



RAPTOR G2 SE

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THE BEGINNING OF THE END

This document isn't a user guide, but a documentation of what I have learned through forums and articles produced by other RC hobbyists, and how I applied it to the Raptor, thank you to all those who share their knowledge and help others solve their problems, and as always, information within this document is believed to be accurate, and the writer assumes no responsibility of the reader's reliance on the information provided in this document.

The Raptor G2 SE is a powerful RC helicopter, inherited in the speed and power is the danger of a destructive accident, as shown below in Figure 1. After this photo was taken, this Raptor went through a transformation in character and soul. This is a good opportunity to do a total rebuild and secure critical parts with CA. The Raptor comes RTF, but in my opinion, as well as others, it should be completely taken apart and assembled properly, the use of CA is critical in securing critical parts, the entire Raptor was assembled without the use of CA, this means that after a couple flights, it will start to come loose all over. It is advisable to read through the Trex 450 assembly manual, downloadable from Align, this will give an understanding of how parts should be assembled and secured, the Raptor is not exactly similar to the Trex, but is similar.



Figure 1: Accidents Happen

After this accident, a journey down a road of repairs began. The damage looks extensive, but it was quite limited considering the severity of the crash. Some parts were reused, such as the main frame, but the main blade holders were not. Ironic, since the main frame was destroyed and the holders showed no damage; it was done to reduce to risk of failure causing impalement of nearby spectators. The situation is listed in Table 1 below.

Table 1: Damaged Parts

PART	DAMAGE	COST (USD)
Main Blade Holders	Possible Fracturing	\$4
Main Blades	Bifurcated	\$12
3 x Servos	Stripped Gears	\$33
Main Frame	Broke to 3 pieces	Repaired – JB Weld
Canopy	Cracked 6 places	Repaired - Tape
1200mAh LiPO	Crushed	(\$31 1200mAh) (\$38 2200mAh)
Tail Boom	Bent	\$4
Main Shaft	Bent	\$4
Transverse Shaft	Bent	\$4
Flybar	Sheared	\$4
TOTAL COST		\$103

The majority of the cost was associated with the servos; all 3 had their teeth knocked out in the violent face plant. The battery destroyed in the accident was a 1200mAh 10C that only provided 2 minutes of flight time, providing 2 minutes of flight time is grounds for destruction anyhow. A new 2200 mAh 12C was purchased. This is an essential battery for the Raptor, as it perfectly balances the center of gravity; meaning no additional weight that reduces the flight time of the Raptor. The battery fits in the tray and canopy VERY tightly, and some upgrades should be made to properly accommodate it; if you want to avoid the hassle of fitting a 2200mAh in there, the 1800mAh would work fine and may be a better option, but it is only 3mm shorter than the 2200mAh, so it may not actually make things easier. The main shaft, and transverse shaft were both extremely bent, these were replaced with new parts. The old ones were never used as this would definitely cause vibrations and instability. As these parts were shipped, the Raptor was stripped and refurbished.

THE BREAKDOWN

In order to rebuild from scratch, everything was taken apart. A very good precision screw driver set is essential, with varying Philips sizes; small size for the frame, and a larger size for servos, etc. The 3 allen keys included in the RTF kit are also invaluable when working on the Raptor.



Organization of the parts is essential, as to not lose any screws or small parts. Recording setup notes indicating where parts are placed makes things much easier when reconstructing. An exploded view of the parts makes everything a lot easier, shown below in Figure 2 and listed in Table 2.

Most of the deconstruction is straight forward, unscrew and pull apart, with the exception of the steering dowel in the sliding set, you must remove the steering shaft before pushing out the steering dowel, confusing right? Check out Figure 8, read that section, and you'll see clearly what you must do. Click on [→ Figure 8 ←](#) to jump to the figure within this PDF. The rest of the deconstruction and reconstruction should be fairly straight forward, if you lose track of where parts go, check out the exploded diagram below.

IMPORTANT: One important point that is not straight forward; the linkage heads must be pushed on by the right side, sometimes they're marked with a #5, check if this side is tapered, it should be, that's the side that must be pushed in, if the other side is pushed in, it will create a loose fit and a lot of play in the linkage will result. Thanks to FMB42 for pointing this one out.

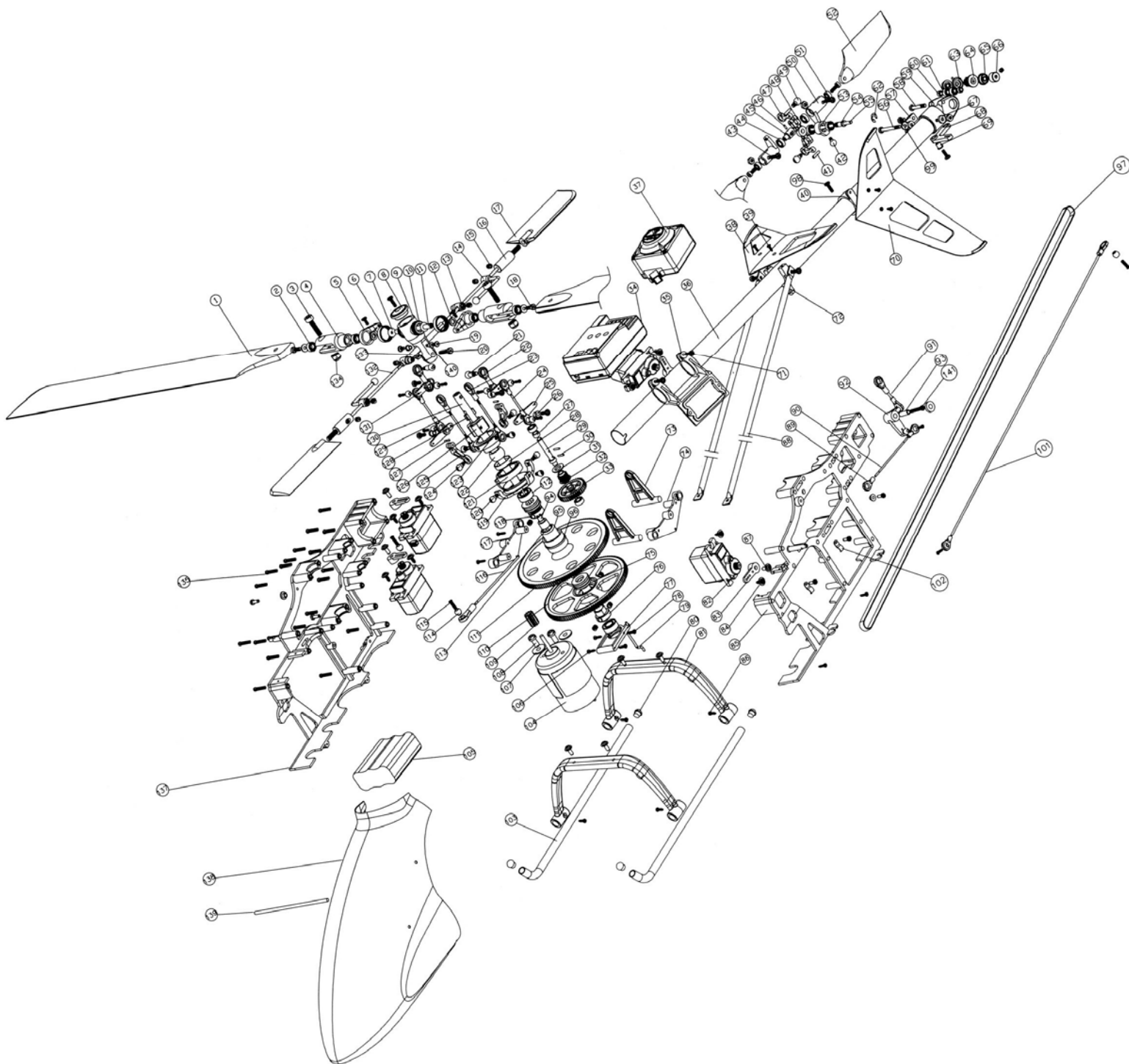


Figure 2: Raptor Parts

Part Code	Description	Q'ty
001	Main Rotor Blade	2
002	Bearing	7
003	Cross Recessed Pan Head Screw	2
004	Blade Holder	2
005	Blade Holder Connector	2
006	Decoration Ring	2
007	Rubber Ring	2
008	Blade Arrester	1
009	Rotor Head	1
010	Rotor Head Transver Shaft	1
011	Main Blade Shaft	1
012	Plain Washer	2
013	Flybar Fixing Block	2
014	Fiybar Paddle Holder	2
015	Hexagon Socket Plain Locking Screw	10
016	Flaybar Screw	2
017	Flybar Paddle	2
018	Cross Recessed Pan Head Screw	4
019	Cross Recessed Pan Head Screw	2
020	Cross Recessed Pan Head Screw	1
021	Ball Linkage	2
022	Ball Linkage	2
023	Ball Link	3
024	Short Ball Link Rod	2
025	Mixer Lever	2
026	Mixing Copper Sleeve	2
027	Belt Gear Sleeve	1
028	Swashplate Main Body (Upper)	1
029	Belt Gear Shaft	1
030	Belt Gear Shaft Pin	2
031	Belt Gear Retaining Ring	1
032	Synchronous Pulley	1
033	Double-Reduction Gear	1
034	Receiver	1

Part Code	Description	Q'ty
035	Servo Holder	1
036	Tail Boom	1
037	Gyro	1
038	Horizontal Stabilizer	1
039	Cross Recessed Pan Head Tapping Screw	10
040	Tail Boom	1
041	Cylindrical Pin 5	2
042	Steel Ball C	1
043	Cross Recessed Pan Head Screw	2
044	Bearing	4
045	Tail Rotor Connecting Shaft	1
046	Tail Shaft Fixing Pin	1
047	Tail Blade Connector	2
048	Tail Rotor Rotation Bellcrank	1
049	Steel Ball B	2
050	Aluminum Tail Rotor Connector	1
051	Bearing	2
052	Tail Rotor Blade	2
053	Tail Shaft Steering Holder	1
054	Tail Blade Sleeve	1
055	Tail Shaft	1
056	Cross Recessed Pan Head Screw	1
057	Tail Rod Holder B	1
058	Cross Recessed Pan Head Screw	1
059	Tail Gear Holder	1
060	Bearing Locating Ring	1
061	Bearing	2
062	Type-E Washer	1
063	Pinion Cover	1
064	Synchromesh Pulley (10 teeth)	1
065	Step Bearing	2
066	Tail Rod Holder	1
067	Tail Rod Holder A	2
068	Rudder Servo Control Arm	1
069	Control Arm Sleeve	1
070	Vertical Stabilizer	1
071	Cross Recessed Pan Head Tapping Screw	2
072	Horizontal Stabilizer Holder	1
073	Steering Holder (Left)	2
074	Deflecting Holder (Right)	1
075	Thrust Bearing	2
076	Oneway Hearing Sleeve	1
077	U-shape Connector	1
078	Cross Recessed Pan Head Tapping Screw	2
079	Short Linkage	1
080	Casing Cap	4
081	Skid Landing	2
082	9g Servo 5	4
083	Servo Bellcrank	4
084	Tapping Screw With Washer	8
085	Main Frame (Rgiht)	1
086	Cross Recessed Pan Head Tapping Screw	4

Part Code	Description	Q'ty
090	Servo Pull Rod 2	1
091	J-shape Ball Link Rod	1
092	Triangle Connector	1
093	Triangle Bellcrank Bush	1
094	Inner Shaft Rod Sleeve	1
095	One-way Bearing	1
096	Main Gear Sleeve	1
097	Toothed Synchromesh Belt	1
098	Cross Recessed Pan Head Tapping Screw	1
099	Cross Recessed Pan Head Screw	1
100	N/A	
101	Tail Servo Pull Rod	1
102	Wire Holder	2
103	Skid Landing Gear	2
104	Motor	1
105	Battery	1
106	Cross Recessed Pan Head Tapping Screw	6
107	Plain Washer (Class C)	2
108	Cross Recessed Pan Head Screw	2
109	Motor Gear	1
110	Reduction Gear	1
111	Main Motor	1
112	Bearing	2
113	Inner Shaft Rod	1
114	Aluminum Ball	12
115	Cross Recessed Pan Head Tapping Screw	12
116	Servo Pull Rod 1	1
117	Swashplate Control Handle	1
118	Main Shaft Retaining Set	1
119	Swashplate Base	1
120	Steel Ball C	4
121	Bearing	1
122	Swashplate Steel Ball	1
123	Swashplate Body (Upper)	1
124	Steel Ball D	4
125	L-Shape Bellcrank	2
126	Shaft Sliding Set	1
127	Mixer Lever Pin	2
128	Steering Dowel	1
129	Ball Linkage 1	2
130	Main Shaft	1
131	Main Rotor Controlling Rod	2
132	Flybar Controlling Rod	1
133	Flybar	1
134	Locking Socket Nut	2
135	Cross Recessed Pan Head Tapping Screw	22
136	N/A	
137	Main Frame (Left)	1
138	Canopy	1
139	Canopy Rod	1
140	Rotor Head Copper Sleeve	2
141	Cross Recessed Pan Head Screw	1

Table 2: Raptor Parts

REPAIR AND REBUILD

The main frame was in 6 pieces, but was easily superglued then JB-Welded back together. Original JB-Weld was used, which means 48 hours must pass before the glue is sufficiently hardened. Once hardened it is stronger than the plastic; because of this, a small dremel bit was used to create pits and holes in the frame so that the JB-Weld could properly hold the frame together. The frame is slightly heavier than before the repairs, but is now stronger in those areas. The repairs are shown below in Figure 3. It should be noted that the frame integrity has been compromised; any non-visible damage will pose a huge risk which can lead to another crash.



Figure 3: The Repaired Main Frame

The JB-Weld used to repair the frame doesn't become strong very quickly, it is supposed to cure in 24 hours, but seems to continually become stronger up to 48-72 hours. Once it is hard, the frame is tough, twisting and pulling doesn't cause much stain. The body was screwed together with the gears placed inside. The canopy holder is superglued at one side so that it doesn't move around. Everything is assembled, and prepared for the arrival of new parts. Parts begin showing up.



Figure 4: New Servos

Nitroplanes shipped 3 servos, one without a horn, one with a horn ready for insertion as the pitch servo, and one with a horn and ball joint ready for installation as a cyclic servo. It is very helpful that Nitroplanes understands damaged servos also mean damaged horns and balls. The servos are all installed and adjusted, as shown below in Figure 5.



Figure 5: Cyclic Servo Setup

Everything was powered up with all servo horns removed, the servos plugged into the receiver, and trims set to center on the remote. Once the servos all centered, the power was unplugged and horns were all placed as close to perpendicular to the strike of the

servos as possible, as shown above in Figure 5. The pushrod adjustments were adjusted later, which is in ADJUSTMENTS.



Figure 6: Completion is on the Way

With all electronics in place, the Raptor has come a long way, but is far from the end of the road. The new main shaft is firmly installed so that it doesn't come loose during flight; the 2 bolts holding it in place have come loose before, they need to be very tight, it is suggested that all critical parts be CA'd, superglued, or loctite'd. While we're on that subject, my swashplate almost fell apart during flight, a postflight inspection found that the bearing cover had fallen off, I bent the rim of the cover so it would be snug, and pushed it back in. The swashplate assembly is in 3 major parts, these parts should be CA'd, but they are not, the chances of the swashplate falling apart mid-air are high, it happens with this design very often, it should be taken apart and CA'd.

The inner rod that controls pitch is easy to install, and difficult to adjust, shown below.



Figure 7: Steering Dowel

Figure 7 above shows the steering dowel outside the slot in the main shaft. The amount that the center rod must penetrate the steering dowel is a fine adjustment that must take place properly, or else complete loss of control could occur during flight. I found that holding the bottom of the center rod with needle nose pliers and turning the rotor head was the best way to install the rod, rather than turning from the bottom, where clearance is limited.



Figure 8: Shaft Sliding Set

Once the sliding set has been put in place right-side-up, pointed out in Figure 8 by the red arrow, the steering dowel can be pushed into the center and through the main shaft slot; this sliding set can be installed upside-down, double check that this doesn't happen. The center shaft (small rod that controls the pitch by moving the sliding set) was turned clockwise from below until it screwed into the steering dowel; the distance it penetrates is adjusted in detail once all assembly is complete; how this was done is told in the chapter on adjustments.



Figure 9: Transverse Shaft

The new transverse shaft is straight, but one nut screws in easier than the other, to solve the problem of varying penetration lengths, pliers were used to hold the shaft while the nut (the nut that screws in the tightest, the looser nut is installed last) was screwed in until the bolt became flush with the end of the nut, as shown in Figure 9 above. Paper was taped on the pliers so that no damage was caused to the shaft being held.



Figure 10: Rotor Head

When the transverse shaft is installed, both sides are equally screwed in, and there is very minimal slack in the transverse shaft. There has to be some play so that the main blades can self balance. Over/under tightening leads to imbalance and major vibrations.



Figure 11: Rotor Head Assembly

The main blade holders that survived the crash were retired, and new guns were enlisted. Critical parts that experience a crash are always replaced and never put into service again. The Raptor has reached the end of the busy construction road, with the end of one chapter begins another.

The installation of the brushless motor is problematic. The brushless must be placed tight enough against the gear so that it doesn't slip, but not too tight as to cause major power loss. The slots where the bolts slide up and down is also too narrow, so adjustment is tricky. Over tightening the bolts will also strip the threads since the aluminum is soft and the threads don't tightly match; remember if the threads are stripped, turn the motor 90 degrees and there's a new set of threads, if these are stripped, retap and use larger bolts, otherwise the bolt will fail in the air and cause a destructive crash, happened to me! Place the motor so that it's just running against the gears, but not tight against them. Rotate the main blades counterclockwise and notice the resistance provided by the motor. Now move the motor closer against the gears and tighten, and once again rotate counterclockwise, if the motor has been placed too tight, there will be a noticeable increase in drag, this will cause increased wear of both the brushless bearings as well as the gear and pinion. Back off the motor incrementally until the drag almost decreases to the point where the motor was just running against the gears, this will be the most effective position. I oil my gears to further reduce friction.

One person said they placed the plastic wrapping between the motor and gear to produce a spacer. I've never tried this but it seems like a good idea.

BLADE BALANCE

As essential to the Raptor as new parts, is the balance of the blades. Thanks to Jim, X marks the spot, the center of gravity (CG). A pencil was used to mark the blades, and the antenna was used as the pivot point. A blade was placed at -45 degrees and marked, then placed at +45 degrees and marked again, this indicates the CG spot.



Figure 12: Finding Center of Gravity for Blade 1



Figure 13: Finding Center of Gravity for Blade 2

Once the CG test has been performed on both blades, the locations were compared.



Figure 14: Comparing Center of Gravity Between Blade 1 and 2

In comparing the CGs of the blades, it is evident that they are different. Tape was added to shift the CG of both blades to the same location. The CG will move towards the tape applied. The CG will be displaced greater if the distance between the tape and original CG is greater. Once the CG has been calibrated to the same location, overall weight must also be equal. This can be done with a mini-scale, or the balance method.

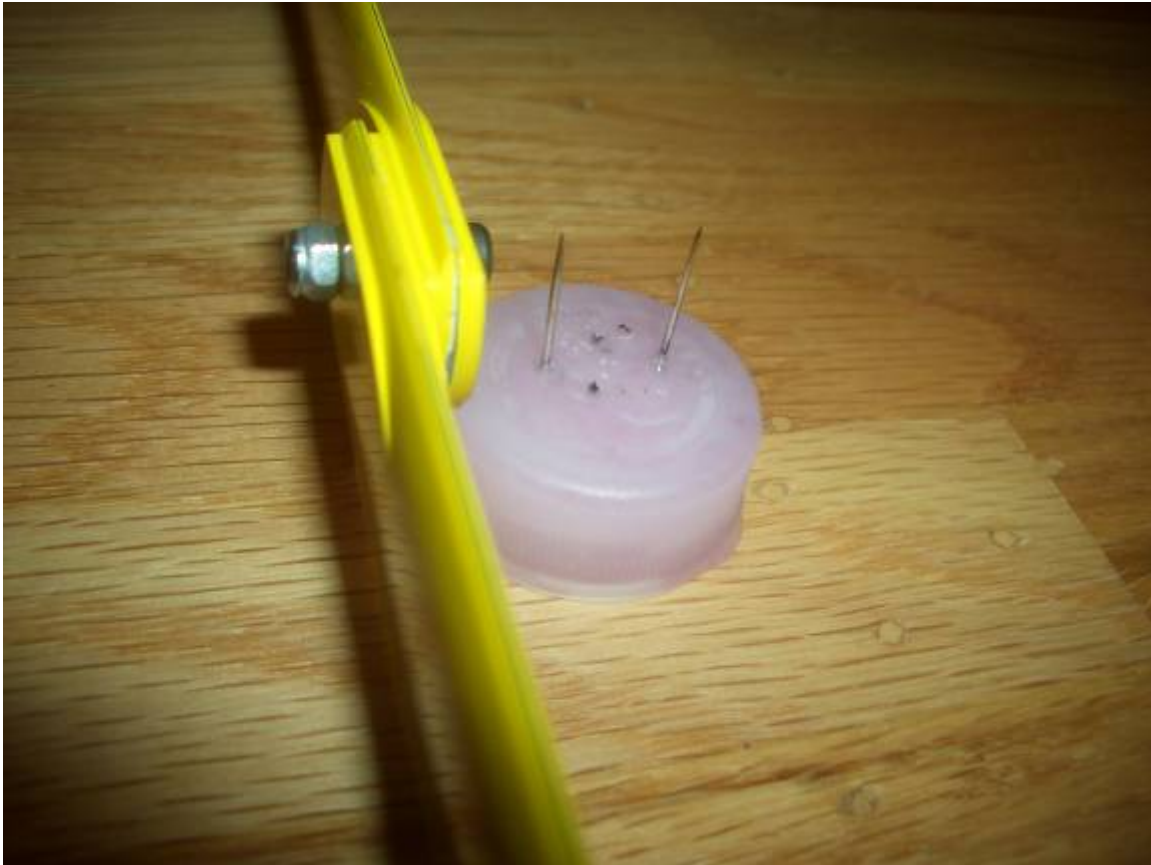


Figure 15: Needle Stand

A needle stand was made of 2 needles and a bottle cap. The needles were pushed through the cap at the proper locations to contact the bolt head and nut. The needle back was cut, and wax from a candle was melted to fill the bottle cap. As the wax cooled, the needles were adjusted so they evenly contact the bolt head and nut. Once completely cooled, balancing began. You could also make something out of 2 straight edges for balancing, instead of the needles.



Figure 16: Blades Balancing on Needle Stand

In balancing the blades, tape was applied to the CG ONLY, in order not to move the CG and cause a mismatch in CGs between blades. Clear packing tape was placed on the lighter blade. The tape was left sticking up into the air, rather than completely wrapping it around the blade. Once enough tape was placed on the lighter blade, excess tape was cut off until both blades sat level to the floor. The balanced blades run much smoother than imbalanced blades.

FLYBAR PADDLES

The flybar paddles were fixed to the flybar. The distance between each flybar was adjusted to the same measurement. This is an important balance that'll reduce vibrations.



Figure 17: Flybar Distance

UPGRADES

This section is dedicated to the extra things done with the Raptor G2 SE, and the equipment it comes with.

Tail Linkage Rod

The tail linkage rod is essential to proper stability of the rudder. The push rod has a tendency to bind, or bend when in compression. This leads to poor control of the rudder, leading to undesired pirouetting. I simply taped a piece of wood across the tail boom support rods, and then taped the control rod casing to the wood, this sufficiently held the rod from binding and allowed my tail to be stable and controllable.

ESC Heatsink

The brushless ESC had a very poor heat sink that didn't contact all intended surfaces. Copper heatsinks were glued to the existing aluminum plate, and the aluminum plate was completely glued to the heated surfaces to be cooled. It is suspected that the ESC fails due to overheating. This modification has kept everything cool and working properly.

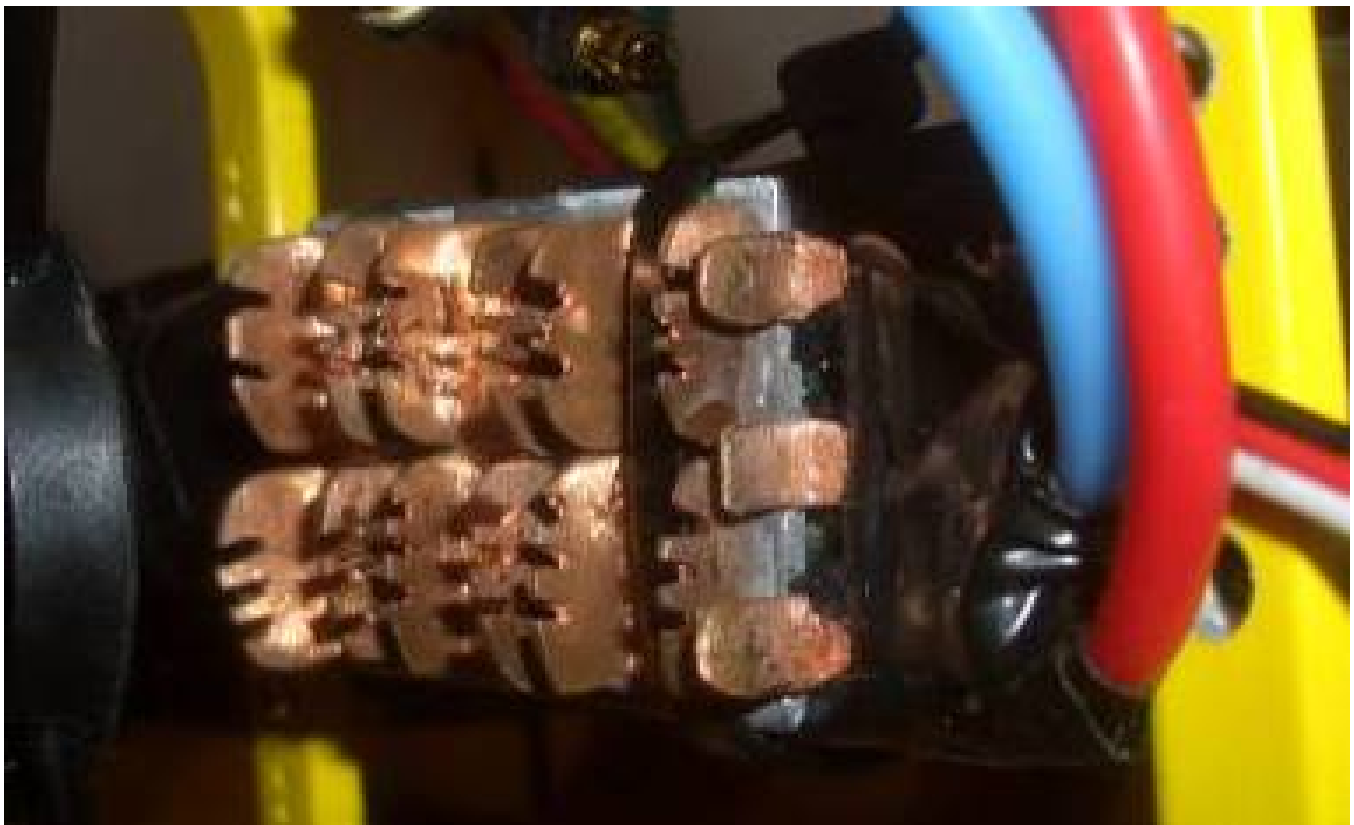


Figure 18: Electronic Speed Control Heatsink

2200 mAh Battery Upgrade

A 12C 2200 mAh battery was purchased to upgrade the power source. This provides a lot more power for increased flight times. It may also provide more punch for the brushless motor. The stock 1250 mAh heated up tremendously after a 3 minute flight, which so happens to be it's longest run time, and it's lifetime of 10 cycles was evidence it was an insufficient battery for the 30A ESC and brushless motor. Castle Creations also indicates that a battery which is not able to provide the required amount of current will damage the ESC in use. At 10C x 1.25Ah, the 1250mAh battery can only provide 12.5A, it's dangerous to use in the Raptor, and I did notice swelling, indicate an explosive LiPO may be in hand. The 1250mAh is not useless; it can be used in the WK-0701 remote. If you place the wires facing up, the battery cover can be put into place with a medium amount of pressure, and the JST plug fits perfectly in the remote. You should top it off after every flight, that way you'll never have to worry about low NiMH or NiCD, or the memory effect from recharging before they're completely drained.



Figure 19: Upgraded Battery - T-Connector

An upgraded 2200mAh battery calls for an upgraded T connector. A thicker wire has also been soldered to the ESC to take advantage of the 12C discharge rate.



Figure 20: Electronic Speed Control Wires

After soldering the power wires to the ESC, the wires going to the receiver were taped up individually, and wrapped as a whole. They are bare at the bottom and really close to the negative terminal of the power; this could short-out and damage components. This actually occurred, but luckily nothing was broken. Caution with these wires, make sure a short doesn't occur.

Reinforced Battery Support

The battery tray has a tendency to crack on hard landings. Some supports were added that provide maximal support with minimal additional weight.

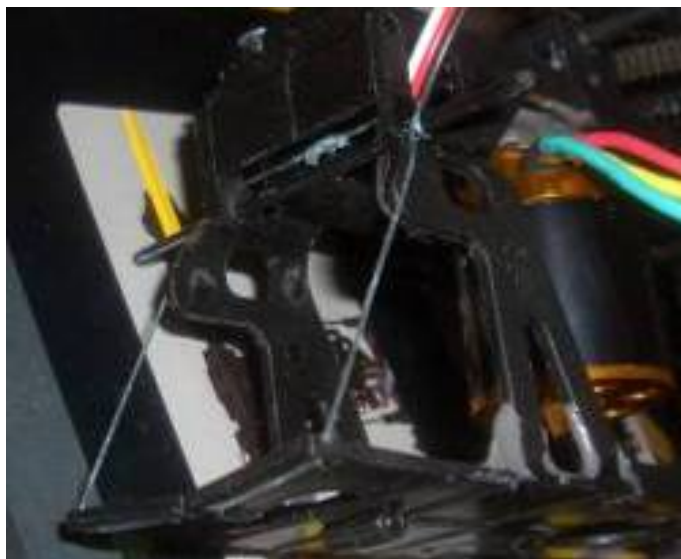


Figure 21: Reinforced Battery Tray

As shown above in Figure 21, adding tension supports to the battery tray will help reduce the chance of cracking the frame. Using fishing line here really strengthens the platform where the heavy 2200mAh battery sits, it takes all the force from the center of gravity of the battery and transfers it to the stronger upper frame. Without this support, the frame is supporting the battery 2 cm into the length of the battery, which is about 10 cm long, this means the cantilever effect is large, causing large tensile stresses to crack the frame. When installing the tension lines, small holes were drilled in the corners of the platform to thread the fishing line through, and a small amount of tension was placed in the line, which causes the platform to bend slightly upwards, this will take all of the tension off the point where cracking occurs at the frame.



Figure 22: 2200mAh LiPO Restraint – Not Applied

A restraint system was added to fully secure the large 2200mAh LiPO. Fishing line, 25lb test, is used to harness the back of the battery near the outrunner; pop bottle plastic is used to create a smooth support that won't damage the LiPO. A single line, and plastic is used to hold the front of the battery.



Figure 23: 2200mAh LiPO Restraint - Applied

Placing the front support around the battery tightly holds the back of the battery against the harness near the outrunner, the battery is secure from lateral movement. A Velcro strap is placed around the battery and the battery tray to restrain vertical movement. It is important to get the backing as close to the outrunner as possible without touching it. The battery will not fit in the canopy if it is too far out.

Simulation Cable for the WK-0701

The use of your own remote as a controller for simulations is easy and cost effective. You must have the WK-0701 PCM, the remote without 12 dip switches doesn't output a PCM signal and can't be used. I used an old headphone jack and some black tape to do the trick. You just need to find the right pins on the serial adaptor that came with the package, and jam the headphone wires into them. Install a program that creates a virtual joystick, "PPJoy", and install and run the program that interprets the signals coming through your microphone input, "SmartPropoPlus". The exact instructions on how to make the cable can be found by searching for SmartPropoPlus, they have exact instructions on the hardware and software. Software setup requires trial and error, once is enough, the proper setup which works for the WK-0701 PCM is shown below.

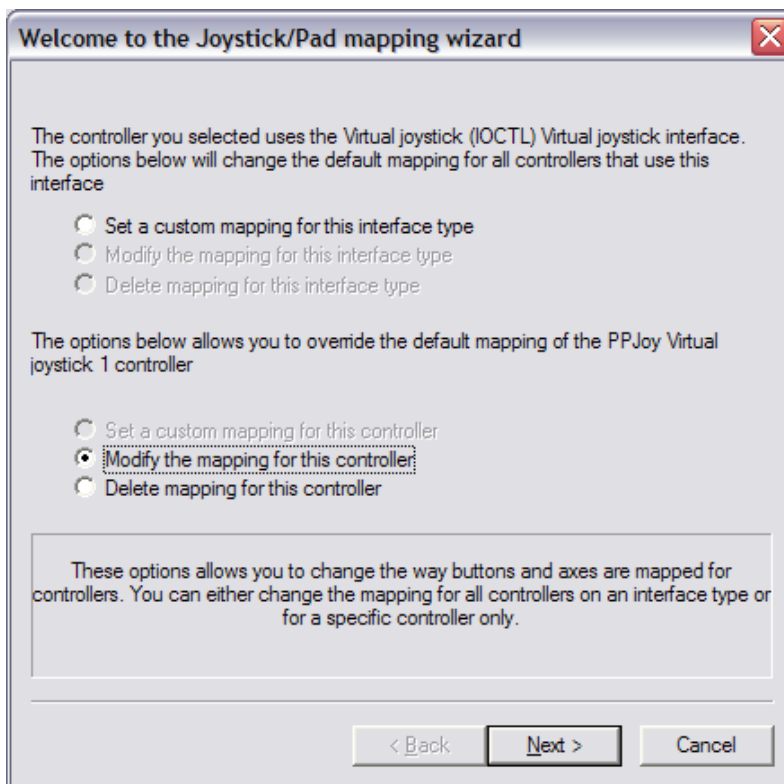


Figure 24: PPJoy Setup #1

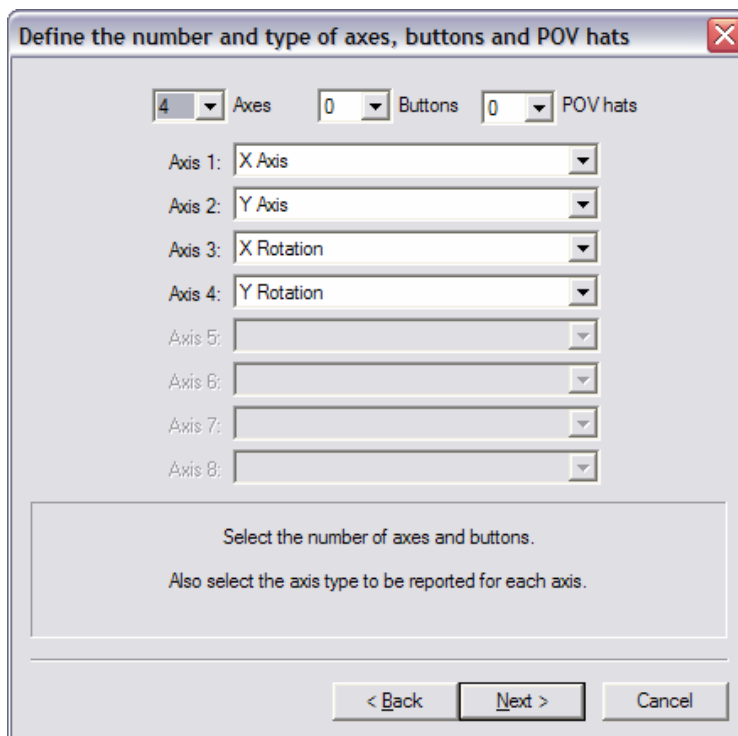


Figure 25: PPJoy Setup #2

Once programs have been installed, open up the start menu and run “Configure Joysticks” under “Parallel Port Joystick”, and add a virtual joystick, once it pops up, click mapping and adjust all the fields accordingly.

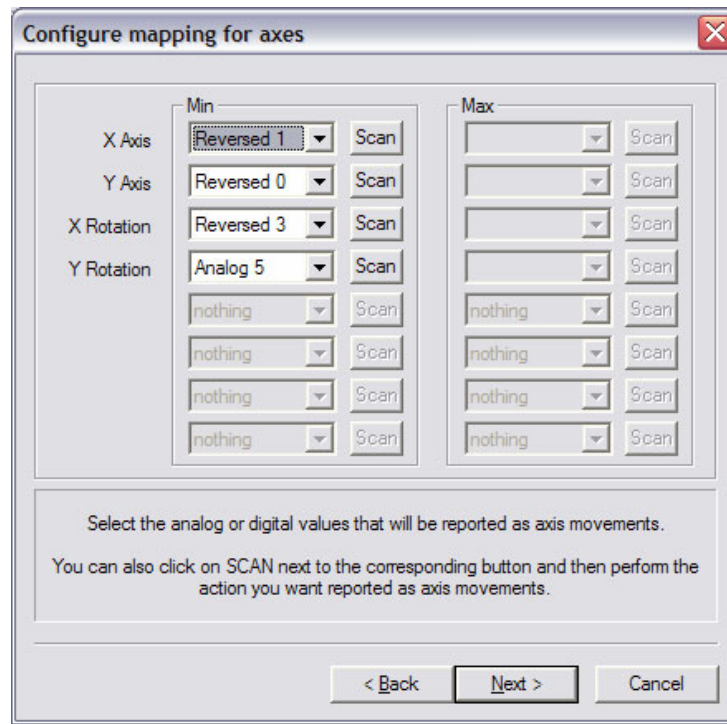


Figure 26: PPJoy Setup #3

Now that PPJoy is completely set up, proceed to plugging in the cable to the microphone or line-in, and start up SmartPropoPlus. Listen to the mic/line-in by un-muting it, you should hear the PCM signal. I had the poles reversed, and it didn't work, make sure you have the polarities correct, the diagram is confusing since it's different facing in or out, same as flying the helicopter, so we shouldn't have a problem there. Once the wiring and signal are correct, set-up SmartPropoPlus as below, and you should be able to calibrate the virtual joystick through the control panel. Do this in 3D mode so the helicopters in the simulations fly as the Raptor G2 does in real life. If you calibrate the remote in Normal mode, it will fly in 3D mode within Flight Model Simulator.

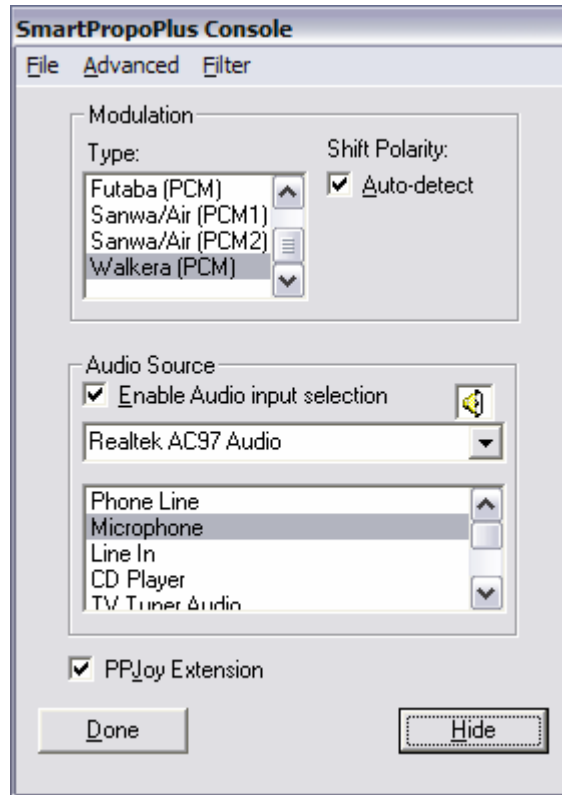


Figure 27: SmartPropoPlus Setup

If you haven't downloaded a simulator yet, search for FMS and download the latest version. There are also a lot of addon planes/helicopters/scenes for download throughout the internet. If it doesn't work correctly, run through the troubleshooting on the SmartPropoPlus web page.

ADJUSTMENTS

The Raptor has achieved victory against the first half of the battle, the second half consists of fine adjustments to achieve proper flight mechanics. All adjustments were performed with the motor disconnected, that is the most important thing if you value your safety.

CYCLIC

Setting the trims to their centers, and powering up the remote, then the Raptor forces each servo to its center position. After achieving the centers of the servos, power was disconnected and adjustments were made as necessary. Figure 28 below shows the swash plate from the front, from this view, it was evident the control arm must be shortened to bring the right side down, leveling out the swash plate to correspond with the center position of the servo.

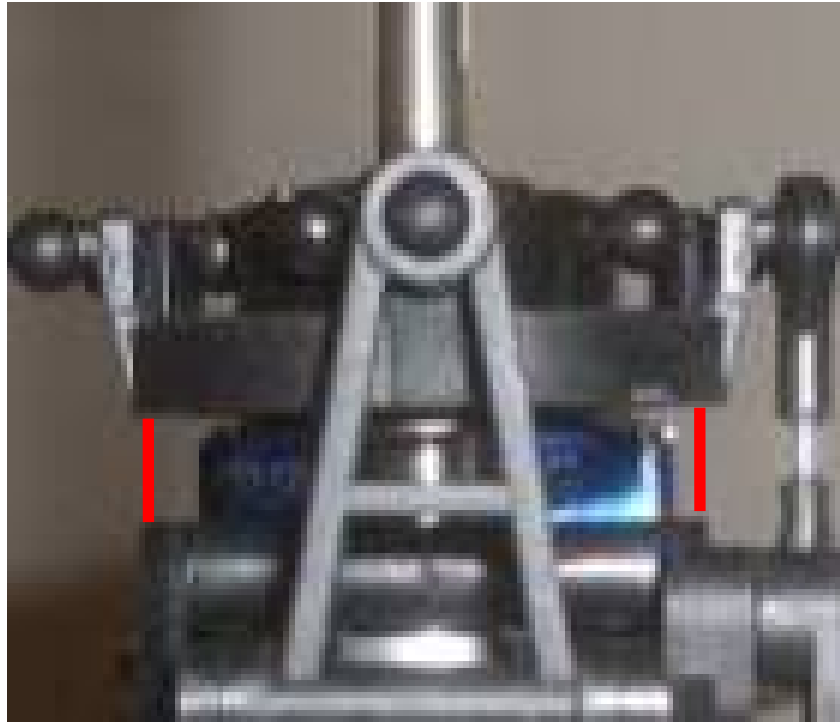


Figure 28: Left-Right Cyclic Before

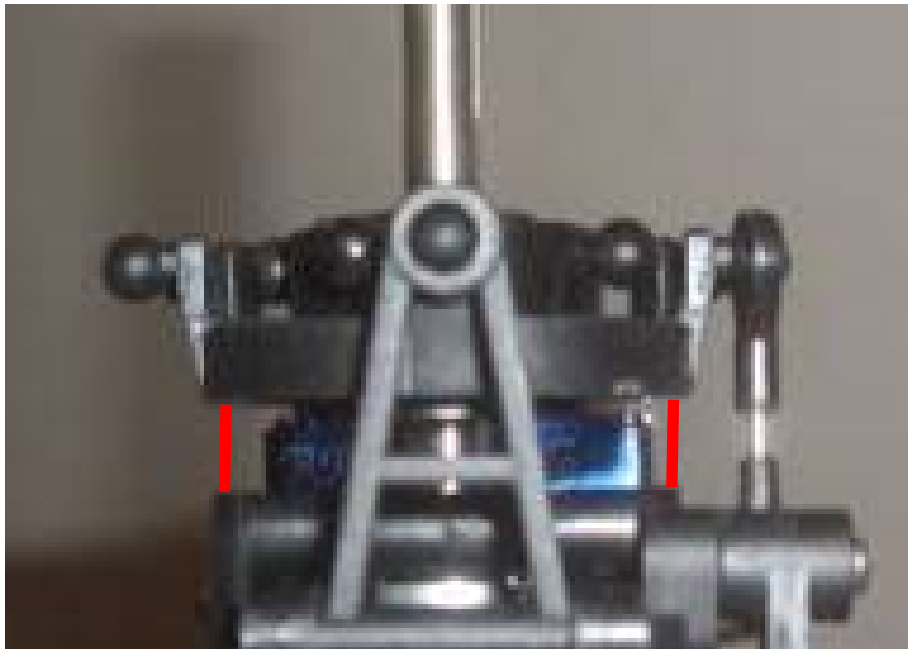


Figure 29: Left-Right Cyclic After

Upon disconnecting the control arm and tightening by one turn, the swash plate leveled out. The same was done with the forward-backward cyclic. I placed the ball joints on

the 3rd hole, and 5th hole from the center for the forward/backward and left/right cyclic, respectively. They belong on the 3rd hole, and should be left that way. I did this because in 3D flight mode, forward and backward was responsive and had full range, but left and right seemed to lack range. By placing the ball joint on the 5th hole to achieve more range, but leave it on the 3rd hole unless you want to test it out.

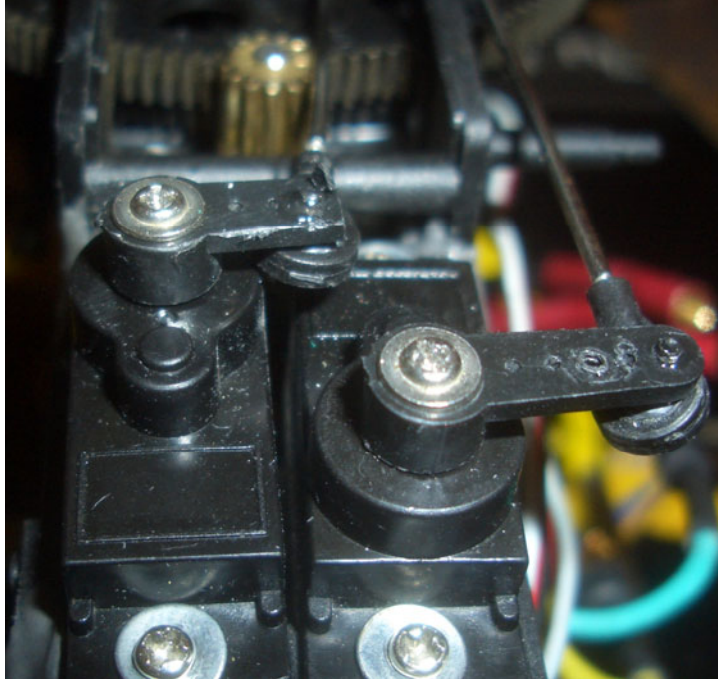


Figure 30: Cyclic Servo Horns

When placing the ball joint in different holes, tap the holes using the self tapping screw that holds down the servo horn, after it's been screwed into the servo horn, the ball joint can be screwed in easily.

PITCH

The pitch adjustments are performed in 3D mode, as calibration requires the use of extremes. Once 3D mode is properly adjusted, normal mode is considered to be properly adjusted. At 0% throttle, normal mode exhibits -2 degrees of pitch, up to 12 degrees pitch at full throttle. This holds true as long as 3D mode is adjusted to -12 to +12 degrees pitch at extremes and a mid-stick of 0 degrees pitch. The pitch curves in the manual reinforce this behavior. The graph that displays normal mode indicates negative pitch at no throttle. So to properly set up pitch, the setup must be calibrated in 3D mode.

The center rod is placed flush to the bottom of the rod holder in order to maximize the penetration of the center rod through the steering dowel. A very important adjustment was made next, in order to avoid a dangerous scenario. By adjusting the WK-0701 pitch range to max, and setting the remote to 3D mode, maximum negative pitch is made possible; push the throttle all the way down, and the servo will go to the lowest position possible. At this setting, the center rod is pulled down as far as possible, at this position, it is crucial that the rod does not contact the spinning main shaft, as in Figure 32 below, if this occurs, the main shaft will spin the center shaft counterclockwise and unscrew it from the steering dowel, leading to no pitch control during flight. If contact occurred between the rod and shaft, the horn was removed from the servo and placed back on the servo in a position that leaves the U-shape connector at its lowest position possible that didn't cause the rod to contact the shaft. The throttle was then placed to mid-stick and the shaft sliding set was checked for the center position. To center the steering dowel, screw in/out the center rod until the servo doesn't push against either extreme. The center rod can be adjusted by turning the connector circled in Figure 31. The adjustment between the remote, pitch servo, and steering dowel is now finalized.

To accurately find the real center position, turn dip switch 10 on (Pitch lock on the WK-0701 PCM remote), which will activate the dials V2 and V1, the remote light turns from purple to light blue. While the remote is in 3D mode, turning V2 to the counterclockwise extreme causes pitch range to be 0; if the remote is left at 50% throttle, turning this dial to the clockwise extreme will not cause a change in the servo, this means the throttle is truly at 50% throttle. Setting pitch range to 0, then adjusting pitch of the blades to 0 degrees will ensure proper calibration as long as the steering dowel adjustment is correct.

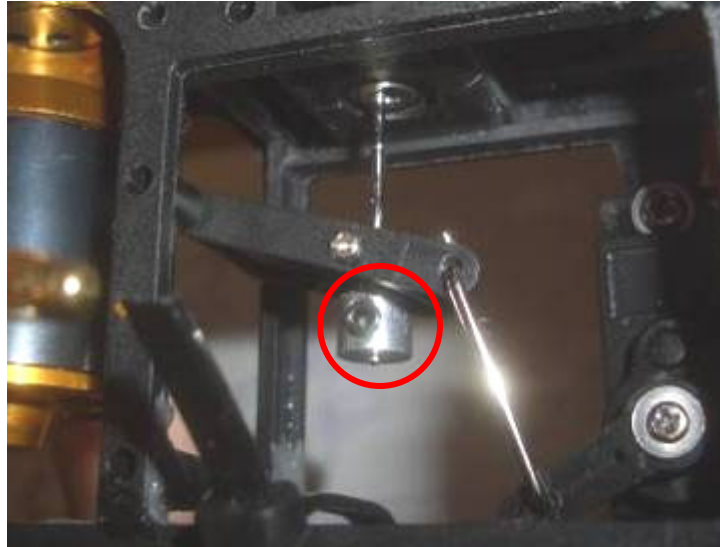


Figure 31: Pitch - Normal

The figure above shows the lowest possible position of the servo. This is the lowest position that doesn't cause the center rod to touch the main shaft.

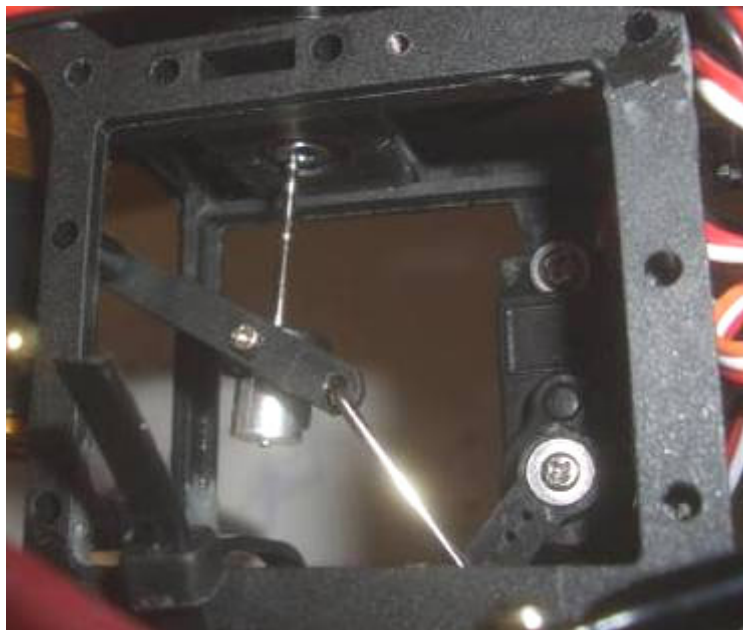


Figure 32: Pitch - Normal.....NOTTTT

The figure above shows a dangerous condition, where the servo is capable of pulling the U-Shape connector so low that the center rod touches the main shaft, this can cause a catastrophic failure, where the rod is unscrewed from the steering dowel. Adjustments must be made to avoid this scenario before any further adjustments are made. Once the pitch horn, and center rod/steering dowel have been adjusted, pitch is surveyed and adjusted accordingly.

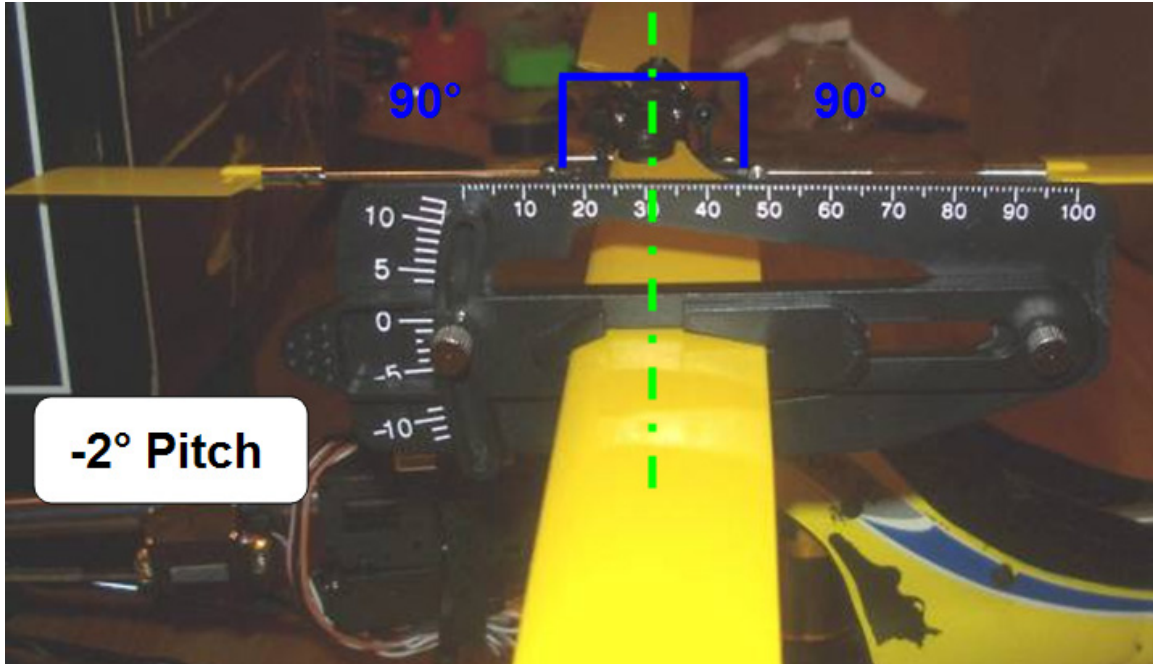


Figure 33: Pitch Gauge

A pitch gauge was used to adjust pitch angles. Figure 33 above shows how I measure pitch. I make sure the flybar is perpendicular to the main shaft, and that the main blades are coming straight out on the blade grips. I then place the pitch gauge on the blade and line up the flybar with the top of the pitch gauge as shown in Figure 33, the pitch gauge reading in this case is -2 degrees. Blade pitch angles were tested and recorded for stunt mode. Results of the first test are shown below in Table 3.

Table 3: Blade Angles

Stick Position	Blade 1 Angle	Blade 2 Angle
0%	+12	+14
50%	0	+2
100%	-12	-10

The results indicated that blade 2 had too much positive pitch. This was corrected by reducing the length of the connecting rod to the rocker arm, as shown in Figure 34. Remember that the sockets must be placed onto the ball in the correct direction (One side is tapered to be pushed onto the ball, the other is TIGHT and should never be pushed on to the joint), so the socket must be turned 360 degrees for each incremental adjustment. Pitch was increased or decreased incrementally by reducing or increasing the length. When the pitch of both blades were adjusted to equal, blade tracking is assumed to be proper, but this is checked at preflight tests.

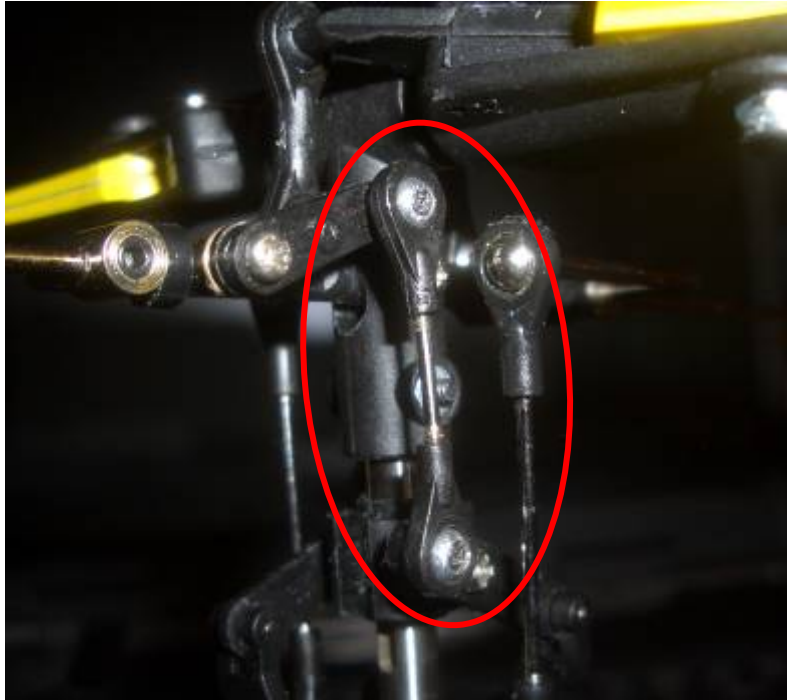


Figure 34: Pitch Connecting Rod

This was reduced by removing, and turning clockwise incrementally until a pitch angle of 0 was achieved. Leaving the helicopter on, with the remote's pitch range set to 0 will ensure the pitch angle is set to 0 when the remote is set to 0. Completion of the adjustments to the center rod/steering dowel and pitch angles were double checked and confirmed.

In addition to the above adjustments, blades should be checked for fracking as described in the manual. The same control arm adjustment is used to reduce fracking, so as to not make the adjustments above obsolete, we must make sure the overall pitch remains the same. We need to adjust the blade pitch with respect to overall blade pitch; look down the length of the blades and check for curving which causes changes in pitch down the length of the blade. Fracking only occurs when there are differences in pitch between blades; for instance, find the blade that curves towards the end and causes a negative pitch towards the end of the blade, this is the blade that must be adjusted with positive pitch, assuming the other blade is less curved. If a blade is curved with positive pitch, reduce that blades' pitch slightly. This phenomenon is shown below in Figure 35.

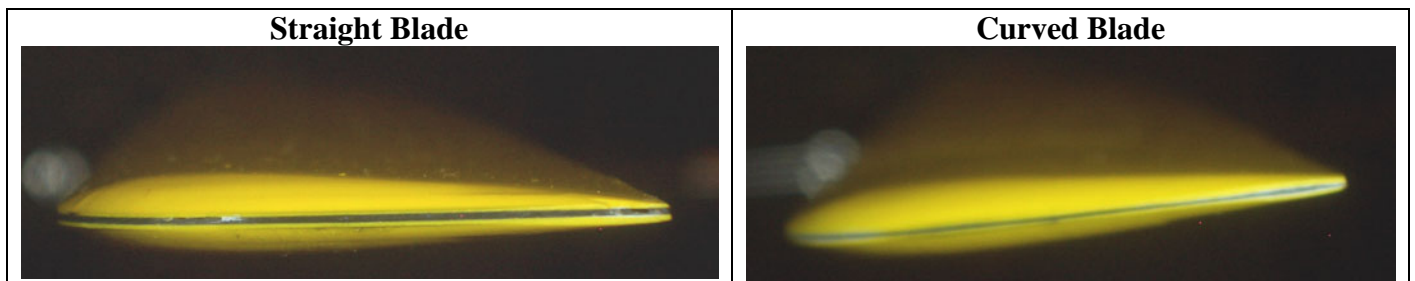


Figure 35: Blade Curves

RUDDER

The rudder servo horn is 90 degrees at center adjustment, as shown below in Figure 36. The servo straps are loosened so that the servo can slide up and down the tail boom. The systems are powered up and the rudder stick is moved to the extreme left and right, the extremes should be reached fully on the tail shaft and the servo shouldn't make a sound when at an extreme, as shown in Figure 38. If it pushes against both extremes or cannot reach the extremes, the "extent" adjustment on the gyro must be adjusted. This can be done using the plastic flat head provided, increase or decrease until the range is within limits. Once the extremes are both reached without the servo constantly pushing, tighten the strap screws.



Figure 36: Rudder Servo

The servo should be positioned so the rod is centered down the tail boom. A big problem that can occur is bending of the push rod when pushing. Extra supports were made using a piece of bamboo and tape. This was taped to the tail struts and push rod casing. This problem can be tested by keeping the tail slider from reaching the extreme when the servo is pushing, if the rod bends then a support should be made, otherwise poor rudder control, and spinning of the helicopter may occur.



Figure 37: Tail - Initial Position

The initial position doesn't look like the center. The servo horn should be perpendicular to the servo strike at startup. If the horn is off center, the center position will also be off center even if the extremes are properly adjusted.



Figure 38: Tail - Extreme Position

The extreme should be reached on both sides of the shaft and the servo should not constantly push on the extreme. Once this has been adjusted, tighten the servo tail mounts.

GYRO

The rear servo provided by Exceed RC is a conventional servo. The G007 is capable of powering a high powered digital servo with the flip of a switch, this switch is left in Nor mode since DS mode causes a conventional servo to move slower and to overheat.



Figure 39: Gyro - G-007

The Delay is set to 0 by turning the potentiometer to the counterclockwise extreme. The gyro gain is set to 100% by turning on dip switch 12 (WK-0701) and adjusting dial V2 to the clockwise extreme. The servo gain adjustment can be set from 0% to 100% by setting V2 from 12 o'clock to 5 o'clock, respectively. The tail exhibited the hunting effect; this is resolved by setting the servo gain to 80% and adding a delay through the gyro.



Figure 40: Tail - Rotated Clockwise

To test that the reverse switch is correct, the Raptor is rotated clockwise, the pitch should become positive to counteract the clockwise rotation.



Figure 41: Tail - Rotated Counterclockwise

By rotating counterclockwise, the pitch should become negative to counteract the counterclockwise rotation. The main rotor is spun clockwise to ensure the correct function of the tail blades, which is counterclockwise when looking from the right side in Figure 41 above. The rudder and gyro have now been setup properly.

Remote – WK-0701

The remote is difficult to set up to say the least. I discovered the proper setup through trial and error, lots of error. Below, I describe what I found out, and how I adjusted my system.

Once the remote is on, 3 switches can be used to change the settings, 10, 11, and 12. My switch setup is shown below in Table 4.

Table 4: WK-0701 Switch Settings

SWITCH NUMBER	FUNCTION	STATUS	FUNCTION
1	ELEV.	OFF	Reverses Channel
2	AILE	ON	Reverses Channel
3	THRO	OFF	Reverses Channel
4	RUDD	ON	Reverses Channel
5	GEAR	OFF	Reverses Channel
6	PIT	ON	Reverses Channel
7	RUDD MIX	OFF	Reverses Channel
8	NOR/CCPM	OFF	CCPM
9	CCPM. ELEV	ON	CCPM
10	PIT LOCK	OFF	Adjustment
11	TH-CRV/EXP	OFF	Adjustment
12	GYRO SENS/RUDD MIX	OFF	Adjustment

Switch 1 through 7 reverses the channel outputs while 8-9 are used to enable and adjust CCPM, presumably 120 degrees since Exceed RC produces a model using this, don't bother with those, just make sure it's off.

Switches 10 to 12 turn on and off the adjustments performed by V2 and V1. Table 5 below summarizes the switches and their functions. Each functions' mode application is labeled with (n/s), (n), and (s), these denote normal/stunt, normal, and stunt modes; these modes are affected by these functions, otherwise it's not adjustable. Switching between normal mode and stunt mode will not change the curve for each mode, the setting must be changed manually if a different curve is desired for different modes.

Table 5: Remote Adjustments

SWITCH NUMBER	FUNCTION	V2	V1
10	PIT LOCK	Pitch Range (n/s)	Pitch Curve (n)
11	TH-CRV/EXP	Cyclic Curve (n)	Throttle Curve (n/s)
12	GYRO SENS/RUDD MIX	Gyro Sensitivity (n/s)	Rudder Mix (n/s)

The helicopter and remote can be turned on to test and adjust these functions, it is necessary to unplug the motor in order to adjust these, since you'll be moving the throttle. It is not advised to test the throttle curve adjustment while the motor is plugged in.

Turning switch 10 on will activate V2 and V1 dials, they now adjust the pitch range and pitch curve, respectively. By using a pitch gauge, the pitch range(V2) can be adjusted to the desired range for stunt mode(switch remote to stunt mode). Don't worry about normal mode, it will be correctly adjusted if the stunt mode is correct. Pitch curve(V1) is only applied to normal mode operation, you'll have to switch the remote to normal mode to see how this affects pitch response. I would use a linear curve, set V1 to 12 o'clock. Turn off switch 10 in order to save V2 and V1 positions.

Turning switch 11 on will activate V2 and V1 dials, they now adjust the cyclic curve and throttle curve, respectively. The cyclic curve(V2) only affects normal mode operation of the cyclic stick, again, adjust the dial and move the stick to see the response, a linear response is the best for a start; switch to stunt mode and try to achieve the same response when in normal mode, by adjusting V2. The throttle curve(V1) affects both normal and stunt mode, I use the full power setting, which is fully clockwise. This leads to a fast headspeed, which allows for more control. Turn off switch 11 in order to save V2 and V1 positions.

Turning switch 12 on will activate V2 and V1 dials, they now adjust gyro sensitivity and rudder mixing, respectively. The gyro sensitivity should be at maximum, fully clockwise, this may cause wagging of the tail; this can be adjusted while hovering, if you have the skills, otherwise land and take off, slowly reducing it until wagging stops. Rudder mix(V1) must be turned off so that the gyro works properly, FULLY COUNTERCLOCKWISE, if this is not done, the helicopter will continue to rotate at rates dependent on throttle position, this can cause loss of control quickly. Turn off switch 12 in order to save V2 and V1 positions.

Don't try powering up the Raptor unless everything is working properly, do all preflight checks for servo ranges/directions, range check, linkages, etc. A reversed channel can lead to a disaster.

THE CONCLUSION TO A GREAT JOURNEY

Everything was set up properly, and a test slide was performed in the living room, no flying actually occurred, only stayed light on the skids. The gyro worked perfectly, and the rudder response was quick for both directions, cyclic seemed to work well. Must be patient and wait for a clear calm day out to perform a test flight. If there's one thing that must be learned, it's patience in waiting for a calm day, otherwise stories like this will be all too frequent.



Figure 42: The End

After setting everything up properly, the Raptor performed perfectly on the first flight. Thanks to the guys at RC Universe for making this possible.

Here's the thread that all Raptor owners should read:

http://www.rcuniverse.com/forum/m_5028125/mpage_1/key_/tm.htm

Happy flying all!