Wheel speed sensor

Rotational Speed Sensor KMI 17/4

Introduction

KMI 17/4 is the sensor which measure rotational speed or the wheel speed. Wheel speed sensor is the integral part of ABS system. KMI 17/4 plays vital role in providing best performance in ABS system by working at its best, easy application and low system cost. It is integrated with magnet and is suitable for ferromagnetic gear wheel application. It is based on AMR technology and has very low jitter performance compiled with his horse solution counterpart. It is a good feat for the indirect TPMS system. On the basics of AMR or Anisotropic Magnetic Resistivity effect, KMI 17/4 with the help of its ferromagnetic teeth detects the rotational speed of passive target wheels. It transmits the speed information's through a current protocol at the supply pins. The designs of the teeth are very effective for specifying the speed information and to detect air gap and also the temperature.

KMI 17/4 has two wire standard current interfaces with a very large range operating terminal voltage from 4.5V – 16Vv. It has integrated temperature offset compensation and it also has very wide operating temperature range from -40\(^\circ\)C- 175\(^\circ\)C. Further it has integrated capacitor between supply terminals to improve EMC performance. The KMI 17/4 is also AEC-Q100 certified with SOT 453 package. The topper most part is the KMI sensor and signal processing ASIC. In the lower most part there is capacitor which helps to improve EMC and EST performance.

Features:

KMI 17/4 provides high performance with its magnetic speed sensing technology for ABS & non ABS speed measurement. The measured data are highly accurate with very low jitter. It performs with high level of integration. It has two wire standard current interfaces with large range of operating terminal voltage. It is adjustable in different temperature range as -40\(^\circ\)C- 175\(^\circ\)C. KMI 17/4 has high electrostatic discharge protection.

Reference Data:
### Pinning & ordering information

<table>
<thead>
<tr>
<th>Pin</th>
<th>Symbol</th>
<th>Description</th>
<th>Simplified outline</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>( V_{CC} )</td>
<td>supply pin</td>
<td><img src="image" alt="Simplified outline of the sensor" /></td>
</tr>
<tr>
<td>2</td>
<td>( \text{GND} )</td>
<td>ground pin</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type number</th>
<th>Package</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>KMI17/4</td>
<td>SIP2</td>
<td>plastic single-ended multi-chip package; magnetized ferrite magnet (4.25 × 5.2 × 3 mm); 4 interconnections; 2 in-line leads</td>
</tr>
</tbody>
</table>

### Functional Operation:

- **Symbol**: \( V_{CC} \)  
  - **Description**: supply pin
- **Symbol**: \( \text{GND} \)  
  - **Description**: ground pin

**Type number**: KMI17/4  
**Package**: SIP2  
**Description**: plastic single-ended multi-chip package; magnetized ferrite magnet (4.25 × 5.2 × 3 mm); 4 interconnections; 2 in-line leads  
**Version**: SOT453E
The operating functions follow a mechanism to read the speed and transmit it to the outsource. The KMI17/4 is very sensitive to the motion of ferrous gear wheel. As per procedure the sensor is placed between the magnetic field and gear wheel which horizontally attracts the field of magnet. Sensor is connected to central ABS system. Magnetic field generates vertical lines. Due to the effects of flux bending the different directions of magnetic field lines in the MR sensor element cause an electric signal. The gear and wheel follows one direction where corresponding magnetic field lines are stroke with its continues movement. The sensor direction of ferrite magnetization the KMI17/4 is sensitive to the movement in the Y direction in front of the sensor.

Equivalent magnetic field strength versus supply voltage in CPTM

CPTM stands for customer production test mode. CPTM is used to measure the air gap safety margin for KMI17/4. When negative supply voltage (-VCC) transmits to the sensor then CPTM is enabled. The main task of CPTM is to add the sensor voltage within ASIC by the variation of –VCC. In the condition when the encoder wheel & CPTM is rotating, VCC should be varied, until the sensor device is just at the edge of failure. The magnetic offset margin should correspond to an air gap margin. In given below diagram we can view the characteristic of Heq versus -VCC in principle.
Characteristics
Characteristics are specified according to the parameter and the unit that is valid for the operating condition voltages are referred to pin GND and with its minimum and maximum value limits. When VCC has exceeded VCC(swOn), the sensor switches on and current levels and current ratios are maintained until VCC falls below VCC(swOff). Module m of the gear wheel is defined as the ratio of outer diameter D and number of teeth N: m = D/N
Wheel speed sensor

Wheel speed sensor is type of sensor used for measuring the speed of the wheels, per unit time. Those system measurement generates the signals which is operated for the electronic stabilization program, traction control or anti lock braking system. These systems completely relay on the information transmitted from the wheel speed sensor. In addition Navigation system also uses this technology for displaying the place. It uses the signals supplied by the sensor and calculates the distance covered by car. The wheel speed sensors normally function from 12 to 24 VDC power supply where the reverse polarity protection is standard and the sensor has built in protection against pulsed transients to -60V, -40V.

When a wheel speed sensor fails or there's a problem in the sensor's wiring circuit, it usually disables the ABS system and causes the ABS warning light to come on. Disabling of wheel speed signal is very risky and serious problem. It may create some issues with locking up. Wheel speed sensors produce an alternating current (AC) output voltage that varies in frequency and amplitude with wheel speed. The faster the wheel turns, the greater the frequency and amplitude of the sensor's output signal. The strength of the signal can be affected by resistance in the sensor, resistance in the wiring and connectors, metallic debris on the end of the sensor, and the air gap between the sensor and tone ring mounted on the axle, hub, brake rotor, drum or CV joint. A narrow air gap is usually necessary to induce a strong signal in the sensor's magnetic windings. Air gaps typically range from .016 in. to as much as .050 in. (0.40 to 1.3 mm) depending on the application. If the ABS warning light is on and you find a code for a wheel speed sensor (and the sensor is adjustable), the problem may be nothing more than too wide an air gap.

Key features of Wheel speed sensor:
Importance of wheel speed sensors

Road traffic is increasing very rapidly, with the increase in traffic there is also increase in the risk of safety issues. The modern tools like wheel speed sensors assists the systems and those standard tools are the fault free functions to maximize the safety issues. In relation to driving safety, wheel speed sensors are of particular importance and are used in numerous applications in various vehicle systems. In driver assistance systems such as ABS, TCS, ESP or ACC, motor control units use these sensors to determine the wheel speed. Due to this variety of applications, wheel speed sensors make a direct contribution to driving dynamics, driving safety, driving comfort and reduced fuel consumption and emissions.

Types of Speed wheel sensor

There are two types of Speed wheel sensor they are passive sensor with sensor gear and Active sensor with encode wheel. In passive sensor the registers speeds from 3 km per hour. It function according to the induction principles and the output signal of this type of sensor has AC voltage.

Whereas, the Active sensor registers the speeds from 0 km per hour. In active sensor the work mechanism is done according to the magneto resistive principle and they must be supplied with current. Further in Active wheel sensors the speed detection is based on anisotropic magneto resistive effect which includes the functions like detecting of stoppage, monitoring the gaps, displaying of current interface, recognition of direction of rotation, etc. These types of function are very useful for exact calculation of the controlling action of ABS and ESP and for low emissions& higher driving dynamics with comfort.

Wheel Speed Sensor circuit diagram with Testing and Replacements details:
Testing the wheel sensors:

All the sensors centrally connect to ABS control unit. Control unit is used to test circuit by probing the wheel sensors from the ABS control unit in disconnects the wiring from the control unit. Disconnecting the wiring from the central control unit & connecting the only released to the corresponding pins of each sensor. Through the sensors we could read approximately 1600 Ohm resistance while within inspects. The right rear reads about 2,000,700 Ohm’s which is nearly an open circuit just like the tribal court. Before replacing the sensor a verification of the wiring from the controller to the final connector the sensor is in order. To do this we must disconnect the final connector located in the trunk. Then connect the jumper wire between the pins on the connector leading to the controller. Now the meter at the controller res 1.1 Ohm’s resistance which mean circuit from the controller to the final connector is good. Next test the connector leading into the sensor. The circuit’s reads open which means the wheel speed sensor is in problem and must be replaced.

Replacing the right rear wheel speed sensor:
The wiring to the censor must take a specific path to prevent it from being stressed or pinched while the vehicle is being driven. Due to the harsh environment ABS sensors are constantly subjective and it is common for rustic corrosion to seize a sensor into the backing plate. After the defective sensors is removed multi holds needs to be cleaned to make it possible to insert the new sensor. To clean a mounting hole you might want to try. Fold the cut coat head wire in half and insert that wire into the drilled part and tighten it down. Before inserting the sensor, check the mounting bracket locations. It is critical for this practice to be positioned and placed in the exact location as the original. After installation we could check if it works or not

Installation:

The sensor normally comes with 3 wires, the red wire should be connected to a 12 - 24V DC supply voltage, the black wire should go to the ground connection and the white wire should go to one of the frequency inputs.

**Mounting Dimensions New Type:**

![Mounting Dimensions New Type](image)

**Mounting Dimensions Old Type:**

![Mounting Dimensions Old Type](image)
The basic parameters when an application is not restricted to a specific target.

**Target Dimensions**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tooth Height</td>
<td>.200 in. (5.06mm) min.</td>
</tr>
<tr>
<td>Tooth Width</td>
<td>.100 in (2.54mm) min</td>
</tr>
<tr>
<td>Tooth Spacing</td>
<td>.400 in. (10.16mm)</td>
</tr>
<tr>
<td>Target Thickness</td>
<td>.250 in. (6.35)</td>
</tr>
</tbody>
</table>

**Target Conditions**

Target condition may be different due to the target size, location, geometry. The reference target configuration and evaluation conditions are given below:
Target

<table>
<thead>
<tr>
<th>Diameter</th>
<th>4in. (101,6mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tooth Width</td>
<td>.350 in. (8,89mm)</td>
</tr>
<tr>
<td>Thickness</td>
<td>.250 in. 96,35mm)</td>
</tr>
</tbody>
</table>

Test Conditions

<table>
<thead>
<tr>
<th>Air Gap</th>
<th>.040 to .080 in. (1,02 to 2,03mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>V Supply</td>
<td>4.5 to 24 V</td>
</tr>
<tr>
<td>RPM</td>
<td>10 min., 3600 max</td>
</tr>
</tbody>
</table>

Testing the new sensor:

A check up the resistance from the controller through the sensor reads 1,609 Ohm’s, which is within inspects. Checking the AC voltage output from the wheel should also be verified. When the wheel spins the exciter ring and a hub also turns and moves the magnetic field across the central linings generating an AC voltage.
Wheel speed sensor error search tree:
References:
