

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74LCX16374AFT

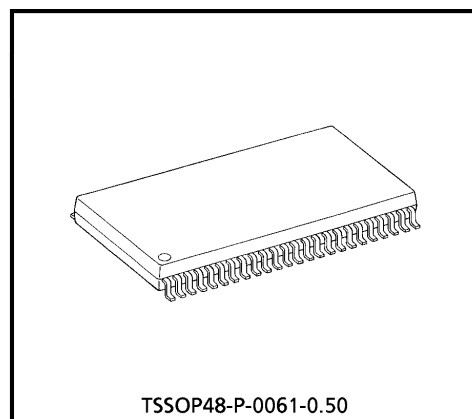
LOW-VOLTAGE 16-BIT D-TYPE FLIP-FLOP WITH 5V TOLERANT INPUTS AND OUTPUTS

The TC74LCX16374AFT is a high performance CMOS 16bit D-TYPE FLIP FLOP. Designed for use in 3.3 Volt systems, it achieves high speed operation while maintaining the CMOS low power dissipation.

The device is designed for low-voltage (3.3V) V_{CC} applications, but it could be used to interface to 5V supply environment for both inputs and outputs.

This 16-bit D-type flip-flop is controlled by a clock input (CK) and a output enable input (\overline{OE}) which are common to each byte. It can be used as two 8-bit flip-flops or one 16-bit flip-flop. When the \overline{OE} input is high, the outputs are in a high impedance state.

All inputs are equipped with protection circuits against static discharge.

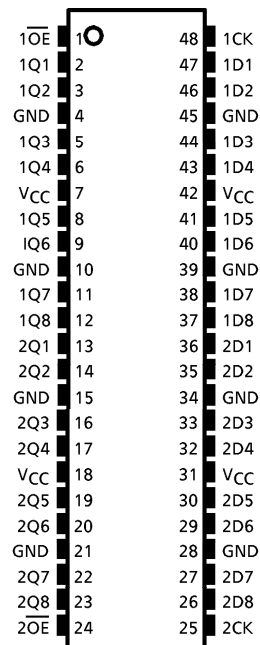


Weight : 0.25g (Typ.)

FEATURES

- Low Voltage Operation : $V_{CC} = 2.0 \sim 3.6V$
- High Speed Operation : $t_{pd} = 7.0ns$ (max.) at $V_{CC} = 3.0 \sim 3.6V$
- Output Current : $|I_{OH}| / I_{OL} = 24mA$ (min.) at $V_{CC} = 3.0V$
- Latch-up Performance : $\pm 500mA$
- Package : TSSOP
(Thin Shrink Small Outline Package)
- Power Down Protection is provided on all inputs and outputs.

PIN CONNECTION



(TOP VIEW)

961001EBA2

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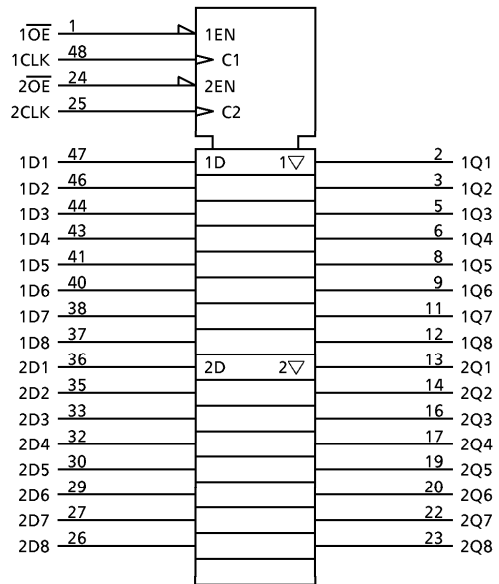
TRUTH TABLE

| INPUT | | | OUTPUT |
|-------|-----|---------|---------|
| 1OE | 1CK | 1D1-1D8 | 1Q1-1Q8 |
| H | X | X | Z |
| L | | X | Qn |
| L | | L | L |
| L | | H | H |

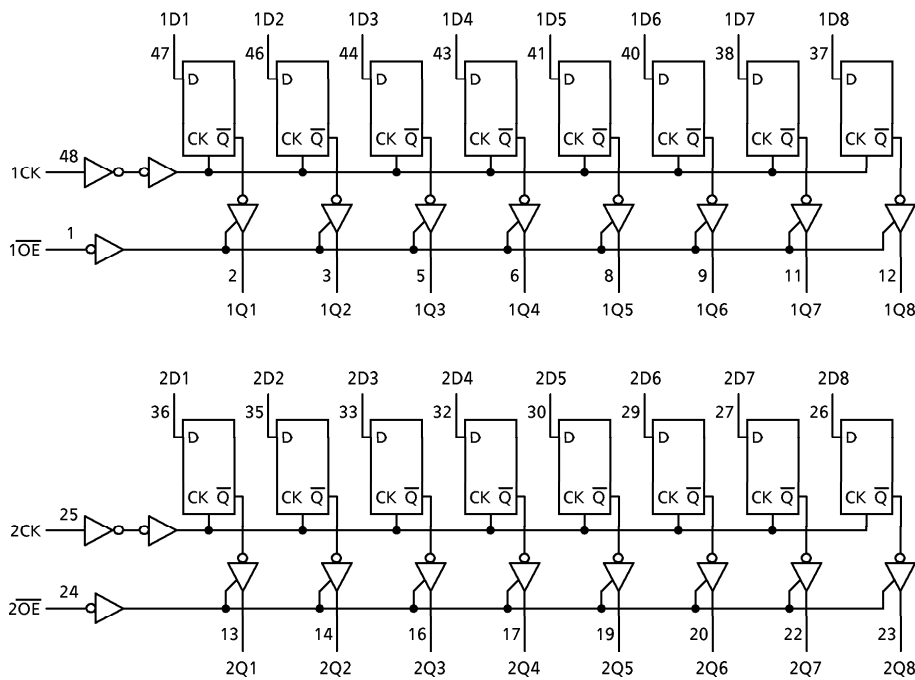
| INPUT | | | OUTPUT |
|-------|-----|---------|---------|
| 2OE | 2CK | 2D1-2D8 | 2Q1-2Q8 |
| H | X | X | Z |
| L | | X | Qn |
| L | | L | L |
| L | | H | H |

X : Don't Care
 Z : High impedance
 Qn : No change

IEC LOGIC SYMBOL



SYSTEM DIAGRAM



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- The information contained herein is subject to change without notice.

MAXIMUM RATINGS

| PARAMETER | SYMBOL | RATING | UNIT |
|--|------------------|------------------------------|------|
| Power Supply Voltage | V_{CC} | -0.5~7.0 | V |
| Input Voltage | V_{IN} | -0.5~7.0 | V |
| Output Voltage | V_{OUT} | -0.5~7.0 (Note 1) | V |
| | | -0.5~ V_{CC} +0.5 (Note 2) | |
| Input Diode Current | I_{IK} | -50 | mA |
| Output Diode Current | I_{OK} | ±50 (Note 3) | mA |
| DC 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} | -65~150 | °C |

(Note 1) Output in Off-State

(Note 2) High or Low State. I_{OUT} absolute maximum rating must be observed.

(Note 3) $V_{OUT} < GND$, $V_{OUT} > V_{CC}$

RECOMMENDED OPERATING RANGE

| PARAMETER | SYMBOL | RATING | UNIT |
|--------------------------|-----------------|----------------------|------|
| Supply Voltage | V_{CC} | 2.0~3.6 | V |
| | | 1.5~3.6 (Note 4) | |
| Input Voltage | V_{IN} | 0~5.5 | V |
| Output Voltage | V_{OUT} | 0~5.5 (Note 5) | V |
| | | 0~ V_{CC} (Note 6) | |
| Output Current | I_{OH}/I_{OL} | ±24 (Note 7) | mA |
| | | ±12 (Note 8) | |
| Operating Temperature | T_{opr} | -40~85 | °C |
| Input Rise And Fall Time | dt/dv | 0~10 (Note 9) | ns/V |

(Note 4) Data Retention Only

(Note 5) Output in Off-State

(Note 6) High or Low State

(Note 7) $V_{CC} = 3.0\sim 3.6V$

(Note 8) $V_{CC} = 2.7\sim 3.0V$

(Note 9) $V_{IN} = 0.8\sim 2.0V$, $V_{CC} = 3.0V$

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = -40~85°C)

| PARAMETER | | SYMBOL | TEST CONDITION | V _{CC} (V) | MIN. | MAX. | UNIT | |
|---------------------------------------|-----------|------------------|---|--------------------------|---------|-----------------------|------|---|
| | | | | | | | | |
| Input Voltage | "H" Level | V _{IH} | | 2.7~3.6 | 2.0 | — | V | |
| | "L" Level | V _{IL} | | 2.7~3.6 | — | 0.8 | V | |
| Output Voltage | "H" Level | V _{OH} | V _{IN} = V _{IH} or V _{IL} | I _{OH} = -100μA | 2.7~3.6 | V _{CC} - 0.2 | — | V |
| | | | | I _{OH} = -12μA | 2.7 | 2.2 | — | |
| | | | | I _{OH} = -18mA | 3.0 | 2.4 | — | |
| | | | | I _{OH} = -24mA | 3.0 | 2.2 | — | |
| | "L" Level | V _{OL} | V _{IN} = V _{IH} or V _{IL} | I _{OL} = 100μA | 2.7~3.6 | — | 0.2 | V |
| | | | | I _{OL} = 12mA | 2.7 | — | 0.4 | |
| | | | | I _{OL} = 16mA | 3.0 | — | 0.4 | |
| | | | | I _{OL} = 24mA | 3.0 | — | 0.55 | |
| Input Leakage Current | | I _{IN} | V _{IN} = 0~5.5V | 2.7~3.6 | — | ±5.0 | μA | |
| 3-State Output Off-State Current | | I _{OZ} | V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0~5.5V | 2.7~3.6 | — | ±5.0 | μA | |
| Power Off Leakage Current | | I _{OFF} | V _{IN} / V _{OUT} = 5.5V | 0 | — | 10.0 | μA | |
| Quiescent Supply Current | | I _{CC} | V _{IN} = V _{CC} or GND | 2.7~3.6 | — | 20.0 | μA | |
| | | | V _{IN} / V _{OUT} = 3.6~5.5V | 2.7~3.6 | — | ±20.0 | | |
| Increase In I _{CC} Per Input | | ΔI _{CC} | V _{IH} = V _{CC} - 0.6V | 2.7~3.6 | — | 500 | μA | |

AC characteristics (Ta = -40~85°C)

| PARAMETER | SYMBOL | TEST CONDITION | V _{CC} (V) | MIN. | MAX. | UNIT |
|---------------------------------|--|----------------|---------------------|------|------|------|
| | | | | | | |
| Maximam Clock Frequency | f _{MAX} | (Fig.1, 2) | 2.7 | — | — | MHz |
| | | | 3.3 ± 0.3 | 170 | — | |
| Propagation Delay Time (CK - Q) | t _{pLH} t _{pHL} | (Fig.1, 2) | 2.7 | — | 8.0 | ns |
| | | | 3.3 ± 0.3 | 1.5 | 7.0 | |
| 3-State Output Enable Time | t _{pZL} t _{pZH} | (Fig.1, 3) | 2.7 | — | 8.2 | ns |
| | | | 3.3 ± 0.3 | 1.5 | 7.2 | |
| 3-State Output Disable Time | t _{pLZ} t _{pHZ} | (Fig.1, 3) | 2.7 | — | 8.2 | ns |
| | | | 3.3 ± 0.3 | 1.5 | 7.2 | |
| Minimum Pulse Width (CK) | t _w (H) t _w (L) | (Fig.1, 2) | 2.7 | 4.0 | — | ns |
| | | | 3.3 ± 0.3 | 3.0 | — | |
| Minimum Set-up Time | t _s | (Fig.1, 2) | 2.7 | 2.5 | — | ns |
| | | | 3.3 ± 0.3 | 2.5 | — | |
| Minimum Hold Time | t _h | (Fig.1, 2) | 2.7 | 1.5 | — | ns |
| | | | 3.3 ± 0.3 | 1.5 | — | |
| Output To Output Skew | t _{osLH} t _{osHL} | (Note 10) | 2.7 | — | — | ns |
| | | | 3.3 ± 0.3 | — | 1.0 | |

(Note 10) 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 = 2.5ns, C_L = 50pF, R_L = 500Ω)

| PARAMETER | SYMBOL | TEST CONDITION | V _{CC} (V) | TYP | UNIT |
|--|------------------|--|---------------------|-----|------|
| | | | | | |
| Quiet Output Maximum Dynamic V _{OL} | V _{OLP} | V _{IH} = 3.3V, V _{IL} = 0V | 3.3 | 0.8 | V |
| Quiet Output Minimum Dynamic V _{OL} | V _{OLV} | V _{IH} = 3.3V, V _{IL} = 0V | 3.3 | 0.8 | V |

Capacitive characteristics (Ta = 25°C)

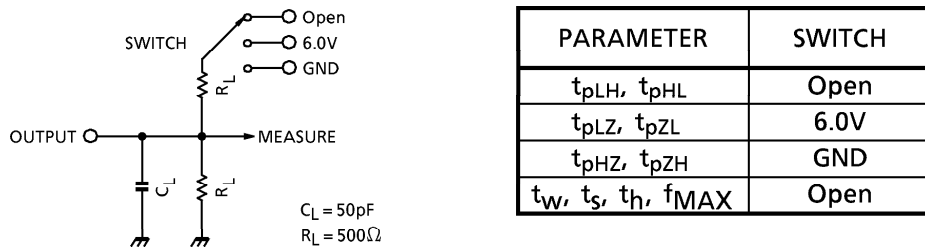
| PARAMETER | SYMBOL | TEST CONDITION | V _{CC} (V) | TYP | UNIT |
|-------------------------------|------------------|----------------|-------------------------|-----|------|
| | | | | | |
| Input Capacitance | C _{IN} | — (Note 11) | 3.3 | 7 | pF |
| Output Capacitance | C _{OUT} | | 3.3 | 8 | pF |
| Power Dissipation Capacitance | C _{PD} | | f _{IN} = 10MHz | 3.3 | 25 |

(Note 11) 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 :

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

Fig.1 Test circuit



AC WAVEFORM

Fig.2 $t_{pLH}, t_{pHL}, t_w, t_s, t_h$

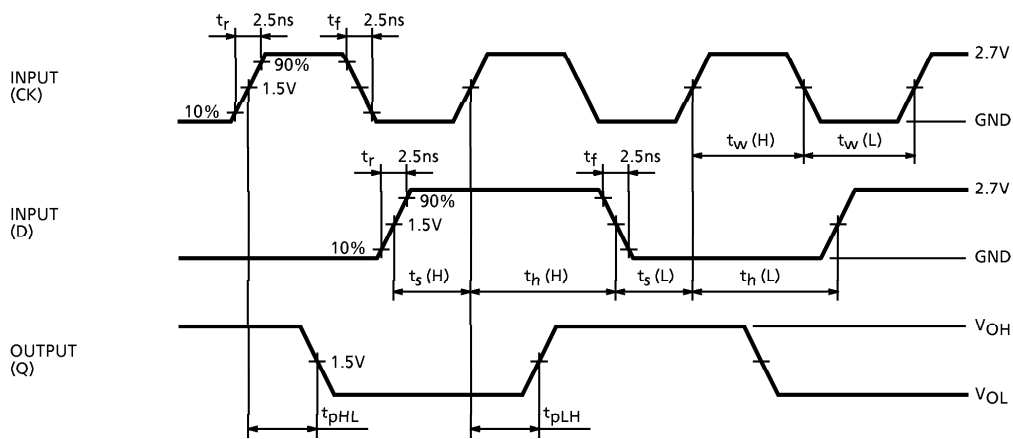
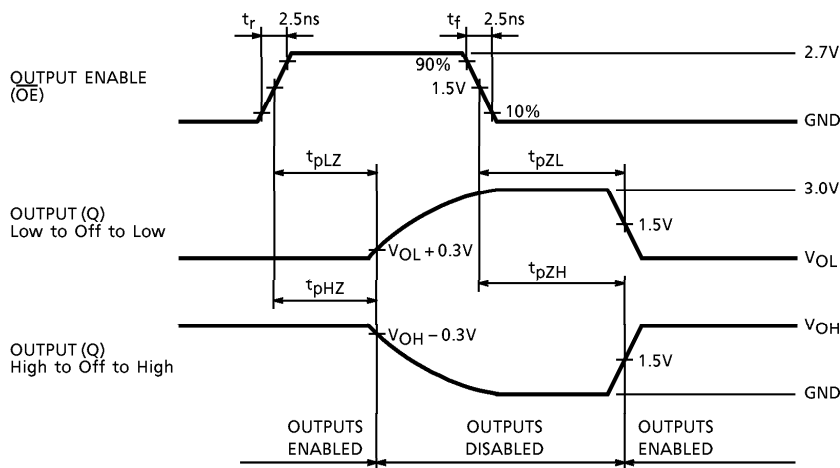


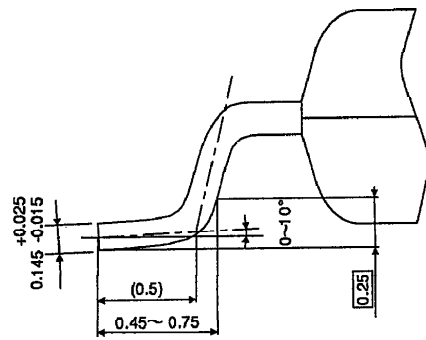
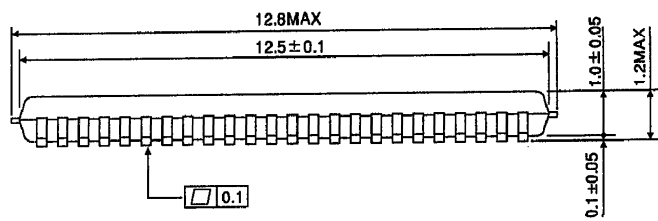
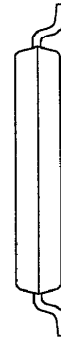
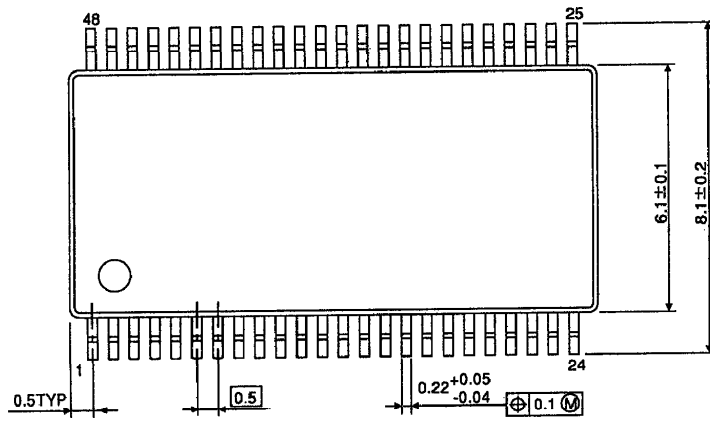
Fig.3 $t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}$



OUTLINE DRAWING

TSSOP48-P-0061-0.50

Unit : mm



Weight : 0.25g (Typ.)