

# DATA SHEET

## **74AVC16836A**

20-bit registered driver with inverted  
register enable and  
Dynamic Controlled Outputs™ (3-State)

Product data  
Supersedes data of 2000 Aug 03

2002 Aug 02

# 20-bit registered driver with inverted register enable and Dynamic Controlled Outputs™ (3-State)

74AVC16836A

## 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  $V_{CC}$  and GND pins for minimum noise and ground bounce
- Power off disables 74AVC16836A outputs, permitting Live Insertion
- Integrated input diodes to minimize input overshoot and undershoot
- Full PC133 solution provided when used with PCK2509S or PCK2510S and CBT16292

## DESCRIPTION

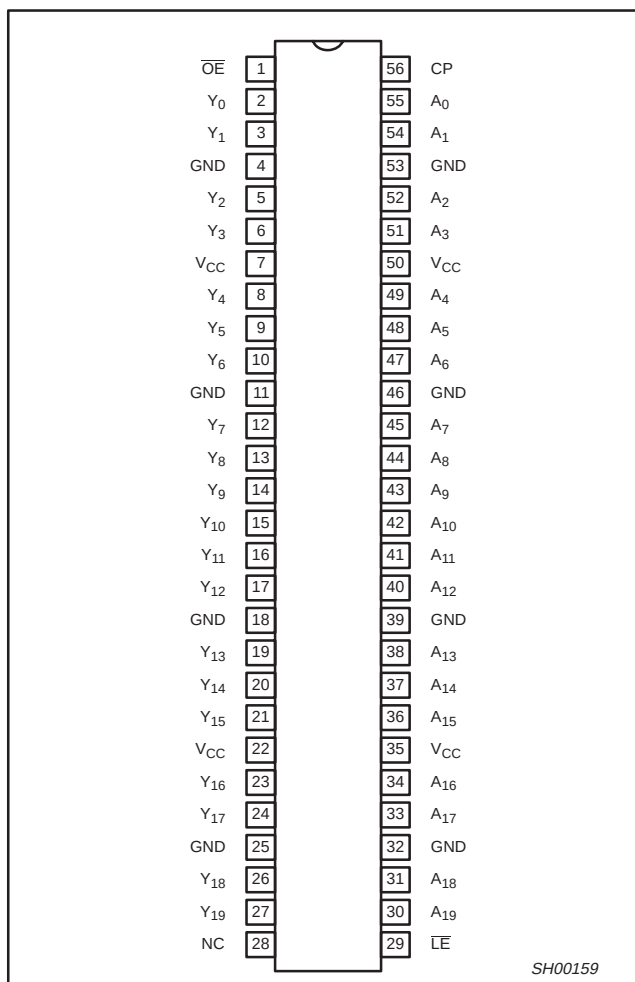
The 74AVC16836A is a 20-bit universal bus driver. Data flow is controlled by output enable ( $\overline{OE}$ ), latch enable ( $\overline{LE}$ ) and clock inputs (CP).

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 the graphs on page 8 for typical curves.

## PIN CONFIGURATION



SH00159

## QUICK REFERENCE DATA

GND = 0 V;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ ;  $t_r = t_f \leq 2.0\text{ ns}$ ;  $C_L = 30\text{ pF}$ .

| SYMBOL            | PARAMETER                                  | CONDITIONS                                                                    |                                    | TYPICAL           | UNIT |
|-------------------|--------------------------------------------|-------------------------------------------------------------------------------|------------------------------------|-------------------|------|
| $t_{PHL}/t_{PLH}$ | Propagation delay<br>An to Yn              | $V_{CC} = 1.8\text{ V}$<br>$V_{CC} = 2.5\text{ V}$<br>$V_{CC} = 3.3\text{ V}$ |                                    | 2.4<br>1.7<br>1.5 | ns   |
| $t_{PHL}/t_{PLH}$ | Propagation delay<br>LE to Yn;<br>CP to Yn | $V_{CC} = 1.8\text{ V}$<br>$V_{CC} = 2.5\text{ V}$<br>$V_{CC} = 3.3\text{ V}$ |                                    | 2.7<br>2.1<br>1.7 | ns   |
| $C_I$             | Input capacitance                          |                                                                               |                                    | 3.8               | pF   |
| $C_{PD}$          | Power dissipation capacitance per buffer   | $V_I = \text{GND to } V_{CC}^1$                                               | Outputs enabled<br>Output disabled | 25<br>6           | pF   |

### NOTE:

1.  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ):  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o)$  where:  $f_i$  = input frequency in MHz;  $C_L$  = output load capacitance in pF;  
 $f_o$  = output frequency in MHz;  $V_{CC}$  = 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 0.5 mm pitch TSSOP | -40 to +85 $^{\circ}\text{C}$ | 74AVC16836ADGG | SOT364-1       |
| 56-Pin Plastic 0.4 mm pitch TVSOP | -40 to +85 $^{\circ}\text{C}$ | 74AVC16836ADGV | SOT481-2       |

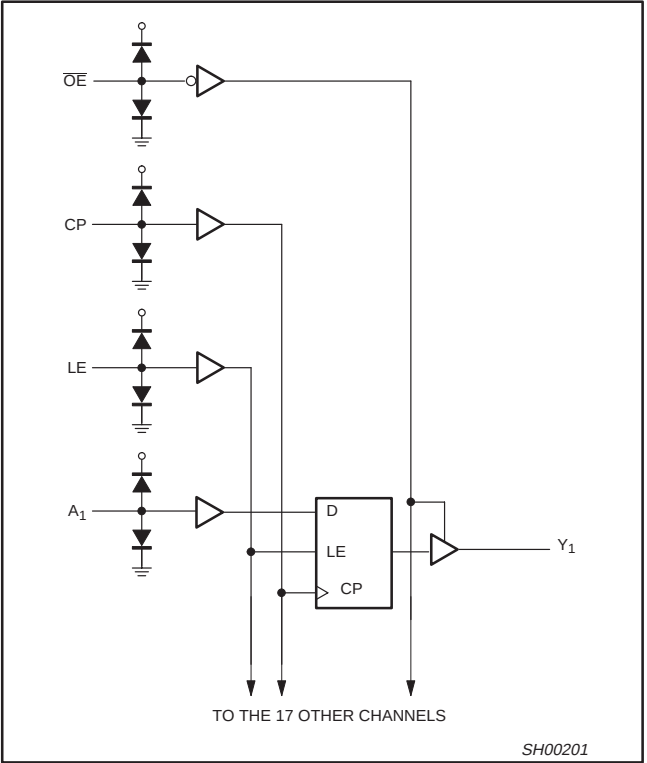
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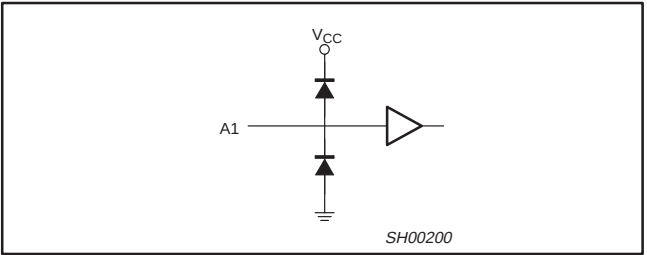
PIN DESCRIPTION

| 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                                                                              | $\overline{\text{OE}}$            | Output enable input (active LOW) |
| 29                                                                             | $\overline{\text{LE}}$            | 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                      |

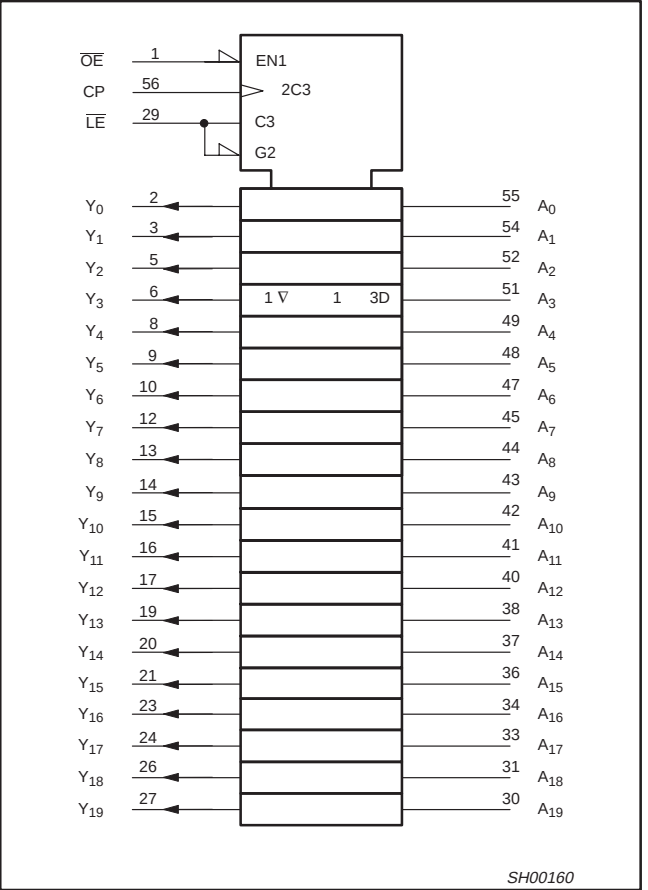
LOGIC SYMBOL



TYPICAL INPUT (DATA OR CONTROL)



LOGIC SYMBOL (IEEE/IEC)



FUNCTION TABLE

| INPUTS                 |                        |    |   | OUTPUTS                     |
|------------------------|------------------------|----|---|-----------------------------|
| $\overline{\text{OE}}$ | $\overline{\text{LE}}$ | 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> |

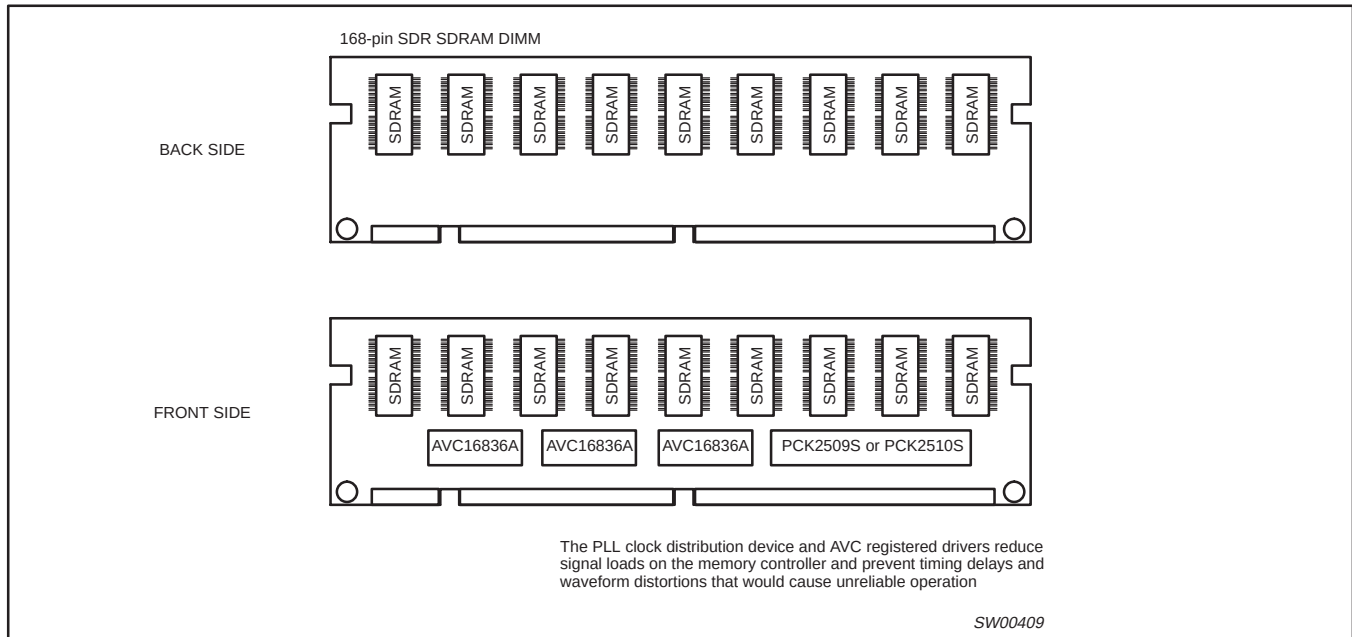
- H = HIGH voltage level  
L = LOW voltage level  
X = Don't care  
Z = High impedance "off" state  
↑ = LOW-to-HIGH level transition

NOTES:

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

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## RECOMMENDED OPERATING CONDITIONS

| SYMBOL     | PARAMETER                                                    | CONDITIONS                 | MIN  | MAX      | UNIT |
|------------|--------------------------------------------------------------|----------------------------|------|----------|------|
| $V_{CC}$   | DC supply voltage (according to JEDEC Low Voltage Standards) |                            | 1.65 | 1.95     | V    |
|            |                                                              |                            | 2.3  | 2.7      |      |
|            |                                                              |                            | 3.0  | 3.6      |      |
| $V_I$      | DC Input voltage range                                       |                            | 0    | 3.6      | V    |
| $V_O$      | DC output voltage range; output 3-State                      |                            | 0    | 3.6      | V    |
|            | DC output voltage range; output HIGH or LOW state            |                            | 0    | $V_{CC}$ |      |
| $T_{amb}$  | Operating free-air temperature range                         |                            | -40  | +85      | °C   |
| $t_r, t_f$ | Input rise and fall times                                    | $V_{CC} = 1.65$ to $2.3$ V | 0    | 30       | ns/V |
|            |                                                              | $V_{CC} = 2.3$ to $3.0$ V  | 0    | 20       |      |
|            |                                                              | $V_{CC} = 3.0$ to $3.6$ V  | 0    | 10       |      |

## 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 $V_O < 0$                                                      | ±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 $V_{CC}$                                                            | ±50                    | mA   |
| $I_{GND}, I_{CC}$ | DC $V_{CC}$ or GND current                                           |                                                                                  | ±100                   | mA   |
| $T_{stg}$         | Storage temperature range                                            |                                                                                  | -65 to +150            | °C   |
| $P_{TOT}$         | Power dissipation per package<br>-plastic thin-medium-shrink (TSSOP) | For temperature range: -40 to +125 °C<br>above +55°C derate linearly with 8 mW/K | 600                    | mW   |

### NOTE:

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

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## 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 <sub>IH</sub>  | HIGH level Input voltage         | V <sub>CC</sub> = 1.2 V                                                                                                        | V <sub>CC</sub>       | —                     | —                   | V    |
|                  |                                  | V <sub>CC</sub> = 1.65 to 1.95 V                                                                                               | 0.65V <sub>CC</sub>   | 0.9                   | —                   |      |
|                  |                                  | V <sub>CC</sub> = 2.3 to 2.7 V                                                                                                 | 1.7                   | 1.2                   | —                   |      |
|                  |                                  | V <sub>CC</sub> = 3.0 to 3.6 V                                                                                                 | 2.0                   | 1.5                   | —                   |      |
| V <sub>IL</sub>  | LOW level Input voltage          | V <sub>CC</sub> = 1.2 V                                                                                                        | —                     | —                     | GND                 | V    |
|                  |                                  | V <sub>CC</sub> = 1.65 to 1.95 V                                                                                               | —                     | 0.9                   | 0.35V <sub>CC</sub> |      |
|                  |                                  | V <sub>CC</sub> = 2.3 to 2.7 V                                                                                                 | —                     | 1.2                   | 0.7                 |      |
|                  |                                  | V <sub>CC</sub> = 3.0 to 3.6 V                                                                                                 | —                     | 1.5                   | 0.8                 |      |
| V <sub>OH</sub>  | HIGH level output voltage        | V <sub>CC</sub> = 1.65 to 3.6 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -100 μA                | V <sub>CC</sub> -0.20 | V <sub>CC</sub>       | —                   | V    |
|                  |                                  | V <sub>CC</sub> = 1.65 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -4 mA                         | V <sub>CC</sub> -0.45 | V <sub>CC</sub> -0.10 | —                   |      |
|                  |                                  | V <sub>CC</sub> = 2.3 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -8 mA                          | V <sub>CC</sub> -0.55 | V <sub>CC</sub> -0.28 | —                   |      |
|                  |                                  | V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -12 mA                         | V <sub>CC</sub> -0.70 | V <sub>CC</sub> -0.32 | —                   |      |
| V <sub>OL</sub>  | LOW level output voltage         | V <sub>CC</sub> = 1.65 to 3.6 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 100 μA                 | —                     | GND                   | 0.20                | V    |
|                  |                                  | V <sub>CC</sub> = 1.65 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 4 mA                          | —                     | 0.10                  | 0.45                |      |
|                  |                                  | V <sub>CC</sub> = 2.3 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 8 mA                           | —                     | 0.26                  | 0.55                |      |
|                  |                                  | V <sub>CC</sub> = 3.0 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 12 mA                          | —                     | 0.36                  | 0.70                |      |
| I <sub>I</sub>   | Input leakage current            | V <sub>CC</sub> = 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND                                                               | —                     | 0.1                   | 2.5                 | μA   |
| I <sub>OFF</sub> | 3-State output OFF-state current | V <sub>CC</sub> = 0 V; V <sub>I</sub> or V <sub>O</sub> = 3.6 V                                                                | —                     | 0.1                   | ± 10                | μA   |
| I <sub>OZ</sub>  | 3-State output OFF-state current | V <sub>CC</sub> = 1.65 to 2.7 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND | —                     | 0.1                   | 5                   | μA   |
|                  |                                  | V <sub>CC</sub> = 3.0 to 3.6 V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND  | —                     | 0.1                   | 10                  |      |
| I <sub>CC</sub>  | Quiescent supply current         | V <sub>CC</sub> = 1.65 to 2.7 V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0                                   | —                     | 0.1                   | 20                  | μA   |
|                  |                                  | V <sub>CC</sub> = 3.0 to 3.6 V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0                                    | —                     | 0.2                   | 40                  |      |

### NOTE:

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

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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 |                  |     | $V_{CC} = 1.5 \pm 0.1$ V |     | $V_{CC} = 1.2$ V |      |
|                   |                                            |          | MIN                      | TYP <sup>1</sup> | MAX | MIN                      | TYP <sup>1</sup> | MAX | MIN                       | TYP <sup>1</sup> | MAX | MIN                      | MAX | TYP              |      |
| $t_{PHL}/t_{PLH}$ | Propagation delay<br>An to Yn              | 1, 7     | 0.7                      | 1.5              | 2.7 | 0.8                      | 1.7              | 3.2 | 1.0                       | 2.4              | 4.4 | 2.0                      | 5.3 | 4.7              | ns   |
|                   | Propagation delay<br>$\overline{LE}$ to Yn | 2, 7     | 0.7                      | 1.7              | 3.4 | 1.0                      | 2.1              | 3.5 | 1.5                       | 2.7              | 5.0 | 2.0                      | 5.6 | 5.0              | ns   |
|                   | Propagation delay<br>CP to Yn              | 3, 7     | 0.7                      | 1.6              | 3.0 | 0.8                      | 1.7              | 3.2 | 1.2                       | 2.3              | 4.1 | 2.0                      | 4.7 | 5.7              | ns   |
| $t_{PZH}/t_{PZL}$ | 3-State output<br>enable time<br>OE to Yn  | 6, 7     | 1.0                      | 1.9              | 3.6 | 1.0                      | 2.4              | 4.0 | 1.5                       | 3.0              | 5.4 | 2.5                      | 6.8 | 6.0              | ns   |
| $t_{PHZ}/t_{PLZ}$ | 3-State output<br>disable time<br>OE to Yn | 6, 7     | 1.0                      | 2.5              | 4.8 | 1.0                      | 2.1              | 4.7 | 1.5                       | 3.7              | 7.5 | 2.5                      | 7.6 | 6.6              | ns   |
| $t_W$             | CP pulse width<br>HIGH or LOW              | 3, 7     | 1.0                      | –                | –   | 1.2                      | –                | –   | 2.0                       | –                | –   | –                        | –   | –                | ns   |
|                   | LE pulse width<br>HIGH                     | 2, 7     | 1.0                      | –                | –   | 1.2                      | –                | –   | 2.0                       | –                | –   | –                        | –   | –                | ns   |
| $t_{SU}$          | Set-up time<br>An to CP                    | 5, 7     | 0.2                      | 0                | –   | 0.3                      | 0                | –   | 0.2                       | 0                | –   | 0.3                      | –   | 0                | ns   |
|                   | Set-up time<br>An to $\overline{LE}$       | 4, 7     | 0.3                      | 0                | –   | 0.6                      | 0.2              | –   | 0.9                       | 0.4              | –   | 1.3                      | –   | 1.2              | ns   |
| $t_H$             | Hold time<br>An to CP                      | 5, 7     | 1.2                      | 0.5              | –   | 0.6                      | 0.2              | –   | 0.6                       | 0.2              | –   | 0.6                      | –   | 0.1              | ns   |
|                   | Hold time<br>An to $\overline{LE}$         | 4, 7     | 1.0                      | 0.5              | –   | 0.5                      | 0.1              | –   | 0.4                       | 0                | –   | 0.2                      | –   | –0.7             | ns   |
| $f_{max}$         | Maximum clock<br>pulse frequency           | 3, 7     | 500                      | –                | –   | 400                      | –                | –   | 250                       | –                | –   | –                        | –   | –                | MHz  |

### NOTE:

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.

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

$$V_M = 0.5 V_{CC}$$

$$V_X = V_{OL} + 0.300\text{ V}$$

$$V_Y = V_{OH} - 0.300\text{ V}$$

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

$$V_I = V_{CC}$$

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

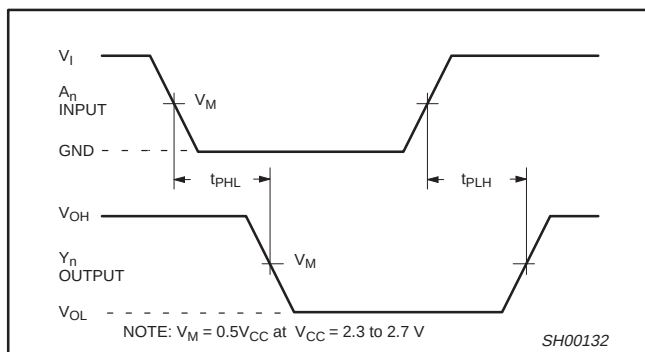
$$V_M = 0.5 V_{CC}$$

$$V_X = V_{OL} + 0.15\text{ V}$$

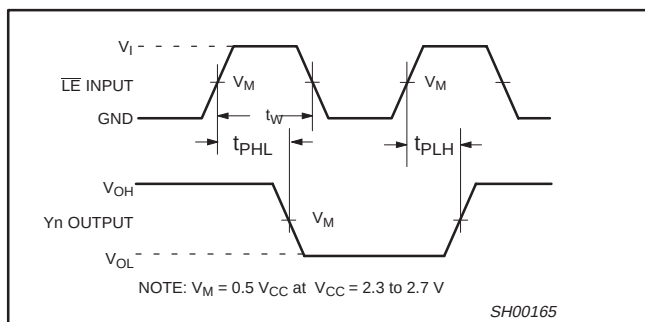
$$V_Y = V_{OH} - 0.15\text{ V}$$

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

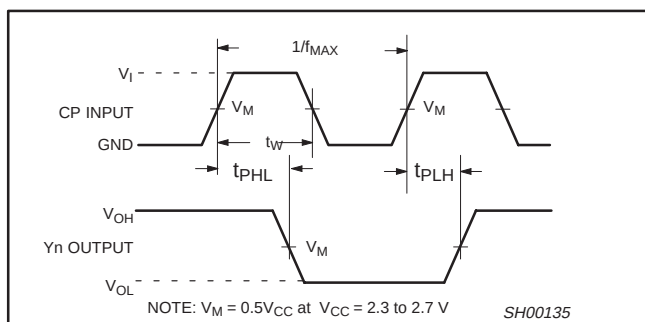
$$V_I = V_{CC}$$



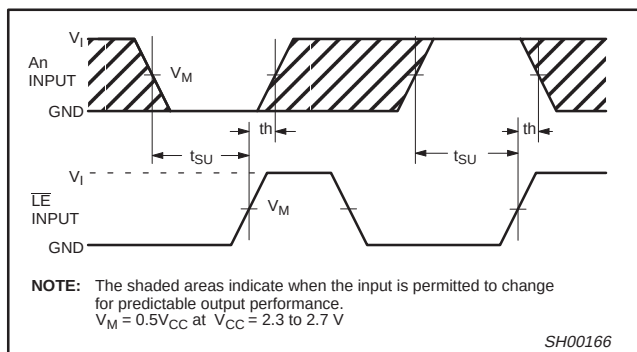
Waveform 1. Input (An) to output (Yn) propagation delay



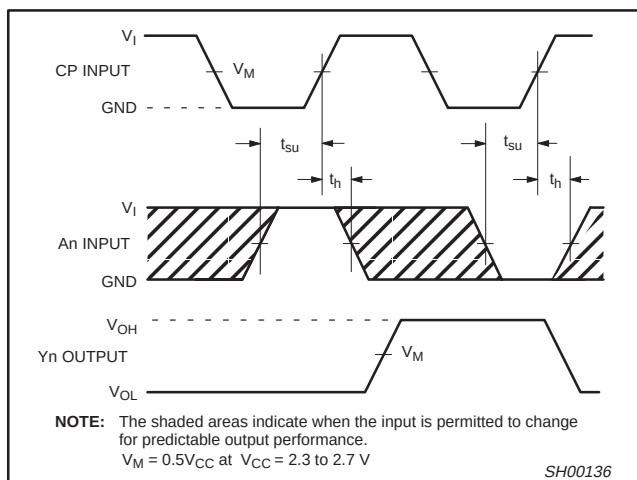
Waveform 2. Latch enable input (LE) pulse width, the latch enable input to output (Yn) propagation delays.



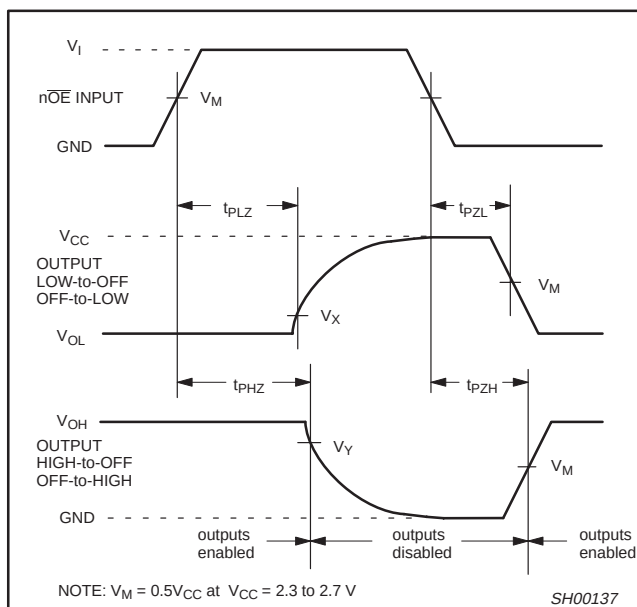
Waveform 3. The clock (CP) to Yn propagation delays, the clock pulse width and the maximum clock frequency.



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

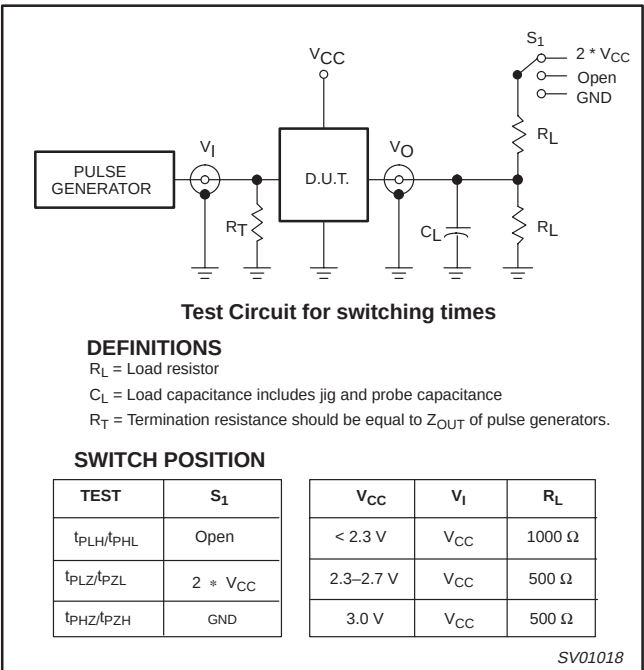


Waveform 6. 3-State enable and disable times

# 20-bit registered driver with inverted register enable and Dynamic Controlled Outputs™ (3-State)

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## TEST CIRCUIT



Waveform 7. Load circuitry for switching times

## GRAPHS

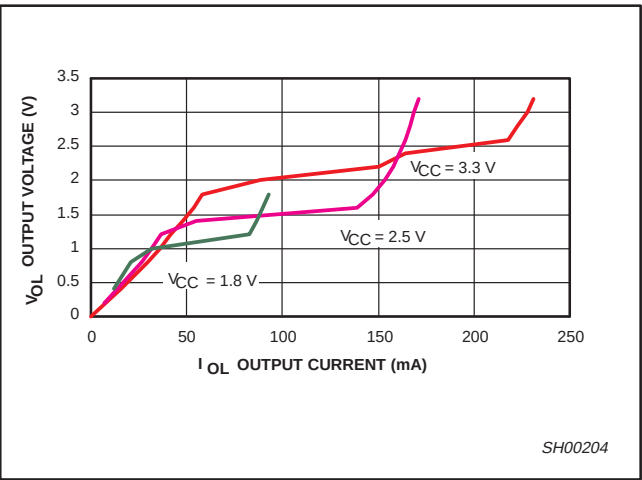


Figure 1. Output voltage ( $V_{OL}$ ) vs. output current ( $I_{OL}$ )

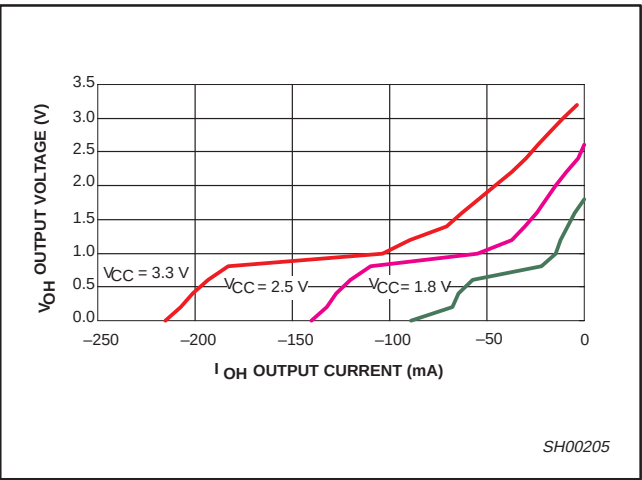


Figure 2. Output voltage ( $V_{OH}$ ) vs. output current ( $I_{OH}$ )

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. Figures 1 and 2 show  $V_{OL}$  vs.  $I_{OL}$  and  $V_{OH}$  vs.  $I_{OH}$  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.

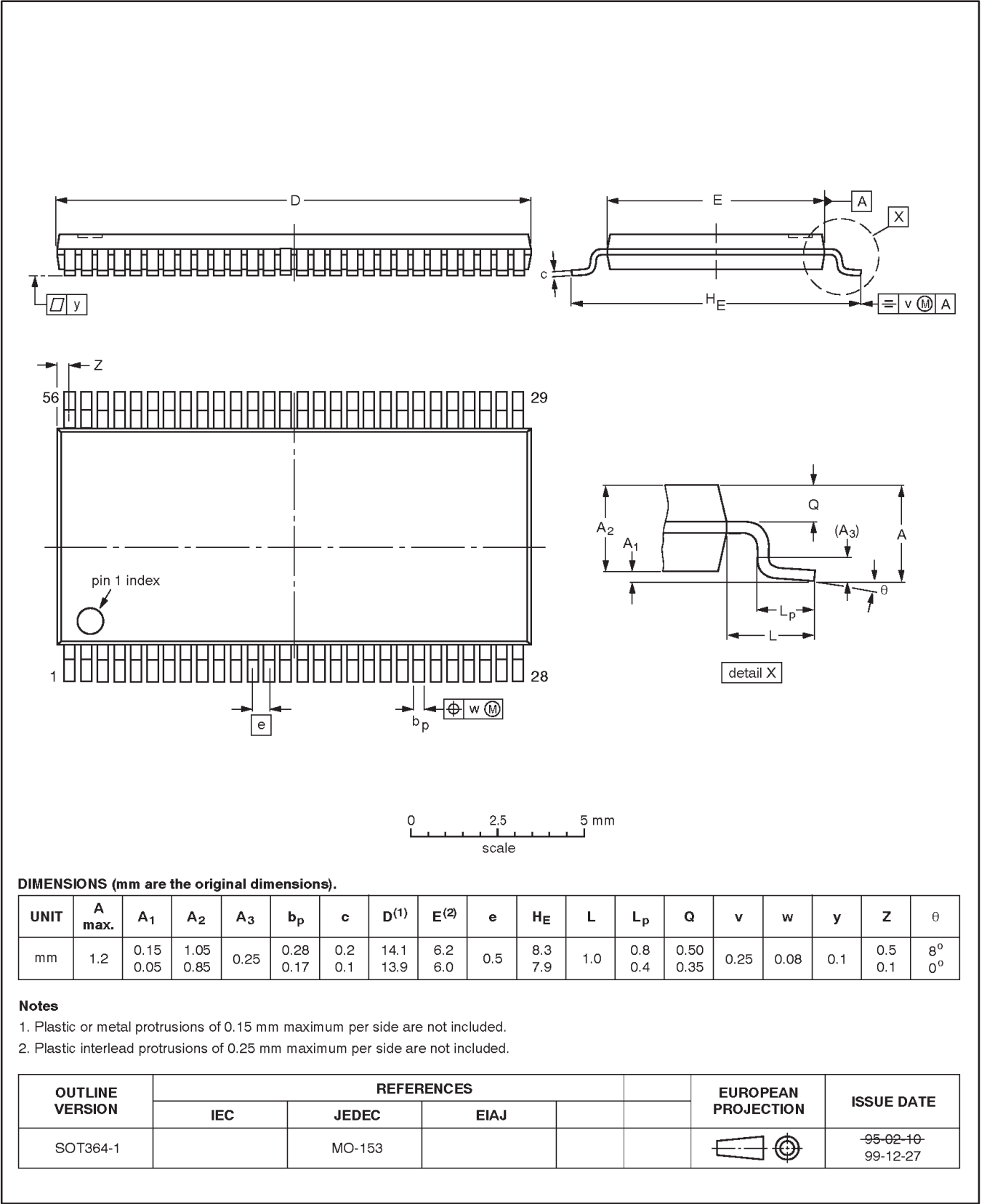


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TSSOP56: plastic thin shrink small outline package; 56 leads; body width 6.1 mm

SOT364-1

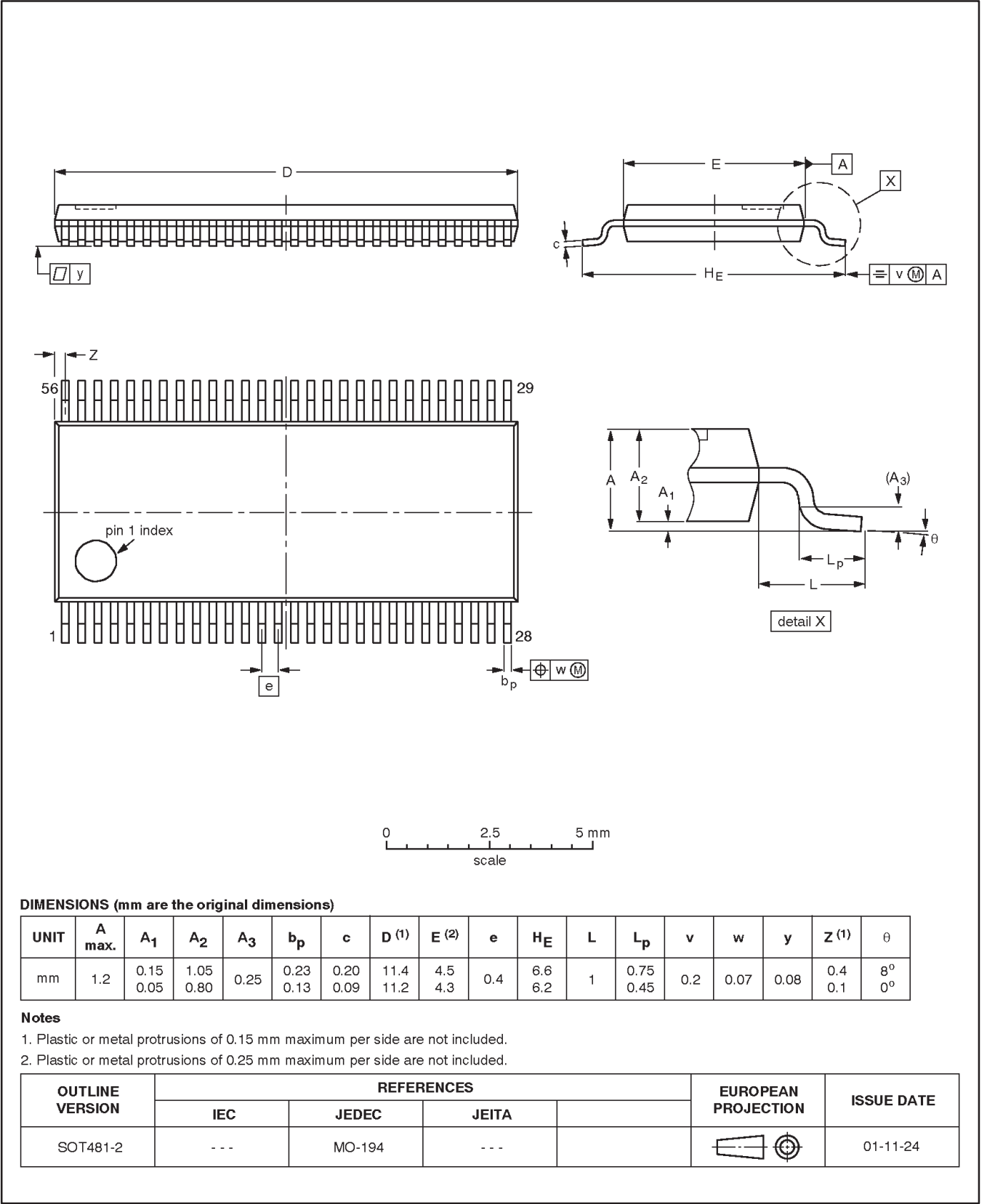


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TSSOP56: plastic thin shrink small outline package; 56 leads; body width 4.4 mm

SOT481-2



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74AVC16836A

## Data sheet status

| Data sheet status <sup>[1]</sup> | Product status <sup>[2]</sup> | Definitions                                                                                                                                                                                                                                                                                                            |
|----------------------------------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Objective data                   | Development                   | This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.                                                                                                                            |
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[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

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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.

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