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TECHNICAL SPECIFICATION
FOR
FUSE AUTO CHANGEOVER SYSTEM (FACS)
FOR USE
IN RAILWAY SIGNALLING

No. RDSO/SPN/209/2012 Ver. 2.0

SIGNAL DIRECTORATE
RESEARCH DESIGN & STANDARD ORGNIZATION
LUCKNOW-226011

SSE/Signal	ADE/Signal	Director/Signal
Prepared By:	Checked By:	Issued By:

DOCUMENT DATA SHEET			
Designation RDSO/SPN/209/2012			Version: 2.0
Title of Document **Technical Specification for Fuse Auto Changeover System for use in Railway Signalling**			
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Abstract This document specifies technical specification and inspection criteria for Fuse Auto Changeover System for use in Railway Signalling.			

DOCUMENT CONTROL SHEET

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REVISIONS/AMENDMENTS

Amendment	Modification done in clause	Reason for change	Effective date
Rev. 0, FIRST ISSUE	----	----	01.01.2013.
Revision 1.0	Pages 3,4	Inclusion of revision table & change of index	01.01.2014
	0.1	Fixed serial no. written instead of Rev. no.	
	0.2 (iii)	Full specs. no. written	
	1.4, , 1.7, 2, 4.1, 9.1(i),13, 1.4.1(new clause)	Due to adding provision for 110 V DC fuses after recommendations of 82nd SSC	
	2	Abbreviation added	
	4.2, 4.4	Recommendation of 82nd SSC	
Version 2.0	9.2.3, 13 (vi) new Cl.	Provision for required no. of common audio visual alarm units and clarity in the specification	01.08.2018

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Technical specifications of Fuse Auto Changeover System:

0. FOREWORD:

0.1 This specification is issued under the fixed serial number RDSO/SPN/209/2012

0.2 This specification requires reference of the following Indian Railway Standards/British Standards/International Standard Specifications:

i) RDSO/SPN/144/2006: Safety and Reliability of Electronic Signalling Equipments.
ii) IRS: S 23: Indian Railway Standard Specification for electrical and electronic based signalling and interlocking equipments.
iii) IEC60127-2: International Standard for miniature fuses.
iv) IS: 9000 Basic environmental testing procedures for electronic and electrical items.

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

0.4 This specification is intended to cover the technical provisions and it does not include all the necessary provisions of a contract.

1. SCOPE:

1.1 This specification lays down the requirements and tests of Fuse Auto Changeover System with Alarm facility along with audio and visual indications suitable for signaling installations of Railways.

1.2 The changeover facility covered in this specification should be suitable for changing over of circuit operation from main fuse to spare fuse automatically when main fuse is blown off without affecting the functioning of signaling circuits. At every change–over, audio/visual indication should appear.

1.3 Equipment shall work either on 24V DC, 60V DC or 110 V AC as specified by the purchaser. The equipment shall be able to work in tolerance range of +20%, -30%. The power supply used in the system shall be SMPS type.
Reverse polarity protection and overload protection voltage should also be provided in the power supply circuit.

1.4 The system shall be modular by design and each module of the system shall have capacity for monitoring either of the following-

TYPE-I: 32 nos. of external Non Deteriorating Type or 'G' type fuses from 0.6 Amp to 4 Amp capacities which are in signaling circuits. System shall have 8 cards with monitoring arrangement of 4 fuses in one card.

TYPE II: 24 no. of external Non Deteriorating Type or 'G' type fuses from 4 A to 10 Amp capacities generally used for point operation circuits. Such system shall have 6 cards with monitoring of 4 fuses in one card.

1.4.1 All fuses being monitored by one card will be of same supply having common ground. It should be possible to combine more than one such system for monitoring of more no. of such fuses in the entire installation.

1.5 The system shall be capable of monitoring fuses with system voltage of fuse circuit as 12V, 24V, 60V or 110V DC/AC.

1.6 Optocoupler shall be used to provide isolation in input circuit for every fuse.

1.7 The standby fuse used in the TYPE I system shall be of 5x20 mm ceramic tube type with high breaking capacity (1500 Amp) as per IEC 60127-2 standard. The standby fuse used in TYPE II system shall be of 6.35x 32 mm ceramic tube type with high breaking capacity (1500 Amp). Standby fuse should be of 250 V rating & same capacity as that of the main fuse and as specified by the purchaser. Standby/Spare fuses from internationally reputed manufacturers like Cooper Bussman, Protectron, Shurter etc. which have internationally approved accreditations and certification like UL, TUV etc. shall only be used.

1.8 Standby fuse shall come in circuit only after blowing of the main fuse and should be out of circuit when RESET switch is pressed after replacement of main fuse.

2. ABBREVIATIONS USED:

RDSO: Research Designs & Standards Organization.

CENELEC: European Committee for Electro technical Standardization

IEC: International Electrotechnical Commission

BS: British Standards

RE: Railway Electrification

MTBF: Mean Time Between Failure

CLS: Colour Light Signalling

LED: Light Emitting Diode

UV: Ultra Violet

OK: Okay

PCB: Printed Circuit Board

NO/NC: Normally Open/Normally Close

AC/DC: Alternating Current/Direct Current

ESM: Electrical Signal Maintainer

ND: Non Deteriorating

3 TERMINOLOGY:

3.1 The terminology used in this specification is covered by the definitions given in IRS: S 23.

4 GENERAL REQUIREMENTS:

4.1 Maximum outline dimensions of each module for TYPE I or TYPE II be such that it is easily fitted in a standard 19 inch rack. The module shall take not more than 4U spaces vertically in a standard 19 inch rack. The depth of the module shall be less than or equal to 165 mm. If the purchaser specifies that the system modules are to be fitted in standard signaling relay rack instead of standard 19 inch rack, then extender fixing plates (2 Nos. per modules) of stainless steel of 1.5mm thickness with suitable fixing holes shall also become part of the system.

4.2 The equipment shall be of robust construction. The housing shall be of cold rolled annealed mild steel sheet of thickness not less than 1 mm. All the modules should be fixed in housing in such a way that there should not be any space left for entry of rodents.

4.3 The equipment housing shall be treated with zinc chromate primer followed by electrostatic epoxy powder coating paint finish. Small metal parts such as nuts, bolts and washers shall be chrome plated. Other metal parts of the system shall also generally be corrosion proof. The layout of the components and wiring shall be such that all parts are easily accessible for inspection, repairs and replacement.

4.4 The cables and wires used shall be neatly secured in position by bunching & strapping. Only copper wires shall be used inside. The gauge of wires used should be adequate such that the current density should not exceed 3 Amps/mm^2. The wires used shall conform to IRS: S 76/89/ or IS:694 of grading 1100 volts. The colour scheme used for wiring shall conform to normal conventions and shall be shown in the Instruction manual.

4.5 AC input portion shall be protected to prevent accidental contacts.

4.6 The following components shall be provided on the Power Card Module of the system.

i. POWER ON Indication (LED based).
ii. Buzzer ACKNOWLEDGE push button.
iii. Fuse for protection of Power card module.
iv. TEST push button for checking health of all indications.
v. Buzzer

4.7 Following components shall be provided on each monitoring card of the system:

i. Standby Fuses.
ii. LED indications for Main and Standby Fuses monitored by the card.
iii. RESET push button (one for each monitoring card)

4.8 Tapping taken out for monitoring the status of fuse shall load the system to the minimum possible. In any case, the current drawn for the monitoring purpose shall not be more than 3 mA for each fuse.

4.9 The system shall be suitable for working on non-electrified, AC electrified and DC electrified areas 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.

5. COMPONENTS:

5.1 Printed Circuit Cards and Electronic Components:

5.1.1 The PCB shall be so designed that it should comply the requirements as laid down in Clause No. 6.0 of RDSO/SPN/144/2006 (latest).

5.1.2 The components used shall meet the requirement of Clause 5.1 of RDSO/SPN/144/2006. Compliance of clause 5.2 of RDSO/SPN/144/2006 shall also be ensured in the design of the equipment.

5.1.3 LEDs used for all indications shall either be of Nichia, Avago, Osram, Cree or Kwality (India) make. LEDs with 3 mm diameter shall be used for indication purpose in the system.

5.1.4 The printed circuit cards shall be specifically designed to suit the circuitry used and no extra wires other than secondary fuse connections shall be used for interconnection of components on the PC cards. Soldering of components shall be neatly done.

5.1.5 After mounting and soldering of all the components & testing, the printed circuit cards shall be coated with transparent epoxy paint or acrylic conformal coating to provide environmental protection.

5.1.6 All LED indications shall be mounted on PCBs and shall not be loose wired.

5.2 Switches & Terminals:

5.2.1 The switches and push buttons used shall be of high quality and performance. These shall be able to withstand >50000 operations. Switches shall be robust in structure and shall be able to withstand jerks. PCB mounted TACT switches/buttons may also be accepted.

5.2.2 All wiring from Relay racks to the system cabinet must be terminated on connectors soldered directly on the cards or motherboard PCB (if used) mounted inside rear of rack with descriptions.

5.2.3 All current carrying terminals shall be of copper or brass and shall be plated for protection against corrosion. Good quality connectors screwless type shall be used at the rear of the system to facilitate external wiring.

6. DESIGN CRITERIA:

6.1 The system design shall be such that it should be only supervisory / Alarm circuit. Failure of any component should not interrupt the supply to load by any means. For monitoring the fuses, wires shall be taken from respective fuses. In each set, a Green LED shall glow for healthy Main fuse & and a separate one for healthy Standby fuse. Similarly, separate Red LEDs shall indicate failure of Main fuse & Standby fuse.

6.2 On the failure of a main fuse, its standby fuse should come in circuit automatically before dropping of signaling relay. The changeover time shall not be more than 20 milliseconds at rated voltage of the system.

6.3 When the system starts for the first time, only main fuses should come in circuit and in no case the standby fuse shall come in circuit if the main fuse is intact.

6.4 The power supply module used inside the equipment should be provided with natural ventilation.

6.5 TEST push button should be able to test the health of all indications.

6.6 Six no. of potential free contacts shall be provided on rear side for initiation of remote Common Audio Visual Alarm or any other utility. These contacts should normally be in MAKE condition.

6.7 On the failure of any main fuse, suitable LED indication should glow and buzzer of the unit should give audio alarm. Simultaneously two no. of potential free contacts out of six should also break for initiation of Common Audio Visual Alarm. If any of the Standby fuses also blows along with its main fuse, the other pair of potential free contacts shall also break for taking out Audio Visual Alarm again. The remaining 2 no. of potential free contacts may be used for extending SMS for main and standby fuse blowing.

6.8 Pressing of the ‘Acknowledge’ button on the unit shall cut off the alarm but the LED indication shall remain till the fuse is replaced.

6.9 The LED should light up till the fault persists and audible alarm shall only be reset. The visual indication should disappear when the fuse is replaced and

RESET button is pressed. However, if another fuse is blown off after resetting / muting the buzzer, the audible buzzer should come again along with the visible indication. Standby fuse shall be mounted in a screw type fuse holder of panel mount type. The fuse holder shall be from reputed UL/UR/CSA/CE approved manufacturers. The body of the fuse holder shall be UL-94 V-0 Thermoplastic. The contacts shall be tinned copper with < 5mOhm contact resistance.

6.10 The audible alarm should be given by buzzer having **dual tone** intermittent sound with 3-5 KHz frequency.

6.11 Any relays if used in the circuit shall be of OEN/PLA/OMRON/GOODSKY make only.

6.12 The system should operate on N+2 wires where N is the no. of monitored fuses of same voltage in the system.

6.13 The system should be able to monitor fuses in different voltage circuits of 12V, 24V, 60V, 110V AC/DC in blocks of 4 fuses of each voltage.

6.14 COMMON AUDIO-VISUAL ALARM UNIT:

6.14.1 Common audio- visual alarm unit shall be hanged in ASM's room or any other convenient place and shall have following features:-

i) Power supply OK (as per Clause 1.3) - YELLOW Indication (5 mm LED).

ii) Common failure LED indication (RED) in case of any main fuse getting blown out at the station.

iii) Another LED indication (RED) if any of the standby fuse also is blown along with its Main fuse. Both the LEDs shall be lit in case of both Main and Standby getting blown.

iv) Piezoelectric buzzer to give audio alarm for failure conditions mentioned in Clause- 6.7.

v) A Non locking type Push Button for acknowledgement of Audio Alarm.

vi) A suitable fuse shall be provided at input of the power supply inside the unit.

NOTE: 5 mm RED LED with suitable holders and flashing indications to be used.

6.15 **Optional Item- GSM Modem**: If the purchaser requires, a GSM modem shall be supplied and with such modem connected, the system(s) shall send SMSs on GSM network to upto 5 preselected GSM mobile numbers in case of any of the fuse blowing. The mobile numbers shall be configurable. SMS shall be generated within 30 seconds of fuse blowing and if the sending fails, subsequent sending of SMS shall be tried by the system immediately. Besides this, provision of separate message indicating blowing of main & standby fuse shall also be there. A separate message shall again be generated when a fuse is replaced. The SIM required for the GSM modem shall be provided by the purchaser.

6.16 The GSM modem shall be from reputed make and compatible to Tri-band GSM 850, 900, 1800 and 1900 MHz. It shall support GPRS class 10 and shall be working on 110V AC with suitable power supply adapter. It shall be able to withstand operating temperature upto 60º C and humidity upto 95%. When a fuse blows, it shall generate SMSs as per following details.

Station code: XXXX (to be fed in the system with flexibility of change by user)

EVENT	SMS
Main fuse blown, standby operative	ATTENTION: FUSE BLOWN AT STATION XXXX, STANDBY OPERATIVE
Main and Standby both fuses blown	ATTENTION: BOTH FUSES BLOWN AT STATION XXXX

7. MARKING:

7.1 All markings/ indications shall be placed in the vicinity of the components to which they refer and shall not be placed on removable parts.

7.2 All terminals shall be suitably marked to facilitate ease of connection. Supply voltage shall be indicated nearby the input terminals.

7.3 Clauses 12.1 and 12.2 of specification no. RDSO / SPN / 144 / 2006 shall be complied.
The words *'Indian Railway Property'* shall be engraved /embossed/ screen printed on every unit in letters of 5 mm size (minimum) at a conspicuous place.

7.4 Following markings shall be done on every unit either on firmly attached anodized name plate or using non erasable screen printing on the body.
(a) Name or trademark of the manufacturer
(b) Serial number of the unit
(c) RDSO's specification number
(d) Operating voltage
(e) Month and year of manufacture

7.5 All markings/indications shall be easily legible and durable. Where the marking is by use of labels, the labels shall be non ferrous metallic and shall be firmly fixed and shall not be capable of being removed by hand. Durability of marking shall be checked by rubbing the marking by hand with a piece of cloth soaked with petroleum spirit. This requirement shall also be met after completion of climatic test.

8 TEST & PERFORMANCE CRITERIA:

8.1 The Fuse Auto Changeover System (the main module, the common audio visual alarm unit & the GSM modem) shall be capable of working in non air conditioned environment in the field. It shall be suitable for installation on AC/ DC electrified and non-electrified sections. It shall be suitable in all areas including where locomotives having thyristor controlled single phase or 3-phase induction motors haul passenger or freight trains and where chopper controlled EMU stocks are operated. The system shall pass the climatic test as per S. No. 1, 2, 3, 4, 5, 6, 7, 10, 12 & 13 of Clause No. 9.3 Specification RDSO/SPN/144/2006.

8.2 After test as per S. No. 9.3 of Specification RDSO/SPN/144/2006, no component shall fail and there shall not be any damage in the unit. The unit shall be completely operational and functional after each test.

8.3 Applied high voltage test for Fuse Auto Changeover System: The equipment shall withstand for one minute without puncture and arcing when a test voltage of 2000Volts rms is applied between

(a) body and input terminals of supply
(b) body and fuse sensing terminals

(For testing with part of body, which is used as heat sink, test voltage shall be 1500Volts rms)

The test voltage shall be alternating of approximately sinusoidal waveform of any frequency between 50 Hz and 100 Hz.

8.4 Insulation Resistance Test for Fuse Auto Changeover System: This test shall be carried out-
(a) Before the high voltage test
(b) After the high voltage test
(c) After completion of the climatic test

The Insulation Resistance shall be measured between the body and the fuse sensing terminals and supply terminals looped together at a potential of 500 V DC. There shall not be appreciable change in the values measured before and after high voltage test and these values shall not be less than 100 Mega ohms. After completion of climatic test, the insulation resistance shall not be less than 10 Mega ohms for the equipment at a temperature of 40°C and relative humidity 60%.

8.5 Vendor shall submit make, grade and data sheet of all electronic components and switches alongwith samples. Vendor shall also submit design parameters like voltages, input current, power consumption etc. along with their tolerances to achieve specified operating parameters.

8.6 Fail Safety:
The equipment shall be so designed that any short/open or any other defect in any of the component will not lead to unsafe / undesirable situation.

9 INSPECTION CRITERA

9.1 Type Test

For type test, two samples of Fuse Auto Changeover System shall be subjected to following tests as applicable:

(i) Visual inspection & dimensional check (Cl. 1.4, 1.4.1, 1.7, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 5.1.3, 5.1.2, 5.1.4, 5.1.5, 5.1.6, 5.2.1, 5.2.2, 5.2.3, 6.4, 7.1, 7.2, 7.3, 7.4, 7.5).
(ii) Operating Parameters (Cl. 1.2, 1.3, 1.5, 1.6, 1.8, 4.8, 6.1, 6.2, 6.3, 6.5, 6.6, 6.7, 6.8, 6.9, 6.10, 6.11, 6.12, 6.13, 6.14, 6.15, 6.16)
(iii) Climatic tests (sub Clause 1, 2, 3, 4, 5, 6, 7, 10, 12 and 13 of Cl. 9.3 of RDSO/SPN/ 144/ 2006).

(iv) Fail safety (as per clause 8.6)
(v) Applied high voltage test (Cl. 8.3)
(vi) Insulation resistance test (Cl. 8.4)
(vii) Fluctuation in input voltage (cl. 1.3)

9.2 Acceptance Test

9.2.1 Out of a lot, 20% of the samples shall be subjected to following tests:

(i) Visual inspection & dimensional check (Cl. 4.7, 5.1.2, 5.1.3, 7.2, 7.3, 7.4, 7.5)
(ii) Operating Parameters (Cl. 6.2, 6.3, 6.5, 6.6, 6.7, 6.8, 6.9 & 6.10)

9.2.2 Minimum five samples from those which have passed tests as per Cl. 9.2.1 shall be subjected to following tests-

(i) Insulation resistance test (Cl. 8.4)
(ii) Fluctuation in input voltage (cl. 1.3)
(iii) Functional test for Common Audio Visual Alarm unit & GSM modem (Cl.6.14, 6.15, 6.16).

9.2.3 Acceptance tests as per Cl. 9.2.2 shall be conducted before and after ambient temperature severity test. The equipment shall be kept in energized condition for 1 hour each at -10°C and + 60°C during ambient temperature severity test. Operating parameters and audio visual alarm tests shall also be conducted after ambient temperature test.

9.2.4 Failure in any of the tests is not acceptable.

9.3 Routine Test

9.3.1 Following routine tests besides other tests, as deemed fit to ensure quality, reliability and compliance of this specification, shall be done by the manufacturer on all the units:

(i) Visual inspection & dimensional check
(ii) Operating Parameters
(iii) Insulation resistance test (cl. 8.4)

9.4. When one main fuse blows/ unscrewed, then buzzer should come along with main fuse failure indication.

10. DOCUMENTATION:

Following documents shall be supplied alongwith each system-

(a) One copy of Installation and maintenance manual. This should also include following information:
(i) Guaranteed performance data, technical and other particulars.
(ii) Schematic block diagram showing mounting arrangement of various components & details of each type of assembled PCB.
(iii) Details of Hardware e.g. schematic diagrams of the system circuits/ components, details for each type of assembled PCB and part list
(iv) Mechanical drawings of every unit.
(v) Part no. and manufacturer's details of components used.
(vi) Trouble shooting procedure alongwith test voltages and waveforms at various test points in PCBs.
(vii) Details/procedure of trouble shooting of Fuse Auto Changeover System.
(b) Dos & Don'ts (Pocket size laminated cards)
(c) Pre-Commissioning check list

11. PACKING & LABELING:

Units shall be packed in suitable boxes / crates, strong enough, with additional packing to prevent damage or loss to the unit during transit. Loose space inside the box/crate shall be filled up with suitable packing material.

12. WARRANTEE:

The supplier shall give a warrantee of 24 months from the date of supply for the equipment supplied under this specification.

13. INFORMATION TO BE GIVEN BY THE PURCHASER:

(i) The system voltage at which the Fuse Auto Changeover System need to work (as per clause 1.3).
(ii) TYPE-I or TYPE II system as per clause 1.4.
(iii) No. of fuses with their respective voltage/current ratings as per clause 1.4
(iv) The requirement of GSM modem for connection to the system(s) in reference to clause 6.14, if any.
(v) Whether the system module is to be mounted in existing relay rack instead of a standard 19 inch rack.
(vi) Required no. of common audio visual alarm units (as per clause 6.14)

14. SCOPE OF SUPPLY

The system shall be supplied along with all standby fuses placed in the system. In addition to it, spare quantity of 100% fuses of each type shall also be supplied along with the system. Extender fixing plates as per clause 4.1 shall also be supplied in case the system is to be installed in existing relay rack instead of a standard 19 inch rack.

15. INFRINGEMENT OF PATENT RIGHTS:

Indian Railways shall not be responsible for infringement of patent rights due to similarity in design, manufacturing process, use of components used in design, development of manufacturing of such equipment and any other factor which may cause such dispute.

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