

# HEF4517B

## Dual 64-bit static shift register

Rev. 7 — 11 November 2011

Product data sheet

### 1. General description

The HEF4517B consists of two identical, independent 64-bit static shift registers. Each register has separate clock (nCP), data input (nD), parallel input-enable/output-enable (nPE/ $\overline{\text{OE}}$ ) and four 3-state outputs of the 16th, 32nd, 48th, and 64th bit positions (nQ16 to nQ64). Data at the nD input is entered into the first bit on the LOW-to-HIGH transition of the clock, regardless of the state of nPE/ $\overline{\text{OE}}$ .

When nPE/ $\overline{\text{OE}}$  is LOW, the outputs are enabled and it is in the 64-bit serial mode.

When nPE/ $\overline{\text{OE}}$  is HIGH, the outputs are disabled (high-impedance OFF-state), the 64-bit shift register is divided into four 16-bit shift registers with nD, nQ16, nQ32 and nQ48 as data inputs of the 1st, 17th, 33rd, and 49th bit respectively. Schmitt-trigger action in the clock input makes the circuit highly tolerant of slower clock rise and fall times.

It operates over a recommended  $V_{\text{DD}}$  power supply range of 3 V to 15 V referenced to  $V_{\text{SS}}$  (usually ground). Unused inputs must be connected to  $V_{\text{DD}}$ ,  $V_{\text{SS}}$ , or another input.

### 2. Features and benefits

- Tolerant of slow clock rise and fall times
- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$
- Complies with JEDEC standard JESD 13-B

### 3. Ordering information

**Table 1. Ordering information**

All types operate from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$

Type number	Package		
	Name	Description	Version
HEF4517BP	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-4
HEF4517BT	SO16	plastic small outline package; 16 leads; body width 7.5 mm	SOT162-1



4. Functional diagram

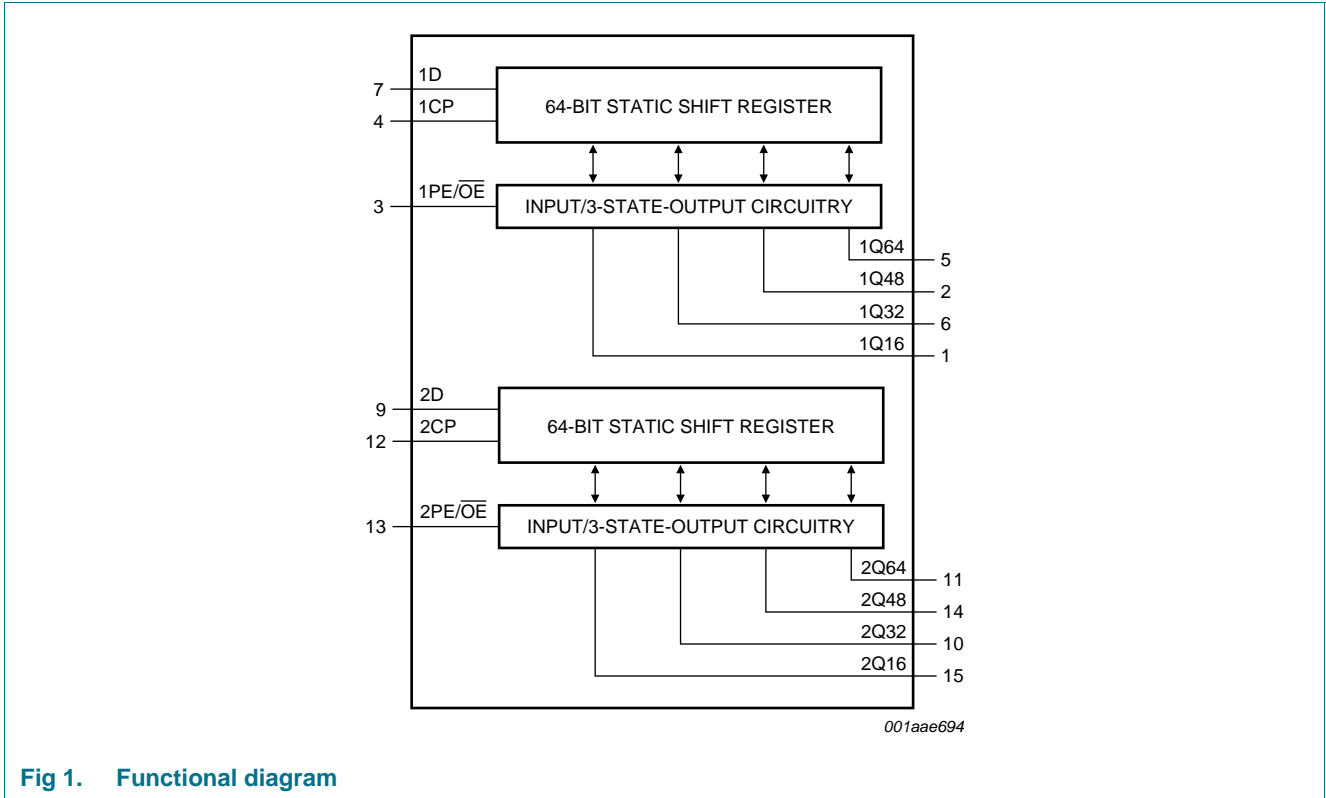


Fig 1. Functional diagram

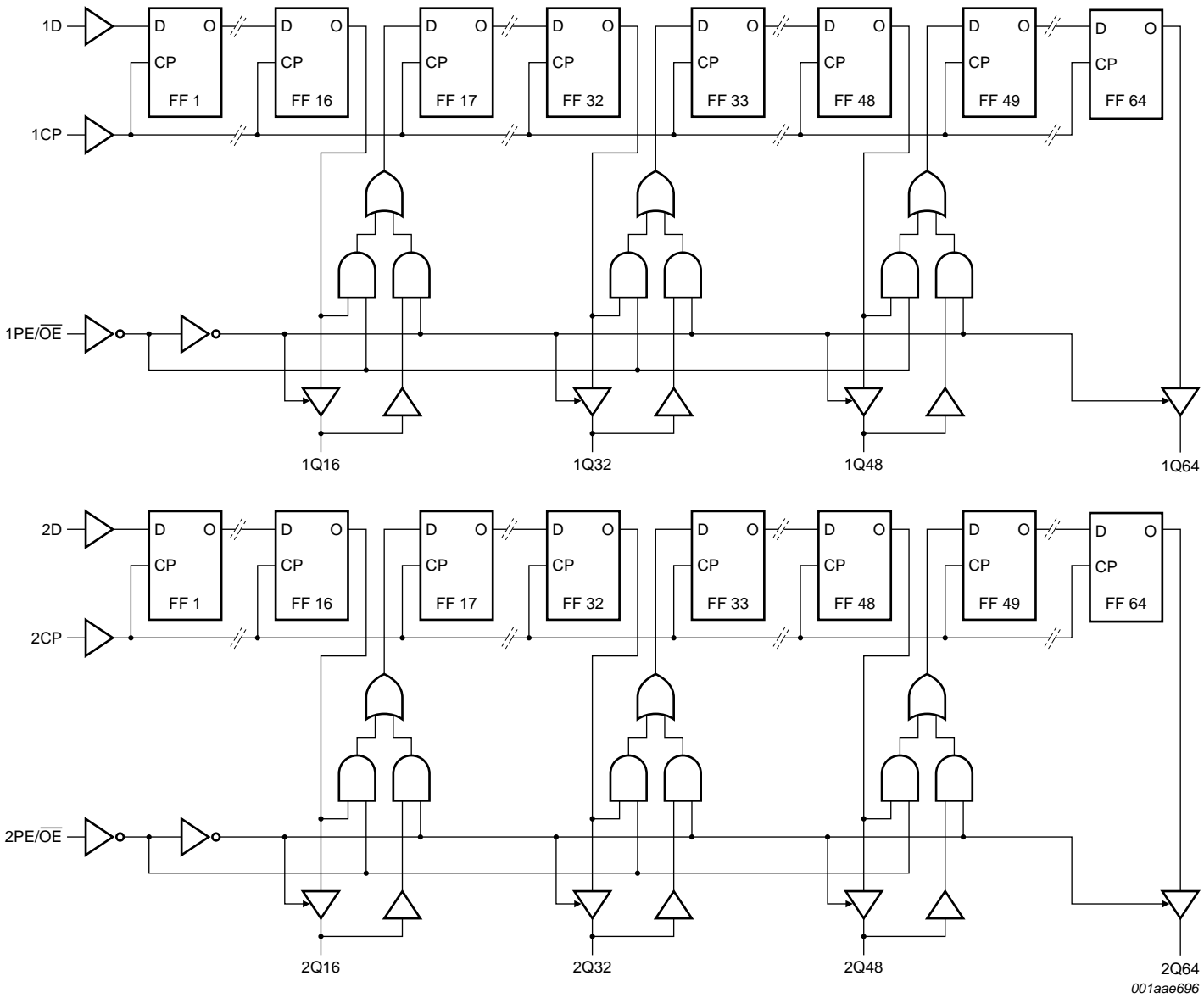
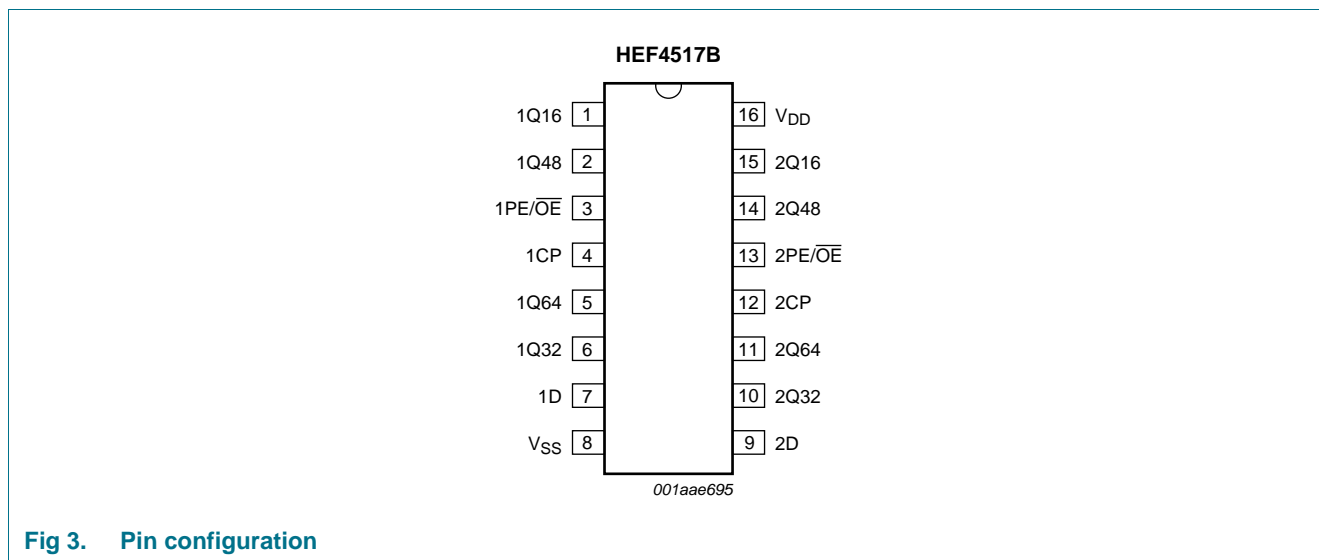


Fig 2. Logic diagram

## 5. Pinning information

### 5.1 Pinning



### 5.2 Pin description

**Table 2. Pin description**

Symbol	Pin	Description
1Q16, 2Q16	1, 15	3-state input/output
1Q48, 2Q48	2, 14	3-state input/output
1PE/ $\overline{OE}$ , 2PE/ $\overline{OE}$	3, 13	parallel input-enable/output-enable input
1CP, 2CP	4, 12	clock input
1Q64, 2Q64	5, 11	3-state input/output
1Q32, 2Q32	6, 10	3-state input/output
1D, 2D	7, 9	data input
V <sub>SS</sub>	8	ground supply voltage
V <sub>DD</sub>	16	supply voltage

## 6. Functional description

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

Inputs			Inputs/outputs				Mode
nCP	nD	nPE/OE	nQ16	nQ32	nQ48	nQ64	
↑	data entered into 1st bit	L	content of 16th bit displayed	content of 32nd bit displayed	content of 48th bit displayed	content of 64th bit displayed	One 64-bit shift register. The content of the shift register is shifted over one stage
↑	data entered into 1st bit	H	data at nQ16 entered into 17th bit	data at nQ32 entered into 33rd bit	data at nQ48 entered into 49th bit	remains in 'Z' state	Four 16-bit shift register. The content of the shift registers is shifted over one stage
↓	X	L	no change	no change	no change	no change	no change
↓	X	H	Z	Z	Z	Z	no change

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

## 7. Limiting values

Table 4. Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit	
V <sub>DD</sub>	supply voltage		-0.5	+18	V	
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>DD</sub> + 0.5 V	-	±10	mA	
V <sub>I</sub>	input voltage		-0.5	V <sub>DD</sub> + 0.5	V	
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>DD</sub> + 0.5 V	-	±10	mA	
I <sub>I/O</sub>	input/output current		-	±10	mA	
I <sub>DD</sub>	supply current		-	50	mA	
T <sub>stg</sub>	storage temperature		-65	+150	°C	
T <sub>amb</sub>	ambient temperature		-40	+85	°C	
P <sub>tot</sub>	total power dissipation	DIP16 package	[1]	-	750	mW
		SO16 package	[2]	-	500	mW
P	power dissipation	per output	-	100	mW	

[1] For DIP16 package: P<sub>tot</sub> derates linearly with 12 mW/K above 70 °C.

[2] For SO16 package: P<sub>tot</sub> derates linearly with 8 mW/K above 70 °C.

## 8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{DD}$	supply voltage		3	-	15	V
$V_I$	input voltage		0	-	$V_{DD}$	V
$T_{amb}$	ambient temperature	in free air	-40	-	+85	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{DD} = 5\text{ V}$	-	-	3.75	$\mu\text{s/V}$
		$V_{DD} = 10\text{ V}$	-	-	0.5	$\mu\text{s/V}$
		$V_{DD} = 15\text{ V}$	-	-	0.08	$\mu\text{s/V}$

## 9. Static characteristics

Table 6. Static characteristics

$V_{SS} = 0\text{ V}$ ;  $V_I = V_{SS}$  or  $V_{DD}$  unless otherwise specified.

Symbol	Parameter	Conditions	$V_{DD}$	$T_{amb} = -40\text{ °C}$		$T_{amb} = 25\text{ °C}$		$T_{amb} = 85\text{ °C}$		Unit
				Min	Max	Min	Max	Min	Max	
$V_{IH}$	HIGH-level input voltage	$ I_O  < 1\ \mu\text{A}$	5 V	3.5	-	3.5	-	3.5	-	V
			10 V	7.0	-	7.0	-	7.0	-	V
			15 V	11.0	-	11.0	-	11.0	-	V
$V_{IL}$	LOW-level input voltage	$ I_O  < 1\ \mu\text{A}$	5 V	-	1.5	-	1.5	-	1.5	V
			10 V	-	3.0	-	3.0	-	3.0	V
			15 V	-	4.0	-	4.0	-	4.0	V
$V_{OH}$	HIGH-level output voltage	$ I_O  < 1\ \mu\text{A}$	5 V	4.95	-	4.95	-	4.95	-	V
			10 V	9.95	-	9.95	-	9.95	-	V
			15 V	14.95	-	14.95	-	14.95	-	V
$V_{OL}$	LOW-level output voltage	$ I_O  < 1\ \mu\text{A}$	5 V	-	0.05	-	0.05	-	0.05	V
			10 V	-	0.05	-	0.05	-	0.05	V
			15 V	-	0.05	-	0.05	-	0.05	V
$I_{OH}$	HIGH-level output current	$V_O = 2.5\text{ V}$	5 V	-	-1.7	-	-1.4	-	-1.1	mA
		$V_O = 4.6\text{ V}$	5 V	-	-0.52	-	-0.44	-	-0.36	mA
		$V_O = 9.5\text{ V}$	10 V	-	-1.3	-	-1.1	-	-0.9	mA
		$V_O = 13.5\text{ V}$	15 V	-	-3.6	-	-3.0	-	-2.4	mA
$I_{OL}$	LOW-level output current	$V_O = 0.4\text{ V}$	5 V	0.52	-	0.44	-	0.36	-	mA
		$V_O = 0.5\text{ V}$	10 V	1.3	-	1.1	-	0.9	-	mA
		$V_O = 1.5\text{ V}$	15 V	3.6	-	3.0	-	2.4	-	mA
$I_I$	input leakage current		15 V	-	$\pm 0.3$	-	$\pm 0.3$	-	$\pm 1.0$	$\mu\text{A}$
$I_{DD}$	supply current	$I_O = 0\text{ A}$	5 V	-	50	-	50	-	375	$\mu\text{A}$
			10 V	-	100	-	100	-	750	$\mu\text{A}$
			15 V	-	200	-	200	-	1500	$\mu\text{A}$
$C_I$	input capacitance		-	-	-	-	7.5	-	-	pF

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

$V_{SS} = 0\text{ V}$ ;  $T_{amb} = 25\text{ °C}$ ; for test circuit see [Figure 8](#); unless otherwise specified.

Symbol	Parameter	Conditions	$V_{DD}$	Extrapolation formula	Min	Typ	Max	Unit
$t_{PHL}$	HIGH to LOW propagation delay	nCP to nQn; see <a href="#">Figure 4</a>	5 V	[1] $193\text{ ns} + (0.55\text{ ns/pF})C_L$	-	220	440	ns
			10 V	$74\text{ ns} + (0.23\text{ ns/pF})C_L$	-	85	170	ns
			15 V	$52\text{ ns} + (0.16\text{ ns/pF})C_L$	-	60	120	ns
$t_{PLH}$	LOW to HIGH propagation delay	nCP to nQn; see <a href="#">Figure 4</a>	5 V	[1] $163\text{ ns} + (0.55\text{ ns/pF})C_L$	-	190	380	ns
			10 V	$64\text{ ns} + (0.23\text{ ns/pF})C_L$	-	75	150	ns
			15 V	$42\text{ ns} + (0.16\text{ ns/pF})C_L$	-	50	100	ns
$t_{PHZ}$	HIGH to OFF-state propagation delay	nPE/ $\overline{\text{OE}}$ to nQn; see <a href="#">Figure 5</a>	5 V		-	40	80	ns
			10 V		-	30	60	ns
			15 V		-	25	50	ns
$t_{PZH}$	OFF-state to HIGH propagation delay	nPE/ $\overline{\text{OE}}$ to nQn; see <a href="#">Figure 5</a>	5 V		-	45	90	ns
			10 V		-	25	50	ns
			15 V		-	20	40	ns
$t_{PLZ}$	LOW to OFF-state propagation delay	nPE/ $\overline{\text{OE}}$ to nQn; see <a href="#">Figure 5</a>	5 V		-	50	100	ns
			10 V		-	30	60	ns
			15 V		-	25	50	ns
$t_{PZL}$	OFF-state to LOW propagation delay	nPE/ $\overline{\text{OE}}$ to nQn; see <a href="#">Figure 5</a>	5 V		-	60	120	ns
			10 V		-	30	60	ns
			15 V		-	25	50	ns
$t_t$	transition time	nQn; see <a href="#">Figure 6</a>	5 V	[1] $10\text{ ns} + (1.00\text{ ns/pF})C_L$	-	60	120	ns
			10 V	$9\text{ ns} + (0.42\text{ ns/pF})C_L$	-	30	60	ns
			15 V	$6\text{ ns} + (0.28\text{ ns/pF})C_L$	-	20	40	ns
$t_{su}$	set-up time	nQn, nD to nCP; see <a href="#">Figure 7</a>	5 V		30	10	-	ns
			10 V		25	5	-	ns
			15 V		20	5	-	ns
$t_h$	hold time	nQn, nD to nCP; see <a href="#">Figure 7</a>	5 V		45	15	-	ns
			10 V		30	10	-	ns
			15 V		25	10	-	ns
$t_w$	pulse width	nQn, nD to nCP; see <a href="#">Figure 7</a>	5 V		-	95	190	ns
			10 V		-	40	80	ns
			15 V		-	30	60	ns
$f_{max}$	maximum frequency	see <a href="#">Figure 7</a>	5 V		2	5	-	MHz
			10 V		6	12	-	MHz
			15 V		8	16	-	MHz

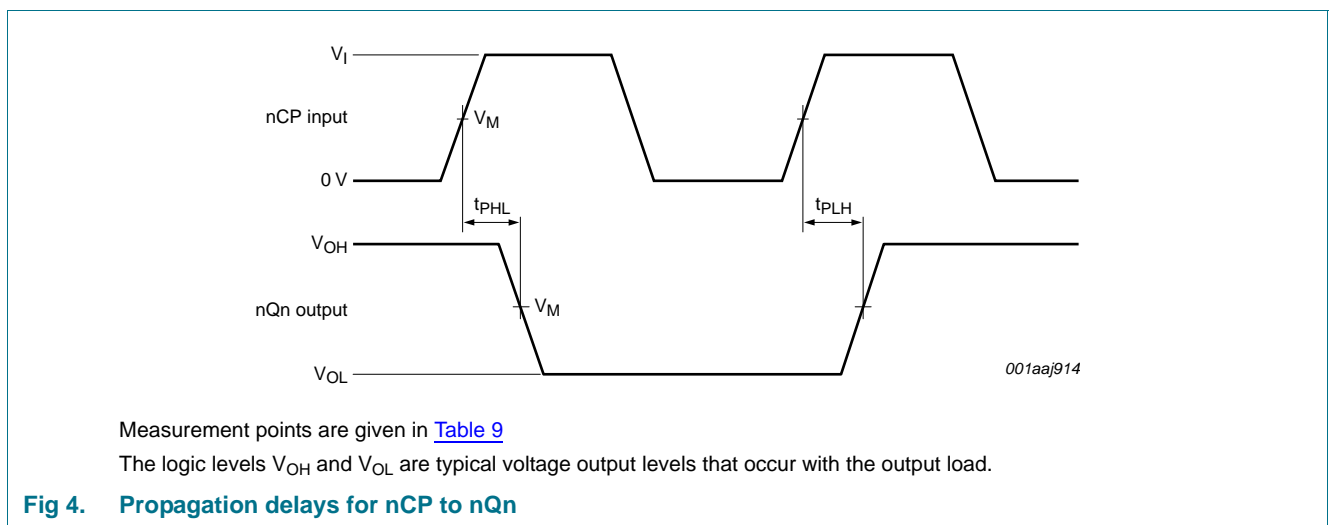
[1] The typical values of the propagation delay and transition times are calculated from the extrapolation formulas shown ( $C_L$  in pF).

**Table 8. Dynamic power dissipation  $P_D$**

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

Symbol	Parameter	$V_{DD}$	Typical formula for $P_D$ ( $\mu\text{W}$ )	where:
$P_D$	dynamic power dissipation	5 V	$P_D = 7000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	$f_i$ = input frequency in MHz,
		10 V	$P_D = 28000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	$f_o$ = output frequency in MHz,
		15 V	$P_D = 70000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$	$C_L$ = output load capacitance in pF, $V_{DD}$ = supply voltage in V, $\Sigma(f_o \times C_L)$ = sum of the outputs.

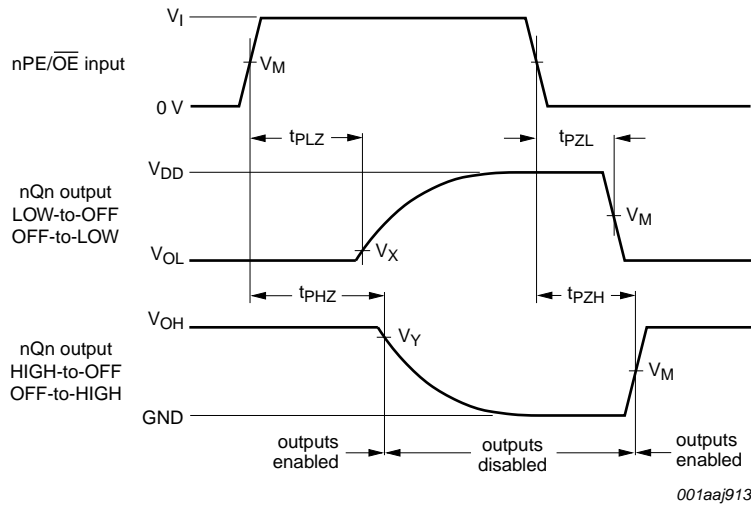
## 11. Waveforms



**Table 9. Measurement points**

Input	Output			
$V_M$	$V_M$	$V_X$	$V_Y$	
$0.5V_I$	$0.5V_{DD}$	$0.1V_{DD}$	$0.9V_{DD}$	

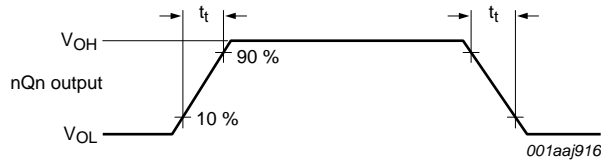




Measurement points are given in [Table 9](#)

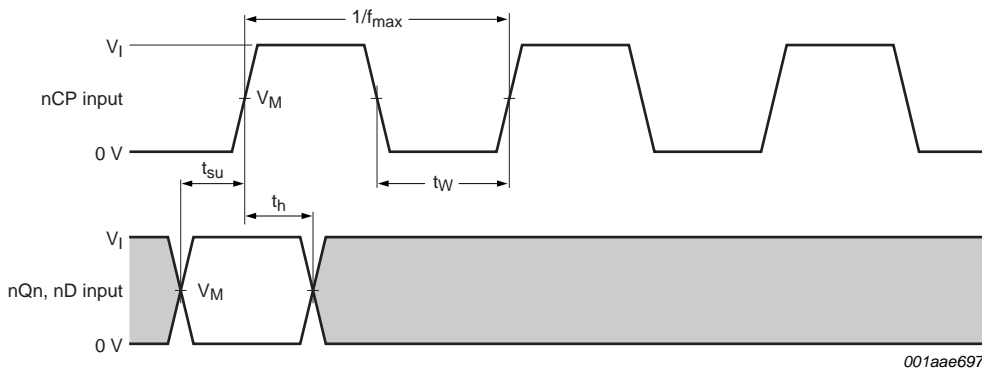
The logic levels  $V_{OH}$  and  $V_{OL}$  are typical voltage output levels that occur with the output load.

**Fig 5. Enable and disable times and 3-state propagation delays**



The logic levels  $V_{OH}$  and  $V_{OL}$  are typical voltage output levels that occur with the output load.

**Fig 6. Transition times for nQn**

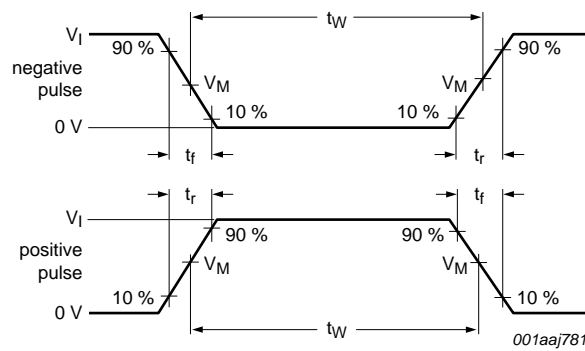


The shading indicates where the data (nQn and nD) is permitted to change for predictable output changes.

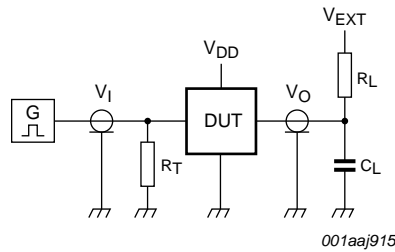
Measurement points are given in [Table 9](#)

The logic levels  $V_{OH}$  and  $V_{OL}$  are typical voltage output levels that occur with the output load.

**Fig 7. Waveforms showing minimum clock pulse width and maximum frequency and set-up and hold times for nQn (as data input) or nD to nCP**



a. Input waveforms



b. Test circuit

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

Definitions for test circuit:

DUT = Device Under Test;

$R_L$  = Load resistance;

$C_L$  = Load capacitance including jig and probe capacitance;

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

**Fig 8. Test circuit for switching times**

**Table 10. Test data**

Supply voltage	Input		Load		$V_{EXT}$		
	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PLZ}, t_{PZL}$	$t_{PHZ}, t_{PZH}$
5 V to 15 V	$V_{DD}$	$\leq 20$ ns	50 pF	1 k $\Omega$	open	$2V_{DD}$	GND

12. Package outline

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

SOT38-4

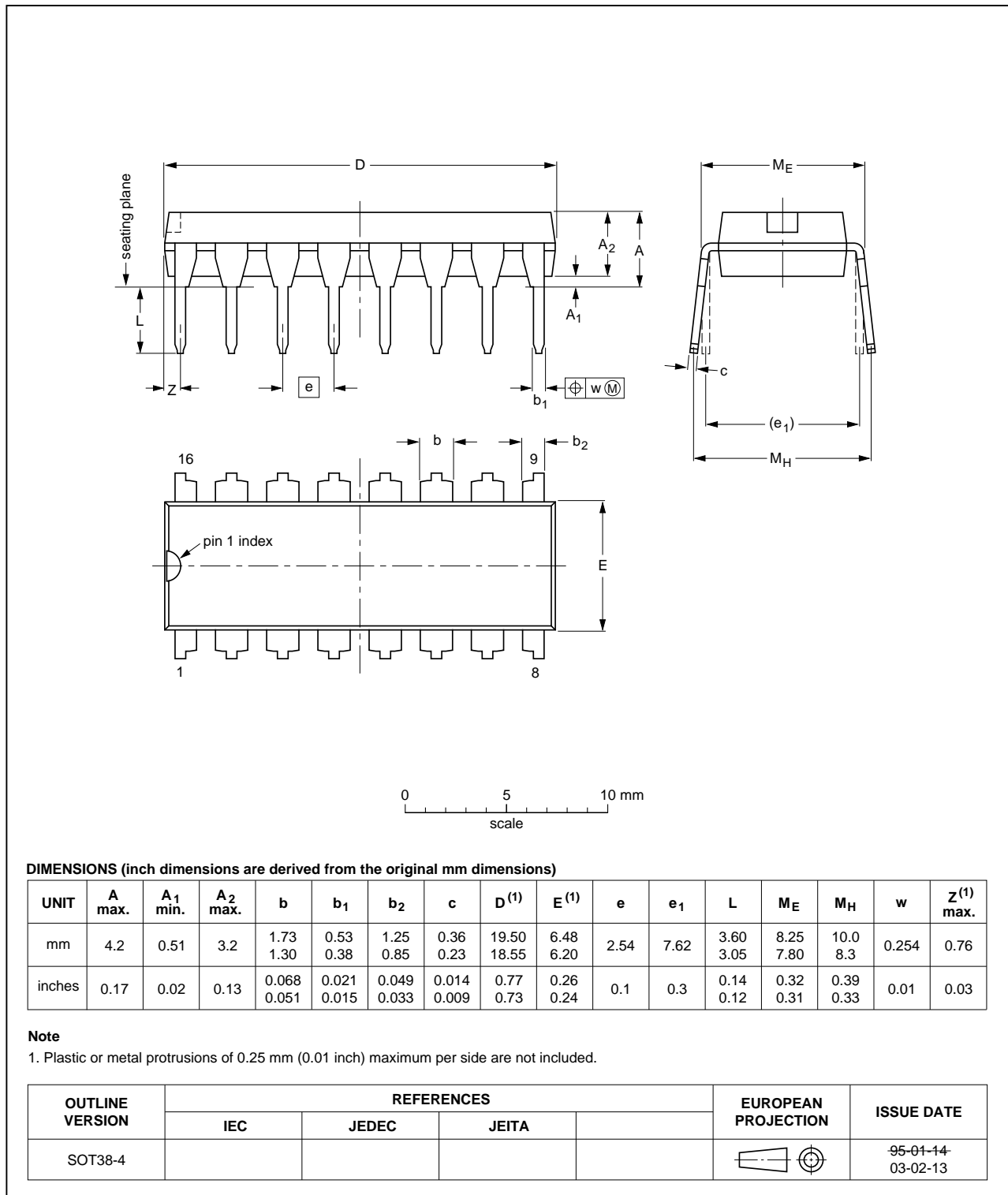


Fig 9. Package outline SOT38-4 (DIP16)

SO16: plastic small outline package; 16 leads; body width 7.5 mm

SOT162-1

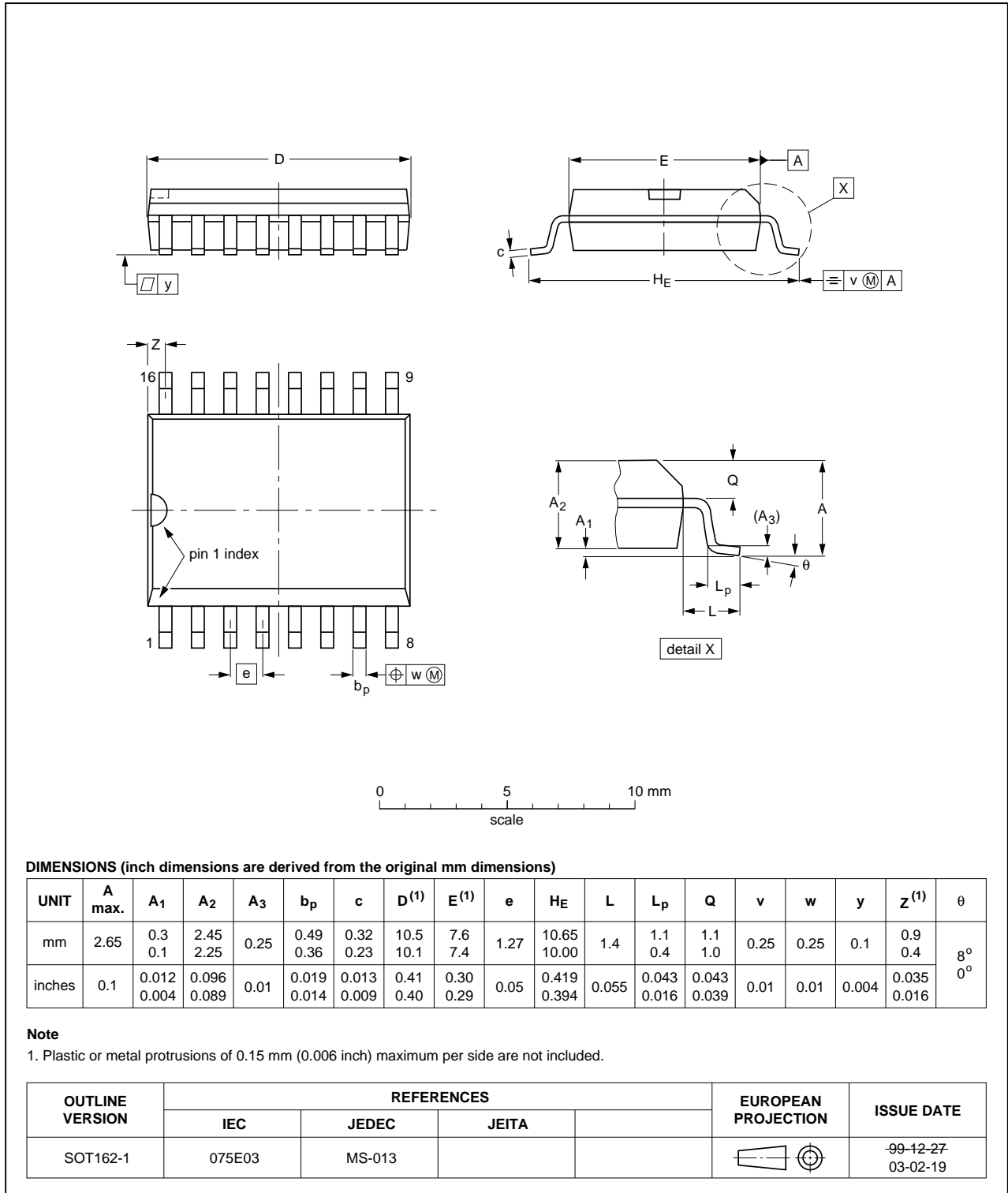


Fig 10. Package outline SOT162-1 (SO16)

## 13. Revision history

**Table 11. Revision history**

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF4517B v.7	20111111	Product data sheet	-	HEF4517B v.6
Modifications:	<ul style="list-style-type: none"><li>• Section Applications removed</li><li>• <a href="#">Table 6</a>: I<sub>OH</sub> minimum values changed to maximum</li><li>• <a href="#">Figure 8</a>: added "DUT = Device Under Test"</li></ul>			
HEF4517B v.6	20091210	Product data sheet	-	HEF4517B v.5
HEF4517B v.5	20090728	Product data sheet	-	HEF4517B v.4
HEF4517B v.4	20090406	Product data sheet	-	HEF4517B_CNV v.3
HEF4517B_CNV v.3	19950101	Product specification	-	HEF4517B_CNV v.2
HEF4517B_CNV v.2	19950101	Product specification	-	-

## 14. Legal information

### 14.1 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.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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## 16. Contents

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