TOSHIBA MOS DIGITAL INTEGRATED CIRCUIT SILICON GATE CMOS

524,288-WORD BY 8-BIT STATIC RAM

DESCRIPTION

The TC55V4000ST 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 from a single 2.3 to 3.6 V power supply. Advanced circuit technology provides both high speed and low power at an operating current of 3 mA/MHz and a minimum cycle time of 70 ns. It is automatically placed in low-power mode at 0.5 μA standby current (V_{DD}=3V, Ta=25°C) 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. This device is well suited to various microprocessor system applications where high speed, low power and battery backup are required. The TC55V4000ST is available in a normal pinout plastic 32-pin thin-small-outline package (TSOP).

FEATURES

- Low-power dissipation
  Operating: 10.8 mW/MHz (typical)
- Single power supply voltage of 2.3 to 3.6 V
- Power down features using $\overline{CE}$
- Data retention supply voltage of 1.5 to 3.6 V
- Direct TTL compatibility for all inputs and outputs
- Standby current (maximum)

3.6V	7 μA
3.0V	5 μA

- Access Times (maximum):

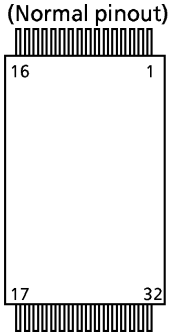
	TC55V4000ST	
	-70	-85
Access Time	70ns	85ns
$\overline{CE}$ Access Time	70ns	85ns
$\overline{OE}$ Access Time	35ns	45ns

- Packages:
  TSOP I 32-P-0.50 (Weight: 0.24g typ)

PIN ASSIGNMENT (TOP VIEW)

o 32 PIN TSOP

(Normal pinout)

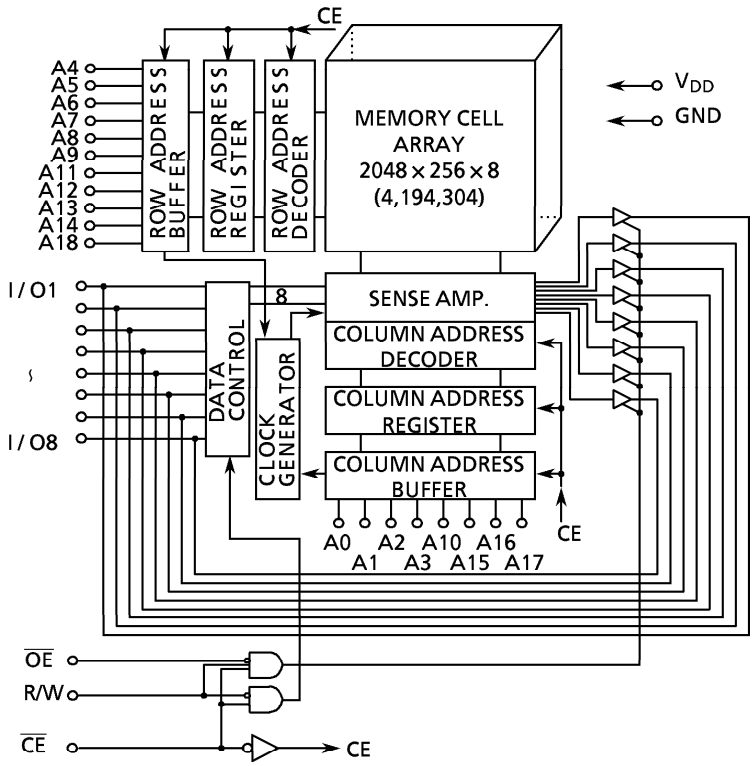


PIN NAMES

A0 to A18	Address Inputs
R/W	Read / Write Control Input
$\overline{OE}$	Output Enable Input
$\overline{CE}$	Chip Enable Input
I/O1 to I/O8	Data Input / Output
V_{DD}	Power
GND	Ground

PIN NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PIN NAME	A_{11}	A_9	A_8	A_{13}	R/W	A_{17}	A_{15}	V_{DD}	A_{18}	A_{16}	A_{14}	A_{12}	A_7	A_6	A_5	A_4
PIN NO.	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
PIN NAME	A_3	A_2	A_1	A_0	I/O1	I/O2	I/O3	GND	I/O4	I/O5	I/O6	I/O7	I/O8	$\overline{CE}$	A_{10}	$\overline{OE}$

BLOCK DIAGRAM



OPERATION MODE

MODE	$\overline{CE}$	$\overline{OE}$	R/W	I/O1 to I/O8	POWER
Read	L	L	H	D_{OUT}	I_{DDO}
Write	L	×	L	D_{IN}	I_{DDO}
Outputs Disabled	L	H	H	High-Z	I_{DDO}
Standby	H	×	×	High-Z	I_{DDS}

Note: × = don't care. H = logic high. L = logic low.

ABSOLUTE MAXIMUM RATINGS

SYMBOL	RATING	VALUE	UNIT
V_{DD}	Power Supply Voltage	− 0.3 to 4.6	V
V_{IN}	Input Voltage	− 0.3* to 4.6	V
$V_{I/O}$	Input/Output Voltage	− 0.5 to V_{DD} + 0.5	V
P_D	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

* − 3.0 V when measured at a pulse width of 50 ns.

DC RECOMMENDED OPERATING CONDITIONS (Ta = – 40° to 85°C)

SYMBOL	PARAMETER	2.3 to 3.6V			UNIT
		MIN	TYP	MAX	
V_{DD}	Power Supply Voltage	2.3	3.0	3.6	V
V_{IH}	Input High Voltage	2.2	–	V_{DD} + 0.3	V
V_{IL}	Input Low Voltage	– 0.3*	–	V_{DD} × 0.22	V
V_{DH}	Data Retention Supply Voltage	1.5	–	3.6	V

* – 3.0 V when measured at a pulse width of 50 ns.

DC CHARACTERISTICS (Ta = – 40° to 85°C, V_{DD} = 2.3 to 3.6 V)

SYMBOL	PARAMETER	TEST CONDITION				MIN	TYP	MAX	UNIT
I_{IL}	Input Leakage Current	V_{IN} = 0 V to V_{DD}				–	–	± 1.0	μA
I_{OH}	Output High Current	V_{OH} = V_{DD} – 0.5 V				– 0.5	–	–	mA
I_{OL}	Output Low Current	V_{OL} = 0.4 V				2.1	–	–	mA
I_{LO}	Output Leakage Current	$\overline{CE}$ = V_{IH} or R/W = V_{IL} or $\overline{OE}$ = V_{IH}, V_{OUT} = 0 V to V_{DD}				–	–	± 1.0	μA
I_{DDO1}	Operating Current	$\overline{CE}$ = V_{IL} and R/W = V_{IH}, I_{OUT} = 0 mA Other Input = V_{IH}/V_{IL}	V_{DD} = 3.0V ± 10%	Tcycle	min	–	–	50	mA
					1 μs	–	–	10	
I_{DDO2}		$\overline{CE}$ = 0.2 V R/W = V_{DD} – 0.2 V, I_{OUT} = 0 mA Other Inputs = V_{DD} – 0.2 V/0.2 V			min	–	–	45	
					1 μs	–	–	5	
I_{DDS1}	Standby Current	$\overline{CE}$ = V_{IH}				–	–	2	mA
I_{DDS2}		$\overline{CE}$ = V_{DD} – 0.2 V V_{DD} = 1.5 to 3.6 V	V_{DD} = 3.0V ± 10%		Ta = 25°C	–	–	0.6	μA
					Ta = – 40~85°C	–	–	6	
			V_{DD} = 3.3V ± 0.3V		Ta = 25°C	–	–	0.7	
					Ta = – 40~85°C	–	–	7	
			V_{DD} = 3.0V		Ta = 25°C	–	0.05	0.5	
					Ta = – 40~40°C	–	–	1	
					Ta = – 40~85°C	–	–	5	

CAPACITANCE (Ta = 25°C, f = 1 MHz)

SYMBOL	PARAMETER	TEST CONDITION	MAX	UNIT
C_{IN}	Input Capacitance	V_{IN} = GND	10	pF
C_{OUT}	Output Capacitance	V_{OUT} = GND	10	

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

AC CHARACTERISTICS AND OPERATING CONDITIONS (Ta = −40° to 85°C, V_{DD} = 2.7 to 3.6 V)

READ CYCLE

SYMBOL	PARAMETER	TC55V4000ST				UNIT
		-70		-85		
		MIN	MAX	MIN	MAX	
t_{RC}	Read Cycle Time	70	–	85	–	ns
t_{ACC}	Address Access Time	–	70	–	85	
t_{CO}	Chip Enable Access Time	–	70	–	85	
t_{OE}	Output Enable Access Time	–	35	–	45	
t_{COE}	Chip Enable Low to Output Active	5	–	5	–	
t_{OEE}	Output Enable Low to Output Active	0	–	0	–	
t_{OD}	Chip Enable High to Output High-Z	–	30	–	35	
t_{ODO}	Output Enable High to Output High-Z	–	30	–	35	
t_{OH}	Output Data Hold Time	10	–	10	–	

WRITE CYCLE

SYMBOL	PARAMETER	TC55V4000ST				UNIT
		-70		-85		
		MIN	MAX	MIN	MAX	
t_{WC}	Write Cycle Time	70	–	85	–	ns
t_{WP}	Write Pulse Width	50	–	55	–	
t_{CW}	Chip Enable to End of Write	60	–	70	–	
t_{AS}	Address Setup Time	0	–	0	–	
t_{WR}	Write Recovery Time	0	–	0	–	
t_{ODW}	R/W Low to Output High-Z	–	25	–	35	
t_{OEW}	R/W High to Output Active	0	–	0	–	
t_{DS}	Data Setup Time	30	–	35	–	
t_{DH}	Data Hold Time	0	–	0	–	

AC TEST CONDITIONS

Output load: 30 pF + 1TTL Gate
Input pulse level: 0.4 V, 2.4 V
Timing measurements: $V_{DD} \times 0.5$
Reference level: $V_{DD} \times 0.5$
t_R, t_F: 5 ns

AC CHARACTERISTICS AND OPERATING CONDITIONS (Ta = −40° to 85°C, V_{DD} = 2.3 to 3.6 V)

READ CYCLE

SYMBOL	PARAMETER	TC55V4000ST				UNIT
		-70		-85		
		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_{COE}	Chip Enable Low to Output Active	5	–	5	–	
t_{OEE}	Output Enable 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_{OH}	Output Data Hold Time	10	–	10	–	

WRITE CYCLE

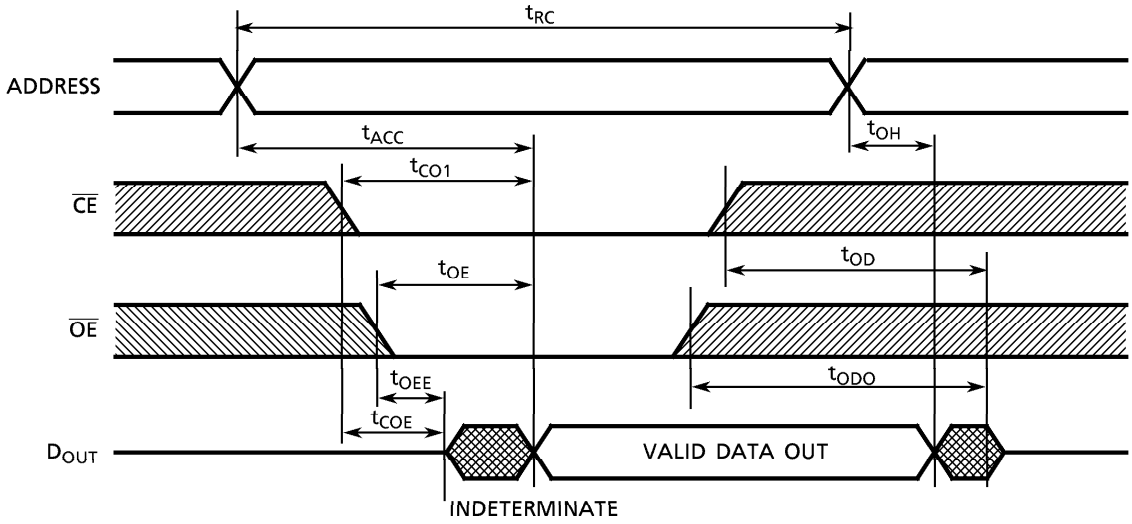
SYMBOL	PARAMETER	TC55V4000ST				UNIT
		-70		-85		
		MIN	MAX	MIN	MAX	
t_{WC}	Write Cycle Time	85	–	100	–	ns
t_{WP}	Write Pulse Width	55	–	60	–	
t_{CW}	Chip Enable to End of Write	70	–	80	–	
t_{AS}	Address Setup Time	0	–	0	–	
t_{WR}	Write Recovery Time	0	–	0	–	
t_{ODW}	R/W Low to Output High-Z	–	35	–	40	
t_{OEW}	R/W High to Output Active	0	–	0	–	
t_{DS}	Data Setup Time	40	–	40	–	
t_{DH}	Data Hold Time	0	–	0	–	

AC TEST CONDITIONS

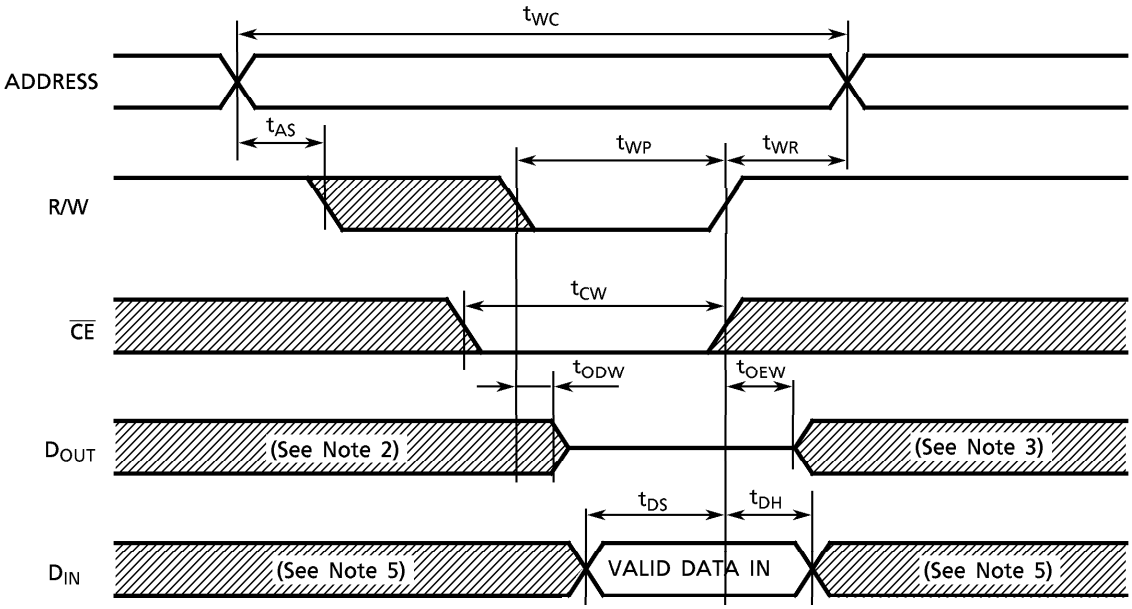
Output load: 30 pF + 1TTL Gate
Input pulse level: V_{DD} − 0.2V, 0.2V
Timing measurements: $V_{DD} \times 0.5$
Reference level: $V_{DD} \times 0.5$
t_R, t_F: 5 ns

TIMING DIAGRAMS

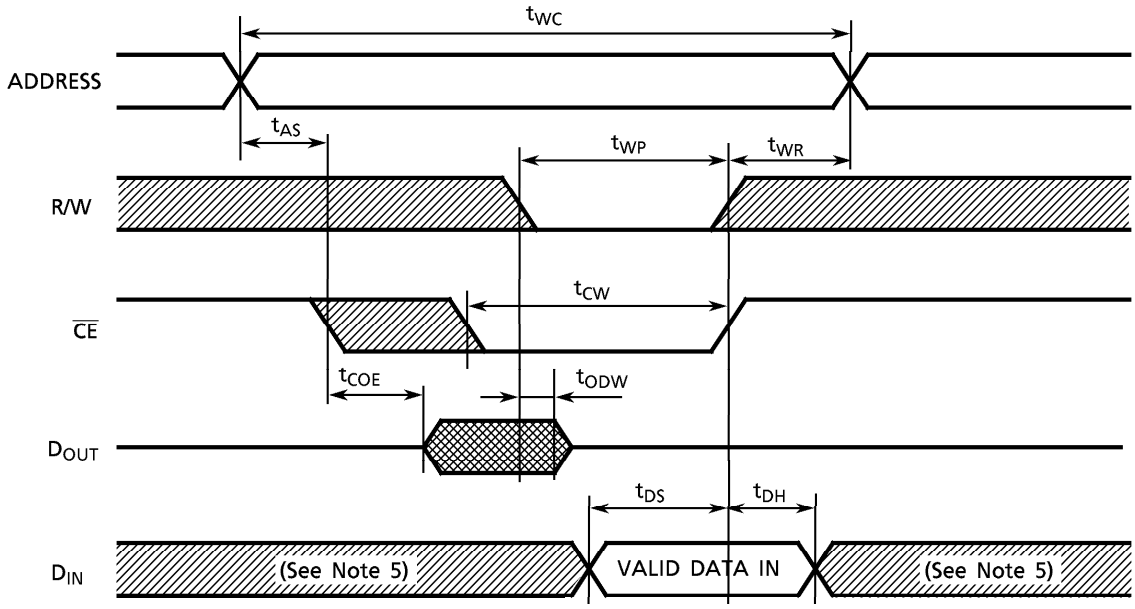
READ CYCLE (See Note 1)



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



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



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.

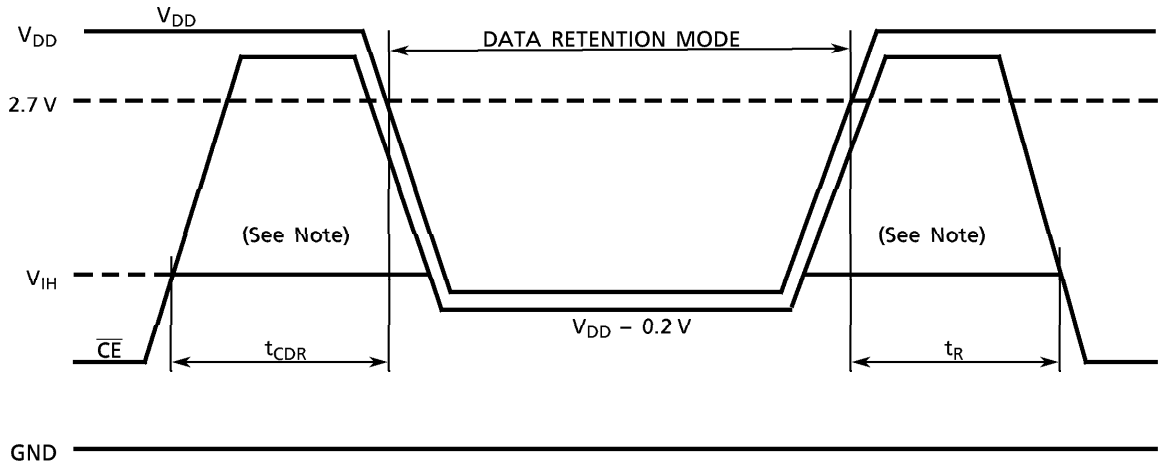
(5) Because I/O signals may be in the output state at this time, input signals of reverse polarity must not be applied.

DATA RETENTION CHARACTERISTICS (Ta = −40° to 85°C)

SYMBOL	PARAMETER			MIN	TYP	MAX	UNIT
V_{DH}	Data Retention Supply Voltage			1.5	–	3.6	V
I_{DDS2}	Standby Current	V_{DH} = 3.0V	Ta = −40 to 40°C	–	–	1	μA
			Ta = −40 to 85°C	–	–	5	
		V_{DH} = 3.6V	Ta = −40 to 85°C	–	–	7	
t_{CDR}	Chip Deselect to Data Retention Mode Time			0	–	–	nS
t_R	Recovery Time			t_{RC} (1)	–	–	nS

Note: (1) Read cycle time

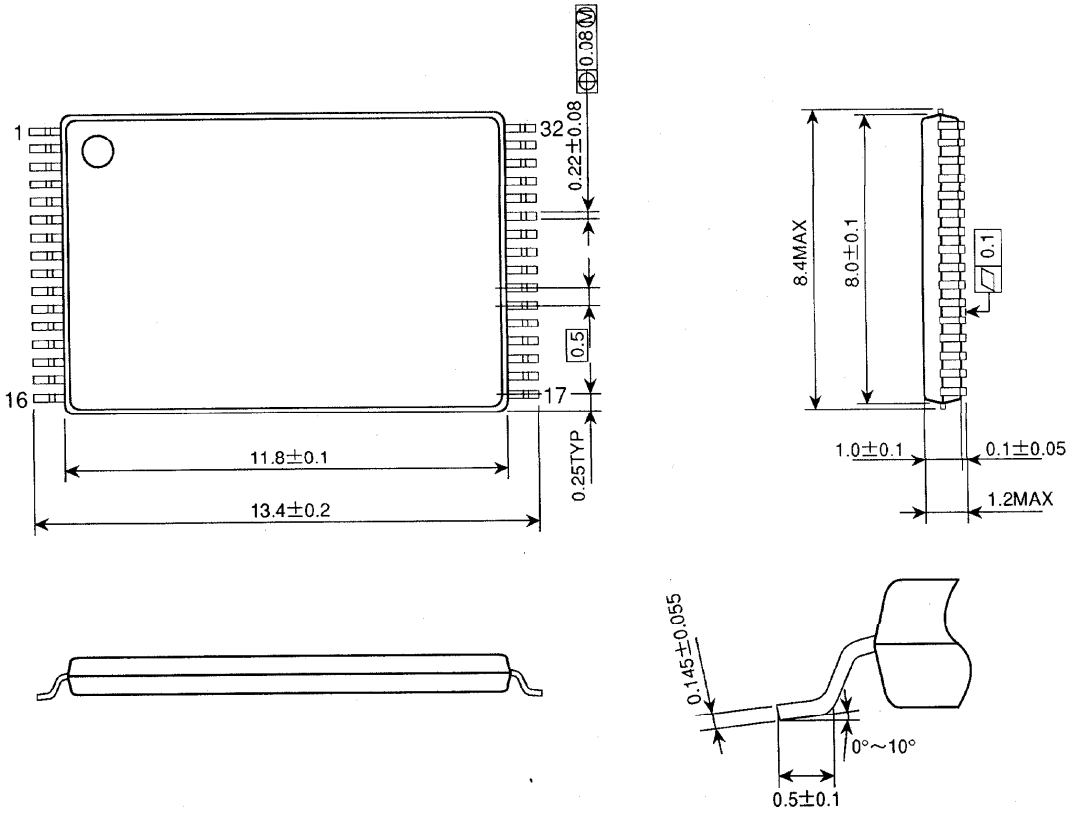
$\overline{CE}$ CONTROLLED DATA RETENTION MODE



Note: When $\overline{CE}$ is operating at the V_{IH} level (2.2 V), the operating current is given by I_{DDS1} during the transition of V_{DD} from 3.6 to 2.4 V.

PACKAGE DIMENSIONS (TSOP I 32-P-0.50)

Units in mm



Weight: 0.24 g (typ)