

# TOSHIBA MOS MEMORY PRODUCTS

256 WORD x 4 BIT CMOS RAM

TC5501P/-1  
TC5501D/-1

## DESCRIPTION

The TC5501P/D is a fully static read write memory organized as 256 words by 4 bits using CMOS technology. Because of ultra low power dissipation, the TC5501P/D can be used as battery operated portable memory system and also as a nonvolatile memory with battery back up. The TC5501P/D operates from a single 5V power supply with a static operation, so that the no refresh periods are required. This simplifies the power supply circuit design.

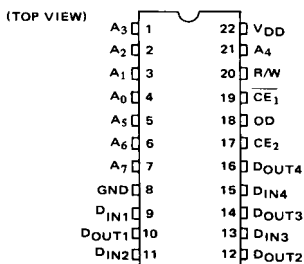
The three state outputs simplify the memory expansion making the TC5501P/D suitable for use in a microprocessor peripheral memory. Since the minimum data retention voltage is 2V, the battery back up system needs only simple circuit. By using Toshiba's original C<sup>2</sup>MOS technology, the device circuitry is not only simplified but wide operating margin and noise margin are also realized.

The TC5501P/D is offered in standard 22 pin plastic and cerdip packages, 0.4 inch in width.

## FEATURES

- Low Power Dissipation
  - 55μW (MAX.) STANDBY
  - 83mW (MAX.) OPERATING
- Single 5V Power Supply
- Data Retention Voltage 2V to 5.5V
- Package
  - Plastic DIP : TC5501P
  - Cerdip DIP : TC5501D
- Fully static operation
- Three State Output
- Input/output, TTL Compatible
- Access Time
  - TC5501P/D : t<sub>ACC</sub> ≦ 450ns (MAX.)
  - TC5501P-1/D-1; t<sub>ACC</sub> ≦ 650ns (MAX.)

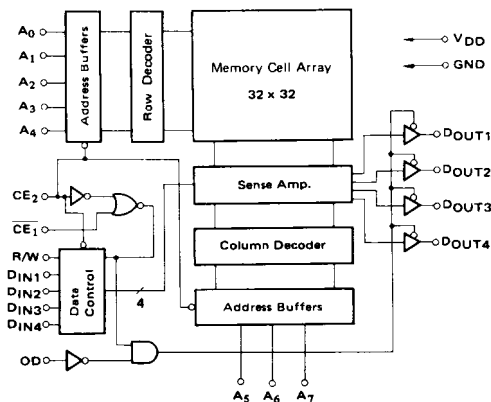
## PIN CONNECTION



## PIN NAMES

|                                   |                        |
|-----------------------------------|------------------------|
| A <sub>0</sub> ~ A <sub>7</sub>   | Address Inputs         |
| R/W                               | Read Write Input       |
| CE <sub>1</sub> , CE <sub>2</sub> | Chip Enable Inputs     |
| DIN <sub>1</sub> ~ 4              | Data Inputs            |
| DOUT <sub>1</sub> ~ 4             | Data Outputs           |
| OD                                | Output Disable Input   |
| V <sub>DD</sub> /GND              | Power Supply Terminals |

## BLOCK DIAGRAM



## MAXIMUM RATINGS

| SYMBOL       | ITEM   | RATING                | UNITS                             |
|--------------|--|-----------------------|-----------------------------------|
| $V_{DD}$     | Power Supply Voltage                           | -0.3 ~ 7.0            | V                                 |
| $V_{IN}$     | Input Voltage                                  | -0.3 ~ $V_{DD} + 0.3$ | V                                 |
| $V_{OUT}$    | Output Voltage                                 | 0 ~ $V_{DD}$          | V                                 |
| $P_D$        | Power Dissipation ( $T_a = 85^\circ\text{C}$ ) | 800                   | mW                                |
| $T_{SOLDER}$ | Soldering Temperature - Time                   | 260 · 10              | $^\circ\text{C} \cdot \text{sec}$ |
| $T_{STG}$    | Storage Temperature                            | -55 ~ 150             | $^\circ\text{C}$                  |
| $T_{OPR}$    | Operating Temperature                          | -30 ~ 85              | $^\circ\text{C}$                  |

## DC RECOMMENDED OPERATING CONDITION

| SYMBOL   | PARAMETER                | MIN. | TYP. | MAX.           | UNITS |
|----------|--------------------------|------|------|----------------|-------|
| $V_{DD}$ | Power Supply Voltage     | 4.5  | -    | 5.5            | V     |
| $V_{IH}$ | Input High Level Voltage | 2.2  | -    | $V_{DD} + 0.3$ | V     |
| $V_{IL}$ | Input Low Level Voltage  | -0.3 | -    | 0.65           | V     |
| $V_{DH}$ | Data Retention Voltage   | 2.0  | -    | 5.5            | V     |

## DC CHARACTERISTICS ( $T_a = -30 \sim 85^\circ\text{C}$ )

| SYMBOL    | PARAMETER              | CONDITIONS   | MIN. | TYP.(1)    | MAX.      | UNITS         |
|-----------|------------------------|--|------|------------|-----------|---------------|
| $I_{IN}$  | Input Current          | $0 \leq V_{IN} \leq V_{DD}$  | -    | $\pm 0.05$ | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{DDS}$ | Standby Current        | $V_{DD} = 2.0\text{V to } 5.5\text{V}$<br>$CE_2 = 0.2\text{V}$ , Output open | -    | 0.2        | 10        | $\mu\text{A}$ |
| $I_{DDO}$ | Operating Current      | $V_{DD} = 5.5\text{V}$ , $t_{CYC} = 1\mu\text{s}$                            | -    | 6.2        | 15        | mA            |
| $I_{LO}$  | Output Leakage Current | $0 \leq V_{OUT} \leq V_{DD}$   | -    | $\pm 0.05$ | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{OH}$  | Output High Current    | $V_{DD} = 4.5\text{V}$ , $V_{OH} = 2.4\text{V}$                              | -1.0 | -2.0       | -         | mA            |
| $I_{OL}$  | Output Low Current     | $V_{DD} = 4.5\text{V}$ , $V_{OL} = 0.4\text{V}$                              | 2.0  | 3.0        | -         | mA            |

Note (1)  $T_a = 25^\circ\text{C}$      $V_{DD} = 5\text{V}$

## CAPACITANCE (2) ( $T_a = 25^\circ\text{C}$ )

| SYMBOL    | PARAMETER          | CONDITIONS                                | MIN. | TYP. | MAX. | UNIT |
|-----------|--------------------|---|------|------|------|------|
| $C_{IN}$  | Input Capacitance  | $V_{IN} = 0\text{V}$ , $f = 1\text{MHz}$  | -    | 5    | 10   | pF   |
| $C_{OUT}$ | Output Capacitance | $V_{OUT} = 0\text{V}$ , $f = 1\text{MHz}$ | -    | 7    | 15   | pF   |

Note (2) This parameter is periodically sampled and is not 100% tested.

**A.C. CHARACTERISTICS**● **READ CYCLE**

| SYMBOL     | PARAMETER                     | TC5501P/D |      | TC5501P-1/D-1 |      | UNIT |
|------------|-------------------------------|-----------|------|---------------|------|------|
|            |                               | MIN.      | MAX. | MIN.          | MAX. |      |
| $t_{RC}$   | Read Cycle Time               | 450       | —    | 650           | —    | ns   |
| $t_{ACC}$  | Address Access Time           | —         | 450  | —             | 650  | ns   |
| $t_{ACC1}$ | $\overline{CE}_1$ Access Time | —         | 400  | —             | 600  | ns   |
| $t_{ACC2}$ | $\overline{CE}_2$ Access Time | —         | 500  | —             | 700  | ns   |
| $t_{OD0}$  | OD Access Time                | —         | 250  | —             | 350  | ns   |
| $t_{COE}$  | Output Enable Time            | 0         | —    | 0             | —    | ns   |
| $t_{DIS}$  | Output Disable Time           | 0         | 130  | 0             | 150  | ns   |
| $t_{OH}$   | Output Data Hold Time         | 0         | —    | 0             | —    | ns   |

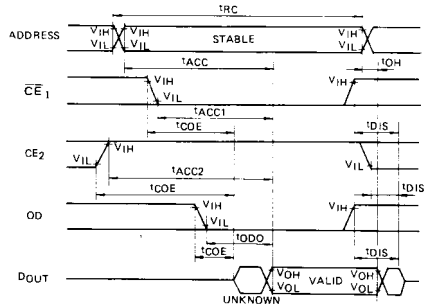
● **WRITE CYCLE**

| SYMBOL   | PARAMETER                    | TC5501P/D |      | TC5501P-1/D-1 |      | UNIT |
|----------|------------------------------|-----------|------|---------------|------|------|
|          |                              | MIN.      | MAX. | MIN.          | MAX. |      |
| $t_{WC}$ | Write Cycle Time             | 450       | —    | 650           | —    | ns   |
| $t_{AW}$ | Address Setup Time           | 130       | —    | 150           | —    | ns   |
| $t_{CW}$ | $\overline{CE}_2$ Setup Time | 130       | —    | 150           | —    | ns   |
| $t_{WP}$ | Write Pulse Width            | 250       | —    | 400           | —    | ns   |
| $t_{DS}$ | Data Setup Time              | 250       | —    | 400           | —    | ns   |
| $t_{DH}$ | Data Hold Time               | 50        | —    | 100           | —    | ns   |
| $t_{WR}$ | Write Recovery Time          | 50        | —    | 50            | —    | ns   |

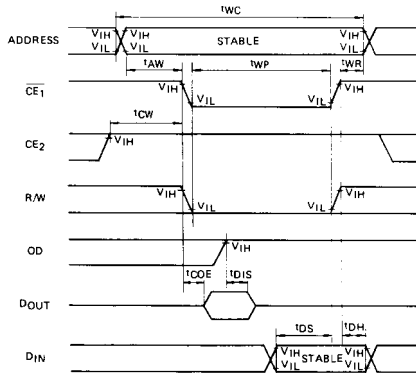
**A.C. TEST CONDITIONS**

- Output Load : 100 pF + 1 TTL Gate
- Input Pulse Levels : 0.45V, 2.4V
- Timing Measurement Reference Levels
  - Input : 0.65V, 2.2V
  - Output : 0.65V, 2.2V
- Input Pulse Rise and Fall Times : 10ns

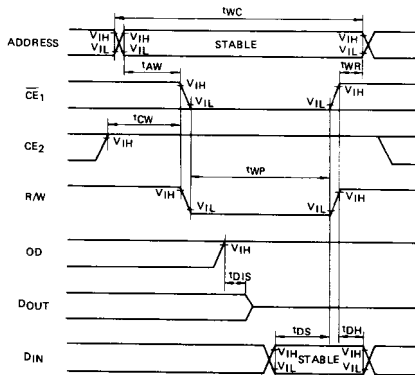
## Read Cycle



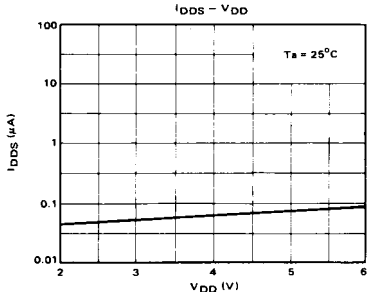
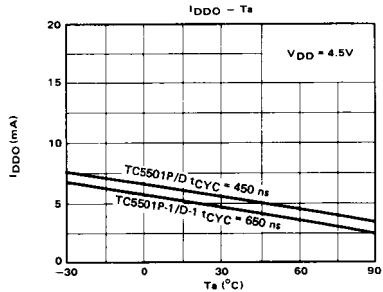
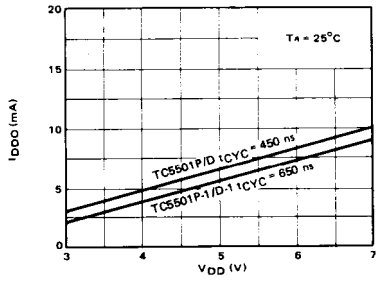
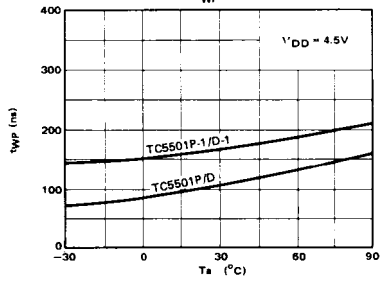
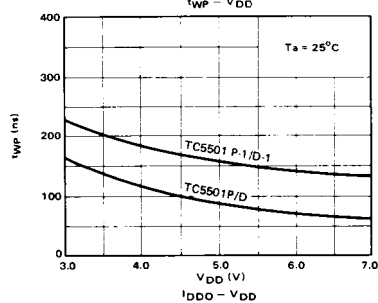
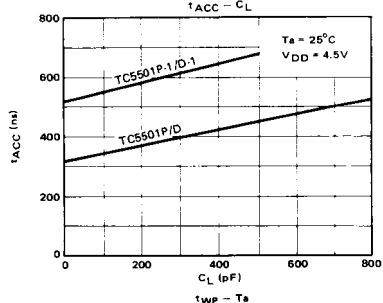
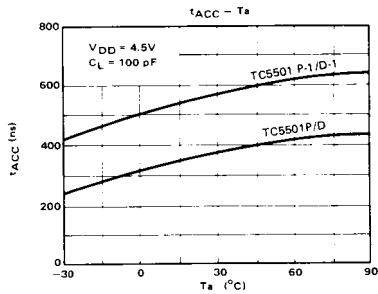
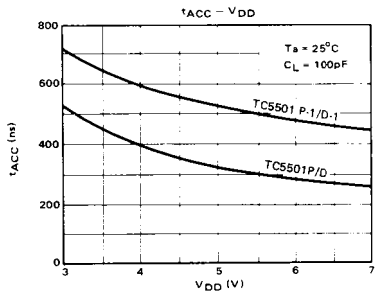
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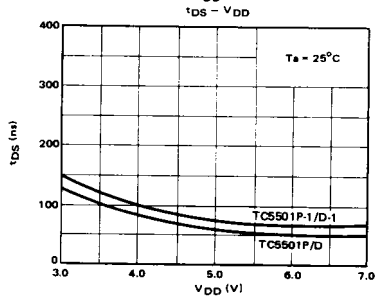
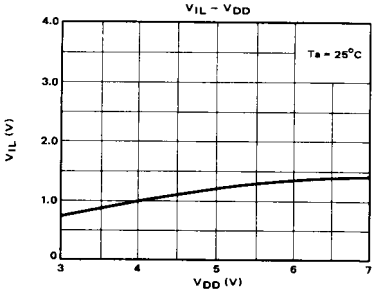
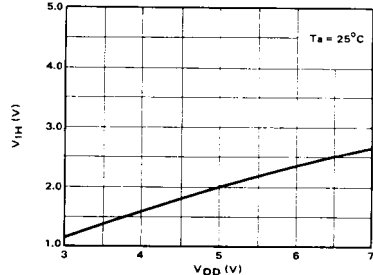
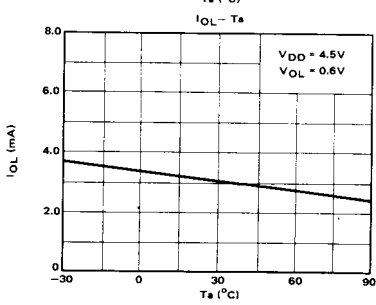
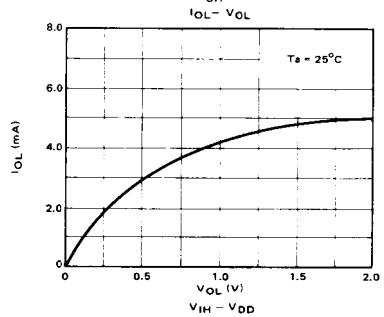
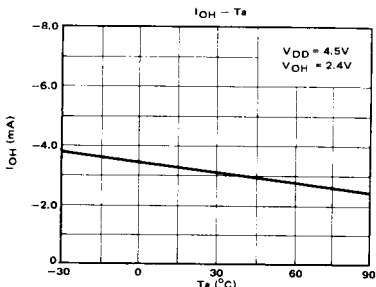
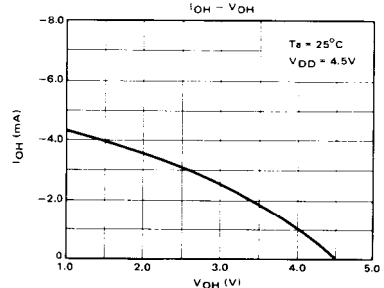
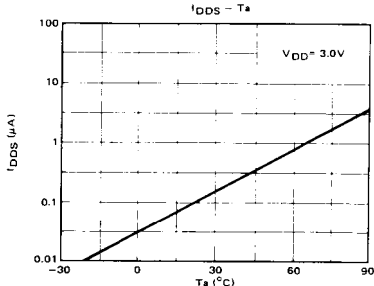


## Write Cycle 2

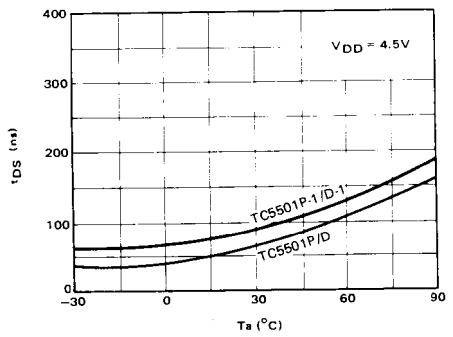


TYPICAL CHARACTERISTICS

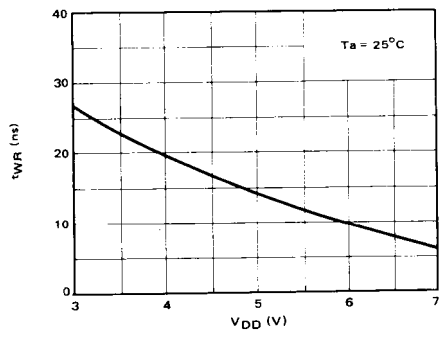




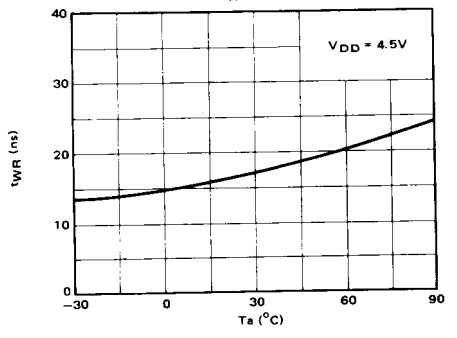
$t_{DS} - T_a$



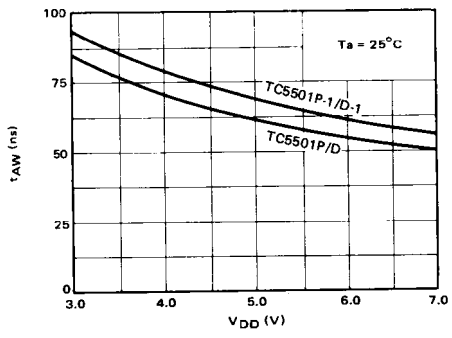
$t_{WR} - V_{DD}$



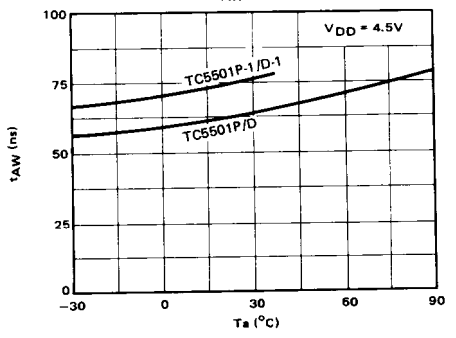
$t_{WR} - T_a$



$t_{AW} - V_{DD}$

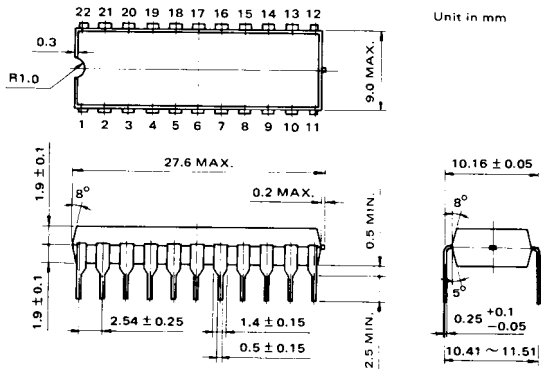


$t_{AW} - T_a$

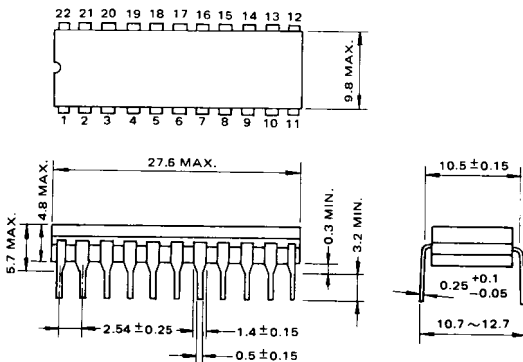


## OUTLINE DRAWINGS

### PLASTIC PACKAGE



### CERDIP PACKAGE



Notes: Each lead pitch is 2.54 mm. All leads are located within 0.25 mm of their true longitudinal position with respect to No. 1 and No. 22 leads.

Note: Toshiba does not assume any responsibility for use of any circuitry described; no circuit patent licenses are implied, and Toshiba reserves the right, at any time without notice, to change said circuitry.

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