

# 74ALVCH16374

2.5 V/3.3 V 16-bit edge-triggered D-type flip-flop; 3-state

Rev. 7 — 23 November 2021

Product data sheet

## 1. General description

The 74ALVCH16374 is a 16-bit edge-triggered D-type flip-flop with bus hold inputs and 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. This device is fully specified for partial power down applications using I<sub>OFF</sub>. The I<sub>OFF</sub> circuitry disables the output, preventing the potentially damaging backflow current through the device when it is powered down..

## 2. Features and benefits

- Wide supply voltage range from 1.2 V to 3.6 V
- Complies with JEDEC standards:
  - JESD8-7 (1.65 V to 1.95 V)
  - JESD8-5 (2.3 V to 2.7 V)
  - JESD8C (2.7 V to 3.6 V)
- CMOS low power dissipation
- MULTIBYTE flow-through standard pin-out architecture
- Low inductance multiple V<sub>CC</sub> and GND pins for minimum noise and ground bounce
- Direct interface with TTL levels
- All data inputs have bus hold
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Output drive capability 50  $\Omega$  transmission lines at 85 °C
- I<sub>OFF</sub> circuitry provides partial Power-down mode operation
- Current drive  $\pm 24$  mA at V<sub>CC</sub> = 3.0 V
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-B exceeds 200 V
- Specified from -40 °C to +85 °C

## 3. Ordering information

Table 1. Ordering information

Type number	Temperature range	Package		
		Name	Description	Version
74ALVCH16374DGG	-40 °C to +85 °C	TSSOP48	plastic thin shrink small outline package; 48 leads; body width 6.1 mm	SOT362-1

4. Functional diagram

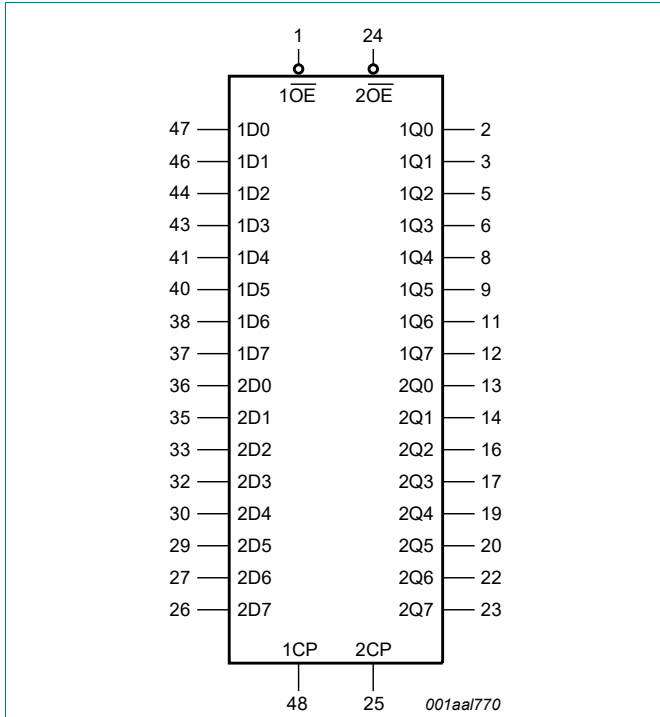


Fig. 1. Logic symbol

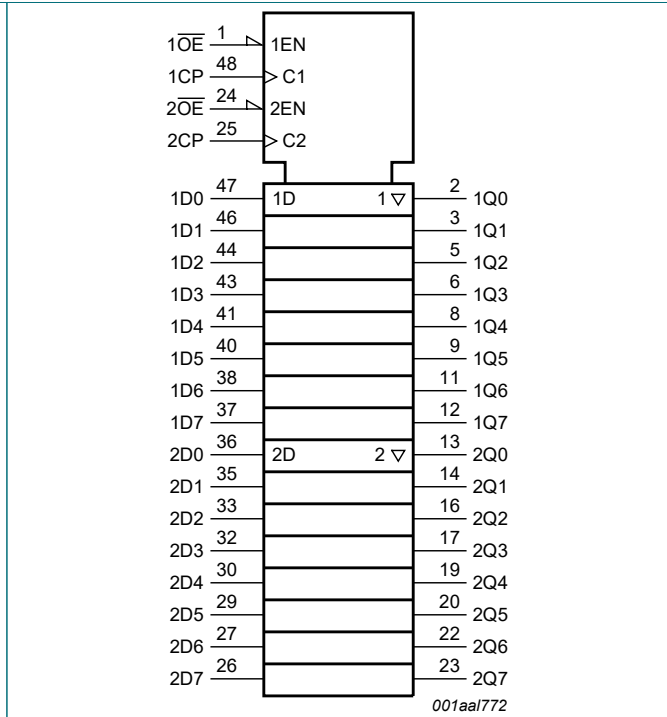


Fig. 2. IEC logic symbol

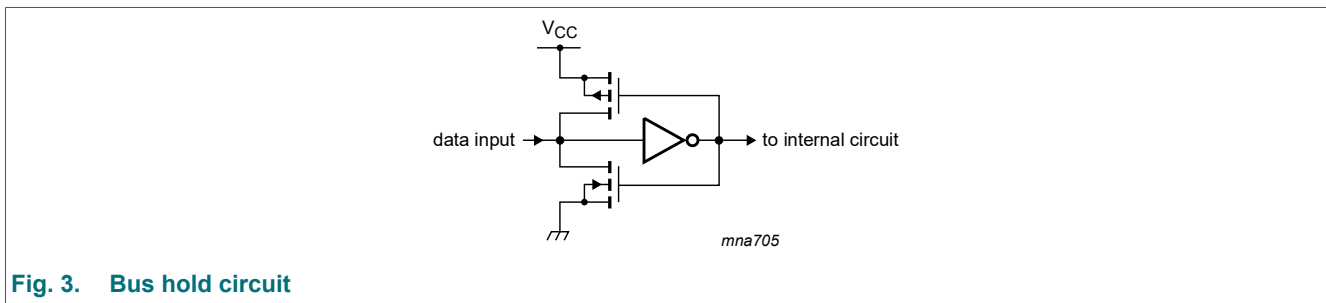


Fig. 3. Bus hold circuit

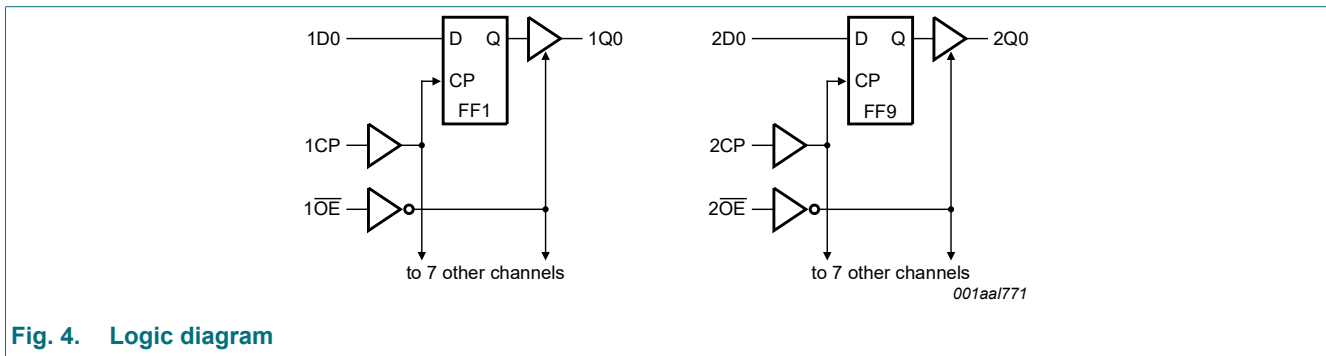
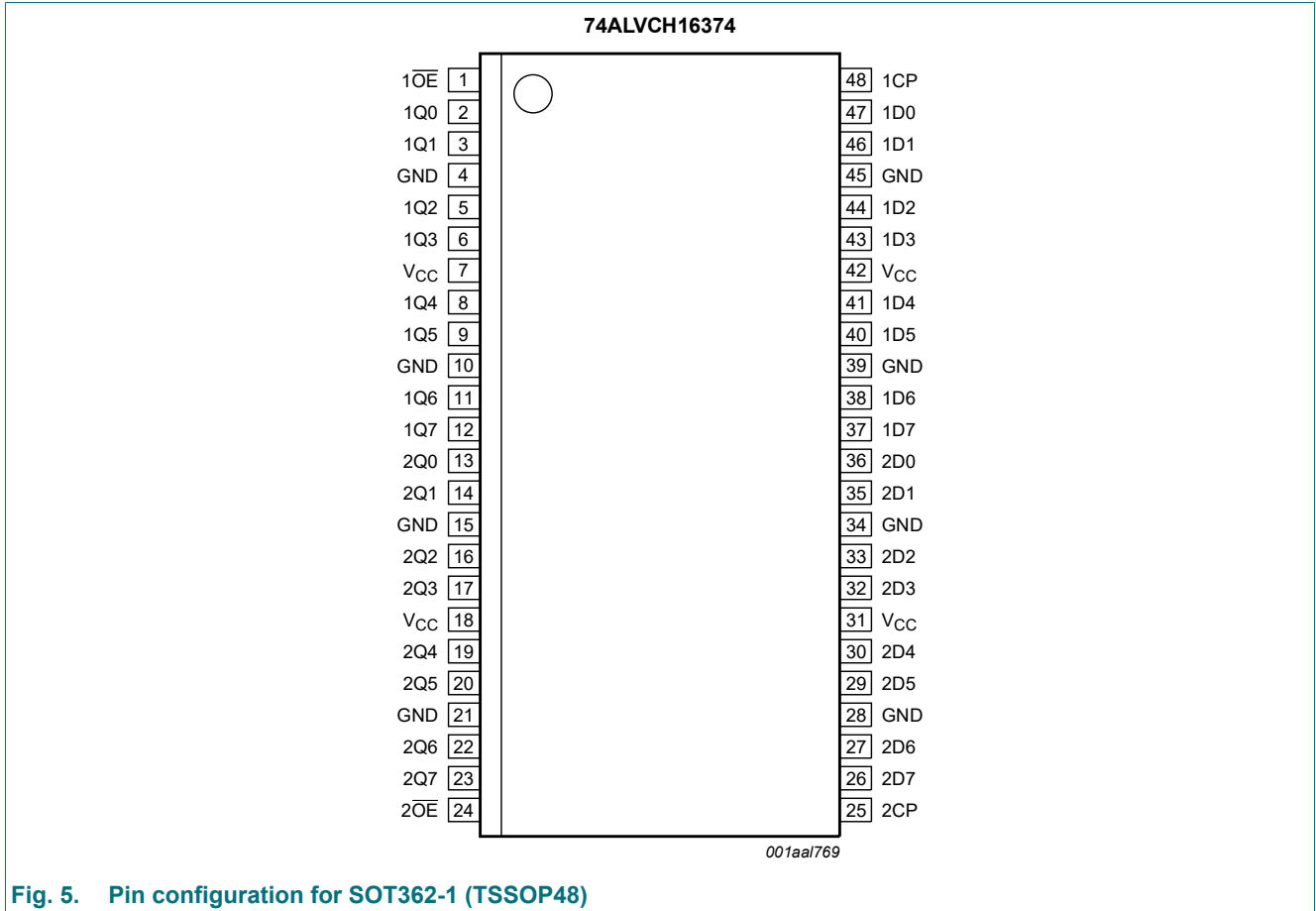


Fig. 4. Logic diagram

## 5. Pinning information

### 5.1. Pinning



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

### 5.2. Pin description

**Table 2. Pin description**

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

## 6. Functional description

**Table 3. Function table**

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

Inputs			Internal flip-flops	Outputs Q0 to Q7	Operating mode
nOE	nCP	nDn			
L	↑	l	L	L	load and read register
L	↑	h	H	H	
H	↑	l	L	Z	load register and disable outputs
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 <sub>CC</sub>	supply voltage		-0.5	+4.6	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < 0 V	-50	-	mA
V <sub>I</sub>	input voltage	control inputs [1]	-0.5	+4.6	V
		data inputs [1]	-0.5	V <sub>CC</sub> + 0.5	V
I <sub>OK</sub>	output clamping current	V <sub>O</sub> > V <sub>CC</sub> or V <sub>O</sub> < 0 V	-	±50	mA
V <sub>O</sub>	output voltage	[1]	-0.5	V <sub>CC</sub> + 0.5	V
I <sub>O</sub>	output current	V <sub>O</sub> = 0 V to V <sub>CC</sub>	-	±50	mA
I <sub>CC</sub>	supply current		-	100	mA
I <sub>GND</sub>	ground current		-100	-	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -40 °C to +85 °C	-	500	mW

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

## 8. Recommended operating conditions

**Table 5. Recommended operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>CC</sub>	supply voltage	maximum speed performance				
		C <sub>L</sub> = 30 pF	2.3	-	2.7	V
		C <sub>L</sub> = 50 pF	3.0	-	3.6	V
		low voltage applications	1.2	-	3.6	V
V <sub>I</sub>	input voltage	data inputs	0	-	V <sub>CC</sub>	V
		control inputs	0	-	5.5	V
V <sub>O</sub>	output voltage		0	-	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature	in free air	-40	-	+85	°C
Δt/ΔV	input transition rise and fall rate	V <sub>CC</sub> = 2.3 V to 3.0 V	0	-	20	ns/V
		V <sub>CC</sub> = 3.0 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	Min	Typ [1]	Max	Unit
<b>T<sub>amb</sub> = -40 °C to +85 °C</b>						
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 1.2 V	V <sub>CC</sub>	-	-	V
		V <sub>CC</sub> = 1.8 V	0.7V <sub>CC</sub>	0.9	-	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	1.2	-	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	1.5	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.2 V	-	-	0	V
		V <sub>CC</sub> = 1.8 V	-	0.9	0.2V <sub>CC</sub>	V
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	1.2	0.7	V
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	1.5	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = -100 µA; V <sub>CC</sub> = 1.8 V to 3.6 V	V <sub>CC</sub> - 0.2	V <sub>CC</sub>	-	V
		I <sub>O</sub> = -6 mA; V <sub>CC</sub> = 1.8 V	V <sub>CC</sub> - 0.4	V <sub>CC</sub> - 0.1	-	V
		I <sub>O</sub> = -6 mA; V <sub>CC</sub> = 2.3 V	V <sub>CC</sub> - 0.3	V <sub>CC</sub> - 0.08	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.3 V	V <sub>CC</sub> - 0.5	V <sub>CC</sub> - 0.17	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	V <sub>CC</sub> - 0.5	V <sub>CC</sub> - 0.14	-	V
		I <sub>O</sub> = -18 mA; V <sub>CC</sub> = 2.3 V	V <sub>CC</sub> - 0.6	V <sub>CC</sub> - 0.26	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = 100 µA; V <sub>CC</sub> = 1.8 V to 3.6 V	-	0	0.20	V
		I <sub>O</sub> = 6 mA; V <sub>CC</sub> = 1.8 V	-	0.09	0.30	V
		I <sub>O</sub> = 6 mA; V <sub>CC</sub> = 2.3 V	-	0.07	0.20	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.3 V	-	0.15	0.40	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	0.14	0.40	V
		I <sub>O</sub> = 18 mA; V <sub>CC</sub> = 2.3 V	-	0.23	0.60	V
I <sub>I</sub>	input leakage current	V <sub>CC</sub> = 1.8 V to 3.6 V				
		control input; V <sub>I</sub> = 5.5 V or GND	-	0.1	5	µA
		data input; V <sub>I</sub> = V <sub>CC</sub> or GND	-	0.1	5	µA
I <sub>OZ</sub>	OFF-state output current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND				
		V <sub>CC</sub> = 1.8 V to 2.7 V	-	0.1	5	µA
I <sub>LIZ</sub>	OFF-state input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND				
		V <sub>CC</sub> = 1.8 V to 2.7 V	-	0.1	10	µA
		V <sub>CC</sub> = 3.6 V	-	0.1	15	µA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A;				
		V <sub>CC</sub> = 1.8 V to 2.7 V	-	0.1	20	µA
ΔI <sub>CC</sub>	additional supply current	V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 2.7 V to 3.6 V				
		per control input	-	5	500	µA
		per data I/O input	-	150	750	µA

## 2.5 V/3.3 V 16-bit edge-triggered D-type flip-flop; 3-state

Symbol	Parameter	Conditions	Min	Typ [1]	Max	Unit
I <sub>BHL</sub>	bus hold LOW current	V <sub>CC</sub> = 2.3 V; V <sub>I</sub> = 0.7 V [2]	45	-	-	μA
		V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = 0.8 V [2]	75	150	-	μA
I <sub>BHH</sub>	bus hold HIGH current	V <sub>CC</sub> = 2.3 V; V <sub>I</sub> = 1.7 V [2]	-45	-	-	μA
		V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = 2.0 V [2]	-75	-175	-	μA
I <sub>BHLO</sub>	bus hold LOW overdrive current	V <sub>CC</sub> = 2.7 V [2]	300	-	-	μA
		V <sub>CC</sub> = 3.6 V [2]	450	-	-	μA
I <sub>BHHO</sub>	bus hold HIGH overdrive current	V <sub>CC</sub> = 2.7 V [2]	-300	-	-	μA
		V <sub>CC</sub> = 3.6 V [2]	-450	-	-	μA
C <sub>I</sub>	input capacitance		-	5.0	-	pF

[1] All typical values are measured at T<sub>amb</sub> = 25 °C.

[2] Valid for data inputs of bus hold parts only.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

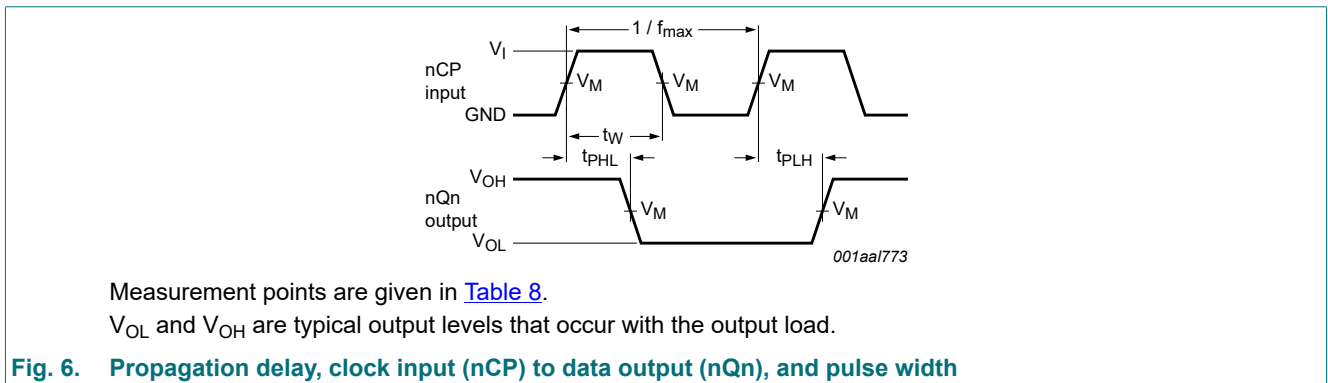
At recommended operating conditions. Voltages are referenced to GND (ground = 0 V); test circuit [Fig. 9](#).

Symbol	Parameter	Conditions	Min	Typ [1]	Max	Unit
<b>T<sub>amb</sub> = -40 °C to +85 °C</b>						
f <sub>max</sub>	maximum frequency	see <a href="#">Fig. 6</a>				
		V <sub>CC</sub> = 1.8 V	125	250	-	MHz
		V <sub>CC</sub> = 2.3 V to 2.7 V	150	300	-	MHz
		V <sub>CC</sub> = 2.7 V	150	300	-	MHz
		V <sub>CC</sub> = 3.0 V to 3.6 V	200	350	-	MHz
t <sub>pd</sub>	propagation delay	nCP to nQn; see <a href="#">Fig. 6</a> [2]				
		V <sub>CC</sub> = 1.2 V	-	7.7	-	ns
		V <sub>CC</sub> = 1.8 V	1.5	3.6	6.5	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	2.3	4.3	ns
		V <sub>CC</sub> = 2.7 V	1.0	2.3	3.8	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.4	3.4	ns
t <sub>en</sub>	enable time	nOE to nQn; see <a href="#">Fig. 7</a> [2]				
		V <sub>CC</sub> = 1.2 V	-	8.7	-	ns
		V <sub>CC</sub> = 1.8 V	1.5	4.0	7.2	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	2.6	4.8	ns
		V <sub>CC</sub> = 2.7 V	1.0	2.9	4.8	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.3	4.0	ns
t <sub>dis</sub>	disable time	nOE to nQn; see <a href="#">Fig. 7</a> [2]				
		V <sub>CC</sub> = 1.2 V	-	6.2	-	ns
		V <sub>CC</sub> = 1.8 V	1.5	3.1	5.4	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.0	2.1	4.0	ns
		V <sub>CC</sub> = 2.7 V	1.0	2.9	4.5	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	2.6	4.1	ns

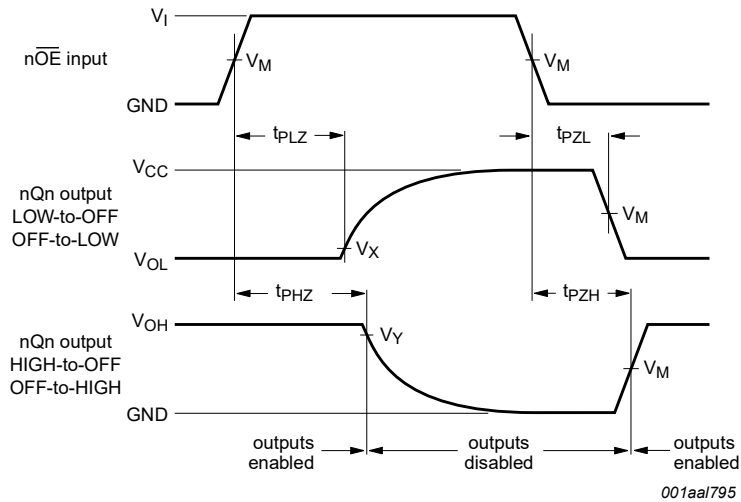
Symbol	Parameter	Conditions	Min	Typ [1]	Max	Unit
t <sub>W</sub>	pulse width	nCP HIGH or LOW; see Fig. 6				
		V <sub>CC</sub> = 1.8 V	4.0	2.0	-	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	3.0	1.6	-	ns
		V <sub>CC</sub> = 2.7 V	3.0	1.6	-	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	2.5	1.4	-	ns
t <sub>su</sub>	set-up time	nDn to nCP; see Fig. 8				
		V <sub>CC</sub> = 1.8 V	1.5	0.2	-	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.2	0.2	-	ns
		V <sub>CC</sub> = 2.7 V	1.5	0.4	-	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.2	0.2	-	ns
t <sub>h</sub>	hold time	nDn to nCP; see Fig. 8				
		V <sub>CC</sub> = 1.8 V	0.6	-0.2	-	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.8	-0.1	-	ns
		V <sub>CC</sub> = 2.7 V	0.6	-0.2	-	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	0.8	0.0	-	ns
C <sub>PD</sub>	power dissipation capacitance	per flip-flop; V <sub>I</sub> = GND to V <sub>CC</sub> [3]				
		outputs enabled	-	16	-	pF
		outputs disabled	-	10	-	pF

- [1] All typical values are measured at T<sub>amb</sub> = 25 °C.  
 Typical values for V<sub>CC</sub> = 2.3 V to 2.7 V are measured at V<sub>CC</sub> = 2.5 V  
 Typical values for V<sub>CC</sub> = 3.0 V to 3.6 V are measured at V<sub>CC</sub> = 3.3 V
- [2] t<sub>pd</sub> is the same as t<sub>PLH</sub> and t<sub>PHL</sub>.  
 t<sub>en</sub> is the same as t<sub>PZL</sub> and t<sub>PZH</sub>.  
 t<sub>dis</sub> is the same as t<sub>PLZ</sub> and t<sub>PHZ</sub>.
- [3] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> 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<sub>i</sub> = input frequency in MHz;  
 f<sub>o</sub> = output frequency in MHz;  
 C<sub>L</sub> = output load capacitance in pF;  
 V<sub>CC</sub> = supply voltage in Volts;  
 N = number of inputs switching;  
 Σ(C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of the outputs.

### 10.1. Waveforms and test circuit

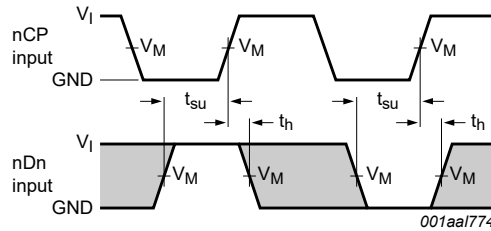


2.5 V/3.3 V 16-bit edge-triggered D-type flip-flop; 3-state



Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical output levels that occur with the output load.

**Fig. 7. 3-state enable and disable times**



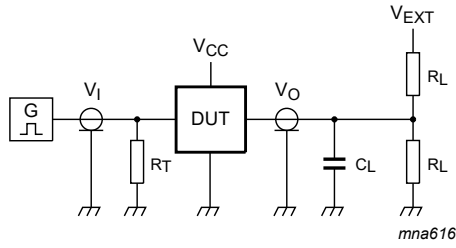
Measurement points are given in [Table 8](#).  
 The shaded areas indicate when the input is permitted to change for predictable output performance.

**Fig. 8. Data setup and hold times for input (nDn) to input (nCP)**

**Table 8. Measurement points**

Supply voltage	Input		Output		
	$V_I$	$V_M$	$V_M$	$V_X$	$V_Y$
1.2 V	$V_{CC}$	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$V_{OL} + 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$
1.8 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. 9. Test circuit for measuring switching times**

**Table 9. Test data**

Supply voltage	Input		Load		$V_{EXT}$		
$V_{CC}$	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PLZ}, t_{PZL}$	$t_{PHZ}, t_{PZH}$
1.2 V	$V_{CC}$	$\leq 2.0$ ns	30 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
1.8 V	$V_{CC}$	$\leq 2.0$ ns	30 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
2.3 V to 2.7 V	$V_{CC}$	$\leq 2.0$ ns	30 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
2.7 V	2.7 V	2.5 ns	50 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND
3.0 V to 3.6 V	2.7 V	2.5 ns	50 pF	500 $\Omega$	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

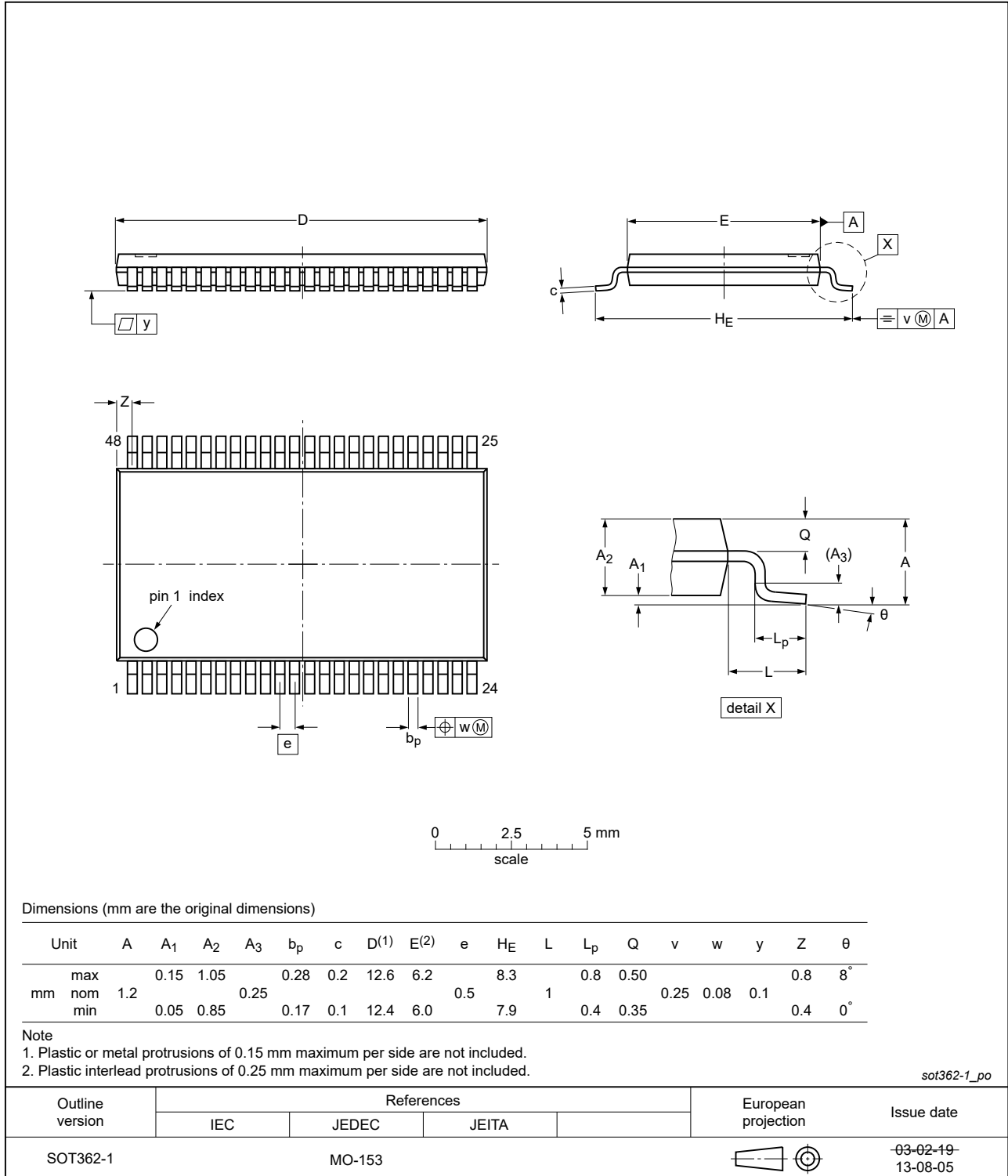


Fig. 10. Package outline SOT362-1 (TSSOP48)

## 12. Abbreviations

Table 10. Abbreviations

Acronym	Description
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
74ALVCH16374 v.7	20211123	Product data sheet	-	74ALVCH16374 v.6.1
Modifications:	<ul style="list-style-type: none"> <li>• <a href="#">Section 1</a> and <a href="#">Section 2</a> updated.</li> <li>• Errata corrected in <a href="#">Table 4</a>.</li> </ul>			
74ALVCH16374 v.6.1	20190307	Product data sheet	-	74ALVCH16374 v.5
Modifications:	<ul style="list-style-type: none"> <li>• The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>• Legal texts have been adapted to the new company name where appropriate.</li> <li>• Type number 74ALVCH16374DL (SOT370-1) removed.</li> <li>• Removed typo in <a href="#">Table 1</a>.</li> </ul>			
74ALVCH16374 v.5	20120709	Product data sheet	-	74ALVCH16374 v.4
Modifications:	<ul style="list-style-type: none"> <li>• <a href="#">Table 8</a> corrected (errata).</li> </ul>			
74ALVCH16374 v.4	20111117	Product data sheet	-	74ALVCH16374 v.3
Modifications:	<ul style="list-style-type: none"> <li>• Legal pages updated.</li> </ul>			
74ALVCH16374 v.3	20100427	Product data sheet	-	74ALVCH16374 v.2
74ALVCH16374 v.2	19980618	Product specification	-	74ALVCH16374 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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