

74LVC2245A

Octal transceiver with direction pin, 30 Ω series termination resistors; 5 V tolerant input/output; 3-state

Rev. 7 — 25 August 2023

Product data sheet

1. General description

The 74LVC2245A is an 8-bit transceiver with 30 Ω termination resistors and 3-state outputs. The device features an output enable ($\overline{OE}$) and send/receive (DIR) for direction control. A HIGH on $\overline{OE}$ causes the outputs to assume a high-impedance OFF-state. Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in mixed 3.3 V and 5 V environments.

Schmitt-trigger action at all 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 potentially damaging backflow current through the device when it is powered down.

2. Features and benefits

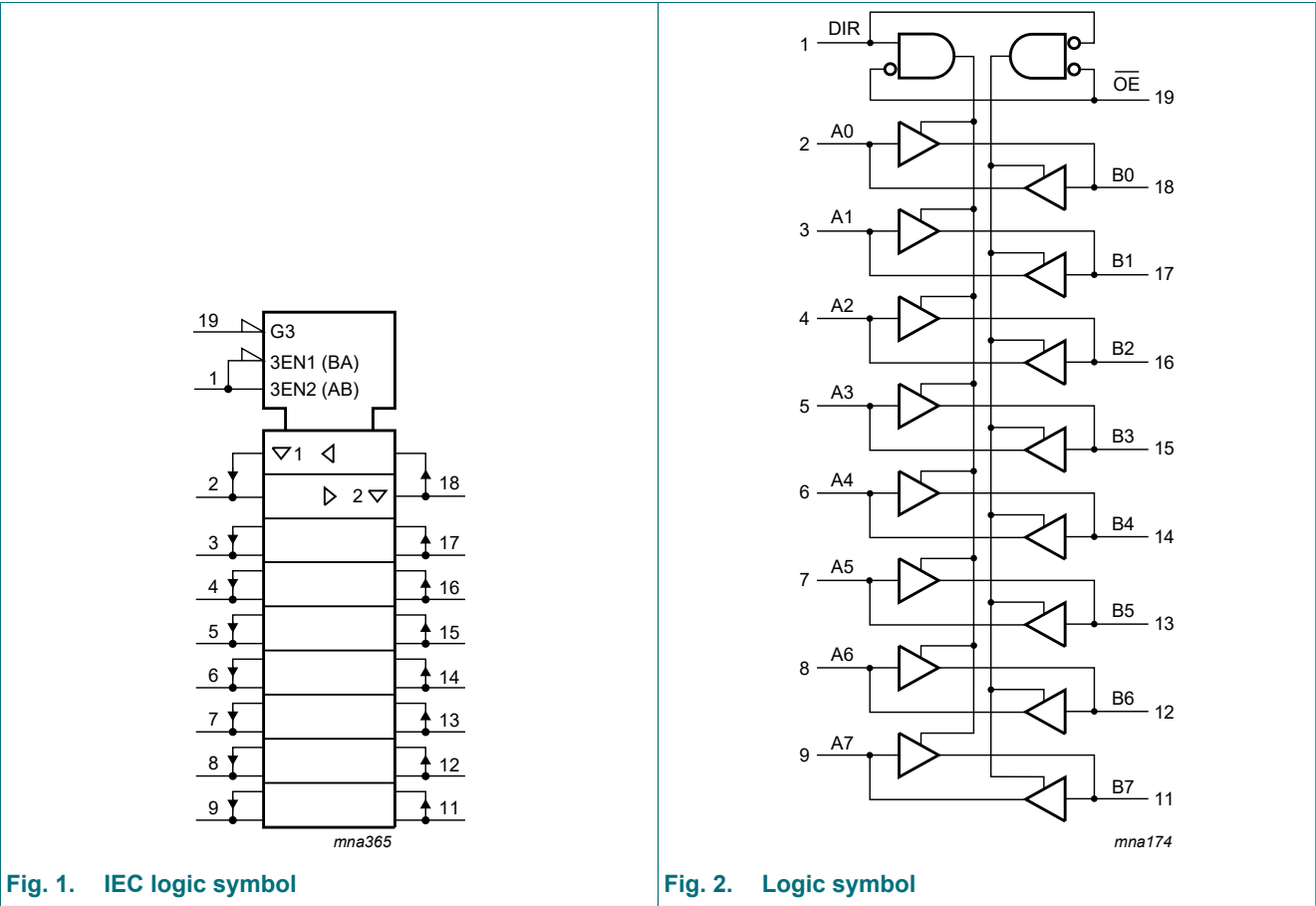
- Overvoltage tolerant inputs to 5.5 V
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low-power consumption
- Direct interface with TTL levels
- I_{OFF} circuitry provides partial Power-down mode operation
- Integrated 30 Ω termination resistors
- Complies with JEDEC standard:
 - JESD8-7A (1.65 V to 1.95 V)
 - JESD8-5A (2.3 V to 2.7 V)
 - JESD8-C/JESD36 (2.7 V to 3.6 V)
- ESD protection:
 - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
 - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- 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
74LVC2245AD	-40 °C to +125 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74LVC2245APW	-40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1
74LVC2245ABQ	-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

D package
SOT163-1 (SO20)

aaa-035026

PW package
SOT360-1 (TSSOP20)

aaa-035027

BQ package
SOT764-1 (DHVQFN20)

aaa-035029

Transparent top view

(1) This is not a ground pin. There is no electrical or mechanical requirement to solder the pad. In case soldered, the solder land should remain floating or connected to GND.

5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
DIR	1	direction control input
A0, A1, A2, A3, A4, A5, A6, A7	2, 3, 4, 5, 6, 7, 8, 9	data input/output
GND	10	ground (0 V)
B0, B1, B2, B3, B4, B5, B6, B7	18, 17, 16, 15, 14, 13, 12, 11	data input/output
OE	19	output enable input (active LOW)
VCC	20	supply voltage

6. Functional description

Table 3. Functional table

Input		Input/output	
OE	DIR	An	Bn
LOW	LOW	A = B	input
LOW	HIGH	input	B = A
HIGH	don't care	Z (high-impedance OFF-state)	Z (high-impedance OFF-state)

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	+6.5	V
I _{IK}	input clamping current	V _I < 0 V	-50	-	mA
V _I	input voltage	[1]	-0.5	+6.5	V
I _{OK}	output clamping current	V _O > V _{CC} or V _O < 0 V	-	±50	mA
V _O	output voltage	output HIGH or LOW state [2]	-0.5	V _{CC} + 0.5	V
		output 3-state [2]	-0.5	+6.5	V
I _O	output current	V _O = 0 V to V _{CC}	-	±50	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 [3]	-	500	mW

- [1] The minimum input voltage ratings may be exceeded if the input current ratings are observed.
[2] The output voltage ratings may be exceeded if the output current ratings are observed.
[3] For SOT163-1 (SO20) package: P_{tot} derates linearly with 12.3 mW/K above 109 °C.
For SOT360-1 (TSSOP20) package: P_{tot} derates linearly with 10.0 mW/K above 100 °C.
For SOT764-1 (DHVQFN20) package: P_{tot} derates linearly with 12.9 mW/K above 111 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{CC}	supply voltage		1.65	-	3.6	V
		functional	1.2	-	-	V
V _I	input voltage		0	-	5.5	V
V _O	output voltage	output HIGH or LOW state	0	-	V _{CC}	V
		output 3-state	0	-	5.5	V
T _{amb}	ambient temperature		-40	-	+125	°C
Δt/ΔV	input transition rise and fall rate	V _{CC} = 1.65 V to 2.7 V	0	-	20	ns/V
		V _{CC} = 2.7 V to 3.6 V	0	-	10	ns/V

9. Static characteristics

Table 6. Static characteristics

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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
V _{IH}	HIGH-level input voltage	V _{CC} = 1.2 V	1.08	-	-	1.08	-	V
		V _{CC} = 1.65 V to 1.95 V	0.65 × V _{CC}	-	-	0.65 × V _{CC}	-	V
		V _{CC} = 2.3 V to 2.7 V	1.7	-	-	1.7	-	V
		V _{CC} = 2.7 V to 3.6 V	2.0	-	-	2.0	-	V
V _{IL}	LOW-level input voltage	V _{CC} = 1.2 V	-	-	0.12	-	0.12	V
		V _{CC} = 1.65 V to 1.95 V	-	-	0.35 × V _{CC}	-	0.35 × V _{CC}	V
		V _{CC} = 2.3 V to 2.7 V	-	-	0.7	-	0.7	V
		V _{CC} = 2.7 V to 3.6 V	-	-	0.8	-	0.8	V
V _{OH}	HIGH-level output voltage	V _I = V _{IH} or V _{IL}						
		I _O = -100 μ A; V _{CC} = 1.65 V to 3.6 V	V _{CC} - 0.2	V _{CC}	-	V _{CC} - 0.3	-	V
		I _O = -2 mA; V _{CC} = 1.65 V	1.2	-	-	1.05	-	V
		I _O = -4 mA; V _{CC} = 2.3 V	1.8	-	-	1.65	-	V
		I _O = -6 mA; V _{CC} = 2.7 V	2.2	-	-	2.05	-	V
		I _O = -9 mA; V _{CC} = 3.0 V	2.4	-	-	2.25	-	V
		I _O = -12 mA; V _{CC} = 3.0 V	2.2	-	-	2.0	-	V
V _{OL}	LOW-level output voltage	V _I = V _{IH} or V _{IL}						
		I _O = 100 μ A; V _{CC} = 1.65 V to 3.6 V	-	-	0.2	-	0.3	V
		I _O = 2 mA; V _{CC} = 1.65 V	-	-	0.45	-	0.65	V
		I _O = 4 mA; V _{CC} = 2.3 V	-	-	0.6	-	0.8	V
		I _O = 6 mA; V _{CC} = 2.7 V	-	-	0.4	-	0.6	V
		I _O = 12 mA; V _{CC} = 3.0 V	-	-	0.55	-	0.8	V
I _I	input leakage current	V _{CC} = 3.6 V; V _I = 5.5 V or GND	-	±0.1	±5	-	±20	μ A
I _{OZ}	OFF-state output current	V _I = V _{IH} or V _{IL} ; V _{CC} = 3.6 V; V _O = 5.5 V or GND	-	±0.1	±5	-	±20	μ A
I _{OFF}	power-off leakage current	V _{CC} = 0 V; V _I or V _O = 5.5 V	-	±0.1	±10	-	±20	μ A
I _{CC}	supply current	V _{CC} = 3.6 V; V _I = V _{CC} or GND; I _O = 0 A	-	0.1	10	-	40	μ A
Δ I _{CC}	additional supply current	per input pin; V _{CC} = 2.7 V to 3.6 V; V _I = V _{CC} - 0.6 V; I _O = 0 A	-	5	500	-	5000	μ A
C _I	input capacitance	V _{CC} = 0 V to 3.6 V; V _I = GND to V _{CC}	-	4.0	-	-	-	pF

[1] All typical values are measured at V_{CC} = 3.3 V (unless stated otherwise) and T_{amb} = 25 °C.

10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 5.

Symbol	Parameter	Conditions	T _{amb} = -40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
t _{pd}	propagation delay	An to Bn; Bn to An; see Fig. 3 [2]						
		V _{CC} = 1.2 V	-	26	-	-	-	ns
		V _{CC} = 1.65 V to 1.95 V	1.8	7.5	17.1	1.8	18.0	ns
		V _{CC} = 2.3 V to 2.7 V	1.5	3.9	8.4	1.5	9.4	ns
		V _{CC} = 2.7 V	1.5	3.9	7.3	1.5	9.5	ns
		V _{CC} = 3.0 V to 3.6 V	1.5	3.3	6.3	1.5	8.0	ns
t _{en}	enable time	OE to An or Bn; see Fig. 4 [2]						
		V _{CC} = 1.2 V	-	28	-	-	-	ns
		V _{CC} = 1.65 V	2.5	9.5	18.8	2.5	21.0	ns
		V _{CC} = 2.3 V to 2.7 V	2.1	5.3	10.3	2.1	11.5	ns
		V _{CC} = 2.7 V	1.5	5.4	9.5	1.5	12.0	ns
		V _{CC} = 3.0 V to 3.6 V	1.5	4.2	8.2	1.5	10.5	ns
t _{dis}	disable time	OE to An or Bn; see Fig. 4 [2]						
		V _{CC} = 1.2 V	-	12.0	-	-	-	ns
		V _{CC} = 1.65 V	3.0	5.0	10.2	3.0	11.0	ns
		V _{CC} = 2.3 V to 2.7 V	1.0	2.8	5.8	1.0	6.3	ns
		V _{CC} = 2.7 V	1.5	3.6	6.9	1.5	9.0	ns
		V _{CC} = 3.0 V to 3.6 V	1.7	3.3	5.9	1.7	7.5	ns
t _{sk(o)}	output skew time	V _{CC} = 3.0 V to 3.6 V [3]	-	-	1.0	-	1.5	ns
C _{PD}	power dissipation capacitance	V _I = GND to V _{CC} [4]						
		V _{CC} = 1.65 V to 1.95 V	-	7.7	-	-	-	pF
		V _{CC} = 2.3 V to 2.7 V	-	11.3	-	-	-	pF
		V _{CC} = 3.0 V to 3.6 V	-	14.4	-	-	-	pF

[1] Typical values are measured at T_{amb} = 25 °C and V_{CC} = 1.2 V, 1.8 V, 2.5 V, 2.7 V, and 3.3 V respectively.

[2] t_{pd} is the same as t_{PLH} and t_{PHL}.

t_{en} is the same as t_{PZL} and t_{PZH}.

t_{dis} is the same as t_{PLZ} and t_{PHZ}.

[3] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

[4] C_{PD} is used to determine the dynamic power dissipation (P_D in μ W).

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:

f_i = input frequency in MHz, f_o = output frequency in MHz,

C_L = output load capacitance in pF,

V_{CC} = supply voltage in Volts,

N = number of inputs switching,

$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of the outputs.

10.1. Waveforms and test circuit

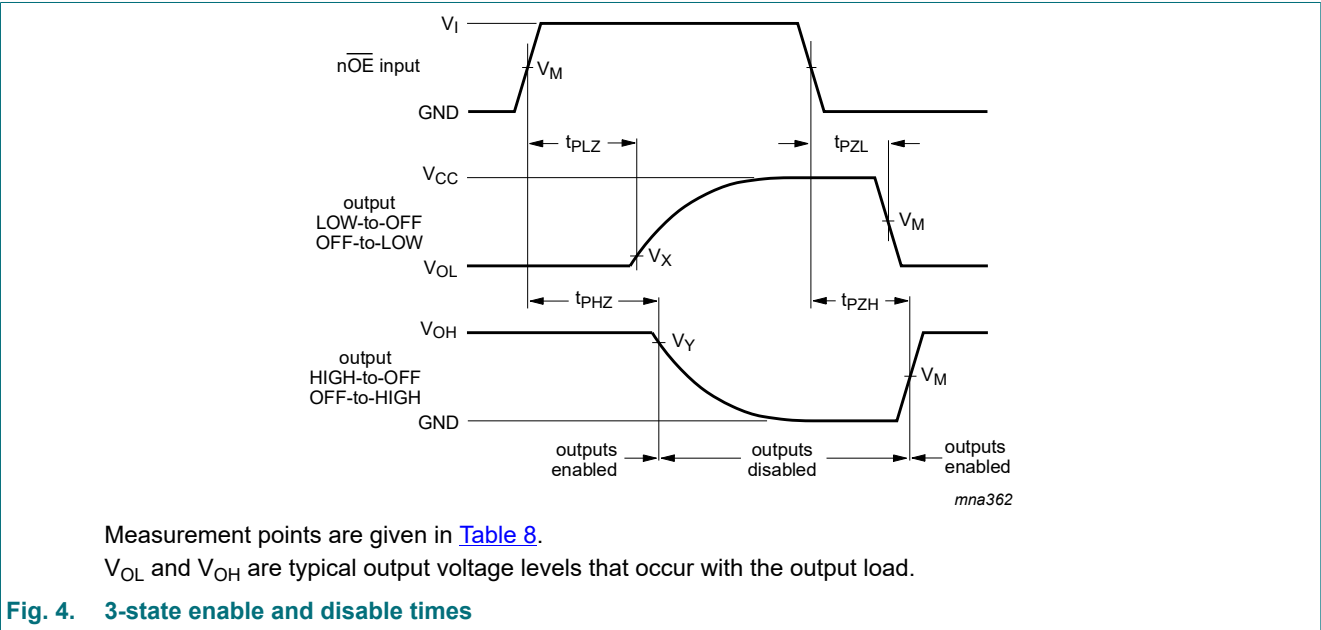
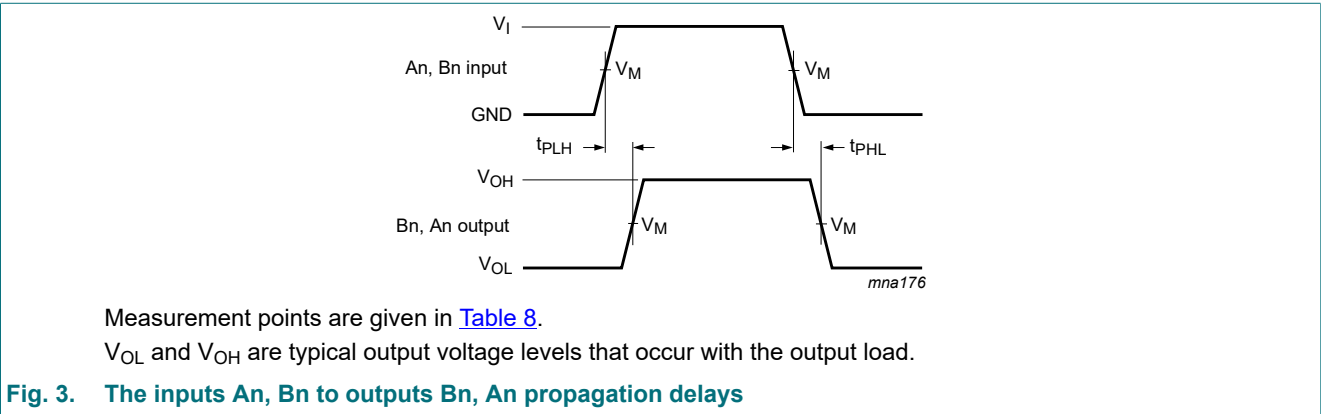


Table 8. Measurement points

Supply voltage	Input	Output		
V_{CC}	V_M	V_M	V_X	V_Y
$V_{CC} < 2.7\text{ V}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15\text{ V}$	$V_{OH} - 0.15\text{ V}$
$V_{CC} \geq 2.7\text{ V}$	1.5 V	1.5 V	$V_{OL} + 0.3\text{ V}$	$V_{OH} - 0.3\text{ V}$

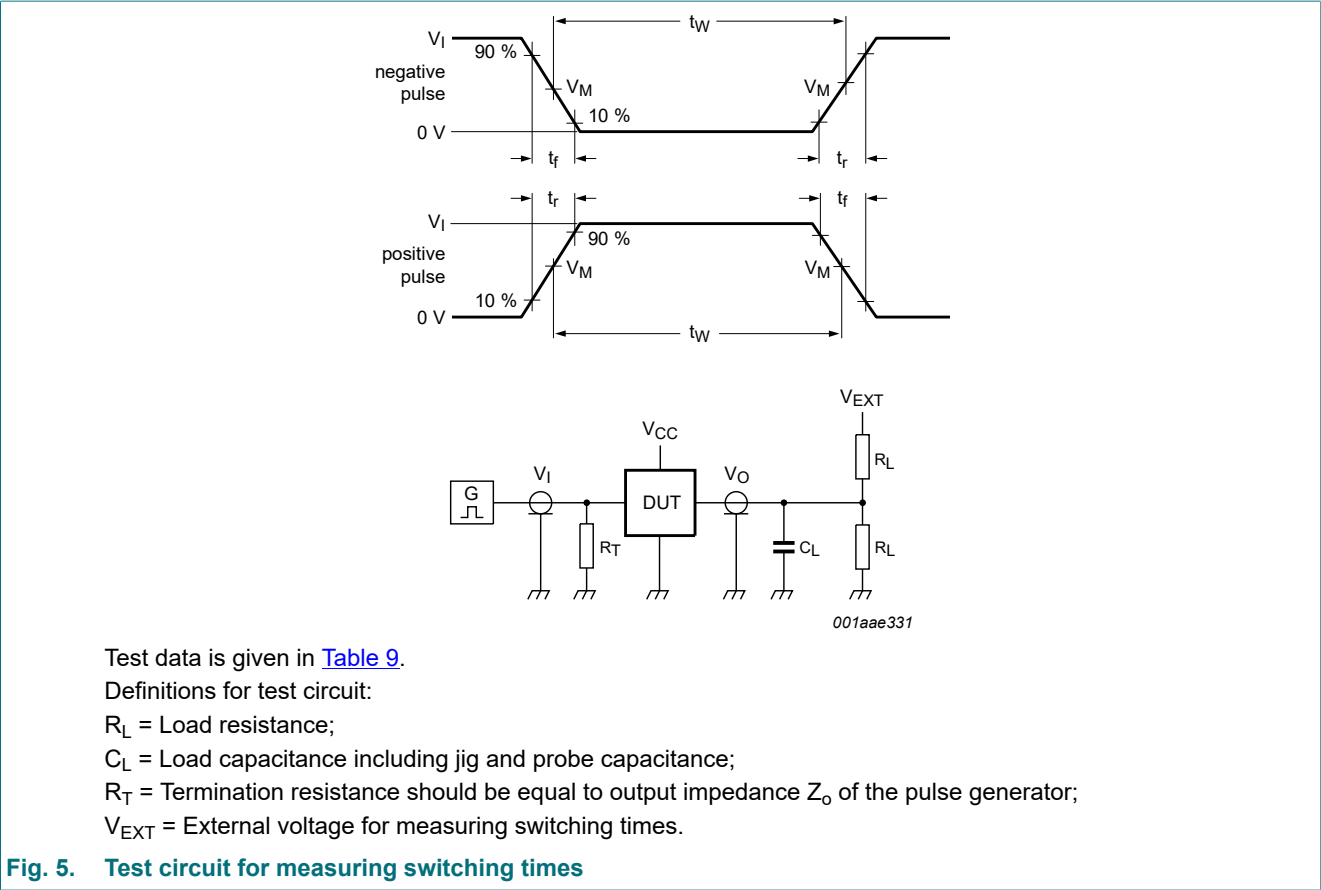


Fig. 5. Test circuit for measuring switching times

Table 9. 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}
1.2 V	V _{CC}	≤ 2 ns	30 pF	1 kΩ	open	2 × V _{CC}	GND
1.65 V to 1.95 V	V _{CC}	≤ 2 ns	30 pF	1 kΩ	open	2 × V _{CC}	GND
2.3 V to 2.7 V	V _{CC}	≤ 2 ns	30 pF	500 Ω	open	2 × V _{CC}	GND
2.7 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	2 × V _{CC}	GND
3.0 V to 3.6 V	2.7 V	≤ 2.5 ns	50 pF	500 Ω	open	2 × V _{CC}	GND

11. Package outline

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

SOT163-1



Fig. 6. Package outline SOT163-1 (SO20)

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

SOT360-1

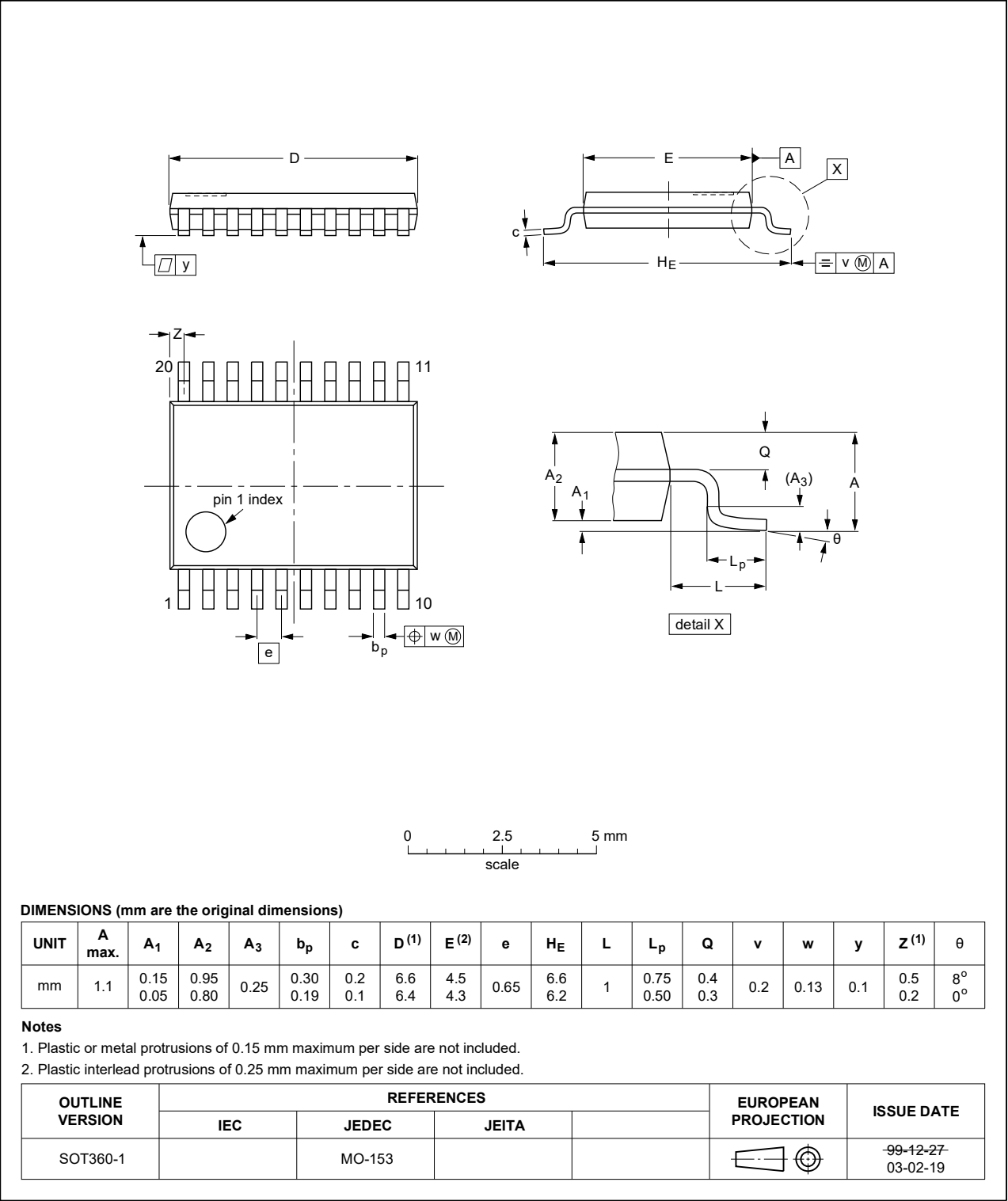


Fig. 7. Package outline SOT360-1 (TSSOP20)

Octal transceiver with direction pin, 30 Ω series termination resistors; 5 V tolerant input/output; 3-state

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

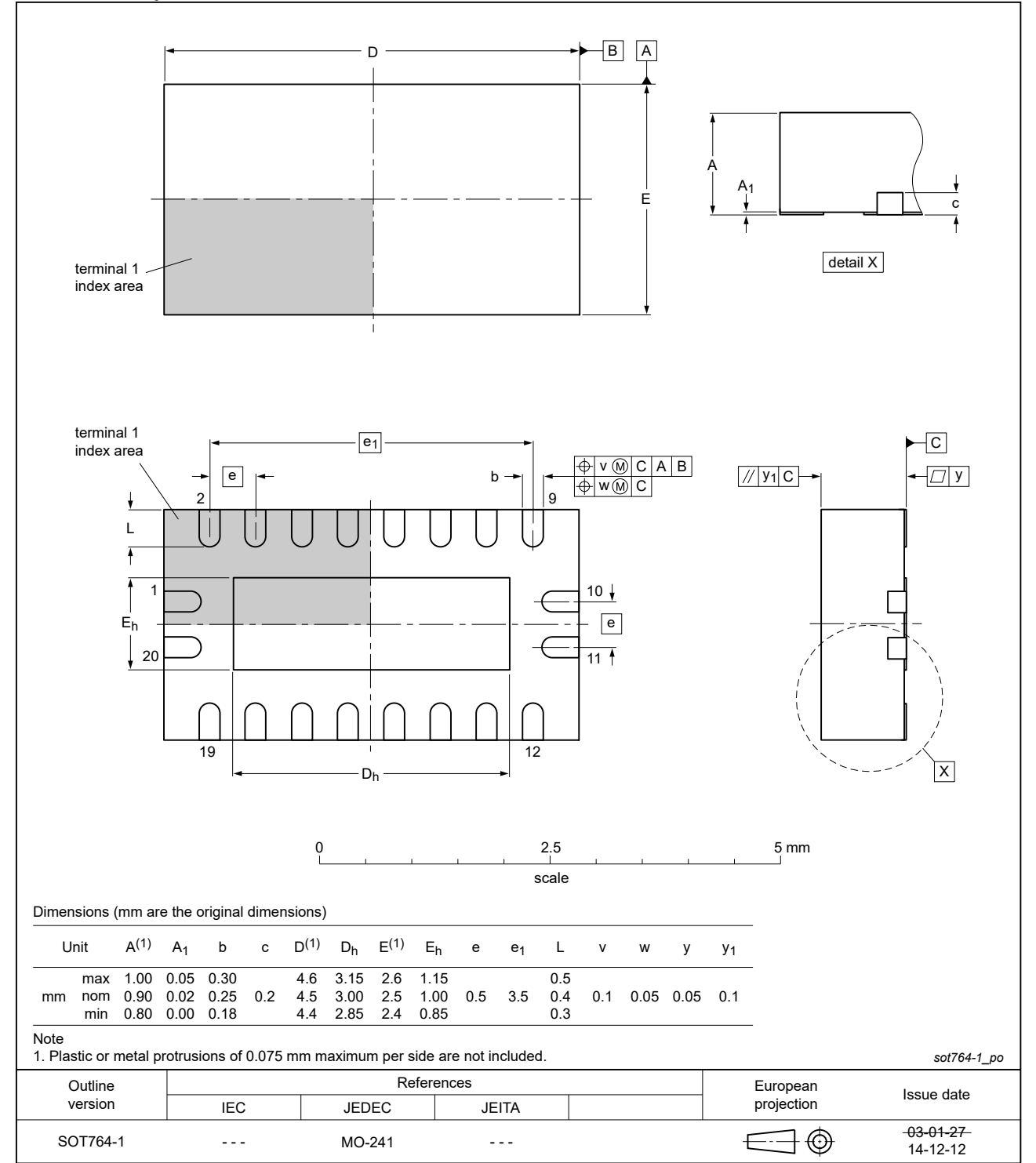


Fig. 8. Package outline SOT764-1 (DHVQFN20)

12. Abbreviations

Table 10. Abbreviations

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

13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC2245A v.7	20230825	Product data sheet	-	74LVC2245A v.6
Modifications:	• Section 2: ESD specification updated according to the latest JEDEC standard.			
74LVC2245A v.6	20210430	Product data sheet	-	74LVC2245A v.5
Modifications:	• 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 74LVC2245ADB (SOT339-1 / SSOP20) removed. • Section 1 and Section 2 updated. • Section 7: Derating values for P_{tot} total power dissipation updated. • Fig. 8: Package outline drawing SOT764-1 (DHVQFN20) updated.			
74LVC2245A v.5	20111104	Product data sheet	-	74LVC2245A v.4
Modifications:	• The format of this document has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate. • Table 4, Table 5, Table 6, Table 7 and Table 9: values added for lower voltage ranges.			
74LVC2245A v.4	20031117	Product specification	-	74LVC2245A v.3
74LVC2245A v.3	20020610	Product specification	-	74LVC2245A v.2
74LVC2245A v.2	19990615	Product specification	-	74LVC2245A v.1
74LVC2245A v.1	19990323	Product specification	-	-

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