

# DATA SHEET

**KMI18/2**

Integrated rotational speed sensor

Preliminary specification

2000 Sep 05

Integrated rotational speed sensor

KMI18/2

FEATURES

- Open collector output
- For active target wheel application
- Wide air gap
- Zero speed capability
- Wide temperature range
- Insensitive to vibration.

DESCRIPTION

The KMI18/2 sensor detects rotational speed of active target wheels with magnetic reference marks.

It consists of a magnetoresistive sensor element, an integrated circuit for signal conditioning and a ferrite magnet.

The frequency of the digital voltage output signal is proportional to the rotational speed of the target wheel.

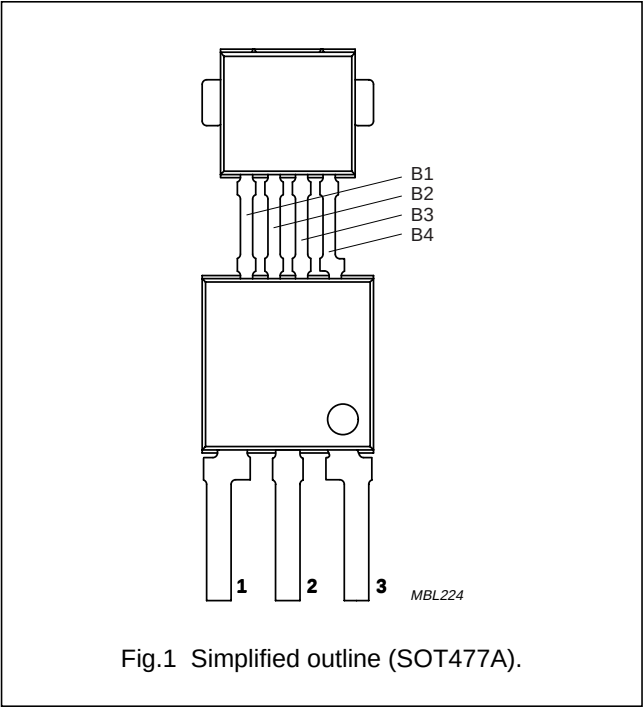
An open collector output gives high flexibility in the design of the subsequent signal conditioning electronics.

CAUTION

Do not press two or more products together against their magnetic forces. Do not expose products to strong magnetic fields of more than 30 kA/m.

PINNING

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



QUICK REFERENCE DATA

| SYMBOL           | PARAMETER                      | CONDITIONS                        | MIN. | TYP. | MAX. | UNIT |
|------------------|--------------------------------|-----------------------------------|------|------|------|------|
| V <sub>CC</sub>  | DC supply voltage              | T <sub>amb</sub> = -40 to +150 °C | 4.5  | 5    | 16.5 | V    |
| I <sub>CC</sub>  | DC supply current              | V <sub>CC</sub> = 5 V             | 6    | 7    | 10   | mA   |
| H <sub>yLH</sub> | magnetic threshold for LH edge |                                   | 100  | 250  | 400  | A/m  |
| H <sub>yHL</sub> | magnetic threshold for HL edge |                                   | -400 | -250 | -100 | A/m  |
| T <sub>amb</sub> | ambient operating temperature  | V <sub>CC</sub> = 5 V; note 1     | -40  | -    | +150 | °C   |

Note

1. Maximum power consumption according to power derating curve, see Fig.3.

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## LIMITING VALUES

In accordance with Absolute Maximum Rating System (IEC 60134);  $T_{amb} = -40$  to  $+150$  °C; see Fig.4.

| SYMBOL          | PARAMETER                     | CONDITIONS                               | MIN. | MAX.  | UNIT |
|-----------------|-------------------------------|------------------------------------------|------|-------|------|
| $V_{CC}$        | DC supply voltage             | not protected against incorrect polarity | -0.5 | +16.5 | V    |
| $V_{OUT}$       | output voltage                | not protected against incorrect polarity | -0.5 | +24   | V    |
| $I_{OUT(max)}$  | maximum output current        | low state; note 1                        | –    | 20    | mA   |
| $I_{OUT(high)}$ | output leakage current        | high state; note 2; see Fig.5            | –    | 100   | µA   |
|                 |                               | high state; note 2; see Fig.6            | –    | 100   | µA   |
| $P_{tot}$       | total power dissipation       | $V_{CC} = 16.5$ V; $I_{OUT} = 20$ mA     | –    | 300   | mW   |
| $T_{amb}$       | ambient operating temperature | $V_{CC} = 5$ V                           | -40  | +150  | °C   |
| $T_{stg}$       | storage temperature           |                                          | -40  | +150  | °C   |
| $T_{sld}$       | soldering temperature         | $t \leq 10$ s                            | –    | 260   | °C   |

## Notes

1. Low: transistor open ( $V_{CE} < 1$  V).
2. High: transistor closed ( $V_{CE} > 4$  V).

## CHARACTERISTICS

$T_{amb} = 26 \pm 10$  °C;  $V_{CC} = 5$  V;  $f_{rm} = 0$  to 25000 Hz; magnetic reading point according to 'Package outline'; unless otherwise specified.

| SYMBOL                               | PARAMETER                                                      | CONDITIONS                                      | MIN.               | TYP. | MAX.  | UNIT |
|--------------------------------------|----------------------------------------------------------------|-------------------------------------------------|--------------------|------|-------|------|
| <b>Sensor characteristics</b>        |                                                                |                                                 |                    |      |       |      |
| $H_{yLH}$                            | magnetic trigger field strength (threshold) for LH-output edge | $T_{amb} = 25$ °C                               | 100                | 250  | 400   | A/m  |
|                                      |                                                                | $T_{amb} = -40$ to $+150$ °C                    | -200               | +250 | +600  | A/m  |
| $H_{yHL}$                            | magnetic trigger field strength (threshold) for HL-output edge | $T_{amb} = 25$ °C                               | -400               | -250 | -100  | A/m  |
|                                      |                                                                | $T_{amb} = -40$ to $+150$ °C                    | -600               | -250 | +200  | A/m  |
| $H_{y0}$                             | magnetic offset                                                |                                                 | -150               | –    | +150  | A/m  |
| $H_{yh}$                             | magnetic trigger hysteresis                                    |                                                 | 100                | 500  | 700   | A/m  |
| $H_x$                                | auxiliary magnetic field strength                              |                                                 | 5                  | 8    | 10    | kA/m |
| $f_{rm}$                             | frequency of magnetic reference marks                          |                                                 | 0                  | –    | 25000 | Hz   |
| <b>Supply conditions</b>             |                                                                |                                                 |                    |      |       |      |
| $I_{CC}$                             | DC supply current                                              | $T_{amb} = 26 \pm 10$ °C;<br>$V_{CC} = 5$ V     | 6.5                | 7.5  | 8.5   | mA   |
|                                      |                                                                | $T_{amb} = -40$ to $+150$ °C;<br>$V_{CC} = 5$ V | 6                  | 7    | 10    | mA   |
| $V_{CC}$                             | DC supply voltage                                              | $T_{amb} = -40$ to $+150$ °C                    | 4.5                | 5    | 16.5  | V    |
| <b>Signal output characteristics</b> |                                                                |                                                 |                    |      |       |      |
|                                      | transfer behaviour                                             | change of magnetic reference field $H_y$        | NS → HL<br>SN → LH |      |       |      |
|                                      | power-on state                                                 |                                                 | undefined          |      |       |      |
| $I_{OUT}$                            | output current                                                 | low state; note 1                               | 0.1                | –    | 20    | mA   |

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| SYMBOL                    | PARAMETER                                                      | CONDITIONS                                                                                                                                     | MIN.               | TYP.               | MAX.            | UNIT        |
|---------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|-----------------|-------------|
| I <sub>OUT</sub> (high)   | output leakage current                                         | high state; note 2;<br>see Fig.6                                                                                                               | –                  | –                  | 100             | μA          |
| V <sub>OUT</sub>          | output saturation voltage                                      | T <sub>amb</sub> = –40 to +150 °C;<br>low state; note 1<br><br>I <sub>OUT</sub> = 1 mA<br>I <sub>OUT</sub> = 10 mA<br>I <sub>OUT</sub> = 20 mA | 0.01<br>0.1<br>0.3 | 0.03<br>0.2<br>0.5 | 0.1<br>0.5<br>1 | V<br>V<br>V |
| t <sub>r</sub> (OUT)      | output signal rise time                                        | low 10% to high 90%;<br>see Fig.7                                                                                                              | 5                  | 12                 | 20              | μs          |
| t <sub>f</sub> (OUT)      | output signal fall time                                        | high 90% to low 10%;<br>see Fig.7                                                                                                              | 0.05               | 0.5                | 1               | μs          |
| t <sub>df</sub> (OUT)     | output signal delay time of HL-edge                            |                                                                                                                                                | 1.5                | 2.5                | 3.5             | μs          |
| d <sub>tdf</sub> (OUT)    | jitter                                                         | measured in harmonic<br>magnetic field in y with<br>H <sub>y(max)</sub> = 1 kA/m;<br>normalized to cycle of<br>one reference mark              | 0                  | –                  | 0.15            | %           |
| Environmental conditions  |                                                                |                                                                                                                                                |                    |                    |                 |             |
|                           | external magnetic influence                                    | note 3                                                                                                                                         | –                  | –                  | 30              | kA/m        |
|                           | ESD protection of sensor pins V <sub>CC</sub> ,<br>OUT and GND | compliance to<br>IEC 0801-2 (IV); note 4                                                                                                       | 2                  | –                  | –               | kV          |
|                           | ESD protection of internal<br>pins B1, B2, B3 and B4           | compliance to<br>IEC 0801-2 (IV); note 5                                                                                                       | 0.3                | –                  | –               | kV          |
|                           | EMC: compliance to ISO 11452-5                                 | A; stripline; 300 V/m;<br>10 kHz to 400 MHz;<br>1500 mm                                                                                        |                    |                    |                 |             |
|                           | interference for pulse: ISO 7637;<br>pulse 4                   | T = 25 °C; harmonic<br>magnetic field in y with<br>H <sub>y(max)</sub> = 1 kA/m and<br>f <sub>m</sub> = 50 Hz                                  | function A         |                    |                 |             |
| Capacity of sensor shield |                                                                |                                                                                                                                                |                    |                    |                 |             |
| C <sub>S</sub>            | shield capacity                                                | B1 vs. B2 of MR bridge;<br>f = 1 MHz; U <sub>osc</sub> = 200 mV                                                                                | 37                 | 43                 | 48              | pF          |

**Notes**

1. Low: transistor open ( $V_{CE} < 1$  V).
2. High: transistor closed ( $V_{CE} > 4$  V).
3. Higher magnetic fields could cause irreversible shifts of parameters.
4. Output pins are designed for electrostatic sensitivity with field strengths up to 2 kV according to Human Body Model (HBM), MIL-STD-883, Method 3015.
5. MR pins are designed for electrostatic sensitivity with field strengths up to 0.3 V according to Human Body Model (HBM), MIL-STD-883, Method 3015.

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## FUNCTIONAL DESCRIPTION

The KMI18/2 is sensitive to the rotation of an active target wheel with magnetic reference marks. The functional principle is shown in Fig.8. Because of the sensor layout and setup of the measuring system, only movements of reference marks in the y-direction will be sensed (coordinate system see Fig.2).

The electrical output signal of the sensor is amplified, temperature compensated and applied to a Schmitt trigger in the signal conditioning circuit (see Fig.9). An additional housing separates the conditioning circuitry from the magnetoresistive sensor element, thereby ensuring optimal sensor performance at high temperatures.

The signal level of the digital output is independent from the sensing distance within the measuring range. Its frequency equals that of the reference marks on the target wheels<sup>(1)</sup>.

An open collector voltage interface ensures accurate transmission (three wires) of the digital sensor signal to the subsequent signal conditioning electronics.

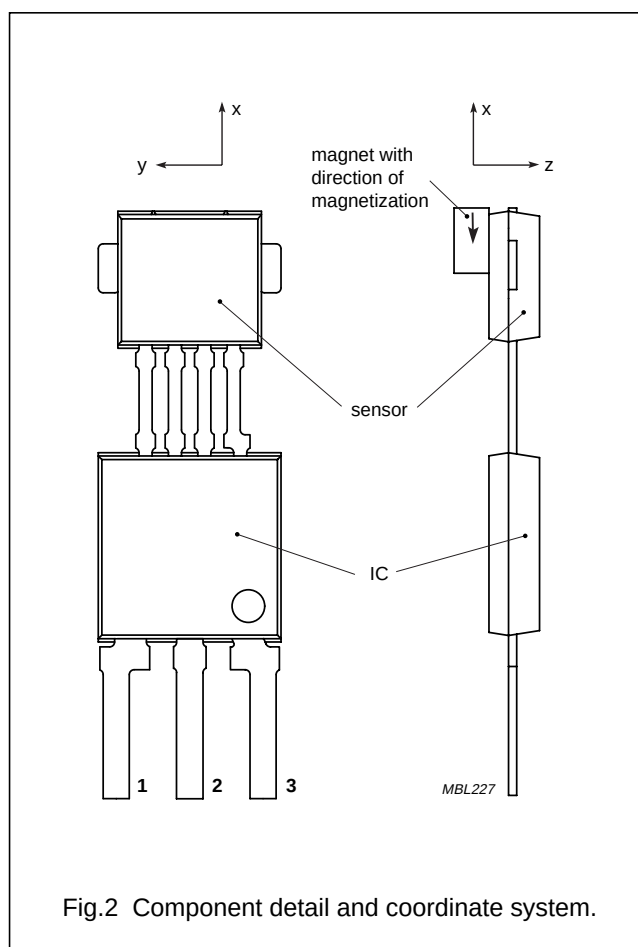


Fig.2 Component detail and coordinate system.

(1) See relevant application notes for specific target wheel data.

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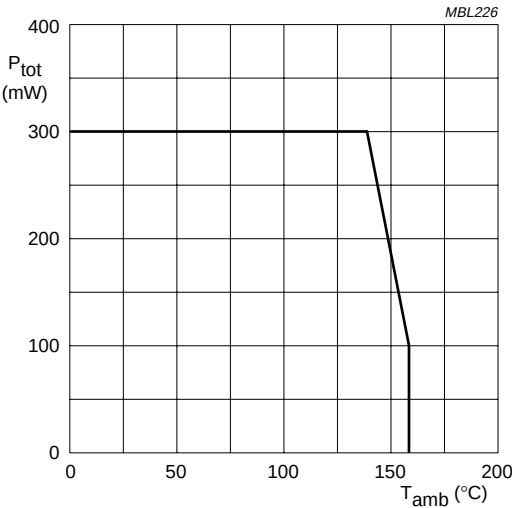


Fig.3 Power derating curve.

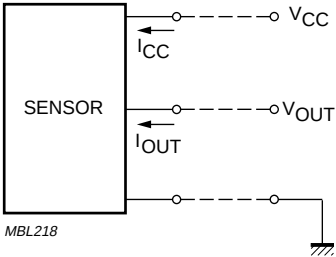


Fig.4 Supply and output.

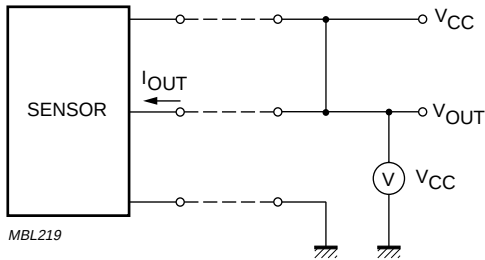


Fig.5 Leakage current test circuit:  $V_{CC}$  to OUT.

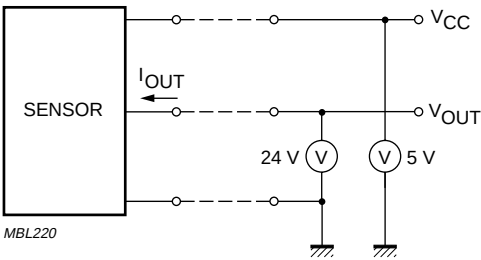


Fig.6 Leakage current test circuit: OUT to GND.

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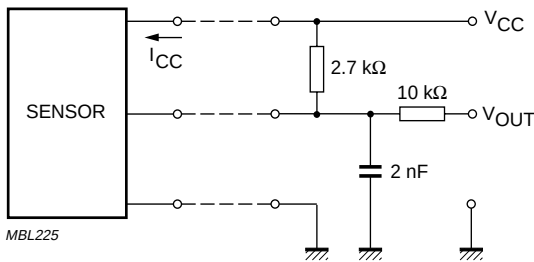


Fig.7 Test and application circuit with additional ceramic capacitor.

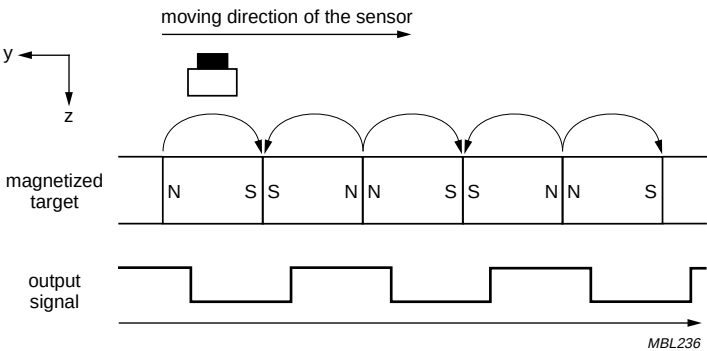


Fig.8 Functional principle.

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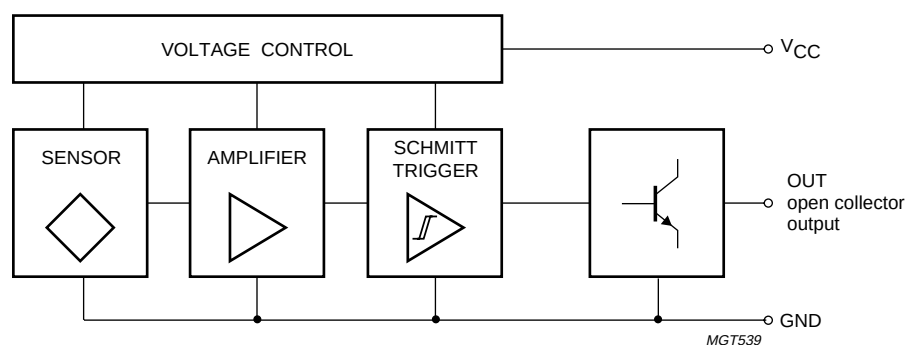


Fig.9 Block diagram.



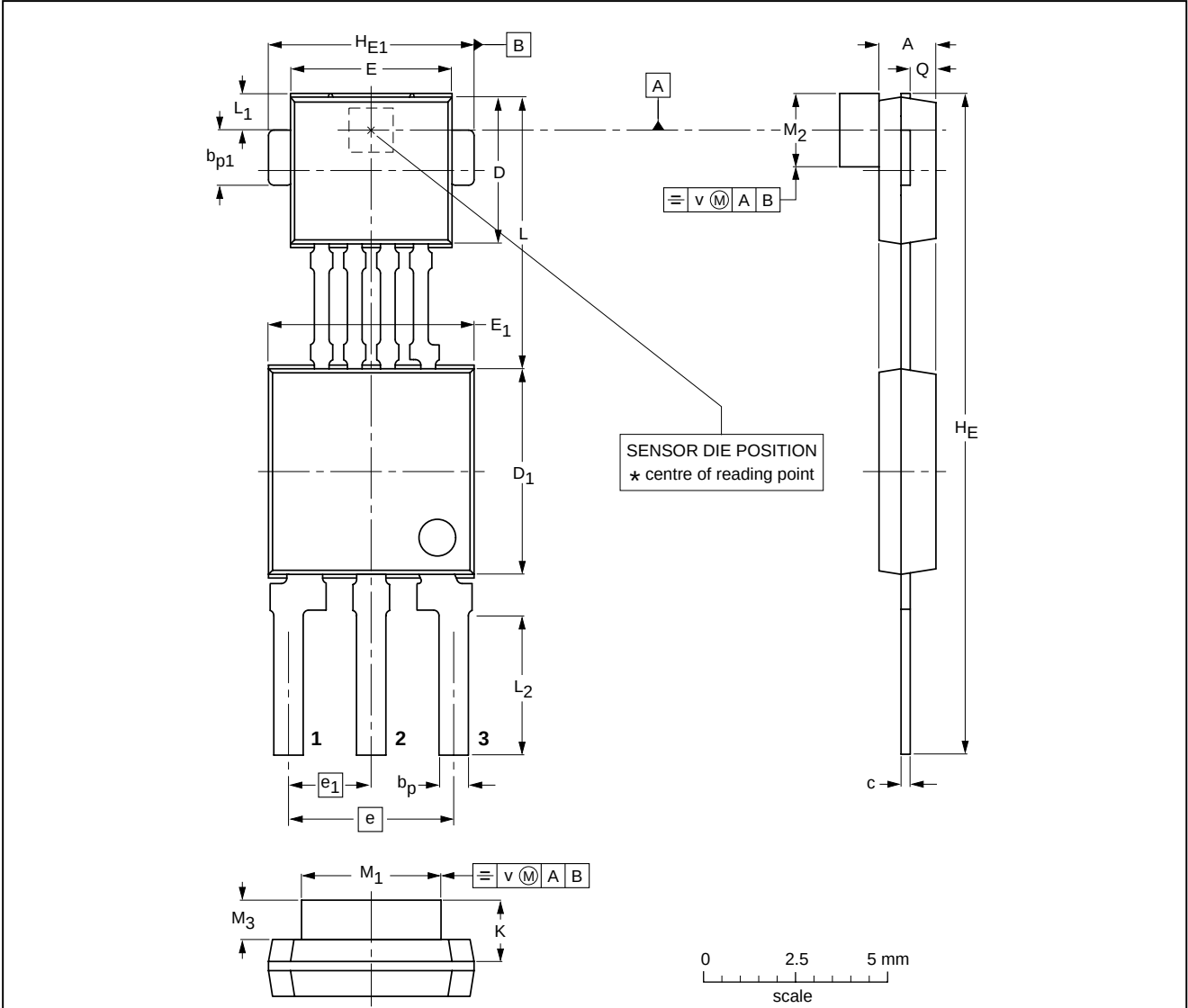
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PACKAGE OUTLINE

Plastic single-ended multi-chip package;  
magnetized ferrite magnet (3.8 x 2 x 0.8 mm); 4 interconnections; 3 in-line leads

SOT477A



DIMENSIONS (mm are the original dimensions)

| UNIT | A <sup>(1)</sup> | b <sub>p</sub> | b <sub>p1</sub> | c           | D <sup>(2)</sup> | D <sub>1</sub> <sup>(2)</sup> | E <sup>(2)</sup> | E <sub>1</sub> <sup>(2)</sup> | e          | e <sub>1</sub> | H <sub>E</sub> | H <sub>E1</sub> | K <sub>max.</sub> | L            | L <sub>1</sub> | L <sub>2</sub> | M <sub>1</sub> | M <sub>2</sub> | M <sub>3</sub> <sup>(1)</sup> | Q            | v    |
|------|------------------|----------------|-----------------|-------------|------------------|-------------------------------|------------------|-------------------------------|------------|----------------|----------------|-----------------|-------------------|--------------|----------------|----------------|----------------|----------------|-------------------------------|--------------|------|
| mm   | 1.7<br>1.4       | 0.8<br>0.7     | 1.57<br>1.47    | 0.3<br>0.24 | 4.1<br>3.9       | 5.7<br>5.5                    | 4.5<br>4.3       | 5.7<br>5.5                    | 4.6<br>4.4 | 2.35<br>2.15   | 18.2<br>17.8   | 5.6<br>5.5      | 1.67              | 7.55<br>7.25 | 1.2<br>0.9     | 3.9<br>3.5     | 3.9<br>3.7     | 2.1<br>1.9     | 0.9<br>0.75                   | 0.75<br>0.65 | 0.25 |

- Notes
1. Glue thickness not included.
  2. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |       |      |  | EUROPEAN<br>PROJECTION | ISSUE DATE |
|--------------------|------------|-------|------|--|------------------------|------------|
|                    | IEC        | JEDEC | EIAJ |  |                        |            |
| SOT477A            |            |       |      |  |                        | 00-08-31   |

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## DATA SHEET STATUS

| DATA SHEET STATUS         | PRODUCT STATUS | DEFINITIONS <sup>(1)</sup>                                                                                                                                                                                                                                 |
|---------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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. |
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## Note

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

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**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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