

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC74VCXR162652FT

## Low-Voltage 16-Bit Bus Transceiver/Register with 3.6-V Tolerant Inputs and Outputs

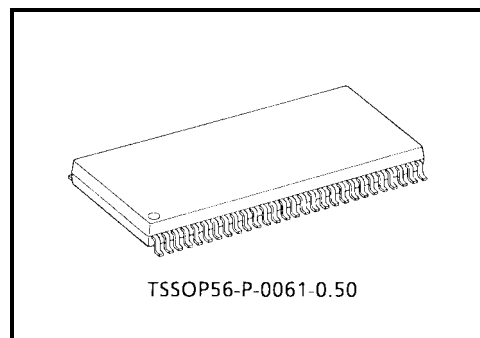
The TC74VCXR162652FT is a high-performance CMOS 16-bit bus transceiver/register. Designed for use in 1.8-V, 2.5-V or 3.3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

It is also designed with overvoltage tolerant inputs and outputs up to 3.6 V.

This device is bus transceiver with 3-state outputs, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the internal registers.

The 26- $\Omega$  series resistor helps reducing output overshoot and undershoot without external resistor.

All inputs are equipped with protection circuits against static discharge.



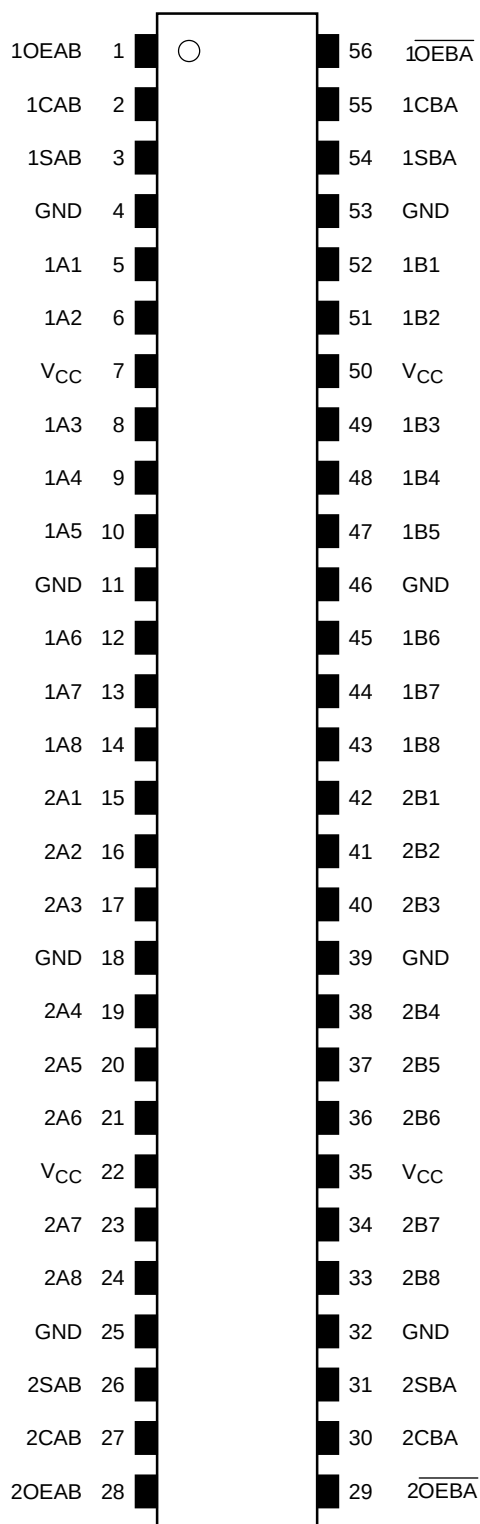
Weight: 0.25 g (typ.)

### Features

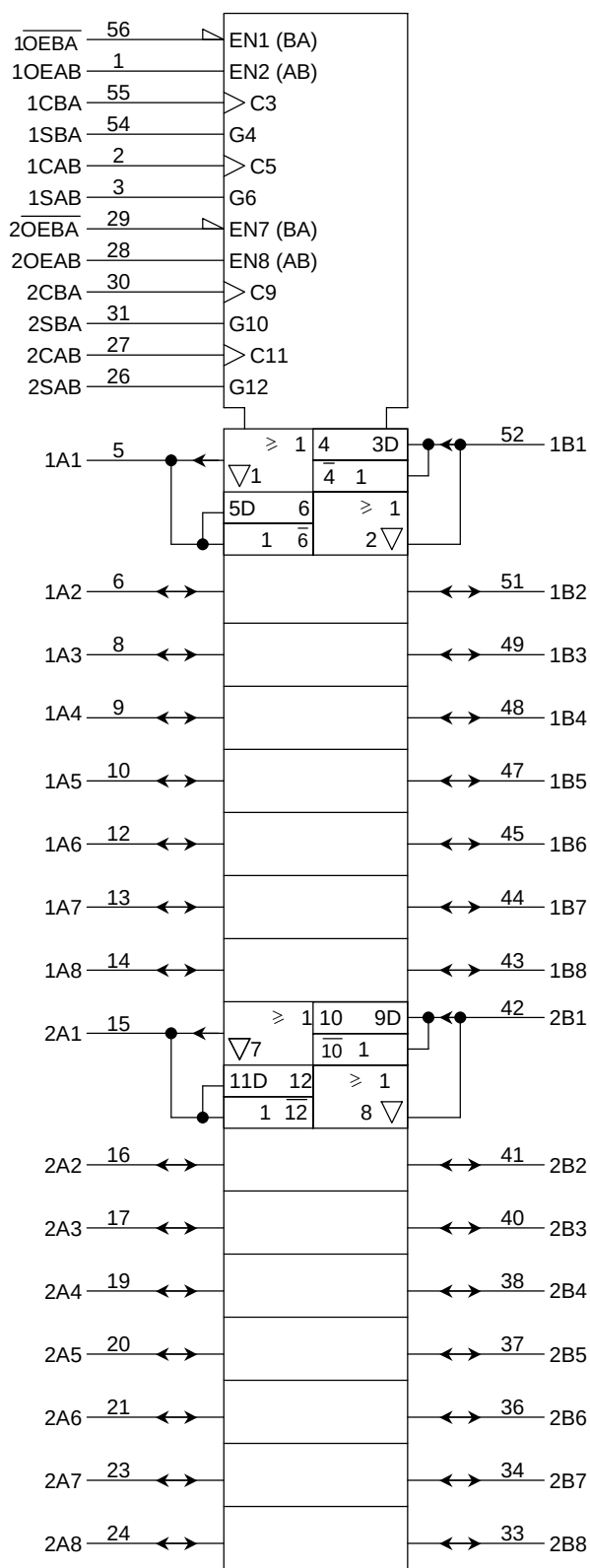
- 26- $\Omega$  series resistors on outputs
- Low-voltage operation:  $V_{CC} = 1.8$  to  $3.6$  V
- High-speed operation:  $t_{pd} = 3.8$  ns (max) ( $V_{CC} = 3.0$  to  $3.6$  V)  
:  $t_{pd} = 4.9$  ns (max) ( $V_{CC} = 2.3$  to  $2.7$  V)  
:  $t_{pd} = 9.8$  ns (max) ( $V_{CC} = 1.8$  V)
- Output current:  $I_{OH}/I_{OL} = \pm 12$  mA (min) ( $V_{CC} = 3.0$  V)  
:  $I_{OH}/I_{OL} = \pm 8$  mA (min) ( $V_{CC} = 2.3$  V)  
:  $I_{OH}/I_{OL} = \pm 4$  mA (min) ( $V_{CC} = 1.8$  V)
- Latch-up performance:  $\pm 300$  mA
- ESD performance: Machine model  $> \pm 200$  V  
: Human body model  $> \pm 2000$  V
- Package: TSSOP (thin shrink small outline package)
- Bidirectional interface between 2.5 V and 3.3 V signals.
- 3.6-V tolerant function and power-down protection provided on all inputs and outputs

Note 1: Do not apply a signal to any bus pins when it is in the output mode. Damage may result.  
All floating (high impedance) bus pins must have their input level fixed by means of pull-up or pull-down resistors.

## Pin Assignment (top view)



## IEC Logic Symbol



## Truth Table

| Control Inputs |                          |                                                                                   |                                                                                     |     |     | Bus    |        | Function                                                                                                                                         |
|----------------|--------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-----|-----|--------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| OEAB           | $\overline{\text{OEBA}}$ | CAB                                                                               | CBA                                                                                 | SAB | SBA | A      | B      |                                                                                                                                                  |
| L              | H                        | X*                                                                                | X*                                                                                  | X   | X   | Input  | Input  | The output functions of A and B Busses are disabled.                                                                                             |
|                |                          |  |    | X   | X   | Z      | Z      | Both A and B Busses are used as inputs to the internal flip-flops. Data on the Bus will be stored on the rising edge of the Clock.               |
| H              | H                        | X*                                                                                | X*                                                                                  | L   | X   | Input  | Output | The data on the A bus are displayed on the B bus.                                                                                                |
|                |                          |                                                                                   |                                                                                     |     |     | L      | L      |                                                                                                                                                  |
|                |                          |                                                                                   |                                                                                     |     |     | H      | H      |                                                                                                                                                  |
|                |                          |  | X*                                                                                  | L   | X   | L      | L      | The data on the A bus are displayed on the B Bus, and are stored into the A storage flip-flops on the rising edge of CAB.                        |
|                |                          |                                                                                   |                                                                                     |     |     | H      | H      |                                                                                                                                                  |
|                |                          | X*                                                                                | X*                                                                                  | H   | X   | X      | Qn     | The data in the A storage flip-flops are displayed on the B Bus.                                                                                 |
| L              | L                        |  | X*                                                                                  | H   | X   | L      | L      | The data on the A Bus are stored into the A storage flip-flops on the rising edge of CAB, and the stored data propagate directly onto the B Bus. |
|                |                          |                                                                                   |                                                                                     |     |     | H      | H      |                                                                                                                                                  |
|                |                          | X*                                                                                | X*                                                                                  | X   | L   | Output | Input  | The data on the B Bus are displayed on the A bus.                                                                                                |
|                |                          |                                                                                   |                                                                                     |     |     | L      | L      |                                                                                                                                                  |
|                |                          |                                                                                   |                                                                                     |     |     | H      | H      |                                                                                                                                                  |
|                |                          | X*                                                                                |  | X   | L   | L      | L      | The data on the B Bus are displayed on the A Bus, and are stored into the B storage flip-flops on the rising edge of CBA.                        |
|                |                          |                                                                                   |                                                                                     |     |     | H      | H      |                                                                                                                                                  |
| H              | L                        | X*                                                                                | X*                                                                                  | X   | H   | Qn     | X      | The data in the B storage flip-flops are displayed on the A Bus.                                                                                 |
|                |                          | X*                                                                                |  | X   | H   | L      | L      | The data on the B Bus are stored into the B storage flip-flops on the rising edge of CBA, and the stored data propagate directly onto the A Bus. |
|                |                          |                                                                                   |                                                                                     |     |     | H      | H      |                                                                                                                                                  |
|                |                          |                                                                                   |                                                                                     |     |     | Output | Output | The data in the A storage flip-flops are displayed on the B Bus, and the data in the B storage flip-flops are displayed on the A.                |
|                |                          | X*                                                                                | X*                                                                                  | H   | H   | Qn     | Qn     |                                                                                                                                                  |

X: Don't care

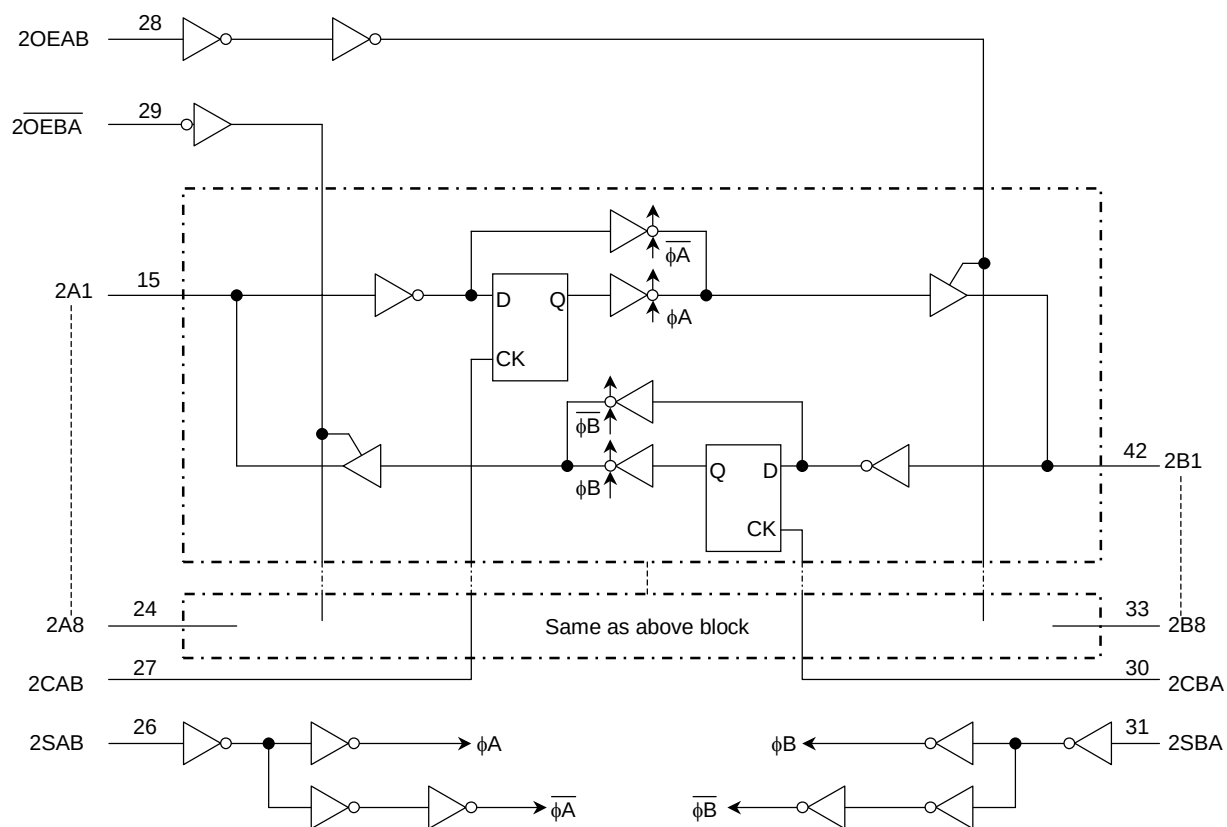
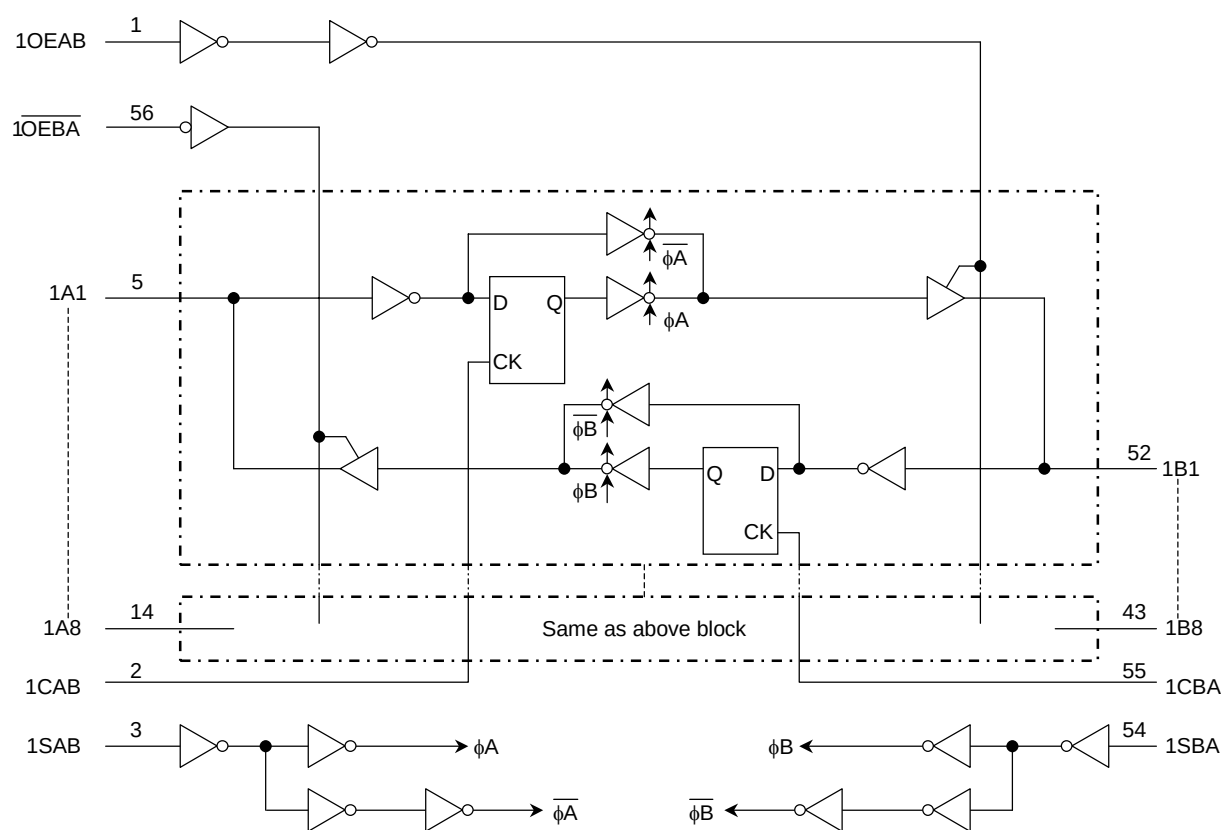
Z: High impedance

Qn: The data stored into the internal flip-flops by most recent low to high transition of the clock inputs.

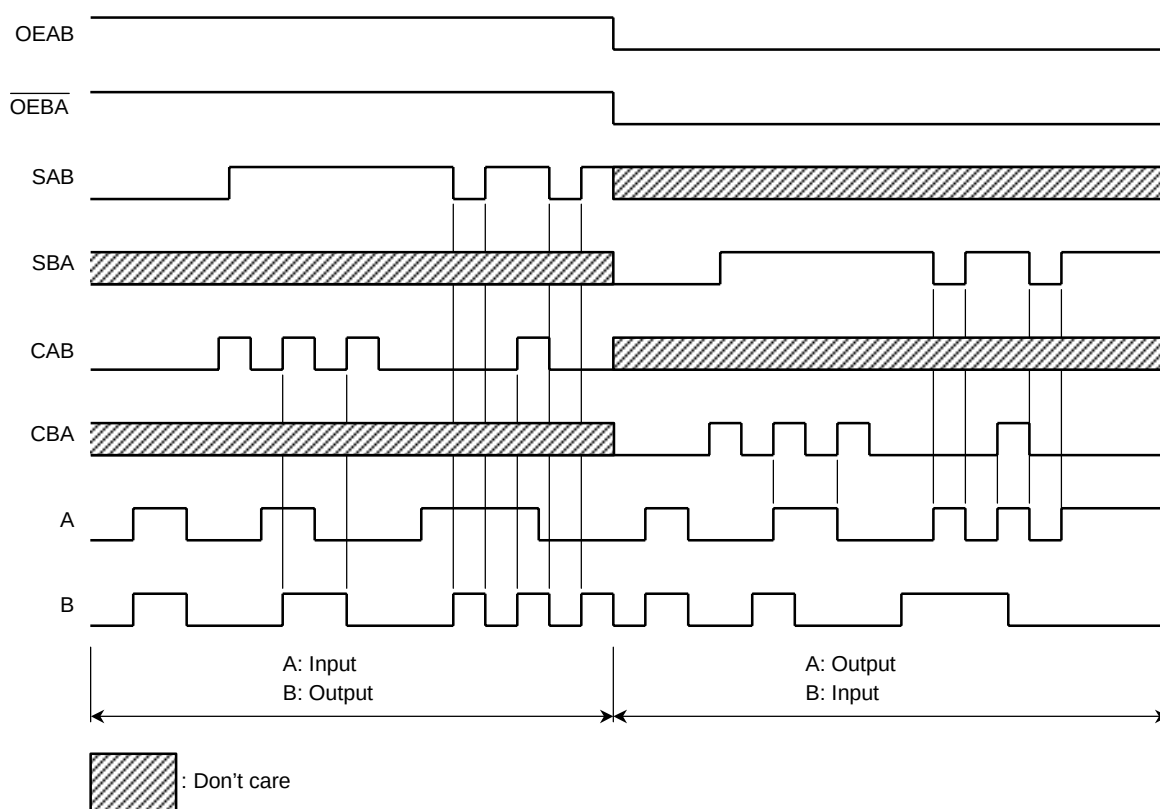
\*: The clocks are not internally gated with either OEAB or  $\overline{\text{OEBA}}$ .

Therefore, data on the A and/or B busses may be clocked into the storage flip-flops at any time.

## System Diagram



## Timing Chart



**Maximum Ratings**

| Characteristics                                                    | Symbol           | Rating                             | Unit |
|--------------------------------------------------------------------|------------------|------------------------------------|------|
| Power supply voltage                                               | $V_{CC}$         | -0.5 to 4.6                        | V    |
| DC input voltage<br>(CAB, CBA, SAB, SBA, OEAB, $\overline{OEBA}$ ) | $V_{IN}$         | -0.5 to 4.6                        | V    |
| DC bus I/O voltage                                                 | $V_{I/O}$        | -0.5 to 4.6 (Note 2)               | V    |
|                                                                    |                  | -0.5 to $V_{CC} + 0.5$<br>(Note 3) |      |
| Input diode current                                                | $I_{IK}$         | -50                                | mA   |
| Output diode current                                               | $I_{OK}$         | $\pm 50$ (Note 4)                  | mA   |
| DC output current                                                  | $I_{OUT}$        | $\pm 50$                           | mA   |
| Power dissipation                                                  | $P_D$            | 400                                | mW   |
| DC $V_{CC}$ /ground current per supply pin                         | $I_{CC}/I_{GND}$ | $\pm 100$                          | mA   |
| Storage temperature                                                | $T_{stg}$        | -65 to 150                         | °C   |

Note 2: OFF state

Note 3: High or low state.  $I_{OUT}$  absolute maximum rating must be observed.

Note 4:  $V_{OUT} < GND$ ,  $V_{OUT} > V_{CC}$

**Recommended Operating Range**

| Characteristics                                                 | Symbol          | Rating                 | Unit |
|-----------------------------------------------------------------|-----------------|------------------------|------|
| Power supply voltage                                            | $V_{CC}$        | 1.8 to 3.6             | V    |
|                                                                 |                 | 1.2 to 3.6 (Note 5)    |      |
| Input voltage<br>(CAB, CBA, SAB, SBA, OEAB, $\overline{OEBA}$ ) | $V_{IN}$        | -0.3 to 3.6            | V    |
| Bus I/O voltage                                                 | $V_{I/O}$       | 0 to 3.6 (Note 6)      | V    |
|                                                                 |                 | 0 to $V_{CC}$ (Note 7) |      |
| Output current                                                  | $I_{OH}/I_{OL}$ | $\pm 12$ (Note 8)      | mA   |
|                                                                 |                 | $\pm 8$ (Note 9)       |      |
|                                                                 |                 | $\pm 4$ (Note 10)      |      |
| Operating temperature                                           | $T_{opr}$       | -40 to 85              | °C   |
| Input rise and fall time                                        | $dt/dv$         | 0 to 10 (Note 11)      | ns/V |

Note 5: Data retention only

Note 6: OFF state

Note 7: High or low state

Note 8:  $V_{CC} = 3.0$  to  $3.6$  V

Note 9:  $V_{CC} = 2.3$  to  $2.7$  V

Note 10:  $V_{CC} = 1.8$  V

Note 11:  $V_{IN} = 0.8$  to  $2.0$  V,  $V_{CC} = 3.0$  V

**Electrical Characteristics**
**DC Characteristics ( $T_a = -40$  to  $85^\circ\text{C}$ ,  $2.7\text{ V} < V_{CC} \leq 3.6\text{ V}$ )**

| Characteristics                       |         | Symbol           | Test Condition                                                                        |                           |                     | Min                   | Max  | Unit |
|---------------------------------------|---------|------------------|---------------------------------------------------------------------------------------|---------------------------|---------------------|-----------------------|------|------|
|                                       |         |                  |                                                                                       |                           | V <sub>CC</sub> (V) |                       |      |      |
| Input voltage                         | H-level | V <sub>IH</sub>  | —                                                                                     |                           | 2.7 to 3.6          | 2.0                   | —    | V    |
|                                       | L-level | V <sub>IL</sub>  | —                                                                                     |                           | 2.7 to 3.6          | —                     | 0.8  |      |
| Output voltage                        | H-level | V <sub>OH</sub>  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                  | I <sub>OH</sub> = -100 μA | 2.7 to 3.6          | V <sub>CC</sub> - 0.2 | —    | V    |
|                                       |         |                  |                                                                                       | I <sub>OH</sub> = -6 mA   | 2.7                 | 2.2                   | —    |      |
|                                       |         |                  |                                                                                       | I <sub>OH</sub> = -8 mA   | 3.0                 | 2.4                   | —    |      |
|                                       |         |                  |                                                                                       | I <sub>OH</sub> = -12 mA  | 3.0                 | 2.2                   | —    |      |
|                                       | L-level | V <sub>OL</sub>  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                  | I <sub>OL</sub> = 100 μA  | 2.7 to 3.6          | —                     | 0.2  |      |
|                                       |         |                  |                                                                                       | I <sub>OL</sub> = 6 mA    | 2.7                 | —                     | 0.4  |      |
|                                       |         |                  |                                                                                       | I <sub>OL</sub> = 8 mA    | 3.0                 | —                     | 0.55 |      |
|                                       |         |                  |                                                                                       | I <sub>OL</sub> = 12 mA   | 3.0                 | —                     | 0.8  |      |
| Input leakage current                 |         | I <sub>IN</sub>  | V <sub>IN</sub> = 0 to 3.6 V                                                          | 2.7 to 3.6                | —                   | ±5.0                  | μA   |      |
| 3-state output OFF state current      |         | I <sub>OZ</sub>  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>OUT</sub> = 0 to 3.6 V | 2.7 to 3.6                | —                   | ±10.0                 | μA   |      |
| Power-off leakage current             |         | I <sub>OFF</sub> | V <sub>IN</sub> , V <sub>OUT</sub> = 0 to 3.6 V                                       | 0                         | —                   | 10.0                  | μA   |      |
| Quiescent supply current              |         | I <sub>CC</sub>  | V <sub>IN</sub> = V <sub>CC</sub> or GND                                              | 2.7 to 3.6                | —                   | 20.0                  | μA   |      |
|                                       |         |                  | V <sub>CC</sub> ≤ (V <sub>IN</sub> , V <sub>OUT</sub> ) ≤ 3.6 V                       | 2.7 to 3.6                | —                   | ±20.0                 |      |      |
| Increase in I <sub>CC</sub> per input |         | ΔI <sub>CC</sub> | V <sub>IH</sub> = V <sub>CC</sub> - 0.6 V                                             | 2.7 to 3.6                | —                   | 750                   |      |      |

**DC Characteristics ( $T_a = -40$  to  $85^\circ\text{C}$ ,  $2.3\text{ V} \leq V_{CC} \leq 2.7\text{ V}$ )**

| Characteristics                  |         | Symbol           | Test Condition                                                                        |                           | V <sub>CC</sub> (V) | Min                   | Max | Unit |
|----------------------------------|---------|------------------|---------------------------------------------------------------------------------------|---------------------------|---------------------|-----------------------|-----|------|
| Input voltage                    | H-level | V <sub>IH</sub>  | —                                                                                     |                           | 2.3 to 2.7          | 1.6                   | —   | V    |
|                                  | L-level | V <sub>IL</sub>  | —                                                                                     |                           | 2.3 to 2.7          | —                     | 0.7 |      |
| Output voltage                   | H-level | V <sub>OH</sub>  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                  | I <sub>OH</sub> = -100 μA | 2.3 to 2.7          | V <sub>CC</sub> - 0.2 | —   | V    |
|                                  |         |                  |                                                                                       | I <sub>OH</sub> = -4 mA   | 2.3                 | 2.0                   | —   |      |
|                                  |         |                  |                                                                                       | I <sub>OH</sub> = -6 mA   | 2.3                 | 1.8                   | —   |      |
|                                  |         |                  |                                                                                       | I <sub>OH</sub> = -8 mA   | 2.3                 | 1.7                   | —   |      |
|                                  | L-level | V <sub>OL</sub>  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                  | I <sub>OL</sub> = 100 μA  | 2.3 to 2.7          | —                     | 0.2 |      |
|                                  |         |                  |                                                                                       | I <sub>OL</sub> = 6 mA    | 2.3                 | —                     | 0.4 |      |
|                                  |         |                  |                                                                                       | I <sub>OL</sub> = 8 mA    | 2.3                 | —                     | 0.6 |      |
| Input leakage current            |         | I <sub>IN</sub>  | V <sub>IN</sub> = 0 to 3.6 V                                                          | 2.3 to 2.7                | —                   | ±5.0                  | μA  |      |
| 3-state output OFF state current |         | I <sub>OZ</sub>  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>OUT</sub> = 0 to 3.6 V | 2.3 to 2.7                | —                   | ±10.0                 | μA  |      |
| Power-off leakage current        |         | I <sub>OFF</sub> | V <sub>IN</sub> , V <sub>OUT</sub> = 0 to 3.6 V                                       | 0                         | —                   | 10.0                  | μA  |      |
| Quiescent supply current         |         | I <sub>CC</sub>  | V <sub>IN</sub> = V <sub>CC</sub> or GND                                              | 2.3 to 2.7                | —                   | 20.0                  | μA  |      |
|                                  |         |                  | V <sub>CC</sub> ≤ (V <sub>IN</sub> , V <sub>OUT</sub> ) ≤ 3.6 V                       | 2.3 to 2.7                | —                   | ±20.0                 |     |      |

DC Characteristics ( $T_a = -40$  to  $85^\circ\text{C}$ ,  $1.8\text{ V} \leq V_{CC} < 2.3\text{ V}$ )

| Characteristics                  |         | Symbol           | Test Condition                                                                        |                           |                     | Min                   | Max                   | Unit  |    |
|----------------------------------|---------|------------------|---------------------------------------------------------------------------------------|---------------------------|---------------------|-----------------------|-----------------------|-------|----|
|                                  |         |                  |                                                                                       |                           | V <sub>CC</sub> (V) |                       |                       |       |    |
| Input voltage                    | H-level | V <sub>IH</sub>  | —                                                                                     |                           | 1.8 to 2.3          | 0.7 × V <sub>CC</sub> | —                     | V     |    |
|                                  | L-level | V <sub>IL</sub>  | —                                                                                     |                           | 1.8 to 2.3          | —                     | 0.2 × V <sub>CC</sub> |       |    |
| Output voltage                   | H-level | V <sub>OH</sub>  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                  | I <sub>OH</sub> = −100 μA | 1.8                 | V <sub>CC</sub> − 0.2 | —                     | V     |    |
|                                  |         |                  |                                                                                       | I <sub>OH</sub> = −4 mA   | 1.8                 | 1.4                   | —                     |       |    |
|                                  | L-level | V <sub>OL</sub>  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                  | I <sub>OL</sub> = 100 μA  | 1.8                 | —                     | 0.2                   |       |    |
|                                  |         |                  |                                                                                       | I <sub>OL</sub> = 4 mA    | 1.8                 | —                     | 0.3                   |       |    |
| Input leakage current            |         | I <sub>IN</sub>  | V <sub>IN</sub> = 0 to 3.6 V                                                          |                           |                     | 1.8                   | —                     | ±5.0  | μA |
| 3-state output OFF state current |         | I <sub>OZ</sub>  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>OUT</sub> = 0 to 3.6 V |                           |                     | 1.8                   | —                     | ±10.0 | μA |
| Power-off leakage current        |         | I <sub>OFF</sub> | V <sub>IN</sub> , V <sub>OUT</sub> = 0 to 3.6 V                                       |                           |                     | 0                     | —                     | 10.0  | μA |
| Quiescent supply current         |         | I <sub>CC</sub>  | V <sub>IN</sub> = V <sub>CC</sub> or GND                                              |                           |                     | 1.8                   | —                     | 20.0  | μA |
|                                  |         |                  | V <sub>CC</sub> ≤ (V <sub>IN</sub> , V <sub>OUT</sub> ) ≤ 3.6 V                       |                           |                     | 1.8                   | —                     | ±20.0 |    |



**AC Characteristics (Ta = -40 to 85°C, input:  $t_r = t_f = 2.0$  ns,  $C_L = 30$  pF,  $R_L = 500$  Ω)**

| Characteristics                                          | Symbol                   | Test Condition               | V <sub>CC</sub> (V) | Min | Max | Unit |
|----------------------------------------------------------|--------------------------|------------------------------|---------------------|-----|-----|------|
|                                                          |                          |                              |                     |     |     |      |
| Maximum clock frequency                                  | $f_{\max}$               | Figure 1, Figure 3           | 1.8                 | 100 | —   | MHz  |
|                                                          |                          |                              | $2.5 \pm 0.2$       | 200 | —   |      |
|                                                          |                          |                              | $3.3 \pm 0.3$       | 250 | —   |      |
| Propagation delay time<br>(An, Bn-Bn, An)                | $t_{pLH}$<br>$t_{pHL}$   | Figure 1, Figure 2           | 1.8                 | 1.5 | 9.8 | ns   |
|                                                          |                          |                              | $2.5 \pm 0.2$       | 0.8 | 4.9 |      |
|                                                          |                          |                              | $3.3 \pm 0.3$       | 0.6 | 3.8 |      |
| Propagation delay time<br>(CAB, CBA-Bn, An)              | $t_{pLH}$<br>$t_{pHL}$   | Figure 1, Figure 3           | 1.8                 | 1.5 | 9.8 | ns   |
|                                                          |                          |                              | $2.5 \pm 0.2$       | 0.8 | 5.8 |      |
|                                                          |                          |                              | $3.3 \pm 0.3$       | 0.6 | 4.1 |      |
| Propagation delay time<br>(SAB, SBA-Bn, An)              | $t_{pLH}$<br>$t_{pHL}$   | Figure 1, Figure 2           | 1.8                 | 1.5 | 9.8 | ns   |
|                                                          |                          |                              | $2.5 \pm 0.2$       | 0.8 | 5.8 |      |
|                                                          |                          |                              | $3.3 \pm 0.3$       | 0.6 | 4.4 |      |
| Output enable time<br>(OEAB, $\overline{OEBA}$ -An, Bn)  | $t_{pZL}$<br>$t_{pZH}$   | Figure 1, Figure 4, Figure 5 | 1.8                 | 1.5 | 9.8 | ns   |
|                                                          |                          |                              | $2.5 \pm 0.2$       | 0.8 | 5.9 |      |
|                                                          |                          |                              | $3.3 \pm 0.3$       | 0.6 | 4.3 |      |
| Output disable time<br>(OEAB, $\overline{OEBA}$ -An, Bn) | $t_{pLZ}$<br>$t_{pHZ}$   | Figure 1, Figure 4, Figure 5 | 1.8                 | 1.5 | 9.4 | ns   |
|                                                          |                          |                              | $2.5 \pm 0.2$       | 0.8 | 5.2 |      |
|                                                          |                          |                              | $3.3 \pm 0.3$       | 0.6 | 4.5 |      |
| Minimum pulse width                                      | $t_w(H)$<br>$t_w(L)$     | Figure 1, Figure 3           | 1.8                 | 4.0 | —   | ns   |
|                                                          |                          |                              | $2.5 \pm 0.2$       | 1.5 | —   |      |
|                                                          |                          |                              | $3.3 \pm 0.3$       | 1.5 | —   |      |
| Minimum setup time                                       | $t_s$                    | Figure 1, Figure 3           | 1.8                 | 2.5 | —   | ns   |
|                                                          |                          |                              | $2.5 \pm 0.2$       | 1.5 | —   |      |
|                                                          |                          |                              | $3.3 \pm 0.3$       | 1.5 | —   |      |
| Minimum hold time                                        | $t_h$                    | Figure 1, Figure 3           | 1.8                 | 1.0 | —   | ns   |
|                                                          |                          |                              | $2.5 \pm 0.2$       | 1.0 | —   |      |
|                                                          |                          |                              | $3.3 \pm 0.3$       | 1.0 | —   |      |
| Output to output skew                                    | $t_{oSLH}$<br>$t_{oSHL}$ | (Note 12)                    | 1.8                 | —   | 0.5 | ns   |
|                                                          |                          |                              | $2.5 \pm 0.2$       | —   | 0.5 |      |
|                                                          |                          |                              | $3.3 \pm 0.3$       | —   | 0.5 |      |

For  $C_L = 50$  pF, add approximately 300 ps to the AC maximum specification.

Note 12: Parameter guaranteed by design.

( $t_{oSLH} = |t_{pLHm} - t_{pLHn}|$ ,  $t_{oSHL} = |t_{pHLm} - t_{pHLn}|$ )

**Dynamic Switching Characteristics**
**(Ta = 25°C, input:  $t_r = t_f = 2.0$  ns,  $C_L = 30$  pF,  $R_L = 500 \Omega$ )**

| Characteristics                              | Symbol           | Test Condition                                           | V <sub>CC</sub> (V) | Typ.  | Unit |
|----------------------------------------------|------------------|----------------------------------------------------------|---------------------|-------|------|
|                                              |                  |                                                          |                     |       |      |
| Quiet output maximum dynamic V <sub>OL</sub> | V <sub>OLP</sub> | V <sub>IH</sub> = 1.8 V, V <sub>IL</sub> = 0 V (Note 13) | 1.8                 | 0.15  | V    |
|                                              |                  | V <sub>IH</sub> = 2.5 V, V <sub>IL</sub> = 0 V (Note 13) | 2.5                 | 0.25  |      |
|                                              |                  | V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V (Note 13) | 3.3                 | 0.35  |      |
| Quiet output minimum dynamic V <sub>OL</sub> | V <sub>OLV</sub> | V <sub>IH</sub> = 1.8 V, V <sub>IL</sub> = 0 V (Note 13) | 1.8                 | -0.15 | V    |
|                                              |                  | V <sub>IH</sub> = 2.5 V, V <sub>IL</sub> = 0 V (Note 13) | 2.5                 | -0.25 |      |
|                                              |                  | V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V (Note 13) | 3.3                 | -0.35 |      |
| Quiet output minimum dynamic V <sub>OH</sub> | V <sub>OHV</sub> | V <sub>IH</sub> = 1.8 V, V <sub>IL</sub> = 0 V (Note 13) | 1.8                 | 1.55  | V    |
|                                              |                  | V <sub>IH</sub> = 2.5 V, V <sub>IL</sub> = 0 V (Note 13) | 2.5                 | 2.05  |      |
|                                              |                  | V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V (Note 13) | 3.3                 | 2.65  |      |

Note 13: Parameter guaranteed by design.

**Capacitive Characteristics (Ta = 25°C)**

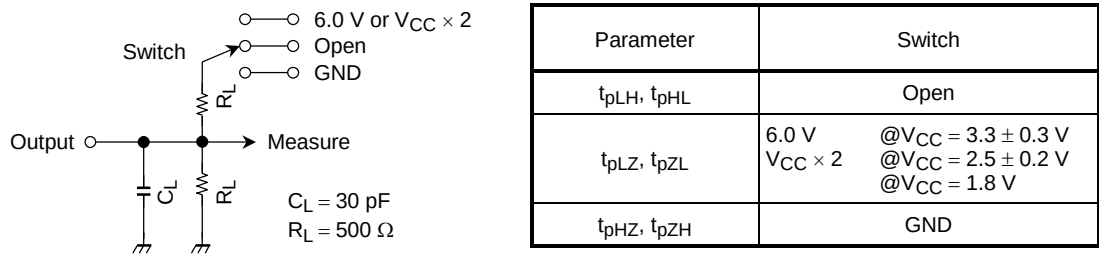
| Characteristics               | Symbol           | Test Condition                     | V <sub>CC</sub> (V) | Typ. | Unit |
|-------------------------------|------------------|------------------------------------|---------------------|------|------|
|                               |                  |                                    |                     |      |      |
| Input capacitance             | C <sub>IN</sub>  | (OEAB, OEBA, CAB, CBA, SAB, SBA)   | 1.8, 2.5, 3.3       | 6    | pF   |
| Bus I/O capacitance           | C <sub>I/O</sub> | An, Bn                             | 1.8, 2.5, 3.3       | 7    | pF   |
| Power dissipation capacitance | C <sub>PD</sub>  | f <sub>IN</sub> = 10 MHz (Note 14) | 1.8, 2.5, 3.3       | 20   | pF   |

 Note 14: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

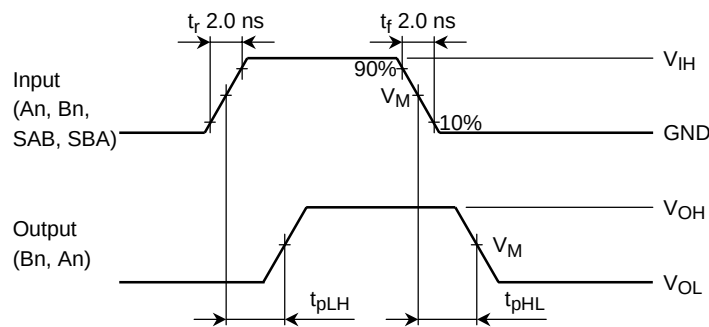
$$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/16 \text{ (per bit)}$$

**AC Test Circuit**

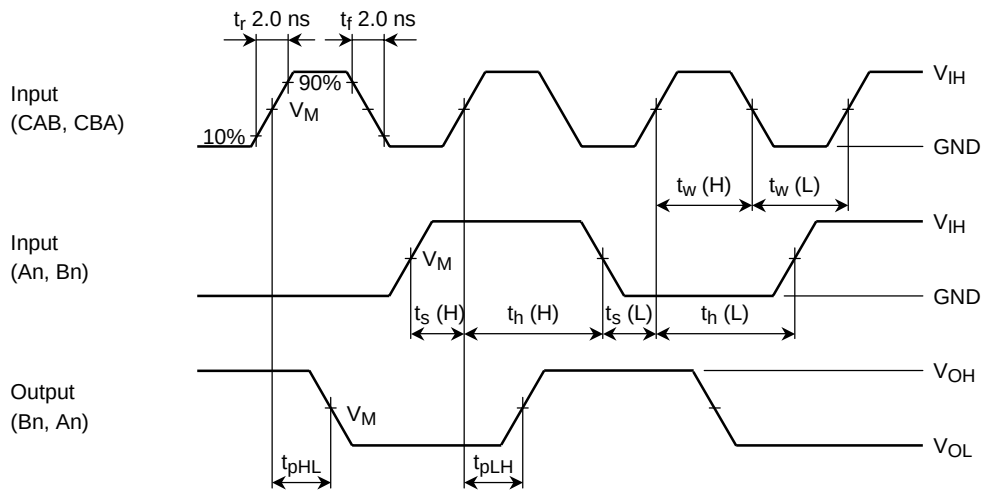


**Figure 1**

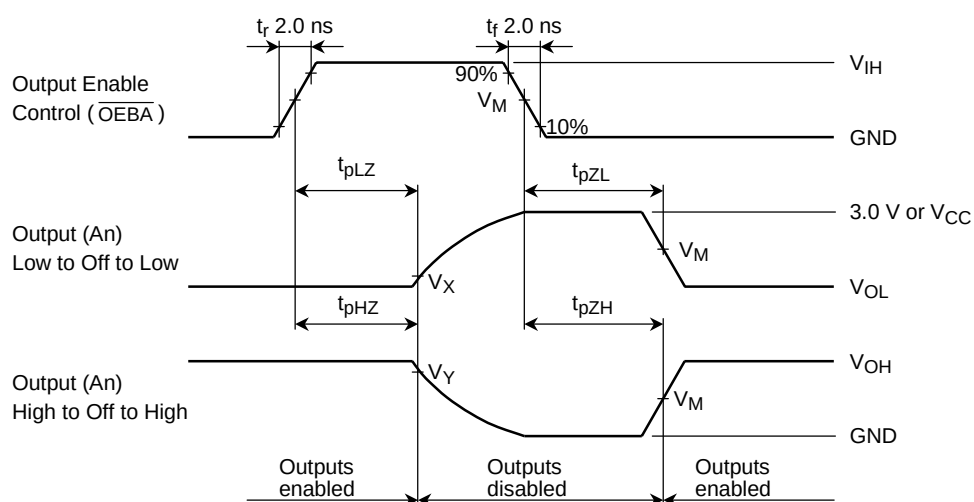
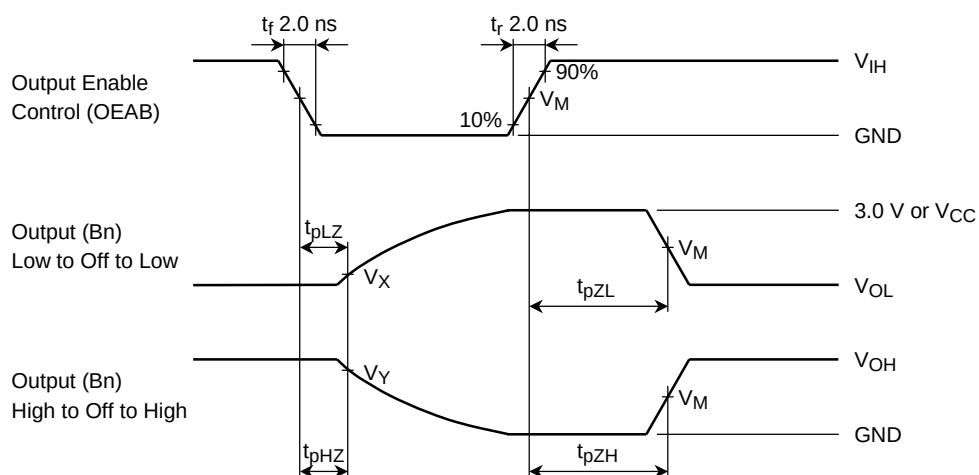
**AC Waveform**



**Figure 2  $t_{pLH}$ ,  $t_{pHL}$**



**Figure 3  $t_{pLH}$ ,  $t_{pHL}$ ,  $t_w$ ,  $t_s$ ,  $t_h$**

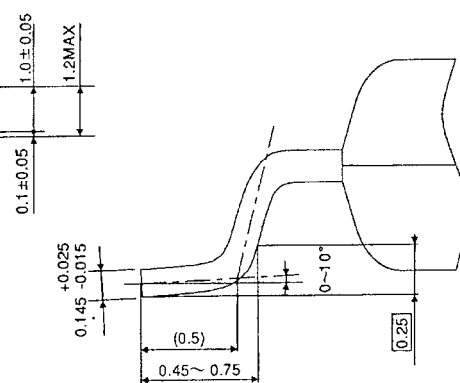
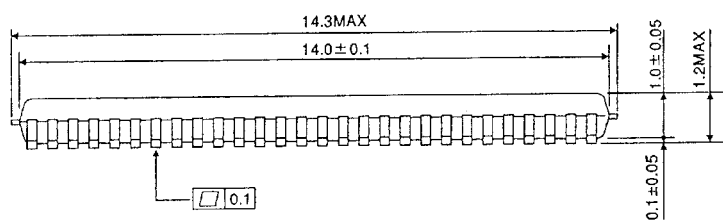
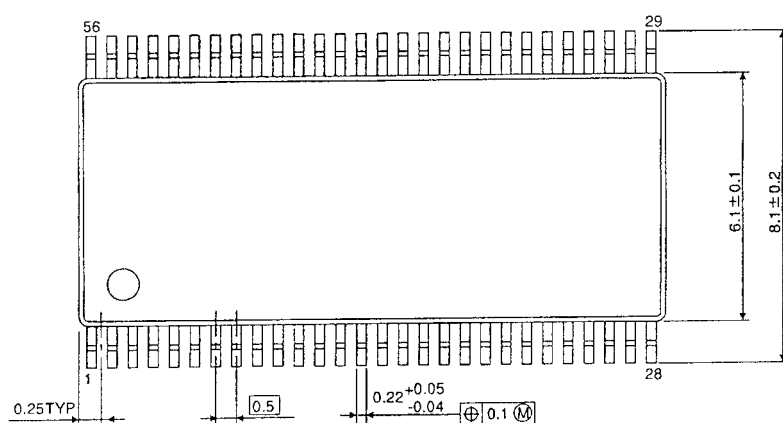

**Figure 4**  $t_{pLZ}$ ,  $t_{pHZ}$ ,  $t_{pZL}$ ,  $t_{pZH}$ 

**Figure 5**  $t_{pLZ}$ ,  $t_{pHZ}$ ,  $t_{pZL}$ ,  $t_{pZH}$ 

| Symbol   | $V_{CC}$                 |                           |                           |
|----------|--------------------------|---------------------------|---------------------------|
|          | $3.3 \pm 0.3 \text{ V}$  | $2.5 \pm 0.2 \text{ V}$   | 1.8 V                     |
| $V_{IH}$ | 2.7 V                    | $V_{CC}$                  | $V_{CC}$                  |
| $V_M$    | 1.5 V                    | $V_{CC}/2$                | $V_{CC}/2$                |
| $V_X$    | $V_{OL} + 0.3 \text{ V}$ | $V_{OL} + 0.15 \text{ V}$ | $V_{OL} + 0.15 \text{ V}$ |
| $V_Y$    | $V_{OH} - 0.3 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$ | $V_{OH} - 0.15 \text{ V}$ |

## Package Dimensions

TSSOP56-P-0061-0.50

Unit : mm



Weight: 0.25 g (typ.)

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000707EBA

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