

74LVCH16541A

16-bit buffer/line driver; 3-state

Rev. 4 — 1 May 2019

Product data sheet

1. General description

The 74LVCH16541A is a 16-bit buffer/line driver with 3-state outputs. The 3-state outputs are controlled by the output enable inputs ($1\overline{O}E_n$ and $2\overline{O}E_n$). A HIGH on $n\overline{O}E_n$ causes the outputs to assume a high-impedance OFF-state.

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.

Bus hold on data inputs eliminates the need for external pull-up resistors to hold unused inputs.

2. Features and benefits

- 5 Volt tolerant inputs and outputs for interfacing with 5 V logic
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low-power consumption
- MULTIBYTE flow-through standard pin-out architecture
- Low inductance multiple power and ground pins for minimum noise and ground bounce
- Direct interface with TTL levels
- High-impedance outputs when $V_{CC} = 0$ V
- All data inputs have bus hold
- 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 JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-B exceeds 200 V
 - CDM JESD22-C101E 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
74LVCH16541ADGG	-40 to +125 °C	TSSOP48	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	SOT362-1

4. Functional diagram

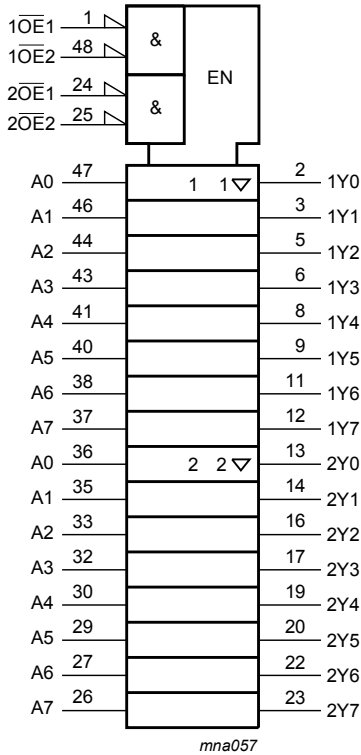


Fig. 1. IEC logic symbol

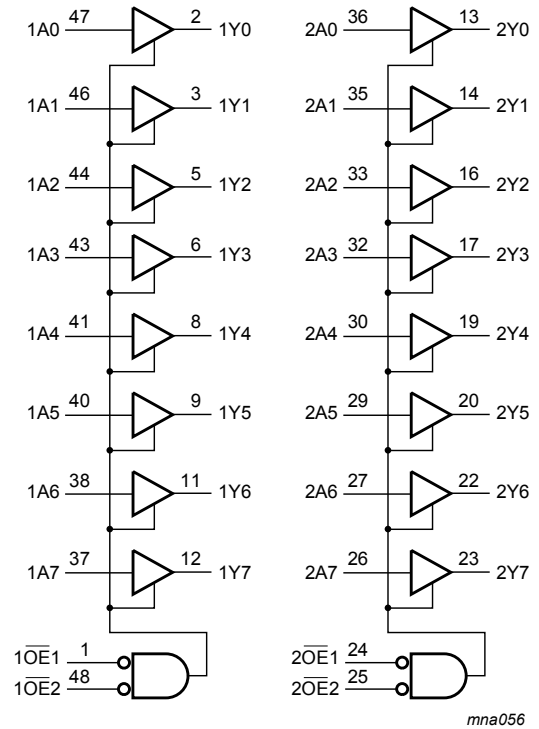


Fig. 2. Logic diagram

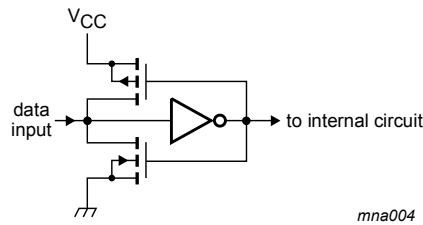


Fig. 3. Bus hold circuit

5. Pinning information

5.1. Pinning

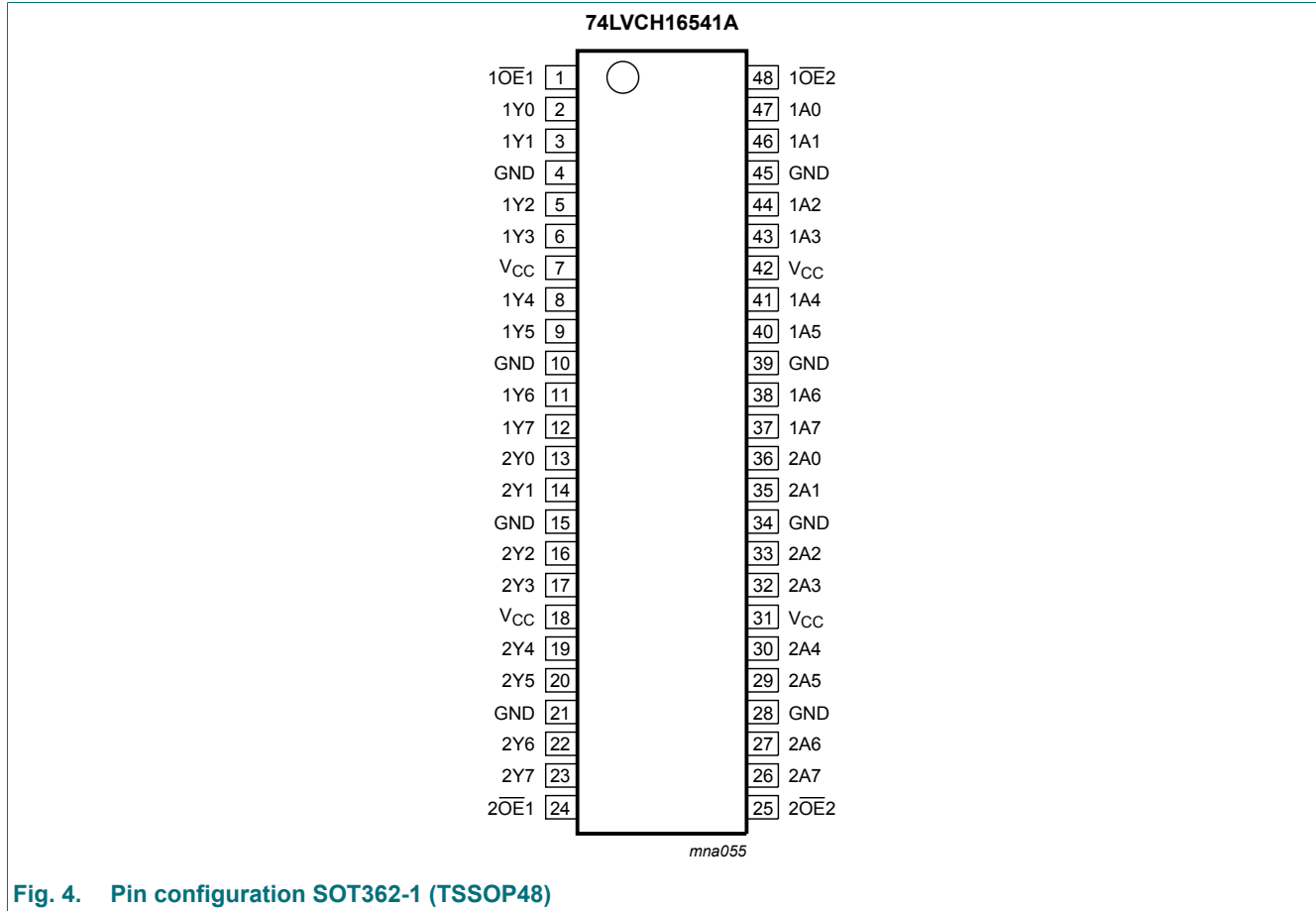


Fig. 4. Pin configuration SOT362-1 (TSSOP48)

5.2. Pin description

Table 2. Pin description

Name	Pin	Description
1OE1	1	output enable input (active LOW)
1OE2	48	output enable input (active LOW)
2OE1	24	output enable input (active LOW)
2OE2	25	output enable input (active LOW)
GND	4, 10, 15, 21, 28, 34, 39, 45	ground (0 V)
V _{CC}	7, 18, 31, 42	positive supply voltage
1Y0, 1Y1, 1Y2, 1Y3, 1Y4, 1Y5, 1Y6, 1Y7	2, 3, 5, 6, 8, 9, 11, 12	data output
2Y0, 2Y1, 2Y2, 2Y3, 2Y4, 2Y5, 2Y6, 2Y7	13, 14, 16, 17, 19, 20, 22, 23	data output
1A0, 1A1, 1A2, 1A3, 1A4, 1A5, 1A6, 1A7	47, 46, 44, 43, 41, 40, 38, 37	data input
2A0, 2A1, 2A2, 2A3, 2A4, 2A5, 2A6, 2A7	36, 35, 33, 32, 30, 29, 27, 26	data input

6. Functional description

Table 3. Function table

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

Input			Output
nOE1	nOE2	nAn	nYn
L	L	L	L
L	L	H	H
X	H	X	Z
H	X	X	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	+6.5	V	
V_I	input voltage	[1]	-0.5	+6.5	V	
I_{IK}	input clamping current	$V_I < 0$	-50	-	mA	
I_{OK}	output clamping current	$V_O > V_{CC}$ or $V_O < 0$	-	± 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] Above 60 °C the value of P_{tot} derates linearly with 5.5 mW/K.

8. Recommended operating conditions

Table 5. Recommended operating operations

Symbol	Parameter	Conditions	Min	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 or $V_{CC} = 0$ V	0	5.5	V
T_{amb}	ambient temperature	in free air	-40	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 1.65$ 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	0.65V _{CC}	-	-	0.65V _{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	-	-	0.35V _{CC}	-	0.35V _{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}	-	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 _{CC} = 3.6 V; V _I = 5.5 V or GND [2]	-	±0.1	±5	-	±20	µA
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 [2]	-	±0.1	±5	-	±20	µA
I _{OFF}	power-off leakage supply	V _{CC} = 0 V; V _I or V _O = 5.5 V	-	±0.1	±10	-	±20	µA
I _{CC}	supply current	V _{CC} = 3.6 V; V _I = V _{CC} or GND; I _O = 0 A	-	0.1	20	-	80	µA
ΔI _{CC}	additional supply current	per input pin; V _{CC} = 1.65 V to 3.6 V; V _I = V _{CC} - 0.6 V; I _O = 0 A	-	5	500	-	5000	µA
C _I	input capacitance	V _{CC} = 0 V to 3.6 V; V _I = GND to V _{CC}	-	5.0	-	-	-	pF

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
I _{BHL}	bus hold LOW current	V _{CC} = 1.65; V _I = 0.58 V [3][4]	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 [3][4]	-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 [3][5]	200	-	-	200	-	µA
		V _{CC} = 2.7 V	300	-	-	300	-	µA
		V _{CC} = 3.6 V	500	-	-	500	-	µA
I _{BHHO}	bus hold HIGH overdrive current	V _{CC} = 1.95 V [3][5]	-200	-	-	-200	-	µA
		V _{CC} = 2.7 V	-300	-	-	-300	-	µA
		V _{CC} = 3.6 V	-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 pin.

[3] For data inputs only; control inputs do not have a bus hold circuit.

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

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

10. Dynamic characteristics

Table 7. Dynamic characteristics

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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
t _{pd}	propagation delay	nAn to nYn; see Fig. 5 [2]						
		V _{CC} = 1.2 V	-	10	-	-	-	ns
		V _{CC} = 1.65 V to 1.95 V	1.8	4.7	10.4	1.8	12.0	ns
		V _{CC} = 2.3 V to 2.7 V	1.5	2.6	5.2	1.5	6.0	ns
		V _{CC} = 2.7 V	1.0	2.5	5.0	1.0	6.5	ns
		V _{CC} = 3.0 V to 3.6 V	1.0	2.2	4.2	1.0	5.5	ns
t _{en}	enable time	n \bar{O} En to nYn; see Fig. 6 [2]						
		V _{CC} = 1.2 V	-	17	-	-	-	ns
		V _{CC} = 1.65 V to 1.95 V	1.5	5.5	14.6	1.5	16.8	ns
		V _{CC} = 2.3 V to 2.7 V	1.0	3.2	7.7	1.0	8.9	ns
		V _{CC} = 2.7 V	1.5	3.4	6.9	1.5	9.0	ns
		V _{CC} = 3.0 V to 3.6 V	1.0	2.6	5.6	1.0	7.0	ns
t _{dis}	disable time	n \bar{O} En to nYn; see Fig. 6 [2]						
		V _{CC} = 1.2 V	-	9.0	-	-	-	ns
		V _{CC} = 1.65 V to 1.95 V	2.6	7.3	9.2	2.6	10.6	ns
		V _{CC} = 2.3 V to 2.7 V	1.0	4.1	5.2	1.0	6.0	ns
		V _{CC} = 2.7 V	1.5	4.6	6.5	1.5	8.5	ns
		V _{CC} = 3.0 V to 3.6 V	1.5	4.5	5.5	1.5	7.0	ns
t _{sk(0)}	output skew time	nYn; V _{CC} = 3.0 V to 3.6 V [3]	-	-	1.0	-	1.5	ns

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ [1]	Max	Min	Max	
C _{PD}	power dissipation capacitance	per input; V _I = GND to V _{CC} [4]						
		V _{CC} = 1.65 V to 1.95 V	-	8.5	-	-	-	pF
		V _{CC} = 2.3 V to 2.7 V	-	12.1	-	-	-	pF
		V _{CC} = 3.0 V to 3.6 V	-	15.3	-	-	-	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 μW).
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$ 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
 Σ(C_L × V_{CC}² × f_o) = sum of the outputs

10.1. Waveforms and test circuit

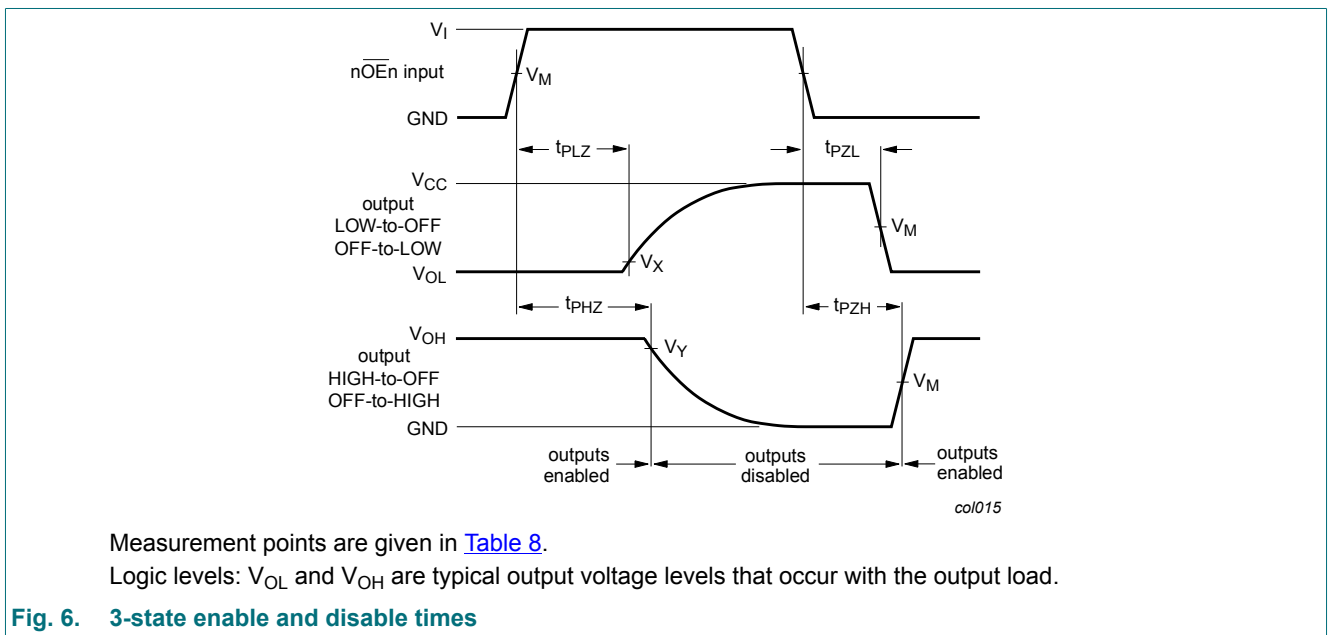
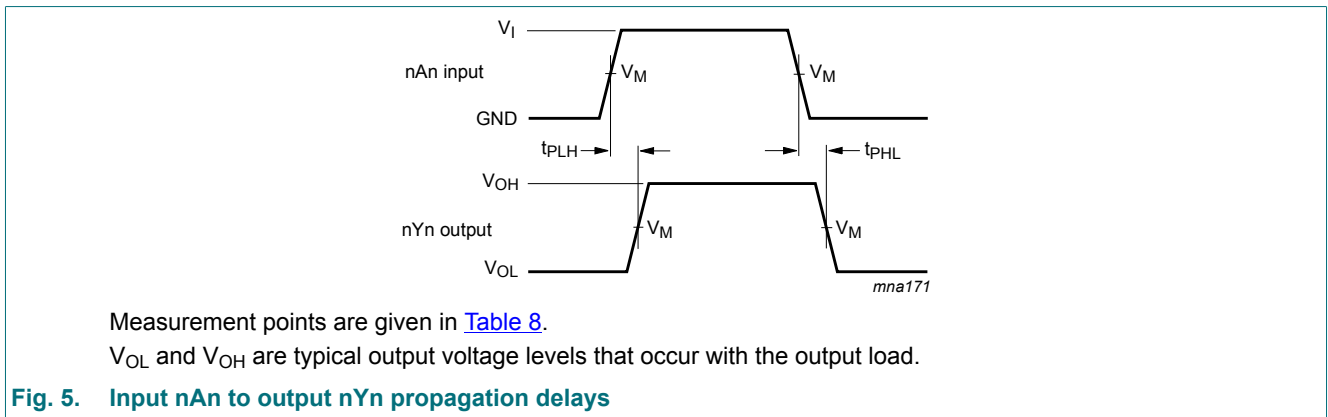
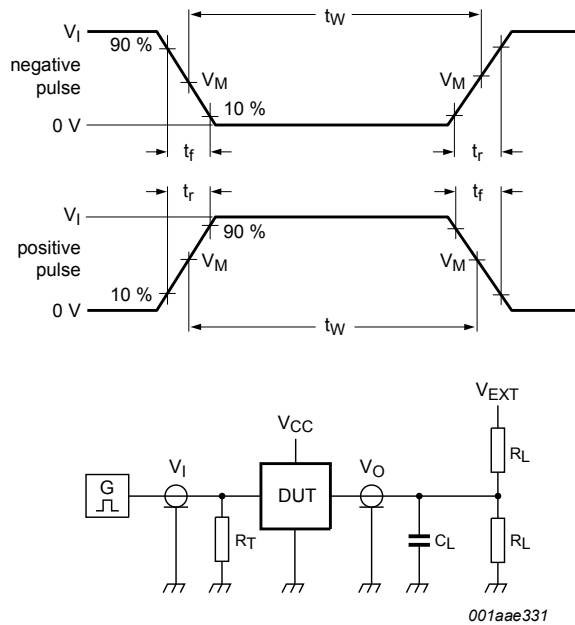


Table 8. Measurement points

Supply voltage	Input		Output		
V_{CC}	V_I	V_M	V_M	V_X	V_Y
1.2 V	V_{CC}	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
1.65 V to 1.95 V	V_{CC}	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
2.3 V to 2.7 V	V_{CC}	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
2.7 V	2.7 V	1.5 V	1.5 V	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$
3.0 V to 3.6 V	2.7 V	1.5 V	1.5 V	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$



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}	$\leq 2 \text{ ns}$	30 pF	1 k Ω	open	$2 \times V_{CC}$	GND
1.65 V to 1.95 V	V_{CC}	$\leq 2 \text{ ns}$	30 pF	1 k Ω	open	$2 \times V_{CC}$	GND
2.3 V to 2.7 V	V_{CC}	$\leq 2 \text{ ns}$	30 pF	500 Ω	open	$2 \times V_{CC}$	GND
2.7 V	2.7 V	$\leq 2.5 \text{ ns}$	50 pF	500 Ω	open	$2 \times V_{CC}$	GND
3.0 V to 3.6 V	2.7 V	$\leq 2.5 \text{ ns}$	50 pF	500 Ω	open	$2 \times V_{CC}$	GND

11. Package outline

TSSOP48: plastic thin shrink small outline package; 48 leads; body width 6.1 mm

SOT362-1

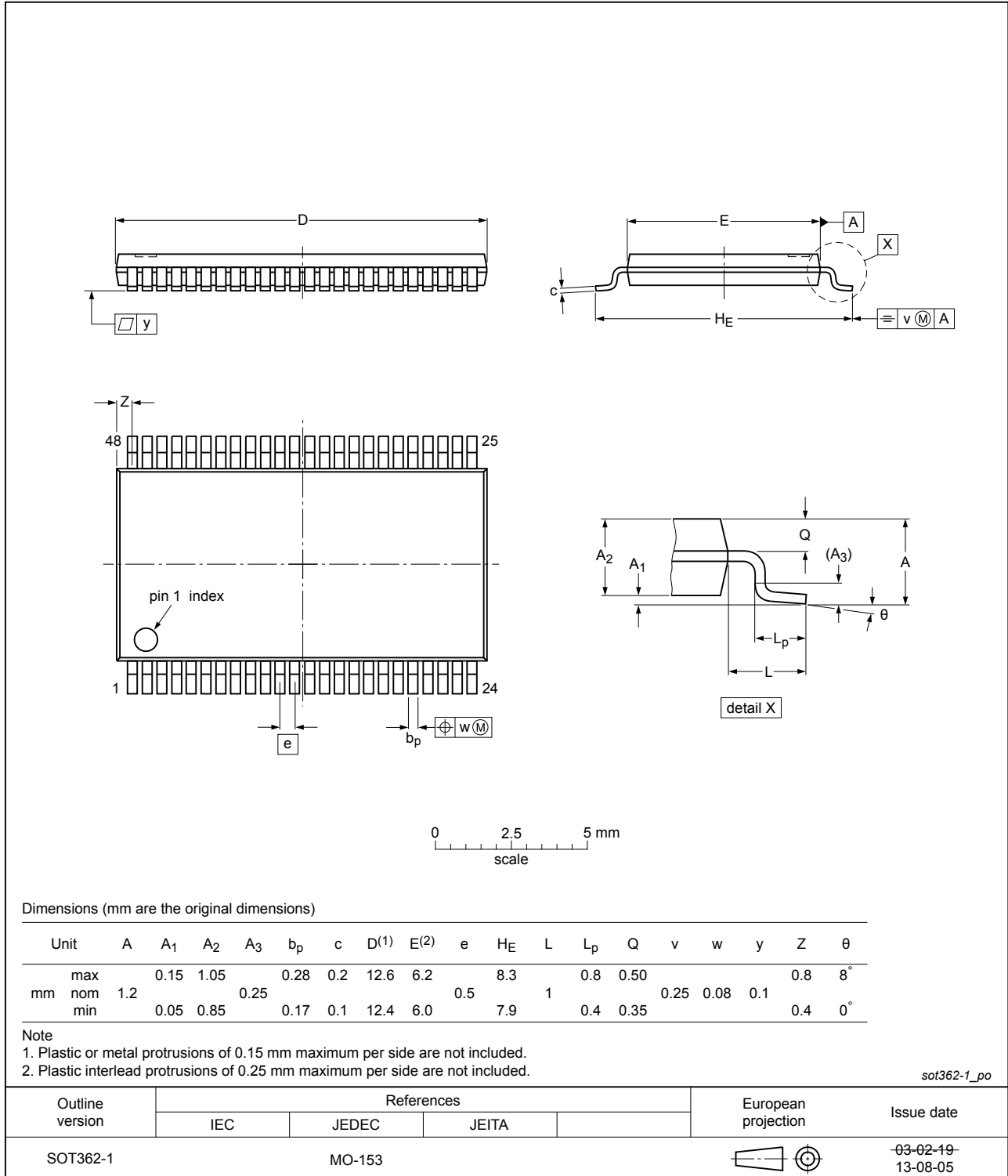


Fig. 8. Package outline SOT362-1 (TSSOP48)

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
MM	Machine Model
TTL	Transistor-Transistor Logic

13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74LVCH16541A v.4	20190501	Product data sheet	-	74LVCH16541A v.3
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 74LVCH16541ADL (SOT370-1) removed. Package outline drawing SOT362-1 (TSSOP48) updated. Typo corrected in Table 8. 			
74LVCH16541A v.3	20120215	Product data sheet	-	74LVCH16541A v.2
Modifications:	<ul style="list-style-type: none"> The format of this data sheet 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. 			
74LVCH16541A v.2	20040218	Product specification	-	74LVCH16541A v.1
74LVCH16541A v.1	19980519	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.
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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Contents

1. General description	1
2. Features and benefits	1
3. Ordering information	1
4. Functional diagram	2
5. Pinning information	3
5.1. Pinning.....	3
5.2. Pin description.....	3
6. Functional description	4
7. Limiting values	4
8. Recommended operating conditions	4
9. Static characteristics	5
10. Dynamic characteristics	6
10.1. Waveforms and test circuit.....	7
11. Package outline	9
12. Abbreviations	10
13. Revision history	10
14. Legal information	11

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