SILICON GATE CMOS

131,072 WORD x 8 BIT STATIC RAM

Description

The TC551001API 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 85ns. When $\overline{CE1}$ 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 TC551001API has three control inputs. Chip enable inputs ($\overline{CE1}$, CE2) allow for device selection and data retention control, while an output enable input ($\overline{OE}$) provides fast memory access. The TC551001API is suitable for use in microprocessor systems where high speed, low power, and battery backup are required. The TC551001API has an operating temperature range of -40 ~ 85°C so it is suitable for use in wide operating temperature systems.

The TC551001API 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).

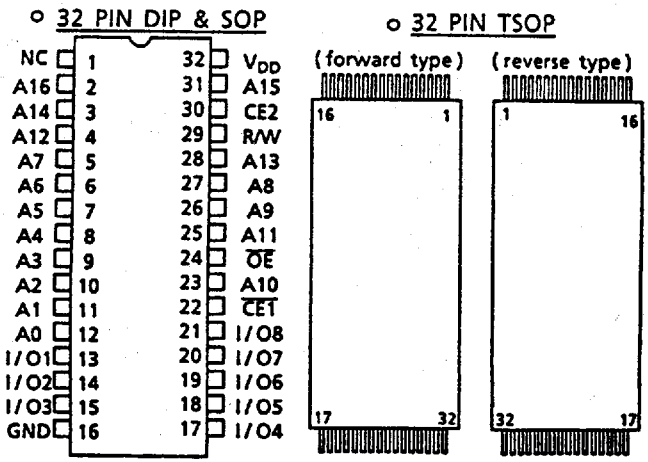
Features

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

	TC551001API/AFI/AFTI/ATRI	
	-85L	-10L
Access Time	85ns	100ns
$\overline{CE1}$ Access Time	85ns	100ns
CE2 Access Time	85ns	100ns
$\overline{OE}$ Access Time	45ns	50ns

- Power down feature: $\overline{CE1}$, CE2
- Data retention supply voltage: 2.0 ~ 5.5V
- Inputs and outputs TTL compatible
- Wide operating temperature: -40 ~ 85°C
- Package TC551001API : DIP32-P-600
  TC551001AFI : SOP32-P-525
  TC551001AFTI : TSOP32-P-0820
  TC551001ATRI : TSOP32-P-0820A

Pin Connection (Top View)

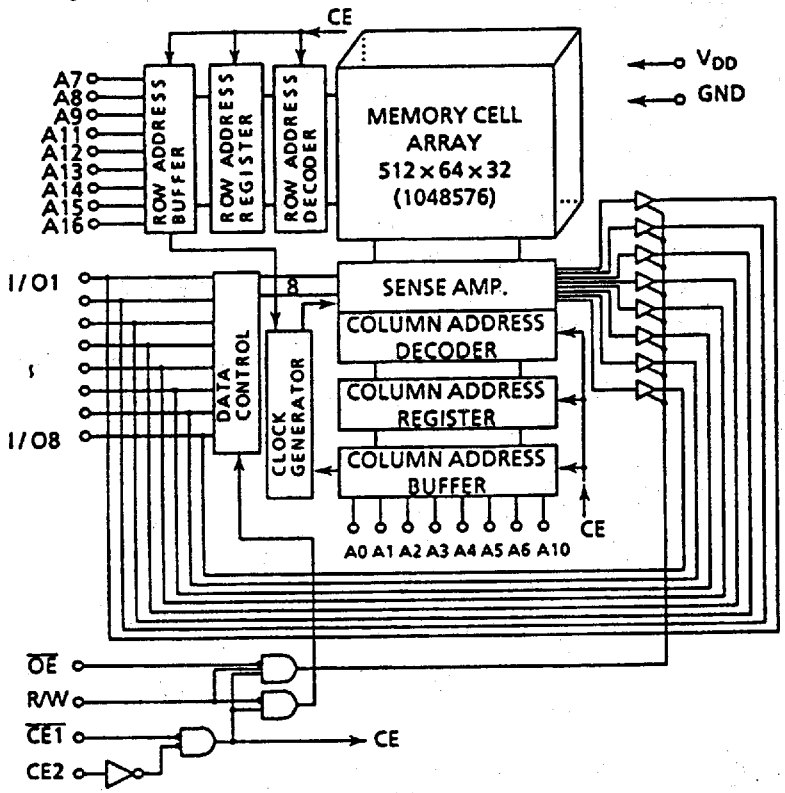


Pin Names

A0 ~ A16	Address Inputs
R/W	Read/Write Control Input
$\overline{OE}$	Output Enable Input
$\overline{CE1}$, CE2	Chip Enable Inputs
I/O1 ~ I/O8	Data Input/Output
V_{DD}	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	$\overline{CE1}$	A_{10}	$\overline{OE}$

Block Diagram



Operating Mode

MODE \ PIN	$\overline{CE1}$	CE2	$\overline{OE}$	R/W	I/01 ~ I/08	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_{DDS}
	*	L	*	*	High-Z	I_{DDS}

* 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	-40 ~ 85	°C

* -3.0V with a pulse width of 50ns
** SOP

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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	2.4	–	V_{DD} + 0.3	
V_{IL}	Input Low Voltage	-0.3	–	0.6	
V_{DH}	Data Retention Supply Voltage	2.0	–	5.5	

DC Characteristics (Ta = -40 ~ 85°C, V_{DD} = 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	$\overline{CE1}$ = V_{IH} or CE2 = V_{IL} or R/W = V_{IL} or $\overline{OE}$ = 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	$\overline{CE1}$ = 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}		$\overline{CE1}$ = 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	$\overline{CE1}$ = V_{IH} or CE2 = V_{IL}			–	–	3	mA
I_{DDS2}(1)		$\overline{CE1}$ = V_{DD} - 0.2V or CE2 = 0.2V V_{DD} = 2.0V ~ 5.5V	Ta = -40 ~ 85°C		–	–	70	μA
			Ta = 25°C		–	2	4	

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

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AC Characteristics (Ta = -40 ~ 85°C, V_{DD} = 5V±10%)

Read Cycle

SYMBOL	PARAMETER	TC551001API/AFI/AFTI/ATRI				UNIT
		-85L		-10L		
		MIN.	MAX.	MIN.	MAX.	
t_{RC}	Read Cycle Time	85	–	100	–	ns
t_{ACC}	Address Access Time	–	85	–	100	
t_{CO1}	$\overline{CE1}$ Access Time	–	85	–	100	
t_{CO2}	CE2 Access Time	–	85	–	100	
t_{OE}	Output Enable to Output in Valid	–	45	–	50	
t_{COE}	Chip Enable ($\overline{CE1}$, CE2) to Output in Low-Z	5	–	5	–	
t_{OEE}	Output Enable to Output in Low-Z	0	–	0	–	
t_{OD}	Chip Enable ($\overline{CE1}$, CE2) to Output in High-Z	–	35	–	40	
t_{ODO}	Output Enable to Output in High-Z	–	35	–	40	
t_{OH}	Output Data Hold Time	10	–	10	–	

Write Cycle

SYMBOL	PARAMETER	TC551001API/AFI/AFTI/ATRI				UNIT
		-85L		-10L		
		MIN.	MAX.	MIN.	MAX.	
t_{WC}	Write Cycle Time	85	–	100	–	ns
t_{WP}	Write Pulse Width	60	–	60	–	
t_{CW}	Chip Selection to End of Write	75	–	80	–	
t_{AS}	Address Setup Time	0	–	0	–	
t_{WR}	Write Recovery Time	0	–	0	–	
t_{ODW}	R/W to Output in High-Z	–	35	–	40	
t_{OEW}	R/W to Output in Low-Z	0	–	0	–	
t_{DS}	Data Setup Time	35	–	40	–	
t_{DH}	Data Hold Time	0	–	0	–	

AC Test Conditions

Input Pulse Levels	2.6V/0.4V
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 = 100pF

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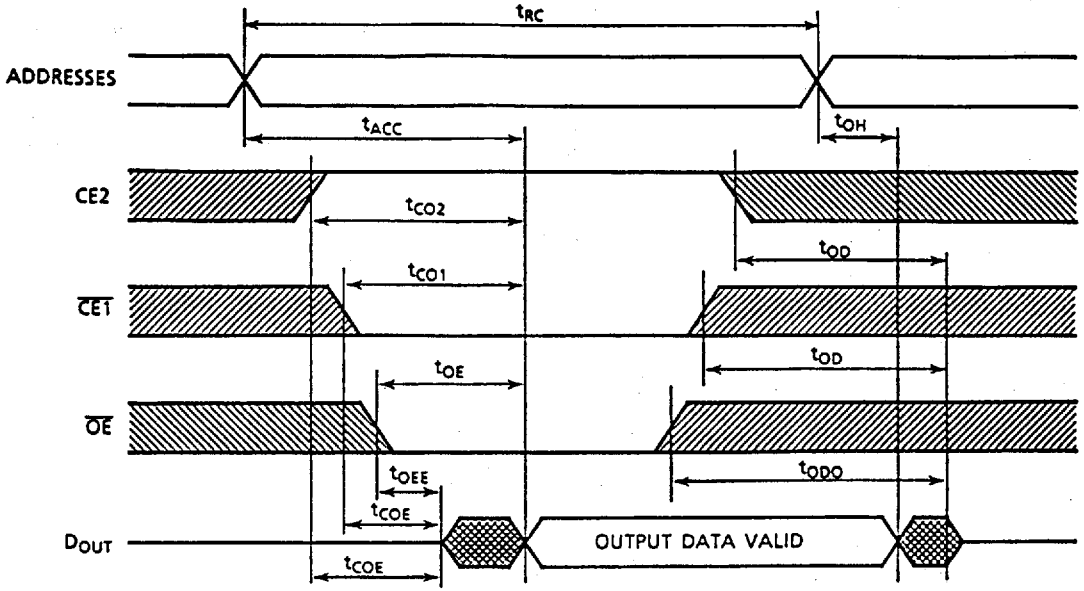
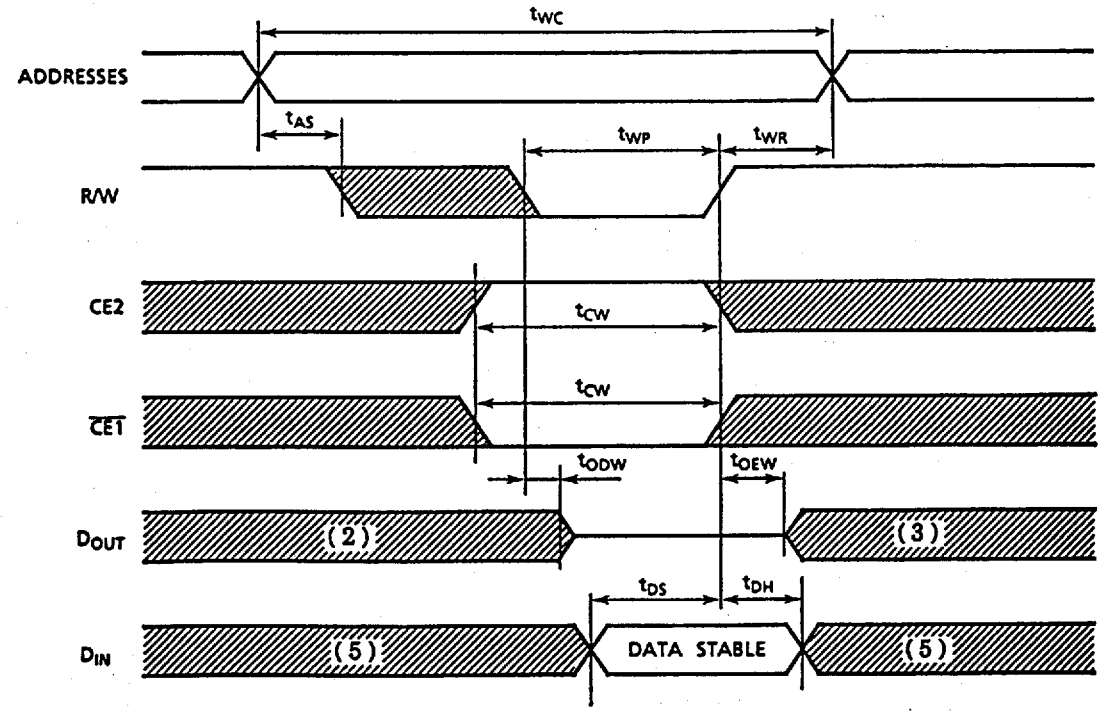
Timing Waveforms

Read Cycle [1]



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



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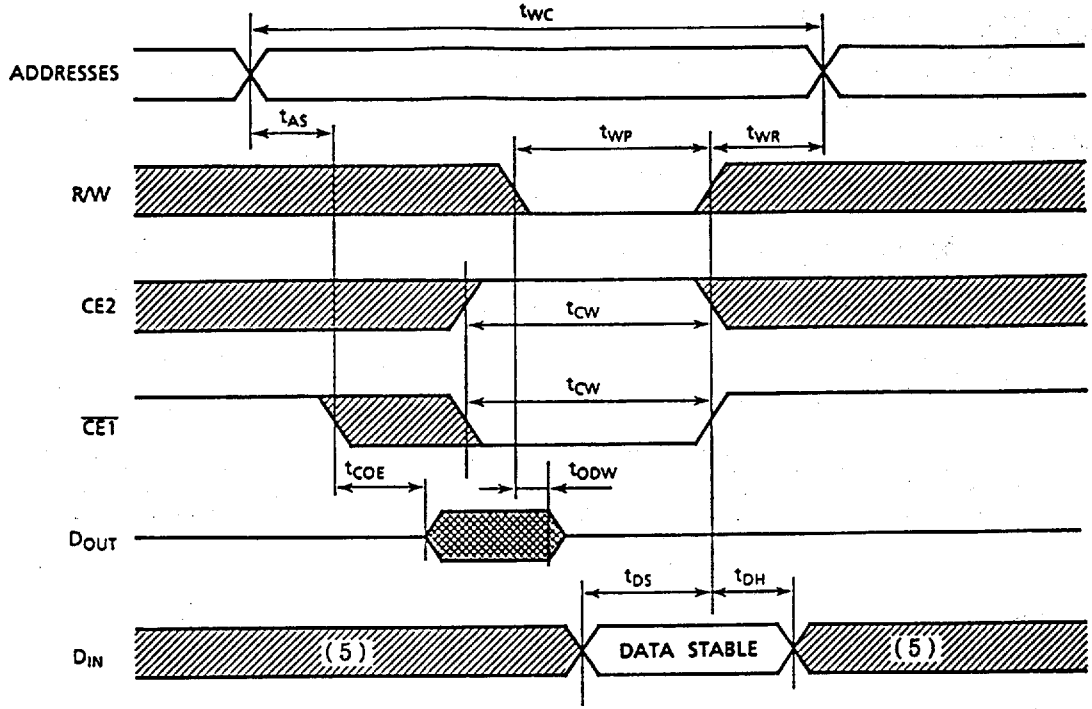
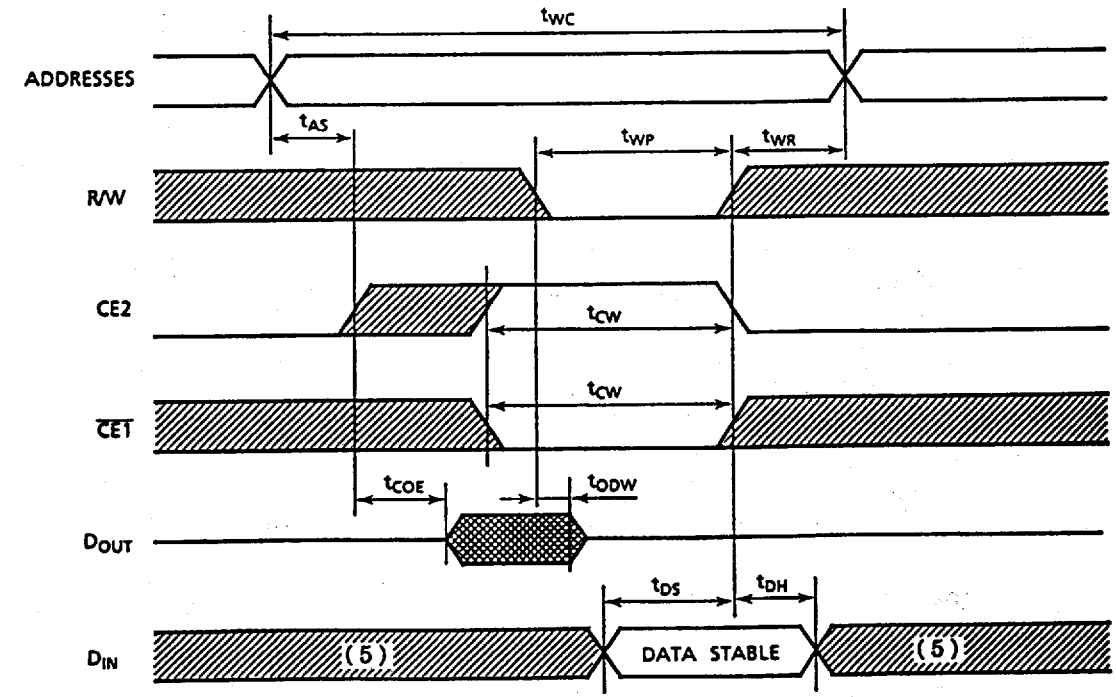
Write Cycle 2 [4] ($\overline{CE1}$ Controlled Write)



Write Cycle 3 [4] (CE2 Controlled Write)



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Notes:

1. R/W is high for read cycles.

2. If the $\overline{CE1}$ 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 $\overline{CE1}$ 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 $\overline{OE}$ 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.

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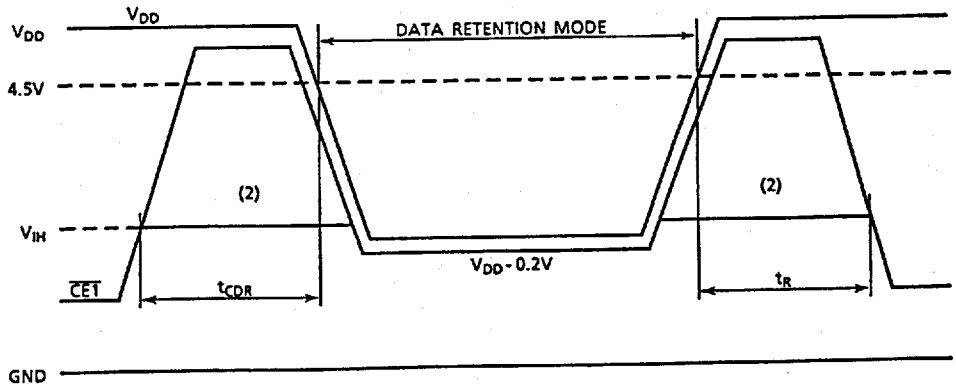
Data Retention Characteristics (Ta = -40 ~ 85°C)

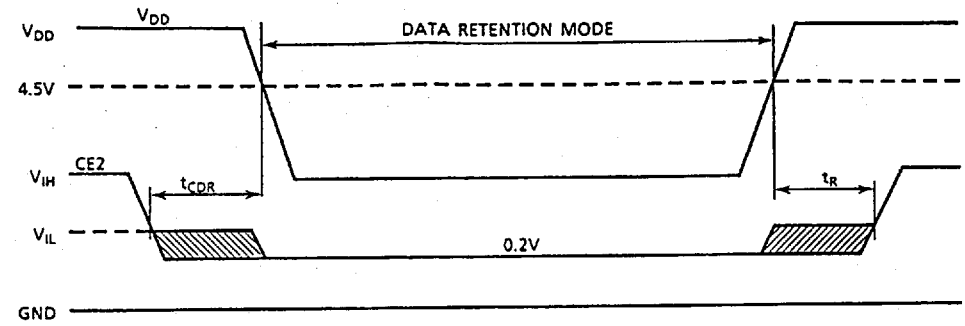
SYMBOL	PARAMETER		MIN.	TYP.	MAX.	UNIT
V_{DH}	Data Retention Supply Voltage		2.0	–	5.5	V
I_{DDS2}	Standby Current	V_{DH} = 3.0V	–	–	35*	µA
		V_{DH} = 5.5V	–	–	70	
t_{CDR}	Chip Deselect to Data Retention Mode		0	–	–	ns
t_R	Recovery Time		5	–	–	ms

*3µA (max.) Ta = -40 ~ 40°C

$\overline{CE1}$ 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 ≤ 0.2V or CE2 ≥ V_{DD} - 0.2V.

2. If the V_{IH} of $\overline{CE1}$ is 2.4V in operation, during the period that the V_{DD} voltage is going down from 4.5V to 2.6V, I_{DDS1} current flows.

3. In the CE2 controlled data retention mode, minimum standby current is achieved under the condition CE2 ≤ 0.2V.

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