

TENTATIVE TOSHIBA MOS DIGITAL INTEGRATED CIRCUIT SILICON GATE CMOS

524,288-WORD BY 16-BIT FULL CMOS STATIC RAM

DESCRIPTION

The TC55W800XB is a 8,388,608-bit static random access memory (SRAM) organized as 524,288 words by 16 bits. Fabricated using Toshiba's CMOS Silicon gate process technology, this device operates from a single 2.3 to 3.3 V power supply. Advanced circuit technology provides both high speed and low power at an operating current of 3 mA/MHz and a minimum cycle time of 70 ns. It is automatically placed in low-power mode at 0.5 μ A standby current (at $V_{DD} = 3$ V, $T_a = 25^{\circ}\text{C}$, maximum) when chip enable ($\overline{\text{CE1}}$) is asserted high or (CE2) is asserted low. There are three control inputs. $\overline{\text{CE1}}$ and CE2 are used to select the device and for data retention control, and output enable ($\overline{\text{OE}}$) provides fast memory access. Data byte control pin ($\overline{\text{LB}}$, $\overline{\text{UB}}$) provides lower and upper byte access. This device is well suited to various microprocessor system applications where high speed, low power and battery backup are required. And, with a guaranteed operating extreme temperature range of -40° to 85°C , the TC55W800XB can be used in environments exhibiting extreme temperature conditions. The TC55W800XB is available in a plastic 48-ball BGA.

FEATURES

- Low-power dissipation
Operating: 9.9 mW/MHz (typical)
- Single power supply voltage of 2.3 to 3.3 V
- Power down features using $\overline{\text{CE1}}$ and CE2
- Data retention supply voltage of 1.5 to 3.3 V
- Direct TTL compatibility for all inputs and outputs
- Wide operating temperature range of -40° to 85°C
- Standby Current (maximum):

3.3 V	10 μ A
3.0 V	5 μ A

- Access Times (maximum at $V_{DD} = 2.7$ to 3.3 V):

	TC55W800XB	
	7	8
Access Time	70 ns	85 ns
$\overline{\text{CE1}}$ Access Time	70 ns	85 ns
CE2 Access Time	70 ns	85 ns
$\overline{\text{OE}}$ Access Time	35 ns	45 ns

- Package:
P-TFBGA48-0811-0.75AZ (Weight: 0.21 g typ)

PIN ASSIGNMENT (TOP VIEW)

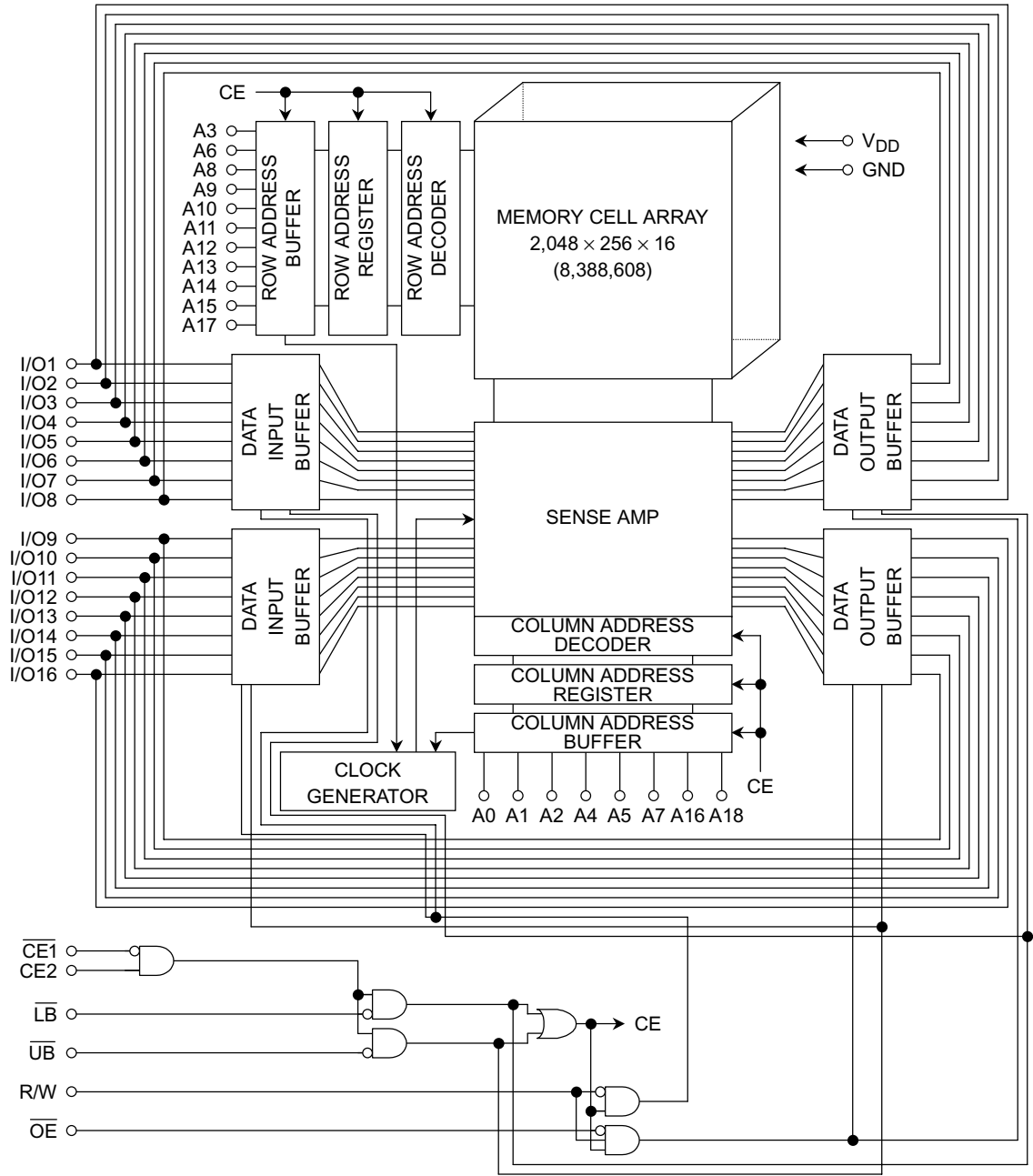
48 PIN BGA

	1	2	3	4	5	6
A	$\overline{\text{LB}}$	$\overline{\text{OE}}$	A0	A1	A2	CE2
B	I/O9	$\overline{\text{UB}}$	A3	A4	$\overline{\text{CE1}}$	I/O1
C	I/O10	I/O11	A5	A6	I/O2	I/O3
D	V_{SS}	I/O12	A17	A7	I/O4	V_{DD}
E	V_{DD}	I/O13	NC	A16	I/O5	V_{SS}
F	I/O15	I/O14	A14	A15	I/O6	I/O7
G	I/O16	NC	A12	A13	R/W	I/O8
H	A18	A8	A9	A10	A11	NC

PIN NAMES

A0~A18	Address Inputs
$\overline{\text{CE1}}$, CE2	Chip Enable
R/W	Read/Write Control
$\overline{\text{OE}}$	Output Enable
$\overline{\text{LB}}$, $\overline{\text{UB}}$	Data Byte Control
I/O1~I/O16	Data Inputs/Outputs
V_{DD}	Power
GND	Ground
NC	No Connection

BLOCK DIAGRAM



OPERATING MODE

MODE	$\overline{\text{CE1}}$	CE2	$\overline{\text{OE}}$	R/W	$\overline{\text{LB}}$	$\overline{\text{UB}}$	I/O1~I/O8	I/O9~I/O16	POWER
Read	L	H	L	H	L	L	Output	Output	I_{DDO}
	L	H	L	H	H	L	High-Z	Output	I_{DDO}
	L	H	L	H	L	H	Output	High-Z	I_{DDO}
Write	L	H	*	L	L	L	Input	Input	I_{DDO}
	L	H	*	L	H	L	High-Z	Input	I_{DDO}
	L	H	*	L	L	H	Input	High-Z	I_{DDO}
Output Deselect	L	H	H	H	*	*	High-Z	High-Z	I_{DDO}
Standby	H	*	*	*	*	*	High-Z	High-Z	I_{DDS}
	*	L	*	*	*	*	High-Z	High-Z	I_{DDS}
	*	*	*	*	H	H	High-Z	High-Z	I_{DDS}

* = don't care
H = logic high
L = logic low

MAXIMUM RATINGS

SYMBOL	RATING	VALUE	UNIT
V_{DD}	Power Supply Voltage	-0.3~4.2	V
V_{IN}	Input Voltage	-0.3*~4.2	V
$V_{I/O}$	Input/Output Voltage	-0.5~ $V_{DD} + 0.5$	V
P_D	Power Dissipation	0.6	W
T_{solder}	Soldering Temperature (10s)	260	°C
T_{stg}	Storage Temperature	-55~125	°C
T_{opr}	Operating Temperature	-40~85	°C

*: -2.0 V when measured at a pulse width of 25ns

DC RECOMMENDED OPERATING CONDITIONS ($T_a = -40^\circ$ to 85°C)

SYMBOL	PARAMETER		MIN	TYP	MAX	UNIT
V_{DD}	Power Supply Voltage		2.3	—	3.3	V
V_{IH}	Input High Voltage	$V_{DD} = 2.3\text{ V} \sim 3.3\text{ V}$	2.0	—	$V_{DD} + 0.3$	V
		$V_{DD} = 2.7\text{ V} \sim 3.3\text{ V}$	2.2			
V_{IL}	Input Low Voltage		-0.3*	—	$V_{DD} \times 0.22$	V
V_{DH}	Data Retention Supply Voltage		1.5	—	3.3	V

*: -2.0 V when measured at a pulse width of 25ns

DC CHARACTERISTICS ($T_a = -40^\circ$ to 85°C , $V_{DD} = 2.3$ to 3.3 V)

SYMBOL	PARAMETER	TEST CONDITION			MIN	TYP	MAX	UNIT	
I _{IL}	Input Leakage Current	V _{IN} = 0 V~V _{DD}			—	—	±1.0	μA	
I _{OH}	Output High Current	V _{OH} = V _{DD} − 0.5 V			−0.5	—	—	mA	
I _{OL}	Output Low Current	V _{OL} = 0.4 V			2.1	—	—	mA	
I _{LO}	Output Leakage Current	CE1 = V _{IH} or CE2 = V _{IL} or $\overline{\text{LB}}$ and $\overline{\text{UB}}$ = V _{IH} or R/W = V _{IL} or OE = V _{IH} , V _{OUT} = 0 V~V _{DD}			—	—	±1.0	μA	
I _{DDO1}	Operating Current	$\overline{\text{CE1}}$ = V _{IL} and CE2 = V _{IH} and $\overline{\text{LB}}$ and $\overline{\text{UB}}$ = V _{IL} and R/W = V _{IH} and I _{OUT} = 0 mA and Other Input = V _{IH} /V _{IL}	t _{cycle}	min	—	—	50	mA	
				1 μs	—	—	10		
I _{DDO2}		$\overline{\text{CE1}}$ = 0.2 V and CE2 = V _{DD} − 0.2 V and $\overline{\text{LB}}$ and $\overline{\text{UB}}$ = 0.2 V, R/W = V _{DD} − 0.2 V and I _{OUT} = 0 mA, Other Input = V _{DD} − 0.2 V/0.2 V	t _{cycle}	min	—	—	45	mA	
				1 μs	—	—	5		
I _{DDS1}	Standby Current	CE1 = V _{IH} or CE2 = V _{IL} or $\overline{\text{LB}}$ and $\overline{\text{UB}}$ = V _{IH}			—	—	2	mA	
I _{DDS2} (Note)		$\overline{\text{CE1}}$ = V _{DD} − 0.2 V or CE2 = 0.2 V or $\overline{\text{LB}}$ and $\overline{\text{UB}}$ = V _{DD} − 0.2 V, V _{DD} = 1.5 V~3.3 V	V _{DD} = 3.0 V	V _{DD} = 3.0 V ± 10%	Ta = 25°C	—	—	1	μA
				Ta = −40~85°C	—	—	10		
				Ta = 25°C	—	0.05	0.5		
				Ta = −40~40°C	—	—	1		
		Ta = −40~85°C	—	—	5				

Note • In standby mode with $\overline{CE1} \geq V_{DD} - 0.2\text{ V}$, these limits are assured for the condition $CE2 \geq V_{DD} - 0.2\text{ V}$ or $CE2 \leq 0.2\text{ V}$.

• In standby mode with \overline{LB} and $\overline{UB} \geq V_{DD} - 0.2\text{ V}$, these limits are assured for the condition $\overline{CE1} \geq V_{DD} - 0.2\text{ V}$ or $\overline{CE1} \leq 0.2\text{ V}$ and $CE2 \geq V_{DD} - 0.2\text{ V}$ or $CE2 \leq 0.2\text{ V}$.

CAPACITANCE ($T_a = 25^\circ\text{C}$, $f = 1\text{ MHz}$)

SYMBOL	PARAMETER	TEST CONDITION	MAX	UNIT
C_{IN}	Input Capacitance	$V_{IN} = \text{GND}$	10	pF
C_{OUT}	Output Capacitance	$V_{OUT} = \text{GND}$	10	pF

Note: This parameter is periodically sampled and is not 100% tested.

AC CHARACTERISTICS AND OPERATING CONDITIONS(Ta = -40° to 85°C, V_{DD} = 2.7 to 3.3 V)**READ CYCLE**

SYMBOL	PARAMETER	TC55W800XB				UNIT
		7		8		
		MIN	MAX	MIN	MAX	
t _{RC}	Read Cycle Time	70	—	85	—	ns
t _{ACC}	Address Access Time	—	70	—	85	
t _{CO1}	Chip Enable($\overline{CE1}$) Access Time	—	70	—	85	
t _{CO2}	Chip Enable(CE2) Access Time	—	70	—	85	
t _{OE}	Output Enable Access Time	—	35	—	45	
t _{BA}	Data Byte Control Access Time	—	70	—	85	
t _{COE}	Chip Enable Low to Output Active	5	—	5	—	
t _{OEE}	Output Enable Low to Output Active	0	—	0	—	
t _{BE}	Data Byte Control Low to Output Active	0	—	0	—	
t _{OD}	Chip Enable High to Output High-Z	—	30	—	35	
t _{ODO}	Output Enable High to Output High-Z	—	30	—	35	
t _{BD}	Data Byte Control High to Output High-Z	—	30	—	35	
t _{OH}	Output Data Hold Time	10	—	10	—	

WRITE CYCLE

SYMBOL	PARAMETER	TC55W800XB				UNIT
		7		8		
		MIN	MAX	MIN	MAX	
t _{WC}	Write Cycle Time	70	—	85	—	ns
t _{WP}	Write Pulse Width	50	—	55	—	
t _{CW}	Chip Enable to End of Write	60	—	70	—	
t _{BW}	Data Byte Control to End of Write	60	—	70	—	
t _{AS}	Address Setup Time	0	—	0	—	
t _{WR}	Write Recovery Time	0	—	0	—	
t _{ODW}	R/W Low to Output High-Z	—	30	—	35	
t _{OEW}	R/W High to Output Active	0	—	0	—	
t _{DS}	Data Setup Time	30	—	35	—	
t _{DH}	Data Hold Time	0	—	0	—	

AC TEST CONDITIONS

PARAMETER	TEST CONDITION
Output load	30 pF + 1 TTL Gate
Input pulse level	0.4 V, 2.4 V
Timing measurements	V _{DD} × 0.5
Reference level	V _{DD} × 0.5
t _R , t _F	5 ns

AC CHARACTERISTICS AND OPERATING CONDITIONS

 (Ta = -40° to 85°C, V_{DD} = 2.3 to 3.3 V)

READ CYCLE

SYMBOL	PARAMETER	TC55W800XB				UNIT
		7		8		
		MIN	MAX	MIN	MAX	
t _{RC}	Read Cycle Time	85	—	100	—	ns
t _{ACC}	Address Access Time	—	85	—	100	
t _{CO1}	Chip Enable($\overline{CE1}$) Access Time	—	85	—	100	
t _{CO2}	Chip Enable(CE2) Access Time	—	85	—	100	
t _{OE}	Output Enable Access Time	—	45	—	50	
t _{BA}	Data Byte Control Access Time	—	85	—	100	
t _{COE}	Chip Enable Low to Output Active	5	—	5	—	
t _{OEE}	Output Enable Low to Output Active	0	—	0	—	
t _{BE}	Data Byte Control Low to Output Active	0	—	0	—	
t _{OD}	Chip Enable High to Output High-Z	—	35	—	40	
t _{ODO}	Output Enable High to Output High-Z	—	35	—	40	
t _{BD}	Data Byte Control High to Output High-Z	—	35	—	40	
t _{OH}	Output Data Hold Time	10	—	10	—	

WRITE CYCLE

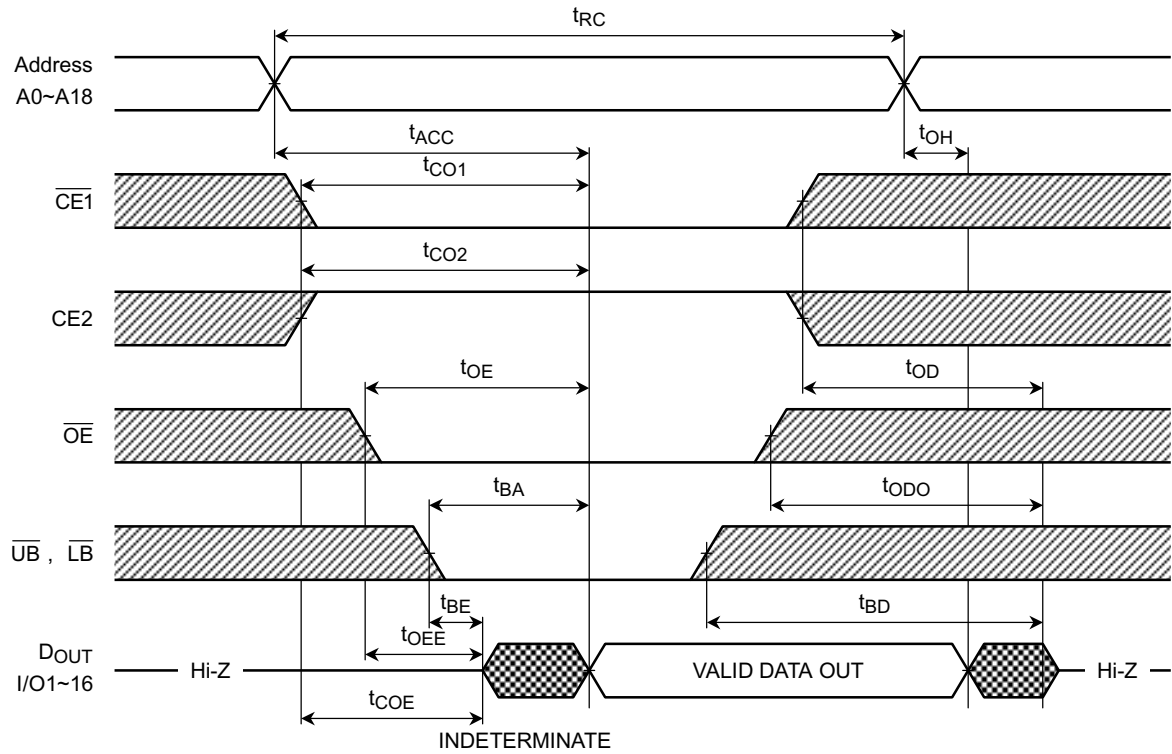
SYMBOL	PARAMETER	TC55W800XB				UNIT
		7		8		
		MIN	MAX	MIN	MAX	
t _{WC}	Write Cycle Time	85	—	100	—	ns
t _{WP}	Write Pulse Width	55	—	60	—	
t _{CW}	Chip Enable to End of Write	70	—	80	—	
t _{BW}	Data Byte Control to End of Write	70	—	80	—	
t _{AS}	Address Setup Time	0	—	0	—	
t _{WR}	Write Recovery Time	0	—	0	—	
t _{ODW}	R/W Low to Output High-Z	—	35	—	40	
t _{OEW}	R/W High to Output Active	0	—	0	—	
t _{DS}	Data Setup Time	35	—	40	—	
t _{DH}	Data Hold Time	0	—	0	—	

AC TEST CONDITIONS

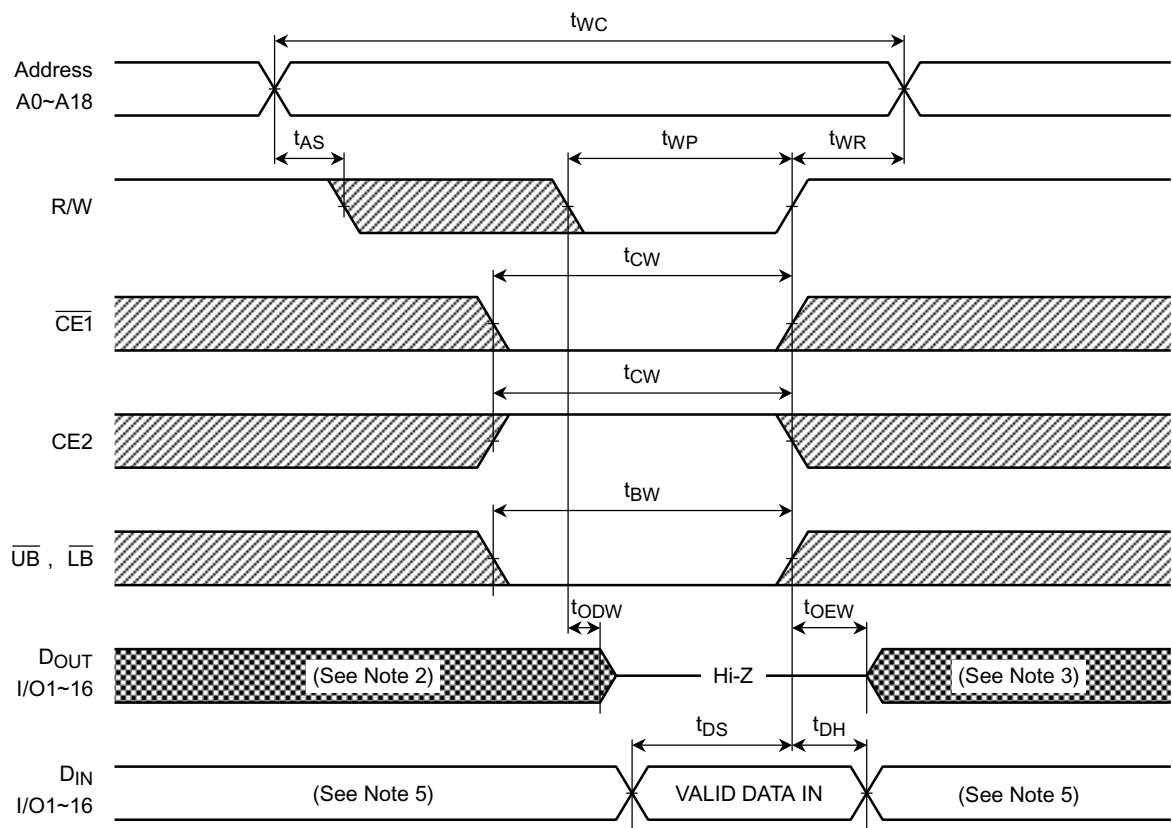
PARAMETER	TEST CONDITION
Output load	30 pF + 1 TTL Gate
Input pulse level	V _{DD} - 0.2 V, 0.2 V
Timing measurements	V _{DD} × 0.5
Reference level	V _{DD} × 0.5
t _R , t _F	5 ns

TIMING DIAGRAMS

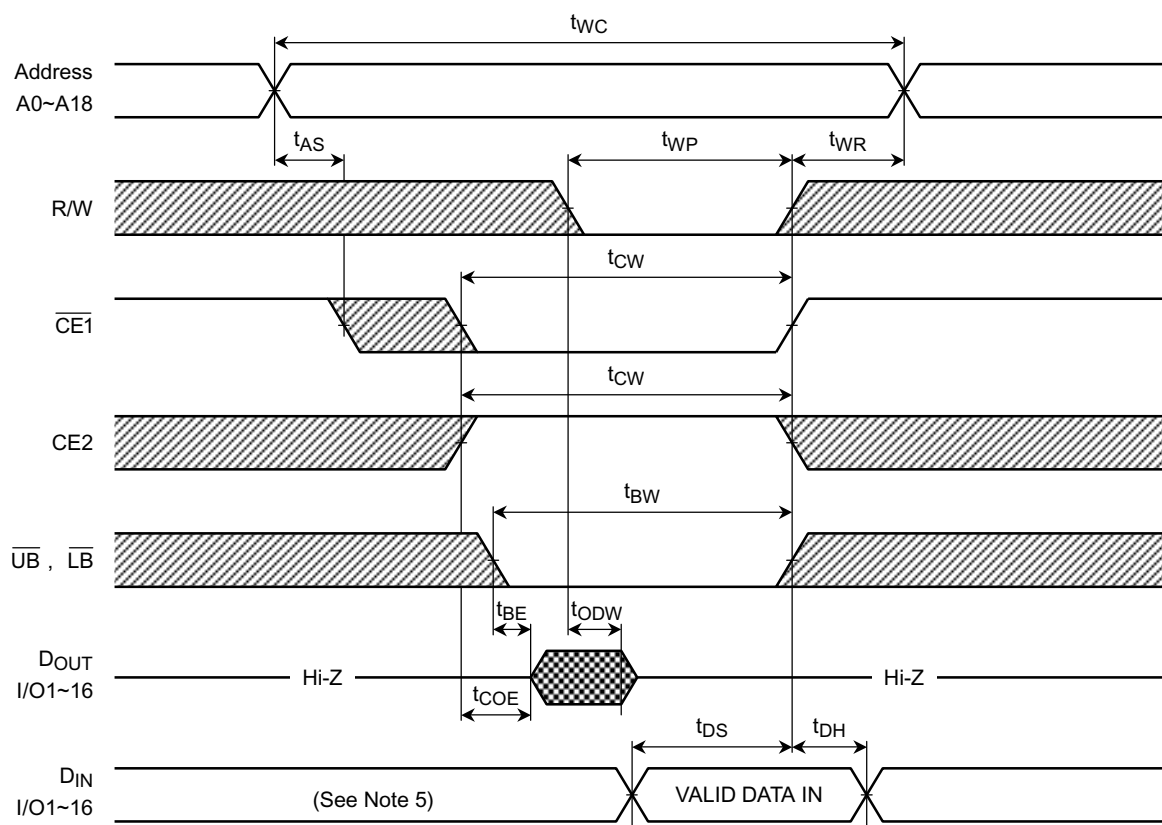
READ CYCLE (See Note 1)



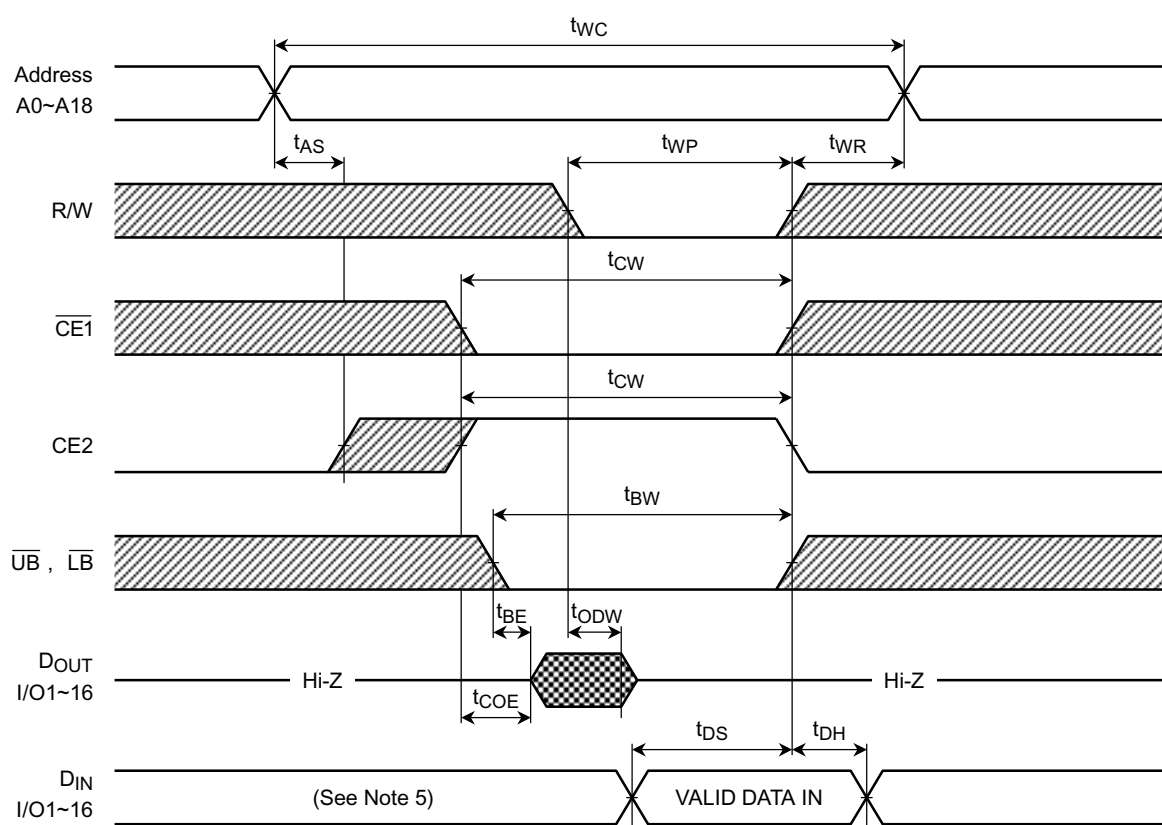
WRITE CYCLE 1 (R/W CONTROLLED) (See Note 4)

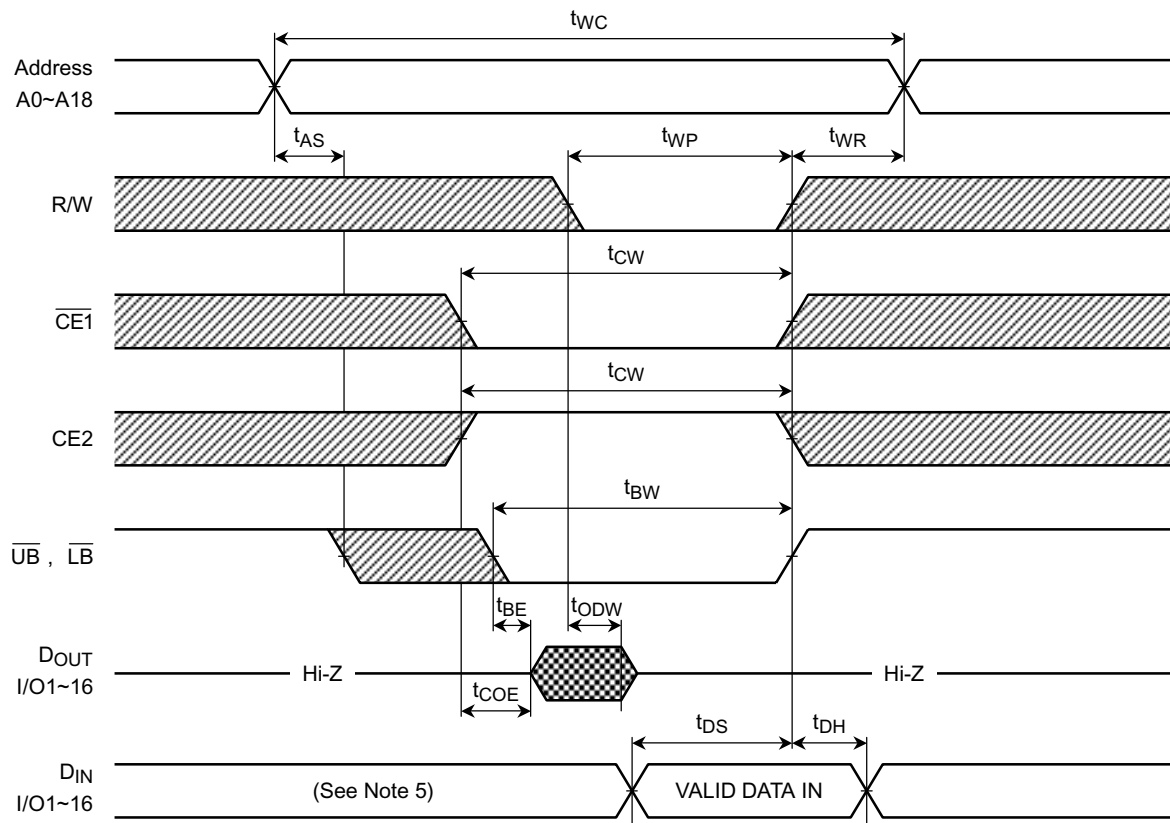


WRITE CYCLE 2 ($\overline{\text{CE1}}$ CONTROLLED) (See Note 4)



WRITE CYCLE 3 (CE2 CONTROLLED) (See Note 4)



WRITE CYCLE 4 (\overline{UB} , \overline{LB} CONTROLLED) (See Note 4)

Note:

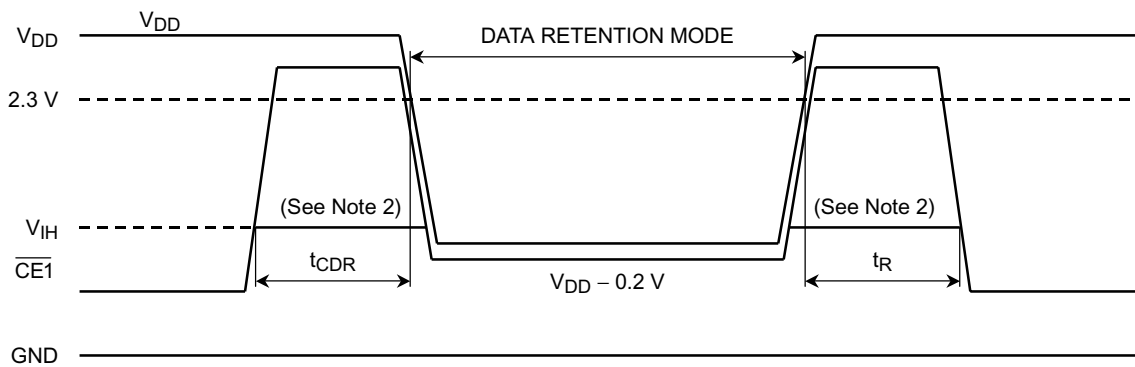
- (1) R/W remains HIGH for the read cycle.
- (2) If $\overline{CE1}$ goes LOW(or CE2 goes HIGH) coincident with or after R/W goes LOW, the outputs will remain at high impedance.
- (3) If $\overline{CE1}$ goes HIGH(or CE2 goes LOW) coincident with or before R/W goes HIGH, the outputs will remain at high impedance.
- (4) If \overline{OE} is HIGH during the write cycle, the outputs will remain at high impedance.
- (5) Because I/O signals may be in the output state at this time, input signals of reverse polarity must not be applied.

DATA RETENTION CHARACTERISTICS (Ta = -40° to 85°C)

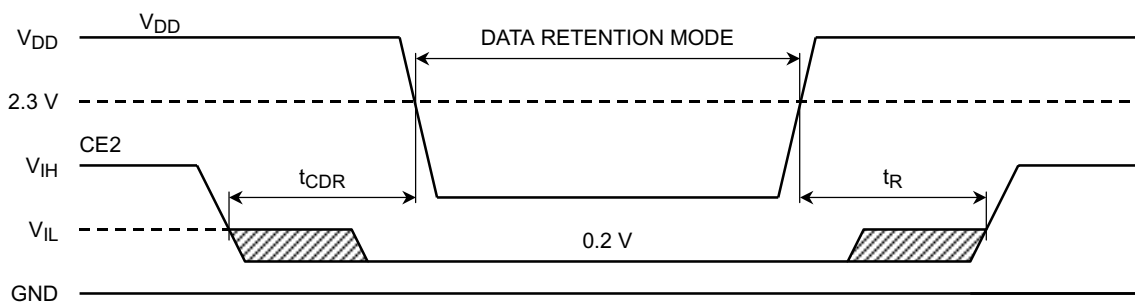
SYMBOL	PARAMETER			MIN	TYP	MAX	UNIT
V _{DH}	Data Retention Supply Voltage			1.5	—	3.3	V
I _{DDS2}	Standby Current	V _{DH} = 3.3 V	Ta = −40~85°C	—	—	10	μA
		V _{DH} = 3.0 V	Ta = −40~40°C	—	—	1	
			Ta = −40~85°C	—	—	5	
t _{CDR}	Chip Deselect to Data Retention Mode Time			0	—	—	ns
t _R	Recovery Time			t _{RC} ^(See Note)	—	—	ns

Note: Read cycle time

CE1 CONTROLLED DATA RETENTION MODE (See Note 1)



CE2 CONTROLLED DATA RETENTION MODE (See Note 3)

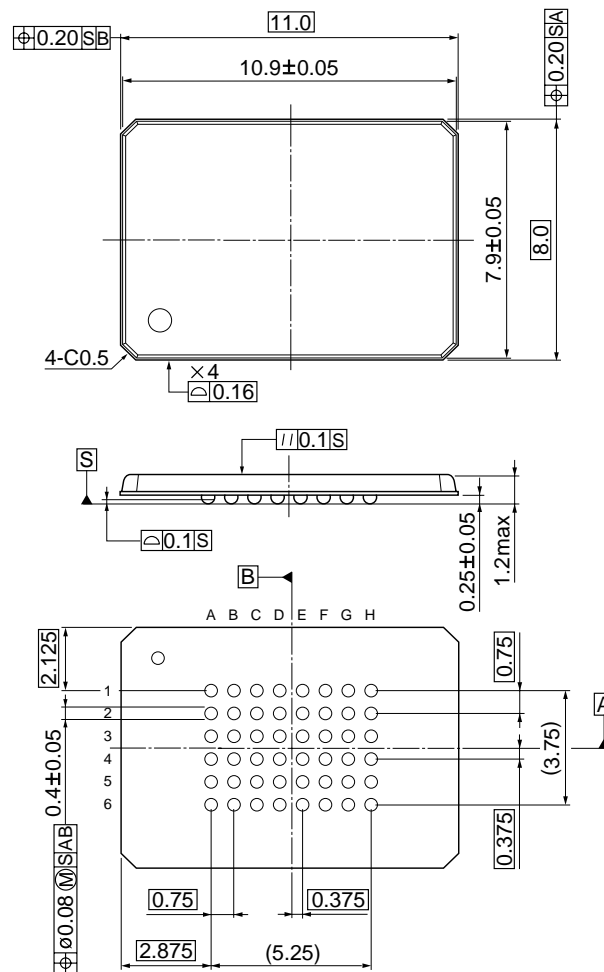


Note:

- (1) In $\overline{\text{CE1}}$ controlled data retention mode, minimum standby current mode is entered when CE2 ≤ 0.2 V or CE2 ≥ V_{DD} - 0.2 V.
- (2) When $\overline{\text{CE1}}$ is operating at the V_{IH} level, the operating current is given by I_{DDS1} during the transition of V_{DD} from 2.3 to 2.2V.
- (3) In CE2 controlled data retention mode, minimum standby current mode is entered when CE2 ≤ 0.2 V.

P-TFBAG48-0811-0.75AZ

Unit: mm



Weight: 0.21 g (typ)

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000707EBA

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