

# HEF40244B

## Octal buffers with 3-state outputs

Rev. 4 — 29 June 2018

Product data sheet

## 1 General description

The HEF40244B is an octal non-inverting buffer with 3-state outputs. It features output stages with high current output capability suitable for driving highly capacitive loads.

The 3-state outputs are controlled by the output enable inputs  $\overline{EOA}$  and  $\overline{EOB}$ . A HIGH on  $\overline{EOA}$  or  $\overline{EOB}$  causes the outputs to assume a high impedance OFF-state. The device also features hysteresis on all inputs to improve noise immunity.

Schmitt-trigger action in the inputs makes the circuit highly tolerant to slower input rise and fall times.

## 2 Features and benefits

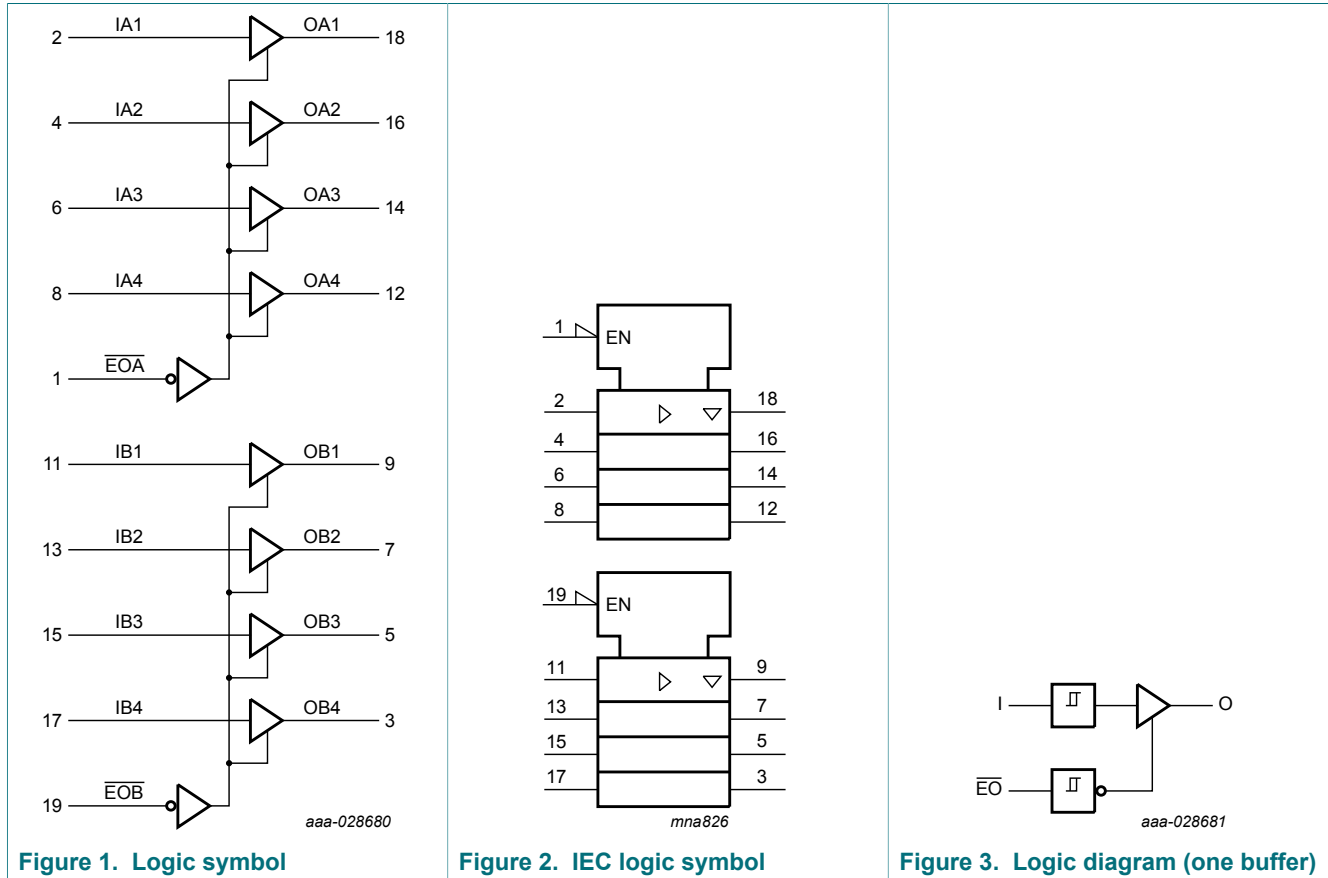
- Octal bus interface
- 3-state buffers
- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$

## 3 Ordering information

Table 1. Ordering information

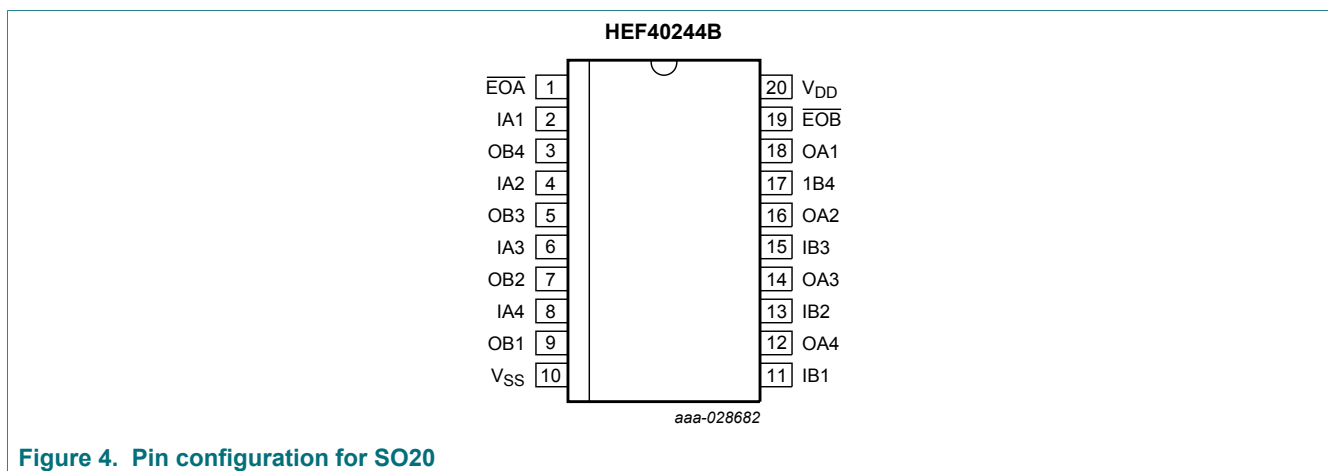
Type number	Package			
	Temperature range	Name	Description	Version
HEF40244BT	$-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1

## 4 Functional diagram



## 5 Pinning information

### 5.1 Pinning



## 5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$\overline{EOA}$ , $\overline{EOB}$	1, 19	output enable inputs (active low)
IA1, IA2, IA3, IA4	2, 4, 6, 8	data inputs
OA1, OA2, OA3, OA4	18, 16, 14, 12	data outputs
IB1, IB2, IB3, IB4	11, 13, 15, 17	data inputs
OB1, OB2, OB3, OB4	9, 7, 5, 3	data outputs
$V_{SS}$	10	ground supply voltage
$V_{DD}$	20	supply voltage

## 6 Functional description

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

Control	Input	Output
$\overline{EOA}$ or $\overline{EOB}$	IAn or IBn	OAn or OBn
L	L	L
L	H	H
H	X	Z

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

## 7 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
$V_I$	input voltage		-0.5	$V_{DD} + 0.5$	V
$I_{DD}$	supply current		-	±100	mA
$I_{IK}$	input clamping current		-	±10	mA
$I_{OK}$	output clamping current		-	±25	mA
$T_{stg}$	storage temperature		-65	+150	°C
$T_{amb}$	ambient temperature		-40	+85	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40\text{ °C to }+85\text{ °C}$			
		SO20 package <sup>[1]</sup>	-	500	mW
P	power dissipation	per output	-	100	mW

[1] For SO20 package:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.

## 8 Recommended operating conditions

Table 5. Operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit
$V_{DD}$	supply voltage	referenced to $V_{SS}$ (usually ground)	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	$T_{amb} = -40\text{ °C}$			$T_{amb} = 25\text{ °C}$			$T_{amb} = 85\text{ °C}$		Unit
			$V_{DD}$	Min	Max	Min	Typ	Max	Min	Max	
$V_{IH}$	HIGH-level input voltage	$ I_O  < 1\ \mu\text{A}$									
		$V_O = 0.5\text{ V}$ or $4.5\text{ V}$	5 V	3.5	-	3.5	-	-	3.5	-	V
		$V_O = 1.0\text{ V}$ or $9.0\text{ V}$	10 V	7.0	-	7.0	-	-	7.0	-	V
		$V_O = 1.5\text{ V}$ or $13.5\text{ V}$	15 V	11.0	-	11.0	-	-	11.0	-	V
$V_{IL}$	LOW-level input voltage	$ I_O  < 1\ \mu\text{A}$									
		$V_O = 0.5\text{ V}$ or $4.5\text{ V}$	5 V	-	1.5	-	-	1.5	-	1.5	V
		$V_O = 1.0\text{ V}$ or $9.0\text{ V}$	10 V	-	3.0	-	-	3.0	-	3.0	V
		$V_O = 1.5\text{ V}$ or $13.5\text{ V}$	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	see <a href="#">Figure 5</a> and <a href="#">Figure 6</a>									
		$V_{OH} = 3.6\text{ V}$	5 V	-9.3	-	-10	-24	-	-10.7	-	mA
		$V_{OH} = 4.6\text{ V}$	5 V	-0.75	-	-0.6	-1.2	-	-0.45	-	mA
		$V_{OH} = 8.4\text{ V}$	10 V	-14.4	-	-15	-46	-	-15	-	mA
		$V_{OH} = 9.5\text{ V}$	10 V	-1.85	-	-1.5	-3.0	-	-1.1	-	mA
		$V_{OH} = 13.2\text{ V}$	15 V	-19.5	-	-20	-62	-	-19.8	-	mA
	$V_{OH} = 13.5\text{ V}$	15 V	-14.5	-	-15	-50	-	-15.5	-	mA	

Symbol	Parameter	Conditions	T <sub>amb</sub> = -40 °C			T <sub>amb</sub> = 25 °C			T <sub>amb</sub> = 85 °C		Unit
			V <sub>DD</sub>	Min	Max	Min	Typ	Max	Min	Max	
I <sub>OL</sub>	LOW-level output current	V <sub>OL</sub> = 0.4 V	5 V	2.9	-	2.3	5.4	-	1.75	-	mA
		V <sub>OL</sub> = 0.5 V	10 V	9.5	-	7.6	17	-	5.5	-	mA
		V <sub>OL</sub> = 1.5 V	15 V	30.0	-	25	45	-	19.0	-	mA
I <sub>I</sub>	input leakage current	[1]	15 V	-	±0.3	-	-	±0.3	-	±1.0	µA
I <sub>OZ</sub>	OFF-state output current	V <sub>O</sub> = V <sub>DD</sub>	15 V	-	1.6	-	-	1.6	-	12.0	µA
		V <sub>O</sub> = V <sub>SS</sub>	15 V	-	-1.6	-	-	-1.6	-	-12.0	µA
I <sub>DD</sub>	supply current	I <sub>O</sub> = 0 A	5 V	-	4.0	-	-	4.0	-	30	µA
			10 V	-	8.0	-	-	8.0	-	60	µA
			15 V	-	16.0	-	-	16.0	-	120	µA
V <sub>H</sub>	hysteresis voltage		5 V	-	-	-	220	-	-	-	mV
			10 V	-	-	-	250	-	-	-	mV
			15 V	-	-	-	320	-	-	-	mV
C <sub>I</sub>	input capacitance			-	-	-	7.5	-	-	-	pF

[1] Unused inputs must be connected to V<sub>DD</sub>, V<sub>SS</sub> or another input.

## 10 Dynamic characteristics

**Table 7. Dynamic characteristics**

V<sub>SS</sub> = 0 V; T<sub>amb</sub> = 25 °C; unless otherwise specified; for waveform and test circuit, see [Figure 10](#).

Symbol	Parameter	Conditions	Extrapolation formula	Min	Typ	Max	Unit
t <sub>PHL</sub>	HIGH to LOW propagation delay	I <sub>AN</sub> to O <sub>AN</sub> ; I <sub>BN</sub> to O <sub>BN</sub> ; see <a href="#">Figure 7</a> . [1]					
		V <sub>DD</sub> = 5 V	83 ns + (0.24 ns/pF)C <sub>L</sub>	-	95	190	ns
		V <sub>DD</sub> = 10 V	35 ns + (0.10 ns/pF)C <sub>L</sub>	-	40	80	ns
		V <sub>DD</sub> = 15 V	26 ns + (0.07 ns/pF)C <sub>L</sub>	-	30	60	ns
t <sub>PLH</sub>	LOW to HIGH propagation delay	I <sub>AN</sub> to O <sub>AN</sub> ; I <sub>BN</sub> to O <sub>BN</sub> ; see <a href="#">Figure 7</a> . [1]					
		V <sub>DD</sub> = 5 V	82 ns + (0.06 ns/pF)C <sub>L</sub>	-	85	170	ns
		V <sub>DD</sub> = 10 V	38 ns + (0.03 ns/pF)C <sub>L</sub>	-	40	80	ns
		V <sub>DD</sub> = 15 V	29 ns + (0.02 ns/pF)C <sub>L</sub>	-	30	60	ns

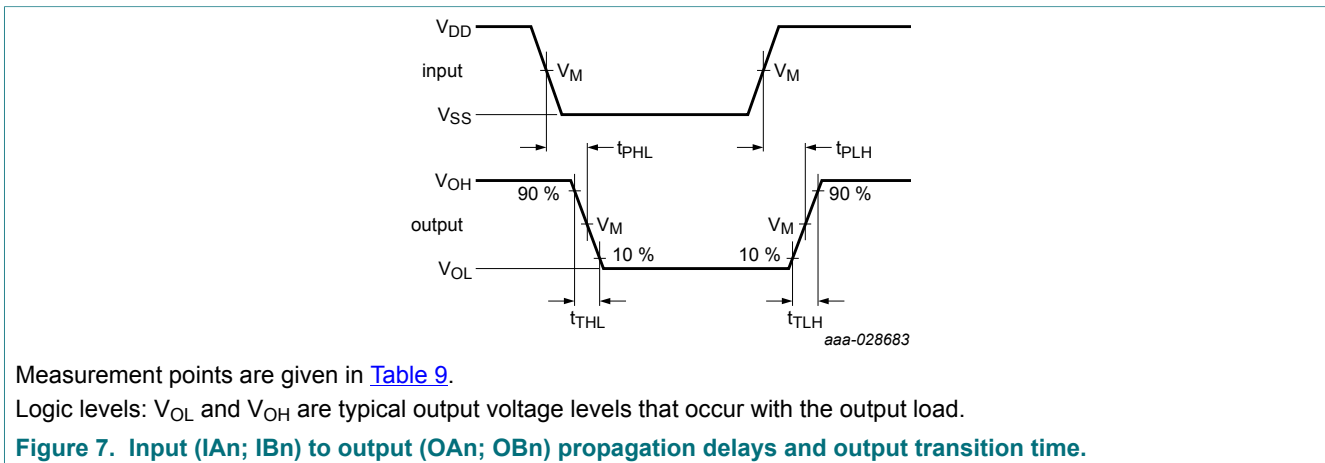
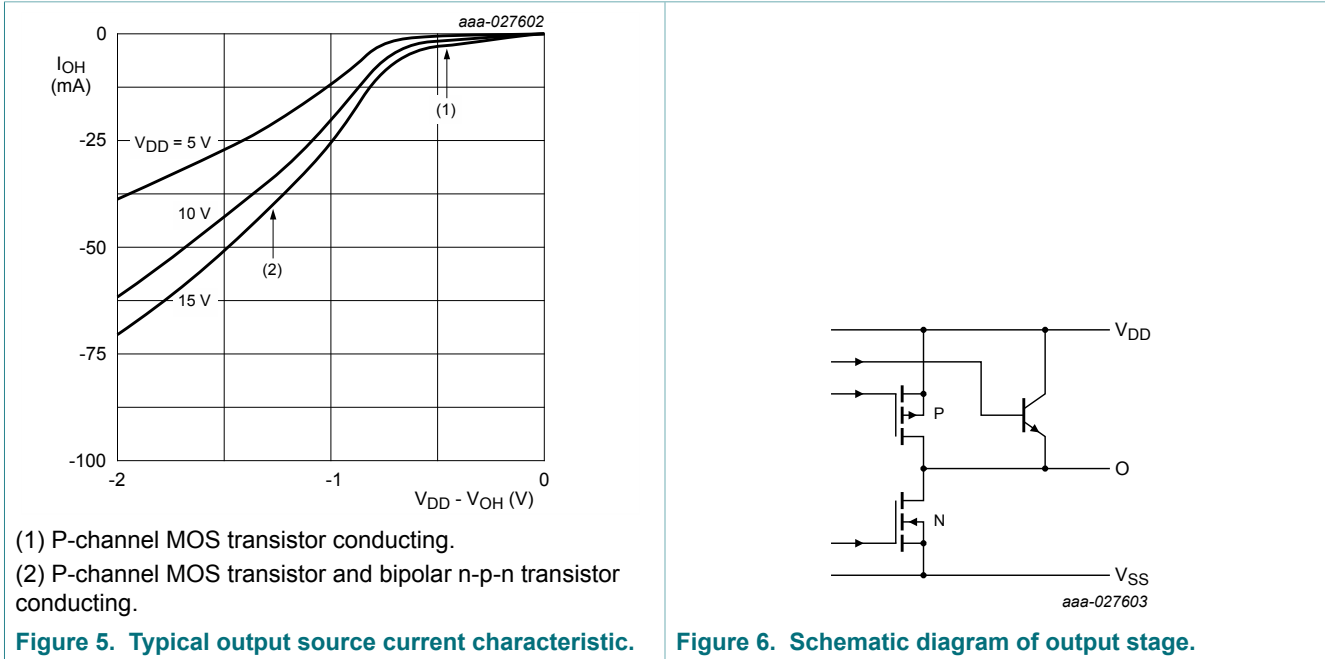
Symbol	Parameter	Conditions	Extrapolation formula	Min	Typ	Max	Unit
t <sub>PZH</sub>	OFF-state to HIGH propagation delay	EOA to OAn; EOB to OBn; see <a href="#">Figure 9</a> .					
		V <sub>DD</sub> = 5 V		-	80	160	ns
		V <sub>DD</sub> = 10 V		-	35	70	ns
		V <sub>DD</sub> = 15 V		-	30	60	ns
t <sub>PZL</sub>	OFF-state to LOW propagation delay	EOA to OAn; EOB to OBn; see <a href="#">Figure 9</a> .					
		V <sub>DD</sub> = 5 V		-	90	180	ns
		V <sub>DD</sub> = 10 V		-	40	80	ns
		V <sub>DD</sub> = 15 V		-	30	60	ns
t <sub>PHZ</sub>	HIGH to OFF-state propagation delay	EOA to OAn; EOB to OBn; see <a href="#">Figure 9</a> .					
		V <sub>DD</sub> = 5 V		-	70	140	ns
		V <sub>DD</sub> = 10 V		-	35	70	ns
		V <sub>DD</sub> = 15 V		-	30	60	ns
t <sub>PLZ</sub>	LOW to OFF-state propagation delay	EOA to OAn; EOB to OBn; see <a href="#">Figure 9</a> .					
		V <sub>DD</sub> = 5 V		-	75	150	ns
		V <sub>DD</sub> = 10 V		-	40	80	ns
		V <sub>DD</sub> = 15 V		-	30	60	ns
t <sub>THL</sub>	HIGH to LOW output transition time	OAn; OBn; see <a href="#">Figure 7</a> and <a href="#">Figure 8</a> .					
		V <sub>DD</sub> = 5 V		-	40	80	ns
		V <sub>DD</sub> = 10 V		-	20	40	ns
		V <sub>DD</sub> = 15 V		-	15	30	ns
t <sub>TLH</sub>	LOW to HIGH output transition time	OAn; OBn; see <a href="#">Figure 7</a> and <a href="#">Figure 8</a> .					
		V <sub>DD</sub> = 5 V		-	30	60	ns
		V <sub>DD</sub> = 10 V		-	20	40	ns
		V <sub>DD</sub> = 15 V		-	15	30	ns

[1] The typical values of the propagation delay are calculated from the extrapolation formulas shown (C<sub>L</sub> in pF).

**Table 8. Dynamic power dissipation**

Symbol	Parameter	V <sub>DD</sub>	Typical formula	where:
P <sub>D</sub>	dynamic power dissipation	5 V	$P_D = 4250 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW)	f <sub>i</sub> = input frequency in MHz; f <sub>o</sub> = output frequency in MHz; C <sub>L</sub> = output load capacitance in pF; Σ(f <sub>o</sub> × C <sub>L</sub> ) = sum of the outputs; V <sub>DD</sub> = supply voltage in V.
		10 V	$P_D = 17000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW)	
		15 V	$P_D = 46000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW)	

10.1 Waveforms and test circuit



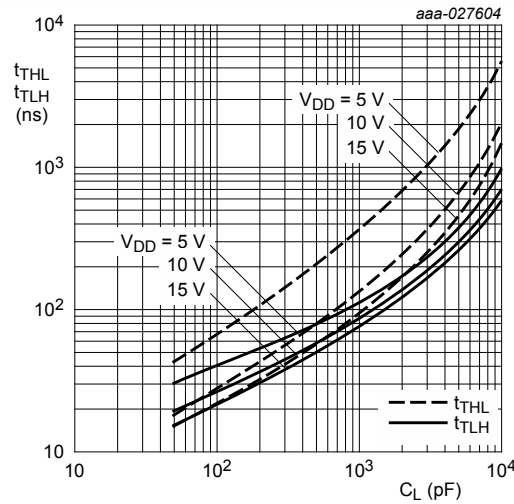
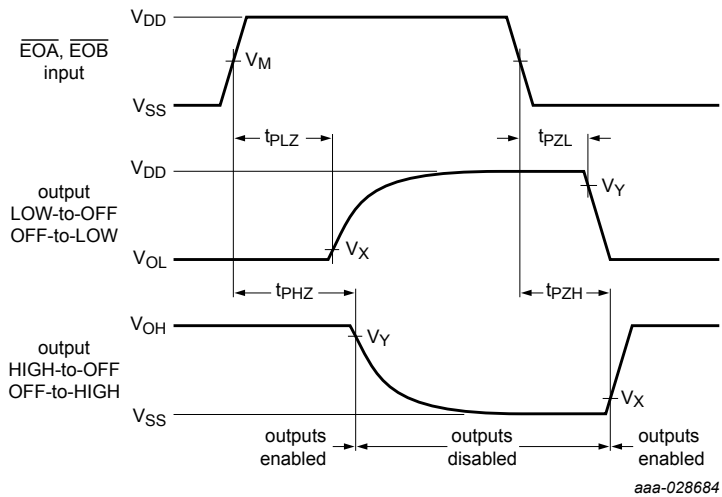


Figure 8. Output transition times as a function of the load capacitance



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

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

Figure 9. 3-state enable and disable times

Table 9. Measurement points

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

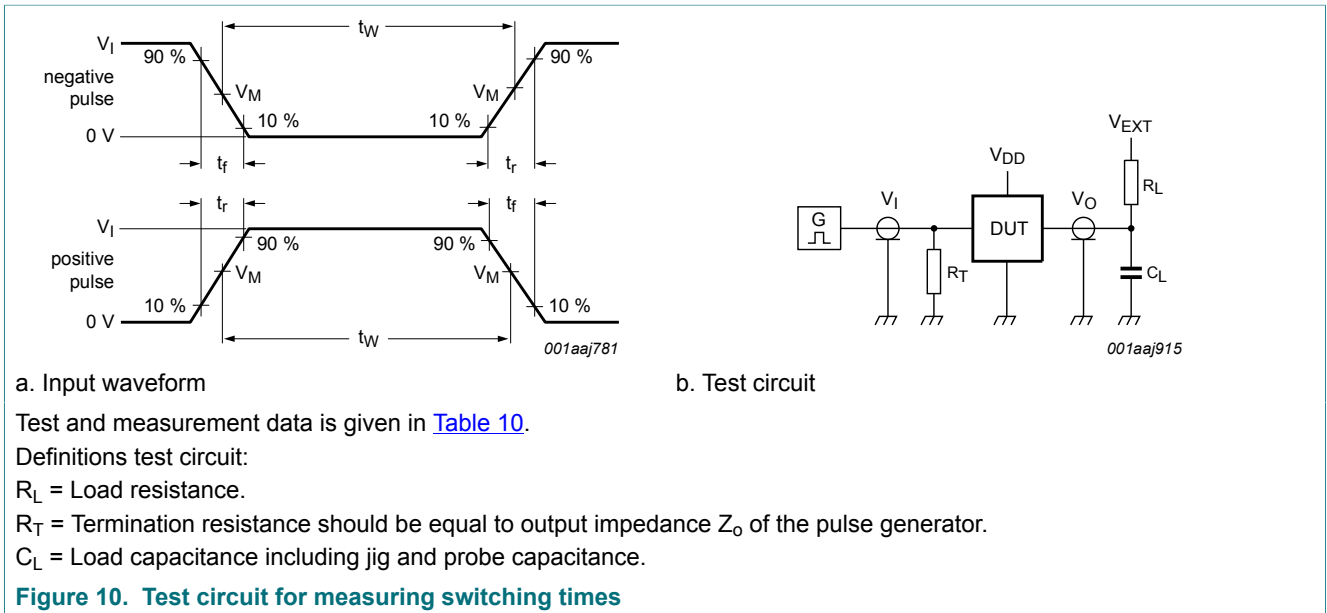


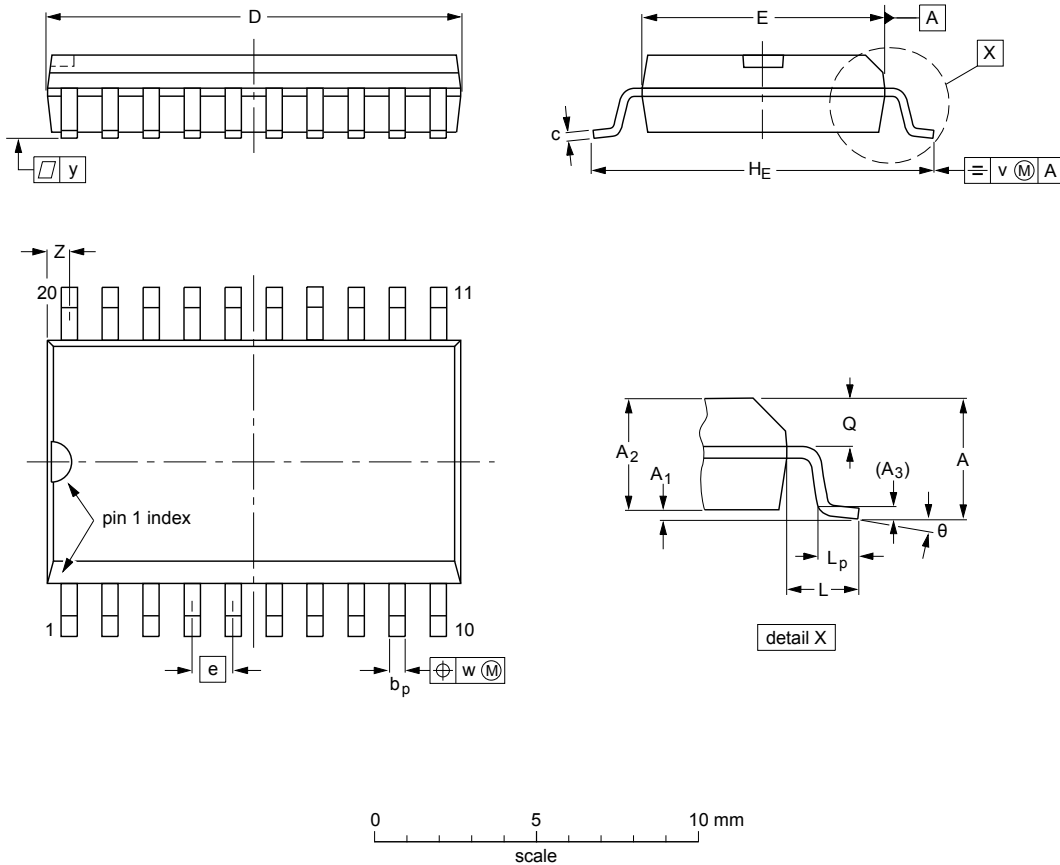
Table 10. Test data

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

11 Package outline

SO20: plastic small outline package; 20 leads; body width 7.5 mm

SOT163-1



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	2.65	0.3 0.1	2.45 2.25	0.25	0.49 0.36	0.32 0.23	13.0 12.6	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.1	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.51 0.49	0.30 0.29	0.05	0.419 0.394	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA		
SOT163-1	075E04	MS-013			99-12-27 03-02-19

Figure 11. Package outline SOT163-1 (SO20)

## 12 Abbreviations

Table 11. Abbreviations

Acronym	Description
DUT	Device Under Test

## 13 Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF40244B v.4	20180629	Product data sheet	-	HEF40244B v.3
Modifications:	<ul style="list-style-type: none"><li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li><li>Legal texts have been adapted to the new company name where appropriate.</li></ul>			
HEF40244B v.3	19950101	Product specification	-	HEF40244B v.2
HEF40244B v.2	19950101	Product specification	-	HEF40244B v.1

## 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".

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Please be aware that important notices concerning this document and the product(s) described herein, have been included in section 'Legal information'.

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