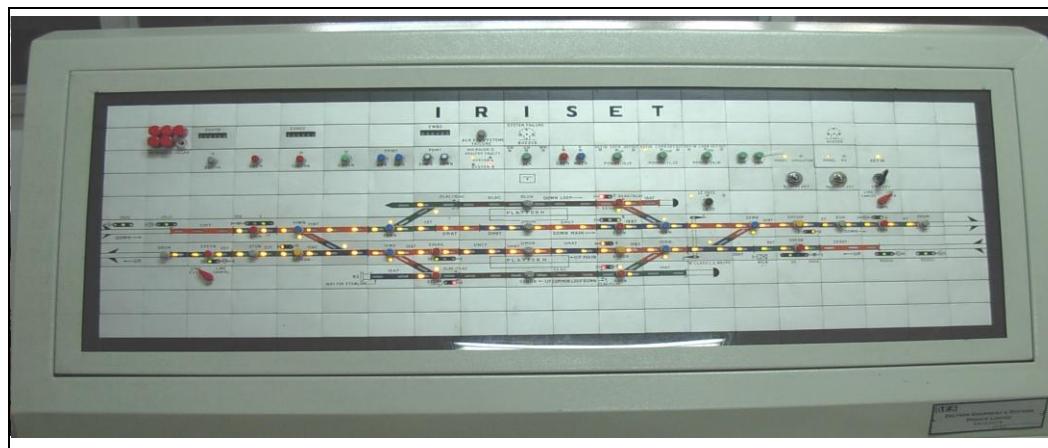


**S-14**

## **INTERLOCKING WITH METAL - METAL RELAYS (SIEMENS)**



**INDIAN RAILWAYS INSTITUTE OF SIGNAL  
ENGINEERING AND TELECOMMUNICATIONS  
TARNAKA ROAD  
SECUNDERABAD - 500 017**

*October 2013*

# S 14

## INTERLOCKING WITH METAL- METAL RELAYS (SIEMENS)

**VISION :** TO MAKE IRISET AN INSTITUTE OF INTERNATIONAL REPUTE, SETTING ITS OWN STANDARDS AND BENCHMARKS

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**INDIAN RAILWAYS INSTITUTE OF  
SIGNAL ENGINEERING & TELECOMMUNICATIONS  
SECUNDERABAD - 500 017**

**Issued in October 2013**

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## CHAPTER - 1

### INTRODUCTION

**1.1** Relay control of railway signalling gears made the following things possible:-

1. Remote control of functions over long distances
2. Fast, efficient and easy operation of gears, and
3. Less maintenance as compared to that of lever frames.

The system in which interlocking of Railway Signalling functions is achieved purely through relays is called “Relay Interlocking” system. Relay Interlocking is to be provided as per IRS specification: S 36/ 87 Amendment No.2

These are classified as:

1. “Non-route setting type Relay Interlocking” system earlier known as “PANEL INTERLOCKING” or “PI”
2. “Route setting type Relay Interlocking” system earlier known as “ROUTE RELAY INTERLOCKING” or “RRI”.

In the “Non-route setting type Relay Interlocking” system, points in the route, overlaps, isolation are to be set individually by pressing concern point buttons and finally for clearance of signal, the signal button along with the route button to be pressed.

In “Route Setting Type Relay Interlocking” system, one single operation of pressing simultaneously signal button and concern route button will initiate the points in route, in overlap, and isolation to set, and signal to get cleared if all the conditions for taking off signal are satisfied.

A practice of these systems prevailing on our railways, called the continental practice is introduced by M/s Siemens of Germany. Their first installation which is of route setting type (RRI) came up in 1958 at Church gate, Mumbai on Western Railway. Subsequently, even as more installations of this type are provided in large yards as well as for small yards.

Both the British and Siemens practices of Relay Interlocking Systems fulfil the requirements laid down in the IRS: S-36/87 Amendment No.2. Also, their requirements are specified as in Indian Railways Signal Engineering Manual.

Entrance - Exit principle (NX) in which two controls, one at the entry point of route and the other near to its exit have to be operated simultaneously, is adopted in Siemens practice.

**1.2** Siemens practice has certain unique features. The important ones are described below:-

1. Modular assembly type construction of control panels with small sections called “DOMINO STRIPS” fixed on a frame of suitable size. This considerably reduces the panel size and also makes its modification easy to suit changes in the yard from time to time.
2. Control buttons are of self restoring type Push buttons, need only feather touch operation. For any vital operation two buttons are to be pressed simultaneously. They are geographically located on the panel in similar positions to those of their connected gears in the yard. This makes the job of operator fast and less tiresome to improve his efficiency.
3. Signal control is based on “**Entrance**” and “**Exit**” (NX) principle. The operator has to operate signal button at the entry of the route along with the Route button near

## INTRODUCTION

its exit simultaneously. This forces the operator to face the panel and make a conscious choice of buttons.

4. Relays used are **K-50** metal to metal contact relays of proved type. Once Relay is picked up, proved de-energised before picking up again.
5. The main advantages of these 60V DC metal to metal contact Relays over the conventional carbon to metal contact relay are their quicker operation and low coil current rating. Also their small size suits the concept of modular relay units called groups for each function control.
6. Modular design of relay groups makes it possible for easy alterations.
7. Uses Relay groups and mechanically latched interlocked relays.
8. Group unit construction of relays which facilitates uniform gear control independent of the peculiarities of local layouts. This improves safety in their operation as the group wiring is factory tested under ideal conditions. Also the wiring is well protected in its enclosed casing. Due to this, the external wiring needed for interconnection and inclusion of other controls is greatly minimised resulting in the saving of installation and commissioning time.
9. Indications on relay groups facilitate quicker fault finding as they appear according to the relay operation sequence in progress.
10. Interlocking and other vital conditions are proved in more than one stages of operation. This prevents the energisation of final control affecting the gear unless the required conditions are retained till the end of operation. This is essential especially with the use of interlocked relays for control.
11. Sectional Route Release is an inbuilt feature.
12. "Emergency full route release", "Emergency Sub route release" and "Emergency Point Operation" features with counters are introduced with this system. These features facilitate for quicker traffic management.
13. All wires are terminated on 'Tag Blocks' fixed on distribution frames which saves the required space for terminations and facilitates for easy identification for attending the failures.
14. Provision of main and intermediate distribution frames for wiring connections between various relay groups and operating panel as well external cables.
15. Fuses with indication tags in bottle type holders occupy less space and their failures can be easily detected.
16. Circuit drawings are vertical.
17. Used Mercury type flasher relay. This is capable of working for ages.
18. Uses Clock worked Timer relay. This gives fixed time as per set value irrespective of no. of continuous operations unlike thermal timer.

\* \* \*

## CHAPTER - 2

### CONTROL PANEL

**2.1** This is made up of rectangular panel sections called ‘DOMINO STRIPS’ having sizes either of 63mm X 38mm (2½” x 1½”) or 54mm X 34mm (2 ¼” X 1¾”). Each panel section has a base and a top plate.

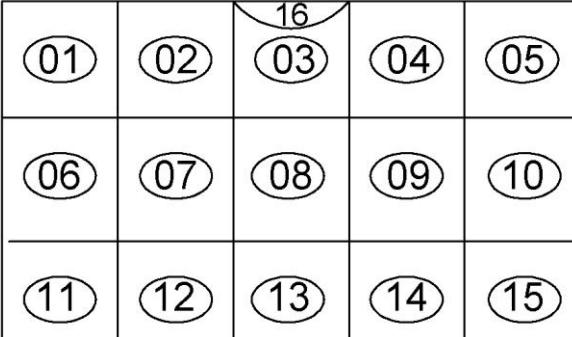
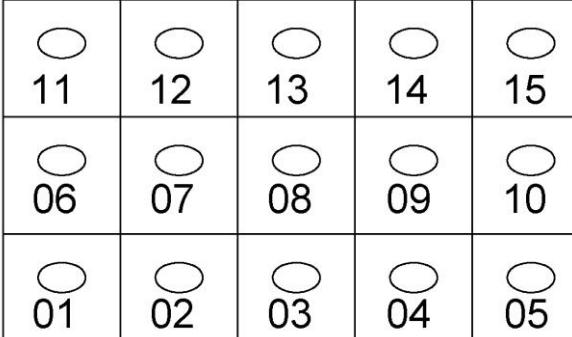
The aluminium cast base has fifteen compartments with removable fibre separators between them. Each compartment has an individual contact at its bottom centre and a common contact plate in the middle connecting all compartments. This plate is connected to the sixteenth terminal at the bottom of the strip. This common terminal carries the neutral connection of supply for indication lamps.

A pencil type 24V 1.2W indication lamp, where provided, occupies one compartment. Red and White indication lamps are available. In new panels, Red, Yellow and Green LEDs are used for indication purposes.

A button fixed on the top plate above has a steel bridge. Its vertical limbs extend below into any two adjacent base compartments and rest close to the contacts at the bottom. These contacts are bridged when the button above is pressed. The button is of self restoring type opening the contact normally.

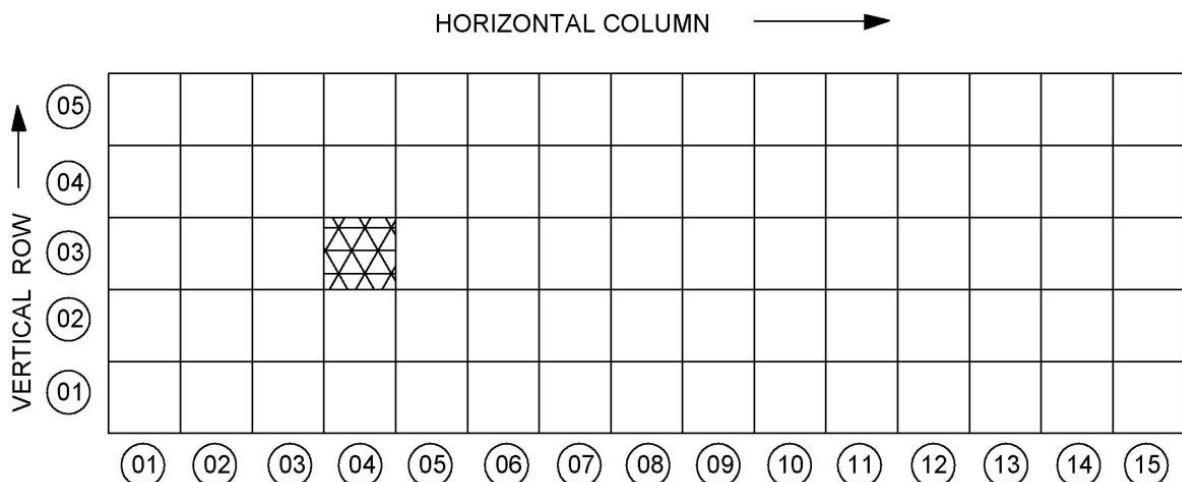
The top plate of the strip actually contains two aluminium and one steel plate one above the other. They are clipped together on all four sides, the top one being painted with slate grey above. The top plate according to its location may carry track, point or signal demarcation with slits cut to size and shape. Transparent white or green films are placed between the lower two plates, as required, give the needed colours to the indications through these slits. Buttons may be fixed on the top plate in a suitable location as required. The top plates situated in the middle of the panel can be removed from their bases with the help of a magnet. The plates can be changed or modified as per alterations effected in the yard layout anytime.

The numbering of base components when viewed from the top and of contact terminals when the domino strip is released from the frame and turned over upside down for accessing is given below :-

 <b>Fig : 2.1</b> <b>Top View when the base is fixed to the frame</b>	 <b>Fig : 2.2</b> <b>View of terminals when the base is removed and turned upside down.</b>
--	---

## CONTROL PANEL

The location numbering of panel sections when their bases are screwed to the frame is as below: -



**Fig: 2.3**

The location of any panel section is identified by its column number followed by its row number. For example, the shaded section in the panel above bears the number of (04.03). The contact terminal number 08 of this section is identified by the number (08.04.03).

The panel sections are generally assembled in multiples of five both horizontally and vertically as per need.

The dull finished grey colour of the panel surface eliminates undesirable reflections. The panel is mounted horizontally in an inclined plane for the convenience of operation.

Sometimes a separate illumination diagram made up of the same sections is mounted upright above the operating panel. If desired, the operating panel may have a simple line diagram of the yard with all demarcations excluding their illuminations.

Warning buzzers are fixed inside the panel. All the panel strip wiring is terminated on tag blocks mounted inside the panel.

## 2.2 PANEL CONTROLS & OPERATIONS

All Signalling functions having manual control will be operated by pressing two buttons simultaneously and releasing them within ten/fifteen seconds i.e. In the case of route setting, buttons shall be kept pressed till the last pair of points in the route start operating. Whereas main signals clear after the buttons are released, for a shunt signal buttons shall be released after the signal has come off. In other operations, buttons can be released immediately after pressing. Buttons required for a vital operation can only be accessed with both hands. This ensures conscious operation by the operator. There are individual control buttons for each gear located near to their panel demarcation and common buttons are located at the top of the panel.

These are identified as below:-

S.No	Button	Description	Colour	Location
1.	GN	(Main) Signal Button	Red	Close to Signal demarcation concerned on track.
2.	Sh-GN	Shunt signal button	Yellow	Close to Signal demarcation concerned on track.
3.	UN	Route Button	Grey	Centre of the berthing or last control track circuit
4.	WN	Point Button (used only for point operation)	Blue	Close to the concern point demarcation.
5.	WN	Point Button (used for point operation and also for sub-Route release)	Blue with white dot on top.	Close to the concern point demarcation.
6.	LXN	Level crossing control release button.	Green or Grey	Close to the level crossing demarcation.
7.	KLN	(Point) Key Lock Release Button.	Green or Grey	Close to the slotted point demarcation.
8.	COGGN	Calling ON Signal control Button (common)	Red	Top of the panel.
9.	EGGN	Common Button to replace a cleared Signal to 'ON'	Red	Top of the panel.
10.	YYN	Common Slot Release Button	Green or Grey	Top of the panel.
11.	YRN	Common Slot Return Acknowledgement button	Green or Grey	Top of the panel.
12.	WWN	Common Point Button for regular operation	Blue	Top of the panel.
13.	EWN	Common point button for emergency operation	Blue	Top of the panel.
14.	CH-YN	Crank Handle Release Button (Separate for each group)	Blue or Green	Top of the panel.
15.	CH-YRN	Crank Handle Slot Return Acknowledgement button (Separate for each group)	Blue or Green	Top of the panel.
16.	AGGN	Common Button to introduce Auto working of a Main Signal	Red	Top of the panel.
17.	AGGRN	Common Button to cancel Auto working of a Main Signal.	Red	Top of the panel.
18.	EUYN	Common Emergency Sub-Route Release button.	Blue with white dot on top	Top of the panel.
19.	EEUYN	Common Emergency Full Route Release Button.	Grey	Top of the panel.
20.	OYN	Common Overlap Release Button.	White or Grey	Top of the panel.

**CONTROL PANEL**

S.No	Button	Description	Colour	Location
21	GXYN or SXYN	Signal lamp Failure Alarm acknowledge Release button.	Red	Top of the panel.
22.	WXYN or PXYN	Point detection Failure Alarm Acknowledge Button.	Blue	Top of the panel.
23.	DAY (Not provided with LED Signals)	Signal lamp voltage Control button for day time lighting.	White or Grey	Top of the panel.
24.	NIGHT (Not provided with LED Signals)	Signal lamp voltage Control button for night time lighting.	White or Grey	Top of the panel.
25.	1.2 (Not provided with LED Panels)	Panel lamp voltage Control buttons for light intensity	White or Grey	Top of the panel.

Buttons EWN and EUYN are normally obstructed for operation by a sealed disc. Before operation, seal has to be broken, seal wire has to be removed and the disc turned to free the button by the operator. In case of EUYN button a key control also provided in addition to the seal. After each operation, the operator has to get resealing done on the disc by the signalling staff.

- 2.3** To record each emergency operation Counters of emergency operations are provided close to the concerned buttons at the top of the panel as below:-

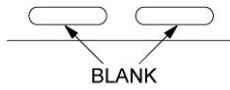
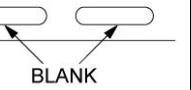
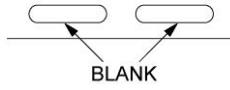
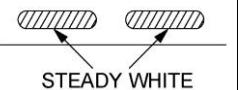
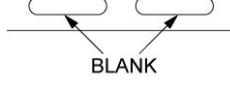
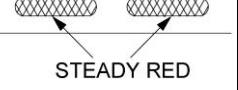
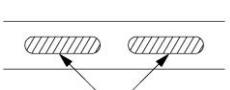
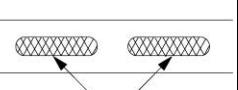
S.No.	Counter	Description	Whether common or individual
1.	EWZ	Emergency Point operation Counter	Common
2.	EUYZ	Emergency Sub-Route Release Counter	Common
3.	EUUYZ	Emergency Full Route Release Counter	Common
4.	OYZ	Overlap Release Counter	Common
5.	COGGZ	'Calling on' Signal Operation Counter	Common
6.	CH <sub>1</sub> Z/ CH <sub>2</sub> Z/etc	Crank handle Release Operation Counter	Individual for each group

Some panels do not have Overlap Release Button (OYN). In its place, EUUYN was utilised instead of OYN.

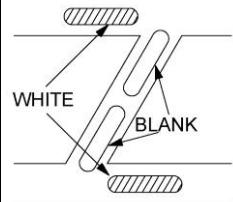
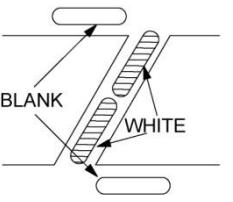
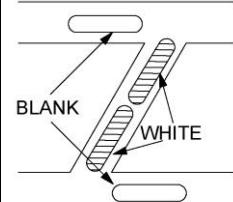
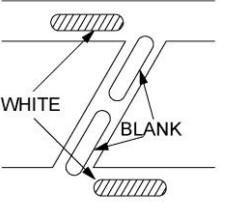
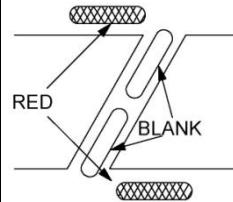
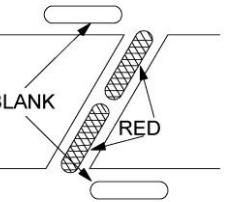
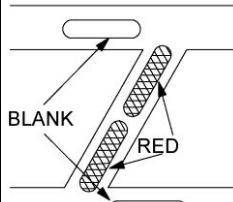
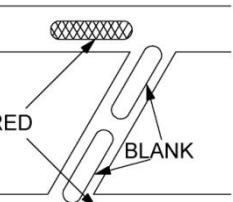
## 2.4 Visual Indications on Panel

1. Track Indication.
2. Point Indication N or R
3. Signal Indication.
4. Route Indication.
5. Signal and Point failure Indication.
6. Button Stuck Indication.
7. Approach Lock Indication.
8. Point Lock Indications.
9. Signal Lock Indication.
10. Power Supply Indication.
11. Panel Illumination Intensity Control
12. Crank Handle Interlocking, Slot, and Gate Control etc. Indications.
13. Audible indications are also provided on panel to indicate the stuck up condition of button, visual indication will continue till faults are put right.

- 2.5** The various panel operations and changes on panel indication consequent upon operation or change of gear conditions are detailed below:-

S.No.	Gear operation or change of condition	Panel illumination or change		Description
		Before operation or change	After operation or change	
1)	Track circuit clear and Route not set	 BLANK	 BLANK	No illumination on strips.
2)	Track circuit clear and Route or Overlap is locked over it.	 BLANK	 STEADY WHITE	Steady white illumination on strips.
3)	Track circuit failed or occupied without route locking on it.	 BLANK	 STEADY RED	Indication turn to red from blank (steady)
4)	Track circuit failed or occupied after route locking over it.	 WHITE	 RED	Indication turn to red from blank white (steady)

CONTROL PANEL

S.No.	Gear operation or change of condition	Panel illumination or change		Description
		Before operation or change	After operation or change	
5)	<b>REGULAR POINT OPERATION:</b> i) Press WWN with the concerned WN and release, to operate points from Normal to Reverse.			Normal steady indication disappears. Reverse indication flashes during operation and becomes steady after operation (white).
	ii) Press WWN with the concerned WN and release, to operate points from Reverse to Normal.			Reverse steady indication disappears. Normal indication flashes during operation and becomes steady after operation (white).
6)	<b>EMERGENCY POINT OPERATION:</b> After ensuring non-occupation of point track circuits break the seal on disc beneath EWN and turn it to free EWN.			
	i) Press EWN with the concerned WN and release to operate points from Normal to Reverse.			Normal steady Red indication disappears. Reverse indication flashes during operation and become steady after operation (Red).
	ii) Press EWN with the concerned WN and release to operate points from Reverse to Normal.			Reverse steady Red indication disappears. Normal indication flashes during operation and becomes steady after operation (Red).

S.No.	Gear operation or change of condition	Panel illumination or change		Description
		Before operation or change	After operation or change	
7)	When points go out of correspondence with control.			
	i) Points changed to Normal with control remaining in Reverse.			Reverse white indications as per control flashes and Normal Red indication (on only one strip) as per point position flashes.
	ii) Points changed to Reverse with control remaining in Normal.			Reverse white indications as per control flashes and Reverse Red indication (on only one strip) as per point position flashes.

#### 8) Main signal clearance operation for diversion movement

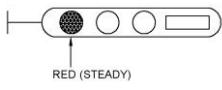
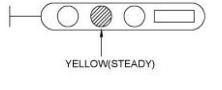
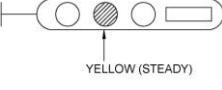
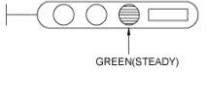
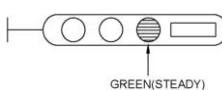
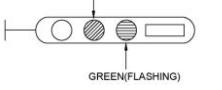
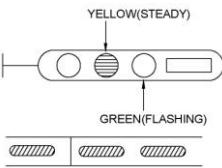
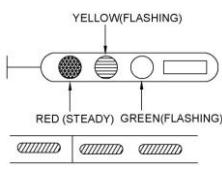
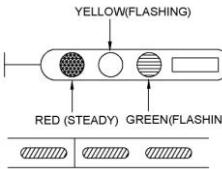
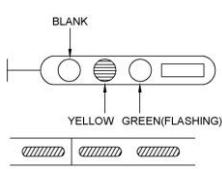
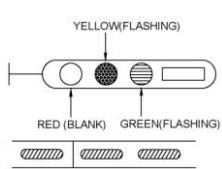
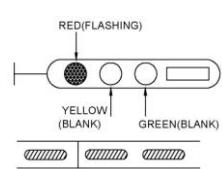
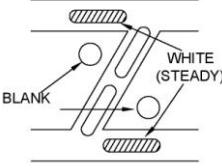
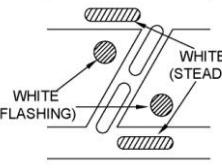
	Press the concerned GN and UN together and release.  Route and overlap are set. (In RRI, points in route, overlap and isolation are set automatically as required. In PI, they are already set to the required position by individual point operation)			
i)	Points in route, overlap and isolation gets locked.			When points get locked in route, overlap or isolation, steady white spot indication appears as shown.
ii)	Route including Overlap gets locked			Route and overlap tracks are illuminated white (steady).

**CONTROL PANEL**

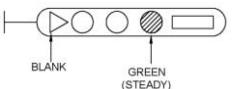
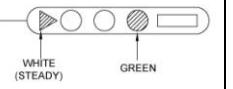
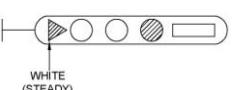
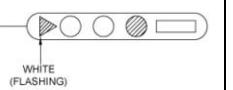
<b>S.No.</b>	<b>Gear operation or change of condition</b>	<b>Panel illumination or change</b>		<b>Description</b>
		<b>Before operation or change</b>	<b>After operation or change</b>	
<b>iii)</b>	Signal locks Route before clearing	 <b>UN</b>	 <b>WHITE (STEDY)</b> <b>UN</b>	Steady white spot indication appears above route button.
<b>iv)</b>	Signal displays HG with Route Indicator	 <b>RED (STEDY)</b> <b>ROUTE</b>	 <b>YELLOW (STEDY)</b> <b>WHITE (STEDY)</b> <b>ROUTE</b>	Red indication disappears and steady white Route indication along with Yellow indication appears on signal demarcation.
<b>(v)</b>	If more than two lamps are fused on Route Indicator	 <b>YELLOW (STEDY)</b> <b>WHITE (STEDY)</b> <b>ROUTE</b>	 <b>RED (STEDY)</b> <b>WHITE (FLASHING)</b> <b>ROUTE</b>	White route indication flashes and Red indication appears on signal demarcation.

**9) Main signal clearance operation for straight road movement.**

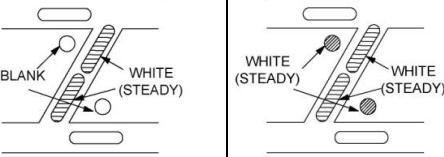
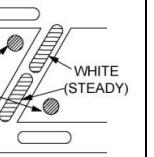
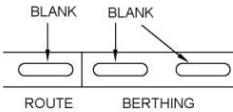
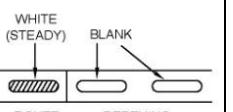
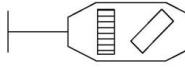
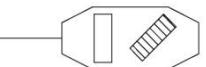
	Press the concerned GN and UN together and release.  Route and overlap are set.  (In RRI, points in route, overlap and isolation are set automatically as required. In PI, they are already set to the required position by individual point operation)			
<b>i)</b>	Points in route, overlap and isolation get locked.	 <b>BLANK</b> <b>ROUTE</b>	 <b>WHITE</b> <b>ROUTE</b>	When points get locked in route, overlap and isolation, steady white spot indication appear as shown.
<b>ii)</b>	Route including overlap gets locked	 <b>SIGNAL IN ADVANCE</b> <b>ROUTE</b> <b>OV</b> <b>BLANK</b>	 <b>SIGNAL IN ADVANCE</b> <b>ROUTE</b> <b>OV</b> <b>WHITE (STEDY)</b>	Route and overlap tracks are illuminate white (steady)
<b>iii)</b>	Signal locks route before clearing.	 <b>WHITE (STEDY)</b> <b>ROUTE</b>	 <b>WHITE (STEDY)</b> <b>ROUTE</b>	Steady white light appears above route button.

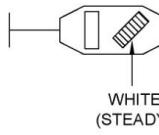
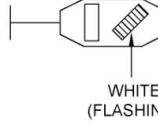
S.No.	Gear operation or change of condition	Panel illumination or change		Description
		Before operation or change	After operation or change	
iv)	Signal displays HG aspect.			Yellow indication appears on signal demarcation.
v)	Signal in advance is cleared for run through movement. Signal displays DG aspect.			Green indication appears on signal demarcation.
vi)	If DG lamp of Signal gets fused now, signal displays HG aspect since cascading control is available			Green indication starts flashing and steady Yellow indication appears on signal demarcation.
vii)	If HG lamp of signal is also fused now, signal displays RG through cascading control.			Simultaneously Green & Yellow flashing indications and steady Red indication are displayed. Route locked indication continues to be displayed.
viii)	If RG lamp of signal is also fused now, the signal remains blank.			Both Green & Yellow indications flashing with control relays picked up. Route locked indication continues to be displayed.
ix)	Press GN and EGGN signal control relays drop.			Red flashing indication appears. It becomes steady only when RG lamp is lit. Route locked indication continues to be displayed.
x)	In RRI, points not lying in the required position shall be operated in automatic route setting. In this process, if any point operation is initiated by route setting but the point operation control fails.			Point locking spot indication flashes. The point indication in the last operated position continues to be displayed.

**CONTROL PANEL**

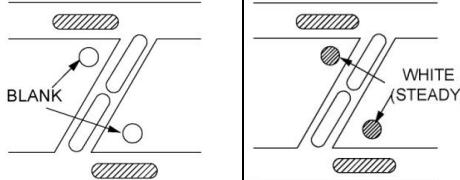
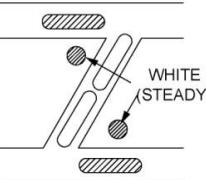
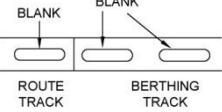
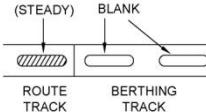
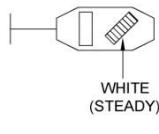
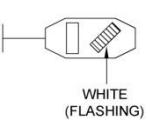
<b>S.No.</b>	<b>Gear operation or change of condition</b>	<b>Panel illumination or change</b>		<b>Description</b>
		<b>Before operation or change</b>	<b>After operation or change</b>	
10)	Introduction of auto working on semi automatic signals & re-introduction of its manual control (only for Straight Road movements)			
i)	Press GN and AGGN together and release after the signal is taken 'OFF' 'A' marker on signal post is lighted.			White (steady) 'A' marker indication on Signal demarcation is lit.
ii)	If 'A' marker lamp on signal post is fused, signal continues to work as automatic signal.			'A' marker indication starts flashing. It becomes steady only when lamp is replaced.
iii)	Press GN and AGGRN together and release. Signal becomes manual controlled 'A' marker on signal post is extinguished.			'A' marker indication disappears.

**11) Shunt signal clearance for diversion movement:**

	Press the concerned Sh.GN and UN together and release. Route excluding overlap is set. In RRI points get operated automatically before locking if they are not already in required (Reverse) position.			
i)	Points in route get locked.			When points in the route get locked, steady White spot indications appear.
ii)	Route gets locked (no overlap)			Route track circuits excluding the berthing track are illuminated.
iii)	Signal displays 'OFF' aspect.			'ON' aspect indication disappears and 'OFF' indication appears.

S.No.	Gear operation or change of condition	Panel illumination or change		Description
		Before operation or change	After operation or change	
iv)	If 'OFF' aspect lamp of shunt signal is fused then 'OFF' aspect on the signal becomes blank.			White illumination of 'OFF' aspect starts flashing. It becomes steady only after the lamp is replaced.

**12) Shunt signal clearance for straight road movement:**

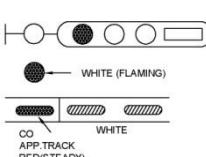
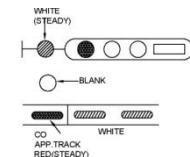
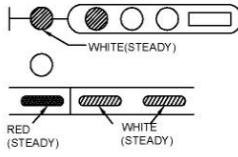
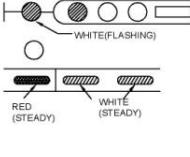
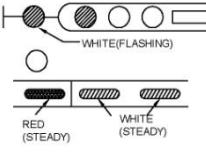
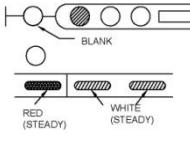
	Press the concerned Sh.GN and UN together and release. Route excluding overlap is set. In RRI points get operated automatically before locking if they are not already in required (Normal) position.			
i)	Points in route get locked.			When points in the route get locked, steady White spot indications appears.
ii)	Route gets locked (no overlap)			Route track circuits excluding the berthing track are illuminated.
iii)	Signal displays 'OFF' aspect.			'ON' aspect indication disappears and 'OFF' indication appears.

**CONTROL PANEL**

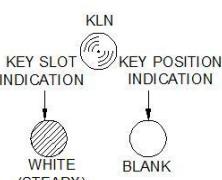
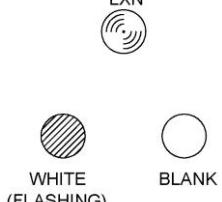
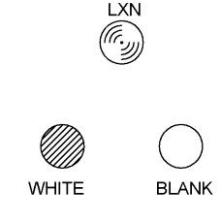
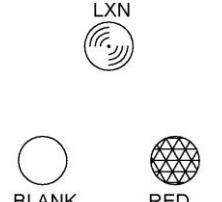
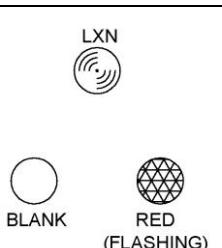
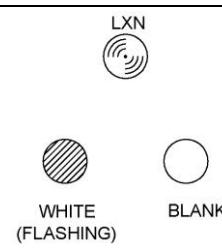
<b>S.No.</b>	<b>Gear operation or change of condition</b>	<b>Panel illumination or change</b>		<b>Description</b>
		<b>Before operation or change</b>	<b>After operation or change</b>	
<b>13) Calling ON signal clearance for diversion movement:-</b>				
	After the train has occupied the Calling 'ON' signal approach track circuit, press COGGN along with the related Main signal GN. Then release only COGGN, keeping GN pressed, press UN now and release both.			
i)	Route gets set and locked. Calling 'ON' signal approach timer starts operation.	<p>The diagram shows two states of a control panel. In the first state (before), the track circuit is labeled 'CO APP TRACK RED(STEADY)' and is shown with a solid black circle. In the second state (after), the track circuit is labeled 'WHITE' and is shown with a white circle. A legend below the diagram indicates: 'WHITE (FLAMING)' (solid black circle), 'WHITE' (white circle), and 'BLANK' (empty circle).</p>	<p>The diagram shows two states of a control panel. In the first state (before), the track circuit is labeled 'CO APP TRACK RED(STEADY)' and is shown with a solid black circle. In the second state (after), the track circuit is labeled 'WHITE (FLAMING)' and is shown with a white circle. A legend below the diagram indicates: 'WHITE (FLAMING)' (solid black circle), 'WHITE' (white circle), and 'BLANK' (empty circle).</p>	Route locked white indication appears on track circuit in route, except berthing track and white approach timer indication starts flashing.
ii)	After 2 minutes, timer operation is completed and Calling 'ON' signal displays 'OFF' aspect.	<p>The diagram shows two states of a control panel. In the first state (before), the track circuit is labeled 'CO APP TRACK RED(STEADY)' and is shown with a solid black circle. In the second state (after), the track circuit is labeled 'WHITE' and is shown with a white circle. A legend below the diagram indicates: 'WHITE (FLAMING)' (solid black circle), 'WHITE' (white circle), and 'BLANK' (empty circle).</p>	<p>The diagram shows two states of a control panel. In the first state (before), the track circuit is labeled 'CO APP TRACK RED(STEADY)' and is shown with a solid black circle. In the second state (after), the track circuit is labeled 'WHITE (STEADY)' and is shown with a white circle. A legend below the diagram indicates: 'WHITE (STEADY)' (white circle), 'WHITE' (white circle), and 'BLANK' (empty circle).</p>	Approach timer indication disappears and Calling 'ON' signal 'OFF' indication appears.

**14) Calling on signal operation for straight road movement:-**

	After the train has occupied the Calling 'ON' signal approach track circuit, press COGGN along with the related Main signal GN. Then release only COGGN, keeping GN pressed, press UN now and release both.			
i)	Route gets set and locked. Calling 'ON' signal approach timer starts operation.	<p>The diagram shows two states of a control panel. In the first state (before), the track circuit is labeled 'CO APP TRACK RED(STEADY)' and is shown with a solid black circle. In the second state (after), the track circuit is labeled 'WHITE' and is shown with a white circle. A legend below the diagram indicates: 'WHITE (FLAMING)' (solid black circle), 'WHITE' (white circle), and 'BLANK' (empty circle).</p>	<p>The diagram shows two states of a control panel. In the first state (before), the track circuit is labeled 'CO APP TRACK RED(STEADY)' and is shown with a solid black circle. In the second state (after), the track circuit is labeled 'WHITE (FLAMING)' and is shown with a white circle. A legend below the diagram indicates: 'WHITE (FLAMING)' (solid black circle), 'WHITE' (white circle), and 'BLANK' (empty circle).</p>	Route locked white indication appears on track circuit in route, except berthing track and white approach timer indication starts flashing.

S.No.	Gear operation or change of condition	Panel illumination or change		Description
		Before operation or change	After operation or change	
ii)	After 2 minutes, timer operation is completed and Calling 'ON' signal displays 'OFF' aspect.			Approach timer indication disappears and Calling 'ON' signal 'OFF' indication appears.
iii)	If Calling 'ON' signal lamp is fused, Calling 'ON' signal becomes blank.			Calling 'ON' signal white indication starts flashing. It becomes steady if CO Sig. lamp is replaced.
iv)	Press (relevant Main Signal Button) along with EGPN, Calling 'ON' signal control relay drops.			Calling 'ON' Signal white flashing indication disappears. Route locked indication continues to be displayed.

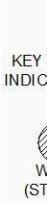
#### 15) Release of Level Crossing Gate slot & its return:-

i)	Press LHN and YYN together and release, when no route or overlap involved is set.  Gate slot is released and attention of gate man is drawn at the gate hut.			Gate slot white indication on panel flashes.
ii)	Gateman takes out the gate slot key in the key lock relay.			Gate slot white indication is extinguished. Gate open condition Red indication starts flashing.
iii)	Gateman replaces the key after closing the gate.			Gate open condition Red indication disappears, indicating gate closed condition. Gate slot white indication starts flashing on panel.

**CONTROL PANEL**

<b>S.No.</b>	<b>Gear operation or change of condition</b>	<b>Panel illumination or change</b>		<b>Description</b>
		<b>Before operation or change</b>	<b>After operation or change</b>	
<b>iv)</b>	Press LZN along with YRN, gate slot gets withdrawn.	  WHITE (FLASHING)      BLANK	  WHITE (STEADY)      BLANK	Gate slot white indication becomes steady.

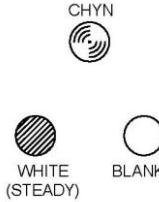
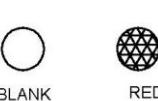
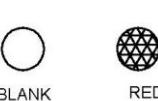
**16) Release of slot on Point Key Lock & its return:-**

<b>i)</b>	Press KLN button along with YYN button and release, when no route or overlap involved is set.	  KEY SLOT INDICATION      KEY POSITION INDICATION WHITE (STEADY)      BLANK	  WHITE (FLASHING)      BLANK	Key slot white indication on panel flashes.
<b>ii)</b>	Key lock control is released and attention of person at site is drawn.	  KLN      BLANK WHITE (FLASHING)      BLANK	  KLN      RED (FLASHING)	Key control indication is extinguished. Key position indication becomes flashing Red, indicating the key is taken out condition.
<b>iii)</b>	Key is replaced in the Key Lock Relay after relocking of points.	  KLN      RED (FLASHING) BLANK      RED (FLASHING)	  KLN      BLANK WHITE (FLASHING)      BLANK	Key position Red indication disappears indicating that Point Key is re-inserted. Key slot White indication starts flashing on the panel.

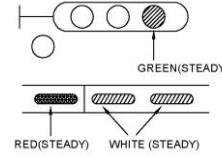
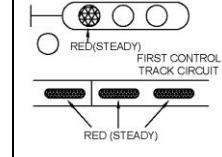
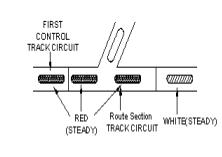
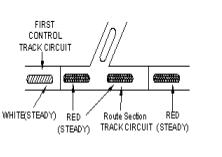
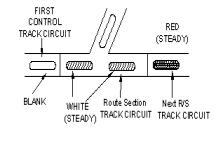
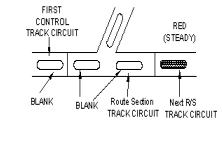
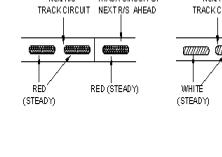
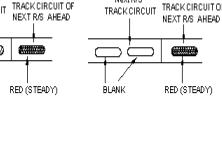
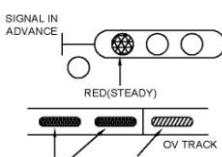
S.No.	Gear operation or change of condition	Panel illumination or change		Description
		Before operation or change	After operation or change	
iv)	Press KLN along with YRN, Key Lock control gets withdrawn.	  WHITE (FLASHING)  BLANK	  WHITE (STEADY)  RED (FLASHING)	Key slot White flashing indication becomes steady.

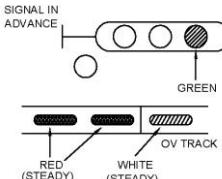
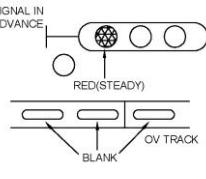
**17) Release of point group crank handles control & its return:-**

i)	When no route or overlap is set involving the points of which the crank handle is to be released, ask for co-operation from site that will be given by pressing CHPB (Crank Handle Push Button) in CH Box at the location.	  	  BLANK  RED (FLASHING)	Crank handle slot indication disappears and Crank Handle Position indication becomes flashing Red.
ii)	On seeing the Red flashing indication that indicating co-operation is required to release CH Key form CH Box, Press CHYN of concerned CH Group along with YYN and release.	  BLANK  RED (FLASHING)	  BLANK  RED (STEADY)	CH Key is extracted from the CH Box.  On the CH position, steady Red indication appears when crank handle slot is released.
iii)	After CH is released from the Point Machine and the key is reinserted in the Key Lock Relay of CH Box Key Lock Relay picks up and it gets locked.	  BLANK  RED(STEADY)	  WHITE (FLASHING)  BLANK	Crank handle position Red indication disappears. Crank handle slot White indication starts flashing.
iv)	Press CHYN along with YRN and release. Crank handle slot gets withdrawn.	  WHITE (FLASHING)  BLANK	  WHITE (STEADY)  BLANK	Crank handle slot White flashing indication becomes Steady.

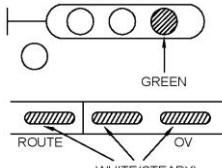
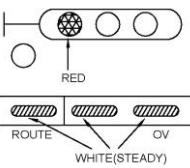
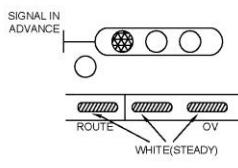
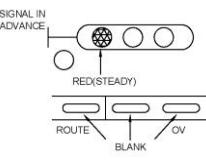
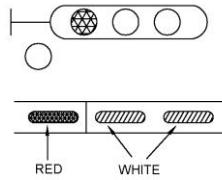
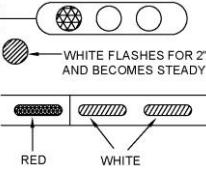
S.No.	Gear operation or change of condition	Panel illumination or change		Description
		Before operation or change	After operation or change	
v)	If without release of crank handle slot from the panel, crank handle key lock checking circuit (CHKLCR) fails, when point operation is attempted, its detection fails and can be restored only after key lock checking fault is removed.	 	 	Crank handle slot indication disappears as soon as key lock checking circuit failed. Crank handle position Red indication starts flashing.

**18) Automatic route release with passage of train over it:-**

i)	<b>Train enters the route.</b> As the first control track circuit is occupied, signal goes to 'ON'.	 	First control track circuit displays Red. Indication on signal demarcation changes to Red (steady).
ii)	As the train occupies and clears track circuits one after another, route sections get released in succession behind the train.	     	As the train progresses, track circuits display Red (occupied) indications one after another. Those track circuits cleared by the train display white indications. When finally, the route section gets cleared, white illumination of route section track circuits completely disappears.
iii)	<b>If the train is not running through:</b> Overlap gets released one minute after the occupation of berthing track circuit and release of last Route Section.		Berthing track displays steady Red indication. Overlap track White indication disappears after one minute.

S.No.	Gear operation or change of condition	Panel illumination or change		Description
		Before operation or change	After operation or change	
iv)	<b>If Route Section in the overlap portion is already set for clearing signal in advance and allowing run through:</b>  Overlap gets released immediately with the passage of train over it.			Overlap set indication which is a part of route locked indication for signal in advance disappears after the passage of train over it.

#### 19) Manual route release in emergency:-

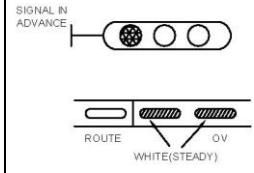
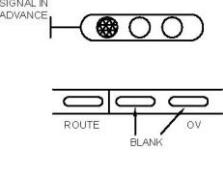
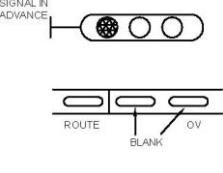
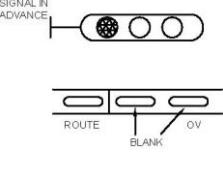
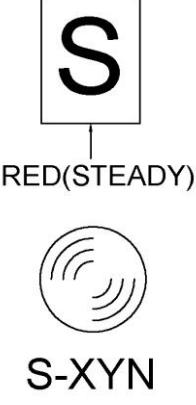
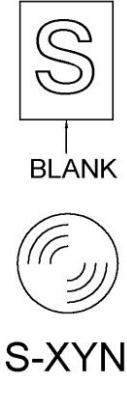
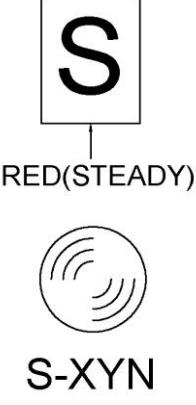
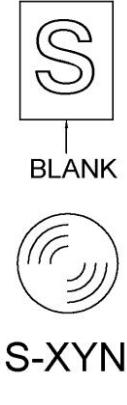
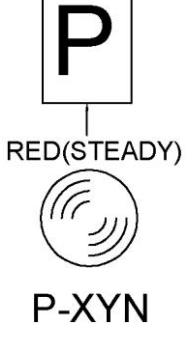
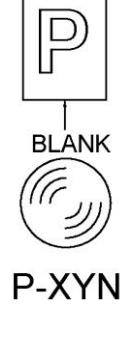
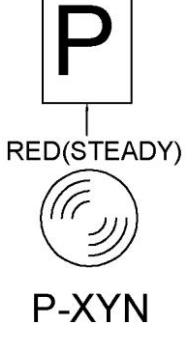
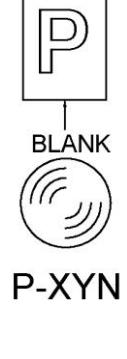
i)	<b>Press GN and EGZN together and release to replace signal at 'ON'</b>			Signal indication changes from Green to Red.
ii)	<b>If approach track is clear:</b> Press GN and EUUYN together and release EUUYN only, keeping GN pressed and then press UN.  Route and overlap get released immediately.			Track circuit illumination of route and overlaps as well as route locked and signal locked indications disappear.  EUUYZ counter progresses by one number.
iii)	<b>If approach track is occupied:</b> Press GN and EUUYN together and release EUUYN only, keeping GN pressed and then press UN.  White approach lock release timer indication appears.			White approach lock release timer indication flashes for two minutes after the operation and then becomes steady.

**CONTROL PANEL**

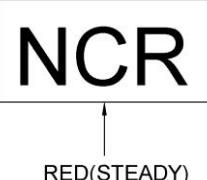
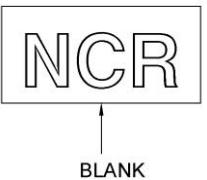
<b>S.No.</b>	<b>Gear operation or change of condition</b>	<b>Panel illumination or change</b>		<b>Description</b>
		<b>Before operation or change</b>	<b>After operation or change</b>	
b)	<p>After timer indication becomes steady: Press GN and EUYN together and release EUYN only, keeping GN pressed and then press UN.  Route and overlap get released.</p>			<p>Track circuit illumination of route and overlap as well as route locked and signal locked indications disappeared as shown in 19 (ii).</p>

**20) Individual route section release in emergency:-**

i)	Break open the seal on disc blocking the EUYN operation and turn it to free EUYN. (This operation is done with cooperation from authorized S&T staff on receiving proper written intimation about the route section release failure)			
ii)	Authorized S&T staff has to insert the EUYN Key on panel and turn.			
iii)	Press the nominated WN for concerned route section release along with EUYN and release. The particular route section gets released.			<p>Route locked indication on concerned track circuit and point locked indication disappear. Point position indication in the last operated condition remains. EUYZ counter progresses by one number.</p>

S.No.	Gear operation or change of condition	Panel illumination or change		Description
		Before operation or change	After operation or change	
21)	<b>Manual overlap release in abnormal conditions:-</b>			
	Press OYN along with the concerned UN and release.	 	 	Unless the last Route Section in the route is released, the overlap releasing is not possible. Overlap white illumination disappears soon after the operation. OYZ counter increment by one number.
22)	<b>Signal lamp fused warning:-</b>			
	A stencilled 'S' Red indication appears at the top of panel and also buzzer sounds.  After noting the location of failure, press S-XYN/GXYN button. Then Buzzer stops and visual indication remains till the signal lamp is replaced.	 	 	Red 'S' indication disappears after the fused signal lamp is replaced.
23)	<b>Point detection failure warning:-</b>			
	A stencilled 'P' Red indication appears at the top of panel and also a buzzer sounds.  After noting the location of failure, press P XYN / WXYN button. Then Buzzer stops and visual indication remains till the point detection is restored.	 	 	Red 'P' indication disappears after the point detection is restored.

CONTROL PANEL

S.No.	Gear operation or change of condition	Panel illumination or change		Description
		Before operation or change	After operation or change	
24)	<b>Indication of Button stuck in pressed condition or button relay/button repeater relay stuck in picked up condition:-</b>	Consequently some button checking relay remains dropped and common button checking relay also drops. Concerned button checking relay and common button checking relay can pick up only when fault is removed.	 	'NNCR' indication is displayed till the fault is removed. Buzzer also does not stop till the fault is removed. No manual operation is possible on panel in this condition.

\* \* \*

## CHAPTER 3

### RELAY GROUPS AND ITS ARRANGEMENT

#### 3.1 SIEMENS Relay groups

A relay group is one enclosure relates to a particular function (Functional Group). Each functional group is standardized and it is Independent of yard layout. We cannot add any relay into the group even though space is available to accommodate. Intra relay wiring within the relay group is factory wired (pre-wired) and tested. Reduces the site wiring about 40% of total wiring, as these functional groups are pre-wired at the factory itself. In the circuit diagrams this pre-wiring is shown with thick lines. One is not allowed to interfere with the group.

- 3.1.1** The following types of relays / relay groups are used in these systems of Siemens practice.

S. No	Type of Relay	Specification	Purpose
1	Non-ACI - K50 Neutral control relay.	Rs Sk-30/0011	For all controls except point motor feed. Switching, in Non-RE areas and internal circuits of RE areas.
2	AC I - K50 Neutral control relay	Rs Sk -30/0078	For external circuit of RE areas.
3	K50 type RECR	Rs Sk -30/0013	For checking ON aspect signal lamp.
4	K50 type DECR / HECR	Rs Sk -30/0014	For checking OFF aspect signal lamp.
5	K50 type UECR	Rs Sk -30/0015	For checking Route aspect signal lamp.
6	K50 Interlocked relays	Rs Sk-30/0012	For internal controls in cabins.
7	Point contactor relay	K 915-1	For point motor feed switching.
8	Motorised clockwork timer relay.	RsSk- 30/0052	Time control of locking releases and calling on signal clearance.
9	Mercury flasher relay	Rs Sk 30/0096 for 12V AC operation 30/0097 for 220V AC operation 30/0098 for 110V AC operation	For generating, flashing indication supply.

S. No	Type of Relay	Specification	Purpose
10	3A Signal group	Rs Sk 3525/46	For controlling the 3 aspect signal unit.
11	2A Signal group	Rs Sk 3525/2	For controlling the 2 aspect signal unit.
12	Shunt Signal group	Rs Sk 3525/67	One group controls two nos of shunt signals
13	Points Minor group Drs II (PI)	Rs Sk 31/0001	For point operation in PI
14	Route Group	Rs Sk 31/0002	For route setting and release.
15	Point Major Group (Drs)	Rs Sk 3515/19	For point operation in RRI
16	Points Chain group	Rs Sk 3515/3	For successive operation control of 8 point groups.
17	Points Switching group	Rs Sk 3515/22	For controlling remote points operation.
18	Points Contactor Unit	Rs Sk 21/0001-A	For controlling points operation other than Siemens installations.

**3.2** K-50 relays are available only in group units of different sizes. Depending upon the unit size, these groups are broadly classified as:

- (1) Mini groups
- (2) Minor Groups
- (3) Major group

The capacities of various groups are as follows:-

S. No.	Class	Capacity
1.	Mini Group	2 Neutral control relays, 1 Interlocked relay or 1 ECR with power conversion unit.
2.	Minor Group	15 Neutral Relays (with one interlocked relay replacing two neutral relays, one contactor relay replacing four neutral relays, or one resistor or condenser fixed in place of one neutral relay in some units).
3.	Major Group (used only in RRI).	Up to 30 neutral relays (with replacements by other relays as in a minor group).

**3.3** The various signalling gears are controlled in these systems by relay groups as shown below:-

S. No	Gears Controlled	Class of Group & Drg. No	Designation & Usage	Number of Various Components									Indications	Transformer
				Single Coil Neutral Relays	Double Coil Neutral Relays	Interlocked Relays	Contactors	Resistances	Condensers	Rectifiers	Terminals			
1	One 2-Asp Main Signal	Minor RsSp 3525/2	Signal Group in PI, RRI or lever Control	10	-	-	-	2	3	2	100	2 ON(R) OFF(G)	-	
2	One 3-Asp Main Signal	Minor RsSp 3525/46	Signal Group in PI, RRI or lever control	13	-	-	-	2	3	3	100	2 ON(R) OFF(G)	-	
3	Two Shunt Signals	Minor RsSp 3525/67	Signal Group in PR, RRI or lever control	13	-	-	-	2	2	4	100	4 ON (R,R) OFF (Y,Y)	-	
4	Two Route Sections	Minor RsSp 31/00021	Universal Route Group in PI, RRI	5	-	3	-	-	-	-	100	2 R/S set(R) & Sub- Route is locked (Y)	-	
5	Two Siemens Point Machine (Successive Controls)	Minor RsSp 31/0001	Drs II Point Group for PI	3	4	2	1	11	1	1	100	1 Point Detection (R)	-	
6	One or Two successively controlled Siemens Point Machines with DC Motor	Major RsPs 3515/19	Drs Point Group for RRI	7	6	5	1	11	1	1	180	3 Pt Detection (Y) - 1 Pt Lock (Y) - 1 Track Fail (R) - 1	-	

**RELAY GROUPS AND ITS ARRANGEMENT**

S. N o	Gears Controlled	Class of Group & Drg.No.	Design ation & Usage	Number of Various Components									
				Single Coil Neutral Relays	Double Coil Neutral Relays	Interlocked Relays	Contactors	Resistances	Condensers	Rectifiers	Terminals	Indications	Transformer
7	One or Two successiv ely controlled Simens Point Machines with AC 3 -Phase Motor	Major RsPs 31/0015	Univers al Point Group for RRI	7	6	5	1	11	1	1	180	-do-	3
8	One or Two successiv ely controlled Siemens Point Machines with AC 3 -Phase Motor	Minor RsSk 31/0003	3Ø Point Group for PI	3	4	2	1	11	1	1	100	1 (R)	1
9	One or Two successiv ely controlled Point Machines of other than Siemens make with AC 3Phase Motor	Minor RsSk 3515/22 (to be used with Main Points Group)	Drs Point switchi ng Group for PI, RRI or lever control	4	1	3	1	-	-	-	100	1 (R)	1
10	Successiv e operation control of eight point groups	Minor RsSk 3515/3	Point Chain Group for RRI	8	-	-	-	-	-	-	-	-	-

### 3.4 Features of K-50 Relays / Relay Groups:

- 1) On the basis of thickness of residual pin / separating pin, relays are classified as:
 

A type : Residual pin thickness is 0.35mm	a) Non AC Immunised Neutral relays
	b) Interlocked relays
B type : Residual pin thickness is 0.15mm	a) AC Immunised Neutral relays
	b) Special or double coil relays
	c) UECR
E type : Residual pin thickness is 0.45mm	a) RECR
	b) HECR / DECR
- 2) Maximum Contacts available = 8 Nos.
- 3) Standard Contact Configuration:
 

i) Neutral / Interlocked Relays	= 4F/4B, 5F/3B, 6F/2B.
ii) ON & OFF ECR	= 3F/3B.
iii) UECR	= 5F/1B.
iv) WJR (Point group)	= 2F/2B.
- 4) Current carrying capacity:
 

Switching current	= 2 Amps.
Continuous current	= 5 Amps
- 5) All contacts are Independent; series double make double break contacts.
- 6) Contact resistance = 0.05 Ohms.
- 7) Working voltage = 60V DC
- 8) For Neutral Relays: Pick up time = 25ms to 60ms  
Drop away time = 7ms to 15ms.
- 9) For AC immunized relays: Pick up time = 200ms  
Drop away time = 50ms
- 10) Code pins are provided to prevent the plugging of wrong relay in a base.
- 11) Guide pins are provided to prevent plugging of relay in a wrong direction i.e., inverting the position of relay.
- 12) The armature operation is assisted by proving action and hence more positive.
- 13) Size of the relay is small. It occupies less space and operation is very fast.
- 14) Contact resistance of metal-to-metal relay is less so that more contacts can be proved in one circuit.

### 3.4.1 Relay configuration and Coil Resistance:

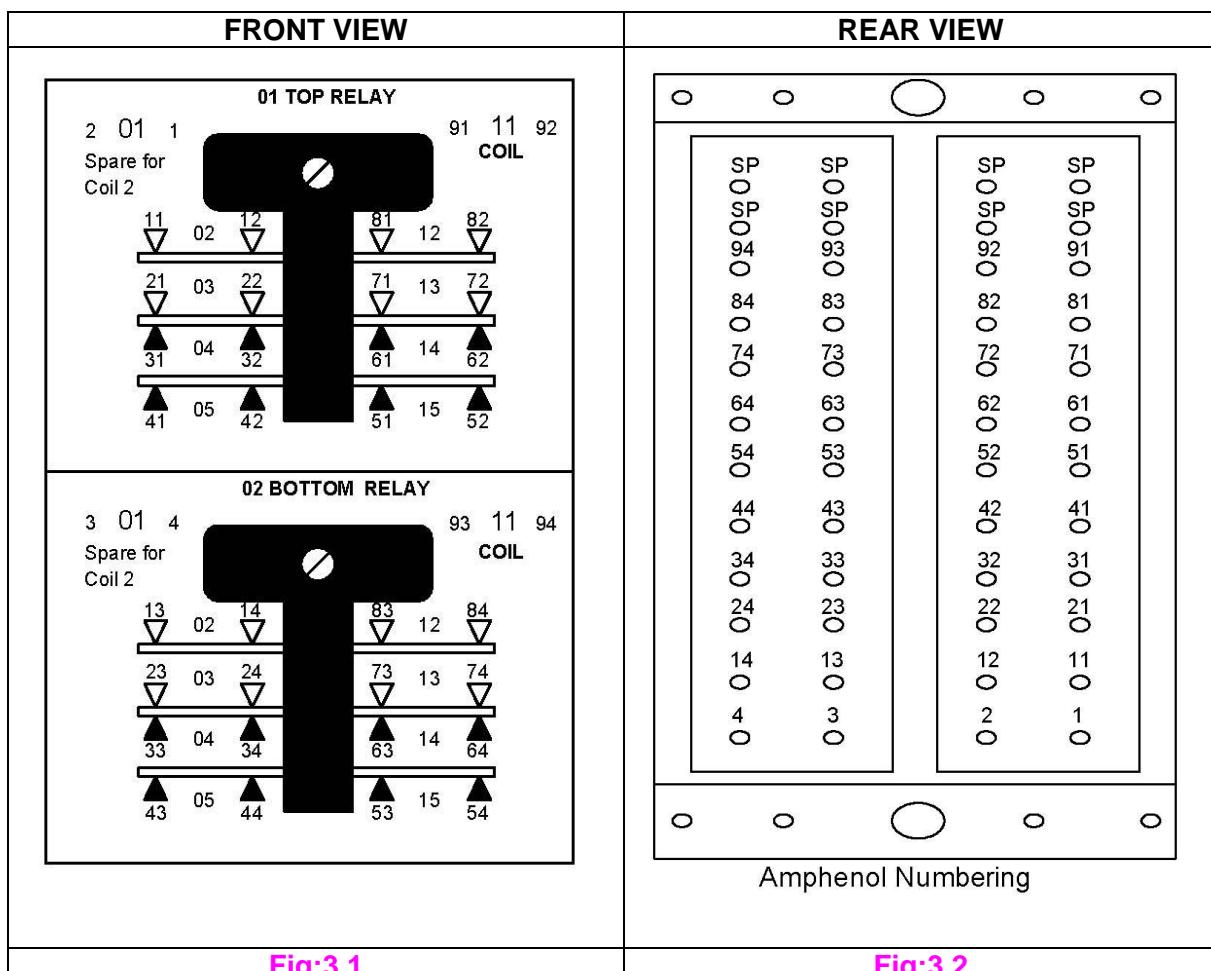
Sl No	Type	Contact configuration	Relay coil Resistance
1	Non AC immunised Neutral Relays	4F/4B	1260 Ω
		5F/3B	1260 Ω
		6F/2B	1840 Ω
2	Interlocked relay	4F/4B, 5F/3B, 6F/2B	615 Ω (To overcome friction)
3	AC immunised relay( Both Top & bottom Relays)	5F/3B	1840 Ω
4	AC immunised relay (Top AC immunised & bottom Non AC immunised Relay)	5F/3B	Top relay : 1840 Ω Bottom Relay: 1260 Ω
5	Double Coil Relays (Z1WR1, Z1NWR, Z1RWR, WKR3, Z1WR, WLR)	-	1st Coil 1340 Ω 2nd Coil 1590 Ω
6	UECR	5F/1B	64.1 Ω
7	ON ECR	3F/3B	64.1 Ω
8	OFF ECR	3F/3B	64.1 Ω
9	WKR1	5F/3B	1840 Ω, Pickup current is 17 to 19 mA but normal working current is 27 mA)
10	WKR2	5F/3B	52.3 Ω (Pickup current is 120mA)
11	WJR	2F/2B	1840 Ω (2500 Mfd capacitor in series with 39Ω Resistor to make slow to release not less than 10 seconds)
12	WR Heavy Duty contactor Relay	2F/2B	60 Ω (Pickup current is 1 A and Holding current is 100 mA±10mA with 600Ω, 25W Resistor in series)

### 3.5 Mini Groups:

Different types of Mini groups available are:

1. Mini Groups with Two Nos. K-50 Neutral Relays.
2. One AC Immunised and one Non – AC Immunised K-50 Neutral relays or Two AC Immunised K-50 Neutral relays.
3. Two Nos. K-50 Inter Locked Relays.
4. Lamp proving relays (3F/3B) for ON and OFF aspect and (5F/1B) for Route Indicator lamps.

Relay Coils and contacts are numbered as shown in figures below.



02-12	always Front contact
05-15	always Back contact
03-13	inter changeable contact
04-14	inter changeable contact

○ ○	○ ○	No wiring
○ ○	○ ○	No wiring
● ●	● ●	Purple
● ●	● ●	Pink
○ ○	○ ○	White
● ●	● ●	Yellow
● ●	● ●	Black
● ●	● ●	Brown
● ●	● ●	Green
● ●	● ●	Gray
● ●	● ●	Red
● ●	● ●	Blue

**K-50 RELAY BASE PLATE ( REAR VIEW)**  
Colour coding of each wire

Relay Coils and contacts are numbered as:

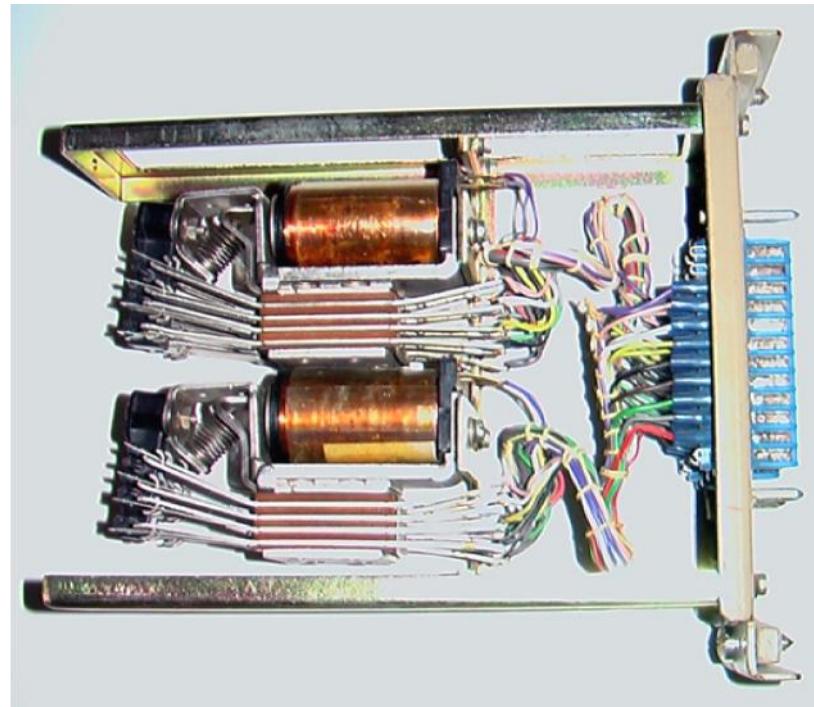
<b>TOP RELAY</b>			
<b>Terminal No.</b>	<b>CONTACT No.</b>	<b>CONTACT No.</b>	<b>Terminal No.</b>
01-02 (sp)	01 (Spare)	11 (Coil)	91-92 (coil)
11-12	02	12	81-82
21-22	03	13	71-72
31-32	04	14	61-62
41-42	05	15	51-52

Contact Numbering is identical for both the Top & Bottom relays.

<b>BOTTOM RELAY</b>			
<b>Terminal No.</b>	<b>CONTACT No.</b>	<b>CONTACT No.</b>	<b>Terminal No.</b>
03-04 (sp)	01 (Spare / 2 <sup>nd</sup> coil , if any)	11 (1 <sup>st</sup> Coil)	93-94 (coil)
13-14	02	12	83-84
23-24	03	13	73-74
33-34	04	14	63-64
43-44	05	15	53-54

### 3.5.1 Mini group with Neutral Relay-Non AC Immunised:

It consists of two nos. of K50 Relays, arranged one on Top and another on Bottom positions. Top Relay position No. is 1 and Bottom Relay position No. is 2. Each neutral relay is capable of working independently. This Relay group has contact configuration of 4F/4B, 5F/3B & 6F/2B. In this group top and bottom relays has same contact configuration.



**K-50 - Non A.C IMMUNISED RELAY**

AC immunity level of Non-AC immunised K-50 Neutral relay is shown in the table below:

Sl. No.	Relay Type	Contacts	AC Immunity Level	Length of parallelism of coil circuit permitted		
				As per old norms	As per new norms	
					In single line Section	In double Section
1.	K-50 A&B	5F.3B	150V	1.7 KM	0.75 KM	0.9 KM
		4F.4B	130V	1.4 KM	0.75 KM	0.9 KM
		6F.2B	120V	1.3 KM	0.75 KM	0.9 KM
2	K-50 B I	5F.3B	175 V	2 KM	0.75 KM	0.9 KM

Note: AC Induced voltage per KM length of parallelism is 35V as per old norms and it is 95 V in double line sections and 116V in single line sections as per new norms.

### 3.5.2 Mini group with AC Immunised K-50 Neutral relays

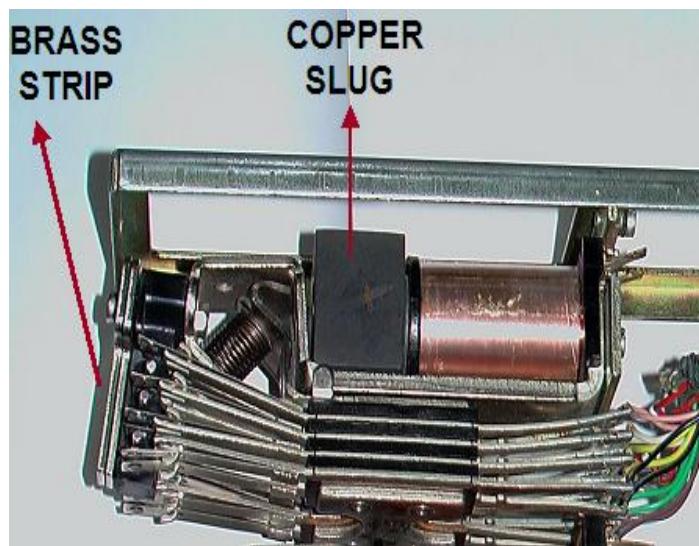
It has contact configuration of 5F.3B only. AC Immunity level is **450 V AC**.

Length of Parallelism of coil circuit per mitted		
As per old norms	As per new norms	
2 KM	1.0 KM	In single line sections.
2 KM	1.2 KM	In double line sections

It is available in two types:

- a) Top Relay is ACI and bottom relay is Non-ACI.
- b) Both Top and bottom relays are ACI.

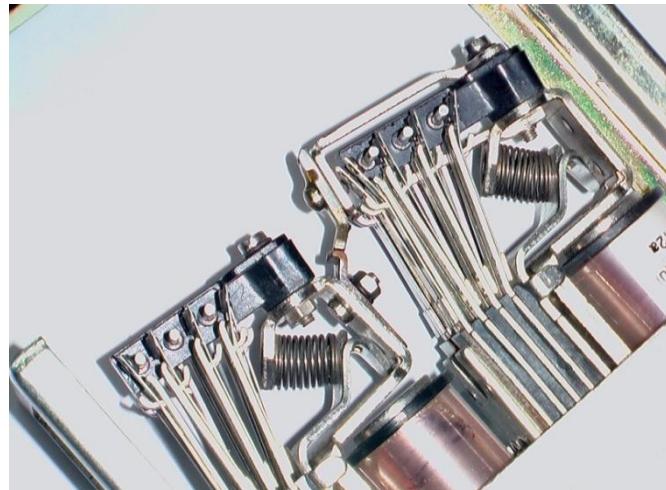
ACI relay is provided with Copper slug for AC Immunisation and Brass strip as a counter weight for reducing release time.



K50 - A.C IMMUNISED RELAY

### 3.5.3 Mini group with Interlocked relays

Two neutral K-50 relays are latched mechanically to form an Interlocked Relay. It works as a memory device to detect the last operation. Top coil is called Reverse coil and Bottom coil is called as Normal coil. Bottom Relay is Normally UP and Top Relay is Normally DOWN position. Picking of one relay de-latches (drops) the other relay. In this process both the relay front contacts are available for a few milli seconds. i.e In Interlocked relays, Front contacts of the one relay breaks only after picking up of the other relay. To cut off feed to the Reverse (top relay) coil after its armature is latched, bottom relay front contact is connected in series with the Reverse (top relay) coil in its external energisation circuit. Similarly, to cut off feed to the Normal (bottom) relay coil after its armature is latched, Top relay front contact is connected in series with the Normal (bottom) relay coil in its external energisation circuit. These front contacts are called as an economizer contacts, since these contacts cut-off the power supply to the latched relay coils after their picking up.



### K 50 - INTERLOCKING RELAY

When one relay is picked up there is possibility of picking of other relay, but both coils can never be in dropped condition. Normally Front contact of top relay is equivalent to a Back contact of bottom relay and vice versa. But in a few circuits front and back contact variation varies. All Inter locked relays are Normalized after completion of movement, but in Point group circuit (R)WLR relay remains in the last operated position.

Inter locked relay groups are available with 4F/4B, 5F/3B and 6F/2B contact configurations.

For Neutral relays, Front Contact and Back Contact are used as per requirement. But for interlocked relays, in one Circuit UP contact is used then in next circuit it's conflicting relay DOWN contact is used.

Interlocked relay is used to achieve an interlocking between conflicting functions.

Originally Point / Route Group Inter locked relays are used but not in Signal Group, on demand it was provided at outside signal group.

#### 3.5.4 Mini group with ECR's

It comprises of a current transformer, bridge rectifier and a neutral relay of K50. Relay is provided on top position and Power conversion unit provided on bottom position. ECRs are supplied separately for ON aspect, OFF aspect and Route indicator.

##### **ON ECR:**

It is used for proving the ON aspect of the signal. In case of double pole lamps, it picks up when both filaments of the signal lamp are lit and it drops when the any one of the filament of signal lamp is fused. But in case of triple pole lamps, it picks up when any one of 33W rated filament is litting and it drops only when both the filaments are fused or not litting. It is not suitable for LED signals.

##### **OFF ECR:**

It is used for proving the OFF aspect of the signal. It picks up Whenever OFF aspect lamp is litting and drops when OFF aspect lamp is fused or not litting. It is suitable for LED signals.

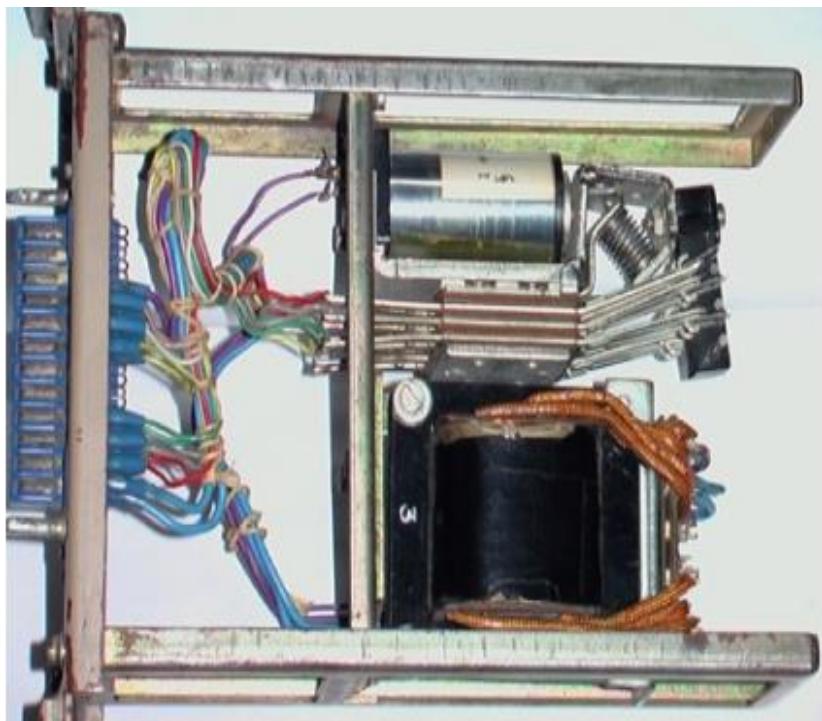


Fig: K50 Mini group with ECR

**UECR:**

It is used for proving the Route Indicator of the signal. The relay gets energized, when at least 3 lamps are lit on the route indicator. If more than 2 lamps are fused in the route indicator, it drops.

Sl. No	Description	ON ECR	OFF ECR	UECR
1	Amphenol terminal No. for relay coil	1-91	1-92	1-91
2	Relay coil Resistance	64.1 Ω	64.1 Ω	64.1 Ω
3	Contact configuration	3F/3B	3F/3B	5F/1B

**3.5.5 Guide Pins and Code Pins:**

**Guide pins** are provided on rear side of the mini group to prevent plugging of relay in inverted position and will enable plugging of the relay in proper alignment.

Holes for **Code pins** are provided on rear side of the mini group in 8 positions. Code pins provided on the relay terminal board (plug board) prevents the plugging of wrong configuration and type relays.

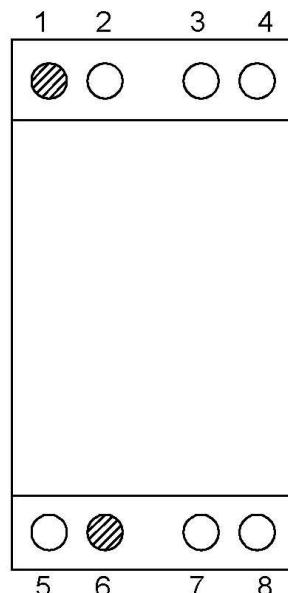
Positions of code pins for various Mini group relays are given in the table below:

Sl.No	Relay Type	Contact configuration	Code Pin Position
(a)	<b>Neutral:</b>	4F/4B	1 & 7
		5F/3B	1 & 6
		6F/2B	1 & 5
(b)	<b>Inter Locked:</b>	4F/4B	3 & 7
		5F/3B	3 & 6
		6F/2B	3 & 5
(c)	<b>AC Immunised:</b>		
		One relay ACI and other relay Non ACI	5F/3B
		Both relays ACI	5F/3B
(d)	<b>ECRs:</b>		
		<b>ON ECR</b>	3F/3B
		<b>OFF ECR</b>	3F/3B
		<b>UECR</b>	5F/1B
			4 & 6

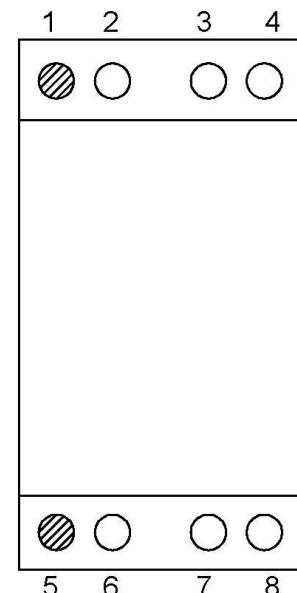
Code pins are shown in the figure by shaded circles provided on the relay back plates. Open holes on back plate corresponding with pin positions. It shall be ensured that blocking screws are not missing in the holes not corresponding with pin positions of the relay group back plate. Otherwise relays can get plugged in wrong bases also, causing unsafe conditions.



NEUTRAL RELAY  
BASE PLATE FOR  
4F,4B RELAY GROUP  
(FRONT VIEW)



NEUTRAL RELAY  
BASE PLATE FOR  
5F,3B RELAY GROUP  
(FRONT VIEW)



NEUTRAL RELAY  
BASE PLATE FOR  
6F,2B RELAY GROUP  
(FRONT VIEW)

For more details on Mini groups please refer IRISET Notes: S19 (Signalling Relays and Cables)

### 3.6 Minor Signal Groups:

1. Main Signal Group : 3 Aspect Signal Group, 2 Aspect Signal Group.
2. Shunt Signal Group : It caters two shunt signals.

#### 3.6.1 3- ASPECT MAIN SIGNAL GROUP:

In this group 13 Relays & 2 condenser and resistor units are provided.

FRONT VIEW			REAR VIEW								
 RKE  DKE									99 98 97 96 95 94 93 92 100 -- -- -- -- -- -- -- -- 91 90 -- -- -- -- -- -- -- -- 81 80 -- -- -- -- -- -- -- -- 71 70 -- -- -- -- -- -- -- -- 61 60 -- -- -- -- -- -- -- -- 51 50 -- -- -- -- -- -- -- -- 41 40 -- -- -- -- -- -- -- -- 31 30 -- -- -- -- -- -- -- -- 21 20 -- -- -- -- -- -- -- -- 11 10 -- -- -- -- -- -- -- -- 01 09 08 07 06 05 04 03 02		
Fig : 3.4			Fig : 3.5								

#### 1. Signal Button Relay (GNR):

This is signal button relay. It picks up when concerned signal button 'GN' is pressed, provided the emergency signal button (EGGN / ERN) is not simultaneously pressed.

#### 2. Emergency Signal Button Relay (EGNR):

This relay operates when the signal button 'GN' along with common Emergency Signal button 'EGGN' is pressed to throw the already taken 'OFF' signal to 'ON' aspect.

#### 3. Red-aspect Lamp Checking Relay (RECR):

It picks up when Red lamp lits. This relay indicates or proves burning of ON aspect. Relay drops immediately when Red aspect filament fuses. As the operating current of this relay is about 275mA, it cannot be used for OFF aspects.

#### 4. Yellow Lamp Checking Relay (HECR):

It picks up when Yellow lamp lits and drops only when Yellow aspect of signal lamp is fused or not liting.

#### 5. Green Lamp Checking Relay (DECR):

It picks up when Green lamp lits and drops only when Green aspect of signal lamp is fused or not liting.

#### 6. RECPR: Repeater of Red Lamp Checking Relay.

#### 7. HECPR: Repeater of Yellow Lamp Checking Relay.

#### 8. DECPR: Repeater of Green Lamp Checking Relay.

**9. Signal Lock Stick Relay (GLSR):**

This relay is used to provide One Train-One Signal feature and is equivalent to the conventional "SR". In Main signal group this relay remains normally in a de-energised condition and picks-up when the route is initiated and it drops before GR2 picks up for clearing the signal. GLSR is made slow to release, by provision of 250 Mfd condenser in series with a 100 Ohm resistance across the relay coil, to pick up Signal Locking Relay G(R)LR. SH GLSR is normally in energized condition.

**10. Signal Control Relay (GR1, GR2, GR3):**

These are the relays which controls the signal aspect. GR1, GR2 together perform the function of conventional HR and GR3 that of DR. In case of 4-Aspect signal, an additional relay GR4 has to be provided externally.

GR1 picks up only when concerned route and signal is initiated and route is locked. It is made slow to release, by connecting a 500Mfd and 100Ω in series with relay coil, to prevent the cleared signal going to danger in case of ahead signal is changing the aspects or power fluctuations or momentarily bobbing of track circuit.

GR1 and GR2 relays together control the 'OFF' aspect of the Signal. GR3 is used to control the Green aspect of the Signal. GR1, GR2 and GR3 must be in pick up condition to take 'OFF' the signal to Green aspect.

**11. GPR1 (Repeater of GR1 Relay) :**

Pickup of GPR1 cut off the feed to the GLSR. In addition, it provides supply to route indicator lamps.

**3.6.2 2- ASPECT MAIN SIGNAL GROUP:**

		RKE			DKE
RECR	1	○ GR1	2	HECR	3
	4	○ GLSR	5	GNR	6
EGNR	7	GLSR	8	GR1	9
GPR1	10	GR2	11	RECPR	12
	13		14	HECPR	15

**Fig:3.6**

In this group 10 Relays & 2 condenser and resistor units are provided.

**1. Signal Button Relay (GNR):**

This is signal button relay. It picks up when concerned signal button 'GN' is pressed, provided the emergency signal button (EGGN / ERN) is not simultaneously pressed.

**2. Emergency Signal Button Relay (EGNR):**

This relay operates when the signal button 'GN' along with common Emergency Signal button 'EGGN' is pressed to throw the already taken 'OFF' signal to 'ON' aspect.

**3. Red-aspect Lamp Checking Relay (RECR):**

It picks up when Red lamp lits. This relay indicates or proves burning of ON aspect. Relay drop immediately when Red aspect filament fuses. As the operating current of this relay is about 275mA, it cannot be used for OFF aspects.

**4. Yellow Lamp Checking Relay (HECR):**

It picks up when Yellow lamp lits and drops only when Yellow aspect of signal lamp is fused or not litting.

**5. RECPR: Repeater of Red Lamp Checking Relay.**

**6. HECPR: Repeater of Yellow Lamp Checking Relay.**

**7. Signal Lock Stick Relay (GLSR):**

This relay is used to provide One Train-One Signal feature and is equivalent to the conventional "SR". In Main signal group this relay remains normally in a de-energised condition and picks-up when the route is initiated and it drops before GR2 picks up for clearing the signal. GLSR is made slow to release, by provision of 250 Mfd condenser in series with a 100 Ohm resistance across the relay coil, to pick up Signal Locking Relay G(R)LR. SH GLSR is normally in energized condition.

**8. Signal Control Relay (GR1, GR2):**

These are the relays which controls the signal aspect. GR1, GR2 together perform the function of conventional HR and GR3 that of DR. In case of 4-Aspect signal, an additional relay GR4 has to be provided externally.

GR1 picks up only when concerned route and signal is initiated and route is locked. It is made slow to release, by connecting a 500Mfd and 100Ω in series with relay coil, to prevent the cleared signal going to danger in case of ahead signal is changing the aspects or power fluctuations or momentarily bobbing of track circuit.

GR1 and GR2 relays together control the 'OFF' aspect of the Signal.

**9. GPR1 (Repeater of GR1 Relay) :**

Pickup of GPR1 cut off the feed to the GLSR. In addition, it provides supply to route indicator lamps.

### 3.6.3 SHUNT SIGNAL GROUP:

 RKE	 HKE	 RKE	 HKE
RECR 1	HECR 2	GLSR 3	
GNR 4	EGNR 5	GR1 6	
GR2 7	 GR1 8	GR2 9	
GNR 10	 GR1 11	GR1 12	
RECR 13	HECR 14	GLSR 15	

Fig:3.7

This group controls two shunt signals independently. For two shunt signals EGNR is a common relay. Except this relay all other relays are separately available in this group for each shunt signal.

#### 1. RECR: Red Lamp checking relay:

It picks up whenever shunt signal ON aspect lamp is litting.

#### 2. HECR: Yellow lamp checking relay.

It picks up whenever shunt signal OFF aspect lamp is litting.

#### 3. GNR: Signal button Relay.

It picks up when concern Signal button is pressed.

#### 4. EGNR: Emergency Signal button Relay.

It is a common relay for two shunt signals. This relay picks up when 'Sh GN' button along with EGNN button is pressed to throw already 'Off' position signal to 'ON' position.

#### 5. GLSR: Signal Lock Stick Relay.

Shunt Signal Lock Stick Relay is used to provide One Train- One Signal feature. In shunt signal group this SH GLSR relay remains normally in energised condition and drops when the route section falling in the shunt signal route is set.

#### 6. GR1: Signal Control Relay - 1

It picks up only when concerned route and signal is initiated. It is made slow to release to prevent cleared signal going to danger in case of power fluctuation or momentarily bobbing of track circuit.

#### 7. GR2: Signal Control Relay -2

GR1 and GR2 relays together control the 'OFF' aspect of the Signal. Sh GN & UN buttons are released, after energisation of GR1 and GR2 relays unlike Main Signal aspect control relays.

#### 8. At space no 8:

Condenser of 1000 mfd is provided for GR1 relay of 1st shunt signal.

#### 9. At space no 11:

Condenser of 1000 mfd is provided for GR1 relay of 2nd shunt signal.

### 3.7 MINOR ROUTE GROUP: UNIVERSAL ROUTE GROUP

FRONT VIEW					REAR VIEW								
 RKE  HKE													
AU(R)S	1		2		BU(R)S	3							
AU(N)S	4		5		BU(N)S	6							
	7	'A' DUCR	8		'B' DUCR	9							
U(R)LR	10		11		UDKR	12							
U(N)LR	13	UYR1	14		UYR2	15							
					99 98 97 96 95 94 93 92 100 -- -- -- -- -- -- -- -- 91 90 -- -- -- -- -- -- -- -- 81 80 -- -- -- -- -- -- -- -- 71 70 -- -- -- -- -- -- -- -- 61 60 -- -- -- -- -- -- -- -- 51 50 -- -- -- -- -- -- -- -- 41 40 -- -- -- -- -- -- -- -- 31 30 -- -- -- -- -- -- -- -- 21 20 -- -- -- -- -- -- -- -- 11 10 -- -- -- -- -- -- -- -- 01 09 08 07 06 05 04 03 02								
<b>Fig:3.8</b>					<b>Fig:3.9</b>								

#### 1. Route Setting Relays [U(R)S/U(N)S]:

There are two sets of route setting relays in each universal route group and cater for two route sections. It is an interlocked relay, when the upper/top coil is latched, it indicates that the route section is set and when the lower armature (bottom relay) latched it indicates that the route section is not set.

In RRI 'A' route section setting relay AU(R)S latched, it controls the setting of points in the sub-route for straight route and 'B' route section setting relay ['B' U(R)S] controls the setting of point in the diverging route.

In PI, U(R)S picks up only after ensuring that the points for the route section are set and locked in the required position. This relay locks the point group electrically.

If the sub-route is having more than two route sections, for additional route sections, such type of one relay is separately provided externally by using the Mini group with Interlocked relays.

#### 2. Sub-Route Clear Indication Relay (UDKR):

This is a neutral and common sub-route clear indication relay for all the route sections of a sub-route. It picks up when a route section is set and all the track circuits in the set Route Section are clear. One UDKR is required for each sub-route irrespective of no. of route sections in that sub-route. This relay helps in sequential proving of sub-route track circuits for automatic route release by passage of the Train.

UDKR is checked for its operation at this signal clearance stage. This is later required to operate again in the route release stage for releasing back locking on the Route Section when a train passes over it.

**3. 'A' Route Section Clear Checking Relay (A DUCR):**

This is neutral relay and normally de-energised condition. It picks up only when 'A' Route section is set and ensures that the points in the concerned route sections and isolation are correctly set and locked. It is provided for each route section of the sub-route.

**4. 'B' Route Section Clear Checking Relay (B DUCR):**

This is neutral relay and normally de-energised condition. It picks up only when 'B' Route section is set and ensures that the points in the concerned route sections and isolation are correctly set and locked. It is provided for each route section of the sub-route.

If the sub-route is having more than two route sections, for additional route sections, such type of one relay is separately provided externally by using the Mini group with neutral relays.

**5. Sub-route Locking Relay [U(R)LR/U(N)LR]:**

This is an interlocked relay used for locking the sub-route when it is engaged in a signalled move. This is common relay for all the route sections in a sub-route.

The latching of upper relay locks the sub-route. Once U(R)LR picks UP, no other simultaneous movement is possible in that sub route. U(N)LR is an interlocked relay for normalizing the locking of the 'sub route', indicates that the sub-route is free.

Picking up of this U(R)LR ensures that:

- a) The concerned route section setting relay U(R)S is latched
- b) Route section is clear of a train
- c) Relevant DUCR is up (relevant route section is checked)
- d) Concerned buttons are released

**6. Route Release Relays (UYR1 & UYR2) :**

These are neutral relays and operate and stick when a train passes over the sub-route proving that the track circuits are actuated in a predetermined sequence. These relays in conjunction with UDKR release the route section after the passage of the train, thus permitting the sectional route release.

**3.8 Minor group DRS-II Panel Point Group:**

RKE															
Z1WR1	1	Z1NWR	2	Z1RWR	3										91
W(R)R	4	(R)WLR	5	WKR2	6										81
W(N)R	7	(N)WLR	8	WKR1	9										71
	10		11	WKR3	12										61
	W	R				WJR									51
	13		14		15										41
															31
															21
															11
							09	08	07	06	05	04	03	02	01

**Fig: 3.10****1. Point Group Initiating the Point Control Relays (Z1WR1):**

This is the first relay to pick-up in a point group for point operation. It is a double coil relay. This relay is to initiate the point switching group where the points are operating by other than Siemens Point Machine.

**2. Point Control Relay [W(R)R/W(N)R]: Point Operation/Detection Circuit Switching Relay.**

This is an interlocked relay. It is used to bring the point group to either operation mode or detection mode.

- When W(N)R latched point detection circuit is closed.
- When W(R)R latched point operation circuit is closed

**3. Normal Point Initiating Relay (Z1NWR):** This is a double coil relay. This relay switches 'ON' Normal Point Controlling Relay, (N)WLR. Once energized, it drops only when the point buttons are released and (N)WLR is picked up.**4. Reverse Point Initiating Relay (Z1RWR):** This is a double coil relay. This relay switches 'ON' Reverse Point Controlling Relay, (R)WLR. Once energized, it drops only when the point buttons are released and (R)WLR is picked up.**5. Reverse/Normal Point operation control Relay [(R)WLR/(N)WLR]:**

This is an interlocked relay used for controlling point operation circuit.

- (N)WLR closes Normal point operation circuit.
- (R)WLR closes Reverse point operation circuit.

This relay does not have heavy duty contacts.

**6. WKR1: Point Detection Relay No.1 to prove the Correspondence continuously.**

This relay detects the correct setting and locking of point in either position. This relay energises only when the point is set, locked and is in correspondence with point group. This relay continuously monitors healthiness of point at site. Independently it cannot indicate the position of the point.

$$\begin{array}{l} W(N)R \uparrow + (N)WLR \uparrow + WKR1 \uparrow = NWKR \uparrow \\ W(N)R \uparrow + (R)WLR \uparrow + WKR1 \uparrow = RWKR \uparrow \end{array}$$

**7. WKR2: Point Detection Relay-2 to prove the out of correspondence and cross protection arrangement.**

This is also called as "Cross Protection Relay". It picks up whenever Z 1RWR or Z 1NWR is picked up during the point's group initiation sequence and switches 'ON' Point Time element Relay. Once WKR2 picks up, it drops only after the energisation of WKR3 at the end of point operation. It energizes when the points at site and the point group is out of correspondence. It also energizes when the point detection circuit draws more than 120mA current due to false feed / cable fault. Once WKR2 is picked up, results WKR1 drops which provides flashing indication.

**8. WKR3:Point Detection Relay No.3 to prove correspondence established at the end of operation.**

It is double coil relay. It is also called as an "End Position Proving Relay". This relay operates:

- i. When the point at site and point group is in correspondence on completion of point operation through point operation supply (i.e. 110V DC). Once energized at the end of Point Operation, stick through its 2nd coil till such time W(N)R is latched.
- ii. It operates during sequence of relay operation in point group when the point operation from Normal to Reverse is initiated to destroy the point detection through WKR1.

**9. Point Time Element Relay (WJR):**

This is a neutral relay. It is made slow to release for a time period of not less than 10 seconds. To make it slow to release a 2500Mfd condenser in a series with  $39\Omega$  resistance connected across the relay coil. This relay controls the point contactor relay for a period of

not less than 10 Seconds to prevent the overloading of point machine in case of obstruction in point. This relay drops as soon as the WKR3 picked up at the end of point operation. It operates during sequence of relay operation in point group when the point operation from Reverse to Normal is initiated to disconnect the point detection supply of WKR1.

**10. Point Contactor Relay (WR):**

This is a contactor Relay having Heavy-duty front contacts with current rating of 10Amps. It is used for the point operation circuits. Points Motor feed is switched 'ON' through these relay front contacts.

Current carrying capacity of a heavy duty front contact = 10 Amps.

Coil Resistance is 60 Ohms only. Once the relay is energised, it will hold through its own front contact in series with  $600\Omega$  resistance to reduce the holding current.

### Coil Resistance of the Relays used in Point Group

SI No.	Relay Name	Coil Resistance	
1	Z1WR1	1 <sup>st</sup> Coil	=1340 Ω
		2 <sup>nd</sup> Coil	=1590 Ω
2	Z1NWR	1 <sup>st</sup> Coil	=1340 Ω
		2 <sup>nd</sup> Coil	=1590 Ω
3	Z1RWR	1 <sup>st</sup> Coil	=1340 Ω
		2 <sup>nd</sup> Coil	=1590 Ω
4	WKR3	1 <sup>st</sup> Coil	=1340 Ω
		2 <sup>nd</sup> Coil	=1590 Ω
5	W(R/N)R	= 615 Ω	
6	(R/N)WLR	= 615 Ω	
7	WKR1	=1840 Ω	
8	WKR2	= 52.3 Ω	
9	WJR	=1840 Ω	
10	WR	= 60 Ω	

### 3.9 Point Major Group (R.R.I.):

Z1WR1	Z1NWR	Z1RWR	Z1WR	WLR	WKR1
W(R)R	(R)WLR1	(R)WLR2	(R)WLR3	W(R)LR	WKR2
W(N)R	(N)WLR1	(N)WLR2	(N)WLR3	W(N)LR	
<b>W</b>	<b>R</b>		WJR	Z2WR1	Z2WR2
			TP <sup>1</sup> R	TP <sup>1</sup> P <sup>2</sup> R	WKR3

**Fig : 3.12 – FRONT VIEW OF POINTS MAJOR GROUP**

199	198	197	196	195	194	193	192		99	98	97	96	95	94	93	92			
200	--	--	--	--	--	--	--	191	100	--	--	--	--	--	--	91			
190	--	--	--	--	--	--	--	181	90	--	--	--	--	--	--	81			
180	--	--	--	--	--	--	--	171	80	--	--	--	--	--	--	71			
170	--	--	--	--	--	--	--	161	70	--	--	--	--	--	--	61			
160	--	141 - 160 NO TERMINATION				151	--	60	--	--	--	--	--	--	--	51			
150	--					141	--	50	--	--	--	--	--	--	--	41			
140	--	--	--	--	--	--	--	131	40	--	--	--	--	--	--	31			
130	--	--	--	--	--	--	--	121	30	--	--	--	--	--	--	21			
120	--	--	--	--	--	--	--	111	20	--	--	--	--	--	--	11			
110	--	--	--	--	--	--	--	101	10	--	09	08	07	06	05	04	03	02	01

**Fig : 3.13 – REAR VIEW OF POINTS MAJOR GROUP**

## **1. Z1WR: Point group Initiating Relay**

It is normally de-energised relay. This is the first relay to pick-up in a point major group for automatic point operation under route setting conditions. It has two coils but only one coil is used. This relay does not respond for individual point operation.

## **2. WLR: Point Locking Relay**

This is a double coil relay. It checks that the point group is initiated due to route setting only and not due to accidental lifting of U(R)S or OVZ2U(R)R. It checks the track locking condition. It switches on the point chain group and helps in sequential operation of points.

## **3. Z1WR1: Point Group Control Initiating Relay**

It is normally de-energised relay. This is the first relay to pick-up in a point major group for individual point operation. It has two coils.

## **4. W(R)R/W(N)R: Point Operation/Detection Circuit Switching Relay.**

This is an interlocked relay. When W(N)R latched point detection circuit is closed and W(R)R latched point operation circuit is closed.

## **5. Z1NWR: Point Normal control Initiating Relay**

This is a double coil relay. This relay switched on Normal point controlling relay [(N)WLR]. Once energized, it drops only when the point buttons are released and (N)WLR is energized.

## **6. Z1RWR: Point Reverse control Initiating Relay**

This is a double coil relay. This relay switched on Reverse point controlling relay [(R)WLR]. Once energized, it drops only when the point buttons are released and Reverse Point controlling relay [(R)WLR] is energized.

## **7. (R/N) WLR1, 2, 3 : Reverse/Normal Point operation control Relay -1**

Three numbers of relays are used for obtaining the required number of contacts. The functions of these relays are same as in the case of minor point group.

(R)WLR1/(N)WLR1 is an interlocked relay used for controlling point operation circuit. (N)WLR closes Point Normal operation circuit and (R)WLR closes Point Reverse operation circuit. These relays do not have heavy-duty contacts.

(R)WLR2/(N)WLR2 is an interlocked relay used for controlling point operation circuit. This is the repeater of (R)WLR1/(N)WLR1.

(R)WLR3/(N)WLR3 is an interlocked relay used for controlling point operation circuit. This is the repeater of (R)WLR2/(N)WLR2.

## **8. WKR1: Point Detection Relay No.1 to prove Correspondence continuously.**

This relay detects the correct setting and locking of point in either position. These relay energies only when the point is correctly set, locked and in correspondence with point group and the points group is in detection mode. This relay continuously monitors healthiness of the points at site.

**9. WKR2: Point Detection Relay No.2 to prove the out of correspondence and cross protection arrangement**

It picks up whenever Z 1RWR or Z 1NWR is picked up during the point's group initiation sequence and switches 'ON' Point Time element Relay. Once WKR2 picks up, it drops only after the energisation of WKR3 at the end of point operation.

It energizes when the points at site and the point group is out of correspondence. It also energizes when the point detection circuit draws more than 120 mA current due to false feed / cable fault. Once WKR2 is picked up, results WKR1drops.

**10. WKR3: Point Detection Relay No.3 to prove correspondence established at the end of operation**

It is double coil relay. This relay operates, when the point at site and point group is in correspondence on completion of operation through point operation supply (i.e. 110 V DC). Once energized at the end of Point Operation, stick through its 2nd coil till such time W(N)R is latched. It operates during sequence of relay operation in point group when the point operation from Normal to Reverse is initiated to destroy the point detection through WKR1.

**11. WJR: Point Time Element Relay**

This is a neutral relay. It is made slow to release for a time period of not less than 10 seconds. This relay controls the point contactor relay for a period of not less than 10 Seconds to prevent the overloading of point machine in case of obstruction in point. This relay drops as soon as the WKR3 picked up at the end of point operation. It operates during sequence of relay operation in point group when the point operation from Reverse to Normal is initiated to disconnect the point detection supply of WKR1.

**12. WR: Point Contactor Relay**

This is a contactor Relay having Heavy-duty front contacts with current rating of 10Amps. It is used for the point operation circuits. Points Motor feed is switched 'ON' through these relay front contacts.

**13. TP1R: Point zone Track circuit Repeater Relay**

**14. TP1P2R: Point zone Track circuit Repeater Relay**

**15. Z2WR1: Points Zone Panel Indication Controlling Relay-1**

This relay picks up when the point is operated during route setting to give indications on point zone tracks in the route or overlap set for more important move.

**16. Z2WR2: Points Zone Panel Indication Controlling Relay**

This relay picks up when the point is operated during route setting to give indications on point zone track in the route or overlap set for less important move.

These relays however do not operate for isolation points.

## **17. W(R/N)LR: Point Group Locking Relay/ Point Group Lock Normalizing Relay**

It is an interlocked relay. When a point falls in the Route/Overlap/Isolation, W(R)LR picks up and locks the point group electrically and indicates by lighting the middle light indication on the point group. W(N)LR latch indicates that the point is electrically free. If the points are already in the favourable conditions, this is the first relay to pick-up in a point major group under route setting conditions.

**Relays Coil Resistance of the Point Major Group**

SI No.	Relay Name	Coil Resistance	
1	Z1WR	1 <sup>st</sup> Coil	=1340 Ω
		2 <sup>nd</sup> Coil	=1590 Ω
2	WLR	1 <sup>st</sup> Coil	=1340 Ω
		2 <sup>nd</sup> Coil	=1590 Ω
3	Z2WR1		=1260 Ω
4	Z2WR2		=1260 Ω
5	TP1R		=1840 Ω
6	TP1P2R		=1260 Ω

Rest all relays function is same as in the case of Minor Point Group.

### **3.10 Point Switching Group:**

This group is provided at the point location for controlling of point machine other than Siemens's type. This group functions in conjunction with the main point group located at the central relay room.

The arrangement of relays in this group is as under:

FRONT VIEW			REAR VIEW								
W(R)R	1	W(R)PR	2	(R)WR	3	99	98	97	96	95	94
W(N)R	4	W(N)PR	5	(N)WR	6	93	92				
Z1WR	7	N/R WR	8	WKR2	9	100	--	--	--	--	--
	10		11	WKR1	12	90	--	--	--	--	--
W	R			WKR3	15	80	--	--	--	--	--
3		14				70	--	--	--	--	--
						60	--	--	--	--	--
						50	--	--	--	--	--
						40	--	--	--	--	--
						30	--	--	--	--	--
						20	--	--	--	--	--
						10	--	--	--	--	--
						09	08	07	06	05	04
						03	02				
											01

Fig : 3.14

Fig : 3.15

**1. Point Switching Group Initiating Relay (Z1WR):**

When the Z1WR1 relay operates in the main point group, it switches on the point switching group by closing the Z1WR relay coil circuit. This relay opens the circuit of WKR1 of both main point group and point switching group.

**2. Points Relay [W(R)R/W(N)R & W(R)PR/W(N)PR]:**

These relays help in switching over point control circuit and point detection circuits.

**3. Points Operation Controlling Relay (N/R WR):**

It is a repeater relay of WJR and WR relay of main point group. This is a neutral relay.

**4. Point Operating Relay [(R/N)WR]:**

This is an interlocked relay. When (R)WR picks up controls reverse operation of point; and (N)WR picks up controls normal operation of point.

**5. Point Detector Relay No.1&2 (WKR1 & WKR2) :**

Same function as main point group.

**6. Point Detector Relay No.3 (WKR3) :**

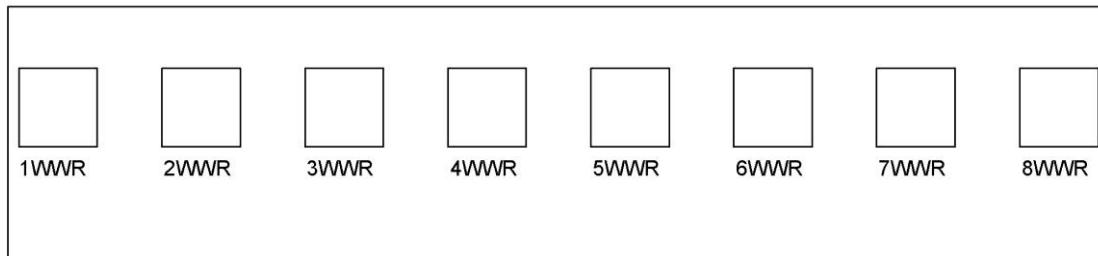
This relay operates at the end of each operation and indicate that the completion of point operation. It causes WKR2 & WR drops and W(N)R and W(N)PR operates.

**7. Point Contactor Relay (WR):**

It controls the feed to point machine and it is having heavy duty front contacts.

**3.11 Point Chain Group:**

CHAIN GROUP FRONT VIEW



CHAIN GROUP REAR VIEW (BASE PINS COUNTING)

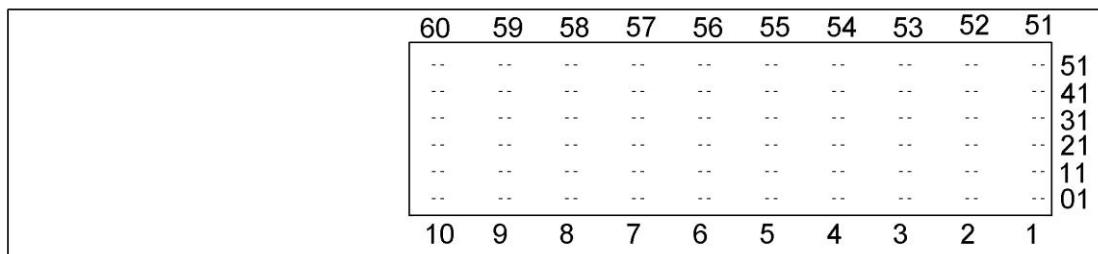


Fig: 3.16

Point Chain group is used only in Route Relay Interlocking (Route Setting Type Relay Interlocking) and located on top of the rack above the major point groups.

In case RRI, all the points in the required route are operated automatically. Chain group prevents the simultaneous operation of all the points of the set route in order to prevent the overloading of 110 V DC source (Battery Bank / Charger). It staggers the point's initiation thereby staggering the point's motor switching currents.

One chain group is provided with eight numbers of WWR neutral relays. WWR is normally drop relay. The circuit is designed in such a way that these relays will picks up one after the other and also drops one after the other. Normally, one chain group can cater eight numbers of major point groups. The pickup contact of 1<sup>st</sup> relay (1WWR) is used for one major point group to energize Z1WR relay during automatic operation of point to initiate the point group.

For further details of chain group operation please refer IRISET Notes S16.

### **3.12 Relay room arrangement and installation:**

The relay racks are erected on pedestal, which are anchored to anchor bolts. Proper side and back supports by means of single irons from the adjoining walls are provided. Ladders are fixed at the side and top of the rack to run the cables and wiring. The distance from the parallel wall to the first row of relay rack should be 1.5M and also from the sidewall it shall not be less than 1.5 meters. The distance between two intermediate rows of racks should not be less than 1 meter so as to enable free movement of maintenance staff in between two rows of racks.

In small installations, the tag blocks are provided in rear of relay rack. Copper wires do the connection between the relay groups and tag blocks.

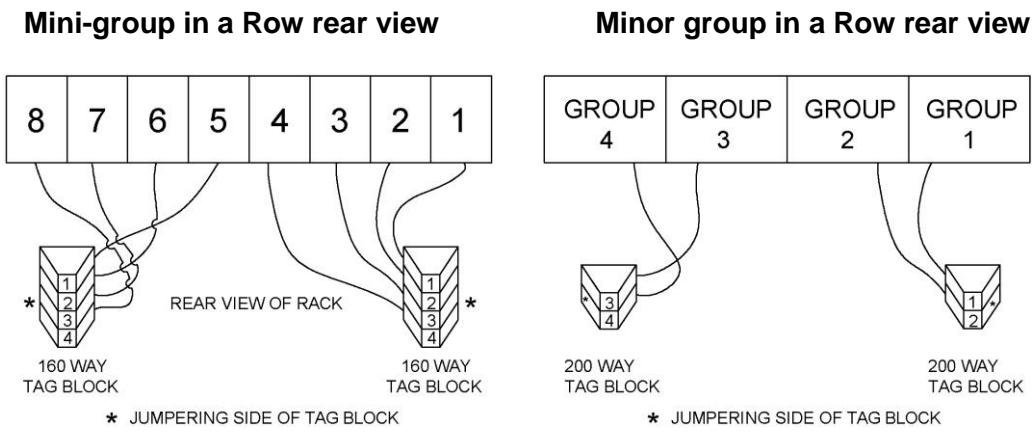
In case of major yards, the tag blocks are fixed on a separate row of racks called as Intermediate Distribution Frames (IDF), numbered according to the relay rack numbering. 60 core and 40 core in door cables are used to makes connection between the relay groups and tag blocks. Inter wiring between one group to another group and to the external connections such as panel, external cables termination is done at the tag blocks by using 0.6 mm diameter jumper wires. More than two wires shall not be terminated on tag block pins. 0.6 mm diameter wires are used for all circuits and 1mm diameter wires are used for point control and signal lamp circuits.

The arrangement as a whole gives a neat appearance and renders alteration to wirings, localisation of faults, etc. extremely easy with minimum disturbance to the working installation. All the connections to terminal boards, IDF, relay groups are done by soldering. The solder joints have proved to be satisfactory in practice.

One relay rack can accommodate -

- a) 8 Nos. of major group and one chain group.
- b) 16 Nos. of minor groups and "G" type fuse blocks on top.
- c) 64 Nos. of mini-group and "G" type fuse blocks on top.

## RELAY GROUPS AND ITS ARRANGEMENT



Two types of tag blocks are available one with 200 terminals and the other one is 160 terminals. One tag block of 200 terminal can accommodate one number of major group or two numbers of minor groups or five numbers of mini-groups. One tag block of 160 terminals is sufficient for four mini-groups.

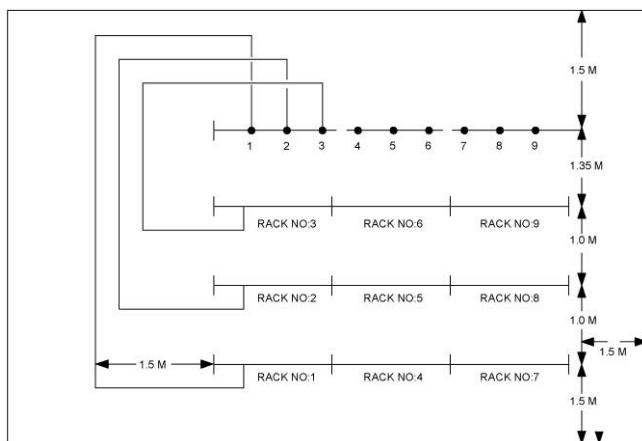


Fig : 3.20

In IDF row, each pillar contains maximum 10 tag blocks of 200 pins. The numbering of a 200-way tag block termination is shown in the diagram block.

This is generally used for terminating the wiring of one major group or two minor groups or five mini-groups. The counting is done from the rear towards the front as shown.

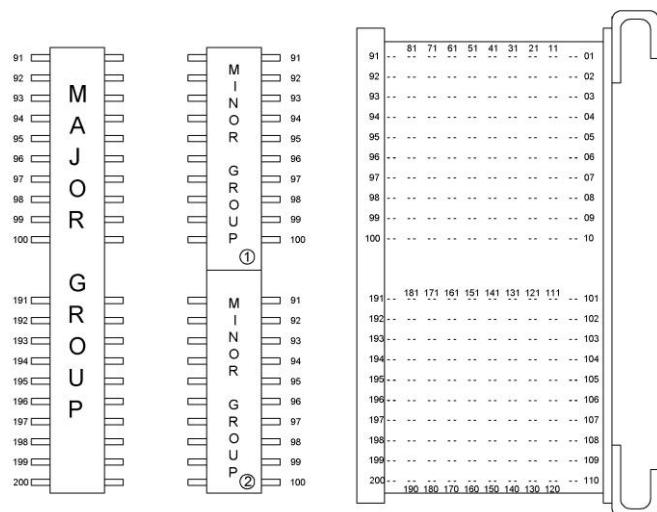


Fig : 3.21

The numbering of a 160-way tag block which is generally used to terminate the wiring of four mini-groups is shown bellow.

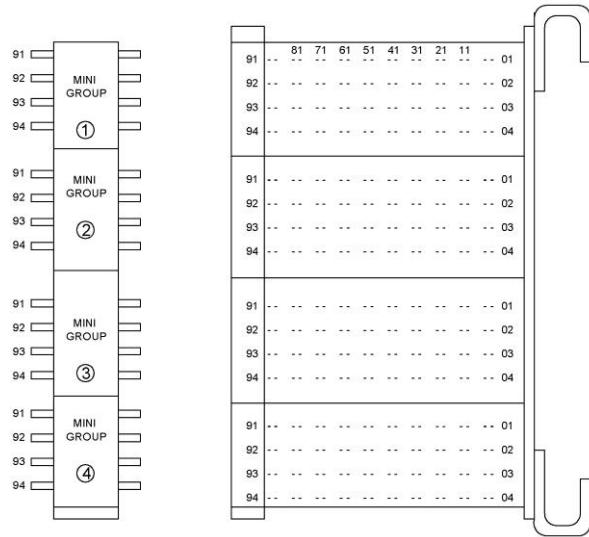


Fig : 3.22

The numbering of a 96-way tag block which is generally used to terminate the wiring at Cable Termination Rack and in the Control Panel is shown bellow.

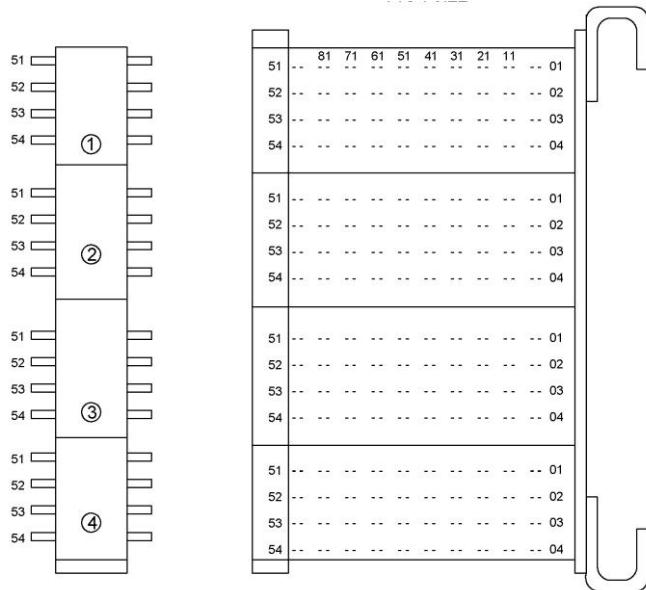


Fig : 3.22

\* \* \*

## CHAPTER - 4

### ROUTE SECTION PLAN

**4.1** The route section plan shows the entrance and exit buttons with their designation at their geographical location. The buttons are represented by small circles in the plan.

In Relay Interlocking (Siemens) System, interlocking between various signalling functions is not provided as in the case of other systems. For this purpose the major yard is divided into zones to signal routes and signal route to sub-routes and sub-routes to route section or overlap. The route sections and overlaps are the basic units for achieving the interlocking.

The entire layout is divided into a signal route and further into a sub-route to facilitate the sectional route release.

Each sub-route includes one or more points in it. Sometimes, sub-routes without point can also exist for achieving special condition of interlocking. Sub-routes are numbered as per the number of any one of the points which exist in it. If there is no point, such sub-route will be numbered as per the signals controlled by it.

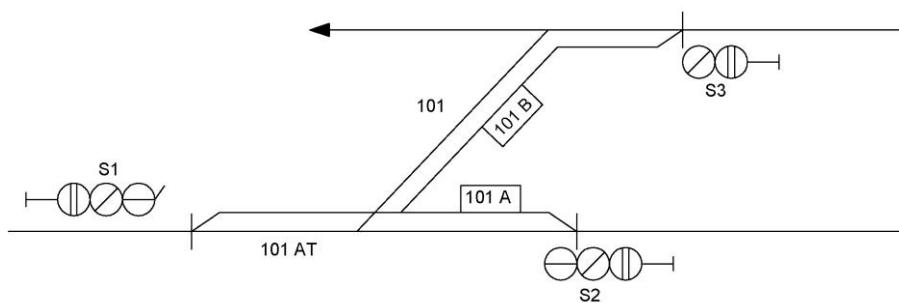
Sub-route which includes one or more points are so formed by combining route sections so that only one movement is possible over that sub-route at a time. This is ensured by using a common sub-route locking relay U(R)LR. For a crossover point, in which parallel movements are possible, there will be two sub-routes. Each sub-route is further divided into route sections. Each route section usually giving certain specified setting of points. The straight movement over a sub-route requiring points in normal position is called "A" route section and the diverging route requiring points in reverse is called B or C or D route section. A sub-route can have one route section or more number of route sections.

The Route sections are marked with solid lines. Route section marking will always starts from the Block Joint of 1st track circuit controlling that point or points and ends at the last Track circuit Block joint controlling that point or points as the case may be. Sometimes adjoining Track circuits also added in the route sections particularly towards Home signal.

Route section names will be written generally in a box attached to the Route section demarcations. Route section name should be written at such a place where it is exclusive for that route section and not at common demarcated portion with other route sections of that Sub-route.

The following examples illustrate the principles involved in demarcation of route sections and formation of sub-route:

**Case No.1:**



**Fig : 4.1**

On point No 101 between signals S1, S2 and S3 the possible route resetting and signal movements are as given below:

Sl. No	Route set with Point No.	Possible movements	Remarks
1	101 Normal (Main Line)	S1 to towards S2	Towards main line
		S2 to towards S1	From main line
2	101 Reverse (Loop Line)	S1 to towards S3	Towards loop line
		S3 to towards S1	From loop line

At any point of time physically there will be only one movement is possible over point No.101. This satisfies the condition for considering the movements over point No. 101 and the route settings to be in one sub route as only one movement is possible.

Locking of Normal route setting (Point No.101 Normal) by Sub-route lock relay [U(R)LR] will lock other diversion route setting (Point No.101 Reverse) and vice-versa.

This sub-route will be named after the point number it is controlling, in this case it is 101Sub-route.

In this 101 Sub-route there are two route settings i.e. '101 Normal' route between S1 and S2 and '101 Reverse' route between S1 and S3. These two routes are sub divisions of 101 sub route with definite setting of point or points.

The route set with 101 Normal will be one route section of Sub-route 101 named as 101A route section. The route set with 101 Reverse will be another route section of Sub-route 101 named as 101B route section. Now the sub route is known as 101A/B sub-route.

Point No. 101 sub-route is 101A/B. Route sections are 101A with point setting 101 Normal with track circuit 101AT and 101B with point setting 101 Reverse with track circuit 101AT.

Point No.	Sub-route Name	Route Section Name	Point setting in the Route section	Track circuits in the Route section
101	101 A/B	101A	101N	101AT
		101B	101R	101AT

### Case No.2:

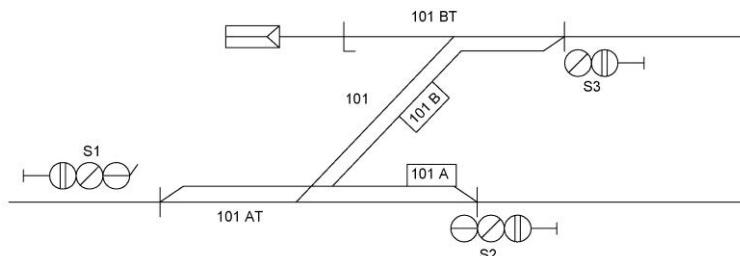


Fig : 4.2

Point No.101 is having only sub-route as only one movement is possible at a time. When the main line end is used for a movement, say clearing the Starter Signal No.2, the other end cannot be used for any other movement except it can be used for setting the overlap.

## ROUTE SECTION PLAN

Point No.101 is having two number of route sections i.e., 101A which control the point in normal position and 101B which controls the point in reverse position.

Point No.	Sub-route Name	Route Section Name	Point setting in the Route section	Track circuits in the Route section
101	101 A/B	101A	101N/101N	101AT
		101B	101R/101R	101AT, 101BT

### Case No.3:

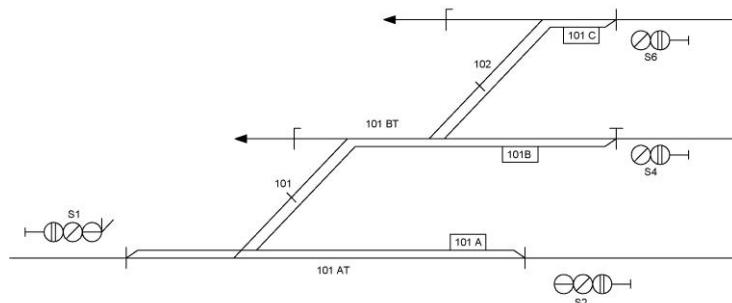


Fig : 4.3

Point No.	Sub-route Name	Route Section Name	Point setting in the Route section	Track circuits in the Route section
101, 102	101 A/B/C	101A	101N	101AT
		101B	101R & 102N	101AT, 101BT
		101C	101R & 102R	101AT, 101BT, 101CT

Point No.101 and Point No.102 is having only one sub-route as only one movement is possible at a time. This sub-route is having three route sections since three possible movements are there. In this, sectional route release facility is not available.

### Case No.4:

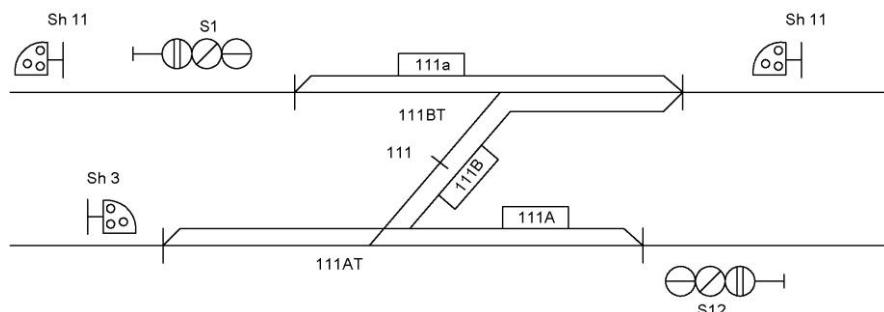


Fig : 4.4

In this case, at some point of time there will be two movements possible over cross over Point number 111 with point 111 in Normal position. Hence all the movements over the cross over Point number 111 cannot be in one sub-route. Each simultaneous possible parallel movement over Point No.111 requires one Sub-route. Route section 111A and 111a can be set simultaneously with points in Normal for parallel movements. Hence, there are two sub-routes for the crossover shown.

Point No. 111 sub-routes are 111A/B and 111a'. In this '111 A/B' is one sub route having two route sections and '111a' is second Sub route having only one route section.

Point No.	Sub-route Name	Route Section Name	Point setting in the route section	Track circuits in the Route section
111	111 A/B	111 A	111N	111AT
		111B	111R	111AT,111BT
	111 a	111a	111N	111BT

Now the new Sub-route will be named after same point number but with one route section with Point No.111 Normal. This route section is named as "111a" (as it is also with point in normal condition) and the Sub-route will be '111a'. In some railways this route section and sub-route are named as '111z'

In some installation, the crossover point above is given dual number, 111/112. This is for the purpose of assigning separate number for the two sub-routes on the crossover distinctly.

#### Case No.5:

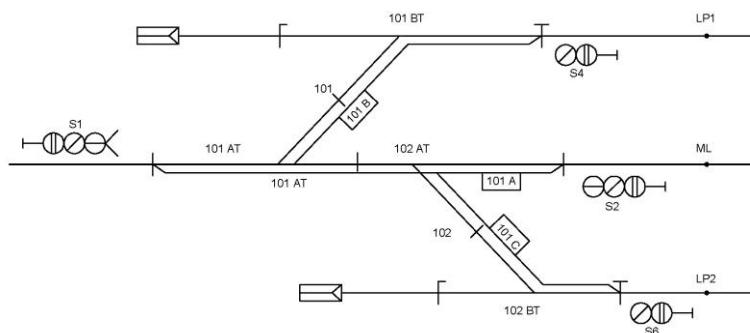


Fig : 4.5

At any point of time there will be only one movement is possible over point No.101 and point no. 102 together. This satisfies the condition for considering the movements over point No. 101 & point No. 102 and the route settings to be in one sub route and named as 101A/B/C sub-route.

Point No. 101&102 sub-route is 101A/B/C. Route sections are 101A with point setting 101 Normal and 102 Normal, 101B Route section with point setting 101 Reverse and 102 Normal and 101C Route section with point setting 101 Normal and 102 Reverse.

Point No.	Sub-route Name	Route Section Name	Point setting in the route section	Track circuits in the Route section
101 102	101 A/B/C	101A	101N & 102N	101AT,102AT
		101B	101R& 102N	101AT,101BT
		101C	101N & 102R	101AT,102AT,102BT

Remark: Sectional Route release facility is not available.

#### Case No.6: (Same yard of Case 5 with Sectional Route Release facility)

With full "Sectional Route Release" feature the same yard will be redesigned with two Sub-Routes as shown here.

For utilizing "Sectional Route Release" arrangement over these points, track circuits should be provided separately for each point and each point may be provided with separate sub-route with two route sections in each Sub-Route. So that on clearance of each point by the train, released points could be used for other movements as permitted by that station interlocking.

## ROUTE SECTION PLAN

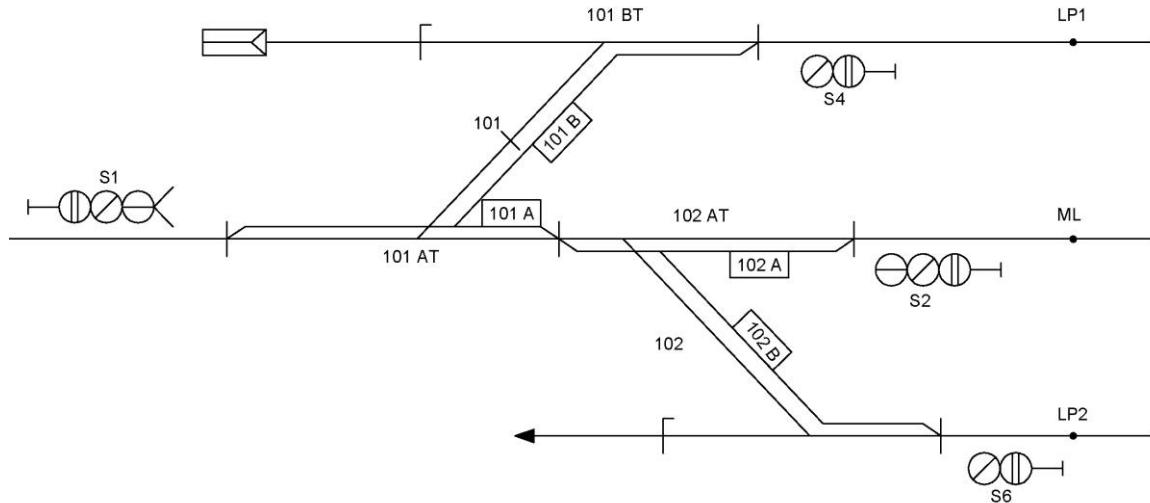


Fig : 4.6

Note: SRR is available.

Point No. 101&102 sub-routes are 101A/B and 102A/B. One Sub-route 101A/B will be marked with two route sections 101A towards Mainline and 101B towards Loop line No.1. Another Sub-route 102A/B will be marked with two route sections 102A towards mainline and 102B towards Loop line No.2.

In sub-route 101A/B, Route sections are 101A with point setting 101 Normal 101AT, 101B Route section with point setting 101 Reverse with track circuit 101AT, 101BT.

In sub-route 102A/B, Route sections are 102A with point setting 102 Normal with track circuit 102AT, 102B Route section with point setting 102 Reverse with track circuit 102AT, 102BT.

Point No.	Sub-route Name	Route Section Name	Point setting in the Route section	Track circuits in the Route section
101	101 A/B	101A	101N	101AT
		101B	101R	101AT, 101BT
102	102 A/B	102A	102N	102AT
		102B	102R	102AT, 102BT

### Case No.7:

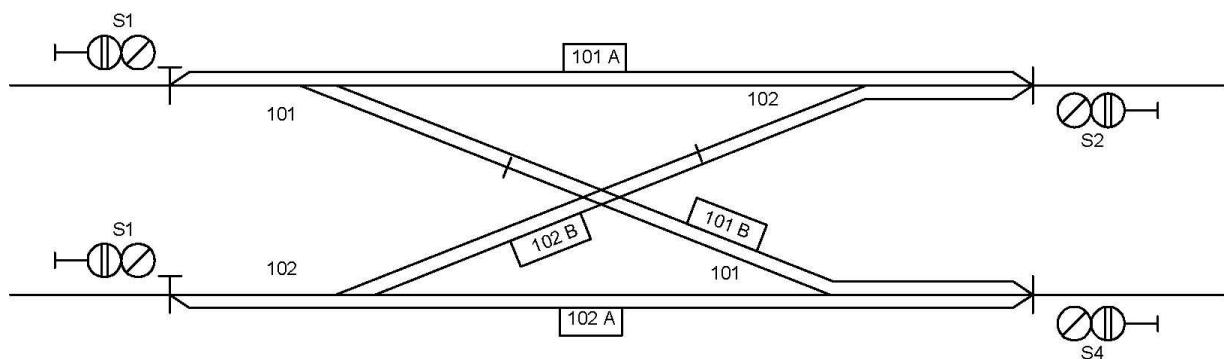


Fig : 4.7

In this case, at some point of time there will be two movements possible over cross over Points No.101 and 102 with 101& 102 in Normal positions. Hence all the movements over cross over Points No.101 and 102 cannot be in one sub-route. Each simultaneous parallel movement

possible over Point No.101 and 102 requires one Sub-route each. Point No. 101&102 sub-routes are 101A/B and 102A/B. One Sub-route 101A/B will be marked from S1 with two route sections 101A towards mainline and 101B towards diversion line. The second Sub-route 102A/B will be marked from S3 with two route sections 102A towards mainline and 102B towards diversion line.

In sub-route 101A/B, Route sections are 101A with point setting 101 Normal & 102 Normal, 101B Route section with point setting 101 Reverse.

In sub-route 102A/B, Route sections are 102A with point setting 101 Normal & 102 Normal, 102B Route section with point setting 102 Reverse.

Point No.	Sub-route Name	Route Section Name	Point setting in the Route section	Track circuits in the Route section
101 & 102	101 A/B	101A	101N & 102N	101AT
		101B	101R	101AT, 102AT
	102 A/B	102A	101N, 102N	102AT
		102B	102R	101AT, 102AT

#### Case No.8:

There are some route sections without points in them to control. In single line section this route section will be provided between Home signal and Advanced starter signal. In case of Double Line Section these route sections will be provided after Home Signal and after Advanced Starter Signal. These route sections are provided for route holding and will be helpful in simplifying the indication locking proving, while releasing the route sections. While route releasing, in each route section the signals, their aspects and their controlling relays on both sides of the route section are proved in normal condition.

Route sections without points are numbered as per the signal (in case of Double line) or signals (in case of single line) controlled by it.

This single line section example shows one route section without points, falling between the Home Signal S1 and Last Stop Signal S3 is numbered as S1/3U(R)S, since it is controlled by the signals S1 and S3.

#### Single Line Section

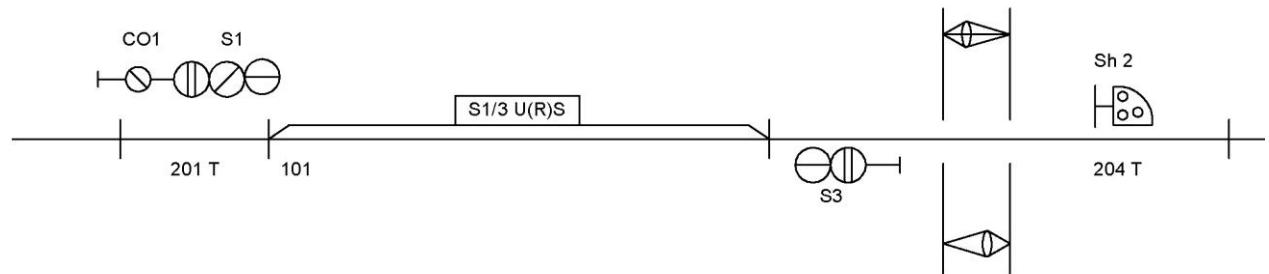


Fig : 4.8 (a)

This double line section example shows two route sections without points. One route section falling after the Home Signal S2, named as S2U(R)S, since it is controlled by S2 signal. Another route section falling after the Last Stop Signal S15, is named as S15 U(R)S, since it is controlled by S15.

## ROUTE SECTION PLAN

### Double Line Section

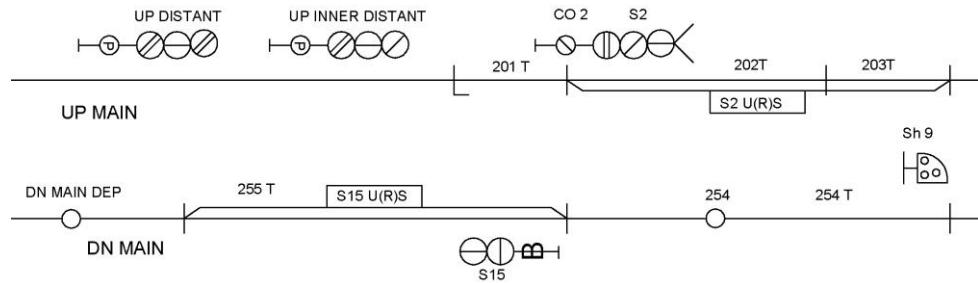
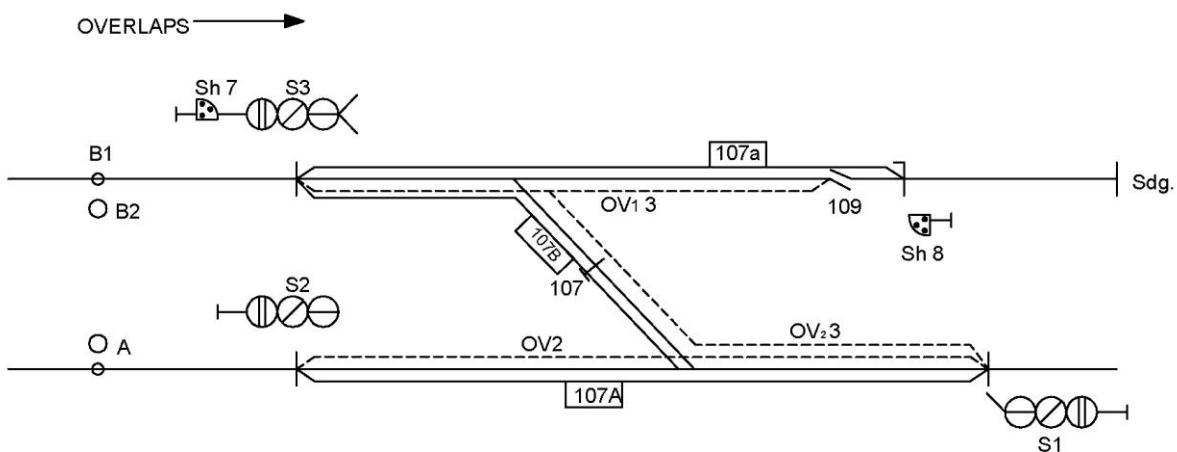


Fig : 4.8(b)



### Overlaps:

Fig: 4.9

Overlap is the adequate distance kept to ensure safety. It is part of complete signal route. Setting of overlap ensures correct setting of points falling in the overlap.

Signal Overlaps are marked in the route section plan. This helps to identify the interlocking required for an overlap with other overlap and route sections. Overlaps are numbered as per the signal numbers beyond which they fall. These are required to be set along with the route for Main signal in rear.

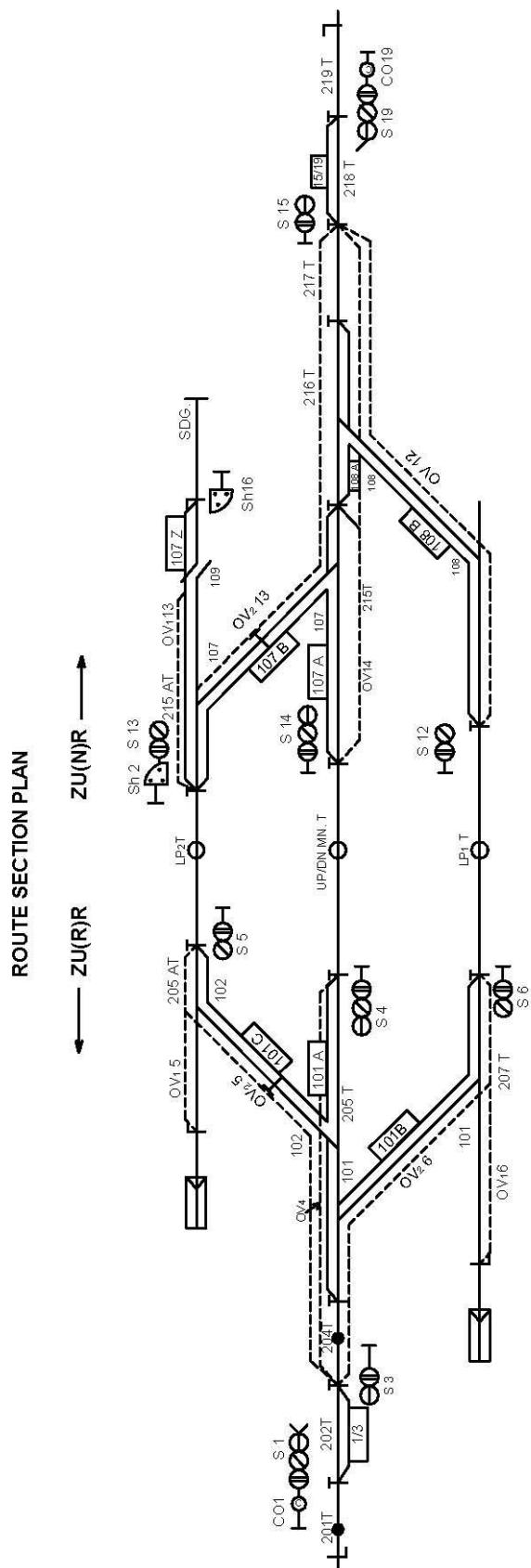
Many places more than one overlap are available to choose from. In the above layout signal No.2 has only one overlap where as signal No.3 has two overlaps. Where there is a choice of overlap, a separate overlap setting relay is provided for each overlap. The buttons are represented by small circles in the plan. In case of non-route setting type of relay interlocking, for selecting the required overlap a separate route buttons are provided as shown in the layout as B1 & B2. In case of non-route setting type of relay interlocking, separate overlap button is not required since points in the overlap also to be set individually to the required position before route initiation.

In route section plan route sections are marked in bold lines preferably with different colours and overlaps are marked in dotted lines. This facilitates their easy identification from one another in big yards with many routes and signals.

Each overlap is provided with one Interlocked relay called OVZ2U(R/N)R. Latching of Reverse coil indicates that the relevant overlap is set and this relay will lock the overlap points.

This relay will ensure normal position only after the specified time delay, after the train has entered the berthing track.

**ROUTE SECTION PLAN**



**Fig : 4.10. ROUTE SECTION PLAN**

## CHAPTER 5

### PRINCIPLES OF OPERATION FOR VARIOUS GEARS

**5.1** The functions operated from the panel are:

1. Points
2. Routes
3. Signals and
4. Slots.

Operation of the first three functions takes place in four stages, viz

1. Initiation
2. Control
3. Checking and
4. Locking

In the ‘INITIATION’ stage, interlocking and other safe conditions are verified and confirmed before changing the position of controlled gear.

In the ‘CONTROL’ stage, initiation is proved and operating feed is connected to the gear after checking the integrity of relays involved in the process.

In the ‘CHECKING & LOCKING’ stages, the changed condition of gear is ascertained and this condition is locked, i.e., retained undisturbed until after the movement of train or fulfilment of the necessary safe conditions in emergencies.

#### **5.2 Operation of Points**

##### **5.2.1 Regular operation:**

In the INITIATION stage, it is proved that the point is free from route locking as well as track locking and that the necessary panel operation is done.

In PI, this panel operation is always individual for each point.

In RRI, either individual operation of points or route setting for a signal collectively.

1. Initiates point control by
  - (i) Checking point locking conditions.
  - (ii) Removing point detection; and
  - (iii) Switching point machine circuit from detection to operation feed.
2. The CONTROL stage following initiation ensures cross protection and overload protection to the machine before starting the motor operation.

In RRI, this also requires setting successive control of all concerned points of the route and overlap in motion soon after the simultaneous beginning of their initiation. This ensures that only two point machines can start moving at a time. It is necessary to limit the load on point feed rectifier and ensure its full output voltage during operation.

The culmination of this stage is in the machine changing the position of points. This happens if only proof of safe conditions established during initiation is not disturbed throughout this stage.

3. The third and last stage of point operation consists at first of its *POSITION DETECTION*. In this, the point machine circuit is switched over to cut off operating feed and connect detection supply. Then, through the machine detection contacts, correspondence between points and control is established by means of a detection relay.

*LOCKING* of this detected condition of points takes place only when a route is set involving this point in RRI. The point becomes free to be operated again after the set route is normalised.

### 5.2.2 Operation in Emergency:

Failure of point track circuit creates an emergency when track locking on point prevents their operation. In that case, a recorded and cautions panel operation is done after physical verification of track conditions to save heavy detentions. An emergency common point's button (EWN) is pressed along with the individual point button (WN). This initiates point operation bypassing track locking conditions (But no signal clearance other than calling ON Signal is possible over the points in this connection)

The rest of point operation is as per the regular procedure.

## 5.3 Signal and Route Initiation

1. *Signal Initiation* and *Route Initiation* take place at a time as signal button and route button are pressed together and released. In these initiations, it is proved that the previous route setting in the location is normalised, be it of the same route or a conflicting route or overlap.

Availability of all the route sections to be set is checked for the purpose of making a traffic movement in a particular direction only. Once the direction is established, it is not possible to initiate any other signal on the same route *in opposite direction*.

Also, interlocking between a main signal and conflicting shunt signals is achieved at this stage by means of a '*shunt signal selection relay*'. Overlap is also set for main signals.

2. Route initiation is followed by *Route Setting* which takes place section wise.

Setting of a route section makes points lying within it, its isolation points and slots inoperative until the route setting is normalised again. This is called 'Route locking of points and slots.'

In RRI, setting of a route section includes operation of the concerned points, if they are not already lying in the required position, before locking them.

3. *Route Checking* involves proving of correct point detection along with route setting and free condition of route section track circuits. The route section does not get normalised unless this locking is released after the passage of train or a cancellation operation in emergency. This takes place only after signal & route buttons are released.

4. The set and checked route section is *locked* by the operation of a common locking relay of the sub-route. The route section does not get normalised unless this locking is released after the passage of train or a cancellation operation in emergency.

### 5.3.1 Main Signal Control:

1. The following conditions are proved in the *Main Signal Control*:
  - (i) Signal in advance is not blank.
  - (ii) Overlap is set.
  - (iii) Points in the overlap are correctly detected
  - (iv) Overlap track circuits are not occupied.
  - (v) Route track circuits are not occupied.
  - (vi) Route sections are checked and locked.
  - (vii) Controls are normalised after the previous signal clearance and train movement or cancellation thereafter (one train only on one signal clearance)

2. Signal control is followed by *Signal Locking*. In this process, a signal engages or locks a route setting before its clearance. This enforces signal to signal interlocking in the yard directly in addition to the directional and other route locking in the initiation stage.

After this, the signal finally gets cleared.

### 5.3.2 Shunt Signal Control:

For *shunt signal*, all the main signal control conditions except setting of overlap, point detection in overlap and non-occupation of last track circuit are proved. In this case, the interlocking provided in the initiation stage is considered sufficient due to the cautious speed permitted by the signal. No second stage locking on the route setting or direct signal locking is proved. Also, shunt signal gets cleared before the buttons are released after operation.

### 5.3.3 Calling ON Signal Control:

For *calling on signal* control, operation is done only after the occupation of Calling ON signal approach track circuit. No signal initiation takes place for this Calling ON signal. Route initiation and setting take place as in the case of main signal concerned. After the necessary time delay, proving the route point detection, the 'Calling ON' signal gets cleared. Signal locking is not considered necessary.

## 5.4 NORMALISATION OF ROUTE

### 5.4.1 With Train Passage:

Regular normalisation of a set route takes place after train movement over it automatically. In this process, signal assuming 'ON' aspect with route occupation releases indication locking on all the route sections. Approach locking and back locking gets free for each route section individually one after the other, when track occupation and clearance take place progressively. This culminates in the release of route locking, route normalisation and release of locking on concerned points. This process is referred to as *Automatic Route Release*.

The process ends with overlap release in case of main signals 1 minute after the last route section is released for a halting, train. Overlap gets released along with route section ahead for a run through train with its passage.

### 5.4.2 In Emergencies:

In emergencies, the various locking releases of route are affected by specified operation on the panel.

#### **5.4.3 Manual Route Release:**

EGGN is pressed with the concerned GN to release indication locking on all sections of the route set. Then, a process known as '*manual route release*' is initiated by the operator by means of three buttons, viz, EUUYN, GN & UN. This operation releases locking and normalises all the route sections as well as the overlap if set at the same time. The locking becomes free soon after the panel operation for route release, in case track circuits in approach of signal are not occupied, nor failed. If they are not clear, the release takes place when the three button operation is repeated after a safe time lapse of 120 seconds, as read from a stabilised panel indication which started flashing after the first three button operation.

The route and overlap release leads to the release of signal locking and point locking.

#### **5.4.4 Emergency Route Section Release:**

In case of track circuit failure in any section of the route set, the route section concerned cannot get released either in the process of automatic route release or manual route release. This situation calls for a joint action of the panel operator along with some responsible official of signalling department to normalise this route section and avoid heavy traffic detentions.

After getting a specific written request from the operator, S&T key is inserted and turned on the panel. Then the operator breaks the seal, turns the disc to free EUYN and presses it along with the specific route section point button, WN. With this, the route section gets unlocked and normalised. Consequently its points get free from route locking and the signal locking relay concerned also gets normalised.

#### **5.4.5 Emergency Overlap Release:**

In case, a signal overlap has to be released in emergency, the pressing of 'OYN' along with the 'UN' concerned behind the signal, releases the overlap instantly provided the last section of the route concerned is already normal. If OYN is not provided on the panel, EUYN is used instead of OYN for this purpose

### **5.5 Release of Crank Handle & Return:**

With the concerned route sections and overlaps normal, the panel operator advises the man at site to cooperate for crank handle release. At site, a push button on the Crank Handle Key lock relay Box is pressed.

Then, the *white indication* near CHYN on the panel extinguished & Red indication flashes. The operator now presses CHYN along with the common Slot Release Button, YYN.

At site, with the button still pressed, a *steady red indication* appears on the box. The key can now be taken out from the Key Lock Relay to operate the point machines concerned. When the key is extracted, the *steady red indication* on the box & control panel continues to be displayed.

When the key is re-inserted on the Key lock Relay after use and turned, the relay drops. The *red indication* at site disappears.

On the panel also, the *steady red* indication disappears and *flashing white* indication reappears. Seeing this, the panel operator has to press CHYN along with common Slot Return Button, YRN. This normalises the slot and the concerned white indication on the panel becomes steady.

## 5.6 Release of Level Crossing Gate Slot & Return:

When route sections and overlaps involving the gate are normal, the panel operator presses LNX along with YYN. The *steady white* indication near LNX on the panel starts flashing.

A *steady red* indication appears on the level crossing Key lock Relay box at site. When the push button on the box is pressed, the key lock relay picks up and releases the key. When the key is extracted, the *steady red* indication on the box remains.

The *flashing white* indication near LNX on the panel disappears and a *flashing red* indication appears. After the gate is closed, when the key is reinserted in the Key lock Relay and turned, the relay drops.

The *flashing red* indication at LNX on the panel disappears, and the *flashing white* indication reappears.

On seeing this, when the panel operator presses LNX alongwith YRN, the slot gets withdrawn and the *white indication* becomes steady.

At site, the *red indication* on the box now disappears.

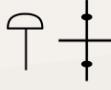
## Release of Point Key Lock Slot & Return:

The operations on the panel and at site are similar in this case and the indications displayed are also the same to those of gate slot explained above. The button operated for point slot release is KLN instead of LNX along with the common buttons YYN and YRN.

\* \* \*

**CHAPTER - 6****SYMBOLS AND NOMENCLATURE**

In Siemens's Relay Interlocking System the circuitry is generally drawn in German Symbols with British Nomenclature. Some of them are mentioned below:

Sl. No.	Symbol	Description / Nomenclature
1		Point Contactor Relay
2		Push Button Pressed Contact
3		Panel Key IN Contact
4		Neutral Relay
5		Interlocked Relay Reverse Coil (Top Relay)
6		Interlocked Relay Normal Coil (Bottom Relay)
7		Track Relay
8		Track Repeater Relay
9		Time element Relay
10		Block Relay in Automatic Territory
11		Normal Position of Neutral Relay is Picked up
12		Normal Position of Neutral Relay is Dropped
13		Normal Position of Interlocked Relay is Picked up (Normal Coil)

Sl. No.	Symbol	Description / Nomenclature
14		Normal Position of Interlocked Relay is Dropped (Reverse Coil)
15		Make Contact
16		Break Contact
17		Neutral Relay, Normally Picked up, Make Contact i.e <b>Front Contact</b>
18		Neutral Relay, Normally Picked up, Break Contact i.e <b>Back Contact</b>
19		Neutral Relay, Normally Dropped, Make Contact i.e <b>Back Contact</b>
20		Neutral Relay, Normally Dropped, Break Contact i.e <b>Front Contact</b>
21	c	Interlocked Relay, Normally Picked up, Make Contact i.e <b>Front Contact</b>
22		Interlocked Relay, Normally Picked up, Break Contact i.e <b>Back Contact</b>
23		Interlocked Relay, Normally Dropped, Make Contact i.e <b>Back Contact</b>
24		Interlocked Relay, Normally Dropped, Break Contact i.e <b>Front Contact</b>
25		Diagonal line inside the relay circle from left top to right bottom indicates that the relay is used in <b>Point</b> circuit
26		Horizontal line inside the relay circle indicates that the relay is used for <b>Route</b> circuit.
27		Diagonal line inside the relay circle from right top to left bottom indicates that the relay is used in <b>Signal</b> circuit

Relays Connected in point Circuit		Relays Connected in Route Circuit		Relays Connected in Signal Circuit	
<b>Symbol</b>	<b>Nomenclature</b>	<b>Symbol</b>	<b>Nomenclature</b>	<b>Symbol</b>	<b>Nomenclature</b>
<b>NEUTRAL RELAYS</b>					
	Point Control Circuit		Route Control Circuit		Signal Control Relay
	Point Detection Relay		Route Checking Relay		Lamp Proving Relay
	Point locking Relay		Route Locking Relay		Signal Locking Relay
<b>INTERLOCKED RELAYS</b>					
	Reverse Coil Used for point control circuit for reverse operation		Reverse coil used for Route Control circuit		Reverse coil used for controlling Signal Control Circuit
	Normal Coil used for Point Control circuit for Normal operation		Normal coil used for Route Control circuit		Normal coil used for controlling Signal Control circuit
	Reverse coil used for locking the Point circuit		Normal coil used for releasing the locking over route circuit		Reverse coil used for locking the Signal control circuit
	Normal coil used for releasing the locked circuit				Normal coil used for releasing the locking of Signal control circuit

Fig:6.1

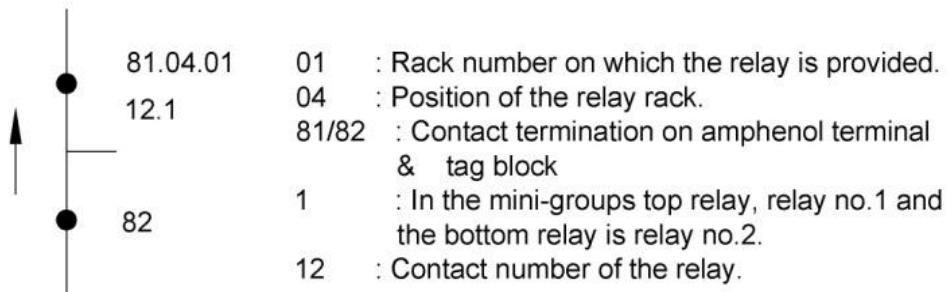


Fig:6.2

<b><u>RELAYS NOMENCLATURE USED IN SIEMENS RELAY INTERLOCKING</u></b>		
	<b><u>Points:</u></b>	
1.	WNR	Point Button Relay
2.	WNCR	Point Buttons Normal Checking Relay
3.	WWNR	Common Points Button Relay for Regular operation
4.	EWNR	Common Points Button Relay for Emergency operation
	<b><u>Initiation:</u></b>	
5.	Z <sub>1</sub> WR	Point group Initiation Relay (with route setting)
6.	Z <sub>1</sub> WR <sub>1</sub>	Point group Initiation Relay (with individual point operation)
7.	Z <sub>1</sub> NWR	Point Normal operation control Initiation Relay
8.	Z <sub>1</sub> RWR	Point Reverse operation control Initiation Relay
9.	WLR	Point Locking Relay
	<b><u>Control:</u></b>	
10.	W(R/R)	Point Operation Circuit Switching Relay
11.	W(N)R	Point Detection Circuit Switching Relay
12.	(R)WLR	Point Reverse operation control Lock Relay
13.	(N)WLR	Point Normal operation control Lock Relay
14.	WJR	Point operation Time limiting Relay
15.	WR	Point contactor Relay
	<b><u>Detection:</u></b>	
16.	WKR <sub>1</sub>	Point Detection Relay -1 (Point final detection Relay) to prove Point correspondence continuously
17.	WKR <sub>2</sub>	Point Detection Relay -2 to prove Point and Points group out of correspondence and cross protection arrangement
18.	WKR <sub>3</sub>	Point Detection Relay -3 to prove Point correspondence with point group at the end of the point operation
19.	NWKR	Point Normal Detection Relay
20.	RWKR	Point Reverse Detection Relay
21.	Z <sub>2</sub> WR <sub>1</sub> & Z <sub>2</sub> WR <sub>2</sub>	Point Indication controlling Relays
22.	W(R)LR	Point group electrically locking Relay

## SYMBOLS AND NOMENCLATURE

23.	W(N)LR	Point group electrically un-locking Relay
	<b>SLOTS</b>	
24.	YYNR	Common Slot Release Button Relay
25.	YRNR	Common Slot Return acknowledge Button Relay
26.	KLNR	Key Lock Point control Button Relay
27.	KL(R)R	Key Lock Point Slot Release Relay
28.	KL(N)R	Key Lock Point Slot Withdrawal Relay
29.	KLCR	Key Lock Point Key IN proving Relay (electro – mechanical Relay, provided at site.)
30.	NP <sub>1</sub> R,NP <sub>2</sub> R & NP <sub>3</sub> R	KLCR Normal repeating Relays (in cabin)
31.	LXNR	Level Crossing gate control Button Relay
32.	LX(R)R	Level Crossing gate control Release Relay
33.	LX(N)R	Level Crossing gate control Withdrawal Relay
34.	LXPR	Gate Slot release Proving Relay (Electro-Mechanical Relay- Provided at site)
35.	LXCPR	LXPR Normal Proving Relay
36.	LXCP <sub>1</sub> R	LXCPR repeater (Provided in cabin)
37.	CHYNR	Crank Handle Release Button Relay
38.	CH/WW/EW NCR	CH YNRs, WWNR and EWNR Normal proving Relay.
39.	Gr1 CHY(R/N)R	Crank Handle Group1 Release/Withdrawal Relay
40.	Gr2 CHY(R/N)R	Point Crank Handle Group2 Release/Withdrawal Relay
41.	Gr1- CHKLR	Point Crank Handle Group1 Slot Release Proving Relay (Electro-Mechanical Relay – Provided at site)
42.	Gr2- CHKLR	Pt. Gr2. Crank Handle Slot Release Proving Relay (Electro-Mechanical Relay – Provided at site)
43.	Gr1- CHKLCR	Point CH Group1 CHKLR Normal Proving Relay (in cabin)
44.	Gr2- CHKLCR	Point CH Group2 CHKLR Normal Proving Relay (in cabin)
45.	CHKLCPR	Repeater for CHKLCR
	<b>Routes &amp; Signals</b>	
46.	UNR	Route Button Relay
47.	UNCR	Route Button relays Normal Proving Relay
	<b>Initiation</b>	
48.	ZU(R/N)R	(Reverse/Normal) Direction Setting Relay.
49.	SH G(R/N)R	Shunt / Main or CO Signal Selecting Relay.
50.	Z <sub>1</sub> UR	Route section Initiating Relay (Common for a Sub route)
51.	Z1UR1	Diversion Selection Initiating Relay
52.	MN-GZR	Main Signal control Initiating Relay.
53.	SH-GZR	Shunt Signal control Initiating Relay.
54.	ZDUCR	Zonal Route Permissibility Checking Relay
55.	OVZ <sub>2</sub> U(R/N)R	Overlap Setting / Releasing Relay.
	<b>R/S Setting.</b>	
56.	U(R/N)S	Route section Setting / Normalising Relay.
57.	UDKR	Sub-Route Clear Indication Relay
58.	DUCR	Route Section Clear Checking Relay.
59.	U(R/N)LR	Sub-Route Locking/Releasing Relay.
	<b>Signal Control &amp; Locking.</b>	

60.	GLSR	Signal Lock Stick Relay.
61.	GR <sub>1</sub>	Signal Aspect control Relay-1
62.	GPR <sub>1</sub>	Repeater of GR <sub>1</sub> (Controls Route Indicator of a Main Signal)
63.	GR <sub>2</sub>	Signal Aspect control Relay-2
64.	GR <sub>3</sub>	Signal Aspect control Relay-3 (Controls DG along with GR1 & GR2)
65.	GR <sub>4</sub>	Signal Aspect control Relay-4 (Controls HHG along with GR1 & GR2)
66.	G(R/N)LR	Signal Locking / Unlocking relay (Locks conflicting Signals of a Main Signal)
67.	COGGNR	Calling ON Signal Button Relay
68.	COULR <sub>1</sub>	Calling ON Signal Route Locking Relay-1
69.	COULR <sub>2</sub>	Calling ON Signal Route Locking Relay-2
70.	RECR	'ON' Aspect Checking Relay
71.	HECR	Caution Aspect Checking Relay(or) 'OFF' Aspect Checking Relay (Shunt Signal)
72.	DECR	Clear Aspect Checking Relay
73.	HHECR	Attention Aspect Checking Relay.
74.	UECR	Route Indicator Lamp Checking Relay
75.	COECCR	CO. Signal Lamp Checking Relay.
76.	GXJR	Signal Lamp Failure Alarm Timer Relay.
77.	WXJR	Point detection Failure Alarm Timer Relay
78.	GXYNR	Signal lamp Failure Alarm Release Button Relay.
79.	WXYNR	Point detection Failure Alarm Release Button Relay.
80.	NCR	Common Checking Relay for Button checking and other concerned Relays
<b>Emergency Releases</b>		
81.	EGGNR	Emergency Button Relay to replace Signal at 'ON'
82.	EGNR	Relay Proving EGNN operation along with a GN / Sh.GN
83.	EUUYNR	Emergency Route Release Button Relay.
84.	EUYNR	Emergency Route section Release Button Relay.
85.	EUUYNCR	Relay Proving EUUYN operation with Route Initiation.
86.	ATR	Approach Track Relay
87.	AJTR <sub>1</sub>	Approach Lock release Time control Relay-1.
88.	AJTR <sub>2</sub>	Approach Lock release Time control Relay-2.
89.	AJTR	App. Lock release Time setting Relay.
90.	AJTR <sub>3</sub>	App. Lock release Time control Relay-3.
91.	EUUYR	Emergency Full Route Release Relay.
92.	EUYR	Emergency Route section Release Relay.
93.	OYNR	Overlap Release Button Relay.
94.	OV-AJTR <sub>2</sub>	Overlap release Time control Relay-2.
95.	OV-AJTR <sub>3</sub>	Overlap release Time control relay-3
96.	OV- AJTR	Overlap Release Time Setting Relay.

## CHAPTER – 7

### EXTRACTS FROM SPECIFICATIONS FOR

## **RELAY INTER LOCKING SYSTEM**

**7.1** For ready reference the extracts of IRS: S 36 are given below:

1. Scope
2. General Requirements
3. Control Panel
4. Interlocking & Circuit requirements
5. Relays
6. Signals
7. Points
8. Track circuits
9. Cables
10. Wiring & Relay Racks
11. Fuses, Terminals & Terminal links
12. Power Supply arrangements
13. General

List of optional requirements.

Appendix – A: Information to be supplied by purchaser.

Appendix – B: Information to be supplied by tenderer.

### **7.2 RELAY INTERLOCKING SYSTEMS**

1. IRS-S-36/87 refers to IRS, IS, BS & BRS Specifications for signalling materials, cables, relays, point machine and various IRS design drawings.
2. Covers mechanical and electrical requirements including ancillary equipment, (Design performance and safety aspects).

### **7.3 RELAY INTERLOCKING:**

- a) Route setting type by entry/exit.
  - b) Non - Route setting type (route set by individual operation of points).
1. For installation in RE Area, equipment and circuitry to comply with requirements as per approved RE Practices.
  2. Signalling Plan and Control Tables to be supplied by purchaser.
  3. Suppliers to furnish detailed wiring diagram, control panel diagram, route control chart, cable diagram, track bonding diagram, relay contact analysis, relay rack arrangement, terminal charts, fuse charts, power panel diagram, power supply scheme, etc.

### **7.4 CONTROL PANEL:**

- Areas covered by each track circuit to be clearly distinguished.

- Normally switches, buttons, etc. to be provided on panel itself in geometrical order unless separate illuminated diagram and console containing operational arrangement are asked for.
- Route setting on basis of entrance - exit principle entrance/exit both buttons or entrance switch (2 or 3 Positions) and exit button.
- Non - Route setting type route to be set by operation of individual points; signals to be cleared by individual push button + common button or individual switch for each signal or common switch for conflicting signals or signals cleared by push button at entrance and push button at exit.
- Point operation for route setting by individual button + common button or individual 2 or 3 Positions switches.
- Approach locking or route release locking to be provided as specified by purchaser.
- Provision to be made for emergency operation of points during point zone track circuit failures. Emergency group point button must be kept sealed and each operation to be recorded in an electric counter.
- Facility to switch over from manual control to automatic working for routes specified by purchaser.
- Slotting facilities available with end cabins, ground frames, LCs, Crank Handles, Siding Points, etc.
- Slot to be controlled by two buttons or a switch similar to route setting principle. Slot cancellation by group cancellation by entrance/exit button. Slot cancellation should be effective after specified time delay and has to be recorded in an electric counter.
- If required by purchaser, switches/buttons to be provided on panel for controlling supply voltage for panel indication (intensity of illumination).
- If required by purchaser, facility for adjusting operating voltage of signal lamps from panel.
- If needed by purchaser, control for selecting power supply from Mains/DG set/AT<sub>1</sub>/AT<sub>2</sub>, on control panel.
- SM's lock up key to be provided, when taken out, all points shall remain inoperative and all signals except those cleared shall also be inoperative. Facility to put back any cleared signal to danger in case of emergency but no route can be altered.
- In major yards, indication panel giving status of various functions in yard, to be provided in relay room for benefit of maintenance staff, if required by purchaser,

## 7.5. CONTROL PANEL INDICATIONS:

### 7.5.1 Point indications

White (Normal) and Green (Reverse) near point switch/button or by White strip light on the leg of point switch; if needed by purchaser, indication lights to flash till points are correctly set and locked. If point does not set with in predetermined time, warning bell to be given which can be stopped on acknowledgement but flashing indication to continue till defect is set right. Point locked in route to be indicated by a small Red or White light near the point or respective switch/button which gets extinguished when point is free. If needed by purchaser, point free indication also to be provided.

### 7.5.2 Route indications

A row of white lamps to show setting and locking of routes, to get extinguished when route is not set. If needed by purchaser one or more first track circuits in route to flash till route is correctly set and locked. When track is occupied colour of indication to change to red and to go back to white when track is free and to get extinguished when route is released.

### 7.5.3 Signal indications:

- Stop Signal at 'ON' by a Red indication and Permissive signal at 'ON' by an Yellow light on the signal symbols on the panel. Corresponding 'OFF' aspects also to be indicated on the panel.
- Shunt signal on same post, no 'ON' indication needed, if on separate post, 'ON' aspect by white light strip or two miniature white lights in horizontal position and for 'OFF' aspect by slanting white light strip or two miniature slanting white lights.
- 'A' or 'AG' marker indication to be provided below signal symbol.
- 'Calling ON' at 'OFF' to be indicated by a white light below corresponding running signal indication.
- If needed by purchaser, a white strip light to be provided over running signal symbol on the panel, when Route Indicator is taken 'OFF'.
- For each track circuit minimum of two red (and white) lights to be provided per track circuit. Red lights to light up when track is occupied and extinguish when track circuit is free.
- Power supply voltage meter to be provided on panel, if required by purchaser.
- Indication to show availability of power supply from mains/DG/AT1/AT2 to be provided on panel.

### 7.5.4 OTHER INDICATIONS:

- Approach track circuit where provided to be indicated on a panel as per table of control for approach locking. An approach track circuit controlling "Calling ON" to be indicated in a distinct manner.
- Advance approach warning to be provided, if required, flashing lights and audible bell, audible warning to stop on acknowledgement. Warning indications to disappear when train on approach track circuit or when signals taken "OFF".
- Where required by purchaser individual or group audible and visual alarms to be given for failure of signal/route bulbs. Audible alarm to be silenced by acknowledgement.
- Near CH control switch/button, white lamp for CH free and red lamp for CH locked to be provided.
- White lamp for emergency route cancellation in approach lock condition, after lapse of time delay, to extinguish after cancellation of route.
- If two position push buttons provided, to indicate audible indication that push buttons are kept pressed.

- Indications for slot, gate control, etc. as required by purchaser.
- Panel indication bulbs to operate by maximum 24V miniature bulbs or LED's as specified by purchaser.
- Return wires for indication lamps to be so provided as not to damage wires due to heating. Any break in return wire should not give wrong indication or pick up a wrong relay.

## 7.6 INTERLOCKING AND CIRCUIT REQUIREMENTS:

- Wiring diagram Symbols as per BS-376 or American/German symbols as required by purchaser and circuit explanations in English.
- A2 size papers for all documents.
- Purchaser to approve table of control.
- If required, internal circuits to be electrically isolated from external circuits.
- Circuit design to be such that fluctuations in power supply or resumption of supply following failure, cannot take signal to a less restrictive aspect than intended.
- If Metal to Metal front contact signalling relays (proved signalling relays) are used, sequential operation of relays to be proved.
- Battery for power supply for line circuits to be kept at farthest end from operated unit. Where it is not practicable, separate cable to be used for outgoing power supply.
- Common return shall not be provided for vital circuits.
- All external safety circuits shall be in cables.
- The route setting and clearance of signal shall be achieved in following sequence:
  - a) Proving that the interlocking is free.
  - b) All points in the route, overlap and isolation are operated to the required position, locked and detected.
  - c) The selected route, overlap and isolation is locked.
  - d) Proving that the track circuits in the route up to the next signal and its overlap are clear.
  - e) Proving that the crank handle for all the points in route, overlap and isolation are locked and their control is not released.
  - f) That all interlocked level crossing gates are closed and locked against road traffic in the route and overlap, if any.
  - g) Clearing of signals.
- Siding control is locked and cannot be released.
- In Non-Route setting type, points in route/overlap/isolation to be operated by individual operation of switches/push-buttons and signal to be cleared after fulfilling/checking various conditions as per route setting type.
- For calling ON signals, Track Circuits in Route and overlap need not be free and proving of points and LC Gates in overlap not needed but isolation points must be set, locked and detected in required position.
- For shunt signals, berthing tracks need not be clear, Points and LC Gates in overlap need not be proved.

## **SYMBOLS AND NOMENCLATURE**

- Conflicting routes to be interlocked through route interlocking circuits.
- Pre-setting of conflicting routes shall not be possible.
- Approach and back locking of signalled route to be effective when all points are finally set but before signal assumes 'OFF' aspect or before 'A' Marker is lit.
- Approach locking or time locking to be provided for all controlled signals and also for electric locks or hand-operated points.
- White indication for block control on LSS to be provided on control panel in absolute block system.

## **7.7 ROUTE RELEASE CIRCUITS:**

Unless automatic route release by passage of train is asked for, route + overlap to be released when signal put to "ON" and corresponding route switch/button is operated to normalise the route.

- If route has number of route sections, route section should not release only by picking up of the concerned track relay. Same is released only after the next track circuit is also dropped and picked up, except where last track is a berthing track. If route is controlled by single track, route release after pre-determined time delay.
- Route release circuit to be effective only if two track circuits' drops and pick up in sequence.
- In route setting type, sectional route release is to be provided where required. Sub route already released can be used in other routes, if permitted by interlocking.
- In Non-Route setting system, sectional route release not required unless specifically asked for. The complete route is to be released after signal put back to "ON" and corresponding route switch/button operated to normalise the route.
- Emergency route release after suitable time delay is to be possible when approach track is occupied (or dead approach locked), if signal put back to danger and the train has not passed the signal during this time interval.
- Overlap points to be released only after lapse of one minute after occupation and clearance of last point track circuit of the route. On cancellation of route, the overlap points also to be released simultaneously along with the main route.
- If required by purchaser, facility for emergency route / sub route cancellation in case of track circuit failure. Emergency cancellation of route/ sub- route shall be possible by cooperation of two persons, one representative of Signal Department and other from Traffic Department and every such cancellation shall be recorded on a counter.

## **7.8 SIGNAL CONTROL CIRCUITS:**

- Where self restoring type push buttons are used, signal to assume "OFF" only after push buttons are pressed and released.
- In case of failure of a signal lamp, lamp of less restrictive aspect is to be lit automatically and in case of failure of red lamp it shall not be possible to clear signal in rear.
- Signal to display most restrictive aspect when signal ahead is blank.
- Fouling protection, approach locking, time locking, route locking, siding control key locking, CH locking, route holding and track locking shall be incorporated in the relevant control circuits.

- Where necessary, each aspect of a signal may be proved and aspect indication shall be provided as needed.
- Wherever required, necessary control on the level crossing, ground frames, cabins, siding control key, crank handles etc. shall be provided.
- LC Gate to be released only when signal is replaced to "ON" and route is released.
- Interlocking between points to be provided only to the minimum extent necessary.
- Point control circuit shall be so designed that a cross connection or a short circuit cannot operate a point or give a false indication of the same.
- The correspondence of point control relays and point indication relays to be proved in signal circuits before the signal displays an 'OFF' aspect.
- Cross overs shall be operated by separate point machine, one at each end and detection of setting and locking of the points at the two ends shall be connected in series.
- CH to be so interlocked with signals that it cannot be released unless signals have been put back to "ON" and concerned route is released.
- Where number of points are more, points can be grouped in different zones and Crank handles of different groups should not be interchangeable.
- Siding control keys to be suitably interlocked with signals leading over that line.

## **7.9 CROSS PROTECTION:**

- Unless specifically required, for purely internal circuits, double cutting or cross protection need not be provided.
- All equipments in external circuits shall be suitably protected from cross connections and immunised to operation by stray currents.

## **7.10 RELAYS:**

- Time element relays electronic type confirming to IRS/BS/BRS Specification shall be used. When electronic timers are used, two numbers are to be used and their contacts are to be in series with each other.
- All plug-in relays and relay groups to be fitted with non-interchangeable interlocking device.
- Removal of relays/relay groups from relay racks during operation shall not cause any unsafe condition in the circuits.
- Maximum possible number of relays to be housed in relay room itself.
- Wherever possible, all relays except track relays to have 10% of working contacts to be spare subject to a minimum of 1F and 1B. Relay rack to have space to accommodate repeater relays in future as required by purchaser.
- Flasher relay shall be used preferably a mercury flasher. Electronic flasher shall not be used for point operation or route setting operation and it can be used for other indications.

## **7.11 Route Indicator:**

- Can be of direction type, multi-lamp type or stencil type.

**7.12 POINTS:**

- Point machine can be with plunger type locking, rotary locking or point clamp type locking.
- Means to cut-off motor feed after pre-determined time in case of obstruction in the point.
- Over load protection and cross protection to be provided.
- CH interlocking by dividing them into number of groups. CH with different wards and corresponding slots in point machine. CH may be provided near group of points to which they refer.
- AC traction area, point machines to be immunised.

**7.13 TRACK CIRCUITS:**

- DC, 50Hz AC,  $83\frac{1}{3}$  Hz AC or Axle Counter, AFTC, can be used.
- Adjacent TC should not wrongly energise relay in case of failure of block joints.
- DC track circuit not be fed directly by transformer - Rectifier, Battery is a must; if battery is disconnected, Rectifier also to get disconnected.
- For centralising track relays, separate 2 core cable of adequate size to be used.

**7.14 CABLES:**

- Unscreened, screened, power cables, axle counter quad cables.
- In each main cable spares to the extent of 20% of total conductors used to be provided up to point zone and 10% spares beyond, no spares required if total number of conductors used is < 3.
- Conductor size such that voltage drop on line is > 10%.
- Cable termination or jointing outdoor, same to be done in water tight junction boxes.
- 2 Cores of cable for telephone communication from relay to end to yard for maintenance purposes, if in different directions, one pair for each direction; in RE area, communication by telecom. Cable.
- ELD's (multi-channel) optional for detecting leakage to earth.

**7.15 WIRING**

- All wiring in cabin & locations to be terminated on terminal blocks/tag blocks.
- Single Core 1mm., multi-core each 1mm., multi-core each 0.6mm or flexible wire 16/0.2mm to be used for internal wiring.
- Relay rack to relay rack wiring by 1.6/1.5 Sq.mm.
- For shelf & plug-in type relays, 16/0.2 Sq.mm.
- Proved type relays, 0.6 Sq.mm. single strand.
- Cable termination to tag blocks and indicators, 1 mm. Single strand.
- CB's, lever locks, etc., single strand 1.5 /1.6 Sq.mm.
- Relay to relay wiring in same rack to be direct without tag blocks/terminals, as far as possible.
- Relay rack to have spare capacity to take 15% more.

### **7.16 FUSES:**

- Each group of circuits to be carefully protected by fuses.
- Fuses giving visual indication during blow off preferred.

### **7.17 POWER SUPPLY:**

- Shall have 20% spare capacity.
- Voltage stabiliser to give  $110V \pm 2\%$ .
- Signal supply transformer to have 0-110-120-130V tappings.
- Where 3 ø track circuits used, each phase voltage being available to be proved in route release circuit.
- No break power supply for AC circuits with automatic/manual switch over facility to stand by during voltage fluctuation or frequency variation by  $> \pm 3\%$ .
- All DC circuits including point machines to have battery back up in both RE and Non-RE areas.

### **7.18 GENERAL:**

- Big yards, busy junction stations where large number of movements take place, relay room shall be Air conditioned, optional in wayside stations.
- Relay rooms in areas prone to dust, fumes, extreme temperatures, etc. may be Air conditioned.
- Route setting type installations, fire detector and alarm of approved design to be provided. All installations are to be provided with fire fighting arrangements.
- Adequate spare relays and other equipments to be provided with each installation.
- Quartz clock shall be provided on indication panel, if required.
- Proper earthing shall be provided for relay racks, panel, power supply, switch board, transformers, inverters, etc.
- In case of major Route Relay Interlocking and Electronic Interlocking Installations, Data Logger shall be provided. At wayside Panel Interlocked Installations, provision of Data Logger is optional.

#### **OPTIONS: To be specified.**

1. RRI or PI.
2. Control & indication panel separate or not.
3. Three position signal switch in PI.
4. Point switches two or three position.
5. Voltage control on panel indication.
6. Voltage control on signal supply.
7. SM's lock.
8. Provision of voltmeter.
9. Requirement of approach warning.
10. Lamp failure indication.

## **SYMBOLS AND NOMENCLATURE**

11. Sectional route release.
12. Double cutting in internal circuits.
13. Holding of overlap,
14. Provision of air conditioning.

## **INFORMATION TO BE SUPPLIED BY THE TENDERER:**

1. Type of panel lamp to be used.
2. Type of over load cut-off in point machine.
3. Specification of cables/wire.
4. List of spares.
5. Requirement of power supply.
6. Additional facilities, if any.

## **INFORMATION TO BE SUPPLIED BY THE PURCHASER:**

1. RRI or PI.
2. RE or Non-RE.
3. Signalling plan and selection table.
4. Control Panel - Separate/Combined.
5. If RRI, push buttons/knob & button; if PI, common signal switch or not.
6. Point switch - 2 or 3 position.
7. Details of alternate overlaps/routes.
8. Semi-automatic working.
9. Details of various slots/controls.
10. Voltage control - Limits.
11. Details of change over arrangement in power supply.
12. Indication panel for maintainer,
13. Type of panel indication bulb.
14. Symbols to be used in circuits.
15. Requirement of external supply.
16. Pre-setting of route.
17. Details of sectional route release.
18. Details of aspect proving required.
19. Grouping of point crank handles.
20. Type of route indicator.
21. Point operation.
22. Type of track circuit.
23. Type of wire to be used.

\* \* \*

## CHAPTER - 8

### CONTACT ANALYSIS OF FUNCTIONAL RELAY GROUPS

#### 8.1 Contact Analysis of K 50 mini- Group Relays on a rack

8 Mini-Groups in each of 8 rows are fixed on a rack. The groups are numbered as below, as seen from the rear of the rack where the wiring is. The group position on the rack is as shown below:

08	07	06	05	04	03	02	01
18	17	16	15	14	13	12	11
28	27	26	25	24	23	22	21
38	37	36	35	34	33	32	31
48	47	46	45	44	43	42	41
58	57	56	55	54	53	52	51
68	67	66	65	64	63	62	61
78	77	76	75	74	73	72	71

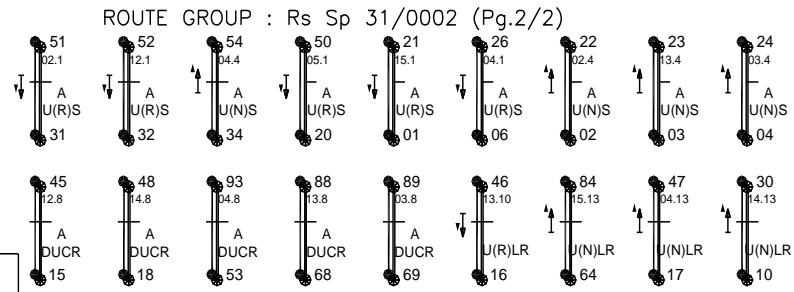
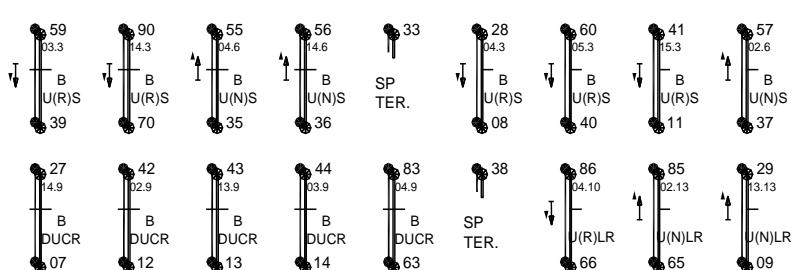
The contact distribution of each mini group is shown in the above numbered slots as shown below

GROUP NUMBER NO. (FRONT CONTACT)	01				AJTR <sub>1</sub>	RELAY DESIGNATION BASE PLATE TERMINATION NUMBERS CONTACT NUMBER AND RELAY NUMBER		
	COIL	11.1 91-92	9	01.1 01-02				
	COIL	12.1 81-82	6	02.1 11-12				
	COIL	13.1 71-72	9	03.1 21-22				
	COIL	14.1 61-62	9	04.1 31-32				
	COIL	15.1 51-52	13	05.1 41-42				
NO. (FRONT CONTACT)	S12							
	COIL	11.2 93-94	9	01.2 03-04				
	COIL	12.2 83-84	6	02.2 13-14				
	COIL	13.2 73-74	9	03.2 23-24				
	COIL	14.2 63-64	26	04.2 33-34				
	COIL	15.2 53-54	9	05.2 43-44				
S13				AJTR <sub>1</sub>	RELAY DESIGNATION SHEET NUMBER IN WHICH CONTACT IS USED	NC(BACK)CONTACT		

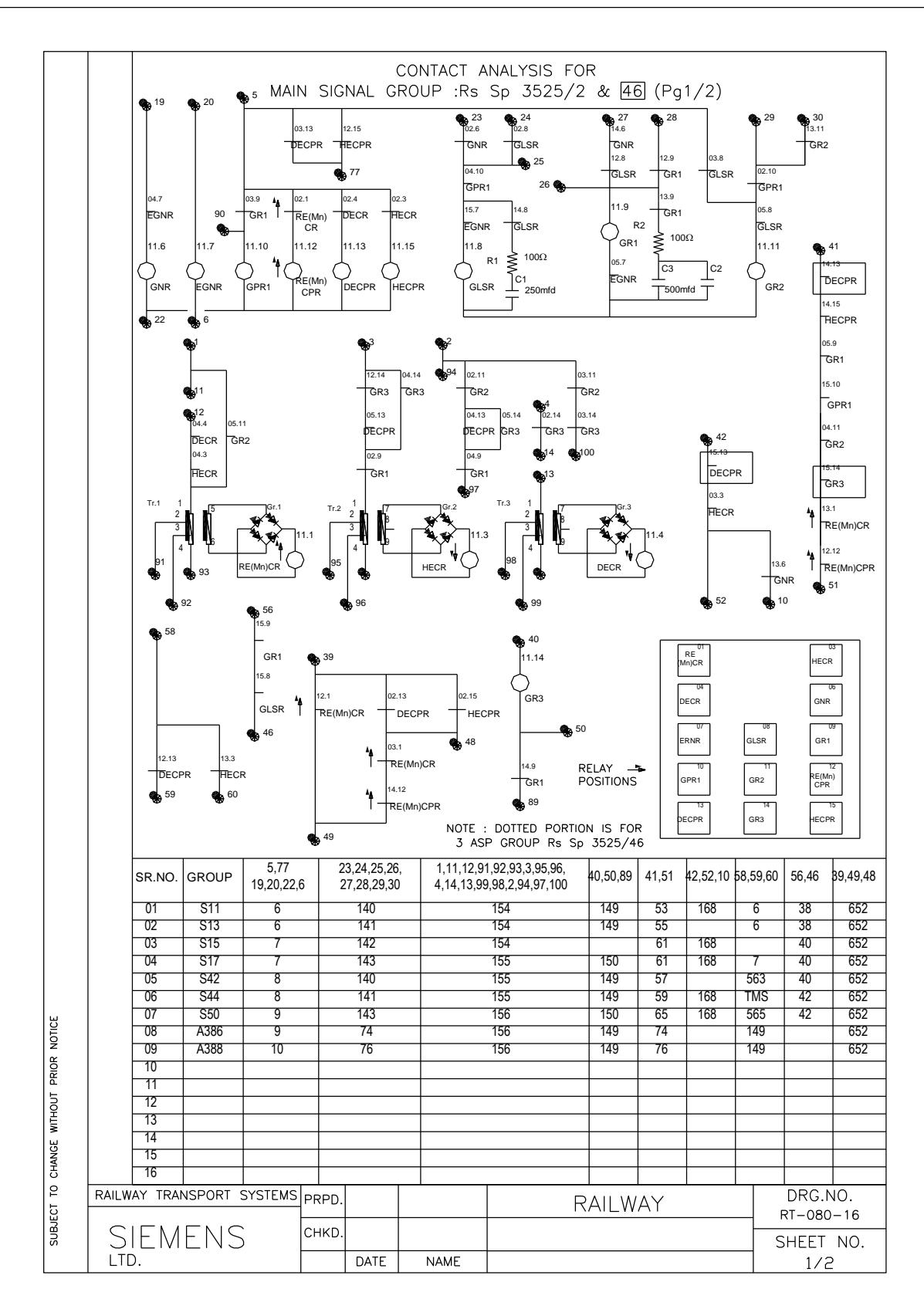
# CONTACT ANALYSIS FOR ROUTE GROUP (Page: 1 of 2)

SUBJECT TO CHANGE WITHOUT PRIOR NOTICE	<b>CONTACT ANALYSIS FOR ROUTE GROUP : RS Sp 31/0002 (Pg. 1/2)</b>																				
	SR.NO.	GROUP	91,71,92,97,72,73,76,98,58,77			94, 25			75, 96		95, 05		100,74,80,78,99,79			49, 19		87, 67		81,61,62,82	
	01	101A/B	53			54			54		53		54			53		54		79	
	02	102A	55			56			56		55		56			55		56		79	
	03	103A/B	57			58			58		57		58			57		58		79	
	04	104A	59			60			60		59		60			59		60		79	
	05	112A/B	61			62			62		61		62			61		62		79	
	06	115A	63			64			64		63		64			63		64		79	
	07	116A/B	65			66			66		65		66			65		66		79	
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16																					
CONTACT ANALYSIS FOR ROUTE GROUP RACK NO.XX												RAILWAY TRANSPORT SYSTEMS <b>SIEMENS</b> LTD.		PRPD.			RAILWAY			DRG.NO. RT-080-16	
CHKD.																					
DATE		NAME																			
1/2		SHEET NO.																			

## CONTACT ANALYSIS FOR ROUTE GROUP (Page: 2 of 2)

SUBJECT TO CHANGE WITHOUT PRIOR NOTICE	<b>CONTACT ANALYSIS FOR ROUTE GROUP : Rs Sp 31/0002 (Pg.2/2)</b>  <table border="1" style="margin-top: 10px; border-collapse: collapse; width: 100%;"> <thead> <tr><th>RACK NO.</th><th>GROUP</th><th>51.31</th><th>52.32</th><th>54.34</th><th>50.20</th><th>21.01</th><th>26.06</th><th>22.02</th><th>23.03</th><th>24.04</th><th>45.15</th><th>48.18</th><th>93.53</th><th>88.68</th><th>89.69</th><th>46.16</th><th>34.64</th><th>47.17</th><th>30.10</th></tr> </thead> <tbody> <tr><td>01</td><td>101A/B</td><td>83</td><td>54</td><td></td><td></td><td>714</td><td>22</td><td>152</td><td></td><td></td><td>53</td><td>132</td><td>136</td><td>132</td><td>136</td><td></td><td>713</td><td></td><td></td></tr> <tr><td>02</td><td>102A</td><td>83</td><td>TMS</td><td>85</td><td>53</td><td>360</td><td>22</td><td>57</td><td>152</td><td></td><td>55</td><td>132</td><td>136</td><td>132</td><td>136</td><td></td><td>713</td><td></td><td></td></tr> <tr><td>03</td><td>103A/B</td><td>83</td><td></td><td>85</td><td>53</td><td>714</td><td>22</td><td>152</td><td>193</td><td></td><td>57</td><td>132</td><td>136</td><td>132</td><td>136</td><td></td><td>713</td><td></td><td></td></tr> <tr><td>04</td><td>104A</td><td>85</td><td>141</td><td></td><td>57</td><td>152</td><td>22</td><td></td><td>195</td><td>195</td><td>59</td><td>132</td><td>136</td><td></td><td>136</td><td></td><td>713</td><td></td><td></td></tr> <tr><td>05</td><td>112A/B</td><td>87</td><td></td><td>166</td><td>360</td><td>45</td><td>21</td><td></td><td></td><td></td><td>61</td><td>132</td><td>136</td><td>132</td><td>136</td><td></td><td>713</td><td></td><td></td></tr> <tr><td>06</td><td>115A</td><td>91</td><td></td><td>166</td><td>65</td><td>360</td><td>21</td><td>152</td><td></td><td></td><td>63</td><td>132</td><td>136</td><td>132</td><td>136</td><td></td><td>713</td><td></td><td></td></tr> <tr><td>07</td><td>116A/B</td><td>89</td><td>65</td><td>91</td><td>66</td><td></td><td>21</td><td>152</td><td>49</td><td>554</td><td>65</td><td>554</td><td>132</td><td>136</td><td>132</td><td>136</td><td></td><td>713</td><td></td><td></td></tr> <tr><td>08</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>09</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>11</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>12</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>13</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>14</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>15</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>16</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>  <table border="1" style="margin-top: 10px; 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RT-080-16</td> </tr> <tr> <td>CHKD.</td> <td></td> <td></td> </tr> <tr> <td colspan="2">SIEMENS LTD.</td> <td>DATE</td> <td>NAME</td> <td colspan="2"></td> <td colspan="2"></td> <td colspan="2">SHEET NO. 2/2</td> </tr> </table>																RAILWAY TRANSPORT SYSTEMS		PRPD.			RAILWAY				DRG.NO. RT-080-16		CHKD.			SIEMENS LTD.		DATE	NAME					SHEET NO. 2/2	
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SR.NO.	GROUP	59.39	90.70	55.35	56.36	33.	28.08	60.40	41.11	57.37	27.07	42.12	43.13	44.14	83.63	38.	86.66	85.65	29.09																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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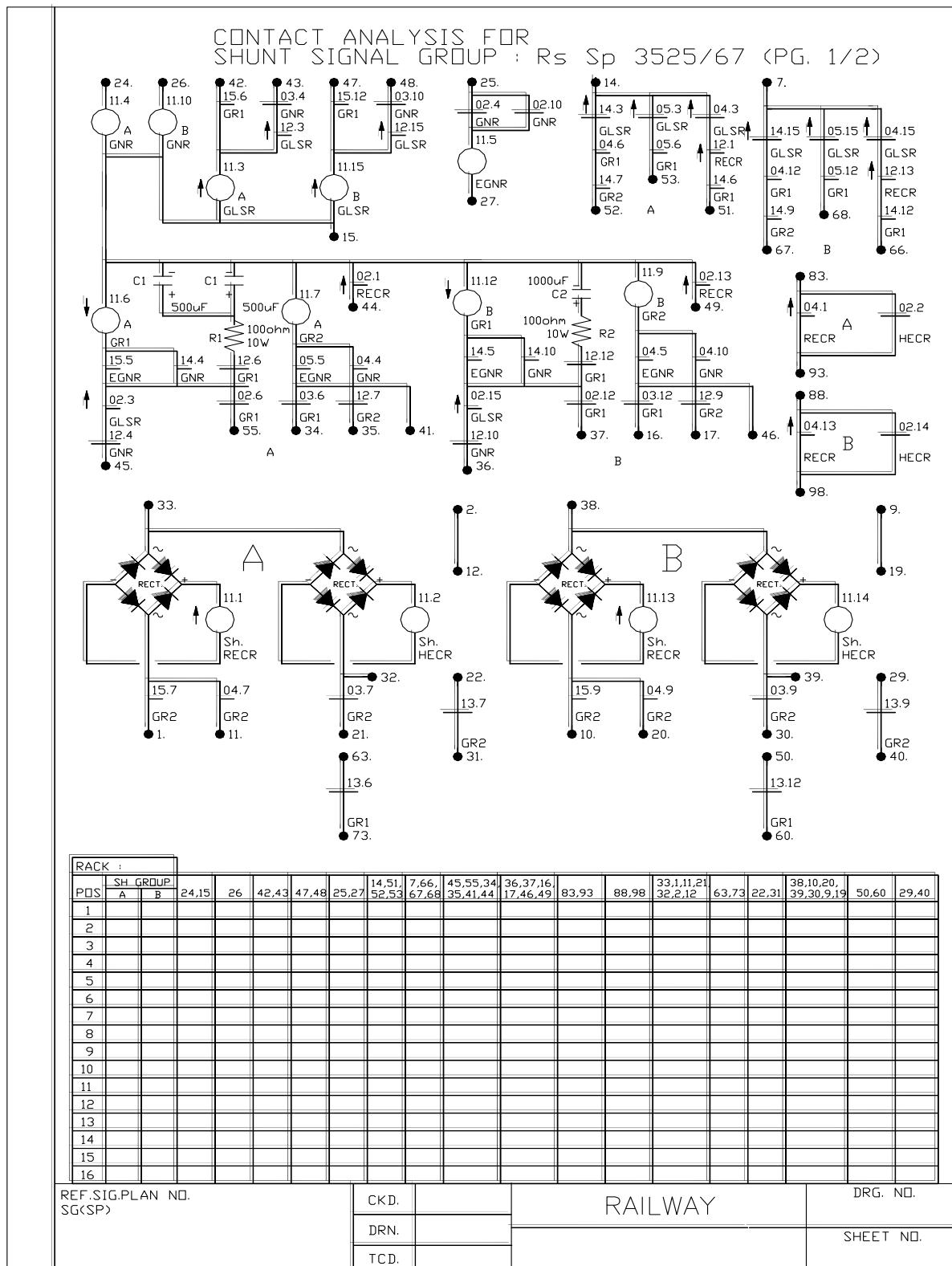
## CONTACT ANALYSIS FOR MAIN SIGNAL GROUP (Page: 1 of 2)



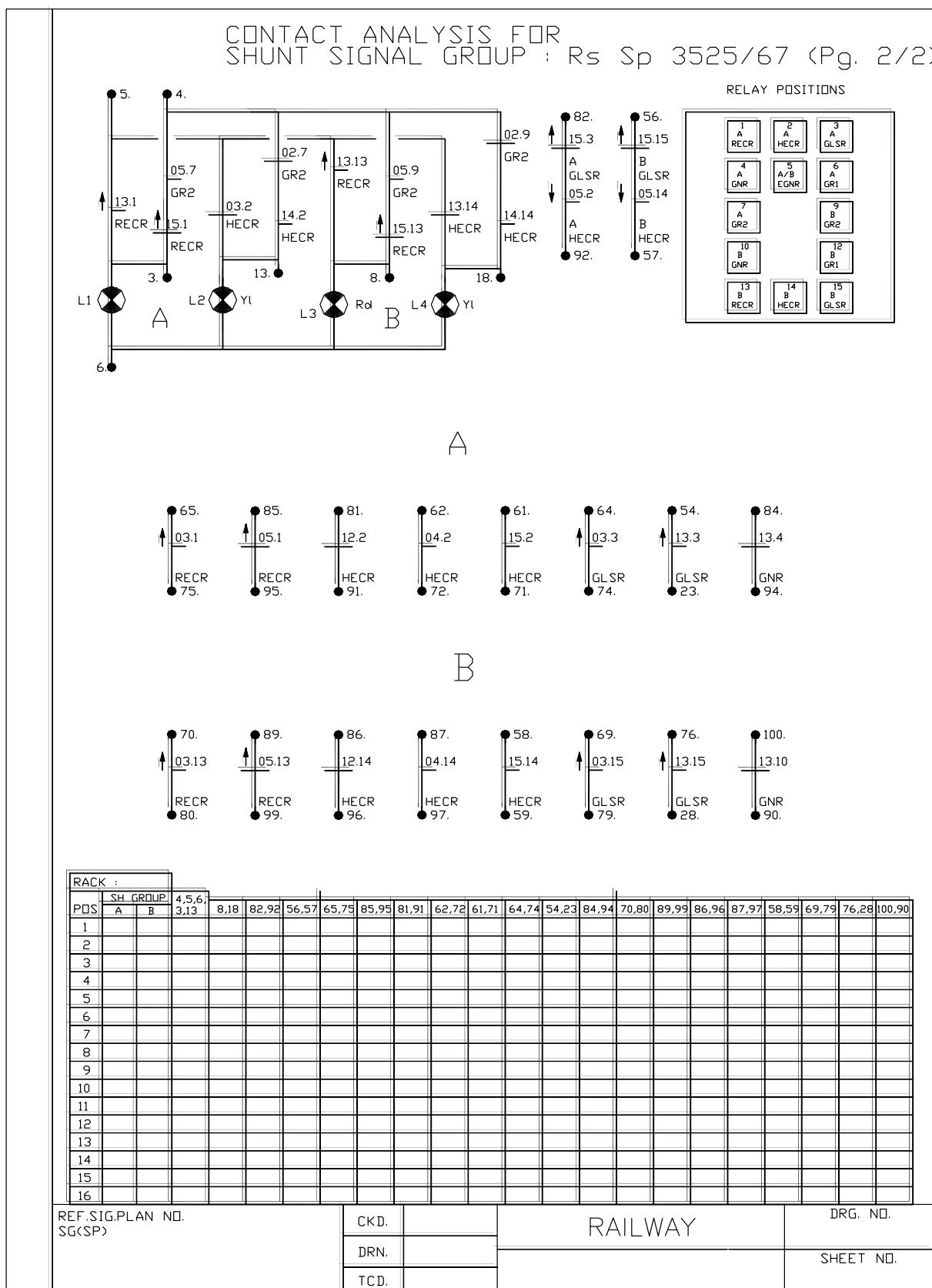
## CONTACT ANALYSIS FOR MAIN SIGNAL GROUP (Page: 2 of 2)

SUBJECT TO CHANGE WITHOUT PRIOR NOTICE	<b>CONTACT ANALYSIS FOR MAIN SIGNAL GROUP : Rs Sp 3525/2 &amp; 46 (Pg 2/2)</b>															
	RACK NO : 46															
	SR.NO.	GROUP	57,47	61,71	67,21	64,74	83,84	65,75	66,76	17,18	37,38	53,43	54,44	55,45		
	01	S11	01	707			168	694	182	694	165	163	694			
	02	S13	01	707				694	182	154			694			
	03	S15	01	707	129		168	694		694			694			
	04	S17	01	707			168	694	182	694	165	163	694			
	05	S42	01	707				155	182	155			694			
	06	S44	01	707			168	695	182	155	165	164	695			
	07	S50	01	707	129		168	695			165	164	695			
	08	A386		707				695		695			695			
	09	A388		707				695		156			695			
	10															
	11															
	12															
	13															
14																
15																
16																
<p>NOTE : DOTTED PORTION IS FOR 3 ASP GROUP Rs Sp 3525/46</p> <p><input type="checkbox"/> ENCLOSED IN THIS SQUARE IS APPLICABLE FOR 2 ASP GROUP Rs Sp 3525/2</p>																
SR.NO.	GROUP	15,16		85,86	81,82	69,79	70,80	62,72	63,73	68,78	87,88	7,8,9,31,32,33,34,35,36				
01	S11	27		694		06	196		53	694		160				
02	S13	27		694		06	197		55	694		160				
03	S15	26				07	199			694	26	160				
04	S17	26		694	26	07	202			694	26	160				
05	S42	27		08		08	695	563	57	08		161				
06	S44	27		695		08	695	564	59	695		161				
07	S50	26		09	26	09	695	565		09	26	161				
08	A386	74		09		09	695	149	74	09		161				
09	A388	76		10		10	695		76	10		162				
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RAILWAY TRANSPORT SYSTEMS		PRPD.				RAILWAY						DRG.NO. RT-080-16				
SIEMENS LTD.		CHKD.														
			DATE	NAME												
													SHEET NO. 2/2			

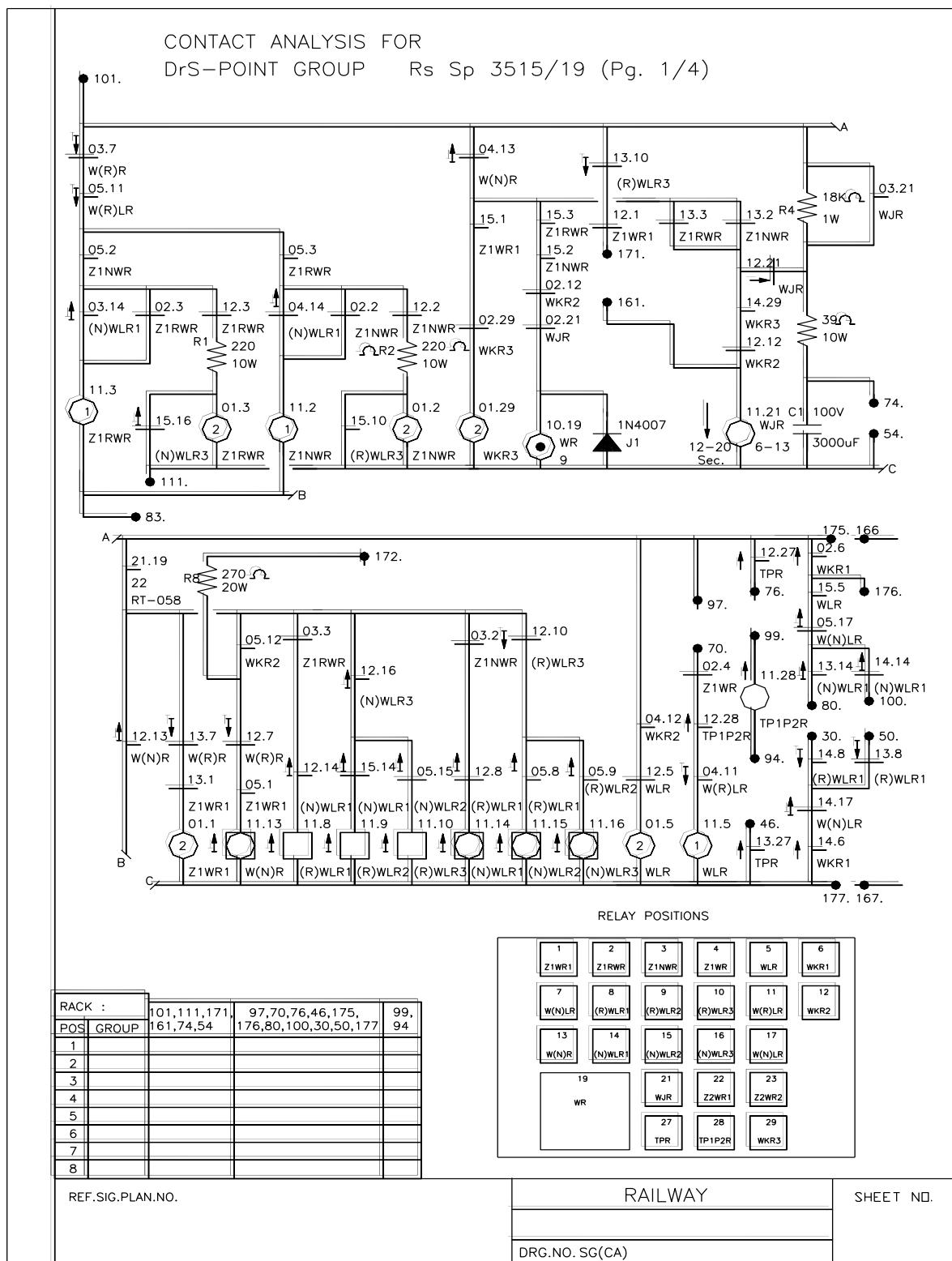
## CONTACT ANALYSIS FOR SHUNT SIGNAL GROUP (Page: 1 of 2)



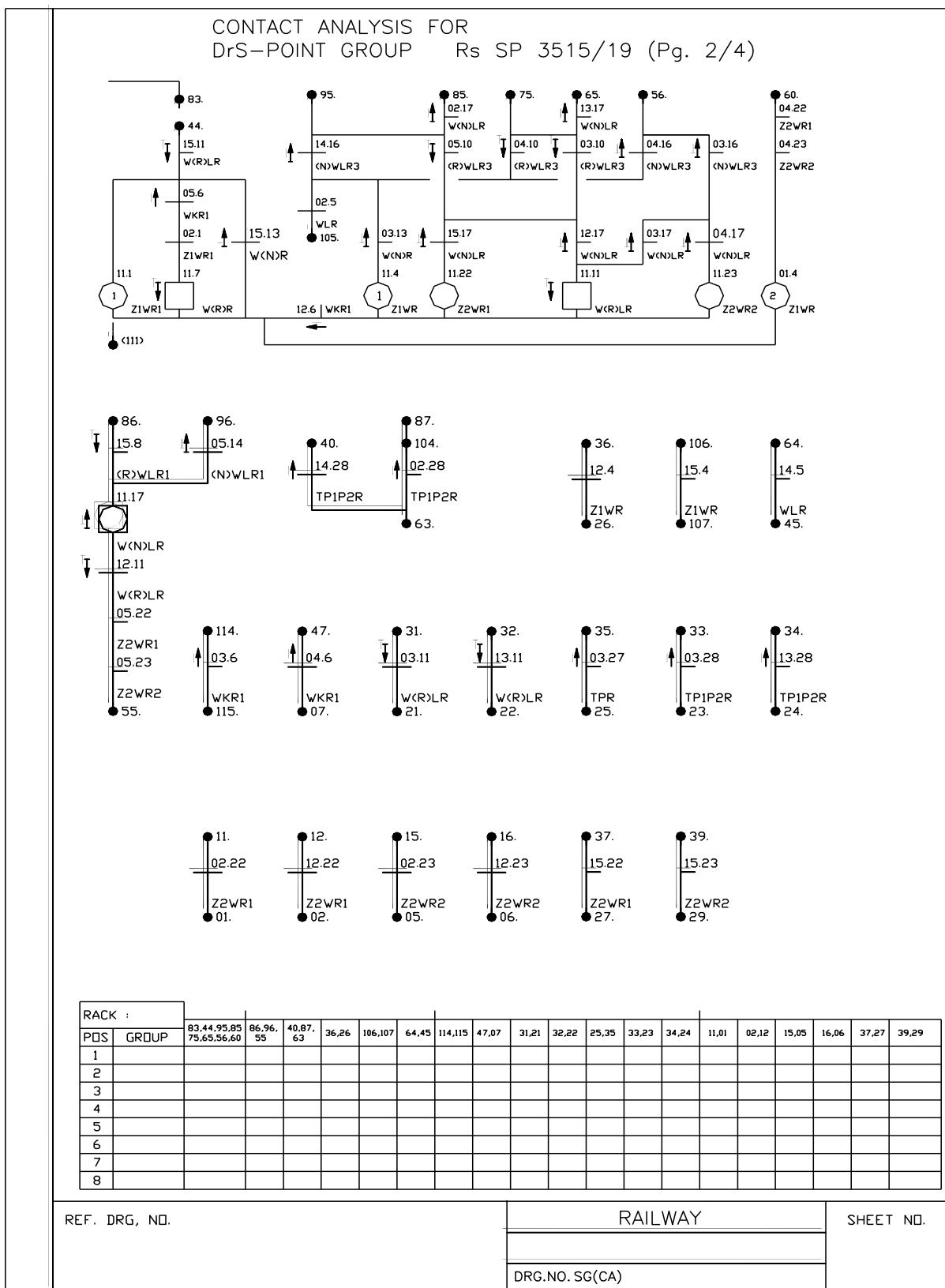
## CONTACT ANALYSIS FOR SHUNT SIGNAL GROUP (Page: 2 of 2)



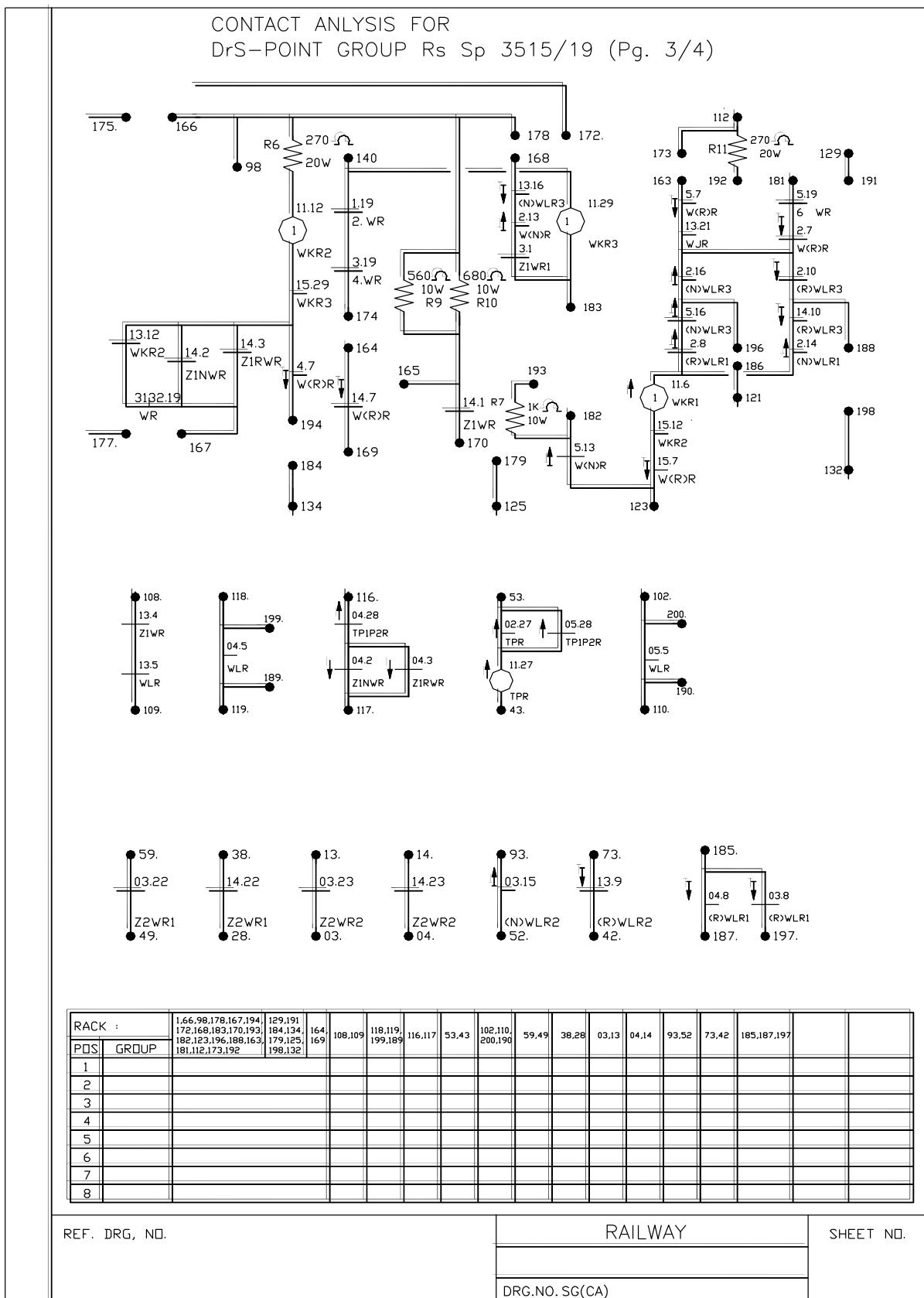
## CONTACT ANALYSIS FOR DrS POINT MAJOR GROUP (Page: 1 of 4)



## CONTACT ANALYSIS FOR DrS POINT MAJOR GROUP (Page: 2 of 4)

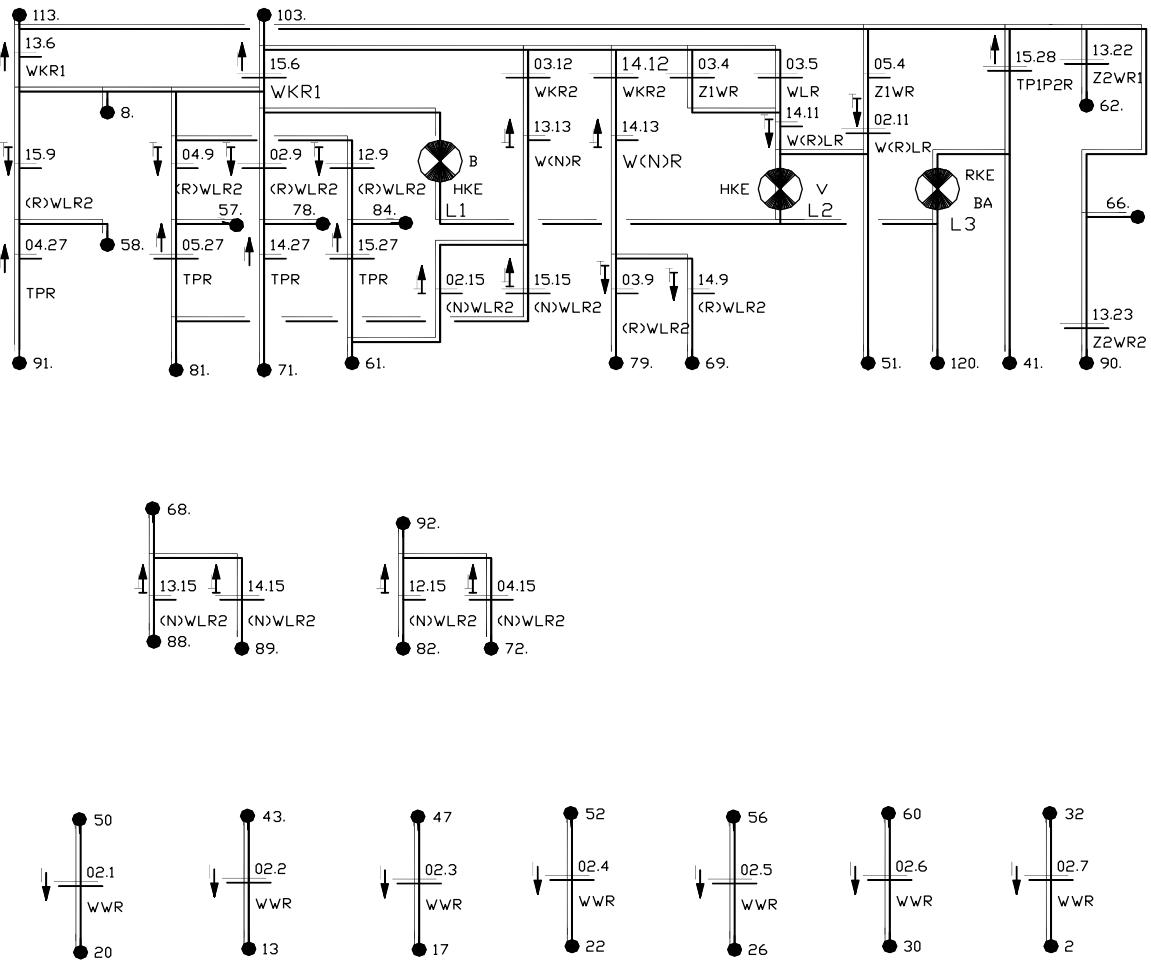


**CONTACT ANALYSIS FOR DrS POINT MAJOR GROUP (Page: 3 of 4)**



## CONTACT ANALYSIS FOR DrS POINT MAJOR GROUP (Page: 4 of 4)

CONTACT ANALYSIS FOR  
DrS-POINT GROUP Rs Sp 3515/19 (Pg. 4/4)

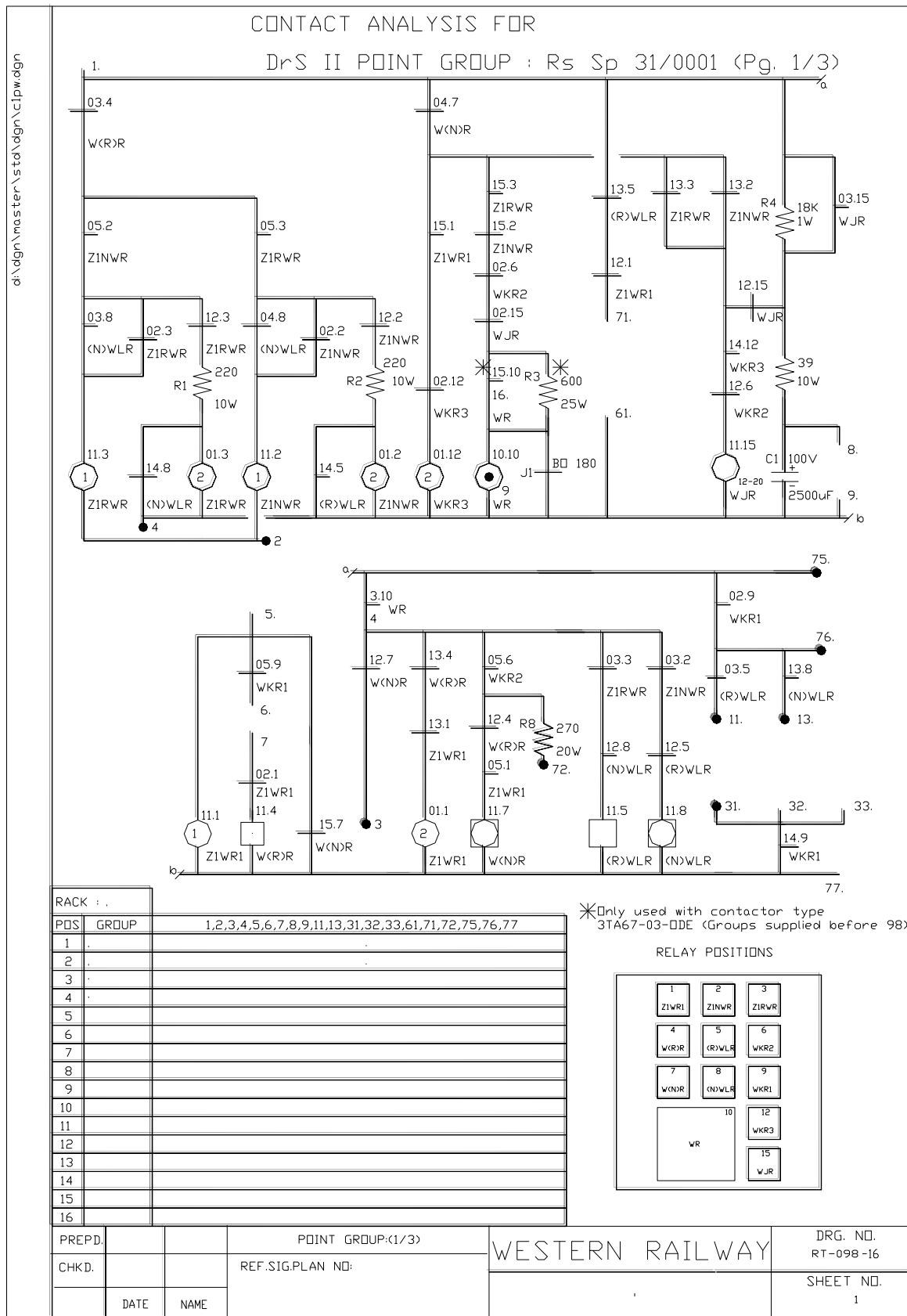


WWR CONTACTS

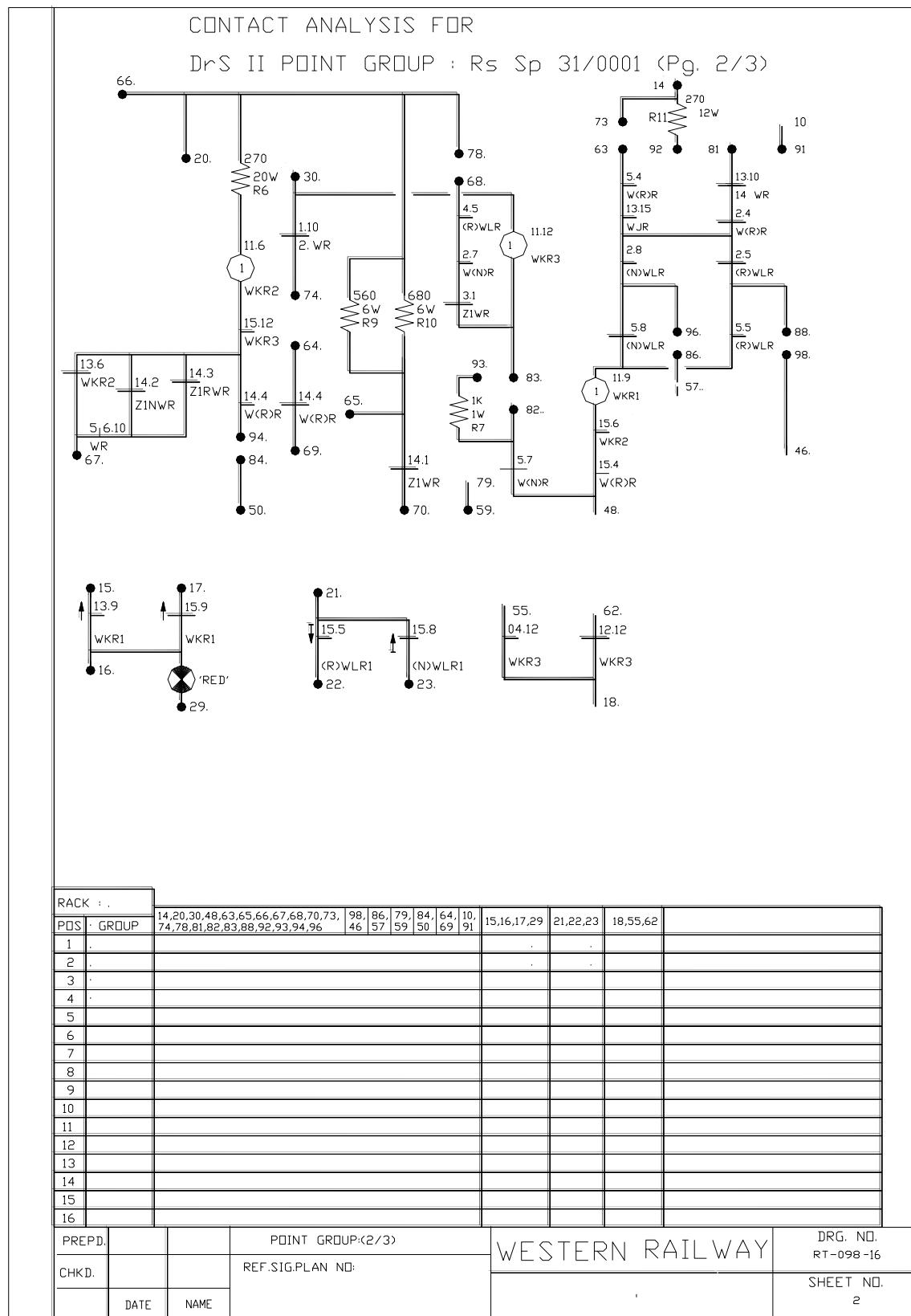
RACK :	
POS	GROUP
1	113, 91, 58, 8, 57, 61, 84, 103, 71, 78, 79, 69, 51, 120, 41, 66, 62, 90, 68, 88, 72, 92, 82, 89
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4	
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6	
7	
8	

REF. DRG. NO.	RAILWAY	SHEET NO.
		DRG.NO. SG(CA)

## CONTACT ANALYSIS FOR DrS II POINT GROUP (PI) (Page: 1 of 3)

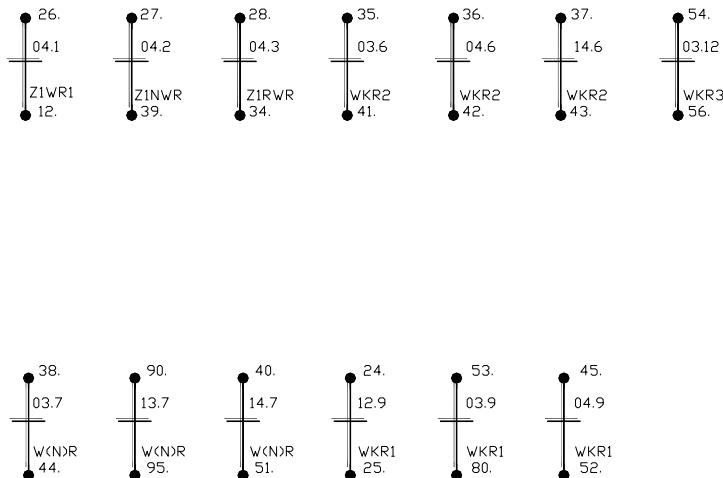


## CONTACT ANALYSIS FOR DrS II POINT GROUP(PI) (Page: 2 of 3)



**CONTACT ANALYSIS FOR DrS II POINT GROUP(PI) (Page: 3 of 3)**

CONTACT ANALYSIS FOR  
DrS II POINT GROUP : Rs Sp 31/0001 (Pg. 3/3)



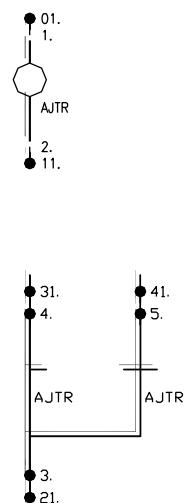
RACK :																	
POS	GROUP	26,12	27,39	28,34	35,41	36,42	37,43	54,56		38,44	90,95	40,51	24,25	53,80	45,52		
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PREPD.				POINT GROUP(3/3)				WESTERN RAILWAY				DRG. NO. RT-098-16					
CHKD.				REF.SIG.PLAN NO:								SHEET NO. 3					
		DATE	NAME														

## Contact analysis for Clock work Time Relay

CONTACT ANALYSIS FOR CLOCK WORK TIME RELAY : Rs Sp 31/0052A (Pg. 1/1)			
RACK : 11			
POS	GROUP	01,11	21,31,41
1	GP1	46	46
2	GP2	46	46
3	GP3	48	48
4	GP4	48	48
11	GP5	50	50
12	GP6	50	50
13	GP7	52	52
14	GP8	52	52
21			
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TRANSPORTATION SYSTEMS		PREPD.		
SIEMENS LTD.		CHKD.		
			DATE	NAME

INDIAN RAILWAYS		DRG. NO. RT-103
		SHEET NO.



## REVIEW QUESTIONS

**Subjective :**

- Q.1 Explain the features of Siemens Relay interlocking System?
- Q.2 Write down the special features of Siemens Relays?
- Q.3 Why Tag Blocks are used in Siemens Relay interlocking System?
- Q.4 Make a Route Section Plan for typical 4-Line station of your Railway?
- Q.5 Explain the following Relay Group
- i) 2-Aspect Signal Group.
  - ii) 3-Aspect Signal Group.
  - iii) Shunt Signal Group.

**Objective :**

**Q. a) Draw the Symbols for**

- |                   |                  |
|-------------------|------------------|
| i) GR1 _____      | IV) U(R)LR _____ |
| ii) RECR _____    | V) TPR _____     |
| iii) G(R)LR _____ | VI) WKR 1 _____  |

**Q. b) Give Nomenclature for following**

- i) UDKR \_\_\_\_\_
- ii) ZDUCR \_\_\_\_\_
- iii) U (R) S \_\_\_\_\_
- iv) EGNR \_\_\_\_\_
- v) WKR1 \_\_\_\_\_
- vi) Z1UR1 \_\_\_\_\_
- vii) ZU(N/R)R \_\_\_\_\_
- Viii) GZR \_\_\_\_\_
- ix) WKR1 \_\_\_\_\_
- x) G(R) LR \_\_\_\_\_

**Q. c) Give the Symbols for**

- i) RECR Drop contact \_\_\_\_\_ ii) W( R)LR Up contact \_\_\_\_\_
- iii) UNCR drop contact \_\_\_\_\_ iv) U( N)S up contact \_\_\_\_\_
- v) Sh GLSR drop contact \_\_\_\_\_

\* \* \*