

# DATA SHEET

## **74ALVT162821**

2.5V/3.3V 20-bit bus-interface

D-type flip-flop; positive-edge trigger with  
30 $\Omega$  termination resistors (3-State)

Product specification  
Supersedes data of 1997 Feb 13  
IC23 Data Handbook

1998 Oct 02

## 2.5V/3.3V 20-bit bus-interface D-type flip-flop; positive-edge trigger with 30Ω termination resistors (3-State)

# 74ALVT162821

### FEATURES

- Outputs include series resistance of 30Ω making external termination resistors unnecessary
- 20-bit positive-edge triggered register
- 5V I/O Compatible
- Multiple  $V_{CC}$  and GND pins minimize switching noise
- Live insertion/extraction permitted
- Power-up reset
- Power-up 3-State
- Output capability +12mA/-12mA
- Latch-up protection exceeds 500mA per Jedec Std 17
- ESD protection exceeds 2000V per MIL STD 883 Method 3015 and 200V per Machine Model
- Bus hold data inputs eliminate the need for external pull-up resistors to hold unused inputs

### DESCRIPTION

The 74ALVT162821 high-performance BiCMOS device combines low static and dynamic power dissipation with high speed and high output drive. It is designed for  $V_{CC}$  operation at 2.5V or 3.3V with I/O compatibility to 5V.

The 74ALVT162821 has two 10-bit, edge triggered registers, with each register coupled to a 3-State output buffer. The two sections of each register are controlled independently by the clock (nCP) and Output Enable ( $\overline{nOE}$ ) control gates.

Each register is fully edge triggered. The state of each D input, one set-up time before the Low-to-High clock transition, is transferred to the corresponding flip-flop's Q output.

The 3-State output buffers are designed to drive heavily loaded 3-State buses, MOS memories, or MOS microprocessors.

The active Low Output Enable ( $\overline{nOE}$ ) controls all ten 3-State buffers independent of the register operation. When  $\overline{nOE}$  is Low, the data in the register appears at the outputs. When  $\overline{nOE}$  is High, the outputs are in high impedance "off" state, which means they will neither drive nor load the bus.

The 74ALVT162821 is designed with 30Ω series resistance in both High and Low output stages. This design reduces the line noise in applications such as memory address drivers, clock drivers and bus receivers/transmitters. The series termination resistors reduce overshoot and undershoot and are ideal for driving memory arrays.

### QUICK REFERENCE DATA

| SYMBOL                 | PARAMETER                      | CONDITIONS<br>$T_{amb} = 25^{\circ}\text{C}$ | TYPICAL    |            | UNIT |
|------------------------|--------------------------------|--|------------|------------|------|
|                        |                                |  | 2.5V       | 3.3V       |      |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation delay<br>nCP to nQ | $C_L = 50\text{pF}$                          | 4.4<br>3.8 | 3.2<br>3.2 | ns   |
| $C_{IN}$               | Input capacitance              | $V_I = 0\text{V}$ or $V_{CC}$                | 3          | 3          | pF   |
| $C_{OUT}$              | Output capacitance             | $V_O = 0$ or $V_{CC}$                        | 9          | 9          | pF   |
| $I_{CCZ}$              | Total supply current           | Outputs disabled                             | 40         | 70         | μA   |

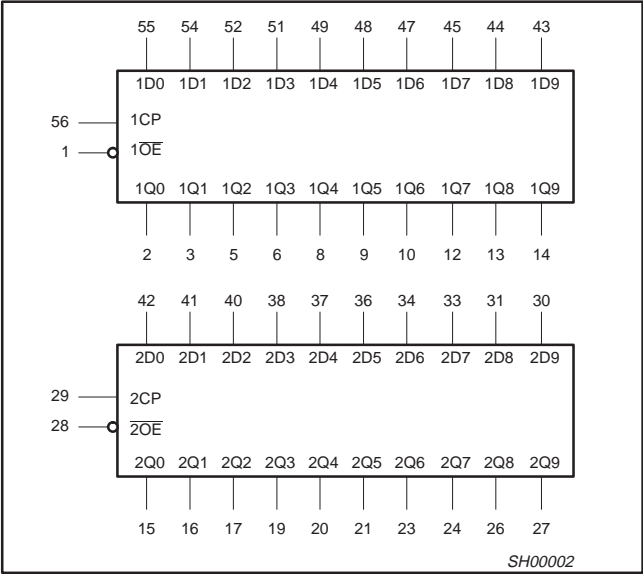
### ORDERING INFORMATION

| PACKAGES                     | TEMPERATURE RANGE | OUTSIDE NORTH AMERICA | NORTH AMERICA | DWG NUMBER |
|------------------------------|-------------------|-----------------------|---------------|------------|
| 56-Pin Plastic SSOP Type III | -40°C to +85°C    | 74ALVT162821 DL       | AV162821 DL   | SOT371-1   |
| 56-Pin Plastic TSSOP Type II | -40°C to +85°C    | 74ALVT162821 DGG      | AV162821 DGG  | SOT364-1   |

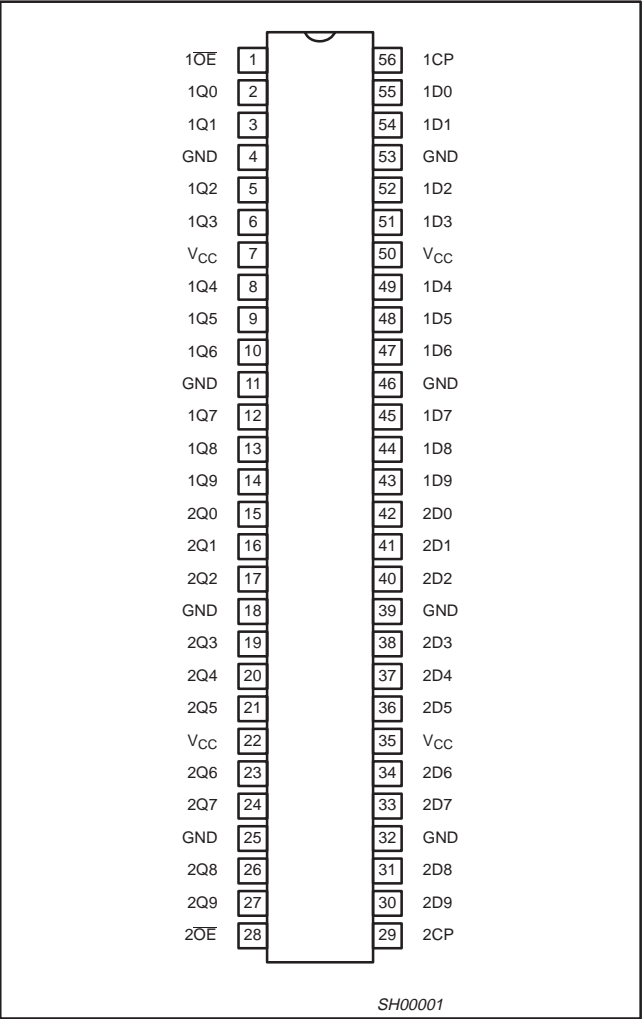
2.5V/3.3V 20-bit bus-interface D-type flip-flop;  
positive-edge trigger with 30Ω termination resistors (3-State)

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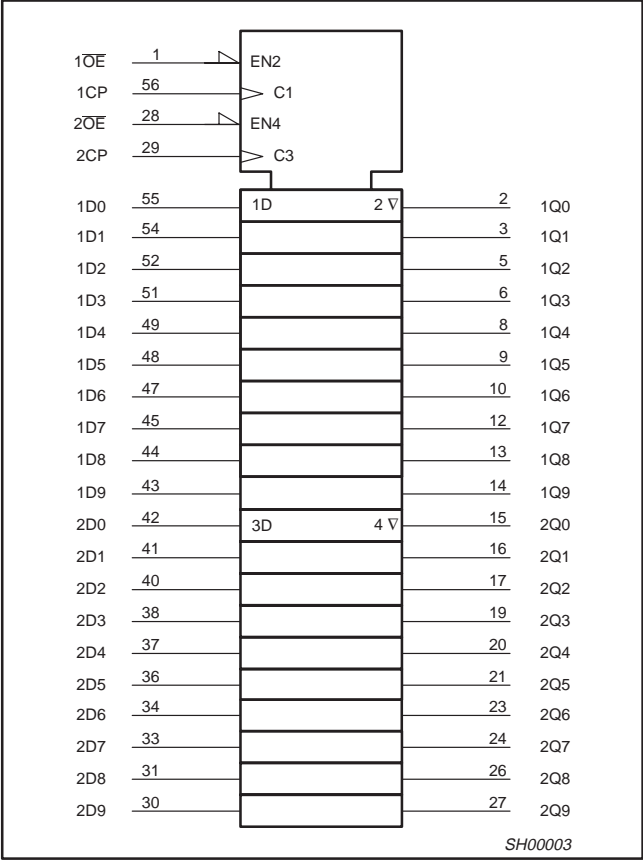
LOGIC SYMBOL



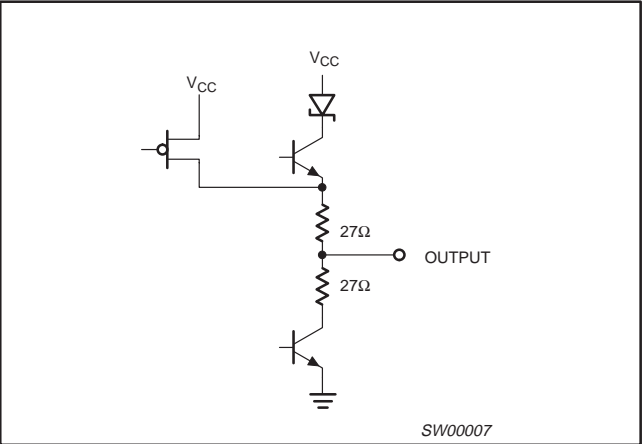
PIN CONFIGURATION



LOGIC SYMBOL (IEEE/IEC)



SCHEMATIC OF EACH OUTPUT



2.5V/3.3V 20-bit bus-interface D-type flip-flop;  
positive-edge trigger with 30Ω termination resistors (3-State)

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PIN DESCRIPTION

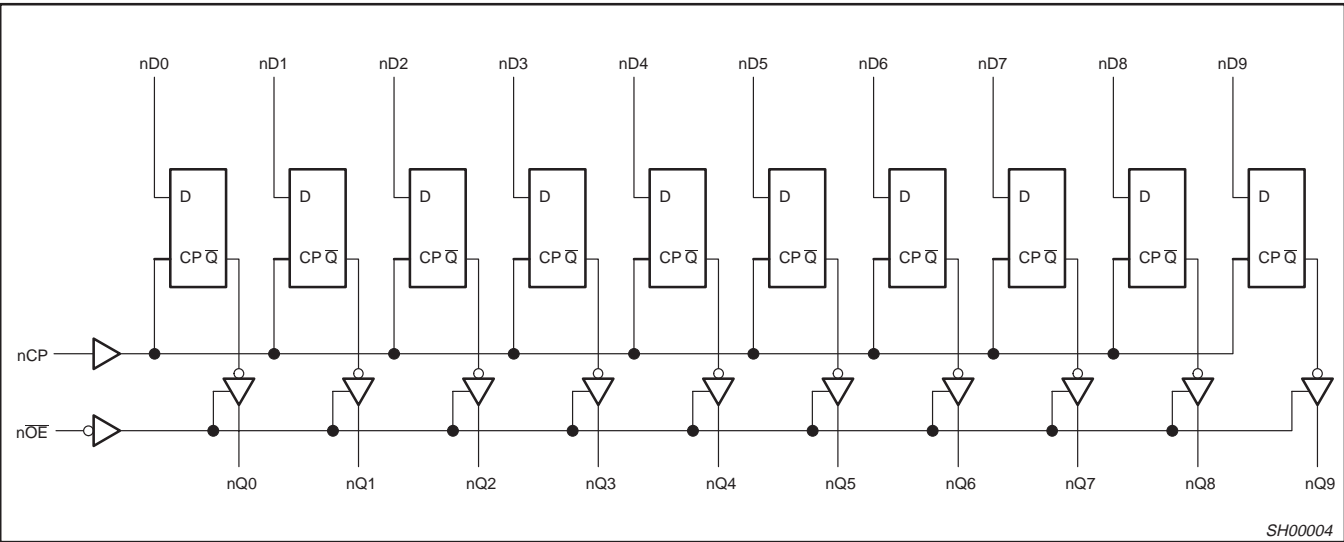
| PIN NUMBER   | SYMBOL                 | FUNCTION                                |
|--|------------------------|---|
| 55, 54, 52, 51, 49, 48, 47, 45, 44, 43, 42, 41, 40, 38, 37, 36, 34, 33, 31, 30 | 1D0 - 1D9<br>2D0 - 2D9 | Data inputs                             |
| 2, 3, 5, 6, 8, 9, 10, 12, 13, 14, 15, 16, 17, 19, 20, 21, 23, 24, 26, 27       | 1Q0 - 1Q9<br>2Q0 - 2Q9 | Data outputs                            |
| 1, 28  | 1OE, 2OE               | Output enable inputs (active-Low)       |
| 56, 29   | 1CP, 2CP               | Clock pulse inputs (active rising edge) |
| 4, 11, 18, 25, 32, 39, 46, 53  | GND                    | Ground (0V)                             |
| 7, 22, 35, 50  | VCC                    | Positive supply voltage                 |

FUNCTION TABLE

| INPUTS |        |         | INTERNAL REGISTER | OUTPUTS   | OPERATING MODE         |
|--------|--------|---------|-------------------|-----------|------------------------|
| nOE    | nCP    | nDx     |                   | nQ0 - nQ9 |                        |
| L<br>L | ↑<br>↑ | l<br>h  | L<br>H            | L<br>H    | Load and read register |
| L      | ↑      | X       | NC                | NC        | Hold                   |
| H<br>H | ↑<br>↑ | X<br>Dn | NC<br>Dn          | Z<br>Z    | Disable outputs        |

H = High voltage level  
h = High voltage level one set-up time prior to the Low-to-High clock transition  
L = Low voltage level  
l = Low voltage level one set-up time prior to the Low-to-High clock transition  
NC= No change  
X = Don't care  
Z = High impedance "off" state  
↑ = Low to High clock transition  
↑ = Not a Low-to-High clock transition

LOGIC DIAGRAM



2.5V/3.3V 20-bit bus-interface D-type flip-flop;  
positive-edge trigger with 30Ω termination resistors (3-State)

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### 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>  |                             | −1.2 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:

1. 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.
2. 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.
3. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

### RECOMMENDED OPERATING CONDITIONS

| SYMBOL           | PARAMETER   | 2.5V RANGE LIMITS |     | 3.3V RANGE LIMITS |     | UNIT |
|------------------|---|-------------------|-----|-------------------|-----|------|
|                  |   | MIN               | MAX | MIN               | MAX |      |
| V <sub>CC</sub>  | DC supply voltage                                   | 2.3               | 2.7 | 3.0               | 3.6 | V    |
| V <sub>I</sub>   | Input voltage                                       | 0                 | 5.5 | 0                 | 5.5 | V    |
| V <sub>IH</sub>  | High-level input voltage                            | 1.7               |     | 2.0               |     | V    |
| V <sub>IL</sub>  | Input voltage                                       |                   | 0.7 |                   | 0.8 | V    |
| I <sub>OH</sub>  | High-level output current                           |                   | −8  |                   | −12 | mA   |
| I <sub>OL</sub>  | Low-level output current                            |                   | 12  |                   | 12  | mA   |
| Δt/Δv            | Input transition rise or fall rate; Outputs enabled |                   | 10  |                   | 10  | ns/V |
| T <sub>amb</sub> | Operating free-air temperature range                | −40               | +85 | −40               | +85 | °C   |

# 2.5V/3.3V 20-bit bus-interface D-type flip-flop; positive-edge trigger with 30Ω termination resistors (3-State)

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## DC ELECTRICAL CHARACTERISTICS (3.3V ± 0.3V RANGE)

|                    |  |  | LIMITS                 |                  |      |    |
|--------------------|--|--|------------------------|------------------|------|----|
|                    |  |  | MIN                    | TYP <sup>1</sup> | MAX  |    |
| V <sub>IK</sub>    | Input clamp voltage  | V <sub>CC</sub> = 3.0V; I <sub>IK</sub> = -18mA  |                        | -0.85            | -1.2 | V  |
| V <sub>OH</sub>    | High-level output voltage  | V <sub>CC</sub> = 3.0 to 3.6V; I <sub>OH</sub> = -100μA  | V <sub>CC</sub> -0.2   | V <sub>CC</sub>  |      | V  |
|                    |  | V <sub>CC</sub> = 3.0V; I <sub>OH</sub> = -32mA  | 2.0                    | 2.3              |      |    |
| V <sub>OL</sub>    | Low-level output voltage   | V <sub>CC</sub> = 3.0V; I <sub>OL</sub> = 100μA  |                        | 0.07             | 0.2  | V  |
|                    |  | 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>6</sup>                                       | V <sub>CC</sub> = 3.6V; I <sub>O</sub> = 1mA; V <sub>I</sub> = V <sub>CC</sub> or GND  |                        |                  | 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   |                        | 0.1              | 10   |    |
|                    |  | V <sub>CC</sub> = 3.6V; V <sub>I</sub> = V <sub>CC</sub>   | Data pins <sup>4</sup> | 0.5              | 1    |    |
|                    |  | V <sub>CC</sub> = 3.6V; V <sub>I</sub> = 0V  |                        | 0.1              | -5   |    |
| I <sub>OFF</sub>   | Off current  | V <sub>CC</sub> = 0V; V <sub>I</sub> or V <sub>O</sub> = 0 to 4.5V   |                        | 0.1              | ±100 | μA |
| I <sub>HOLD</sub>  | Bus Hold current<br>Data inputs <sup>7</sup>                                   | V <sub>CC</sub> = 3V; V <sub>I</sub> = 0.8V  | 75                     | 130              |      | μA |
|                    |  | V <sub>CC</sub> = 3V; V <sub>I</sub> = 2.0V  | -75                    | -140             |      |    |
|                    |  | 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  |                        | 10               | 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><br>OE/OE = Don't care |                        | 1                | ±100 | μA |
| I <sub>OZH</sub>   | 3-State output High current  | V <sub>CC</sub> = 3.6V; V <sub>O</sub> = 3.0V; V <sub>I</sub> = V <sub>IL</sub> or V <sub>IH</sub>                               |                        | 0.5              | 5    | μA |
| I <sub>OZL</sub>   | 3-State output Low current   | V <sub>CC</sub> = 3.6V; V <sub>O</sub> = 0.5V; V <sub>I</sub> = V <sub>IL</sub> or V <sub>IH</sub>                               |                        | 0.5              | -5   | 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                               |                        | 0.07             | 0.1  | 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                                |                        | 5.1              | 7    |    |
| 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 <sup>5</sup>              |                        | 0.07             | 0.1  |    |
| 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,<br>Other inputs at V <sub>CC</sub> or GND                      |                        | 0.04             | 0.4  | mA |

### NOTES:

- All typical values are at V<sub>CC</sub> = 3.3V and T<sub>amb</sub> = 25°C.
- This is the increase in supply current for each input at the specified voltage level other than V<sub>CC</sub> or GND.
- This parameter is valid for any V<sub>CC</sub> between 0V and 1.2V with a transition time of up to 10msec. From V<sub>CC</sub> = 1.2V to V<sub>CC</sub> = 3.3V ± 0.2V a transition time of 100μsec is permitted. This parameter is valid for T<sub>amb</sub> = 25°C only.
- Unused pins at V<sub>CC</sub> or GND.
- I<sub>CCZ</sub> is measured with outputs pulled up to V<sub>CC</sub> or pulled down to ground.
- For valid test results, data must not be loaded into the flip-flops (or latches) after applying power.
- This is the bus hold overdrive current required to force the input to the opposite logic state.

## AC CHARACTERISTICS (3.3V ± 0.3V RANGE)

GND = 0V; t<sub>R</sub> = t<sub>F</sub> = 2.5ns; C<sub>L</sub> = 50pF; R<sub>L</sub> = 500Ω; T<sub>amb</sub> = -40°C to +85°C.

| SYMBOL                               | PARAMETER                                      | WAVEFORM | LIMITS   |            |            | UNIT |
|--------------------------------------|--|----------|--|------------|------------|------|
|                                      |  |          | T <sub>amb</sub> = −40 to +85°C<br>V <sub>CC</sub> = +3.3V |            |            |      |
|                                      |  |          | MIN  | TYP        | MAX        |      |
| f <sub>MAX</sub>                     | Maximum clock frequency                        | 1        | 150  |            |            | MHz  |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation delay<br>nCP to nQx                | 1        | 1.0<br>1.0   | 3.2<br>3.2 | 5.0<br>4.7 | ns   |
| t <sub>PZH</sub><br>t <sub>PZL</sub> | Output enable time<br>to High and Low level    | 3<br>4   | 1.0<br>0.5   | 3.4<br>2.3 | 5.6<br>3.7 | ns   |
| t <sub>PHZ</sub><br>t <sub>PLZ</sub> | Output disable time<br>from High and Low level | 3<br>4   | 1.5<br>1.5   | 3.7<br>3.0 | 5.4<br>4.3 | ns   |

### NOTE:

- All typical values are at V<sub>CC</sub> = 3.3V and T<sub>amb</sub> = 25°C.

2.5V/3.3V 20-bit bus-interface D-type flip-flop;  
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**AC SETUP REQUIREMENTS (3.3V ± 0.3V RANGE)**GND = 0V,  $t_R = t_F = 2.5\text{ns}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 500\Omega$ 

| SYMBOL                                   | PARAMETER                             | WAVEFORM | LIMITS   |            | UNIT |
|--|---------------------------------------|----------|--|------------|------|
|  |                                       |          | T <sub>amb</sub> = -40 to +85°C<br>V <sub>CC</sub> = +3.3V ±0.3V |            |      |
|  |                                       |          | MIN  | TYP        |      |
| t <sub>s</sub> (H)<br>t <sub>s</sub> (L) | Setup time, High or Low<br>nDx to nCP | 1        | 1.5<br>1.5   | 0.1<br>0.1 | ns   |
| t <sub>h</sub> (H)<br>t <sub>h</sub> (L) | Hold time, High or Low<br>nDx to nCP  | 2        | 0.5<br>0.5   | 0.1<br>0.1 | ns   |
| t <sub>w</sub> (H)<br>t <sub>w</sub> (L) | nCP pulse width<br>High or Low        | 2        | 1.5<br>1.5   |            | ns   |

**DC ELECTRICAL CHARACTERISTICS (2.5V ± 0.2V RANGE)**

| 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> = 2.3V; I <sub>IK</sub> = -18mA  |                        |                       | -0.85            | -1.2  | V    |
| V <sub>OH</sub>    | High-level output voltage  | V <sub>CC</sub> = 2.3 to 3.6V; I <sub>OH</sub> = -100μA  |                        | V <sub>CC</sub> -0.2  | V <sub>CC</sub>  |       | V    |
|                    |  | V <sub>CC</sub> = 2.3V; I <sub>OH</sub> = -8mA   |                        | 1.8                   | 2.1              |       |      |
| V <sub>OL</sub>    | Low-level output voltage   | V <sub>CC</sub> = 2.3V; I <sub>OL</sub> = 100μA  |                        |                       | 0.07             | 0.2   | V    |
|                    |  | V <sub>CC</sub> = 2.3V; I <sub>OL</sub> = 24mA   |                        |                       | 0.3              | 0.5   |      |
|                    |  | V <sub>CC</sub> = 2.3V; I <sub>OL</sub> = 8mA  |                        |                       |                  | 0.4   |      |
| V <sub>RST</sub>   | Power-up output low voltage <sup>7</sup>                                       | V <sub>CC</sub> = 2.7V; I <sub>O</sub> = 1mA; V <sub>I</sub> = V <sub>CC</sub> or GND  |                        |                       |                  | 0.55  | V    |
| I <sub>I</sub>     | Input leakage current  | V <sub>CC</sub> = 2.7V; V <sub>I</sub> = V <sub>CC</sub> or GND  | Control pins           |                       | 0.1              | ±1    | μA   |
|                    |  | V <sub>CC</sub> = 0 or 2.7V; V <sub>I</sub> = 5.5V   |                        |                       | 0.1              | 10    |      |
|                    |  | V <sub>CC</sub> = 2.7V; V <sub>I</sub> = V <sub>CC</sub>   | Data pins <sup>4</sup> |                       | 0.1              | 1     |      |
|                    |  | V <sub>CC</sub> = 2.7V; V <sub>I</sub> = 0   |                        |                       | 0.1              | -5    |      |
| I <sub>OFF</sub>   | Off current  | V <sub>CC</sub> = 0V; V <sub>I</sub> or V <sub>O</sub> = 0 to 4.5V   |                        |                       | 0.1              | ± 100 | μA   |
| I <sub>HOLD</sub>  | Bus Hold current   | V <sub>CC</sub> = 2.3V; V <sub>I</sub> = 0.7V  |                        |                       | 90               |       | μA   |
|                    | Data inputs <sup>6</sup>   | V <sub>CC</sub> = 2.3V; V <sub>I</sub> = 1.7V  |                        |                       | -10              |       | μA   |
| 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> = 2.3V  |                        |                       | 10               | 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><br>OE/OE = Don't care |                        |                       | 1                | ± 100 | μA   |
| I <sub>OZH</sub>   | 3-State output High current  | V <sub>CC</sub> = 2.7V; V <sub>O</sub> = 2.3V; V <sub>I</sub> = V <sub>IL</sub> or V <sub>IH</sub>                               |                        |                       | 0.5              | 5     | μA   |
| I <sub>OZL</sub>   | 3-State output Low current   | V <sub>CC</sub> = 2.7V; V <sub>O</sub> = 0.5V; V <sub>I</sub> = V <sub>IL</sub> or V <sub>IH</sub>                               |                        |                       | 0.5              | -5    | μA   |
| I <sub>CCH</sub>   | Quiescent supply current   | V <sub>CC</sub> = 2.7V; Outputs High, V <sub>I</sub> = GND or V <sub>CC</sub> , I <sub>O</sub> = 0                               |                        |                       | 0.04             | 0.1   | mA   |
| I <sub>CCL</sub>   |  | V <sub>CC</sub> = 2.7V; Outputs Low, V <sub>I</sub> = GND or V <sub>CC</sub> , I <sub>O</sub> = 0                                |                        |                       | 2.3              | 4.5   |      |
| I <sub>CCZ</sub>   |  | V <sub>CC</sub> = 2.7V; Outputs Disabled; V <sub>I</sub> = GND or V <sub>CC</sub> , I <sub>O</sub> = 0 <sup>5</sup>              |                        |                       | 0.04             | 0.1   |      |
| ΔI <sub>CC</sub>   | Additional supply current per input pin <sup>2</sup>                           | V <sub>CC</sub> = 2.3V to 2.7V; One input at V <sub>CC</sub> -0.6V, Other inputs at V <sub>CC</sub> or GND                       |                        |                       | 0.04             | 0.4   | mA   |

**NOTES:**

1. All typical values are at  $V_{\text{CC}} = 2.5\text{V}$  and  $T_{\text{amb}} = 25^\circ\text{C}$ .
2. This is the increase in supply current for each input at the specified voltage level other than  $V_{\text{CC}}$  or GND.
3. This parameter is valid for any  $V_{\text{CC}}$  between 0V and 1.2V with a transition time of up to 10msec. From  $V_{\text{CC}} = 1.2\text{V}$  to  $V_{\text{CC}} = 2.5\text{V} \pm 0.3\text{V}$  a transition time of 100μsec is permitted. This parameter is valid for  $T_{\text{amb}} = 25^\circ\text{C}$  only.
4. Unused pins at  $V_{\text{CC}}$  or GND.
5.  $I_{\text{CCZ}}$  is measured with outputs pulled up to  $V_{\text{CC}}$  or pulled down to ground.
6. Not guaranteed.
7. For valid test results, data must not be loaded into the flip-flops (or latches) after applying power.

# 2.5V/3.3V 20-bit bus-interface D-type flip-flop; positive-edge trigger with 30Ω termination resistors (3-State)

74ALVT162821

## AC CHARACTERISTICS (2.5V ± 0.2V RANGE)

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 |
|--------------------------------------|--|----------|--|------------|------------|------|
|                                      |  |          | T <sub>amb</sub> = -40 to +85°C<br>V <sub>CC</sub> = +2.5V ±0.2V |            |            |      |
|                                      |  |          | MIN  | TYP        | MAX        |      |
| f <sub>MAX</sub>                     | Maximum clock frequency                        | 1        | 150  |            |            | MHz  |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation delay<br>nCP to nQx                | 1        | 1.0<br>1.0   | 4.4<br>3.8 | 7.0<br>6.4 | ns   |
| t <sub>PZH</sub><br>t <sub>PZL</sub> | Output enable time<br>to High and Low level    | 3<br>4   | 1.5<br>1.0   | 4.6<br>2.8 | 7.5<br>4.6 | ns   |
| t <sub>PHZ</sub><br>t <sub>PLZ</sub> | Output disable time<br>from High and Low level | 3<br>4   | 1.5<br>1.0   | 3.5<br>3.7 | 5.5<br>5.7 | ns   |

### NOTE:

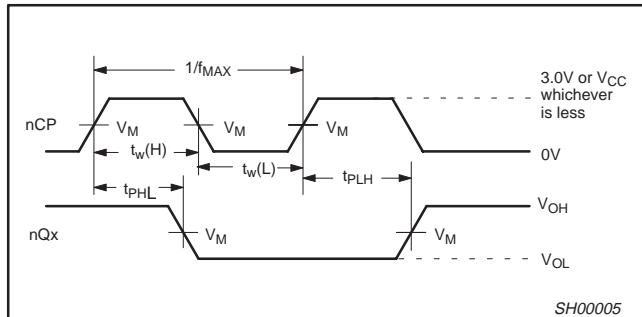
1. All typical values are at  $V_{\text{CC}} = 3.3\text{V}$  and  $T_{\text{amb}} = 25^\circ\text{C}$ .

## AC SETUP REQUIREMENTS (2.5V ± 0.2V RANGE)

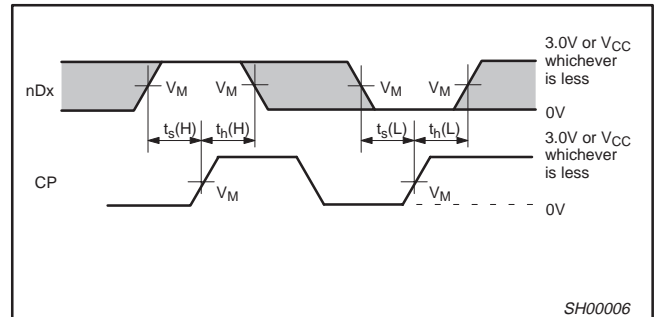
GND = 0V;  $t_R = t_F = 2.5\text{ns}$ ;  $C_L = 50\text{pF}$ ;  $R_L = 500\Omega$ 

| SYMBOL   | PARAMETER                             | WAVEFORM | LIMITS   |              | UNIT |
|--|---------------------------------------|----------|--|--------------|------|
|  |                                       |          | $T_{\text{amb}} = -40 \text{ to } +85^{\circ}\text{C}$<br>$V_{\text{CC}} = +2.5 \pm 0.2\text{V}$ |              |      |
|  |                                       |          | MIN  | TYP          |      |
| $t_{\text{S}}(\text{H})$<br>$t_{\text{S}}(\text{L})$ | Setup time, High or Low<br>nDx to nCP | 1        | 1.5<br>2.0   | 0.1<br>0.5   | ns   |
| $t_{\text{H}}(\text{H})$<br>$t_{\text{H}}(\text{L})$ | Hold time, High or Low<br>nDx to nCP  | 2        | 0.3<br>0.5   | -0.5<br>-0.1 | ns   |
| $t_{\text{W}}(\text{H})$<br>$t_{\text{W}}(\text{L})$ | nCP pulse width<br>High or Low        | 2        | 1.5<br>1.5   |              | ns   |

## AC WAVEFORMS

 $V_M = 1.5\text{V}$  at  $V_{\text{CC}} \geq 3.0\text{V}$ ;  $V_M = V_{\text{CC}}/2$  at  $V_{\text{CC}} \leq 2.7\text{V}$  $V_X = V_{\text{OL}} + 0.3\text{V}$  at  $V_{\text{CC}} \geq 3.0\text{V}$ ;  $V_X = V_{\text{OL}} + 0.15\text{V}$  at  $V_{\text{CC}} \leq 2.7\text{V}$  $V_Y = V_{\text{OH}} - 0.3\text{V}$  at  $V_{\text{CC}} \geq 3.0\text{V}$ ;  $V_Y = V_{\text{OH}} - 0.15\text{V}$  at  $V_{\text{CC}} \leq 2.7\text{V}$ 

Waveform 1. Propagation Delay, Clock Input to Output, Clock Pulse Width, and Maximum Clock frequency

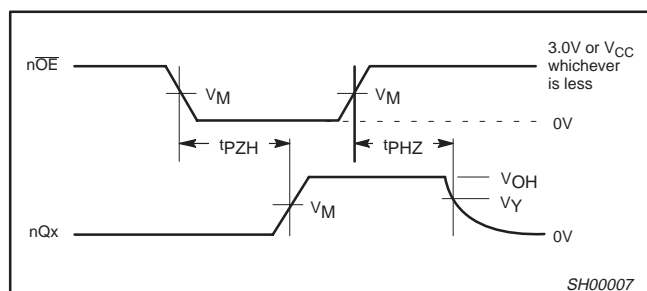


Waveform 2. Data Setup and Hold Times

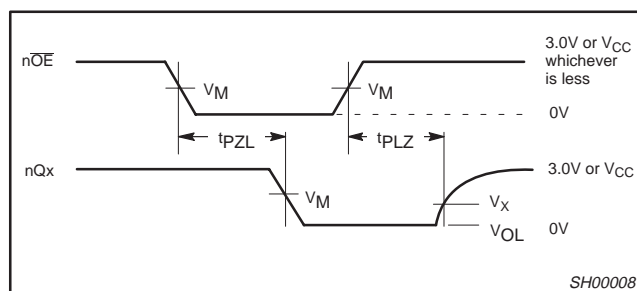


2.5V/3.3V 20-bit bus-interface D-type flip-flop;  
positive-edge trigger with 30Ω termination resistors (3-State)

74ALVT162821

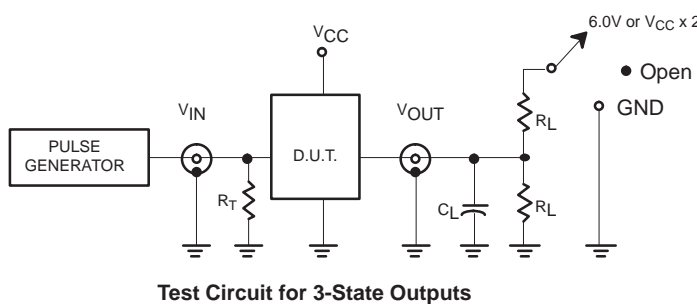


**Waveform 3. 3-State Output Enable Time to High Level and Output Disable Time from High Level**



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

### TEST CIRCUIT AND WAVEFORM



## SWITCH POSITION

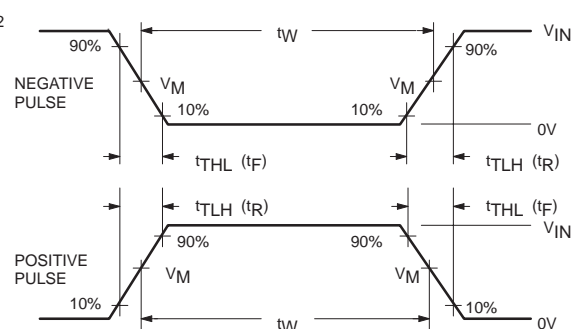
| TEST                               | SWITCH                    |
|------------------------------------|---------------------------|
| t <sub>PLZ</sub> /t <sub>PZL</sub> | 6V or V <sub>CC</sub> x 2 |
| t <sub>PLH</sub> /t <sub>PHL</sub> | Open                      |
| t <sub>PHZ</sub> /t <sub>PZH</sub> | 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.



| FAMILY   | INPUT PULSE REQUIREMENTS                        |           |                |                |                |
|----------|---|-----------|----------------|----------------|----------------|
|          | Amplitude                                       | Rep. Rate | t <sub>W</sub> | t <sub>R</sub> | t <sub>F</sub> |
| 74ALVT16 | 3.0V or V <sub>CC</sub><br>whichever<br>is less | ≤ 10MHz   | 500ns          | ≤ 2.5ns        | ≤ 2.5ns        |

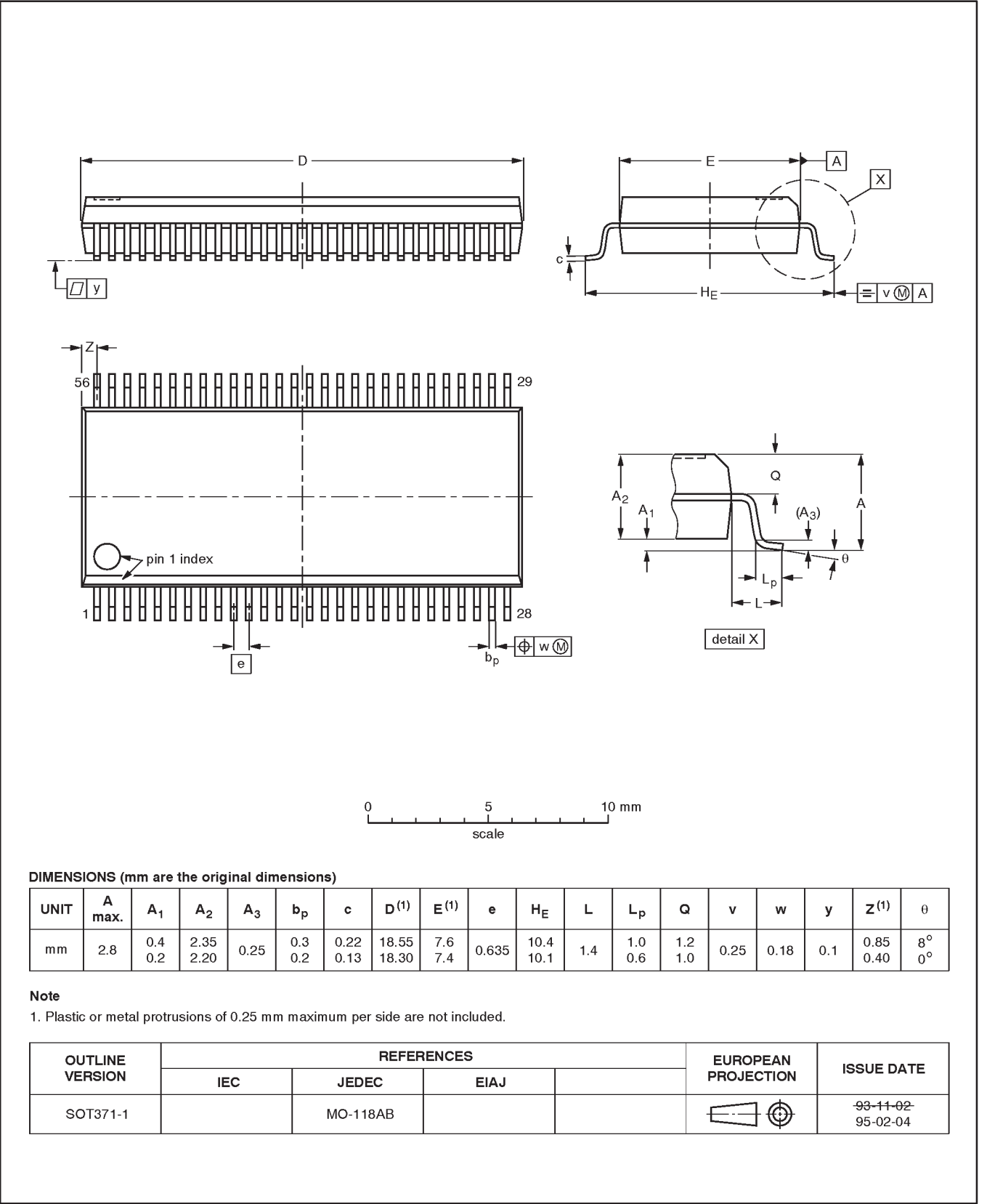
SW00025

2.5V/3.3V 20-bit bus-interface D-type flip-flop;  
positive-edge trigger with 30Ω termination resistors (3-State)

74ALVT162821

SSOP56: plastic shrink small outline package; 56 leads; body width 7.5 mm

SOT371-1

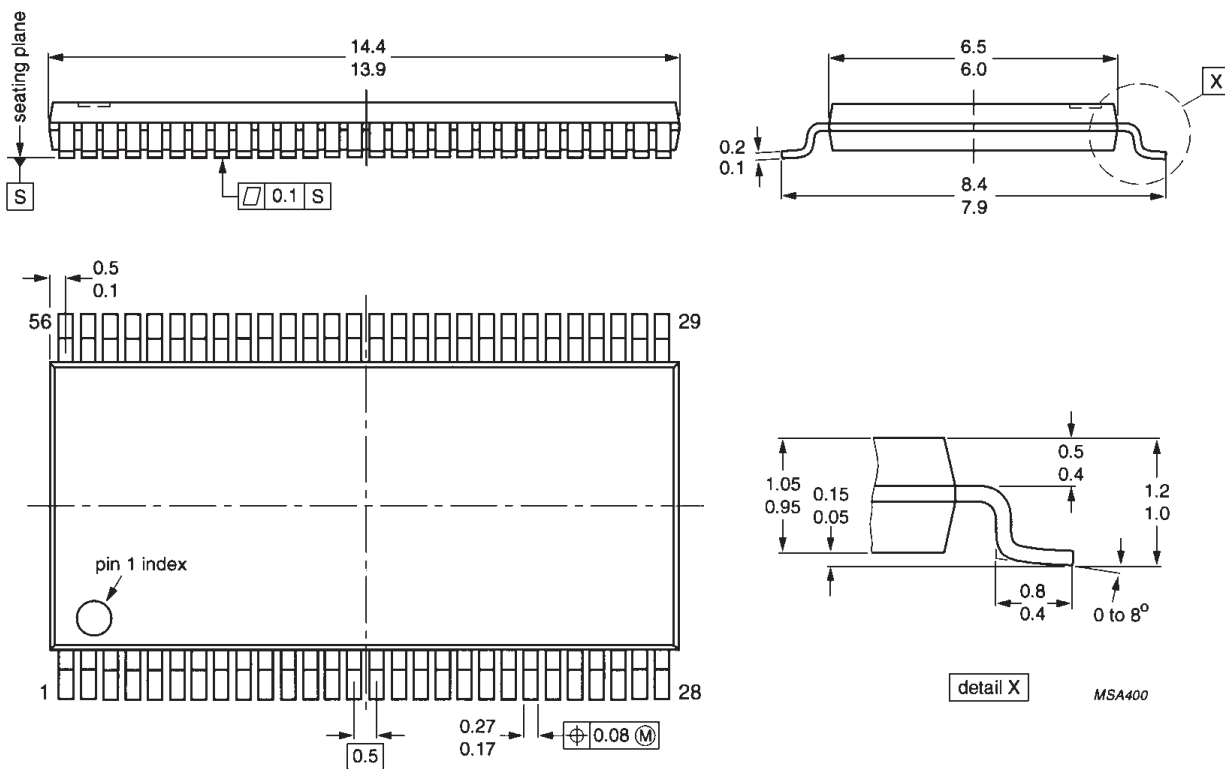


2.5V/3.3V 20-bit bus-interface D-type flip-flop;  
positive-edge trigger with 30Ω termination resistors (3-State)

74ALVT162821

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

**SOT364-1**



2.5V/3.3V 20-bit bus-interface D-type flip-flop;  
positive-edge trigger with 30Ω termination resistors (3-State)

74ALVT162821

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 chages 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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**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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