

Chapter C: Splitting Distant Signals

1 Introduction

This Chapter shows how splitting distant signals are implemented. The requirements for these signals in Signalling Principles Standards GK/RT0031 (ref. 1), GK/RT0032 (ref. 2) & GE/RT8035 (ref. 3) and in Network Rail Company Standard RT/E/C/11600 (ref. 4) have been followed in the preparation of this Chapter.

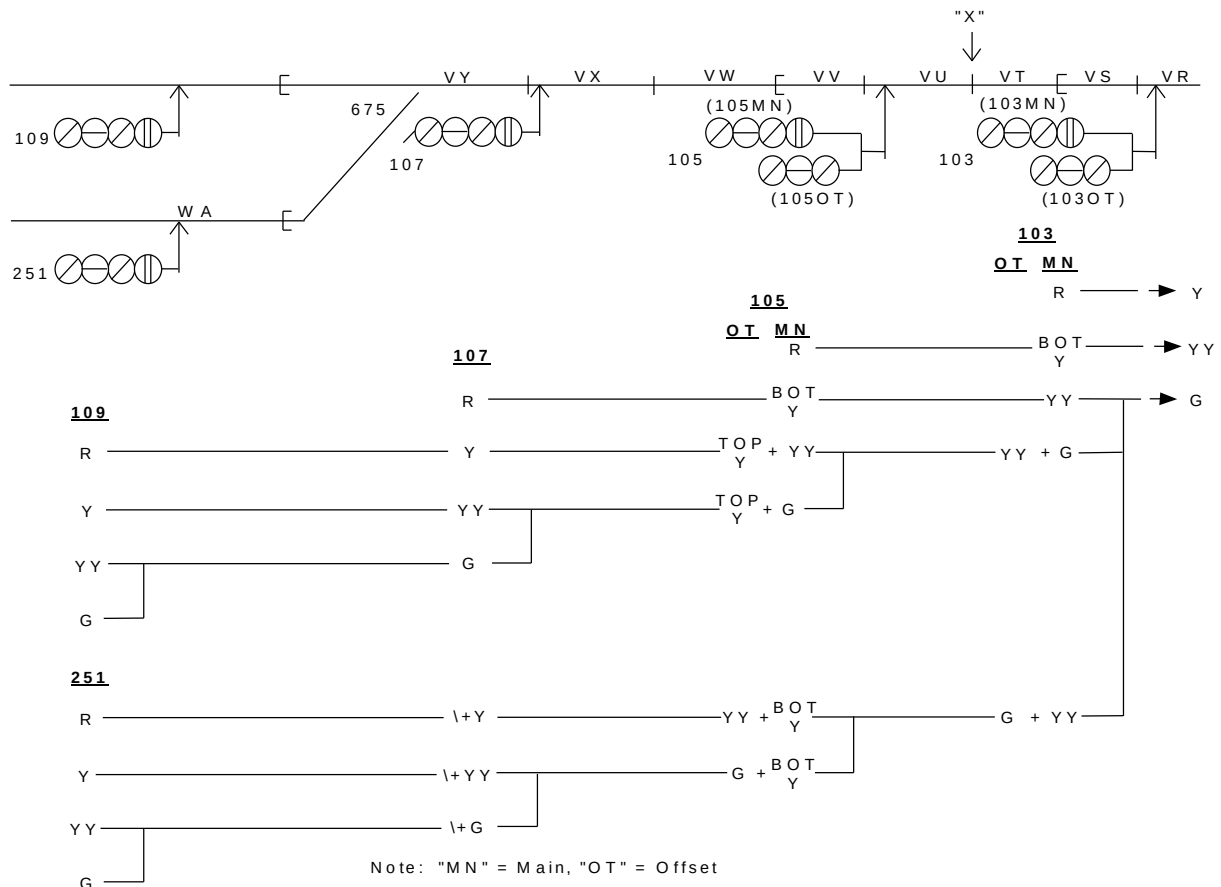
2 Principles

2.1 Signal Head Cross Proving

2.1.1 Diverging Route to the Left

A typical arrangement of inner and outer splitting distant signals and their aspect sequence is shown below where the diverging route is to the left. The junction signal is 107, the inner splitting distant signal is 105 and the outer splitting distant signal is 103.

RT/E/C/11600 Part S Section 8.1 h) requires that when an aspect is displayed involving both heads, the head displaying the single yellow must be lit for the other to display any aspect less restrictive than single yellow. This is taken as applying to the inner splitting distant signal.



Diverging Route to the Left with Optional Outer Splitting Distant Signal

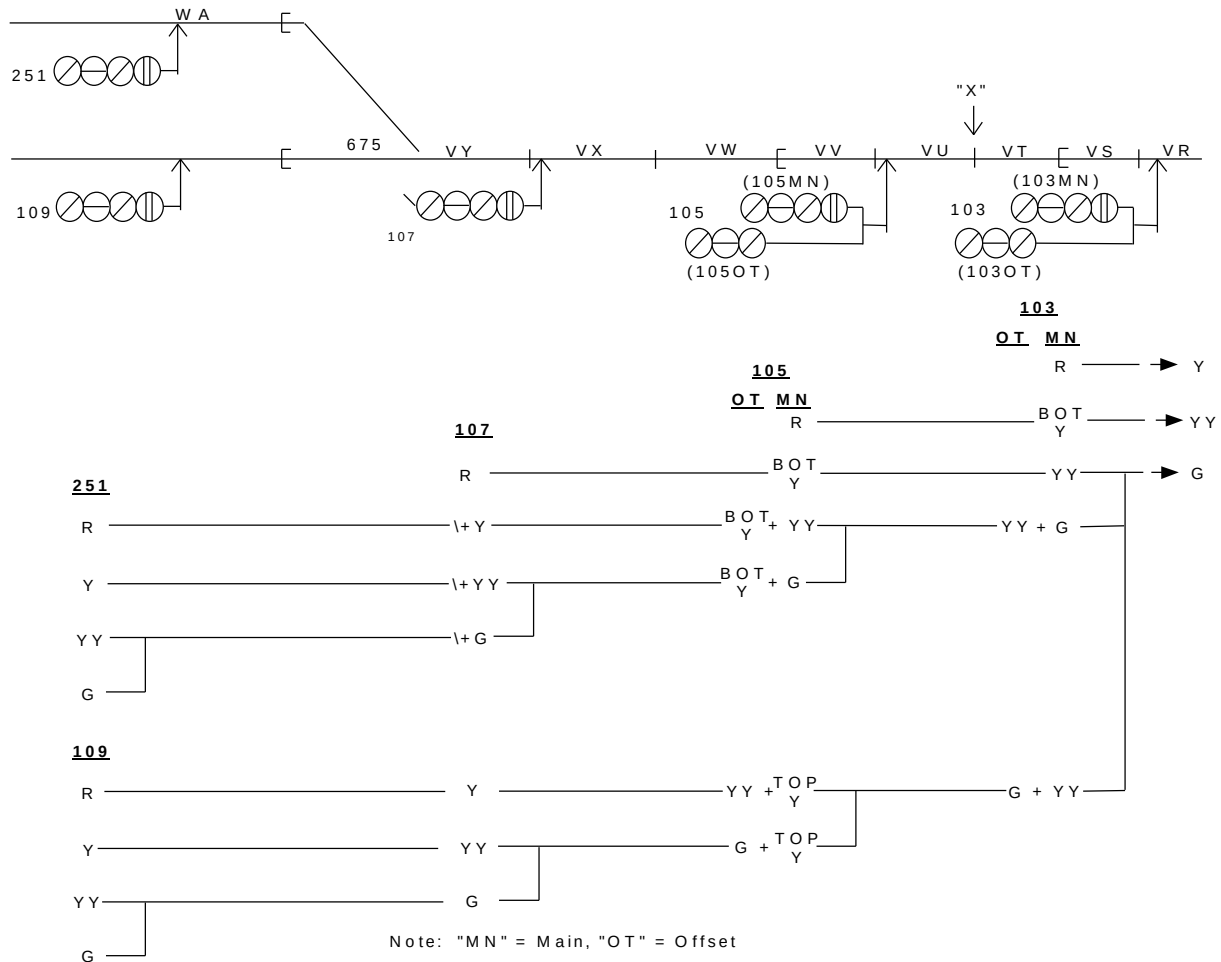
In the example above, with the straight ahead route set, on the clearance of signal 107, signal 105 main head will be held at single yellow until the top yellow in the offset head is switched on and proved alight, when the main head will then change from single yellow to double yellow or green, as appropriate.

With the diverging route set, on the clearance of signal 107, assuming signal 105 main head is already proved lit at single yellow, then the offset head can be switched on straight away to double yellow or green, as appropriate.

For the optional outer splitting distant signal, it has been deduced that in changing to double yellow plus green, before the green can be displayed in the offset head, at least one of the two yellows in the main head will be required to be proved alight first. This is needed to avoid misleading a Driver on the state of the junction which can arise if only the green is lit (an aspect of single yellow plus green would not mislead).

2.1.2 Diverging Route to the Right

The situation where the diverging route is to the right is now considered. Again, the junction signal is 107, the inner splitting distant signal is 105 and the outer splitting distant signal is 103.



Diverging Route to the Right with Optional Outer Splitting Distant Signal

The requirement in RT/E/C/I 600 Part S Section 8.1 h) in Section 2.1.1 above is applied in a similar fashion.

In the example above, with the straight ahead route set, on the clearance of signal 107, signal 105 offset head will be switched on and held at single yellow until the top yellow in the main head is switched on and proved alight (the bottom yellow having been switched off), when the offset head will then change from single yellow to double yellow or green, as appropriate.

With the diverging route set, on the clearance of signal 107, signal 105 main head will be held at single yellow until the bottom yellow in the offset head is switched on and proved alight, when the main head will then change from single yellow to double yellow or green, as appropriate.

For the optional outer splitting distant signal, it has been deduced that in changing to double yellow plus green, before the green can be displayed in the main head, at least one of the two yellows in the offset head will be required to be proved alight first. This is needed to avoid misleading a Driver on the state

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of the junction which can arise if only the green is lit (an aspect of single yellow plus green would not mislead).

2.2 Proving of Splitting Distant Signals in Signal in Rear

Note that the term "signal in rear" has the well-established signalling definition of a signal on the approach side.

For the signal in rear of the inner splitting distant signal to clear or remain clear requires the latter adequately lit. When the aspect displayed is involving both heads then at least one lamp lit in either head is sufficient.

Aspect sequencing will then depend on what lamps are actually lit in the inner splitting distant signal. Just a single yellow lit will only permit a double yellow in rear. A single yellow lit, with a single yellow or double yellow or green lit, will permit a green in rear, or a green plus double yellow if the signal in rear is an outer splitting distant. Advantage can be taken of the cross-proving between heads as just a double yellow or just a green cannot arise, thus at least a single yellow or green lit in the head that should be showing double yellow or green is sufficient proof.

The signal in rear of the outer splitting distant signal requires the latter adequately lit. When the aspect displayed is involving both heads then the double yellow plus green is acceptable, as is a failed second yellow giving a single yellow plus green. However, advantage can be taken of the cross-proving between heads as just a green cannot arise, thus at least a single yellow proved alight is sufficient for the signal in rear to clear or remain off.

Aspect sequencing will then depend on what should be displayed by the outer splitting distant signal. When just a single yellow should be displayed then this lit will only permit a double yellow in rear. When a double yellow should be displayed, then at least one yellow lit will permit a green in rear. When a double yellow plus green should be displayed, then at least one yellow lit will permit a green in rear.

2.3 Junction Signal in View before Indicator Readable

GK/RT0032 Section B10.7.3 requires that with a diverging route set, if possible, the route or junction indicator of the junction signal is to be readable at the same time as the main aspects. If this is not possible then:

- the junction signal is to be maintained at red if the approaching train has reached a position less than the required reading time on the approach to the inner splitting distant signal (point "X" in the above two examples), and
- after the junction signal has cleared, it is to be replaced and kept at red if the inner splitting distant signal then fails, or subsequently fails, to display the correct aspect.

The implications of the second bullet point are that:

- "the correct aspect" at the inner splitting distant signal is one that gives a complete indication of the junction, i.e. double yellow or green, plus single yellow, with all required lamps lit,
- and, after the junction signal has cleared for the diverging route, a period of time has to elapse to allow the inner splitting distant signal to change from single yellow to a two-headed aspect before the proving of this latter aspect is applied.

2.4 Splitting Distant Signal AWS

GE/RT8035 Section B8.I requires a splitting distant signal's AWS electro-magnet to be energised if either head is displaying a green aspect.

2.5 Signal Lamps Requiring Proving

From the above Sections the lamp proving requirements can be deduced, these varying depending on whether a left-hand or right-hand junction is involved and whether Section 2.3 applies.

Lamp Proving Required for Inner Splitting Distant Signal with Diverging Route to the Left

		Option in Section 2.3	
		Does not apply	Applies
Main Head	Top Yellow	N	N
	Green	Y	Y
	Bottom Yellow	Y	Y
	Red	Y	Y
Offset Head	Top Yellow	Y	Y
	Green	Y	Y
	Bottom Yellow	N	Y

Lamp Proving Required for Inner Splitting Distant Signal with Diverging Route to the Right

Main Head	Top Yellow	Y
	Green	Y
	Bottom Yellow	Y
	Red	Y
Offset Head	Top Yellow	N
	Green	Y
	Bottom Yellow	Y

Lamp Proving Required for Optional Outer Splitting Distant Signal

Main Head	Top Yellow	N
	Green	Y
	Bottom Yellow	Y
	Red	Y
Offset Head	Top Yellow	N
	Green	Y
	Bottom Yellow	Y

Either the bottom or top yellow could be lamp proved, but the former has been selected by convention.

3 Data - General

There are two cases to consider.

Sections 4 & 5 cover the simpler case, for the left and right-hand junctions respectively, where the main aspect of the junction signal is not visible before the indication of route is readable, i.e. Section 2.3 above does not apply.

Section 6 covers the provision of the outer splitting distant signal.

Section 7 covers the changes and additions required for the more complicated case where the main aspects of the junction signal may be visible before the indication of route, i.e. Section 2.3 above does apply.

Section 8 covers the case of an Interlocking boundary between the junction signal and the inner splitting distant signal.

Guidance on the preparation of data for the simpler case now follows. Note that any TORR associated data has not been shown in the data examples.

4 Data - Simpler Case - Left-hand Junction

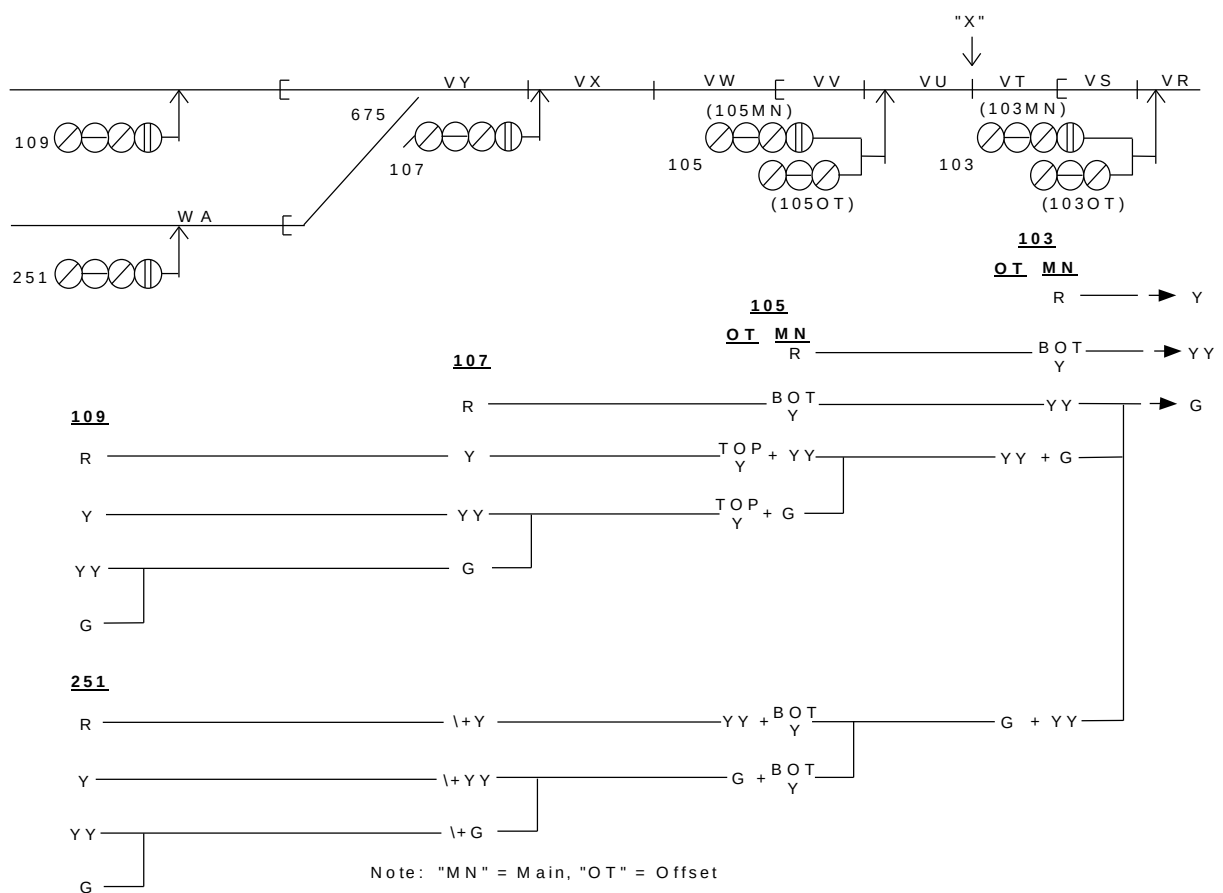
4.1 Identities

The inner splitting distant signal (<ISDS>) needs two identities in the SIG file to represent it in the Interlocking - S<ISDS>MN for the main head, and S<ISDS>OT for the offset head. Identity S<ISDS> is not provided. This separate identifying of heads makes it straightforward to provide a full display of the aspects on the Signalling Display System, where an IECC is used. Note the avoidance of brackets in these identity names, as they may be used by the IECC.

The testing of the state of the inner splitting distant signal is carried out as follows (the Feature Reference in MAP file data is applied to S<ISDS>MN only):

Test	Identity tested
TORR test passed	S<ISDS>MN only
not red retained	S<ISDS>MN only or both, depends on objective of testing
route/junction indicator proved	S<ISDS>MN only
signal stick set	S<ISDS>MN only
aspect not disconnected	Both - see Section on OPT data
temp. app. control not applied	Both - see Section on OPT data
train in section proving code:	S<ISDS>MN only
lamp proved	S<ISDS>MN only or both, and perhaps second yellow, depends on objective of testing
in auto mode	S<ISDS>MN only
free of approach locking	S<ISDS>MN only
aspect control set	S<ISDS>MN only
button pulled	S<ISDS>MN only
aspect code	S<ISDS>MN only or both, depends on objective of testing
approach locking timer	S<ISDS>MN only

Henceforth the typical signal numbers in the figure below have been adopted:



Diverging Route to the Left with Optional Outer Splitting Distant Signal

4.2 TFM Allocation

Two TFM's are used to control this signal, one for each head. (In theory one TFM can be used, for a left-hand junction where Section 2.3 does not apply, but for consistency two TFM's have been assumed in all cases.) The inner splitting distant signal's main head must use a lower numbered telegram than for the offset head.

The following TFM allocations are typical for main head SI05MN which has the standard arrangement for a four aspect signal.

SSI MODULE DATA ENTRY FORM

Interlocking [] Location [] Module No [20] Type [S]

OUTPUTS				MODE	RETURN PATH	RELAY PROVING		NOTE
						EC/GC	EK/WC	
7	[SI05MN	][R	][GE	[RR]	[1]	[]	[5]	[]
6	[SI05MN	][H	][GE	[PS]	[1]	[]	[5]	[]
5	[SI05MN	][HH	][GE	[PS]	[0]	[]	[4]	[]
4	[SI05MN	][D	][GE	[PS]	[1]	[]	[5]	[]
3	[SI05MN	][]	][I	[PS]	[0]	[]	[]	[]
2	[]	][]	][]	[PS]	[]	[]	[]	[]
1	[]	][]	][]	[PS]	[]	[]	[]	[]
0	[]	][]	][]	[PS]	[]	[]	[]	[]
Fixed	[]	][]	][]		[]			[]
	[]	][]	][]		[]			[]
	[]	][]	][]		[]			[]

SSI MODULE DATA ENTRY FORM

Interlocking [] Location [] Module No [20] Type [S]

INPUTS				MODE	NOTE
7	[SI05MN	][]	][EC	[]	[1]
6	[]	][]	][]	[]	[]
5	[SI05MN	][]	][EK	[ES]	[]
4	[SI05MN	][(HH)	][EK	[ES]	[]
3	[]	][]	][]	[]	[]
2	[]	][]	][]	[]	[]
1	[]	][]	][]	[]	[]
0	[]	][]	][]	[]	[]

NOTES:

1. [SI05MN R, bottom Y & G lamp provg.] 5. []
2. [] 6. []
3. [] 7. []
4. [] 8. []

For the inner splitting distant signal's offset head, the single yellow is taken as that being opposite a yellow in the main head - in this instance this is the top yellow. Note that the lamp-proved yellow is the top yellow, the head is as though it is upside down. The following TFM allocations are typical for offset head SI05OT. Note that red retaining is NOT used for this head.

SSI MODULE DATA ENTRY FORM

Interlocking [] Location [] Module No [21] Type [S]

OUTPUTS				MODE	RETURN PATH	RELAY PROVING		NOTE
						EC/GC	EK/WC	
7	[S1050T	][H	][GE	][PS]	[1]	[]	[5]	[1]
6	[S1050T	][HH	][GE	][PS]	[0]	[]	[4]	[2]
5	[S1050T	][D	][GE	][PS]	[1]	[]	[5]	[]
4	[	][	][	][PS]	[]	[]	[]	[]
3	[	][	][	][PS]	[]	[]	[]	[]
2	[	][	][	][PS]	[]	[]	[]	[]
1	[	][	][	][PS]	[]	[]	[]	[]
0	[	][	][	][PS]	[]	[]	[]	[]
Fixed	[	][	][		[]			[]
	[	][	][		[]			[]
	[	][	][		[]			[]

SSI MODULE DATA ENTRY FORM

Interlocking [] Location [] Module No [21] Type [S]

INPUTS				MODE	NOTE
7	[S1050T	][	][EC	[]	[3]
6	[	][	][	[]	[]
5	[S1050T	][	][EK	[ES]	[]
4	[S1050T	][(HH)	][EK	[ES]	[]
3	[	][	][	[]	[]
2	[	][	][	[]	[]
1	[	][	][	[]	[]
0	[	][	][	[]	[]

NOTES:

- 1.[Top yellow aspect] 5.[]
- 2.[Bottom yellow aspect] 6.[]
- 3.[S1050T top Y & G lamp proving] 7.[]
- 4.[] 8.[]

4.3 IPT File Data for Inner Splitting Distant Signal

The data for the main head (SI05MN) is typically.

*I20

"SI05MN 7 / Red, bottom yellow & green lamp proving
 <data for any other inputs>
 . / end of tgm 20

The data for the offset head (SI05OT) is typically:

*I21

"SI05OT 7 / First (i.e. top) yellow & green lamp proving
 <data for any other inputs>
 . / end of tgm 21

4.4 OPT File Data for Inner Splitting Distant Signal

The signal output data for the main head SI05MN is typically:

```

*020
'S105MN
    R105 s , @R105MN
    G s 7 . / Set red aspect
$
. / End of tgm 20

*R105MN
<standard TISP, SSU, RSU data>
if <standard controls>
    S1050T set asdis
\ . / ACD
<no TAC data, standard RJ1 data>
G s 7 \
if ( TVU o or S105MN set tac , S1050T set tac )
then if R107B s , S1050T set y+lp
    then S107 seq 4 , G s 7654
    else G s 6 , G c 7 , S105MN set y
\
\ . / ASD
G s 3 . / AWS
<standard ALR, RR data>
\

```

The signal output data for offset head S1050T is typically:

```

*021
'S1050T
    R105 s , @R1050T
. / Note no telegram command - aspect
$ / is 'black' if no route set.
. / End of tgm 21

*R1050T
<no TISP, SSU, RSU data>
if S105MN ascon \ . / ACD
<no TAC, RJ1 data>
\ / No telegram command required.
if S107 set <s then @R1050TASD \ . / ASD
G20 s 3 . / AWS
<no ALR, RR data>
\

*R1050TASD
if R107A s , S105MN set lp+y
then S107 seq yy+g , G s 765
else if R107B s , S105MN set <s
    then G s 7 , S1050T set y
\
\
\

```

The bulk of signal 105's output telegram data is in the data for the main head; that in the data for the offset head is mainly confined to aspect sequencing for this head.

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When signal 105 is "on" a red is displayed in the main head and nothing in the offset head. When the signal clears to single yellow, the bottom yellow is displayed in the main head and nothing in the offset head.

If the junction signal now clears for the diverging route, the main head stays at single (bottom) yellow, and if proved alight, the offset head changes from extinguished to double yellow or green (as appropriate).

If the junction signal instead now clears for the straight route, the main head initially stays at single (bottom) yellow and the offset head changes from extinguished to single (top) yellow. When the latter is proved alight, the main head changes from single yellow to double yellow or green, as appropriate.

If the Technician's controls "aspect disconnect" or "temporary approach control" are applied to either signal identity then it must affect both heads. Here full aspect control data is provided for the main head and the offset head's aspect control data just proves the main head's "ascon" bit set. Each aspect disconnect bit is tested automatically in its own aspect control data, thus the offset head's aspect disconnect bit has to be tested in the main head's aspect control data.

Normal TAC data cannot be used; the special data shown above has to be provided in the aspect sequence data for the main head and the aspect sequence data for the offset head then proves the main head at at least single yellow.

The AWS electro-magnet is switched on by the AWS data for the main or offset head, depending on which head is actually displaying the lit green.

4.5 OPT File Data for Signals in Rear of Inner Splitting Distant Signal

See Section 6 for the control of the optional outer splitting distant signal - the data that follows is for a single head four aspect signal.

The lamp proving of the inner splitting distant signal in the aspect control data of any running signals in rear is typically done by the following tests, the clearing of such signals requiring at a minimum at least one lamp proved alight in one of the heads.

... (S105MN set lp or S1050T set lp) ...

Aspect sequencing for these signals is typically done by the following in aspect sequence data:

```

if ( S105MN set <y+lp or S1050T set <y+lp )
then S105MN seq 4, G s 7654                                / (i)
else if S105MN set lp
    then S105MN seq r+y+yy , G s 765                        / (ii)
    else S1050T seq r+y+yy , G s 765                        / (iii)
\
\

```

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In line (i), if signal I05's main head is lit at YY or G (and thus its offset head is lit at Y) or its offset head is lit at YY or G (and thus its main head is lit at Y) then signal I03 is set to G.

In line (ii), if signal I05's main head is lit at R then signal I03 is set Y. If signal I05's main head is lit at Y and its offset head is required to be out, or is at YY or G and the proved Y or G lamp is not yet proved lit or has failed, then signal I03 is set YY.

In line (iii), if signal I05's offset head is lit at Y and its main head is at YY or G but the proved Y or G lamp has failed then signal I03 is set to YY.

Note that the use of the aspect sequence command must be maximised.

4.6 PRR File Data for Inner Splitting Distant Signal

The data for the route setting and button replacing of the inner splitting distant signal should only clear and set respectively the "bpull" bit for the main head.

4.7 Signaller's Indication for Inner Splitting Distant Signal

It is assumed that the Signaller's panel indication for an inner splitting distant signal with a red aspect will be the same as used for a single-headed stop signal, thus there will be a flashable "on" indication and a non-flashable "off" indication. The "on" indication functions in the same manner as that for a single-headed signal. The "off" indication will be lit when either head has at least one lamp lit and that head is at single yellow, double yellow or green.

Because of the "off" indication, the standard PSD file data cannot be used, thus null data (an end marker) is added to this file for the two signal identities.

The following data is added to the POD file. That for the "on" indication utilises just the signal identity for the main head and replicates the functionality provided by the PSD file. Both signal identities are used to control the "off" indication. Note the single end marker.

```
if S105MN set lp+>y
then if S105MN set bpull , S105MN clear foal
    then I105RG sf
    else I105RG s
    \
else I105RG xs
\

if ( S105MN set lp+<s or S1050T set lp+<s )
then I105DG s
else I105DG xs
\ .
```

5 Data - Simpler Case - Right-hand Junction

5.1 Identities

The inner splitting distant signal (<ISDS>) needs two identities in the SIG file to represent it in the Interlocking - S<ISDS>MN for the main head, and S<ISDS>OT for the offset head. Identity S<ISDS> is not provided. This separate identifying of heads makes it straightforward to provide a full display of the aspects on the Signalling Display System, where an IECC is used. Note the avoidance of brackets in these identity names, as they may be used by the IECC.

The testing of the state of the inner splitting distant signal is carried out as follows (the Feature Reference in MAP file data is applied to S<ISDS>MN only):

Test	Identity tested
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not red retained	S<ISDS>MN only or both, depends on objective of testing
route/junction indicator proved	S<ISDS>MN only
signal stick set	S<ISDS>MN only
aspect not disconnected	Both - see Section on OPT data
temp. app. control not applied	Both - see Section on OPT data
train in section proving code:	S<ISDS>MN only
lamp proved	S<ISDS>MN only or both, and perhaps second yellow, depends on objective of testing
in auto mode	S<ISDS>MN only
free of approach locking	S<ISDS>MN only
aspect control set	S<ISDS>MN only
button pulled	S<ISDS>MN only
aspect code	S<ISDS>MN only or both, depends on objective of testing
approach locking timer	S<ISDS>MN only

In addition to the above identities, the following extra identity is required in the FLG file to register whether the main head second (i.e. top) yellow is lit.

L<ISDS>MNYLP

Henceforth the typical signal numbers in the figure below have been adopted: