TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

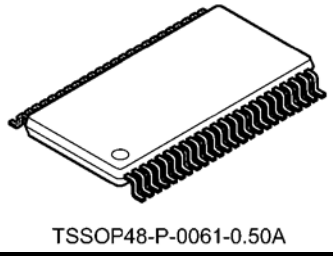
TC74LCX164245FT

16-Bit Dual Supply Bus Transceiver

The TC74LCX164245FT 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 buses 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.



TSSOP48-P-0061-0.50A

Weight: 0.25 g (typ.)

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

Features (Note)

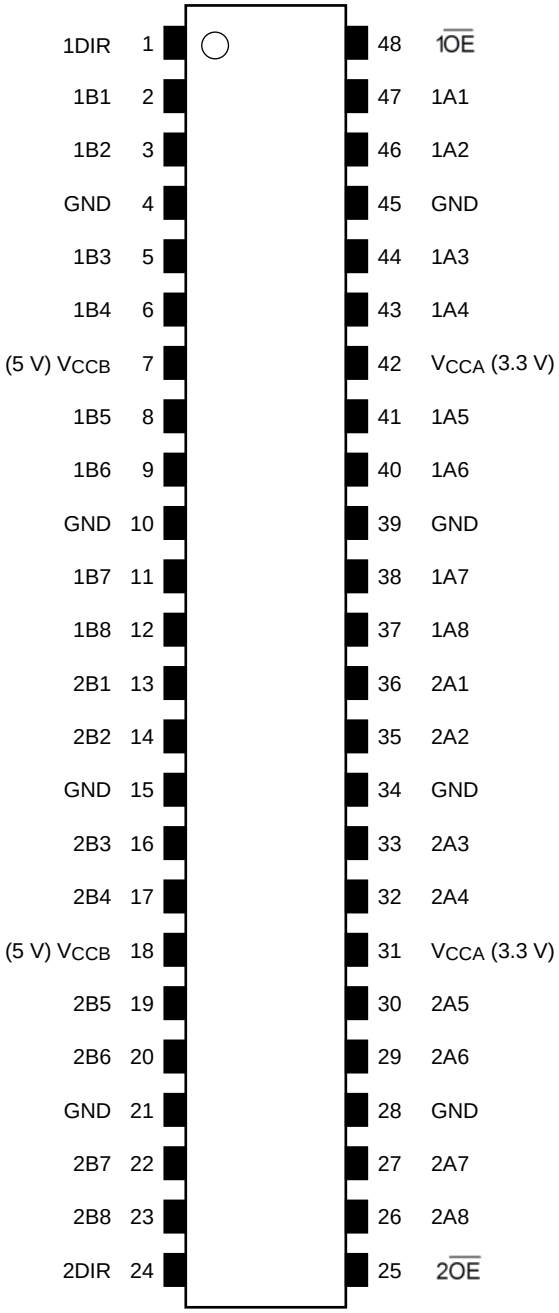
- Bidirectional interface between 5-V and 3.3-V or 2.5-V buses
- Wide operating temperature range: Topr = −40 to 125 °C (Note 1)
- High-speed: t_{pd} = 5.8 ns (max)
  (V_{CCB} = 5.0 ± 0.5 V/V_{CCA} = 3.3 ± 0.3 V, Ta = −40 to 85°C)
- Low power dissipation: I_{CC} = 80 μA (max) (Ta = −40 to 85°C)
- Symmetrical ouput impedance: I_{OUTA} = ±24 mA (min)
  I_{OUTB} = ±24 mA (min)
  (V_{CCA} = 3.0 V/V_{CCB} = 4.5 V)
- Power-down protection 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.

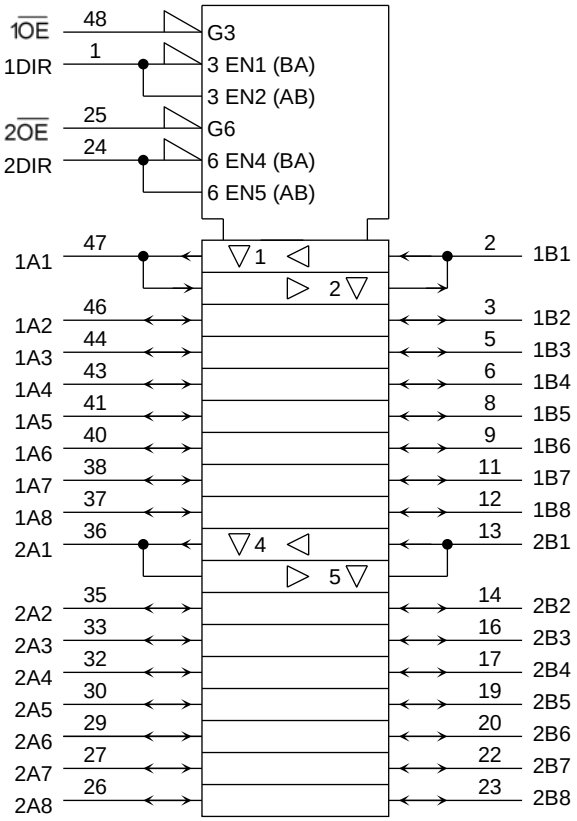
Note 1: For devices with the ordering part number ending in (*KF. Topr = -40 °C to 85 °C for the other devices.

Start of commercial production
2020-01

Pin Assignment (top view)



IEC Logic Symbol



Truth Table

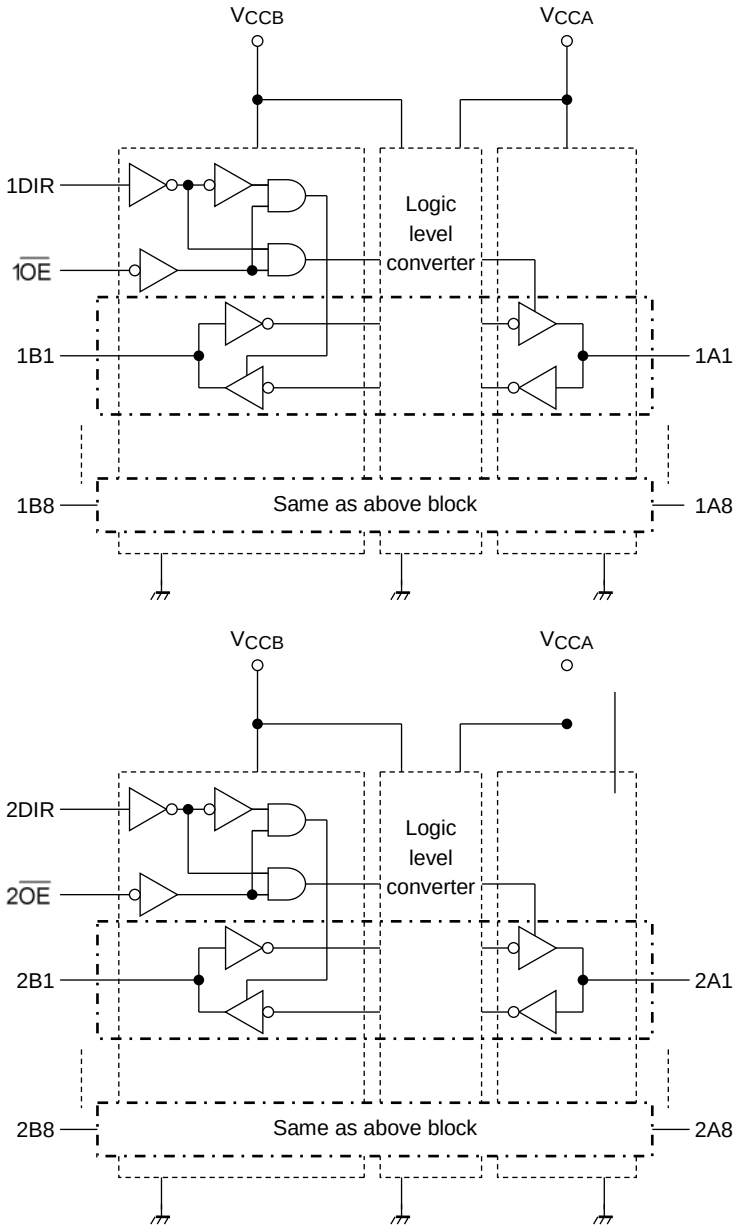
Inputs		Function		Outputs
$1\overline{OE}$	1DIR	Bus 1A1-1A8	Bus 1B1-1B8	
L	L	Output	Input	A = B
L	H	Input	Output	B = A
H	X	Z		Z

Inputs		Function		Outputs
$2\overline{OE}$	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)

Characteristics	Symbol	Rating	Unit
Power supply voltage (Note 1)	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 2)	V
		−0.5 to V_{CCB} + 0.5 (Note 3)	
	$V_{I/OA}$	−0.5 to 7.0 (Note 2)	
		−0.5 to V_{CCA} + 0.5 (Note 3)	
Input diode current	I_{IK}	−50	mA
Output diode current	$I_{I/OK}$	±50 (Note 4)	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 (Note 5)	mW
Storage temperature	T_{stg}	−65 to 150	°C

Note : 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 1: Don’t supply a voltage to V_{CCA} terminal when V_{CCB} is in the off-state.

Note 2: OFF state

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

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

Note 5: 400 mW in the range of T_a = -40 to 85. From T_a = 85 to 125 °C a derating factor of -6.25 mW/°C shall be applied until 150 mW.

Operating Ranges (Note)

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 1)	V
		0 to V_{CCB} (Note 2)	
	$V_{I/OA}$	0 to 5.5 (Note 1)	
		0 to V_{CCA} (Note 2)	
Output current	I_{OUTB}	±24 (Note 3)	mA
		±24 (Note 4)	
	I_{OUTA}	±8 (Note 5)	
Operating temperature	T_{opr}	−40 to 125 (Note 6)	°C
Input rise and fall time	dt/dv	0 to 10 (Note 7)	ns/V

Note : 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 1: OFF state

Note 2: High or low state

Note 3: V_{CCB} = 4.5 to 5.5 V

Note 4: V_{CCA} = 3.0 to 3.6 V

Note 5: V_{CCA} = 2.3 to 2.7 V

Note 6: For devices with the ordering part number ending in (*KF. Topr = -40 °C to 85 °C for the other devices.

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 (Unless otherwise specified, Ta = -40 to 85 °C)

Characteristics	Symbol	Test Condition		V_{CCB} (V)	V_{CCA} (V)	Min	Max	Unit
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_{ILA}	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_{INA} = V_{IHA} or V_{ILA} V_{INB} = V_{IHB} or V_{ILB}	I_{OHB} = –100 μA	5.0 ± 0.5	2.3 to 3.6	V_{CCB} – 0.2	—	V
			I_{OHB} = –24 mA	4.5	2.3 to 3.6	3.8	—	
	V_{OHA}		I_{OHA} = –100 μA	5.0 ± 0.5	2.3 to 3.6	V_{CCA} – 0.2	—	
			I_{OHA} = –24 mA	5.0 ± 0.5	3.0	2.2	—	
			I_{OHA} = –8 mA	5.0 ± 0.5	2.3	1.8	—	
L-level output voltage	V_{OLB}	V_{INA} = V_{IHA} or V_{ILA} V_{INB} = V_{IHB} or V_{ILB}	I_{OLB} = 100 μA	5.0 ± 0.5	2.3 to 3.6	—	0.2	V
			I_{OLB} = 24 mA	4.5	2.3 to 3.6	—	0.44	
	V_{OLA}		I_{OLA} = 100 μA	5.0 ± 0.5	2.3 to 3.6	—	0.2	
			I_{OLA} = 24 mA	5.0 ± 0.5	3.0	—	0.55	
			I_{OLA} = 8 mA	5.0 ± 0.5	2.3	—	0.6	
3-state output OFF state current	I_{OZB}	V_{IN} = V_{IHB} or V_{ILB} $V_{I/OB}$ = 0 to 5.5 V		5.0 ± 0.5	2.3 to 3.6	—	±5.0	μA
	I_{OZA}	V_{IN} = V_{IHB} or V_{ILB} $V_{I/OA}$ = 0 to 5.5 V		5.0 ± 0.5	2.3 to 3.6	—	±5.0	
Input leakage current	I_{IN}	V_{IN} (DIR, $\overline{OE}$) = 0 to 5.5 V		5.5	3.6	—	±5.0	μA
Power-off leakage current	I_{OFF}	V_{INA}/V_{INB} = 5.5 V		0	0	—	10	μA
Quiescent supply current	I_{CCB1}	$V_{I/OA}$ = Open, V_{CCA} = Open V_{INB} = V_{CCB} or GND $\overline{OE}$ = V_{CCB}, DIR = GND		5.5	Open	—	80	μA
	I_{CCB2}	V_{INA} = V_{CCA} or GND V_{INB} = V_{CCB} or GND		5.5	3.6	—	80	
	I_{CCA}	V_{INA} = V_{CCA} or GND V_{INB} = V_{CCB} or GND		5.5	3.6	—	50	
	I_{CCTB}	V_{INB} = 3.4 V per input		5.5	2.3 to 3.6	—	2.0	mA
	I_{CCTA}	V_{INA} = V_{CCA} – 0.6 V per input		5.0 ± 0.5	3.6	—	500	μA

DC Characteristics (Note) (Unless otherwise specified, Ta = -40 to 125 °C)

Characteristics	Symbol	Test Condition		V_{CCB} (V)	V_{CCA} (V)	Min	Max	Unit
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_{ILA}	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_{INA} = V_{IHA} or V_{ILA} V_{INB} = V_{IHB} or V_{ILB}	I_{OHB} = –100 μA	5.0 ± 0.5	2.3 to 3.6	V_{CCB} – 0.2	—	V
			I_{OHB} = –24 mA	4.5	2.3 to 3.6	3.4	—	
	V_{OHA}		I_{OHA} = –100 μA	5.0 ± 0.5	2.3 to 3.6	V_{CCA} – 0.2	—	
			I_{OHA} = –24 mA	5.0 ± 0.5	3.0	1.9	—	
			I_{OHA} = –8 mA	5.0 ± 0.5	2.3	1.55	—	
L-level output voltage	V_{OLB}	V_{INA} = V_{IHA} or V_{ILA} V_{INB} = V_{IHB} or V_{ILB}	I_{OLB} = 100 μA	5.0 ± 0.5	2.3 to 3.6	—	0.2	V
			I_{OLB} = 24 mA	4.5	2.3 to 3.6	—	0.6	
	V_{OLA}		I_{OLA} = 100 μA	5.0 ± 0.5	2.3 to 3.6	—	0.2	
			I_{OLA} = 24 mA	5.0 ± 0.5	3.0	—	0.8	
			I_{OLA} = 8 mA	5.0 ± 0.5	2.3	—	0.9	
3-state output OFF state current	I_{OZB}	V_{IN} = V_{IHB} or V_{ILB} $V_{I/OB}$ = 0 to 5.5 V		5.0 ± 0.5	2.3 to 3.6	—	±20.0	μA
	I_{OZA}	V_{IN} = V_{IHB} or V_{ILB} $V_{I/OA}$ = 0 to 5.5 V		5.0 ± 0.5	2.3 to 3.6	—	±20.0	
Input leakage current	I_{IN}	V_{IN} (DIR, $\overline{OE}$) = 0 to 5.5 V		5.5	3.6	—	±20.0	μA
Power-off leakage current	I_{OFF}	V_{INA}/V_{INB} = 5.5 V		0	0	—	40	μA
Quiescent supply current	I_{CCB1}	$V_{I/OA}$ = Open, V_{CCA} = Open V_{INB} = V_{CCB} or GND $\overline{OE}$ = V_{CCB}, DIR = GND		5.5	Open	—	320	μA
	I_{CCB2}	V_{INA} = V_{CCA} or GND V_{INB} = V_{CCB} or GND		5.5	3.6	—	320	
	I_{CCA}	V_{INA} = V_{CCA} or GND V_{INB} = V_{CCB} or GND		5.5	3.6	—	200	
	I_{CCTB}	V_{INB} = 3.4 V per input		5.5	2.3 to 3.6	—	2.0	mA
	I_{CCTA}	V_{INA} = V_{CCA} – 0.6 V per input		5.0 ± 0.5	3.6	—	5.0	mA

Note : For devices with the ordering part number ending in (*KF. Topr = -40 °C to 85 °C for the other devices.

AC Characteristics

(Unless otherwise specified, Ta = -40 to 85 °C, input: $t_r = t_f = 2.5$ ns, $R_L = 500\ \Omega$)

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

Characteristics	Symbol	Test Condition	CL (pF)	V_{CCB} (V)	Min	Max	Unit
Propagation delay time (Bn → An)	t_{pLH} t_{pHL}	Input: Bn Output: An (DIR = "L")	50	5.0 ± 0.5	1.0	5.8	ns
3-state output enable time ($\overline{OE}$ → An)	t_{pZL} t_{pZH}		50	5.0 ± 0.5	1.0	9.0	
3-state output disable time ($\overline{OE}$ → An)	t_{pLZ} t_{pHZ}		50	5.0 ± 0.5	1.0	9.0	
Propagation delay time (An → Bn)	t_{pLH} t_{pHL}	Input: An Output: Bn (DIR = "H")	50	5.0 ± 0.5	1.0	5.8	ns
3-state output enable time ($\overline{OE}$ → Bn)	t_{pZL} t_{pZH}		50	5.0 ± 0.5	1.0	8.9	
3-state output disable time ($\overline{OE}$ → Bn)	t_{pLZ} t_{pHZ}		50	5.0 ± 0.5	1.0	9.0	
Output to output skew	t_{osLH} t_{osHL}	(Note1)	50	5.0 ± 0.5	—	1.0	ns

Note1: Parameter guaranteed by design.
($t_{osLH} = |t_{pLHm} - t_{pLHn}|$, $t_{osHL} = |t_{pHLm} - t_{pHLn}|$)

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

Characteristics	Symbol	Test Condition	CL (pF)	V_{CCB} (V)	Min	Max	Unit
Propagation delay time (Bn → An)	t_{pLH} t_{pHL}	Input: Bn Output: An (DIR = "L")	30	5.0 ± 0.5	1.0	8.4	ns
3-state output enable time ($\overline{OE}$ → An)	t_{pZL} t_{pZH}		30	5.0 ± 0.5	1.0	11.0	
3-state output disable time ($\overline{OE}$ → An)	t_{pLZ} t_{pHZ}		30	5.0 ± 0.5	1.0	10.0	
Propagation delay time (An → Bn)	t_{pLH} t_{pHL}	Input: An Output: Bn (DIR = "H")	50	5.0 ± 0.5	1.0	9.0	ns
3-state output enable time ($\overline{OE}$ → Bn)	t_{pZL} t_{pZH}		50	5.0 ± 0.5	1.0	10.5	
3-state output disable time ($\overline{OE}$ → Bn)	t_{pLZ} t_{pHZ}		50	5.0 ± 0.5	1.0	10.3	
Output to output skew	t_{osLH} t_{osHL}	(Note1)	30 or 50	5.0 ± 0.5	—	1.0	ns

Note1: Parameter guaranteed by design.
($t_{osLH} = |t_{pLHm} - t_{pLHn}|$, $t_{osHL} = |t_{pHLm} - t_{pHLn}|$)

AC Characteristics (Note)

(Unless otherwise specified, Ta = -40 to 125 °C, input: $t_r = t_f = 2.5$ ns, $R_L = 500\ \Omega$)

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

Characteristics	Symbol	Test Condition	CL (pF)	V_{CCB} (V)	Min	Max	Unit
Propagation delay time (Bn → An)	t_{pLH} t_{pHL}	Input: Bn Output: An (DIR = "L")	50	5.0 ± 0.5	1.0	6.3	ns
3-state output enable time ($\overline{OE}$ → An)	t_{pZL} t_{pZH}		50	5.0 ± 0.5	1.0	9.7	
3-state output disable time ($\overline{OE}$ → An)	t_{pLZ} t_{pHZ}		50	5.0 ± 0.5	1.0	9.7	
Propagation delay time (An → Bn)	t_{pLH} t_{pHL}	Input: An Output: Bn (DIR = "H")	50	5.0 ± 0.5	1.0	6.3	ns
3-state output enable time ($\overline{OE}$ → Bn)	t_{pZL} t_{pZH}		50	5.0 ± 0.5	1.0	9.6	
3-state output disable time ($\overline{OE}$ → Bn)	t_{pLZ} t_{pHZ}		50	5.0 ± 0.5	1.0	9.6	
Output to output skew	t_{osLH} t_{osHL}	(Note1)	50	5.0 ± 0.5	—	1.0	ns

Note : For devices with the ordering part number ending in (*KF. Topr = -40 °C to 85 °C for the other devices.

Note1: Parameter guaranteed by design.
($t_{osLH} = |t_{pLHm} - t_{pLHn}|$, $t_{osHL} = |t_{pHLm} - t_{pHLn}|$)

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

Characteristics	Symbol	Test Condition	CL (pF)	V_{CCB} (V)	Min	Max	Unit
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	11.8	
3-state output disable time ($\overline{OE}$ → An)	t_{pLZ} t_{pHZ}		30	5.0 ± 0.5	1.0	11.8	
Propagation delay time (An → Bn)	t_{pLH} t_{pHL}	Input: An Output: Bn (DIR = "H")	50	5.0 ± 0.5	1.0	9.7	ns
3-state output enable time ($\overline{OE}$ → Bn)	t_{pZL} t_{pZH}		50	5.0 ± 0.5	1.0	11.3	
3-state output disable time ($\overline{OE}$ → Bn)	t_{pLZ} t_{pHZ}		50	5.0 ± 0.5	1.0	11.1	
Output to output skew	t_{osLH} t_{osHL}	(Note1)	30 or 50	5.0 ± 0.5	—	1.0	ns

Note : For devices with the ordering part number ending in (*KF. Topr = -40 °C to 85 °C for the other devices.

Note1: Parameter guaranteed by design.
($t_{osLH} = |t_{pLHm} - t_{pLHn}|$, $t_{osHL} = |t_{pHLm} - t_{pHLn}|$)

Capacitive Characteristics (Unless otherwise specified, Ta = 25°C)

V_{CCB} = 5.0 V

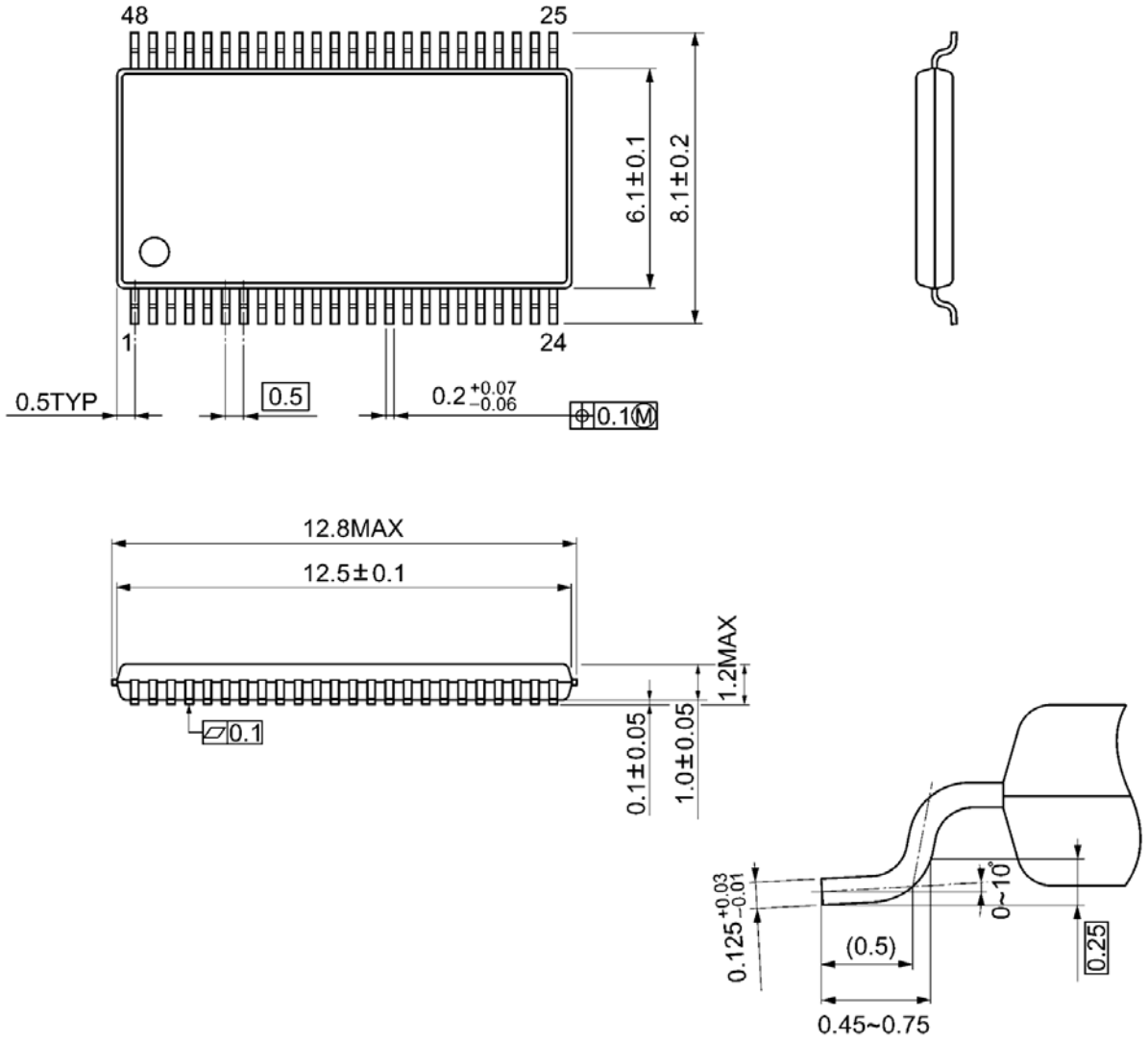
Characteristics	Symbol	Test Circuit	Test Condition	V_{CCA} (V)	Typ.	Unit
Input capacitance	C_{IN}	—	DIR, $\overline{OE}$	2.5, 3.3	7	pF
Output capacitance	$C_{I/O}$	—	An, Bn	2.5, 3.3	8	pF
Power dissipation capacitance (Note1)	C_{PDA}	—	A ⇒ B (DIR = "H")	2.5, 3.3	2	pF
			B ⇒ A (DIR = "L")	2.5, 3.3	26	
	C_{PDB}	—	A ⇒ B (DIR = "H")	2.5, 3.3	36	
			B ⇒ A (DIR = "L")	2.5, 3.3	4	

Note1: 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:
$I_{CC\ (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/16$ (per bit)

Package Dimensions

TSSOP48-P-0061-0.50A

Unit: mm



Weight: 0.25 g (typ.)

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