

Ref:	SSI8003-51D
Issue:	8
Date:	05/09/2015
Compliance date:	06/12/2015

Chapter D:

Boundaries through Crossovers, SSI/RRI Boundaries, and Relay Interfaces between SSIs

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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Published and Issued by Network Rail, 2nd Floor, One Eversholt Street, London. NW1 2DN.



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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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1 Crossover Straddling a Boundary

The example in Figure C1 and the data in Section 1, both in Chapter C, describe an "end on" boundary between two Interlocking areas, such as would occur where one Interlocking is used to control each end of a through station. The advantages of this choice of boundary are that each set of points is entirely contained within a single Interlocking. Another type of boundary is illustrated in Figure D1, where two sets of parallel tracks are controlled from separate Interlockings, and the boundary must pass through a connecting crossover. The method of setting and releasing a route over the boundary is the same as described above for the "end-on" boundary, but a similar process is also necessary when the points are to be moved by means of a points key, or one of the parallel routes requiring the points normal is requested.

In the example points 1003 are connected to one of the TFMs controlled from the "Controlling" Interlocking ("NORTH"), and this Interlocking's Panel Processor deals with the points key detection and points indications. As in the examples in Chapter C, the telegrams on the Internal Data Links between the two Interlockings include one telegram used to convey request codes, and a second telegram within which either individual bits or a three bit code are used to convey aspect control and map search information for the routes between the two Interlockings. In the "NORTH" to "SOUTH" direction, additional bits in the second telegram (or, if these are not available, three bits in another telegram) are used to copy the current state of points detection and certain route locking to the "Non-controlling" Interlocking, i.e. that one that is not directly connected to the points.

1.1 Identities

The same identity naming conventions specified in Chapter B Section 2.1 and Chapter C Section 1.9 apply, thus identities associated with route 51B (that from signal 51 to signal 131) will have a line nomenclature of 'FF>GF' and identities associated with route 56B (that from signal 56 to signal 136) will have a line nomenclature of 'GF>FF'.

The Controlling Interlocking has a points identity allocated to the crossover points in the standard manner. A duplicate identity for these points is also required, in the Non-controlling Interlocking, in order to receive point detection.

A duplicate track circuit identity and a track-circuit-occupied latch is allocated in the Controlling Interlocking to receive from the Non-controlling Interlocking the state of the latter's track circuit associated with the crossover. The track circuit identity is tested in the crossover's PFM file data and the latch is used in releasing the sub-route adjacent to the boundary.

Any further track circuits, in the Non-controlling Interlocking, involved in locking the crossover, such as track circuit locking conditioned by points or time-of-

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operation locking, are passed across the boundary into appropriate identities using individual bits in the IDL telegrams.

Also provided in the Controlling Interlocking are one special sub-route and one duplicate sub-route that lock the crossover points through being tested in the points PFM file data (Sections 1.2 & 1.7 refer). The special sub-route is associated with the sub-route(s) in either direction through that end of the crossover normal in the Non-controlling Interlocking. Nomenclature takes the form of adding the letter Z after the first letter of the name (or composite name) of the corresponding sub-route(s), thus in Figure D1 this will be UZGF-AB/BA. The duplicate sub-route is associated with the sub-route through that end of the crossover reverse in the trailing direction in the Non-controlling Interlocking and thus in Figure D1 will be UdGF-CA. Any sub-overlaps on the crossover in the Non-controlling Interlocking in the same position may need corresponding special or duplicate sub-overlaps in the Controlling Interlocking (Section 1.8 refers).

The above special sub-route (and special sub-overlap) requires, in the Non-controlling Interlocking, a corresponding sub-route- (and sub-overlap-) releasing latch. Nomenclature of the latch takes the form of prefixing the special sub-route (or sub-overlap) name with the letter L, hence in Figure D1 this will be LUZGF-AB/BA.

A latch identity is required in the Non-controlling Interlocking for receiving proof from the Controlling Interlocking that the special sub-route above is locked. This is tested in the aspect controls of routes that pass through the crossover points normal in the Non-controlling Interlocking. Nomenclature of the latch takes the form of L<special sub-route>(L), hence in Figure D1 this will be LUZGF-AB/BA(L).

1.2 Point-Locking Conditions

PFM file data has to be provided in the Controlling Interlocking for this set of points, this containing all the locking conditions relevant to both Interlockings. (Null PFM file data also has to be provided in the Non-controlling Interlocking merely to satisfy the data compiler.)

The state of any track circuits in the Non-controlling Interlocking that lock the points, whether in dead track circuit locking, track circuit locking conditioned by points or time-of-operation locking are copied across the boundary, into appropriate duplicate identities or specifically allocated latches. The duplicate identities and/or latches are then tested in the crossover's PFM file data.

For routes that pass through the crossover points normal in the Non-controlling Interlocking, the sub-routes (and sub-overlaps, if present) that route-lock these points normal have corresponding special sub-routes (and sub-overlaps) provided in the Controlling Interlocking to be tested for being free in the points PFM file data. These are locked by the route-setting requests as they access the Controlling Interlocking, and are freed in a manner similar to that used to free sub-routes (and sub-overlaps) across Interlocking boundaries. For further

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details of locking and freeing these special sub-routes (and sub-overlaps) see Sections 1.4, 1.5 & 1.7.

For routes that pass through the crossover points reverse from the Controlling Interlocking to the Non-controlling Interlocking, the sub-route that route-locks these points reverse has a corresponding duplicate sub-route provided in the Controlling Interlocking to be tested for being free in the points PFM file data. This duplicate sub-route is updated to the state of its corresponding sub-route by a telegram bit in the IDL (see Section 1.6).

Wherever this duplicate sub-route is tested for being free in the points PFM file data, a test (for being free) on the previous sub-route on the crossover points reverse in the Controlling Interlocking must also be included. This covers the potential time gap between the route being set in the Controlling Interlocking and the duplicate sub-route being updated to the locked state of its corresponding sub-route in the Non-controlling Interlocking. This is an isolated instance of using a duplicate sub-route to apply route-locking; by default special sub-routes (or sub-overlaps) must be used elsewhere.

Thus points availability tests on points controlled, points free-to-move conditions or on points key memory have to be done in the Controlling Interlocking only. Tests on points disabled are automatically done as part of the points free to move tests in the Controlling Interlocking, with the points disabled control only being applied by the Technician in this Interlocking.

The PFM file data for points 1003 follows. The comment shown in NORTH Interlocking must be provided to avoid any subsequent inadvertent altering of what may appear as duplicate route-locking.

```
/ NORTH Interlocking

*P1003N
  TFF c , TdGF c
  UFF-BC f
  UFF-CB f , UdGF-CA f      / dual locking - see SSI8003-51D
\

*P1003R
  TFF c , TdGF c
  UFF-AC f , UFF-CA f , UZGF-AB/BA f
\

/ SOUTH Interlocking

*Pd1003N \      / Null data

*Pd1003R \      / Null data
```

1.3 Point Key Operations

As all the locking conditions are available in the Controlling Interlocking, then the Non-controlling Interlocking does not normally need to be accessed when the crossover points straddling the boundary are to be moved using the points

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key. (An exception to this can arise when the crossover is within an overlap - see Section 1.9.) Data provided in the PRR file of the Controlling Interlocking is thus of the standard format and that for keying the points normal is as follows:

/ NORTH Interlocking

```
*QP1003QN
  if E1003KC < 5 , L1003KN s
  then P1003 kn , P1003 xkr
      if P1003 cnf then P1003 cn \
  \
  E1003KC = 5 , L1003KN xs .
```

That data for keying the points reverse is similar.

For IECC controlled Interlockings the standard format panel request (see SSI8003-53) is also used.

1.4 Setting Routes through Crossover Reverse

Data for the setting of routes passing over the crossover reverse is as shown in Chapter C Section 1.2, with the tests for the crossover points controlled or free to move reverse, and the associated command to set the points reverse control bit, being provided only in the Controlling Interlocking.

Note that any route locking must be directly applied in the Controlling Interlocking at the time of either calling the points or checking the points are in the previously called position. Such directly applied route locking is the putting to a locked state a sub-route (or sub-overlap) in the Controlling Interlocking that is tested in the crossover points PFM file data.

PRR file data examples follow for setting routes in both directions through the crossover reverse. As in Chapter C Section 1.2.4, an acknowledgement latch and telegram acknowledgement timer is provided to suppress any repeat acknowledgement requests (the alternative method in Chapter C Section 1.2.7(ii) may be used). The data shown in *italics* is only provided if necessary (see Chapter C Section 1.4).

/ NORTH Interlocking

```
*QR51B (M)
  if R51B a
      R136 xs , UFE-AB f
      P1003 crf
      EG70 stopped
  then P1003 cr
      EG70 = 0 , G70 = 1
  \ .
  / =QR51B (M) -RQ to SOUTH
```

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/ SOUTH Interlocking

```
*QR51B(M)-RQ
  if OGG-AB f
    EG70 stopped
  then RFF>GF s
    UFF>GF 1 , UGF-CA 1 , UGG-BA 1 , OGH-BA 1
    EG70 = 9 , G70 = 1 / =QR51B(M)-AK to NORTH
  \ .
```

/ NORTH Interlocking

```
*QR51B(M)-AK
  if LR51B(M)-AK xs
  then if R51B a
    R136 xs , UFE-AB f
    P1003 cr
    EG70 < 11
    then R51B s , LRFF>GF xs
      UFE-BA 1 , UFF-CB 1
      S51 clear bpull
    \
    LUFF>GF xs , EG70 stopped , LR51B(M)-AK s
  \
  EG70AK = 0 .
```

/ SOUTH Interlocking

```
*QR56B(M)
  if R56B a
    R131 xs , UGG-BA f
    EG70 stopped
  then EG70 = 0 , G70 = 2 / =QR56B(M)-RQ to NORTH
  \ .
```

/ NORTH Interlocking

```
*QR56B(M)-RQ
  if OFE-BA f
    P1003 crf
    EG70 stopped
  then RGF>FF s
    P1003 cr
    UGF>FF 1 , UFF-BC 1 , UFE-AB 1 , OFD-AB 1
    EG70 = 9 , G70 = 2 / =QR56B(M)-AK to SOUTH
  \ .
```

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/ SOUTH Interlocking

```
*QR56B (M) -AK
  if LR56B (M) -AK xs
  then if R56B a
    R131 xs , UGG-BA f
    EG70 < 11
    then R56B s , LRGF>FF xs
      UGG-AB 1 , UGF-AC 1
      S56 clear bpull
    \
    LUGF>FF xs , EG70 stopped , LR56B (M) -AK s
  \
EG70AK = 0 .
```

## 1.5 Setting Routes through Crossover Normal

Again, note that any route locking must be directly applied in the Controlling Interlocking at the time of either calling the points or checking the points are in the previously called position. Such directly applied route locking is the putting to a locked state a sub-route (or sub-overlap) in the Controlling Interlocking that is tested in the crossover points PFM file data.

The setting of a route through the crossover normal in the Controlling Interlocking does the required checks that there is no locking of the points reverse entirely within this Interlocking. Thus this route-setting does not have to access the Non-controlling Interlocking. A PRR file data example follows.

/ NORTH Interlocking

```
*QR51A
  if R51A a
    R136 xs , UFE-AB f , OFG-AB f
    P1003 cnf
  then R51A s
    P1003 cn
    UFE-BA 1 , UFF-CA 1 , UFG-BA 1 , OFH-BA 1
    S51 clear bpull
  \ .
```

The setting of a route through the crossover normal in the Non-controlling Interlocking has to access the Controlling Interlocking in order to make the required checks that there is no locking of the points reverse. The Non-controlling Interlocking requiring to set such a route first evaluates the availability of the route in its own area, and then sends a request code to the Controlling Interlocking.

If the crossover points are controlled normal or free to move in the Controlling Interlocking, this Interlocking sets its points memory normal control bit, locks the special sub-route that route-locks the crossover normal and sends an acknowledgement request to the Non-controlling Interlocking.

The Non-controlling Interlocking then rechecks the route availability in its area and, if OK, sets the route. The sub-route-releasing latch corresponding with the

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special sub-route is unset, irrespective of whether route-setting succeeds, in order to generate a release request to free this special sub-route if the route fails to set or when the route releases. The whole process is very similar to that for setting a route across the boundary.

A PRR file data example follows. As in Chapter C Section 1.2.4, an acknowledgement latch and telegram acknowledgement timer is provided to suppress any repeat acknowledgement requests (the alternative method in Chapter C Section 1.2.7(ii) may be used).

```

/ SOUTH Interlocking

*QR56A
  if R56A a
    R131 xs , UGG-BA f , OGE-BA f
    EG70 stopped
  then EG70 = 0 , G70 = 3          / =QR56A-RQ to NORTH
  \ .

/ NORTH Interlocking

*QR56A-RQ
  if P1003 cnf
    EG70 stopped
  then P1003 cn
    UZGF-AB/BA 1
    EG70 = 9 , G70 = 3          / =QR56A-AK to SOUTH
  \ .

/ SOUTH Interlocking

*QR56A-AK
  if LR56A-AK xs
  then if R56A a
    R131 xs , UGG-BA f , OGE-BA f
    EG70 < 11
  then R56A s
    UGG-AB 1 , UGF-AB 1 , UGE-AB 1 , OGD-AB 1
    S56 clear bpull
  \
    LUZGF-AB/BA xs , EG70 stopped , LR56A-AK s
  \
EG70AK = 0 .

```

If such route setting has to access a further Interlocking to reach the exit of the route then special precautions have to be taken to prevent latch LUZGF-AB/BA triggering the freeing of the associated special sub-route whilst this further Interlocking is accessed. This is covered in Chapter E Section 1.3.

## 1.6 Transfer of Information Associated with Points

For routes which pass through the crossover points normal in the Non-controlling Interlocking, the aspect control data is entirely within this Interlocking, thus information about the crossover points has to be passed from the Controlling Interlocking in order to be included in this data. As all point detection, even split detection, is input via the Controlling Interlocking, then the