

TC551001APL/AFL/AFTL/ATRL-70L/85L/10L(LV)

SILICON GATE CMOS

131,072 WORD x 8 BIT STATIC RAM

Description

The TC551001APL is a 1,048,576 bit CMOS static random access memory organized as 131,072 words by 8 bits and operated from a single 5V power supply. Advanced circuit techniques provide both high speed and low power features with an operating current of 5mA/MHz (typ.) and a minimum cycle time of 70ns. When CE1 is a logical high, or CE2 is low, the device is placed in a low power standby mode in which the standby current is 2μA typically. The TC551001APL has three control inputs. Chip enable inputs (CE1, CE2) allow for device selection and data retention control, while an output enable input (OE) provides fast memory access. The TC551001APL is suitable for use in microprocessor systems where high speed, low power, and battery backup are required. The TC551001APL-L(V) operates and is characterized at both 3 and 5 volts.

The TC551001APL is offered in a standard dual-in-line 32-pin plastic package, a small outline plastic package, and a thin small outline plastic package (forward type, reverse type).

Features

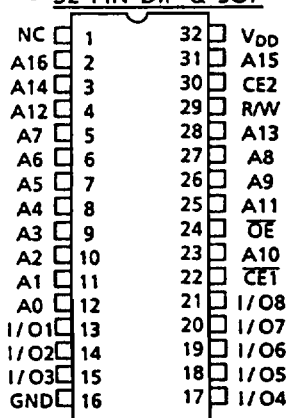
- Low power dissipation: 27.5mW/MHz (typ.)
- Standby current: 4μA (max.) at Ta = 25°C
- Single 5V power supply
- Access time (max.)

	TC551001APL/AFL/AFTL/ATRL		
	-70L(LV)	-85L(LV)	-10L(LV)
Access Time	70ns	85ns	100ns
CE1 Access Time	70ns	85ns	100ns
CE2 Access Time	70ns	85ns	100ns
OE Access Time	35ns	45ns	50ns

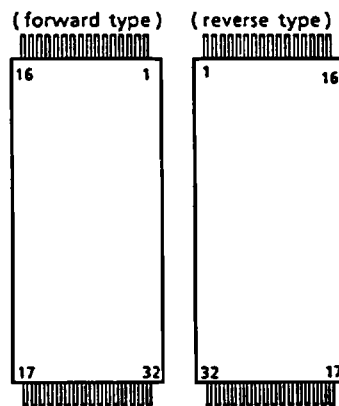
- Power down feature: CE1, CE2
- Data retention supply voltage: 2.0 ~ 5.5V
- Inputs and outputs TTL compatible
- Package
 - TC551001APL : DIP32-P-600
 - TC551001AFL : SOP32-P-525
 - TC551001AFTL : TSOP32-P-0820
 - TC551001ATRL : TSOP32-P-0820A

Pin Connection (Top View)

32 PIN DIP & SOP



32 PIN TSOP

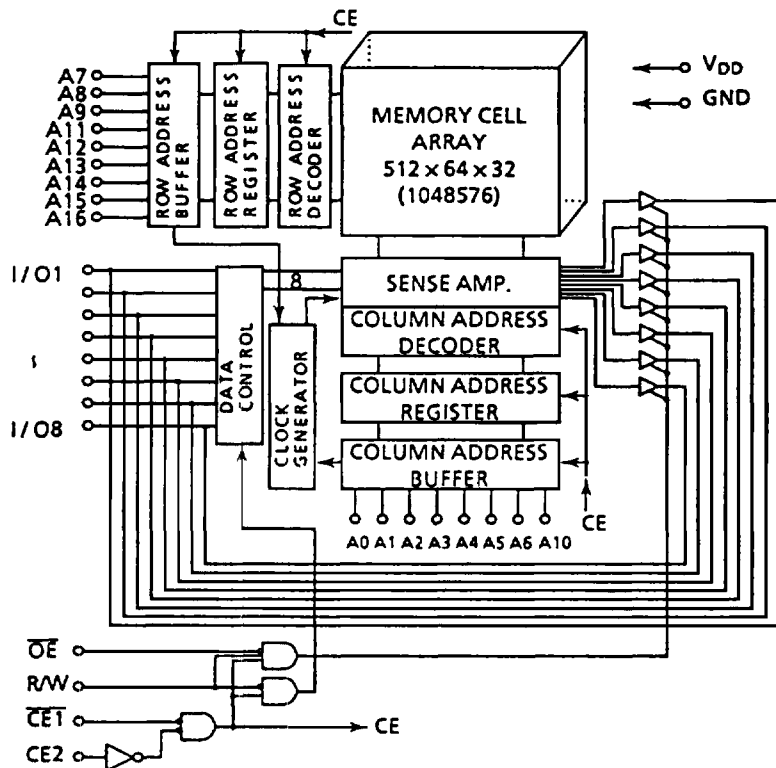


Pin Names

A0 ~ A16	Address Inputs
R/W	Read/Write Control Input
OE	Output Enable Input
CE1, CE2	Chip Enable Inputs
I/O1 ~ I/O8	Data Input/Output
VDD	Power (+5V)
GND	Ground
NC	No Connection

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	CE2	A ₁₅	V _{DD}	NC	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	CE1	A ₁₀	OE

Block Diagram



Operating Mode

MODE \ PIN	$\overline{\text{CE1}}$	CE2	$\overline{\text{OE}}$	R/W	I/O1 ~ I/O8	POWER
Read	L	H	L	H	D _{OUT}	I _{DDO}
Write	L	H	*	L	D _{IN}	I _{DDO}
Output Deselect	L	H	H	H	High-Z	I _{DDO}
Standby	H	*	*	*	High-Z	I _{ODS}
	*	L	*	*	High-Z	I _{ODS}

* H or L

Maximum Ratings

SYMBOL	ITEM	RATING	UNIT
V _{DD}	Power Supply Voltage	-0.3 ~ 7.0	V
V _{IN}	Input Voltage	-0.3* ~ 7.0	V
V _{I/O}	Input and Output Voltage	-0.5 ~ V _{DD} + 0.5	V
P _D	Power Dissipation	1.0/0.6**	W
T _{SOLDER}	Soldering Temperature • Time	260 • 10	°C • sec
T _{STRG}	Storage Temperature	-55 ~ 150	°C
T _{OPR}	Operating Temperature	0 ~ 70	°C

* -3.0V with a pulse width of 50ns

.. SOP

DC Recommended Operating Conditions

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V _{DD}	Power Supply Voltage	4.5	5.0	5.5	V
V _{IH}	Input High Voltage	2.2	–	V _{DD} + 0.3	
V _{IL}	Input Low Voltage	-0.3	–	0.8	
V _{DH}	Data Retention Supply Voltage	2.0	–	5.5	

DC Characteristics (Ta = 0 ~ 70°C, VDD = 5V±10%)

SYMBOL	PARAMETER	TEST CONDITION			MIN.	TYP.	MAX.	UNIT
I _{LI}	Input Leakage Current	V _{IN} = 0 ~ V _{DD}			–	–	±1.0	μA
I _{LO}	Output Leakage Current	CE1 = V _{IH} or CE2 = V _{IL} or R/W = V _{IL} or OE = V _{IH} , V _{OUT} = 0 ~ V _{DD}			–	–	±1.0	μA
I _{OH}	Output High Current	V _{OH} = 2.4V			-1.0	–	–	mA
I _{OL}	Output Low Current	V _{OL} = 0.4V			4.0	–	–	mA
I _{DDO1}	Operating Current	CE1 = V _{IL} and CE2 = V _{IH} and R/W = V _{IH} , I _{OUT} = 0mA Other Inputs = V _{IH} /V _{IL}	t _{cycle}	Min.	–	–	70	mA
				1μs	–	–	20	
I _{DDO2}		CE1 = 0.2V and CE2 = V _{DD} - 0.2V R/W = V _{DD} - 0.2V I _{OUT} = 0mA Other Inputs = V _{DD} - 0.2V/0.2V	t _{cycle}	Min.	–	–	60	
				1μs	–	–	10	
I _{DDS1}	Standby Current	CE1 = V _{IH} or CE2 = V _{IL}			–	–	3	mA
I _{DDS2} ⁽¹⁾		CE1 = V _{DD} - 0.2V or CE2 = 0.2V	Ta = 0 ~ 70°C		–	–	30	μA
		V _{DD} = 2.0V ~ 5.5V	Ta = 25°C		–	2	4	

Note (1): If CE1 ≥ VDD - 0.2V, the specified limits are guaranteed under the condition CE2 ≥ VDD - 0.2V or CE2 ≤ 0.2V.

Capacitance* (Ta = 25°C, f = 1MHz)

SYMBOL	PARAMETER	TEST CONDITION	MAX.	UNIT
C _{IN}	Input Capacitance	V _{IN} = GND	10	pF
C _{OUT}	Output Capacitance	V _{OUT} = GND	10	

*This parameter is periodically sampled and is not 100% tested.

AC Characteristics ($T_a = 0 \sim 70^\circ\text{C}$, $V_{DD} = 5V \pm 10\%$)**Read Cycle**

SYMBOL	PARAMETER	TC551001APL/AFL/AFTL/ATRL						UNIT
		-70L(LV)		-85L(LV)		-10L(LV)		
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
t _{RC}	Read Cycle Time	70	—	85	—	100	—	ns
t _{ACC}	Address Access Time	—	70	—	85	—	100	
t _{CO1}	CE1 Access Time	—	70	—	85	—	100	
t _{CO2}	CE2 Access Time	—	70	—	85	—	100	
t _{OE}	Output Enable to Output in Valid	—	35	—	45	—	50	
t _{COE}	Chip Enable (CE1, CE2) to Output in Low-Z	10	—	10	—	10	—	
t _{OEE}	Output Enable to Output in Low-Z	5	—	5	—	5	—	
t _{OD}	Chip Enable (CE1, CE2) to Output in High-Z	—	25	—	30	—	35	
t _{ODO}	Output Enable to Output in High-Z	—	25	—	30	—	35	
t _{OH}	Output Data Hold Time	10	—	10	—	10	—	

Write Cycle

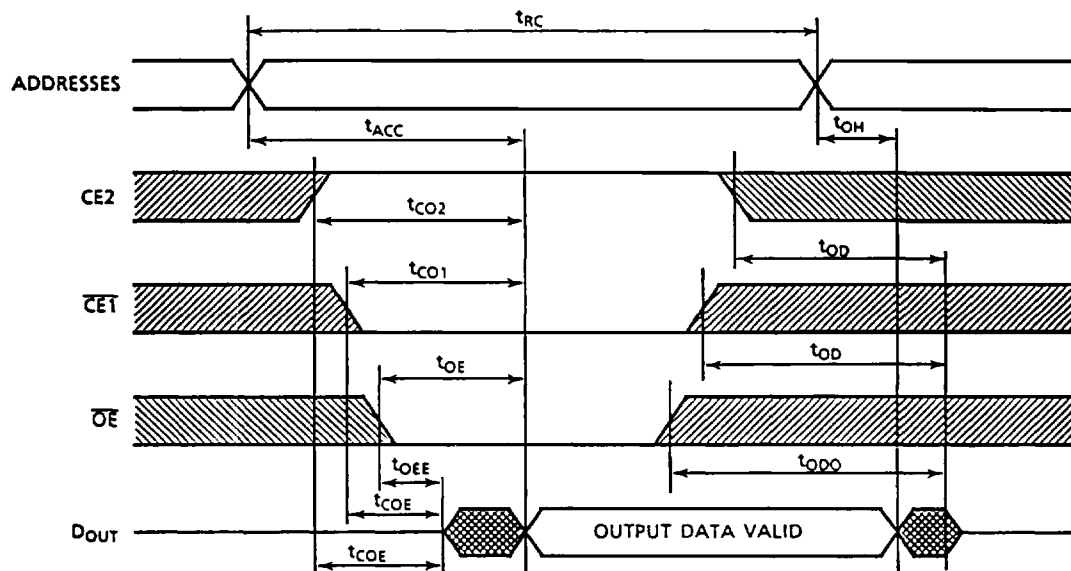
SYMBOL	PARAMETER	TC551001APL/AFL/AFTL/ATRL						UNIT
		-70L(LV)		-85L(LV)		-10L(LV)		
		MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
t _{WC}	Write Cycle Time	70	—	85	—	100	—	ns
t _{WP}	Write Pulse Width	50	—	60	—	60	—	
t _{CW}	Chip Selection to End of Write	60	—	75	—	80	—	
t _{AS}	Address Setup Time	0	—	0	—	0	—	
t _{WR}	Write Recovery Time	0	—	0	—	0	—	
t _{ODW}	R/W to Output in High-Z	—	25	—	30	—	35	
t _{OEW}	R/W to Output in Low-Z	5	—	5	—	5	—	
t _{DS}	Data Setup Time	30	—	35	—	40	—	
t _{DH}	Data Hold Time	0	—	0	—	0	—	

AC Test Conditions

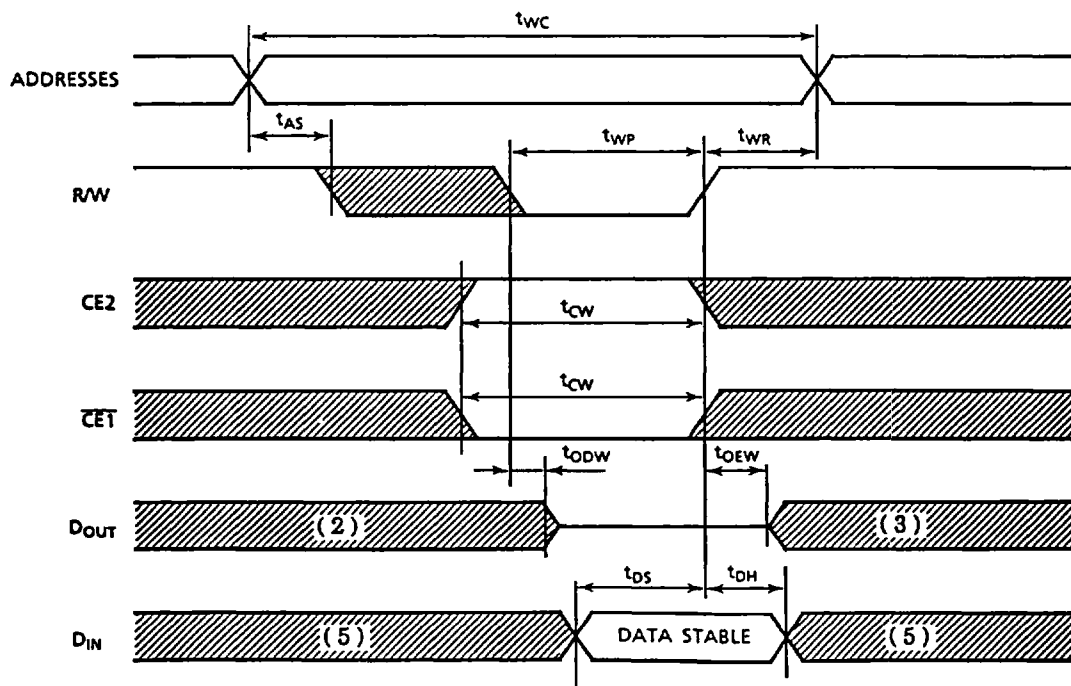
Input Pulse Levels	2.4V/0.6V
Input Pulse Rise and Fall Time	5ns
Input Timing Measurement Reference Levels	1.5V
Output Timing Measurement Reference Levels	1.5V
Output Load	1 TTL Gate and $C_L = 100\text{pF}$

Timing Waveforms

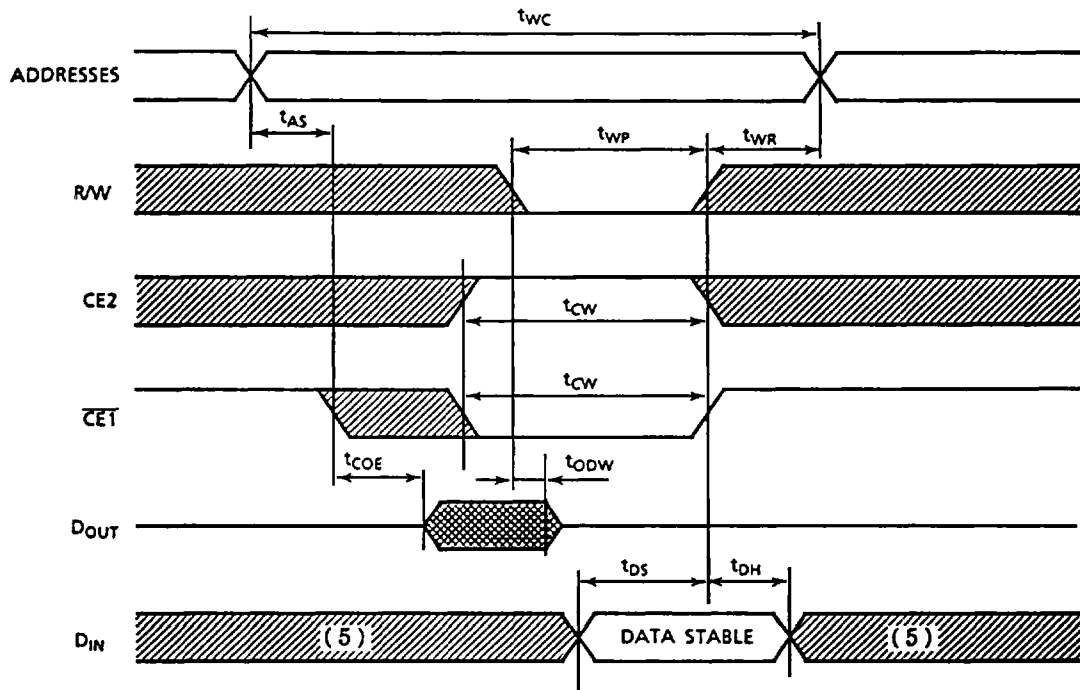
Read Cycle ⁽¹⁾



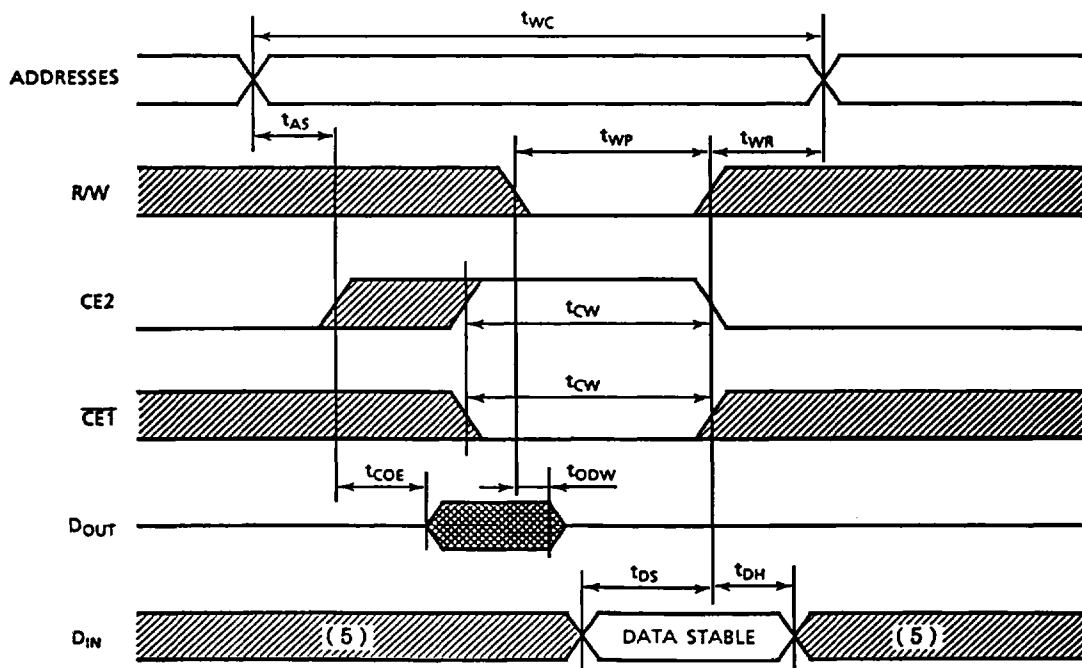
Write Cycle 1 ⁽⁴⁾ (R/W Controlled Write)



Write Cycle 2 ⁽⁴⁾ ($\overline{\text{CE1}}$ Controlled Write)



Write Cycle 3 ⁽⁴⁾ (CE2 Controlled Write)



Notes:

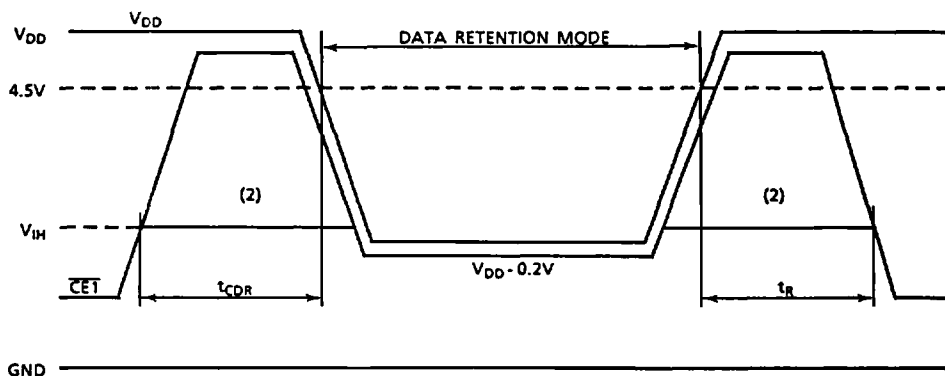
1. R/W is high for read cycles.
2. If the $\overline{\text{CE1}}$ low transition or CE2 high transition occurs coincident with or after the R/W low transition, outputs remain in a high impedance state.
3. If the $\overline{\text{CE1}}$ high transition or CE2 low transition occurs coincident with or prior to the R/W high transition, outputs remain in a high impedance state.
4. If $\overline{\text{OE}}$ is high during a write cycle, the outputs are in a high impedance state during this period.
5. The I/O may be in the output state during this time; therefore input signals of opposite phase must not be applied.

Data Retention Characteristics (Ta = 0 ~ 70°C)

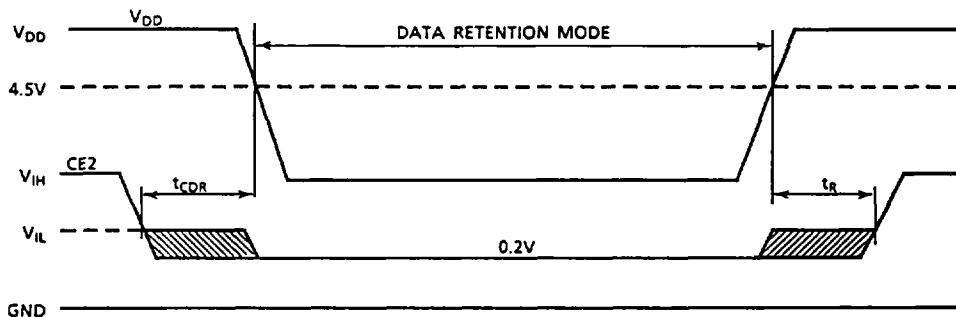
SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V_{DH}	Data Retention Supply Voltage	2.0	—	5.5	V
I_{DDS2}	Standby Current	$V_{DH} = 3.0V$	—	15*	μA
		$V_{DH} = 5.5V$	—	30	
t_{CDR}	Chip Deselect to Data Retention Mode	0	—	—	ns
t_R	Recovery Time	5	—	—	ms

* 3 μA (max.) Ta = 0 ~ 40°C

CE1 Controlled Data Retention Mode (1)



CE2 Controlled Data Retention Mode (3)



Notes:

1. In the $\overline{CE1}$ controlled data retention mode, minimum standby current is achieved under the condition $CE2 \leq 0.2V$ or $CE2 \geq V_{DD} - 0.2V$.
2. If the V_{IH} of $\overline{CE1}$ is 2.2V in operation, during the period that the V_{DD} voltage is going down from 4.5V to 2.4V, I_{DDS1} current flows.
3. In the CE2 controlled data retention mode, minimum standby current is achieved under the condition $CE2 \leq 0.2V$.

3V Operation**DC Recommended Operating Conditions**

SYMBOL	PARAMETER	MIN.	TYP.	MAX.	UNIT
V_{DD}	Power Supply Voltage	2.7	3.0	3.3	V
V_{IH}	Input High Voltage	$V_{DD} - 0.2$	—	$V_{DD} + 0.3$	
V_{IL}	Input Low Voltage	-0.3	—	0.2	

DC Characteristics (Ta = 0 ~ 70°C, V_{DD} = 3V±10%)

SYMBOL	PARAMETER	TEST CONDITION			MIN.	TYP.	MAX.	UNIT
I _{LI}	Input Leakage Current	V _{IN} = 0 ~ V _{DD}			—	—	±1.0	μA
I _{LO}	Output Leakage Current	CE1 = V _{IH} or CE2 = V _{IL} or R/W = V _{IL} or OE = V _{IH} , V _{OUT} = 0 ~ V _{DD}			—	—	±1.0	μA
I _{OH}	Output High Current	V _{OH} = V _{DD} - 0.2V			-0.1	—	—	mA
I _{OL}	Output Low Current	V _{OL} = 0.2V			0.1	—	—	mA
I _{DDO2}	Operating Current	CE1 = 0.2V and CE2 = V _{DD} - 0.2V R/W = V _{DD} - 0.2V I _{OUT} = 0mA Other Inputs = V _{DD} - 0.2V/0.2V	t _{cycle}	Min.	—	—	20	mA
				1μs	—	—	5	
I _{DDs2} ⁽¹⁾	Standby Current	CE1 = V _{DD} - 0.2V or CE2 = 0.2V	Ta = 0 ~ 70°C		—	—	20	μA
			Ta = 25°C		—	1	2	

Note (1): If $\overline{CE1} \geq V_{DD} - 0.2V$, the specified limits are guaranteed under the condition $CE2 \geq V_{DD} - 0.2V$ or $CE2 \leq 0.2V$.

Capacitance* (Ta = 25°C, f = 1MHz)

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

*This parameter is periodically sampled and is not 100% tested.

3V Operation

AC Characteristics ($T_a = 0 \sim 70^\circ\text{C}$, $V_{DD} = 3V \pm 10\%$)

Read Cycle

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
t_{RC}	Read Cycle Time	150	—	ns
t_{ACC}	Address Access Time	—	150	
t_{CO1}	$\overline{CE1}$ Access Time	—	150	
t_{CO2}	$\overline{CE2}$ Access Time	—	150	
t_{OE}	Output Enable to Output in Valid	—	75	
t_{COE}	Chip Enable ($\overline{CE1}$, $\overline{CE2}$) to Output in Low-Z	10	—	
t_{OEE}	Output Enable to Output in Low-Z	5	—	
t_{OD}	Chip Enable ($\overline{CE1}$, $\overline{CE2}$) to Output in High-Z	—	50	
t_{ODO}	Output Enable to Output in High-Z	—	50	
t_{OH}	Output Data Hold Time	10	—	

Write Cycle

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
t_{WC}	Write Cycle Time	150	—	ns
t_{WP}	Write Pulse Width	100	—	
t_{CW}	Chip Selection to End of Write	120	—	
t_{AS}	Address Setup Time	0	—	
t_{WR}	Write Recovery Time	0	—	
t_{ODW}	R/W to Output in High-Z	—	50	
t_{OEW}	R/W to Output in Low-Z	5	—	
t_{DS}	Data Setup Time	60	—	
t_{DH}	Data Hold Time	0	—	

AC Test Conditions

Input Pulse Levels	$V_{DD} - 0.2V/0.2V$
Input Pulse Rise and Fall Time	5ns
Input Timing Measurement Reference Levels	1.5V
Output Timing Measurement Reference Levels	1.5V
Output Load	$C_L = 100\text{pF}$