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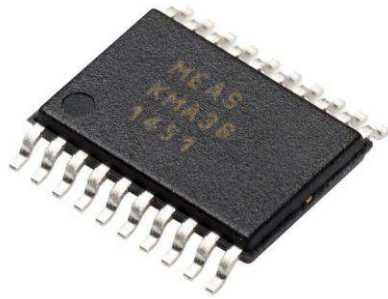
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# KMA36

## Contactless Rotational and Linear Encoder

### SPECIFICATIONS

- Contactless Absolute 360° (180°) angle measurement
- Incremental mode
- Linear mode
- Standard I2C Interface (100 kHz)
- Programmable resolution up to 13 bit (0.04 degree)
- Very low hysteresis
- High accuracy mode
- User programmable parameters
- Low power mode
- Sleep and automatic wake-up over I2C
- Programmable zero position
- Device address hardware configurable
- Small Pb-Free package (TSSOP20)
- RoHS compliant

The KMA36 is a highly reliable universal magnetic position sensor for precise rotational or linear measurement with a resolution up to 0.04 degree. These digital position sensors feature a system-on-chip technology that combines a magnetoresistive element along with analog to digital converter and signal processing in a standard small package. By using Anisotropic Magneto Resistive (AMR) technology, the KMA36 is able to determine accurately and non-contacting the magnetic angle of an external magnet over 360°, as well as the incremental position on a magnetic pole strip with 5 mm pole length. Its sleep and low power mode as well as automatic wake-up over I2C – make the KMA36 ideal for many battery applications. Position data can be transmitted using a PWM or digital two-wire (SDA, SCL) communication bus. Using the programmable parameters of this digital position sensor, the user can have access to a wide range of configuration to ensure the maximum of freedom and functionalities.

Used as both a linear position sensor or a rotary position sensor, these KMA36 magnetoresistive sensors designed by MEAS (Measurement Specialties) are insensitive to magnetic drift due to mechanical tolerances, changes in temperature or thermal stress. The maintenance-free operation and high bandwidth of this universal magnetic encoder makes it a good choice for dynamic applications in harsh environments.

## KEY-FEATURES

| Resolution | 13 Bit / 0.04 degree |
|---|---|
| **Operating power supply range of 3V to 5.5V** | 3.0 – 5.5V |
| **Operating temperature** | - 25 - +85 °C |
| **Average current** | 10 – 30 mA |
| **Sleep current** | 1.5 mA |
| **Data Update rate** | 24 – 720 Hz |
| **I²C Clockrate** | Up to 100 kBit/s |

## APPLICATIONS

Industrial environment

Harsh environment

Handling machine

Machine tools

Robotics

Potentiometer

Motor motion control

## PIN ASSIGNMENT
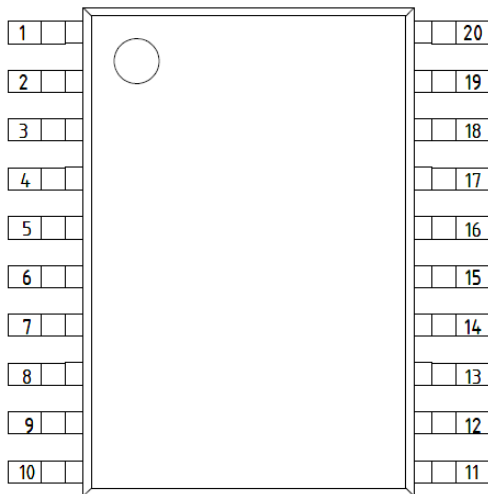


| Pin No. KMA36 TSSOP | Symbol | Type | Description |
|---|---|---|---|
| 1 | A1 | NC | Not connected |
| 2 | A0 | I | Slave address config. pin |
| 3 | DVCC_SE | O | Drive pin to power sensor |
| 4 | SDA | I/O | Two-wire interface data pin |
| 5 | PWM | O | PWM output |
| 6 | SCL | I | Two-wire interface clock pin |
| 7 | GND_SE | S | Sensor supply ground pin |
| 8 | VCC_SE | S | Sensor power supply pin |
| 9 | NC | NC | Not connected |
| 10 | NC | NC | Not connected |
| 11 | NC | NC | Not connected |
| 12 | COILP | I | Coil power supply pin |
| 13 | COILN | I | Coil power supply pin |
| 14 | AREF | I | Asic analog reference |
| 15 | NC | NC | Not connected |
| 16 | GND_AS | S | Asic supply ground |
| 17 | NC | NC | Not connected |
| 18 | VCC_AS | S | Asic power supply |
| 19 | DCOILN | O | Drive pin to coil power supply |
| 20 | DCOILP | O | Drive pin to coil power supply |

**Figure 1**: Pin assignment

## ELECTRICAL CHARACTERISTICS



**Figure 2:** Functional block description
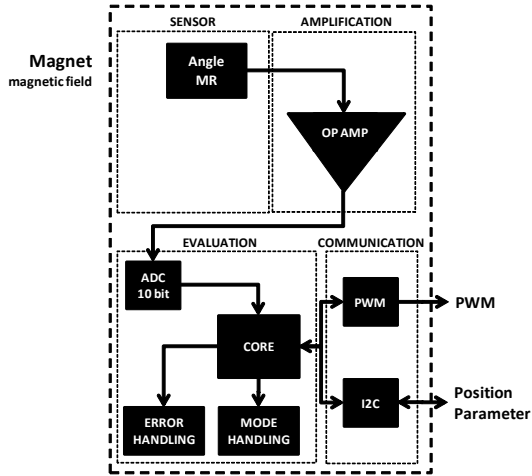
Unless otherwise specified, all voltages are referenced to the power ground supply VSS. Typical values are based on Top= 25 °C, VCC = 5 V. They are given only as design guidelines and are not tested in production. Data based on characterization results, design simulation and/or technology characteristics are indicated in the table footnotes and are not tested in production.

Absolute maximum ratings are limiting values of permitted operation and should never be exceeded under the worst possible conditions either initially or consequently. If exceeded by even the smallest amount, instantaneous catastrophic failure can occur. And even if the device continues to operate satisfactorily, its life may be considerably shortened.

**Absolute maximum ratings**

CAUTION: Exceeding these values may destroy the product.

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------|------|------|------|------|
| $T_{op}$ | Operating temperature | | - 25 | | + 85 | °C |
| $T_{sto}$ | Storage temperature | | - 40 | | + 85 | °C |
| $V_{cc}$ | Operating voltage | | 2.9 | | 6.0 | V |
| $V_{in}$ | Input voltage on any Pin | | -0.5 | | $V_{cc}$+0.5 | V |
| $I_{in}$ | DC Current through any I/O Pin | | | | 40 | mA |
| $I_{in}$ | DC Current through S Pin | | | | 200 | mA |
| $I_{in}$ | DC Current through any C Pin | | | | 60 | mA |

**Table 1:** Absolute maximum ratings

- **Operating conditions**

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------|------|------|------|------|
| $T_{op}$ | Operating temperature | | - 25 | | + 85 | °C |
| $V_{cc}$ | Operating voltage | | 3 | | 5.5 | V |
| $V_{in}$ | Input voltage on I/O pin | | -0.3 | | $V_{cc}$+0.5 | V |
| $A_{Ref}$ | External Analog Reference[1] | | 1.8 | 2.2 | 2.5 | V |
| $R_{AREF}$ | Analog Reference input resistance | | - | 32 | - | kΩ |

**Table 2:** Operating conditions

[1] Apply 2.2V at AREF for best results

Please refer to the typical application section to know which external components should be connected.

- **AC/DC characteristics**

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------|------|------|------|------|
| $I_{avg}$ | Average current[1] | Except in sleep mode, $V_{cc} = 5V$ | 10 | | 30 | mA |
| $I_{avg}$ | Average current[1] | Except in sleep mode, $V_{cc} = 3V$ | 5 | | 16 | mA |
| $I_{sleep}$ | Sleep current | $V_{cc} = 5V$ $V_{cc} = 3V$ | | 2 0.5 | | mA |
| $V_{IL}$ | Input low voltage | | -0.5 | | $0.3 \times V_{CC}$ | V |
| $V_{IH}$ | Input high voltage | | $0.6 \times V_{CC}$ | | $V_{CC} + 0.5$ | V |
| $V_{OL}$ | Output low voltage | $I_{OL} = 5$ mA | | | 0.6 | V |
| $V_{OH}$ | Output high voltage | $I_{OH} = 5$ mA | $0.86 \times V_{CC}$ | | | V |

**Table 3:** AC/DC characteristics

1)    Current measurement has been done with a standard circuit including a voltage divider on AREF.

- **System parameters**

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $f_{data}$ | Update rate[1] [2] | | 24 | | 720 | Hz |
| $t_{start}$ | Starting time MCU | | | 5 | | ms |
| $t_{start}$ | Starting time PWM output | | | 20 | | ms |
| $\alpha_{rd}$ | Resolution digital | $H_0$=25 kA/m, I2C mode [3] | | 13 [5] | 15 | Bit |
| $\alpha_{ra}$ | Resolution analog | $H_0$=25 kA/m, PWM mode [3] | | 10 | | Bit |
| $\Delta\alpha$ | Accuracy [4] | $H_0$=25 kA/m [3] $T_{op}$=25°C, I2C mode, Oversampling=32 | | ±0.3 | ±1 | ° |
| $\Delta\alpha_H$ | Hysteresis error (Repeatability) [4] | $H_0$=25 kA/m [3] $T_{op}$=25°C, I2C mode, Oversampling=32 | | ±0.1 | ±0.25 | ° |
| $V_{bwn}$ | Brown-out reset voltage | | | 2.7 | | V |
| $t_{bwn}$ | Brown-out reset pulse width | | | 2 | | µs |
| $H_y$ | Applied magnetic field | PWR-Bit = 0 | 15 | 25 | 60 | kA/m |
| $R_{COIL}$ | Internal coil resistance | | 75 | 100 | 150 | Ω |
| $I_{COIL}$ | Internal coil current | $H_0$=25 kA/m | 15 | 20 | 40 | mA |
| $f_{PWM}$ | PWM frequency | | | 7.8 | | kHz |

**Table 4:** System parameters

[1] Maximum is measured in speed mode with minimum oversampling. Minimum is measured with maximum oversampling.

[2] When using the analog-output configuration then update rate is fixed at 88Hz

[3] System parameters apply only for recommended measurement setup (please refer to the arrangement section)

[4] Hysteresis and accuracy are depending nearly inversely proportional on the magnetic field strength.
   The accuracy is defined as the max. angular difference between actual field angle and measured angle.
   The hysteresis is defined as angular difference between left and right turn

[5] Using higher resolutions than 13 Bit may cause "missing bits" / increased linearity error.

**Update rate**

$$f_{data} = 1 / (1.4\ msec \times oversampling / const)$$

| SPD Bit | const |
|---------|-------|
| 0 | 1 |
| 1 | 2 |

| in [Hz] | I2C | | Analog |
|---------|-----|-----|--------|
| Oversampling | normal mode | speed mode | |
| 2 | 357 | 714 | 88 |
| 4 | 179 | 357 | |
| 8 | 89 | 179 | |
| 32 | 22 | 45 | |

## SYSTEM OUTPUT

The system has two possible hardware output configurations: two-wire interface or analog output.

- **Analog Output**

The system has a Pulse Width Modulation unit with 10 bit resolution which can be easily coupled with a first order low-pass filter[1] to generate an analog output between Vss and Vcc corresponding to 0° and 360°. In this hardware configuration, all internal registers are loaded with initial values. No digital configuration is necessary, all available configurations can be set by changing the hardware setup[2] of the KMA36.

[1] Please refer to the typical application section for further information.
[2] Please refer to the hardware configuration section for further information.

- **I²C (Digital Output)**

The KMA36 has an I²C Interface unit (two-wire interface, based on the standard I²C-bus specification defined by Philips Semiconductors) with an 8-bit data bus which can be easily used to retrieve measurement and configuration information. (Please refer to the two-wire interface section for details)

# TWO WIRE IN INTERFACE

- **Physical interface parameters**

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------|------|------|------|------|
| $B_{rt}$ | Clockrate | | 1 | 50 | 100 | kBit/s |
| $A_L$ | Address length | | | 7 | | bit |
| $A_S$ | Address[1] | | | 0x59 | | Hex |

**Table 5:** Physical interface parameters

1) Please refer to the hardware configuration section to determine how to configure other addresses.

- **Timing parameters**

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------|------|------|------|------|
| $t_{SU:STA}$ | Start setup time | | 4.7 | | | µs |
| $t_{HD:STA}$ | Start hold time | | 4.0 | | | µs |
| $t_{SU:STO}$ | Stop setup time | | 4.0 | | | µs |
| $t_{HIGH}$ | Clock high time | | 4.0 | | 50 | µs |
| $t_{LOW}$ | Clock low time | | 4.7 | | | µs |
| $t_r$ | Rise time | | | | 1 | µs |
| $t_f$ | Fall time | | | | 0.3 | µs |
| $t_{SU:DAT}$ | Data input setup time | | 0.25 | | | µs |
| $t_{BUF}$ | Bus free time | | 4.7 | | | µs |

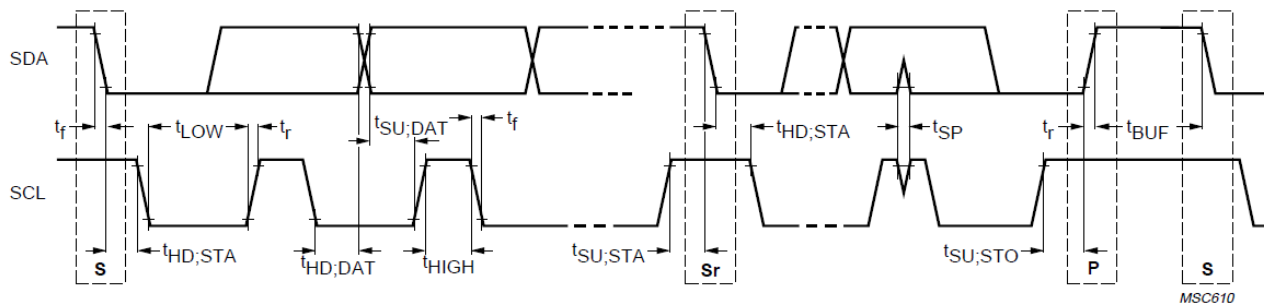**Table 6:** Start, stop and data timing parameters



**Figure 3:** Timing definitions[2]

2) Please refer to the standard I²C-bus specification defined by Philips Semiconductors for further information.

- **Registers (Overview)**

The KMA36 contains the following I/O registers:

| Registers of the KMA36 | | | |
|---|---|---|---|
| **Register** | **Size** | **Read/Write** | **Function** |
| KCONF | 8 bit | R/W | Configuration bits |
| KRES | 16 bit | R/W | Resolution |
| MA | 16 bit | R | Magnetic angle |
| ILC | 32 bit | R | Incremental Counter |

**Table 7:** Registers of the KMA36

- **I²C Bus**

The KMA36 is always operating as a pure slave.

- **I²C Reading data**

It is possible to read up to ten bytes as described in the following figure.

**TWI - Read data**

| Byte | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| | MA0 | MA1 | ILC0 | ILC1 | ILC2 | ILC3 | KCONF | KRESL | KRESH | CSSEND |
| Read/Write | R | R | R | R | R | R | R | R | R | R |
| Initial value | 0x00 | 0x00 | 0x00 | 0x00 | 0x00 | 0x00 | 0x03 | 0x00 | 0x04 | |

Byte 0:1 - MA1:0: Magnetic angle
Unsigned integer giving the magnetic angle in degree with the
configured resolution

Byte 2:5 - ILC3:0: Incremental linear
counter
Signed long giving the incremental linear counter in degree with the configured
resolution.

Byte 6 - KCONF: Configuration register
Unsigned char giving the configuration register
value.

Byte 8:7 - KRES: Resolution register
Contains the desired
resolution.

Byte 9 - CSSEND: Checksum - Senddata (Low-Byte of sum of
Byte[0..9])

**Table 8:** Read data

- **I²C Writing data (general)**

The KMA36 can be controlled using two internal registers. The configuration (KCONF) is an 8-bit register and the resolution (KRES) is a 16-bit register. To write the 16-bit register (KRES) through the two-wire interface with an 8-bit data bus, it is necessary to send the high byte first and then the low byte.

In order to change the KMA configuration, four bytes should be sent through the two-wire 8-bit data bus. The first three bytes correspond to the configuration and resolution registers. The last byte contains a 8-Bit Cyclic Redundancy Check (CRC) value which can be calculated as described in the example.

After writing via I2C the KMA36 needs 60ms + time of 2 measurements (with new configuration) to process to data (worst case at 22Hz update rate = 151ms). Initiating any I2C communication within this period may cause unpredictable behavior.

**TWI - Send data**

| Byte | 0 | 1 | 2 | 3 |
|------|------|-------|-------|------|
| | KCONF | KRESH | KRESL | KCS |
| Read/Write | W | W | W | W |
| Initial value | - | - | - | - |

Byte 0: KCONF: Configuration register
Contains the desired system configuration.

Byte 1:2 - KRES: Resolution register
Contains the desired resolution.

Byte 3 - KCS:
Checksum
Contains the checksum.

**Table 9:** Send data

**Example**

| | KCONF | KRESH | KRESL | KCS |
|------|-------|-------|-------|------|
| data | 0x03 | 0x7F | 0xFF | 0x7F |

| KCS | = 0xFF - (KCONF + KRESH + KRESL) + 0x01 |

| KCS | = 0xFF - (0x03 + 0x7F + 0xFF) + 0x01 = 0x7F |

**Table 10:** CS Example

- **KCONF (Configuration register)**

The configuration register is used to control and monitor the status and modes of the system:

**KCONF - Configuration register**

| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| | SLP | - | LIN | CNT | PWR | SPD | OVCS1 | OVSC0 |
| Read/Write | W | R/W | R/W | R/W | R/W | R/W | R/W | R/W |
| Initial value | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |

Bit 7 - SLP: Sleep mode

Writing this bit to one enables the sleep mode. This bit will be always set to zero by hardware.

Bit 5 - LIN: Mode

Writing this bit to one disables the rotational mode and enables the linear mode.

Bit 4 - CNT: Mode

Writing this bit to one enables the incremental counter mode. By writing it to zero, the counter mode is turned off and reset

Bit 3 - PWR: Low power mode

Writing this bit to one enables the low power mode.

Bit 2 - SPD: Speed mode

Writing this bit to one enables the fast speed mode.

Bit 1:0 - OVCS1:0: Oversampling

These bits determines the accuracy of the angle evaluation.

**Table 11:** KCONF – Configuration Register

- Rotational measurement      used to measure the angle of a rotating magnet disc centered above the magnetic sensor center of the KMA36. [1]

- Linear measurement      used to measure the linear movement of the KMA36 along a magnetic pole strip with 5mm pole length. A lookup table is used for internal error correction [1]

- Sleep mode      used to power down the KMA36. Wake up is initiated by I$^2$C communication

[1]    Please refer to the arrangement section.

- **SLP-Bit (KCONF register)**

Writing a "1" to this Bit will activate the sleep mode. The KMA36 will power down to sleep mode.
To wake up the KMA36 please follow this procedure:

- Initiate a I2C read (minimum 1 byte) on any I2C address (The KMA36 will wake up temporarily)
- Wait 10..15 ms
- Initiate a I2C read (minimum 1 byte) on the I2C address of the KMA36 (The KMA36 will keep awake and start a new measurement)
- **LIN-Bit (KCONF register)**

Writing a "1" to this Bit will activate the linear measurement mode.
This mode is used to measure the linear movement of the KMA36 along a magnetic pole strip with 5mm pole length.
   A lookup table is used for internal error correction
Please refer to the arrangement section.

Writing a "0" to this Bit will activate the rotational measurement mode.
This mode is used to measure the angle of a rotating magnet disc centered above the magnetic sensor center of the KMA36.
Please refer to the arrangement section.

- **CNT-Bit (KCONF register)**

In addition, there is an incremental counter implemented, which can be enabled by writing a one to the CNT-Bit in the KCONF register.

- **PWR-Bit (KCONF register)**

The current consumption can be reduced with the low power mode accessible through the PWR bit. In low power mode only **180°** measurement are possible.

- **SPD-Bit (KCONF register)**

The measurement update rate can be increased by activating the fast mode with SPD bit. In fast mode measurement accuracy is reduced.

| **Update rate** | |
|:---:|:---:|
| $f_{data}$ = 1 / (1.4 msec x oversampling / const) | |
| **SPD Bit** | **const** |
| 0 | 1 |
| 1 | 2 |

**Table 12:** Update rate

- **OVCS-Bits (KCONF register)**

To increase the measurement accuracy, it is possible to configure the oversampling rate by using the OVSCx bits. Please notice that a higher accuracy leads to a reduction of the update rate (Please refer to the Update rate table)

| OVS1 | OVS0 | Oversampling |
|------|------|--------------|
| 0 | 0 | 2 |
| 0 | 1 | 4 |
| 1 | 0 | 8 |
| 1 | 1 | 32 |

**Table 13:** OVSC - Oversampling

- **KRES (Resolution register)**

The resolution can be set to any decimal value between 1 and 32768. Any other value would lead to unexpected system behavior.

**KRES - Resolution register**

| Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| KRESH | KRES15 | KRES14 | KRES13 | KRES12 | KRES11 | KRES10 | KRES9 | KRES8 |
| KRESL | KRES7 | KRES6 | KRES5 | KRES4 | KRES3 | KRES2 | KRES1 | KRES0 |
| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Read/Write | W | W | W | W | W | W | W | W |
|  | W | W | W | W | W | W | W | W |
| Initial value | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|  | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Bit 15:0 KRES15:0:
Resolution

**Table 14:** KRES - Resolution Register

For example, a resolution of decimal 360 (0x00168) leads to rotational data in steps of 1 degree. A resolution of decimal 3600 (0x0E10) results in steps of 0.1°.

## HARDWARE CONFIGURATION

The hardware configuration depends on the desired output: two-wire interface or (analog) PWM output.
In both modes it is not allowed to left pin A0 floating / unconnected.
In two-wire interface configuration, the slave address of the system can be configured by connecting A0 and another pin as described in following table.

**TWI - Slave address configuration**

| Address | Connection | |
|---------|-----|---------|
| 0x59 | A0 | GND |
| 0x5A | A0 | DCOILP |
| 0x5B | A0 | DCOILN |
| 0x5C | A0 | DVCC_SE |
| 0x5D | A0 | VCC |

**Table 15:** TWI / I²C Slave address configuration

In analog mode, the rotation direction can be configured by connecting DVCC_SE and a power supply pin. The user zero reference angle calibration can be activated by connecting A0 and COILP. When the user zero reference angle calibration is active, the next evaluated magnetic angle will be set as the new zero reference angle. The user selectable output voltage for the zero reference angle can be configured by connecting A0 in series with a 4,7k ohm resistor and a port pin. The percentage indicated is relative to the power supply value Vcc and is defined at the zero reference angle position.

**ANALOG - Rotation direction configuration**

| Direction | Connection | |
|---|---|---|
| CW | DVCC_SE | VCC |
| CCW | DVCC_SE | 4,7K to GND |

**ANALOG - User selectable output for zero reference**

| Percent | Connection | |
|---|---|---|
| 0% | A0 | 4,7K to VCC |
| 10% | A0 | 4,7K to DVCC_SE |
| 25% | A0 | 4,7K to DCOILN |
| 50% | A0 | 4,7K to GND |

**ANALOG - Zero reference angle user calibration**

| Status | Connection | |
|---|---|---|
| Active | A0 | COILP |
| Inactive | A0 | - |

**Table 16:** Analog-Mode configuration

## TYPICAL APPLICATION

- **Electrical circuit**
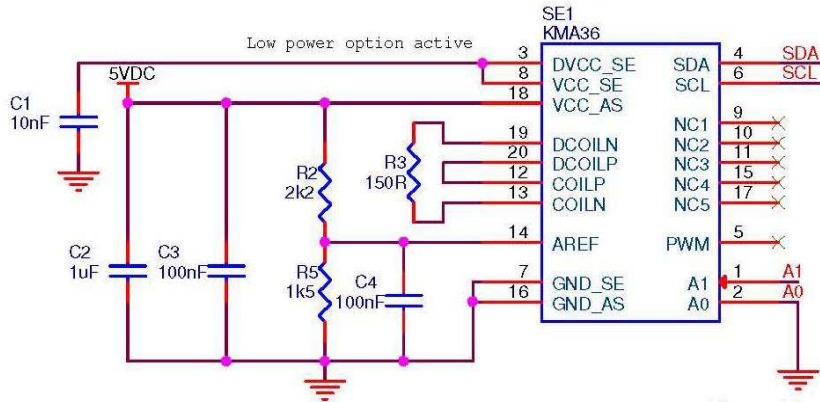


**Figure 4:** Typical circuit with two-wire interface
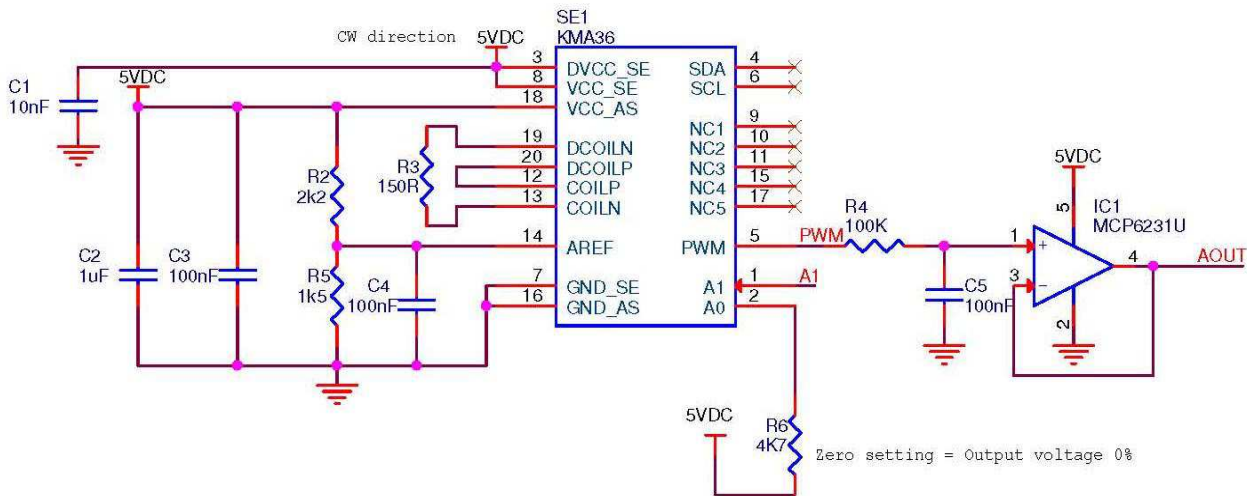


**Figure 5:** Typical circuit with analog interface

## ARRANGEMENT

Due to the magneto resistive technology which senses the magnetic field in the sensor plane, it is advised to mount the magnet disc centered above the sensor center. Please refer to the magnets and scales section for more information about the magnetic center position of the KMA36. The magnetic scale should be placed perpendicularly to the KMA36 as depicted in the following figure rather in the middle along the width of the scale. For best results the KMA36 should be as close as possible to the magnet.

- **Rotational (recommended) setup (for best results)**



Rotational mode
Bit LIN = 0
**Pay attention to the magnetic center of the KMA36**

- **Linear setup**
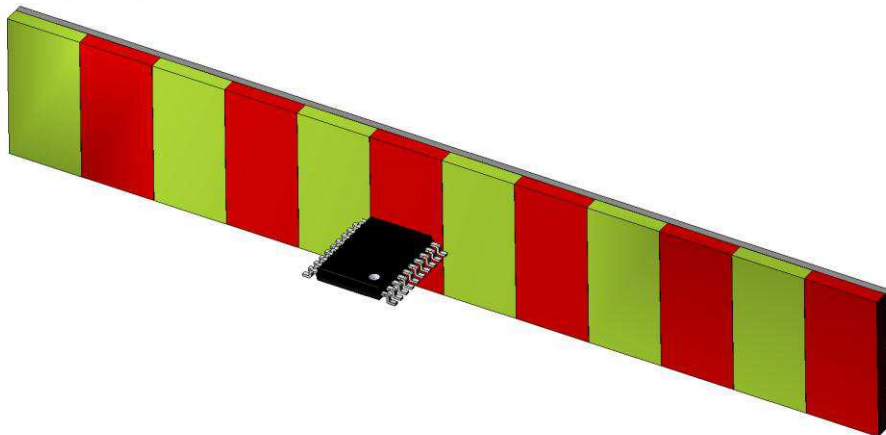


Linear mode
Bit LIN =1
**use magnetic pole strip with 5mm pole length for best results**

**Figure 6:** Mounting

## MAGNETS AND SCALES

**Rotational Mode**

The KMA36 can be used with a magnet, preferably of disc or square shape or a magnet scale with pole pitch 5mm.

For development purposes, MEAS offers a magnet disc made of plastic bonded Nd-Fe-B magnetic material which provides an homogenous magnetic field with sufficient magnetic field strength for typical application with the KMA36. The following table describes typical magnets parameters. Please refer to the website **http://www.magnetfabrik.de** (article number 67.044-1 ) and its application note section for more information.

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------|------|------|------|------|
| Ø | Diameter | Neofer 48/60p only | | 14 | | mm |
| T | Thickness | Neofer 48/60p only | | 2.5 | | mm |
| $B_r$ | Magnetic field strength | Neofer 48/60p only | | 540 | | mT |
| $T_{op}$ | Operating temperature | Neofer 48/60p only | | | 150 | °C |

**Table 17a:** Typical MEAS disc-magnet specification

**Linear Mode**

The linear mode of the KMA36 is designed for a magnetic scale with pole pitch 5mm. A magnetic scale is made of a magnetic ferrite tape bonded on a steel support which guarantees mechanical stability. The steel support is made of an optimum stainless steel alloy that provides no loss of magnetic field strength. MEAS offers a standard scale with the following parameters for development purpose:

| Symbol | Parameter | Condition | Min. | Typ. | Max. | Unit |
|--------|-----------|-----------|------|------|------|------|
| $L_T$ | Length | MEAS magnetic scale only | | 1 | | m |
| $L_P$ | Pole length | MEAS magnetic scale only | | 5 | | mm |
| W | Width | MEAS magnetic scale only | | 10 | | mm |
| T | Thickness | MEAS magnetic scale only | | 1.3 | | mm |
| Δp | Accuracy | MEAS magnetic scale only | | 40 | | µm/m |
| $T_{op}$ | Operating temperature | MEAS magnetic scale only | -40 | | 100 | °C |

**Table 17b:** Typical MEAS magnet-scale specification

The correct magnet dimensions and assembly geometry depend on the specific arrangement of the application and are part of the specification of the entire system.
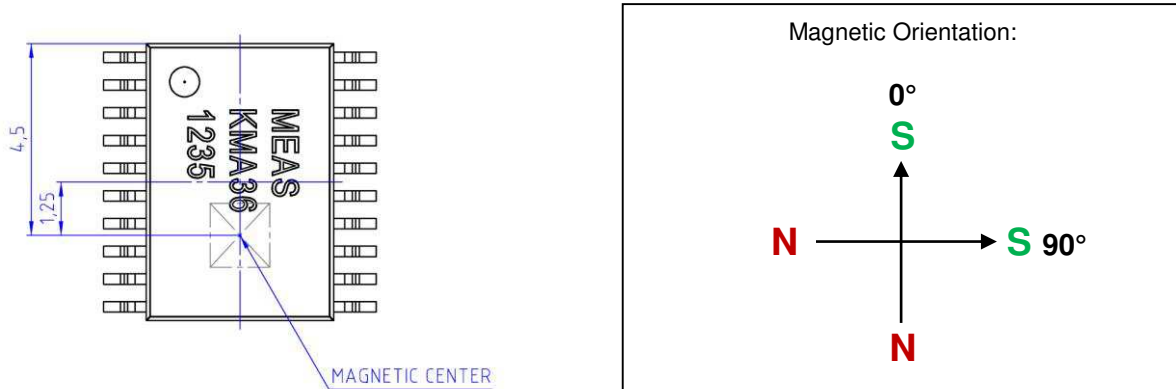
# PACKAGE DRAWING



Magnetic Orientation:

0°
**S**

**N** → **S** 90°

**N**

**Figure 7**: Package drawing (Magnetic center & Magnetic orientation)
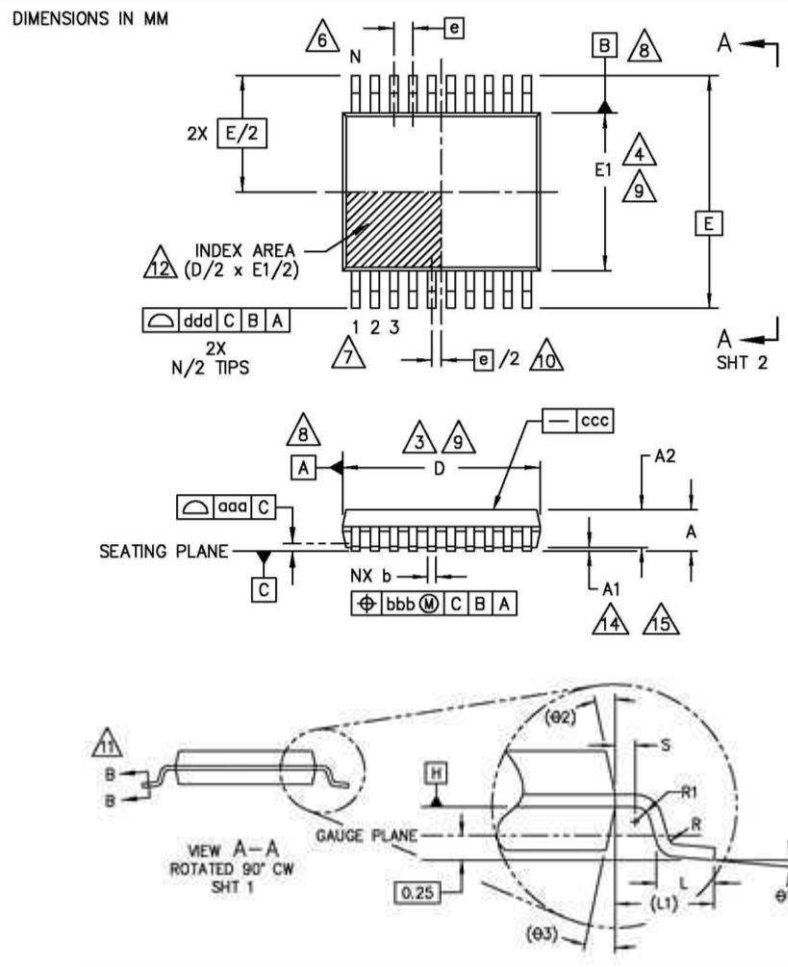


**Figure 8**: Package drawing

| COMMON DIMENSIONS (MILLIMETERS) | | | |
|---|---|---|---|
| Symbol | Min. | Typ. | Max. |
| A | - | - | 1.20 |
| A1 | 0.05 | - | 0.15 |
| A2 | 0.80 | 1.00 | 1.05 |
| b | 0.19 | - | 0.30 |
| D | 6.40 | 6.50 | 6.60 |
| E | - | 6.40 | - |
| E1 | 4.30 | 4.40 | 4.50 |
| e | - | 0.65 | - |
| L | 0.45 | 0.60 | 0.75 |
| N | - | 20 | - |
| R | 0.09 | - | - |
| S | 0.20 | - | - |
| θ1 | 0° | - | 8° |

**Table 18:** common dimensions

## ORDERING CODE

| Product | Description | Article number |
|---|---|---|
| KMA36 | KMA36 TSSOP20 | G-MRMO-031 |

**Table 19:** Ordering codes

This data sheet contains data from the preliminary specification. Supplementary data will be published later. Measurement Specialties reserves the right to change the specification without notice, in order to improve the design and performance of the product.

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