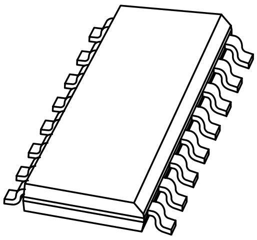
# DATA SHEET



# KMZ52
## Magnetic Field Sensor

Product specification

2000 Jun 09

Philips Semiconductors

PHILIPS

## 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 |

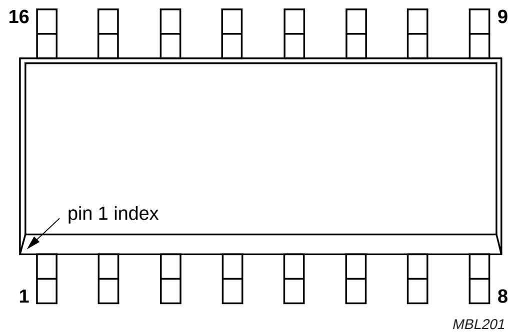



Fig.1 Simplified outline SOT109-1.

## QUICK REFERENCE DATA

| SYMBOL | PARAMETER | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{CC}$ | bridge supply voltage | – | 5 | 8 | V |
| S | sensitivity (uncompensated) | 12 | 16 | – | $\frac{mV/V}{kA/m}$ |
| $V_{offset}$ | offset voltage per supply voltage | –1.5 | 0 | +1.5 | mV/V |
| $R_{bridge}$ | bridge resistance | 1 | 2 | 3 | kΩ |
| $R_{comp}$ | compensation coil resistance | 100 | 170 | 300 | Ω |
| $A_{comp}$ | field factor of compensation coil; note 1 | 19 | 22 | 25 | $\frac{A/m}{mA}$ |
| $R_{flip}$ | 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 $H_{comp} = A_{comp} \times I_{comp}$ in addition to the external field $H_{ext}$. Sensor output will become zero if $H_{ext} = H_{comp}$.
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:<br>flip coil and Wheatstone bridge;<br>compensation coil and Wheatsone bridge;<br>flip coil and compensation coil | – | 60 | V |

## THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | VALUE | UNIT |
|---|---|---|---|
| $R_{th\ j\text{-}a}$ | terminal resistance from junction to ambient | 105 | K/W |

## CHARACTERISTICS

$T_{bridge}$ = 25 °C; $V_{CC1}$ = $V_{CC2}$ = 5 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 | – | $\frac{mV/V}{kA/m}$ |
| TCS | temperature coefficient of sensitivity | $T_s$ = –25 to +125 °C | – | 0.31 | – | %/K |
| $k_{SX}$ | sensitivity synchronism | note 2 | 92 | 100 | 108 | % |
| $TCV_O$ | temperature coefficient of output voltage | $V_{CC}$ = 5 V; $T_{bridge}$ = –25 to +125 °C | – | –0.4 | – | %/K |
| $R_{bridge}$ | bridge resistance | note 3 | 1 | 2 | 3 | kΩ |
| $TCR_{bridge}$ | temperature coefficient of bridge resistance | $T_{bridge}$ = –25 to +125 °C; note 4 | – | 0.3 | – | %/K |
| $V_{offset}$ | offset voltage per supply voltage | | –1.5 | 0 | +1.5 | mV/V |
| $TCV_{offset}$ | temperature coefficient of offset voltage | $T_{bridge}$ = –25 to +125 °C; note 5 | –3 | 0 | +3 | $\frac{\mu V/V}{K}$ |
| 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 | $\frac{A/m}{mA}$ |
| $R_{flip}$ | resistance of set/reset coil | note 7 | 1 | 2 | 3 | Ω |
| $TCR_{flip}$ | temperature coefficient of resistance of set/reset coil | $T_{flip}$ = –25 to +125 °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 | – | – | MΩ |
| $V_{isol}$ | voltage between isolated systems | note 8 | – | – | 50 | V |
| $R_{isol\_dice}$ | isolating resistance between dice | die 1 to die 2 | 1 | – | – | MΩ |
| 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. $k_{SX} = 100 \times \frac{A_{comp1} \times S_1}{A_{comp2} \times S_2} \%$
3. Bridge resistance die 1: between pins 5 and 12; bridge resistance die 2: between pins 2 and 3.
4. $TCR_{bridge} = 100 \frac{R_{bridge(T_2)} - R_{bridge(T_1)}}{R_{bridge(T_1)}(T_2 - T_1)}$ Where $T_1 = -25°C$; $T_2 = 125°C$.

5. $TCV_{offset} = \frac{V_{offset(T_2)} - V_{offset(T_1)}}{(T_2 - T_1)}$ Where $T_1 = -25°C;\ T_2 = 125°C$.

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.

## 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 α ($V_{out2}$) and an output proportional to sin α ($V_{out1}$).

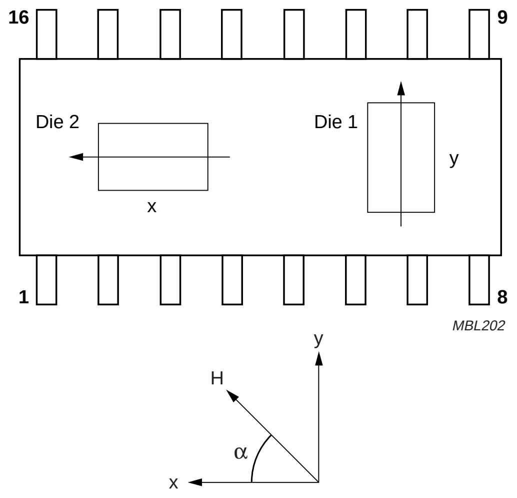



Fig.2 Angular relationship of dice.

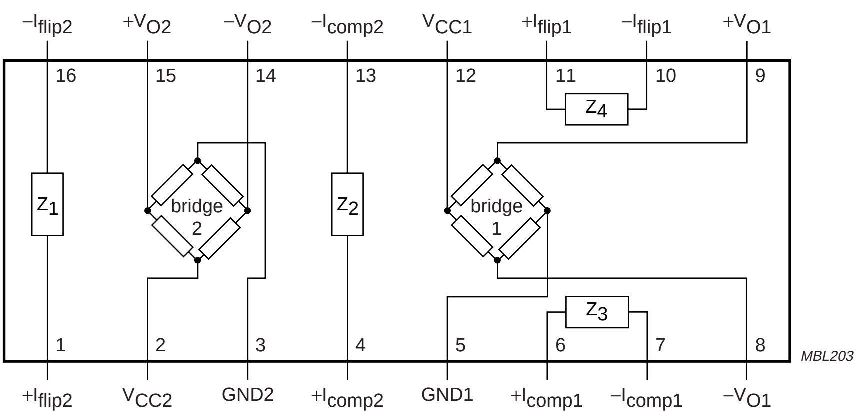
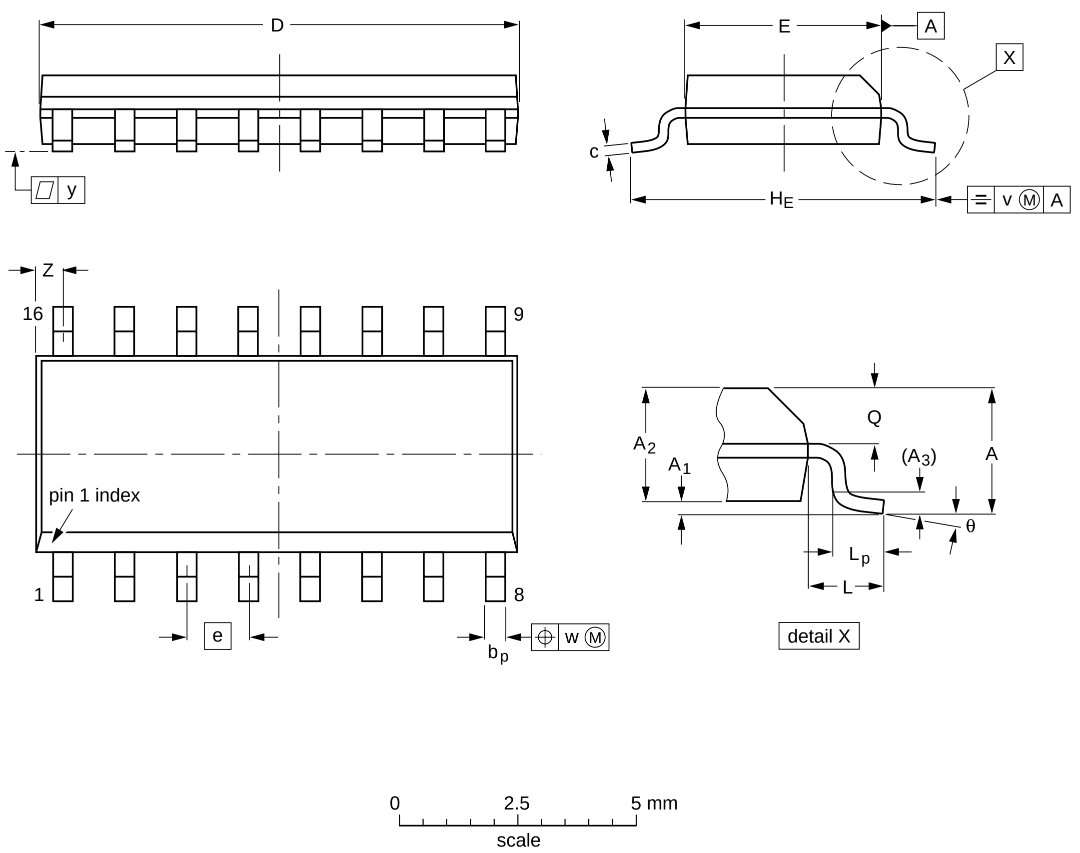



Fig.3 Simplified circuit diagram.

## 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<br>0.10 | 1.45<br>1.25 | 0.25 | 0.49<br>0.36 | 0.25<br>0.19 | 10.0<br>9.8 | 4.0<br>3.8 | 1.27 | 6.2<br>5.8 | 1.05 | 1.0<br>0.4 | 0.7<br>0.6 | 0.25 | 0.25 | 0.1 | 0.7<br>0.3 | $8^o$<br>$0^o$ |
| inches | 0.069 | 0.010<br>0.004 | 0.057<br>0.049 | 0.01 | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.39<br>0.38 | 0.16<br>0.15 | 0.050 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.020 | 0.01 | 0.01 | 0.004 | 0.028<br>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~~<br>99-12-27 |

## 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. |
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**Note**

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**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

## NOTES

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