इरिसेट IRISET

S 26

TRAIN DETECTION DEVICES AXLE COUNTERS - ANALOG AND DIGITAL

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

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TRAIN DETECTION DEVICES
AXLE COUNTERS – ANALOG & DIGITAL

VISION :	TO MAKE IRISET AN INSTITUTE OF INTERNATIONAL REPUTE, SETTING ITS OWN STANDARDS AND BENCHMARKS
MISSION :	TO ENHANCE QUALITY AND INCREASE PRODUCTIVITY OF SIGNALLING & TELECOMMUNICATION PERSONNEL THROUGH TRAINING

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INDIAN RAILWAYS INSTITUTE OF
SIGNAL ENGINEERING & TELECOMMUNICATIONS
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Issued in August, 2013

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AXLE COUNTERS – ANALOG & DIGITAL

Checked By	ITD3, SSE (D), LS2, PS1
No. of Pages	136
Date of Issue	August , 2013
Version	A3

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CHAPTER-1: AXLE COUNTER SYSTEM - INTRODUCTION

1.1 INTRODUCTION

ISSUES IN CONVENTIONAL TRACK CIRCUITING

a) Insulation Joints

(i) Presently Civil Engg dept uses Continuous Welded Rails to improve riding. DC track circuits require Insulated Rail Joints (IRJ) and AFTC also require IRJ at point zones and IRJ requires cutting of rails but it is not desirable to cut the long welded rails.

(ii) Though in place of IRJ now a days glued joint s are used, glued joints requires welding work on its both side so Insertion/replacement of glued joints becomes time consuming and laborious job for Engg department .

(i) In yards having single or double slip points, the 'Track Circuit Bonding' becomes much complicated involving large number of IRJ /glued joints.

(ii) Many track circuit failures are caused due to rail fracture, failure of welding, accumulation of iron filings at centre place of insulation joint.

b) Concrete Sleepers

(i) Both DC track circuit & AFTC require wooden / concrete sleepers. But at some places like iron girder bridges it is not feasible to provide such type of sleepers.

(ii) Where Concrete Sleepers are provided High level of maintenance of track circuit is required to maintain 'Insulation of Sleepers' in good condition i.e.: pads / Liners.

c) Ballast Maintenance

(i) Low Ballast resistance affects the working of track circuit and it is difficult to maintain high ballast resistance at Jn. Station's / Terminal's platform lines. Low ballast resistance results in failure of track circuit which causes heavy detention to trains at such busy stations.

(ii) Improper drainage arrangement by Engg. Dept leads water stagnation in track which results in track circuit failure.

Axle Counter is one of the train detection devices used to detect the presence of a train on the specified portion of the track. This specified portion of the track can be 'Platform lines'/ 'Main lines'/ 'Loop lines' of station yard or 'Point's Zone' area or 'Block Section'.

Axle counters were developed as a substitute for track circuits. Initially axle counters were imported from Germany to gain experience and to evaluate their suitability for adoption on Indian Railways. Having gained acceptability for introduction on a wide scale on Indian Railways, it was considered to take up indigenous development of axle counters, so it was taken up by RDSO in collaboration with IIT, Delhi and DOE.

Initially 'Single Entry/Exit' (RDSO Mark-I) model was introduced in Indian Railways after performing extensive laboratory and field trials under various conditions. Then on the base of field feedback, two more models of axle counters known as 'Single Entry/Exit' (RDSO Mark-II) axle counter and 'Multi Entry/Exit' axle counter were emerged. After doing extensive laboratory and field trials under various conditions these designs were finalised and also commercialised through private sector as well as public sector.

New axle counter developed by RDSO is known as "UNIVERSAL AXLE COUNTER". It is universal system up to 4 'Entry / Exit' ends of axle counter section on Straight Track or Points Zone portion. Numbers of 'Entry/ Exit' ends are easily convertible at site as per the required application.

1.2 ADVANTAGES

The advantages of Axle counter over a conventional track circuit are that

(a) It does not require wooden sleepers (where concrete sleepers are not available) except for 'short length' track circuits which is used to suppress the 'counts' due to movement of insulated trolleys.

(b) An axle counter system can cover a very long section up to 15-20 Kms compared to 750 mts of maximum length of conventional track circuit.

(c) Axle counter working does not get affected by climatic changes like flooding of track.

(d) It does not require IRJ/Glued joints, thus, rails can be continuously welded. This reduces track maintenance cost, low wear and tear of tracks and vehicles. And also it increases traveling comfort.

(e) Efficiency and safe working of axle counters does not depend upon various track parameters such as length, ballast condition, drainage, stray voltage and currents, track feed voltage and track lead cables, poor maintenance of track etc which are highly susceptible for track circuit working.

(f) Ordinary '24 V Line relay' in case of Alcatel axle counter and '60 V Line relay' (K-50) in case of Siemens axle counter are used as a 'TPR'. The axle counter has inherent characteristic of slow to pick up and therefore, the use of QSPA-1 relay as the first track repeater in RE area is not needed.

(g) The maintenance effort is less compared to the conventional track circuits. Due to extensive Jumpering / bonding in point zone track circuit the trouble shooting is difficult thereby prolonging the failure time.

(h) Digital axle counters have better fault diagnostics

1.3 APPLICATIONS

Axle counters have been finding more and more uses on modern safety signalling systems in railways.

These are being used presently for the following

(a) Monitoring of berthing tracks in station areas and yards.

(b) Monitoring of point zones in station areas and yard.

(c) Automatic Signalling systems.

(d) Block Proving by Axle Counter.

(e) Level-crossing warning system using axle counter.

(f) Intermediate Block Signalling in Double line sections.

1. 4 OVER VIEW

Axle counter consists of 'Track Device' mounted on the rails, trackside 'Electronic Equipment' and 'Evaluator'. Evaluator monitors the counts of track device(s)

Axle counters work on the principle of counting the number of axles of the train 'entering' and 'leaving' the specified section of the track by sensing the wheels and also it gives clear/occupied indication.

Wheel sensing is done by track device fixed on the either side of the track section to be monitored.

It counts the number of axles entering a section of train as 'IN COUNTS' and the number of axles leaving the section as 'OUT COUNTS'.

If the IN COUNTS are equal to OUT COUNTS then section is set to 'clear', else it is 'occupied'.

1.5 CLASSIFICATON

Axle counters are broadly classified as

1. Analog Axle Counters
   - Single Section Axle Counters (Universal Axle Counter- UAC)
     - CEL Make (Drg No. S-15602-04 & IRS: S-42/85.)
     - Signal & Telecom Workshop, Byculla, Central Railway (Drg No S-15602-04 & IRS: S-42/85.)
     - Signal Workshop, Podanur-641 023, Southern Railway (Drg No S-15602-04 & IRS: S-42/85.)

   In Analog Axle Counters, incoming signals from track side equipment are processed through Electronic circuits and all the required logics are achieved through hardware only.

2. Digital Axle Counters
   - Single Section Digital Axle Counters (SSDAC)(RDSO/SPN/177/ 2012(Ver-3)
     - CEL Make. …
     - ALCATEL (ELDYNE) Make
     - GG TRONICS Make
   - Multi Section Digital Axle Counters (MSDAC) (RDSO/SPN/176/2005 (Ver.2)
     - ALCATEL (ELDYNE) Make
     - SIEMENS Make. .
     - CEL Make. ……

   In Digital Axle Counters the received signal data is processed through analog circuits and Microprocessors / Microcontrollers and all the required logics are designed through software.

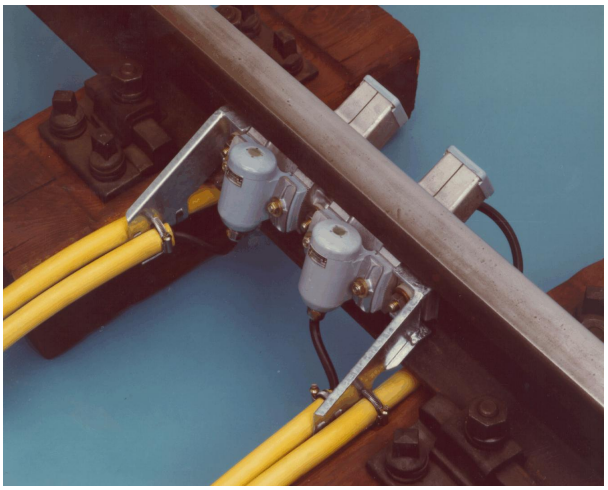
1.6 COMPONENTS OF AXLE COUNTER SYSTEM

a) TRACK MOUNTINGS AND TRACK SIDE EQUIPMENT

Track mounting equipment consists of a pair of Transmitter and Receiver coils housed in specially designed housings, which are fixed to flange/web of a rail section by means of suitable arrangement. Each detection point has two sets of such track devices mounted on same rail with a fixed distance (staggering) between them. The two transmitter coils of a detection point are fed with 5 KHz (in Analog AXC) or 21 KHz / 23 KHz or 28 KHz / 30 KHz (in Digital AXC) frequencies depending upon the manufacturer. These frequencies are fed by the 'Track Side Electronic Equipment' which is located near the track side device. The output of the two Receiver coils of detection point is fed to the 'Track Side Electronic Equipment' through cables.

For 'wheel detection' track device uses either 'Amplitude Modulation' technique or 'Phase Reversal Modulation' technique accordingly their type. Generally, in case of analog axle counters 'Amplitude Modulation' technique is used and in case of Digital Axle Counters 'Phase Reversal Modulation' technique is favored for its advantage of not requiring trolley suppression Track Circuit.

Track device in analog axle counter
Fig. 1.1



Track device in digital axle counter
Fig. 1.2

b) TRANSMISSION MEDIA BETWEEN 'TRACK SIDE EQUIPMENT' AND 'CENTRAL EVALUATOR'

Where ever the data processing is done at the centralised place then the connection between 'Trackside Equipment' and 'Central Evaluator' is made using twin twisted 'Quad' cables. Other media such as 'Optic Fiber' and 'Wireless System' may also be used in place of cable by incorporating appropriate interfacing equipment at transmitting and receiving ends.

c) CENTRAL EVALUATOR WITH VITAL OUTPUT RELAYS

The signals received from the track side electronic equipments are processed in the central evaluator to produce suitable output in terms of picking up or dropping of 'Vital Output' relays.

The 'Dips' generated by wheels as they pass over the track devices installed at detection points are processed at 'Evaluator' to generate 'count pulses' in a fail-safe manner. These pulses are identified as 'IN-COUNTS' or 'OUT-COUNTS' depending on the direction of movement of vehicles over the monitored section. These counts are processed and give the decision to drive the vital output relays or not.

d) RESET BOX

This equipment is installed in Station Master's room to enable resetting of axle counter system in case of failure of system after observing 'Prescribed Procedure'. This unit functions in conjunction with 'Line Verification Box'. The reset unit consists of RESET key (which gets actuated after inserting, turning and pressing) the counter and LED indications (red, yellow and green). 'Green' indication is given for track clear and 'Red' indication is given for occupied conditions. The yellow LED indicates co-operative permission for resetting the axle counter.

e) LINE VERIFICATION BOX

The 'Line Verification Box' has to be fixed outside SM's office near monitored track portion (when axle counter is used in station yard) for achieving co-operative feature. Line verification box consists of a key actuated Push Button Switch with which co-operation for Axle Counter Reset can be extended after verifying the section in case of the Axle Counter failure. In case, numbers of line verification box are more, 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. This unit functions in conjunction with Reset box.

1.7 TYPES OF SYSTEM

In Indian Railways, depending on the applications, Single section analog axle counter systems are used up to four detection points. This single section analog axle counter system is universal system for all single section applications.
Types of axle counter as per number of 'Detection Points':-
These are 1D, 2D, 3D, 4D. : Where D stands for 'Detection Point'

a) 1 - D SYSTEM

In this system, there is a common detection point for 'Entry' as well as 'Exit' for a section which is to be monitored. This system is useful for monitoring the berthing track of terminal yard (For example – Mumbai CST, Nampalli station) or Long sidings with 'dead end'.

Axles of train entering into such section are detected by the 'detection point' which are registered as 'IN-COUNTS', then this same 'detection point' will detect axles going out of section which will be registered as 'OUT-COUNTS'

Typical arrangement is used in this1D system

Only one detection unit with two channels (Four inductors) is used. See next fig. Evaluator used for this 1D system is with minimum four channels but actual channels provided at site are two only 'A' & 'B' so in evaluator, channel 'A&C' are fed in parallel and 'B&D' are also fed in parallel. Because of such parallel feeding, at the time of each 'ENTRY' of axle, 'evaluator' registers two 'IN-COUNTS' and at the time of EXIT of each axle, 'evaluator' registers two 'OUT-COUNTS'.

Whenever 'IN-COUNTS' & 'OUT-COUNTS' are equal then only section will show as 'CLEAR' else 'OCCUPIED'

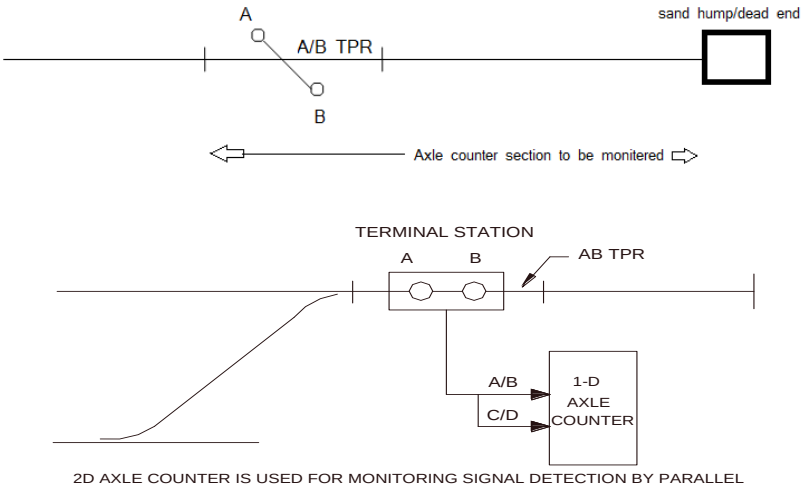


Fig. 1.3

b) 2-D SYSTEM

The principle of working of this system is similar to 1 -D System except that in this system there are two detection points, one at each end of the monitored section. This system is useful for providing track circuiting on berthing track.

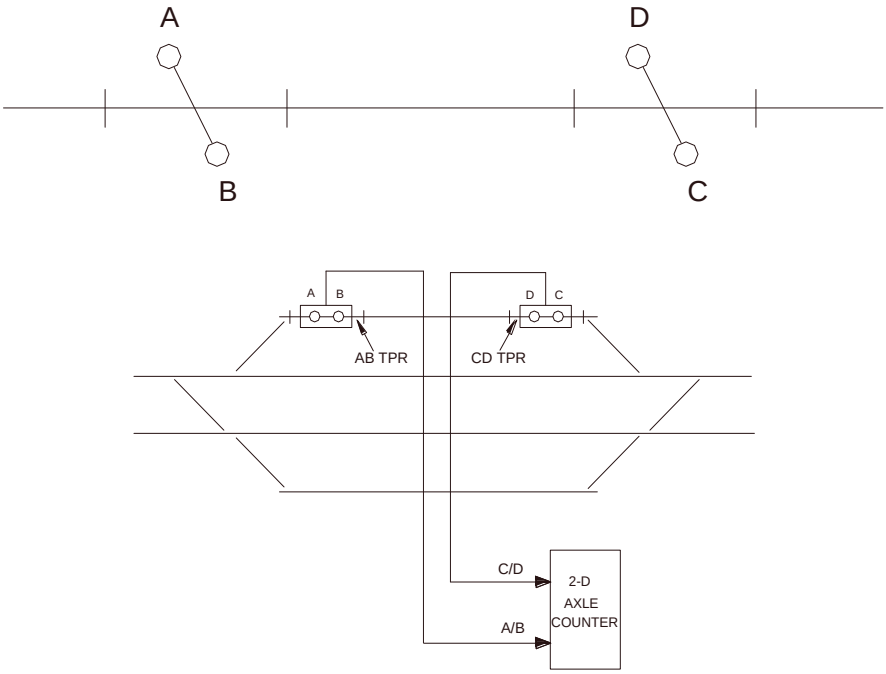


Fig: 1.4

c) 3-D SYSTEM

In this system, there are three detection points. The principle of working of this system is similar to 2-D System. This system is useful for providing track circuitry on points, crossing and siding.

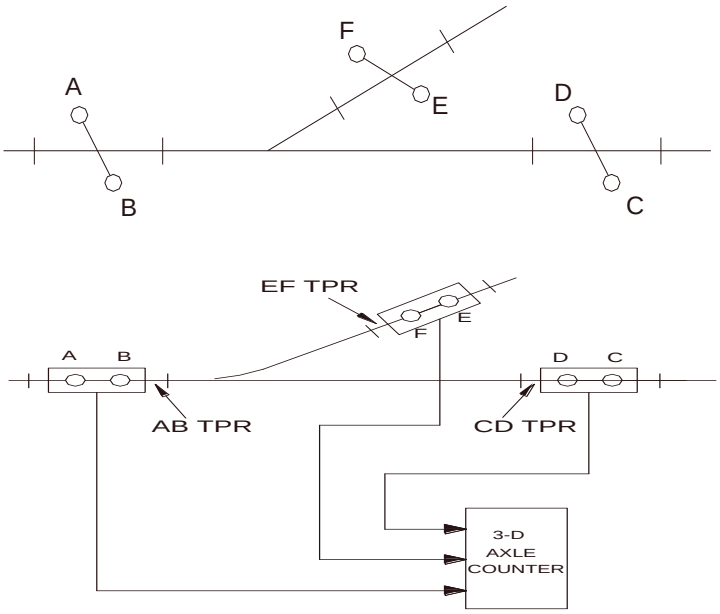


Fig: 1.5

d) 4-D SYSTEM

In this system, there are four detection points. The principle of working of this system is similar to 2-D system. This system is useful for providing track circuiting on branch lines, sidings and points and crossing.

The design of 4-D system is such that it can be converted into 2-D system and 3-D system and vice-versa.

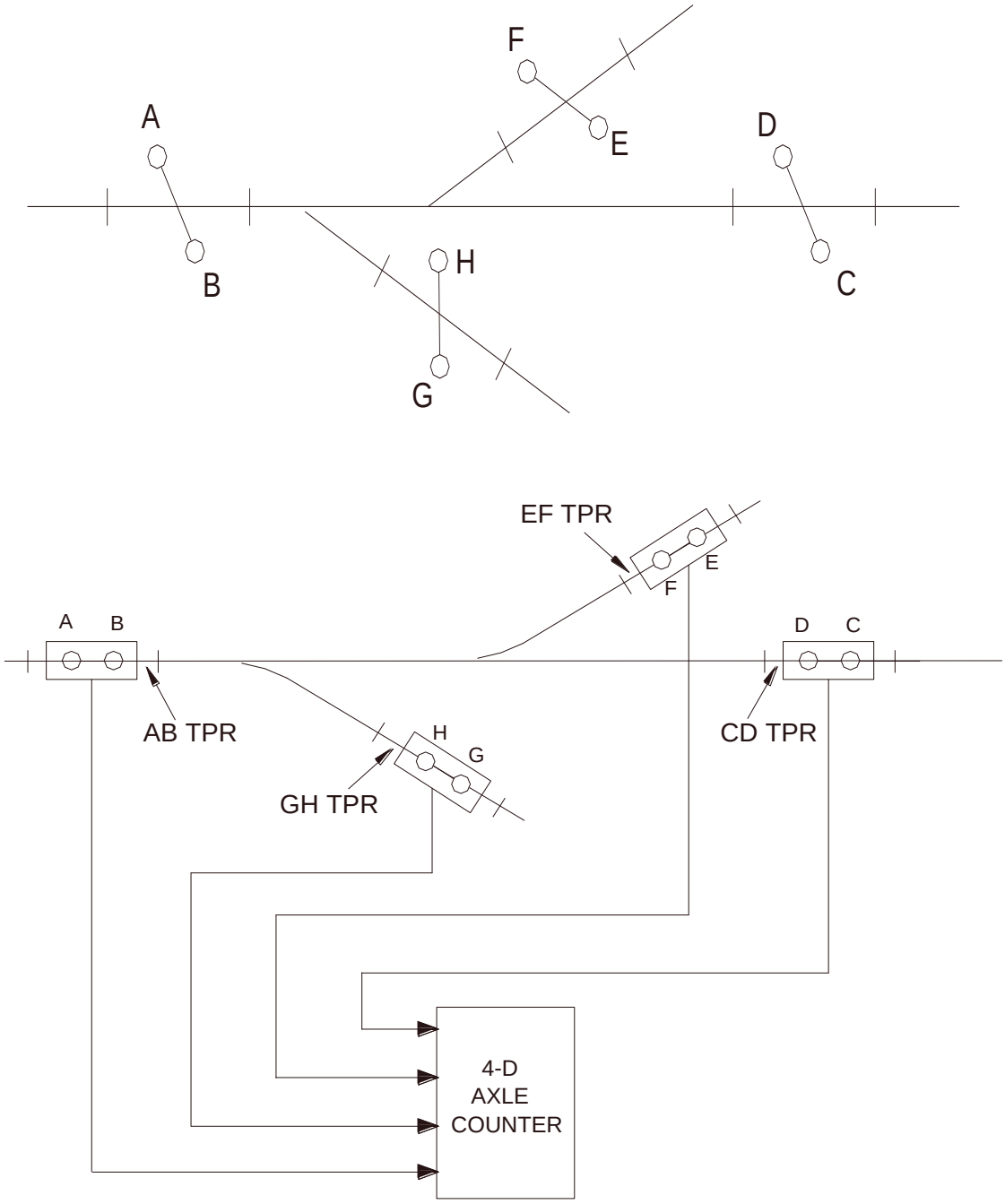


Fig. 1.6

1.8 RESETTING

Resetting of axle counter system is required to be done, in case of failure of system but after observing prescribed procedure. Analog and Digital axle counters have been introduced on a large scale on Indian Railways. Resetting is an integral part of these axle counter systems. Depending on the application of axle counter, different types of reset procedures are followed by the railways.

1.8.1 DIRECT HARD RESET

Direct Hard Reset shall not be provided normally. Such a reset will directly reset the axle counter to show clear indication without any physical verification/ co-operation/ piloting.

1.8.2 CONDITIONAL HARD RESET

In Conditional Hard Reset, the reset is activated on reset box after physical verification of a failed axle counter section from site using line verification box. So it is called co-operation reset. The axle counter will show clear after application of the conditional hard reset.

1.8.3 PREPARATORY RESET

In preparatory reset, after initiating reset, axle counter continues to show 'OCCUPATION' status until a fresh 'IN' & 'OUT' counts are registered. When 'IN-COUNTS' & 'OUT-COUNTS' tally with each other for first one 'PILOT TRAIN' movement in the section, resetting of axle counter takes place for restoring normal working or else failure continues.

1.8.4 MODIFIED PREPARATORY RESET

Modified Preparatory Reset is in use in some railways –SWR, SR, NWR where in Pilot train is dispatched on signals prior to count balancing. If Count balancing fails, then signal for subsequent trains is not cleared.

1.8.5 SUPERVISORY RESET / AUTO RESET

Supervisory track sections (STS's) have been made using the detection points of track sections for automatically resetting the track sections. If any track section fails and its corresponding supervisory track section is clear, it will automatically reset the failed track section. (Please see annexure 8)

Sl.No.	Axle counter Track Section	Type of Reset
1	Points Zone	Conditional Hard Reset
2	Loop line and Sidings	Conditional Hard Reset
3	Main line	Preparatory Reset
4	Section between Advance starter and IBS	Preparatory Reset
5	Auto section	Preparatory Reset / Supervisory Reset
6	Block Instrument and BPAC	Preparatory Reset

1.9 TROLLEY SUPPRESSION

Need: Push trolleys may be put on track randomly and may pass at 'detection points' and may be taken out of axle counter track section randomly causing track 'OCCUPATION' indication and failure of signals. These push trolley wheels should not get detected for counting purpose and are to be suppressed.

HOW ACHIEVED: -

- In Amplitude modulation it is achieved by providing a small track Circuit (whose length depends on Train speed) is used to distinguish a 'Normal Train' axle from a 'Push Trolley' axle. As these 'Push Trolleys' axles are insulated hence track circuit will not get short so 'pulse' is not generated when a wheel passes. But for 'Normal Train' movement 'Track Relay' drops, which enables normal generation of 'pulses'.

- In Phase Reversal Modulation technique such arrangements are not required, as the system will take care of validation of generated pulses caused by passage of wheel over the track device, depending upon the phase shift of the pulse. (This phase shift of the pulse may be normally 160° to 180° for a train wheel and it may be approximately 100° to 120° for a push trolley wheel.)

  Details may be seen in concerned chapters.

CHAPTER - 2: ANALOG AXLE COUNTER UNIVERSAL AXLE COUNTER SYSTEM (UAC)

2.1 THE COMPLETE SYSTEM CONSISTS OF

(a) Track Side (out door) Equipment.

(b) Transmission media between 'Trackside Equipment' and 'Central Evaluator'.

(c) Central Evaluator with 'EV relay' and 'SUP relay' as its output.

(d) Reset box.

(e) Line verification box.

2.2 TRACK SIDE (OUT DOOR) EQUIPMENT

To monitor particular section 'Outdoor Equipment' is fixed on each end of the section. The 'multiple Entry / Exit' axle counter can cater maximum four Inputs (detection points). Such 'Track Side Equipment' consists of the following:

2.2.1 TRACK DEVICE ASSEMBLY

The 'Track Device Assembly' consists of two transmitter coils and two receiver coils which are fitted with suitable mounting arrangements on the 'rail base clamp', which in turn fitted to the bottom of rails. The two transmitter coils at each of the detection point are fed in series by a 5 KHz sinusoidal signal from the 'Electronic Junction Box' (EJB), which forms an electromagnetic field across the receiver coils. The receiver coil in turn generates induced voltage. The induced voltage of the receiver coil drops to a minimum whenever a wheel passes between the transmitter and receiver coils.

Two sets of 'Track Transducers', each set consisting of

(a) A 'Transmitter coil' in Fiber-glass Reinforced Plastics (FRP) housing.

(b) A 'Receiver coil' in a composite Aluminium Fiber-glass housing.

(c) A Base Clamp fitted on to the bottom flange of the rail for mounting the 'transmitter' and 'receiver' housings.

Transmitter coil

The transmitter coil is placed in FRP housing and it is potted in place by M – Seal compound. It is fixed on the rail clamp on the outer side of the rail. Each transmitter coil will be provided with a 10 meter or 15 meter, 24/0.2 PVC twin twisted cable.

Receiver coil

The receiver coil is housed in a composite Aluminium Fiberglass housing and is potted in place by M-Seal compound. The receiver housing is fixed on the base clamp on the inner side of the rail. Each receiver coil will be provided with a 10 or 15 meter, 24/0.2 PVC twin twisted cable.

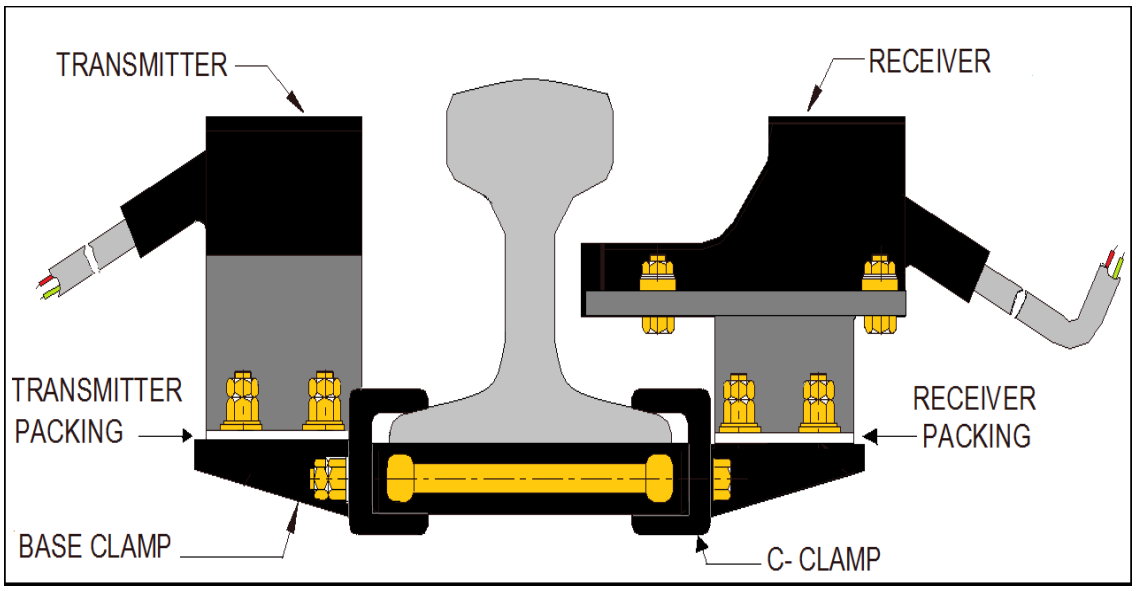


Fig. 2.1

2.2.2 OPERATING PRINCIPLE OF TRACK TRANSDUCERS

The transmitter housing is fixed on the base clamp and on the outer side of the rail, the receiver housing is also fixed on base clamp but on the inner side rail. Transmitter coils are energised by the common oscillator. The design of the transmitter and receiver coils is such that two magnetic flux paths Ø1 & Ø2 are generated in the vicinity of the rail.

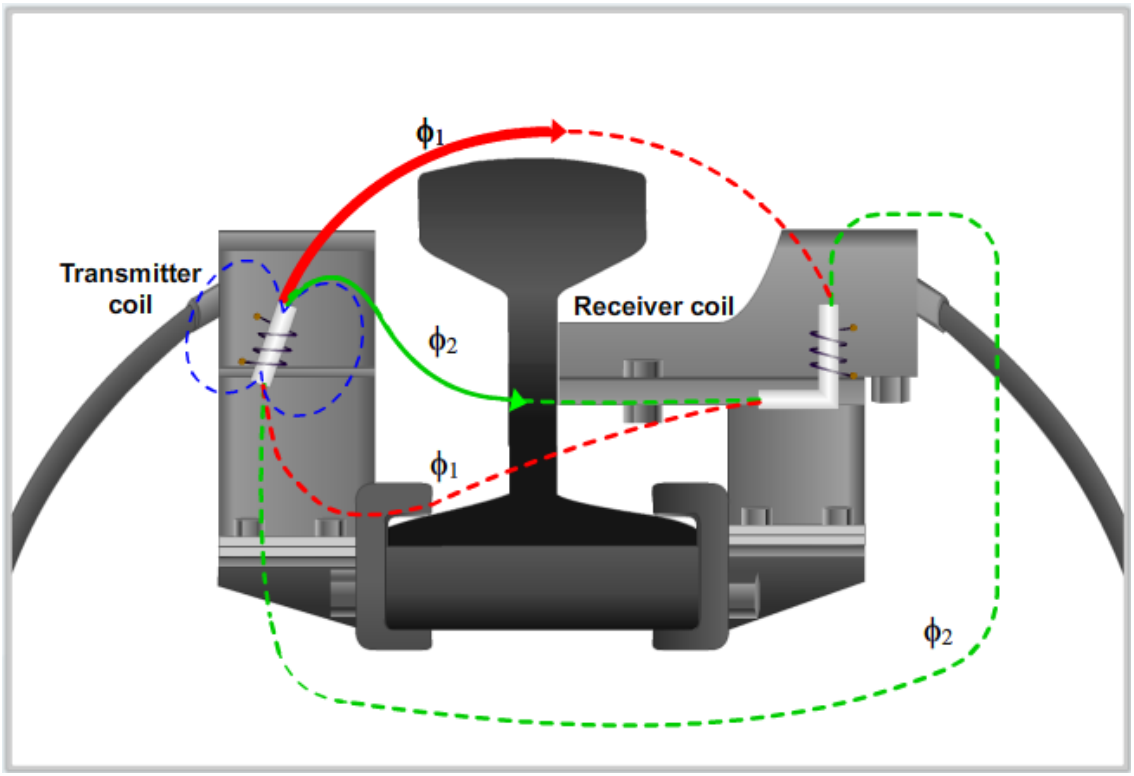


Fig. 2.2

These two magnetic fluxes pass through receiver coil in opposite directions. Reluctance of the magnetic path of these two fluxes is different under normal condition that is when no wheel is passing over the track. The flux Ø1 is large compared to flux Ø2. The resultant flux induces a voltage in the receiver coil. When the wheel passes over the track transducers the screening effect of wheel flange causes a reduction of flux Ø1 to a value nearly equal in magnitude to that of flux Ø2. These two fluxes cancel each other and the induced voltage in the receiver falls to a low value.

The ratio of two fluxes can be adjusted with suitable initial adjustment by moving the transmitter coil either up or down on the clamp to get maximum dip possible in the induced signal under wheel dip conditions. The adjustment depends on the profiles of different rail sections. The track transducers are fitted in staggered position on the rails of the track. Each receiver coil therefore detects signals, which are displaced in time. It is only from the stagger of these signals that the logic circuits provided in the evaluator discriminates the direction of the movement of the train and connects the pulses either to the 'IN' counter or to the 'OUT' counter as the case may be.

2.2.3 INSTALLATION OF TRACK DEVICE

Before installation of track device on rails, the following precautions are to be taken

1. The track device should be fixed in the center of track circuit in case of single line section. In case of double line section, the device is fixed either in the center 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.
2. The track device should not be fixed under any circumstances within the sleepers carrying the rail joints.
3. The track device should be installed on a closed track circuit.
4. 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 first repeater relay to get minimum drop away time
5. The separation between two track devices of different axle counter system should be at least 3 meters away, so as to, avoid mutual interference.
6. The track device should be fixed as per the nomenclature given in different drawings for 1D system, 2D system, 3D system and 4D systems.
7. The base clamp should be fixed in the space between two sleepers.
8. The clear spacing between two sleepers, in which both the track devices are fixed, should be minimum 550 mm.
9. It should be ensured that the rail is not badly worn out causing the wheel flange to graze over the fittings.
10. The design of track device is suitable for 90R, 52 Kg, 60 Kg rails.
11. The maximum size of packing required are as given below

    a) For 52 Kg: - 6 mm (3 mm x 2 PCS)
    b) For 60 Kg –12 mm (3 mm x 4 PCS)

12. The transmitter and receiver coils are provided with 24/0.2 cables of 10 meters or 15 meters length and have to be taken to location box directly without any loops.
13. These cables should be put in HDPE pipe for safety and laid at a depth of >1 meter from bottom of rail.
14. Transmitter and receiver cables should be run separately at a minimum separation of 500mm.
15. Transmitter cables and receiver cables of individual track devices are to be laid in different pipes.

2.2.4 ADJUSTMENTS OF TRACK DEVICE

Keeping the transmitter coil on the single rail clamp butting against rail, the maximum output from receiver coil is obtained (without any packing on Rx coil). Now select the number of nylon packing up to 12 mm for Rails of 52 / 60 kg step by step below the Transmitter coils and required packing in receiver coils to obtain the maximum output on receiver coils. Under the above condition, the output of Rx coil should not be less than 1.2 V AC without EJB Load and 1 V AC with EJB load. The proper wheel Dip is also obtained under this condition.

2.2.5 WHEEL DIP

When a wheel passes between Tx and Rx coils, the magnetic flux path gets disturbed and induced voltage in the Rx coil reduces substantially. The drop in the Rx coil output under the influence of wheel is called “Wheel Dip”. Wheel dip depends on several factors such as type of wheel, rail profile and type of sleepers and orientation of wheel in relation to transmitter and receiver coils. Fig: No 2.3 shows 4 types of wheel dips.

Figure (a) shows ‘INADEQUATE WHEEL DIP’ where signal does not fall fully. In this position the axle counter system may miss some counts. Therefore, this type of dip is undesirable.

Figure (b) shows ‘PREDOMINANT DOUBLE DIP’ where the signal level falls to minimum but as the wheels move further towards the centerline of the track devices, the signal level rises again, falls to the minimum second time and then rises as the wheel moves further away from the track device. This type of dip may cause extra counts. This type of dip is therefore, undesirable.

Figure (c) shows a ‘SHARP SINGLE DIP’ and the signal level falls to minimum only when the wheel is near the centerline of the track devices. In this position system may count correctly.

Figure (d) shows a slight ‘WIDE DIP’ where the dip is slightly broadened and the rise in signal at the centerline of track device is less than 15%. This is considered the most correct adjustment of the wheel dip.

2.2.6 ADJUSTMENT OF WHEEL DIP

Wheel dip adjustments enumerated above are made by changing the position transmitter body on the rail clamp by moving forward or backward and serving the receiver coil signal on multi-meter when a dummy wheel is moved over the track device.

A dummy wheel is a metallic plate which when placed on the rail in between transmitter and receiver coil , causes a ‘Dip’ in the receiver coil signal similar to one caused by an wheel. A dummy wheel has graduated markings to enable it to be set for the type of rails to which track devices have been fitted. For 52 Kg rails, proper wheel adjustment is obtained by setting the dummy wheel at 52 mm mark.

To measure the signal level of receiver coil, Sensitive multimeter should be connected across receiver. The receiver coils have been designed to give normal output signal of less than 1.0 V AC without wheel which falls to less than 15% when the dummy wheel is placed centrally and vertically on track device.

First measure and note down the signal level of receiver coil without dummy wheel, then place dummy wheel in the correct position on track devices and move TX coil forward or backward and keep on observing signal level for each position of transmitter housing. Note down the position of transmitter housing at which signal of the receiver coil with dummy wheel falls below 15% of the original signal level. Now tighten transmitter’s holding down bolts securely. Remove dummy wheel and see that signal level should again rise to near about the original level. This is called ‘Wheel Dip Adjustment’. Correct functioning of the axle counter system depends on correct adjustment of wheel dip and due care is to be taken to ensure correct adjustment for wheel dip.

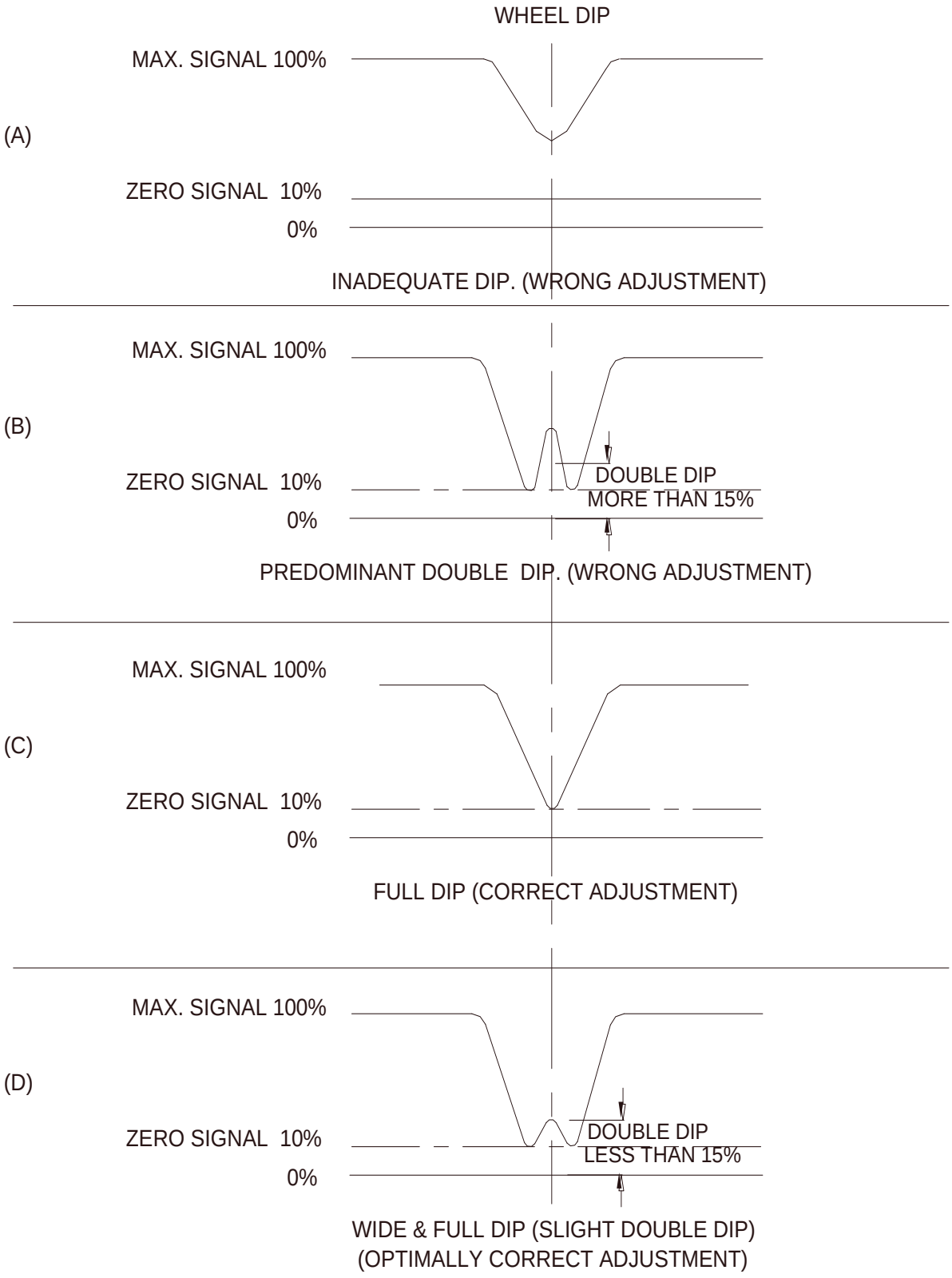

WHEEL DIP
MAX. SIGNAL 100%
(A)
ZERO SIGNAL 10%
0%
INADEQUATE DIP. (WRONG ADJUSTMENT)
MAX. SIGNAL 100%
(B)
ZERO SIGNAL 10%
DOUBLE DIP
MORE THAN 15%
0%
PREDOMINANT DOUBLE DIP. (WRONG ADJUSTMENT)
MAX. SIGNAL 100%
(C)
ZERO SIGNAL 10%
0%
FULL DIP (CORRECT ADJUSTMENT)
MAX. SIGNAL 100%
(D)
ZERO SIGNAL 10%
DOUBLE DIP
LESS THAN 15%
0%
WIDE & FULL DIP (SLIGHT DOUBLE DIP)
(OPTIMALLY CORRECT ADJUSTMENT)

Fig. 2.3

2.2.7 TROLLEY SUPPRESSION TRACK CIRCUIT

This is short length track circuit provided at each end of axle counter section. If the track circuit length is less than 5 Rail-lengths, the maximum energisation should not exceed 200 % in case of Q-style track relay (9 ohms) and 150 % in case of shelf type track relay (9 ohms). This will ensure dropping of TPR before train wheel passes the 'track device'. Thus drop away time of TPR will play important role in dropping of TPR before train wheel passes the 'track device',

The length of track circuit in terms of rail length (R.L) for 'single line' and 'double line' sections for different speeds using Q-style track relays with the recommended distance between the IRJ & 'track device' is given in table below

Speed in Kmph	**Length of trolley suppression track circuit**		
	On single line	**On double line**	
	Length of Track Ckt **('track device' fixed at center)**	Length of Track Ckt	**Track device' at a minimum distance from insulation joint in train approaching direction.**
15	1 R.L	1 R.L	08 m
50	1 R.L	1 R.L	08 m
90	2 R.L	2 R.L	20 m
100	3 R.L	2 R.L	20 m
120	3 R.L	2 R.L	20 m
140	3 R.L	2 R.L	20 m
160	4 R.L	3 R.L	20 m
200	5 R.L	3 R.L	33 m

Note: One Rail Length = 13 meters

2.2.8 ELECTRONIC JUNCTION BOX - EJB

Electronic junction box is kept near to the 'track devices' within a distance of 10 meters at each detection point. Electronic Junction box houses PCB modules that are inter- connected through motherboard. All the incoming/outgoing signals are terminated on the MS couplers (7 pin) mounted on its back side. EJB consist 3/4 cards, first card is 'Oscillator Card' second and third cards are 'Receiver Amplifier Cards'. (4^{th} card is provided in only 2-wire system.)

Input to the first 'Oscillator Card' is 24 V DC to give output of 60 V AC with 5 KHz frequency and it is fed to both transmitter coils which are already connected in series. The induced signal levels from receiver coils are separately fed to respective 'Receiver Amplifier Cards'. The output of these 'Receiver Amplifier Cards' is sent to evaluator either through a 4-wire system or a 2-wire system.

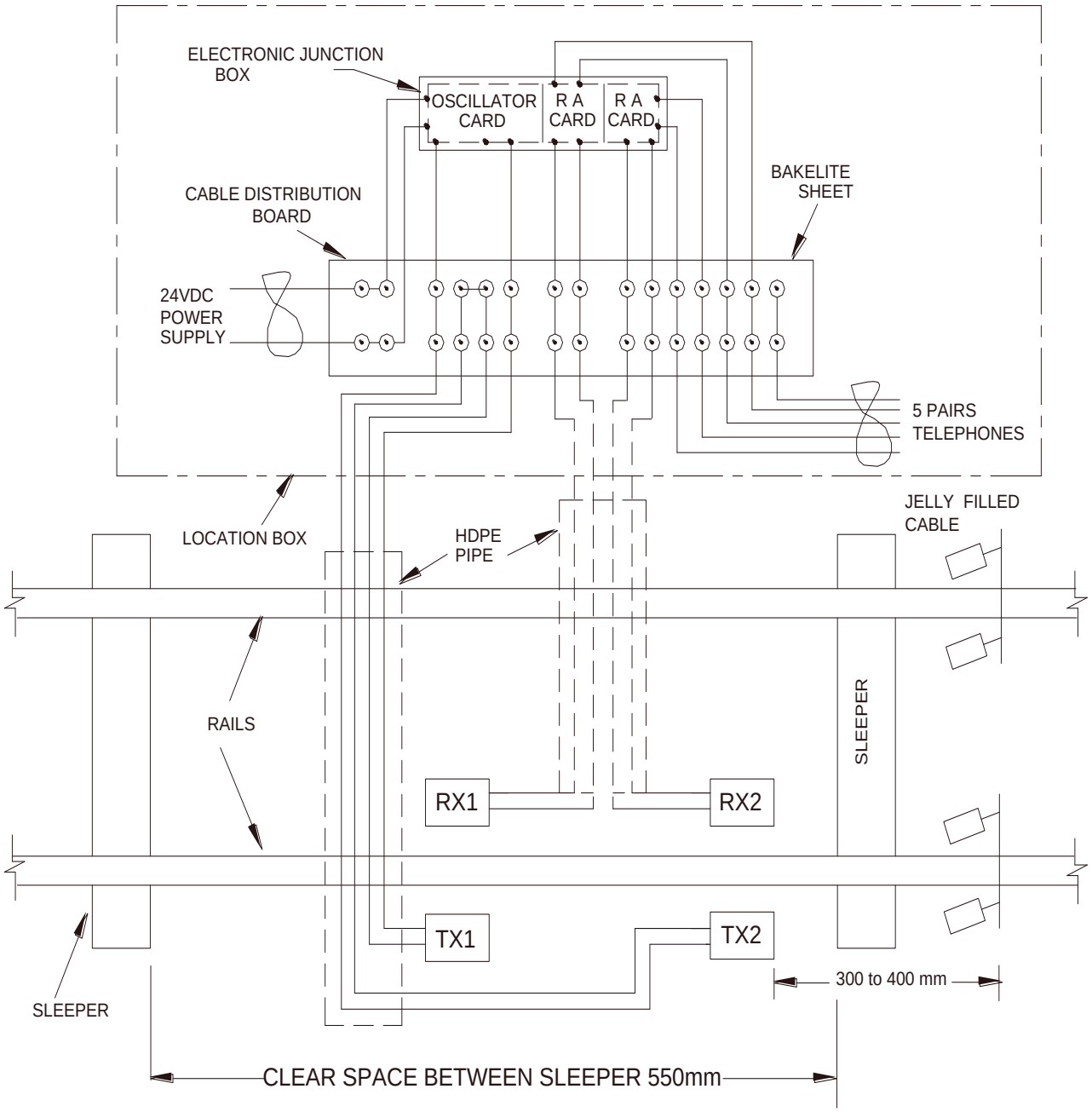

ELECTRONIC JUNCTION BOX
OSCILLATOR CARD
R A CARD
R A CARD
BAKELITE SHEET
CABLE DISTRIBUTION BOARD
24VDC POWER SUPPLY
5 PAIRS TELEPHONES
LOCATION BOX
HDPE PIPE
JELLY FILLED CABLE
RAILS
SLEEPER
RX1
RX2
TX1
TX2
300 to 400 mm
SLEEPER
CLEAR SPACE BETWEEN SLEEPER 550mm

Fig. 2.4

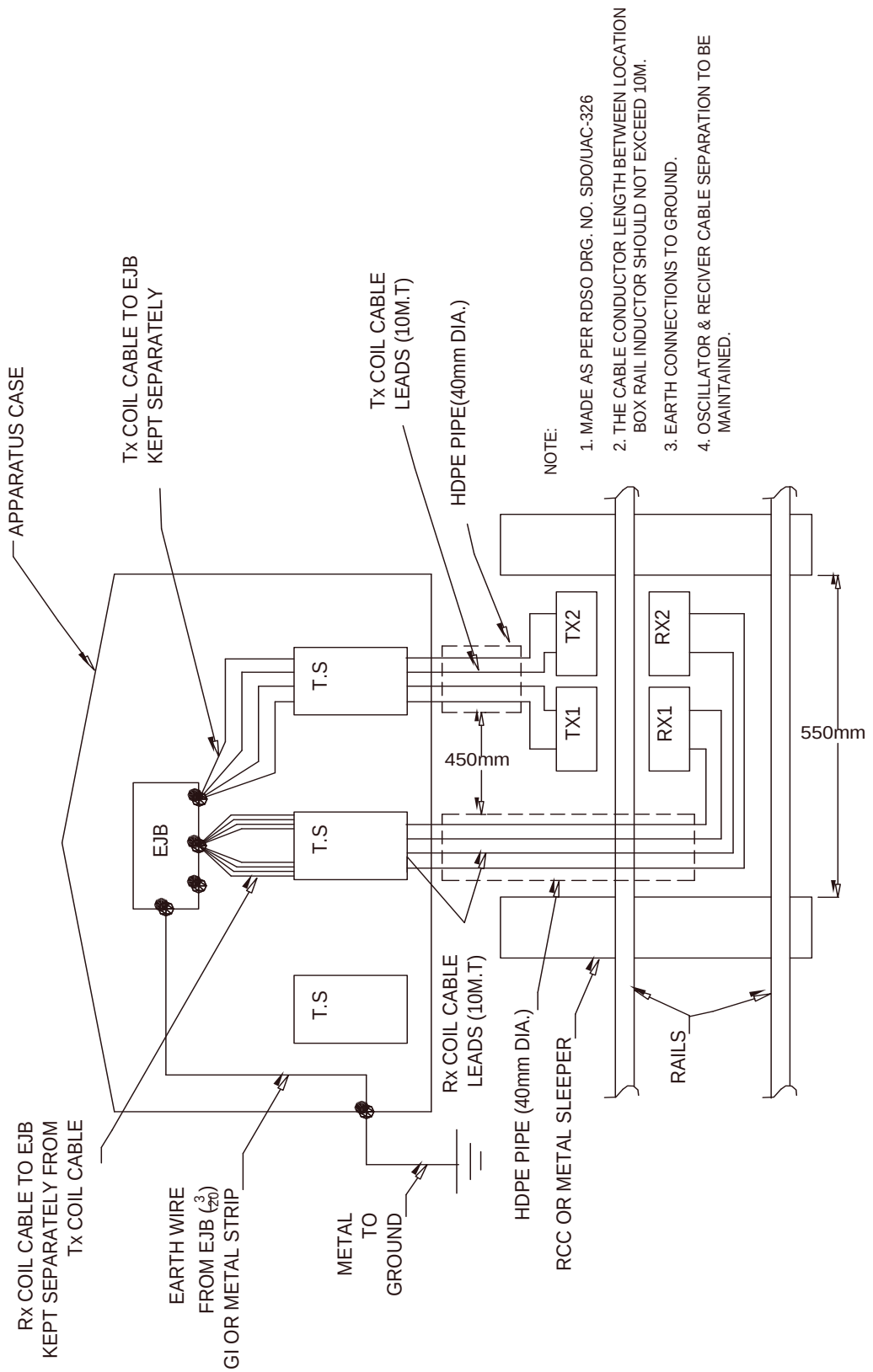
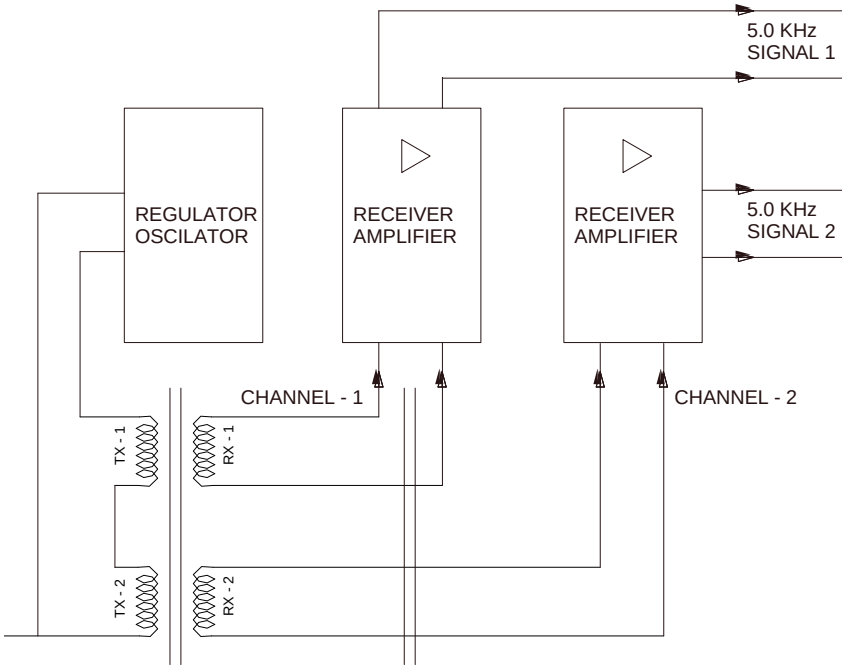

APPARATUS CASE
Tx COIL CABLE TO EJB KEPT SEPARATELY
Tx COIL CABLE LEADS (10M.T)
HDPE PIPE(40mm DIA.)
NOTE:
1. MADE AS PER RDSO DRG. NO. SDO/UAC-326
2. THE CABLE CONDUCTOR LENGTH BETWEEN LOCATION BOX RAIL INDUCTOR SHOULD NOT EXCEED 10M.
3. EARTH CONNECTIONS TO GROUND.
4. OSCILLATOR & RECIVER CABLE SEPARATION TO BE MAINTAINED.
T.S
T.S
T.S
EJB
TX2
TX1
RX2
RX1
450mm
550mm
Rx COIL CABLE LEADS (10M.T)
HDPE PIPE (40mm DIA.)
RCC OR METAL SLEEPER
RAILS
Rx COIL CABLE TO EJB KEPT SEPARATELY FROM Tx COIL CABLE
EARTH WIRE FROM EJB (3/20) GI OR METAL STRIP
METAL TO GROUND

Fig. 2.5

2.2.9 4-WIRE SYSTEM

In 4-wire system, two pairs of under -ground cable are required to send outputs of two 'Receiver Amplifier Cards' of EJB to the evaluator for counting the dips. In this system EJB is provided with only three cards, 1st card is regulator 'Oscillator Card', 2nd card is 'Receiver Amplifier Card' for first channel, 3rd card is also 'Receiver Amplifier Card' but for second channel.



Electronic Junction Box Cards (4 wire systems)
Fig. 2.6

CARD No.1: (Regulator Oscillator Card)

This generates 60 V AC ± 10% with 5 KHz ± 20 Hz sinusoidal signal, which is fed to the both transmitter coils which are connected in series. The current drawn by these two coils is 420 ma ± 10%

CARD No.2: (Receiver Amplifier Card- 1st channel)

The induced signals received from the receiver coils of the track transducers are being fed to a 'two stage tuned amplifier' which is tuned to a frequency of 5 KHz with a 3db band width of lower frequency 4100 Hz to 4500 Hz and higher frequency 5500 Hz to 5900 Hz. Thus any noise, picked up by the transducers in RE areas, being of low frequency (50 Hz) are suppressed in the 'Receiver Amplifier Card' and only 5 kHz signals with voltage level more than 1.2 V AC are transmitted through the cable to the evaluator equipment.

The LED indicator of 'CARD OK' is provided when input signals are present.

CARD No.3: (Receiver Amplifier Card – 2nd channel)

This card is exactly similar to card no.2 and is used for receiver coil (2).

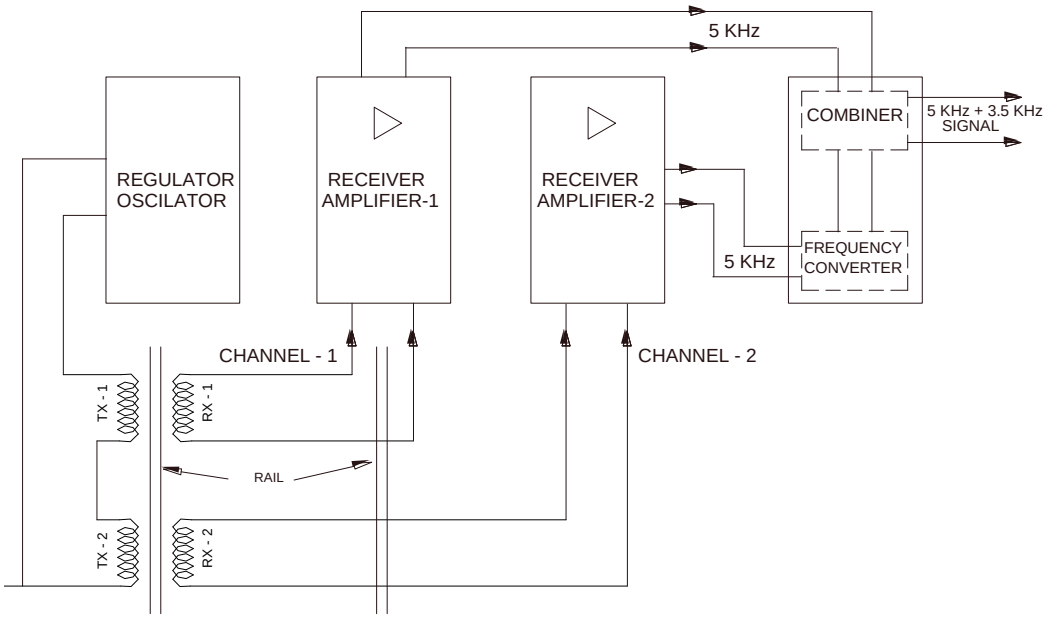
2.2.10 2-WIRE SYSTEM

This system is used where working of 'Axle Counter' on two pairs of cables from EJB to Evaluator is not feasible. In this system only one pair is used in between EJB and Evaluator.

CARD No.1: (Regulator Oscillator Card)
CARD No.2: (Receiver Amplifier Card- 1st channel)
CARD No.3: (Receiver Amplifier Card – 2nd channel)

These all three cards are same as above in 4 wire system
CARD No. 4: (4W to 2W Converter Card)

In this system 4th card is inserted in the EJB, which converts the frequency of the 2nd channel signal to 3.5 KHz and combines it with 5 KHz signal of first channel and sent on 2 wires to Evaluator.



Electronic Junction Box Cards (2 wire systems)
Fig. 2.7

2.2.11 SHIELDING

The Evaluator and EJB racks are to be well shielded for better noise immunity. All the metallic frames of the rack are interconnected to the main frame by means of 35/0.3 wire. Shielded cables are used in system, shield of which is connected to the back panel of the evaluator.

2.3 CABLE CONNECTIONS

For connecting the output of electronic junction box to evaluator, the following cables are to be used. Type of the cable depends upon the distance between 'EJB and evaluator' and also depends upon whether to be used in R.E. or non R.E. Area.

(a) 4 quad axle counter cable as per specification No. TC-30

(b) 4 quad axle counter cable as per specification No**.** TC-31 (Non-RE)

(c) PET quad of main telecom cable as per specification No.TC-14/75

(d) Polythene jelly filled telephone cable as per specification No.TC-40/91.

2.3.1 THE ELECTRICAL CHARACTERISTICS OF ABOVE CABLES ARE AS GIVEN BELOW

Sl No	Type of cable	Parameters at 5 KHz	0.51 mm Dia	0.63 mm Dia.	0.9 mm Dia
1.	4 quad axle counter cable TC-30	Characteristic Impedance	338 Ohm	N.A	180 Ohm
		Loss in db/km	3.27 db	N.A	1.81 db
2.	4 quad axle counter cable TC-31	Characteristic Impedance	338 Ohm	N.A	180 Ohm
3.	PET quad of Main telecom cable TC- 14/75	Characteristic Impedance	N.A	N.A	180 Ohm
		Loss in db/km	N.A	N.A	1.81db
4.	Polythene jelly filled Tele-phone cable TC-40/91	Characteristic Impedance	338 Ohm	270 Ohm	180 Ohm
		Loss in db/km	3.42 db	2.72 db	1.81db

2.3.2 THE FOLLOWING CABLE SHOULD BE USED AS PER THE DISTANCE BETWEEN EJB & EVALUATOR.

Distance between EJB & Evaluator	TYPE OF CABLE							
	TC-30		TC-31		TC-14/75		TC-40/91	
	0.5 mm	0.9 mm	0.5 mm	0.9 mm	0.5 mm	0.9 mm	0.63 mm	0.9 mm
In R.E.AREA 1) Up to 2 Km	√	√	-	-	√	√	√	√
2) Up to 5 Km	-	√	-	-	-	√	√	√
3) From 5 Km to 15K Km	-	√	-	-	-	√	-	√
In Non R.E. AREA 1) Up to 2 Km	-	√	√	√	√	√	√	√
2) Up to 5 Km	-	√	-	√	-	√	√	√
3) From 5 Km to 15 Km	-	√	-	√	-	√	-	√

The output impedance of EJB and input impedance of evaluator is 180 Ohm and since 0.9 mm dia. cable is having characteristic impedance of 180 Ohm, there will not be any mismatch of cable.

Similarly, for carrying 24 V DC from axle counter room, 2 x 25 sq.mm Aluminum power cable should be laid up to main junction box and from main junction box to axle counter EJB junction box 2 x 2.5 Sq.mm signalling cable can be used.

In case of block working through axle counter, the EJB works on 2-wire system at remote end (Advance). For this working 4TH card (4 wire to 2 wire conversion card) is to be used in EJB as discussed above. While using 2W system for EJB, a 2-wire to 4-wire converter at evaluator end has to be used.

All precautions as per telecom manual for laying communication cable should be followed. Earthing should be done with each of the equipment.

2.4 INDOOR EQUIPMENT

Indoor equipments are

(a) Evaluator

(b) Counts Display Card

(c) 'CLEAR' and 'OCCUPIED' LED indications

(d) Mother Board

(e) EV & SUP Relay

(f) Reset Relay

(g) Reset Box

(h) Line verification box

2.5 EVALUATOR

This unit processes the 5 kHz signals received from the junction boxes and accordingly generates EV and SUP relay outputs to indicate occupancy or clearance of the particular section of the track being monitored. It also displays the in counts and out counts in the display card mounted on the front panel. The wiring for signals and local indication is to be done by the user from the contacts of EV & SUPR relays. The evaluator itself is housed inside the rack.

The evaluator consists of 10 PCB modules.

(a) FILTER- Attenuator & Amplifier - Rectifier Card (for A, B, C, D channels).

(b) FILTER- Attenuator & Amplifier - Rectifier Card (for E, F, G, H channels).

(c) Pulse shaper card (for A, B, C, D channels).

(d) Pulse shaper card (for E, F, G, H channels).

(e) Logic- I Card (for E, F, G, H channels).

(f) Logic-II Card (for A, B, C, D channels).

(g) Counter Comparator card.

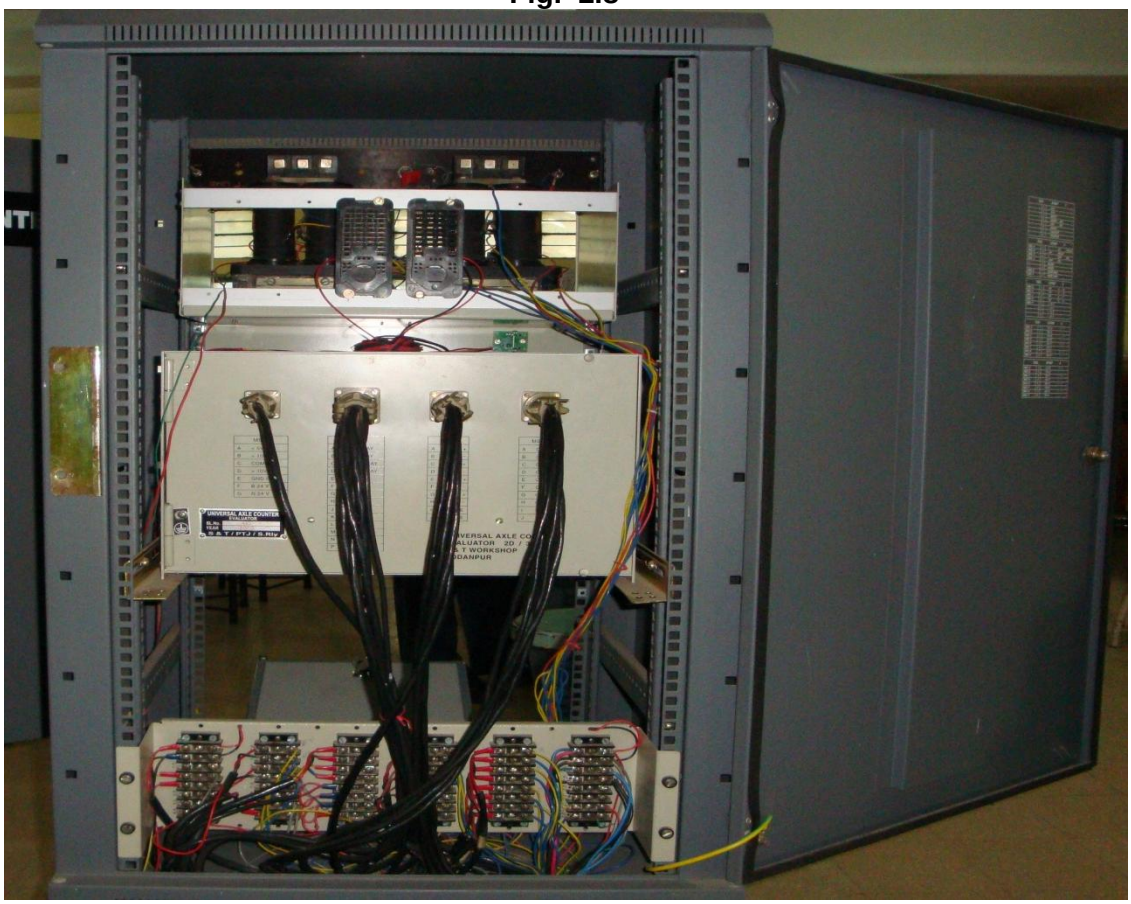
(h) General Supervision card.

(i) Relay Driver card.

(j) DC-DC CONVERTER CARD.

The interconnections between various PC cards are made with the help of a motherboard. The polarisation arrangement (to avoid wrong insertion of modules) is provided on the aluminum modular sheets in each.

Evaluator front view
Fig. 2.8



Evaluator rear view
Fig. 2.9

2.5.1 FILTER- ATTENUATOR & AMPLIFIER - RECTIFIER CARD (Card no.1)

This card contains 4 identical channels, used for A, B, C and D channels. Each channel comprising of a 5 KHz high pass filter, a line matching transformer, attenuator pads, a two-stage amplifier and a full wave rectifier. The inputs to these channels are the signals received from the trackside equipment. The outputs of the receiver amplifier cards of the junction box are fed over cables as channel input to card 1 & 2. The output of each channel can be set precisely by means of a lockable shaft potentiometer mounted at the front end of the card. Typical output is 105 mv ± 5 mv AC.

2.5.2 FILTER - ATTENUATOR & AMPLIFIER - RECTIFIER CARD (Card no.2)

This contains 4 identical channels. It is used for E, F, G, and H channels. The function of this card is similar to the card no.1. This card is used in 3D or 4D evaluator version. In case of 2D evaluator system dummy card is used in place of this card.

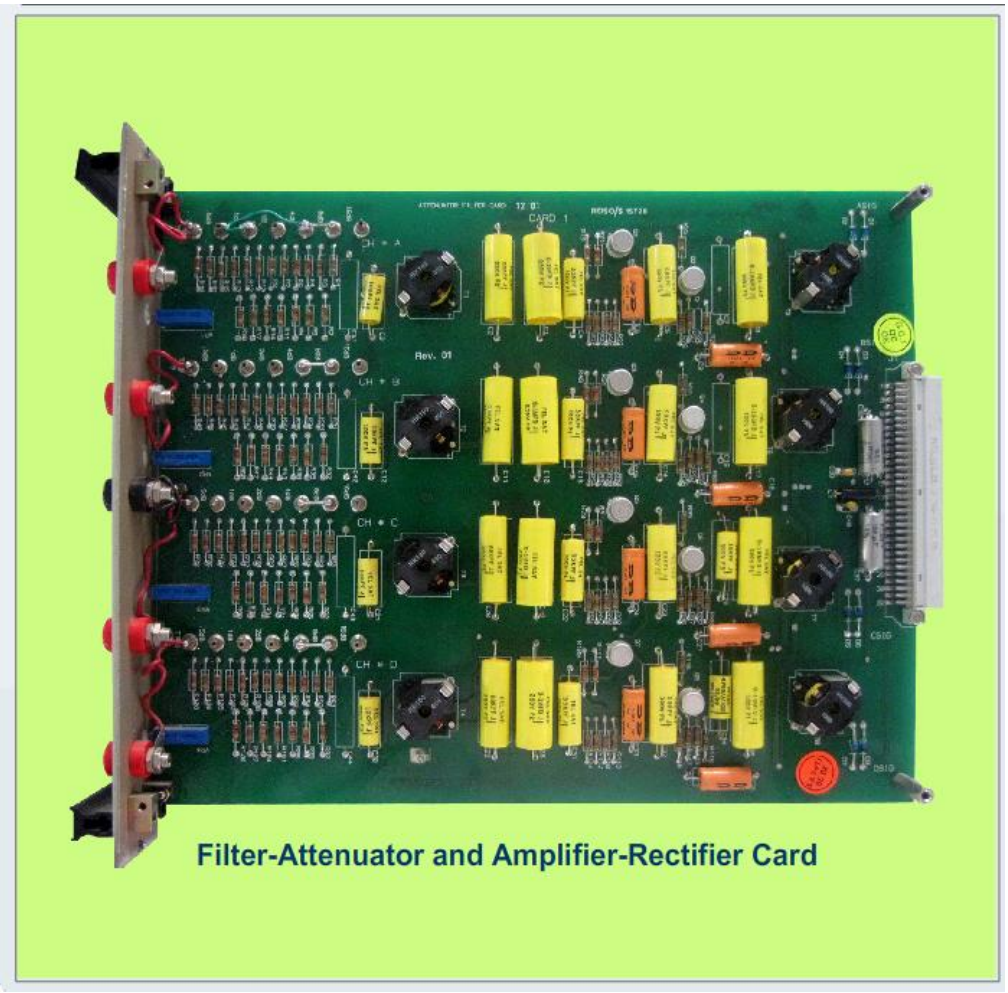


Fig. 2.10

Adjustments on Card No-1 and 2

On card no.1 & 2 (Filter-Attenuator and Amplifier-Rectifier cards), output test terminals, attenuator pads and 5 KΩ potentiometer are available. Attenuator pads (0.5, 1, 2, 4, 8, 16 db) and 5 KΩ potentiometer are required for adjusting the signal level. The output of these cards for all channels should be adjusted and checked with a high input impedance digital Multi meter.

Connect all the cards and power supply switched 'ON', pull out card 1 and connect it through an extension card. Open its cover plate. Keep the potentiometer in extreme clockwise position. Now adjust the pads in such a manner, so that the output of card for a particular channel is about 150 mV AC (rms). In this position, the attenuator pads should be soldered carefully and then by adjusting the potentiometer, the output of card is adjusted to 105 mV AC (rms). Similar adjustments have to be done for other channels on Card 1 & 2.

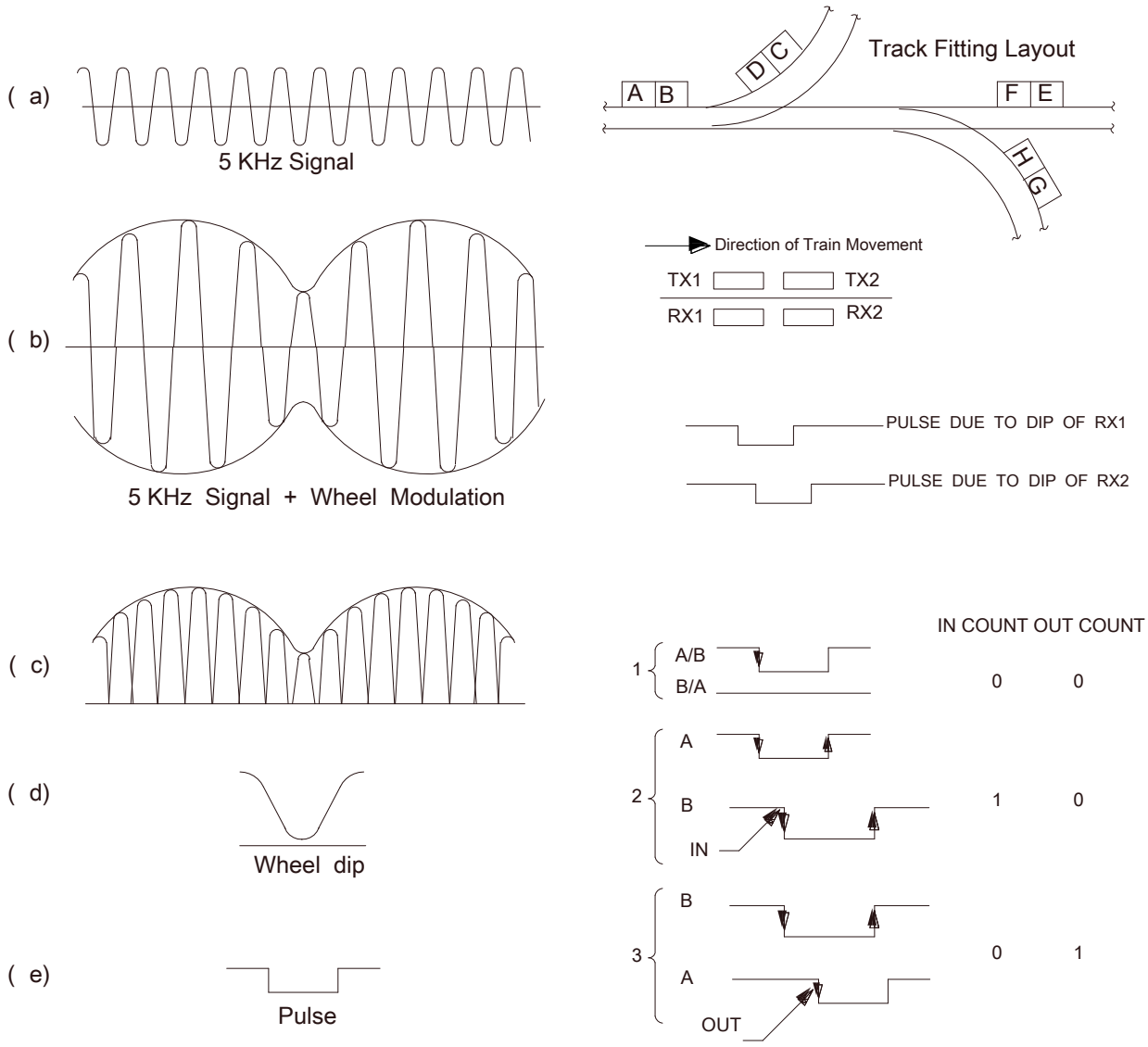


Fig. 2.11

2.5.3 PULSE SHAPER CARD (Card no.3)

This card houses 4 channels (A, B, C & D). Since all the channels are identical the circuit description of only 'A' Channel is given below

Each of these consists of 4 sections as given below:

(i) Low pass filter.

(ii) Schmitt trigger.

(iii) Impulse time filter.

(iv) Level converter.

1. **Low pass filter**: The low pass filter (300 cycles) separates, modulated signal representing wheel dip from 5 KHz carrier. The demodulated signal is fed as input to a Schmitt trigger circuit, which converts it to a slow rising / falling signal.

2. **Schmitt trigger**: The Schmitt trigger is designed to trigger at 50% of the normal input level to convert a dip in to a pulse. Fig.(e) shows output Pulses waveform of the Schmitt trigger circuit.

3. **Impulse time filter**: This Circuit is for eliminating noise and is designed to pass pulses of width 3.5 milli-seconds and above. *(Pulses with width less than 3.5 milli-seconds are rejected as noise.)*

4. **Level converter**: The output pulses obtained at Impulse time filter have amplitude of 10 volts. The level converter converts 10 V level signals to 5 V level TTL compatible signals. The outputs of these channels are used for further processing in logic cards, counter card etc.

2.5.4 PULSE SHAPER CARD (Card no.4)

The function of this card is same as card no.3 and serves for four channels, (E, F, G & H). i.e evaluator will have two nos. of pulse shaper cards (Card No.3 & 4) for 3D and 4D Systems.

Trolley suppression *is incorporated at both the Pulse Shaper cards,*

- *By using front contact of Track Relay (As push trolleys are Insulated, the track relay remains in Picked up condition) to apply a 10 V DC voltage at Euro connector pin 5, causing permanent conduction of transistor of Schmitt trigger and no pulse is generated even if a dip is received from a channel.*

- *But a normal Train movement drops the Track Relay, which enables normal generation of pulses.*

2.5.5 LOGIC- I CARD (Card no.5)

This Card is used only in 3D or 4D input evaluator. A dummy card uses this space for 2D input evaluator.

3 Input E, F channels are present. G & H Channels are absent and G & H are tied to Vcc through jumpers. (Jumpers J2 & J4 are selected)

4 Input E, F, G & H Channels are present (Jumpers J1 & J3 are selected)

This card has following circuits for E, F, G & H channels and the same circuits are also available in LOGIC II Card (Card No.6) for A, B, C & D channels.

i) Logic circuits for channels E, F, G & H.

ii) Channel failure / low proving circuit for E, F, G & H channels

(i) Logic circuits for channels E, F, G & H

This card houses the logic circuitry to generate 'IN-COUNTS', 'OUT-COUNTS', 'DUPLICATE IN-COUNTS' and 'DUPLICATE OUT-COUNTS' pulses due to the dips caused from channel inputs from the track detection points E, F,G and H. These pulses are fed separately to different combiner gates housed in card 6 (Logic-II) and thereafter to either the 'IN Counter' or 'OUT Counter' in Counter Comparator card (card-7) for further processing.

It also ensures a fixed pulse width for a count pulse generated by channel input pairs EF & GH irrespective of the train speed.

It also prevents failure of the system due to the two IN-COUNTS / OUT-COUNTS of EF & GH channels being fed to the counters simultaneously by use of train of clock pulses (CLK2 and CLK4). These clock pulses are generated in Interrogator or Clock generator circuit located in Logic II Card (Card 6).

(ii) Channel failure / low proving circuit for E, F, G & H channels

This card also houses channel failure proving circuits for E, F, G & H channels. If any channel is not restored back to normal after each count then the 'DUPLICATE IN-COUNT' and 'DUPLICATE OUT-COUNT' is stopped. This is finally locked in supervision circuits and SUPR Relay is dropped permanently. The system can be restored to normal by external reset only. These channel failure proving circuits locks the system to occupied condition, if the channel behavior is not normal.

2.5.6 LOGIC-II CARD (Card no.6)

This card comprises of following circuits.

i) Logic circuits for channels A, B, C & D.
ii) Channel failure / low proving circuit for A, B, C & D channels.
iii) Interrogator or clock generator
iv) The combiner NAND gates.
v) The 'IN-OUT' supervision circuit
vi) 1st OUT count inhibit circuit
vii) Minimum one OUT Count Reset (1st OUT Count Reset)
viii) Power ON Reset.
ix) Preparatory Reset (pilot train) circuit.
x) LED Indications.

Additional to logic II card

(i) Logic circuits for channels A, B, C & D

These logic circuits are identical to those of Logic-1 (card 5) in function. The only difference is that instead of feeding EFGH channel signals to the inputs as in Logic-1 (card-5), ABCD channel signals are fed in logic-II (card-6).

The logic circuit of card-6 identifies the direction of train movement for AB & CD channels and generates the 'IN-COUNT' and 'OUT-COUNT' pulses. 'DUPLICATE IN-COUNT' and 'DUPLICATE OUT-COUNT' pulses are also generated for supervision purposes. The 'IN-COUNT', 'OUT-COUNT', and 'DUPLICATE IN-COUNT', 'DUPLICATE OUT-COUNT' pulses are fed separately to different combiner gates housed in this card and thereafter to the 'IN Counter' or 'OUT Counter' of Counter Comparator card (card-7) for further processing.

It also ensures a fixed pulse width for a count pulse generated by channel input pairs EF & GH irrespective of the train speed.

Fig below shows Counting technique in UAC.

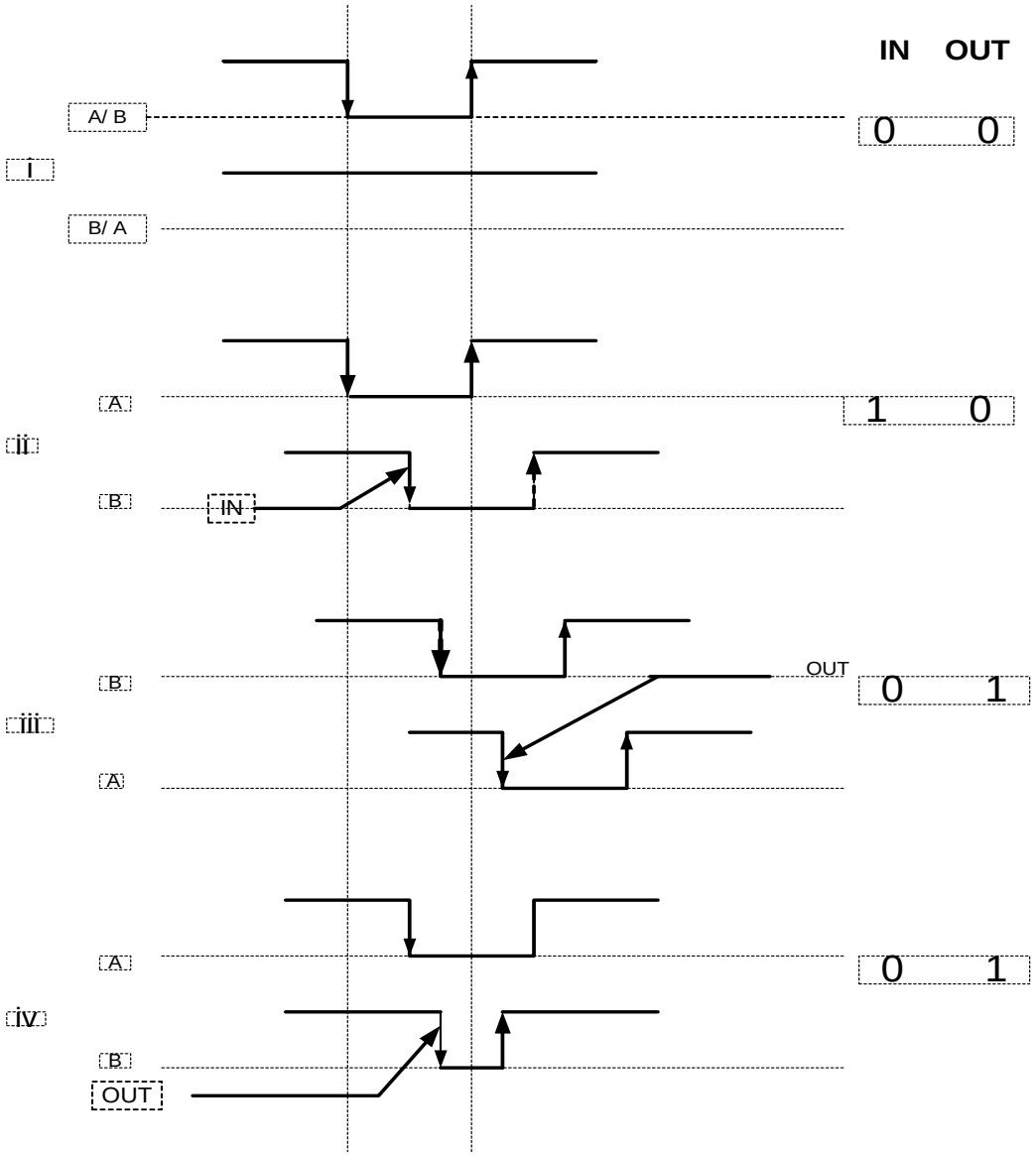


Fig. 2.12

(ii) Channel Failure / Low Proving Circuit for A, B, C, D Channels

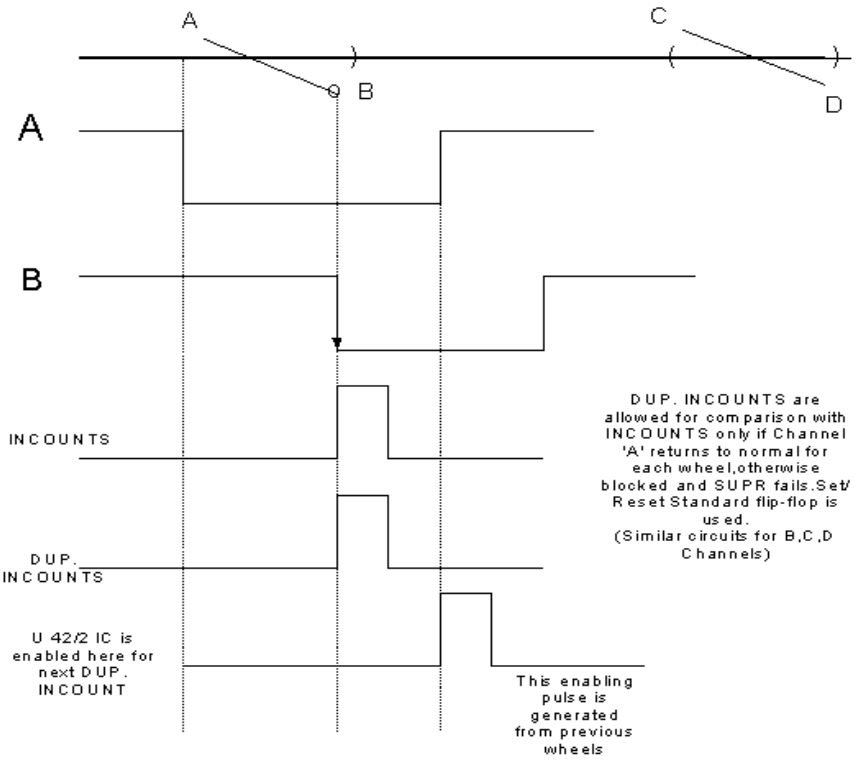


Fig. 2.13

This card also houses channel failure proving circuits for A, B, C & D channels, which locks the SUPR Relay to drop condition if any channel fails during train movement at the detection points.

If any channel is not restored back to normal after each count then the 'DUPLICATE IN-COUNT' and 'DUPLICATE OUT-COUNT is stopped. This is finally locked in supervision circuits and SUPR Relay is dropped permanently. The system can be restored to normal by external reset only. These channel failure proving circuits locks the system to occupied condition, if the Channel behavior is not normal. During the reset condition the levels A, C, E and H are all at Logic'1' level. The logic levels at various points from this circuit are monitored in General Supervision Card (Card 8) and Relay Driver Card (Card 9). Any logic state failing to achieve its normal condition after passage of a train will latch the system to permanent failure condition by dropping SUPR Relay.

(iii) Interrogator or clock generator

It has also an 'INTERROGATOR' circuit. This generates four clock pulse trains such as CLK1, CLK2, CLK3 and CLK4. All these four pulse trains are staggered in Time phase, with each of these pulse trains having a phase difference of 25 µsec as compared to the subsequent one. These clock pulse trains are fed to the Logic Cards (Card 5 & 6), General Supervision Card (Card 8) and Relay driver Card (Card 9).

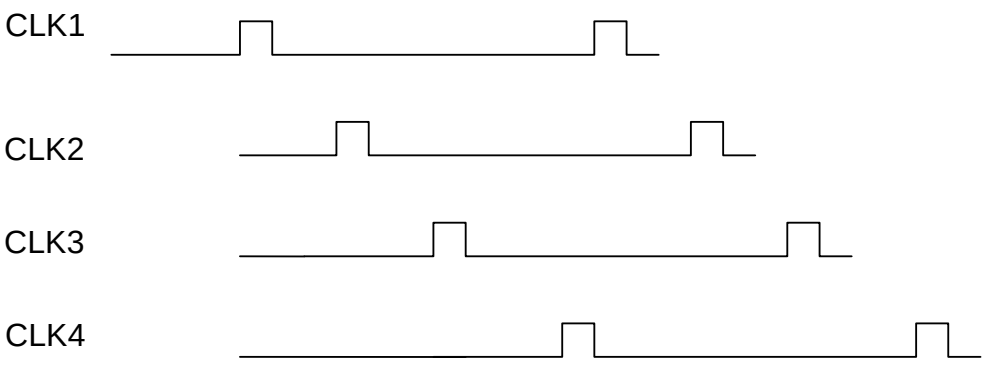


Fig. 2.14

The interrogator ensures that even if more than one in count or more than one out count are fed simultaneously (Ex. during shunting movement when in counts or out counts may get registered from entry and exit end of the monitored section) from different detection points, the final count pulses fed to the counter card get staggered and thus counts are not missed. To achieve this CLK2 and CLK4 are fed to the Logic I Card (Card 5) for the counts generated due to EF and GH channels and CLK1 and CLK3 are used in this Logic II Card for the counts generated due to AB and CD channels.

(iv) Combiner NAND gates

It has combiner gates, which combine the count pulses generated from all the detection points AB, CD, EF, and GH. The various 'IN-COUNTS', 'OUT-COUNTS', 'DUPLICATE IN-COUNTS' and 'DUPLICATE OUT-COUNTS' are generated either from Logic-I (card.5) or Logic-II (card-6) circuits are combined using these gates. The final outputs of these gates are fed to the counter & the counts supervision circuits of Counter comparator (card-7)

(v) IN-OUT Supervision Circuit

This card houses the IN / OUT supervision circuits. If the 'IN-COUNTS', and 'OUT-COUNTS' tally and the last count registered is an 'OUT-COUNT', it enables a CLEAR indication by giving logic 1 levels to General supervision Card and Relay driver Card. In case the last count generated by the passage of a train is not an 'OUT-COUNT' the system latches to permanent failure condition (logic 0 level).

(vi) 1ST OUT Count Inhibit Circuit

This circuit ensures that the 1st count fed to counter comparator card (card-7) is always an 'IN-COUNT'. In case the 1st count generated is an 'OUT-COUNT' then the 'DUPLICATE OUT-COUNT' gets inhibited, at card 6 and does not reach the Counter comparator card (card-7) on account of which the system latches to failure mode.

(vii) Minimum one OUT Count Reset: (1st OUT Count Reset)

The minimum one out count has to be registered in the system after train entry into the section for applying SM's reset. Otherwise the SM's Reset will be disabled. The system goes to preparatory reset condition after SM applies reset in the system. During power OFF / ON condition of the system Pin 8 of U51 is normal and SM's Reset is allowed.

(viii) Power ON Reset

As soon as power is switched on, this feature resets various flip flops, Counters etc.

(ix) Preparatory Reset (Pilot Train) circuit

After SM applies Reset in the system, SUPR is relay is dropped. Once the 'IN-COUNTS', and 'OUT-COUNTS' are registered by a pilot train and the counts are equal, SUPR relay picks up. So, any time External Reset is applied by S.M. the pilot train movement brings the system to clear condition. Jumper settings are required to be adjusted in this card in order to select either Preparatory reset or Conditional hard reset.

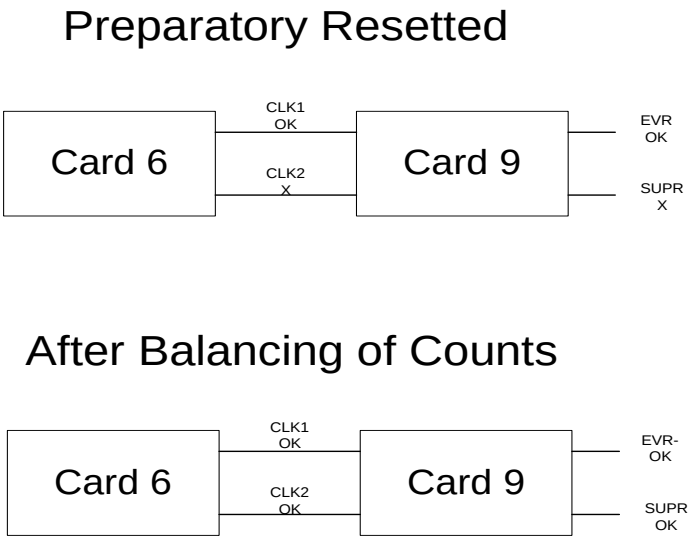


Fig No: 2.15

(x) LED Indications

The Card is provided with LED indications for display of normal position in the card. The health of the normal level of each signal is indicated by LEDs. The LEDs are numbered and its monitoring signal is given below:

Sl. No	LED No	Signal	Normal LED position
1	LD1	INCOUNT	ON
2	LD2	OUTCOUNT	ON
3	LD3	DUP.INCOUNT	ON
4	LD4	DUP.OUTCOUNT	ON
5	LD5	Clock-01	ON
6	LD6	Clock-02	ON
7	LD7	Clock-03	ON
8	LD8	Clock-04	ON
9	LD9	IN OUT Supervision1	Normal – ON Train in section --OFF
10	LD10	IN OUT Supervision2	Normal – ON Train in section --OFF
11	LD11	Prep. Reset Clock-02	(a) When prep. Reset-- OFF (b) Normal – ON (c) Train in section --OFF

All the 11 Nos. of LED's are ON (lit) with normal signal levels in the card. If any failure takes place in the card the corresponding LED becomes OFF. This card may not be OK and is to be sent repair.

(Note :- Some of the features such as (vi)- (ix) are provided only in later models of UAC and not provided in earlier models).

2.5.7 COUNTER COMPARATOR CARD (Card No.7)

This card is similar in the 2D, 3D & 4D version evaluators of the Axle Counter System. It houses two '10 stage' digital counters, one for counting the 'IN-COUNTS' and the other for 'OUT-COUNTS'. This also has count supervision circuits, both for in counts as well the out counts, to check the integrity of the counters and to check for correspondence from the counter chain for every pulse received from the duplicate logic and thereby ensure that for every count pulse generated by the logic circuit the counter has updated itself correctly.

In addition there are two comparators, one being a duplicate of the other, to compare the counts from the two counters 'IN' counter' and 'OUT' counter'. The outputs of the comparators are further compared with EX-OR chain to ensure integrity of the comparators.

The exclusive-OR gate output serves to indicate the difference between the outputs of two sets of comparators. The output of two sets of comparators are combined in two '13 input NAND' gates to give two evaluator outputs indicating whether the 'IN' & 'OUT' counts are equal or not.

The 'IN-COUNTS' and 'OUT-COUNTS' from the counter card are displayed by a seven segment display in display card mounted on the front panel.

2.5.8 GENERAL SUPERVISION CARD (Card no.8)

This card is used in all the three versions (2D, 3D and 4D) of the Universal axle counter system. The power supply in general supervision card (card-8) is provided with decoupling capacitors between ground and the Vcc line to reduce the ripple

This card comprises of various supervisory circuits, which supervise proper functioning of all the previous cards. This card accommodates the following supervisory circuits.

(i) LDO mono-shot chain.

(ii) Fault supervision circuit.

(iii) EV supervision circuit.

i) LDO mono-shot chain

The input to the LDO mono chain is a train of clock pulses from the interrogator circuit of Logic-II (card-6). These clock pulses pass through the monoshot chain and sense the logic levels and ground levels at various points of the chain for proper levels. This final LDO output is used in relay driver card (card-9) to drive the supervisory relay. Any logic level or ground level attaining an opposite level causes the LDO to get blocked and supervisory relay drops. All the pulse shaper supervision output (APSS, BPSS etc.) is monitored in the LDO chain. In case any one of these fails to attain its original high state after clearing of the section LDO gets blocked and supervisory relay fails to pickup.

ii) Fault Supervision

The fault supervision circuit 'FS' is to guard against one particular mode of failure, which cannot be identified during normal operation of the evaluator. This particular failure is caused due to failure of any one of the flip-flops in the out counter chain at level '1'. This leads to permanent storage of some counts in the out counter. Thus during the passage of a train there is a likely hood that the system may normalise even though the actual out counts generated may be less than the in counts.

This Fault Supervision being constantly sensed by the supervisory relay driver chain in relay driver card (card-9). The drive to supervisory relay is cut off due to Fault Supervision getting latched to '0' level and the SUP relay drops.

iii) EV Supervision

This is to guard against failure of comparator chips in counter comparator card (card-7) under unsafe conditions. The EV-1 and EV-3 outputs of counter comparator, which are duplicates of each other, are compared here. The 0 to 1 transition of both EV-1 and EV-3 after the last out count may at best have a delay of only a few μ seconds so that a reset pulse may be generated to normalise the pulse shaper supervision circuits. Any delay more than this caused due to failure of any chip in an unsafe manner will make the system latch to permanent failure condition.

The comparator outputs from counter comparator card (card-7), EV1 & EV3 are both at logic '1' state during normal condition. At the advent of the 1st 'IN-COUNT' EV1 & EV3 both make a transition from 1 to 0. At the registering of the last 'OUT-COUNT' both EV1 and EV3 regain the logic 1 status provided the in counts and out counts tally.

2.5.9 RELAY DRIVER CARD (Card No.9)

This card consists of the following circuits

(i) Channel level detector

(ii) Voltage monitor to monitor + 5V supply voltage

(iii) EV and SUP relay drivers

i) Channel Level Detector

A maximum of 8 channel level detectors are housed in the card to prove the 8 channels from amplifier rectifier cards (cards 1 & 2) in the case of 4D system. In the case of 3 D system, 6 channels from amplifier rectifier cards (cards 1 & 2) and in the case of 2 D system 4 channels from amplifier rectifier card (card-I) are proved in this card. The unused channels in both 2 D and 3 D systems are locally tied high to Vcc + 5V at the IC pins. A long as all the channel level detectors are high enough to generate a dc voltage of 3 volts at the pin of corresponding monoshot, the clock pulse fed at the input of supervisory relay driver chain are passed to the output and the clock pulses drive the opto-coupler, tuned amplifiers and SUPR pickup. In case any channel output drops, clock pulses are blocked and supervisory relay is prevented from picking up.

ii) Voltage Monitor

It acts as a 'WATCH DOG 'for the +5 V power supply to the evaluator. As long as Vcc +5 V is available this circuit functions and VM (Voltage Monitor) is available. In case Vcc +5 V fails due to any reason even momentarily, multi-vibrator stops and VM is not available which further stops the clock pulses in the supervisory chain, preventing the SUPR picking up till it is reset externally to start the multi-vibrator.

iii) EV Relay Driver

Evaluator relay picks-up when counts recorded by the system, both in count and out-count chains are equal. When counts become equal, the status of EV1, EV2 and EV3 goes to logic '1' level, in Counter Comparator Card (card-7), and the same is proved in this card by three different mono-shots. Whenever, all EV levels are high, the clock pulses (frequency of 10 KHz) from the logic-II (card-6) are fed to this card and passes to the frequency divider to divide the frequency to 5 KHz. Then it is amplified and rectified, it to get 10 V DC to drive the EV Relay. This 10 V DC is sufficient to drive 1000 Ohms Signalling relay. If counts are un-equal at any time then the status of EV1, EV2 and EV3 goes to low and EV Relay drops.

iv) SUP Relay Driver

This circuit consists of a series of monoshots the output of one being coupled to the input of succeeding monoshot. The following levels are proved by the monoshot chain.

- This circuit consists of series of monoshots, which prove the following levels.
- Output of all channels from amplifier rectifier cards, which are in normal conditions 0-4 V DC full wave rectified levels.
- The fault supervision output of general supervision card (card-8).
- The high level of voltage monitors output generated locally in relay driver card itself.
- The zero level from logic-II (card-6).
- GND level of GND R1 (coming from reset relay).

Clock pulses from logic-II (card-6) are fed at the input of monoshot chain. When all the above levels are present the signal is processed and appears as a pulse output. This signal is further fed to a flip- flop. The flip-flop output is fed to an opto-coupler. The output of greater than 10 V is available between euro connector pin 20 and 22. This is the supervisory relay drive and is used to energise SUP Relay.

2.5.10 POWER SUPPLY CARD / DC-DC CONVERTER CARD (Card No.10)

This card supplies the various supply voltages required by the evaluator and is housed in the evaluator rack. This is a 10th card module in the evaluator. The input to the DC-DC converter is + 24 V DC from a battery on float charge. The various output voltages of the dc-dc converter are as follows:

+ 5 V @ 5 Amps. with $\pm$ 0.1% line & load regulation.
+10 V @ 1 Amp. with $\pm$ 0.1% line & load regulation.
+10 V Isolated @ 500 mA for Relay Drive.

The DC-DC converter in turn derives its power from a + 24 V DC source i.e. Battery Charger & Battery Bank.

2.5.11 COUNTS DISPLAY CARD

The display card is having seven-segment counts display and is connected to counter-comparator card through flat cable connectors (16 pin). The 'IN' and 'OUT' count information up to 1023 counts is available for maintenance personnel. This card is mounted on front panel of evaluator and counts are recorded in decimal system.

2.5.12 'CLEAR' and 'OCCUPIED' Indications

Two LEDs (Green & Red) have been provided in the front side of the axle counter rack in a metallic strip for locally displaying the position of the above relays. These indications are helpful for maintenance personnel and it is just the replica of the indications available in SM reset box.

2.5.13 MOTHER BOARD

This is mounted at the back of the evaluator. This is mounted at right angles to the other 10- Cards and serves the purpose of providing various inter connections between them. The female part of the Euro Connectors is mounted on this PCB and the corresponding male parts, which are mounted on the PCB's (Card 1 to 10) mate with them when the card modules are inserted in the unit. The motherboard also provides access, through MS Couplers, to feed various inputs like channel inputs from the track, power supply and trolley suppression and to feed outputs to the EV and supervisory relay kept in the rack.

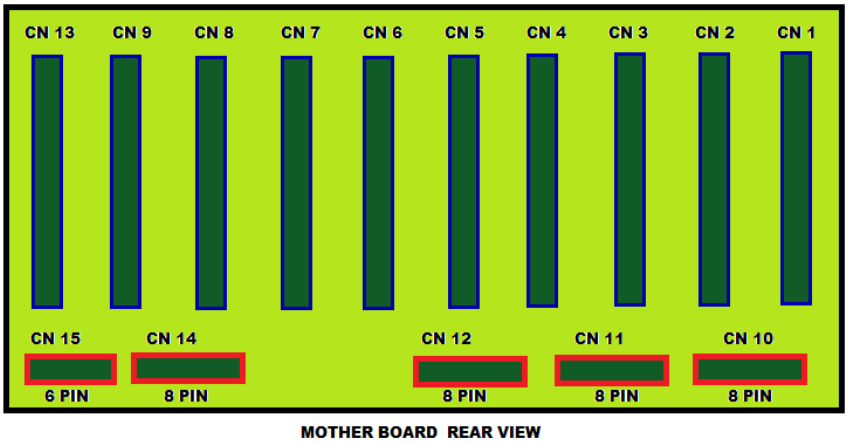


Fig No: 2.16

2.6 2D/3D/4D (BY JUMPER SELECTION/DUMMY CARDS)

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/DUMMY 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

2.7 RESET RELAY

This is mounted at the back of the evaluator on the motherboard. A 67DP–24-4C3 OEN Relay is mounted on this PCB with a mounting socket. This relay resets the system whenever required to do so.

2.8 EV AND SUP RELAYS

These relays are plug-in type (QS3) 12V / 1000Ω DC neutral line relays (Non-immunized) with 4F / B metal to carbon contacts. A BY 127 diode is connected across each relay coil to suppress the transient voltage (more than 800 V) generated when the relays drop and can affect the fast acting sensitive ICs used in the evaluator. These relays are used to indicate Track Clear or Occupied indications to control signal aspects.

2.9 RESET BOX

This equipment is installed in stationmaster's room to enable resetting of central evaluator in case of failure of system after observing prescribed procedure. This unit requires 24 V DC supply for its operation. This unit functions in conjunction with line verification box.

Reset box

Fig. 2.17

The 24 V Reset box consists of the following features:

(i) The reset of axle counter will be possible only when at least one of the two relays (EVR / SUPR) is dropped.

(ii) Co-operative feature circuit consisting of line verification key.

(iii) The Reset indicating counter advances only when the resetting of axle counter is complete (i.e. only on the picking up of both EVR and SUPR relays).

2.10 LINE VERIFICATION BOX

The line verification box has to be fixed outside SM's office near monitored track portion (when axle counter is used in station yard) for achieving co-operative feature to enable resetting of central evaluator in case of failure of system after observing prescribed procedure. This unit functions in conjunction with Reset box.

2.11 FINAL TRACK CLEAR PROVING RELAY (AZTR)

The relay indicates the position of axle counter and Trolley Suppression Track Circuit. The pickup contacts of EVR, SUPR and trolley suppression track circuit (TPRs) are proved in this relay circuit. In case, trolley suppression track circuit is not provided for crossover track device, final track clear proving relay picks up with EVR & SUPR relay contacts only.

To avoid de-energisation of HR relay due to push trolley movement over track device, AZTPR front contact should be by-passed with 'HR' front contact (when AZTPR has been used in HR circuit)

2.12 POWER SUPPLY

The Electronic Junction box and the Reset box are also powered from 24V DC battery bank. All the supplies have over current protection while 5V supply has additional crow bar protection at 6.2 volts.

The capacity of the charger has to be decided with respect to current drain. The maximum current drain of 2D System is 1.5 A and 2.0 A for 3D/4D system including EJB and reset box. Depending on the back up period requirement i.e. 24 hrs or 48 hrs the actual capacity can be calculated.

For Evaluator, EJB and Reset Box 24V battery bank along with Battery Charger IRS: 86/2000 with specific mention of axle counter is used. For 1 set of Evaluator, EJB and Reset Box, 80 AH battery bank is used for 24 hours back-up time. For 2 sets of Evaluator, EJB and Reset Box, 120 AH battery bank is used for 24 hours back-up time. For 3 sets of Evaluator, EJB and Reset Box, 200 AH battery bank is used for 24 hours back-up time.

2.13 TECHNICAL DETAILS

(a) PARAMETERS & SPECIFICATIONS

Sl. No	PARAMETER	SPECIFICATIONS
1.	No. of Detection Points ACS-55/56/57	2/3/4
2.	Maximum Train Speed	200 KMPH
3.	Counting Capacity	1023
4.	Max. Line attenuation (over cable)	20 dB
5.	Signal Input (5 KHz sinusoidal).	Min. 150 mv AC Max.1500 mv AC
6.	Relay Drive Voltage for 1000 Ω Shelf type 4F / 4B relay or QS3 Plug in Relay 1000 Ω, 4F / 4B	>10 V DC

(b) POWER REQUIREMENT

1.	Evaluator 24 V (21.6 - 28.8 V DC)	-10% , +20%	1.5 Amps (2D) 2 Amps (3D / 4D)
2.	Junction Box 24 V (21 .6 - 28.8 V DC)	-10% , +20%	< 250 mA
3.	Reset Box 24 V (21.6 - 28.8 V DC)	-10% , +20%	500 mA (only when reset key is pressed)

2.14 LIMITATION OF UAC

A single UAC can be used only for a max of 4 detection points of one track section only. Hence in a station having many track circuits (both Plain & Point Zones), this requires many UAC s which pose maintenance problems. In such cases MSDAC gives a viable solution which is described in subsequent chapters.

2.15 EARTHING & PROTECTION

Earthing arrangement shall normally consist 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 lung portion above the ground.

The lead wires connecting the installation and the Earth electrode shall ordinarily be of stranded copper wire of 29 sq.mm(19 strand wires of 1.4 mm dia). Copper wire has been specified because G.I wires usually subject to greater corrosion. However, in areas where copper wire may be subject to frequent loss by theft, ACSR of size 64 sq.mm (19 strands of 2.11 mm dia. can be used). ***(For further details on earthing ref: IRISET Notes: S9, Transients, Lightning, Surge Protection Systems and Earthing).*** Maximum permissible values of earth resistances for earthing axle counter system shall be not more than 1Ω.

Class-D Surge Protection Device is provided at the input of the Evaluator Unit, where all the cables coming from EJBs are terminated.

2.16 MAINTENANCE SCHEDULE

2.16.1 WEEKLY INSPECTION OF OUTDOOR EQUIPMENT

(a) Measure the output voltage of all channels on the EJB with 180 Ohms cable connected at the output of EJB. It should be approximately 1.2 V AC. Record and compare with the reading taken previously. The change should not be more than + 10%. If the difference is more, adjust the track device.

(b) Inspect the battery bank for EJB in case of 24 V EJB. Check electrolytic level, specific gravity and voltage. Efficient maintenance of the battery is a must for the satisfactory performance of equipment.

(c) Inspect the battery charger. Measure charging current and ensure it is neither too low nor too high.

(d) Any tampering with power supply, connections of oscillator receiver amplifier cards and transmitter and receiver coils is likely to cause random counting by the evaluator and cause failure of axle counter. It should be done only after ensuring that no train is occupying or approaching the controlled section.

(e) Inspect the Trolley suppression track circuit, its connections, block Joints etc. and ensure all are in good condition.

2.16.2 WEEKLY INSPECTION OF INDOOR EQUIPMENTS

(a) Measure the incoming voltage, of all channels on CTB with DMM and ensure these are within the prescribed limits.

(b) Record the readings and compare it with reading taken previously, It should not be more than + 10% of previous reading. If it is more check the EJB output and readjust the track device.

(c) Observe the counts on the display unit after passage of a train and compare it with the actual number of axles of the train. Verify that the counting is correct.

(d) Check the indications on evaluator panel and it should be same as that is available on SM reset box.

(e) Measure EVR and SUPR relays voltages and ensure that these are more than 10 V.

(f) Measure the voltages on EVR and SUPR relay control terminals when the relays are de-energised and ensure that the voltage is not more than 0.5 V.

(g) Inspect the battery bank of evaluator. Check electrolytic level, specific gravity and voltage. Efficient maintenance of the battery is a must for the satisfactory performance of the equipment.

(h) Inspect the battery charger. Measure charging current and ensure it is neither too low nor too high.

(i) Any interference with power supply and evaluator connections is likely to cause random counting and failure of axle counter. This should be done only after ensuring that no train is occupying or approaching the controlled section.

(j) Ensure that RESET BOX and LINE VERIFICATION Box are sealed properly.

2.16.3 QUARTERLY INSPECTION OF OUTDOOR EQUIPMENTS

In addition to all items mentioned under weekly inspection, the following should be checked.

(a) Check all nuts and bolts of base clamp, receiver and transmitter housing and ensure that these are fully tight.

(b) Check the regulated dc voltage output in regulator oscillator card and it should be 18 V + 0.2 V in 24 V Junction box.

(c) Check that oscillator output frequency is 5000 Hz ± 20 Hz.

(d) Check that oscillator output voltage is 60 V AC ± 10%.

(e) Check that oscillator circulating current is 420 mA ± 10%

(f) Check that output level of receiver amplifiers is 1 .2 V AC.

(g) Check that DC current drain of 24 V DC supplies is less than 250 mA.

(h) Check the dip of the rail inductors. The dip is 10 % to 15 % of the output voltage of rail inductors.

2.16.4 QUARTERLY INSPECTION OF INDOOR EQUIPMENT

In addition to all items mentioned under weekly inspection the following should be checked.

(a) With the help of train simulator, check proper functioning of evaluator giving equal ‘IN’ and ‘OUT’ counts.

(b) Give ‘OUT-COUNT’ first and then equal ‘IN-COUNTS’, check that EVR relay picks up but SUPR relay is dropped.

(c) Drop one channel momentarily, SUPR relay drops and remains in dropped condition even after the channel is restored, until system is 'RESET'. The test should be done after removing trolley suppression voltage, which should be restored after the test is over. Repeat the test for all the channels.

(d) Drop one channel and give equal 'IN' and 'OUT' counts by complimentary channel. 'SUPR' relay should drop. Repeat the test on all channels.

(e) Check working of trolley suppression track circuit.

(f) Check working of SM reset box circuit.

(g) Switch 'ON' and 'OFF' the battery charger at quick intervals. Ensure that no false count is registered by the evaluator.

2.16.5 INSPECTION AFTER REPAIRS

(a) Normally no repairing of cards should be carried out at the station.

(b) Before declaring the cards as faulty, the fault should be analysed properly with the help of system test

(c) When repairs involving change of components are carried out, the concerned card should be tested thoroughly as per the detailed test schedule issued by RDSO by the concerned inspection authority.

2.17 DO'S AND DON'TS FOR AXLE COUNTER MAINTENANCE

2.17.1 DO'S DURING MAINTENANCE OF OUTDOOR EQUIPMENT

(a) Ensure all the nuts and bolts are properly tightened.

(b) Ensure that the power supply for Junction box is as given below

(i) 24 V Junction box 21 .6 to 28.8 V at the input of Jn. Box.

(ii) Check the oscillator output is 60 V AC ± 10 %.

(c) Check the dip with the help of dummy wheel and it should be less than 15 % of normal output.

(d) Check the receiver coil output with EJB disconnected and it should not be less than 1 V AC.

(e) Check the EJB output with evaluator connected and it should be 1 .2 V AC.

2.17.2 DO'S DURING MAINTENANCE OF INDOOR Equipment

(a) Use prescribed digital multimeter for measurements.

(b) Ensure that the power supply to dc-dc convertor is between 21.6 V to 28.8 V.

(c) Check that the output of card 1 (1D/2D) and card 1 & 2 (3D/4D) is l05 mV AC measured at test terminals.

(d) Ensure correct fitting of modular shields.

2.17.3 DON'TS DURING MAINTENANCE OF INDOOR AND OUTDOOR EQUIPMENT

(a) Don't do any adjustment at site when train is already in the section.

(b) Don't do any wiring change or replacement of card when train is already in the section.

(c) After making any adjustment. Make sure that there is no train in the section before resetting the system.

(d) Don't reset Axle counter when train is in the section.

2.18 TYPICAL FAILURES IN AXLE COUNTER (TROUBLE SHOOTING GUIDE)

(a) SUPR RELAY DROPPING INTERMITTENTLY

In this condition, normally SUPR replay is in picked up condition but after some time relay drops intermittently, however, after resetting once again it picks up.
In such a case

(i) Check the AC ripple of battery charger (<10 mv AC rms).

(ii) Check the output of card 1 (l05 mV AC).

(iii) Check the minimum pickup value of relay (1000 Ω DC line relay 4F / 4B). It should not be more than 6.0 V DC. For QS3 relay it should not be more than 10 V DC.

(iv) Check the BY1 27/1N4007 diodes on EVR/SUPR & TPR Relays are connected.

(b) MIS-COUNTING TAKING PLACE

Check the 'Dip' **(**15 % of normal value). If dip is not proper, then miscounting can take place. But in this condition there will be more difference between the 'IN' and 'OUT' counts.

(c) RANDOM COUNTS APPEARING IN AXLE COUNTER

In this condition even when there is no train in the section, random counts appear.

(i) Check the track input wires

(ii) It might be possible that there is some loose connection in track device cable and/or in EJB cable terminations.

(iii) Check the Battery connection & AC ripple:

(iv) It might be possible that there is some loose connection in power wiring or the AC ripple of the battery charger is on higher side.

(d) DISPLAY COUNTS ARE RESETTING

In the idle condition or when train is in the section, counts are getting reset.

(i) Check the equipment earth.

(ii) Check that evaluator and DC-DC converter are mounted properly in the rack with the help of screws.

2.19 PARAMETERS OF UNIVERSAL AXLE COUNTER: Are given in Annexure--2

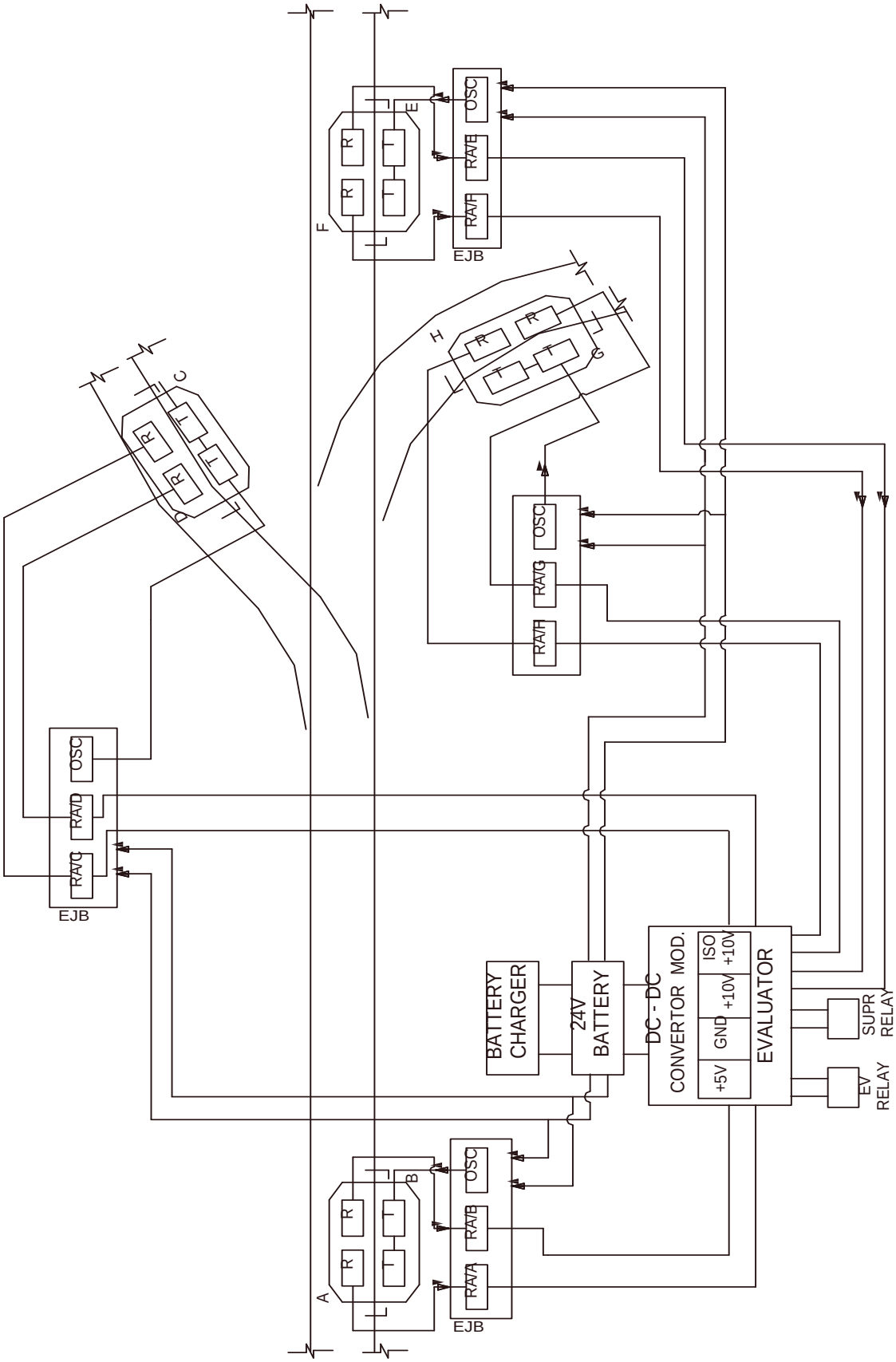


Fig. 2.18

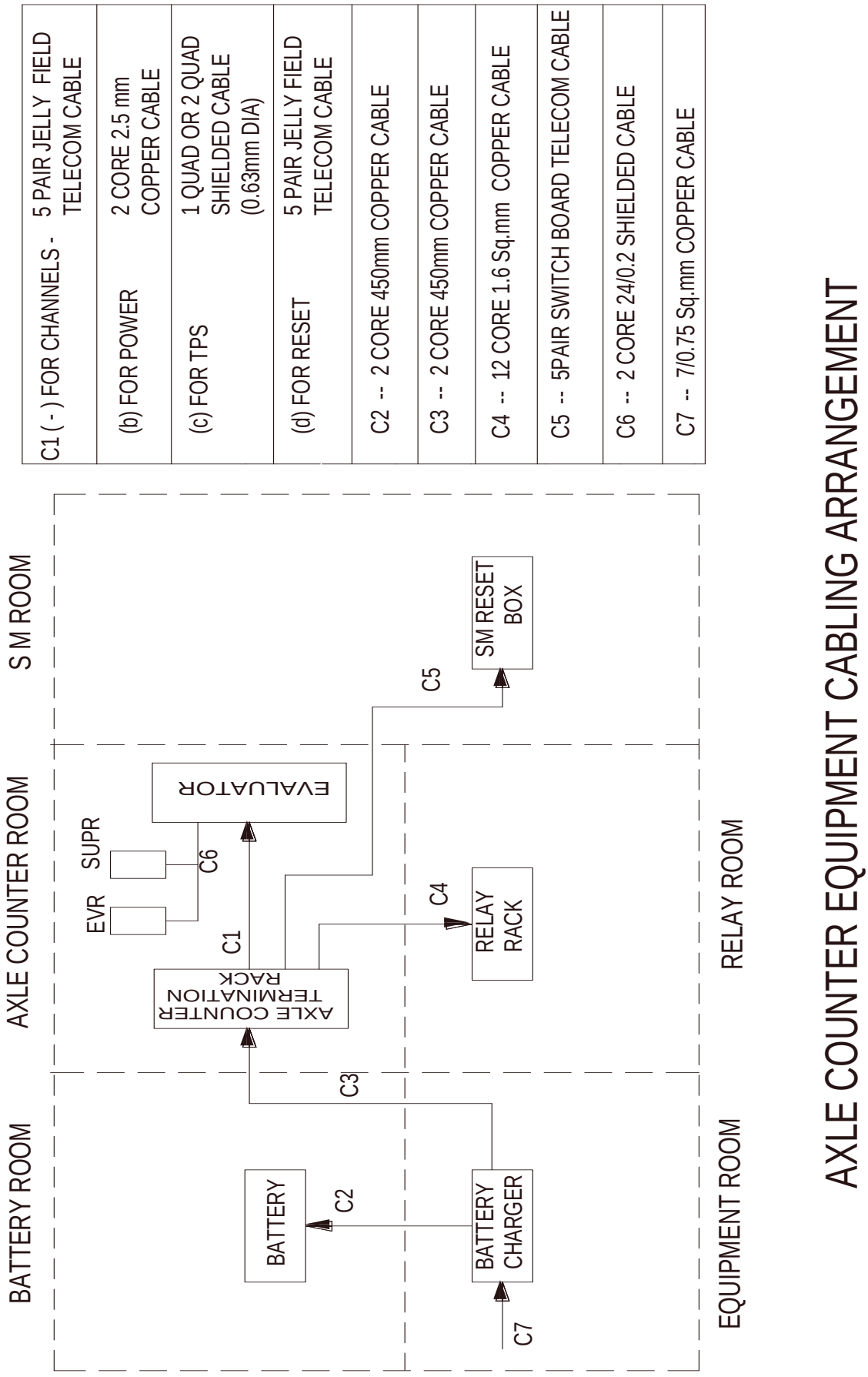

AXLE COUNTER EQUIPMENT CABLING ARRANGEMENT
C1 (-) FOR CHANNELS - 5 PAIR JELLY FIELD TELECOM CABLE
(b) FOR POWER 2 CORE 2.5 mm COPPER CABLE
(c) FOR TPS 1 QUAD OR 2 QUAD SHIELDED CABLE (0.63mm DIA)
(d) FOR RESET 5 PAIR JELLY FIELD TELECOM CABLE
C2 -- 2 CORE 450mm COPPER CABLE
C3 -- 2 CORE 450mm COPPER CABLE
C4 -- 12 CORE 1.6 Sq.mm COPPER CABLE
C5 -- 5PAIR SWITCH BOARD TELECOM CABLE
C6 -- 2 CORE 24/0.2 SHIELDED CABLE
C7 -- 7/0.75 Sq.mm COPPER CABLE
S M ROOM
AXLE COUNTER ROOM
BATTERY ROOM
RELAY ROOM
EQUIPMENT ROOM
SM RESET BOX
EVALUATOR
SUPR
EVR
AXLE COUNTER TERMINATION RACK
RELAY RACK
BATTERY
BATTERY CHARGER
C1
C2
C3
C4
C5
C6
C7

Fig. 2.19

2.20 RDSO approved list of firms for manufacture and supply of electrical signalling items: as on Jan 2012

ITEM: TRACK CIRCUIT EQUIPMENTS – AXLE COUNTER – UNIVERSAL TYPE

<table>
<tr><td colspan="2">Spec No.: IRS: S-42/85 & Drg No. S-15602-04</td></tr>
<tr><td>APPROVED UNDER PART: I</td><td>APPROVED UNDER PART: II</td></tr>
<tr><td rowspan="2">M/s Central Electronics Ltd.,</td><td>M/s Signal & Telecom Workshop, Byculla, Central Railway</td></tr>
<tr><td>M/s Signal Workshop, Podanur-641 023, Southern Railway</td></tr>
</table>

CHAPTER- 3: SINGLE SECTION DIGITAL AXLE COUNTER – CEL make

Model 710A - Amplitude type and 710P - Phase Reversal type: (RDSO / SPN / 177 / 2012)

3.1 INTRODUCTION

The axle counter equipment is working on high frequency and using amplitude modulation or phase modulation for detection of presence of wheel. The equipment described in this notes is 710P (Phase modulation type) for the detection of presence of wheel. In the 'Phase modulation type' track device, the detection of presence of wheel is with the phase reversal of 180^0 out of phase, which enables this system to be more healthy and safe.

In 'Phase Reversal Modulation' technique, 'Trolley Suppression Arrangements' to prevent the counting of wheels caused by push trolley passing over the track device, are not required as the system will take the care of validation of generated pulses caused by passage of wheel over the track device, depending upon the phase shift of the pulse. This phase shift of the pulse may be normally 160° to 180° for a 'Train Wheel' and it may be approximately 100° to 120° for a 'Push Trolley Wheel' beyond phase of reference signal.

This is Digital Axle Counter equipment for single track sections containing 2 out of 2 micro-controllers to count the axles, establish the track occupancy of a track section and to provide this information to the block or the interlocking equipment.

In this system no separate evaluator is required and no analog data is being transmitted. One set of Axle counter equipment is provided at entry end and other set provided at exit end. Both sets are being connected through a twisted pair of telecom cable i.e. existing RE cable one PET quad is used for both UP and DN Axle Counters. Digital DATA is being transmitted between two ends of Axle counters (Outdoor track side Detection points).This system is a 'full duplex' and capable of operating according to CCITT V.21 and the Data will be transmitted at the rate of 300bit/sec. This data Transmitted ensure negligible interference of the noise. The system is highly reliable.

3.2 FEATURES

(a) The system consists of
  (i) Single Section Digital Axle Counter (SSDAC) units with Vital Relays (VR,PR)
  (ii) Tx / Rx coils.
  (iii) Reset box (259A)

(b) Tx/Rx coil axle detectors are mounted to the web of the rails. The design of system consists of 21 KHz & 23 KHz High frequency Phase Reversal type axle detectors.

(c) Compatible with 90 R, 52 Kg & 60 Kg rail profiles. Easy to install, commission & maintain.

(d) Track devices at both (entry & exit) ends of the section, should be fixed on the same rail.

(e) System is designed to detect the solid wheels with diameter > 400 mm with standard wheel flange.

(f) The system works in pairs. For monitoring single-track section one pair of SSDAC units are required and to be installed near the trackside one at the beginning and another at the end of the track section. i.e Trackside electronic counting equipment.

(g) The basic design of the system is based on counting the number of axles passing at each detection point. These stored counts are transmitted to the second unit of the system and vice versa by means of modem communication.

(h) The communication consists of digital packets having details of Counts & Health.

(i) If counts registered at both detection points are equal, the section is cleared otherwise the section is shown as occupied. The system ensures no error condition to arrive at the decision of clearance.

(j) System is designed as per CENELEC, SIL- 4 (European standard), using micro controller along with other electronic circuits and programmed using dedicated software. When any of these circuits fail, the system goes to fail safe condition.

(k) It is programmable for either Preparatory Reset or Conditional Hard Reset as per requirement.

(l) Micro controller based design with 2 out of 2 decisions and counting through software.

(m) V.21 Modem communication (2-wire) on ½ quad cables and also compatible to work on voice channel of OFC & Radio.

(n) Opto isolated vital relay drive for Q-style 24 V, 1000 Ω and Vital Relay output can be giving at both ends of the system.

(o) It can be used upto 20km (if 30db loss @ 2KHz)

3.3 APPLICATIONS

The system can be widely used in Railways for Block Working (BPAC), Intermediate Block Signaling, Auto signalling and Track circuiting for: i) Loop line ii) Main line iii) yard lines

3.4 SYSTEM DESCRIPTION

The Single Section Digital Axle Counter (SSDAC) is supplied with Phase reversal type Axle detectors. The system model nos. as on dec 2011 is as follows:

Sr.	Item	Model number	Quantity	Remark
1	SSDAC	DACF 710P	One unit at both end of axle counter section	To be installed in location box which is near to track device
2	Axle Detectors	AD - 711	One Tx coils set and one Rx coils set at both end of axle counter section	One set(Tx/Rx) includes two coils of 21KHz and 23KHz
3	Vital Relay Box with PR	VR 721	One set at both end of axle counter section	Dual Relay-two relays named as VR, PR
4	Reset Box	RB 259	One reset box in station at both end of axle counter section	When SSDAC is used for block section
			One reset box in station	When SSDAC is used in station yard
5	SVPD	SV - 121	Two sets at both end of axle counter section	Surge Voltage Protection device

3.5 AXLE DETECTORS - AD711

(a) The design of system consists of 21 KHz & 23 KHz High frequency Phase Reversal type axle detectors.

(b) Axle detectors (AD711) consist of 2 Tx coils in one set & 2 Rx coils in one set and each sets are installed at both ends of axle counter section

(c) In one set of Tx / Rx coils always right hand side coil is 21 KHz and left hand side coil is 23 KHz. These sets of axle detectors are mounted on the web of the rails.

(d) Compatible with 90 R, 52 Kg & 60 Kg rail profiles. Easy to install, commission & maintain.

(e) Track devices at both (entry & exit) ends of the section, should be fixed on the same rail.

(f) System is designed to detect the solid wheels with diameter > 400mm with standard wheel flange.

3.6 SSDAC (DACF 710P) UNIT

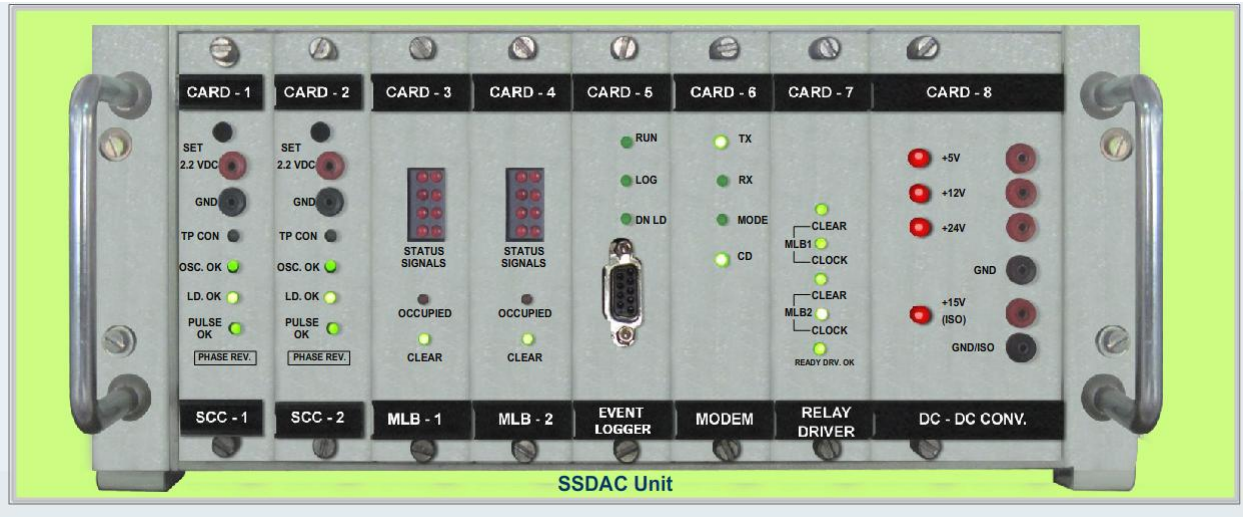


Fig. 3.1

(i) SIGNAL CONDITIONER CARD (Card 1&2) (SCC)

- The Signal conditioner Card-1 (SCC-1) generates 21 KHz carrier signals, which is transmitted to right side (1^{st})Tx coil always
- The Signal conditioner Card-2 (SCC-2) generates 23 KHz carrier signals, which is transmitted to left side (2^{nd})Tx coil always.
- The respective Rx coils receive respective signals and induced signals are with phase difference of 180^0 with respective to reference signals
- When the train wheel passes over the axle detectors, the Rx signal gets phase modulated.
- These SCC cards receives respective induced modulated signal and demodulates it to generate valid train pulses.

(ii) MICRO-CONTROLLER LOGIC BOARD/ CARD (Card 3&4) (MLB)

The Micro-controller Logic Board (MLB) is the heart of the system.

- FEATURES
  - 8051 Based Architecture
  - 8 Bit Micro Controller
  - ATMEL AT89S8252 Micro controller
  - 2 out of 2 Decision
  - Uses C subset language
- SOFTWARE- TOOLS
  - KEIL µ Vision Development System
  - Universal Programmer

- ATMEL AT89S8252 Micro controller is used.
  - 2KB Program Memory
  - 256 bytes RAM
  - 8KB Flash memory
  - 32 Programmable I/O lines
  - Wide Operating Voltage range of 4 V - 6 V
  - Full Duplex Serial Port
  - Programmable Watch Dog Timer
  - Fully Static operation up to 24 MHz (Upgraded to 40 MHz)
  - Operating Temperature of –40°C - +85°C
- SOFTWARE
  - Software Version S006
  - Use of State Machine for Axle Counting
  - Use of ASCII MODBUS protocol
  - Use of CRC16 technique for Error Checking during communication
- These cards implement the
  - Wheel detection,
  - Train direction checking and
  - Wheel counting functions.
  - It receives the remote wheel count and computes the status of the section for clear or occupied.
  - It also checks various supervisory signal levels like supervisory of Tx/Rx coils, presence of various cards, communication link failure etc. These cards communicate with each other for wheel count.

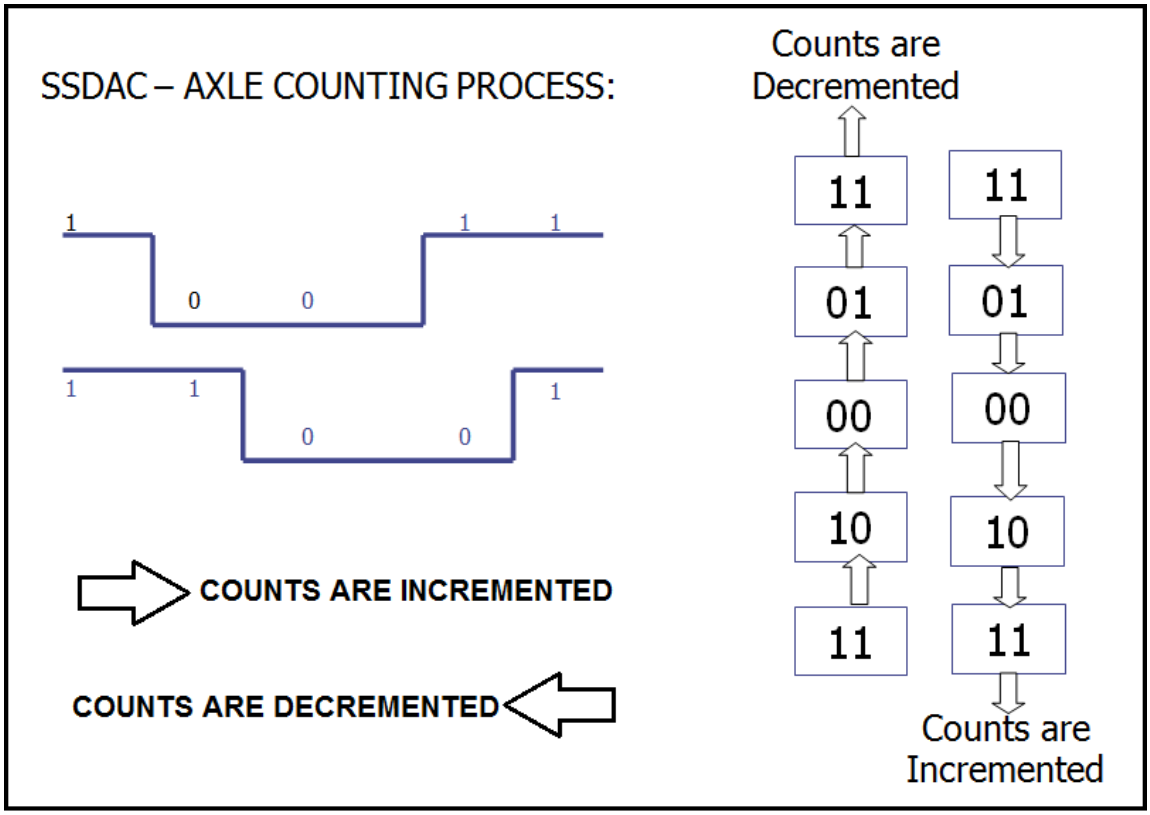
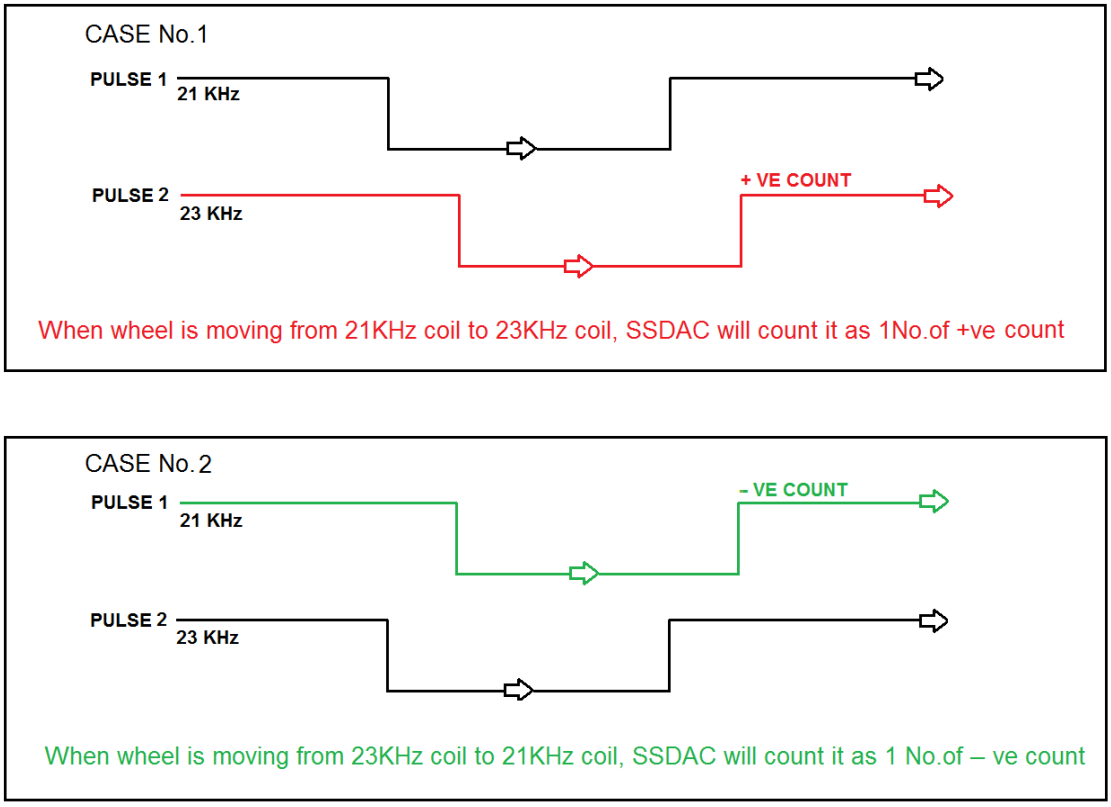


Fig. 3.2



Pulse formation in SSDAC

Fig. 3.3

Wheels entering into the axle counter section from 'Entry End' are 'Incremented' and wheels going out of axle counter section from 'Exit End' are also 'Incremented'

Wheels entering into the axle counter section from 'Exit End' are 'Decremented' and wheels going out of axle counter section from 'Entry End' are also 'Decremented'

This MLB card is having Extensive LED display.

- A block of 8 LED indicators for count progress / error display,
- 2 independent LED indicators for section status.
- The errors occurring in the system during the operation of the SSDAC are encoded and are indicated by means of the 8-LED block present on the front panel of the MLB cards.

LED BLOCK FRONT VIEW **VALUE GIVEN TO LEDS**

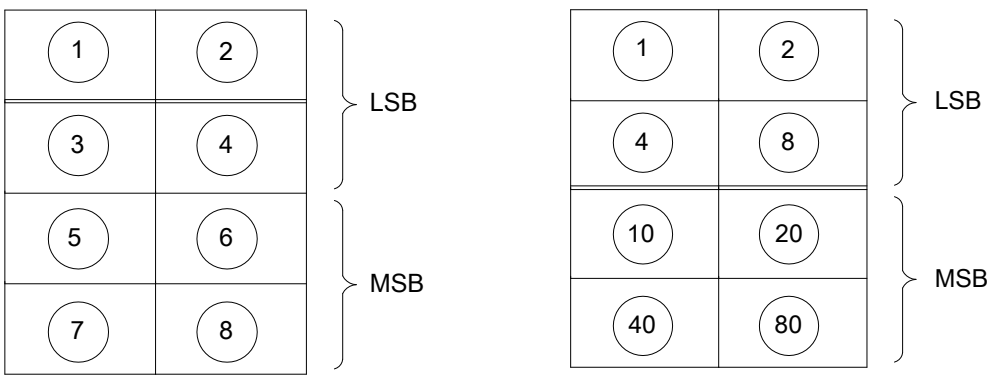


Fig. 3.4

Fig. 3.5

The example for reading an error from the above LED's is as follows

LED's 1 & 3 of LSB glow and LED's 5 & 6 of MSB glow and other LED's are OFF. By adding LSB + MSB LED's values, the error no. is 35 i.e. negative count errors.

ERROR CODES are given in Annexure-3

(iii) EVENT LOGGER CARD (Card 5)

Event logger card is designed to capture and store important signals from the remote and local SSDAC units. The stored data can be downloaded from the event logger card for the purpose of analyzing the events occurring during the operations of the SSDAC. The data can be analyzed with the help of CEL data analyzer software.

The event logger card captures following signals

(i) Pulse signals.

(ii) Supervisory signals.

(iii) Card removal information

(iv) Serial packets from:

- MLB1 (Local unit)
- MLB2 (Local unit)
- Remote unit (communication failure and composite information from MLB1 & MLB2.

Event Logger card has a Rabbit processor and 2 MB FLASH MEMORY to store packets. The data is initially stored in the buffer and subsequently transferred to FLASH memory every two minutes. Normally 4096 pages of the data can be stored in flash memory on FIFO (first in first out) basis.

Run: This LED blinks continuously indicating the normal working of the event

Log: This LED blinks whenever data is being logged into the flash memory. (Approx, after every 2 minutes)

Dnld: This LED is ON when data is being downloaded from the flash memory of the card and becomes OFF when download is complete.

(iv) MODEM CARD (Card 6)

(i) The modem card transmits and receives the digital packet information from one counting unit to the other.
The packet will appear after every 1.8 sec. and the packet carries the latest information such as:

- Count change information,
- Count update information
- Reset information if any
- Error information if any.

(ii) The modem card being used is V.21 type (2-wire) in SSDAC.

(iii) This card interfaces with serial RS232C port of both Micro-controller Logic Boards.

(iv) It multiplexes the two RS232C inputs and selects one of the two channels and provides signal conversion from digital to analog (FSK modulation) and vice- versa.

(v) Data transmission rate is 300 bits/sec.

(vi) Automatic Gain Control circuit is incorporated, hence no gain adjustments required.

(vii) Mode selection on Modem card. The modem has been set in 'ORIGINATOR' mode for entry and in the 'ANSWER' mode for exit in the factory.

The selection of dip switches (2-way) is given below in table.

S	SSDAC units	Dip switch settings-SW2		Dip switch settings-SW3	
		1st Way	2nd Way	1st Way	2nd Way
1	Exit end unit	OFF	ON	OFF	ON
2	Entry end unit	ON	ON	ON	OFF

(viii) LED Indications provided on Modem card

a) Tx -Transmitting the signal when LED is flashing.

b) Rx- Receiving the signal when LED is flashing.

c) MODE-Remains OFF in SSDAC.

d) CD-Carrier is detected when LED is glowing.

(v) RELAY DRIVER CARD (Card 7)

The card directly plugs into the motherboard of SSDAC unit. One RD card is used in each SSDAC counting unit. This 'Relay Driver' card receives the command of 'Clear' and 'Clock signals' from MLB1 & MLB2 cards and drives the vital relay (VR) to energized condition when section is clear. If a train occupies the section, the vital relay is de-energised.

Output for the preparatory reset relay (PR) is also driven from this card when system becomes normal after reset application.

The main functions of this card are:

a) Dual Clock Checking circuits
b) Opto isolator Circuit.
c) Vital Relay Drive Output.(24VDC)
d) Preparatory Reset (PR) Relay drive output. .(24VDC)

The vital relay status is read back by the system as per the driving output. The command signals and vital relay pick up is indicated on the card.

LED Indications

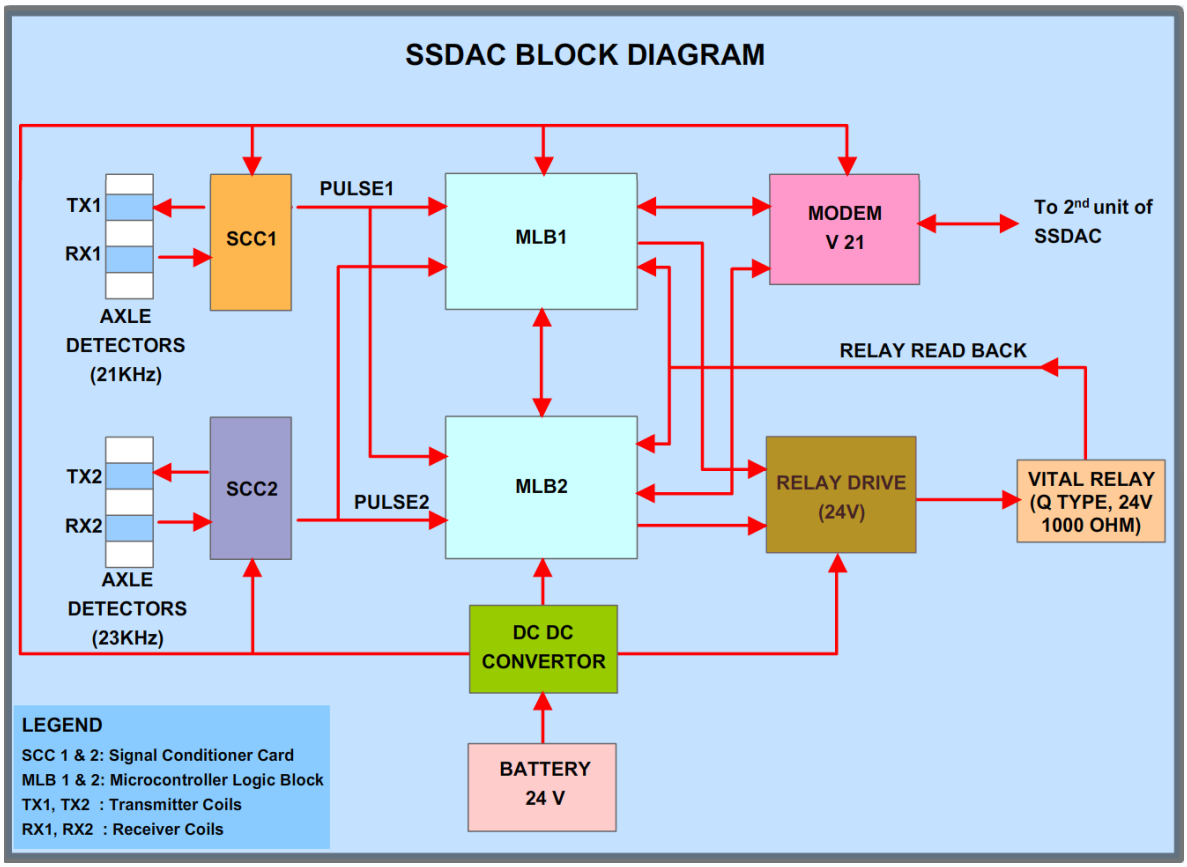
- MLB1
  - Clear indication
  - Clock indication – LED flashes when the section is clear.
- MLB2
  - Clear indication
  - Clock indication – LED flashes when the section is clear.
- Relay driver ok- indication

All the above LED's are lit for section clear condition.

(vi) DC-DC CONVERTER CARD (Card 8)

Sl. No	Item	Nominal Voltage	Required voltage
1	Input voltage	24V DC Maximum current drain= 1.2A	18V DC to 30V DC.
2	Output voltage	+5 V DC @ 2 A	4.75 to 5.25V DC
		+12V DC @ 200 mA	11.75 to 12.25V DC
		+24V DC @ 300 mA with common ground	23.5 to 24.5V DC
		+15V DC @ 100 mA with isolated ground	14.5 to 15.5V DC

- Its input and outputs are protected for short circuit and input reverse polarity.
- LED indications and Monitoring sockets are provided for all output voltages.



Functional diagram of CEL SSDAC
Fig. 3.6

(vii) VR box, VR, VPR, PR, PPR relays

VR box

VR box (VR-721) supplied along with this system with provision for VR relay and PR relay. It is also provided with 2/3 indications (Green, Yellow, Red)

a) Green LED glows when VR is picked up.
b) Red LED glows when VR is dropped.
c) Yellow LED glows when PR is picked up after reset application.

Vital Relay (VR), VPR

VR is QN1 type, 24 V, 1000Ω, 6F/6B relay which is supplied along with the system. The vital relay is housed in the VR box. The relay coil and its contacts are terminated on to the 7-pin MS coupler (MS-7) fixed at the back of the relay box. The relay drive output from SSDAC unit is taken out through coupler MS-3 and is connected to 'Vital Relay Box' through coupler MS-7.

1N5408 DIODE is connected across the R1, R2 in reverse bias condition to suppress the transient voltage. This relay is driven by relay driver card (24VDC). The VR relay picks up only when section is 'CLEAR'.

Through front contact of VR relay, VPR is picked up in relay room.VPR is QN1 type, 24 V, 1000Ω, 6F/6B, AC immunised relay. Front and back contacts of VPR are used in reset circuit and also in interlocking as per requirement.

Preparatory Relay (PR), PPR

PR is QN1 type, 24 V, 1000Ω, 6F/6B relay which is supplied along with the system. The preparatory relay is housed in the VR box. The relay drive output from SSDAC unit is taken out through coupler MS-3 and is connected to 'Vital Relay Box' through coupler MS-7.

Back contact D3-D4 of VR is proved in series with its coil circuit.

1N5408 DIODE is connected across the R1, R2 in reverse bias condition to suppress the transient voltage. This relay is driven by relay driver card (24VDC). The PR relay picks up only when reset command is applied after system goes in error state. Its energisation proves VR is in drop condition and all required logics are fulfilled for reset application.

Through front contact of PR relay, PPR is picked up in relay room. PPR is QN1 type, 24 V, 1000Ω, 6F/6B, AC immunised relay. Front and back contacts of PPR are used in reset circuit and also in interlocking as per requirement.

Vital Relay Box

S.No.	MS coupler (MS-7)		Description of signal to vital relay	Connection to be made
	Pin	Cable		
1.	A	BLUE	Prep. Reset (24V) In	Direct coupler to coupler cable to be connected between VR Box (MS-7) to SSDAC to (MS-3)
2.	B	ORANGE	Coil R2	
3.	C	GREEN	Coil R1	
4.	D	BROWN	D1	
5.	E	GREEN	D5	
6.	F	BLUE-WHITE	D2 & D6	
7.	G	GREEN	NC	

3.7 ADDRESSING Scheme for 2D System of SSDAC

The address setting for 'ENTRY' or 'EXIT' of the units is already fixed at the factory itself. The units are factory tested for one pair. The address setting of units is given inside motherboard and should not be disturbed after assigned a particular code at the time of installation. The address setting of SSDAC unit is designed with a unique 8-bit address code. This code is selected through a 8-way DIP switch located on the mother board.

Further details on address setting are given in annexure 3

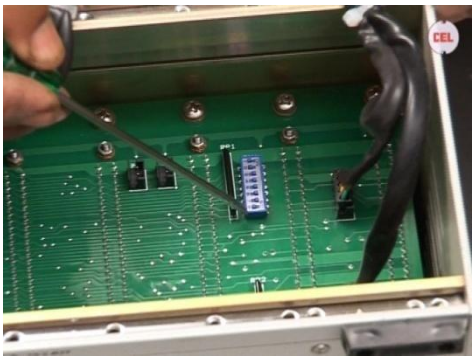


Fig. 3.7

3.8 SM's RESET BOX (RB259)

The reset box is a tabletop model has been designed as per RDSO Drawing No S/2000/3. It has the following components

1. The LED indications displaying the section status
   a. Section Clear green indication LED of 10 mm.
   b. Section Occupied Red indication LED of 10 mm.
   c. Power ON Yellow indication of 3 mm.
   d. Prep. Reset Green indication of 3 mm.
   e. Line Verification Yellow indication of 3 mm.
2. SM's Key actuator
3. Push Button Red colour
4. Counter for recording the number of reset operations.
5. 20 X 2 LCD display with Backlit
6. 4 Keys Keypad for setting the date and time operation.
7. 9 pin D-sub connector is given on the motherboard of reset box which can be used for downloading the data from flash for analysis purpose.
8. Miniature reset switch for refreshing the LCD display.

Reset box at ENTRY END & EXIT END

Fig. 3.8

3.8.1 FEATURES OF RESET BOX

The reset box (RB-259) supplied by SSDAC consists of two cards.

(i) **Card 1** of reset box is Interface card or controller block which is plugged in ECN2 connector of motherboard.

a) This interface card is used to provide interface with the SSDAC unit on a pair of cable (2 wire of Quad is preferred).This communication from reset box and SSDAC unit is used for transmission of packets from SSDAC to the reset box. These packets are then processed in the reset box to display the information in the form of Axle Counts and Error Code of both local unit and remote unit.

b) It has onboard flash memory which stores the serial packets of the local unit. In order to analyse the local SSDAC packets, this data can be downloaded from the flash by using any windows compatible PC.

c) It has support for Keypad consisting of 4 keys. The keypad is used for setting up time and date of the reset box.

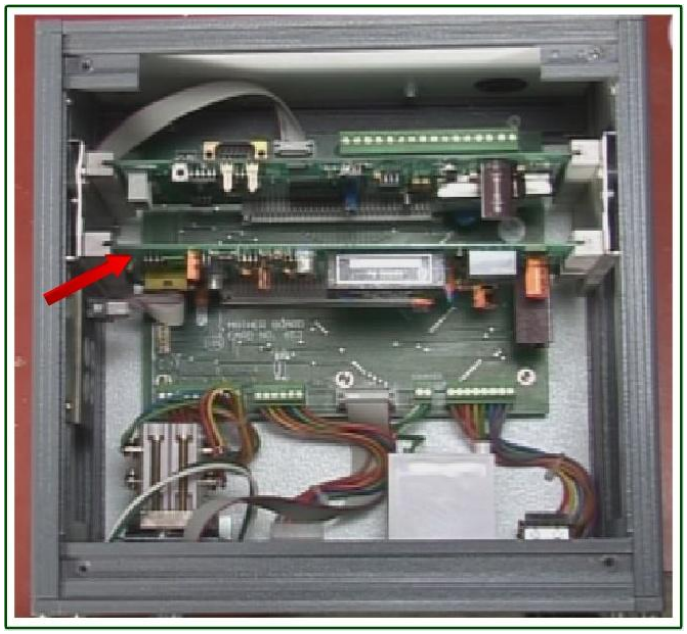
(ii) **Card 2** of reset box is Reset Card is plugged in ECN1 connector of the motherboard which controls the following activities.

a) SM's Key actuator & Reset button for resetting.
b) Flashing of the Prep Reset. LED is controlled by this card. When preparatory reset state is achieved then signal is given by Interface card for making the LED steady.
c) Counter for recording no. of resets.
d) 24 V to 48 V DC-DC converter which generates 48 V DC required for resetting of SSDAC unit.

(iii) Motherboard

The following functions are controlled in the motherboard of reset box

a) Line Verification proving circuit is provided.
b) This card has the provision for extending the 24 V when reset button and SM's Key is pressed. NC proving of SM's key & reset Button is also provided. It can be used for extending the reset command to remote location in case it is required.



Top cover of Reset box opened

Fig no: 3.9

3.8.2 RESETTING OPERATION WHEN SSDAC USED FOR TRACK CIRCUITING AT STATIONS

1. Process
    a) Insert SM's key, turn right and keep pressed.
    b) Press Reset button for 2 seconds
    c) Release SM's Key and Reset Button
    d) Turn left, remove SM's key and keep in safe custody.

2. With the above operation from step 1 (i) & (ii) the 48V DC from the reset box is extended and connected to the SSDAC, the 48 V DC activates the reset circuit in modem card (card 6) of SSDAC unit and generates reset command to the Micro Controllers in MLB1 and MLB2 cards (Card 3 & 4).

3. Reset command to Microcontrollers will not be generated if system is in clear / preparatory / occupied state. System can be resetted if it is in error state or out counts were registered after occupied state.

4. The SSDAC units are reset and counts become zero. The self test is carried out in both the units. The SSDAC unit attains the preparatory reset state. The PR& PPR Relays pick up and preparatory reset LED indication glows on the reset box in SM's room. Resetting operation by both stations is required and is necessary in BPAC use.

5. The counter reading also increments by 1 count through the Prep. Reset command after a gap of 5 sec. approximately. The counter reading should be recorded.

6. One pilot train is to be passed in the section to make the system normal. Thereafter, the vital relay picks up.

3.8.3 RESETTING OPERATION WHEN SSDAC USED IN BLOCK SECTIONS

Both sides resetting operation is required with or without time gap in BPAC use. The procedure for resetting is as follows: -

1. Process
    i. Insert SM's key, turn right and keep pressed.
    ii. Press Reset button for 2 seconds
    iii. Preparatory LED starts flashing.
    iv. Release SM's Key and Reset Button
    v. Turn left, remove SM's key and keep in safe custody.

2. With the above operation from step 1(I) & (ii) the 48Vdc from the reset box is extended and connected to the SSDAC, this 48V DC activates the reset circuit in modem card (card 6) of SSDAC unit and generates reset command to the Micro Controllers in MLB1 and MLB2 cards (Card 3 & 4).

3. Reset command to Microcontrollers will not be generated if system is in clear / preparatory / occupied state. System can be resetted if it is in error state or out counts were registered after occupied state.

4. The SSDAC units are reset and counts become zero. The self-test is carried out in both the units. The SSDAC units attain the preparatory reset state. The PR & PPR relays pick up and preparatory reset LED indication glows on the reset box in SM's room. Resetting operation by both stations is required and is necessary in BPAC use.

5. The counter reading also increments by 1 count through the Prep. Reset command after a gap of 5 sec approx. The counter reading should be recorded.

6. One pilot train is to be passed in the section to make the system normal. Thereafter, the vital relay picks up at both stations.

3.9 TROLLEY SUPPRESSION

Regular Train wheel produces about 160° to 180° of phase modulation while a Push Trolley produces much less of the order of 100° to 120°, which is discriminated at S.C. Card. Hence no separate Track circuit is required for trolley suppression.

The push trolleys for which the system works normally are- 4 spokes wheel trolley, 8 spokes wheel, Rail dolly

(Note: The system may go to ERROR condition for - Motor trolley, Push trolley with perforated wheel, Dip lorry)

3.10 SURGE VOLTAGE AND LIGHTNING PROTECTION

Transient surge voltages arise as a result of Lightning discharge, switching operations in electrical systems and electrostatic discharge. These surge voltages often destroy the electronic equipment to a large extent.

In order to prevent surge voltages from destroying the equipment, all the input lines of SSDAC i.e. Power Supply (24V), Reset (48V) & Modem is to be routed through surge voltage protection devices for effectively protecting the system. These devices (4 numbers) are mounted in a box and supplied along with the system. One number of SVPD box is to be installed at each location and wired to the SSDAC.

Each surge voltage protection device consists of two parts.

(a) Base

(b) Plug Trab

The Base of the device is used for wiring the input and output signals. The connection details from relay room to the box and from box to SSDAC unit are provided on the box.

The Plug Trab consists of MOV and GD Tube and diverts the excess energy during surge voltages or lightning into the ground connection. The operation of these devices relies on a high quality ground connection in order to safely shunt away the unwanted energy. The impedance of the ground connection is critical and it should be less than 2 Ohms.

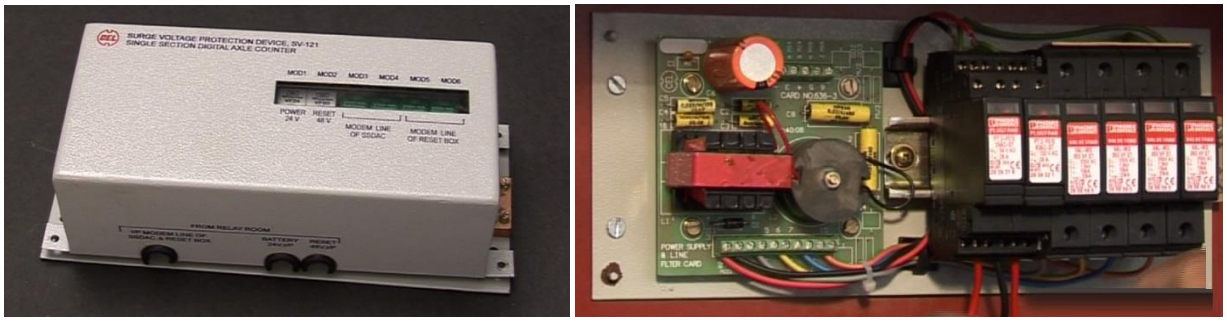
NOTE: The 4 Plug Trab connections are not to be interchanged with one another. The plug Trab is a detachable device and can be replaced with SPARE unit in case of blown device, which is indicated by means of LED for 24 V.

3.10.1 EFFECTIVENESS OF PLUG TRABS

The effectiveness of plug Trab depends wholly on the Earth connection provided to the system. The earth provided to the system should be less than 1 ohm and connections should be firm and proper to the SSDAC unit, VR box, etc.

3.10.2 SURGE VOLTAGE AND PROTECTION DEVICE SV-121

The Surge Voltage protection device is to be installed at each location along with every SSDAC unit.



SVPD (SV-121)
Fig. 3.10

3.11 EARTHING

The lead wires connecting the installation and the earth electrode shall ordinarily be of stranded copper wire of 29 sq. mm (19 strand wires of 1.4 mm diameter). Copper wire has been specified because GI wires usually are having greater corrosion. However, in areas where copper wire may be frequently stolen due to theft, ACSR of size 64 sq. mm (19 strands of 2.11 mm diameter) may be used.

3.11.1 LIMITS OF EARTH RESISTANCE

(a) Apparatus case connected to Earth (SSDAC and vital Relay Box is housed in Apparatus case and Connected to earth at outdoor) shall be less than or equal to 1 Ω.

(b) All cable connected to same earth shall be less than or equal to 1 Ω.

(c) Reset box connected to earth near SM s Room shall be less than or equal to 1 Ω.

3.11.2 EQUIPMENT TO BE EARTHED

A Common Earth should be provided for SSDAC for items (a) & (b) of the above at the outdoor.

(a) The Apparatus Case is to be connected to earth (the chassis of SSDAC & Vital Relay Box should be properly connected to apparatus case).

(b) Metallic sheath and armouring of all the underground main cables are to be earthed

(i) In R.E area, the metallic sheath and armouring of main telecom cables are earthed at both ends.

(ii) In R.E area, the armouring of Jelly filled cable shall be earthed at both ends.

(c) The Earthing shall be provided at every location box where cables are terminated.

(d) Earth already available for other equipment may be used for earthing of Reset Box near SM s Room / Cabin etc.

3.12 LIMITATIONS OF CEL SSDAC

CEL SSDAC is not suitable for point zone applications, where more than 2 detection points are required to monitor one track section.

3.13 DO'S and DON'TS for SINGLE SECTION DIGITAL AXLE COUNTER

(a) DO S

(i) The inter connection drawings are to be followed for connecting the Transmitter & Receiver coils. Tx1 is 21 KHz, Tx2 is 23 KHz & Rx1 and Rx2 coils are 21 KHz & 23 KHz, respectively.

(ii) Ensure that Receiver and Transmitter coil cables have been laid in different pipes.

(iii) Ensure that both the TX coils & Rx coils are having proper alignment on Rail.

(iv) Ensure that packing of sleepers with ballast on both sides of Axle detector is proper.

(v) Check that metal sheaths of the outdoor cable are connected to earth at both ends.

(vi) Recommended cables for wiring of the system at site should be used.

(vii) Steady Battery voltage 24 V should be maintained.

(viii) Cable connections should not be connected loosely.

(ix) M.S Circular connectors of SSDAC are checked and maintained firmly.

(x) SSDAC & Reset box is provided with sealing arrangement. They should be sealed at site.

(xi) Resetting should be done only after ensuring that there is no train in the section

(b) Don'ts

(i) Don't install the Axle detectors near the rail Joint (should be more than 6 sleepers away).

(ii) Don't install the Axle detectors where the rail is badly worn out.

(iii) Don't cut or Join the Transmitter / Receiver cables supplied along with the coil. It would result in change of frequency of signal.

(iv) Don't lay the TX and RX coil cables in the same pipe.

(v) Don't use any other outdoor cable other than the recommended cables.

(vi) Avoid installing the Axle detectors on curve of rail / too much slope of rail to the possible extent

(vii) Don't remove the cards from SSDAC units under power ON condition of system. Remove card if necessary after Switching OFF the power to the unit.

3.14 MAINTENANCE SCHEDULE (MONTHLY)

(a) TX & RX COIL AXLE DETECTORS (AT SITE)

(i) Measure the TX coil (21 KHz & 23 KHz) signal levels and record them. These measurements are to be tallied with the previous readings. These should be within the specified limits and should not change more than 10%.

(ii) Measure the Rx coil (21 KHz & 23 KHz) signal levels and record them. These measurements are to be tallied with the previous readings. These should be within the specified limits and should not change more than 10%.

(iii) Check the M12 Bolts & Nuts of web mounted TX & Rx coil Axle detectors. All the nuts should be in tight condition.

(iv) Check and tighten the deflector plates if found loose.

(b) SSDAC UNIT (At site)

(i) The 2.2 V DC signal levels of card 1&2 of the SSDAC Counting Units are measured and recorded. The level should be between 2.0 to 2.5 V DC.

(ii) DC-DC converter output voltages should be measured and recorded. The outputs measured should remain within the specified limits and match with the previous readings.

(iii) The modem card output should be measured and recorded. The reading should match with the previous readings.

(iv) Check the relay driver output and it should be > 20 V DC. This reading is recorded.

(v) Ensure that screws of modules are tight.

(vi) Ensure that MS circular connectors are tight.

(c) POWER SUPPLY (Battery Room & Site)

(i) The 24 V DC power supply should be measured and recorded. The 24 V DC should remain within specified limits.

(ii) Inspect the battery charger and check its charging current and ensure it is properly charging the battery.

(iii) Any interference with power supply and connections of SSDAC is likely to cause failure. This should be done only after ensuring that no train is occupying or approaching the section.

(d) INSPECTION OF RESET BOX (SMs Room)

(i) Monitor the reset box while the train is occupying the section. The occupied (red) LED should be glowing.

(ii) When the train clears the section, the clear LED (green) glows.

(iii) The Reset to the system is controlled through the key actuator & Reset button of reset box. This should not be disturbed.

(e) GENERAL

(i) Check all the cable connections on the CT board of apparatus case at both locations. Ensure that these are in tight condition.

(ii) Check the deflector plates of the Axle detectors are in normal position. If found loose this should be properly tightened.

(f) REPAIR OF FAULTY CARDS

(i) Before declaring any card is faulty, the fault should be analysed and confirmed.

(ii) Repair of cards is a highly technical Job and is not possible at site. Hence Railways should not carry it out. The card should be sent to CEL for repair.

3.15 PARAMETERS OF SSDAC are given in Annexure-3

3.16 RECENT DEVELOPMENTS

Since Axle Counters are now increasingly used for Block section clearance, any failure of axle counters will have adverse effect on Train operations. In some Railways, two sets of axle counters are used as redundancy. CEL has applied redundancy principle in the same unit and launched a High Availability Axle Counter in 2011 with Two processors in each MLB card and two modems cards instead of one Modem card, which can be connected to two independent transmission media such as two pairs of quad cable or one quad cable and one OFC ckt etc to improve system availability.

3.17 RDSO approved list of firms for manufacture and supply of electrical signalling items: as on December 2011

<table>
<tr><td colspan="2">RDSO/SPN/177/2005 (Ver.2) with Amendment-1</td></tr>
<tr><td>APPROVED UNDER PART: I</td><td>APPROVED UNDER PART: II</td></tr>
<tr><td rowspan="2">NIL</td><td>M/s G.G. Tronics,</td></tr>
<tr><td>M/s Central Electronics Ltd</td></tr>
</table>

CHAPTER - 4: SINGLE SECTION DIGITAL AXLE COUNTER – ALCATEL (ELDYNE) make

4.1 INTRODUCTION

This is vital Digital Axle Counter equipment (AzLS) for single track sections containing 2 out of 2 micro-controllers to count the axles, establish the track occupancy of a track section and to provide this information to the block instrument and the interlocking circuit.

In this system no separate evaluator is required and no analog data is being transmitted. One set of Axle counter equipment is provided at entry end and other set provided at exit end. Both sets are being connected through a twisted pair of telecom cable i.e. existing RE cable one PET quad is used for both UP and DN Axle Counter. Digital DATA is being transmitted between two ends of Axle counters (Out door track side Detection points, Zp).

The Zp axle counter equipment is working on high frequency and using phase modulation for detection presence of wheel with the phase reversal of 180^0 out of phase, which enables this system to be more healthy and safe. This system is a fully duplex and modem is capable of operating according to CCITT V.21 and the Data will be transmitted at the rate of 300bit/sec. This data Transmitted ensure negligible interference of the noise. The system is highly reliable.

4.2 SYSTEM OVERVIEW

The AzLS is Digital Axle Counter equipment containing micro controllers to count the axles, establish the track occupancy of the track section and to provide this information to the block instrument and the interlocking circuit

The AzLS, consisting of two nos. of outdoor trackside detection points i.e.: Zp. It is provided at both ends of 'Axle Counter Section' which is to be monitored. Each Zp consists of double rail contact Sk30H (which is mounted on rail), and an electronic unit EAK30 (which is installed near the rail contact). AzLS provides 'fail-safe' train detection information to concerned block instrument and the interlocking circuit

In EAK30 Evaluator card ('Digital card') evaluates the data at each end of the associated track section. It determines whether the concerned track section is 'Occupied' or 'Clear' by assigning the counts to the section. Signalling relays are operated by the EAK to indicate whether the concerned 'section is occupied' or 'section is clear'.

The diagnostic interface provides the facility to interrogate the system and determine its status.

4.3 The AzLS System is only having Outdoor Trackside System (Detection Point: Zp). It consists of

1) Rail Contact (Sk)

- Transmitter
- Receiver
- Protective hose
- Fixing parts for hose

2) Housing for electronic unit (EAK)

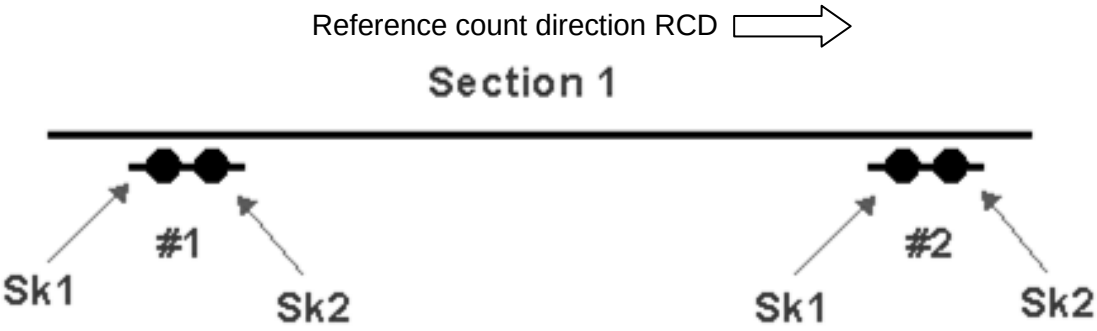
- Back plane
- Evaluator board
- Analog board

- Housing
- Mounting base
- Test equipment interface

4.3.1 RAIL CONTACT

Rail contact SK30H is provided at both ends of axel counter section.

SK30H consists of two physically offset coil sets Sk1 and Sk2, these sets are installed on the same rail of track. At each end EAK is provided near the rail contact and connected to SK1 and SK2.



Rail Contact -1 Rail Contact -2

Fig. 4.1

The SK30H consists of two transmitter heads (Tx), installed on the outside of the rail and two receiver heads (Rx), installed on the inside of the rail directly opposite the respective Tx heads. The Tx head consists of a highly resilient casing. It contains the Tx coil. The casing of the Rx head is made of aluminium alloy. It contains the Rx coil.

The SK30H is fitted by three bolts to the web of the rail. Height of these three holes from bottom of rail depends upon rail size.(60kg,52kg,90paund). The Tx heads are adjustable for optimising the wheel detection. After intial installation, further adjustment is not normally required.

Each Tx/Rx head is equipped with fixed cables of 4m or 5.5 m length for connection to the electronic Junction box (EAK). Upon request, longer cable lengths 8 m can be provided. The entire rail contact SK30H is electrically insulated from the rail.

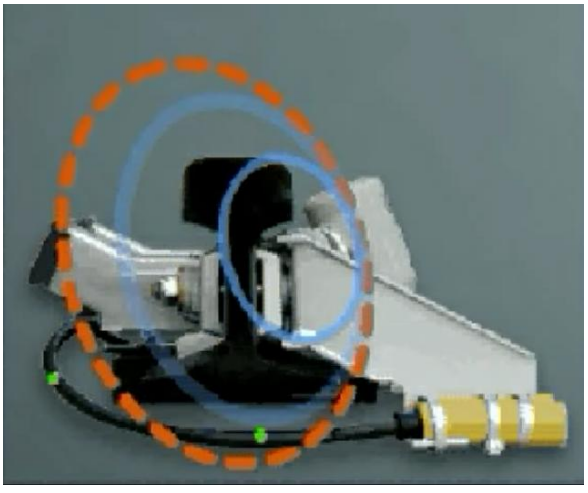


Fig. 4.2

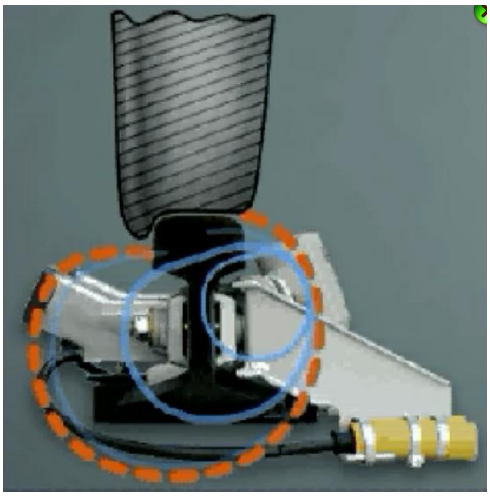


Fig. 4.3

The two Tx coils are fed with different frequencies (approx. 30.6KHz and 28KHz) and the resultant fields couple around the rail with the Rx coils and induce a voltage in these. The Tx/Rx coils are arranged in such a way that in the presence of a wheel flange the polarity (phase) of the induced voltage is reversed. The electronics of the EAK30H detect the phase reversal and interpret it as a detected wheel.

The fig No. 4.2&4.3 shows electromagnetic flux linking with Rx coils.

If the wheel is at a distance of more than 200mm away from the imaginary centre line of the Rail contact the electromagnetic flux meet the winding at an angle '+alpha' referred to the perpendicular of the receiver coil and an AC voltage which is phase synchronous to transmit(reference) voltage is received. It is shown in Fig. 4.2

If the Flange of the wheel is within the 200mm from the imaginary centre line of rail contact, the electromagnetic flux lines meet the receiver coil almost vertically and hence induce voltage in receiver coil is zero at this point a wheel is detected. It is shown in Fig. 4.3

If the Flange of the wheel is directly over the Rail contact the electromagnetic flux meet the winding at an angle '-alpha' referred to the perpendicular of the receiver coil and an AC voltage which is phase–shifted by 180^0 compared to transmit (reference) voltage is received. It is shown in Fig. 4.3

4.3.2 ELECTRONIC UNIT EAK

It is mainly consists of

(a) Analog board

(b) Evaluator or Digital board

(c) Subrack

(d) Ground plate

(e) Cable to

- Transmitter 1
- Receiver 1
- Receiver 2
- Transmitter 2

(f) housing base

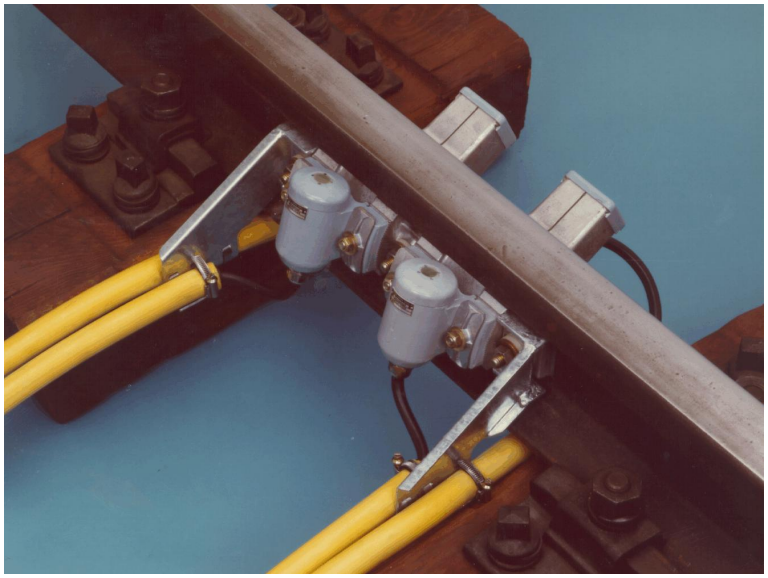


Fig. 4.4

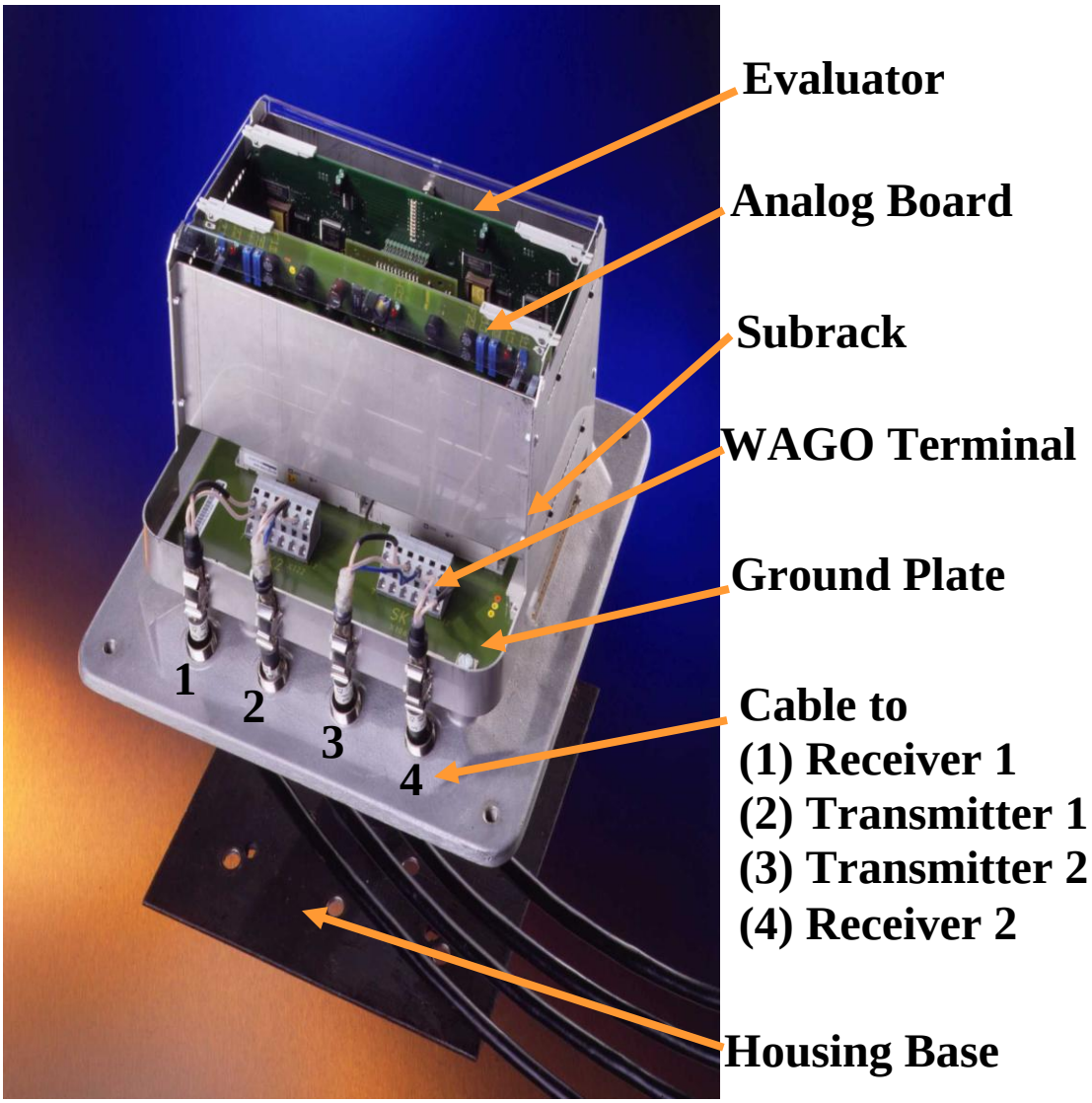


Fig. 4.5

4.3.3 EAK PERFORMS FOLLOWING FUNCTIONS

It functions as EJB and Evaluator and provided at location side of Track devices and connected to Track devices by four sealed cable of each 4m or 5.5 m or 8m length.

- Generation of 30KHz and 28KHz voltages and supplies to the track device i.e., Transmitter coils through shield cables of 4m or 5.5 m or 8m length.
- Receive the induced voltage in receiver coils through sealed cable of 4m or 5.5 m or 8m length.
- Process the counting of Axles passing over the Rail contacts fixed on one rail only.
- Transmit the counted Axle numbers simultaneously to other end connected Zp.
- Maintain the communication between both the Zp.
- Read back the status of interface relay.

Sk30H = Sk1 + Sk2

Sk1- Consist of Transmitter coil and one receiver coil.

Sk2- Consist of Transmitter coil and one receiver coil.

4.3.4 ANALOG CARD

It does the following

- Generates stable voltage output 24V for use by the module.
- Generates 30 KHz and 29 KHz signals for Tx (Transmitters).
- Amplifies received signals from Receivers.
- Phase sensitive rectification.
- Generates wheel pulse MESSAB, which is an analog pulse.
- Generates wheel pulse RADIMP, which is a digital pulse used for counting by CPU.

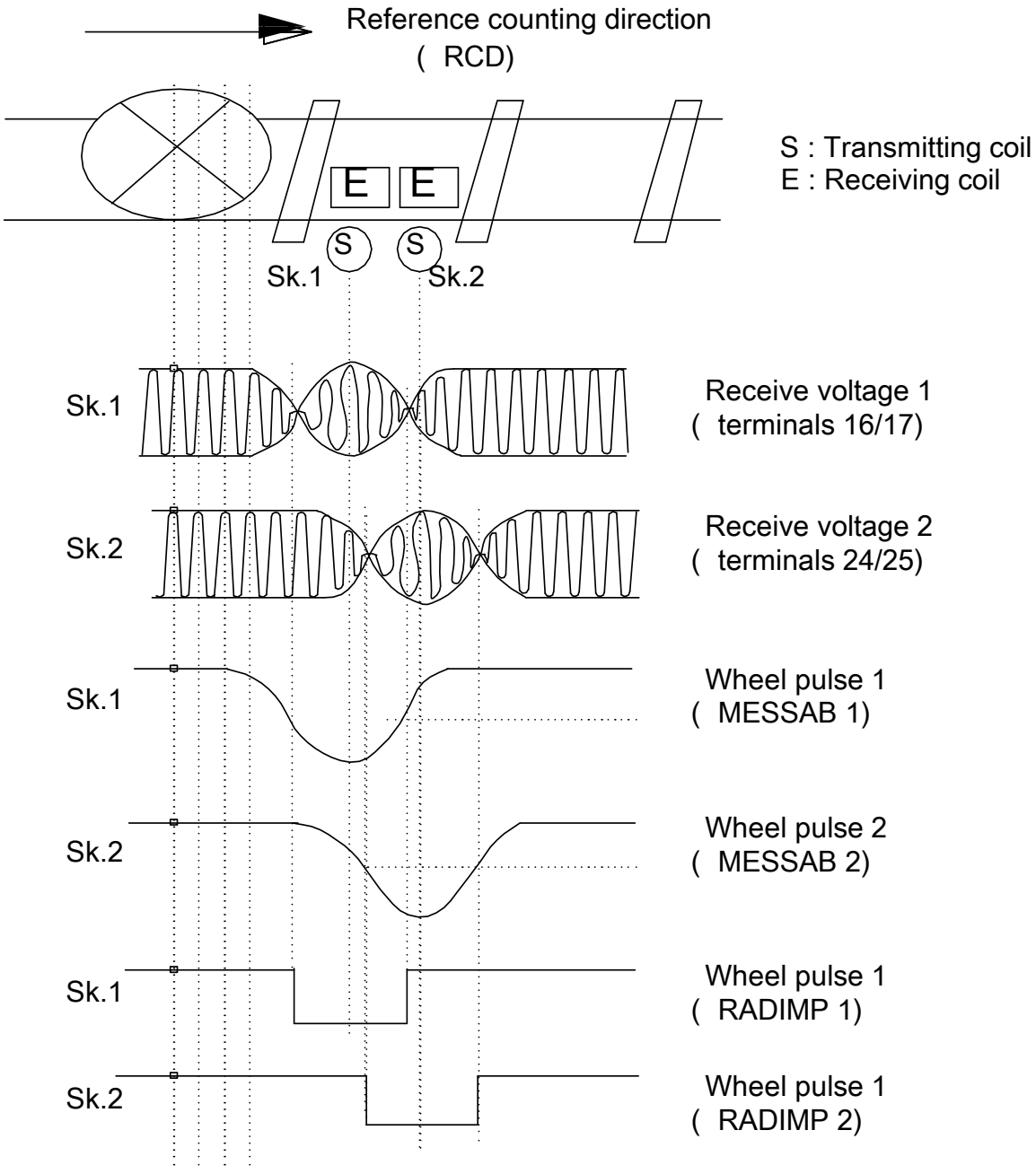
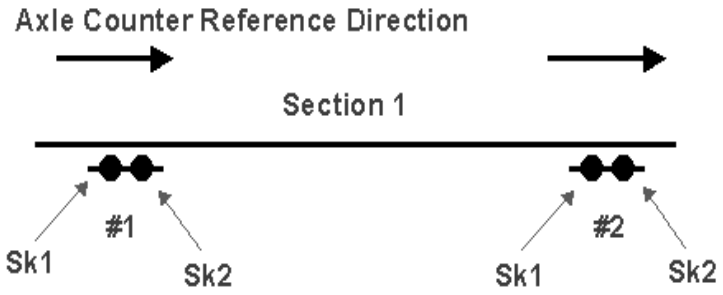


Fig. 4.6

4.3.5 DIGITAL / EVALUATOR CARD

It does the following

- Counts wheel pulse.
- Determines Reference Counting Direction (RCD).
- Supervises integrity of Rail Contacts.
- Codes data telegrams and sent to other end.
- Decodes data telegrams received from other end.
- Compares counts from adjacent evaluator card of AzLS and evaluates Free / Occupied' status.
- Controls and supervises relay circuit for AzLS.



Reference Counting Direction (RCD)
Fig. 4.7

- Axles are IN-COUNTED in the section when a train passes detection point #1 in the direction of the arrow. The system will COUNT-OUT when the axle passes through the detection point #2.
- For defined address setting the rail contact, which is first passed through the axle counter in the reference count direction is defined as Sk1, and the second one is Sk2 of rail contact 1.

4.4 AZLS: GENERAL ARRANGEMENT

- Depending on application, two types of Addl. Evaluator PCB could be inserted in the spare slot of the EAK of AzLS.
- Digital PCB of AzLS in case of double section application.
- Digital PCB of AzLM in case the AzLS need to be interfacing with another multi- section axle counter AzLM.

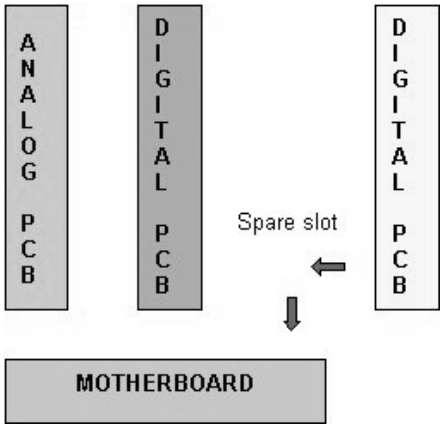
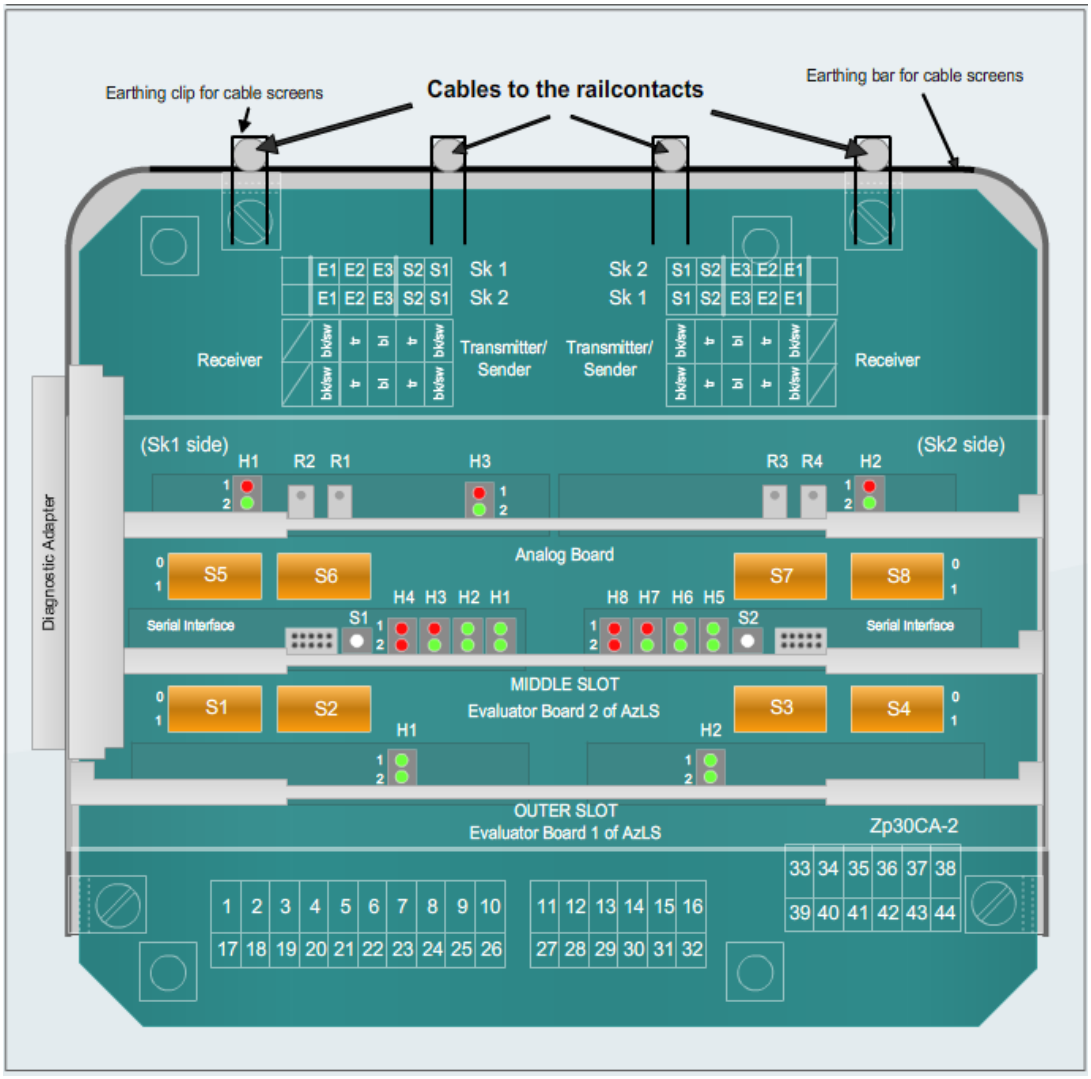


Fig. 4.8



EAK top view
Fig. 4.9
Please see annexure 4 for indications details

4.5 APPLICATIONS OF AZLS

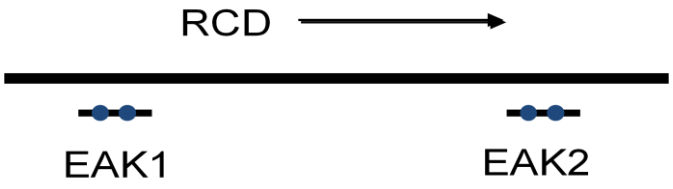


Fig. 4.10

- AzLS can be configured as a single section axle counter with Rail Contact (RC) and Electronic Control Unit (EAK) combination at both ends of the section and with a two wire fault tolerant link (FTL) between the two. The Zp30 equipment is positioned at the boundaries of the track section to be supervised.

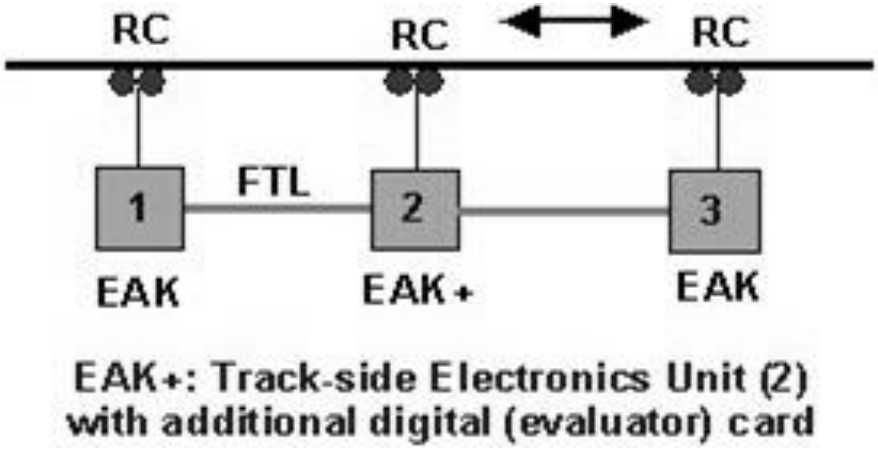


Fig. 4.11

- AzLS could be configured as a straight double section application. Additional Digital PCB or evaluator card is required to be used at the common detection point (EAK2). The Zp30 equipment is positioned at the boundaries of the track sections to be supervised with a shared detection point in between having an additional evaluator card.

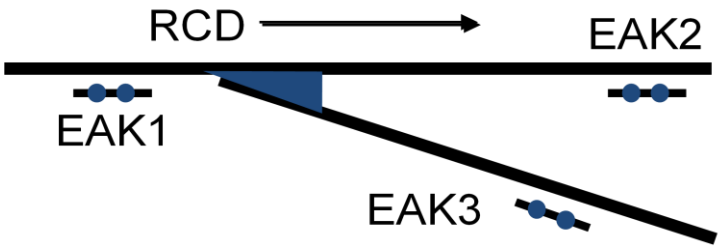


Fig. 4.12

- AzLS could be configured as point zone application. Maximum 3 Nos. of Zp30 equipments are positioned at the boundaries of the track sections to be supervised. It is not suitable for point zone track section having more than 3 detection points.

4.6 AZLS RESETTING - PREPARATORY RESET

- Reset is required to clear an axle counter section initially during commissioning or when it has become disturbed.
- For Zp30CA-2 equipment, preparatory reset function is provided.
- The preparatory reset is initiated through an external relay circuit, which reverses the polarity of the supply voltage to one of the detection points of the section.
- The preparatory reset can also be initiated through two buttons at the evaluator board directly.
- It is sufficient that one of the detection points of the relevant section receives a preparatory reset.
- The preparatory reset does not clear the section immediately. After carrying out the preparatory reset, a train must pass through the section on “cautious running conditions”. Only then the section will be cleared.
- The preparatory reset function reduces the risk of operator mistakes.

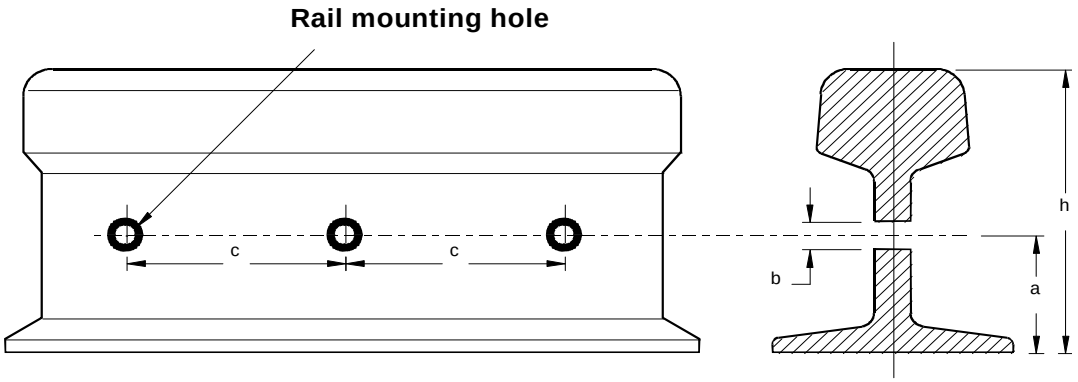
4.7 INSTALLATION & COMMISSIONING

- AzLS is fairly easy to install.
- In either type it comprises installation of the dual rail contact SK30H and the trackside mounted electronic unit EAK.

1) RAIL CONTACT SK30H

(a) Selection of Installation site

- Installation between two sleepers
- Web without embossing.
- Minimum distance 2 m from insulated Joint.
- Minimum distance 2m from neighboring Rail Contact.
- Tx heads mounted on Al Casting with two M8 bolts, bowed pressure plates, washers and self-locking nuts. The teethes and grooves must be lined-up carefully. Torque applied 25 Nm.
- Brackets, protecting tube and cable to be installed as per guideline



h = height of the rail (in new condition)
b = 13 mm ± 0.2 mm
c = 148 mm ± 0.2 mm

Approximation Formula: a = (0.409 x h) ± 1.5 (mm)

Fig. 4.13

2) STEPS FOR INSTALLATION

Step 1: Do the selection of 'Detection Point' on track location where 3 holes are to be drilled. Three holes of 13 mm diameter are to be drilled at a distance of 148mm ± 0.2mm apart. Height 'a' is calculated from the height 'h' of the rail. Concurrently identify location for mounting trackside electronic unit (EAK) within around 4 meters of the rail contact. Height 'a' for all the three holes must not differ from each other by more than 1 mm.

Rail Profile	90 lb	52 Kg	60 Kg
a [mm]	56 ±1.5mm	63 ±1.5mm	68 ±1.5mm

Step 2: Cleaning the area, marking, punching and running a pilot drill of 6 mm diameter, if required. Punch with a punch guide, which is normally used to mark the holes.

Step 3: Drilling the three holes of 13 mm ± 0.2mm diameter with drill machine.

Step 4: Cleaning and de-burring the drilled holes.

Step 5: Fixing of Dual Rail contacts (Track devices). Ensure Tx heads on the outside and Rx heads on the inside of the rail.

Step 6: Protecting tube should be mounted on brackets with integral cable as per specified bends and clamping.

Step 7: Fixing of Deflector plates on both side of Rail Contact. Deflector plates are provided to protect the Rail Contacts from any hanging part of train.

3) TRACKSIDE UNIT EAK

(a) Steps for Installation

- Identify location for mounting Trackside unit (EAK) which is to be mounted in Mushroom cover or in location box and it is as far from the rails as is practical.
- Ensure as clean and dry as possible, by the side of the track.
- Identify route for laying the integral cable in a protective hose from EAK to Rail Contact.
- Grout mushroom cover pedestal for stability.
- Prepare for Rail Contact cable termination.
- Integral Cable should not be shortened, if found excess to be coiled in figure of eight shape.
- Perfect 'Earthing' with earth resistance not more than 1 Ω has to be provided to this EAK equipment.
- Sub-rack houses the Euro size PCBs that must be inserted in according to labeling on the sub-rack. PCBs are polarised.

(b) Trackside Unit EAK Address Setting

- 16-bit unique address is provided to each trackside unit by means of DIP switch setting so that each detection point can identify the other detection point - monitoring the same section properly.
- Bit 1 to Bit 13 represents the detection point processor number.
- Bit 14 indicates whether the corresponding evaluator card is monitoring a straight section or a point zone. Bit 14 is 0 for straight section and 1 for point zone.
- Bit 15 defines the counting direction corresponding to RCD (Reference Counting Direction). Bit 15 is 0 for increase in number of axles in the corresponding section and 1 for decrease in number of axles in the corresponding section.
- All addresses of a section must be within the defined address range.
- The addresses of all detection points must be sequential, in axle counter reference direction and without gaps.
- The addresses of all count-in detection points of a section must be lower than those of all the count-out detection points of that section.

4.8 TEST EQUIPMENT ETU001

It does the following

- Checking of internal Voltages of DC-DC Converter of Analog Card.
- Adjustment & Measurement of MESSAB-Rectified Voltage.
- Adjustment and Measurement of PEGGUE-Reference Voltage.
- Measurement of Rail Contact Transmitting Voltages & Frequencies.

Adjustment of Tx head with Dummy wheel and Tool Kit

- The Tx head is adjusted such that the received rectified voltage produced when a wheel is present has the same amplitude but the opposite polarity as the voltage produced with the wheel absent.
- Adjustment of dummy wheel: The insertion depth of this device is set to 40 mm; this corresponds to the influence produced by the smallest wheel (diameter 300 mm on main line vehicles) likely to be used in the railway network.

4.9 LIMITATIONS OF ALCATEL SSDAC

ALCATEL SSDAC is not suitable in point's zone track section having more than 3 detection points.

4.10 RDSO approved list of firms for manufacture and supply of electrical signalling items: as on Jan 2012

RDSO/SPN/177/2003 (Ver.1) with Amendment-2	
APPROVED UNDER PART: I	**APPROVED UNDER PART: II**
NIL	M/s Eldyne Electro Systems Pvt. Ltd

.

CHAPTER -5:
SINGLE SECTION DIGITAL AXLE COUNTER –GG TRONICS

5.1 INTRODUCTION

This is vital Digital Axle Counter equipment (G36) for single track sections containing 2 out of 2 micro-controllers to count the axles, establish the track occupancy of a track section and to provide this information to the block instrument and the interlocking circuit

5.2 SYSTEM OVERVIEW

SSDAC-G36 units can be configured for the following applications:

- **2DP1S:** For providing clear/occupied status of a single section block or entry/exit of a station.
- **3DP1S:** For proving point zone/set points working
- **3DP2S:** For proving two consecutive sections in a straight line treating each independent of the other
- **AS:** For auto signalling

5.3 THE G36 SYSTEM

It has;

a) Outdoor Equipments

- Axle detectors
- SSDAC-G36 unit
- Vital relay box
- Display module

b) Indoor Equipments

- SM's reset box

5.4 OUTDOOR EQUIPMENTS

5.4.1 AXLE DETECTORS

It consists of two transmitter heads (Tx), installed on the outside of the rail and two receiver heads (Rx), installed on the inside of the rail directly opposite the respective transmitter heads.

Two different frequencies are given to the transmitter coils (ranges between 20.802–21.302 KHz and 24.75–25.25 KHz). A flux is generated across the rails which induce a voltage in the receiver coils. When a wheel is passed over between transmitter and receiver a Dip is produced.

Two 40–70 V_{rms} signals are generated by the phase detector cards for the two channels which after modulation is again received in these cards and get demodulated and rectified.

In presence of a wheel this voltage is reduced to less than 1 V. Otherwise in unoccupied or push trolley (4 or 8 spoke) movement the rectified voltage is 10–12 V DC.

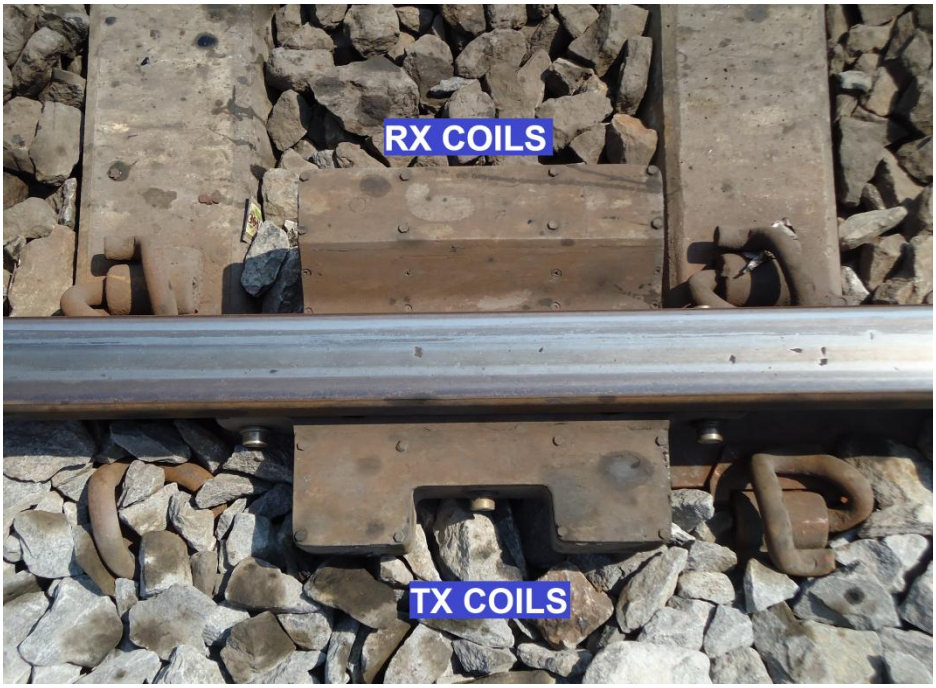


Fig. 5.1

5.4.2 INSTALLATION OF TRACK DEVICE

The Axle detector separation between two sets of different SSDAC systems should be at least 2 meters away so as to avoid mutual interference. The detectors have to be fixed on the clear spacing between two sleepers.

The transmitter and Receiver coils are provided with 23/0.2mm, 2 core shielded PVC cable. For easy identification of the cables, the colors of the sheath of the cables are made as Grey for 21 KHz and Blue for 25 KHz. For further identification of TX and RX coils, both ends of the cables are provided with colored sticky tapes as follows 21 KHz Tx-Red, 21 KHz Rx-Yellow, 25 KHz Tx-Blue, 25 KHz Rx-Black.

The TX coil cables of 21 KHz & 25 KHz are taken together in one HDPE pipe to the location Box. Similarly both 21 KHz & 25 KHz Rx coil cables are taken together but separately from TX coil cables to the location box.

Transmitter and Receiver cables should run separately at a minimum separation of 400 mm in different HDPE pipes. The cables have to be laid in the 40 mm Dia HDPE pipe for safety and buried underground below ballast at the depth of more than 0.3 m.

The 3 holes of 13 mm diameter are required to be marked and drilled for fixing web mounted transmitter/receiver coils at each location with spacing of 183 mm. From bottom of the rail drill the holes at 68 mm for 52 KG, 84 mm for 60 KG and 57 mm for 90 R. The marking and drilling of holes on the web to the given dimensions are very important for proper working of the system.

The Axle detectors are to be fixed on web of the rail by using torque wrench at the drilled holes by means of M12 bolts & nuts with spring washers and check nuts.

Transmitter coil assembly (21 KHz & 25 KHz) should be fixed on the outer side of rail & the receiver coil assembly (21 KHz & 25 KHz) should be fixed on the inner side of rail.

To protect axle detectors against the damage from hanging parts of train, deflector plates should be mounted on both sides of the axle detectors. These should be installed in the sleeper space (approximately 30 cm to 40 cm next to the axle detectors).

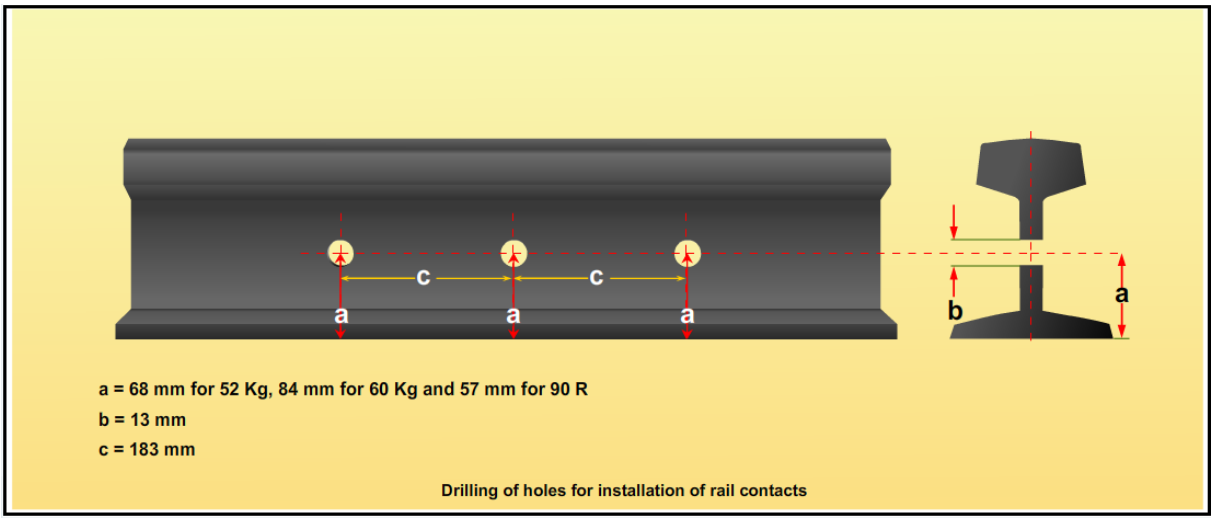


Fig. 5.2

5.4.3 SSDAC-G36 UNIT

It is installed in location box near to the detection point. The hardware & software modules of all configurations of SSDAC-G36 are same.

Each unit of SSDAC-G36 contains the following hardware modules:

- Phase Detector cards (PD1 & 2)
- Central Processing Unit (CPU 1 & 2)
- Communication Module
- Relay Drive Module
- SM-CPU/Event Logger card
- DC-DC converter card

Fig. 5.3

5.4.4 PHASE DETECTOR CARD NO. 1 (PD1)

It generates 21 KHz signal for transmitter coil of channel 1. It receives the signal from receiver of channel 1 & produces a demodulated analog voltage. Under no wheel Tx and Rx signals will be 180° OUT-Of-PHASE >10 V. Under wheel condition Tx and Rx will be IN-PHASE <100 mV. This demodulated signal is again converted into a digital pulse of 5 V & is sent to the CPU1 & 2 cards for processing purpose. It detects the movement of train axles/wheels that is more than 550 mm in diameter. It rejects trolley, dolly, spoke wheels and push trolley wheels with solid mass.

5.4.5 PHASE DETECTOR CARD NO. 2 (PD 2)

It generates 25 KHz signal for transmitter coil of channel 2, rest of its functioning are same as Phase detector card no.1.

5.4.6 CPU CARD (CPU1 & CPU2)

It works on failsafe '2 out of 2 architecture' for controlling and monitoring the 'SSDAC unit' for reliable operation. Digital pulses received from PD1 & PD2 are processed by both the CPUs independently. After processing the data they tally the results by polling between the CPUs and when the result matches then only it gives an output to the relay driver module (RD) for driving the vital relay. Moreover they conduct self diagnostics to check whether the cards are functioning properly or not. CPUs provide the counting information to the other end SSDAC unit by CPUs via communication module.

Please see annexure 5 for error code list

5.4.7 COMMUNICATION CARD (COM1 & COM2)

Vital data like axle counts and system status are transmitted / received between the SSDAC units via communication card. Communication between two SSDAC systems is through FSK communication at 1200 bps V.23 standard along with CRC check.

5.4.8 RELAY DRIVE CARD (RD1 &RD2)

The relay drive card receives instructions from CPU for actuating vital relay for blocking a section as soon as the first axle is detected. It is cleared after both IN and OUT counts of the section match.

5.4.9 SM-CPU OR EVENT LOGGER CARD

It can store up to 14,000 events which can be downloaded using RS 232 serial port provided on the card. It logs vital events during normal and error operation in real time. Optional display connected to Event Logger Card displays the communication errors happening in Real-time which aids in assessing the health of communication channel.

As many as 95 different events are recorded. Following events are logged into the event logger card:

- Event logged during normal operation
  - Communication status ok
  - Vital and Preparatory Relay pickup/drop
  - Reset operations

- Event logged during error operation
  - Communication link fail
  - System down due to failure of any card
  - Vital and Preparatory Relay error status
  - +5 V DC variations
  - Errors

5.4.10 DC-DC CONVERTER CARD

It generates the following multiple power supplies for system working from 24 V DC input : +5 V DC, +12 V DC, -12 V DC, +18 V DC & +24 V DC

5.4.11 VITAL RELAY BOX

It comprises of VR (Vital Relay) & PR (Preparatory reset relay). These are Q type 24 V, 1000 Ω 6F, 6B relays. Their conditions are repeated in relay room using VPR and PPR. Feedback from the contacts of these relays is also taken to the system for processing.

Fig.5.4

5.4.12 DISPLAY UNIT

A display module placed above the unit shows plain English messages on the status of the system and also wheel counts through a 4 line 40 character alphanumeric display. In addition to this Alphanumeric display unit on reset box and 7 segment displays and LEDs on the hardware modules of units help in monitoring the working of the system

Fig. 5.5

5.5 INDOOR EQUIPMENTS

SM'S RESET BOX

SM Key – To prevent unauthorized operation SM's key is used. For executing a reset command, this key needs to be inserted & turned.

Reset Push Button – For sending the reset command to the SSDAC unit the reset button needs to be pressed along with SM's Key simultaneously & momentarily.

Line Verification Box –Only in case of conditional hard reset, line verification box is required (in 3DP1S system which is used for point zone applications).

Counter – Every time a reset operation is done the reset counter gets incremented by one unit.

Display – The System Status, Checksum and Version No, Counts and error code are displayed in the LCD display provided on the reset box.

SM Reset box
Fig. 5.6

5.6 PARAMETERS

Description	Range
24 V supply voltage	22-30 V DC
Transmitter voltage	40-70 V_{rms}
TX1 Frequency	20.802 to 21.302 KHz
TX2 Frequency	24.750 to 25.250 KHz
Receiver voltage (measured between test terminals 29 & 30 for RX1 and between 33 & 34 for RX2)	300 mV to 1.2 V (AC)
Receiver voltage (measured between RX SIG & GND Socket)	750 mV to 1200 mV
Phase Detector voltage (measured between RX PH-SIG & GND Socket)	10 V to 12 V (Without dummy wheel) & <1 V (With dummy wheel)
DC-DC Converter	
• For 5 V	4.75 V to 5.25 V
• For 12 V	11.75 V to 12.25 V
• For –12 V	–11.75 V to –12.25 V
• For 18 V	17.75 V to 18.25 V
• For 24 V	22 V to 26 V

5.7 DO'S AND DON'TS

DO's

1) The interconnection drawings are to be followed for connecting the transmitter and receiver Coils. Tx1 is 21 KHz, Tx2 is 25 KHz & Rx1 and RX2 coils are 21 KHz & 25 KHz, respectively.
2) Ensure that Receiver and Transmitter coil cables have been laid in different pipes.
3) Ensure that both the TX coils & RX coils are having proper alignment on rail.
4) Ensure that packing of sleepers with ballast on both sides of Axle detector is proper.
5) Check that metal sheaths of the outdoor cable are connected to earth at both ends.
6) The recommended cables for wiring of the system at site should be used.
7) The steady battery voltage 24 V should be maintained.
8) The cable connections should not be connected loosely.

9) The MS Coupler connectors of SSDAC System are checked and maintained firmly.
10) Preparatory Resetting should be done only after ensuring that there is no train in the section.
11) It is recommended that heat resisting paint to be used on the apparatus case so that the temperature inside apparatus case is maintained lower in comparison to other normal paints.
12) Caution Board has to be placed near the SSDAC Axle Detectors to avoid damaging of coils from packing machines.
13) Deflector Plates must be mounted near the SSDAC Axle Detectors to avoid damaging of coils.
14) Usage of Spokes Trolley wheel reduces the SSDAC system entering the Error mode and increases the Availability. The straight movements or passing of Motor Trolley or Push Trolley with solid mass wheel does not affect the SSDAC system.

Don'ts

1) Don't cut or joint the Transmitter/Receiver cables supplied along with the coil. It would result in change of input Receiver signal.
2) Don't remove the modules from SSDAC System under Power ON condition. Remove the modules if necessary after switching OFF the power to the SSDAC system
3) Local Address of the CPU – 1, CPU – 2 and Configuration settings of the SSDAC System should not be changed at the field.
4) The Hardware of Communication module and Relay Drive module are similar for all systems. However their position of mounting is different in different unit types. These modules have to be equipped correctly after verifying the drawings, which indicates their positions
5) When Section is in Occupied/Preparatory Mode, Motor Trolley wheel, Push Trolley with solid mass wheel and Material Trolley wheel must not be allowed to Enter/Exit the Section to avoid SSDAC System going to Error condition.
6) The SSDAC System does not support Entry / Exit of Motor Trolley wheel whether fixed to Motor Trolley or Push Trolley in Occupied sections, back to back movement within a period of 6 seconds, shunting operations. The SSDAC system may enter into Error mode if the Motor Trolley or Push Trolley with solid mass wheel movement on the track is Wobbling.

5.8 APPLICATIONS

GG Tronics SSDAC unit can be used in station yard and block proving purpose.

- 2DP1S system can be used for straight section applications where 2 detection points (SF and EF) are required.
- 3DP2S system can be used for straight section applications with 3 detection points (SF, CF and EF).
- 3DP1S system can be used for point zone applications with 3 detection points (Unit A, Unit B and Unit C).

5.9 LIMITATIONS

It can be used for a maximum of 3 detection points only.

CHAPTER- 6: MULTI SECTION DIGITAL AXLE COUNTER (MSDAC) –ALCATEL make

6.1 INTRODUCTION

Digital axle counter field unit / counting device is the track side 'Electronic Assembly' that energize the 'Axle Detectors' for detecting the passing wheels by establishing the direction of movement and keeping the 'Counting of Wheels'. It transmits the 'Count' and 'Health Information' to the central evaluator at regular intervals. Based on the information detected, central evaluator determines status of track section whether it is 'Clear' or 'Occupied'.

This chapter deals with two models of MSDAC –ALCATEL make, CEL make.

6.2 IT COMPRISES OF

(a) Detection Point

(b) Central Evaluator Unit

(c) Reset Unit

(d) Relay Unit

(e) Event logger and diagnostic terminal

(i) Detection point comprises of Axle detectors, Digital Axle Counter Field Unit connected to it.

(ii) Axle detector is web mounting type and is comprises of two sets of Tx / Rx coils. Different frequencies are used for each set of Tx / Rx coils.

(iii) DAC Field Unit is provided with 2 out of 2 architecture. It detects and counts axles passing over the axle detector. It determines the direction of passing of axles. The field unit communicates with central evaluator unit at regular intervals regarding health status, axle counts, removal of cards from the unit, voltage fluctuation beyond upper and lower limits and power fails and restore back.

(iv) The Central Evaluator unit receives count and health information from Digital Axle Counter Field units. It evaluates the counts received from the digital axle counter field units to generate relay-driving signals for individual track-sections. It supports up to 40 detection points and generates Vital Relay outputs for up to 39 track sections. The Central Evaluator is connected to DAC field units in Star configuration.

(v) Each track section can be reset independently from the Reset Box. Resetting commands the setting to zero the records of counted axles. Depending on the application option for providing the Preparatory Reset or Conditional Hard Reset.

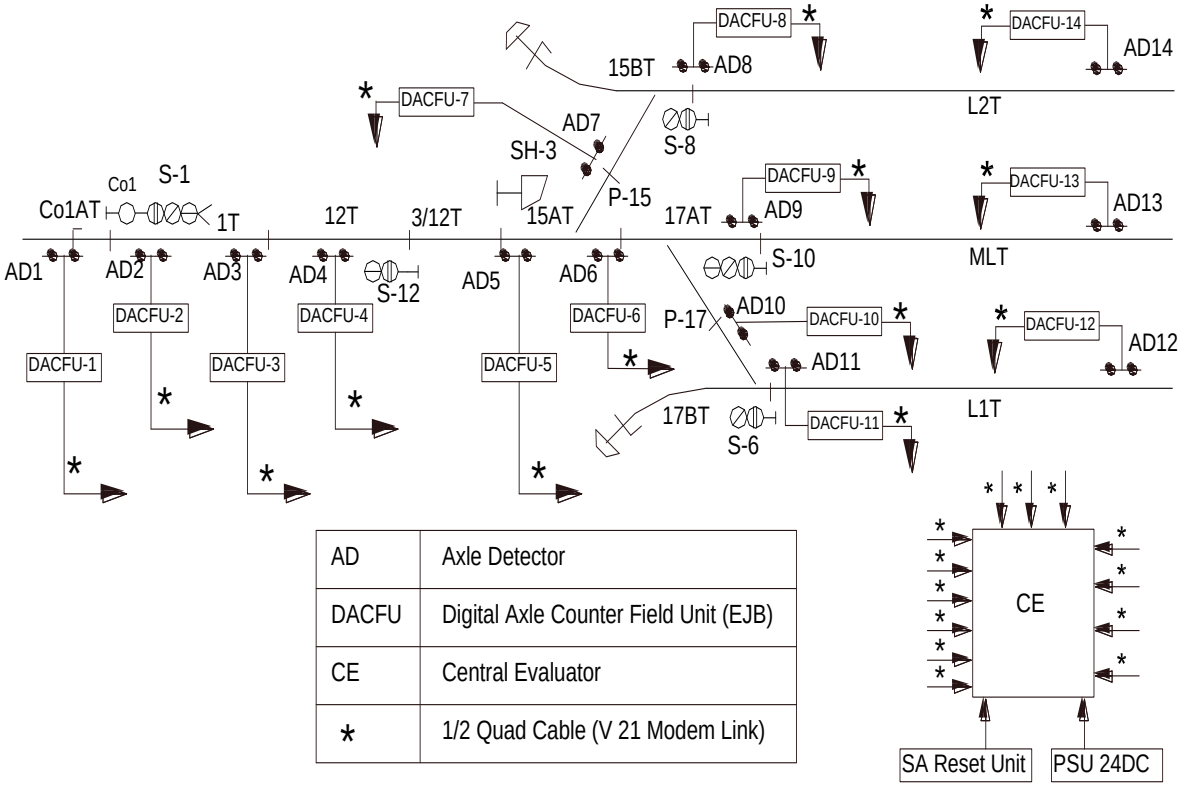
(vi) Central Evaluator unit drives 24 V DC, 1000 ohms Plug-in type Vital Relay. Free and occupied indication of an axle counter section (track section) is available in the form of vital relay pick up and drop contacts respectively.

(vii) The event logger records all the events occurring in the multiple section of the system. The events are status of track section i.e. clear, occupied, failed or preparatory reset, application of reset command, Failures/errors in field units or central evaluator, communication link failures, change in date/time etc., It logs minimum 40000 events. To down load the logged events from event logger card a diagnostic terminal (computer) is connected through a standard communication port.

6.2.1 APPLICATIONS

The multi section digital axle counter can be widely deployed for simultaneous monitoring of following track section in a station or yard area

1.	**Main Line**	**5.**	**Point Zones**
2.	**Loop Line**	**6.**	**Dead End**
3.	**Platform Line**	**7.**	**Stabling Lines**
4.	**Common Line**	**8.**	**Goods Lines**



AD	Axle Detector
DACFU	Digital Axle Counter Field Unit (EJB)
CE	Central Evaluator
*	1/2 Quad Cable (V 21 Modem Link)

Fig. 6.1

6.3 MULTI-SECTION DIGITAL AXLE COUNTER (MSDAC) – ALCATEL MAKE

The AZLM (Multi Section Digital axle counter) system comprises of Indoor and outdoor equipment.

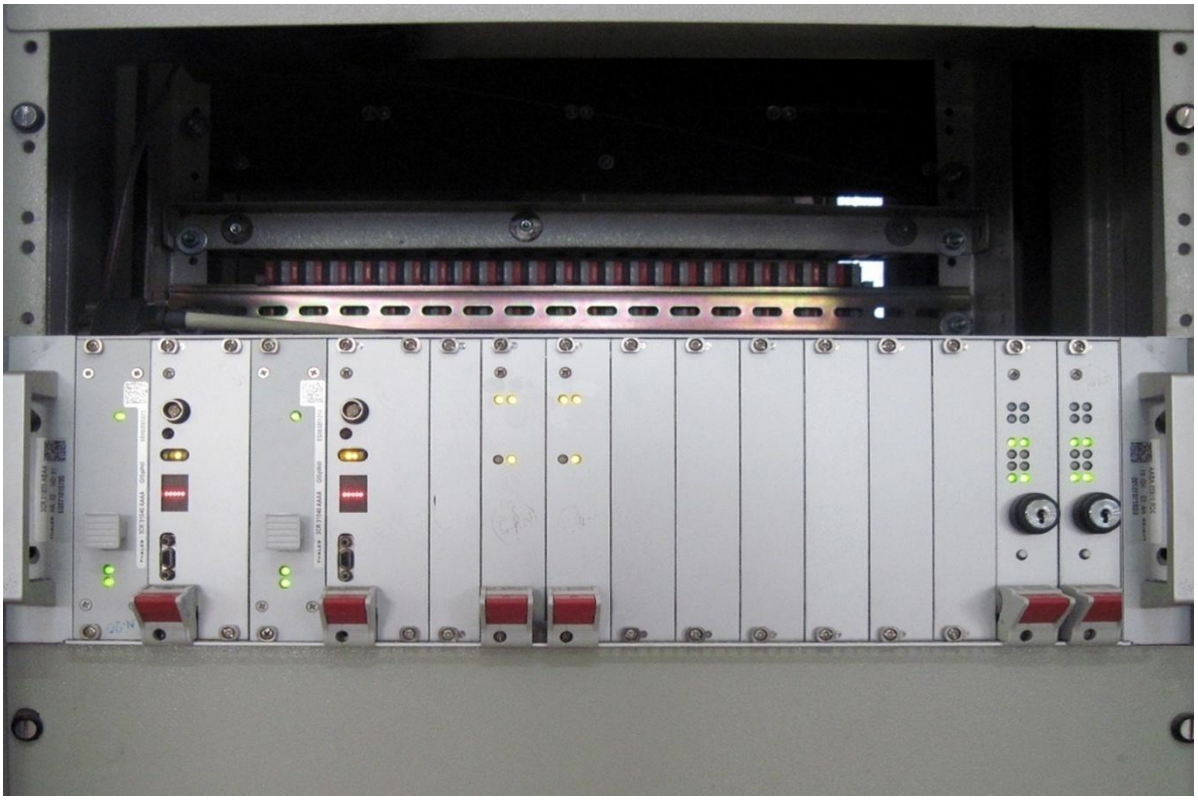
6.3.1 INDOOR EQUIPMENT

1. Axle Counter central Evaluator (ACE)
2. Vital Relay
3. Reset Box

6.3.2 OUTDOOR EQUIPMENT

1. Trackside Electronic Units (EAK)
2. Rail Contacts (SK1, SK2).
3. Power Data Coupling Units (PDCU)

6.3.3 AXLE COUNTER CENTRAL EVALUATOR (ACE)



ACE
Fig. 6.2

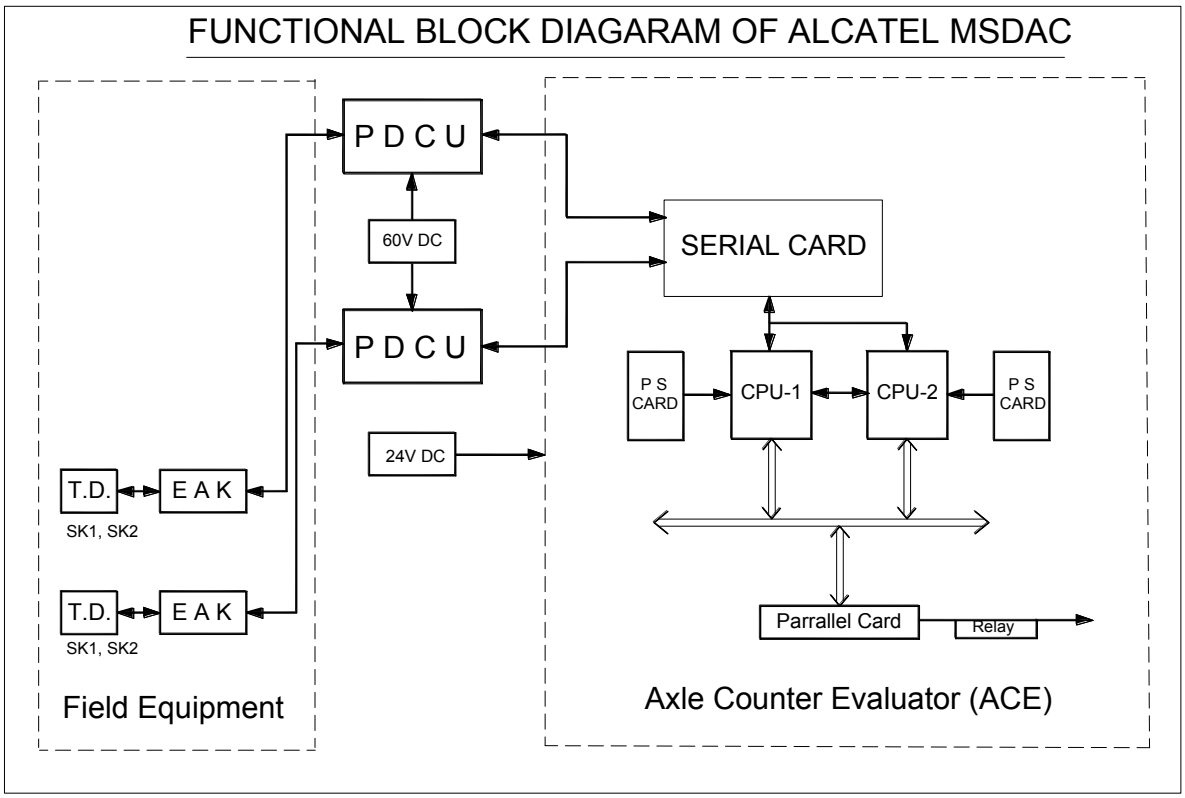
Axle Counter Central Evaluator is the decision-making unit for multi section digital axle counter. It has the following sub components.

CPU Card acts as the brain of AzLM. Two CPU Cards are required for 2 out of 2 system. These CPU Cards have diagnostic interfaces and an alphanumeric display. For a specific application, the CPU Cards used must be loaded with the site-specific software. Diagnostic interfaces are available on CPU Card to connect it to a PC and check the system status, health messages etc. with the help of diagnostic software.

Power Supply Card has DC-DC converters. It works on 24V DC and generates 5V DC and 12 V DC required for the electronic circuitry. Two Power Supply Cards are required for 2out of 2 system.

Serial Card receives information from detection points through ISDN communication link and provides this information to CPU Cards. One Serial Card can monitor maximum two detection points.

Parallel Card is responsible for providing section information. This card takes instruction from CPU Cards and gives section Clear / Occupied output through potential free contact of relays in it. The reset of a section is commanded through the Parallel Card. A Parallel Card has two non-vital outputs that are also configurable through site-specific software for getting different signals, for example, indication of acceptance of reset by the system or a technical defect in a section etc.



BLOCK DIAGRAM OF ALCATEL MSDAC
Fig. 6.3

6.3.4 TRACKSIDE ELECTRONIC UNIT (EAK)

TRACK SIDE ELECTRONICS UNIT (EAK)

Fig. 6.4

The EAKs are provided at every detection point to connect Rail contacts (SK1, SK2). EAK is housed in the Mushroom Cover, if installed, outside the location box and if it is placed inside the location box it is housed with a dust cover.

To obtain the correct direction of counting, an axle counter reference direction (RCD) has been defined. The rail contact that is first crossed by an axle in the axle counter reference direction is defined as rail contact 1 (Rx1/Tx1) and the other rail contact as rail contact 2 (Rx2/Tx2).

Recommended power supply for trackside electronic unit (EAK) for AzLM is 54V DC to 72V DC. The power consumption per EAK is 9W (approximately). The ripple content of the power supply is recommended to be lower than 24mV peak to peak. Extreme care should be taken to see that the power source does not have any change over time from mains to battery during mains failure. Care should also be taken to see that power supply does not have any kick beyond upper tolerance value (72VDC) during startup or charging after power failure. Care should also be taken that power supply source is not under / over loaded beyond its specification.

Before installation the available voltages are to be checked at the power supply connectors 1 & 11. This must be ensured that in all the conditions the available power supply voltages should be in the above tolerance limit (54V DC to 72V DC). As there is a SMPS based DC-DC converter in the analog card, it takes much higher current during startup. Therefore care should be taken considering cable resistance and available voltage at the EAK so that the system can start up in a normal way.

The EAK has to be connected to the earth return rail with a copper cable of minimum 25sq.mm or an iron cable of minimum 50sq.mm. If earths return rail is not available, the housing has to be earthed to a suitable low inductance (approx. L<40µH) and low resistance (approx. R<4 Ω) earth. The earthing rules of the railway must be adhered.

6.3.5 COMMUNICATION LINK

For communication with the axle counter central evaluator, a physical communication link must be needed. The system uses two wires ANSI T1.601communication protocol with ISDN modulation. The maximum transmission distance is 10.5Km with PDCU (12Km without PDCU) with a good quality communication cable having maximum resistance of 56 Ω/KM and capacitance of 45nF/KM. For better reliability the correct pair of star quad cable (diameter 0.9 mm / IRS: TC-30/96) should be used with proper terminations.

6.3.6 PDCU

POWER DATA COUPLING UNIT
Fig. 6.5

PDCU is the interface between outdoor equipment (Detection Point) and indoor equipment (ACE). It has a superimposing circuit for using same conductor for power and data. One PDCU is used for one detection point only. The power to the EAK goes through 315mA fuse provided in PDCU and if it is blown then there will be no power at detection point and a red LED within the PDCU will glow.

6.3.7 REFERENCE COUNT DIRECTION (RCD)

The reference count direction (RCD) must be defined for the track layout independent of the direction of travel. This would normally be the direction of increasing mileage. The use of RCD ensures that the correct order of counting into and out of a section is maintained throughout a series of detection points. Without the RCD the system cannot be correctly configured.

In below fig, axles are counted in the section when a train passes Rail Contact1 in the direction of the arrow or a train passes Rail Contact 2 in the opposite direction of the arrow. Axles are counted out of the Section when a train passes Rail Contact1 in the opposite direction of the arrow or a train passes Rail Contact2 in the direction of the arrow.

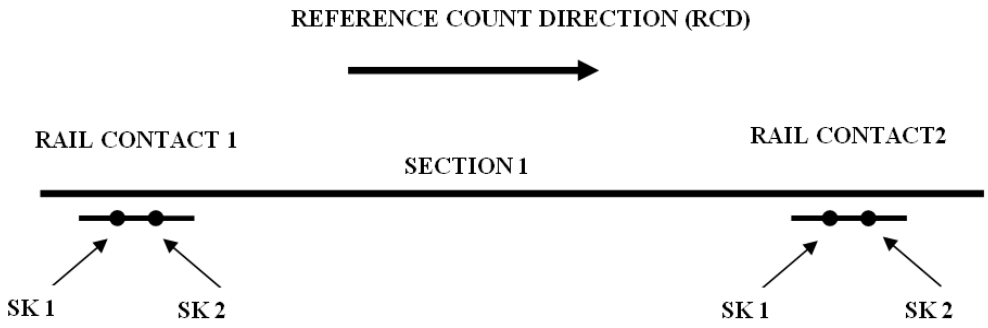
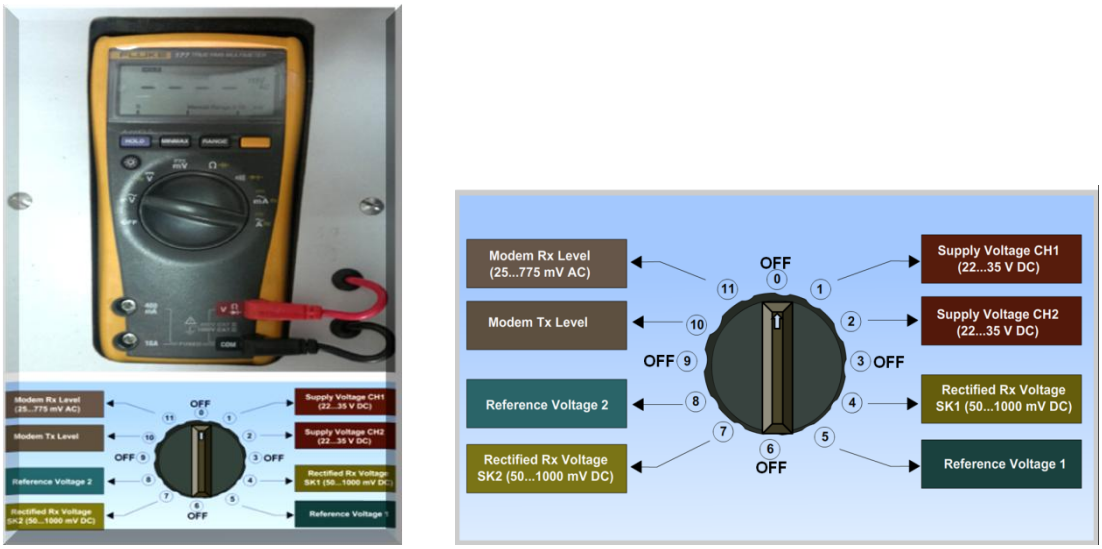


Fig. 6.6

6.3.8 TOOL KIT - ETU001

It is provided with:

- Integral cable with connector. (The connector fits to matching connector on EAK)
- Dummy wheel. (It simulates wheel presence)
- True RMS multi-meter.
- Multi function Selector Switch.
- Adjustable Torque Wrench.



Multi function Selector Switch
Fig. 6.7

6.3.10 DIFFERENT LED INDICATIONS FOR EVALUATOR / DIGITAL CARD DURING SYSTEM OPERATION

LED	Colour	Indication	Flashing
H1-1	Green	Transmitting data	Flashing
H1-2	Green	CPU1 indicates a fault during self-test of Analog part	OFF
H2-1	Green	Transmitting data	Flashing
H2-2	Green	CPU2 indicates a fault during self-test of Analog part	OFF

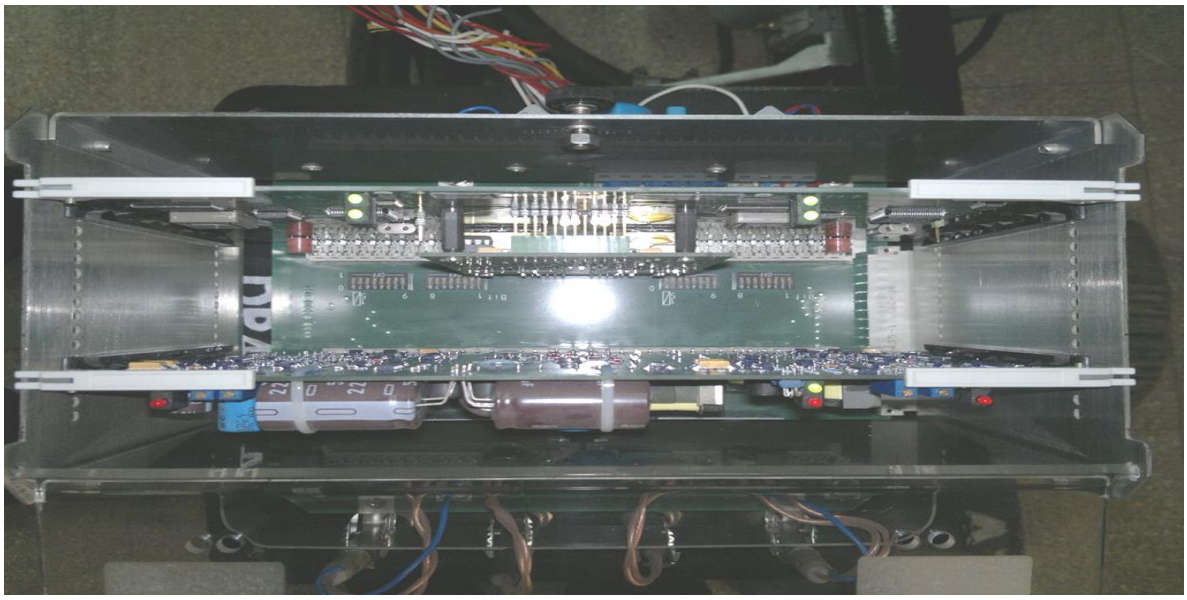
6.3.9 DIFFERENT LED INDICATIONS FOR ANALOG CARD

LED	Colour	Indication	Flashing
H1-1	Red	ON: wheel on rail contact 1 OFF: no wheel on rail contact 1	
H1-2	Green	OFF: Wheel approaching	Sensor Voltages (MESSAB 1) within tolerance, no wheel approaching
H2-1	Red	ON: wheel on rail contact 2 OFF: no wheel on rail contact 2	
H2-2	Green	OFF: Wheel approaching	Sensor Voltages (MESSAB 2) within tolerance, no wheel approaching
H3-1	Red	ON: voltage H24V out of tolerance OFF: voltage H24V within tolerance	
H3-2	Green	ON: voltage H5V O.K. OFF: voltage H5V NOT O.K.	

Reading & adjustments with Tool Kit ETU001

- For adjustment, the test equipment must be connected to the diagnostic port of EAK and the Tx heads are moved upward or downward along the serration, if necessary.
- The selector switch position 1 shows the value of the output of 1st internal DC-DC Converter (Channel1) in Analog card. This should be within the range of 22VDC to 35VDC.
- The selector switch position 2 shows the value of output voltage of 2nd internal DC-DC Converter (Channel2) in Analog card. This should also be within the range of 22VDC to 35VDC.

- The selector switch position 4 shows the rectified Rx voltage (MESSAB1) for SK1. This should be positive without dummy wheel. After placing the dummy wheel on Rx1 vertically on the center, the MESSAB1 voltage should be negative. In ideal condition and for proper adjustment of rail contact, MESSAB1 voltage without dummy wheel should be equal to the MESSAB1 voltage with dummy wheel but having an opposite polarity. The value of MESSAB1 should be within 80mV to 1000mV depending upon the drill position and rail profile.
- Turning the potentiometer (R2) on analog board, the rectified voltage without dummy wheel must be set to positive maximum.
- The rectified voltage has to be checked with dummy wheel. If there is a big difference between the positive value and the negative value, the Transmitter head should be taken pulled up or pushed down.
- Taking the transmitter head upwards increases the negative voltage and decreases the positive voltage and vice versa.
- After getting the positive and negative voltages within the specified limit the transmitter head has to be tightened properly with the torque wrench set at 25 Nm.
- For proper adjustment the positive voltage should be greater than negative voltage by a value not less than 30mV for achieving suppression of spoke trolley wheels so that the rectified Rx voltage does not go to negative with the specified trolley wheel. It is recommended that the adjustment should be done using a spoked trolley wheel that is normally used in the section. For fine adjustment the potentiometer R2 may be used.
- The selector switch position 5 shows the value of reference voltage for SK1 (PEGUE1). This can be adjusted by the potentiometer R1 on the Analog board and is made equal (or ±2%) to the value of MESSAB1 as measured without the dummy wheel.
- Keeping the selector switch at position 7, the SK2 is adjusted by measuring rectified Rx voltage for SK2 (MESSAB2) following the same way as mentioned above. For fine adjustment the potentiometer R4 on the Analog board should be used.
- The selector switch position 8 shows the reference voltage for SK2 (PEGUE2) and can be adjusted.



EAK TOP VIEW
Fig. 6.8

6.4 See Annexure 6 for parameters

6.5 DO's and DON'Ts

6.5.1 DO's

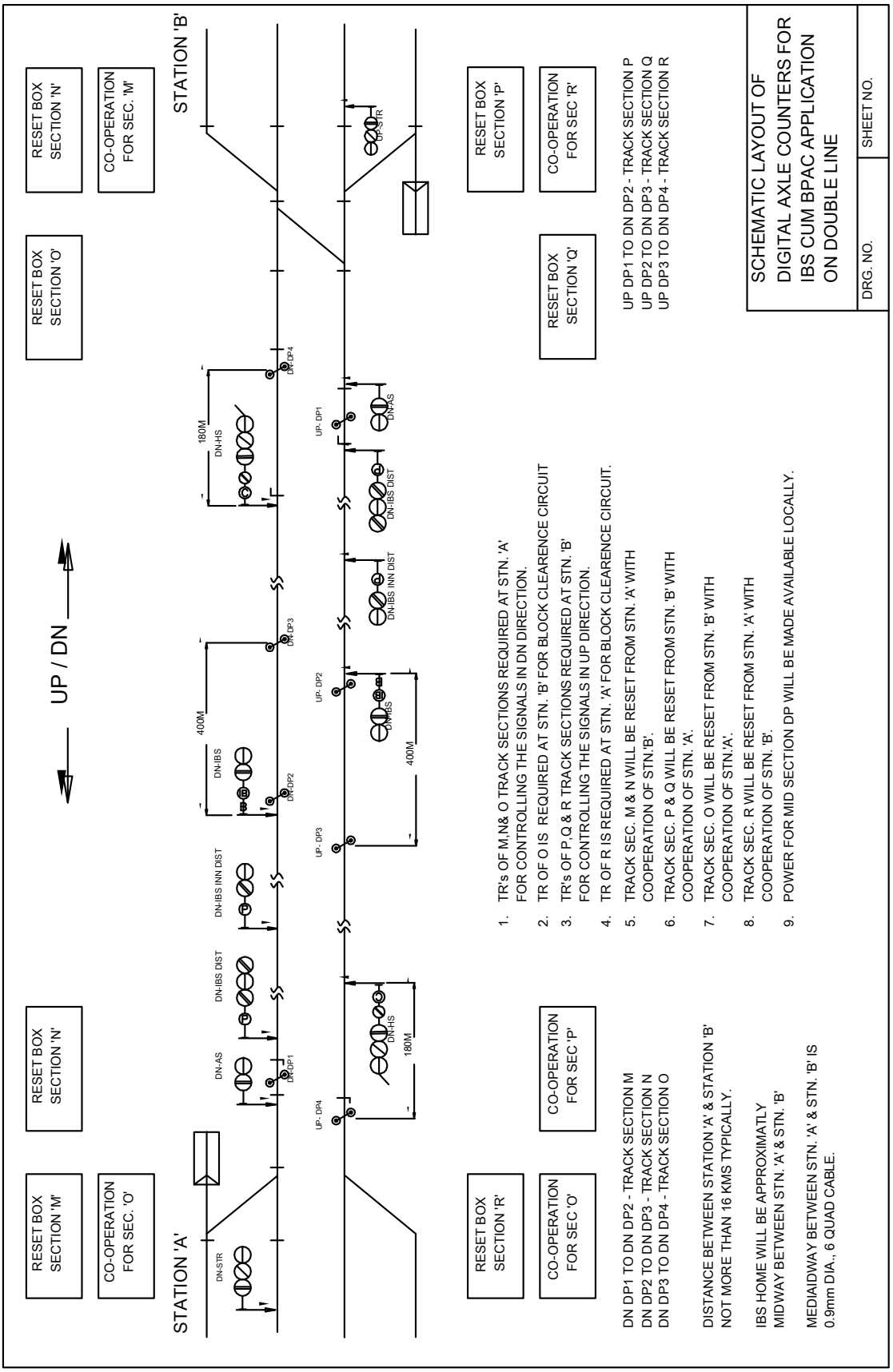
1) Always use recommended tools
2) Selection of 'Installation Point' on rail shall be strictly followed as per manual.
3) Adjustments and measurements shall be strictly done with tool kit ETU001 only.
4) Reset Box Connection shall be strictly followed as per manual.
5) For address setting of EAK please take the help of installation document.

6.5.2 DON'Ts

1) Never practice any self made guideline which is not recommended in manual.
2) Tools other than those recommended in the manual can cause damage to the system and hence is not recommended.
3) Never bypass mandatory recommendation as stated in the manual.
4) Recommendation if not followed can damage the sensitive electronics.
5) Never use inferior/unreliable power source.

6.6 RDSO approved list of firms for manufacture and supply of Electrical Signaling items: as on Jan 2012

RDSO/SPN/176/2005 (Ver.2))	
APPROVED UNDER PART: I	**APPROVED UNDER PART: II**
NIL	M/s Eldyne Electro Systems Pvt. Ltd
	SIEMENS Make



MSDAC application for IBS cum BPAC on DOUBLE LINE
Fig. 6.10

CHAPTER- 7:
MULTI SECTION DIGITAL AXLE COUNTER (MSDAC) – Siemens make

7.1 INTRODUCTION

'Siemens Transportation System' is the 2 of 2 microcomputer-controlled axle counter system. This axle counter is fit to work in any type of interlocking over IR

Throughout this chapter, this axle counting system will be referred to under its short name Az S 350 U.

Az S 350 U evaluates the received data coming from site 'Track Connection Box' and gives the information to signal interlocking that whether the related track section is 'Clear' or 'Occupied'.

Sl. no	Abbreviations	Details
1	Az S 350 U	It is German abbreviation of 'Achse Zähler from Siemens' Az S - Axle counter from Siemens 350 - is series number by Siemens U - universal design for all over the world
2	ZP 43	WDE with 43 kHz frequency generation.
3	WDE	Wheel detection equipment (it includes DEK & TCB)
2	DEK 43	Electronic double wheel detector (Transmitter &receiver coils) with 43 kHz frequency for transmitter
4	TCB	Track side connection box (TX & RX coils are connected to this TCB)
5	CH	Counting Head (means one complete ZP 43 which is connected to EC)
5	EC	Evaluation Computer (evaluator)
6	TVDS	Track vacancy detection section (axle counter section)

7.2 APPLICATIONS

The SIEMENS multi section digital axle counter Az S 350 U can be widely deployed for simultaneous monitoring of following track section in a station or yard area

1.	**Main Line**	**5.**	**Point Zones**
2.	**Loop Line**	**6.**	**Dead End**
3.	**Platform Line**	**7.**	**Stabling Lines**
4.	**Common Line**	**8.**	**Goods Lines**

7.3 Az S 350 U COMPRISES OF

(f) Central Evaluator Unit (called EC – EVALUATION COMPUTER)

(g) Reset Unit, LV box (Line verification box)

(h) Detection Point - ZP 43 (DEK, TCB, Earth connection)

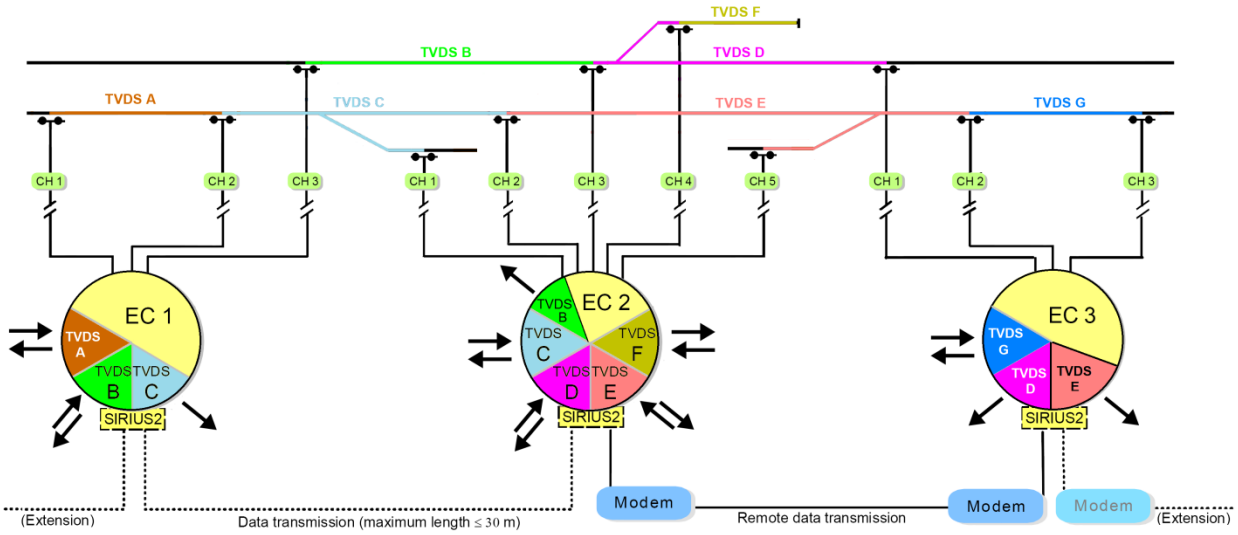
(i) Track Section Relay

One 'Evaluation Computer' (EC) can be connected directly to 5 detection points, that means it can monitor max 4 track sections directly.

One 'Evaluation Unit' can evaluate data of max 6 'Remote' detection points by interconnecting 'Evaluation Units'. "Remote" detection points are those counting heads whose data is transmitted via the serial interfaces of the "adjacent" 'Evaluation Units'.

Each 'Evaluation Unit' can be connected to two other 'Evaluation Units' via SIRIUS2 board. SIRIUS2 is the name of one board which is provided with two serial V.24 interfaces (ports). An overall system consisting of three evaluation computers is able to process the signals of up to 11 wheel detectors per evaluation computer and to detect up to 12 track vacancy detection sections per overall system.. Such linking of 'Evaluation Units' is called '**CASCADING'** of 'Evaluation Units'. This arrangement permits linking of any number of 'Evaluation Units'

Linking of two 'Evaluation Units' can be done without modem or with modem. When data transmission in between two 'Evaluation Units' is without modem, then the length of data transmission is limited up to 30m. But by using modem for data transmission in between two 'Evaluation Units' the length of data transmission is unlimited. The modem-to-modem connection may be implemented via a copper cable, fibre-optic cable or radio relay system.
The modem-to-modem exchange of Data is via FASIT method. (Fail-safe single channel transmission of status information - EN 50159-1 specifications) The status data is transmitted in the form of telegrams at a transmission rate of 9,600 bit/s or 1,200 bit/s and is protected by a 64 bit error detection suffix (Hamming distance 9).



CH=Counting Head, TVDS=Track Vacancy Detection Section, EC = Evaluation Computer.
'CH1 of TVDS-D', 'CH2 of TVDS (E-G)' and 'CH2 of TVDS (A-C)' are 'Remote CH' for EC2
'CH3 of TVDS (B-D)' is 'Remote CH' for EC1.

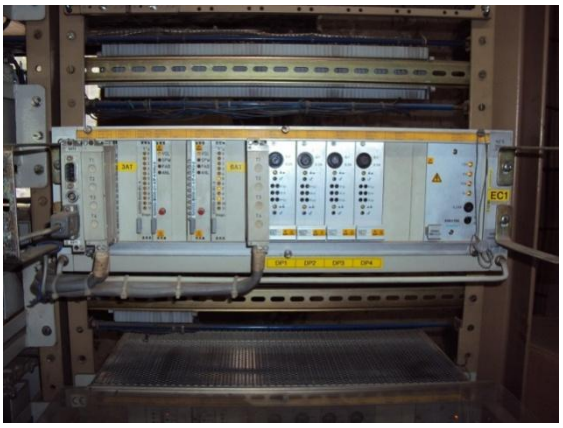
Linking of evaluator units
Fig. 7.1

Besides detection of track section, this system is also with a special provision to transmit other information like block instrument information, relay status i.e. (LCPR position, SR position etc). This data is also transmitted using the FASIT procedure which is stated in above Para. This arrangement is provided in BLEA12 board and transmission is done by SIRIUS2 board. The maximum 12 'User-Defined Information' can be transmitted.

7.4 INDOOR EQUIPMENT OF Az S 350 U

7.4.1 Evaluation Computer (EC)

Evaluation unit with 5 CH



Evaluation units with 4 CH

Fig. 7.2

Front view

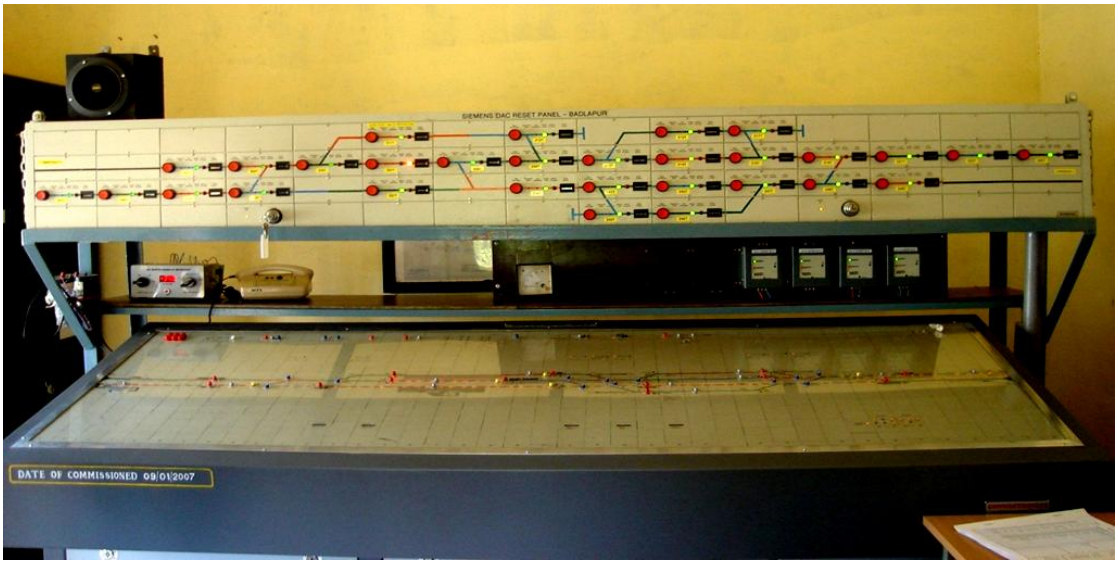
Rear view

Evaluation unit installed on rack
Fig. 7.3

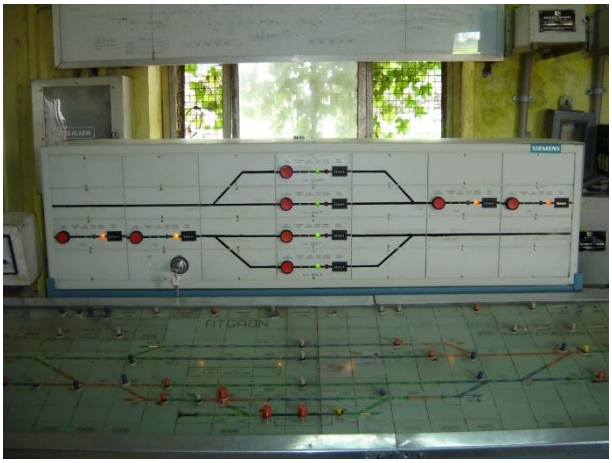
The evaluation computer

- Evaluates the signals transmitted from the counting heads,
- Compares the number of axles counted into a track vacancy detection section with the number of axles counted out,
- Monitors the track vacancy detection sections and generates a track clear or occupied indication.

7.4.2 SM reset panel, Line verification box (LV).



Reset Box Panel in station Master's room



Reset Box Panel in station Master's room

line verification box

Fig. 7.4

Reset panel is domino type panel.
Reset panel is provided in station masters room in front of operating panel.

Reset panel consist of resetting key, reset button, counter, layout of track sections with different colours, names of track sections, and LED indication on track section (red and green).

Two methods are used for resetting the system:

- Immediate axle count reset (hard reset with co-operation)

- Preparatory axle count reset

LV - line verification box is installed at suitable outside place from where concerned line can be verified physically by an agency of operating department.

In station yard where hard resetting with co-operation is given, there, LV provision is compulsory. For Block-section detection, preparatory resetting is compulsory and LV is never provided.

7.5 OUTDOOR EQUIPMENT - (ZP 43 - WHEEL DETECTION EQUIPMENT)

7.5.1 Track side connection box (TCB):

It is installed in foundation near track with 'Track Vacancy Detection Sections' assigned to it. Cables from DEK-43 (inductors) are connected inside this TCB.The 'Trackside Connection Box' of the ZP 43 V Wheel Detection Equipment is made of plastic. It is moisture-proof (IP67 rating) and has a removable, lockable cover.

TCB - Track Side Connection Box

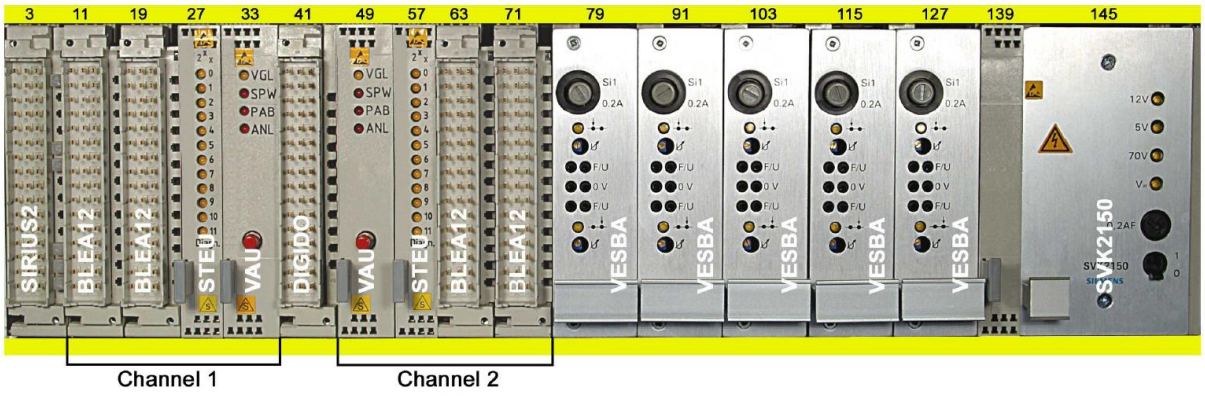
Fig. 7.5

7.5.2 Electronic Double Wheel Detector with transmitter and receiver. (DEK 43)

The transmitter and receiver of the DEK 43 Electronic Double Wheel Detector are bolted to the rail web and connected to the trackside connection box (TCB) via connecting cables.

DEK 43 double wheel detector
Fig. 7.6

7.6 EVALUATION COMPUTER – (EC)



Front view of Az S 350 U evaluation computer (including slot numbers)

Fig. 7.7

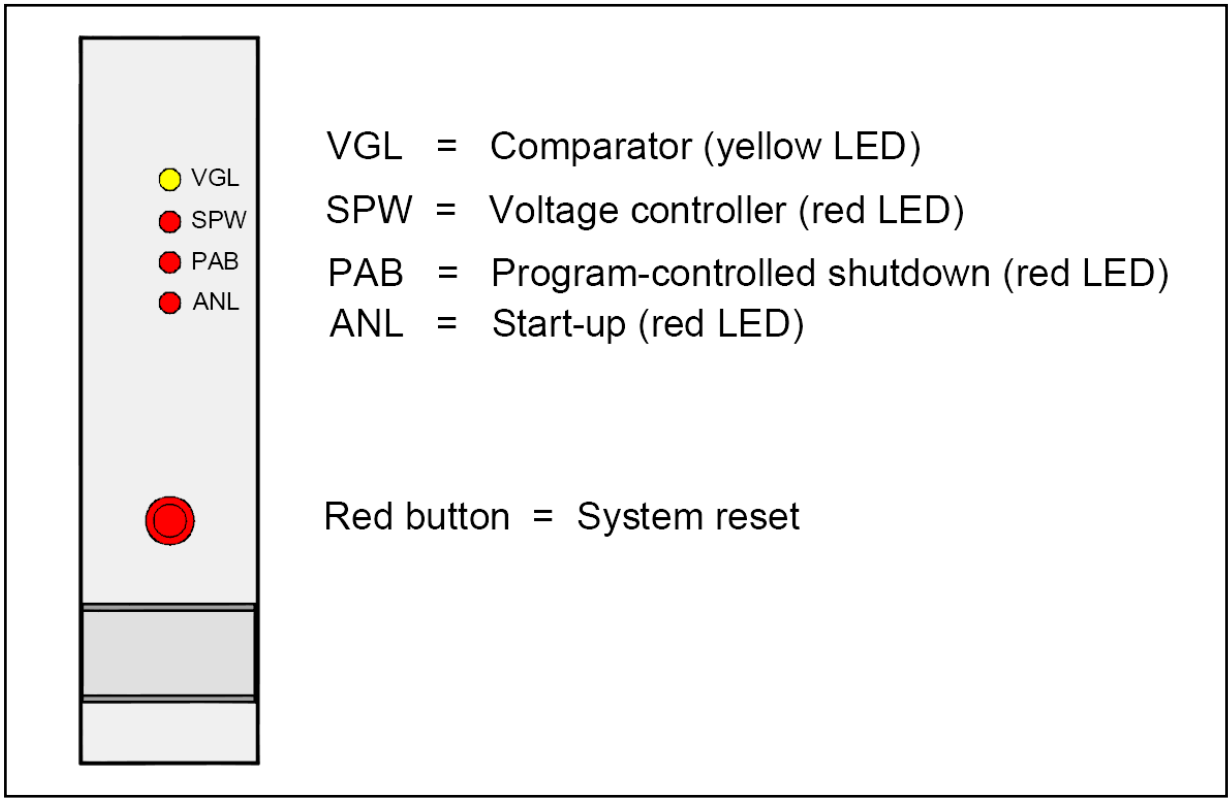
Quantity	Short designation of board	Description
1	MF	Mounting frame
2	VAU	Processing and monitoring board
2	STEU	Control and diagnostics board
2 or 4	BLEA12	Block input/output board
0 or 1	SIRIUS2	Serial computer interface universal board
0 to 5	VESBA	Amplifier, trigger and band-pass filter board
0 or 1	DIGIDO	Digital double-usage board
1	SVK2150	Power supply board

Board DIGIDO is not used in IR

The plug-in boards are accommodated in a single-tier mounting frame with wiring backplane. Dummy boards are inserted into the slots intended for optional boards.

7.6.1 VAU BOARD

Processing and monitoring board



Front view of VAU Board
Fig. 7.8

This board is Equipped with 2 MHz 8085 microprocessors, the two VAU boards make up the core of the microcomputer system. They have 8 KB RAM and 32 KB EPROM. Due to the dual-channel layout of the evaluation computer, there is one VAU board per channel.

The VAU board is a SIMIS CPU board, in which two independent MES80 microcomputers are connected without additional circuits to form a clock synchronised dual-channel microcomputer system providing SIMIS core functions.

Each VAU board monitors and compares the synchronous and identical operation of both microcomputers and, in case of a fault, transmits a switch-off control signal (SCS) in order to disconnect the signalling and safety peripherals connected.

After a system reset, the standard sequence of operations starts on the VAU boards. In order to make both channels start synchronously, both reset buttons on the front panels of the boards must be pressed simultaneously for approx. 1 second.

If both LEDs "VGL" on the VAU boards light up, the evaluation computer is operational. Both synchronously working microcomputers process identical data. A lit LED "SPW" indicates that the operating voltage is above or below the permissible value of 5 V DC. The system has to be restarted. A lit LED "PAB" indicates a program-controlled emergency shutdown. The system has to be restarted.

During evaluation computer start-up, the LED "ANL" lights up for approx. 3 s.

7.6.2 STEU BOARD

The control and diagnostic board buffers the signals transmitted by the counting heads. Due to the dual-channel layout of the evaluation computer, there is one STEU board per channel. The LEDs on this board display the following:

- **Normal Display**: display of operating states of the four track vacancy detection sections (TVDS) (during operation; operating state display)
- **Statistics Display** (diagnostics): display of operating states for a certain counting head or track vacancy detection section (switchover/selection via AzGrH button).
- **Display After Emergency Shutdown**: display of operating states in case of emergency shutdown

7.6.3 BLEA12 BOARD

The BLEA12 board is the input/output interface of the AZ S 350 U. It has 12 floating relay outputs and 12 floating Opto coupler inputs. Inputs and outputs are made via a 48-pin connector on the front panel of the board.

The BLEA12 is a single-channel board. This is why the dual-channel Az S 350 U system uses two boards of this type, one in channel 1 and one in channel 2 (first pair of BLEA12 boards). A maximum of four track clear/occupied indications with the associated reset restriction (RR) and reset acknowledgement (RA) can be output. The remaining inputs and outputs can be used for freely configurable, operator-specific information (e.g. block information).

The BLEA12 board has a MES80 bus port, which is used for exchange of data with the VAU board. The BLEA12 board also provides the port for the SCSI internal switch-off control signal, which can be used to switch off the power supply of the output relays.

The BLEA12 board executes the following functions:

- Output of track clear/occupied indication (CI and ¬ CI) of up to four TVDS
- Output of reset restriction (RR) of evaluation computer for each TVDS
- Output of reset acknowledgement (RA) on successful axle count reset for each TVDS
- Input of immediate or preparatory axle count reset (by actuating the AzGrT or vAzGrT button) for each TVDS of the evaluation computer
- Input of cancellation of reset restriction (RR) by actuating the AzGrH button for each TVDS via optional front connector
- Configuring by means of 96 DIP switches
- Block inputs/outputs for freely configurable, operator-specific information

The relay output system for the output of the track clear/occupied indications is of dual-channel design, i.e. the output data is generated and output on each of the two computer channels. Each computer channel has two relays. The relay contacts are linked to form two contact chains.

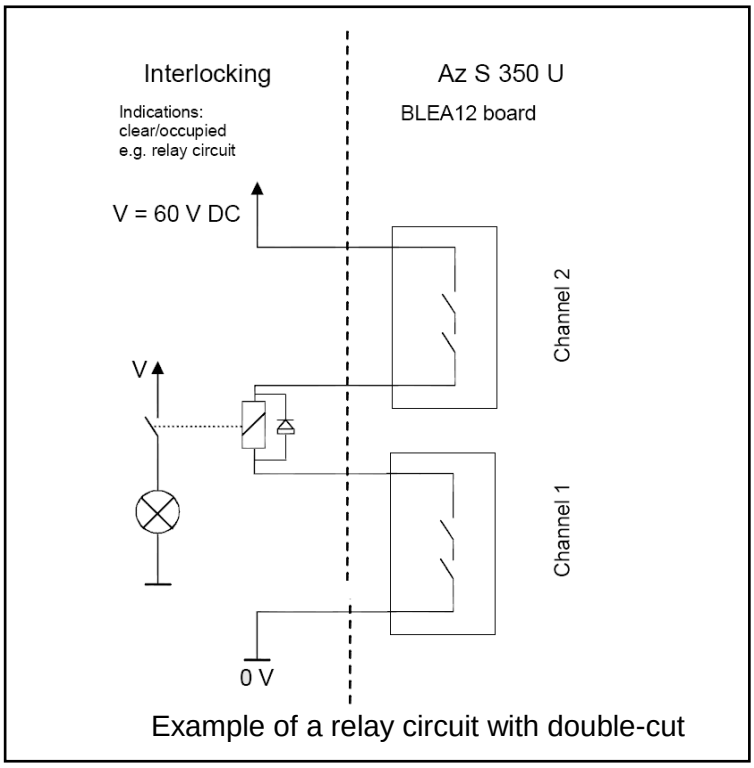


Fig. 7.9

7.6.4 SIRIUS2 BOARD

Serial computer interface universal board.

For controlling the transmission system (data transmission between evaluation computers), the Az S 350 U has a SIRIUS2 board. The SIRIUS2 board provides two serial, bidirectional interfaces for data transmission, each of them being equipped with a V.24 output. One of these V.24 interfaces has two control signals (RTS1 and CTS1).

The SIRIUS2 board contributes to fail-safety by providing reliable electrical isolation between peripherals and hardware core. For the transmission of fail-safe data, the procedure-protected data transmission procedure FASIT (fail-safe, single-channel transmission of status information) is used.

On the front panel, there is a 48-pin connector providing the connection for all interface signals.

7.6.5 VESBA BOARD

Amplifier, trigger and band-pass filter board.

The functions of the VESBA amplifier trigger and band-pass filter board are as follows:

- Connection of ZP 43 E/V wheel detection equipment (counting heads)
- Forwarding of power supply (from SVK2150) to counting heads

The VESBA board provides electrical isolation between outdoor equipment (counting head) and indoor equipment. It splits the signal frequencies f_1 and f_2 into two independent channels and filters, amplifies, rectifies and evaluates (trigger) the data transmitted from the counting head.

The front panel incorporates measuring sockets for fault diagnosis, LEDs for displaying the traversal state and potentiometers for adapting to different cable lengths and setting the transmission levels. Please read (f1 = 3.50 kHz & f2= 6.37 kHz) for IR.

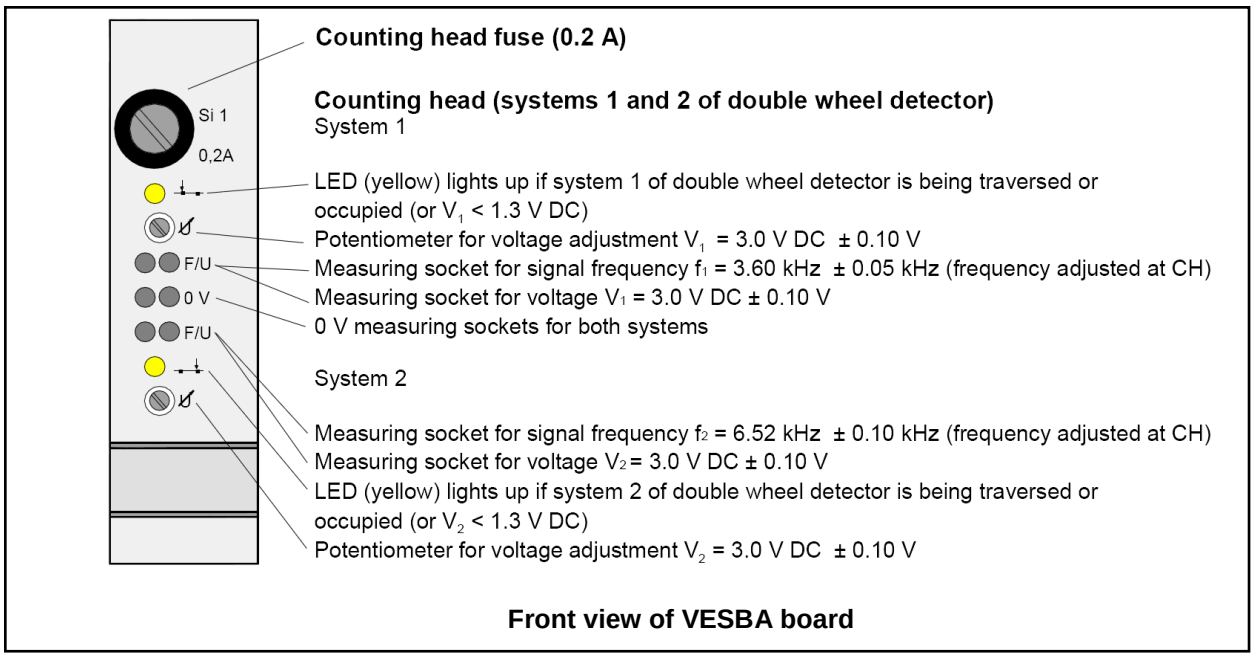


Fig. 7.10

7.6.6 SVK 2150 POWER SUPPLY BOARD

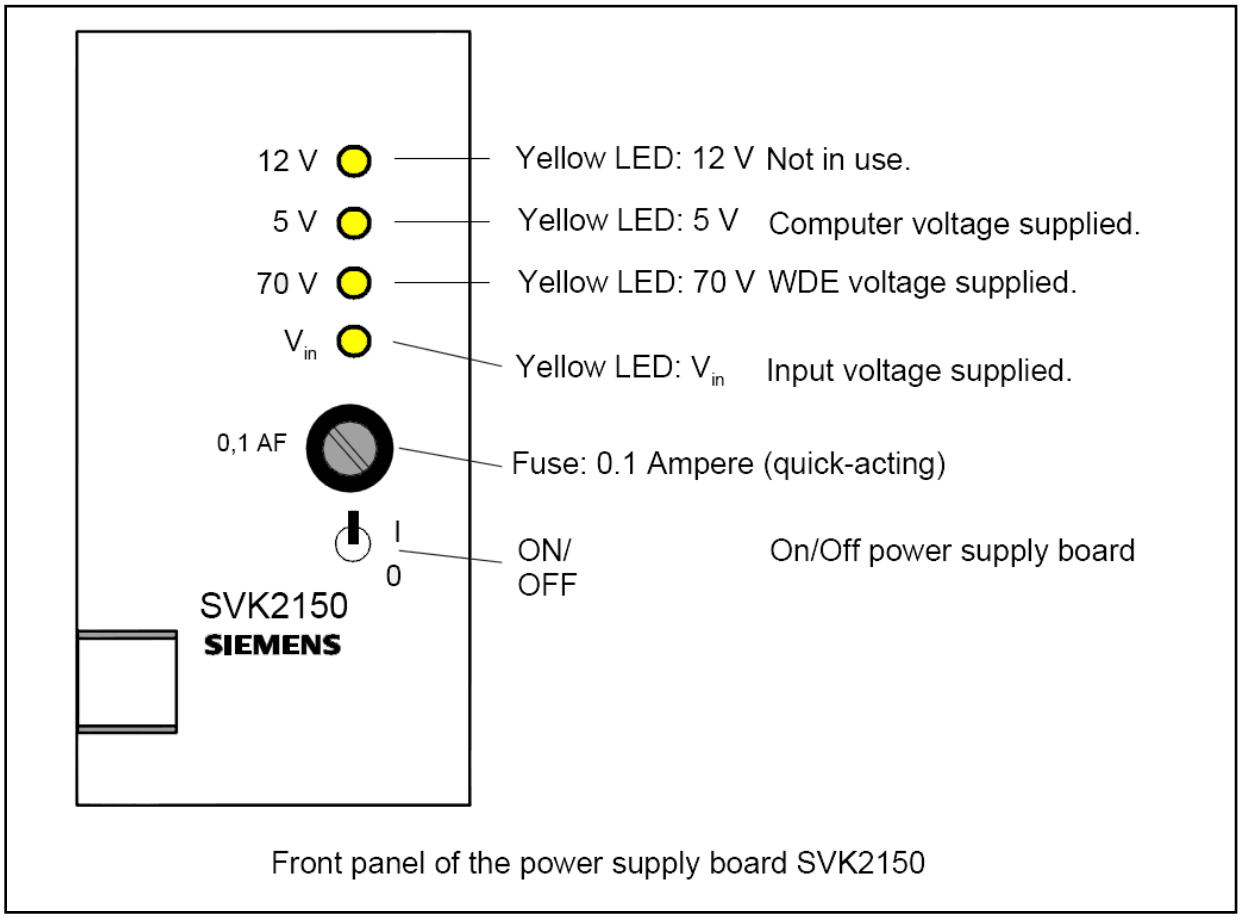


Fig. 7.11

The SVK2150 Supply board generates the following operating voltages required by Az S 350 U:

- 5 V DC for internal operation
- 70 V DC for external operation of max five counting heads.

As an option, the counting heads can be supplied with power directly from an on-site voltage source via an additional band-pass filter board for external supply (in the ZP 43 wheel detection equipment).

All voltages are monitored by voltage controllers. Input and output voltages are electrically isolated.

The SVK 2150 board is ready for operation when a voltage is supplied to the connecting input. This is indicated by the yellow LED marked "V_{in}". When the switch on the front panel is set to "I" the yellow LEDs marked "5 V" and "70 V" indicate the presence of the voltage(s). ("12 V" is not used in **Indian Railway**).

In case of under voltage, the output voltage is switched off. When the output voltage is missing, the fuse (fuse 0.1 A; quick-acting) on the front panel is activated. The unit can only go back into operation after this fuse has been replaced.

7.7 FAIL SAFETY

Az S 350 U is operated as a fail-safe computer in a 2-out-of-2 configuration on the basis of the proven SIMIS fail-safe microcomputer system from Siemens.

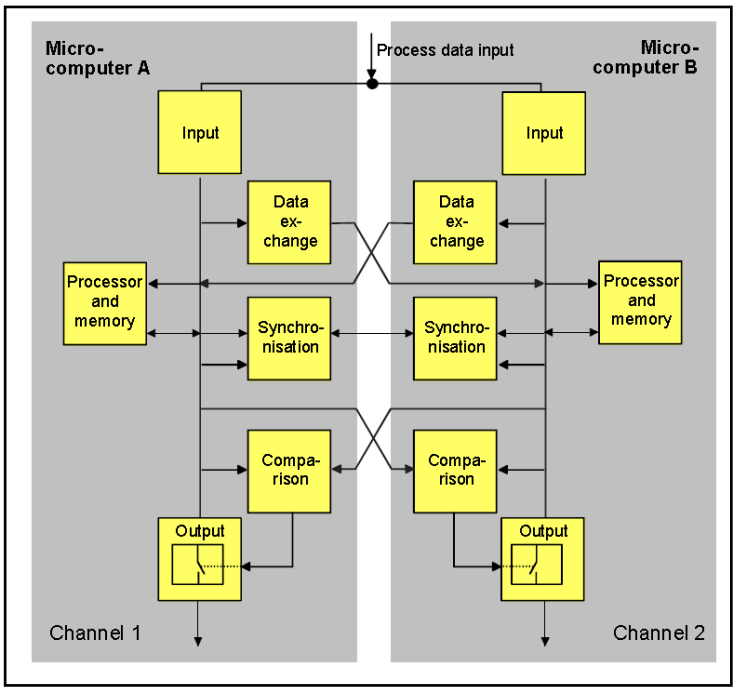


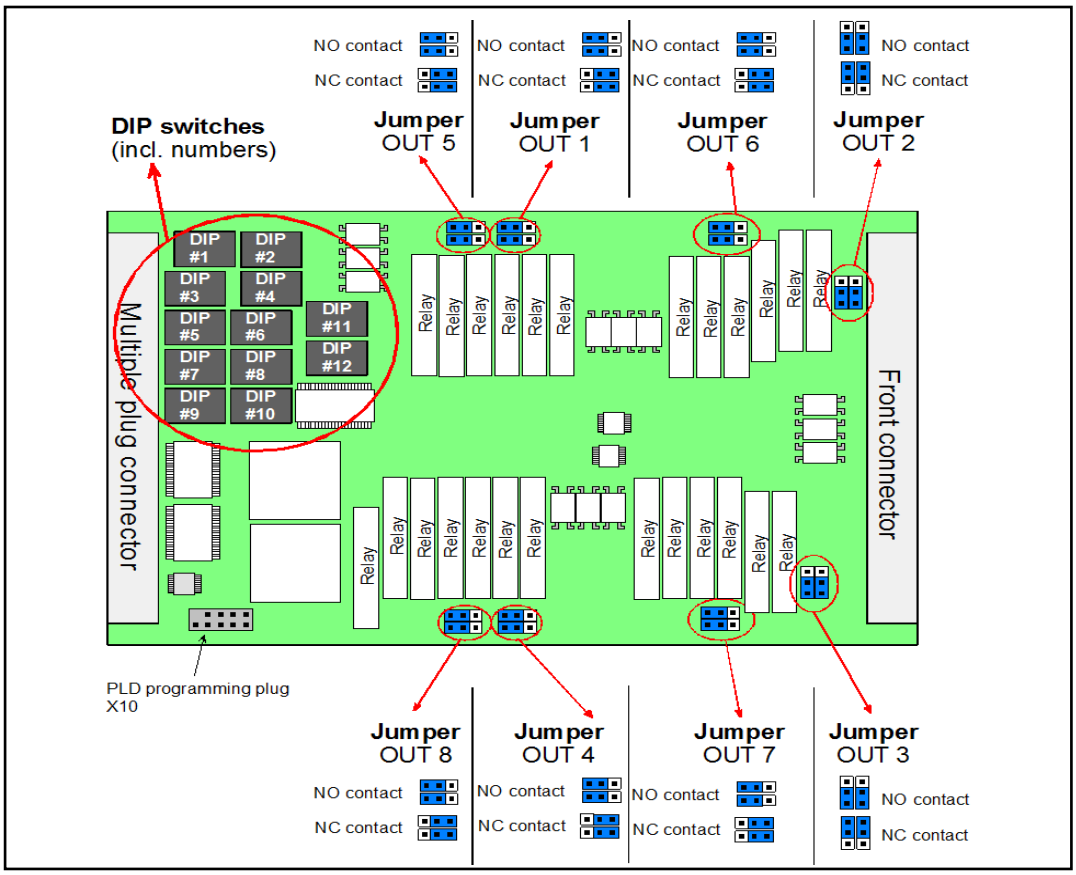
Fig. 7.12

The SIMIS fail-safe microcomputer system from Siemens comprises two independent microcomputers of identical structure. The microcomputers are supplied with the same input information which, because they run the same programs, process in an identical manner thus generating the desired output information on two channels.

Only if the output information is the same in the two independent comparators then only output is permitted to the follow-on circuitry. A cut-off unit is connected downstream of the comparators for this purpose and de-energises the output circuits if the output data does not agree.

7.8 CONFIGURATION OF SYSTEM

Arrangement of DIP Switches / Jumpers are given on BLEA12 Board for Configuring the Az S 350 U



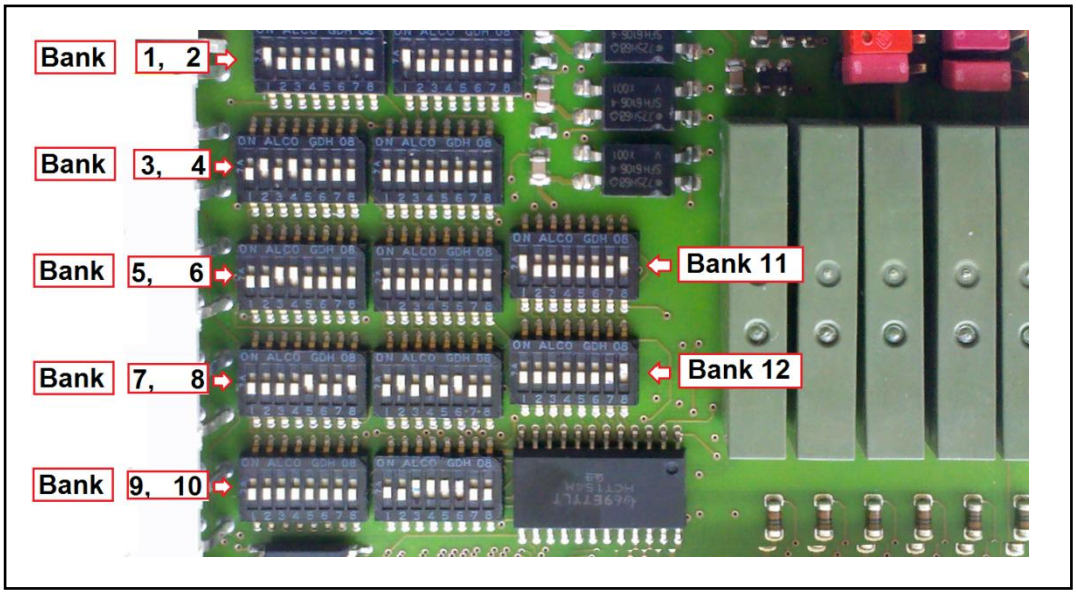


Fig. 7.13

One BLEA12 card is required for each channel and since two channels are there, this setting is required to be done in both BLEA12 cards.

Note: for the setting of these switches please follow OEM manual.

7.9 WHEEL DETECTION EQUIPMENT- WDE ZP43

The ZP 43 V Wheel Detection Equipment is installed at the track section limits. It consists of a 'Double Wheel Detector' (DEK) and 'Trackside Connection Box' (TCB), which together form a single functional unit (Counting Head). DEK is connected to TCB via cable of inductors of length 5m or 10 m long.

7.9.1 BLOCK DIAGRAM OF WDE ZP 43

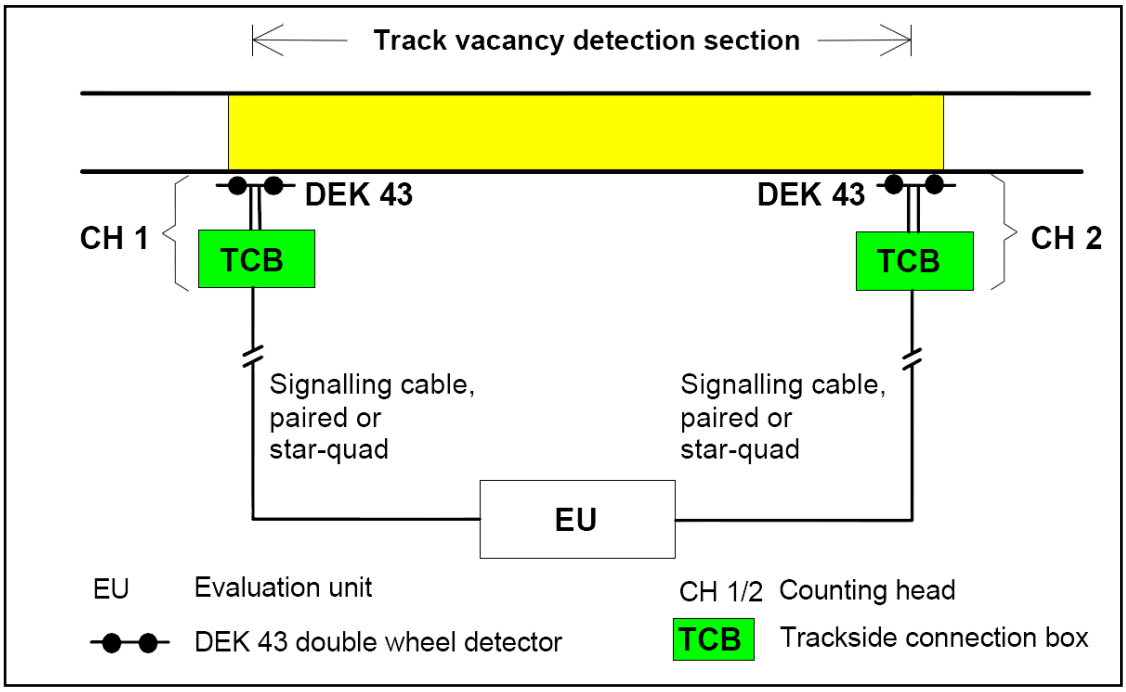


Fig. 7.14

7.9.2 EARTHING OF TCB

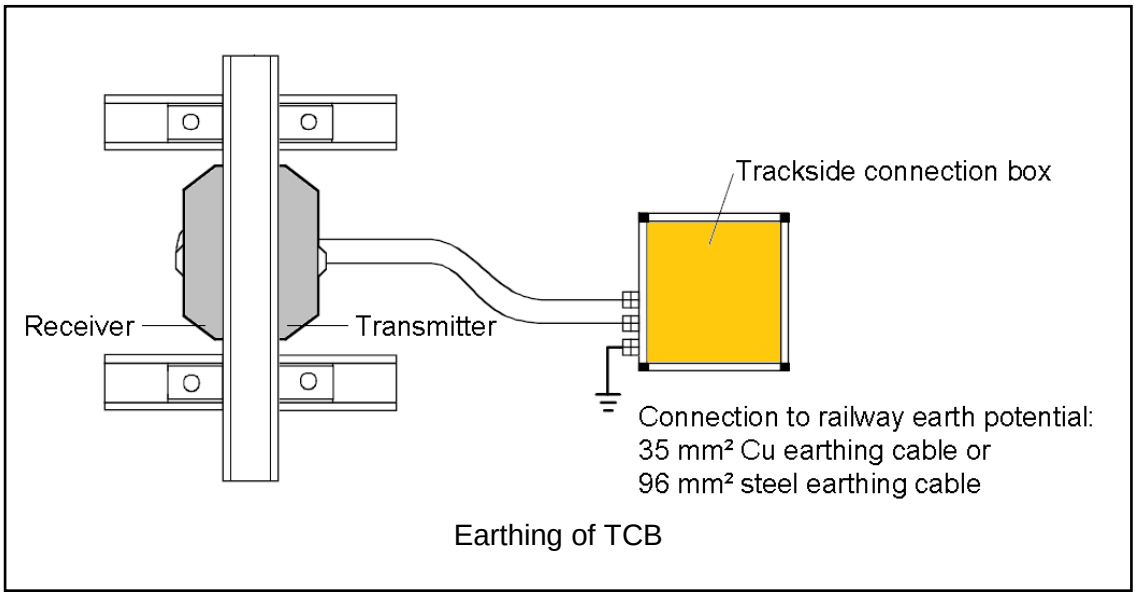
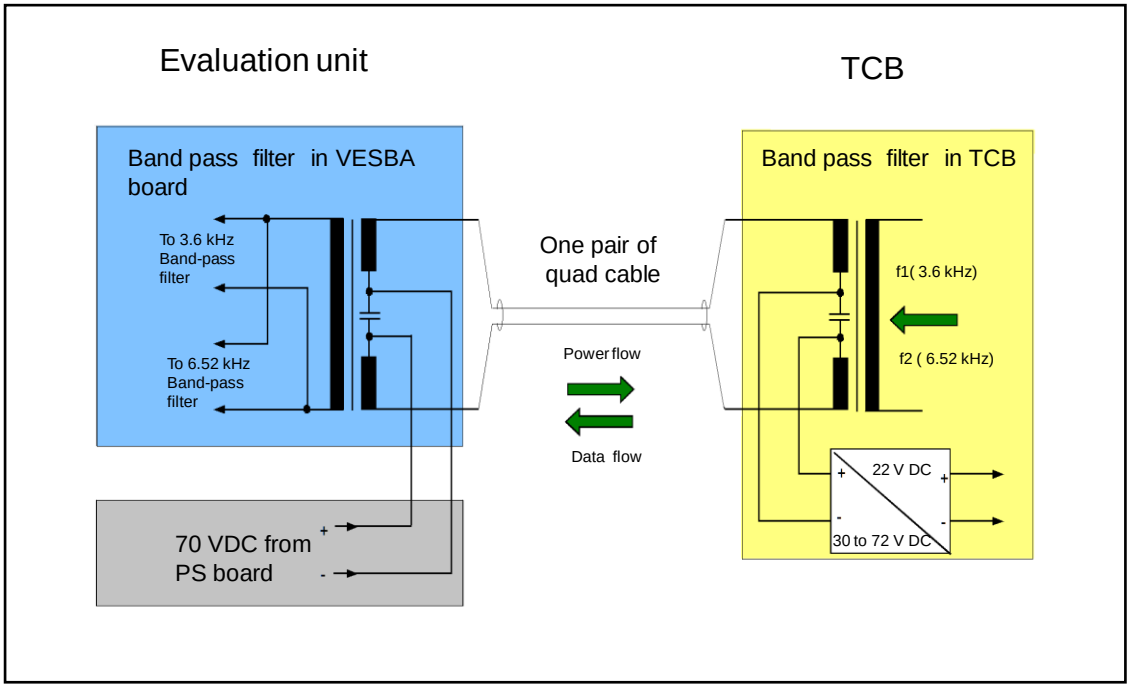


Fig. 7.15

7.9.3 CABLING BETWEEN TCB AND EU

In between TCB and EU, the Super imposition of data and power on same pair of conductors of quad cable is achieved by the arrangement as shown in block diagram given below.

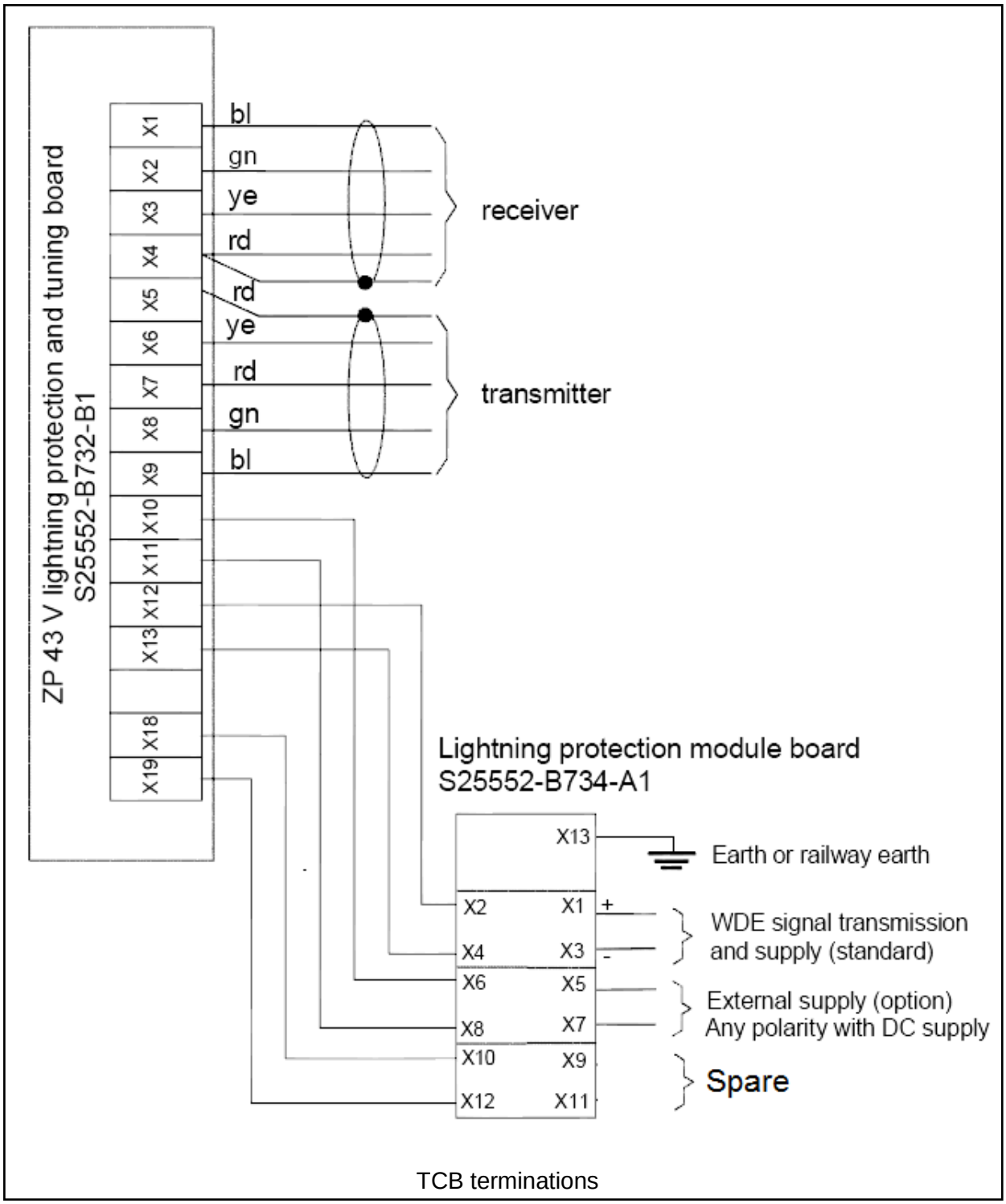


Cabling between EC and TCB
Fig. 7.16

For Cabling between the 'Track Connection Box' (TCB) and the 'Evaluation Computer'- Star-quad, shielded cables are used.The maximum possible cable length between the 'Track Connection Box' (TCB) and the 'Evaluation Computer' for the application of star-quad signalling cables are

Supply arrangement	Dia. of conductor	Length of cable
Direct current supply with 60 V	0.9 mm	5.3 km
	1.4 mm	6.5 km
Direct current supply with 70 V	0.9 mm	6.5 km
	1.4 mm	6.5 km

7.9.4 TERMINAL ASSIGNMENT IN TRACKSIDE CONNECTION BOX-(TCB)

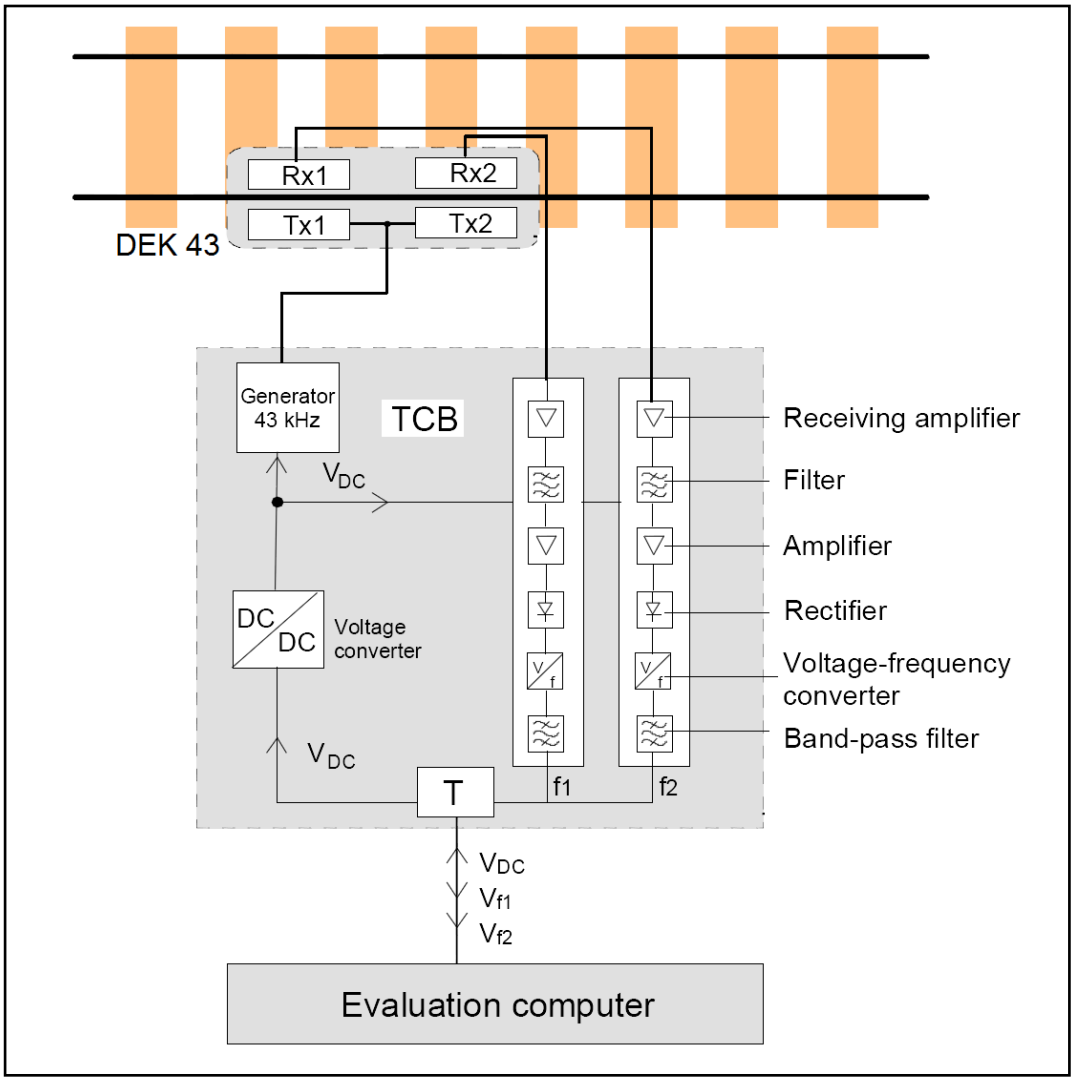


TCB terminations

Fig. 7.17

Terminal from 14 to 19 are spare.

7.9.5 BLOCK DIAGRAM OF TRACKSIDE CONNECTION BOX-(TCB)



BLOCK diagram of ZP43
Fig. 7.18

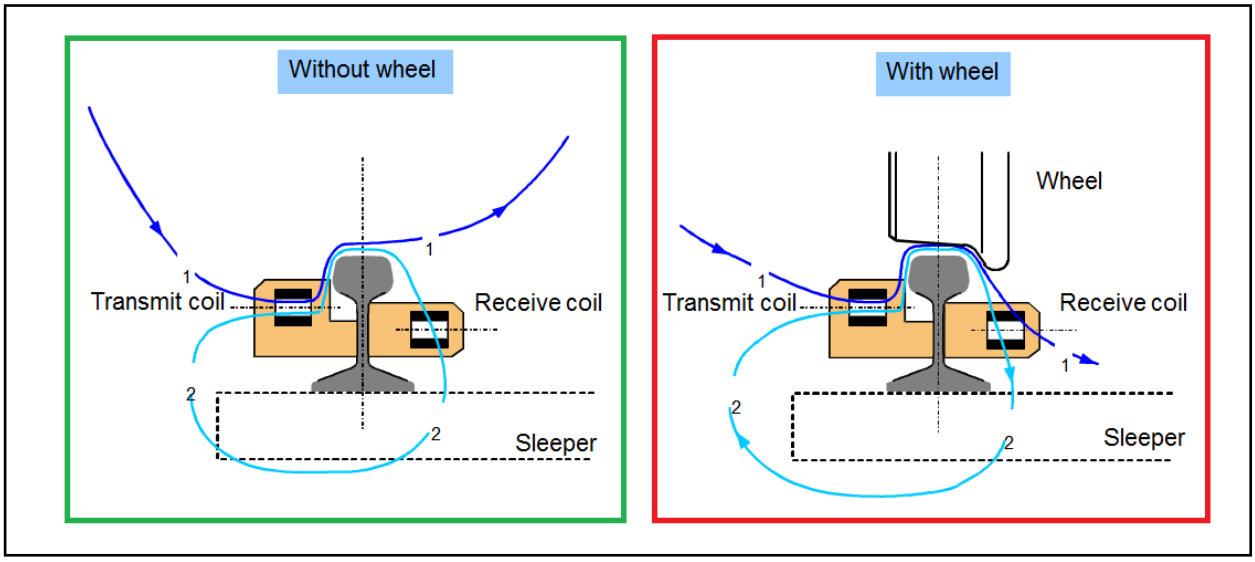
7.9.6 WORKING PRINCIPLE OF ZP43

When a wheel enters the sensing range of the 'Double Wheel Detector (DEK)', the magnetic coupling between the transmitter coil and receiver coil is increases. Consequently, the induced voltage in the receiving coil increases. The receive voltages are transmitted via the connecting cable to the two receiving amplifiers in the 'Trackside Connection Box' (TCB). After filtering, the amplitude of the interference-free receive signals is raised to the appropriate level in the downstream amplifier and then the signals are rectified.

Up to this point, both channels operate identically. The voltage-frequency converter generates a voltage whose frequency (f1 = 3.50 kHz & f2= 6.37 kHz) depends on the amplitude of the rectified receive voltages. The downstream band-pass filters only let the fundamental wave of this voltage pass. This corresponds to the idle state of the system (no wheel within the sensing range of the double wheel detector).

If a wheel enters the sensing range of the double wheel detector, the increased magnetic coupling between transmitter and receiver makes the receive voltage rise above the quiescent voltage (voltage when no wheels are passing). The voltage-frequency converter reacts by increasing the frequency beyond the upper band limit of the band-pass filter. The band-pass filter attenuates the signal. This corresponds to the occupied state of the double wheel detector. The subsequent transformer combines the signals of both channels and feeds them into the signalling cable.

In addition, the transformer separates the supply voltage received (coming from the interlocking/relay room) from the signals to be transmitted to the evaluation computer.



Magnetic coupling at receiver coil without wheel and with wheel
Fig. 7.19

7.9.7 DIMENSIONS FOR INSTALLING THE DEK 43 IN THE CENTRE OF A SPACE BETWEEN SLEEPERS

Mark out the holes to be drilled in the rail web according to the dimensions given in Fig below and dot their centres using a centre punch.

For drilling the holes (Ø 13 mm), a drilling jig (C25326-A28-A1) can be used.

When installing the DEK 43 Electronic Double Wheel Detector over a sleeper, remove the rail fastening accessories on both sides of the rail.

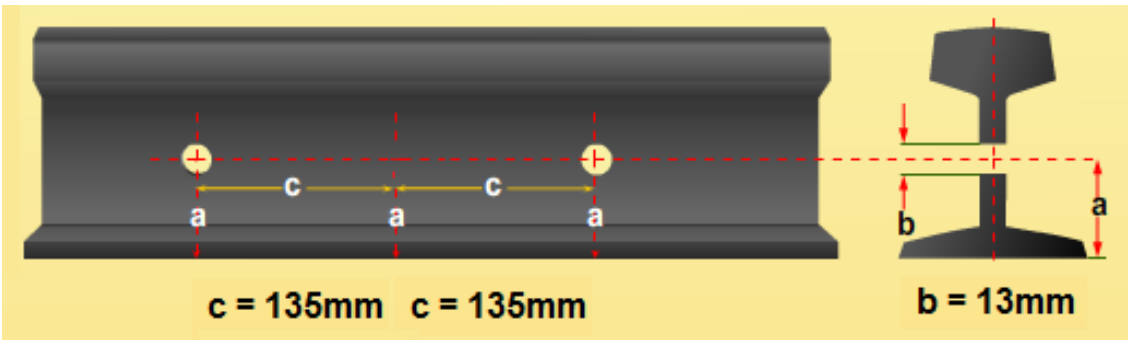


Fig. 7.20

Rail profile ⇨	60 Kg. Rail	52 Kg. Rail	90R Rail
Distance **a** [mm] ± 1.5 mm	85 mm	69 mm	56 mm

7.10 SEE ANNEXURE-7 FOR PARAMETERS.

7.11 DO's and DON'Ts

7.11.1 DO's

1) Always use recommended tools
2) Selection of 'Installation Point' on rail shall be strictly followed as per manual.
3) Adjustments and measurements shall be strictly done with OEM tool kit only.
4) Reset Box Connection shall be strictly followed as per manual.
5) For bank switch setting of BLEA12 please take the help of installation document.

7.11.2 DON'Ts

1) Never practice any self made guideline which is not recommended in manual.
2) Tools other than those recommended in the manual can cause damage to the system and hence is not recommended.
3) Never bypass mandatory recommendation as stated in the manual.
4) Recommendation if not followed can damage the sensitive electronics.
5) Never use inferior/unreliable power source

CHAPTER- 8:
MULTI SECTION DIGITAL AXLE COUNTER (MSDAC) – CEL make

8.1 INTRODUCTION

(a) The MSDAC 730 has been indigenously designed & developed by CEL & RDSO under the aegis of DSIR.(Department of Scientific & Industrial Research)

(b) The system can connect up to 40 detections and monitor up to 40 track sections covering platforms and point zones having 2, 3, 4 and above up to 8 Detection point track sections.

(c) Central evaluator has been designed & developed with modular structure (5 sets of cards).

(d) System has the provision to scale up or scale down to the user requirement at station.

8.2 SYSTEM COMPONENTS

It comprises of the following

(a) High Frequency Axle Detectors

(b) Axle Counter Field units

(c) Central Evaluator

(d) Station Master's Reset Panel

(e) Monitoring Unit

(f) Configuration and Diagnostics tools

8. 3 AXLE DETECTORS

(a) Operating Frequency: 21 KHz/ 23KHz.

(b) Phase Reversal type.

(c) Web Mounting.

(d) No need for Trolley Suppression Circuit.

(e) Do not detect push trolley with 4 / 6 / 8 spokes.

8.4 FIELD UNIT

(a) Each Digital Axle counter field unit is configured as one Detection point.

(b) Detects wheels and store counts based on 2 out of 2 logic.

(c) Transmits count and health information to Central Evaluator.

(d) Each field unit is connected to Central Evaluator on half Quad cable in Star Configuration as shown in fig below.

Field unit MSDAC CEL
Fig. 8.1

8. 5 CENTRAL EVALUATOR

(a) Housed in pre wired 19” rack.

(b) Receives count and health information from field units.

(c) Evaluates the counts section-wise to generate vital relay outputs for various track sections.

(d) Comprise of 5 Nos. of Evaluator Module (EM08) & 5 Nos. of Relay Driver Modules.

(e) Dual DC-DC converter for redundancy.

(f) Inbuilt Event Logger card for event recording.

(g) Configuration card for onsite yard layout.

(h) Operates on central 24V DC Battery.

Central evaluator is provided with:

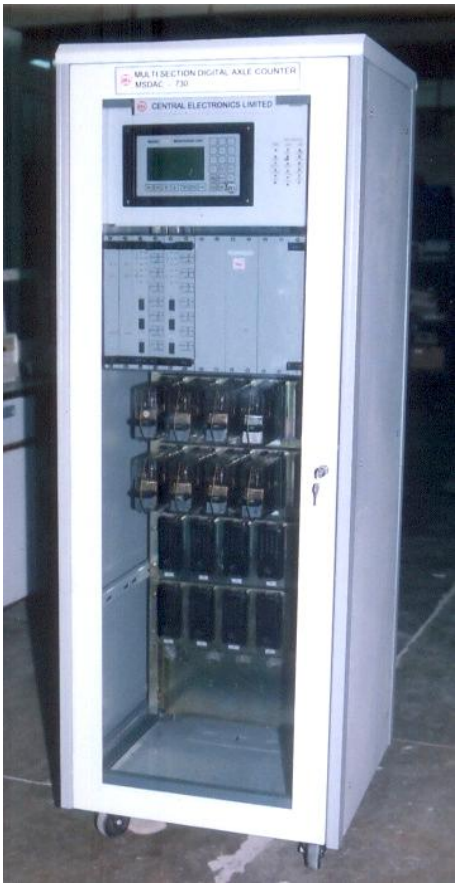
(i) Evaluator Module Card.

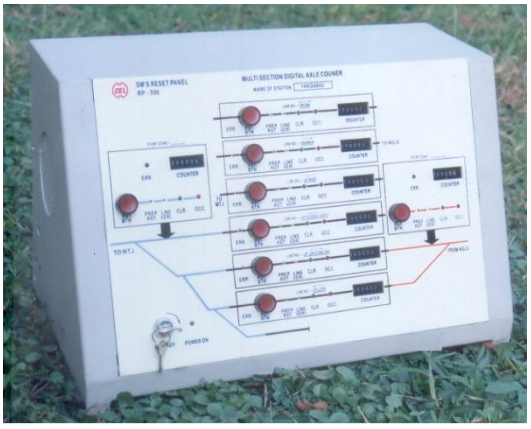
(ii) Relay Driver card.

(iii) Configuration Card.

(iv) Event Logger Card.

(v) DC-DC converter Card.





Central evaluator **SM reset panel**

Fig. 8.2

8. 6 SM's RESET PANEL

(a) Customised panel as per yard layout

(b) Section-wise Resetting with Line verification

(c) Section wise indications of Section Clear, Occupied, Preparatory reset & Line Verification

(d) SM's Control Key

(e) Section wise counter for recording reset

8.7 MAINTENANCE MONITORING UNIT

(a) LCD based unit for maintainer staff

(b) Displays complete Information at Central Evaluator

(c) Connected through serial port to Central Evaluator

(d) Inbuilt help menu for user friendly monitoring

(e) Provides information of counts, Section status, Error condition, health etc of Field Units & Central Evaluator

8.8 DIAGNOSTICS & CONFIGURATION TOOLS

(a) Dedicated PC connected for diagnostics & configuration.

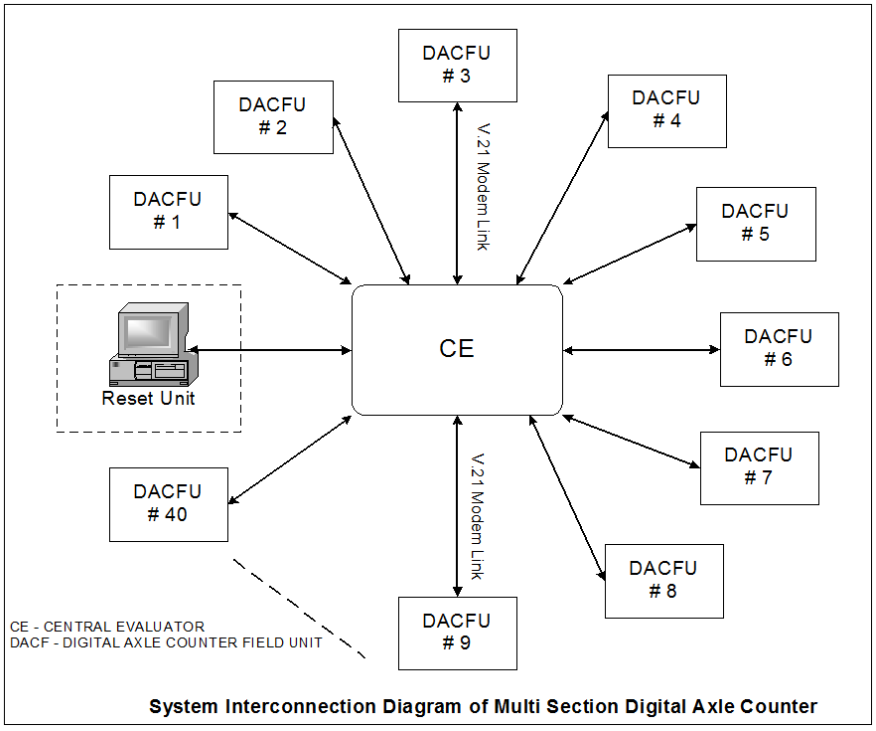
(b) User Friendly configuration tool for configuring system in factory or at site.

(c) Diagnostic tool for downloading and analysing of events

(d) Report generation with Date & time stamping

8.9 ADVANTAGES

(a) Modular and robust design
(b) Faster Response Time
(c) Ease of System Configuration
(d) Failure of EM-08 module affects the operation of only those track-sections that are
(e) Controlled by the affected module and not all track-sections
(f) Low Mean Time To Repair (MTTR)



System Interconnection Diagram of Multi Section Digital Axle Counter

The system has been installed at Faridabad N. Rly and is undergoing field trials

ANNEXURE – 1

COMPARISON OF AXLE COUNTERS

COMPARISON OF ANALOG AND DIGITAL AXLE COUNTERS				
Sl. No	**DESCRIPTION**	**ANALOG AXLE COUNTER**	**DIGITAL AXLE COUNTER**	
		UAC	**CEL**	**ALCATEL**
1	TRACK DEVICE - Mounting Type	Base clamp on rail flange	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 & 30.6 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 (QS3-12VDC)	2 Relays: VR & PR (QN1-24VDC)	1 Relay: TPR (QN1-24VDC)
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.

COMPARISON OF ANALOG AND DIGITAL AXLE COUNTERS

Sl. No	DESCRIPTION	ANALOG AXLE COUNTER	DIGITAL AXLE COUNTER	
		UAC	CEL	ALCATEL
9	Maximum no. of Detection Points per system	4 Detection Points	2 Detection Points for SSDAC 40 Detection Points for MSDAC	3 Detection Points for SSDAC 24 Detection Points for MSDAC
10	Maximum no. of Track Sections per system	1 Track Sections	1 Track Section for SSDAC 40 Track Sections for MSDAC	1 Track Section for SSDAC 32 Track Sections for MSDAC
11	Length of inductor cable	10m/15m	10m	4m/5.5m/8m
12	Sleeper spacing	550mm	400mm	400mm
13	HDPE pipe spacing	450mm	400mm	400mm
14	Distance between two Detection points of different track sections	5m	2m	2m
15	Power feeding	Local Power Supply	Local Power Supply	Local or Remote feeding of Power Supply
16	Power requirement	24V DC	24V DC for SSDAC 24V DC for MSDAC	60V DC for SSDAC 24V DC & 60V DC for MSDAC

COMPARISON OF ANALOG AND DIGITAL AXLE COUNTERS

Sl. No	DESCRIPTION	ANALOG AXLE COUNTER	DIGITAL AXLE COUNTER	
		UAC	CEL	ALCATEL
17	DC-DC convertor/PS output	+5VDC,+10VDC, +10VDC-ISO	+5VDC,+12VDC, +24VDC, +15VDC-ISO	+5VDC,+12VDC
18	Conditional Hard Reset / Preparatory Reset selection option	Available	Available	Available
19	Type of Cable used	Quad Cable	Quad Cable or OFC or Radio link with suitable interface	Quad Cable or OFC or Radio link with suitable interface
20	Db loss in communication cable	20db	30db at 2 KHz	24db at 2 KHz
21	Augmentation by connectivity between equipments	Not possible	Possible for MSDAC and Not Possible for SSDAC	Possible for SSDAC & MSDAC
22	Length of section	15Km	20Km	10.4Km(with PDCU) 12.0Km (without PDCU)
23	System fit for working in max speed of train	200Km/h	250Km/h	380Km/h
24	Compatibility for SIL-4	Not Compatible	Compatible	Compatible

ANNEXURE – 2
UNIVERSAL AXLE COUNTER

PARAMETERS OF UNIVERSAL AXLE COUNTER			
Sl. No.	**Item**	**Nominal Voltage**	**Limit**
1	EJB, EVALUATOR, RESET BOX Battery Voltage	24 VDC	21.6 to 28.8 VDC
2	Battery Charger IRS: S86/2000 (for Axle counters)	24 VDC	Ripple content should be less than 10mv AC (rms)
3	**EJB Location Box**		
	Oscillator card Output Voltage	60 VAC	54V to 66V AC
	Oscillator card Output Current	420mA AC	380 - 460 mA AC
	Oscillator card Output frequency	5KHz	5KHz ± 20Hz
	Rx output to Receiver Amplifier card	1.0 VAC	0.7V -1.0 V AC @ 5KHz
	Receiver Amplifier card output to Evaluator	1.2 VAC	2 V AC with out EV connected 1.2 VAC with EV connected
	DIP of the rail inductor	90% of normal value(measured Voltage=10 % of normal value)	85-90% of the normal value (measured Voltage=10-15% of normal value)
4	**EVALUATOR UNIT**		
	a) DC-DC Converter output	5 VDC	5 VDC ± 0.1%
		10 VDC	10 VDC± 0.1%
		10 VDC (ISO)	9.1 to 10.5 VDC
	b) Signal input to Evaluator unit	175mv	150mv to 1500mv AC
	c) Channel level in Card No:1&2	105mv	105mv AC ± 5mv

ANNEXURE – 3

ERROR LIST OF CEL MAKE SSDAC-710P

SL. NO	ERROR	ERROR NUMBER (Hex decimal)	ERROR DUE TO
1	SYSTEM NORMAL (NO ERROR)	00	NORMAL
2	ROM_TEST_DURING POST	11	ROM TEST DURING POST
3	RAM_TEST_DURING POST	12	RAM TEST DURING POST
4	SERIAL_TEST_DURING POST	13	SERIAL PORT TEST DURING POST
5	CARD_TEST_DURING POST	14	CARD PRESENCE TEST DURING POST
6	RELAY_TEST_DURIN POST	15	RELAY TEST FAIL DURING POST
7	ROM_TEST_DURING SYS WORKING	21	ROM TEST FAIL DURING SYSTEM WORKING
8	RAM_TEST_DURING SYS WORKING	22	RAM TEST FAIL DURING SYSTEM WORKING
9	CARD_TEST_DURING SYS WORKING	24	CARD PRESENCE FAIL DURING SYSTEM WORKING
10	LINK ERROR	30	LOSS OF CARRIER OR LINK
11	SEQUENCE ERROR	31	SEQUENCE OF INPUTS MISMATCH
12	SELF_COUNT_MISMATCH	32	SELF COUNT MISMATCH ERROR
13	INOUT_ERROR	33	MOVEMENT OF TRAIN BEFORE PREPARATORY RESET
14	OUT_B4_IN_ERROR	34	REGISTRATION OF OUTCOUNT BEFORE INCOUNT
15	NEGATIVE_COUNT_ERROR	35	NEGATIVE COUNT ERROR
16	SHUNT_ERROR	36	MOVEMENT OF TRAIN WHEEL ON THE SENSOR
17	SUPERVISORY_ERROR	37	SUPERVISORY ERROR
18	INTERNAL_SHUNT_ERROR	38	SINGLE CHANNEL DROP ERROR
19	COUNT UNEQUAL ERROR	39	COUNTS MISMATCH IN MLB OF SAME UNIT
20	COMMUNICATION_ERROR	40	CORRUPTION OF PACKETS
21	CRC_ERROR_CONST	41	CORRUPTION OF DATA
22	EOB_ERROR_CONST	42	CORRUPTION OF DATA
23	WHEEL_SHUNT_ERROR	43	WHEEL SHUNT ERROR
24	INDEPENDENT PULSES ERROR	44	OCCURRENCE OF NON OVERLAPPING PULSE IN FORWARD DIRECTION
25	INDEPENDENT PULSES ERROR	45	OCCURRENCE OF NON OVERLAPPNG PULSE IN REVERSE DIRECTION
26	EXIT MISMATCH ERROR	46	TRAIN / TROLLEY IN AND TROLLEY / TRAIN OUT
27	TRAIN TROLLEY ERROR	47	FOLLOWING TROLLEY SHUNTS BACK.
28	NON OVERLAP B4 OVERLAP ERROR	48	TRAIN ENTERS AFTER MOTOR TROLLEY.
29	RELAY ERROR DURING POST (CLR)	50	RELAY ERROR DURING POST IN CLR STATE
30	RELAY ERROR DURING POST (OCC)	51	RELAY ERROR DURING POST IN OCC STATE

S. NO	ERROR	ERROR NUMBER	ERROR DUE TO
31	RELAY ERROR DURING CLR STATE.	52	RELAY CONTACT NOT READ BACK IN CLR STATE
32	RELAY ERROR DURING OCC STATE	53	RELAY CONTACT NOT READ BACK IN OCC STATE
33	TRACING ERROR	60	CORRUPTION OF SOFTWARE IN MICRO CONTROLLERS.
34	SECONDRY CPU DECISION ERROR	61	DECISIONOFBOTHMLBSMISMATCHES
35	SECONDRY CPU FAIL	62	SECONDRY CPU FAILS
36	WATCHDOG RESET ERROR	66	MICRO CONTROLLERS WATCHDOG TIMER RESETS
37	CONFIGURATION ERROR	70	CHANGE IN CONFIGURATION DURING POST
38	J PKT CONFIGURATION ERROR	71	J PACKET CONFIGURATION ERROR
39	R PKT CONFIGURATION ERROR	72	R PACKET CONFIGURATION ERROR
40	CONFIGURATION ERROR	73	ADDRESS CHANGE DURING SYSTEM RUNNING
41	U PKT CONFIGURATION ERROR	74	U PACKET CONFIGURATION ERROR
42	REMOTE ERROR	80	ERROR IN REMOTE SYSTEM
43	REMOTE RESET ERROR	7F	REMOTE UNIT IS RESETTED, LOCAL IS NOT
44	SELF RESET ERROR	3F	LOCAL UNIT IS RESETTED, REMOTE IS NOT

PARAMETERS OF SSDAC - CEL MAKE				
Sl.No.	Item		Test Points	Limit
1	Battery (24V)		TS1 1&5	22-30V
2	Tx1 Vrms/ freq.		TS4 1&2	30 -40V 21KHz
3	Tx2 Vrms/ freq.		TS4 3&4	30 -40V 23KHz
4	Rx1 Vrms		TS4 5&6	350 to 650 mV
5	Rx2 Vrms		TS4 7&8	350 to 650 mV
6	Modem (card6) Vrms		TS2 7&8	150mV (approx)
7	SCC1 (Card1) DC Volts	Without dummy wheel	Red & Black Socket	2.0 to 2.5V DC
		With dummy wheel	Red & Black Socket	< 0.7V DC
8	SCC2 (Card2) DC Volts	With out dummy wheel	Red & Black Socket	2.0 to 2.5V DC
		With dummy wheel	Red & Black Socket	< 0.7V DC
9	DC-DC Converter DC Volts	5V	Monitoring Sockets on card 8	4.75 to 5.25 V DC
		12V		11.75 to 12.25 VDC
		24V		23.5 to 24.5 V DC
		15V (ISO)		14.5 to 15.5 V DC

Address setting of SSDAC CEL Units:

SW1 is 8-way sliding type dip switch setting on mother board (to access this switch, open 6 No's of screws on back cover). The switches can be slide to move to Right (ON) or Left (OFF) as required.

8-way Switch Position								Mode	Address Setting	
8	7	6	5	4	3	2	1			
ON	ON	ON	ON	ON	ON	OFF	ON	Entry	02	PAIR1
ON	ON	ON	ON	ON	ON	OFF	OFF	Exit	03	
ON	ON	ON	ON	ON	OFF	ON	ON	Entry	04	PAIR2
ON	ON	ON	ON	ON	OFF	ON	OFF	Exit	05	
ON	ON	ON	ON	ON	OFF	OFF	ON	Entry	06	PAIR3
ON	ON	ON	ON	ON	OFF	OFF	OFF	Exit	07	
ON	ON	ON	ON	OFF	ON	ON	ON	Entry	08	PAIR4
ON	ON	ON	ON	OFF	ON	ON	OFF	Exit	09	
ON	ON	ON	ON	OFF	ON	OFF	ON	Entry	0A	PAIR5
ON	ON	ON	ON	OFF	ON	OFF	OFF	Exit	0B	
ON	ON	ON	ON	OFF	OFF	ON	ON	Entry	0C	PAIR6
ON	ON	ON	ON	OFF	OFF	ON	OFF	Exit	0D	
ON	ON	ON	ON	OFF	OFF	OFF	ON	Entry	0E	PAIR7
ON	ON	ON	ON	OFF	OFF	OFF	OFF	Exit	0F	
ON	ON	ON	OFF	ON	ON	ON	ON	Entry	10	PAIR8
ON	ON	ON	OFF	ON	ON	ON	OFF	Exit	11	
ON	ON	ON	OFF	ON	ON	OFF	ON	Entry	12	PAIR9
ON	ON	ON	OFF	ON	ON	OFF	OFF	Exit	13	
ON	ON	ON	OFF	ON	OFF	ON	ON	Entry	14	PAIR10
ON	ON	ON	OFF	ON	OFF	ON	OFF	Exit	15	
ON	ON	ON	OFF	ON	OFF	OFF	ON	Entry	16	PAIR11
ON	ON	ON	OFF	ON	OFF	OFF	OFF	Exit	17	
ON	ON	ON	OFF	OFF	ON	ON	ON	Entry	18	PAIR12
ON	ON	ON	OFF	OFF	ON	ON	OFF	Exit	19	
ON	ON	ON	OFF	OFF	ON	OFF	ON	Entry	1A	PAIR13
ON	ON	ON	OFF	OFF	ON	OFF	OFF	Exit	1B	
ON	ON	ON	OFF	OFF	OFF	ON	ON	Entry	1C	PAIR14
ON	ON	ON	OFF	OFF	OFF	ON	OFF	Exit	1D	
ON	ON	ON	OFF	OFF	OFF	OFF	ON	Entry	1E	PAIR15
ON	ON	ON	OFF	OFF	OFF	OFF	OFF	Exit	1F	

ANNEXURE - 4
INDICATIONS OF SSDAC (ALCATEL)

1) INDICATIONS ON ANALOG CARD

LED	Colour	Indication	Flashing
H1-1	red	on: wheel on rail contact 1 off: no wheel on rail contact 1	
H1-2	green	off: wheel approaching	Sensor voltage (MESSAB1) within tolerance, no wheel approaching
H2-1	red	on: wheel on rail contact 2 off: no wheel on rail contact 2	
H2-2	green	off: wheel approaching	Sensor voltage (MESSAB2) within tolerance, no wheel approaching
H3-1	red	on: voltage H24V out of tolerance off: voltage H24V within tolerance	
H3-2	green	on: voltage H5V o.k. off: voltage H5V not o.k.	

2) INDICATIONS ON EVALUATOR CARD MIDDLE SLOT

LED	Colour	Indication if permanently ON	Indication if permanently OFF	Flashing
H1/H5-1	green	Prepatory reset is input	Prepatory reset is not input	
H1/H5-2	green	Voltage on relay coil (Section Clear)	No voltage on relay coil (Section Occupied / Disturbed / Defect)	
H2/H6-1	green	Telegrams from all other detection point received	Telegram missing / Communication loss	
H2/H6-2	green		No transmission of telegram	Transmission of telegram is taking place
H3/H7-1	Red	Negative axles in section	After accepting reset	After restart and after test phase
H3/H7-2	green	Single point reset: Reset command accepted Co-operative reset: Reset command accepted at one detection point	No reset active or rejected	Sweeping in progress (only for preparatory reset)
H4/H8-1	Red	Disturbance[1] of own detection point computer	No disturbance	Disturbance of other detection point received
H4/H8-2	Red	Defect[2] of own detection point computer	No defect	Defect of other detection point received

3) INDICATIONS ON EVALUATOR CARD OUTER SLOT

LED	COLOR	INDICATION	NORMAL OPERAITON
H1-1	green	Transmitting data	Flashing
H1-2	green	CPU1 indicates a fault during self test of analog part	OFF
H2-1	green	Transmitting data	Flashing
H2-2	green	CPU2 indicates a fault during self test of analog part	OFF

ANNEXURE- 5
ERROR CODES OF SSDAC (GG TRONICS)

Error Code on Display of CPU

Error Code on Display of CPU	Errors	Analysis	Corrective measure
01	PD1_BOARD_MISSING	Error occurred due to missing of the Phase detector 1 module (PD1-21 KHz) during run time and boot time diagnosis.	Place the PD1 module in the slot and reset the system.
02	PD2_BOARD_MISSING	Error occurred due to missing of the Phase detector 2 module (PD2-25 KHz) during run time and boot time diagnosis.	Place the PD1 module in the slot and reset the system.
03	SM_CPU_MISSING	Error occurred due to missing of the SM-CPU module during run time and boot time diagnosis.	Place the SM-CPU module in the slot and reset the system.
04	MODEM_MODULE_A_MISSING	Error occurred due to missing of the Communication A module during run time and boot time diagnosis.	Place the Communication A module in the slot and reset the system.
05	MODEM_MODULE_B_MISSING	Error occurred due to missing of the Communication B module during run time and boot time diagnosis.	Place the Communication B module in the slot and reset the system.
06	RELAY_DRIVE_A_MISSING	Error occurred due to missing of the Relay Drive A module during run time and boot time diagnosis.	Place the Relay Drive A module in the slot and reset the system.
07	RELAY_DRIVE_B_MISSING	Error occurred due to missing of the Relay Drive B module during run time and boot time diagnosis.	Place the Relay Drive B module in the slot and reset the system.
08	PEER_CPU_MISSING	Error occurred due to missing of the any one of the CPU module during run time and boot time diagnosis.	Place the CPU module missing in the slot and reset the system.
09	COMM_LU1_TO_US1_FAILURE	When EF CPU1 could not transmit to remote unit (CF or SF) CPU1. **Cause 1:** Check the communication links (MS Coupler) and reset the system. **Cause 2:** CPU 1 of EF Unit bad. **Cause 3:** COMM1 of EF Unit bad.	1. Make the connection properly. 2. Replace CPU1 of EF Unit. 3. Replace COMM1 of EF Unit.
10	COMM_LU1_TO_US2_FAILURE	When EF CPU1 could not transmit to remote unit (SF or CF) CPU2. **Cause 1**: Check the communication links (MS Coupler) and reset the system. **Cause 2**: CPU1 of EF bad. **Cause 3**: COMM1 of EF Unit bad.	1. Make the connection properly. 2. Replace CPU1 of EF Unit. 3. Replace COMM1 of EF Unit.
11	COMM_LU1_TO_DS1_FAILURE	When SF CPU1 could not transmit to remote unit (CF or EF) CPU1. **Cause 1**: Check the communication links (MS Coupler) and reset the system. **Cause 2**: CPU1 of SF bad. **Cause 3**: COMM2 of SF Unit bad.	1. Make the connection properly. 2. Replace CPU1 of SF Unit. 3. Replace COMM2 of SF Unit.
12	COMM_LU1_TO_DS2_FAILURE	When SF CPU1 could not transmit to remote unit (CF or EF) CPU2. **Cause 1**: Check the communication links (MS Coupler) and reset the system. **Cause 2**: CPU1 of SF bad. **Cause 3**: COMM2 of SF Unit bad.	1. Make the connection properly. 2. Replace CPU1 of SF Unit. 3. Replace COMM2 of SF Unit.

Error Code on Display of CPU	Errors	Analysis	Corrective measure
13	COMM_US 1_TO_LU1 _FAILURE	When EF CPU1 could not receive any response from the remote unit (SF or CF) CPU1. **Cause 1**: Check the communication links (MS Coupler) and reset the system. **Cause 2**: CPU1 of EF bad. **Cause 3**: COMM1 of EF Unit bad.	1. Make the connection properly. 2. Replace CPU1 of EF Unit. 3. Replace COMM1 of EF Unit.
14	COMM_US 2_TO_LU1 _FAILURE	When EF CPU2 could not receive any response from the remote unit (SF or CF) CPU1. **Cause 1**: Check the communication links (MS Coupler) and reset the system. **Cause 2**: CPU2 of EF bad. **Cause 3**: COMM1 of EF Unit bad.	1.Make the connection properly. 2. Replace CPU2 of EF Unit. 3. Replace COMM1 of EF Unit.
15	COMM_DS 1_TO_LU1 _FAILURE	When SF CPU1 could not receive any response from the remote unit (CF or EF) CPU1. **Cause 1**: Check the communication links (MS Coupler) and reset the system. **Cause 2**: CPU1 of SF bad. **Cause 3**: COMM2 of SF Unit bad.	1. Make the connection properly. 2. Replace CPU1 of SF Unit. 3. Replace COMM2 of SF Unit.
16	COMM_DS 2_TO_LU1 _FAILURE	When SF CPU2 could not receive any response from the remote unit (CF or EF) CPU1. **Cause 1**: Check the communication links (MS Coupler) and reset the system. **Cause 2**: CPU2 of SF bad. **Cause 3**: COMM2 of SF Unit bad.	1. Make the connection properly. 2. Replace CPU2 of SF Unit. 3. Replace COMM2 of SF Unit.
17	COMM_LU 2_TO_US1 _FAILURE	When EF CPU2 could not transmit to remote unit (SF or CF) CPU1. **Cause 1**: Check the communication links (MS Coupler) and reset the system. **Cause 2**: CPU2 of EF bad. **Cause 3**: COMM1 of EF Unit bad.	1. Make the connection properly. 2. Replace CPU2 of EF Unit. 3. Replace COMM1 of EF Unit.
18	COMM_LU 2_TO_US2 _FAILURE	When EF CPU2 could not transmit to remote unit (SF or CF) CPU2. **Cause 1**: Check the communication links (MS Coupler) and reset the system. **Cause 2**: CPU2 of EF bad. **Cause 3**: COMM1 of EF Unit bad.	1. Make the connection properly. 2. Replace CPU2 of EF Unit. 3. Replace COMM1 of EF Unit.
19	COMM_LU 2_TO_DS1 _FAILURE	When SF CPU2 could not transmit to remote unit (CF or EF) CPU1. **Cause 1**: Check the communication links (MS Coupler) and reset the system. **Cause 2**: CPU2 of SF bad. **Cause 3**: COMM2 of SF Unit bad.	1. Make the connection properly. 2. Replace CPU2 of SF Unit. 3. Replace COMM2 of SF Unit.
20	COMM_LU 2_TO_DS2 _FAILURE	When SF CPU2 could not transmit to remote unit (CF or EF) CPU2. **Cause 1**: Check the communication links (MS Coupler) and reset the system. **Cause 2**: CPU2 of SF bad. **Cause 3**: COMM2 of SF Unit bad.	1. Make the connection properly. 2. Replace CPU2 of SF Unit. 3. Replace COMM2 of SF Unit.

Error Code on Display of CPU	Errors	Analysis	Corrective measure
21	COMM_US 1_TO_LU2 _FAILURE	When EF CPU1 could not receive any response from the remote unit (SF or CF) CPU2. **Cause 1**: Check the communication links (MS Coupler) and reset the system **Cause 2**: CPU1 of EF bad. **Cause 3**: COMM1 of EF Unit bad.	1. Make the connection properly. 2. Replace CPU1 of EF Unit. 3. Replace COMM1 of EF Unit.
22	COMM_US 2_TO_LU2 _FAILURE	When EF CPU2 could not receive any response from the remote unit (SF or CF) CPU2. **Cause 1**: Check the communication links (MS Coupler) and reset the system. **Cause 2**: CPU2 of EF Bad. **Cause 3**: COMM1 of EF Unit bad.	1. Make the connection properly. 2. Replace CPU2 of EF Unit. 3. Replace COMM1 of EF Unit.
23	COMM_DS 1_TO_LU2 _FAILURE	When SF CPU1 could not receive any response from the remote unit (CF or EF) CPU2. **Cause 1**: Check the communication links (MS Coupler) and reset the system. **Cause 2**: CPU1 of SF bad. **Cause 3**: COMM2 of SF Unit bad.	1. Make the connection properly. 2. Replace CPU1 of EF Unit. 3. Replace COMM1 of EF Unit.
24	COMM_DS 2_TO_LU2 _FAILURE	When SF CPU2 does not receive any response from the remote unit (CF or EF) CPU2. **Cause 1**: Check the communication links (MS Coupler) and reset the system. **Cause 2**: CPU2 of SF bad. **Cause 3**: COMM2 of SF Unit bad.	1. Make the connection properly. 2. Replace CPU2 of SF Unit. 3. Replace COMM2 of SF Unit.
25	MODEM_E RROR_NO _CARRIER	Carrier signal is being blocked by modem **Cause 1**: COMM1/COMM2 gone Bad.	1. Replace COMM1/COMM2.
26	PEER_CP U_LINK_F AILURE	**Cause 1:** SMCPU/Event Logger gone bad. **Cause 2:** CPU1/CPU2 gone bad.	1. Replace SMCPU/Event Logger. 2. Replace CPU1/CPU2.
27	FAILURE_ AT_DS	Error at Down stream unit. **Cause 1**: Failure in the remote unit.	Check the error at remote unit, rectify the error and reset the system.
28	FAILURE_ AT_US	Error at Up stream unit. **Cause 1**: Failure in the remote unit.	Check the error at remote unit, rectify the error and reset the system.
30	BOOTUP_ PD_FAIL	PD Wheel Detection during Power On Condition. **Cause 1:** Train moving in the Section on TX/RX coils, power OFF & ON in fraction of seconds.	Reset the system.
33	PD1_SUP_ LOW	PD1 module supervisory is low for 3 seconds. **Cause 1:** TX1/RX1 coils not connected properly. **Cause2**: TX1/RX1 coil gone bad. **Cause 3:** CPU1/CPU2 gone bad. **Cause 4:** PD1 module gone bad.	1. Make the connection properly. 2. Replace TX1/RX1 Coil. 3. Replace CPU1/CPU2. 4. Replace PD1 Module.

Error Code on Display of CPU	Errors	Analysis	Corrective measure
34	PD2_SUP_LOW	PD2 module supervisory is low for 3 seconds. **Cause 1:** TX2/RX2 coils not connected properly. **Cause2**: TX2/RX2 coil gone bad. **Cause 3:** CPU1/CPU2 gone bad. **Cause 4:** PD1 module gone bad.	1. Make the connection properly. 2. Replace TX1/RX1 coil. 3. Replace CPU1/CPU2. 4. Replace PD2 module.
35	PD1_PULSING	Error occurs when any one sensor is influenced two or more times. **Cause 1:** Loose contacts of TX1/RX1 connections. **Cause 2:** PD1 module gone bad.	1. Make the connection properly. 2. Replace TX1/RX1 coil. 3. Replace PD1 module.
36	PD2_PULSING	Error occurs when any one sensor is influenced two or more times. **Cause 1**: Loose contacts of TX1/RX1 connections. **Cause 2**: PD1 module gone bad.	1. Make the connection properly. 2. Replace TX2/RX2 coil. 3. Replace PD2 module.
37	PD_STATE_MISSING	Error occurs when double sensor is influence in the sequence. **Cause 1**: Loose contacts of TX1/RX1, TX2/RX2 connections. **Cause 2**: PD1, PD2 module gone bad.	1. Make the connection properly. 2. Replace TX1/RX1, TX2/RX2 coil. 3. Replace PD1, PD2 module.
38	PD_SUP_PULSATING	If supervisory signals pulsates more than 4 times. **Cause 1:** TX1/RX1 or TX2/RX2 coils not connected properly. **Cause 2**: TX1/RX1, TX2/RX2 coil gone bad. **Cause 3:** CPU1/CPU2 gone bad. **Cause 4:** PD1, PD2 module gone bad.	1. Make the connection properly. 2. Replace TX1/RX1, TX2/RX2 coil. 3. Replace CPU1/CPU2 4. Replace PD1, PD2 module.
39	PD_STATE_FAIL	Error occurs when any wheel counting state sequence is missing. **Cause 1:** TX1/RX1 or TX2/RX2 coils not connected properly. **Cause 2**: TX1/RX1, TX2/RX2 coil gone bad. **Cause 3:** CPU1/CPU2 gone bad. **Cause 4:** PD1, PD2 module gone bad.	1. Make the connection properly. 2. Replace TX1/RX1, TX2/RX2 coil. 3. Replace CPU1/CPU2. 4. Replace PD1, PD2 module.
40	PD_NOT_SENSING	Error occurs when both the PD modules doesn't sense the wheel for more than 3 times. **Cause 1:** TX1/RX1 or TX2/RX2 coils not connected properly. **Cause 2**: TX1/RX1, TX2/RX2 coil gone bad. **Cause 4:** PD1, PD2 module gone bad.	1. Make the connection properly. 2. Replace TX1/RX1, TX2/RX2 coil. 3. Replace PD1, PD2 module.
41	PREPARATORY_RELAY_A_FAILURE	No/Improper feedback from Preparatory A relay. **Cause 1:** Loose contacts of Preparatory relay connections. **Cause 2**: Relay Drive 1 module gone bad. **Cause 4:** CPU1/CPU2 module gone bad.	1. Make the connection properly. 2. Replace Relay Driver 1 module. 3. Replace CPU1/CPU2 module.

Error Code on Display of CPU	Errors	Analysis	Corrective measure
42	PREPARATORY_RELAY_B_FAILURE	No/Improper feedback from Preparatory B relay. **Cause 1:** Loose contacts of Preparatory relay connections. **Cause 2**: Relay Drive 2 module gone bad. **Cause 4:** CPU1/CPU2 module gone bad.	1. Make the connection properly. 2. Replace Relay Driver 2 module. 3. Replace CPU1/CPU2.
43	VITAL_RELAY_A_FAILURE	No/Improper feedback from Vital Relay A relay. **Cause 1:** Loose contacts of Preparatory relay connections. **Cause 2**: Relay Drive 1 module gone bad. **Cause 4:** CPU1/CPU2 module gone bad.	1. Make the connection properly. 2. Replace Relay Driver 1 module. 3. Replace CPU1/CPU2.
44	VITAL_RELAY_B_FAILURE	No/Improper feedback from Vital Relay B relay. **Cause 1:** Loose contacts of Preparatory relay connections. **Cause 2**: Relay Drive 2 module gone bad. **Cause 4:** CPU1/CPU2 module gone bad.	1. Make the connection properly. 2. Replace Relay Driver 2 module. 3. Replace CPU1/CPU2.
45	DIRECT_OUT_COUNT	Without IN COUNT, OUT COUNT registered.	Reset the system.
49	TRANSIENT_POWER_FAILURE_DS1	Power failure at Down stream CPU1. **Cause 1:** Loose contacts of power connections.	Make the connection properly.
50	TRANSIENT_POWER_FAILURE_DS2	Power failure at Down stream CPU2. **Cause 1:** Loose contacts of power connections.	Make the connection properly.
51	TRANSIENT_POWER_FAILURE_US1	Power failure at Up stream CPU1. **Cause 1:** Loose contacts of power connections.	Make the connection properly.
52	TRANSIENT_POWER_FAILURE_US2	Power failure at Up stream CPU2. **Cause 1:** Loose contacts of power connections.	Make the connection properly.
57	INVALID_NETWORK_ADDRESS	When CPU address range wrong.	Change the address settings by using LK10 to LK17 links and reset the system.
58	INCORRECT_CODE_CRC	This is a Boot Up error. When CRC of the code mismatches with the stored CRC.	Re-program the processor and code memory checksum.
59	INVALID_CONFIGURATION	When unit type and address of CPU is wrong.	Change the address and configuration settings as per the requirement and reset the system.
60	INVALID_COUNTS	Train with 10,000 wheels.	Reset the system.
61	RAM_TEST_FAILED	This is a Boot up error when RAM (In- built memory of Micro controller) is failed.	Replace the Micro Controller.

ANNEXURE- 6
MSDAC (ALCATEL)

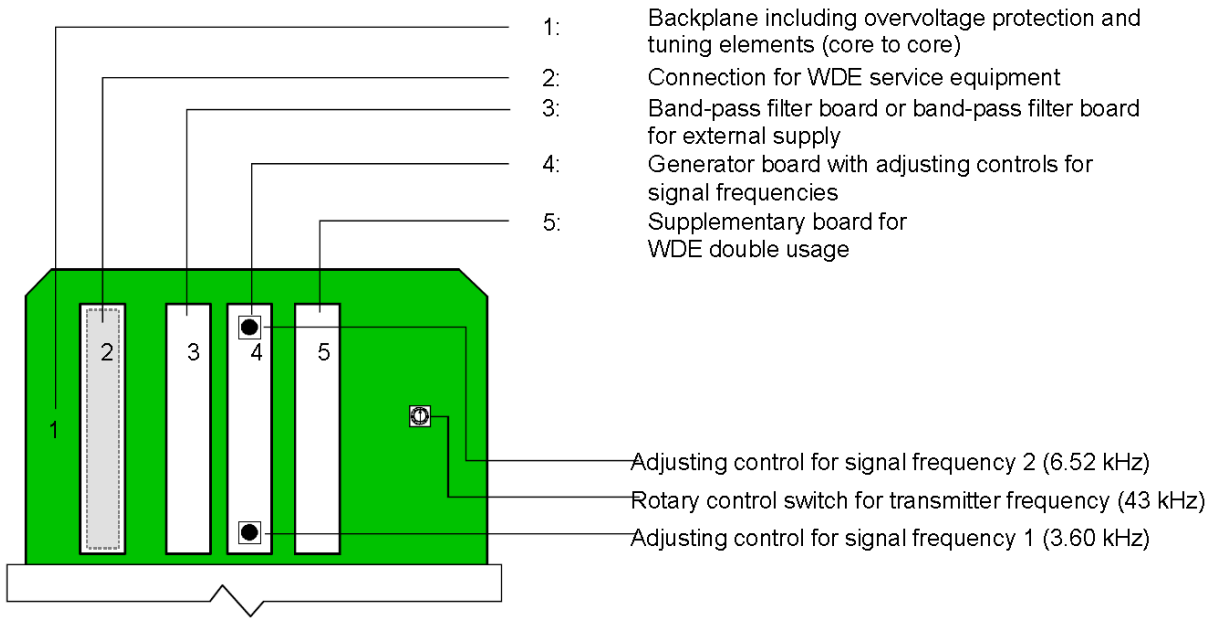
PARAMETERS OF MSDAC (ALCATEL)
Reading with Tool Kit ETU001

Selector position in test unit	Description	Tolerance Range
1	Power Supply Channel 1	22…35V DC
2	Power Supply Channel 2	22…35V DC
3	**OFF**	
4	Rectified Rx 1 Voltage MESSAB1	+80…..+1000mV
	Dummy wheel set on 40 mm	-80…..-1000mV
5	Reference Voltage PEGUE1	Adjust
6	**OFF**	
7	Rectified Rx 1 Voltage MESSAB1	+80…..+1000mV
	Dummy wheel set on 40 mm	-80…..-1000mV
8	Reference Voltage PEGUE1	Adjust
Terminal 3&13	Power Supply Voltage	54V…..72V
Terminal Sk1/S1 & Sk2/S2	Transmitter Freq.Sk1	30……31.25KHz
	Transmitter Volt.Sk1	40…….85V AC
Terminal Sk1/S1 & Sk2/S2	Transmitter Freq.Sk2	27.4….28.6KHz
	Transmitter Volt.Sk2	40…….85V AC
Analog Board Indications	H1-1 Red / H1-2 Green	Observe
	H2-1 Red / H2-2 Green	Observe
	H3-1 Red / H3-2 Green	Observe
Indication Digital Board	H1-1 Green / H2-1 Green	Observe
	H1-2 Green / H2-2 Green	Observe

ANNEXURE- 7
MSDAC (SIEMENS)

Electrical Set points of the ZP 43 V Wheel Detection Equipment

Display	Measured quantity	Setpoint	Tolerance range
U60=	WDE voltage	60 V DC	30 V to 72 V
U24=	Operating voltage	24 V DC	21.3 V to 22.4 V
FS	Transmitter frequency of the double wheel detector	43 kHz	42.8 kHz to 43.2 kHz
F 1	Signal frequency 1	3.60 kHz	3.55 kHz to 3.65 kHz
F 2	Signal frequency 2	6.52 kHz	6.42 kHz to 6.62 kHz
Ur1=	Rectified voltage 1	5.5 V DC	5.3 V to 6.0 V
Ur2=	Rectified voltage 2	5.5 V DC	5.2 V to 5.9 V
uE 1	Receiver voltage 1	AC	60 mV to 150 mV Observe note in Section 9.4.3.8
uE 2	Receiver voltage 2	AC	60 mV to 150 mV Observe note in Section 9.4.3.8
UL	WDE output voltage with direct supply with external supply	 ≥ 1.0 V AC ≥ 1.0 V AC	 0.48 V to 1.80 V 0.70 V to 2.70 V



ZP 43 V board arrangement

Fig. 7A-1

ANNEXURE – 8
SUPERVISORY RESET

Concept of Supervisory Track Sections & Auto Resetting

Supervisory track sections (STS's) have been made using the detection points of track sections for automatically resetting the track sections. If any track section fails and its corresponding supervisory track section is clear, it will automatically reset the failed track section.

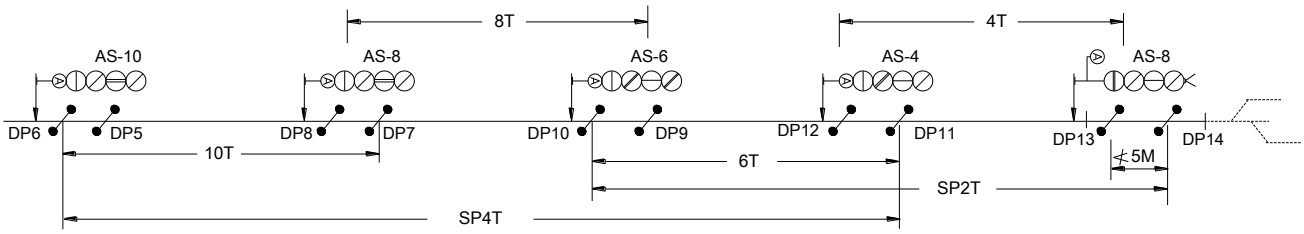


Fig. 8A.1 arrangement of Supervisory Track Sections

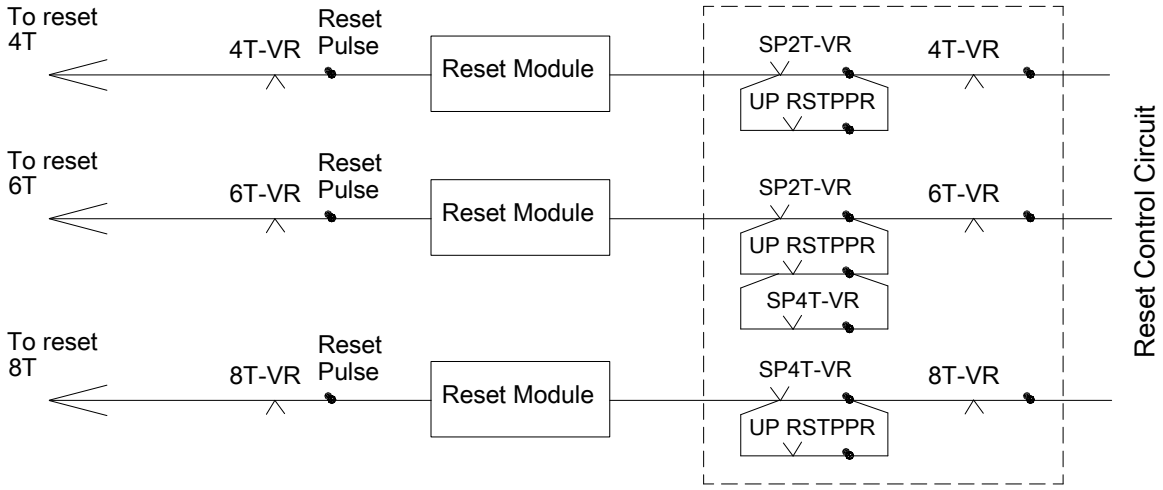


Fig. 8A- 2: Typical circuit for auto resetting through Supervisory Track Sections

ANNEXURE- 9: AUTOMATIC SIGNALLING WITH MULTI SECTION DIGITAL AXLE COUNTERS

9.1 INTRODUCTION

Automatic Signalling with track circuits suffer from some disadvantages. They have several relay huts in mid-section distributed over the entire block section. With Multi Section Digital Axle Counters, enables centralization of vital electronic equipments; their placement in better maintained, easily approachable location, reduction in number of relay huts in mid section.

Supervisory track Sections (STS's) can be made, using the detection points of normal track sections. These STS's will cover 2 or 3 track sections & in case any track section has failed & its STS is clear, the failed section can be given a resetting command automatically without resorting to manual resetting & waiting for the entire block section to be free of trains.

9.2 Typical arrangement of MSDAC with STS

(a) Type of section	= Double line
(b) Station to station distance	= 10 kms. (Max.)
(c) Inter signal distance	= 1.0 to 1.4 kms.
(d) No. of auto sections	= 6 (Up) + 6 (Dn)
(e) No. of detection points	= 14 (Up) + 14 (Dn)
(f) No. of track sections	= 6 (Up) + 6 (Dn)
(g) No. of Supervisory track sections	= 3 (Up) + 3 (Dn)
(h) No. of signals (incl. Home & Adv. St. signals)	= 7 (Up) + 7 (Dn)
(i) No. of Relay Huts (RHs)/ Gate Lodge	= 1
(j) Evaluators of MSDAC located at	= Stations
(k) The distance of advance starter & home Signals from respective stations assumed as	= 1 km.

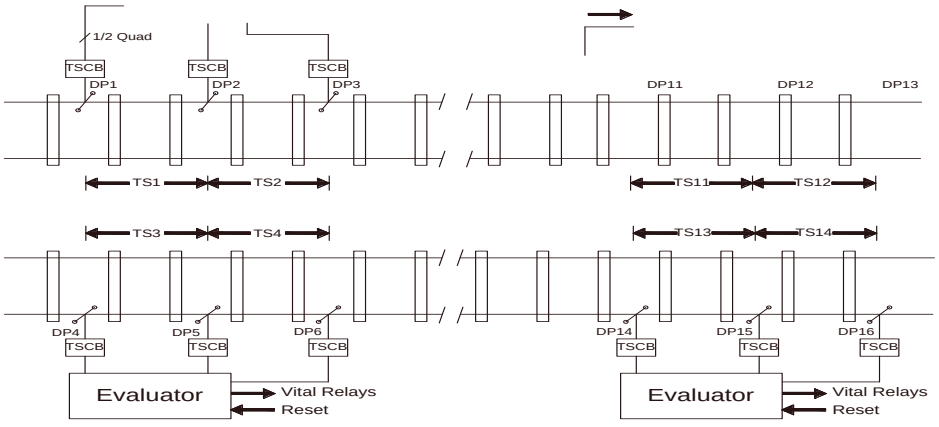


Fig. 9A-1: Typical arrangement of an MSDAC.

9.3 Reduced number of Track Sections

There is only one track section for each signal, which includes berthing as well as overlap portion. Thereby, improving the reliability & also the system capacity comparatively due to correct sized overlap

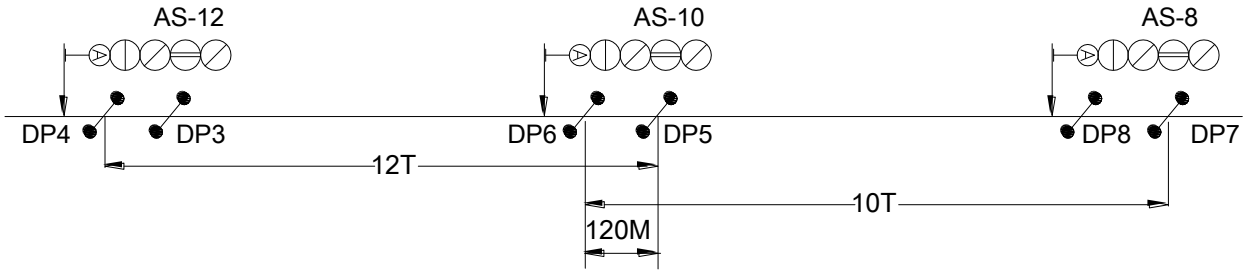


Fig. 9A-2: Typical arrangement of Detection Point

9.4 Centralization for easy maintenance & quick restoration

It is possible to have its evaluator at a central place & its DPs in the field up to a sufficiently long distance. Up to certain distance, power & communication both are carried on same ½ quad between Evaluator & DP up to a certain distance say10 kms, it is possible to connect all DPs to the stations with some DPs working with special arrangement & local power supply.

9.5 Feeding of maximum Signals from stations

Maximum number of signals can be fed from Stations and least number of signals should be fed from Relay Hut.

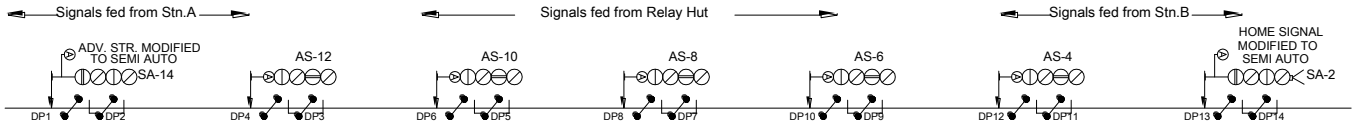
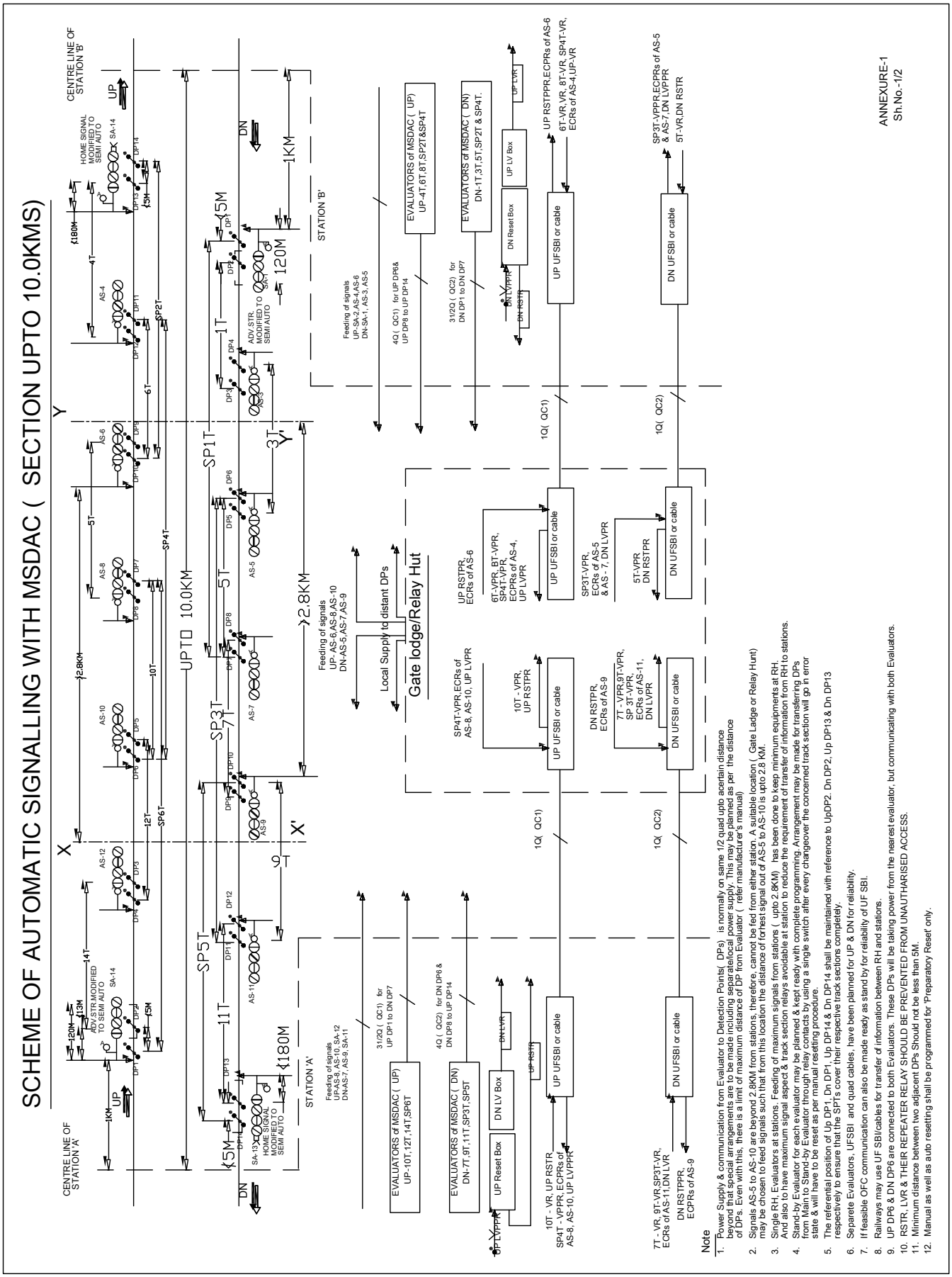
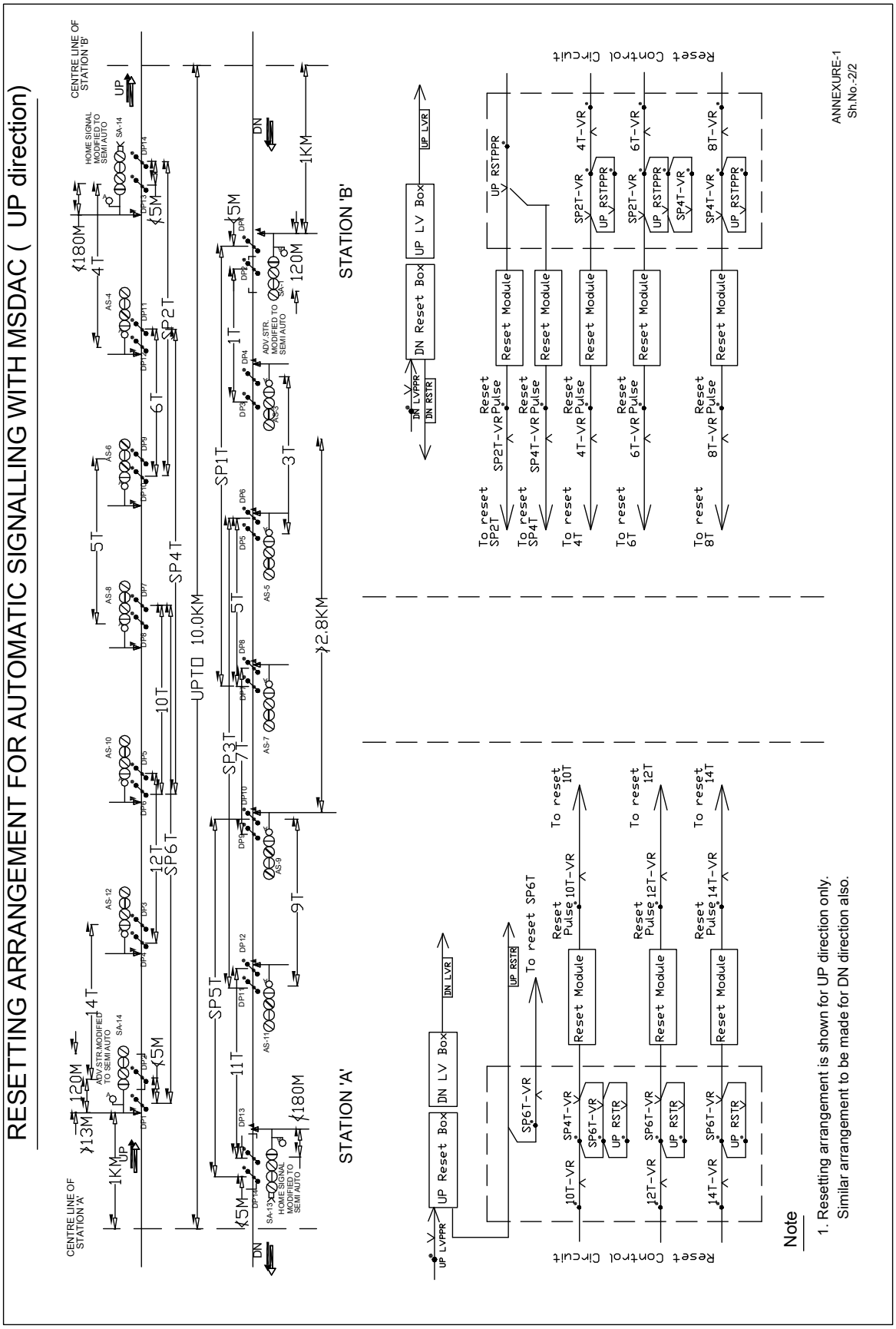


Fig 3: Feeding locations of Signal



Note

1. Power Supply & communication from Evaluator to Detection Points(DPs) is normally on same 1/2 quad upto acertain distance beyond that special arrangements are to be made including separate/local power supply. This may be planned as per the distance of DPs. Even with this, there is a limit of maximum distance of DP from Evaluator (refer manufacturer's manual)
2. Signals AS-5 to AS-10 are beyond 2.8KM from stations, therefore, cannot be fed from either station. A suitable location (Gate Ladge or Relay Hunt) may be chosen to feed signals such that from this location the distance of farhest signal out of AS-5 to AS-10 is upto 2.8 KM.
3. Single RH Evaluators at stations. Feeding of maximum signals from stations (upto 2.8KM) has been done to keep minimum equipments at RH. And also to have maximum signal aspect & track section relays avoidable at station to reduce the requirement of transfer of information from RH to stations.
4. Stand-by Evaluator for each evaluator may be planned & kept ready with complete programming. Arrangement may be made for transferring DPs from Main to Stand-by Evaluator through relay contacts by using a single switch after every changeover the concerned track section will go in error state & will have to be reset as per manual resetting procedure.
5. The referential position of Up DP1, Dn DP1, Up DP14 & Dn DP14 shall be maintained with reference to UpDP2. Dn DP2, Up DP13 & Dn DP13 respectively to ensure that the SPTs cover their respective track sections completely.
6. Separete Evaluators, UFSBI and quad cables, have been planned for UP & DN for reliability.
7. If feasible OFC communication can also be made ready as stand by for reliability of UF SBI.
8. Railways may use UF SBI/cables for transfer of information between RH and stations.
9. UP DP6 & DN DP6 are connected to both Evaluators. These DPs will be taking power from the nearest evaluator, but communicating with both Evaluators.
10. RSTR, LVR & THEIR REPEATER RELAY SHOULD BE PREVENTED FROM UNAUTHARISED ACCESS.
11. Minimum distance between two adjacent DPs Should not be less than 5M.
12. Manual as well as auto resetting shall be programmed for 'Preparatory Reset' only.



Note

1. Resetting arrangement is shown for UP direction only.
   Similar arrangement to be made for DN direction also.

ANNEXURE – 10

RRI WITH MSDAC

Route Relay Interlocking are sanctioned on the Indian Railways at major junction stations, terminals and other big stations. It has been our that the gestation periods of RRIs are long. One of the main reasons is the constraint of track circuiting. Several cabin portions, Sidings, goods yards, etc., forming part of such RRIs and the no. of turn outs and track portions to be track circuited are very large.

The space requirement for digital axle counters is considerably less. OMC housing of normal analog axle counter can accommodate up to 26 DPs. Cable requirement for multi-section digital axle counters is also reduced due to availability of power data coupler (PDC) facilitating transmission of data and power to the detection joints on the same pair of quad cable.

Ordinary 24 V. line relay in case of Alcatel and 60 V. line relay (K-50) in case of Siemens are used as a TPR. The axle counter has inherent characteristic of slow to pick up and therefore, the use of QSPA-1 relay as the first track repeater in RE area not needed.

The power consumption is also greatly reduced as typically, each detection point takes 7-8 watts of power.

Track detection system in several yards where panel interlocking was to be commissioned have been provided with the use of single / double section axle counters of Alcatel make, which is ideally suitable where number of DPs / track circuits is less, say up to 10 DPs / 6 track circuits, in which range of configuration system is viable.

REVIEW QUESTIONS
CHAPTER-1

Subjective questions

1. Why resetting is required for axle counters? What are the different reset procedures available for axle counters and where they are used?
2. What are the applications of axle counters?
3. Briefly explain the classification of axle counters.

Objective questions

1. Preparatory reset can be used in case of the _____sections provided with axle counters. (D)

   A) Main line B) Section between Advance starter and IBS
   C) BPAC D) all of these.

CHAPTER-2

Subjective questions

1. Briefly explain the universal axle counter system with the help of functional diagram.
2. What are the precautions to be take while installing the track device
3. What are the parameters required to be known to attend the failure of Universal axle counter system?
4. What are cards available in the Evaluator unit of Universal axle counter system and how do you adjust the evaluator card 1 & 2 to get the proper out put voltage?

Objective questions

1. Two sets of Tx / Rx coils are required at one detection point to establish the direction of traffic. (T)
2. Transmitter coils are always connected inside the rail. (F)
3. Preparatory reset prepares to reset the axle counter and ensures that the SM/ASM pilot the train. (T)
4. In preparatory reset, after resetting, axle counter continues to show occupied until one train movement in the section carries out correct balancing of track section. (T)
5. In UAC, both the Transmitter coils are connected in Series. (T)
6. In analog axle counter, the receiver output signal due to passage of train is an amplitude modulated signal. (T)
7. In axle counter for each axle passing over detection point causes a ‘dip’ in the receiver signal. (T)
8. In UAC, input voltage to EJB and EV is ---------- (C)

   A) 12V & 24V DC respectively B) 110 V AC C) 24V DC D) 12V DC

9. In UAC, DC-DC converter output voltages are ____, _____ & _____ (C)

   A) +5 V, +12V, +12V(ISO) B) +5 V, -12V, +12V(ISO)

   C) +5 V, +10V, +10V (ISO) D) +5 V, -10V, +10V(ISO)

10. Preparatory reset can be used in case of the _____sections provided with axle counters. (D)

   A) Main line B) Section between Advance starter and IBS

   C) Block Instrument and BPAC D) all of these.

11. In universal or multi entry axle counter evaluator consists of 8No.s of cards including Power Supply card. (F)

12. Main purpose of trolley suppression track circuit is to prevent the conversion of pulses from the dip caused by trolley wheel. (T)

13. In Universal Axle counter, the transmitter signal frequency is 5 KHz. (T)

14. In Universal Axle counter, with one evaluator unit maximum 8 detection points can be connected. (F)

15. In Universal axle counters, we have an option to select either Preparatory Reset or Conditional Hard Reset in Logic Card used for A, B, C, D channels. (T)

16. Trolley suppression track circuit is provided in card no. 3 for ABCD channels. (T)

17. Channel voltage after attenuator pads of card no 1 &2 is 105mv AC. (T)

18. SUPR & EVR are controlled through card no.9. (T)

19. Transmitter & Receiver cables should be put in HDPE pipe for safety and laid at a depth of >1 meter from bottom of rail. (T)

20. Axle counter Transmitter cables and receiver cables of individual track devices can be laid in same pipe. (F)

CHAPTER-3

Subjective questions

1. Explain the CEL SSDAC system with the help of the functional diagram.

Objective questions

1. In CEL single section digital axle counters, event logger card is optional with each set of axle counters used for monitoring the one track section. (F)

2. Phase reversal modulation technique is used in digital axle counters to avoid the trolley suppression track circuit. (T)

3. In SSDAC of CEL make, SCC-1 generates the frequency of 21KHz carrier signals, which is transmitted to 1^{ST} set of Tx coils. (T)

4. In SSDAC of CEL make, SCC-2 generates the frequency of 21KHz carrier signals, which is transmitted to 2^{nd} set of Tx coils. (F)

5. In SSDAC of CEL make, when the train wheel passes over the axle detectors, the Rx signal gets phase modulated. (T)

6. In SSDAC of CEL make, the SCC conditions the modulated signal and demodulates it to generate valid train pulses. (T)

7. SSDAC used with block working, type of reset used is _____ (C)

   A) Direct Hard Reset B) Conditional Hard Reset

   C) Preparatory Reset D) Any one these can be used

8. In SSDAC of CEL make, card no 5 is _____ (B)

   A) Modem Card. B) Event Logger Card.

   C) Micro controller Logic Board D) Relay Driver Card.

9. In SSDAC of CEL make, card no 6 is _____ (A)

   A) Modem Card. B) Event Logger Card.

   C) Micro controller Logic Board D) Relay Driver Card.

10. In SSDAC of CEL make, card no 7 is _____ (D)

    A) Modem Card. B) Event Logger Card.

    C) Micro controller Logic Board D) Relay Driver Card.

11. In SSDAC of CEL make, card no 8 is _____ (C)

    A) Modem Card. B) Event Logger Card.

    C) DC-DC Converter Card D) Relay Driver Card.

12. In SSDAC of CEL make, card no 1&2 are _____ (B)

    A) Modem Card. B) Signal Conditioning Cards.

    C) Micro controller Logic Boards D) Relay Driver Card.

CHAPTER- 4

Subjective questions

1. Explain briefly about ALCATEL SSDAC system

Objective questions

1. Amplitude modulation technique is used in digital axle counters to avoid the trolley suppression track circuit. (F)
2. SSDAC- ELDYNE (AzLS) is containing 2 out of 2 micro-controllers to count the axles, establish the track occupancy of a track section. (T)
3. The AzLS, consisting double rail contact Sk30H and an electronic unit. (T)
4. In AzLS, Analog card of Electronic Unit generates Tx signal, Amplifies Rx signal, does phase sensitive rectification and also generates wheel pulse of MESSAB and RADIMP. (T)
5. In AzLS, Digital card of Electronic Unit Counts wheel pulse, Determines RCD, Supervises Rail Contact, Codes telegrams. (T)
6. AzLS can be configured as a single section axle counter with one Rail Contact (RC) and Electronic Control Unit (EAK) combination at both ends of the section and with a two-wire fault tolerant link (FTL) between the two. (T)
7. In AzLS, additional Digital PCB or evaluator card is not required to be used at the common detection point (EAK). (F)

8. AzLS could be configured in a double section application including point zone application. (T)
9. Baud rate in SSDAC of ELDYNE (AzLS) is ---------- (C)

   A) 56KBPS B) 3000BPS C) 300 BPS D) 9600BPS

10. In AzLS, EAK consists of _____ (D)

    A) Backplane B) Evaluator board C) Analog board D) all of these

CHAPTER-5

Subjective questions

1. Explain briefly about GG TRONICS SSDAC system

Objective questions state true or false

1. The Axle detectors are to be fixed on web of the rail (T)
2. Phase detector card no. 1 (pd1):It generates 23 KHz signal for transmitter coil of channel 1 (F)
3. Communication between two SSDAC systems is through FSK communication at 1200 bps V.23 standard along with CRC check. (T)
4. DC-DC Convertor generates the multiple power supplies for system working from 24 V DC input. (T)
5. RDSO/SPN/177/2005 (Ver.2) with Amendment-1 is the RDSO specification of GG Tronics SSDAC (T)

CHAPTER-6

Subjective questions

1. Briefly explain the ALCATEL MSDAC with the help of functional diagram.

Objective questions

1. Axle detectors do not detect push trolley with 4 / 6 / 8 spokes. (T)
2. Multi-section Digital Axle Counter system consists of _____

   a) Detection Point (d)

   b) Central Evaluator Unit and Reset Unit

   c) Relay Unit and Event logger and diagnostic terminal

   d) All of these

3. In MSDAC, Central Evaluator unit drives _____ Vital Relay in order to give Free and occupied indication of an axle counter track section.

   a) 24VDC, 1000 ohms Plug-in type (a)

   b) 12VDC, 1000 ohms Shelf type

   c) 110VAC, 1000 ohms Plug-in type

   d) None of these.

CHAPTER-7

Subjective questions

1. Briefly explain the Siemens MSDAC with the help of functional diagram.

Objective questions

1. Axle detectors do not detect push trolley with perforated wheel (F)
2. Multi-section Digital Axle Counter Az S 350 U system consists of _____ (d)
   a) DEK b) Central Evaluator Unit and Reset Unit
   b) TCB c) All of these
3. In MSDAC, Az S 350 U system Central Evaluator unit switch setting is provided in card _____.
   a) BLEA12 (a)
   b) VESBA
   c) POWER SUPPLY CARD
   d) None of these.

CHAPTER-8

1. Briefly explain the CEL MSDAC.
2. In CEL MSDAC, Each field unit is connected to Central Evaluator on half Quad cable in Star Configuration. (T)
3. In CEL MSDAC, each Digital Axle counter field unit _____
   (a) Is configured as one Detection point. (d)
   (b) Detects wheels and store counts based on 2 out of 2 logic.
   (c) Transmits count and health information to Central Evaluator.
   (d) All of these