

# 74AVC16836A

20-bit registered driver with inverted register enable and  
Dynamic Controlled Outputs; 3-state

Rev. 6 — 24 September 2018

Product data sheet

## 1. General description

The 74AVC16836A is a 20-bit universal bus driver. Data flow is controlled by output enable ( $\overline{OE}$ ), latch enable ( $\overline{LE}$ ) and clock inputs (CP).

This product is designed to have an extremely fast propagation delay and a minimum amount of power consumption.

To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor (Live Insertion).

A Dynamic Controlled Output (DCO) circuitry is implemented to support termination line drive during transient. See [Fig. 5](#) for typical curves.

## 2. Features and benefits

- Wide supply voltage range from 1.2 V to 3.6 V
- Complies with JEDEC standards:
  - JESD8-7 (1.2 V to 1.95 V)
  - JESD8-5 (1.8 V to 2.7 V)
  - JESD8-1A (2.7 V to 3.6 V)
- CMOS low power consumption
- Input/output tolerant up to 3.6 V
- Dynamic Controlled Output (DCO) circuit dynamically changes output impedance, resulting in noise reduction without speed degradation
- Low inductance multiple  $V_{CC}$  and GND pins to minimize noise and ground bounce
- Power off disables 74AVC16836A outputs, permitting Live Insertion
- Integrated input diodes to minimize input overshoot and undershoot

## 3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74AVC16836ADGG	-40 °C to + 85 °C	TSSOP56	plastic thin shrink small outline package; 56 leads; body width 6.1 mm	SOT364-1

### 4. Functional diagram

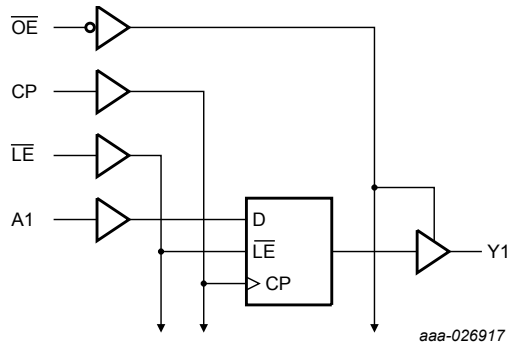


Fig. 1. Logic diagram

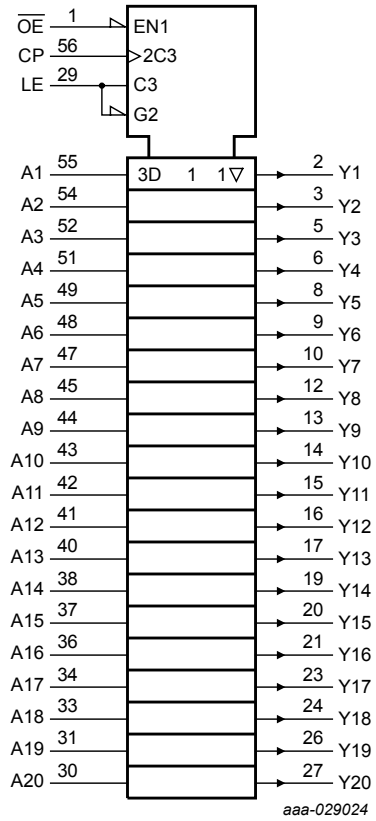


Fig. 2. Logic symbol (IEEE/IEC)

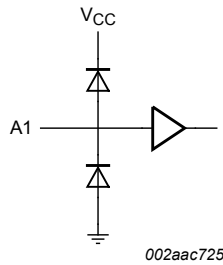


Fig. 3. Typical input (data or control)

## 5. Pinning information

### 5.1. Pinning

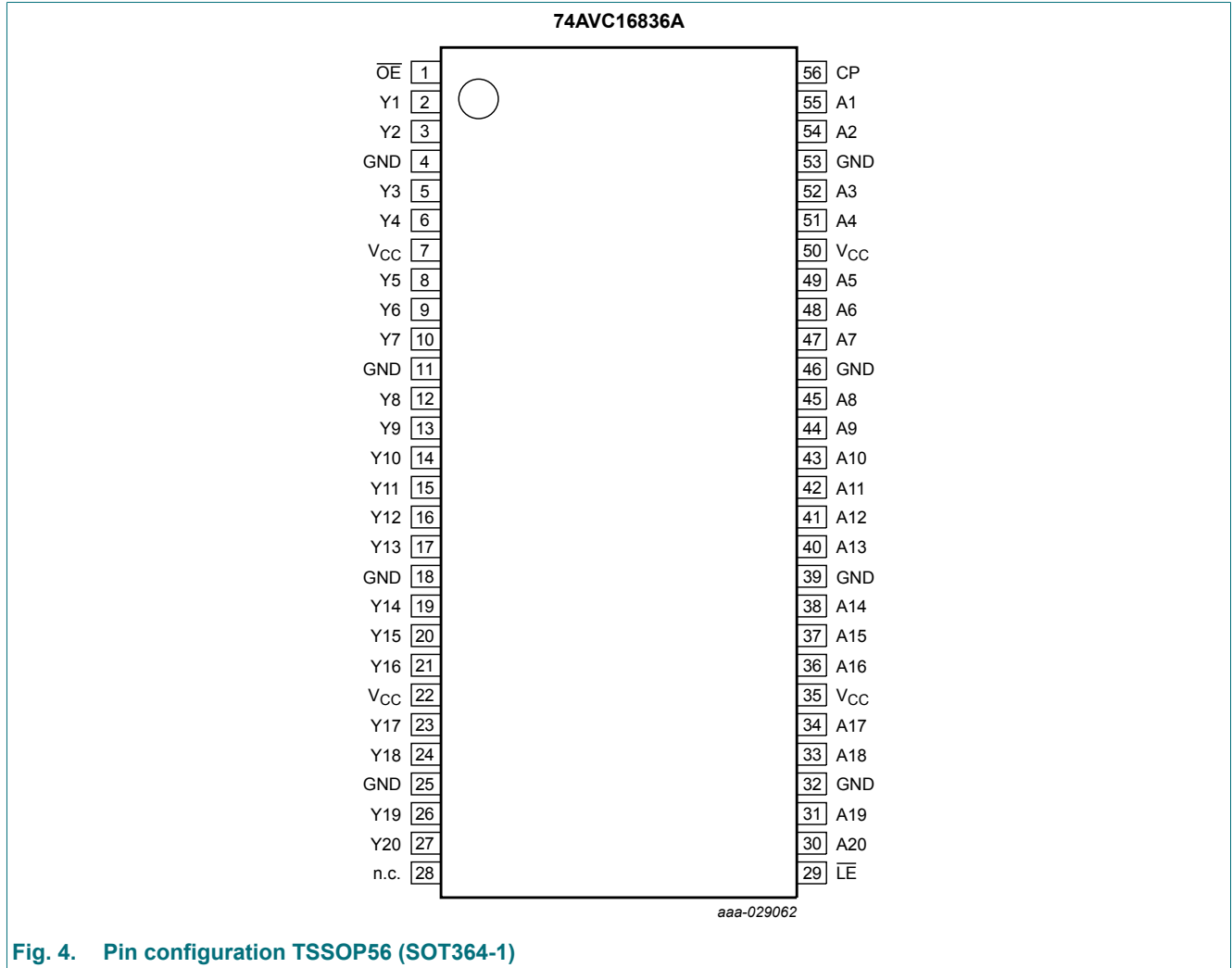


Fig. 4. Pin configuration TSSOP56 (SOT364-1)

## 5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17, A18, A19, A20	55, 54, 52, 51, 49, 48, 47, 45, 44, 43, 42, 41, 40, 38, 37, 36, 34, 33, 31, 30	data inputs
Y1, Y2, Y3, Y4, Y5, Y6, Y7, Y8, Y9, Y10, Y11, Y12, Y13, Y14, Y15, Y16, Y17, Y18, Y19, Y20	2, 3, 5, 6, 8, 9, 10, 12, 13, 14, 15, 16, 17, 19, 20, 21, 23, 24, 26, 27	data outputs
n.c.	28	not connected
$\overline{\text{LE}}$	29	latch enable input (active LOW)
$\overline{\text{OE}}$	1	output enable input (active LOW)
CP	56	clock input (LOW-to-HIGH, edge-triggered)
GND	4, 11, 18, 25, 32, 39, 46, 53	ground (0 V)
V <sub>CC</sub>	7, 22, 35, 50	supply voltage

## 6. Functional description

Table 3. Function selection

H = HIGH voltage level; L = LOW voltage level; X = Don't care; Z = high-impedance OFF-state;  $\uparrow$  = LOW to HIGH level transition.

Inputs				Outputs
OE	LE	CP	An	Yn
H	X	X	X	Z
L	L	X	L	L
L	L	X	H	H
L	H	$\uparrow$	L	L
L	H	$\uparrow$	H	H
L	H	H	X	Y <sub>0</sub> [1]
L	H	L	X	Y <sub>0</sub> [2]

[1] Output level before the indicated steady-state input conditions were established, provided that CP is high before  $\overline{\text{LE}}$  goes low.

[2] Output level before the indicated steady-state input conditions were established.

## 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	[1]	-0.5	+4.6	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	output HIGH or LOW	[1]	-0.5	V <sub>CC</sub> + 0.5	V
		output 3-state	[1]	-0.5	+4.6	V
I <sub>O</sub>	output current	V <sub>O</sub> = 0 V to V <sub>CC</sub>	-	±50	mA	

## 20-bit registered driver with inverted register enable and Dynamic Controlled Outputs; 3-state

Symbol	Parameter	Conditions	Min	Max	Unit
$I_{CC}$	supply current		-	100	mA
$I_{GND}$	ground current		-100	-	mA
$T_{stg}$	storage temperature		-65	+150	°C
$P_{tot}$	total power dissipation	$T_{amb} = -40\text{ °C to }+85\text{ °C}$ [2]	-	600	mW

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

[2] Above 55 °C the value of  $P_{tot}$  derates linearly with 8 mW/K.

## 8. Recommended operating conditions

Table 5. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{CC}$	supply voltage	for low-voltage applications	1.2	-	3.6	V
		according to JEDEC Low Voltage Standards	1.65	-	1.95	V
			2.3	-	2.7	V
			3.0	-	3.6	V
$V_I$	input voltage	0	-	3.6	V	
$V_O$	output voltage	output HIGH or LOW	0	-	$V_{CC}$	V
		output 3-state	0	-	3.6	V
$T_{amb}$	ambient temperature	in free air	-40	-	+85	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 1.65\text{ V to }2.3\text{ V}$	0	-	30	ns/V
		$V_{CC} = 2.3\text{ V to }3.0\text{ V}$	0	-	20	ns/V
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	0	-	10	ns/V

## 9. Static characteristics

Table 6. Static characteristics

At recommended operating conditions;  $T_{amb} = -40\text{ °C to }+85\text{ °C}$ ; Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Typ[1]	Max	Unit
$V_{IH}$	HIGH-level input voltage	$V_{CC} = 1.2\text{ V}$	$V_{CC}$	-	-	V
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	$0.65 \times V_{CC}$	0.9	-	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.7	1.2	-	V
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	2.0	1.5	-	V
$V_{IL}$	LOW-level input voltage	$V_{CC} = 1.2\text{ V}$	-	-	GND	V
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	-	0.9	$0.35 \times V_{CC}$	V
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	-	1.2	0.7	V
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	-	1.5	0.8	V

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Symbol	Parameter	Conditions	Min	Typ[1]	Max	Unit
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> = 1.65 V to 3.6 V	V <sub>CC</sub> - 0.20	V <sub>CC</sub>	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	V <sub>CC</sub> - 0.45	V <sub>CC</sub> - 0.10	-	V
		I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	V <sub>CC</sub> - 0.55	V <sub>CC</sub> - 0.28	-	V
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 3.0 V	V <sub>CC</sub> - 0.70	V <sub>CC</sub> - 0.32	-	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> = 1.65 V to 3.6 V	-	GND	0.20	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	0.10	0.45	V
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	0.26	0.55	V
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 3.0 V	-	0.36	0.70	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 3.6 V	-	0.1	2.5	μA
I <sub>OFF</sub>	power-off leakage current	V <sub>I</sub> or V <sub>O</sub> = 3.6 V; V <sub>CC</sub> = 0 V	-	0.1	±10	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> = 1.65 V to 2.7 V	-	0.1	5	μA
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	0.1	10	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> = 1.65 V to 2.7 V	-	0.1	20	μA
		V <sub>CC</sub> = 3.0 V to 3.6 V	-	0.2	40	μA
C <sub>I</sub>	input capacitance		-	3.8	-	pF

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

### 9.1. Dynamic Controlled Output graphs

A Dynamic Controlled Output (DCO) circuit is designed in. During the transition, it initially lowers the output impedance to effectively drive the load and, subsequently, raises the impedance to reduce noise. Fig. 5 shows V<sub>OL</sub> vs. I<sub>OL</sub> and V<sub>OH</sub> vs. I<sub>OH</sub> curves to illustrate the output impedance and drive capability of the circuit. At the beginning of the signal transition, the DCO circuit provides a maximum dynamic drive that is equivalent to a high drive standard output device.

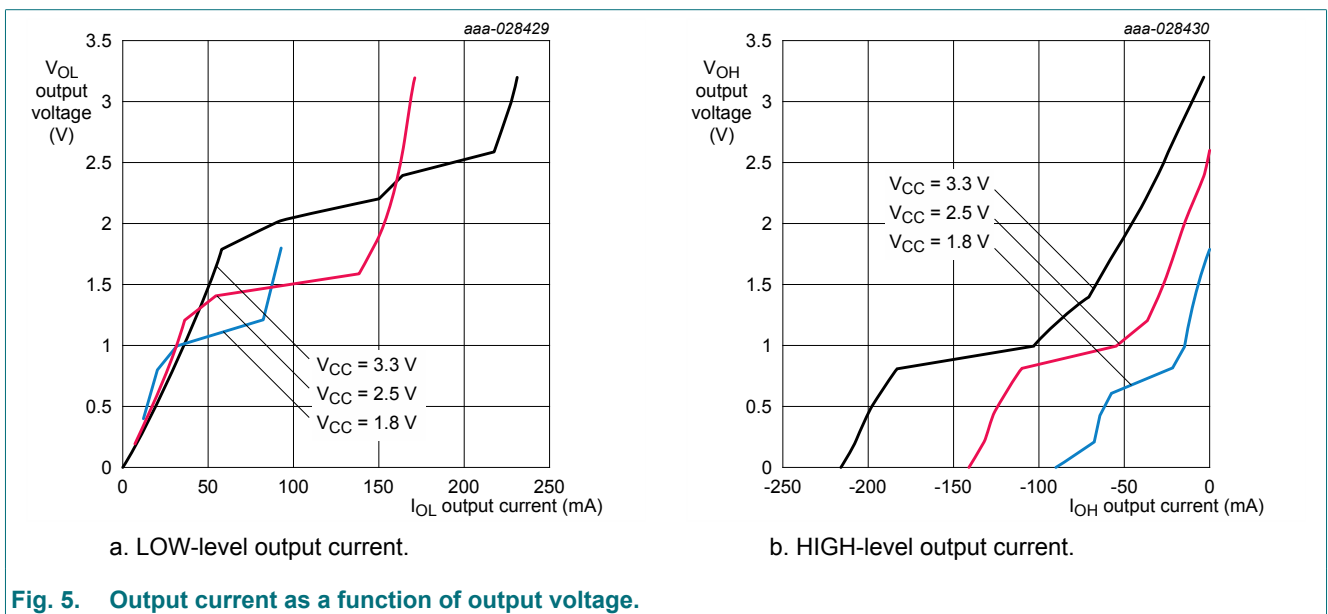


Fig. 5. Output current as a function of output voltage.

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V). For test circuit see [Fig. 12](#).

Symbol	Parameter	Conditions	Min	Typ [1]	Max	Unit
$t_{pd}$	propagation delay	An to Yn; see <a href="#">Fig. 6</a> [2]				
		$V_{CC} = 1.2\text{ V}$	-	4.7	-	ns
		$V_{CC} = 1.4\text{ V to }1.6\text{ V}$	2.0	-	5.3	ns
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	1.0	2.4	4.4	ns
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	0.8	1.7	3.2	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	0.7	1.5	2.7	ns
		$\overline{LE}$ to Yn; see <a href="#">Fig. 7</a> [2]				
		$V_{CC} = 1.2\text{ V}$	-	5.0	-	ns
		$V_{CC} = 1.4\text{ V to }1.6\text{ V}$	2.0	-	5.6	ns
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	1.5	2.7	5.0	ns
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.0	2.1	3.5	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	0.7	1.7	3.4	ns
		CP to Yn; see <a href="#">Fig. 9</a> [2]				
		$V_{CC} = 1.2\text{ V}$	-	5.7	-	ns
		$V_{CC} = 1.4\text{ V to }1.6\text{ V}$	2.0	-	4.7	ns
$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	1.2	2.3	4.1	ns		
$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	0.8	1.7	3.2	ns		
$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	0.7	1.6	3.0	ns		
$t_{en}$	enable time	$\overline{OE}$ to Yn; see <a href="#">Fig. 11</a> [2]				
		$V_{CC} = 1.2\text{ V}$	-	6.0	-	ns
		$V_{CC} = 1.4\text{ V to }1.6\text{ V}$	2.5	-	6.8	ns
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	1.5	3.0	5.4	ns
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.0	2.4	4.0	ns
$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	1.9	3.6	ns		
$t_{dis}$	disable time	$\overline{OE}$ to Yn; see <a href="#">Fig. 11</a> [2]				
		$V_{CC} = 1.2\text{ V}$	-	6.6	-	ns
		$V_{CC} = 1.4\text{ V to }1.6\text{ V}$	2.5	-	7.6	ns
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	1.5	3.7	7.5	ns
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.0	2.1	4.7	ns
$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	2.5	4.8	ns		
$t_w$	pulse width	CP HIGH or LOW; see <a href="#">Fig. 9</a> .				
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	2.0	-	-	ns
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.2	-	-	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	-	-	ns
		$\overline{LE}$ HIGH; see <a href="#">Fig. 7</a> .				
		$V_{CC} = 1.65\text{ V to }1.95\text{ V}$	2.0	-	-	ns
		$V_{CC} = 2.3\text{ V to }2.7\text{ V}$	1.2	-	-	ns
$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	1.0	-	-	ns		

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Symbol	Parameter	Conditions	Min	Typ [1]	Max	Unit
t <sub>su</sub>	set-up time	An to CP; see Fig. 10				
		V <sub>CC</sub> = 1.2 V	-	0.0	-	ns
		V <sub>CC</sub> = 1.4 V to 1.6 V	0.3	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.2	0.0	-	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.3	0.0	-	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	0.2	0.0	-	ns
		An to $\overline{\text{LE}}$ ; see Fig. 8				
		V <sub>CC</sub> = 1.2 V	-	1.2	-	ns
		V <sub>CC</sub> = 1.4 V to 1.6 V	1.3	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.9	0.4	-	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.6	0.2	-	ns
V <sub>CC</sub> = 3.0 V to 3.6 V	0.3	0.0	-	ns		
t <sub>h</sub>	hold time	An to CP; see Fig. 10				
		V <sub>CC</sub> = 1.2 V	-	0.1	-	ns
		V <sub>CC</sub> = 1.4 V to 1.6 V	0.6	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.6	0.2	-	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.6	0.2	-	ns
		V <sub>CC</sub> = 3.0 V to 3.6 V	1.2	0.5	-	ns
		An to $\overline{\text{LE}}$ ; see Fig. 8				
		V <sub>CC</sub> = 1.2 V	-	-0.7	-	ns
		V <sub>CC</sub> = 1.4 V to 1.6 V	0.2	-	-	ns
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.4	0.0	-	ns
		V <sub>CC</sub> = 2.3 V to 2.7 V	0.5	0.1	-	ns
V <sub>CC</sub> = 3.0 V to 3.6 V	1.0	0.5	-	ns		
f <sub>max</sub>	maximum frequency	CP; see Fig. 9				
		V <sub>CC</sub> = 1.65 V to 1.95 V	250	-	-	MHz
		V <sub>CC</sub> = 2.3 V to 2.7 V	400	-	-	MHz
		V <sub>CC</sub> = 3.0 V to 3.6 V	500	-	-	MHz
C <sub>PD</sub>	power dissipation capacitance	per buffer; V <sub>I</sub> = GND to V <sub>CC</sub> [3]				
		outputs enabled	-	25	-	pF
		outputs disabled	-	6	-	pF

[1] Typical values are measured at T<sub>amb</sub> = 25 °C and V<sub>CC</sub> = 1.5 V, 1.8 V, 2.5 V and 3.3 V respectively.

[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

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

10.1. Waveforms and test circuit

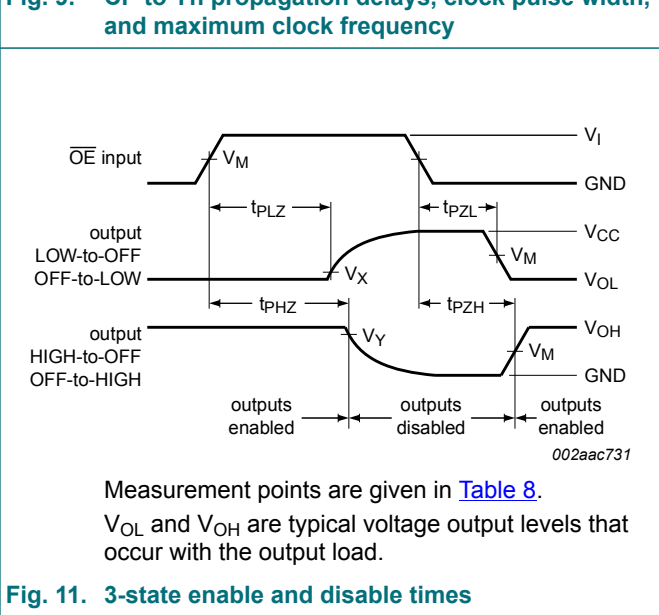
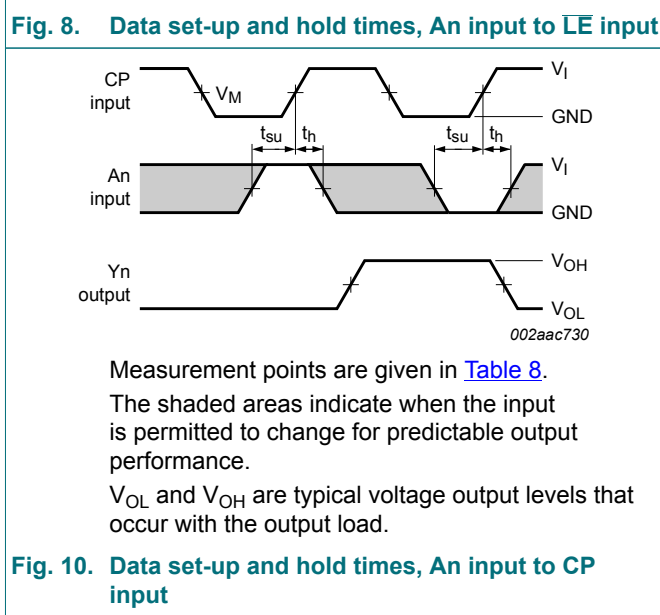
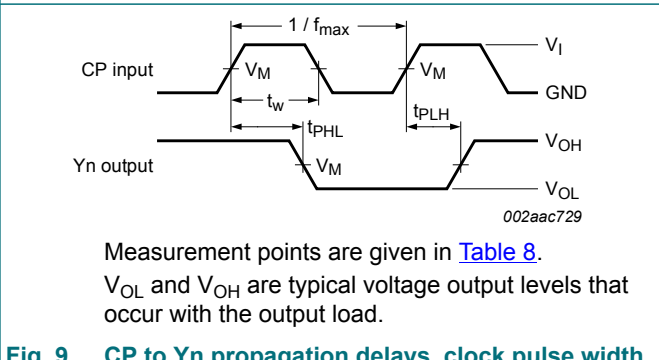
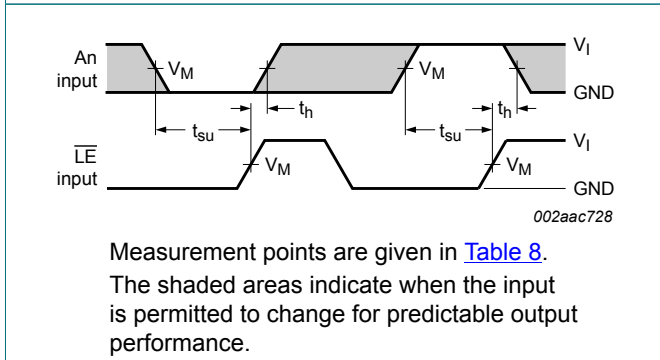
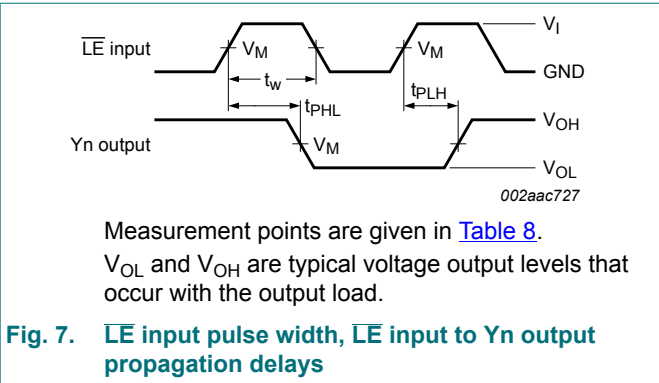
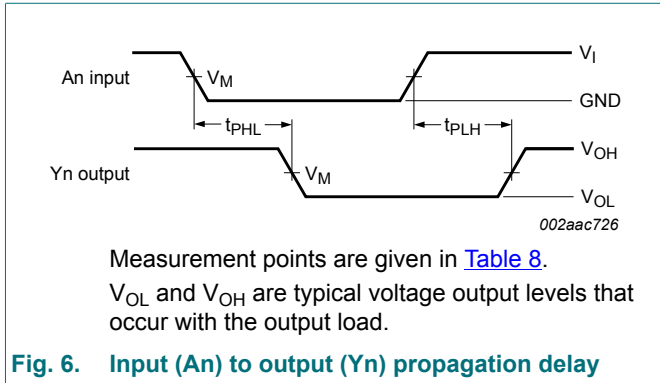
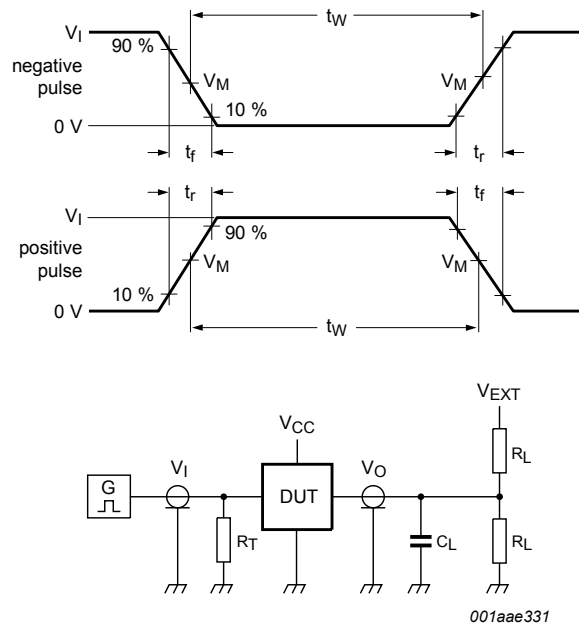


Table 8. Measurement points

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

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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. 12. Test circuit for measuring switching times**

**Table 9. Test data**

Supply voltage	Input		Load		$V_{EXT}$		
$V_{CC}$	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PLH}, t_{PHL}$	$t_{PLZ}, t_{PZL}$	$t_{PHZ}, t_{PZH}$
$\leq 2.3$ V	$V_{CC}$	$\leq 2.0$ ns	30 pF	1000 $\Omega$	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
3.0 V to 3.6 V	$V_{CC}$	$\leq 2.0$ ns	30 pF	500 $\Omega$	open	$2 \times V_{CC}$	GND

### 11. Package outline

TSSOP56: plastic thin shrink small outline package; 56 leads; body width 6.1 mm

SOT364-1

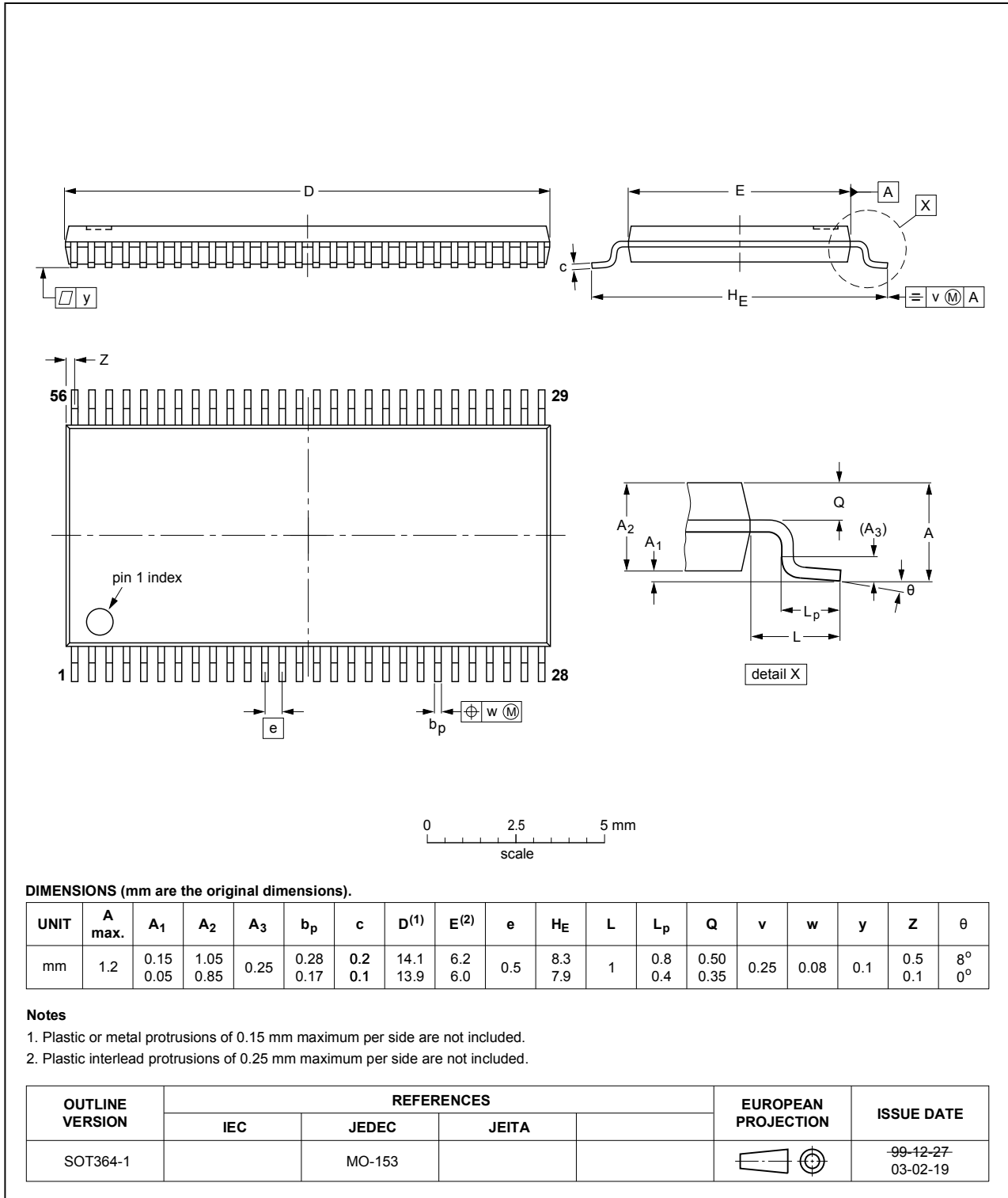


Fig. 13. Package outline SOT364-1 (TSSOP56)

## 12. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DCO	Dynamic Controlled Output
DUT	Device Under Test

## 13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AVC16836A v.6	20180924	Product data sheet	-	74AVC16836A 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 74AVC16836ADGV (SOT481-2) removed.</li> </ul>			
74AVC16836A v.5	20020802	Product data sheet	-	74AVC16836A v.4
74AVC16836A v.4	20000803	Product specification	-	74AVC16836A v.3
74AVC16836A v.3	20000502	Preliminary specification	-	74AVC16836 v.2
74AVC16836 v.2	19990723	Preliminary specification	-	74AVC_AVCH16836 v.1
74AVC_AVCH16836 v.1	19981207	Objective 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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