David Viewing's Gauge One starter engine
The Greenly 0-4-0

Builder's Guide

David Viewing with Adrian Johnstone – update K issued 27th June 2026

Published by the Gauge One 3D Circle - a specialist group within **G1MRA**

The Gauge 1 Model Railway Association https://www.g1mra.com

Preface

This document is for those interested in building a Greenly Starter Engine using one of the kits available from G1MRA. You can order a kit from http://www.g1mra.com/ under the **Sales/Models** tab.

The kit comes in three variants: A: Ready to Run (RTR), B: pluggable and C: solderable.

Type A (Ready to Run) models are complete and usable out of the box but they are **undecorated**. The locomotive as delivered looks like the white engine pictured on the front cover. Type B (pluggable) models need assembly skills, but the electronics has been wired up for you and just needs to be plugged together. Type C (solderable) models are not wired up: you need electronics construction experience to tackle one of these.

If you are building a Type B kit, simply work through all sections of this guide in sequence. If you get stuck, you'll find advice and contact emails on the G1MRA web site.

Appendix A covers the wiring and soldering needed to connect together the electronic components in a type C kit; effectively explaining how to make a type B kit from a type C kit.

All of the design and development of these kits, along with the work needed to identify a cost-effective supply chain is the work of David Viewing.

Adrian Johnstone supplied a little encouragement and wrote most of this guide whilst constructing both a pilot and a production variant.

Many others have helped and offered suggestions, especially those attending the 3D Circle Zoom group and the builders of the ten pilot engines. Thank you to everybody involved.

Adrian and David, June 2026

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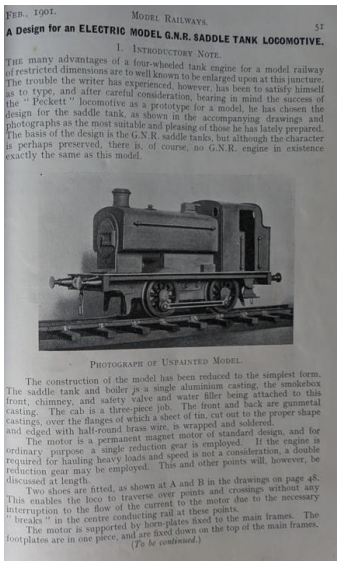
1: Background to the project

In the February 1910 issue of his magazine *Model Railways and Locomotives* Henry Greenly introduced a construction series for a simple 0-4-0 locomotive. He wrote '*The basis of the design is the G.N.R saddle tanks, but although the character is perhaps preserved, there is, of course, no GNR engine in existence exactly the same as this model'.* Henry is presumably referring to the GNR class J13-J17 0-6-0 saddle tank engines designed by Stirling.



FEB., 1910. MODEL RAILWAYS. 51

A Design for an ELECTRIC MODEL G.N.R. SADDLE TANK LOCOMOTIVE.

I. INTRODUCTORY NOTE.

THE many advantages of a four-wheeled tank engine for a model railway of restricted dimensions are to well known to be enlarged upon at this juncture. The trouble the writer has experienced, however, has been to satisfy himself as to type, and after careful consideration, bearing in mind the success of the "Peckett" locomotive as a prototype for a model, he has chosen the design for the saddle tank, as shown in the accompanying drawings and photographs as the most suitable and pleasing of those he has lately prepared. The basis of the design is the G.N.R. saddle tanks, but although the character is perhaps preserved, there is, of course, no G.N.R. engine in existence exactly the same as this model.

PHOTOGRAPH OF UNPAINTED MODEL.

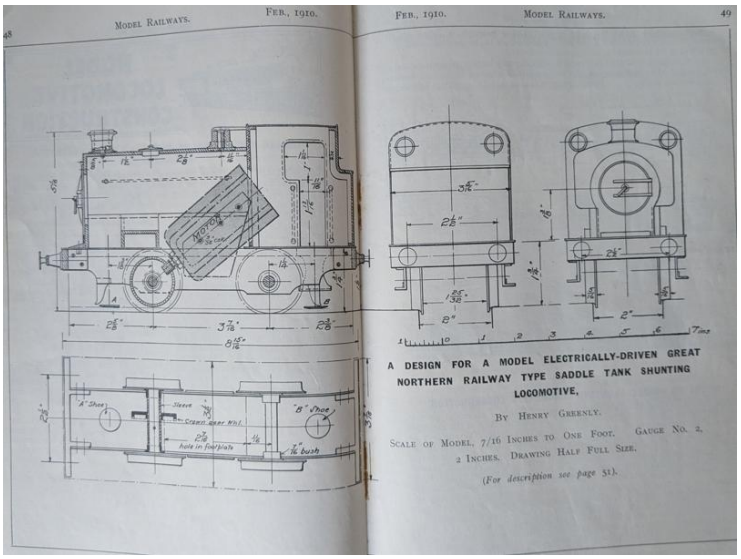
The construction of the model has been reduced to the simplest form. The saddle tank and boiler is a single aluminium casting, the smokebox front, chimney, and safety valve and water filler being attached to this casting. The cab is a three-piece job. The front and back are gunmetal castings, over the flanges of which a sheet of tin, cut out to the proper shape and edged with half-round brass wire, is wrapped and soldered.

The motor is a permanent magnet motor of standard design, and for ordinary purpose a single reduction gear is employed. If the engine is required for hauling heavy loads and speed is not a consideration, a double reduction gear may be employed. This and other points will, however, be discussed at length.

Two shoes are fitted, as shown at A and B in the drawings on page 48. This enables the loco to traverse over points and crossings without any interruption to the flow of the current to the motor due to the necessary "breaks" in the centre conducting rail at these points.

The motor is supported by horn-plates fixed to the main frames. The footplates are in one piece, and are fixed down on the top of the main frames.

(*To be continued.*)



MODEL RAILWAYS. FEB., 1910. FEB., 1910. MODEL RAILWAYS. 49

A DESIGN FOR A MODEL ELECTRICALLY-DRIVEN GREAT NORTHERN RAILWAY TYPE SADDLE TANK SHUNTING LOCOMOTIVE.

BY HENRY GREENLY.

SCALE OF MODEL, 7/16 INCHES TO ONE FOOT. GAUGE NO. 2, 2 INCHES. DRAWING HALF FULL SIZE.

(For description see page 51).

Greenly's article finishes with the fatal words *To be continued* but as far as we know, there were no further instalments. The model as originally described is Gauge 2 (two inches between the rails) not Gauge 1. It seems that some models were sold commercially of which at least one survives, featuring an aluminium one-piece casting for the saddle tank. David Viewing owns the surviving example, and designed a radio control 3D printed chassis to go beneath it. He then developed bodywork in three sizes to go with it.

Here we see the whole family. From left to right: (i) the original Henry Greenly Gauge 2 body atop a modern chassis; (ii) in white, a Gauge 3 resin print; (iii) David's Gauge 2 prototype printed in black nylon with a coloured vinyl wrap; and (iv) on the right David's protoype Gauge 1 engine, printed in black nylon and sprayed with car-paint rattle cans.

The Gauge One Model Railway Association (G1MRA) has a long tradition of promoting 'starter' locomotives as an introduction to live steam, and recognised that a low-cost electric loco would also be an attractive way into large scale modelling. David found that Henry's simple design could be economically reproduced using commercial 3D printing technologies, and also researched low-cost radio control and even ultrasonic 'smoke' generators.

The prototypes were well-received by the G1MRA committee who then financially underwrote the production of ten pilot kits, with costs recovered from those builders who bought kits. At the 2025 AGM in Darlington, G1MRA awarded the 2025 President's Cup to David Viewing for this initiative, who then demonstrated the prototypes running at speed with a full load on the Midland Group's Carding Road track: you can watch a video of that run at https://www.youtube.com/watch?v=jOOP2zo-2o0

Feedback from the ten pilot builders led to an improved V7.1 design in which the electronics were mounted in a separate backhead assembly to avoid water spillage from the smoke generator. At the same time, David added some detailing to the cab, and a flickering LED to simulate an open firebox.

This production version was formally launched with an article in the March 2026 edition of G1MRA's *Newsletter and Journal*. An initial run of twenty kits sold out immediately, with many collected at the Spring 2026 G1MRA meeting at Statfold Barn. Towards the end of the day, the Anglia Roads outer electric track was taken over by a procession of four trains, each hauled by a Greenly starter engine.

The lead train comprised eleven RCH wagons, a van and a brake van: this was easily handled by the engine.

Also on track was Elizbeth Scott's Cadbury No. 15 loco hauling heavily weighted Northern Finescale vans along with Steve Andrews' NCB loco and brake van, and Roger Hopkin's Archie.

The engine is a fine runner and can pull a heavy train for hours so it makes a great backup for live steam runners with recalcitrant engines – the batteries will hold charge for months.

Importantly, the design is robust enough to handled and operated by young children and will easily cope with 55cm radius curves for that classic round-the-christmas-tree track.

We also use it on our exhibition table-top layout as you can see in this video taken at a model railway show https://www.youtube.com/watch?v=mrYZMpy5XrM where the engine ran for five hours continuously without exhausting its batteries. The grey track is 3D printed.

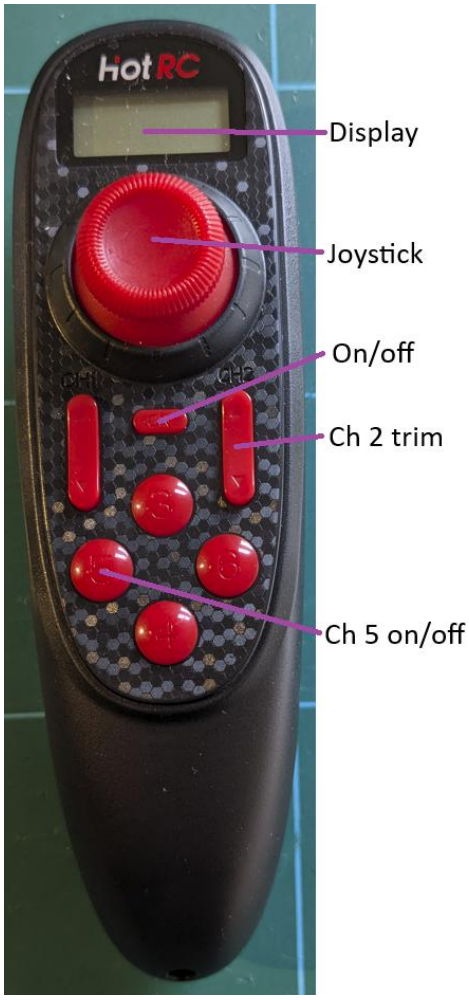
We hope you enjoy running and (for kit purchasers) building this model. Please let us know how you get on.

2: Running the completed engine

The Greenly engine itself has a single control – the on/off switch that is inside the cab. When the engine is on, the firebox LED will be lit.

When the engine is off, its batteries may be charged by connecting a USB-C charger to the socket next to the firebox LED. There is a light on the charging board that is visible from underneath the loco. Whilst the batteries are charging up it will glow red; it will change to blue when the batteries are fully charged.

The transmitter



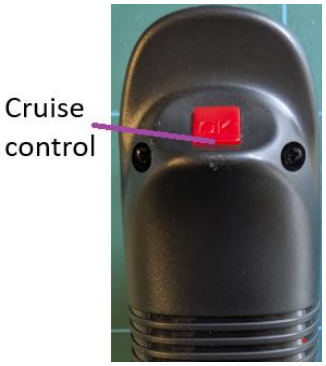
The engine is controlled remotely using this hand-held radio transmitter. Transmitters do not interfere with each other – you can have multiple Greenly engines running together on a track and each will know which transmitter they are linked to. The transmitter has its own charging socket on the left-hand side to which a USB-C charger may be connected – the charging light glows red when charging and changes to green when fully charged.

Switch on the transmitter by pressing the **On/off** button for half a second or so. The hand-held will play a short rising tune and the display will come on, showing the battery voltage levels at each end of the link and the signal strength.

Move the joystick up and down, and the engine will move back and forth.

If, when the joystick is in its rest position, the motor hums or creeps, then adjust the zero position with the **Ch 2 trim** rocker until it is quiet. You should not need to do this again.

The 'smoke' generator is switched on and off with the **Ch 5 on/off** button after loading the smokebox water tank with distilled water (see below).



The transmitter **Cruise control** button is underneath. If you set the locomotive running at your preferred speed and press this button, you can then release the joystick and the engine will continue at that speed until you press the Cruise control button again (or until the transmitter switches off).

If you do not touch a button for around 15 minutes the transmitter will start to beep to attract your attention. It will switch itself off if you continue to ignore it.

It is possible to limit the maximum speed of the engine and to reverse the sense of the joystick by modifying transmitter modes – see the fold-out manual with your transmitter for details.

Filling the water tank

The smoke effect is created by a metal disc vibrating at very high frequency. Water from a tank is drawn up by a wick and passes through microscopic holes in the disc before being thrown into the air.

To fill the tank, gently ease the smokebox door away from the body to expose the metal disc and the filler hole. Load 8cc of distilled water into the tank and slide it back into the locomotive body. Please be mindful of the fine wire connecting the disc and avoid spilling water on the engine – water and electronics do not mix well.

3: Starting the build: check that you have everything

Here are the main elements of the kit as supplied.

Please check that you have all of the following items. Note that the electrics shown are for a type C kit; for a type B kit they will already have been wired together and only need to be plugged together and tested which we will do in Section 7.

Electronics

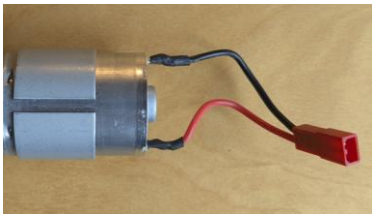
This section lists the electronic elements of the Type A (Ready to Run) and Type B (pluggable) options in which the components are pre-soldered and the electronics just plugs together, as shown in Section 7.

For the Type C (component level) option, please refer to the component parts list in Appendix A.

1. Two protected LIPO pouch cells.
   Warning: Treat LIPO batteries with great care! Do not puncture the pouches or short circuit the connections!

2. Motor RS-385PH-2270 or RS385PV-2270 wired to connecting lead

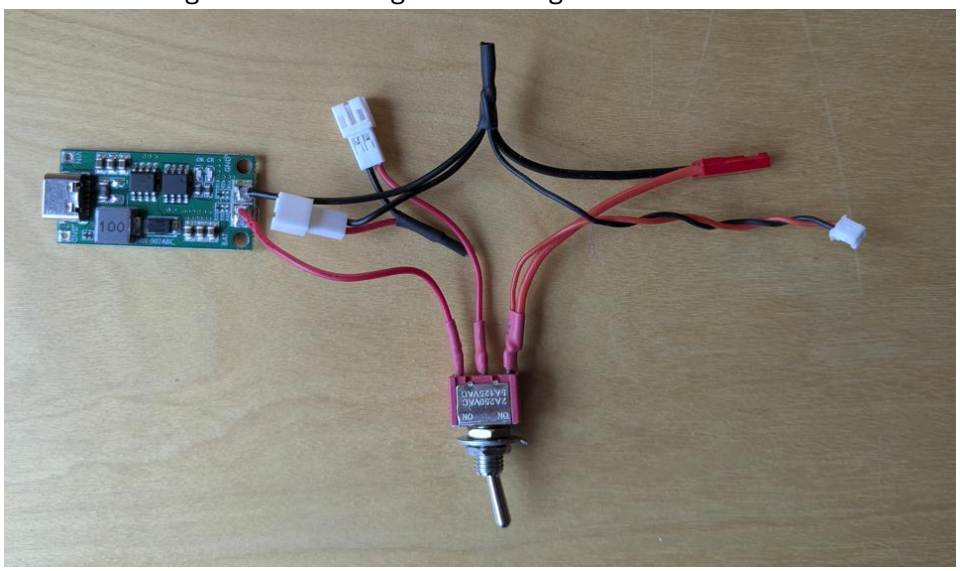




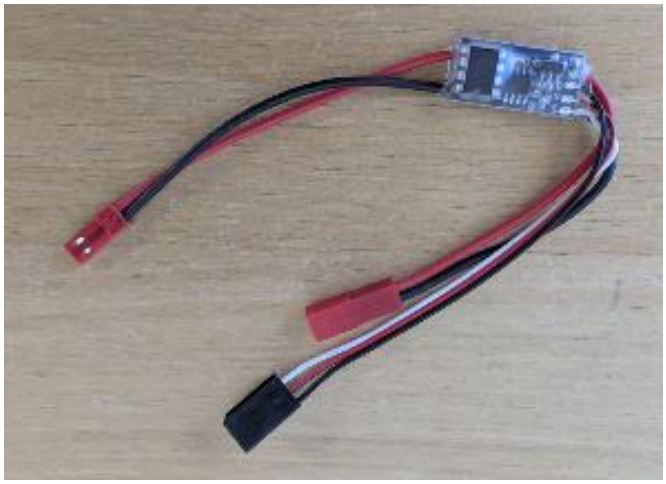
3. Hand-held radio control transmitter, boxed with manual, charging lead and wrist cord.


4. Radio control receiver with attached short aerial lead.

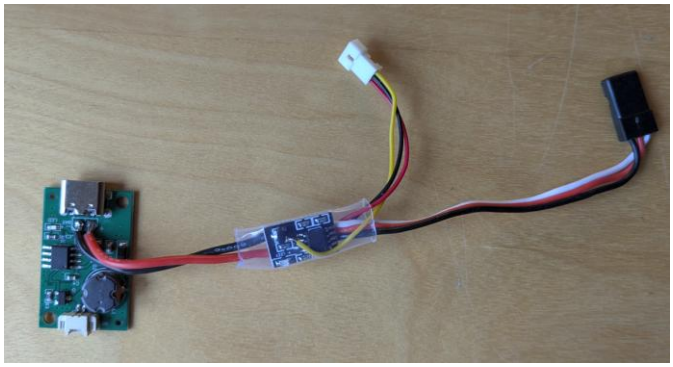
5. Charging board, power switch and battery connections. The two white connectors on the left go to the batteries. The red connector goes to the Electronic Speed Controller. The small white plug on the twisted wires goes to the voltage monitoring socket on the receiver.



6. Electronic speed controller. The black three-way Futaba connector plugs into the radio control receiver on channel 2. The red two-way socket at the same end as the three-way connector goes via the switch to the batteries; the other red two-way connector goes to the motor.

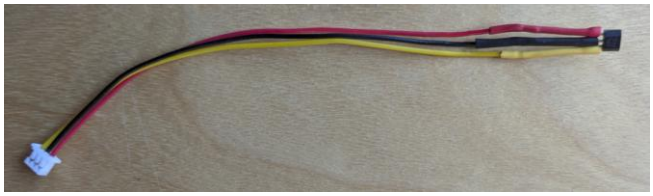


7. Radio control switch and ultrasonic control board. The black Futaba connector goes to Channel 5 of the receiver. The white connector flying 3-wire connector goes to the Hall effect sensor. The grey socket on the board is the connector for the nebuliser disk

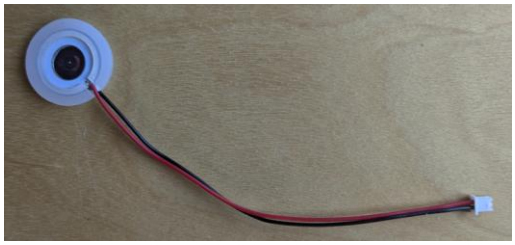


8. Flickering firebox LED with Futaba connector

9. Hall effect sensor to control ‘smoke’ puffs



10. Nebuliser disc and connecting lead



11. Nebuliser wick

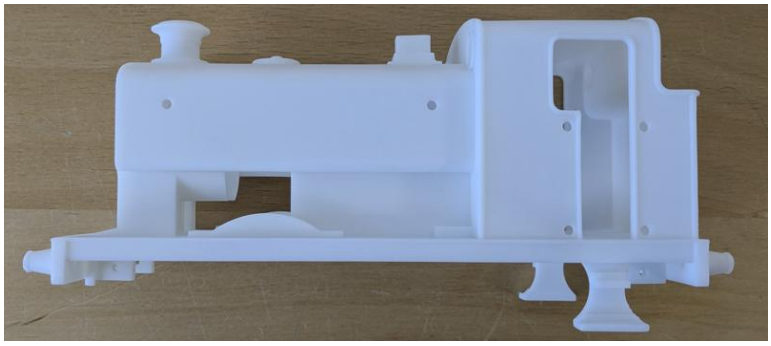
Gearbox

12. Printed nylon sprue with gearbox components

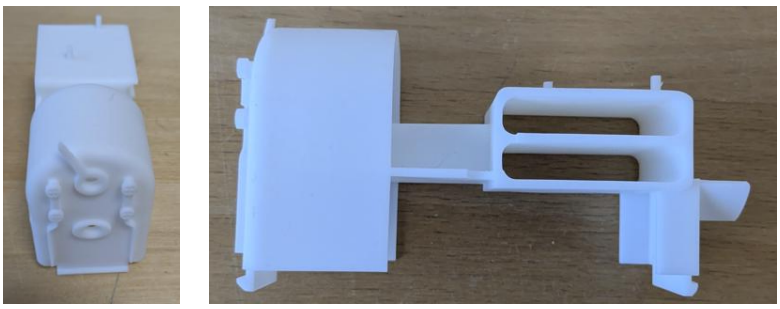
13. Two 5mm diameter axles, two 3mm diameter axles and one RZ-3 crown wheel bearing

Body and chassis

14. Printed body in white resin



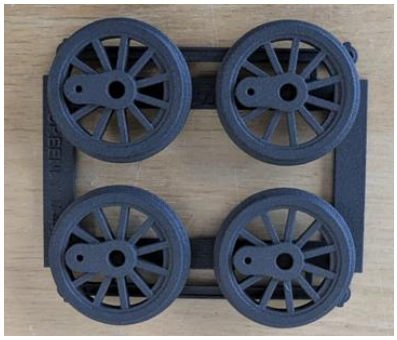
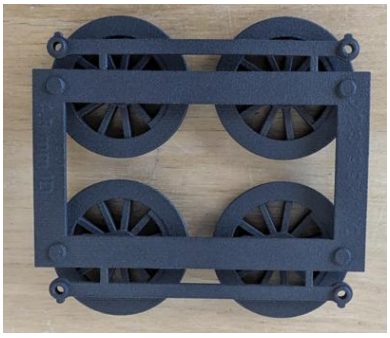
15. Printed backhead and electronics carrier in white resin



16. Printed black nylon chassis

17. Printed black nylon smoke generator and firebox door

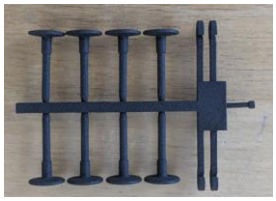
18. Printed nylon sprue with wheels and coupling rods

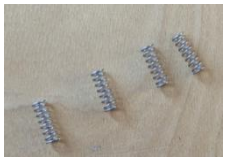
19. Printed nylon sprue with axle boxes and handrail knobs

20. Printed nylon sprue with further handrail knobs

21. Printed nylon sprue with buffers and coupling hooks



22. Four 2.5mm inside diameter buffer springs



23. One length (or four 10mm long cut pieces) of 2mm outside diameter spring for suspension

24. Two pieces of clock chain for three-link couplings

25. Four M2.5 8mm round head hex socket crankpins (coupling rod screws) with hex key

26. Four M2.5 buffer retaining nuts

27. Two M2.6 motor mounting screws

28. Four M3 slot head body fixing screws

29. Two 2mm diameter by 3mm Neodymium magnets

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30. (Optional – not supplied) M2.5 by 6mm charging board fixing screw

 (

31. Optional – not supplied) Two 2.5mm diameter by 4mm grub screws for final drive gear

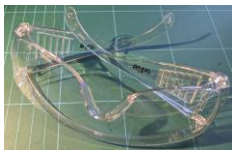
32. (Optional – not supplied) Steel or brass 1-2mm rod for hand rails

33. (Optional – not supplied) 180g of self-adhesive tyre balance weights for ballast

4: Collect tools

1. A cutting mat to protect your work surface

2. Safety glasses, particularly when cutting parts from sprues as they can fly off at speed



3. A 3mm slotted head screwdriver and a size 00 Philips driver

4. A robust craft knife, preferably with a retractable blade

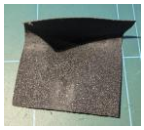
5. A small electric drill or rotary tool - I prefer the trigger operated style of electric drill as it gives me more control when I am opening out holes in plastic.


6. *Sharp* 2mm, 3mm and 5mm drill bits

7. Substantial side cutters for removing parts from sprues. I use a Xuron 2175 track cutter

8. A vice, to press wheels on with

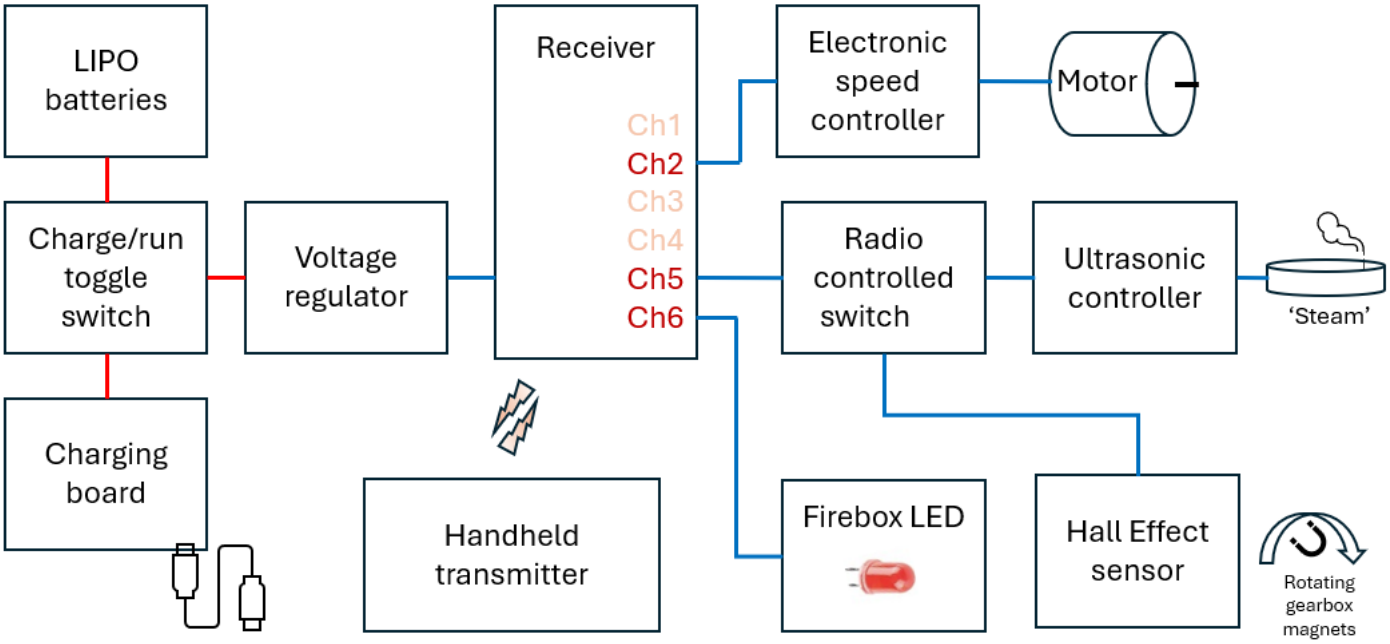
9. Some emery paper or a small file to take the edge off of the pre-cut axles




10. A digital caliper may be useful to ensure that the right size screws are being used

5: Understand the electronic blocks

This is a block diagram showing the electronic components and their interconnections.



Power

Power is supplied by two protected LIPO batteries wired in series to produce a nominal 7.4V supply. A charging board allows a USB-C power supply to be connected to the batteries, and a toggle switch selects between charging and run modes. When not in use, the switch is left in the 'charge' position to avoid battery drain. A full charge should allow several hours of loco operation depending on load. The unregulated 7.4V supply is regulated down to 5V. (In detail, the voltage regulator is physically on the Electronic Speed Controller board but we have shown them separately here as they are indepdendent functions.)

Radio control

The radio control system is based around the commercial HOT-RC DS600 radio control system which provides a cost-effective hand-held transmitter and receiver. The transmitter may be used with multiple receivers, but only one may be switched on at a time.

Importantly, the controller provides 'cruise control' - pressing the button underneath causes the system to maintain that speed without needing joystick inputs: just what we need for continuous running.

The transmitter has its own USB-C charging port; a full charge should give around 15 hours of transmitter operation.

The system provides six independent channels, three of which are in use in this loco. The joystick on the handheld controller sends a proportional signal to channel 1 for left/right motion and channel 2 for up/down motion. We only want to control motor speed, and use channel 2 so that up and down movement of the stick controls the engine's speed.

Channels 3-6 are on/off only, controlled by the four buttons arranged in a diamond on the controller. Channel 5 (the leftmost button) switches the smoke generator on and off. The other buttons are not presently used. Channel 6 on the receiver is used simply to supply power to the flickering firebox LED.

The system also has a single 'telemetry' back channel, which allows the transmitter to display the received signal strength and battery voltage at the receiver. If the receiver voltage approaches 7V, then it is time to put the loco on charge.

Motor control

The motor speed and direction are controlled by an Electronic Speed Controller (ESC), which is a standard piece of radio control equipment that plugs into the receiver and converts proportional inputs at the transmitter into a DC voltage that drives the motor. The ESC has a three-wire connector called a Futaba connector that plugs directly into channel 2 of the receiver. It has a two-wire connection to the battery power, and a two-wire connection to the motor.

'Smoke' generator

The 'smoke' is really just a fine mist of water droplets, created by shaking a metal disk up and down at 108kHZ. A water tank under the disk and a wick are used to provide a supply of water to the mist generator. Left to itself, the ultrasonic controller board will excite the disk continuously, but we use a radio-controlled electronic switch connected to channel 5 to modulate the power supply to the ultrasonic board, and thus the output of 'steam'.

The electronic switch only powers the ultrasonics if (i) channel 5 is switched on *and* (ii) the Hall effect sensor does not detect a nearby magnet. The locomotive gearbox contains a wheel with two embedded magnets that rotate with the main drive axle, giving two pulses per revolution which then switch off the smoke generator for two quarters of each revolution, creating a 'puffing smoke' effect synchronised to the wheels. At moderate and high speed, the puffs will merge into a continuous stream.

Firebox LED

Orange light emitting diodes (LEDs) are available which have a built-in flicker. Simply by connecting one to the channel 6 power rail we create a firebox glow effect in the cab.

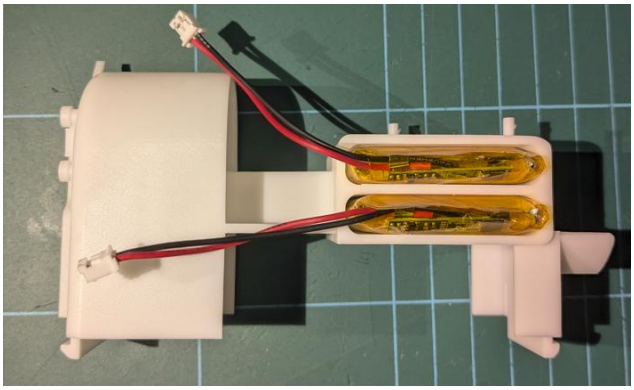
6: Initial physical battery check

LiPo batteries are remarkable devices but must be treated with respect. They must not be over-charged or over-discharged. Fortunately, the supplied batteries come with a small built-in circuit board which protects the cell against over- and under-voltage conditions. They come already partially charged so if your batteries are not showing any charge at all then they are duds and should be replaced.

Warning: Do not at this stage connect the flying leads for the batteries to avoid an accidental short circuit.

It is very important that the batteries are not physically damaged or swollen. Puncturing a cell can cause it to catch fire. The best way to check that the pouch cells are in good physical condition is to slot them into the backhead electronics carrier. The batteries should be an easy loose fit. If they are bloated and have to be forced in, then they should be replaced.

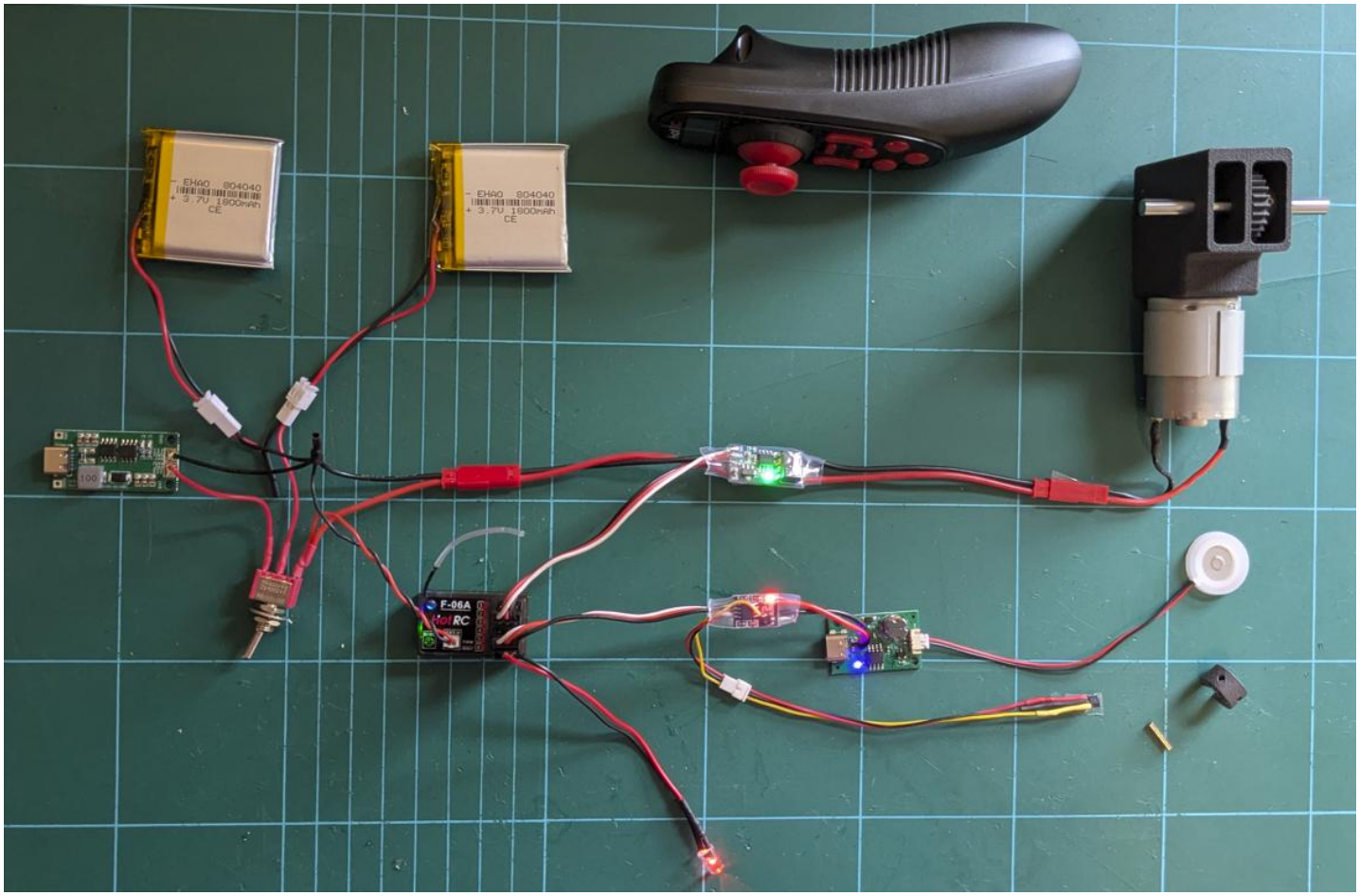
Warning: Do not use swollen batteries.

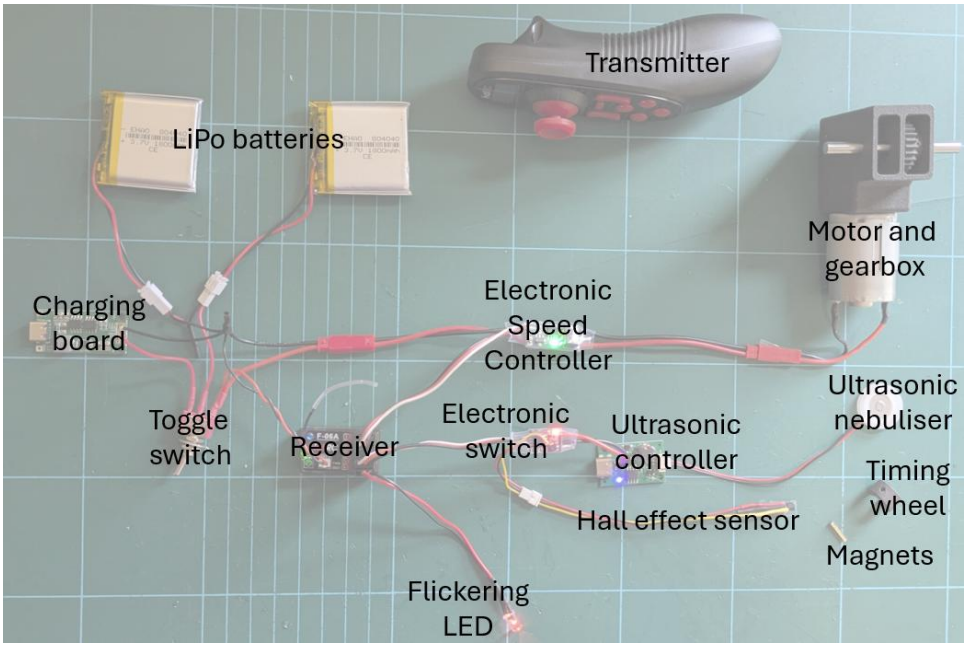


7: Bench test the electronics

The kit usually comes with pre-wired electronics ready to be plugged together as shown below.

If you have a Type C kit and are soldering the wiring yourself, then go through Appendix A before proceeding with this section.





Make sure that you carefully follow the picture to ensure everything is properly connected.

You may find it useful to zoom into the picture to get a closer look at the connections.

Note that there are two sets of 2-pin JST connectors wired to the Electronic Speed Controller (ESC) The socket goes to the switch for battery power; the plug goes to the motor.

The ESC connects to channel 2, the ultrasonics to channel 5 and the LED to channel 6

Please also view this video to see the electronics in action: https://www.youtube.com/watch?v=Tb0P4ghVhkU

You can test the electronics with the motor loose on the bench, or after assembling the motor into the gearbox as described in Section 9.

Once you have everything connected, make sure that the transmitter is switched off, and then switch on the receiver with the toggle switch. Just as in the picture above, you should see a continuous blue light on the receiver and a green light flashing on the receiver at approximately 1Hz. You should also see the firebox LED glow orange with occasional changes in brightness, and the green light on the Electronic Speed Controller should flash with a double beat.

Now switch on the transmitter using the small central button immediately below the joystick. The transmitter will play a short ascending tune, and the flashing green lights on both the receiver and the ESC should stop flashing and stay on continuously.

If this change in the green lights does not happen then you need to 'bind' the receiver to the transmitter so that they recognise each other.

Binding the receiver to the transmitter

Binding is performed by starting both the receiver and the transmitter in a special mode by holding down buttons as they are switched on. The receiver has a button labelled Bind just below the antenna connection, and the transmitter has a large red button underneath labelled OK. We call this the cruise control button.

Switch off both the receiver and the transmitter. Now hold the Bind button on the receiver down and switch on with the toggle switch. The green light will flash rapidly to indicate that it is listening for a new transmitter. Now, whilst pressing the cruise control button underneath the transmitter, switch the transmitter on.

The transmitter will play its rising tune, and then beep repeatedly. Press the cruise control button again and the beeping will stop, the receiver blue light will go out, and the receiver green light will stop flashing. You have now bound the receiver and the transmitter.

You only need to do this once: the receiver will remember which transmitter it 'belongs' to. If you have more than one engine, you can bind them both to the same transmitter, but you will only be able to use one at a time.

Testing the motor and setting the zero point

Switch on the transmitter and receiver. You should now be able to run the motor forwards and backwards using the joystick. If the motor hums or turns when the stick is at its central 'off' position, use the trim rocker buttons on the transmitter to set a zero point.

Using the cruise control

Set the motor running by pushing the joystick and then press the cruise control button (underneath the handset) and release the joystick. The motor should continue to run at the same speed, which is very helpful when running on a continuous loop. To exit cruise control mode and regain manual control of the motor, press the cruise control button again.

Telemetry

Check the voltage display on the transmitter to ensure that the telemetry connection is working. When fully charged it will show around 8V, reducing to around 7V when the battery is nearly flat.

Charging

Once you have the motor turning under the control of the transmitter you can test the charging board. Turn off the loco with the toggle switch. The batteries are now connected to the charging board and will begin charging when you connect a USB-C charger. During charging, the charger board will show a red LED which turns blue when the battery is fully charged. A full charge takes 4-5 hours, which will then run the engine for several hours depending on load.

The transmitter handset has its own USB-C charging socket. There is an internal LED which you can just about see through the casing near the charging socket which glows red when charging. A full charge should give around 15 hours of transmitter operation

Ultrasonics and timing wheel

The ultrasonic control board is switched on and off by radio channel 5. A blue light will glow on the ultrasonic board when it is on.

Check that the ultrasonic nebuliser is working by putting a couple of drops of water on to it and pressing the channel 5 button on the transmitter. The blue light should come on, and the water on the nubuliser disk should dissipate in a cloud of very fine droplets that look like steam (but are cold!)

Warning: we strongly recommend that you use distilled water in the nebuliser tank. The disk has microscopic perforations to draw the water through from a wick underneath and evaporation of hard water will leave a deposit that eventually blocks these.

Now test the Hall Effect sensor. The sensitive face is the one with the printing on it. Bring one end of one of the magnets up to it and watch the blue light on the ultrasonic control board – it should go out. If it does not, turn the magnet round and try the other end.

The end of the magnet that successfully turns the blue light off is the 'hot' end. The other end is the cold end.

The magnets fit into this timing wheel which you will find on the end of the gearbox sprue. The wheel has four magnet holes at 90 degree intervals. Steam locomotive cylinders are double acting; each cylinder produces two exhaust puffs per revolution and so a twin cylinder engine produces four puffs per revolution; hence the four magnet holes.

In practice, the puffs merge into each other at speed, so only put two magnets in on opposite sides of the wheel. Push the cold end into the wheel and leave about 1mm of the hot end exposed. A flat bladed steel screwdriver will pick up the magnet and makes a useful pushing tool.

Set the timing wheel aside for now. At the end of the gearbox build in Section 9, the wheel will be clipped onto the final drive axle.

8: Clean up and de-sprue printed parts

We need to separate the individual metal and 3D printed plastic parts, remove flashing and ensure holes are correctly sized.

Prepare axles

The axles need their sharp corners removed so as not to tear the plastic parts when they are pressed on. This can be done by spinning the axle in a drill with the end against a piece of emery paper, or by careful work with a file.

Wear a glove! The axle and emery paper will get hot as you spin the axle.

Cut springs

If not supplied already formed, cut four 10mm lengths of the 2mm outside diameter spring for the axle boxes, and our 15mm lengths of the 2.5mm inside diameter spring for the buffers. It is a good idea to cut the spring inside a plastic bag – the pieces tend to fly off and hide in dark corners. Wear safety glasses.

Cleaning out and sizing holes

The 3d printing process is quite low tolerance so most of the printed parts have holes which are deliberately undersized and thus need opening out. The nylon material has a tendency to smear and tear, so rather than using a proper reamer we recommend drilling out the holes with a *sharp* drill bit. It is best to do this whilst the components are still on the sprue to make them easier to handle, but it can be done with care after de-spruing.

Clean up axle boxes

Before removing the axle boxes from the sprue, clean up the holes using a sharp 5mm drill.

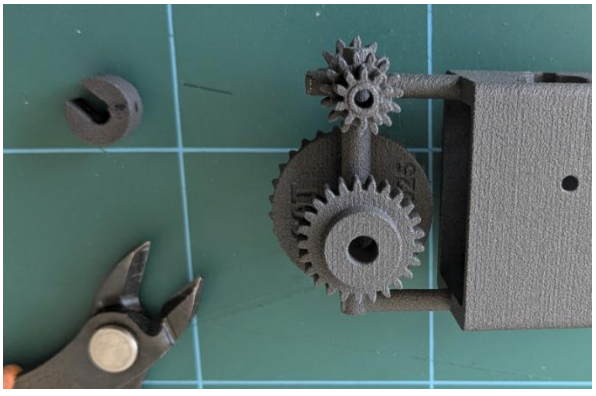
After you have drilled them out, insert one of the **5mm** diameter axles and ensure that the axle boxes are a loose running fit – there should be no binding at all: any stiffness in the axle boxes will severely impact the performance of the engine.

If you put a box on an axle and flick the box it should spin freely. If does not, work the drill bit back and forth a few times to open out the hole.

Clean up gear box components

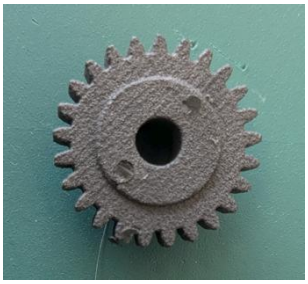
The crown gear and the idler gear also need to spin freely on their smaller **3mm** diameter axles. Open their holes out in the same way, using a 3mm bit, and use the 'flick test' to confirm that they are free running. If they are not, work the drill bit back and forth a few times to open out the hole.

De-sprue



Now cut all items from the sprues using robust side cutters.

Warning: you will now have a lot of loose parts: don't lose them!



Carefully trim the stubs of sprue from the gears and wheels to give a smooth surface, otherwise parts may bind against the framing.

Shorten the idler gear

The idler gear as printed is a little overlength. Trim the **smaller** gear end with a craft knife until the gear slides freely between the narrow walls of the gearbox.

You do not need to remove much material, so at each step just pare off a sliver of plastic and check the fit.

Clear the Hall effect cutout

There is a trapezoidal cutout in the gearbox. Open it out until the Hall effect sensor just passes through.

Clear the buffer stocks

The supplied buffers can be glued permanently in place, but the engine is designed to have sprung buffers. If you want to use the buffer springs, you will need to open out the buffer stocks to allow the buffers to slide freely. Use a sharp 4mm drill bit and test for free movement, running the bit back and forth as necessary. Do not open out more than you need to as the stock needs to contain the spring. The final diameter needs to be less than the diameter of the spring, but greater than the diameter of the buffer shank.

Starting the crank pins

The coupling rods are mounted onto the wheels with crank pins which are the 8mm round head hex socket shown in Item 30 of the parts list. They self-tap into the wheels and must be driven in square so that the rods do not bind.

This can be quite difficult to do accurately when the wheels are on their axles: it is best to start the threading at this stage with the wheels flat on the mat. Do not drive them all the way in: just screw them in for a few turns and check from all angles that the crankpins are square to the wheels. Then unscrew the pins and set them to one side.

The crank pins are supplied with a small Allen key, but I found it quite hard to apply the necessary pressure to get the screw to dig in and bite the nylon when starting the thread. Instead, I used a subminiature hex bit driver as shown.

Clear the coupling rod holes

Ensure that the coupling rods spin freely on the dome headed hex key crank pins (item 25).

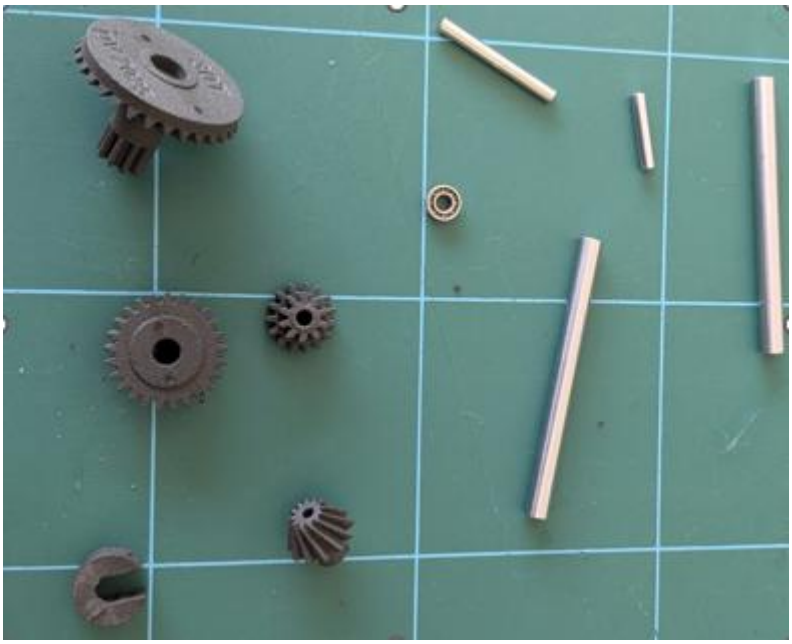
Clear the switch hole

Ensure that the switch passes easily through the back head upper hole, and open out with a 3mm drill if necessary.

Clear the charging socket cutout

As supplied, the charger board is a little tight fitting into the firebox. Clear the inside of the opening in the firebox corner with a sharp knife so that it slides in as a tight fit.

9: Assemble the gearbox



Here are the gearbox components laid out prior to assembly.

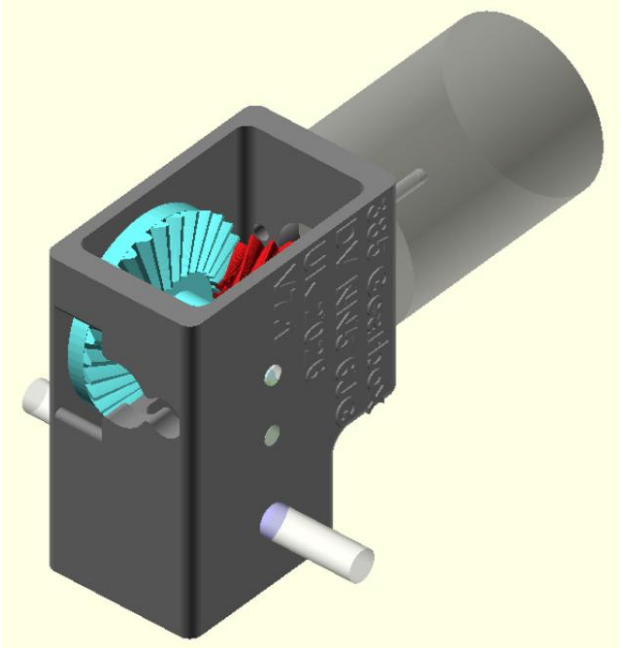
Note that the idler gear and the crown wheel rotate freely on their fixed axles but the motor bevel pinion, final drive gear, timing wheel and driven wheels are rigidly fixed to their axles which themselves rotate.

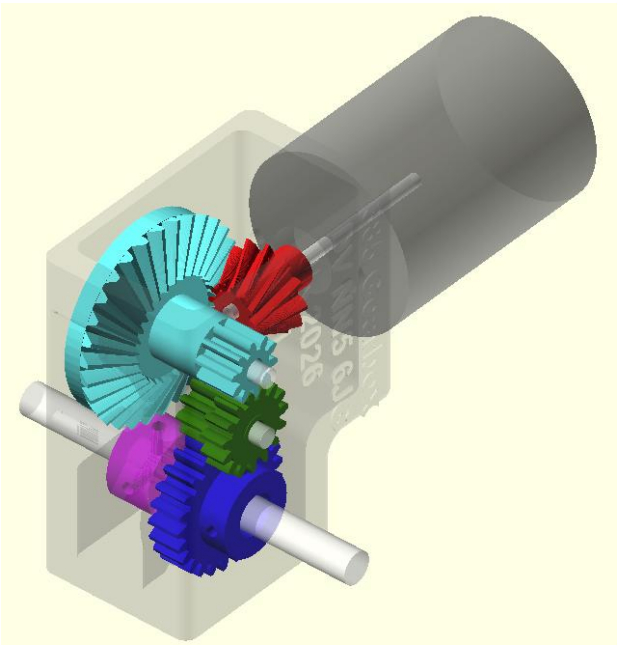
Gearbox assembly sequence

The elements of the gearbox should be assembled in this sequence:

1. Motor
2. Motor bevel pinion
3. Idler gear
4. Crown wheel
5. Final drive gear
6. Timing wheel with magnets

The completed box looks like this:

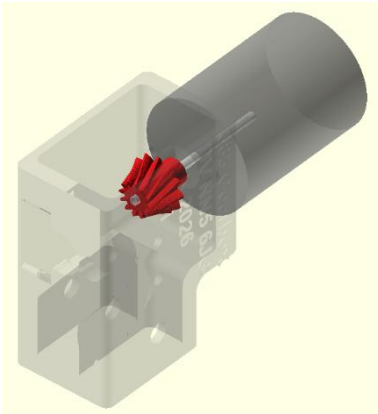




G1: Attach the motor to the gearbox frame

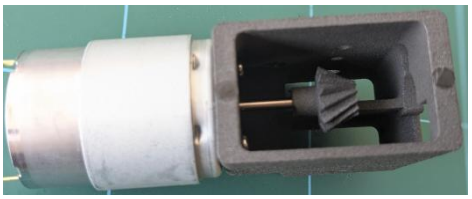
Begin by attaching the motor to the gearbox frame using the M2.6 screws. A magnetized screwdriver is a great help.

G2: Motor bevel pinion



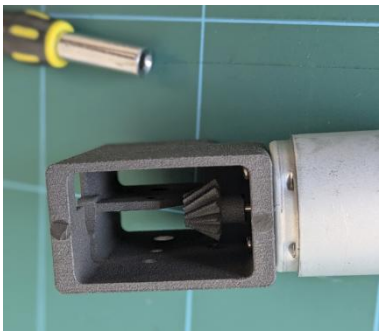
The motor bevel pinion is an interference fit, and some force may be needed to get the pinion onto shaft.

I start the process by sliding the pinion onto the shaft by down a few mm which I can do with hand pressure.



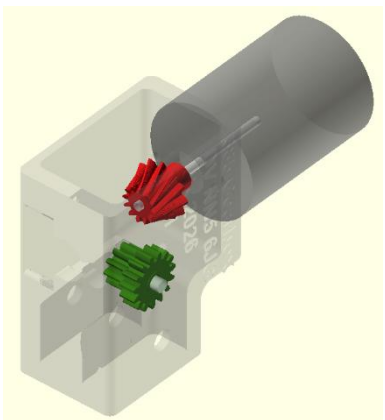
Warning: There is a danger that the motor internals might be damaged if you force the pinion on whilst holding the motor body. Instead, stand the motor up on a solid surface so that the end of the shaft is supported, and push the pinion on with force being transmitted through the shaft to the surface and not though the body of the motor.

I used a my subminiature hex-bit driver (without a bit) as a pusher.



It is a good idea to reconnect the motor to the electronics after fitting the pinion to make sure everything is still working correctly before proceeding.

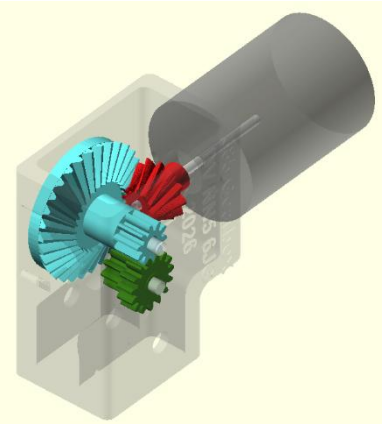
G3: Idler gear



Ensure that you have trimmed the smaller gear end with a craft knife until the gear slides freely between the narrow walls of the gearbox. Ensure that the idler spins freely (but without wobbling) on a 3mm axle. Open the bore out with a drill as necessary.

Slide the idler gear into the box, making sure that the **larger** gear is against the external wall of the gearbox and the bore is aligned with the sidewall holes, and then push the axle through. Support the inner frame with a small block of wood to prevent bowing as the shaft is inserted.

G4: Crown wheel

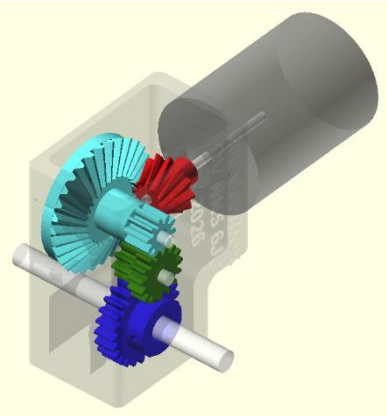


Ensure that the crown wheel rotates freely on a 3mm axle. Snap the ball race bearing into the base of the crown wheel and align the wheel with the axle holes in the gearbox housing. The crown wheel should engage with the motor pinion and the idler gear.

Insert the axle from the side of the gearbox away from the bearing. I found it helpful to put the box down on the cutting mat on its side (crown wheel down) and gently tap the axle down the last few mm to seat it in the wall of the gearbox. You might prefer to use a vice.

Check the alignment of the motor pinion by manually turning the crown wheel and then running the motor under power. Ideally the pinion should mesh tightly with the crown wheel, but not so tightly as to cause binding: there should be a small amount of backlash. Adjust the alignment by slight movements of the motor pinion up and down the motor shaft – a pair of long nosed pliers or a flat blade screwdriver will help.

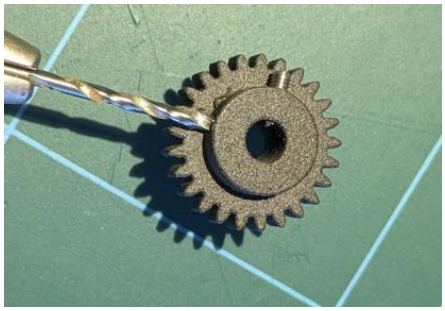
G5: Final drive gear



The final drive gear is an interference fit onto the 5mm main axle. As before, I put the gearbox crown-wheel down onto the cutting mat and drove the axle through the final drive gear and gearbox wheel with gentle taps from a small hammer. You might prefer to use a vice.

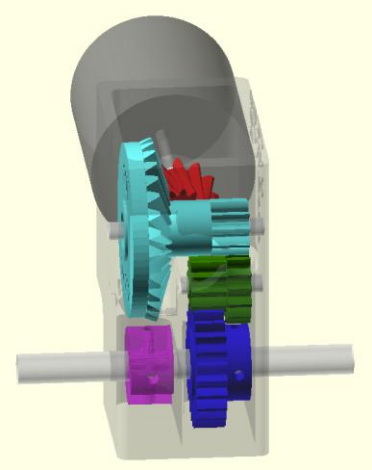
Warning: The drive gear must be a tight fit on the axle since this carries drive between the motor and the wheels.

There are holes for M2.5 grub screws if your gear is loose; drill out the holes to 2mm and carefully drive the screw in – it will self-tap.



Alternatively, put a drop of super glue down the hole and rotate the axle through the gear to spread the superglue round the inside of the glue. **Only do this after the wheels have been fitted** since once glued you will not be able to adjust the position of the gear on the axle.

G6: Timing wheel



The timing wheel has four holes each of which is a push fit for the magnets (item 34 in the Section 3 parts list). The polarity of the magnets matters. During the electronics bench test you will have identified the 'hot' end and have fitted the magnets correctly.

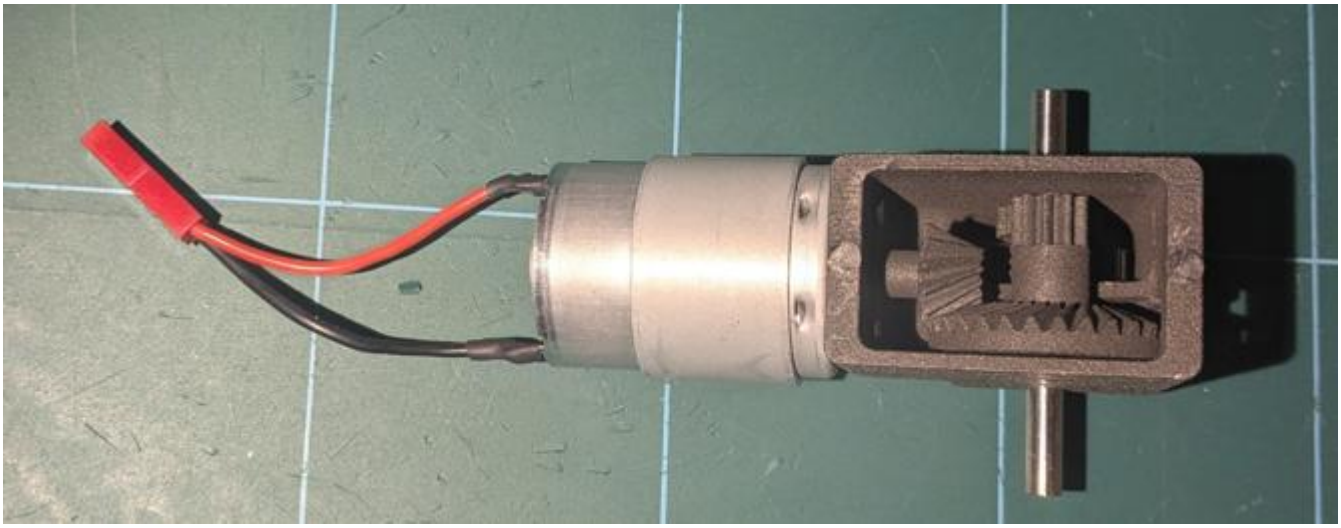
In practice, only two magnets should be fitted, otherwise the gap between them is too small. Even with only two, the puffing effect is best observed at low speed.

The wheel then just clips onto the 5mm axle in the cavity in front of the crown wheel.

Running in

Run the gearbox on the bench for a while to get everything bedded in, then check alignments.

Warning: The 3mm crown wheel axle and the 3mm idler axle should be gripped by the walls of the gearbox and should not turn. If the axles do rotate, then they will eventually work their way out. The gears would then come out of alignment and probably be damaged. After running in, if you see that they are moving, then let a couple of drops of superglue seep into the axle/wall interface and leave to set.



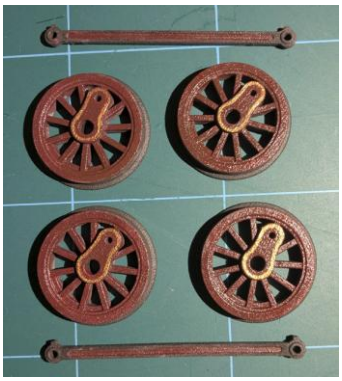
Warning: Do not be tempted to add any sort of lubricants as the nylon gears do not need them – all you will do is create a sticky dust-collecting mess.

10: Apply livery

It is best to paint and line the wheels, coupling rods, backhead and body before proceeding further. In particular, it is much easier to paint the wheels when they are flat on the bench.

The white resin body will take rattle-can paint directly, but a first coat of car body primer coat is advisable.

These examples are from Elizabeth Scott's Cadbury No. 14 engine, but as an industrial engine, a wide choice of liveries are acceptable. A GNR livery would echo the inspiration for Greenly's design. The gallery images after Section 12 might provide some inspiration.

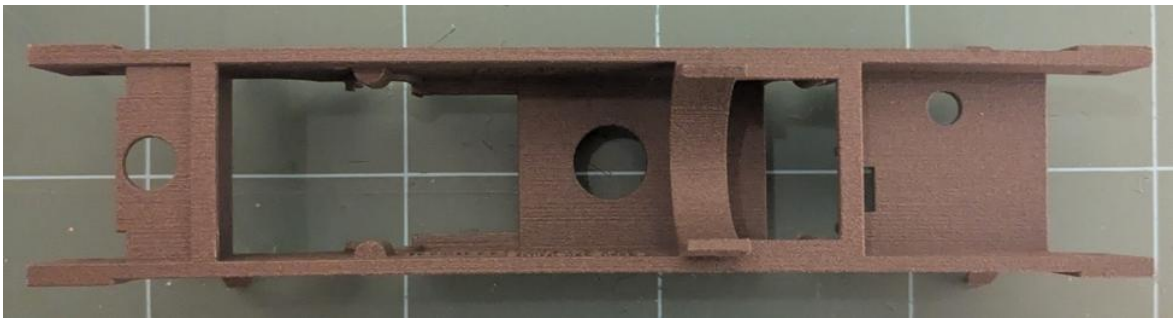


The white resin components and the firebox have been sprayed with car-body grey primer and then painted with acrylic paints. The chassis and the inside of the wheels (and rims) have been left in their native black nylon

The lettering and numbering has been done with computer-printed water-slide transfers that are then over-painted by hand to soften their edges and look good at a distance.

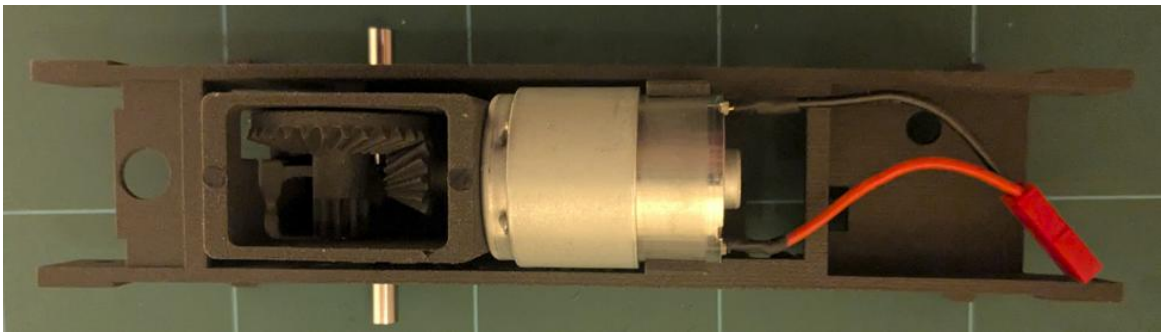
11: Press wheels and assemble the chassis

The chassis is a one-piece nylon print which includes the motor bracket.



The chassis clips together in an ingenious way: the motor goes into the round bracket on top, and the sprung axle boxes clip into the frames. Everything can be unclipped, so you can safely try a dry run before final assembly.

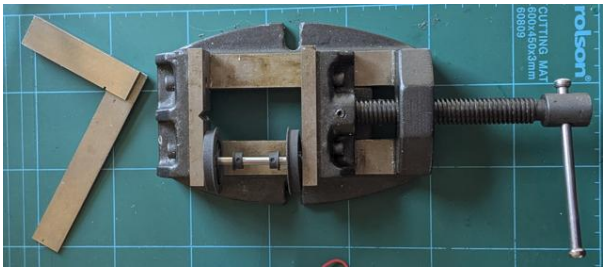
Warning: It is important to ensure that the motor is facing the correct way – like this.



Adding axle boxes and pressing on wheels

Locate the remaining 5mm axle, two wheels and two axle boxes. The axle boxes should just slide on easily because you opened them out in Section 8. If they do not spin freely, then open then out some more. The flanges on the axle boxes should on the **outside** as in this picture.

Now press on the first wheel. This requires considerable force, and the wheel needs to be set accurately at a right angle to the axle. It is easy to press the wheel on at a slight angle so you end up with a wobbly wheel.



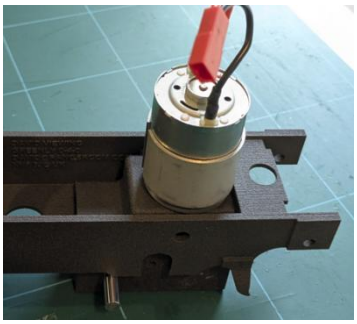
I think that the best way to do this is with a vice: do not attempt to do it by hand. The outside face of the wheel has a projection for the balance weight, and it is a good idea to put a shim under the rest of the wheel to keep it square in the vice jaws. I used a 1.5mm drill bit laid across the top of the wheel.

Check the alignments carefully and drive the axle in slowly by tightening the vice jaws, checking as you go. The end of the axle should be flush with the balance weight as shown here.

Now press on the second wheel. The left-hand wheel should *lead*: that is, it should be rotated 90 degrees ahead of the right-hand wheel. It is sufficient at this stage to align the wheels approximately by sighting through the spokes. We will fix any issues when we put the coupling rods on.

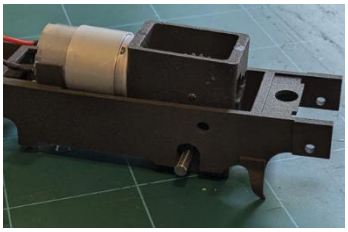
Add two axle boxes to the driven axle, flanges outside as before and then press on the final two wheels with the same 90 degree left hand lead as for the undriven axle.

Fitting the motor and gearbox assembly



Easing the motor through the frames requires some care as there are several lumps and bumps on the inside of the frame that can block the motor's passage.

Insert the top of the motor from below with the casing right up against the frame spacer that has the round hole through it.



Jiggle the motor a little and it will pass through. You can then clip the motor in.

(In this picture, I've shown the motor without wheels for clarity – by this stage you will have the wheels on.)

Fitting springs and axle boxes

First check that the spring pockets underneath the chassis are clear. The printing process sometimes leaves some powder in the bottom which may block the springs. Use an undersized drill bit to measure the depth of each hole – on my chassis they were a little over 7mm deep. If some are blocked then gently juggle the sharp end of the bit in the hole to free the compacted power. Do not drill into the chassis.

Invert the frame and drop springs into the spring pockets for the axles. Rest the undriven axle and its axle boxes on the top edge of the frame and then rotate both axle boxes until the indent for the top of the spring is facing down. Now push the assembly down – it should mate with the frame with a satisfying click, with the springs providing suspension.

If all did not go well, unclip the axle boxes from the frame and try again.

Repeat this with the driven axle, and then seat the motor properly in its clip.

Place the chassis right side up and check that all four springs are effective and nothing is rubbing by bouncing the chassis on the wheels.

Fitting the coupling rods

The coupling rods rotate on crank pins which are screwed into the wheel. Ideally, you will have already given the holes a 'start' as described in Section 8 but if you missed that step all Is not lost: you just need to be careful.

If you already have the wheels on the axles, then it still worth screwing the crank pins in for a turn or two without the coupling rods in position. Check they are going in at right angles to the wheel viewed from all sides.

Now undo the crank pins, put one connecting rod on and then screw in the crank pins so that the rods are free to move but close to the wheel.

Traditionally (but not universally) the rods should be 90 degrees out of phase with the left-hand rod (looking ahead) leading. It does not in fact affect operation if the angle is, say, 85 or 95 degrees. The critical thing is that both rods should be precisely horizontal at every position of the wheels. So-called 'crossed rods' occur when the two rods are not precisely parallel with each other, and this will cause the engine to run unevenly or completely seize up.

I recommend that you put one rod on one side and use this as a datum, measuring the height of the crank pin above the rail carefully to make sure both pins are the same height. Then on the other side of the engine ensure the driven wheel is where you want it (aprox 90 degrees before or after the first side). Then adjust the undriven wheel so that it too has a crankpin hole exactly the same height above the rail and fit the coupling rods.

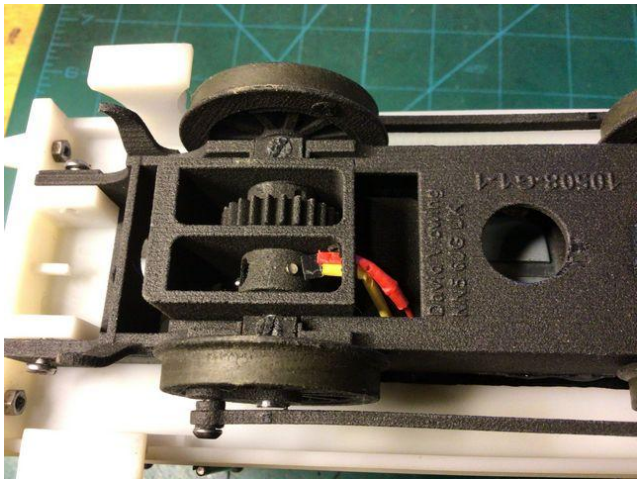
If you grip the wheels you will find that you can twist them a little on the axles to fix any alignment issues.

Rotate the driven wheels by hand to feel that nothing is binding: tweak the undriven wheel if necessary. Then put power onto the motor and ensure that there everything runs sweetly.

12: Fit the electronics and bodywork

Fit the Hall Effect sensor into the gearbox

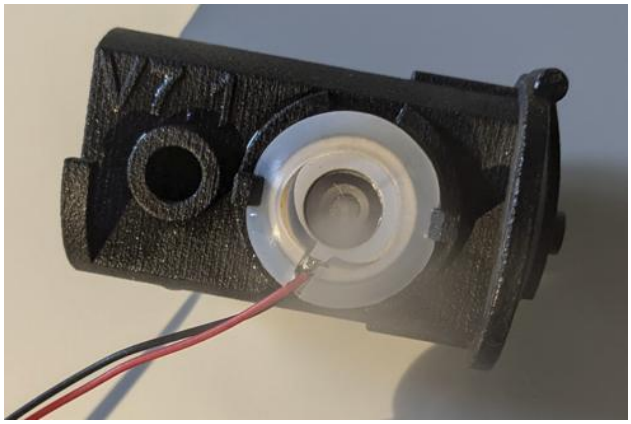
The sensor can be inserted in the bottom flange of the gearbox shell. The trapezoidal cutout will need little easing with a sharp knife and provided this is not overdone the insulation will hold the sensor in place. Insert the sensor chamfered (and lettered) face down, facing the rotating magnets and as close as practicable without them hitting.



Feed the wiring up through the chassis and round the motor.

Fit the nebuliser disc into the smokebox unit

Cut a 21mm length of nebuliser wick so that, when inserted vertically, the wick will touch the base of he nebuliser disk. Insert into the tank.



The nebuliser disc clips onto the front of the smokebox. The soldered connections to the disk must be **on top**, as shown here. There is a recess pressed into the disk that must be in contact with the wick below.

Adding ballast

The engine is mostly plastic, and thus very light. There is plenty of power to pull heavy loads, but the engine needs mass to achieve the necessary adhesion and avoid wheel spin. Adding about 180g of ballast is recommended, most easily achieved by adding self-adhesive tyre balancing weights (not supplied). Alternatively, a piece of lead flashing may be folded into the tank interior.

Buffers and couplings

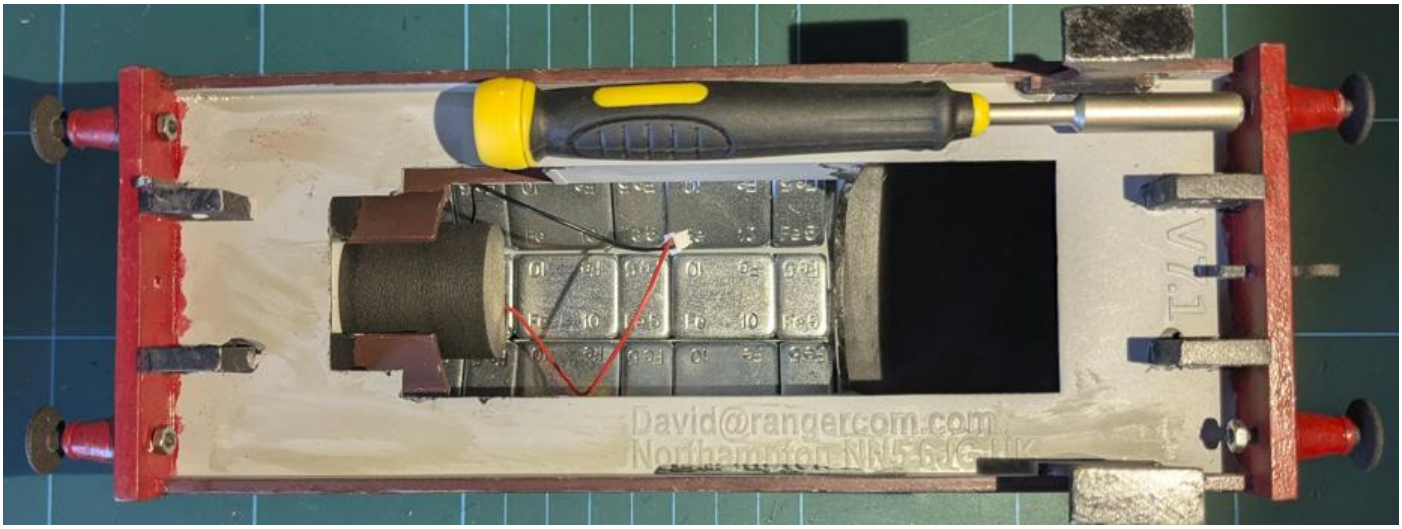
Nylon buffers and coupling hooks are supplied. The rectangular holes for the coupling hooks will need to be opened out a little with a small file to form an interference fit with the hook. It is advisable to wick some superglue into the join at the back to stop the hooks working their way out in use. Avoid putting superglue on the front of the buffer beam as it will dry to a shiny finish and spoil your paint work.

Three links of clock chain may then be added to the retaining hole in the hook.

The buffers can be glued permanently in place, or you can add the supplied springs with the buffer nuts tightened directly onto the buffer shanks.

If using sprung buffers, ensure that you have opened out the front section of the buffer shanks with a 4mm drill to allow the buffers to move freely – do not drill all the way through as a shoulder is required to contain the spring.

Put the nuts on the ends of the buffers before fitting to the chassis. I used a nut spinner to hold the nut and then turned the buffer slowly and carefully to cut a thread – I continued until there was about a 1mm projection from the back of the nut so that I could see that there was a good square thread. A drop of washing up liquid makes a good lubricant during thread cutting, though I cut mine dry.



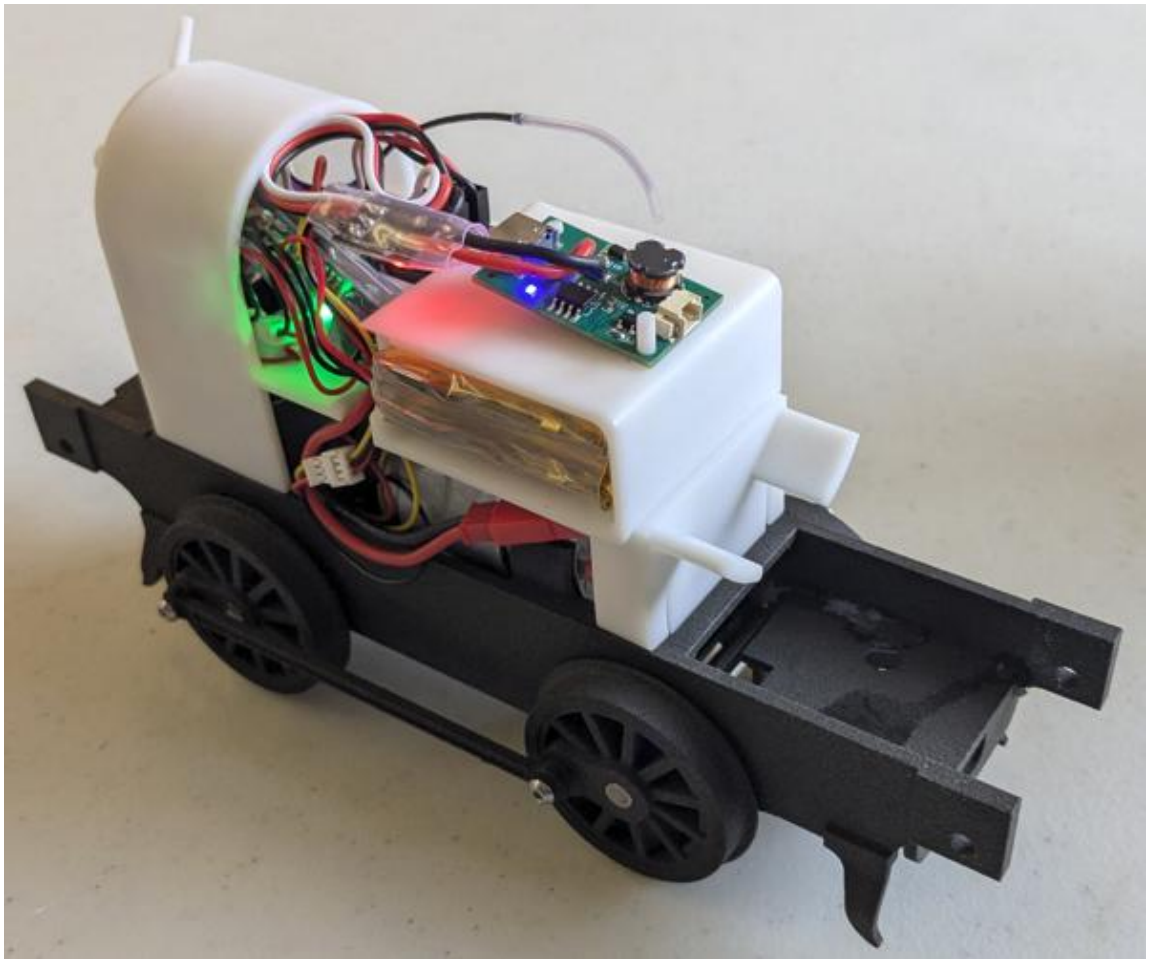
Load the backhead

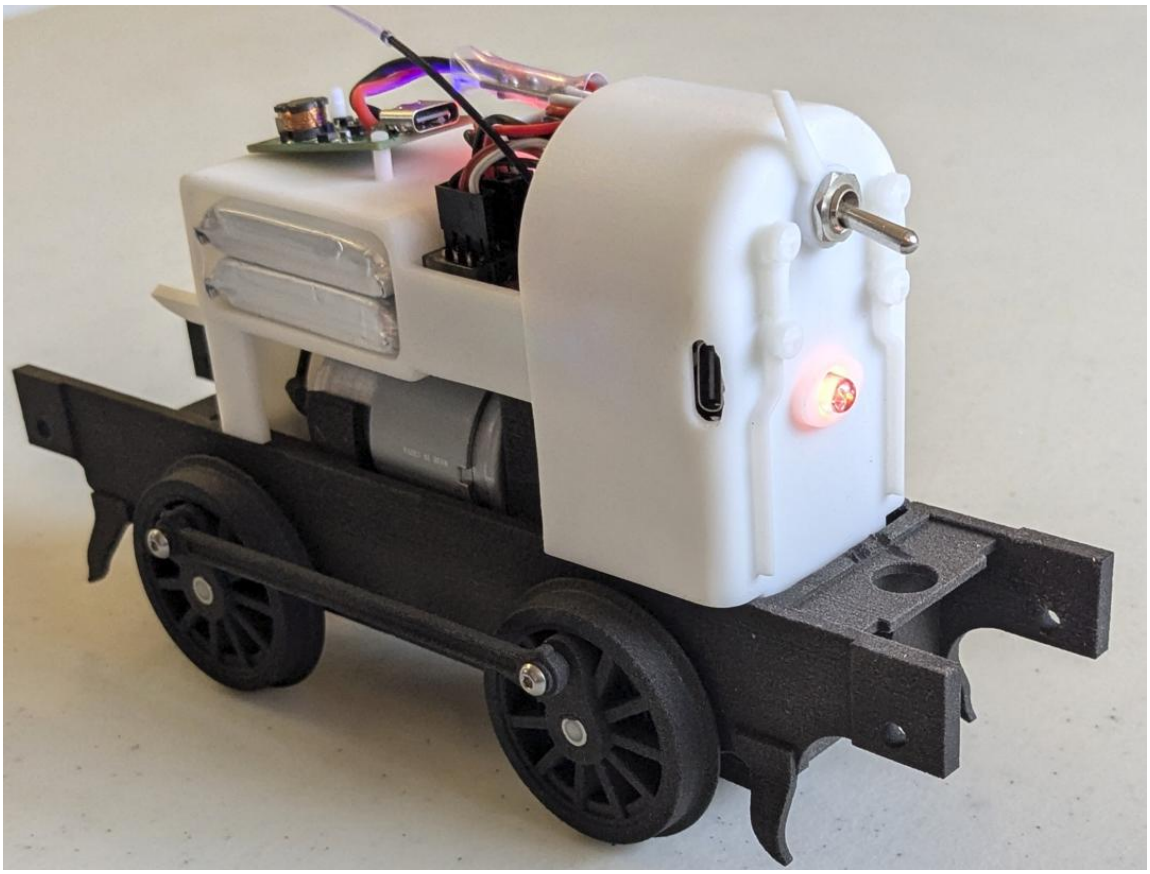
The rest of the electronics is housed in the backhead assembly – the idea being to keep everything well away from the ultrasonic water tank as water and electronics to not mix well. The two pictures on the next page show David's production prototype and give the general packaging idea; the toggle switch mounts at the top of the backhead, the charger board fits at an angle lower down in the backhead with the flickering LED just below it.

The electronic speed controller sits behind these.

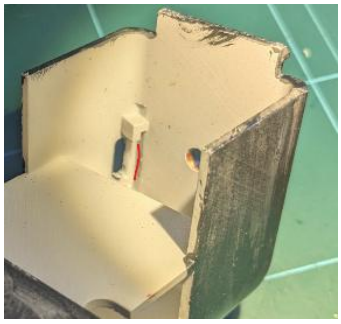
The ultrasonic control board fits onto two pegs on top of the backhead with the electronic switch immediately behind it.

Warning: be very careful of the wiring – it is easy to break wires and solder connections, especially the wires to the charging board.





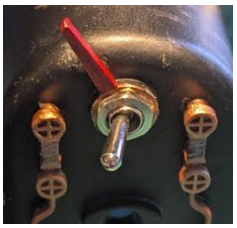
Detailed procedure for loading the backhead



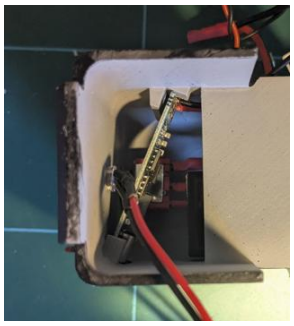
1. First do a dry run with the charging board which fits diagonally across the cavity immediately behind the backhead. It is quite a fiddly job to fit. The backhead charging slot has a lip behind it that will foul the board (highlighted in red in this picture).

   Ideally the board will just slip into the bracket around the opening, and push tightly down onto the shelf in the opposite corner. If it does not, then shave some slivers away from the lip with a craft knife from outside the charging slot. I use needle nose pliers to maneuver the board.

2. Once you have a good fit, remove the charging board.

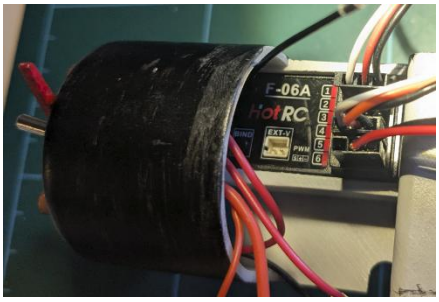


3. Install the toggle switch, I removed the washer with the tag and installed the switch with one nut and the anti-shake washer behind the backhead and one nut on the front of the backhead. I have the switch horizontal.



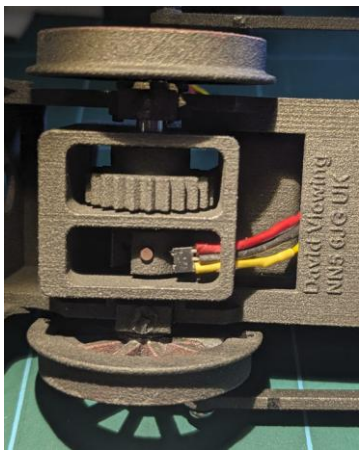
4. Install the flickering LED and flatten the wires so that they do not block the charging board.

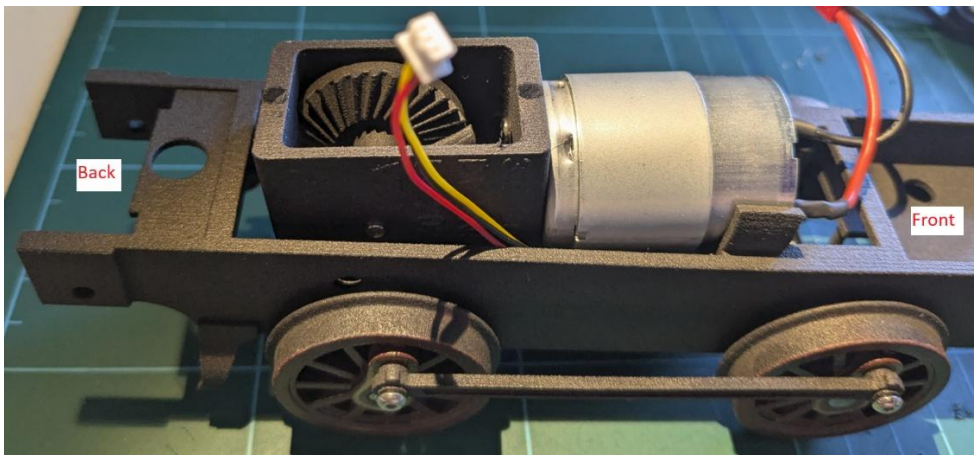
5. Do a final install of the charging board. If your board is loose, then a small screw will help secure it.



6. Now install the receiver into the open box behind the backhead and connect the three Futaba plugs to channels 2, 5 and 6.

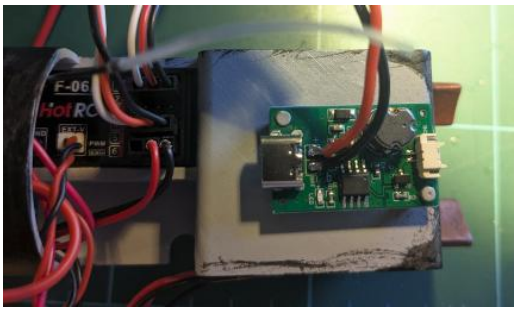
7. Install the Hall effect sensor into the gearbox and thread the wiring up through the frames.



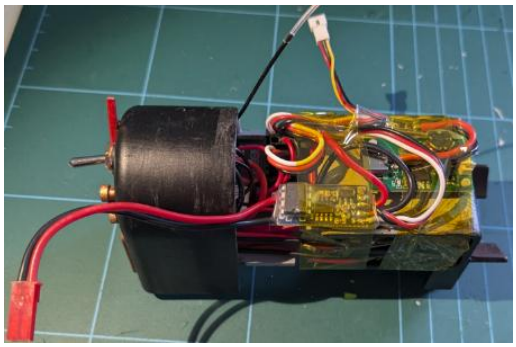


Note the front and back of the chassis – the big hole is the back (cab end).

8. Push the ultrasonic control board down onto the two pegs at the top of the backhead assembly.



9. Tidy the wiring. We suggest using a length of Kapton tape (not supplied) to keep everything in place.



10. Take the firebox water tank and thread the wires through the body. Connect the nebuliser disc wires to the ultrasonic control board.

11. Clip the backhead assembly onto the chassis, and connect the motor and Hall effect sensor wires. Ensure that they are routed via the cutout in the backhead carrier. The body is a very tight fit.

12. Lower the body onto the chassis and backhead, taking care to avoid snagging wires.

13. Test all functions before securing the body.

14. Secure the body to the chassis using four M3 slot head screws (item 28 in the parts list in Section 1).

Handrails

Handrail knobs simply push into the 12 holes in the body, and may be superglued in.

They are designed to take 2mm wires which may look a little chunky. Some builders have used 1mm or 1.2mm rodding which is closer to a scale size with a little dab of glue to keep them in place.

Gallery

David Viewing's rattle-can painted and vinyl wrapped prototypes in action at the 2025 G1MRA AGM

Steve Andrews' weathered NCB loco with added external cylinders, safety valves, bunker and spectacle bars

William Ayerst's completed engine and Roger Hopkin's Archie

Elizabeth Scott's Cadbury engine running on Mike and Christine Blands' track with Northern Finescale vans

David Viewing’s Gauge 3 prototype running on the Warton Road layout at the 2026 National Garden Rail Show

The surviving GNR J13 preserved in the National Collection

Andrew Barclay prototypes *– images courtesy of Wikpedia under terms of CC BY-SA 4.0*

The Andrew Barclay saddle tank came with various cabs and the characteristic NER-like saddle tank. See https://en.wikipedia.org/wiki/Andrew_Barclay_Sons_%26_Co.

Unlike our model, these engines had external cylinders but see Steve Andrews' model above to which he fitted some cylinders printed from a Thingiverse design.

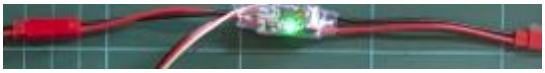
Appendix A: Soldering the Type C kit electronics

We assume that you have the necessary skills to solder electronic components.

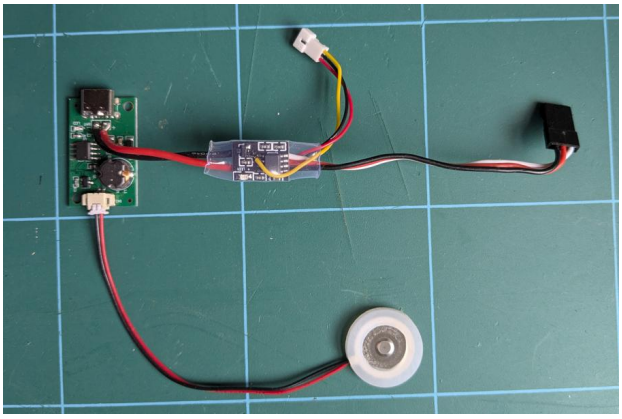
Tasks

There are six wiring tasks.

A: Modified electronic speed controller

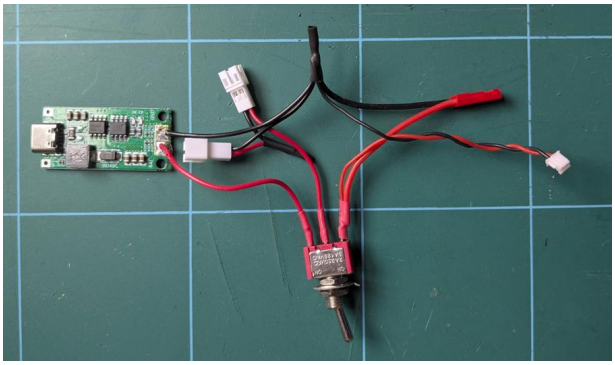


B: Modified electronic switch and ultrasonic control board

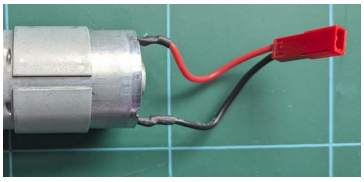


C: Hall effect sensor and plug

D: Charging board, switch and series battery connections



E Motor and socket



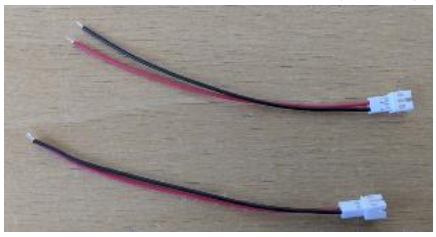
F: Flickering LED and Futaba plug

After soldering, test all functions by following the procedure in Section 7.

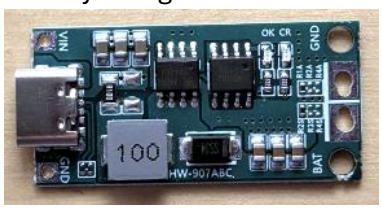
Check that you have everything

1. Two protected LIPO pouch cells.
   Warning: Treat LIPO batteries with great care! Do not puncture the pouches or short circuit the connections!

2. Two LIPO battery connectors and wires.
   Warning: do not connect batteries to leads before they are soldered up as the loose leads may touch and short circuit the battery. Keep them separate for now.



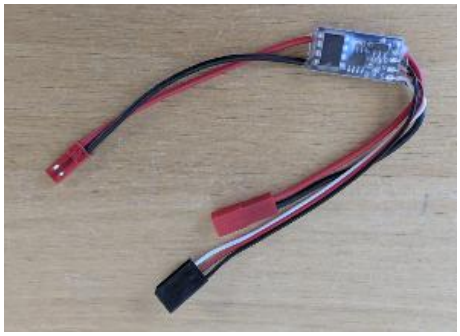
3. Battery charger board fitted with a USB-C connector.



   Warning: these boards come in several sizes. We need the 37mm long variant. See the note in the assmbly instructions.

4. A single pole, double throw (SPDT) toggle switch that connects the batteries to *either* the charger board or the electronic speed controller. When not in use, switch off by connecting to the charger board.

5. Electronic speed controller. The three-way Futaba connector plugs into the radio control receiver. The (socket) two-way connector at the same end as the three-way connector goes via the switch to the batteries; the other (plug) two-way connector goes to the motor.

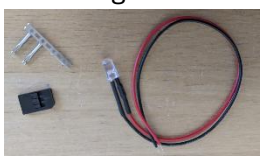


6. Motor RS-385PH-2270 or RS385PV-2270.


7. Radio control receiver with attached short aerial lead, and a telemetry lead which will allow battery levels to be sent back to the hand-held transmitter. Keep these in the box for now.

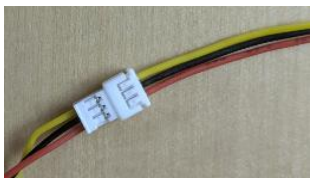
8. Hand-held radio control transmitter, boxed with manual, charging lead and wrist cord.


9. Flickering firebox LED with Futaba connector parts

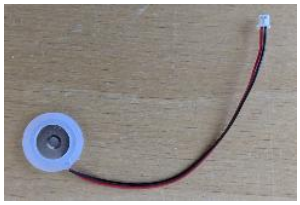


10. A3144 Hall effect sensor to control ‘smoke’ puffs

11. JST three-wire connectors for Hall effect sensor



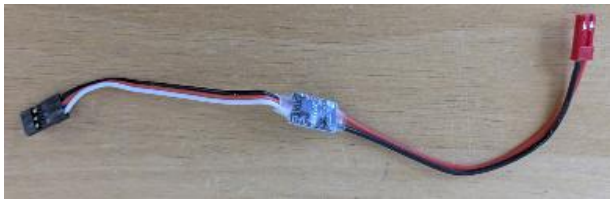
12. Ultrasonic ‘smoke’ nebuliser disc



13. Nebuliser wick

14. Ultrasonic control board – note this USB-C connector is not used


15. Radio controlled ultrasonic switch



16. JST two-wire connector leads

Collect tools

1. Small side cutters

2. Small needle nose pliers

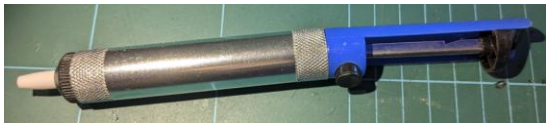
3. I find a pair of spring loaded tweezers useful for handling small components and as a heat sink

4. A wire stripper is very helpful when removing insulation from thin wires

5. A soldering iron or soldering station, and some resin-cored solder

This yellow style of iron is common, but I recommend using a temperature controlled soldering station like the one on the right.

6. Mistakes happen, so a solder sucker for undoing joints is helpful



7. For connecting to open terminals on the switch, motor and LED, 2mm inside diameter heat shrink sleeving provides insulation and mechanical support. For the Hall effect sensor, 1mm tube is needed. For re-insulating the electronic switch board, 22mm transparent tubing is needed.

8. After soldering, a hair dryer or heat gun is needed to shrink the sleeving.

9. For crimping the connector pins on the Futaba connector, a bootlace crimp tool is helpful.

10. For close up work, an Optivisor really helps. This is a real one with glass lenses; there are cheaper versions available with not-very-well moulded plastic lenses which are false economy in my view.

General advice

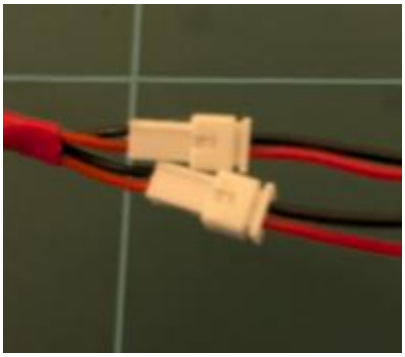
Heat shrink tubing

We strongly recommend using heat shrink tubing for all inline connections so as to provide some mechanical support for the wires and insulation against the elements – Gauge 1 tracks are rather hostile environments.

You will also need wide heat shrink sleeving to re-encapsulate the radio controlled switch after soldering.

I use 1mm inside diameter for connections to the Hall effect sensor, 2mm for connections to the motor and switch and 22mm transparent to re-insulate the electronic switch board.

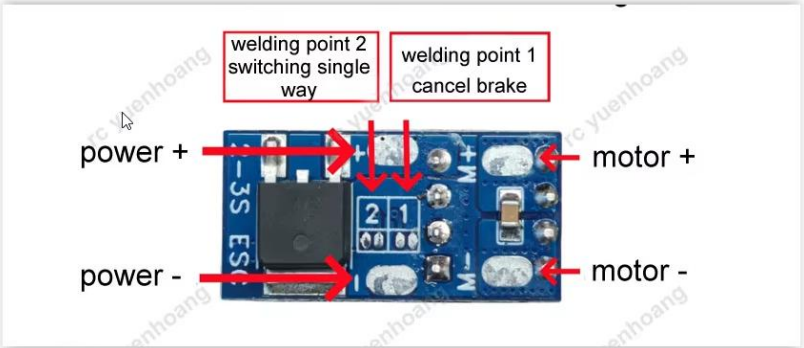
Connector polarity



Warning: the various connectors are keyed, but can have the red and black leads connected either way round depending on the supplier, which is unhelpful. To avoid nasty surprises, always connect red to red and black to black; if the connector leads do not match up, then ease the pins out of the shell and rearrange.

A: Modified electronic speed controller

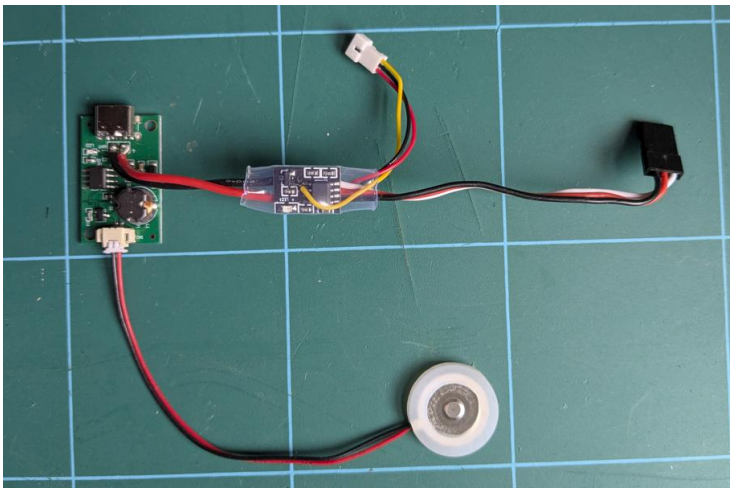
The speed controller illustrated requires two pads to be shorted with a bridge of solder or fine wire in order to disable the braking feature, which is undesirable in a locomotive! This is 'welding point 1' in the illustration below:



B: Modified electronic switch and ultrasonic control board with Hall effect socket

The radio controlled electronic switch provides power to the ultrasonic control board which can be switched on and off via channel 5 on the transmitter,

In addition, a Hall effect sensor is wired to the output transistor so that bringing a magnet up to the sensor will also cut power to the ultrasonic board; a timing wheel with magnets clipped to the final drive axle in the gearbox then provides a puffing effect.



1. Carefully remove the heat shrink covering from the electronic switch board taking care not to damage any of the components. I use side cutters to nibble through the length of the transparent heat shrink sleeve on non-component side.

2. Identify the **socket** connector on the JST-PH 1.25mm connector which will be wired to the electronic switch board.

3. The **plug** connector of the JST-PH 1.25mm connector will be wired to the Hall effect sensor.

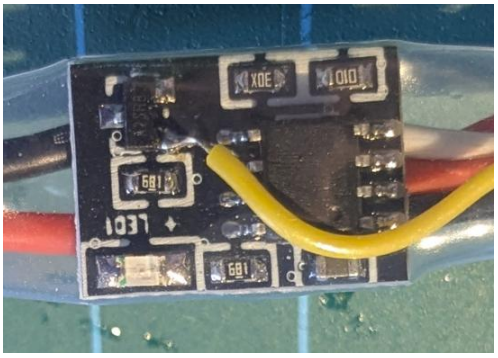
4. Cut the socket connector wires down to leave 4cm of wire for the red and black wires, and 4.3cm for the yellow wire.

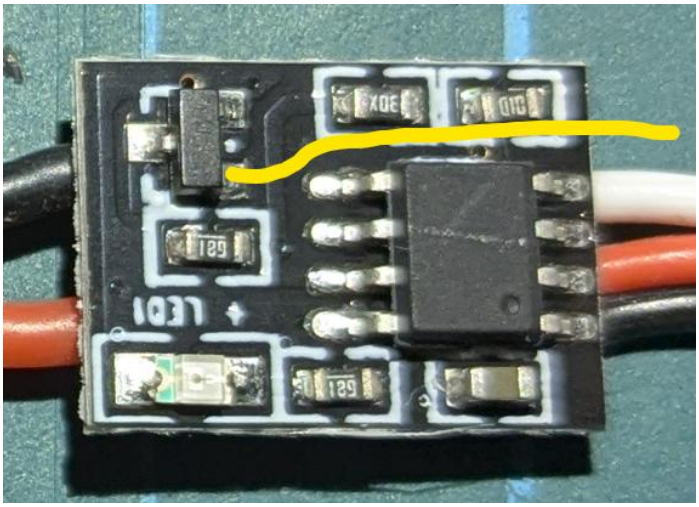
5. Identify the red JSC 2-pin connector coming from the electronic switch board.

6. Cut the JSC 2-pin connector wires leaving 4cm of wire attached to the PCB. **Retain the connector and its wire – we will use this when wiring up the switch.**

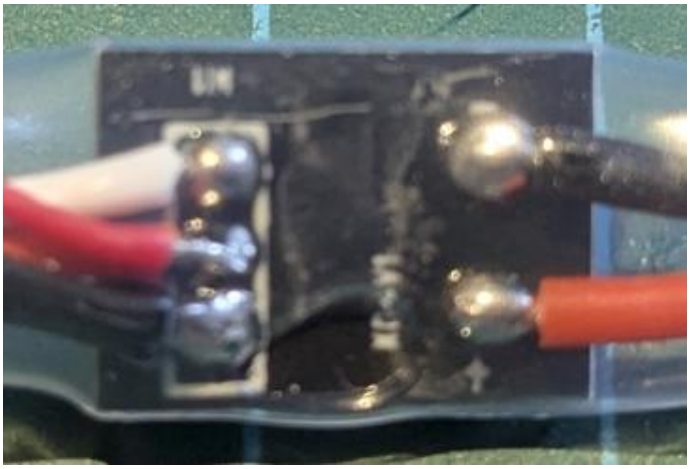
7. Strip no more than 1-2mm from the end of each of these five wires and tin the ends. We are only leaving a very short section of wire exposed because all of these connections are made by dabbing onto existing solder pads.

8. On the top of the electronic switch board, tin the lowest transistor leg, and connect the yellow wire to it as shown here.

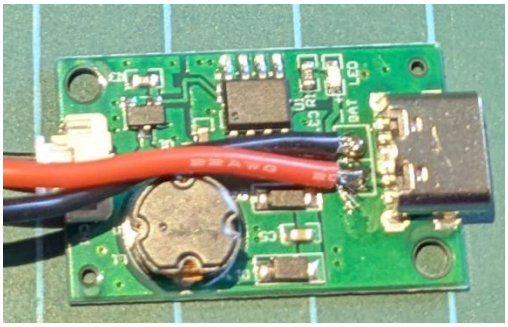




9. On the bottom of the electronic switch board, connect the red and black wires from the JSC 3-way connector on top of the red and black supply lines from the Futaba socket as shown here.

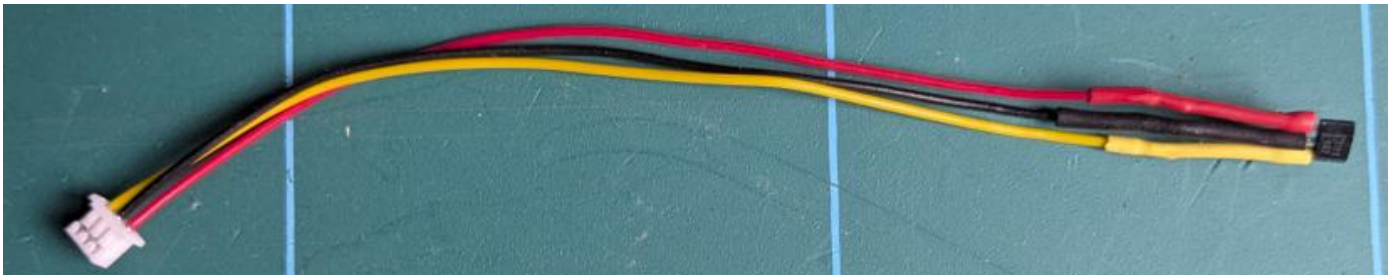


10. On the ultrasonic control board, tin the supply connection pads marked + and – adjacent to the USB-C connector and connect the thick black and red wires from the electronic switch PCB as shown here.



11. Re-insulate the electronic switch PCB with transparent heat shrink sleeving and shrink with hot air.

C: Hall effect sensor and plug



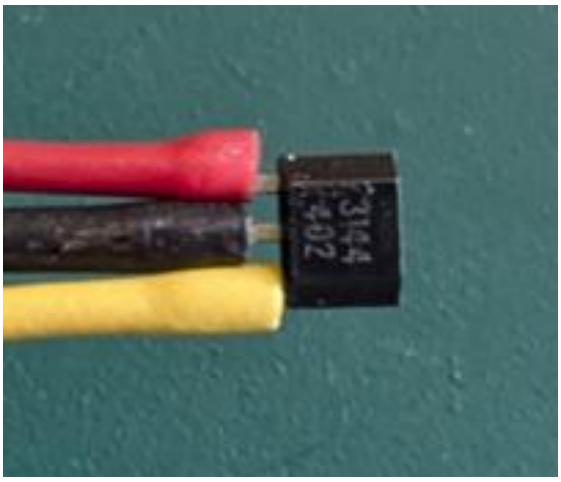
The A3144 Hall effect sensor is a three-wire device that is wired to the **plug** side of the JST-PH 1.25mm connector.

1. Thread a 2cm length of 1mm inside diameter heat shrink tubing onto each wire.

2. Do not trim the wires to length – they are the right length already.

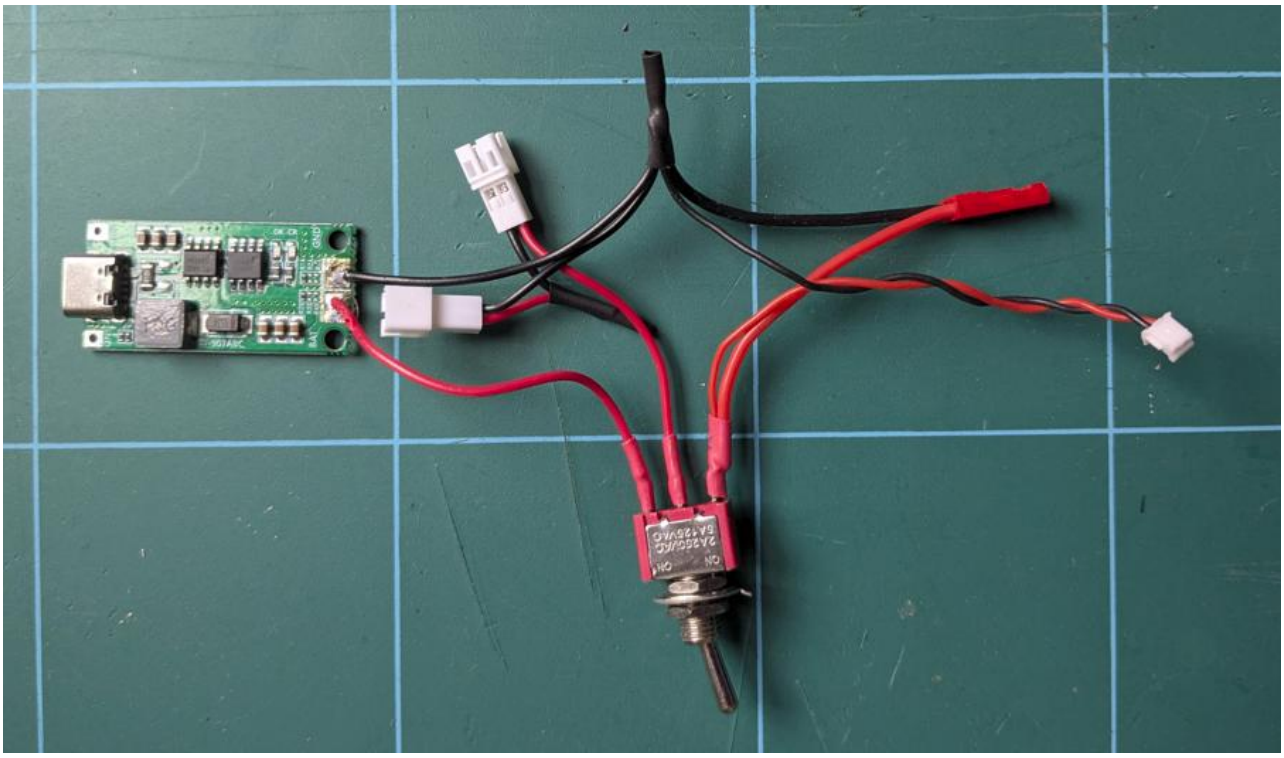
3. Strip 3mm of insulation from the end of each wire and tin.

4. Solder to the Hall effect sensor as shown. Note that the sensor in these pictures is oriented with the chamfered and lettered side up.



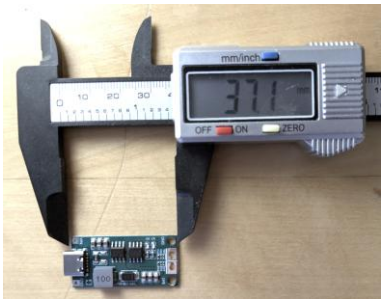
5. Push on the heat shrink tube and shrink with hot air.

D: Charging board, switch and series battery connections

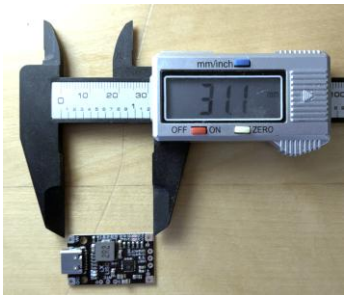


Component check

Warning: charging boards come in different sizes. The firebox is designed for the **37mm** variant. Shorter boards will not locate securely – if you have one of those then please request a replacement.

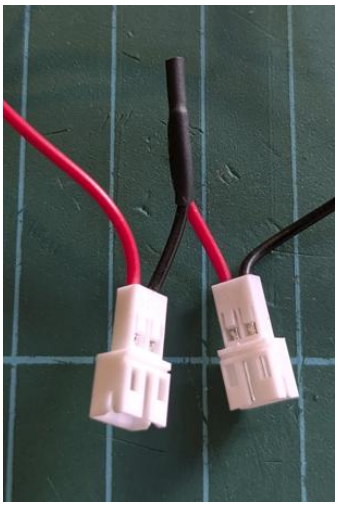


RIGHT - 37mm



WRONG – too short

1. Identify the two battery connector sockets on flying leads (item 2 in the Appendix A parts list).
2. On one socket trim the **red** lead to 2cm. On the other socket trim the **black** lead to 2cm.
3. Strip 3mm from the end of each trimmed wire. **Do not tin.**
4. Twist the trimmed, stripped wires together and tin to form a joint
5. Slip a 1.5cm length of 1mm heat shrink sleeving over the end ensuring that 5mm of the sleeve projects beyond the end of the wires. Shrink with hot air.

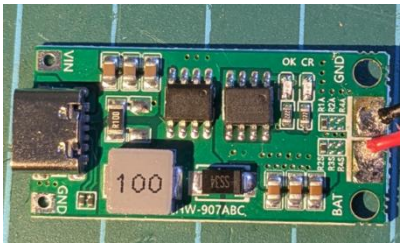


6. Trim the other battery connector leads to 4cm and strip 3mm

7. Identify the JSC 2-pin plug that you cut off of the electronic switch PCB. Do not trim further but strip 3mm.

8. Identify the twisted red/black telemetry wire with a small white plug that came in the box with the transmitter. Strip both leads 3mm.

9. Cut 5cm red and 5cm black wire and strip 3mm. Solder red wire to pad labelled BAT on charger board and black wire to adjacent GND pad.



10. Slip 1cm lengths of heat shrink tubing over the three thick red wires,

11. Solder the wiring loom as shown

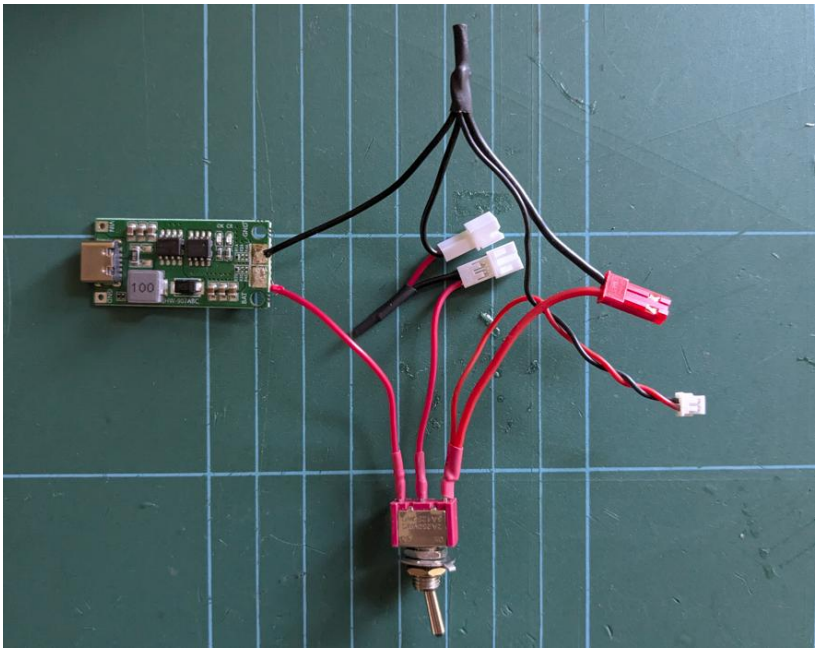
    (a) red charging board to switch left

    (b) red batterry to switch center

    (c) red JSC **and** red telemetry to switch right

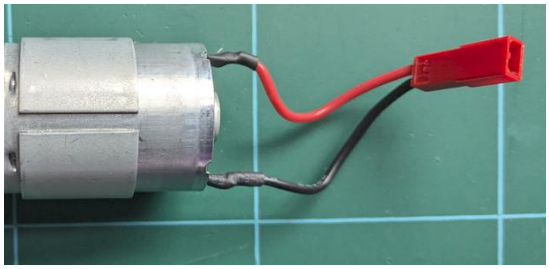
    (d) All black wires commoned

12. Slip a 2cm length of 2mm heat shrink tubing over the commoned black wires and shrink with hit air



13. Push the heatshrink sleeves over the switch terminals and shrink with hot air.

E Motor and JSC socket



1. Identify a JSC 2-pin connector **socket**

2. Cut the wires down to 5cm length

3. Strip 3mm and tin.

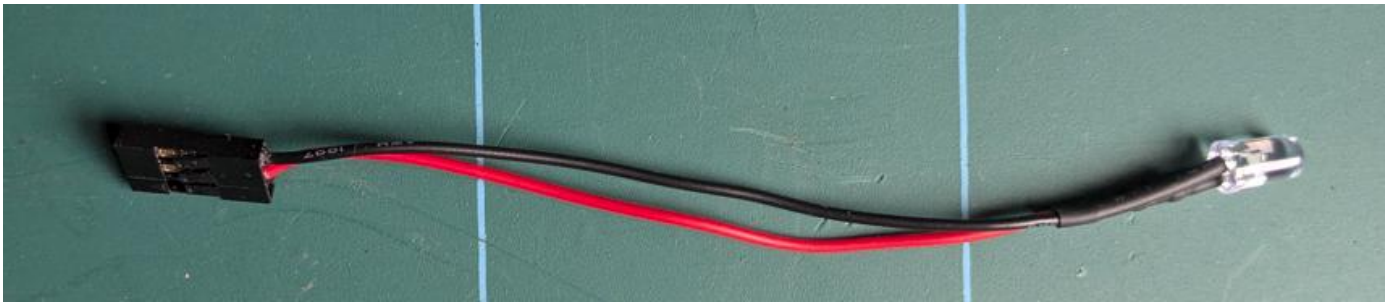
4. Thread 1cm lengths of 2mm heat shrink tubing onto each wire.

5. Solder to the motor terminals.

6. Push on the heat shrink tube and shrink with hot air.

Note: due to the gearbox geometry, if you solder the red lead to the motor tag with the red dot, the engine will run backwards when you push the stick forwards. Therefore, some builders solder the black wire to the tag with the red dot. Alternatively, you can attach the red wire to the red tag, and switch over the directions by setting the transmitter mode as described in Section 2.

F: Flickering LED and Futaba plug



1. Strip 3mm from the end of each wire and crimp on the Futaba connector pins.

2. Double check the red/black connections to the Futaba plug by comparison with the pre-wired connectors on the electronic speed controller and electronic switch boards, and inset pins accordingly. Note that Futaba connectors are keyed.

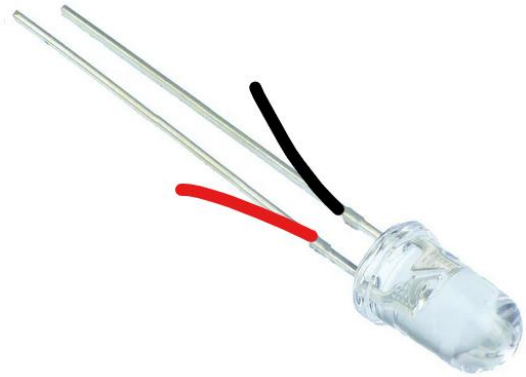
3. Thread 2cm lengths of heat shrink tubing onto the wires.

4. Strip 3mm from the ends and tin.

5. Solder to the LED legs. As is usual with LEDs, the long leg is the anode which connects to the red wire. The short leg is the cathode which connects to the black wire.

6. Trim the legs down to the solder joint.

7. Push on the heat shrink tube and shrink with hot air.



Note: alternate wiring scheme for the flickering LED

The flickering LED will operate on 5-9V, and so it could, if you prefer, be directly connected to the unregulated battery supply at the switch.

This saves having to crimp the Futaba connector and releases a radio control channel for those wishing to experiment with extra radio-controlled functions..

Appendix B: 3D printable accessories

The 3D circle is a specialist subgroup of the Gauge 1 Model Railway Association which began in July 2019 after David HalfPenny invited me to show off some 3D printing at the Spring G1MRA show. To my surprise, we were inundated all day with interested visitors. I learned that quite a few people had bought a 3D printer but then struggled to learn 3D Computer Aided Design; their machines were gathering dust.

The idea of the 3D Circle is to bring together experienced designers who also happen to be Gauge 1 enthusiasts and get them to produce high-quality *free* designs that others can print. We have a forum at https://gaugeone3dcircle.groups.io and a model archive site at https://www.g1-3d.uk both of which are completely public: you can access all of the material without needing an account. In fact, you only need an account on the forum if you want to post a question, and you only need an account on the archive site if you want to upload a design.

The 3D Circle has been an unexpected success, with several hundred forum members, a growing collection of ready-to-print designs and a weekly Zoom meeting. In 2025, discussions started by Davd Viewing led to us consider how to support G1MRA members who are not 3D printing enthusiasts but want to access our designs. David went on to produce this starter locomotive and, most importantly, figure out how to get small batches made for us by cost-effective third party printing services. The gearbox and RC system will be very useful in other designs.

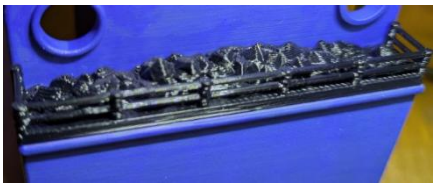
I think it is fair to say that the amount of work involved in (i) producing a model that is easy for others to use and (ii) making a supply chain *far* exceeds the initial effort required to get a prototype working, and David deserves a medal for both the original creation and the deployment of his long experience as a hi-tech entrepreneur to get this project off the ground. Fortunately he has at least got a silver cup – the G1MRA committee recognised his outstanding contribution by awarding the 2025 President's Cup to him.

Other members of the core 3D Circle community have also swung into action and are supporting the project both with their labour (we have occasional 'build days' where the kits are assembled and tested) and with their design skills. If you have access to a 3D printer, or perhaps access to a 3D printing enthusiast, then you might like to try some of these possibilities. You will find links to interesting design files on the Greenly page of the G1MRA website at http://www.g1mra.com/ under the **Resources/Designs** tab. Here are some examples.

Donald Pickett's coal loads and spectacle glass bars inspired by Steve Andrews' detailing

A clip in coal load with rails for the bunker along with bars to protect the spectacle glasses.

Donald designed these after seeing Steve's detailing mods on his NCB engine which you can view in the gallery photographs above.



Tref Willingham's carry box

Tref prints boxes for his designs which clip together for secure storage and carriage.

The ingenious design also acts as a re-railer, and allows the loco to be driven in and out of the box straight onto the track.

Tref has produced a box customised for this design. It is quite a big print which takes some hours to make but produces a very professional looking result.