

# DATA SHEET

## **HEF4794B**

8-stage shift-and-store register

LED driver

Product specification  
Supersedes data of 1994 Jul 01  
File under Integrated Circuits, IC04

1999 Jun 30

# 8-stage shift-and-store register LED driver

# HEF4794B

### APPLICATIONS

- Automotive
- Industrial.

### GENERAL DESCRIPTION

The HEF4794B is an 8-stage serial shift register having a storage latch associated with each stage for strobing data from the serial input to parallel LED driver outputs  $O_0$  to  $O_7$ . Data is shifted on positive-going clock transitions. The data in each shift register stage is

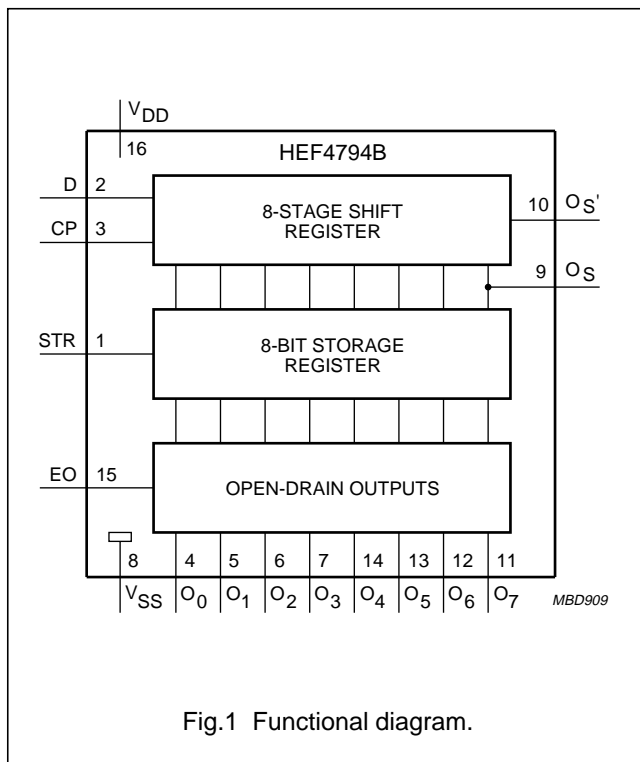
transferred to the storage register when the strobe (STR) input is HIGH. Data in the storage register appears at the outputs whenever the output enable (EO) signal is HIGH.

Two serial outputs ( $O_S$  and  $O_S'$ ) are available for cascading a number of HEF4794B devices. Data is available at  $O_S$  on positive-going clock edges to allow high-speed operation in cascaded systems in which the clock rise time is fast. The same serial information is available at  $O_S'$  on the next negative-going clock edge and provides cascading HEF4794B devices when the clock rise time is slow.

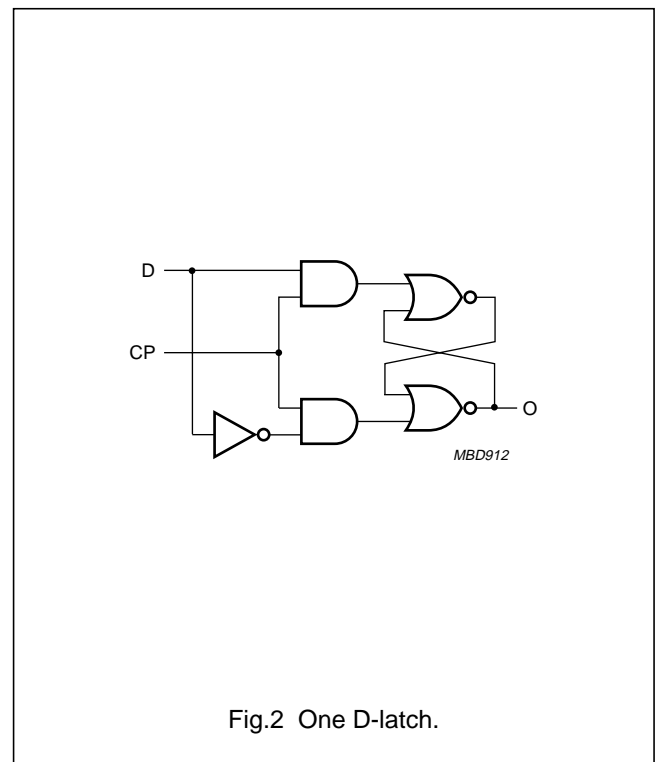
### ORDERING INFORMATION

TYPE NUMBER	PACKAGES			
	PINS	PIN POSITION	MATERIAL	CODE
HEF4794BT	16	SO16	plastic	SOT109-1
HEF4794BP	16	DIP16	plastic	SOT38-1

### FUNCTIONAL DIAGRAM

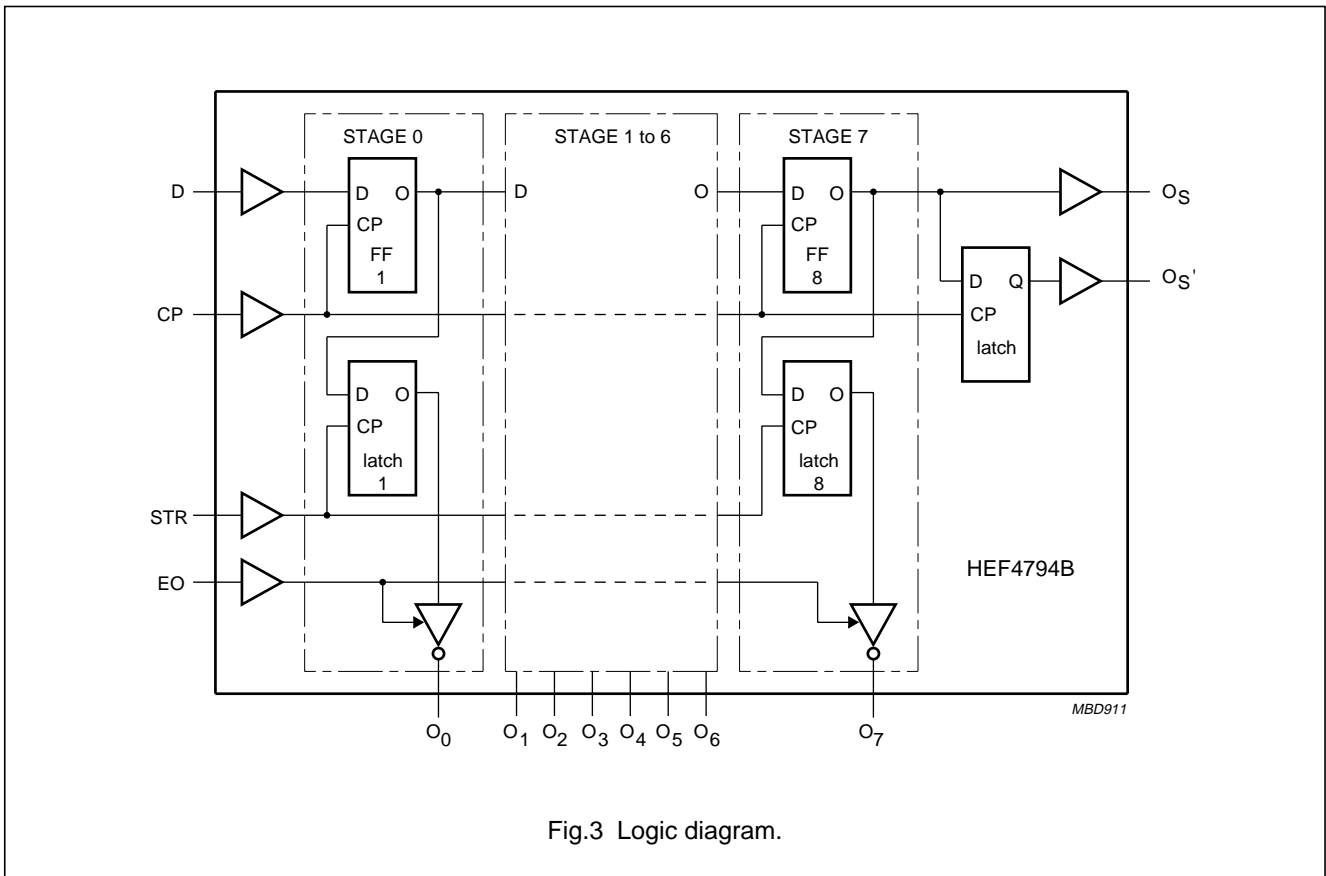


### LOGIC DIAGRAMS



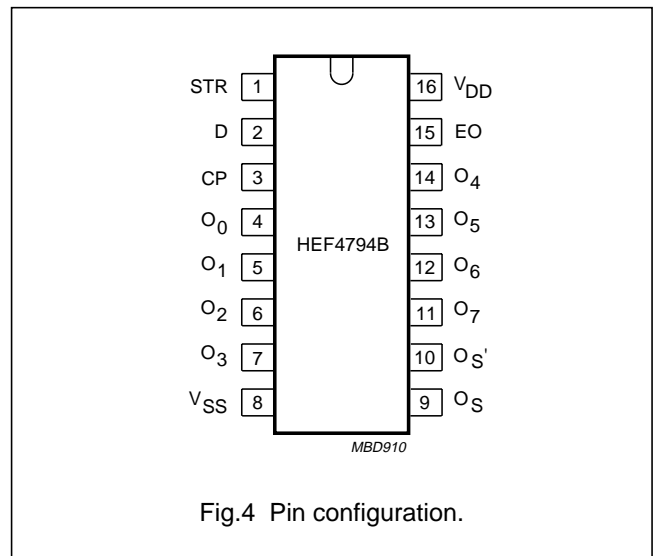
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**PINNING**

SYMBOL	PIN	DESCRIPTION
STR	1	strobe input
D	2	data input
CP	3	clock input
O <sub>0</sub> to O <sub>3</sub>	4 to 7	parallel outputs 0 to 3 (open drain)
V <sub>SS</sub>	8	ground
O <sub>S</sub> , O <sub>S</sub> '	9 and 10	serial outputs
O <sub>7</sub>	11	parallel output 7 (open drain)
O <sub>6</sub>	12	parallel output 6 (open drain)
O <sub>5</sub>	13	parallel output 5 (open drain)
O <sub>4</sub>	14	parallel output 4 (open drain)
EO	15	output enable input
V <sub>DD</sub>	16	supply voltage



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## FUNCTIONAL DESCRIPTION

Table 1 Function table; note 1

INPUTS				PARALLEL OUTPUTS		SERIAL OUTPUTS	
CP	EO	STR	D	O <sub>0</sub>	O <sub>n</sub>	O <sub>s</sub>	O <sub>s</sub> '
↑	L	X	X	Z	Z	O <sub>6</sub> '	nc
↓	L	X	X	Z	Z	nc	O <sub>7</sub>
↑	H	L	X	nc	nc	O <sub>6</sub> '	nc
↑	H	H	L	L	O <sub>n-1</sub>	O <sub>6</sub> '	nc
↑	H	H	H	H	O <sub>n-1</sub>	O <sub>6</sub> '	nc
↓	H	H	H	nc	nc	nc	O <sub>7</sub>

## Note

- H = HIGH state;  
L = LOW state;  
X = don't care;  
↑ = positive-going transition;  
↓ = negative-going transition;  
Z = high-impedance OFF state;  
nc = no change;  
O<sub>6</sub>' = the information in the seventh shift register stage.  
a) At the positive clock edge the information in the 7<sup>th</sup> register stage is transferred to the 8<sup>th</sup> register stage and the O<sub>s</sub> output.

## FAMILY DATA

See "Family Specifications" except for: rating for DC current into any open-drain output is 40 mA.

I<sub>DD</sub> LIMITS CATEGORY MSI

See "Family Specifications" for ratings.

## DC CHARACTERISTICS

V<sub>SS</sub> = 0 V.

SYMBOL	PARAMETER	CONDITIONS	T <sub>amb</sub> (°C)						UNIT
			-40		+25		+85		
			MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
V <sub>OL</sub>	LOW level output voltage	V <sub>I</sub> = V <sub>SS</sub> or V <sub>DD</sub> ;  I <sub>O</sub>   < 20 mA; V <sub>DD</sub> = 5 V	–	0.75	–	0.75	–	1.5	V
		V <sub>I</sub> = V <sub>SS</sub> or V <sub>DD</sub> ;  I <sub>O</sub>   < 20 mA; V <sub>DD</sub> = 10 V	–	0.75	–	0.75	–	1.5	V
		V <sub>I</sub> = V <sub>SS</sub> or V <sub>DD</sub> ;  I <sub>O</sub>   < 20 mA; V <sub>DD</sub> = 15 V	–	0.75	–	0.75	–	1.5	V
I <sub>OZH</sub>	HIGH level output leakage current; 3-state	V <sub>O</sub> = 15 V; V <sub>DD</sub> = 5 V	–	2	–	2	–	15	μA
		V <sub>O</sub> = 15 V; V <sub>DD</sub> = 10 V	–	2	–	2	–	15	μA
		V <sub>O</sub> = 15 V; V <sub>DD</sub> = 15 V	–	2	–	2	–	15	μA

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**AC POWER CHARACTERISTICS** $V_{SS} = 0\text{ V}$ ;  $T_{amb} = 25\text{ °C}$ ; input transition times  $\leq 20\text{ ns}$ ; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	TYPICAL FORMULA FOR P ( $\mu\text{W}$ ) <sup>(1)</sup>
P	dynamic power dissipation per package	$V_{DD} = 5\text{ V}$	$1200f_i + \Sigma(f_o C_L) \times V_{DD}^2$
		$V_{DD} = 10\text{ V}$	$5550f_i + \Sigma(f_o C_L) \times V_{DD}^2$
		$V_{DD} = 15\text{ V}$	$15000f_i + \Sigma(f_o C_L) \times V_{DD}^2$

**Note**

1. Where:

 $R_L = \infty$ ; $f_i$  = input frequency (MHz); $f_o$  = output frequency (MHz); $C_L$  = load capacitance (pF); $\Sigma(f_o C_L)$  = sum of outputs; $V_{DD}$  = supply voltage (V).**AC TIMING CHARACTERISTICS** $V_{SS} = 0\text{ V}$ ;  $T_{amb} = 25\text{ °C}$ ;  $C_L = 50\text{ pF}$ ; input transition times  $\leq 20\text{ ns}$ ; unless otherwise specified.

SYMBOL	PARAMETER	$V_{DD}$ (V)	MIN.	TYP.	MAX.	UNIT	TYPICAL EXTRAPOLATION FORMULA
$t_{PHL}$	propagation delay time CP to $O_S$ ; HIGH-to-LOW	5	–	160	320	ns	$132\text{ ns} + (0.55\text{ ns/pF})C_L$
		10	–	65	130	ns	$53\text{ ns} + (0.23\text{ ns/pF})C_L$
		15	–	45	90	ns	$37\text{ ns} + (0.16\text{ ns/pF})C_L$
$t_{PLH}$	propagation delay time CP to $O_S$ ; LOW-to-HIGH	5	–	130	260	ns	$102\text{ ns} + (0.55\text{ ns/pF})C_L$
		10	–	55	110	ns	$44\text{ ns} + (0.23\text{ ns/pF})C_L$
		15	–	40	80	ns	$32\text{ ns} + (0.16\text{ ns/pF})C_L$
$t_{PHL}$	propagation delay time CP to $O_S'$ ; HIGH-to-LOW	5	–	120	240	ns	$92\text{ ns} + (0.55\text{ ns/pF})C_L$
		10	–	50	100	ns	$39\text{ ns} + (0.23\text{ ns/pF})C_L$
		15	–	40	80	ns	$32\text{ ns} + (0.16\text{ ns/pF})C_L$
$t_{PLH}$	propagation delay time CP to $O_S'$ ; LOW-to-HIGH	5	–	130	260	ns	$102\text{ ns} + (0.55\text{ ns/pF})C_L$
		10	–	60	120	ns	$49\text{ ns} + (0.23\text{ ns/pF})C_L$
		15	–	45	90	ns	$37\text{ ns} + (0.16\text{ ns/pF})C_L$
$t_{PZL}$	propagation delay time CP to $O_n$ ; OFF-to-LOW	5	–	240	480	ns	note 1
		10	–	80	160	ns	
		15	–	55	110	ns	
$t_{PLZ}$	propagation delay time CP to $O_n$ ; LOW-to-OFF	5	–	170	340	ns	note 1
		10	–	75	150	ns	
		15	–	60	120	ns	

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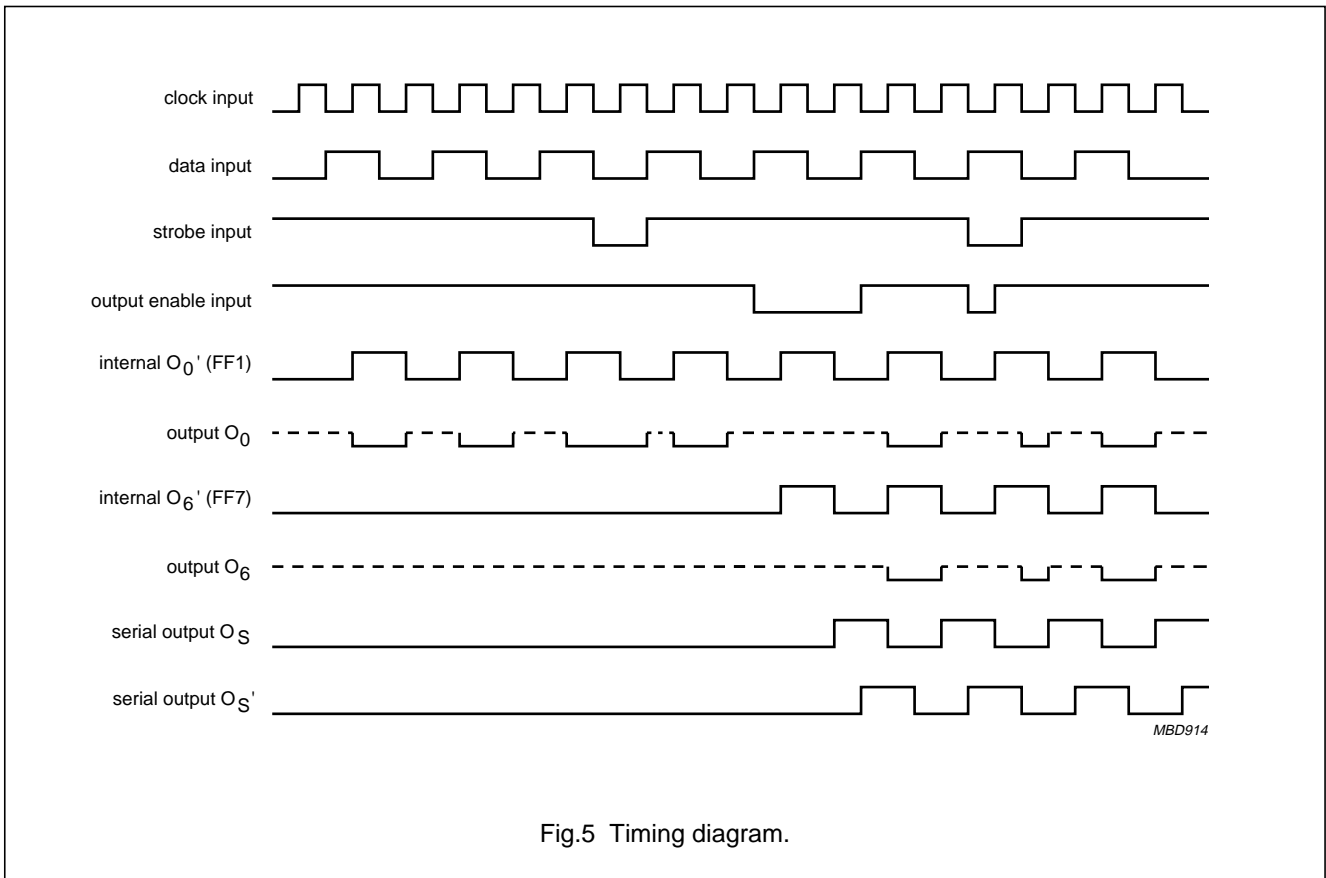
SYMBOL	PARAMETER	V <sub>DD</sub> (V)	MIN.	TYP.	MAX.	UNIT	TYPICAL EXTRAPOLATION FORMULA
t <sub>pZL</sub>	propagation delay time STR to O <sub>n</sub> ; OFF-to-LOW	5	–	140	280	ns	note 1
		10	–	70	140	ns	
		15	–	55	110	ns	
t <sub>pLZ</sub>	propagation delay time STR to O <sub>n</sub> ; LOW-to-OFF	5	–	100	200	ns	note 1
		10	–	40	100	ns	
		15	–	35	70	ns	
t <sub>THL</sub>	output transition time O <sub>S</sub> and O <sub>S</sub> '; HIGH-to-LOW	5	–	85	170	ns	35 ns + (1.0 ns/pF)C <sub>L</sub>
		10	–	40	80	ns	19 ns + (0.42 ns/pF)C <sub>L</sub>
		15	–	30	60	ns	16 ns + (0.28 ns/pF)C <sub>L</sub>
t <sub>TLH</sub>	output transition time O <sub>S</sub> and O <sub>S</sub> '; LOW-to-HIGH	5	–	85	170	ns	35 ns + (1.0 ns/pF)C <sub>L</sub>
		10	–	40	80	ns	19 ns + (0.42 ns/pF)C <sub>L</sub>
		15	–	30	60	ns	16 ns + (0.28 ns/pF)C <sub>L</sub>
t <sub>pZL</sub>	output enable time EO to O <sub>n</sub> ; OFF-to-LOW	5	–	100	200	ns	note 1
		10	–	55	110	ns	
		15	–	50	100	ns	
t <sub>pLZ</sub>	output disable time EO to O <sub>n</sub> ; LOW-to-OFF	5	–	80	160	ns	note 1
		10	–	40	80	ns	
		15	–	30	60	ns	
t <sub>wCPL</sub>	minimum clock pulse width LOW	5	60	30	–	ns	
		10	30	15	–	ns	
		15	24	12	–	ns	
t <sub>wSTRH</sub>	minimum strobe pulse width HIGH	5	80	40	–	ns	
		10	60	30	–	ns	
		15	24	12	–	ns	
t <sub>su</sub>	set-up time D to CP	5	60	30	–	ns	
		10	20	10	–	ns	
		15	15	5	–	ns	
t <sub>h</sub>	hold time D to CP	+5	+5	–15	–	ns	
		10	20	5	–	ns	
		15	20	5	–	ns	
f <sub>clk(max)</sub>	maximum clock frequency	5	5	10	–	MHz	
		10	11	22	–	MHz	
		15	14	28	–	MHz	

**Note**

1. Definition of symbol equivalent to 3-state outputs.

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APPLICATION INFORMATION

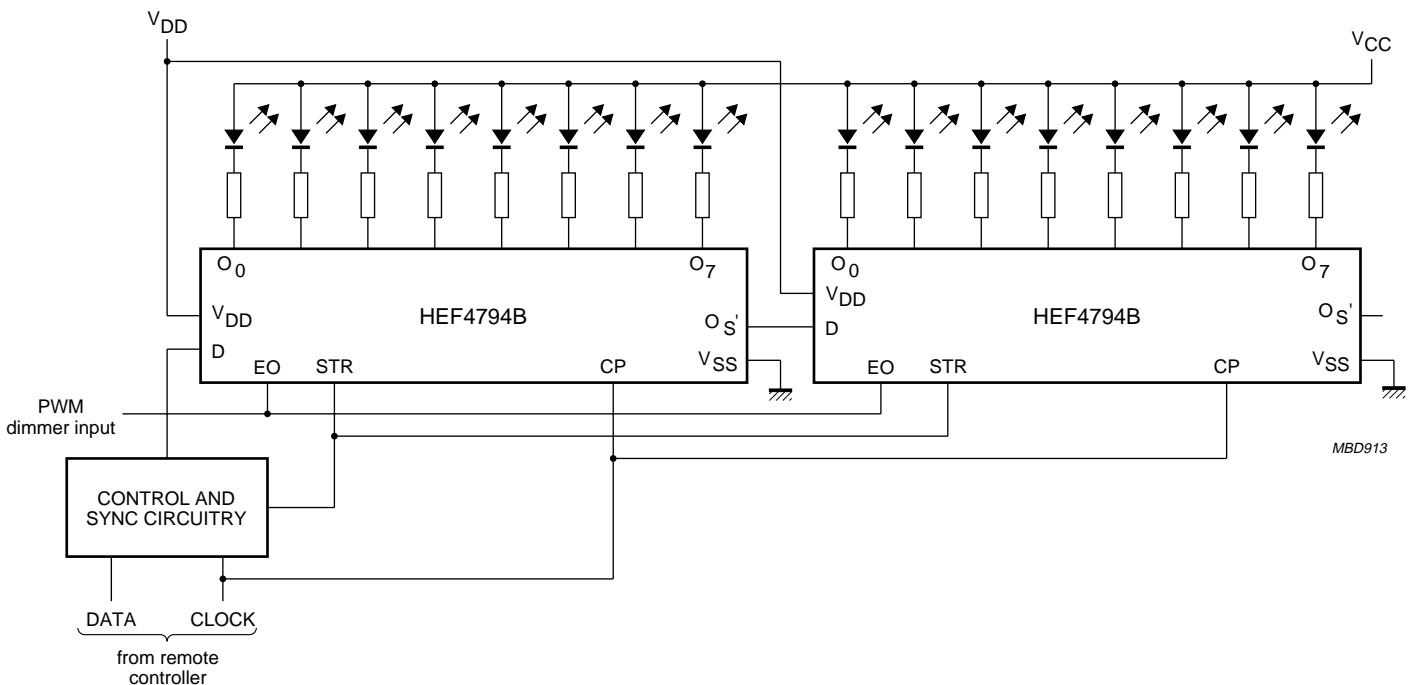


Fig.6 Application example: serial-to-parallel converting LED drivers.



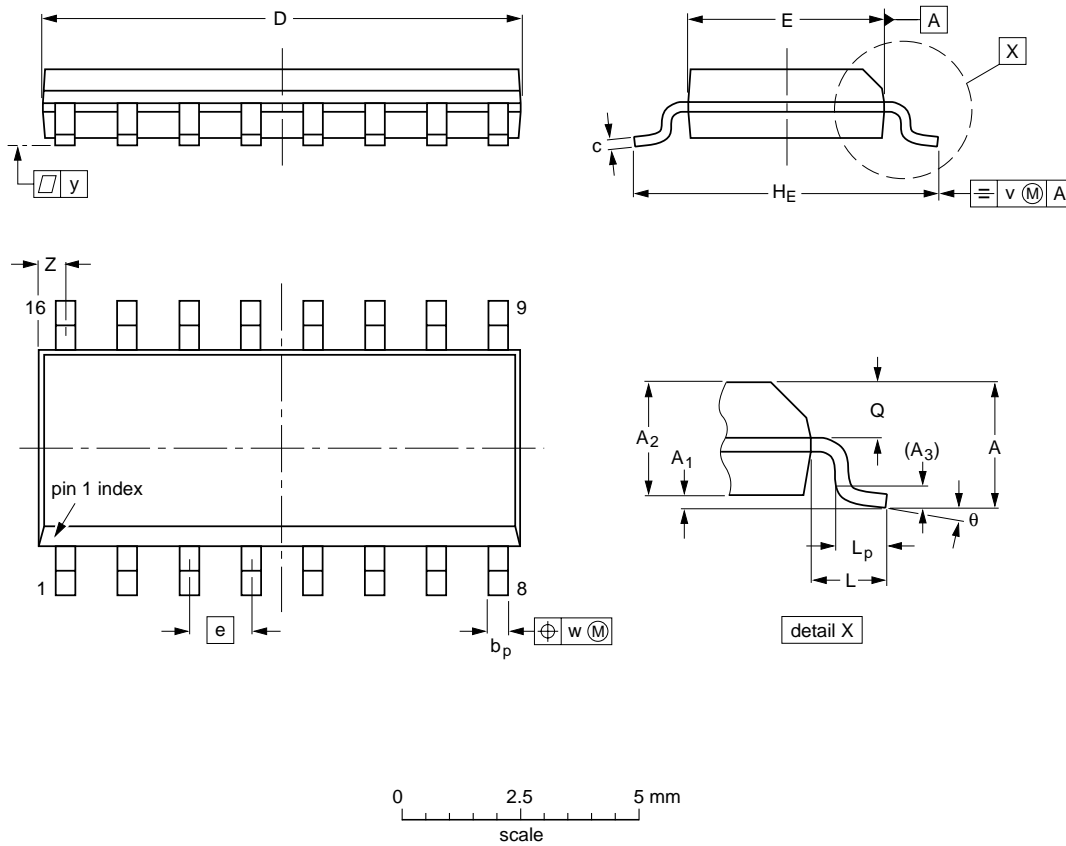
8-stage shift-and-store register LED driver

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PACKAGE OUTLINES

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 <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	z <sup>(1)</sup>	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.

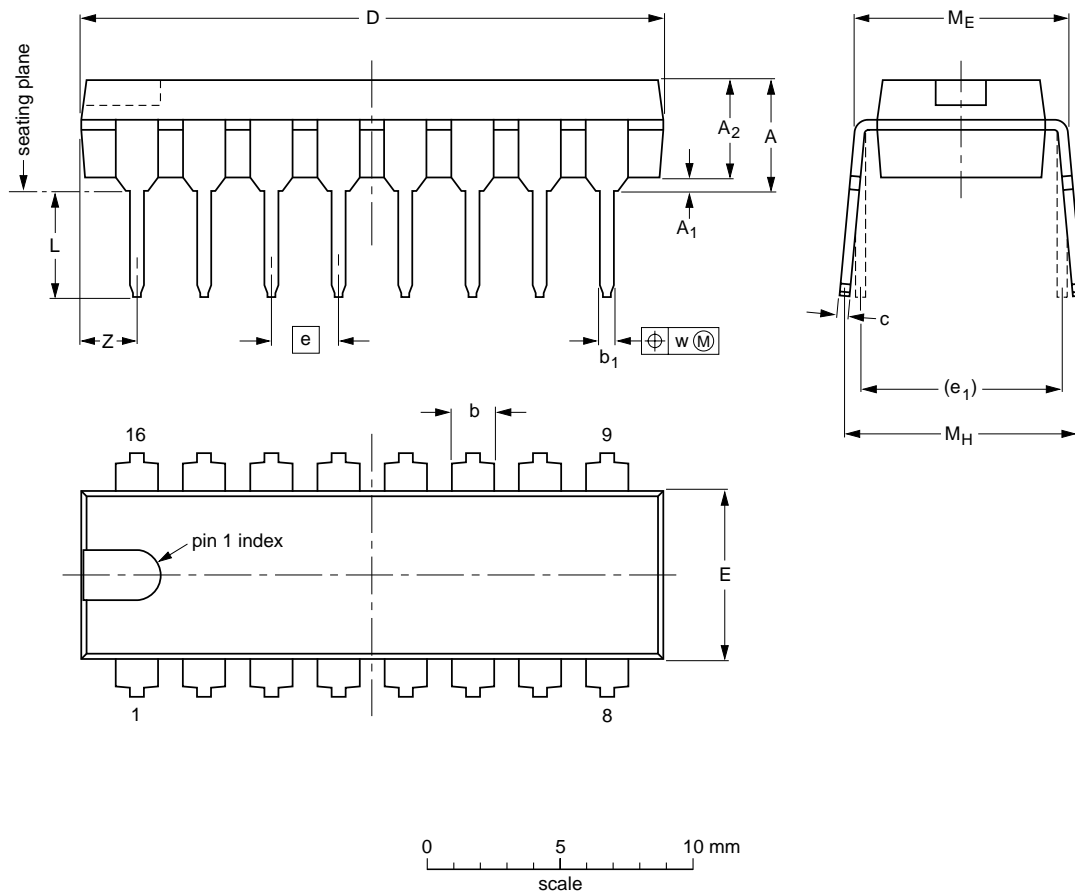
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT109-1	076E07S	MS-012AC				95-01-23 97-05-22

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DIP16: plastic dual in-line package; 16 leads (300 mil); long body

SOT38-1



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

UNIT	A max.	A <sub>1</sub> min.	A <sub>2</sub> max.	b	b <sub>1</sub>	c	D <sup>(1)</sup>	E <sup>(1)</sup>	e	e <sub>1</sub>	L	M <sub>E</sub>	M <sub>H</sub>	w	Z <sup>(1)</sup> max.
mm	4.7	0.51	3.7	1.40 1.14	0.53 0.38	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	2.2
inches	0.19	0.020	0.15	0.055 0.045	0.021 0.015	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	0.15 0.13	0.32 0.31	0.37 0.33	0.01	0.087

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT38-1	050G09	MO-001AE				92-10-02 95-01-19

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**SOLDERING****Introduction**

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our "Data Handbook IC26; Integrated Circuit Packages" (document order number 9398 652 90011).

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mount components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mount ICs, or for printed-circuit boards with high population densities. In these situations reflow soldering is often used.

**Through-hole mount packages**

## SOLDERING BY DIPPING OR BY SOLDER WAVE

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joints for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ( $T_{stg(max)}$ ). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

## MANUAL SOLDERING

Apply the soldering iron (24 V or less) to the lead(s) of the package, either below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

**Surface mount packages**

## REFLOW SOLDERING

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several methods exist for reflowing; for example, infrared/convection heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 100 and 200 seconds depending on heating method.

Typical reflow peak temperatures range from 215 to 250 °C. The top-surface temperature of the packages should preferably be kept below 230 °C.

## WAVE SOLDERING

Conventional single wave soldering is not recommended for surface mount devices (SMDs) or printed-circuit boards with a high component density, as solder bridging and non-wetting can present major problems.

To overcome these problems the double-wave soldering method was specifically developed.

If wave soldering is used the following conditions must be observed for optimal results:

- Use a double-wave soldering method comprising a turbulent wave with high upward pressure followed by a smooth laminar wave.
- For packages with leads on two sides and a pitch (e):
  - larger than or equal to 1.27 mm, the footprint longitudinal axis is **preferred** to be parallel to the transport direction of the printed-circuit board;
  - smaller than 1.27 mm, the footprint longitudinal axis **must** be parallel to the transport direction of the printed-circuit board.

The footprint must incorporate solder thieves at the downstream end.

- For packages with leads on four sides, the footprint must be placed at a 45° angle to the transport direction of the printed-circuit board. The footprint must incorporate solder thieves downstream and at the side corners.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

## MANUAL SOLDERING

Fix the component by first soldering two diagonally-opposite end leads. Use a low voltage (24 V or less) soldering iron applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C.

When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

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## Suitability of IC packages for wave, reflow and dipping soldering methods

MOUNTING	PACKAGE	SOLDERING METHOD		
		WAVE	REFLOW <sup>(1)</sup>	DIPPING
Through-hole mount	DBS, DIP, HDIP, SDIP, SIL	suitable <sup>(2)</sup>	–	suitable
Surface mount	BGA, SQFP	not suitable	suitable	–
	HLQFP, HSQFP, HSOP, HTQFP, HTSSOP, SMS	not suitable <sup>(3)</sup>	suitable	–
	PLCC <sup>(4)</sup> , SO, SOJ	suitable	suitable	–
	LQFP, QFP, TQFP	not recommended <sup>(4)(5)</sup>	suitable	–
	SSOP, TSSOP, VSO	not recommended <sup>(6)</sup>	suitable	–

## Notes

1. All surface mount (SMD) packages are moisture sensitive. Depending upon the moisture content, the maximum temperature (with respect to time) and body size of the package, there is a risk that internal or external package cracks may occur due to vaporization of the moisture in them (the so called popcorn effect). For details, refer to the Drypack information in the *"Data Handbook IC26; Integrated Circuit Packages; Section: Packing Methods"*.
2. For SDIP packages, the longitudinal axis must be parallel to the transport direction of the printed-circuit board.
3. These packages are not suitable for wave soldering as a solder joint between the printed-circuit board and heatsink (at bottom version) can not be achieved, and as solder may stick to the heatsink (on top version).
4. If wave soldering is considered, then the package must be placed at a 45° angle to the solder wave direction. The package footprint must incorporate solder thieves downstream and at the side corners.
5. Wave soldering is only suitable for LQFP, QFP and TQFP packages with a pitch (e) equal to or larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
6. Wave soldering is only suitable for SSOP and TSSOP packages with a pitch (e) equal to or larger than 0.65 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.5 mm.

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**DEFINITIONS**

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

**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 customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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**NOTES**

8-stage shift-and-store register LED driver

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**NOTES**

# Philips Semiconductors – a worldwide company

**Argentina:** see South America

**Australia:** 34 Waterloo Road, NORTH RYDE, NSW 2113,  
Tel. +61 2 9805 4455, Fax. +61 2 9805 4466

**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, Piazza IV Novembre 3,  
20124 MILANO, Tel. +39 02 67 52 2531, Fax. +39 02 67 52 2557

**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:** Ul. Lukiska 10, PL 04-123 WARSZAWA,  
Tel. +48 22 612 2831, Fax. +48 22 612 2327

**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, 6F, No. 96, Chien Kuo N. Rd., Sec. 1,  
TAIPEI, Taiwan Tel. +886 2 2134 2886, Fax. +886 2 2134 2874

**Thailand:** PHILIPS ELECTRONICS (THAILAND) Ltd.,  
209/2 Sanpavuth-Bangna Road Prakanong, BANGKOK 10260,  
Tel. +66 2 745 4090, Fax. +66 2 398 0793

**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 62 5344, Fax. +381 11 63 5777

**For all other countries apply to:** Philips Semiconductors,  
International Marketing & Sales Communications, Building BE-p, P.O. Box 218,  
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**Internet:** <http://www.semiconductors.philips.com>

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