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Module

Relay Interfaced SSI

Endorsement and Authorisation

For endorsement, authorisation and issue record of this document, please refer to the SSI Applications Manual Contents, NR/L2/SIG/17002.

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User information

This Network Rail standard contains colour-coding according to the following Red–Amber–Green classification.

Red requirements – *No deviations, could stop the railway*

- **Red requirements will** always be complied with and achieved.
- Red requirements are presented in a red box **with the word “shall” or as a direct instruction**.
- Accountability for the efficacy of red requirements lies with the Professional Head/Standard Owner.
- Red requirements are monitored for compliance.
- Corrective actions will be enforced if deviations are discovered through functional checks (e.g. engineering verification visits, audit or Operations Self-Assurance).

Amber requirements – *Controlled deviations, approved risk analysis and mitigation*

- **Amber requirements will** be complied with unless deviation has been approved in advance.
- Amber requirements are presented with an amber sidebar **and with the word “shall” or as a direct instruction**.
- Accountability for the efficacy of these requirements lies with the Professional Head/Standard Owner, or their nominated Delegated Authority.
- Amber requirements are monitored for compliance.
- Deviations **may** be permitted. Deviations are approved by the Standard Owner or through existing Delegated Authority arrangements.
- Corrective actions will be enforced if **non-approved** deviations are discovered through functional checks (e.g. engineering verification visits, audit or Operations Self-Assurance).

Green – *Guidance*

- Guidance is based on good practice. Guidance represents supporting information to help achieve **Red** and **Amber** requirements.
- Guidance is presented with a dotted green sidebar **and with the word “should” (usually in notes)**.
- Guidance is **not mandatory** and is not monitored for compliance.
- Alternative solutions may be used. Alternative solutions do not need to be formally approved.
- Decisions made by a competent person to use alternative solutions should be backed up by appropriate evidence or documentation.

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Issue record

Issue	Date	Comments
1	October 2005	First Issue
2	June 2011	Second Issue
3	03/12/2011	Third Issue

Compliance

This Network Rail standard is mandatory and shall be complied with by Network Rail and its contractors if applicable from 03/12/2011.

When this standard is implemented, it is permissible for all projects that have formally completed GRIP Stage 3 (Option Selection) to continue to comply with the issue of any relevant Network Rail standards current when GRIP Stage 3 was completed and not to comply with requirements contained herein, unless stipulated otherwise in the scope of this standard.

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1 Introduction

1.1 General

This document describes the modifications to standard SSI data and interface wiring that are necessary in order to design an SSI replacement for a relay based interlocking, whilst retaining the existing external lineside equipment and cabling.

This method would usually be deployed at sites where the interlocking wiring within the relay room is in a degraded state, but the external wiring and equipment are still serviceable.

Trackside Functional Modules (TFMs) are used to drive output interface relays. The output interface relays control the existing relay room outgoing lineside circuits. Similarly, the existing incoming lineside circuits are used to operate input interface relays. TFM inputs will be taken over contacts of these relays.

2 System Architecture

2.1 Signal Modules

Signal Modules are used to drive signal control circuits (e.g. HR, UHR) and to take inputs from signal repeat circuits (e.g. RGPR, H/DGPR), as well as miscellaneous input and output circuits. Typical circuits for the control and indication of signals are shown on circuit figures 1 to 3. Inter-dependent signal functions e.g. RGPR/HGPR should be connected to the same module.

2.2 Points Modules

Points Modules are used to drive point control circuits (e.g. WR) and to take inputs from detection circuits (e.g. WKR), as well as miscellaneous input circuits. Typical circuits for the control and detection of points are shown on circuit figures 4 & 5. Figure 4 applies to points where the WJR was originally in the Relay Room, and the circuit to the external NWR/RWR relays only needs to be made while the points are motoring. Figure 5 applies to points where the WJR is in the location, and the external NWR/RWR relays require a constantly-fed circuit.

Where existing location case wiring differs from that shown in figures 4 and 5, it should be checked for compatibility with the new equipment room wiring. In particular, if the point contactors are down-proved in the detection circuits back to the TFM, then the contactor circuit shall include a back contact of the relevant local detection relay so that the contactor drops when detection is made.

Where points were direct-fed from the relay interlocking, and so new point contactors are provided in the new equipment room rather than in an existing location case, then the new contactor and detection circuits should be drawn to latest standard circuits.

2.3 Output Relays

TFM output interface relays should be co-located with their associated TFMs.

Where the point WR relays are not mounted on the same rack as their controlling modules then snubbing diodes should be provided (see circuit figures 4 & 5). These

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diodes should be connected across the relay coils and be mounted on or as near as possible to the relay base.

2.4 Polar Circuits

Cross-proving of relays in outgoing polar circuits should be provided in situations where rapid switching between the two states could result in both relays being energised at the same time, thus blowing the line fuse. In figure 4, for example, contacts of the WR relays are cross-proved in the outgoing polar circuit to prevent a momentary short-circuit if both relays should be energised at the same time, e.g. if the points are reversed mid-throw. This situation is unlikely to occur with polar circuits used for selecting routes from the same signal (see figure 2), because of the time required to cancel one route and set another.

2.5 Newton Modifications

For panel schemes Newton modifications shall be included (for further details see [SSI8151](#) Retrospective and Other Amendments).

Where an existing panel is to be retained but it is not practical to install the PMUX equipment within 30m of the panel, then a solution is to provide panel interface relays.

If it is not practical to add the extra (TM) button contacts required for the Newton Modifications, then the functionality of these contacts can be replicated using the back contacts of that particular function's (F) interface relay. This allows the conventional SSI Newton data constructs to be utilised.

2.6 Data Link

Because of the co-location of TFMs, and hence DLMs, the baseband data link will be much shorter than conventional SSI installations. If the interlocking is located within the normal baseband range of the equipment room containing the DLMs and TFMs, a baseband system will be sufficient, otherwise a long line link will be required, in that case the baseband datalink will be confined to the equipment room.

Compliance with the specification for data link arrangements given in this section will ensure that the transmission characteristics will be similar to installations that have performed satisfactorily under test.

All components and methods of interconnection of the data links should be as given in [SSI8500](#), with the exception of sections of the baseband data link that are internal to the equipment room; these use 2-core 16/0.2mm twisted pair cable to [DEF STAN 61-12](#) Pt5. The braided screen should be left un-terminated.

To conform to the analysis and experiments performed at BR Research, each baseband link should have a simple linear topology with no spurs and with 100 Ohm termination resistors at both ends.

There is no minimum length for a data link and the maximum length is 10 km, with no repeaters. Interfaced SSI installations are not likely to exceed 50-100m.

Telegram transmission timing calculations can then allow a maximum of 5 μ s for transmission along the baseband data link.

The data links can be wired in a conventional diverse manner or because of a more predictable environment, both the A&B data links can be wired in the same order.

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An alternative to the conventional data link layout above is to configure the data links as a Star Point connection, similar to internal datalink arrangements. For this configuration the data links consist of busbars, with spurs from the bus-bar to termination blocks on each DLM rack (It may be found that data links of less than 500 m work better as spurs without terminating resistors at the outer end).

The transmitted voltage on the data link, when measured at the DLM, shall be within the range $4.5 \pm 0.5V$ pk-pk. This is a wider range than permitted for normal SSI systems, as experience has shown that lower voltages are found on the shorter data links used by an interfaced SSI system.

2.7 Surge Suppression and Interference

If the Data link is connected to DLMs outside the equipment room then this should be suitably isolated and Data Link Surge Protection Units fitted as close to the point of entry as practical. It is preferable to keep any datalink extending outside the equipment room separate from that feeding the interfaced equipment within the equipment room, e.g. by feeding separate datalinks from the L and R datalink connections of a back-to-back DLM repeater-pair.

All lineside cabling entering the equipment room shall be kept separate from the TFM input/output wiring.

2.8 Earthing

The earthing arrangements for the TFM (filter and chassis) shall be such that electrical noise is not, as far as possible, passed on to other TFMs. For example, this will involve separate earth wires from the filter and the chassis to a local earthing point on each rack.

2.9 Power Supplies

The power supplies for TFMs and DLMs can be provided using conventional TFM, Point and Signal transformers or by providing common 110V and 140V supplies. The use of common supplies on commissioned systems has been found to run reliably without the need for individual isolating transformers between the supply and the TFMs, however, earth leakage detectors shall be provided.

For Interfaced SSI systems, the TFMs only drive relays consequently taking only a small load from the supply compared with a conventional SSI arrangement. Therefore, if an existing traction-derived power-supply has to be retained then the use of an Uninterruptible Power Supply is a practical means of power conditioning the supply.

2.10 Interlocking Power Supply Failures

There is a possibility, following a short term transient trackside power failure (such as circuit breakers reacting to lightning or during a changeover to an alternative supply), that some track circuits may drop and then pickup in an order matching the track circuit release sequence for subroutes or a signal's approach locking; therefore, the interlocking shall be prevented from reacting to TFM input changes until the track circuits have settled. This mainly applies to schemes where the trackside supply is separate to the interlocking and TFM supply.

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Interlockings can be prevented from reacting to input changes by adding 'power off' relays to the trackside supply, contacts of these relays can then be used with one of the following methods to isolate the data links for 10 seconds. For Base Band systems, this can be achieved by cutting the supply to 'Back to Back' DLM repeaters added for this purpose at the start of the data links. For Long Line systems the same effect can be achieved by cutting the supply to the LDTs. Note that all TFMs fed by the affected 'Back to Back' DLM or LDT will enter "red retaining" mode, and *all* functions input by those TFMs (including point detection, signal lamp-proving, etc.) will be lost while the supply to the DLM/LDT is cut.

An alternative arrangement is to input "power on" monitoring into a TFM, and use IPT data to set the relevant track circuit memories to the undefined state unless the "power on" input has been timed for at least 10 seconds. This method avoids the TFMs going into "red retaining" mode and the loss of other inputs.

For longer interruptions to the trackside supply a technician should be in attendance to restore the supply, therefore the interlocking is protected by procedure.

Where the interlocking(s), TFMs and the trackside share a common power supply, in the event of a long power supply interruption, the effects of the trackside on the interlocking are protected against by the interlocking start up modes. The ideal solution is a common power supply backed with a UPS and seamless transition to a generator set.

3 Diagnostics

3.1 Technician's Terminal

A standard Technician's Terminal should be provided in the vicinity of the Central Interlocking. If the DLMs and TFMs are situated remotely from the Central Interlocking, then a remote terminal will also be required in the equipment room housing the TFMs.

Some of the diagnostic features provided by a standard SSI will not be available with an Interfaced SSI, as detailed below.

3.2 Main Aspect Lamp Failure

In the event of a main aspect lamp failure the Technician's Terminal will only report a signal lamp failure, no indication will be given as to which aspect has failed.

Associated line circuit faults will also be reported as a lamp failure. (see message example in the TFM Schedule, Section 8).

3.3 Route and Junction Indicator Lamp Failure

All route and junction indicator lamp proving is normally part of the external location wiring associated with the main signal. As a result, there will be no line circuits specifically to provide information to the interlocking for the state of the route and junction indicator lamps, therefore no diagnostic reporting will be available in the event of a failure.

3.4 First Filament Failure

First filament failure indications coming into the equipment room can remain in their original groups and be indicated on the existing technician's indication panel,