TENTATIVE TOSHIBA MOS DIGITAL INTEGRATED CIRCUIT SILICON GATE CMOS

131,072-WORD BY 16-BIT FULL CMOS STATIC RAM

DESCRIPTION

The TC55V200FT/TR/UB is a 2,097,152-bit static random access memory (SRAM) organized as 131,072 words by 16 bits. Fabricated using Toshiba's CMOS Silicon gate process technology, this device operates from a single 2.7 to 3.6V 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 0.5μA standby current (at V_{DD}=3V, Ta=25°C, maximum) when chip enable ($\overline{CE1}$) is asserted high or (CE2) is asserted low. There are three control inputs. $\overline{CE1}$ and CE2 are used to select the device and for data retention control, and output enable ($\overline{OE}$) provides fast memory access. Data byte control pin ($\overline{LB}$, $\overline{UB}$) 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 range of −40° to 85°C, the TC55V200FT/TR/UB can be used in environments exhibiting extreme temperature conditions. The TC55V200FT/TR/UB is available in normal and reverse pinout plastic 48-pin thin-small-outline package (TSOP) and 48-BGA with 0.75mm ball pitch chip scale package.

FEATURES

- Low-power dissipation
  Operating: 10.8 mW/MHz (typical)
- Single power supply voltage of 2.7 to 3.6V
- Power down features using $\overline{CE1}$ and CE2
- Data retention supply voltage of 1.5 to 3.6V
- Direct TTL compatibility for all inputs and outputs
- Wide operating temperature range of −40° to 85°C
- Standby current (maximum)

3.6V	7 μA
3.0V	5 μA

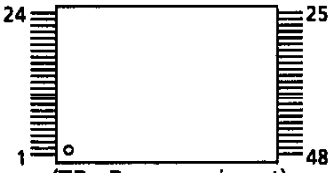
- Access Times (maximum):

	TC55V200FT/TR/UB		
	-70	-85	-10
Access Time	70 ns	85 ns	100 ns
$\overline{CE1}$ Access Time	70 ns	85 ns	100 ns
CE2 Access Time	70 ns	85 ns	100 ns
$\overline{OE}$ Access Time	35 ns	45 ns	50 ns

- Package:
  TSOP I 48-P-1214-0.50 (FT) (Weight:0.38g typ)
  TSOP I 48-P-1214-0.50A (TR) (Weight:0.38g typ)
  P-TFBGA48-0907-0.75AZ (UB) (Weight:0.08g typ)

PIN ASSIGNMENT (TOP VIEW)

(FT : Normal pinout)



(TR : Reverse pinout)

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

(UB : BGA)

PIN NAMES

A0 to A16	Address Inputs
$\overline{CE1}$, CE2	Chip Enable Input
R/W	Read / Write Control Input
$\overline{OE}$	Output Enable Input
$\overline{LB}$, $\overline{UB}$	Data Byte Control Inputs
I/O1 to I/O16	Data Inputs / Outputs
V_{DD}	Power
GND	Ground
NC	No Connection
NU*	Not Used

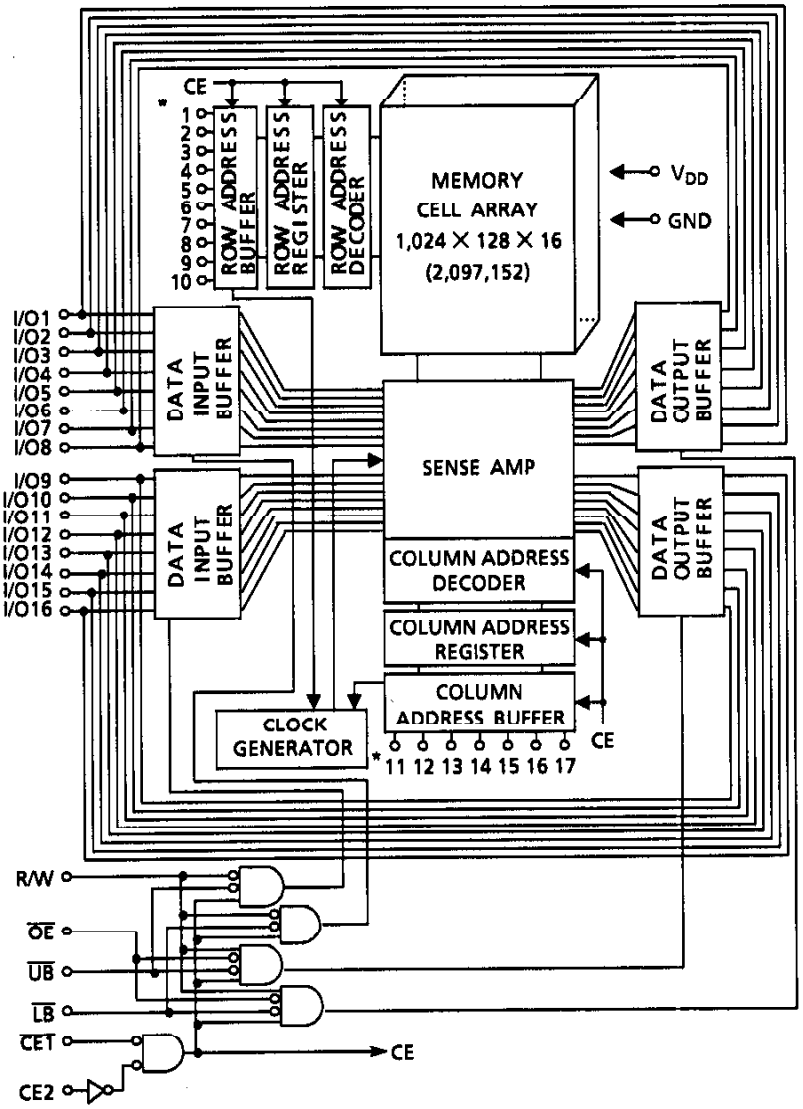
* Input signals of reverse polarity must not be applied.

(TSOP)

Pin No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Pin Name	A15	A14	A13	A12	A11	A10	A9	A8	NC	NC	R/W	CE2	NC	$\overline{UB}$	$\overline{LB}$	NC
Pin No.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Pin Name	NC	A7	A6	A5	A4	A3	A2	A1	A0	$\overline{CE1}$	GND	$\overline{OE}$	I/O1	I/O9	I/O2	I/O10
Pin No.	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Pin Name	I/O3	I/O11	I/O4	I/O12	V_{DD}	I/O5	I/O13	I/O6	I/O14	I/O7	I/O15	I/O8	I/O16	GND	NC	A16

980910EBA1

BLOCK DIAGRAM



*

Address		FT/TR	UB
ROW ADDRESS	1	A4	A3
	2	A5	A4
	3	A6	A5
	4	A7	A6
	5	A8	A7
	6	A9	A8
	7	A10	A9
	8	A11	A10
	9	A12	A11
	10	A13	A13
COLUMN ADDRESS	11	A0	A0
	12	A1	A1
	13	A2	A2
	14	A3	A12
	15	A14	A14
	16	A15	A15
	17	A16	A16

OPERATING MODE

MODE	$\overline{CE1}$	CE2	$\overline{OE}$	R/W	$\overline{LB}$	$\overline{UB}$	I/O1 to I/O8	I/O9 to I/O16	POWER
Read	L	H	L	H	L	L	D_{OUT}	D_{OUT}	I_{DDO}
					H	L	High-Z	D_{OUT}	I_{DDO}
					L	H	D_{OUT}	High-Z	I_{DDO}
Write	L	H	X	L	L	L	D_{IN}	D_{IN}	I_{DDO}
					H	L	High-Z	D_{IN}	I_{DDO}
					L	H	D_{IN}	High-Z	I_{DDO}
Output Deselect	L	H	H	H	X	X	High-Z	High-Z	I_{DDO}
	L	H	X	X	H	H			
Standby	H	X	X	X	X	X	High-Z	High-Z	I_{DDS}
	X	L	X	X	X	X			

Note: X = don't care, H = logic high, L = logic low.

MAXIMUM RATINGS

SYMBOL	RATING	VALUE	UNIT
V_{DD}	Power Supply Voltage	− 0.3 to 4.6	V
V_{IN}	Input Voltage	− 0.3 * to 4.6	V
$V_{I/O}$	Input/Output Voltage	− 0.5 to V_{DD} + 0.5	V
P_D	Power Dissipation	0.6	W
T_{solder}	Soldering Temperature (10 s)	260	°C
T_{strg}	Storage Temperature	− 55 to 150/125 **	°C
T_{opr}	Operating Temperature	− 40 to 85	°C

* − 3.0 V when measured at a pulse width of 30 ns. ** UB

DC RECOMMENDED OPERATING CONDITIONS (Ta = −40° to 85°C)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT
V_{DD}	Power Supply Voltage	2.7	−	3.6	V
V_{IH}	Input High Voltage	2.2	−	V_{DD} + 0.3	V
V_{IL}	Input Low Voltage	− 0.3 *	−	0.6	V
V_{DH}	Data Retention Supply Voltage	1.5	−	3.6	V

* − 3.0 V when measured at a pulse width of 30 ns.

DC CHARACTERISTICS (Ta = −40° to 85°C, V_{DD} = 2.7 to 3.6V)

SYMBOL	PARAMETER	TEST CONDITION				MIN	TYP	MAX	UNIT
I_{IL}	Input Leakage Current	V_{IN} = 0 V to 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	$\overline{CE1}$ = V_{IH} or CE2 = V_{IL} or R/W = V_{IL} or $\overline{OE}$ = V_{IH} V_{OUT} = 0 V to V_{DD}				−	−	±1.0	μA
I_{DDO1}	Operating Current	$\overline{CE1}$ = V_{IL} and CE2 = V_{IH} and R/W = V_{IH} and I_{OUT} = 0 mA Other Input = V_{IH}/V_{IL}	V_{DD} = 3 V ± 10%	Tcycle = min	-70	−	−	50	mA
					-85,-10	−	−	45	
				Tcycle = 1μs		−	−	10	
			V_{DD} = 3.3 V ± 0.3 V	Tcycle = min	-70	−	−	55	
					-85,-10	−	−	50	
				Tcycle = 1μs		−	−	12	
I_{DDO2}		$\overline{CE1}$ = 0.2 V and CE2 = V_{DD} − 0.2 V and R/W = V_{DD} − 0.2 V, I_{OUT} = 0 mA Other Inputs = V_{DD}−0.2V/0.2V	V_{DD} = 3 V ± 10%	Tcycle = min	-70	−	−	45	
					-85,-10	−	−	40	
				Tcycle = 1μs		−	−	5	
			V_{DD} = 3.3 V ± 0.3 V	Tcycle = min	-70	−	−	50	
					-85,-10	−	−	45	
				Tcycle = 1μs		−	−	6	
I_{DDS1}	Standby Current	$\overline{CE1}$ = V_{IH} or CE2 = V_{IL}				−	−	2	mA
I_{DDS2} (Note)		$\overline{CE1}$ = V_{DD} − 0.2 V or CE2 = 0.2 V V_{DD} = 1.5 to 3.6 V	V_{DD} = 3 V ± 10%	Ta = 25°C		−	−	0.6	μA
				Ta = −40 to 85°C		−	−	6	
			V_{DD} = 3.3 V ± 0.3 V	Ta = 25°C		−	−	0.7	
				Ta = −40 to 85°C		−	−	7	
			V_{DD} = 3 V	Ta = 25°C		−	0.05	0.5	
				Ta = −40 to 40°C		−	−	1	
				Ta = −40 to 85°C		−	−	5	

Note: In standby mode with $\overline{CE1} \geqq V_{DD}-0.2V$, these limits are assured for the condition $CE2 \geqq V_{DD}-0.2V$ or $CE2 \leqq 0.2V$.

CAPACITANCE (Ta = 25°C, f = 1 MHz)

SYMBOL	PARAMETER	TEST CONDITION	MAX	UNIT
C_{IN}	Input Capacitance	V_{IN} = GND	10	pF
C_{OUT}	Output Capacitance	V_{OUT} = 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 3.6V)

READ CYCLE

SYMBOL	PARAMETER	TC55V200FT/TR/UB						UNIT
		-70		-85		-10		
		MIN	MAX	MIN	MAX	MIN	MAX	
t_{RC}	Read Cycle Time	70	—	85	—	100	—	ns
t_{ACC}	Address Access Time	—	70	—	85	—	100	
t_{CO1}	Chip Enable ($\overline{CE1}$) Access Time	—	70	—	85	—	100	
t_{CO2}	Chip Enable (CE2) Access Time	—	70	—	85	—	100	
t_{OE}	Output Enable Access Time	—	35	—	45	—	50	
t_{BA}	Data Byte Control Access Time	—	35	—	45	—	50	
t_{COE}	Chip Enable Low to Output Active	5	—	5	—	5	—	
t_{OEE}	Output Enable Low to Output Active	0	—	0	—	0	—	
t_{BE}	Data Byte Control Low to Output Active	0	—	0	—	0	—	
t_{OD}	Chip Enable High to Output High-Z	—	30	—	35	—	40	
t_{ODO}	Output Enable High to Output High-Z	—	30	—	35	—	40	
t_{BD}	Data Byte Control High to Output High-Z	—	30	—	35	—	40	
t_{OH}	Output Data Hold Time	10	—	10	—	10	—	

WRITE CYCLE

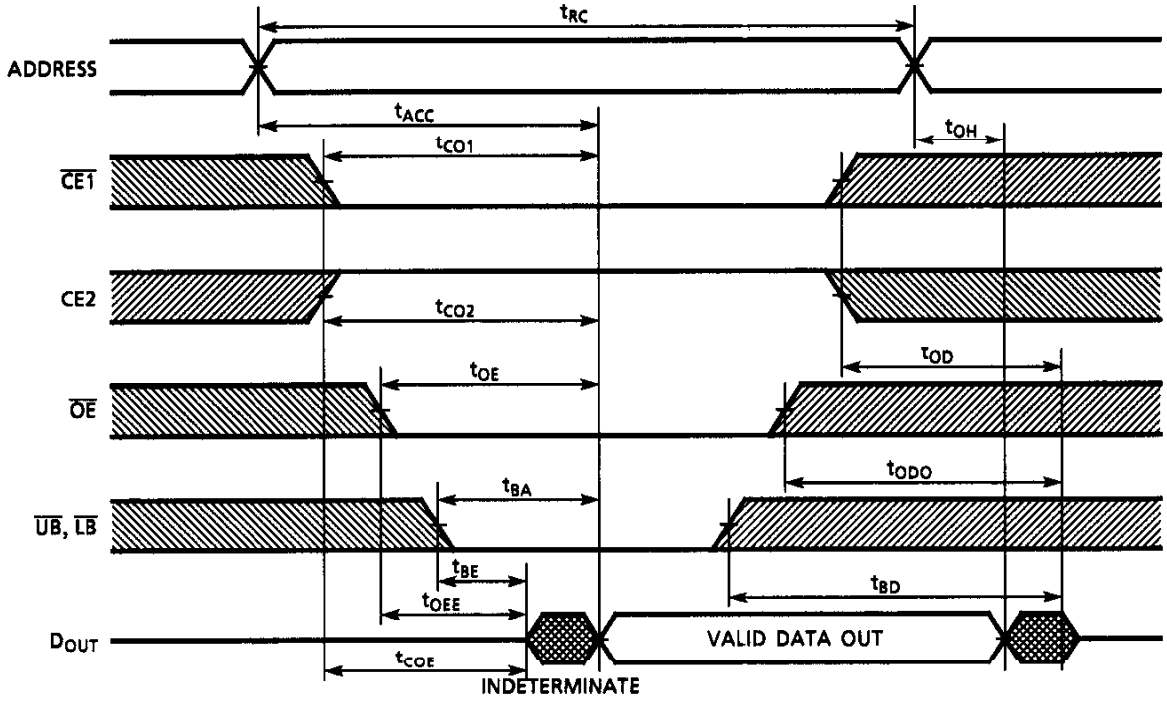
SYMBOL	PARAMETER	TC55V200FT/TR/UB						UNIT
		-70		-85		-10		
		MIN	MAX	MIN	MAX	MIN	MAX	
t_{WC}	Write Cycle Time	70	—	85	—	100	—	ns
t_{WP}	Write Pulse Width	50	—	55	—	60	—	
t_{CW}	Chip Enable to End of Write	60	—	70	—	80	—	
t_{BW}	Data Byte Control to End of Write	50	—	55	—	60	—	
t_{AS}	Address Setup Time	0	—	0	—	0	—	
t_{WR}	Write Recovery Time	0	—	0	—	0	—	
t_{ODW}	R/W Low to Output High-Z	—	30	—	35	—	40	
t_{OEW}	R/W High to Output Active	0	—	0	—	0	—	
t_{DS}	Data Setup Time	30	—	35	—	40	—	
t_{DH}	Data Hold Time	0	—	0	—	0	—	

AC TEST CONDITIONS

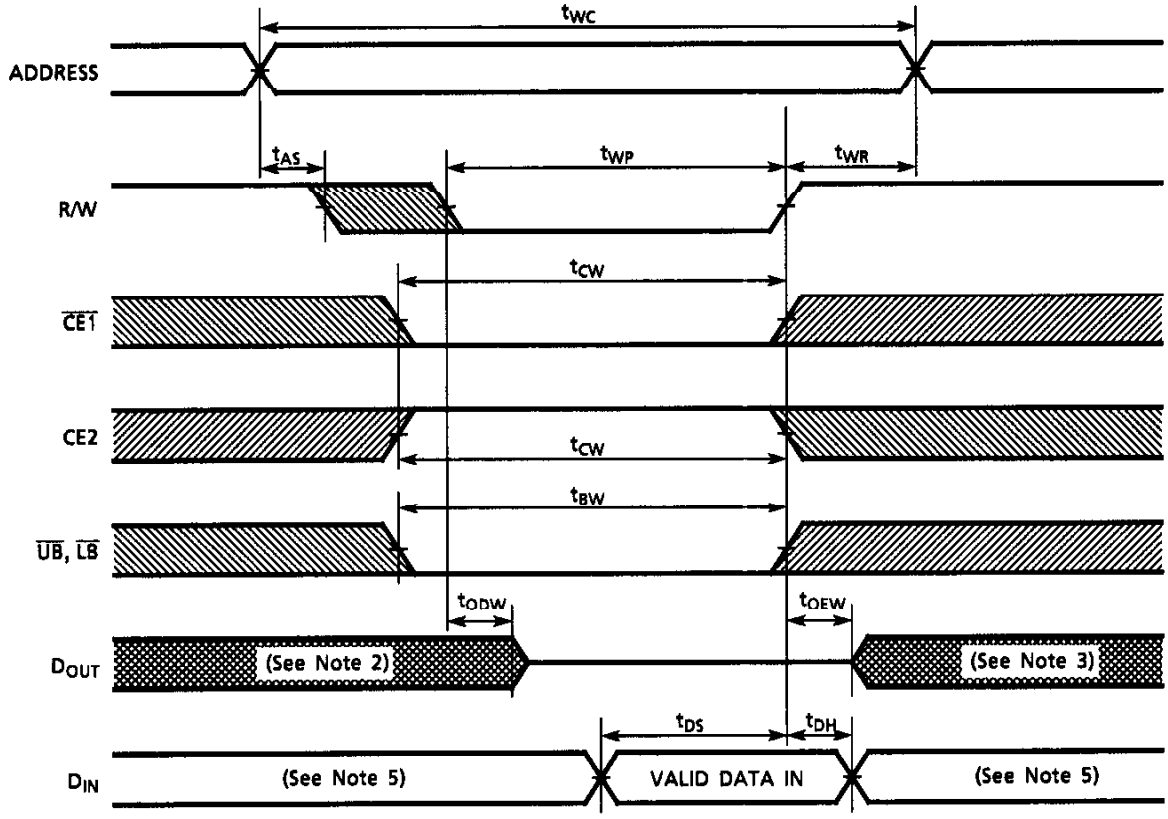
Output load: 30 pF + one TTL gate (-70)
: 100 pF + one TTL gate (-85, -10)
Input pulse level: 0.4 V, 2.4 V
Timing measurements: 1.5 V
Reference level: $V_{DD} \times 0.5$
t_R, t_F: 5 ns

TIMING DIAGRAMS

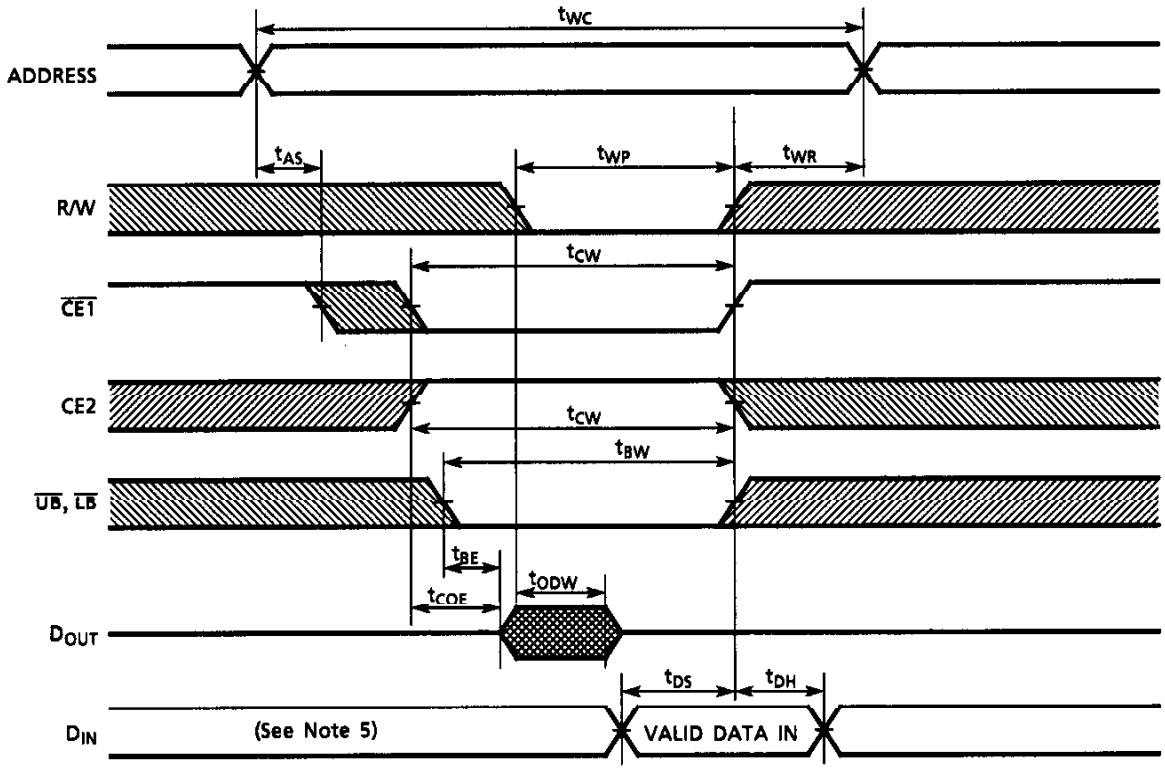
READ CYCLE (See Note 1)



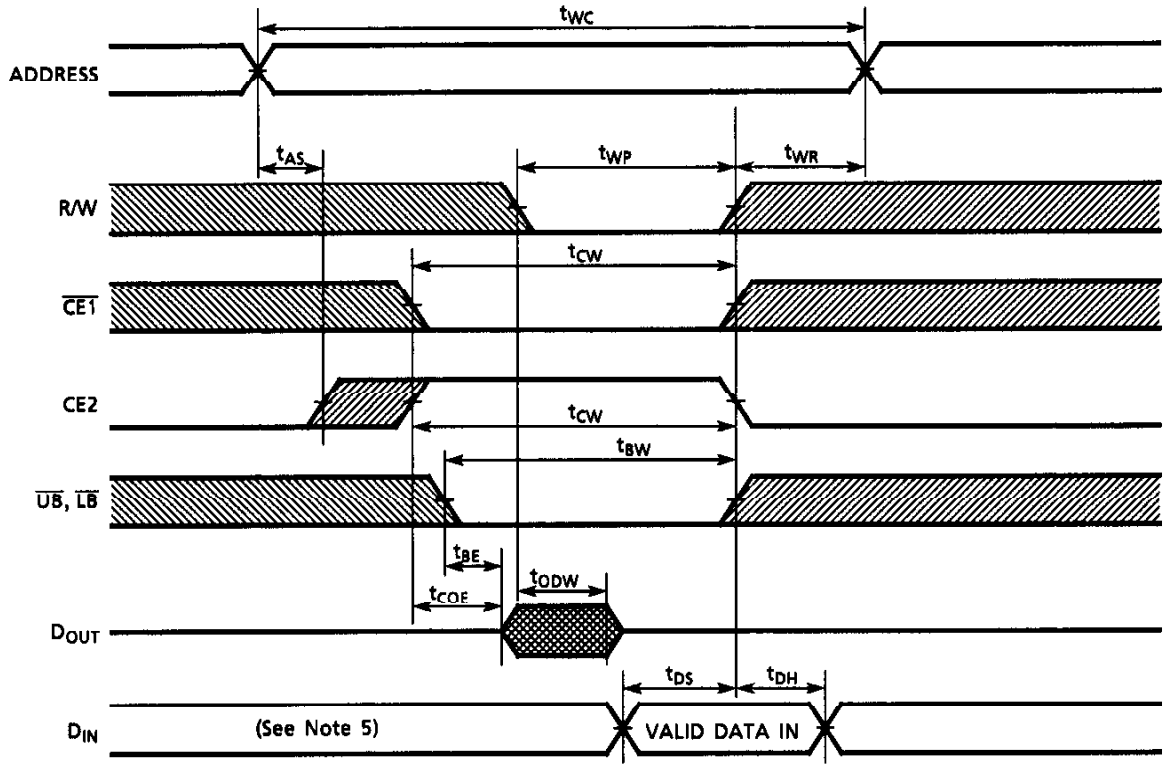
WRITE CYCLE 1 (R/W CONTROLLED) (See Note 4)



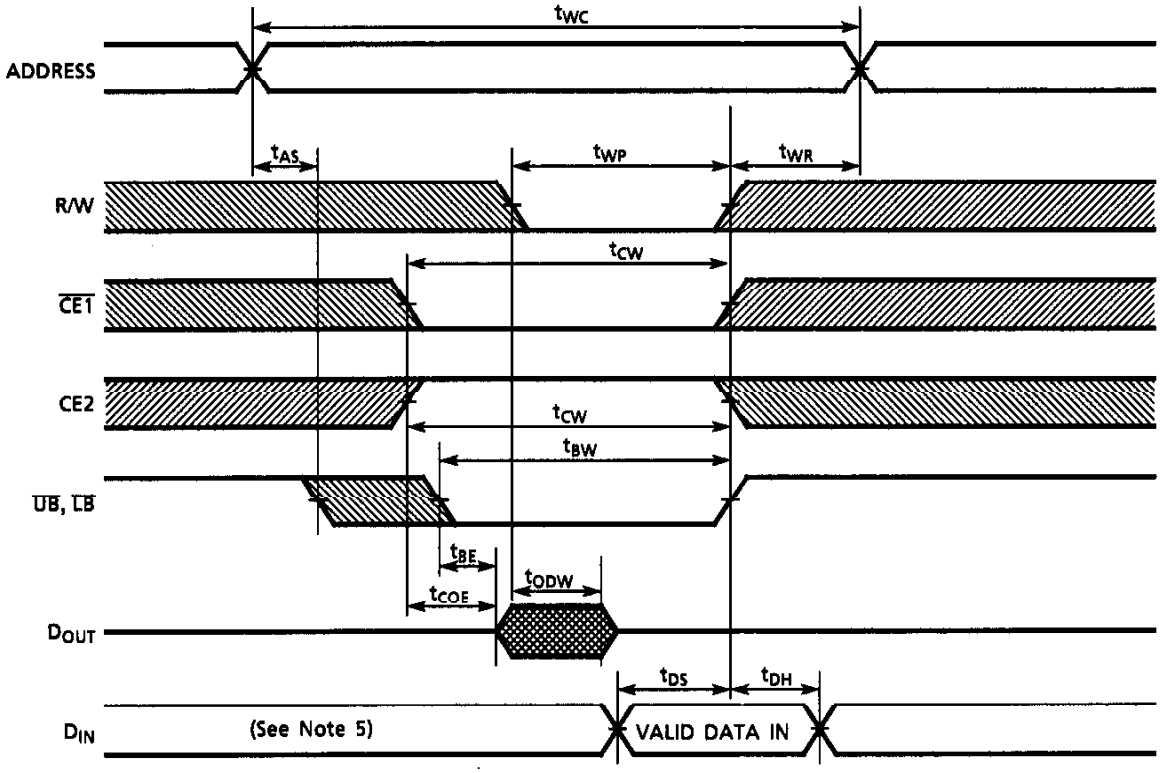
WRITE CYCLE 2 ($\overline{CE1}$ CONTROLLED) (See Note 4)



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.

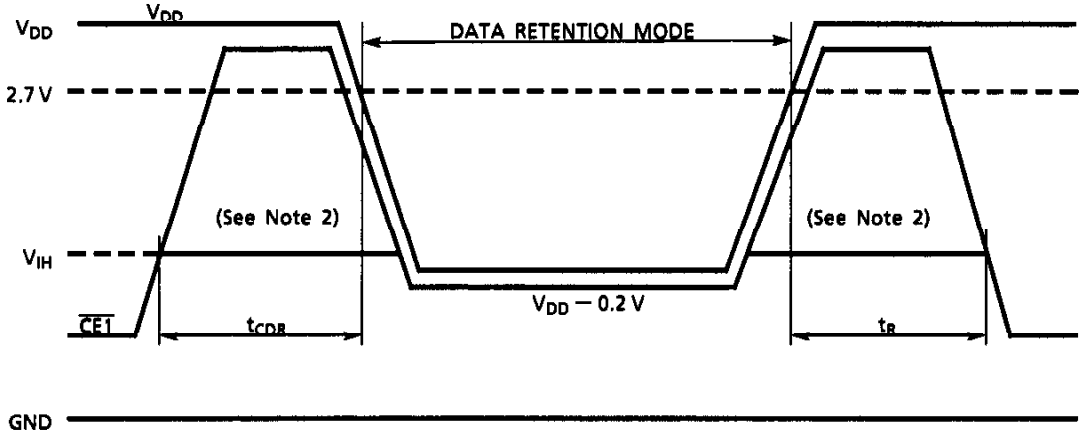
(5) Because I/O signals may be in the output state at this time, input signals of reverse polarity must not be applied.

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

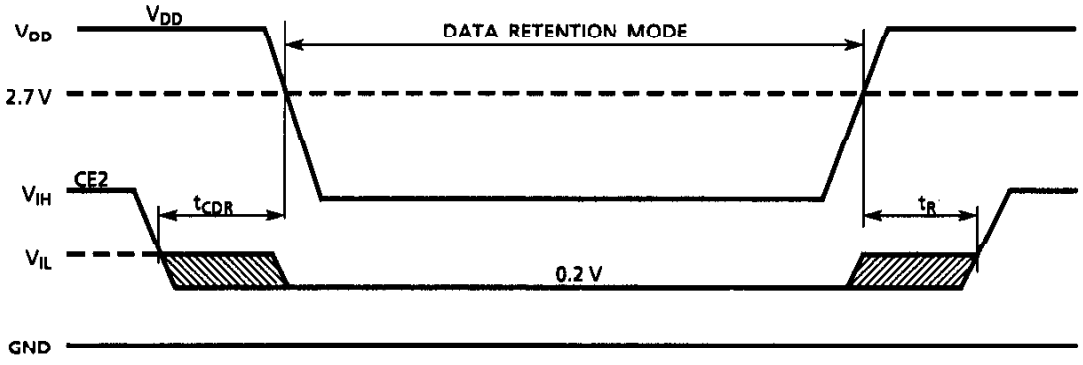
SYMBOL	PARAMETER			MIN	TYP	MAX	UNIT
V_{DH}	Data Retention Supply Voltage			1.5	—	3.6	V
I_{DDS2}	Standby Current	V_{DH} = 3.0 V	Ta = −40° to 40°C	—	—	1	μA
			Ta = −40° to 85°C	—	—	5	
		V_{DH} = 3.6 V	Ta = −40° to 85°C	—	—	7	
t_{CDR}	Chip Deselect to Data Retention Mode Time			0	—	—	nS
t_R	Recovery Time			t_{RC} (See Note)	—	—	nS

Note: Read cycle time

$\overline{CE1}$ CONTROLLED DATA RETENTION MODE (See Note 1)



CE2 CONTROLLED DATA RETENTION MODE (See Note 3)



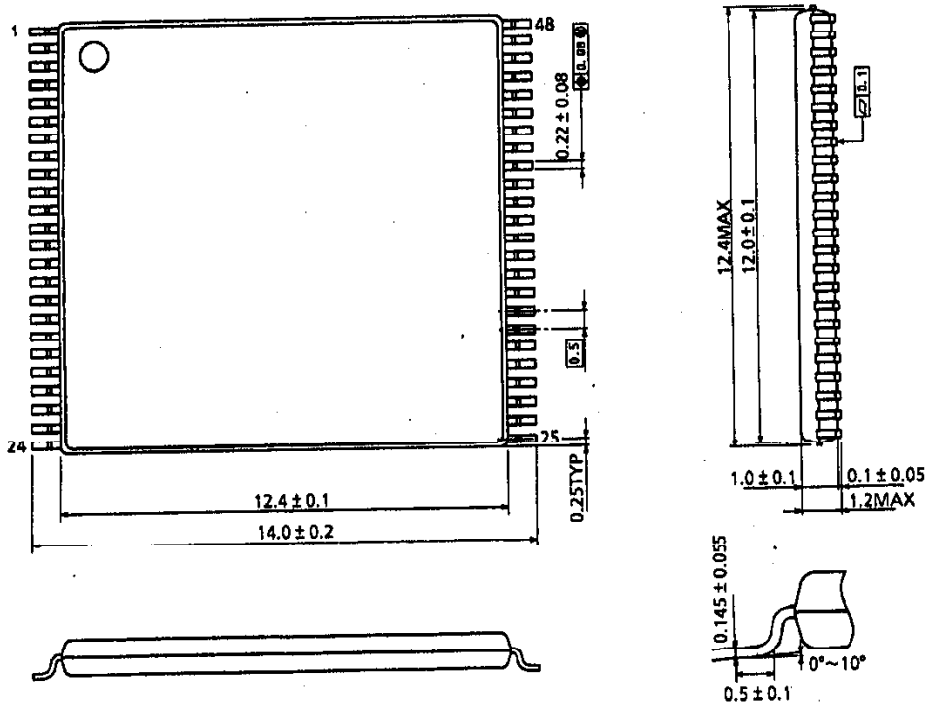
Note: (1) In $\overline{CE1}$ controlled data retention mode, minimum standby current mode is entered when CE2 ≦ 0.2 V or CE2 ≧ V_{DD} − 0.2 V.

(2) When $\overline{CE1}$ is operating at the V_{IH} level (2.2 V), the operating current is given by I_{DDS1} during the transition of V_{DD} from 3.6 to 2.4 V.

(3) In CE2 controlled data retention mode, minimum standby current mode is entered when CE2 ≦ 0.2 V.

PACKAGE DIMENSIONS (TSOP I 48-P-1214-0.50)

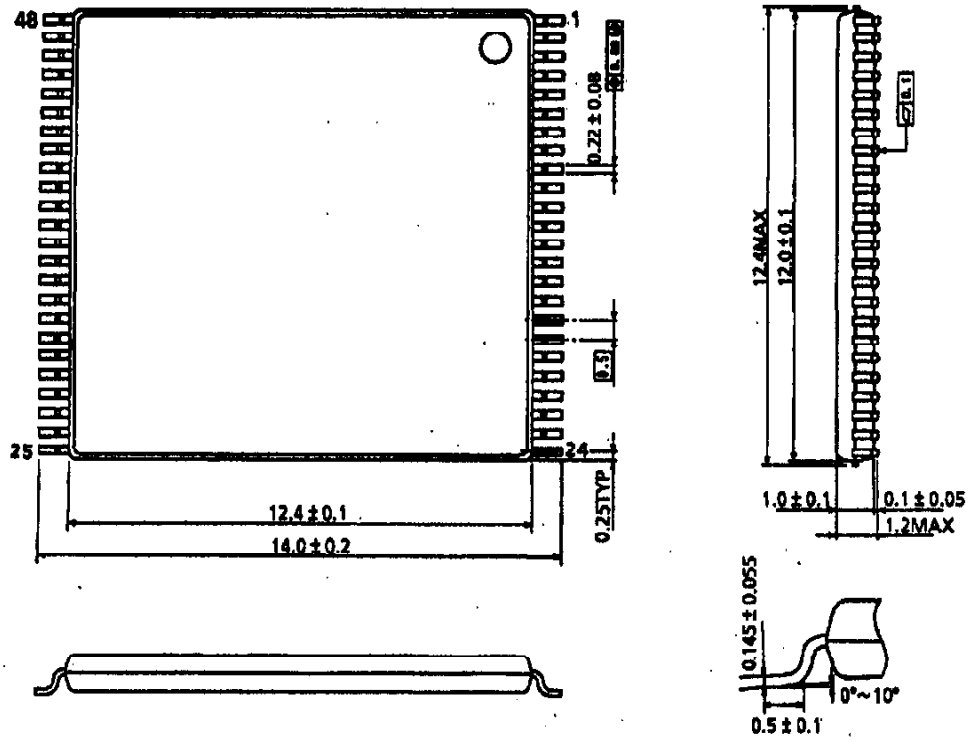
Units in mm



Weight: 0.38 g (typ)

PACKAGE DIMENSIONS (TSOP I 48-P-1214-0.5A)

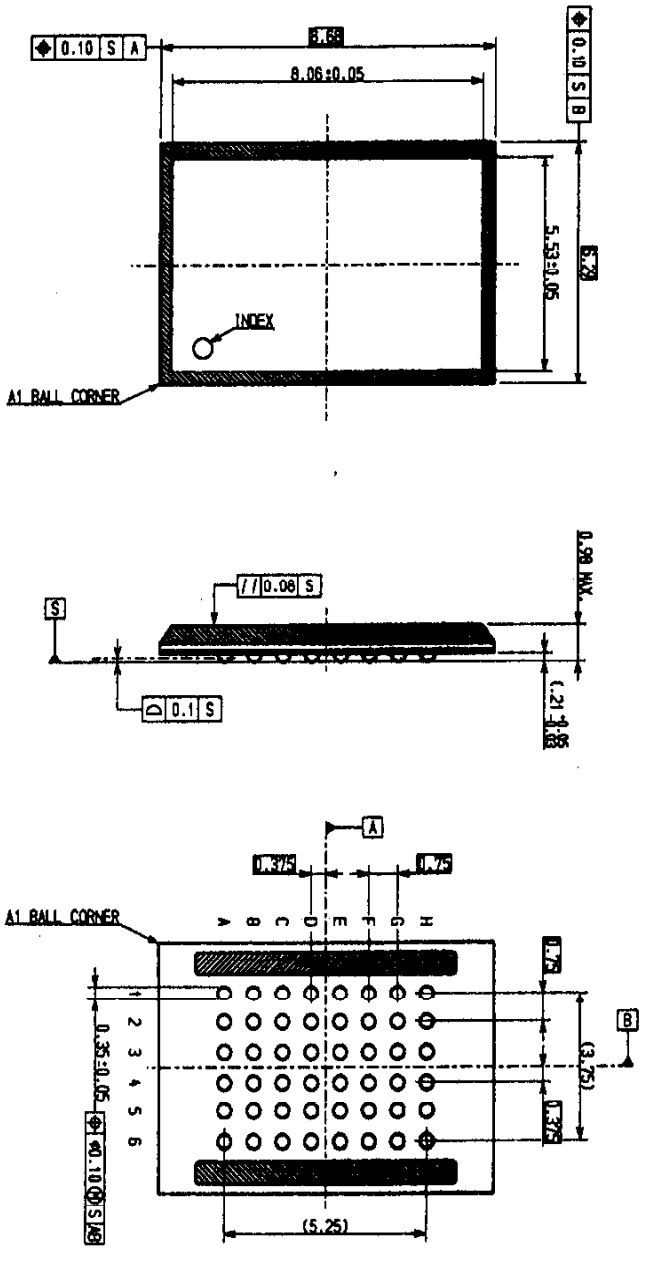
Units in mm



Weight: 0.38 g (typ)

PACKAGE DIMENSIONS (P-TFBGA48-0907-0.75AZ)

Units in mm



Weight: 0.08 g (typ)