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

Philips
Semiconductors

PHILIPS

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

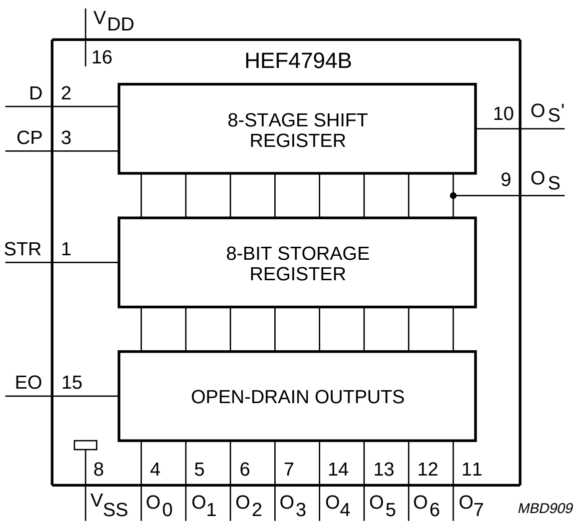


Fig.1 Functional diagram.

LOGIC DIAGRAMS

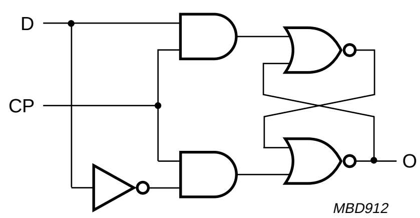


Fig.2 One D-latch.

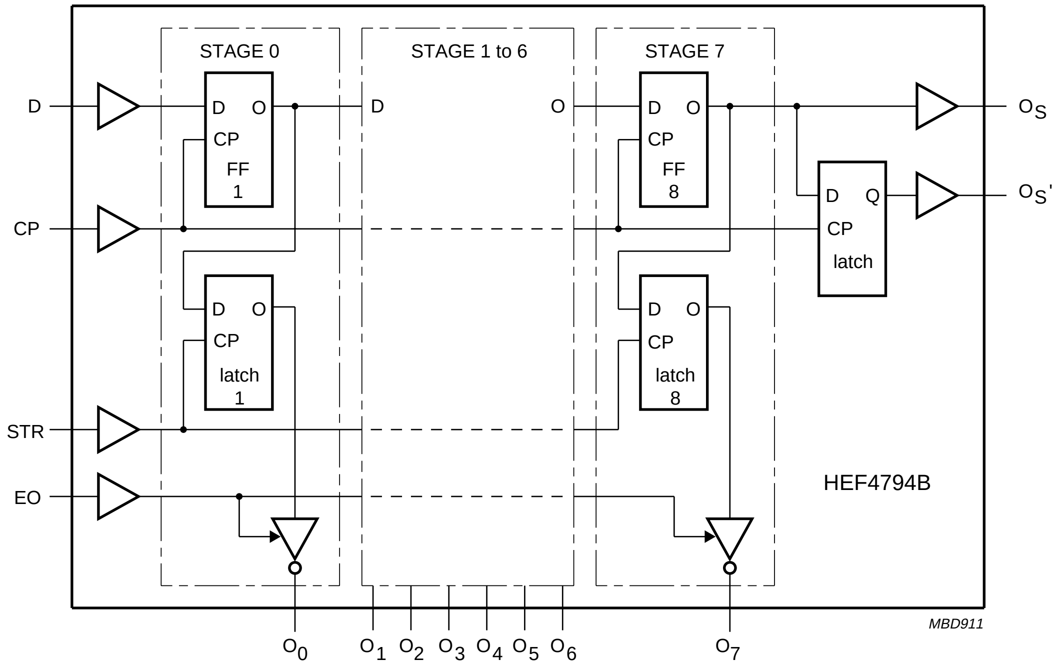


Fig.3 Logic diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
STR	1	strobe input
D	2	data input
CP	3	clock input
O_0 to O_3	4 to 7	parallel outputs 0 to 3 (open drain)
V_{SS}	8	ground
O_S,O_S'	9 and 10	serial outputs
O_7	11	parallel output 7 (open drain)
O_6	12	parallel output 6 (open drain)
O_5	13	parallel output 5 (open drain)
O_4	14	parallel output 4 (open drain)
EO	15	output enable input
V_{DD}	16	supply voltage

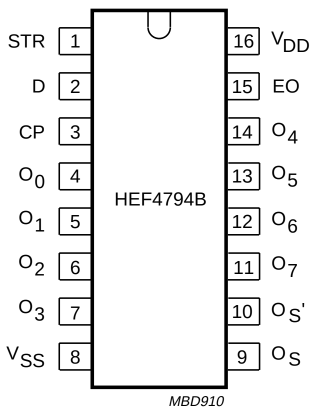


Fig.4 Pin configuration.

FUNCTIONAL DESCRIPTION

Table 1 Function table; note 1

INPUTS				PARALLEL OUTPUTS		SERIAL OUTPUTS	
CP	**EO**	**STR**	**D**	**O_0**	**O_n**	**O_S**	**O_S'**
↑	L	X	X	Z	Z	O_6'	nc
↓	L	X	X	Z	Z	nc	O_7
↑	H	L	X	nc	nc	O_6'	nc
↑	H	H	L	L	O_{n-1}	O_6'	nc
↑	H	H	H	H	O_{n-1}	O_6'	nc
↓	H	H	H	nc	nc	nc	O_7

Note

1. 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_6' = the information in the seventh shift register stage.
   a) At the positive clock edge the information in the 7th register stage is transferred to the 8th register stage and the O_S output.

FAMILY DATA

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

I_{DD} LIMITS CATEGORY MSI

See *"Family Specifications"* for ratings.

DC CHARACTERISTICS

V_{SS} = 0 V.

SYMBOL	PARAMETER	CONDITIONS	T_{amb} (°C) –40 MIN.	–40 MAX.	+25 MIN.	+25 MAX.	+85 MIN.	+85 MAX.	UNIT
V_{OL}	LOW level output voltage	$V_I = V_{SS}$ or V_{DD}; $\lvert I_O \rvert$ < 20 mA; V_{DD} = 5 V	–	0.75	–	0.75	–	1.5	V
		$V_I = V_{SS}$ or V_{DD}; $\lvert I_O \rvert$ < 20 mA; V_{DD} = 10 V	–	0.75	–	0.75	–	1.5	V
		$V_I = V_{SS}$ or V_{DD}; $\lvert I_O \rvert$ < 20 mA; V_{DD} = 15 V	–	0.75	–	0.75	–	1.5	V
I_{OZH}	HIGH level output leakage current; 3-state	V_O = 15 V; V_{DD} = 5 V	–	2	–	2	–	15	µA
		V_O = 15 V; V_{DD} = 10 V	–	2	–	2	–	15	µA
		V_O = 15 V; V_{DD} = 15 V	–	2	–	2	–	15	µA

AC POWER CHARACTERISTICS

V_{SS} = 0 V; T_{amb} = 25 °C; input transition times ≤ 20 ns; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	TYPICAL FORMULA FOR P (μW)(1)
P	dynamic power dissipation per package	V_{DD} = 5 V	$1200f_i + \Sigma(f_oC_L) \times V_{DD}^2$
		V_{DD} = 10 V	$5550f_i + \Sigma(f_oC_L) \times V_{DD}^2$
		V_{DD} = 15 V	$15000f_i + \Sigma(f_oC_L) \times V_{DD}^2$

Note

1. Where:
   $R_L = \infty$;
   f_i = input frequency (MHz);
   f_o = output frequency (MHz);
   C_L = load capacitance (pF);
   $\Sigma(f_oC_L)$ = sum of outputs;
   V_{DD} = supply voltage (V).

AC TIMING CHARACTERISTICS

V_{SS} = 0 V; T_{amb} = 25 °C; C_L = 50 pF; input transition times ≤20 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 ns + (0.55 ns/pF)C_L
		10	–	65	130	ns	53 ns + (0.23 ns/pF)C_L
		15	–	45	90	ns	37 ns + (0.16 ns/pF)C_L
t_{PLH}	propagation delay time CP to O_S; LOW-to-HIGH	5	–	130	260	ns	102 ns + (0.55 ns/pF)C_L
		10	–	55	110	ns	44 ns + (0.23 ns/pF)C_L
		15	–	40	80	ns	32 ns + (0.16 ns/pF)C_L
t_{PHL}	propagation delay time CP to O_S'; HIGH-to-LOW	5	–	120	240	ns	92 ns + (0.55 ns/pF)C_L
		10	–	50	100	ns	39 ns + (0.23 ns/pF)C_L
		15	–	40	80	ns	32 ns + (0.16 ns/pF)C_L
t_{PLH}	propagation delay time CP to O_S'; LOW-to-HIGH	5	–	130	260	ns	102 ns + (0.55 ns/pF)C_L
		10	–	60	120	ns	49 ns + (0.23 ns/pF)C_L
		15	–	45	90	ns	37 ns + (0.16 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	

SYMBOL	PARAMETER	V_{DD} (V)	MIN.	TYP.	MAX.	UNIT	TYPICAL EXTRAPOLATION FORMULA
t_{PZL}	propagation delay time STR to O_n; OFF-to-LOW	5	–	140	280	ns	note 1
		10	–	70	140	ns	
		15	–	55	110	ns	
t_{PLZ}	propagation delay time STR to O_n; LOW-to-OFF	5	–	100	200	ns	note 1
		10	–	40	100	ns	
		15	–	35	70	ns	
t_{THL}	output transition time O_S and O_S'; HIGH-to-LOW	5	–	85	170	ns	35 ns + (1.0 ns/pF)C_L
		10	–	40	80	ns	19 ns + (0.42 ns/pF)C_L
		15	–	30	60	ns	16 ns + (0.28 ns/pF)C_L
t_{TLH}	output transition time O_S and O_S'; LOW-to-HIGH	5	–	85	170	ns	35 ns + (1.0 ns/pF)C_L
		10	–	40	80	ns	19 ns + (0.42 ns/pF)C_L
		15	–	30	60	ns	16 ns + (0.28 ns/pF)C_L
t_{PZL}	output enable time EO to O_n; OFF-to-LOW	5	–	100	200	ns	note 1
		10	–	55	110	ns	
		15	–	50	100	ns	
t_{PLZ}	output disable time EO to O_n; LOW-to-OFF	5	–	80	160	ns	note 1
		10	–	40	80	ns	
		15	–	30	60	ns	
t_{WCPL}	minimum clock pulse width LOW	5	60	30	–	ns	
		10	30	15	–	ns	
		15	24	12	–	ns	
t_{WSTRH}	minimum strobe pulse width HIGH	5	80	40	–	ns	
		10	60	30	–	ns	
		15	24	12	–	ns	
t_{su}	set-up time D to CP	5	60	30	–	ns	
		10	20	10	–	ns	
		15	15	5	–	ns	
t_h	hold time D to CP	+5	+5	–15	–	ns	
		10	20	5	–	ns	
		15	20	5	–	ns	
$f_{clk(max)}$	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.

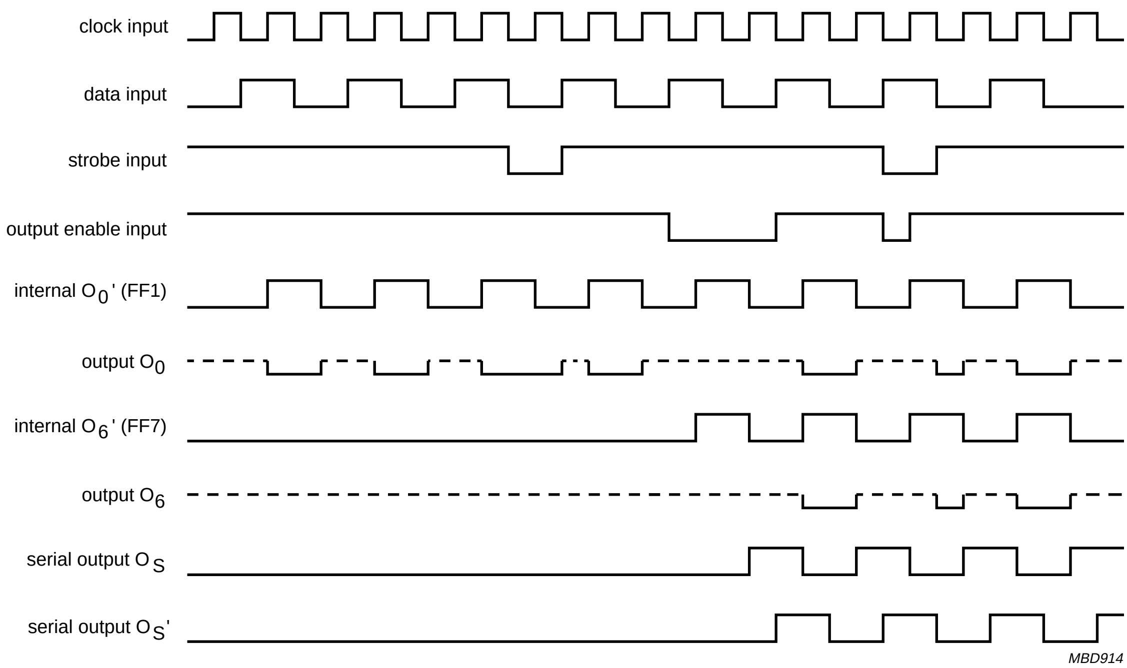


Fig.5 Timing diagram.

APPLICATION INFORMATION

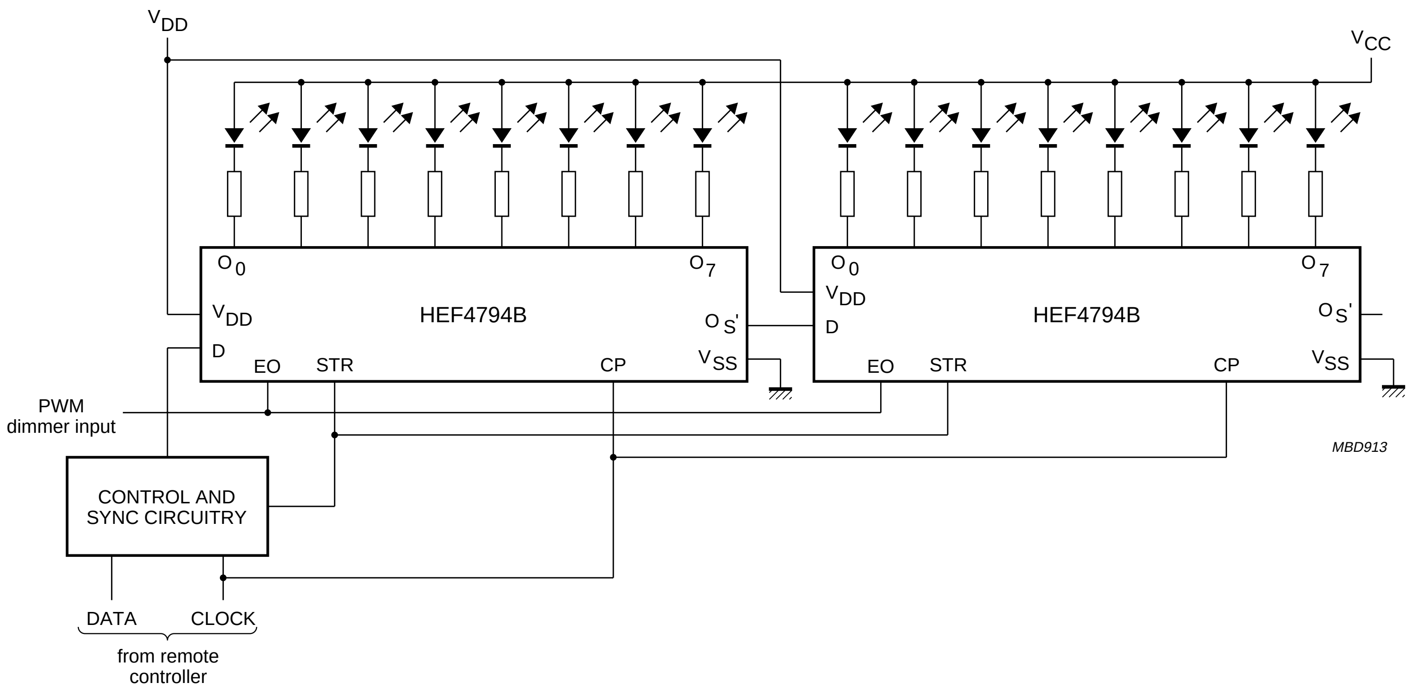
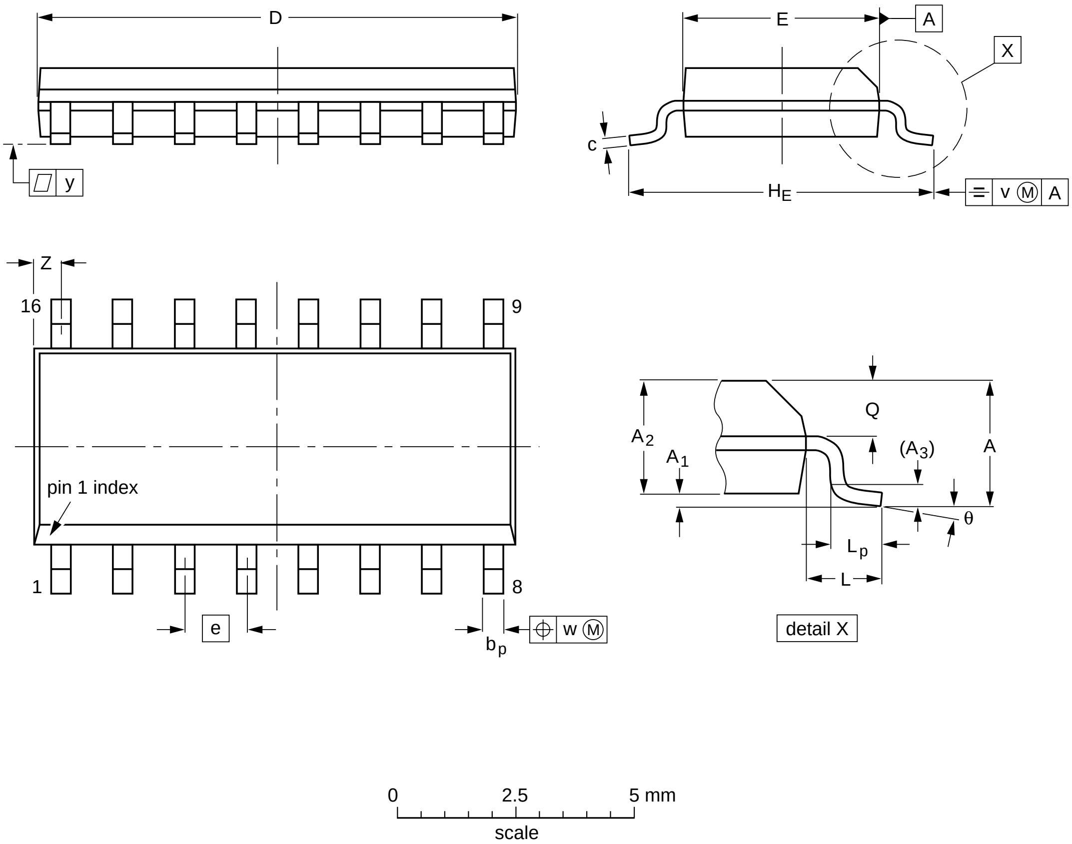


Fig.6 Application example: serial-to-parallel converting LED drivers.

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)

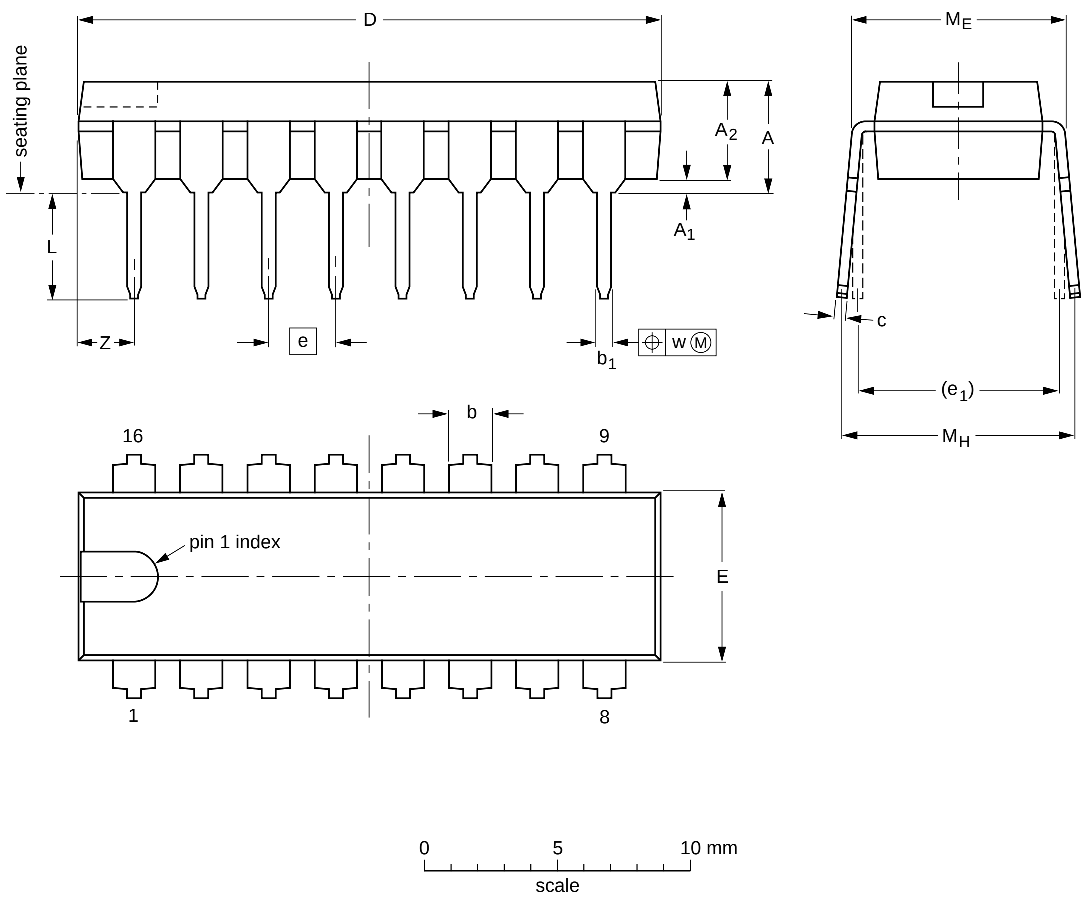
UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8^o 0^o
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	0.050	0.244 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

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_1 min.	A_2 max.	b	b_1	c	D [(1)]	E [(1)]	e	e_1	L	M_E	M_H	w	Z [(1)] 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

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 preferable 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.

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

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

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.	

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.

NOTES

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,
5600 MD EINDHOVEN, The Netherlands, Fax. +31 40 27 24825

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

Printed in The Netherlands

245002/02/pp16

Date of release: 1999 Jun 30

Document order number: 9397 750 06151

Let's make things better.

Philips
Semiconductors

PHILIPS