इरिसेट IRISET

S 30

SIGNALLING DATA HAND BOOK

Indian Railways Institute of
Signal Engineering and Telecommunications
SECUNDERABAD - 500 017

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Issued in April 2010

INDIAN RAILWAYS INSTITUTE OF

SIGNAL ENGINEERING & TELECOMMUNICATIONS

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S-30
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CHAPTER 1: BASICS OF SIGNALLING ENGINEERING

1.1 OVERLAPS

Sl.No.	BLOCK OVER LAP	DESCRIPTION
1	400 Mts.	Two Aspect Signalling
2	180 Mts.	Multi Aspect Signalling

Sl.No.	SIGNAL OVERLAP	DESCRIPTION
1	180 Mts.	Two Aspect Signalling
2	120 Mts.	Multi Aspect Signalling

1.2 VISIBILITY OF SIGNALS

TWO ASPECT SIGNALLING

Sl.No.	VISIBILITY (MIN)	SIGNAL	DESCRIPTION
1	1200 Mts.	Outer	If Section Speed is 100 kmph & Above
2	800 Mts.	Outer	if section speed is less than 100 kmph
3	400 Mts.	Outer	Where Warner is Separate
4	400 Mts.	Warner	Warner On a Post By It Self
5	400 Mts.	Home Signal	----------
6	400 Mts.	M / L Starter	----------
7	200 Mts.	All Other Signals	----------

MULTI ASPECT SIGNALLING

Sl.No.	VISIBILITY (MIN)	SIGNAL	DESCRIPTION
1	400 Mts.	Distant	----------
2	200 Mts.	Inner Distant	Where Provided
3	200 Mts.	All Stop Signals	Suitable Speed Restriction if it is not Visible within 200 Mts.

1.3 ASPECT CONTROL WITH DOUBLE DISTANT

Sl.No.	DISTANT	INNER DISTANT	HOME	INDICATION
1	YY	Y	R	Stop at Home Signal
2	YY	YY	Y (With route)	Enter the Station (Loop Line) , be ready to Stop at the Starter if “ON”
3	G	YY	Y	Enter the station (Main Line), be prepared to Stop at Starter if “ON”
4	G	G	G	Run-through via Main Line

1.4 INTER-SIGNAL DISTANCES

Sl.No.	GEAR	MIN DISTANCE	FROM SIGNAL
1	Distant	1000 Mts.	Home Signal
2	Goods Warning Board	1400 Mts.	Home Signal
3	Inner Distant	1000 Mts.	Home Signal
4	Distant	1000 Mts.	Inner Distant
5	BSLB	180 Mts.	Home Signal

1.5 CLASSIFICATION OF STATIONS

CLASS `A' STATIONS: Where line clear may not be given for a train, unless the line on which it is intended to receive the train is clear for at least 400 metres beyond the Home Signal, or up to the starter.

CLASS `B' STATIONS: Where line clear may be given for a train before the line has been clear for the reception of the train within the station section.

CLASS `C' STATIONS or BLOCK HUTS: Where permission to approach may not be given for a train unless the whole of the last proceeding train has passed complete at least 400 Mts. beyond the Home Signal (IBS / IBH) and is continuing its journey. This will also include an Intermediate Block Post.

1.6 STATION SECTION

Station section is that portion of station limits, which can be used for shunting even after granting Line clear to station in Rear. It exists only for Class B Station explained below in the table.

	STATION SECTION	
At a Class `B' station provided with	**On Double Line**	**On Single Line**
Two-aspect signals	Between Home Signal and the Last Stop Signal of the Station in either direction	Between the Shunting Limit Boards or Advanced Starters (if any), Or Between the Home Signals if there are no Shunting Limit Boards or Advanced Starters, Or Between the outermost facing points, if there are no Home Signals or Shunting Limit Boards or Advanced Starters.
Multiple-aspect or modified lower quadrant signals	Between the outermost facing points and the last Stop Signal of the station in either direction, Or Between the Block Section Limit Board, where provided, and the last Stop Signal of the station in either direction	Between the Shunting Limit Boards or Advanced Starters (if any), Or Between the outermost facing points if there are no Shunting Limit Board or Advanced Starters.

1.7 ISOLATION

Isolation between	**Passenger line**	**Goods line**	**Siding**
Passenger line	Not Required if speed < 50 Kmph. Required if speed ≥ 50 Kmph	Required irrespective of speed	
Goods lines	Required irrespective of speed	Not Required if speed < 50 Kmph Required if speed ≥ 50 Kmph	Desirable
Siding		Desirable	NA
For further details refer: - Ch-VIII, Part III of “Rules for the opening of a Railway”			

1.8 STANDARDS OF INTERLOCKING

INDIAN RAILWAY SIGNAL ENGINEERING MANUAL, PART - I (1988 EDITION) ADDENDUM AND CORRIGENDUM SLIP NO. 6 (RB'S LETTER NO. 2003/SIG/SEM/3; DT. 19.05.2004, CHAPTER VII, PARA 7.131, SECTION 'M'

Sl. No.	ITEM	Important Minimum Signalling Features As Per New Revised Para 7.131			
		STD I (R)	**STD II (R)**	**STD III (R)**	**STD IV (R)**
	Permissible Speed in KMPH	**Up to 50**	**Up to 110**	**Up to 140**	**Up to 160**
1	Isolation	Y*	Y	Y	Y
2	Type of Signalling	2A/MA	2A/MA	MA	MA
3	Double Distant	N	Y**	Y	Y
4	Point Operation	Mech.	Mech. / Elec.	Mech. / Elec.	Elec.
5	Point Locking	KEY/ FPL/ HPL	FPL / PT M/C	FPL / PT M/C	CLAMP TYPE DIRECT (Desirable)
6	Point Detection	Mech. / Elec.	Mech. / Elec.	Mech. / Elec.	Elec.
7	Lock Detection	N	Y	Y	Y
8	Interlocking	KEY / Mech.	Mech. / Elec. / Electronic	Mech. / Elec./ Electronic	Elec. / Electronic
9	Track Circuiting	N	Mech. interlocking: All run through lines Elect/ Electronic: All running lines	All running lines	All running lines
10	Block Working	Token	Token / SGE	# SGE / TC	# SGE / TC
11	Preventing SPAD	N	N	N	Y (Desirable)

Legends:

* Isolation is not compulsory provided that the condition laid down in the second paragraph of the general rule 90c or 4.11 are complied with limits of speed while running through station

** Double distant on sections where goods trains have a breaking distance of more than 1 km

At CPI or high density routes means for verifying complete arrival of train by suitable means.

1.9 MINIMUM EQUIPMENT OF SIGNALS

CLASS OF STATION	MINIMUM EQUIPMENT	ADDITIONAL EQUIPMENT
A. TWO ASPECT SIGNALLING:		
'A'	Warner, Home, Starters	Or under approved special instructions an outer, Warner behind outer and starter
B - Single Line	Outer, Home	Warner if trains run through at speeds exceeding 50 kmph without stopping. Advanced starter or SLB where shunting in the face of an approaching train is required.
B - Double Line	Outer, Home and Starters	Warner if trains run through at speeds exceeding 50 kmph without stopping.
'C'	Warner, Home	-------
'D'	These are Non - Block Stations	
B. MULTIPLE ASPECT SIGNALLING:		
'B'	Distant, Home, Starters	Advanced starter or SLB on Single Line where Shunting in the face of an Approaching train is required. Starters on Double Line. Block Section Limit Board where there are no points or outermost point at the Approach end is in trailing direction on Double Line.
'C'	Distant, Home	-------
C. MODIFIED LOWER QUADRANT:		
'B'	Distant, Home, Warner below Main Home & Starters	MLQ Signalling may be used only where it is expressly sanctioned by a special order of the Railway Board
'C'	Distant & Home	

1.10 SUMMARY

Sl. No.	CLASS → SIGNALLING ↓	'A' CLASS STATION	'B' CLASS STATION	'C' CLASS STATION
1	TALQ	Warner Home Starter	S/L: Outer, Home D/L: Outer, Home, Starter (Warner below Outer for speeds more than 50 KMPH)	Warner Home
2	MLQ*	- N/A -	Distant, Home, Starter Warner below Main Home	Distant Home
3	MAUQ and MACLS	- N/A -	Distant Home Starter	Distant Home

***** To be provided only on special sanction from Railway Board

Day and night indications of the Shunting Permitted Indicator (SPI) shall be as follows:

Type	Indication when shunting is permitted in the direction to which it refers		Indication when shunting is not permitted in the direction to which it refers	
	Day Indication	Night Indication	Day Indication	Night Indication
Disc Type	Black disc with a yellow cross painted on it.	Yellow cross light	Edge of disc	No light
Light type	Yellow cross light	Yellow cross light	No light	No light

1.11 LC GATES

1.11.1 Classification of LC gates as per TVUs

Sl. No.	CLASS	CRITERIA	INTERLOCKING
1	Special class	TVU's greater than 50,000	ROB to be provided. (Gate to be interlocked till ROB is functional)
2	'A' class	TVU's between 50,000--30,000 and number of road vehicle greater than 1000	Compulsory
3	'B' class	TVU's between 30,000--20,000 and number of road vehicle greater than 750	Compulsory
	'B1'class	TVU's between 30, 000—25,000	
	'B2'class	TVU's between 25, 000—20,000	----------
4	'C' class	All other L C Gates not covered in above classes	----------
5	'D' class	For cattle crossings	----------

1.11.2 Additional information for L.C.Gates

(a) TVU- Train Vehicle Unit (No. of trains per day X No. of road vehicle units)

(b) The census shall be done once in 3 years by team consisting of Supervisors of Engg, S&T, and Traffic Dept. for 7 days generally and average per day is taken and gate is classified as shown above.

(c) If 'TVU' is more than 6000 or L.C. Gate visibility is poor –Unmanned gate is to be converted into manned gate.

(d) TVUs unit of measurement:

  (i) Train, Motor vehicle, bullock carts & Tanga – 1 unit

  (ii) Cycle rickshaw & auto rickshaw – ½ unit

(e) Visibility of manned gate – 5 Mts.

(f) Fencing parallel to the track – 15 Mts.

(g) Gate lodge –6 Mts. from center of track

(h) Speed Breakers – 20 Mts. from center of track

(i) Height gauge – 8 Mts. from center of track

(j) Gate post – 5 Mts. from center of track.

1.11.3 Types of Gates

(a) Swing Type
(b) Lifting Barrier type
(c) Movable type

L.C.Gate Range of operation is 150 Mts (when it is operated by winch & wire). Lifting barrier boom height from road surface should be maintained between 0.8 Mts. and 1 Mts.

The open position of the lifting barrier shall be with in **80 to 85 degrees** from the horizontal and the closed position shall be within **0 to 10 degrees** from the horizontal.

It shall be ensured that Boom locking is effective and it is not possible to lift the boom by more than **10 degree** from closed position.

1.11.4 Parameters of L. C. Gates

Sl. No.	DETAILS	CLASSES			
		SPECIAL CLASS	'A'	'B'	'C'
1	Normal position of gate	Open to road traffic	Open to road to traffic	Closed to road traffic	Closed to road traffic
2	If within station limit	Should be interlocked with station signals	Should be interlocked with station signals	Should be interlocked with station signals	Should be interlocked with station signals
3	If outside the station limit	Should be interlocked with gate signals	Should be interlocked with gate signals	Should be interlocked with gate signals	Should be interlocked with gate signals
4	Telephone facility If within station limit or out of station limit	Communication with station master is compulsory	Communication with station master is compulsory	Communication with station master is compulsory	Communication with station master is compulsory
5	Warning bell	Should be provided	Should be provided	Should be provided	Should be provided

1.11.5 Minimum Equipment and Additional Equipment at L.C.Gate.

Class of Station	Minimum Equipment	Additional Equipment
a. Two Aspect Signalling:		
'A' Class	Warner, Home, Starters	or under approved special instructions an Outer, Warner behind outer and starter
'B' Class SINGLE LINE	Outer, Home	Warner if trains run through at speeds exceeding 50 kmph without stopping. Advance starter or SLB where shunting in the face of an approaching train is required.
'B' Class DOUBLE LINE	Outer, Home and Starters	Warner if trains run through at speeds exceeding 50 kmph without stopping.
'C' Class	Warner, Home	----------
'D' Class	(These are Non- Block stations)	----------
b. Multiple aspect signaling:		
'B' Class	Distant, Home, Starters	Advanced starter or SLB on single line where shunting in the face of an approaching train is required. Starters on double line. Block section limit board where there are no points or outermost point at the approach end is in trailing direction on double line.
'C' Class	Distant, Home	----------
c. Modified lower quadrant:		
'B' Class	Distant, home, Warner below main home & starters	MLQ signaling may be used only where it is expressly sanctioned by a special order of the Rail way board
'C' Class	Distant & Home	----------

1.11.6 Parts of Lifting Barrier gate

1	Parts of lifting barrier type	1) Boom sizes 10m or 8m or 6m or 4m 2) Clamp 'A' 3) Drum Roller 4) Trunnion Bracket 5) Roller path 6) Stop on trunnion Bracket 7) Rim on drum 8) Drum wheel 9) Auxiliary weight 10) Pedestal 11) Link assembly for bell 12) Tie rod 13) Stop post
2	Parts of the winch	1) Pinion – 'A; 2) Pinion – 'B' 3) Locking wheel 4) Gear 5) Handle
3	Safety checking in LC gate	1) Boom lock 2) Drum lock 3) Winch Lock
4	Periodicity of checking of LC gate accessories with wire rope and winch once in a	Week
5	Periodicity of checking wire ropes inside the pipes should be pulled out once in a	Week
6	Periodicity of checking winch and economizer locks once in	Week
7	Periodicity of checking Drum locking and Boom locking once in a	Week

1.12 SIDINGS

Siding to be provided	Purpose	If the Gradient is Steeper than
Slip Siding	To Protect Block section	1:100 falling away from the station
Catch Siding	To Protect Station Section	1:80 falling towards the station

CHAPTER 2: SIGNALLING GENERAL

2.1 DESCRIPTION

Sl. No	DESCRIPTION	Details
1.	Periodicity of foot plate inspection: For JE/SE For SE/SSE (In charge)	Once in a month Once in a 3 months
2.	Allowed gauge tolerances on straight line (BG)	1676 ± 3 mm
3.	Maximum permissible speed on A route	130 to 160 kmph
4.	Maximum permissible speed on B route	Above 100 to 130 kmph
5.	Maximum permitted gradient in station yard	1 in 400
6.	Recommended gradient	1 in 1200
7.	If gradient steeper than 1 in 80 falling towards the station	Catch siding should be provided
8.	If gradient steeper than 1 in 100 falling away from the station	Slip siding should be provided
9.	Maximum super elevation permitted in BG	165 mm
10.	Maximum super elevation permitted in MG	100 mm
11.	SWR must be read in conjunction with	G&SR, BWM
12.	SWR Revision	3 Years or after 3 corrections
13.	Signalling plan (IP) prepare on the basis of	Engineering plan
14.	The clearance between bottom of the rail and top of leading stretcher bar under the S/rail	1.5 to 3 mm
15.	Minimum distance between centre to centre of track in BG	4.25 Mts. Existing 5.3 Mts. For new works
16.	Minimum clearance of check rail at level crossing	51 mm
17.	Minimum depth of space for wheel flange from rail level	38 mm
18.	Currency of green notice (for N I)	3 months
19.	Clear Standing Length (CSL/ CSR)	Existing 686 Mts. New 715 Mts.
20.	CCRS head quarters	Lucknow
21.	Currency of CRS sanction	12 months
22.	Validity of competency certificate issued by zonal training school	3 years

Sl. No	DESCRIPTION	Details
23.	Period of over hauling for inter locking frames	Once in three years
24.	Resumption of normal working of lever frame with more than 20 working levers	ASTE/DSTE
25.	Maximum permitted earth resistance	10 ohms
26.	Token census to be carried out	Once in Six months
27.	Period of over hauling for SGE block instrument	Once in seven years
28.	Period of over hauling for S/L token block instrument	Once in ten years
29.	Signal sighting committee.	SE/SSE – Signal, Loco & TI
30.	Opening of tongue rail in B.G	113 – 115 mm
31.	Signalling plan is approved by	C.S.T.E or CSE
32.	Disconnection for testing of point for obstruction test	Not required
33.	Period of Over hauling of lock bar clips	Once in a year
34.	Approach locking, back locking, indication locking should be tested	Once in three years
35.	Point testing to be carried out.	Once in a month by J.E/S.E
36.	Signal posts, lever frames to be painted	Once in three years

Note *:- The ladder of signal post to be blanked off (Strapping with sheet metal around ladder) at the height above the rail level from 2060 mm to 2360 mm when ladder is at 2360 mm from the nearest center line of the track.*

2.2 Approvals and Checking

Sl. No.	Description	By Whom
1.	Signalling Plans (IP), Locking Tables (LT) and Selection Tables	Approved by CSTE (OR) CSE
2.	Locking chart (Dog Chart) Prepared on the Basis of approved Locking Table.	Above 50 levers: As item 1 above Upto 50 levers – checked in full by ASTE Approved by: DSTE/SSTE
3.	Typical wiring diagrams such as inter-cabin Slotting, Auto signalling, Track Circuit, Indication circuit etc.	Checked in full by: ASTE and SSTE Approved by: Dy CSTE
4.	Detailed wiring diagrams for individual stations Prepared on the basis of approved Typical wiring diagrams.	Checked in full by: ASTE Checked and approved by Wiring diagrams DSTE/SSTE
5.	Typical circuit diagrams for various circuits Such as route locking, approach locking, Sectional route release, point and Signal control, lamp proving circuits, relay interlocking Circuits etc.	Checked in full by: DSTE/SSTE and Dy. CSTE Approved by : CSTE
6.	Detailed circuit and wiring diagram based on Typical diagram including those submitted by contractors and Firms.	Checked in full by: DSTE/SSTE and Approved by: Dy.CSTE/Sr.DSTE (Authorized by) CSTE
7.	Signal Sighting committee report	To be submitted after jointly inspected and signed by SSE/SE(S), Loco inspector and Traffic inspector (Optg.) and then only bring the signal(s) or installation into use.
8.	Type of Block Working	Approved by CRS
9.	Type of Block Instruments	Approved by RDSO

2.3 Trolleys – Lorries

Sl. No.	DESCRIPTION	Details
1	Maximum number of persons allowed to travel on a p/trolley	10
2	Maximum number of persons allowed to travel on a motor trolley with 4 HP motor	7
3	Maximum number of persons allowed to travel on a motor trolley with 6 HP motor	10
4	Min. no of persons to travel on a motor trolley	4
5	Trolley / Motor trolley competency certificate is valid for	One year
6	Protection of lorry in single line when stopped in mid section for unloading	By placing one banner flag at 600 Mts. on both sides and three detonators at 1200 Mts. from the place of obstruction.

2.4 Tongue Rail Wear and Tear

Sl. No.	VERTICAL WEAR	LATERAL WEAR
1	8 mm for 60 Kg	8 mm for 60 Kg
2	5 mm for 52 Kg & 90 R	6 mm for 52 Kg & 90 R
3	3 mm for 75 R & 60 R	5 mm for 75 R & 60 R

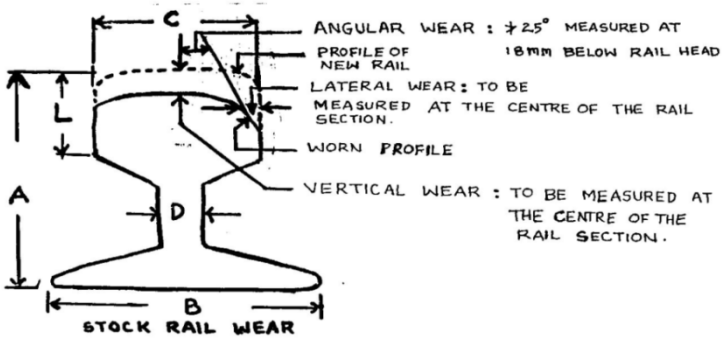


Fig No: 2.1

Rail Section	A	B	C	D	L
52 KG's	156	136	67	15.5	38.82
60 KG's	172	150	74.3	16.5	37.5
90 R	112.83	136.5	66.68	13.89	32.53
75 LBs	128.59	122.24	61.91	13.10	29.37
60 LBs	114.30	109.59	57.15	11.10	-

2.5

Revised Codal life of assets As per Advance correction slip. No. 62 (of Indian Railway Finance Code Vol-1 para 219) dated 24.5.06

2.5.1 SIGNALLING SYSTEM

Sl. No	CLASS OF ASSETS	ROUTES	AVERAGE LIFE IN YEARS
1.	Electrical/ Mechanical Signalling System	Route- A Route-/ Suburban Section Big yards on all routes	25 Years.
		Routes-B Routes-D Routes-D- "special"	25 to 28 Years depending Upon location & condition
		Routes-'E' Routes-'E'-'special'	30 Years
2	Electronic signaling system like SSI, Axle counter, AWS,AFTC,IPS etc.,		15 years or based on Obsolescence.

2.5.2 TELECOMMUNICATION EQUIPMENT

Sl. No	CLASS OF ASSETS	AVERAGE LIFE IN YEARS
1	Microwave Equipments	12-15 Years
2	Exchange & accessories including Telephone equipment	12-15 Years
3	Under Ground Cables	Quad-20 Years
		OFC -20 Years
4	Overhead alignment	25 Years
5	All other electronic /wireless items including OFC equipment	12-15 Years
6	Cell Phones	5-8 Years
7	FAX	10 Years
8	Walkie –Talkie Sets/VHF	5-8 Years
9	Datacomm. Equipment, Routers, Modems, PCs etc.	5-8 Years

2.5.3 COMPUTER AND OTHER IT SYSTEM

S.NO	Class of assets	Average life in years
1	Passive Networking equipment (viz .Network Cabling)	10
2	Larger Multiuser system (s) & Active Networking Equipment viz. mis systems including external storage systems and their inter connects)	6
3	PRS systems	4
4	Small Multi-user system (s) and Power Supply equipments viz. Individual office LANs, UPS)	4
5	PCs	3
6	Secondary Systems (viz. Painters, Portable computers, Dumb Terminals)	3

2.5.4 SIGNALLING EQUIPMENTS

S. NO	Class of assets	Life in terms of operations	Average life in years				
			Routes				
			A	B	C/ Sub	D & D spl'	E & E 'spl'
1	Cranks and compensators	50,000	2	2	1	4	4
2	Lock Bars Clips	1,00,000	3	3	3	5	7
3	FPL with bolt detection	3,00,000	8	8	8	15	15
4	Mechanical Detector	5,00,000	-	15	-	20	25
5	Circuit breakers	5,00,000	15	15	15	25	30
	Lever locks	-	7	7	7	12	15
6	EKT	-	10	10	10	15	15
7	SM's Slide frame	-	30	30	30	30	30
8	EPD & Reversors	-	15	15	15	20	20
9	Signal Machines	1,50,000	-	10	-	20	20
10	Signal wire Transmission	-	3	3	3	3	3
11	Point Machine	3,00,000	12	12	7	15	15
12	Plug in and shelf type relays	10,00,000	25	28	25	28	30
13	Track feed battery charger	-	10	10	10	10	10
14	Signal Transformers, Transformer.	-	12	12	12	12	12
	Battery chargers, DG Sets, inverters	-	10	10	10	10	10
15	Batteries		4	4	4	4	4
16	Block instruments	-	25	25	25	25	25
17	Cable	-	20	20	20	20	20
18	Block instruments Electromechanical		20	20	20	20	20

2.5.5 CIVIL ENGINEERING ASSESTS RAIL & FASTENTINGS etc

S.NO	CLASS OF ASSESTS	AVERAGE LIFE IN YEARS			
		ROUTES			
		A &B	C(Sub)	D	E
1.	Rails	20	15	30	30
2.	Wooden sleepers	10	10	10	10
3.	Metal sleepers(Cast iron& steel)	20	20	20	20
4.	Fittings steel trough	10	10	10	10
5.	Concrete sleepers	35	35	40	40
6.	Elastic Rail clips	5-8	5-8	8-10	8-10
7.	Rubber Pads/Liners	2-4	2-4	4	4-6
8.	Switches	4	2/3	5	5
9.	Crossings	5	4/5	8	8

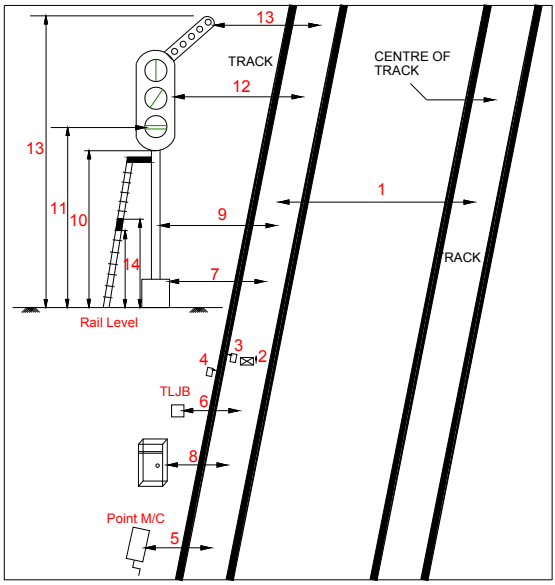


Fig No: 2.2

Sl. No	ITEM
1	Minimum distance centre to centre line of adjacent track is 5.3 m
2	Maximum height of equipment provided between the rails of the track is 64 mm above the rail level.
3, 4	For a distance of 229 mm outside and 140 mm inside the gauge faces of the rail, no gear or track fittings must project above rail level except such parts as are required to be actuated by the wheels or wing rails
5	Point machine/ electrical point detector should be provided at a Min. distance of 1.6 m from nearest c/L of track.
6	TLJB should be provided at a Min. distance of 1905 mm from nearest C/L of track.
7	If the edge of a signal foundation height is within 305 mm from above the rail level, then it should be at a Min. distance 1905 mm from nearest C/L of track.
8	Location Box should be provided at a Min. distance 2360mm from nearest C/L of track.
9	Signal post should be provided at a Min. distance 2360mm from nearest C/L of track
10	Minimum height of signal post should be 3355 mm from above the rail level (if the post is within 2360 mm from nearest Centre Line of track)
11	Red aspect of a signal should be at a height 3.65 m from above the rail level.
12	If a signal's post is at a distance 2360mm from nearest C/L of track and if its height is 3355mm above the rail level then the Signal unit should be at a Min. distance 2135mm from nearest C/L of the track
13	Route indicator of a signal (i) if it is at a height about 4420mm to 4610 mm above rail level then it should be at a Min. distance 2135 to 1980 mm from the nearest C/L of the track. (ii) if it is at a height about 4610mm to 6250 mm above rail level ,then it should be at a Min. distance 1600 mm from the nearest C/L of the track.
14	*If a Ladder of signal erected at a distance with in 2360 mm from C/L of adjacent track then it should be blanked off (strap around by a sheet around ladder) to a height* of 300mm between 2060mm and 2360mm above rail level.

Note : The distances from the gauge fare would be less by 1672 ÷ 2 = 83 cm

2.6 A tongue rail is classified as worn out when-

(a) Chipped/cracked over small lengths totaling to 200 mm within 1000 mm from the toe. Chipped length is the portion where tongue rail has worn out for a depth of more than 10mm over a continuous length of 10mm.
(b) Developed a knife edged tip — thickness of tip less than 2mm over a length of more than 100mm anywhere up to a distance of 1000mm from its toe.
(c) Badly twisted and does not house properly and cause a gap of more than 5mm at the toe.
(d) Vertical wear which is measured at a point where tongue and stock rails are at the same level. Vertical wear allowed is 8mm for 60 kg. Lateral wear is 8 mm for 60kg.
(e) Burred stock rail to be replaced.
(f) Tongue rails should bear evenly on all the slide chairs.
(g) All sleepers should be packed properly.
(h) When the tongue rail is in closed position, it must bear evenly against distance studs or blocks.
(i) Wear on switches can be reduced by lubrication of the gauge face of the tongue rail.
(j) On wooden sleeper layout assembly, the slide chairs should be fixed to the timbers by plate screws. Round spikes not to be used for this purpose.

2.7 Ensure the Following While Checking the Engg. Plan

(a) 1 in 8 1/2 turn-outs should not be laid on the inside of curves
(b) Turn-outs/Crossovers should not be proposed on girder bridge and LC gates
(c) Avoid diamond crossings, single slips and double slips. There should be adequate space between two points taking off in opposite direction (One lock bar length or 5 meter in case of electric operation of points)
(d) Level Crossing to be avoided in the overlaps
(e) Specific zonal rules/practices as applicable (e.g. in some railways, provisions of trap is Not accepted as means of isolation on passenger lines)
(f) There should be no change of gradient within 30 m in case of BG and within 15 m in case of MG of the point.
(g) Permissible station gradient should extend up to 45 m beyond outer most point
(h) If proposed lines are passing nearby existing electrical mast, flood light mast or any other permanent structure, clear distance from face of structure to the nearest track may be marked
(i) For passenger lines, 1 in 12 turnouts or less steeper turnout should be used. However, I in 8 1/2 turnouts with curved switches may be proposed.

2.8 Information to be recorded in Signalling Plan

(a) Standard of interlocking and class of station,
(b) Holding capacity of all running lines and sidings.
(c) Direction of reception and dispatch on running lines and description of sidings,
(d) Restriction on dead-end sidings (e.g. no stabling) if any.
(e) All gradients within the station limits and up to 2.5 kilometers in rear of first stop signal,
(f) Kilometer and class of level crossings within the station limits, whether interlocked or not,
(g) Type of Block Working with adjacent station and location of block Instruments,
(h) Up and Down directions and names of important junctions on either side.
(i) Reference to condonation of gradient infringements, CRS dispensation for deviations from General Rules/Signal Engineering Manual, if any.

(j) Reference to approved Engineering plan on which the signalling plan is based.
(k) Note regarding telephone communication provided between A. S. M./ Cabin man and level crossings within and outside station limits.
(l) Aspect sequence chart for colour light signals.
(m) Whether turnout is 1 in 8-1/2 or 1 in 12 or 1 in 16 etc.
(n) Details of Detection Table etc., which are not apparent in the plan.
(o) Details of Track Circuits/Axle Counter/Treadles.
(p) Intestinal distances and distance between Warning Boards and Signals.
(q) Details of open bridges.
(r) Location of water column, ash pit/tray.
(s) Signal overlap in big yards.
(t) Custody of spare keys.
(u) Date of commissioning the installation.

2.9 Measurement and Reading – Track and Vehicle

(a) **Track Readings at Accident Site**

(i) Gauge should be checked at the following locations in case of points and crossings.

- 305 mm (1 foot) in advance of nose of tongue rail.
- 152 mm inside nose of tongue rail for straight and turn out.
- At middle of tongue rail for straight & turnout.
- At heel of tongue rail for straight & turnout.

Note: *Gauge should be correct at all locations except at toe. At toe, for PSC layouts up to 3 mm tight gauge is allowed.*

(ii) Gauge at Crossings
- 610 (2 feet) in advance of nose of crossing on straight & T/Out
- 152 mm behind the nose of crossing on straight & T/Out
- 76 mm behind the nose of crossing on straight & T/Out.

The gauge should be correct.

(iii) Check rail (Wing Rail) Clearance on Crossings:
BG 44 to 48 mm
MG 41 to 44 mm

Ensure checkrail clearance should be between the values mentioned above.

(iv) Measure vertical wear of stock and tongue rails.
Maximum permissible vertical wear on wing rails or nose of crossings: 10mm

Rail	Section	BG	MG
S/Rail (wing rail also)	60Kg	13 mm	---
	52 Kg	8 mm	---
	90 R	5 mm	6 mm
	75 lbs	---	4.55 mm
	60 lbs	---	3.0 mm
T/Rail 1	60 Kg.	8 mm	---
2	52 Kg/90R	5 mm	---
3	75 R/60R	3 mm	---

(v) Measure Lateral Wear of stock and Tongue Rail

S/Rail	8 mm /10 mm max	for A, B / Other routes in straight line
	6 mm / 8 mm max	for A, B / Other route in curve
T/Rail	60Kg - 8 mm max	-----
	52Kg / 90R - 6 mm max	-----
	75R / 60R -5 mm max	-----

Measure both wears on T/rail at a point with 13 mm head width and at the point where T/Rail and S/Rail are at the same level

(vi) Check for angular wear of Stock Rail

(vii) Check for clipping of T/Rail within 100 mm (1Mtr) from toe

(viii) Check for knife-edge of T/Rail within 1 m from toe. If the thickness of the T/Rail in less than 2 mm continuous for 100 mm (10 Cms) anywhere within 1 meter from ATS then it is knife edged.

(ix) Measure track readings (Gauge, Cross level, Versine etc) jointly.

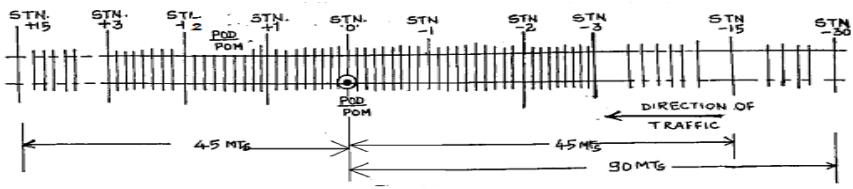


Fig No : 2.3

- Identify and mark Point of Drop (POD)/Point of Mount (POM) as Station 'O'. In case both POD/POM are available then take which ever is first to come (moving in the direction of the train) as Station. 'O'

- Mark 15 Stations 3m apart in rear of POM/POD up to 45 Mts. Station ahead are marked +1, +2 etc, and rear are marked –1, -2, etc.

Note: *In case of any doubt of POM/POD, mark another 15 stations in rear from the suspected POD/POM at 3 Mts. up to 90 Mts. I.e. total 30 stations in rear because clues for the cause of the accident are available mostly in rear portion.*

- Take the reading at every sleeper up to 3 stations (i.e. up to 9 Mts.) on both sides of POD/POM.

Measure the gauge, cross-level and versine jointly

- The versine difference between the std value and the recorded value at every point shall not be more than $\pm$ 4 mm.

- The difference between any two recorded values shall not be more than $\pm$ 3 mm

If the versine difference is not within the limits of ± 4 mm between std value and any recorded value and/or within ± 3 mm between any two reading then the track curvature is defective.

Note: *A crossover point is a track in curvature, but without any super elevation. Hence all the parameters need to be maintained correctly.*

Track Twist: It is an important parameter having crucial impact on safety.

The rate of change of cross-levels is called 'twist'. Cross-level means difference of level of rails. Cross-levels are measured on left rail as seen in the direction of train involved in derailment.

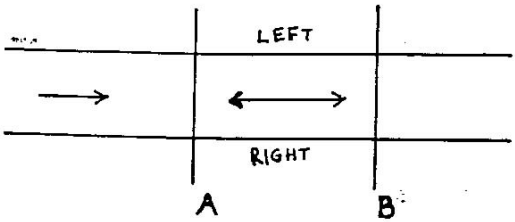


Fig No : 2.4

$$\text{Track Twist} = \frac{\text{Algebraic difference of Cross Level at A \& B in}}{\text{Distance between A \& B}}$$

Ex: Cross level at 'A' = +5 mm (Left rail is higher than right rail by 5 mm)
Cross level at 'B' = -7 mm (Left rail is lower than right rail by 7 mm)

If the distance between A & B is 3 Mts. then

$$\text{Track Twist} = \frac{(+5) - (-7)}{3} = 12/3 = 4 \text{ mm / Mts.}$$

Permitted Cross Level Difference (Twist)

For a new track, cross level difference permitted is 1 in 720

A vehicle with defective spring gear travelling on a track with twist is an invitation to derailment. In cases of improper loading, the chances are further increased.

Draw a Sketch of the Accident Site and note

- Make the exact position where engine & vehicles came to rest.
- Prepare a diagram of the Engine and all the vehicles with reference to track indicating the position of derailed vehicles etc.
- Exact position where loose components of vehicles and track are found.
- Whether Engg. staff were on work
- POM/POD, damage to sleepers, rails and other track fastenings.

- Position of wheels in relation to displaced rails in normal alignment.
- Condition of track at least ½ a mile in rear.
- The condition of signals, points, L/Bars, Levers/Knobs and their relevant indications, SM slides, position of Block Instrument etc.
- Whether any S & T Staff working
- Check the records, register, PN books etc. Seize the order books, if required.
- In case of shunting operation whether proper locking & clamping of points done or not.

(b) <u>Carriage and Wagon</u>

Variation in wheel diameter within the wheels of same axle shall not be more than 0.5 mm for both goods and coaching stocks

- Difference of wheel diameter between wheels of same axle - within 0.5mm
- Difference of wheel diameter between wheels of two adjacent axles of the same trolley

  Goods: within 13mm Coaching: within 5mm
- Difference of wheel diameter between wheels of different trolleys of a bogie:
- Goods: within 25 mm Coaching: within 13mm

Due to difference in wheel diameter, there will be angular motion of the wheels. Wheel with lesser diameter will have tendency to mount over rails and derail whereas wheel with more diameter will cause increased wear and tear.

Sharp Flange

- Flange of the wheel some times wears to form a knife edge which becomes unsafe when radius of the flange at the tip is less than 5mm
- A wheel with sharp flange has biting action particularly while negotiating curves.
- Sharp flange may split open a slightly gaping point.
- While travelling in facing direction it may even mount the tongue rail.
- Rejection limit for flange tip radius is less than 5 mm for BG/MG

Thin Flange

- Flange becomes thin by wear and tear of the tyre and flange and is considered unsafe when it becomes less than 16 mm.
- This increases clearance between wheel flange and rail, which in turn increases the derailment proneness.

- Oscillations increase due to greater play between wheel set and track resulting in greater instability of the vehicles

- Rejection limit is 16mm BG/MG measured at 13 mm from the flange tip.

- It also damages tongue rails due to more play.

Flat Tyre /Skidded wheel

It may occur due to continuous brake binding, skidding, brake block tilting and jamming against the tyre.

- Flat tyres cause passenger discomfort and may become unsafe.

- Flat tyre causes greater hammering action on the rail and rail fractures may take place.

Deep Flange

- Deep Flange may hit track fittings like fishplate joints, lock bars, point and distance blocks.
- A deep flange tends to ride on fishplate and distance or check blocks and damage the track, particularly if there is vertical wear on railhead.

- Rejection limit in depth of flange greater than 35mm (BG), 32mm (MG) measured at 63.5 for BG and 57 mm for MG away from back of wheel.

False Flange/Hollow Tyre

- Excessively worn-out tyre on tread is a hollow tyre. Hollow tyres develop a false flange. The false flange formed may force open the switches when the vehicle runs in the trailing direction on points and crossing.

- False flange can be dangerous at the wings of crossing as it may ride over the wing rail, lifting the wheels and creating conditions favourable to derailment.

- If the hollowness is more then it results in difference in wheel diameter and the
wheel may ride over the rails.

CHAPTER 3: SIGNALLING IN 25 KV AC ELECTRIFIED SECTION

3.1 STRAY VOLTAGES & CURRENTS - MAX. LIMITS

Stray voltage on track	=	Max.100 mV.
Stray current for track circuit less than 100m	=	Max. 10 mA
Stray current for track circuit more than 100m	=	Max. 100 mA

3.2 Modification required in case of DC Track Circuit

(a) Only single rail (one rail common for traction return current)

(b) Track relay should be AC immunized.

(c) B type chokes at feed-end.

(d) Surge arrestors at feed-end and at relay end.

(e) Longitudinal bonds for rail continuity

(f) Cross bonding at every100m between un-insulated rails.

(g) Transverse /short bonds at ends of each track circuits.

(h) Only 09 ohms track relay should be used in AC RE area.

Sl. No.	Section	Max. Length	Relay
1.	Wooden sleepers in block section	450 Mts.	QT 9 ohms AC immune or shelf type 9 Ohms AC immune
2.	Wooden sleepers in station section	450 Mts.	----Do--------
3.	PSC sleepers in block section	450 Mts.	----Do--------
4.	PSC sleepers in station section	350 Mts.	----Do--------
5.	PSC sleepers in station section	750 Mts.	QBAT with choke at relay end

3.3 OVER HEAD EQUIPMENT

OHE Height of contact wire		Regulated OHE	5.55 Mts.
		Un-regulated OHE	5.75 Mts.
		Under bridges	4.65 Mts.
Distance between RE masts		On straight track	72 Mts.
Staggering of contact wire		On straight track	200 mm
		On curves	300 mm
Description		**Stationary**	**Moving**
Clearances between any live part of OHE and part of any fixed structure	Vertical	320 mm	270 mm
	Lateral	320 mm	220 mm
Normal implantation of RE mast		For the centre line of nearest track	2.5 Mts.
The nearest part of the signal post from the centre of track		For a signal with horizontal route	2.844 Mts.
The distance between the signal and the mast in front of it.			Min.: 30 Mts.
The distance between the signal and the mast just in advance of signal			Min.: 10 Mts.
OHE Height of contact wire		Regulated OHE	5.55 Mts.
		Un-regulated OHE	5.75 Mts.
		Under bridges	4.65 Mts.
Distance between RE masts		On straight track	72 Mts.
Staggering of contact wire		On straight track	200 mm
		On curves	300 mm
Description		**Stationary**	**Moving**
Clearances between any live part of OHE and part of any fixed structure	Vertical	320 mm	270 mm
	Lateral	320 mm	220 mm
Normal implantation of RE mast		For the centre line of nearest track	2.5 Mts.
The nearest part of the signal post from the centre of track		For a signal with horizontal route	2.844 Mts.
The distance between the signal and the mast in front of it.			Min.: 30 Mts.
The distance between the signal and the mast just in advance of signal			Min.: 10 Mts.

3.4 Direct Feeding of Signals with unscreened cable

Direct Feeding	Single Line	Double Line
By using 110 V	180 Mts.	220 Mts
By using 300 V (These feeding ckts are not to be used for Future installations as per Rly Bd instructions.)	440 Mts	605 Mts

To control the signals beyond direct feeding range two methods are in use.
(a) Local Feed (b) Remote Feed

3.4.1 Length of DC circuits – Line Relays with Unscreened cable shall be restricted as given below.

Sl.No	Relay	AC Immunity Level in volts	Maximum permissible length	
			Single Line	Double Line
1.	Shelf Type AC Immunized	750	2.1 KM	2.8 KM
2.	QNA1	1000	2.1 KM	2.8 KM
3.	K-50 (B-1)	170	1.0 KM	1.2 KM
4.	K-50	130	750 Mts.	900 Mts.
Ref:- SEM correction slip No.5 dated 30.1.2007				

3.4.2 Maximum Permissible length of direct feed of Point Machine from Point Contactor unit

Sl. No	Type of Point Machine	AC Immunity Value (Volts)	Maximum permissible separation (metres) between Point Contractor and Point Machine on	
			Single Track	Double Track
1.	GRS – 5E	90	515	630
2.	IRS.24	160	910	1100
3.	Siemen's IA	160	910	1100
4.	Siemen's IB	300	1650	2100
5.	Siemen's IC	400	2200	2800

RDSO specification No.S24/90 - for Electrical Point Machine non-trailable type, specifies the A.C. immunity level of Electrical Point Machine shall not be less than 160 V at 50 Hz.

3.5 UPGRADATION OF EXISTING SYSTEM

The final Revised Design norms are given below

Sl. No.	Description	Details
1.	Centenary Current	800 Amps on Single Line, short circuit current 6000 Amps 1000 Amps on Double Line, short circuit current 8000 Amps
2.	Soil Resistivity	1500 Ohm. Meters.
3.	Rail Impedance	0.701 Single Line (when both lines are available for traction return current) 0.561 Double Line (when all the four lines are available for traction return current).
4.	Rail Reduction Factor	0.3926 Single Line (when both the rails are available for traction return current) 0.2666 Double Line (when all the four rails are available for traction return current)
5.	Track Cable Separation	8 Mts. - Single line (when both the rails are available for traction return current) 9 Mts - Double line (when all the four rails are available for traction return current).
6.	New screening factor	0.91
7.	Unscreened Cable with armor earthed	The Induced Voltage under the above parameters, has been calculated as 95 V/KM for Double Line 116V/KM for Single Line
8.	Safe handling voltage	400 V
9.	Factor of safety	1.5
10.	Induced voltages	Double line 95 V/KM Single line 116 V/KM
11.	Max. Length of parallelism of circuits	Double line 2.8 KM Single line 2.1 KM
12.	Max. Range of direct feeding of signals	Double line 220 Mts. Single line 180 Mts.

CHAPTER 4: POWER SUPPLY FOR SIGNALLING

4.1 Description of Power Supply Arrangements

S No	Description	Values
1	Fully charged lead acid cell voltage	2.2 Volts.
2	Discharged lead acid cell voltage	1.85 Volts.
3	Specific gravity of a charged lead acid cell	1220 $\pm$5
4	Specific gravity of a discharged lead acid cell	1180 $\pm$5
5	Electrolyte used in lead acid cell Electrodes	Dilute Sulphuric Acid PbO_2 is + ve Sponge Pb is - ve
6	AC to DC converter	Rectifier
7	DC to AC converter	Inverter
8	IRS Specification no. of a battery charger	IRS-S-86/2000 AMDT- NO 4
9	In put voltage range of a battery charger	160 –270 V AC
10	Initial Charging Voltage, Current	2.7 V/cell at I = 4% of Capacity
11	Float charging voltage, current	2.12 - 2.3 V /cell,
12	Boost charging voltage , Current	2.4 V / cell at I = 10% of Capacity
13	Capacity of cell	$\frac{\text{Load current X back up time}}{\text{Depth of discharge permitted.}}$
14	Discharging current	C/10 (C = Capacity of the cell)
15	Current rating of a charger	Load current +AH Capacity of the cell/10
16	Input voltage range of FRVS	160 -270 Volts
17	FRVS output voltage	230 $\pm$1% Volts AC
18	Specification of IPS	RDSO/SPN/ 165/ 2004
19	Input voltage range of SMR	160 – 270 Volts AC
20	SMPS output voltage	110 V DC
21	CVT input voltage	160 – 270 V AC
22	CVT output voltage	230 V AC
23	Input voltage of DC - DC converter in IPS	110V DC
24	Resistance of earth	< 10 Ω

CHAPTER 5: COLOUR LIGHT & AUTOMATIC SIGNALLING

5.1 PARAMETERS COLOUR LIGHT, LED & AUTOMATIC SIGNALS

CLS unit Accessories	**Diameter, Material & Colour**	**Type**	**Normal focal length/ Length**
Main running signal (Inner lens)	140 mm, Glass/ polycarbonate & Red / green/Yellow	Out side step	13 mm
Main running signal (Outer lens)	213 mm, Glass/ polycarbonate & clear	Inside stepped	102 mm
Route indicators Junction type (Inner lens)	92 mm, Glass & Lunar White	Out side step	16 mm
Route indicators Junction type (outer lens)	127 mm, Glass/ polycarbonate & Clear	Inside stepped	70 mm
Shunt signal (outer lens)	101 mm, Glass/ polycarbonate & Clear	Inside stepped	---------
Shunt signal (inner lens)	101 mm, Glass/ polycarbonate & Lunar White	Out side step	---------
CLS post	140 mm Dia. (tubular)	Length 3.5 Mts., 4.5 Mts. & 5.5 Mts.	
CLS base	160 mm Dia. Cast iron	---------	---------
CLS Unit Four aspect Three aspect Two aspect	Cast iron / fibre Length x width 1.905 Mts. (On post 1.80Mtrs.) x 0.45 Mts. Apprx. Length x width 1.590 Mts. (On post 1.51Mtrs.) x 0.45 Mts. Apprx. Length x width 1.280 Mts. (On post 1.18Mtrs.) x 0.45 Mts. Apprx.		
Ladder	**Width**- 25 cm Maximum		

5.2 SIGNAL LAMPS

Reference:	Pins, Pole & filament & other	Main filament Rating	Auxiliary filament rating	Life of the lamp	Remarks
SL 5,	Two pin Two pole & single filament	12V/4W	---	---	Indication
SL 18,	Three pin double pole & single filament	12V/24W	---	1000hrs	OFF Aspect (cascaded Ccts.)
SL 17	Three pin double pole & double filament	12V/6W	16V /12W	1000hrs	OFF Aspect (Non cascaded Ccts.)
SL –21		12V/24W	16V /12W	1000hrs	ON Aspect only
SL –33,	Three pin double pole & single filament	110V	25W	1000hrs	Junction type route indicators
SL35A	Three pin triple pole & double filament	12V /24W	12V / 24W	1000hrs	Triple pole, double filament lamp
SL–35AL (Long life)		12V /24W	12V / 24W	5000hrs	CLS ON Aspect
SL-35B		12V /33W	12V / 33W	1000hrs	CLS
SL-35BL		12V /33W	12V / 33W	5000hrs	CLS ON Aspect
SL-65	Two pin double pole & single filament	60V /25W	--	1000hrs	Shunt signal series wiring
Lamp glow volt.	2.3 Volt	Lamp terminal voltage		Min of 10.8 V or 90% of lamp's rated voltage	
Fuse ratting	0.63 Amp for 110/12 aspect control circuit				
Signal transformer Rating & No Load current	110V / 12V, 40VA & Should not be more than 15 mA	Primary tapping 0 & 110		Secondary tapping 0, 0.5 & ,1 volts and, 13,14.5 & 16 volts	

5.3 PARAMETERS OF LED SIGNALS (Sanarti Make)

Reference & Parameters	**Main Signal**	**C0-ON Signal**	**Route Lighting unit**	**Shunt lighting unit**
Rated voltage at Input terminals of current Regulator	110 V ± 25%	110 V ± 20%	110 V ± 20%	110 V ± 20%
Current at input terminals of current Regulator for 110 V AC	125 mA (proposed 140 mA) +10%, - 20% (rms)	125 mA +10% -20% (rms)	25 mA ±5% (rms)	55 mA ± 5%(rms)
Note	Total current of any aspect remain near to 125 mA			
Current at input terminals of current Regulator for 110 V DC	105 mA (proposed 25 mA)+10%, -15%	125 mA+10%, -15%	23 mA ± 5%	50 mA ± 5%

ECR to be used with LED signals	Railway board letter no 2003/SIG/CLS (LED Dated 26.03.04) RDSO Specification RDSO/SPN/153/2007 Rev.-4					
	Make	Conventional ECR	Suitability with LED signal			
	ABB For AC Lit LED	ON Metal to Metal	YES	YES	--	--
	Siemens For AC Lit LED	OFF Metal to Metal	YES	YES	--	--
	CGL & Hytronics For AC Lit LED	ON Metal to Carbon	YES	YES	YES	YES
	Nominated LED ECR.	LED AC	RDSO Specification STS/E/RELAY/**AC** lit LEC Signal Contact configuration 4F/4B, Pick current/ drop away 108/72 mA, coil resistance 32 Ω			
		LED DC	RDSO Specification STS/E/RELAY/**DC** lit LEC Signal Contact configuration 4F/4B, Pick current/ drop away 80/55 mA, coil resistance 75 Ω			
	1. Main aspect means one LED signal unit, one current regulator and one health monitoring unit 2. One spare current regulator shall be supplied with every eight current regulator 3. Warranty – supplier shall give warranty of 60 months for all type of LED signal lighting unit, current regulator and health monitoring unit. Note- Total current of circuit (Relay room side) shall be maintained to suite pick up current of ECR					

IMMUNITY LEVEL

- DC LED : Up to 300 V AC
- AC LED : Up to 60 V AC

CHAPTER 6: RELAY INTERLOCKING (BRITISH)

6.1 NOMENCLATURE OF RELAYS

Sl. No.	Nomenclature	Description	Remark /Function
* 1	SMR/SMCR	Station Master's (control) Relay	Authorised Operation
* 2	TSR	Track Stick Relay	One Signal - One Train
3	RR	Signal Knob / Switch Reverse Relay	For taking "OFF" Signal in PI / RRI
4	LR	Route Selection / Initiation Relay	For setting Route and taking "OFF" Signal in RRI
5	UCR	Route Checking Relay	Confirms Correct Route Set when picks up
6	Co UCR	Calling 'ON' Signal Route Checking Relay	Confirms Correct Route Set For calling 'ON' when picks up
7	HR/HHR/DR	Signal control Relays for Yellow / Double Yellow/ Green	Allows Signal to take 'OFF'
8	UHR/UR 1,2,3	Signal control Relays for Route	Allows Route Lamps to burn
9	HPR/HHPR/DPR	Repeater relays of Signal control Relays	Used in Locations for RE cutting
10	RECR/HECR/ DECR/UECR	Signal Lamp proving Relays for RED/Yellow/Green /Route etc.	When pick up .Proves Lamp concerned burning at signal unit.
* 11	ASR/ALSR	Approach Lock Stick Relay	When pick up , Route free When drop , Route locked
* 12	OVSR	Over lap Stick Relay	When drop , locks points in overlap
13	UYR1,2,3..	Sequential Route Release Relays	Proves directional arrival of a train
* 14	TLSR	Track Left Stick Relay	Used in RRI for Sectional Route Release for Leftward movement
* 15	TRSR	Track right Stick Relay	Used in RRI for Sectional Route Release for rightward movement
16	GNR	Signal Button Relay	Pick up when signal button is pressed
17	UNR	Route Button Relay	Pick up when Route button is pressed
18	WR	Point Button Relay	Pick up when point button is pressed
19	CH1R, CH2R..	Crank Handle Button Relays	Pick up when crank handle button is pressed
20	Z1NR, Z2NR..	Siding Control Button Relay (S)	Pick up when siding control button is pressed

Sl. No.	Nomenclature	Description	Remark /Function
21	WWNR	Point common button Relay (normal)	Pressed along with point button for Normal operation.
22	WWRR	Point common Button Relay (Reverse)	Pressed along with point button for Reverse operation.
* 23	GNCR	All Signal Button Normal Relay	Drops when any signal button is pressed
* 24	UNCR	All Route button Normal Relay	Drops when any Route button is pressed
* 25	WNCR	All point button Normal Relay	Drops when any Point button is pressed
* 26	ZNCR	Misc. Button normal Relay	Crank Handle, Sdg. Control etc.
* 27	NNCR	All panel Button Normal Relay	Drops when any panel button is stick-up
28	NNCYNR	Button Stick up Ack. Relay	Stops Buzzer
* 29	GXJR	Signal Lamp Proving Relay	All Signals Burning
* 30	WXJR	Point Indication Proving Relay	Point Indication OK
31	GXYNR	Lamp Failure Ack. Button Relay	Buzzer Mute
32	WXYNR	Point Indication Failure Ack. Button Relay	Buzzer Mute
* 33	GECR	Signal Aspect Checking / Proving Relay	Signal Not Blank
* 34	MECR	Signal Main Filament Proving Relay	Main Filament Burning
* 35	WLR	Point Lock Relay	Locks point in dropped condition.
36	WNR / WRR	Point Normal / Reverse control Relay	First Relay to pick up in point control cct.
37	WJR	Point Time control Relay	Controls DC 110V to point motor
38	XR	Special Relay	Controls DC 110V to point motor
39	NWR / RWR	Normal / Reverse point operating Relay	Final Relay for point operation
40	NWPR/ RWPR	Repeaters of NWR / RWR	Final Relay for point operation
41	NWCR/RWCR	Point Contactor Relay (Normal / Reverse)	Switches 110 v DC to point motor
* 42	NWKR	Normal Point indication Relay	Pick up when point set and locked in Normal
* 43	RWKR	Reverse point indication Relay	Pick up when point set and locked in Reverse
* 44	NWSR/ RWSR	Normal / Reverse point indication stick Relay	Indication stick relay
* 45	NWKLR/ RWKLR	Normal / Reverse point indication stick Relay	Indication stick relay, Proves all controlling relays are down

Sl. No.	Nomenclature	Description	Remark /Function
46	NCR / RCR	Point Normal / Reverse Contact Relay	Switch control relays
47	EGGNR	Emergency (Group) signal cancellation button relay	To put back signal to ”ON”
48	EGCR	Emergency Signal Cancellation Relay	To put back signal to “ON”
49	EUUYNR	Emergency Route cancellation button Relay	To release Route
50	EUYRR	Emergency Route cancellation Initiation Relay	Initiates Timer Circuits
51	EWNR	Emergency Point Operation Button Relay	Point operation in case of Track circuit Failure
* 52	POR	Power ‘ON’ Relay	Proves the integrity of in coming AC 230 V
* 53	LVR	Low voltage Relay	Drops for low AC 230 voltage
54	SLR	Power ‘ON’ Ack. Relay	To suppress the Buzzer
55	THT / EJ / ET	Timer relays (Mech., Thermal, Electronic)	To ensure time delay during cancellation operation.
56	JSR	Time Stick Relay	Pick up with HOT contact
57	JR	Timer Relay	Pick up with Cold contact make
58	JSLR	Timer Stick lock Relay	Initiates Timers
59	NJPR	Normal Timer (out) proving Relay	Pick up after 120 sec.
60	RJPR	Reverse Time proving Relay	Proves JSLR‘s and NJPR’s are dropped
61	CHLR	Crank Handle Lock Relay	Proves Crank Handle ‘IN’
62	CHNR	Crank Handle Normal Relay	Proves crank Handle at N including control
63	CH (IN) PR	Crank Handle (IN) Proving relay	Proves Crank Handle ‘IN’
64	CHYNR (T)	Crank Handle slot Relay (Trans)	Crank Handle Slot Transmission Indicates
65	CHYRR (R)	Crank Handle slot Relay (Receive)	Crank Handle Slot Reception Indicates
66	Siding NPR	Siding Normal Proving Relay	Proves Siding at Normal position
67	LXPR	Level Crossing Proving Relay	Proves L.C.Gate Closed.
68	LXNR	Level Crossing Normal Relay	Proves L.C.Gate Control at Normal
69	LX (IN) PR	Level Crossing Key ‘IN’ Proving Relay	Used at Location

6.2 Relays Used in RRI (System II)

Sl.No	Relay Circuit	Details
1	CR	Checking Relay
2	NR	Normal Relay
3	RR	Reverse Relay
4	(R) UR	Right Route Relay
5	(L) UR	Left Route Relay
6	(R) OHR	Right Overlap Holding Relay
7	(L) OHR	Left Overlap Holding Relay
8	(R) OCR	Right Overlap Checking Relay (For Main Signal)
9	(L) OCR	Left Overlap Checking Relay (For Main Signal)
10	(R) ZR	Spl. Relay (Right) For Main Signal
11	(L) ZR	Spl. Relay (Left) For Main Signal

* Relays Normally in Pick up condition.
(System –II is available in S.Rly, S.C.Rly)

6.3 DESCRIPTION OF RELAYS

Sl. No.	Description of Circuit	Conditions Required to be proved
1	SMCR/SMR	SM's Key Turned to N
2	TSR	Controlling TPR↑, Knob (N), RR↓, HR↓, ASR↑.
3	RR	SMCR↑, Knob (R), Conf. RRs ↓
4	LR	SMCR↑, Route button pressed, Signal Knob reverse or button pressed, Conf. LRs↓, Stick path provided.
5	NNR	NRR Concerned↓, ALSR Concerned↑, Stick path provided.
6	NRR	Conflicting NNRs ↑, UNR↑, GNRR ↑,EGGNR↓,UYR↓, Stick path provided.
7	UCR	CHLRs↑, Conflicting ASRs↑ , Conflicting UCRs↓, NWKRs/ RWKRs ↑, RR↑, Double cutting , Cross protection
8	ASR	Signal controlling relays HR↓, DR ↓, Off ECRs↓, UCR↓, RR↓, Knob (N) ,Back lock TPRs ↑, UYRs ↑/ (JSLR↑,NJPR ↑)/Approach TPRs ↑, TSR ↑, Stick path
9	OVSR	Home ASR ↑,Berthing TPR ↑, Stick path, or Timer release after 120 sec.
10	HR	CHLRs ↑, UYRs ↓ JSLR↓, RJPR↑, LXPR ↑, Conflicting ASRs↑, Conflicting UCRs ↓, NWKR/RWKRs ↑,Concerned ↑, RR ↑, UCR↑, ASR ↓, TSR ↑, Back lock TPRs↑, Berthing TPRs↑ , Over lap TPRs ↑,GECR ↑, Siding NPR ↑, Cross protection, Double cutting.
11	DR	HR ↑, DR & DECR of signal ahead ↑
12	GECR	RECR ↑/ HECR ↑/ DECR ↑
13	GNR (GNRR)	SMCR↑, Concerned Signal Button Pressed, Conf. GNR ↓.
14	UNR	SMCR↑. Concerned Route button Pressed. Conf. UNR ↓.
15	WR	SMCR↑, Point button Pressed. Conf. WR ↓.
16	WLR	Concerned ASRs ↑, OVSRs ↑, Track locking TPRs ↑, CHLR↑, Stick path.
17	NLR	NRR↑, WNR ↓, RLR ↓ Slow to Release.
18	RLR	NRR↑, WRR↓,NLR ↓, Slow to Release.
19	WNR	NLR ↑, SMCR↑, Point zone TPRs ↑, EW(N/R)CR↓, WLR↑, WR ↓, EWNR↓, WRR↓.
20	WRR	RLR ↑, SMCR↑, Point zone TPRs ↑, EW(N/R)CR ↓, WLR↑,WR↓, EWNR↓, WNR ↓.
21	CHLR	Crank handle key is 'In' turned clockwise & left

CHAPTER 7: RELAY INTERLOCKING (Siemen`s type)

7.1 DESCRIPTION OF RELAYS (Point indication relays)

Sl.No	Relay	Resistance	Working current
1	WKR1	1840 Ω	28 mA
2	WKR2	52.3 Ω	186 mA
3	WKR3	1340 (1st coil) Ω	47 mA on 110 V DC

7.2 Point minor group relays remains in pickup condition in different cases

Sl.No	Condition	Relays in point minor group in pick up condition
1	Point position Normal	W(N)R , (N)WLR , WKR1
2	Point position Reverse	W(N)R , (R)WLR , WKR1
3	Point buttons pressed for Reverse operation	W(R)R , (R)WLR, Z1WR1 , Z1RWR , WKR2 , WJR
4	Point buttons pressed and released for Reverse operation	W(R)R , (R)WLR, WKR2 ,WJR , WR
5	Point failed to operate for Reverse position	W(R)R , (R)WLR WKR2 After 10 second WJR drops and WR drops
6	Point set and locked in Reverse position	W(N)R , (R)WLR , WKR1
7	Point buttons pressed for Normal operation	W(R)R , (N)WLR, Z1WR1, Z1NWR, WKR2, WJR
8	Point buttons pressed and released for Normal operation	W(R)R , (N)WLR WKR2 ,WJR , WR
9	Point failed to operate for Normal position	W(R)R , (N)WLR WKR2 After 10 second WJR drops and WR drops
10	Point set and locked in Normal position	W(N)R , (N)WLR , WKR1
11	Cable fault in Normal position of point	W(N)R , (N)WLR WKR2
12	Cable fault in Reverse position of point	W(N)R , (R)WLR WKR2
13	Disconnection in WKR1 circuit in Normal position of point	W(N)R , (N)WLR
14	Disconnection in WKR1 circuit in Reverse position of point	W(N)R , (R)WLR
15	B 60 V External fuse blown OFF in Normal position of point	W(N)R , (N)WLR
16	B 60 V External fuse blown OFF in Reverse position of point	W(N)R , (R)WLR

7.3 Relays in pick up condition - Signal group - TWO aspects

Sl. No	Different Conditions	Relays in signal group (2-Aaspect) in pick up condition
1	Signal post displaying RED aspect	RECR, RECPR
2	RED bulb fused	---------
3	GN &UN pressed	RECR, RECPR, GNR, GLSR,
4	GN &UN released after pressing	GR1, GPR1, GR2, HECR, HECPR
5	GN &UN released after pressing but HG bulb fused	GR1,GPR1,GR2, RECR, RECPR
6	GN &UN released after pressing but HG bulb fused, and also RED bulb fused (signal post blank after clearing the signal)	GR1, GPR1, GR2

7.4 Relays in pick up condition - signal group - Three aspects

Sl. No	Different Conditions	Relays in signal group (3 Aspect) in pick up Condition
1	Signal post displaying RED aspect	RECR, RECPR
2	RED bulb fused	RECR / RECPR Drop
3	GN &UN pressed	RECR, RECPR, GNR, GLSR,
4	GN &UN released after pressing (signal is cleared for YELLOW aspect)	GR1, GPR1, GR2, HECR, HECPR
5	GN &UN released after pressing but HG bulb fused	GR1, GPR1, GR2, RECR, RECPR
6	GN &UN released after pressing but HG bulb fused, and also RED bulb fused (signal post blank after clearing the signal)	GR1, GPR1, GR2
7	Signal is cleared for GREEN aspect	GR1, GPR1, GR2, GR3, DECR, DECPR
8	Signal is cleared for GREEN aspect but DG bulb fused &YELLOW aspect is burning	GR1, GPR1, GR2, GR3, HECR, HECPR
9	Signal is cleared for GREEN aspect but DG bulb &YELLOW bulb both are fused	GR1, GPR1, GR2, GR3, RECR, RECPR
10	Signal is cleared for GREEN aspect but DG bulb, YELLOW bulb & RG bulb are fused (signal post blank after clearing the signal)	GR1, GPR1, GR2, GR3

7.5 Relays in pick up condition - Route - Minor group

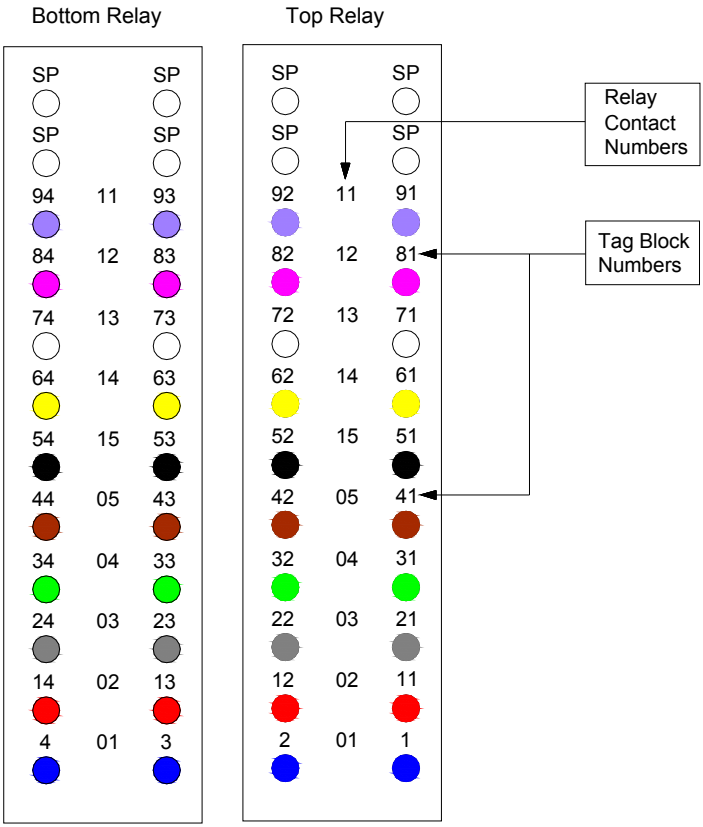
Sl.No	Different Conditions	Relays in route minor group in pick up condition
1	Sub route is normal	AU(N)S, BU(N)S, U(N)LR,
2	GN &UN pressed for straight route section	AU(R)S, BU(N)S, U(N)LR, ADUCR, UDKR
3	GN &UN released after pressing for straight route section	AU(R)S, BU(N)S, U(R)LR, ADUCR,UDKR
4	After arrival of train for straight route section	AU(N)S, BU(N)S, U(N)LR,
5	GN &UN pressed for first diversion route section	AU(N)S, BU(R)S, U(N)LR, BDUCR, UDKR
6	GN &UN released after pressing for first diversion route section	AU(N)S, BU(R)S, U(R)LR, BDUCR, UDKR
7	After arrival of train for first diversion route section	AU(N)S, BU(N)S, U(N)LR,
8	GN &UN pressed for second diversion route section	AU(N)S, BU(N)S, U(N)LR, UDKR
9	GN &UN released after pressing for second diversion route section	AU(N)S, BU(N)S, U(R)LR, UDKR
10	After arrival of train for second diversion route section	AU(N)S, BU(N)S, U(N)LR,

7.6 Relay provided for

Sl.No	Relay	Description
1	GNR	One For each signal
2	UNR	One for each route button
3	GNCR	Only one for all main & shunt signals
4	UNCR	Only one for all route buttons
5	Mn. GNPR	Only one for all main signals
6	Sh. GNPR	Only one for all shunt signals
7	Mn. GZR	Only one for all main signals
8	Sh. GZR	Only one for all shunt signals
9	ZDUCR	Only one for one lay out
10	Z1UR	One for each sub-route
11	ZU(R) R/ ZU (N) R	One for each berthing portion
12	G(R) LR	One for each berthing portion
13	OVZ2U(R) R/ OVZ2U (N) R/	One for each overlap
14	U (R) S / U (N) S	One for each route section
15	UDKR	One for each sub-route
16	DUCR	One for each route section with point
17	U (R) LR/ U (N) LR	One for each sub-route with point
18	WNR	One for each point
19	WNCR	Only one for all points
20	EGGNR	Only one for all main & shunt signals
21	WWNR	Only one common relay for all points
22	EWNR	Only one common relay for all points
23	EUYNR	Only one for all sub routes

7.7 K-50 RELAY BASE PLATE REAR VIEW

Bottom relay **Top relay**



7.8 Relays features

Sl.No	Relay Name	Description
1	ZU(R)R	One For each right to left movement
2	ZU(N)R	One For each Left to right movement
3	ZDUCR	Must pick up for each signal clearance (main & shunt)
4	Mn. GZR	Must pick up for each main signal clearance
5	Sh. GZR	Must pick up for each shunt signal clearance
6	Mn. GNPR	Must pick up for any main signal button in pressed condition
7	Sh. GNPR	Must pick up for any shunt signal button in pressed condition

CHAPTER 8: ELECTRONIC INTERLOCKING

8.1 Redundancy

Single Hardware with software redundancy.	Dual Hardware Hardware redundancy 2 out of 2 system	Triple Modular redundancy - Hardware redundant – 2 out of 3 system
MICROLOK -II US&S.	EBI LOCK 850 – Bombardier Transportation. AZD Praha	ALSTOM – SSI
VPI – Vital Processing Interlocking – ALSTOM.	SIMIS S - SIEMENS EI SICAS S5 – SIEMENS EI	SIMIS –W - SIEMENS
ASCV (SMARTLOK) – ALSTOM.	ESA 11 – IR - AZD Praha	SICAS – SIEMENS
VHLC – GE Transportation	-----	ESTWL90 – ALCATEL

8.2 Microlok II equipment - system details:

(a) Card file.
(b) CPU PCB.
(c) Power Supply PCB.
(d) Vital Output PCB.
(e) Vital Input PCB.
(f) Non-Vital-Input/ Output PCB.
(g) VCOR- Vital Cut Off Relay.
(h) Wiring hardware

8.3 Communication equipment used

(i)	422 CFCR	Used as interface between Microlok and Redundant modem (OSD1250LC)
(ii)	OSD 1250LC	Redundant optical modem (2Ch-OFC) Communication between Microlok-II to Microlok-II
(iii)	485 LDRC	RS232 to RS485/422 converter cum Isolator. Used between Microloks to Operator's PC / Maintenance PC.
(iv)	OSD 136L	Optical modem without ring protection. Used for communication between Microlok-II to Data logger.

Various indications/buttons available on front side of the CPU card is tabled below.

Fig	LABEL	DEVICE	PURPOSE
1,2	(None)	4 – Character alpha numeric displays	On site Configuration programming menus and options
3	A,B,C,D,E	Yellow LED s	Reserved for serial link status
4	1,2,3,4,5,6,7,8	Red LED s	User- defined in application software
5	ON LINE	Green LED s	When lit , indicates normal system operation (successful diagnostics)
6	VPP ON	Yellow LED	When Lit , indicates FLASH + 5 V or +12 V programming voltage enabled (via board jumper)
7	RESET	Red LED	When Lit , Indicates that the system is in RESET mode.
8	RESET	Momentary Push Button	When Pressed , RESETs the CPU. Also used to replace the CPU in the RESET mode.
9	MENU L - R	3 – Position (Return to Centre) toggle switch	Used to search main program menu items shown on displays.
10	MENU UP- DOWN	3 – Position (Return to centre) toggle switch .	Used to select main program menu items shown on displays.
11	ADJUST UP-DOWN	3 – Position (Return to Centre) toggle switch	Used to cycle through configuration values to be selected with ACTION switch.
12	ACTION ACCEPT-REJECT	3 – Position (Return to Centre) toggle switch	Executes or Cancels configuration value selected with ADJUST switch.

8.4 Power Supply PCB:

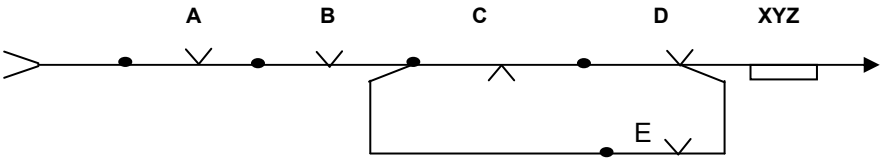
Card file Power Supply Printed Circuit Board Outputs*		
For System Card file PCB 5V Internal Circuits	For System Card file PCB 12V Internal Circuits	To VCOR Relay
+5V @ 3A	+12V @1A, -12V @ 1A	+12V into 400 Ω Coil

Power Input to System Card file				
Voltage Range	Nominal Voltage	Min. System Start-Up	Maximum Ripple	Current Draw
9.5 to 16.5 VDC	12 VDC	11.5 VDC	0.5 V P-P	Determined by Installation (No. of signal lamps, cab carrier frequency, etc.)

8.5 Symbols Used in Application Program

*	Series
+	Parallel
(	Start of Parallel Path
)	End of Parallel Path
~	Back Contact
,	BIT Separation
;	End of Statement / Section

Example of Conversion of Circuit to Equation



ASSIGN A * B * (~ C * D + E) To XYZ ;

8.6 Requirements

(a) Approved Interlocking Plan

(b) Approved Panel / Front Plate Diagram

(c) Selection table.

8.7 Card File Mother Board Keying Plug Locations:

Printed Circuit board	**Keying Plug Location**											
	1	2	3	4	5	6	7	8	9	10	11	12
CPU	√	√			√	√	√		√			
Power Supply (with out Panel)	√	√	√					√	√			√
Standard Vital O/P (24 v)	√	√		√					√		√	√
Vital I/P (24v)	√	√		√						√	√	√
Code System interface	√	√			√	√	√			√		
Non- Vital I/O (N17000601)	√	√		√					√	√		√
Non-Vital I/O (N17061501)	√	√		√					√	√	√	

- Application Software is station specific.
- Executive Software is Universal & common . PI check it as shown under.

Installations Commissioned	Check-sum & CRC of the Executive software
(a) After 6-8-2008	Check-sum :- 14FE CRC :- 08B1 Version :- CC2.0
(b) Before 6-8-2008	Check-sum :- 69 FA CRC :- Version :- CC 1.0

Address Select PCB						
Board Order	**Non – Lamp Board Jumpers**					
	1	2	3	4	5	6
1	0	0	0	0	0	1
2	0	1	0	0	0	1
3	0	0	1	0	0	1
4	0	1	1	0	0	1
5	0	0	0	1	0	1
6	0	1	0	1	0	1
7	0	0	1	1	0	1
8	0	1	1	1	0	1
9	0	0	0	0	1	1
10	0	1	0	0	1	1
11	0	0	1	0	1	1
12	0	1	1	0	1	1
13	0	0	0	1	1	1
14	0	1	0	1	1	1
15	0	0	1	1	1	1
16	0	1	1	1	1	1

8.8 Do's & Don'ts

Do's

(a) Keep the Microlok II room free from dust.

(b) Finger Tighten the boards after insertion.

(c) Ensure all terminations are fully tightened.

(d) Place the removed boards with a tag into a conductive shielding bag.

(e) Maintain Minimum 13.5 V to 16.5 V DC at the power supply board terminals.

(f) Maintain 24V to 28V DC at the Microlok II Input /Output power Modules.

(g) Check Microlok II system fuses at regular intervals.

(h) Take back up of User Data Log / Event Log / Error Log data files weekly.

(i) Ensure synchronization of Microlok II clock time with Maintenance PC after the System changes over.

(j) After completion of diagnostics, Reset that system and enable CPS in up mode (Ref: "CPS CLEAR FUNCTION" details).

(k) During Maintenance changeover of one system to other system, SGE block Instrument must be kept in TOL Condition.

(l) Use Vacuum for the externally accumulated dust and dirt.

DO NOT

(a) Don't attempt Troubleshooting if you do not have proper Microlok II training

(b) Don't switch ON Radio Equipment within the vicinity of Microlok II.

(c) Don't use non-conductive materials such as Styrofoam cups, Plastic ashtrays and Cell phone wrappers in the vicinity of Microlok II.

(d) Don't reset the system using Maintenance Tool/CPU front panel Reset push butt when working.

(e) Don't remove boards, VCOR relays, fuses / Links and 48/96 pin

(f) Connectors when the system is ON.

(g) Don't force boards into the Slots during insertion.

(h) Don't change jumper settings in CPU board & Address select PCBs.

(i) Don't touch the board components.

(j) Don't repair boards on your own.

(k) Don't alter Microlok II system, Maintenance PC & Operator PC settings without authorization.

(l) Don't delete/Modify Application logic programs without authorization.

(m) Don't apply blower for cleaning dust.

(n) Don't use any kind of Solvents, Detergents or Abrasive cleaners on the Card file or internal components.

(o) Don't use vacuum cleaner inside the Card file.

8.9 Vital Pre Commissioning Check List for Microlok

Sl. No.	Check Points	Requirement
1	Earthing / Surge & Lightning protection for EI system.	Follow the RDSO/SPN/197/2008 for "Code of practice for Earthing of Signalling Equipments" issued by RDSO on 19.09.2009.
2	Grounding	The EI racks, which are having Epoxy coating, will be provided with copper foil.
		Shielded cable between termination rack and control panel is to be properly grounded at the termination side.
		Check whether one end of every serial cable shield is connected to rack earth.
3	230 V Surge suppressor for Operator PC/ Maintenance PC	Check whether OBO 230V Surge suppressor is provided in PC power supply and check the wiring is as per Interface Circuits.
		Check whether earth terminal of the OBO arrestor is connected to the REB in respective rooms.
4	Visual check Installation of surge protection equipment	Check the whether surge protection placement as much as close to the REB as given inUM 6800B / 8.3.
5	DC/DC Converter for MLK-II system power (12V)	Check whether 12V DC-DC Converter (N+1) configuration is provided for Microlok- II card file supply.
		Check the wiring as per Interface Circuits.
6	DC/DC Converter for MLK-II I/O Boards & Panel power (24V)	Check whether 24V DC-DC Converter (N+1) configuration is provided for MLK-II I/O Boards & Panel supply.
		Check the wiring as per Interface Circuits.
		Two redundant power supply terminal for B24 & N24 is used in parallel for input/ output modules should be provided.
		Power supplies and wiring connection for vital input board and output board should be isolated from the other power supplies of EI.
7	DC/DC Converter for RTC & Event Log Backup (5V)	Check whether 5V DC-DC Converter (N+1) configuration is provided for Microlok- II RTC & Event Log Backup.
		Check the wiring as per Interface Circuit.
8	Serial Equipment location	Check whether the serial Opto isolators and RS232<-> 485 Converters are properly placed and wired as per the interface circuits between Microlok to Microlok, Microlok to OP.PC, Microlok to M.PC and Microlok to Datalogger.
9	230V AC Connection	Check whether 230V supply cable for operator/ Maintenance PC is routed properly and is kept away from serial communication cables.
		It should be ensured that 230V AC supply to Operator/Maintenance PC is properly connected.
		Proper connection for Phase, Neutral and earth shall be ensured at Operator/Maintenance PC. Proper Earth for Maintenance PC shall be ensured.

10	Isolator/ Modem Wiring	Check the isolator/485 converter wiring as per the Interface Circuits.
11	RS-232 Isolator	Check whether RS-232 isolator is provided between Microlok- Microlok serial link.
12	Converter cum Isolator switch settings of Operator PC	Check the 485 converter switch settings as per that is given in this document.
13	Isolator for Maintenance PC	Check whether opto-isolator is wired for the serial port coming out of Maintenance PC, as given in UM-6800B manual, section 9.1.
14	Labels/markers/Ferrule/Heat shrink	Ensure that all terminations have markers and ferrules for their right connection.
		Check whether gaskets are provided on the cable entry cut outs in the racks and cable trays.
		Check whether the wire size of the power switching circuits (in case of warm stand by) is as per the Interface circuits.
15	Lithium Battery CR2032 Panasonic CPU backup	Check whether Lithium Battery CR2032 is installed on “BATT1” location in the CPU board is loaded with right polarity.
16	KELVIN Connection	Check whether SPD is provided as per the KELVIN Connection is done as shown in UM-6800B manual section 13.
17	24V/110V DC External supply for Fan supply	Check whether Fan feed with separate 24V/110V DC is connected External supply, as shown in UM-6800B manual section 14.
18	MLK-II Fan input supply	Check whether Tranzorb (Part No.5KP30A) connected across the MLK-II Fan input supply, as shown in UM-6800B manual section 14.
19	Jumper settings for loading the application software	Remove the CPU card from the card file and put the jumpers JMP 20 and JMP 23 to position 2-3. Repeat this for all the CPU cards installed in the station.
20	Voltages at IPS/ MLK-II	After switching on the power, Check the voltages at the IPS terminals & at the respective Microlok-II power terminals and ensure that all the Microlok-II card file power terminals have minimum 13.5V DC.
		Ensure that the 24V I/O supplies at respective Microlok-II terminals are 27V DC minimum after the VCOR has picked up.
21	Voltages in respect to earth for every Bus	Ensure that Zero Voltage recorded when connected to different bus polarity.
22	Yard layout and its indications on Control cum Indication panel, VDU and MT	Check the yard layout on CCIP/VDU/MT whether it is according to the approved signalling plan.
23	VDU Active flashing indication	Check the RGY colour bar on the right hand top corner of the VDU screen is flashing in sequence. The flashing of this indication depicts that the VDU is active.
24	Password protection for Emergency operation	Check from VDU that all emergency operations are protected with password.

25	Connectivity with External Datalogger (If provided)	Check the RDSO approved Datalogger should be connected to EI and events are logged in chronological order with date and time stamp.
26	Check-sum & CRC	Check the Check-sum & CRC of the Application software (Station Specific).
		Check the Check-sum & CRC of the Executive software. Check-sum :- 14 FE CRC :- 08 B1 Version :- CC 2.0

8.10 Maintenance

Weekly (by Maintainer)
(a) Check voltages (12V &24VDC) at IPS and MLK Rack.
(b) Check all fuses.

Weekly By signal engineer:
(a) Back up schedule: user data log, event log& error log back to be taken in hard disk as well as floppy disk for remote storage.

Monthly By signal engineer:

(a) System changeover; System changeover from A to B/ B to A to carried out monthly
(b) Measuring of earth readings.

Annually

(a) Replace the lithium battery.
(b) Check the converter cum isolator
(c) Perform the inspection activities mentioned in section 8.3 of um 6800C manual.

FIVE YEARS By signal engineer:

Inspect surge protection devices, replace if required**.**

CHAPTER 9: SIGNALLING RELAYS & CABLES

9.1 "Q" Style Relays Particulars:-

Sr. No.	Relay Name	Specn. No.	Resistance in OHMS	Normal Working Voltage	Working Current	Total No. of Contacts	Remarks
1	QN1 (N)	BRS930A	400 (345)	24V DC	60 mA	8F / 8B 12F / 4B	NON-ACI
2	QNN1 (N)	BRS960	470	24V DC	50 mA	4F / 4B + 4F / 4B	NON-ACI (2 Relays)
3	QNA1 (N)	BRS931A	215	24V DC	110 mA	8F / 8B 12F / 4B	ACI-1000V
4	QS3 (N)	BRS930A	1000	12V DC	12 mA	4F / 4B	NON-ACI
5	QSA3 (N)	BRS931A	1000	12V DC	12 mA	4F / 4B	ACI-300V
6	QB3 (B)	PTJ / QB3	200	12V DC	60 mA	4F / 2B	NON-ACI
7	QBA1 (B)	BRS932A	215	24V DC	110 mA	8F / 8B 12F / 4B 8F / 4B	ACI-300V
8	QLI	BRS935A	145 (R) 680 (N)	24V DC	160 mA 35 mA	11F / 4B 8F / 6B	NON-ACI
9	QBCAI (B)	BRS943A	208	24V DC	120 mA	2F (HD) 4B	ACI-300V (HD: 30Amps)
10	QSRA 1 (N)	BRS934A	208	24V DC	120 mA	8F / 4B	ACI 300V RT: 260 Milli Secs.
11	QSPA 1 (N)	BRS943A	208	24V DC	120 mA	8F / 4B	ACI 300V PT: 540-600 milli secs.
12	QT2 (TR)	BRS938 BRS 26/6	4 (> 100 M) 9 (≤100 M)	0.3-0.5V DC 1.5 V	103 mA	2F / IB	NON-ACI (Track Relay)
13	QTA2	BRS939A BRS966F	9	1.4V DC	120 mA	2F / IB	ACI 50V
14	QBAT (TR)	BRS939A BRS966F RDSO - S: 84/88	9	1.1 to 1.75 V DC	140 mA to 175mA	2F / 2B	ACI 80V BIASED
15	PR (P)	IRS:S31-80	77	1.9V DC	25 mA	IN / IR	NON-ACI (Immunity: Upto 10V AC)

9.2 SIEMENS' Relays Particulars

Description	Details and Remarks		
Types	RS SK30 / 0011 RS SK30 / 0012 RS SK30 / 0013 RS SK30 / 0014 RS SK30 / 0015	Neutral Relay Interlocked Relay 'ON' Lamp Checking Relay (RECR) 'OFF' Lamp Checking Relay (HDECR) 'ROUTE' Lamp Checking Relay (UECR)	
No. of. Contacts	**RS SK30 / 0011** **NEUTRAL RELAY** 4F/4B - 1260 Ω - 46 mA 5F/3B - 1260 Ω - 46 mA 6F/2B - 1840 Ω - 32 mA	**RS SK30 / 0012** **INTERLOCKED RELAY** 4F/4B - 615 Ω - 98 mA 5F/3B - 615 Ω - 98 mA 6F/2B - 615 Ω - 98 mA	**RS SK30 / 0013/14/15** **LAMP CHECKING Relay** ON/OFF : 3F/3B : 64.1 Ω Route : 5F/1B : 64.1 Ω
Groups	Mini group - 02 Relays Minor group - 15 Relays (Signal / Point / Route) Major group - 30 Relays (Signal / Point / Route)		
AC Immunity of Siemens Relays	**RS SK 31/0078 - 1 (5F/3B)** Top Relay: ACI 450 V Bottom Relay : NON-ACI - 150 V	**RS SK30 / 0011A(ACI) 5F/3B** top & bottom 450 AC	-------
Siemens Track Relay	**RS SK 30 / 0071** DRS-50 (ACI – 50 VOLTS) RES. - 50 Ω Working Voltage - 1.77 D.C. Working Current - 30 m A Contacts : 1F/1B or 1F/ 2B		Note : Same relay is used in RE with a CHOKE at both F/End and R/End

9.3 Outdoor Under Ground Cables

Type of Cable	Corage	PVC Copper Conductor
Signal Cable	6C/12C/18C/24C/30C.	1.5 Sq.mm.
	2C for Track Circuits.	2.5 Sq.mm.
	4 Quad / 6 Quad.	0.9 mm. dia.
OFC	**2/4/6/8/12/28 – Fibres**	---------
Power Cables	2C	10, 25.
	3C	50,70 Sq.mm – Alu.

9.4 Indoor Cables

PVC Single Strand copper Cables	20C/40C/60C For Rack – Rack, Rack-Tag Block, Relay Base – Tag Block and Panel etc.
1 mm dia. Copper annealed wire for high current circuits	For Signal lamp circuit, point operation circuit, gate circuit, etc.
0.6 mm dia. Copper wire.	For relay, indication and panel wiring
16/0.20 mm dia. Flexible Copper wire (Multi strand)	For Q-Series relays wiring.
3/20 mm dia. Flexible Copper wire Multi strand Copper wire	For Power Distribution

9.5 CABLE LAYING

Description	Details
The cables laid parallel to the track buried at a depth	Min. 0.8 Mts.
The depth of tail cables	Min.0.50 Mts.
If cable is laid one meter from the RE mast, its trench depth	Max. 0.5 Mts.
If the cable is laid at more than 0.5 Meters depth the distance between trench and mast	Min.3 Mts.
In the vicinity of TSS the cables shall be laid	At least one metre away from any metallic part of the OHE In RCC Pipes, 300 Mts. on either side of TSS feeding point
Cables laid in the vicinity of the switching station earthing	At least 5 Mts. away from earth.
TRACK CROSSING	
The cables should cross the track at right angles.	At right angles
The cables should not cross the track under	Points and crossings
The cables are to be laid while crossing the track	In concrete pipes
The cables shall be buried below the rail flange	At a depth 1.0 Mts.

LOCATION	Distance from centre line of the track
Outside station limits	Min. 8 to 10 Mts. from center of nearest track
Within station limits with OHE mast	Min. 5.5 Mts.
Within station limits no OHE mast	Min. 3 Mts.

CHAPTER 10: TRACK DETECTION DEVICES

10.1 PARAMETER OF DC TC

Table A

Maximum length of Track Circuit under different track parameter conditions shall not exceed the limits as given in this table

Sl. No	RE / Non- RE	Sleeper	Section Yard / Block	Min. R_B in Ω per Km	TSR in Ω	Max. Length of Track Circuit in meters	Type of Track Relay to be used (L= Length of the Track circuit)	Remarks
1	Non- RE	Wooden / PSC	Block	4	0.5 Ω	1000 Mts.	QT2 of 4Ω or 9 Ω / Shelf type track relay of 2.25 Ω or 9 Ω.	• If L ≤100 Mts., 9Ω QT2 or Shelf type Track relay. • If L>100 Mts., 4Ω for QT2 or 2.25 Ω for Shelf type Track relay
2		Wooden / PSC	Yard	2	0.5 Ω	670 Mts.	QT2 of 4Ω or 9 Ω / Shelf type track relay of 2.25 Ω or 9 Ω.	• If L ≤100 Mts., 9Ω QT2 or Shelf type Track relay. • If L>100 Mts., 4Ω for QT2 or 2.25 Ω for Shelf type Track relay..

Table A

Maximum length of Track Circuit under different track parameter conditions shall not exceed the limits as given in this table

Sl. No	RE / Non- RE	Sleeper	Section Yard / Block	Min. R_B in Ω per Km	TSR in Ω	Max. Length of Track Circuit in meters	Type of Track Relay to be used (L= Length of the Track circuit)	Remarks
3	RE	Wooden / PSC	Block	4	0.5 Ω	450 Mts.	QTA2 / Shelf Type 9 Ω AC Immunised Track Relay	• QSPA1 Relay shall be used as a 1st repeater relay for QTA2 Track Relay.
4		Wooden	Yard	2	0.5 Ω	450 Mts.	QTA2 / Shelf Type 9 Ω AC Immunised Track Relay	• QSPA1 Relay shall be used as a 1st repeater relay for QTA2 Track Relay.
5		PSC	Yard	2	0.5 Ω	350 Mts.	QTA2 / Shelf Type 9 Ω AC Immunised Track Relay	• QSPA1 Relay shall be used as a 1st repeater relay for QTA2 Track Relay.
6		PSC	Yard	2	0.5 Ω	750 Mts.	QBAT (ACI level = 80V AC, PU. 1.75 V, 175 mA) in conjunction with QSPA1 With B-type Choke at relay end.	• QSPA1 Relay shall be used as a 1st repeater relay for QBAT Track Relay.

Note :- (i) B type choke shall be connected in series with the relay also for its protection to enhance the AC immunity of the track relay.

(ii) In the case of shelf type ACI track relay with this choke in series, 450 Mts. long track circuit can be worked even with traction return current up to 1000 Amps. Without this choke, 450 Mts. long track circuit can be worked only when the traction return current is within 600 Amps.

Table B		
Sl. No.	**Description**	**Details**
1	Length of TC	Minimum Length : 26 Mts. Maximum Length : Refer above table
2	PSC sleeper insulation resistance	Not less than 500 Ω.
3	Glued joint insulation resistance	Dry – Not less than 25 M. Ω. Wet – Not less than 3 K. Ω.
4	Stray voltage	Not more than 10 milli volts for any length of TC.
5	Stray current	Not more than 10 mA for TC upto 100 Mts. Not more than 100 mA for length of TC above 100 Mts.
6	'B' Type Choke for 25 KV AC RE Area	120 Ω Impedance and 3 Ω Resistances.
7	Under Max. Bat. Voltage and Max. Ballast resistance with 0.5 Ohms TSR across the relay, the D A Voltage should be adjusted to ...	Not be more than 85% of it's rated D A Voltage
8	Max. Permissible excitation of a track relay under Max. Bat. Voltage and Max. Ballast resistance.	SHELF TYPE – 250%; QT2/QTA2 – 300%; QBAT – 235%.
9	Min. excitation of a track relay under Min. Bat. Voltage and Min. ballast resistance.	125%. (Except QBAT). QBAT = 122 %

10.2 Feed & Relay Ends

Feed End:- Track feed Charger of 110 V AC/ 2-10 V D.C is used with 40AH/80AH secondary Cell in float to feed track Circuit in series with Regulating Resistance. In RE areas, one B Type Choke (R=3 Ω & Z= 120Ω at 50 HZ) is also used in series.

Relay End:- Track Relays used are - Shelf Type (9 Ω, 2.25 Ω in Non-RE areas, ACI- 9 Ω in RE areas), QT2(9 Ω, 4 Ω in Non-RE), QTA2(9 ohms in RE areas) . QBAT is used for Longer Track Circuit. B Type Choke (R=3 Ω & Z= 120Ω at 50 HZ) may also used in series to increase Immunity level of Track Relay in RE areas.

(a) Due to the passage of traction return current through one of its rails & to safe guard against short circuit current only A.C.I Track relays of 9 Ω - Shelf type/ QTA 2/ QBAT type shall be used with this track circuit.
(b) QTA2 (With ACI= 50 V) and Shelf Type relays (With ACI= 50 V) are used for Track lengths up to 450 Mts. beyond which up to 750 Mts. QBAT (with 80 V ACI) is used. (*Use of shelf type track relay is not favoured due to its sluggish operation.)
(c) QSPA1 relay only shall be used (to add slight delay of 540 to 600 m secs) as repeater for QTA2 or QBAT track relay. However, for ACI shelf type track relay, any AC immunized line relay can be used as repeater due to its greater operate time lag.

B type choke shall be connected in series with the track relay also to enhance the AC immunity of the track relay. In the case of shelf type ACI track relay with 'B' type choke in series in relay end, 450 Mts. long track circuit can be worked even with traction return current up to 1000 Amps. Without this choke, 450 Mts. long track circuit can be worked only when the traction return current is within 600 Amps

10.3 NON-RE: Typical Parameters of D.C Track Circuits:

Type of TC	Type of Relay	Resistance of Track Relay (L= Length of the Track Circuit)	Cells at Feed end	PU Voltage Approx	PU Current Approx
DC TC for Non-RE	Non ACI shelf type	For L < 100 Mts. → 9 Ω	1 cells (2 V)	0.4 V	40 mA
		For L > 100 Mts. → 2.25Ω	1 cells (2 V)	0.2 V	80 mA
	Non ACI Plug in Type (QT2)	For L < 100 Mts. → 9 Ω	1 cells (2 V)	1.4 V	150 mA
		For L > 100 Mts. → 4 Ω	2 cells (4 V)	0.5 V	125 mA

10.4 RE AREA: Typical Parameters of DC Track Circuits

Type of TC	Type of Track Relay	Track Relay Resistance	Cells at Feed end	PU Voltage Approx	PU Current Approx
DC Single Rail Track circuit – AC RE Area	ACI Shelf type	9 Ω	1 cell (2 V)	0.68 V	72 mA
	ACI Plug in Type QTA2	9 Ω	2 cells up to < 100 Mtrs. 3 cells > 100 Mtrs.	1.4 V	140 mA
	ACI Plug in Type QBAT	9 Ω	2 cells up to < 100Mtrs. 3 cells > 100 Mtrs. to 450 Mtrs. 4 cells up to 750 Mtrs.	1.75 V	175 mA

Subject	Under Conditions	Track Relay Voltage V_R
Minimum Excitation at Track Relay	Max leakage (R_B Minimum) & Minimum Battery voltage	• Not less than 125% of rated PU voltage for all Track Relays except QBAT. • Not less than 122% of rated PU voltage for QBAT
Maximum Excitation at Track Relay	Min Leakage (R_B Maximum), Rr Minimum and Fully charged Battery voltage	• Not more than 250% of rated PU voltage for Shelf Type Track Relay • Not more than 300% of rated PU voltage for Plug in Type Track Relay except QBAT • Not more than 235% of rated PU voltage for QBAT
Dropping of Track Relay	Irrespective of R_B conditions, with the application of TSR=0.5 Ω	• Not more than 85% of rated DA voltage

10.5 VITAL SAFETY CHECKS FOR TRACK CIRCUITS:

(a) Track relay must drop when shunted by any Vehicle other than Insulated Push trolleys.

For any adjustment on D.C. track Circuits, TSR Shall not be less than 0.5 Ohms.

(b) Max Excitation at Relay end shall not exceed 250 % or 300 % or 235% of its rated pickup value as per Relay type.

(c) Block Joint protecting Fouling shall not be less than 3 Mts. from Fouling mark. It shall be towards divergence.

(d) Staggering of polarity between adjacent rails is to be maintained. Crossing shall be maintained at negative polarity.

(e) Dead section shall not be more than 1.8 Mts. (6').

(f) Track relays shall be located at the entry end of the train wherever feasible.

(g) Feed and relay ends shall be connected by separate and individual cables.

(h) Jumper connections shall normally so made that the whole of track circuit is in series excluding traction return rail. When the rails of a track circuit are in parallel, integrity of jumper connections to be ensured.

(i) Distance from SRJ of the loop line point to Block joint shall be 13 Mts. The distance between this Block joint and the starter shall be 11 Mts. Hence the starter is located at 24 Mts. from the SRJ.

10.6 SIEMENS AFTC (FTGS-46)

Sl. No	CARD No.	DESCRIPTION	SOCKET No.	RANGE
1	B-42	Filter card	3 and 4	30 V to100 V AC
2	B-41	Amplifier I/P	1 and 2	9 V to 12 V AC
3	B-41	Amplifier O/P	3.1 and 4.1	60 V to 90 V AC
4	B-30-A2	Tx-card	LED's	Observe Flickering Frequency Code
5	B-33	RX-I CH I I/P	I-5 & II-8	≥ 6.5 V AC with Track clear
6	B-33	RX-I CH II I/P	II-5 & II-8	≥ 6.5 V AC with Track clear
7	B-33	RX-I CH I I/P	I-5 & II-8	≤ 5 V AC with Track occupied
8	B-33	RX-I CH III/P	II-5 & II-8	≤ 5 V AC with Track occupied
9	B-33	RX-I CH I O/P	I-6 & II-8	12 V to 15 V DC
10	B-33	RX-I CH II O/P	II-6 & II-8	12 V to 15 V DC
11	B-33	Demodulator Input – CH I	I7 & II-8	1. 3 V to 2 V AC
12	B-33	Demodulator Input – CH II	II7 & II-8	1. 3 V to 2 V AC
13	B-39/34	Relay voltage CH - I	I-11 & I-12	16.5 V ± 1 V DC
14	B-39/34	Relay voltage CH - II	II-11&II-12	16.5 V ± 1 V DC

10.7 ALSTOM AFTC (DTC-24)

Card	Test Points	Allowed Values
T_X CARD	**V T_X** Square wave output.	(50V Fuse) 10 – 90 V AC (10V Fuse) 4 – 7.5 V AC
	Frequency Range at **V $_{OUT}$**	F $_{channel}$ ±100 Hz
	V $_{OUT}$ T_X Filter output.	2- 40 V AC
	DC level (50 V Fuse)	45-58 V DC
	DC level (10 V Fuse)	9.0 - 11 V DC
R_X CARD	24 V DIG	22 - 28 V DC
	V_{IN}	**>** 0.300 V AC
	VR_X ; when Track Circuit is **Vacant**.	0.500 to 0.900 V AC
	VR_X ; when Track Circuit is **Occupied.**	0.010 to 0.280 V AC
RT CARD	+12 V	11.8 -12.2 V DC
	-12 V	12.2 to 11.8 V DC
	+5 V	4.9 - 5.1 V DC
	24V LOC	22 - 27 V DC
	OUT PUT; when Track Circuit is **Vacant.**	20-28 V DC
	OUT PUT; when Track Circuit is **Occupied.**	**<** 0.6 V DC
	OUT MSR; when Track Circuit is **Vacant.**	4.8 - 7 V DC
	OUT MSR; when Track Circuit is **Occupied.**	**<** 4.2 V DC
	20 KHZ Voltage.	25 - 32 V AC
	MSR + - ; when Track Circuit is **Vacant.**	9.8 - 20 V DC

10.8 Ansaldo STS (US&S) AFTC (UM-71)

US&S (UM-71)-Non Coded AFTC		
At PSU	Input voltage	110VAC ± 25%
	Output voltage	24VDC ± 1V
At Tx (KEM)	Input voltage	24V DC ± 1V
	Output voltage	25 to 50 V AC
	Frequency	2300 Hz ± 3 Hz
	Gain adjustment (V1 - V10)	V5 to V6 - 3Units
At TMU (Tuning & Matching Unit) (Tx end)	Input at E1 & E2	25 to 50VAC
	Frequency	2300 ± 3 Hz
	Output of TMU	1V to 5VAC
	Input across the track	1V to 5VAC
At TMU (Rx end)	Voltage across the track (ie. Input to TMU at Rx end)	0.2 to 0.8 VAC
	Output of TMU (Rx end)	0 to 3VAC ie. V1 - V2
At RX (KRV)	Input to RX (v1 - V2)	0 to 3V AC
	Voltage at R1 R2	> 250mv AC
	Gain adjustment (R3.... R10)	KRV56
At KRV **K= adjustment** **RV = Rx Input.**	PU. TSR	1 Ω
	Drop TSR	0.5 Ω
	KRV	56
At TR	Voltage across the TR without T.S.R	24 to 30V DC
	Voltage across the TR with 0.5 Ω T.S.R	0 V DC

10.8 AXLE COUNTERS

Important Parameters of A/Cs

Sl. No.	A) Installation	Details
1	Separation between 2 track Devices of different A/C's	Min. 3 Mtrs. (UAC), 2 mts (Digital)
2	Tx / Rx not to be fitted	Below or in-between Rail Joints.
3	Tx / Rx should be in the center of Track Circuits	At least 2-3 RL on either side.
4	Fish plate joint distance on either side of Tx / Rx	Min 6 sleeper on either side of Tx / Rx
5	Location to Tx / Rx	Max. 10 Mts.(for UAC, SSDAC) 12 Mts. (MSDAC-Alcatel)
6	Depth of trench for Tx / Rx cables	1 Mts. depth
7	Separation between Tx and Rx cables in HDPE Pipe	Min. 500 mm.
8	Rail deflectors on either side of Tx / Rx.	400 mm to 500 mm.
9	Tx cable Length	Max.10 Mtrs.
10	Rx cable Length	Max.15 Mtrs.
11	Transmission Media (U/G cable)	4 Qd / 6 Qd = 0.51 mm or 0.9 mm dia
12	Gap between two sleeper for fixing Tx/Rx	Min. 550 mm
13	Db Loss	20db for Analog A/C and 30 db for Digital A/C

S No	B) Maintenance	Details
1	I / P to EJB	21.6 to 28.6 (300 mA)
2	O/P of Osc.	54 V to 66 V AC (380-460 mA)-UAC 30-40V (SSDAC)
3	Freq. of Osc.	5 KHz (UAC), 21, 23 khz (SSDAC-CEL), 30.6, 28 KHZ (MSDAC-Alcatel)
4	Rx O/P to RA	0.7 V-1.0 V AC @ 5KHz-UAC 750-1200 mv for AM type of SSDAC 275-600 mv for PM type of SSDAC 80-1000 mv for MSDAC-Alcatel
5	R/A, R/B O/P to EJB	2V W/o EV load (1.2 V with EV connected)
6	DIP	In between 85-90%
7	EJB current	500 mA (UAC)
8	EV current	1.0 - 1.2 Amps.
9	At EV Min. channel I/P	150 mV AC 5 KHz adjust to 105 mV to Card No.2
10	EVR / SUPR	QS3 with BY 127 across R1/R2 (Min 10 Volts)
11	Type of Battery	EJB – 80 AH; Evaluator - 120/200 AH
12	Type of Charger	IRS : S - 60/90 ; S - 66/92 (Max. ripple voltage : 40 mV AC.)
13	O/P of the DC-DC Converter	UAC:- +5V @ 5 Amps +10V @ 1 Amps +10V ISO @ 300 mA
14	Stg. of Tx / Rx (Not for UAC)	165 mm –185 mm

10.9 2D/3D/4D (BY JUMPER SELECTION/DUMMY CARDS) for UAC

For converting 4D/3D Universal Axle counter system to 2D system three types of dummy cards are required to be used in the following modular state as shown below

The 2D Axle Counter Evaluator may be converted into 3D or 4D and Vice versa by the jumper selection/dummy cards given below.

Sl. No.	CARD NUMBER	CONNECT JUMPER/DUMMAY CARD FOR		
		2D	3D	4D
1	Card1	Normal	Normal	Normal
2	Card 2	Dummy 2	Normal	Normal
3	Card3	Normal	Normal	Normal
4	Card 4	Dummy 4	Normal	Normal
5	Card 5	Dummy 5	Normal with jumpers J2 & J4	Normal with jumpers J2 & J3
6(a)	Card 6 with prep. Reset	Normal with Jumpers J1, J3, J5, J7, J11 & J12	Normal with Jumpers J2, J4, J6, J8, J11 & J12	Normal with Jumpers J1, J3, J5, J7, J11 & J12
6(b)	Card 6 with out prep. Reset	As above in 6(a) and connect Jumper J9 & open resistor R132.	As above in 6(a) and connect Jumper J9 & open resistor R132.	As above in 6(a) and connect Jumper J9 & open resistor R132.
7	Card 7	Normal	Normal	Normal
8	Card 8	Normal with Jumpers J1 & J3	Normal with Jumpers J2 & J4	Normal with Jumpers J1 & J3
9	Card9	NORMAL WITH JUMPERS J2, J4, J7 & J10	NORMAL WITH JUMPERS J1, J3, J6 & J9	NORMAL WITH JUMPERS J1, J3, J5 & J8

COMPARISON OF AXLE COUNTERS				
Sl. No	**DESCRIPTION**	**ANALOG AXLE COUNTER**	**DIGITAL AXLE COUNTER**	
		UNIVERSAL AXLE COUNTER	**CEL**	**ALCATEL**
1	Track device - Mounting Type	Rail Base with Clamps	Rail Web	Rail Web
2	Track device- Train detection Technique	Amplitude Modulation	Amplitude Modulation / Phase reversal Modulation	Phase reversal Modulation
3	Transmitter Coil frequencies	5 KHz	21 KHz & 23 KHz	28 KHz & 30 KHz
4	Trolley suppression	Track Circuit Required	• Track Circuit required for Amplitude modulation type only • Track Circuit is not Required for Phase reversal modulation Type	Track Circuit is not Required being of Phase modulation type
5	No. of Vital output relays	2 relays: EVR & SUPR	2 Relays: VR & PR	1 Relay: TPR
6	Required logics achieved through	Hardware	Software	Software
7	Availability of Single / Multi section models	Single Section only	Single Section & Multi Section Models are separately available	Single Section & Multi Section Models are separately available
8	Suitability for Points zone	Yes	Only Multi Section Model is suitable and Single section model is not suitable	Both Single section model and Multi Section Model are suitable. But Single section model is suitable only up to 3 detection points.

10.10 CEL Single Section Digital Axle Counters (SSDAC)

Amplitude Modulation types- 700 A, 710 A

Phase Modulation Types- 700 AP, 710 AP, 701 P

10.10.1 Cards

(a) Signal Conditioner Cards
(b) Micro Controller Logic Boards
(c) Event Logger Card
(d) Modem Card
(e) Relay Driver Card
(f) DC-DC Converter Card

10.10.2 Parameters

Sl. No.	Installation	Details
1	I/P Voltage	I/P : 24 Volts D.C. / 1.2 amps Max.
2	O/P Voltage	**+ 05 V D.C. @ 2Amps for IC's, MLB 1&2.** + 12 V D.C. @ 200 m A for MODEM, SCC 1&2. + 24 V D.C. @ 300 m A for analog ccts. + 15 V D.C. @ 100 m A (ISO) for relay drive.
3	TX 1	30 – 40 volts A.C. @ 21 KHZ
4	RX 1	@ 21 KHZ Amplitude Type : 750-1200 mv Phase Type: 275- 600 mv.
5	TX 2	30 – 40 volts A.C. @ 23 KHZ
6	RX 2	@ 23 KHZ Amplitude Type : 750-1200 mv Phase Type: 275- 600 mv.
7	Signal Conditioning Card – 1	2.0 - 2.5 Volts D.C. (After DIP : Not more than 0.7 Volts)
8	Signal Conditioning Card – 2	2.0 - 2.5 Volts D.C. (After DIP : Not more than 0.7 Volts)
9	Data Refresh Rate between local & Remote Units	1.8 Sec
10	Max loss allowed in Quad cable	< 30 Db for entire length at 2 KHZ

10.10.3 Address settings

Section	Address of SSDAC	Detection Point
Single Section (2 detections)	Address '02'	ENTRY
	Address '03'	EXIT

10.10.4 8-Way DIP switch setting on Mother Board

Unit	Position							
	8	7	6	5	4	3	2	1
Entry	ON	ON	ON	ON	ON	ON	OFF	ON
Exit	ON	ON	ON	ON	ON	ON	OFF	OFF

Note:- Factory Default settings are shown above. If used for more than one line, settings to be made as 04-05, 06-07 etc

CHAPTER 11: AWS & DATA LOGGERS

11.1 AWS Frequencies

F1	**2800 Hz**
F2	3600 Hz
F3	4400 Hz
F4	5200 Hz
F5	6000 Hz
F6	6800 Hz
F7	7600 Hz
Field tolerance	55Hz / + 60 Hz

11.2 Frequency Combination for various aspect and conditions

1)	F3+F4	Green and Double Yellow
2)	F1+F4	Yellow (Inter Signal distance < 700 Mts. or > 700 Mts. with route)
3)	F2+F4	Yellow (Inter Signal distance > 700 Mts.)
4)	F1+F5	Permissive Red
5)	F1+F2	Absolute Red
6)	F1+F6	Release of Brake Curve (used at Addl. magnet)
7)	F2+F6	No change in earlier information (used at Addl. magnet)
8)	F5+F6	Reduced braking distance after second next signal
9)	F3+F5	End of AWS section

11.3 DATA LOGGER

Sl.No	Description	Efftronics	HBL
1	Specification	IRS/S/99/2001. IRS/S/99/2006 AMD-3	IRS/S/99/2001.
2	Processor	32-bit MOTOROLA 68000 Microprocessor	Intel 80C188 Intel Pentium III 800 Mhz minimum
3	RAM	2MB of Flash RAM	128 MB.
4	Operating system	Windows	Windows
5	Data logger Equipment	Efftronics	HBL
6	Front End Processor	32-bit MOTOROLA 68000 Microprocessor	-------
7	Central monitoring unit	------	-------
8	Power Supply required.	12V DC	24V DC
9	Total Storage capacity DLE	• 3.5 Lakhs events • Currently it is 10 Lakhs events as per IRS/S/99/2006 AMD-3	3.5 Lakhs events
10	Digital Inputs per Scanning Unit	512	1024
11	Analog Inputs per Scanning Unit	24	32
12	Maximum Digital Inputs that can be connected.	4096	4096
13	Maximum Analog Inputs that can be connected.	96	96
14	Digital Inputs scanning time	16 milli Sec.	20 milli Sec.

Sl.No	Description	Efftronics	HBL
15	Analog Inputs scanning time	Less than 1 Sec.	Less than 1 Sec.
16	Processor Used in Data logger.	68000 Motorola	Intel 80C188
17	LED display of Digital Inputs.	Available	Not available.
18	LCD Display	Two line display (2x24).	Four line display (4x24).
19	Serial ports available.	6	6
20	Provision of Printer Port.	Available	Available
21	Digital Input current	10 mA	10 mA
22	Availability of CMU	Available	Available
23	Software used	Delphi.	Windows
24	Network capacity.	A maximum of 32 Data loggers can be connected to one FEP	A maximum of 32 Data loggers can be connected to one FEP.
25	Storage capacity of Front End Processor (FEP)	3.5 lakhs events 10 lakhs telegrams	4 lakhs. events
26	Type of memory.	Flash ROMs	Flash ROMs.

CHAPTER 12: REVERSERS, SLOTS & KEY TRANSMITTERS

12.1 PARAMETERS OF REVERSER, LEVER LOCK, RKT, SLOTS, Etc

Name of the Equipment	Normal Working Voltage	Working Current	Coil Resistance	Remarks	Schedule of maintenance		
					Maintainer	JE/ SE (Sig)	SSE (Sig)
Lever Lock (IRS) Type	12 V DC	----	4.5 Ω		F	M	Q
Rotary Key transmitter (RKT)	3.75VDC+ Line Voltage Drop, use appropriate resistance as min. 12 volt only available.	350 mA	12.5 Ω	Position of contacts:- Key in 1,2 &3,4 make. Key in & TURN to RHS 1, 2 & 3, 5 make. Key OUT, All contacts break	--	--	--
Electric Signal Reverser (Style B)	12 V DC (7.5 Volts Min.)	17 - 20 mA	600 Ω	Mini. Working voltage is 7.5 V DC. At every 15 days coil terminals to be interchanged.	F	M	Q
Electrical Signal machine	12VDC (7.5 Volts Min.) 110 Volts DC are also available but rarely used	Motor - 1.6A Pick Up Coil - 220mA Hold Off Coil - 17mA Snubbing current - 1.0 Amps	Pick UP Coils Resistance- 45Ω Hold Off coils Resistance- 580Ω	DC Series Motor (4 pole)	F	M	Q
Electric Lifting Barrier	24 VDC - 36 VDC	6-8 Amps		Operating time (10-12) seconds	--	--	--
Electric Lifting Barrier	110 V AC	2 Amps		Operating time (10-12) seconds	--	--	--

CHAPTER 13: ELECTRIC POINT MACHINE

13.1 PARAMETERS OF ELECTRICAL POINT MACHINE

Details		SIEMENS	IRS	IRS (CLAMP TYPE)	GRS 5E
Normal Working Voltage		110VDC.	110VDC.	110VDC.	110VDC.
Minimum Working Voltage		60VDC	60VDC	60VDC	88VDC
Normal Working Current		2-3 Amps	2-3 Amps	3-5 Amps	3-5 Amps
Slipping Current	Upper limit shall not be more than	1.5 to 2 (1.65) times of Normal working current.			
	Lower limit	Difference between normal working current & slipping current shall not be less than 0.5 Amp			
Stroke of the Point Machine		143 mm.	143 mm.	220 mm.	150 mm.
Minimum AC immunity level		160V AC	160V AC	160V AC	------
Mode of Locking		Rotary type locking.	Rotary type locking.	Rotary type locking.	In & out type of locking
				Clamp type locking	
Locking of switches		Common one lock slide.	Independent Two lock slide.	Independently Two lock slide. Physically lock open & close switch	Independent Two lock slide.
Operating time		3-5 Secs	3-5 Secs	5 –6 Secs	3-5 Secs
Friction clutch		Self adjustable	Self adjustable	Self adjustable	Adjustable
Sleeper spacing Nob,3&4 Centre of hole of chair plate		685 mm	710 mm	745 mm	565 mm
Snubbing		Mechanical	Mechanical	Mechanical	Electrical
Contacts on normal & reversed side	Control	02+02	02+02	02+02	01+01
	Detection	02+02	02+02	02+02	02+02& (01+01 snubbing)

13.2 PARAMETERS OF ELECTRICAL POINT MOTOR

MOTOR	**Type**	**DC series Split field Motor**	**DC series Split field Motor**	**DC series Split field Motor**	**DC series Split field Motor** (or) Permanent magnet
	Insulation grade	10 m Ω Class – 'B'			
R.P.M		1700	1700	1700	1500
Power		440 Watts	440 Watts	440 Watts	590 Watts
Rated motor working time		10 minutes	10 minutes	10 minutes	10 minutes
Rated motor current		5.3 Amps	5.3 Amps	5.3 Amps	---
Lubrication	No. of nipple	08	11	11	---
	Oil & Grease Type	**Oil SAE** 30 (specification IS: 1628) /**QUANTITY** 100 ml /**FREQUENCY** ones in 6 month/10000 operations. **GREASE** non-corrosive all temperature (specification Nos. IS:507 or IS:508) once in 6 months or as local conditions need			
Inspection schedule		Maintainer – fortnightly, JE/ SE (Sig)- monthly & SE / SSE (Sig.) (In Charge) Quarterly			

CHAPTER 14: BLOCK SIGNALLING

14.1 Single Line Token & DLBI

Feature	NBT	NTT	D/L
Types of token configuration	5 Types	5 Types	No Token
Used for	Single line only	Signal line only	Only for Double line
TCF/TGT Coil	28 Ω 160 mA 4.5V	28 Ω 160 mA 5V	Separate Indication for Up & Down line (TGTK/TCFK) 140 Ohms, 25 mA, 2.4 V
Galvo	150 Ω 20 mA 3V	150 Ω 20 mA 3V	Not applicable
Polarised Relay	77 Ω 25 mA 1.8 V	77 Ω 25 mA 1.8V	77 Ω 25 mA 1.8V
Authority to proceed	Ball Token & LSS	Tablet Token & LSS	Last stop signal
Bell coil	25 Ω 80 mA 2V	25 Ω 80 mA 2V	Separate Bell coil & bell relay are available Bell coil 60 Ω 200 mA / Bell Relay 500 Ω 24 mA
Door lock coil	Not applicable	Not applicable	50 Ω , 240 mA
Manufacturer	Saxby & Farmer	Saxby & Farmer	Podanur, Byculla & Howrah
No. of Position for Block Handle	Line closed, TCF & TGT	Line closed, TCF& TGT	Line closed, Line clear, & TOL
Handle lock in	All 3 position	All 3 position	Only in TOL Position if it brought from line clear position
TGT lock picks up	Handle can be turned to TGT	Handle can be turned to TGT	Not applicable
TCF lock picks up	Handle can be turned to Line closed from TCF & TGT, TO TCF from Line closed	Handle can be turned to Line closed from TCF & TGT, TO TCF from Line closed	Not applicable
TOL Lock or Door lock coil	Not applicable	Not applicable	Picks up release the block handle to line closed
P.O.H	10 year	10 year	07 year
P.O.H of PR	With the instrument	With the instrument	With the instrument

14.2 BLOCK SIGNALLING-TLBI (FM & PB TYPES)

Feature	FM Handle type	Push button Instrument
Bell	-Ve on L1	+Ve on L1
TCF	+Ve Carrier 85HZ	- + -
TGT	+Ve Carrier 65HZ	- - +
TOL	Carrier 65HZ	- - -
Line closed	+Ve Carrier 85HZ	- + +
Shunt Key	Is in-built and provided by the manufacturer	Shunt key is not in-built and not provided by the manufacturer
TOL Indication	Appears in sending and receiving instruments	Appears in sending and receiving instruments
TOL Buzzer	Sounds at both sending and receiving instruments	Sounds intermittently at the receiving end only.
Authority to proceed	OFF aspect of LSS	OFF aspect of LSS
Bell coil resistance	310 ohm	200 ohm
Manufacturer	S&T work shop Howrah	S&T workshop Podanur
Shunt key can be extracted	In Line closed and TGT position	In Line closed and TGT- TOL position
Shunt key when taken out	Locks the Block handle mechanically	Makes the instrument inoperative electrically.
P.O.H	Since having some mechanical parts overhauling is required and it is 7 years.	Not required since it is purely relay interlocking.
Operated By	A block handle which is having three positions TCF, TGT & Line closed	Pressing different Knobs for different operations
Co operation	Co operation is required for all operations on the instrument	Cooperation is eliminated for line clear and closing the instrument hence full advantage of Tokenless block working obtained. But Co-operation required for Line clear cancellation & Push back cancellation.
No drain circuit feature	It is not there	It is there
Usage	It can be used in AC RE as well as NON RE Area	It cannot not be used in AC RE Area
Push back normalization	S2 Knob is provided for push back normalization	No Knob is provided
Turn Table	Provided for maintenance convenience	No turn table is provided and it is floor mounted
Galvo	Provided	Not Provided

Feature	FM Handle type	Push button Instrument
Slip/Catch Siding Key	Not Provided	Slip/catch siding Key can be provided externally if required
Maintenance	Requires Maintenance	Less Maintenance

14.3 INTERMEDIATE BLOCK SIGNAL

Sl. No.	DESCRIPTION	DATA
1	Overlap	400 Mts.
2	IBS Defective, Phone Defective	5 min. wait
3	IBS Defective, Phone Defective, Visibility good	15 kmph
4	IBS Defective, Phone Defective, Visibility poor	8 kmph
5	Axle Counter in Rear Section	2D D.P.
6	D.P – LSS	1 No.
7	D.P – Block Overlap	1 No.
8	Max. Trains in IBS	2 No.
9	Power Supply IB Hut	230 V AC
10	AT Capacity	5 KVA
11	Supply- IB, IB Dist.	110 V AC
12	Supply- AC DP	24 V DC
13	Signal Cable – Station – IB	12 C

14.4 BPAC/ACBW

Sl. No.	DESCRIPTION	DATA
1	BPAC – AC	2D
2	LSS	1No.
3	Block Overlap	1No.
4	Cable - ACBW - with mux	1 ½ Quad
5	Cable - ACBW – w/o mux	3 Quad
6	QUAD	DIA. 0.9 mm
7	EJB – LSS	2W EJB
8	2W EJB	5 TO 3.5 KHZ
9	Block Panel Distance	25 Mts. Max.
10	ACBW- Relays	24
11	QNA1- 8F/8B	22
12	QNN1 – 4F/4B	2
13	Power Supply	24 V DC
14	MUX	12 Channel

CHAPTER 15: ESSENTIALS OF INTERLOCKING

15.1 Locking relation between Signal – Point – Lock bar – L.C Gate, Slot.

Sl No.	Main function	Sub function	Locking relation
1	Signal	Signal	Signal locks normal the conflicting signal
			Signal is released by the signal in advance
			Signal releases signal in rear
		Point	Signal locks normal the point if required in normal
			Signal is released by the point if required in reverse
			Signal locks both ways the point for route holding purpose
		Lock bar	Signal is released by first facing lock bar
			Signal locks normal the trailing lock bar
		LC. Gate	Signal is released by L.C. Gate in the route
		Slot	Signal releases slot in rear for the same direction
			Signal locks normal the slot for the opposite direction

Sl No.	Main function	Sub function	Locking relation
2	Point	Signal	Point locks normal the Signal if required in normal
			Point releases the Signal if required in reverse
		Point	Point locks normal the conflicting points
			Point is released by more important point in the route
			Point releases less important point in the route
		Lock bar	Point releases lock bar in case of trap point
			Point released by lock bar in case of fouling protection
			Point is released by in lock bar in both ways in case of Slip siding /Catch siding
		L.C. Gate	Point is released by L.C. Gate in the route in case of siding point
		Slot	Point locks normal the slot if required in normal
			Point locks normal the slot in case of isolation

Sl. No.	Main function	Sub function	Locking Relation
3	Lock bar	Signal	First facing lock bar releases the signal
			Trailing lock bar locks normal the signal
		Point	Lock bar released by point in case of trap point
			Lock bar releases Point in case of fouling protection
			Lock bar is released by point in both ways in case of Slip siding /Catch siding
			Lock bar locks its own point both ways
		Lock bar	Lock bar is released by lock bar in advance in the route
			Lock bar releases lock bar in rear in the route
			Lock bar locks normal the opposite lock bar in the route
		L.C. Gate	No relation
		Slot	First facing lock bar releases the slot
			Trailing lock bar locks normal the slot

Sl No.	Main function	Sub function	Locking Relation
4	LC gate	Signal	LC gate Releases signal in the route
		Point	LC gate Releases the siding point
		Lock bar	No relation
		L.C. Gate	No relation
		Slot	LC gate Releases slot in the route
			LC gate Releases slot conditionally if separate overlap is available

Sl no.	Main function	Sub function	Locking relation
5	Slot	Signal	Slot released by Signal in advance for the same direction
			Slot locks Normal the Signal for the opposite direction
		Point	Slot locks Normal the Point if required in normal
			Slot locks Normal the Point in case of isolation
		Lock bar	Slot released by the First facing lock bar
			Slot locks Normal the Trailing lock bar
		L.C. Gate	Slot Released by L.C. Gate in the route
			Slot Released by L.C. Gate conditionally if separate overlap is available in the route
		Slot	Slot is released by slot in advance the route
			Slot releases slot in rear the route

15.2 Strokes of different levers:

Sl.No	Description	Stroke of the tappet	Width of the channel	Pitch of the channel	Section of the bridle bar	Maximum no. of bridle bars in the channel	Pitch of the tappet
1	Direct type interlocking frame	346 mm	60 mm	110 mm	16 x 12 mm	6	125 mm
2	Catch handle lever frame	65 mm	40 mm	55 mm	16 x 12 mm	4	100 mm
3	Double wire lever frame	40 mm	40 mm	55 mm	16 x 12 mm	4	125 mm

General rules for interlocking

Sl. No.	Locking Lever	Locked Lever
1	It should always have a normal notch	It will have a) Normal notch – for locks normal b) Reverse notch – for released by c) Both Normal & Reverse -- for locks both Notches ways
2	Lock should be in side the notch	Lock should be out side the notch
3	If the lock is on R.H.S	The lock should be on the L.H.S
4	If the lock is on L.H.S	The lock should be on the R.H.S

Sl. No	Lever	Locking lever	Locked lever		Condition imposing lever	
			Locks Normal Relation	Released by Relation	Normal Condition	Reverse Condition
1	Required notch	N	N	R	R	N
2	Can be substituted by swinger	R	R	N	N	R

Sl.No	Description	Above Channel	Below Channel
1	Fouling Notches	'N' notch	'N' notch
2	Fouling Notches	'N' notch	'R' notch
3	Fouling Notches	'R' notch	'R' notch
4	Notches not Fouling	'R' notch	'N' notch

CHAPTER 16: MECHANICAL SIGNALLING

16.1 LEVER FRAMES

Sl.No.	Details	SA - 530 Direct Type	SA-1101 CH Type
1	Pitch of the lever	5 "	4 "
2	Length of the lever	2275 mm	1980 mm
3	Mechanical Advantage	5.4	5.6
4	Minimum No. of Channels	2	6
5	Maximum No. of Channels	8	No Limit
6	Size of the plunger	50X16 mm	40 x10 mm
7	Pitch of the Channel	110 mm	55 mm
8	Width of the Channel	70mm	40 mm
9	Stroke of Tappet	346 mm	65 mm
10	Stroke available in lever tail for a point lever	125,150,200 mm	125,150,200 mm
11	Stroke available in lever tail for a signal lever	250, 300 mm	250, 300 mm
12	Total stroke for N-R operation	346 mm	65 mm
13	Total stroke for R-N operation	346 mm	65 mm
14	No. of bridle bars	3+3	2+2
15	Size of bridle bar	16x12 mm	16x12 mm
16	Size of locks in direct type lever frame	15, 30, 40,48 mm	-----
17	No. of levers per bay	5/7	8/10
18	No. of channels in interlocking box	4+4	6/8/10/No Limit

16.2 CRANK AND COMPENSATOR

Sl.No.	Functional Requirement	Type of Crank
1	Last crank of Rodding run	Adjustable Crank
2	Place for straight arm crank	Point assembly Reversing the motion Changing the alignment of rod run
3	Diversion of rodding	Up to 20° relief crank
4	Connecting inside and outside lead	Vertical crank
5	Place using horizontal crank	Diverting the rod 90°
6	Adjustable straight arm crank	Diversion
7	Sizes of crank in outside lead	12”x12” or 14”x14”
8	Size of adjustable crank arm	12 " X 18 "
9	Size of straight arm crank	12 " X 12 " and 10 "X 10 "
10	Size of relief crank	12 "
11	Size of the vertical crank	12 " X 12 "
12	Size of accommodating crank	300 X 300 and 250 X 250 mm
13	Size of the horizontal crank	300 X 300 mm and 300 X 400 mm
14	Size of the adjustable straight crank	300 X 450 mm
15	Main parts of I.R.S Rod Compensator	Base, Obtuse angle crank, Acute angle crank and Link rod
16	Size of acute angle crank	406 X 253 mm
17	Size of obtuse angle crank	406 X 253 mm
18	Size of link of rod compensator	275 mm
19	Minimum length of rod can be compensated by 200 mm stroke	210 Mts.
20	Maximum length of rod compensated by 150 mm stroke	390 Mts.
21	Maximum length of rod compensated by a crank	L.B : 18.5 Mts. And Point : 12 Mts.
22	Periodicity of lubricating crank and compensator	Weekly
23	Periodicity of checking throw of compensator	Monthly
24	Periodicity of checking adjusting screw of crank and compensator	Weekly

16.3 LOCKS

1	Accessories required for F.P.L fittings: a) Cast Iron base with cover b) Switch extension piece L.H and R.H and Bolt and Nuts ¾ " X 3 ½ " (4- Nos) c) Nuts and Bolts for fixing the cover is ½ " X 1 ½ " (6 Nos) d) Plunger of size - 20 " X ¾ " X 2 " e) Nut and Bolt for fixing the F.P.L 8" X ¾" (4-Nos) f) Split stretcher bar (Short and Long)	
2	Distance of which the F.P.L can be fitted from running face of the rail on B.G.	500 mm
3	Size of the notch of the split stretcher bar	2 ⅛" X ⅞"
4	Distance between Normal and Reverse Notch	115 mm
5	Periodicity of cleaning and lubricating of chair plates	Monthly, Weekly, Quarterly
6	Periodicity of checking of switch opening (4 ½")	Monthly
7	Periodicity of checking of condition of tongue rail	Monthly
8	Periodicity of checking of condition of bearing place and stretcher bars	Monthly
9	Periodicity of checking of squareness of points	Monthly
10	Periodicity of checking of play of tongue rail	Monthly
11	Periodicity of checking condition of sleepers under switch	Monthly
12	Periodicity of checking condition of gauge tie plate and butt plate	Monthly
13	Periodicity of checking of point spring	Weekly
14	Periodicity of obstruction tent of point with 3.25 mm	Weekly
15	Periodicity of checking squaring and lubricating of lock plunger	Weekly
16	Periodicity of adjustment of lock plunger and switch extension bracket stretcher blade	Weekly
17	Clearance of lock plunger from split stretcher bars when unlocked position (½")	12 mm
18	Clearance of lock plunger when locked position	1 ½" Projected out

16.4 LOCK BAR

1	Components of the lock bar clips: (a) Rocker arm –5 ½" (137 mm for inside lock bar) (b) Stud washer for lock bar clip (c) Front clamp (d) Back clamp with bolts and nuts (e) Rocker pin (f) Bolt and nut	
2	Components required for lock bar: (a) Lock bar angle 50 mm x 50 mm x 6 mm (3 Nos.) (b) Lock bar clip (12 Nos.) (c) Lock bar stopper (3 Nos.) (d) Lock bar driving attachment (e) Lock driving rod (f) Lock bar driving rod (g) Radial guide (h) 'T' Rod (i) Horizontal Crank (300 mm x 300 mm)	
3	Length of lock bar rail	13 Mts.
4	Length of lock bar	12.810 Mts.
5	Section of lock bar	50x50x6 mm
6	Numbers of lock bar clips	12 Nos.
7	Number of lock bar stops	3 Nos.
8	Distance of stock rail joint from the toe of switch	825 mm
9	Clearance available between lock bar and toe of the switch in locked condition	25 mm
10	Size of crank is used to connect the lock bar during rod	300 x 300 mm
11	Maximum distance between two clips	1220 mm
12	No. Of pieces consists in lock bar	3
13	Total lift of the lock bar	44 mm
14	Clearance from the top of the rail either in Normal or in Reverse position	38 mm
15	Clearance of the lock bar from the top of the rail in mid position	6 mm
16	Size of the locking plunger of F.P.L	755 x 50 x 20 mm
17	Periodicity of checking of bars, driving attachment lock bar clips, stops and guides	Weekly
18	Periodicity of over-hauling of L/bars, clips stops and guides to be over-hauled	Yearly

19	Periodicity of checking creeping of lock bar rails	Weekly
20	Periodicity of tenting of a lock bar	Weekly
21	Adjusting the lock bar: (a) See that the lock bar lever travels freely both sides with 200 mm stroke after disconnecting the throw rod. (b) Adjust the stops or 38 mm. Clearance from top of the rail (c) Calculate the stroke at adjustable crank increase the stroke if required (d) Keep the lock bar and lever in center position adjust correct length of throw rod, and see it moves properly in either position, balance the stroke and adjust it.	

16.5 Compensators

1	With only one compensator: 200 mm stroke with only single rod compensator 150 mm stroke with only single rod compensator	 210 Mts. 390 Mtrs.
2	With point or Lock bar 150 mm stroke 320 Mts. 200 mm stroke 460 Mts. D/W M Stroke 730 Mts.	SLM 180 Mts. 275 Mts.
3	Compensator not required: For point upto For L/Bar upto	12 Mts. 18.5 Mts.
4	Center of compensator/crank to roller stand	900 mm
5	Center of screw Coupling/lug to roller stand	300 mm
6	Lock plunger minimum stroke	150 Mts.
7	L/Bar last clip & first clip distance from ends	225 mm

16.6 Adjustment of Point

1	To adjust a point gap in normal of a cross-over	Check up crank, Compensator of rod run Increasing or decrease the stroke as required
2	To adjust point gap in normal and reverse of a cross-over	Calculate the stroke and divide it both sides of the point
3	Maximum spring of a point tongue rail	3 mm
4	Calculating the stroke for adjustment of point in 450mm adjustable arm of adjusting crank	115+ 3 mm spring = 118/200 X 300 = 177 mm
5	Dividing calculated stroke to normal and reverse of a point	From adjusting screw of cross-rod
6	Minimum spring of a point lever both in normal and reverse over quadrant	12 mm
7	To test the spring of a point	Open with the help of Tommy bar and gradually release it to normal

16.7 Detector

1	Width of notch of point detection slide	15 mm
2	Throw of the lock detection slide	32 mm
3	Width of the lock detection slide	25 mm
4	Clearance between signal slide and point slide	12 mm
5	Section of signal slide	38 X12 mm
6	Depth of signal slide notch	12 mm
7	Section of point and lock slide	50 X12 mm
8	Size of the notch of signal slide	27 X12 mm
9	Size of the notch of the point slide	15 X12 mm
10	Clearance are available between signal slide and point slide when signal slide is normal	3 mm
11	Periodicity of checking detector, detector shoe, angle slide, plunger detection and detector rod.	Fort nightly
12	Periodicity of obstruction tent to be conducted in mechanical detector.	Weekly
13	Periodicity of checking signal and point slide	Fort nightly

16.8 E Type Lock

1	Parts of 'E' type lock: (a) C.I.Base-1 (b) Cover -1 (c) Brass tumblers-3 (d) Operating piece-1 (e) Lock Bolt (Plunger) (f) Spi-got-1 (g) Spring for operating piece-1 (h) Spring for brass tumblers-3	
2	Size of key lock	155 X 95 X 65 mm & 100 x 75 x 65 mm
3	'E' type lock consists	a) Feather- 5 mm thickness b) Ward –12 mm thickness c) Lug - 10 mm thickness
4	Common combinations of `E' type locks	42 but 24 are used
5	Movement of 'E' type lock plunger	25 mm
6	Wards in a key	3

16.9 Type of Signal Post

Types of signal posts: Three types

(a) Channel Iron
(b) Lattice post
(c) Tubular post

16.10 Spectacle

1	Types of Spectacle	Two types: a) 'A' type, (I.R.S) b) 'B' type, (B.N.R)
2	Size of roundels of 'A' type spectacle	a) Red - 213 mm (83/8") b) Green – 245 mm (95/8")
3	Size of the roundels of 'B' type spectacle	a) Red -245 mm (9 5/8") b) Green – 245 mm (9 5/8")
4	Dead space in 'A' type spectacle	63 mm (2 ½")
5	Dead space in 'B' type spectacle	37 mm (1 ½")
6	Distance between the fulcrum and the down rod connection of 'A' type spectacle	154 mm
7	Distance between the fulcrum and the down rod connection of 'B' type spectacle	118 mm
8	'A' type spectacle the roundel rings is fixed from	Front side
9	'B' type spectacle the roundel rings is fixed from	Back side

16.11 Type of Signal Arm

1	Types of Arms: (a) Square ended Red – 4' – 0" long (1220 mm) (b) Fish-tail Red and Yellow - 4'-0" long (1220 mm) (c) Square Ended Red – 2'-6" long for shunt signal. (760 mm)	
2	Periodicity of checking signal post, Guy, Deck-board, Signal arm and Signal post fittings.	Once in a Month
3	Periodicity of checking lubrication of arm spindles. Studies and counter weight lever.	Once in a Week
4	Periodicity of maintenance of spectacle roundels once.	Once in a Week
5	Periodicity of cleaning of signal glasses and lamps to be done.	Once in a Month
6	Periodicity of maintenance of signal lamps and focusing of signal.	Once in a Month
7	Periodicity of overhauling of signal lamp.	Once in a Quarter

16.12 Transmission of Signal Wire

1	Types of Signal wire transmission (a) Short distance transmission up to (b) Long distance transmission more than	 300 Mts. 300 Mts.
2	Materials required for straight signal wire transmission: (a) Pulley stake - 40 mm x 40 mm x 5 mm (b) Pulley Bracket – (i) 1 way (ii) 2 ways (c) Pulley Bolt – 1way or 2 (d) Top fixing bolt (e) Pulley wheel (f) Signal wire (S.W.G -10)	
3	Length of pulley stake	1220 mm
4	Minimum distance from the Ground to Signal wire	150 mm
5	Minimum distance between two wires of signal wire run	150 mm
6	Signal wire can run in one pulley stake	4 Nos
7	Distance between one pulley stake to other pulley stake	10 Mts.
8	Types of pulleys in single wire.	**Two types** • Flat type • Swing type
9	Materials required for signal wire joints in signal tail	(a) Shackle (b) Split link (c) Thimble (d) Wire rope 7/17 or 10 SWG (e) Wire adjusting screw (f) Wire rope sling (g) Vertical wheel (h) Sleeve (i) Sleeve rivets

16.13 Facing Points, Point fittings and Locks

1	Split Stretcher Bar notch size	53 x 22 mm (2 ⅛ X ⅞)
2	Size of the lock plunger	500 X 50 X 20 mm (20x2x¾)
3	Travel between (N) to (R)	115 mm
4	Minimum projection of plunger when locked	38 mm out side of FPL
5	Clearance of plunger from special St Bar when unlocked	Min. 12 mm
6	Clearance of Lock bar to toe when locked	25 mm (1 ")
7	Total lift of Lock bar	38 + 6 = 44 mm
8	Minimum spring of Point lever in both (N) & (R)	= 12 mm over quadrant
9	Signalling wire Transmission Short range Long range	= 300 Mts. = > 300 Mts.

16.14 Material required for Guide Roller Assembly

SL.NO.	MATERIAL	2 – WAY	4 WAY
1	Trestle	1	1
2	Roller stand	3	5
3	Bottom rollers	2	4
4	Top rollers	2	4
5	Top roller pins	2	4
6	Split pins (65x5 mm)	3	5
7	Bolts & Nuts (40x12 mm)	6	10

CHAPTER 17: DOUBLE WIRE SIGNALLING

17.1 Mechanical advantage of Double wire signalling is 10.4.

17.2 Details of Strokes:

Sl. No.	Type of lever	Angular throw	Stroke of the transmission	Locking tappet stroke	Function to be operated	Range of operation
1	Direct lever	N to R & R to N 180 ^{0}	500 mm	40 mm downwards & 40 mm up wards	Signal	Up to 1200 Mts.
2	Direct lever	N to R & R to N 180 ^{0}	600 mm	40 mm downwards & 40 mm upwards	Signal	Greater than 1200 Mts.
3	Clutch lever	N to R & R to N 180 ^{0}	500 mm	40 mm downwards & 40 mm upwards	Signal with detector	600 Mts.
4	Clutch lever	N to R & R to N 180 ^{0}	600 mm	40 mm downwards & 40 mm upwards	Signal with detector	730 Mts.
5	Clutch lever	N to R & R to N 180 ^{0}	500 mm	40 mm downwards & 40 mm upwards	Detector	600 Mts.
6	Clutch lever	N to R & R to N 180 ^{0}	600 mm	40 mm downwards & 40 mm upwards	Detector	730 Mts.
7	Clutch lever	N to R & R to N 180 ^{0}	500 mm	40 mm downwards & 40 mm upwards	Points & Lock bars	500 Mts.
8	Clutch lever	N to R & R to N 180 ^{0}	600 mm	40 mm downwards & 40 mm upwards	Points & Lock bars	730 Mts.
9	Rack & Pinion lever	N to R & R to N 180 ^{0}	200 mm	40 mm downwards & 40 mm upwards	Points / lock bars	Single end Points 460 Mts.
10	Rack & Pinion lever	N to R & R to N 180 ^{0}	200 mm	40 mm downwards & 40 mm upwards	Points / lock bars	Double end Points 275 Mts.

Sl. No.	Type of lever	Angular throw	Stroke of the transmission	Locking tappet stroke	Function to be operated	Range of operation
11	2-position Miniature lever	N to R & R to N 13^0 and 16^0	------	40 mm upwards & 40 mm downwards	Electrical slots, LC gate control, Siding control etc.,	One function can be operated
12	3 - position Miniature lever	N to Pull & N to Push 6^0 38'	------	20 mm upwards & 20 mm downwards	Electrical slots, LC gate control, Siding control etc.,	Two conflicting functions can be operated

17.3 Details of Clutch lever

Sl. No.	Description	Tension difference / wire breakage	Rope drum movement	Magnitude of locking tappet	Direction of locking tappet
1	Tripping at Normal	85 Kgs.	75 mm	12 mm	Up wards
2	Tripping at Reverse	85 Kgs.	75 mm	12 mm	Down wards
3	De -clutching	During tight locked condition	22 mm	----	----

17.4 Stroke between Facing point mechanism and Rack.

Sl. No.	Description	Point mechanism movement	Rack movement
1	Unlocking stroke 127 mm	127 mm	51 mm
2	Point setting stroke	268 mm	107 mm
3	Relocking Stroke	105 mm	42 mm
	Total	500 mm	200 mm

17.5 Stroke between facing point lock and cross detection slide

Details	Lock plunger movement	Cross Detection Slide Movement
1	9 mm	Idle
2	33 mm	16 mm
3	122 mm	Idle
4	33 mm	16 mm
5	3 mm	Idle
Total:	200 mm	32 mm

Signal Mechanism					
Sl No.	**Lever stroke**	**Initial idle stroke**	**Working stroke**	**Final idle stroke**	**Over run stroke**
1	500 mm	137 mm	250 mm	113 mm	275 mm

DW Rotary Detector					
Sl.No.	**Description**	**Bottom Rim**	**Locking Rim**	**Detecting Rim**	**Control Rim**
1	Length of rim	176 mm	30 mm	869 mm	75 mm
2	Height of the rim with reference to Bottom rim	----	10 mm	10 mm	25 mm
3	Thickness of the rim with reference to Bottom rim	----	12 mm	12 mm	12 mm

IMPORTANT REFERENCES

Sl. No.	DESCRIPTION	GR/SR reference	SEM reference	IRISET Notes reference
1	A marker Litting	GR 3.17(1)	7.168.2 / 20.1.2.5(a)	S1 - 7.12(b) (ii), page 40 S11 - 1.7, page 16
2	Alternative routes for the same receptions line.	SR 3.19	21.2.10	S12 - Fig 4.16 Page46, S13 - Sht-29
3	Approach locking.	SR 3.36(5.2)	13.38.5(b), 21.3.6(a)	S11 - 2.3.2, page-25, S12 - 4.2.5, page-34 S13 - sht16
4	Arm repeater / Light repeater	GR 3.23	7.8	S1 - 7.17 page 46, S11 - 5.3 page 53, S12 – Fig 4.54, Page75, S13 - Sht-28,40,43
5	CLS territories miniature right repeater defective signal should be treated as defective.	SR 3.23. 2(d)	19.84.2	--------
6	Colour for Semaphore arm Warner	-------	7.14	---------
7	Colour of Semaphore arm	-------	7.15.1	---------
8	Combination of signals	-------	7.16.8	---------
9	Conditions for taking off Gate Stop signal	GR 3.44	14.1.8.2	----------
10	Conditions for taking off Calling on signal	GR 3.45	7.19.1	S11 - 1.2,page-1, S12 - 4.17, page-48
11	Conditions for taking off Home signal	GR 3.40	21.6.1	S11 - 1.2,page-1, S12 - 4.16, page-46, S13 - Sht-24
12	Conditions for taking off Last Stop signal	GR 3.42	7.89(a), 7.109(vi)	S22 - 1.7 , page-3 S23 - 8.25 , page-94 S24 - Fig1.6, page-15,37
13	Conditions for taking off Outer signal	GR 3.41	---------	S2 Fig 4.2.7 Page-25
14	Crank handle, interlocking	GR 3.38.8 (2) GR 3.38.8(3) iv	7.107/13.3 8.5(i)	S11-4.1,page-46, S12-4.52/4.53, page-62 S13-Sht 2
15	Distant combined with Gate Signal.(Gate / Distant)	SR 3.34 (2)	7.34	S1 - Fig 18.7(iii), page-103
16	Distant Signal acting as Gate signal should be located at 180 Mts in rear of LC gate	GR 3.73(4)	7.43	----------

Sl. No.	DESCRIPTION	GR/SR reference	SEM reference	IRISET Notes reference
17	Distinguished markers for signals (P) marker,(A) marker, (AG) marker etc.,	GR 3.17 (2), (3)	7.168/ 20.1.2.5(b)	S1 - 7.12(b) (ii), page 40, S11 - 1.7, page 16
18	Distinguishing of signals relevance to concerned line.	SR 3.21(a)	7.17	S1 - 6.2 / 6. 3, page 25/26, S11 - 1.5, page 5 S12 - Fig-3.1, Page22, S13 - TOC-Sht-1
19	Gate signals controlled by 9the gate.	GR 3.34 (1)	7.43	S1 - 18.3 page-97, S13 - Sht-3, 24
20	If one end is disconnect other ends are to be clamped	GR 3.51(7)	--------	--------
21	(i) If the Signal does not assume steady aspect for 60 sec, then it should be treated as defective (ii)If the signal shows more than one aspect it should be treated as defective (Cascading method is adopted	SR 3.74	7.1.1(b)	S20 -6.7 Page 46
22	Indication locking on Point lever	----	7.102	S11-2.2-page 22
23	Indication locking on Signal lever	----	7.101	S11-2.3-page 24
24	Interlocking of LC gate out side Stn limits	3,34	7.45	-------
25	Intermediate siding	GR 3.35	7.75	S1- Annexure-1, page-111
26	Location of Advanced Starter, Track circuit between Starter & Advanced Starter	-------	7.16.6	S2-4.2.7 Page 24 S11 Fig1.5 Page 5 S12 Fig 3.1 Page 22 S13 TOC Sht-1
27	Location of Home /Routing Home signal	3.09(3),3. 09(4)	7.16.2 / 7.16.3	S2-4.2.7 Page 24 S11 Fig1.5 Page 5 S12 Fig 3.1 Page 22 S13 TOC Sht-1
28	Location of Intermediate Starter signals	3.10	7.16.5	S2-4.2.7 Page 24 S11 Fig1.5 Page 5 S12 Fig 3.1 Page 22 S13 TOC Sht-1
29	Location of Outer /Home signal	3.09(2)	7.16.1	S2- 4.2.7 Page 24
30	Location of Starter signals	-------	7.16.4	-------
31	Motor point indication correspondence at cabin	SR 3.38(7.1)	7.102	S21 - Fig5.5(C) , page-52 S12 - 4.28, page-55 S13-Sht11
32	Normal aspect of automatic stop signal shall be Proceed	GR 3.37(2)	7.163.1	S10 - 6.4, page-42
33	Normal aspect of fixed signal shall be most restrictive	GR 3.37(1)	-------	S13 – Sht 29
34	Operator shall not leave the place of duty	GR 3.51(2)	-------	-------

Sl. No.	DESCRIPTION	GR/SR reference	SEM reference	IRISET Notes reference
35	Outer, H/S, LSS shall not be used for Shunting	GR 3.46 (1)	-------	-------
36	Outside interference to be avoided	-------	7.4	-------
37	Placing of calling signals on running signals.	GR 3.13	7.19.5	S1 - 7.10 page 36, S11 - 4.3 page 49 S12 - 4.2.13, Page 46, S13 - TOC-Sht-1
38	Placing of Warner	GR 3.06	7.14.5	S2 Fig 4.2.7 Page-24
39	Placing stop signals at converging junctions.	SR 3.20	7.18	S1 - 6.2/6.3, page 25/26, S11 - 1.5 page 5 S12 - Fig-3.1, Page22, S13 - TOC-Sht-1
40	Point locking at site in addition to interlocking between levers	GR 3.39	7.102	S21 - Fig5.5(C) , page-52 S12 - 4.28, page-55 S13 - Sht11
41	Points shall normally be set for straight line	GR 3.51(1)	-------	-------
42	Principles of interlocking	GR 3.38	7.82	S2 - 3.1, page-9
43	Provision of A/S, SLB, BSLB	GR 3.32	7.57, 7.58	S1 - 7.16 page-43 S12 - Fig-3.1, Page 22 S13 - TOC-Sht-1
44	Reduction of distance between Signals	-------	7.16.7	-------
45	Route holding	GR 3.36 (2)	7.83 21.5	S2 - 3.3, page-9, S11 - 2.4.2,page-32, S12 - 2.12, page-13 S13 - Sht4,8
46	Route indicator (UECR cct).	SR 3.19	7.41	S1 - 7.15, page 42, S11 - 1.6, page 10, S12 - 4.16, page-46, S13 - Sht-29
47	Semi Automatic signal		7.163.2	S11-1.7-page 16
48	Shall not interfere with points for repairs without prior permission of SM	GR 3.51(3)	-------	S8-Page-36
49	Shunt signal no aspect when placed below stop signal	3.14	7.20	-------
50	Signal at on position to be ensured for Granting line clear	SR 3.49.4.1	-------	------

Sl. No.	DESCRIPTION	GR/SR reference	SEM reference	IRISET Notes reference
51	Signal indicators repeaters at cabin in CLS territory.	SR 3.23.1.3	19.79	S1 - 7.17, page 46, S11 - 5.3 page 53 S12 - Fig-4.54 Page75, S13 - Sht-28, 40,43
52	Signal shall remain/ restore on in case of any part failure	GR 3.36 (1)	21.6.2	S3 - 8.1, page-86, S4 - 5.2.3, page-36 S11 - 1.2(p) page-2, S12 - Fig 4.16, page -46 S13 - Sht-24,
53	Signals shall be on Bracketed posts	SR3.08 (2)	7.17	-------
54	Signals shall be placed on LHS	3.04(1)	7.1.2	-------
55	Slip Siding/ Catch Siding normally set to siding	GR 3.50.3(b)	7.93	-------
56	Slotted signals	-------	7.5	-------
57	SM slot.	GR 3.36 (3)	7.87, 7.88	S11 - 1.4, page-8 S12 - 4.2.1, page-29 S13 - Sht1
58	Starter used for shunting where A/S is provided	GR 3.46 (2)	-------	-------
59	Trap point / Slip Siding/ Catch Siding	GR 3.50	7.67/7.93	-------
60	UECR in HR cct.	SR 3.19 (2)	13.38.5 (f)	S11 - Page 57, S12 - Fig-4.16 , Page46, S13 - Sht-29
61	Warner / Distant Signal shall not be taken off for temporary speed restrictions in station limits less than 50 kmph	SR 3.43	7.40.1, 7.40.2	S13-Sht-40
62	Warner to main line only & Warner slot	3.43	7.14.3	S2 Fig 4.2.7 Page-25

BLOCK SIGNALLING

S.No.	DESCRIPTION	GR	BWM
1	Block competency to be given by ZTS		DL 2.2
2	Bell Codes	GR 14.05	
3	Acknowledgement of Signals	GR 14.06	SL 2.5
4	Train signal Register	GR 14.07	DL 2.7
5	Authority to proceed	GR14.08	SL 3.15
6	Access to and operation of block instrument by authorised person	GR 5.08	SL 3.1
7	Rules and regulations for working of trains during total interruption of communications on single line section	GR 6.02	
8	Essentials of the Absolute Block System	GR 8.01	
9	Conditions for granting Line Clear at a class `A` station , overlap to be kept clear up to starter	GR 8.02	
10	Conditions for granting Line Clear at a class ‘B’ station	GR 8.03	
11	Conditions for granting Line Clear at a class ‘C’ station	GR 8.04	
12	Obstruction on double line at a block station when a train is approaching	GR 8.05	
13	Obstruction on double line at a block section	GR 8.06	
14	Obstruction on Single line at a block station when a train is approaching	GR 8.07	
15	Obstructing the block section at a class `A` station on single line	GR 8.08	
16	Obstruction in the face of an approaching train at a class ‘B’ station on single line	GR 8.09	
17	Obstruction within station section at a class ‘B’ station on single line	GR 8.10	
18	Shunting between LSS and opposite FSS on S/L in 2Aspect territory-memo by SM to pass LSS at ON	GR 8.11	
19	Obstruction outside station section at a class `B` single line station equipped with manually operated multiple-aspect signals	GR 8.12	
20	Obstruction outside the first stop signal at a class `B` station on single line	GR 8.13	
21	Block back or Block forward	GR 8.14	
22	Authority for shunting or obstruction in block section	GR 8.15	
23	Protection of a train stopped in an Automatic block signalling section	GR 9.10	

24	Authority for Temporary Single Line working on “Double Line”	GR 9.1	
25	Minimum equipment of fixed signals in Automatic Block territory on single line	GR 9.04	
26	Essentials of the Automatic Block System on single line	GR 9.03	
27	Conditions for taking ‘off’ manual stop signal in Automatic Block territory on single line	GR 9.06	
28	Outlying siding controlled by Token of the block section - provision of token key exchanger	GR 3.35	SL 3.5
29	Driver to examine authority to proceed, Caution order	GR 4.09	
30	Train in Block section without authority to proceed	GR 6.06	
31	Withdrawal of line clear in case of emergency		SL 3.4
32	Applying for line clear to shunt beyond FSS		SL3. 5
33	When a block instrument considered to have failed	GR 14.13	
34	Procedure during failure of Automatic signalling	GR 9.12	
35	One train only -where to be used-short terminal branches on single line	GR 13.01	
36	Essentials of one train only system	GR 13.02	
37	Authority to enter the section	GR 13.03	
38	procedures in case of accident or disablement of one train only-protection of train , engine to be sent	GR 13.04	
39	Means of granting or obtaining line clear	GR 14.01	
40	Cancellation of line clear in Neale’s block	GR 14.22	SL 3.3
41	Provision of instruments	GR14.02.	
42	Consent required before interfering with Block working equipment	GR 14.03	
43	Competency certificate	GR 14.04	
44	Bell codes	GR 14.05	
45	Acknowledgement of signals	GR 14.06	DL 2.4
46	Entry in TSR to be made in ink only	GR 14.07	DL 2.7
47	Authority to proceed	GR 14.08	
48	Loco Pilot to examine authority to proceed	GR 14.09	

49	Conditions for closing the block section	GR 14.10	
50	Responsibility of Station Master as to authority to proceed	GR 14.11	
51	Special responsibility as to electrical token instruments and to the token	GR 14.12	
52	Failure of electrical block instruments or track circuits or axle counters	GR 14.13	
53	Closing of Intermediate Block Post deemed to be closed in case of failure of signal/axle counter	GR 14.14	
54	Where block inst not provided, signal under special instrument shall be transmitted through communication equipment	GR 14.15	
55	Block Stations at which Electrical Block Instruments are not provided	GR 14.16	
56	Written authority to proceed	GR 14.17	
57	Forms for messages and written authority to proceed	GR 14.18	
58	Writing and signing of messages and written authorities to proceed	GR 14.19	
59	Messages to be written in full	GR 14.20	
60	Preservation of messages and written authorities to proceed for one month	GR 14.21	
61	Cancellation of Line Clear	GR 14.22	
62	Loco pilot not to take his train without authority to proceed	GR 14.23	
63	Authority to proceed when to be given to loco pilot	GR 14.24	
64	Line clear Tickets	GR 14.25	
65	Use and Operation of Block working equipment by approval of railway board	GR 14.26	
66	Refusal of line clear signal and sending obstruction danger signal		SL5.1
67	Procedure for testing block instrument		SL TLBI 7.4
68	Electrical lock on LSS and LSS lever key for shunting		DL1.4
69	Home signal lever contacts to be proved for release of lock on operating handle		DL 1.5
70	First vehicle track circuit, ESR on LSS and Last vehicle track		DL 1.6

71	Conditions for closing block section -BLOCK release circuit	GR 14.10	DL 3.11
72	Precautions before giving train out of section and obstruction removed signal		DL 3.12
73	Block forward	GR1.02(9)	DL 5.3
74	Block Back	GR 1.02(8)	
75	Block instrument Maintenance work by signal staff		DL 7.5
76	Working of trains during failure or suspension of block instrument		DL 8.6
77	Features of daido handle type instrument		SL TLBI 1.2
78	Electric locking on last stop signal not to be released without line clear		SL TLBI 1.2

CONVERSION TABLES

Length **Mass (Weight)**

Centimeters	Cm or Inch	Inch		Kilo gram (Kg)	Kg or lb	Pounds (lb)
2.54	1	0.394		0.454	1	2.205
5.08	2	0.787		0.907	2	4.409
7.62	3	1.181		1.361	3	6.614
10.16	4	1.575		1.814	4	8.819
12.70	5	1.969		2.268	5	11.023
15.24	6	2.362		2.722	6	13.228
17.75	7	2.756		3.175	7	15.432
20.32	8	3.150		3.629	8	17.637
22.86	9	3.543		4.082	9	19.842
25.40	10	3.937		4.536	10	22.046
50.80	20	7.874		9.072	20	44.092
76.20	30	11.811		13.608	30	66.139
101.60	40	15.748		18.144	40	88.185
127.00	50	19.685		22.680	50	110.231

Length **Area**

Kilo meters (KM)	KM or Miles	Miles		Hectares (ha)	Acres	Acres
1.609	1	0.621		0.405	1	2.471
3.219	2	1.243		0.809	2	4.942
4.828	3	1.864		1.214	3	7.413
6.437	4	2.485		1.619	4	9.884
8.047	5	3.107		2.023	5	12.884
9.656	6	3.728		2.428	6	14.826
11.265	7	4.350		2.833	7	17.297
12.875	8	4.871		3.237	8	19.769
14.484	9	5.592		3.642	9	22.240
16.093	10	6.214		4.047	10	24.711
32.187	20	12.427		8.094	20	49.421
48.280	30	18.641		12.140	30	70.132
64.374	40	24.855		16.187	40	98.842
80.467	50	31.069		20.234	50	123.553

CONVERSION FORMULAE

To Convert	Multiply by
Inches to Centimeters	2.54
Centimeters to Inches	0.393701
Feet to Meters	0.3048
Meters to Feet	3.2808
Yards to Meters	0.9144
Meters to Yards	1.09361
Miles to kilometers	1.60934
Kilometers to Miles	0.621371
Sq Inches to Sq Cm	6.4516
Sq Cm to Sq Inches	0.155
Sq Meters to Sq Feet	10.7639
Sq Feet to Sq Meters	0.092903
Sq Yards to Sq Meters	0.836127
Sq Meters to Sq Yards	1.19599
Sq Miles to Sq Kilometers	2.58999
Sq Kilometers to Sq Miles	0.386103
Gallons to Liters	4.546
Liters to Gallons	0.22
Pounds to Grams	453.592
Grams to Pounds	0.00220462
Pounds to Kilograms	0.4536
Kilograms to Pounds	2.20462
Tons to Kilograms	1016.05
Kilograms to Tons	0.0009842

Paper Sizes	
A0	841 x 1189 mm
A1	594 x 841 mm
A2	420 x 594 mm
A3	297 x 420 mm
A4	210 x 297 mm
A5	148 x 210 mm

Name	ADDRESS / Phone Nos.