

# DATA SHEET

## **74LVT543**

**3.3V Octal latched transceiver with  
dual enable (3-State)**

Product specification  
Supersedes data of 1994 May 20  
IC23 Data Handbook

1998 Feb 19

3.3V Octal latched transceiver with dual enable  
(3-State)

74LVT543

FEATURES

- Combines 74LVT245 and 74LVT373 type functions in one device
- 8-bit octal transceiver with D-type latch
- Back-to-back registers for storage
- Separate controls for data flow in each direction
- Output capability: +64mA/−32mA
- TTL input and output switching levels
- Input and output interface capability to systems at 5V supply
- Bus-hold data inputs eliminate the need for external pull-up resistors to hold unused inputs
- Live insertion/extraction permitted
- No bus current loading when output is tied to 5V bus
- Power-up 3-State
- Power-up reset
- Latch-up protection exceeds 500mA per JEDEC Std 17
- ESD protection exceeds 2000V per MIL STD 883 Method 3015 and 200V per Machine Model

DESCRIPTION

The 74LVT543 is a high-performance BiCMOS product designed for  $V_{CC}$  operation at 3.3V.

This device contains two sets of D-type latches for temporary storage of data flowing in either direction. Separate Latch Enable ( $\overline{LEAB}$ ,  $\overline{LEBA}$ ) and Output Enable ( $\overline{OEAB}$ ,  $\overline{OEBA}$ ) inputs are provided for each register to permit independent control of data transfer in either direction. The outputs are guaranteed to sink 64mA.

FUNCTIONAL DESCRIPTION

The 74LVT543 contains two sets of eight D-type latches, with separate control pins for each set. Using data flow from A to B as an example, when the A-to-B Enable ( $\overline{EAB}$ ) input and the A-to-B Latch Enable ( $\overline{LEAB}$ ) input are Low the A-to-B path is transparent. A subsequent Low-to-High transition of the  $\overline{LEAB}$  signal puts the A data into the latches where it is stored and the B outputs no longer change with the A inputs. With  $\overline{EAB}$  and  $\overline{OEAB}$  both Low, the 3-State B output buffers are active and display the data present at the outputs of the A latches.

Control of data flow from B to A is similar, but using the  $\overline{EBA}$ ,  $\overline{LEBA}$ , and  $\overline{OEBA}$  inputs.

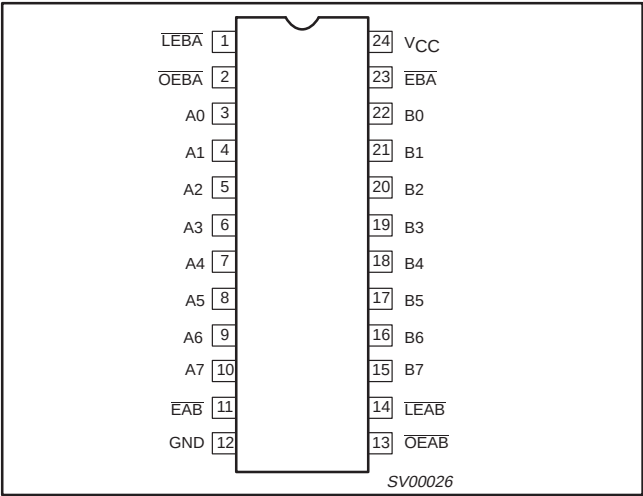
QUICK REFERENCE DATA

| SYMBOL                 | PARAMETER                                 | CONDITIONS<br>$T_{amb} = 25^{\circ}C$ ; $GND = 0V$ | TYPICAL    | UNIT |
|------------------------|-------------------------------------------|----------------------------------------------------|------------|------|
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>An to Bn or Bn to An | $C_L = 50pF$ ;<br>$V_{CC} = 3.3V$                  | 2.3<br>3.0 | ns   |
| $C_{IN}$               | Input capacitance                         | $V_I = 0V$ or $3.0V$                               | 4          | pF   |
| $C_{I/O}$              | I/O capacitance                           | Outputs disabled; $V_{I/O} = 0V$ or $3.0V$         | 10         | pF   |
| $I_{CCZ}$              | Total supply current                      | Outputs disabled; $V_{CC} = 3.6V$                  | 0.13       | mA   |

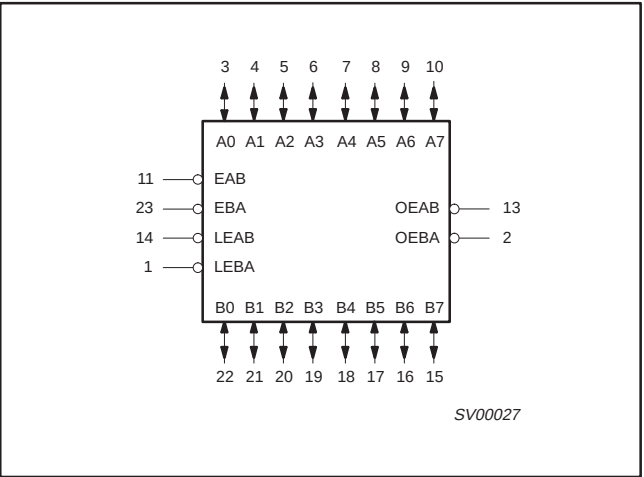
ORDERING INFORMATION

| PACKAGES                    | TEMPERATURE RANGE | OUTSIDE NORTH AMERICA | NORTH AMERICA | DWG NUMBER |
|-----------------------------|-------------------|-----------------------|---------------|------------|
| 24-Pin Plastic SOL          | −40°C to +85°C    | 74LVT543 D            | 74LVT543 D    | SOT137-1   |
| 24-Pin Plastic SSOP Type II | −40°C to +85°C    | 74LVT543 DB           | 74LVT543 DB   | SOT340-1   |
| 24-Pin Plastic TSSOP Type I | −40°C to +85°C    | 74LVT543 PW           | 74LVT543PW DH | SOT355-1   |

PIN CONFIGURATION



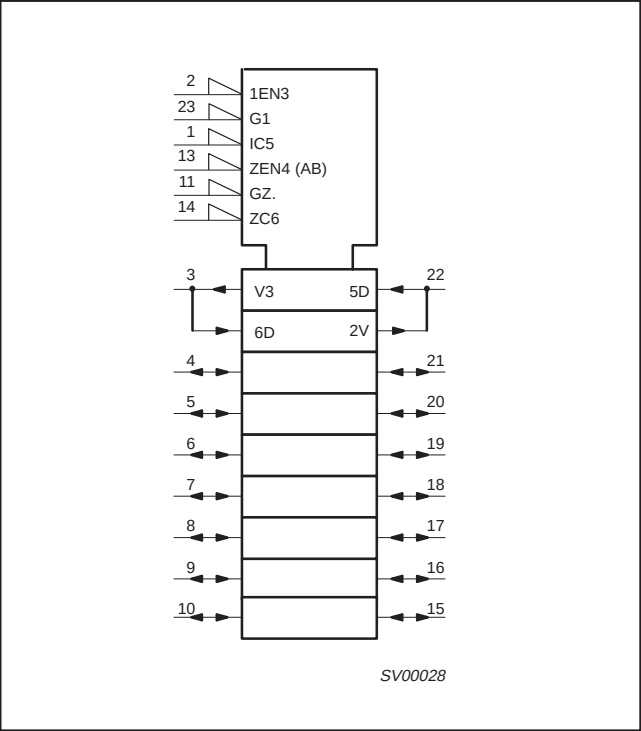
LOGIC SYMBOL



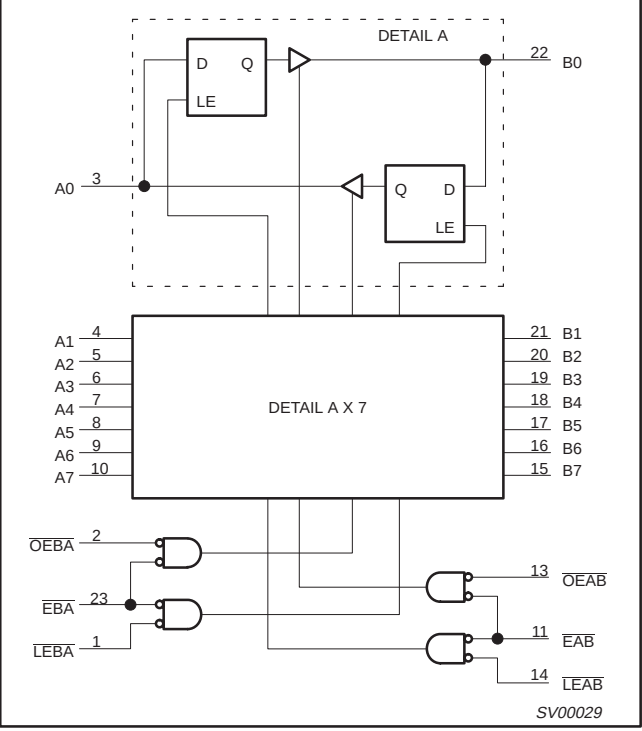
3.3V Octal latched transceiver with dual enable  
(3-State)

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LOGIC SYMBOL (IEEE/IEC)



LOGIC DIAGRAM



PIN DESCRIPTION

| PIN NUMBER                     | SYMBOL                                            | FUNCTION                                         |
|--------------------------------|---------------------------------------------------|--------------------------------------------------|
| 14, 1                          | $\overline{\text{LEAB}} / \overline{\text{LEBA}}$ | A to B / B to A Latch Enable input (active-Low)  |
| 11, 23                         | $\overline{\text{EAB}} / \overline{\text{EBA}}$   | A to B / B to A Enable input (active-Low)        |
| 13, 2                          | $\overline{\text{OEAB}} / \overline{\text{OEBA}}$ | A to B / B to A Output Enable input (active-Low) |
| 3, 4, 5, 6, 7, 8, 9, 10        | A0 – A7                                           | Port A, 3-State outputs                          |
| 22, 21, 20, 19, 18, 17, 16, 15 | B0 – B7                                           | Port B, 3-State outputs                          |
| 12                             | GND                                               | Ground (0V)                                      |
| 24                             | V <sub>CC</sub>                                   | Positive supply voltage                          |

FUNCTION TABLE

| INPUTS                    |                          |                           |                                  | OUTPUTS                          | STATUS           |
|---------------------------|--------------------------|---------------------------|----------------------------------|----------------------------------|------------------|
| OE $\overline{\text{XX}}$ | E $\overline{\text{XX}}$ | LE $\overline{\text{XX}}$ | A <sub>n</sub> or B <sub>n</sub> | B <sub>n</sub> or A <sub>n</sub> |                  |
| H                         | X                        | X                         | X                                | Z                                | Disabled         |
| X                         | H                        | X                         | X                                | Z                                | Disabled         |
| L                         | ↑                        | L                         | h                                | Z                                | Disabled + Latch |
| L                         | ↑                        | L                         | l                                | Z                                |                  |
| L                         | L                        | ↑                         | h                                | H                                | Latch + Display  |
| L                         | L                        | ↑                         | l                                | L                                |                  |
| L                         | L                        | L                         | H                                | H                                | Transparent      |
| L                         | L                        | L                         | L                                | L                                |                  |
| L                         | L                        | H                         | X                                | NC                               | Hold             |

H = High voltage level

h = High voltage level one set-up time prior to the Low-to-High transition of LE $\overline{\text{XX}}$  or E $\overline{\text{XX}}$  (XX = AB or BA)

L = Low voltage level

l = Low voltage level one set-up time prior to the Low-to-High transition of LE $\overline{\text{XX}}$  or E $\overline{\text{XX}}$  (XX = AB or BA)

X = Don't care

↑ = Low-to-High transition of LE $\overline{\text{XX}}$  or E $\overline{\text{XX}}$  (XX = AB or BA)

NC= No change

Z = High impedance or "off" state

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## ABSOLUTE MAXIMUM RATINGS<sup>1, 2</sup>

| 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 <sup>3</sup>  |                             | −0.5 to +7.0 | V    |
| $I_{OK}$  | DC output diode current        | $V_O < 0$                   | −50          | mA   |
| $V_{OUT}$ | DC output voltage <sup>3</sup> | Output in Off or High state | −0.5 to +7.0 | V    |
| $I_{OUT}$ | DC output current              | Output in Low state         | 128          | mA   |
|           |                                | Output in High state        | −64          |      |
| $T_{stg}$ | Storage temperature range      |                             | −65 to 150   | °C   |

### NOTES:

- Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability. The maximum junction temperature of this integrated circuit should not exceed 150°C.
- The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.

## RECOMMENDED OPERATING CONDITIONS

| SYMBOL              | PARAMETER                                                          | LIMITS |     | UNIT |
|---------------------|--------------------------------------------------------------------|--------|-----|------|
|                     |                                                                    | MIN    | MAX |      |
| $V_{CC}$            | DC supply voltage                                                  | 2.7    | 3.6 | V    |
| $V_I$               | Input voltage                                                      | 0      | 5.5 | V    |
| $V_{IH}$            | High-level input voltage                                           | 2.0    |     | V    |
| $V_{IL}$            | Low-level input voltage                                            |        | 0.8 | V    |
| $I_{OH}$            | High-level output current                                          |        | −32 | mA   |
| $I_{OL}$            | Low-level output current                                           |        | 32  | mA   |
|                     | Low-level output current; current duty cycle ≤ 50%; $f \geq 1$ kHz |        | 64  |      |
| $\Delta t/\Delta v$ | Input transition rise or fall rate; outputs enabled                |        | 10  | ns/V |
| $T_{amb}$           | Operating free-air temperature range                               | −40    | +85 | °C   |

# 3.3V Octal latched transceiver with dual enable (3-State)

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## DC ELECTRICAL CHARACTERISTICS

| SYMBOL             | PARAMETER                                                                      | TEST CONDITIONS                                                                                                                 |                            | LIMITS                |                      |      | UNIT |
|--------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|----------------------------|-----------------------|----------------------|------|------|
|                    |                                                                                |                                                                                                                                 |                            | Temp = -40°C to +85°C |                      |      |      |
|                    |                                                                                |                                                                                                                                 |                            | MIN                   | TYP <sup>1</sup>     | MAX  |      |
| V <sub>IK</sub>    | Input clamp voltage                                                            | V <sub>CC</sub> = 2.7V; I <sub>IK</sub> = −18mA                                                                                 |                            |                       | −0.9                 | −1.2 | V    |
| V <sub>OH</sub>    | High-level output voltage                                                      | V <sub>CC</sub> = 2.7 to 3.6V; I <sub>OH</sub> = −100μA                                                                         |                            | V <sub>CC</sub> -0.2  | V <sub>CC</sub> -0.1 |      | V    |
|                    |                                                                                | V <sub>CC</sub> = 2.7V; I <sub>OH</sub> = −8mA                                                                                  |                            | 2.4                   | 2.5                  |      |      |
|                    |                                                                                | V <sub>CC</sub> = 3.0V; I <sub>OH</sub> = −32mA                                                                                 |                            | 2.0                   | 2.2                  |      |      |
| V <sub>OL</sub>    | Low-level output voltage                                                       | V <sub>CC</sub> = 2.7V; I <sub>OL</sub> = 100μA                                                                                 |                            |                       | 0.1                  | 0.2  | V    |
|                    |                                                                                | V <sub>CC</sub> = 2.7V; I <sub>OL</sub> = 24mA                                                                                  |                            |                       | 0.3                  | 0.5  |      |
|                    |                                                                                | V <sub>CC</sub> = 3.0V; I <sub>OL</sub> = 16mA                                                                                  |                            |                       | 0.25                 | 0.4  |      |
|                    |                                                                                | V <sub>CC</sub> = 3.0V; I <sub>OL</sub> = 32mA                                                                                  |                            |                       | 0.3                  | 0.5  |      |
|                    |                                                                                | V <sub>CC</sub> = 3.0V; I <sub>OL</sub> = 64mA                                                                                  |                            |                       | 0.4                  | 0.55 |      |
| V <sub>RST</sub>   | Power-up output low voltage <sup>5</sup>                                       | V <sub>CC</sub> = 3.6V; I <sub>O</sub> = 1mA; V <sub>I</sub> = GND or V <sub>CC</sub>                                           |                            |                       | 0.13                 | 0.55 | V    |
| I <sub>I</sub>     | Input leakage current                                                          | V <sub>CC</sub> = 3.6V; V <sub>I</sub> = V <sub>CC</sub> or GND                                                                 | Control pins               |                       | ±0.1                 | ±1   | μA   |
|                    |                                                                                | V <sub>CC</sub> = 0 or 3.6V; V <sub>I</sub> = 5.5V                                                                              |                            |                       | 1                    | 10   |      |
|                    |                                                                                | V <sub>CC</sub> = 3.6V; V <sub>I</sub> = 5.5V                                                                                   | I/O Data pins <sup>4</sup> |                       | 1                    | 20   |      |
|                    |                                                                                | V <sub>CC</sub> = 3.6V; V <sub>I</sub> = V <sub>CC</sub>                                                                        |                            |                       | 0.1                  | 1    |      |
|                    |                                                                                | V <sub>CC</sub> = 3.6V; V <sub>I</sub> = 0                                                                                      |                            |                       | −1                   | -5   |      |
| I <sub>OFF</sub>   | Output off current                                                             | V <sub>CC</sub> = 0V; V <sub>I</sub> or V <sub>O</sub> = 0 to 4.5V                                                              |                            |                       | 1                    | ±100 | μA   |
| I <sub>HOLD</sub>  | Bus Hold current A inputs <sup>6</sup>                                         | V <sub>CC</sub> = 3V; V <sub>I</sub> = 0.8V                                                                                     |                            | 75                    | 150                  |      | μA   |
|                    |                                                                                | V <sub>CC</sub> = 3V; V <sub>I</sub> = 2.0V                                                                                     |                            | −75                   | −150                 |      |      |
|                    |                                                                                | V <sub>CC</sub> = 0V to 3.6V; V <sub>CC</sub> = 3.6V                                                                            |                            | ±500                  |                      |      |      |
| I <sub>EX</sub>    | Current into an output in the High state when V <sub>O</sub> > V <sub>CC</sub> | V <sub>O</sub> = 5.5V; V <sub>CC</sub> = 3.0V                                                                                   |                            |                       | 60                   | 125  | μA   |
| I <sub>PU/PD</sub> | Power up/down 3-State output current <sup>3</sup>                              | V <sub>CC</sub> ≤ 1.2V; V <sub>O</sub> = 0.5V to V <sub>CC</sub> ; V <sub>I</sub> = GND or V <sub>CC</sub> ; OE/OE = Don't care |                            |                       | 15                   | ±100 | μA   |
| I <sub>CCH</sub>   | Quiescent supply current                                                       | V <sub>CC</sub> = 3.6V; Outputs High, V <sub>I</sub> = GND or V <sub>CC</sub> , I <sub>O</sub> = 0                              |                            |                       | 0.13                 | 0.19 | mA   |
| I <sub>CCL</sub>   |                                                                                | V <sub>CC</sub> = 3.6V; Outputs Low, V <sub>I</sub> = GND or V <sub>CC</sub> , I <sub>O</sub> = 0                               |                            |                       | 3                    | 12   |      |
| I <sub>CCZ</sub>   |                                                                                | V <sub>CC</sub> = 3.6V; Outputs Disabled; V <sub>I</sub> = GND or V <sub>CC</sub> , I <sub>O</sub> = 0                          |                            |                       | 0.13                 | 0.19 |      |
| ΔI <sub>CC</sub>   | Additional supply current per input pin <sup>2</sup>                           | V <sub>CC</sub> = 3V to 3.6V; One input at V <sub>CC</sub> -0.6V, Other inputs at V <sub>CC</sub> or GND                        |                            |                       | 0.1                  | 0.2  | mA   |

### NOTES:

1. All typical values are at  $V_{CC} = 3.3V$  and  $T_{amb} = 25^\circ C$ .
2. This is the increase in supply current for each input at the specified voltage level other than  $V_{CC}$  or  $GND$ .
3. This parameter is valid for any  $V_{CC}$  between  $0V$  and  $1.2V$  with a transition time of up to  $10msec$ . From  $V_{CC} = 1.2V$  to  $V_{CC} = 3.3V \pm 0.3V$  a transition time of  $100\mu sec$  is permitted. This parameter is valid for  $T_{amb} = 25^\circ C$  only.
4. Unused pins at  $V_{CC}$  or  $GND$ .
5. For valid test results, data must not be loaded into the flip-flops (or latches) after applying the power.
6. This is the bus hold overdrive current required to force the input to the opposite logic state.

# 3.3V Octal latched transceiver with dual enable (3-State)

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## AC CHARACTERISTICS

GND = 0V,  $t_R = t_F = 2.5\text{ns}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 500\Omega$ ;  $T_{\text{amb}} = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ .

| SYMBOL                               | PARAMETER                                     | WAVEFORM | LIMITS                       |                  |            |                        | UNIT |
|--------------------------------------|-----------------------------------------------|----------|------------------------------|------------------|------------|------------------------|------|
|                                      |                                               |          | V <sub>CC</sub> = 3.3V ±0.3V |                  |            | V <sub>CC</sub> = 2.7V |      |
|                                      |                                               |          | MIN                          | TYP <sup>1</sup> | MAX        | MAX                    |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation delay<br>An to Bn, Bn to An       | 2        | 1.0<br>1.0                   | 2.3<br>3.0       | 4.7<br>4.6 | 5.5<br>5.8             | ns   |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation delay<br>LEBA to An, LEAB to Bn   | 1<br>2   | 1.0<br>1.0                   | 3.6<br>4.2       | 5.9<br>5.7 | 7.3<br>7.3             | ns   |
| t <sub>PZH</sub><br>t <sub>PZL</sub> | Output enable time<br>OEBA to An, OEAB to Bn  | 4<br>5   | 1.0<br>1.1                   | 3.8<br>3.8       | 5.8<br>6.4 | 7.6<br>8.2             | ns   |
| t <sub>PHZ</sub><br>t <sub>PLZ</sub> | Output disable time<br>OEBA to An, OEAB to Bn | 4<br>5   | 2.4<br>2.0                   | 3.7<br>3.5       | 6.5<br>5.8 | 7.1<br>5.9             | ns   |
| t <sub>PZH</sub><br>t <sub>PZL</sub> | Output enable time<br>EBA to An, EAB to Bn    | 4<br>5   | 1.0<br>1.4                   | 4.0<br>4.1       | 6.0<br>6.7 | 7.6<br>8.3             | ns   |
| t <sub>PHZ</sub><br>t <sub>PLZ</sub> | Output disable time<br>EBA to An, EAB to Bn   | 4<br>5   | 2.3<br>2.0                   | 3.7<br>3.5       | 6.4<br>5.4 | 7.1<br>5.6             | ns   |

### NOTE:

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

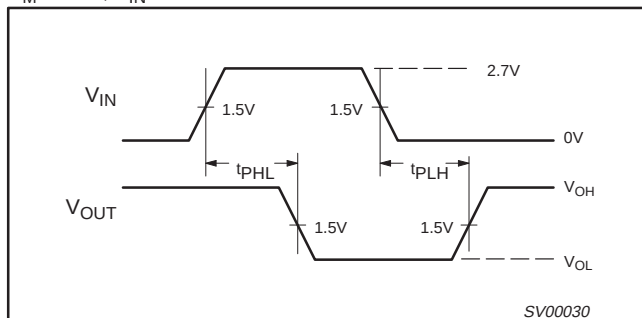
## AC SETUP REQUIREMENTS

GND = 0V,  $t_R = t_F = 2.5\text{ns}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 500\Omega$ ;  $T_{\text{amb}} = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ .

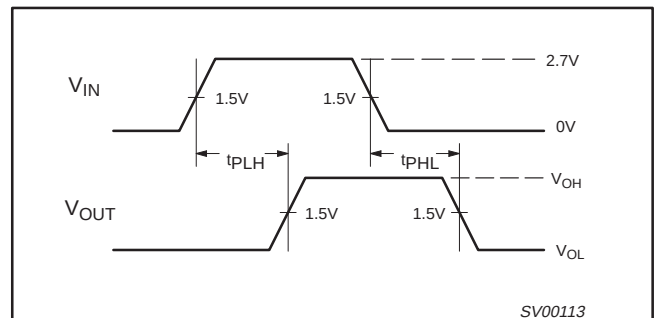
| SYMBOL               | PARAMETER                                                       | WAVEFORM | LIMITS                   |     |                 | UNIT |
|----------------------|-----------------------------------------------------------------|----------|--------------------------|-----|-----------------|------|
|                      |                                                                 |          | $V_{CC} = 3.3V \pm 0.3V$ |     | $V_{CC} = 2.7V$ |      |
|                      |                                                                 |          | MIN                      | MAX | MIN             |      |
| $t_S(H)$<br>$t_S(L)$ | Setup time<br>An to $\overline{LEAB}$ , Bn to $\overline{LEBA}$ | 3        | 0<br>0.8                 |     | 0<br>1.1        | ns   |
| $t_H(H)$<br>$t_H(L)$ | Hold time<br>An to $\overline{LEAB}$ , Bn to $\overline{LEBA}$  | 3        | 1.7<br>1.7               |     | 1.7<br>1.7      | ns   |
| $t_S(H)$<br>$t_S(L)$ | Setup time<br>An to $\overline{EAB}$ , Bn to $\overline{EBA}$   | 3        | 0<br>0.9                 |     | 0<br>1.2        | ns   |
| $t_H(H)$<br>$t_H(L)$ | Hold time<br>An to $\overline{EAB}$ , Bn to $\overline{EBA}$    | 3        | 1.8<br>1.8               |     | 1.8<br>1.8      | ns   |
| $t_W(L)$             | Latch enable pulse width, Low                                   | 3        | 3.3                      |     | 3.3             | ns   |

## AC WAVEFORMS

$V_M = 1.5V$ ,  $V_{IN} = \text{GND to } 2.7V$



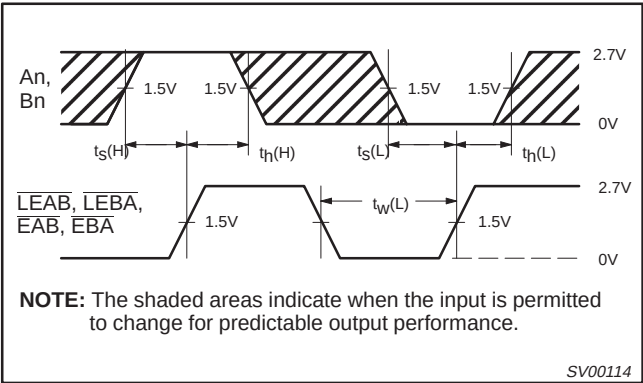
Waveform 1. Propagation Delay For Inverting Output



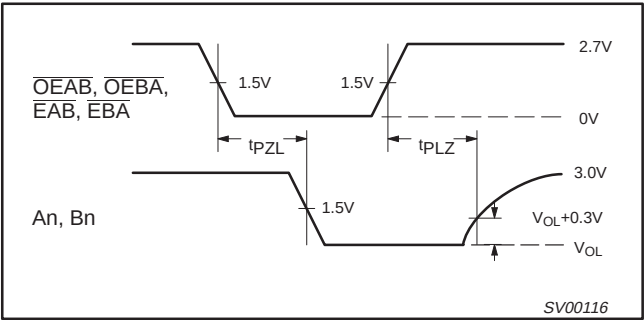
Waveform 2. Propagation Delay For Non-Inverting Output

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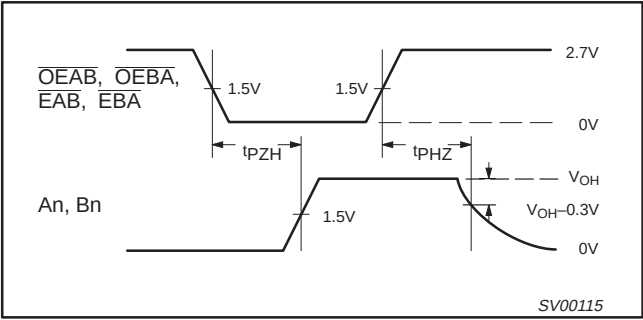
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Waveform 3. Data Setup and Hold Times And Latch Enable Pulse Width



Waveform 5. 3-State Output Enable Time to Low Level and Output Disable Time from Low Level



Waveform 4. 3-State Output Enable Time to High Level and Output Disable Time from High Level

TEST CIRCUIT AND WAVEFORM

Test Circuit for 3-State Outputs

| TEST              | SWITCH |
|-------------------|--------|
| $t_{PLH}/t_{PHL}$ | Open   |
| $t_{PLZ}/t_{PZL}$ | 6V     |
| $t_{PHZ}/t_{PZH}$ | GND    |

**DEFINITIONS**

$R_L$  = Load resistor; see AC CHARACTERISTICS for value.

$C_L$  = Load capacitance includes jig and probe capacitance; see AC CHARACTERISTICS for value.

$R_T$  = Termination resistance should be equal to  $Z_{OUT}$  of pulse generators.

$V_M = 1.5V$   
Input Pulse Definition

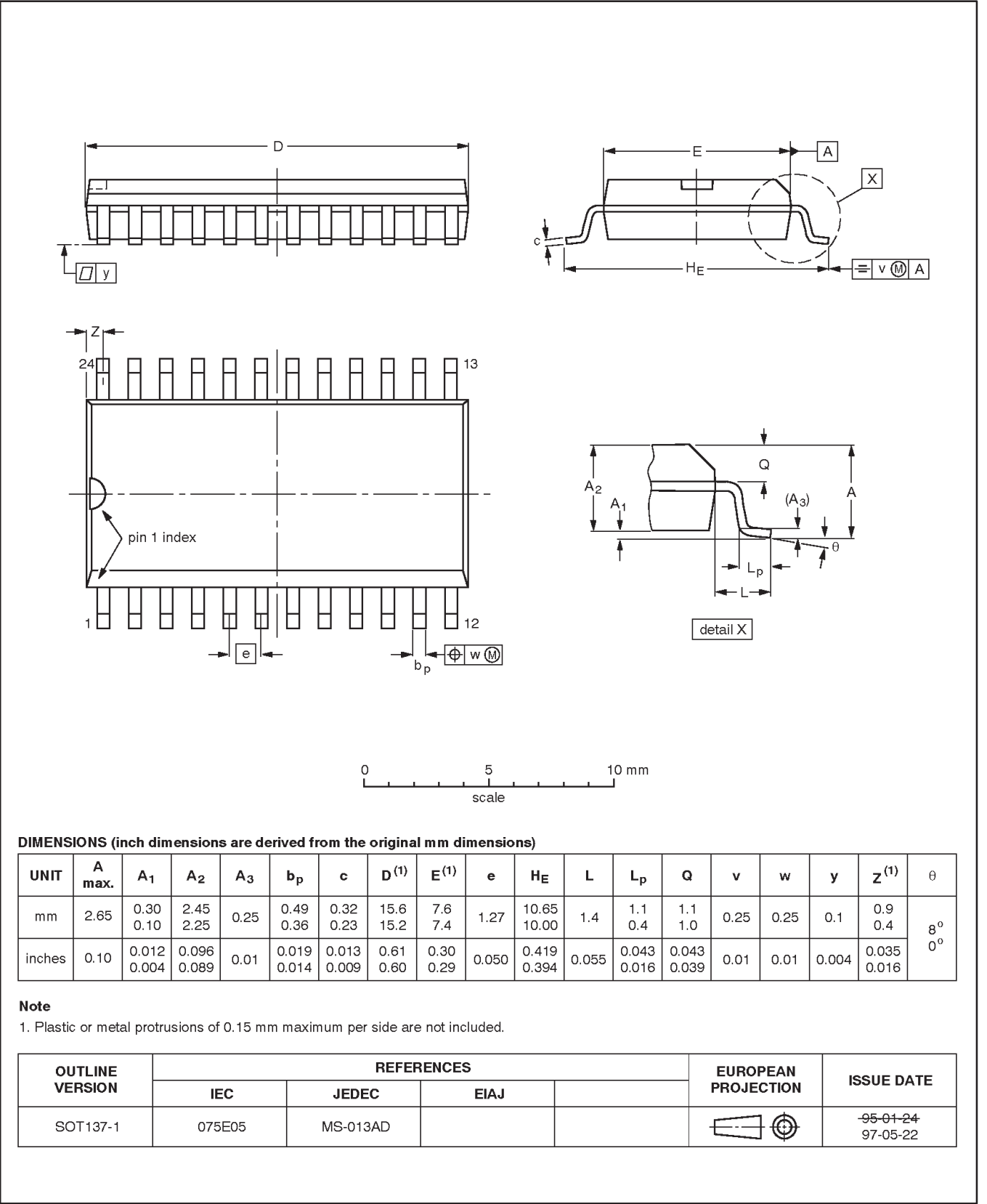
| FAMILY | INPUT PULSE REQUIREMENTS |              |       |              |              |
|--------|--------------------------|--------------|-------|--------------|--------------|
|        | Amplitude                | Rep. Rate    | $t_W$ | $t_R$        | $t_F$        |
| 74LVT  | 2.7V                     | $\leq 10MHz$ | 500ns | $\leq 2.5ns$ | $\leq 2.5ns$ |

3.3V Octal latched transceiver with dual enable  
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SO24: plastic small outline package; 24 leads; body width 7.5 mm

SOT137-1



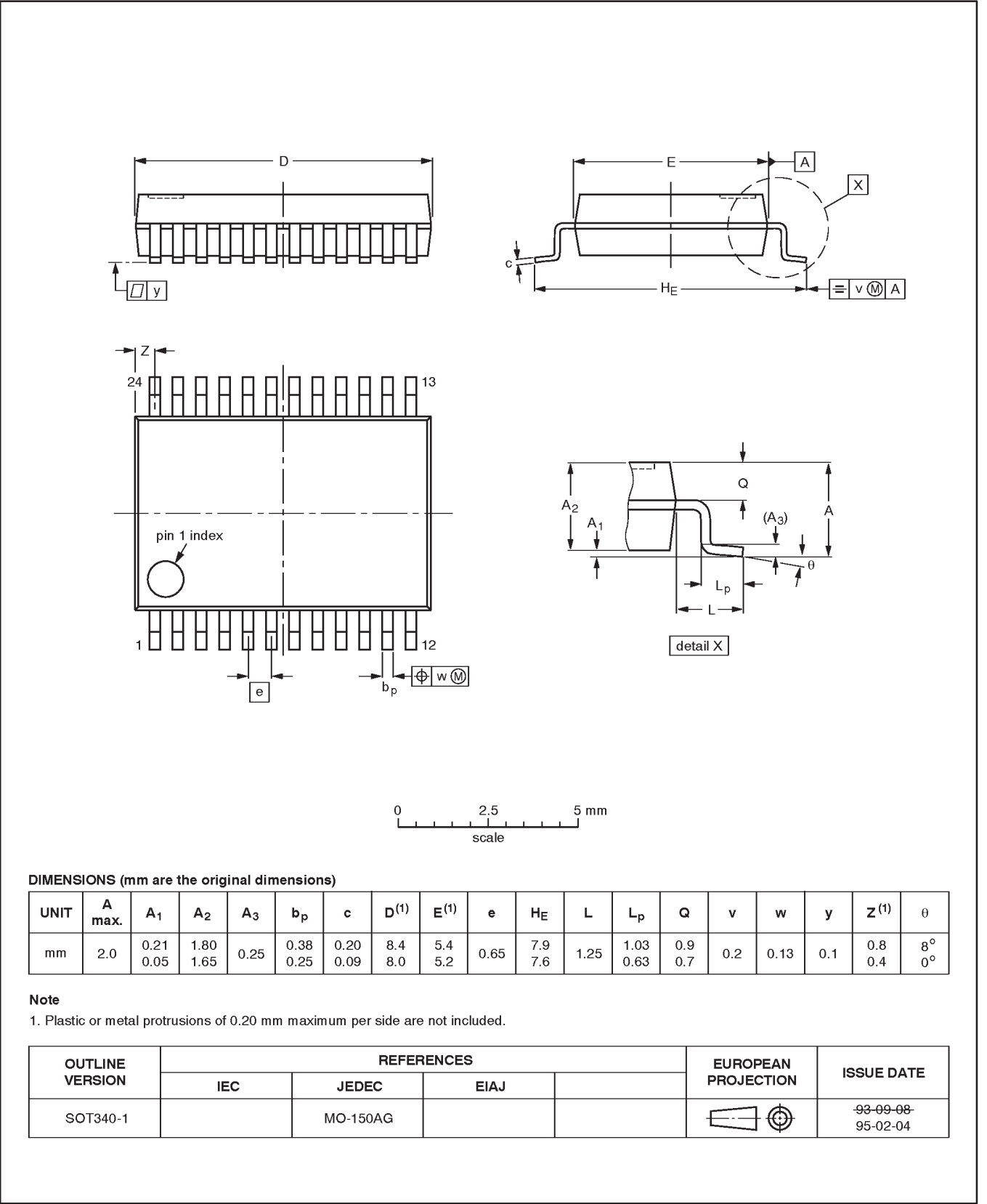


3.3V Octal latched transceiver with dual enable  
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SSOP24: plastic shrink small outline package; 24 leads; body width 5.3 mm

SOT340-1

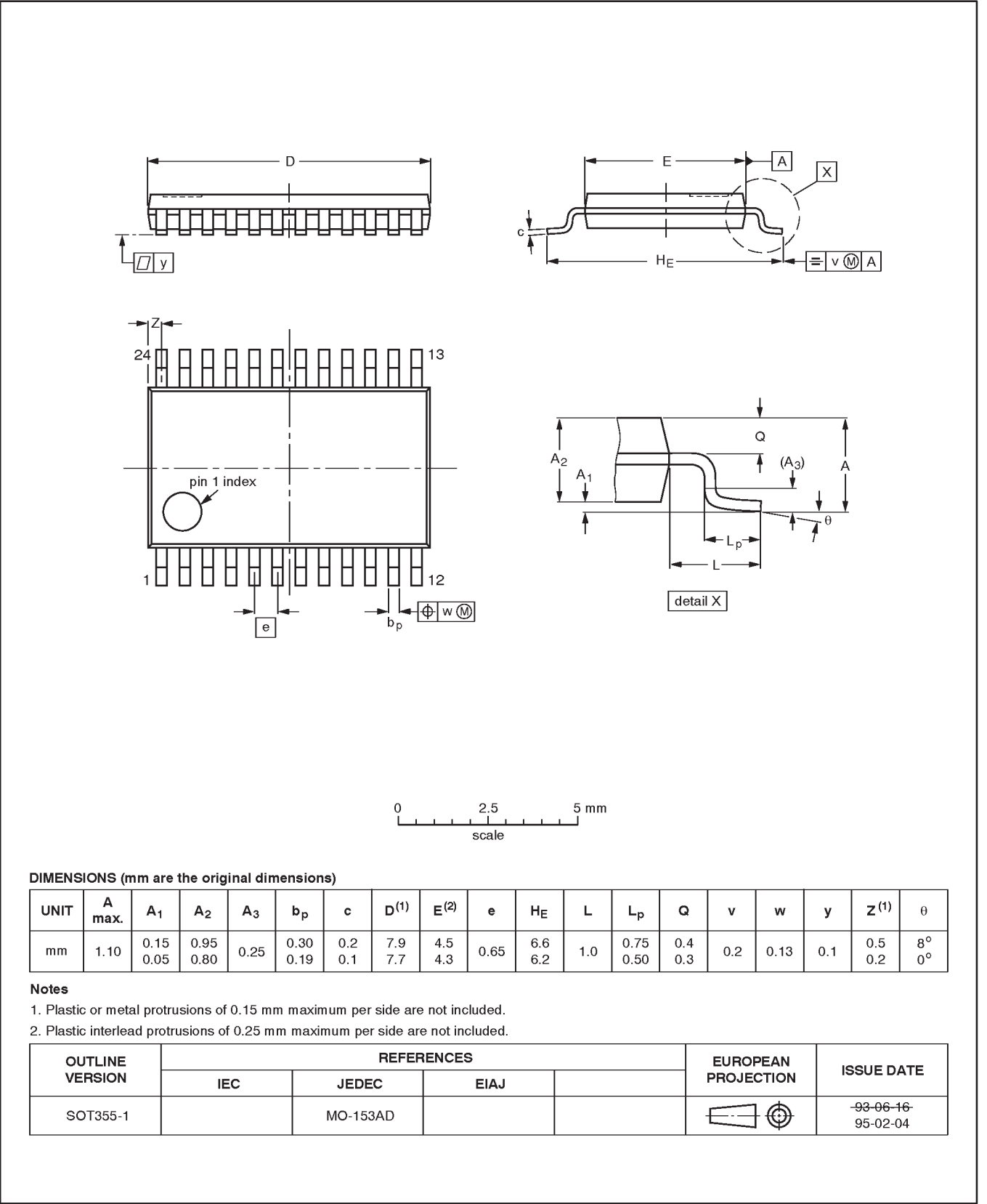


3.3V Octal latched transceiver with dual enable  
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TSSOP24: plastic thin shrink small outline package; 24 leads; body width 4.4 mm

SOT355-1



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## 3.3V Octal latched transceiver with dual enable (3-State)

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### NOTES

# 3.3V Octal latched transceiver with dual 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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