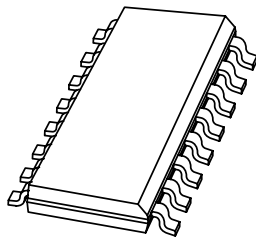


DATA SHEET



KMZ52 Magnetic Field Sensor

Product specification

2000 Jun 09

Magnetic Field Sensor

KMZ52

FEATURES

- High sensitivity
- Integrated compensation coil
- Integrated set/reset coil.

APPLICATIONS

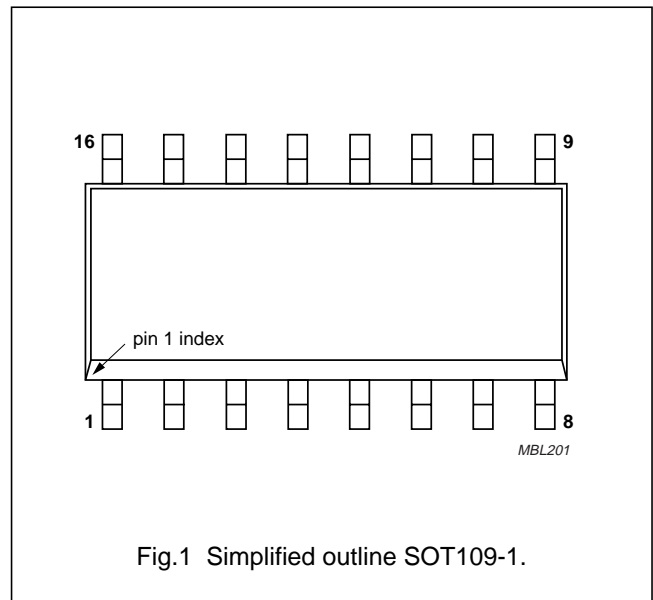
- Navigation
- Current and earth magnetic field measurement
- Traffic detection.

DESCRIPTION

The KMZ52 is an extremely sensitive magnetic field sensor, employing the magnetoresistive effect of thin-film permalloy. The sensor contains two magnetoresistive Wheatstone bridges physically offset from one another by 90° and integrated compensation and set/reset coils. The integrated compensation coils allow magnetic field measurement with current feedback loops to generate outputs that are independent of drift in sensitivity. The orientation of sensitivity may be set or changed (flipped) by means of the integrated set/reset coils. A short current pulse should be applied to the compensation coils to recover (set) the sensor after exposure to strong disturbing magnetic fields. A negative current pulse will reset the sensor to reversed sensitivity. By use of periodically alternated flipping pulses and a lock-in amplifier, the output is made independent of sensor and amplifier offset.

PINNING

| SYMBOL | PIN | DESCRIPTION |
|---------------------|-----|-----------------------|
| +I _{flip2} | 1 | flip coil |
| V _{CC2} | 2 | bridge supply voltage |
| GND2 | 3 | ground |
| +I _{comp2} | 4 | compensation coil |
| GND1 | 5 | ground |
| +I _{comp1} | 6 | compensation coil |
| -I _{comp1} | 7 | compensation coil |
| -V _{O1} | 8 | bridge output voltage |
| +V _{O1} | 9 | bridge output voltage |
| -I _{flip1} | 10 | flip coil |
| +I _{flip1} | 11 | flip coil |
| V _{CC1} | 12 | bridge supply voltage |
| -I _{comp2} | 13 | compensation coil |
| -V _{O2} | 14 | bridge output voltage |
| +V _{O2} | 15 | bridge output voltage |
| -I _{flip2} | 16 | flip coil |



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QUICK REFERENCE DATA

| SYMBOL | PARAMETER | MIN. | TYP. | MAX. | UNIT |
|---------------------|---|------|-------|-------|-----------------------------------|
| V _{CC} | bridge supply voltage | – | 5 | 8 | V |
| S | sensitivity (uncompensated) | 12 | 16 | – | $\frac{\text{mV/V}}{\text{kA/m}}$ |
| V _{offset} | offset voltage per supply voltage | –1.5 | 0 | +1.5 | mV/V |
| R _{bridge} | bridge resistance | 1 | 2 | 3 | k Ω |
| R _{comp} | compensation coil resistance | 100 | 170 | 300 | Ω |
| A _{comp} | field factor of compensation coil; note 1 | 19 | 22 | 25 | $\frac{\text{A/m}}{\text{mA}}$ |
| R _{flip} | resistance of set/reset coil | 1 | 2 | 3 | Ω |
| I _{flip} | recommended flipping current for stable operation; note 2 | ±800 | ±1000 | ±1200 | mA |
| t _{flip} | flip pulse duration; note 2 | 1 | 3 | 100 | μs |

Notes

1. The compensation coil generates a field $H_{\text{comp}} = A_{\text{comp}} \times I_{\text{comp}}$ in addition to the external field H_{ext} . Sensor output will become zero if $H_{\text{ext}} = H_{\text{comp}}$.
2. Average power consumption of the flipping coil, defined by current, pulse duration and pulse repetition rate may not exceed the specified limit, see Chapter “Limiting values”.

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 60134).

| SYMBOL | PARAMETER | MIN. | MAX. | UNIT |
|-------------------------|--|------|------|------|
| V _{CC} | bridge supply voltage | – | 8 | V |
| P _{tot} | total power dissipation | – | 130 | mW |
| T _{stg} | storage temperature | –65 | +150 | °C |
| T _{amb} | maximum operating temperature | –40 | –125 | °C |
| I _{comp} | maximum compensation current | – | 15 | mA |
| I _{flip (max)} | maximum flipping current | – | 1500 | mA |
| P _{flip (max)} | maximum flipping power dissipation | – | 50 | mW |
| V _{isol} | voltage between isolated systems: flip coil and Wheatstone bridge; compensation coil and Wheatstone bridge; flip coil and compensation coil | – | 60 | V |

THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | VALUE | UNIT |
|---------------------|--|-------|------|
| R _{th j-a} | terminal resistance from junction to ambient | 105 | K/W |

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CHARACTERISTICS

$T_{\text{bridge}} = 25\text{ °C}$; $V_{\text{CC1}} = V_{\text{CC2}} = 5\text{ V}$; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|------------------------------|---|--|-----------|------------|------------|-----------------------------------|
| V_{CC} | bridge supply voltage | note 1 | – | 5 | 8 | V |
| H | field strength operating range in sensor plane | | –0.2 | – | +0.2 | kA/m |
| S | sensitivity | open circuit | 12 | 16 | – | $\frac{\text{mV/V}}{\text{kA/m}}$ |
| TCS | temperature coefficient of sensitivity | $T_{\text{s}} = -25\text{ to }+125\text{ °C}$ | – | 0.31 | – | %/K |
| k_{SX} | sensitivity synchronism | note 2 | 92 | 100 | 108 | % |
| TCV_{O} | temperature coefficient of output voltage | $V_{\text{CC}} = 5\text{ V}$; $T_{\text{bridge}} = -25\text{ to }+125\text{ °C}$ | – | –0.4 | – | %/K |
| R_{bridge} | bridge resistance | note 3 | 1 | 2 | 3 | k Ω |
| $\text{TCR}_{\text{bridge}}$ | temperature coefficient of bridge resistance | $T_{\text{bridge}} = -25\text{ to }+125\text{ °C}$; note 4 | – | 0.3 | – | %/K |
| V_{offset} | offset voltage per supply voltage | | –1.5 | 0 | +1.5 | mV/V |
| $\text{TCV}_{\text{offset}}$ | temperature coefficient of offset voltage | $T_{\text{bridge}} = -25\text{ to }+125\text{ °C}$; note 5 | –3 | 0 | +3 | $\frac{\mu\text{V/V}}{\text{K}}$ |
| FH | hysteresis of output voltage | | – | – | 2 | %FS |
| R_{comp} | resistance of compensation coil | note 6 | 100 | 170 | 300 | Ω |
| A_{comp} | field factor of compensation coil | | 19 | 22 | 25 | $\frac{\text{A/m}}{\text{mA}}$ |
| R_{flip} | resistance of set/reset coil | note 7 | 1 | 2 | 3 | Ω |
| TCR_{flip} | temperature coefficient of resistance of set/reset coil | $T_{\text{flip}} = -25\text{ to }+125\text{ °C}$ | – | 0.39 | – | %/K |
| I_{flip} | recommended flipping current for stable operation | | ± 800 | ± 1000 | ± 1200 | mA |
| t_{flip} | flip pulse duration | | 1 | 3 | 100 | μs |
| R_{isol} | isolating resistance | note 8 | 1 | – | – | M Ω |
| V_{isol} | voltage between isolated systems | note 8 | – | – | 50 | V |
| $R_{\text{isol_dice}}$ | isolating resistance between dice | die 1 to die 2 | 1 | – | – | M Ω |
| f | operating frequency | | 0 | – | 1 | MHz |
| α | angle die-to-die | note 9 | 88 | 90 | 92 | deg |
| β | angle dice-to-package | note 9 | –5 | 0 | +5 | deg |

Notes

1. Due to the ratiometric output, the same supply voltage (V_{CC}) must be applied to both dice in one KMZ52 device.

$$2. k_{\text{SX}} = 100 \times \frac{A_{\text{comp1}} \times S_1}{A_{\text{comp2}} \times S_2} \%$$

3. Bridge resistance die 1: between pins 5 and 12; bridge resistance die 2: between pins 2 and 3.

$$4. \text{TCR}_{\text{bridge}} = 100 \frac{R_{\text{bridge}(T_2)} - R_{\text{bridge}(T_1)}}{R_{\text{bridge}(T_1)} (T_2 - T_1)} \quad \text{Where } T_1 = -25\text{ °C}; T_2 = 125\text{ °C}.$$

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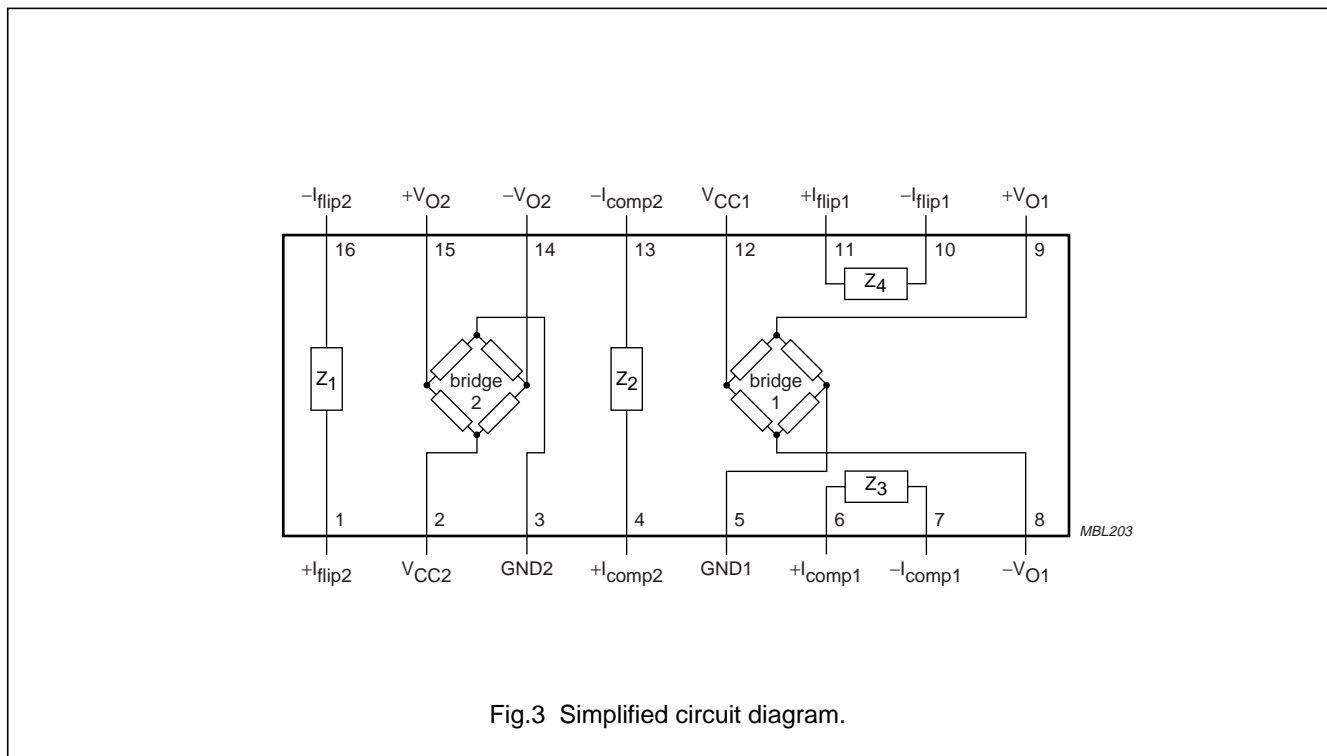
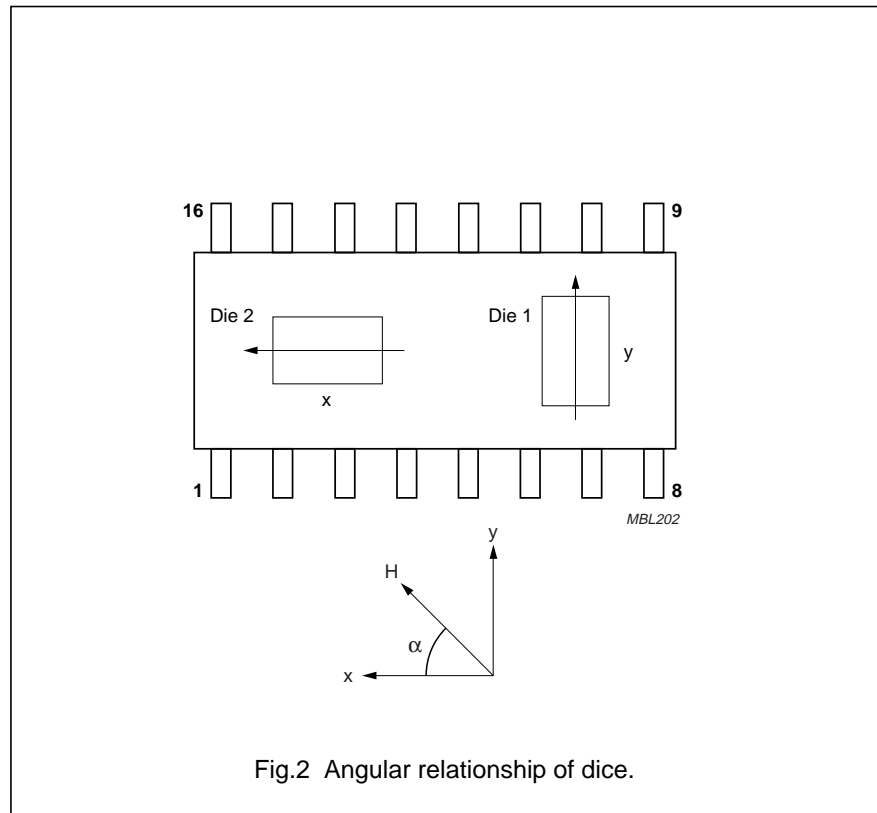
5. $TCV_{\text{offset}} = \frac{V_{\text{offset}(T_2)} - V_{\text{offset}(T_1)}}{(T_2 - T_1)}$ Where $T_1 = -25^\circ\text{C}$; $T_2 = 125^\circ\text{C}$.
6. Resistance of compensation coil die 1: between pins 6 and 7;
resistance of compensation coil die 2: between pins 4 to 13.
7. Resistance of set/reset coil die 1: between pins 10 and 11;
resistance of set/reset coil die 2: between pins 1 to 16.
8. Isolating resistance die 1: pins 7 and 8, 7 and 10 and 8 to 10;
isolating resistance die 2: pins 1 to 2, 1 to 4 and 2 to 4.
9. Angle die-to-die: die 2 is turned by 90 ± 2 degrees in anticlockwise direction with respect to die 1;
angle dice-to-package: both dice in their fixed die-to-die position are tilted towards the package edges by 0 ± 5 degrees.

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APPLICATION INFORMATION

If the angle α between external magnetic field H and the long axis of the package is zero, H is parallel to the most sensitive direction of die 2 and perpendicular to the sensitive direction of die 1. A magnetic field turning clockwise (see Fig.2) thus yields an output proportional to $\cos \alpha$ (V_{out2}) and an output proportional to $\sin \alpha$ (V_{out1}).



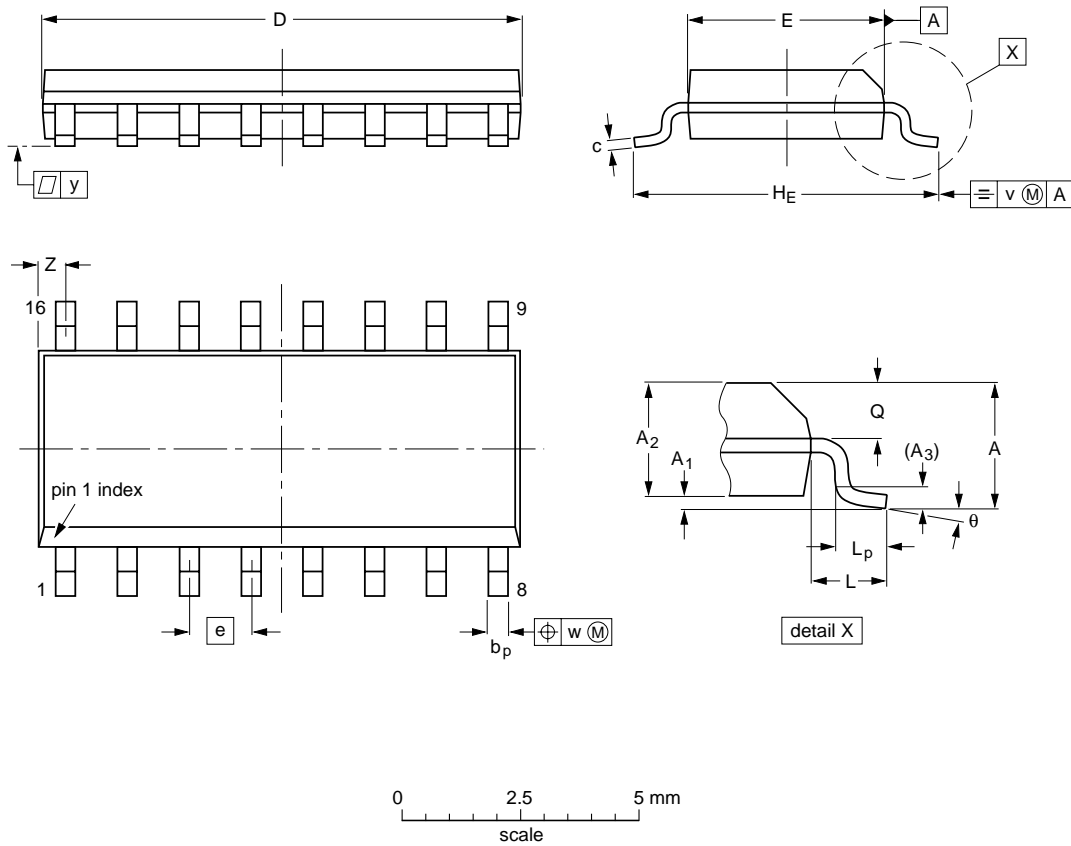
Magnetic Field Sensor

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PACKAGE OUTLINE

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽¹⁾ | e | H _E | L | L _p | Q | v | w | y | Z ⁽¹⁾ | θ |
|--------|--------|----------------|----------------|----------------|----------------|------------------|------------------|------------------|-------|----------------|-------|----------------|----------------|------|------|-------|------------------|----------|
| mm | 1.75 | 0.25 0.10 | 1.45 1.25 | 0.25 | 0.49 0.36 | 0.25 0.19 | 10.0 9.8 | 4.0 3.8 | 1.27 | 6.2 5.8 | 1.05 | 1.0 0.4 | 0.7 0.6 | 0.25 | 0.25 | 0.1 | 0.7 0.3 | 8° 0° |
| inches | 0.069 | 0.010 0.004 | 0.057 0.049 | 0.01 | 0.019 0.014 | 0.0100 0.0075 | 0.39 0.38 | 0.16 0.15 | 0.050 | 0.244 0.228 | 0.041 | 0.039 0.016 | 0.028 0.020 | 0.01 | 0.01 | 0.004 | 0.028 0.012 | |

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|--------|------|---------------------|-----------------------|
| | IEC | JEDEC | EIAJ | | |
| SOT109-1 | 076E07 | MS-012 | | | 97-05-22- 99-12-27 |

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DATA SHEET STATUS

| DATA SHEET STATUS | PRODUCT STATUS | DEFINITIONS ⁽¹⁾ |
|---------------------------|----------------|--|
| Objective specification | Development | This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice. |
| Preliminary specification | Qualification | This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product. |
| Product specification | Production | This data sheet contains final specifications. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product. |

Note

1. Please consult the most recently issued data sheet before initiating or completing a design.

DEFINITIONS

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). 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.

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NOTES

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