

Application manual

Acceleration, inclination and vibration sensor KAS901- (KAS903-) series



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1. Applications

Typical applications for the KAS series sensors are:

- inclination limiter (tilt sensor)
- levelling
- inclination
- acceleration
- vibration

Depending on the intended use the best suitable type must be selected. Please contact our product specialists for information. Phone: +41 44 806 22 00.

1.1 Tilt and levelling applications

Typical applications can be tilt limiters, levelling of machinery, apparatuses or measuring equipment, automatic levelling of jibs / booms, excavator shovels, platforms etc.

1.2 Inclination and angle measuring

Examples: inclination measuring in measuring equipment like lasers, in vehicles, robots, surgical operation tables, building and production machinery

1.3 Acceleration measuring

Applications such as shock and crash monitoring, movement monitoring and recording for fitness analysis or elderly / handicapped persons combined with alert systems, free fall detection, automobile equipment as ESP (electronic stabilising program) and ABS (anti blocking system).

1.4 Vibration measuring

Applications are for example bearing damage monitoring, Baby monitoring system, theft protection, earth quake safety switch-off devices.

2 Characteristics / Technology

2.1 Shock resistance of the sensing element

The sensing elements based on capacitive measuring principle feature high precision and high shock resistance, resulting from the particular 3D micromechanics technology made of high purity silicon. Thanks to the optimized structure, no drifts caused by deformation must be expected, even after severe shocks.

2.2 Repeatability and long term stability

With SCA61T for instance repeatability up to 0,01° or 0,2mg and long term stabilities of the same order can be achieved. The hysteresis (e.g. 0,02°) caused by quick temperature changes degenerates to zero within a short time.

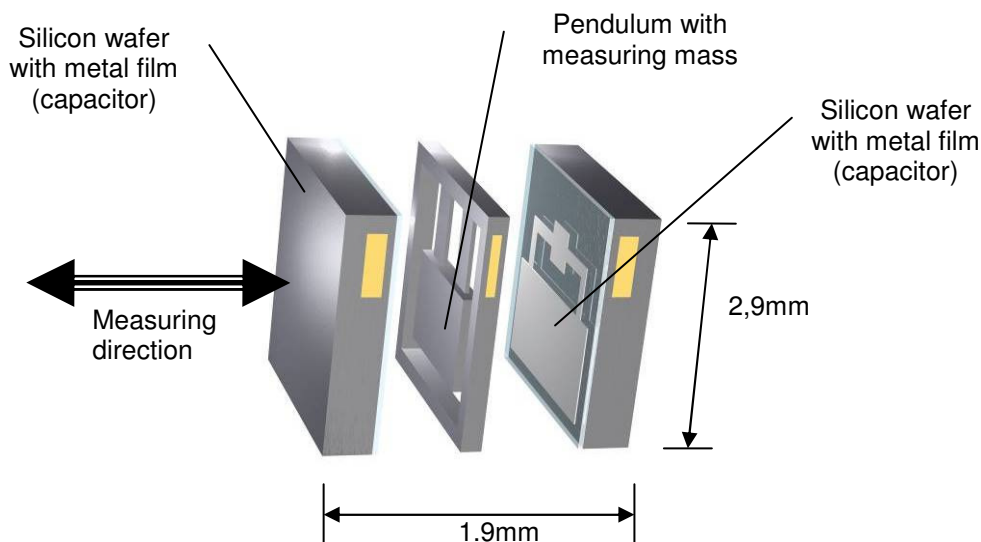
2.3 Resolution

The sensing elements formed by a dual capacitor produce extremely low noise levels and a high output signal. The major part of the noise is caused by the signal conditioning circuitry. Resolutions in the order of $0,001^\circ$ or $7\mu\text{g}/\sqrt{\text{Hz}}$ (KAS901-4x) are possible.

2.4 Reduced sensitivity to vibrations thanks to gas attenuation

Influences by vibrations may interfere with inclination measuring. The gas attenuation in the sensing element filters a good part of such interferences and in addition helps avoid overshooting of the sensing pendulum. Additional resonance frequencies are completely damped. For inclination sensors the influence of vibrations is reduced, for vibration sensors the sensor's natural resonance is damped. This means that the appropriate sensor type must be selected for each application.

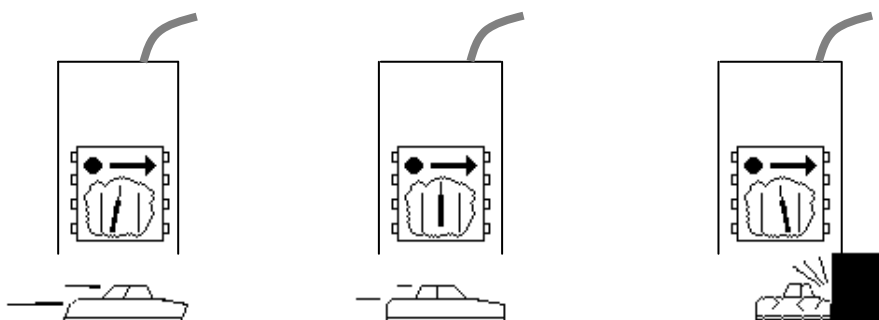
2.5 Structure of the sensing element



2.6 Functional principle

The pendulum with the measuring mass is moved in the measuring direction by a force (acceleration, inclination, vibration) acting in this direction. The movement of the measuring mass causes a change of capacitance which is registered as primary measuring signal. The output signal ($0,5 \dots 4,5\text{V}$) is proportional to the deflection, thus to the acceleration. For inclination measuring the conversion from $g = 9,81 \text{ m/s}^2$ into angular degrees is a sine function. A sensor with small measuring range ($\pm 0,5g$) has a higher resolution than a sensor with large ($\pm 12g$) measuring range.

Measuring principle and alignment (e.g. for acceleration / shocks)

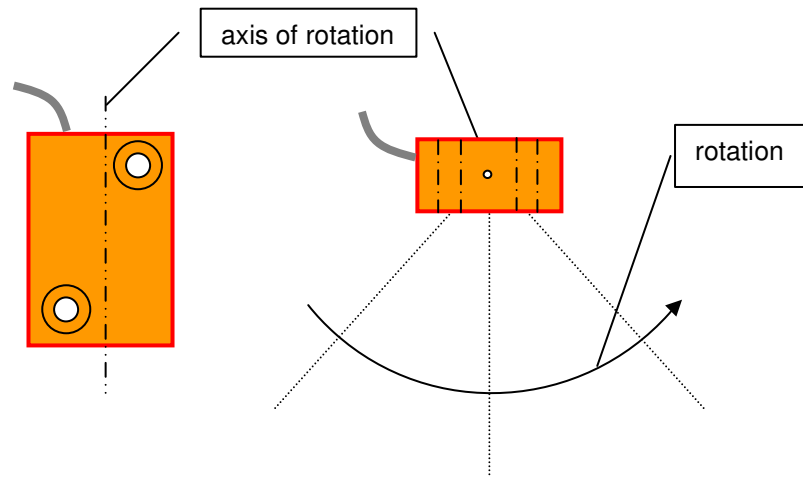


3 Mechanical mounting

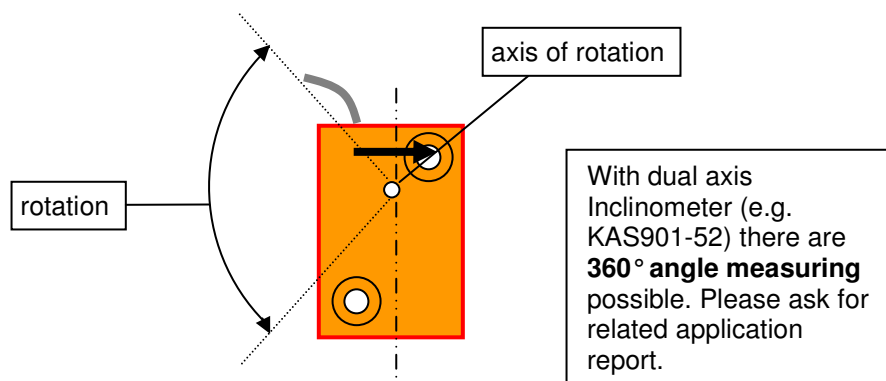
The housings are marked with a symbol indicating the measuring direction.

3.1 Alignment for inclination measuring

3.1.1: Possibility 1



3.1.2: Possibility 2:



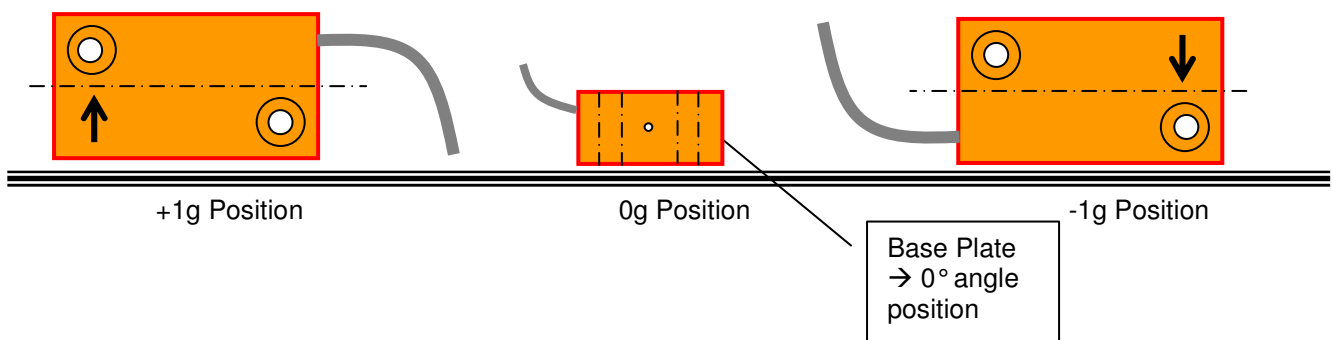
3.1.3: Mounting and output

Example 1:

+1g ⇔ +90° Position ⇔ 4,5V

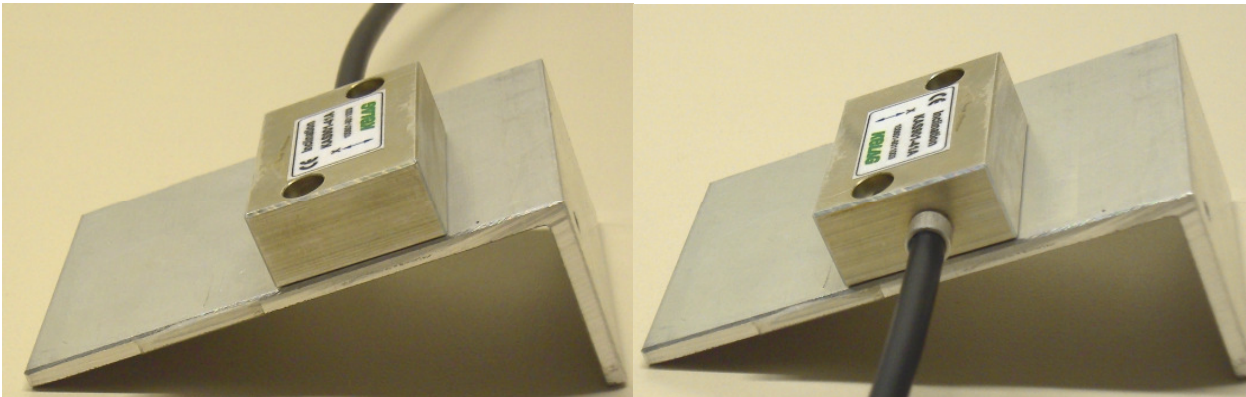
0g ⇔ 0° Position ⇔ 2,5V

-1g ⇔ -90° Position ⇔ 0,5V



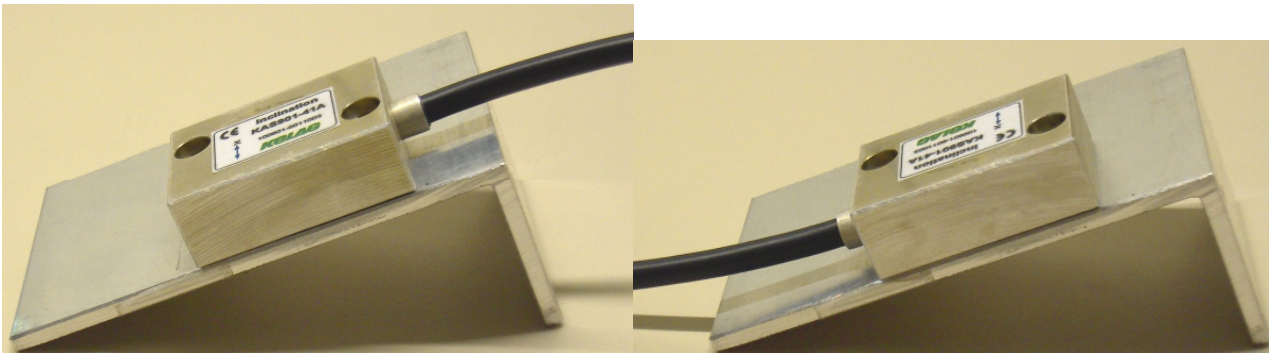
Example 2:

The pictures describe how the tilt is and what sort of output (direction) has to be expected.



X-axis: 3.14 V → >2.5V

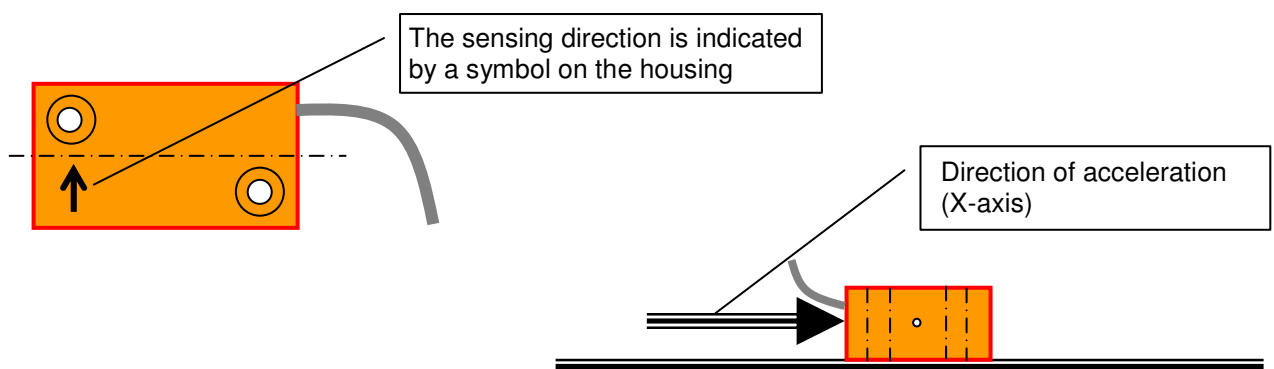
1.81 V → >2.5V



Y-axis: 3.16 V → >2.5V

1.82V → <2.5V

3.2 Mounting for acceleration and vibration



3.3 Offset-Alignment

Caused by the integration into the application a mechanical offset between the sensor and the application may occur. For precise measuring we recommend an offset alignment at the position 0g ⇔ 0° ⇔ 2,5V. The alignment will be done in the application device by matching the offset voltage. Thus the absolute precision increases considerably.

Additionally we offer a an additional 0-point calibration. Then the mounting has to be so, that the “potting” side is on the upper side. For that we offer an additional cap. Please contact our local sales representative or factory. (see also chapter 3.4 Temperature compensation)

3.4 Temperature compensation

Due to shrinking / dilatation of the sensing element at temperature variations the geometry of the element slightly varies. This will have an effect on the result of the measurement. Due to the symmetrical shape of the sensing element, most of this effect is automatically compensated. The remaining drift caused by temperature variation is very low, but should be compensated additionally for high precision applications.

Methods:

- applying temperature compensated sensors of the KAS901-01A, KAS901-02A, KAS901-5x, KAS901-4x and KAS903-Serie
- for the temperature compensated sensors calibration data is available on demand, stating the remaining temperature sensitivity after compensation. These data may be used for external correction algorithms. In addition the built-in temperature sensor in the SCA61T, SCA100T and SCA103T series may be used.
- For information please contact our technical consultants by phoning: +41 44 806 22 00.

3.5. Inclination in relation to earth gravity g

