

# DATA SHEET

## **74LVT245**

**3.3V Octal transceiver with direction pin  
(3-State)**

Product specification  
Supersedes data of 1994 May 20  
IC23 Data Handbook

1998 Feb 19

## 3.3V Octal transceiver with direction pin (3-State)

## 74LVT245

### FEATURES

- Octal bidirectional bus interface
- 3-State buffers
- 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
- Power-up 3-State
- No bus current loading when output is tied to 5V bus
- 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 LVT245 is a high-performance BiCMOS product designed for  $V_{CC}$  operation at 3.3V.

This device is an octal transceiver featuring non-inverting 3-State bus compatible outputs in both send and receive directions. The control function implementation minimizes external timing requirements. The device features an Output Enable ( $\overline{OE}$ ) input for easy cascading and a Direction (DIR) input for direction control.

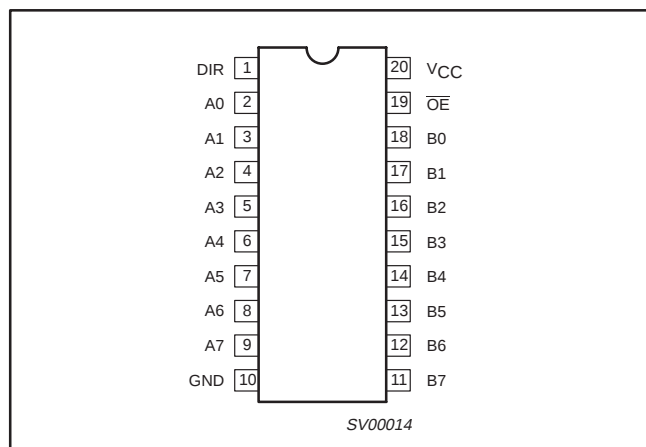
### QUICK REFERENCE DATA

| SYMBOL                 | PARAMETER                                 | CONDITIONS<br>$T_{amb} = 25^{\circ}\text{C}$ ; GND = 0V | TYPICAL | UNIT |
|------------------------|-------------------------------------------|---------------------------------------------------------|---------|------|
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>An to Bn or Bn to An | $C_L = 50\text{pF}$ ;<br>$V_{CC} = 3.3\text{V}$         | 2.4     | ns   |
| $C_{IN}$               | Input capacitance<br>DIR, $\overline{OE}$ | $V_I = 0\text{V}$ or 3.0V                               | 4       | pF   |
| $C_{I/O}$              | I/O pin capacitance                       | Outputs disabled; $V_{I/O} = 0\text{V}$ or 3.0V         | 10      | pF   |
| $I_{CCZ}$              | Total supply current                      | Outputs disabled; $V_{CC} = 3.6\text{V}$                | 0.13    | mA   |

### ORDERING INFORMATION

| PACKAGES             | TEMPERATURE RANGE                              | OUTSIDE NORTH AMERICA | NORTH AMERICA | DWG NUMBER |
|----------------------|------------------------------------------------|-----------------------|---------------|------------|
| 20-Pin Plastic SO    | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 74LVT245 D            | 74LVT245 D    | SOT163-1   |
| 20-Pin Plastic SSOP  | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 74LVT245 DB           | 74LVT245 DB   | SOT339-1   |
| 20-Pin Plastic TSSOP | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ | 74LVT245 PW           | 74LVT245PW DH | SOT360-1   |

### PIN CONFIGURATION



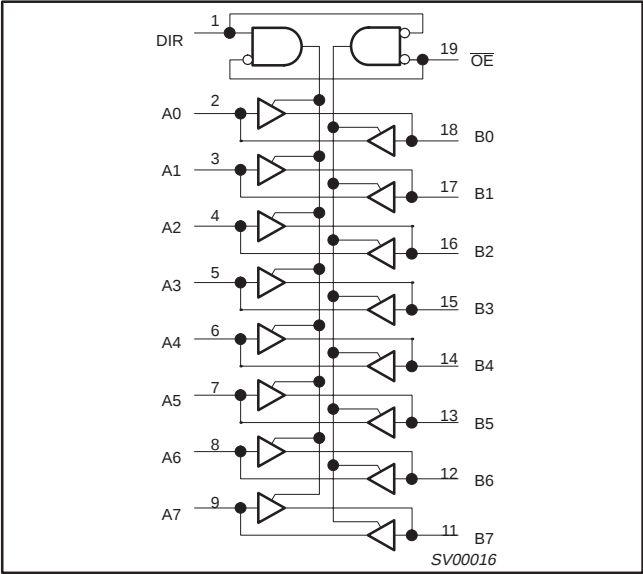
### PIN DESCRIPTION

| PIN NUMBER                     | SYMBOL          | NAME AND FUNCTION                |
|--------------------------------|-----------------|----------------------------------|
| 1                              | DIR             | Direction control input          |
| 2, 3, 4, 5, 6, 7, 8, 9         | A0 – A7         | Data inputs/outputs (A side)     |
| 18, 17, 16, 15, 14, 13, 12, 11 | B0 – B7         | Data inputs/outputs (B side)     |
| 19                             | $\overline{OE}$ | Output enable input (active–Low) |
| 10                             | GND             | Ground (0V)                      |
| 20                             | $V_{CC}$        | Positive supply voltage          |

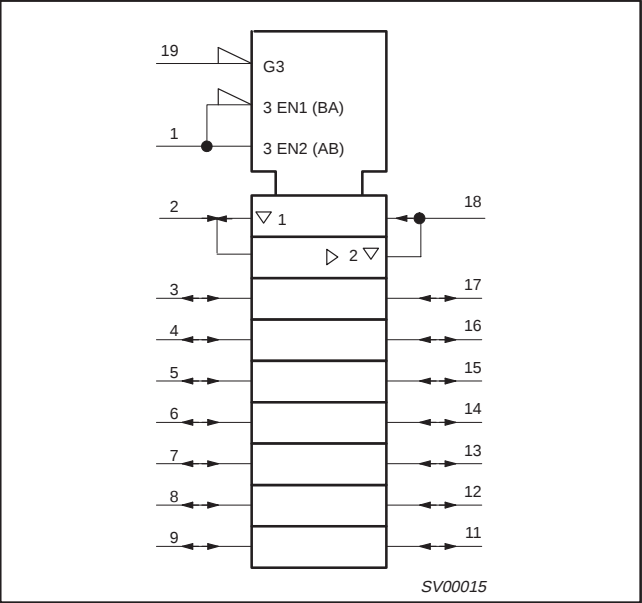
3.3V Octal transceiver with direction pin (3-State)

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LOGIC SYMBOL



LOGIC SYMBOL (IEEE/IEC)



FUNCTION TABLE

| INPUTS          |     | INPUTS/OUTPUTS                  |                                 |
|-----------------|-----|---------------------------------|---------------------------------|
| OE <sub>n</sub> | DIR | A <sub>n</sub>                  | B <sub>n</sub>                  |
| L               | L   | A <sub>n</sub> = B <sub>n</sub> | Inputs                          |
| L               | H   | Inputs                          | B <sub>n</sub> = A <sub>n</sub> |
| H               | X   | Z                               | Z                               |

H = High voltage level  
L = Low voltage level  
X = Don't care  
Z = High impedance "Off" state

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

| SYMBOL           | PARAMETER                      | CONDITIONS                  | RATING       | UNIT |
|------------------|--------------------------------|-----------------------------|--------------|------|
| V <sub>CC</sub>  | DC supply voltage              |                             | −0.5 to +4.6 | V    |
| I <sub>IK</sub>  | DC input diode current         | V <sub>I</sub> < 0          | −50          | mA   |
| V <sub>I</sub>   | DC input voltage <sup>3</sup>  |                             | −0.5 to +7.0 | V    |
| I <sub>OK</sub>  | DC output diode current        | V <sub>O</sub> < 0          | −50          | mA   |
| V <sub>OUT</sub> | DC output voltage <sup>3</sup> | Output in Off or High state | −0.5 to +7.0 | V    |
| I <sub>OUT</sub> | DC output current              | Output in Low state         | 128          | mA   |
|                  |                                | Output in High state        | −64          |      |
| T <sub>stg</sub> | 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.

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## 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    |
| $V_{IL}$            | 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 $\leq 50\%$ ; $f \geq 1$ 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   |

## 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 |      |
| I <sub>I</sub>     | Input leakage current                                                          | V <sub>CC</sub> = 0 or 3.6V; V <sub>I</sub> = 5.5V                                                                              | Control pins               |                       | 1                    | 10   | μA   |
|                    |                                                                                | V <sub>CC</sub> = 3.6V; V <sub>I</sub> = V <sub>CC</sub> or GND                                                                 |                            |                       | ±0.1                 | ±1   |      |
|                    |                                                                                | 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>5</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 ouptut 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. This is the bus hold overdrive current required to force the input to the opposite logic state.

3.3V Octal transceiver with direction pin (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  $+85^{\circ}\text{C}$ .

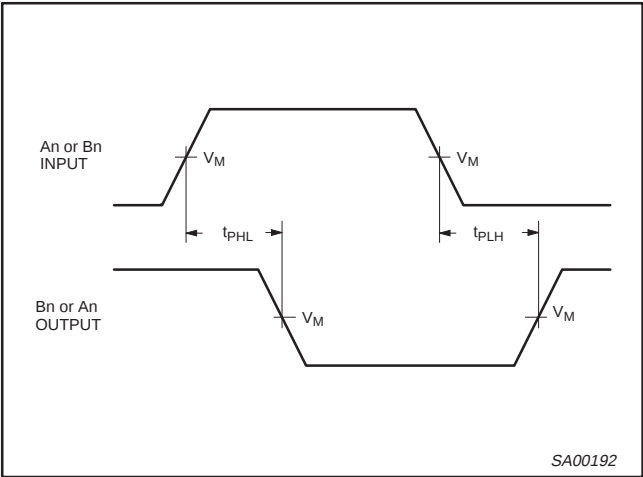
| SYMBOL                 | PARAMETER                                      | WAVEFORM | LIMITS                               |                  |            |                        | UNIT |
|------------------------|------------------------------------------------|----------|--------------------------------------|------------------|------------|------------------------|------|
|                        |                                                |          | $V_{CC} = 3.3\text{V} + 0.3\text{V}$ |                  |            | $V_{CC} = 2.7\text{V}$ |      |
|                        |                                                |          | MIN                                  | TYP <sup>1</sup> | MAX        | MAX                    |      |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>An to Bn or Bn to An      | 1        | 1.0<br>1.0                           | 2.4<br>2.4       | 4.0<br>4.0 | 4.7<br>4.6             | ns   |
| $t_{PZH}$<br>$t_{PZL}$ | Output enable time<br>to High and Low level    | 2        | 1.1<br>1.5                           | 3.3<br>3.2       | 5.5<br>5.5 | 7.1<br>6.5             | ns   |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output disable time<br>from High and Low Level | 2        | 2.2<br>2.0                           | 3.6<br>3.4       | 5.9<br>4.8 | 6.5<br>4.8             | ns   |

NOTES:

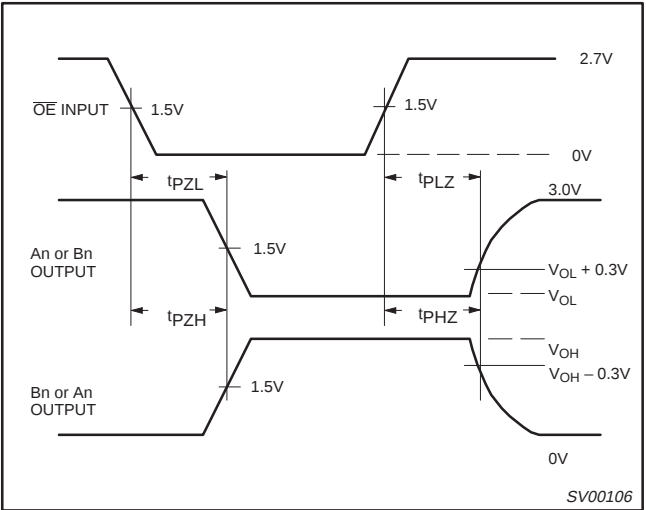
1. All typical values are at  $V_{CC} = 3.3\text{V}$  and  $T_{\text{amb}} = 25^{\circ}\text{C}$ .

AC WAVEFORMS

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



Waveform 1. Input (An or Bn) to Output (Bn or An) Propagation Delays

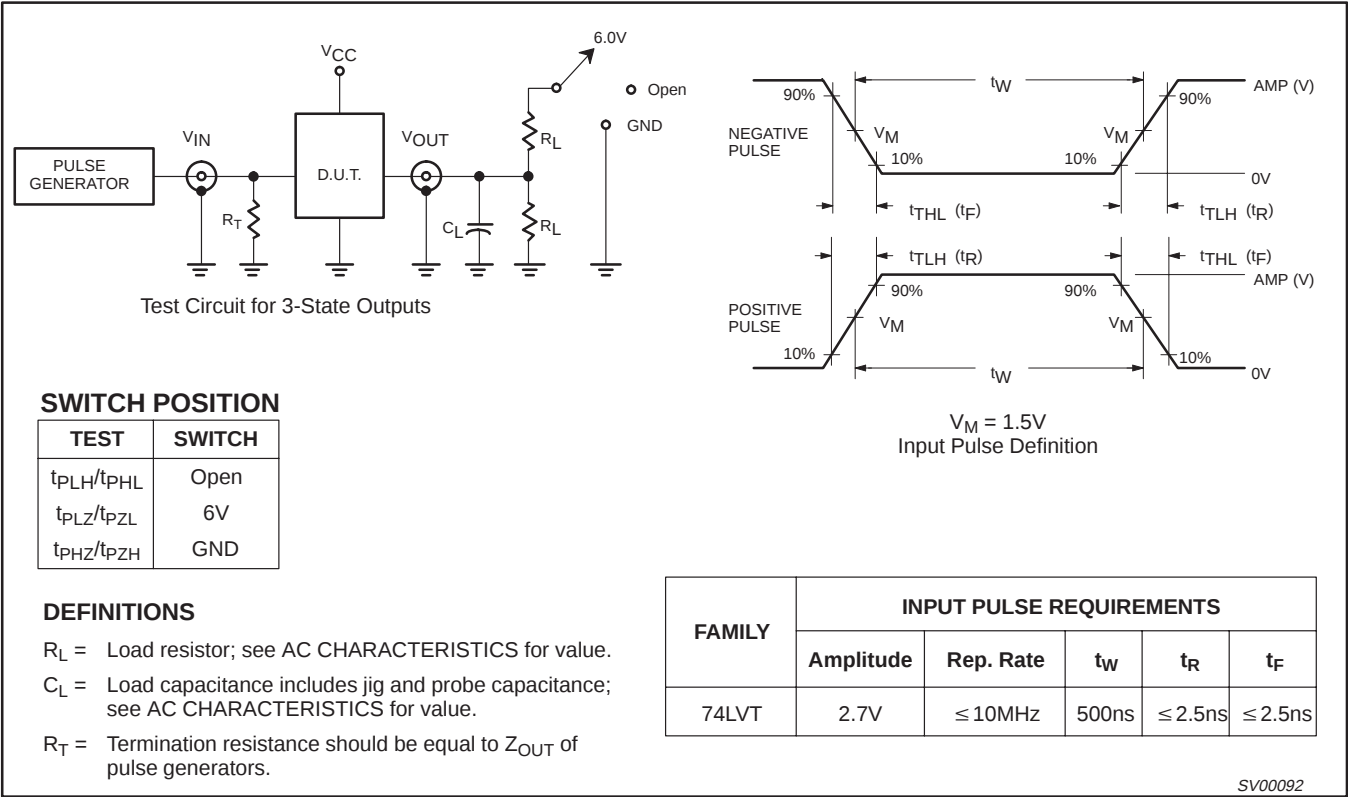


Waveform 2. 3-State Output Enable and Disable Times

3.3V Octal transceiver with direction pin (3-State)

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TEST CIRCUIT AND WAVEFORMS

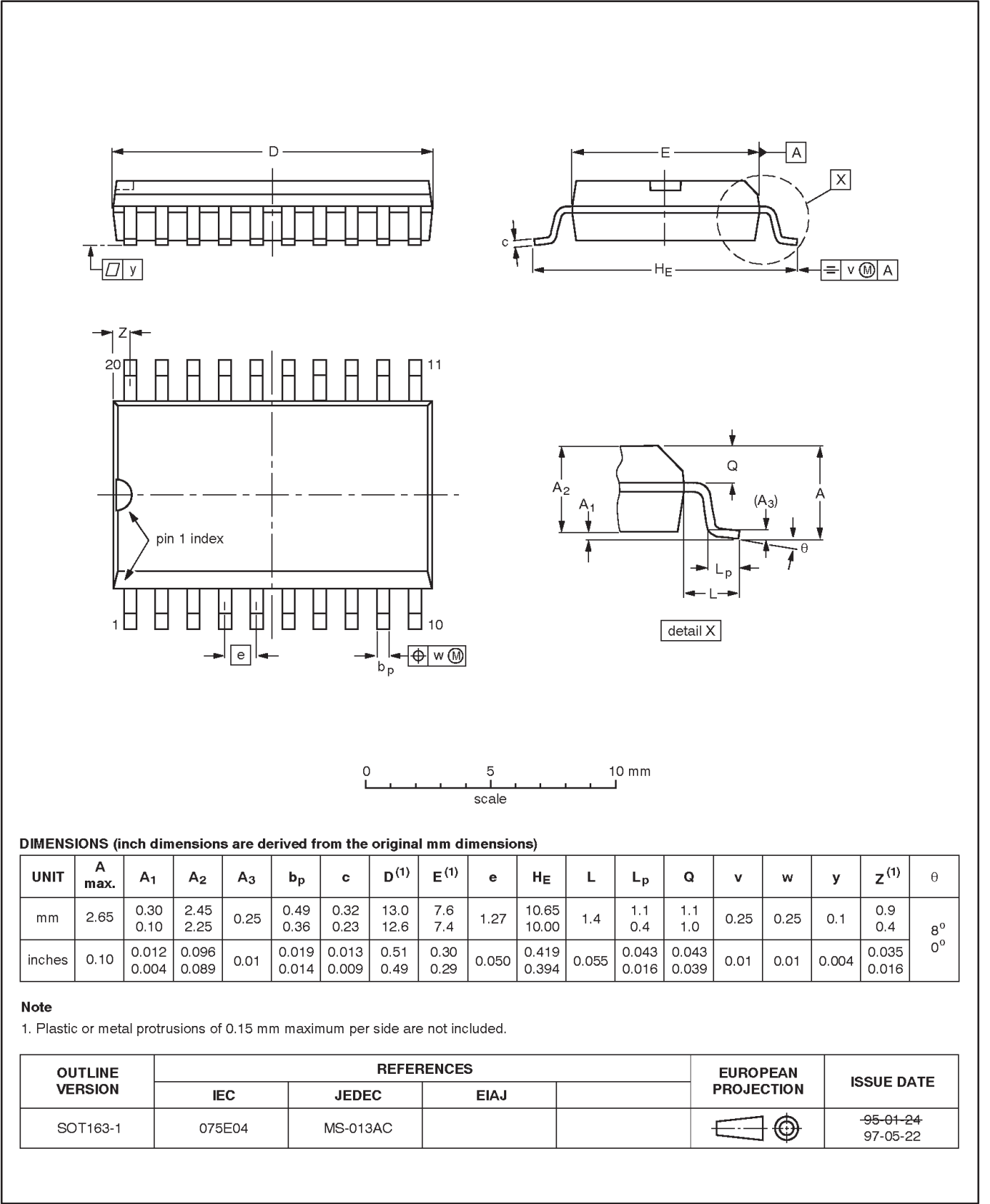


3.3V Octal transceiver with direction pin (3-State)

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SO20: plastic small outline package; 20 leads; body width 7.5 mm

SOT163-1

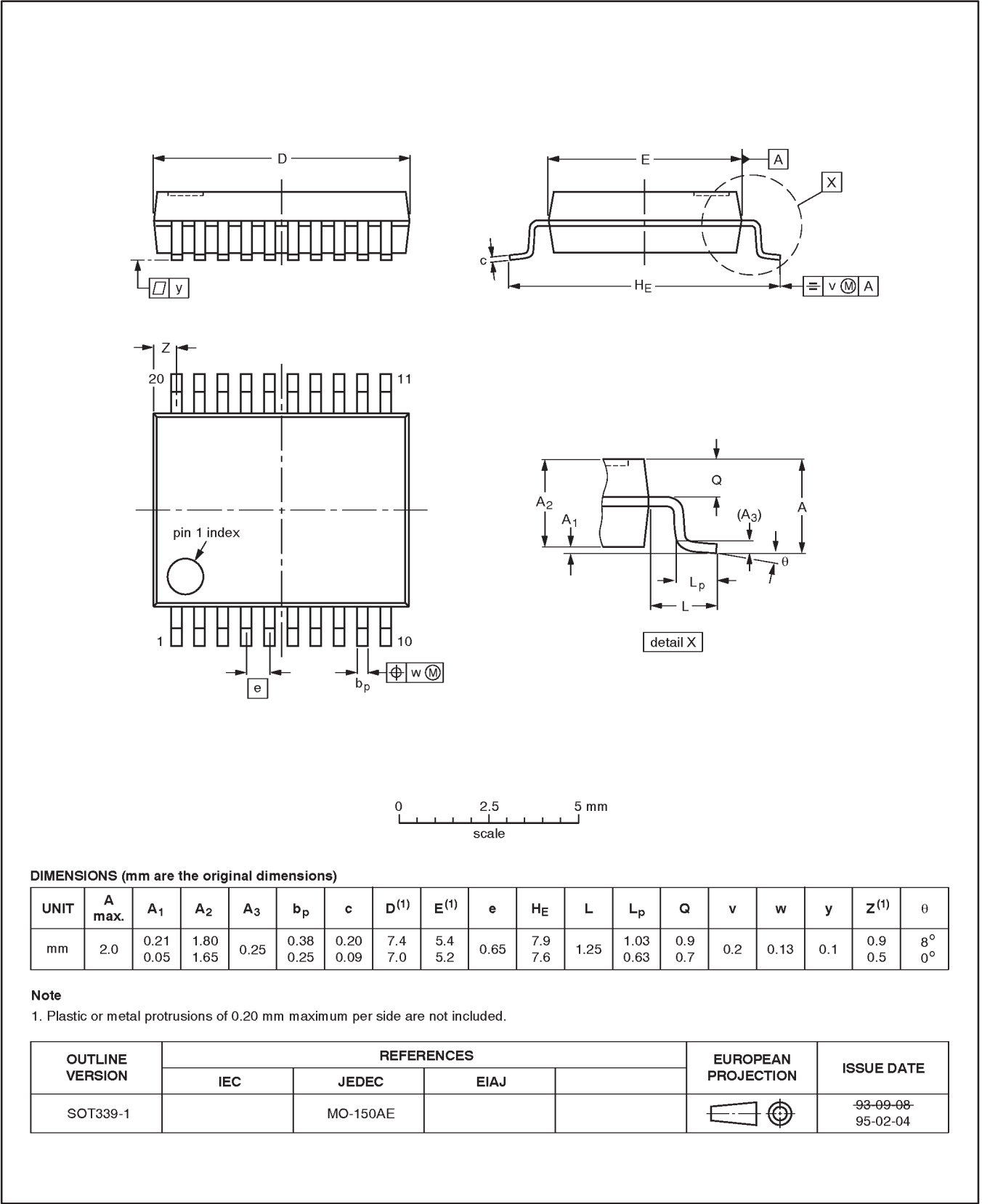


3.3V Octal transceiver with direction pin (3-State)

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SSOP20: plastic shrink small outline package; 20 leads; body width 5.3 mm

SOT339-1

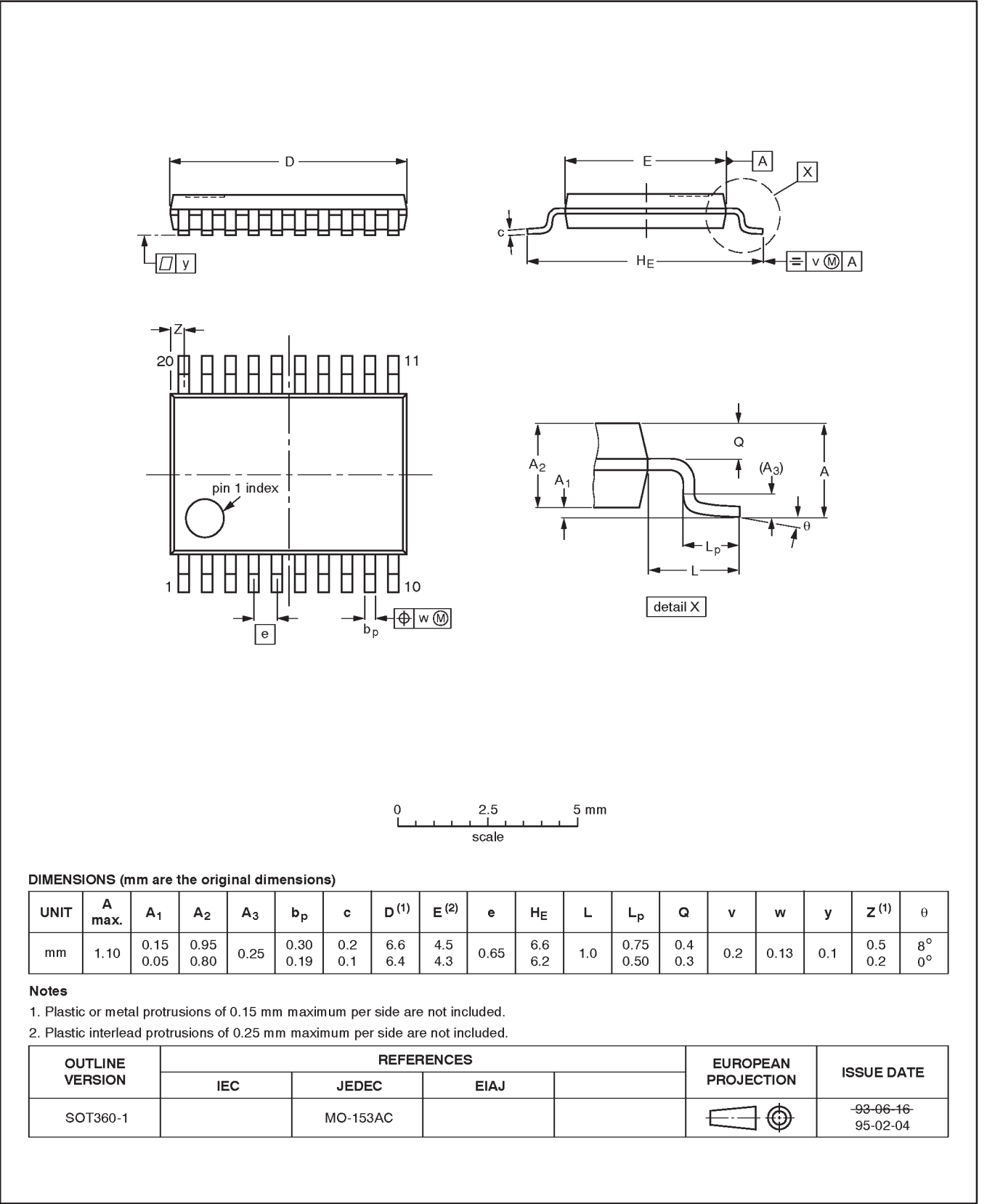


3.3V Octal transceiver with direction pin (3-State)

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TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm

SOT360-1



## 3.3V Octal transceiver with direction pin (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. |
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[1] Please consult the most recently issued datasheet before initiating or completing a design.

## Definitions

**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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