

Weatronic internal gyro programming 1

This article describes how to program a Weatronic receiver internal gyro for single gain and fade-out. A further article to follow later, Weatronic gyro programming 2, with more complex programming will describe how to have multiple gains and fade-out.

If you have other ways of programming these features, or suggestions to improve these programs, please do post them to the thread at http://www.rcuniverse.com/forum/m_9129187/mpage_1/key_/tm.htm which is popular in the English speaking community especially amongst jet fliers who use Weatronic, or to the Weatronic support area at http://www.rcuniverse.com/forum/forumid_482/tt.htm

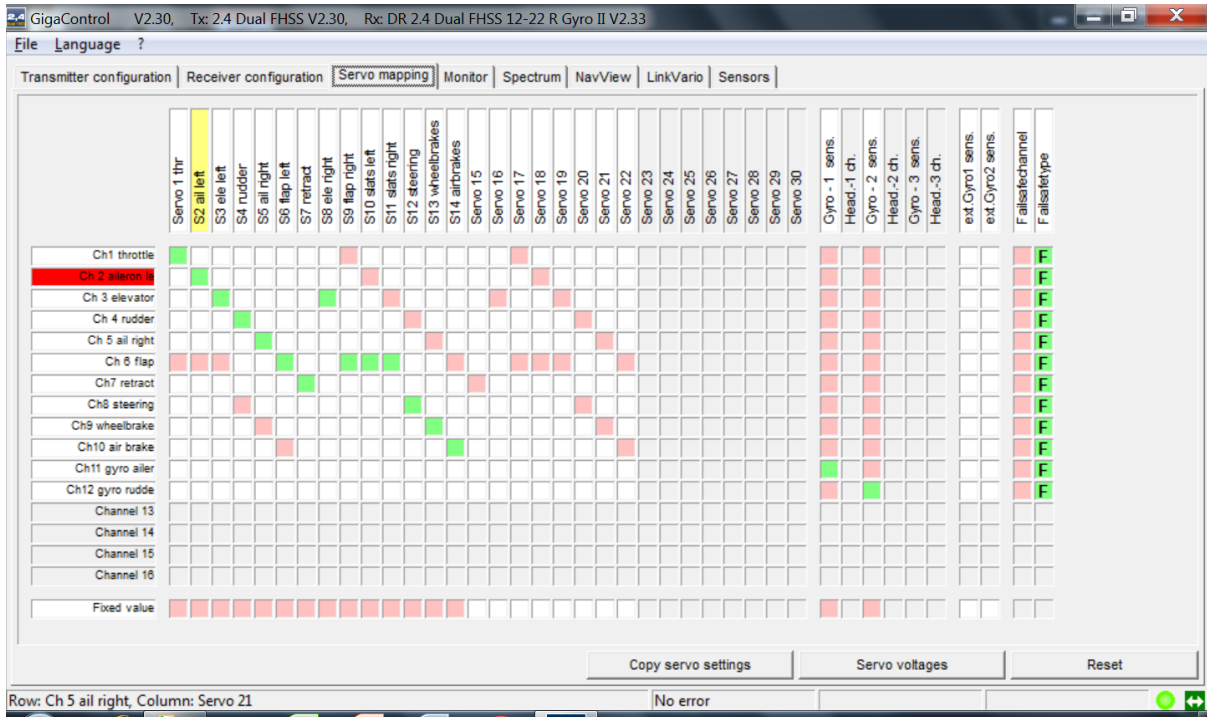
Fade-out is the ability of the gyro to reduce its gain as the stick is moved so that by full stick movement, the gain is zero and the gyro has no effect. Fade-out has different names depending on the brand of gyro. Most add-on gyros have fade-out built into their software, but Weatronic Rx internal gyros do not seem to have this feature.

Why do you want fade-out? The gyro will try to oppose your commands, for example when you command a roll the gyro will sense that roll and apply its level of gain the opposite way, thus reducing the amount of aileron travel. The effect is a much reduced rate of roll. You might try to counter that by increasing the aileron travel by moving the pushrod further out the servo arm or moving the pushrod further in on the control surface horn. That is not a good solution as it reduces the force that the servo can apply to the control surface, making it more liable to suffer from blow-back and flutter. If on the other hand the gyro effect is reduced to zero, full travel is available and the roll rate is normal.

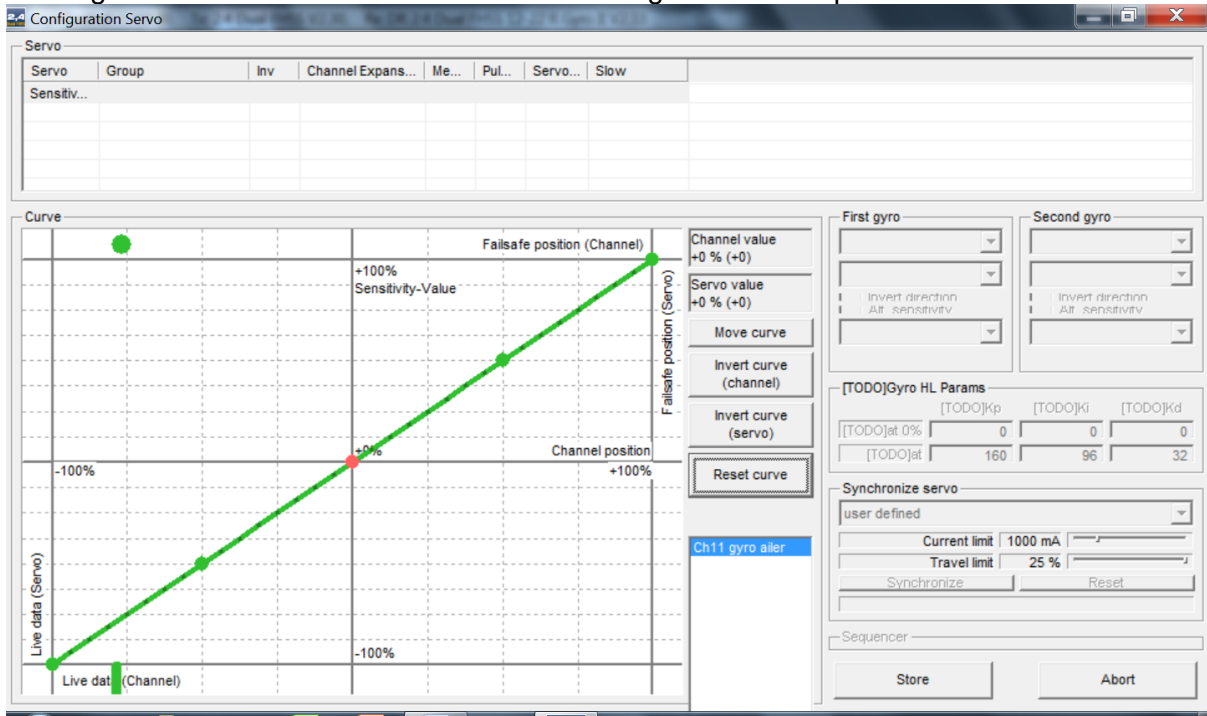
For the purpose of this article, I will be using channel 11 from the Tx as the channel that controls the gyro gain, servos 2 and 5 for the ailerons, and Weatronic internal gyro 1. My Tx is a Multiplex Profi 4000 and you will have to adapt the Tx settings to your brand.

First choose your Tx channel that will control the gain. At first you need to be able to control that channel by a slider or rotary knob and also a switch so that you can disable the gyro at any time if you get into trouble. Later on, after test flights establish the correct gain, you need to be able to alter that channel to be controlled by the aileron stick and the switch, instead of the slider/knob.

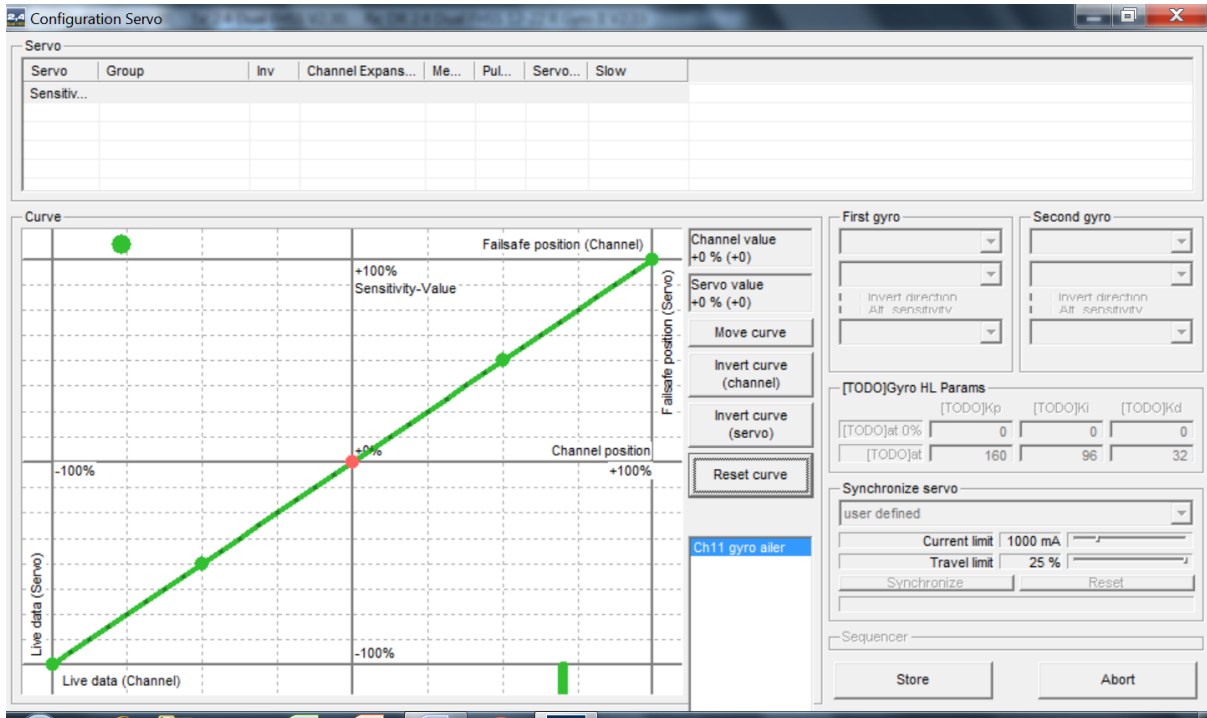
In Weatronic GigaControl, start by assigning internal gyro 1 on the controlling channel, in this case channel 11. You will see that I have also set the failsafe to F as I will be setting the failsafe to go to zero gain rather than hold at the last gain setting.



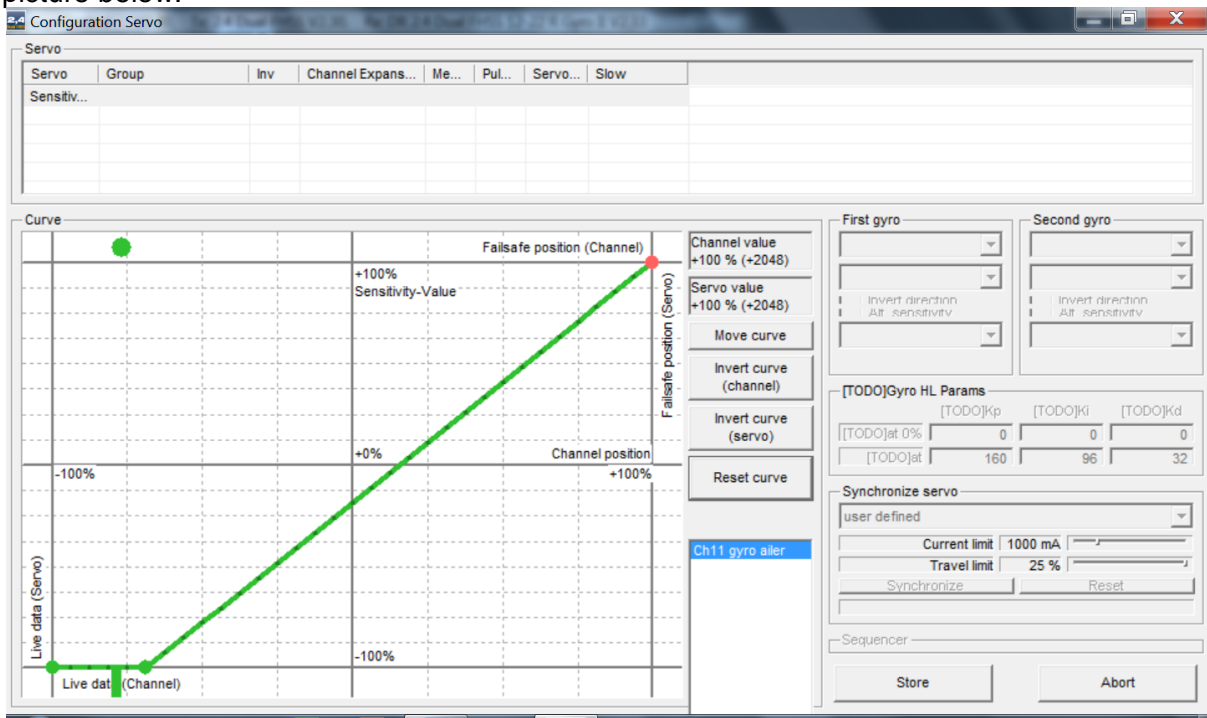
Right click on the gyro green box to open the gyro program. I will be using rate mode only, heading hold mode can have unforeseen and dangerous consequences.



The green bar on the horizontal axis shows the position of the Tx slider knob, the height of the green line at that point shows the value of the gain, with zero gain at the bottom of the graph and maximum gain at the top. Your slider/knob at its zero position should make the green bar on the horizontal axis be well over to the left, and if you move the slider/knob to the maximum gain position the green bar should be well over to the right, see picture below. If yours is the opposite way around then either reverse the channel (servo) at the Tx, or leave it that way around and mirror the pictures below in GigaControl.

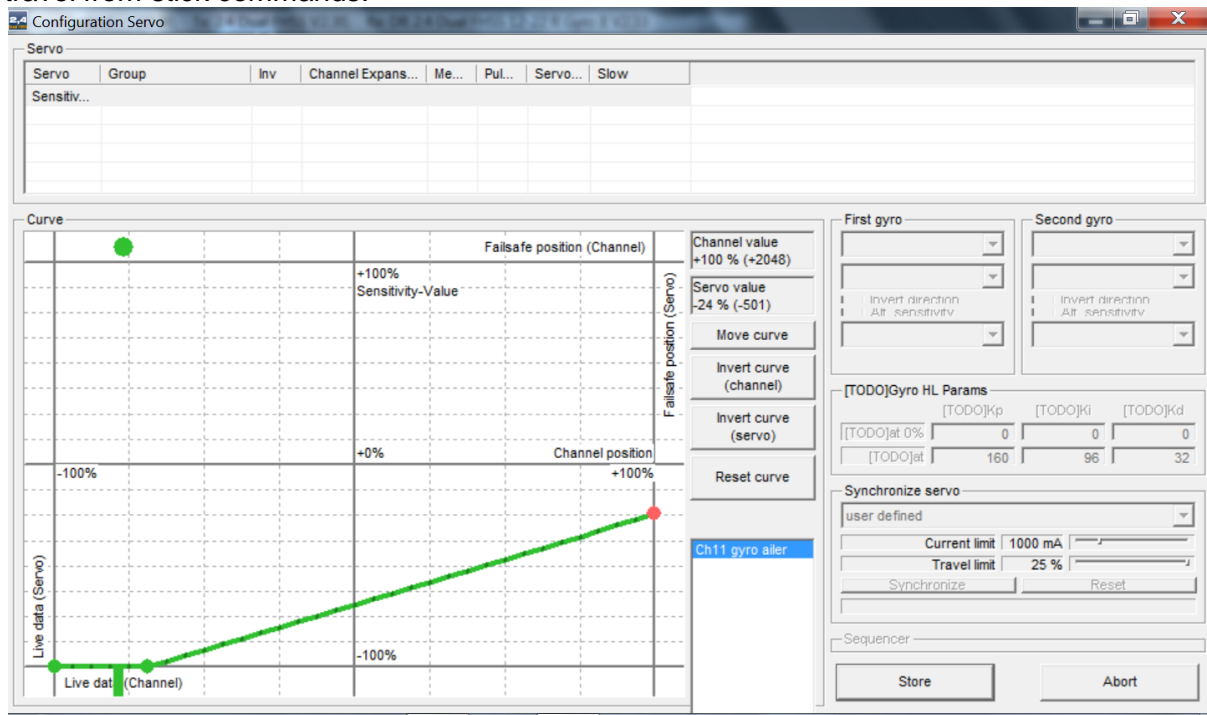


Now you set a slope for the gain. Start by creating a zero band at the left end of the slope so that when the slider is at the zero position the green bar is within the zero gain band. See picture below.



You do this by right clicking on one of the black dots on the green line to turn it red and it can then be dragged down to the bottom. The line will then look a bit crooked, right click on all the other large green dots to remove them and you will get the line shown above.

This means that you can move the slider to zero gain at any time and you can start test flights with zero gain. It means that you can nudge the slider a little away from the end point before it starts to make the gain rise. The slope of the gain, (how much it increases as you move the slider/knob) depends on how high up you put the point at the right end of the slope. If the slope is very shallow you may not get as much gain as you want even at full travel of the slider, whereas if it is much too high the slider/knob will be very sensitive, it will only just be moved away from the starting position to get as much gain as you need and it will be too easy to get the gain too high and cause control problems. How high the end of the slope should be is simply guesswork at this stage, but since maximum possible gain is more than normal servo travel, a maximum gain of just half way up is a reasonable starting point. The picture below shows a typical slope that I start with but it may vary for your model, I get this slope by turning the slider to maximum gain and rocking the model rapidly to see how much travel the gyro puts on the ailerons. I want it to be a bit less than normal travel from stick commands.

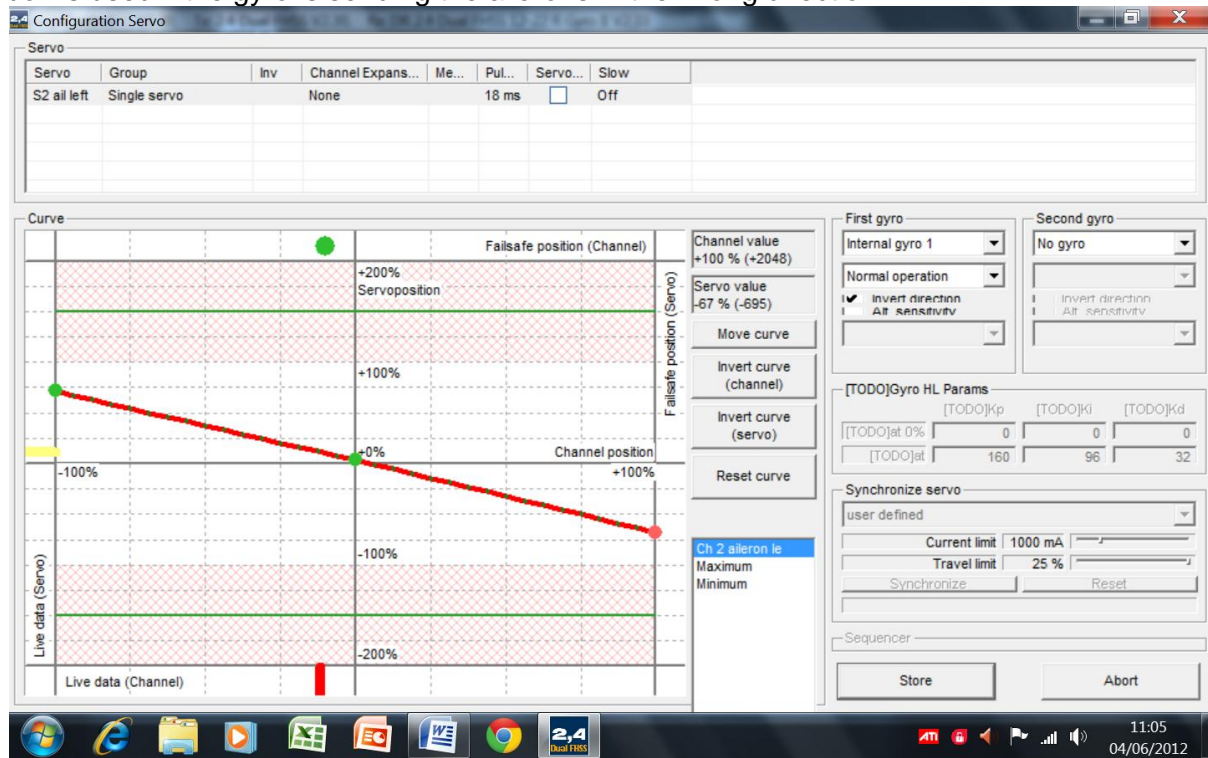


Note the setting of the failsafe green dot along the top of the graph, in case of failsafe it will take the gain to zero, you may want a different gain setting is preferable during failsafe.

Now program your Tx switch. I will call it the gyro master switch, because I use that one switch to enable or disable all gyros at once. I strongly advise programming a gyro master switch so that if you ever encounter the violent wobbles due to having gain too high, or an add-on gyro or Rx with internal gyros comes loose off its mountings and causes glitches, you can instantly disable all gyros and land without further control problems. With the switch in the ON position it should allow the slider/knob to have full control of the channel. With the switch in the OFF position it should disable the slider/knob and force the travel to the zero gain end of travel. With a Multiplex 4000 Tx I assign servomix to the gain channel, inputs are the slider and fixed value, the switch then toggles between slider ON fixed value OFF, and slider OFF fixed value ON. The fixed value is whichever + or - 100% servo travel that sends the control bar in GigaControl to the zero gain band at the left end of the graph and makes it stay there no matter what you do with the slider/knob.

Finally we can assign the gyro to the relevant servos. Right click on the servo's green assignment box and then in the drop down box select whichever gyro you are using, in this

case internal gyro 1, and ensure that the alt sensitivity is unticked. The invert direction tick box is used if the gyro is sending the ailerons in the wrong direction.



Workshop tests

Next we do ground tests of the gyro. Assemble the model so that the relevant servos will work, e.g. if aileron then you need the wings on the model and servos connected. Set the gyro master switch to the ON position, set the slider/knob to the zero gain position and roll the model from side to side. The ailerons should not move, because the gain is at zero. Now move the slider/knob to maximum gain and prepare to check the direction of travel is correct. STOP! Never test direction of travel by waggling the stick or the model to test gyro, and then working out if it has moved the correct way. Your brain will too easily agree with what you see and may accept the travel in the wrong direction which will be catastrophic. Always work out in advance what you should see and then test it, you will see errors much more easily. For any direction of roll, the gyro must send the aileron in the opposite direction to the way the aileron would move when you command the plane to roll that way so you can easily get confused and accept a reversed gyro. So work out which way the left wing aileron should go when you roll left and when you roll right. As you roll the model left, the gyro should apply right aileron, which is left wing aileron down. As you roll the model right again, the left wing aileron should go left, which is aileron comes up. In other words the gyro should make the left aileron point in the direction that wing is going, if the wing is going down the aileron will go down, if the wing is going up the aileron will go up. Work it out for the right wing and you will see it is the same – if the gyro direction is correct, it will make the aileron on any wing go in the same direction as that wing. Now that you know what you should see, you can test it on the model. Watch each aileron in turn as you roll the model left and right and confirm that the gyro sends the aileron the same way as the direction of roll. If any aileron is being sent the wrong way, go into the graph for that servo, and select invert direction, and test again.

With the gyro moving the ailerons in the correct direction, leave the slider/knob at max gain and set the gyro master switch to off. Test the model again by moving it, the ailerons must

not move. Move the slider/knob to midway and test again, then back to zero gain and test again, this proves the gyro master switch locks the gyro off at all points of the slider/knob. It is necessary to check this as some Japanese radios have very muddled software in which altering one point moves others that you did not realise, so you need to check that the switch does indeed disable the gyro at all points of the slider/knob.

Flight tests

Get an experienced fellow modeller to do a further check of the gyro direction as per above – gyro master switch on, gyro slider/knob at maximum gain and ask him/her to independently check that your surfaces move the correct way in response to roll/yaw/pitch. We can all make mistakes when setting up a model in the workshop so getting it independently checked is a wise thing to do.

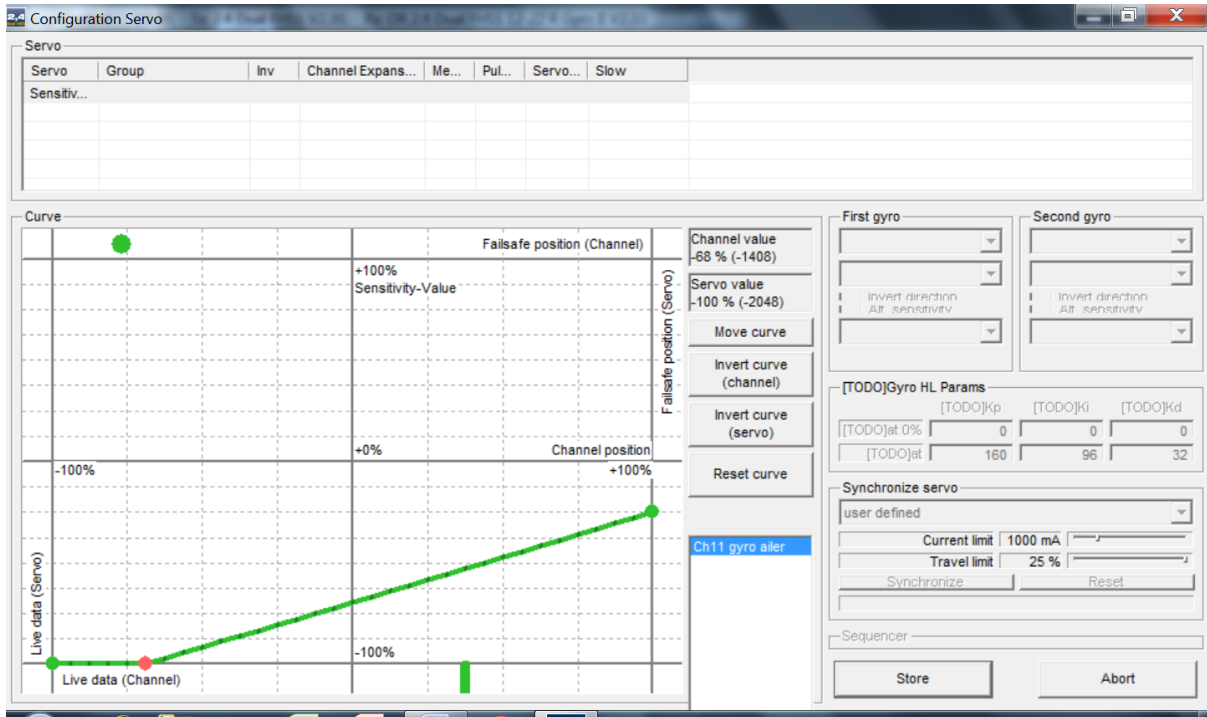
Set the gyro master switch to ON, slider/knob to zero gain and fly. Move the slider/knob until you get the effect that you want. If the model suddenly starts rocking/yawing/pitching violently either move the slider/knob back a lot or move the gyro master switch to OFF immediately. The rapid oscillation is because the gain is too high. Reducing the gain or moving the master switch to OFF should stop it immediately. Try again but do not move the gain so far. When you have a gain that you feel is correct, it is likely that you have set it while at a cruise speed. It needs to be tested at the maximum speed the model will be flown at. The reason is that the gyro is a “dumb” device not a “smart” device. It does not actively manage the roll rate as a fly-by-wire fighter does. The gyro simply applies a fixed amount of aileron per rate of roll. At higher speeds the aileron is much more effective so the amount that the gyro moves the aileron may be too much and the violent oscillation sets in as the system keeps overshooting. So when you think you have the correct gain, gently take the model up to the maximum speed you think it will encounter, keeping your finger on the gyro master switch. If the oscillation starts you must switch the gyro off immediately as it can be a severe test of the model’s structure! Slow down, turn the gain down a bit, switch the gyro master back ON and do the speed test again.

Note how the roll rate is now much slower, as the gyro opposes the roll. If you feel it will be a hazard on landing with such a slow roll response, simply set the gyro master switch to OFF. Do not move the slider/knob from the setting that you have chosen.

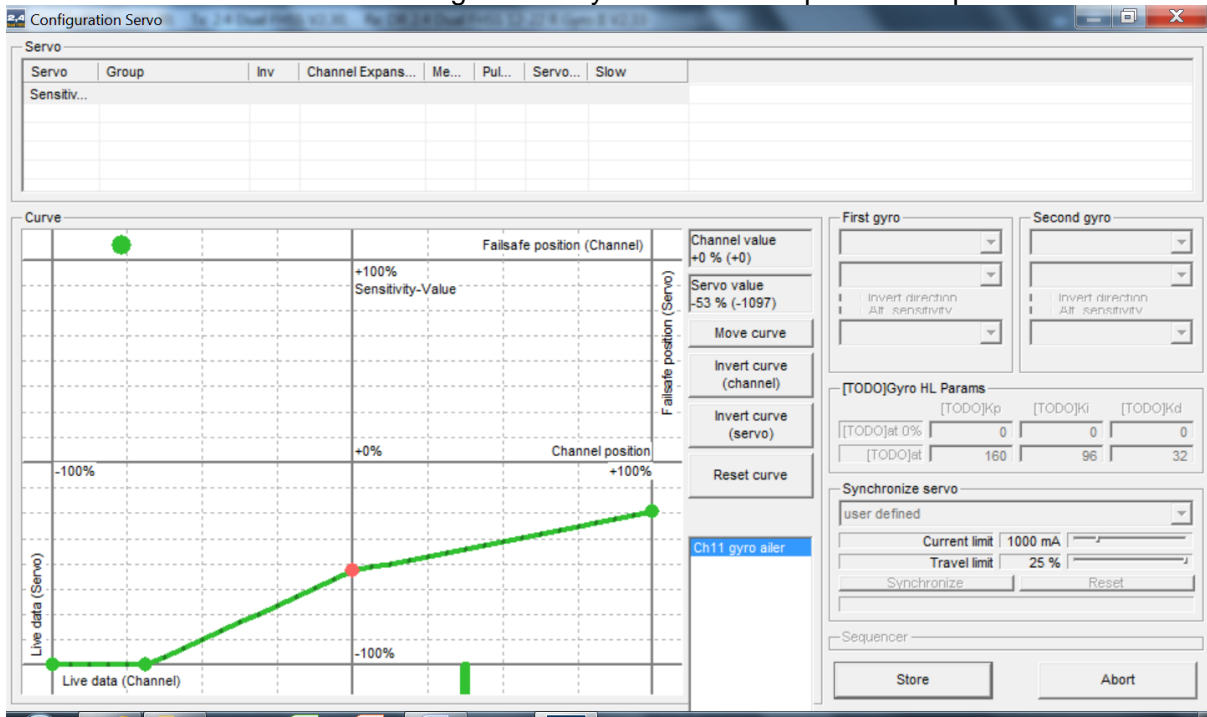
Setting the fade out

The flight test has established the maximum safe gain but has drastically reduced the roll rate. We can now alter the gain program to introduce fade-out. It is important that you do not accidentally move the slider or knob from the test-flight setting until you have read the value in GigaControl.

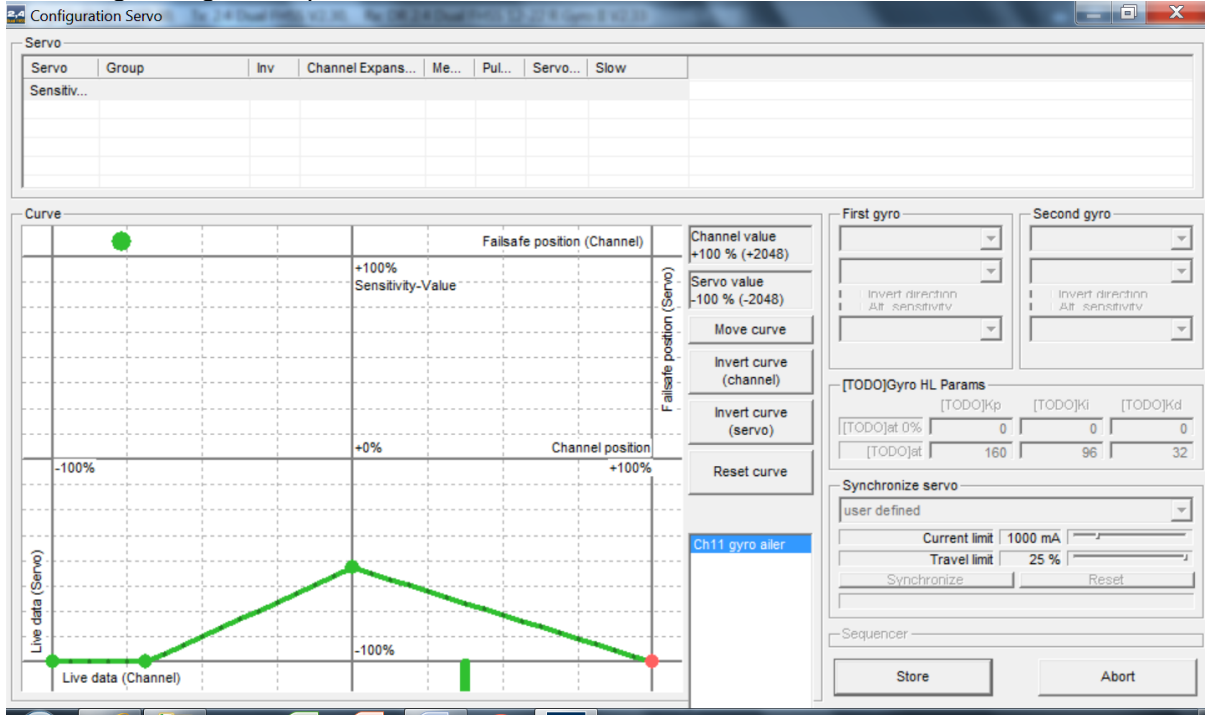
Open the gyro screen in GigaControl and read the value of the vertical axis of the green line, that corresponds to the green control marker on the horizontal axis. That is the maximum gain that we will now set in a new gain curve. In the picture below you can see the gain slider/knob is a bit to the right of centre and the corresponding height of the slope is almost 4 divisions high. That height is the amount of gain that you have set and will be the maximum height of the fade-out curve that we are about to create.



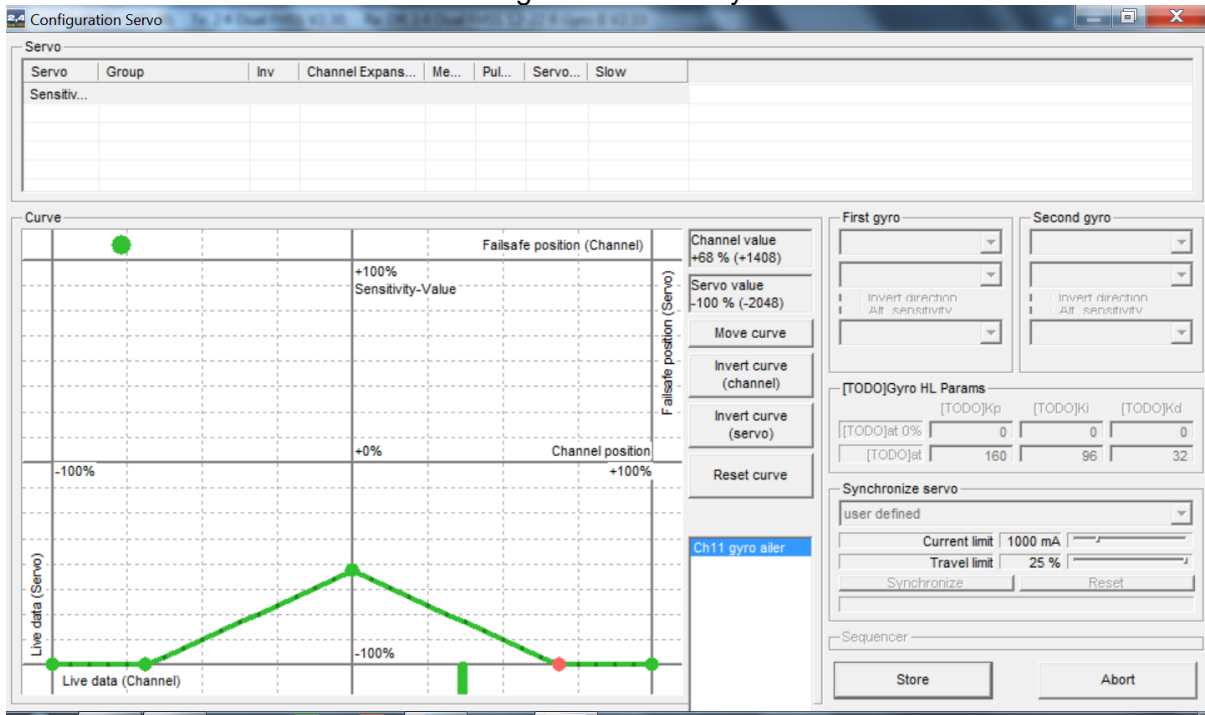
Now create a new point on the curve in the middle of the horizontal axis by right clicking on it, and set it to that vertical value, note that the original will move as you drag the curve up or down so do make a note of the height before you set the new point. See picture below.



Now drag the right end point of the curve down to the zero vertical value.

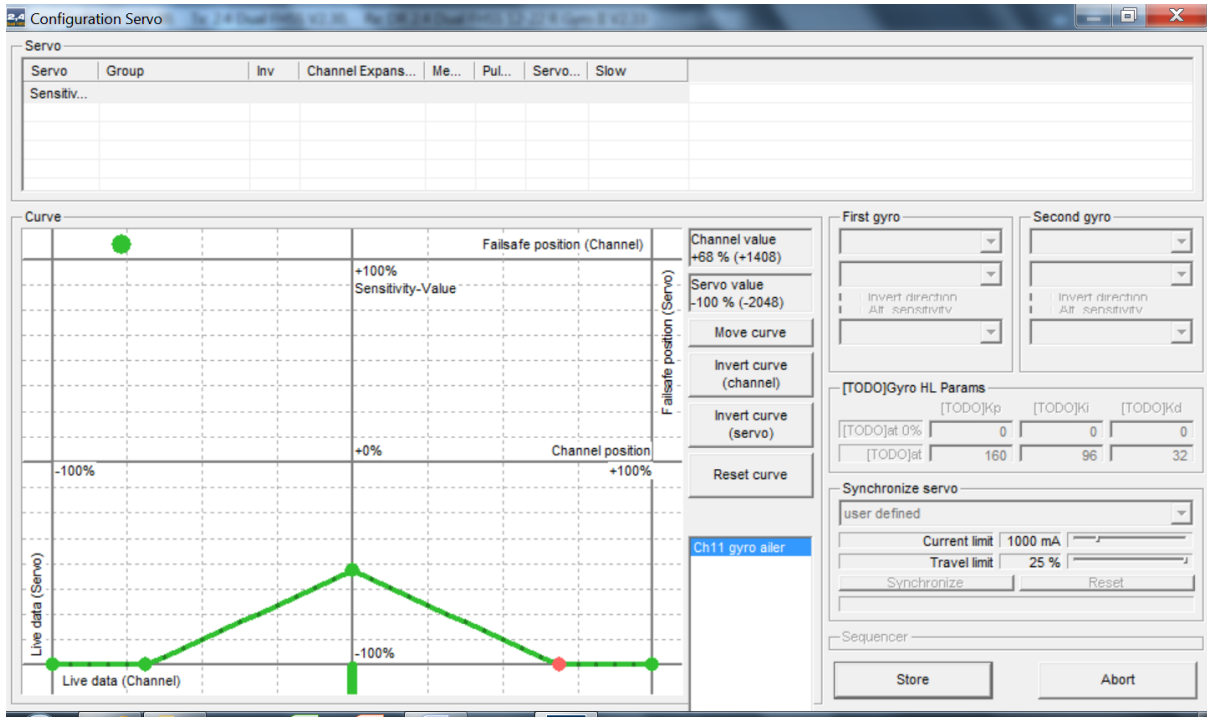


Now add in one more point towards the right end and drag it down to zero gain so that it matches the left side. The curve of the gain should be symmetrical.

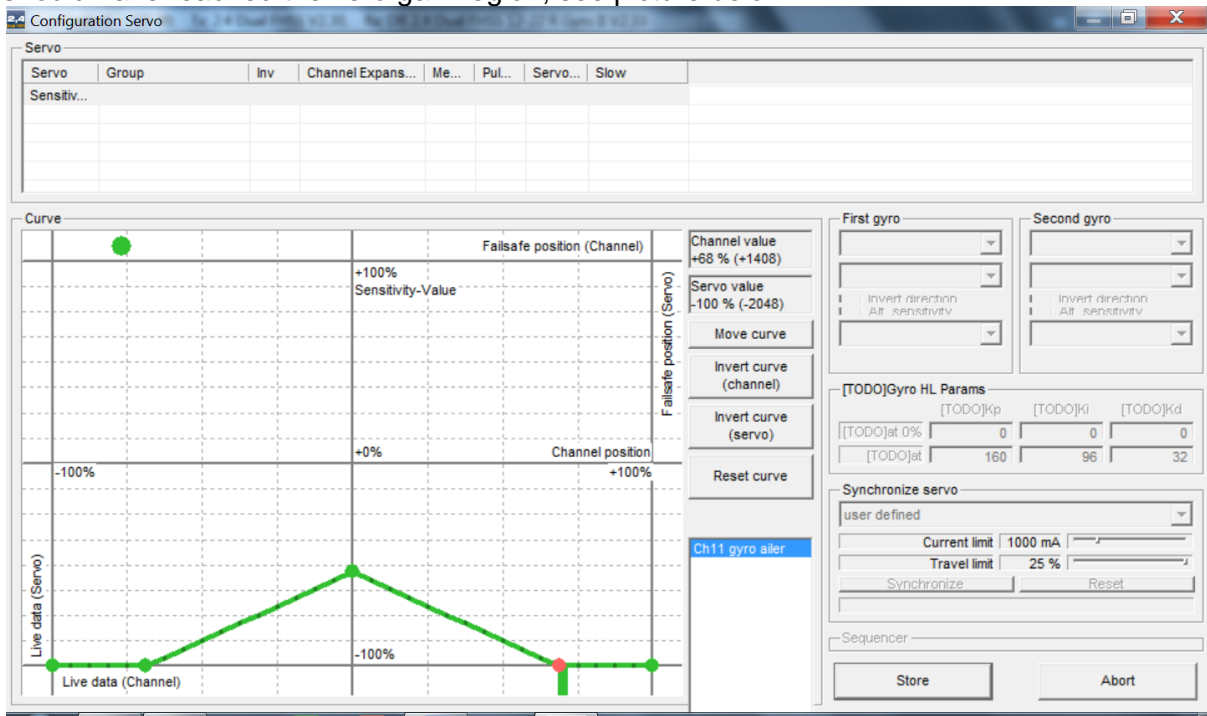


Next, change your Tx program to send aileron control without trim to the gain channel and remove the slider control from the gain channel. You want the aileron channel without trim so that trim does not affect the gain position, and also without any altered centre point, sub-trims etc. If your Tx software does not allow you to send the stick position without trims etc, we can accommodate this with a slight variation in GigaControl later. The aileron stick will

now control the gain and if you look at it in the gyro screen in GigaControl you will see the green control marker should now rest in the middle of the horizontal axis when the aileron stick is at neutral, and will move left and right as you move the aileron stick. Don't worry if the marker moves the opposite way to the stick, the gain curve is symmetrical so the direction does not matter. If the control marker on the horizontal axis is not at centre when the stick is at centre, your tx is adding in trims or an offset or mixing or some other setting. Ideally these must all be removed but if your Tx does not allow this do not worry, we can accommodate it.



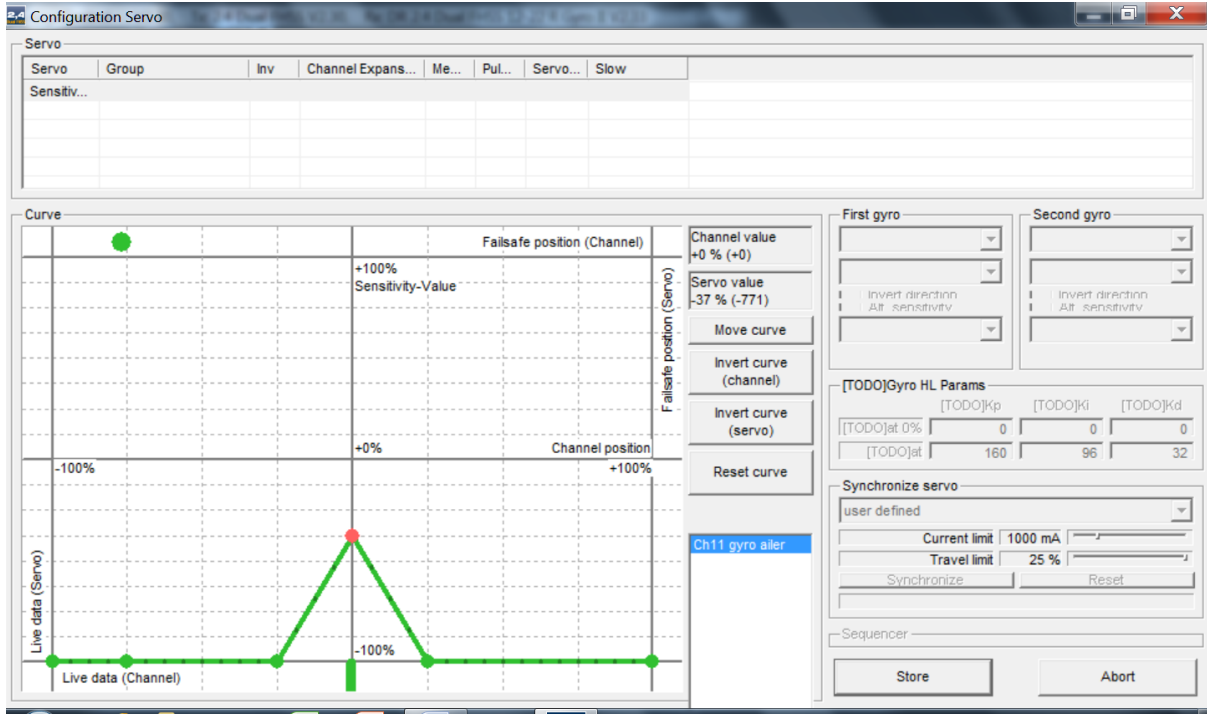
When the aileron stick is at full left or right, the horizontal axis control marker in GigaControl should have reached the zero gain region, see picture below.



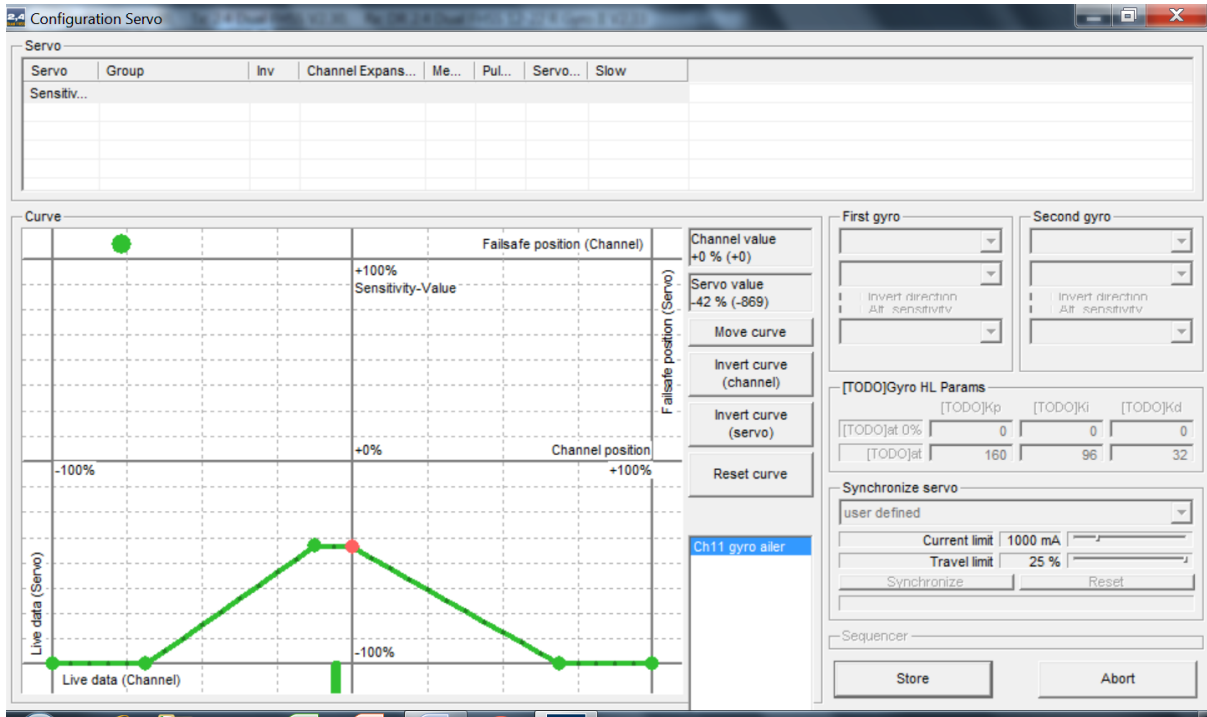
If not, create points on the curve closer in to the middle and set them to zero gain. If your Tx can not be adjusted to send a genuine centre signal and does not reach the zero gain band in just one direction, just add in another point closer to the centre for that direction and set it to zero vertical gain.

Note that this will give a good exponential effect so you should reduce or turn off the expo setting in your Tx.

I prefer a sharp fade-out of the gyro effect so I use this curve shown below.



If your Tx is not sending a genuine centre signal due to trims etc, either offset the entire curve left or right to match the centre, or use a curve with a flat top instead of a pointed top, the flat top will allow the gain to stay at the chosen value despite the control being off-centre, see picture below



After altering the graph, the direction of the gyro effect should still be the same as it is set in the individual servo screen, however it is always good practice to check the gyro again by moving the model and checking the direction of control surface travel. As a final safety measure you may want to switch the gyro master to OFF before take-off and establish level flight at a safety altitude before switching it to ON.