Tip: Marklin 3650 Upgrade with 60944 Kit LP5.0 and LED Lighting

Date: 22-03-2025

Hi All,

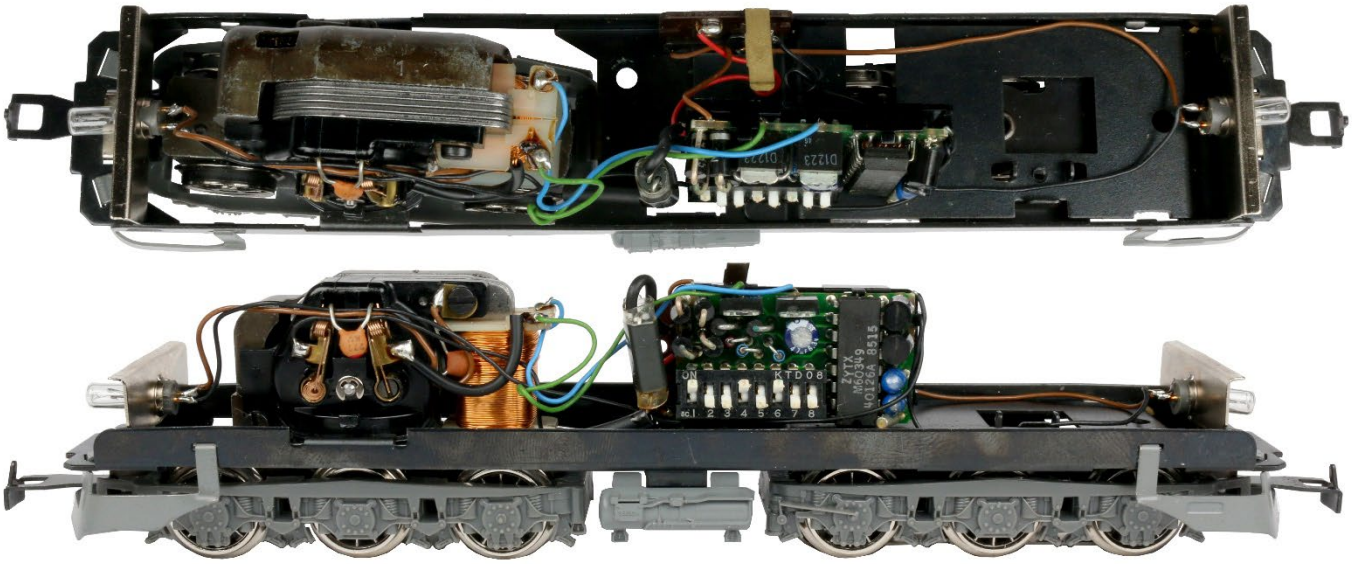
Märklin 3650 manufactured 1985-1988. Locomotive # **11445**

Upgrade Requirements

- Service and clean locomotive **11445**.
- LED cabin light at front and rear end of the Locomotive.
- Single white rear light front and rear, both on for parking lights
- Paint cabin console and place train driver in front and rear cabins.
- Use **59629 ESU LokPilot 5 DCC 21MTC** decoder.
- Use **51957 ESU Adapter board 21MTC**
- Use **60944 Märklin Motor Kit**.
- Speed profile the locomotives in TrainController.
- Create new functions for TrainController.

For this locomotive I have kept the number of functions down to a minimum to save on costs.

Existing Locomotive Base Line



The base line of the locomotive at the beginning of this project is shown above with 6080 Decoder, AC motor and a single bulb at each end of the locomotive.

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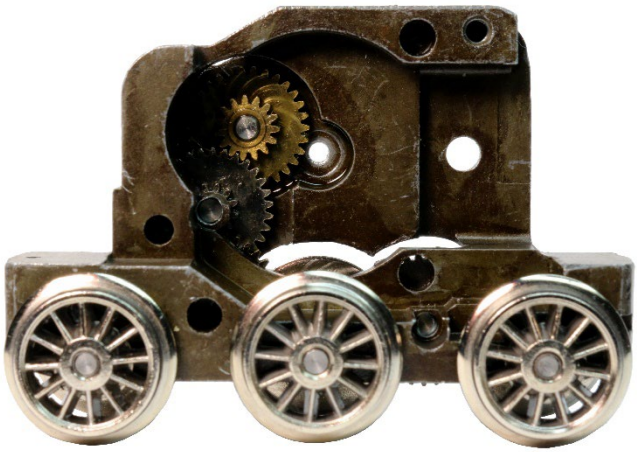
Chassis Strip Down

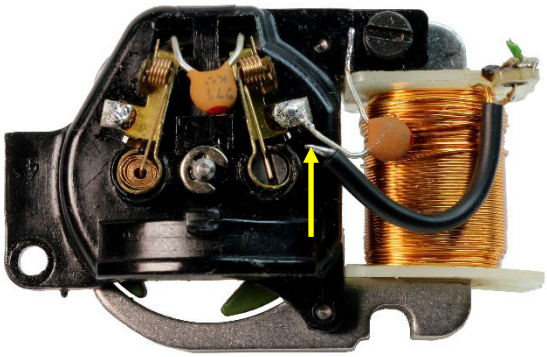
The decoder and all wiring were removed from the chassis. The motor was removed and stripped down for a thorough clean.



Reducing Excess Axel Float

The axle float has been reduced to allow the gears to always fully mesh and as a bonus the motor runs much quieter. The washers on the non-gear side as shown orange arrow have a thickness of **0.48** mm.

Old Motor Parts



The coil wires yellow arrow, are unsoldered from the brush plate to prevent wire breakage.

The brushes, brush plate, armature and magnet with coil are stored in a sealed plastic bag for spare parts for someone who runs analogue trains.

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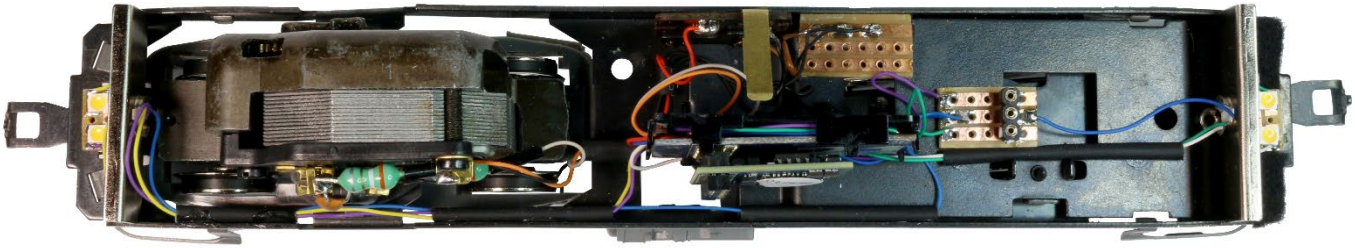
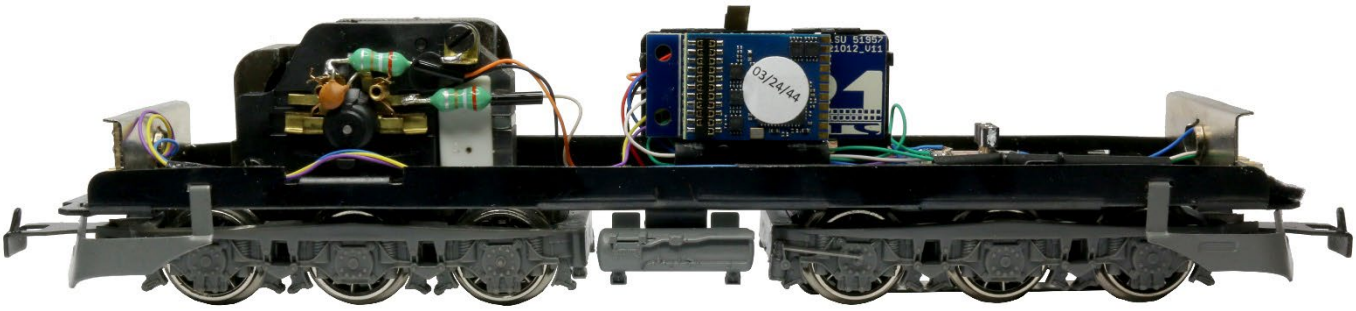
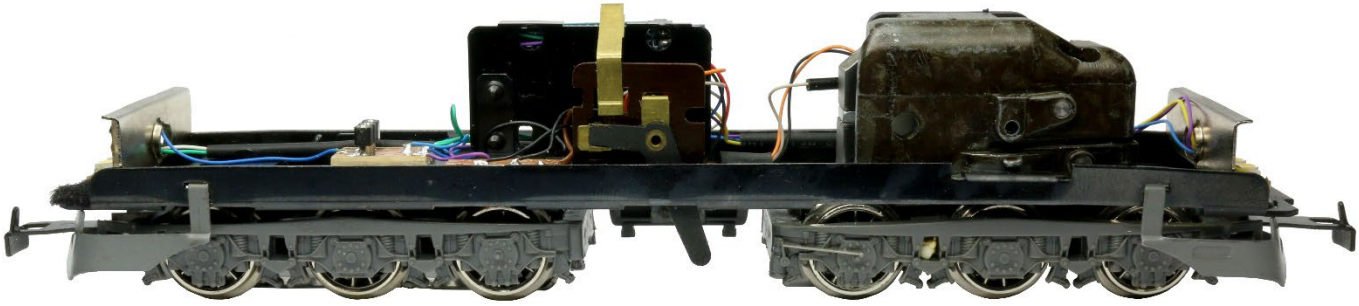
Component Layout Complete



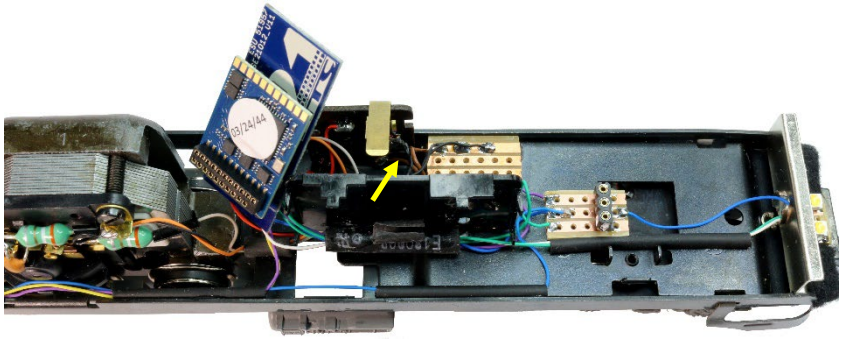
- The top view shows the **60944** Märklin motor kit fitted.
- The bulb sockets have been removed and LED lights are at each end of the locomotive.
- The **51957** Adaptor board and **59629** ESU LokPilot 5 DCC decoder mounted on the original decoder mount.
- A small interconnection Vero board for the ground/masse wires.
- A small interconnection Vero board with socket PL1 for the cabin lights.
- Lengths of heat shrink tube are gel super glued to the chassis to contain the wiring.



- The righthand side view shows the motor chokes and ground solder tab on the motor.
- The PL1 socket is painted white for pin 1.



- The lefthand side view shows the power selection switch.



This close up shows the brown ground chassis wire is soldered to a solder tab on the power selection switch yellow arrow then the other end is solder to the ground interconnection PCB.

A heat shrink tube is gel super glued to the decoder mount then another tube is split to hold the 21MTC adaptor board and is glued on top of the first heat shrink tube.

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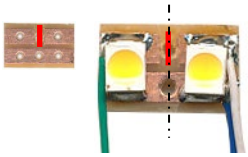
Component Layout Complete continued

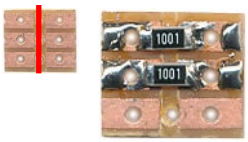
- Both photos show the LED light PCB and the Resistor PCB.
- The left photo shows the rear of the locomotive without the felt light masking.
- The right photo shows the front of the locomotive with 1mm thick black felt masking fitted.
- The lefthand LED is for the left marker and top light.
- The right LED is for the right marker light where both the rear and front can be switched together for parking lights.
- The wire colours for the rear and front lights relate to the wiring diagram on page 5.

LED Lighting PCB



The LEDs are warm white PLCC2 size with the cathode of the LEDs at the top and the anodes of the LEDs are common and connected to the **+U blue** wire. This photo shows the front lights. The foil has been cut at the red line location.

Resistor PCB

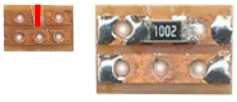


The three foils have been cut at the red line location shown actual size.
Two 1k 1206 resistors have been soldered across the isolated gap as shown.

The centre line of the lighting PCB must be gel super glued to the chassis centre line.

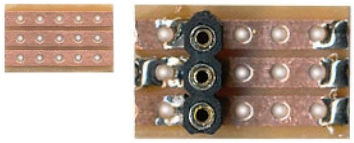
The resistor PCBs have been gel super glued at the locations in the photos at the top of the page. The gap between the LEDs must be kept free of wires to allow a light mask to separate the two LEDs.

Cabin Light Resistor PCB



One foil is cut at the red line and a 10k 1206 resistor is soldered across the gap as shown. The ends of the foils are tinned to make soldering the wires to the PCB easier.

Cabin Light Connector PCB



The cabin light connector **PL1** is made from Rolled IC socket pins and the foils are tinned to make soldering the wires to the PCB easier.

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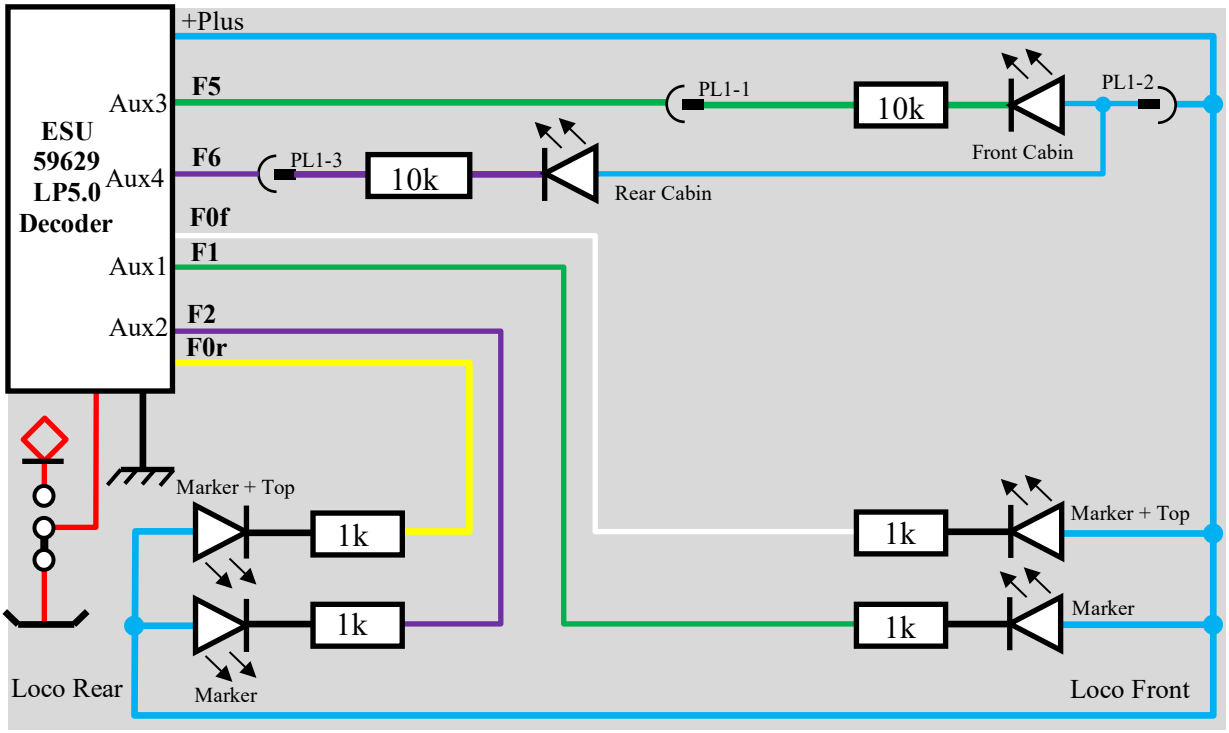
Wiring Diagram



Component Legend

- All resistor values shown above, 1206 size.
- The cabin LEDs are white 1206 size.
- All other LEDs are warm white PLCC2 size

Please note the decoder red wire, is wired direct to the track and overhead power switch.

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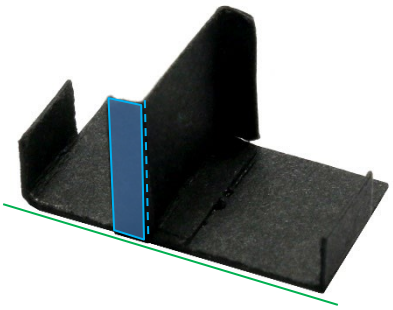
Main Light Masks

Two main light masks made from thin black card are required for the project made from parts M1 + M2.



M1 + M2 are true size and can be used as a template.
The red dashed lines indicate the tabs are bent up and the blue dashed line tab is bent down

M1+ M2 should only be glued together at a later stage when the body shell is being assembled see page 8.

The green line indicates the bottom edge of the light mask.

Top Light Mask

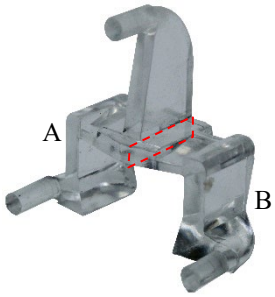
Two top light masks made from thin black card are required to prevent the top light from illuminating the unlight cabin and to prevent the cabin light from illuminating the unlight top light.

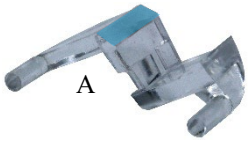
The photo is a rear view of the light pipe.
The thin black card is bent up at the red dashed lines to make a 'U' channel that is placed in between the metal cabin insert that masks the light pipe at the front and the black card masks the rear of the light pipe.

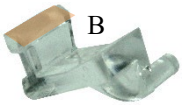
The light pipe requires further modification and the final assembly is quite intricate with the two masks see details page 8.

Light Pipe Modification

The two light pipes have to be modified by separating into two parts A + B







Caution: Be very careful as this is the point of no return, think twice cut once.

1. The first cut with a razor saw is beside the top face of the light pipe shown by the red dashed rectangle forming part 'A' and part 'B'.
2. Part 'A' is chamfered to a 45° chamfer see blue shape using a fine file. This will allow a brighter top light.
3. Part 'B' is chamfered to a 45° chamfer see orange shape using a fine file.

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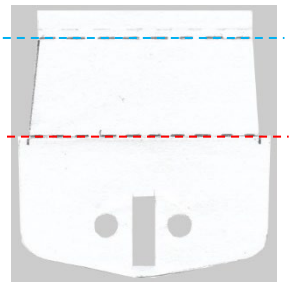
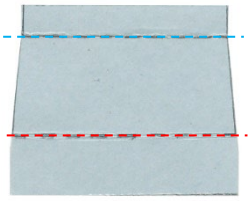
Cabin Details

The locomotive doesn't have plastic interior inserts for the cabin to place drivers in. I decided to construct the above cabin inserts with drivers from paper and thin card.



The white area is the required shape true size, print without scale which can be used as a template. The material is 80gm bond paper. The two holes and one slot are most important as these hold the cabin in position on the final assembly.



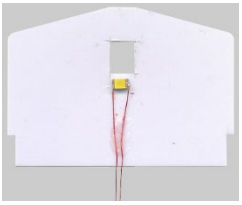
The grey thin card on the right is true size.

Both components are bent at 90° up red line and 90° down at the blue line

The grey card is super glued to the white paper by gluing one surface at a time until you get the final cabin shape in the top photos. The super glue provides a stiff shape allowing the cabin to remain ridged.

Cabin Roof Insulator and Reflector with LED

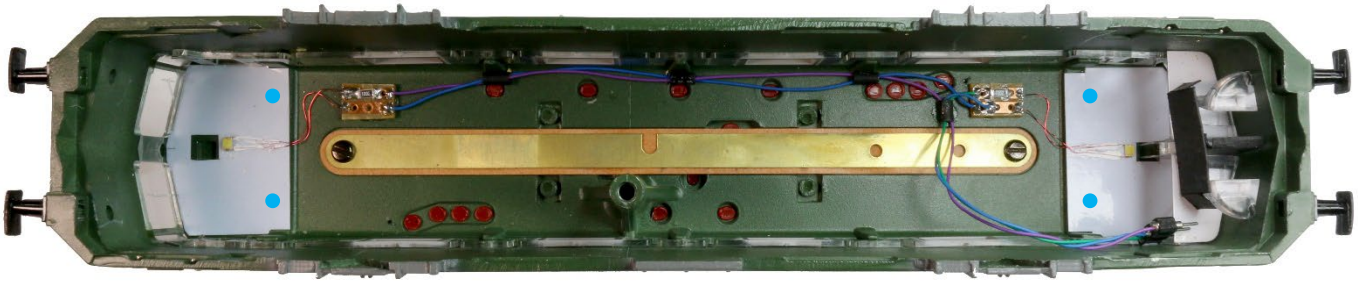
The roof insulator/reflector is made from white plastic decoder packaging and is shown true size, print without scale which can be used as a template.



A 0805 warm white LED has 0.15 100mm length enamelled copper wires soldered to it. The LED with wires is gel super glued at the location shown.

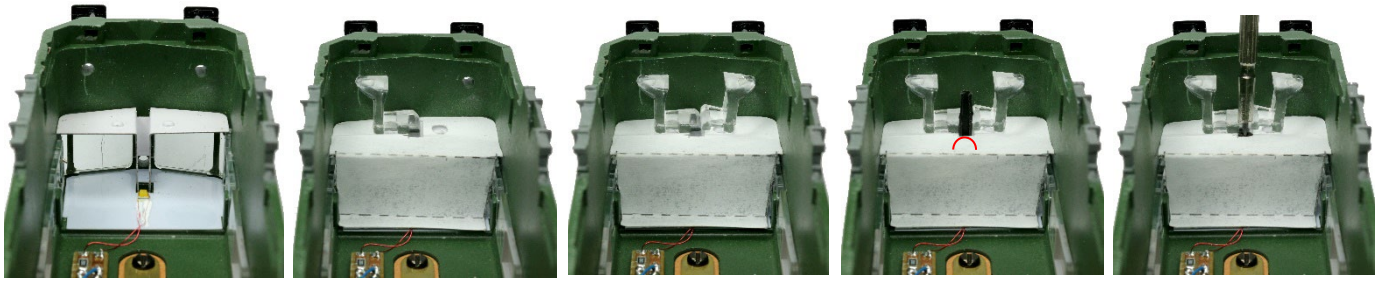
Body Shell Assembly

The body shell assembly has a number of progressive steps to complete the assembly.

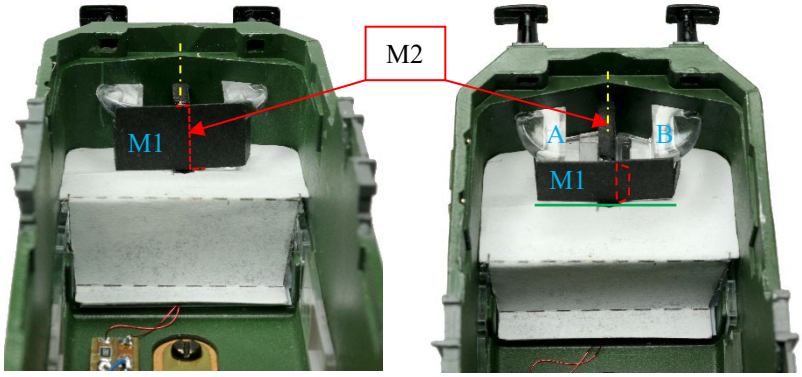


1. The cabin roof insulator/reflector with LED is gel super glued to the roof of the body shell at the blue spot locations.
2. The cabin light resistor PCBs are gel super glued at the shown locations.
3. The LED enamelled copper wires are cut to length and soldered to the resistor PCB.
4. Small lengths of heat shrink tube are gel super glued to the roof at the locations shown.
5. ESU coloured wires used are supported by the heat shrink tubes and wired to the rolled IC pin plug PL1, refer to the wiring diagram page 5.

Body Shell Assembly continued



6. At each end insert the metal cabin insert as shown left.
7. Insert the rear and front cabins. The cabin floor hole will fit over the raised dimples of the metal insert.
8. Insert light pipe part ‘A’ into the hole of the cabin then manipulate the light pipe into the body shell light holes.
9. Insert light pipe part ‘B’ into the remaining body shell light hole.
10. Insert the top light mask into the hole, note the direction of the red arc.
11. Use a small screwdriver, push the mask down and ensure it is inside the metal cabin insert.



12. At each end place mask ‘M2’ between light pipe parts ‘A’ and ‘B’. The blue tab of ‘M2’ see page 6 must be under light pipe part ‘B’.
13. Gel super glue mask ‘M1” to the tab of ‘mask ‘M2’ at the red dashed area righthand photo.
14. The tab of mask ‘M2’ must be equal distance about the centre line to allow it to fit between the PLCC2 LEDs.

The body shell is positioned beside the chassis and the plug **PL1** from the body shell is plugged into the socket PL1 on the chassis making sure the painted key index on the plug and socket match.

The body shell is now fitted onto the chassis making sure no wires are pinched before screwing together. Make sure the plug and socket with wire loom are below the pantograph contact yellow arrow.

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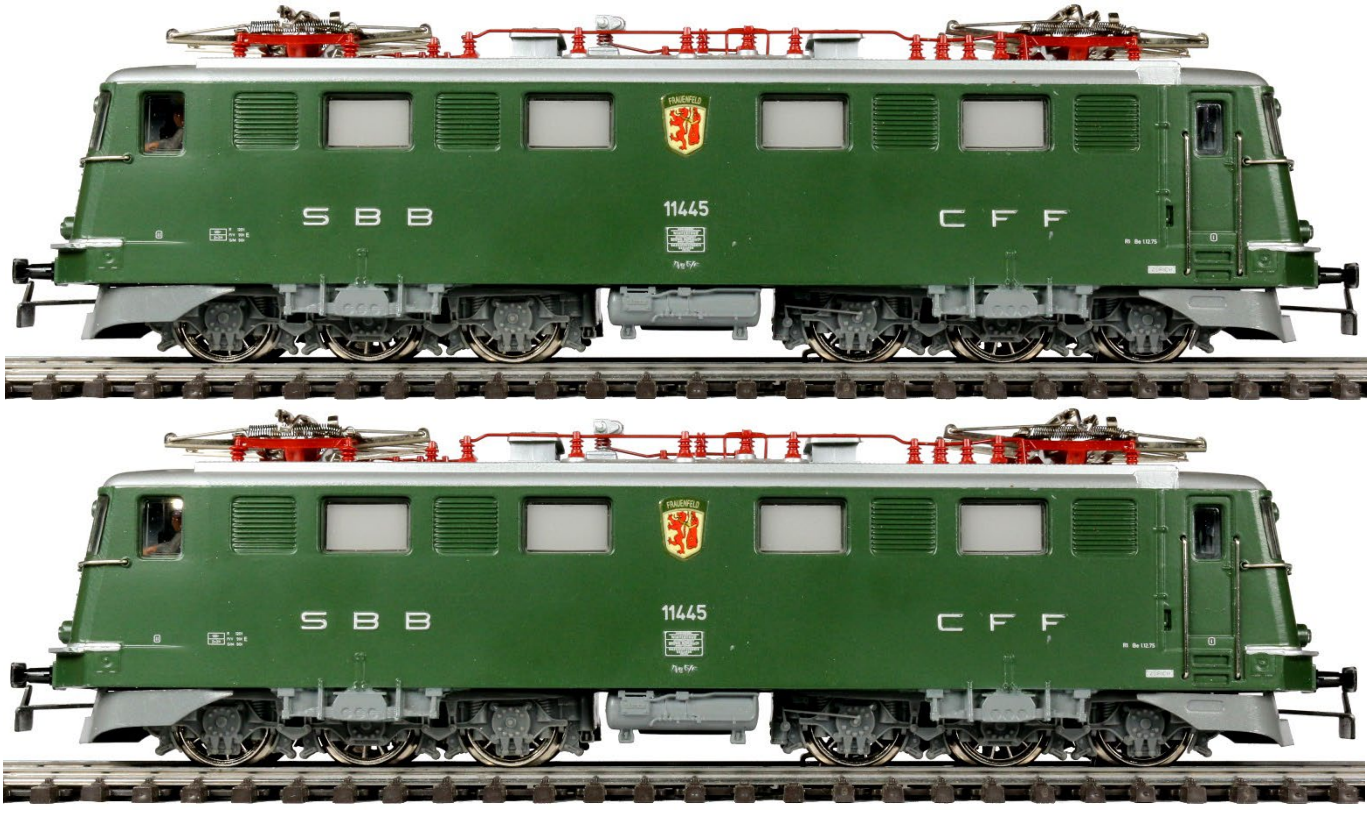
Final Lighting Results

Photos below show the lights on at each end of the locomotive.

Front View

Rear View



Side View

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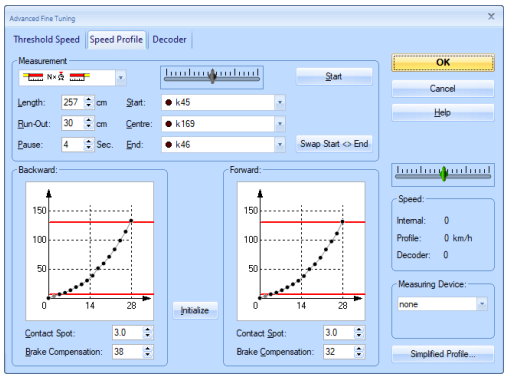
Miscellaneous

The weight of the locomotive is **510gm** with a drawbar pull **245gm.**

I have provided the following ESU project file to allow the curious to have a closer look how the decoder was programmed.

[3650 Project File]

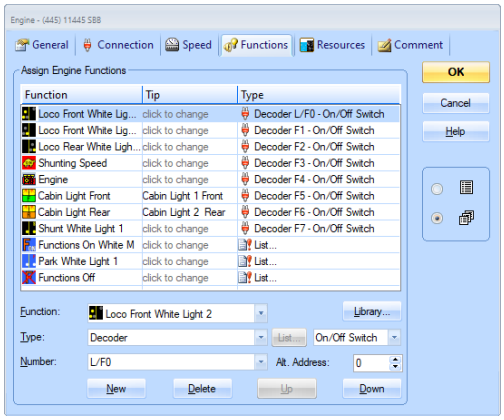
TrainController Settings

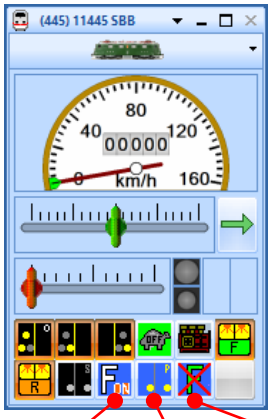


Speed graph for locomotive **3650**. A single speed step profile was performed to ensure the maximum speed was 130 km/h for forward and reverse on each locomotive.

The LokPilot 5.0 decoder **CV5** value was adjusted to meet this maximum speed requirement. Motor trim was used for fine speed adjustments.

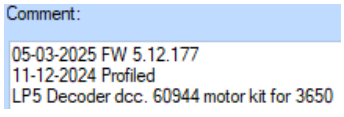
TrainAnimator file **3650.yra**  is supplied in **3650.zip** file.



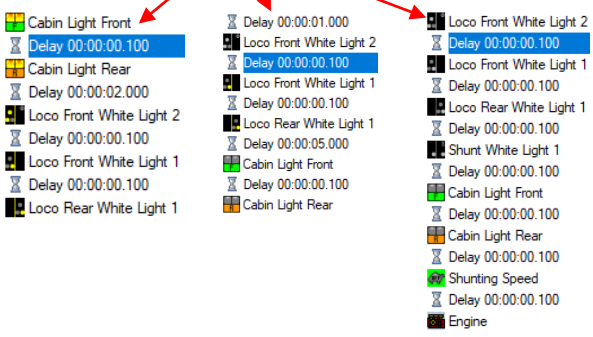


The functions were defined shown left and the TrainWindow shows the layout of the functions.

For **40+ year old** locomotive which has never been run the results of upgrading to a LokPilot 5.0 decoder has provided smooth and quiet running which I'm very pleased with. It looks and preforms like a new locomotive.



I have started to provide useful information in the comment field for the engine.



The function list commands provide easy light control.

As always enjoy your model trains.