LONG SHOT 4, 4D

Building instructions

Dear customer,

You have just became owner of our RC hand launch glider (Discus Launch Glider, DLG) Long Shot 4. It is the new version of our very successful Long Shot 3. Thank you for your decision.

The DLG models are designed to be launched by the “discus launch” method. The flyer holds the model at the peg located in the wingtip, between forefinger and middle finger, rotates 360 deg and releases the model. The model will climb much higher than by the classical “javelin” style launch. Another important advantage is that the joints of your arm will not suffer pain and injuries are almost unknown.

The basic feature of the DLG of this type is the rear position of the centre of the model side area. It is achieved with the large area of fin and rudder and low wing dihedral. This is the most important feature of the design, so do not change these elements.

The wing is equipped with a series of airfoils AG 45xx ct designed by Mark Drela. It has very low drag, allowing a high climb during the launch and rapid cruising while hunting thermals.

The structure makes use of the excellent properties of modern materials. The result is light and very rigid construction. The weight of the model ready to fly can be as low as about 280 grams. The fuselage is of pod and boom design. The pod is carbon or carbon/Kevlar shell, carbon reinforced. The boom is made of carbon/glass composite tapered tube, which is very strong yet light.

The new version differs in the use of thicker and much more rigid tailboom. The rigidity is very important, as the flexible tailboom consumes some launch energy. The more rigid (and heavier boom) is compensated with longer pod.

The Long Shot 4D version of the model provides even more rigid wing. It is allowed by use of the excellent properties of the “Disser” fabric, which is used for the wing skin. It is made of Aramide cloth and carbon mesh. The 4D version features also boom made of HM carbon, which makes the boom even more rigid.

Assembly

You will need:

RC transmitter, at least 4 channels, computer radio and lightweight unit recommended.
Micro receiver, at least 4channels.

Note: The number channels required depends on the way the model is setup. Five channels are required on the transmitter if 2 aileron servos are fitted in wings.

4 micro servos (6 to 9 grams). We recommend digital servos for the ailerons (9 mm thick Atlas DS09).
Another good aileron servos are the Dymond D60. The suitable servos for the tail are Dymond D47.
Power supply: 4 NiMh cells 250 mAh or similar. Or LiPo 2S with voltage controller. The weight should be about 30-35 grams
CA glue, good Epoxy.
Basic modeling tools.

Fuselage

The fuselage is loaded by very high centrifugal forces during the launch and must be very strong and rigid.

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Mark up (drill and file out) the aileron servo cable access hole in the wing saddle, with the centre about 30 mm behind the wing leading edge. This hole serves also as the aileron servo cables exit. **The hole must be oval and as small as possible**, about 12 mm wide and 18 mm long. A large hole and/or a hole with sharp edges would weaken the pod in this area, substantially.

Cutting the boom to length.
Roughen the rear of the Pod using fine sandpaper. Trial fit the boom and if not very snug, carefully shorten the boom by small amounts until a nice snug fit is obtained. Then cut the rear of the tube to length, as shown on the drawing.

WARNING: DO NOT GLUE THE BOOM TO THE POD IN THIS STAGE YET!

Cut a slot in the fin 28 mm deep, approx. 8 mm wide – check the width, so that it fits onto the boom end neatly.

Take the rudder and elevator servos. Make up the opening for the servos in the balsa servo tray. Fit the floor with the ply cross pieces, drill holes for the servo fastening screws and install the complete tray in place. **For the pod-side walls strength it is important to mount the servos on the servo tray provided. DO NOT omit the servo tray as it plays important structural role in fuselage resistance against the centrifugal forces during the launch** (the tray serves as the shear web, the fuselage sides are the "spar strips").

Make the canopy lock of double piano wire 0,8 mm. Bend to shape, the ends meet in the middle of the length of the lock. CA dip glue the lock wire to the hatch in the middle, spray CA activator. Do not use much CA, as it can get hot and warm the canopy during the hardening.
Secure with epoxy soaked rectangle of carbon cloth (see the procedure for the wing joiners).

Using a fine file, make small notches in both ends of the hatch opening, so that the lock wire slots in and can not shift sidewise.

Wing

The foam colors can vary according depending on the manufacturer and does not affect its properties.

VERY IMPORTANT WARNING: NEVER touch the wing / stab surface with nitrate base solvent. The skin is slightly porous and the solvent would definitely damage the foam core!!!
For the same reason do not use common CA glue for the wing / stab assembly.

The wing is supplied in two parts. Test to make sure the wing servo plugs fit through the access holes in each wing. If they don't fit, carefully drill out the holes to fit.
Mark position of the two mounting screws on the root ribs and make up small half-round notches with rat-tail file (2 in each panel).
Check the fit of the wings at the correct dihedral. If they are not a neat fit , carefully sand each wing root so the two halves fit perfectly together. Use good 5 minutes Epoxy to glue the wing parts together. The dihedral of each panel is 6 deg. With one wing panel laying flat on the building board, the second panel is supported 155 mm at the tip (2x6 deg = 12 deg).
Carefully open the wing hold down holes to 5 mm dia. The axis of the holes MUST be perpendicular to the horizontal plane of the model. Use drill press and support both part of the wing equally. Check for correct fit, file out the holes if necessary. Cut the supplied aluminum tube roughly in half (make sure one is long enough for the front bolt) and epoxy in place.

Locate the position of the launching peg: in the left wing tip for right hander and vice versa. Make the hole for the launch peg.

Make patches from the carbon cloth/adhesive tape according to the pattern (four patches for the wing centre connection, two round patches for the peg reinforcement. **Do NOT** try to separate the cloth from the tape in this stage!!! Soak the carbon with thin slow curing epoxy and lay down over the center/tip connection seam and over the peg hole, top and bottom. Use gloves and press with fingers, soak up excess epoxy with a cloth and secure in place with wide adhesive tape completely covering each patch. After the epoxy sets, remove all of the adhesive tapes. The surface of the patches should be nice and shiny.
Carefully open the 4 mm holes for the mounting screws and the opening for launching carbon peg with a sharp exacto knife. Epoxy the peg in place, ensuring a small fillet. of epoxy is left on both sides for strength.

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Note: It is possible that the peg/epoxy joint will loose as it is loaded. When it happens, apply drop of thin CA into the seam for the good and permanent joint.

Attach the wing on the fuselage with the front screw. Square up the wings to the fuselage by temporarily fitting the boom and attaching a string line to the boom and measuring to each wingtip. Once satisfied the wing is square, locate and drill a tapping drill for a M4 thread (3.2 mm) for the rear plastic screw in the pod and tap a M4 thread..

Note: Over the years, it has been found, that the 4 carbon wing connection patches over the mounting points have proved to give sufficient strength, provided the model is flown in F3K style, on a flat field.
If the model has a rather hard landing, the wing halves will usually separate in the middle and can be repaired very easily. However, there is in the a piece of glass cloth, which can be used to cut two strips 10- 15 mm wide to secure the winds along the seam on top and bottom.
If you want to do some slope flying, do not use a 'hard' discuss type launch on the descending ground.The large angle of attack against the wing can cause the wing break. We recommend you reinforce the seam, as described above. Any case, be very careful when doing DLG launches on a slope as it is easy to slip over and suffer serious injury.

Tail

Horizontal stabilizer first:
Test fit the rudder to the boom to determine the stab location. Wrap emery cloth around the boom where the stab will be mounted and sand a radius on the bottom of the stab mount, to match the boom. Drill a 1,5mm hole in the side of the mount so it can be secured to the boom with thread (Kevlar or similar) after it has been glued to the boom. CA soak the thread tip to make a “needle”.
Screw the stab on the mount and roughen the boom by lightly sanding the boom where the mount will be attached. Position the assembly carefully on the boom, so that the stab lower surface is parallel to the boom upper surface. CA drop in place. When satisfied, use more middle density CA. Or, you can use epoxy to install the stab as it will give you more time for the correct alignment. Use a string line to ensure stab is square with the boom.
Drill the 1,5 mm holes through the boom and insert the carbon pegs all the way. The pegs are very helpful.
CA or epoxy the horn in place.

Vertical stabilizer:
Join the fin and the boom. The fin should be perpendicular to the stab and can be checked with a square. Secure with epoxy. Strengthen the fin mounting with two approx 30 x 25 mm patches of fiberglass and coat with epoxy.
CA or epoxy the horn in place.
NOTE : Best results are gained by fitting the rudder horn on the RH side of the rudder for RH throwers. This helps prevent flutter at launch.

Final assembly

Screw the wing to the fuselage. Push the boom/tail group assembly on the pod and use the thin CA glue **NOW**, while checking for correct position of the tail in respect to the wing. Easiest way is to set model upside down so both wingtips are resting on the ground and using a square to ensure fin is vertical. Secure the seam with epoxy bead all around.
Drill a hole through the front of the boom and pod and install a 1,5 mm carbon peg through to prevent pod/boom from tear-off.
Install the servos in fuselage, usually side-by-side. Connect the rudder and elevator horns to the servo arms. Use the micro pushrods consisting of Teflon tubing and steel inner part. CA or epoxy the outer tubing to the inside of the pod, on either side and run out of two 1,5 mm holes in the rear of the wing saddle, down the top of the boom, to the tail. The terminals can be done using Z Bends (servo arm) and L Bends (horns) - shaped piano wire 0,8 mm, joined to the steel wire with a 12mm piece of heat shrinking tubing and thin CA. The stab can be fully detachable.

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Aileron servos:

Check that the servos you are going to use are in good condition, without any gear slop. Once fitted, servo replacement is time-consuming job.
Carefully open the servo cables outlet in the wing bottom center. If necessary, use servo extensions for the aileron servos. Cut-off the servo mounting flanges. Run the servo cables through the channels in wing. Push the aileron servos into the openings in the wing (making sure they are snug fit). Glue in place with a bead of silicone sealant and secure with adhesive tape over the top of the servos.

Install the horns in the ailerons: The horns must protrude **through** the aileron. Ensure the epoxy forms fillets in all four corners of the horn, so that the aileron is “clamped” in between!!!
Connect the horns with servo arms. The link from servo to aileron must be **without any play**, otherwise the ailerons can flutter during the launch.

Recommended method: make the pushrods from 2 mm soft steel of aluminum wire. Bend about 4-5 mm of its end in right angle and tap a M2 thread. Run M2 tap into the appropriate hole in the servo arm. Screw the rod directly into the servo arm. Shorten the rod to appropriate length; tap a M2 thread and screw the clevis on. This creates the perfect connection without any play.

The extension cable between wing exit connector and receiver can consist of 4-wires only, which divide into two plugs to be pushed into the receiver. For example:

1. + and left aileron servo signal
2. – and right aileron servo signal

A single 4-pole connector is used for the servos to extension lead connection:

1. + both servos
2. – both servos
3. left aileron servo signal
4. right aileron servo signal

Install the micro receiver and battery. Do NOT run the aerial(s)inside the carbon fuselage, nor run the aerial on the carbon surface. Both of these installations can seriously decrease the control range.
Drill a small hole either side of the pod and run the antennas on the outside of the pod.

Check the CG position. It should be about 80 mm behind the wing leading edge. Plasticine can be inserted into the fuselage nose to shift the CG into correct position.

Control movements

The model is normally equipped with 4 servos: two for ailerons, one for stabilizer, one for rudder.

Ailerons - **direction control**
(measured from neutral aileron position)
12 mm up, 6 mm down
brakes: 30 mm down
flaps: 2-3 mm down
brakes and flaps should be compensated for with appropriate elevator movements: down elevator for down ailerons.

Elevator
up/down 10 mm

Rudder
left/right 15 mm, coupled with ailerons
Note: If the wing airbrakes deploy down (as mentioned above) be sure to install the rudder servo. The model can not be directionally controlled with ailerons when they are deployed f down.

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These movements can vary according to your personal preference.

Flying

Generally:

Discus launching is not likely to harm your body in any way, but it is sensible to warm up your muscles before trying to launch at full power. If you suddenly strain your muscles when they are still stiff from driving for several hours, or if you work in an office and don't get much exercise, then it is advisable to treat your joints and muscles with care.

Waving your arms about is not going to help much. The best method is probably to jog up and down the field for a few minutes, gradually building up speed. (You don't often see modelers doing this on my flying field.) A more appealing alternative is to launch about ten times, starting very softly, then gradually building up to almost full power by the tenth launch. In this way your muscles will become warmer and at the same time, you will have had sensible and useful launching practice.

In the first attempts, test glide by “ordinary” overhead Javelin type launch and make any necessary trim changes. Then try to launch with more force, still in the “Javelin” style. When satisfied, try the first discus launches.

Start with full 360 deg circle, slowly and **smoothly** from the very beginning. It is important to always do the same sequence of footsteps. Draw the model from your back and twist your body from this position. Release with slight nose up.
Apply full down elevator on the top to bring the model into the level flight. A smooth transition will minimise loss of launch height.
Increase very slowly the launch velocity. You will be surprised, how easily you can get really reasonable height.

Usual mistakes:

Very important: Keep you arm straight all the way, **especially in the release stage**. Avoid any tendency to “throw” the model. Surprisingly, it is nor quite easy.

Use your body as a “torsion spring”: Draw the model from behind of your back. Unwind before the launch and in the last launch phase twist the body and move your arm.

Move the CG and trim the elevator, so that the model climbs mildly. Play also with the CG position so that the amount of the inherent stability suits your flying style: these models fly at low heights and often must cope with lots of turbulent air. Larger amount of longitudinal stability provided by more forward CG position can be of advantage.

The wing flaps are in neutral position for launch and fast flights while hunting for thermals and for rapid returns from downwind distances.
The ”neutral position” is with flat wing surface bottom.
For the low sinking rate deploy the flaps about 3 mm down (measured in the wing centre). Deploy the flaps about 40 deg down for escape from height and landing. The directional control with fully deployed flaps should be done with rudder rather than with ailerons. The model with flaps full down slows down. When moved rapidly back to the neutral position, the model can stall because the air speed is too low for the wing in this configuration.

Important notes:

- NEVER launch model **if there are persons** in front of you!!! Remember, the launch velocity of the model can be close to 150 km/hour!
- If released too early, the model can fly low over the ground, to the right side (right hander). BE ALWAYS SURE there are no persons in this area!!!
- Secure the receiver crystal in place with adhesive tape (when used). Otherwise, it can slip out of the socket due the launch acceleration!!!
- Do not launch model in weeds taller than about knee-height. You would easily damage the outer wing tip. Also, when the wingtip hits the weeds, the sound is ear-breaking.

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- Before the first flying, complete a range test of the RC gear. The carbon used for the fuselage can influence the signal reception. If you do not have the 2.4 GHz radio, the “old fashioned” antenna run between receiver and the top of the fin still works best.

Enjoy your new LONG SHOT 4!
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