

## TOSHIBA MOS DIGITAL INTEGRATED CIRCUIT SILICON GATE CMOS

32,768 WORDS  $\times$  8 BIT STATIC RAM

## DESCRIPTION

The TC55257DPI is 262,144 bit static random access memory organized as 32,768 words by 8 bits using CMOS technology, and operated from a single 2.7~5.5V supply. Advanced circuit techniques provide both high speed and low power features with an operating current of 5 mA / MHz (Typ.) and minimum cycle time of 70 ns.

When CE is a logical high, the device is placed in low power standby mode in which standby current is 0.3  $\mu$ A typically. The TC55257DPI has two control inputs. Chip enable (CE) allows for device selection and data retention control, and an output enable input (OE) provides fast memory access. Thus the TC55257DPI is suitable for use in various microprocessor application systems where high speed, low power, and battery back up are required. And TC55257DPI guarantees -40~85°C operating temperature, so TC55257DPI is suitable for use in wide operating temperature system.

The TC55257DPI is offered in a standard dual-in-line 28 pin plastic package (0.6 inch width), small-out-line plastic package and thin-small-out-line plastic package (forward type, reverse type).

## FEATURES

- Low Power Dissipation  
27.5 mW / MHz (Typ.) Operating
- Standby Current : 2  $\mu$ A (Max.) at Ta = 25°C
- Single Power Supply : 2.7~5.5 V
- Power Down Feature : CE
- Data retention Supply Voltage : 2.0~5.5 V
- Directly TTL Compatible  
: All Inputs and Outputs
- Wide Temperature Operating : -40~85°C

- Access Time (Max.) :

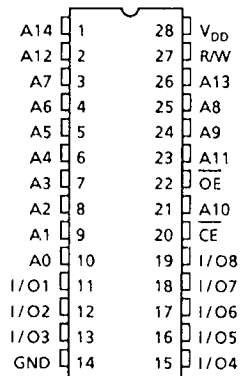
|                | 5V $\pm$ 10% |      | 2.7~5.5V |       |
|----------------|--------------|------|----------|-------|
|                | -70V         | -85V | -70V     | -85V  |
| Access Time    | 70ns         | 85ns | 120ns    | 150ns |
| CE Access Time | 70ns         | 85ns | 120ns    | 150ns |
| OE Access Time | 35ns         | 45ns | 70ns     | 75ns  |

- Package :

DIP28-P-600-2.54 (DPI) (Weight: 4.42 g typ)  
 SOP28-P-450-1.27 (DFI) (Weight: 0.79 g typ)  
 TSOP I 28-P-0.55 (DFTI) (Weight: 0.22 g typ)  
 TSOP I 28-P-0.55A (DTRI) (Weight: 0.22 g typ)

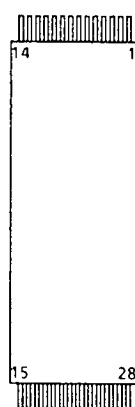
## PIN CONNECTION (TOP VIEW)

## o 28 PIN DIP &amp; SOP



## o 28 PIN TSOP

(forward type)



(reverse type)



## PIN NAME

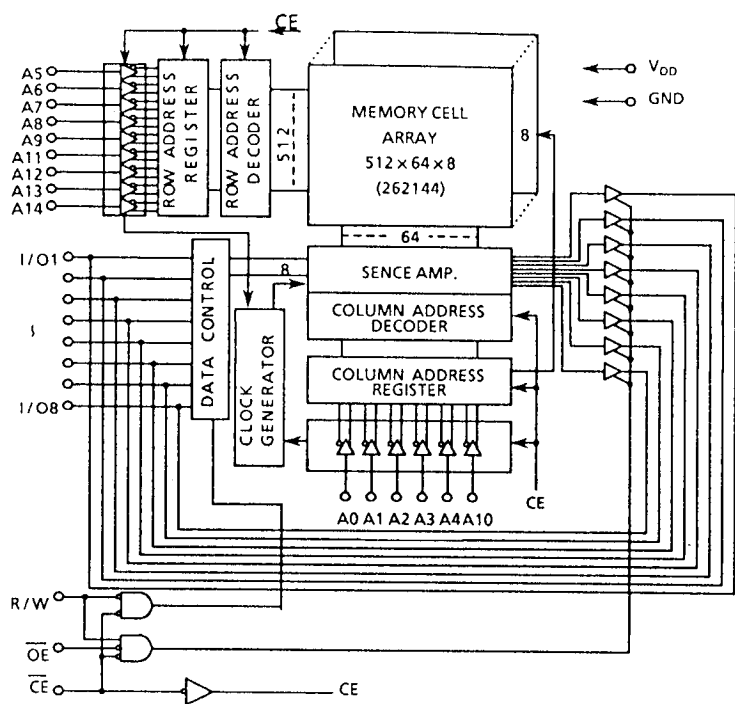
|           |                            |
|-----------|----------------------------|
| A0~A14    | Address Inputs             |
| R/W       | Read / Write Control Input |
| OE        | Output Enable Input        |
| CE        | Chip Enable Input          |
| I/O1~I/O8 | Data Input / Output        |
| VDD       | Power                      |
| GND       | Ground                     |

|          |                |                 |                |                |                 |      |                 |                 |                 |                |                |                |                |                 |
|----------|----------------|-----------------|----------------|----------------|-----------------|------|-----------------|-----------------|-----------------|----------------|----------------|----------------|----------------|-----------------|
| PIN NO.  | 1              | 2               | 3              | 4              | 5               | 6    | 7               | 8               | 9               | 10             | 11             | 12             | 13             | 14              |
| PIN NAME | OE             | A <sub>11</sub> | A <sub>9</sub> | A <sub>8</sub> | A <sub>13</sub> | R/W  | V <sub>DD</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> | A <sub>3</sub>  |
| PIN NO.  | 15             | 16              | 17             | 18             | 19              | 20   | 21              | 22              | 23              | 24             | 25             | 26             | 27             | 28              |
| PIN NAME | 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           | CE             | A <sub>10</sub> |

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BLOCK DIAGRAM



OPERATION MODE

| OPERATION MODE  | $\overline{CE}$ | $\overline{OE}$ | R/W | I/O1~I/O8        | POWER            |
|-----------------|-----------------|-----------------|-----|------------------|------------------|
| Read            | L               | L               | H   | D <sub>OUT</sub> | I <sub>DDO</sub> |
| Write           | L               | *               | L   | D <sub>IN</sub>  | I <sub>DDO</sub> |
| Output Deselect | L               | H               | H   | High-Z           | I <sub>DDO</sub> |
| Standby         | H               | *               | *   | High-Z           | I <sub>DDs</sub> |

\* : H or L

ABSOLUTE MAXIMUM RATINGS

| SYMBOL              | ITEM                         | RATING                     | UNIT |
|---------------------|------------------------------|----------------------------|------|
| V <sub>DD</sub>     | Power Supply Voltage         | -0.3~7.0                   | V    |
| V <sub>IN</sub>     | Input Voltage                | -0.3*~7.0                  | V    |
| V <sub>I/O</sub>    | Input and Output Voltage     | -0.5*~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          | -55~150                    | °C   |
| T <sub>opr</sub>    | Operating Temperature        | -40~85                     | °C   |

\* : -3.0 V at pulse width 50 ns

\*\* : SOP

D.C. RECOMMENDED OPERATING CONDITIONS ( $T_a = -40 \sim 85^\circ\text{C}$ )

| SYMBOL   | PARAMETER                     | 5V $\pm$ 10% |      |                | 2.7~5.5V       |      |                | UNIT |
|----------|-------------------------------|--------------|------|----------------|----------------|------|----------------|------|
|          |                               | MIN.         | TYP. | MAX.           | MIN.           | TYP. | MAX.           |      |
| $V_{DD}$ | Power Supply Voltage          | 4.5          | —    | 5.5            | 2.7            | —    | 5.5            | V    |
| $V_{IH}$ | Input High Voltage            | 2.4          | —    | $V_{DD} + 0.3$ | $V_{DD} - 0.2$ | —    | $V_{DD} + 0.3$ |      |
| $V_{IL}$ | Input Low Voltage             | -0.3*        | —    | 0.6            | -0.3*          | —    | 0.2            |      |
| $V_{DH}$ | Data Retention Supply Voltage | 2.0          | —    | 5.5            | 2.0            | —    | 5.5            |      |

\*: -3.0V at pulse width at 50ns Max.

D.C. and OPERATING CHARACTERISTICS ( $T_a = -40 \sim 85^\circ\text{C}$ ,  $V_{DD} = 5\text{V} \pm 10\%$ )

| SYMBOL     | PARAMETER              | TEST CONDITION   | MIN.                                   | TYP. | MAX.      | UNIT          |
|------------|------------------------|--|--|------|-----------|---------------|
| $I_{IL}$   | Input Leakage Current  | $V_{IN} = 0 \sim V_{DD}$   | —                                      | —    | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{OH}$   | Output High Current    | $V_{OH} = 2.4\text{V}$   | -1.0                                   | —    | —         | mA            |
| $I_{OL}$   | Output Low Current     | $V_{OL} = 0.4\text{V}$   | 4.0                                    | —    | —         | mA            |
| $I_{LO}$   | Output Leakage Current | $\overline{CE} = V_{IH}$ or $R/W = V_{IL}$ or $\overline{OE} = V_{IH}$ , $V_{OUT} = 0 \sim V_{DD}$   | —                                      | —    | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{DDO1}$ | Operating Current      | $\overline{CE} = V_{IL}$<br>$R/W = V_{IH}$ , $I_{OUT} = 0\text{mA}$<br>Other Input = $V_{IH}/V_{IL}$                                       | $t_{\text{cycle}} = 1\mu\text{s}$      | —    | 10        | mA            |
|            |                        |  | $t_{\text{cycle}} = \text{Min. cycle}$ | —    | —         |               |
| $I_{DDO2}$ |                        | $\overline{CE} = 0.2\text{V}$<br>$R/W = V_{DD} - 0.2\text{V}$ , $I_{OUT} = 0\text{mA}$<br>Other Input = $V_{DD} - 0.2\text{V}/0.2\text{V}$ | $t_{\text{cycle}} = 1\mu\text{s}$      | —    | 5         | mA            |
|            |                        |  | $t_{\text{cycle}} = \text{Min. cycle}$ | —    | —         |               |
| $I_{DDs1}$ | Standby Current        | $\overline{CE} = V_{IH}$   | —                                      | —    | —         | mA            |
| $I_{DDs2}$ |                        | $\overline{CE} = V_{DD} - 0.2$<br>$V_{DD} = 2.0\text{V} \sim 5.5\text{V}$  | $T_a = -40 \sim 85^\circ\text{C}$      | —    | —         | 30            |
|            |                        |  | $T_a = 25^\circ\text{C}$               | —    | 0.3       | 2             |

D.C. and OPERATING CHARACTERISTICS (Ta = -40~85°C, V<sub>DD</sub> = 3V ± 10%)

| SYMBOL            | PARAMETER              | TEST CONDITION   |                               |                 | MIN.  | TYP. | MAX.  | UNIT |
|-------------------|------------------------|--|-------------------------------|-----------------|-------|------|-------|------|
| I <sub>IL</sub>   | Input Leakage Current  | V <sub>IN</sub> = 0 ~ V <sub>DD</sub>  |                               |                 | —     | —    | ± 1.0 | μA   |
| I <sub>OH</sub>   | Output High Current    | V <sub>OH</sub> = V <sub>DD</sub> - 0.2V   |                               |                 | - 0.1 | —    | —     | mA   |
| I <sub>OL</sub>   | Output Low Current     | V <sub>OL</sub> = 0.2V   |                               |                 | 0.1   | —    | —     | mA   |
| I <sub>LO</sub>   | Output Leakage Current | $\overline{CE} = V_{IH}$ or R/W = V <sub>IL</sub> or<br>$\overline{OE} = V_{IH}$ , V <sub>OUT</sub> = 0 ~ V <sub>DD</sub>        |                               |                 | —     | —    | ± 1.0 | μA   |
| I <sub>DDO2</sub> | Operating Current      | $\overline{CE} = 0.2V$<br>R/W = V <sub>DD</sub> - 0.2V,<br>I <sub>OUT</sub> = 0mA<br>Other Input = V <sub>DD</sub> - 0.2V / 0.2V | T <sub>cycle</sub>            | Min.            | —     | —    | 20    | mA   |
|                   |                        |  |                               | 1μs             | —     | —    | 5     |      |
| I <sub>DD52</sub> | Standby Current        | $\overline{CE} = V_{DD} - 0.2V$  | V <sub>DD</sub><br>= 3V ± 10% | Ta = 25°C       | —     | 1    | 1.5   | μA   |
|                   |                        |  |                               | Ta = -40 ~ 85°C | —     | —    | 20    |      |
|                   |                        | V <sub>DD</sub> = 3.0V   |                               | Ta = 25°C       | —     | —    | 1     |      |
|                   |                        |  |                               | Ta = -40 ~ 40°C | —     | —    | 2     |      |
|                   |                        |  |                               | Ta = -40 ~ 85°C | —     | —    | 15    |      |

## CAPACITANCE (Ta = 25°C, f = 1MHz)

| 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 periodically sampled is not 100% tested.

**A.C. CHARACTERISTICS** (  $T_a = -40 \sim 85^\circ\text{C}$ ,  $V_{DD} = 5\text{V} \pm 10\%$  )

Read Cycle

| SYMBOL           | PARAMETER                         | TC55257DPI / DFI / DFTI / DTRI |      |       |      | UNIT |
|------------------|-----------------------------------|--------------------------------|------|-------|------|------|
|                  |                                   | - 70V                          |      | - 85V |      |      |
|                  |                                   | 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>  | CE Access Time                    | –                              | 70   | –     | 85   |      |
| t <sub>OE</sub>  | Output Enable to Output in Valid  | –                              | 35   | –     | 45   |      |
| t <sub>COE</sub> | Chip Enable to Output in Low-Z    | 5                              | –    | 5     | –    |      |
| t <sub>OEE</sub> | Output Enable to Output in Low-Z  | 0                              | –    | 0     | –    |      |
| t <sub>OD</sub>  | Chip Enable to Output in High-Z   | –                              | 25   | –     | 30   |      |
| t <sub>ODO</sub> | Output Enable to Output in High-Z | –                              | 25   | –     | 30   |      |
| t <sub>OH</sub>  | Output Data Hold Time             | 10                             | –    | 10    | –    |      |

Write Cycle

| SYMBOL           | PARAMETER                      | TC55257DPI / DFI / DFTI / DTRI |      |       |      | UNIT |
|------------------|--------------------------------|--------------------------------|------|-------|------|------|
|                  |                                | - 70V                          |      | - 85V |      |      |
|                  |                                | 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 Selection to End of Write | 60                             | –    | 65    | –    |      |
| t <sub>AS</sub>  | Address Set up Time            | 0                              | –    | 0     | –    |      |
| t <sub>WR</sub>  | Write Recovery Time            | 0                              | –    | 0     | –    |      |
| t <sub>ODW</sub> | R / W to Output in High-Z      | –                              | 25   | –     | 30   |      |
| t <sub>OEW</sub> | R / W to Output in Low-Z       | 0                              | –    | 0     | –    |      |
| t <sub>DS</sub>  | Data Set up Time               | 30                             | –    | 40    | –    |      |
| t <sub>DH</sub>  | Data Hold Time                 | 0                              | –    | 0     | –    |      |

A.C. Test Conditions

Output Load : 100 pF + 1 TTL Gate ( -70V, -85V )  
 Input Pulse Level : 0.4 V, 2.6 V  
 Timing Measurement : 1.5 V  
 Reference Level : 1.5 V  
 $t_r$ ,  $t_f$  : 5 ns

**A.C. CHARACTERISTICS** ( $T_a = -40 \sim 85^\circ\text{C}$ ,  $V_{DD} = 2.7 \sim 5.5\text{V}$ )

Read Cycle

| SYMBOL           | PARAMETER                         | TC55257DPI / DFI / DFTI / DTRI |      |       |      | UNIT |
|------------------|-----------------------------------|--------------------------------|------|-------|------|------|
|                  |                                   | – 70V                          |      | – 85V |      |      |
|                  |                                   | MIN.                           | MAX. | MIN.  | MAX. |      |
| t <sub>RC</sub>  | Read Cycle Time                   | 120                            | –    | 150   | –    | ns   |
| t <sub>ACC</sub> | Address Access Time               | –                              | 120  | –     | 150  |      |
| t <sub>CO</sub>  | $\overline{CE}$ Access Time       | –                              | 120  | –     | 150  |      |
| t <sub>OE</sub>  | Output Enable to Output in Valid  | –                              | 70   | –     | 75   |      |
| t <sub>COE</sub> | Chip Enable to Output in Low-Z    | 5                              | –    | 5     | –    |      |
| t <sub>OEE</sub> | Output Enable to Output in Low-Z  | 0                              | –    | 0     | –    |      |
| t <sub>OD</sub>  | Chip Enable to Output in High-Z   | –                              | 50   | –     | 50   |      |
| t <sub>ODO</sub> | Output Enable to Output in High-Z | –                              | 50   | –     | 50   |      |
| t <sub>OH</sub>  | Output Data Hold Time             | 10                             | –    | 10    | –    |      |

Write Cycle

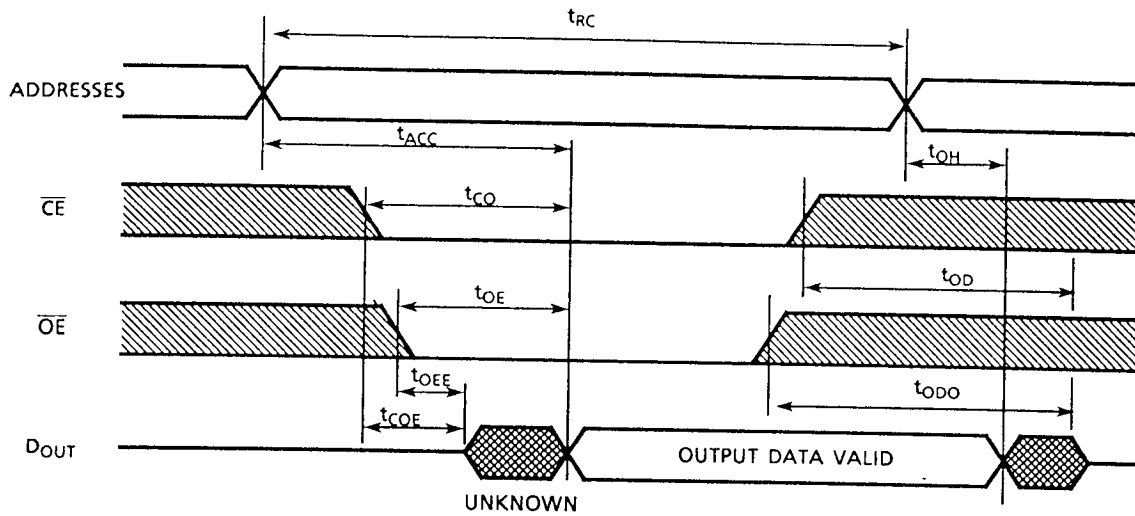
| SYMBOL           | PARAMETER                      | TC55257DPI / DFI / DFTI / DTRI |      |       |      | UNIT |
|------------------|--------------------------------|--------------------------------|------|-------|------|------|
|                  |                                | – 70V                          |      | – 85V |      |      |
|                  |                                | MIN.                           | MAX. | MIN.  | MAX. |      |
| t <sub>WC</sub>  | Write Cycle Time               | 120                            | –    | 150   | –    | ns   |
| t <sub>WP</sub>  | Write Pulse Width              | 80                             | –    | 100   | –    |      |
| t <sub>CW</sub>  | Chip Selection to End of Write | 100                            | –    | 120   | –    |      |
| t <sub>AS</sub>  | Address Set up Time            | 0                              | –    | 0     | –    |      |
| t <sub>WR</sub>  | Write Recovery Time            | 0                              | –    | 0     | –    |      |
| t <sub>ODW</sub> | R/W to Output in High-Z        | –                              | 50   | –     | 50   |      |
| t <sub>OEW</sub> | R/W to Output in Low-Z         | 0                              | –    | 0     | –    |      |
| t <sub>DS</sub>  | Data Set up Time               | 50                             | –    | 60    | –    |      |
| t <sub>DH</sub>  | Data Hold Time                 | 0                              | –    | 0     | –    |      |

A.C. TEST CONDITIONS

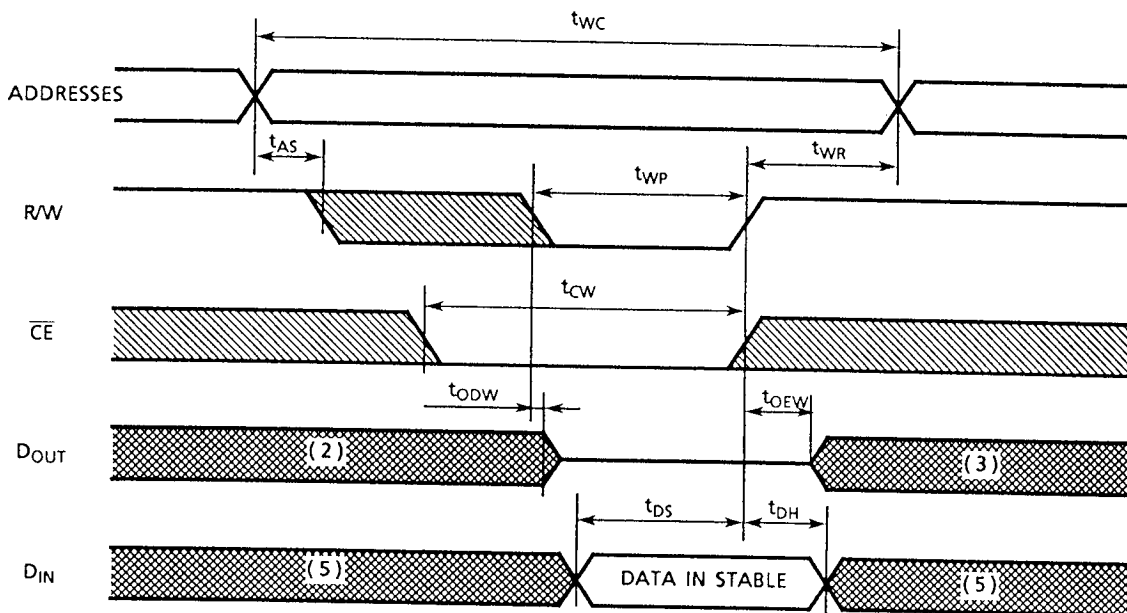
- Output Load : 100pF (Include Jig)
- Input Pulse Level :  $V_{DD} - 0.2\text{V} / 0.2\text{V}$
- Timing Measurement  $V_{IN}$  : 1.5V  
Reference Level  $V_{OUT}$  : 1.5V
- $t_r, t_f$  : 5ns

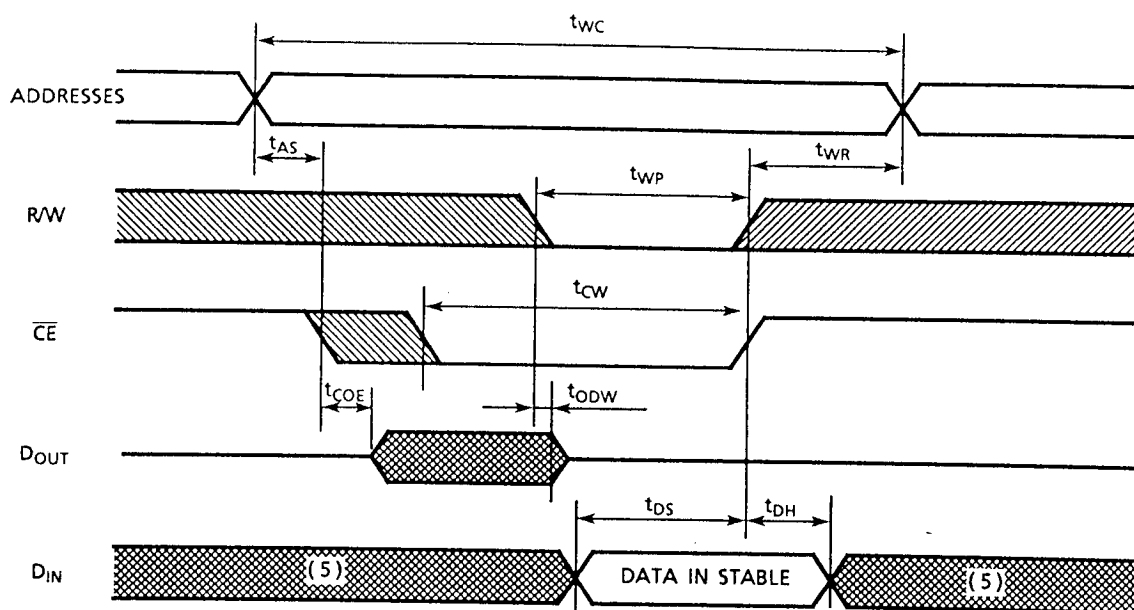
TIMING WAVEFORMS

Read Cycle (1)



Write Cycle 1 (4) (R/W Controlled Write)



Write Cycle 2 (4) ( $\overline{CE}$  Controlled Write)


Note : (1) R/W is High for read cycle.

- (2) Assuming that  $\overline{CE}$  low transition occurs coincident with or after R / W Low transition, Outputs remain a high impedance state.
- (3) Assuming that  $\overline{CE}$  High transition occurs coincident with or prior to R / W High transition, Outputs remain a high impedance state.
- (4) Assuming that  $\overline{OE}$  is High for Write Cycle, Outputs are in high impedance state during this period.
- (5) The I/O may be in the output state at this time, input signals of opposite phase must not be applied.

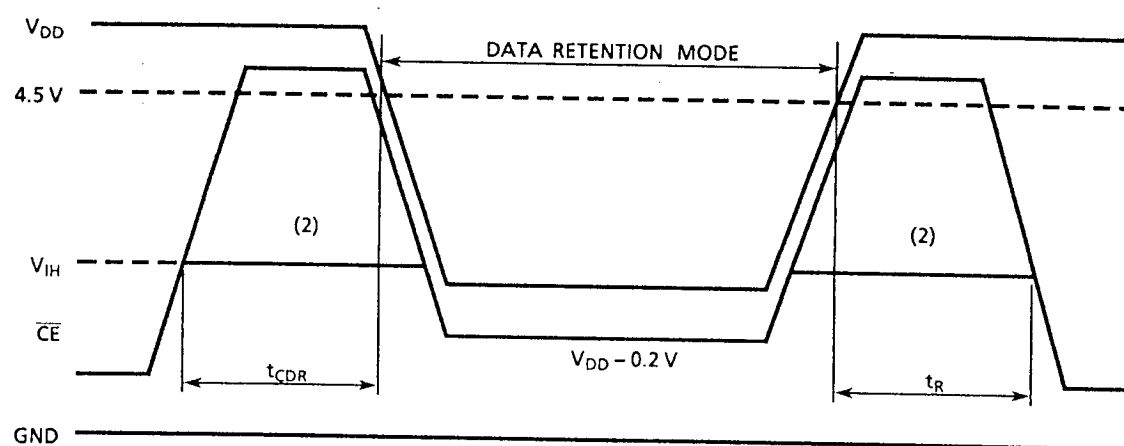


**DATA RETENTION CHARACTERISTICS (Ta = -40~85 °C)**

| SYMBOL     | PARAMETER                               | MIN.                    | TYP. | MAX. | UNIT          |
|------------|---|-------------------------|------|------|---------------|
| $V_{DH}$   | Data Retention Supply Voltage           | 2.0                     | —    | 5.5  | V             |
| $I_{DD52}$ | Standby Supply Current                  | $V_{DH} = 3.0\text{ V}$ | —    | 15*  | $\mu\text{A}$ |
|            |   | $V_{DH} = 5.5\text{ V}$ | —    | 30   | $\mu\text{A}$ |
| $t_{CDR}$  | Chip Deselection to Data Retention Mode |                         | —    | —    | ns            |
| $t_R$      | Recovery Time                           |                         | —    | —    | ns            |

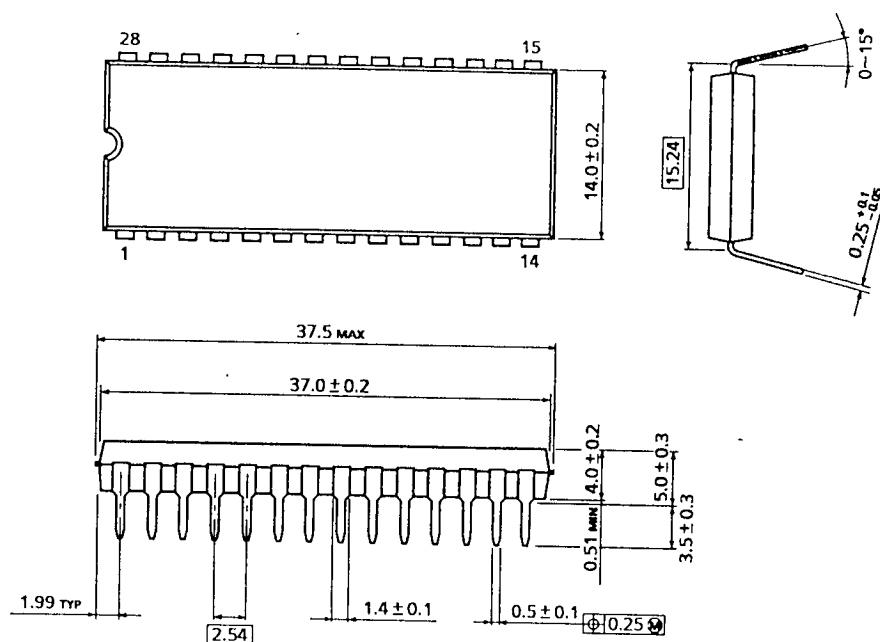
Note (1) : Read Cycle Time.

 \*) 2 $\mu\text{A}$  (Max.) Ta = -40~40°C

 **$\overline{\text{CE}}$  Controlled Data Retention Mode**

 Note (2) : If the  $V_{IH}$  of  $\overline{\text{CE}}$  is 2.4 V in operation,  $I_{DD51}$  current flows during the period that the  $V_{DD}$  voltage is going down from 4.5 V to 2.6 V

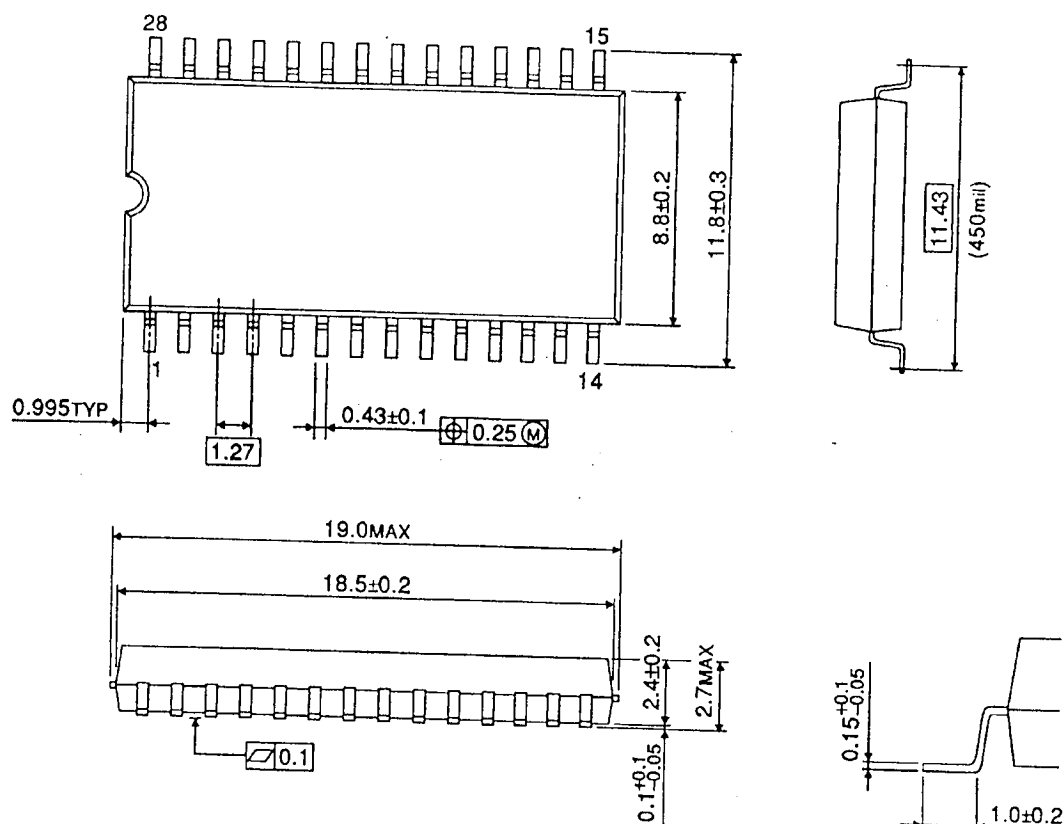
PACKAGE DIMENSIONS (DIP28-P-600-2.54)

Units in mm



Weight: 4.42 g (typ)

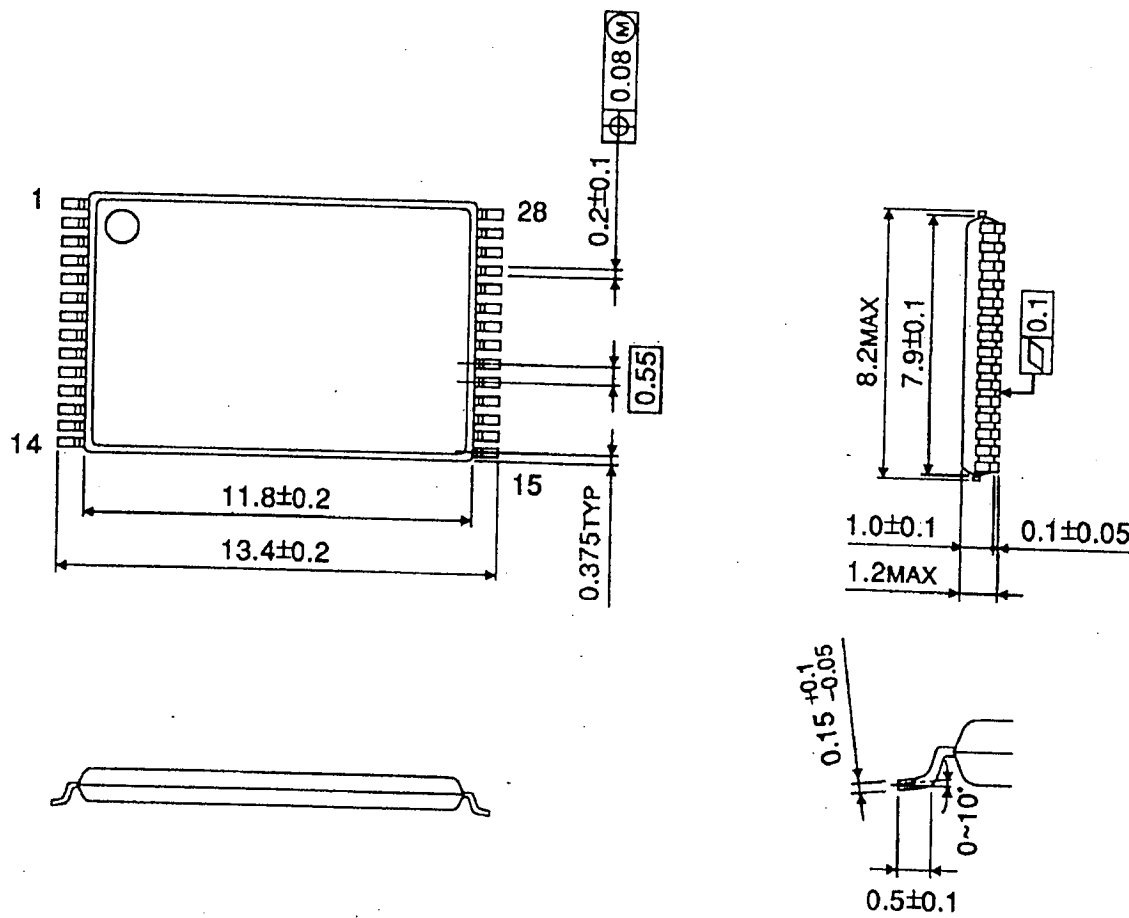
## Units in mm



Weight: 0.79 g (typ)

PACKAGE DIMENSIONS (TSOP I 28-P-0.55)

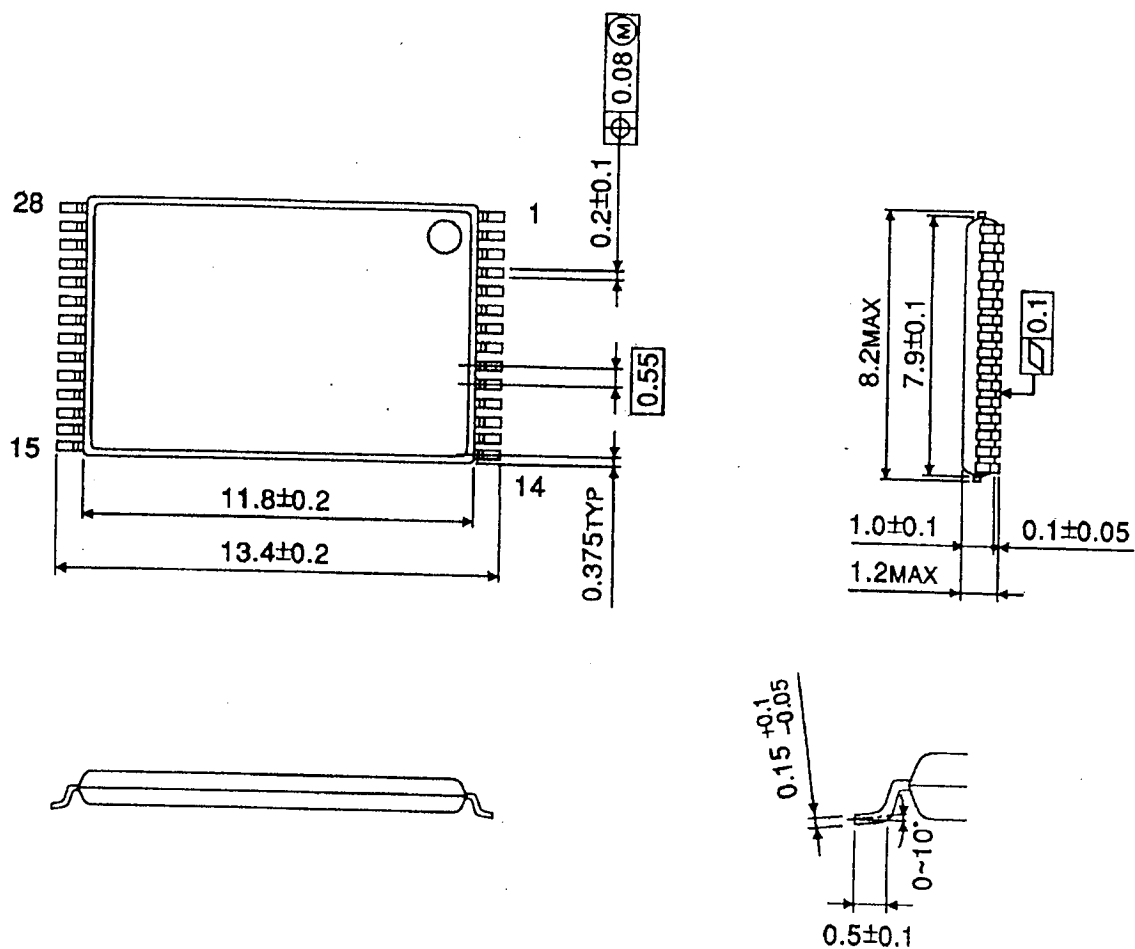
Units in mm



Weight: 0.22 g (typ)

### PACKAGE DIMENSIONS (TSOP I 28-P-0.55A)

Units in mm



Weight: 0.22 g (typ)