

74LVC16374A; 74LVCH16374A

16-bit edge-triggered D-type flip-flop; 5 V tolerant; 3-state

Rev. 13 — 27 September 2021

Product data sheet

1. General description

The 74LVC16374A; 74LVCH16374A is a 16-bit edge-triggered D-type flip-flop with 3-state outputs. The device can be used as two 8-bit flip-flops or one 16-bit flip-flop. The device features two clocks (1CP and 2CP) and two output enables (1 \overline{OE} and 2 \overline{OE}), each controlling 8-bits. The flip-flops will store the state of their individual D-inputs that meet the set-up and hold time requirements on the LOW-to-HIGH clock (nCP) transition. A HIGH on n \overline{OE} causes the outputs to assume a high-impedance OFF-state. Operation of the n \overline{OE} input does not affect the state of the flip-flops. 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 dissipation
- Multibyte flow-through standard pinout architecture
- Low inductance multiple supply pins for minimum noise and ground bounce
- Direct interface with TTL levels
- All data inputs have bus hold (74LVCH16374A only)
- High-impedance outputs when V_{CC} = 0 V
- I_{OFF} circuitry provides partial Power-down mode operation
- 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
74LVC16374ADGG	-40 °C to +125 °C	TSSOP48	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	SOT362-1
74LVCH16374ADGG				

4. Functional diagram

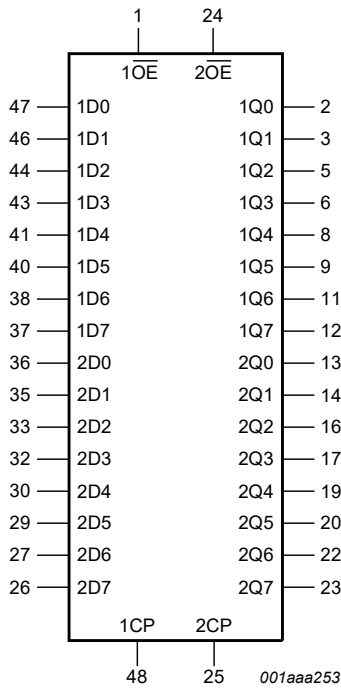


Fig. 1. Logic symbol

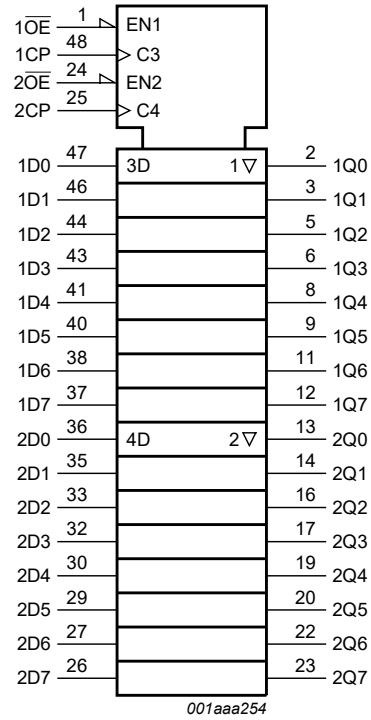


Fig. 2. IEC logic symbol

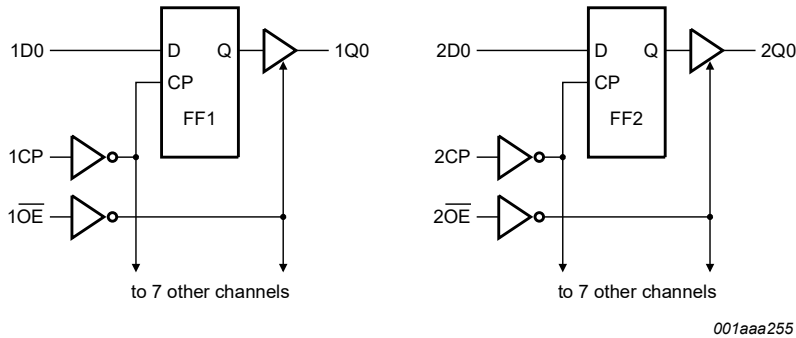


Fig. 3. Logic diagram

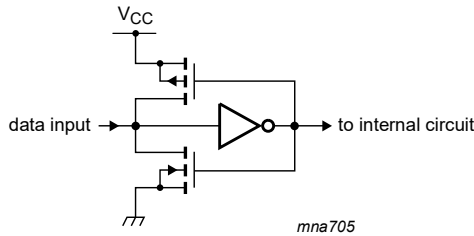


Fig. 4. Bus hold circuit

5. Pinning information

5.1. Pinning

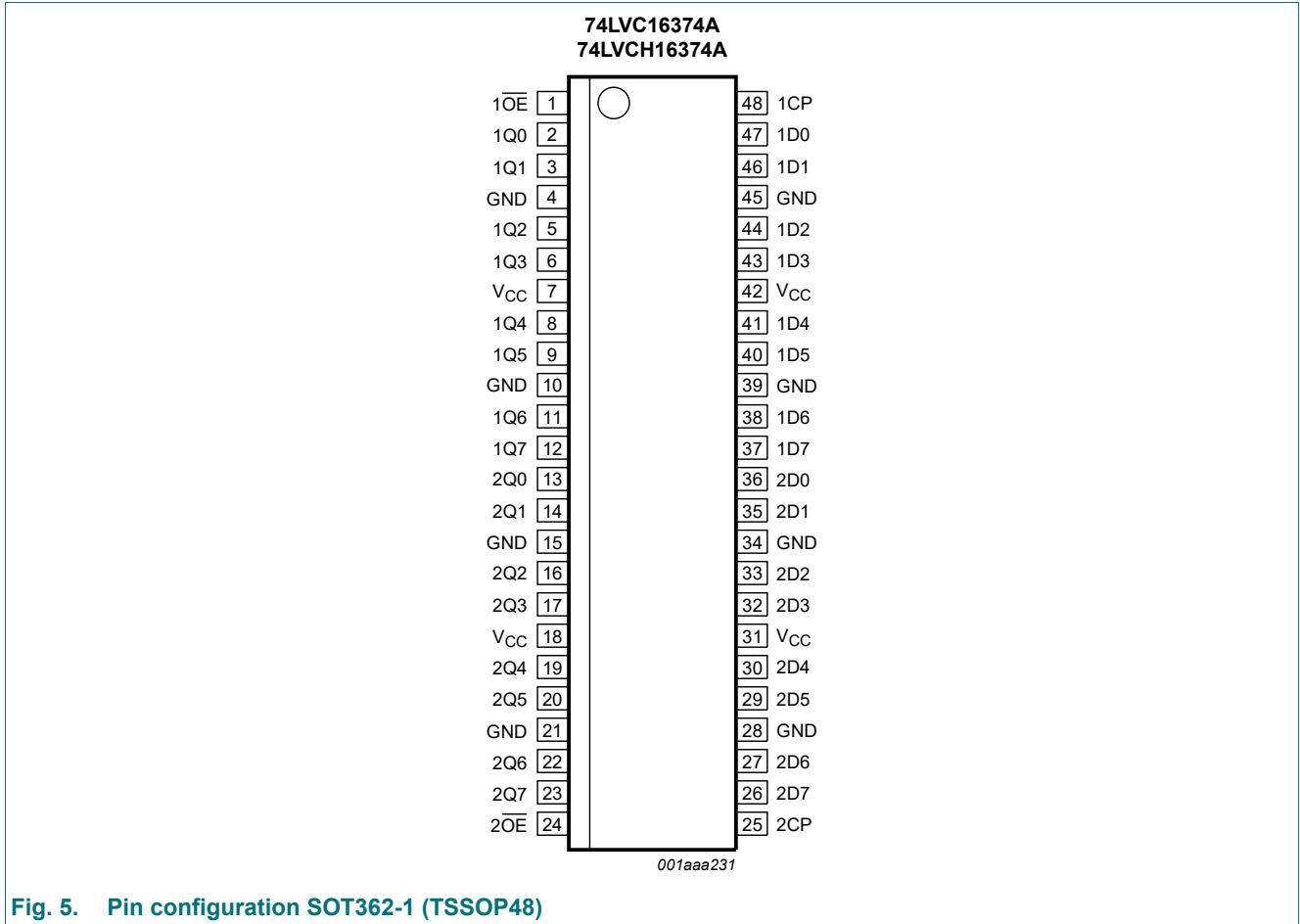


Fig. 5. Pin configuration SOT362-1 (TSSOP48)

5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
1OE, 2OE	1, 24	output enable input (active LOW)
GND	4, 10, 15, 21, 28, 34, 39, 45	ground (0 V)
V _{CC}	7, 18, 31, 42	supply voltage
1Q0, 1Q1, 1Q2, 1Q3, 1Q4, 1Q5, 1Q6, 1Q7	2, 3, 5, 6, 8, 9, 11, 12	data output
2Q0, 2Q1, 2Q2, 2Q3, 2Q4, 2Q5, 2Q6, 2Q7	13, 14, 16, 17, 19, 20, 22, 23	data output
1D0, 1D1, 1D2, 1D3, 1D4, 1D5, 1D6, 1D7	47, 46, 44, 43, 41, 40, 38, 37	data input
2D0, 2D1, 2D2, 2D3, 2D4, 2D5, 2D6, 2D7	36, 35, 33, 32, 30, 29, 27, 26	data input
1CP, 2CP	48, 25	clock input

6. Functional description

Table 3. Function selection

*H = HIGH voltage level; h = HIGH voltage level one set-up time prior to the HIGH-to-LOW CP transition;
L = LOW voltage level; l = LOW voltage level one set-up time prior to the HIGH-to-LOW CP transition;
Z = high-impedance OFF-state; ↑ = LOW-to-HIGH transition.*

Operating mode	Input			Internal flip-flop	Output nQ0 to nQ7
	nOE	nCP	nDn		
Load and read register	L	↑	l	L	L
	L	↑	h	H	H
Load register and disable outputs	H	↑	l	L	Z
	H	↑	h	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	+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 SOT362-1 (TSSOP48) packages: P_{tot} derates linearly with 12.2 mW/K above 109 °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	active mode	0	-	V _{CC}	V
		power-down mode; V _{CC} = 0 V	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	0.65V _{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	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 current	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} = 2.7 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
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

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
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] Valid for data inputs (74LVCH16374A) 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

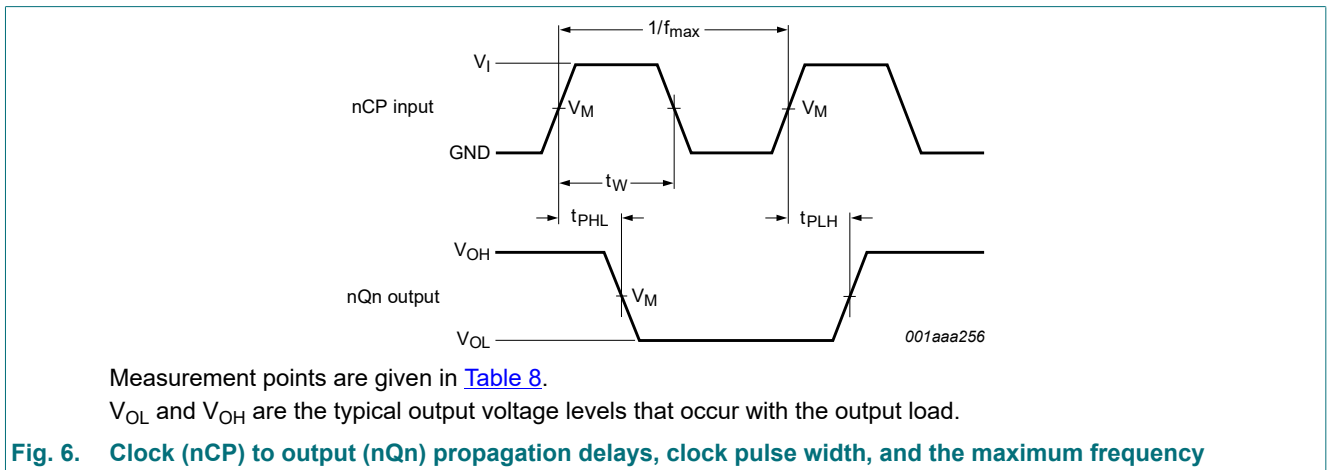
Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 9.

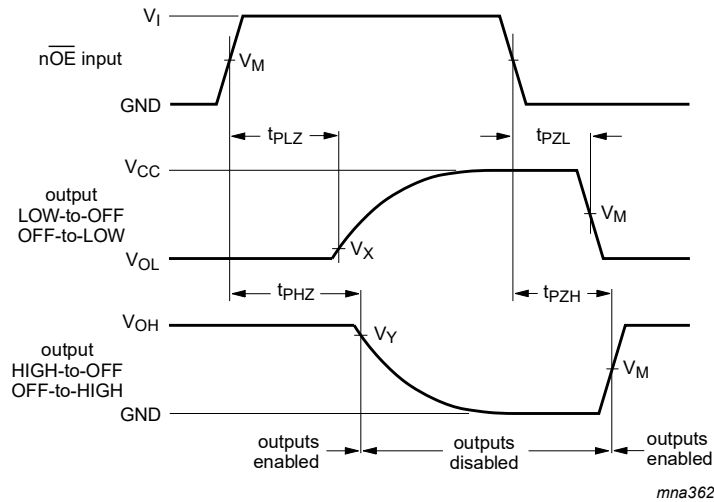
Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	
t _{pd}	propagation delay	nCP to nQn; see Fig. 6 [2]						
		V _{CC} = 1.2 V	-	14	-	-	-	ns
		V _{CC} = 1.65 V to 1.95 V	2.1	6.9	13.5	2.1	15.6	ns
		V _{CC} = 2.3 V to 2.7 V	1.5	3.7	6.7	1.5	7.7	ns
		V _{CC} = 2.7 V	1.5	3.4	6.0	1.5	7.5	ns
		V _{CC} = 3.0 V to 3.6 V	1.5	3.1	5.4	1.5	7.0	ns
t _{en}	enable time	n $\overline{\text{OE}}$ to nQn; see Fig. 7 [2]						
		V _{CC} = 1.2 V	-	20	-	-	-	ns
		V _{CC} = 1.65 V to 1.95 V	1.5	5.9	13.1	1.5	15.1	ns
		V _{CC} = 2.3 V to 2.7 V	1.5	3.4	6.9	1.5	8.0	ns
		V _{CC} = 2.7 V	1.5	3.6	6.0	1.5	7.5	ns
		V _{CC} = 3.0 V to 3.6 V	1.0	2.7	5.2	1.0	6.5	ns
t _{dis}	disable time	n $\overline{\text{OE}}$ to nQn; see Fig. 7 [2]						
		V _{CC} = 1.2 V	-	12	-	-	-	ns
		V _{CC} = 1.65 V to 1.95 V	2.8	4.6	9.1	2.8	10.5	ns
		V _{CC} = 2.3 V to 2.7 V	1.0	2.5	4.9	1.0	5.7	ns
		V _{CC} = 2.7 V	1.5	3.4	5.1	1.5	6.5	ns
		V _{CC} = 3.0 V to 3.6 V	1.5	3.1	4.9	1.5	6.5	ns
t _w	pulse width	nCP HIGH; see Fig. 6						
		V _{CC} = 1.65 V to 1.95 V	5.0	-	-	5.0	-	ns
		V _{CC} = 2.3 V to 2.7 V	4.0	-	-	4.0	-	ns
		V _{CC} = 2.7 V	3.0	-	-	3.0	-	ns
		V _{CC} = 3.0 V to 3.6 V	3.0	1.5	-	3.0	-	ns

Symbol	Parameter	Conditions	-40 °C to +85 °C			-40 °C to +125 °C		Unit	
			Min	Typ[1]	Max	Min	Max		
t _{su}	set-up time	nDn to nCP; see Fig. 8							
		V _{CC} = 1.65 V to 1.95 V	4.0	-	-	4.0	-	ns	
		V _{CC} = 2.3 V to 2.7 V	3.0	-	-	3.0	-	ns	
		V _{CC} = 2.7 V	1.9	-	-	1.9	-	ns	
t _h	hold time	nDn to nCP; see Fig. 8							
		V _{CC} = 1.65 V to 1.95 V	3.0	-	-	3.0	-	ns	
		V _{CC} = 2.3 V to 2.7 V	2.5	-	-	2.5	-	ns	
		V _{CC} = 2.7 V	1.1	-	-	1.1	-	ns	
f _{max}	maximum frequency	see Fig. 6							
		V _{CC} = 1.65 V to 1.95 V	100	-	-	80	-	ns	
		V _{CC} = 2.3 V to 2.7 V	125	-	-	100	-	ns	
		V _{CC} = 2.7 V	150	-	-	120	-	MHz	
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	per input; V _I = GND to V _{CC} [4]					
		V _{CC} = 1.65 V to 1.95 V	-	14.1	-	-	-	pF	
		V _{CC} = 2.3 V to 2.7 V	-	16.4	-	-	-	pF	
C _{PD}	power dissipation capacitance	V _{CC} = 3.0 V to 3.6 V	-	18.5	-	-	-	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

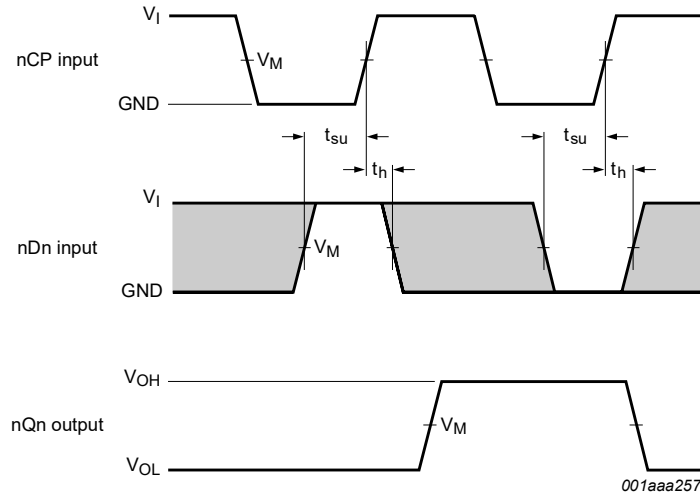




Measurement points are given in [Table 8](#).

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

Fig. 7. 3-state enable and disable times



Measurement points are given in [Table 8](#).

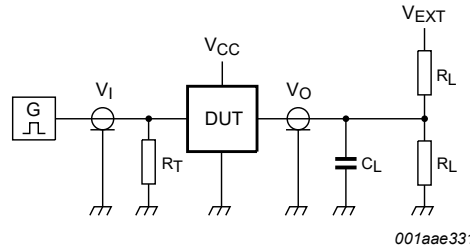
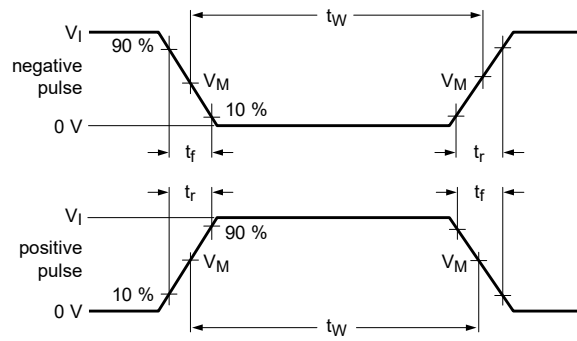
The shaded areas indicate when the input is permitted to change for predictable performance.

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

Fig. 8. Data set-up and hold times for the nDn input to the nCP input

Table 8. Measurement points

Supply voltage	Input		Output		
	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	$V_{OL} + 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$



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

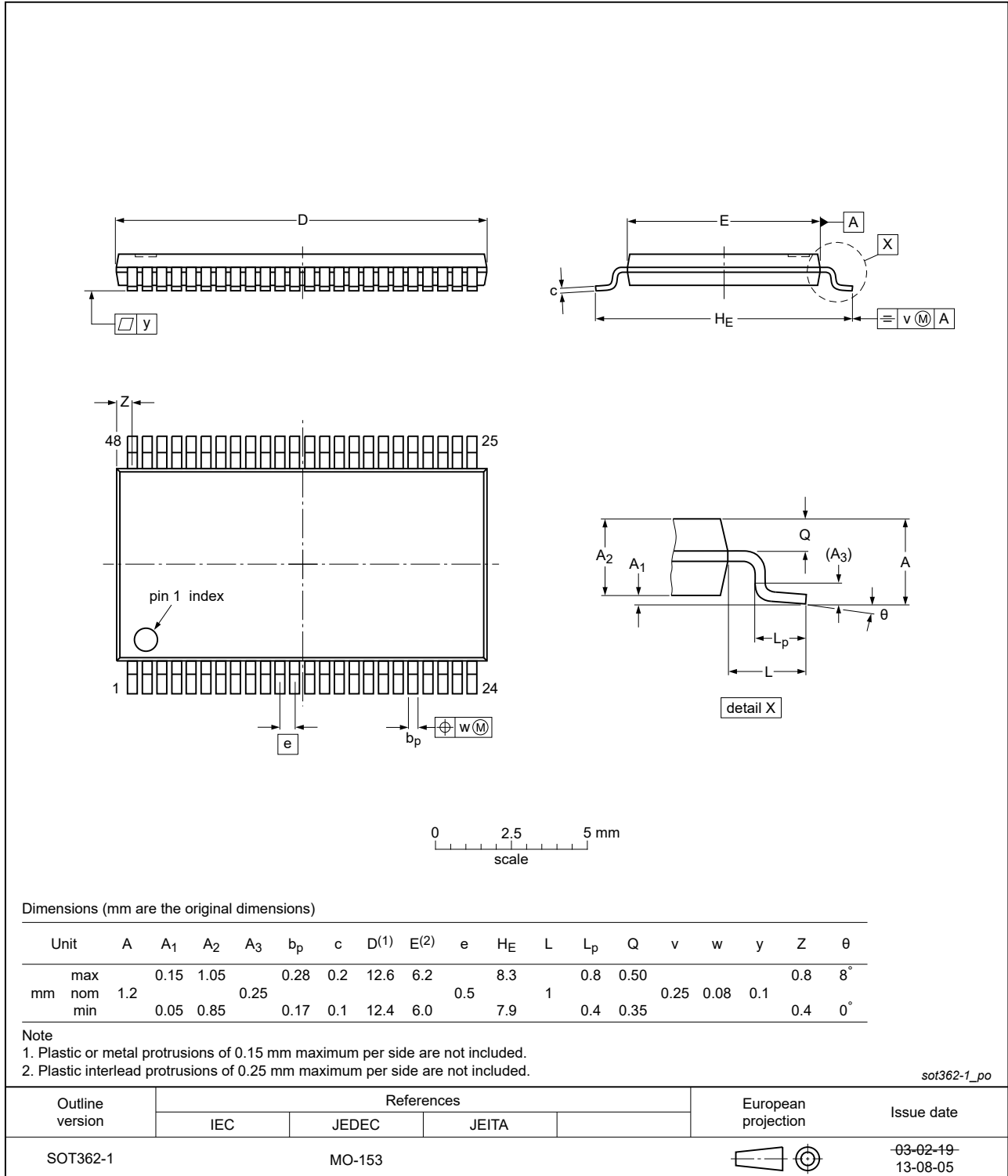


Fig. 10. Package outline SOT362-1 (TSSOP48)

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
74LVC_LVCH16374A v.13	20210927	Product data sheet	-	74LVC_LVCH16374A v.12
Modifications:	<ul style="list-style-type: none"> • Section 1 and Section 2 updated. • Type number 74LVC16374ADL (SOT370-1/SSOP48) removed. • Section 7: Derating values for P_{tot} total power dissipation updated. 			
74LVC_LVCH16374A v.12	20181120	Product data sheet	-	74LVC_LVCH16374A v.11
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 numbers 74LVCH16374ADL (SOT370-1/SSOP48), 74LVC16374ABX and 74LVCH16374ABX (SOT1134-1/HXQFN60U) removed. 			
74LVC_LVCH16374A v.11	20130116	Product data sheet	-	74LVC_LVCH16374A v.10
Modifications:	<ul style="list-style-type: none"> • Minor non-technical text changes and corrections • Document revision history correction 			
74LVC_LVCH16374A v.10	20120301	Product data sheet	-	74LVC_LVCH16374A v.9
74LVC_LVCH16374A v.9	20111219	Product data sheet	-	74LVC_LVCH16374A v.8
74LVC_LVCH16374A v.8	20110621	Product data sheet	-	74LVC_LVCH16374A v.7
74LVC_LVCH16374A v.7	20100323	Product data sheet	-	74LVC_LVCH16374A v.6
74LVC_LVCH16374A v.6	20090212	Product data sheet	-	74LVC_LVCH16374A v.5
74LVC_LVCH16374A v.5	20031212	Product specification	-	74LVC_H16374A v.4
74LVC_H16374A v.4	19980317	Product specification	-	74LVC16374A_74LVCH16374A v.3
74LVC16374A_74LVCH16374A v.3	19980317	Product specification	-	74LVC16374A v.2
74LVC16374A v.2	19970822	Product specification	-	74LVC16374A v.1
74LVC16374A v.1	-	-	-	-

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".
- [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 <https://www.nexperia.com>.

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