

Guardian New User's Guide

This guide is to assist in the initial setup of an Eagle Tree Guardian 2D/3D Stabilizer. It is intended to supplement the manual, not replace it. The next three pages walk you step-by-step through a successful Guardian installation in the most common type of plane, a typical 4 channel model, using a radio with optimum features. Later in the guide is some supplemental information, appendices with suggestions for handling some common radio and airframe variations, and some FAQs. This guide should answer many questions, what's critical and what isn't, and avoid some common pitfalls even if your installation varies from the standard configuration. If you have problems or, especially if you encounter something you find odd, please look through the FAQs first. Join us and share your experience on the RC-Groups thread linked below. (This document assumes you are using v10.63 of the PC application with v1.24 of the firmware or later. Some functionality described here will not be available if earlier versions are used.)

This guide assumes you have looked through the manual, but not necessarily understood everything, and you have the following equipment:

- A four channel aircraft of any size and power with standard configuration; one channel each for ailerons, elevator, rudder, and throttle with no mixing. For other configurations look through Appendix 2.
- A six+ channel transmitter and receiver with a three position switch and a rotary or sliding variable knob available on channels 5 or 6. If you don't have this, look through Appendix 1 before starting.
- An Eagle Tree Guardian 2D/3D Stabilizer, not the OSD add-on.
- A USB cable with a USB micro-B plug on one end and standard USB-A plug on the other. This is a very common cell phone cable found everywhere, you probably already have several. Some cables in circulation for cell phone use are charge-only and lack the connections for communication. If you have trouble with the PC app not recognizing that your Guardian is connected, try a different cable rated for charge and synch.

Resources

- Eagle Tree Support: <http://www.eagletreesystems.com/Support/support.html>
- RC Groups Guardian thread: <http://www.rcgroups.com/forums/showthread.php?t=1596644>
- Eagle Tree configuration tutorial: <http://www.youtube.com/watch?v=Rt8Y3Lxnv-0>
- Demo of some 3D features in a Polaris: <http://www.youtube.com/watch?v=fAFsk39Ysbo>
- Illustration of Heading Hold vs. Rate modes: <https://www.youtube.com/watch?v=OSsBtlCFiEk>
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Software/Firmware

Eagle Tree provides PC software for setting up certain options in the Guardian and updating the device firmware. This may be downloaded from here: <http://www.eagletreesystems.com/Support/apps.htm> While this isn't absolutely crucial, it provides many benefits and it's definitely worth loading the latest version. Please note that in Eagle Tree's distribution the firmware for the Guardian is imbedded in the software application. This means that to upgrade the firmware, you must download and install new PC software. Once the firmware is updated to match the PC application it will only update your firmware or notify you of new firmware when you install a new version of the PC app.

Preliminaries

1. Download and install the PC software application on your computer.
2. Unpack your Guardian and install the provided connection pigtail (with all the white wires). Carefully but firmly push the rectangular connector into the socket on the Guardian. Be sure it is completely seated and verify this with a tug on the wires. This sometimes feels like it is seated when it is still loose and causes problems later. You only have to do this once so do it carefully and do it right.
3. Plug in the USB cable to the computer and Guardian. Be very careful to push the USB plug straight in and out of the Guardian socket. This has been a trouble spot in early units and side force may pry the socket off the board. Recent production has a reinforced connection but still be careful. No other power or connection to the Guardian is required or recommended.
4. The PC application will install with an eagle logo and the label "Data Recorder". If it opens to the "eLogger" screen, click on the "Hardware" drop down and select "Configure Guardian 2D/3D Stabilizer"
5. The version # displayed at the top or bottom of the window should be 10.63 or greater. If not, go to the URL indicated earlier and install the latest version.
6. If necessary, update the firmware in your Guardian. It must be at least v1.24.
7. Go ahead and explore the software at this point, you won't hurt anything. The artificial horizon display is kind of fun. Come back to step 8 when you are ready to proceed.
8. Hold the Guardian approximately flat to a table top or floor and click the "factory reset" button. This will restore any changes you may have made. Do it even if you have made no changes.
9. There is an option to reset the gyros. It is not necessary to do this now but could be helpful later on if you should encounter drift. Be sure to brace the Guardian perfectly still while doing it (level is not necessary) and be aware that a factory reset after a gyro reset will undo the gyro reset so the factory reset should be first.
10. Be sure the "Enable Flaperon Mixing within Guardian" box is not checked, even if you plan to use flaperons.
11. Leave 2D as the default mode, even if you plan to fly in 3D most of the time. The 3D default option should only be used if you have no mode selection channel.
12. While here, it's a good idea to go to the 2D tab and increase the "Stabilization roll angle" slider to the maximum 80°. This will make it easier to turn in 2D mode, particularly if your "dual rates" are set at less than 80%.
13. You may also configure the Guardian modes to your mode switch. This is done appropriately on the "Mode Config" tab. For now, if you have a three position switch, leave the defaults. If you have a two position switch, change the "pos 0" assignment to "stabilization off". There is an extensive discussion of modes later.
14. All the other defaults should be OK for now. Click the OK box on the general tab and unplug your Guardian.

Installation

1. Locate a place in the plane for installation. Near the CG and on the centerline is recommended but don't obsess over this as a few inches off seems to work fine. It can be mounted inverted if that is more convenient but not sideways. It must point forward as indicated by the airplane symbol on the unit. It need not be perfectly aligned with the plane, up to 25° off in pitch or roll is OK, but try to be closer than that wide spec. The wires need to reach, of course. It's best but not critical that the USB connection and LED be accessible. A longer connection pigtail is available from Eagle Tree if necessary. A short (5") USB pigtail can be left permanently attached in tight installations to provide USB access if desired. The on-board pots should be accessible. Turn them fully clockwise now. If it will be mounted where the LED or pots will not be accessible, you should follow all steps in setup (below) before making the mounting permanent.
2. Attach the unit to the plane with servo tape. Alternatives include Velcro, which works well for many installations, or 3M outdoor mounting tape (grey tape with red separator). Don't use the 3M indoor mounting tape (foam tape with green plaid separator) or budget alternatives.

3. Plug the wires from the Guardian into the receiver with care. The plugs are marked by function, aileron, elevator, etc. Be sure they are plugged into the correct receiver channel and are not upside down or one pin off, as is easy to do with soft cases on the Guardian and many receivers.
4. The wire marked “mod” (mode selection) should be plugged into a channel controlled by a three position switch such as is provided on the “flap” channel of many transmitters.
5. The wire marked “gain” should be plugged into a channel controlled by a knob or slider such as provided on “aux” channels of many transmitters.
6. If you don’t have a three position switch or a knob some alternatives are offered in Appendix 1.
7. Plug the servos into the marked channels on the Guardian, again take care that the plugs are correct.

Setup (all these steps are important, do not proceed unless each step is working correctly)

1. Switch the mode switch through all three positions and use the LED on the Guardian to verify the mode selection. A blinking LED indicates 2D mode, a solid LED indicates 3D mode, and LED off indicates Guardian off. You may reverse the mode channel in your transmitter or change the switch assignments in the PC app to have the switch operate in the direction of your preference (switch up = 2D, for example). Make a note to yourself of which position selects which mode. More on mode selection in the “Supplemental Information” later.
2. Similarly, verify the direction of operation of the gain knob. Switch the mode to 3D and move the plane around. With the gain knob at one extreme the surfaces should respond as you move the plane around (gain = max). With the knob at the other extreme there should be no surface movement from the Guardian as you move the plane around (gain = zero). This can also be reversed to your preference by reversing the channel in the transmitter.
3. Run through your usual setup for your aircraft and transmitter with the Guardian switched off. This includes making sure all your channels are working as expected, in the proper direction, with no binding.
4. Be sure to set the proper throw on each surface as indicated in the instructions for your aircraft. It is highly recommended that the transmitter travel and the Dual-Rate high setting be left at 100%. If it is necessary to reduce the travel to meet the requirements of the aircraft instructions, this should be done mechanically by modifying the linkages. A shorter servo arm or longer control horn will reduce the throw. This is good practice without a Guardian, but more important here as reducing transmitter travel can cause some additional problems with a Guardian. (If you must reduce tx travel, see the “limit” item in FAQs.)
5. It is necessary to insure the Guardian is also issuing control commands to your surfaces properly and in the same direction. This is best done with the Guardian in 3D mode and gain at max, set 3D mode and max gain now.
6. All surfaces should respond in the direction you move the plane. Lift the right wing, the right aileron should rise. Lift the tail, the elevator should rise. Push the tail right, the rudder should move right. Watch the tutorial video under “resources” for an illustration. If any of these are moving in the wrong direction, turn the corresponding axis pot on the Guardian all the way counterclockwise and test again. This is critical, be sure it is working correctly before moving on.
7. Back off the Guardian on-board pots to half their max gain. Do this by turning the pot from its current position at max clockwise or max counterclockwise as determined in the preceding step, halfway back towards the center. The pots should now be at approximately the 3:00 or 9:00 positions. This doesn’t need to be precise, just approximate. No pot should be at the center position.
8. Repeat step 6, you should see the same thing but with less surface deflection as you move the plane.
9. Initial setup is complete.

At the Field

1. Prepare your plane for flight.
2. Switch the Guardian off and fly your model. Take the time to trim it carefully for stable cruising at low to moderate airspeed. Land the plane with the Guardian still off and unplug the aircraft battery.
3. The 2D level must be set for the self leveling feature to function properly. Prop up your model so the wings are level and the pitch is your best estimate of cruising pitch attitude. This is an educated guess and will be tuned by trial and error. A leveling device isn't necessary. Hint: it usually requires a higher pitch angle than you think at first.
4. Setting or re-setting "level": Plug in your aircraft battery and don't move the plane. Flip the mode switch one click, pause a second, and flip it back to its original position (the starting position doesn't matter). This switch "gesture" resets the Guardian's understanding of "level" to match the angle at which the plane is currently sitting. It also sets the Guardian's understanding of neutral or center stick to match your current transmitter settings including any trim you may have entered. Watch for a twitch in your ailerons and elevator as a confirmation by Guardian that your switch gesture was accepted. If you don't see the twitch, unplug your aircraft battery and try again. Note that a switch gesture is a movement from one mode position to another and back, this constitutes one "gesture". It must be done within 15 seconds of plugging in your receiver battery. If you are having trouble making this work (no confirming twitch) try waiting a few seconds after plugging in the battery before starting the gesture.
5. Setting or re-setting "trims only": Important: from now on avoid moving your transmitter trims, they shouldn't be needed anyway since 3D heading hold and 2D compensate automatically. Periodically, maybe every 10 flights, switch Guardian off in flight and re-check your transmitter trims. If your model needs re-trimming do so. Before the next flight, reset your trims only by plugging in your aircraft battery and executing two switch gestures as described in step 4. This resets the Guardian to accommodate any changes you just made without disturbing the level setting. The plane does not need to be level when you do this. Making trim changes without executing a trim reset will cause drift in 2D and may prevent 3D heading hold from locking the attitude.
6. You are now ready to try the Guardian in flight.

Trying out your Guardian

1. Set the master gain knob on the transmitter to midpoint.
2. Launch your model with Guardian off and climb to a stable cruise several "mistakes" high.
3. Switch on 3D with heading hold.
4. If your model spontaneously goes nuts at this point, one or more of your pots are reversed. Shut the Guardian off and revisit step 6 in "Setup".
5. If your model begins oscillating on one or more axes, slow down. If that doesn't stop it, lower the master gain. Refer to the section on Gain and Oscillation.
6. In 3D with heading hold your plane will be neutrally stable and will retain whatever attitude you put it in.
7. Switch to 2D mode. The first thing that will happen is that your plane will immediately assume level flight. Flying in this mode will feel very different and possibly not natural. The most aggressive aerobat becomes the most docile trainer in 2D. You will find that turning in 2D is rather different as you must hold the stick throughout the turn, not just to start the turn. Let your sticks go to center and make note of the cruising attitude. If the plane is climbing or descending more than you want, adjust the level. Do not correct this with trims. See the section on level setting in the Supplemental Information.
8. You're all set, enjoy your flying!

Supplemental Information and explanations:

Gain and Oscillation

All stabilizers are feedback systems, meaning the output of the system affects the input of the system. You have no doubt heard feedback in a public address system manifest itself as squeal. This is basically runaway feedback where the output swings one way until it drives the input that way and then the system corrects by swinging in the opposite direction and continues back and forth. When this occurs in a stabilizer it is called “oscillation” and causes the model to swing back and forth on an axis. Aileron oscillation can be seen in the first take-off in the “Polaris” video under resources. It will most likely occur on one axis before the others. There are two solutions for oscillation; slow down, or lower the gain.

There are two methods of controlling gain in a Guardian; the master gain controlled by the transmitter knob, and the pot gains that control each axis. You should think of these like the gain controls on an audio mixer. The pot gains are like the gains for individual instruments and the master gain is an overall volume control. An audio engineer can set the volume levels individually for the piano, guitar, and bass, or change the overall loudness of the recording. You can use the pots to change the gain on each axis individually or use the master gain on your transmitter to adjust the gain on all axes simultaneously.

So how do you do it? Generally the Guardian will perform better with higher gain, but if it is too high it will cause oscillation. Here is an approach to tuning the gain:

1. In flight, turn up the master gain until you see oscillation. This will tend to occur at higher speeds.
2. When you see oscillation make note of which axis and slow down or lower the master gain.
3. Before the next flight reduce the gain on the Guardian pot for that axis.
4. Go back to step one.
5. If you aren't seeing any oscillation, consider raising the gains until you do.
6. After a few flights you will have tuned the gains for your model.

Some other thoughts about gain:

- This isn't a precise setting, a wide range of gain settings are likely to be workable on any model. Don't over think or overwork it.
- Models with a wide speed range have more need of adjusting gain in flight. A model hovering or flying a “harrier”, needs a lot of gain because the airspeed is very low and large aggressive throws are needed for corrections. The same plane flying fast might need much lower gain as the higher airflow causes it to respond quickly with less throw.
- A sport plane flying the whole flight at medium speeds will probably never need a gain change in flight.
- Very fast, heavy, or expensive models should start with lower gain settings and work up to higher settings. Or if you are just nervous about it.
- For slower “foamies” it's OK to start at max gain and work your way down.
- It is possible to get more precise pot settings by connecting to the PC and observing the pot positions on the screen.
- Sometimes you may want to lower the master gain to “soften” the flight. A high gain may feel a bit too “snappy”. In higher turbulence, on the other hand, you may want higher gain with snappier response to counter the turbulence and hold the attitude better.

About Guardian Modes

Some people seem to buy the Guardian with the intention of using just one of the modes exclusively. This is often due to a lack of understanding or appreciation for what it can do. Don't short change yourself, try 2D and 3D HH at least.

2D? How do you fly a plane in two dimensions? The simple answer, of course, is that you can't. Air is a three dimensional medium. We also live and drive our cars in a three dimensional world but they operate mainly in two dimensions. In 2D, think of flying like driving a car. You can turn left and right. You can even go over hills, but you can't roll or loop your car, at least not with me in it please! In 2D mode you can turn, climb and descend but you can't loop or roll. Guardian will prevent any pitch or roll movement past vertical.

2D is useful for self rescue (auto leveling when you get in trouble), when you are disoriented or have flown too far away, for taking a break, training, camera planes, and for some scale planes and sailplanes. It is also very useful for landings. If you set the 2D level for a no- or low-power landing approach the plane practically lands itself, probably slower than you could fly it, and automatically corrects for turbulence all the way down. It's really fun to watch. Also, with this pitch setting adding a little power will hold altitude and more power will climb, making this a very versatile setup.

2D is not as useful as you might think for launching, however. When taking off you really don't want the plane level, you want it nose up and climbing. With 2D you need to hold up elevator until you reach altitude, so you can't launch hand's off (Some users set up a switchable up-trim or a throttle to elevator mix only active at high throttle settings to take care of this). Also in 2D the rudder isn't effective at holding the yaw against torque and P-factor. 3D heading hold is much simpler and generally more effective for launching. Just point the plane where you want it to go, activate 3D, and hit the throttle. Watch the 3D hand's off launches in the "Polaris" video under "resources".

3D with heading hold (HH) locks the plane to the current 3 axis attitude when the sticks are centered, so long as the plane is aerodynamically capable. This works great for launching (mentioned above), general flying, most aerobatics, and some pilots like it for landing as well, although most prefer landing in 2D. You have to try this for yourself to full appreciate it. Think about it. One characteristic of a good aerobatic plane is neutral stability, it should stay in whatever attitude you put it. That's exactly what 3D with heading hold does for all models! This is demonstrated in the hands-off inverted and knife-edge in the Polaris video. Because of the asymmetric configuration the Polaris is a difficult plane to fly knife-edge but the Guardian makes it easy!

Rate Mode and Direct Rate (there's no such thing as "Direct Rate Mode")

"Rate mode" is the simplest form of gyro stabilization. In this mode the stabilizer is simply reacting to un-commanded rate of change. If it detects an un-commanded roll right due to turbulence it corrects with left aileron. The magnitude of the correction is proportional to the rate of change. It only reacts to the rate of change and makes no attempt to restore the original attitude once the disturbance is halted. This is what you would have if you put a helicopter rate gyro on each axis. This is also the type of stabilization offered by simple stabilizers like the AS3X or Orange RX3S. A Guardian is in "rate mode" if 3D is active and heading-hold is off. Rate mode corrections are also a contributing component of 3D HH and 2D stabilization and so it is active whenever the Guardian is on. The aggressiveness of rate mode corrections is controlled by the derivative gain on the 3D tab. See the illustration video in "Resources".

"Direct rate" sounds similar but is completely unrelated. Direct rate is a sort of fly-by-wire. Yes, everything we do with our aircraft is fly-by-wire, or wireless, but the term implies some form of intelligence is being applied between the pilot and the control surface. Normally when we apply aileron stick, for example, we are commanding a proportional movement of the aileron surfaces. This may be modified by the travel-limits, dual-rates, digital servo programming, and expo settings but it is still proportional. (Expo is logarithmically proportional) With direct-rate you are actually not commanding an aileron movement at all, you are commanding a roll-rate as established by the "Direct rate speed roll" slider on the 3D page. Guardian will move the surfaces as needed to achieve this target rate so the servo responses may

not match your stick movements, especially on the ground where the plane is not responding. In the air, however, the effect is transparent and works fine.

Mode Selection

The Guardian mode is selectable in flight by using a 2 or 3 position switch controlling the channel where the wire marked "MOD" is connected. Each position of the switch may be assigned one of the following modes:

- 3D with HH is one of the main reasons many people install a Guardian. It locks the plane into its current attitude when the sticks are centered and is very useful for launching, general flight, and most aerobatics.
- 3D without HH is sometimes called "rate mode". It does not hold the attitude and corrects only for transient disturbances like turbulence. It offers the most "natural" stabilization, may be used for all aerobatics and precision flight, and some may use it as a substitute for off since it does the least of any mode. (See the "rate mode" paragraph above.)
- 2D with HH self levels when the sticks are centered and holds an azimuth. This is useful as described above.
- 2D without HH is the same but doesn't hold an azimuth. This is useful for pilots who like to use rudder control, on landings for example, as HH will oppose your rudder inputs.
- Off (Stabilization inactive. Guardian mixing such as elevons or V-tail still apply)

Initially use 3D HH and off with a two position mode switch or 2D HH, off, and 3D HH with a three position switch. You may, of course, change these assignments to your taste at any time with the PC app. These assignments are made on the "Mode Config" tab of the PC app. If you followed step 13 in the preliminaries you have already set this up. (Note that the labels on the switch positions are arbitrary for reference and may not match the labels on your transmitter but correspond to up, center, and down which will reverse with reversing the channel.)

Level Setting

There are four methods of setting or adjusting the 2D level in your Guardian:

1. A single switch gesture within 15 seconds of powering up the receiver. (We used this in the "At the field" section)
2. The "Reset Level Pitch/Roll" button in the PC app. (Requires a PC USB connection)
3. In flight, clicking the mode switch from 2D and back five times will set the level to the current attitude. This must start in 2D. The attitude is retained from the first click so it's OK if the attitude doesn't remain perfect while the remaining clicks are made. Anywhere from 5-10 clicks will work. This does not reset the trims, nor should it. Hint: To make this easier, break the rules. Leave your sticks centered and achieve the desired attitude with trim, but count the clicks. After resetting the level, apply an opposite number of trim clicks to restore the original trim. Another useful trick is to turn the gain to zero before establishing the attitude.
4. In the PC app, on the "General" tab next to the Artificial Horizon Indicator, the current values for pitch and roll are displayed. Adjacent to these values are arrows which are used to adjust the values by one degree per click, which may then be written back into your Guardian. These can be very useful for fine tuning. (Don't be surprised if the roll setting is not zero. This can occur if your Guardian mounting is not perfectly level, which is OK, or if you used method 3 above.)

All the methods work, my recommendation is #1, with adjustments via #4 if precision is needed. The Guardian does not have an altimeter so holding altitude means holding the set level attitude and is speed sensitive. So what target level do you set? My recommendation is to find the perfect landing approach attitude as described under 2D mode, earlier.

Appendix 1: Radio Options

- **Consider your choice of switches.** It's better to be consistent and use the same switch for the same purpose on all models. For example; if you are using the flap switch for Guardian mode control, use the transmitter's flight mode switch to control your flaps. If you do this across all planes, consistency can be maintained.
- **I don't have a knob or slider for the master gain?**
Many radios have 8 or more channels but only a 6 channel receiver. There usually isn't a knob on channels 1-6 but often a knob or slider from a higher channel can be assigned to channel 5 or 6, check your transmitter manual. Otherwise you can use a three position switch to select low/mid/high gain values by adjusting the travel limits and offset values in your transmitter. Or a two position switch can be used for low/high.
- **I have only a 2 position switch for mode selection?**
As above, you may be able to assign an unused 3 pos switch to the channel. Or use the two position switch to select your assigned modes. Off can be accomplished by turning or switching the gain to zero which effectively inactivates the Guardian, although the LED will still show the active mode. If you have another switch that can control a switchable mix it may be possible to program a virtual center off mode with a two position mode switch. The method is to mix the mode channel back to itself -100% in both directions. When active, this mix will override the mode switch and force the mode channel to the center signal value even if the mode switch has no center position. This gives you on/off control on the mix switch and mode control on the mode switch.
- **I only have one channel available for Guardian control?**
If only one channel is available it is best used for mode selection, preferably with a 3 pos switch. You can leave the gain wire disconnected. Doing so will reduce the effective gain to about 40% of maximum so you may need higher pot settings. If only a 2 pos switch is available it may be used as described above.
- **I don't have any channels available for Guardian control!**
You can fly a Guardian with no control channels. As mentioned above you will likely require higher pot gain settings without the master gain wire connected. With no mode selection available, field resets will not be possible. It would be best to use the PC software to change your default mode to 3D and use that mode for your flying. If you do want to use 2D, it would be wise to set the default to 3D first, get your gain pots adjusted, and verify that all is working properly. Then you can set the default back to 2D for future flying. Level and trim resets will have to be done with the PC application. If flying in 2D with no mode control, you may want to try "Center Stick Stabilization" (on the "2D Mode" tab). This will permit some aerobatics that are normally restricted in 2D, while retaining the self leveling feature when the sticks are centered.

An option that has become feasible with the new software is slaving the mode to another function with a Y cable. For instance, gear up=3D, gear down=2D. Or mid-flap=3D-HH (for takeoff), flap-up=3D-noHH (for flying), flap-down=2D (for landing).

- **Can I use Transmitter mixes with the Guardian?**
They are not prohibited but not recommended. Mixes to compensate for flaws, like cross coupling, are not generally needed since the Guardian compensates for these automatically in 3D HH or 2D. Mixes can interfere with Guardian functions as the Guardian can't distinguish between a rudder to aileron mix, for example, vs. an actual aileron command. The most common problem is unintended disabling of the 3D HH attitude lock.

Appendix 2: Airframe Options

- **My model has elevons?**
Guardian supports elevons just fine using the aileron and elevator channels for the elevons. One thing must be done differently; you must use the elevon mixing in the Guardian and the elevon mixing in the transmitter must be disabled. This is because the Guardian, obviously, needs to use the elevons to control the plane. If the mixing is done in the transmitter it is not available to the Guardian which then has no means of knowing your plane uses elevons. If mixing is active in both places they counter each other and bad things happen. Setup is easy; just click the button in the PC application for elevons instead of fixed wing. Setup your transmitter as if the plane has a conventional tail. The Guardian will continue to perform the elevon mix even if it is in “off” mode and it is not affected by the gain settings.
- **My model has a V tail?**
Same as Elevons, just use “V Tail” and the elevator/rudder channels instead.
- **My model has flaperons?**
Use the “aux” channel on the Guardian for your second aileron channel. Setup flaperons in your transmitter as described in your transmitter manual. The “Enable Flaperon Mixing within Guardian” box in the PC application must not be checked. It is unlikely but you may need to reverse the second aileron channel in the PC application
- **My model uses dual ailerons (perhaps with aileron differential)?**
Same as flaperon setup above.
- **My model is 3 channel (Rudder, Elevator, Throttle {or spoilers})?**
Guardian works fine with 3 channel aircraft within the obvious limitations of the airframe, of course. Plug the Guardian’s aileron channel into your receiver’s aileron channel. Plug the rudder servo into the Guardian’s aileron port. Guardian’s rudder port is left empty.
- **My model has no rudder?**
Not a problem, just leave the rudder channel disconnected.
- **My model is a glider?**
Guardian does not interact with the throttle in any way so it works fine with gliders.
- **My model has retractable gear?**
The Guardian does not interact directly with retractable gear but, in 3D HH or 2D, it will automatically compensate for any pitch changes resulting from gear movement. Any such compensation should be eliminated from the transmitter.
- **My model uses several high power servos, how can I stay within the Guardian’s 5A limit?**
Please see the power distribution paper from here: <http://www.rcgroups.com/forums/member.php?u=354219>

More....

- **My model has flaps?**

The Guardian does not interact directly with flaps but there are some considerations. Like gear, 3D HH and 2D will automatically compensate for pitch changes with flap movement. The usual technique of programming elevator compensation with flap movement will interfere with 3D HH since the Guardian will see the elevator compensation as an elevator stick not centered and release the attitude lock. If you do your landings in 3D HH, it's better to eliminate the tx compensation and let the Guardian handle the elevator correction.

If you do your landings in 2D, it's a little different. 2D will hold the particular pitch attitude you set, even when flaps are deployed. With some planes where the flaps are very effective, like sailplanes, this can cause the airspeed to drop too low and initiate a stall. In such cases, programming some down elevator compensation with flaps can be beneficial by telling the Guardian to assume a steeper 2D attitude with flap deployment.

- **My model uses “tailerons” (dual elevator servos)?**

If you have two (or more) elevator servos working together from the same elevator command, this isn't really tailerons and it should be possible to implement with the Guardian. Run a single elevator channel to the Guardian and split the Guardian's elevator output to the multiple servos. It may be necessary to use an equalizer or matchbox type of device to synchronize the servos to work together. Here is an example: <https://www.smart-fly.com/Products/EqualizerII/equalizer.htm>

If your elevator halves are driven independently and act as ailerons as well, that is a “taileron” setup, which the Guardian does not natively support. You can, of course, combine them to a single channel and implement as above, but that defeats the tailerons. It is possible, but klugey, to implement the Guardian with tailerons using a combination of external mixers. I've not heard of anyone doing this and wouldn't recommend it as it introduces multiple failure points. It is also possible, and has been done successfully, to run only one side of the elevator through the Guardian. This will produce a roll force when Guardian makes elevator corrections but that will be corrected automatically by the ailerons and your tailerons will still work. Post an inquiry on RC Groups for more help.

- **I use “wet” power, will I have a vibration problem?**

Probably not, but some do. Anti vibration gel pads can be effective. In difficult cases the most effective solution so far is a suspended platform such as the one illustrated from Range Video. The strength of the rubber and weight of the platform can be varied to tune out the vibration. Success has also been reported by attaching the Guardian to the battery and isolating the battery mass with some foam. Check on RC Groups for more advice.



Appendix 3: FAQs

- **I'm concerned about oscillation. I have seen planes destroyed by flutter and I don't want that to happen?**
Oscillation is not flutter. Flutter is an aerodynamic phenomenon similar to a flag flapping in a strong wind. It is powered by the energy in the airstream and there is no limit to the frequency or magnitude of the swings. Oscillation is powered by your servos. Oscillation cannot operate faster or further than your servos can move and therefore cannot operate faster than you could move the surfaces yourself if you were trying to. It's not impossible for oscillation to pull a hinge loose, etc. but it's unlikely and if it is that loose, it was already a problem. Your best defense against problems is to check the security of your hinges, linkages, etc. There is an example of oscillation in the first take-off in the Polaris video.
- **Your setup procedure uses only 3D, don't I have to setup 2D?**
Only setting the level, this is a trial and error process at the field. For the rest of the setup, if 3D works, 2D will work. Also, the responses in 2D can be confusing for new users. 3D is more intuitive and easier to see.
- **Can I use my dual rates and expo with the Guardian?**
Yes. DR works as expected but can affect 2D turning, see "slow to turn" fix below. Expo also works as expected but can make the near-center stick position a bit "notchy" in 3D HH.
- **Dual Rates don't seem to work in 3D?**
- **I'm seeing more throw with 3D on than off?**
- **There is a dead band near the end of my stick movement, the surfaces stop moving?**
There is an illusion that occurs on the ground in 3D that can make it look like you have more throw in 3D than off, can make it look like dual rates aren't working, can make it look like there is a dead band of no surface motion near the end of your stick travel. If you are noticing one of these symptoms you probably have all three if you observe carefully. Don't bother, it's perfectly normal and is not representative of what happens in flight. This is a symptom of the direct-rate feature. Direct rate tries to translate 100% stick throw into 100% of the roll rate you have set on the 3D page. It can't succeed on the ground because the plane is stationary, but in trying to do so it moves the ailerons more aggressively and runs out of travel before you run out of stick. This makes it look like you have a higher rate with G on than off and creates the dead band after the travel runs out. Ignore this. It won't behave this way in the air where the plane is responding. If you want to prove this to yourself, turn off direct-rate and see if the symptom you are seeing goes away. Don't leave it off, however, or your roll rate may suffer. (More on direct rate in the "Supplemental Information" section)
- **My model rolls faster with the Guardian off than in 3D, can this be fixed?**
Tune the "Direct Rate Speed Roll" slider on the 3D tab until the roll rates match. It's uncommon but in theory this could apply to pitch and yaw as well. (See above and "Supplemental Information" for more on direct rate)
- **My model is really slow to turn in 2D, how can I fix this?**
The turn rate is affected by your dual-rates or reduced travel limits. Switch to 100% rate when using 2D. For many users setting the "stabilization roll angle" on the 2D tab to the maximum 80° is a convenient alternative and is recommended especially if you often fly at less than 100% rates. (also see below)
- **I reduced the transmitter travel limits to prevent binding. Do I need to do anything in the Guardian?**
Yes. It's better to avoid reducing the transmitter travel if possible by adjusting the linkages as described in step 4 of "Setup". But if you must reduce transmitter travel; the transmitter limits are not visible to the Guardian, it uses its own limits. These limits are set on the "Servo Config" tab. Basically, midpoint or neutral is 1500µs. The

default range is 1100-1900 μ s, which matches most transmitters 100% range. Setting limits closer to 1500 reduces Guardian's travel range, while values further from 1500 increase the range. Check for binding in 3D with gains and DR at max and adjust the custom servo limits so no binding occurs. If the transmitter ranges are reduced significantly, it can impact 2D turning as described above and can make 3D sluggish, which can be compensated with the direct-rate sliders on the 3D tab.

- **I set up my planes with greater than 100% travel to improve "resolution", do I need to do anything in Guardian?**

Note that increasing the resolution in this manner has the tradeoff of slowing the travel time of your surfaces between any two points, something many fliers are not aware of. If you still want to do this, increase the custom limits as described above.

- **I use digital servos. Do I need to change anything?**

No, but there might be some benefit. If all the servos connected to the Guardian are digital, you might consider increasing the pulse frequency on the "Servo Config" tab per the servo specs. At least one user has reported this allowed higher gain without oscillation. Important: do not increase the pulse frequency if there are any analog servos connected to the Guardian, they can be permanently damaged and it could cause in-flight failure.

It should be noted that a few users have encountered problems using certain digital servos with the Guardian specifically, but maybe not limited to, the E-Flight **EFLR7155**. If you notice a continuous jitter or an unmoving servo or an unexpected spasm, only with multiple digital servos plugged into the Guardian, and the problem goes away when the servos are plugged directly into the receiver, you should contact Eagle Tree support.

- **When I yaw my model on the ground in 2D the rudder does not move but the ailerons do. What's up?**

This is normal behavior. It's also one reason ground testing in 2D is not recommended.

- **Do I need to activate the automatic turn compensation? (2D tab)**

It depends on the plane and your flying style. Many planes don't need turn compensation. Many pilots automatically feed in rudder (often too much). If you are in the habit of mixing ailerons to rudder or are unsure of how much rudder your model needs, automatic turn compensation is a much better solution.

- **Which mode should I use for take-offs?**

Use 3D HH. Point the plane where you want it to go with wings level and the desired climb angle. Switch on 3D. Put the plane down for a ground launch or prepare for a hand launch. You may taxi the plane without disturbing the launch attitude if you are careful to use rudder only. Hit full throttle and watch the plane climb to altitude. To take control back, just move the ailerons or elevator and start flying. Demos are in the Polaris video.

- **I notice some drift or creep in one or more surfaces. Is this normal?**

First, execute a trim reset to be sure that isn't causing it. A little drift seems to be common but it has little practical effect. In flight the plane's attitude will just slowly rotate on the creeping axis. This can be seen in the Polaris video. If you watch carefully you can see the knife edge is creeping slowly from the initial angle. That was an unusually long stretch with no control inputs so there was a lot of time to creep. Usually you don't hold an attitude for more than a couple of seconds and it's unnoticeable. You may be able to eliminate the drift by resetting the gyros on the "General" page of the PC app. Be sure the Guardian is braced absolutely still when you execute the gyro reset and don't follow it with a factory reset.