Please note:

This is a NEW DESIGN of *RADIO CONTROLED VEHICLE (RCV),* and must be used in conjunction with the new *"RADIO CONTROL 27.145mHz PCB (2 band)"* instructions.

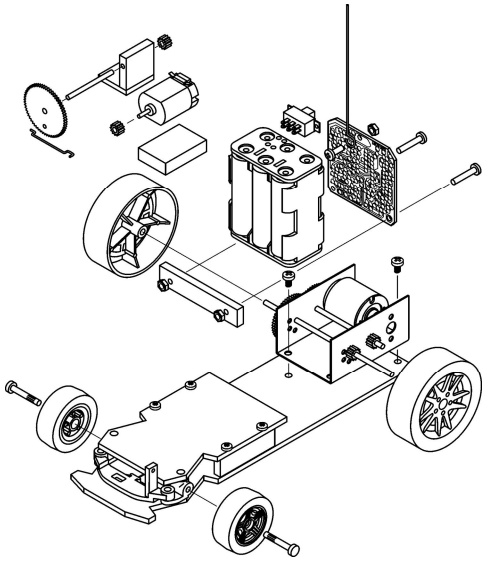
- Please read these both carefully.

WARNING:
1. this kit and these instructions CANNOT be used with previously supplied versions of the *RADIO CONTROL VEHICLE (Mark 3)* or the earlier *27&40 mHz RCV PCBs*.
2. previously issued Teaching units (prior to October 2010 issue) will NOT work with this current kit.

Note: there are changes to the *RADIO CONTROLLED VEHICLE* and its kit. The revised *RCV* kit has:

- various design changes, to suit the new RC PCB design
- changes to the steering design.

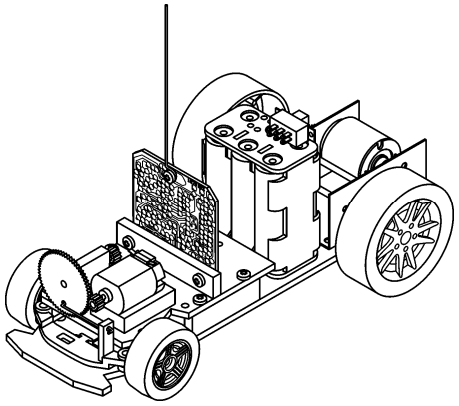
Thank you, and good luck!



RADIO CONTROLLED VEHICLE

DESCRIPTION

The *RADIO CONTROLLED VEHICLE (RCV)* is a motorised vehicle, controlled and steered by remote control. There is a Receiver PCB (Printed Circuit Board) mounted on the vehicle and a Transmitter PCB in a hand held control box.



This remote control unit controls the vehicle's forward and reverse motion, as well as the steering.

The vehicle is driven by a gearbox/motor assembly, and steered by an electric motor through a steering rod and a steering link.

The radio transmission distance is approximately 25 metres, and under favourable conditions can be greater.

SECTION 1: GENERAL AND PLANNING INFORMATION

THE PROJECT

The major aspects of this project are the planning, design, construction, assembly and evaluation stages – key competencies or requirements under the VELS and other educational programs.

This project provides a number of different areas which may be investigated, either individually or in pairs or teams. A number are listed in *RADIO CONTROL – 2 Band* unit for Radio Control related ideas, and below are some additional suggestions.

- Examine the steering design. What other ways are there for steering a vehicle? Have a look at *FOLLOW WHITE LINE VEHICLE's* steering - it has a different way of controlling it.
- Evaluate the choice and suitability of various materials (aluminium, PVC, perspex, etc.).
- Calculate the vehicle's turning circle. Can you set up an equation to do this calculation??
- What design elements influence the turning circle? Is a small or large turning circle better?

PLANNING STAGE

Before commencing work the student should spend time planning the project. Draw up a plan describing:

- The sequence of work required to complete the *RADIO CONTROLLED VEHICLE (RCV)*. This could be set out as a timeline showing the anticipated completion dates for each section of work. This timeline can be used to properly manage classroom time.
- How the *RADIO CONTROLLED VEHICLE* will function.

These plans should also take into account what items should be recorded on an ongoing basis, throughout the life of the project. These could include:

- Completion of a Log Book, recording such items as: the results of individual and team research; Recording progress on a weekly or daily basis etc..
- Detailed information about problems encountered, measurements taken and observations made. These will be used in the evaluation process.
- Reflection on progress and completion in relation to the planned timeline.

At the start, the teacher and student should pose a number of evaluation questions before commencing the project, to be evaluated at the completion. The questions could be in a variety of fields:

- Technical questions. Eg. do the gears mesh well? How well does the steering work?
- Aesthetic questions: for example: can the appearance be improved?
- Practical questions: for example: How can the design be improved?
- Self-critique: for example: is the quality of finish and workmanship satisfactory? How could the execution of the project be improved? Would a different design be created second time around?
- Evaluation of the project: what difficulties were experienced? What caused them? Can they be reduced or eliminated in future projects? How long did the project actually take?
- Critique of the Teaching unit: was anything vital missed which would have been of value? (please tell us if you do identify possible improvements)

DESIGN STAGE

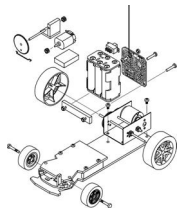
The drawings in this unit show the construction of our prototype model. An evaluation may be made of this design, looking at the vehicle's balance, turning circle, component layout, space efficiency.
NOTE: This unit MUST be used in conjunction with the *RADIO CONTROL – 2 Band* unit. That Teaching unit contains additional instructions, which are not in this unit.

The design stage is crucial. At this stage the locations of all the components must be worked out. This allows the optimum size and shape of the vehicles platform and chassis to be developed on paper. This layout affects the functionality and the ease of assembly.

For information to help with design, please read the entire unit first for ideas – as many sections have useful information, including the sections on the Steering / clearance to the front wheels, and the Gearbox and motor. Some of our other kits have other useful information, for example: *DRAGSTER* has sections on Speed and acceleration and Gearing; the *FOLLOW WHITE LINE VEHICLE* has other steering possibilities, and a brief section on calculation of the turning circle.

DESIGN ELEMENTS

The following points are given as pointers to be taken into consideration during planning.



1 PLATFORM DESIGN

- The RCV consists of a platform / chassis on which the components are mounted. Before starting, the component location needs to be carefully planned and layed out. For best functionality of the vehicle, the designer must look at the vehicle as a complete unit - not just as a collection of separate parts.
- The exploded view shows the overall design of our vehicle, although each designer has scope for originality and innovation in their design. Note: the drawings at the end of the unit, are meant as a guide only, and are not drawn to scale. Apart from a few critical dimensions, the size and shape of the vehicle is up to each designer.
- When designing the platform and upper plate, the size of the P.C.B., battery holder and the gear box assembly must be considered.
- The vehicle's front end and steering measurements are critical and should be maintained as accurately as possible. This will ensure the steering mechanism's proper operation. Some measurements also need to be taken from the supplied components.
- Sufficient clearance must be provided for the wheels (refer below).

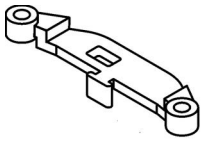
2 CLEARANCE TO THE FRONT WHEELS

The platform needs to be designed, so as to provide clearance to the front wheels. This is to allow the wheels to turn approximately 20 - 25 degrees in either direction. During the design stage allow adequate clearance for the wheels, and at the construction stage add turn limiters to restrict the amount the wheels can turn.
Note: if a longer steering link is to be used, the dimensions defining the wheel cut-outs also need to be increased by the same amount (refer section 6 Steering link).

3 THE STEERING LINK

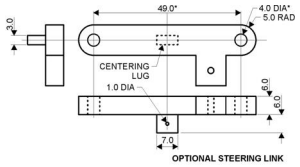
The parts supplied in the kit are designed to work as shown in the exploded diagram. Using these parts, the designer has some scope for variation (detailed below), or can design a different method of setting up and controlling the steering.

USING THE SUPPLIED STEERING LINK



By assembling the steering, using the supplied steering link, a neat steering set-up is achieved. However, when using these parts, the front wheel track (i.e. the distance between the wheels) is rather narrow.
- a lug needs to fabricated and glued to the steering link (as shown in the steering rod assembly detail, of the exploded diagram – compare the steering link to the drawing)

FABRICATING A STEERING LINK



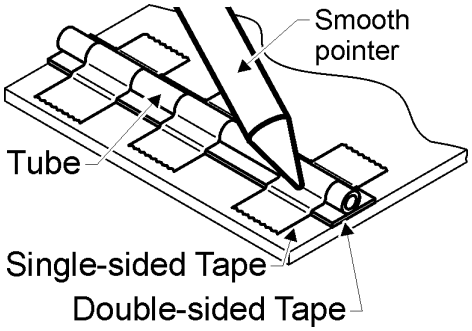
Depending on the vehicle's front end design, the designer may choose to fabricate a new steering link. The design of a simple, straight link is shown in the drawings at the end of this unit.
Note: the dimensions shown are for a steering link, which provides the same track as the supplied link, and allows eg. a shorter front on the vehicle, or a body to be installed.

FABRICATING A LONGER STEERING LINK

For the vehicle to have a wider track, a longer steering link can be fabricated.
The design of a simple, straight link is shown in the drawings at the end of this unit. To make a longer link, the 49mm dimension needs to be increased, together with the corresponding 49mm dimension on the lower platform and the upper plate, as well as any other dimensions affected.

4 OTHER MECHANICAL COMPONENTS / DESIGN

- The Gearbox offers a choice of 3 ratios to choose from, depending on the desired reduction speeds. The one to be used must be decided upon, prior to assembling it. For this decision to be made, the vehicle's desired speed will be need to be considered. Refer to the Section on „Assembling the Gearbox" for more information, in relation to motor speed, and the gearbox reduction ratios.
  - For driving our vehicle, we chose the Third reduction gearbox (the first is not suitable - the single reduction does not provide enough torque to move the vehicle)
- The higher the gear ratio, the lower the vehicle's speed.
- The motors are low power units, therefore to minimize friction all clearances should be liberal.
- To increase the steering motor's effectiveness, the hole for the steering rod needs to be located reasonably close to the centre of the spur gear. As the motor supplies a given torque, the force available at a smaller radius is larger.
- The method of attaching various items, such as, eg. the motor, need to be decided upon. Suitable methods include screws, hot glue (roughen both surfaces first), or a foam backed double-sided tape.



Notes:
- normal double-sided tape is too thin to be effective.
- the transfer shaft's mounting must be firmly adhered – double sided tape is not suitable for this usage

- Spacers need to be attached to the platform, for mounting the Receiver PCB. The length of these spacers is affected by which way the PCB is mounted – track side up or track side down.
- Decide how best to mount both the Receiver PCB and the antenna – the 3rd hole in the PCB is the antenna's mounting hole as well.
- The control box for the transmitter unit is not shown, and the size and design of that is up to the designer.

EVALUATION OF THE RADIO CONTROLLED VEHICLE

The evaluation report is based on the vehicle's function and operation. During the Evaluation stage, those questions posed before starting the project should be evaluated. Students should also include an outline of any modifications they made during construction, that differ or were not included in their original plan. It also seems reasonable for some self evaluation, by commenting on the construction processes and the skills the student has learnt or needs to improve.

Some questions which could be evaluated are.-

- What new skills have you learnt?
- What skills do you need to work on improving?
- Does the vehicle operate as expected?
- Does the vehicle steer as well as you expected?
- What is the maximum distance of the transmitter's effective control?
- Is the (electrical) current consumption as anticipated?
- Is the hand control ergonomic?
- If you made modifications from your original plan, give reasons why they were necessary.
- If you had to make repairs, what was the cause of the problem?
- If you were to make the vehicle again, what areas of your design would you change to make it better?
- What suggestions for improvement, would you make to the kit designer (please e-mail us)

SECTION 2: COMPONENTS & MATERIAL REQUIRED

2. COMPONENTS & MATERIAL REQUIRED

2.1 COMPONENTS SUPPLIED (IN THE KIT)

1 x *RADIO CONTROL UNIT (RC)* **

1 x Multi-ratio Gearbox case
1 x 4.5V Electric motor (Round)
1 x 3.0 V Electric motor (Flat – Green end)
2 x Capacitors 473 Z (C15, C17)
2 x 50Tx10T Spur gears (white/2.4mm hole)
2 x 50Tx10T Spur gear (yellow/2.6mm hole)
1 x 60Tx10T Spur gear (white/2.4mm hole)
1 x 12T Pinion gear (1.9mm hole)
3 x 12T Pinion gears (2.4mm hole)
1 x 10T Pinion gear (1.9mm hole)
1 x 2.5 mm dia x 70mm long steel rod
2 x 2.5 dia x120 mm long steel rod
2 x Axle shafts (Knurled pin 3x20mm)
2 x Front wheel knuckle (LH & RH)
1 x Centreing spring
1 x Steering link
2 x 35 mm dia. wheels (3.1mm hole)
2 x 52 mm dia. wheels
2 x 2.6 x 4mm long Self- tapping screws
4 x 3 x 5mm Wood screws
7 x 3 x 10mm long Self- tapping screws
3 x M3 x 8mm long bolt
1 x M3 x 12mm long bolt
3 x M3 Nut
2 x Washer (3mm ID / 0.5mm thick)
1 x Washer (3mm ID / 1.0mm thick)

** *Refer to the RADIO CONTROL – 2 band Teaching unit for the list of parts in that kit*

2.2 ADDITIONAL REQUIREMENTS

2.2.1 Available from us are 2.3mm, 2.6 mm and 3.5mm diameter drill bits, and if required, these need to be ordered seperately.

2.2.2 The additional requirements are: fine electric wire (different colours), 6x AA batteries and one 9 volt battery (Alkaline batteries are recommended).

2.2.3 For other requirements, refer to the *RADIO CONTROL – 2 band (RC)* Teaching unit. If you don't have a copy, it can also be downloaded from our website.

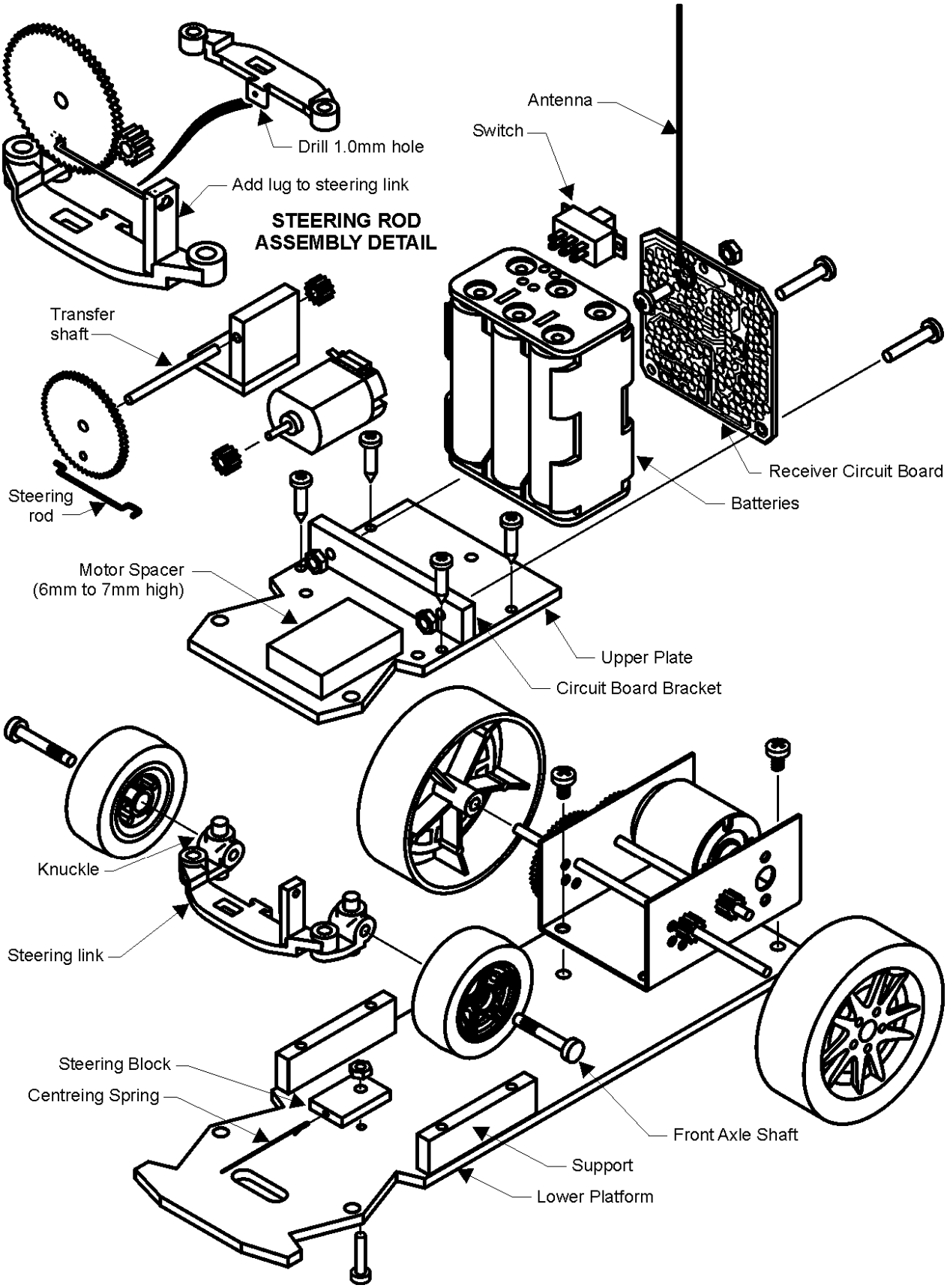
2.3 COMPONENTS TO BE MADE

In addition, a variety of materials are required to allow fabrication of all the other parts: Platform and steering components, Control unit housing & Battery mount and everything else needed.

Note: Refer to the exploded diagram, and drawings at the end of this unit, for pictorial information.

Comments – about the material used for the platform and other components:

- for our prototype we used 3.0 and 4.5 mm thick PVC sheet. Do they need to be that thick, or are thinner sheets of PVC just as effective (and lighter)?


Drill 1.0mm hole
Add lug to steering link
STEERING ROD
ASSEMBLY DETAIL
Antenna
Switch
Transfer
shaft
Steering
rod
Receiver Circuit Board
Batteries
Motor Spacer
(6mm to 7mm high)
Upper Plate
Circuit Board Bracket
Knuckle
Steering link
Steering Block
Centreing Spring
Front Axle Shaft
Support
Lower Platform

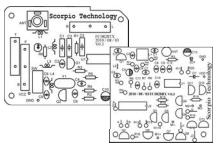
- Acrylic was found to be undesirable for the Platform and plate, due to its brittle properties (and thus the use of self-tapping screws is not suitable with acrylic)
- Aluminium seems to be suitable because of its lightness, but care needs to be exercised with wiring, due to its electrical conductivity. Note: if a metal base is used care must be taken when mounting the receiver PCB.
- Plywood may be worth investigating, as it is thin and a non-conductor of electricity.
- What other materials are available, that may be suitable?
- Steering rod – make from 1mm wire or a paper clip

SECTION 3: ASSEMBLY INSTRUCTIONS

3.1 ASSEMBLY INSTRUCTIONS – GENERAL

Before you commence ensure that you have ALL components – both the supplied ones, as well as all the additional requirements listed in both Teaching units - *RADIO CONTROLLED VEHICLE* and the *RADIO CONTROL – 2 Band* .

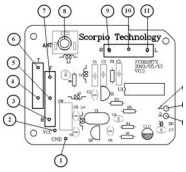
3.2. ASSEMBLY INSTRUCTIONS – THE PCBs



If you have a set of un-assembled PCBs, you will need to refer to the *RADIO CONTROL – 2 Band* unit for instructions and component information.

NOTE: even if you have the assembled PCBs, there is useful component information in that unit.

3.3 WIRING UP THE TRANSMITTER AND RECEIVER PCBs



For information on wiring switches, battery holders etc to the PCBs, you will need to refer to the *RADIO CONTROL – 2 Band* unit for drawings and instructions.

3.4 THE ANTENNAS & CONNECTIONS

For information on making and connecting the antennas to the PCBs, you will need to refer to the *RADIO CONTROL – 2 Band* unit for drawings and instructions.

SECTION 4: MAKING THE BODY AND PARTS

The vehicles platform parts, steering and other associated parts need to be made. The sizes and shapes will be as defined at the Design stage, taking into account all the parts to be mounted, the desired width of the front end and any other desired criteria. These parts include:

- The upper Plate & and lower Platform
- Supports (platform to upper plate)
- Insulated PCB Spacers
- Control unit housing & Battery mount
- Transfer shaft mounting
- Steering Block
- Lug for the steering rod
- Steering rod (wire or a paper clip)
- Steering link (if required)

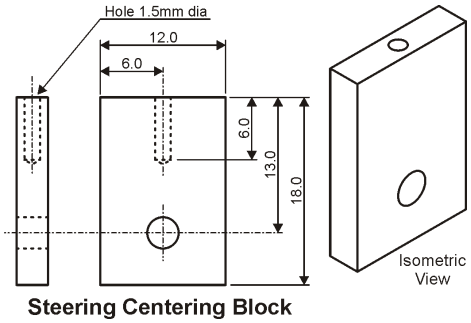
NOTE 1: the measurements shown in the drawings, for the vehicle's front end, are critical and should be maintained as accurately as possible. This will ensure the proper operation of the steering mechanism. Some measurements need to be taken from the actual components supplied.

NOTE 2: When making the platform, adequate clearance must be provided, when the wheels are turned, for movement of the steering link's lug. A slot must be cut in the chassis to allow adequate travel of this steering lug. (The slot can be cut with a routing tool or the careful use of a 4 or 5 mm drill bit, coping saw and files).

SECTION 5: MAKING AND ASSEMBLING THE STEERING

The Steering mechanism's assembly can be tricky and requires some planning and care. For the layout and assembly, refer to the exploded diagram.

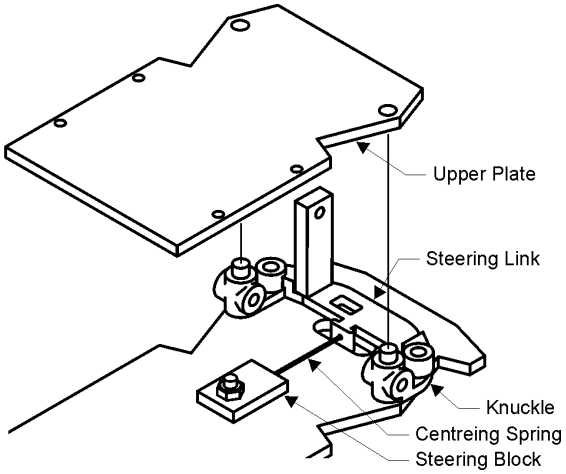
Note: if using the supplied steering link, a lug needs to fabricated and glued to the steering link (as shown in the steering assembly detail, of the exploded diagram – compare the steering link to the drawing)



Steering Centering Block

STEERING CENTERING MECHANISM

- Drill a hole into the Steering link for the straight end of the centreing spring
- Fabricate the Steering Centreing block as shown: the large hole is to suit a 3mm bolt, and the small hole for the centreing spring's bent over end.
- Assemble the Centreing spring to the Steering block, by pushing the spring's bent back end fully into the block, until it locks into position.



GENERAL STEERING SET-UP

- Assemble the wheels, knuckles and the axle shafts.
- Mount the wheel and steering knuckle assemblies onto the lower platform.
- Assemble the steering link to the steering knuckles.
- Insert the Centreing spring's straight end into the hole in the Steering link.
  Note: ensure that the spring remains engaged in the extremes of movement: i.e. not only at the centred position, but also at the limits of travel in both directions.
- Attach the Steering block to the lower platform using the M3x12mm bolt, nut and washer – at this point leave the nut finger tight.
- Install the upper plate, using 4 off the 3x10 self-tapping screws.

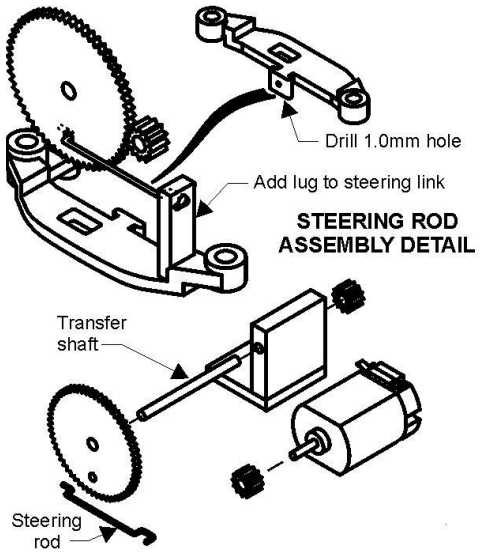
NOTE:CHECK the movement of the Steering knuckles at this time – they must be a loose fit. If they are tight fit, you should slightly enlarge the holes with a round file. This is necessary – a tight fit will not allow the steering to centre itself, into the straight ahead position.

- Adjust the wheels to point straight ahead by using the Centreing block.
- Tighten the nut, to hold the Centreing block in that position.

STEERING MOTOR AND TRANSFER SHAFT

The steering motion is supplied by the motor through the transfer shaft, gears and steering rod.

- 60 Tooth Gear: In the 60 Tooth gear, a 1.5 mm diameter hole must be drilled approximately halfway between the gear centre and the teeth.
  NOTES:
  - The force applied by the 60 tooth gear increases, the closer the hole is to the centre
  - If the hole is too close to the centre, an 'over centre' condition occurs, and the steering 'locks' in one position.
  - If desired, experimentation can be carried out to determine the best position of the hole relative to the centre (i.e. in regard to steering response and effectiveness). This can be done by drilling a number of 1.5 mm dia holes in the 60 Tooth spur gear, for the steering rod, in various locations, each progressively further out from the centre, and testing each position.



- Steering rod. Make the steering rod - from 1 mm diameter wire (or a paper clip).
- Install the steering rod, to go between the transfer shaft's gear and the lug on the steering link. This must be connected before the transfer shaft and its mounting are fastened to the platform. This must be glued or screwed – Double sided tape is not strong enough to retain this firmly.
- Make the transfer shaft mounting. The size and shape / configuration of this is up to the student to determinē. The important thing is that the Transfer shaft's Spur gear must mesh with the steering motor's pinion gear.
  HINT: the material used for this should be of sufficient thickness (at least 4.0mm) to allow the drilling of a 2.6mm hole through it, for the transfer shaft.
- Assemble the transfer shaft mounting, 2.5mm diameter transfer shaft and both gears. Note: the 12 tooth (2.4mm hole) pinion gear is used as a locator, to prevent the transfer shaft from sliding out of the mounting – there should be enough free-play, to allow the shaft to turn freely, but not enough to allow the 60 Tooth gear to dis-engage from the motor's gear.
- Mount the transfer shaft assembly, which should be as low as possible, so that the gear and the platform have a minimal clearance.
- Assemble the 12 tooth Pinion gear (1.9mm hole) to the motor.

HINT: Place the gear on the bench, insert the motor's shaft into the pinion gear's hole and gently tap the end of the shaft (where it exits the motor) with a small hammer. Stop when the gear is 0.5 to 1mm from the motor's body.
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.

- Solder the 473z Capacitor across the motor's terminals, before mounting the motor.

- Locate the steering motor, on the platform. When satisfied that the steering motor's and transfer shaft's gears operate smoothly, and with the location of both parts, attach the motor to the platform. Hot glue is quite suitable for this.

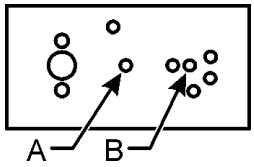
SECTION 6: ASSEMBLING THE GEARBOX AND MOTOR

The *MULTI-RATIO GEARBOX* kit provides a choice of 3 gear ratios to choose from. Before starting assembly, the desired gear ratio must be chosen for the driving speed, as this defines the parts to be used and the assembling procedure.

Also refer to the Design Stage section for our gearbox ratio choice.

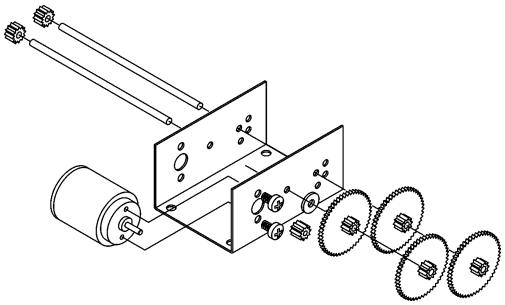
6.1 GEARBOX OPTIONS

GEARBOX STAGE / Reduction ratio	OUTPUT SHAFT	RATIO
Double reduction	Hole B	1:25
Triple reduction	Hole A	1:125
Standard Motor (round) - Rated at 4.5V	Performance	
6 Volts: ie. Powered by 4xAA batteries	12,600 rpm	
Torque	17.9 g.cm	



Motor speeds quoted are approximate rpms under load

6.2 ASSEMBLING THE GEARBOX



GENERAL:

- for this Gearbox, the holes marked 'A' & 'B' in the drawings are to be used - the available gears will not function if fitted to any other holes
- the 10T pinion gear (which has a 1.9mm hole) is press fit on to the electric motor's 2.0mm shaft
- the 12T pinions are used as locators.
- the white spur and 12T pinion gears (which have a 2.4mm hole) are press fit on to the 2.5mm shafts while the yellow spur gears are free wheeling on the shaft and have a 2.6 diameter hole.
- the outside two 50T spur gears (ie one on each shaft) must be white 50T gears, and are press fit, while the inner (closer to the case) are yellow 50T, which are free spinning .
- the gears can be assembled onto the shaft/s with a help of small hammer.

6.2.1 GEARBOX SELECTION

Before starting assembly, and depending on the intended speed of the vehicle:

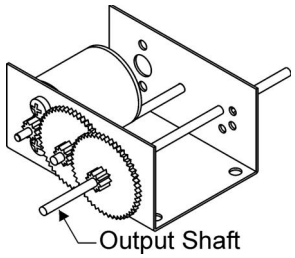
- determine the desired gearbox ratio – as this will define which output shaft will be used as the axle (we recommend the 3rd Reduction ratio)
- define the length of the axle shaft, and cut (and de-burr) the steel rod to that length.

6.2.2 ASSEMBLY PROCEDURE:

Assemble the steel rods, and all the gears, to the gearcase - as shown in the appropriate drawing– Double or Triple reduction. Also refer to the exploded diagram.

DOUBLE REDUCTION

- Start by fitting the first shaft to the hole nearest the motor (Hole A), add the 12T pinion gear (locator), with the 1.0mm washer between the case and the (white) 50T spur gear
- Add the second shaft to Hole B, and add the 12T pinion gear (locator) and the (white) 50T spur gear.

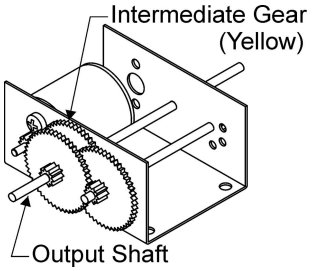


DOUBLE REDUCTION

TRIPLE REDUCTION

- Start by fitting the first shaft to the hole nearest the motor (Hole A), add the 12T pinion gear (locator), with the 1.0mm washer between the case and one (yellow) 50T spur gear
- Add the second shaft to Hole B, and add the 12T pinion gear (locator) and one (white) 50T spur gear.
- Install a (white) 50T Spur gear on the shaft nearest the motor.

- for the THIRD reduction ratio, this shaft is the output shaft.



TRIPLE REDUCTION

6.2.3 ASSEMBLING THE MOTOR, GEAR AND CAPACITOR

- Press the 10T pinion onto the motor shaft - stop when the gear is 0.5 to 1mm from the motor's body.

HINT: Place the gear on the bench, insert the motor shaft into the pinion gear's hole and gently tap the end of the shaft (where it exits the motor) with a small hammer.

- *When the end of the gear is flush with the end of the shaft, drill a 3mm diameter hole in a piece of scrap wood.*
- *Place the gear over the hole, so that the shaft can go into the hole, and tap the end of the shaft.*
- *Stop when the gear is 0.5 to 1mm from the motor's body.*

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.

- Solder the 473z Capacitor across the motor's terminals, before mounting the motor.
- Secure the motor to the gearbox case using the two self-tapping screws.
- Solder a suitable length of wire to each of the motor's terminals. The length will be dictated by the planned usage / location of the Gearbox and the other components

SECTION 7: ASSEMBLING THE VEHICLE

7.1 GENERAL

For drilling the pilot holes for the 2.6mm self tapping screws, use a 2.3 mm drill bit, and for the 3mm self tapping or wood screws, use a 2.6 mm drill bit.

7.2 MOUNTING THE GEARBOX AND MOTOR ASSEMBLY

- Locate the gearbox and motor assembly on the platform.
- Mark the location of the gearbox attaching holes, and drill them (2 diagonally located holes are a minimum). 3 x 5mm wood screws are supplied for this.
- Make sure the gearbox shafts are at 90 degrees to the body, to ensure that the vehicle travels straight.

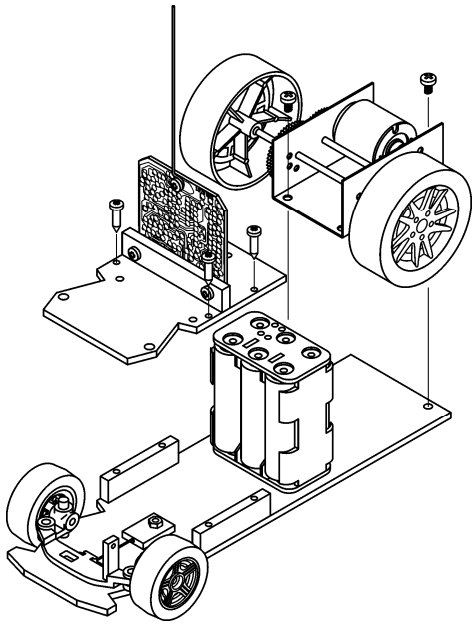
- Press the wheels on to the shafts. The rear wheels may also be hot glued for additional strength.

7.3 MOUNTING THE P.C.B.

- When the gearbox is in place, use the Receiver PCB as a template and mark where to drill the mounting holes for the PCB.
  Note: if mounting the PCB upright (as shown in our diagrams, make sure that the antenna mounting hole is at the top.

WARNING: Care must be taken when mounting the Receiver PCB, to ensure that neither the antenna nor the attaching screws and spacers can short across any tracks.

- *This is done by the use of insulated spacers between the P.C.B. and the platform - fibre, plastic or wooden spacers should provide sufficient insulation. This prevents the soldered side of the P.C.B. from shorting out if the base is made from a conducting material, such as aluminium. Attach the PCB, using 3mm x 10mm long self tappers, M3x8 bolts, nuts & washers, or in some other way.*



7.4 FINISHING THE VEHICLE

- Mount the battery holders, and wire them up.
- Mount the On-off switch (SW1) to the vehicle. Locating it towards the vehicle's rear is suggested, to provide easy access to the switch.
- complete anything else left uncompleted

At this stage, testing should be carried out, prior to fitment of any optional / additional bodywork etc (such as eg. a vacuum formed body shell).

SECTION 8: TESTING AND TROUBLE SHOOTING

After completing the design, manufacture and assembly of the RCV vehicle, a number of tests and adjustments still need to be carried out. These are detailed below.
NOTE: some of the information below is a duplication of what is found in the *RADIO CONTROL – 2 Band* unit.

8.1. BEFORE TESTING:

WARNING: CHECK ALL WIRING THOROUGHLY BEFORE CONNECTING THE BATTERIES.

- *It is worth spending a bit of time and give the wiring and soldering a thorough visual check.*

If you experience any problems, recheck the wires and soldering (if another working unit is available, compare it to yours).

8.2 WHAT TO EXPECT IN YOUR TESTING

When both motors are driven, they will draw up to 800 mA (milli-Amps) from the batteries. The drive motor's current useage is normally between 400 to 500 mA and for the steering motor it is 250 to 300 mA. The effective range of the transmitter is approximately 25 metres, and can reach 50 metres (if the conditions are favourable. Because of the large currents drawn, Alkaline batteries are recommended for the motors. Low battery voltage can cause erratic performance.

8.3 TESTING THE *RADIO CONTROLLED VEHICLE*

8.3.1 TESTING:

Insert the batteries, move the Receiver's On-off switch to the "ON" position, and check that the following occur:

- when the Transmitter's direction-controlling toggle switch (Forward-Stop-Reverse) is operated, the *RCV* 's rear wheels turn in the selected direction. If not reverse the mounting direction of the switch on the Radio Control unit.
- when the Transmitter's steering push button switches (Right-Left) are operated, the *RCV* 's front wheels turn in the same direction. When neither switch is operated the vehicle should go straight.
- if the switches operate the RCV, but in the wrong direction, swap the position of the switches on the Radio Control unit.

8.3.2 TROUBLESHOOTING:

If any of the above are not achieved, turn off the power immediately and check the following:

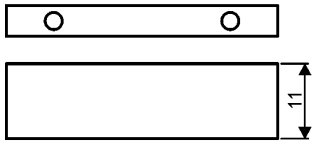
- that the batteries have adequate charge
- that all the PCB components are correctly located and oriented
- that the +ve (red) and –ve (black) from the battery connectors go to the correct positions on the P.C.B.
- bare wire ends do not touch other wires or connections on the PCB
- check that there are no solder bridges between the terminals
- that all the wiring is connected as per instructions
- Make sure there are no dry joints - the soldering may look dry or lumpy or you may notice the solder does not actually connect to the wire. This will look like a dark ring around the wire: try pulling the wire to see if the lead comes out or moves (a magnifying glass or eye piece will help)

NOTE: in this section, one set of pre-assembled PCBs is useful, as it helps to quickly identify which PCB is faulty, and what the correct component placement is.

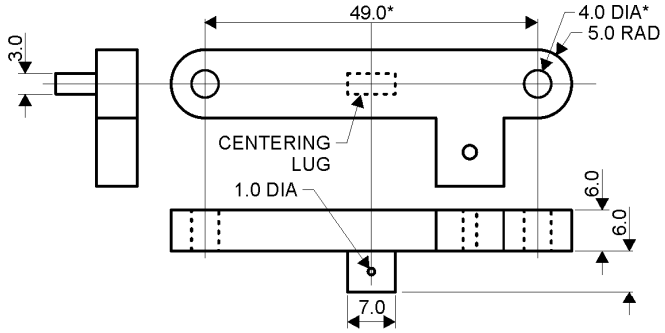
You have now successfully built your *RADIO CONTROL VEHICLE* !!!

Well done – that's a major task achieved !

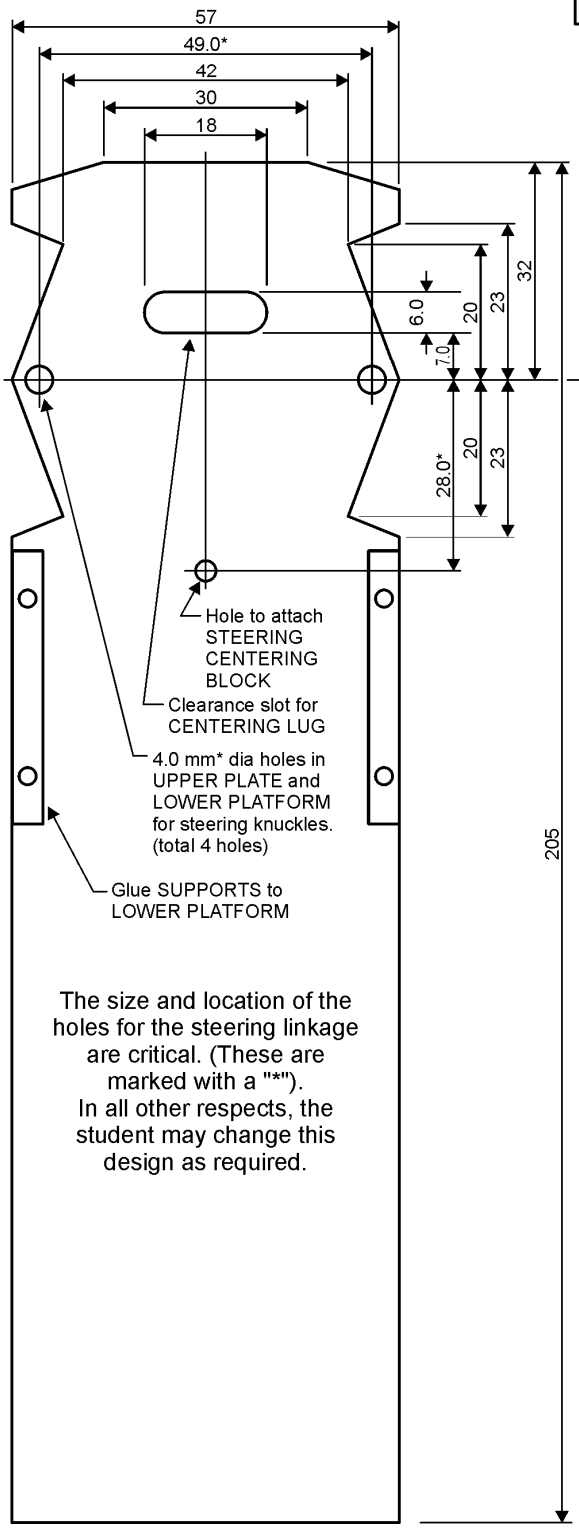
SECTION 9: DRAWINGS

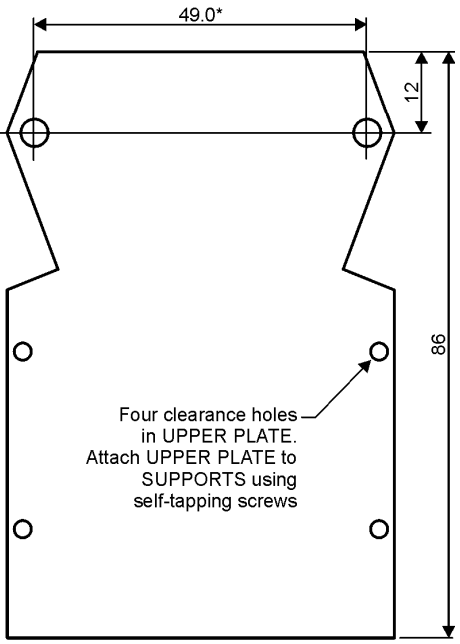


SUPPORTS (2 Required)
4.5mm thick



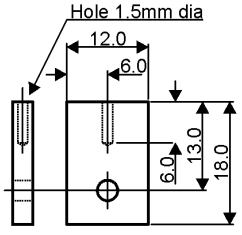
OPTIONAL STEERING LINK





UPPER PLATE
3.0mm thick

The size and location of the holes for the steering linkage are critical. (These are marked with a "*").
In all other respects, the student may change this design as required.



STEERING CENTERING BLOCK

NOTE: These drawings are not to scale

MATERIAL: PVC or EQUIVALENT

Where required, use PVC cement (Clipsal or equivalent).