

BALANCE PLANE

(NO SOLDER KIT)

CONTENTS:

Section 1: General and Planning information

Section 2: Components and Material required

Section 3: Constructing the *BALANCE PLANE*

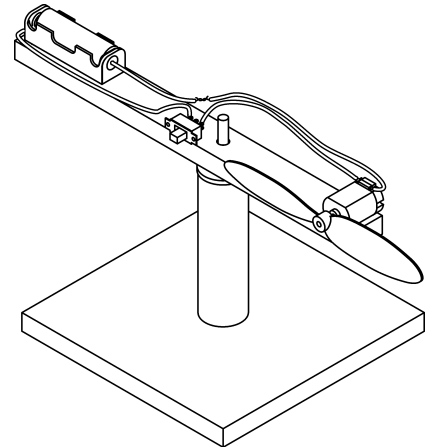
Section 4: Wiring up *BALANCE PLANE*

Section 5: What to do with *BALANCE PLANE*

DESCRIPTION

In this project a beam is used, with an electric motor and a propeller on one end and a battery holder on the other end. It is placed in a balanced state, on a vertical upright.

This beam is designed to be rotated about its central point, in a horizontal plane, by the motor-driven propeller.



SECTION 1:

GENERAL AND PLANNING INFORMATION

1.1. DESIGN

The major parts of this project are the planning, design, construction and assembly.

1.2 GENERAL:

- The basic construction is shown in the drawing. The students should make a drawing to determine the overall size of the device.
- Different length and different weight beams will rotate at different speeds
- The base must be fairly sturdy so that the device can't fall over. For the upright a piece of dowel is best, as this can be inserted in a hole drilled in the base.
- The equilibrium point (centre of balance) should be determined after the components have been assembled on the beam.

1.3 THE BEAM:

- The rotating beam can be made from wood, plywood, balsa or plastic.
- The beam needs to be large enough not to flex. For example, a beam 15 x 15 mm should be adequate.
- The beam's width needs to be enough for all components to be securely mounted.
- The weight of the beam will affect the acceleration ie. a lighter beam provides faster acceleration. The weight is determined by the size of the beam, and the density of the material chosen. For example, compare a piece of balsa wood, and a piece of hardwood.
- The beam must be assembled and balanced before mounting it on the vertical support.

SECTION 2: COMPONENTS & MATERIAL REQUIRED

2.1 COMPONENTS SUPPLIED

The following components are supplied in a plastic bag :

1x	3.0V Electric Motor (white wires)	1x	Propeller 74 mm long
1x	Sliding Switch (small with 2 wires)	2x	Washers 3.0mm ID
1x	2 x AA Battery Holder		



SCORPIO TECHNOLOGY VICTORIA PTY. LTD.

A.B.N. 34 056 661 422

17 Inverell Ave., Mt. Waverley, Vic. 3149

Issued: 19 March 2011

Tel: (03) 9802 9913 Fax: (03) 9887 8158 www.scorpiontechnology.com.au

2.2 ADDITIONAL REQUIREMENTS

- 2.2.1 Available from us are 2.3mm drill bits and 2 x AA batteries, and these need to be ordered separately.
- 2.2.2 The additional requirements are: material for the beam, base and upright, fine electric wire, a 3.0mm drill bit, one 2.5mm diameter nail, hot glue or double sided foam tape.

Note: it is suggested that, before you commence construction, you check the components supplied in your kit, and ensure that you have everything required.

SECTION 3: CONSTRUCTING THE *BALANCE PLANE*

3.1 MAKING AND ASSEMBLING THE BEAM

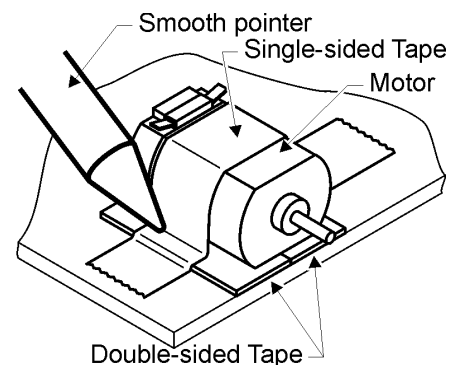
- Cut the rotating beam to the desired size and length, and make the base and upright.
- Press the propeller on to the motor's shaft.

HINT: Place the end of the shaft (where it exits the motor) on a hard surface, and push the propeller down.

WARNING: Don't just push the motor down by hand as this can push the motor armature out of its bearings and jam the motor.

- Attach the motor and propeller to one end of the beam and the battery holder to the other end.
- The switch is to be mounted approximately midway along the beam and it should be located so as not interfere with the pivot.
- Attach the motor, switch and battery holder on to the chassis using double sided foam tape or hot glue or (if using hot glue, roughen the surfaces to be glued with sandpaper to improve adhesion).

WARNING: if using Hot glue, be very careful, as it can burn you, if you get it on yourself.



3.2 DETERMINING THE EQUILIBRIUM POINT

- Once the beam is constructed and assembled, the equilibrium point (centre of balance) needs to be determined.

Notes:

This must be done with the batteries in place.

The equilibrium point can be found by placing the beam on the edge of a ruler.

- Start at the middle of the beam and keep moving it until the beam balances on its own.
- Drill a 3.0 mm diameter hole through the centre of the beam at this point.
- If after drilling the hole the beam does not balance, place some blu-tack or plasticine on the light end until it balances.

3.3 MAKING THE BASE AND THE FINAL ASSEMBLY

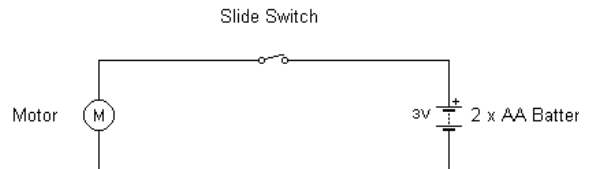
- Cut the material for the base and upright.
- Fasten the upright in place on the base.

- Drill a guide hole in the top end of the upright and drive into it a 2.5 mm diameter nail (with the head cut off).
- Place two washers on the nail and install the beam in place. The washers minimise the friction generated during rotation.

SECTION 4: WIRING UP THE *BALANCE PLANE*

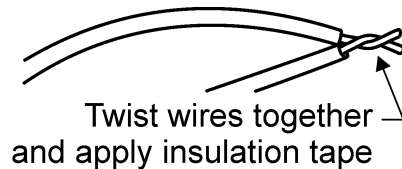
The Switch should be wired as shown in the "Circuit diagram"

- Connect the battery holder's red wire to one of the red wires from the. Twist them firmly together.
- Connect the switch's other red wire, to the motor's red wire. Twist them firmly together.
- Twist the black wires from the motor and battery holder together.



CIRCUIT DIAGRAM

- Insert the batteries, and turn the switch on:
 - when connected correctly the propeller will spin and blow air back over the motor.
- If the propeller spins in the correct direction, your wiring is correct - apply insulation tape over all the joined wires
- If the propeller spins in the wrong direction, you will need to swap the motor's wires:
 - remove the motor's red wire from the switch and untwist the black wires from the motor and battery holder.
 - twist the red wire from the motor to the black wire from the battery holder .
 - connect the motor's black wire to the remaining red wire on the switch.
 - twist them firmly together.
 - apply insulation tape to all the joined wires.



Note: this kit has components that allow this to be assembled without soldering. However, the connections will be more effective and permanent if they are soldered.

SECTION 5: WHAT TO DO WITH THE *BALANCE PLANE*?

5. WHAT TO DO WITH THE *BALANCE PLANE*?

The balance plane is completed! Now what?

The beam's design and simplicity of construction allow for further work and some experimentation. For example:

- Count the times the beam rotates in one minute (r.p.m. – revolutions per minute).
- Work out at what speed the end of the beam is travelling
- Work out the distance travelled by the beam in one minute.
- Remove both washers. Use one washer. Smear oil between both. See what effect (if any) friction has on the speed.
- If the propeller and battery holder are not permanently attached, see if altering the positions (ie. closer to the centre) affect the r.p.m. and speed. (Alternatively, make different length beams as a class.
- Does adding a balanced weight onto the beam change the rate it moves?