

TOSHIBA MOS DIGITAL INTEGRATED CIRCUIT SILICON GATE CMOS

262,144-WORD BY 16-BIT STATIC RAM

**DESCRIPTION**

The TC554161FTI is a 4,194,304-bit static random access memory (SRAM) organized as 262,144 words by 16 bits. Fabricated using Toshiba's CMOS Silicon gate process technology, this device operates from a single 5 V ± 10% power supply. Advanced circuit technology provides both high speed and low power at an operating current of 10 mA/MHz (typ) and a minimum cycle time of 85 ns. It is automatically placed in low-power mode at 200 μA standby current (max) 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. Data byte control pin ( $\overline{LB}$ ,  $\overline{UB}$ ) provides lower and upper byte 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° to 85°C, the TC554161FTI can be used in environments exhibiting extreme temperature conditions. The TC554161FTI is available in a plastic 54-pin thin-small-outline package (TSOP).

**FEATURES**

- Low-power dissipation  
Operating: 55 mW/MHz(typical)
- Standby current of 200 μA (maximum)
- Single power supply voltage of 5 V ± 10%
- Power down features using  $\overline{CE}$ .
- Data retention supply voltage of 2 to 5.5 V
- Direct TTL compatibility for all inputs and outputs
- Wide operating temperature range of - 40° to 85°C

- Access Times (maximum):

	TC554161FTI	
	-85	-10
Access Time	85 ns	100 ns
$\overline{CE}$ Access Time	85 ns	100 ns
$\overline{OE}$ Access Time	45 ns	50 ns

- Package:  
TSOP II 54-P-400-0.80 (FTI) (Weight: 0.55 g typ)

**PIN ASSIGNMENT (TOP VIEW)**

NC □ 1 ○	54 □ A4
A3 □ 2	53 □ A5
A2 □ 3	52 □ A6
A1 □ 4	51 □ A7
A0 □ 5	50 □ NC
I/O16 □ 6	49 □ I/O1
I/O15 □ 7	48 □ I/O2
V <sub>DD</sub> □ 8	47 □ V <sub>DD</sub>
GND □ 9	46 □ GND
I/O14 □ 10	45 □ I/O3
I/O13 □ 11	44 □ I/O4
$\overline{UB}$ □ 12	43 □ $\overline{LB}$
$\overline{CE}$ □ 13	42 □ $\overline{OE}$
OP □ 14	41 □ OP
R/W □ 15	40 □ NC
I/O12 □ 16	39 □ I/O5
I/O11 □ 17	38 □ I/O6
GND □ 18	37 □ GND
V <sub>DD</sub> □ 19	36 □ V <sub>DD</sub>
I/O10 □ 20	35 □ I/O7
I/O9 □ 21	34 □ I/O8
NC □ 22	33 □ A8
A17 □ 23	32 □ A9
A16 □ 24	31 □ A10
A15 □ 25	30 □ A11
A14 □ 26	29 □ A12
A13 □ 27	28 □ NC

(Normal pinout)

**PIN NAMES**

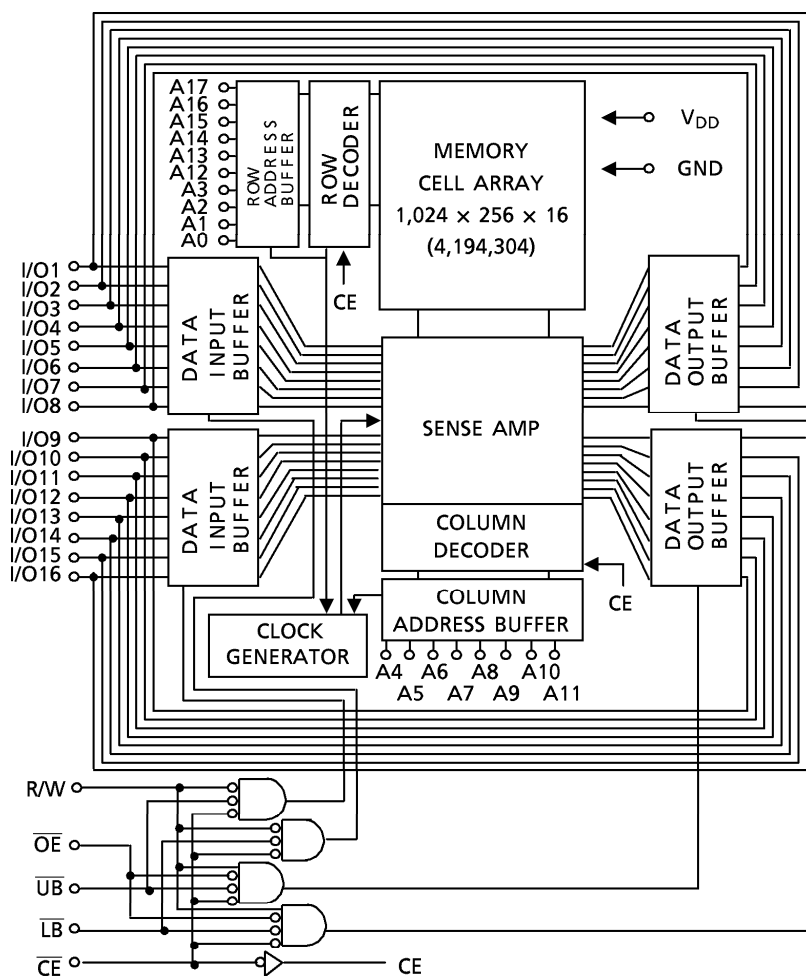
A0 to A17	Address Inputs
I/O1 to I/O16	Data Inputs/Outputs
$\overline{CE}$	Chip Enable
R/W	Read/Write Control
$\overline{OE}$	Output Enable
$\overline{LB}$ , $\overline{UB}$	Data Byte Control Input
V <sub>DD</sub>	Power (+ 5 V)
GND	Ground
NC	No Connection
OP*	Option

\*: OP pin must be open or connected to GND.

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**BLOCK DIAGRAM**



**MAXIMUM RATINGS**

SYMBOL	RATING	VALUE	UNIT
$V_{DD}$	Power Supply Voltage	- 0.3 to 7.0	V
$V_{IN}$	Input Voltage	- 0.3 * to 7.0	V
$V_{I/O}$	Input/Output Voltage	- 0.5 to $V_{DD} + 0.5$	V
$P_D$	Power Dissipation	0.6	W
$T_{solder}$	Soldering Temperature (10 s)	260	°C
$T_{strg}$	Storage Temperature	- 55 to 150	°C
$T_{opr}$	Operating Temperature	- 40 to 85	°C

\* - 3.0 V when measured at a pulse width of 30 ns

**DC RECOMMENDED OPERATING CONDITIONS ( $T_a = - 40^\circ$  to  $85^\circ\text{C}$ )**

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT
$V_{DD}$	Power Supply Voltage	4.5	5.0	5.5	V
$V_{IH}$	Input High Voltage	2.4	-	$V_{DD} + 0.3$	V
$V_{IL}$	Input Low Voltage	- 0.3 *	-	0.6	V
$V_{DH}$	Data Retention Supply Voltage	2.0	-	5.5	V

\* - 3.0 V when measured at a pulse width of 30 ns

**DC CHARACTERISTICS** (Ta = - 40° to 85°C, VDD = 5 V ± 10%)

SYMBOL	PARAMETER	TEST CONDITION		MIN	TYP	MAX	UNIT	
I <sub>IL</sub>	Input Leakage Current	V <sub>IN</sub> = 0 V to V <sub>DD</sub>		-	-	± 1.0	μA	
I <sub>LO</sub>	Output Leakage Current	$\overline{CE} = V_{IH}$ or $R/W = V_{IL}$ or $\overline{OE} = V_{IH}$ V <sub>OUT</sub> = 0 V to 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>DDO 1</sub>	Operating Current	$\overline{CE} = V_{IL}$ $R/W = V_{IH}$ , I <sub>OUT</sub> = 0 mA Other Inputs = V <sub>IH</sub> /V <sub>IL</sub>	Tcycle	min	-	-	100	mA
				1 μs	-	15	-	
I <sub>DDO 2</sub>	Operating Current	$\overline{CE} = 0.2 V$ $R/W = V_{DD} - 0.2 V$ , I <sub>OUT</sub> = 0 mA Other Inputs = V <sub>DD</sub> - 0.2 V/0.2 V	Tcycle	min	-	-	90	mA
				1 μs	-	10	-	
I <sub>DDS 1</sub>	Standby Current	$\overline{CE} = V_{IH}$		-	-	3	mA	
I <sub>DDS 2</sub>		$\overline{CE} = V_{DD} - 0.2 V$ , Ta = - 40° to 85°C V <sub>DD</sub> = 2.0 to 5.5 V		-	-	200	μA	

**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.

**OPERATING MODE**

MODE	$\overline{CE}$	$\overline{OE}$	R/W	$\overline{LB}$	$\overline{UB}$	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-Z	Output	I <sub>DDO</sub>
				L	H	Output	High-Z	I <sub>DDO</sub>
Write	L	x	L	L	L	Input	Input	I <sub>DDO</sub>
				H	L	High-Z	Input	I <sub>DDO</sub>
				L	H	Input	High-Z	I <sub>DDO</sub>
Outputs Disable	L	H	H	x	x	High-Z	High-Z	I <sub>DDO</sub>
	L	x	x	H	H			
Standby	H	x	x	x	x	High-Z	High-Z	I <sub>DDS</sub>

x = don't care  
 H = logic high  
 L = logic low

**AC CHARACTERISTICS AND OPERATING CONDITIONS** ( $T_a = -40^\circ$  to  $85^\circ\text{C}$ ,  $V_{DD} = 5\text{ V} \pm 10\%$ )

**READ CYCLE**

SYMBOL	PARAMETER	TC554161FTI				UNIT
		-85		-10		
		MIN	MAX	MIN	MAX	
$t_{RC}$	Read Cycle Time	85	-	100	-	ns
$t_{ACC}$	Address Access Time	-	85	-	100	
$t_{CO}$	Chip Enable Access Time	-	85	-	100	
$t_{OE}$	Output Enable Access Time	-	45	-	50	
$t_{BA}$	Data Byte Control Access Time	-	45	-	50	
$t_{OH}$	Output Data Hold Time	10	-	10	-	
$t_{COE}$	Chip Enable Low to Output Active	5	-	5	-	
$t_{OEE}$	Output Enable Low to Output Active	0	-	0	-	
$t_{BE}$	Data Byte Control Low to Output Active	0	-	0	-	
$t_{OD}$	Chip Enable High to Output High-Z	-	35	-	40	
$t_{ODO}$	Output Enable High to Output High-Z	-	35	-	40	
$t_{BD}$	Data Byte Control High to Output High-Z	-	35	-	40	

**WRITE CYCLE**

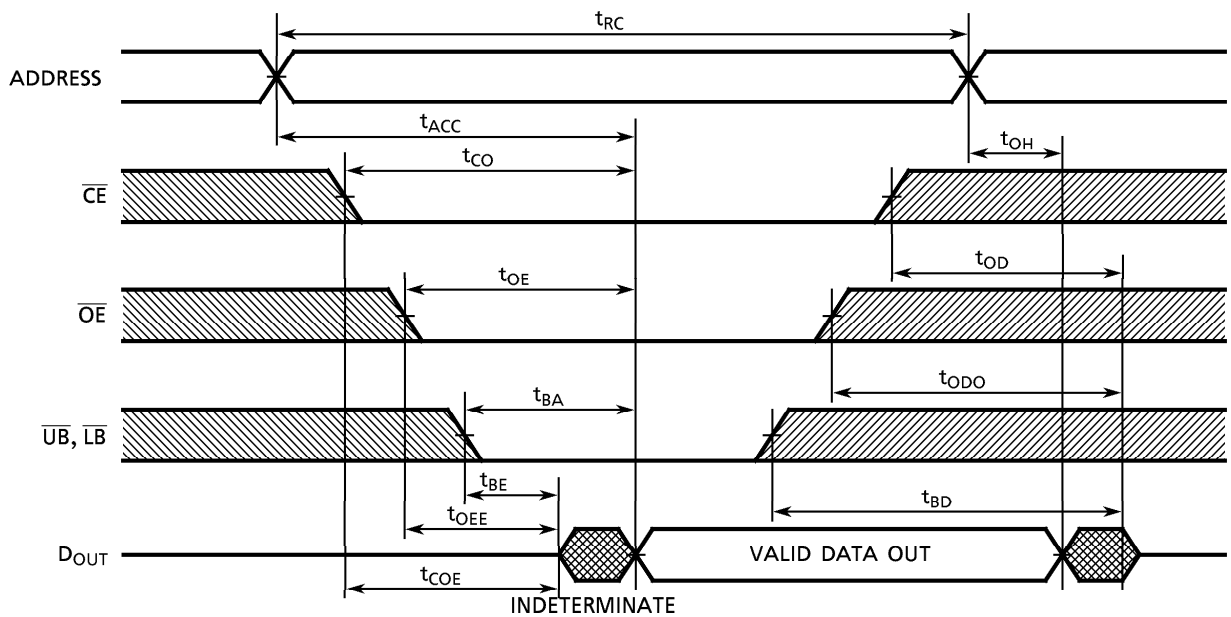
SYMBOL	PARAMETER	TC554161FTI				UNIT
		-85		-10		
		MIN	MAX	MIN	MAX	
$t_{WC}$	Write Cycle Time	85	-	100	-	ns
$t_{WP}$	Write Pulse Width	55	-	60	-	
$t_{CW}$	Chip Enable to End of Write	70	-	80	-	
$t_{BW}$	Data Byte Control to End of Write	55	-	60	-	
$t_{AS}$	Address Setup Time	0	-	0	-	
$t_{WR}$	Write Recovery Time	0	-	0	-	
$t_{DS}$	Data Setup Time	35	-	40	-	
$t_{DH}$	Data Hold Time	0	-	0	-	
$t_{OEW}$	R/W High to Output Active	0	-	0	-	
$t_{ODW}$	R/W Low to Output High-Z	-	35	-	40	

**AC TEST CONDITIONS**

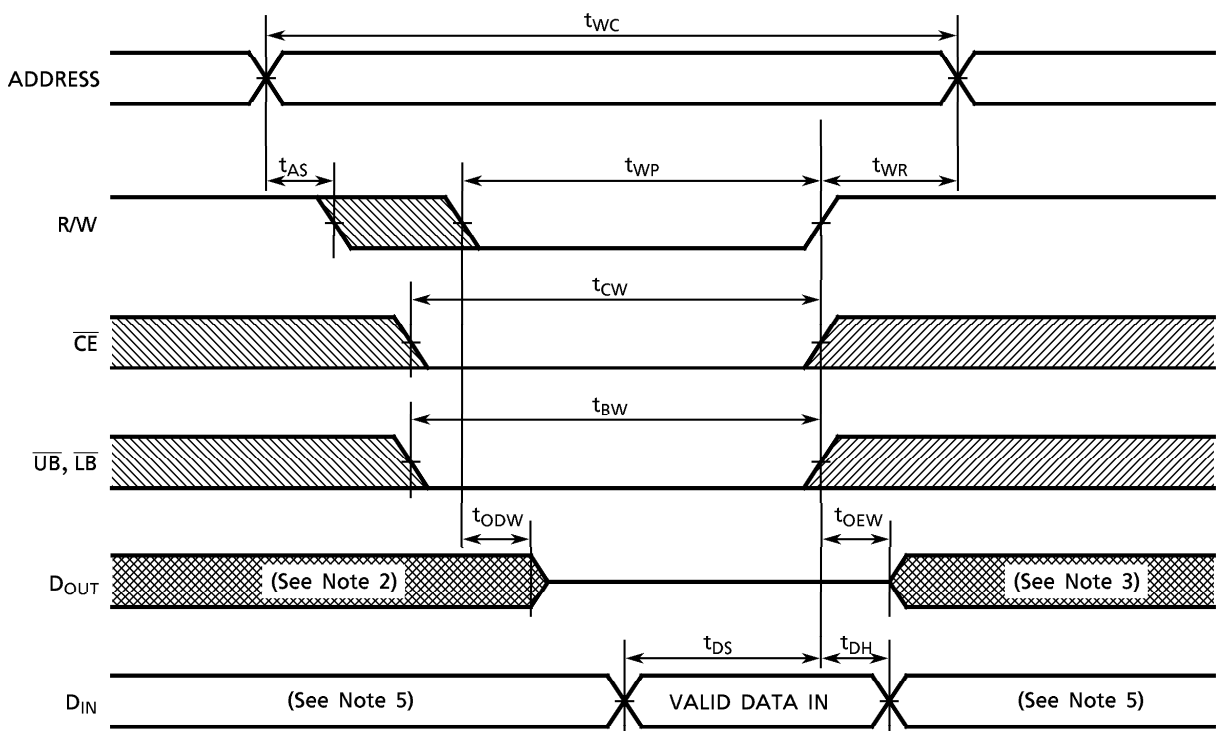
Output load: 100 pF + one TTL gate  
 Input pulse level: 0.4 V, 2.6 V  
 Timing measurements: 1.5 V  
 Reference level: 1.5 V  
 $t_R, t_F$ : 5 ns

**TIMING DIAGRAMS**

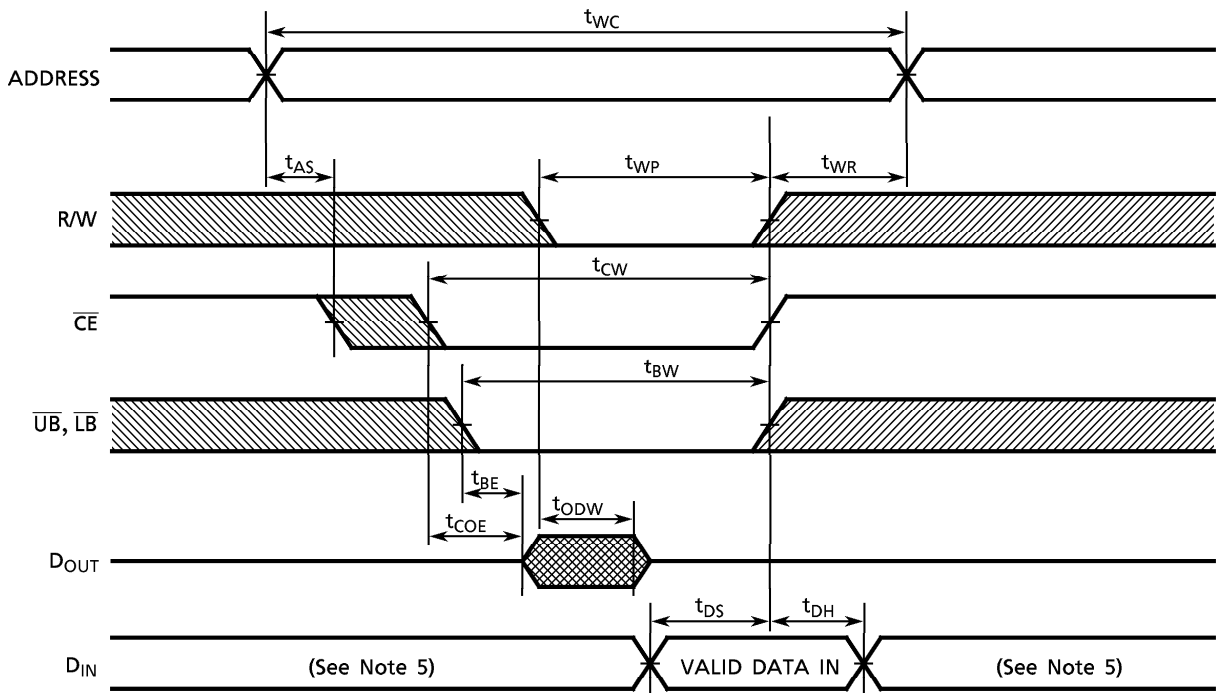
**READ CYCLE (See Note 1)**



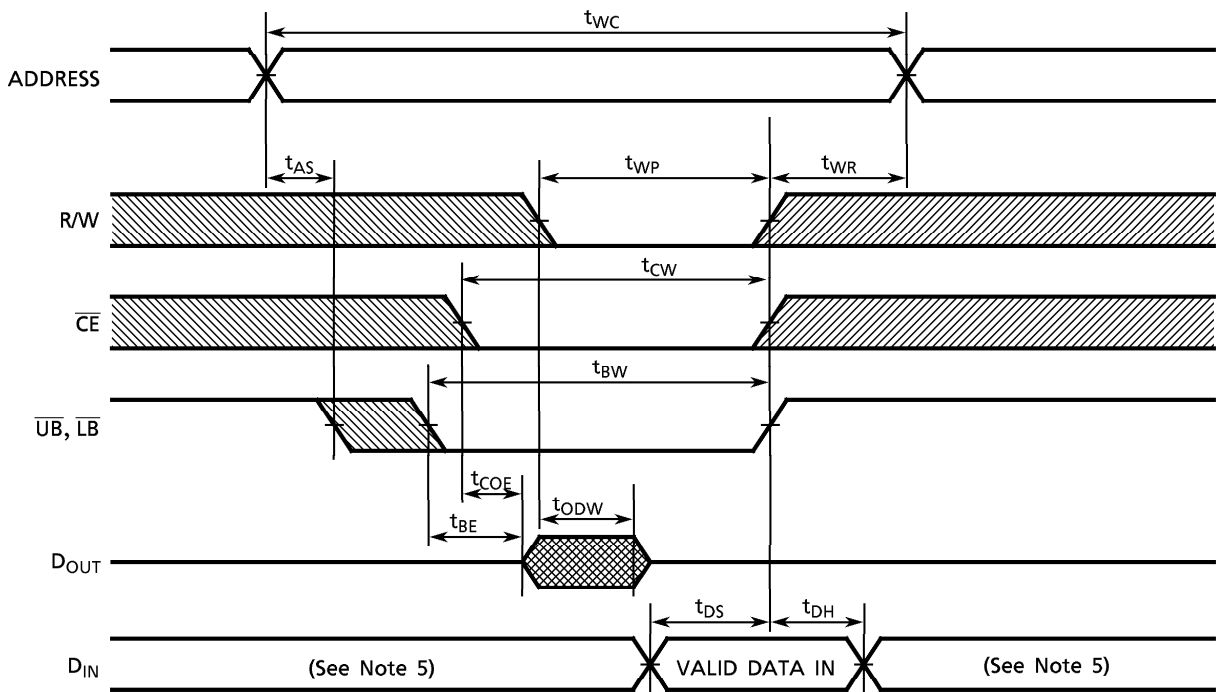
**WRITE CYCLE 1 (R/W CONTROLLED) (See Note 4)**



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



WRITE CYCLE 3 ( $\overline{UB}$ ,  $\overline{LB}$  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.

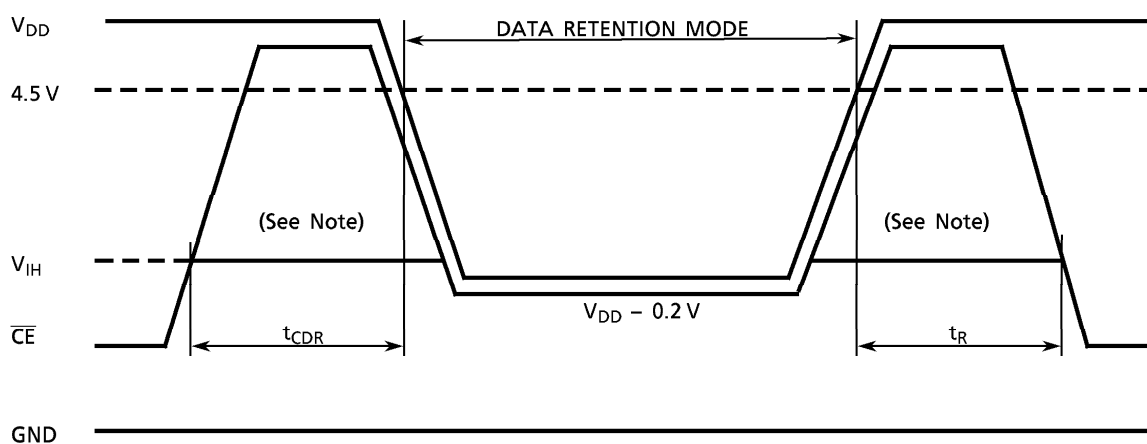
(4) If  $\overline{OE}$  is HIGH during the write cycle, the outputs will remain at high impedance.

(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** ( $T_a = -40^\circ$  to  $85^\circ\text{C}$ )

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT
$V_{DH}$	Data Retention Supply Voltage	2.0	–	5.5	V
$I_{DDS2}$	Standby Current	$V_{DH} = 3.0\text{ V}$	–	100	$\mu\text{A}$
		$V_{DH} = 5.5\text{ V}$	–	200	
$t_{CDR}$	Chip Deselect to Data Retention Mode Time	0	–	–	nS
$t_R$	Recovery Time	5	–	–	mS

**$\overline{CE}$  CONTROLLED DATA RETENTION MODE**

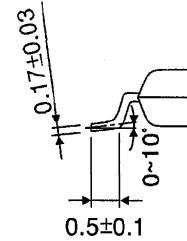
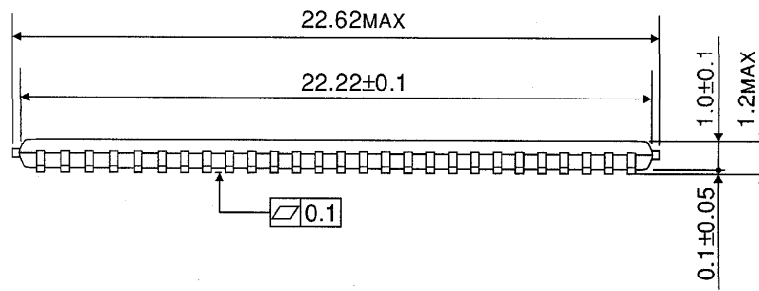
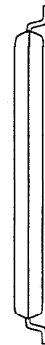
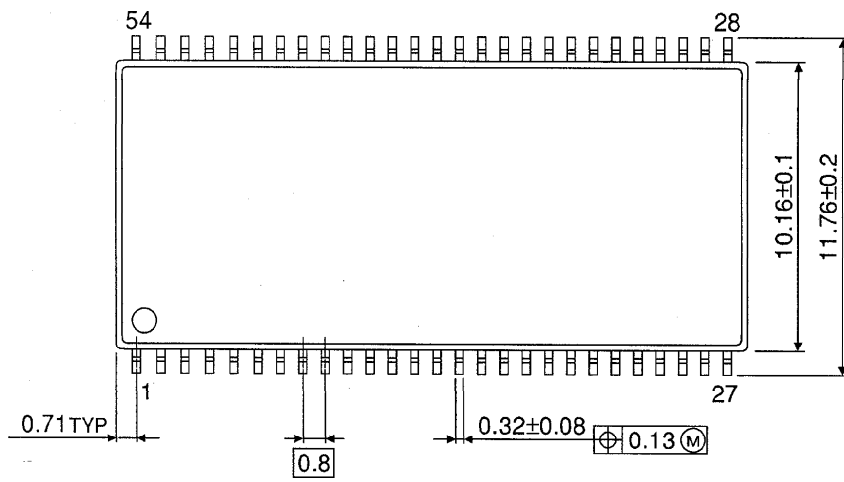


Note: When  $\overline{CE}$  is operating at the  $V_{IH}$  level (2.4 V), the operating current is given by  $I_{DDS1}$  during the transition of  $V_{DD}$  from 4.5 to 2.6 V.



PACKAGE DIMENSIONS (TSOPII 54-P-400-0.80)

Units in mm



Weight: 0.55 g (typ)