

# DATA SHEET

**74ALVCH16952**

**16-bit registered transceiver (3-State)**

Preliminary specification  
Supersedes data of 1994 Jul  
IC24 Data Handbook

1998 Sep 01

## 16-bit registered transceiver (3-State)

## 74ALVCH16952

## FEATURES

- Complies with JEDEC standard no. 8-1A
- CMOS low power consumption
- MULTIBYTE™ flow-through pin-out architecture
- Low inductance, multiple center power and ground pins for minimum noise and ground bounce
- Direct interface with TTL levels
- Output drive capability 50Ω transmission lines @ 85°C

## DESCRIPTION

The 74ALVCH16952 consists of two sections, each containing a dual octal non-inverting registered transceiver. Two 8-bit back to back registers store data flowing in both directions between two bi-directional busses. Data applied to the inputs is entered and stored on the rising edge of the clock (CP<sub>XX</sub>, where X is AB or BA) provided that the clock enable ( $\overline{CE}_{XX}$ ) is LOW. The data is then present at the 3-State output buffers, but is only accessible when the output enable input ( $\overline{OE}_{XX}$ ) is LOW. Data flow from A inputs to B outputs is the same as for B inputs to A outputs.

## QUICK REFERENCE DATA

GND = 0V; T<sub>amb</sub> = 25°C; t<sub>r</sub> = t<sub>f</sub> = 2.5ns

| SYMBOL                             | PARAMETER   | CONDITIONS   | TYPICAL | UNIT |
|------------------------------------|---|--|---------|------|
| t <sub>PHL</sub> /t <sub>PLH</sub> | Propagation delay<br>CP <sub>n</sub> , to A <sub>n</sub> , B <sub>n</sub> | V <sub>CC</sub> = 3.3V, C <sub>L</sub> = 50pF<br>V <sub>CC</sub> = 2.5V, C <sub>L</sub> = 30pF | 3.2     | ns   |
| f <sub>MAX</sub>                   | Maximum clock frequency   |  | 350     | MHz  |
| C <sub>I</sub>                     | Input capacitance   |  | 3.0     | pF   |
| C <sub>PD</sub>                    | Power dissipation capacitance per buffer                                  | V <sub>I</sub> = GND to V <sub>CC</sub> <sup>1</sup>   | 30      | pF   |

## NOTES:

1. C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW):

$$P_D = C_{PD} \times V_{CC}^2 \times f_i + \sum (C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

f<sub>i</sub> = input frequency in MHz; C<sub>L</sub> = output load capacity in pF;

f<sub>o</sub> = output frequency in MHz; V<sub>CC</sub> = supply voltage in V;

$\sum (C_L \times V_{CC}^2 \times f_o)$  = sum of outputs.

## ORDERING INFORMATION

| PACKAGES                     | TEMPERATURE RANGE | OUTSIDE NORTH AMERICA | NORTH AMERICA | DWG NUMBER |
|------------------------------|-------------------|-----------------------|---------------|------------|
| 56-Pin Plastic TSSOP Type II | -40°C to +85°C    | 74ALVCH16952 DGG      | ACH16952 DGG  | SOT364-1   |

FUNCTION TABLE for register A<sub>n</sub> or B<sub>n</sub>

| INPUTS                           |                  |                      | INTERNAL<br>Q | OPERATING<br>MODE |
|----------------------------------|------------------|----------------------|---------------|-------------------|
| A <sub>n</sub> or B <sub>n</sub> | CP <sub>XX</sub> | $\overline{CE}_{XX}$ |               |                   |
| X                                | X                | H                    | NC            | Hold data         |
| L                                | ↑                | L                    | L             | Load data         |
| H                                | ↑                | L                    | H             | Load data         |

H = HIGH voltage level

L = LOW voltage level

↑ = LOW-to-HIGH transition

## FUNCTION TABLE for output enable

| INPUTS               | INTERNAL<br>Q | A <sub>n</sub> or B <sub>n</sub><br>OUTPUTS | OPERATING<br>MODE |
|----------------------|---------------|---|-------------------|
| $\overline{OE}_{nn}$ |               |   |                   |
| H                    | X             | Z   | Disable outputs   |
| L                    | L             | L   | Enable outputs    |
| L                    | H             | H   | Enable outputs    |

NC = no change

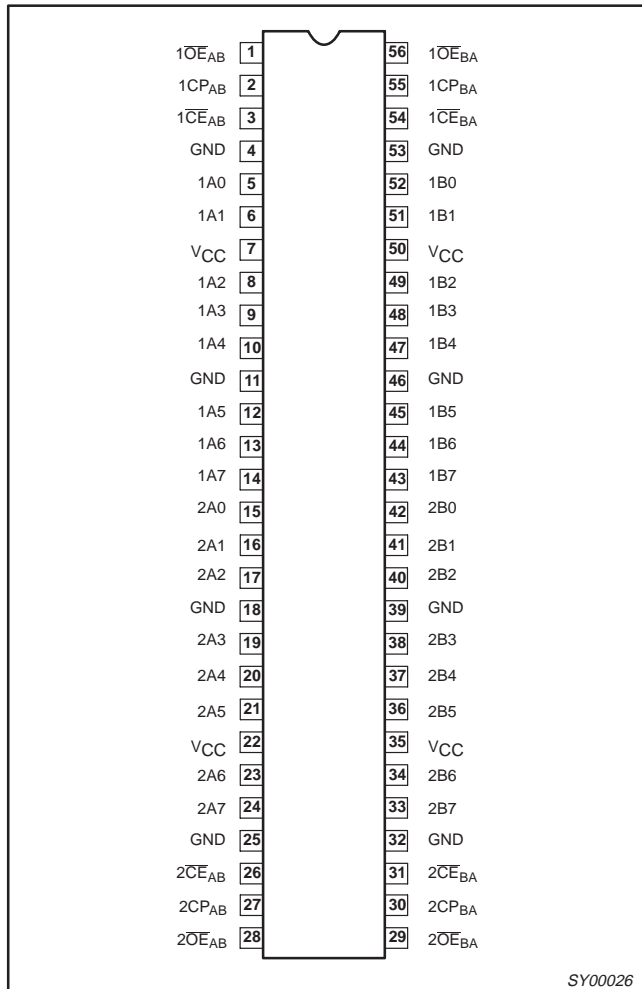
X = don't care

Z = high impedance OFF-state

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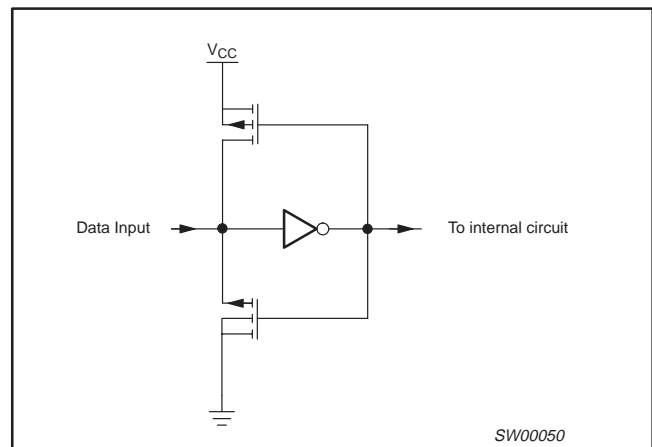
## PIN CONFIGURATION



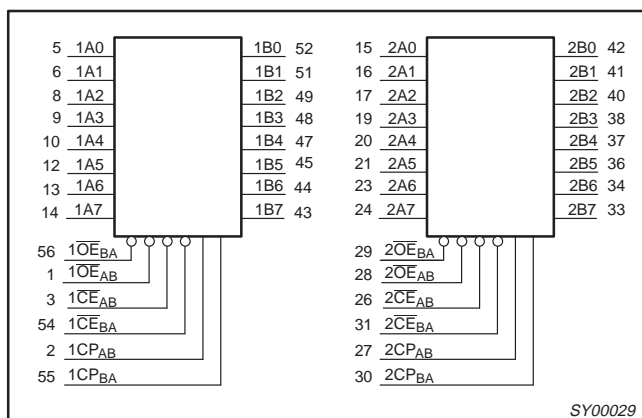
## PIN DESCRIPTION

| PIN NUMBER                     | SYMBOL            | NAME AND FUNCTION       |
|--------------------------------|-------------------|-------------------------|
| 1, 28                          | nOE <sub>AB</sub> | Output enable A-to-B    |
| 2, 27                          | nCP <sub>AB</sub> | Clock input A-to-B      |
| 3, 26                          | nCE <sub>AB</sub> | A-to-B enable           |
| 5, 6, 8, 9, 10, 12, 13, 14     | 1A0 to 1A7        | Data inputs/outputs     |
| 4, 11, 18, 25, 32, 39, 46, 53  | GND               | Ground (0V)             |
| 7, 22, 35, 50                  | V <sub>CC</sub>   | Positive supply voltage |
| 15, 16, 17, 19, 20, 21, 23, 24 | 2B0 to 2B7        | Data inputs/outputs     |
| 29, 56                         | nOE <sub>BA</sub> | Output enable B-to-A    |
| 30, 55                         | nCP <sub>BA</sub> | Clock input B-to-A      |
| 31, 54                         | nCE <sub>BA</sub> | B-to-A enable           |
| 42, 41, 40, 38, 37, 36, 34, 33 | 2B0 to 2B7        | Data inputs/outputs     |
| 52, 51, 49, 48, 47, 45, 44, 43 | 1B0 to 1B7        | Data inputs/outputs     |

## BUSHOLD CIRCUIT



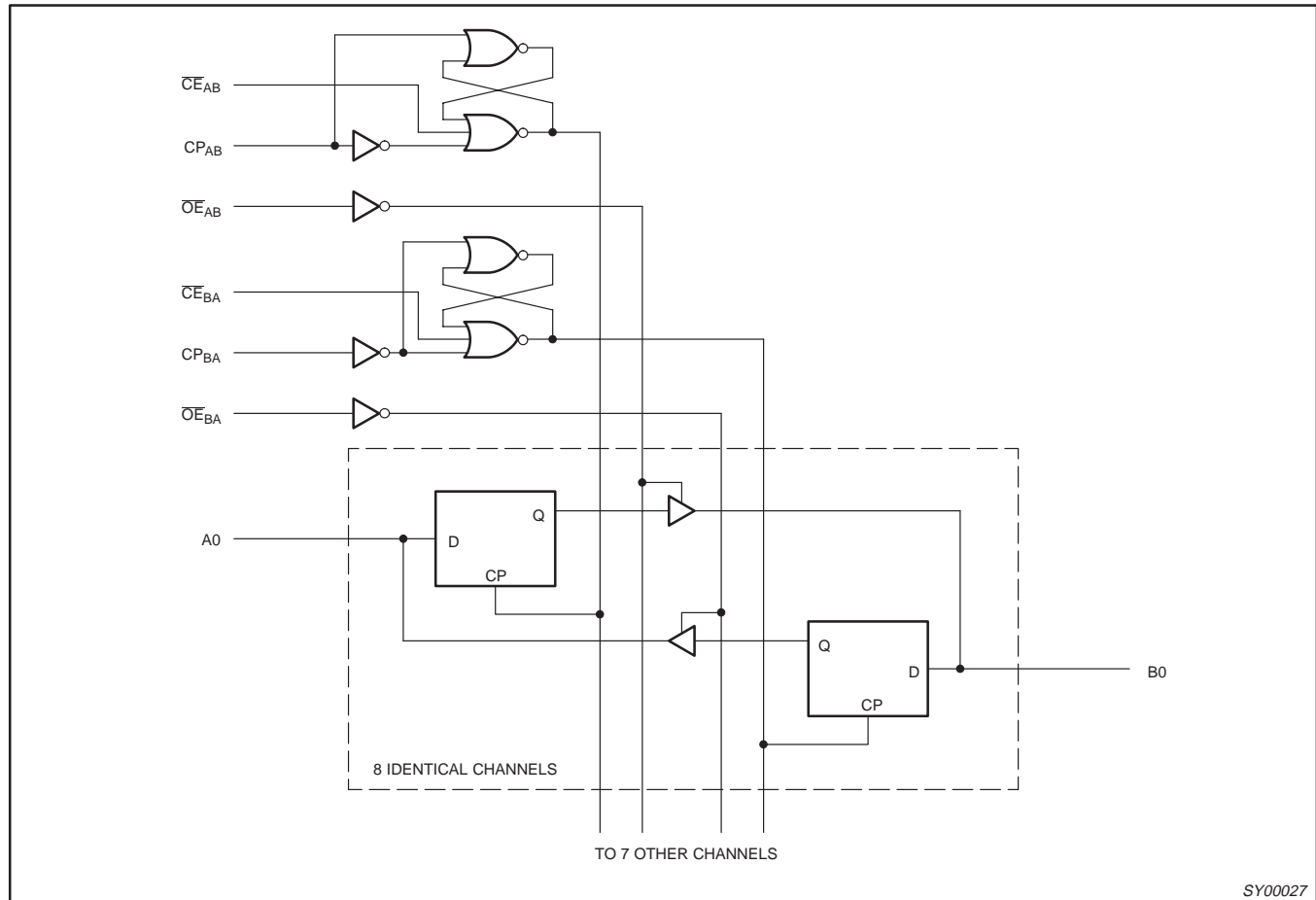
## LOGIC SYMBOL



# 16-bit registered transceiver (3-State)

# 74ALVCH16952

## LOGIC SYMBOL (one section)

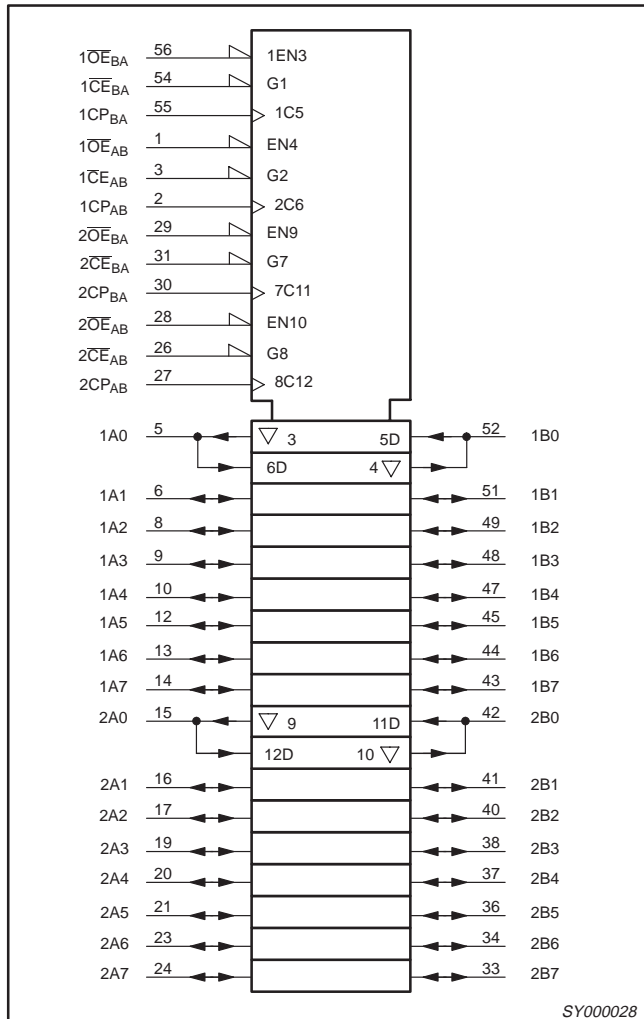


SY00027

# 16-bit registered transceiver (3-State)

74ALVCH16952

## LOGIC SYMBOL (IEEE/IEC)



## 16-bit registered transceiver (3-State)

74ALVCH16952

## RECOMMENDED OPERATING CONDITIONS

| SYMBOL     | PARAMETER   | CONDITIONS   | LIMITS |          | UNIT |
|------------|---|--|--------|----------|------|
|            |   |  | MIN    | MAX      |      |
| $V_{CC}$   | DC supply voltage 2.5V range (for max. speed performance @ 30 pF output load) |  | 2.3    | 2.7      | V    |
|            | DC supply voltage 3.3V range (for max. speed performance @ 50 pF output load) |  | 3.0    | 3.6      |      |
| $V_I$      | DC Input voltage range  |  | 0      | $V_{CC}$ | V    |
| $V_O$      | DC output voltage range   |  | 0      | $V_{CC}$ | V    |
| $T_{amb}$  | Operating free-air temperature range  |  | -40    | +85      | °C   |
| $t_r, t_f$ | Input rise and fall times   | $V_{CC} = 2.3$ to $3.0V$<br>$V_{CC} = 3.0$ to $3.6V$ | 0<br>0 | 20<br>10 | ns/V |

## ABSOLUTE MAXIMUM RATINGS

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

Voltages are referenced to GND (ground = 0V)

| 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 control pins <sup>1</sup>   | -0.5 to +4.6           | V    |
|                   |   | For data inputs <sup>1</sup>  | -0.5 to $V_{CC} + 0.5$ |      |
| $I_{OK}$          | DC output diode current   | $V_O > V_{CC}$ or $V_O < 0$   | ±50                    | mA   |
| $V_O$             | DC output voltage   | 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 medium-shrink (SSOP)<br>–plastic thin-medium-shrink (TSSOP) | For temperature range: -40 to +125 °C   | 850                    | mW   |
|                   |   | above +55°C derate linearly with 11.3 mW/K<br>above +55°C derate linearly with 8 mW/K | 600                    |      |

## NOTE:

1. 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> = 2.3 to 2.7V   | 1.7                   | 1.2                    |      | V    |
|                   |                                     | V <sub>CC</sub> = 2.7 to 3.6V   | 2.0                   | 1.5                    |      |      |
| V <sub>IL</sub>   | LOW level Input voltage             | V <sub>CC</sub> = 2.3 to 2.7V   |                       | 1.2                    | 0.7  | V    |
|                   |                                     | V <sub>CC</sub> = 2.7 to 3.6V   |                       | 1.5                    | 0.8  |      |
| V <sub>OH</sub>   | HIGH level output voltage           | V <sub>CC</sub> = 2.3 to 3.6V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -100μA                    | V <sub>CC</sub> - 0.2 | V <sub>CC</sub>        |      | V    |
|                   |                                     | V <sub>CC</sub> = 2.3V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -6mA                             | V <sub>CC</sub> - 0.3 | V <sub>CC</sub> - 0.08 |      |      |
|                   |                                     | V <sub>CC</sub> = 2.3V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -12mA                            | V <sub>CC</sub> - 0.6 | V <sub>CC</sub> - 0.26 |      |      |
|                   |                                     | V <sub>CC</sub> = 2.7V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -12mA                            | V <sub>CC</sub> - 0.5 | V <sub>CC</sub> - 0.14 |      |      |
|                   |                                     | V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -12mA                            | V <sub>CC</sub> - 0.6 | V <sub>CC</sub> - 0.09 |      |      |
|                   |                                     | V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = -24mA                            | V <sub>CC</sub> - 1.0 | V <sub>CC</sub> - 0.28 |      |      |
| V <sub>OL</sub>   | LOW level output voltage            | V <sub>CC</sub> = 2.3 to 3.6V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 100μA                     |                       | GND                    | 0.20 | V    |
|                   |                                     | V <sub>CC</sub> = 2.3V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 6mA                              |                       | 0.07                   | 0.40 | V    |
|                   |                                     | V <sub>CC</sub> = 2.3V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 12mA                             |                       | 0.15                   | 0.70 | V    |
|                   |                                     | V <sub>CC</sub> = 2.7V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 12mA                             |                       | 0.14                   | 0.40 |      |
|                   |                                     | V <sub>CC</sub> = 3.0V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; I <sub>O</sub> = 24mA                             |                       | 0.27                   | 0.55 |      |
| I <sub>I</sub>    | Input leakage current               | V <sub>CC</sub> = 2.3 to 3.6V;<br>V <sub>I</sub> = V <sub>CC</sub> or GND   |                       | 0.1                    | 5    | μA   |
| I <sub>OZ</sub>   | 3-State output OFF-state current    | V <sub>CC</sub> = 2.7 to 3.6V; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ;<br>V <sub>O</sub> = V <sub>CC</sub> or GND |                       | 0.1                    | 10   | μA   |
| I <sub>CC</sub>   | Quiescent supply current            | V <sub>CC</sub> = 2.3 to 3.6V; V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0                                      |                       | 0.2                    | 40   | μA   |
| ΔI <sub>CC</sub>  | Additional quiescent supply current | V <sub>CC</sub> = 2.3V to 3.6V; V <sub>I</sub> = V <sub>CC</sub> - 0.6V; I <sub>O</sub> = 0                                     |                       | 150                    | 750  | μA   |
| I <sub>BHL</sub>  | Bus hold LOW sustaining current     | V <sub>CC</sub> = 2.3V; V <sub>I</sub> = 0.7V <sup>2</sup>  | 45                    | -                      |      | μA   |
|                   |                                     | V <sub>CC</sub> = 3.0V; V <sub>I</sub> = 0.8V <sup>2</sup>  | 75                    | 150                    |      |      |
| I <sub>BHH</sub>  | Bus hold HIGH sustaining current    | V <sub>CC</sub> = 2.3V; V <sub>I</sub> = 1.7V <sup>2</sup>  | -45                   |                        |      | μA   |
|                   |                                     | V <sub>CC</sub> = 3.0V; V <sub>I</sub> = 2.0V <sup>2</sup>  | -75                   | -175                   |      |      |
| I <sub>BHLO</sub> | Bus hold LOW overdrive current      | V <sub>CC</sub> = 3.6V <sup>2</sup>   | 500                   |                        |      | μA   |
| I <sub>BHHO</sub> | Bus hold HIGH overdrive current     | V <sub>CC</sub> = 3.6V <sup>2</sup>   | -500                  |                        |      | μA   |

**NOTES:**

1. All typical values are at T<sub>amb</sub> = 25°C.
2. Valid for data inputs of bus hold parts.

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**AC CHARACTERISTICS FOR  $V_{CC} = 2.3V$  TO  $2.7V$  RANGE**GND = 0V;  $t_r = t_f \leq 2.0ns$ ;  $C_L = 30pF$ 

| SYMBOL            | PARAMETER   | WAVEFORM | LIMITS                   |     |     | UNIT |
|-------------------|---|----------|--------------------------|-----|-----|------|
|                   |   |          | $V_{CC} = 2.5V \pm 0.2V$ |     |     |      |
|                   |   |          | MIN                      | TYP | MAX |      |
| $t_{PLH}/t_{PHL}$ | Propagation delay<br>nCP <sub>AB</sub> to nBn, nCP <sub>BA</sub> to nAn     | 3        | 1.0                      |     | 4.1 | ns   |
| $t_{PZH}/t_{PZL}$ | 3-State output enable time<br>nOE to nAn, nBn                               | 4        | 1.0                      |     | 5.4 | ns   |
| $t_{PHZ}/t_{PLZ}$ | 3-State output disable time<br>nOE to nAn, nBn                              | 4        | 1.0                      |     | 5.3 | ns   |
| $t_W$             | Pulse width HIGH or LOW<br>nCP <sub>AB</sub> , nCP <sub>BA</sub>            | 3        | 3.3                      |     |     | ns   |
| $t_{SU}$          | Set up time<br>An or Bn before CP <sub>AB</sub>                             | 3        | 1.7                      |     |     | ns   |
|                   | Set up time<br>CE <sub>AB</sub> or CE <sub>BA</sub> before CP <sub>AB</sub> | 3        | 1.2                      |     |     |      |
| $t_h$             | Hold time<br>An or Bn after CP <sub>AB</sub>                                | 3        | 0.6                      |     |     | ns   |
|                   | Hold time<br>An or Bn after CP <sub>AB</sub>                                | 3        | 1.1                      |     |     |      |
| $F_{max}$         | Maximum clock pulse frequency   | 3        | 150                      |     |     | MHz  |

**NOTE:**1. All typical values are at  $V_{CC} = 2.5V$  and  $T_{amb} = 25^\circ C$ .**AC CHARACTERISTICS FOR  $V_{CC} = 3.0V$  TO  $3.6V$  RANGE AND  $V_{CC} = 2.7V$** GND = 0V;  $t_r = t_f = 2.5ns$ ;  $C_L = 50pF$ 

| SYMBOL            | PARAMETER   | WAVEFORM | LIMITS                   |                     |     |                 |                  |     | UNIT |
|-------------------|---|----------|--------------------------|---------------------|-----|-----------------|------------------|-----|------|
|                   |   |          | $V_{CC} = 3.3V \pm 0.3V$ |                     |     | $V_{CC} = 2.7V$ |                  |     |      |
|                   |   |          | MIN                      | TYP <sup>1, 2</sup> | MAX | MIN             | TYP <sup>1</sup> | MAX |      |
| $t_{PHL}/t_{PLH}$ | Propagation delay<br>nCP <sub>AB</sub> to nBn, nCP <sub>BA</sub> to nAn     | 1, 4     | 1.0                      |                     | 3.9 | 1.0             |                  | 4.6 | ns   |
| $t_{PZH}/t_{PZL}$ | 3-State output enable time<br>nOE to nAn, nBn                               | 2, 4     | 1.0                      |                     | 4.4 | 1.0             |                  | 5.3 | ns   |
| $t_{PHZ}/t_{PLZ}$ | 3-State output disable time<br>nOE to nAn, nBn                              | 2, 4     | 1.1                      |                     | 4   | 1.4             |                  | 4.4 | ns   |
| $t_W$             | Pulse width HIGH or LOW<br>nCP <sub>AB</sub> , nCP <sub>BA</sub>            | 3, 4     | 3.3                      |                     |     | 3.3             |                  |     | ns   |
| $t_{SU}$          | Set up time<br>An or Bn before CP <sub>AB</sub>                             | 3, 4     | 1.5                      |                     |     | 1.9             |                  |     | ns   |
|                   | Set up time<br>CE <sub>AB</sub> or CE <sub>BA</sub> before CP <sub>AB</sub> | 3, 4     | 1                        |                     |     | 1               |                  |     |      |
| $t_h$             | Hold time<br>An or Bn after CP <sub>AB</sub>                                | 3, 4     | 0.8                      |                     |     | 0.6             |                  |     | ns   |
|                   | Hold time<br>An or Bn after CP <sub>AB</sub>                                | 3, 4     | 1.1                      |                     |     | 0.9             |                  |     |      |
| $F_{max}$         | Maximum clock pulse frequency   | 1, 4     | 150                      |                     |     | 150             |                  |     | MHz  |

**NOTES:**1. All typical values are at  $T_{amb} = 25^\circ C$ .2.  $V_{CC} = 3.3V$



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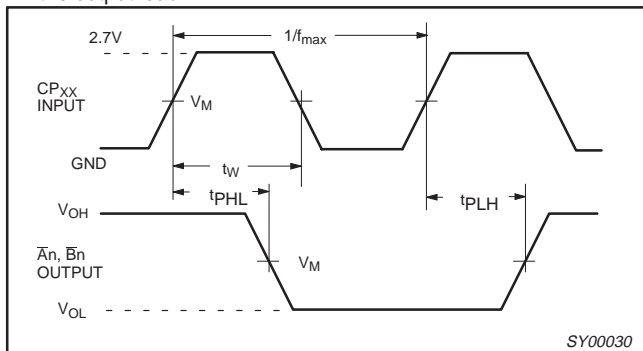
## AC WAVEFORMS

### V<sub>CC</sub> = 2.3 TO 2.7 V RANGE

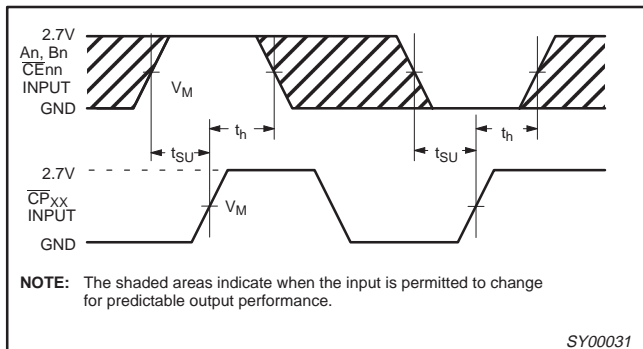
1. V<sub>M</sub> = 0.5 V
2. V<sub>X</sub> = V<sub>OL</sub> + 0.15V
3. V<sub>Y</sub> = V<sub>OH</sub> - 0.15V
4. V<sub>I</sub> = V<sub>CC</sub>
5. V<sub>OL</sub> and V<sub>OH</sub> are the typical output voltage drop that occur with the output load.

### V<sub>CC</sub> = 3.0 TO 3.6 V RANGE AND V<sub>CC</sub> = 2.7 V

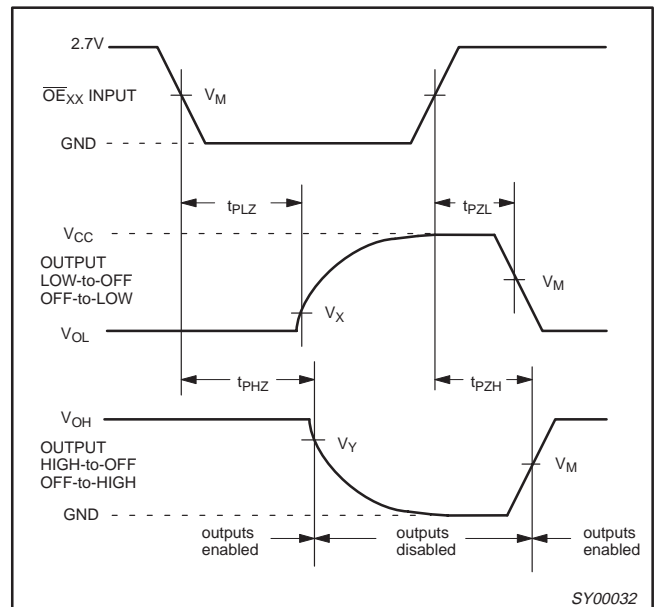
1. V<sub>M</sub> = 1.5 V
2. V<sub>X</sub> = V<sub>OL</sub> + 0.3V
3. V<sub>Y</sub> = V<sub>OH</sub> - 0.3V
4. V<sub>I</sub> = 2.7 V
5. V<sub>OL</sub> and V<sub>OH</sub> are the typical output voltage drop that occur with the output load.



**Waveform 1. Clock input (CP<sub>BA</sub>, CP<sub>AB</sub>) to output (B<sub>n</sub>, A<sub>n</sub>) propagation delays, the clock pulse width and the maximum clock pulse frequency.**

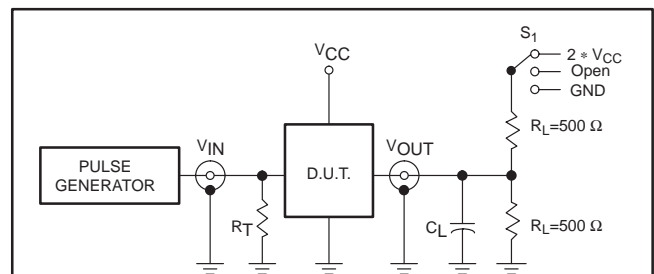


**Waveform 2. Set-up and hold times for the A<sub>n</sub>, B<sub>n</sub> and CE<sub>XX</sub> inputs.**



**Waveform 3. 3-State enable and disable times**

## TEST CIRCUIT



**Test Circuit for 3-State Outputs**

### SWITCH POSITION

| TEST                               | SWITCH              |
|------------------------------------|---------------------|
| t <sub>PLH</sub> /t <sub>PHL</sub> | Open                |
| t <sub>PLZ</sub> /t <sub>PZL</sub> | 2 * V <sub>CC</sub> |
| t <sub>PHZ</sub> /t <sub>PZH</sub> | GND                 |

| V <sub>CC</sub> | V <sub>IN</sub> |
|-----------------|-----------------|
| < 2.7V          | V <sub>CC</sub> |
| 2.7 – 3.6V      | 2.7V            |

### DEFINITIONS

- R<sub>L</sub> = Load resistor
- C<sub>L</sub> = Load capacitance includes jig and probe capacitance
- R<sub>T</sub> = Termination resistance should be equal to Z<sub>OUT</sub> of pulse generators.

SW00047

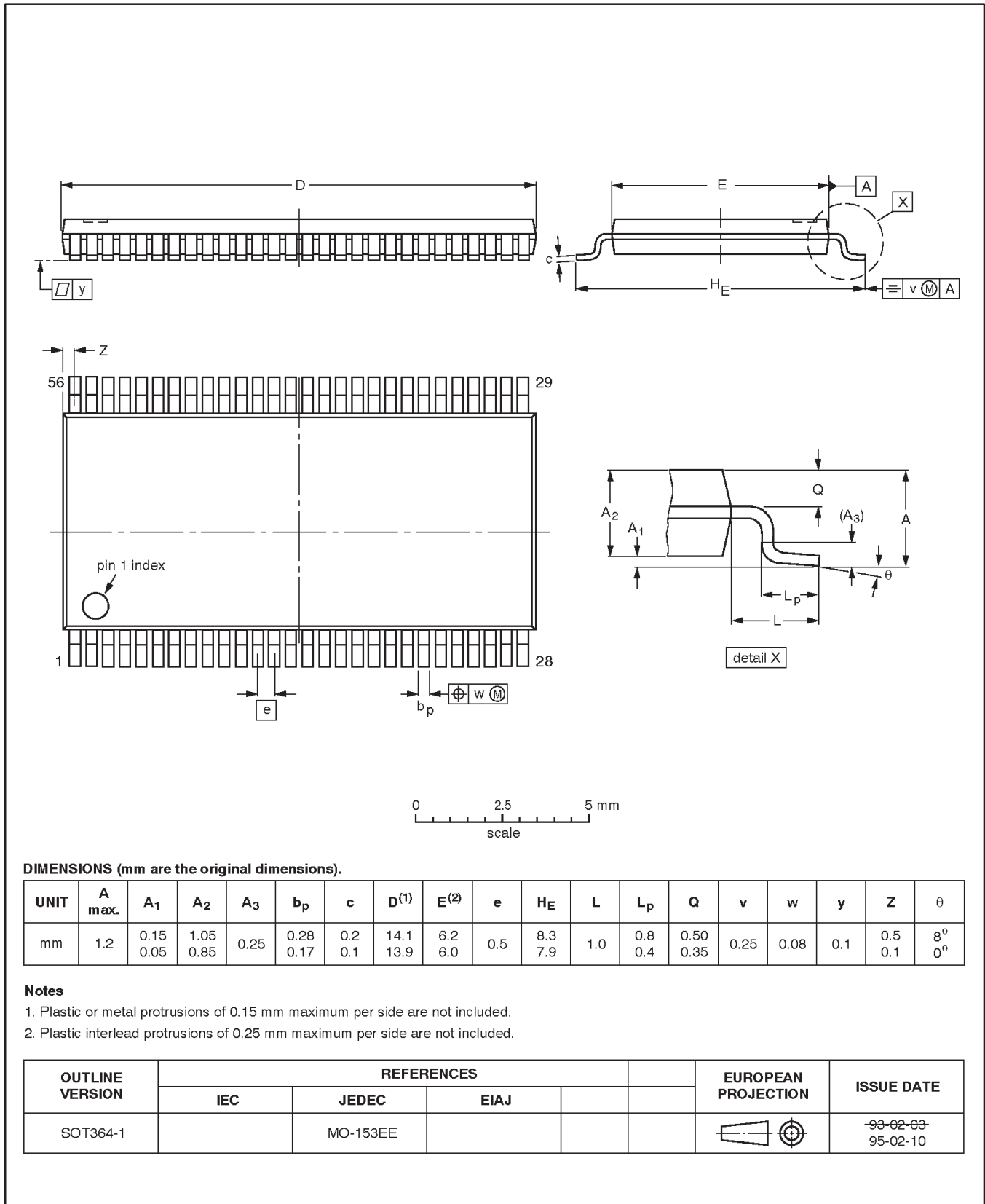
**Load circuitry for switching times**

# 16-bit registered transceiver (3-State)

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

**SOT364-1**



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**NOTES**

## 16-bit registered transceiver (3-State)

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## DEFINITIONS

| Data Sheet Identification        | Product Status                | Definition   |
|----------------------------------|-------------------------------|--|
| <i>Objective Specification</i>   | <b>Formative or in Design</b> | This data sheet contains the design target or goal specifications for product development. Specifications may change in any manner without notice.   |
| <i>Preliminary Specification</i> | <b>Preproduction Product</b>  | 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. |
| <i>Product Specification</i>     | <b>Full Production</b>        | 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.  |

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Date of release: 06-98

Document order number:

9397-750-04563

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