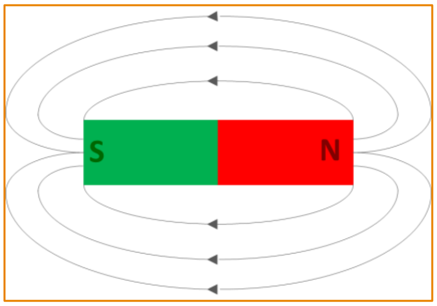
Linear measurement with KMA36

APPLICATION NOTE

Linear Measurement



In general, the KMA36 is designed for the measurement of magnetic field angles. This characteristic is typically used for rotational measurements, however also linear measurements are possible. This results from the fact that over the length of the magnet, the magnetic field rotates by 180°. So, when the magnet is moved linearly, the KMA36 recognizes this magnetic field rotation. The sensor signal can be received as an I²C or PWM signal.

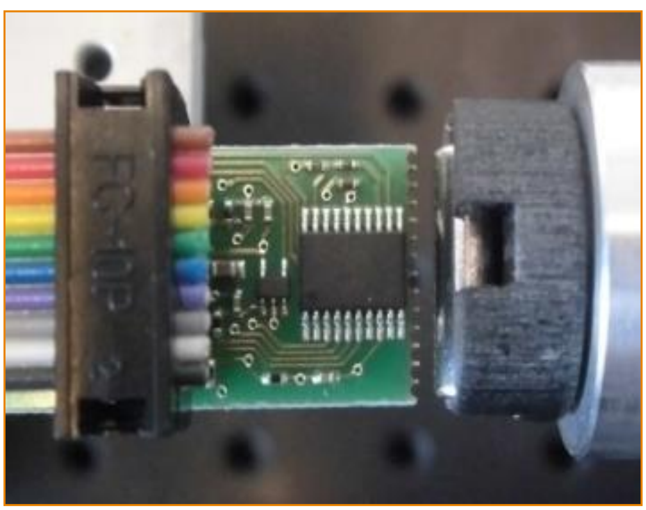
Figure 1: The schematic field distribution of a bar magnet indicates a field rotation of 180° over the length of the magnet

Linear measurement with rod magnet (14mm x ø4mm)

In this example, a rod magnet made from sintered NdFeB with grade N38 and geometrical dimensions length 14mm, diameter 4mm is used, as it can be found in many applications.

ALIGNMENT

The sensor and the rod magnet need to be aligned at the same level as it shown in Figure 2 below. The air gap between the rod magnet and the sensor depends on the magnetic field strength the magnet produces. The KMA36 is designed to work with magnetic field strengths between 25-60 kA/m. In this example the air gap is chosen to be 1mm. The arrangement is made for the rod magnet to make a linear movement as indicated.



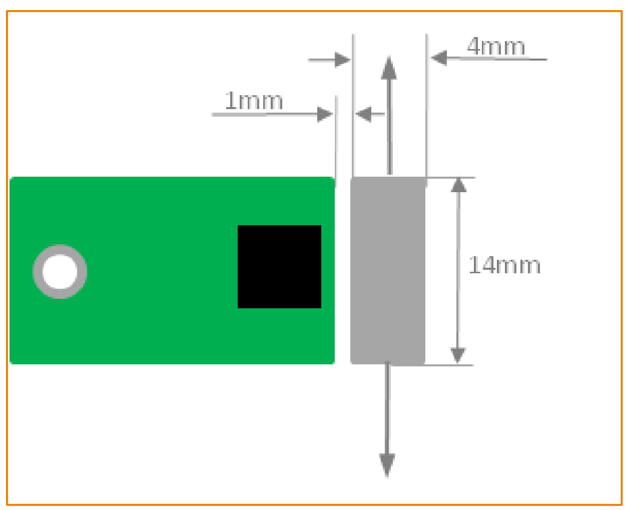


Figure 2: Sensor – magnet alignment and air gap definition

CONFIGURATION

Before starting the measurement, the sensor needs to be configured via I²C with the following parameters:

Low power mode	activated	PWR-Bit in KCONF reg
Oversampling	32	OVCS-Bits in KCONF reg
Resolution	8192	KRES reg

RESULT

Starting with the magnetic center positioned centered in front of the KMA36, the sensor readings show linear behavior to an extend of 14 mm. Figure 3 shows the sensor response for different positions of KMA36 for an air gap of 1mm.

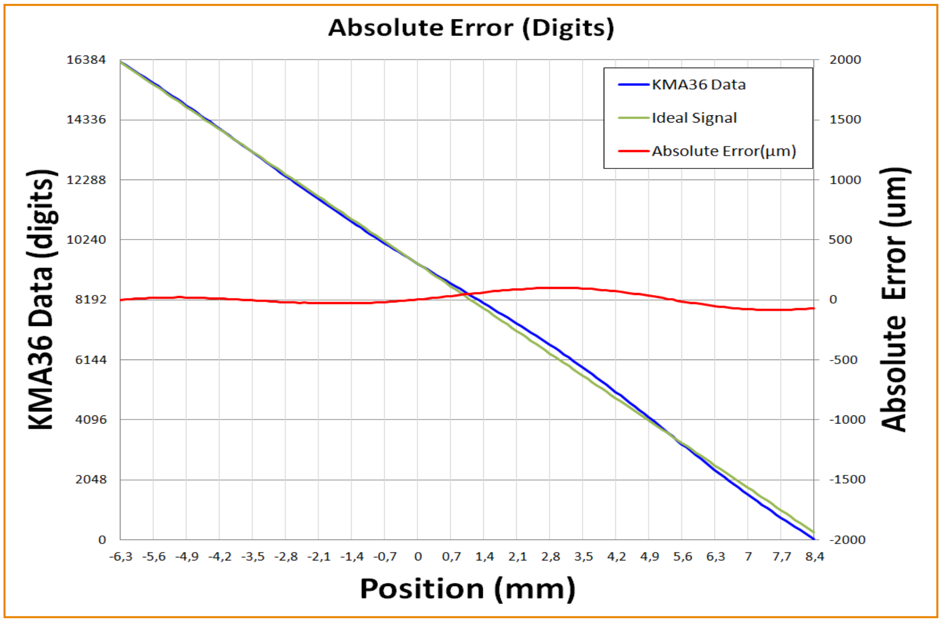


Figure 3: Digital sensor output and absolute error

The blue line shows the output from the sensor (left y-axis), which is nearly linear. The red line shows the absolute positioning error in um (right y-axis) with a maximum error of ~+/- 90 um. The error is the difference between the signal and the ideal linear course.

CONCLUSION

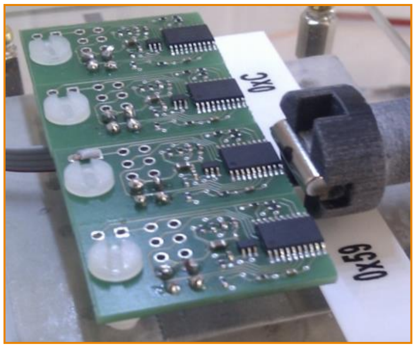
Analysis of the useful magnet movement range (linear-like behavior) in a linear measurement arrangement with a rod magnet has been done and a linear range of about 14 mm with an absolute max error of 150 micrometer was detected.

Linear measurement with KMA36 array and rod magnet (14mm x ø4mm)

In this application note we present an example of a measurement of a linear magnet movement of 60mm utilizing an array of KMA36 sensors. In this example we used a cylindrical rod magnet made from sintered NdFeB with grade N38 and geometrical dimensions of 14mm length and a diameter of 4mm.

ALIGNMENT

For this measurement the sensor and the rod magnet need to be aligned at the same level. The air gap between the rod magnet and the sensor depends on the magnetic field strength the magnet produces. The KMA36 is designed to work with magnetic field strengths between 15 and 60 kA/m. The air gap in this example is chosen to be 1mm. The arrangement is made for the rod magnet to make a linear movement as indicated in figure 4.



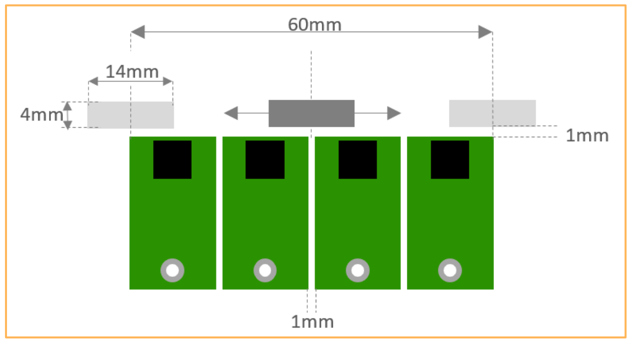


Figure 4: Real (left) and schematic (right) set up

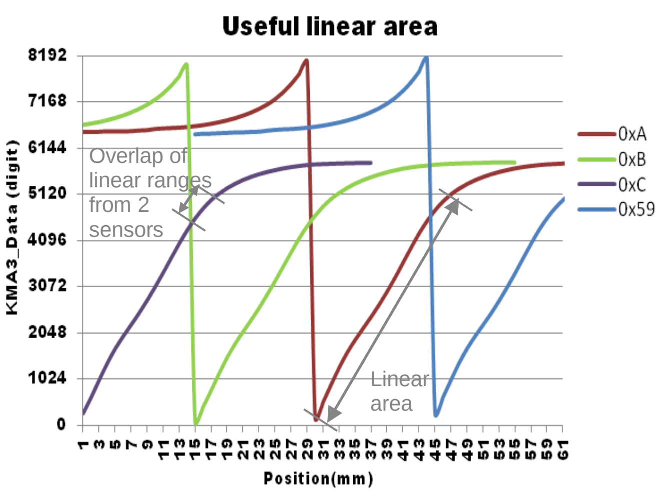
CONFIGURATION

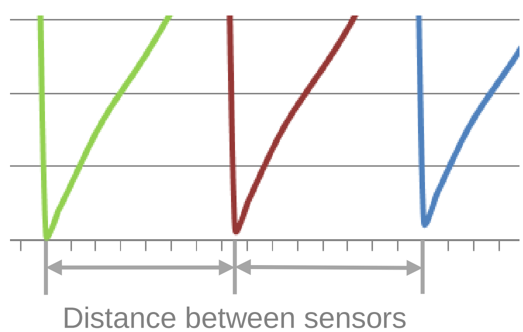
Before starting the measurement, the sensor needs to be configured via I²C with the following parameters:

Linear mode	deactivated	LIN-Bit in KCONF reg
Incremental-Counter-Mode:	activated	CNT-Bit in KCONF reg
Oversampling	32	OVCS-Bits in KCONF reg
Resolution	8192	KRES reg

RESULT

As the rod magnet makes a linear movement in front of 4x KMA36 sensor system, each KMA responds with a characteristic signal output curve. As seen in the previous example, the output is very linear if the magnet moves in front of the sensor. There are several ways to decide, which of the four KMA sensors is used for determining the actual position.

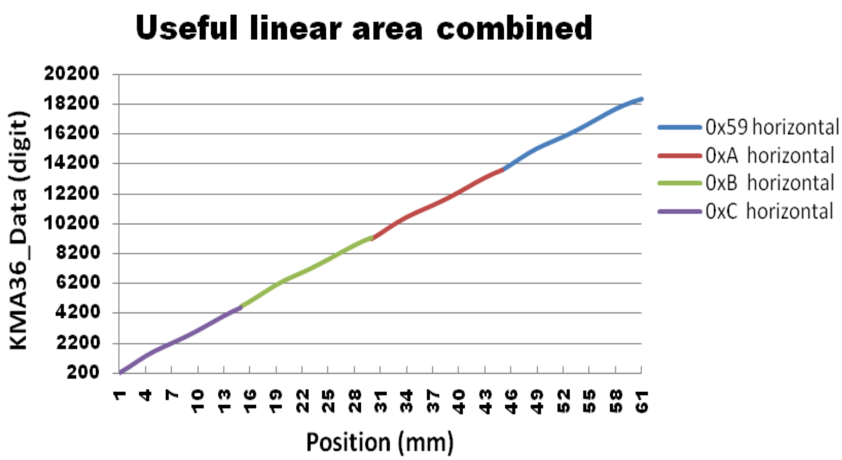




The linear ranges of two sensors placed next to each other have to overlap to ensure that at least one sensor is always in its linear range. There are different possibilities to evaluate the signal in this overlapping area. For example, the signals can be weighted or switched at a defined value. At least it is not critical which method is chosen, it is just important that the signal is correctly summed up with the offset of the previous sensor.

CONCLUSION

The usable linear-like areas of all the four sensors were analyzed. The diagram below shows the sum of all four linear areas combined. The total system shows an almost linear-like behavior to an extend of around 60mm. Appropriate fitting algorithms allow position errors less than 1% FS.



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