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Module

Chapter G: Cabling and Connections

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 variations, could stop the railway

- **Red requirements shall** always be complied with and achieved.
- Red requirements shall be presented in a red box **with the word “shall” or expressed 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 shall be enforced if deviations are discovered through functional checks (e.g. engineering verification visits, audit or Operations Self-Assurance).

Amber requirements – Controlled variations, approved risk analysis and mitigation

- **Amber requirements shall** be complied with unless variation has been approved in advance.
- Amber requirements shall be presented with an amber sidebar **and with the word “shall” or expressed 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.
- Variations **may** be permitted. Variations are approved by the Standard Owner or through existing Delegated Authority arrangements.
- Corrective actions shall be enforced if **non-approved** variations 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 shall be presented with a dotted green sidebar **and with the word “should” (usually in notes) or as a direct instruction**.
- 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
12	05/09/2015	AMD 04/01 (7) incorporated

Compliance

This Network Rail standard is mandatory and shall be complied with by Network Rail and its contractors if applicable from 06/12/2015.

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

One of the design objectives of the SSI project was for a reduction in wiring and cabling compared with a relay based signalling scheme. With the exception of trackside tail cables, the remaining lineside requirement is for power supply and Data Link cables. It is therefore important that cable design and installation standards are high if high overall long term system availability and reliability are to be achieved.

All cables should be permanently labelled at each end to identify the cable.

2 Cabling – Control Centre

2.1 Control Centre - General

Requirements for Control Centre data transmission cabling are shown schematically in Figure G1. The Data Link Cable Termination Rack shall be used to mount the outgoing Data Link Data Link Surge Protection Units and Data Link terminating resistors where required.

Cables shall be permanently labelled to indicate the equipment/plug coupler to which they are connected. All external connections to the CI cubicle and the TT are via plug and socket connectors.

2.2 Central Interlocking (CI) Identity & Version Connections

Each CI has an Identity and Version No. (see Chapter D Section 8) which shall be wired into the 50 way connector for each interlocking MPM. The wired in Version number is reduced by using the remainder in binary form after dividing the number by 8. Thus Version number 9 becomes 001, 23 becomes 111 and 4 becomes 100. Figure G2 shows the connections required. The Diagnostic MPMs and PPMs do not require Identity or Version number connections.

2.3 Simulator MPM Adaptor Cables

The bottom Interlocking MPM in a CI cubicle can be converted to a Simulator MPM for On-site Simulation, and part of this conversion includes adding an adaptor cable between each of the MPM's two connectors and its associated connector in the cubicle wiring. As there are two options for On-site Simulation, either with or without adjacent Interlockings simulated, the cable for the 50 way connector either comes in two versions (WSL) or with an in-line connector for converting the cable (GEC). Full details of On-site Simulation are included in [GS/SI8300](#) and [NR/L2/SIG/30014](#).

Temporary disconnections of Data Links and associated addition of temporary terminating resistors are covered by "Signalling Works Testing". Figure G1 sheet 2 can be used to identify between which pins, of connectors E, F & G, these resistors can be connected.

3 Cabling and Connections – External

3.1 Locations - General

Typical location internal wiring arrangements are shown in Figures G3 to G7, wire and cable types and connector details are given in Chapter I.

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Crimped connections in free connectors may only contain one wire each. All sockets of the wire wrapping type provided in the free connectors for PMs, SMs or LDTs shall be sleeved to avoid the sockets making electrical contact with each other or with the connector shroud.

Free connectors for TFMs, LDTs and DLMs shall be labelled with the Module identity and the BX110 or B12 busbar and fuse number.

Physical separation shall be provided between PVC covered wires to [DEF STAN 61-12](#) Part 6 type 3 (typically used for connections to Modules) and PCP covered wires to [GS/ES 0872](#) (typically used for tail cables).

3.2 Data Link Modules (DLMs)

All the "TFM connections", as defined in Figure G8, whether connected to TFMs, LDTs or other DLMs, shall be via twisted pair cables.

Twisted pair cable connections between the duplicated TDL and TFMs via the DLMs are shown in Figure G8 with a typical application in Figure G3. Disconnection links shall be used if more than one DLM is connected to a single data link. DLM to LTU connections should be kept as short as possible. Where TFMs are housed in a location case adjacent to the DLMs, the case to case connection shall be made with external grade twisted twin cables via disconnection links.

The connections required for two DLMs to be connected in "back to back mode" and function as a repeater are shown in Figure G8.

3.3 Long Distance Terminal (LDT)

Details of connections are shown in Figure G16. These include the wire wrap connections which configure the Control Centre Identity number and whether the LDT is at the CI or the trackside. All the "TFM connections", as defined in Figure G16, whether connected to TFMs or DLMs, shall be via twisted pair cables.

3.4 Trackside Functional Module - Addressing and Modifier

Figure G9 shows the TFM address coding calculation and connections which are contained within the bodyshell of each TFM free connector forming part of the location case wiring. The address connections, including modifier shall each form a complete loop, wire wrapped onto the pins and carried out in insulated wire (black for "0"; red for "1").

Figure G9 also shows connections required for the "modifier" to inhibit or introduce flashing aspect capability to the SM or configure the PM for the number of point ends in each Module point group. Address lines for processors A and B shall be connected identically for any given Module.

Figure G4 shows typical application of these connections to a detailed location diagram.

3.5 Signal Module (SM), Outputs and Inputs

Figure G10 shows SM output and return current path connection details corresponding with the outputs and return paths available for allocation on the Signal Module Schedule, Chapter D Figure D2. Also shown are the looping requirements associated with the Red Retaining feature.

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Where the Signal Module Schedule specifies an item of equipment is to be supplied from the "Fixed Source", the item shall be fed direct from the same BX110 fuse as supplies the Module. Alternatively, the signal may be connected as per standard circuit [T28301](#).

Figures G4 and G5 show typical application of these connections to a detailed location diagram.

Figure G11 shows the connector pin allocation for the SM inputs and input supplies, typical application is shown on Figures G4 and G5.

BX/NX pairs should not be divided between different layers of any multi core signalling cable used for module connections.

3.6 Module (PM), Outputs and Inputs

Output and power supply input connections for the PM are shown in Figure G12. Due to the maximum current rating of each connector pin, a separate BX140/CNX connection shall be made for each clamp lock pump motor; Figure G6 shows typical application of these connections for one double ended set of points. All pump motor inputs and outputs shall be made in 32/0.2mm wire. Where other types of point machines are driven via interface relays connected to the valve outputs, the BX140/CNX motor input connections are not required but the BX140 and BX110 Module power supplies shall both be connected.

Module input and input supplies are shown in Figure G13, and Figure G6 shows a typical application.

3.7 Signal Module (SM), Flashing Aspects

Connection details for a 4 aspect signal with flashing yellow aspects are shown in Figure G14; the modifier associated with the address looping shall be connected to logic "1" (Figure G9). If a signal with a single flashing yellow is to be driven from a Module, resistor R1 is omitted and output 0 shall remain unconnected but output 5 may be used as a normal non flashing output.

R1 & R2 are 680 ohm, 10W resistors which give a bright/dim current ratio of 30% $\pm$ 5%. During the dim period this will maintain the signal head ER (BR Specification 903F) energised but will keep the output current below the Module's current proving threshold.

When driving LED signals, the resistors R1 and R2 are not required, and shall be omitted. Note that in this case the Signal Module outputs 1 and 0 may not be used for other purposes. The module allocation shall be filled in as usual, with a note that the outputs concerned are not to be used.

Where the flashing signal has no red, a 110V a.c. relay is connected to output 7, this configured as a "protected source". A front contact of this relay shall be added in each Module output circuit, adjacent to the Module, that feeds an aspect of the signal concerned. The output of the signal's AWS magnet shall similarly be disconnected by double cutting the output of the transformer rectifier. BX110 from the Module's 110V supply fuse ("fixed source") is then connected, via a back contact, to the in-line fuse of each output required to display the most restrictive aspect, i.e. single or double yellow. Note that all outputs associated with the signal are cut to allow for the

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relay wrongly de-energising, and this is a special exception to the rule of not cutting Module output circuits with relay contacts.

3.8 Signal Module (SM), Current Proving

The use of an external resistor makes it possible to current prove non-standard loads, see Figures G15A and G15B. The external resistor shall be of rugged wire wound construction, its value is calculated according to the formula shown. Calculations should take supply voltage tolerances into account. Non linear characteristics of lamps and their level of illumination at lower than specified currents should also be considered in designing non-standard current proving circuits. Wiring to external resistors should be kept short, not exceeding one metre of 32/0.2 wire.

When proving lower currents than the standard loads provided by a SM, see Section D 3.2 and Figure G 15A, the external resistor is added in series with the SM internal resistor.

When proving higher currents than the standard provision, the SM internal resistors are not used and the load is returned via the external current proving resistor to CP0. A connection is made between the load side of the external resistor and the current sense 1 or current sense 2, 3, 4 as appropriate.

Irrespective of use of current paths, connections to current sense 1 and current sense 2,3,4 shall always be made as per Figure G14, or as per Figure G15 for non-standard current proving.

If multiple connections are made to CP0, a suitable low impedance bus bar shall be provided on the CP0 circuit. This shall be located as close as is practical to the module. Where a lamp proving resistor (ECRO) is provided, loop wiring should be kept as short as possible and consideration given to other loads returning through CP0 (e.g. AWS).

DAT315 TBD

3.9 Signal Module (SM), TPWS

Circuits for interfacing to TPWS are shown in outline in Figures G17 to G23 inclusive, according to the method used. Further details are given in Typical Circuits [T34030](#) to [T34039](#) inclusive. The methods are described in Chapter D, Section 3.4.

3.10 Signal Module – Track Circuit Interruptors

Track circuit interruptor inputs should be wired using single core cables.

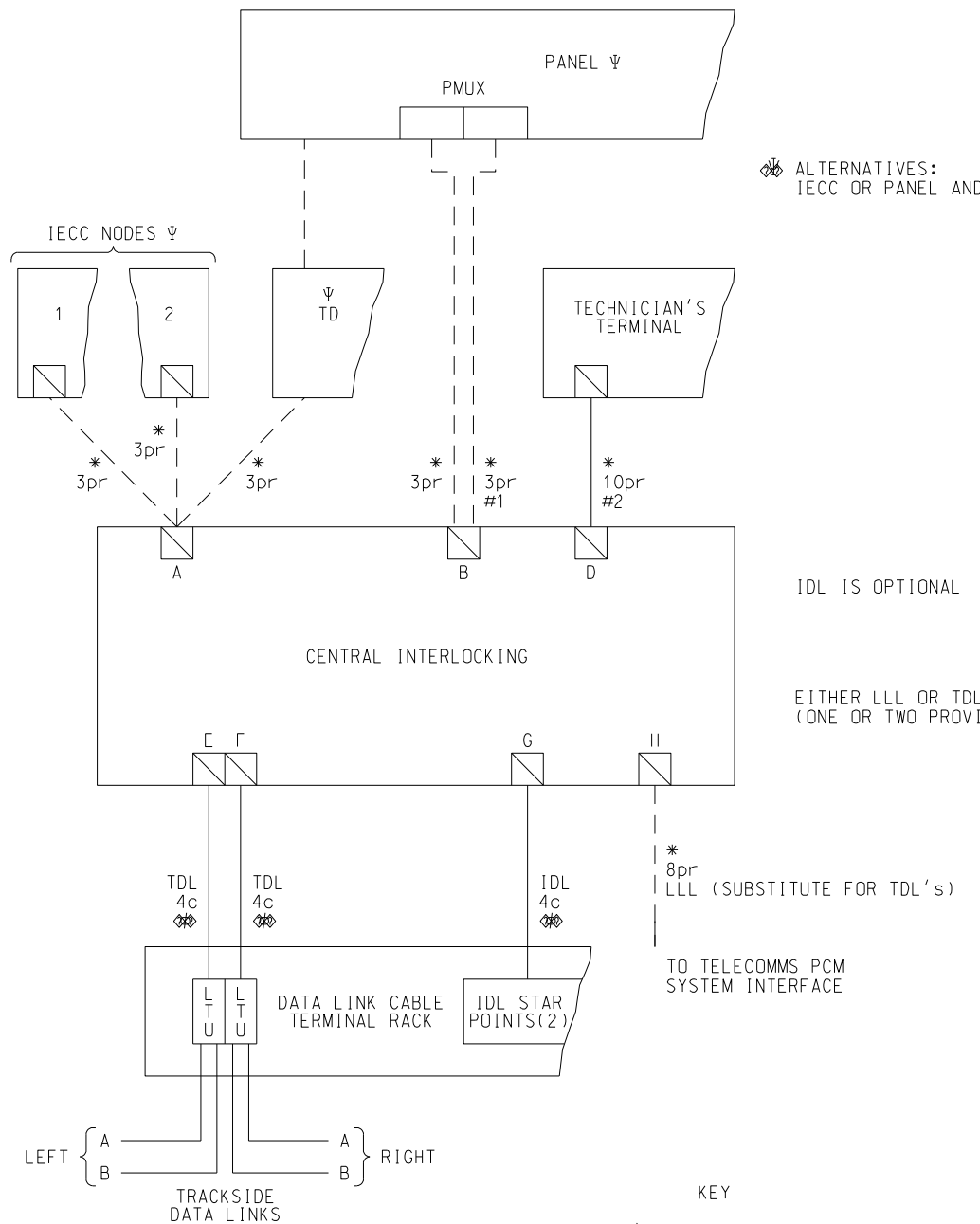
3.11 Data link Cable Marking

Where two or more Data Link cables share the same section of cable route, the cables shall be marked in accordance with [NRL3/SIG/11303](#) Module 2W10, issue 3.

4 Earthing, Bonding & Surge Suppression

The earthing and bonding and surge suppression requirements for SSI equipment are detailed in [SSI8503](#).

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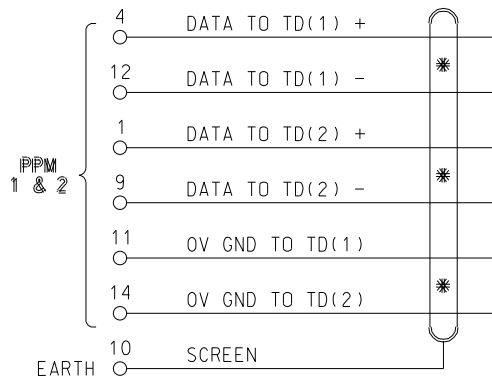


NOTE: CABLES FOR ONE INTERLOCKING SHOWN

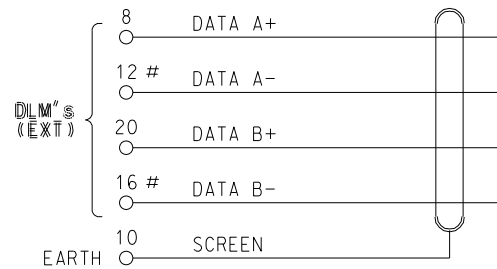
SHEET 1 of 4

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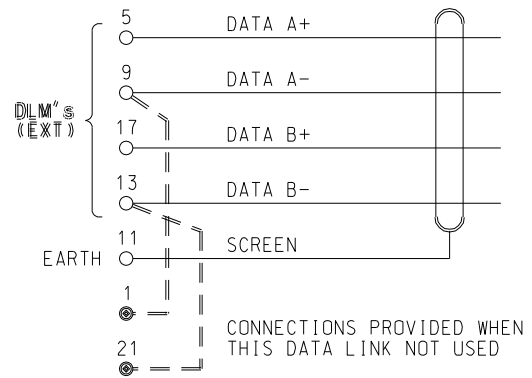
PLUG A (TO TD)



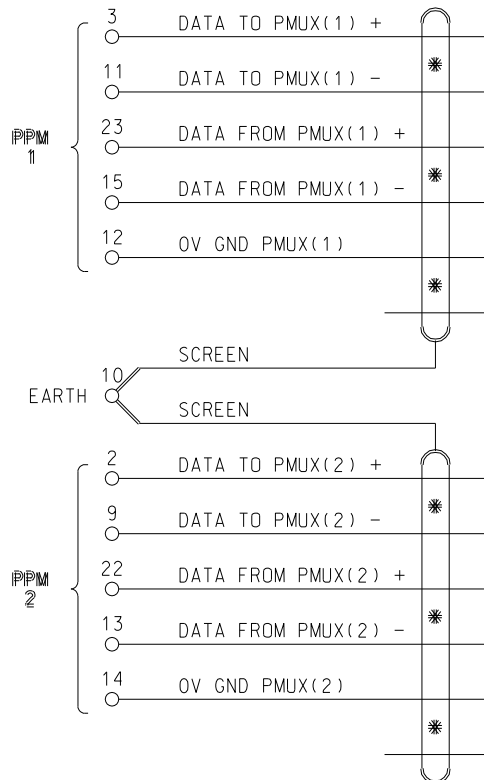
PLUG E (TO TRACKSIDE DATA LINK-L)



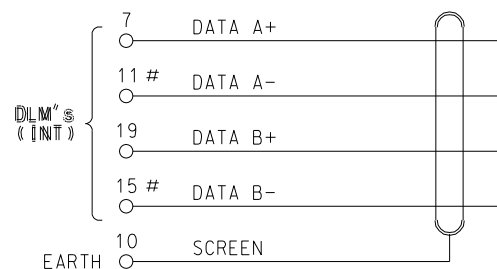
PLUG F (TO TRACKSIDE DATA LINK-R)



PLUG B (TO PMUX)



PLUG G (TO INT. DATA LINK)



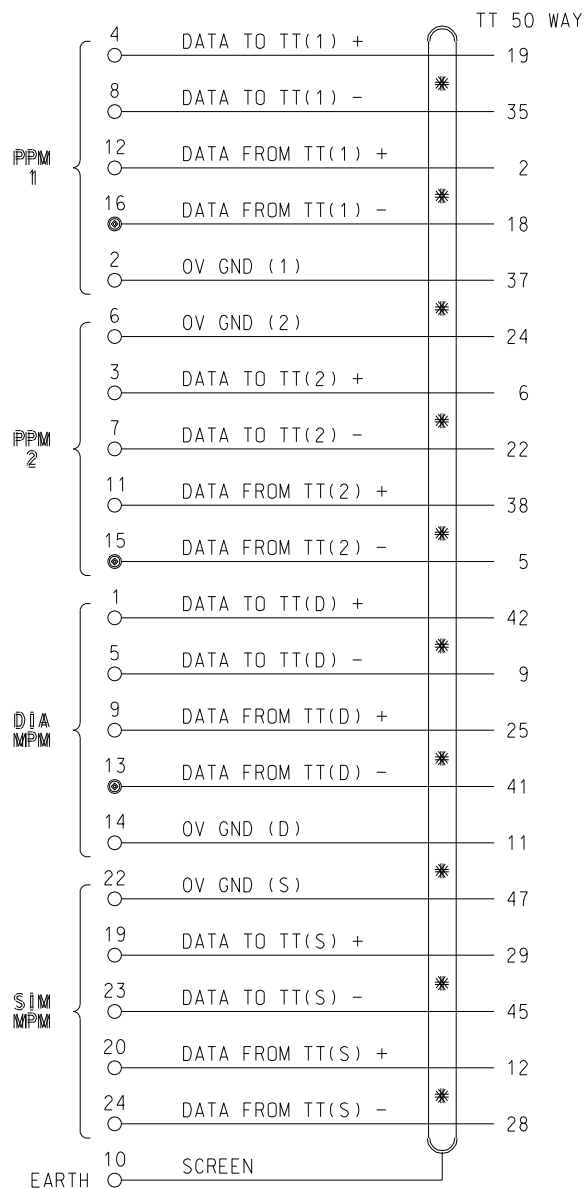
* TWISTED PAIR
47 OHM TERMINATING RESISTOR,
PROVIDED IF FREE CONNECTOR UNPLUGGED

○ PIN
● SOCKET } IN FREE
CONNECTOR

SHEET 2 of 4

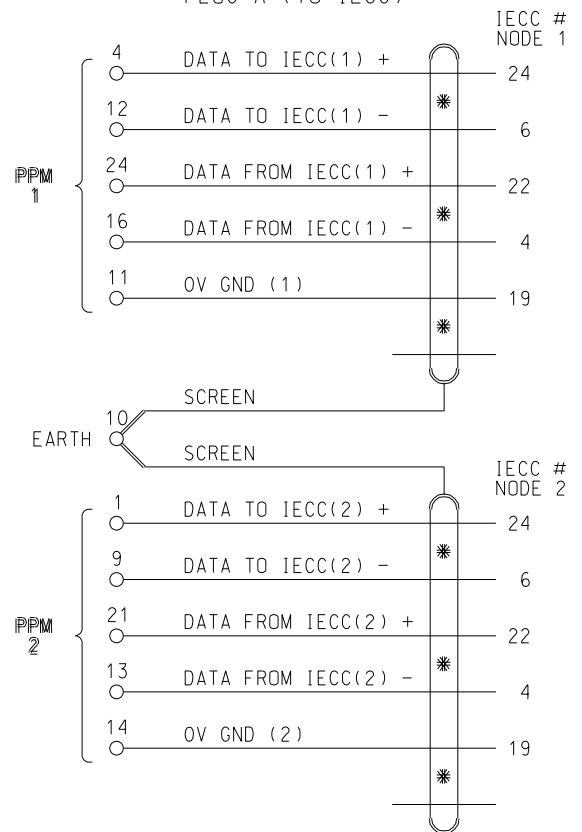
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PLUG D (TO TECHNICIAN'S TERMINAL)



○ PIN
● SOCKET } IN FREE CONNECTOR

PLUG A (TO IECC)



37 D-TYPE FEMALE CONNECTOR
9/11/13/28 LINKED & 27/29/31/37 LINKED

* TWISTED PAIR

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