User Manual for the RAMK Rotational Absolute Magnetic Kit Encoder

By Frederic Bourget and Emmanuel Lemelle

INTRODUCTION

The purpose of this user manual is to define the precautions for unpacking, mounting, and using RAMK encoder displacement sensors.

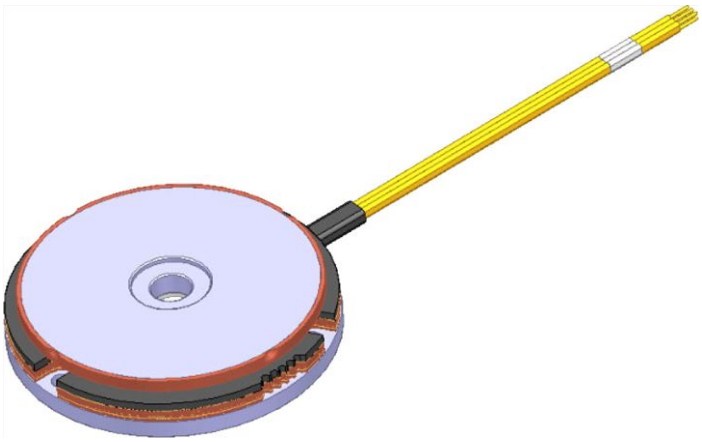

Fig. 1 - Isometric view of a RAMK040

- True absolute system
- Accuracy up to 17 bits (depending on model)
- Resolutions up to 20 bits (depending on model)
- Low profile
- Plug and play

This range of products consists of a rotor and stator kit separated by a free space. The rotor has to be fixed to the moving part of the customer's device, and the stator has to be fixed to the immobilized part. This allows maximum integration into the customer's system.

The rotor is composed of magnetic material fixed on a stainless steel part. The stator is composed of a stainless steel interface and an electronic circuit that detects the magnetic field of magnetic parts to provide the position of the sensor (angle between the rotor and the stator).

The RAMK provides an absolute function. Therefore, all datasheets give an accuracy - not to be confused with resolution.

The resolution of the Vishay encoders is a real / physical resolution. It is not an extrapolation or interpolation calculation. Therefore, all bits of resolution can be used.

The electronic noise is also very low, so the customer can use the best of the accuracy and resolution parameters.

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MAIN CHARACTERISTICS

The product's main characteristics are defined in its respective datasheets.

PACKING CONDITIONS

The RAMK is packaged in ESD packaging. The number of products per box may vary by model, but usually it is one part per box. Most of the time, the rotor and stator are paired to provide the performance of the product. In this case, the rotor and stator are packaged in the same box.

DELIVERY CONDITIONS

Delivery conditions may vary by device. For more information, contact mcbprecisionpot@vishay.com.

STORAGE CONDITIONS

In addition to storage temperatures written on their respective datasheets, storage conditions are also applicable. It is important to notice that values in technical datasheets predispose those of this document:

- Absence of UV radiation
- Hygrometry: < 70 % (no condensing)
- Do not store close to a high magnetic field: (< 30 mT at 50 mm)
- Lifetime in storage conditions: one year for version with wires; three years for version with connector

OPERATION AND UNPACKING CONDITIONS

WARNING!

As usual for electronic circuits, during product handling do not touch electronic circuits, wires, or sensors without suitable ESD protection. The operator shall use ESD equipment to avoid the risk of circuit damage.

For the rotor that supports the magnets, avoid all contact with other foreign magnetic sources in proximity.

For rotor and stator kits, avoid any shock.

MOUNTING CONDITIONS

ENCODER MOUNTING CONDITIONS

Environmental

The RAMK is not sensitive to temperature variations. Nevertheless, the range of +15 °C to +25 °C is recommended for mounting to minimize all stress due to thermal expansion behavior.

Cleaning

While the RAMK is not sensitive to external pollution like dust, grease, oil, moisture, or separating agents (for example, loose paint), it is better to avoid such pollution through assembly in the usual industrial working conditions.

In particular, customers should avoid all pollution-containing magnetic particles.

To clean the surface, only use a clean cloth and alcohol.

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Electrical

The customer's equipment has to be designed in accordance with all the data provided in the "Electric Interface Description" of Vishay datasheets.

Additional details are supplied to each customer in a detailed technical datasheet.

Note

- For each model in the technical datasheet supplied to the customer, the recommended perpendicularity, radial runout, and more are detailed

Magnetic Environment

The design of the Vishay encoder's architecture has been specially chosen to be insensitive to external permanent magnetic fields.

The maximum magnetic field allowed is specified in the detailed technical datasheet. Exceeding the maximum values in the datasheet will have some consequences in regard to the encoder's performance. In some cases, it could modify the magnet's magnetic field irreversibly.

The impact of the magnetic source depends on its distance and value. Due to the proximity of electrical motors in applications (like a robot's arm joint or gimbal application), the design has to protect them as well as possible. Basically, if there is not direct contact between a magnet source and the rotor of the encoder kit, there is rarely damage to the encoder.

In every case, the Vishay engineering team recommends checking the behavior of the encoder in the presence of the customer's magnetic environment. With 3D magnetic values (due to an electrical motor for instance) provided by the customer, Vishay proposes to simulate the behavior of magnetic encoders. To confirm the simulation, with the loan of an electrical motor, the Vishay engineering team can perform the tests in real conditions and supply the tests results report to the customer.

MECHANICAL

Most of the time the rotor and stator are paired. Clear packaging and marking help to not mistake them. Without this pairing, optimal performance could not be reached.

Though encoders are individually calibrated before the delivery, the customer must take some precautions for their encoder assemblies. The rotor's radial runout, airgap (beat included), and the stator's misalignment are key parameters in reaching the encoder's full performance.

Rotor's Radial Runout

The magnetic field radial runout, compared to magnetic cells, creates an accuracy error. All encoders are calibrated before their delivery. The calibration of the encoder is done with a set-up that minimizes the magnetic field runout. But when the customer assembles the encoder on their equipment, the runout set-up is different.

It is very difficult to measure the magnetic field runout of the encoder rotor during the assembly process. But it can be divided in two main parameters:

1. The rotor's shaft radial runout
2. The gap between the shaft and rotor hole

The rotor's shaft runout can be measured as shown in Fig. 2.

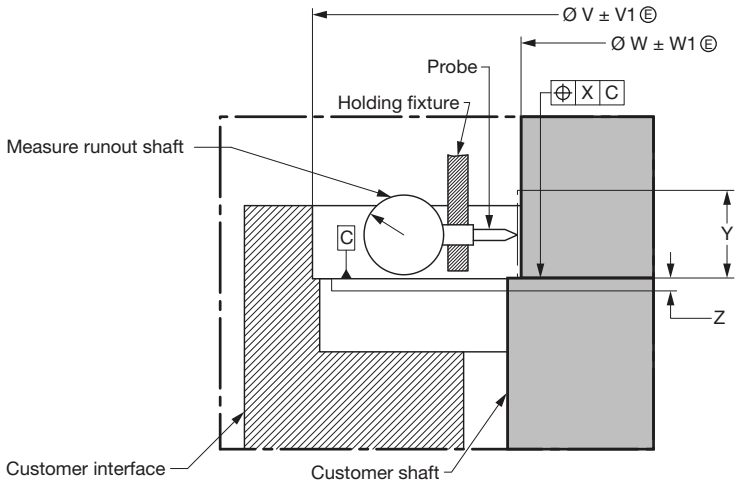

Fig. 2 - Rotor's shaft radial runout

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The gap between the rotor's hole diameter and the shaft's diameter is calculated as shown below:

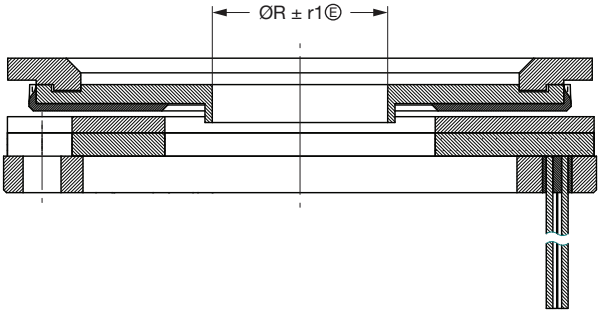

Fig. 3 - Rotor's hole diameter

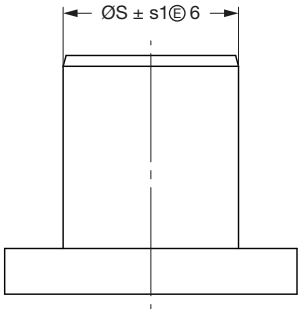

Fig. 4 - Rotor's shaft diameter

The maximum gap is determined by:

$$Gap_{max.} = ØR_{max.} - ØS_{min.}$$

$$Gap_{max.} = (ØR + r1) - (ØS - s1)$$

The radial runout results is a combination of all these parameters. Moreover, it depends on the encoder's architecture (the number of cells that do the magnetic field measurement). The allowable tolerances to obtain the encoder's full performance are detailed in the technical datasheet of each encoder.

Below, Fig. 5 shows the results after a radial runout setup identical to the calibration's radial runout setup.

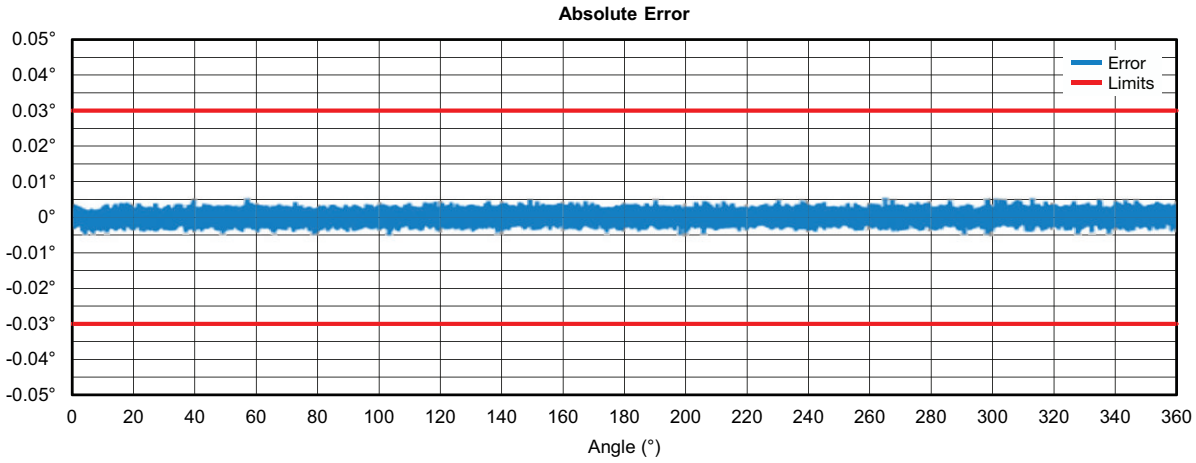

Fig. 5 - Accuracy result without runout

Fig. 6 shows the results after a radial runout setup that is different than the calibration's radial runout setup, but in the limit defined.

APPLICATION NOTE

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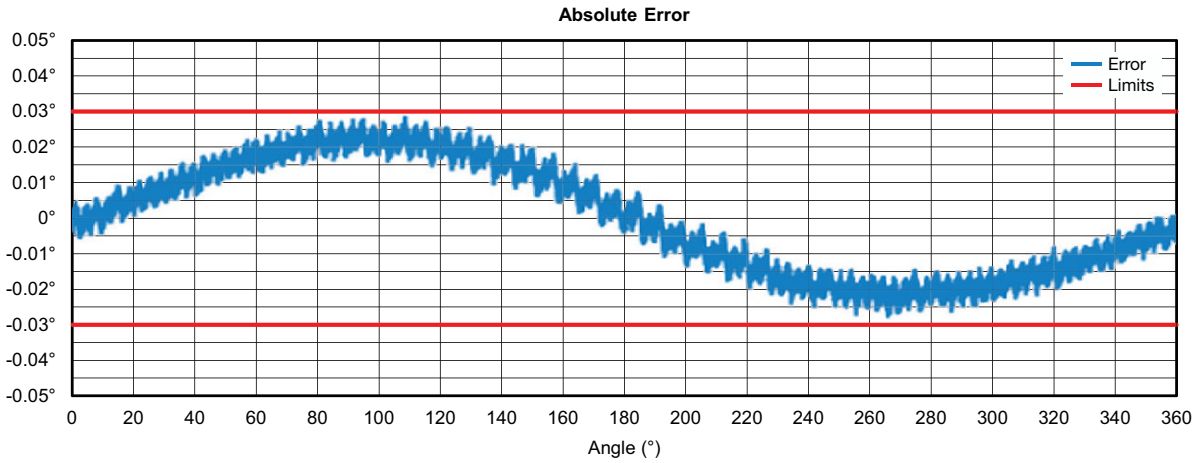

Fig. 6 - Example of runout close to the limit value

AIRGAP

The airgap is the distance between the top of a magnetic cell and the top of a magnet (without the varnish thickness).

Important note: the encoder's user must take care to ensure the distance between the fixing reference of the stator and the fixing reference of the rotor (see Fig. 2 dimension named "Z").

This distance is detailed in the technical datasheet of each encoder.

The encoder's architecture accepts variations under some tolerances. As for the radial runout, the calibration of the encoder is done with a setup as close as possible to the nominal value. But when the customer assembles the encoder on their equipment, the airgap setup is different.

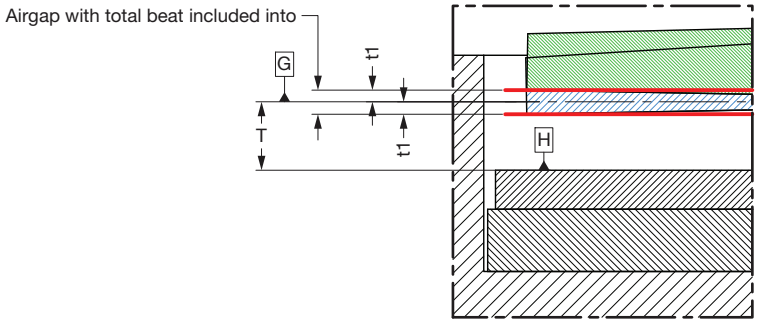

Fig. 7 - Airgap between magnet's top and magnetic cells top

In the encoder's assembly process, the high H of the external cell is measured for each encoder.

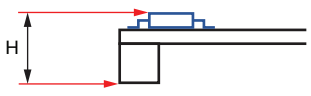

Fig. 8 - Sensor electronic part high

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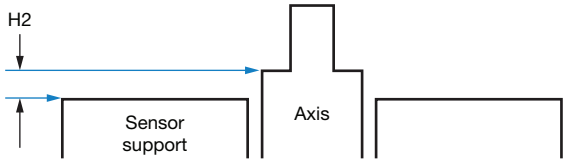


Fig. 9 - Test bench dimension

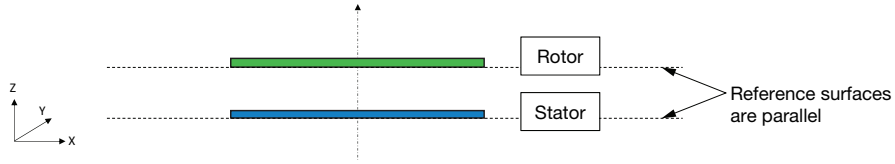
The airgap adjustment = H2 - H - airgap wanted

The correction is made by the insertion of washers on the rotor or a rotor's rework (depending on the encoder's model).

BEAT

The rotor's beat versus magnetic cells has an influence on the encoder's performance. Though the encoder's architecture allows some deviations, the rotor's beat must be included in the airgap tolerance (see Fig. 10 and Fig. 11). Values depend on the encoder's references. For more detail, see the technical datasheet of each encoder.

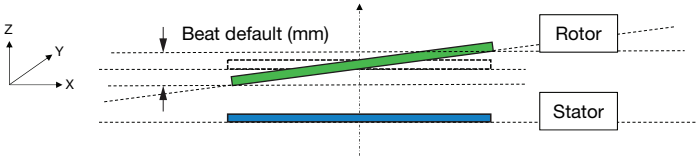
The image below shows a stator and rotor mounting without default.



Rotor axis and stator axis are the same → reference surfaces are parallel

Fig. 10 - Ideal configuration definition

Below the beat default configuration is illustrated.



Rotor axis and stator axis are the same but the reference surfaces are not parallel

Fig. 11 - Beat default configuration definition

STATOR'S MISALIGNMENT

The encoder's architecture is less sensitive to the stator's misalignment than the rotor's radial runout. For more detail, see the technical datasheet of each encoder.

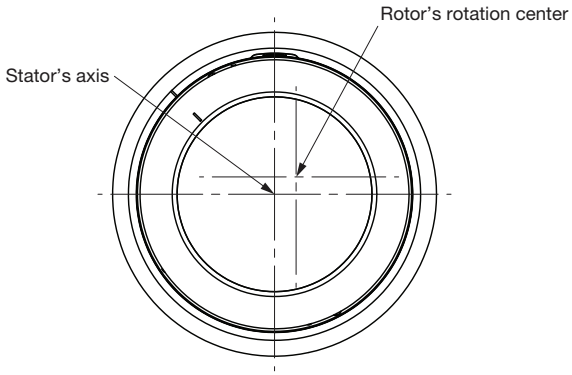


Fig. 12 - Stator's misalignment vs rotor's rotation center

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USING CONDITIONS

As soon as the kit is mounted, the product is **COMPLETELY PLUG AND PLAY**; no calibration is needed from the user.

If the customer respects the tolerances of mounting, they will achieve the best performance. After mounting, the customer does not need a calibration; all needed actions have been performed in Vishay's factory. Therefore, no additional software is needed with the product's delivery.

Operating conditions are specified in the technical datasheet for each encoder. Depending on the encoder's architecture, there are some differences.

SPECIFIC CONDITIONS OF USE

Comments:

- The RAMK encoders are not vacuum compatible
- For the compatibility of the RAMK encoder with common industrial oils, grease, or other material, the products have a good behavior. For any details, please contact Vishay MCB

END OF LIFE

In order to preserve, protect, and improve the quality of the environment, as well as to protect the health of human beings and to use natural resources prudently, the user is asked to treat the product at the end of its life in accordance with regulations in force in the country of use.

Packaging materials (cardboard, plastics, pallets) can be reused or recycled in a specialized sector in the treatment of packaging materials.

For products with a strong metallic content, it is recommended to move closer to the metal waste treatment sector.

For other products, they must be considered as ordinary industrial waste (OIW).