

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74VCXH16827FT

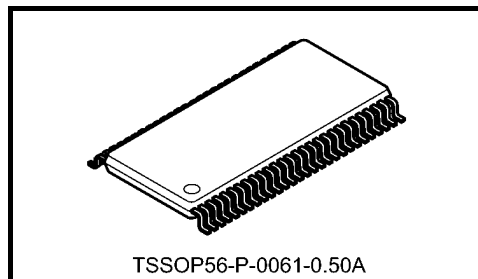
Low-Voltage 20-Bit Bus Buffer with Bushold

The TC74VCXH16827FT is a high-performance CMOS 20-bit bus buffer. 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.

The TC74VCXH16827FT is composed of two 10-bit sections with separate output-enable signals. For either 10-bit buffer section, the two output-enable (1OE1 and 1OE2 or 2OE1 and 2OE2) inputs must both be low for the corresponding Y outputs to be active. When the OE input is high, the outputs are in a high-impedance state. This device is designed to be used with 3-state memory address drivers, etc.

The A data inputs include active bushold circuitry, eliminating the need for external pull-up resistors to hold unused or floating data inputs at a valid logic level.

All inputs are equipped with protection circuits against static discharge.

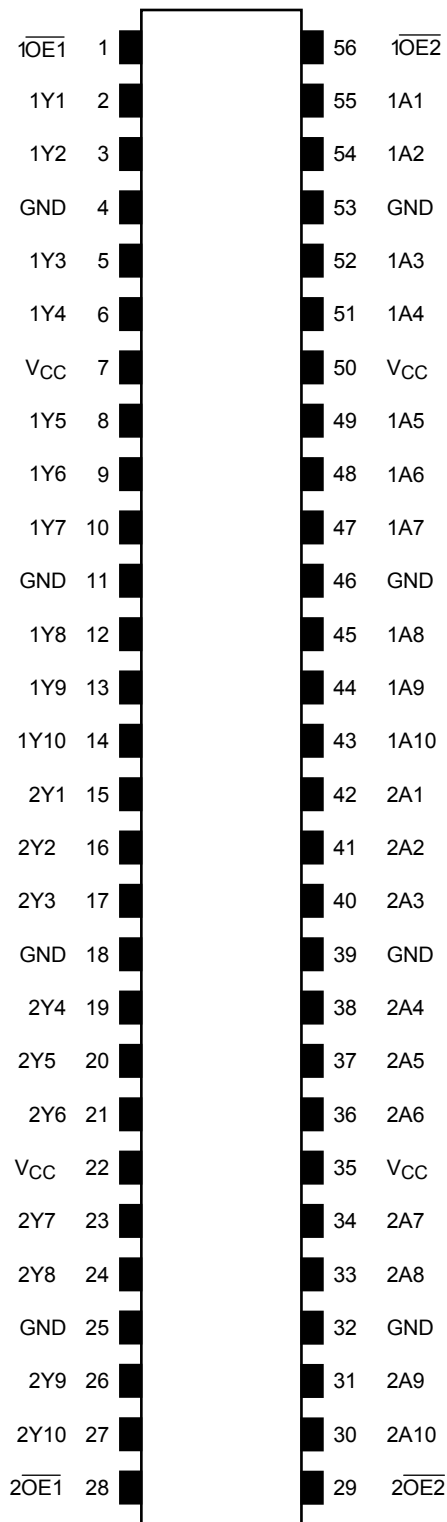


Weight: 0.25 g (typ.)

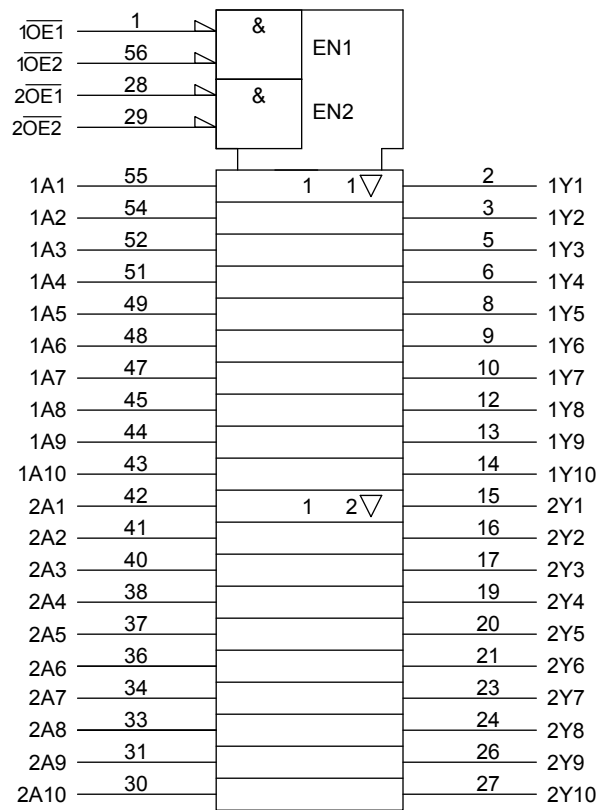
Features

- Low-voltage operation: $V_{CC} = 1.8$ to 3.6 V
- Bushold on data inputs eliminating the need for external pull-up/pull-down resistors
- High-speed operation: $t_{pd} = 2.5$ ns (max) ($V_{CC} = 3.0$ to 3.6 V)
: $t_{pd} = 3.0$ ns (max) ($V_{CC} = 2.3$ to 2.7 V)
: $t_{pd} = 6.0$ ns (max) ($V_{CC} = 1.8$ V)
- Output current: $I_{OH}/I_{OL} = \pm 24$ mA (min) ($V_{CC} = 3.0$ V)
: $I_{OH}/I_{OL} = \pm 18$ mA (min) ($V_{CC} = 2.3$ V)
: $I_{OH}/I_{OL} = \pm 6$ mA (min) ($V_{CC} = 1.8$ V)
- Latch-up performance: -300 mA
- ESD performance: Machine model $\geq \pm 200$ V
Human body model $\geq \pm 2000$ V
- Package: TSSOP
- 3.6-V tolerant function and power-down protection control inputs and outputs

Pin Assignment (top view)



IEC Logic Symbol



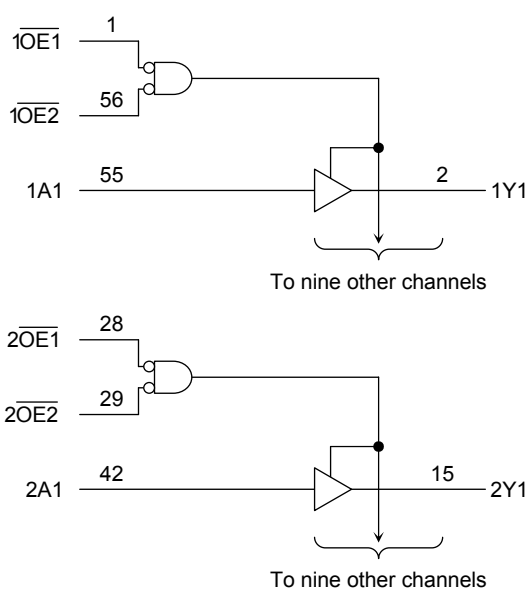
Truth Table (each 10-bit latch)

| Input | | | Output Y |
|------------------|------------------|---|-------------|
| $\overline{OE1}$ | $\overline{OE2}$ | A | |
| L | L | L | L |
| L | L | H | H |
| H | X | X | Z |
| X | H | X | Z |

X: Don't care

Z: High impedance

System Diagram



Absolute Maximum Ratings (Note 1)

| Characteristics | | Symbol | Rating | Unit |
|--|---------------------|------------------|------------------------------------|------|
| Power supply voltage | | V_{CC} | -0.5 to 4.6 | V |
| DC input voltage | (\overline{OE}) | V_{IN} | -0.5 to 4.6 | V |
| | (An) | | -0.5 to $V_{CC} + 0.5$ | |
| DC output voltage | | V_{OUT} | -0.5 to 4.6 (Note 2) | V |
| | | | -0.5 to $V_{CC} + 0.5$ (Note 3) | |
| Input diode current | | I_{IK} | -50 | mA |
| Output diode current | | I_{OK} | ± 50 (Note 4) | mA |
| Output current | | I_{OUT} | ± 50 | mA |
| Power dissipation | | P_D | 400 | mW |
| DC V_{CC} /ground current per supply pin | | I_{CC}/I_{GND} | ± 100 | mA |
| Storage temperature | | T_{stg} | -65 to 150 | °C |

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 2: OFF state

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

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

Operating Ranges (Note 1) (Note 2)

| Characteristics | | Symbol | Rating | Unit |
|--------------------------|---------------------|-----------------|------------------------|------|
| Power supply voltage | | V_{CC} | 1.8 to 3.6 | V |
| | | | 1.2 to 3.6 (Note 3) | |
| Input voltage | (\overline{OE}) | V_{IN} | -0.3 to 3.6 | V |
| | (An) | | 0 to V_{CC} | |
| Output voltage | | V_{OUT} | 0 to 3.6 (Note 4) | V |
| | | | 0 to V_{CC} (Note 5) | |
| Output current | | I_{OH}/I_{OL} | ± 24 (Note 6) | mA |
| | | | ± 18 (Note 7) | |
| | | | ± 6 (Note 8) | |
| Operating temperature | | T_{opr} | -40 to 85 | °C |
| Input rise and fall time | | dt/dv | 0 to 10 (Note 9) | ns/V |

Note 1: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either V_{CC} or GND.

Note 2: Floating or unused control inputs must be held high or low.

Note 3: Data retention

Note 4: OFF state

Note 5: High or low state

Note 6: $V_{CC} = 3.0$ to 3.6 V

Note 7: $V_{CC} = 2.3$ to 2.7 V

Note 8: $V_{CC} = 1.8$ V

Note 9: $V_{IN} = 0.8$ to 2.0 V, $V_{CC} = 3.0$ V

Electrical Characteristics

DC Characteristics (Ta = -40 to 85°C, 2.7 V < V_{CC} ≤ 3.6 V)

| Characteristics | | Symbol | Test Condition | | V _{CC} (V) | Min | Max | Unit |
|--|-----------------------|---|--|---------------------------|---------------------|-----------------------|------|------|
| | | | | | | | | |
| Input voltage | H-level | V _{IH} | — | | 2.7 to 3.6 | 2.0 | — | V |
| | L-level | V _{IL} | — | | 2.7 to 3.6 | — | 0.8 | |
| Output voltage | H-level | V _{OH} | V _{IN} = V _{IH} or V _{IL} | I _{OH} = -100 μA | 2.7 to 3.6 | V _{CC} - 0.2 | — | V |
| | | | | I _{OH} = -12 mA | 2.7 | 2.2 | — | |
| | | | | I _{OH} = -18 mA | 3.0 | 2.4 | — | |
| | | | | I _{OH} = -24 mA | 3.0 | 2.2 | — | |
| | L-level | V _{OL} | V _{IN} = V _{IH} or V _{IL} | I _{OL} = 100 μA | 2.7 to 3.6 | — | 0.2 | |
| | | | | I _{OL} = 12 mA | 2.7 | — | 0.4 | |
| | | | | I _{OL} = 18 mA | 3.0 | — | 0.4 | |
| | | | | I _{OL} = 24 mA | 3.0 | — | 0.55 | |
| Input leakage current | (\overline{OE}) | I _{IN} | V _{IN} = 0 to 3.6 V | | 2.7 to 3.6 | — | ±5.0 | μA |
| | (An) | | V _{IN} = V _{CC} or GND | | 2.7 to 3.6 | — | ±5.0 | |
| Bushold input minimum drive hold current | I _I (HOLD) | V _{IN} = 0.8 V | | 3.0 | 75 | — | μA | |
| | | V _{IN} = 2.0 V | | 3.0 | -75 | — | | |
| Bushold input over-drive current to change state | I _I (OD) | (Note 1) | | 3.6 | — | 450 | μA | |
| | | (Note 2) | | 3.6 | — | -450 | | |
| 3-state output OFF state current | I _{OZ} | V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0 to 3.6 V | | 2.7 to 3.6 | — | ±10.0 | μA | |
| Power-off leakage current | I _{OFF} | V _{OUT} = 0 to 3.6 V | | 0 | — | 10.0 | μA | |
| Quiescent supply current | I _{CC} | V _{IN} = V _{CC} or GND | | 2.7 to 3.6 | — | 20.0 | μA | |
| | | V _{CC} ≤ V _{OUT} ≤ 3.6 V (Note 3) | | 2.7 to 3.6 | — | ±20.0 | | |
| Increase in I _{CC} per input | ΔI _{CC} | V _{IH} = V _{CC} - 0.6 V | | 2.7 to 3.6 | — | 750 | μA | |

Note 1: An external driver must source at least the specified current to switch LOW-to-HIGH.

Note 2: An external driver must sink at least the specified current to switch HIGH-to-LOW.

Note 3: Outputs high impedance only.

DC Characteristics (Ta = -40 to 85°C, 2.3 V ≤ VCC ≤ 2.7 V)

| Characteristics | | Symbol | Test Condition | | VCC (V) | Min | Max | Unit |
|--|---------------------|-----------------------|---|---------------------------|------------|-----------------------|-----|------|
| | | | | | | | | |
| Input voltage | H-level | V _{IH} | — | | 2.3 to 2.7 | 1.6 | — | V |
| | L-level | V _{IL} | — | | 2.3 to 2.7 | — | 0.7 | |
| Output voltage | H-level | V _{OH} | V _{IN} = V _{IH} or V _{IL} | I _{OH} = -100 μA | 2.3 to 2.7 | V _{CC} - 0.2 | — | V |
| | | | | I _{OH} = -6 mA | 2.3 | 2.0 | — | |
| | | | | I _{OH} = -12 mA | 2.3 | 1.8 | — | |
| | L-level | V _{OL} | V _{IN} = V _{IH} or V _{IL} | I _{OL} = 100 μA | 2.3 to 2.7 | — | 0.2 | |
| | | | | I _{OL} = 12 mA | 2.3 | — | 0.4 | |
| | | | | I _{OL} = 18 mA | 2.3 | — | 0.6 | |
| Input leakage current | (\overline{OE}) | I _{IN} | V _{IN} = 0 to 3.6 V | 2.3 to 2.7 | — | ±5.0 | μA | |
| | (An) | | V _{IN} = V _{CC} or GND | 2.3 to 2.7 | — | ±5.0 | | |
| Bushold input minimum drive hold current | | I _I (HOLD) | V _{IN} = 0.7 V | 2.3 | 45 | — | μA | |
| | | | V _{IN} = 1.6 V | 2.3 | -45 | — | | |
| Bushold input over-drive current to change state | | I _I (OD) | (Note 1) | 2.7 | — | 300 | μA | |
| | | | (Note 2) | 2.7 | — | -300 | | |
| 3-state output OFF state current | | I _{OZ} | V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0 to 3.6 V | 2.3 to 2.7 | — | ±10.0 | μA | |
| Power-off leakage current | | I _{OFF} | V _{OUT} = 0 to 3.6 V | 0 | — | 10.0 | μA | |
| Quiescent supply current | | I _{CC} | V _{IN} = V _{CC} or GND | 2.3 to 2.7 | — | 20.0 | μA | |
| | | | V _{CC} ≤ V _{OUT} ≤ 3.6 V (Note 3) | 2.3 to 2.7 | — | ±20.0 | | |

Note 1: An external driver must source at least the specified current to switch LOW-to-HIGH.

Note 2: An external driver must sink at least the specified current to switch HIGH-to-LOW.

Note 3: Outputs high impedance only.

DC Characteristics (Ta = -40 to 85°C, 1.8 V ≤ VCC < 2.3 V)

| Characteristics | | Symbol | Test Condition | | VCC (V) | Min | Max | Unit |
|--|----------------------------|---|--|---------------------------|------------|-----------------------|-----------------------|------|
| | | | | | | | | |
| Input voltage | H-level | V _{IH} | — | | 1.8 to 2.3 | 0.7 × V _{CC} | — | V |
| | L-level | V _{IL} | — | | 1.8 to 2.3 | — | 0.2 × V _{CC} | |
| Output voltage | H-level | V _{OH} | V _{IN} = V _{IH} or V _{IL} | I _{OH} = -100 μA | 1.8 | V _{CC} - 0.2 | — | V |
| | | | | I _{OH} = -6 mA | 1.8 | 1.4 | — | |
| | L-level | V _{OL} | V _{IN} = V _{IH} or V _{IL} | I _{OL} = 100 μA | 1.8 | — | 0.2 | |
| | | | | I _{OL} = 6 mA | 1.8 | — | 0.3 | |
| Input leakage current | ($\overline{\text{OE}}$) | I _{IN} | V _{IN} = 0 to 3.6 V | | 1.8 | — | ±5.0 | μA |
| | (An) | | V _{IN} = V _{CC} or GND | | 1.8 | — | ±5.0 | |
| Bushold input minimum drive hold current | I _I (HOLD) | V _{IN} = 0.36 V | | 1.8 | 25 | — | μA | |
| | | V _{IN} = 1.26 V | | 1.8 | -25 | — | | |
| Bushold input over-drive current to change state | I _I (OD) | (Note 1) | | 1.8 | — | 200 | μA | |
| | | (Note 2) | | 1.8 | — | -200 | | |
| 3-state output OFF state current | I _{OZ} | V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0 to 3.6 V | | 1.8 | — | ±10.0 | μA | |
| Power-off leakage current | I _{OFF} | V _{OUT} = 0 to 3.6 V | | 0 | — | 10.0 | μA | |
| Quiescent supply current | I _{CC} | V _{IN} = V _{CC} or GND | | 1.8 | — | 20.0 | μA | |
| | | V _{CC} ≤ V _{OUT} ≤ 3.6 V (Note 3) | | 1.8 | — | ±20.0 | | |

Note 1: An external driver must source at least the specified current to switch LOW-to-HIGH.

Note 2: An external driver must sink at least the specified current to switch HIGH-to-LOW.

Note 3: Outputs high impedance only.

AC Characteristics (Ta = -40 to 85°C, input: t_r = t_f = 2.0 ns, C_L = 30 pF, R_L = 500 Ω) (Note 1)

| Characteristics | | Symbol | Test Condition | | VCC (V) | Min | Max | Unit |
|-----------------------------|--|--------------------|----------------|--|---------|-----|-----|------|
| | | | | | | | | |
| Propagation delay time | t _{pLH} t _{pHL} | Figure 1, Figure 2 | 1.8 | | 1.8 | 1.5 | 6.0 | ns |
| | | | 2.5 ± 0.2 | | 1.0 | 3.0 | | |
| | | | 3.3 ± 0.3 | | 0.8 | 2.5 | | |
| 3-state output enable time | t _{pZL} t _{pZH} | Figure 1, Figure 3 | 1.8 | | 1.8 | 1.5 | 9.8 | ns |
| | | | 2.5 ± 0.2 | | 1.0 | 4.9 | | |
| | | | 3.3 ± 0.3 | | 0.8 | 3.8 | | |
| 3-state output disable time | t _{pLZ} t _{pHZ} | Figure 1, Figure 3 | 1.8 | | 1.8 | 1.5 | 7.6 | ns |
| | | | 2.5 ± 0.2 | | 1.0 | 4.2 | | |
| | | | 3.3 ± 0.3 | | 0.8 | 3.7 | | |
| Output to output skew | t _{osLH} t _{osHL} | (Note 2) | 1.8 | | 1.8 | — | 0.5 | ns |
| | | | 2.5 ± 0.2 | | — | 0.5 | | |
| | | | 3.3 ± 0.3 | | — | 0.5 | | |

Note 1: For C_L = 50 pF, add approximately 300 ps to the AC maximum specification.

Note 2: Parameter guaranteed by design.

$$(t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|)$$

Dynamic Switching Characteristics

($T_a = 25^\circ\text{C}$, input: $t_r = t_f = 2.0 \text{ ns}$, $C_L = 30 \text{ pF}$, $R_L = 500 \Omega$)

| Characteristics | Symbol | Test Condition | V _{CC} (V) | Typ. | Unit |
|--|------------------|---|---------------------|-------|------|
| | | | | | |
| Quiet output maximum dynamic V _{OL} | V _{OLP} | V _{IH} = 1.8 V, V _{IL} = 0 V (Note) | 1.8 | 0.25 | V |
| | | V _{IH} = 2.5 V, V _{IL} = 0 V (Note) | 2.5 | 0.6 | |
| | | V _{IH} = 3.3 V, V _{IL} = 0 V (Note) | 3.3 | 0.8 | |
| Quiet output minimum dynamic V _{OL} | V _{OLV} | V _{IH} = 1.8 V, V _{IL} = 0 V (Note) | 1.8 | -0.25 | V |
| | | V _{IH} = 2.5 V, V _{IL} = 0 V (Note) | 2.5 | -0.6 | |
| | | V _{IH} = 3.3 V, V _{IL} = 0 V (Note) | 3.3 | -0.8 | |
| Quiet output minimum dynamic V _{OH} | V _{OHV} | V _{IH} = 1.8 V, V _{IL} = 0 V (Note) | 1.8 | 1.5 | V |
| | | V _{IH} = 2.5 V, V _{IL} = 0 V (Note) | 2.5 | 1.9 | |
| | | V _{IH} = 3.3 V, V _{IL} = 0 V (Note) | 3.3 | 2.2 | |

Note: Parameter guaranteed by design.

Capacitive Characteristics ($T_a = 25^\circ\text{C}$)

| Characteristics | Symbol | Test Condition | V _{CC} (V) | Typ. | Unit |
|-------------------------------|------------------|---------------------------------|---------------------|------|------|
| | | | | | |
| Input capacitance | C _{IN} | — | 1.8, 2.5, 3.3 | 6 | pF |
| Output capacitance | C _{OUT} | — | 1.8, 2.5, 3.3 | 7 | pF |
| Power dissipation capacitance | C _{PD} | f _{IN} = 10 MHz (Note) | 1.8, 2.5, 3.3 | 20 | pF |

Note: C_{PD} 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:

$$I_{CC(\text{opr})} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/20 \text{ (per bit)}$$

AC Test Circuit

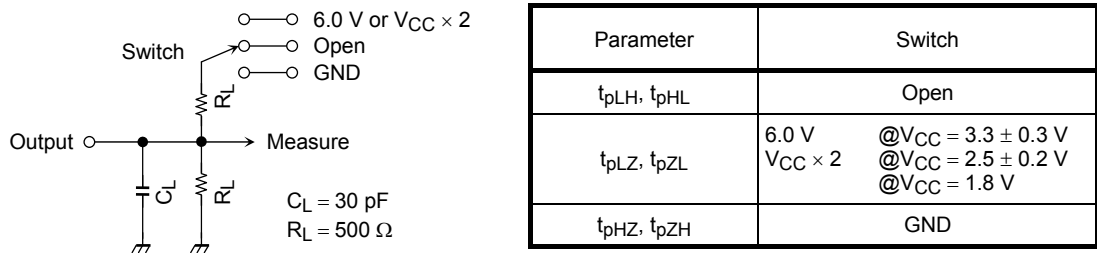


Figure 1

AC Waveform

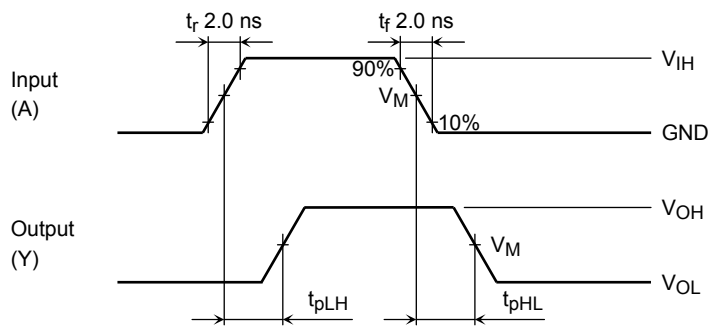


Figure 2 t_{pLH}, t_{pHL}

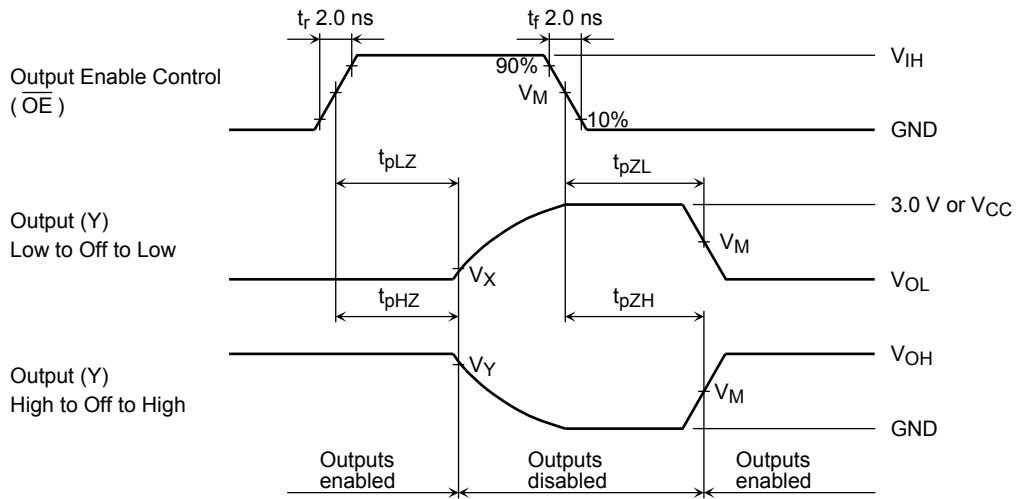


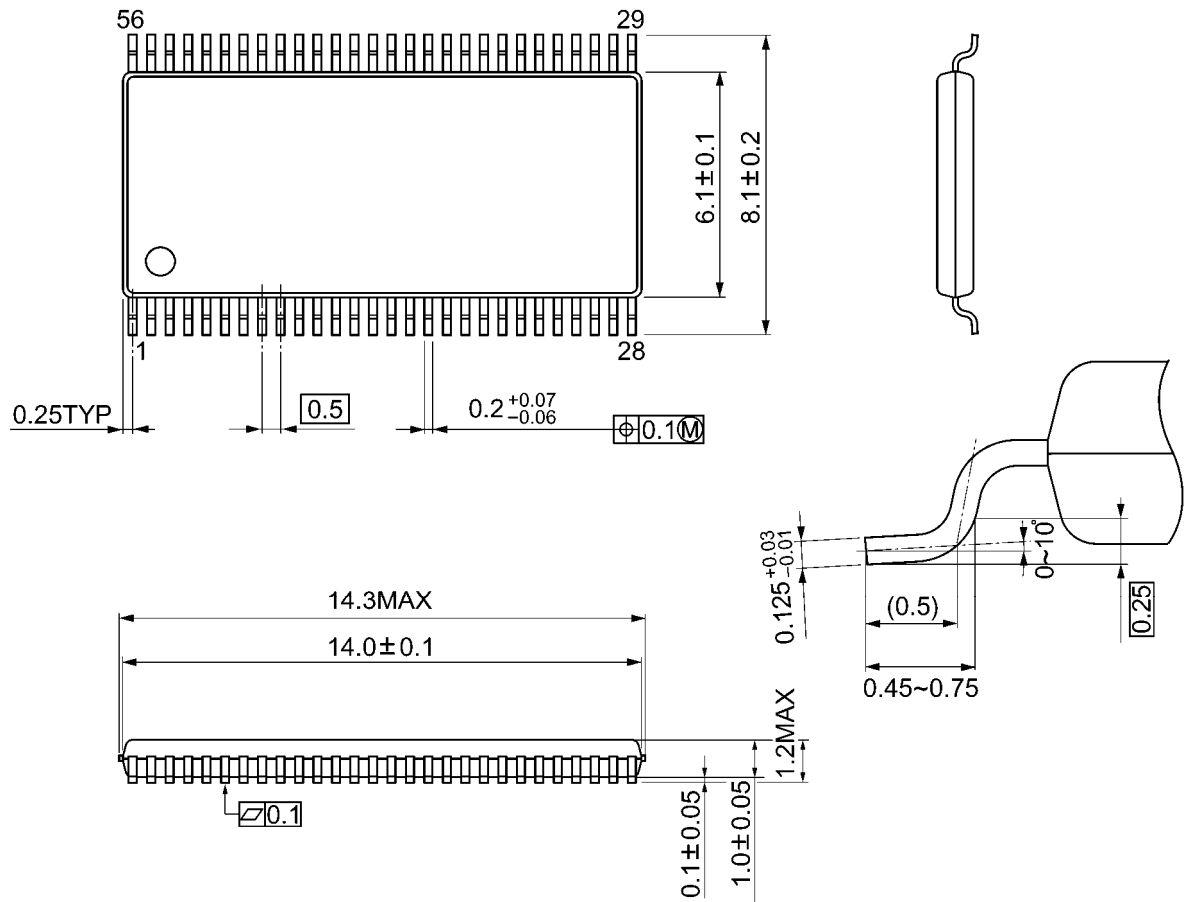
Figure 3 t_{pLZ} , t_{pHZ} , t_{pZL} , t_{pZH}

| Symbol | V_{CC} | | |
|----------|------------------|-------------------|-------------------|
| | 3.3 ± 0.3 V | 2.5 ± 0.2 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 | $V_{OL} + 0.3$ V | $V_{OL} + 0.15$ V | $V_{OL} + 0.15$ V |
| V_Y | $V_{OH} - 0.3$ V | $V_{OH} - 0.15$ V | $V_{OH} - 0.15$ V |

Package Dimensions

TSSOP56-P-0061-0.50A

Unit: mm



Weight: 0.25 g (typ.)

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