

SSI Application of Bombardier Fibre Optic Colour Light Signal, Full Size Fibre Optic Alpha Numeric Route Indicator and Fibre Optic Junction Route Indicator

1. Document Status

This is a document for SSI Signalling Principles Group ("SSISPG") discussion and has been approved for use.

2. Purpose of paper

To discuss a SSI version of the hardware application and changes to the monitoring on the Technician's Terminal for the new Fibre Optic signal range from Bombardier, specifically for use at Ladbroke Grove. This document is limited purely to the application of the new Fibre Optic signal range which is being used as a direct replacement for the traditional multiple aspect Colour Light Signal (CLS), Full size Fibre Optic Alpha Numeric Route Indicators and PLJI. These signals separate the lamps and associated electrical equipment from the optical arrangements allowing the latter low maintenance head unit to be smaller and located closer to driver's eye level, and closer to the OLE than a Technician can get without an isolation. The Fibre Optic Colour Light Signal displays red, yellow and green through the same lens, as in a conventional searchlight signal. There are no 4 aspect applications on this scheme. There are no flashing aspects on these signals within this scheme, and the dark proving would need re-visiting before using any.

There are 2 types of Route Indicator, an alpha numeric replacement for the 'Standard' full size Alpha Numeric Route Indicator (Theatre MLRI or older style FORI) which uses a single lamp for each route, and a Fibre Optic Junction Route Indicator [FOJRI] displaying arrows, as a replacement for the conventional PLJI, which uses 2 lamps for each route with a changeover relay. There are no Miniature Alpha Numeric Route Indicators involved. This document was prepared on the basis that Ladbroke Grove would utilise the FOJRI but it is now intended to use the "like 4 like" LED PLJI from Dorman instead.

The mechanism of using a low value external resistor in the current proving path in place of the resistor within the module is also suitable, subject to choosing a suitable resistor, for other applications that draw *more* current than the standard loads catered for by the TFM's internal resistors.

3. Operation

The Ladbroke Grove Remodelling interlockings to be modified are located at Slough Signal Box and are controlled from Slough New IECC Signal Box. The trackside interfaces to be modified run from the buffer stops at Paddington to the 2 ¼ milepost.

There is no proposal to change any of the data (other than for the re-modelling) as all the signals proposed will be like for like replacements. The exception to this is the new FOJRIs that are being provided with two lamps, main and auxiliary and therefore a change to the TFM database is necessary and so also the diagnostic data for monitoring of these on the Technician's Terminal.

The new Fibre Optic signal uses a different current path for lamp proving due to the different current resulting from the change in style of lamp used on the new signals. This is considered in the hardware application and TFM allocation. Also, a heater element will be provided for the Colour Light lens only to prevent condensation. This is included for completeness and has no affect on the SSI.

4. Application

The application of the Bombardier Fibre Optic signal range is broken down into three parts, namely, FOCLS, Full Size Fibre Optic Alpha Numeric Indicator and FOJRI, each with an associated circuit diagram.

All of the new range of signal objects use the same 50 W Halogen lamp and therefore the interface for all signals is the same. This is addressed in the FOCLS section of the document only.

The SSI Signal Module has four Current Paths (CP) inputs as follows:-

- CP1 = 3.3 Ohm resistor, Lamp Proving of one SL35 lamp, current detect >190mA, no current detect <150mA.
- CP2 = 0.82 Ohm resistor 1 x 60 W lamp failed out of 2, Current detect >760mA, no current detect < 630mA
- CP3 = 1.0 Ohm resistor 3 x 24W lamps failed out of 5, current detect > 630mA, no current detect <510mA.
- CP4 = Lamp Proving of one SL35 lamp, current detect >190mA, no current detect <150mA.

When CP1 is in use, a loop is made from Current Detect 1 [CD1] to Current Sense 1 [CS1]

When one of CP2/3/4 is in use, a loop is made from Current Detect 234 [CD234] to Current Sense 234 [CS234]

The value of current in the 110V circuit of a SL35 signal is normally of the order of 220mA. Lamp failure will be detected when the current reduces to a value between 190mA and 150mA, i.e. between 86% and 68% of the normal operating value. The value of current in the 110V circuit of a Quartz Halogen 50W lamp is of the order of 500mA. If connected to CP1 or CP4 lamp failure will be detected when the current reduces to a value between 38% and 30% of the normal operating value. One risk is that if a high resistance develops in the circuit the luminosity of the lamp may be below visible threshold before failure is detected.

To obtain a correct resistor value in the Current Path it is sometimes possible to connect an external resistor in series with CP2 or CP3. However, at Ladbrooke Grove these Current Paths may already be allocated. Therefore as a universal solution it is proposed that the Current Path resistor for proving 50 W quartz halogen lamps be implemented by omitting the loop from Current Sense to Current Detect and instead, inserting a single 1.2 Ohm resistor in the return path connected to CP0 and connecting its remote end to CS1, or alternatively to CS234. With the very low value of this resistor, it is important not to allow the associated cabling and connections to add to the resistance.

CP0 frequently provides a current return path for other loads, e.g. AWS, TPWS, Signal Lamps, etc. , and care must be taken to ensure that these currents do not generate voltages in the connection to Rext. This requirement can be achieved by installing Rext such that the wire length to the TFM CP0 is 1m or less. If this is not practical introduce a CP0 Busbar connected to the TFM CP0 connector with 1m length or less of 32/0.02 wire. One metre length will introduce only 0.02 Ohms resistance which at 1A from other loads will introduce an error of only 20mV. A dedicated wire can then be teed off to Rext.

4.1 Fibre Optic Colour Light Signal (3 Aspect, Single Lens, Searchlight Style)

The 3-aspect searchlight FOCLS is a direct replacement for the traditional CLS with the exception of the current return path. This is detailed on the circuit diagrams, Figures 1 and 2 at the end of this document.

The lamp used in the Fibre Optic CLS is a 12 V 50 W Halogen lamp. Due to the higher current drawn by the Halogen lamp, it has been necessary to change the current return path connection on the module from CP1 or CP4 to CP0 with the use of an external 1.2 Ohm resistor in place of that within the TFM. There are 2 lamps with a change over relay for each aspect which operate in a similar manner to a conventional twin filament lamp and change over relay.

There are no changes to the SSI application data or fault reporting, as there are no changes to the way the signal data is handled.

Additionally, a 330 Ohm 50 Watt heater resistor is provided for the Fibre Optic CLS to prevent condensation on the lens unit, as there are no electrical parts in the signal head. All the electrical components are in the distribution box. The heater is driven from an 110 V source and is directly connected via the distribution box from the supply.

4.2 Full Size Fibre Optic Alpha Numeric Route Indicator

The new Fibre Optic Alpha Numeric Route Indicator is a direct replacement for the traditional full size Standard Fibre Optic Alpha Numeric Route Indicator with the exception of the current path. This is detailed on the circuit diagrams, Figures 3 and 4 at the end of this document.

The application is identical to the FOCLS above except that only one lamp is used to drive the indication and no changeover facility is provided in line with the current Standard Fibre Optic Alpha Numeric Route Indicator interface.

There are no changes to the SSI application data or fault reporting, as there are no changes to the way the signal data is handled.

4.3 Fibre Optic Junction Route Indicator

The new FOJRI differs from the traditional PLJI in its construction and operation. The new FOJRI is electrically the same as the new FOCLS using twin Halogen lamps to produce each Route Indication. The interface is therefore identical to the FOCLS having a main and auxiliary lamp. This is detailed on the circuit diagrams, Figures 1 and 5 at the end of this document. There is no pivot lamp common to all route indications.

The main/auxiliary lamps have been provided for availability, as there is otherwise no tolerance of lamp failures as with the traditional PLJI and the proving of just 3 out of 5 lamps. The FOJRI has a change over arrangement to switch to an auxiliary lamp when the main lamp fails. Therefore an additional input is required on the TFM for the FOJRI to monitor the status of the lamps.

There are no changes to the SSI application data (apart from deleting the data for the pivot on multi route indicators) but there is a need to change the way the fault reporting is provided. This is discussed in Section 5 of this document.



5. TFM Database

The new FOJRI has two lamps; therefore an additional input is required for 'first filament' failure monitoring purposes. The existing "UEC" current proving input will be used to prove either lamp lit whilst a new input "UEK" will prove the main lamp lit. Therefore if the main lamp fails the "UEC" bit will remain set and the "UEK" bit will become unset.

This is demonstrated in the following TFM Allocation Table: