

# HEF4794B

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

Rev. 03 — 12 August 2008

Product data sheet

### 1. General description

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The HEF4794B is an 8-stage serial shift register. It has a storage latch associated with each stage for strobing data from the serial input (D) to the parallel LED driver outputs (QP0 to QP7). Data is shifted on the positive-going clock (CP) transitions. The data in each shift register stage is transferred to the storage register when the strobe input (STR) is HIGH. Data in the storage register appears at the outputs whenever the output enable input (OE) signal is HIGH.

Two serial outputs (QS1 and QS2) are available for cascading a number of HEF4794B devices. Serial data is available at QS1 on positive-going clock edges to allow high-speed operation in cascaded systems with a fast clock rise time. The same serial data is available at QS2 on the next negative going clock edge. This is used for cascading HEF4794B devices when the clock has a slow rise time.

It operates over a recommended  $V_{DD}$  power supply range of 3 V to 15 V referenced to  $V_{SS}$  (usually ground). Unused inputs must be connected to  $V_{DD}$ ,  $V_{SS}$ , or another input. It is also suitable for use over both the industrial ( $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$ ) and automotive ( $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$ ) temperature ranges.

### 2. Features

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- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Operates across the automotive temperature range  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$
- Complies with JEDEC standard JESD 13-B
- ESD protection:
  - ◆ HBM JESD22-A114E exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V

### 3. Applications

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- Automotive and industrial

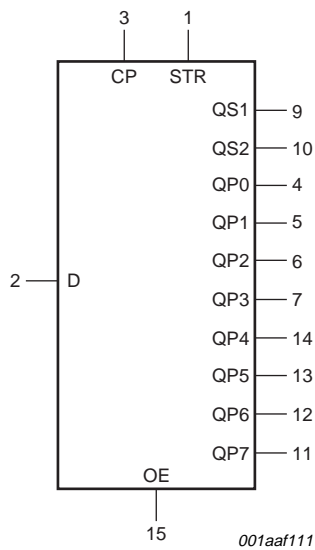
## 4. Ordering information

**Table 1. Ordering information**

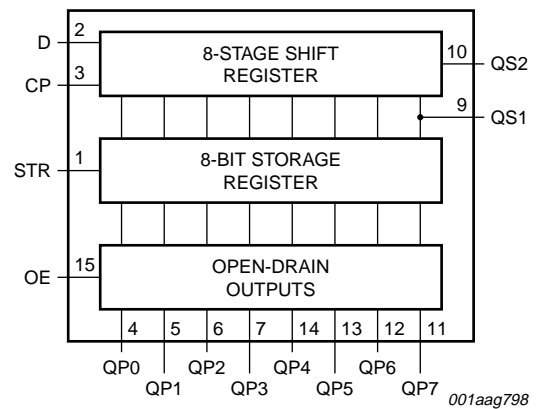
All types operate from  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

Type number	Package		Version
	Name	Description	
HEF4794BP	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-4
HEF4794BT	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

## 5. Functional diagram



**Fig 1. Logic symbol**



**Fig 2. Functional diagram**

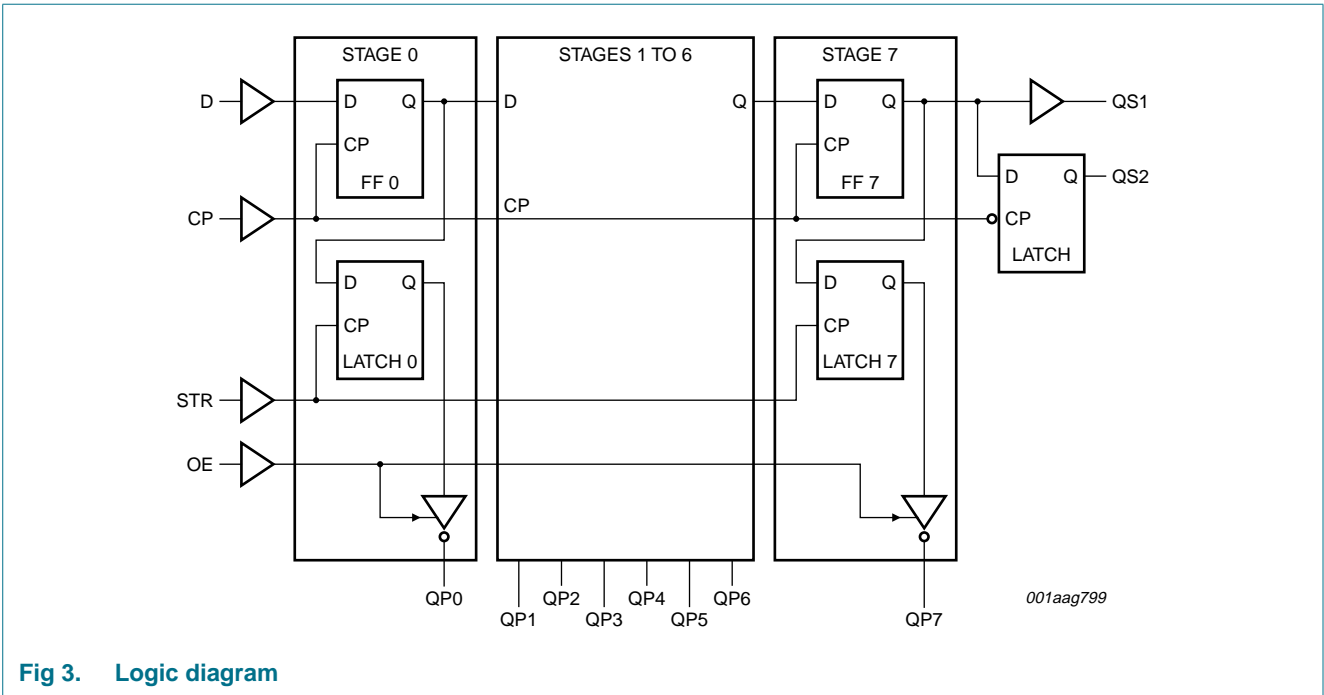


Fig 3. Logic diagram

## 6. Pinning information

### 6.1 Pinning

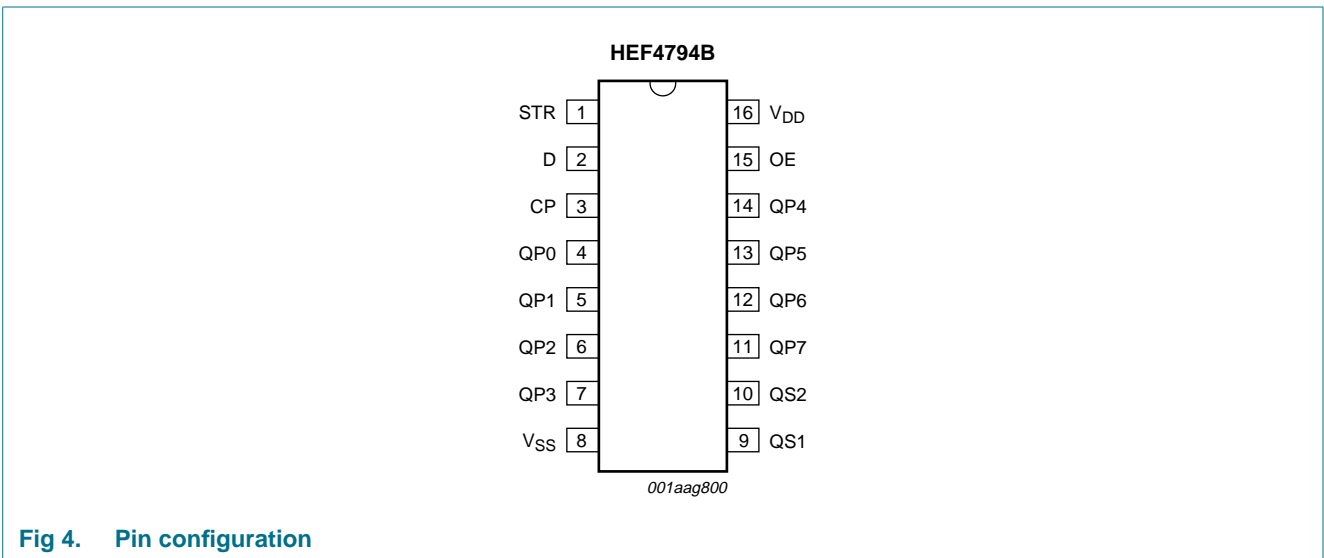


Fig 4. Pin configuration

## 6.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
D	2	serial input
QP0 to QP7	4, 5, 6, 7, 14, 13, 12, 11	parallel output
QS1	9	serial output
QS2	10	serial output
CP	3	clock input
STR	1	strobe input
OE	15	output enable input
V <sub>DD</sub>	16	supply voltage
V <sub>SS</sub>	8	ground (0 V)

## 7. Functional description

Table 3. Function table<sup>[1]</sup>

Input				Parallel output		Serial output	
CP	OE	STR	D	QP0	QPn	QS1 <sup>[2]</sup>	QS2 <sup>[3]</sup>
↑	L	X	X	Z	Z	Q6S	no change
↓	L	X	X	Z	Z	n.c.	Q7S
↑	H	L	X	no change	no change	Q6S	no change
↑	H	H	L	Z	QPn-1	Q6S	no change
↑	H	H	H	L	QPn-1	Q6S	no change
↓	H	H	H	no change	no change	no change	Q7S

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care; Z = high-impedance OFF-state; ↑ = LOW-to-HIGH clock transition; ↓ = HIGH-to-LOW clock transition.

[2] Q6S = the data in register stage 6 before the LOW to HIGH clock transition.

[3] Q7S = the data in register stage 7 before the HIGH to LOW clock transition.

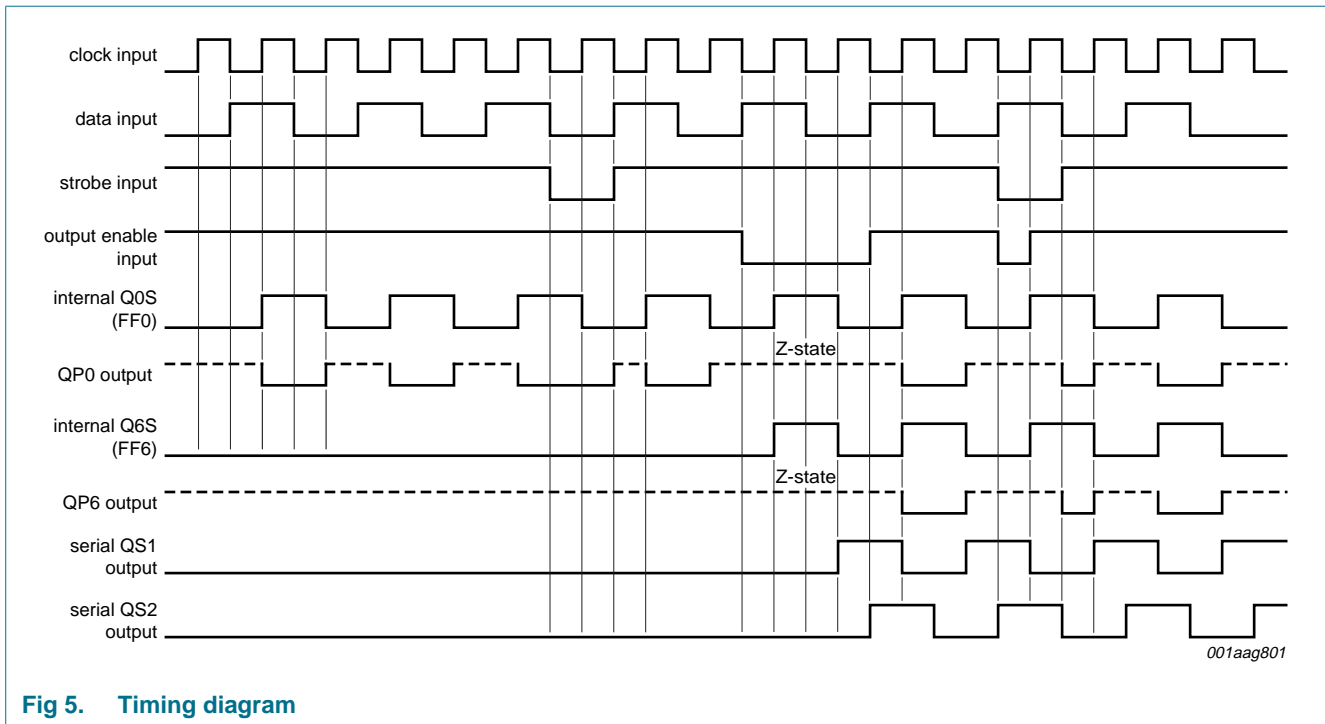


Fig 5. Timing diagram

## 8. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit	
$V_{DD}$	supply voltage		-0.5	+18	V	
$I_{IK}$	input clamping current	$V_I < 0.5\text{ V}$ or $V_I > V_{DD} + 0.5\text{ V}$	-	$\pm 10$	mA	
$V_I$	input voltage		-0.5	$V_{DD} + 0.5$	V	
$I_{OK}$	output clamping current	QSn outputs; $V_O < 0.5\text{ V}$ or $V_O > V_{DD} + 0.5\text{ V}$	-	$\pm 10$	mA	
		QPn outputs; $V_O < 0.5\text{ V}$	-	40	mA	
$I_I$	input current		-	$\pm 10$	mA	
$I_O$	output current	QSn outputs	-	$\pm 10$	mA	
		QPn outputs	-	40	mA	
$T_{stg}$	storage temperature		-65	+150	°C	
$T_{amb}$	ambient temperature		-40	+125	°C	
$P_{tot}$	total power dissipation	$T_{amb} = -40\text{ °C}$ to $+125\text{ °C}$				
		DIP16 package	[1]	-	750	mW
		SO16 package	[2]	-	500	mW
P	power dissipation		-	100	mW	

[1] For DIP16 package:  $P_{tot}$  derates linearly with 12 mW/K above 70 °C.

[2] For SO16 package:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.

## 9. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>DD</sub>	supply voltage		3	15	V
V <sub>I</sub>	input voltage		0	V <sub>DD</sub>	V
T <sub>amb</sub>	ambient temperature	in free air	-40	+125	°C
Δt/ΔV	input transition rise and fall rate	V <sub>DD</sub> = 5 V	-	3.75	ns/V
		V <sub>DD</sub> = 10 V	-	0.5	ns/V
		V <sub>DD</sub> = 15 V	-	0.08	ns/V

## 10. Static characteristics

**Table 6. Static characteristics**

V<sub>SS</sub> = 0 V; V<sub>I</sub> = V<sub>SS</sub> or V<sub>DD</sub>; unless otherwise specified.

Symbol	Parameter	Conditions	V <sub>DD</sub>	T <sub>amb</sub> = -40 °C		T <sub>amb</sub> = 25 °C		T <sub>amb</sub> = 85 °C		T <sub>amb</sub> = 125 °C		Unit	
				Min	Max	Min	Max	Min	Max	Min	Max		
V <sub>IH</sub>	HIGH-level input voltage	I <sub>O</sub>   < 1 μA	5 V	3.5	-	3.5	-	3.5	-	3.5	-	V	
			10 V	7.0	-	7.0	-	7.0	-	7.0	-	V	
			15 V	11.0	-	11.0	-	11.0	-	11.0	-	V	
V <sub>IL</sub>	LOW-level input voltage	I <sub>O</sub>   < 1 μA	5 V	-	1.5	-	1.5	-	1.5	-	1.5	V	
			10 V	-	3.0	-	3.0	-	3.0	-	3.0	V	
			15 V	-	4.0	-	4.0	-	4.0	-	4.0	V	
V <sub>OH</sub>	HIGH-level output voltage	QSn outputs;  I <sub>O</sub>   < 1 μA	5 V	4.95	-	4.95	-	4.95	-	4.95	-	V	
			10 V	9.95	-	9.95	-	9.95	-	9.95	-	V	
			15 V	14.95	-	14.95	-	14.95	-	14.95	-	V	
V <sub>OL</sub>	LOW-level output voltage	QSn outputs;  I <sub>O</sub>   < 1 μA	5 V	-	0.05	-	0.05	-	0.05	-	0.05	V	
			10 V	-	0.05	-	0.05	-	0.05	-	0.05	V	
			15 V	-	0.05	-	0.05	-	0.05	-	0.05	V	
		QP outputs;  I <sub>O</sub>   < 20 mA	5 V	-	0.75	-	0.75	-	1.5	-	1.5	V	
			10 V	-	0.75	-	0.75	-	1.5	-	1.5	V	
			15 V	-	0.75	-	0.75	-	1.5	-	1.5	V	
I <sub>OH</sub>	HIGH-level output current	QSn outputs	V <sub>O</sub> = 2.5 V	5 V	-1.7	-	-1.4	-	-1.1	-	-1.1	-	mA
			V <sub>O</sub> = 4.6 V	5 V	-0.64	-	-0.5	-	-0.36	-	-0.36	-	mA
			V <sub>O</sub> = 9.5 V	10 V	-1.6	-	-1.3	-	-0.9	-	-0.9	-	mA
			V <sub>O</sub> = 13.5 V	15 V	-4.2	-	-3.4	-	-2.4	-	-2.4	-	mA
I <sub>OL</sub>	LOW-level output current	QSn outputs	V <sub>O</sub> = 0.4 V	5 V	0.64	-	0.5	-	0.36	-	0.36	-	mA
			V <sub>O</sub> = 0.5 V	10 V	1.6	-	1.3	-	0.9	-	0.9	-	mA
			V <sub>O</sub> = 1.5 V	15 V	4.2	-	3.4	-	2.4	-	2.4	-	mA
I <sub>I</sub>	input leakage current		15 V	-	±0.1	-	±0.1	-	±1.0	-	±1.0	μA	

**Table 6. Static characteristics ...continued**  
 $V_{SS} = 0\text{ V}$ ;  $V_I = V_{SS}$  or  $V_{DD}$ ; unless otherwise specified.

Symbol	Parameter	Conditions	V <sub>DD</sub>	T <sub>amb</sub> = -40 °C		T <sub>amb</sub> = 25 °C		T <sub>amb</sub> = 85 °C		T <sub>amb</sub> = 125 °C		Unit
				Min	Max	Min	Max	Min	Max	Min	Max	
I <sub>OZ</sub>	OFF-state output current	QPn output is HIGH; V <sub>O</sub> = 15 V	5 V	-	2	-	2	-	15	-	15	μA
			10 V	-	2	-	2	-	15	-	15	μA
			15 V	-	2	-	2	-	15	-	15	μA
I <sub>DD</sub>	supply current	I <sub>O</sub> = 0 A	5 V	-	5	-	5	-	150	-	150	μA
			10 V	-	10	-	10	-	300	-	300	μA
			15 V	-	20	-	20	-	600	-	600	μA
C <sub>I</sub>	input capacitance		-	-	-	-	7.5	-	-	-	-	

## 11. Dynamic characteristics

**Table 7. Dynamic characteristics**  
 $V_{SS} = 0\text{ V}$ ; T<sub>amb</sub> = 25 °C unless otherwise specified. For test circuit, see [Figure 10](#).

Symbol	Parameter	Conditions	V <sub>DD</sub>	Extrapolation formula	Min	Typ	Max	Unit
t <sub>PHL</sub>	HIGH to LOW propagation delay	CP to QS1; see <a href="#">Figure 6</a>	5 V	<sup>[1]</sup> 132 ns + (0.55 ns/pF)C <sub>L</sub>	-	160	320	ns
			10 V	53 ns + (0.23 ns/pF)C <sub>L</sub>	-	65	130	ns
			15 V	37 ns + (0.16 ns/pF)C <sub>L</sub>	-	45	90	ns
		CP to QS2; see <a href="#">Figure 6</a>	5 V	92 ns + (0.55 ns/pF)C <sub>L</sub>	-	120	240	ns
			10 V	39 ns + (0.23 ns/pF)C <sub>L</sub>	-	50	100	ns
			15 V	32 ns + (0.16 ns/pF)C <sub>L</sub>	-	40	80	ns
t <sub>PLH</sub>	LOW to HIGH propagation delay	CP to QS1; see <a href="#">Figure 6</a>	5 V	<sup>[1]</sup> 102 ns + (0.55 ns/pF)C <sub>L</sub>	-	130	260	ns
			10 V	44 ns + (0.23 ns/pF)C <sub>L</sub>	-	55	110	ns
			15 V	32 ns + (0.16 ns/pF)C <sub>L</sub>	-	40	80	ns
		CP to QS2; see <a href="#">Figure 6</a>	5 V	102 ns + (0.55 ns/pF)C <sub>L</sub>	-	130	260	ns
			10 V	49 ns + (0.23 ns/pF)C <sub>L</sub>	-	60	120	ns
			15 V	37 ns + (0.16 ns/pF)C <sub>L</sub>	-	45	90	ns
t <sub>PZL</sub>	OFF-state to LOW propagation delay	CP to QPn; see <a href="#">Figure 6</a>	5 V		-	240	480	ns
			10 V		-	80	160	ns
			15 V		-	55	110	ns
		STR to QPn; see <a href="#">Figure 7</a>	5 V		-	140	280	ns
			10 V		-	70	140	ns
			15 V		-	55	110	ns
t <sub>PLZ</sub>	LOW to OFF-state propagation delay	CP to QPn; see <a href="#">Figure 6</a>	5 V		-	170	340	ns
			10 V		-	75	150	ns
			15 V		-	60	120	ns
		STR to QPn; see <a href="#">Figure 7</a>	5 V		-	100	200	ns
			10 V		-	40	100	ns
			15 V		-	35	70	ns

**Table 7. Dynamic characteristics ...continued**

$V_{SS} = 0\text{ V}$ ;  $T_{amb} = 25\text{ °C}$  unless otherwise specified. For test circuit, see [Figure 10](#).

Symbol	Parameter	Conditions	$V_{DD}$	Extrapolation formula	Min	Typ	Max	Unit	
$t_{en}$	enable time	OE to QPn; see <a href="#">Figure 8</a>	5 V	[2]	-	100	200	ns	
			10 V		-	55	110	ns	
			15 V		-	50	100	ns	
$t_{dis}$	disable time	OE to QPn; see <a href="#">Figure 8</a>	5 V	[2]	-	80	160	ns	
			10 V		-	40	80	ns	
			15 V		-	30	60	ns	
$t_t$	transition time	QS1, QS2; see <a href="#">Figure 6</a>	5 V	[1] [3]		85	170	ns	
			10 V		$35\text{ ns} + (1.00\text{ ns/pF})C_L$	-	40	80	ns
			15 V		$19\text{ ns} + (0.42\text{ ns/pF})C_L$	-	30	60	ns
$t_W$	pulse width	CP; LOW and HIGH; see <a href="#">Figure 6</a>	5 V		60	30	-	ns	
			10 V		30	15	-	ns	
			15 V		24	12	-	ns	
		STR; HIGH; see <a href="#">Figure 7</a>	5 V		80	40	-	ns	
			10 V		60	30	-	ns	
			15 V		24	12	-	ns	
$t_{su}$	set-up time	D to CP; see <a href="#">Figure 9</a>	5 V		60	30	-	ns	
			10 V		20	10	-	ns	
			15 V		15	5	-	ns	
$t_h$	hold time	D to CP; see <a href="#">Figure 9</a>	5 V		+5	-15	-	ns	
			10 V		20	5	-	ns	
			15 V		20	5	-	ns	
$f_{clk(max)}$	maximum clock frequency	CP; see <a href="#">Figure 6</a>	5 V		5	10	-	MHz	
			10 V		11	22	-	MHz	
			15 V		14	28	-	MHz	

[1] The typical values of the propagation delay and transition times are calculated from the extrapolation formulas shown ( $C_L$  in pF).

[2]  $t_{en}$  is the same as  $t_{PZL}$  and  $t_{dis}$  is the same as  $t_{PLZ}$

[3]  $t_t$  is the same as  $t_{TLH}$  and  $t_{THL}$

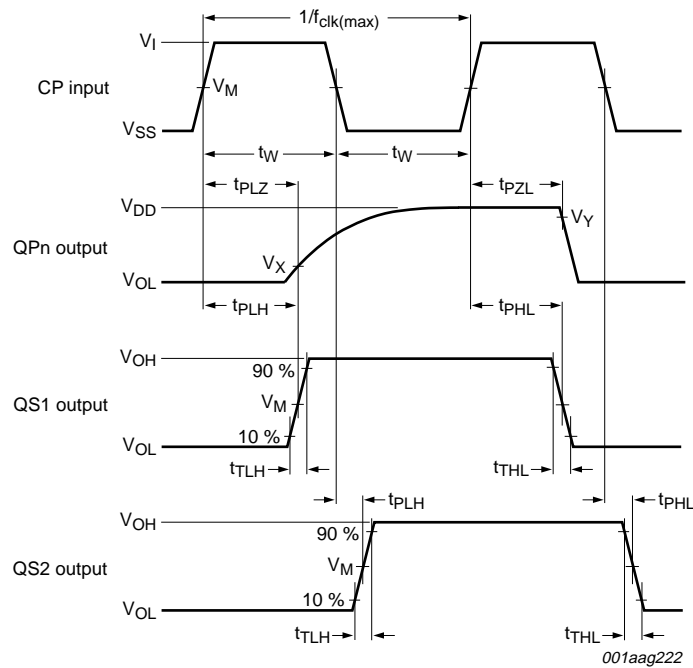
**Table 8. Dynamic power dissipation**

$P_D$  can be calculated from the formulas shown.  $V_{SS} = 0\text{ V}$ ;  $t_r = t_f \leq 20\text{ ns}$ ;  $T_{amb} = 25\text{ °C}$ .

Symbol	Parameter	$V_{DD}$	Typical formula	Where
$P_D$	dynamic power dissipation	5 V	$P_D = 1200 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2\ \mu\text{W}$	$f_i$ = input frequency in MHz;
		10 V	$P_D = 5550 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2\ \mu\text{W}$	$f_o$ = output frequency in MHz;
		15 V	$P_D = 15000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2\ \mu\text{W}$	$C_L$ = output load capacitance in pF; $\Sigma(f_o \times C_L)$ = sum of the outputs; $V_{DD}$ = supply voltage in V.



12. Waveforms

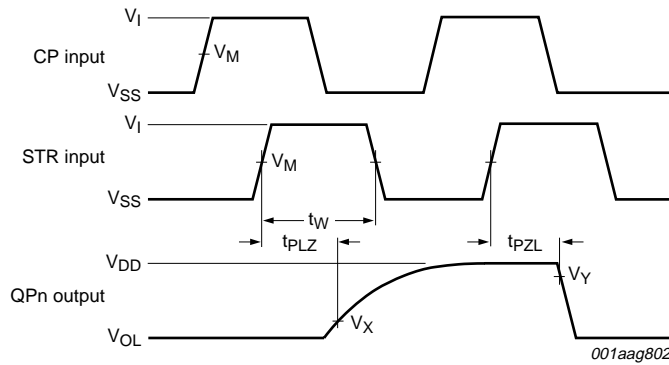


Parallel output measurement points are given in [Table 9](#).  
 $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Fig 6. Propagation delay clock (CP) to output (QPn, QS1, QS2), clock pulse width and maximum clock frequency**

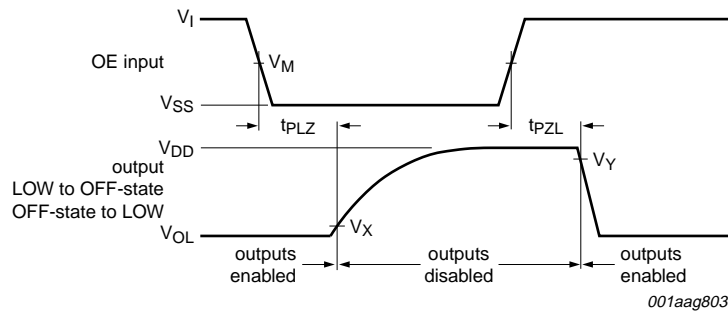
**Table 9. Measurement points**

Supply	Input	Output		
$V_{DD}$	$V_M$	$V_M$	$V_X$	$V_Y$
5 V to 15 V	$0.5V_{DD}$	$0.5V_{DD}$	$0.1V_O$	$0.9V_O$



Measurement points are given in [Table 9](#).  
 $V_{OL}$  is the typical output voltage level that occurs with the output load.

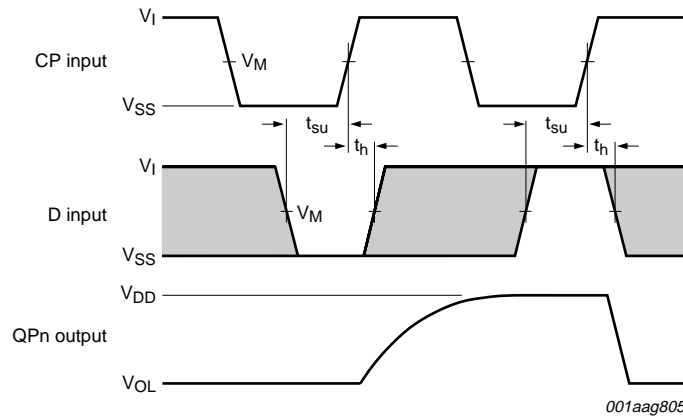
**Fig 7. Strobe (STR) to output (QPn) propagation delays and the strobe pulse width**



Measurement points are given in [Table 9](#).

$V_{OL}$  is the typical output voltage level that occurs with the output load.

**Fig 8. Enable and disable times for input OE**

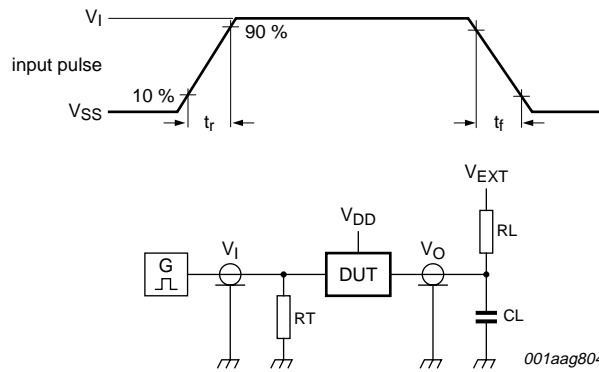


Measurement points are given in [Table 9](#).

The shaded areas indicate when the input is permitted to change for predictable output performance.

$V_{OL}$  is the typical output voltage level that occurs with the output load.

**Fig 9. Set-up and hold times for the data input (D)**



Test data is given in [Table 10](#).

Definitions for test circuit:

DUT - Device Under Test.

$R_L$  = Load resistance.

$C_L$  = load capacitance.

$R_T$  = Termination resistance should be equal to output impedance of  $Z_o$  of the pulse generator.

$V_{EXT}$  = External voltage for measuring switching times.

**Fig 10. Test circuit for measuring switching times**

**Table 10. Test data**

Supply	Input		$V_{EXT}$		Load	
$V_{DD}$	$V_I$	$t_r, t_f$	$t_{PLZ}, t_{PZL}$	$t_{PLH}, t_{PHL}$	$C_L$	$R_L$
5 V to 15 V	$V_{DD}$	$\leq 20$ ns	$V_{DD}$	open	50 pF	1 k $\Omega$



14. Package outline

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

SOT38-4

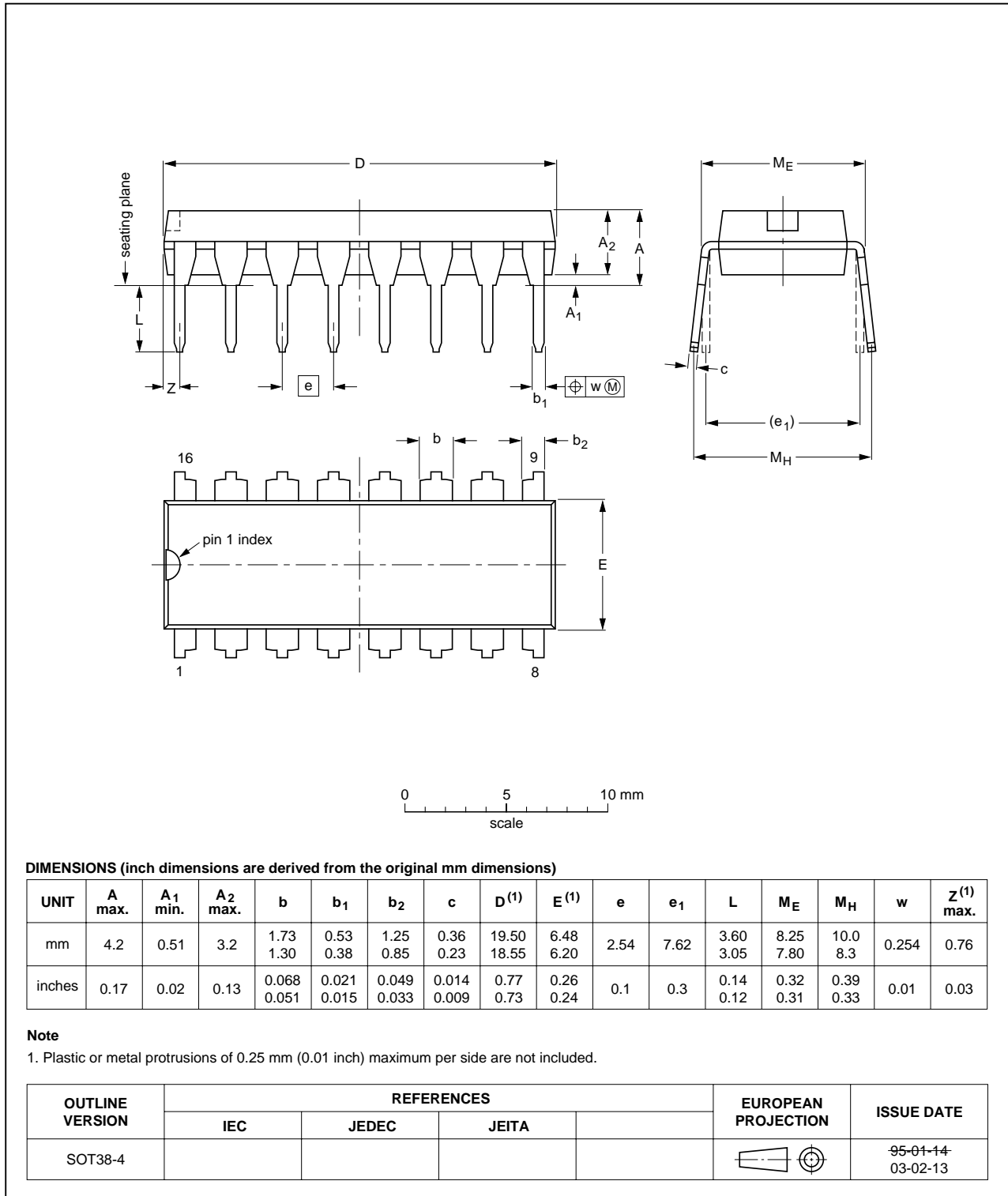


Fig 12. Package outline SOT38-4 (DIP16)

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1

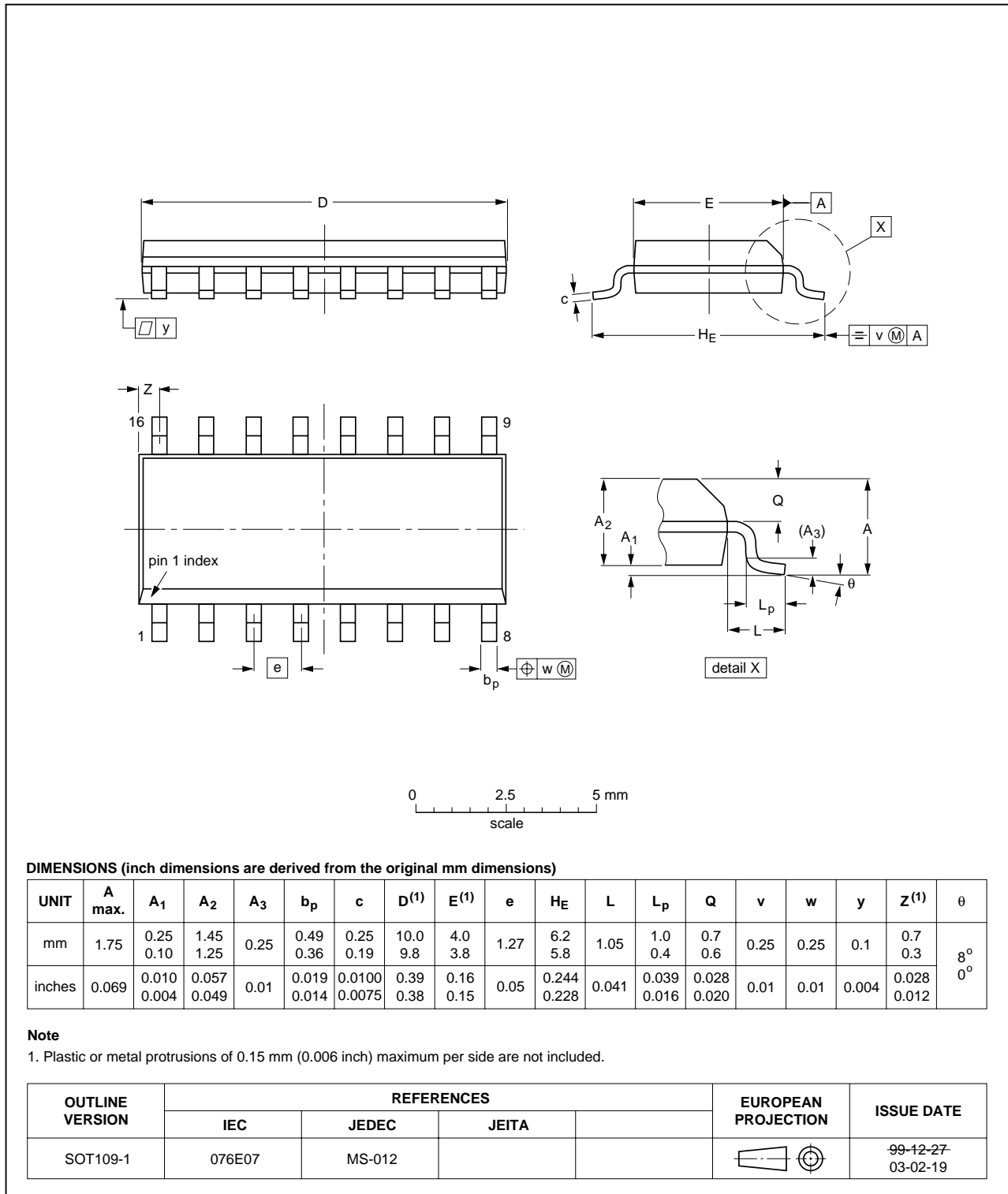


Fig 13. Package outline SOT109-1 (SO16)

## 15. Abbreviations

Table 11. Abbreviations

Acronym	Description
CMOS	Complementary Metal Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
TTL	Transistor-Transistor Logic

## 16. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF4794B_3	20080812	Product data sheet	-	HEF4794B_2
Modifications:	<ul style="list-style-type: none"> <li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li> <li>• Legal texts have been adapted to the new company name where appropriate.</li> <li>• Package version SOT38-1 changed to SOT38-4 in <a href="#">Section 4</a>, and <a href="#">Figure 12</a>.</li> <li>• <a href="#">Section 2 “Features”</a> added.</li> <li>• <a href="#">Section 3 “Applications”</a> added.</li> <li>• <a href="#">Table 2 “Pin description”</a> pin names modified.</li> <li>• Correction made to two entries in <a href="#">Table 3 “Function table<sup>[1]</sup>”</a>.</li> <li>• <a href="#">Section 8 “Limiting values”</a> and <a href="#">Section 10 “Static characteristics”</a> added, taken from the HE4000B Family Specifications data sheet.</li> <li>• <a href="#">Table 4 “Limiting values”</a> and <a href="#">Table 6 “Static characteristics”</a> reordered.</li> <li>• <a href="#">Section 9 “Recommended operating conditions”</a> added.</li> <li>• <a href="#">Section 10 “Static characteristics”</a> <math>I_{OH}</math>, <math>I_{OL}</math>, <math>I_I</math>, and <math>I_{DD}</math> values updated.</li> <li>• <math>V_X</math> and <math>V_Y</math> added and <math>V_M</math> deleted from <a href="#">Figure 6</a>, <a href="#">Figure 7</a> and <a href="#">Figure 8</a>.</li> <li>• Symbol <math>I_{OZH}</math> renamed to <math>I_{OZ}</math> throughout.</li> <li>• Symbol <math>I_I</math> renamed to input leakage current throughout.</li> <li>• Input capacitance <math>C_I</math> added to <a href="#">Table 6 “Static characteristics”</a>.</li> <li>• Symbol <math>f_{max}</math> changed to <math>f_{clk(max)}</math> maximum clock frequency throughout.</li> <li>• <a href="#">Figure 10 “Test circuit for measuring switching times”</a> renamed and negative pulse waveform deleted.</li> <li>• <a href="#">Table 9 “Measurement points”</a> and <a href="#">Table 10 “Test data”</a> added.</li> <li>• <a href="#">Section 15 “Abbreviations”</a> added.</li> <li>• Soldering information removed.</li> </ul>			
HEF4794B_2	19990630	Product specification	-	HEF4794B_1
HEF4794B_1	19940701	Product specification	-	-

## 17. Legal information

### 17.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

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