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# EVKT702-KNOB-Q-01A

## Rotary Knob Kit for the MagAlpha

### DESCRIPTION

The EVKT-KNOB is an evaluation kit for the MagAlpha magnetic position sensor family. The EVKT-KNOB allows users to run and test the MagAlpha sensor quickly. It is delivered assembled with a knob and magnet. The sensor is mounted in an end-of-shaft configuration.

The EVKT-KNOB is compatible with the MACOM kit, offering seamless connection and operation of the MagAlpha and allowing users to evaluate MagAlpha functionalities and performances, such as noise level, refresh rate, power-up time, magnetic field dependence, and so on.

### FEATURES

- Ready-to-Use Knob with End-of-Shaft Magnet
- Extra Spacers
- Compatible with MagAlpha Communication Interface Kit (EVKT-MACOM)

### APPLICATIONS

- Knobs
- Potentiometer Replacements
- Dials
- Appliances
- Consumer Goods

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### OVERVIEW

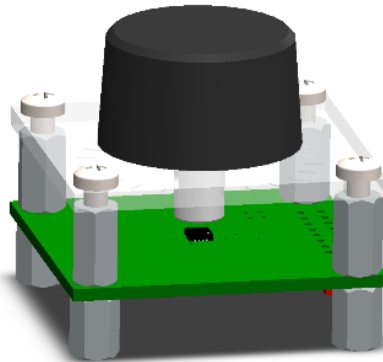


Figure 1: EVKT-KNOB

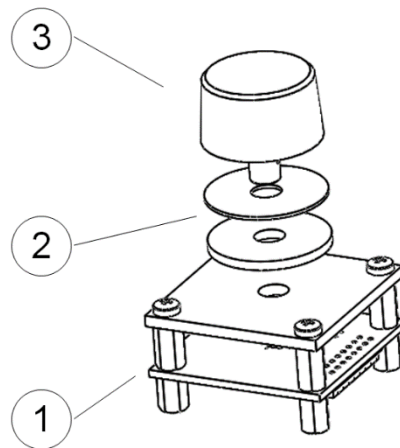
### Board Type

Different board types are available, and each of them has a different schematic and layout design. The board type to use is determined by the selected sensor part number.

**Table 1: Board Type**

| Board Type   | Kit Part Number | Board Part Number | MPS Chip Part Number |
|--------------|-----------------|-------------------|----------------------|
| Board type 1 | EVKT100-KNOB    | EVMA100-Q-00A     | MA100                |
|              | EVKT300-KNOB    | EVMA300-Q-00A     | MA300                |
|              | EVKT700-KNOB    | EVMA700-Q-00A     | MA700                |
|              | EVKT750-KNOB    | EVMA750-Q-00A     | MA750                |
| Board type 2 | EVKT102-KNOB    | EVMA102-Q-01A     | MA102                |
|              | EVKT302-KNOB    | EVMA302-Q-01A     | MA302                |
|              | EVKT310-KNOB    | EVMA310-Q-01A     | MA310                |
|              | EVKT702-KNOB    | EVMA702-Q-01A     | MA702                |
|              | EVKT710-KNOB    | EVMA710-Q-01A     | MA710                |
|              | EVKT730-KNOB    | EVMA730-Q-01A     | MA730                |
|              | EVKT800-KNOB    | EVMA800-Q-01A     | MA800                |
|              | EVKT820-KNOB    | EVMA820-Q-01A     | MA820                |
| EVKT850-KNOB | EVMA850-Q-01A   | MA850             |                      |

### EVKT-KNOB Content



**Figure 2: Kit Contents**

1. EVMA board with MagAlpha mounted
2. 0.7mm and 2.0mm spacers
3. Knob with magnet
4. Extra cylinder magnet, NdFeB N35 D=5mm H=2.5mm (not shown)

## BOARD TYPE 1

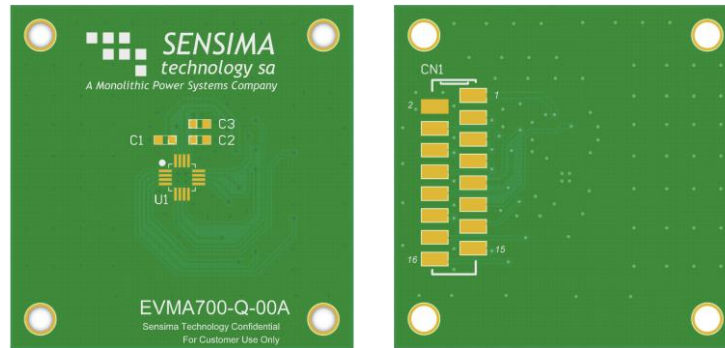


Figure 3: Board Overview Type 1

## Schematic

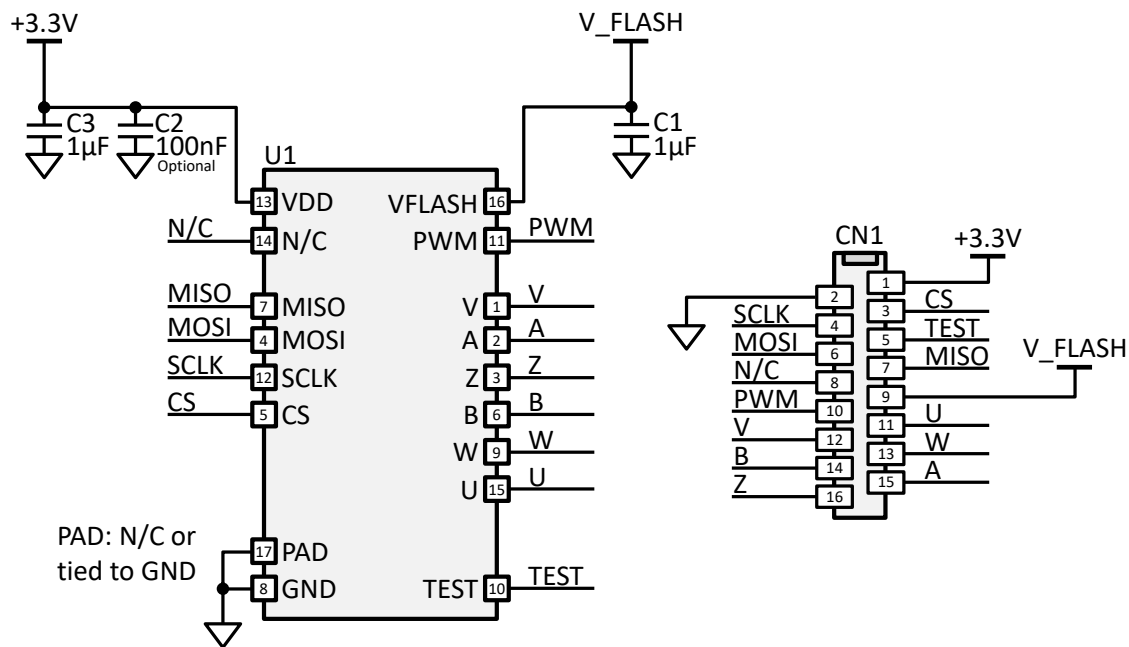


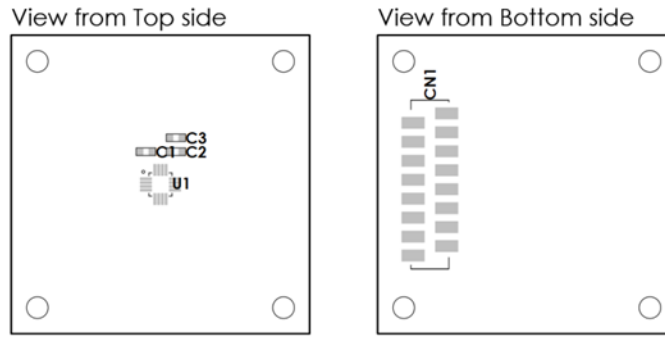
Figure 4: Schematic Type 1

## Bill of Materials

Table 2: Bill of Materials Type 1

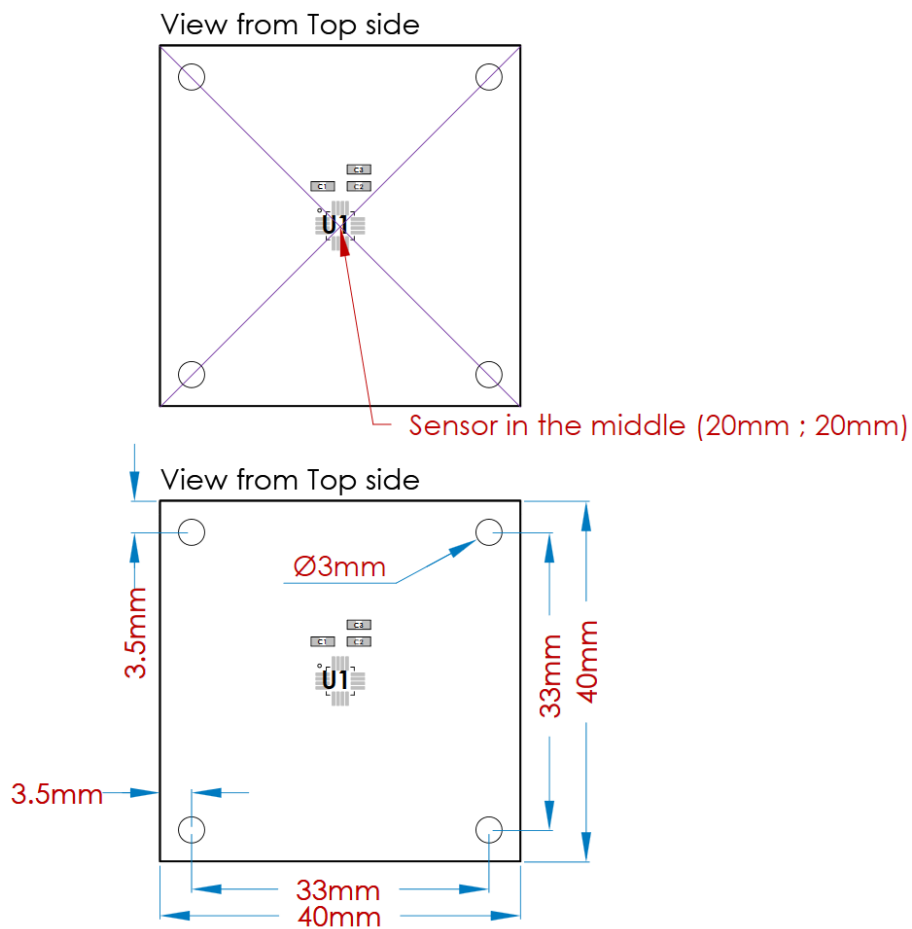
| Quantity | Designator    | Description  | Value | Manufacturer                        | Manufacturer PN             |
|----------|---------------|--|-------|-------------------------------------|-----------------------------|
| 2        | C1, C3        | Ceramic capacitor;16V;X7R;0603;                                    | 1µF   | Murata                              | GRM188R71C105MA12D          |
| 1        | C2 (optional) | Ceramic capacitor;25V;X7R;0603;                                    | 100nF | Murata                              | GRM188R71E104MA01D          |
| 1        | U1            | MagAlpha magnetic position sensor                                  | MAxxx | MPS                                 |                             |
| 1        | CN1           | 16 position receptacle connector 0.100" (2.54mm) surface mount tin |       | Würth Elektronik or TE Connectivity | 690367281676 or 8-2178711-6 |

**Assembly View**

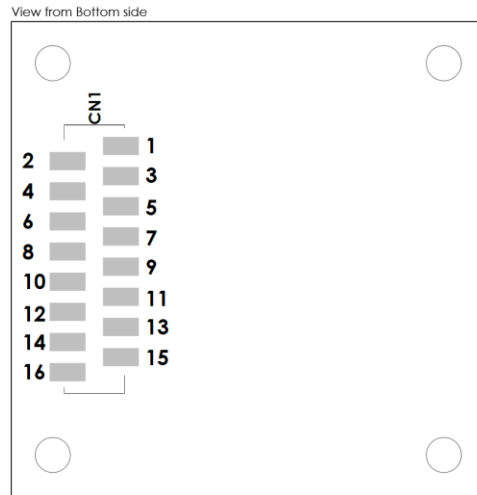


**Figure 5: Assembly View Type 1**

**Mechanical Drawing**



**Figure 6: Mechanical Drawing Type 1**

**Connector Pin-Out**

**Figure 7: Connector Pin-Out Type 1**
**Table 3: Connector Pin Mapping Type 1**

| Pin    | Name             | Description   |
|--------|------------------|---|
| CN1.1  | VDD              | 3.3V supply.  |
| CN1.2  | GND              | Ground.   |
| CN1.3  | CS               | Chip select (serial).                                   |
| CN1.4  | SCLK             | Clock (serial).   |
| CN1.5  | TEST             | Test pin.   |
| CN1.6  | MOSI             | Master out slave in (serial).                           |
| CN1.7  | MISO             | Master in slave out (serial).                           |
| CN1.8  | -                | Leave unconnected.                                      |
| CN1.9  | V_FLASH          | Flash power supply (3.9V only powered during flashing). |
| CN1.10 | PWM <sup>1</sup> | Pulse width modulation output (option).                 |
| CN1.11 | U <sup>1</sup>   | U output (motor commutation option).                    |
| CN1.12 | V <sup>1</sup>   | V output (motor commutation option).                    |
| CN1.13 | W <sup>1</sup>   | W output (motor commutation option).                    |
| CN1.14 | A <sup>1</sup>   | A output (incremental encoder option).                  |
| CN1.15 | B <sup>1</sup>   | B output (incremental encoder option).                  |
| CN1.16 | Z <sup>1</sup>   | Z output (incremental encoder option).                  |

**NOTE:**

- 1) The availability of this option depends of the chip part ID. Please refer to the part datasheet directly.

## BOARD TYPE 2

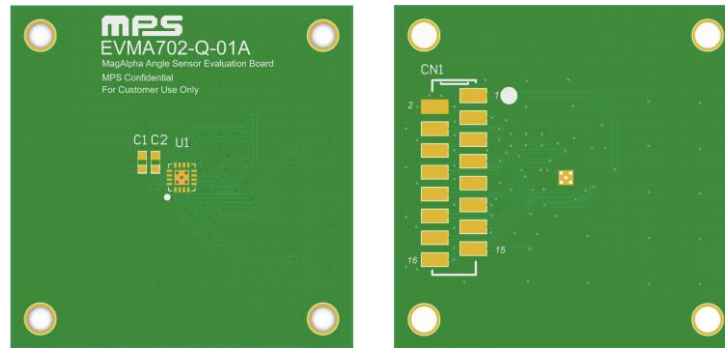


Figure 8: Board Overview Type 2

## Schematic

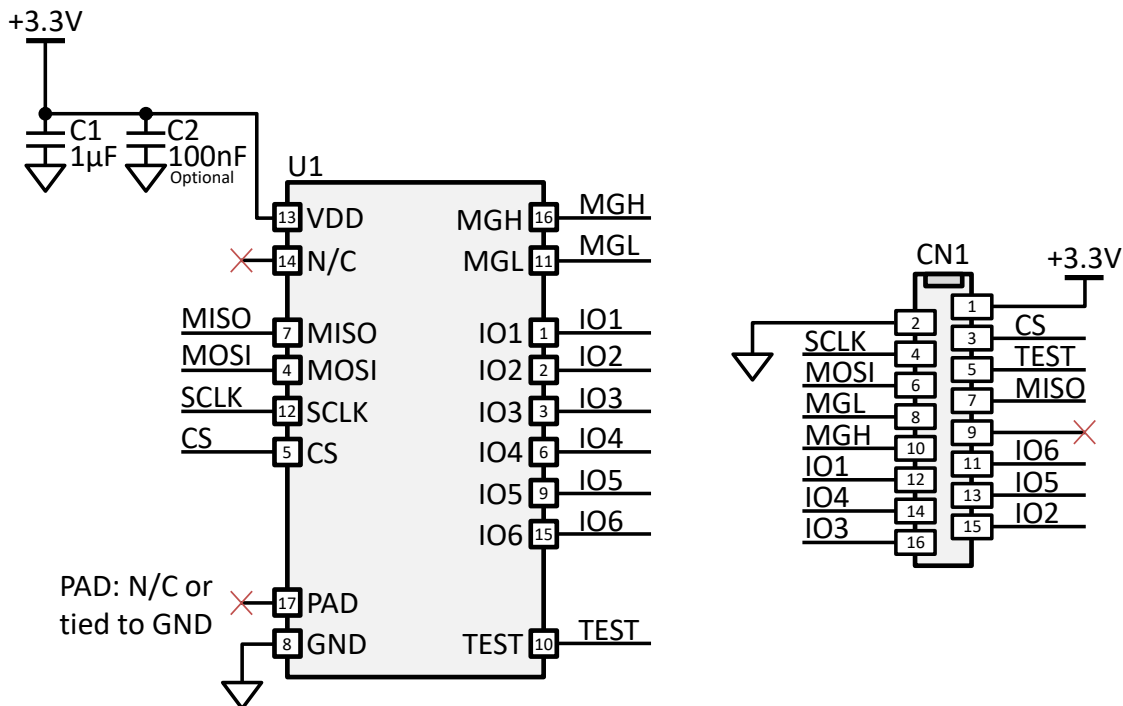


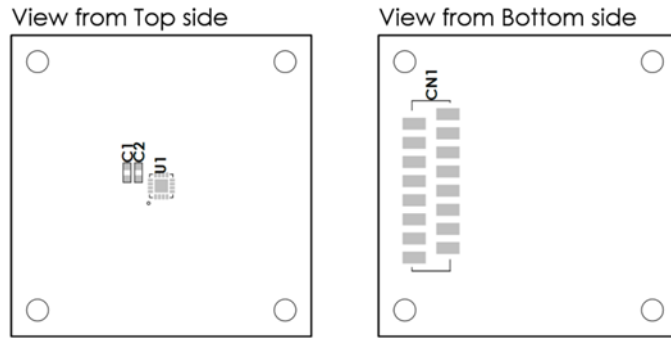
Figure 9: Schematic Type 2

## Bill of Materials

Table 4: Bill of Materials Type 2

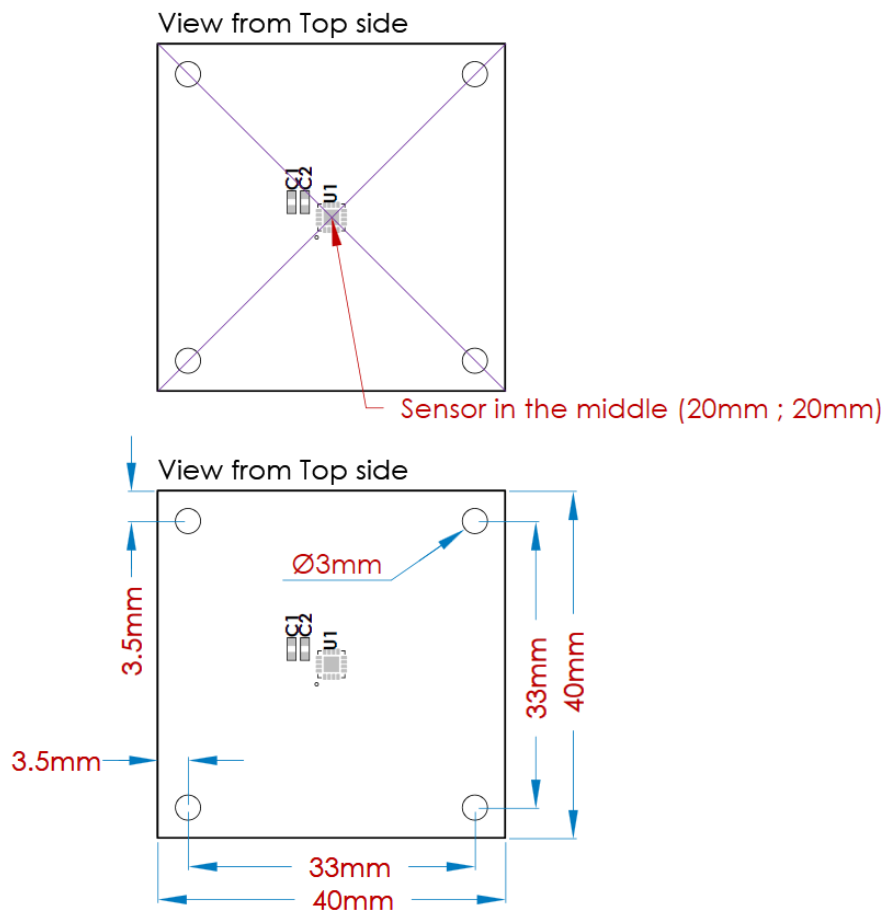
| Quantity | Designator         | Description  | Value     | Manufacturer                        | Manufacturer PN             |
|----------|--------------------|--|-----------|-------------------------------------|-----------------------------|
| 1        | C1                 | Ceramic capacitor; 16V;<br>X7R; 0603;                              | 1 $\mu$ F | Murata                              | GRM188R71C105MA12D          |
| 1        | C2 (not populated) | Ceramic capacitor; 25V;<br>X7R; 0603;                              | 100nF     | Murata                              | GRM188R71E104MA01D          |
| 1        | U1                 | MagAlpha magnetic position sensor                                  | MAxxx     | MPS                                 |                             |
| 1        | CN1                | 16 position receptacle connector 0.100" (2.54mm) surface mount tin |           | Würth Elektronik or TE Connectivity | 690367281676 or 8-2178711-6 |

**Assembly View**

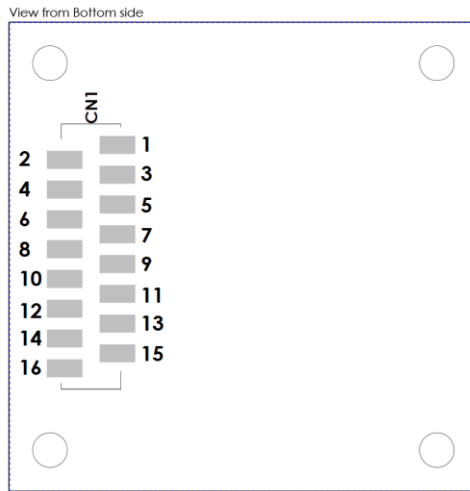


**Figure 10: Assembly View Type 2**

**Mechanical Drawing**



**Figure 11: Mechanical Drawing Type 2**

**Connector Pin-Out**

**Figure 12: Connector Pin-Out Type 2**
**Table 5: Connector Pin Mapping Type 2**

| Pin    | Name             | Description                   |
|--------|------------------|-------------------------------|
| CN1.1  | VDD              | 3.3V supply.                  |
| CN1.2  | GND              | Ground.                       |
| CN1.3  | CS               | Chip select (serial).         |
| CN1.4  | SCLK             | Clock (serial).               |
| CN1.5  | TEST             | Test pin.                     |
| CN1.6  | MOSI             | Master out slave in (serial). |
| CN1.7  | MISO             | Master in slave out (serial). |
| CN1.8  | MGL <sup>2</sup> | Magnetic level low (option).  |
| CN1.9  | -                | -                             |
| CN1.10 | MGH <sup>2</sup> | Magnetic level high (option). |
| CN1.11 | IO6 <sup>3</sup> | Pin 15 (IO).                  |
| CN1.12 | IO1 <sup>3</sup> | Pin 1 (IO).                   |
| CN1.13 | IO5 <sup>3</sup> | Pin 9 (IO).                   |
| CN1.14 | IO4 <sup>3</sup> | Pin 6 (IO).                   |
| CN1.15 | IO2 <sup>3</sup> | Pin 2 (IO).                   |
| CN1.16 | IO3 <sup>3</sup> | Pin 3 (IO).                   |

**NOTES:**

- 2) The availability of this option depends of the chip part ID. Please refer to the part datasheet directly.
- 3) Please refer to the chip datasheet directly to know which feature is available on this pin.



## MAGNETIC FIELD

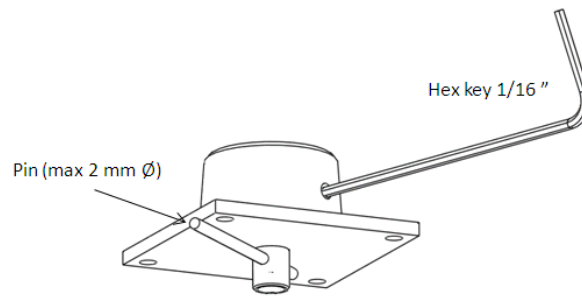
A NdFeB cylinder magnet is mounted at the end of the aluminum shaft.

**Table 6: Magnet Characteristics**

| Material       | NdFeB (N35 or N35H) |
|----------------|---------------------|
| Remanence (Br) | 1.2T                |
| Diameter       | 5mm                 |
| Height         | 2.5mm               |
| Magnetization  | Diametrical         |

### How to Change the Mechanical Zero

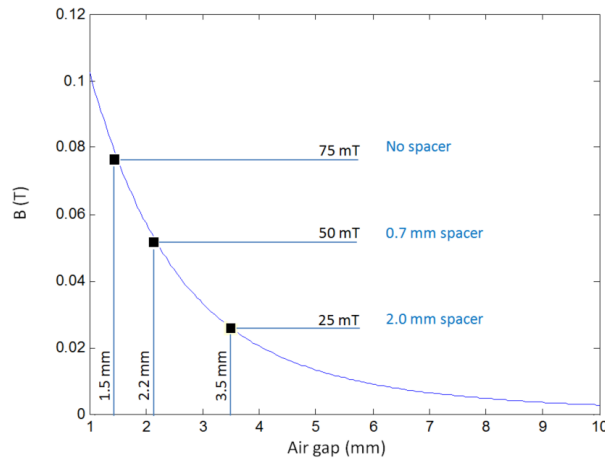
Unscrew the knob with a Hex key 1/16". Hold the shaft with a pin inserted in the 2mm diameter hole and rotate the knob to the desired position. When tightening the screw, ensure that the shaft is fully inserted. Note that the zero position can also be adjusted through programming, as described in the MagAlpha datasheet.



**Figure 13: Adjusting the Magnet Angular Position**

### How to Change the Magnetic Field Amplitude

The performance of the MagAlpha remains the same from 75mT to 150mT and higher (the MagAlpha has no maximum operating field). The critical region is the lower end of the specified range. Some parameters (i.e.: noise, linearity) deteriorate gradually when the magnetic field becomes weak. The two spacers enclosed in this evaluation kit allow the sensor (the noise level in particular) to be tested at low magnetic fields.

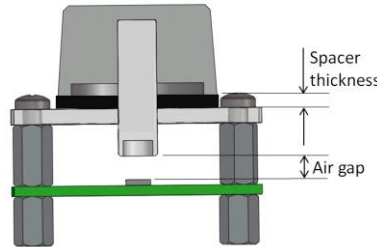


**Figure 14: Magnetic Field vs. Air Gap for the Supplied Magnet**

The EVMA nominal magnet sensor distance is 1.5mm, providing a magnetic field of 75mT. With the spacers, the field strength is reduced to 50mT or 25mT (see Table 7).

**Table 7: Setting of the Air Gap**

| Spacer Thickness (mm) | Air Gap (mm) | Magnetic Field (mT) |
|-----------------------|--------------|---------------------|
| None                  | 1.5          | 75                  |
| 0.7                   | 2.2          | 50                  |
| 2                     | 3.5          | 25                  |


**Figure 15: Air Gap Setting**

## MAGNET SUPPLIERS

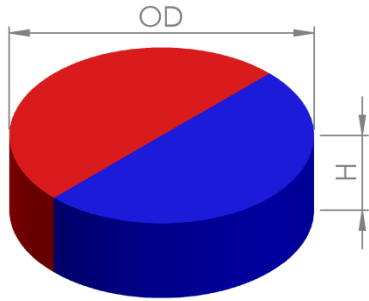
The table below shows a non-exhaustive list of possible magnet suppliers. The magnetization direction must be chosen wisely given the fact that most magnets sold are often axially magnetized, which is not a magnetization direction usually required in magnetic angle sensing applications. Angle sensing applications usually use diametrically magnetized magnets.

**Table 8: Magnet Suppliers**

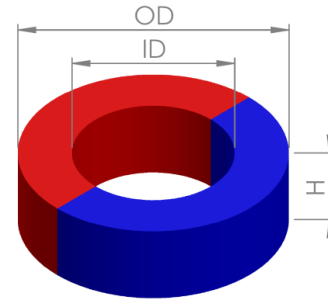
| Company                      | Website  | Address   |
|------------------------------|--|---|
| Maurer Magnetics AG          | <a href="http://www.maurermagnetic.ch">www.maurermagnetic.ch</a>         | Industriestrasse 8<br>8627 Grüningen<br>Switzerland   |
| Arnold Technologies AG       | <a href="http://www.arnoldmagnetics.com">www.arnoldmagnetics.com</a>     | Hübelacherstrasse 15<br>5242 Birr-Lupfig<br>Switzerland   |
| Bomatec AG                   | <a href="http://www.bomatec.com">www.bomatec.com</a>                     | Hofstrasse 1<br>8181 Höri<br>Switzerland  |
| Dexter Magnetic Technologies | <a href="http://www.dextermag.com">www.dextermag.com</a>                 | 1050 Morse Avenue<br>Elk Grove Village, IL 60007-5110<br>USA  |
| JPMF                         | <a href="http://www.jpmp.com.cn">www.jpmp.com.cn</a>                     | 8 LongWan Road<br>Jiangmen City<br>GuangDong Province<br>China                                      |
| Binicmagnet                  | <a href="http://www.binicmagnet.com">www.binicmagnet.com</a>             | Unit 612 Yuanzhong Building<br>No. 1905 Hongmei Road<br>Shanghai<br>P. R. China 200233              |
| China Rare Earth Magnet      | <a href="http://www.permanentmagnet.com">www.permanentmagnet.com</a>     | Room 705, Tower A Century Holiday Plaza<br>9030 Shennan Rd<br>Nanshan District<br>Shenzhen<br>China |
| Goudsmit Magnetic Systems    | <a href="http://www.goudsmit-magnetics.nl">www.goudsmit-magnetics.nl</a> | Petunialaan 19<br>5582 HA Waalre<br>Netherland  |

**Maurer Magnetic**

Maurer Magnetic has a selection of diametrically magnetized magnets well-suited for contactless rotary angle applications. Samples of the types mentioned below should always be available with no lead time.



**Figure 16: Cylinder Magnet, Diametrically Magnetized**



**Figure 17: Ring Magnet, Diametrically Magnetized**

**Table 9: Maurer Magnetic Diametrically Magnetized Magnets**

| OD (mm) | ID (mm) | H (mm) | Material   | Remanence (Br) (T) | Magnetization | Part Number |
|---------|---------|--------|------------|--------------------|---------------|-------------|
| 4.0     | -       | 3.0    | N35        | 1.2                | Diametrical   | M610403     |
| 4.0     | -       | 3.0    | Sm26/16-17 | 1.08               | Diametrical   | M410403     |
| 5.0     | -       | 2.5    | N35        | 1.2                | Diametrical   | M610502     |
| 5.0     | -       | 2.5    | Sm26/16-17 | 1.08               | Diametrical   | M410502     |
| 5.0     | 1.25    | 2.5    | N35        | 1.2                | Diametrical   | M610512     |
| 5.0     | 1.25    | 2.5    | Sm26/16-17 | 1.08               | Diametrical   | M410512     |
| 6.0     | -       | 2.5    | N35        | 1.2                | Diametrical   | M610602     |
| 6.0     | -       | 2.5    | Sm26/16-17 | 1.08               | Diametrical   | M410602     |
| 6.0     | 1.5     | 2.5    | N35        | 1.2                | Diametrical   | M610612     |
| 6.0     | 1.5     | 2.5    | Sm26/16-17 | 1.08               | Diametrical   | M410612     |
| 6.0     | 1.5     | 3.0    | N35        | 1.2                | Diametrical   | M610613     |
| 6.0     | 1.5     | 3.0    | Sm26/16-17 | 1.08               | Diametrical   | M410613     |
| 8.0     | -       | 2.5    | N35        | 1.2                | Diametrical   | M610802     |
| 8.0     | -       | 2.5    | Sm26/16-17 | 1.08               | Diametrical   | M410802     |

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