#### TOSHIBA MOS DIGITAL INTEGRATED CIRCUIT SILICON GATE CMOS

### 524,288 WORDS × 8 BIT STATIC RAM **DESCRIPTION**

The TC554001FI/FTI is a 4,194,304-bit static random access memory (SRAM) organized as 524,288 words by 8 bits. Fabricated using Toshiba's CMOS Silicon gate process technology, this device operates words by 8 bits. Fabricated using Toshiba's CMOS Silicon gate process technology, this device operates from a single  $5V \pm 10\%$  power supply. Advanced circuit technology provides both high speed and low power at an operating current of 10mA/MHz(typ) and minimum cycle time of 85 ns.It is automatically placed in low-power mode at  $140~\mu\text{A}$  standby current (max) when chip enable ( $\overline{\text{CE}}$ ) is asserted high. There are two control inputs.  $\overline{\text{CE}}$  is used to select the device and for data retention control, and output enable ( $\overline{\text{OE}}$ ) provides fast memory 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  $85^{\circ}\text{C}$ , the  $\overline{\text{TC554001FI/FTI}}$  can be used in environments exhibiting extreme temperature conditions. The  $\overline{\text{TC554001FI/FTI}}$  is available in a standard plastic 32-pin small-outline package(SOP) and 32-pin thin-small-outline package(TSOP).

#### **FEATURES**

- Low-power dissipation Operating: 55 mW/MHz (typical)
- Standby current of  $8 \mu A$  (maximum) at  $Ta = 25^{\circ}C$
- Single power supply voltage of 5 V ± 10 %
- Power down features using CE
- Data retention supply voltage of 2.0 to 5.5 V
- Directly TTL compatibility for all inputs and
- Wide operating temperature range of 40° to 85°C

#### • Access Time (maximum)

	TC5510	01FI/FTI
	-85L	-10L
Access Time	85 ns	100 ns
CE Access Time	85 ns	100 ns
OE Access Time	45 ns	50 ns

• Package:

SOP32-P-525-1.27 (FI)

(Weight: 1.14 g typ) TSOP II 32-P-400-1.27 (FTI) (Weight: 0.51 g typ)

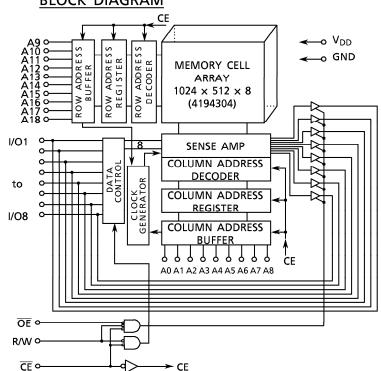
## PIN ASSIGNMENT (TOP VIEW)

○ <u>32 PIN</u>	<u>FI/FTI</u>
A18 🗆 1	32 □ V <sub>DD</sub>
A16 ☐ 2	31 🗀 🗡 A15
A14 🔲 3	30 🗀 🗡 A17
A12 ☐ 4	29  □ R/W
A7 🗌 5	28 🗀 🗡 A13
A6 □ 6	27 🗀 🗚
A5 🗌 7	26 🗀 🗚 9
A4 🗌 8	25 🗀 🗡 A11
A3 🗌 9	24 🔲 🛛 ŌĒ
A2 🗌 10	23 🗀 🗡 A10
A1 🛚 11	22 🔲 🛛 🖽
A0 🗌 12	21 🔲 1/08
I/O1 🔲 13	20 🗀 1/07
I/O2 🔲 14	19 🔲 1/06
I/O3 🛘 15	18 🔲 1/05
GND ☐ 16	17 1/04

#### PIN NAMES

A0 to A18	Address Inputs
R/W	Read/Write Control
ŌĒ	Output Enable
CE	Chip Enable
I/O1 to I/O8	Data Input/Output
V <sub>DD</sub>	Power (+ 5 V)
GND	Ground

## **BLOCK DIAGRAM**



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## **OPERATION MODE**

OPERATION MODE	CE	ŌĒ	R/W	I/O1 to I/O8	POWER
Read	L	L	Н	D <sub>OUT</sub>	I <sub>DDO</sub>
Write	L	×	L	D <sub>IN</sub>	I <sub>DDO</sub>
Output Disabled	L	Н	Н	High-Z	I <sub>DDO</sub>
Standby	Н	×	×	High-Z	I <sub>DD\$</sub>

Note:  $\times = \text{don't care. } H = \text{logic high. } L = \text{logic low.}$ 

## **ABSOLUTE MAXIMUM RATINGS**

SYMBOL	RATING	VALUE	UNIT
$V_{DD}$	Power Supply Voltage	- 0.3 to 7.0	V
V <sub>IN</sub>	Input Voltage	- 0.3* to 7.0	V
V <sub>I/O</sub>	Input and Output Voltage	- 0.5 to V <sub>DD</sub> + 0.5	V
P <sub>D</sub>	Power Dissipation	0.6	W
Tsolder	Soldering Temperature (10 s)	260	°C
Tstrg.	Storage Temperature	– 55 to 150	°C
Topr.	Operating Temperature	- 40 to 85	°C

<sup>\*</sup> -3.0 V when measured at a pulse width of 50 ns

# <u>DC RECOMMENDED OPERATING CONDITIONS</u> (Ta = $-40^{\circ}$ to $85^{\circ}$ C)

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT
V <sub>DD</sub>	Power Supply Voltage	4.5	5.0	5.5	V
$V_{IH}$	Input High Voltage	2.4	-	V <sub>DD</sub> + 0.3	V
$V_{IL}$	Input Low Voltage	- 0.3*	-	0.6	V
$V_{DH}$	Data Retention Supply Voltage	2.0	-	5.5	٧

<sup>\*</sup> -3.0 V when measured at a pulse width of 50 ns

## DC CHARACTERISTICS (Ta = $-40^{\circ}$ to 85°C, $V_{DD} = 5 V \pm 10\%$ )

SYMBOL	PARAMETER	TEST CONDITION			MIN	TYP	MAX	UNIT
I <sub>IL</sub>	Input Leakage Current	$V_{IN} = 0 V \text{ to } V_{DD}$			_	_	± 1.0	μΔ
I <sub>OH</sub>	Output High Current	V <sub>OH</sub> = 2.4 V			- 1.0	-	-	mA
l <sub>OL</sub>	Output Low Current	V <sub>OL</sub> = 0.4 V			2.1	-	_	mA
I <sub>LO</sub>	Output Leakage Current	$\overline{CE} = V_{IH}$ or R/W = $V_{IL}$ or $\overline{OE} = V_{IH}$ $V_{OUT} = 0 \text{ V to } V_{DD}$		-	_	± 1.0	μΑ	
		$\overline{CE} = V_{IL}$ and R/W = $V_{IH}$	T	min	_	-	80	-m A
I <sub>DDO1</sub>	Operating Correct	$I_{OUT} = 0 \text{ mA}$ Other Inputs = $V_{IH}/V_{IL}$	Tcycle	1 <i>μ</i> s	1	15	_	mA
	Operating Current	$\overline{CE} = 0.2 \text{ V} \text{ and } \text{R/W} = \text{V}_{DD} - 0.2 \text{ V}$		min	1	1	70	4
I <sub>DDO2</sub>		$I_{OUT} = 0 \text{ mA}$ Other Inputs = $V_{DD} - 0.2 \text{ V}/0.2 \text{ V}$	Tcycle	1 μs	-	10	_	mA
I <sub>DD\$1</sub>		CE = V <sub>IH</sub>			-	-	3	mA
	Standby Current	$\overline{CE} = V_{DD} - 0.2 V$	a = 25°C		_	4	8	
I <sub>DDS2</sub>		$V_{DD} = 2.0 \text{ to } 5.5 \text{ V}$	a = -40° 1	to 85°C	_	_	140	μΑ

## <u>CAPACITANCE</u> (Ta = $25^{\circ}$ C, f = 1 MHz)

SYMBOL	PARAMETER	TEST CONDITION	MAX	UNIT
C <sub>IN</sub>	Input Capacitance	V <sub>IN</sub> = GND	10	pF
<b>c</b> <sub>out</sub>	Output Capacitance	V <sub>OUT</sub> = GND	10	pF

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

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

## READ CYCLE

			TC5540	01FI/FTI	1FI/FTI	
SYMBOL	PARAMETER	-8	5L	-1	0L	UNIT
		MIN	MAX	MIN	MAX	
t <sub>RC</sub>	Read Cycle Time	85	ı	100	-	
t <sub>ACC</sub>	Address Access Time	-	85	ı	100	
t <sub>CO</sub>	Chip Enable Access Time	_	85	_	100	
t <sub>OE</sub>	Output Enable Access Time	-	45	_	50	
t <sub>COE</sub>	Chip Enable Low to Output in Active	5	-	5	-	ns
t <sub>OEE</sub>	Output Enable Low to Output Active	0	-	0	_	
t <sub>OD</sub>	Chip Enable Hige to Output High-Z	-	35	-	40	
t <sub>ODO</sub>	Output Enable Hige to Output High-Z	_	35	_	40	
t <sub>OH</sub>	Output Data Hold Time	10	_	10	_	

#### WRITE CYCLE

		TC554001FI/FTI				
SYMBOL	PARAMETER	-8	5L	-1	0L	UNIT
		MIN	MAX	MIN	MAX	
t <sub>WC</sub>	Write Cycle Time	85	_	100	_	
t <sub>WP</sub>	Write Pulse Width	55	_	60	_	
t <sub>CW</sub>	Chip Enable to End of Write	70	_	80	_	
t <sub>AS</sub>	Address Setup Time	0	_	0	-	
t <sub>WR</sub>	Write Recovery Time	0	_	0	_	ns
t <sub>ODW</sub>	R/W Low to Output High-Z	-	35	_	40	
t <sub>OEW</sub>	R/W High to Output Active	0	_	0	-	
t <sub>D\$</sub>	Data Setup Time	35	_	40	_	
t <sub>DH</sub>	Data Hold Time	0	_	0	_	

## AC TEST CONDITIONS

Output Load: 100 pF + one TTL gate

Input Pulse Level:  $0.4\,\mathrm{V},\ 2.6\,\mathrm{V}$ 

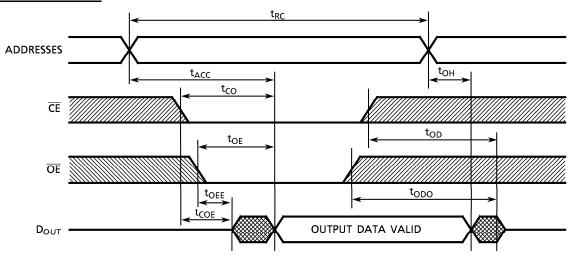
Timing Measurements: 1.5 V

Reference Level: 1.5 V

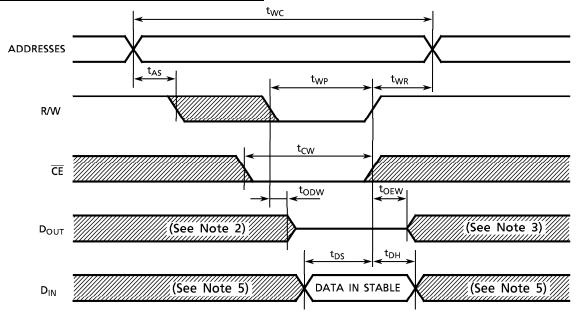
 $t_r$ ,  $t_F$ : 5 ns

### **TIMING WAVEFORMS**

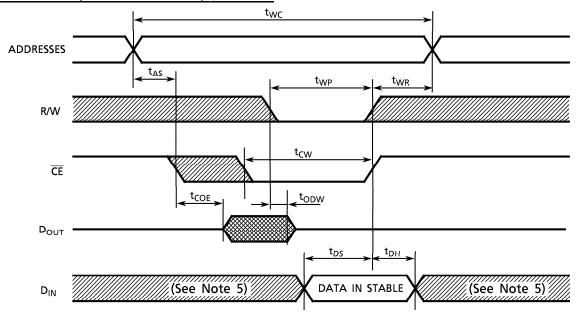
#### READ CYCLE (See Note 1)



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



### WRITE CYCLE 2 (CE CONTROLLED) (See Note 4)



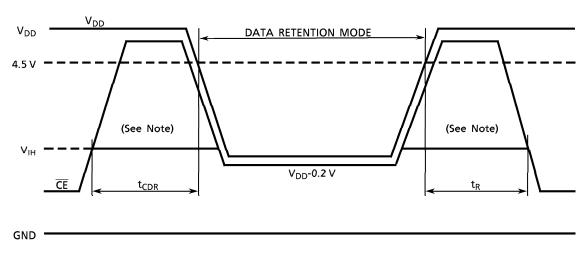
- (1) R/W remains High for Read Cycle.
- (2) If  $\overline{\text{CE}}$  goes coincident with or after R/W goes LOW, the output will remain at high impedance.
- (3) If  $\overline{\text{CE}}$  goes HIGH coincident with or before R/W goes HIGH, the output will remain at high impedance.
- (4) IF  $\overline{\text{CE}}$  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 (Ta = - 40° to 85°C)

SYMBOL	PARAMETER		MIN	TYP	MAX	UNIT
V <sub>DH</sub>	Data Retention Supply Voltage		2.0	-	5.5	V
lana.	I <sub>DDS2</sub> Standby Current	V <sub>DH</sub> = 3.0 V	-	-	70 *	
מטטי		V <sub>DH</sub> = 5.5 V	-	-	140	μ <b>Α</b>
t <sub>CDR</sub>	Chip Deselect to Data Retention Mode Time		0	-	-	nS
t <sub>R</sub>	Recovery Time		5	-	_	mS

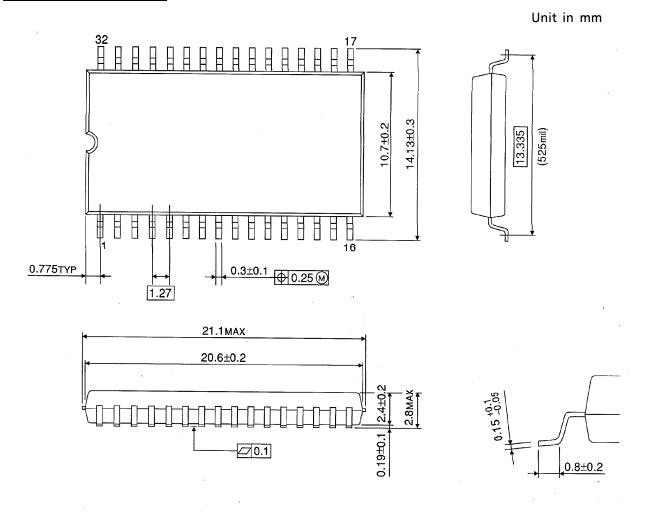
<sup>\*)</sup>  $6 \,\mu\text{A}$  (max)  $Ta = -40^{\circ} \text{ to } 40^{\circ}\text{C}$ 

## CE Controlled Data Retention Mode



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

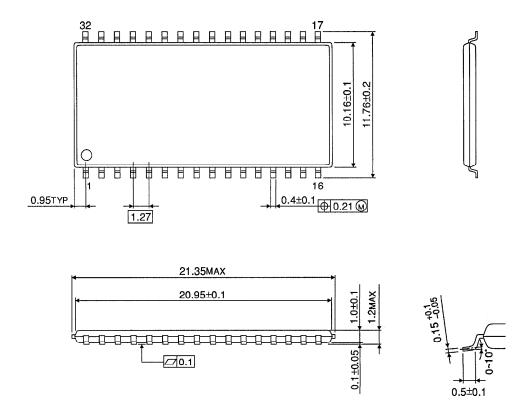
# PACKAGE DIMENSIONS (SOP32-P-525-1.27)



Weight: 1.14 g (typ)

## PACKAGE DIMENSIONS (TSOPII 32-P-400-1.27)

Unit in mm



Weight: 0.51 g (typ)