

## TOSHIBA MOS DIGITAL INTEGRATED CIRCUIT SILICON GATE CMOS

### 1,048,576-WORD BY 16-BIT CMOS STATIC RAM

#### DESCRIPTION

The TC55V16100FT is a 16,777,216-bit high-speed static random access memory (SRAM) organized as 1,048,576 words by 16 bits. Fabricated using CMOS technology and advanced circuit techniques to provide high speed, 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 ( $\overline{LB}$ ,  $\overline{UB}$ ) 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 LVTTTL compatible. The TC55V16100FT is available in plastic 54-pin TSOP with 400mil width for high density surface assembly.

#### FEATURES

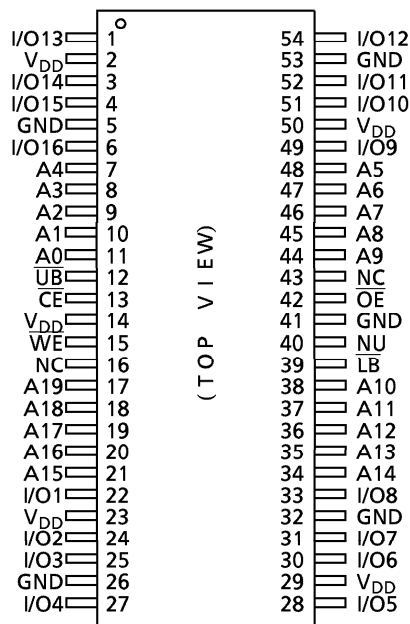
- Fast access time(the following are maximum values)
  - TC55V16100FT-10: 10 ns
  - TC55V16100FT-12: 12 ns
  - TC55V16100FT-15: 15 ns
- Low-power dissipation
- Single power supply voltage:  $3.3V \pm 5\%$  (-10)  
 $: 3.3V \pm 0.3V$  (-12, -15)
- Fully static operation
- All inputs and outputs are LVTTTL compatible
- Output buffer control using  $\overline{OE}$
- Data byte control using  $\overline{LB}$  (I/O1 to I/O8) and  $\overline{UB}$  (I/O9 to I/O16)
- Package:  
 TSOP II 54-P-400-0.80B(FT) (Weight: 0.55g typ)

Cycle Time	10	12	15	20	30	ns
Operation (max)	450	420	380	—	—	mA
Operation (typ)	340	280	250	190	150	mA

Typical condition :  $V_{DD} = 3.3V$

Standby : 4mA(max)

#### PIN ASSIGNMENT



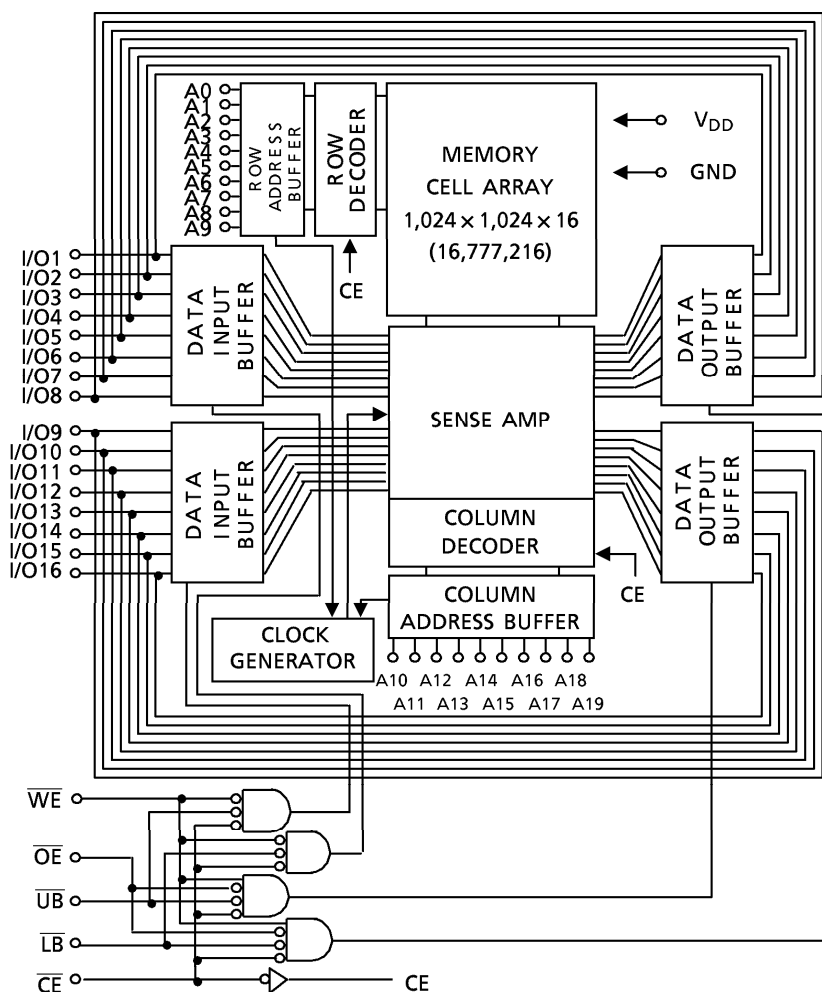
#### PIN NAMES

A0 to A19	Address Inputs
I/O1 to I/O16	Data Inputs / Outputs
$\overline{CE}$	Chip Enable Input
$\overline{WE}$	Write Enable Input
$\overline{OE}$	Output Enable Input
$\overline{LB}$ , $\overline{UB}$	Data Byte Control Inputs
$V_{DD}$	Power (+ 3.3V)
GND	Ground
NC	No Connection
NU	Not Usable

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**BLOCK DIAGRAM**



**MAXIMUM RATINGS**

SYMBOL	RATING	VALUE	UNIT
V <sub>DD</sub>	Power Supply Voltage	- 0.5 to 4.6	V
V <sub>IN</sub>	Input Terminal Voltage	- 0.5* to 4.6	V
V <sub>I/O</sub>	Input/Output Terminal Voltage	- 0.5* to V <sub>DD</sub> + 0.5**	V
P <sub>D</sub>	Power Dissipation	1.8	W
T <sub>solder</sub>	Soldering Temperature (10 s)	260	°C
T <sub>strg</sub>	Storage Temperature	- 65 to 150	°C
T <sub>opr</sub>	Operating Temperature	- 10 to 85	°C

\* : -1.5V with a pulse width of 20% · t<sub>RC</sub> min (4ns max)  
 \*\* : V<sub>DD</sub>+1.5V with a pulse width of 20% · t<sub>RC</sub> min (4ns max)

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

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT
V <sub>DD</sub>	Power Supply Voltage	-10	3.135	3.465	V
		-12,-15	3.0	3.6	
V <sub>IH</sub>	Input High Voltage	2.0	-	V <sub>DD</sub> + 0.3**	V
V <sub>IL</sub>	Input Low Voltage	- 0.3*	-	0.8	V

\* : -1.0V with a pulse width of 20% · t<sub>RC</sub> min (4ns max)  
 \*\* : V<sub>DD</sub>+1.0V with a pulse width of 20% · t<sub>RC</sub> min (4ns max)

**DC CHARACTERISTICS** (Ta = 0° to 70°C, V<sub>DD</sub> = 3.3V ± 5% : -10, V<sub>DD</sub> = 3.3V ± 0.3V : -12,-15)

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP*	MAX	UNIT	
I <sub>IL</sub>	Input Leakage Current (Except NU pin)	V <sub>IN</sub> = 0 to V <sub>DD</sub>	-1	-	1	μA	
I <sub>LO</sub>	Output Leakage Current	$\overline{CE} = V_{IH}$ or $\overline{WE} = V_{IL}$ or $\overline{OE} = V_{IH}$ V <sub>OUT</sub> = 0 to V <sub>DD</sub>	-1	-	1	μA	
I <sub>I(NU)</sub>	Input Current (NU pin)	V <sub>IN</sub> = 0 to 0.8V	-1	-	20	μA	
		V <sub>IN</sub> = 0 to 0.2V	-1	-	1		
V <sub>OH</sub>	Output High Voltage	I <sub>OH</sub> = -2mA	2.4	-	-	V	
		I <sub>OH</sub> = -100μA	V <sub>DD</sub> - 0.2	-	-		
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub> = 2mA	-	-	0.4		
		I <sub>OL</sub> = 100μA	-	-	0.2		
I <sub>DDO</sub>	Operating Current	$\overline{CE} = V_{IL}$ , I <sub>out</sub> = 0mA $\overline{OE} = V_{IH}$ Other Inputs = V <sub>DD</sub> - 0.2V or 0.2V	tcycle = 10ns	-	340	450	mA
			tcycle = 12ns	-	280	420	
			tcycle = 15ns	-	250	380	
			tcycle = 20ns	-	190	-	
			tcycle = 30ns	-	150	-	
I <sub>DDS1</sub>	Standby Current	$\overline{CE} = V_{IH}$ , Other Inputs = V <sub>IN</sub> or V <sub>IL</sub>	-	-	105	mA	
I <sub>DDS2</sub>		$\overline{CE} = V_{DD} - 0.2V$ Other Inputs = V <sub>DD</sub> - 0.2V or 0.2V	-	-	4		

\* Typical Condition : V<sub>DD</sub> = 3.3V

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

SYMBOL	PARAMETER	TEST CONDITION	MAX	UNIT
C <sub>IN</sub>	Input Capacitance	V <sub>IN</sub> = GND	6	pF
C <sub>I/O</sub>	Input/Output Capacitance	V <sub>I/O</sub> = 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 <sub>DDO</sub>
				H	L	High Impedance	Output	I <sub>DDO</sub>
				L	H	Output	High Impedance	I <sub>DDO</sub>
Write	L	x	L	L	L	Input	Input	I <sub>DDO</sub>
				H	L	High Impedance	Input	I <sub>DDO</sub>
				L	H	Input	High Impedance	I <sub>DDO</sub>
Outputs Disable	L	H	H	x	x	High Impedance	High Impedance	I <sub>DDO</sub>
	L	x	x	H	H			
Standby	H	x	x	x	x	High Impedance	High Impedance	I <sub>DDS</sub>

x: 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** ( $T_a = 0^\circ$  to  $70^\circ\text{C}$  (Note 1),  $V_{DD} = 3.3\text{V} \pm 5\%$ :-10,  $V_{DD} = 3.3\text{V} \pm 0.3\text{V}$ :-12,-15)  
**READ CYCLE**

SYMBOL	PARAMETER	TC55V16100FT-10		TC55V16100FT-12		TC55V16100FT-15		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
$t_{RC}$	Read Cycle Time	10	–	12	–	15	–	ns
$t_{ACC}$	Address Access Time	–	10	–	12	–	15	
$t_{CO}$	Chip Enable Access Time	–	10	–	12	–	15	
$t_{OE}$	Output Enable Access Time	–	5	–	6	–	8	
$t_{BA}$	Upper Byte, Lower Byte Access Time	–	5	–	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	–	6	–	7	–	8	
$t_{ODO}$	Output Disable Time from Output Enable	–	6	–	7	–	8	
$t_{BD}$	Output Disable Time from Upper Byte, Lower Byte	–	6	–	7	–	8	

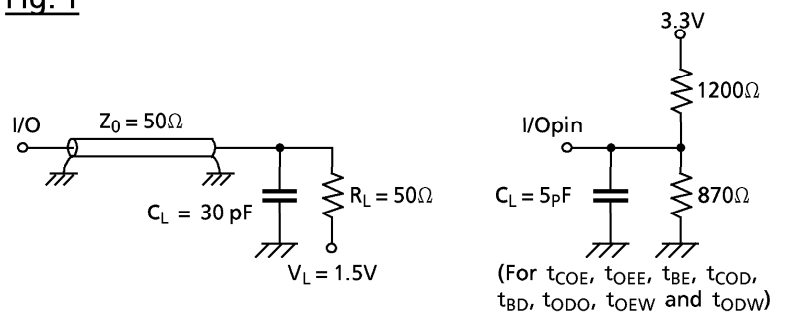
**WRITE CYCLE**

SYMBOL	PARAMETER	TC55V16100FT-10		TC55V16100FT-12		TC55V16100FT-15		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
$t_{WC}$	Write Cycle Time	10	–	12	–	15	–	ns
$t_{WP}$	Write Pulse Width	7	–	8	–	10	–	
$t_{CW}$	Chip Enable to End of Write	8.5	–	9	–	11	–	
$t_{BW}$	Upper Byte, Lower Byte Enable to End of Write	8.5	–	9	–	11	–	
$t_{AW}$	Address Valid to End of Write	8.5	–	9	–	11	–	
$t_{AS}$	Address Setup Time	0	–	0	–	0	–	
$t_{WR}$	Write Recovery Time	0	–	0	–	0	–	
$t_{DS}$	Data Setup Time	6	–	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	–	6	–	7	–	8	

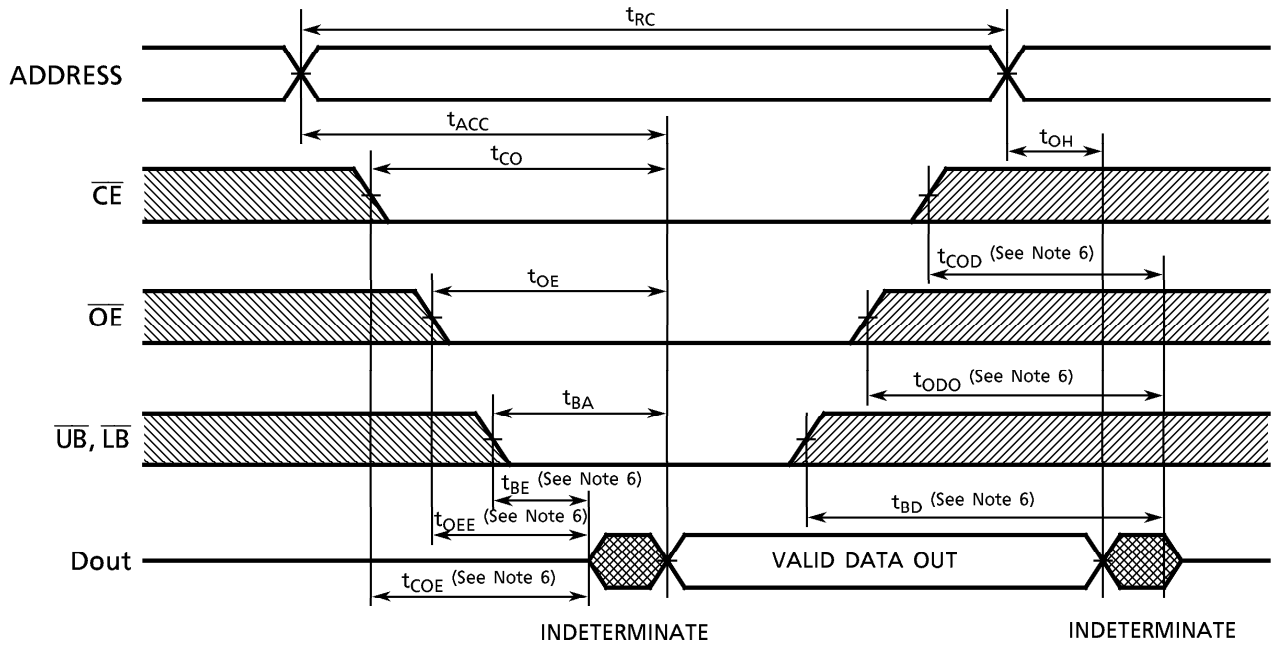
**AC TEST CONDITIONS**

Input Pulse Level	3.0V/0.0V
Input Pulse Rise and Fall Time	2ns
Input Timing Measurement Reference Level	1.5V
Output Timing Measurement Reference Level	1.5V
Output Load	Fig. 1

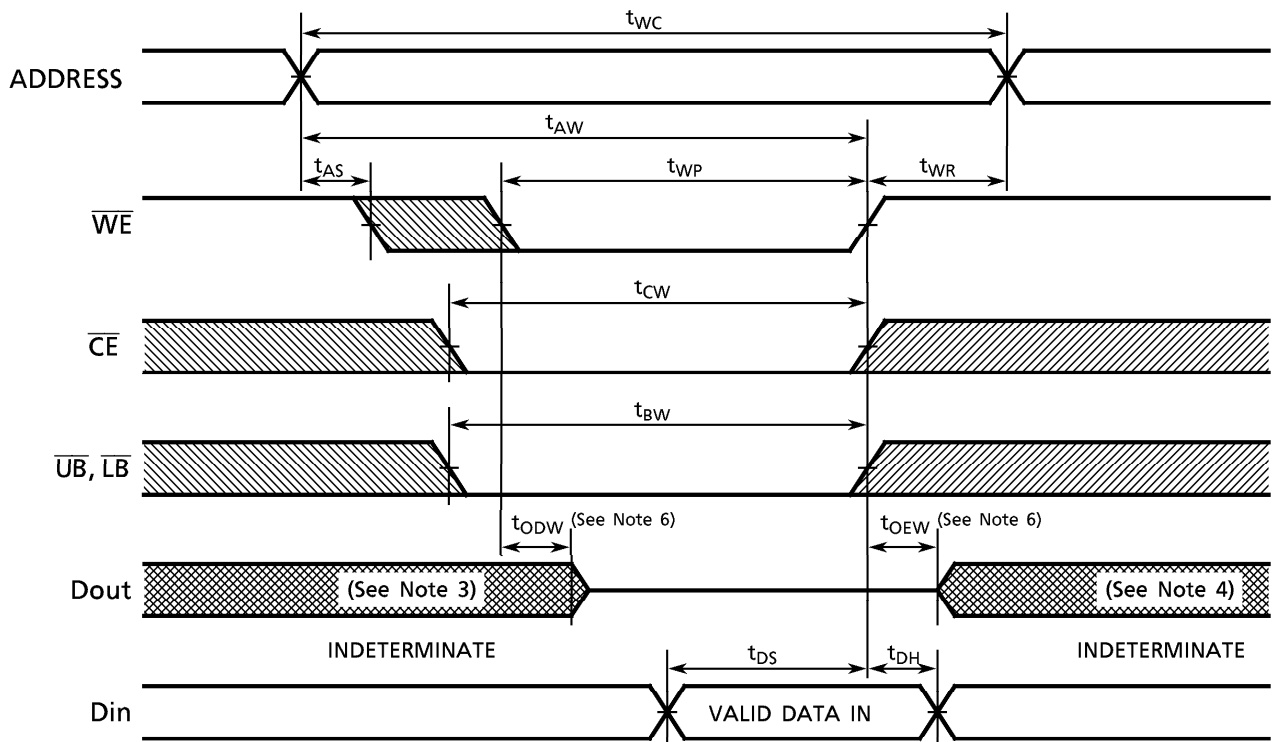
**Fig. 1**



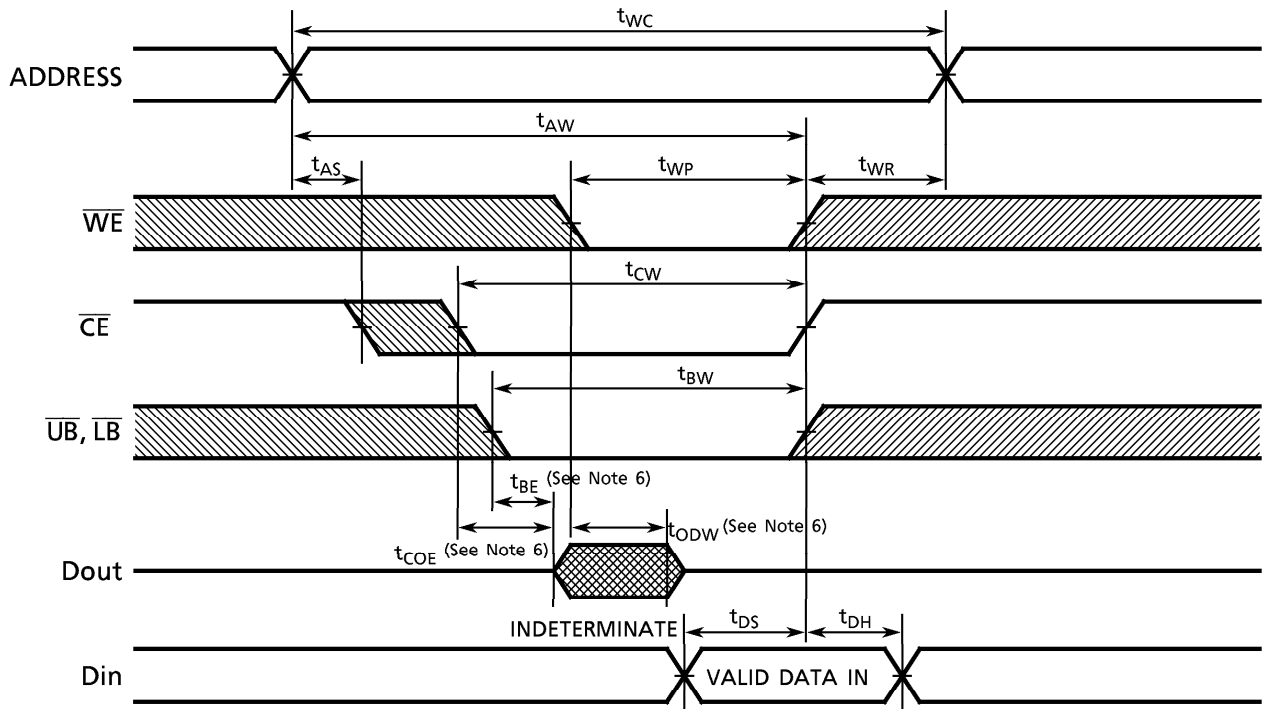
**TIMING DIAGRAMS**  
**READ CYCLE (See Note 2)**



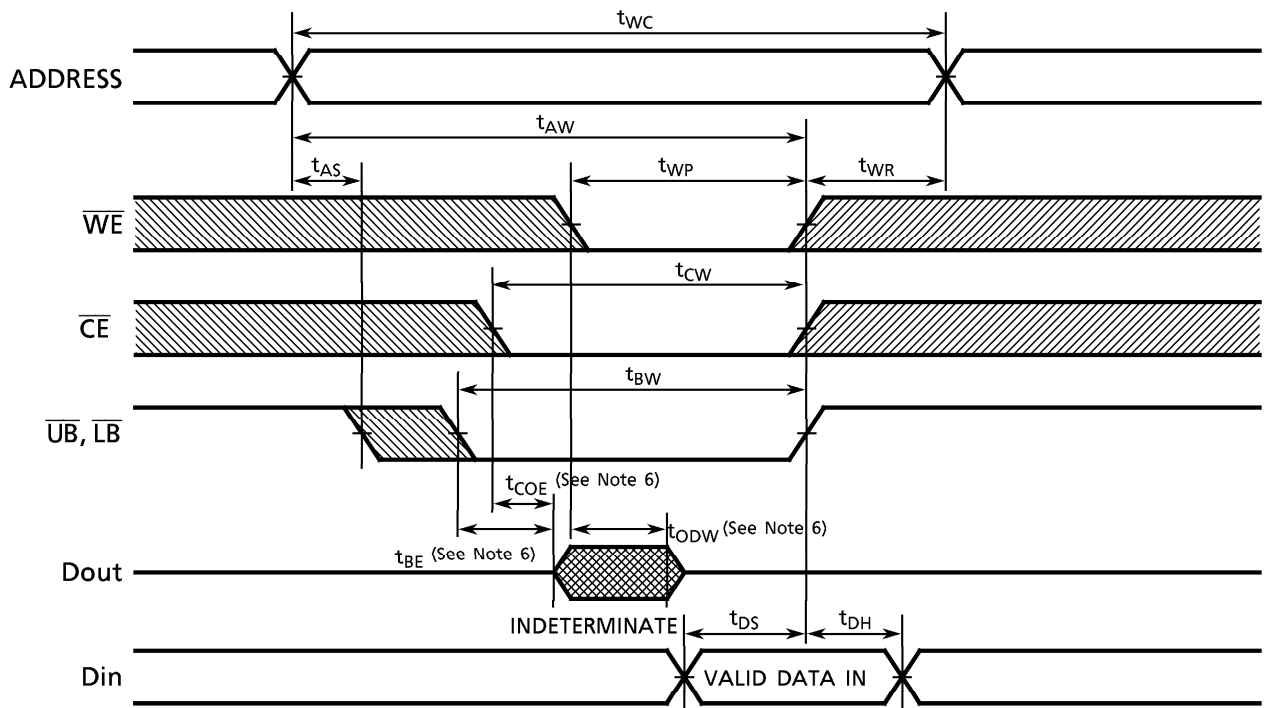
**WRITE CYCLE 1 ( $\overline{WE}$  CONTROLLED) (See Note 5)**



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



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



Note: (1) Operating temperature ( $T_a$ ) 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.

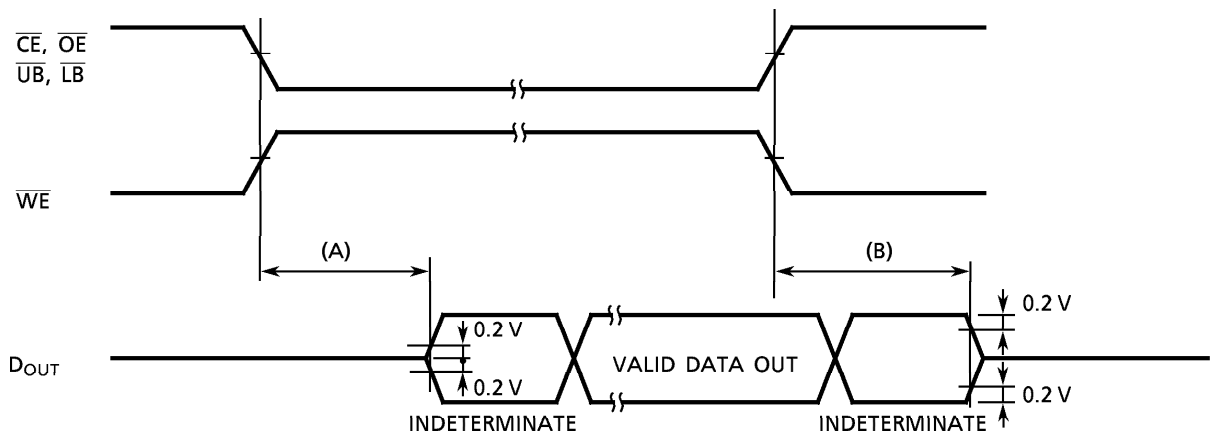
(4) If  $\overline{CE}$  goes HIGH coincident with or before  $\overline{WE}$  goes HIGH, the outputs will remain at high impedance.

(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

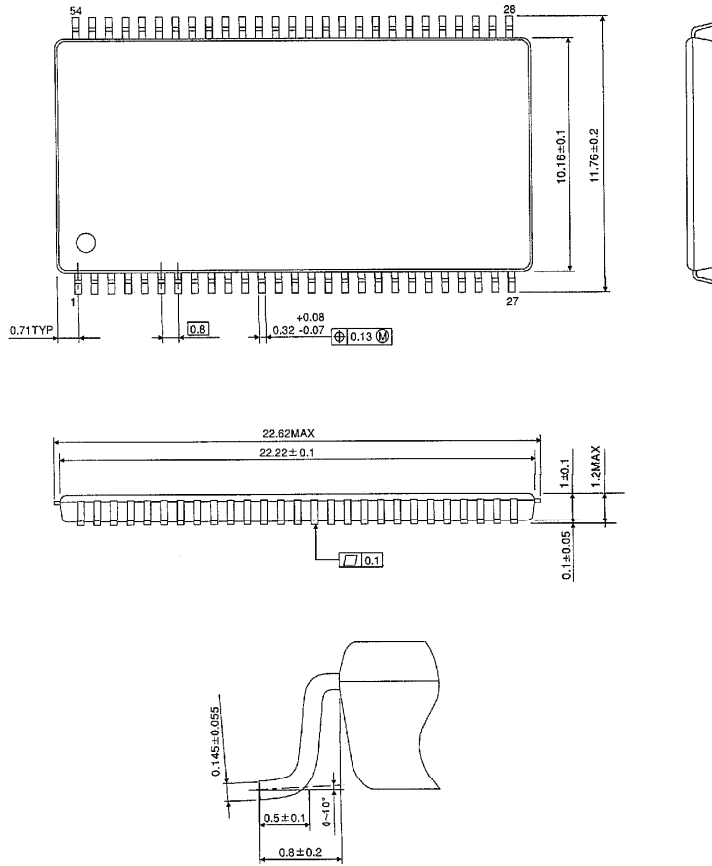
(B)  $t_{COD}, t_{ODO}, t_{BD}, t_{ODw}$  ..... Output Disable Time



**PACKAGE DIMENSIONS**

Plastic TSOP (TSOPII 54-P-400-0.80B)

Unit in mm



Weight : 0.55g (Typ)