

HALL EFFECT ACTIVE SPEED SENSOR FOR IGBT TRACTION CONVERTER

USER MANUAL

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1. INTRODUCTION

This document provides the technical details and usage of Hall Effect based Active Speed Sensor which is used to measure the speed of traction motor fed by IGBT converter in Electric Locomotives.

2. APPLICATION

There are two cables coming out from the speed sensor. One is signal cable and other one is power cable. The signal cable is of 2x1x1 mm² and power cable is 2x1 mm² (both are twisted shielded pair type) cable. All the connectors for interfacing with the loco side remains the same as that of Wiegond TM Sensors.

In the signal cable, two 90° Phase shifted pulses are fed to IGBT converter, viz channel-1 and channel-2. Using these 90° phase shifted pulses, direction is resolved within the converter electronics.

The output pulses are open collector type and hence amplitude depends upon the supply voltage. The pulses have a duty ratio of 50% and frequency proportional to speed.

3. TECHNICAL DESCRIPTION

The working principle is illustrated in **FIGURE-1**. Two Hall Effect Sensors are placed closely in the sensor housing such that it is very close to the toothed wheel. Associated with the Hall Sensors is a biasing magnet placed in the very close proximity.

An iron-toothed wheel having a uniform tooth pattern is mounted on the motor shaft. The toothed wheel has 120 teeth. When the toothed wheel moves under the Hall-Effect sensors, the magnetic field linking with the sensors vary according to the tooth and trough of the wheel. The flux variation is measured by the sensor and amplified. Two sensors are mounted with a shift such that the outputs of these two sensors are 90 electrical degrees phase shifted, which are conditioned and brought out through suitable cable & connectors. The power supply needed for the sensor circuit is derived from the electronic rack itself.

For every revolution of the tooth wheel (means motor shaft), 120 pulses are generated. The sensor reliably reproduces the pulses from near zero speed to above 3000 rpm, which has been tested and validated. The sensors conform to IEC-60571 & IEC-61373.

The output signals are taken using signal cables intended for traction application. The cable used is of 2x1 mm² EB irradiated cross linked type, shielded with reinforcement for outdoor traction applications like that of speed sensor. The length of the cable is 270 cm each.

The salient data sheet of the speed sensor is given in **TABLE 1**.

The signal outputs are terminated on 5-PIN circular connector (Female), bearing ITT Cannon part number KPSE06E14-5SDZ. These connectors have a special termination arrangement for providing a heat shrinkable boot shield termination, which takes care of the stress relieving and ingress protection. These female connectors can be directly plugged into the 5-PIN male receptacles provided on the locomotive under frame. The power supply cable is terminated in a 3-PIN circular connector of ITT Cannon part number KPSE06E12-3SDZ. The corresponding panel mount male receptacle bearing ITT Cannon part Number KPSE07F12-3P is supplied as loose item along with the sensor. These connectors conform to MIL-C-26482 standard.

The sensor is totally sealed to comply with IP68 ingress protection class according to IEC-60529.

4. MECHANICAL CONSTRUCTION

The Speed Sensor is mechanically 100% compatible to the original Wiegand type speed sensor provided in the traction motors of Indian Railways, needing no modifications in the mechanical housing. The toothed wheel also has the same fixing dimensions and diameter. The sensor has two output cables, one is used for sensor signals S1 & S2 and the other is used for deriving rack power supply from Converter rack. The shield of the cable is connected to pin E.

The mechanical drawings of the speed sensor are given at **FIGURE-2**.

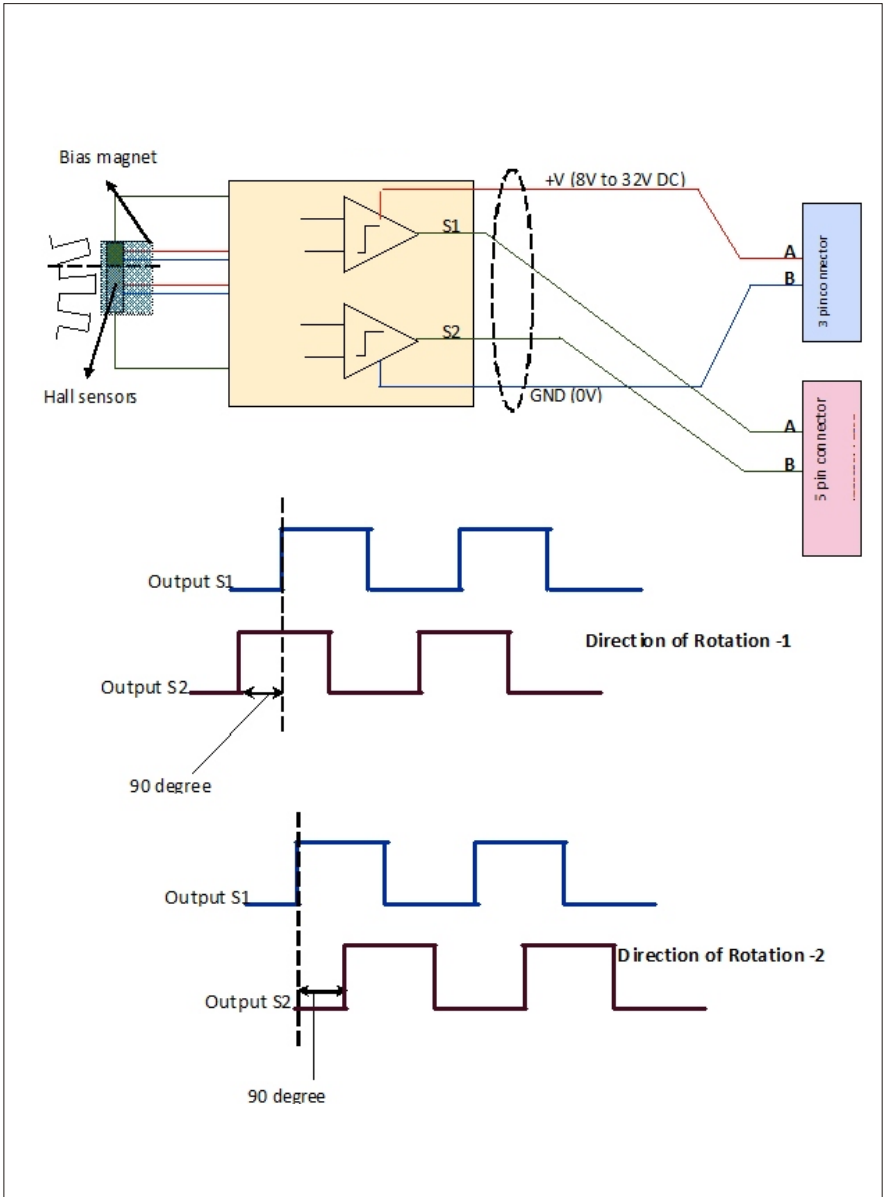


FIGURE-1

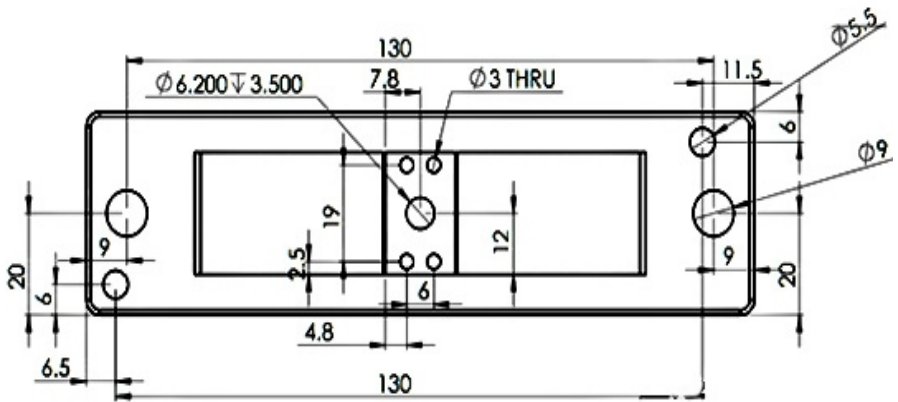
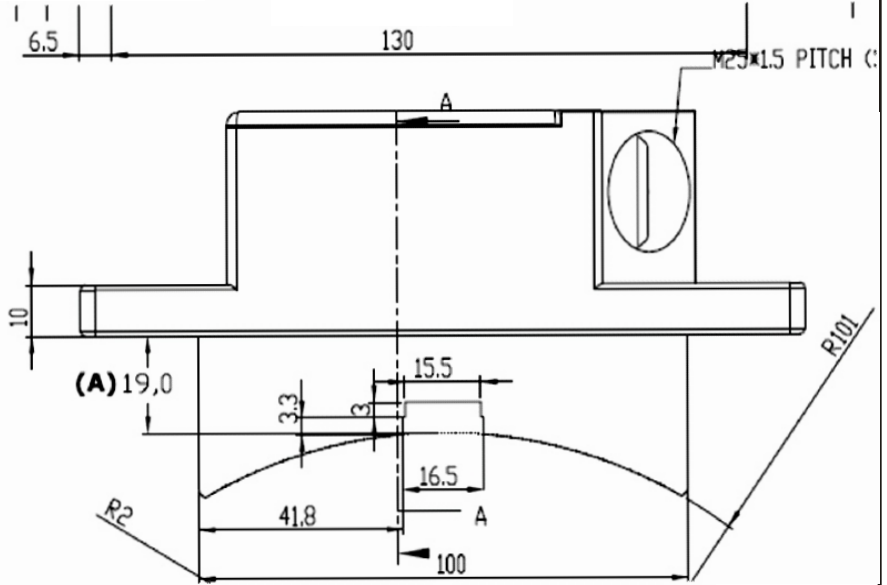


FIGURE-2

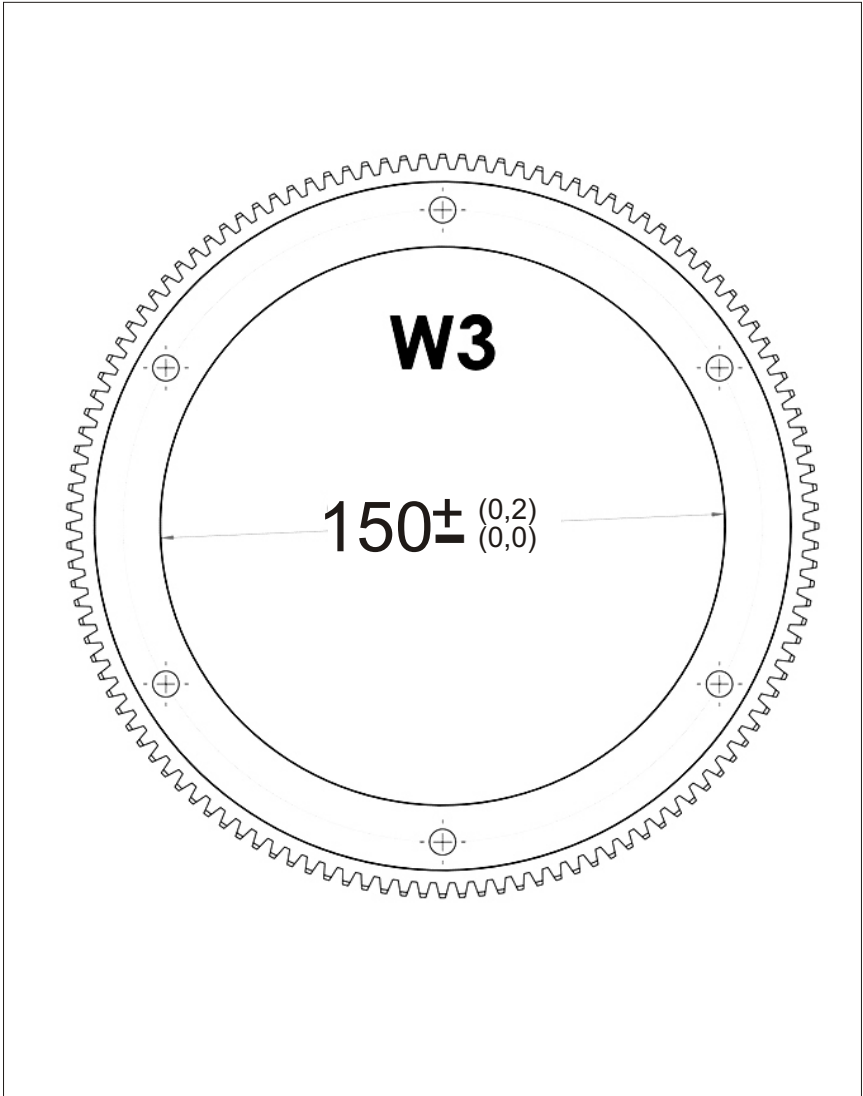


FIGURE-3

5. PROCEDURE FOR COMMISSIONING

For retrofitment in older locomotives (IGBT- converter fed) remove the dust cover and replace the old pulse generating wheel with new pulse generating wheel (if the old wheel is damaged) in the traction motor and check the tightening. Fix the dust cover .

Remove the old sensor assembly from the dust cover and connector end from the terminal box. Fix the new speed sensor and connect as per loco side wiring diagram.

! PRECAUTIONS TO BE TAKEN, WHILE COMMISSIONING :

- 5 pin connector have signals and SHOULD NOT be connected to high voltage.
- 3 pin connector is a power connector and SHOULD be connected to the respective male connector- A + (positive) and B (negative).
- Check the gap before mounting, using a suitable test gauge.
- Mounting surface SHOULD be clean and if the gap is too narrow use shims. The air gap ideally has to be above 1mm and below 1.5 mm.
- Before connecting to the Power connector, check and verify the voltage at the terminals on loco side, using a Multimeter.

6. PROCEDURE FOR CONNECTION OF SPEED SENSOR AND CRO SETTINGS FOR TESTING ON THE TEST BENCH

Connect 3 pin female connector to dc power supply, pin A to be connected to positive of the DC power supply and pin B to be connected to negative of the DC power supply. Connect signal cable to CRO probes. In signal connector pin A and B are to be connected to positive probes of the CRO. Ground probes and negative of the power supply are shorted.

CRO settings are given bellow.

Channel 1: set the voltage/div as 5 V.

Channel 2: set the voltage/div as 5 V.

Time/div: 100us.

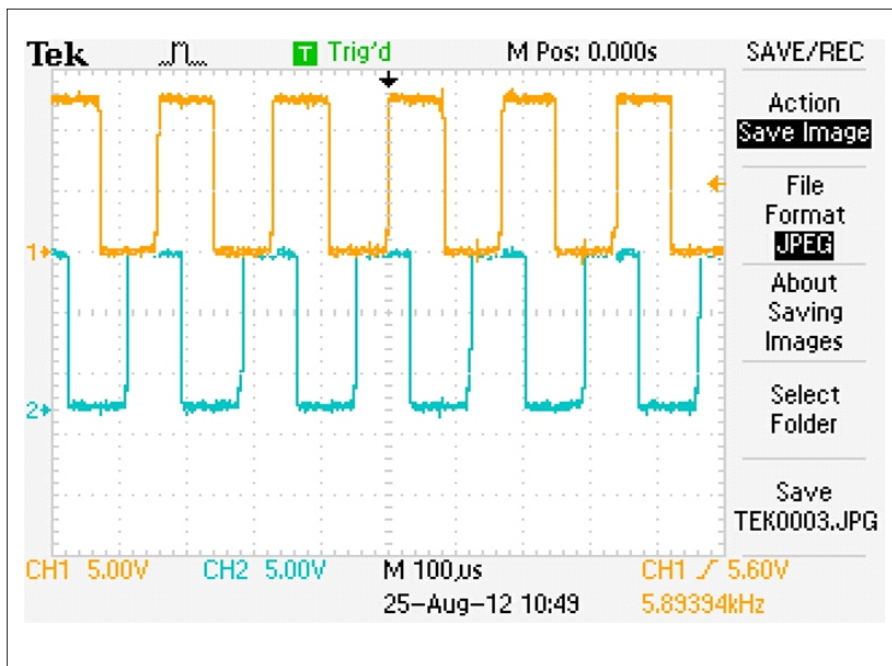


FIGURE-5

7. DATA SHEET OF THE SPEED SENSOR.

The salient data sheet of the speed sensor is given in **TABLE-1**.

SI No	PARAMETER	VALUE
1	Type	Active, Hall Effect Sensor Type
2	Sensor Input	8V to 32V DC from Converter Rack.
3	Output Signal	90 degree phase shifted square Pulses (S1& S2), 50% duty ratio, open collector, short circuit protected. Signal ground common to power supply ground.
4	Pulse Frequency	120 pulses per revolution of motor shaft.
5	Impulse Ring	Iron (MS) Tooth Wheel, Zinc Plated, 120 teeth
6	Power connector	3 PIN circular, conforming to MIL-C-26482, ITT Cannon Make, Part No.KPSE06E12-3SDZ. Can be Identified by RED color sleeve.
7	Signal Connector	5 PIN circular, conforming to MIL-C-26482, ITT Cannon Make, Part No.KPSE06E14-5SDZ. Can be Identified by BLUE color sleeve.
8	Cable (Signal & Power)	Huber+Suhner make Part No.12583003, 270 cm each

TABLE-1

8. TROUBLE SHOOTING.

Likely problems and solutions for the problems are listed in **TABLE-2**.

SI No	DDS MESSAGES	LIKELY REASONS
1	I. Error Tachogenerator. II. Rotational Speed greater than Maximum. III. Error rotational Speed Exceeds Maximum. IV. Speed Disturbance.	a). Sensor output Frequency not matching with that of the other sensors. b). Absence of pulses whereas other sensor delivers normal pulses. C). Rotational direction doesn't match with the other sensors.

Suggested Remedial Actions:

1. Check the air gap between sensor and toothwheel. It should be between 1mm and 1.5 mm.
2. Check the pulses on a test zig with air gap adjusted to less than 1.5 mm. If the pulses are found disturbed, change the sensor with a new.

If pulses are GOOD, refit the sensor with proper air gap as mentioned above and check the connections, wiring, AS peri card and AS controller.

TABLE-2

9. SCOPE OF SUPPLY

SI No	DESCRIPTION OF SUB-ASSEMBLY	QUANTITY / SPEED SENSOR
1	Rotational Speed Sensor	1
2	Ferrous Toothed Wheel for Traction Motor	1
3	Cable Type H+S part number 12583003 : RADOX TENUIS-TW/S EMC-SC, 600/1000V, 2x1 mm ² 18AWG : (cable will be connected with the sensor and crimped with the specified female connector) • Signal Cable 270 cm • Power Cable 270 cm	01 No. 01 No.
4	Fixing Bolt for Sensor & Toothed Wheel (I) Hex Hd Screw M8x25 Zn plated, Grade 8.8 to IS:1364(Pt2)'92 (ISO-4017-88) for fixing sensor (II) Hex socket Hd Cap screw M6x16-12.9 Zn plated to IS:2269-95 and machined washer 6.4 to IS:2016 '67 & Steel to IS:2062 '99 Gr.A Type M6x16 Allen Screws for fixing the toothed wheel.	(I) 02 Nos (II) 06 Nos

TABLE-3

CONTACT DETAILS:
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