

# DATA SHEET

## **74AVC16836**

20-bit registered driver with inverted register enable (3-State)

Preliminary specification

1999 Jul 23

Replaces datasheet 74AVC16836/74AVCH16836 dated 1998 Dec 07

# 20-bit registered driver with inverted register enable (3-State)

## 74AVC16836

### FEATURES

- Wide supply voltage range of 1.2 V to 3.6 V
- Complies with JEDEC standard no. 8-1A/5/7.
- CMOS low power consumption
- Input/output tolerant up to 3.6 V
- DCO (Dynamic Controlled Output) circuit dynamically changes output impedance, resulting in noise reduction without speed degradation
- Low inductance multiple V<sub>CC</sub> and GND pins for minimum noise and ground bounce
- Power off disables 74AVC16836 outputs, permitting Live Insertion

### DESCRIPTION

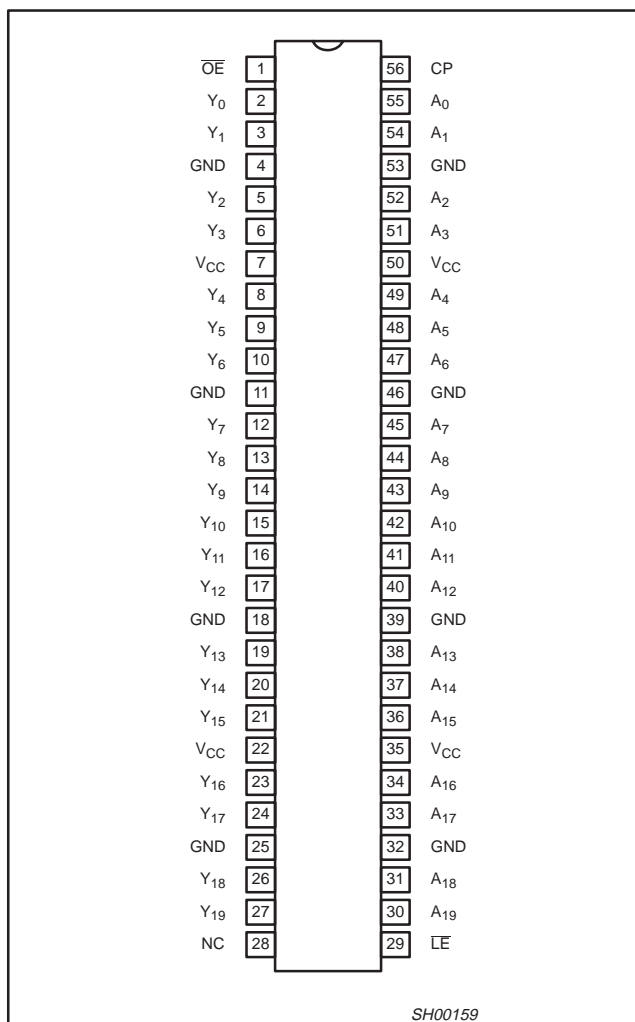
The 74AVC16836 is a 20-bit universal bus driver. Data flow is controlled by output enable ( $\overline{OE}$ ), latch enable ( $\overline{LE}$ ) and clock inputs (CP).

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<sub>CC</sub> through a pullup resistor (Live Insertion).

A Dynamic Controlled Output (DCO) circuitry is implemented to support termination line drive during transient. See the graphs on page 8 for typical curves.

### PIN CONFIGURATION



SH00159

### QUICK REFERENCE DATA

GND = 0 V; T<sub>amb</sub> = 25°C; t<sub>r</sub> = t<sub>f</sub> ≤ 2.0 ns; C<sub>L</sub> = 30 pF.

SYMBOL	PARAMETER	CONDITIONS	TYPICAL	UNIT	
t <sub>PHL</sub> /t <sub>PLH</sub>	Propagation delay An to Yn	V <sub>CC</sub> = 1.8 V V <sub>CC</sub> = 2.5 V V <sub>CC</sub> = 3.3 V	2.6 2.0 1.7	ns	
t <sub>PHL</sub> /t <sub>PLH</sub>	Propagation delay $\overline{LE}$ to Yn; CP to Yn	V <sub>CC</sub> = 1.8 V V <sub>CC</sub> = 2.5 V V <sub>CC</sub> = 3.3 V	3.0 2.4 2.0	ns	
C <sub>I</sub>	Input capacitance		5.0	pF	
C <sub>PD</sub>	Power dissipation capacitance per buffer	V <sub>I</sub> = GND to V <sub>CC</sub> <sup>1</sup>	Outputs enabled Output disabled	25 6	pF

### NOTES:

- C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW):  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o)$  where: f<sub>i</sub> = input frequency in MHz; C<sub>L</sub> = output load capacitance in pF;  
 f<sub>o</sub> = output frequency in MHz; V<sub>CC</sub> = supply voltage in V;  $\sum (C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.

### ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	ORDER CODE	DRAWING NUMBER
56-Pin Plastic Thin Shrink Small Outline (TSSOP) Type II	-40°C to +85°C	74AVC16836 DGG	SOT364-1

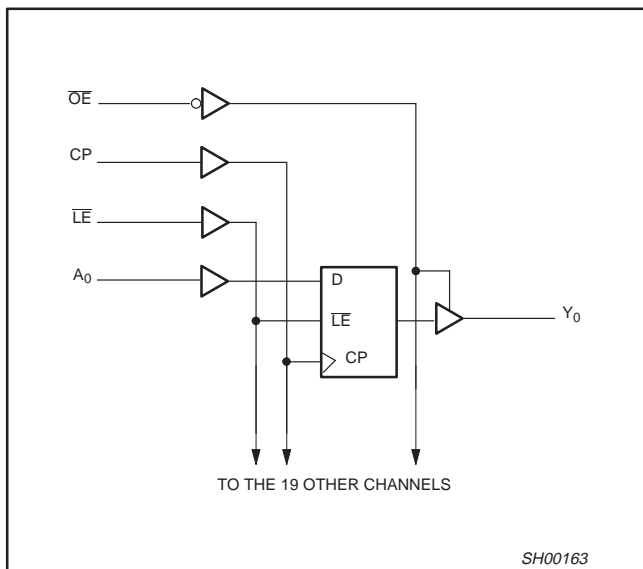
# 20-bit registered driver with inverted register enable (3-State)

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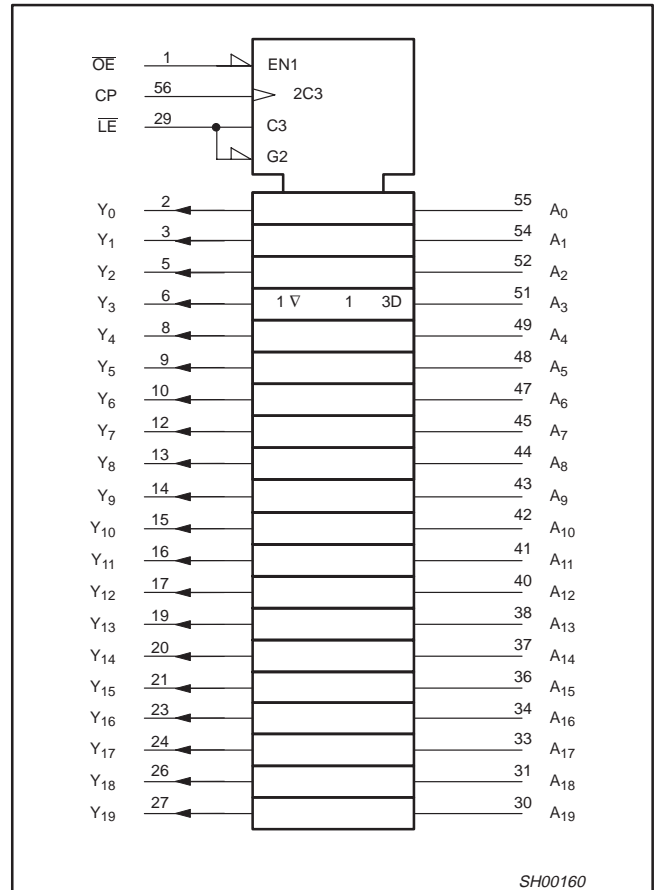
## PIN DESCRIPTION

PIN NUMBER	SYMBOL	NAME AND FUNCTION
28	NC	No connection
2, 3, 5, 6, 8, 9, 10, 12, 13, 14, 15, 16, 17, 19, 20, 21, 23, 24, 26, 27	Y <sub>0</sub> to Y <sub>19</sub>	Data outputs
4, 11, 18, 25, 32, 35, 39, 46, 53	GND	Ground (0V)
7, 22, 35, 50	V <sub>CC</sub>	Positive supply voltage
1	$\overline{OE}$	Output enable input (active LOW)
29	$\overline{LE}$	Latch enable input (active LOW)
56	CP	Clock input
55, 54, 52, 51, 49, 48, 47, 45, 44, 43, 42, 41, 40, 38, 37, 36, 34, 33, 31, 30	A <sub>0</sub> to A <sub>19</sub>	Data inputs

## LOGIC SYMBOL



## LOGIC SYMBOL (IEEE/IEC)



## FUNCTION TABLE

INPUTS				OUTPUTS
$\overline{OE}$	$\overline{LE}$	CP	A	
H	X	X	X	Z
L	L	X	L	L
L	L	X	H	H
L	H	↑	L	L
L	H	↑	H	H
L	H	H	X	Y <sub>0</sub> <sup>1</sup>
L	H	L	X	Y <sub>0</sub> <sup>2</sup>

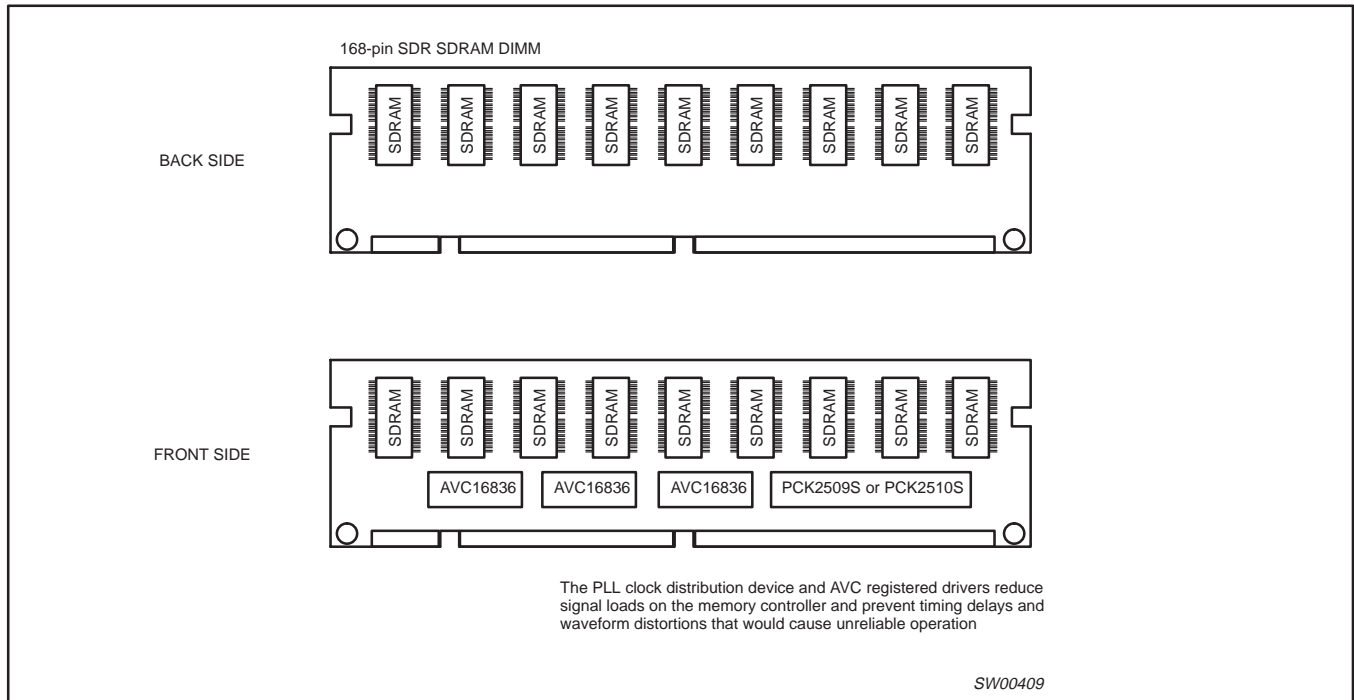
- H = HIGH voltage level
- L = LOW voltage level
- X = Don't care
- Z = High impedance "off" state
- ↑ = LOW-to-HIGH level transition

### NOTES:

1. Output level before the indicated steady-state input conditions were established, provided that CP is high before LE goes low.
2. Output level before the indicated steady-state input conditions were established.

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## RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	MIN	MAX	UNIT
V <sub>CC</sub>	DC supply voltage (according to JEDEC Low Voltage Standards)		1.65 2.3 3.0	1.95 2.7 3.6	V
	DC supply voltage (for low voltage applications)		1.2	3.6	
V <sub>I</sub>	DC Input voltage range		0	3.6	V
V <sub>O</sub>	DC output voltage range; output 3-State		0	3.6	V
	DC output voltage range; output HIGH or LOW state		0	V <sub>CC</sub>	
T <sub>amb</sub>	Operating free-air temperature range		-40	+85	°C
t <sub>r</sub> , t <sub>f</sub>	Input rise and fall times	V <sub>CC</sub> = 1.65 to 2.3 V V <sub>CC</sub> = 2.3 to 3.0 V V <sub>CC</sub> = 3.0 to 3.6 V	0 0 0	30 20 10	ns/V

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## ABSOLUTE MAXIMUM RATINGS

In accordance with the Absolute Maximum Rating System (IEC 134)

Voltages are referenced to GND (ground = 0 V)

SYMBOL	PARAMETER	CONDITIONS	RATING	UNIT
$V_{CC}$	DC supply voltage		-0.5 to +4.6	V
$I_{IK}$	DC input diode current	$V_I < 0$	-50	mA
$V_I$	DC input voltage	For all inputs <sup>1</sup>	-0.5 to 4.6	V
$I_{OK}$	DC output diode current	$V_O > V_{CC}$ or $V_O < 0$	$\pm 50$	mA
$V_O$	DC output voltage; output 3-State	Note 1	-0.5 to 4.6	V
$V_O$	DC output voltage; output HIGH or LOW state	Note 1	-0.5 to $V_{CC} + 0.5$	V
$I_O$	DC output source or sink current	$V_O = 0$ to $V_{CC}$	$\pm 50$	mA
$I_{GND}, I_{CC}$	DC $V_{CC}$ or GND current		$\pm 100$	mA
$T_{stg}$	Storage temperature range		-65 to +150	°C
$P_{TOT}$	Power dissipation per package -plastic thin-medium-shrink (TSSOP)	For temperature range: -40 to +125 °C above +55°C derate linearly with 8 mW/K	600	mW

### NOTE:

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

## DC ELECTRICAL CHARACTERISTICS

Over recommended operating conditions. Voltage are referenced to GND (ground = 0 V).

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNIT
			Temp = -40°C to +85°C			
			MIN	TYP <sup>1</sup>	MAX	
$V_{IH}$	HIGH level Input voltage	$V_{CC} = 1.2$ V	$V_{CC}$	-	-	V
		$V_{CC} = 1.65$ to $1.95$ V	$0.65V_{CC}$	0.9	-	
		$V_{CC} = 2.3$ to $2.7$ V	1.7	1.2	-	
		$V_{CC} = 3.0$ to $3.6$ V	2.0	1.5	-	
$V_{IL}$	LOW level Input voltage	$V_{CC} = 1.2$ V	-	-	GND	V
		$V_{CC} = 1.65$ to $1.95$ V	-	0.9	$0.35V_{CC}$	
		$V_{CC} = 2.3$ to $2.7$ V	-	1.2	0.7	
		$V_{CC} = 3.0$ to $3.6$ V	-	1.5	0.8	
$V_{OH}$	HIGH level output voltage	$V_{CC} = 1.65$ to $3.6$ V; $V_I = V_{IH}$ or $V_{IL}$ ; $I_O = -100$ $\mu$ A	$V_{CC} - 0.20$	$V_{CC}$	-	V
		$V_{CC} = 1.65$ V; $V_I = V_{IH}$ or $V_{IL}$ ; $I_O = -4$ mA	$V_{CC} - 0.45$	$V_{CC} - 0.10$	-	
		$V_{CC} = 2.3$ V; $V_I = V_{IH}$ or $V_{IL}$ ; $I_O = -8$ mA	$V_{CC} - 0.55$	$V_{CC} - 0.28$	-	
		$V_{CC} = 3.0$ V; $V_I = V_{IH}$ or $V_{IL}$ ; $I_O = -12$ mA	$V_{CC} - 0.70$	$V_{CC} - 0.32$	-	
$V_{OL}$	LOW level output voltage	$V_{CC} = 1.65$ to $3.6$ V; $V_I = V_{IH}$ or $V_{IL}$ ; $I_O = 100$ $\mu$ A	-	GND	0.20	V
		$V_{CC} = 1.65$ V; $V_I = V_{IH}$ or $V_{IL}$ ; $I_O = 4$ mA	-	0.10	0.45	
		$V_{CC} = 2.3$ V; $V_I = V_{IH}$ or $V_{IL}$ ; $I_O = 8$ mA	-	0.26	0.55	
		$V_{CC} = 3.0$ V; $V_I = V_{IH}$ or $V_{IL}$ ; $I_O = 12$ mA	-	0.36	0.70	
$I_I$	Input leakage current	$V_{CC} = 1.65$ to $3.6$ V; $V_I = V_{CC}$ or GND	-	0.1	2.5	$\mu$ A
$I_{OFF}$	3-State output OFF-state current	$V_{CC} = 0$ V; $V_I$ or $V_O = 3.6$ V	-	0.1	$\pm 10$	$\mu$ A
$I_{IHZ}/I_{ILZ}$	3-State output OFF-state current	$V_{CC} = 1.65$ to $3.6$ V; $V_I = V_{CC}$ or GND	-	0.1	12.5	$\mu$ A
$I_{OZ}$	3-State output OFF-state current	$V_{CC} = 1.65$ to $2.7$ V; $V_I = V_{IH}$ or $V_{IL}$ ; $V_O = V_{CC}$ or GND	-	0.1	5	$\mu$ A
		$V_{CC} = 3.0$ to $3.6$ V; $V_I = V_{IH}$ or $V_{IL}$ ; $V_O = V_{CC}$ or GND	-	0.1	10	
$I_{CC}$	Quiescent supply current	$V_{CC} = 1.65$ to $2.7$ V; $V_I = V_{CC}$ or GND; $I_O = 0$	-	0.1	20	$\mu$ A
		$V_{CC} = 3.0$ to $3.6$ V; $V_I = V_{CC}$ or GND; $I_O = 0$	-	0.2	40	

### NOTES:

1. All typical values are at  $T_{amb} = 25^\circ\text{C}$ .

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## AC CHARACTERISTICS

GND = 0 V;  $t_r = t_f \leq 2.0$  ns;  $C_L = 30$  pF

SYMBOL	PARAMETER	WAVEFORM	LIMITS										UNIT
			$V_{CC} = 3.3 \pm 0.3$ V			$V_{CC} = 2.5 \pm 0.2$ V			$V_{CC} = 1.8 \pm 0.15$ V			$V_{CC} = 1.2$ V	
			MIN	TYP <sup>1</sup>	MAX	MIN	TYP <sup>1</sup>	MAX	MIN	TYP <sup>1</sup>	MAX	TYP	
$t_{PHL}/t_{PLH}$	Propagation delay An to Yn	1, 7	0.7	1.7	2.5	0.8	2.0	3.0	1.0	2.6	4.5	5.2	ns
	Propagation delay LE to Yn	2, 7	0.7	2.0	3.0	0.8	2.4	3.6	1.0	3.0	5.5	6.0	
	Propagation delay CP to Yn	3, 7	0.7	1.9	2.9	0.8	2.2	3.3	0.9	2.8	5.2	5.5	
$t_{PZH}/t_{PZL}$	3-State output enable time $\overline{OE}$ to Yn	6, 7	1.0	2.5	4.5	1.0	2.8	5.0	1.5	3.5	6.5	6.0	ns
$t_{PHZ}/t_{PLZ}$	3-State output disable time $\overline{OE}$ to Yn	6, 7	1.0	2.5	4.0	1.0	2.4	4.5	1.5	4.0	6.5	6.0	ns
$t_w$	CP pulse width HIGH or LOW	3, 7	1.0	-	-	1.2	-	-	2.0	-	-	-	ns
	LE pulse width HIGH	2, 7	1.0	-	-	1.2	-	-	2.0	-	-	-	
$t_{SU}$	Set-up time An to CP	5, 7	0.3	-	-	0.4	-	-	0.5	-	-	-	ns
	Set-up time An to $\overline{LE}$	4, 7	0.3	-	-	0.4	-	-	0.5	-	-	-	
$t_h$	Hold time An to CP	5, 7	0.3	-	-	0.4	-	-	0.5	-	-	-	ns
	Hold time An to $\overline{LE}$	4, 7	0.3	-	-	0.4	-	-	0.5	-	-	-	
$F_{max}$	Maximum clock pulse frequency	3, 7	500	-	-	400	-	-	250	-	-	-	MHz

**NOTES:**

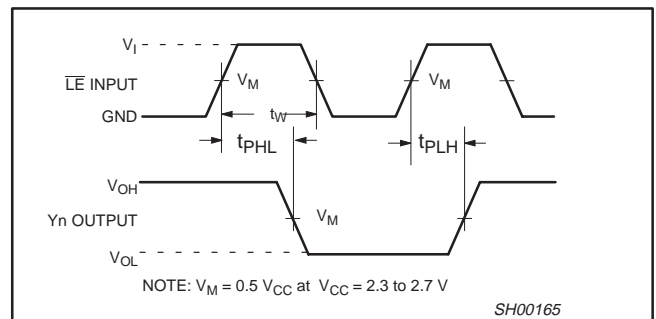
1. All typical values are measured at  $T_{amb} = 25^\circ\text{C}$  and at  $V_{CC} = 1.8$  V, 2.5 V, 3.3 V.

### AC WAVEFORMS FOR $V_{CC} = 3.0$ V TO 3.6 V RANGE

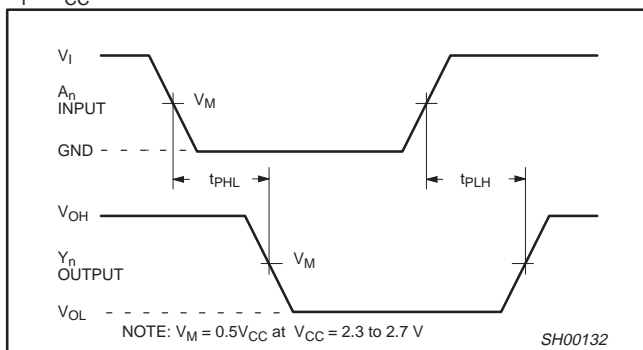
$V_M = 0.5 V_{CC}$   
 $V_X = V_{OL} + 0.300$  V  
 $V_Y = V_{OH} - 0.300$  V  
 $V_{OL}$  and  $V_{OH}$  are the typical output voltage drop that occur with the output load.  
 $V_I = V_{CC}$

### AC WAVEFORMS FOR $V_{CC} = 2.3$ V TO 2.7 V AND $V_{CC} < 2.3$ V RANGE

$V_M = 0.5 V_{CC}$   
 $V_X = V_{OL} + 0.15$  V  
 $V_Y = V_{OH} - 0.15$  V  
 $V_{OL}$  and  $V_{OH}$  are the typical output voltage drop that occur with the output load.  
 $V_I = V_{CC}$



**Waveform 2.** Latch enable input ( $\overline{LE}$ ) pulse width, the latch enable input to output ( $Y_n$ ) propagation delays.



**Waveform 1.** Input ( $A_n$ ) to output ( $Y_n$ ) propagation delay

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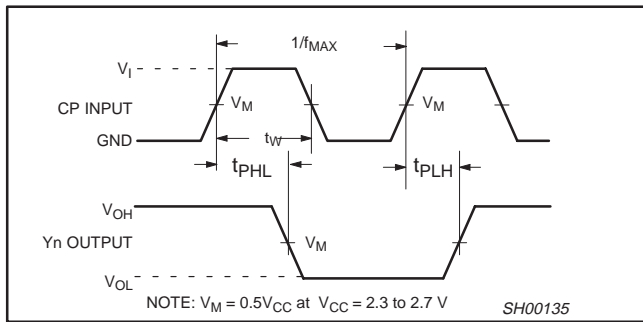
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## AC WAVEFORMS FOR $V_{CC} = 3.0\text{ V TO }3.6\text{ V RANGE}$ (Continued)

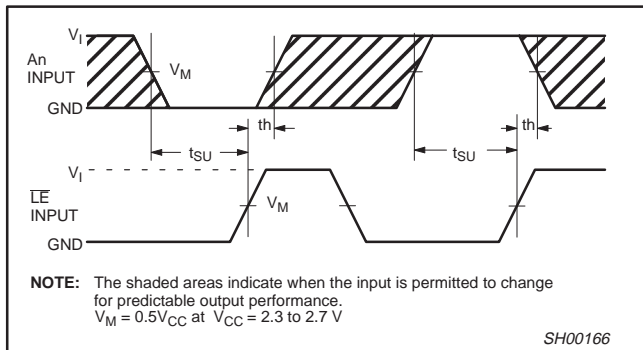
$V_M = 0.5 V_{CC}$   
 $V_X = V_{OL} + 0.300\text{ V}$   
 $V_Y = V_{OH} - 0.300\text{ V}$   
 $V_{OL}$  and  $V_{OH}$  are the typical output voltage drop that occur with the output load.  
 $V_I = V_{CC}$

## AC WAVEFORMS FOR $V_{CC} = 2.3\text{ V TO }2.7\text{ V AND }V_{CC} < 2.3\text{ V RANGE}$ (Continued)

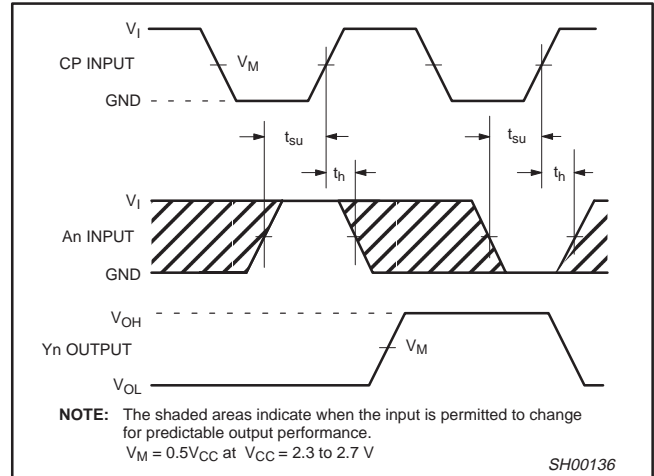
$V_M = 0.5 V_{CC}$   
 $V_X = V_{OL} + 0.15\text{ V}$   
 $V_Y = V_{OH} - 0.15\text{ V}$   
 $V_{OL}$  and  $V_{OH}$  are the typical output voltage drop that occur with the output load.  
 $V_I = V_{CC}$



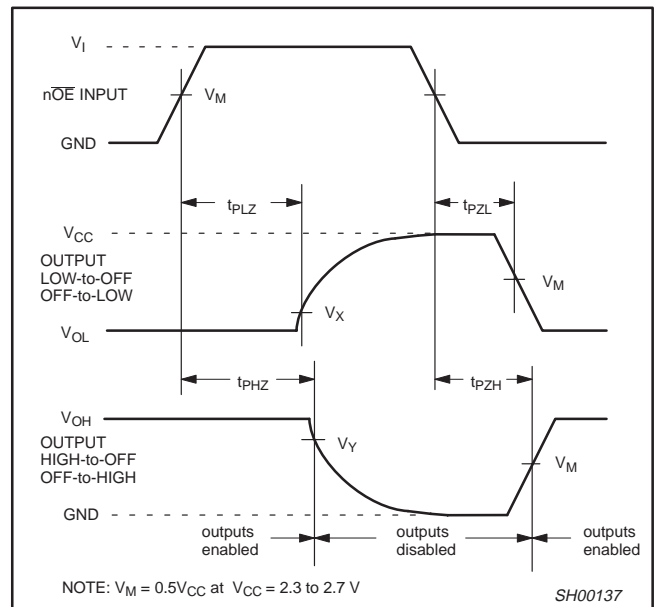
Waveform 3. The clock (CP) to Yn propagation delays, the clock pulse width and the maximum clock frequency.



Waveform 4. Data set-up and hold times for the An input to the LE input



Waveform 5. Data set-up and hold times for the An input to the clock CP input

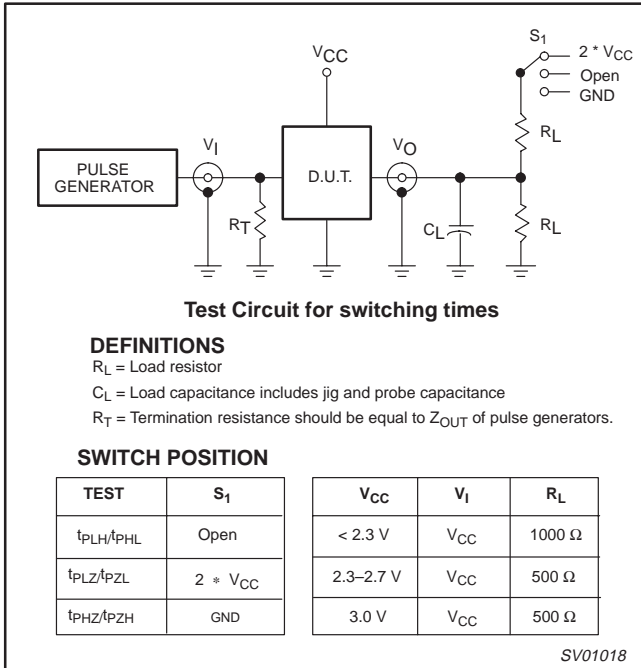


Waveform 6. 3-State enable and disable times

# 20-bit registered driver with inverted register enable (3-State)

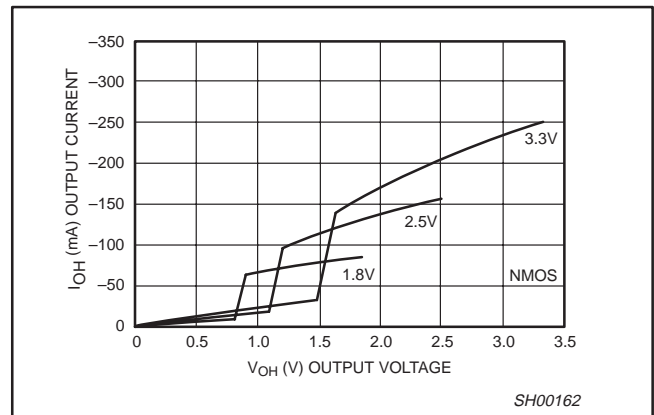
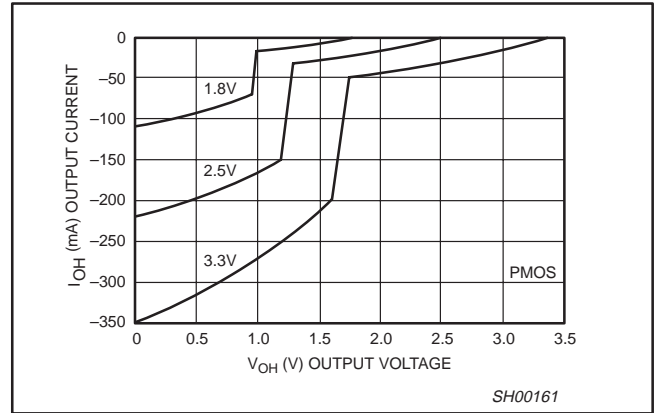
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## TEST CIRCUIT



Waveform 7. Load circuitry for switching times

## GRAPHS



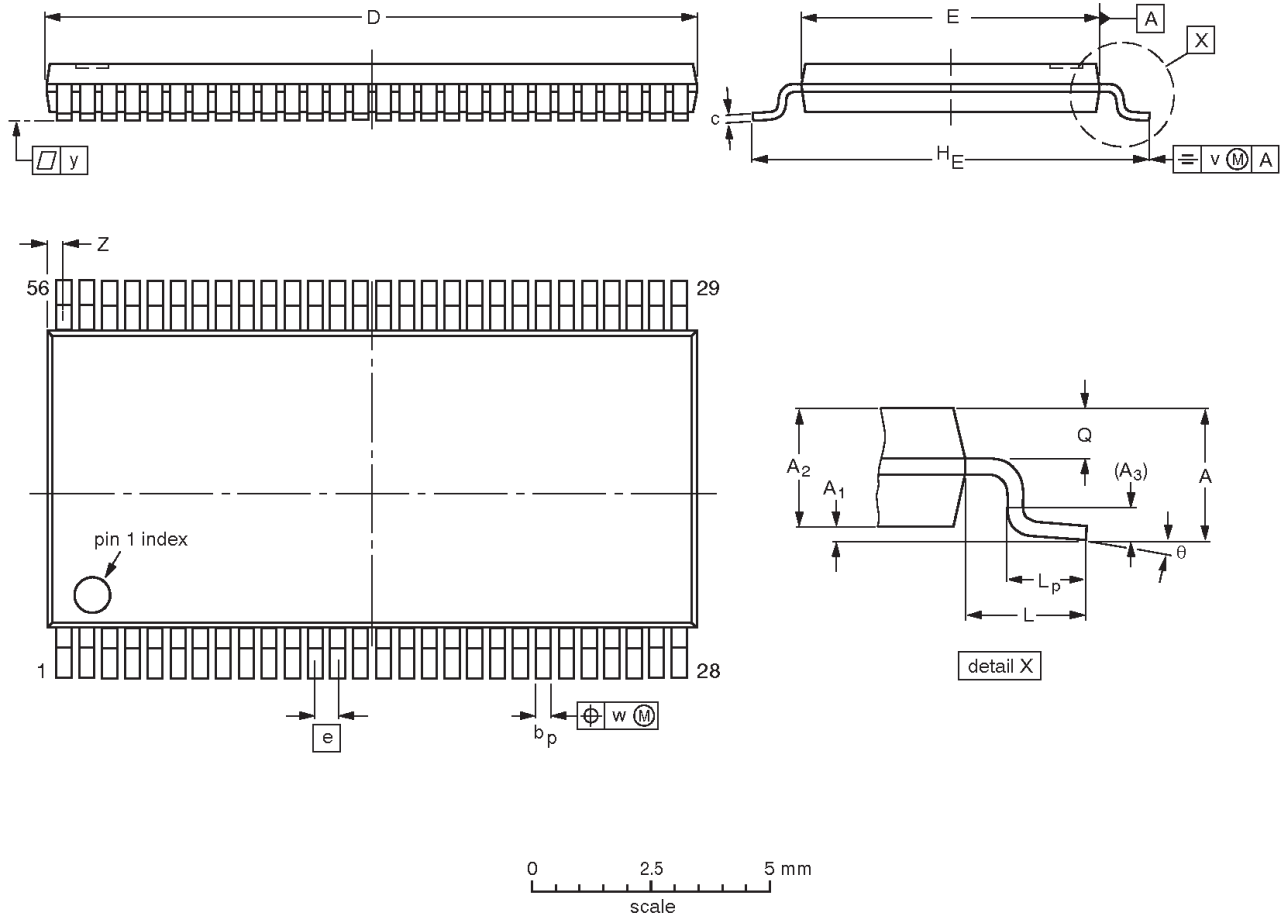


# 20-bit registered driver with inverted register enable (3-State)

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

SOT364-1



**DIMENSIONS (mm are the original dimensions).**

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(2)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	Z	$\theta$
mm	1.2	0.15 0.05	1.05 0.85	0.25	0.28 0.17	0.2 0.1	14.1 13.9	6.2 6.0	0.5	8.3 7.9	1.0	0.8 0.4	0.50 0.35	0.25	0.08	0.1	0.5 0.1	8° 0°

**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	EIAJ			
SOT364-1		MO-153EE				93-02-03 95-02-10

# 20-bit registered driver with inverted register enable (3-State)

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## Data sheet status

Data sheet status	Product status	Definition [1]
Objective specification	Development	This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.
Preliminary specification	Qualification	This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.
Product specification	Production	This data sheet contains final specifications. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.

[1] Please consult the most recently issued datasheet before initiating or completing a design.

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**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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Philips Semiconductors  
811 East Arques Avenue  
P.O. Box 3409  
Sunnyvale, California 94088-3409  
Telephone 800-234-7381

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