



**SPECIFICATION FOR  
SOLID STATE BLOCK PROVING BY AXLE COUNTER (DIGITAL)  
(Tentative)**

**Version 1**  
Number of Pages 25

**SPECIFICATION NO. RDSO/SPN/175/2005**

**SIGNAL DIRECTORATE  
RESEARCH DESIGN & STANDARDS ORGANISATION  
LUCKNOW-226011**

<b>DOCUMENT DATA SHEET</b>			
Designation <b>RDSO/SPN/175/2005</b>			Version 1
Title of Document  <b>SOLID STATE BLOCK PROVING BY AXLE COUNTER (DIGITAL) (Tentative)</b>			
Authors:  <b>Sudip Mukhopadhyay Designation: Director/Signal/RDSO</b>			
Approved by  <b>Name: Shri G.D. Bhatia Designation: Sr. Executive Director/Signal, RDSO</b>			
Abstract:  This document defines specification for SOLID STATE BLOCK PROVING BY AXLE COUNTER (DIGITAL)			

**DOCUMENT CONTROL SHEET**

<b>NAME</b>	<b>ORGANISATION</b>	<b>FUNCTION</b>	<b>LEVEL</b>
Sudip Mukhopadhyay	RDSO	Member	Prepare
G.D. Bhatia	RDSO	-	Approve

**AMENDMENTS**

<b>Version</b>	<b>Chapter/Annexure</b>	<b>Amendment</b>	<b>Effective date</b>
0	--	First issue	
1			15.01.05



**SPECIFICATION FOR  
SOLID STATE BLOCK PROVING BY AXLE COUNTER (DIGITAL)  
(Tentative)**

**SIGNAL DIRECTORATE  
RESEARCH DESIGN & STANDARDS ORGANISATION  
LUCKNOW-226011**

<b><i>Table of Content</i></b>
--------------------------------

	Page No.
1.0 Foreword.	7
2.0 Scope.	7
3.0 Reference Specifications.	7-8
4.0 System configurations and brief description.	9-18
5.0 Operational requirements.	18-19
6.0 General Requirements.	19-20
7.0 Fail safety requirements.	20
8.0 Software developments and validation.	20
9.0 Performance Requirement.	20
10.0 Safety & Reliability Requirements	20
11.0 Type Test.	20-21
12.0 Maintenance type approval.	21
13.0 Acceptance test.	22
14.0 Routine Test.	22
15.0 Test Procedure.	22-23
16.0 Plant and Machinery.	24
17.0 Marking, Identification & Packing	25
18.0 Warranty	25
19.0 Quality assurance.	25
20.0 Documentation	25
21.0 Information to be supplied by Railways.	25

**1.0 FOREWORD:**

- 1.1 This specification is issued under the fixed Serial No. RDSO/SPN/ 175 / 2005 followed by the year of adoption as standard or in case of revision the year of latest revision.
- 1.2 The specification has been made to aid the development and validation of SSBPAC (D) i.e Solid State Block Proving by Axle Counter (DIGITAL) system for railway signaling. This should follow the provisions of General Rules of 1976 and Indian Railway (Open Lines) General (amendment) rules 2002
- 1.3 The specification may undergo minor changes during the development of the product. If during the process of development it is considered that changes are required in the specification, it shall be carried out by RDSO /Lucknow.
- 1.4 The specification will be frozen only after the laboratory and field tests are completed. .
- 1.5 This specification is intended to cover the technical provisions and it does not include all the necessary provisions of a contract.

**2.0 SCOPE**

- 2.1 This specification covers the operational, technical, safety, performance and documentation requirements of SSBPAC (D) for single / double line section to be used on Indian Railways for block working.
- 2.2 System shall house necessary relays for field interface.

**3.0 REFERENCE SPECIFICATIONS**

- 3.1 This specification requires reference to the following Standards and specifications.

IRS: S23	Indian Railway Standard specification for electrical and electronic based signaling and interlocking equipment.
RDSO/SPN/188	Block Panel Wth UFSBI/MUX-Combiner.
RDSO/SPN/144	Safety and reliability of electronic signaling equipment.
RDSO/SPN/177	Specification of Single section Digital Axle Counter.
RDSO/SPN 147	Specification of universal Fail Safe Block Interface.
RDSO SPN 165/2004	Specification of SMPS based Integrated Power Supply System (IPS) for S&T Installation of Indian Railways.
IRS: S-76	Specification of Cable Signaling Indoor for Signaling Installations.
IRS S-86 / 2000	Specification for Battery Charger for Signalling Installations.
IRS S- 21/2001	Specification of EKT.

BRS: 930A & 931A	Relays 'Q' Series Neutral Line.
IS: 7088	Recommended practice for anodizing aluminum and its alloys.
TC 30/97	Specification for Jelly filled Quad cable.
IS: 513	Cold rolled low carbon steel sheets and strips – Specification.
IS: 7569	Specification for cast acrylic sheets for use in luminaries.
IS: 2629	Recommended practice for hot-dip galvanising of iron and steel.
IS: 694	Specification for PVC insulated cable.
IS: 1573	Specification for electroplated coatings of zinc on iron and steel.
IS: 2147-1962	Degree of protection provided by enclosures for low-voltage switchgear and control gear.
IS: 5-1994	Colours for ready mixed paints and enamels.
IS: 814	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel – Specification.
IEC 947-7-1	International standard on terminal blocks for copper conductors.
IS :9000	Basic environmental testing procedures for electronic and electrical items.
ISO 9001	Quality systems – model for quality assurance in design, development, production, installation and serving.
IEC529 / EN 60529	Specification for degree of protection provided by enclosures (IP code).
PrEN50126	Railway applications - specification and demonstration of - reliability, availability, maintainability and safety.
PrEN50128	Railway applications – Signaling and Communications – Software for Railway Control and Protection system.
PrEN50129	Railway application: Safety related electronic systems for signaling.
EN 50159-1 & 2	Railway Application: Signaling and Communication Safety related communication in closed and open Transmission system.

- 3.2 Whenever in this specification, any of the above mentioned specification is referred by number only, without mentioning the year of issue, the latest issue of that specification is implied, otherwise the particular issue referred to is meant.



#### **4.0 SYSTEM CONFIGURATION AND BRIEF DESCRIPTION**

- 4.1 Solid State Block Proving by Axle Counter (Digital) is a microprocessor based system used for exchanging signaling information between two stations forming a block section. It controls signaling of block section through a block panel. Objective of the system is to provide interlocking functions of block signaling according to approved method of working, ensuring high degree of safety, availability & reliability.
- 4.2 The train shall be worked on the absolute block system. Block section (s) shall be provided with a digital axle counter(s) to verify the occupation or clearance of block section. System shall implement block working on following principals.
- 4.2.1. It shall not be possible to take the last stop signal to OFF unless LINE CLEAR has been obtained from station at the other end.
- 4.2.2. It shall not be possible to obtain LINE CLEAR unless block section & an adequate distance beyond first stop signal of station at other end is clear of trains, Last stop Signal & its control at ON/NORMAL & on single line no line clear has been taken by the station at other end to send a train towards the station taking line clear. Shunting Key shall be IN at both stations.
- 4.2.3. The Last Stop Signal shall assume 'ON' aspect automatically on entry of train into block section and when so replaced, shall be maintained in its 'ON' position, till a fresh LINE CLEAR is obtained on block panel.
- 4.2.4. Block section automatically shows TRAIN ON LINE on panel when train enters into block section on LINE CLEAR.
- 4.2.5. Train entry/exit buzzer to/ from block section are provided and to be acknowledged.
- 4.2.6. Block section shall automatically close on complete arrival of train at the receiving station after ensuring reception signal (s) & its controls at on / normal, as well as last stop signal & its control at on / normal at sending station and on single line SHUNTING KEY of EKT is IN at both the stations.
- 4.2.7. System shall have control with train receiving station to prevent sending station to take LINE CLEAR on its Block Panel without the consent of receiving station.
- 4.2.8. A control to cancel the line clear already taken by SM at other end (if already taken) such cancellation shall be with co-operation of other end SM.
- 4.2.9. It shall be possible to close the block section only if no train has entered the Block Section and at least 120 seconds have elapsed after application of cancellation as per Cl. 4.2.8 above.

4.2.10. On single line, a control to permit shunting in block section.

4.3 The system (SSBPAC (D)) will require the following sub system for its working as per scheme depicted in RDSO's Drg No. RDSO/S/32025 for double line & RDSO/S/32023 for single line:

- (i) Block Panel
- (ii) Single section Digital Axle Counter
- (iii) Block Telephone
- (iv) Quad Cable or Voice channel
- (v) Battery Set
- (vi) Battery Charger / IPS module
- (vii) Relay rack with relays
- (viii) Electronic interlocking and communication module ( SSBPAC (D) equipment)

4.3.1 BLOCK Panel: As per para 3.1 of RDSO / SPN 188

4.3.2 Single Section Digital Axle Counter: As per para 3.3 of RDSO / SPN 188

4.3.3 Block Telephone: As per para 3.4 of RDSO / SPN 188

4.3.4 Quad Cable Or Voice channel: Railways shall provide 3 pair copper conductors or 3 voice channels in OFC for single line block working and 4 pair copper conductor or 4 voice channels in OFC for double line block working from station to station. Cable shall be as per specification TC 30/97.

4.3.5 Battery Set: As per para 3.6 of RDSO / SPN 188

4.3.6 Charger / Module of IPS: As per para 3.7 of RDSO / SPN 188

4.3.7 Relay Rack & Signaling Relays:

4.3.7.1 All the relays used shall be of RDSO approved make. Relays used as repeater of external relays shall be of 1000 ohms. Relay Rack can be separate or it can be in the same cabinet of Electronic interlocking and communication module (SSBPAC (D) equipment)

#### 4.3.7.2 NOMENCLATURE OF RELAYS FOR SINGLE LINE

S. No.	RELAY	TYPE and NORMAL STATUS	DESCRIPTION
1)	TGTR	QL1, 11F.4B DROP	TRAIN GOING TO Relay. Operates to pick up on receipt of LINE CLEAR at train sending station. Normalises, when station at the other end sets to Line closed after train arrival or cancellation of LINE CLEAR.
2)	TCFR	QL1, 11F.4B DROP	TRAIN COMING FROM Relay. Operates to pick up on receipt of LINE CLEAR enquiry from train sending station.

			Normalises after complete train arrival or cancellation of LINE CLEAR.
3)	ASCR	QN1, 8F.8B DROP	Advance Starter Signal Control relay. Picks up, when LINE CLEAR is available and necessary controls are reversed by SM. Drops in any of the under-mentioned cases: a) Entry of train in Block Section b) Withdrawal of any SM control
4)	AZTR	QNA1, 8F.8B PICK UP	Block Section track Relay. Drops in the under mentioned case: (a) Entry of train in block section. (b) Failure of axle counter.
5)	HS ATPR	QNA1, 8F.8B PICK UP	First track for direction proving repeater relay. Picks up when HSAT track circuit is vacant else drop.
6)	HS BTPR	QNA1, 8F.8B PICK UP	Second track for direction proving repeater relay. Picks up when HSBT track circuit is vacant else drop.
7)	AS GNCR	QNA1, 8F.8B PICK UP	Advance Starter Signal Normal checking Relay. Picks up when Advance Starter Signal (LSS) and all its controls are at ON/Normal, else drops.
8)	HS GNCR	QNA1, 8F.8B PICK UP	Reception Signal Normal Checking Relay. Picks up when Reception signal/signals and all its controls are at ON/Normal, else drops.
9)	SHKR	QN1, 8F.8B PICK UP	Shunt Key indicating relay. Picks up when key of EKT is 'IN' & shunt Release key is OUT, else drop.

#### 4.3.7.3 NOMENCLATURE OF RELAYS FOR DOUBLE LINE

S. No.	RELAY	TYPE and NORMAL STATUS	DESCRIPTION
1)	TGTR	QL1, 11F.4B DROP	TRAIN GOING TO Relay. Operates to pick up on receipt of LINE CLEAR at train sending station. Normalises, when station in advance sets to Line closed after train arrival or cancellation of LINE CLEAR.
2)	TCFR	QL1, 11F.4B DROP	TRAIN COMING FROM Relay. Operates to pick up on receipt of LINE CLEAR enquiry from train sending station. Normalises after complete train arrival or cancellation of LINE CLEAR.

3)	ASCR	QN1, 8F.8B DROP	Advance starter signal control relay Picks up, when LINE CLEAR is available and necessary controls are reversed by SM. Drops in any of the under-mentioned cases: a) Entry of train in Block Section. b) Withdrawal of any SM control.
4)	(R ) AZTR	QNA1, 8F.8B PICK UP	Block Section track Relay of receive line. Drops in the under mentioned cases: (a) Entry of train in block section, or (b) Axle Counter failure.
5)	[D] AZTR	QNA1, 8F.8B PICK UP	Block Section track Relay of dispatch line. Drops in the under mentioned cases: (a) Entry of train in block section, or (b) Axle Counter failure
6)	HS ATPR	QNA1, 8F.8B PICK UP	First track for direction proving repeater relay. Picks up when HSAT track circuit is vacant else drop.
7)	HS BTPR	QNA1, 8F.8B PICK UP	Second track for direction proving repeater relay. Picks up when HS BT track circuit is vacant else drop.
8)	AS GNCR	QNA1, 8F.8B PICK UP	Advance Starter Signal Normal checking Relay. Picks up when Advance Starter Signal and all its controls are at Normal, else drops.
9)	HS GNCR	QNA1, 8F.8B PICK UP	Reception Signal Normal Checking Relay Picks up when Reception signal/signals and all its controls are at Normal, else drops.

4.3.7.4 **Wiring of Relay Rack:** As per Para 3.8.4 of RDSO / SPN 188

#### 4.3.8 **Electronic Interlocking & Communication Module (SSBAC (D) equipment)**

##### 4.3.8.1 **Architecture of SSBPAC (D)**

System shall follow two out of three hardware architecture with identical hardware and common software. The system shall comprise of the following modules :

- i) Power supply modules
- ii) Processor modules
- iii) Input modules
- iv) Output modules
- v) Communication Interface module

**4.3.8.1.1 Power Supply module:**

(a) Two power supply modules should be used in hot-stand by mode. Each power supply module should be able to take 150% of full load of the equipment. If one power supply module fails, the other should take over the load without hampering the working of the equipment. Separate power supply should be provided for block bell and block telephone.

(b) The power supply that will be provided by Rly is +24VDC, +30%, -20% with ripple content as per para 5.4.23 of IPS specification No. RDSO/SPN/165/2000 Amd. I or Para 5.4.2 of IRS: S 86/2000 (specification of Self Regulating Battery Charger), It shall have Short circuit protection and there shall not be any minimum load requirements for the working of power supply. It will have power failure signal and overload indication. Suitable measures for radio interference suppression shall be provided. With load variation from 0 to 100 %, output variation shall not exceed 50 mV and control will be exercised in less than 1 millisecond time. It should have polarity protection, over voltage protection (more than 36V), under voltage protection (less than 16 V) at input, efficiency should be more than 80 %.

**4.3.8.1.2 Processor Module**

a) Processor card should be based on high performance 16/32 bit microprocessors / micro controllers.

b) It shall have built-in internal and external Watchdog for monitoring program sequence. Trigger time shall be possible to be set in 5 milliseconds time.

c) Processor should have extensive serial I/O sub-units to support inter processor and intersystem communication requirements.

d) It shall have voltage monitor which will trigger power failure signal when power supply falls below 4.5 volts

e) It shall have on – line alarm display (alphanumeric) and remote alarm monitoring to ensure easy diagnostic of faults.

**4.3.8.1.3 Input module:**

(a) Input module shall be able to read relays / switches/ keys.

(b) Inputs shall be isolated using opto-isolators with an isolation voltage of 2000 volts minimum.

(c) All inputs shall be protected against surge and transient voltages.

(d) Input Cards shall be address independent.

- (e) Both make and break contacts of switch/relays/keys shall separately be sensed.
- (f) All power supplies on cards where digital ICs are used shall be locally de-coupled using a capacitor of good high frequency characteristics.
- (g) Input card shall be driven through software controlled I/O bus.
- (h) LED shall display condition of input on the front facia panel
- (i) Number of inputs per card –16
- (j) Input voltage        24 volts
- (k) For” 0 “signal –30 volts to +5 volts
- (l) For “1 “signal + 13 volts to + 30 volts
- (m) Input current 10 m A

#### 4.3.8.1.4        **Output module:**

- a) Output module shall be capable of driving Q series relays through AC coupled drivers with optical/galvanic isolation.
- b) Output card shall accept inputs from 3 processors, which shall be fed to hardware voter to derive the majority voted output. The validated outputs shall be buffered through AC coupled optically/galvanically isolated drivers.
- c) Health status of processors shall be continuously monitored. In case of error, output shall be withdrawn.
- d) Relay driver outputs shall be read back from at least two stages. Display output shall be read back from at least one stage.
- e) Output shall be driven through software controlled I/O bus
- f) Output card shall provide transient free short circuit protected 24V supply for driving external Q series relays.
- g) Output shall have overload and short circuit protection. Status bit of channel shall switch ON automatically after the end of over load.

#### 4.3.8.1.5        **Communication Driver & Common hardware Module**

- a) This module shall accommodate hardware common for all three processors.
- b) It shall provide driver interface for inter block communication as per CCITT standard at baud rate 1200 minimum.

- c) Inter processor communication speed shall be sufficiently high to meet cycle time requirements.
- d) It shall provide external (global) re-set hardware
- e) It shall monitor 2/3 logic processor activities

f) **Reset Switch**

A non-lock reset switch with a veeder counter shall be provided for the user to “start” the SSBPAC (D) processing after power ON. SSBPAC (D) shall remain in power ON self-test mode till the reset switch is pressed, after which the system shall enter into normal functional as per mode transition description given in software functions.

- g) Two connected SSBPAC (D) should work for a transmission loss of upto 20 dB at 1KHz.

#### 4.3.8.2 **TECHNICAL REQUIREMENTS**

4.3.8.2.1 No change in the hardware shall be required for making the system to work for single line / double line section. System shall be so constructed that there are minimum changes in single line/ double line sections for using.

4.3.8.2.2 Lightening & Surge protection to be provided as per RDSO/SPN/144.

4.3.8.2.3 For implementation of interlocking, appropriate track repeater relays, Signal normal checking relays shall be available in the SSBPAC (D). SSBPAC (D) shall drive TGTR relay at the train sending station and TCFR relay at train receiving station. On single line, a shunting key control relay (SHKR) is required. Contacts of these relays shall be available at the SSBPAC (D) terminals for controlling signals/interlocking. The interlocking logic should be same as that of RDSO drawing No. RDSO/S/32018 & 32020.

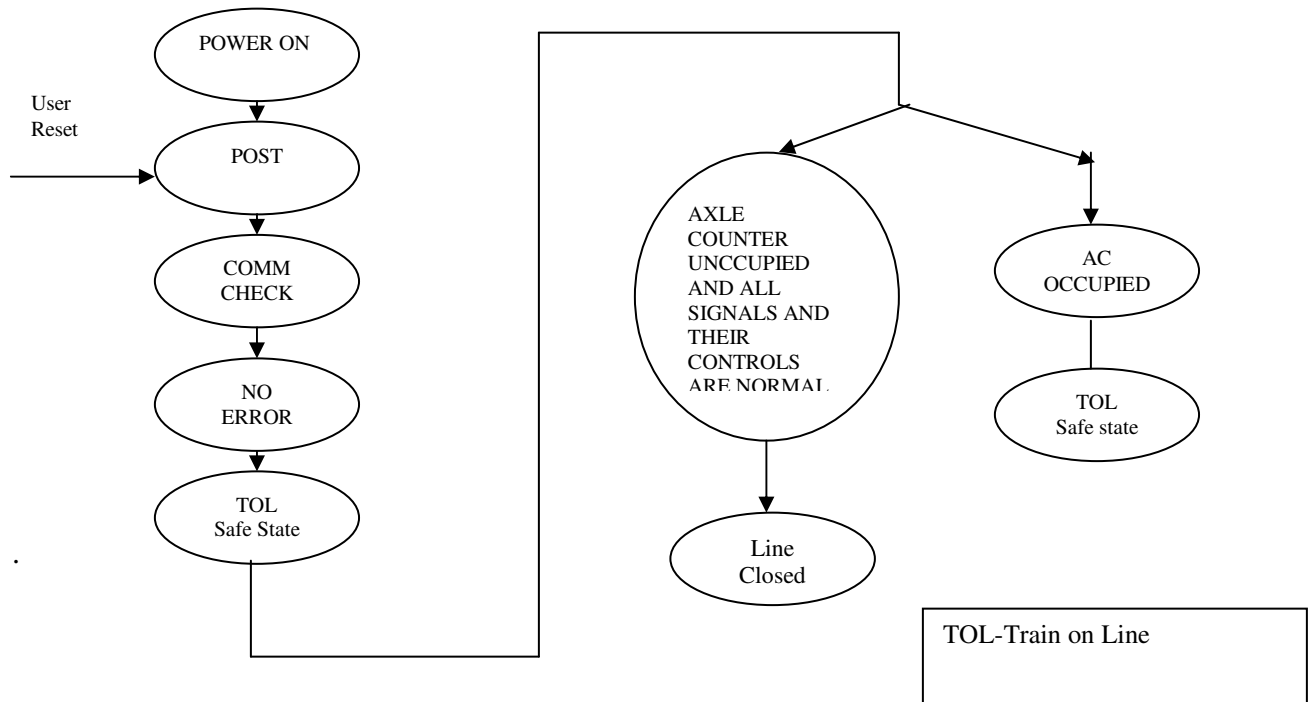
4.3.8.2.4 Provision should be there for repeating relay condition of at least two relays from one end to other end. These relays will have no requirements of operation of SSBPAC (D).

#### 4.3.8.3 **SOFTWARE FUNCTIONS**

4.3.8.3.1 The system shall be 2 out of 3 type wherein at least 2 systems must agree to release command. Voting shall take place for vital decisions.

4.3.8.3.2 Software shall implement block-working requirements listed in para 4.2, 4.3.7, 4.3.8.2 and operation requirements listed in para 5.

- 4.3.8.3.3 Status of relays /switches /keys shall be sensed by both front & back contacts so that valid data is either 01 or 10. Input 11 and 00 are invalid. The processor shall read, de-bounce & locally validate the status of contacts periodically.
- 4.3.8.3.4 Inter processor communications shall be used for the validation of data.
- 4.3.8.3.5 Various modes of the system shall be clearly defined.
- 4.3.8.3.5.1 System shall go through a set of diagnostic routines (POST) at power ON. It shall be ensured just after power ON that output relays are de-energized condition. Within POST the system shall perform sufficient tests to ensure the integrity of the system before starting the actual operation.
- 4.3.8.3.5.2 After successful execution of POST system shall wait for reset operation. After reset the system shall transit to safe state (train on line) waiting for inter block communication. After successful reception of at least three inter block communications system shall transit to normal state (Line Close) if no other failure condition exist and section is clear of vehicles and signals are at ON.





- 4.3.8.3.5.3 Reset shall not be effective during POST.
- 4.3.8.3.6 Integrity of the software stored in EPROM shall be protected by CRC. This shall be checked at least every one second interval.
- 4.3.8.3.7 All free areas in the EPROM shall be loaded by software trap codes (mine fields)
- 4.3.8.3.8 Software shall run self-diagnostic to check health of the processor. This shall be executed every one second
- 4.3.8.3.9 The SSBPAC (D) shall assign specific addresses to each Block System (by hard-wired logic) and ensure that the message/telegram sent is received by the Block System for which it is meant.
- 4.3.8.3.10 SSBPAC(D) in the section shall have a unique address, which shall be stored in the system. Address of the adjacent equipment shall be hard wired.
- 4.3.8.3.11 The information exchanged between the pair of the SSBPACD shall contain the source & destination address.
- 4.3.8.3.12 The data packet for inter processor communication shall be protected with CRC .
- 4.3.8.3.13 The coding of signal information shall take care noise generally encountered in the transmission system and to ensure safety in operation against those noise levels.
- 4.3.8.3.14 Message integrity between two connected SSBPAC (D) shall be ensured by adequate CRC to obtain hamming distance of 5 or better.
- 4.3.8.3.15 Wrongly addressed information packets shall be promptly rejected by the system and continuous receipt of such packets should raise an alarm and result in shutdown of the system.
- 4.3.8.3.16 Less restrictive message shall not be asserted to the application logic until it has been received in two consecutive messages.
- 4.3.8.3.17 A more restrictive input shall be asserted in application logic after one message has been received.
- 4.3.8.3.18 An output, which is more restrictive, shall be latched and transmitted until acknowledged by receiver. Latching shall be done as a result of stable system. Stable system means system has processed all application logics triggered as a result of changes in input or other application variable changes. OR system is logically stable.

4.3.8.3.19 Handling of communication failure: SSBPAC (D) shall exchange health status of system at regular interval not exceeding 10 seconds. On non-receipt of health status out put relays shall shut down. When system health becomes normal it shall take action as under:

- 1) Individual system health is normal & axle counter are showing unoccupied condition:- In this situation system shall assume normal working without intervention from Station Master.
- 2) If system is showing error it can be re-setted after taking the precautions that section is free of vehicles.

4.3.8.3.20 **Cycle time:** Cycle time of system shall not exceed 500 milliseconds.

4.3.8.3.21 Processor must cross check with each other on their health and actions. In the event of one processor disagreeing with the decision of other processor, the system shall raise an alarm to indicate the failure of one system.

4.3.8.3.22 In the event of a failure of any component/module/sub-system or bug in the software, the system shall revert all its vital output to the most restrictive mode of operation (i.e. Train On Line) and remove power from the physical output in a fail-safe manner.

## 5. OPERATIONAL REQUIREMENTS

### 5.1 Indications on Block Panel

- a) As per para 4.0 of Specification. RDSO/SPN/188
- b) The following indications shall be driven from relay contacts.
  - SNK indication (Cl 4.1.6 and 4.2.6 of Specification. RDSO/SPN/188)
  - LSS indication Red/Green (Cl. 4.1.8 & 4.2.8 of Specification. RDSO/SPN/188)
  - Line free / occupied

### 5.2 Description of Block Panel for Single Line:

As per para 7.0 of Specification. RDSO/SPN/188.

### 5.3 Description of Block Panel for Double Line

As per para 8.0 of Specification. RDSO/SPN/188.

### 5.4 Method of signaling train from Block station to Block station on Single Line

As per Para 9.0 of Specification. RDSO/SPN/188.

## 5.5 Method of signaling train from Block station to Block station on Double Line

As per Para 10 of Specification. RDSO/SPN/188.

## 5.6 Method of line clear cancellation both of Single & Double line.

### 5.6.1 As per para 11.0 of Specification RDSO/SPN/188.

### 5.6.2 If axle counter or overlap track circuit becomes occupied during the cancellation process, cancellation process shall be with drawn.

## 6. GENERAL REQUIREMENTS

6.1 The system shall be suitable for working in area having 25KV AC traction and where passenger/freight trains hauled by single-phase thyristor controlled or three phase induction motor controlled AC locomotives or chopper controlled EMU stock are operated (lowering / raising of pantograph of electrical locos should not affect the equipment).

6.2 The system shall be capable of working in non-air-conditioned environment in an ambient temperature range of -10°C to 70°C and RH upto 95% at 40°C.

6.3 The equipment shall be so constructed as to prevent unauthorized access to the system. The instrument shall be so constructed as to give easy access to various parts for repairs/maintenance. However, there shall be no opening on the exterior, which would permit irregular access through its interior, permitting irregular operation and /or interference to it working parts.

6.4 19” rack mountable and 4 U high cabinets made of aluminum of minimum thickness 2 mm should be used for housing the PCB cards. The cabinet should be powder coated as per specification of Block Panel (RDSO/SPN/188). The front & backsides of the cabinets shall have the facility for completely locking and sealing the equipment.

6.5 Overall height of cabinet and panel shall help SM in operating the Block Panel.

6.6 Insertion of PCB in wrong card slots should not be possible.

6.7 Shielding at card level shall be provided by metallic plate over the cards.

6.8 Conformal coating shall be provided on all cards to work in rough environments.

6.9 System shall be suitable natural air-cooling.

6.10 The ICs used in the equipment shall be of industrial grade capable of withstanding surface temperature of 85°C.

- 6.11 Event Logger-should have inbuilt event logger with date & time stamping for logging events up to 10,000 events minimum. The event logger should be protected from unauthorized intervention. There must be down loading & report generating facility using common computer in windows environments.
- 6.12 Events to be logged.
- 6.12.1 Change of state of the section.
- 6.12.2 Change of state of input & output relays.
- 6.12.3 Failure of cards.
- 6.12.4 All errors.
- 6.13 There should be provision for connection to data logger (as per IRS-S-99/2001). The protocol should be as per IRS-S-99/2001.

## **7 FAIL SAFETY REQUIREMENTS**

- 7.1 Unsafe condition shall not develop due to faults. Adequate safety margins must be incorporated in the design for all modes of failures.
- 7.2 No single failure shall result in an unsafe condition i.e. the system shall be brought to a safe state as soon as a failure occurs. The failure should be suitably indicated.
- 7.3 System shall meet SIL-4 requirements.

## **8 SOFTWARE DEVELOPMENTS AND VALIDATION**

System shall comply the requirements listed in CENELEC standards PrEN 50126, EN50128 & EN 50129 for SIL-4. System shall comply the requirements listed in CENELEC standards PrEN50159 specified in Part I, which is for safety related communication in closed transmission systems.

## **9 PERFORMANCE REQUIREMENT**

- 9.1 MTBF of complete system excluding DAC shall be better than 20000 hours.

## **10 SAFETY AND RELIABILITY REQUIREMENT**

As per RDSO/SPN/144.

## **11 TYPE TESTS**

- 11.1 The following shall comprise type tests:
- a) Visual inspection
  - b) Insulation resistance

- c) Test for continuous operation
- d) Applied high voltage test
- e) Card level checking
- f) System-level checking
- g) Module level checking
- h) Climatic tests and environmental test.
- i) 7 KV Discharge test.
- j) Hard ware fail safety test.

(For initial type approval only, if there is design change then in maintenance type approval also)

- k) SIL-4 documentation and Validation from approved validator.

- 11.2 One type of complete equipment shall be tested for this purpose. The equipment shall successfully pass the entire type test for proving conformity with this specification. If the equipment fails in any of the type tests, the purchaser or his nominee at his discretion, may call for another equipment of the same type and subject it to all tests or to the test(s) in which failures occurred. No failure shall be permitted in the repeat test (s).
- 11.3 To obtain a type approval certificate, the manufacturer or supplier shall submit to the testing authority two numbers of samples, for conducting all the tests mentioned. In case of maintenance type approval, the samples shall be selected at random from regular production lots so as to be as representative as possible of the type under consideration. If, however, specially manufactured samples are offered, validity period of the equipment may be reduced accordingly.
- 11.4 Tests may also be carried out on actual installation to make sure that the equipment shall correctly perform the required function.
- 11.5 Type approval shall be issued to a manufacturer if samples pass all the prescribed tests in accordance with this specification.
- 11.6 Type approval certificate once issued shall not be valid if a change in design, construction, material used or manufacturing process is made subsequently, unless this change has the approval of RDSO.

## 12. MAINTENANCE TYPE APPROVAL

- 12.1 At the end of validity period of 3 years or earlier if necessary, the Testing authority may call for fresh samples for type testing for the purpose of Maintenance Type Approval.

**13. ACCEPTANCE TEST**

- 13.1 Inspecting authority shall carry out acceptance tests on all the equipment/sub units at manufacturers premises.
- 13.2 The following shall comprise acceptance tests
- a) Visual inspection.
  - b) Insulation resistance.
  - c) Card level checking.
  - d) System level checking.
  - e) Module level checking.
- 13.3 A complete test report of all the tests conducted shall be submitted, giving the detailed observations made in every case and actual values recorded. Specific mention shall be made whenever the equipment has failed to comply with the requirements and indicating as to how far it has failed to comply.
- 13.4 Disposal of samples: Sample equipment, which has been subjected to type tests mentioned in clause 11, shall not form part of supply.

**14. ROUTINE TEST**

- 14.1 Following shall constitute routine tests and shall be conducted by manufacturer on every equipment/sub units and test results shall be submitted during the inspection.
- a) Visual inspection.
  - b) Insulation resistance.
  - c) Card level checking.
  - d) System level checking.
  - f) Module level checking.

**15. TEST PROCEDURE****15.1 Visual Inspection**

- 15.1.1 The equipment/sub units shall be examined for provisions of all facilities stipulated in this specification such as correct wiring, proper mounting and marking of components, marking, workmanship and finish for which no tests have been specified.

**15.2 Insulation Resistance Test**

- 15.2.1 To be carried out as per RDSO/SPN/144.

**15.3 Test for continuous operation**

15.3.1 The equipment shall be subjected to continuous run for 48 hrs with maximum input voltage specified. After this test the equipment shall satisfy the requirements of clause 15.2 and there shall not be any deterioration in the performance.

**15.4 Applied High voltage test**

15.4.1 To be carried out as per RDSO/SPN/144.

**15.5 Card level checking**

PCB laminates thickness

Quality of soldering

General track layout

Conformal coating and shielding

Legend printing

Green masking

**15.6 System level checking**

One system shall be completely assembled in factory and functional tests of the specification shall be performed.

**15.7 Module level checking**

Mechanical polarization

General shielding arrangement of individual cards

Indication and display

Mounting and clamping of connectors

Proper housing of cards

**15.8 Climatic Tests and Environmental Test.**

15.8.1 To be carried out as per RDSO/SPN/144.

15.9 7 KV Discharge Test.

15.9.1 To be carried out as per RDSO/SPN/144.

15.10 Hardware Fail-safety Test.

15.10.1 To be carried out as per CENELEC guidelines.

## 16 PLANTS AND MACHINERY

### 16.1 Essential machinery and plants required for production:

1. Hot & cold climate chambers for temperature cycling
2. Burn-in chamber
3. Computer aided design system with workstations
4. Microcomputer based development workstations for hardware & software.
5. Programmer & eraser as required for embedded software.
6. Flow solder line consisting of-
  - Magnifier for PCB examination
  - Automatic Integrated soldering machine
  - Temperature controlled manual soldering machine
  - Aqueous cleaner for automatic cleaning and degreasing (if out sourced to be indicated in QAP).
7. Component forming machine (if out sourced to be indicated in QAP).
8. PCB populating machine (if out sourced to be indicated in QAP).

### 16.2 ESSENTIAL TESTING EQUIPMENTS REQUIRED FOR QUALITY ASSURANCE:

1. Pentium IV or equivalent PC system with serial communication facility.
2. Storage dual beam oscilloscope of 20 MHz or above bandwidth.
3. True R.M.S digital millimeter – 4 digits display with facility of diode & transistor testing.
4. True R.M.S digital millimeter- 4 ½ digits suitable upto 50 KHz, high accuracy.
5. Function generator.
6. Frequency counter 10 MHz.
7. Variable DC power supply (+5V, +12V, 24V, 0-48V) (of suitable current capacity as required). (0- 130V for data logger).
8. Digital IC tester.
9. Million Mega ohm meter (500V).
10. D.C. high voltage tester (0-5KV).
11. Digital LCRQ meter.
12. Variac ( 0 to 260v, 1 KVA).
13. Computerized test set up with relevant software.
14. Specialised test stations for testing electronic sub-assemblies/PCBs.
15. Test jigs and fixtures.
16. Electro magnetic interference simulator.
17. Circuit measuring apparatus.
18. Rails of size 52Kg, 60Kg, 90lb each of at least 5 meter length for axle counter.
19. Test setup for measurement of communication between equipments.

### 16.3 Manufacturer shall also attempt to automate the testing of the system.



**17 MARKING, IDENTIFICATION AND PACKING.**

- 17.1 A nameplate shall be provided in a conspicuous position giving manufacturer's name, specification reference, serial number of the equipment, date of manufacture etc.
- 17.2 Packing should be as per RDSO/SPN/144.

**18. WARRANTY**

- 18.1 The warranty of the equipment shall be in accordance with IRS Specification No. S-23.

**19. QUALITY ASSURANCE**

- 19.1 The equipment shall be manufactured by using best quality material and workmanship as per quality assurance procedure laid down so as to meet the requirements of the specification.
- 19.2 Amongst other requirements of the specification, validation and system of monitoring of QA procedure shall form a part of type approval. The necessary plant, Machinery and Test instruments shall be available with the manufacturer.
- 19.3 Along with the prototype sample for type test, the manufacturer shall submit the Quality Assurance Manual, operation, maintenance & fault repairing manuals.

**20 DOCUMENTATION**

- 20.1 Manufacturer will provide following documentation with each set of equipment Installation and Maintenance manual.
- 20.2 Trouble shooting chart
- 20.3 Mechanical Drawings

**21. INFORMATION TO BE SUPPLIED BY RAILWAYS**

- 21.1 Whether SSBPAC (D) is required for Single line or double line section.
- 21.2 Whether communication medium between two stations will be 0.9 mm dia quad cable as per IRS: TC-30/97 or voice channel in OFC.

\*\*\*\*\*