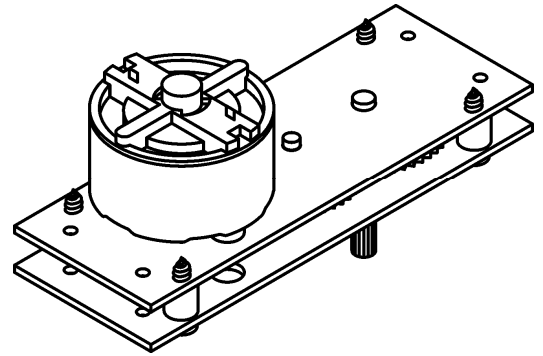


GEARBOX & MOTOR/GENERATOR KIT

DESCRIPTION

The *GEARBOX & MOTOR/GENERATOR KIT* provides electric power, through a 3 stage gearbox connected to a small DC generator. This can be turned by hand, connected to a water wheel, a windmill or whatever else the student decides upon.



INVESTIGATION

The use of this unit, either on its own or within a larger project provides a number of different areas, which may be investigated. The most common areas to look at are **SYSTEM DESIGN** and **TECHNICAL** issues. Some ideas are listed below, to provide a starting point.

- How does a generator work? Is the DC generator the only type?
 - In this case a 3 stage gearbox was used. How does it work – what are the 3 stages?
 - How can the generated power be utilised? How can it be stored?
- ... and the list can go on, and on

1. COMPONENTS REQUIRED

1.1 COMPONENTS SUPPLIED

The following parts are supplied in the kit:

1x	DC generator	4x	7 mm Brass Spacers
1x	3mm x 20mm Knurled Shaft	2x	2mm Brass Spacers
1x	4mm x 33mm Knurled Shaf	8x	2.6mm x 12mm Self Tapping Screws
2x	Gear Box Plates	3x	3mm I.D. Washers
1x	10 Tooth (M0.6) Pinion Gear	1x	4.5 mm I.D. Washer
1x	30 Tooth (M0.6) Spur Gear	4x	2.6mm x 5mm screws
1x	40 Tooth (M0.6) Spur Gear	1x	3mm x 8 mm screw
1x	50 Tooth (M0.6) Spur Gear	1x	3mm Nut
1x	3.0mm x 50mm Steel Rod		

Note: I.D. = Inner Diameter (for washers)

Note: the gears used in this kit are 0.6 Module, and are NOT the same as used in other *SCORPIO TECHNOLOGY* kits, or the other individual gears available.

1.2 ADDITIONAL REQUIREMENTS

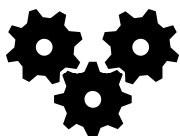
1.2.1 A 3.0mm drill bit is needed.

1.2.2 The kit provides all the components for a complete Gearbox and generator (motor).

Integration of that unit into a system of some sort, will require additional components. If required, we can provide rechargeable batteries and battery holders, LEDs, pulleys and belts, wheels etc. – refer to the Technology catalogue.

2. DESIGN CONSIDERATIONS

2.3.1 The *GEARBOX & MOTOR/GENERATOR KIT* is a complete mechanical system, and is made up of a gear train containing 4 gears. At one end of the gear train is a shaft that needs to be turned in some way. One turn of the 4mm shaft causes the DC generator to turn 60 times, giving it a turns ratio of 60:1 (ie. 60 rpm). While doing this, the generator produces about 6 volts DC.



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3. ASSEMBLING THE GEARBOX AND GENERATOR

The gearbox consists of a number of gears, assembled between 2 plates. The generator is attached to one of these plates. Note: refer to the Exploded Gearbox diagram for the location of the components.

3.1 ASSEMBLING THE GEARBOX

The 2 gearbox plates each have 2 lots of 4 holes (all 2.3 mm diameter). The 4 holes (shown in the Exploded diagram with the screws going to them) are for holding the plates together, the other 4 can be used to attach the gearbox in its mounted location.

3.1.1 PREPARATION - DRILLING

Before starting assembly, you must enlarge the four holes that are used to hold the two plates together - on **one plate only**. These holes are to be enlarged using a 3 mm drill.

3.1.1.2 If required, this (modified) plate can be used to mark out and drill 5 holes on the mounting (4 off 3mm holes for attaching the gearbox case, and one 4.5mm hole for the generator's shaft).

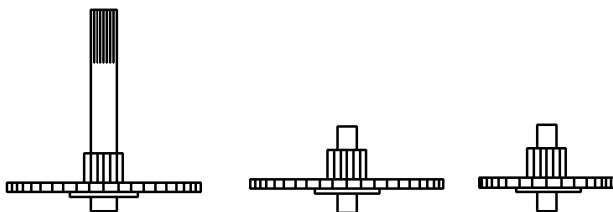
Note: The generator will be attached to the unmodified plate.

3.1.2 ASSEMBLING THE GEARS

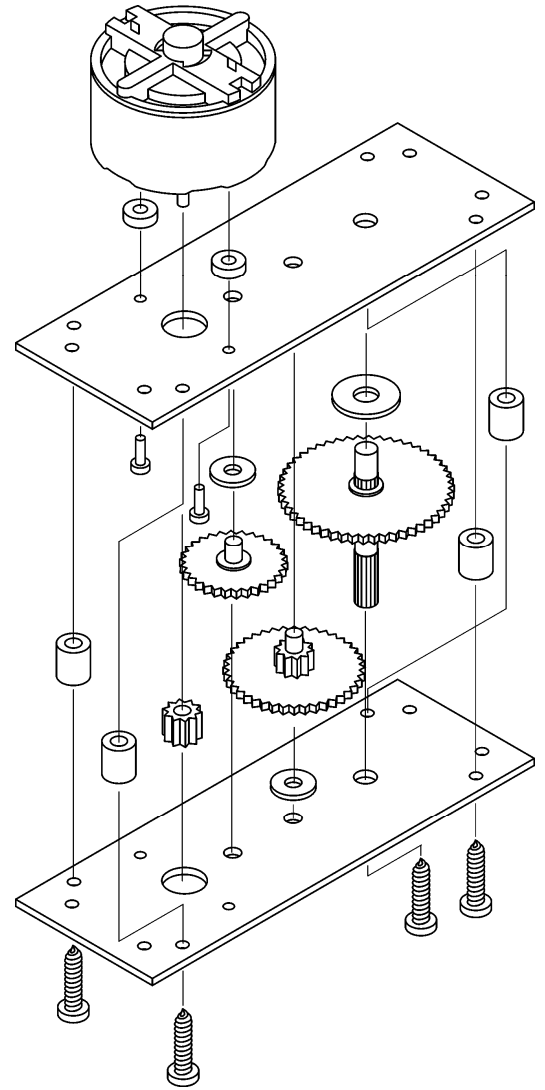
- Cut two 12mm lengths from the 3mm rod - de-burr the ends.
- Tap the rods into the 30 and 40 tooth gears. The rod must be tapped through the gear, so that equal lengths of the rod protrude from each side of the gear.

Hint: This can be done by supporting the gears on a vice (with the jaws open about 3mm) or on a piece of wood with a 3mm diameter hole drilled into it.

- Place the 50 tooth gear with the small gear facing up. Position the 4mm knurled shaft's end (where the knurling starts about 4mm from the end), into the gear's hole. Tap the shaft into the gear, until the bare end of the shaft protrudes about 3mm past the other side of the gear.

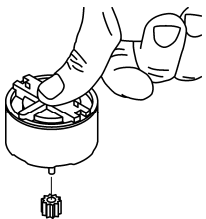


Gear and Shaft assemblies



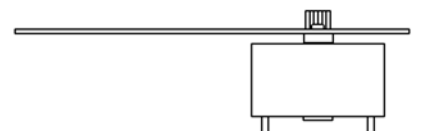
Gearbox Exploded view

3.1.3 THE GENERATOR



- Press the 10 tooth pinion gear onto the generator's shaft. Hint: Put the 10 tooth pinion gear on the bench, place your thumb on the middle of the generator (as shown), push the shaft into the pinion gear until the shaft hits the bench top.
- Fit the 2mm spacers between the generator and the top gear plate. Use 2 off 2.6mm x 5mm screws to attach the generator to the (unmodified) gear plate –

finger tight at this stage.



3.1.4 ASSEMBLING THE GEARBOX

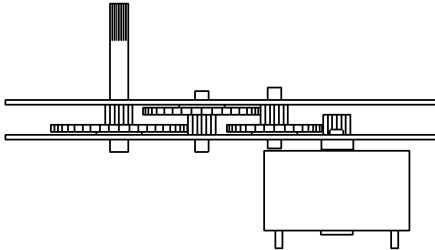
3.1.4.1 To assemble the gear box, begin by holding the steel plate with the generator attached, with the generator downwards. Assemble

the gears as per the Exploded view, ensuring washers are in the indicated places. *Generator to plate*

- With the 30 tooth gear and washer assembled to the plate, check that the generator's gear meshes snugly with the 30 tooth gear. When working satisfactorily, tighten the 2 screws holding the generator to the plate.
- Assemble the 40 tooth gear (with the washer on top) and 50 tooth gear and its washer (below) to the gearbox plate.

3.1.4.2 To install the second plate on top:

- Begin by placing the 4mm knurled shaft into the 4mm hole. Note: The knurled section of the shaft is a tight fit - press the plate firmly and it will slide past the knurling.
 - Carefully align the other two 3mm shafts with the remaining holes. Slide the plate down onto the gears. Hint: Use sticky tape around the centre of the plates to hold them together temporarily.
 - Place the four 7mm spacers between the plates and in line with the holes for the 12mm screws.
 - Insert 4 of the 2.6mm x12mm screws through the holes you enlarged in the plate. Press down firmly with the screw driver. With enough pressure on the screw driver the screws will cut a thread into the other plate. Tighten the screws. Remove the sticky tape.
- A small spray of WD40 or similar lubricant will reduce the friction on the gearbox and allow it to turn more easily. In fact, until this is done, you may have difficulty getting it to spin easily.



3.1.6 TESTING THE GENERATOR

The *GEARBOX & MOTOR/GENERATOR KIT* is now completed. The generator's power output should be tested. Note: the *WIND-UP TORCH's* Teaching unit (on our website) has instructions on how to make a knob and handle, for this generator.

4. TESTING

4.1 MECHANICAL TESTING

Check that the generator can be turned freely in both directions

4.2 TESTING THE GENERATOR

When the gearbox is completed, connect a DC Voltmeter to the output terminals. When turned, the generator will produce about 30 volts (open circuit voltage). This may seem to be far too high considering that we expect this generator to produce 6 volts. The generator's output will be 6 volts only when the generator is connected to some sort of load. A load is a component that consumes power, such as a light globe. When a 6 volt torch globe is connected to the terminals you should measure close to 6 volts.

