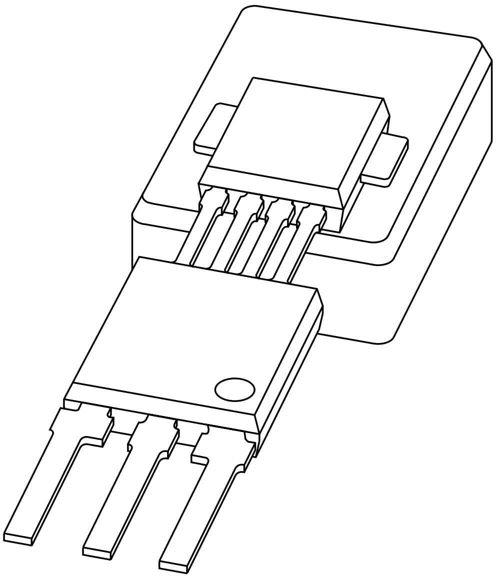
DATA SHEET



KMI16/1
Integrated rotational speed sensor

Preliminary specification
File under Discrete Semiconductors, SC17

1998 May 15

Philips
Semiconductors

PHILIPS

Integrated rotational speed sensor KMI16/1

FEATURES

- Open collector output signal
- Zero speed capability
- Wide air gap
- Wide temperature range
- Insensitive to vibration
- EMC resistant.

DESCRIPTION

The KMI16/1 sensor detects rotational speed of ferrous gear wheels and reference marks.
The sensor consists of a magnetoresistive sensor element, a signal conditioning integrated circuit in bipolar technology and a magnetized ferrite magnet.
The frequency of the digital current output signal is proportional to the rotational speed of a gear wheel.

CAUTION
Do not press two or more products together against their magnetic forces.

PINNING

PIN	DESCRIPTION
1	V_{CC}
2	V_{out}
3	GND

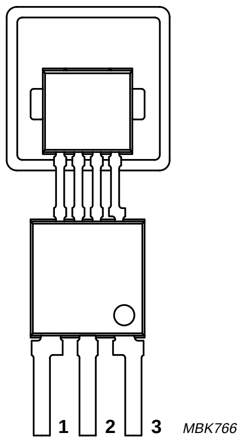


Fig.1 Simplified outline (SOT477B).

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CC}	DC supply voltage		4.5	12	16.5	V
$V_{out\ (low)}$	remaining open collector voltage		–	–	0.5	V
I_{CC}	DC supply current		6.5	10	12	mA
d_{max}	maximum sensing distance	target wheel m = 2 mm	–	2	–	mm
f_t	operating tooth frequency		0	–	25000	Hz
T_{amb}	ambient operating temperature		–40	–	+150	°C

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC}	DC supply voltage	T_{amb} = –40 to +150 °C; $I_{out (low)}$ = 20 mA	–	16	V
V_{out}	output voltage		–0.5	+10	V
T_{stg}	storage temperature		–40	+150	°C
T_{amb}	ambient operating temperature		–40	+150	°C
T_{sld}	soldering temperature	t ≤ 10 s	–	260	°C

CHARACTERISTICS

T_{amb} = 25 °C; V_{CC} = 12 V; d = 1.9 mm; f_t = 2 kHz; test circuit: see Fig.5; sensor positioning: see Fig.11; gear wheel: module 2 mm; material 1.0715; see Fig.6; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{out (low)}$	remaining open collector voltage	$I_{out (low)}$ = 10 mA	–	–	0.5	V
		$I_{out (low)}$ = 20 mA	–	–	1	V
t_r	output signal rise time	10 to 90% value	–	11.5	–	µs
t_f	output signal fall time	10 to 90% value	–	0.3	–	µs
t_d	switching delay time	between stimulation pulse (generated by a coil) and output signal	–	1	–	µs
f_t	operating tooth frequency	for both rotation directions	0	–	25000	Hz
d_{min}	minimum sensing distance	target wheel m = 2 mm; see Fig.11; and note 1	–	0.3	–	mm
d_{max}	maximum sensing distance	target wheel m = 2 mm; see Fig.11; and note 1	–	2	–	mm
δ	duty cycle		30	50	70	%

Note

1. High rotational speeds of wheels reduce the sensing distance due to eddy current effects (see Fig.13).

FUNCTIONAL DESCRIPTION

The KMI16/1 sensor is sensitive to the motion of ferrous gear wheels or reference marks. The functional principle is shown in Fig.3. Due to the effect of flux bending, the different directions of magnetic field lines in the magnetoresistive sensor element will cause an electrical signal. Because of the chosen sensor orientation and the direction of ferrite magnetization, the KMI16/1 is sensitive to movement in the ‘y’ direction in front of the sensor only (see Fig.2).

The magnetoresistive sensor element signal is amplified, temperature compensated and passed to a Schmitt trigger in the conditioning integrated circuit (Fig 4).
The digital output signal level is independent of the sensing distance within the measuring range (Fig.10).
A (3-wire) output current enables safe transfer of the sensor signal to the detecting circuit (see Fig.5).
The integrated circuit housing is separated from the sensor element housing to optimize the sensor behaviour at high temperatures.

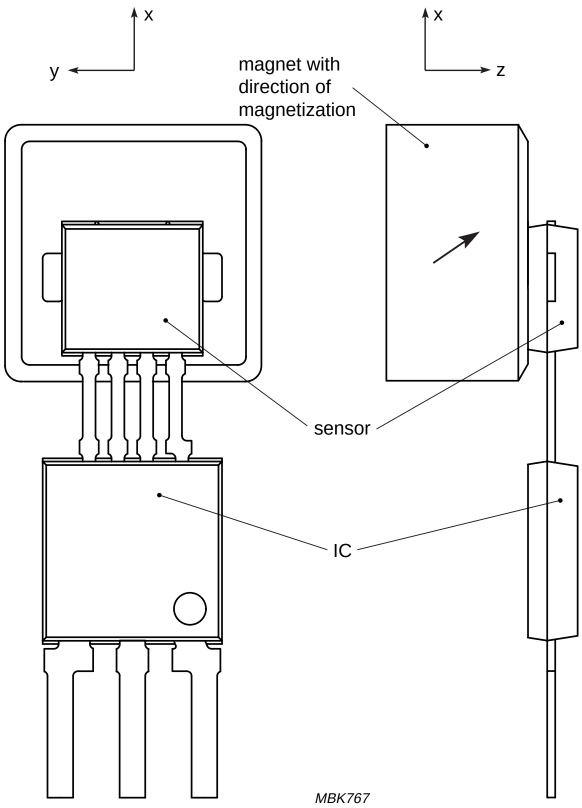


Fig.2 Component detail of the KMI16/1.

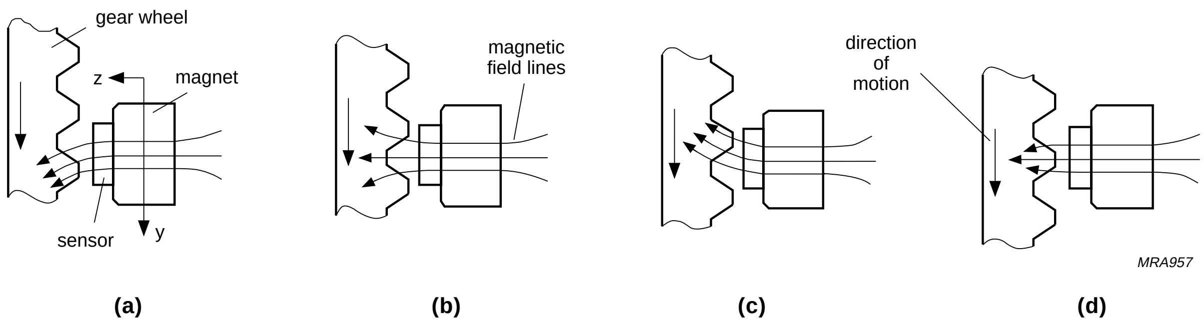


Fig.3 Functional principle.

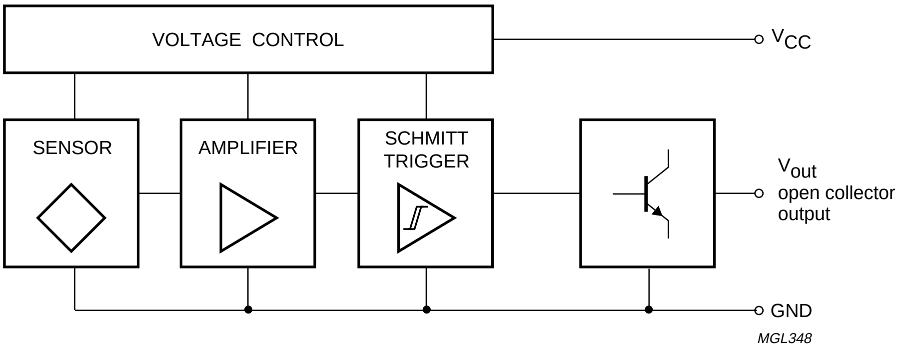


Fig.4 Block diagram.

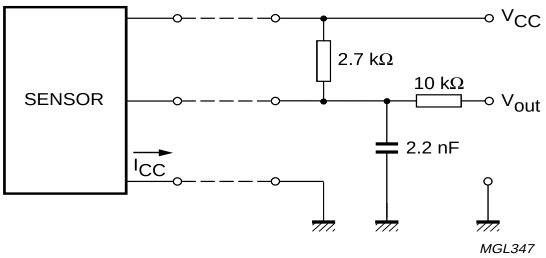


Fig.5 Test and application circuit.

APPLICATION INFORMATION

Mounting conditions

The recommended sensor position in front of a gear wheel is shown in Fig.11. The distance ‘d’ is measured between the sensor front and the tip of a gear wheel tooth.
The KMI16/1 senses ferrous indicators like gear wheels in the ± y direction only (no rotational symmetry of the sensor); see Fig.2. The effect of incorrect mounting positions on sensing distance is shown in Figs 7, 8 and 9. The symmetrical reference axis of the sensor corresponds to the axis of the ferrite magnet.

Environmental conditions

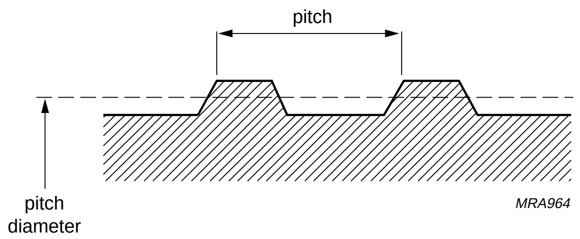
Due to eddy current effects the sensing distance depends on the tooth frequency (Fig.13). The influence of gear wheel module on the sensing distance is shown in Fig.12.

Gear Wheel Dimensions

SYMBOL	DESCRIPTION	UNIT
German DIN		
z	number of teeth	
d	diameter	mm
m	module m = d/z	mm
p	pitch $p = \pi \times m$	mm
ASA; note 1		
PD	pitch diameter (d in inch)	inch
DP	diametric pitch DP = z/PD	$inch^{-1}$
CP	circular pitch $CP = \pi/DP$	inch

Note

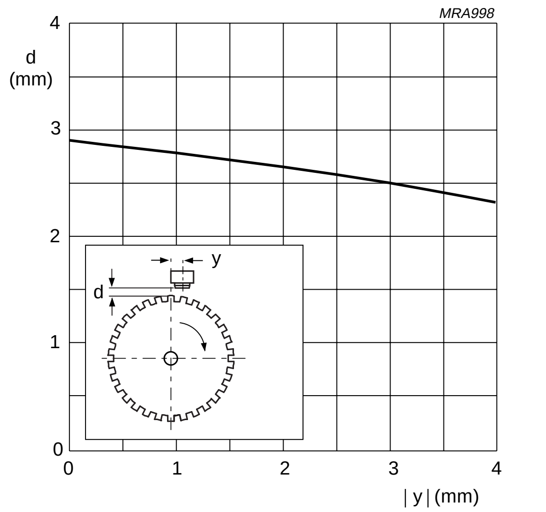
1. For conversion from ASA to DIN: m = 25.4 mm/DP; p = 25.4 mm × CP.



$$\text{module} = \frac{\text{pitch diameter}}{\text{number of teeth}}$$

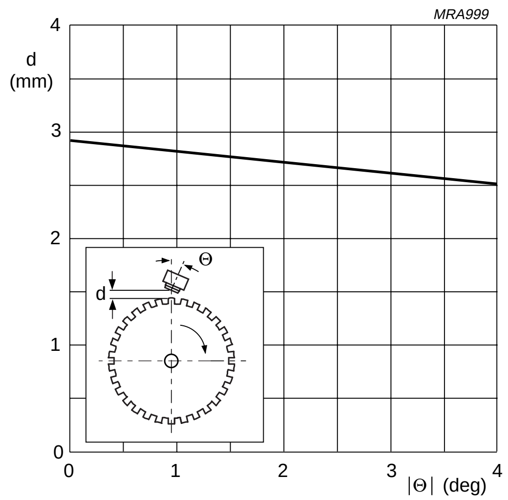
pitch = module × π

Fig.6 Gear wheel dimensions.



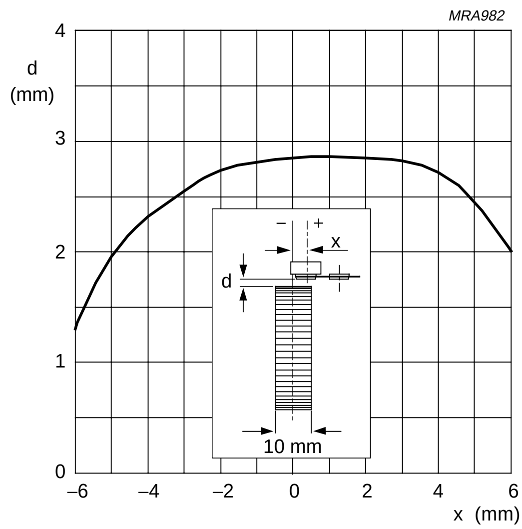
V_{CC} = 12 V; f_t = 2 kHz; module = 2 mm; pitch diameter = 100 mm.

Fig.7 Sensing distance as a function of positional tolerance in the y-axis; typical values.



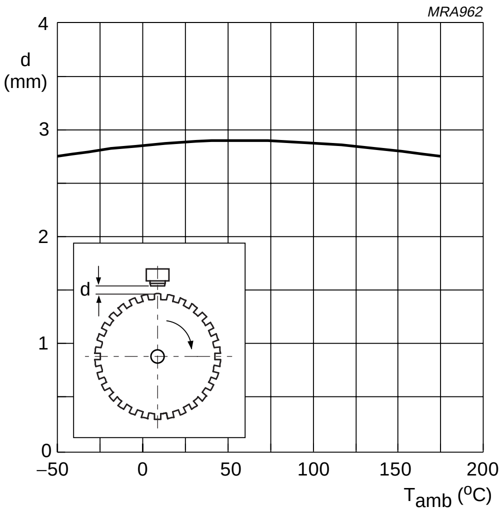
V_{CC} = 12 V; f_t = 2 kHz; module = 2 mm.

Fig.8 Sensing distance as a function of positional tolerance; typical values.



V_{CC} = 12 V; f_t = 2 kHz; module = 2 mm.

Fig.9 Sensing distance as a function of positional tolerance in the x-axis; typical values.



V_{CC} = 12 V; f_t = 2 kHz; module = 2 mm.

Fig.10 Sensing distance as a function of ambient temperature; typical values.

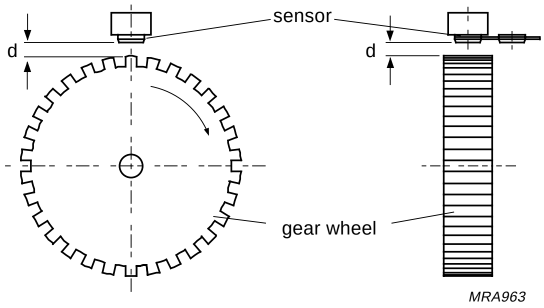
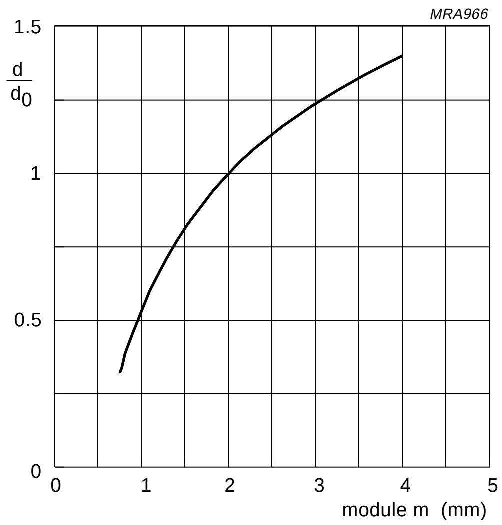
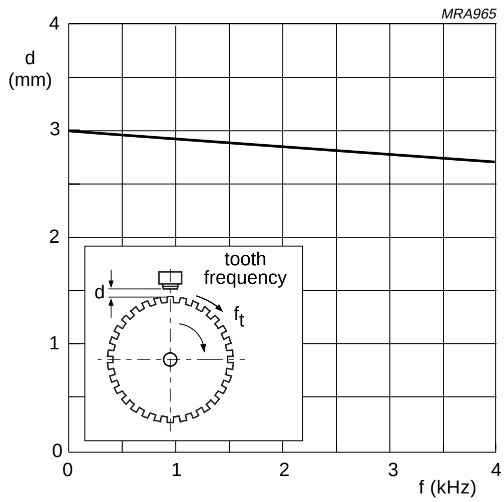


Fig.11 Sensor positioning.



d_o = measuring distance for a gear wheel with module m = 2 mm.

Fig.12 Normalized maximum sensing distance as a function of gear wheel module; typical values.

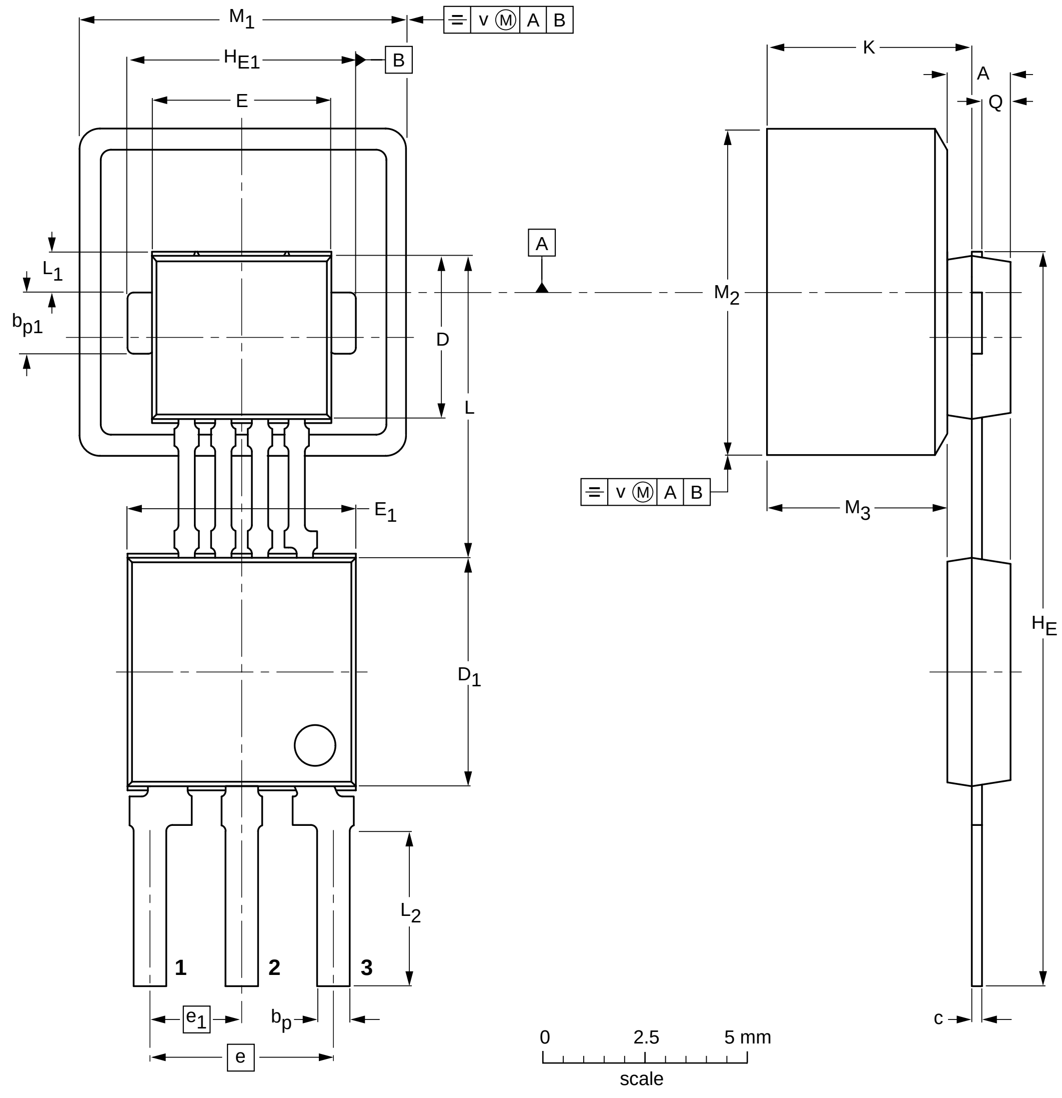


V_{CC} = 12 V; module = 2 mm.

Fig.13 Sensing distance as a function of tooth frequency; typical values.

PACKAGE OUTLINE

Plastic single-ended combined package; magnetoresistive sensor element; bipolar IC; magnetized ferrite magnet (5.5 x 5.5 x 3.0 mm); 3 in-line leads **SOT477B**



DIMENSIONS (mm are the original dimensions)

UNIT	A	b_p	b_{p1}	c	D(1)	D_1(1)	E(1)	E_1(1)	e	e_1	H_E	H_{E1}	K max.	L	L_1	L_2	M_1	M_2	M_3	Q	v
mm	1.7 1.4	0.8 0.7	1.57 1.47	0.3 0.24	4.1 3.9	5.7 5.5	4.5 4.3	5.7 5.5	4.6 4.4	2.35 2.15	18.2 17.8	5.6 5.5	5.37	7.55 7.25	1.2 0.9	3.9 3.5	8.15 7.85	8.15 7.85	4.7 4.3	0.75 0.65	0.25

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			
SOT477B						98-05-12

DEFINITIONS

Data sheet status	
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.
Limiting values	
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.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

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