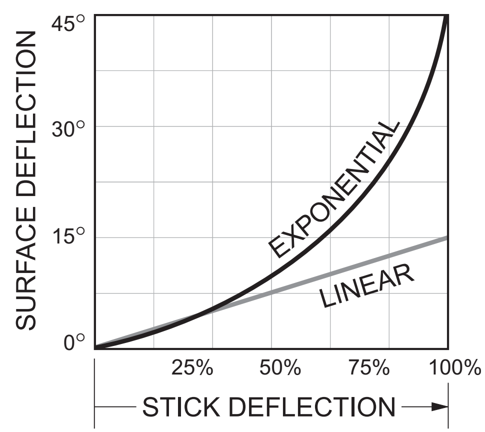
3D Airplane Features and Control Setup

Dual Rates
Exponential

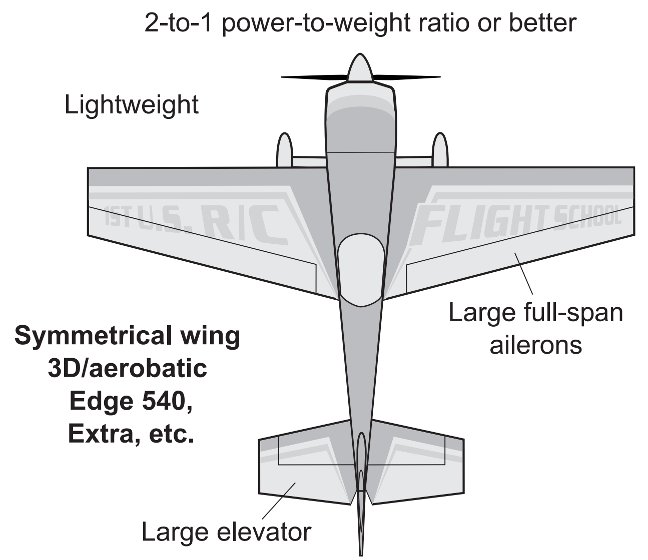


Travels - Differential - Mixing

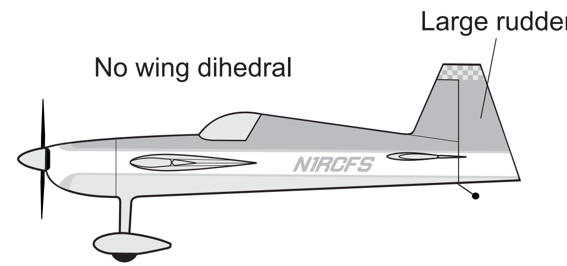
DAS
PARKFLY

3D Airplane Features

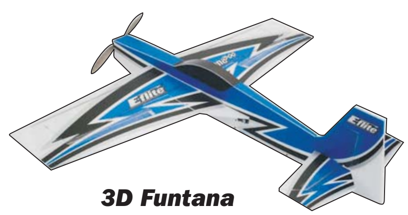
The “3D” reference associated with some airplanes indicates that the plane is lightly constructed and features large control surfaces capable of deflecting 40 degrees or more. (Since most 3D flying occurs at very low airspeeds, it takes very large surfaces to maintain control authority when there’s very little airflow to work with.) A good 3D airplane will also have at least a 2-to-1 power-to-weight ratio, and thus be able to hover at half throttle with power to spare.



There are generally two types of 3D airplanes: A lightweight scale model such as an Edge, Extra, Ultimate, or Yak, with large control surfaces, a tapered wing, no dihedral and a symmetrical airfoil, is capable of both precision aerobatic flying and 3D. The non-scale dedicated 3D models such as the Funtana, U-can-do, Harrier, and many flat-plate airfoil “foamies” are designed primarily for 3D flying (and consequently make poor precision aerobatic airplanes). This distinction is important because it will ultimately influence how you set up and fly your plane. For example, if you’re flying an airplane designed primarily for 3D, you won’t be happy with the results you get if you try to fly aerobatics with it.

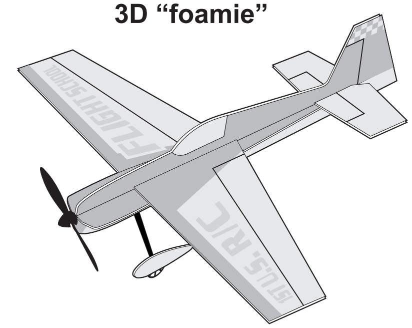


3D flying is where lightweight foamies shine! One of the better 3D training planes available is the *E-flite* Funtana foamie with a brushless electric motor. Everyone makes mistakes learning to fly 3D, and the Funtana is one of the more durable foamies on the market, yet it is light and therefore performs well at slow speeds. The Funtana also utilizes 2 aileron servos so you can program flaperons and other mixes to aid in certain flight situations. The tradeoffs are that flat-plate airfoil foamies don’t handle wind well, and their inherent pitch instability makes it nearly impossible to find an elevator trim setting that works consistently.



3D Funtana

Flat-plate airfoil
3D “foamie”

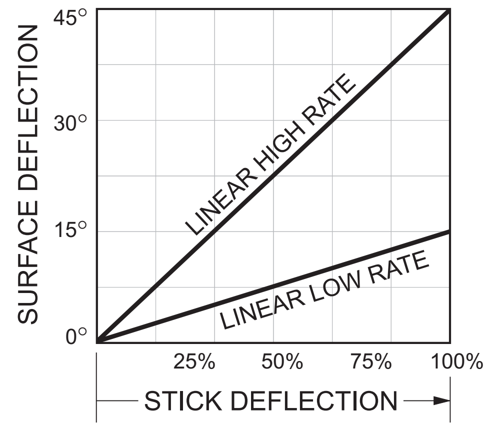


KPTR: Dedicated 3D designs excel at 3D, but tend to handle poorly outside of 3D flying.

Dual Rate and Expo Basics

A computer radio with dual rates (D/R) and exponential (expo) is required to fly 3D. The large control surface deflections required for 3D maneuvers would cause an airplane to be much too responsive during normal flight. Dual rates allow you to change the travel of the aileron, elevator, and sometimes rudder via a switch to achieve the optimal response rates for different modes of flight: The “high rate” setting allows maximum travels for 3D flight, while the “low” or “normal rate” setting provides the optimum travel for precision aerobatic flying, takeoff and landing. Understand, the low rate setting affords plenty of control response, just not as much as the high rates.

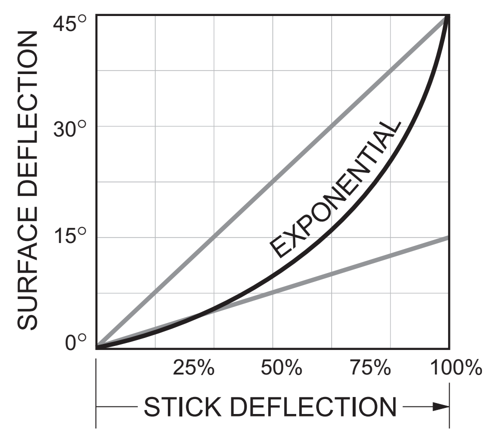
DUAL RATES



Since you want to stay focused on flying and not on flipping switches, it’s recommended that you put all your dual rate (and expo) settings on one switch. A helpful way to remember the switch positions is to remember “high away, low close:” Program all the high rate settings with the switch positioned away from you, and program all the low rate settings with the switch pulled closer to you.

On high 3D rates, a plane will tend to be too sensitive and hard to control between maneuvers, thus exponential is used to effect a softer control feel by causing the servo to move less than the stick movement through the first third or half of deflection. In short, expo will allow you to fly with the “feel” of normal rates when your control inputs are less than half, but then rapidly increase beyond that.

30-50% EXPO ON HIGH RATE



Note: Most recommended low rates are low *relative* to high 3D rates, but are still too much for precision aerobatics, takeoff and landing, and that is why manufacturers still recommend expo on low rates. However, in order to develop the precise timing required to fly aerobatics well, it’s important to maintain a 1-to-1 correlation between your control inputs and the response of the plane. Thus, if you’re flying a dual-purpose 3D/aerobatic airplane, the ideal low or aerobatic rate should provide a comfortable control response with minimal use of expo. In other words, if your plane is touchy on low rates, before you add expo, try reducing the low rate percentage.

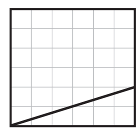
KPTR: On low rates, reduce sensitivity by decreasing the D/R percentage.
On high rates, reduce sensitivity around neutral by increasing expo.

Control Surface Travel and Expo Rules-of-thumb

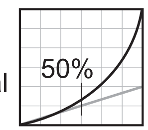
The manufacturer's recommended control throws are typically good starting points, but don't make the mistake of thinking that they are what the manufacturer intends you to stay with or get used to. To fly your best, you must adjust each control to suit your immediate skill level. Here are some control surface travel and expo rules-of-thumb to help get you started:

Aerobatic (Low/Normal) Rates				**3D (High) Rates**			
Deflection:		Expo:		Deflection:		Expo:	
Aileron	10-15°	Aileron	0%	Aileron	30°	Aileron	50%
Elevator	10-15°	Elevator	0-10% *	Elevator	45°	Elevator	50%
Rudder	20-30°	Rudder	0-10%	Rudder	45°	Rudder	50%

Linear = Predictable



Exponential



* Note: You will probably need to add a small amount of expo (5-10%) on the low rate elevator to help dampen some of the pitch instability (jumpiness) due to the omission of wing incidence on most models. For more information, see *Precision Aerobatics* or *Advanced Aerobatics* manuals.

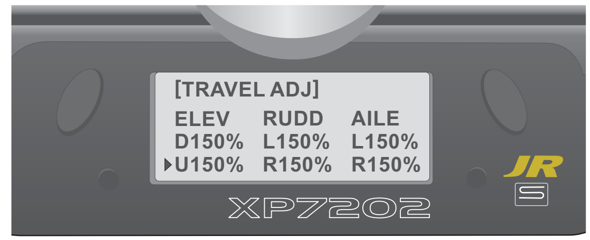
! Attention: When setting travels, it is vital that you triple check the physical deflections of the surfaces in all directions! For a variety of reasons, it's often necessary to program different percentages to achieve the same physical travel of a surface in both directions. Every year thousands of airplanes are faulted because their owners make certain assumptions based on the "numbers" they read off of the transmitter, but leave out the step of confirming all the physical deflections. They then either end up unhappy with the way their planes handle, or assume that having to make numerous and/or large adjustments later is an indication of a faulty design. In some cases, there may simply be more left aileron travel than right, and other than that their planes are just fine.

Tip: Remember to check the position of the D/R switch when programming the high rate, low rate, and exponential settings for each control. (Sooner or later everyone overlooks this step and has to go back and reprogram.)

! KPTR: Transmitter settings are to be based on actual deflections and your comfort level, not #'s!

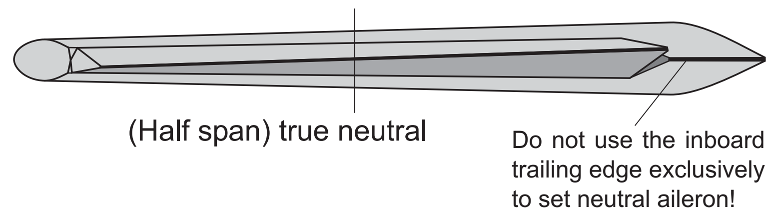
Control Surface Setup Basics

The first step to achieve the recommended high 3D deflections is to increase the control travels in your radio to the maximum (e.g., 150%). Make sure that you max both left and right, up and down, and don't forget the Flap/Aux channel when using 2 aileron servos and flaperons. The next step is to mechanically adjust the control linkages to set the neutral positions and the high rate deflections for all the control surfaces. As a rule, use the radio only as a last resort to fine tune things. Not only will this approach help you to achieve maximum servo resolution and thus a more precise control response, but programming will be simpler when you start flying and need to make adjustments.



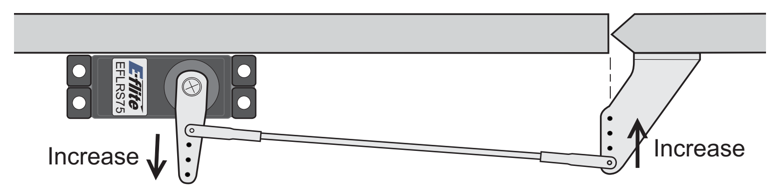
Side note: Since control surfaces often have a slight twist to them, make sure that you account for and "average" the twist in order to set the true neutral position of each surface. It is a mistake, for example, to set neutral by lining up the end of the aileron with the wing tip or the inboard trailing edge of the wing!

Exaggerated aileron twist example (symmetrical wing):



The best servo resolution and mechanical advantage (torque) is achieved when the control linkages are hooked-up closer to the center of the servo arm, and further out on the control surface horn. This would be ideal. However, it is not always possible to achieve 3D travels with this setup. Therefore, if you need more travel, move out a hole or two on the servo arm. If you still need more travel, move in one hole on the control horn. Go back and forth until you achieve the travel that you seek.

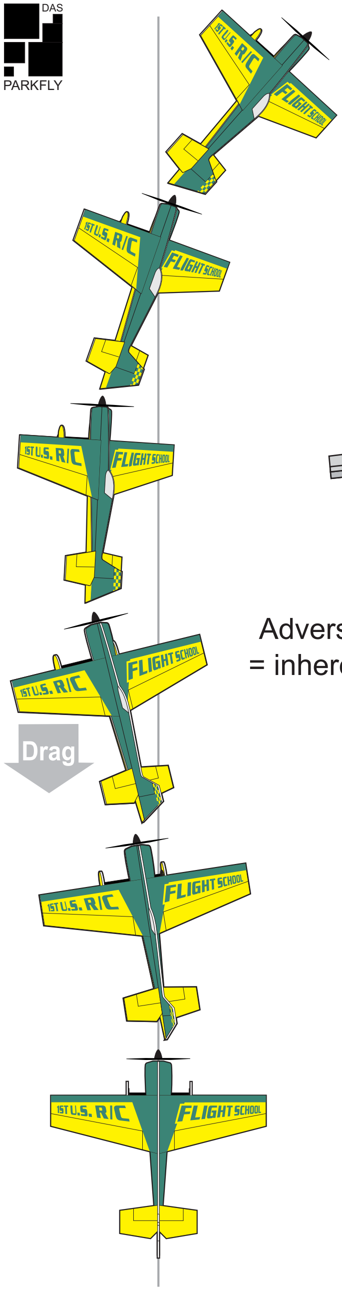
Aileron control setup example (flate-plate airfoil):



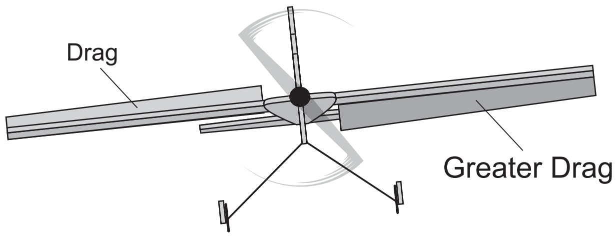
Ideal / Starting Point

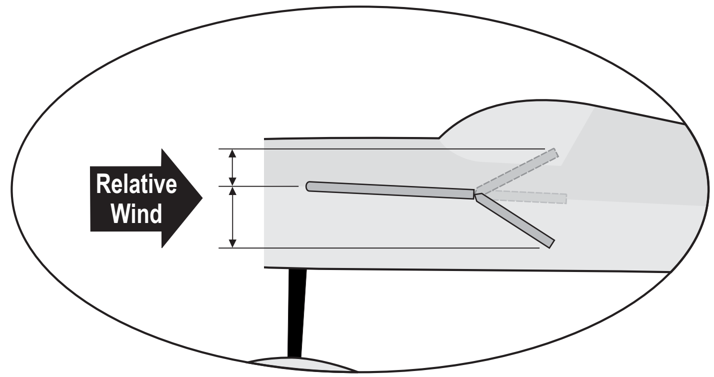
KPTR: Maxing the travels in your radio, then mechanically setting neutrals and high rate deflections, typically makes programming adjustments easier later on.

Optional Differential Aileron Travel Setup



Adverse yaw is an unfavorable condition in which an airplane inherently yaws in the opposite direction that the ailerons are applied. Explained: A positive angle of attack is generally required for a flat-plate or symmetrical airfoil wing to produce the lift required to keep a plane in the air. When viewed from the front, you will notice that when the ailerons are deflected with the wing at a positive angle of attack, the down aileron presents a wider frontal area cross section. Thus, in flight the down aileron will create more drag and cause the plane to yaw.



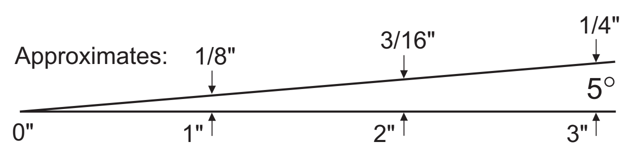


Adverse Yaw: Right aileron bank
= inherent left yaw, and vice-versa

When using 2 aileron servos and the flaperon function, adverse yaw can be lessened by programming a small amount of *differential* aileron travel, i.e., approx. 5 degrees less down aileron deflection than up—thus improving control and allowing for more axial rolling. Note: Eliminating adverse yaw entirely requires inputting rudder with the aileron in the same direction, or mixing rudder with the aileron through the radio.

(High rate) Differential Aileron Deflections	
Right Aileron: 35° Up 30° Down	Left Aileron: 35° Up 30° Down

5 degree differential reference: A 2" wide aileron would deflect approx. 3/16" more up than down.



 KPTR: 5 degrees less down aileron travel than up provides a crisper control feel and keeps banks and rolls more axial.

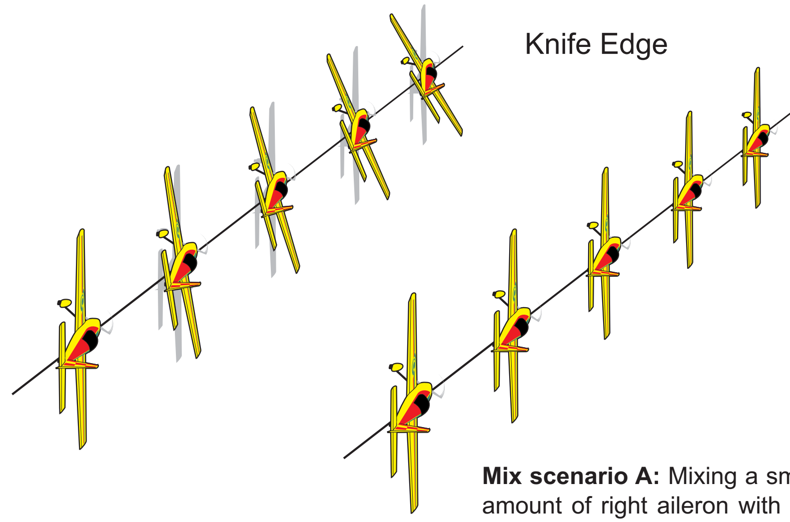
Programmable Mixing Concepts

Programmable "mixes" give you the option to automatically mix another control with your primary input to reduce or eliminate some of the unwanted tendencies associated with certain inputs and maneuvers.

Example: When a large amount of rudder is applied to sustain knife edge flight, most planes tend to gently roll in the direction that the rudder is being held. Therefore, flyers routinely mix a small amount of opposite aileron with the rudder to cancel out the rolling tendency during knife edge.

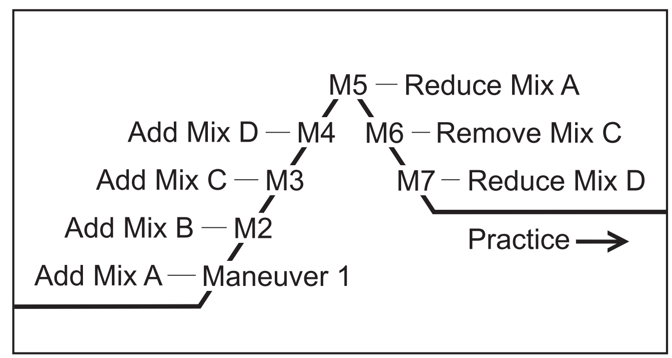
However, everything in aviation is a tradeoff. Each mix that you put in may only be applicable to that maneuver. That mix may turn out to be contrary to what's needed during another maneuver, or end up causing a deviation somewhere else that otherwise would not have existed. And that is why you must be prudent with your mixes.

Exhibit A: Holding in left rudder during knife edge flight results in the airplane also gently rolling left.



Mix scenario A: Mixing a small amount of right aileron with left rudder cancels the roll tendency during knife edge.

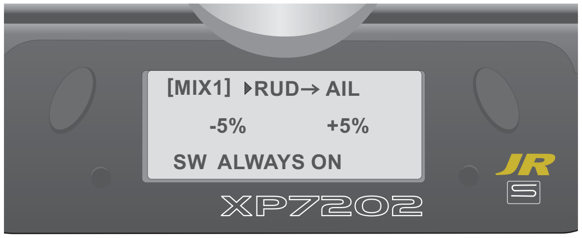
The process of programming mixes typically unfolds this way: When a new maneuver is practiced, a competent pilot will detect a tendency or frequent deviation that he or she will try to eliminate using a mix. As more maneuvers are introduced, the pilot starts running into situations where the deviation that he or she wants to remove is actually caused by an earlier mix. What follows is many hours of experimentation to determine which mixes stay, which need to be reduced, which need to be removed or reversed, and when it's time to take the initiative to correct yourself.



KPTR: A mix can simplify the maneuver for which it is intended, but it can also introduce deviations to other maneuvers if you mix too much.

Programmable Mixing Concepts Cont.

Unless you intend to only fly a few maneuvers, the most efficient and effective use of programmable mixes is to use the rule-of-thumb of mixing no more than 5-10% (15% max): If the tendency that you want to correct is slight, try a 5% mix. If it is more noticeable, try a 10% mix. Limiting each mix to 5-10% (15% max) will help make your flying easier without having too much impact on other maneuvers or causing you to do a lot of back-tracking as your repertoire increases.



Note: Many "tendencies" are held in check at higher speeds, and only show up when the plane is flying slower. Some tendencies show up at higher throttle settings, but not when the throttle is low. A lot of mixes are therefore only appropriate at certain airspeeds and throttle settings. This partly explains why those who look to mixing to take the place of developing better flying skills experience little overall improvement. Sure, a person could spend a life time flipping switches and trying to program complex mixing curves in an attempt to eliminate every unwanted tendency through the radio. But, at a certain point, the returns for all that effort are negligible. At some point, you will have to settle for being close on your setup and start focusing on improving your flying skills. One can travel across the country and observe flyers involved in an endless cycle of trying to "dial" into their radios the corrections that they could easily be making—only to have to keep repeating the process each time conditions change, a new maneuver grabs their interest, or a different airplane is flown. Indeed, programming their radios has become their hobby! In many cases, it no longer even occurs to people that sometimes the simplest and most effective thing that they could do to improve their flying is learn to make the corrections. Mixes can prove very helpful, but nothing will have more impact on your flying than your flying skills.

KPTR: Mixes are there to help you, but are not substitutes for learning the skills to fly the maneuvers!