

TENTATIVE

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74VCXH16543FT

Low-Voltage 16-Bit Registered Transceiver with Bushold

The TC74VCXH16543FT is a high-performance CMOS 16-bit registered transceiver. Designed for use in 1.8-V, 2.5-V or 3.3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

The TC74VCXH16543FT can be used as two 8-bit transceivers or one 16-bit transceiver. Separate latch-enable ($\overline{\text{LEAB}}$ or $\overline{\text{LEBA}}$) and output-enable ($\overline{\text{OEAB}}$ or $\overline{\text{OEBA}}$) inputs are provided for each register to permit independent control in either direction of data flow.

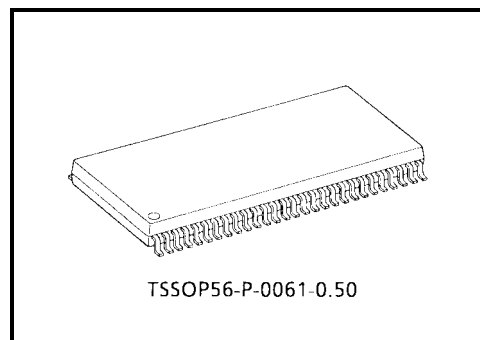
The A-to-B enable ($\overline{\text{CEAB}}$) input must be low in order to enter data from A or to output data from B. If $\overline{\text{CEAB}}$ is low and $\overline{\text{LEAB}}$ is low, the A-to-B latches are transparent; a subsequent low-to-high transition of $\overline{\text{LEAB}}$ puts the A latches in the storage mode. With $\overline{\text{CEAB}}$ and $\overline{\text{OEAB}}$ both low, the 3-state B outputs are active and reflect the data present at the output of the A latches.	TSSOP56-P-0061-0.50 Weight: 0.25 g (typ.)
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Data flow from B to A is similar but requires using the $\overline{\text{CEBA}}$, $\overline{\text{LEBA}}$, and $\overline{\text{OEAB}}$ inputs.

When the $\overline{\text{OE}}$ input is high, the outputs are in a high-impedance state. This device is designed to be used with 3-state memory address drivers, etc.

The A, B data inputs include active bushold circuitry, eliminating the need for external pull-up resisitors to hold unused or floating data inputs at a valid logic level.

All inputs are equipped with protection circuits against static discharge.



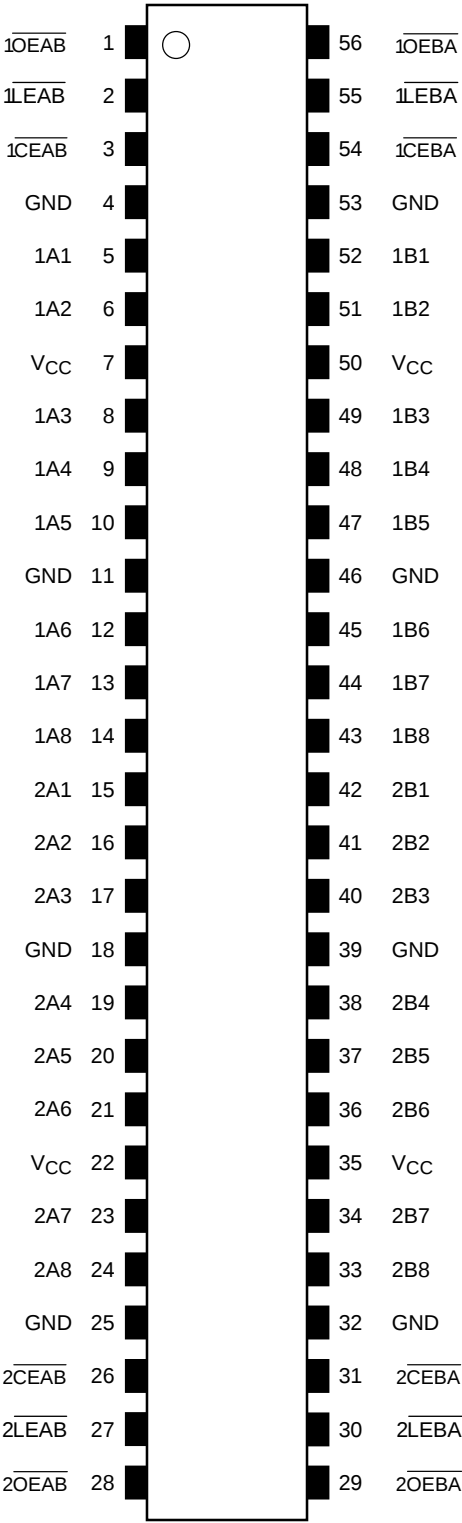
Weight: 0.25 g (typ.)

Features

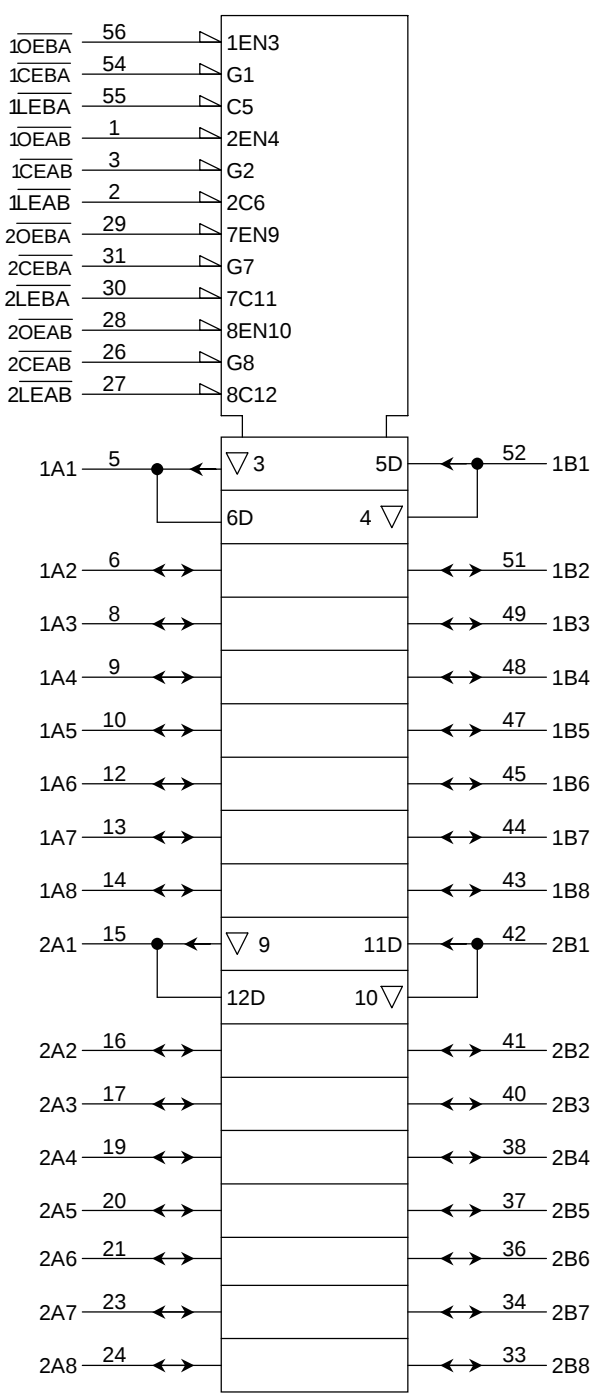
- Low-voltage operation: VCC = 1.8 to 3.6 V
- Bushold on data inputs eliminating the need for external pull-up/pull-down resistors
- High-speed operation: t_{pd} = 3.5 ns (max) (VCC = 3.0 to 3.6 V)
 : t_{pd} = 4.0 ns (max) (VCC = 2.3 to 2.7 V)
 : t_{pd} = 8.0 ns (max) (VCC = 1.8 V)
- 3.6-V tolerant control inputs
- Output current: I_{OH}/I_{OL} = ±24 mA (min) (VCC = 3.0 V)
 : I_{OH}/I_{OL} = ±18 mA (min) (VCC = 2.3 V)
 : I_{OH}/I_{OL} = ±6 mA (min) (VCC = 1.8 V)
- Latch-up performance: ±300 mA
- ESD performance: Machine model > ±200 V
 : Human body model > ±2000 V
- Package: TSSOP (thin shrink small outline package)

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

Pin Assignment (top view)



IEC Logic Symbol



Truth Table (A bus → B bus each 8-bit latch)

Inputs				Outputs B
$\overline{\text{CEAB}}$	$\overline{\text{LEAB}}$	$\overline{\text{OEAB}}$	A	
H	X	X	X	Z
X	X	H	X	Z
L	H	L	X	B0 (Note 2)
L	L	L	L	L
L	L	L	H	H

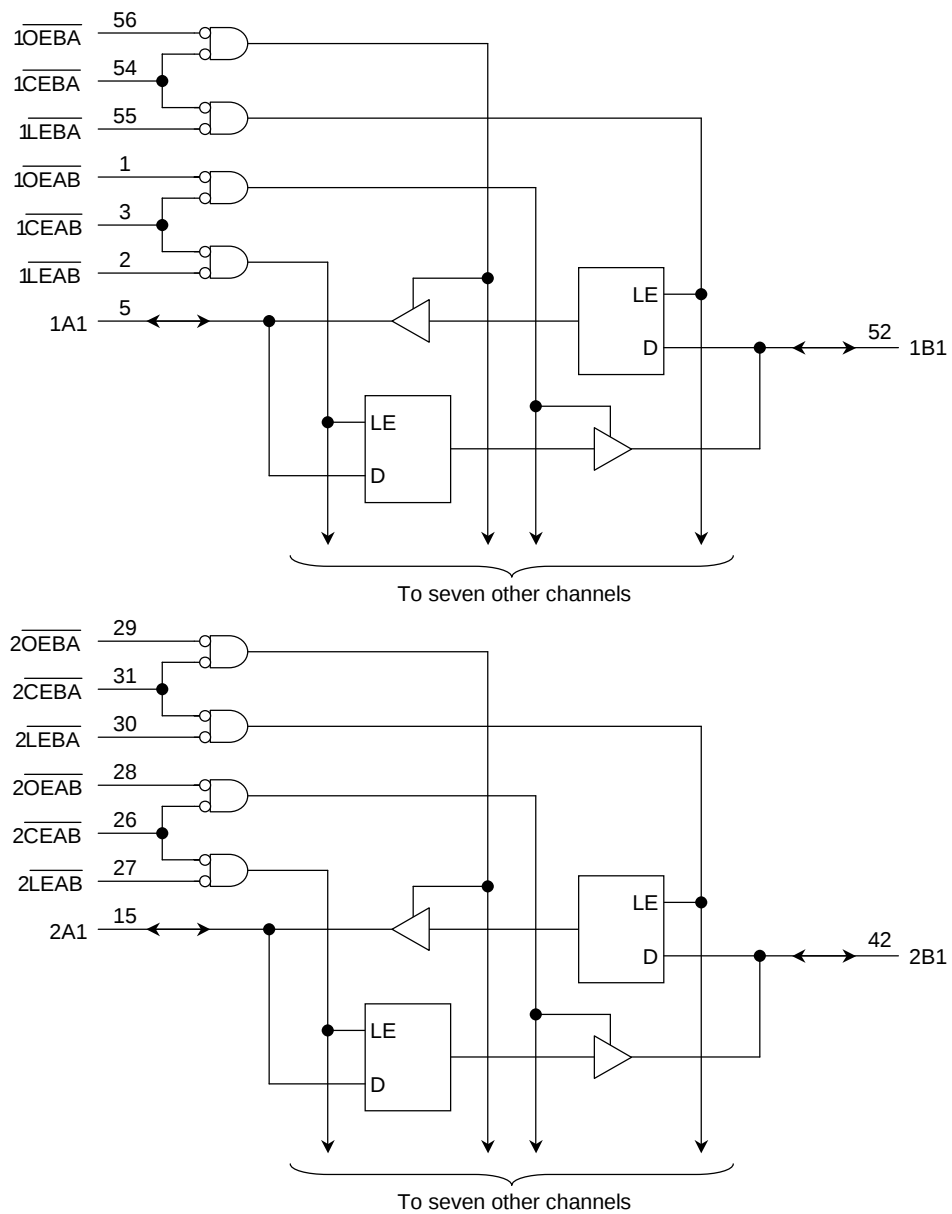
Note 2: Output level before the indicated steady-state input conditions were established.

Truth Table (B bus → A bus each 8-bit latch)

Inputs				Outputs A
$\overline{\text{CEBA}}$	$\overline{\text{LEBA}}$	$\overline{\text{OEBA}}$	B	
H	X	X	X	Z
X	X	H	X	Z
L	H	L	X	A0 (Note 2)
L	L	L	L	L
L	L	L	H	H

Note 2: Output level before the indicated steady-state input conditions were established.

System Diagram



Maximum Ratings

Characteristics		Symbol	Rating	Unit
Power supply voltage		V_{CC}	-0.5 to 4.6	V
DC input voltage	($\overline{OEAB}$, $\overline{OEBA}$, $\overline{LEAB}$, $\overline{LEBA}$, $\overline{CEAB}$, $\overline{CEBA}$)	V_{IN}	-0.5 to 4.6	V
	(An, Bn)		-0.5 to $V_{CC} + 0.5$ (Note 3)	
DC output voltage	(An, Bn)	V_{OUT}	-0.5 to $V_{CC} + 0.5$ (Note 4)	V
Input diode current		I_{IK}	-50	mA
Output diode current		I_{OK}	± 50 (Note 5)	mA
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 to 150	°C

Note 3: OFF state

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

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

Recommended Operating Range (Note 6)

Characteristics		Symbol	Rating	Unit
Power supply voltage		V_{CC}	1.8 to 3.6	V
			1.2 to 3.6 (Note 7)	
Input voltage	($\overline{OEAB}$, $\overline{OEBA}$, $\overline{LEAB}$, $\overline{LEBA}$, $\overline{CEAB}$, $\overline{CEBA}$)	V_{IN}	-0.3 to 3.6	V
	(An, Bn)		0 to V_{CC} (Note 8)	
Output voltage	(An, Bn)	V_{OUT}	0 to V_{CC} (Note 9)	V
Output current		I_{OH}/I_{OL}	± 24 (Note 10)	mA
			± 18 (Note 11)	
			± 6 (Note 12)	
Operating temperature		T_{opr}	-40 to 85	°C
Input rise and fall time		dt/dv	0 to 10 (Note 13)	ns/V

Note 6: Floating or unused control inputs must be held high or low.

Note 7: Data retention only

Note 8: OFF state

Note 9: High or low state

Note 10: $V_{CC} = 3.0$ to 3.6 V

Note 11: $V_{CC} = 2.3$ to 2.7 V

Note 12: $V_{CC} = 1.8$ V

Note 13: $V_{IN} = 0.8$ to 2.0 V, $V_{CC} = 3.0$ V

Electrical Characteristics
DC Characteristics (Ta = -40 to 85°C, 2.7 V < V_{CC} ≤ 3.6 V)

Characteristics		Symbol	Test Condition			Min	Max	Unit	
			V _{CC} (V)						
Input voltage	H-level	V _{IH}	—			2.7 to 3.6	2.0	—	V
	L-level	V _{IL}	—			2.7 to 3.6	—	0.8	
Output voltage	H-level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = −100 μA	2.7 to 3.6	V _{CC} − 0.2	—	V	
				I _{OH} = −12 mA	2.7	2.2	—		
				I _{OH} = −18 mA	3.0	2.4	—		
				I _{OH} = −24 mA	3.0	2.2	—		
	L-level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	2.7 to 3.6	—	0.2		
				I _{OL} = 12 mA	2.7	—	0.4		
				I _{OL} = 18 mA	3.0	—	0.4		
				I _{OL} = 24 mA	3.0	—	0.55		
Input leakage current ($\overline{OEAB}$, $\overline{OEBA}$, $\overline{LEAB}$, LEBA, CEAB, CEBA)		I _{IN}	V _{IN} = 0 to 3.6 V			2.7 to 3.6	—	±5.0	μA
Bushold input minimum drive hold current		I _I (HOLD)	V _{IN} = 0.8 V			3.0	75	—	μA
			V _{IN} = 2.0 V			3.0	−75	—	
Bushold input over-drive current to change state		I _I (OD)	(Note 14)			3.6	—	450	μA
			(Note 15)			3.6	—	−450	
3-state output OFF state current		I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = V _{CC} or GND			2.7 to 3.6	—	±10.0	μA
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND			2.7 to 3.6	—	20.0	μA
Increase in I _{CC} per input		ΔI _{CC}	V _{IH} = V _{CC} − 0.6 V			2.7 to 3.6	—	750	μA

Note 14: An external driver must source at least the specified current to switch from LOW-to-HIGH.

Note 15: An external driver must sink at least the specified current to switch from HIGH-to-LOW.

DC Characteristics ($T_a = -40$ to 85°C , $2.3\text{ V} \leq V_{CC} \leq 2.7\text{ V}$)

Characteristics		Symbol	Test Condition			Min	Max	Unit	
			V _{CC} (V)						
Input voltage	H-level	V _{IH}	—			2.3 to 2.7	1.6	—	V
	L-level	V _{IL}	—			2.3 to 2.7	—	0.7	
Output voltage	H-level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = −100 μA	2.3 to 2.7	V _{CC} − 0.2	—	V	
				I _{OH} = −6 mA	2.3	2.0	—		
				I _{OH} = −12 mA	2.3	1.8	—		
				I _{OH} = −18 mA	2.3	1.7	—		
	L-level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	2.3 to 2.7	—	0.2		
				I _{OL} = 12 mA	2.3	—	0.4		
				I _{OL} = 18 mA	2.3	—	0.6		
Input leakage current ($\overline{OEAB}$, $\overline{OEBA}$, $\overline{LEAB}$, $\overline{LEBA}$, $\overline{CEAB}$, $\overline{CEBA}$)		I _{IN}	V _{IN} = 0 to 3.6 V			2.3 to 2.7	—	±5.0	μA
Bushold input minimum drive hold current		I _I (HOLD)	V _{IN} = 0.7 V			2.3	45	—	μA
			V _{IN} = 1.6 V			2.3	−45	—	
Bushold input over-drive current to change state		I _I (OD)	(Note 14)			2.7	—	300	μA
			(Note 15)			2.7	—	−300	
3-state output OFF state current		I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = V _{CC} or GND			2.3 to 2.7	—	±10.0	μA
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND			2.3 to 2.7	—	20.0	μA

Note 14: An external driver must source at least the specified current to switch from LOW-to-HIGH.

Note 15: An external driver must sink at least the specified current to switch from HIGH-to-LOW.

DC Characteristics (Ta = -40 to 85°C, 1.8 V ≤ V_{CC} < 2.3 V)

Characteristics		Symbol	Test Condition		V _{CC} (V)	Min	Max	Unit
Input voltage	H-level	V _{IH}	—		1.8 to 2.3	0.7 × V _{CC}	—	V
	L-level	V _{IL}	—		1.8 to 2.3	—	0.2 × V _{CC}	
Output voltage	H-level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = −100 μA	1.8	V _{CC} − 0.2	—	V
				I _{OH} = −6 mA	1.8	1.4	—	
	L-level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	1.8	—	0.2	
				I _{OL} = 6 mA	1.8	—	0.3	
Input leakage current (<u>OEAB</u> , <u>OEBA</u> , <u>LEAB</u> , <u>LEBA</u> , <u>CEAB</u> , <u>CEBA</u>)		I _{IN}	V _{IN} = 0 to 3.6 V		1.8	—	±5.0	μA
Bushold input minimum drive hold current		I _I (HOLD)	V _{IN} = 0.36 V		1.8	25	—	μA
			V _{IN} = 1.26 V		1.8	−25	—	
Bushold input over-drive current to change state		I _I (OD)	(Note 14)		1.8	—	200	μA
			(Note 15)		1.8	—	−200	
3-state output OFF state current		I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = V _{CC} or GND		1.8	—	±10.0	μA
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND		1.8	—	20.0	μA

Note 14: An external driver must source at least the specified current to switch from LOW-to-HIGH.

Note 15: An external driver must sink at least the specified current to switch from HIGH-to-LOW.

AC Characteristics (Ta = -40 to 85°C, input: $t_r = t_f = 2.0$ ns, $C_L = 30$ pF, $R_L = 500$ Ω)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Min	Max	Unit
Propagation delay time (An, Bn-Bn, An)	t_{pLH} t_{pHL}	Figure 1, Figure 2	1.8	1.5	8.0	ns
			2.5 ± 0.2	0.8	4.0	
			3.3 ± 0.3	0.6	3.5	
Propagation delay time ($\overline{LEAB}$, $\overline{LEBA}$ -Bn, An)	t_{pLH} t_{pHL}	Figure 1, Figure 2	1.8	1.5	9.8	ns
			2.5 ± 0.2	0.8	5.0	
			3.3 ± 0.3	0.6	3.9	
3-state output enable time ($\overline{OEAB}$, $\overline{OEBA}$, $\overline{CEAB}$, $\overline{CEBA}$)	t_{pZL} t_{pZH}	Figure 1, Figure 4	1.8	1.5	9.8	ns
			2.5 ± 0.2	0.8	4.9	
			3.3 ± 0.3	0.6	3.8	
3-state output disable time ($\overline{OEAB}$, $\overline{OEBA}$, $\overline{CEAB}$, $\overline{CEBA}$)	t_{pLZ} t_{pHZ}	Figure 1, Figure 4	1.8	1.5	7.6	ns
			2.5 ± 0.2	0.8	4.2	
			3.3 ± 0.3	0.6	3.7	
Minimum pulse width ($\overline{LEAB}$, $\overline{LEBA}$, $\overline{CEAB}$, $\overline{CEBA}$)	t_W (L)	Figure 1, Figure 2, Figure 3	1.8	4.0	—	ns
			2.5 ± 0.2	1.5	—	
			3.3 ± 0.3	1.5	—	
Minimum setup time (An, Bn- $\overline{LE}$, $\overline{CE}$)	t_s	Figure 1, Figure 2, Figure 3	1.8	2.5	—	ns
			2.5 ± 0.2	1.5	—	
			3.3 ± 0.3	1.5	—	
Minimum hold time (An, Bn- $\overline{LE}$, $\overline{CE}$)	t_h	Figure 1, Figure 2, Figure 3	1.8	1.0	—	ns
			2.5 ± 0.2	1.0	—	
			3.3 ± 0.3	1.0	—	
Output to output skew	t_{osLH} t_{osHL}	(Note 16)	1.8	—	0.5	ns
			2.5 ± 0.2	—	0.5	
			3.3 ± 0.3	—	0.5	

For $C_L = 50$ pF, add approximately 300 ps to the AC maximum specification.

Note 16: Parameter guaranteed by design.

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

Dynamic Switching Characteristics
(Ta = 25°C, input: $t_r = t_f = 2.0$ ns, $C_L = 30$ pF, $R_L = 500 \Omega$)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit
Quiet output maximum dynamic V _{OL}	V _{OLP}	V _{IH} = 1.8 V, V _{IL} = 0 V (Note 17)	1.8	0.25	V
		V _{IH} = 2.5 V, V _{IL} = 0 V (Note 17)	2.5	0.6	
		V _{IH} = 3.3 V, V _{IL} = 0 V (Note 17)	3.3	0.8	
Quiet output minimum dynamic V _{OL}	V _{OLV}	V _{IH} = 1.8 V, V _{IL} = 0 V (Note 17)	1.8	−0.25	V
		V _{IH} = 2.5 V, V _{IL} = 0 V (Note 17)	2.5	−0.6	
		V _{IH} = 3.3 V, V _{IL} = 0 V (Note 17)	3.3	−0.8	
Quiet output minimum dynamic V _{OH}	V _{OHV}	V _{IH} = 1.8 V, V _{IL} = 0 V (Note 17)	1.8	1.5	V
		V _{IH} = 2.5 V, V _{IL} = 0 V (Note 17)	2.5	1.9	
		V _{IH} = 3.3 V, V _{IL} = 0 V (Note 17)	3.3	2.2	

Note 17: Parameter guaranteed by design.

Capacitive Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit
Input capacitance	C _{IN}	—	1.8, 2.5, 3.3	6	pF
Bus I/O capacitance	C _{I/O}		1.8, 2.5, 3.3	7	pF
Power dissipation capacitance	C _{PD}	f _{IN} = 10 MHz (Note 18)	1.8, 2.5, 3.3	20	pF

 Note 18: 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:

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

AC Test Circuit

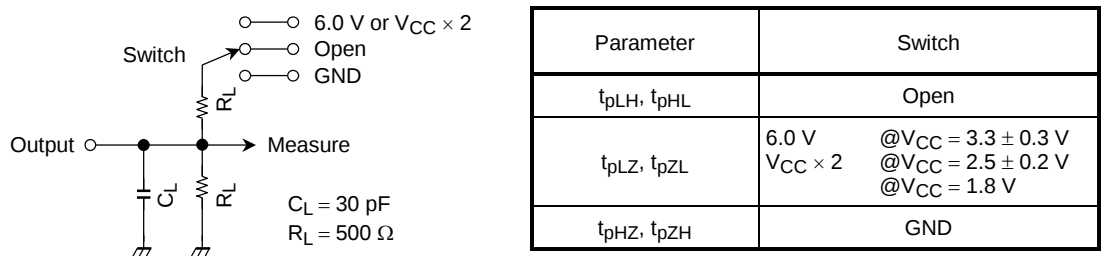


Figure 1

AC Waveform

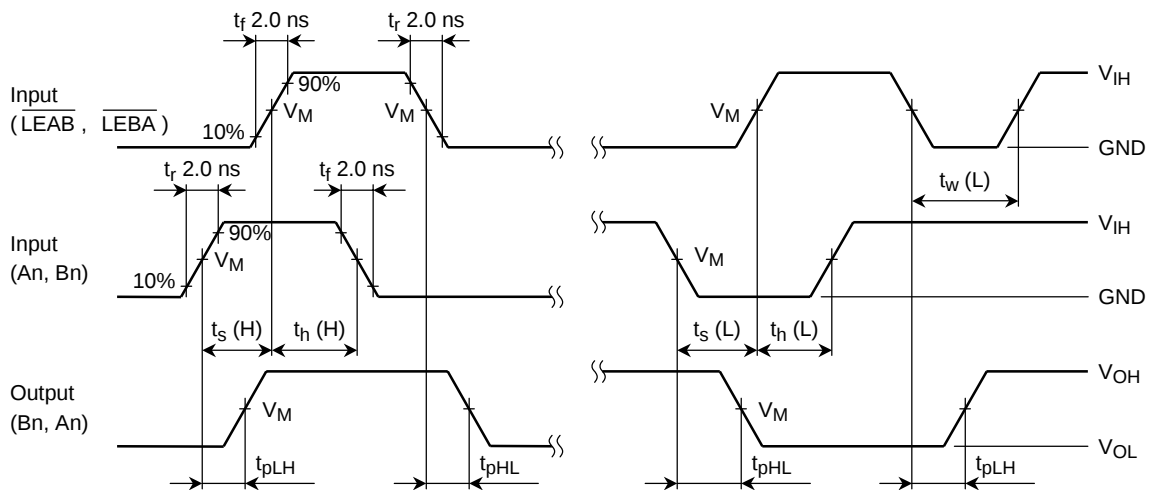


Figure 2 t_{pLH} , t_{pHL} , t_w , t_s , t_h

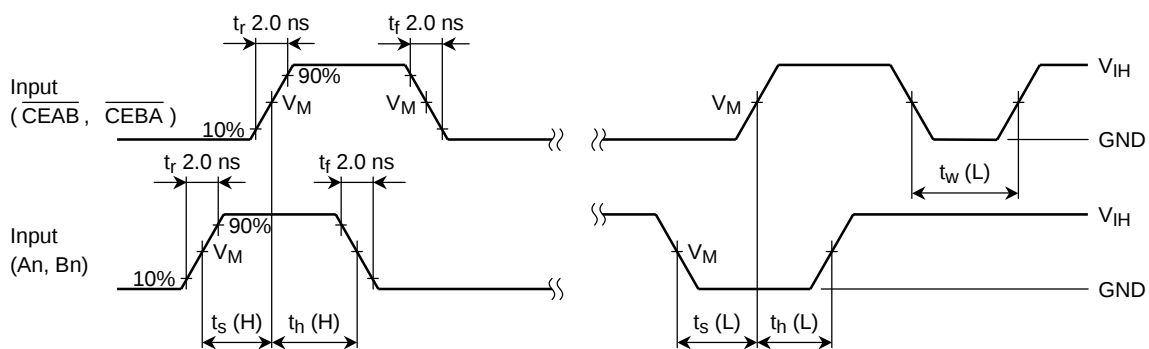


Figure 3 t_w , t_s , t_h

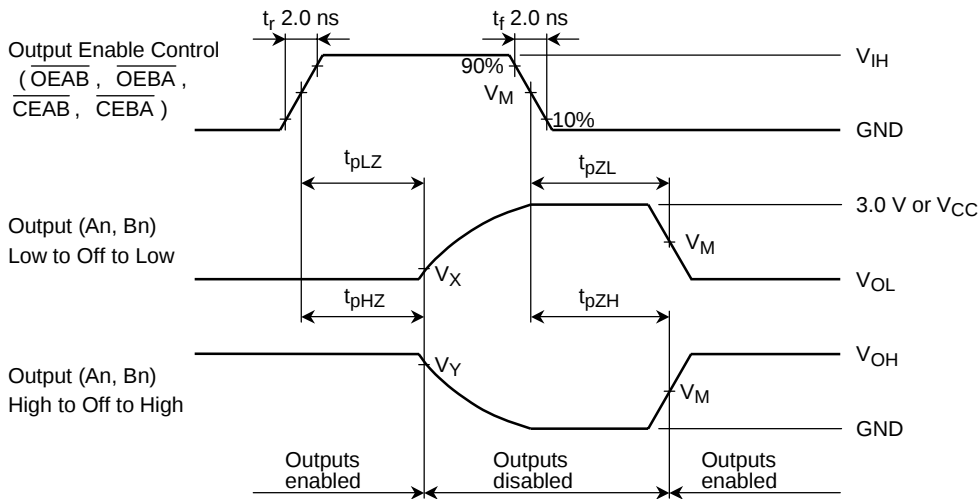


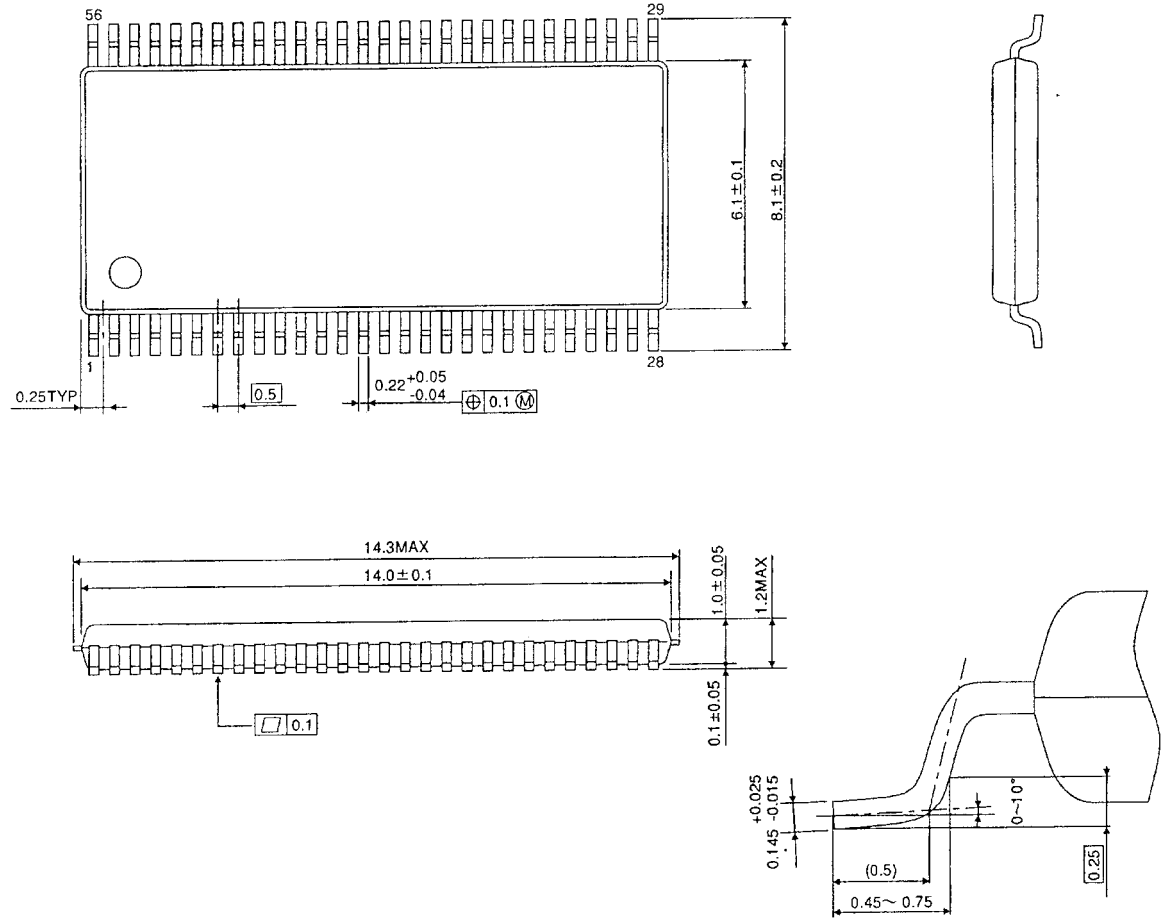
Figure 4 t_{pLZ} , t_{pHZ} , t_{pZL} , t_{pZH}

Symbol	V_{CC}		
	3.3 ± 0.3 V	2.5 ± 0.2 V	1.8 V
V_{IH}	2.7 V	V_{CC}	V_{CC}
V_M	1.5 V	$V_{CC}/2$	$V_{CC}/2$
V_X	$V_{OL} + 0.3$ V	$V_{OL} + 0.15$ V	$V_{OL} + 0.15$ V
V_Y	$V_{OH} - 0.3$ V	$V_{OH} - 0.15$ V	$V_{OH} - 0.15$ V

Package Dimensions

TSSOP56-P-0061-0.50

Unit : mm



Weight: 0.25 g (typ.)

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