could use a switch press to set a global variable to match a slider. You could then use this global variable to control the weight on the flap to elevator compensation. So you could tune the landing elevator compensation while flying, then set the correct value after landing. Just one of the possibilities.

The GVARS in each row can be one of two things, either an independent value, or track a value from another flight mode. For example, if we use one of the GVARS for the aileron throw we might want speed, launch and zoom to have the same sensitivity, so FM3 and FM2 GVAR would track FM1 value. We might want cruise and thermal to be independent. So this would look like this:



The translation is that GV2 is aileron rate. In FM1, 2 and 3 the rate is 20%, and in Cruise its 30% and Thermal its 30% (independently adjustable). We need to use this now in the mixer. So back on the mixer screen for the two ailerons we make this change:



(Note that one aileron might need to be set to –GV2 to move the correct direction.)

Now the aileron movement, instead of always being 30%, varies by flight mode, somewhat like automatic dual rates.

The question now becomes what we want on the GVAR screen. This starts to become a matter of personal preference. In some cases if we want something to change “rate” by flight mode the use of the GVARs is very helpful. (Here is an example, suppose you want to use the throttle stick for your camber slider, but only in thermal mode, you could do this easily with a flight mode dependent GVAR that gives just a little weight to the flaps in thermal mode, but full weight if in other modes). If the value doesn’t need to change by flight mode then use of the GVAR is just a convenience to get it on the same screen.

I prefer not to waste the GVARs on non-flight-mode dependent functions and make the adjustments in the mixers or servo screen, but again, personal preference comes into play here.

Some GVAR usage examples:

13.2 Special Functions

Special functions are another new concept for traditional radio users. A special function is an action taken that doesn’t generally contribute to a control movement. They aren’t mixers, if you will. The purpose of a special function is to make some kind of one time (or repeating thing) happen as a result of physical or logical switch. One of the most useful special functions is to get the Taranis to make noise. This can be playing a file or announcing a value. There are many uses for the special functions that go way beyond what we need. So this discussion will focus on common things that DLG’s might want.

13.3 6 Position Switch

- 13.4 Timers
- 13.5 Announcing Flight Modes
- 13.6 Sequence of setting up a new airplane
- 13.7 Moving the spring loaded switch

DRAFT

Appendicies

A Basic Taranis Navigation

A.1 Transmitter Setup

A.2 Model Setup

B Q&A

This section contains questions asked online and answered online.

Q:*Edit: upon rereading the document, I'm still not 100% clear on matching aileron servo centres prior to actual servo installation in the wings. Previously (pre Taranis) with the servos on the bench I would set the servo horns as close to centre as possible, then sub trim both to be 90° to the case and matching each other, then install pushrods/flap horns. Am I correct in thinking that in Taranis land all that is taken care of in the servo output curve, i.e. no sub trim per se? Thanks.*

A:*The short answer is yes. You still need to center the servos as well as you can. But I suggest you install the servos (centered) and make the pushrods with the servos being held at center (using a "trim" model in taranis helps), with the flaps blocked down about 10mm. Then switch to the desired real model in taranis and use the curves to adjust the centers and throws for the ailerons. The aileron mixing for a DLG is the most complicated and you don't want to have to go fiddle about with the offsets and weights for each mixer on each aileron to make up for different mechanical center and throw. The value of using the output curve to match the servos is that you can use that single "camber" channel for all the mixing without having to resort to a bunch of separate (and different) mix settings for each aileron. We are so trained to get this right with old radios by tweaking subtrims, mixer offsets and mixer weights that this new way seems too easy, but it is. When you match the servos, all the mixing is "clean", meaning the values represent just what you want the mixing to do, not what you want the mixing to do obscured by all the tweaks to make up for the mismatched mechanicals on the servos.*

FAQ's

C A complex Setup Explained