

RMLV0416E Series

4Mb Advanced LPSRAM (256-kword × 16-bit)

R10DS0205EJ0200
Rev.2.00
2016.1.12

Description

The RMLV0416E Series is a family of 4-Mbit static RAMs organized 262,144-word × 16-bit, fabricated by Renesas's high-performance Advanced LPSRAM technologies. The RMLV0416E Series has realized higher density, higher performance and low power consumption. The RMLV0416E Series offers low power standby power dissipation; therefore, it is suitable for battery backup systems. It is offered in 44-pin TSOP (II) or 48-ball fine pitch ball grid array.

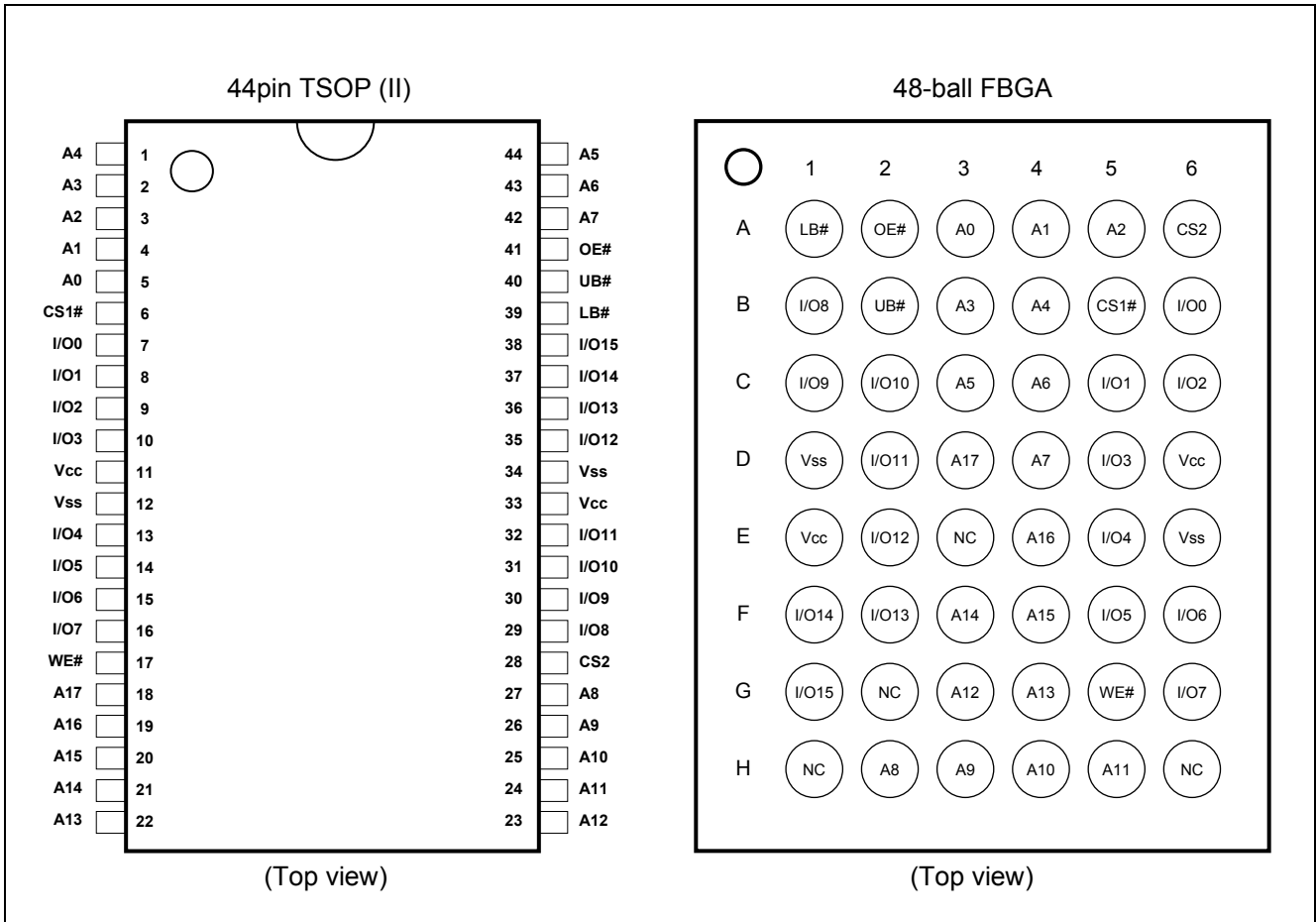
Features

- Single 3V supply: 2.7V to 3.6V
- Access time: 45ns (max.)
- Current consumption:
 - Standby: 0.4μA (typ.)
- Equal access and cycle times
- Common data input and output
 - Three state output
- Directly TTL compatible
 - All inputs and outputs
- Battery backup operation

Orderable part number information

Orderable part number	Access time	Temperature range	Package	Shipping container
RMLV0416EGSB-4S2#AA*	45 ns	-40 ~ +85°C	400-mil 44pin plastic TSOP (II)	Tray
RMLV0416EGSB-4S2#HA*				Embossed tape
RMLV0416EGBG-4S2#AC*			48-ball FBGA with 0.75mm ball pitch	Tray
RMLV0416EGBG-4S2#KC*				Embossed tape

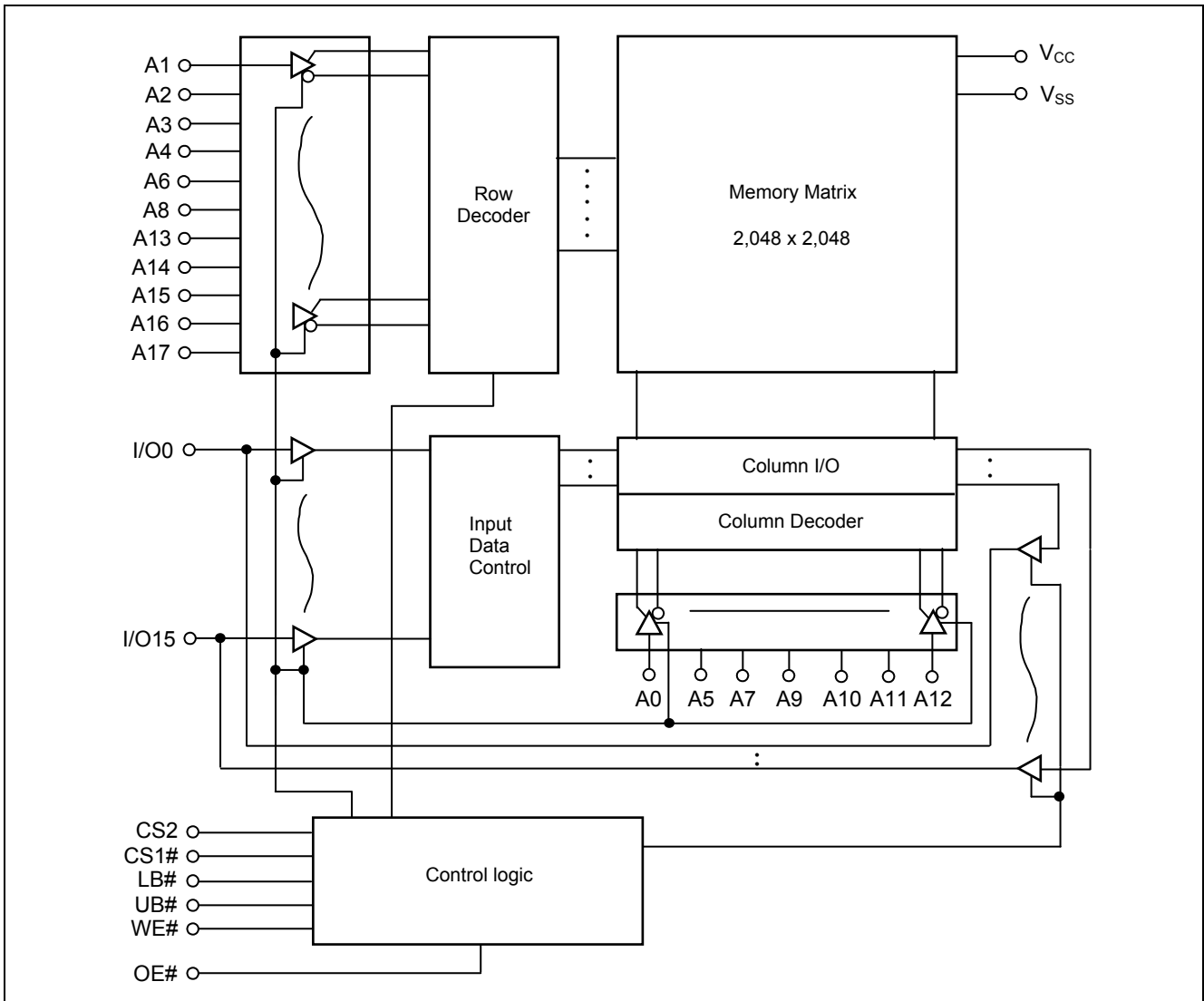
Pin Arrangement



Pin Description

Pin name	Function
V _{CC}	Power supply
V _{SS}	Ground
A0 to A17	Address input
I/O0 to I/O15	Data input/output
CS1#	Chip select 1
CS2	Chip select 2
OE#	Output enable
WE#	Write enable
LB#	Lower byte select
UB#	Upper byte select
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	X	X	X	X	X	High-Z	High-Z	Standby
X	L	X	X	X	X	High-Z	High-Z	Standby
X	X	X	X	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	X	L	L	Din	Din	Write
L	H	L	X	H	L	Din	High-Z	Lower byte write
L	H	L	X	L	H	High-Z	Din	Upper byte write
L	H	H	H	X	X	High-Z	High-Z	Output disable

Note 1. H: V_{IH} L: V_{IL} X: 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^{*2} to $V_{CC}+0.3^{*3}$	V
Power dissipation	P_T	0.7	W
Operation 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

Note 2. -3.0V for pulse \leq 30ns (full width at half maximum)

3. Maximum voltage is +4.6V.

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	4
Ambient temperature range	T_a	-40	—	+85	°C	

Note 4. -3.0V for pulse \leq 30ns (full width at half maximum)

DC Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions	
Input leakage current	$ I_{LI} $	—	—	1	μ A	$V_{in} = V_{SS}$ to V_{CC}	
Output leakage current	$ I_{LO} $	—	—	1	μ A	CS1# = V_{IH} or CS2 = V_{IL} or OE# = V_{IH} or WE# = V_{IL} or LB# = UB# = V_{IH} , $V_{I/O} = V_{SS}$ to V_{CC}	
Operating current	I_{CC}	—	—	10	mA	CS1# = V_{IL} , CS2 = V_{IH} , Others = V_{IH}/V_{IL} , $I_{I/O} = 0$ mA	
Average operating current	I_{CC1}	—	—	20	mA	Cycle = 55ns, duty = 100%, $I_{I/O} = 0$ mA, CS1# = V_{IL} , CS2 = V_{IH} , Others = V_{IH}/V_{IL}	
		—	—	25	mA	Cycle = 45ns, duty = 100%, $I_{I/O} = 0$ mA, CS1# = V_{IL} , CS2 = V_{IH} , Others = V_{IH}/V_{IL}	
	I_{CC2}	—	—	2.5	mA	Cycle = 1 μ s, duty = 100%, $I_{I/O} = 0$ mA, CS1# \leq 0.2V, CS2 \geq $V_{CC}-0.2$ V, $V_{IH} \geq V_{CC}-0.2$ V, $V_{IL} \leq 0.2$ V	
Standby current	I_{SB}	—	0.1^{*5}	0.3	mA	CS2 = V_{IL} , Others = V_{SS} to V_{CC}	
Standby current	I_{SB1}	—	0.4^{*5}	2	μ A	$\sim +25^\circ\text{C}$	$V_{in} = V_{SS}$ to V_{CC} , (1) CS2 \leq 0.2V or (2) CS1# \geq $V_{CC}-0.2$ V, CS2 \geq $V_{CC}-0.2$ V or (3) LB# = UB# \geq $V_{CC}-0.2$ V, CS1# \leq 0.2V, CS2 \geq $V_{CC}-0.2$ V
		—	—	3	μ A	$\sim +40^\circ\text{C}$	
		—	—	5	μ A	$\sim +70^\circ\text{C}$	
		—	—	7	μ A	$\sim +85^\circ\text{C}$	
Output high voltage	V_{OH}	2.4	—	—	V	$I_{OH} = -1$ mA	
	V_{OH2}	$V_{CC}-0.2$	—	—	V	$I_{OH} = -0.1$ mA	
Output low voltage	V_{OL}	—	—	0.4	V	$I_{OL} = 2$ mA	
	V_{OL2}	—	—	0.2	V	$I_{OL} = 0.1$ mA	

Note 5. Typical parameter indicates the value for the center of distribution at 3.0V ($T_a=25^\circ\text{C}$), and not 100% tested.

Capacitance

($V_{CC} = 2.7\text{V} \sim 3.6\text{V}$, $f = 1\text{MHz}$, $T_a = -40 \sim +85^\circ\text{C}$)

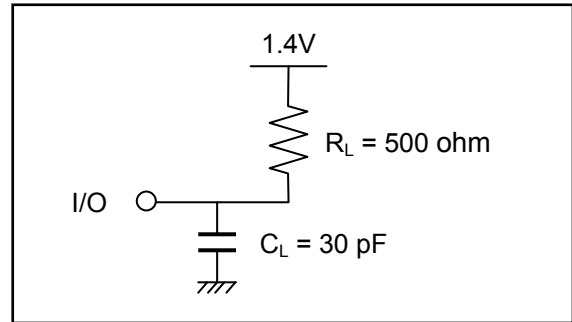
Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions	Note
Input capacitance	C_{in}	—	—	8	pF	$V_{in} = 0$ V	6
Input / output capacitance	$C_{I/O}$	—	—	10	pF	$V_{I/O} = 0$ V	6

Note 6. This parameter is sampled and not 100% tested.

AC Characteristics

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

- Input pulse levels: $V_{IL} = 0.4V$, $V_{IH} = 2.4V$
- Input rise and fall time: 5ns
- Input and output timing reference level: 1.4V
- Output load: See figures (Including scope and jig)



Read Cycle

Parameter	Symbol	Min.	Max.	Unit	Note
Read cycle time	t_{RC}	45		ns	
Address access time	t_{AA}	—	45	ns	
Chip select access time	t_{ACS1}	—	45	ns	
	t_{ACS2}	—	45	ns	
Output enable to output valid	t_{OE}	—	22	ns	
Output hold from address change	t_{OH}	10	—	ns	
LB#, UB# access time	t_{BA}	—	45	ns	
Chip select to output in low-Z	t_{CLZ1}	10	—	ns	7,8
	t_{CLZ2}	10	—	ns	7,8
LB#, UB# enable to low-Z	t_{BLZ}	5	—	ns	7,8
Output enable to output in low-Z	t_{OLZ}	5	—	ns	7,8
Chip deselect to output in high-Z	t_{CHZ1}	0	18	ns	7,8,9
	t_{CHZ2}	0	18	ns	7,8,9
LB#, UB# disable to high-Z	t_{BHZ}	0	18	ns	7,8,9
Output disable to output in high-Z	t_{OHZ}	0	18	ns	7,8,9

Note 7. This parameter is sampled and not 100% tested.

8. At any given temperature and voltage condition, t_{CHZ1} max is less than t_{CLZ1} min, t_{CHZ2} max is less than t_{CLZ2} min, t_{BHZ} max is less than t_{BLZ} min, and t_{OHZ} max is less than t_{OLZ} min, for any device.

9. t_{CHZ1} , t_{CHZ2} , t_{BHZ} and t_{OHZ} are defined as the time when the I/O pins enter a high-impedance state and are not referred to the I/O levels.

Write Cycle

Parameter	Symbol	Min.	Max.	Unit	Note
Write cycle time	t_{WC}	45	—	ns	
Address valid to write end	t_{AW}	35	—	ns	
Chip select to write end	t_{CW}	35	—	ns	
Write pulse width	t_{WP}	35	—	ns	10
LB#,UB# valid to write end	t_{BW}	35	—	ns	
Address setup time to write start	t_{AS}	0	—	ns	
Write recovery time from write end	t_{WR}	0	—	ns	
Data to write time overlap	t_{DW}	25	—	ns	
Data hold from write end	t_{DH}	0	—	ns	
Output enable from write end	t_{OW}	5	—	ns	11
Output disable to output in high-Z	t_{OHZ}	0	18	ns	11,12
Write to output in high-Z	t_{WHZ}	0	18	ns	11,12

Note 10. t_{WP} is the interval between write start and write end.

A write starts when all of (CS1#), (CS2), (WE#) and (one or both of LB# and UB#) become active.

A write is performed during the overlap of a low CS1#, a high CS2, a low WE# and a low LB# or a low UB#.

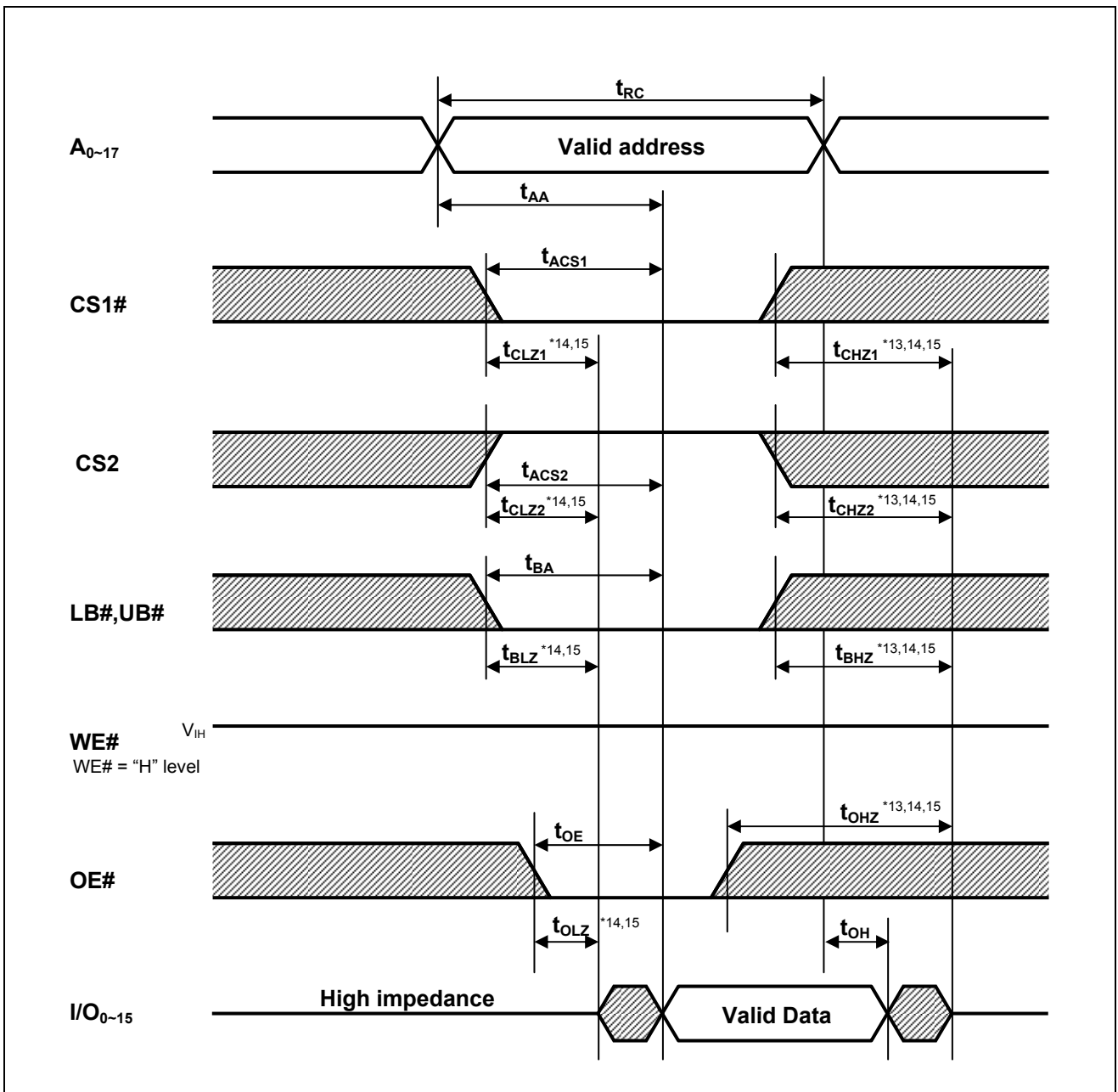
A write ends when any of (CS1#), (CS2), (WE#) or (one or both of LB# and UB#) becomes inactive.

11. This parameter is sampled and not 100% tested.

12. t_{OHZ} and t_{WHZ} are defined as the time when the I/O pins enter a high-impedance state and are not referred to the I/O levels.

Timing Waveforms

Read Cycle

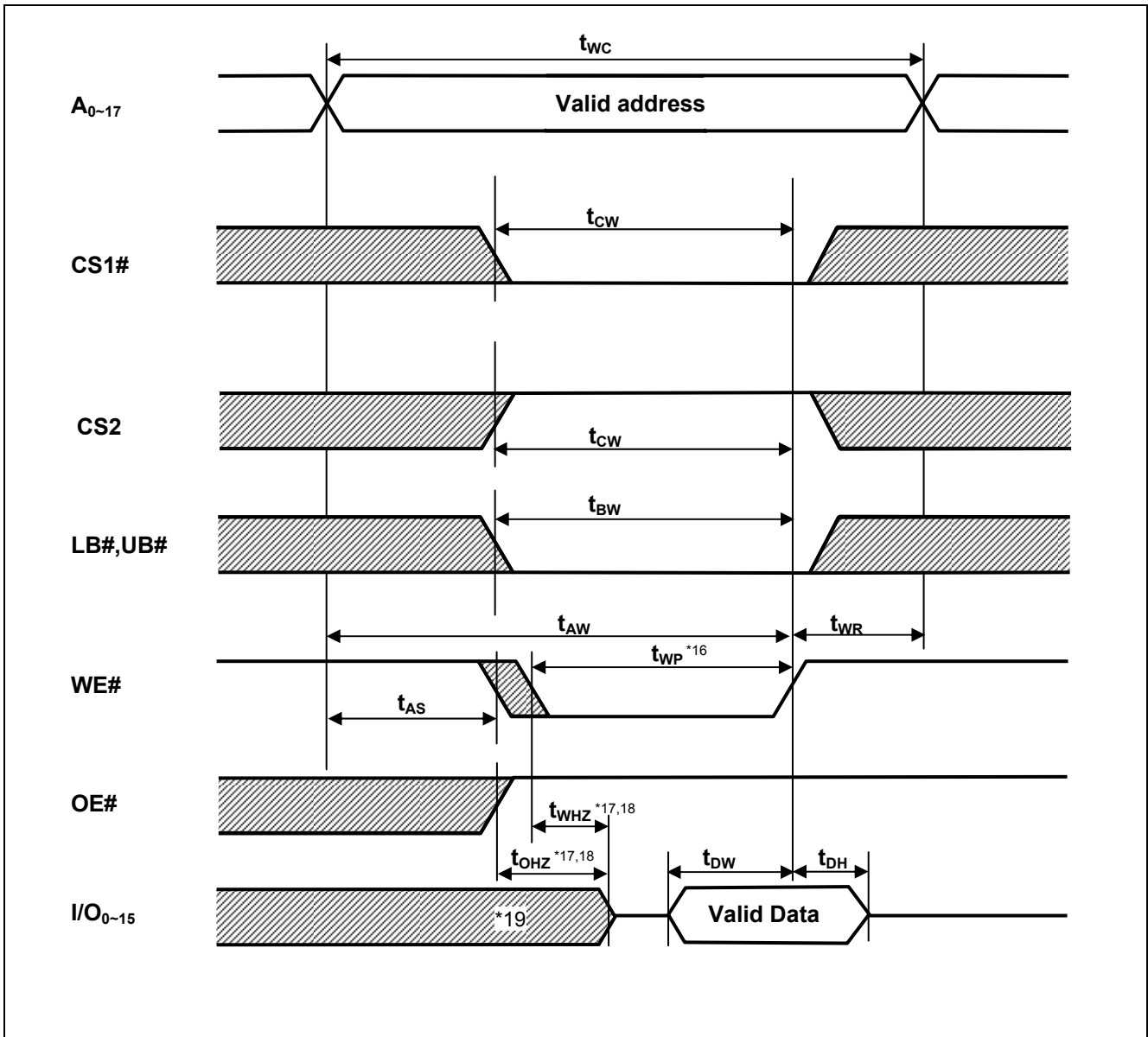


Note 13. t_{CHZ1} , t_{CHZ2} , t_{BHZ} and t_{OHZ} are defined as the time when the I/O pins enter a high-impedance state and are not referred to the I/O levels.

14. This parameter is sampled and not 100% tested

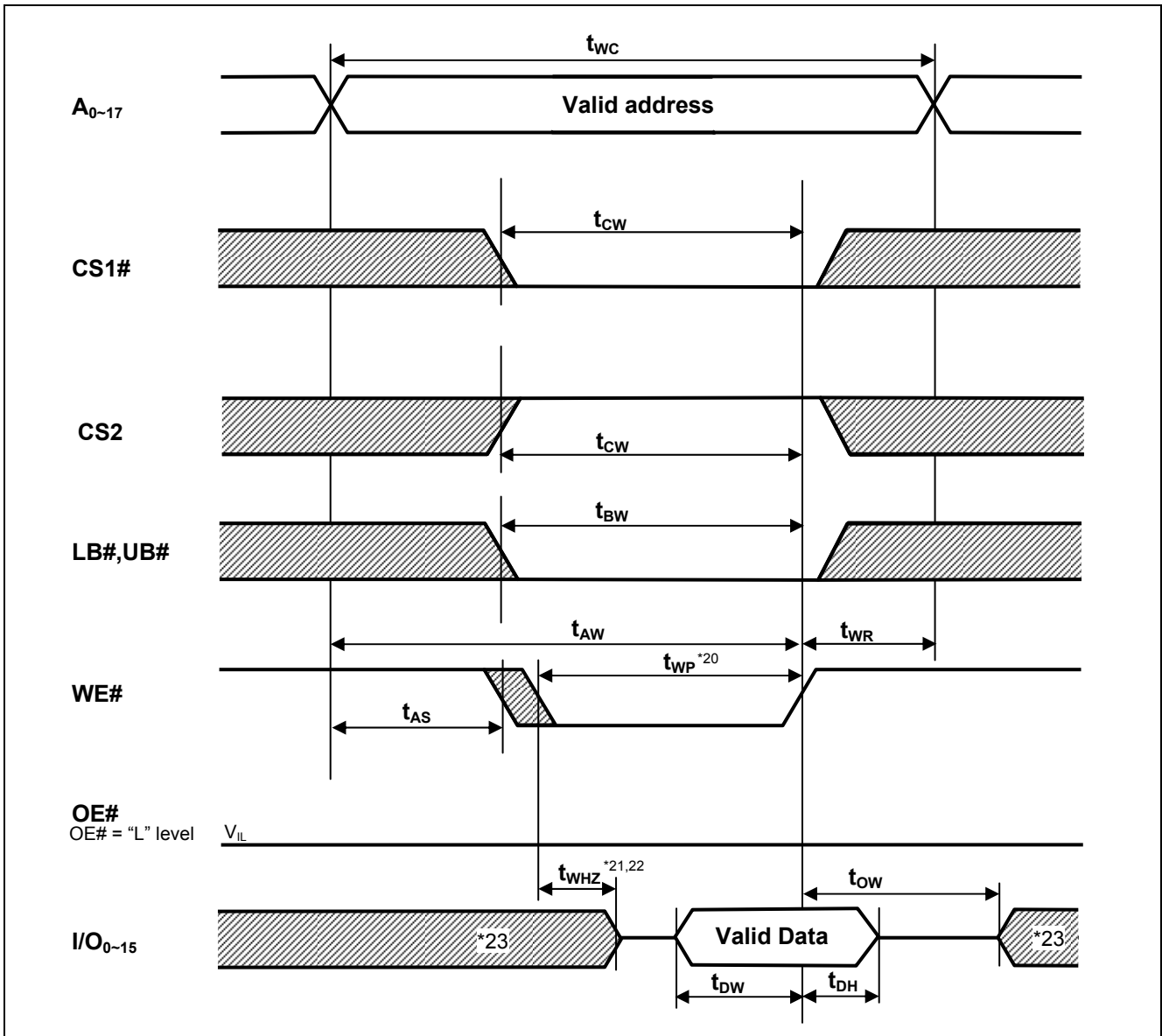
15. At any given temperature and voltage condition, t_{CHZ1} max is less than t_{CLZ1} min, t_{CHZ2} max is less than t_{CLZ2} min, t_{BHZ} max is less than t_{BLZ} min, and t_{OHZ} max is less than t_{OLZ} min, for any device.

Write Cycle (1) (WE# CLOCK, OE#="H" while writing)



- Note 16. t_{WP} is the minimum time to perform a write.
 A write starts when all of (CS1#), (CS2), (WE#) and (one or both of LB# and UB#) become active.
 A write is performed during the overlap of a low CS1#, a high CS2, a low WE# and a low LB# or a low UB#.
 A write ends when any of (CS1#), (CS2), (WE#) or (one or both of LB# and UB#) becomes inactive.
17. t_{OHZ} and t_{WHZ} are defined as the time when the I/O pins enter a high-impedance state and are not referred to the I/O levels.
18. This parameter is sampled and not 100% tested
19. During this period, I/O pins are in the output state so input signals must not be applied to the I/O pins.

Write Cycle (2) (WE# CLOCK, OE# Low Fixed)



Note 20. t_{WP} is the minimum time to perform a write.

A write starts when all of (CS1#), (CS2), (WE#) and (one or both of LB# and UB#) become active.

A write is performed during the overlap of a low CS1#, a high CS2, a low WE# and a low LB# or a low UB#.

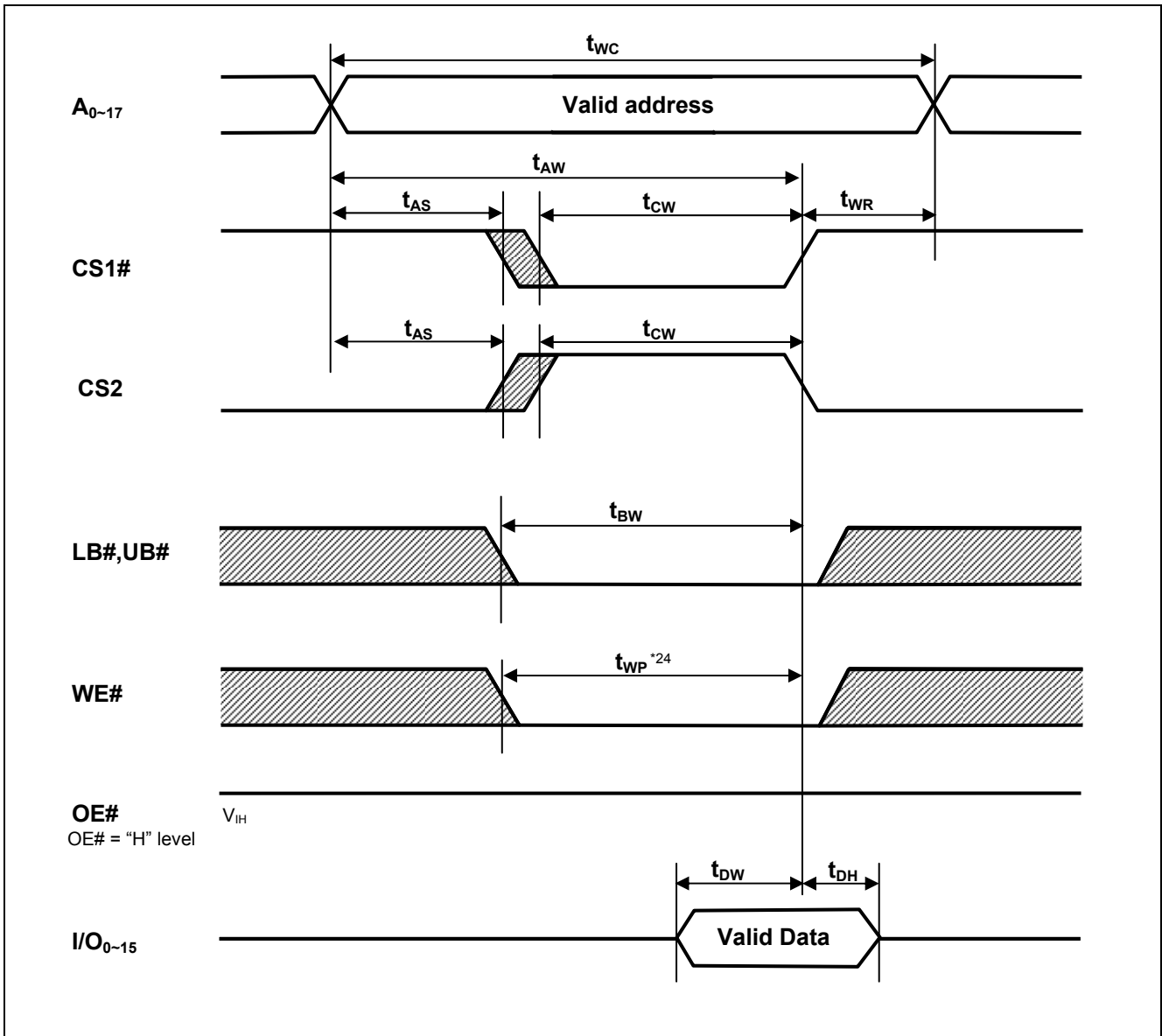
A write ends when any of (CS1#), (CS2), (WE#) or (one or both of LB# and UB#) becomes inactive.

21. t_{WHZ} is defined as the time when the I/O pins enter a high-impedance state and are not referred to the I/O levels.

22. This parameter is sampled and not 100% tested.

23. During this period, I/O pins are in the output state so input signals must not be applied to the I/O pins.

Write Cycle (3) (CS1#, CS2 CLOCK)



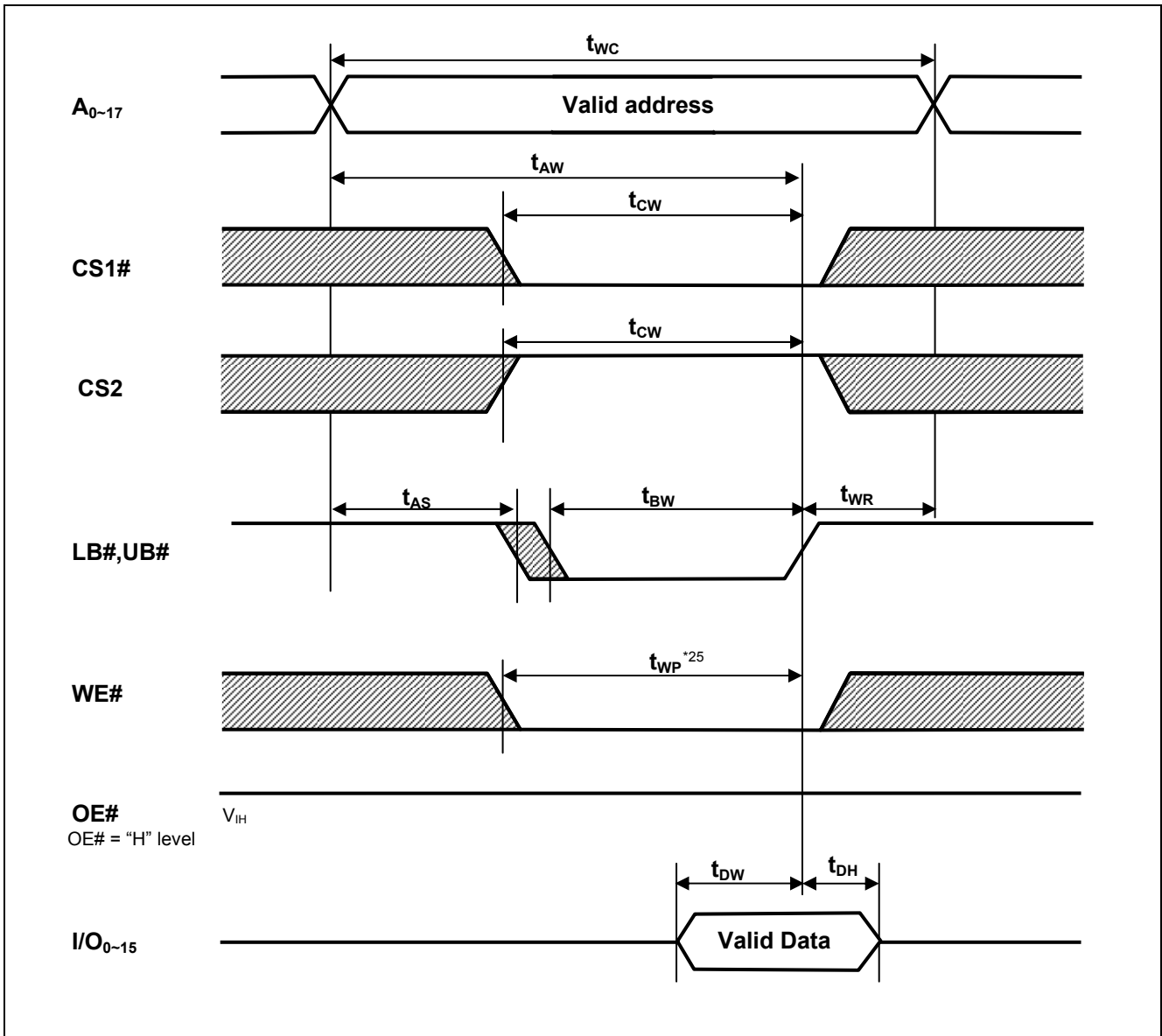
Note 24. t_{WP} is the minimum time to perform a write.

A write starts when all of (CS1#), (CS2), (WE#) and (one or both of LB# and UB#) become active.

A write is performed during the overlap of a low CS1#, a high CS2, a low WE# and a low LB# or a low UB#.

A write ends when any of (CS1#), (CS2), (WE#) or (one or both of LB# and UB#) becomes inactive.

Write Cycle (4) (LB#, UB# CLOCK)



Note 25. t_{WP} is the minimum time to perform a write.

A write starts when all of (CS1#), (CS2), (WE#) and (one or both of LB# and UB#) become active.

A write is performed during the overlap of a low CS1#, a high CS2, a low WE# and a low LB# or a low UB#.

A write ends when any of (CS1#), (CS2), (WE#) or (one or both of LB# and UB#) becomes inactive.

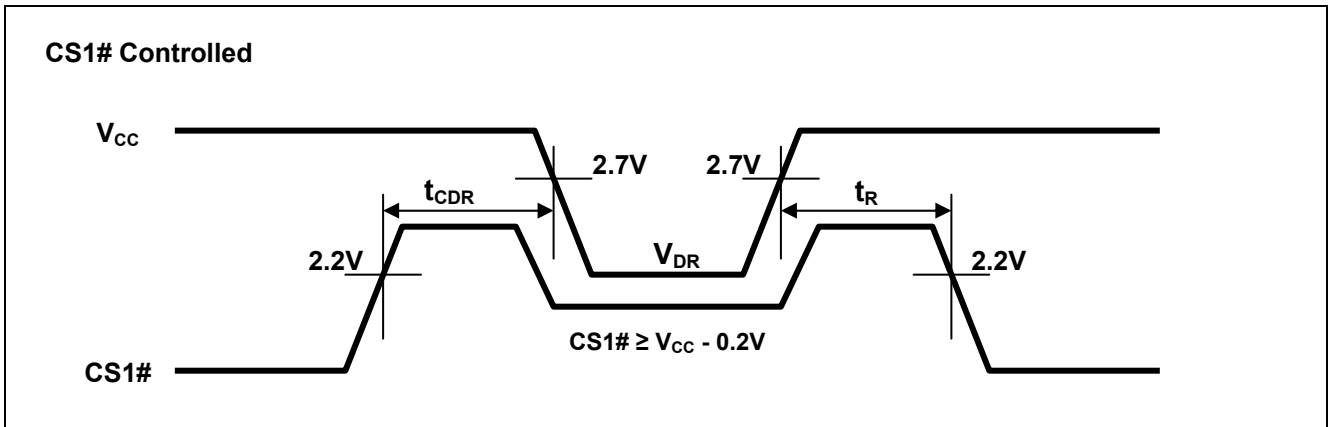
Low V_{CC} Data Retention Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions ^{*27}	
V_{CC} for data retention	V_{DR}	1.5	—	—	V	$V_{in} \geq 0V$, (1) $CS2 \leq 0.2V$ or (2) $CS1\# \geq V_{CC}-0.2V$, $CS2 \geq V_{CC}-0.2V$ or (3) $LB\# = UB\# \geq V_{CC}-0.2V$, $CS1\# \leq 0.2V$, $CS2 \geq V_{CC}-0.2V$	
Data retention current	I_{CCDR}	—	0.4 ^{*26}	2	μA	$\sim +25^{\circ}C$	$V_{CC} = 3.0V$, $V_{in} \geq 0V$, (1) $CS2 \leq 0.2V$ or (2) $CS1\# \geq V_{CC}-0.2V$, $CS2 \geq V_{CC}-0.2V$ or (3) $LB\# = UB\# \geq V_{CC}-0.2V$, $CS1\# \leq 0.2V$, $CS2 \geq V_{CC}-0.2V$
		—	—	3	μA	$\sim +40^{\circ}C$	
		—	—	5	μA	$\sim +70^{\circ}C$	
		—	—	7	μA	$\sim +85^{\circ}C$	
Chip deselect time to data retention	t_{CDR}	0	—	—	ns	See retention waveform.	
Operation recovery time	t_R	5	—	—	ms		

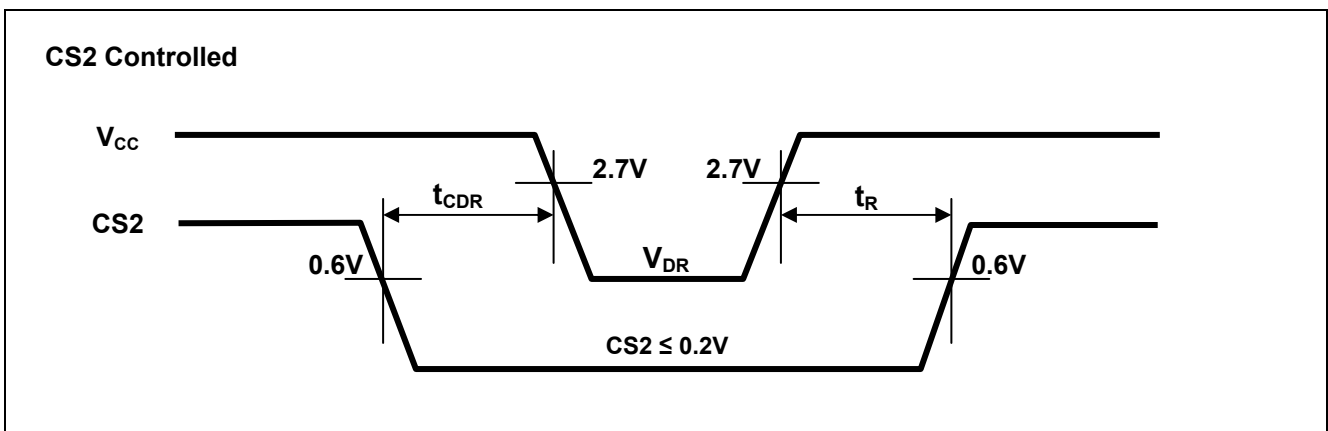
Note 26. Typical parameter indicates the value for the center of distribution at 3.0V ($T_a=25^{\circ}C$), and not 100% tested.

27. CS2 controls address buffer, WE# buffer, CS1# buffer, OE# buffer, LB# buffer, UB# buffer and I/O buffer. If CS2 controls data retention mode, V_{in} levels (address, WE#, CS1#, OE#, LB#, UB#, I/O) can be in the high impedance state. If CS1# controls data retention mode, CS2 must be $CS2 \geq V_{CC}-0.2V$ or $CS2 \leq 0.2V$. The other inputs levels (address, WE#, OE#, LB#, UB#, I/O) can be in the high-impedance state.

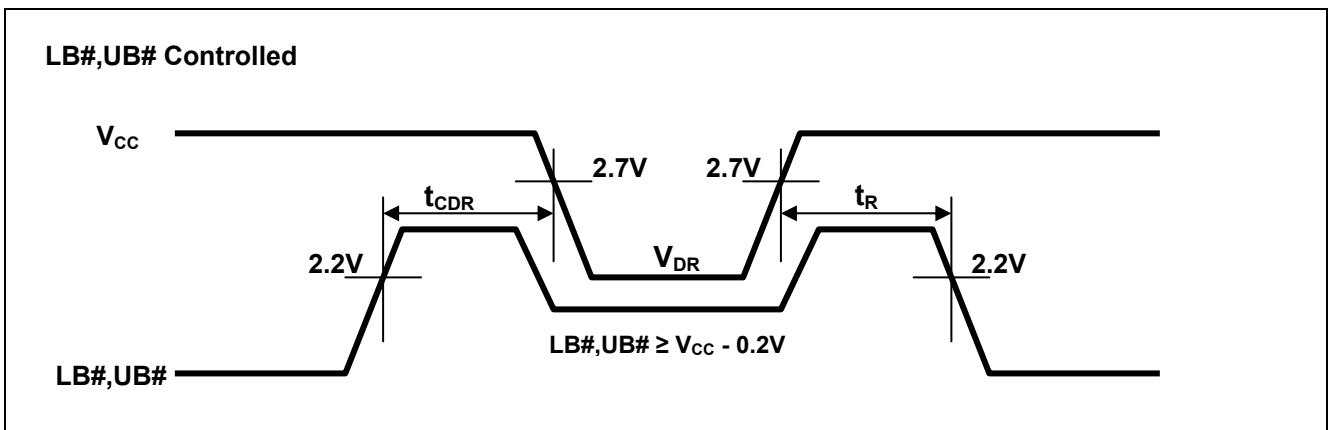
Low Vcc Data Retention Timing Waveforms (CS1# controlled)



Low Vcc Data Retention Timing Waveforms (CS2 controlled)



Low Vcc Data Retention Timing Waveforms (LB#,UB# controlled)



Revision History	RMLV0416E Series Data Sheet
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Rev.	Date	Description	
		Page	Summary
1.00	2014.2.27	—	First edition issued
2.00	2016.1.12	1	Changed section from “Part Name Information” to “Orderable part number information”

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Renesas Electronics America Inc.

2801 Scott Boulevard Santa Clara, CA 95050-2549, U.S.A.
Tel: +1-408-588-6000, Fax: +1-408-588-6130

Renesas Electronics Canada Limited

9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited

Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: +44-1628-585-100, Fax: +44-1628-585-900

Renesas Electronics Europe GmbH

Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.

Room 1709, Quantum Plaza, No.27 ZhiChunLu Haidian District, Beijing 100191, P.R.China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.

Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, P. R. China 200333
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited

Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022

Renesas Electronics Taiwan Co., Ltd.

13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

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80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

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