
R1LV0408C-I Series

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

REJ03C0098-0200Z
Rev. 2.00
May.25.2004

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

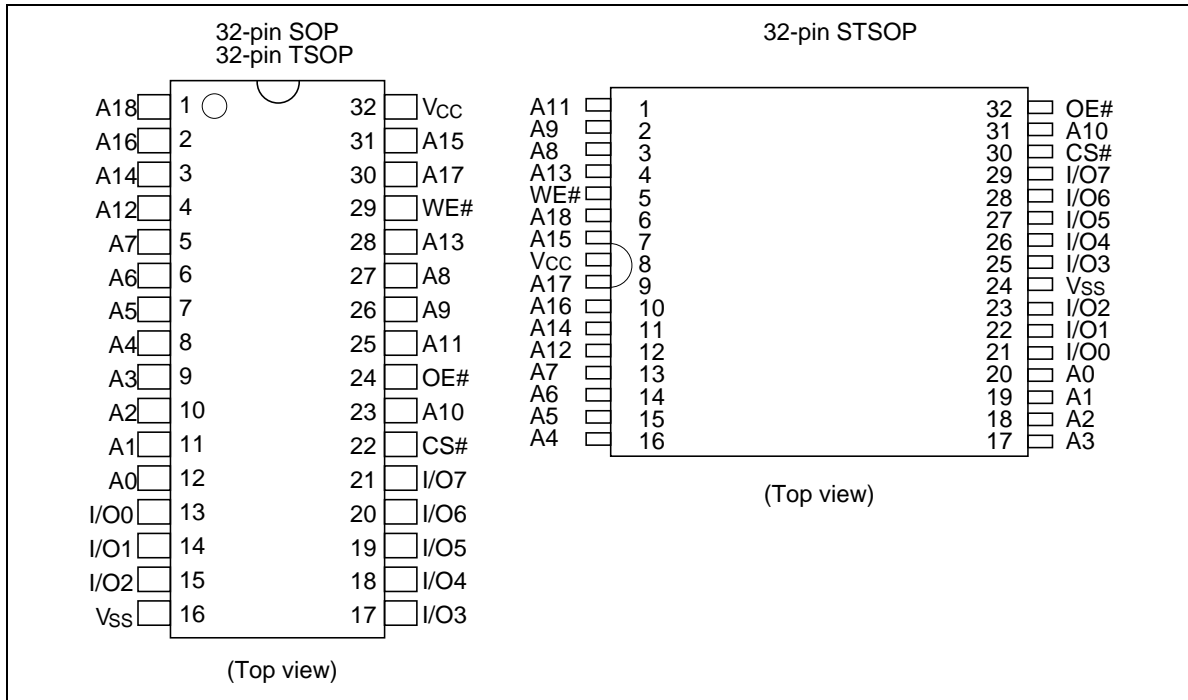
- Single 3 V supply: 2.7 V to 3.6 V
- Access time: 55/70 ns (max)
- Power dissipation:
 - Active: 6 mW/MHz (typ)
 - Standby: 1.5 μ W (typ)
- Completely static memory.
 - No clock or timing strobe required
- Equal access and cycle times
- Common data input and output.
 - Three state output
- Directly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

R1LV0408C-I Series

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	

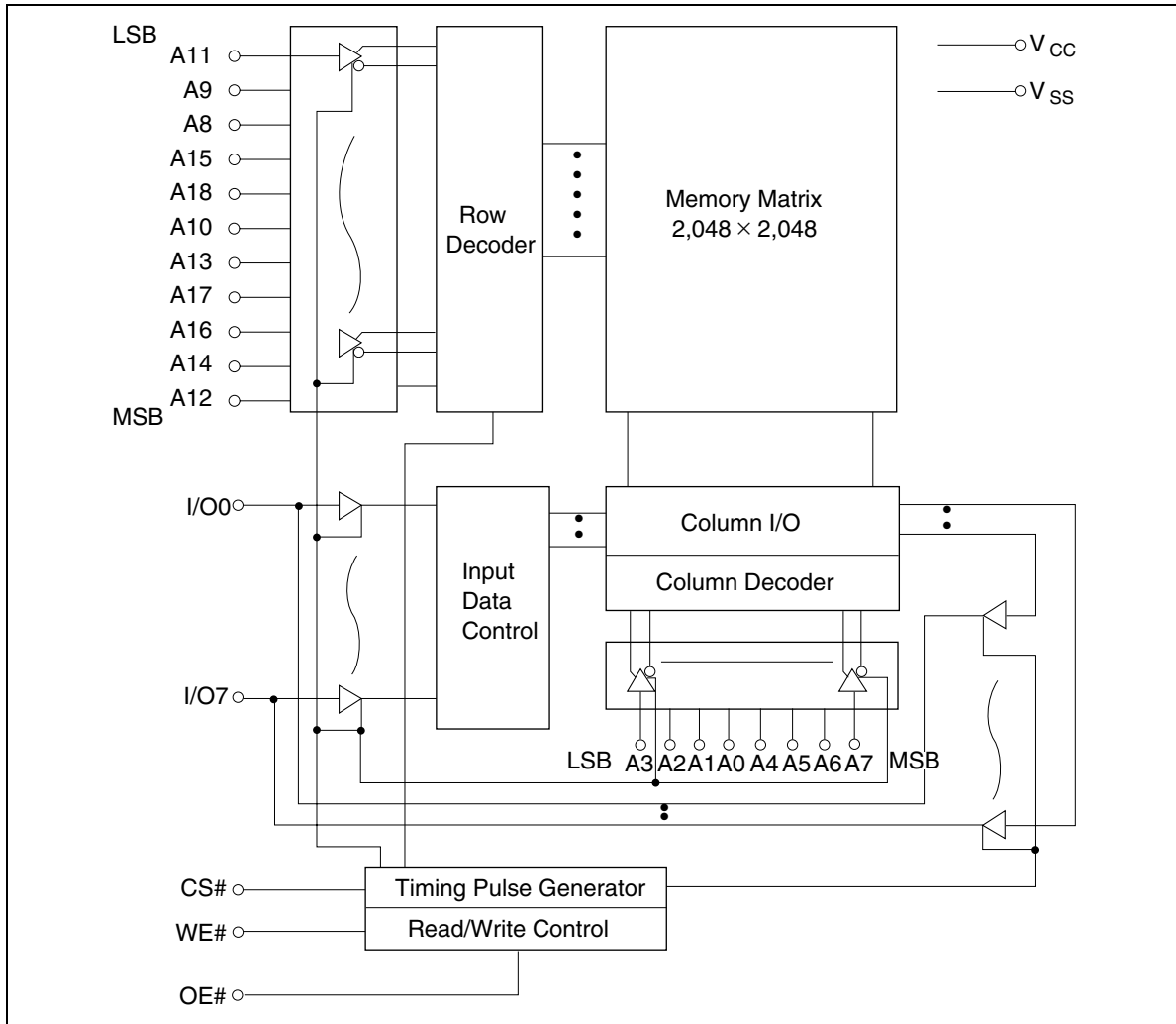
Pin Arrangement



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 _{CC}	Power supply
V _{SS}	Ground

Block Diagram



Operation Table

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

Note: H: V_{IH}, L: V_{IL}, ×: V_{IH} or V_{IL}

Absolute Maximum Ratings

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

Notes: 1. V_T min: -3.0 V for pulse half-width ≤ 30 ns.

2. Maximum voltage is +4.6 V.

DC Operating Conditions

(T_a = -40 to +85°C)

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	V _{CC}	2.7	3.0	3.6	V
	V _{SS}	0	0	0	V
Input high voltage	V _{IH}	2.2	—	V _{CC} + 0.3	V
Input low voltage	V _{IL}	-0.3* ¹	—	0.6	V

Note: 1. V_{IL} 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	μA	$V_{in} = V_{SS} \text{ to } V_{CC}$		
Output leakage current	$ I_{LO} $	—	—	1	μA	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 μs , 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	μA	$V_{in} \geq 0 \text{ V}$, CS# $\geq V_{CC} - 0.2 \text{ V}$	
		to +70°C	I_{SB1}	—	8	μA		
		to +40°C	I_{SB1}	—	0.7^{*2}	3		μA
		to +25°C	I_{SB1}	—	0.5^{*1}	3		μA
	-7LI	to +85°C	I_{SB1}	—	20	μA		
		to +70°C	I_{SB1}	—	16	μA		
		to +40°C	I_{SB1}	—	0.7^{*2}	10		μA
		to +25°C	I_{SB1}	—	0.5^{*1}	10		μA
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

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

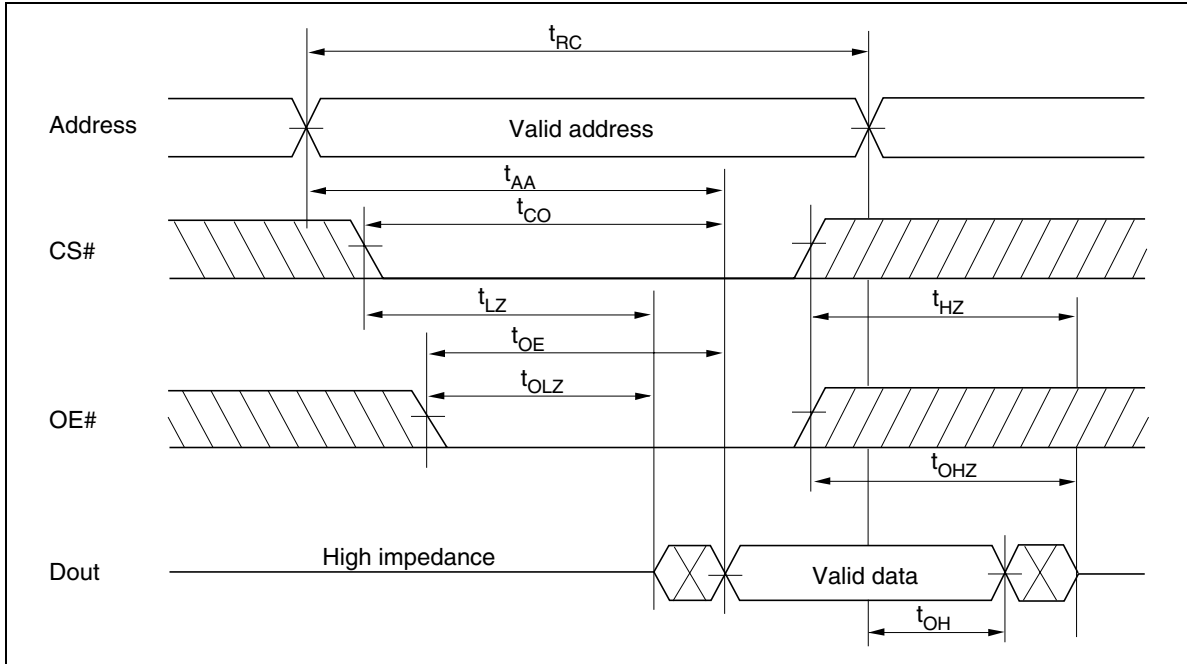
Write Cycle

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

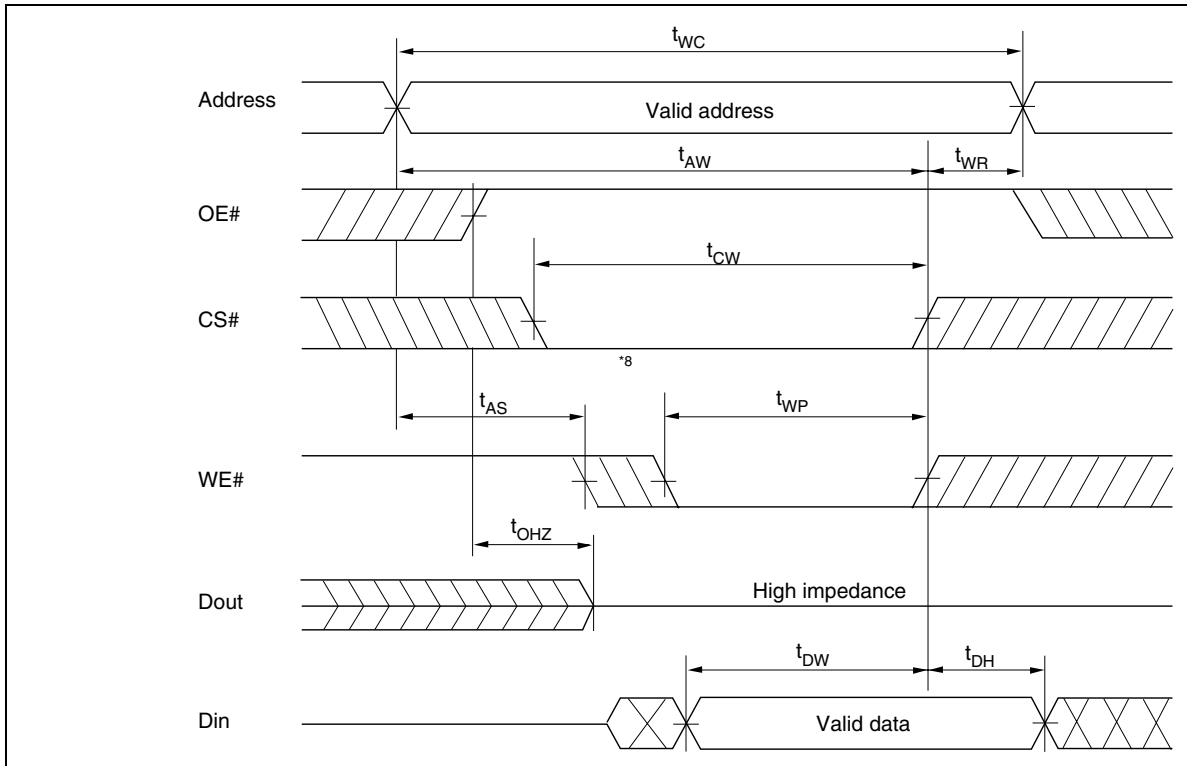
- Notes:
- t_{HZ} , t_{OHZ} and t_{WHZ} are defined as the time at which the outputs achieve the open circuit conditions and are not referred to output voltage levels.
 - This parameter is sampled and not 100% tested.
 - A write occurs during the overlap (t_{WP}) of a low CS# and a low WE#. A write begins 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

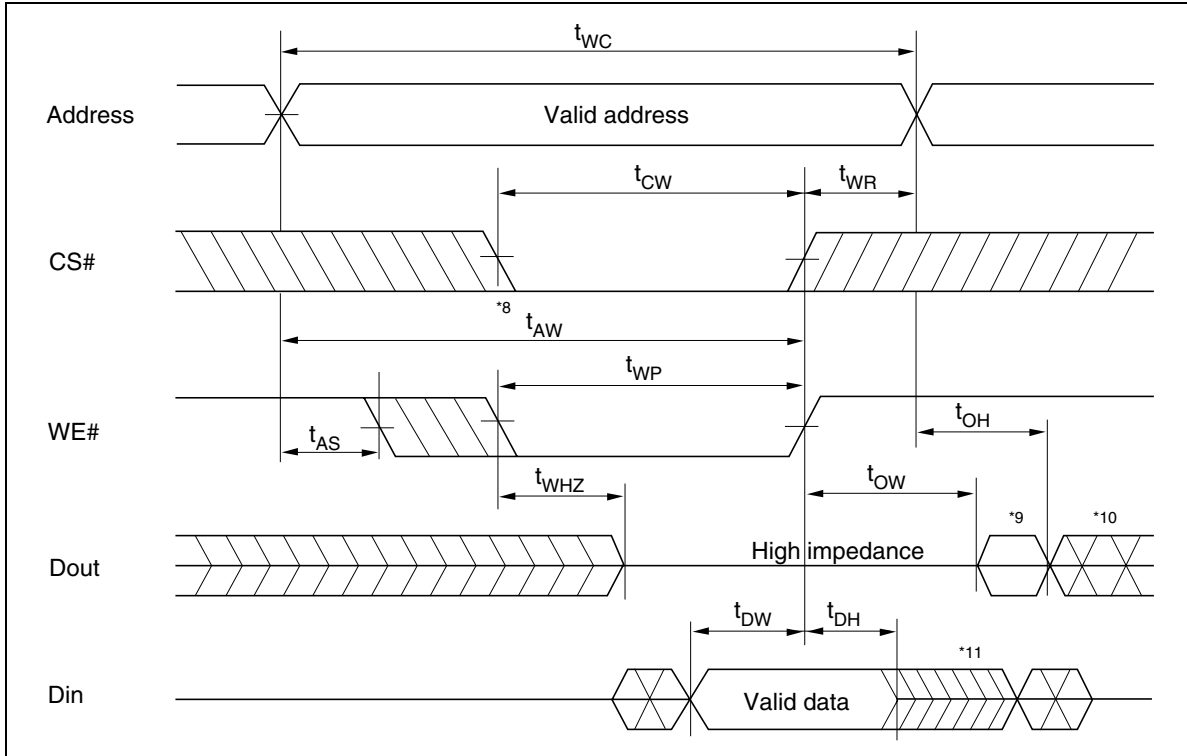
Read Timing Waveform (WE# = V_{IH})



Write Timing Waveform (1) (OE# Clock)



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



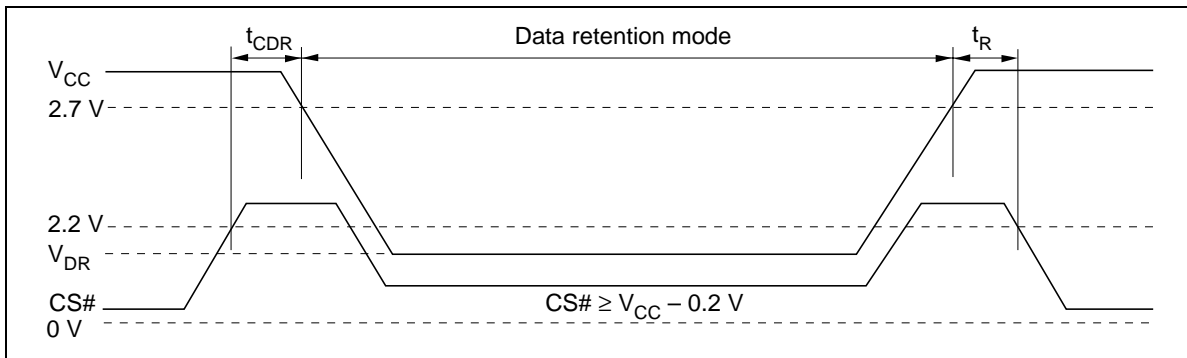
Low V_{CC} Data Retention Characteristics

(T_a = -40 to +85°C)

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

- Notes: 1. Typical values are at V_{CC} = 3.0 V, T_a = +25°C and specified loading, and not guaranteed.
 2. Typical values are at V_{CC} = 3.0 V, T_a = +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_{RC} = read cycle time.

Low V_{CC} 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 μ W (typ) to 1.5 μ 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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450 Holger Way, San Jose, CA 95134-1368, U.S.A
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Tel: <44> (1628) 585 100, Fax: <44> (1628) 585 900

Renesas Technology Europe GmbH

Dornacher Str. 3, D-85622 Feldkirchen, Germany
Tel: <49> (89) 380 70 0, Fax: <49> (89) 929 30 11

Renesas Technology Hong Kong Ltd.

7/F., North Tower, World Finance Centre, Harbour City, Canton Road, Hong Kong
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Renesas Technology Taiwan Co., Ltd.

FL 10, #99, Fu-Hsing N. Rd., Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

Renesas Technology (Shanghai) Co., Ltd.

26/F., Ruijin Building, No.205 Maoming Road (S), Shanghai 200020, China
Tel: <86> (21) 6472-1001, Fax: <86> (21) 6415-2952

Renesas Technology Singapore Pte. Ltd.

1, Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001

