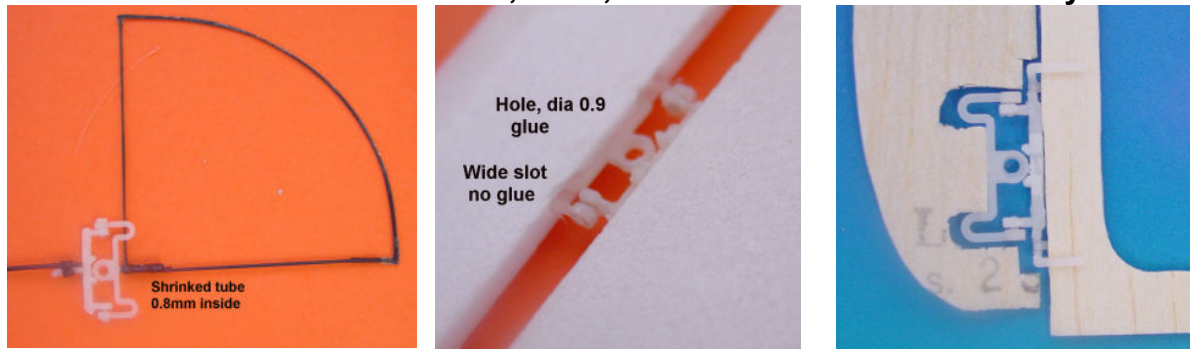


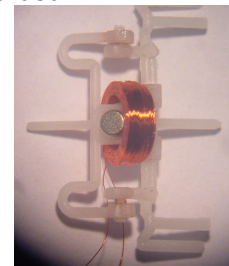
## PolyBIRD

**A versatile BIRD : carbon, foam, balsa construction : do it easy !**



Send pictures of your construction examples, you will be rewarded.

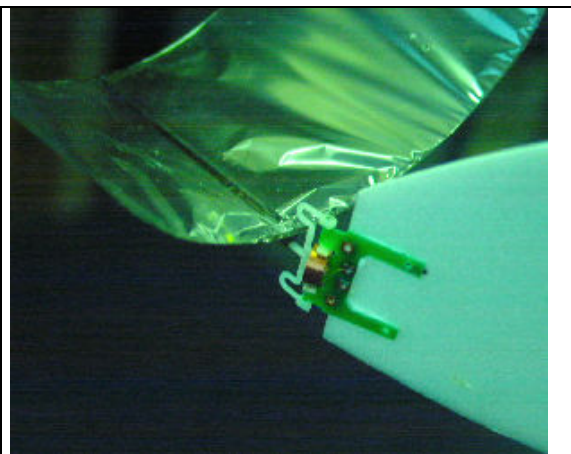
The **PolyBird** is a magnetic actuator specifically designed to be « **built-in rudder device** » (the generic name BIRD was coined by John Worth in 1996). It is easy to integrate into ultralight planes of less than 10 grams. It can accept different coils and magnets and have a weight between 0.2 and 0.5 grams for a torque between 0.15 gcm and 0.6 gcm.



**New - June 2009**

**PCB to make the wire soldering easy**

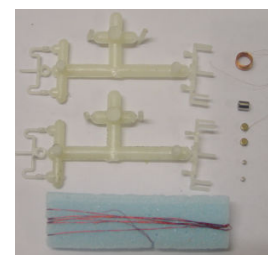
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The **PolyBIRD** has several advantages over competitors

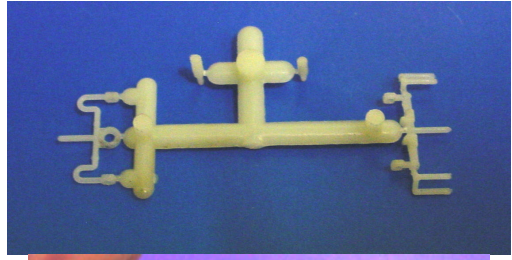
- ultralight construction (0.067g of plastic)
- different weights and power by selecting the coils and magnets
- easy to adapt to different construction methods
- easy to remove the control surface . It can be changed at the field to find the best manoeuvrability.

The **PolyBIRD** is sold as a cheap, easy to assemble kit. Two options are available for the coils : 55 Ohm, 0.14.g and 125 Ohm, 0.11g. Two solutions are proposed for the magnets, they allow to adapt the torque to the control surface. Two centering magnets are also included.

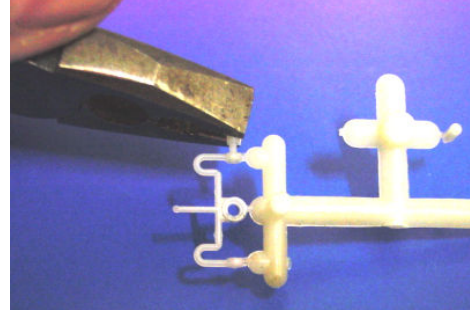
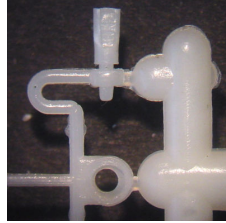


## Assembly

- 1 Do not separate the pieces immediately. Two sets are provided in case you loose or break a part.

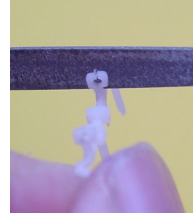
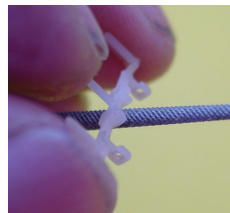


- 2 Insert the pins on the moving part, while still attached. Just push with a small plier.



If you plan to use the strong 2.5 mm magnet, enlarge the magnet hole now (see later)

- 3 Detach the parts with a sharp knife or plier. Cut closer where you have cut. It must be smooth.



bad

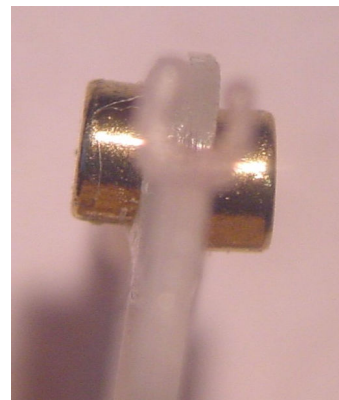


good

- 4 Cut with a precision plier or a razor blade the big diameter part of pin.

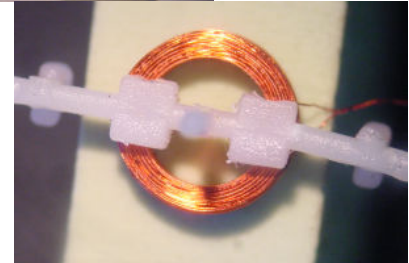
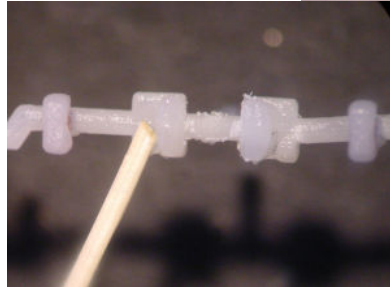
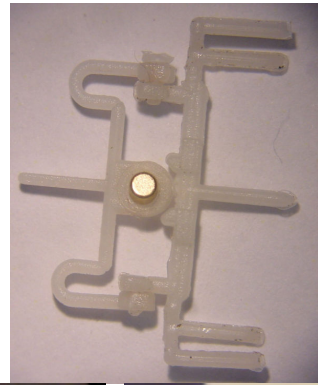


- 5 Position the  $\text{\O}2 \times 1.2\text{mm}$  magnets on opposite sides of the moveable part. The trick is to put one magnet on a razor blade, then put the plastic piece on top, then drop the second magnet that will position by itself. Then slide the razor blade off. For lighter weight, Tanaka has  $\text{\O}2 \times 1.0$  and  $\text{\O}2 \times 0.8$  mm magnets. Add a microdrop of CA if you do not plan to test other magnets.



- 6 Test the assembly before gluing the coil in place. If there is friction, check the hinges and the centre.

Place the coil centred on a 8mm wide block. Put a drop of CA on the corners of the tabs that that will receive the coil. Press the fixed part of the PolyBird into the coil.



### Coils

Coil inside diameter is 4.0mm, height 2.3mm. External diameter depends on number of turns and wire diameter. Available coils are

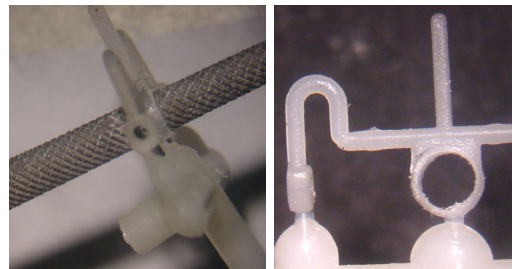
C55 0.05mm wire, 450 turns ca 55 Ohm, 0.14g

C125 0.04mm wire, 400 turns, ca 125 Ohm, 0.11g

### Magnets

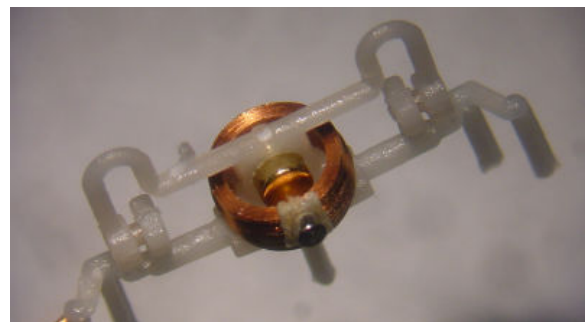
5 magnets are provided. The 2.5 mm magnet need a special preparation with a fine file, before the piece is detached. Be gentle! Make it so the magnet slides in and glue with thin CA. With this magnet, you get twice the torque for an increase of weight of 0.05g.

You may understand it was impossible to mold this thin shape (the rest was already difficult)



### Centering magnets

The two small magnets are for centering, if you believe it is important. It reduces the torque at maximum travel, but is known to help linearize actuator travel. Glue a piece of paper or 0.5mm balsa on the coil and glue the magnet so that it is attracted to the moving magnet (in center position). Add the second magnet on the other side, or use thicker balsa depending on the centering force you need.



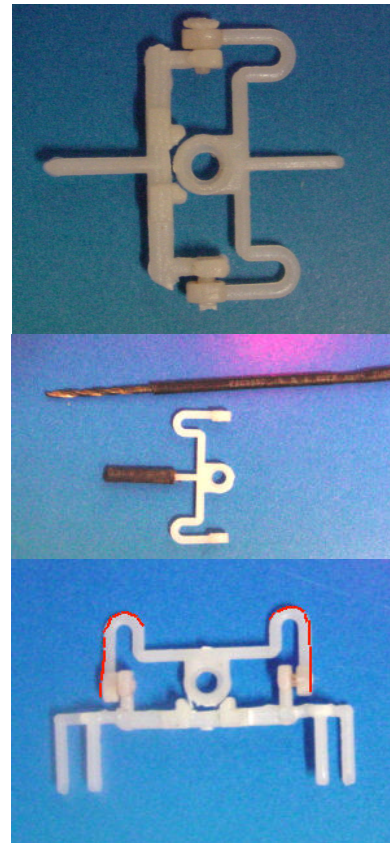
## Implementations

The central pin is for gluing on a carbon rod or tube. The side hooks can be removed in this case.

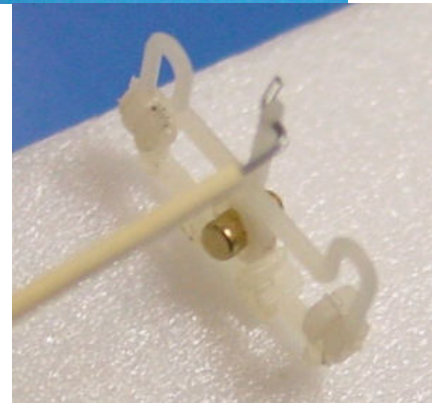
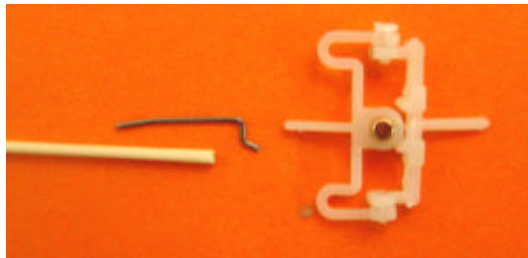
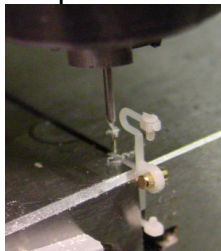
If the fuselage is of 3mm Depron, the pin is useful to maintain the fixed part while gluing.

For the moveable part, it may be convenient to glue a 0.8mm plastic tube on the rudder. Friction on the pin is good enough for our low forces. Make the tube from small diameter heatshrink by shrinking onto a 0.8mm drill.

The central pin should be cut if the Bird is clipped onto 0.6 mm balsa or thin foam. Do not put glue on the moveable part where indicated in red. You need flexibility there to make the rudder removable.

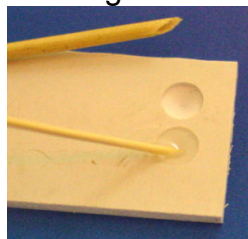
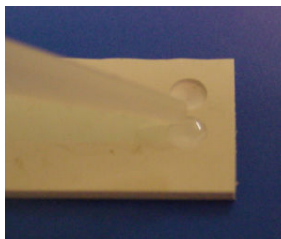


A 0.5mm hole can be drilled on the movable part pin if a push-rod is preferred.



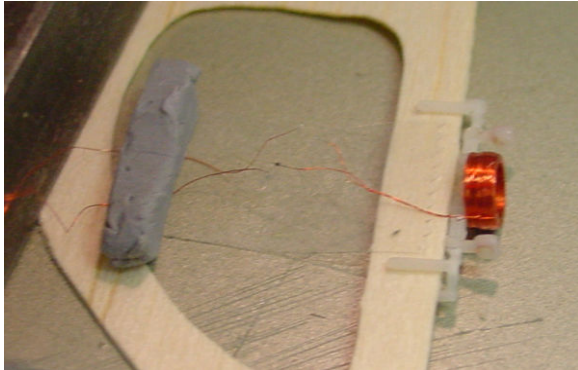
Note for push-rod lovers : use a dry grass stem and not a carbon rod. It is lighter, and since it is a tube, it is stronger and allows for easy adjustment. For an adjustable length, push rod, bend thin wire into an "S"-shape so that it is a tight fit inside the grass.

While talking about dry grass, make your stock now, autumn is the best. You can also find decorative grass in hobby shops. When you have to put a small drop of CA some place, put a bigger drop in a 5mm hole, 1mm deep in any plastic, and pick with the tip of a grass the microdrop you need. The CA goes per capillarity inside the tube, and act a little as a reservoir. Cut the end of the grass when required.

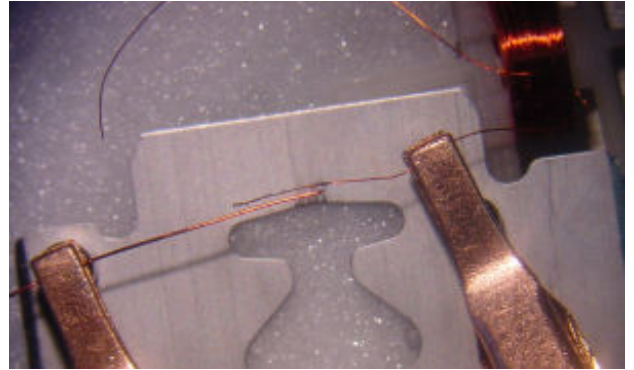


## Soldering wires

Wires supplied with the coil are 20 cm long. You may experience the problem of short or broken wire at some point. Replacement magnet wire is available from several mirco R/C suppliers. It would be a shame to use insulated wire when ultra low weight is the objective. The tricky part is to align the wire ends to be soldered and keep them in a stable position while the soldering iron is applied.

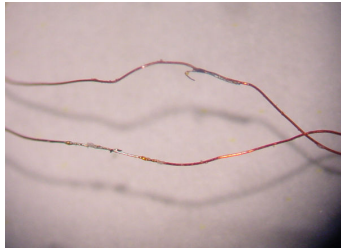


Our old solution was to double sided tape or Bluetac to hold the wires in place Do not cut the wires at the same length so they cannot short circuit.

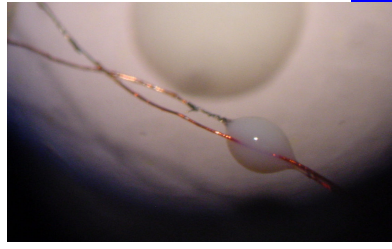


The new trick is to use these alligator clip (looks more like a gavia) that can be positioned with magnets on any metal surface.

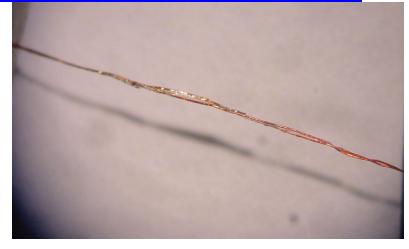
See <http://www.didel.com/lr/ConnKit.pdf>



Put some flux on the wires, have the soldering iron add fresh solder touching the two wires.



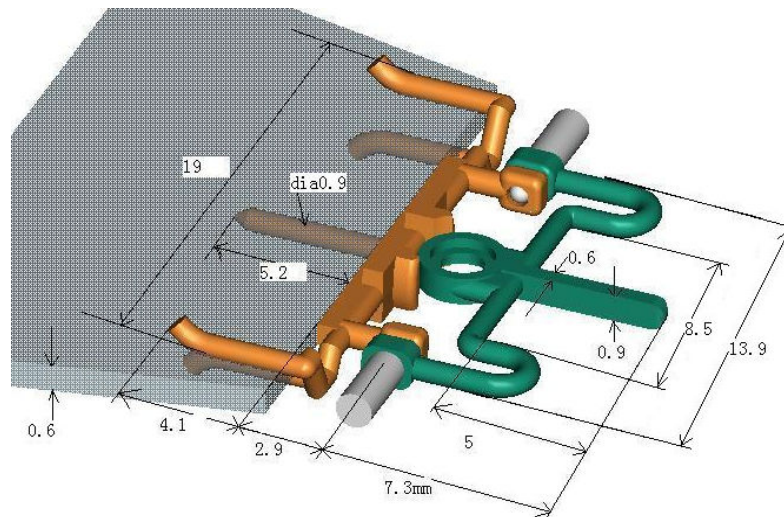
Use superphatic or PVA glue to glue the two wires. CA should not be used as it dries too hard. Some CA will also attack the wire insulation.



Slide the wires between your fingers to spread the glue and use the same glue to stick the wire along the fuselage. It is advisable to wrap the wire around the coil a couple of times so only the thicker lead our wire protrudes. Make sure soldered wire joints do not touch and short out.

## PolyBIRD sizes

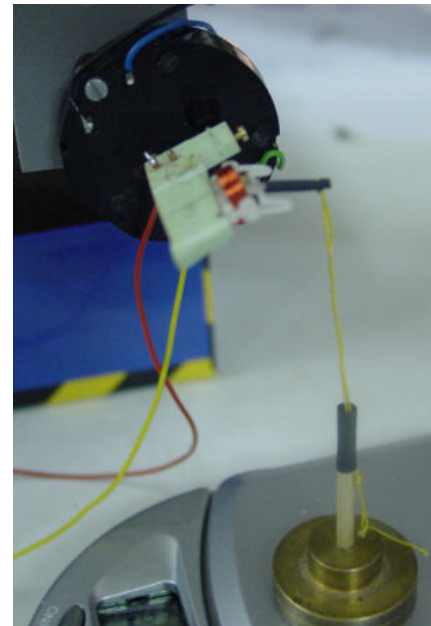
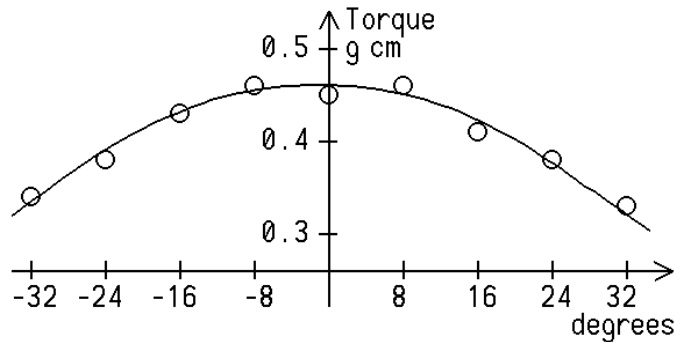
Plastic parts weight : Fixed part 0.042g Movable part 0.023g Pins (cut) 0.002g **Total 0.067g**



## Torque characteristics

The test fixture uses a stepping motor (Vid29) to rotate the fixed part. The lever of the movable part stays horizontally and lifts a weight. DC voltage of 3.5Volt is applied to the coil. This allows to measure the torque in relation to the angle. As expected, the torque decreases significantly when we would like to have it at maximum !

Typical measure :



## Options – new measures will be done with the definitive coils

Magnet	weight for 2 magnets	Coil	Weight	Power factor W*T/R	Measured torque
1.6x1.6	0.055 g	400 turns 0.035mm 170 Ohm	0.08g	130	0.15 gcm @ 3.9V
2.0x1.0x2	0.052g	500 turns 0.050mm 78 Ohm	0.16g	333	
2.0x1.2x2	0.061g	500 turns 0.050mm 78 Ohm	0.17g	390	
2.0x1.6x2	0.092g	- 500 turns 0.060mm 50 Ohm	0.30g	920	0.45 gcm @3.9V
2.5x3	0.11g				

magnets 1.6x1.6 not worth, 2x1 not worth, 2.1.6 touch if not perfectly centered

## Note on coils

For a given wire diameter, the torque does not depends on the number of turns: more turns mean higher resistance, that is less current. Magnetic force depends on the product of the number of turns by the current, and is constant (indeed, it gets lower if the additional turns increases the diameter).

Jdn 071217

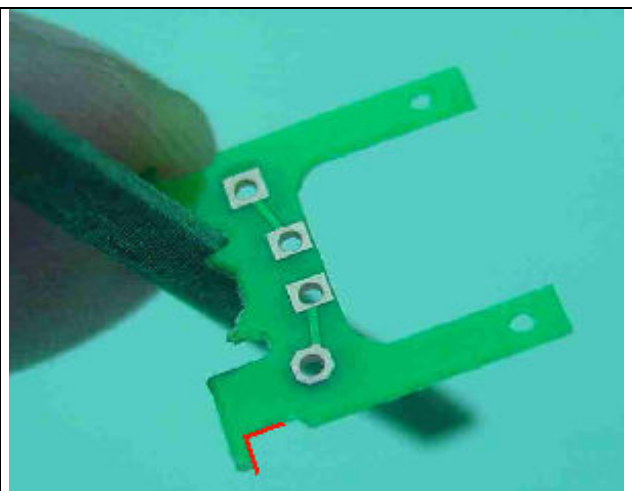
## A PCB for the hinge

A PCB will be included in the next delivered 125 Ohm PolyBirds.

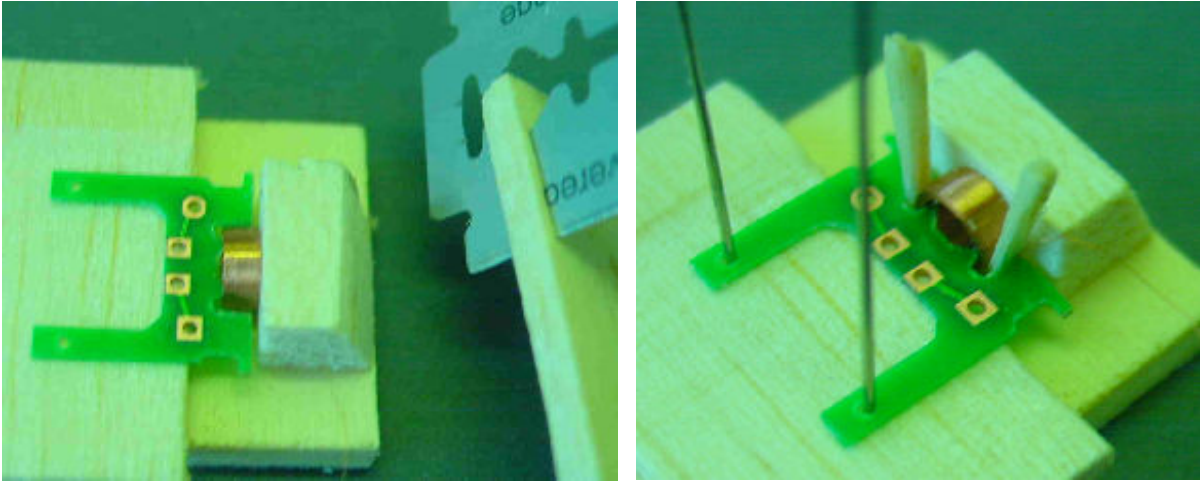
The difficulty is the wiring of the thin wires. The 50 Ohm Polybird has long wires, that are supposed to go up to the receiver. If too short, they are reasonably easy to be lengthened.

The 125 Ohm Polybird have thin, short and delicate wires. Didel developed a PCB that replace the fixed plastic part, adding only 30 milligrams (0.03g) of weight. It allows to prepare the coil with its wire soldered, and then connect the wires to go toward the receiver.

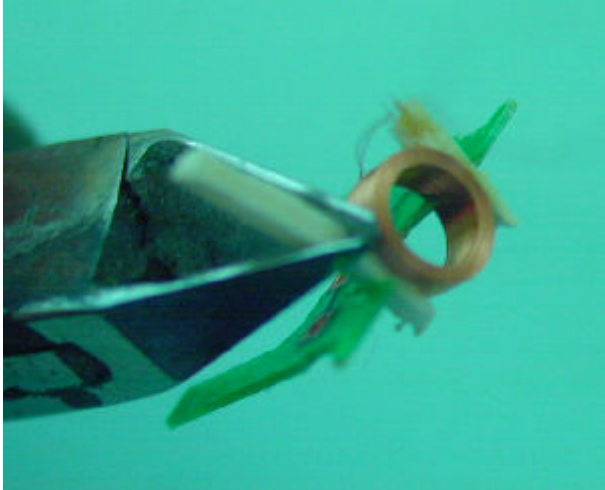
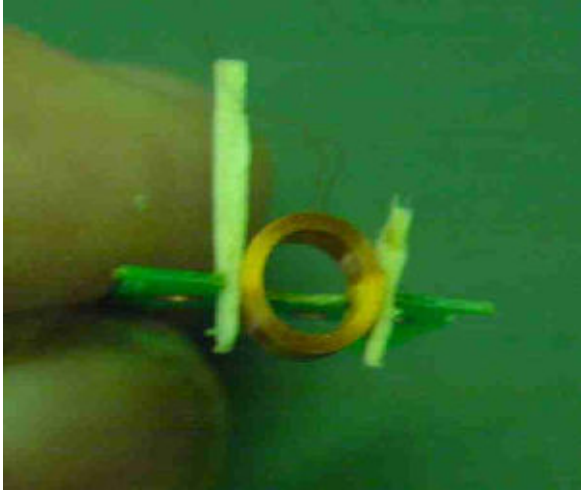
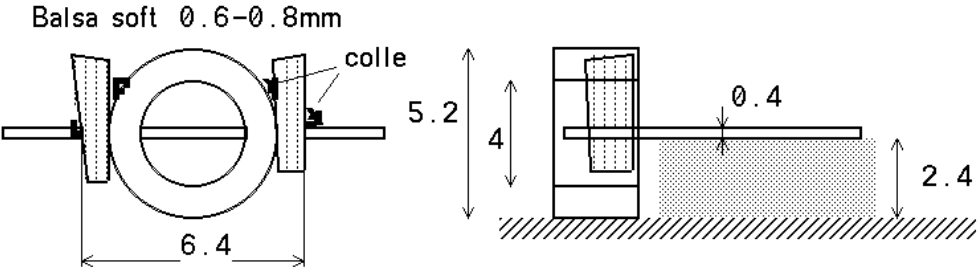
First step, clean the PCB edges and make a sharp edge (red mark) for the hinges. Round the corners with a small file to reduce the friction.



Prepare a piece of balsa wood or any material, 2.4mm thick, and glue next to it a 5-6 mm high block, as in the picture.



Cut on a 2mm soft balsa sheet wedges that fit between the coil and the PCB, and position the coil in place. Put some glue (CA extra thin) and cut the excess length with a razor blade or a precision pleyer.



Las operation, solder the coils wires. The insulation on the wire is removed by the heat.

