The 2mm Scale Association
etched replacement chassis for the Graham Farish BR 08 shunter body
(parts list updated August 2013)

Required Parts List

Class 08 etch (supplied)
Motor (10mm diameter coreless Maxon or Faulhaber, or Association can motor recommended)
Association frame spacer PCB
6 x 9mm extended axle drivers
6 x crankpins and crankpin washers
1 x 30:1 worm set
1 x Machined steel sleeve as interface between Maxon motor shaft and worm.
3 x gear muffs (6 if building with spur gear drive)
2 x axle muffs (not required if building with spur gear drive)
2 x 18 tooth M0.4 or 64DP spur gears (4 if building with spur gear drive)
2 x 13 or 14 tooth M0.4 or 64DP spur gears (4 if building with spur gear drive)
12 (max) phosphor-bronze frame bushes (exact number depends on gear train)
1 or 2 brass frame bushes for motor shaft.
Motor mount bush if using Maxon or Faulhaber motor
0.3mm brass or nickel silver rod
0.3mm thick PCB (optional, for backing to etched bufferbeams)
paint, solder and tools

Assembly instructions

General

Certain parts of the etch are very delicate, and therefore care is needed when cutting both them and adjacent parts out. Spares are provided of certain small or delicate items.
Unless otherwise indicated, fold lines for 90 degree folds are on the inside of the fold, for 180 degree lines on the outside of the fold.
An enlarged picture of the etched fret is provided for clarification, as well as an arrangement drawing showing the recommended location of frame spacers. Study these and the instructions carefully before beginning assembly. The recommended course to follow for construction is outlined within these instructions which have been written following a test building and analysis of the kit and is a direct result of recommendations made by the designer and builder. It is not to be regarded as the definitive way to put together this or any other kit of parts in any scale/gauge combination just the result of experience in this particular case. A photographic sequence is included which covers some of the section where it is felt it will be of advantage. However of necessity not every step of construction is illustrated.
The text refers to the left and right hand side of the locomotive. This is taken to mean as though the builder were standing in the cab of the loco, looking towards the nose, or in other words, the left side view of the loco, is that in which the nose of the loco is on the left, and the cab on the right. Similarly the front of the loco is the nose end, the rear the cab end.

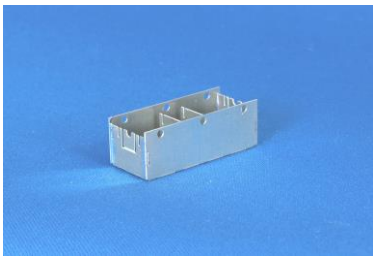


Figure 1 Frame Assembly jig

1. A special frame assembly jig is provided. It is recommended this is constructed now. It should be folded up and soldered. (see Fig. 1) Check that the frame material will sit in the slots intended for them. Etching is not an exact science and however good a design, minor variations can occur in the etching process It will be much easier to remove cusp at this stage rather than try to do it after the jig is constructed.

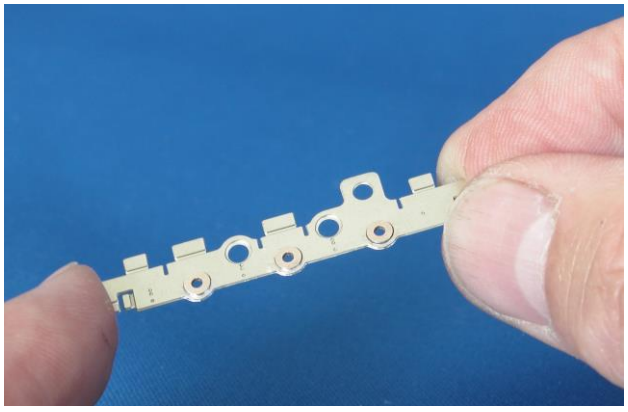


Figure 2 inside frames with bearings partially inserted

2. Cut out the inside frames and solder into place the axle bearings in the axle holes (three), as well as those for the intermediate drive gears. (see Fig 2) If building the loco with spur gear drive between the wheels, solder in two additional bearings in the holes between the axles.
3. Fold over the tabs which are used as location guides for the frame spacers (folding inwards) and also those which fold outwards and which will later form the attachment points for the outside frames. The arrangement drawing should be used to familiarise yourself with these. On one of the inside frames an integral gearbox is included. This should also be folded up and soldered at this point, and bearings soldered into both ends of the resulting gearbox.
4. The two frames are inserted into the jig constructed earlier, where slots will accurately locate them. Axle steel can be inserted through the holes in jig and frames to lock everything in place (see Fig 3). It may be necessary to slightly ream the axle bearings so that the rods will pass through, but this should be done very carefully so as not to excessively enlarge the holes. The frames can be inserted either way up into the jig, according to which way you find most convenient when adding the frame spacers.

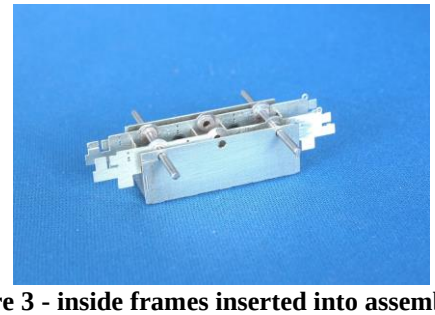
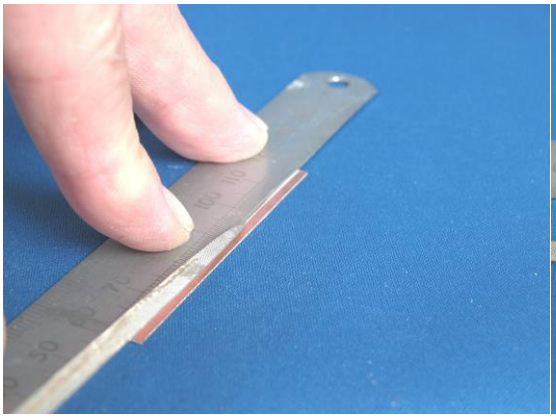


Figure 3 - inside frames inserted into assembly jig

5. Spacers are cut from the PCB strip, and soldered into place. Fig 4,5, and 6. It may be found useful to employ a steel rule as a straight edge to file the insulation gaps in the frame spacer material before it is cut to length.



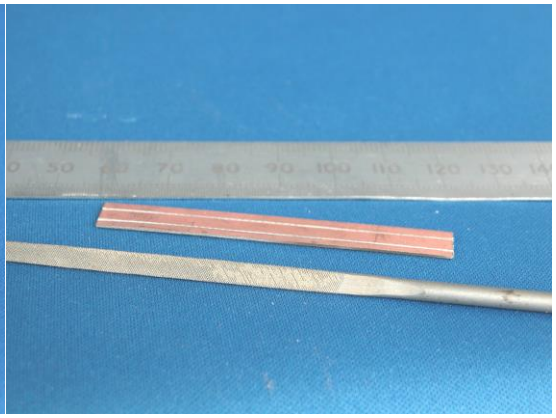
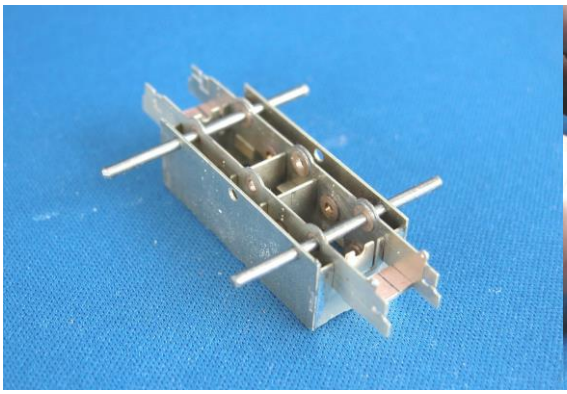


Figure 4 – filing insulation gaps in the frame spacer material **Figure 5 – insulation gaps completed**



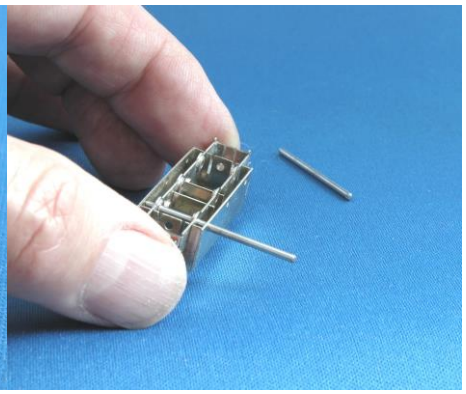


Figure 6 – frame spacers soldered into place **Figure 7 – removing the rods from the assembly jig**

6. When all spacers have been fixed, the rods can be removed from the jig, and the chassis eased out. (see Fig 7 and 8)

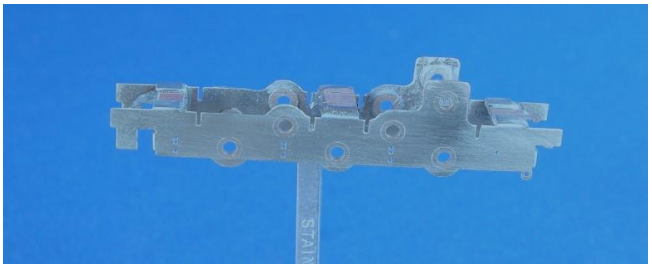


Figure 8 – completed chassis assembly

7. The chassis may be built in a variety of gear configurations. All use a 30:1 worm set as the first gear stage. A two stage gearing, driving onto the rear axle with either 13:18 or 14:18 ratio, or a three stage, driving via a spur axle located between centre and rear axle, again with either 13:18 or 14:18 reduction, are the reduction options. Therefore a variety of reductions between 38:1 and 57:1 can be employed. Fig 7, 8 & 9 illustrates the 3 different set up arrangements. Note that the temporary axles are only added for illustration purposes.

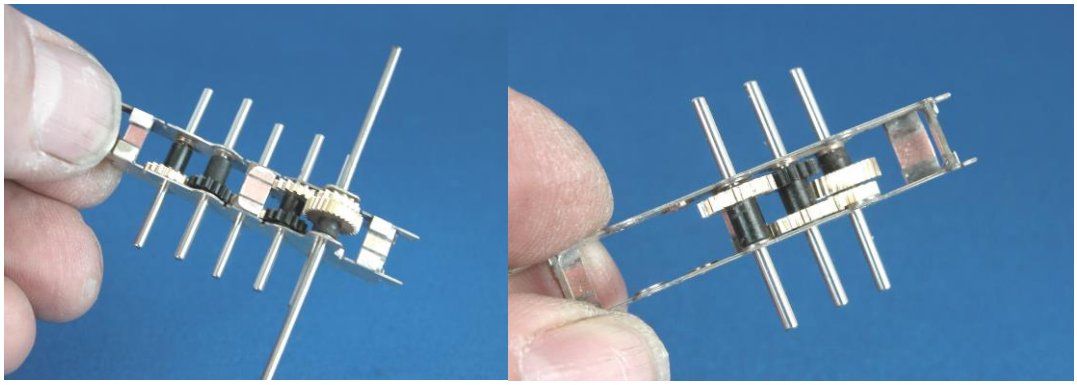


Figure 9 – triple reduction gearing with spur drive to all axles
Figure 10 – triple reduction gearing with drive to centre axle

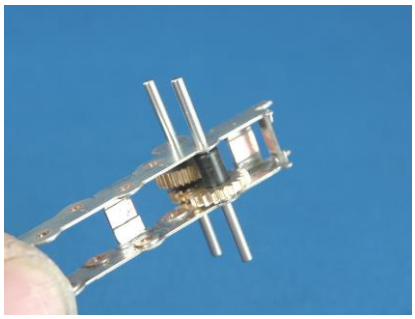


Figure 11 – double reduction gearing with drive to lead axle

8. Now add the wheels to the chassis. The drive axles should have an offset 18 tooth final drive gear on an axle muff, and so should the other two axles if building with spur gear drive. For spur gearing, the two additional stub axles should have 13T or 14T spur gears. The worm wheel stub axle should have the 30T worm wheel centralised, and a 13T or 14T spur gear offset. The wheels and stub axles are fitted in the usual manner (see the available notes on this from Bill Blackburn for details), except that quartering is not relevant at this stage.
9. See if everything is turning freely at this stage.
10. No specific motor mounts are provided with the chassis. It is intended that one end of the motor is supported by its drive shaft where it passes through the gearbox. It is necessary that the motor has a 1.5mm drive shaft for this to occur, and therefore motors with a 1.0mm or other shaft will need a sleeve for this to be achieved. It is not necessary for the drive shaft to reach all the way through the gearbox, as a 1.5mm stub shaft can be inserted at the opposite end.
11. A simple and elegant solution for mounting the other end of the motor is to use rigid wire of sufficient size that when soldered from the motor terminals to the inside frames it will hold the motor firmly in place, and by unsoldering these two wires the motor my be removed for maintenance. However DCC users will need to find an alternative solution.
12. Once the motor has been added, if spur gear drive was chosen, a running chassis should now result. If not, then there should be drive to one axle. If not running smoothly, make adjustments until it is.
13. Add brake blocks to the chassis. These fold up into a U shape, and can be added in one of two ways. Using the first method described the brakes will be removable.
14. The brake blocks are fixed on the front (bonnet) end of the wheels and can be attached as follows:-.

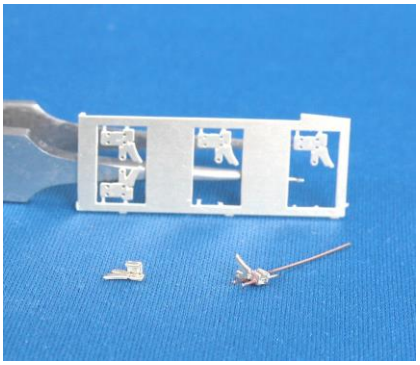


Figure 12 – removing and assembling the brake shoes

15. Method 1 First fold up brake shoe etch. Once the brake shoe etch is folded make sure thee .3mm wire will go right through by running a .3mm drill through from one side to the other. Now thread .3mm brass wire through the upper two etched holes. (see figure 12) These correspond to the lower two holes in the locomotive side-frames (the lower etched hole on the **shoe assembly** is for fixing the brake rigging later whereas the upper etched hole in the **loco side-frame** is specifically for the locomotive 'springing' method employed by some builders). *If you do not intend to spring the locomotive then ignore the upper etched holes in the side-frames.*
Allow sufficient wire to protrude through one of the holes in the back of the brake shoe assembly where it contacts the frame to enable it to pass through the etched holes in **both** side-frames. Solder the wire to the shoe assemblies and trim back that which is protruding on the front face of the shoes. Thread the longer lengths of wire through the etched holes in the side frames which, in conjunction with the shorter length brass wire, will correctly align the shoes in relation to the driving wheels. (see Fig 13 & 14)

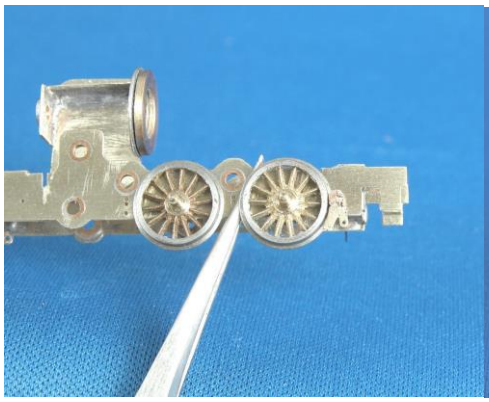


Figure 13 – adding a brake shoe

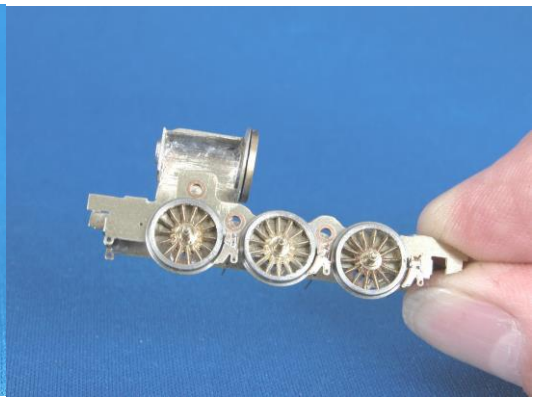


Figure 14 – brake shoes on one side added

16. Fix the brake rigging to the bottom of the brake shoe assembly. It has to pass in front of the wheels and not interfere with their running so is soldered on the outside face of the brake shoe assemblies. It may be found necessary to use some thin card to separate the outer face of the brake blocks and the inner face of the brake rigging to create a uniform distance between the two and ensure no fouling of the driving wheels occur when the wheels rotate. However, it will also have to lie behind the outside frames, so do not leave excessive space in front of the wheels.

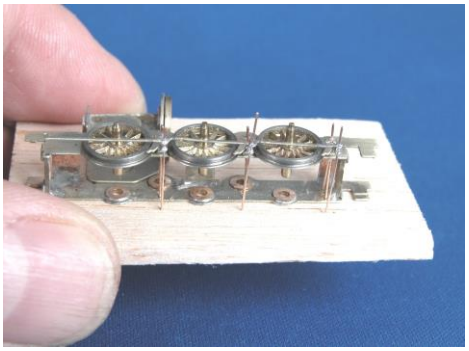
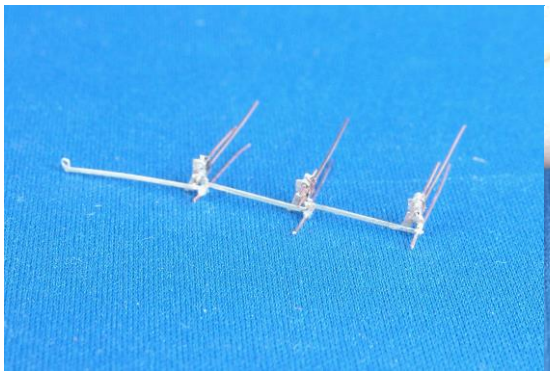


Figure 15 – adding the brake rigging

17. In Fig 15 a small piece of balsa wood is used into which the brass wire may be pressed through the chassis which is laid on it's side to give a firm base on which to carry out the operation of fixing the brake rigging. Once this has been done the brake assembly can be withdrawn from the chassis and cleaned up. (see Fig 16 & 17). Using this method of assembly the brakes can be removed for maintenance.



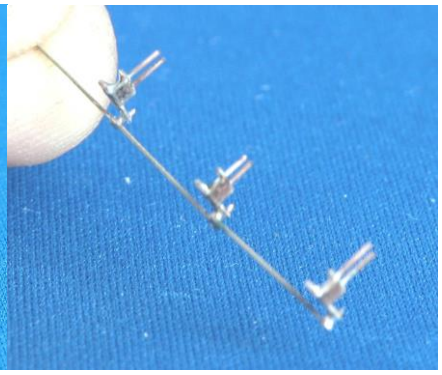


Figure 16 – brake rigging and shoes removed for cleanup Figure 17 – brake rigging with wires shortened.

18. Method 2 If the builder requires to permanently fix brakes in place then follow all previous steps relative to brake shoe assembly and after the driving wheels have been fitted and are running without any tightness or binding the brakes can simply be soldered to the side-frames. If the builder chooses to solder the brakes on as described in this paragraph are any subsequent removal of the driving wheels may prove difficult to achieve without causing damage.
19. The brake rigging is secured to the eyelet at the rear of the main frames using .5mm brass wire. Using a very small amount of solder this method can be employed whether the brakes are removable or not since this soldered joint is easily accessible when construction is complete.
20. Add outside cranks to the axle ends. These holes may need to be reamed slightly for a snug fit. Do not solder the crank to the axles at this point. You can use 2 layers of the etched cranks to create a good thickness for them. Solder a crankpin into to each crank then solder cranks to axles
.
21. Cut out the coupling rods including their supporting frame and fold the three layers together, solder, and cut and file off the remaining tabs. Check the holes are a running fit on the crankpins, and ream if necessary.
22. The cranks must now be quartered. It is essential for good running that this is accurately done. Work slowly and carefully. Apply the coupling rods back to front to each axle pair in turn, checking for free running with no sticking points. Then check with all three axles connected. If however spur gear drive

is being used, this step is not so critical, and the coupling rod holes are reamed out to a loose fit, so as not to interfere with the gear drive.
23. The etched balance weights can be added to the wheels. The larger ones are for the centre axle.
24. The outside frames can now be constructed. They should be cut out from the etch including the etched axlebox overlays. These are then folded over in concertina fashion to align the three levels of overlay, soldered together and the supporting frame cut away.
25. Assemble the front and rear bufferbeam stays and solder onto the frames.
26. Fold up the front footsteps and solder in place on the outside frames. It may be possible to use the plastic Farish items as an alternative. Add handrails using 0.3mm brass rod and two handrail knobs.
27. Fold up and solder the rear footsteps in place on the footplate. There are locating notches in the top of the outside frames for them.
28. Now attach the outside frames to the locating tabs on the inside frames. Wither soldering or gluing could be used. Ensure that the wheels and cranks are still running freely.
29. Optional front and rear bufferbeams are provided in case the builder wishes to replace the Farish plastic items. If using them, first solder the front and rear bufferbeam overlays to the inner bufferbeams. It is not possible to attach by soldering to the outside frames directly, as this will short the two sides of the split frame chassis. Instead a piece of thin double-sided 0.3mm PCB (not included) can be used on the rear of the bufferbeams, or they could be attached using glue to preserve the insulation.