



सत्यमेव जयते

भारत सरकार
रेल मंत्रालयGOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

FUNCTIONAL REQUIREMENT SPECIFICATION

FOR

SPEED INTERFACE UNIT FOR 3-PHASE ELECTRIC LOCOMOTIVES

FRS No: RDSO/2020/EL/FRS/0xxx (Rev'0')

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Approved by	Signature
PEDSE	

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Status of Revision

S.N.	Date of Revision	Page No.	Revision	Reasons for Revision
1.		All	0	First issue
2.				
3.				
4.				

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1.0 Scope & Object

- 1.1. At present, PG (Pulse generator) having speed sensors are provided in ESMON (Speedometer) to sense & indicate the speed of locomotive. The PG is mounted on the axle & prone to failure owing to various reasons i.e. ingress of grease, dust deposition on sensor, water ingress in PG, breakage of driving fork, connector (SENSCON) breakage, external hitting by ballast etc. In 3- phase Electric locomotive, TM speed sensors are being used to provide the slip-slide control of locomotive. RDSO has planned to eliminate the use of PG for speed sensing in 3 phase Electric locomotive. Instead of PG, speed sensors of TM to be utilized for speed input to ESMON. The use of TM sensors will not only remove the requirement of PG but will address the failures caused by PG and in turn will make the ESMON more reliable.
- 1.2 In compliance to Railway Board's decision on items of 39th MSG (Electric Loco) meeting held at Ajni, CR on 14th & 15th Oct'2019, this Functional Requirement Specification has been prepared for the development of Speed Interface Unit for 3-phase Electric locomotives which will eliminate the requirement of Pulse Generator (PG).
- 1.3 The requirement of Speed Interface Unit will be included in the specification for ESMON based on the experience gained with the Speed Interface Unit developed as per this Functional Requirement Specification.

2.0 Terminology:

Terms/abbreviations used frequently in the documents are explained below:

SIU	:	Speed Interface Unit
TMSS	:	Traction Motor Speed Sensor
ESMON	:	Energy Cum Speed Monitoring System
RCI	:	Recorder cum Indicator Unit
FRS	:	Functional Requirement Specification
IEC	:	International Electrotechnical Commission
DIP	:	Dual In-line Package
PG	:	Pulse Generator

3.0 Documentation:

The manufacturer shall furnish:-

- 3.1 Mechanical interface diagram (Outline General Arrangement), assembly drawings of complete unit, mounting arrangement and weight.
- 3.2 BOM (Bill of Material), Data sheets for components/devices and other equipment proposed for use.

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- 3.3 Mounting arrangement drawing and weight.
- 3.4 Clause by Clause compliance of Functional Requirement specification.
- 3.5 Test protocol with procedure of testing
- 3.6 Any other information as deemed fit from user's point of view.
- 3.7 Functional description

4.0 Marking:

The following information shall be legibly and indelibly marked on the equipment and housing case at a suitable place.

- a) Name or trademark of the manufacturer.
- b) Serial number of the equipment.
- c) Specification number.
- d) Month and year of manufacture
- a) Approximate gross weight
- f) The legend "INDIAN RAILWAY PROPERTY".

5.0 General features

Traction motor speed is sensed in 3-phase electric locomotives using the Hall-effect based active speed sensor (TMSS) for slip-slide control. TMSS generates 120 pulses /revolution. The output from TMSS is fed to traction converter. This speed information received from TMSS is utilized by the traction converter for computation of various locomotive parameters.

The SIU taps the signals from TMSS output in an isolated manner such that these signals are not loaded or disturbed when fed to traction converter. An isolated opto-isolator should be used for this purpose. The output of opto isolator is passed through low pass filter to reject unwanted harmonics. Only useful frequency is fed to the SIU micro controller.

The micro controller in the SIU utilizes the output from TMSS to calculate the locomotive speed based on the Traction motor gear ratio. Provisions should be made in the SIU for changing the gear ratio required for different locomotives through DIP switch (SW2) OR by any other means.

The calculated locomotive speed is then converted to ESMON frequency signal & fed to ESMON RCI unit through junction box. The converted ESMON frequency is proportional to the PG slots of the ESMON. SIU should have a provision of DIP switch (SW1) for changing of PG slots to any value viz. 30/60/120/200 or any other value. Speed should be calculated according to the given formula.

$$\text{Speed} = (\text{RPM of the wheel}/\text{Gear ratio}) * \text{Pulse ratio}$$

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The tentative block/schematic diagram of the system is shown in Annexure-I.

6.0 Power Supply Requirement:

- 6.1 There should not be requirement of external power supply for SIU unit. The power should be derived from the ESMON.
- 6.2 The SIU converts ESMON supply (5-24V DC) to necessary voltage required for operation of SIU.
- 6.3 The SIU unit should be a very low power consumption module & should preferably draw only 0.5W of power from the ESMON.

7.0 Functional Requirements:

- 7.1 Each locomotive consists of two Speed Interface Unit (SIU).
- 7.2 Accuracy of the system should be within +/- 1.5% of Full scale.
- 7.3 The output from each SIU unit should be terminated in a junction box. Existing junction box of ESMON unit can be utilized for the same.
- 7.4 DIP Switches should be provided inside the Unit to select different gear ratios and different PG slots without need of reprogramming ESMON to suit the conditions.
- 7.5 All the signals of SIU unit should be optically isolated from Traction converter & active speed sensor.
- 7.6 SIU unit should have suitable processor/microcontroller to process the signals. The SIU unit should have active low pass filter to eliminate the noisy signals.
- 7.7 The output from SIU unit should be buffered & made compatible to ESMON unit.
- 7.8 Multi core shielded PTFE cables with minimum conductor area of 0.5mm² should be used. All the cables should possess FRLS jacketing.
- 7.9 The SIU will be installed in side cab and therefore the SIU unit should be compact and size should preferably be not more than 100mm (W) x 100mm (L) x 50mm (H) excluding connectors.
- 7.10 Manufacturer should have facility to test the performance of the SIU unit using TM Active speed sensor and ESMON unit.

8.0 Climatic & Environmental Condition

The climatic and environmental conditions prevailing are as following:

➤ Temperature	(a) Maximum temperature: Stabled Locomotive under sun : 70 °C On board working loco under Shed : 55 °C (b) Ambient temperature: Operating : -10 °C to 70 °C Storage : -10 °C to 55 °C
➤ Relative Humidity	100% saturation during rainy season

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➤ Altitude	Up to 1776 m above mean sea level
➤ Rain fall	Very heavy in certain areas.
➤ Atmospheric During Hot Weather	Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach a high value of 1.6 mg/m ³ .
➤ Coastal area	Humid and salt laden atmosphere with maximum pH value of 8.5, Sulphate of 7 mg per liter, maximum concentration of chlorine 6 mg per liters and maximum conductivity of 130 micro Siemens /cm.
➤ Electromagnetic pollution	High degree of electromagnetic pollution is anticipated in locomotive machine room/HT & LT compartment, where the equipment shall be mounted. Necessary precaution shall be taken in this regard. The system shall be interference free from the communication system between the Guard-Driver-Control and Public address system. The system should be tested as per IEC 61000 for Electro Magnetic Compatibility.
➤ Vibration	The system shall be designed to withstand the vibrations and shock encountered in service satisfactorily as specified in IEC 1287 and 60571 publications for the electronic equipments used on Rail Vehicle and relevant IECs as applicable to other equipment.

9.0 SCOPE OF SUPPLY

- 9.1 The scope of supply covers design, development and commissioning of Speed interface unit for 3-phase Electric Locomotives.
- 9.2 Necessary connectors should be provided on the SIU Unit for interfacing Active speed sensor signals & output to ESMON.
- 9.3 Necessary cabling in the locomotive.
- 9.4 Detailed operation and maintenance manual and spares catalogue and installation drawings.

10.0 Tests:

The following tests as stipulated in RDSO specification no. ELRS/SPEC/SPM/0002 (Rev.4) issued on 17.07.2018 shall be carried out along with SIU. However, additional tests may be carried out, if required to prove functionality of system.

SN	Tests	Clause no.
1.	Visual Inspection	6.2.1
2.	Performance test	6.2.2

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3.	Reverse polarity test	6.3
4.	Dielectric test	6.9

11.0 Infringement to Patent rights:

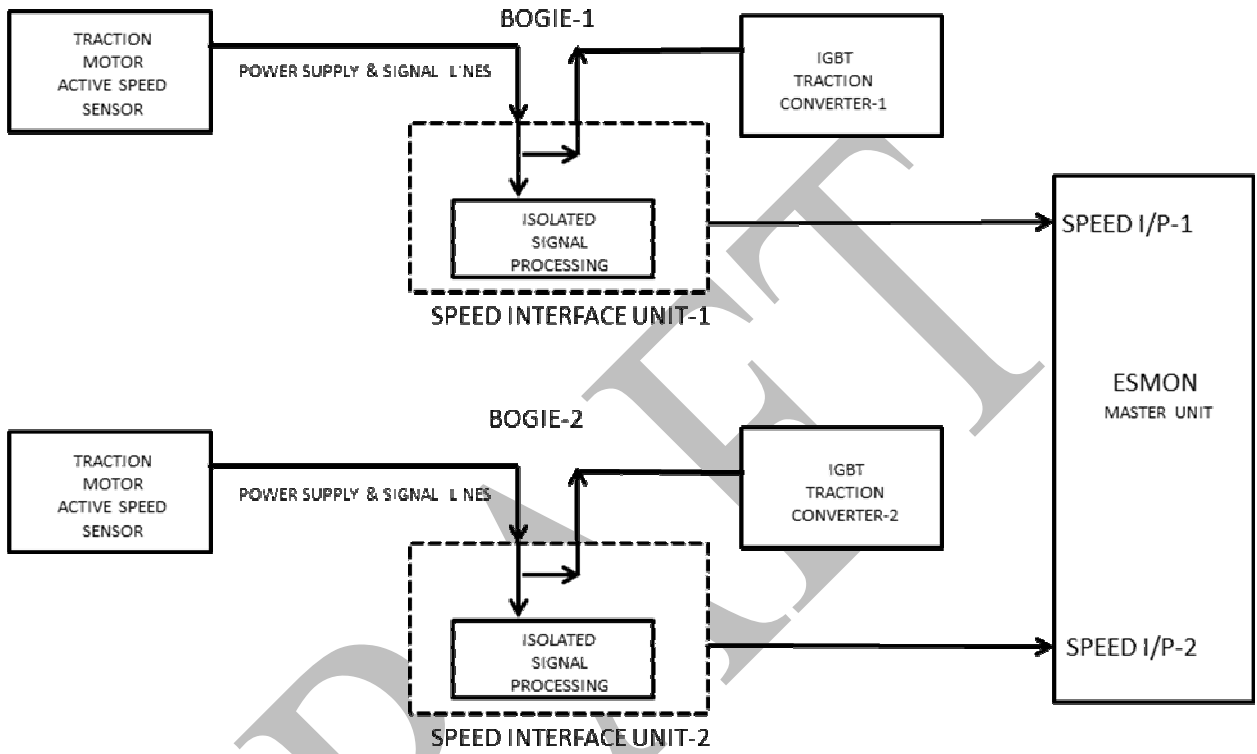
Indian Railways shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of components, used in design, development and manufacturing of Speed Interface Unit and any other factors which may cause such dispute. The responsibility to settle any issue lies with the manufacturer.

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Annexure-I

GENERAL ARRANGEMENT OF SPEED INTERFACE UNIT IN IGBT TRACTION CONVERTER LOCOMOTIVES



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