

# DATA SHEET

## **KM110BH/2430; KM110BH/2470** 30° and 70° angle sensor hybrids

Product specification  
Supersedes data of 1996 Nov 08  
File under Discrete Semiconductors, SC17

1998 Mar 26

30° and 70° angle sensor hybrids

KM110BH/2430;  
KM110BH/2470

FEATURES

- Angle measuring range 30° or 70°
- Contactless, therefore wear-free and no microlinearity problems
- Easy to mount, ready for use
- Analog voltage output signal
- Operating temperatures up to 125 °C
- Precision of ± 0.5° in the temperature range (−15° ≤ α ≤ +15°)
- EMC resistant
- Sample kit with magnet available.

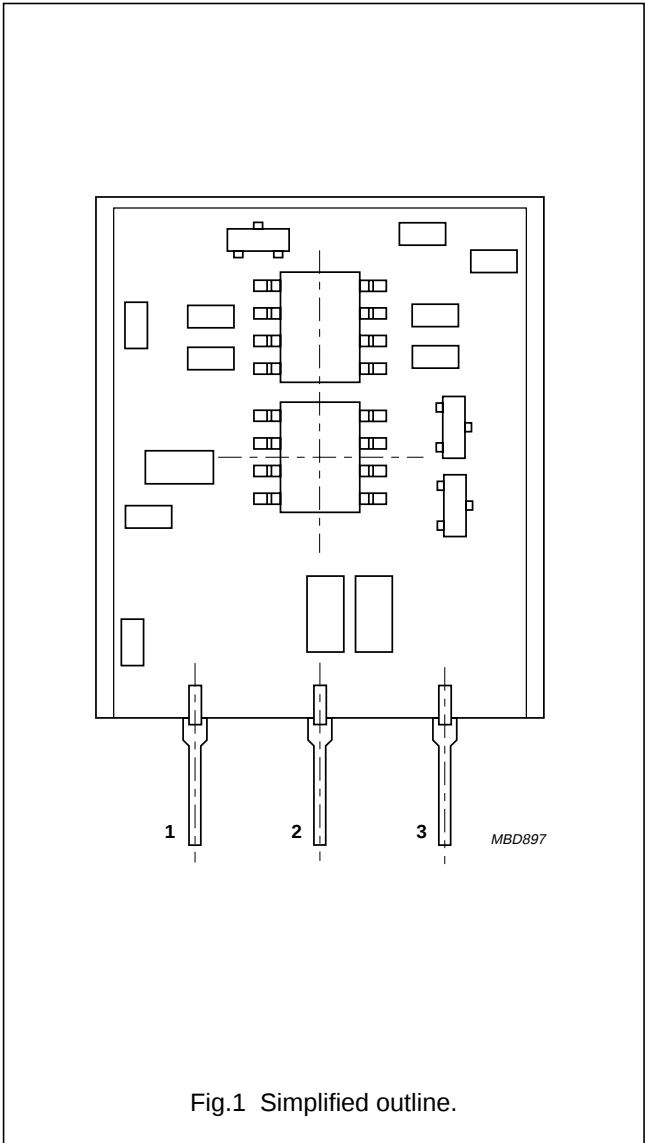
DESCRIPTION

The KM110BH/2430 and the KM110BH/2470 are sensor modules for contactless measurement of angular displacements of strong magnetic fields. The modules are a ready-trimmed (sensitivity and zero point) combination of a magnetoresistive KMZ sensor and a signal conditioning circuit in hybrid technology.

The KM110BH/2430 delivers a voltage output signal which is a linear function of the direction of the magnetic field. The KM110BH/2470 delivers a sinusoidal voltage output signal. The modules can be used for contactless angle measurement.

PINNING

| PIN | SYMBOL          | DESCRIPTION       |
|-----|-----------------|-------------------|
| 1   | GND             | ground            |
| 2   | V <sub>CC</sub> | DC supply voltage |
| 3   | V <sub>O</sub>  | output voltage    |



QUICK REFERENCE DATA

| SYMBOL            | PARAMETER             | MIN. | TYP.       | MAX. | UNIT |
|-------------------|-----------------------|------|------------|------|------|
| V <sub>CC</sub>   | DC supply voltage     | 4.5  | 5          | 16   | V    |
| T <sub>oper</sub> | operating temperature | −40  | −          | +125 | °C   |
| α                 | angle range:          |      |            |      |      |
|                   | KM110BH/2430          | −    | −15 to +15 | −    | deg  |
|                   | KM110BH/2470          | −    | −35 to +35 | −    | deg  |
| V <sub>O</sub>    | output voltage range  | −    | 0.5 to 4.5 | −    | V    |

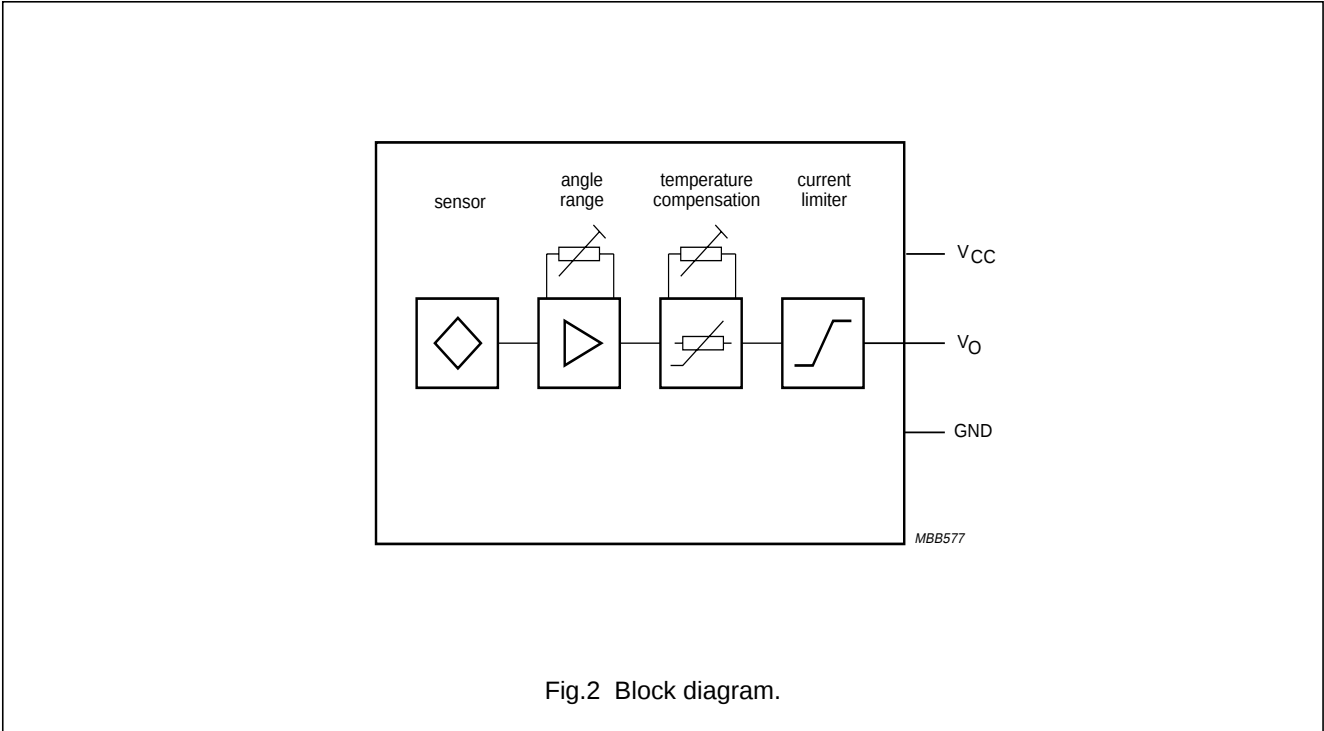
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EMC RESISTIVITY

The EMC compatibility is dependent on the assembly of the sensors. The EMC resistivity has to be tested in the final application.

BLOCK DIAGRAM



LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL            | PARAMETER                     | MIN.                  | MAX. | UNIT |
|-------------------|-------------------------------|-----------------------|------|------|
| V <sub>CC</sub>   | DC supply voltage             | 4.5                   | 16   | V    |
| I <sub>CC</sub>   | supply current                | –                     | 15   | mA   |
| T <sub>stg</sub>  | storage temperature           | –40                   | +125 | °C   |
| T <sub>oper</sub> | operating temperature; note 1 | –40                   | +125 | °C   |
|                   | output short-circuit duration | permanent; see note 2 |      |      |

Notes

- For operations above T<sub>oper</sub> = 100 °C, maximum V<sub>CC</sub> derates linearly from 16 V to 5 V at T<sub>oper</sub> = 125 °C.
- If pin 3 is shorted to either pin 1 or pin 2, a current may flow permanently, without damaging the device.

## 30° and 70° angle sensor hybrids

KM110BH/2430;  
KM110BH/2470**CHARACTERISTICS**

$T_{amb} = 25\text{ °C}$ ;  $V_{CC} = 5\text{ V}$ ;  $R_L = 1.7\text{ k}\Omega$  and a homogeneous magnetic field  $H_{ext} = 100\text{ kA/m}$  in the sensitive layer of the KMZ sensor, unless otherwise specified.

| SYMBOL                                           | PARAMETER                                                                      | CONDITIONS                                             | MIN.      | TYP.                     | MAX.       | UNIT             |
|--------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------------------------|-----------|--------------------------|------------|------------------|
| $\alpha$                                         | angle range:<br>KM110BH/2430<br>KM110BH/2470                                   | note 1                                                 | –<br>–    | –15 to +15<br>–35 to +35 | –<br>–     | deg<br>deg       |
| $V_O$                                            | output voltage range:<br>KM110BH/2430<br>KM110BH/2470                          | linear; see Fig.4<br>sinusoidal; see Fig.5             | –<br>–    | 0.5 to 4.5<br>0.5 to 4.5 | –<br>–     | V<br>V           |
| $V_{zero}$                                       | zero point voltage                                                             | $\alpha = 0^\circ$                                     | –         | 2.5                      | –          | V                |
| $V_{off}$                                        | zero point offset voltage:<br>KM110BH/2430<br>KM110BH/2470                     | related to sinusoidal sensor characteristic; see Fig.5 | –<br>–    | $\pm 25$<br>$\pm 15$     | –<br>–     | mV<br>mV         |
| $\alpha_{off}$                                   | zero point offset angle                                                        | related to hybrid edges; see Fig.7                     | –         | 1                        | 3          | deg              |
| S                                                | sensitivity:<br>KM110BH/2430<br>KM110BH/2470                                   | $\alpha = 0^\circ$ ; note 2                            | 137<br>73 | 140<br>74.5              | 143<br>76  | mV/deg<br>mV/deg |
| P                                                | precision:<br>KM110BH/2430<br>KM110BH/2470                                     | –20 to +100 °C                                         | –         | 0.2<br>0.5               | 0.5<br>1.2 | deg<br>deg       |
| FL                                               | deviation of linearity:<br>KM110BH/2430<br>KM110BH/2470                        | note 3                                                 | –<br>–    | $\pm 1$<br>–             | –<br>–     | %FS<br>%FS       |
| $R_p$                                            | reproducibility                                                                | $\alpha = 0^\circ$ ; note 4                            | –         | <0.001                   | –          | deg              |
| $R_s$                                            | resolution                                                                     | $\alpha = 0^\circ$ ; note 5                            | –         | <0.001                   | –          | deg              |
| FH                                               | hysteresis                                                                     | $\alpha = 0^\circ$ ; note 6                            | –         | <0.05                    | –          | deg              |
| $SP_{max}$                                       | maximum angular speed:<br>KM110BH/2430<br>KM110BH/2470                         |                                                        | –<br>–    | 60<br>150                | –<br>–     | deg/ms<br>deg/ms |
| $R_L$                                            | load resistance                                                                |                                                        | 1.7       | –                        | –          | k $\Omega$       |
| $C_L$                                            | load capacitance                                                               |                                                        | –         | –                        | 10         | nF               |
| <b>Temperature coefficients (–40 to +100 °C)</b> |                                                                                |                                                        |           |                          |            |                  |
| $TCV_{zero}$                                     | temperature coefficient of zero point voltage:<br>KM110BH/2430<br>KM110BH/2470 |                                                        | –<br>–    | 0.2<br>0.1               | 0.6<br>0.3 | mV/K<br>mV/K     |
| TCS                                              | temperature coefficient of sensitivity                                         | –20 to 100 °C                                          | –         | $100 \times 10^{-6}$     | –          | K <sup>–1</sup>  |

## 30° and 70° angle sensor hybrids

KM110BH/2430;  
KM110BH/2470**Notes to the characteristics**

1. Refer to Fig.3. The magnetic field  $H_{\text{ext}} = 100 \text{ kA/m}$  can be achieved using the magnets listed in Table 1.
2. The sensitivity will change slightly with  $+0.33\%$  per 10% magnetic field increase if  $H_{\text{ext}}$  deviates from 100 kA/m.
3. Deviation from best straight line in angle range.
4. Difference in output signal (expressed in degrees) between two zero point ( $\alpha = 0^\circ$ ) measurements, in which the zero point is approached from the same side of the measuring range (e.g. cycle:  $+15^\circ \Rightarrow 0^\circ \Rightarrow +15^\circ \Rightarrow 0^\circ$ ).
5. The smallest detectable change of angle  $\Delta\alpha$  for  $\alpha = 0^\circ$  (cycle:  $0^\circ \Rightarrow \Delta\alpha$ ).
6. As note 4, but with the zero point being approached from the upper end and lower end of the measuring range respectively (cycle:  $+15^\circ \Rightarrow 0^\circ \Rightarrow -15^\circ \Rightarrow 0^\circ$ ).

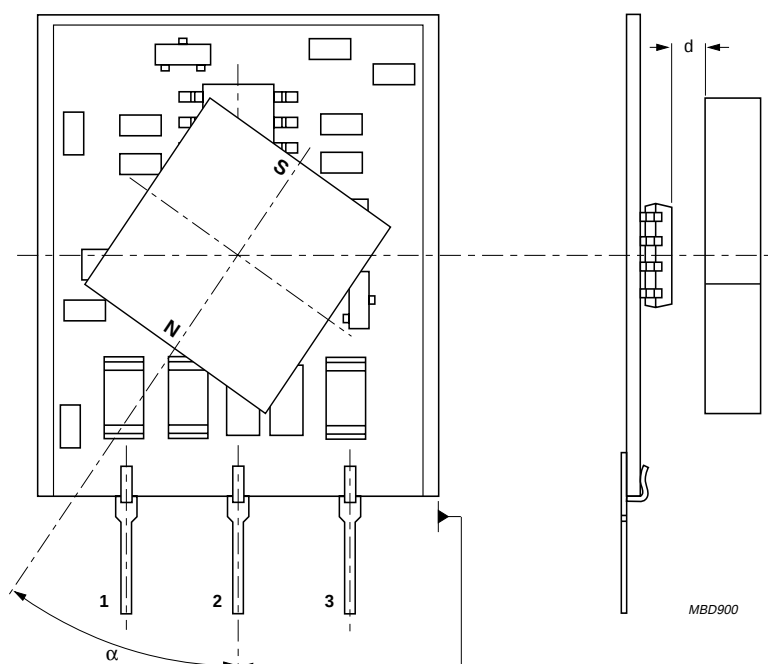


Fig.3 Optimum magnet position relative to the sensor module.

## 30° and 70° angle sensor hybrids

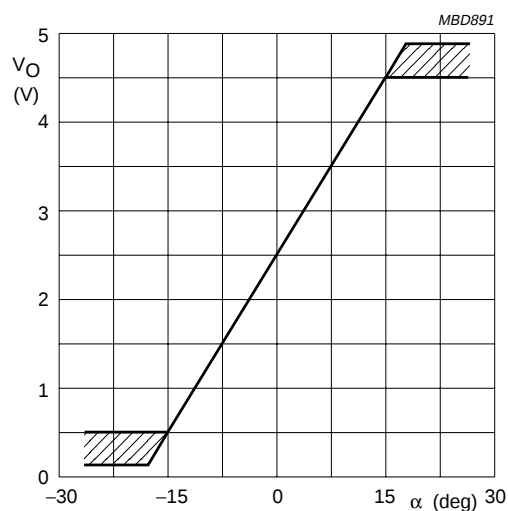
KM110BH/2430;  
KM110BH/2470

Fig.4 KM110BH/2430 output signal as a function of angle position.

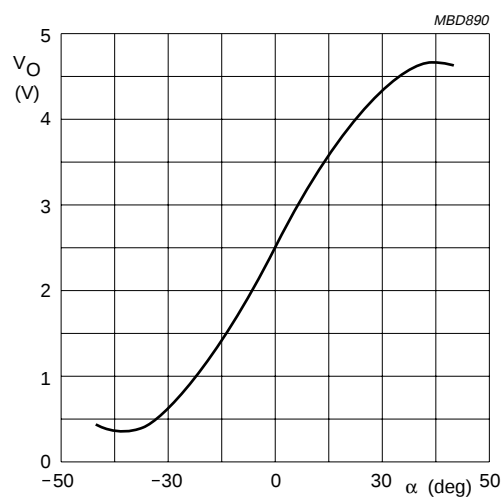
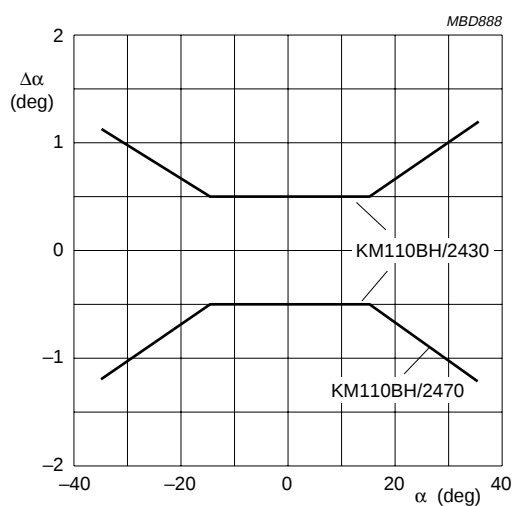


Fig.5 KM110BH/2470 output signal as a function of angle position.



$T_{amb} = -25$  to  $+85^\circ\text{C}$ .

$\alpha = 0^\circ$  for  $T_{amb} = 25^\circ\text{C}$  and  $V_O = 2.5$  V.

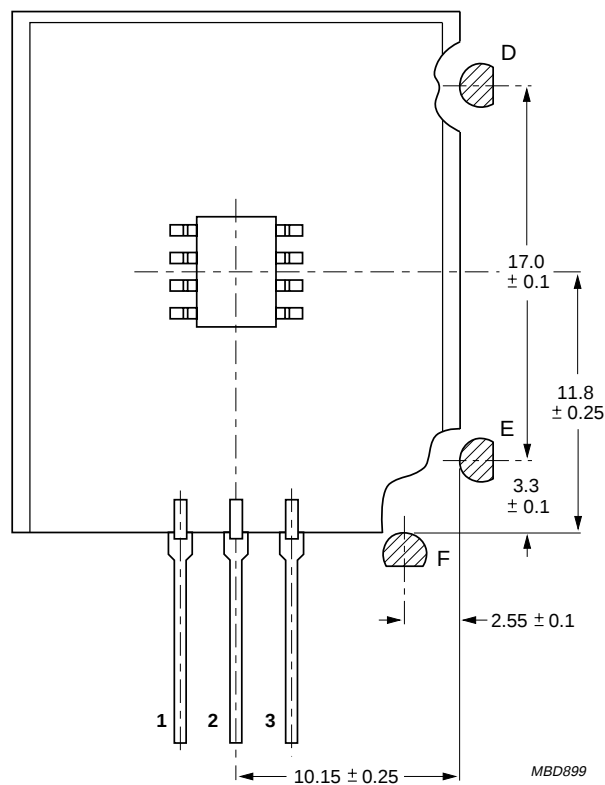
$\Delta\alpha$  increases by a factor 2 in the temperature range:

$V_O = 2.5 + 2.128 \times \sin(2\alpha)$  for  $-36.5^\circ \leq \alpha \leq +36.5^\circ$ .

$T_{amb} = 25^\circ\text{C}$ ;  $V_{CC} = 5$  V;  $H_{ext} = 100$  kA/m.

Fig.6 Maximum angle error  $\Delta\alpha$  as a function of the angle position.

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KM110BH/2470

Dimensions in mm.

D, E, F : reference points for sensor assembly.

D, E : definition of reference side for angle  $\alpha$ .

Fig.7 Reference data for hybrid assembly and magnet positioning.

Table 1 Magnets for angle sensor hybrid

| MATERIAL                         | DIMENSIONS <sup>(1)</sup><br>(mm) | d <sup>(2)</sup><br>(mm) | TOLERANCE <sup>(3)</sup><br>d (mm) | ECCENTRICITY <sup>(4)</sup><br>(mm) | T <sub>amb</sub><br>(°C) |
|----------------------------------|-----------------------------------|--------------------------|------------------------------------|-------------------------------------|--------------------------|
| Sm <sub>2</sub> Co <sub>17</sub> | 11.2 × 5.5 × 8                    | 2.1                      | ±0.30                              | ±0.25                               | -55 to +125              |
|                                  | 6 × 3 × 5                         | 0.7                      | ±0.15                              | ±0.15                               |                          |
|                                  | 8 × 3 × 7.5                       | 0.5                      | ±0.30                              | ±0.20                               |                          |

## Notes

1. The magnetization is always parallel to the latter dimensions given.
2. Distance (d) between magnet and KMZ sensor front as shown in Fig.3.
3. Maximum deviation of distance (d) for which the change in sensor output signal is smaller than 0.5% of full scale sensor signal.
4. Maximum deviation of magnet rotational axis to sensor rotational axis for which the change in sensor output signal is smaller than 0.5% of full scale sensor signal.

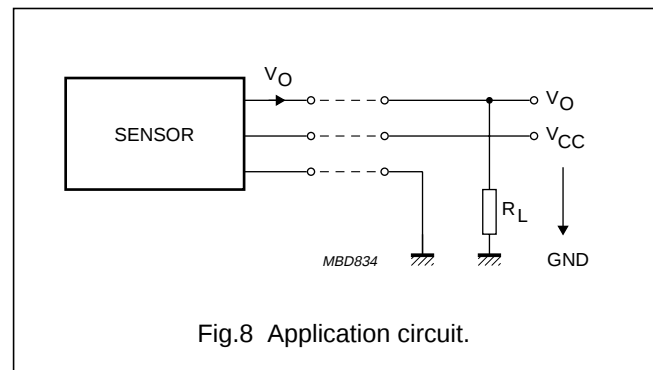
## 30° and 70° angle sensor hybrids

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KM110BH/2470

### APPLICATION INFORMATION

The sensor hybrids KM110BH/2430 and KM110BH/2470 are available with different electrical contacts:

1. Stretched pins with a pitch of 2.54 mm; these pins are recommended for connector and/or cable connections (see Fig.9).
2. Double 's' bent pins (see Fig.10) with a pitch of 5.71 mm; bent pins are recommended for rigid soldered connections to compensate for mechanical stress. Quote type numbers KM110BH/2430G and KM110BH/2470G respectively for these hybrids.



## 30° and 70° angle sensor hybrids

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## PACKAGE OUTLINES

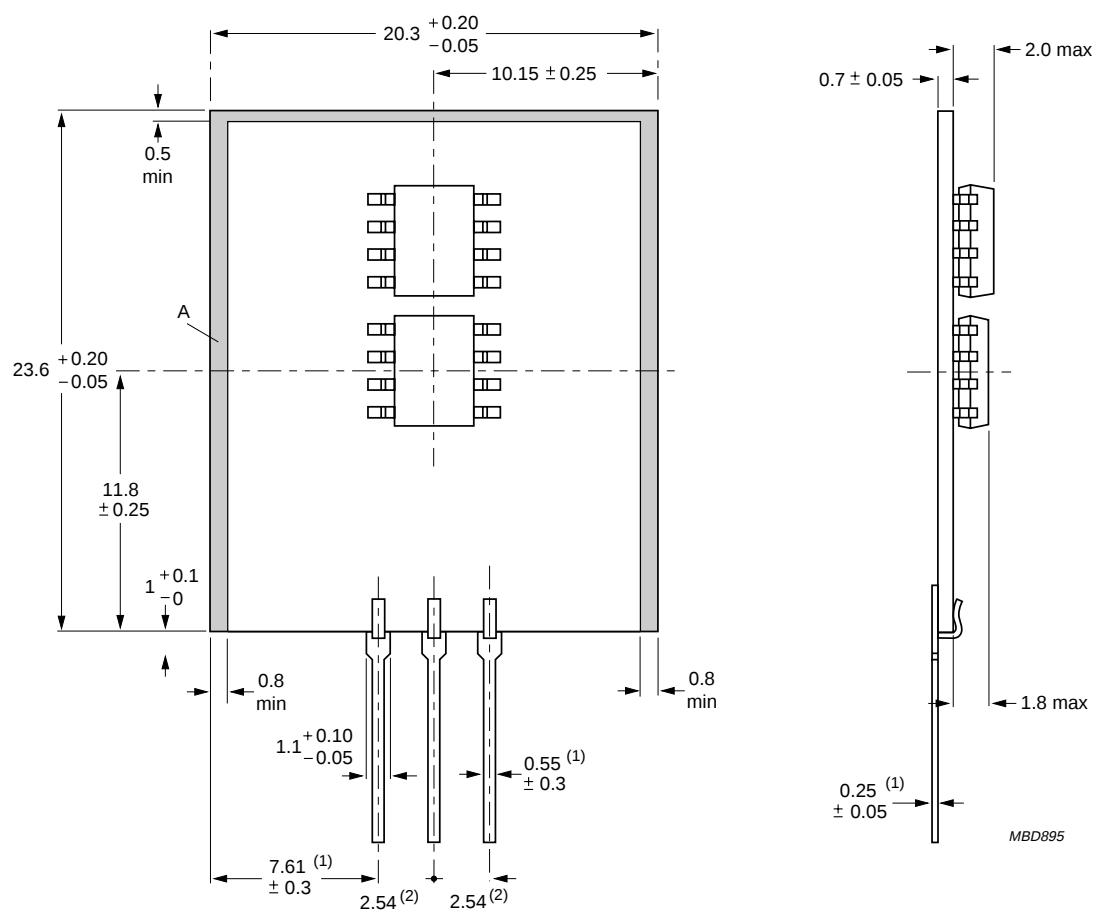


Fig.9 Outline of KM110BH/2430 and KM110BH/2470.

## 30° and 70° angle sensor hybrids

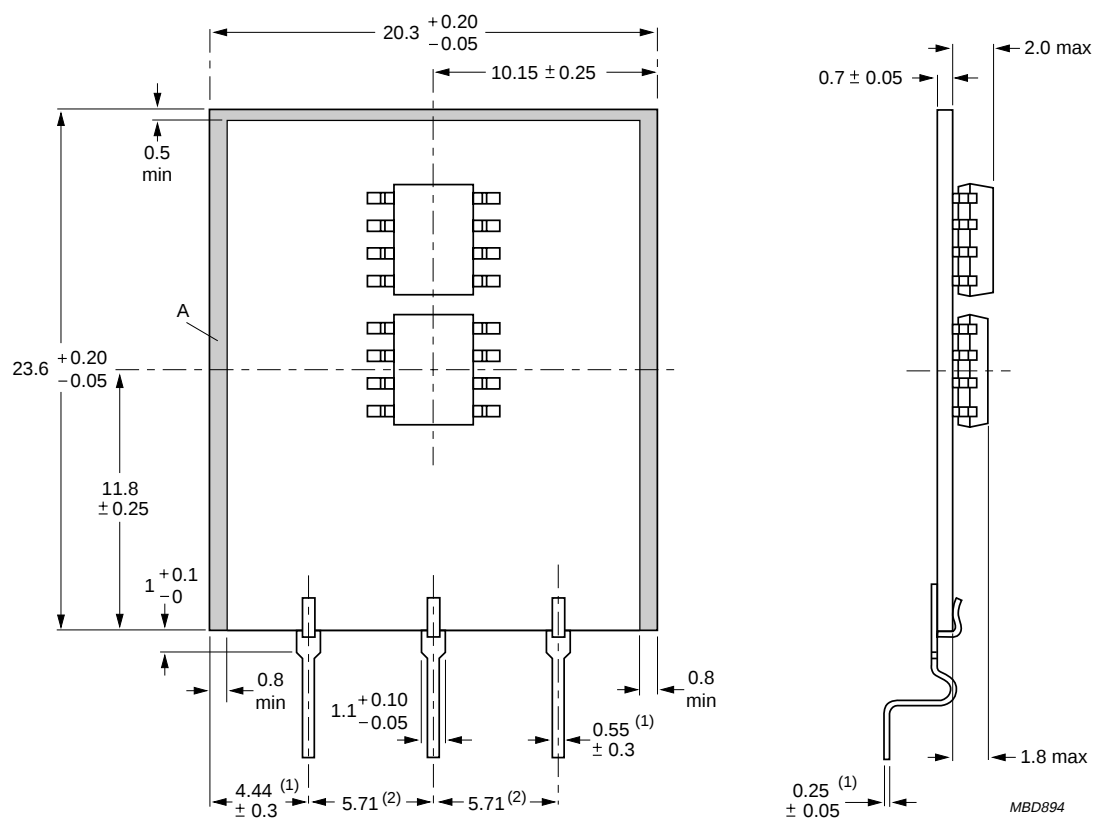
KM110BH/2430;  
KM110BH/2470

Fig.10 Outline of KM110BH/2430G and KM110BH/2470G.

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**30° and 70° angle sensor hybrids**

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**KM110BH/2430;  
KM110BH/2470**

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**DEFINITIONS**

| <b>Data Sheet Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Objective specification                                                                                                                                                                                                                                                                                                                                                                                                                                   | This data sheet contains target or goal specifications for product development.       |
| Preliminary specification                                                                                                                                                                                                                                                                                                                                                                                                                                 | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification                                                                                                                                                                                                                                                                                                                                                                                                                                     | This data sheet contains final product specifications.                                |
| <b>Limiting values</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                       |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability. |                                                                                       |
| <b>Application information</b>                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                       |
| Where application information is given, it is advisory and does not form part of the specification.                                                                                                                                                                                                                                                                                                                                                       |                                                                                       |

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