
R1LV0416D Series

4M SRAM (256-kword × 16-bit)

REJ03C0311-0100

Rev.1.00

May.24.2007

Description

The R1LV0416D is a 4-Mbit static RAM organized 256-kword × 16-bit, fabricated by Renesas's high-performance 0.15μm CMOS and TFT technologies. R1LV0416D Series has realized higher density, higher performance and low power consumption. The R1LV0416D Series offers low power standby power dissipation; therefore, it is suitable for battery backup systems. The R1LV0416D Series is packaged in a 44-pin thin small outline mount device, or a 48-ball fine pitch ball grid array.

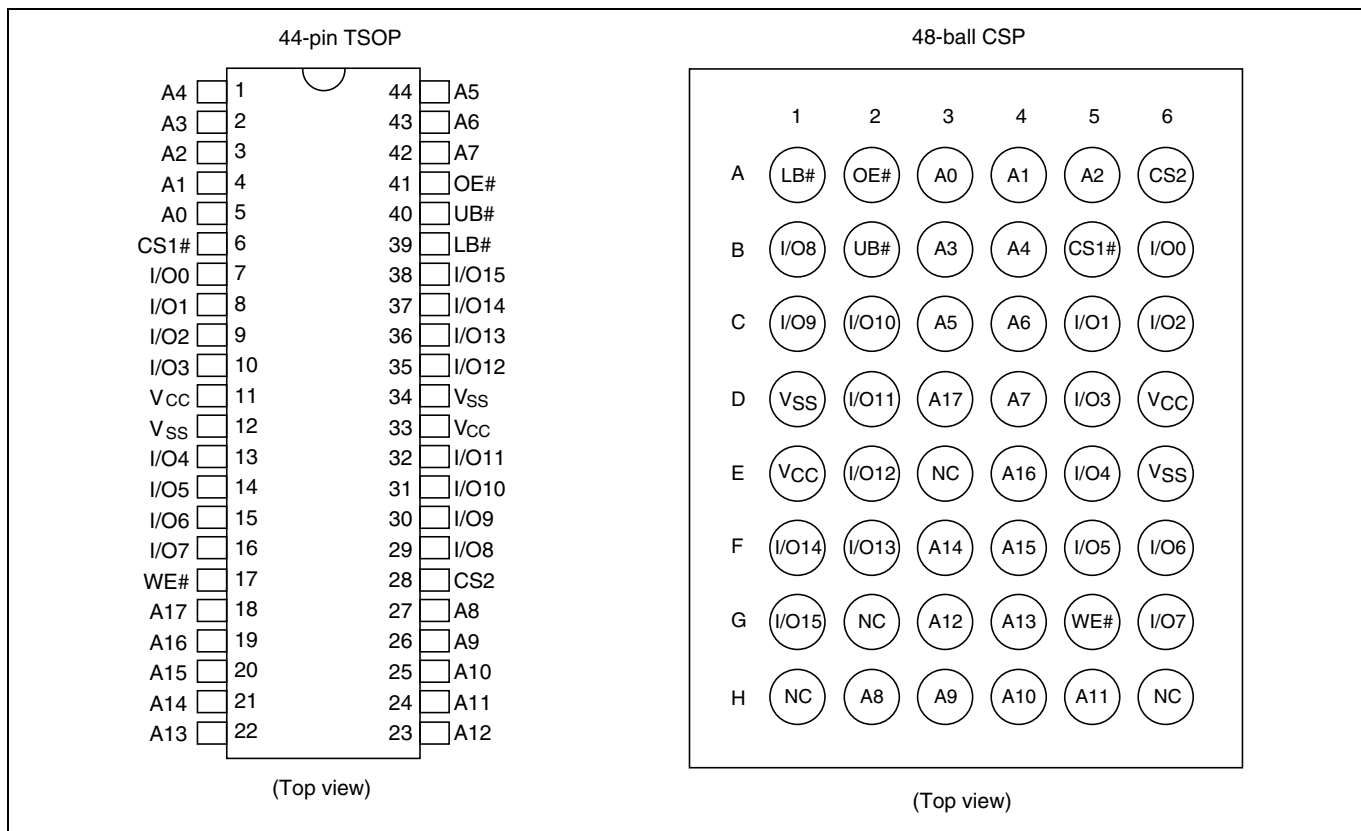
Features

- Single 3.0 V supply: 2.7 V to 3.6 V
- Fast access time: 55/70 ns (max)
- Power dissipation:
 - Standby: 3 μW (typ) ($V_{CC} = 3.0$ V)
- Equal access and cycle times
- Common data input and output.
 - Three state output
- Battery backup operation.
 - 2 chip selection for battery backup
- Temperature Range: -40 to +85°C

Ordering Information

Type No.	Access time	Package
R1LV0416DSB-5SI	55 ns	400-mil 44-pin plastic TSOP II PTSB0044GA-A (44P3W-H)
R1LV0416DSB-7LI	70 ns	
R1LV0416DBG-5SI	55 ns	48-ball CSP with 0.75 mm ball pitch PTBG0048HB-A (48FHH)
R1LV0416DBG-7LI	70 ns	

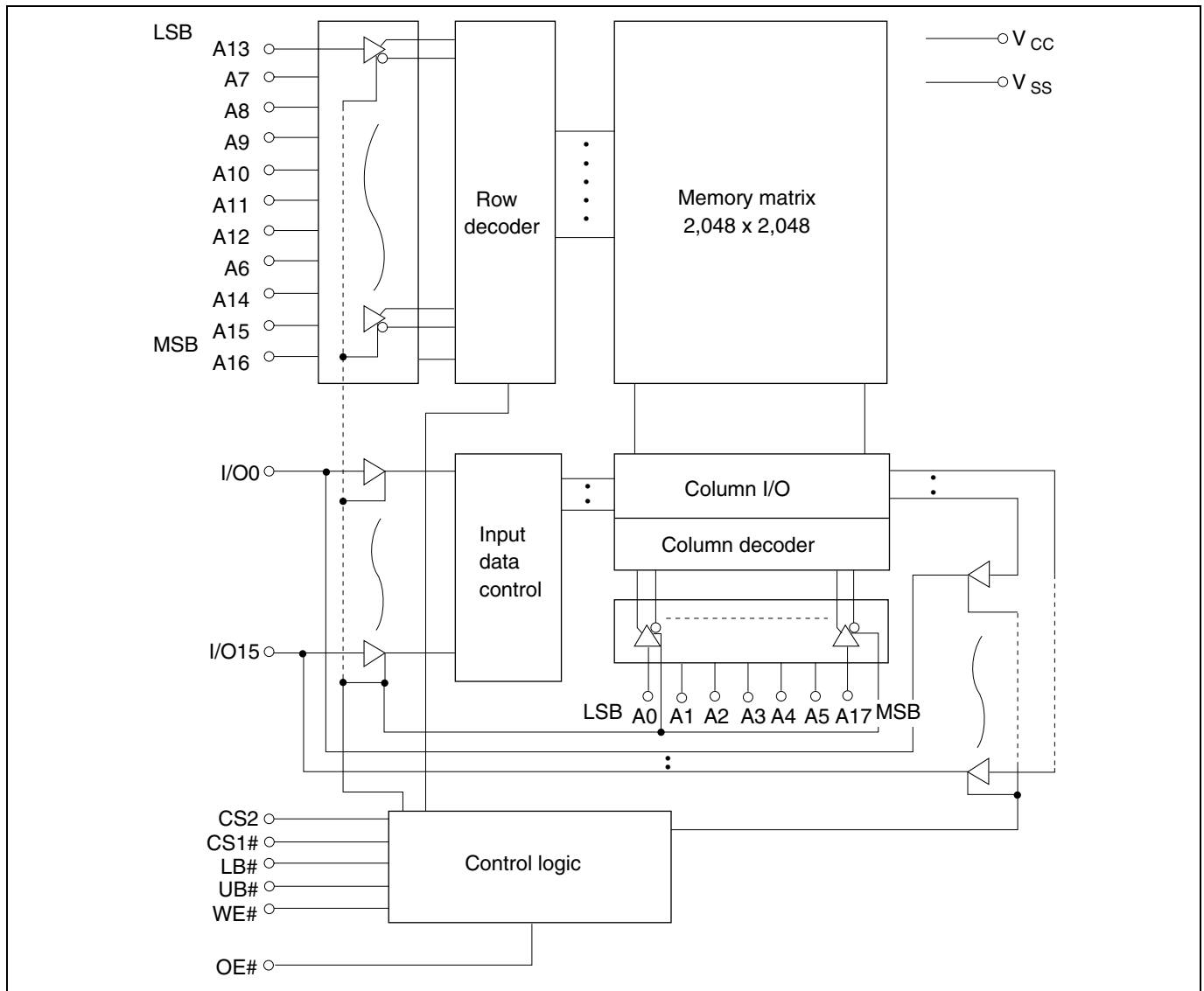
Pin Arrangement



Pin Description

Pin name	Function
A0 to A17	Address input
I/O0 to I/O15	Data input/output
CS1# ($\overline{CS1}$)	Chip select 1
CS2	Chip select 2
OE# (\overline{OE})	Output enable
WE# (\overline{WE})	Write enable
LB# (\overline{LB})	Lower byte select
UB# (\overline{UB})	Upper byte select
V _{cc}	Power supply
V _{ss}	Ground
NC	No connection

Block Diagram



Operation Table

CS1#	CS2	WE#	OE#	UB#	LB#	I/O0 to I/O7	I/O8 to I/O15	Operation
H	×	×	×	×	×	High-Z	High-Z	Standby
×	L	×	×	×	×	High-Z	High-Z	Standby
×	×	×	×	H	H	High-Z	High-Z	Standby
L	H	H	L	L	L	Dout	Dout	Read
L	H	H	L	H	L	Dout	High-Z	Lower byte read
L	H	H	L	L	H	High-Z	Dout	Upper byte read
L	H	L	×	L	L	Din	Din	Write
L	H	L	×	H	L	Din	High-Z	Lower byte write
L	H	L	×	L	H	High-Z	Din	Upper byte write
L	H	H	H	×	×	High-Z	High-Z	Output disable

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 $V_{CC} + 0.3$ * ²	V
Power dissipation	P_T	0.7	W
Operating temperature ¹	Topr	-40 to +85	°C
Storage temperature range	Tstg	-65 to +150	°C
Storage temperature range under bias	Tbias	-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

Parameter	Symbol	Min	Typ	Max	Unit	Note
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	—	0.6	V	1
Ambient temperature range	Ta	-40	—	+85	°C	

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	$V_{in} = V_{SS}$ to V_{CC}
Output leakage current			$ I_{LO} $	—	—	1	μA	CS1# = V_{IH} or CS2 = V_{IL} or OE# = V_{IH} or WE# = V_{IL} or LB# = UB# = V_{IH} , $V_{IO} = V_{SS}$ to V_{CC}
Operating current			I_{CC}	—	—	20	mA	CS1# = V_{IL} , CS2 = V_{IH} , Others = V_{IH}/V_{IL} , $I_{IO} = 0 \text{ mA}$
Average operating current			I_{CC1}	—	—	25	mA	Min. cycle, duty = 100%, $I_{IO} = 0 \text{ mA}$, CS1# = V_{IL} , CS2 = V_{IH} , Others = V_{IH}/V_{IL}
			I_{CC2}	—	—	5	mA	Cycle time = 1 μs , duty = 100%, $I_{IO} = 0 \text{ mA}$, CS1# $\leq 0.2 \text{ V}$, CS2 $\geq V_{CC} - 0.2 \text{ V}$ $V_{IH} \geq V_{CC} - 0.2 \text{ V}$, $V_{IL} \leq 0.2 \text{ V}$
Standby current			I_{SB}	—	0.1* ¹	0.3	mA	CS2 = V_{IL}
Standby current	-5SI	to +85°C	I_{SB1}	—	—	10	μA	$V_{in} \geq 0 \text{ V}$ (1) $0 \text{ V} \leq \text{CS2} \leq 0.2 \text{ V}$ or (2) CS1# $\geq V_{CC} - 0.2 \text{ V}$, CS2 $\geq V_{CC} - 0.2 \text{ V}$ or (3) LB# = UB# $\geq V_{CC} - 0.2 \text{ V}$, CS2 $\geq V_{CC} - 0.2 \text{ V}$, CS1# $\leq 0.2 \text{ V}$ Average values
		to +70°C	I_{SB1}	—	—	8	μA	
		to +40°C	I_{SB1}	—	—	3	μA	
		to +25°C	I_{SB1}	—	1* ¹	2.5	μA	
	-7LI	to +85°C	I_{SB1}	—	—	20	μA	
		to +70°C	I_{SB1}	—	—	16	μA	
		to +40°C	I_{SB1}	—	—	10	μA	
		to +25°C	I_{SB1}	—	1* ¹	10	μA	
Output high voltage			V_{OH}	2.4	—	—	V	$I_{OH} = -1 \text{ mA}$
			V_{OH2}	$V_{CC} - 0.2$	—	—	—	V
Output low voltage			V_{OL}	—	—	0.4	V	$I_{OL} = 2 \text{ mA}$
			V_{OL2}	—	—	0.2	V	$I_{OL} = 100 \mu\text{A}$

Note: 1. Typical values are at $V_{CC} = 3.0 \text{ V}$, $T_a = +25^\circ\text{C}$ 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_{IO}	—	—	10	pF	$V_{IO} = 0 \text{ V}$	1

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

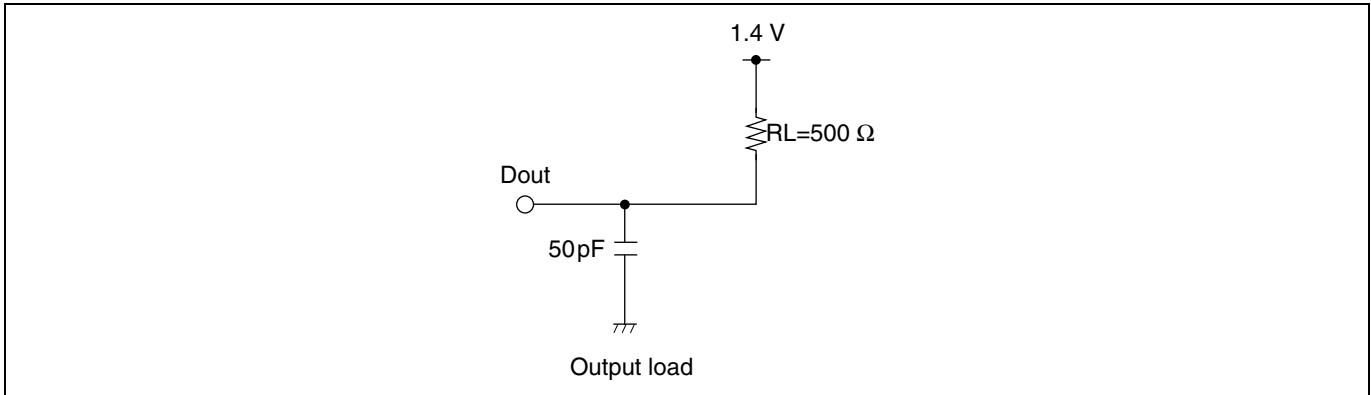
AC Characteristics

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

Test Conditions

Input pulse levels: $V_{IL} = 0.4$ V, $V_{IH} = 2.4$ V

- Input rise and fall time: 5 ns
- Input/output timing reference levels: 1.4 V
- Output load: See figures (Including scope and jig)



Read Cycle

Parameter	Symbol	R1LV0416D				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_{ACS1}	—	55	—	70	ns	
	t_{ACS2}	—	55	—	70	ns	
Output enable to output valid	t_{OE}	—	35	—	40	ns	
Output hold from address change	t_{OH}	10	—	10	—	ns	
LB#, UB# access time	t_{BA}	—	55	—	70	ns	
Chip select to output in low-Z	t_{CLZ1}	10	—	10	—	ns	2, 3
	t_{CLZ2}	10	—	10	—	ns	2, 3
LB#, UB# disable to low-Z	t_{BLZ}	5	—	5	—	ns	2, 3
Output enable to output in low-Z	t_{OLZ}	5	—	5	—	ns	2, 3
Chip deselect to output in high-Z	t_{CHZ1}	0	20	0	25	ns	1, 2, 3
	t_{CHZ2}	0	20	0	25	ns	1, 2, 3
LB#, UB# disable to high-Z	t_{BHZ}	0	20	0	25	ns	1, 2, 3
Output disable to output in high-Z	t_{OHZ}	0	20	0	25	ns	1, 2, 3

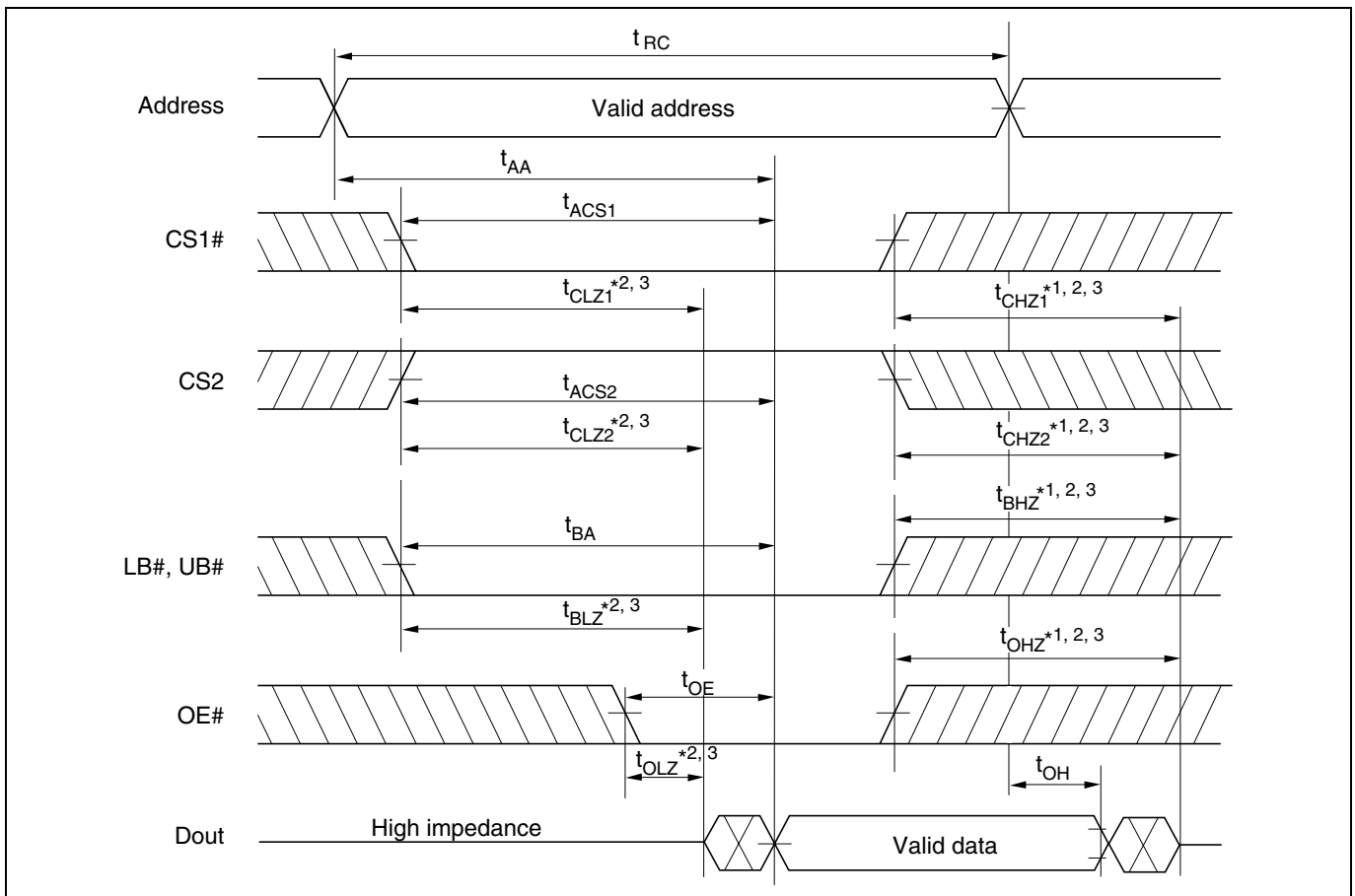
Write Cycle

Parameter	Symbol	R1LV0416D				Unit	Notes
		-5SI		-7LI			
		Min	Max	Min	Max		
Write cycle time	t_{WC}	55	—	70	—	ns	
Address valid to end of write	t_{AW}	50	—	60	—	ns	
Chip selection to end of write	t_{CW}	50	—	60	—	ns	5
Write pulse width	t_{WP}	40	—	50	—	ns	4
LB#, UB# valid to end of write	t_{BW}	50	—	55	—	ns	
Address setup time	t_{AS}	0	—	0	—	ns	6
Write recovery time	t_{WR}	0	—	0	—	ns	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, 3
Write to output in high-Z	t_{WHZ}	0	20	0	25	ns	1, 2

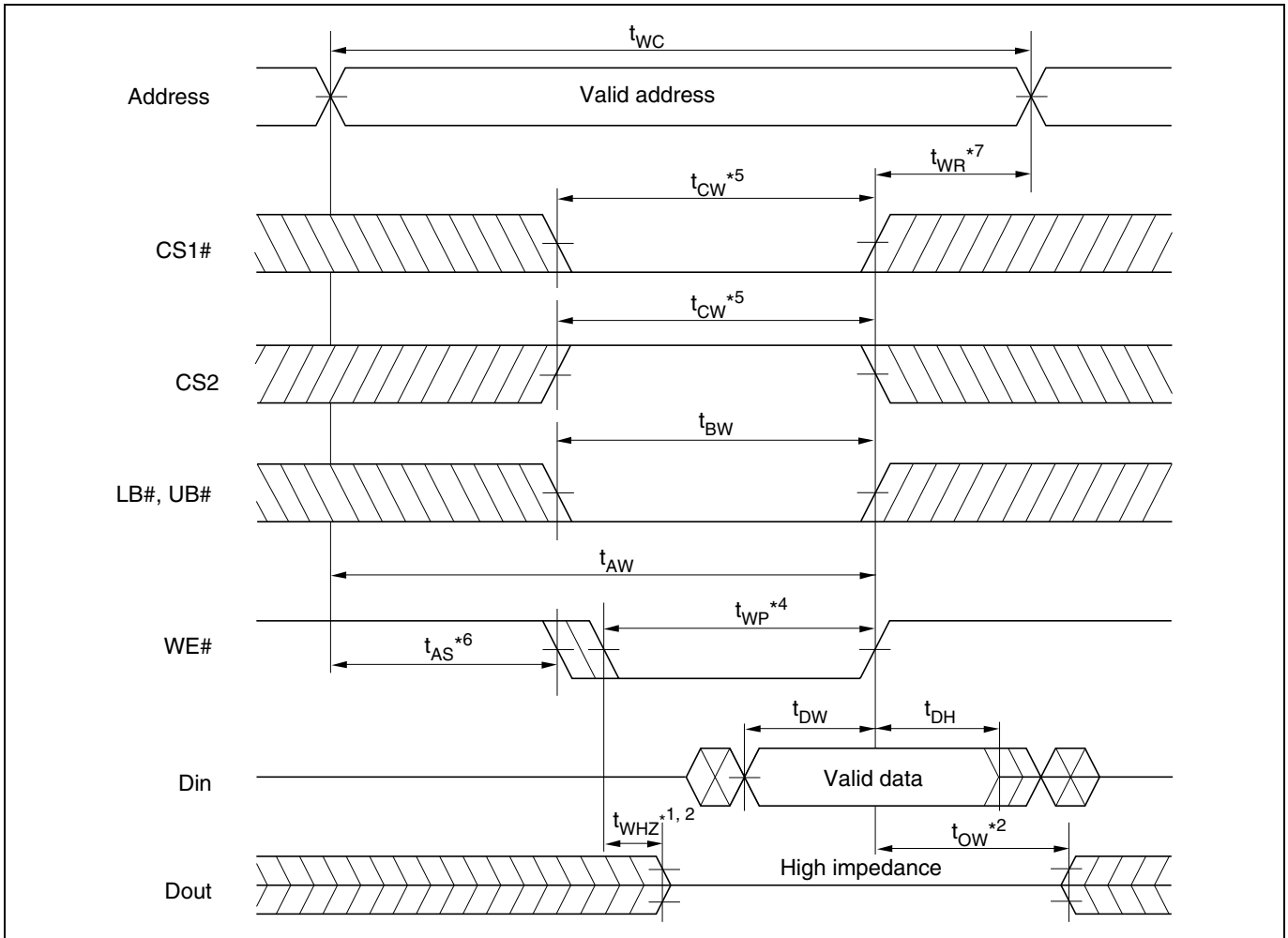
- Notes: 1. t_{CHZ} , t_{OHZ} , t_{WHZ} and t_{BHZ} are defined as the time at which the outputs achieve the open circuit conditions and are not referred to output voltage levels.
2. This parameter is sampled and not 100% tested.
3. At any given temperature and voltage condition, t_{HZ} max is less than t_{LZ} min both for a given device and from device to device.
4. A write occurs during the overlap of a low CS1#, a high CS2, a low WE# and a low LB# or a low UB#. A write begins at the latest transition among CS1# going low, CS2 going high, WE# going low and LB# going low or UB# going low. A write ends at the earliest transition among CS1# going high, CS2 going low, WE# going high and LB# going high or UB# going high. t_{WP} is measured from the beginning of write to the end of write.
5. t_{CW} is measured from the later of CS1# going low or CS2 going high to the end of write.
6. t_{AS} is measured from the address valid to the beginning of write.
7. t_{WR} is measured from the earliest of CS1# or WE# going high or CS2 going low to the end of write cycle.

Timing Waveform

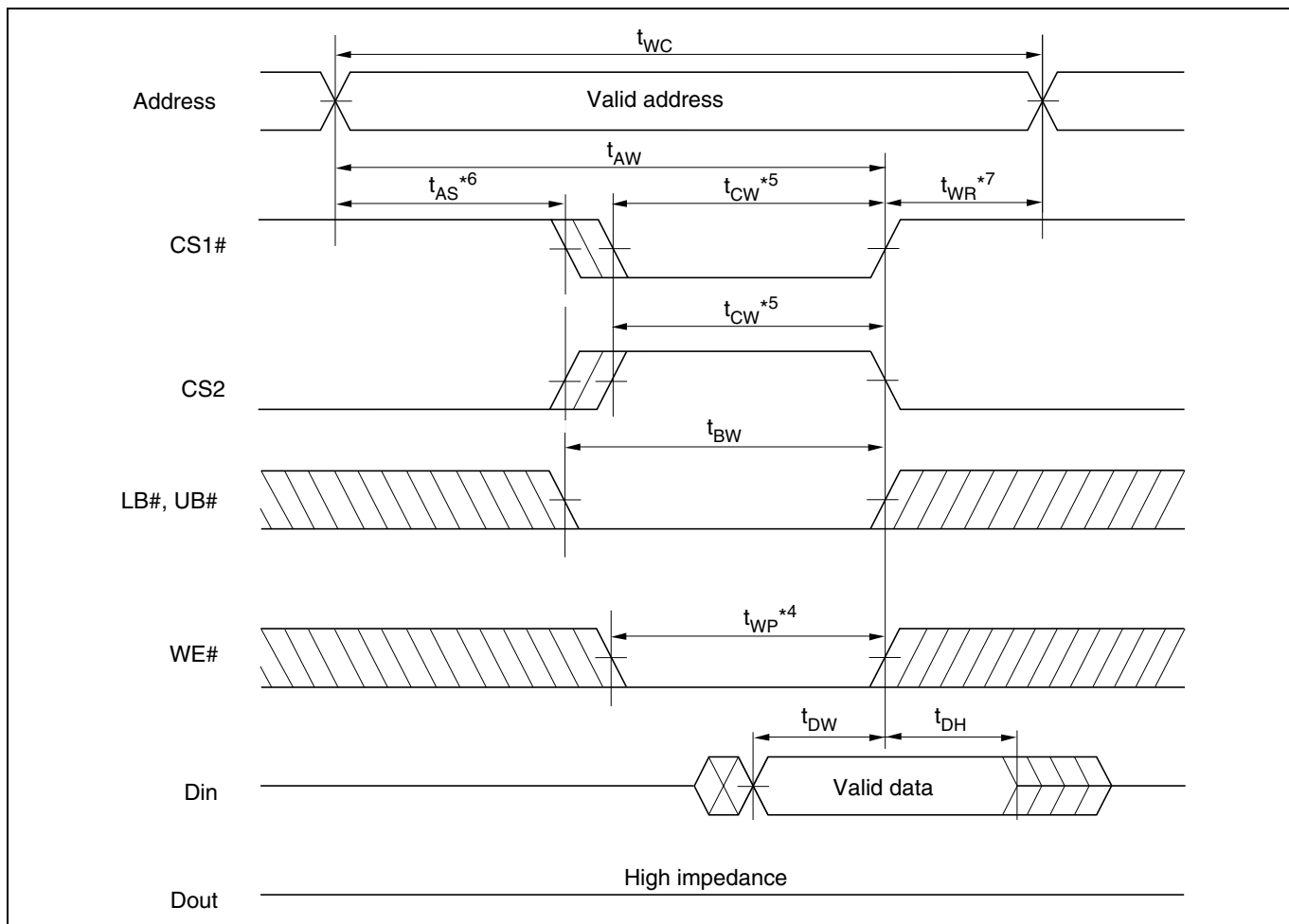
Read Timing Waveform (WE# = V_{ih})



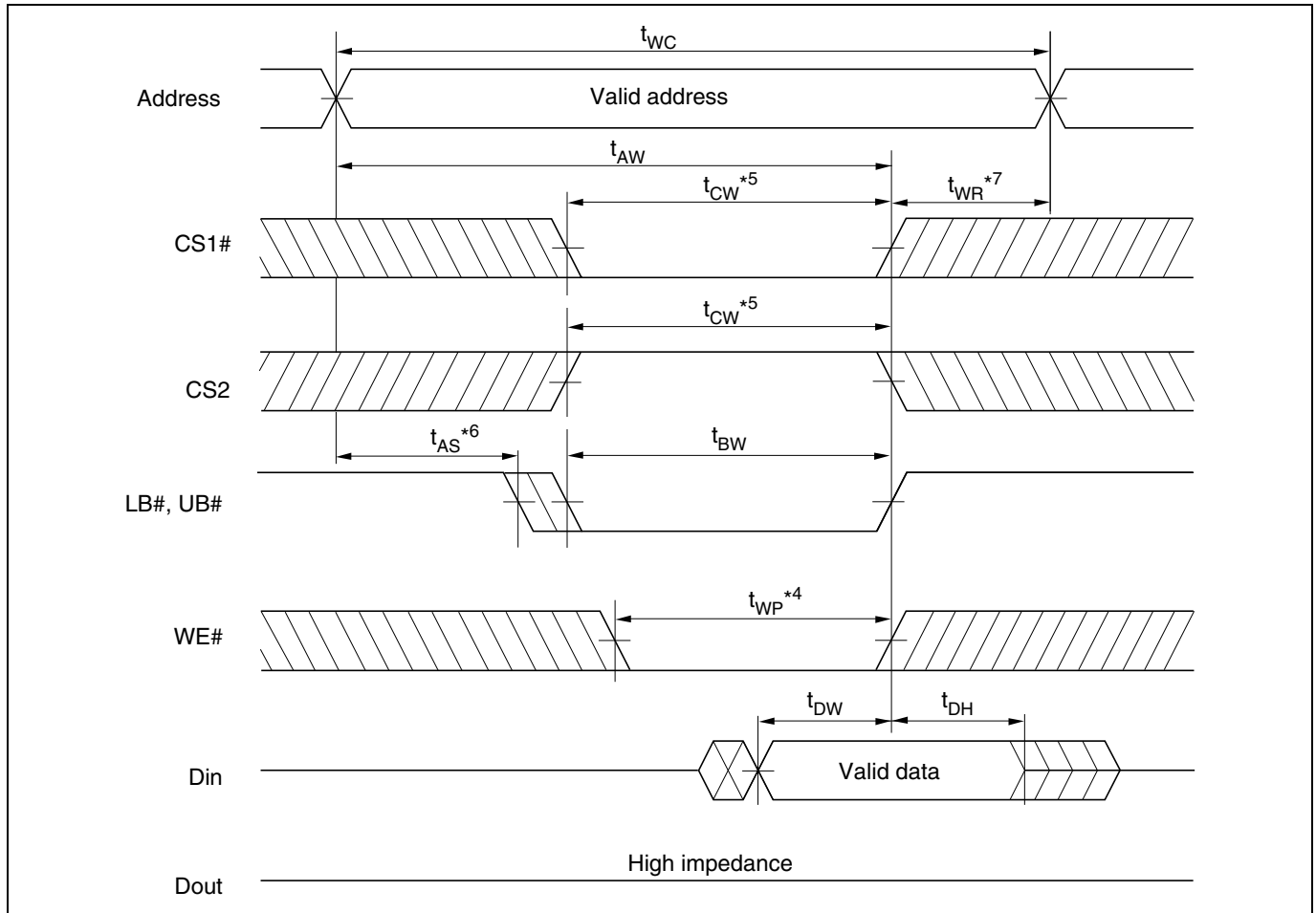
Write Timing Waveform (1) (WE# Clock)



Write Timing Waveform (2) (CS# Clock, OE# = V_{IH})



Write Timing Waveform (3) (LB#, UB# Clock, OE# = V_{IH})



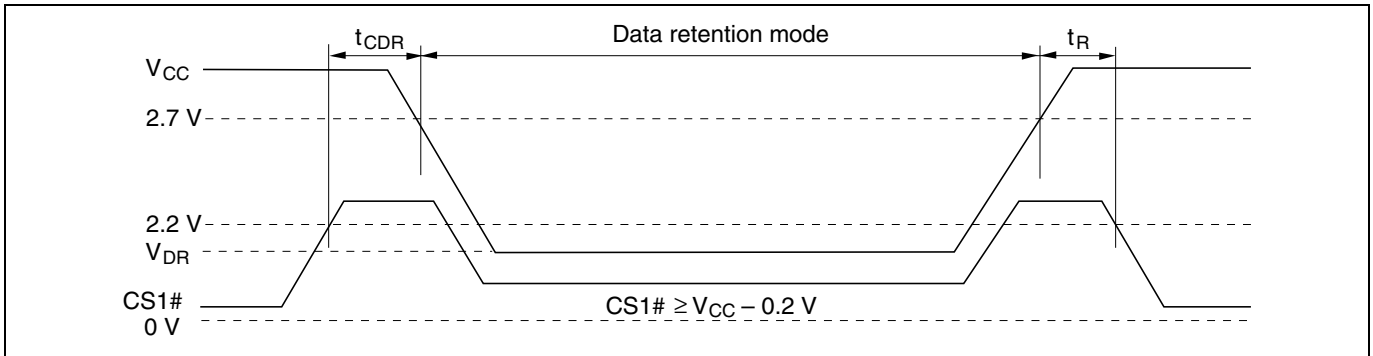
Low V_{CC} Data Retention Characteristics

(Ta = -40 to +85°C)

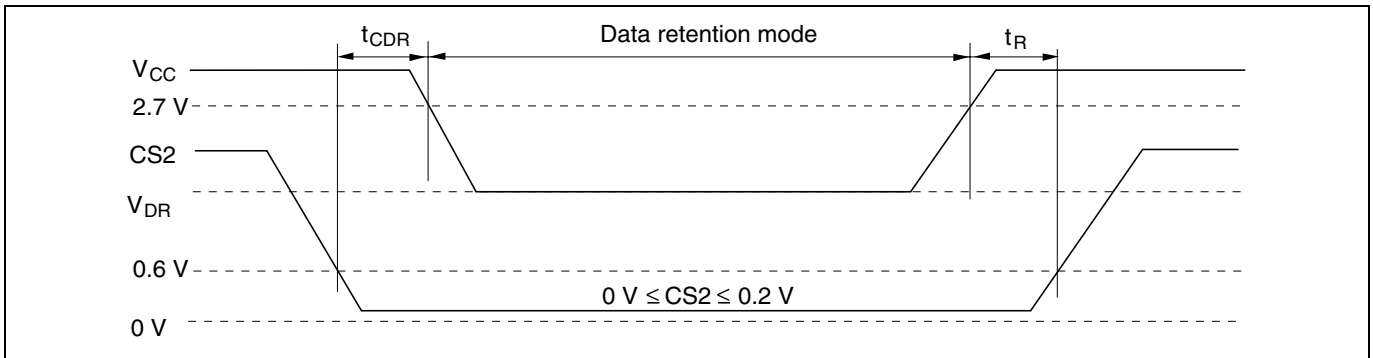
Parameter			Symbol	Min	Typ	Max	Unit	Test conditions
V_{CC} for data retention			V_{DR}	2.0	—	—	V	$V_{in} \geq 0V$ (1) $0V \leq CS2 \leq 0.2V$ or (2) $CS2 \geq V_{CC} - 0.2V$, $CS1\# \geq V_{CC} - 0.2V$ or (3) $LB\# = UB\# \geq V_{CC} - 0.2V$, $CS2 \geq V_{CC} - 0.2V$, $CS1\# \leq 0.2V$
Data retention current	-5SI	to +85°C	I_{CCDR}	—	—	10	μA	$V_{CC} = 3.0V$, $V_{in} \geq 0V$ (1) $0V \leq CS2 \leq 0.2V$ or (2) $CS2 \geq V_{CC} - 0.2V$, $CS1\# \geq V_{CC} - 0.2V$ or (3) $LB\# = UB\# \geq V_{CC} - 0.2V$, $CS2 \geq V_{CC} - 0.2V$, $CS1\# \leq 0.2V$ Average values
		to +70°C	I_{CCDR}	—	—	8	μA	
		to +40°C	I_{CCDR}	—	—	3	μA	
		to +25°C	I_{CCDR}	—	1* ¹	2.5	μA	
	-7LI	to +85°C	I_{CCDR}	—	—	20	μA	
		to +70°C	I_{CCDR}	—	—	16	μA	
		to +40°C	I_{CCDR}	—	—	10	μA	
		to +25°C	I_{CCDR}	—	1* ¹	10	μA	
Chip deselect to data retention time			t_{CDR}	0	—	—	ns	See retention waveform
Operation recovery time			t_R	5	—	—	ms	

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

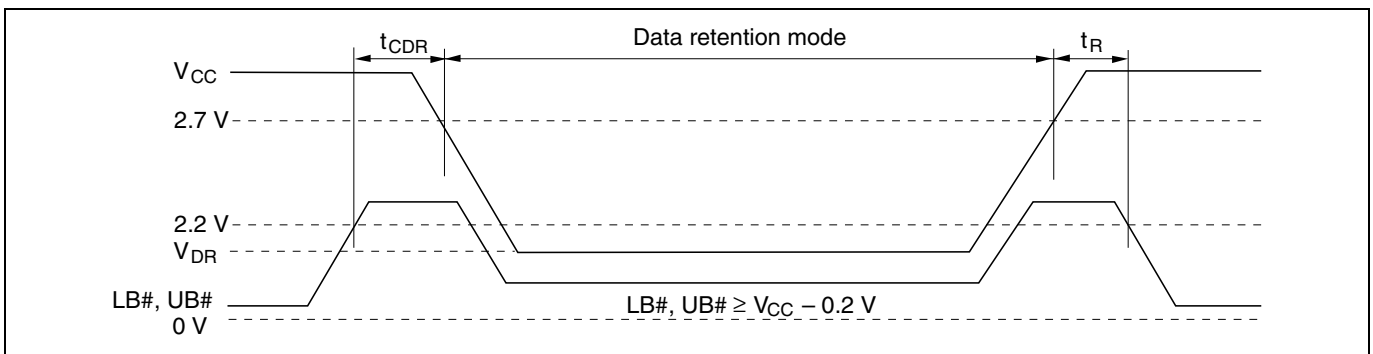
Low V_{CC} Data Retention Timing Waveform (1) (CS1# Controlled)



Low V_{CC} Data Retention Timing Waveform (2) (CS2 Controlled)



Low V_{CC} Data Retention Timing Waveform (3) (LB#, UB# Controlled)



Revision History

R1LV0416D Series Data Sheet

Rev.	Date	Contents of Modification	
		Page	Description
0.01	Dec. 25, 2006	—	Initial issue
1.00	May. 24, 2007	2	Ordering Information R1LV0416DSB-5S% to R1LV0416DSB-5SI R1LV0416DSB-7L% to R1LV0416DSB-7LI R1LV0416DBG-5S% to R1LV0416DBG-5SI R1LV0416DBG-7L% to R1LV0416DBG-7LI
		3	Pin Arrangement A6 to A13, A13 to A6
		4	Change of Block Diagram
		5	Absolute Maximum Ratings: Deletion of R ver. specification
		5	DC Operating Conditions: Deletion of R ver. specification
		6	DC Characteristics I_{SB1} (-5SI) (to +25°C) max: 3 μ A to 2.5 μ A
		7	AC Characteristics: Change of Test Conditions
		14	Low V_{CC} Data Retention Characteristics I_{CCDR} (-5SI) (to +25°C) max: 3 μ A to 2.5 μ A Deletion of note 2

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