

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74LCXR164245FT

16-Bit Dual Supply Bus Transceiver with Series Resistor

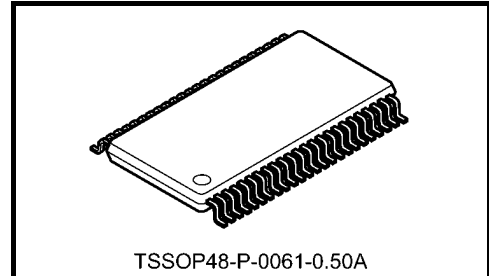
The TC74LCXR164245FT is a dual supply, advanced high-speed CMOS 16-bit dual supply voltage interface bus transceiver fabricated with silicon gate CMOS technology.

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

It is intended for 2 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 5-V bus, the A-port with the 3.3-V or 2.5-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.)

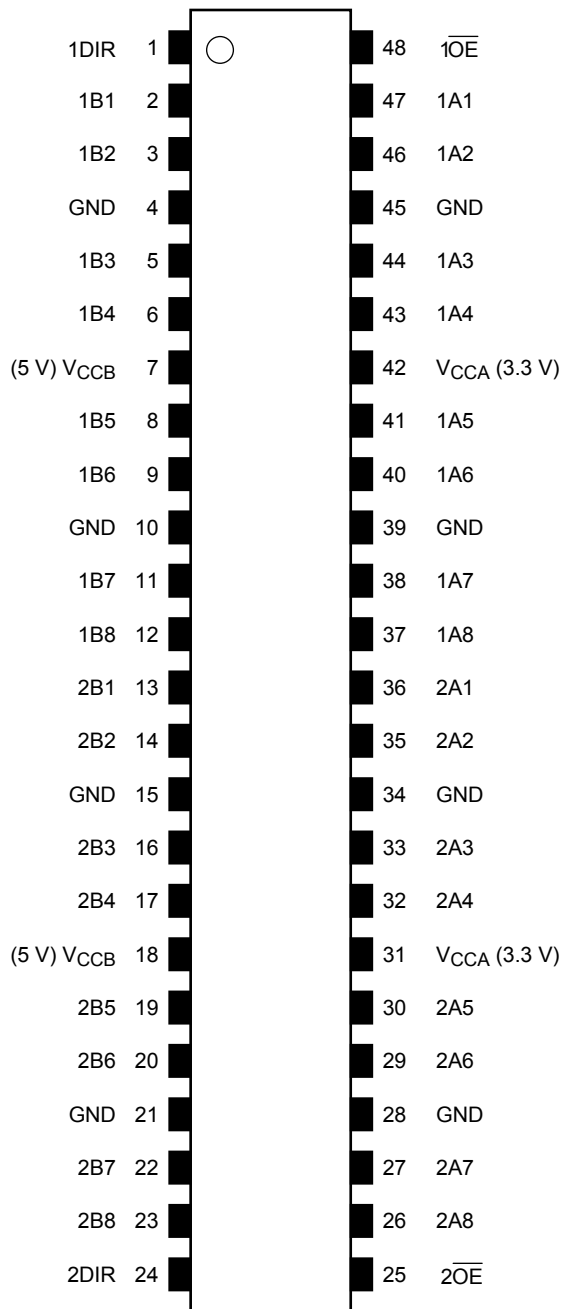
Features (Note)

- Bidirectional interface between 5 V and 3.3 V or 2.5 V buses
- 26- Ω series resistors on outputs
- High-speed: $t_{pd} = 6.8$ ns (max)
($V_{CCB} = 5.0 \pm 0.5$ V/ $V_{CCA} = 3.3 \pm 0.3$ V, $T_a = -40$ to 85°C)
- Low power dissipation: $I_{CC} = 80$ μA (max) ($T_a = -40$ to 85°C)
- Symmetrical output impedance: $I_{OUTB} = \pm 12$ mA (min)
 $I_{OUTA} = \pm 12$ mA (min)
($V_{CCB} = 4.5$ V/ $V_{CCA} = 3.0$ V)
- Power-down protection is provided on all inputs and outputs.
- Allows A port and V_{CCA} to float simultaneously when \overline{OE} is "H"
- Latch-up performance: -500 mA
- Package: TSSOP

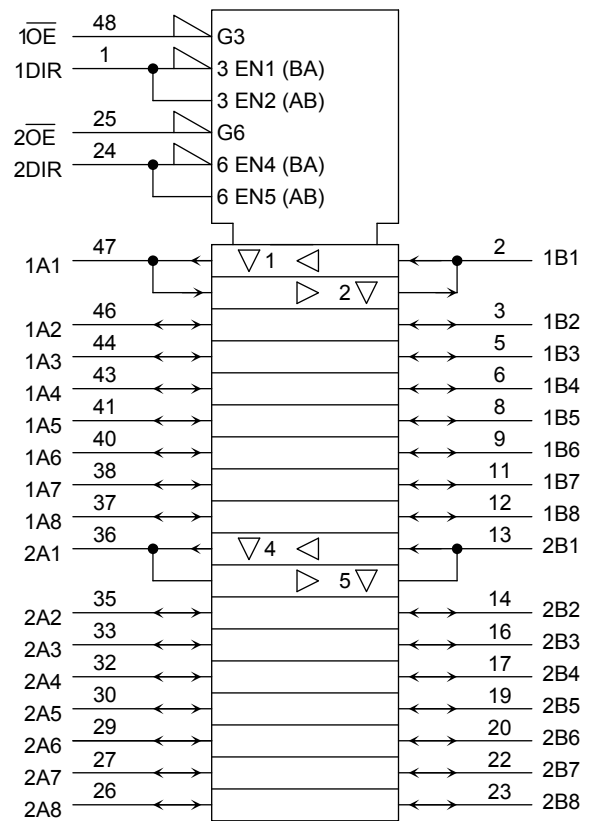
Note: Do not apply a signal to any bus pins when it is in the output mode. Damage may result.
All floating (high impedance) bus pins must have their input fixed by means of pull-up or pull-down resistors.

Start of commercial production
2000-08

Pin Assignment (top view)



IEC Logic Symbol



Truth Table

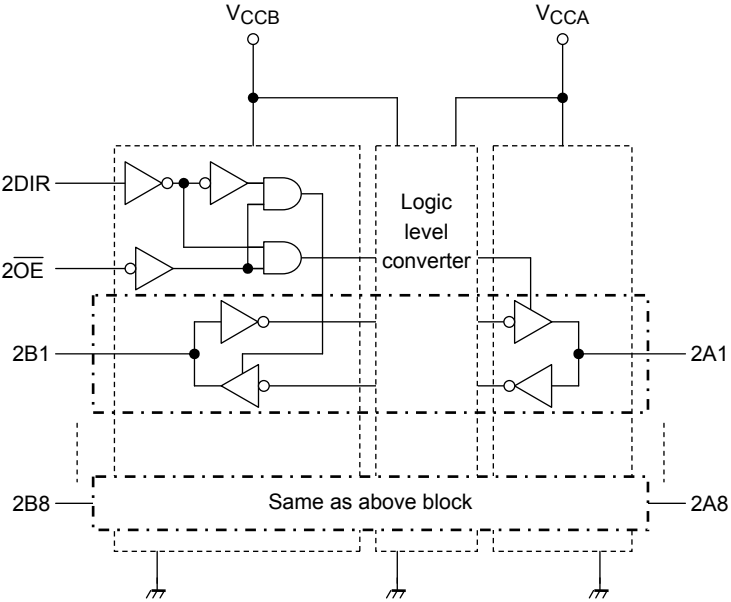
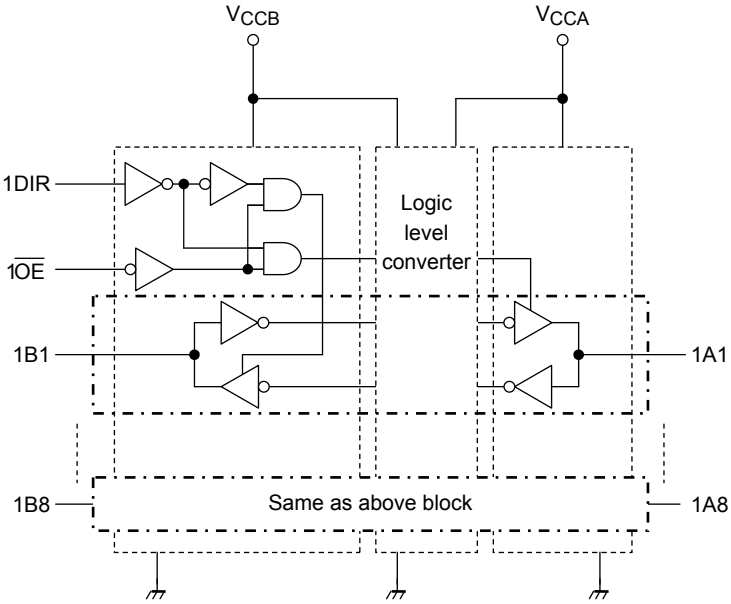
Inputs		Function		Outputs
$\overline{1OE}$	1DIR	Bus 1A1-1A8	Bus 1B1-1B8	
L	L	Output	Input	A = B
L	H	Input	Output	B = A
H	X	Z		Z

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 $V_{CCB} + 0.5$	
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	$^{\circ}\text{C}$

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: OFF state

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

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

Operating Ranges (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CCB}	4.5 to 5.5	V
	V_{CCA}	2.3 to 3.6	
Input voltage (DIR, \overline{OE})	V_{IN}	0 to 5.5	V
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
	I_{OUTA}	± 12 (Note 5)	
		± 4 (Note 6)	
Operating temperature	T_{opr}	-40 to 85	$^{\circ}\text{C}$
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 V_{CC} or GND. Please connect both bus inputs and the bus outputs with V_{CC} 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: OFF state

Note 3: High or low state

Note 4: $V_{CCB} = 4.5$ to 5.5 V

Note 5: $V_{CCA} = 3.0$ to 3.6 V

Note 6: $V_{CCA} = 2.3$ to 2.7 V

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

$V_{INA} = 0.8$ to 2.0 V, $V_{CCA} = 3.0$ 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{OE} , Bn	5.0 ± 0.5	2.3 to 3.6	2.0	—	V	
	V _{IHA}	An	5.0 ± 0.5	2.5 ± 0.2	1.7	—		
				5.0 ± 0.5	3.3 ± 0.3	2.0	—	
L-level input voltage	V _{ILB}	DIR, \overline{OE} , Bn	5.0 ± 0.5	2.3 to 3.6	—	0.8	V	
	V _{I LA}	An	5.0 ± 0.5	2.5 ± 0.2	—	0.7		
				5.0 ± 0.5	3.3 ± 0.3	—	0.8	
H-level output voltage	V _{OHB}	V _{I NA} = V _{I HA} or V _{I LA} V _{I NB} = V _{I HB} or V _{I LB}	I _{OHB} = -100 μA	5.0 ± 0.5	2.3 to 3.6	V _{CCB} - 0.2	—	V
			I _{OHB} = -12 mA	4.5	2.3 to 3.6	3.7	—	
	V _{OHA}		I _{OHA} = -100 μA	5.0 ± 0.5	2.3 to 3.6	V _{CCA} - 0.2	—	
			I _{OHA} = -12 mA	5.0 ± 0.5	3.0	2.2	—	
		I _{OHA} = -4 mA	5.0 ± 0.5	2.3	1.8	—		
L-level output voltage	V _{OLB}	V _{I NA} = V _{I HA} or V _{I LA} V _{I NB} = V _{I HB} or V _{I LB}	I _{OLB} = 100 μA	5.0 ± 0.5	2.3 to 3.6	—	0.2	V
			I _{OLB} = 12 mA	4.5	2.3 to 3.6	—	0.7	
	V _{OLA}		I _{OLA} = 100 μA	5.0 ± 0.5	2.3 to 3.6	—	0.2	
			I _{OLA} = 12 mA	5.0 ± 0.5	3.0	—	0.8	
			I _{OLA} = 4 mA	5.0 ± 0.5	2.3	—	0.6	
3-state output OFF state current	I _{OZB}	V _{I N} = V _{I HB} or V _{I LB} V _{I/OB} = 0 to 5.5 V	5.0 ± 0.5	2.3 to 3.6	—	±5.0	μA	
	I _{OZA}	V _{I N} = V _{I HB} or V _{I LB} V _{I/OA} = 0 to 5.5 V	5.0 ± 0.5	2.3 to 3.6	—	±5.0		
Input leakage current	I _{IN}	V _{I N} (DIR, \overline{OE}) = 0 to 5.5 V	5.5	3.6	—	±5.0	μA	
Power-off leakage current	I _{OFF}	V _{I NA} /V _{I NB} = 5.5 V	0	0	—	10	μA	
Quiescent supply current	I _{CCB1}	V _{I/OA} = Open, V _{CCA} = Open V \overline{OE} = V _{CCB} , DIR = GND	5.5	Open	—	80	μA	
	I _{CCB2}	V _{I NA} = V _{CCA} or GND V _{I NB} = V _{CCB} or GND	5.5	3.6	—	80		
	I _{CCA}	V _{I NA} = V _{CCA} or GND V _{I NB} = V _{CCB} or GND	5.5	3.6	—	50		
	I _{CCTB}	V _{I NB} = 3.4 V per input	5.5	2.3 to 3.6	—	2.0	mA	
	I _{CCTA}	V _{I NA} = V _{CCA} - 0.6 V per input	5.0 ± 0.5	3.6	—	500	μA	

AC Characteristics (input: $t_r = t_f = 2.5 \text{ ns}$, $R_L = 500 \Omega$)

$V_{CCA} = 3.3 \pm 0.3 \text{ V}$

Characteristics	Symbol	Test Condition	CL (pF)	V_{CCB} (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	6.8	ns
3-state output enable time (\overline{OE} → An)	t_{pZL} t_{pZH}		50	5.0 ± 0.5	1.0	10.0	
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	6.8	ns
3-state output enable time (\overline{OE} → Bn)	t_{pZL} t_{pZH}		50	5.0 ± 0.5	1.0	10.0	
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.
 $(t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|)$

$V_{CCA} = 2.5 \pm 0.2 \text{ V}$

Characteristics	Symbol	Test Condition	CL (pF)	V_{CCB} (V)	Ta = -40 to 85°C		Unit
					Min	Max	
Propagation delay time (Bn → An)	t_{pLH} t_{pHL}	Input: Bn Output: An (DIR = "L")	30	5.0 ± 0.5	1.0	9.0	ns
3-state output enable time (\overline{OE} → An)	t_{pZL} t_{pZH}		30	5.0 ± 0.5	1.0	12.5	
3-state output disable time (\overline{OE} → An)	t_{pLZ} t_{pHZ}		30	5.0 ± 0.5	1.0	11.5	
Propagation delay time (An → Bn)	t_{pLH} t_{pHL}	Input: An Output: Bn (DIR = "H")	50	5.0 ± 0.5	1.0	10.0	ns
3-state output enable time (\overline{OE} → Bn)	t_{pZL} t_{pZH}		50	5.0 ± 0.5	1.0	12.5	
3-state output disable time (\overline{OE} → Bn)	t_{pLZ} t_{pHZ}		50	5.0 ± 0.5	1.0	11.5	
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} = 5.0 V

Characteristics	Symbol	Test Circuit	Test Condition	V _{CCA} (V)	Typ.	Unit
Input capacitance	C _{IN}	—	DIR, \overline{OE}	2.5, 3.3	7	pF
Output capacitance	C _{I/O}	—	An, Bn	2.5, 3.3	8	pF
Power dissipation capacitance (Note)	C _{PDA}	—	A ⇒ B (DIR = "H")	2.5, 3.3	2	pF
			B ⇒ A (DIR = "L")	2.5, 3.3	26	
	C _{PDB}	—	A ⇒ B (DIR = "H")	2.5, 3.3	36	pF
			B ⇒ A (DIR = "L")	2.5, 3.3	4	

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

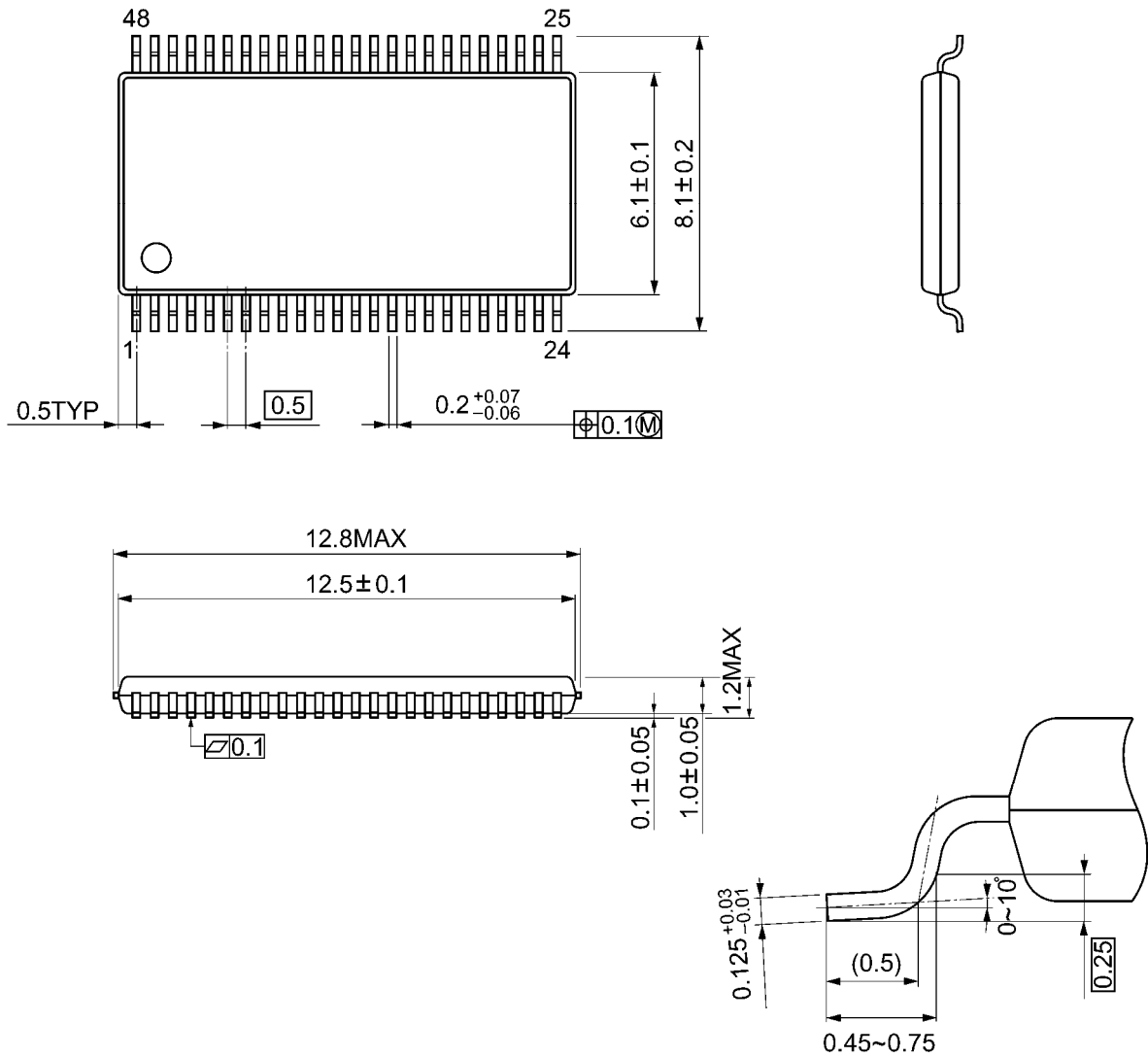
Average operating current can be obtained by the equation:

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

Package Dimensions

TSSOP48-P-0061-0.50A

Unit: mm



Weight: 0.25 g (typ.)

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