



HEF40244B-Q100

Octal buffers with 3-state outputs

Rev. 1 — 20 October 2023

Product data sheet

1. General description

The HEF40244B-Q100 is an 8-bit buffer/line driver with 3-state outputs. The device can be used as two 4-bit buffers or one 8-bit buffer. The device features two output enables (1 $\overline{O}E$ and 2 $\overline{O}E$), each controlling four of the 3-state outputs. A HIGH on n $\overline{O}E$ causes the outputs to assume a high-impedance OFF-state. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 3) and is suitable for use in automotive applications.

2. Features and benefits

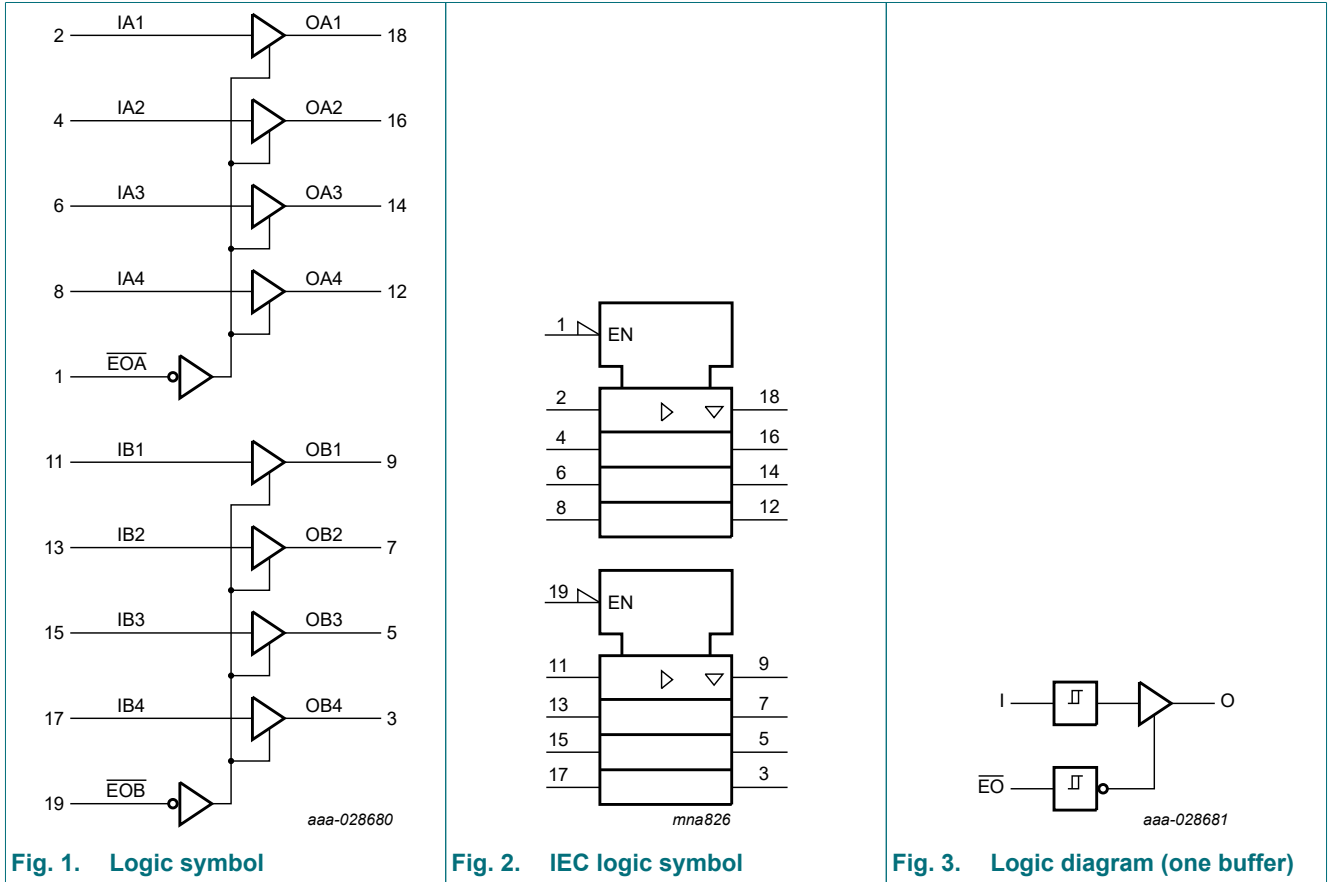
- Automotive product qualification in accordance with AEC-Q100 (Grade 3)
 - Specified from -40 °C to +85 °C
- Wide supply voltage range from 3.0 to 15.0 V
- CMOS low power dissipation
- High noise immunity
- Complies with JEDEC standard JESD 13-B
- ESD protection
 - HBM ANSI/ESDA/JEDEC JS-001 exceeds 2000 V
 - MM EIA/JESD22-A115-A exceeds 200 V

3. Ordering information

Table 1. Ordering information

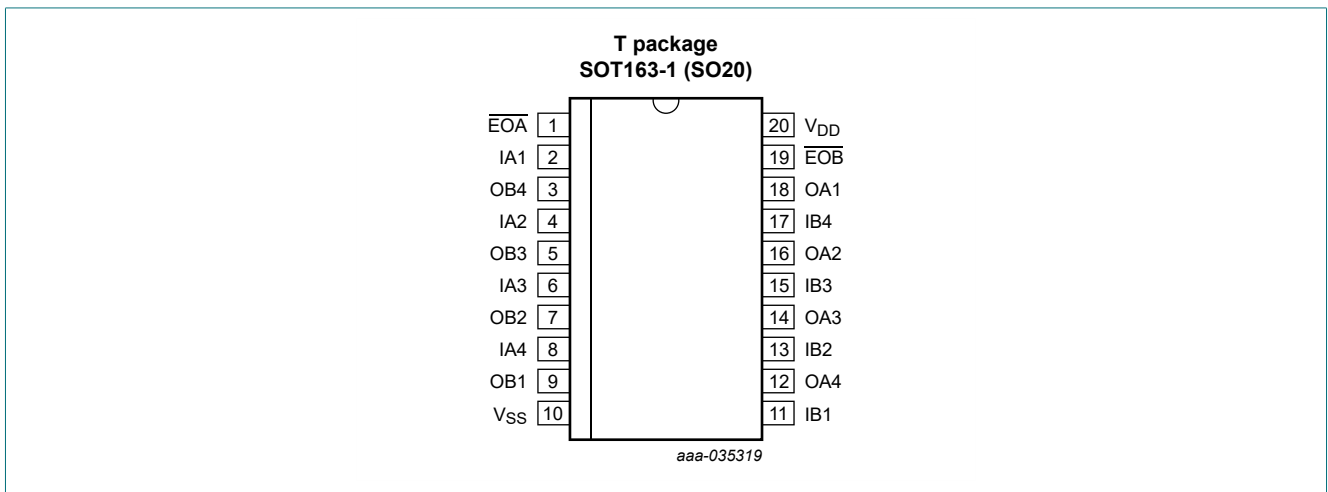
Type number	Package			
	Temperature range	Name	Description	Version
HEF40244BT-Q100	-40 °C to +85 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1

4. Functional diagram



5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
EOA, 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

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

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

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 °C to +85 °C	-	500	mW
P	power dissipation	per output	-	100	mW

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_{O1} < 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_{O1} < 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_{O1} < 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_{O1} < 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 Fig. 4 and Fig. 5									
		$V_{OH} = 3.6\text{ V}$	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
I_{OL}	LOW-level output current	$V_{OL} = 0.4\text{ V}$	5 V	2.9	-	2.3	5.4	-	1.75	-	mA
		$V_{OL} = 0.5\text{ V}$	10 V	9.5	-	7.6	17	-	5.5	-	mA
		$V_{OL} = 1.5\text{ V}$	15 V	30.0	-	25	45	-	19.0	-	mA
I_I	input leakage current	[1] 15 V	-	± 0.3	-	-	± 0.3	-	± 1.0	μA	
I_{OZ}	OFF-state output current	$V_O = V_{DD}$	15 V	-	1.6	-	-	1.6	-	12.0	μA
		$V_O = V_{SS}$	15 V	-	-1.6	-	-	-1.6	-	-12.0	μA

Symbol	Parameter	Conditions	$T_{amb} = -40\text{ }^{\circ}\text{C}$		$T_{amb} = 25\text{ }^{\circ}\text{C}$			$T_{amb} = 85\text{ }^{\circ}\text{C}$		Unit	
			V_{DD}	Min	Max	Min	Typ	Max	Min		Max
I_{DD}	supply current	$I_O = 0\text{ A}$	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_H	hysteresis voltage		5 V	-	-	-	220	-	-	-	mV
			10 V	-	-	-	250	-	-	-	mV
			15 V	-	-	-	320	-	-	-	mV
C_i	input capacitance			-	-	-	7.5	-	-	pF	

[1] Unused inputs must be connected to V_{DD} , V_{SS} or another input.

10. Dynamic characteristics

Table 7. Dynamic characteristics

$V_{SS} = 0\text{ V}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$; unless otherwise specified; for waveform and test circuit, see Fig. 9.

Symbol	Parameter	Conditions	Extrapolation formula	Min	Typ	Max	Unit
t_{PHL}	HIGH to LOW propagation delay	I_{An} to O_{An} ; I_{Bn} to O_{Bn} ; [1] see Fig. 6.					
		$V_{DD} = 5\text{ V}$	$83\text{ ns} + (0.24\text{ ns/pF})C_L$	-	95	190	ns
		$V_{DD} = 10\text{ V}$	$35\text{ ns} + (0.10\text{ ns/pF})C_L$	-	40	80	ns
		$V_{DD} = 15\text{ V}$	$26\text{ ns} + (0.07\text{ ns/pF})C_L$	-	30	60	ns
t_{PLH}	LOW to HIGH propagation delay	I_{An} to O_{An} ; I_{Bn} to O_{Bn} ; [1] see Fig. 6.					
		$V_{DD} = 5\text{ V}$	$82\text{ ns} + (0.06\text{ ns/pF})C_L$	-	85	170	ns
		$V_{DD} = 10\text{ V}$	$38\text{ ns} + (0.03\text{ ns/pF})C_L$	-	40	80	ns
		$V_{DD} = 15\text{ V}$	$29\text{ ns} + (0.02\text{ ns/pF})C_L$	-	30	60	ns
t_{PZH}	OFF-state to HIGH propagation delay	\overline{EOA} to O_{An} ; \overline{EOB} to O_{Bn} ; see Fig. 8.					
		$V_{DD} = 5\text{ V}$		-	80	160	ns
		$V_{DD} = 10\text{ V}$		-	35	70	ns
		$V_{DD} = 15\text{ V}$		-	30	60	ns
t_{PZL}	OFF-state to LOW propagation delay	\overline{EOA} to O_{An} ; \overline{EOB} to O_{Bn} ; see Fig. 8.					
		$V_{DD} = 5\text{ V}$		-	90	180	ns
		$V_{DD} = 10\text{ V}$		-	40	80	ns
		$V_{DD} = 15\text{ V}$		-	30	60	ns
t_{PHZ}	HIGH to OFF-state propagation delay	\overline{EOA} to O_{An} ; \overline{EOB} to O_{Bn} ; see Fig. 8.					
		$V_{DD} = 5\text{ V}$		-	70	140	ns
		$V_{DD} = 10\text{ V}$		-	35	70	ns
		$V_{DD} = 15\text{ V}$		-	30	60	ns
t_{PLZ}	LOW to OFF-state propagation delay	\overline{EOA} to O_{An} ; \overline{EOB} to O_{Bn} ; see Fig. 8.					
		$V_{DD} = 5\text{ V}$		-	75	150	ns
		$V_{DD} = 10\text{ V}$		-	40	80	ns
		$V_{DD} = 15\text{ V}$		-	30	60	ns

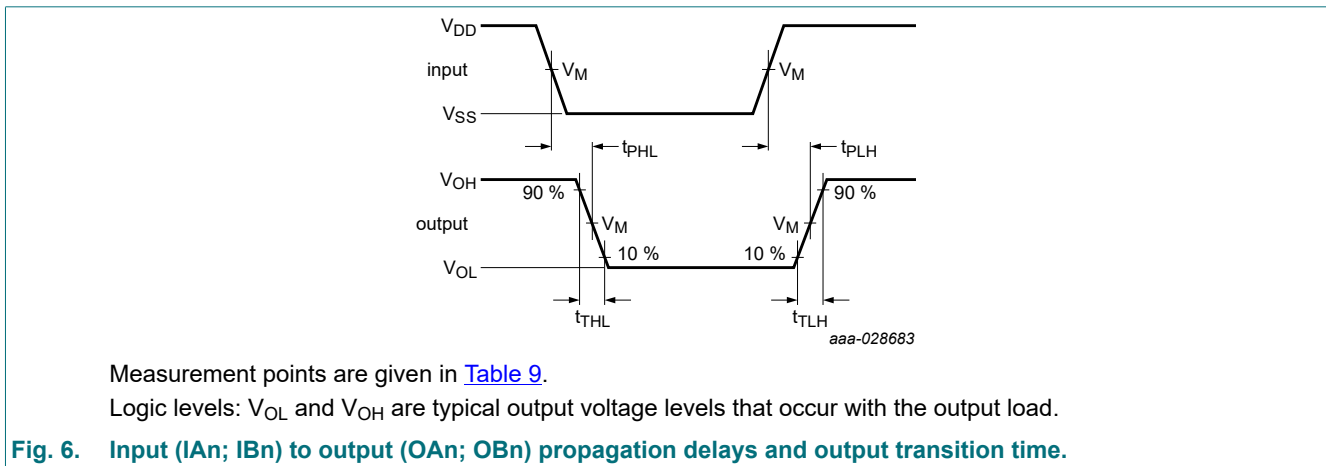
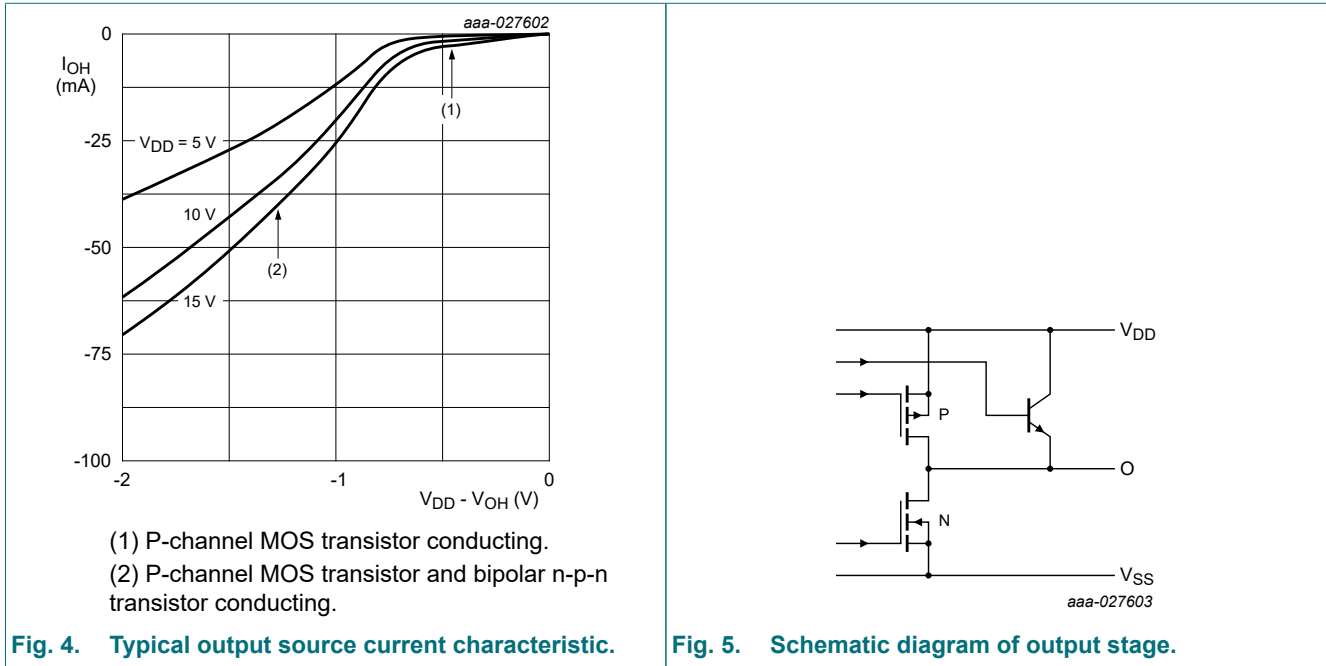
Symbol	Parameter	Conditions	Extrapolation formula	Min	Typ	Max	Unit
t _{THL}	HIGH to LOW output transition time	OAn; OBn; see Fig. 6 and Fig. 7.					
		V _{DD} = 5 V		-	40	80	ns
		V _{DD} = 10 V		-	20	40	ns
t _{TLH}	LOW to HIGH output transition time	OAn; OBn; see Fig. 6 and Fig. 7.					
		V _{DD} = 5 V		-	30	60	ns
		V _{DD} = 10 V		-	20	40	ns
		V _{DD} = 15 V		-	15	30	ns

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

Table 8. Dynamic power dissipation

Symbol	Parameter	V _{DD}	Typical formula	where:
P _D	dynamic power dissipation	5 V	$P_D = 4250 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW)	f _i = input frequency in MHz; f _o = output frequency in MHz; C _L = output load capacitance in pF; Σ(f _o × C _L) = sum of the outputs; V _{DD} = 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



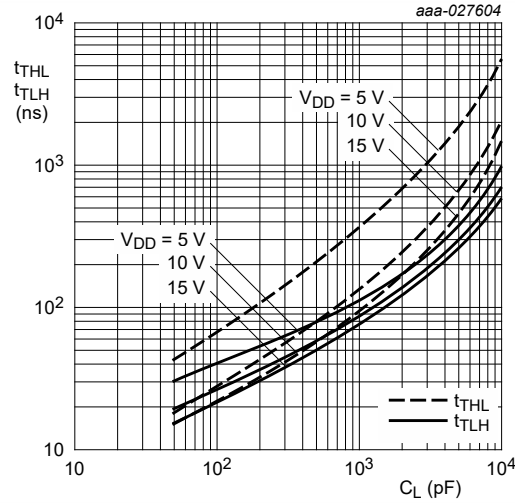
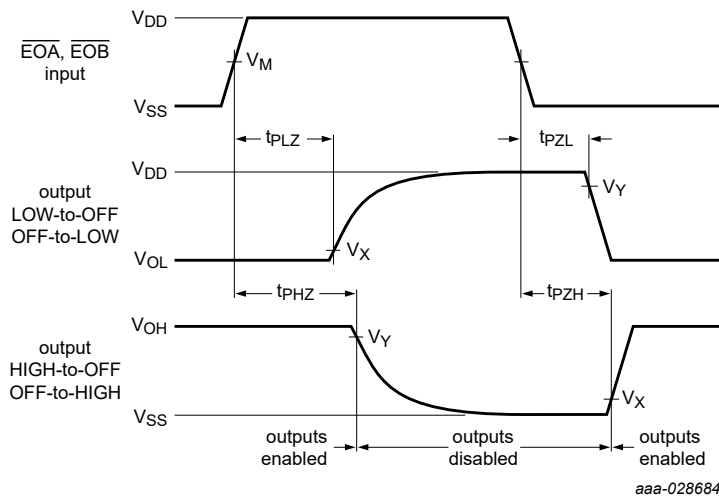


Fig. 7. Output transition times as a function of the load capacitance



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.

Fig. 8. 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	$0.5 \times V_{DD}$	$0.5 \times V_{DD}$	$0.1 \times V_{DD}$	$0.9 \times V_{DD}$

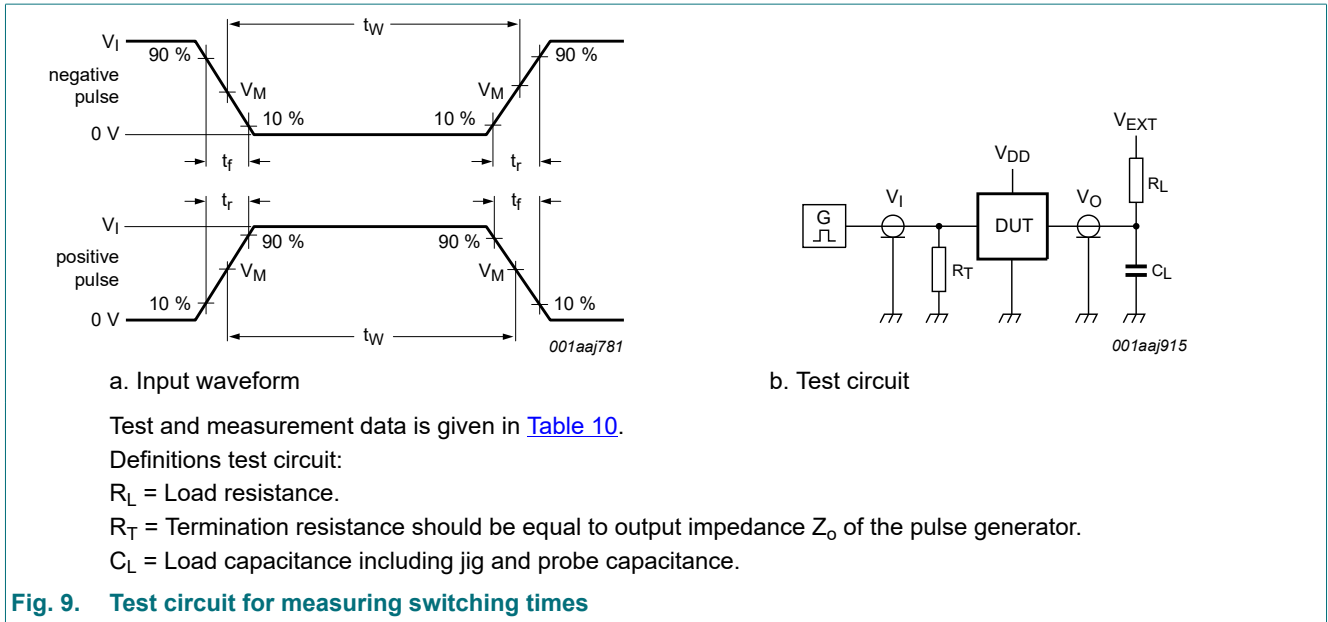


Table 10. Test data

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}	≤ 20 ns	50 pF	1 k Ω	open	V_{SS}	V_{DD}

11. Package outline

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

SOT163-1

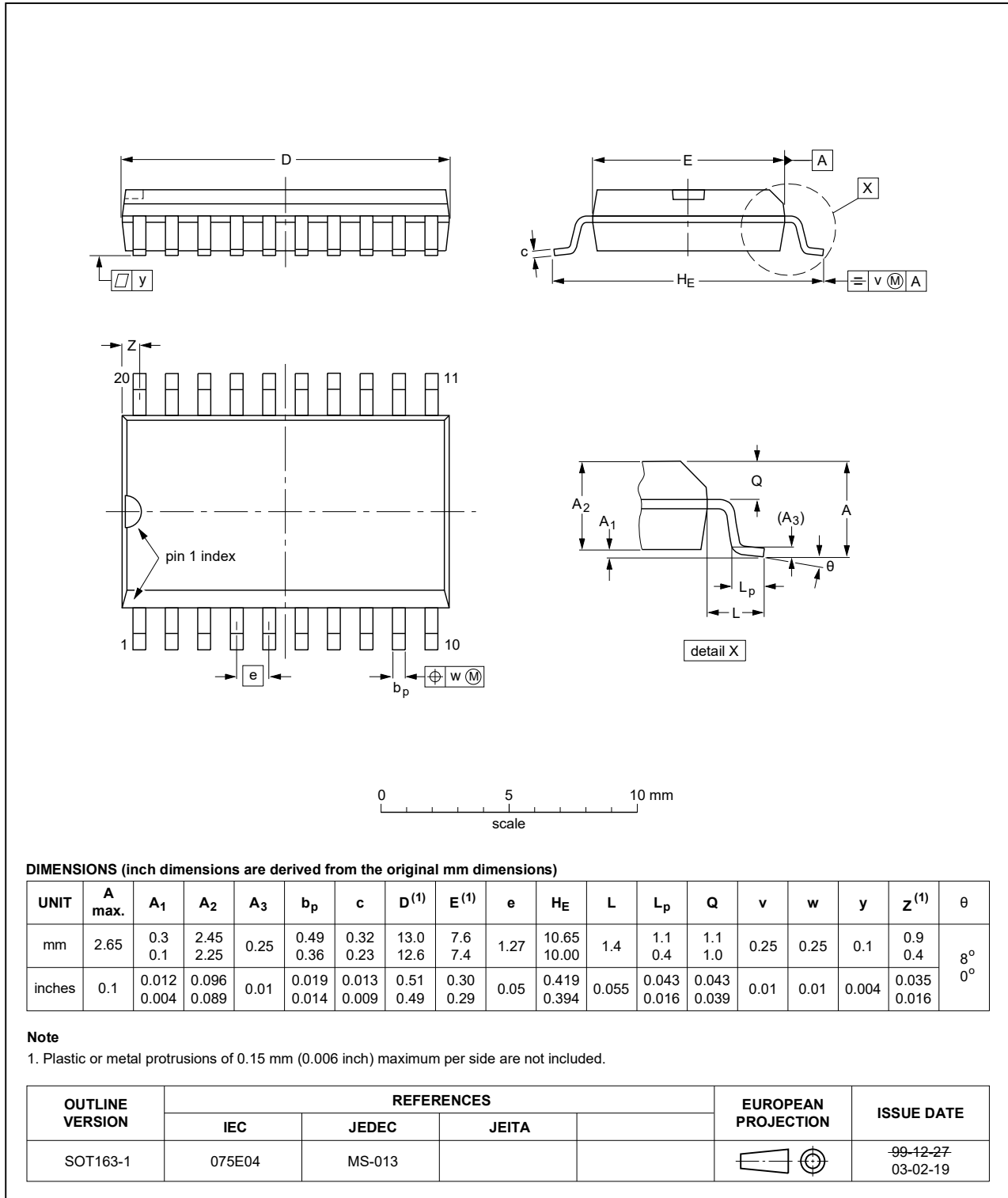


Fig. 10. Package outline SOT163-1 (SO20)

12. 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

13. Revision history

Table 12. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
HEF40244B_Q100 v.1	20231020	Product data sheet	-	-

14. Legal information

Data sheet status

Document status [1][2]	Product status [3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
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