

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74LCX16245AFT

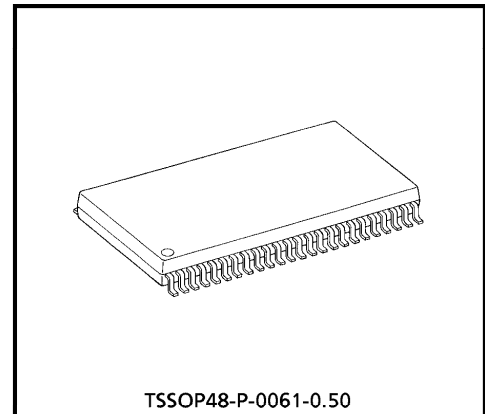
LOW-VOLTAGE 16-BIT BUS TRANSCEIVER WITH 5V TOLERANT INPUTS AND OUTPUTS

The TC74LCX16245AFT is a high performance CMOS 16bit BUS TRANSCEIVER. 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 16bit bus transceiver is controlled by direction control (DIR) inputs and output enable (\overline{OE}) inputs which are common to each byte. It can be used as two 8bit transceiver or one 16bit transceiver. The direction of data transmission is determined by the level of the DIR inputs. The \overline{OE} inputs can be used to disable the device so that the busses are effectively isolated.

All inputs are equipped with protection circuits against static discharge.



Weight : 0.25g (Typ.)

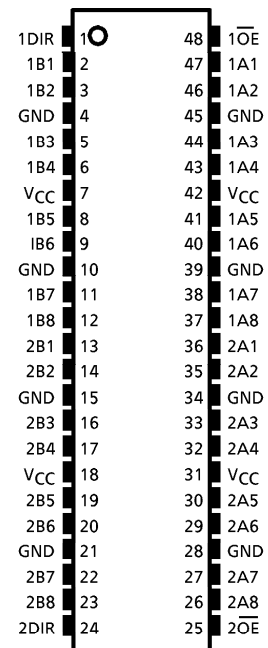
FEATURES

- Low Voltage Operation : $V_{CC} = 2.0 \sim 3.6V$
- High Speed Operation : $t_{pd} = 5.2 \text{ ns (max.)}$ at $V_{CC} = 3.0 \sim 3.6V$
- Output Current : $|I_{OH}| / I_{OL} = 24\text{mA (MIN)}$ at $V_{CC} = 3.0V$
- Latch-up Performance : $\pm 500\text{mA}$
- Package : TSSOP
(Thin Shrink Small Outline Package)
- Bidirectional interface between 5V and 3.3V signals.
- Power Down Protection is provided on all inputs and outputs

NOTE

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

PIN CONNECTION



(TOP VIEW)

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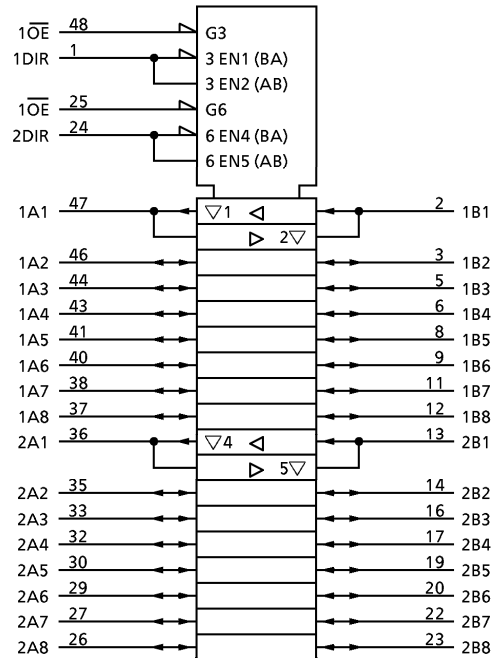
TRUTH TABLE

| INPUT | | FUNCTION | | OUTPUT |
|-------------------|------|----------------|-------------|--------|
| 1 \overline{OE} | 1DIR | BUS 1A1-1A8 | BUS 1B1-1B8 | |
| L | L | OUTPUT | INPUT | A = B |
| L | H | INPUT | OUTPUT | B = A |
| H | X | High Impedance | | Z |

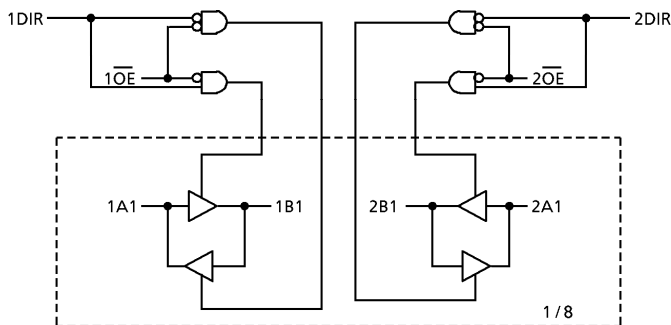
| INPUT | | FUNCTION | | OUTPUT |
|-------------------|------|----------------|-------------|--------|
| 2 \overline{OE} | 2DIR | BUS 2A1-2A8 | BUS 2B1-2B8 | |
| L | L | OUTPUT | INPUT | A = B |
| L | H | INPUT | OUTPUT | B = A |
| H | X | High Impedance | | Z |

X : Don't Care
Z : High impedance

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 |
| DC Input Voltage (DIR, \overline{OE}) | V_{IN} | -0.5~7.0 | V |
| DC Bus I/O Voltage | $V_{I/O}$ | -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 | $^{\circ}C$ |

(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 (DIR, \overline{OE}) | V_{IN} | 0~5.5 | V |
| Bus I/O Voltage | $V_{I/O}$ | 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 | $^{\circ}C$ |
| 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} = -12mA | 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 |
|-----------------------------|-------------------|----------------|---------------------|------|------|------|
| | | | | | | |
| Propagation Delay Time | t _{pLH} | (Fig.1, 2) | 2.7 | — | 6.2 | ns |
| | t _{pHL} | | 3.3 ± 0.3 | 1.5 | 5.2 | |
| 3-State Output Enable Time | t _{pZL} | (Fig.1, 3) | 2.7 | — | 7.5 | ns |
| | t _{pZH} | | 3.3 ± 0.3 | 1.5 | 6.5 | |
| 3-State Output Disable Time | t _{pLZ} | (Fig.1, 3) | 2.7 | — | 7.0 | ns |
| | t _{pHZ} | | 3.3 ± 0.3 | 1.5 | 6.0 | |
| Output To Output Skew | t _{osLH} | (Note 10) | 2.7 | — | — | ns |
| | t _{osHL} | | 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)

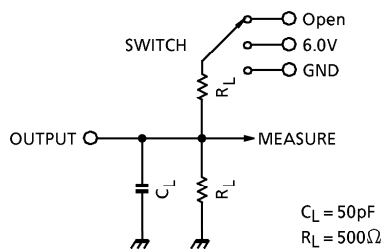
| PARAMETER | SYMBOL | TEST CONDITION | V _{CC} (V) | TYP | UNIT |
|-------------------------------|------------------|-----------------------------------|---------------------|-----|------|
| | | | | | |
| Input Capacitance | C _{IN} | DIR, OE | 3.3 | 7 | pF |
| Bus Input Capacitance | C _{I/O} | An, Bn | 3.3 | 8 | pF |
| Power Dissipation Capacitance | C _{PD} | f _{IN} = 10MHz (Note 11) | 3.3 | 25 | pF |

(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



| PARAMETER | SWITCH |
|--------------------|--------|
| t_{pLH}, t_{pHL} | Open |
| t_{pLZ}, t_{pZL} | 6.0V |
| t_{pHZ}, t_{pZH} | GND |

AC WAVEFORM

Fig.2 t_{pLH}, t_{pHL}

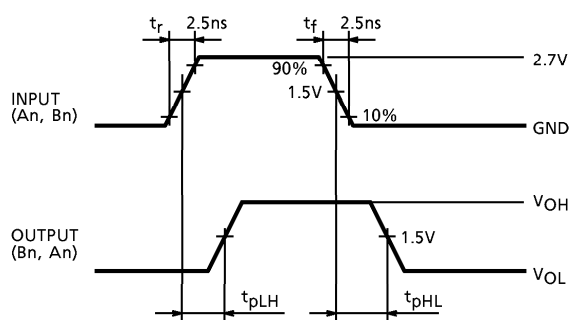
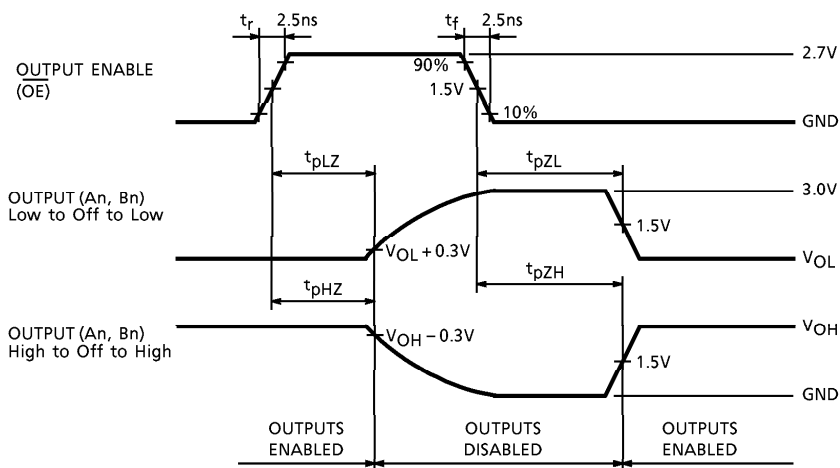


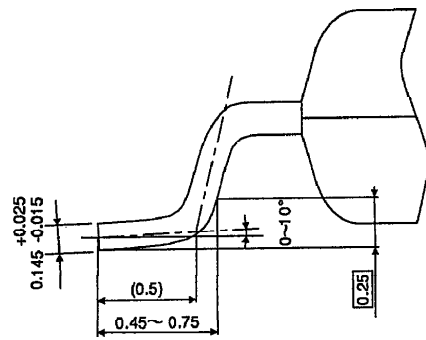
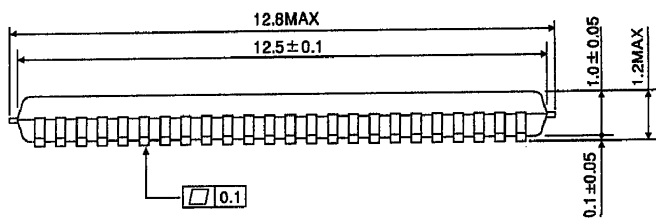
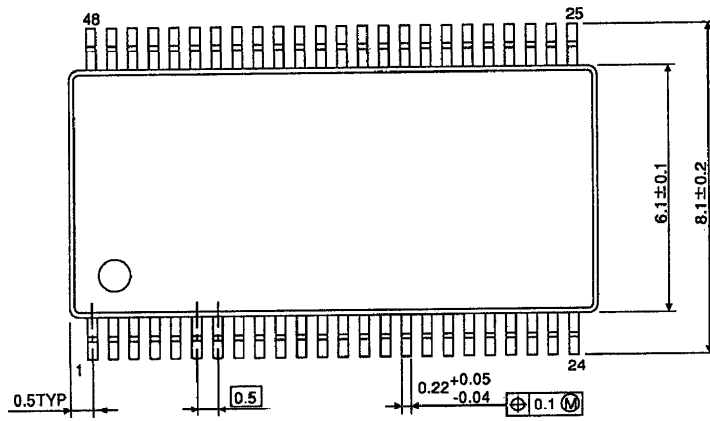
Fig.3 $t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}$



OUTLINE DRAWING

TSSOP48-P-0061-0.50

Unit : mm



Weight : 0.25g (Typ.)