

BLOCK WORKING ON DOUBLE LINE BY AXLE COUNTER

1.0 INTRODUCTION

In Indian Railways, Absolute Block System is in existence for double line section. This system requires conventional double line block instruments. The complete arrival of train is physically verified by receiving end Station Master (SM)/ Cabinman/ switchman/ ASM, who checks the “Last Vehicle Board” or the Tail Lamp. When it is not possible to do so, a certificate indicating that :

- The train has arrived completely, and
- Train is standing clear of fouling mark,

is taken from the Guard. This results in detention to the trains .

In busy section if receiving end SM fails to follow the procedure strictly, there is a possibility of block being closed even if parting has occurred in mid-section and complete train has not arrived. Some accidents had taken place on this account. To avoid detentions to trains and ensure safe working of trains, Axle counters are used for complete arrival of trains and closing of block sections automatically.

The axle counter block system is operated on a continuously energized principle. The train occupies & clear the block section automatically.

2.0 DETAILS OF EQUIPMENT

2.1 The Axle Counter Block System for a block section, comprises of the following equipment :

EQUIPMENT		QTY.
INDOOR	Station master's block panel	2 Nos.
	Axle counter rack	2 Nos.
	a) Multiplexers- Transmitter & Receiver	2 Nos.
	B) Combiner/Converter - Transmitter & Receiver	2 Nos.
	Composite relay rack	2 Nos.
OUT- DOOR	Track devices alongwith junction boxes 4 Wire/2 Wire	2 Sets
	4 Wire type	2 Sets
	PET Quad in RE cable	1 ½

2.1.1 S.M.'s Block panel

SM's control panel is shown in the diagram. It is provided with the following:

- Two lighted strips - One for Train Going To (TGT) and another for Train Coming From (TCF). Each strip shows:
 - ◆ Yellow light for 'Line Closed' condition.
 - ◆ Green light for TGT/TCF condition.
 - ◆ Red light for 'Train On Line' (TOL) condition.



**SM's Block
Fig. No. 1**

- Four LED indications for the following.
 - ◆ TGT line free - Green.
 - ◆ TCF line free - Green
 - ◆ TGT line occupied or block forward/back - Red.
 - ◆ TCF line occupied or block forward/back - Red.
- A Red colored 'Train Going To' push button .
- An SM's Key for controlling SM's panel keeping control over operations.
- Two acknowledgment push buttons with yellow light indication.
 - ◆ 'TGT' "Line occupied / Line free" acknowledgment.
 - ◆ 'TCF' "Line occupied / Line free" acknowledgment
- A "Line Clear" Blocking Key (LCB)-meant for

- ◆ withdrawing the Line Clear already taken.
- ◆ preventing fresh line clear.
- A bell push button for calling other end SM's attention and to be pressed along with 'TGT' button to take line clear or with Reset key out to withdraw line clear already taken.
- A Reset Cooperation Push Button and Reset Key - To be operated during failure of the block system.
- Telephone- For conversation with other end SM.
- LSS indication - Last stop signal aspects proving indications i.e. ON & OFF aspects are given.
- Counter - To register number of Axle Counter resetting cases.

2.1.2 Axle counter rack

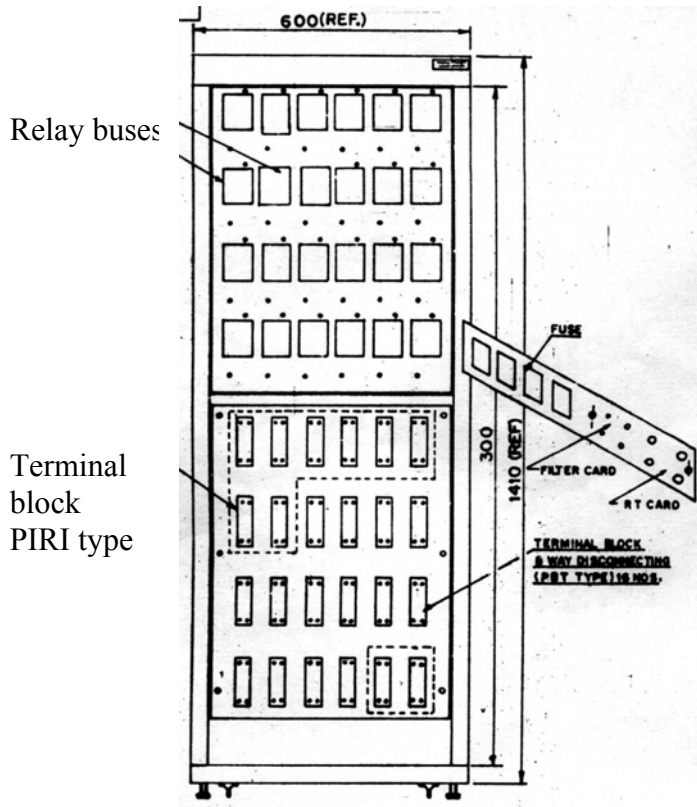
The axle counter rack (contains the evaluator, SUPR, EVR etc.) is installed in relay room.

The axle counter receives the track side signals through a quad cable from advance starter and home signal locations.

The evaluators for each direction of block working are kept at the receiving station and the axle counter monitors the complete portion of track between the last stop signal (LSS) at Train Sending station and block overlap (180 Mts.) in advance of the home signal at Train receiving station.

2.1.3 Prewired relay rack

- Relay rack consists of provision for 24 plug-in type QNA1/ QNN1 relays & sub racks. Tx - MUX, Rx -MUX and Combiner- Converter.
- The rack alongwith axle counter is installed on a raised platform inside relay room.
- Details of the connections between track device, multiplexer and axle counter evaluator are indicated in diagram.



Relay Rack(Rear View)
Fig. No.2

Multiplexer

- The purpose of the multiplexer is to obtain the status of relays at one station and reproduce them at other station using only one pair of wires in each direction. It may be seen from fig. that for Down line the axle counter is kept at station B and it receives the information from the track device at the block overlap Train exit point of block section in station B directly by a local Axle Counter cable. This axle counter also has to monitor the track device ahead of the LSS (last stop signal) of station A (Train entry point) for the Down direction. This information comes through half quad of main telecom. cable between station A and B along with the multiplexed information from station A to station B.
- Both the multiplexer information from 4W/2W EJB at LSS location and the axle counter track device information come on the same pair of cable since these are transmitted at different frequencies.



**Multiplexer & Prewired Relay Rack
Fig. No. 3**

- Similarly the other half quad is used for transmitting the axle counter track device at LSS location information from station B which is required by the up evaluator at station A and also for transmitting the multiplexer information from station B to station A. Since there are two track devices associated with each detection point, normally 2 pairs of wires are required to carry 5 KHz signals up to the evaluator. To economise over pair of wires between stations, Channel B at track device at LSS location is converted from 5 KHz to 3.5 KHz and combined with 5 KHz at 'A' Channel at same location for transmission at a single pair.
- The multiplexer has a total capacity for handling 10 relay inputs.
- The multiplexer works in TDM (Time Division Multiplexing) mode and converts the relays status in to digital bits 0 and 1.
- It transmits them through the cable after doing frequency shift key modulation using two frequencies of 1100 Hz/1300 Hz for one direction and 1500 Hz /1700 Hz for other direction.
- From each station seven relays are repeated from station A to station B and vice versa for Up & Dn. direction, the multiplexer has five spare inputs at each station. In the 16 bits of data of the multiplexer two parity check bits are used for error detection purpose.
- The multiplexer has a duplicated circuitry by way of hardware redundancy.
- The maximum cable attenuation between transmitter and receiver of the multiplexer could be 20 dB.
- It works on 24 V +20 %
-10 % } The current consumption is 3 Amp. including 24 nos. of
Plug in Relays in Rack . }

2.1.5 4 Wire / 2 Wire EJB design feature

- It consist of four modules. It is installed at Advanced starter for detecting the train entry in to the section.
- The 4 wire/2 wire converter has been designed to economize the requirement of cable pairs in transmitting information from EJB (Electronic Junction Box) to evaluator.
- This is an extra card to be fitted in conventional EJB and works on EJB's power supply.
- It converts frequency of Channel at track device channel 5 KHz frequency to 3.5 KHz.
- It consists of three conventional modules namely :
 - ◆ OSC. Card
 - ◆ REC1 Card
 - ◆ REC2 Card and a 4W/2W convertor card as 4th module.
- Since, A and B outputs are at different frequencies, it is possible to transmit the outputs of two receiver coils to the evaluator through one pair of cable ($1/2$ quad) only.

Combiner

- It is a part of 2nd card in combiner converter.
- It combines the FSK output of Mux Transmitter & composite signal from EJB and launches it on 1120 side of VFT Transformer for tranmission to other station.

Converter

- Likewise at the other end of the cable a 2 wire/6 wire equipment is used which again reproduces the original two receiver outputs of 5 KHz. from the combined 5 KHz - 3.5 KHz. signal coming through 2 wire circuit.
- The 4 wire output of the 2 wire/6 wire equipment at the receiving end is connected to the evaluator.
- It demuxes the composite signal, received from other station on VI Transformer in to 3 signals.
 - ◆ 5 KHz A Channel for Evaluation.

- ◆ 3.5 KHz B Channel later on converts it to 5 KHz for evaluator through frequency 3.5 KHz.
- ◆ FSK signal for receiver 1100/1300 Hz or 1500/1700 Hz.

2.1.6 Track devices

- Track devices are installed at Home signal & Advanced starter.
- Track devices detect the passage wheels/axles passing it.

2.1.7 Cable

- The frequencies 1100/1300 Hz and 1500/1700 Hz are different from the frequencies used for axle counters and therefore the multiplexer information as well as the axle counter track device (output of 4W/2W converter unit) information from station A to station B can go on one pair i.e. ½ PET Quad of main telecommunication. pair on the PET quad. Similarly the multiplexer information and axle counter track device information from station B to station A can go on another ½ PET quad of the main telecom. cable.
- The data is transmitted through the cable at the speed of 110 BPS.
- The bell code transmission is by transmission of 150-190 Hz. AC signal rectified & fed to Bell Relay, Telephone transmission takes place on one pair of wire.

3.0 OPERATION OF THE SYSTEM

3.1 In the conventional double line block instrument all the operations are performed by the receiving end station master. But in Axle Counter Block System, all operations are performed by sending end station master except for withdrawal /cancellation of line clear.

When it is intended to dispatch a train to the next station, the SM of the sending station pushes the TGT (Train Going To) button on his panel. If all the conditions for the reception of the train are satisfied at the receiving station, an indication of "Train Going To" (Green light) appears on the SM's panel at the sending station. Simultaneously an indication of TCF (Train Coming From) appears on the panel at receiving end station.

TGT indication on the panel enables the SM at the sending end to clear the Advanced starter at his station.

When the train enters in the block section, the green TGT indication disappears and a red indication of TOL (Train On Line) appears automatically on the SM's panels at sending end and receiving end, Green TCF indication disappears at receiving end. In addition buzzers ring at both stations to draw the attention of the station masters at both stations.

Information of departure of train into block section is given by sending end SM to receiving end SM on phone.

The SM at the receiving station clears the Home signal and receives the train.

Line closed (Yellow) indication appears automatically on the SM's panel at both Station, on complete arrival of Train.

3.2 Cancellation

Where a line clear has been obtained and it is afterwards found that the train to which it referred, has to be detained owing to any reason, the following procedure must be adopted:-

- If LSS (last stop signal) is not taken off SM should not clear the LSS.
- If LSS is already taken off, it must be put back to "ON " and SM should inform the driver of the train for which the LSS was taken off, regarding cancellation of the line clear obtained for the said train as per SR 3.36 (5) (ii).

For cancelling the " line clear " the following procedure must be adopted.

- Sending end station gives " call attention " to receiving end SM and informs that the train for which "Line Clear" has been obtained is being detained and the "Line Clear" is to be canceled. In support of this he gives a private number.
- Receiving end SM acknowledges and give consent by giving a private number. Also takes out the LCB Key and simultaneously presses Bell push button with SM's key "IN".
- At receiving end "Train Coming From" green indication disappears & "Line Closed" white indication appears on the Block panel. LCB Key is inserted and turned.
- At sending end, "Train Going TO" green indication disappears & "Line Closed" white indication appears on the Block panel.

NOTE : Next train can now be sent following the regular procedure & as per station working order.

3.3 Reset

It may be required to reset the Axle counter in very rare cases of extra ordinary conditions. It is necessary to take all precautions to verify the block section is free of vehicles before the reset operation is carried out in the system. The procedure is given below in clauses 3.3.1 and 3.3.2 for reset operation taking in to account of the working rules of Railway.

3.3.1 Reset push button : (Reset co-operation from sending end)

The receiving end SM requests the reset co-operation for resetting of axle counter after his verification of the last train passed in the section. The sending end SM presses the reset cooperation push button on the panel. This will actuate one of the Multiplexer Relays on the receiving end and is indicated by yellow LED glow near reset counter. This permits the receiving end SM to reset the Axle counter inserting Axle Counter reset key & pressing it for a moment.

3.3.2 Resetting of the Axle Counter : (Receiving end)

I. During Installation and Commissioning

The reset is applied in Axle counter by pressing the key actuator push button after the reset cooperation is obtained as given in para 3.3.1. The section verification is not required and the reset is applied in a normal course.

II. There can be following failures of block system :

Case I :

When the train has been received at the receiving station, but the “Line occupied” red indication remains on the panel. In such cases the receiving end SM verifies the clearance of block section by checking the last vehicle of the train at his station and initiates the following action-

- **If last vehicle has arrived :-** The receiving end SM requests the Reset cooperation from station in rear A station as per clause 3.3.1 after obtaining the reset cooperation by means of yellow LED indication available on panel. As soon as the reset relay in Axle counter is actuated the Axle Counter becomes Resetted when the key actuator is released in the SM's panel, the counter increments by one count only on successful reset of Axle Counter. The sending end reset cooperation is also to be withdrawn later. After the above procedure the Axle Counter gets resetted and line free indication of block section is available on the panel. The line clear for next train movement may be taken in a normal manner without the observation of caution order.
- When Last Vehicle could not be checked by receiving end SM it may be verified from station ahead, the receiving end SM initiates and follows the procedure for reset of Axle Counter given above. But the next train is allowed on caution order as per the Railway Working Rules.

Case 2 : Axle Counter fails without any train movement in the block section

The following may be the reasons :

- ◆ Tx/Rx coil broken/damaged on track side.

- ◆ Failure of cards in junction box & Axle Counter Evaluator.
- ◆ Failure of Advance/Home track circuits.

In such cases of failures the ESM is required to attend the failure. After rectification of fault, the SM of receiving end follows the resetting procedure and the Axle Counter is resetted. The line clear for the next train is taken and train is sent on caution order.

4.0 STATUS OF RELAYS DURING TRAIN WORKING

- 4.1 The following chart gives the position of relays at both stations for getting 'Line closed' condition on both 'up' and 'down' lines of the block section.

DESPATCH RELAYS AT SENDING STATION		RECEPTION RELAYS AT RECEIVING STATION	
ADV TPR	↑	AZTR	↑
SR	↑	BCR	↑
AMR	↑	ADV TPR	↑
		BPR	↑
AZTPR	↑	HOME TPR	↑
TGTR	↓	AMR	↑
TCFPR	↓	TCFR	↓
DR	↓	TGTPR	↓
TOLR	↓	TOLR	↓
BCPR	↑	ZR	↓
		BSMR	↓
		ASMR	↓
		AXPR	↓

- 4.2 The position of relays for getting 'Train Going To' and 'Train Coming From' on sending and receiving stations SM's panel respectively.

Assume the names of block stations as 'A' and 'B' and SM of the sending station takes 'line clear' for despatching a train from 'A' to 'B'.

S.M's key should be turned to 'ON' position at station 'A' and LCB key should be turned to 'ON' position at station 'B'

STATION - A DESPATCH RELAYS STATUS		STATION - B RECEPTION RELAYS STATUS	
S.M's key should be in 'ON' position		LCB key should be in 'ON' position	
ADV TPR	↑	AZTR	↑
SR	↑	BCR	↑
AMR	↑	ADV TPR	↑
		BPR	↑
AZTPR	↑	HOME TPR	↑

TGTR	↑	AMR	↑
TCFPR	↑	TCFR	↑
DR	↓	TGTPR	↑
TOLR	↓	TOLR	↓
BCPR	↓	ZR	↓
		BSMR	↓
		ASMR	↓
		AXPR	↓

NOTE - DR relay picks up (↑) when signal is lowered.

- 4.3** The status of Relays when 'Train On Line' indication appears on the SM's panel of both stations after the train has entered the block section completely.

STATION - A STATUS OF DESPATCH RELAYS		STATUS - B STATUS OF RECEPTION RELAYS	
ADV TPR	↓	AZTR	↓
SR	↓	BCR	↓
AMR	↓	ADV TPPR	↑
		BPR	↓
AZTPR	↓	HOME TPR	↑
TGTR	↓	AMR	↓
TCFPR	↓	TCFR	↓
DR	↓	TGTPR	↓
TOLR	↑	TOLR	↑
BCPR	↓	ZR	↓
		BSMR	↓
		ASMR	↓
		AXPR	↓

5.0 INSTALLATION

- Manual supplied with Axle Counter should be referred.
- The SM's panel is to be installed in SM's/ ASM's/ cabin in such a way so that the marked layouts of TGT/ TCF provided on the SM's panel is in correspondence with the actual layout.
- The SM's panel should be so installed to have sufficient space for opening the back door for connecting the MS couplers and for maintaining the circuits inside the SM's panel.
- Open the back door and take out the open ends of 24 pin and 19 pin MS coupler cables, through the respective holes provided at the bottom of SM's panel. The two M.S.Coupler plugs are to be tightened by rotating the couplers in clockwise direction
- The SM's key and L.C.B. key have to be inserted in their respective positions and turned to 'ON' position for normal operation of block. The reset key is to be inserted and kept in its position.
- The axle counter rack is installed in relay room with in 100 Mts. from SM's panel installation.
- The axle counter rack may be installed on a raised platform. EVR and SUPR are placed inside axle counter relay rack and wired with 16/0.2 PVC wires.
- The track side electronic junction box and respective track devices are installed near advanced starter and home signals on a minimum 3 rail length of closed track circuit.
- The track devices are located at 33 Mts. from the start of the track circuit & 6 Mts., from end of track circuit in the direction of train.
- Relay rack and axle counter rack are installed side by side.
- The relay rack and axle counter should have clear space of 650 MM. on front, back and any side to open the door for installation and maintenance.
- The rack is having provisional space for 24 plug in type QNA1/QNN1 relays. The plug in relays supplied are identified by the relay name and each is to be inserted in to its respective socket and clamped with relay clamp.
- Combiner/converter are installed at the bottom most space of the rack. Tighten the two 10 pin MS Couplers (plug) to the respective receptacles of combiner/converter sub system from the back side of the rack.
- The Rx-Mux is to be inserted in the middle of the rack. Install and tighten the two 14 pin M.S.Coupler and one 7 pin MS Coupler into their respective receptacles.

- The Tx-Mux sub system is to be installed above the Rx-Mux at the top slot. The Tx-Mux MS couplers are of 14 pin and 10 pin type and have to be tightened to their respective receptacles.
- The cable coming from SM's panel, axle counter rack, battery banks, advance and home lever circuit controller. Connections have to be terminated as per drawing supplied by the Manufacturer.
- Battery bank (+ 24 V) supply connections are made only at the final stage i.e. after completing and checking of all wiring. "Power on" switches of Tx-Mux, Rx- Mux must be kept in 'off' position and switched 'ON' only after ensuring the correctness of wiring.
- Cable coming from other station is directly terminated in relay rack as per drawing supplied by manufacturer.
- Axle Counter cable shall only be earthed at Evaluator end/combiner as the case may be, rest of the cable shall not be earthed at any point, wherever cable pair is to tapped out shield and armour of cable shall be made through insulated from each other.
- The track relay used shall be Q series plug in type - QT/QTA/QBAT followed by QN1/QNA1/QSPA1 need not be provided for trolley protection in block section.

6.0 EARTHING

- All equipment are to be earthed properly as per instructions given by Manufacturer.
- Earth resistance should not be more than 3 ohms.

7.0 COMMISSIONING

To be commissioned as per Manufacturer's instructions.

8.0 MAINTENANCE

8.1 Battery bank and battery charger (weekly)

- Check battery bank i.e. batteries electrolyte level, specific gravity and voltage.
- For efficient battery maintenance refer Hand book on lead acid secondary cell issued by IRCAMTECH, Gwalior.
- Inspect the charging equipment, measure charging current and ensure that it is adequate more than load current about 25%.

8.2 Relay rack (Fortnightly)

- Ensure that the retainer clips are holding the relays properly.

- Check proper sequential functioning of the relays as per the train movement.
- Check DC voltage to the relay rack, it should be within specified limit i.e. $24V \pm 20\% - 10\%$.
- Check the tightness and proper fitting of the fuses provided at the rear of the relay rack.

8.3 Transmitter Multiplexer (Fortnightly)

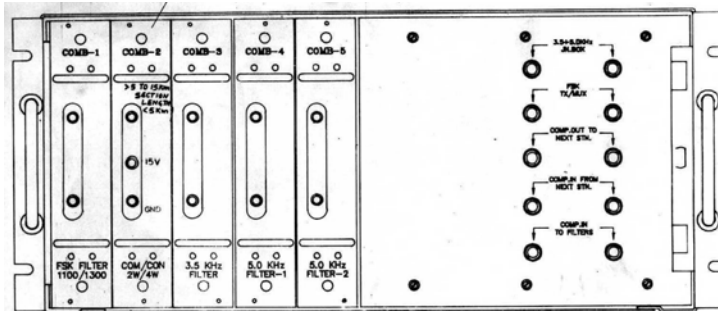
- Ensure that all PCB modules are properly inserted and confirm that the captive screws provided in the front plate are tight.
- Ensure that the MS couplers provided at the rear plate are tight.
- Ensure 10.8 ± 0.2 V DC at the socket provided on the front plate 8th module.
- Check the FSK signal output at the FSK socket provided in 3rd module. It should be in the range of $1.5 \pm 0.2V$. If necessary adjust the level with the potentiometer provided on the module. The locking nut of the potentiometer should then be tightened.
- On the same module a high/low switch will be available in same equipment high for block section length more than 5 Kms. & low for other wise.

8.4 Receiver Multiplexer (Fortnightly)

- Ensure that all PCB modules are properly inserted and the captive screws are tight.
- Ensure that the MS couplers provided at the rear plate are tight.
- Measure the DC regulated voltage at the 10 V sockets provided in 7th module. It should be $10.8 \pm 0.2V$.
- With a high impedance multimeter check the FSK signal output at the socket in 7th module. It should be $1.5V \pm 0.2V$ rms. (AC). If necessary adjust with the potentiometer. The locking nut of the potentiometer should be tightened after adjustment.

8.5 Combiner/Converter (fortnightly)

- Ensure that all PCB modules are properly inserted and the captive screws are tight.
- Ensure that the couplers provided at the rear plate are tight.
- With a high impedance digital multimeter check & maintain as shown in fig. 4, the following voltage levels at the monitoring socket of combiner / converter.



- ◆ 3.5 KHz + 5.0 KHz junction. box-1.2 to 1.6 V rms.(AC V)
 - ◆ FSK Tx-Mux -1.0 to 1.2V rms (AC V)
 - ◆ Combiner output to next station- more
- Fig. No. 4**

than 1.5 V rms.

- ◆ Combiner in from next station -more than 200 mV rms.
- ◆ Combiner in to filter -will be 50% to 70% of Combiner in from next station.

8.6 SM's panel (Fortnightly)

- Check the proper functioning of all push button switches/keys provided on SM's panel .
- Ensure proper cleaning of SM's panel. Ensure so that the indications provided on panels are properly visible.
- Ensure that panel is free from vibrations during train movement. Tighten surface mounting bolts if necessary.

8.7 Axle counter (Weekly)

8.7.1 Check for the following level at Electronic Junction Box in field.

- Oscillator Voltage output 60V \pm 10% (RMS).
- Oscillator Frequency 5000 \pm 20 Hz.
- Oscillator current 420 mA \pm 10%.
- Ensure the Receiver coil output to- more than 1.2 V without EJB on single rail coils.
- More than 1.0 V with EJB. on single rail coils
- Check the EJB output-more than 1.0V RMS.

8.7.2 Evaluator

- Check at Evaluator check all PCB cards are properly inserted and the captive screws are tight.
- Ensure that the MS couplers provided at the rear side are tight.
- Ensure that all channel's individual levels at card no.1 are $05 \text{ mV} \pm 5$.
- Ensure that EV / SUP relay voltage is more than 10 V DC of universal axle counter.
- Ensure that BY 127 diode is fixed across the coil of EV/SUP Relays.

9.0 DO's AND DON'Ts

9.1 DO's

- Tighten all the couplers properly in the combiner/converter and Mux/ Receiver/ Mux-Transmitter.
- Insert fuse holders provided in the relay rack (F1 to F4) properly.
- Insert all the cards properly in the mother board before replacement of new cards, since any loose fitting of these cards can also lead to error condition.
- Avoid rough handling of relays during insertion and removal.
- Check proper earthing.

9.2 DON'Ts

- Insert or remove cards from Mux-Transmitter or Mux-receiver when the 'Power ON' switch is in 'ON' position.
- Operate bell plunger push button for exchanging block codes when telephonic conversation is taking place.
- Apply oil/grease on push buttons.

FAULT CHART FOR MUX TRANSMITTER ERROR CARD 1

SR. NO.	ERROR NO.	ERROR DESCRIPTION	ERROR DUE TO	CARDS TO BE REPLACED
1	2	3	4	5
1	E1	bit-by-bit error for gr-1	Input & local decoded outputs in Gr-1 not matching (channel A to channel F) i. Input-1 card not multiplexing the input correctly. ii. local decoding is not proper in decoder card. iii. decoding is OK but XTAL card is not giving proper matching output	1. Input- card 1 2. Decoder card 3. XTAL card 4. Error-1 card
2	E2	All output in Gr-1-Zero error	All inputs in Gr-1 i.e. CH-A to CH-F become zero level. all locally decoded received output become zero level.	1. Input-1 card 2. Decoder card 3. XTAL card 4. Error-1 card
3	E3	Clock Error-I	Clock circuits AQ clock, BQ clock not functioning or large mismatch in their timings.	1. XTAL card 2. Error-1 card
4	E4	Clock Error II	-----do-----	1. XTAL card 2. Error-1 card
5	E5	Gr-1 parity Error	Parity Generation bit is not according to inputs available to system i.e. CH. A to CH. F Even inputs = parity bit (0) Odd inputs =Parity bit (1)	1. XTAL card 2. Input- 1 card 3. Error-1 card

6	E6	bit-by-bit error for Gr.II	Inputs & local decoded outputs in Gr.-II not matching (i.e. CH-G to CH-L) i.) Inputs -2 card not multiplexing the input correctly. ii.) Inputs-1 card not processing the multiplexed input correctly. iii.) decoder card is not properly decoding the locally received outputs. iv.) Decoding is OK, but sync. card is not giving proper matching output.	1. Input-2 card 2. Input -1 card 3. Decoder card 4. Sync card 5. Error -1 card
7	E7	All output in Gr-1 zero error complimented	i.) All inputs in Gr-1 CH-A to CH-F become zero level. ii.)All locally decoded received output becomes zero level.	1. Input-1 card 2. XTAL card 3. Error-1 card 4. Card 2 of CC
8	E8	Gr-1 parity error complimented	Parity generator bit for Gr-1 is not according to inputs available to system	1. XTAL card 2. Decoder card 3. Input-1 card 4. Error-1 card

FAULT CHART FOR MUX TRANSMITTER ERROR CARD-2

SR. NO.	ERROR NO.	ERROR DESCRIPTION	ERROR DUE TO	CARDS TO BE REPLACED IN SEQUENCE UNTILL THE ERROR GETS REPLACED
1	E9	Gr-1 input all zero error complimented.	All inputs in Gr-1 CH-A to CH-F become zero level.	1.Input -1 card 2. Error-2 card
2	E10	Gr-2 input all zero error complimented.	All inputs in Gr-2 ch-G to ch-L become zero level.	1.Input-1 card 2. Error-2 card
3	E11	Gr-2 parity error complimented.	Parity generation bit for Gr-2 is not according to inputs available to system.	1. Sync card 2.Input-2 card 3.Error-2 card 4.Decoder card
4	E 12	All out[put in Gr-2 zero error complimented.	All inputs in Gr-2 ch-G to ch-L become zero level.	1.Input-2 card 2.Decoder card 3.Sync .card 4.Error-2 card
5	E13	Gr-2 parity error	Parity generation bit is not according to inputs available to system i.e. ch -G to ch-L Even input =parity bit (0) odd input = parity bit (1)	1. Sync. card 2. Input-2 card 3. Error-2 card
6	E14	All outputs in Gr-2 zero error.	All inputs in Gr-2 i.e. ch G to ch L become zero level	1. Sync. card 2. Decoder card 3. Input-2 card 4. Error-2 card 5. Input-1 card
7	E 15	Sync. clock Error-1 complimented	Clock circuits AQS,BQS not functioning or large mismatch in their timings.	1. XTAL- card 2. Sync.-card 3. Error-2 card
8	E 16	Sync. clock Error -2 complimented.	Clock circuits AQS, BQS not functioning or large mismatch in their timings	1. XTAL- card 2. Sync.-card 3. Error-2 card
9	E 15	Sync. clock Error-1 complimented.	Clock circuits AQS, BQS not functioning or large mismatch in their timings.	1. XTAL- card 2. Sync.-card 3. Error-2 card

FAULT CHART FOR MUX RECEIVER- ERROR CARD-1

SR. NO.	ERROR NO.	ERROR DESCRIPTION	ERROR DUE TO	CARDS TO BE REPLACED IN SEQUENCE UNTILL THE ERROR GETS REPLACED
1	E1	Relay driver-1 proving	i) Relay driver-1 card not inserted properly. ii) Error-1 card going faulty.	1. Insert relay driver-1 card properly. 2. Error-1 card
2	E2	All outputs in Gr-1- zero error.	All output in Gr-1 i.e. ch-A to ch-F become zero level	1.Decoder card 2.XTAL- card 3.Error-1 card
3	E3	Clock error-1	Clock circuits AQ clock BQ clock not functioning or large mismatch in their timings	1. XTAL card 2. Error-1 card
4	E4	Clock error-11	Clock circuits AQ clock BQ clock not functioning or large mismatch in their timings	1. XTAL card 2. Error-1 card
5	E5	Gr-1 parity error	Parity generation bit is not according to inputs available to system i.e. ch -A to ch-F Even input=parity bit (O) odd input = parity bit (1)	1. XTAL card 2. Input-1 card 3. Error-1 card
6	E6	Relay driver-2 proving	i) Relay driver-2 card not inserted properly. ii) Error-1 card going faulty.	1. Insert relay driver-2 card properly. 2..Error-1 card
7	E7	All output in Gr-1 zero error complimented	i.) All inputs in Gr-1 CH-A to CH-F become zero level. ii.)All locally decoded received output becomes zero level.	1. Input-1 card 2. XTAL card 3..Error-1 card
8	E8	Gr-1 parity error complimented	Parity generator bit for Gr-1 is not according to inputs available to system	1. XTAL card 2. Decoder card 3. Input-1 card 4. Error-1 card

FAULT CHART FOR MUX RECEIVER ERROR CARD-2

SR. NO.	ERROR NO.	ERROR DESCRIPTION	ERROR DUE TO	CARDS TO BE REPLACED IN SEQUENCE UNTILL THE ERROR GETS REPLACED
1	E9	Relay driver -3 proving	Relay driver-3 card not inserted properly.	1. Insert relay driver-3 card properly. 2. Relay driver -3 card 3. Error -2 card
2	E10	Relay driver -4 proving.	Relay driver-4 card not inserted properly.	1. Insert relay driver-4 card properly. 2. Relay driver -4 card 3. Error -2 card
3	E11	Gr-2 parity error complimented.	Parity generation bit for Gr-2 is not according to inputs available to system.	1. Sync. card 2. Error-2 card 3. Decoder card
4	E12	All outputs in Gr-2 zero error complimented.	All inputs in Gr-2 i.e. ch G to ch L become zero level	1. Sync. card 2. Decoder card 3. Error-2 card 4. Check quad cable connection & loss
5	E13	Gr-2 parity error	Parity generation bit is not according to inputs available to system i.e. ch-G to ch-L Even input=parity bit (0) odd input = parity bit (1)	1. Sync. card 2. Error-2 card
6	E14	All output in Gr-2 zero error	All inputs in Gr-2 i.e. ch G to ch L become zero level	1. Sync. card 2. Decoder card 3. Input-2 card 4. Error-2 card 5. Input-1 card
7	E15	Sync. clock Error-1 complimented.	Clock circuits AQS, BQS not functioning or large mismatch in their timings.	1. XTAL- card 2. Sync.-card 3. Error-2 card
8	E16	Sync. clock Error -2 complimented.	Clock circuits AQS, BQS not functioning or large mismatch in their timings	1. XTAL- card 2. Sync.-card 3. Error-2 card