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# MK2 MFLR Speedwagon O&M Manual



Tom Burton

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## 2 INTRODUCTION

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This document forms the Operations and Maintenance Manual (O&M) for the MK2 version of the Manor Farm Light Railway (MFLR) Speedwagon.

Note that MK1 of this wagon was initially called the REO Speedwagon; REO representing 'Reverse Exactly Opposite (of Forward)' as the wagon operates in either direction.

The MK2 version of the wagon is based on a bespoke tool wagon kit designed and manufactured by Steve Blackmore and, like its predecessor, has been designed to provide minutes, if not hours, of enjoyment by indicating the scale speed (1:19.05) of the wagon as it is pulled or pushed around a SM32 gauge track.

The design and construction is of keep it simple-silly (KISS) philosophy in order to provide maximum reliability and longevity.

The wagon is supplied to the user on receipt of the cost of the materials: i.e. the wagon has been built as a hobby and not on a commercial basis for profit. Thus no declaration of conformity is provided and no CE marking has been applied etc.

Even though many hours have been expended (along with copious amounts of earl grey) in the research, development and trial running of the wagon and all relevant good engineering practice has been applied, there is no guarantee that the indicated speed is/remains accurate, nor that the wagon is/remains fit for purpose and so no warranty is given or implied. In particular the low level assembler software running in the microcontroller is not guaranteed to be 'bug free'.

It is highly recommended that any suspicion of incorrect operation, or any suggestions for the enhancement/modification of the operation of the wagon is reported back for consideration: such feedback will be positively received. In addition any remedial action that is required to resolve a reported anomaly will be carried out once a solution to the issue has been found and the solution tested.

## 3 WARNINGS

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The vast majority of SM32 enthusiasts are sensible. However I feel obliged to list the main potential hazards present whilst using this wagon for the purposes of safety of the users etc.

### 3.1 EFFECT ON RADIO TRANSMITTERS ETC.

There is an extremely small chance that the wagon may interfere with, or be affected by, radio equipment etc. In such an event the wagon is to be immediately turned off.

### 3.2 RAIN/SNOW/INCLEMENT WEATHER

The MK2 version, been constructed from wood and, although may have been stained, or protected from the elements in some other manner, is not considered to be dust or waterproof. Thus it is not recommended to operate the wagon outdoors during rain, snow or other similar inclement weather.

### 3.3 EXTREMELY HOT WEATHER

Although there is no actual evidence, a risk has been identified that in extremely hot weather, particularly when bright sunshine means that the display brightness or intensity has been set to maximum, that the wagon may fail due to the built up of heat within the same. Thus if there is any suspicion of such heat build-up turn of the same and remove the top in order to disperse this heat.

### 3.4 RE-CHARGEABLE BATTERIES

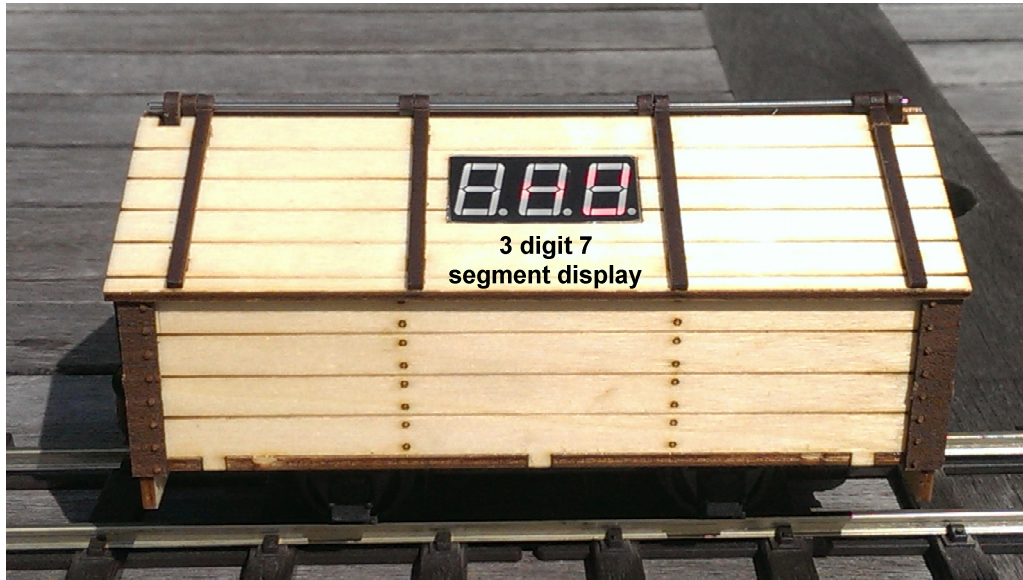
The wagon is designed to accommodate rechargeable batteries (not supplied) that can be re-charged in situ using a proprietary 'smart' charger (not supplied). If non rechargeable batteries are used, please to not forget this fact and attempt to charge them!!!

**The wagon may have been supplied from new with non-rechargeable alkaline batteries. Please therefore check the battery type before attempting to charge the batteries for the 1<sup>st</sup> time.**

## 4 OPERATION

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### 1 3 digit 7 segment LED Display



The display indicates the scale speed in miles per hour (mph) or kilometers per hour (kph), depending on the absence or presence respectively of the shorting header across pins 1 and 2 of JP1 on the controller circuit board (item 2).

The maximum displayed scale speed is 99.9 mph/kph: if the wagon travels faster than this maximum speed than the display reads "99.9."

For indicated scale speeds of less than 10.0 mph/kph the left hand side digit of the display is blanked to save power: see the above image for an example.

The actual scale speed displayed is the average speed over the previous 1 second, so different scale speeds may be observed at the same track location with the same tractive effort particularly if the wagon is accelerating or decelerating due to the slope of the track at that point.

Thus the speed wagon is the most accurate at constant speed on level tracks.

The actual accuracy of the displayed speed is  $1\% \pm 0.2$ : e.g. at a typical light railway maximum speed of 25mph, the indicated speed is  $25.0 \pm 0.45$ mph. At the maximum displayed speed of 99mph, the accuracy is  $99.0 \pm 1.2$ mph. These figures compare favorably with the accuracy of a typical car speedometer.

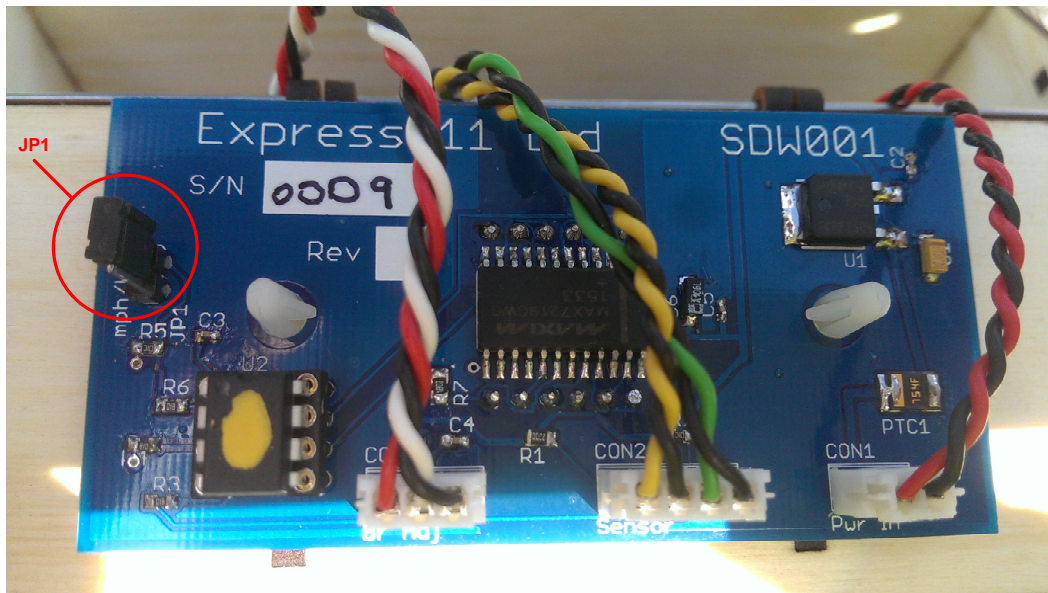
On power up all the segments on all the digits are flashed three times so that the user can verify that all the segments are operational prior to use.

In order to save power, after four minutes of no movement the display goes into 'sleep' mode. As a result the “\_0.0” displayed (\_ = Blank) is replaced by “\_.”: the single dot indicates to the user that the wagon is still turned on. The wagon will come out of 'sleep' mode once it is on the move again.

Any of the following may indicate that the batteries are run down and require replacement/recharging change:

- No speed is indicated when not stationary, i.e. “\_0.0” (\_ = blank)
- The displayed speed is 'locked', i.e. will not change
- The display brightness varies and depends on the no. of display segments that are illuminated – less segments displayed is brighter

## 2 mph/kph Mode Select Header Pins, JP1



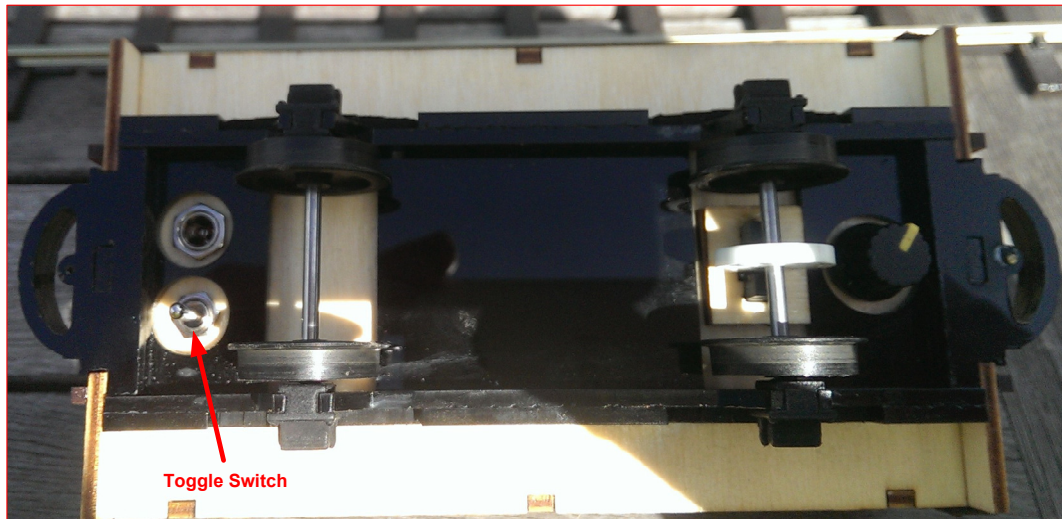
JP1 is located on the controller printed circuit board (pcb) that is mounted on the inside of the one of the 'flip over' covers of the wagon.

On power up, if there is no shorting link between the two pins of JP1 on the controller board, then the wagon operates in 'mph mode' with a scale speed resolution of 'about' 0.2 mph, although the math is such that at certain speeds, the right hand side digit of the display is an odd number (the sensor resolution is actually 0.2008 mph).

If on power up, there is a shorting link fitted between the two pins of JP1, then the wagon operates in 'kph mode' with a scale speed resolution of 'about' 0.3 or 0.4 kph (the sensor resolution is actually 0.3232 kph).



3 **ON/OFF/CHARGE Toggle Switch**



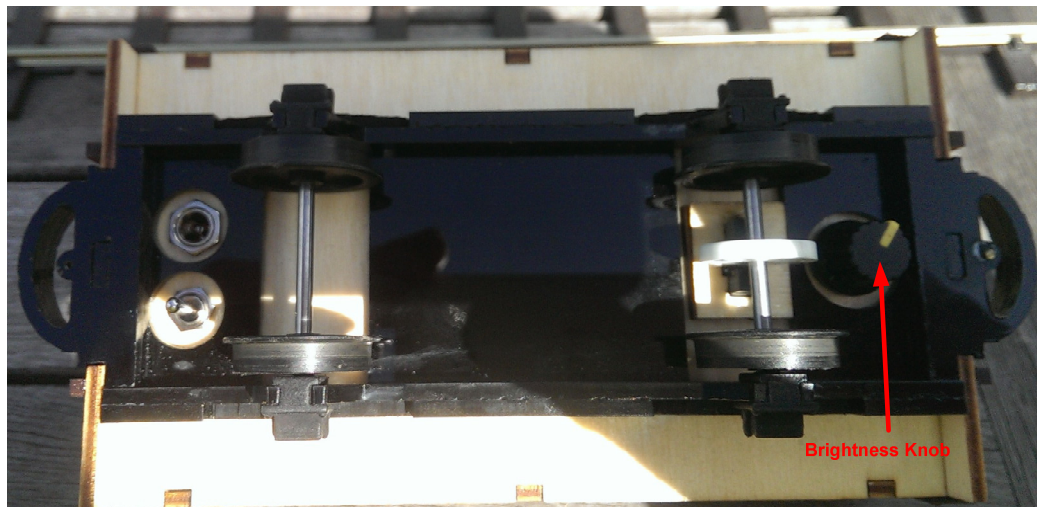
The wagon is OFF when the switch is in the centre position

The wagon is ON when the switch is in the outside position (nearest to the side of the base)

The batteries can be charged when the switch is in the inside position (furthest away from the side of the base/nearest to the charger socket).

**Note:** the battery voltage will be present on the centre pin of the charging socket (item 5) when the switch is in the CHARGE position and a 2.1mm plug is inserted (handy for charging up your mobile phone???)

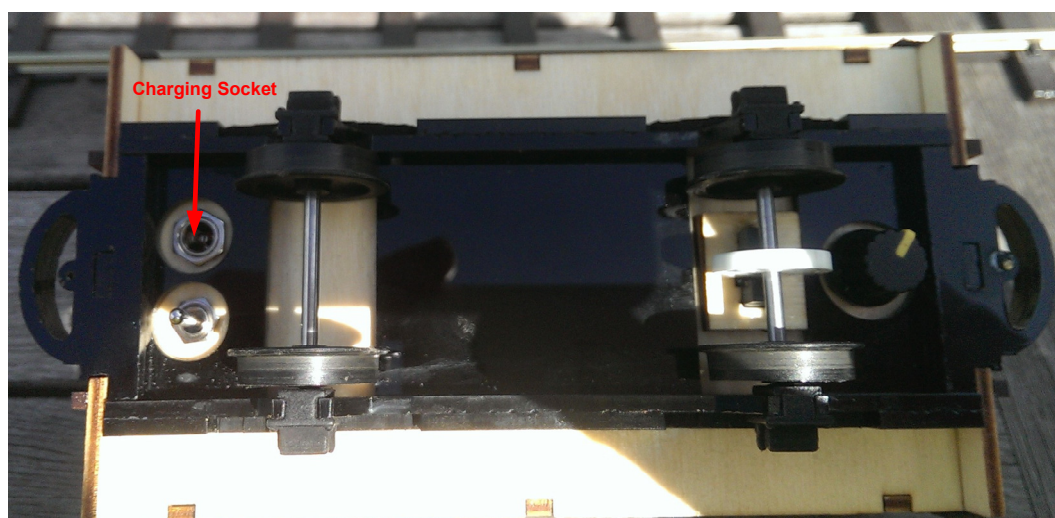
4 **Brightness/Intensity Adjustment Knob**



The brightness, or intensity, knob adjusts the brightness or intensity of the speed display in sixteen steps from minimum to maximum. For reasons of battery longevity, the brightness should be adjusted to the minimum acceptable/readable level for the local ambient light levels.

**Note:** the design is such that the maximum brightness is that technically achievable without exceeding the display manufacturers' specified maximum current rating is actually implemented, i.e. it is not possible for the display to be any brighter.

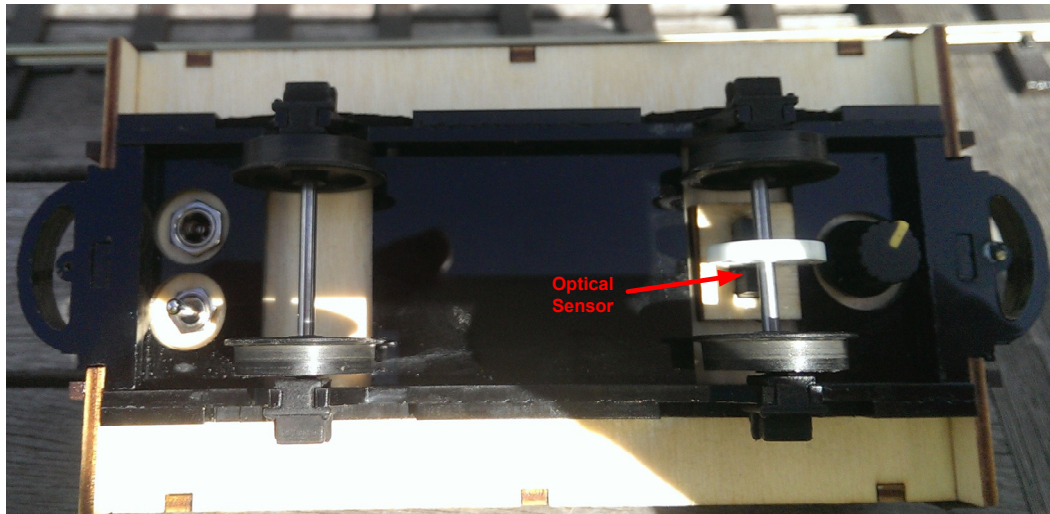
5 **Charging Socket**



The 2.1mm positive inner pin charging socket is present so that, if rechargeable batteries are fitted, these can be recharged in situ using a proprietary 'smart' charger.



6 **Optical Sensor**

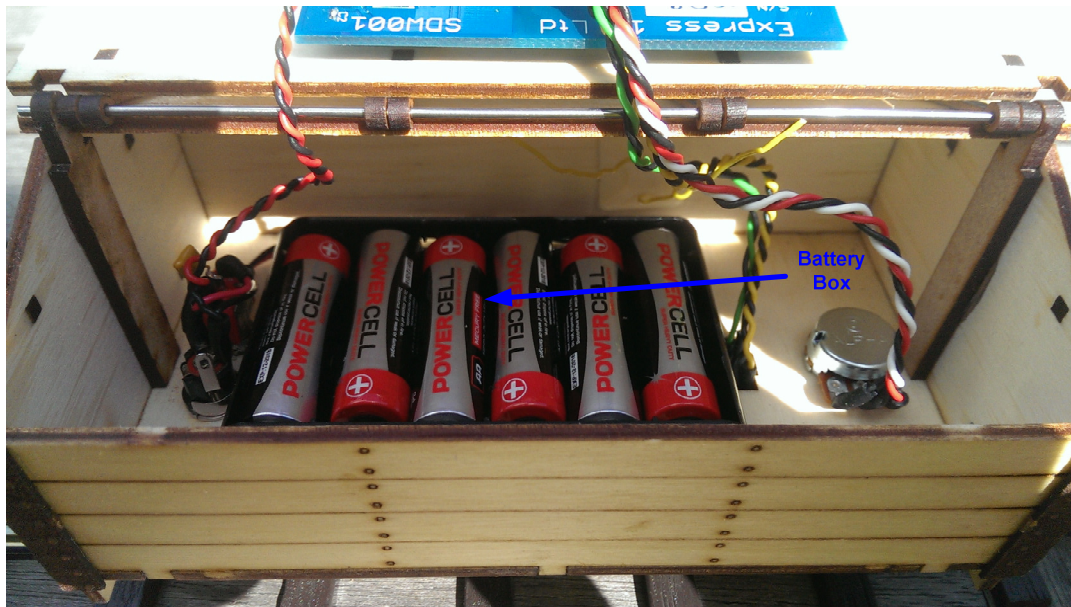


The optical sensor 'counts' the number of transitions between spoke and non-spoke and non-spoke and spoke of the passing sensor cog attached to the middle of the axle.

For the MK2 wagon, it is not possible, or necessary, to adjust the position of this sensor.

**Note:** when the display is in 'sleep' mode, the optical sensor is still powered.

7 **Battery Box**



The battery box accommodates 6 off AA batteries and is located on the inside of the base of the wagon. Any batteries supplied are non-rechargeable so that the wagon is 'ready to run': the owner can then choose his/her preference of rechargeable batteries.



The wagon should be turned off prior to installing or removing the batteries.

**Heed the warning in Section 3 regarding the recharging of non-rechargeable batteries.**

Any of the following may indicate that the batteries are run down and require replacement/recharging change:

- No speed is indicated, i.e. “\_0.0” (\_ = blank)
- The displayed speed is ‘locked’, i.e. will not change
- The display brightness varies and depends on the no. of display segments that are illuminated – less segments displayed is brighter

If 2500mAh batteries are used and with the display at maximum brightness, at a displayed scale speed of 25.0, the battery life is approximately 10 hours: on minimum brightness this life is about 48 hours (2 days!!): these figures clearly demonstrate that fully charged batteries will last during all but an extremely lengthy steam up!

If the wagon is inadvertently left powered up, these batteries will last up 50 hours on maximum brightness, or up to 65 hours at minimum brightness before they are completely discharged.

**Note:** when the display is in ‘sleep’ mode, the optical sensor is still powered.

In order to prevent damage to the batteries and/or the associated box in the event of a short circuit, e.g. on the charger socket, an automatically resettable fuse is installed between the box and the toggle switch.

## 5 MAINTENANCE

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Other than recharging the batteries, if rechargeable batteries are indeed fitted, no routine maintenance is necessary.