

131,072-WORD BY 8-BIT STATIC RAM

**DESCRIPTION**

The TC55V1001AFI/AFTI/ATRI/ASTI/ASRI 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 2.7 to 3.6 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 85 ns. It is automatically placed in low-power mode at 0.5  $\mu$ A standby current (L-Version at  $V_{DD}=3V$ ,  $T_a=25^\circ C$ ) 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 ( $\overline{OE}$ ) provides fast memory access. This device is well suited to various microprocessor system applications where high speed, low power and battery backup are required. The TC55V1001AFI/AFTI/ATRI/ASTI/ASRI is available in a 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: 10.8 mW/MHz (typical)
- Single power supply voltage of 2.7 to 3.6 V
- Power down features using CE1 and CE2.
- Data retention supply voltage of 2 to 3.6 V
- Direct TTL compatibility for all inputs and outputs
- Wide operating temperature range of  $-40^\circ$  to  $85^\circ C$
- Standby current ( $T_a=25^\circ C$  maximum)

	TC55V1001AFI/AFTI/ATRI/ASTI/ASRI	
	-85, -10	-85L, -10L
3.6V	3 $\mu$ A	0.9 $\mu$ A
3.0V	1 $\mu$ A	0.5 $\mu$ A

- Access Times (maximum):

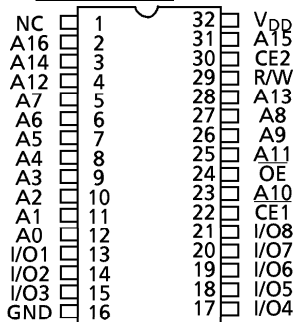
	TC55V1001AFI/AFTI/ATRI/ASTI/ASRI	
	-85, -85L	-10, -10L
Access Time	85ns	100ns
$\overline{CE1}$ Access Time	85ns	100ns
CE2 Access Time	85ns	100ns
$\overline{OE}$ Access Time	45ns	50ns

- Packages:

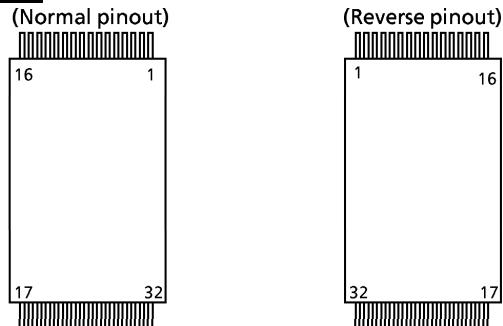
- SOP32-P-525-1.27 (AFI) (Weight: 1.04 g typ)
- TSOP I 32-P-0820-0.50 (AFTI) (Weight: 0.34 g typ)
- TSOP I 32-P-0820-0.50A (ATRI) (Weight: 0.34 g typ)
- TSOP I 32-P-0.50 (ASTI) (Weight: 0.24 g typ)
- TSOP I 32-P-0.50A (ASRI) (Weight: 0.24 g typ)

**PIN ASSIGNMENT (TOP VIEW)**

○ 32 PIN SOP



○ 32 PIN TSOP



**PIN NAMES**

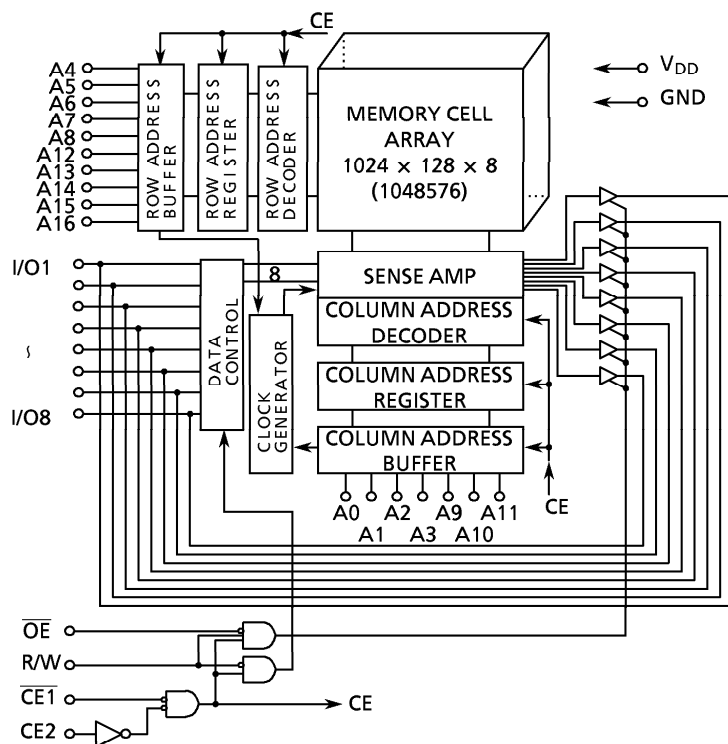
A0 to A16	Address Inputs
R/W	Read/Write Control
$\overline{OE}$	Output Enable
CE1, CE2	Chip Enable
I/O1 to I/O8	Data Input/Output
$V_{DD}$	Power
GND	Ground
NC	No Connection

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	$\overline{CE1}$	A <sub>10</sub>	$\overline{OE}$

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**BLOCK DIAGRAM**



**OPERATION MODE**

MODE	$\overline{CE1}$	CE2	$\overline{OE}$	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 4.6	V
V <sub>IN</sub>	Input Voltage	- 0.3* to 4.6	V
V <sub>I/O</sub>	Input/Output Voltage	- 0.5 to V <sub>DD</sub> + 0.5	V
P <sub>D</sub>	Power Dissipation	0.8	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 (Ta = -40° to 85°C)**

SYMBOL	PARAMETER	2.7 to 3.6 V			UNIT
		MIN	TYP	MAX	
V <sub>DD</sub>	Power Supply Voltage	2.7	-	3.6	V
V <sub>IH</sub>	Input High Voltage	2.2	-	V <sub>DD</sub> + 0.3	
V <sub>IL</sub>	Input Low Voltage	- 0.3*	-	0.6	
V <sub>DH</sub>	Data Retention Supply Voltage	2.0	-	3.6	

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

**DC CHARACTERISTICS (Ta = -40° to 85°C, V<sub>DD</sub> = 2.7 to 3.6 V)**

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> = V <sub>DD</sub> - 0.5 V	-0.5	-	-	mA			
I <sub>OL</sub>	Output Low Current	V <sub>OL</sub> = 0.4 V	2.1	-	-	mA			
I <sub>LO</sub>	Output Leakage Current	$\overline{CE1} = V_{IH}$ or $CE2 = V_{IL}$ or $R/W = V_{IL}$ or $OE = V_{IH}$ , 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 $CE2 = V_{IH}$ and $R/W = V_{IH}$ , I <sub>OUT</sub> = 0 mA Other Input = V <sub>IH</sub> /V <sub>IL</sub>	V <sub>DD</sub> = 3 V ± 10%	Tcycle	min	-	-	35	mA
					1 μs	-	-	10	
I <sub>DDO2</sub>	Operating Current	$\overline{CE1} = 0.2$ V and $CE2 = V_{DD} - 0.2$ V $R/W = V_{DD} - 0.2$ V, I <sub>OUT</sub> = 0 mA Other Inputs = V <sub>DD</sub> - 0.2 V/0.2 V	V <sub>DD</sub> = 3.3 V ± 0.3 V	Tcycle	min	-	-	40	
					1 μs	-	-	12	
I <sub>DDO2</sub>	Operating Current	$\overline{CE1} = 0.2$ V and $CE2 = V_{DD} - 0.2$ V $R/W = V_{DD} - 0.2$ V, I <sub>OUT</sub> = 0 mA Other Inputs = V <sub>DD</sub> - 0.2 V/0.2 V	V <sub>DD</sub> = 3 V ± 10%	Tcycle	min	-	-	30	
					1 μs	-	-	5	
I <sub>DDO2</sub>	Operating Current	$\overline{CE1} = 0.2$ V and $CE2 = V_{DD} - 0.2$ V $R/W = V_{DD} - 0.2$ V, I <sub>OUT</sub> = 0 mA Other Inputs = V <sub>DD</sub> - 0.2 V/0.2 V	V <sub>DD</sub> = 3.3 V ± 0.3 V	Tcycle	min	-	-	35	
					1 μs	-	-	6	
I <sub>DDS1</sub>	Standby Current	$\overline{CE1} = V_{IH}$ or $CE2 = V_{IL}$	-	-	2	mA			
I <sub>DDS2</sub> (Note)		$\overline{CE1} = V_{DD} - 0.2$ V or $CE2 = 0.2$ V V <sub>DD</sub> = 2.0 to 3.6 V	V <sub>DD</sub> = 3 V ± 10%	Ta = 25°C	-85, -10	-	1	2	
	-85L, -10L				-	0.5	0.7		
	Ta = -40° to 85°C			-85, -10	-	-	40		
				-85L, -10L	-	-	25		
	V <sub>DD</sub> = 3.3 V ± 0.3 V			Ta = 25°C	-85, -10	-	2	3	
					-85L, -10L	-	0.7	0.9	
	Ta = -40° to 85°C		-85, -10	-	-	45			
			-85L, -10L	-	-	30			
	V <sub>DD</sub> = 3 V		Ta = 25°C	-85, -10	-	-	1		
				-85L, -10L	-	-	0.5		
			Ta = -40° to 40°C	-85, -10	-	-	3		
				-85L, -10L	-	-	2		
Ta = -40° to 85°C		-85, -10	-	-	35				
		-85L, -10L	-	-	20				

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

**CAPACITANCE (Ta = 25°C, f = 1 MHz)**

SYMBOL	PARAMETER	TEST CONDITION	MAX	UNIT
C <sub>IN</sub>	Input Capacitance	V <sub>IN</sub> = GND	10	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>OUT</sub> = GND	10	

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

**AC CHARACTERISTICS AND OPERATING CONDITIONS** (Ta = -40° to 85°C, V<sub>DD</sub> = 2.7 to 3.6 V)

**READ CYCLE**

SYMBOL	PARAMETER	TC55V1001AFI/AFTI/ATRI/ASTI/ASRI				UNIT
		-85, -85L		-10, -10L		
		MIN	MAX	MIN	MAX	
t <sub>RC</sub>	Read Cycle Time	85	-	100	-	ns
t <sub>ACC</sub>	Address Access Time	-	85	-	100	
t <sub>CO1</sub>	Chip Enable (CE1) Access Time	-	85	-	100	
t <sub>CO2</sub>	Chip Enable (CE2) Access Time	-	85	-	100	
t <sub>OE</sub>	Output Enable Access Time	-	45	-	50	
t <sub>COE</sub>	Chip Enable Low to Output Active	5	-	5	-	
t <sub>OOE</sub>	Output Enable Low to Output Active	0	-	0	-	
t <sub>OD</sub>	Chip Enable High to Output High-Z	-	35	-	40	
t <sub>ODO</sub>	Output Enable High to Output High-Z	-	35	-	40	
t <sub>OH</sub>	Output Data Hold Time	10	-	10	-	

**WRITE CYCLE**

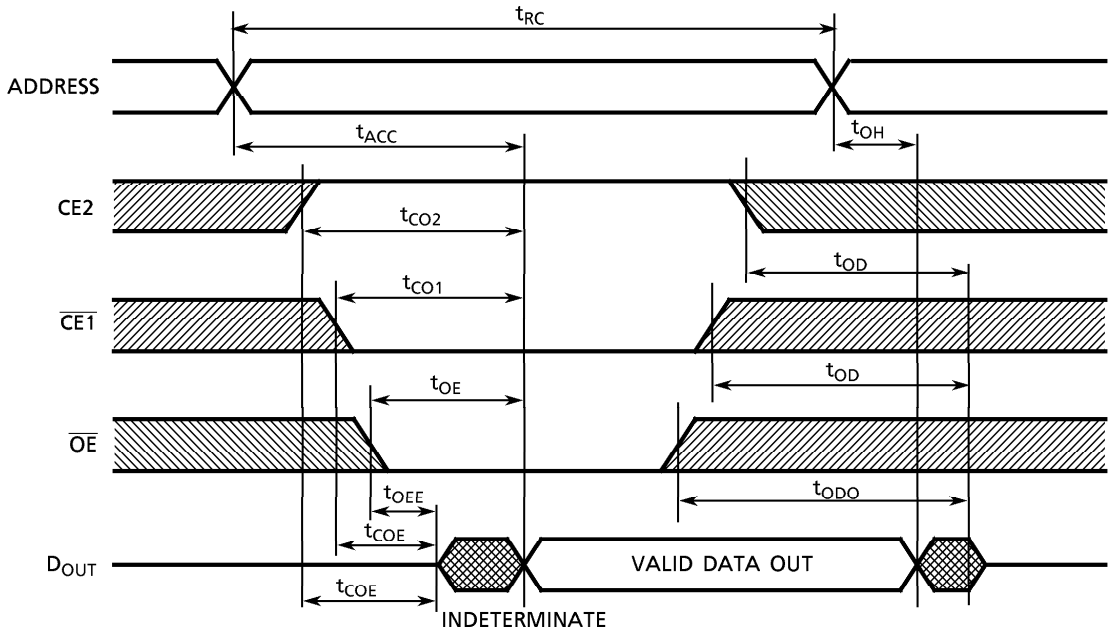
SYMBOL	PARAMETER	TC55V1001AFI/AFTI/ATRI/ASTI/ASRI				UNIT
		-85, -85L		-10, -10L		
		MIN	MAX	MIN	MAX	
t <sub>WC</sub>	Write Cycle Time	85	-	100	-	ns
t <sub>WP</sub>	Write Pulse Width	60	-	60	-	
t <sub>CW</sub>	Chip Enable to End of Write	75	-	80	-	
t <sub>AS</sub>	Address Setup Time	0	-	0	-	
t <sub>WR</sub>	Write Recovery Time	0	-	0	-	
t <sub>ODW</sub>	R/W Low to Output High-Z	-	35	-	40	
t <sub>OEW</sub>	R/W High to Output Active	0	-	0	-	
t <sub>DS</sub>	Data Setup Time	35	-	40	-	
t <sub>DH</sub>	Data Hold Time	0	-	0	-	

**AC TEST CONDITIONS**

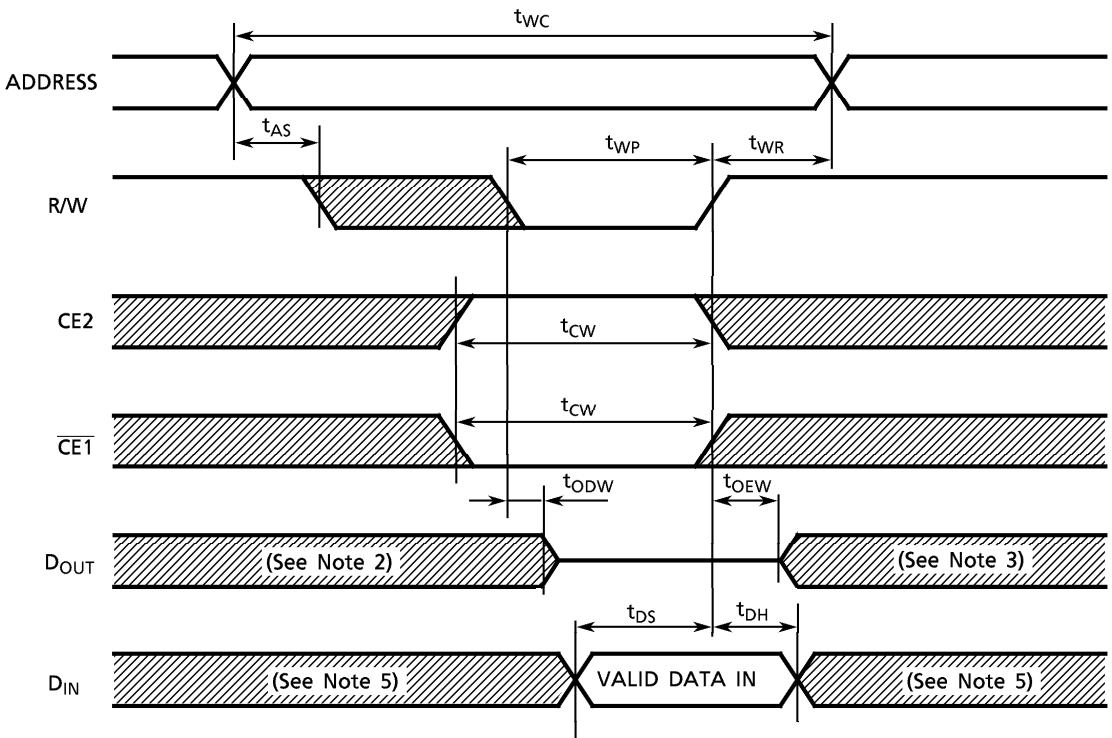
Output load: 100 pF + one TTL gate  
 Input pulse level: 0.4 V, 2.4 V  
 Timing measurements: 1.5 V  
 Reference level: 1.5 V  
 t<sub>R</sub>, t<sub>F</sub>: 5 ns

**TIMING DIAGRAMS**

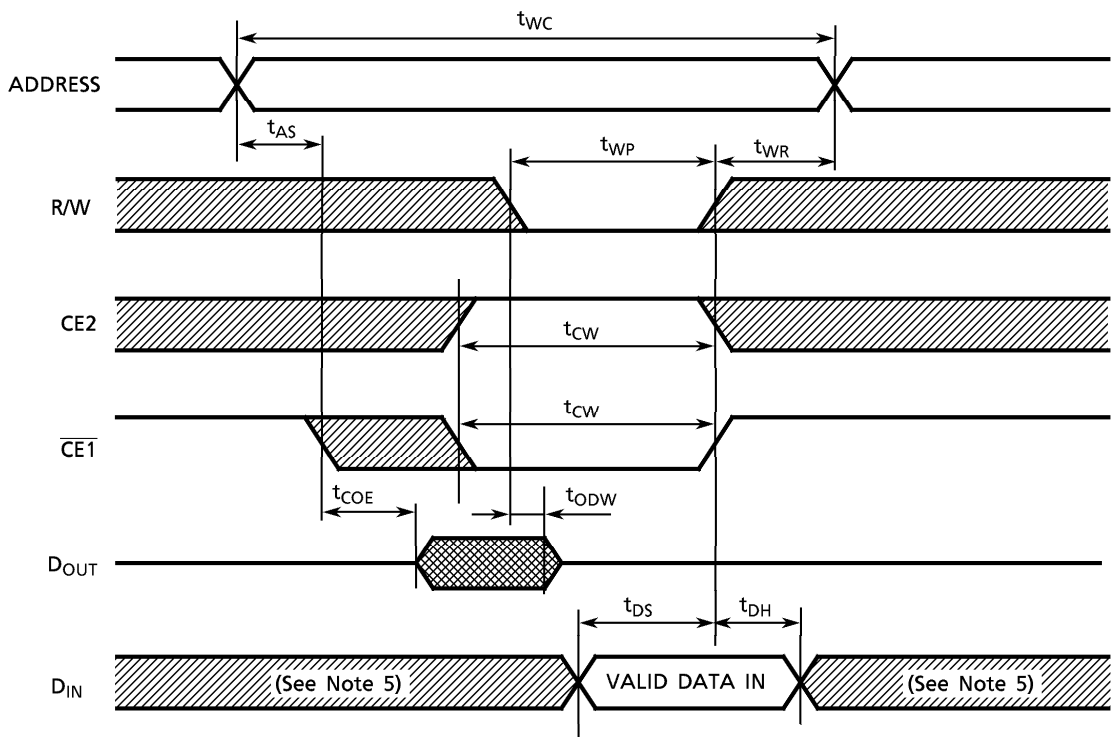
**READ CYCLE (See Note 1)**



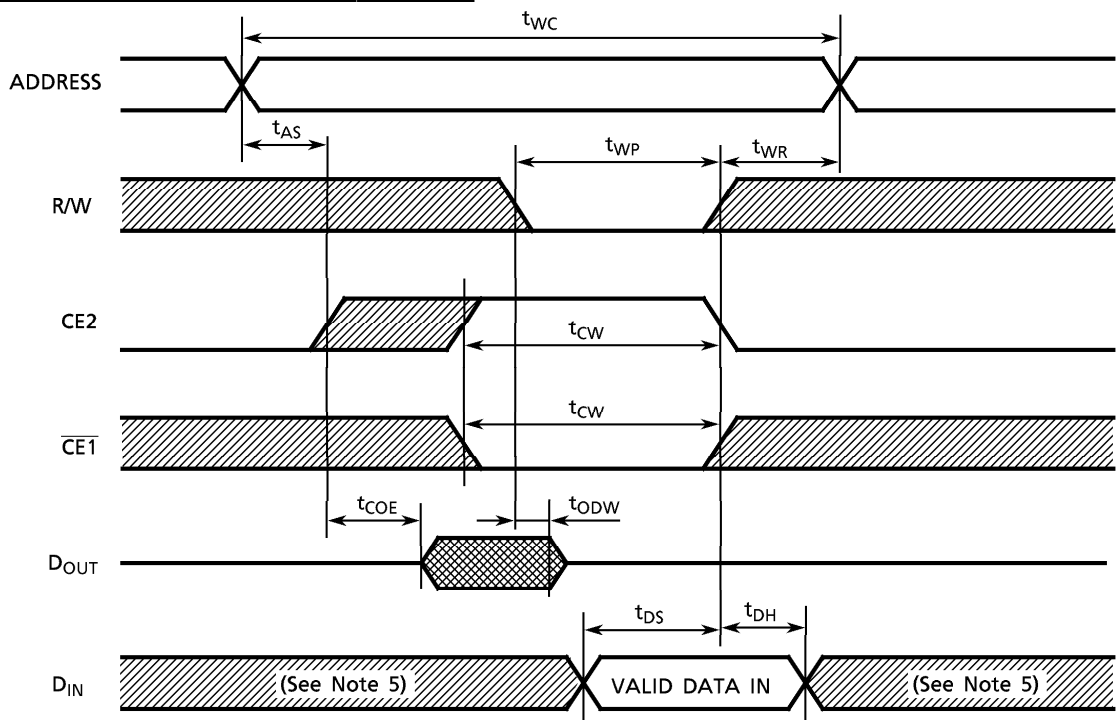
**WRITE CYCLE 1 (R/W CONTROLLED) (See Note 4)**



WRITE CYCLE 2 (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  $\overline{CE1}$  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.

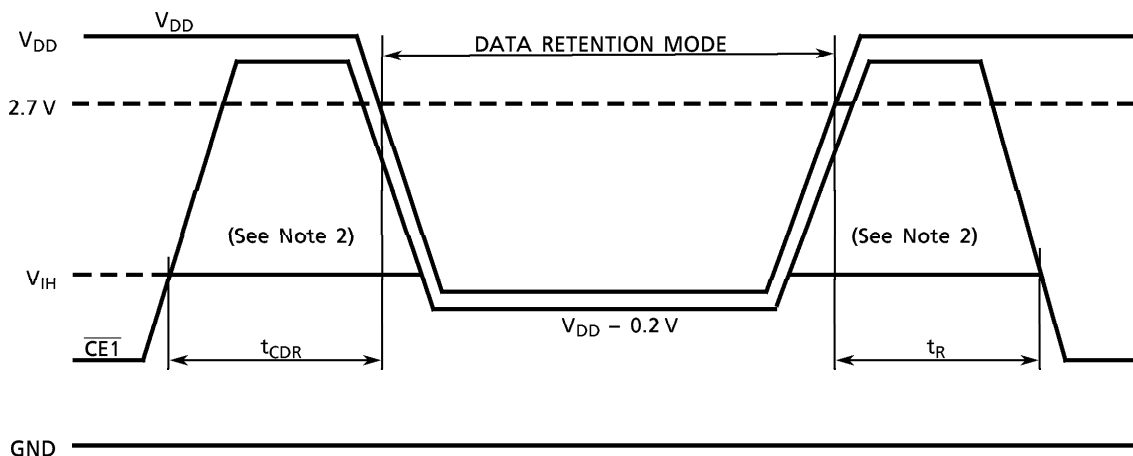
(4) If  $\overline{OE}$  is HIGH during the write cycle, the outputs will remain at high impedance.

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

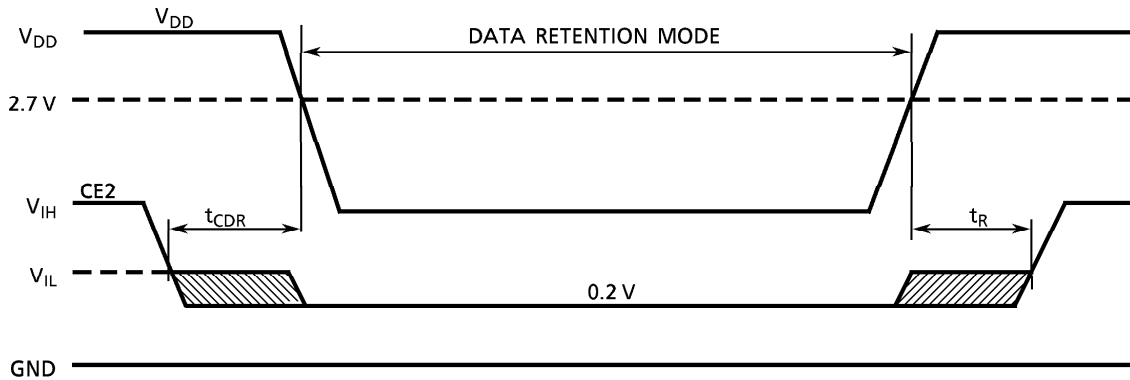
**DATA RETENTION CHARACTERISTICS (Ta = -40° to 85°C)**

SYMBOL	PARAMETER		MIN	TYP	MAX	UNIT	
V <sub>DH</sub>	Data Retention Supply Voltage		2.0	-	3.6	V	
I <sub>DD2</sub>	Standby Current	V <sub>DH</sub> = 3.0V	Ta = -40° to 40°C	-85, -10	-	3	μA
				-85L, -10L	-	2	
		V <sub>DH</sub> = 3.6V	Ta = -40° to 85°C	-85, -10	-	35	
				-85L, -10L	-	20	
		V <sub>DH</sub> = 3.6V	Ta = -40° to 85°C	-85, -10	-	45	
				-85L, -10L	-	30	
t <sub>CDR</sub>	Chip Deselect to Data Retention Mode Time		0	-	-	nS	
t <sub>R</sub>	Recovery Time		5	-	-	mS	

**CE1 CONTROLLED DATA RETENTION MODE (See Note 1)**



CE2 CONTROLLED DATA RETENTION MODE (See Note 3)

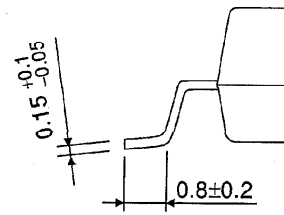
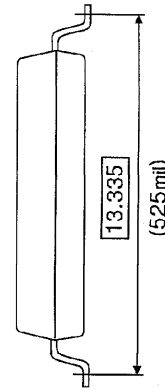
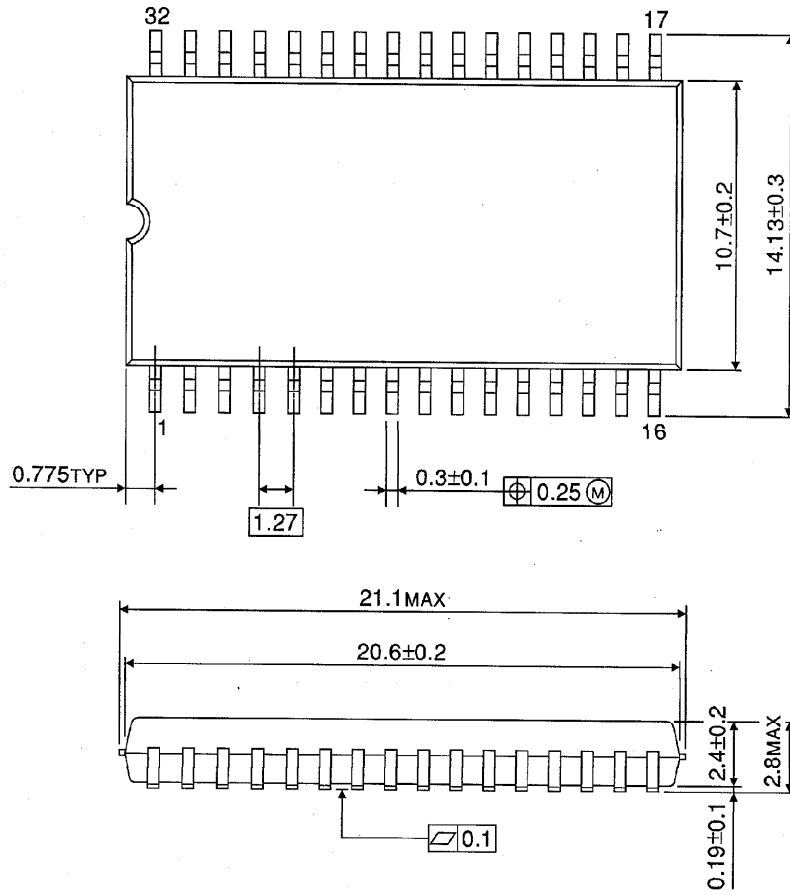


- Note: (1) In  $\overline{CE1}$  controlled data retention mode, minimum standby current mode is entered when  $CE2 \leq 0.2 \text{ V}$  or  $CE2 \geq V_{DD} - 0.2 \text{ V}$ .
- (2) When  $\overline{CE1}$  is operating at the  $V_{IH}$  level (2.2 V), the operating current is given by  $I_{DDs1}$  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  $CE2 \leq 0.2 \text{ V}$ .



PACKAGE DIMENSIONS (SOP32-P-525-1.27)

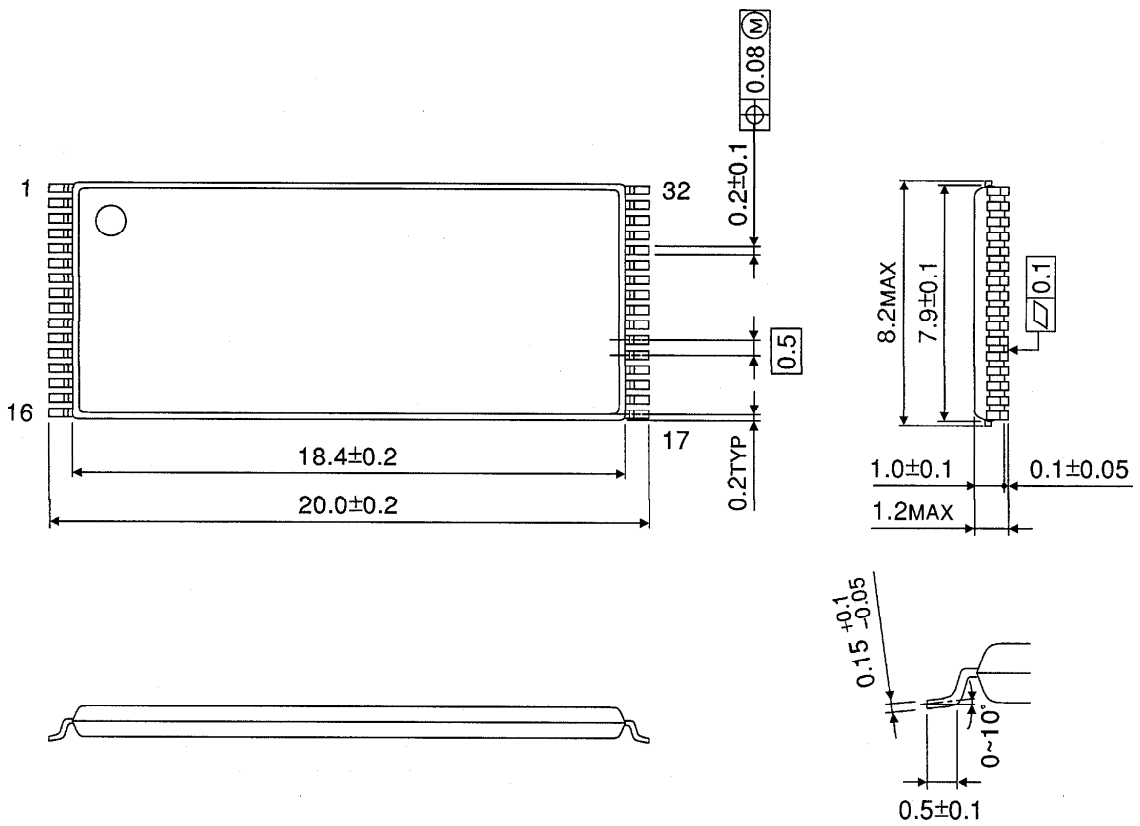
Units in mm



Weight: 1.04 g (typ)

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

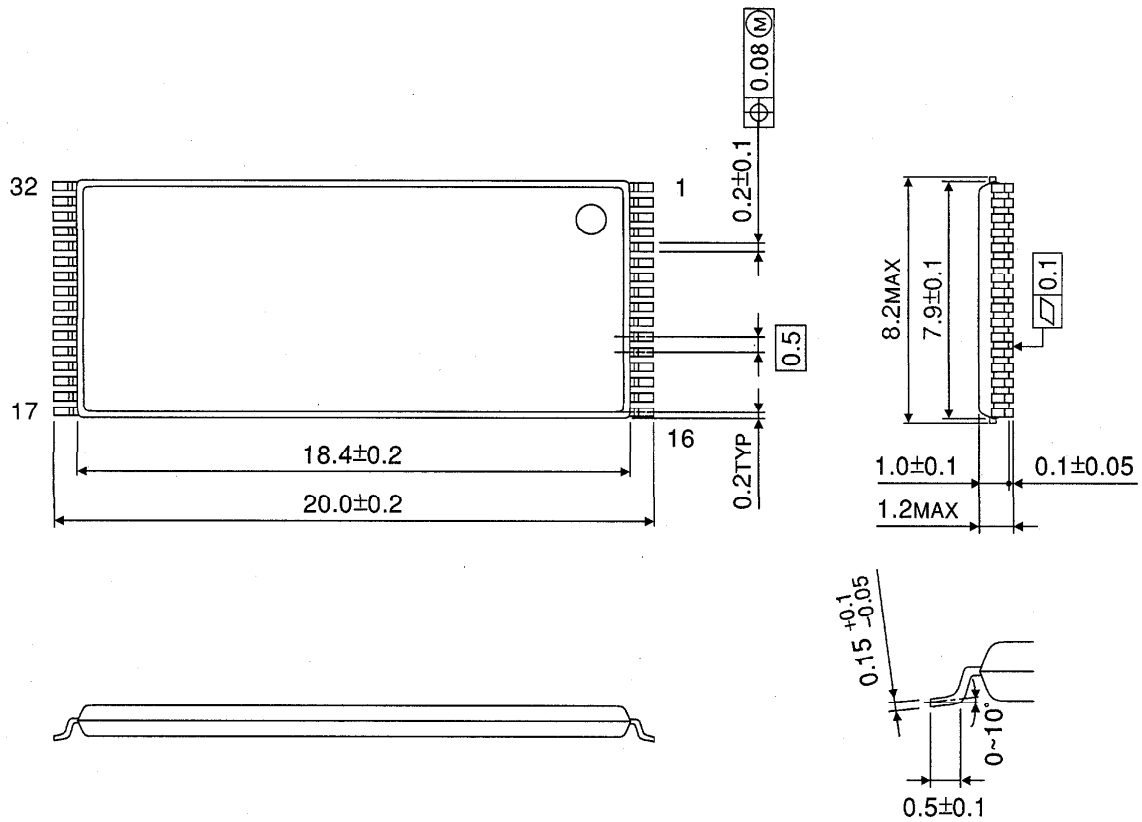
Units in mm



Weight: 0.34 g (typ)

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

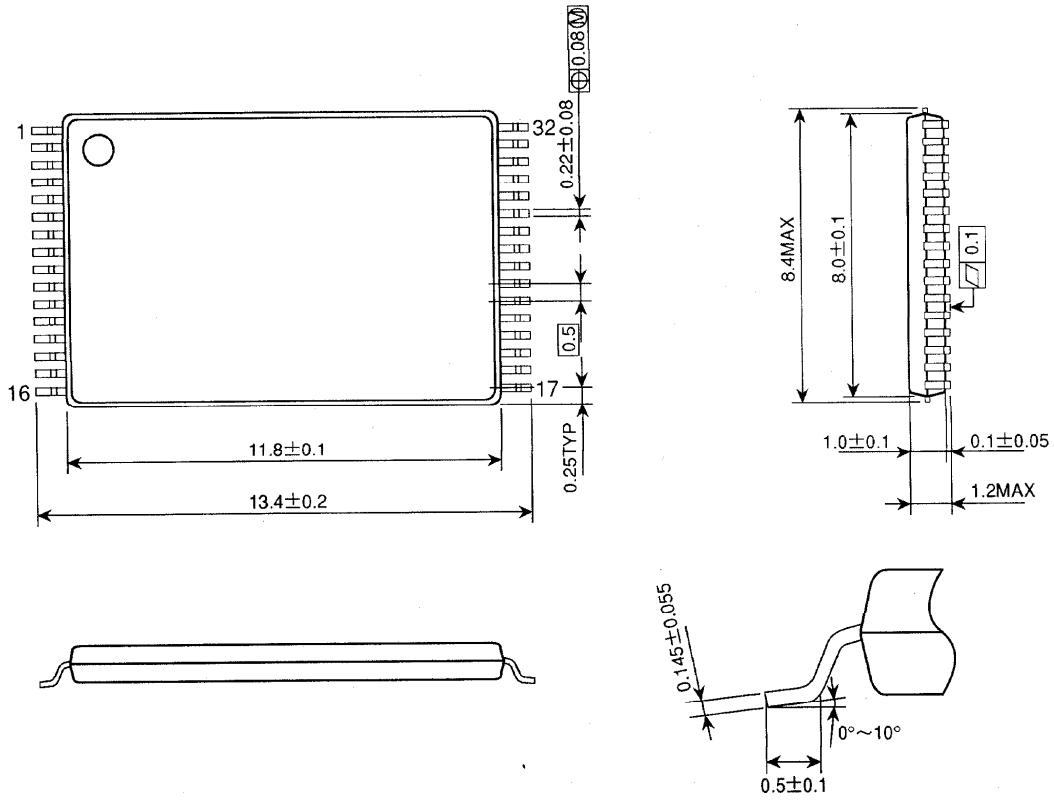
Units in mm



Weight: 0.34 g (typ)

PACKAGE DIMENSIONS (TSOP I 32-P-0.50)

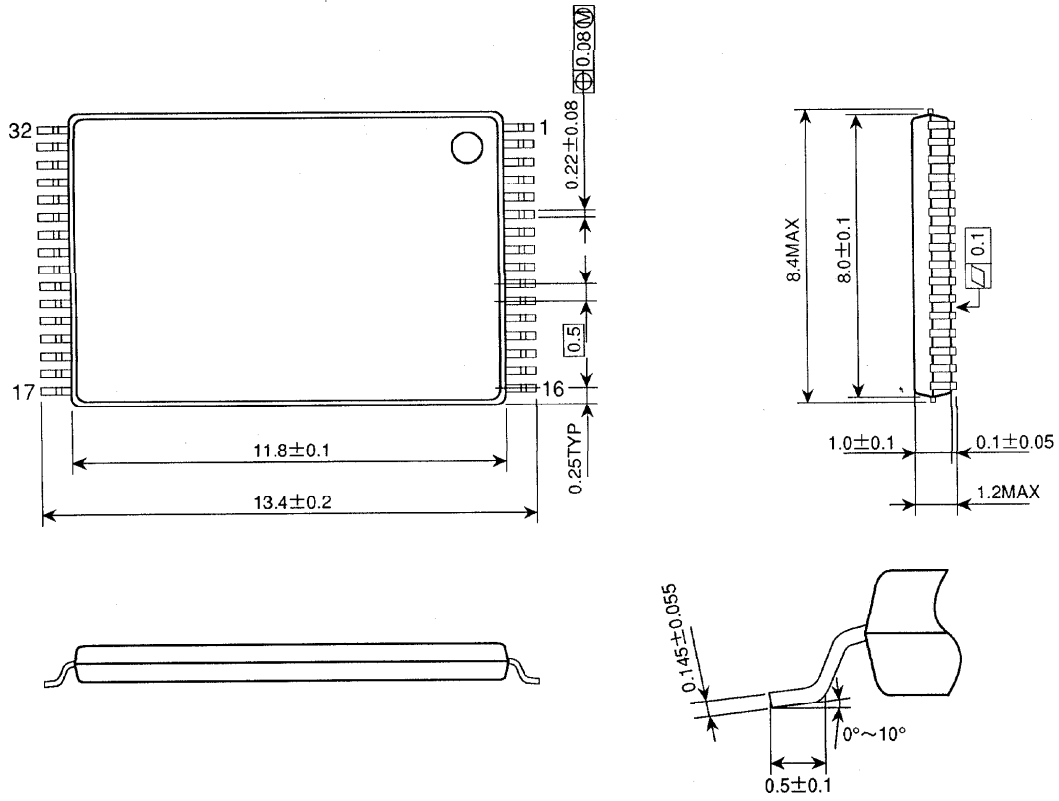
Units in mm



Weight: 0.24 g (typ)

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

Units in mm



Weight: 0.24 g (typ)