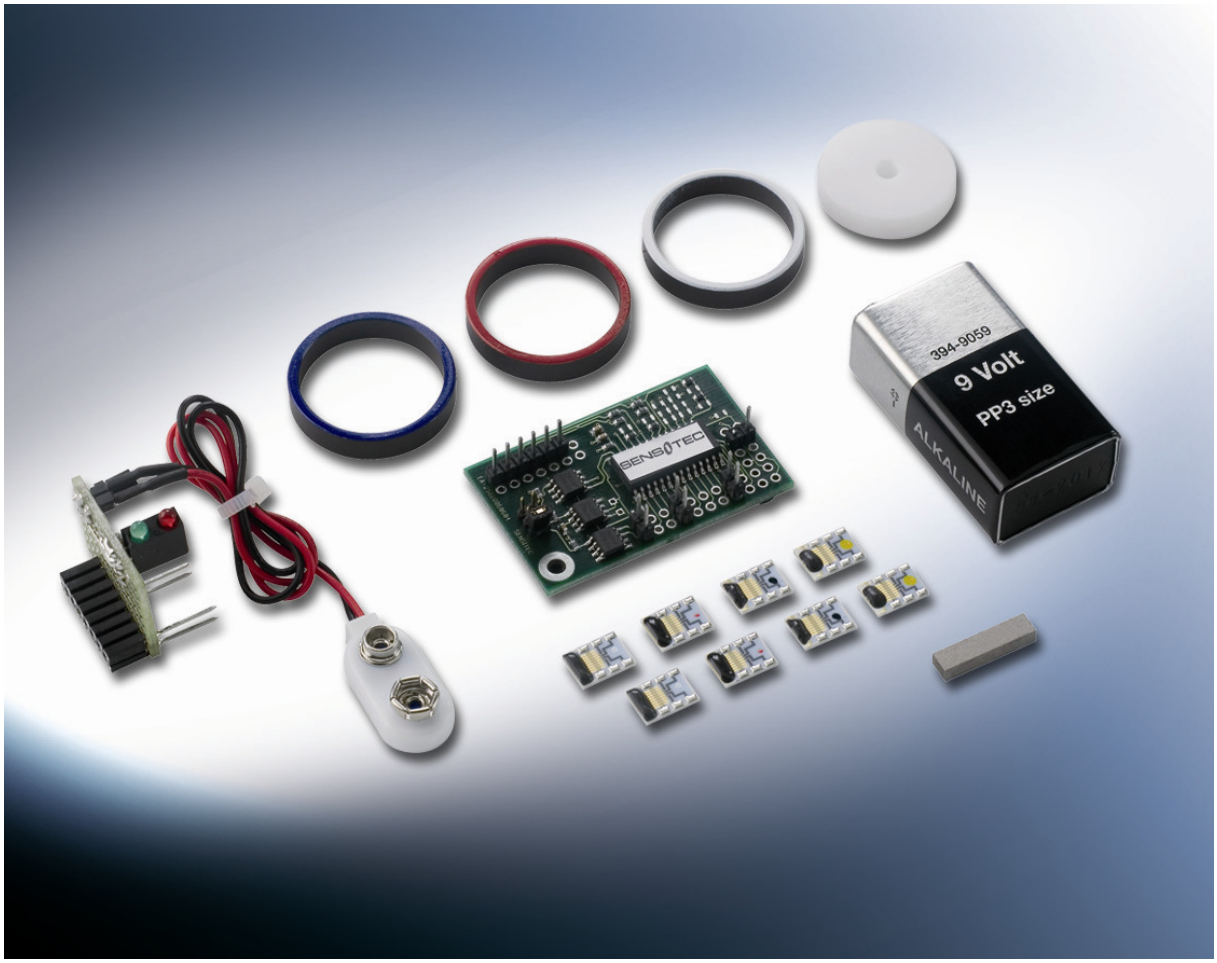
SENSITEC
MagnetoResistive Sensors

EKW01
Evaluation Kit for Angle Measurement

User Manual



User Manual

This evaluation kit provides the opportunity to learn the features and benefits of AMR sensor technology, as used in angle measurement systems, in a quick and easy manner.

Please note, that the parts are sensitive to electrostatic fields.

Please take care to observe the polarity of the signal processing circuit and do not change the jumper while a voltage is applied.

Please do not solder too hot resp. too long. That can damage the sensor.

Please do not touch parts with the magnet or other magnetic parts and keep it away from strong electromagnetic fields

The kit includes a 9 V battery and a cable including voltage controller and an LED for displaying the output signal (green A, red B rectangular signal). If an external voltage supply is used (+ 5 V) this can be connected directly to the signal processing circuit. In this case a connecting cable is not necessary.

The products included in this package are not RoHS-compliant and are therefore not intended for private use. Please follow local regulations regarding the disposal of batteries. Sensitec can dispose of the parts on your behalf if they are returned cost-free to our premises.

The quality of the measurement signals and the subsequent evaluation depends primarily on the measuring setup and the arrangement of the sensor and the measurement scale. Please keep this in mind when first using the evaluation kit. A mechanical guidance mechanism, which guides the sensor along the scale is ideal.

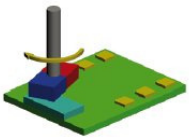
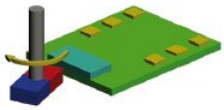
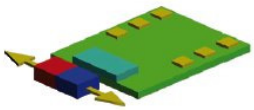
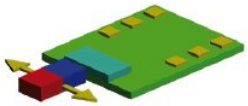
The components have been specially selected to allow study of the different influences on the resolution and accuracy of a length measurement system, for example the pitch of the magnetic scale or the interpolation factor of the interpolation ASIC.

The scales have a different colour depending on the pole pitch and can thus be assigned easily to the corresponding sensors. With the exception of the LK40 sensor (yellow), which can be used for pole pitches above 2 mm, all other sensors have a fixed assignment to a scale with a corresponding pole pitch.

The standard measuring configuration between sensor and scale is shown in figure 5 of the enclosed overview of measuring configurations.
Figures 1, 2, 3 and 4 show arrangements which can be executed using the LK40 sensor and the bar magnet. Sensors of the LK14, LK16 and LK29 series are not suitable for this arrangement.

A reference value for the maximum air gap between the leading face of the sensor and the scale surface is half the pitch measured in mm. For further information and advice please do not hesitate to contact us.

Setting up Measurements

No	Depiction	Configuration	Application Example
1		Rotating magnet; sensor mounted in the axis of rotation on a substrate.	Absolute angle measurement up to 180° at the shaft end (axial).
2		Rotating magnet; sensor mounted on a substrate perpendicularly to the axis of rotation.	Absolute angle measurement up to 180° at the shaft end (radial).
3		Magnet moves linearly; sensor mounted at the edge of a substrate.	Absolute length measurement along a magnet.
4		Magnet moves linearly; sensor mounted at the edge of a substrate.	Magnetic switch.
5		Magnetic pole ring with fixed pitch; sensor mounted on substrate radially to the pole ring; sensor surface in the plane of the pole ring.	Incremental angle measurement at the shaft circumference.

Testboard EA-nI-0060601
Signal with Interpolation ASIC

Characteristic

- Interpolation factor: 1, 10, 50
- Variable interpolation with jumper
- TTL/CMOS compatible output
- Output incremental
- Output frequency AX/BX up to 400KHz

Application

- Decoder incremental angle- and length resolution with a phase shift of 90°
- Resolution for incremental encoders

Short Description

The signal processing of the MR sensor signals is carried out by means of the interpolation ASIC. It is based on amplifiers, A/D converters and logic circuits. By means of the amplifier the signals are amplified in such a way that the A/D converter works in an optimized range. The amplified sensor signals are led to the SIN and COS connections. These connections should not be used during operation, because loading of the circuit could falsify the measurement signal. The sensor signal is output as rectangular signals with a 90° phase shift and the appropriate resolution at the AX and BX connections (green and red LED). When using the corresponding measurement scale the required input signal for the interpolation ASIC is provided by the LK14, LK16, LK29 or LK40 AMR sensor. The interpolation generates a multiple of the basic period of the system. An interpolation factor of 1 is equivalent to a comparator and both sensor signals have a resolution of 4 flanks.

EKW01
Evaluation Kit for Angle Measurement

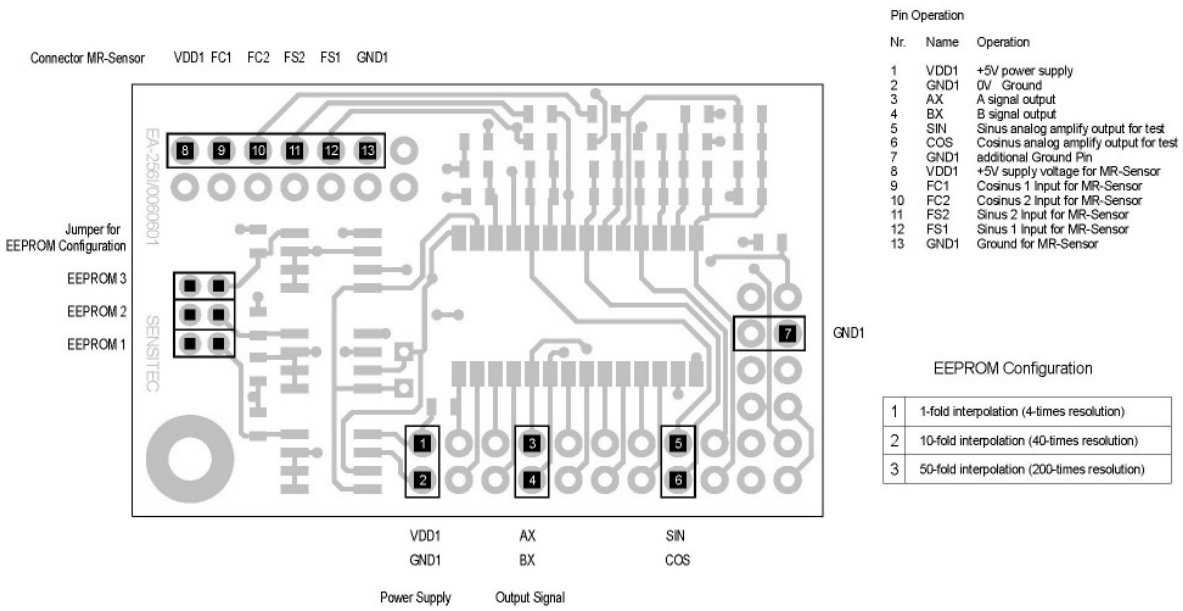
Technical Data

Power supply :	5 VDC ± 10 %
Current consumption:	< 30 mA (output active)
Temperature range:	-20 up to +70 °C
Input signal:	differential 100 mV ± 20 %
Output signal:	square wave phase shift 90°

Pin Assignment

No.	Name	Function
1	VDD1	+5 VDC power supply
2	GND1	Ground
3	AX	Incremental output track A
4	BX	Incremental output track B
5	SIN	Amplifier output SIN
6	COS	Amplifier output COS
7	GND1	Additional ground
8	VDD1	+5 VDC power supply for MR sensor
9	FC1	Cos 1 input for MR sensor
10	FC2	Cos 2 input for MR sensor
11	FS2	Sin 2 input for MR sensor
12	FS1	Sin 1 input for MR sensor
13	GND1	Ground for MR sensor

Pin Configuration EA-nl-0060601



LK14A AMR sensor for Angle Measurement

The LK14A is a magnetoresistive **FIX**PITCH sensor, with an active structure adapted to a measurement scale with a 5 mm pole pitch. The sensor chip features 2 complete Wheatstone bridges. The signal at the output of the first bridge corresponds to the sine of the measurement scale, while the matching cosine signal is available at the output of the second bridge. The sensor operates without the need for a stabilising magnetic field. As long as the sensor is used in saturation, the amplitude is largely independent of the air gap. Typically that is up to half the pitch of the measurement scale (2.5 mm air gap). A separation of up to 3.5 mm is possible with reduced performance.

Absolute Maximum Ratings

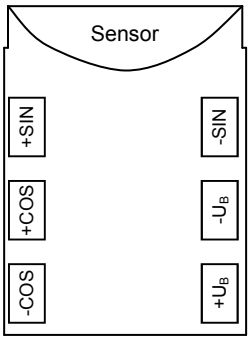
Maximum voltage	$\|U_B\|$	≤ 5.5 V
Operating temperature range	T	-20 °C up to +85 °C

Electrical Characteristics (25 °C, H > 30 kA/m):

Sensor resistance	R_S	(1.5 ± 0.5) kΩ
Bridge resistance	R_B	(3 ± 1) kΩ
Signal amplitude in the operating distance	U_a/U_B	≥ 9.5 mV/V
Offset	$\|U_{off}/U_B\|$	≤ 1 mV/V
Offset drift	$\|\Delta U_{off} / U_B\ \Delta t\|$	≤ 100 nV/Vh
Temperature coefficient of signal amplitude	T_{KU}	$(-4.0 \pm 0.8)^* 10^{-3} K^{-1}$
Temperature coefficient of R_s	TK_{RS}	$(2.6 \pm 0.6) *10^{-3} K^{-1}$

Sensitec reserves the right to modify technical specifications without prior notice.

Pin Configuration LK14AG



LK16A AMR sensor for Angle Measurement

The LK16A is a magnetoresistive **FIX**PITCH sensor, with an active structure adapted to a measurement scale with a 2 mm pole pitch. The sensor chip features 2 complete Wheatstone bridges. The signal at the output of the first bridge corresponds to the sine of the measurement scale, while the matching cosine signal is available at the output of the second bridge. The sensor operates without the need for a stabilising magnetic field. As long as the sensor is used in saturation, the amplitude is largely independent of the air gap. Typically that is up to half the pitch of the measurement scale (1 mm air gap). A separation of up to 1.5 mm is possible with reduced performance.

Absolute Maximum Ratings

Maximum voltage	$\|U_B\|$	≤ 5.5 V
Operating temperature range	T	-20 °C up to +85 °C

Electrical Characteristics (25 °C, H > 30 kA/m):

Sensor resistance	R_S	(1.7 ± 0.6) kΩ
Bridge resistance	R_B	(3.4 ± 1.2) kΩ
Signal amplitude in the operating distance	U_a/U_B	≥ 8 mV/V
Offset	$\|U_{off}/U_B\|$	≤ 2 mV/V
Offset drift	$\|\Delta U_{off} / U_B\ \Delta t\|$	≤ 100 nV/Vh
Temperature coefficient of signal amplitude	T_{KU}	$(-4.0 \pm 0.8)^* 10^{-3}\ K^{-1}$
Temperature coefficient of R_s	TK_{RS}	$(2.5 \pm 0.6) *10^{-3}\ K^{-1}$

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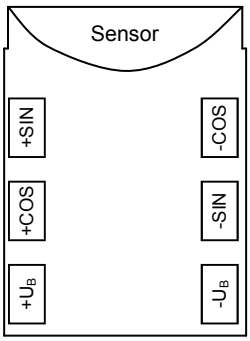
Pin Configuration LK16AG



LK29A AMR sensor for Angle Measurement

The LK29A is a magnetoresistive **FIX**PITCH sensor, with an active structure adapted to a measurement scale with a 1 mm pole pitch. The sensor chip features 2 complete Wheatstone bridges. The signal at the output of the first bridge corresponds to the sine of the measurement scale, while the matching cosine signal is available at the output of the second bridge. The sensor operates without the need for a stabilising magnetic field. As long as the sensor is used in saturation, the amplitude is largely independent of the air gap. Typically that is up to half the pitch of the measurement scale (0.5 mm air gap). A separation of up to 0.7 mm is possible with reduced performance.

Absolute Maximum Ratings

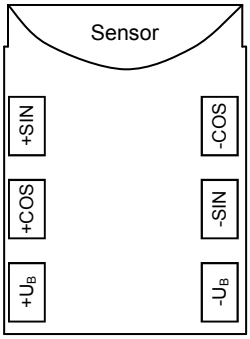
Maximum voltage	$\|U_B\|$	≤ 5.5 V
Operating temperature range	T	-20 °C up to +85 °C

Electrical Characteristics (25 °C, H > 30 kA/m):

Sensor resistance	R_S	(1.8 ± 0.6) kΩ
Bridge resistance	R_B	(3.6 ± 1.2) kΩ
Signal amplitude in the operating distance	U_a/U_B	≥ 8 mV/V
Offset	$\|U_{off}/U_B\|$	≤ 2 mV/V
Offset drift	$\|\Delta U_{off} / U_B\ \Delta t\|$	≤ 100 nV/Vh
Temperature coefficient of signal amplitude	T_{KU}	$(-3.8 \pm 0.8)^* 10^{-3} K^{-1}$
Temperature coefficient of R_s	TK_{RS}	$(2.6 \pm 0.6) *10^{-3} K^{-1}$

Sensitec reserves the right to modify technical specifications without prior notice

Pin Configuration LK29AG



LK40B AMR sensor for Angle Measurement

The LK40B is a magnetoresistive **FREE**PITCH sensor not tied to a particular pole length. The sensor detects 2 pole magnets and pole lengths of more than 2 mm. It features 2 complete Wheatstone bridges. The signal at the output of the bridges corresponds to the sine and cosine. The sensor operates without the need for a stabilising magnetic field. As long as the sensor is used in saturation, the amplitude is largely independent of the air gap. Typically that is up to half the pitch of the measurement scale as long as the pole structure is regular. With reduced performance even a bigger air gap is possible.

Absolute Maximum Ratings

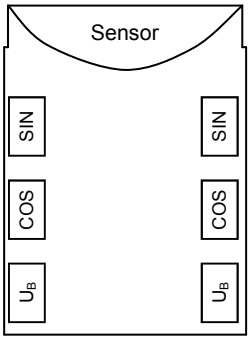
Maximum voltage	$\|U_B\|$	≤ 5.5 V
Operating temperature range	T	-40 °C up to +120 °C @ 120 °C limited lifetime 7200 h

Electrical Characteristics (25 °C, H > 30 kA/m):

Sensor resistance	R_S	(1.7 ± 0.7) kΩ
Bridge resistance	R_B	(3.4 ± 1.4) kΩ
Signal amplitude in the operating distance	U_a/U_B	8 - 13 mV/V
Offset	$\|U_{off}/U_B\|$	≤ 2 mV/V
Offset drift	$\|\Delta U_{off} / U_B\ \Delta t\|$	≤ 100 nV/Vh
Temperature coefficient of signal amplitude	T_{KU}	$(-4.0 \pm 0.8)^* 10^{-3} K^{-1}$
Temperature coefficient of R_s	TK_{RS}	$(2.6 \pm 0.6) *10^{-3} K^{-1}$

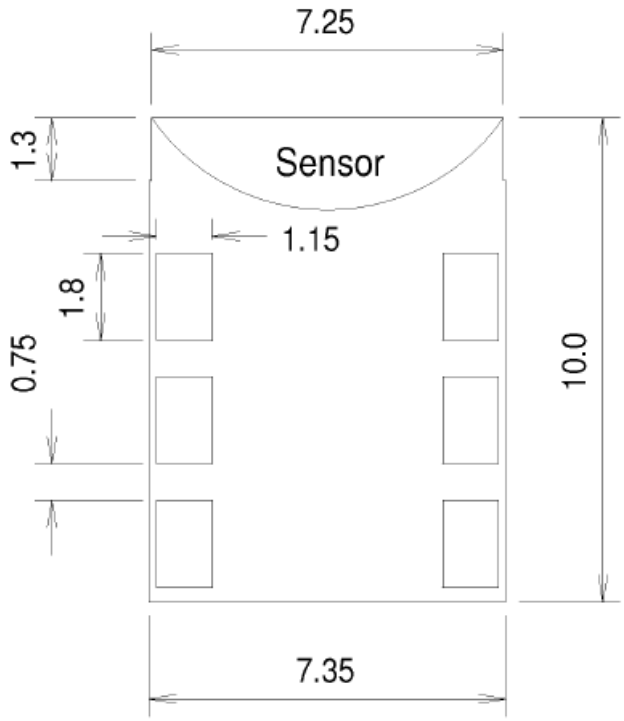
Sensitec reserves the right to modify technical specifications without prior notice.

Pin Configuration LK40BG



Mechanical Dimensions of Ceramic Board

The thickness of the ceramic is 0.7 mm. The pads are covered with solderable material.



Kit content

Quantity	Article	Label	Note
3	LK14AG	White	1 unit incl. 200 mm cable for pole length 5 mm
3	LK16AG	Red	1 unit incl. 200 mm cable for pole length 2 mm
3	LK29AG	Black	1 unit incl. 200 mm cable for pole length 1 mm
3	LK40BG	Yellow	1 unit incl. 200 cable for pole length 2 mm and longer
1	MLI-1000-100	Blue	Linear scale 100 x 10 x 1.3 mm³ with 1 mm pole division
1	MLI-2000-100	Red	Linear scale 100 x 10 x 1.3 mm³ with 2 mm pole division
1	MLI-3000-100	White	Linear scale 100 x 10 x 1.3 mm³ with 5 mm pole division
1	EA-nl-0060601		Testboard incl. 3 interpolation factors
1	Cable		Battery cable with LED and connector
1	Battery		9 V battery
1	Magnet		Magnet 12 x 3 x 2 mm
1	Documentation		Pin configuration manual and data sheets
1	Package		ESD-package

General nformation

Product Status

The product is in series production. **Note:** The status of the product may have changed since this user manual was published. The latest information is available on the internet at www.sensitec.com.

Right to make changes

Sensitec GmbH reserves the right to make changes, without notice, in the products, including software, described or contained herein in order to improve design and/or performance. Sensitec GmbH assumes no responsibility or liability for the use of any of these products.

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Applications that are described herein for any of these products are for illustrative purposes only. Sensitec GmbH makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

Life critical applications

These products are not qualified for use in life support appliances, aeronautical applications or devices or systems where malfunction of these products can reasonably be expected to result in personal injury.

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