

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74LCXR163245FT

16-Bit Dual Supply Bus Transceiver with Series Resistor

The TC74LCXR163245FT is a dual supply, advanced high-speed CMOS 16-bit dual supply voltage interface bus transceiver fabricated with silicon gate CMOS technology.

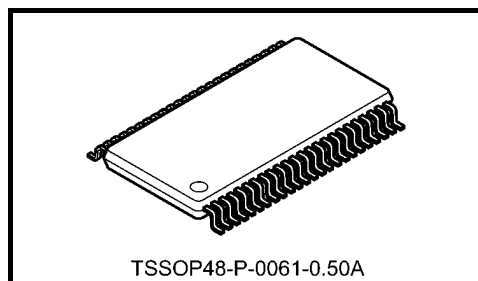
Designed for use as an interface between a 3.3-V or a 2.5-V bus and a 5-V bus in mixed 3.3-V or 2.5-V/5-V supply systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

It is intended for two-way asynchronous communication between data busses. The direction of data transmission is determined by the level of the DIR input. The enable input (\overline{OE}) can be used to disable the device so that the busses are effectively isolated.

The B-port interfaces with the 3.3 V or 2.5 V bus, the A-port with the 5 V bus.

The 26- Ω series resistor helps reducing output overshoot and undershoot without external resistor.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.



Weight: 0.25 g (typ.)

Features (Note 1) (Note 2)

- Bidirectional interface between 3.3 V or 2.5 V buses and 5 V buses
- 26- Ω series resistors on outputs
- High-speed operation: $t_{pd} = 8.5$ ns (max)
($V_{CCB} = 3.3 \pm 0.3$ V/ $V_{CCA} = 5 \pm 0.5$ V, $T_a = -40$ to 85°C)
- Low-voltage operation: $I_{CC} = 80$ μA (max) ($T_a = -40$ to 85°C)
- Symmetrical output impedance: $I_{OUTB} = \pm 12$ mA (min)
 $I_{OUTA} = \pm 12$ mA (min)
($V_{CCB} = 3.0$ V/ $V_{CCA} = 4.5$ V)
- Power-down protection provided on all inputs and outputs
- Allows A port and V_{CCA} to float simultaneously in high state at \overline{OE} pin
- Latch-up performance: -500 mA
- ESD performance: Machine model $> \pm 200$ V (Note 2)
- Package: TSSOP

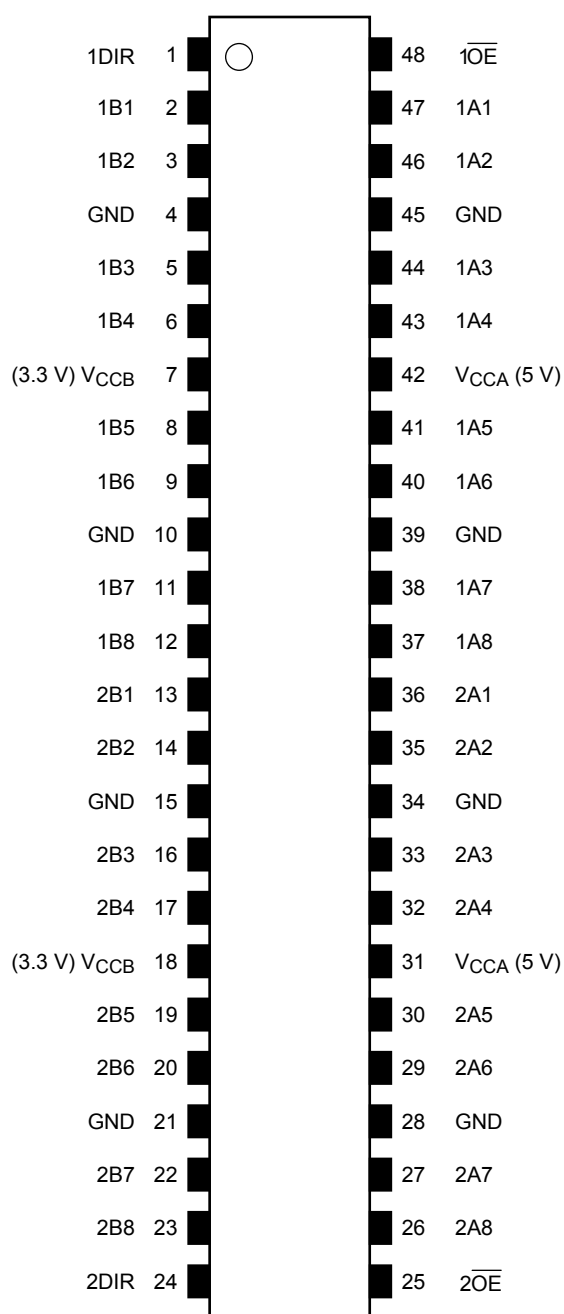
Note 1: Do not apply a signal to any bus pins when it is in the output mode. Damage may result.

All floating (high impedance) bus pins must have their input fixed by means of pull-up or pull-down resistors.

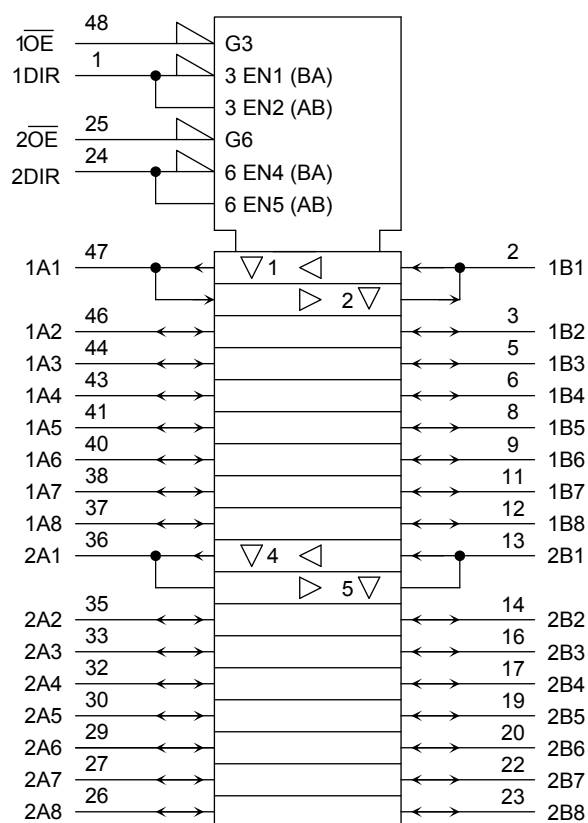
Note 2: This device is electrostatic sensitivity (human body model > 1 kV).

Please handle with caution.

Pin Assignment (top view)



IEC Logic Symbol



Truth Table

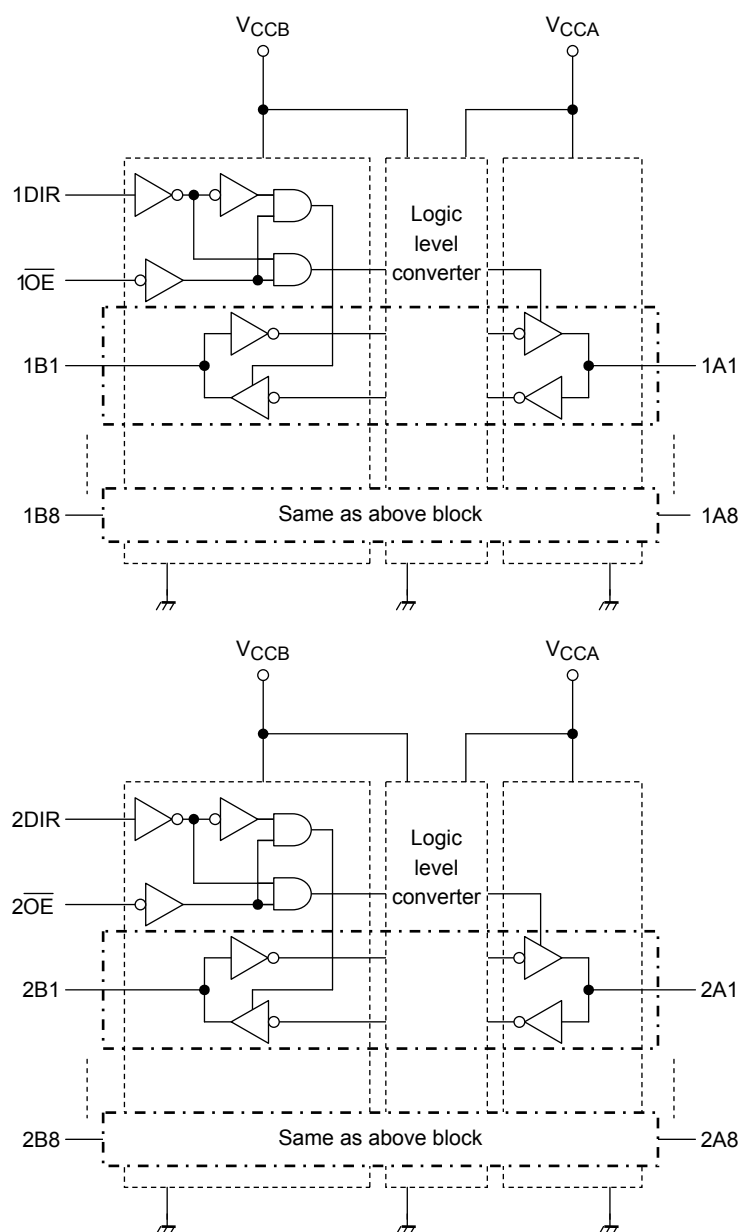
Inputs		Function		Outputs
$\overline{1OE}$	1DIR	Bus 1A1-1A8	Bus 1B1-1B8	
L	L	Output	Input	A = B
L	H	Input	Output	B = A
H	X	Z		Z

Inputs		Function		Outputs
$\overline{2OE}$	2DIR	Bus 2A1-2A8	Bus 2B1-2B8	
L	L	Output	Input	A = B
L	H	Input	Output	B = A
H	X	Z		Z

X: Don't care

Z: High impedance

Block Diagram



Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage (Note 2)	V_{CCB}	−0.5 to 7.0	V
	V_{CCA}	−0.5 to 7.0	
DC input voltage (DIR, \overline{OE})	V_{IN}	−0.5 to 7.0	V
DC bus I/O voltage	$V_{I/OB}$	−0.5 to 7.0 (Note 3)	V
		−0.5 to $V_{CCB} + 0.5$ (Note 4)	
	$V_{I/OA}$	−0.5 to 7.0 (Note 3)	
		−0.5 to $V_{CCA} + 0.5$ (Note 4)	
Input diode current	I_{IK}	−50	mA
Output diode current	$I_{I/OK}$	±50 (Note 5)	mA
DC output current	I_{OUTB}	±50	mA
	I_{OUTA}	±50	
DC V_{CC} /ground current per supply pin	I_{CCB}	±100	mA
	I_{CCA}	±100	
Power dissipation	P_D	400	mW
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: Don't supply a voltage to V_{CCA} terminal when V_{CCB} is in the OFF state.

Note 3: Output in OFF state

Note 4: High or low state. I_{OUT} absolute maximum rating must be observed.

Note 5: $V_{OUT} < GND$, $V_{OUT} > V_{CC}$

Operating Ranges (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CCB}	2.3 to 3.6	V
	V_{CCA}	4.5 to 5.5	
Input voltage (DIR, \overline{OE})	V_{IN}	0 to 5.5	V
DC bus I/O voltage	$V_{I/OB}$	0 to 5.5 (Note 2)	V
		0 to V_{CCB} (Note 3)	
	$V_{I/OA}$	0 to 5.5 (Note 2)	
		0 to V_{CCA} (Note 3)	
Output current	I_{OUTB}	± 12 (Note 4)	mA
		± 4 (Note 5)	
	I_{OUTA}	± 12 (Note 6)	
Operating temperature	T_{opr}	-40 to 85	°C
Input rise and fall time	dt/dv	0 to 10 (Note 7)	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 VCC or GND. Please connect both bus inputs and the bus outputs with VCC or GND when the I/O of the bus terminal changes by the function. In this case, please note that the output is not short-circuited.

Note 2: Output in OFF state

Note 3: High or low state

Note 4: $V_{CCB} = 3.0$ to 3.6 V

Note 5: $V_{CCB} = 2.3$ to 2.7 V

Note 6: $V_{CCA} = 4.5$ to 5.5 V

Note 7: $V_{INB} = 0.8$ to 2.0 V, $V_{CCB} = 3.0$ V
 $V_{INA} = 0.8$ to 2.0 V, $V_{CCA} = 5.0$ V

Electrical Characteristics
DC Characteristics

Characteristics	Symbol	Test Condition		V _{CCB} (V)	V _{CCA} (V)	Ta = −40 to 85°C		Unit
						Min	Max	
H-level input voltage	V _{IHB}	DIR, $\overline{\text{OE}}$, Bn		2.5 ± 0.2	5.0 ± 0.5	1.7	—	V
				3.3 ± 0.3	5.0 ± 0.5	2.0	—	
	V _{IHA}	An		2.3 to 3.6	5.0 ± 0.5	2.0	—	
L-level input voltage	V _{ILB}	DIR, $\overline{\text{OE}}$, Bn		2.5 ± 0.2	5.0 ± 0.5	—	0.7	V
				3.3 ± 0.3	5.0 ± 0.5	—	0.8	
	V _{ILA}	An		2.3 to 3.6	5.0 ± 0.5	—	0.8	
H-level output voltage	V _{OHB}	V _{INA} = V _{IHA} or V _{ILA} V _{INB} = V _{IHB} or V _{ILB}	I _{OHB} = −100 μA I _{OHB} = −12 mA I _{OHB} = − 4 mA	2.3 to 3.6	5.0 ± 0.5	V _{CCB} − 0.2	—	V
				3.0	5.0 ± 0.5	2.2	—	
				2.3	5.0 ± 0.5	1.8	—	
	V _{OHA}		I _{OHA} = −100 μA I _{OHA} = −12 mA	2.3 to 3.6	5.0 ± 0.5	V _{CCA} − 0.2	—	
				2.3 to 3.6	4.5	3.7	—	
L-level output voltage	V _{OLB}	V _{INA} = V _{IHA} or V _{ILA} V _{INB} = V _{IHB} or V _{ILB}	I _{OLB} = 100 μA I _{OLB} = 12 mA I _{OLB} = 4 mA	2.3 to 3.6	5.0 ± 0.5	—	0.2	V
				3.0	5.0 ± 0.5	—	0.8	
				2.3	5.0 ± 0.5	—	0.6	
	V _{OLA}		I _{OLA} = 100 μA I _{OLA} = 12 mA	2.3 to 3.6	5.0 ± 0.5	—	0.2	
				2.3 to 3.6	4.5	—	0.7	
3-state output OFF state current	I _{OZB}	V _{IN} = V _{IHB} or V _{ILB} V _{I/OB} = V _{CCB} or GND		2.3 to 3.6	5.0 ± 0.5	—	±5.0	μA
	I _{OZA}	V _{IN} = V _{IHB} or V _{ILB} V _{I/OA} = V _{CCA} or GND		2.3 to 3.6	5.0 ± 0.5	—	±5.0	
Input leakage current	I _{IN}	V _{IN} (DIR, $\overline{\text{OE}}$) = V _{CCB} or GND		3.6	5.5	—	±5.0	μA
Power-off leakage current	I _{OFF}	V _{INA} /V _{INB} = 0 to 5.5 V		0	0	—	10	μA
Quiescent supply current	I _{CCB1}	V _{I/OA} = Open, V _{CCA} = Open V $\overline{\text{OE}}$ = V _{CCB} , DIR = GND		3.6	Open	—	50	μA
	I _{CCB2}	V _{INA} = V _{CCA} or GND V _{INB} = V _{CCB} or GND		3.6	5.5	—	50	
	I _{CCA}	V _{INA} = V _{CCA} or GND V _{INB} = V _{CCB} or GND		3.6	5.5	—	80	
	I _{CCTB}	V _{INB} = V _{CCB} − 0.6 V per input		3.6	5.0 ± 0.5	—	500	
	I _{CCTA}	V _{INA} = 3.4 V per input		2.3 to 3.6	5.5	—	2.0	mA

AC Characteristics (input: $t_r = t_f = 2.5 \text{ ns}$, $R_L = 500 \Omega$)
 $V_{CCB} = 3.3 \pm 0.3 \text{ V}$

Characteristics	Symbol	Test Condition	CL (pF)	V_{CCA} (V)	Ta = -40 to 85°C		Unit
					Min	Max	
Propagation delay time (Bn → An)	t_{pLH} t_{pHL}	Input: Bn Output: An (DIR = "L")	50	5.0 ± 0.5	1.0	7.5	ns
3-state output enable time (\overline{OE} → An)	t_{pZL} t_{pZH}		50	5.0 ± 0.5	1.0	9.5	
3-state output disable time (\overline{OE} → An)	t_{pLZ} t_{pHZ}		50	5.0 ± 0.5	1.0	9.5	
Propagation delay time (An → Bn)	t_{pLH} t_{pHL}	Input: An Output: Bn (DIR = "H")	50	5.0 ± 0.5	1.0	8.5	ns
3-state output enable time (\overline{OE} → Bn)	t_{pZL} t_{pZH}		50	5.0 ± 0.5	1.0	9.5	
3-state output disable time (\overline{OE} → Bn)	t_{pLZ} t_{pHZ}		50	5.0 ± 0.5	1.0	9.5	
Output to output skew	t_{osLH} t_{osHL}	(Note)	50	5.0 ± 0.5	—	1.0	ns

Note: Parameter guaranteed by design.

 $(t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|)$
 $V_{CCB} = 2.5 \pm 0.2 \text{ V}$

Characteristics	Symbol	Test Condition	CL (pF)	V_{CCA} (V)	Ta = -40 to 85°C		Unit
					Min	Max	
Propagation delay time (Bn → An)	t_{pLH} t_{pHL}	Input: Bn Output: An (DIR = "L")	50	5.0 ± 0.5	1.0	9.0	ns
3-state output enable time (\overline{OE} → An)	t_{pZL} t_{pZH}		50	5.0 ± 0.5	1.0	13.0	
3-state output disable time (\overline{OE} → An)	t_{pLZ} t_{pHZ}		50	5.0 ± 0.5	1.0	14.0	
Propagation delay time (An → Bn)	t_{pLH} t_{pHL}	Input: An Output: Bn (DIR = "H")	30	5.0 ± 0.5	1.0	9.5	ns
3-state output enable time (\overline{OE} → Bn)	t_{pZL} t_{pZH}		30	5.0 ± 0.5	1.0	12.5	
3-state output disable time (\overline{OE} → Bn)	t_{pLZ} t_{pHZ}		30	5.0 ± 0.5	1.0	10.0	
Output to output skew	t_{osLH} t_{osHL}	(Note)	30 or 50	5.0 ± 0.5	—	1.0	ns

Note: Parameter guaranteed by design.

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

Capacitive Characteristics (Ta = 25°C)
V_{CCB} = 2.5, 3.3 V

Characteristics	Symbol	Test Circuit	Test Condition	V _{CCA} (V)	Typ.	Unit
Input capacitance	C _{IN}	—	DIR, $\overline{\text{OE}}$	5.0	7	pF
Output capacitance	C _{I/O}	—	An, Bn	5.0	8	pF
Power dissipation capacitance (Note)	C _{PDA}	—	A ⇒ B (DIR = "H")	5.0	20	pF
			B ⇒ A (DIR = "L")	5.0	66	
	C _{PDB}	—	A ⇒ B (DIR = "H")	5.0	34	pF
			B ⇒ A (DIR = "L")	5.0	4	

Note: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

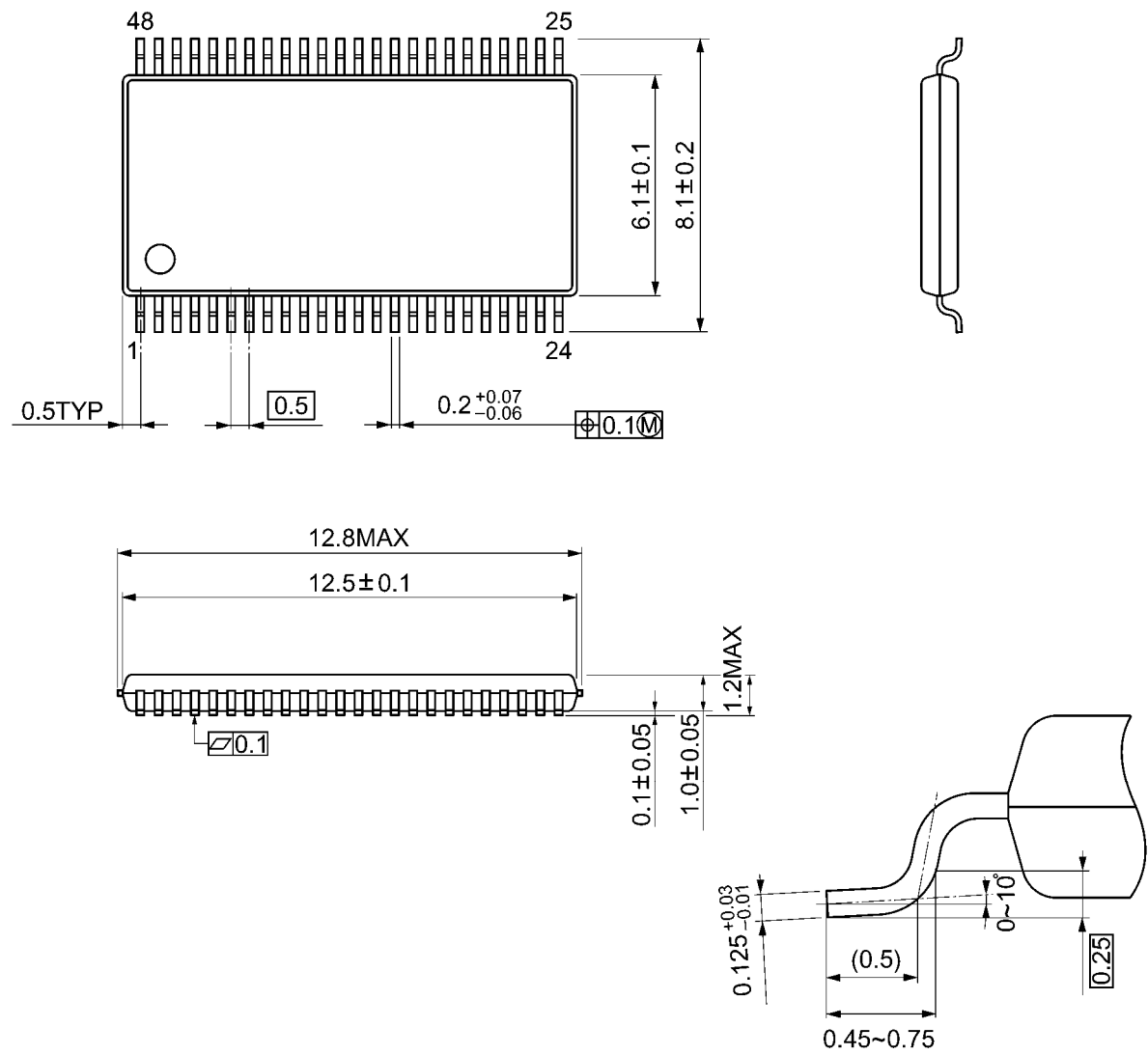
Average operating current can be obtained by the equation:

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

Package Dimensions

TSSOP48-P-0061-0.50A

Unit: mm



Weight: 0.25 g (typ.)

RESTRICTIONS ON PRODUCT USE

20070701-EN

- The information contained herein is subject to change without notice.
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc.
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk.
- The products described in this document shall not be used or embedded to any downstream products of which manufacture, use and/or sale are prohibited under any applicable laws and regulations.
- Please contact your sales representative for product-by-product details in this document regarding RoHS compatibility. Please use these products in this document in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances. Toshiba assumes no liability for damage or losses occurring as a result of noncompliance with applicable laws and regulations.