INSTALLATION OF AXLE COUNTER

1. Introduction

Axle counters were developed as a solution of track circuit.

There are four types of axle counter systems used in Indian Railways:

- 1-D system
- 2-D system
- 3-D system
- 4-D system

2. Installation

2.1 Outdoor Equipment

i) The track device is fixed in the centre of track circuit in case of single line section. In case of double line section, the device is fixed either in the centre or at the end of track circuit depending upon the length of track circuit provided, so that in case of wrong side movement the axle counter should work satisfactorily.

ii) The track device is not to be fixed under any circumstances within the sleepers carrying the rail joints.

iii) The track unit is installed on a closed track circuit.

iv) Since the track circuit is necessary to prevent operation of system by insulated trolley, care is to be taken to reduce the length of track circuit by using minimum number of relays for achieving minimum drop away time

v) The separation between two track devices of different axle counter system should be at least 3 meters, so as to, avoid mutual interference.

vi) The clear spacing between two sleepers in which both the track devices are fixed is minimum 520 mm.

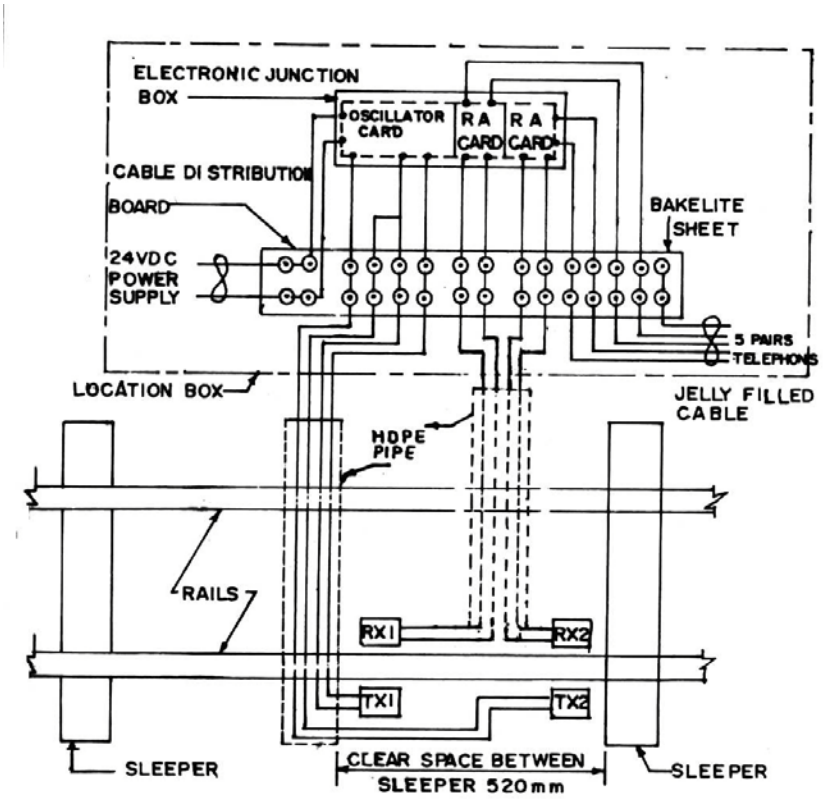
vii) The design of track device is suitable for 52 Kg , 60 Kg rails.

viii) The maximum size of packing required are as follow:-

A) For 52 Kg- 6mm (3mm X 2 packing)
B) For 60 Kg- 12mm (3mm X 4 packing)

ix) The transmitter and receiver coils are provided with 10/15 meter length lead cable and have to be taken directly to location box with out any loop i.e. Tx. coil and Rx. coil should be provided in zigzag manner.

x) These cables are carried in HDPE (high density poly-ethylene) pipe for safety and laid not less than 1 meter below from bottom of rail.



RDSO Drg. No. SDO/UAC-326
Figure - 1

xi) A transmitter and receiver cables are run separately at a minimum separation of 500 mm. Transmitter and receiver cables of individual track devices are to be laid in different pipes.

2.1.1 Cable

For connecting the output of EJB (Electronic Junction Box) to evaluator, the following cables are to be used:

Type of cable	**Specification No.**
i) 4 Quad axle counter cable	TC-30
ii) 4 Quad axle counter cable	TC-31
iii) PET quad of main telecom. cable	TC-14/75
iv) Polythene jelly filled telephone cable	TC-41/90

2.1.2 Procedure for fixing track device

i) Fixing of base plate :

- Base plate can be fixed from any direction as design is same on either side of Tx. and Rx coils.
- The base plate is fixed with the help of bolts, nuts and rail clamp. The nuts and bolts is fully tightened and locked by means of lock washers to prevent any movement related to rails during passing of train.
- To avoid the fitting getting loosened due to passage of train proper leverage is used for tightening.(It should be tighten with slotted nut through split pin in it if possible

ii) Fixing of Transmitter and Receiver coil Assembly

- After fixing base plate, receiver and transmitter coil assemblies are to be fixed on base plate with the help of four bolts.

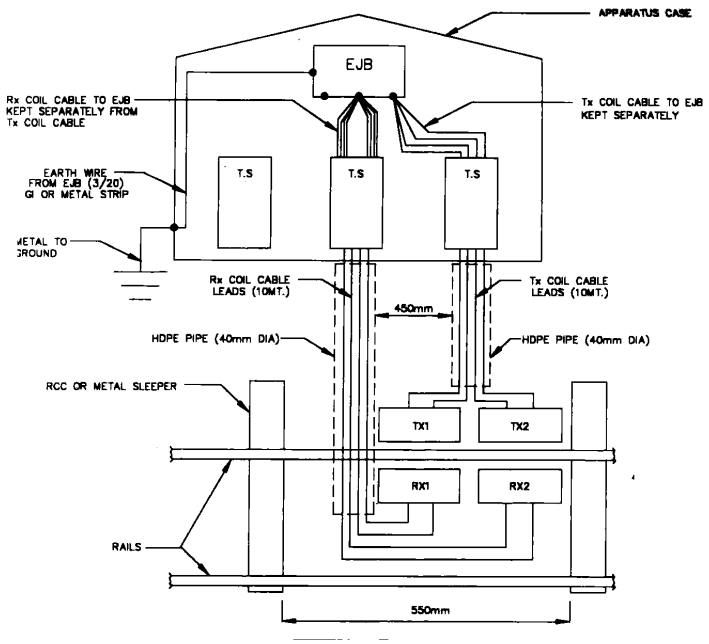


Figure - 2

- The base of transmitter assembly should butt against the foot of the outer side of rail. Required number of nylon packing piece (minimum 3mm packing) should be placed between the base plate and transmitter base.
- The receiver coil assembly is fixed on the inner side of the rail and a paper gap should be available between receiver housing and the rail web. This gap is essential to protect the receiver coil from any damage due to vibration of rail. Similar to transmitter coil, nylon-packing piece/pieces should be used below the receiver housing.

- It should be ensured that transmitter coil assembly and receiver coil assembly is fixed parallel to each other and in the same centre line.

iii) Procedure for fixing Rail Deflector.

- To protect the track fittings against damage from hanging parts of moving train, rail deflector plates are mounted on both sides of the fittings.
- These deflector plates are fitted to deflector clamp with bolts and nuts on each side.
- These plates are installed in the sleeper space (approximate 30 cm to 40 cm away from the track fittings.
- Before fixing deflector plates, it should be ensured that the transmitter deflector plate (smaller width) comes in front of transmitter and Receiver deflector plate (larger width) comes in front of receiver.

iv) Trolley protection track circuit:

- Trolley protection track circuit is of closed track circuit type.
- The length of track circuit depends on the type of track relay used and its drop away time. Normally Q- type track relay (9 ohm) is used.
- The recommended distance between the block joint and the installation of track device in the direction of train movement are tabulated for different speeds in table –1:

Table - 1

Speed in KMPH	Minimum Distance	
	Shelf type	**Q-type**
15	5.4 m	08 m
50	16.2 m	08 m
90	32.5 m	20 m
100	36.1 m	20 m
120	43.3 m	20 m
140	50.6 m	20 m
160	57.8 m	33 m
200	72.2 m	33 m

- The length of track circuit in terms of rail length for single and double line section for different speeds using Shelf type, Q type track relay is given in table 2.

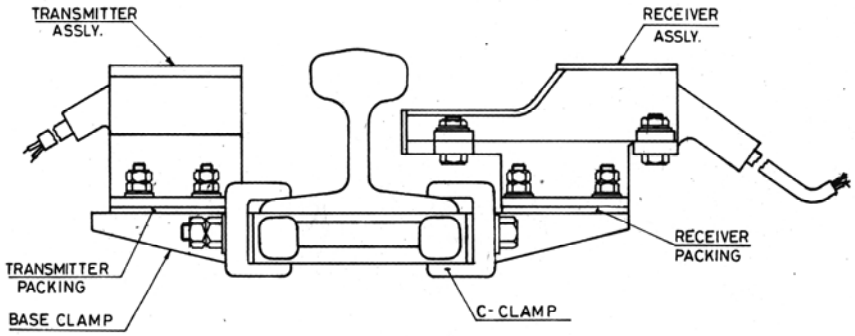
Table - 2

Speed in KM/ PH	Length of track circuit with track device in centre		Length of track circuit with track device at distance given in table 1	
	For single line		For double line	
	Shelf type track relay	Q-style Track relay	Shelf type track relay	Q-style Track relay
15	1T	1T	1T	1T
50	3T	1T	3T	1T
90	5T	2T	4T	2T
100	6T	3T	4T	2T
120	7T	3T	4T	2T
140	8T	3T	5T	2T
160	9T	4T	6T	3T
200	12T	5T	7T	3T

- In AC area, it is preferable to have 'QT2' (2F/2B for block proving by axle counter and QT2/ 2F/1B for other axle counter use) type relay to be kept at location. This relay is having less drop away time. The repetition of this relay is 'QNA1' type.
- In non-AC area, QT2 relay along with QN1 should be used for trolley protection purposes.

2.1.3 Adjustment of Track Device

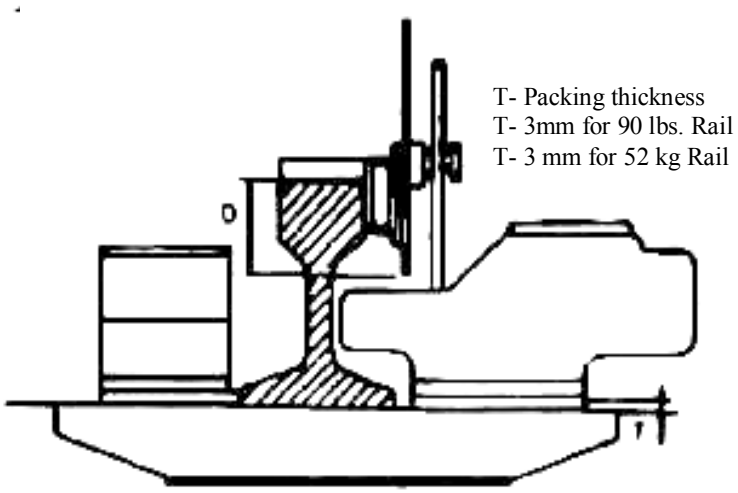
- Keeping the transmitter coil on the single rail clamp butting against rail, maximum output from receiver coil is obtained (without any packing on coil).
- Select the no. of nylon packing up to 12 mm for rails of 60 kg step by step below the transmitter coils to obtain the maximum output on receiver coils.
- Under the above condition, the out put of Rx coils should not be less than 1.2 V (rms) without EJB load and 1.0 V(rms) with EJB load as shown below.



TRACK DEVICE ASSEMBLY
Figure - 3

2.1.4 Wheel Dip

- Dummy wheel is a metallic plate which when placed in between the transmitter and receiver coils, parallel to track causes a 'Dip' in the receiver coil signal similar to one caused by an actual wheel.
- A dummy wheel has graduated markings to enable it to be set for the type of rails on to which track devices have been fitted as shown below.



Where "D" is the distance from the rail level to the lowest edge of the dummy wheel.

Figure – 4

Ex. For 52 KG rails, proper wheel dip adjustment is obtained by setting the dummy wheel at 52 mm mark Having adjusted for dummy wheel to 52 mm mark, it is placed on receiver coil housing with its support brackets so adjusted that the plate remains vertical. Sensitive Multi-meter is to be connected across receiver coil. The receiver coil have been designed to give normal output signal of more than 1.0V (rms) without wheel, which falls to less than 10% when the dummy wheel is placed centrally and vertically on track device.

- Wheel dip adjustment are made by changing the position of transmitter body on the base plate by moving forward or backward and observing the receiver coil signal on CRO or Multi-meter when a dummy wheel is moved over the track device.
- Ensure that there is no possibility of double dip. Keeping the dummy wheel to left side of track device and slowly moving it to right side of track device. Monitor the Multi-meter reading and ensure that the value is once coming to lower side not twice.
- After final adjustment, all nuts bolt connections are checked and secured properly.

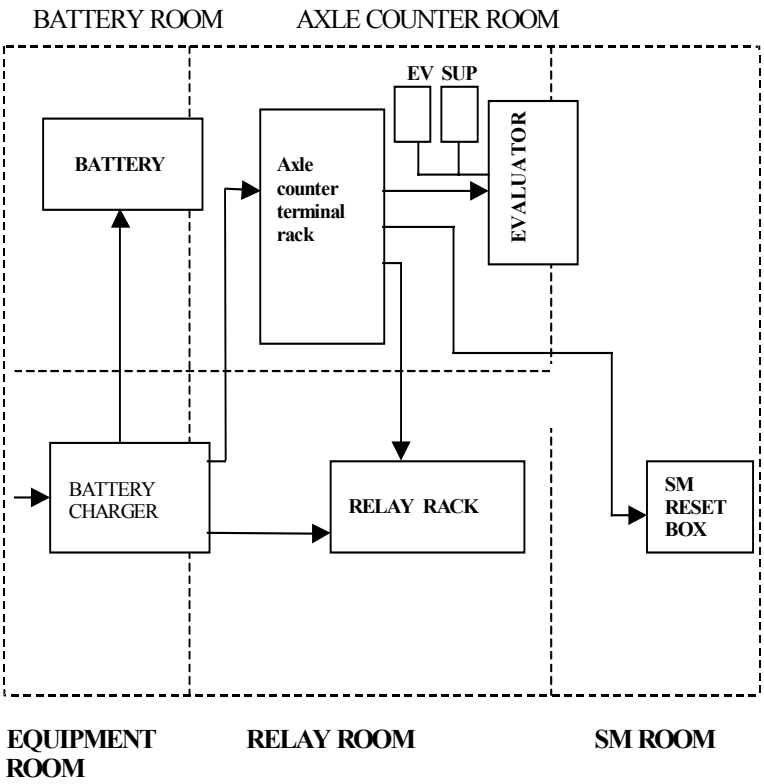
2.2 Indoor Equipment

The indoor equipment consists of

2.2.1 Cable termination cum relay rack
2.2.2 Evaluator system
2.2.3 SM reset box
2.2.4 Line verification box
2.2.5 Power supply arrangement

2.2.1 Cable termination cum Relay rack

In cable termination cum relay rack, all the incoming cable from field, outgoing cables to evaluator, relay rack, batteries, battery charger and SM room are terminated.



AXLE COUNTER EQUIPMENT CABLING ARRANGEMENT

As Per RDSO DRG No.SDO/UAC-347

Figure – 5

Also all the trolley suppression track-repeating relays are installed on this rack. Depending upon the termination of cables, the rack is divided in to three parts:

a) Power supply bus bars
b) Trolley suppression track relays/ Axle counter relay
c) Cable termination

a) Power supply bas bars:

i) Three buss bars from batteries/battery charger for DC-DC converter, reset box and track clear proving relays are terminated on upper portion of this rack.
ii) Individual fuses as per IRS specification no. S:78-92 are to be provided for each dc-dc converter reset box and track clear proving relays.
iii) The fuses are fixed on 12 mm Bakelite sheet. The –ve bus bar is of 3 mm copper strip.

b) Trolley suppression relays:

i) Track repeating relays of Q style (QNA 1 or QN1) for trolley suppression tracks are fixed below the bus bar (two row, each of 8 relays are provided in the rack).
ii) These relays are mounted on anodized square bars. The +10V feed from evaluator for trolley suppression circuit of the evaluator is taken though the pick up contact of these relays when track device is fixed in the track circuited area.

c) Cable termination

i) All the incoming, outgoing and internal terminations are done on bottom side of the rack.
ii) The termination is carried out on 8 way barrier terminal block preferably of PBT material fixed on 12 mm Bakelite sheet.
iii) In this the terminations are divided in 12 rows.

a) A, B, C and D rows are for incoming channels voltage levels from EJBs.
b) Whenever track device channel is common to two evaluators, the requisite looping of channel can be done in E row.
c) F,G and H rows are for reset box termination.
d) J row has been used for trolley protection circuit i.e. incoming cables from evaluator and outgoing cables to evaluator after proving relays pick up contacts.
e) K row is used for final track clear proving relay circuit.
f) L and M rows are for field cable for trolley suppression relays and their repetition to the relay rack or vice versa.

Installation of cable termination rack.

i) The installation of this rack is similar to Siemen's relay rack with provision of insulators.
ii) The position of this rack should be such that it is as near as possible to evaluator.

2.2.2 Evaluator system

The following constitutes evaluator system

a) Base channel
b) Axle counter cabinet
c) Evaluator with DC DC converter module
d) EVR and SUPR relays
e) RB plate
f) Display unit
g) CLR and Occupied indication
h) Final track clear proving relay

a) Base channel

It is a unit in which evaluator rack is to be erected.

This is having holes for erecting the rack as well as erecting base channel on RCC platform. Base channel is also having anti vibration pads on the top surface, which takes care of any damage to evaluator due to vibration. It should be fixed on RCC platform by grouting MS bolts.

b) Axle counter cabinet

There is one type of cabinet:

20U Rack

It can house one set of evaluator with 10 cards which includes dc dc converter module are to be fixed. The bottom space is left for TB plate, air circulation etc.

Installation of cabinet

i) The axle counter cabinet should be installed in a axle counter room/ relay room or at a location, which is not accessible to unauthorized persons.

ii) It should be installed as per RDSO drg. No. SDO/UAC – 336 shown below so as to, protect from rain water. With this arrangement the maintenance personnel will have easy access to TB plate of evaluator.

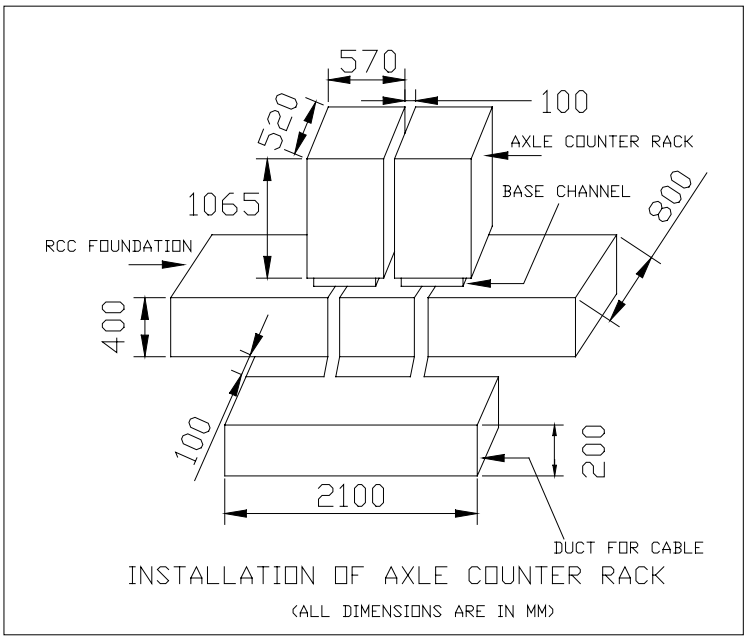


Figure – 6

iii) As far as possible, the cabinet should be located away from any source of heavy electromagnetic interference like industrial machinery, motor, generator or welding plants.

DC-DC converter

i) DC – DC converter should be as per specification no. RDS/SPN/121/92.
ii) The output of DC-DC converter are +5V, +10V with common ground and 10V (Isolate).
iii) The input of dc-dc converter is 24V (+20% to – 10%).
iv) DC-DC converter module should be fitted inside evaluator.
v) DC-DC converter module inspected by RDSO, are only to be used.

Installation of DC-DC converter module

i) The DC-DC converter is fixed inside the evaluator.
ii) The connection to evaluator is made through Euro connector.
iii) Power supply from TB plate to dc-dc converter is connected by means of 2 core shielded cable. The other end of this cable is connected to –ve and +ve of 24 +V of input of MS coupler. Finally the 24V input supply is taken to 10^{th} module of evaluator through Jalex converter.

c) Installation of evaluator

The evaluator chassis is fixed inside the rack with nuts and bolts. The external connection to termination plate is made through, 2 nos. of 10 pin MS coupler and 1 no. of 7 pin MS coupler for 2D/3D and 4D system.

All the modules are fitted with Euro connectors (64 pins) and these modules are plugged in the 64 pins

receptacles fixed on mother board. These modules are fixed in position by front end tightening screws. The four couplers cater for the following connections.

Evaluator input

i) Eight input wires for 4 channels in case of 2D system and 16 input wires for 8 channels in case of 3D/4D system coming from the cable termination rack, are connected through MS coupler. The first 4 channels are connected through a 10 pin coupler and other four channels through another 10 pin coupler.
ii) The 14 pin coupler is used for:
    a) EVR and SUPR relays output.
    b) Trolley suppression circuits.
    c) Reset circuit.
iii) A cable having 7 pin MS coupler is used for connection to dc-dc converter in the evaluator, as 24V input. The generated output of +5 V, +10V and +10V isolated supply from dc-dc converter is taken directly in the motherboard to the cards.

Evaluator output

For connecting evaluator output to EVR and SUPR relays, (non-immunized) with 4F/B metal to carbon contacts, two pairs of shielded cable, one pair for each relay with one end terminated to TB plate and other end to relay. A BY 127 diode was connected across each relay coil.

d) EVR and SUPR relays

i) The EVR and SUPR relays are of 12V/100 ohms DC neutral line relays (non-immunized) with 4F/B metal to carbon contacts.
ii) These relays can either plug in type 9QS3) or shelf type.

Installation of EV and SUP relays

i) Plug in type (QS3) relays are fixed on MS angle (plated) whereas shelf type relays are mounted on alluminium tray provided in the rack.
ii) Alluminium tray for fixing EVR and SUPR relays is provided.
iii) Relays output is provided with BY 127 diode to suppress the transient voltage (more than 800 V) generated when the relays drop and can affect the fast acting sensitive LS TTL ICs used in the evaluator.

Caution: The internal cabling is already done at factory with two nos. of QS3 plug boards already mounted in relay module. Only external wiring has to be done at site.

e) Termination box plate

All outgoing and incoming connections are terminated on this plate. This fixed on back bottom side of the rack. Other end of the cables have MS coupler at one

end are terminated on terminal block no. 1,2,3,4,& 5 in case 2D,3D and 4D systems. TB1 is for EVR and SUPR relay contacts, which are used for reset box. The wires from evaluator are terminated on right hand side of terminals and wires from cable termination rack are terminated on left-hand side of terminals.

f) Display unit

The display unit card is having seven segment counts display and is connected to counter comparator card through flat cable connectors 16 pins. The IN and OUT count information is available for maintenance personnel. Whenever the cable is removed and reconnected, the random counts are to be reset.

g) CLR and OCC indications

Separate indications for axle counter CLR and OCC conditions has been provided on strip plate to front side. These indications are helpful for maintenance personnel and it is just the replica of the indications available in SM reset box.

h) Final track clear proving relay (AZTR)

This relay indicates the position of the axle counter and trolley suppression track circuit. The pick up contacts of EVR, SUPR and trolley suppression track circuit (TPRs) are proved.

In case trolley suppression track circuit is not provided for cross over track device, final track clear proving relay picks up with EVR and SUPR relay contacts only.

To avoid dropping of HR relay (when final track clear proving relay has been used in HR circuit) due to push trolley movement over track device, AZTPR front contact should be by-passed with HR front contact.

2.2.3 SM reset box

i) This unit is placed on a teakwood or hylum sheet shelf supported by MS angle in SM room and is used to reset axle counter system in case of failure or during testing and maintenance of axle counter system. The wiring details are available inside of the top cover.
ii) The connections between SM reset box and cable termination rack of axle counter should be made by 5 pair switch board telecom. cable taken in PVC conduit pipe and connection directly on SM reset box terminal strips.
iii) Reset switch also operates a counter. Counter readings should be recorded in the register maintained for this purpose indicating the reasons for each resetting. Counter will move to next number only when actual resetting has taken place.

iv) It should be ensured that no resetting is done when the section is occupied or when the train is likely to

be received in the axle counter controlled sections. A typical wiring is shown on next page.

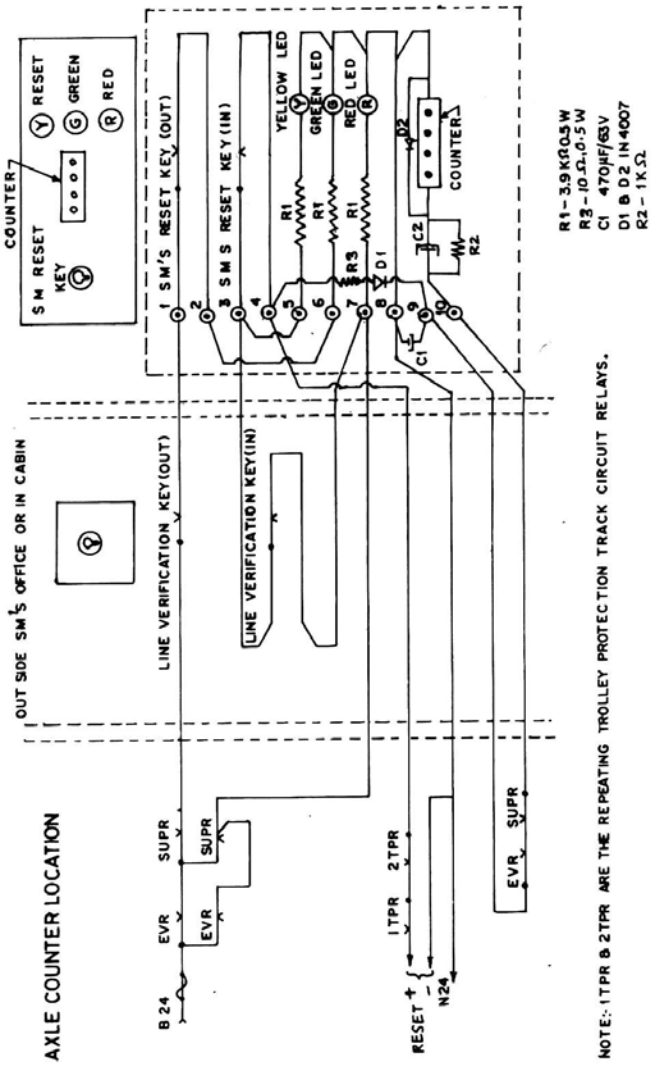

COUNTER
SM RESET KEY
Y RESET
G GREEN
R RED
1 SM'S RESET KEY (OUT)
3 SMS RESET KEY (IN)
YELLOW LED
GREEN LED
RED LED
R1
R3
D1
C1
C2
R2
IC2
COUNTER
OUT SIDE SM'S OFFICE OR IN CABIN
LINE VERIFICATION KEY(OUT)
LINE VERIFICATION KEY(IN)
AXLE COUNTER LOCATION
B 24
EVR
SUPR
ITPR
2TPR
RESET + -
N24
R1 - 3.9 KΩ 0.5 W
R3 - 10 Ω, 0.5 W
C1 470 MF/63V
D1 & D2 IN4007
R2 - 1 K Ω
NOTE: ITPR & 2TPR ARE THE REPEATING TROLLEY PROTECTION TRACK CIRCUIT RELAYS.

Figure – 7

v) Resetting should be done only when it is ensured that the controlled track section is free from any obstruction and same, is communicated through a line verification box actuation. Two types of circuits for wiring of reset box are available.
   a) Wiring of axle counter when used in station yard.
   b) Wiring of axle counter when used in IBS and axle counter block.

Circuit description

i) In case EVR or SUPR drop, RED LED will glow indicating section is occupied.
ii) When both EVR and SUPR pick up GREEN LED will glow.
iii) When axle counter fails and resetting procedure has been initiated i.e. controlled track section is free from any obstruction and line verification key is actuated SM will actuate his key for resetting and if the system gets reset, GREEN LED will glow.
iv) Resetting is possible only when trolley suppression track relays are up.
v) In case of IBS or axle counter block the line verification key can be kept with other section.
vi) Resetting is possible only when SM reset keys and line verification key are “N”.

2.2.4 Line verification box

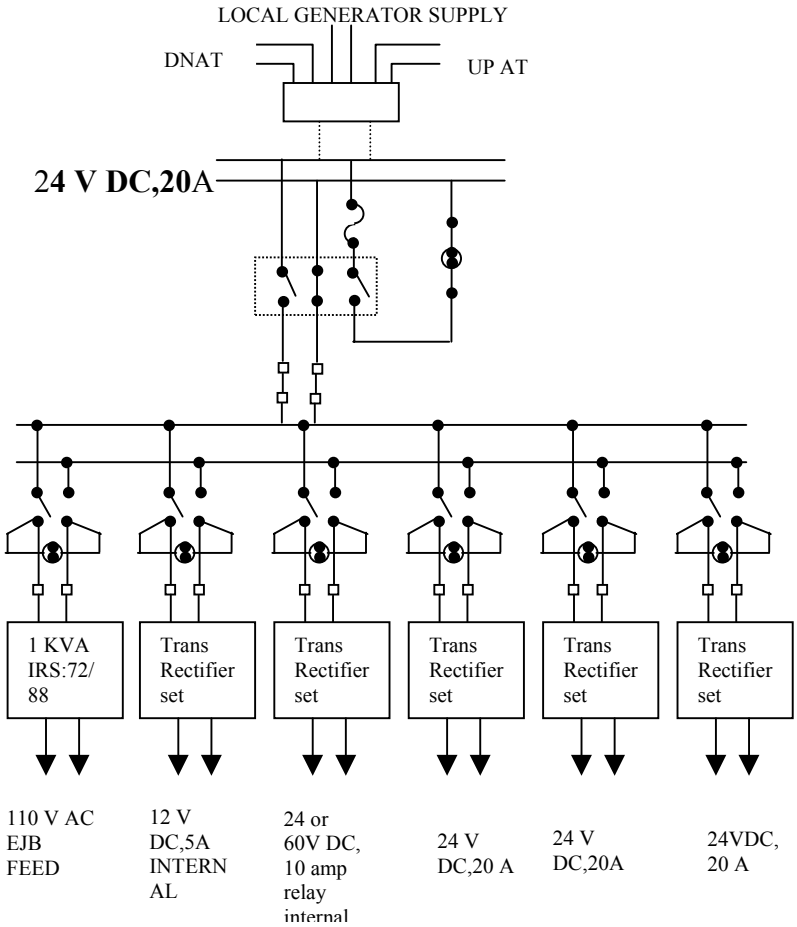
The line verification box has to be fixed outside SMs office (when axle counter is used in station yard).

For fixing of line verification box, two bolts are to be fixed on the wall and a through hole in the wall is required to carry the wires. In case number of line verification box are more common base plate can be used for fixing the same. The wiring has to be done with 16/0.2 wire on the terminals provided in the line verification box. Care has to be taken that all the line verification box keys are of separate wards.

For easier identification axle counter number should be painted on line verification box so that in case of failure of axle counter particular axle counter only be reset.
In case of IBH or axle counter block, line verification box has to be kept with SM or other station.

2.2.5 Power Supply Arrangement

The various power supplies and its equipment required for axle counter are shown as per RDSO drg. No. SDO/UAC/ 343 on next page.



POWER SUPPLY ARRANGEMENT
Figure – 8

3. Earthing of Axle Counter System

Earthing arrangement consists of one or more galvanised iron pipes of not less than 38mm internal diameter and not less than 2.5 m in length with spike at one end and a lung at the other for connecting earth lead. The pipe is embedded vertically, leaving the lug portion above the ground as shown below.

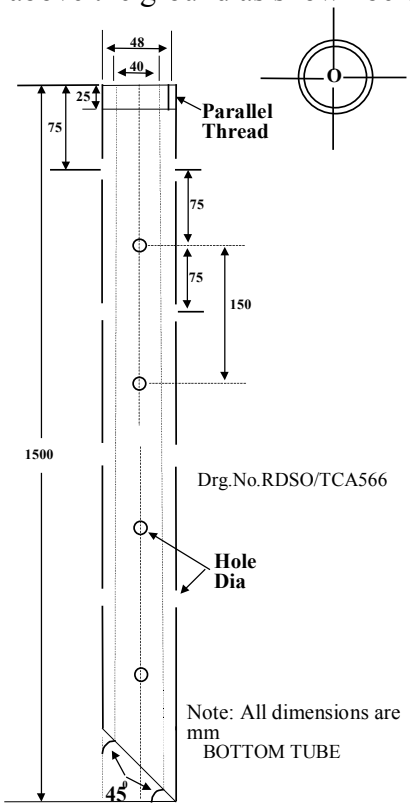


Figure – 9

3.1 Treatment of soil

To reduce the resistivity of the soil, it is necessary to dissolve in the moisture normally contained in the soil some substance, which is highly conductive in its water solution. In case of salt and soft coke and salt and charcoal mixture, the earth electrodes should be surrounded in the earth pit by alternate layers of finely divided coke, crushed coal or charcoal and common salt for at least 150mm all round. Addition of less than one part by weight of salt of 200 of soil mixture has been found to reduce to resistivity by 80%.

The earthing arrangement should be located in the natural soil, as far as possible. The made up soil is likely to be eroded by weather.

3.2 Earth lead wires

The lead wires connecting the installation and the earth electrode shall ordinarily be of stranded copper wire of 29mm^2 (19 strand wires of 1.4 mm dia.). Copper wire has been specified because GI wires usually subject to greater corrosion. However, in areas where copper wire may be subject to frequent loss by theft, ACSR of size 64mm^2 (19 strands of 2.11 mm dia can be used.).

3.3 Limits of the earth resistance

Maximum values of the earth resistance specified for earthing axle counter system are as given in table-3.

Table – 3

1	Earth for lightening discharger	Should not be more than 10 ohms.
2	Earth for equipment	Should not be more than 10 ohms.
3	Jelly filled telephone cable in RE area	Should not be more than 5 ohms.
4	Aluminum sheathed telecom cable screened in AC electrified area.	Should not be more than 1 ohms.
5	4 quad axle counter cable screened in AC electrified area	Should not be more than 1 ohms.
6	Jelly filled/ 4 quad non RE axle counter cable armouring	Should not be more than 1 ohms.

3.4 Equipment to be earthed

Separate earthing should be provided for the following:

All the axle counter racks in the room shall be connected together separate earthing.

Metallic sheath and armouring of all underground main cables.

a) In RE area the metallic sheath and armouring of main telecom cables are earthed at both ends.
b) In RE area the armouring of jelly filled telephone cable shall be earthed at both end.
c) In non RE area the armouring of axle counter cable shall be earthed at one end i.e. at evaluator end.
d) The earthing shall be provided at every location box, where cables are terminated.
e) It is not necessary to earth the sheath and armouring of screened cables or armouring of unscreened cables when they are used as a tail cables except in special cases where the length of the tail cable exceeds normal prescribed limits.
f) Where a number of cables are run together, it is advantageous to earth each cable separately.

3.5 Precautions to be taken during earthing

- The earth electrodes shall be free from paint, enamel or grease.
- Under ordinary conditions of soil, GI or MS electrode is used.
- In areas where corrosions are likely to be excessive it is preferable to use either copper or copper clad electrode.
- The length of electrode should not be more than 2.5 meter.
- When a rocky soil is encountered at a depth of less than 2 meter the electrode may be buried inclined to the vertical the inclination being limited to 30° from vertical.
- The diameter of earth electrode is such that it can easily withstand the strain of driving.
- The earthing lead should be adequate size to offer negligible resistance.
- In case the earth lead wire is buried underground, it should be protected from corrosion by an application of suitable anti-corrosive paint or bitumen or varnish.
- Where more than one earthing arrangements are employed, the distance between earthing electrodes should not be less than 3 m.
- The earthing leads for separate earthing arrangements should be electrically insulated from each other.
- The minimum clearance of equipment earths from system earths provided by the Electrical

department either of the Railways or of the other administrations should be 20 meters.

- In place where the soil is extensively corrosive, the soil may be chemically examined before deciding the material of the earth electrode.
- The earth wire should be soldered to the screen/armouring and securely connected to the earth electrode.

3.6 Maintenance and testing of earth

- The ground surrounding the earth electrode should be kept moist by periodically pouring saline water.
- All earth and connections should be examined at an interval of not more than one month to ensure that all connections are intact and soldered joints are in proper condition.

  Resistance of every earth should be measured at an interval not exceeding one year. Earth resistance, date of last test and location of earth should be entered on a register/ signal failure registers.

4. Do's and Don'ts

4.1 Do's during installation of outdoor equipment

- At the time of fixing of base clamp, ensure that the base clamp is mounted properly on rail.
- Ensure that proper nylon packing has been used for getting max out put from receiver coil. Also in this condition maximum dip is achieved.
- Ensure that proper sizes of nuts and bolts for base clamp transmitter and receiver assemblies have been used.
- After tightening the nuts and bolts use proper adhesive on nuts for proper grip.
- At the time of initial adjustment of track devices, the max output is obtained by selecting number of packing for transmitter and receiver and keeping transmitter in its lowest position. Also dip is to be obtained by moving the transmitter coil backward if necessary.

4.2 Do's during installation of indoor equipment

- Check if the power supply to DC-DC converter is within the range of 24 V, 10% +20% (21.6 V to 28.8 V).
- Before switching "ON" DCDC converter check that the polarity of power supply is correct.
- Check that the AC ripple across the battery charger is less than 40 mV(p-p).

- Check that the EVR and SUPR relay pick up voltage is less that 6 V for shelf type relay and less than 10V for QS3 relay.
- Check that BY 127 diode is connected across EVR and SUPR relay coils.

4.3 Don'ts during installation of outdoor equipment

- Do not install the track device near the rail joint (should be more that 6 sleepers away).
- Do not install track device where the rail is badly worn out.
- Do not cut or join the transmitter / receiver cable supplied alongwith the coil. It would result in change of frequency of signal.
- Do not lay the Rx and Tx coil cables in the same pipe.
- Do not use any other outdoor cables except which are prescribed.

4.4 Don'ts during installation of indoor equipment

- Do not use +10V available on evaluator for indication (CLR, OCC) on SM reset box and evaluator.
- Do not use +10V for resetting purpose.
- Do not insert cards meant of 3D axle counter in to 4D axle counter and vice versa.
- Do not feed wrong battery voltage and wrong polarity.
- Do not give any bend to display card flat cable.

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