TUNING SECTION

ABOUT ADJUSTMENTS

R/C race cars, in general, are some of the most adjustable racing machines of any scale. What's really amazing is just how easy and quick it is to make all of our changes: remove a ball stud to change roll center, one screw to change springs, or tape in some weight to change the car's distribution. On top of that, the X – 6 Squared is even more adjustable, adding options like the transmission height and the servo position that many other cars don't have. It's easy to get lost though, so here's some advice from one of the best in R/C racing, Brian Kinwald: "At any given track, only a few adjustments will help the car get around the track faster. 90% of set-up changes just alter how the car feels. The trick is to find those changes that really make a difference, and use the rest of them to get the car to suit your driving style." If you ever feel lost, like the car isn't working at all and you can't seem to get it back on track, change completely back to a standard set-up or something that worked previously and start again – it's how we learn!

When there are lap times available, pay attention to both your fastest lap and you consistency (how close the other fast laps are to the fastest one). If your fast lap is significantly quicker than average, work on making the car easier to drive; if you can run close to that fast lap the whole race, add some more steering or power and see if you can go faster.

Finally, don't be afraid to acknowledge if a set-up change didn't seem to affect the car on the track. Some adjustments are subtle, and different driving styles are sensitive to various adjustments. Learning that an adjustment didn't change much for you is a valuable result – focus on other things, and perhaps try it again later as your driving experience accumulates and set-up evolves.

DRIVING THE X – 6 SQUARED

The mid-motor X – 6 Squared is obviously a lot different than a rear-motor buggy, and it can take a bit of driving to get used to. With its weight more central the X – 6 Squared naturally caries more corner speed. With no "pendulum effect" from the motor hanging off the rear axle, the car likes taking smoother racing lines, while the rear end stays more planted. Watch out that you don't slam into the motor guards of other buggies through the infield!

The initial disadvantage of the mid-motor concept was a lack of forward bite out of corners, especially on slick tracks. X Factory designed the 4-gear transmission to help solve this problem: by turning the motor so it rotates in the same direction as the wheels, the motor itself helps transfer weight to the rear under acceleration, dramatically increasing forward bite. Further, the XF Team has put a lot of work into set-ups, developing cars that often have more rear bite than our competitors!

The starting set-ups in this manual have several features that add rear traction to help ease the transition to driving a mid-motor buggy. These include starting with the 4° rear toe-in block, running the rear hubs all the way forward, and using 30° front caster blocks. As you become more familiar with the car, you may find yourself surprised to be searching for steering. Read through the rest of this Tuning Section; check the set-ups posted by team drivers on our website, and feel free to post questions in the forum about your car. We love talking about this stuff!

TIRES

Tires are the most important tuning element by far: they're the car's only connection to the ground, and all other suspension or chassis changes must act through them. That said, tires are obviously very track- and condition-specific, so there's not much we can tell about them here. If you don't already have the right tires for your local tracks, see what the fast guys there are running. That's usually it.

SLIPPER AND DIFFERENTIAL

In previous sections we described breaking in your diff, adjusting it, and how to test your slipper clutch. Now, a few words about setting them! The diff and slipper can have a big impact on how your car corners and lays down the power.

The slipper clutch allows some 'give' in the driveline, which both protects the rest of the driveline from shock loads and takes the edge off the car in the high-torque range of the motor's rpm. Off the line and out of corners the slipper will slip some, just as its name implies, which helps prevent wheelspin and lets the car hook up. On slippery or looser tracks, we generally run a 'looser' slipper: back the nut off so that, when checking on the bench, the front end barely rises off the table. As traction comes up, you can tighten the slipper accordingly. On super high-bite surfaces, you'll actually back the slipper off some to prevent the car from pulling hard wheelies. The nice thing about slippers is the

ease of adjustment: have a friend take a ¼" wrench out to the track, and a few brief pit stops later you can have the car completely dialed.

Adjusting the differential for track performance is a tougher science, especially since the adjustment window is pretty small – less than full turn on the diff screw can go from too loose to locked up. The idea is, the looser your diff is, the more corner speed the car will carry. A tighter diff will have more forward bite – kind of like running a locked diff in a drag car. Diff adjustment isn't changed often but can be useful; always be sure the slipper gives before the differential barks.

FRONT CASTER

Your X – 6 Squared comes with 30° caster blocks. These give the car great corner entry steering while keeping it stable on exit. There are also 25° and 20° blocks available (ASC #9580 and #9592, respectively), which will progressively take away from turn in while adding exit steering. Honestly, the XF team worldwide runs the 30° blocks almost exclusively; there are usually better ways to gain steering without losing stability.

STEERING BLOCKS

One way to increase steering is to switch from the stock trailing axles to inline axles (ASC #9623) and inline steering blocks (ASC #9577). When you install these parts, move the spacer from behind the caster blocks (installed in step A9) to the front, and use the rear Ackerman hole in the steering rack. These axles will give much more aggressive steering in and out of the corner, though they sacrifice straight-line stability: they can make the steering feel twitchy. To combat this twitchy feel, many X Factory drivers have experimented with running the inline axles while leaving the caster blocks forward. This extends the car's wheelbase while taking some weight off the front tires, all of which smoothes out the car's steering.

ANTI-SQUAT

Rear anti-squat is the angle of the rear hinge pins relative to the ground. Lowering the rear toe-in block by removing spacers increases the amount of anti-squat in the car. With no spacers, the car has 4° of anti-squat; with approximately .120" (3 mm) of spacing the car has 0°, so every .030" (.74 mm) of spacers is a degree less. The thin white nylon shims included in the kit are .030"; the thicker ones are .060".

More anti-squat will generally take away rear side bite, add forward bite, and let the car spring more off jumps, generating a higher arc in the air. A car with more anti-squat will 'rotate' easier in sharp corners. Less anti-squat will make the car feel more stable and locked-in. Generally anti-squat is a "feel" adjustment, changing the way the car drives more than the fastest lap. It's another set-up change that's really quick and easy to do, so have a play with it and see what you like best.

REAR WHEELBASE

The wheelbase of your X – 6 Squared can be adjusted by moving the shims on the inner or outer rear hinge pins. As the pins are parallel to each other, moving the arm or the hub carrier by the same amount will have the same effect.

Moving the hub carrier forward increases rear traction in two ways: Primarily you are adding more 'angle' to the driveshaft, so there's more scrub between the dog bone and the outdrive as well as in the CVD joint. All this friction locks in the rear end and creates traction. Moving the hub carrier forward also increases the percentage of weight on the rear tires, further increasing bite.

Moving the hub carriers back is probably the easiest way to add steering and corner speed to the X – 6 Squared. It's one of the most commonly used adjustments for UK Champion Ellis Stafford. Moving the hub carrier or arm back some will increase steering throughout the corner. It also makes the car more stable in bumps, and because the driveshaft isn't as bound up, the car will "pop" better over jumps.

TRANSMISSION HEIGHT

The X – 6 Squared features X Factory's adjustable-height transmission. While not the easiest adjustment, it's a very powerful tuning tool to adapt the car to different surfaces. Included in Bag E (step E11) are several sets of transmission shims, four each of .030" (silver), .060" (gold), .090" (black), and .120" (green). Counting zero, that's five transmission height positions. When you change transmission height, make sure to re-check rear ride-height (remember the race preparation list?). Keeping the ride height the same will allow you to feel the isolated effect of the transmission height.

Important Note: For settings above .060", you'll want to shim up the motor plate support. We generally use #4 flat washers for this. Also, as you adjust the transmission height keep an eye on the driveshafts' position in the outdrive: use the small shims added in

step F11 to move the axles in and out, keeping the CVD engaged in the outdrive at full droop without bottoming out on compression.

Adjusting the height of the transmission changes several things at once. Primarily, it sets the distance between the inner hinge pins and outdrives; a greater distance allows the CVD to exert greater force on the suspension. It also changes the car's center of gravity slightly, as you're adjusting the height of the motor too.

Raising the transmission will give your car more forward bite. It effectively stiffens the rear of the car, which means the car will break loose sooner in corners and will bounce more over washboards or small bumps. A softer rear shock package is generally recommended when running the transmission high. Lowering the transmission does the opposite: less forward bite, but greater side bite and a smoother, more stable car over rough sections.

FRONT AND REAR TOE ADJUSTMENTS

Toe-in (or out) is the angle of the tires to parallel when viewed from above. Zero degrees of toe is when the tires are parallel to each other; toe-in is when the front of the tires point toward each other, and toe-out is when the front of the tires point away. Toe in the front of the car is very easily adjusted by turning the steering tie-rods between the steering rack and the steering blocks. The front tires are generally run with zero degrees of toe. Adding some toe-out will increase the initial steering in the car, but can feel twitchy and wander-y. Toe-in will stabilize the car, especially out of turns, but slows down the steering response and slightly decreases corner speed.

The rear tires are always run with toe-in, but the amount can be changed. It is adjusted by switching the rear pivot block (installed in step G8). More rear toe-in (the 4^{o} block) gives the car more forward traction but makes it harder to pivot the car. Less rear toe-in (the 3^{o} block) will let the car flow through corners and pivot well, but at a loss of stability off the line and out of corners.

CAMBER

Camber describes the angle of the tire from vertical when viewed from the front or back. If the top of the tire leans out past the bottom you have positive camber; if the tire leans in at the top it has negative camber. A good starting point is to have -1^{o} of camber all around; the team generally runs between 0 and -3^{o}. In general, more negative camber

will give more traction in the corners, while less gives more bite while the car is level. A good method of adjusting camber is actually watching tire wear or dirt build-up: if the tire looks even or uniform coming off the track, then you're close to spot-on.

RIDE HEIGHT

Ride height is how high the car sits off the ground at rest. Pick up the whole car and drop it from a height of 6 inches (15 cm) or so onto a flat surface, letting the shocks settle. To check ride height by eye, look at the molding seams in the middle of the control arms: are they parallel with the ground (called "level") or do they angle up or down? If the center of the car is lower than the hub carriers/caster blocks, so the arms angle up as they go out, that is referred to as 'below level', and vice-versa if they're angled down. If you have a ride-height gauge, touch off just behind the front bumper for the front and just under the transmission for the rear (the chassis will wear underneath the rear pivot block through the chassis life; measuring under the transmission will be more consistent).

The standard ride height is with the front arms level, or about 24 mm off the ground using a gauge (gauge measurement will vary based on the diameter of front tires); and the rear arms just below level, or roughly 23mm with similar considerations for tires. Raising the whole car up will add traction, feel better on rough tracks, and jump better. It also makes the car more prone to traction-rolls, though. When the traction comes up, it's better to lower the car some. This makes the car feel more direct, with faster reactions, and helps prevent roll-overs.

Check the car from the side using the same drop technique. This lets you see the "rake" of the chassis: the angle from front to back. In general you want to keep the car flat front-to-rear, or perhaps a touch higher in the back. Lowering one end of the car will give that end a little more grip, but extreme differences can make the car hard to control on the track.

CAMBER LINKS

Camber links are one of the more complicated adjustments on any R/C Car, and your X – 6 Squared is no different. The inside hole groups are referred to by numbers, and the outside holes are called by letter. The more inside the hole is, the lower the value. Thus a "2B" rear camber link is in the outside hole of the rear bulkhead (2) and the middle hole in the rear hub carrier (B); a "1A" link would be the inside holes in both.

Camber links adjust the car's roll centers – points critical to understanding how the suspension and chassis will roll through a corner. Without going through the geometry here, remember this: the shorter and more angled down the camber links are (inside lower than the outside), the higher the roll centers are. A higher roll center reacts more quickly but with less overall effect. Thus, removing washers or shortening links makes the car react more quickly but have less total roll. Adding washers or lengthening the link will slow down the reactions but make the car feel stiffer. Changing washers is generally a smaller effect than changing the length of the link. Remember:

Less washers (inside) = shorter link = higher roll center = more aggressive
More washers (inside) = longer link = lower roll center = slower, stiffer

If the above is the theoretical look at camber links, here's a more direct view: In the front, removing washers/shortening the link will quicken steering response but give the front less roll, leading to a possible mid-corner push, or steering which seems to wash out. A longer link will slow the reaction but give you more mid-corner steering. In the rear, removing washers/shortening the link means the back end will roll less and square up out of corners better. A longer link will give more rear traction in corners.

For a more systematic approach: Think about the outside ball studs first. The further out in the hub carrier or caster block you run, the more "square" that end of the car will run. This is especially felt in the rear: the 'C' hole in the rear hub carrier has more side bite in the corner, but when the car does break loose it will spin hard. The 'A' hole will let the rear end slide more, but it's much easier to control with throttle. The inside holes go through bumps a little better, too. Second, the inside ball stud location: the inside hole (longer links) will give more traction and feel safer while the outside hole is more aggressive. Last, find the number of ball stud washers you like: more washers will give that end of the car more corner traction but slow down its response.

A final note about camber links: keep an eye on the balance of the front and rear links. Having a short link up front and a long one in the back can make the car feel less confident and consistent. If you find yourself liking a long rear link, try a longer front one to go with it, and vice versa.

SHOCKS

The shock absorbers on your X – 6 Squared pack quite a lot of adjustment potential, and with good reason: they're working all the time, through corners, bumps and jumps, even just going straight! On your shocks you can change the spring rate, the damping and pack, mounting locations, and travel limits.

Changing the spring rate is pretty easy: change the springs. We've included the most commonly used springs worldwide to get you on the track; AE offers two shock spring kits, one for the front (ASC # 1581) and rear (# 1582), which will give you plenty of options. In general, stiffer springs will make the car feel more direct and jump a little better; they're suitable for high traction surfaces. Softer springs are better for bumpier surfaces, and can help generate traction on low-traction tracks. That holds true for each end of the car. Stiffer front springs will take away steering but can make it easier to drive, while soft springs add steering. Too soft will make the car hook spin out mid-corner. Stiff rear springs will add steering, especially in long sweepers, but at a loss of rear traction. Going softer in the rear will add bite, good on bumpy tracks, but take away steering.

The damping in your shocks is a combination of the pistons inside and the oil they travel through. Heavier damping (thicker shock oil) will make the car smoother on the track, and better landing jumps, but will make the car bouncy in bumpy or choppy sections. Lighter damping makes the car more reactive overall and better through bumps, but it will bottom out more jumping and be slightly harder to drive.

You should also consider the "pack" your shocks have. Due to fluid dynamics, the resistive force of our dampers greatly increases at high shock speeds. The smaller the shock piston holes, the more quickly the shock will pack and the greater the force will be. Big shock piston holes are the opposite. By adjusting the shock pistons and oil together, you can tune both the static damping and pack. To change the pack while leaving the static damping similar, adjust the oil 5 wt for each piston change. So if you started with #2 pistons and 30 wt oil, you could:

Increase pack with #3's and 25 wt
Decrease pack with #1's and 35 wt

and all three shocks would feel very similar on the bench (static damping). Increased pack is good over smooth tracks and very good for big jumps with flat landings; it also carries more corner speed. If your car is bottoming out hard landing jumps, try increasing pack in the rear. Less pack is good for bumpy sections, as the suspension can soak up high speed movement better.

Suspension travel is controlled by adding limiters inside and outside of the shock. Limiting inside the shock (where the oil goes) reduces the amount of downtravel in the suspension: how far down the arms can go. More downtravel (fewer limiters inside) is better for rough tracks, as it goes over bumps and lands jumps better. Less downtravel (more limiters) makes the car corner flatter, change directions quicker, and prevents traction rolls, all at the expense of rough-track handling. In the rear, make sure you limit

downtravel enough that the CVD's cannot pop out of the outdrives; especially when using the inside shock hole on the rear arm the X – 6 Squared has quite a bit of travel. Limiting uptravel (adding spacers outside the shock body) is rarely used, usually only in the rear to prevent the CVD bone from hitting the outdrive.

Finally, we discuss shock mounting. Changing the bottom shock mounts affects quite a lot: the further inside the shock is mounted on the arm the softer the suspension feels (because the wheel has longer lever arm on the shock) and the more travel you have. To keep downtravel the same, it's generally recommended to add .060" (1.5mm) of spacers inside the shock for every hole you move in on the arm (and take out spacers when you move out, obviously). Running the front shock on the inside hole will add low speed steering at the expense of stability. The more in the rear shock is mounted, the "safer" the car will feel around the track: it's softer and soaks up bumps better. Moving the rear shocks out on the arm will add steering and is generally recommended for high traction, smoother tracks.

The upper shock mounts are much easier: the shocktowers holes are designed in an arc so that the suspension travel doesn't change as much. Inclined shocks (mounted in on the tower) have a progressive feel to them. They're smoother around the track and provide more side bite. Vertical shocks have more forward bite and are better over jumps.

THAT BODY AND… WOW, IS THAT THE WING?

The body on the X – 6 Squared is definitely different than about anything else out there. While it gets mixed reactions at first, most of the family has grown to like it in time since the car was released. The body was certainly designed for function over form, and it performs it's function very well: creating rear traction. Take the body off for practice once – we're pretty sure you'll want it back on before completing a lap. There's emerging a market for aftermarket X – 6 Squared bodies, so if the body doesn't grow on you after a while shop around, there are some cool alternatives out there.

That monstrous wing for the rear of the car is that way for a reason: to develop the most rear traction of any car out there. And it's good at its job. Air comes off the body and hits that scoop behind the shocktower, and the wing is as wide as legally allowed. The key to such a big wing is that it's adjustable: you can always trim it down. Kind of hard to add lexan to a smaller one though...

There are several cut lines along the back of the wing to help you set the Gurney height (the vertical piece at the back, named after Dan Gurney, American F1 driver and team

owner). Obviously the higher cut line used the more force the wing develops. The downside is that the car loses steering and, more importantly, will begin to jump nose-up over larger jumps. If you experience this problem in the air, cut the wing down until the car flies correctly. At some tracks we've actually cut away some of the back angled section to get the downforce we wanted. Adding a front wing can also help balance the car in the air.