

TENTATIVE TOSHIBA MOS DIGITAL INTEGRATED CIRCUIT SILICON GATE CMOS

524,288-WORD BY 8-BIT STATIC RAM

## DESCRIPTION

The TC55NEM208AFPV/AFTV is a 4,194,304-bit static random access memory (SRAM) organized as 524,288 words by 8 bits. Fabricated using Toshiba's CMOS Silicon gate process technology, this device operates from a single 2.7 to 5.5 V power supply. Advanced circuit technology provides both high speed and low power at an operating current of 3 mA/MHz (typ) and a minimum cycle time of 55 ns. It is automatically placed in low-power mode at 1  $\mu$ A standby current (typ) when chip enable ( $\overline{CE}$ ) is asserted high. There are two control inputs.  $\overline{CE}$  is 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. And, with a guaranteed operating range of  $-40^{\circ}$  to  $85^{\circ}\text{C}$ , the TC55NEM208AFPV/AFTV can be used in environments exhibiting extreme temperature conditions. The TC55NEM208AFPV/AFTV is available in a standard 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: 15 mW/MHz (typical)
- Single power supply voltage of 2.7 to 5.5 V
- Power down features using  $\overline{CE}$ .
- Data retention supply voltage of 2.0 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): 20  $\mu$ A

- Access Times (maximum):

	TC55NEM208AFPV/AFTV	
	55	70
Access Time	55 ns	70 ns
$\overline{CE}$ Access Time	55 ns	70 ns
$\overline{OE}$ Access Time	30 ns	35 ns

- Package:

SOP32-P-525-1.27 (AFPV) (Weight: g typ)  
 TSOP II32-P-400-1.27 (AFTV) (Weight: g typ)

## PIN ASSIGNMENT (TOP VIEW)

### 32 PIN SOP & TSOP

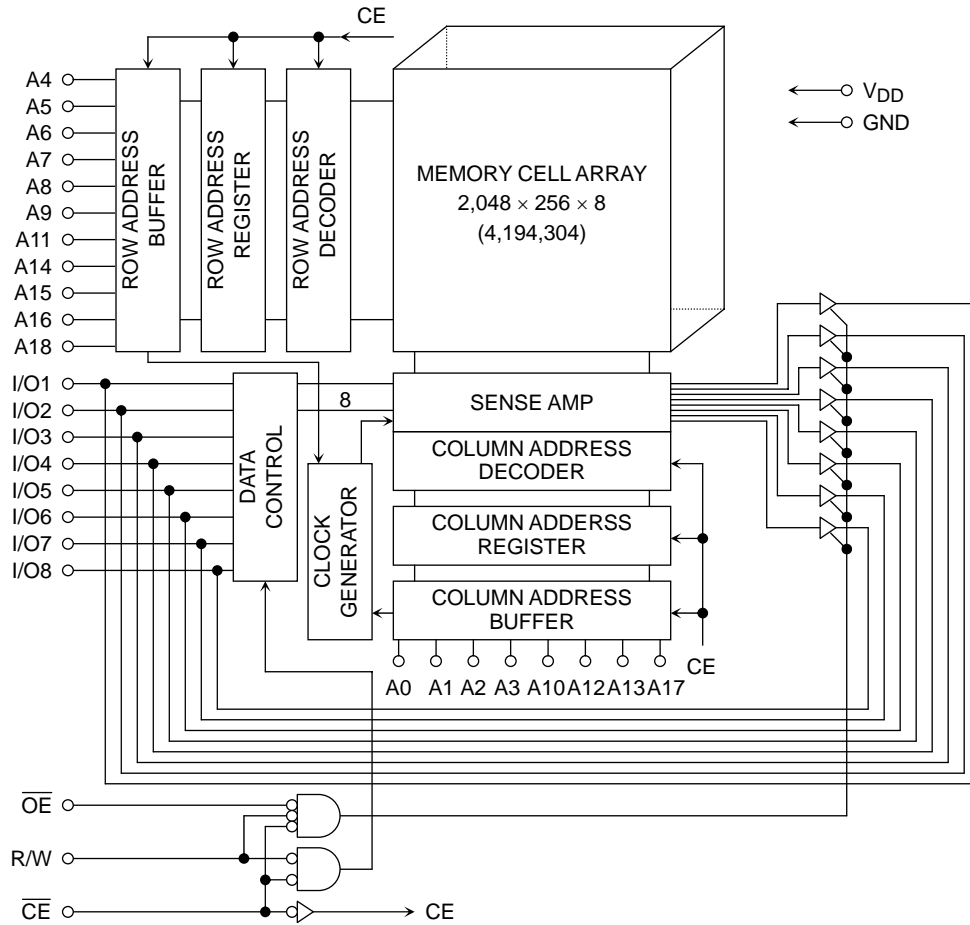
A18	□ 1	32	□ V <sub>DD</sub>
A16	□ 2	31	□ A15
A14	□ 3	30	□ A17
A12	□ 4	29	□ R/W
A7	□ 5	28	□ A13
A6	□ 6	27	□ A8
A5	□ 7	26	□ A9
A4	□ 8	25	□ A11
A3	□ 9	24	□ $\overline{OE}$
A2	□ 10	23	□ A10
A1	□ 11	22	□ $\overline{CE}$
A0	□ 12	21	□ I/O8
I/O1	□ 13	20	□ I/O7
I/O2	□ 14	19	□ I/O6
I/O3	□ 15	18	□ I/O5
GND	□ 16	17	□ I/O4

(AFPV/AFTV)

## PIN NAMES

A0~A18	Address Inputs
R/W	Read/Write Control
$\overline{OE}$	Output Enable
$\overline{CE}$	Chip Enable
I/O1~I/O8	Data Inputs/Outputs
V <sub>DD</sub>	Power
GND	Ground

## BLOCK DIAGRAM



## OPERATING MODE

MODE	$\overline{CE}$	$\overline{OE}$	R/W	I/O1~I/O8	POWER
Read	L	L	H	Output	$I_{DDO}$
Write	L	*	L	Input	$I_{DDO}$
Output Deselect	L	H	H	High-Z	$I_{DDO}$
Standby	H	*	*	High-Z	$I_{DSD}$

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

## MAXIMUM RATINGS

SYMBOL	RATING	VALUE	UNIT
$V_{DD}$	Power Supply Voltage	-0.3~7.0	V
$V_{IN}$	Input Voltage	-0.3*~7.0	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	-55~150	°C
$T_{opr}$	Operating Temperature	-40~85	°C

\*: -2.0 V when measured at a pulse width of 20ns

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

SYMBOL	PARAMETER	5 V ± 10%			2.7 V~5.5 V			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
V <sub>DD</sub>	Power Supply Voltage	4.5	5.0	5.5	2.7	5.0	5.5	V
V <sub>IH</sub>	Input High Voltage	2.2	—	V <sub>DD</sub> + 0.3	V <sub>DD</sub> - 0.2	—	V <sub>DD</sub> + 0.3	V
V <sub>IL</sub>	Input Low Voltage	-0.3*	—	0.6	-0.3*	—	0.2	V
V <sub>DH</sub>	Data Retention Supply Voltage	2.0	—	5.5	2.0	—	5.5	V

\*: -2.0V when measured at a pulse width of 20 ns

## DC CHARACTERISTICS (Ta = -40° to 85°C, V<sub>DD</sub> = 5 V ± 10%)

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT			
I <sub>IL</sub>	Input Leakage Current	V <sub>IN</sub> = 0 V~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	2.1	—	—	mA			
I <sub>LO</sub>	Output Leakage Current	$\overline{CE} = V_{IH}$ or R/W = V <sub>IL</sub> or $\overline{OE} = V_{IH}$ , V <sub>OUT</sub> = 0 V~V <sub>DD</sub>	—	—	±1.0	μA			
I <sub>DDO1</sub>	Operating Current	$\overline{CE} = V_{IL}$ and R/W = V <sub>IH</sub> , I <sub>OUT</sub> = 0 mA, Other Input = V <sub>IH</sub> /V <sub>IL</sub>	t <sub>cycle</sub>	MIN	—	—	35	mA	
				1 μs	—	8	—		
I <sub>DDO2</sub>	Operating Current	$\overline{CE} = 0.2$ V and R/W = V <sub>DD</sub> - 0.2 V, I <sub>OUT</sub> = 0 mA, Other Input = V <sub>DD</sub> - 0.2 V/0.2 V	t <sub>cycle</sub>	MIN	—	—	30	mA	
				1 μs	—	3	—		
I <sub>DDS1</sub>	Standby Current	$\overline{CE} = V_{IH}$	Ta = 25°C	—	—	3	mA		
I <sub>DDS2</sub>				$\overline{CE} = V_{DD} - 0.2$ V, V <sub>DD</sub> = 2.0 V~5.5 V	Ta = -40~40°C	—		—	3
					Ta = -40~85°C	—		—	20

## DC CHARACTERISTICS (Ta = -40° to 85°C, V<sub>DD</sub> = 3 V ± 10%)

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT		
I <sub>IL</sub>	Input Leakage Current	V <sub>IN</sub> = 0 V~V <sub>DD</sub>	—	—	±1.0	μA		
I <sub>OH</sub>	Output High Current	V <sub>OH</sub> = V <sub>DD</sub> - 0.2 V	-0.1	—	—	mA		
I <sub>OL</sub>	Output Low Current	V <sub>OL</sub> = 0.2 V	0.1	—	—	mA		
I <sub>LO</sub>	Output Leakage Current	$\overline{CE} = V_{IH}$ or R/W = V <sub>IL</sub> or $\overline{OE} = V_{IH}$ , V <sub>OUT</sub> = 0 V~V <sub>DD</sub>	—	—	±1.0	μA		
I <sub>DDO2</sub>	Operating Current	$\overline{CE} = 0.2$ V and R/W = V <sub>DD</sub> - 0.2 V, I <sub>OUT</sub> = 0 mA, Other Input = V <sub>DD</sub> - 0.2 V/0.2 V	t <sub>cycle</sub>	MIN	—	—	30	mA
				1 μs	—	3	—	
I <sub>DDS2</sub>	Standby Current	$\overline{CE} = V_{DD} - 0.2$ V	Ta = 25°C	—	1	—	μA	
			Ta = -40~40°C	—	—	3		
			Ta = -40~85°C	—	—	20		

## 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	pF

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

## AC CHARACTERISTICS AND OPERATING CONDITIONS (Ta = -40° to 85°C, VDD = 5 V ± 10%)

### READ CYCLE

SYMBOL	PARAMETER	TC55NEM208AFPV/AFTV				UNIT
		55		70		
		MIN	MAX	MIN	MAX	
t <sub>RC</sub>	Read Cycle Time	55	—	70	—	ns
t <sub>ACC</sub>	Address Access Time	—	55	—	70	
t <sub>CO</sub>	Chip Enable Access Time	—	55	—	70	
t <sub>OE</sub>	Output Enable Access Time	—	30	—	35	
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	—	25	—	30	
t <sub>ODO</sub>	Output Enable High to Output High-Z	—	25	—	30	
t <sub>OH</sub>	Output Data Hold Time	10	—	10	—	

### WRITE CYCLE

SYMBOL	PARAMETER	TC55NEM208AFPV/AFTV				UNIT
		55		70		
		MIN	MAX	MIN	MAX	
t <sub>WC</sub>	Write Cycle Time	55	—	70	—	ns
t <sub>WP</sub>	Write Pulse Width	40	—	50	—	
t <sub>CW</sub>	Chip Enable to End of Write	45	—	55	—	
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	—	25	—	30	
t <sub>OEW</sub>	R/W High to Output Active	0	—	0	—	
t <sub>DS</sub>	Data Setup Time	25	—	30	—	
t <sub>DH</sub>	Data Hold Time	0	—	0	—	

### AC TEST CONDITIONS

PARAMETER	TEST CONDITION
Output load	100 pF + 1 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

## AC CHARACTERISTICS AND OPERATING CONDITIONS (Ta = -40° to 85°C, VDD=2.7 to 5.5 V)

### READ CYCLE

SYMBOL	PARAMETER	TC55NEM208AFPV/AFTV				UNIT
		55		70		
		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>CO</sub>	Chip Enable 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

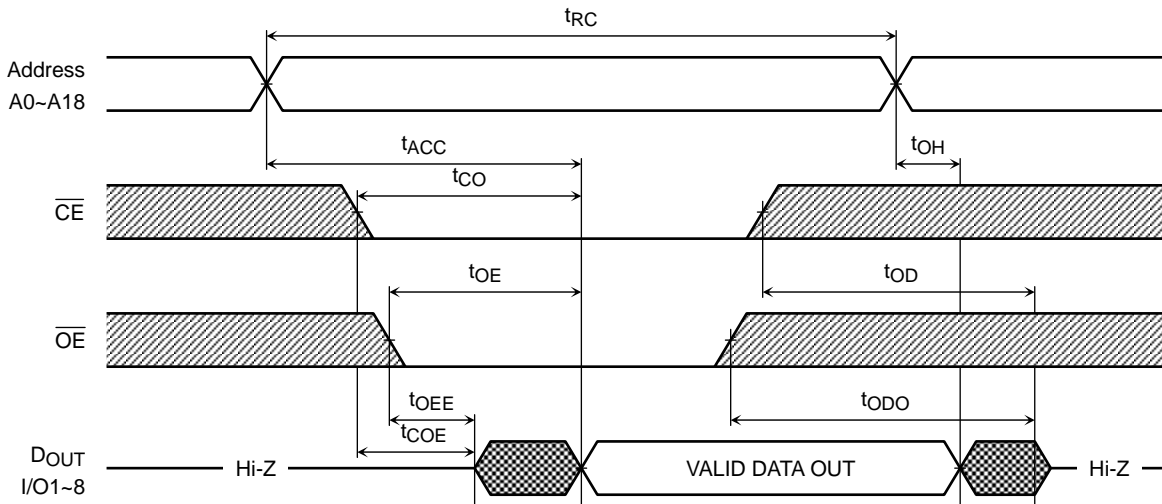
SYMBOL	PARAMETER	TC55NEM208AFPV/AFTV				UNIT
		55		70		
		MIN	MAX	MIN	MAX	
t <sub>WC</sub>	Write Cycle Time	70	—	85	—	ns
t <sub>WP</sub>	Write Pulse Width	50	—	55	—	
t <sub>CW</sub>	Chip Enable to End of Write	55	—	60	—	
t <sub>AS</sub>	Address Setup Time	0	—	0	—	
t <sub>WR</sub>	Write Recovery Time	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

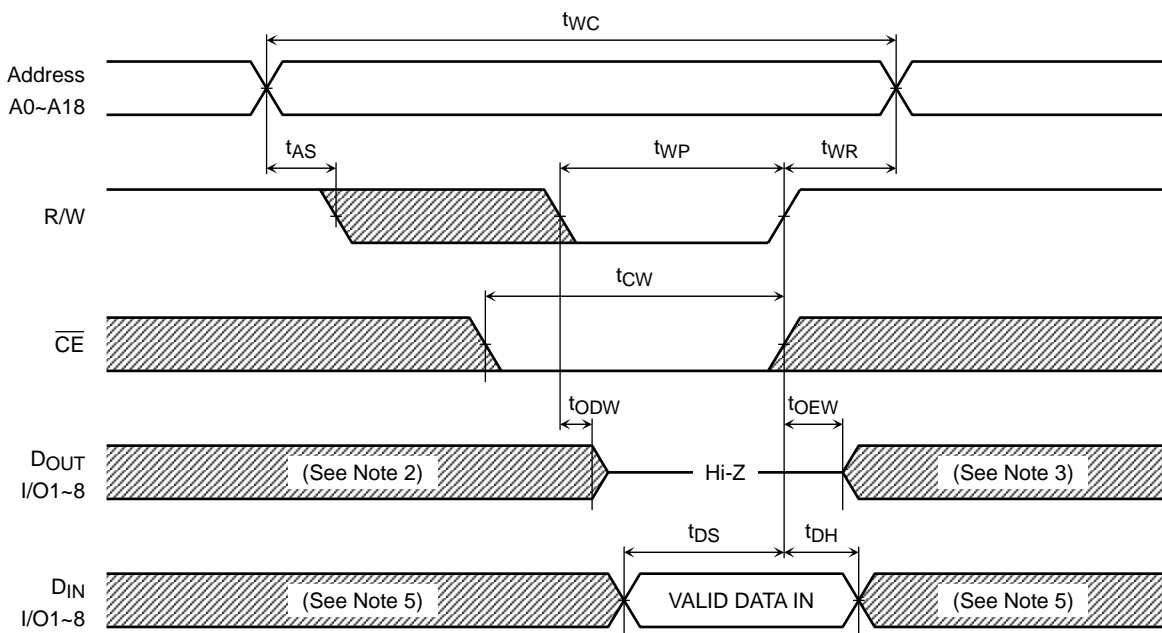
PARAMETER	TEST CONDITION
Output load	100 pF (Include Jig)
Input pulse level	0.2 V, V <sub>DD</sub> - 0.2 V
Timing measurements	1.5 V
Reference level	1.5 V
t <sub>R</sub> , t <sub>F</sub>	5 ns

## TIMING DIAGRAMS

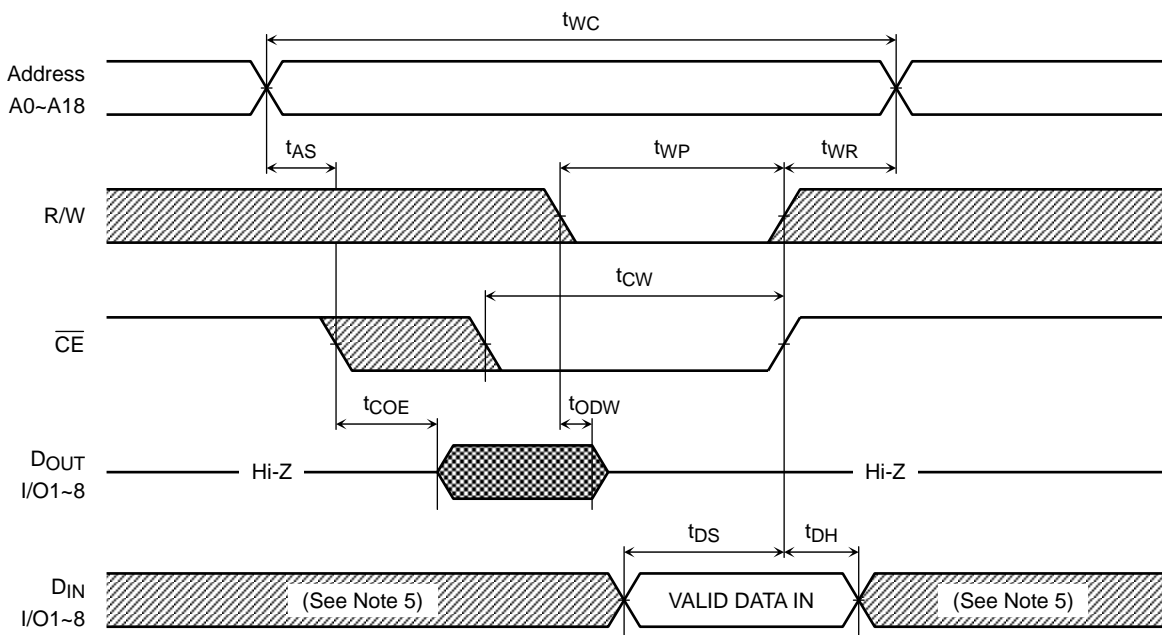
### READ CYCLE (See Note 1)



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



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



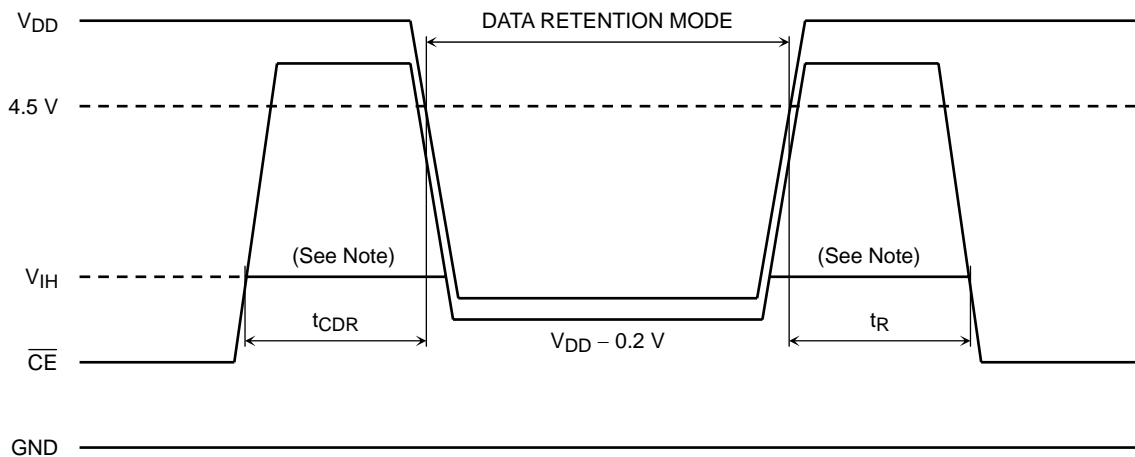
### Note:

- (1) R/W remains HIGH for the read cycle.
- (2) If  $\overline{CE}$  goes LOW coincident with or after R/W goes LOW, the outputs will remain at high impedance.
- (3) If  $\overline{CE}$  goes HIGH 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	—	5.5	V
I <sub>DDS2</sub>	Standby Current	Ta = -40~40°C	—	3	μA
		Ta = -40~85°C	—	20	
t <sub>CDR</sub>	Chip Deselect to Data Retention Mode Time	0	—	—	ns
t <sub>R</sub>	Recovery Time	5	—	—	ms

### CE CONTROLLED DATA RETENTION MODE



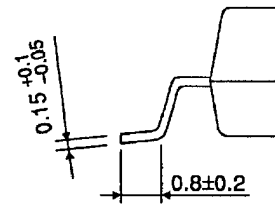
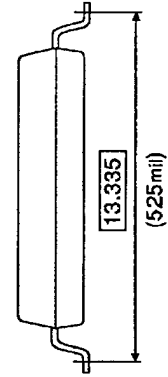
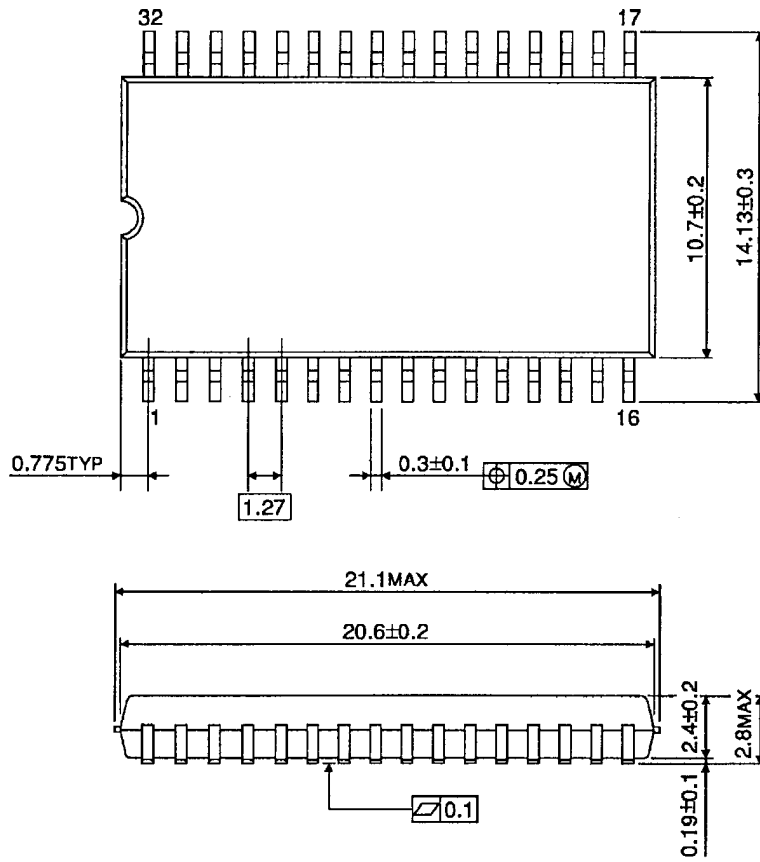
Note: When  $\overline{CE}$  is operating at the V<sub>IH</sub> level (2.2V), the standby current is given by I<sub>DDS1</sub> during the transition of V<sub>DD</sub> from 4.5 to 2.4V.



## PACKAGE DIMENSIONS

SOP32-P-525-1.27

Unit : mm

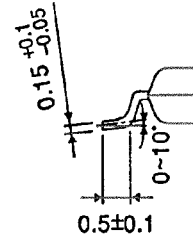
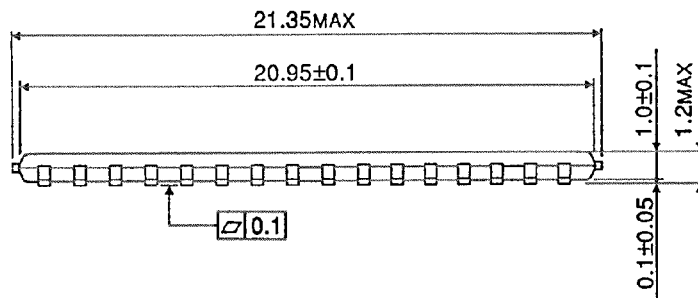
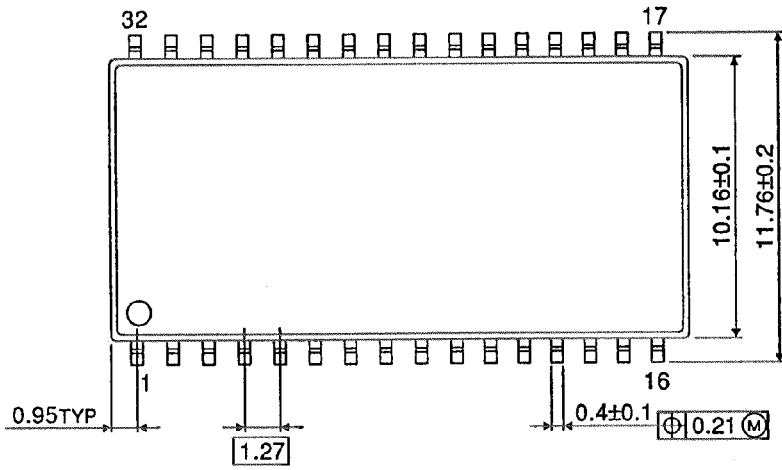


Weight: g (typ)

## PACKAGE DIMENSIONS

TSOPII32-P-400-1.27

Unit: mm



Weight: g (typ)

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000707EBA

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