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# R1LV0408C-I Series

Wide Temperature Range Version  
4M SRAM (512-kword × 8-bit)

REJ03C0098-0200Z  
Rev. 2.00  
May.25.2004

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## Description

The R1LV0408C-I is a 4-Mbit static RAM organized 512-kword × 8-bit. R1LV0408C-I Series has realized higher density, higher performance and low power consumption by employing CMOS process technology (6-transistor memory cell). The R1LV0408C-I Series offers low power standby power dissipation; therefore, it is suitable for battery backup systems. It has packaged in 32-pin SOP, 32-pin TSOP II and 32-pin STSOP.

## Features

- Single 3 V supply: 2.7 V to 3.6 V
- Access time: 55/70 ns (max)
- Power dissipation:
  - Active: 6 mW/MHz (typ)
  - Standby: 1.5 μW (typ)
- Completely static memory.
  - No clock or timing strobe required
- Equal access and cycle times
- Common data input and output.
  - Three state output
- Directly TTL compatible.
  - All inputs and outputs
- Battery backup operation.
- Operating temperature: -40 to +85°C

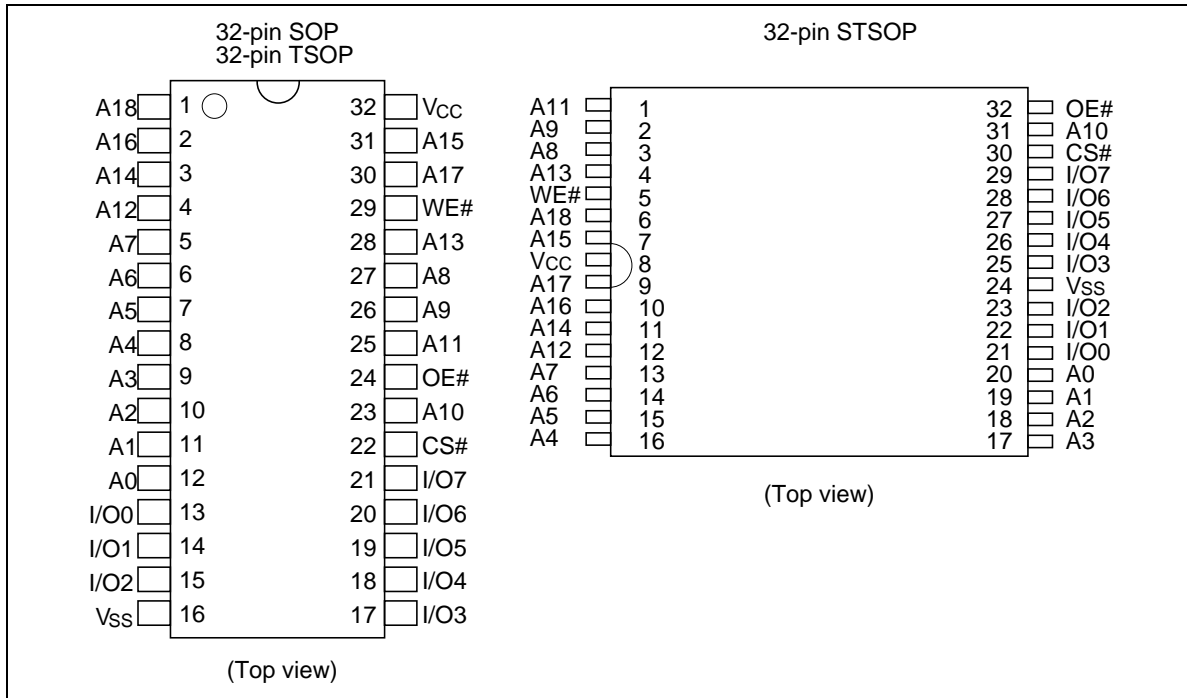
## R1LV0408C-I Series

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### Ordering Information

Type No.	Access time	Package
R1LV0408CSP-5SI	55 ns	525-mil 32-pin plastic SOP (32P2M-A)
R1LV0408CSP-7LI	70 ns	
R1LV0408CSB-5SI	55 ns	400-mil 32-pin plastic TSOP II (32P3Y-H)
R1LV0408CSB-7LI	70 ns	
R1LV0408CSA-5SI	55 ns	8mm × 13.4mm STSOP (32P3K-B)
R1LV0408CSA-7LI	70 ns	

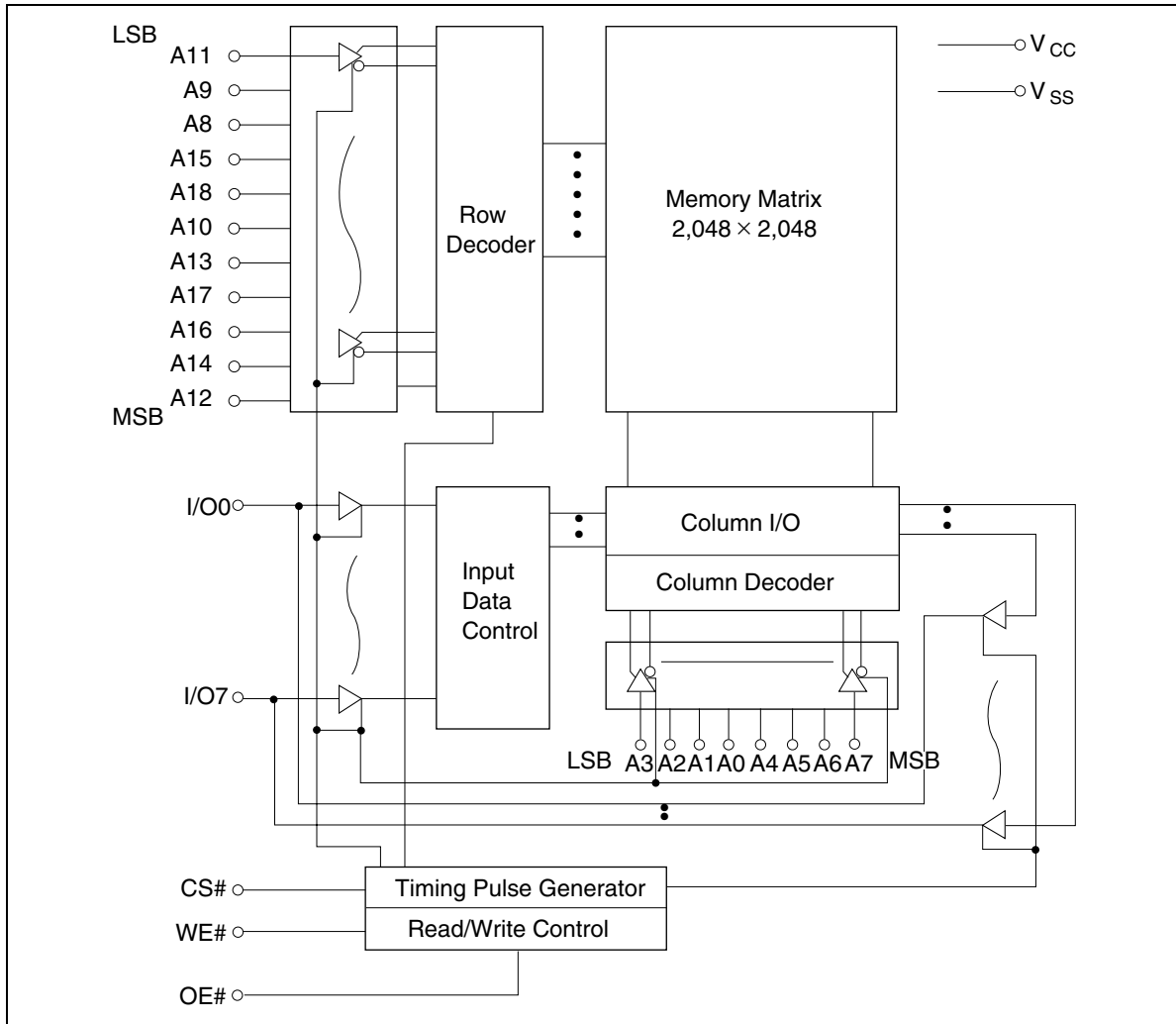
## Pin Arrangement



## Pin Description

Pin name	Function
A0 to A18	Address input
I/O0 to I/O7	Data input/output
CS# ( $\overline{CS}$ )	Chip select
OE# ( $\overline{OE}$ )	Output enable
WE# ( $\overline{WE}$ )	Write enable
V <sub>cc</sub>	Power supply
V <sub>ss</sub>	Ground

Block Diagram



## Operation Table

WE#	CS#	OE#	Mode	V <sub>CC</sub> current	I/O0 to I/O7	Ref. cycle
×	H	×	Not selected	I <sub>SB</sub> , I <sub>SB1</sub>	High-Z	—
H	L	H	Output disable	I <sub>CC</sub>	High-Z	—
H	L	L	Read	I <sub>CC</sub>	Dout	Read cycle
L	L	H	Write	I <sub>CC</sub>	Din	Write cycle (1)
L	L	L	Write	I <sub>CC</sub>	Din	Write cycle (2)

Note: H: V<sub>IH</sub>, L: V<sub>IL</sub>, ×: V<sub>IH</sub> or V<sub>IL</sub>

## Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Power supply voltage relative to V <sub>SS</sub>	V <sub>CC</sub>	-0.5 to +4.6	V
Terminal voltage on any pin relative to V <sub>SS</sub>	V <sub>T</sub>	-0.5* <sup>1</sup> to V <sub>CC</sub> + 0.5* <sup>2</sup>	V
Power dissipation	P <sub>T</sub>	0.7	W
Operating temperature	T <sub>opr</sub>	-40 to +85	°C
Storage temperature range	T <sub>stg</sub>	-65 to +150	°C
Storage temperature range under bias	T <sub>bias</sub>	-40 to +85	°C

Notes: 1. V<sub>T</sub> min: -3.0 V for pulse half-width ≤ 30 ns.

2. Maximum voltage is +4.6 V.

## DC Operating Conditions

(T<sub>a</sub> = -40 to +85°C)

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	V <sub>CC</sub>	2.7	3.0	3.6	V
	V <sub>SS</sub>	0	0	0	V
Input high voltage	V <sub>IH</sub>	2.2	—	V <sub>CC</sub> + 0.3	V
Input low voltage	V <sub>IL</sub>	-0.3* <sup>1</sup>	—	0.6	V

Note: 1. V<sub>IL</sub> min: -3.0 V for pulse half-width ≤ 30 ns.

**DC Characteristics**

Parameter	Symbol	Min	Typ	Max	Unit	Test conditions		
Input leakage current	$ I_{LI} $	—	—	1	$\mu\text{A}$	$V_{in} = V_{SS} \text{ to } V_{CC}$		
Output leakage current	$ I_{LO} $	—	—	1	$\mu\text{A}$	CS# = $V_{IH}$ or OE# = $V_{IH}$ or WE# = $V_{IL}$ or $V_{IO} = V_{SS} \text{ to } V_{CC}$		
Operating current	$I_{CC}$	—	$5^{*1}$	10	mA	CS# = $V_{IL}$ , Others = $V_{IH}/V_{IL}$ , $I_{IO} = 0 \text{ mA}$		
Average operating current	$I_{CC1}$	—	$8^{*1}$	25	mA	Min. cycle, duty = 100%, CS# = $V_{IL}$ , Others = $V_{IH}/V_{IL}$ , $I_{IO} = 0 \text{ mA}$		
	$I_{CC2}$	—	$2^{*1}$	5	mA	Cycle time = 1 $\mu\text{s}$ , duty = 100%, $I_{IO} = 0 \text{ mA}$ , CS# $\leq 0.2 \text{ V}$ , $V_{IH} \geq V_{CC} - 0.2 \text{ V}$ , $V_{IL} \leq 0.2 \text{ V}$		
Standby current	$I_{SB}$	—	$0.1^{*1}$	0.3	mA	CS# = $V_{IH}$		
Standby current	-5SI	to +85°C	$I_{SB1}$	—	10	$\mu\text{A}$	$V_{in} \geq 0 \text{ V}$ , CS# $\geq V_{CC} - 0.2 \text{ V}$	
		to +70°C	$I_{SB1}$	—	8	$\mu\text{A}$		
		to +40°C	$I_{SB1}$	—	$0.7^{*2}$	3		$\mu\text{A}$
		to +25°C	$I_{SB1}$	—	$0.5^{*1}$	3		$\mu\text{A}$
	-7LI	to +85°C	$I_{SB1}$	—	20	$\mu\text{A}$		
		to +70°C	$I_{SB1}$	—	16	$\mu\text{A}$		
		to +40°C	$I_{SB1}$	—	$0.7^{*2}$	10		$\mu\text{A}$
		to +25°C	$I_{SB1}$	—	$0.5^{*1}$	10		$\mu\text{A}$
Output low voltage	$V_{OL}$	—	—	0.4	V	$I_{OL} = 2.1 \text{ mA}$		
	$V_{OL2}$	—	—	0.2	V	$I_{OL} = 100 \mu\text{A}$		
Output high voltage	$V_{OH}$	2.4	—	—	V	$I_{OH} = -1.0 \text{ mA}$		
	$V_{OH2}$	$V_{CC} - 0.2$	—	—	V	$I_{OH} = -0.1 \text{ mA}$		

Notes: 1. Typical values are at  $V_{CC} = 3.0 \text{ V}$ ,  $T_a = +25^\circ\text{C}$  and specified loading, and not guaranteed.  
 2. Typical values are at  $V_{CC} = 3.0 \text{ V}$ ,  $T_a = +40^\circ\text{C}$  and specified loading, and not guaranteed.

**Capacitance**

( $T_a = +25^\circ\text{C}$ ,  $f = 1.0 \text{ MHz}$ )

Parameter	Symbol	Min	Typ	Max	Unit	Test conditions	Note
Input capacitance	$C_{in}$	—	—	8	pF	$V_{in} = 0 \text{ V}$	1
Input/output capacitance	$C_{I/O}$	—	—	10	pF	$V_{I/O} = 0 \text{ V}$	1

Note: 1. This parameter is sampled and not 100% tested.

## R1LV0408C-I Series

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### AC Characteristics

( $T_a = -40$  to  $+85^\circ\text{C}$ ,  $V_{CC} = 2.7$  V to  $3.6$  V, unless otherwise noted.)

#### Test Conditions

- Input pulse levels:  $V_{IL} = 0.4$  V,  $V_{IH} = 2.4$  V
- Input rise and fall time: 5 ns
- Input and output timing reference levels: 1.5 V
- Output load: 1 TTL Gate +  $C_L$  (50 pF) (R1LV0408C-5SI)  
1 TTL Gate +  $C_L$  (100 pF) (R1LV0408C-7LI)  
(Including scope and jig)

#### Read Cycle

Parameter	Symbol	R1LV0408C-I				Unit	Notes
		-5SI		-7LI			
		Min	Max	Min	Max		
Read cycle time	$t_{RC}$	55	—	70	—	ns	
Address access time	$t_{AA}$	—	55	—	70	ns	
Chip select access time	$t_{CO}$	—	55	—	70	ns	
Output enable to output valid	$t_{OE}$	—	30	—	35	ns	
Chip select to output in low-Z	$t_{LZ}$	10	—	10	—	ns	2
Output enable to output in low-Z	$t_{OLZ}$	5	—	5	—	ns	2
Chip deselect to output in high-Z	$t_{HZ}$	0	20	0	25	ns	1, 2
Output disable to output in high-Z	$t_{OHZ}$	0	20	0	25	ns	1, 2
Output hold from address change	$t_{OH}$	10	—	10	—	ns	

## R1LV0408C-I Series

### Write Cycle

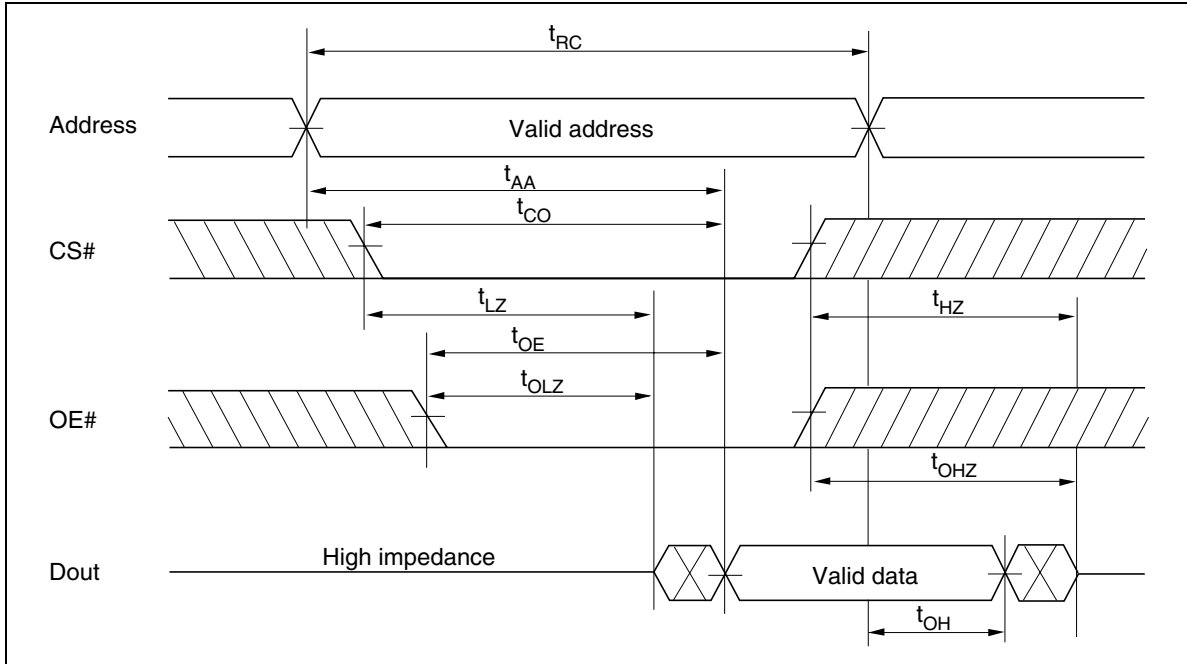
Parameter	Symbol	R1LV0408C-I				Unit	Notes
		-5SI		-7LI			
		Min	Max	Min	Max		
Write cycle time	$t_{WC}$	55	—	70	—	ns	
Chip selection to end of write	$t_{CW}$	50	—	60	—	ns	4
Address setup time	$t_{AS}$	0	—	0	—	ns	5
Address valid to end of write	$t_{AW}$	50	—	60	—	ns	
Write pulse width	$t_{WP}$	40	—	50	—	ns	3, 12
Write recovery time	$t_{WR}$	0	—	0	—	ns	6
Write to output in high-Z	$t_{WHZ}$	0	20	0	25	ns	1, 2, 7
Data to write time overlap	$t_{DW}$	25	—	30	—	ns	
Data hold from write time	$t_{DH}$	0	—	0	—	ns	
Output active from end of write	$t_{OW}$	5	—	5	—	ns	2
Output disable to output in high-Z	$t_{OHZ}$	0	20	0	25	ns	1, 2, 7

- Notes:
- $t_{HZ}$ ,  $t_{OHZ}$  and  $t_{WHZ}$  are defined as the time at which the outputs achieve the open circuit conditions and are not referred to output voltage levels.
  - This parameter is sampled and not 100% tested.
  - A write occurs during the overlap ( $t_{WP}$ ) of a low CS# and a low WE#. A write begins at the later transition of CS# going low or WE# going low. A write ends at the earlier transition of CS# going high or WE# going high.  $t_{WP}$  is measured from the beginning of write to the end of write.
  - $t_{CW}$  is measured from CS# going low to the end of write.
  - $t_{AS}$  is measured from the address valid to the beginning of write.
  - $t_{WR}$  is measured from the earlier of WE# or CS# going high to the end of write cycle.
  - During this period, I/O pins are in the output state so that the input signals of the opposite phase to the outputs must not be applied.
  - If the CS# low transition occurs simultaneously with the WE# low transition or after the WE# transition, the output remain in a high impedance state.
  - Dout is the same phase of the write data of this write cycle.
  - Dout is the read data of next address.
  - If CS# is low during this period, I/O pins are in the output state. Therefore, the input signals of the opposite phase to the outputs must not be applied to them.
  - In the write cycle with OE# low fixed,  $t_{WP}$  must satisfy the following equation to avoid a problem of data bus contention.  $t_{WP} \geq t_{DW} \text{ min} + t_{WHZ} \text{ max}$

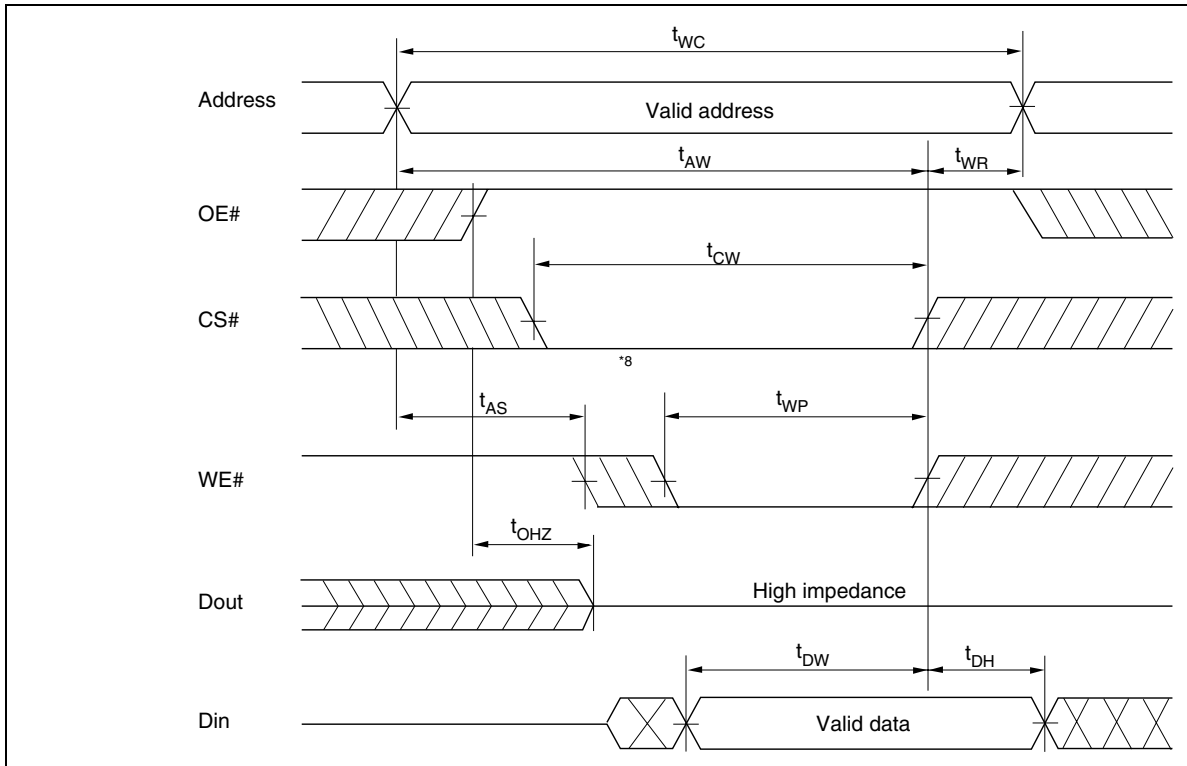


## Timing Waveform

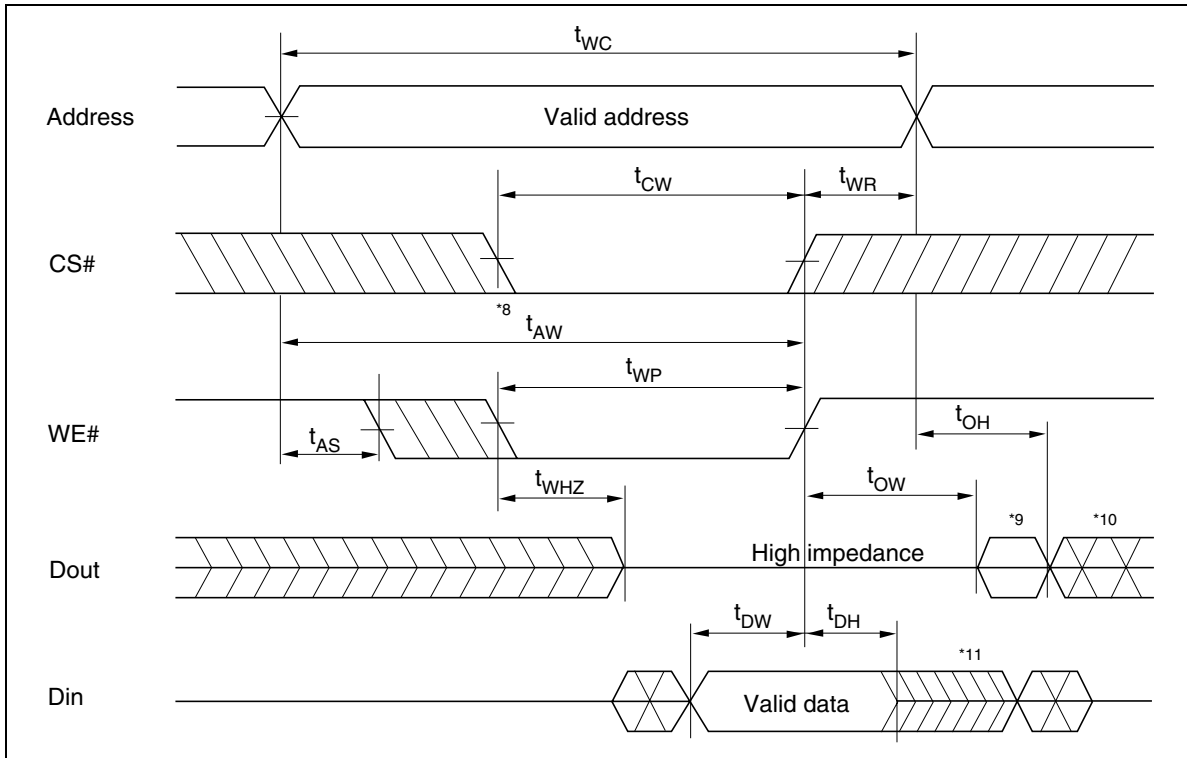
### Read Timing Waveform (WE# = V<sub>IH</sub>)



Write Timing Waveform (1) (OE# Clock)



Write Timing Waveform (2) (OE# Low Fixed)



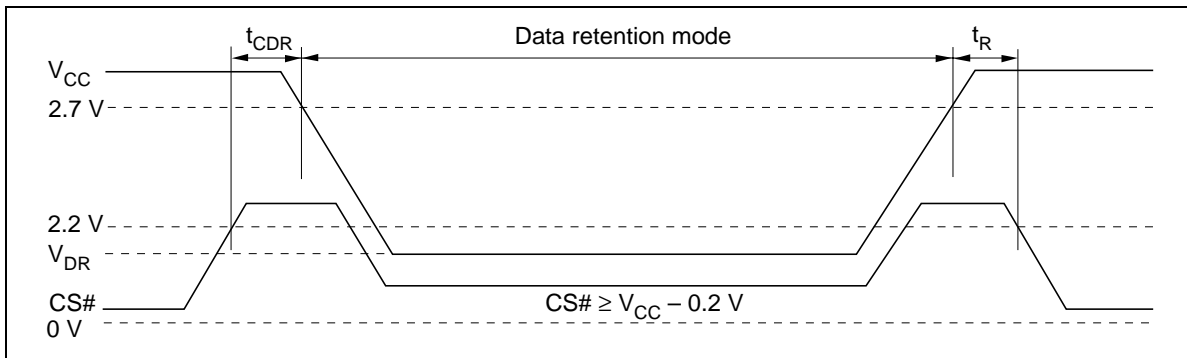
**Low V<sub>CC</sub> Data Retention Characteristics**

(T<sub>a</sub> = -40 to +85°C)

Parameter			Symbol	Min	Typ	Max	Unit	Test conditions* <sup>3</sup>
V <sub>CC</sub> for data retention			V <sub>DR</sub>	2.0	—	—	V	CS# ≥ V <sub>CC</sub> - 0.2 V, Vin ≥ 0 V
Data retention current	-5SI	to +85°C	I <sub>CCDR</sub>	—	—	10	μA	V <sub>CC</sub> = 3.0 V, Vin ≥ 0 V
		to +70°C	I <sub>CCDR</sub>	—	—	8	μA	CS# ≥ V <sub>CC</sub> - 0.2 V
		to +40°C	I <sub>CCDR</sub>	—	0.7* <sup>2</sup>	3	μA	
		to +25°C	I <sub>CCDR</sub>	—	0.5* <sup>1</sup>	3	μA	
	-7LI	to +85°C	I <sub>CCDR</sub>	—	—	20	μA	
		to +70°C	I <sub>CCDR</sub>	—	—	16	μA	
		to +40°C	I <sub>CCDR</sub>	—	0.7* <sup>2</sup>	10	μA	
		to +25°C	I <sub>CCDR</sub>	—	0.5* <sup>1</sup>	10	μA	
Chip deselect to data retention time			t <sub>CDR</sub>	0	—	—	ns	See retention waveform
Operation recovery time			t <sub>R</sub>	t <sub>RC</sub> * <sup>4</sup>	—	—	ns	

- Notes: 1. Typical values are at V<sub>CC</sub> = 3.0 V, T<sub>a</sub> = +25°C and specified loading, and not guaranteed.  
 2. Typical values are at V<sub>CC</sub> = 3.0 V, T<sub>a</sub> = +40°C and specified loading, and not guaranteed.  
 3. CS# controls address buffer, WE# buffer, OE# buffer, and Din buffer. In data retention mode, Vin levels (address, WE#, OE#, I/O) can be in the high impedance state.  
 4. t<sub>RC</sub> = read cycle time.

**Low V<sub>CC</sub> Data Retention Timing Waveform (CS# Controlled)**



## Revision History

## R1LV0408C-I Series Data Sheet

Rev.	Date	Contents of Modification	
		Page	Description
1.00	Jul.24.2003	—	Initial issue
2.00	May.25.2004	1	Features Standby: 2.4 $\mu$ W (typ) to 1.5 $\mu$ W (typ)
		5	Absolute Maximum Ratings Notes 2 : +7.0 V to +4.6 V
		6	DC characteristics -5SI and -7LI items' description are divided.
		12	Low $V_{CC}$ Data Retention Characteristics -5SI and -7LI items' description are divided.
		12	Low $V_{CC}$ Data Retention Timing Waveform 4.5 V to 2.7 V 2.4 V to 2.2 V

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