HALL EFFECT ACTIVE SPEED SENSOR

FOR 3 PHASE TRACTION MOTOR TYPES 6FRA6068 & 6FXA7059 FED FROM GTO CONVERTER

USER MANUAL

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ADVANCED RAIL CONTROLS PRIVATE LIMITED

#59/1-2, 1 & 2 FLOOR (ABOVE BANK OF INDIA)

G-BLOCK, SAHAKARNAGAR

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1. INTRODUCTION

The Rotational Speed Sensor working on Hall Effect principle as per CLW specification is suitable for the traction motors used in WAG9, WAG9H, WAP7 & WAP5 class of locomotives. TM type 6FRA6068 is used in WAG9, WAP7 & WAG9H locomotives and TM type 6FXA7059 is used in WAP5. One set of Speed Sensor consists of the sub-assemblies as mentioned in TABLE-2.

2. TECHNICAL DESCRIPTION

The working principle is illustrated in FIGURE-1. Two Hall Effect Sensors are placed closely in the sensor housing (FIGURE-3) 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 (FIGURE-4) having a uniform tooth pattern is mounted on the motor shaft. The toothed wheel has 120 teeth. When the tooth 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 phase shift of 90 electrical degrees. The outputs of these two sensors are used to resolve the direction of the tooth wheel.

The final output coming out of the sensor is galvanically isolated and contains the direction information. The output waveform is compatible to the Wiegand type speed sensors used originally in the three phase locomotives. There are two galvanically isolated output channels. In WAG9/WAG9H/WAP7 locomotives, only one channel needs to be connected and the other channel is kept as spare. In WAP5 locomotives, both the channels of the same sensor are to be connected to the AS-Peri card.

For every revolution of the tooth wheel(ie. Motor shaft), 120 pulses are generated, which is exactly same as the originally used Wiegand sensors. Due to this compatibility, there is no need of any modifications in the electronics hardware and software (ALG). The sensor will reliably reproduce the pulses from near zero speed to above 3000 rpm, which has been tested and validated. The sensor has been type tested and passed according to IEC-60571 & IEC-61373.

The data sheet of the speed sensor is given in **FIGURE-2**. The average pulse height is close to 2V, which is compatible to the Wiegand Sensor. The pulse width is also compatible to the Wiegand sensor.

Power supply to the sensor is provided from locomotive battery at 110V DC (nominal). This is permitted to a variation of 77V to 137.5V according to IEC-60571. The input is protected against any surges and transients to comply with IEC-60571.

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

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 direcery revolution of the tooth wheel (means motor shaft), 120 tly 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

In the present arrangement, there is no provision for providing the power supply receptacle in the connector plate. Hence, a modified connector mounting plate is also supplied as part of each sensor.

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

3. MECHANICAL CONSTRUCTION

The Active Speed Sensor is mechanically 100% compatible to Wiegand type speed sensor, needing no modifications in the mechanical housing. The toothed wheel also has the same fixing dimensions and diameter. The sensor has three output cables, two are for two sensor output channels and the third one is for the power supply (110 V DC from loco battery).

The drawings of the speed sensor and toothed wheel are given at **FIGURE-3**&**FIGURE-4**).

4. TESTS

The sensor has been type tested and passed according to IEC-60571 & IEC-61373.

5. MOUNTING

Speed sensors have to be mounted on the housing which is part of the traction motor.It is very important to notice that the speed sensors should not rub with the wheel and the air gap should not be more than 1.6mm for satisfactory performance.Ideal air gap is between 0,5mm and 1,5mm. If the air gap is more than 1.6mm there may be a chance of missing the pulses,so it is very important to take care of the air gap while mounting.

After adjusting to suitable air gap mount the speed sensor with m8 screws provided. If the air gap is too low, shims can be used to increase the gap to safe levels.

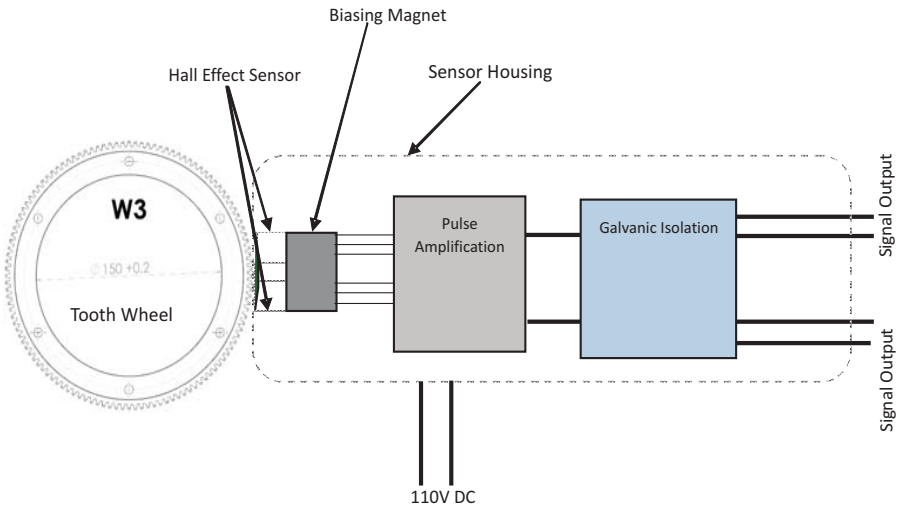
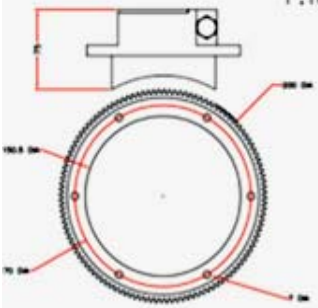
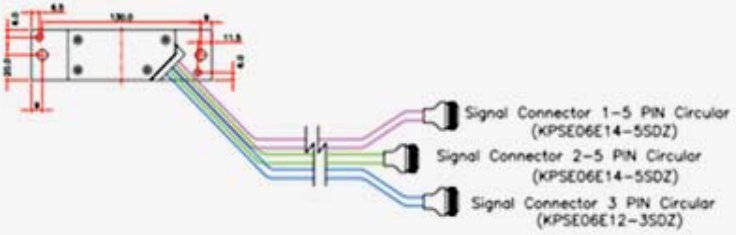

Biasing Magnet
Hall Effect Sensor
Sensor Housing
W3
150 +0.2
Tooth Wheel
Pulse
Amplification
Galvanic Isolation
Signal Output
Signal Output
110V DC

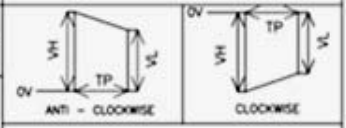
FIGURE -1

T.M. SPEED SENSOR DATA SHEET





ELECTRICAL INTERFACE

Connector ID	PIN	Signal	Value/Range
Signal Connector 1	A & B	Sensor Output Pulse	
Signal Connector 2	A & B	Sensor Output Pulse	
			120 Pulses/Revolution
Power Connector	A	+110V DC	110V DC Nominal (77V – 137.5V) DC
	B	BAT. RET	

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SAHAKAR NAGAR, BANGALORE – 92

FIGURE-2

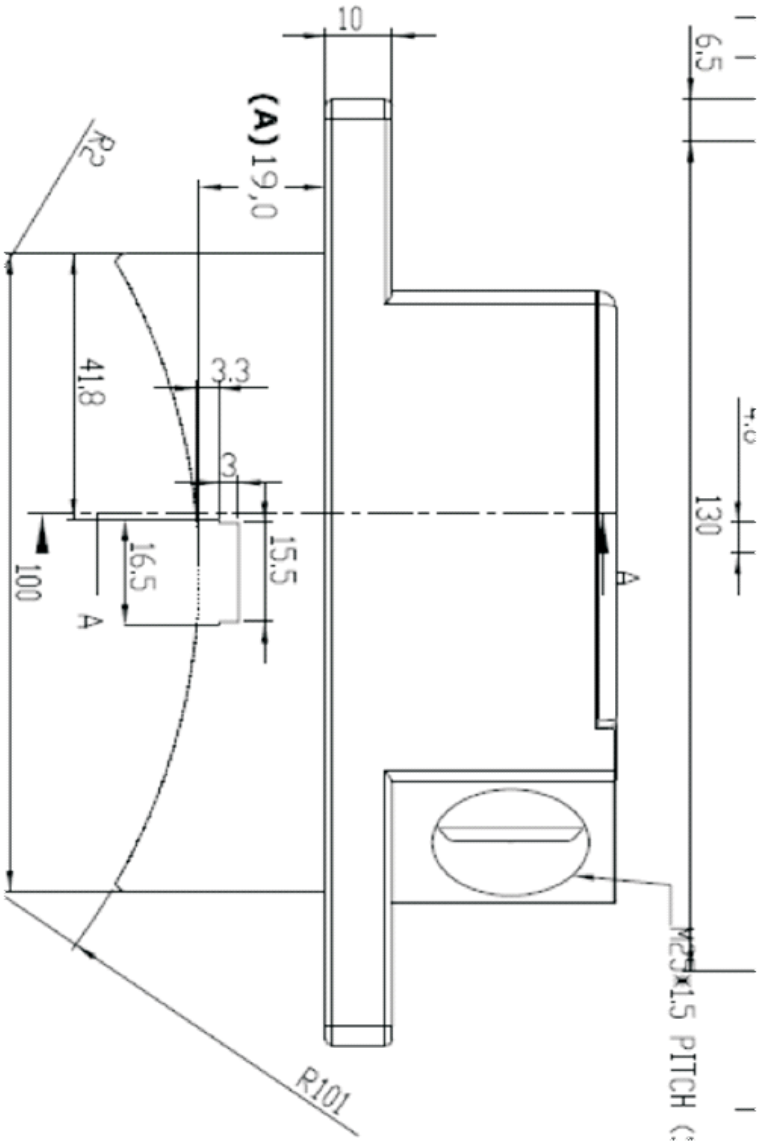

FIGURE-3

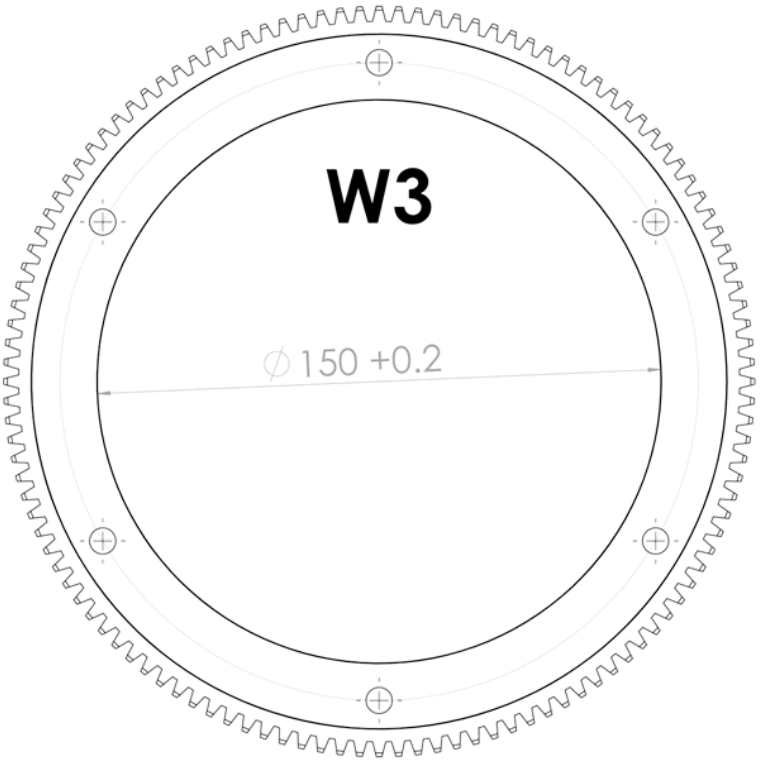

FIGURE-4

6. PROCEDURE FOR CONNECTION OF SPEED SENSOR WITH CRO SETTINGS 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(FIGURE-7). Connect signal cable to CRO probes. In signal connector pin A to be connected to positive probe of the CRO and Pin B to the ground probe.

CRO settings are given bellow.

Channel 1: set the voltage/div to 1volt.
Channel 2: set the voltage/div to 1volt.
Time/div: 25us.

If motor runs in anti-clockwise (looking from wheel end) direction of pulses should be in positive direction as shown in theFIGURE-5.

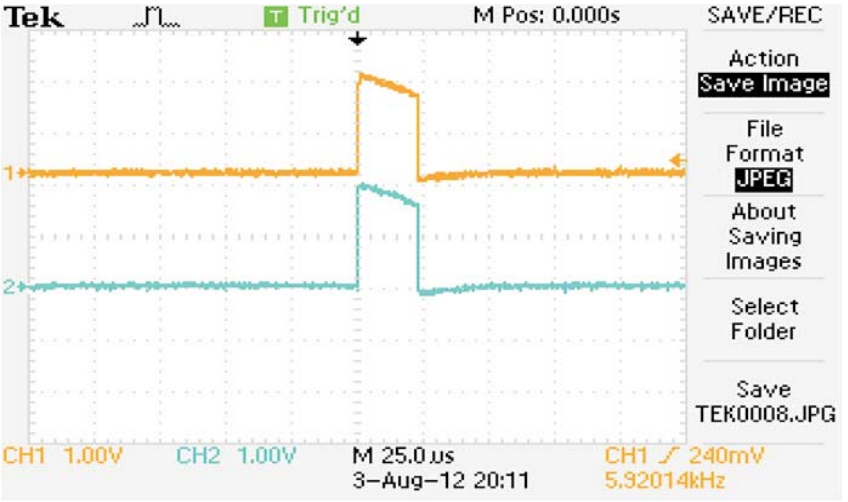

FIGURE-5

If motor runs in clockwise direction (looking from wheel side) pulses should be in negative direction as shown in the FIGURE-6.

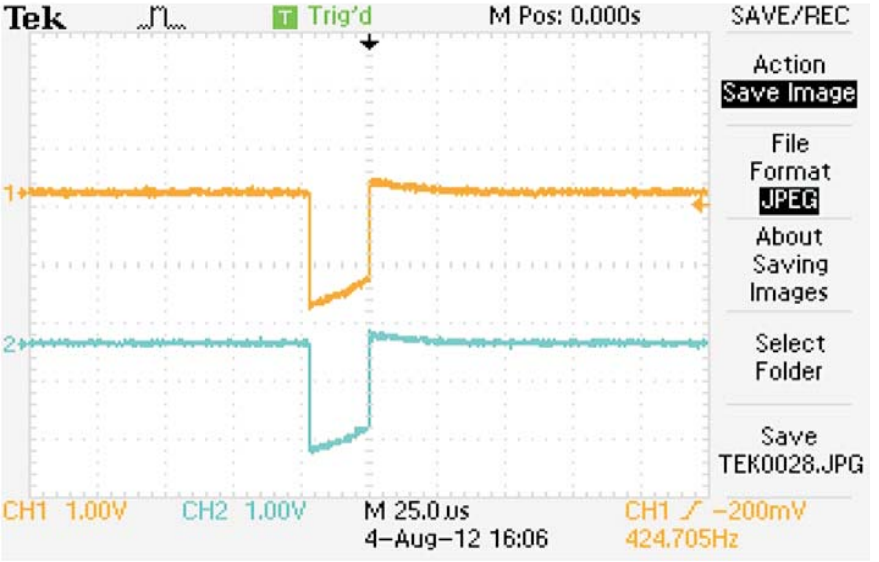

FIGURE-6

When the traction motor runs in maximum speed (say 3000 RPM),the frequency shown in CRO should be close to 6kHz.

Relation between frequency and RPM is mentioned in the below formula:

F=(RPM *120)/60 in Hz.
For eg: RPM =3000, then Frequency is,
F=(3000*120)/60
F=6000 Hz or 6KHz.

7 CONNECTION DETAILS

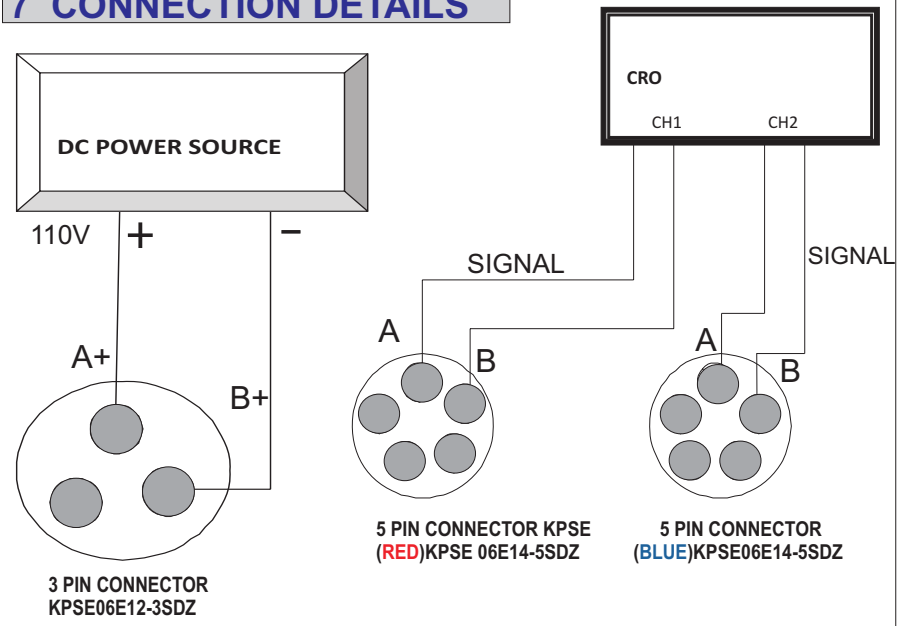

FIGURE-7

! PRECAUTIONS TO BE TAKEN WHILE MOUNTING.

5 pin connector carries signal and should not be connected to High voltage.

3 pin connector is a power connector and is to be connected to 110 Volt. Pin A to + (positive) and pin B to - (negative).

Check the gap before mounting using suitable test gauge.

Mounting surface to be clean and if the gap is too less use shims.

7. TROUBLE SHOOTING

Likely problems and solutions to the problems are listed in **TABLE-1.**

SL. NO.	LIKELY PROBLEMS	SOLUTIONS
1	Error in tacho generator message	Check the air gap and maintain <1.6mm and if the gap is too less, then use shims. Check the wheel version and it must be W-3 version.
2	Speed not increasing more than 1 kmph	Check the air gap, mount the sensor within the specified gap. If the air gap is correct and problem is not solved then Change the sub D connector from respective sensor on SR rack.
3	Speed exceed maximum	Check the mounting of the sensor. Place the sensor with suitable mounting specification
4	Speed exceeds maximum motor- damage possible.	Check the mounting of the sensor. Place the sensor with suitable mounting specification
5	Speed disturbance possible	Check the sensor on test bench if no pulses are visible on CRO then change the sensor with new one.

TABLE-1

9. SCOPE OF SUPPLY

Sl. No.	Description of Sub-Assembly	Quantity (nos)/ Speed Sensor
1	Active Speed Sensor	1
2	Tooth Wheel	1
3	Cable Type H+S part number 12583003 : RADOX TENUIS-TW/S EMC-SC, 600/1000V, 2x1 mm2 18AWG : (cable will be connected with the sensor and crimped with the specified female connector) · 1) Signal Cable - 270 cm 2)Power Supply Cable - 270 cm	 2 1
4	Fixing Bolt for Sensor & Tooth Wheel 1) Hex Hd Screw M8x25 Zn plated, Grade 8.8 to IS:1364(Pt2)'92 (ISO-4017-88) for fixing sensor 2) 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 Tooth Wheel.	2 6
5	1)ITT Cannon Connector KPSE07F12-3P (Loose Supply) with fasteners 2)SS Plate to accommodate connector receptacles	1 1

TABLE-2

Note: In one WAG-9/ WAG9H/ WAP7 locomotive, 06 such sensors are used.
In WAP5 locomotive, 04 such sensors are used.

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