74LVC245A-Q100; 74LVCH245A-Q100

Octal bus transceiver; 3-state

Rev. 1 — 3 September 2012 Product data sheet

1. General description

The 74LVC245A-Q100; 74LVCH245A-Q100 are 8-bit transceivers featuring non-inverting 3-state bus compatible outputs in both send and receive directions. The device features an output enable ($\overline{OE}$) input for easy cascading and a send/receive (DIR) input for direction control. $\overline{OE}$ controls the outputs so that the buses are effectively isolated.

Inputs can be driven from either 3.3 V or 5 V devices. When disabled, up to 5.5 V can be applied to the outputs. These features allow the use of these devices in mixed 3.3 V and 5 V applications.

The 74LVCH245A-Q100 bus hold on data inputs eliminates the need for external pull-up resistors to hold unused inputs.

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

2. Features and benefits

- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - Specified from −40 °C to +85 °C and from −40 °C to +125 °C
- 5 V tolerant inputs/outputs for interfacing with 5 V logic
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low-power consumption
- Direct interface with TTL levels
- Inputs accept voltages up to 5.5 V
- High-impedance when V_{CC} = 0 V
- Bus hold on all data inputs (74LVCH245A-Q100 only)
- 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:
  - MIL-STD-883, method 3015 exceeds 2000 V
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74LVC245AD-Q100	−40 °C to +125 °C	SO20	plastic small outline package; 20 leads; body width 7.5 mm	SOT163-1
74LVCH245AD-Q100				
74LVC245APW-Q100	−40 °C to +125 °C	TSSOP20	plastic thin shrink small outline package; 20 leads; body width 4.4 mm	SOT360-1
74LVCH245APW-Q100				
74LVC245ABQ-Q100	−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
74LVCH245ABQ-Q100				

4. Functional diagram

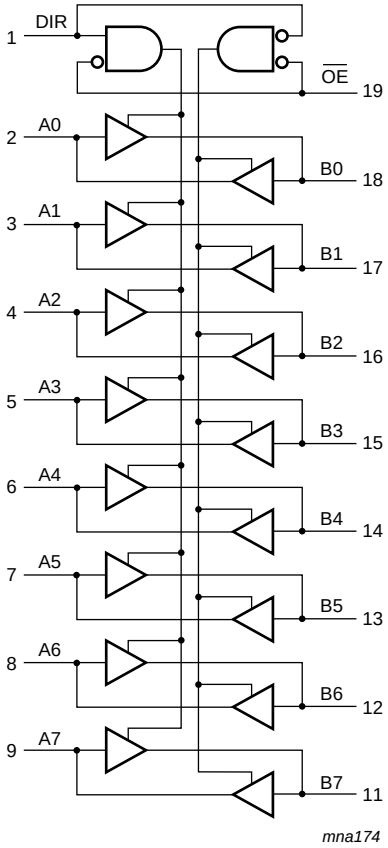


Fig 1. Logic diagram

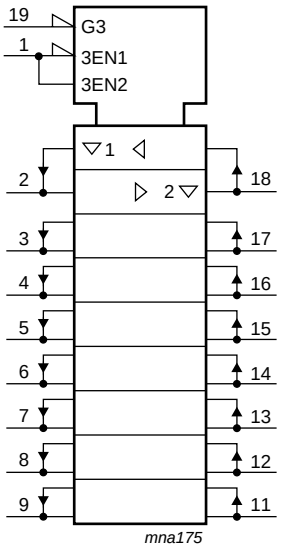


Fig 2. IEC logic symbol

5. Pinning information

5.1 Pinning

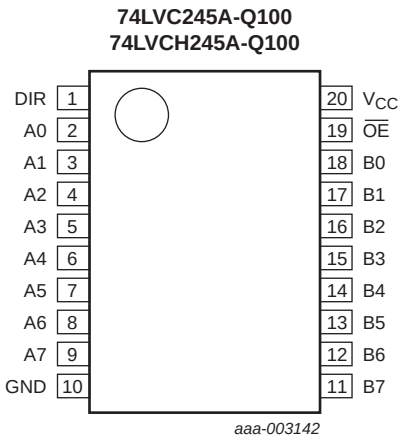
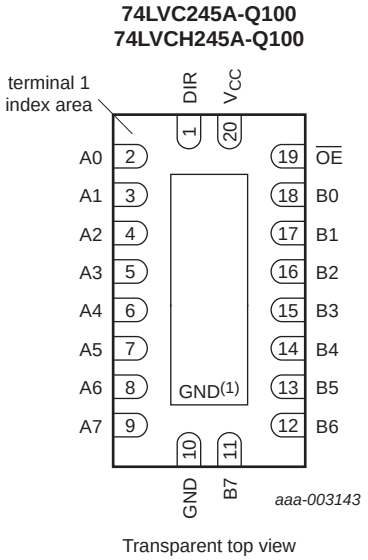


Fig 3. Pin configuration for SO20 and TSSOP20



(1) This is not a supply pin. The substrate is attached to this pad using conductive die attach material. There is no electrical or mechanical requirement to solder this pad. However, if it is soldered, the solder land should remain floating or be connected to GND.

Fig 4. Pin configuration for DHVQFN20

5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
DIR	1	direction control
A0 to A7	2, 3, 4, 5, 6, 7, 8, 9	data input/output
GND	10	ground (0 V)
B0 to B7	18, 17, 16, 15, 14, 13, 12, 11	data input/output
$\overline{OE}$	19	output enable input (active LOW)
V_{CC}	20	supply voltage

6. Functional description

Table 3. Function selection[1]

Inputs		Inputs/outputs	
$\overline{OE}$	DIR	An	Bn
L	L	An = Bn	inputs
L	H	inputs	Bn = An
H	X	Z	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). 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	[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 SO20 package: above 70 °C derate linearly with 8 mW/K.
For TSSOP20 package: above 60 °C derate linearly with 5.5 mW/K.
For DHVQFN20 package: above 60 °C derate linearly with 4.5 mW/K.

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	-	3.6	V
V_I	input voltage		0	-	5.5	V
V_O	output voltage	output HIGH or LOW	0	-	V_{CC}	V
		output 3-state	0	-	5.5	V
T_{amb}	ambient temperature	in free air	−40	-	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	V_{CC} = 1.2 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 μA; V_{CC} = 1.65 V to 3.6 V	V_{CC} − 0.2	-	-	V_{CC} − 0.3	-	V
		I_O = −4 mA; V_{CC} = 1.65 V	1.2	-	-	1.05	-	V
		I_O = −8 mA; V_{CC} = 2.3 V	1.8	-	-	1.65	-	V
		I_O = −12 mA; V_{CC} = 2.7 V	2.2	-	-	2.05	-	V
		I_O = −18 mA; V_{CC} = 3.0 V	2.4	-	-	2.25	-	V
		I_O = −24 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 μA; V_{CC} = 1.65 V to 3.6 V	-	-	0.2	-	0.3	V
		I_O = 4 mA; V_{CC} = 1.65 V	-	-	0.45	-	0.65	V
		I_O = 8 mA; V_{CC} = 2.3 V	-	-	0.6	-	0.8	V
		I_O = 12 mA; V_{CC} = 2.7 V	-	-	0.4	-	0.6	V
		I_O = 24 mA; V_{CC} = 3.0 V	-	-	0.55	-	0.8	V
I_I	input leakage current	V_I = 5.5 V or GND; V_{CC} = 3.6 V [2]	-	±0.1	±5	-	±20	μA

Table 6. Static characteristics *…continued*

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	
I_{OZ}	OFF-state output current	$V_I = V_{IH}$ or V_{IL}; V_O = 5.5 V or GND; V_{CC} = 3.6 V	[3]	-	±0.1	±5	-	±20	μA
I_{OFF}	power-off leakage current	V_I or V_O = 5.5 V; V_{CC} = 0.0 V		-	±0.1	±10	-	±20	μA
I_{CC}	supply current	$V_I = V_{CC}$ or GND; I_O = 0 A; V_{CC} = 3.6 V		-	0.1	10	-	40	μA
ΔI_{CC}	additional supply current	per input pin; $V_I = V_{CC} - 0.6$ V; I_O = 0 A; V_{CC} = 2.7 V to 3.6 V		-	5	500	-	5000	μA
C_I	input capacitance	V_{CC} = 0 V to 3.6 V; V_I = GND to V_{CC}		-	4.0	-	-	-	pF
$C_{I/O}$	input/output capacitance	V_{CC} = 0 V to 3.6 V; V_I = GND to V_{CC}		-	10	-	-	-	pF
I_{BHL}	bus hold LOW current	V_{CC} = 1.65; V_I = 0.58 V	[4][5]	10	-	-	10	-	μA
		V_{CC} = 2.3; V_I = 0.7 V		30	-	-	25	-	μA
		V_{CC} = 3.0; V_I = 0.8 V		75	-	-	60	-	μA
I_{BHH}	bus hold HIGH current	V_{CC} = 1.65; V_I = 1.07 V	[4][5]	–10	-	-	–10	-	μA
		V_{CC} = 2.3; V_I = 1.7 V		–30	-	-	–25	-	μA
		V_{CC} = 3.0; V_I = 2.0 V		–75	-	-	–60	-	μA
I_{BHLO}	bus hold LOW overdrive current	V_{CC} = 1.95 V		200	-	-	200	-	μA
		V_{CC} = 2.7 V		300	-	-	300	-	μA
		V_{CC} = 3.6 V	[4][6]	500	-	-	500	-	μA
I_{BHHO}	bus hold HIGH overdrive current	V_{CC} = 1.95 V		–200	-	-	–200	-	μA
		V_{CC} = 2.7 V		–300	-	-	–300	-	μA
		V_{CC} = 3.6 V	[4][6]	–500	-	-	–500	-	μA

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

[2] The bus hold circuit is switched off when $V_I > V_{CC}$ allowing 5.5 V on the input terminal.

[3] For I/O ports, the parameter I_{OZ} includes the input leakage current.

[4] Valid for data inputs of bus hold parts only (74LVCH245A-Q100). Note that control inputs do not have a bus hold circuit.

[5] The specified sustaining current at the data input holds the input below the specified V_I level.

[6] The specified overdrive current at the data input forces the data input to the opposite input state.

10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit see Figure 7.

Symbol	Parameter	Conditions		−40 °C to +85 °C			−40 °C to +125 °C		Unit
				Min	Typ[2]	Max	Min	Max	
t_{pd}	propagation delay	nAn to nBn; nBn to nAn; see Figure 5	[1]						
		V_{CC} = 1.2 V		-	17.0	-	-	-	ns
		V_{CC} = 1.65 V to 1.95 V		1.5	6.5	14.6	1.5	16.9	ns
		V_{CC} = 2.3 V to 2.7 V		1.0	3.4	7.6	1.0	8.7	ns
		V_{CC} = 2.7 V		1.5	3.4	7.3	1.5	9.5	ns
		V_{CC} = 3.0 V to 3.6 V		1.5	2.9	6.3	1.5	8.0	ns
t_{en}	enable time	$n\overline{OE}$ to nAn, nBn; see Figure 6	[1]						
		V_{CC} = 1.2 V		-	22.0	-	-	-	ns
		V_{CC} = 1.65 V to 1.95 V		1.9	8.3	19.5	1.9	22.5	ns
		V_{CC} = 2.3 V to 2.7 V		1.5	4.6	10.7	1.5	12.4	ns
		V_{CC} = 2.7 V		1.5	4.8	9.5	1.5	12.0	ns
		V_{CC} = 3.0 V to 3.6 V		1.5	3.7	8.5	1.5	11.0	ns
t_{dis}	disable time	$n\overline{OE}$ to nAn, nBn; see Figure 6	[1]						
		V_{CC} = 1.2 V		-	12.0	-	-	-	ns
		V_{CC} = 1.65 V to 1.95 V		2.9	5.5	12.3	2.9	14.2	ns
		V_{CC} = 2.3 V to 2.7 V		1.0	3.1	7.1	1.0	8.2	ns
		V_{CC} = 2.7 V		1.5	3.9	8.0	1.5	10.0	ns
		V_{CC} = 3.0 V to 3.6 V		1.7	3.6	7.0	1.7	9.0	ns
$t_{sk(o)}$	output skew time		[3]	-	-	1.0	-	1.5	ns
C_{PD}	power dissipation capacitance	per input; 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

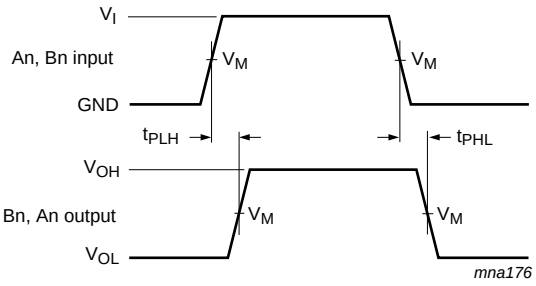
[1] t_{pd} is the same as t_{PLH} and t_{PHL}.
t_{en} is the same as t_{PZL} and t_{PZH}.
t_{dis} is the same as t_{PLZ} and t_{PHZ}.

[2] 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.

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

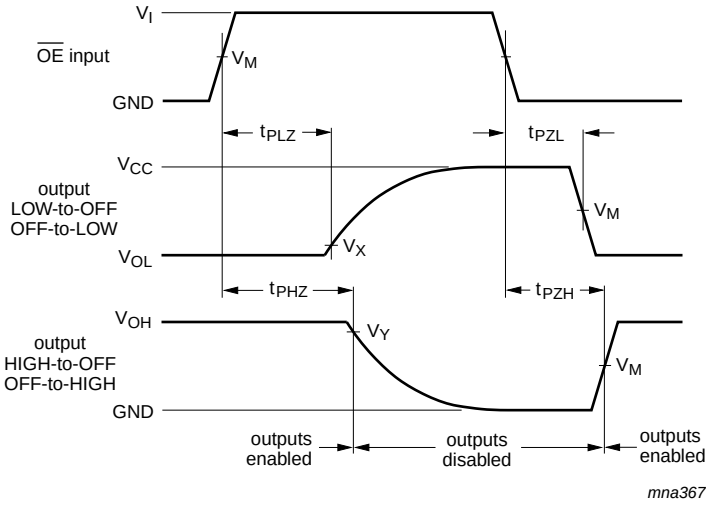
11. AC waveforms



See Table 8 for measurement points

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

Fig 5. Input (An, Bn) to output (Bn, An) propagation delays and output transition times



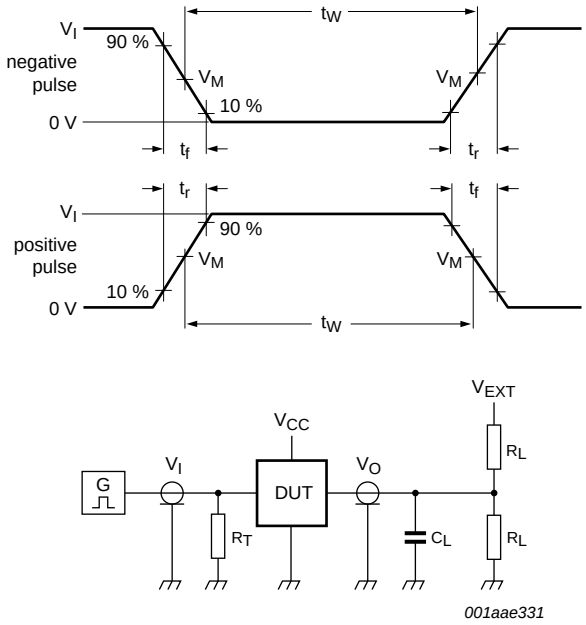
See Table 8 for measurement points

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

Fig 6. Enable and disable times

Table 8. Measurement points

Supply voltage	V_M	Input			
V_{CC}		V_I	$t_r = t_f$	V_X	V_Y
1.2 V	$0.5 \times V_{CC}$	V_{CC}	≤ 2.5 ns	V_{OL} + 0.15 V	V_{OH} − 0.15 V
1.65 V to 1.95 V	$0.5 \times V_{CC}$	V_{CC}	≤ 2.5 ns	V_{OL} + 0.15 V	V_{OH} − 0.15 V
2.3 V to 2.7 V	$0.5 \times V_{CC}$	V_{CC}	≤ 2.5 ns	V_{OL} + 0.15 V	V_{OH} − 0.15 V
2.7 V	1.5 V	2.7 V	≤ 2.5 ns	V_{OL} + 0.3 V	V_{OH} − 0.3 V
3.0 V to 3.6 V	1.5 V	2.7 V	≤ 2.5 ns	V_{OL} + 0.3 V	V_{OH} − 0.3 V



Test data is given in Table 9.

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 output impedance Z_o of the pulse generator.

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

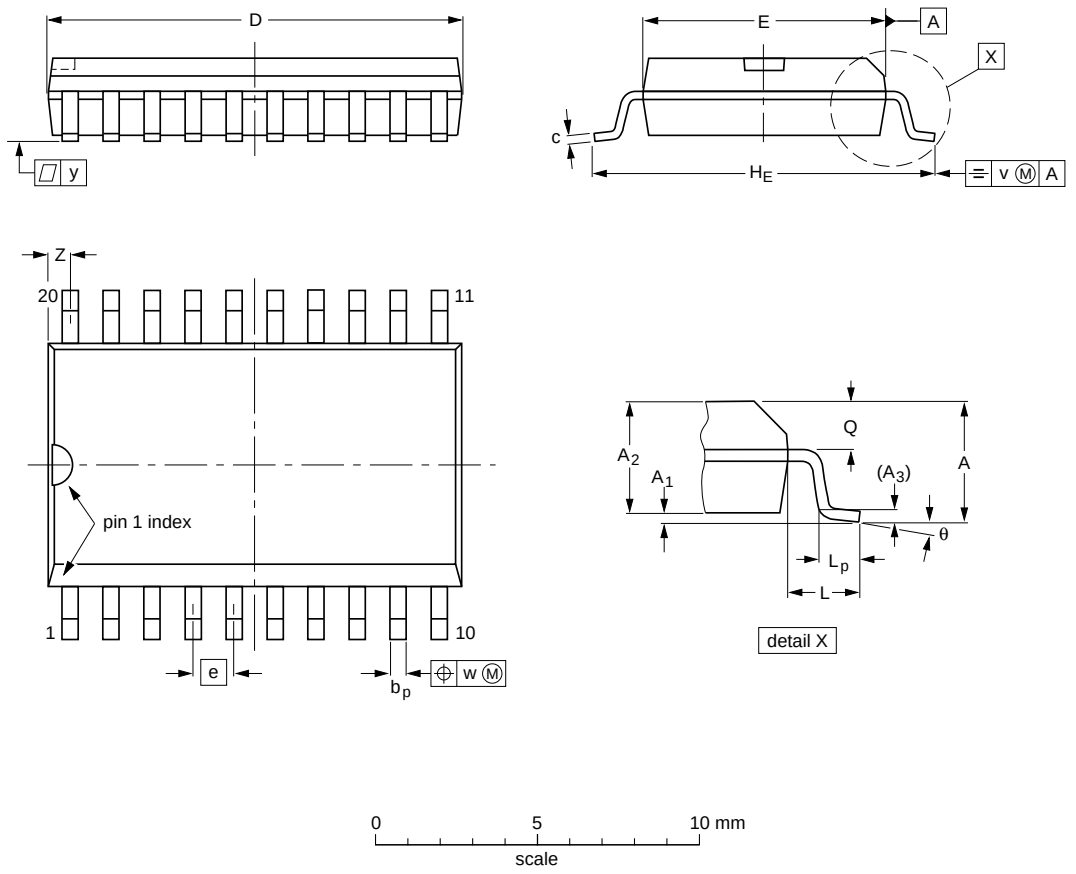
Fig 7. Test circuit for measuring switching times

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

12. 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_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	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^o 0^o
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	

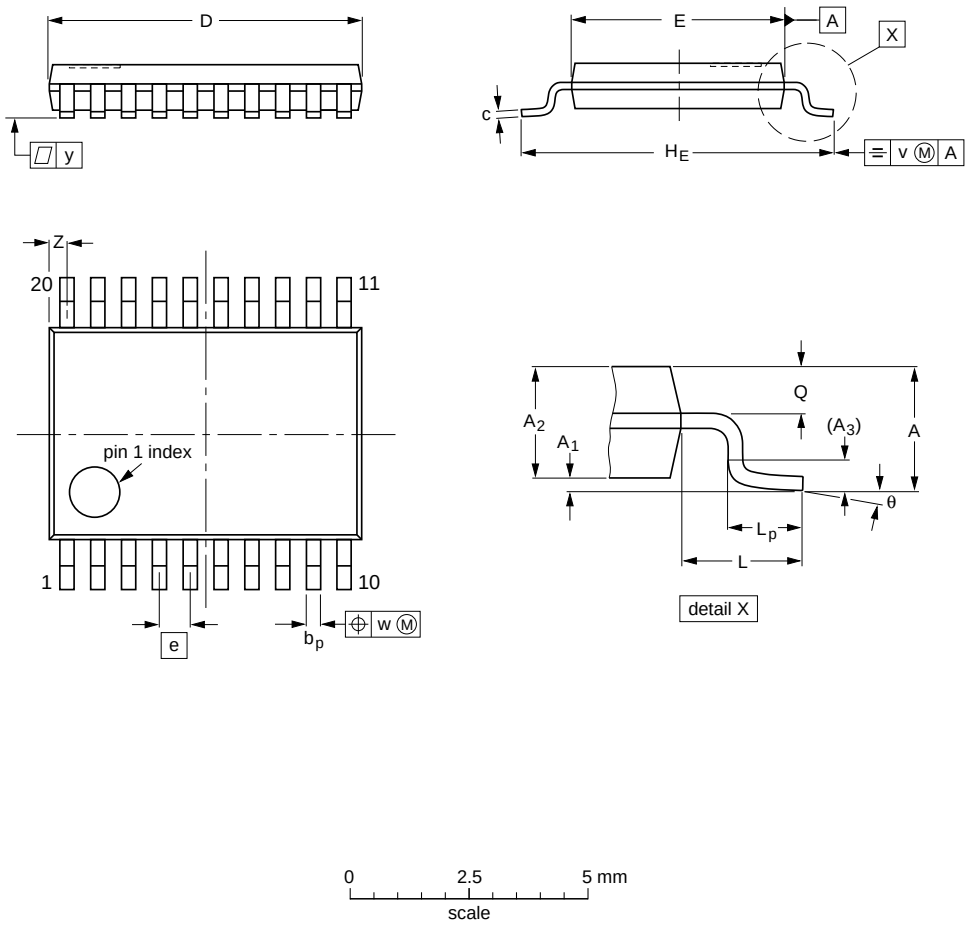
Note

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

Fig 8. Package outline SOT163-1 (SO20)

TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm **SOT360-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (2)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	6.6 6.4	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.5 0.2	8^o 0^o

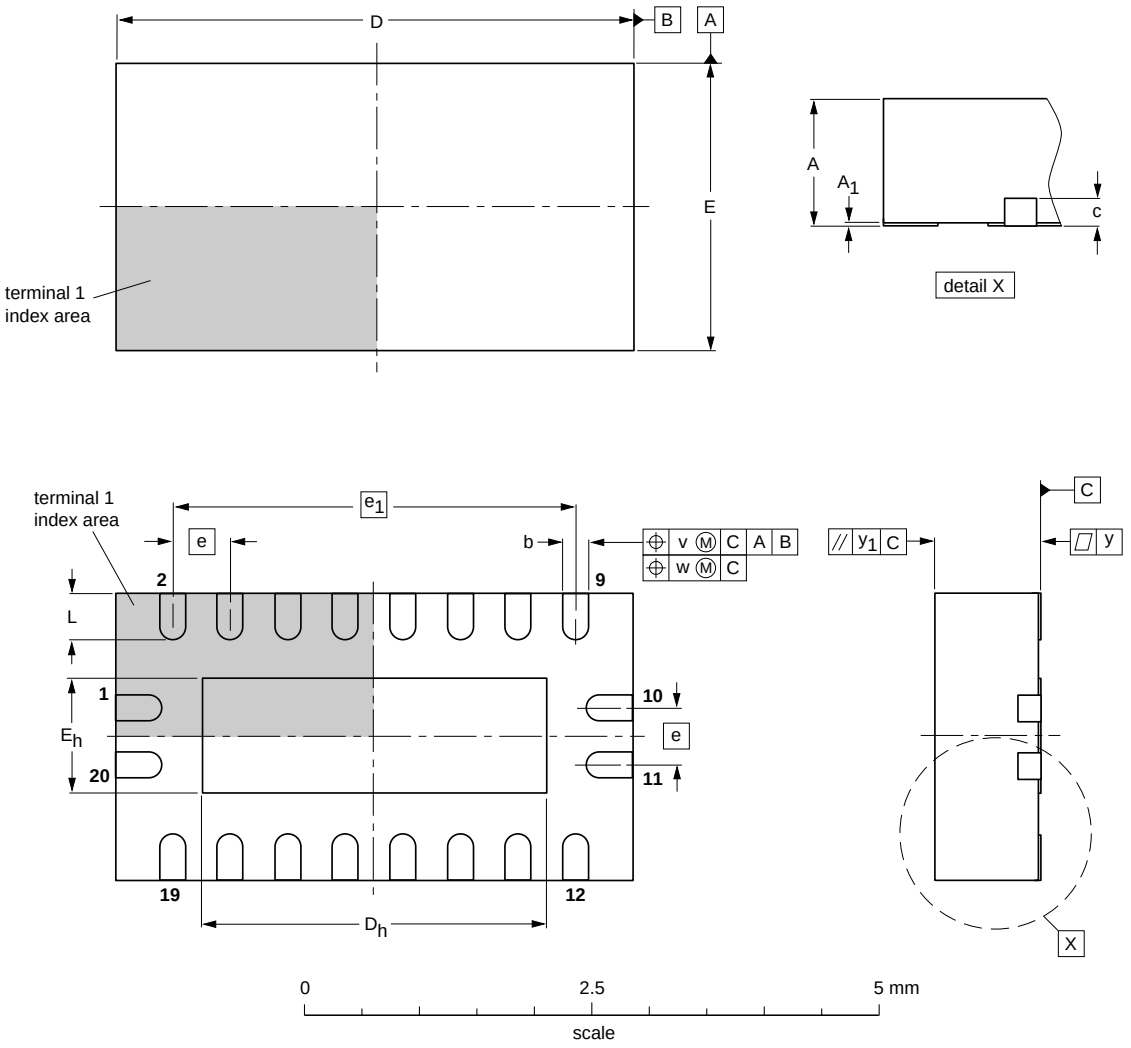
Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT360-1		MO-153				~~99-12-27~~ 03-02-19

Fig 9. 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**



DIMENSIONS (mm are the original dimensions)

UNIT	A(1) max.	A_1	b	c	D(1)	D_h	E(1)	E_h	e	e_1	L	v	w	y	y_1
mm	1	0.05 0.00	0.30 0.18	0.2	4.6 4.4	3.15 2.85	2.6 2.4	1.15 0.85	0.5	3.5	0.5 0.3	0.1	0.05	0.05	0.1

Note

1. Plastic or metal protrusions of 0.075 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT764-1	- - -	MO-241	- - -			~~02-10-17~~ 03-01-27

Fig 10. Package outline SOT764-1 (DHVQFN20)

13. 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
MM	Machine Model
TTL	Transistor-Transistor Logic
MIL	Military

14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVC_LVCH245A_Q100 v.1	20120903	Product data sheet	-	-

15. Legal information

15.1 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".

[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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17. Contents

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