TOSHIBA MOS DIGITAL INTEGRATED CIRCUIT SILICON GATE CMOS

# 65,536-WORD BY 16-BIT CMOS STATIC RAM

## DESCRIPTION

The TC55V1664FT is a 1,048,576-bit high-speed static random access memory (SRAM) organized as 65,536 words by 16 bits. Fabricated using CMOS technology and advanced circuit techniques to provide high speed and low-voltage operation, it operates from a single 3.3 V power supply. Chip enable ($\overline{CE}$) can be used to place the device in a low-power mode, and output enable ($\overline{OE}$) provides fast memory access. Data byte control signals (LB, UB) provide lower and upper byte access. This device is well suited to cache memory applications where high-speed access and high-speed storage are required. All inputs and outputs are directly LVTTL compatible. The TC55V1664FT is available in plastic 44-pin TSOP packages (400 mil width) for high density surface assembly.

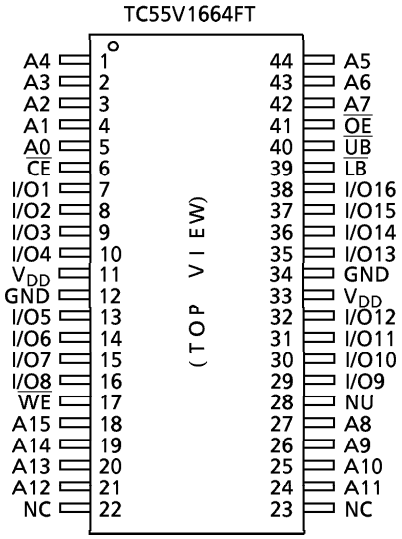
## FEATURES

- Fast access time (the following are maximum values)
  TC55V1664FT-12: 12 ns
  TC55V1664FT-13: 13 ns
  TC55V1664FT-15: 15 ns
- Low-power dissipation
  (the following are maximum values)

| Cycle Time | 12 | 13 | 15 | 20 | 30 | ns |
|---|---|---|---|---|---|---|
| Operation (max) | 190 | 180 | 170 | 150 | 130 | mA |

  Standby: 2 mA (all devices)
- Single power supply voltage of 3.3 ± 0.3 V.
  TC55V1664FT-12, -13: 3.3 V ± 5%
  TC55V1664FT-15: 3.3 ± 0.3 V
- Fully static operation
- All inputs and outputs are LVTTL compatible
- Output buffer control using $\overline{OE}$
- Data byte control using $\overline{LB}$ (IO1 to IO8) and $\overline{UB}$ (IO9 to IO16)
- Packages:
  TSOP Ⅱ 44-P-400-0.80 (Weight: 0.45 g typ)

## PIN ASSIGNMENT




(TSOP)

## PIN NAMES

| | |
|---|---|
| A0 to A15 | Address Inputs |
| I/O1 to I/O16 | Data Inputs/Outputs |
| $\overline{CE}$ | Chip Enable |
| $\overline{WE}$ | Write Enable Input |
| $\overline{OE}$ | Output Enable |
| $\overline{LB}$, $\overline{UB}$ | Data Byte Control Inputs |
| $V_{DD}$ | Power (+ 3.3 V) |
| GND | Ground |
| NC | No Connection |
| NU | Not Used (Input) |

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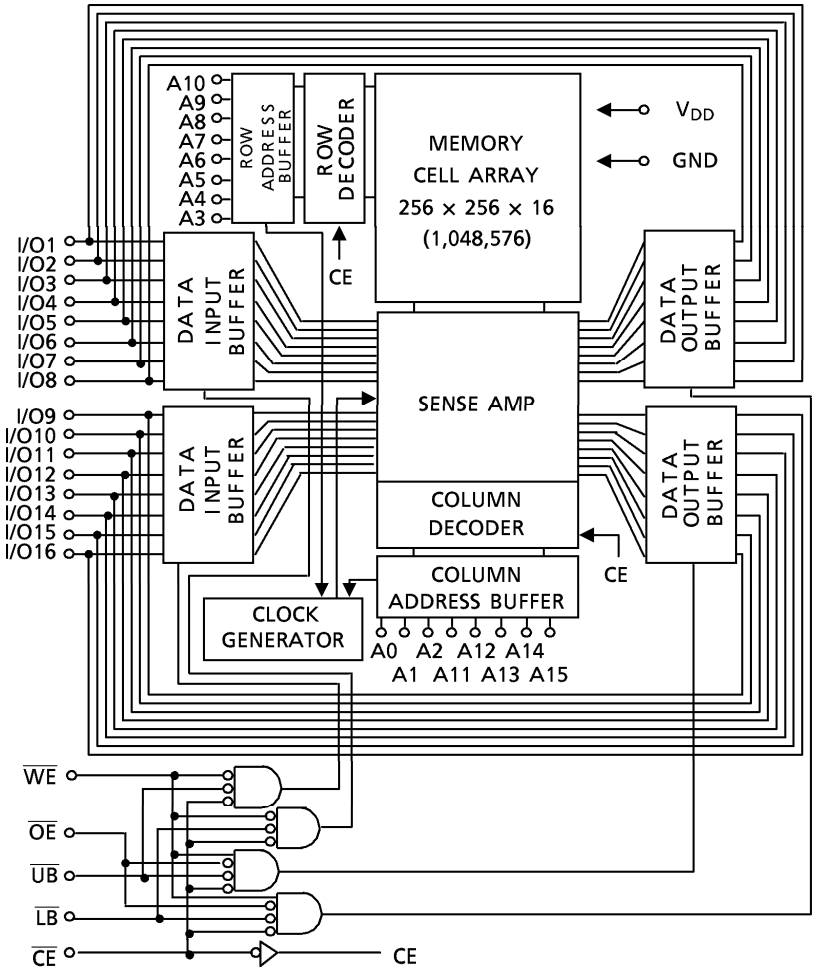
## BLOCK DIAGRAM




## MAXIMUM RATINGS

| SYMBOL | RATING | VALUE | UNIT |
|---|---|---|---|
| $V_{DD}$ | Power Supply Voltage | − 0.5 to 4.6 | V |
| $V_{IN}$ | Input Terminal Voltage | − 0.5 * to 4.6 | V |
| $V_{I/O}$ | Input/Output Terminal Voltage | − 0.5 * to $V_{DD}$ + 0.5** | V |
| $P_D$ | Power Dissipation | 1.2 | W |
| $T_{solder}$ | Soldering Temperature (10 s) | 260 | °C |
| $T_{strg}$ | Storage Temperature | − 65 to 150 | °C |
| $T_{opr}$ | Operating Temperature | − 10 to 85 | °C |

*: − 1.5 V with a pulse width of 20% · $t_{RC}$ min (4 ns max)
**: $V_{DD}$ + 1.5 V with a pulse width of 20% · $t_{RC}$ min (4 ns max)

## DC RECOMMENDED OPERATING CONDITIONS (Ta = 0° to 70°C)

| SYMBOL | PARAMETER | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{DD}$ | Power Supply Voltage | – 12, – 13 | 3.135 | 3.3 | 3.465 | V |
| | | – 15 | 3.0 | 3.3 | 3.6 | |
| $V_{IH}$ | Input High Voltage | | 2.0 | – | $V_{DD}$ + 0.3** | V |
| $V_{IL}$ | Input Low Voltage | | – 0.3 * | – | 0.8 | V |

*: – 1.0 V with a pulse width of 20% · $t_{RC}$ min (4 ns max)
**: $V_{DD}$ + 1.0 V with a pulse width of 20% · $t_{RC}$ min (4 ns max)

## DC CHARACTERISTICS (Ta = 0° to 70°C, -12, -13: $V_{DD}$ = 3.3 V ± 5%, -15: $V_{DD}$ = 3.3 ± 0.3 V)

| SYMBOL | PARAMETER | TEST CONDITION | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $I_{IL}$ | Input Leakage Current (Except NU Pin) | $V_{IN}$ = 0 V to $V_{DD}$ | | – 1 | – | 1 | μA |
| $I_{LO}$ | Output Leakage Current | $\overline{CE}$ = $V_{IH}$ or $\overline{WE}$ = $V_{IL}$ or $\overline{OE}$ = $V_{IH}$<br>$V_{OUT}$ = 0 V to $V_{DD}$ | | – 1 | – | 1 | μA |
| $I_{I(NU)}$ | Input Current (NU Pin) | $V_{IN}$ = 0 to 0.8 V | | – 1 | – | 20 | μA |
| | | $V_{IN}$ = 0 to 0.2 V | | – 1 | – | 1 | |
| $V_{OH}$ | Output High Voltage | $I_{OH}$ = – 2 mA | | 2.4 | – | – | V |
| | | $I_{OH}$ = – 100 μA | | $V_{DD}$ – 0.2 | – | – | |
| $V_{OL}$ | Output Low Voltage | $I_{OL}$ = 2 mA | | – | – | 0.4 | |
| | | $I_{OL}$ = 100 μA | | – | – | 0.2 | |
| $I_{DDO}$ | Operating Current | $\overline{CE}$ = $V_{IL}$, Iout = 0 mA<br>Other Inputs = $V_{IH}$ or $V_{IL}$ | tcycle = 12 ns | – | – | 190 | mA |
| | | | tcycle = 13 ns | – | – | 180 | |
| | | | tcycle = 15 ns | – | – | 170 | |
| | | | tcycle = 20 ns | – | – | 150 | |
| | | | tcycle = 30 ns | – | – | 130 | |
| $I_{DDS1}$ | Standby Current | $\overline{CE}$ = $V_{IH}$, Other Inputs = $V_{IH}$/$V_{IL}$ | | – | – | 20 | mA |
| $I_{DDS2}$ | | $\overline{CE}$ = $V_{DD}$ – 0.2 V<br>Other Inputs = $V_{DD}$ – 0.2 V/0.2 V | | – | – | 2 | |

## CAPACITANCE (Ta = 25°C, f = 1.0 MHz)

| SYMBOL | PARAMETER | TEST CONDITION | MAX | UNIT |
|---|---|---|---|---|
| $C_{IN}$ | Input Capacitance | $V_{IN}$ = GND | 6 | pF |
| $C_{I/O}$ | Input/Output Capacitance | $V_{I/O}$ = GND | 8 | pF |

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

## OPERATING MODE

| MODE | $\overline{CE}$ | $\overline{OE}$ | $\overline{WE}$ | $\overline{LB}$ | $\overline{UB}$ | I/O1 to I/O8 | I/O9 to I/O16 | POWER |
|---|---|---|---|---|---|---|---|---|
| Read | L | L | H | L | L | Output | Output | $I_{DDO}$ |
| | | | | H | L | High Impedance | Output | $I_{DDO}$ |
| | | | | L | H | Output | High Impedance | $I_{DDO}$ |
| Write | L | × | L | L | L | Input | Input | $I_{DDO}$ |
| | | | | H | L | High Impedance | Input | $I_{DDO}$ |
| | | | | L | H | Input | High Impedance | $I_{DDO}$ |
| Outputs Disable | L | H | H | × | × | High Impedance | High Impedance | $I_{DDO}$ |
| | L | × | × | H | H | | | |
| Standby | H | × | × | × | × | High Impedance | High Impedance | $I_{DDS}$ |

×: Don't care

Note: The NU pin must be left unconnected or tied to GND or a voltage level of less than 0.8 V. You must not apply a voltage of more than 0.8 V to the NU.

## AC CHARACTERISTICS

(Ta = 0° to 70°C (Note 1), -12, -13: $V_{DD}$ = 3.3 V ± 5%, -15: $V_{DD}$ = 3.3 ± 0.3 V)

### READ CYCLE

| SYMBOL | PARAMETER | TC55V1664FT-12 | | TC55V1664FT-13 | | TC55V1664FT-15 | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN | MAX | MIN | MAX | MIN | MAX | |
| $t_{RC}$ | Read Cycle Time | 12 | – | 13 | – | 15 | – | ns |
| $t_{ACC}$ | Address Access Time | – | 12 | – | 13 | – | 15 | |
| $t_{CO}$ | Chip Enable Access Time | – | 12 | – | 13 | – | 15 | |
| $t_{OE}$ | Output Enable Access Time | – | 6 | – | 6 | – | 8 | |
| $t_{BA}$ | Upper Byte, Lower Byte Access Time | – | 6 | – | 6 | – | 8 | |
| $t_{OH}$ | Output Data Hold Time from Address Change | 3 | – | 3 | – | 3 | – | |
| $t_{COE}$ | Output Enable Time from Chip Enable | 3 | – | 3 | – | 3 | – | |
| $t_{OEE}$ | Output Enable Time from Output Enable | 1 | – | 1 | – | 1 | – | |
| $t_{BE}$ | Output Enable Time from Upper Byte, Lower Byte | 1 | – | 1 | – | 1 | – | |
| $t_{COD}$ | Output Disable Time from Chip Enable | – | 7 | – | 7 | – | 8 | |
| $t_{ODO}$ | Output Disable Time from Output Enable | – | 7 | – | 7 | – | 8 | |
| $t_{BD}$ | Output Disable Time from Upper Byte, Lower Byte | – | 7 | – | 7 | – | 8 | |

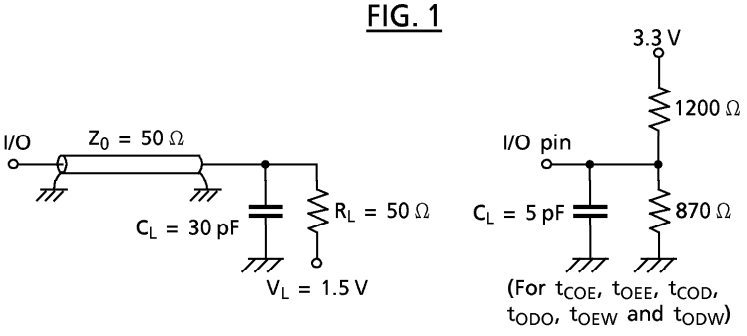
### WRITE CYCLE

| SYMBOL | PARAMETER | TC55V1664FT-12 | | TC55V1664FT-13 | | TC55V1664FT-15 | | UNIT |
|---|---|---|---|---|---|---|---|---|
| | | MIN | MAX | MIN | MAX | MIN | MAX | |
| $t_{WC}$ | Write Cycle Time | 12 | – | 13 | – | 15 | – | ns |
| $t_{WP}$ | Write Pulse Width | 8 | – | 8 | – | 9 | – | |
| $t_{CW}$ | Chip Enable to End of Write | 10 | – | 10 | – | 12 | – | |
| $t_{BW}$ | Upper Byte, Lower Byte Enable to End of Write | 10 | – | 10 | – | 11 | – | |
| $t_{AW}$ | Address Valid to End of Write | 10 | – | 10 | – | 11 | – | |
| $t_{AS}$ | Address Setup Time | 0 | – | 0 | – | 0 | – | |
| $t_{WR}$ | Write Recovery Time | 0 | – | 0 | – | 0 | – | |
| $t_{DS}$ | Data Setup Time | 7 | – | 7 | – | 8 | – | |
| $t_{DH}$ | Data Hold Time | 0 | – | 0 | – | 0 | – | |
| $t_{OEW}$ | Output Enable Time from Write Enable | 1 | – | 1 | – | 1 | – | |
| $t_{ODW}$ | Output Disable Time from Write Enable | – | 7 | – | 7 | – | 8 | |

## AC TEST CONDITIONS

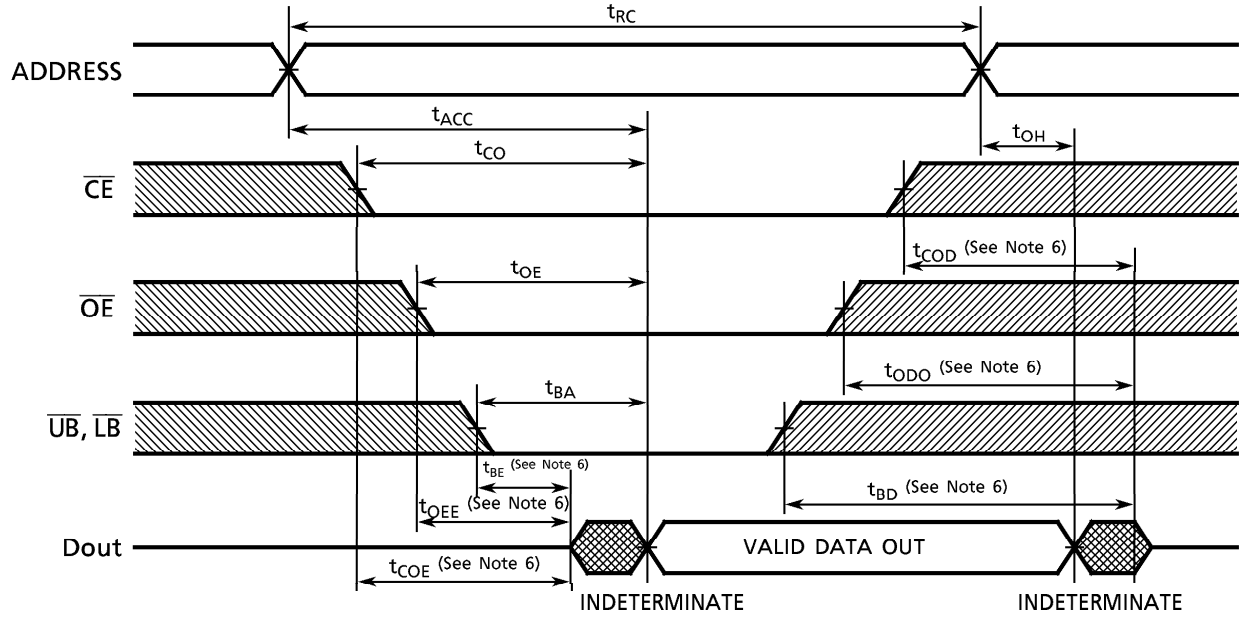
| | |
|---|---|
| Input Pulse Level | 3.0 V, 0.0 V |
| Input Pulse Rise and Fall Time | 3 ns |
| Input Timing Measurement Reference Level | 1.5 V |
| Output Timing Measurement Reference Level | 1.5 V |
| Output Load | Fig. 1 |

FIG. 1

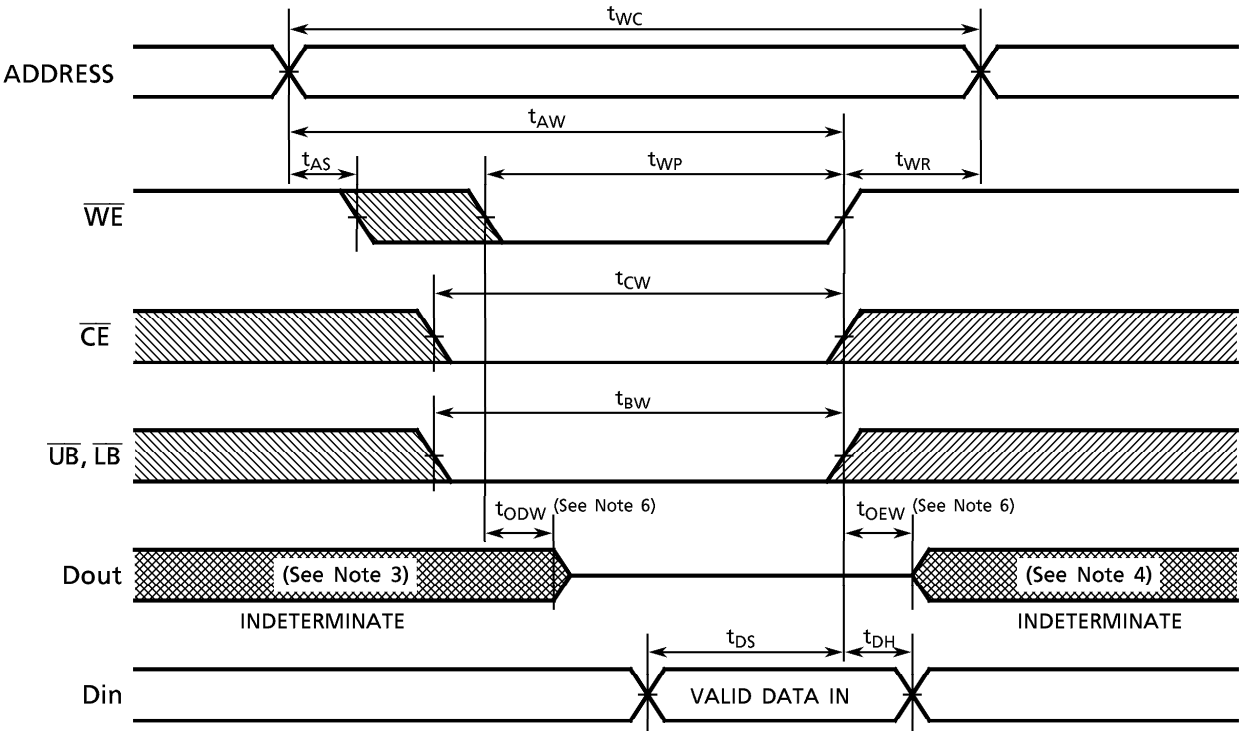


## TIMING DIAGRAMS

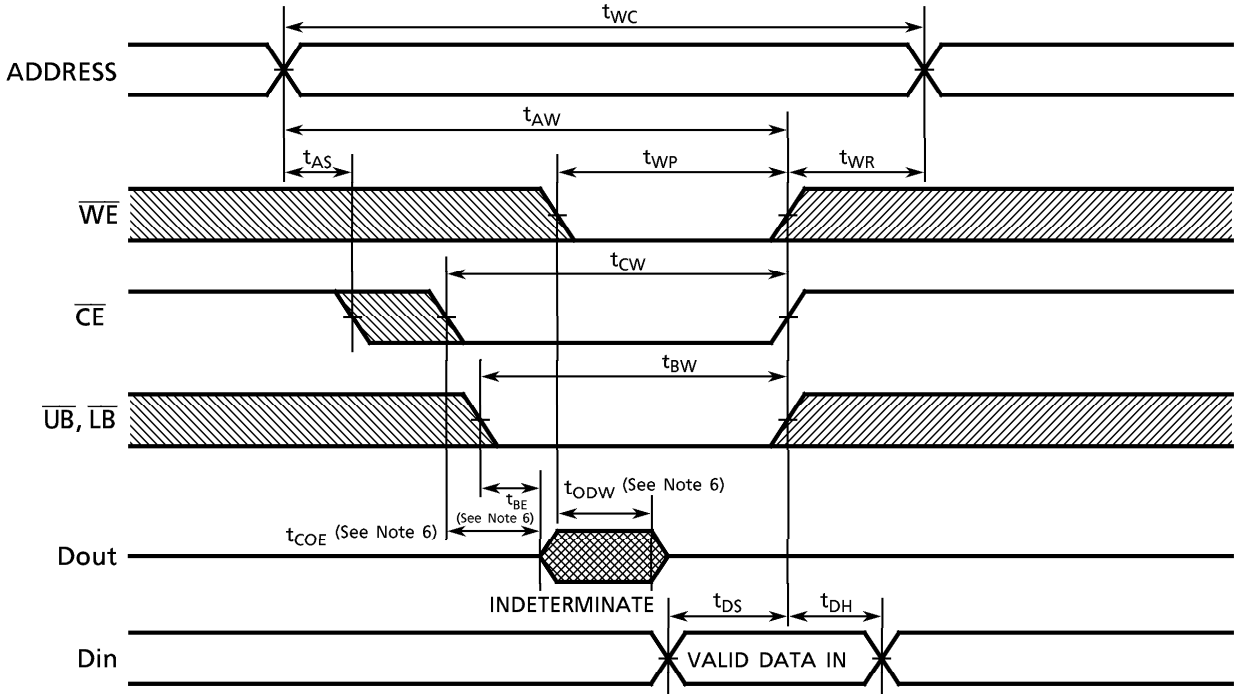
### READ CYCLE (See Note 2)



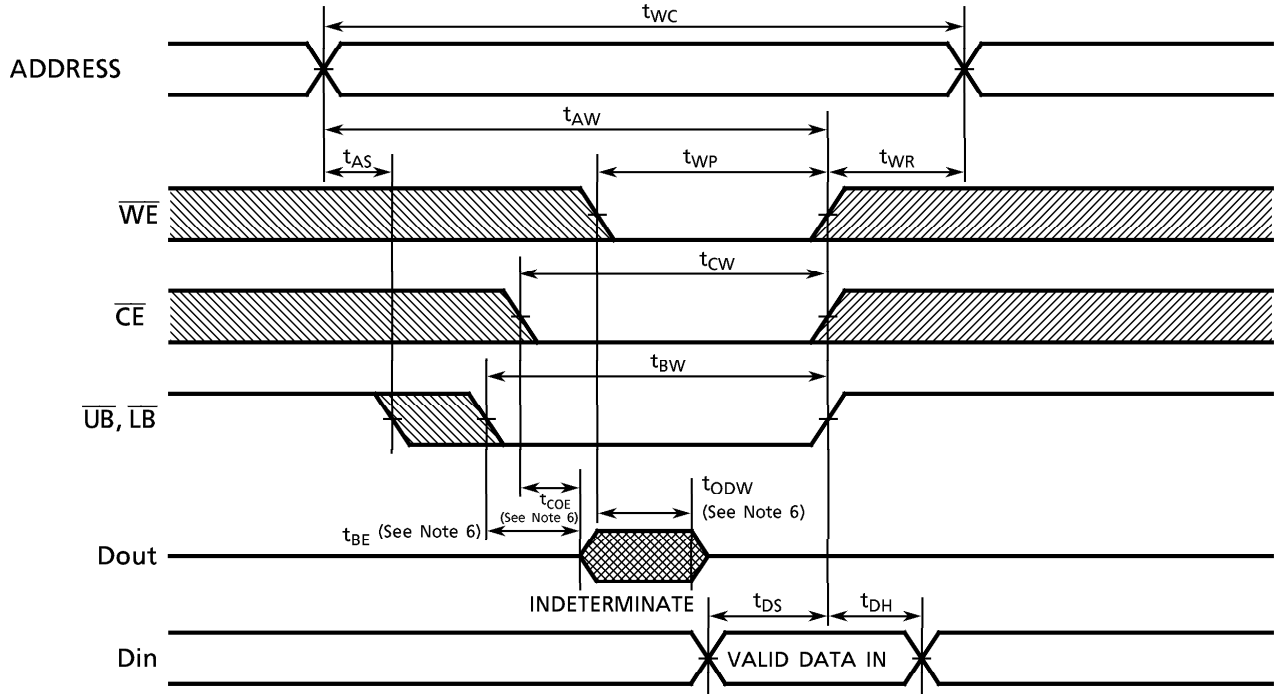

### WRITE CYCLE 1 ($\overline{WE}$ CONTROLLED) (Note 5)



WRITE CYCLE 2 ($\overline{CE}$ CONTROLLED) (See Note 5)




WRITE CYCLE 3 ($\overline{UB}$, $\overline{LB}$ CONTROLLED) (See Note 5)



Note: (1) Operating temperature (Ta) is guaranteed for transverse air flow exceeding 400 linear feet per minute.

(2) $\overline{WE}$ remains High for the Read Cycle.

(3) If $\overline{CE}$ goes LOW coincident with or after $\overline{WE}$ goes LOW, the outputs will remain at high impedance.

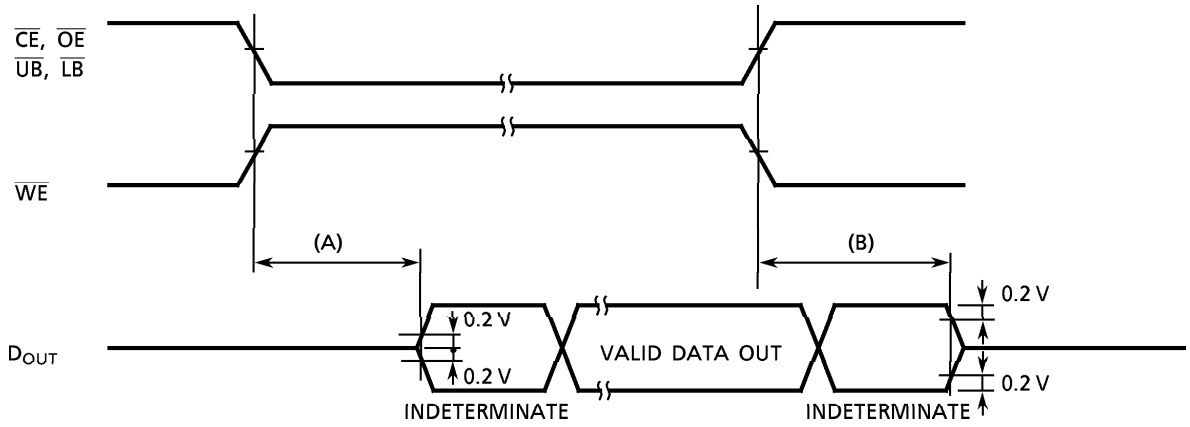
(4) If $\overline{CE}$ goes HIGH coincident with or before $\overline{WE}$ goes HIGH, the outputs will remain at high impedance.

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

(6) The parameters specified below are measured using the load shown in Fig. 1

(A) $t_{COE}$, $t_{OEE}$, $t_{BE}$, $t_{OEW}$ ····· Output Enable Time

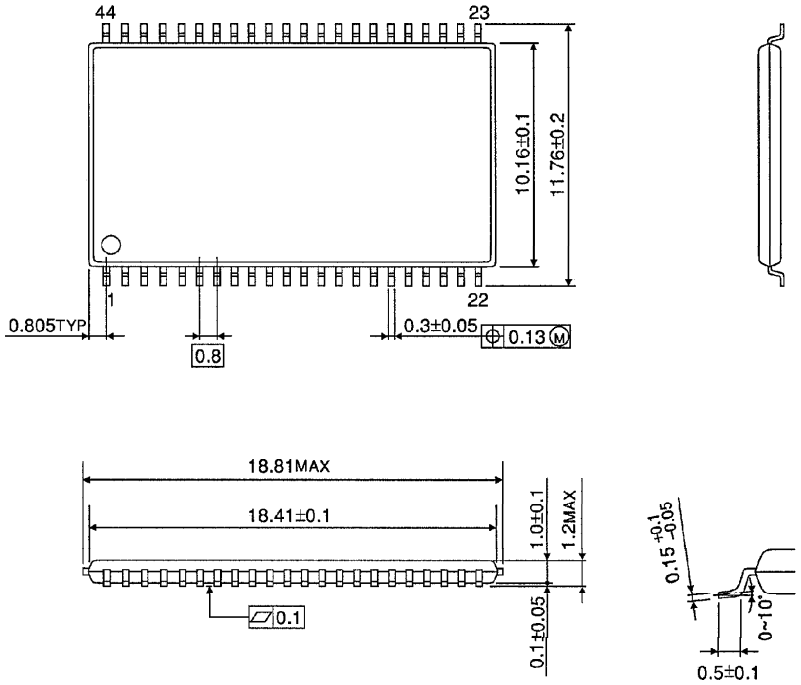
(B) $t_{COD}$, $t_{ODO}$, $t_{BD}$, $t_{ODW}$ ····· Output Disable Time



## PACKAGE DIMENSIONS

Plastic TSOP (TSOP II 44-P-400-0.80)

Units in mm




Weight: 0.45 g (typ)