

## TENTATIVE

## TOSHIBA MOS DIGITAL INTEGRATED CIRCUIT SILICON GATE CMOS

131,072-WORD BY 8-BIT STATIC RAM

## DESCRIPTION

The TC551001CPI/CFI/CFTI/CTRI/CSTI/CSRI is a 1,048,576-bit static random access memory (SRAM) organized as 131,072 words by 8 bits. Fabricated using Toshiba's CMOS Silicon gate process technology, this device operates from a single  $5\text{ V} \pm 10\%$  power supply. Advanced circuit technology provides both high speed and low power at an operating current of  $5\text{ mA/MHz}$  (typ) and a minimum cycle time of  $70\text{ ns}$ . It is automatically placed in low-power mode at  $1\text{ }\mu\text{A}$  standby current (typ) when chip enable (CE1) is asserted high or (CE2) is asserted low. There are three control inputs. CE1 and CE2 are used to select the device and for data retention control, and output enable (OE) provides fast memory 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  $-40^\circ$  to  $85^\circ\text{C}$ , the TC551001CPI/CFI/CFTI/CTRI/CSTI/CSRI can be used in environments exhibiting extreme temperature conditions. The TC551001CPI/CFI/CFTI/CTRI/CSTI/CSRI is available in a standard plastic 32-pin dual-in-line package (DIP), plastic 32-pin small-outline package (SOP) and normal and reverse pinout plastic 32-pin thin-small-outline package (TSOP).

## FEATURES

- Low-power dissipation  
Operating:  $27.5\text{ mW/MHz}$  (typical)
- Single power supply voltage of  $5\text{ V} \pm 10\%$
- Power down features using CE1 and CE2.
- Data retention supply voltage of 2 to 5.5 V
- Direct TTL compatibility for all inputs and outputs
- Wide operating temperature range of  $-40^\circ$  to  $85^\circ\text{C}$

- Standby Current (maximum) :

	TC551001CPI/CFI/CFTI/CTRI/CSTI/CSRI	
	-70, -85	-70L, -85L
5.5V	$200\text{ }\mu\text{A}$	$40\text{ }\mu\text{A}$
3.0V	$100\text{ }\mu\text{A}$	$20\text{ }\mu\text{A}$

- Access Times (maximum):

	TC551001CPI/CFI/CFTI/CTRI/CSTI/CSRI	
	-70, -70L	-85, -85L
Access Time	$70\text{ ns}$	$85\text{ ns}$
CE1 Access Time	$70\text{ ns}$	$85\text{ ns}$
CE2 Access Time	$70\text{ ns}$	$85\text{ ns}$
OE Access Time	$35\text{ ns}$	$45\text{ ns}$

- Packages:

DIP32-P-600-2.54 (CPI)	(Weight: $4.45\text{ g typ}$ )
SOP32-P-525-1.27 (CFI)	(Weight: $1.04\text{ g typ}$ )
TSOP I 32-P-0820-0.50 (CFTI)	(Weight: $0.34\text{ g typ}$ )
TSOP I 32-P-0820-0.50A (CTRI)	(Weight: $0.34\text{ g typ}$ )
TSOP I 32-P-0.50 (CSTI)	(Weight: $0.24\text{ g typ}$ )
TSOP I 32-P-0.50A (CSRI)	(Weight: $0.24\text{ g typ}$ )

## PIN ASSIGNMENT (TOP VIEW)

## ○ 32 PIN DIP &amp; SOP

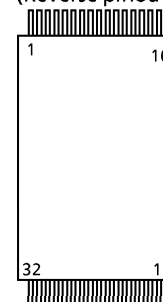
NC	1	32	$V_{DD}$
A16	2	31	A15
A14	3	30	CE2
A12	4	29	R/W
A7	5	28	A13
A6	6	27	A8
A5	7	26	A9
A4	8	25	A11
A3	9	24	OE
A2	10	23	A10
A1	11	22	CE1
A0	12	21	I/O8
I/O1	13	20	I/O7
I/O2	14	19	I/O6
I/O3	15	18	I/O5
GND	16	17	I/O4

## ○ 32 PIN TSOP

(Normal pinout)



(Reverse pinout)



## PIN NAMES

A0 to A16	Address Inputs
R/W	Read/Write Control
OE	Output Enable
CE1, CE2	Chip Enable
I/O1 to I/O8	Data Input/Output
$V_{DD}$	Power (+ 5 V)
GND	Ground
NC	No Connection

Pin No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Pin Name	A <sub>11</sub>	A <sub>9</sub>	A <sub>8</sub>	A <sub>13</sub>	R/W	CE2	A <sub>15</sub>	$V_{DD}$	NC	A <sub>16</sub>	A <sub>14</sub>	A <sub>12</sub>	A <sub>7</sub>	A <sub>6</sub>	A <sub>5</sub>	A <sub>4</sub>
Pin No.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Pin Name	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>	I/O1	I/O2	I/O3	GND	I/O4	I/O5	I/O6	I/O7	I/O8	CE1	A <sub>10</sub>	OE

961001EBA1

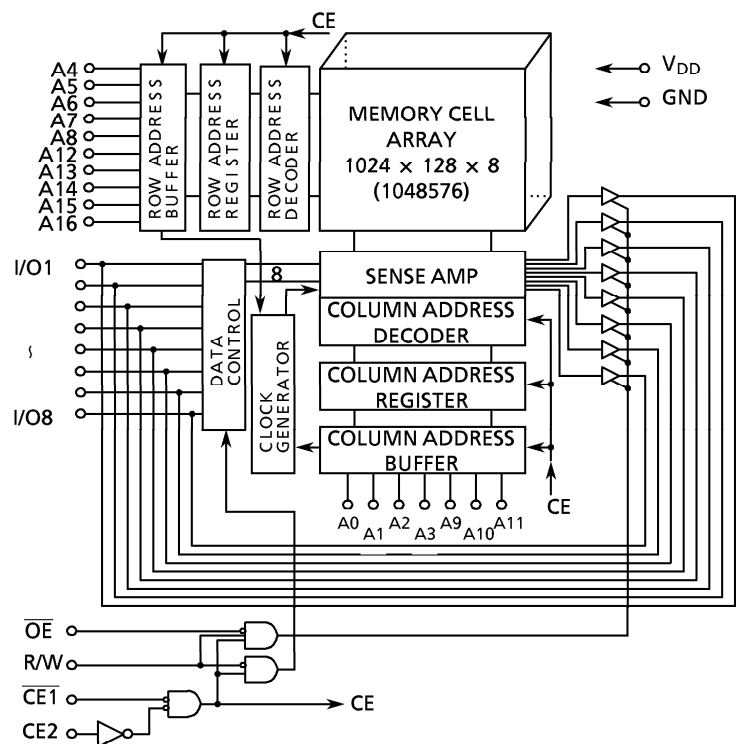
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**BLOCK DIAGRAM**



**OPERATION MODE**

MODE	CE1	CE2	OE	R/W	I/O1 to I/O8	POWER
Read	L	H	L	H	D <sub>OUT</sub>	I <sub>DDO</sub>
Write	L	H	x	L	D <sub>IN</sub>	I <sub>DDO</sub>
Outputs Disabled	L	H	H	H	High-Z	I <sub>DDO</sub>
Standby	H	x	x	x	High-Z	I <sub>DDS</sub>
	x	L	x	x	High-Z	I <sub>DDS</sub>

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

**ABSOLUTE MAXIMUM RATINGS**

SYMBOL	RATING	VALUE	UNIT
V <sub>DD</sub>	Power Supply Voltage	- 0.3 to 7.0	V
V <sub>IN</sub>	Input Voltage	- 0.3* to 7.0	V
V <sub>I/O</sub>	Input and Output Voltage	- 0.5 to V <sub>DD</sub> + 0.5	V
P <sub>D</sub>	Power Dissipation	1.0/0.6**	W
T <sub>solder</sub>	Soldering Temperature (10 s)	260	°C
T <sub>strg.</sub>	Storage Temperature	- 55 to 150	°C
T <sub>opr.</sub>	Operating Temperature	- 40 to 85	°C

\* - 3.0 V when measured at a pulse width of 50 ns

\*\* SOP

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

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT
$V_{DD}$	Power Supply Voltage	4.5	5.0	5.5	V
$V_{IH}$	Input High Voltage	2.4	–	$V_{DD} + 0.3$	
$V_{IL}$	Input Low Voltage	$-0.3^*$	–	0.6	
$V_{DH}$	Data Retention Supply Voltage	2.0	–	5.5	

\*  $-3.0\text{ V}$  when measured at a pulse width of 50 nsDC CHARACTERISTICS ( $T_a = -40^\circ$  to  $85^\circ\text{C}$ ,  $V_{DD} = 5\text{ V} \pm 10\%$ )

SYMBOL	PARAMETER	TEST CONDITION			MIN	TYP	MAX	UNIT	
I <sub>IL</sub>	Input Leakage Current	V <sub>IN</sub> = 0 V to V <sub>DD</sub>			–	–	± 1.0	μA	
I <sub>OH</sub>	Output High Current	V <sub>OH</sub> = 2.4 V			– 1.0	–	–	mA	
I <sub>OL</sub>	Output Low Current	V <sub>OL</sub> = 0.4 V			4.0	–	–	mA	
I <sub>LO</sub>	Output Leakage Current	$\overline{CE1} = V_{IH}$ or CE2 = V <sub>IL</sub> or R/W = V <sub>IL</sub> or $\overline{OE} = V_{IH}$ , V <sub>OUT</sub> = 0 V to V <sub>DD</sub>			–	–	± 1.0	μA	
I <sub>DDO1</sub>	Operating Current	$\overline{CE1} = V_{IL}$ and CE2 = V <sub>IH</sub> and R/W = V <sub>IH</sub> , I <sub>OUT</sub> = 0 mA Other Inputs = V <sub>IH</sub> /V <sub>IL</sub>		Tcycle	min	–	–	70	mA
1 μs					–	–	20		
I <sub>DDO2</sub>		$\overline{CE1} = 0.2\text{ V}$ and CE2 = V <sub>DD</sub> – 0.2 V R/W = V <sub>DD</sub> – 0.2 V, I <sub>OUT</sub> = 0 mA Other Inputs = V <sub>DD</sub> – 0.2 V/0.2 V		Tcycle	min	–	–	60	mA
1 μs					–	–	10		
I <sub>DDS1</sub>	Standby Current	$\overline{CE1} = V_{IH}$ or CE2 = V <sub>IL</sub>			–	–	3	mA	
I <sub>DDS2</sub> (Note)		$\overline{CE1} = V_{DD} - 0.2\text{ V}$ or CE2 = 0.2 V V <sub>DD</sub> = 2.0 to 5.5 V	-70, -85	Ta = 25°C		–	1	–	μA
				Ta = –40° to 85°C		–	–	200	
		-70L, -85L	Ta = 25°C		–	1	2		
			Ta = –40° to 85°C		–	–	40		

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  $CE2 \leq 0.2\text{ V}$ .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	

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

**AC CHARACTERISTICS AND OPERATING CONDITIONS** ( $T_a = -40^\circ$  to  $85^\circ\text{C}$ ,  $V_{DD} = 5\text{ V} \pm 10\%$ )

**READ CYCLE**

SYMBOL	PARAMETER	TC551001CPI/CFI/CFTI/CTRI/CSTI/CSRI				UNIT
		-70, -70L		-85, -85L		
		MIN	MAX	MIN	MAX	
t <sub>RC</sub>	Read Cycle Time	70	–	85	–	ns
t <sub>ACC</sub>	Address Access Time	–	70	–	85	
t <sub>CO1</sub>	Chip Enable (CE1) Access Time	–	70	–	85	
t <sub>CO2</sub>	Chip Enable (CE2) Access Time	–	70	–	85	
t <sub>OE</sub>	Output Enable Access Time	–	35	–	45	
t <sub>COE</sub>	Chip Enable Low to Output Active	5	–	5	–	
t <sub>OEE</sub>	Output Enable Low to Output Active	0	–	0	–	
t <sub>OD</sub>	Chip Enable High to Output High-Z	–	30	–	35	
t <sub>ODO</sub>	Output Enable High to Output High-Z	–	30	–	35	
t <sub>OH</sub>	Output Data Hold Time	10	–	10	–	

**WRITE CYCLE**

SYMBOL	PARAMETER	TC551001CPI/CFI/CFTI/CTRI/CSTI/CSRI				UNIT
		-70, -70L		-85, -85L		
		MIN	MAX	MIN	MAX	
t <sub>WC</sub>	Write Cycle Time	70	–	85	–	ns
t <sub>WP</sub>	Write Pulse Width	50	–	60	–	
t <sub>CW</sub>	Chip Enable to End of Write	60	–	75	–	
t <sub>AS</sub>	Address Setup Time	0	–	0	–	
t <sub>WR</sub>	Write Recovery Time	0	–	0	–	
t <sub>ODW</sub>	R/W Low to Output High-Z	–	30	–	35	
t <sub>OEW</sub>	R/W High to Output Active	0	–	0	–	
t <sub>DS</sub>	Data Setup Time	30	–	35	–	
t <sub>DH</sub>	Data Hold Time	0	–	0	–	

**AC TEST CONDITIONS**

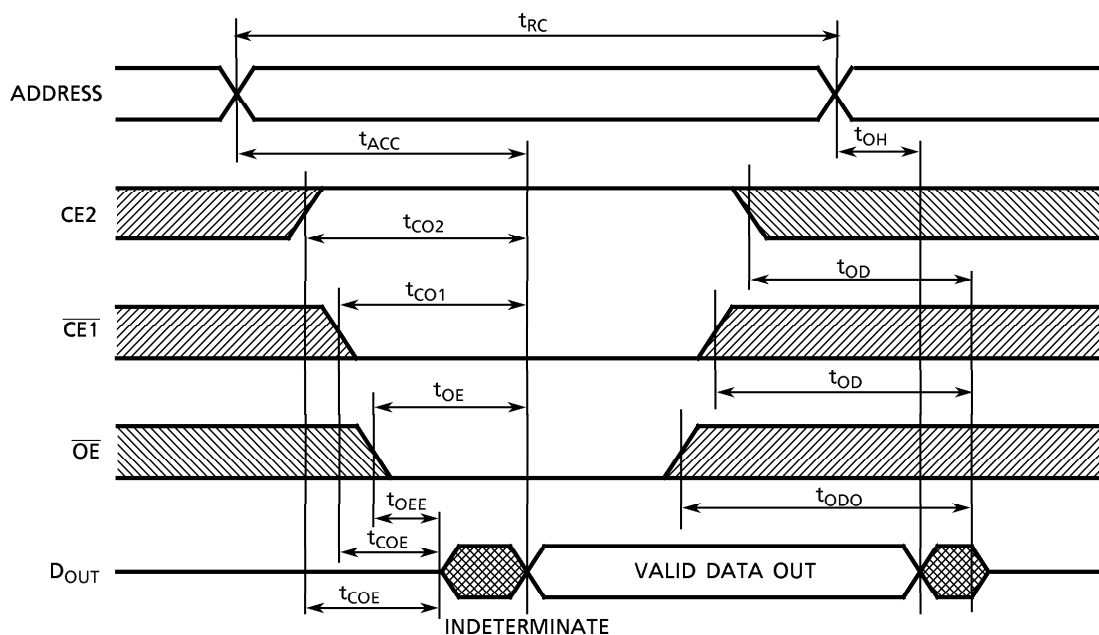
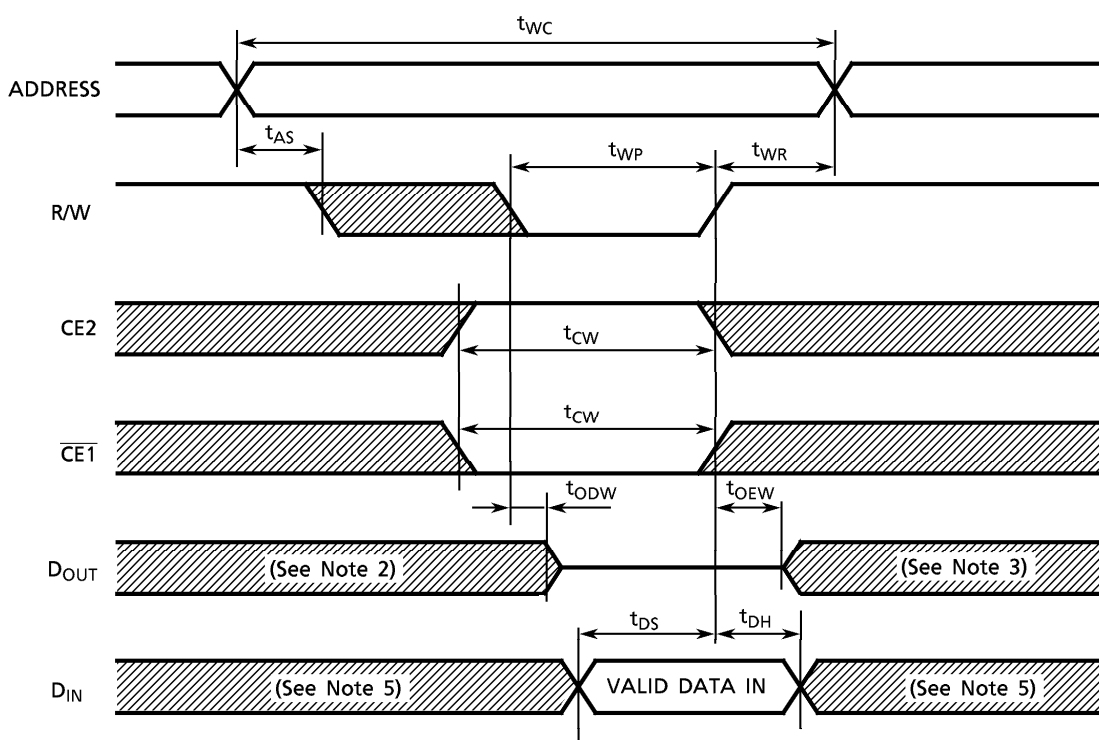
Output load: 100 pF + one TTL gate

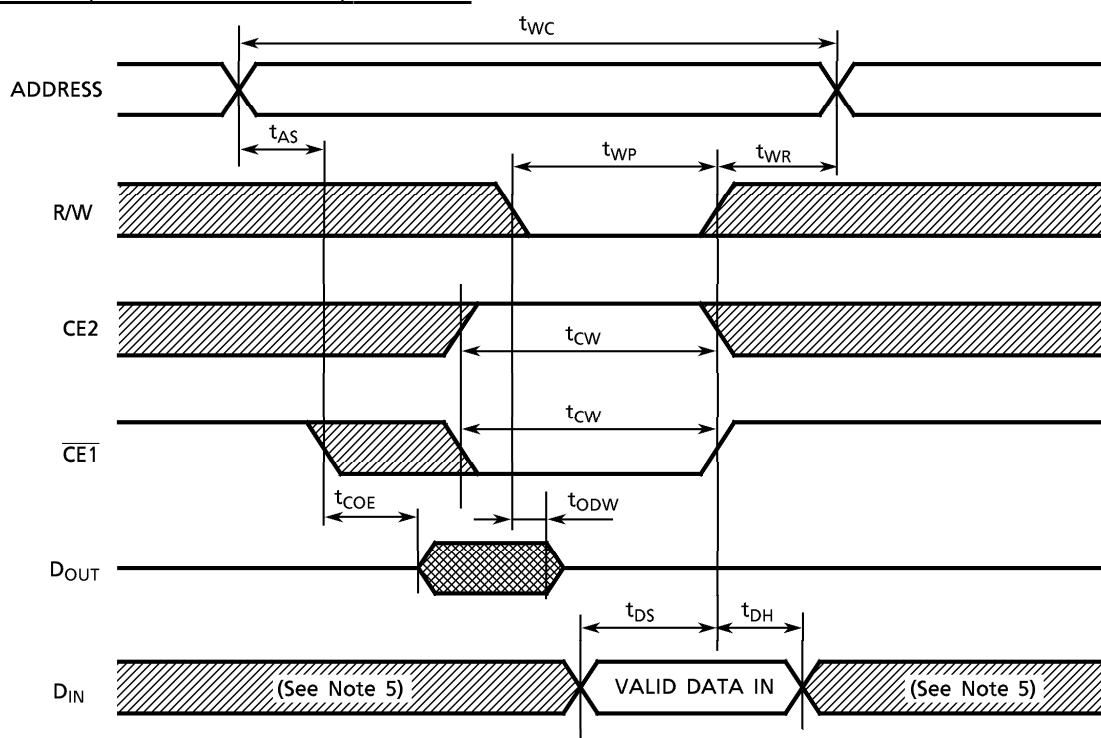
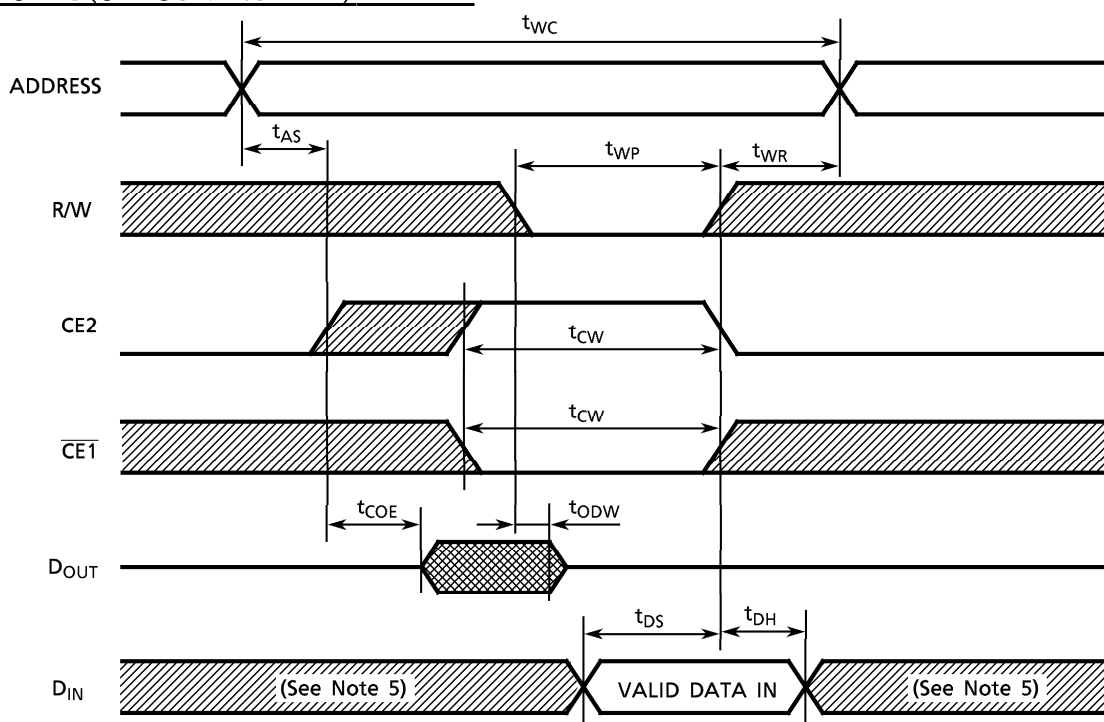
Input pulse level: 0.4 V, 2.6 V

Timing measurements: 1.5 V

Reference level: 1.5 V

$t_R$ ,  $t_F$ : 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)**


Note: (1) R/W remains HIGH for the read cycle.

(2) If  $\overline{\text{CE1}}$  goes LOW (or CE2 goes HIGH) coincident with or after R/W goes LOW, the outputs will remain at high impedance.

(3) If  $\overline{\text{CE1}}$  goes HIGH (or CE2 goes LOW) coincident with or before R/W goes HIGH, the outputs will remain at high impedance.

(4) If  $\overline{\text{OE}}$  is HIGH during the write cycle, the outputs will remain at high impedance.

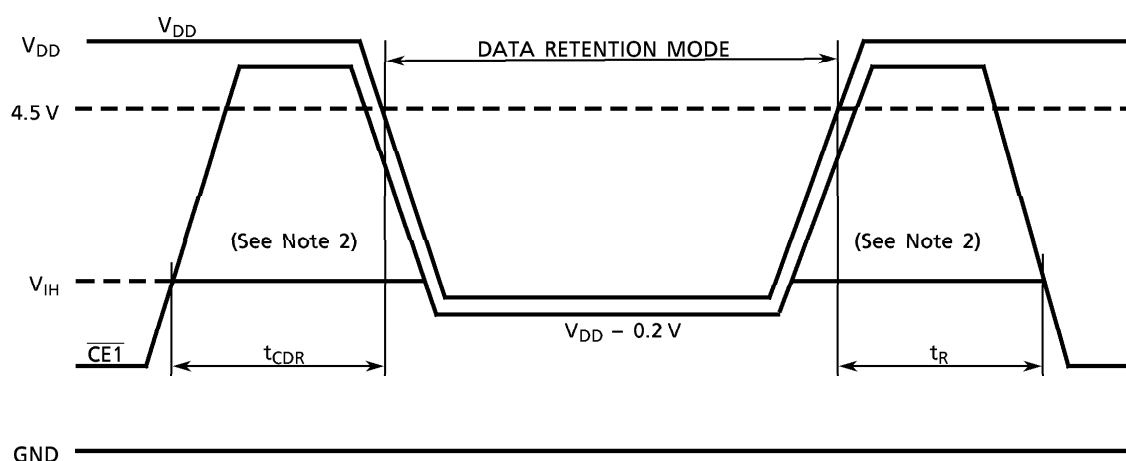
(5) Because I/O signals may be in the output state at this time, input signals of reverse polarity must not be applied.

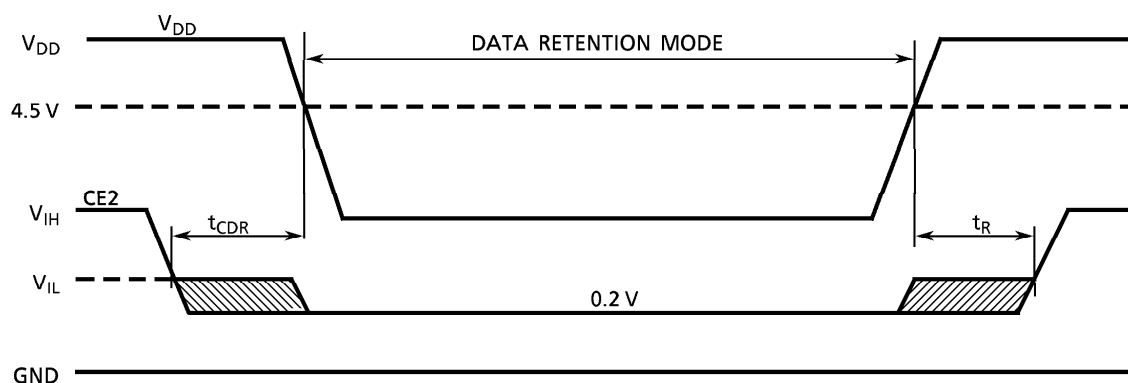
### DATA RETENTION CHARACTERISTICS (Ta = - 40° to 85°C)

SYMBOL	PARAMETER			MIN	TYP	MAX	UNIT
V <sub>DH</sub>	Data Retention Supply Voltage			2.0	–	5.5	V
I <sub>DD52</sub>	Standby Current	-70, -85	V <sub>DH</sub> = 3.0 V	–	–	100	μA
			V <sub>DH</sub> = 5.5 V	–	–	200	
		-70L, -85L	V <sub>DH</sub> = 3.0 V	–	–	20*	
			V <sub>DH</sub> = 5.5 V	–	–	40	
t <sub>CDR</sub>	Chip Deselect to Data Retention Mode Time			0	–	–	nS
t <sub>R</sub>	Recovery Time			5	–	–	mS

\* 2 μA (max) at Ta = - 40° to 40°C

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



**CE2 CONTROLLED DATA RETENTION MODE (See Note 3)**


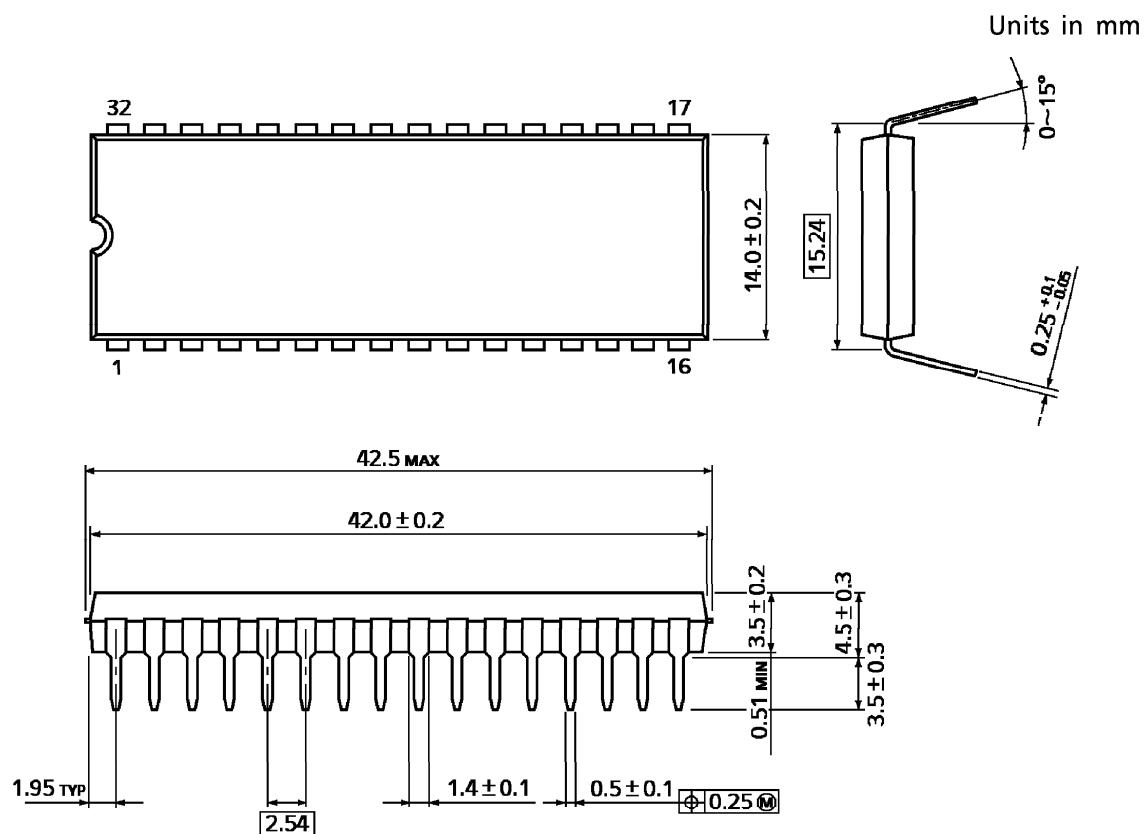
Note: (1) In  $\overline{CE1}$  controlled data retention mode, minimum standby current mode is entered when

$$\overline{CE2} \leq 0.2 \text{ V or } \overline{CE2} \geq V_{DD} - 0.2 \text{ V.}$$

(2) When  $\overline{CE1}$  is operating at the  $V_{IH}$  level (2.4 V), the operation current is given by  $I_{DDSI}$  during the transition of  $V_{DD}$  from 4.5 to 2.6 V.

(3) In  $\overline{CE2}$  controlled data retention mode, minimum standby current mode is entered when  $\overline{CE2} \leq 0.2 \text{ V}$ .

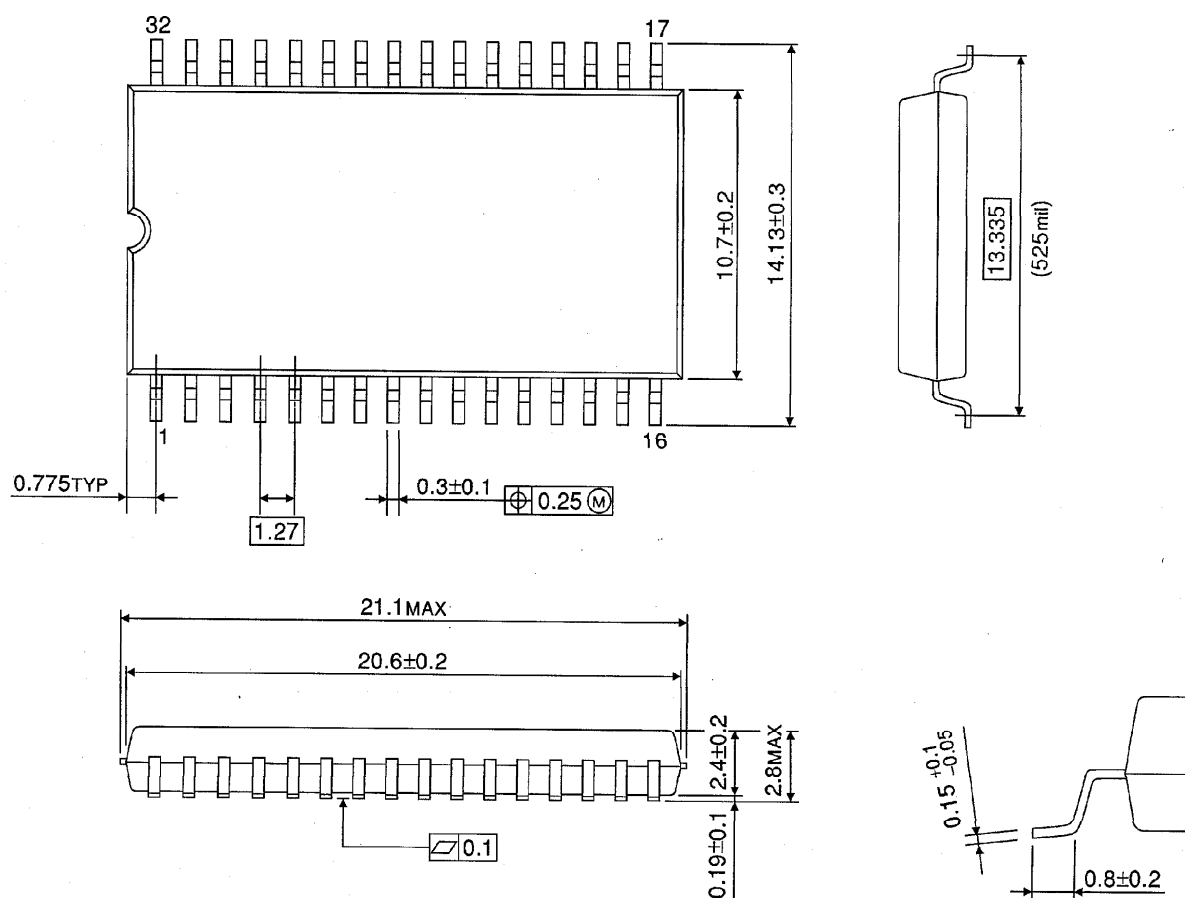


**PACKAGE DIMENSIONS (DIP32-P-600-2.54)**


Weight: 4.45 g (typ)

**PACKAGE DIMENSIONS (SOP32-P-525-1.27)**

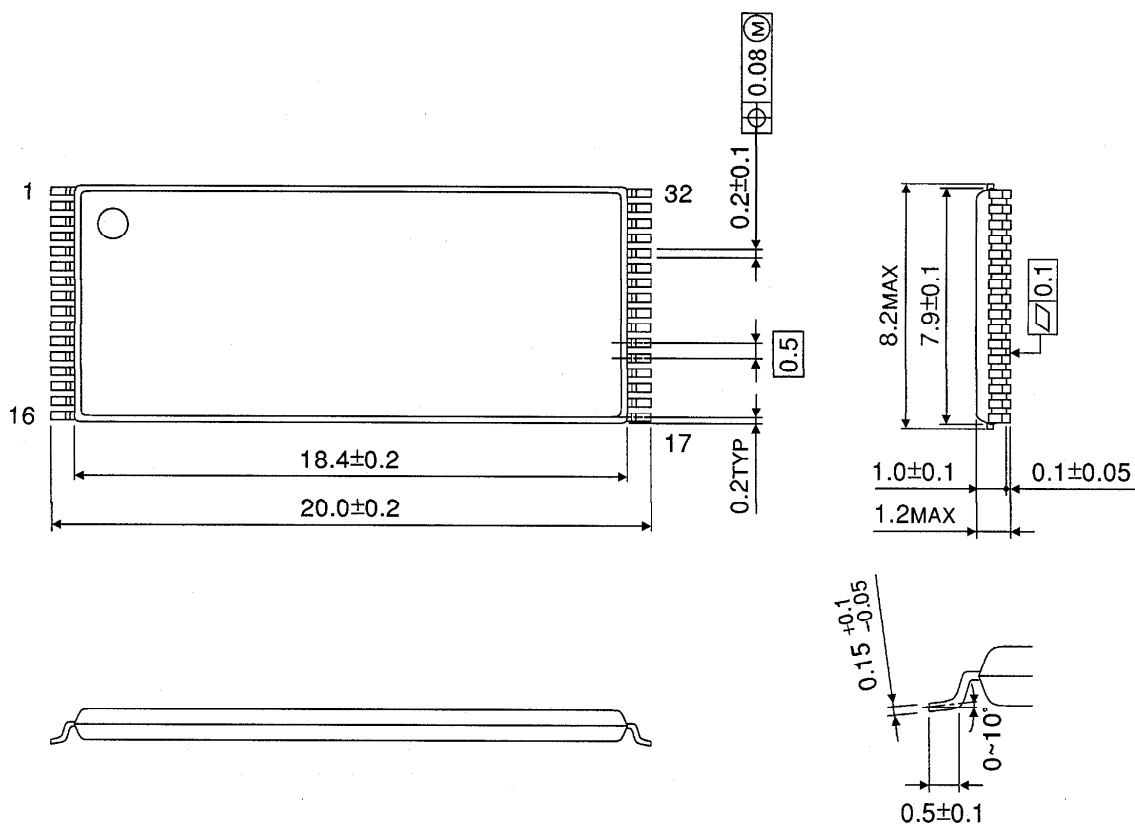
Units in mm



Weight: 1.04 g (typ)

**PACKAGE DIMENSIONS (TSOP I 32-P-0820-0.50)**

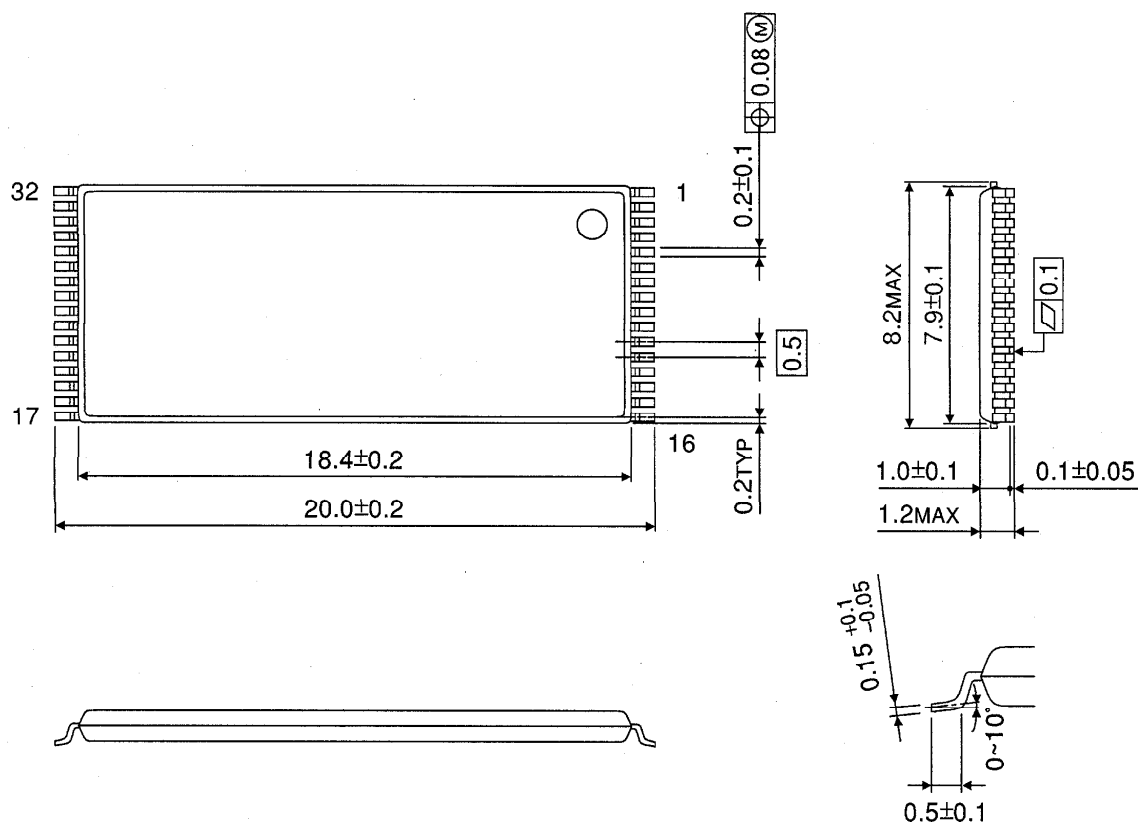
Units in mm



Weight: 0.34 g (typ)

**PACKAGE DIMENSIONS (TSOP I 32-P-0820-0.50A)**

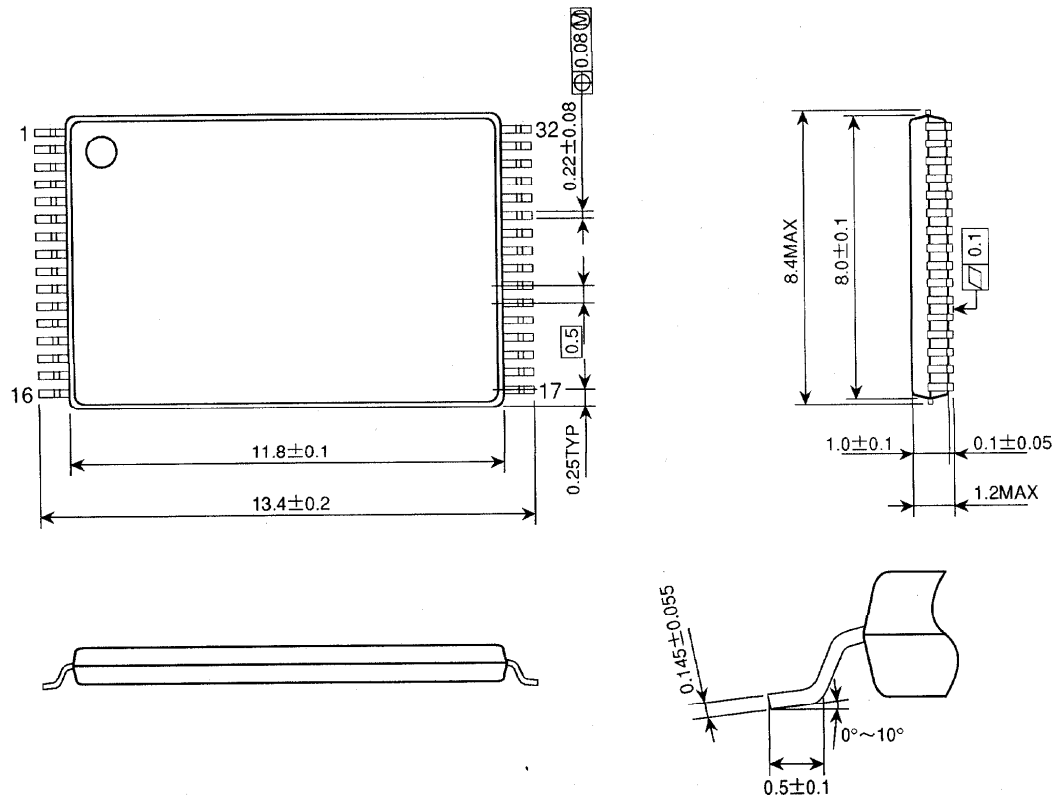
Units in mm



Weight: 0.34 g (typ)

**PACKAGE DIMENSIONS (TSOP I 32-P-0.50)**

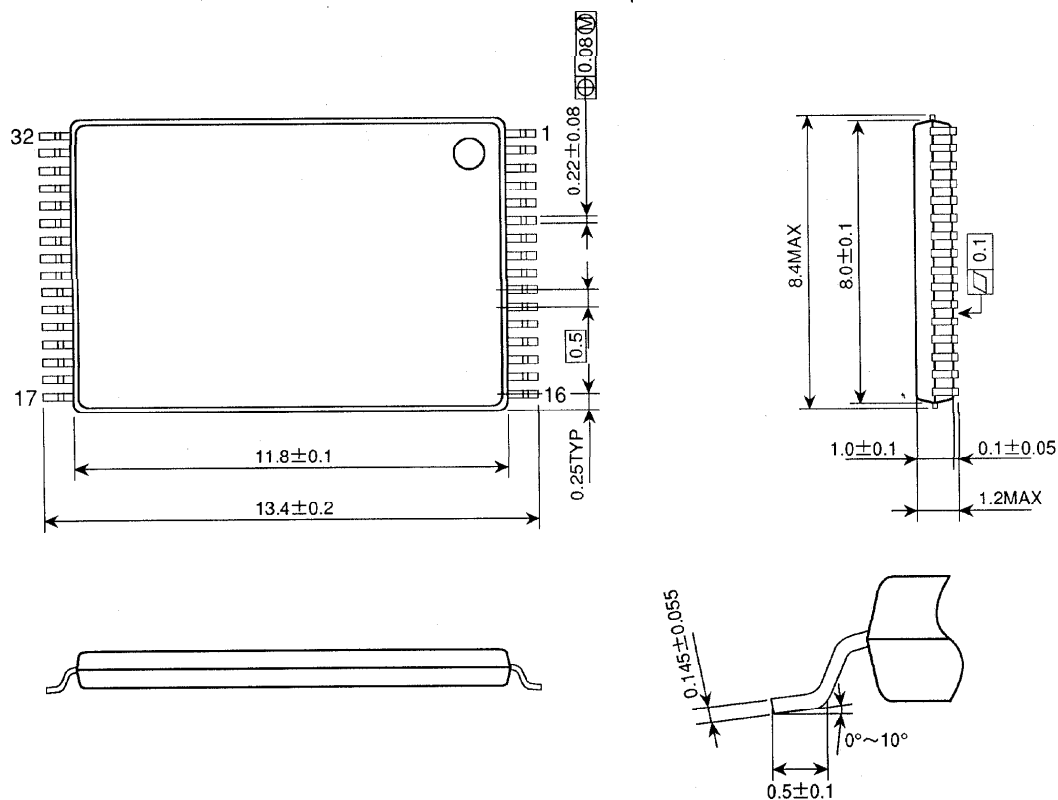
Units in mm



Weight: 0.24 g (typ)

**PACKAGE DIMENSIONS (TSOP I 32-P-0.50A)**

Units in mm



Weight: 0.24 g (typ)