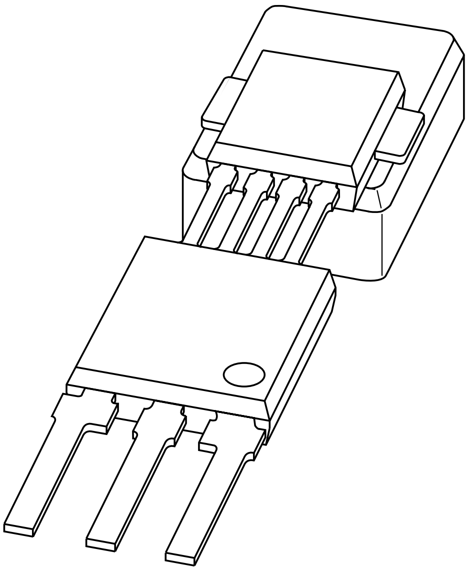
DATA SHEET



KMI18/4
Integrated rotational speed sensor

Objective specification

2000 Sep 05

Philips Semiconductors

PHILIPS

Integrated rotational speed sensor KMI18/4

FEATURES

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

DESCRIPTION

The KMI18/4 sensor detects rotational speed of passive targets wheels with ferrous 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 (see Fig.3).

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

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_{CC}	DC supply
2	OUT	open collector output
3	GND	ground

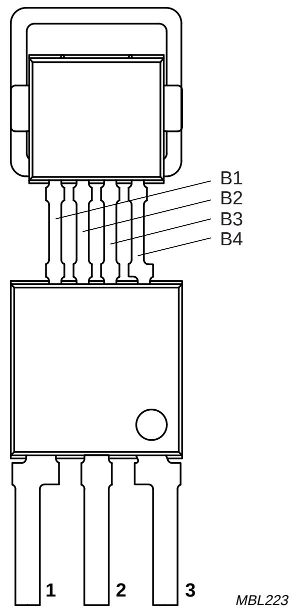


Fig.1 Simplified outline (SOT477C).

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CC}	DC supply voltage	T_{amb} = –40 to +150 °C	4.5	5	16.5	V
I_{CC}	DC supply current	V_{CC} = 5 V	6	7	10	mA
d_{max}	maximum sensing distance	gear wheel; see Fig.4	2.2	2.7	–	mm
d_{min}	minimum sensing distance	gear wheel; see Fig.4	–	–	0.3	mm
T_{amb}	ambient operating temperature	V_{CC} = 5 V; note 1	–40	–	+150	°C

Note

1. Maximum power consumption according to power derating curve, see Fig.5.

LIMITING VALUES

Limiting values in accordance with the Absolute Maximum Rating System (IEC 60134) for T_{amb} = –40 to +150 °C; see Fig.6.

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.7	–	100	µA
		high state; note 2; see Fig.8	–	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 ≤ 10 s	–	260	°C

Notes

1. LOW: open collector output transistor open (V_{OUT} < 1 V).
2. HIGH: open collector output transistor closed (V_{OUT} > 4 V).

CHARACTERISTICS

T_{amb} = 26 ± 10 °C; V_{CC} = 5 V; f_{rm} = 0 to 25000 Hz; gear wheel according to Fig.4; magnetic reading point Fig.10 unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Sensor characteristics						
d_{max}	maximum sensing distance	T_{amb} = –40 to +150 °C	2.2	2.7	–	mm
d_{min}	minimum sensing distance	T_{amb} = –40 to +150 °C	–	–	0.3	mm
$\Delta\varphi$	repeatability of rotational angle	T_{amb}; f_{rm}; d; = constant	–	0.01	0.02	deg
H_{yLH}	magnetic trigger field strength (threshold) for LH-output edge	T_{amb} = –40 to +150 °C	–200	+300	+600	A/m
H_{yHL}	magnetic trigger field strength (threshold) for HL-output edge	T_{amb} = –40 to +150 °C	–600	–300	+200	A/m
H_{y0}	magnetic offset		–200	–	+200	A/m
H_{yh}	magnetic trigger hysteresis		100	500	700	A/m
H_x	auxiliary magnetic field strength		–11	–5.8	–3	kA/m
f_{rm}	frequency of magnetic reference marks		0	–	25000	Hz
Supply conditions						
I_{CC}	DC supply current	T_{amb} = 26 ± 10 °C; V_{CC} = 5 V	6.5	7.5	8.5	mA
		T_{amb} = –40 to +150 °C; 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
Signal output characteristics						
	transfer behaviour	change of position of reference mark	see Fig.3			
	power-on state		undefined			
I_{OUT}	output current	low state; note 1	0.1	–	20	mA
$I_{OUT(high)}$	output leakage current	high state; note 2; see Fig.7	–	–	100	µA
V_{OUT}	output saturation voltage	T_{amb} = –40 to 150 °C; low state; note 1				
		I_{OUT} = 1 mA	0.01	0.03	0.1	V
		I_{OUT} = 10 mA	0.1	0.2	0.5	V
		I_{OUT} = 20 mA	0.3	0.5	1	V
t_{rOUT}	output signal rise time	low 10% to high 90%; see Fig.9	5	12	20	µs
t_{fOUT}	output signal fall time	high 90% to low 10%; see Fig.9	0.05	0.5	1	µs

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
t_{dfOUT}	output signal delay time of HL-edge		1.95	2.3	2.55	µs
		T_{amb} = (–40 to +150) °C	1.5	–	3.5	µs
d_{tdfOUT}	jitter of HL-edge	normalized to cycle of one reference mark; note 3	0	–	0.15	%
Environmental conditions						
	external magnetic influence	note 4	–	–	30	kA/m
	ESD protection of sensor pins V_{CC}, OUT and GND	compliance to IEC 0801-2 (IV); note 5	2	–	–	kV
	ESD protection of internal pins B1, B2, B3 and B4	compliance to IEC 0801-2 (IV); note 6	0.3	–	–	kV
	EMC: Compliance to ISO 11452-5	(A, stripline, 300 V/m, 10 kHz to 400 MHz, 1500 mm); note 7	–	–	–	
	interference for pulse: ISO 7637; pulse 4	T = 25 °C; note 7	function A			
Capacity of sensor shield						
C_s	shield capacity	B1 versus B2 of MR bridge; f = 1 MHz; U_{osc} = 200 mV	37	43	48	pF

Notes

1. LOW: open collector output transistor open (V_{OUT} < 1 V).
2. HIGH: open collector output transistor closed (V_{OUT} > 4 V).
3. Measured with harmonic magnetic field in ‘y’ with $H_{y\,max}$ = 1 kA/m and f_m = 10, 1000 and 8000 Hz.
4. Higher magnetic fields could cause irreversible shifts of parameters.
5. 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.
6. MR pins are designed for electrostatic sensitivity with field strengths up to 0.3 kV according to Human Body Model (HBM), MIL-STD-883, Method 3015.
7. Measured with harmonic magnetic field in ‘y’ with $H_{y\,max}$ = 1 kA/m and f_m = 50 Hz.

FUNCTIONAL DESCRIPTION

The KMI18/4 is sensitive to the rotation of an passive target wheel with ferrous reference marks. The functional principle is shown in Fig.3. 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.11). 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. Accuracy of the HL-edge, as a measure of the rotational angle, strongly depends on the properties of the chosen target wheel and the operating conditions.

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

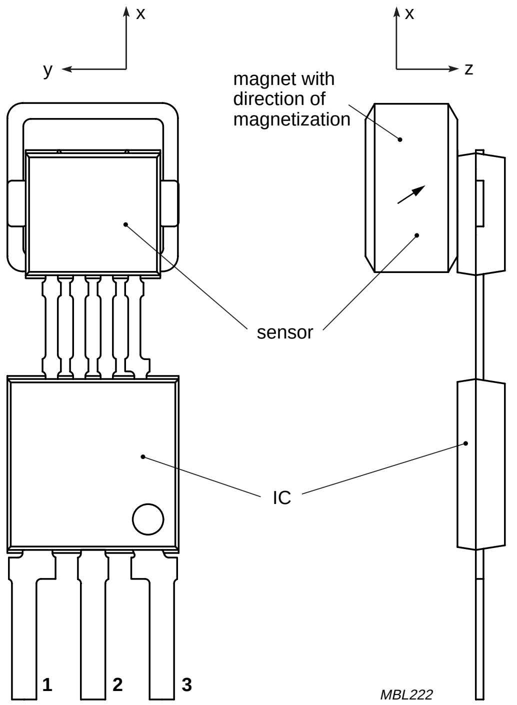


Fig.2 Component detail and coordinate system.

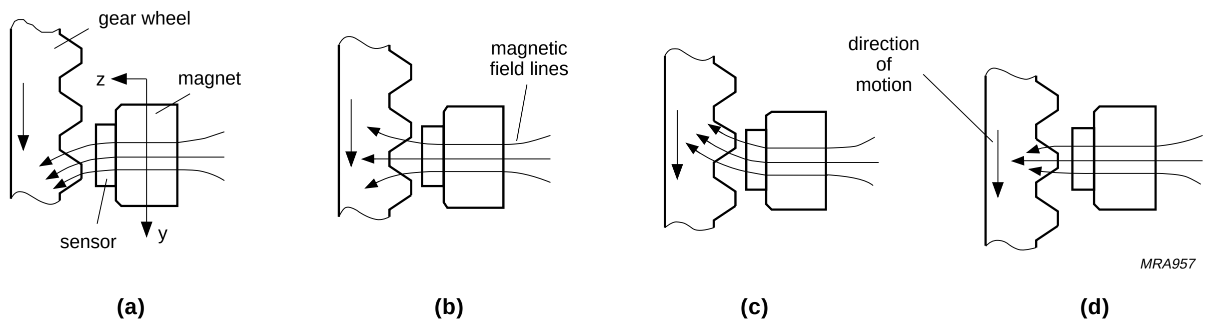
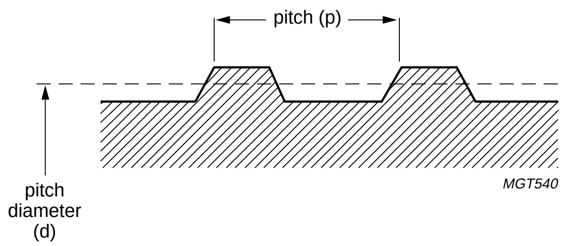


Fig.3 Functional principle.

Table 1 Gear wheel dimensions

SYMBOL	DESCRIPTION	VALUE	UNIT
German DIN			
z	number of teeth	50	
d	diameter	104	mm
m	module m = d/z	2.08	mm
p	pitch $\pi = p \times m$	6.53	mm
ASA			
PD	pitch diameter (d in inches)	4.09	inch
DP	diametric pitch DP = 25.4 mm/m	12.2	$inch^{-1}$
CP	circular pitch CP = p/25.4 mm	0.26	inch



Material: 9SMnPb28k.

Fig.4 Gear wheel.

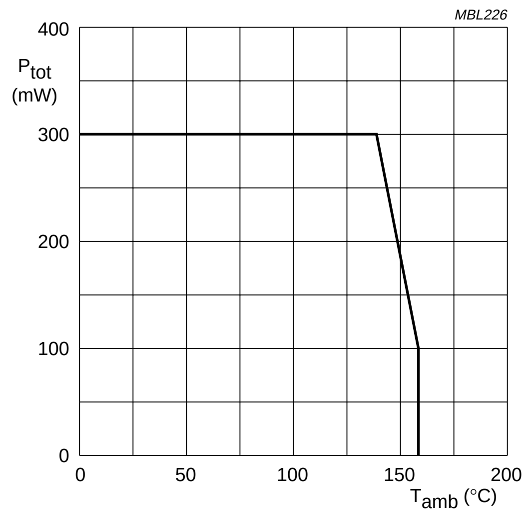


Fig.5 Power derating curve.

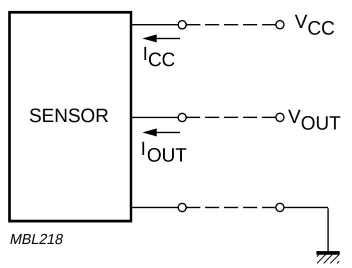


Fig.6 Supply and output.

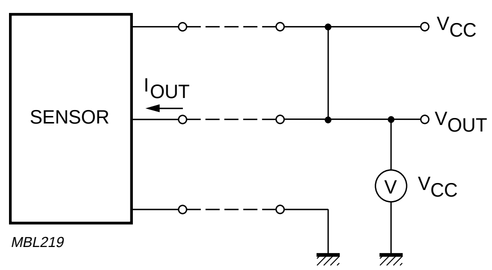


Fig.7 Leakage current test circuit: V_{CC} to OUT.

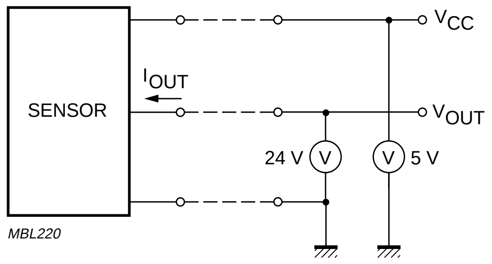


Fig.8 Leakage current test circuit: OUT to GND.

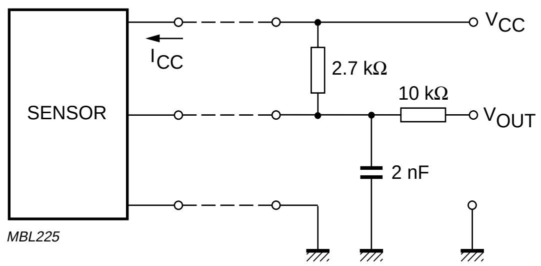


Fig.9 Test and application circuit with additional ceramic capacitor.

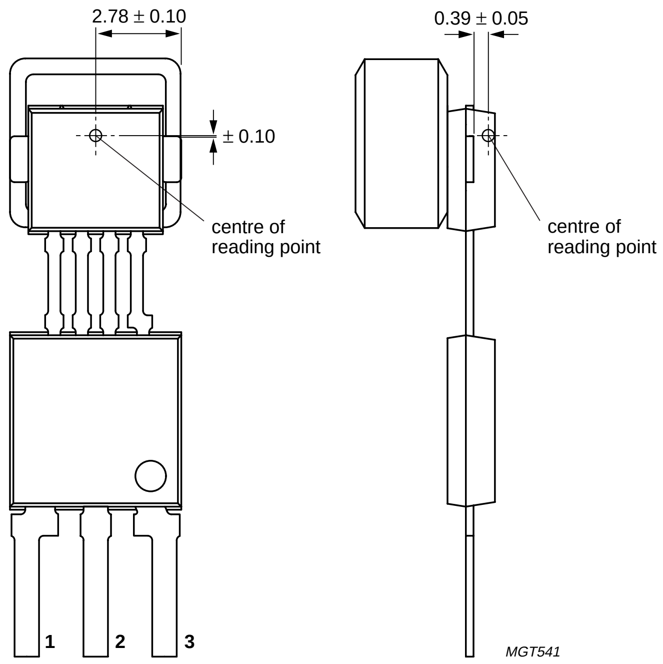


Fig.10 Definition of magnetic reading point.

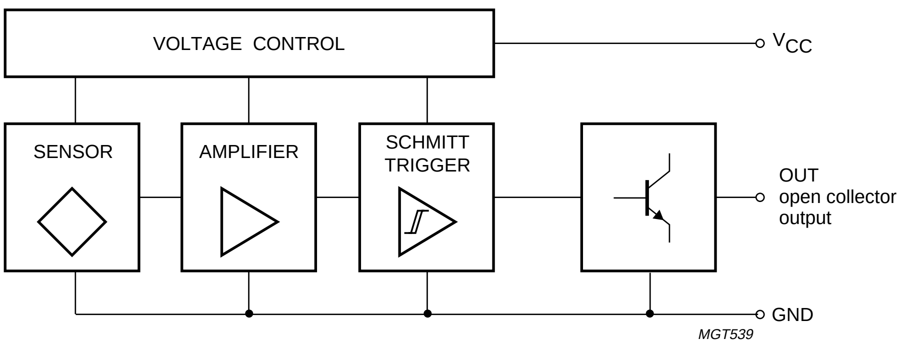
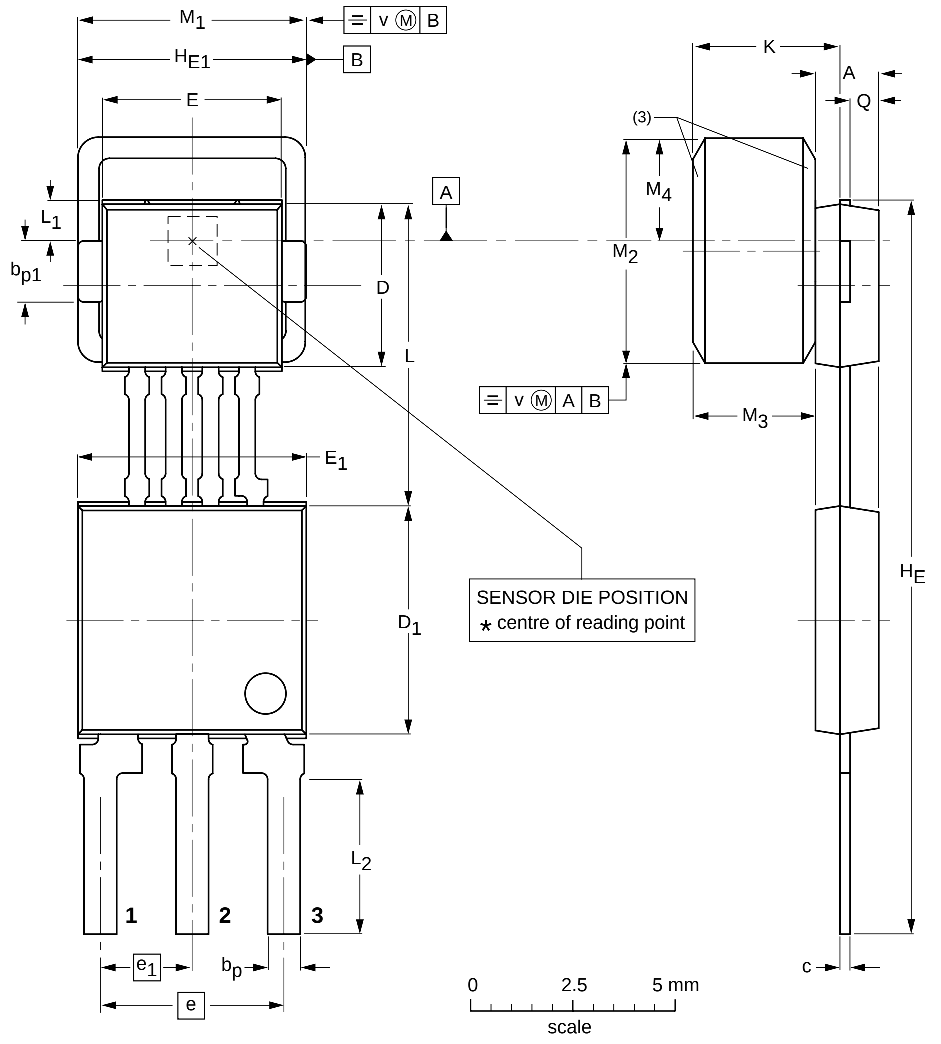


Fig.11 Block diagram.

PACKAGE OUTLINE

Plastic single-ended multi-chip package;
magnetized ferrite magnet (5.5 x 5.5 x 3 mm); 4 interconnections; 3 in-line leads **SOT477C**



DIMENSIONS (mm are the original dimensions)

UNIT	A(1)	b_p	b_{p1}	c	D(2)	D_1(2)	E(2)	E_1(2)	e	e_1	H_E	H_{E1}	K max.	L	L_1	L_2	M_1	M_2	M_3(1)	M_4	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	3.87	7.55 7.25	1.2 0.9	3.9 3.5	5.65 5.35	5.65 5.35	3.05 2.95	2.6 2.4	0.75 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.
3. Magnet chamber optional.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT477C						00-08-31

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.

Application information — Applications that are described herein for any of these products are for illustrative purposes only. Philips Semiconductors make no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

DISCLAIMERS

Life support applications — These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips Semiconductors customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips Semiconductors for any damages resulting from such application.

Right to make changes — Philips Semiconductors reserves the right to make changes, without notice, in the products, including circuits, standard cells, and/or software, described or contained herein in order to improve design and/or performance. Philips Semiconductors assumes no responsibility or liability for the use of any of these products, conveys no licence or title under any patent, copyright, or mask work right to these products, and makes no representations or warranties that these products are free from patent, copyright, or mask work right infringement, unless otherwise specified.

Philips Semiconductors – a worldwide company

Argentina: see South America

Australia: 3 Figtree Drive, HOMEBUSH, NSW 2140, Tel. +61 2 9704 8141, Fax. +61 2 9704 8139

Austria: Computerstr. 6, A-1101 WIEN, P.O. Box 213, Tel. +43 1 60 101 1248, Fax. +43 1 60 101 1210

Belarus: Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6, 220050 MINSK, Tel. +375 172 20 0733, Fax. +375 172 20 0773

Belgium: see The Netherlands

Brazil: see South America

Bulgaria: Philips Bulgaria Ltd., Energoproject, 15th floor, 51 James Bourchier Blvd., 1407 SOFIA, Tel. +359 2 68 9211, Fax. +359 2 68 9102

Canada: PHILIPS SEMICONDUCTORS/COMPONENTS, Tel. +1 800 234 7381, Fax. +1 800 943 0087

China/Hong Kong: 501 Hong Kong Industrial Technology Centre, 72 Tat Chee Avenue, Kowloon Tong, HONG KONG, Tel. +852 2319 7888, Fax. +852 2319 7700

Colombia: see South America

Czech Republic: see Austria

Denmark: Sydhavnsgade 23, 1780 COPENHAGEN V, Tel. +45 33 29 3333, Fax. +45 33 29 3905

Finland: Sinikalliontie 3, FIN-02630 ESPOO, Tel. +358 9 615 800, Fax. +358 9 6158 0920

France: 51 Rue Carnot, BP317, 92156 SURESNES Cedex, Tel. +33 1 4099 6161, Fax. +33 1 4099 6427

Germany: Hammerbrookstraße 69, D-20097 HAMBURG, Tel. +49 40 2353 60, Fax. +49 40 2353 6300

Hungary: see Austria

India: Philips INDIA Ltd, Band Box Building, 2nd floor, 254-D, Dr. Annie Besant Road, Worli, MUMBAI 400 025, Tel. +91 22 493 8541, Fax. +91 22 493 0966

Indonesia: PT Philips Development Corporation, Semiconductors Division, Gedung Philips, Jl. Buncit Raya Kav.99-100, JAKARTA 12510, Tel. +62 21 794 0040 ext. 2501, Fax. +62 21 794 0080

Ireland: Newstead, Clonskeagh, DUBLIN 14, Tel. +353 1 7640 000, Fax. +353 1 7640 200

Israel: RAPAC Electronics, 7 Kehilat Saloniki St, PO Box 18053, TEL AVIV 61180, Tel. +972 3 645 0444, Fax. +972 3 649 1007

Italy: PHILIPS SEMICONDUCTORS, Via Casati, 23 - 20052 MONZA (MI), Tel. +39 039 203 6838, Fax +39 039 203 6800

Japan: Philips Bldg 13-37, Kohnan 2-chome, Minato-ku, TOKYO 108-8507, Tel. +81 3 3740 5130, Fax. +81 3 3740 5057

Korea: Philips House, 260-199 Itaewon-dong, Yongsan-ku, SEOUL, Tel. +82 2 709 1412, Fax. +82 2 709 1415

Malaysia: No. 76 Jalan Universiti, 46200 PETALING JAYA, SELANGOR, Tel. +60 3 750 5214, Fax. +60 3 757 4880

Mexico: 5900 Gateway East, Suite 200, EL PASO, TEXAS 79905, Tel. +9-5 800 234 7381, Fax +9-5 800 943 0087

Middle East: see Italy

Netherlands: Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB, Tel. +31 40 27 82785, Fax. +31 40 27 88399

New Zealand: 2 Wagener Place, C.P.O. Box 1041, AUCKLAND, Tel. +64 9 849 4160, Fax. +64 9 849 7811

Norway: Box 1, Manglerud 0612, OSLO, Tel. +47 22 74 8000, Fax. +47 22 74 8341

Pakistan: see Singapore

Philippines: Philips Semiconductors Philippines Inc., 106 Valero St. Salcedo Village, P.O. Box 2108 MCC, MAKATI, Metro MANILA, Tel. +63 2 816 6380, Fax. +63 2 817 3474

Poland: Al.Jerozolimskie 195 B, 02-222 WARSAW, Tel. +48 22 5710 000, Fax. +48 22 5710 001

Portugal: see Spain

Romania: see Italy

Russia: Philips Russia, Ul. Usatcheva 35A, 119048 MOSCOW, Tel. +7 095 755 6918, Fax. +7 095 755 6919

Singapore: Lorong 1, Toa Payoh, SINGAPORE 319762, Tel. +65 350 2538, Fax. +65 251 6500

Slovakia: see Austria

Slovenia: see Italy

South Africa: S.A. PHILIPS Pty Ltd., 195-215 Main Road Martindale, 2092 JOHANNESBURG, P.O. Box 58088 Newville 2114, Tel. +27 11 471 5401, Fax. +27 11 471 5398

South America: Al. Vicente Pinzon, 173, 6th floor, 04547-130 SÃO PAULO, SP, Brazil, Tel. +55 11 821 2333, Fax. +55 11 821 2382

Spain: Balmes 22, 08007 BARCELONA, Tel. +34 93 301 6312, Fax. +34 93 301 4107

Sweden: Kottbygatan 7, Akalla, S-16485 STOCKHOLM, Tel. +46 8 5985 2000, Fax. +46 8 5985 2745

Switzerland: Allmendstrasse 140, CH-8027 ZÜRICH, Tel. +41 1 488 2741 Fax. +41 1 488 3263

Taiwan: Philips Semiconductors, 5F, No. 96, Chien Kuo N. Rd., Sec. 1, TAIPEI, Taiwan Tel. +886 2 2134 2451, Fax. +886 2 2134 2874

Thailand: PHILIPS ELECTRONICS (THAILAND) Ltd., 60/14 MOO 11, Bangna Trad Road KM. 3, Bagna, BANGKOK 10260, Tel. +66 2 361 7910, Fax. +66 2 398 3447

Turkey: Yukari Dudullu, Org. San. Blg., 2.Cad. Nr. 28 81260 Umraniye, ISTANBUL, Tel. +90 216 522 1500, Fax. +90 216 522 1813

Ukraine: PHILIPS UKRAINE, 4 Patrice Lumumba str., Building B, Floor 7, 252042 KIEV, Tel. +380 44 264 2776, Fax. +380 44 268 0461

United Kingdom: Philips Semiconductors Ltd., 276 Bath Road, Hayes, MIDDLESEX UB3 5BX, Tel. +44 208 730 5000, Fax. +44 208 754 8421

United States: 811 East Arques Avenue, SUNNYVALE, CA 94088-3409, Tel. +1 800 234 7381, Fax. +1 800 943 0087

Uruguay: see South America

Vietnam: see Singapore

Yugoslavia: PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD, Tel. +381 11 3341 299, Fax.+381 11 3342 553

For all other countries apply to: Philips Semiconductors, Marketing Communications, Building BE-p, P.O. Box 218, 5600 MD EINDHOVEN, The Netherlands, Fax. +31 40 27 24825

Internet: http://www.semiconductors.philips.com

Printed in The Netherlands 613520/01/pp12 Date of release: 2000 Sep 05 Document order number: 9397 750 07255