Rotational speed sensor

Constantly aware of that speed sensation

Compact and easy to design in, our KMI magnetoresistive sensors provide simple and cost-effective solutions for all your rotational speed measurement needs. They meet the high EMC, reliability and temperature range requirements of the automotive sector, and are available in a range of options to maximize design freedom.

Key benefits

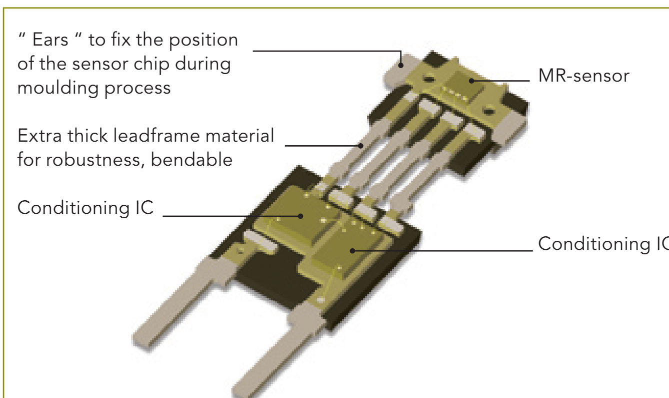
- Wide air gap between sensor and target
- Speed detection down to 0 Hz
- Very low jitter
- Wide frequency range
- Insensitive to vibrations
- Temperature range: -40 to +150 °C
- Prepared for injection moulding

Key applications

- ABS
- Engine management
- Gearbox
- Transmission systems
- Vehicle speed
- DC motor commutation

Accurate rotational speed measurement is a vital component in maintaining performance, safety and reliability in modern vehicles. It forms the basis of numerous applications from anti-lock braking to engine management systems, and opens the way for embedding intelligence throughout the car with the introduction of advanced X-by-wire networks and control systems.

NXP's KMI family of magnetoresistive (MR) rotational speed sensors provides a solution for all applications. Designed specifically to meet the needs of automotive systems, they are complete, ready-to-use modules comprising sensor, back-biasing magnet and advanced signal conditioning IC. Enabling maximum design flexibility, the devices are available with a choice of output signals and individually magnetized back-biasing magnets.

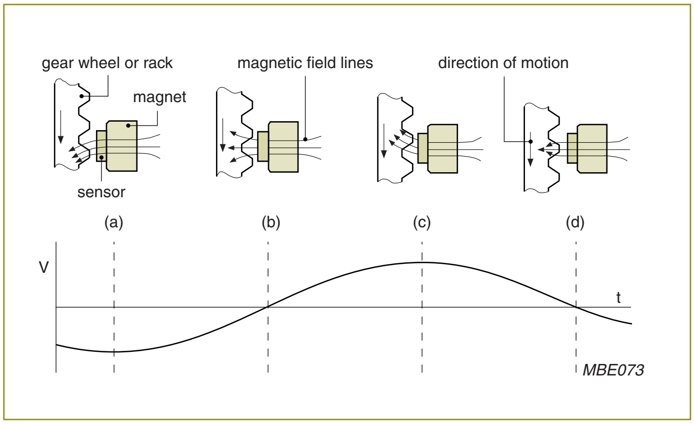


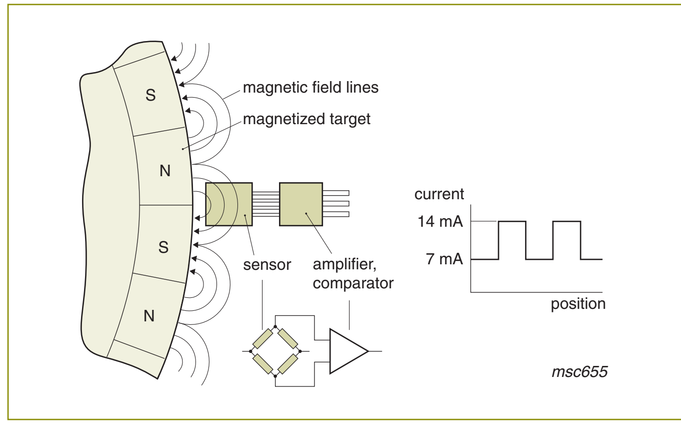
Component detail of the KMI20

founded by Philips

How to measure rotation with MR sensors

The KMI sensors are designed to sense the motion of ferrous gear wheels or of magnetized targets. A periodic magnetic field stemming from the effect of flux bending by ferrous gear wheels or directly from magnetized targets will be transformed by a MR sensor into an analog electrical signal. The frequency of this signal is proportional to the rotational speed of the target.





A subsequent integrated circuit transforms the analogue into a digital output signal. The output level is independent of the sensing distance within the measurement range.

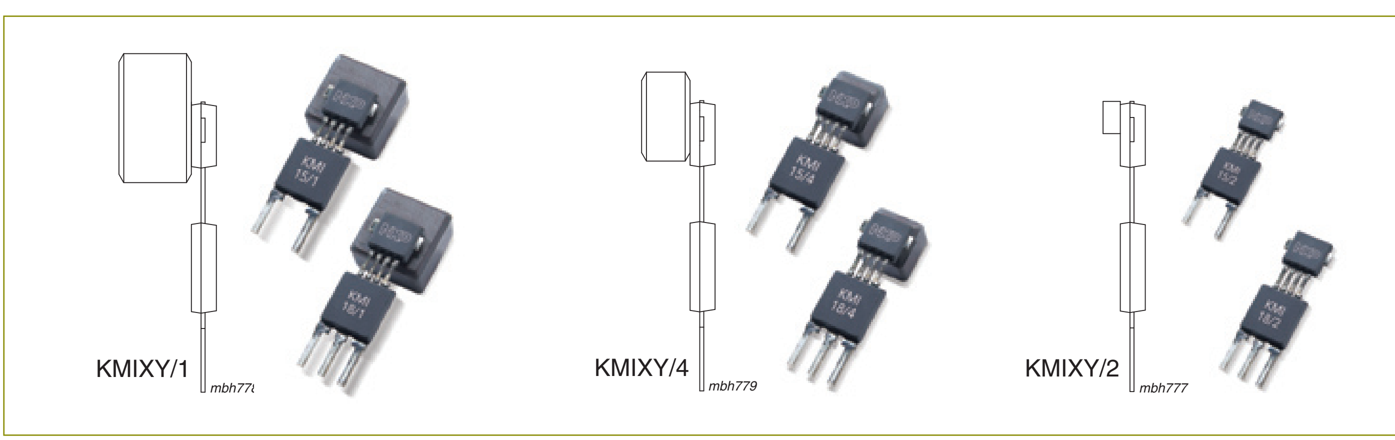
Back-biasing magnets, individually magnetized for each sensor

- Large (8.0 x 8.0 x 4.5 mm) – for maximum air gap between sensor and ferrous targets
- Medium (5.5 x 5.5 x 3.0 mm) – for use with ferrous targets where space is limited
- Small (3.8 x 2.0 x 0.8 mm) – for magnetized targets, stabilizing the inherently bi-stable MR sensor

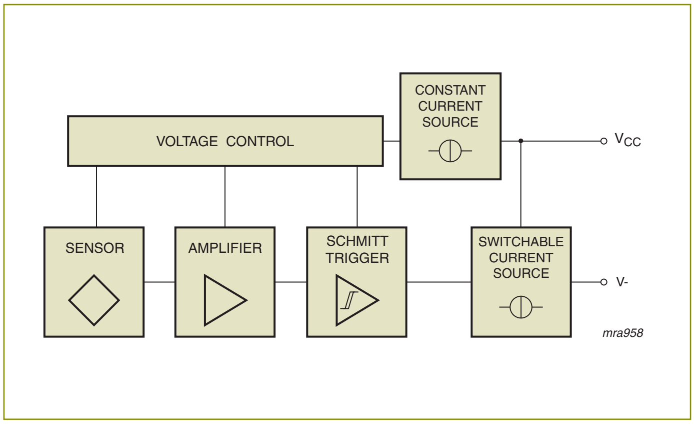
Output signals

For high flexibility in the design of the subsequent signal conditioning electronics, the KMI sensors are available with:

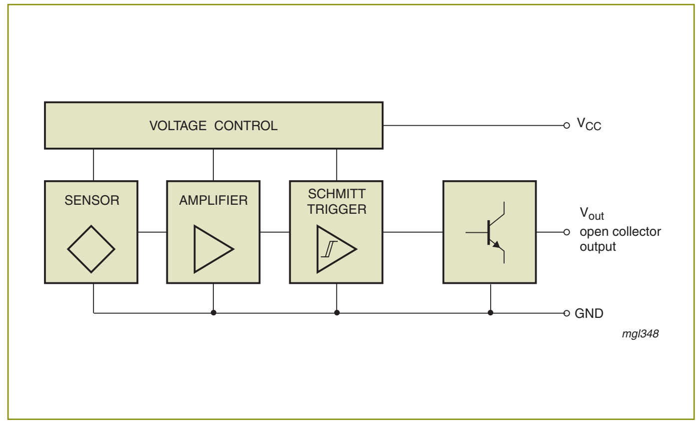
- a digital current output signal (2-wire)
- an open collector output signal (3-wire)



KMI15 – 7/14 mA current output (2-wire)

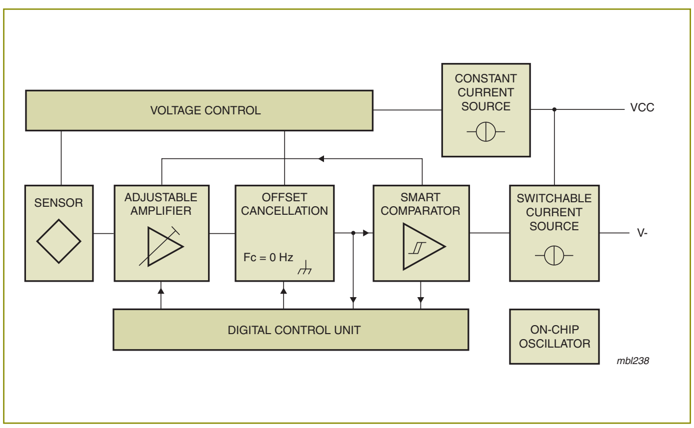


KMI18 – open collector output (3-wire)

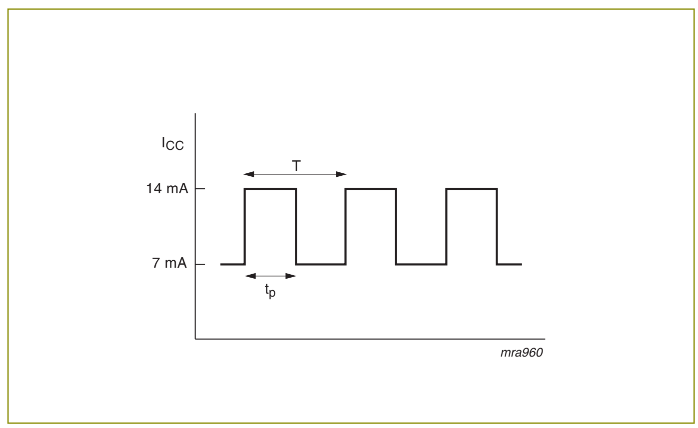


The MR sensor signal is amplified, temperature compensated and passed to a Schmitt trigger.

KMI20 – 7/14 mA current output (2-wire), extended air gap



The MR sensor signal is fed into the conditioning IC. The offset, gain and hysteresis are digitally adapted to ensure an exceptional air gap capability.



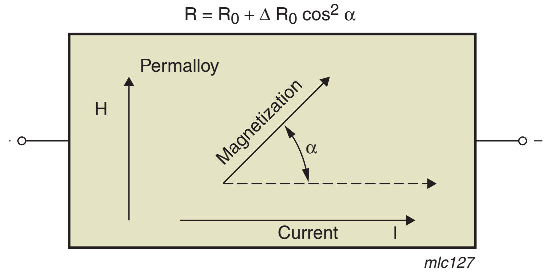
7/14 mA output signal as a function of time

Product overview

Sensor type	typ. sensing distance (mm)	Tooth frequency (Hz)	Target	Interface	Magnet size (mm)
KMI15/1	0.9 - 2.9	0 - 25.000	note 1	Current	8 x 8 x 4.5
KMI15/2	0.5 - 2.7	0 - 25.000	note 2	Current	3.8 x 2 x 0.8
KMI15/4	0.5 - 2.3	0 - 25.000	note 1	Current	5.5 x 5.5 x 3
KMI18/1	0.9 - 2.9	0 - 25.000	note 1	Open collector	8 x 8 x 4.5
KMI18/2	0.5 - 2.7	0 - 25.000	note 2	Open collector	3.8 x 2 x 0.8
KMI18/4	0.5 - 2.3	0 - 25.000	note 1	Open collector	5.5 x 5.5 x 3
KMI20/1	0.9 - 3.5*	0 - 2.500	note 1	Current	8 x 8 x 4.5
KMI20/2	0.5 - 3.2*	0 - 2.500	note 2	Current	3.8 x 2 x 0.8
KMI20/4	0.5 - 2.8*	0 - 2.500	note 1	Current	5.5 x 5.5 x 3

* + 1 mm dynamic reserve | note 1 - ferrous target | note 2 - magnetized target

Advantages by design



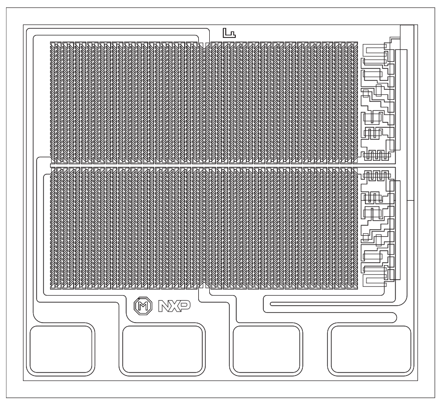
The magnetoresistive effect in permalloy

MR sensors offer a uniquely versatile combination of features and important cost benefits. Based on the MR effect, specifically designed sensors for angle and linear displacement measurements are also available from NXP, as are solutions for weak field detection.

NXP sensors are based on the MR effect, where the resistance of a current-carrying magnetic material, for example a permalloy (19% Fe, 81% Ni) changes under the influence of an external magnetic field. If an external field is applied, in the plane of the current flow, the internal magnetization vector will rotate by the angle of this field, changing the resistance of the material.

The MR sensor consists of four sensitive resistors in a Wheatstone bridge configuration, with each resistor arranged to maximize sensitivity and minimize temperature influences. Such a Wheatstone bridge design along with the inherent benefits of MR technology provides several advantages:

- reduction of temperature drift
- independent of mechanical assembly tolerances / shifts
- maximum signal output
- reduction of non-linearity



Tipical sensor bridge structure

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NXP Semiconductors is in the process of being established as a separate legal entity in various countries worldwide. This process will be finalized in the course of 2006.

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