

74CBTLVD3244

8-bit level-shifting bus switch with 4-bit output enables

Rev. 3 — 5 April 2019

Product data sheet

1. General description

The 74CBTLVD3244 is a dual 4-pole, single-throw bus switch. The device features two output enable inputs ($n\overline{OE}$) that each control four switch channels. The switches are disabled when the associated $n\overline{OE}$ input is HIGH. Schmitt trigger action at control inputs makes the circuit tolerant of slower input rise and fall times. This device is fully specified for partial power-down applications using I_{OFF} . The I_{OFF} circuitry disables the output, preventing the damaging backflow current through the device when it is powered down.

2. Features and benefits

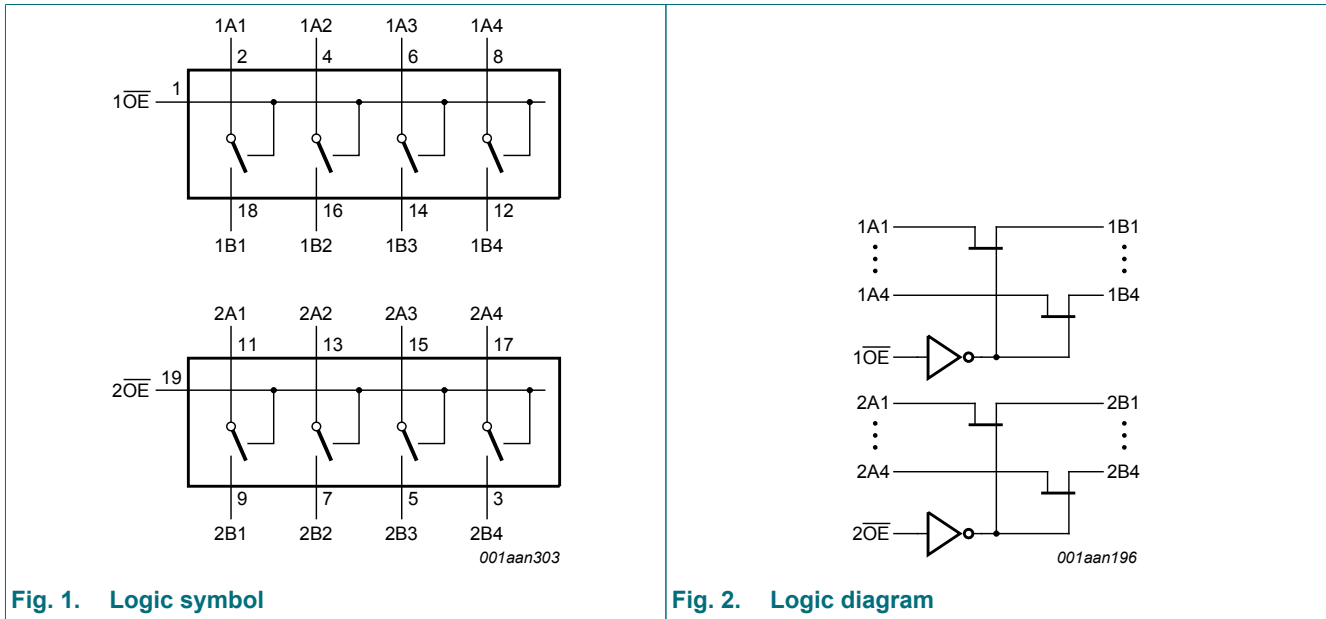
- Supply voltage range from 3.0 V to 3.6 V
- High noise immunity
- Complies with JEDEC standard:
 - JESD8-B/JESD36 (3.0 V to 3.6 V)
- ESD protection:
 - HBM JESD22-A114F exceeds 2000 V
 - CDM AEC-Q100-011 revision B exceeds 1000 V
- 5 Ω switch connection between two ports
- Rail to rail switching on data I/O ports
- CMOS low power consumption
- Latch-up performance exceeds 250 mA per JESD78B Class I level A
- I_{OFF} circuitry provides partial Power-down mode operation
- Multiple package options
- Specified from -40 °C to +85 °C and -40 °C to +125 °C

3. Ordering information

Table 1. Ordering information

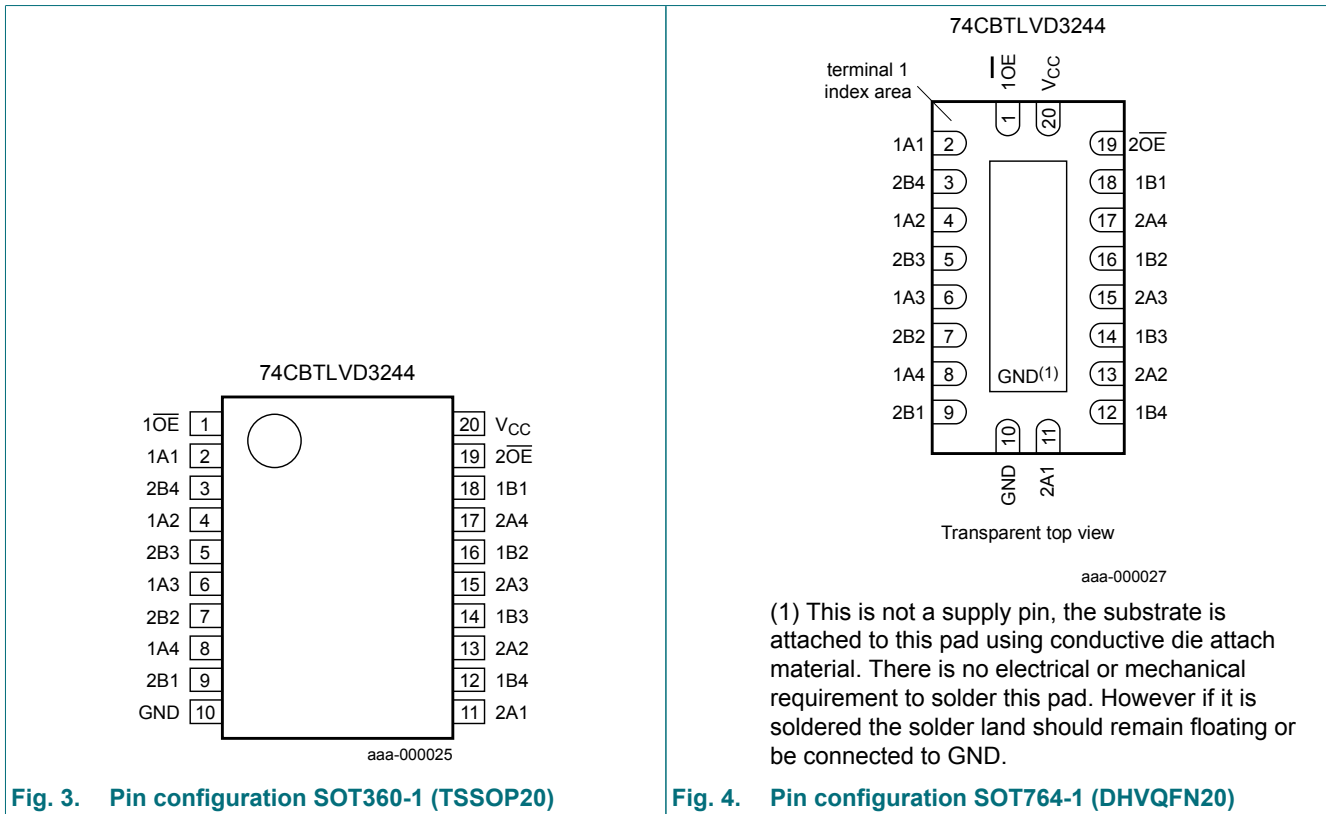
Type number	Package			
	Temperature range	Name	Description	Version
74CBTLVD3244PW	-40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1
74CBTLVD3244BQ	-40 °C to +125 °C	DHVQFN20	plastic dual-in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body 2.5 × 4.5 × 0.85 mm	SOT764-1

4. Functional diagram



5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
$1\overline{OE}$, $2\overline{OE}$	1, 19	output enable input (active LOW)
1A1 to 1A4	2, 4, 6, 8	data input/output (A port)
2B1 to 2B4	9, 7, 5, 3	data input/output (B port)
GND	10	ground (0 V)
2A1 to 2A4	11, 13, 15, 17	data input/output (A port)
1B1 to 1B4	18, 16, 14, 12	data input/output (B port)
V_{CC}	20	positive supply voltage

6. Functional description

Table 3. Function selection

H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state.

Input	Input/output
$n\overline{OE}$	nAn, nBn
L	nAn = nBn
H	Z

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		-0.5	+4.6	V
V_I	input voltage		[1] -0.5	+4.6	V
V_{SW}	switch voltage	enable and disable mode	[1] -0.5	$V_{CC} + 0.5$	V
I_{IK}	input clamping current	$V_{IO} < -0.5$ V	-50	-	mA
I_{SK}	switch clamping current	$V_I < -0.5$ V	-50	-	mA
I_{SW}	switch current	$V_{SW} = 0$ V to V_{CC}	-	±128	mA
I_{CC}	supply current		-	+100	mA
I_{GND}	ground current		-100	-	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	total power dissipation	$T_{amb} = -40$ °C to +125 °C	[2] -	500	mW

[1] The minimum input and output voltage ratings may be exceeded if the input and output current ratings are observed.

[2] For TSSOP20 packages: above 60 °C the value of P_{tot} derates linearly at 5.5 mW/K.
For DHVQFN20 packages: above 60 °C the value of P_{tot} derates linearly at 4.5 mW/K.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		3.0	3.6	V
V_I	input voltage		0	3.6	V
V_{SW}	switch voltage	enable and disable mode	0	V_{CC}	V
T_{amb}	ambient temperature		-40	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 3.0\text{ V to }3.6\text{ V}$ [1]	0	200	ns/V

[1] Applies to control signal levels.

9. Static characteristics

Table 6. Static characteristics

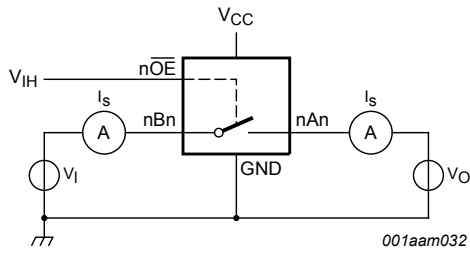
At recommended operating conditions voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	$T_{amb} = -40\text{ °C to }+85\text{ °C}$			$T_{amb} = -40\text{ °C to }+125\text{ °C}$		Unit
			Min	Typ [1]	Max	Min	Max	
V_{IH}	HIGH-level input voltage	$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	2.0	-	-	2.0	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	-	-	0.9	-	0.9	V
I_I	input leakage current	pin \overline{OE} ; $V_I = \text{GND to }V_{CC}$; $V_{CC} = 3.6\text{ V}$	-	-	± 1	-	± 20	μA
V_{pass}	pass voltage	$V_I = V_{CC}$; see Fig. 7 to Fig. 11	-	-	-	-	-	V
$I_{S(OFF)}$	OFF-state leakage current	$V_{CC} = 3.6\text{ V}$; see Fig. 5	-	-	± 1	-	± 20	μA
$I_{S(ON)}$	ON-state leakage current	$V_{CC} = 3.6\text{ V}$; see Fig. 6	-	-	± 1	-	± 20	μA
I_{OFF}	power-off leakage current	V_I or $V_O = 0\text{ V to }3.6\text{ V}$; $V_{CC} = 0\text{ V}$	-	-	± 10	-	± 50	μA
I_{CC}	supply current	$V_I = V_{CC}$; $I_O = 0\text{ A}$; $V_{CC} = 3.6\text{ V}$; $V_{SW} = \text{GND or }V_{CC}$	-	-	20	-	50	μA
		$V_I = \text{GND}$; $I_O = 0\text{ A}$; $V_{CC} = 3.6\text{ V}$; $V_{SW} = \text{GND or }V_{CC}$	-	-	100	-	150	μA
ΔI_{CC}	additional supply current	pin \overline{OE} ; $V_I = V_{CC} - 0.6\text{ V}$; $V_{SW} = \text{GND or }V_{CC}$; $V_{CC} = 3.6\text{ V}$ [2]	-	-	300	-	2000	μA
C_I	input capacitance	pin \overline{OE} ; $V_{CC} = 3.3\text{ V}$; $V_I = 0\text{ V to }3.3\text{ V}$	-	0.9	-	-	-	pF
$C_{S(OFF)}$	OFF-state capacitance	$V_{CC} = 3.3\text{ V}$; $V_I = 0\text{ V to }3.3\text{ V}$	-	2.5	-	-	-	pF
$C_{S(ON)}$	ON-state capacitance	$V_{CC} = 3.3\text{ V}$; $V_I = 0\text{ V to }3.3\text{ V}$	-	9.0	-	-	-	pF

[1] All typical values are measured at $T_{amb} = 25\text{ °C}$.

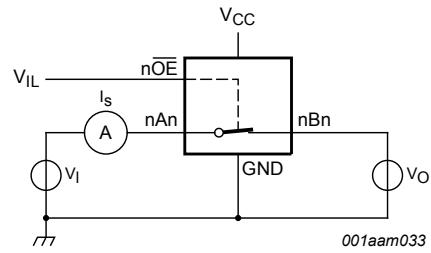
[2] One input at 3 V, other inputs at V_{CC} or GND.

9.1. Test circuits



$V_I = V_{CC}$ or GND and $V_O = GND$ or V_{CC} .

Fig. 5. Test circuit for measuring OFF-state leakage current (one switch)



$V_I = V_{CC}$ or GND and $V_O = \text{open circuit}$.

Fig. 6. Test circuit for measuring ON-state leakage current (one switch)

9.2. Typical pass voltage graphs

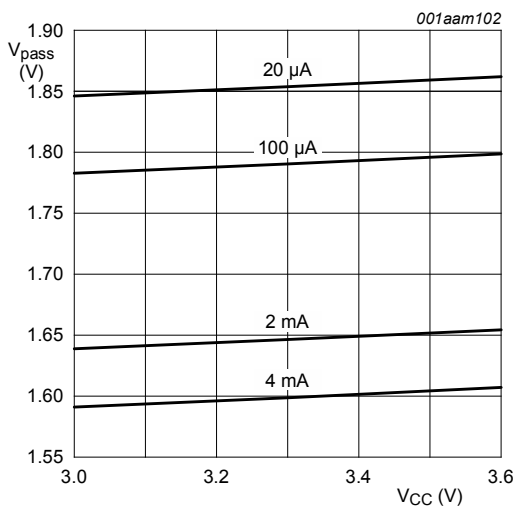


Fig. 7. Pass voltage versus supply voltage; $T_{amb} = 125\text{ °C}$ (typical)

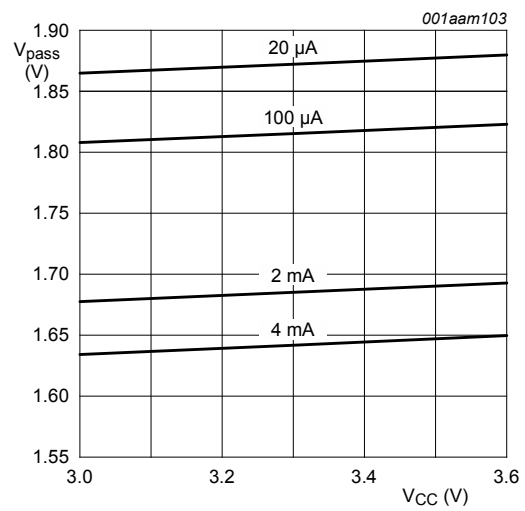


Fig. 8. Pass voltage versus supply voltage; $T_{amb} = 85\text{ °C}$ (typical)

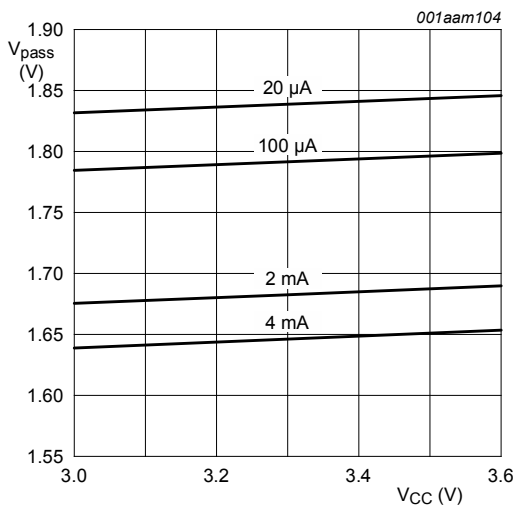


Fig. 9. Pass voltage versus supply voltage; $T_{amb} = 25\text{ °C}$ (typical)

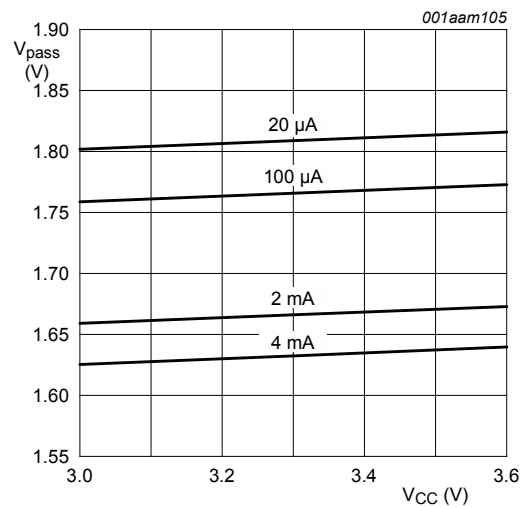


Fig. 10. Pass voltage versus supply voltage; $T_{amb} = 0\text{ °C}$ (typical)

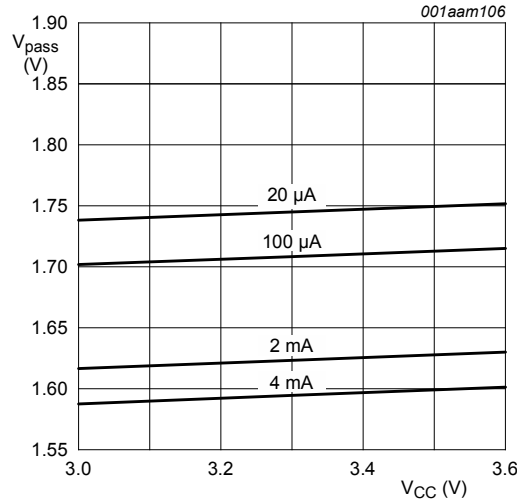


Fig. 11. Pass voltage versus supply voltage; $T_{amb} = -40\text{ °C}$ (typical)

9.3. ON resistance

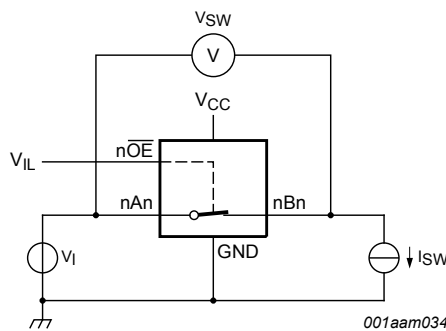
Table 7. Resistance R_{ON}

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 12.

Symbol	Parameter	Conditions	$T_{amb} = -40\text{ °C to }+85\text{ °C}$			$T_{amb} = -40\text{ °C to }+125\text{ °C}$		Unit
			Min	Typ [1]	Max	Min	Max	
R_{ON}	ON resistance	$V_{CC} = 3.0\text{ V to }3.6\text{ V}$ [2]						
		$I_{SW} = 64\text{ mA}; V_I = 0\text{ V}$	-	3.7	7.0	-	10.0	Ω
		$I_{SW} = 24\text{ mA}; V_I = 0\text{ V}$	-	3.7	7.0	-	10.0	Ω
		$I_{SW} = 15\text{ mA}; V_I = 1.2\text{ V}$	-	4.7	10.0	-	12.0	Ω

[1] Typical values are measured at $T_{amb} = 25\text{ °C}$ and nominal V_{CC} .

[2] Measured by the voltage drop between the A and B terminals at the indicated current through the switch. ON-state resistance is determined by the lower of the voltages of the two (A or B) terminals.



$$R_{ON} = V_{SW} / I_{SW}$$

Fig. 12. Test circuit for measuring ON resistance (one switch)

10. Dynamic characteristics

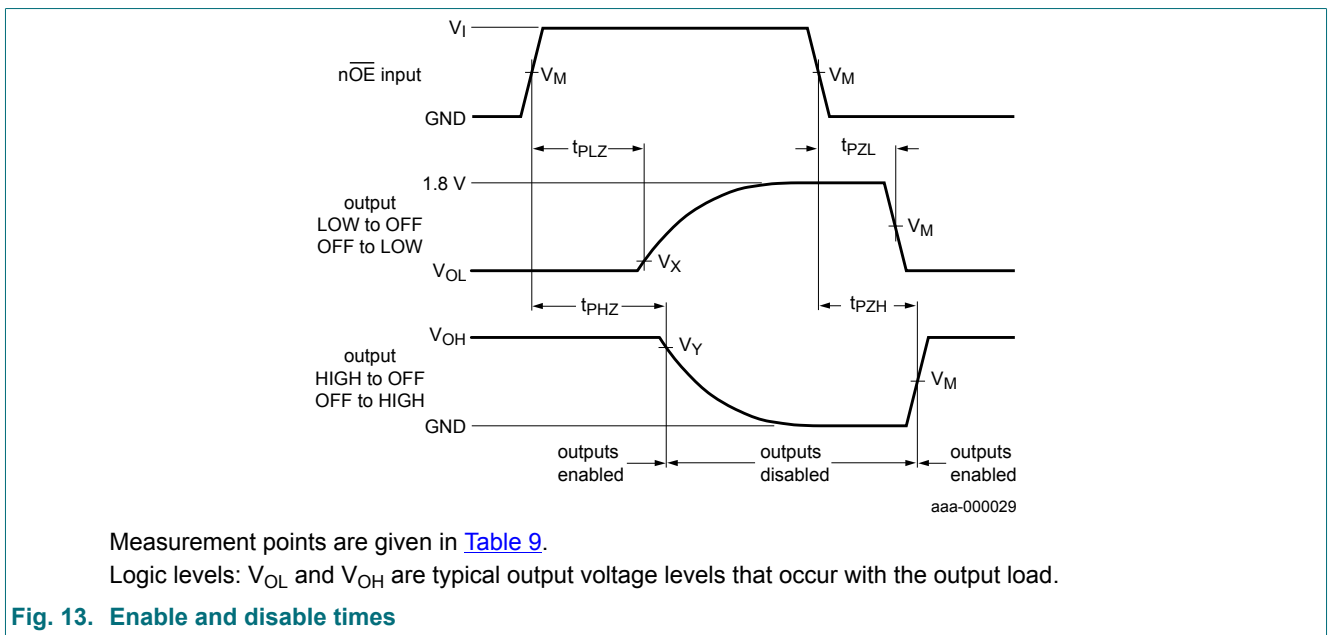
Table 8. Dynamic characteristics

$GND = 0\text{ V}$; for test circuit see [Fig. 15](#)

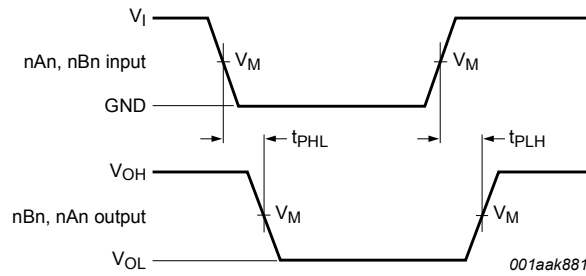
Symbol	Parameter	Conditions	$T_{amb} = -40\text{ °C to }+85\text{ °C}$			$T_{amb} = -40\text{ °C to }+125\text{ °C}$		Unit
			Min	Typ [1]	Max	Min	Max	
t_{pd}	propagation delay	nAn to nBn or nBn to nAn; $V_{CC} = 3.0\text{ V to }3.6\text{ V}$; see Fig. 14 [2][3]	-	-	0.11	-	0.22	ns
t_{en}	enable time	\overline{nOE} to nAn or nBn; $V_{CC} = 3.0\text{ V to }3.6\text{ V}$; see Fig. 13 [4]	1.5	2.8	5.0	1.5	6.0	ns
t_{dis}	disable time	\overline{nOE} to nAn or nBn; $V_{CC} = 3.0\text{ V to }3.6\text{ V}$; see Fig. 13 [5]	0.8	3.1	7.0	0.8	8.0	ns

- [1] All typical values are measured at $T_{amb} = 25\text{ °C}$ and at nominal V_{CC} .
- [2] The propagation delay is the calculated RC time constant of the typical on-state resistance of the switch and the load capacitance, when driven by an ideal voltage source (zero output impedance).
- [3] t_{pd} is the same as t_{PLH} and t_{PHL} .
- [4] t_{en} is the same as t_{PZH} and t_{PZL} .
- [5] t_{dis} is the same as t_{PHZ} and t_{PLZ} .

10.1. Waveforms and test circuit



8-bit level-shifting bus switch with 4-bit output enables



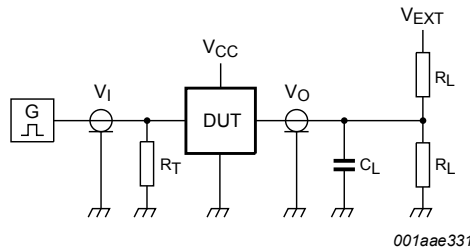
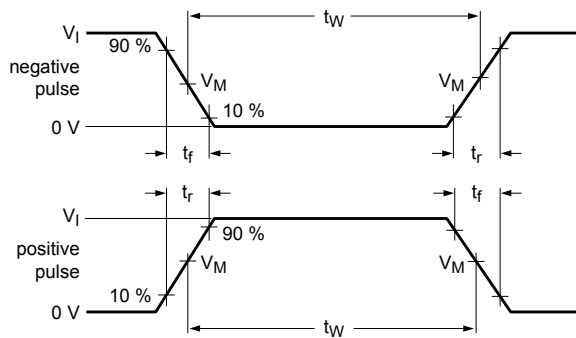
Measurement points are given in [Table 9](#).

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

Fig. 14. The data input (nAn, nBn) to output (nBn, nAn) propagation delay times

Table 9. Measurement points

Supply voltage	Input			Output		
V_{CC}	V_M	V_I	$t_r = t_f$	V_M	V_X	V_Y
3.0 V to 3.6 V	$0.5V_{CC}$	V_{CC}	≤ 2.0 ns	0.9 V	$V_{OL} + 0.15$ V	$V_{OH} - 0.15$ V



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

Definitions for test circuit:

R_L = Load resistance.

C_L = Load capacitance including jig and probe capacitance.

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

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

Fig. 15. Test circuit for measuring switching times

Table 10. Test data

Supply voltage	Load		V_{EXT}		
V_{CC}	C_L	R_L	t_{PLH}, t_{PHL}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ}
3.0 V to 3.6 V	30 pF	1 k Ω	open	GND	3.6 V

10.2. Additional dynamic characteristics

Table 11. Additional dynamic characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); $V_I = GND$ or V_{CC} (unless otherwise specified); $t_r = t_f \leq 2.5$ ns.

Symbol	Parameter	Conditions	$T_{amb} = 25\text{ }^\circ\text{C}$			Unit
			Min	Typ [1]	Max	
$f_{(-3dB)}$	-3 dB frequency response	$V_{CC} = 3.3\text{ V}$; $R_L = 50\text{ }\Omega$; see Fig. 16 [2]	-	575	-	MHz

[1] Typical values are measured at $T_{amb} = 25\text{ }^\circ\text{C}$ and $V_{CC} = 3.3\text{ V}$.

[2] f_i is biased at $0.5V_{CC}$.

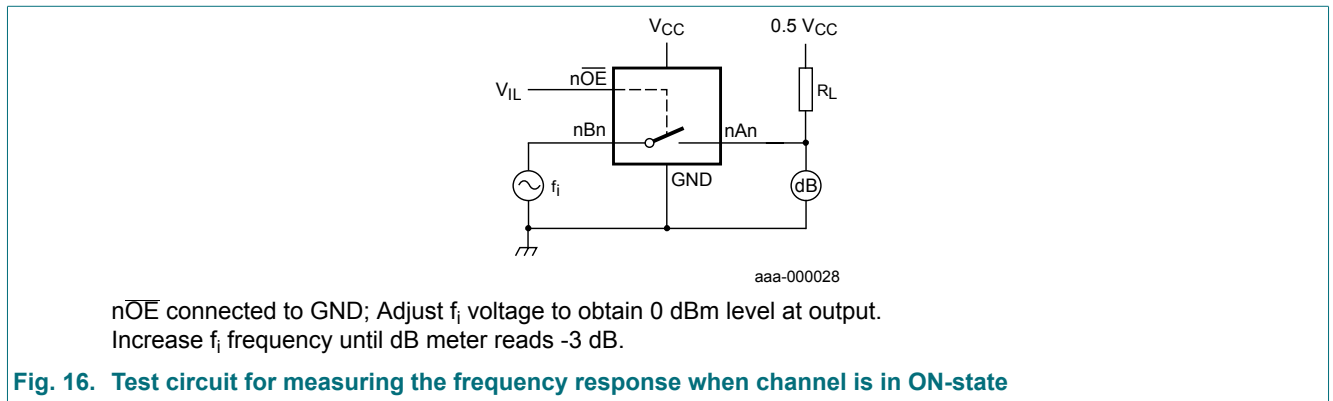


Fig. 16. Test circuit for measuring the frequency response when channel is in ON-state

11. Package outline

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm

SOT360-1

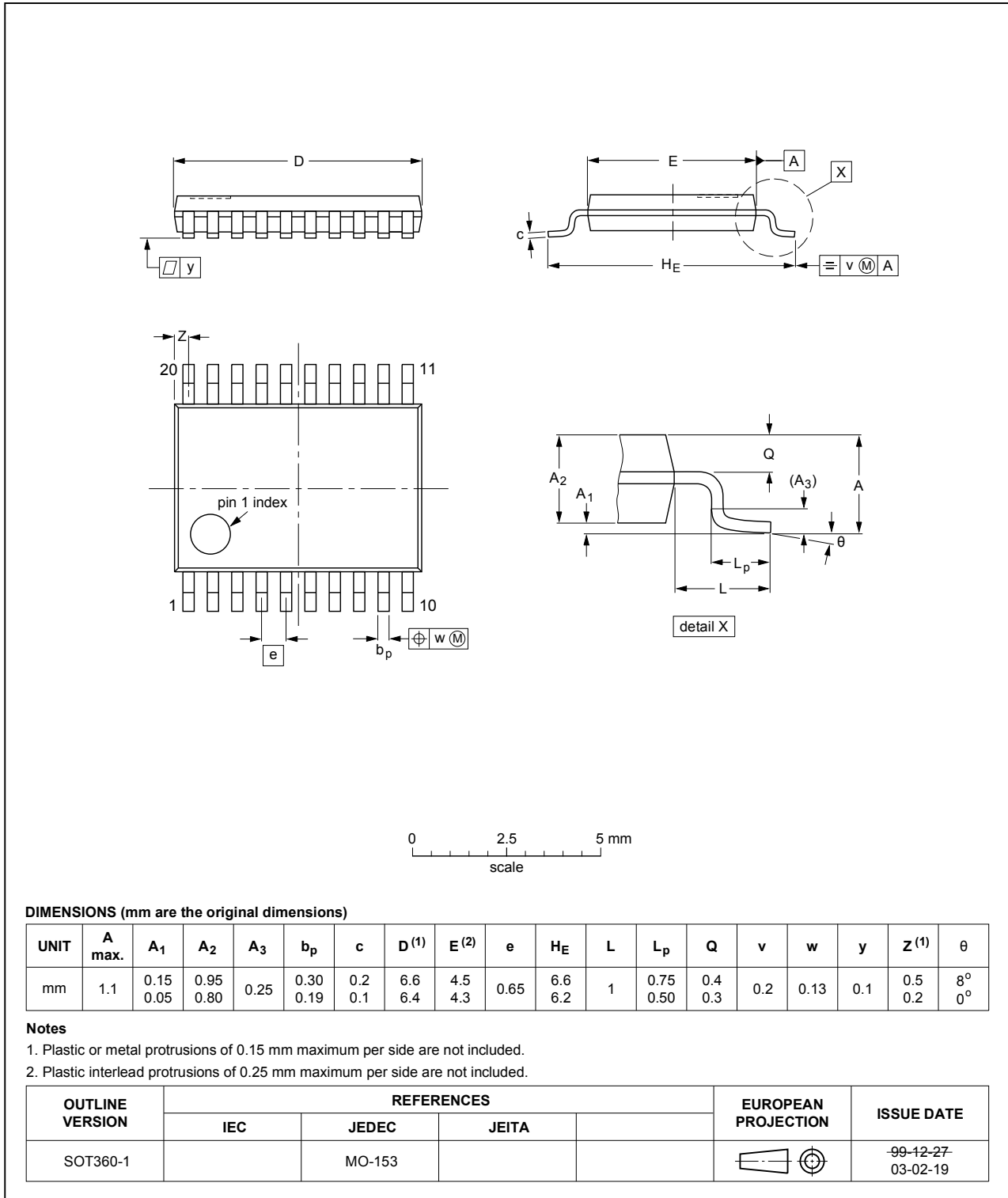


Fig. 17. Package outline SOT360-1 (TSSOP20)

DHVQFN20: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 20 terminals; body 2.5 x 4.5 x 0.85 mm

SOT764-1

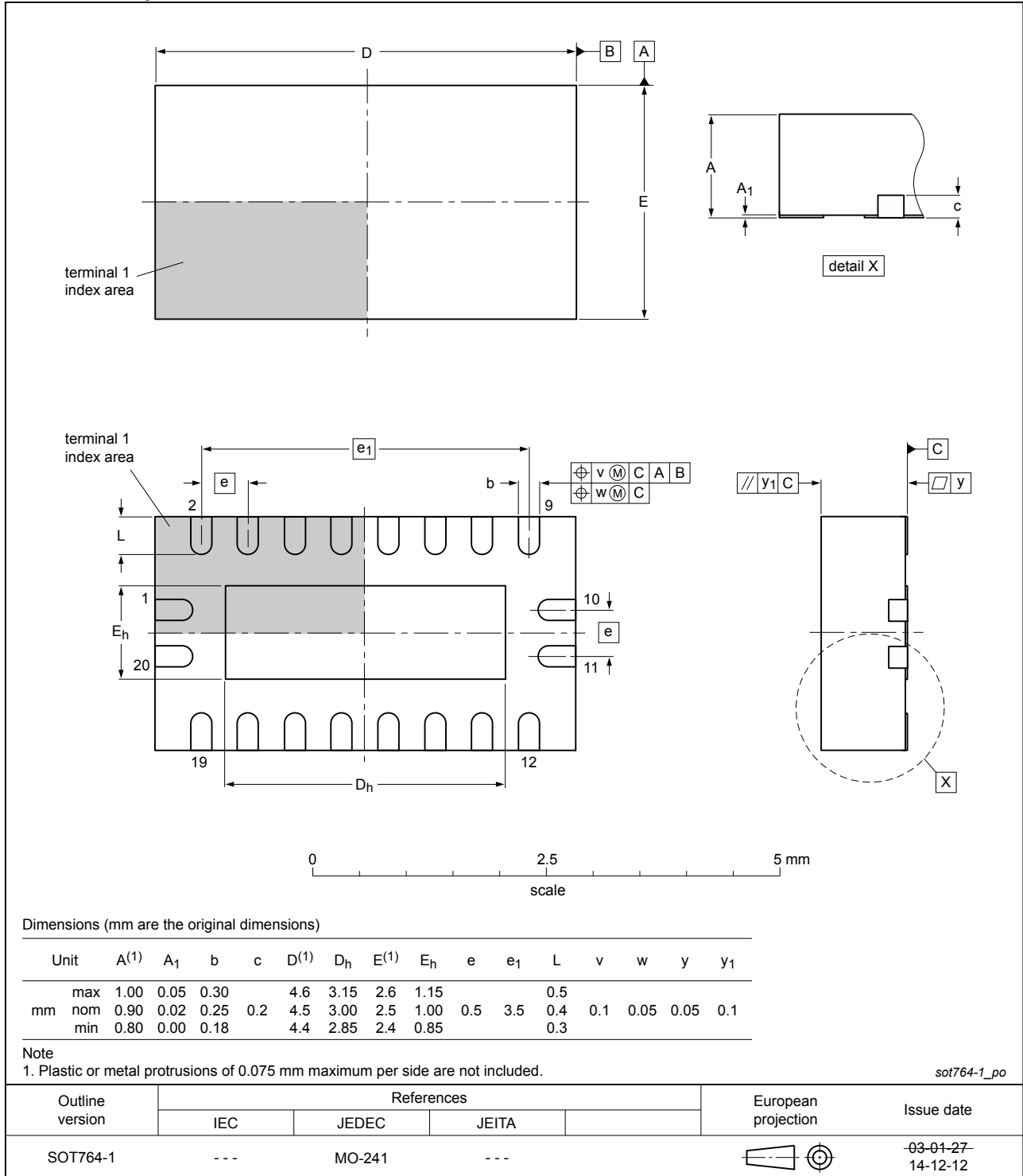


Fig. 18. Package outline SOT764-1 (DHVQFN20)

12. Abbreviations

Table 12. Abbreviations

Acronym	Description
CDM	Charged Device Model
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model

13. Revision history

Table 13. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74CBTLVD3244 v.3	20190405	Product data sheet	-	74CBTLVD3244 v.2
Modifications:	<ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. Type number 74CBTLVD3244DS (SSOP20/SOT724-1) removed. Package outline drawing SOT764-1 (DHSVFN20) updated. Typo corrected in Table 2. 			
74CBTLVD3244 v.2	20111216	Product data sheet	-	74CBTLVD3244 v.1
Modifications:	<ul style="list-style-type: none"> Legal pages updated. 			
74CBTLVD3244 v.1	20110715	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.
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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Date of release: 5 April 2019