

RMLV0414E Series

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

R10DS0216EJ0300
Rev.3.00
2021.8.18

Description

The RMLV0414E 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 RMLV0414E Series has realized higher density, higher performance and low power consumption. The RMLV0414E Series offers low power standby power dissipation; therefore, it is suitable for battery backup systems. It is offered in 44-pin TSOP (II).

Features

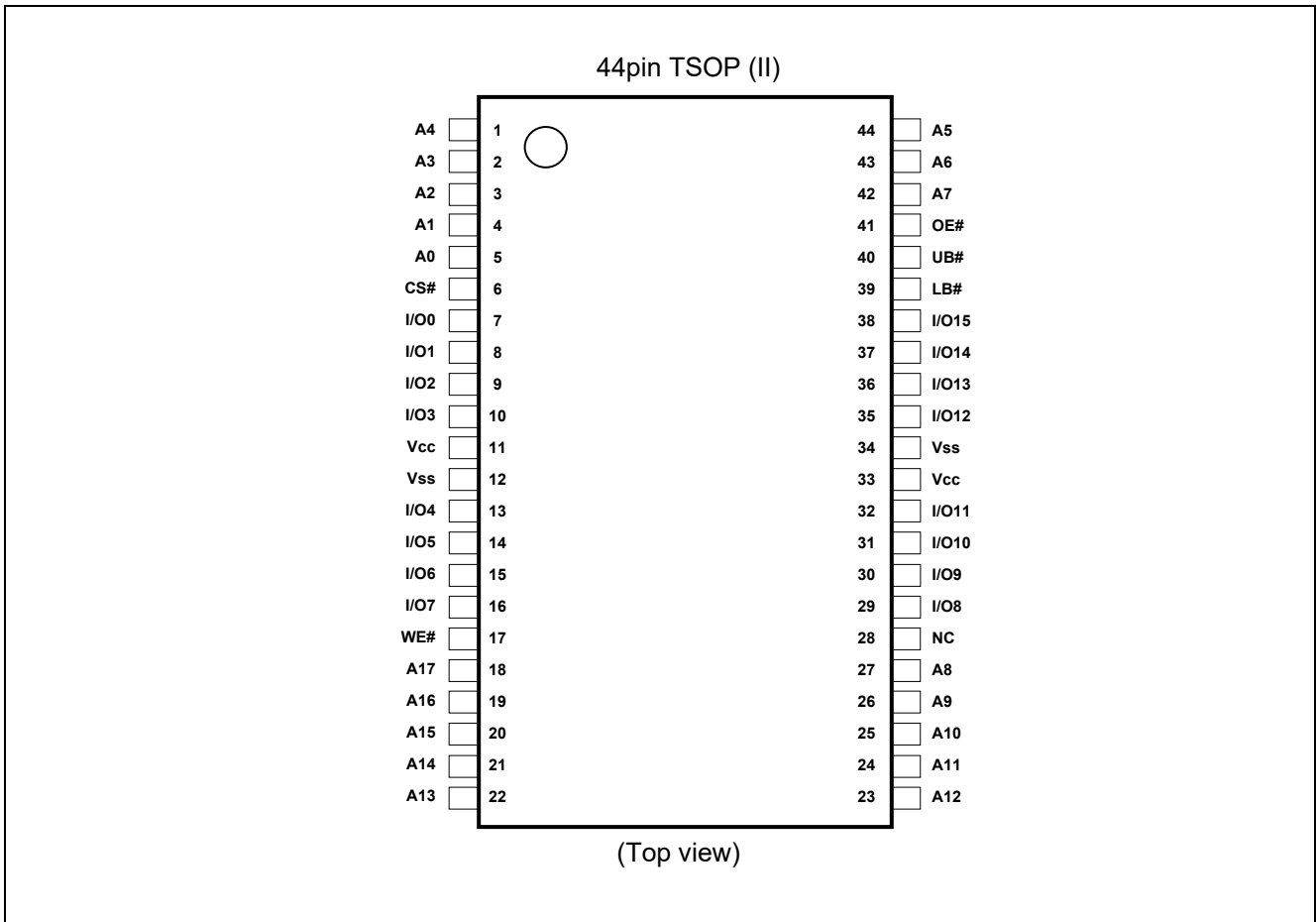
- Single 3V supply: 2.7V to 3.6V
- Access time: 45ns (max.)
- Current consumption:
 - Standby: 0.3μA (typ.)
- Equal access and cycle times
- Common data input and output
 - Three state output
- Directly TTL compatible
 - All inputs and outputs
- Battery backup operation

Orderable part number information

Part name	Access time	Temperature range	Package	Shipping container
RMLV0414EGSB-4S2#AA*	45 ns	-40 ~ +85°C	400-mil 44pin plastic TSOP (II)	Tray
RMLV0414EGSB-4S2#HA*				Embossed tape

Note 1. * = Revision code for Assembly site change, etc. (* = 0, 1, etc.)

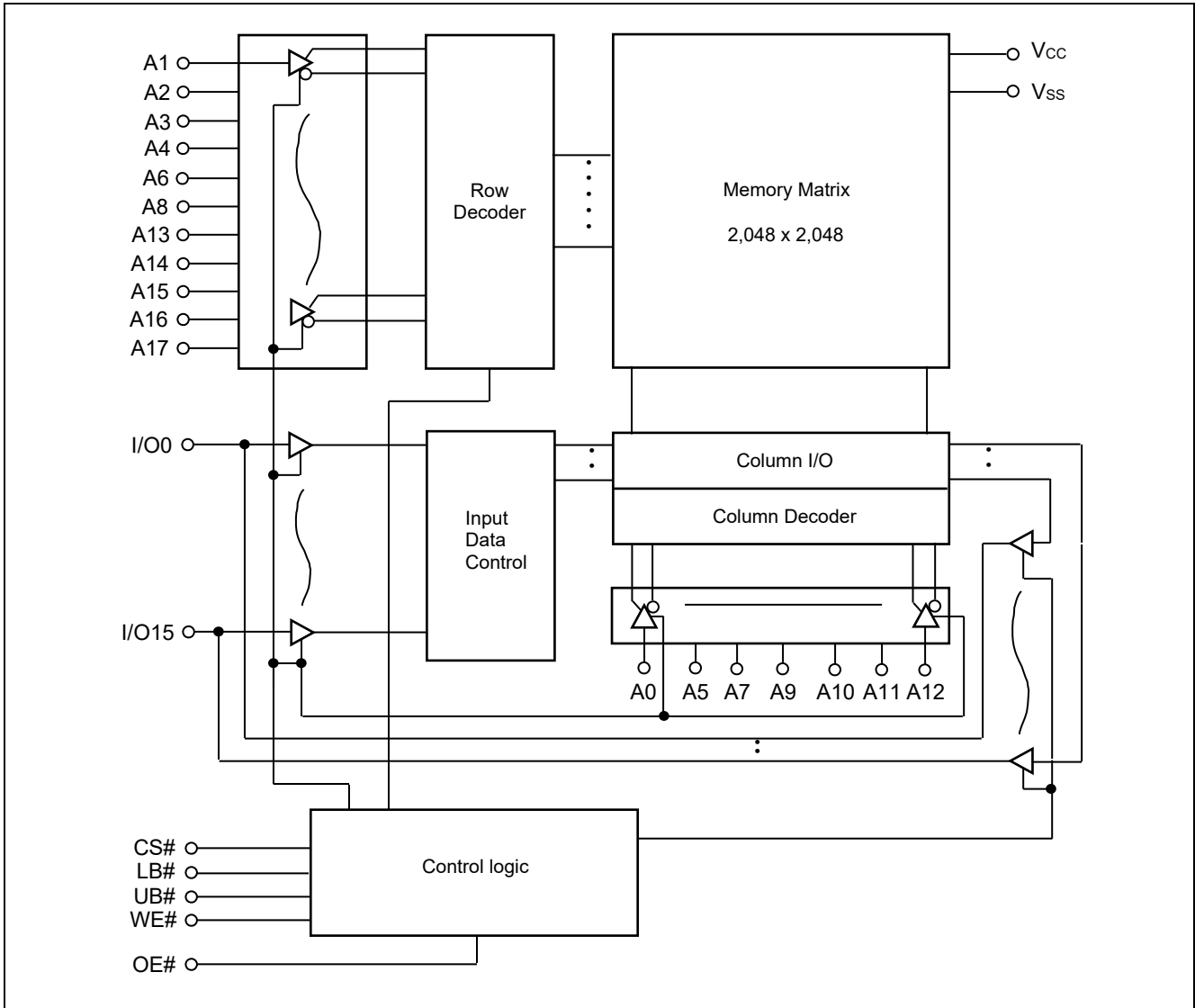
Pin Arrangement



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
CS#	Chip select
OE#	Output enable
WE#	Write enable
LB#	Lower byte select
UB#	Upper byte select
NC	No connection

Block Diagram



Operation Table

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

Note 2. 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 ^{*3} to V _{CC} +0.3 ^{*4}	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 3. -3.0V for pulse ≤ 30ns (full width at half maximum)

4. 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	5
Ambient temperature range	T _a	-40	—	+85	°C	

Note 5. -3.0V for pulse ≤ 30ns (full width at half maximum)

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	CS# = V _{IH} 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	CS# = V _{IL} , Others = V _{IH} /V _{IL} , I _{I/O} = 0mA	
Average operating current	I _{CC1}	—	—	20	mA	Cycle = 55ns, duty = 100%, I _{I/O} = 0mA, CS# = V _{IL} , Others = V _{IH} /V _{IL}	
		—	—	25	mA	Cycle = 45ns, duty = 100%, I _{I/O} = 0mA, CS# = V _{IL} , Others = V _{IH} /V _{IL}	
	I _{CC2}	—	—	2.5	mA	Cycle = 1μs, duty = 100%, I _{I/O} = 0mA CS# ≤ 0.2V, V _{IH} ≥ V _{CC} -0.2V, V _{IL} ≤ 0.2V	
Standby current	I _{SB}	—	0.1 ^{*6}	0.3	mA	CS# = V _{IH} , Others = V _{SS} to V _{CC}	
Standby current	I _{SB1}	—	0.3 ^{*6}	2	μA	~+25°C	V _{in} = V _{SS} to V _{CC} , (1) CS# ≥ V _{CC} -0.2V or (2) LB# = UB# ≥ V _{CC} -0.2V, CS# ≤ 0.2V
		—	—	3	μA	~+40°C	
		—	—	5	μA	~+70°C	
		—	—	7	μA	~+85°C	
Output high voltage	V _{OH}	2.4	—	—	V	I _{OH} = -1mA	
	V _{OH2}	V _{CC} -0.2	—	—	V	I _{OH} = -0.1mA	
Output low voltage	V _{OL}	—	—	0.4	V	I _{OL} = 2mA	
	V _{OL2}	—	—	0.2	V	I _{OL} = 0.1mA	

Note 6. Typical parameter indicates the value for the center of distribution at 3.0V (T_a=25°C), and not 100% tested.

Capacitance

(V_{CC} = 2.7V ~ 3.6V, f = 1MHz, T_a = -40 ~ +85°C)

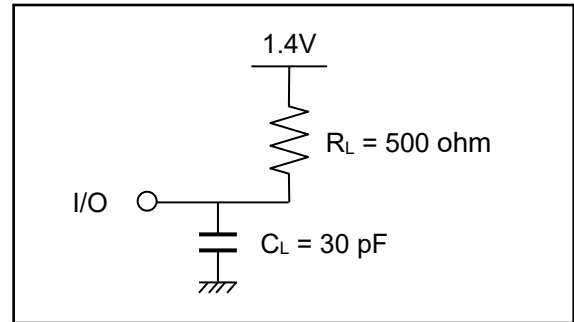
Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions	Note
Input capacitance	C _{in}	—	—	8	pF	V _{in} = 0V	7
Input / output capacitance	C _{I/O}	—	—	10	pF	V _{I/O} = 0V	7

Note 7. 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_{ACS}	—	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_{CLZ}	10	—	ns	8,9
LB#, UB# enable to low-Z	t_{BLZ}	5	—	ns	8,9
Output enable to output in low-Z	t_{OLZ}	5	—	ns	8,9
Chip deselect to output in high-Z	t_{CHZ}	0	18	ns	8,9,10
LB#, UB# disable to high-Z	t_{BHZ}	0	18	ns	8,9,10
Output disable to output in high-Z	t_{OHZ}	0	18	ns	8,9,10

Note 8. This parameter is sampled and not 100% tested.

9. At any given temperature and voltage condition, t_{CHZ} max is less than t_{CLZ} min, t_{BHZ} max is less than t_{BLZ} min, and t_{OHZ} max is less than t_{OLZ} min, for any device.

10. t_{CHZ} , 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	11
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	12
Output disable to output in high-Z	t_{OHZ}	0	18	ns	12,13
Write to output in high-Z	t_{WHZ}	0	18	ns	12,13

Note 11. t_{WP} is the interval between write start and write end.

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

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

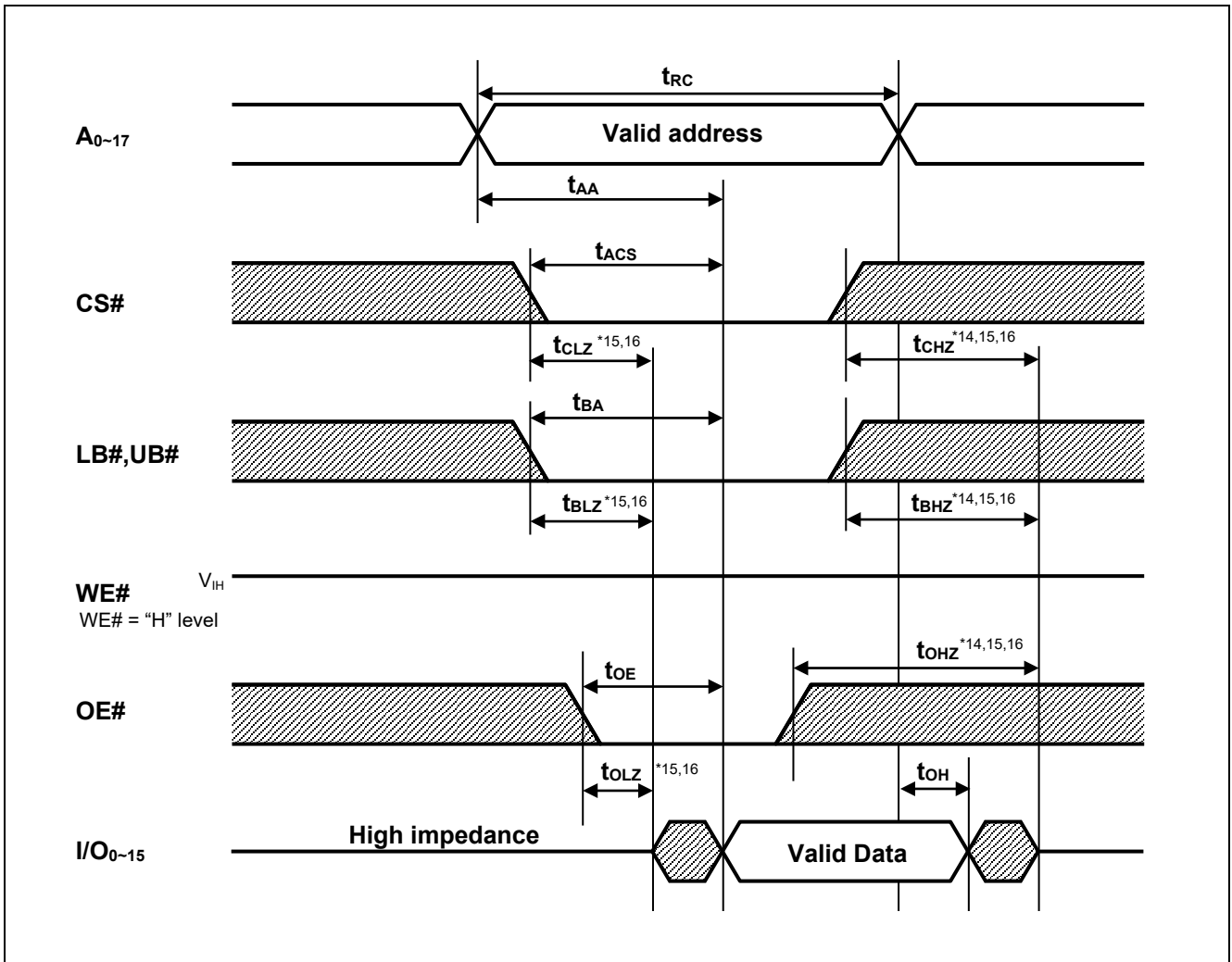
A write ends when any of (CS#), (WE#) or (one or both of LB# and UB#) becomes inactive.

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

13. 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.

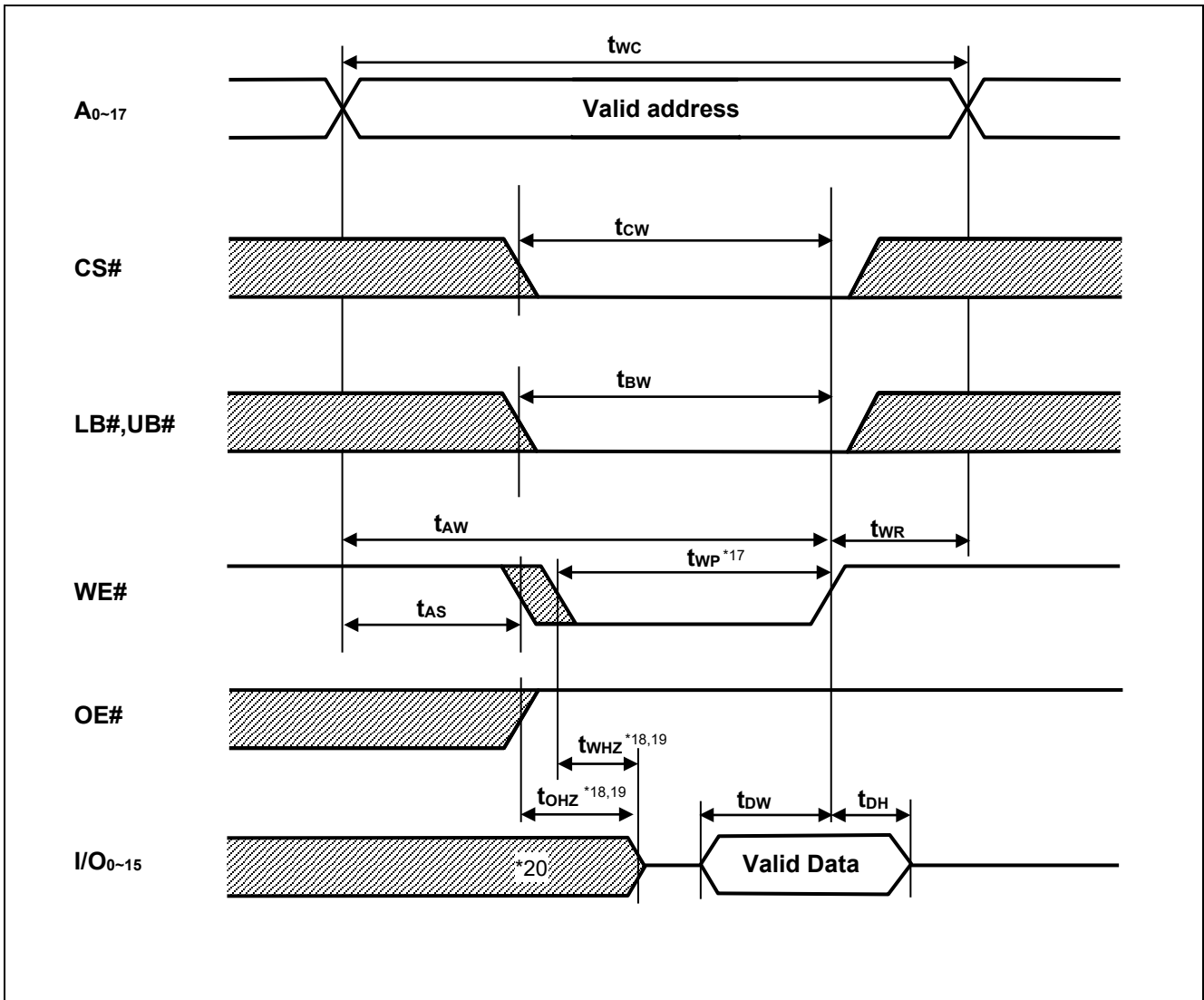
Timing Waveforms

Read Cycle



- Note 14. t_{CHZ} , 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.
15. This parameter is sampled and not 100% tested.
16. At any given temperature and voltage condition, t_{CHZ} max is less than t_{CLZ} 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 17. t_{WP} is the interval between write start and write end.

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

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

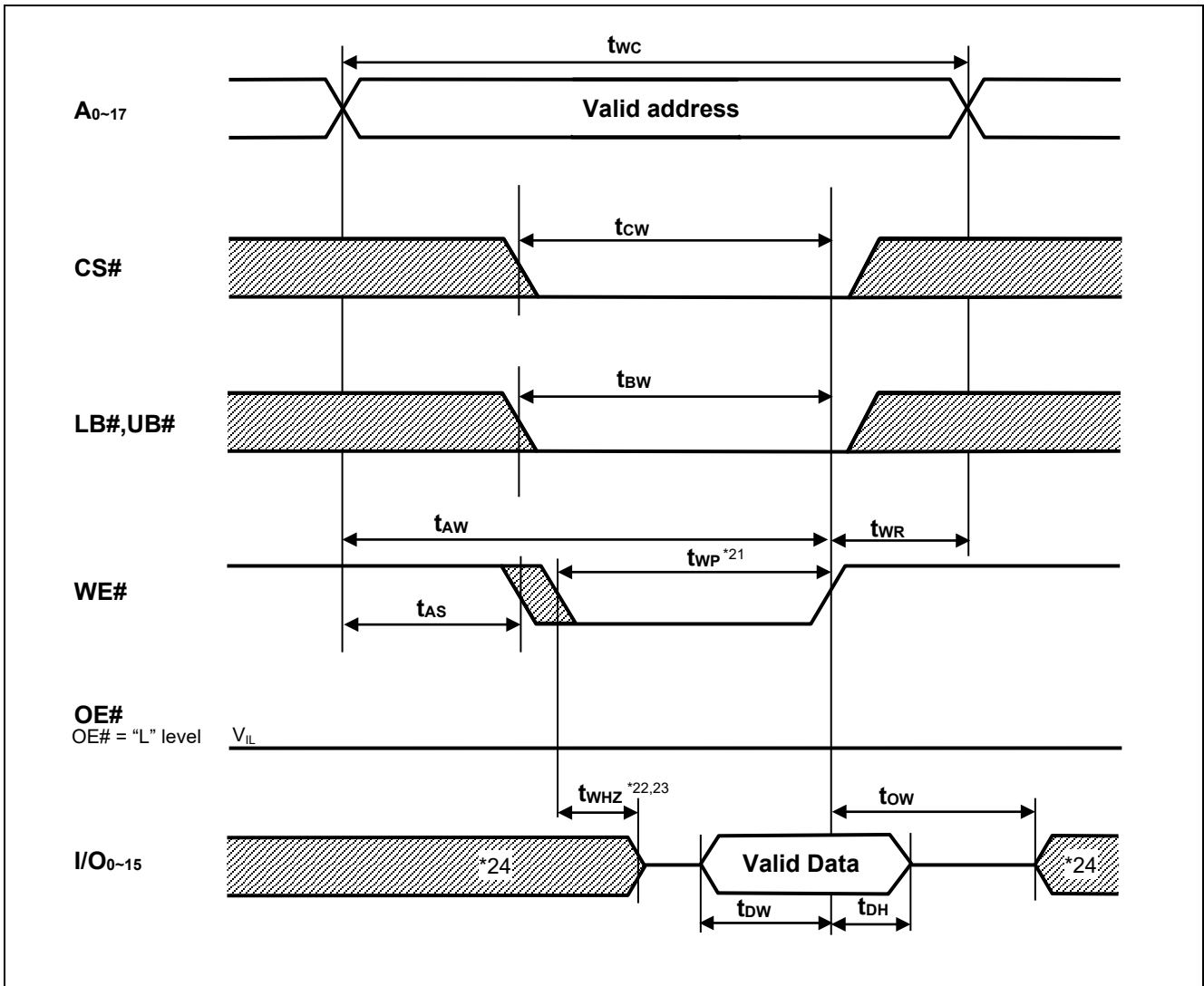
A write ends when any of (CS#), (WE#) or (one or both of LB# and UB#) becomes inactive.

18. 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.

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

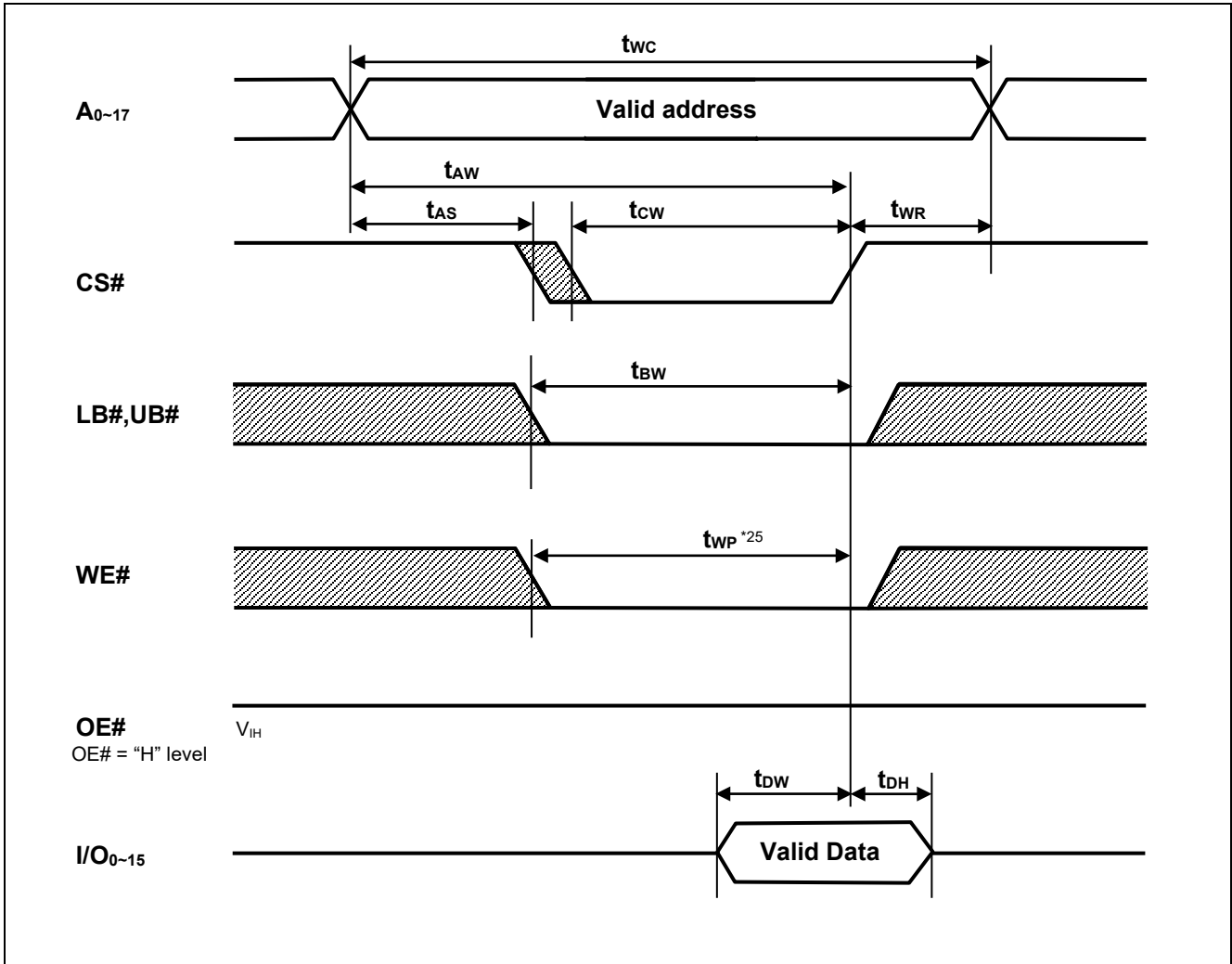
20. During this period, I/O pins are in the output state so input signals must not be applied to the I/O pins.

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



- Note 21. t_{WP} is the interval between write start and write end.
 A write starts when all of (CS#), (WE#) and (one or both of LB# and UB#) become active.
 A write is performed during the overlap of a low CS#, a low WE# and a low LB# or a low UB#.
 A write ends when any of (CS#), (WE#) or (one or both of LB# and UB#) becomes inactive.
22. 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.
23. This parameter is sampled and not 100% tested.
24. 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) (CS# CLOCK)



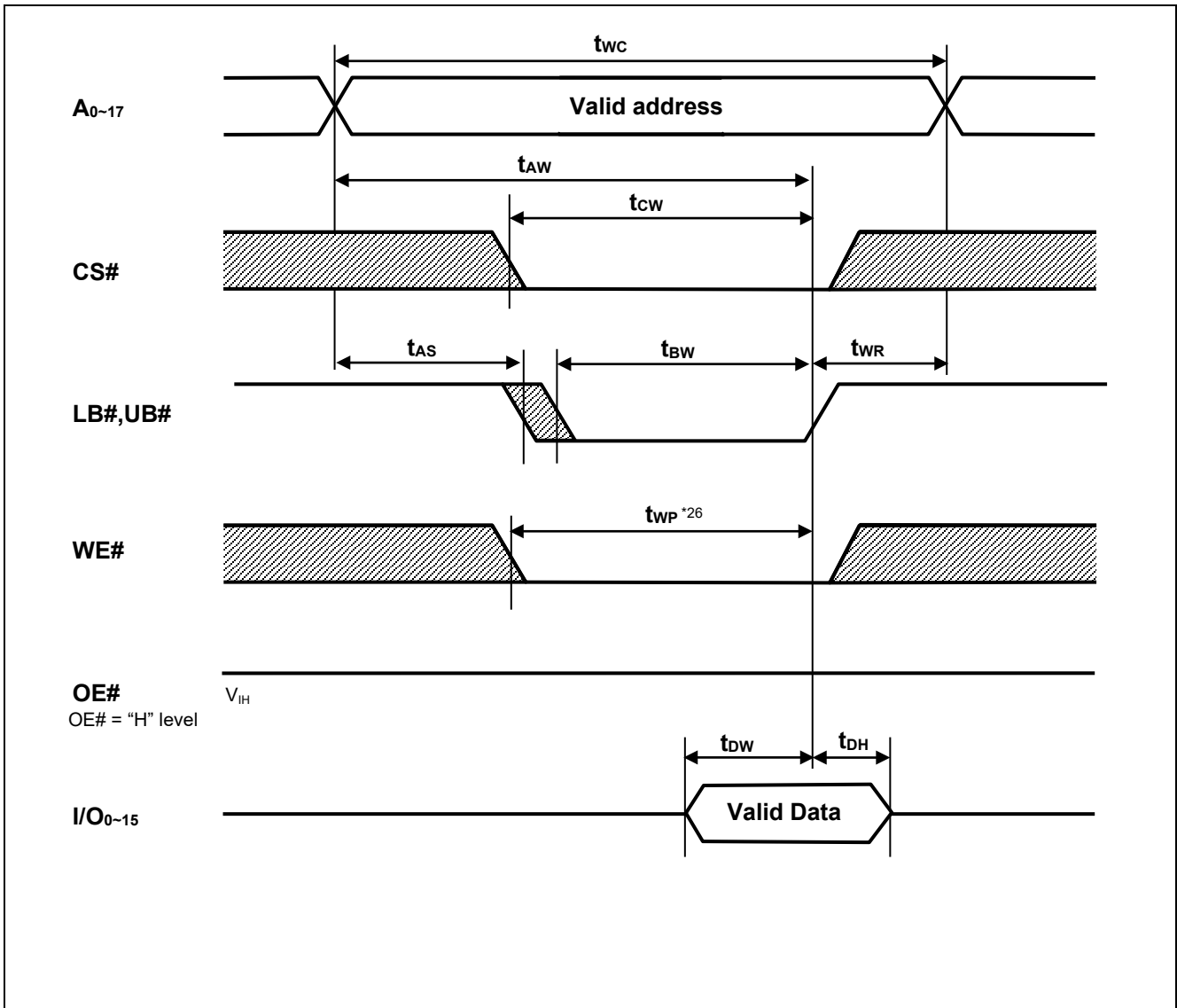
Note 25. t_{WP} is the interval between write start and write end.

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

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

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

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



Note 26. t_{WP} is the interval between write start and write end.

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

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

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

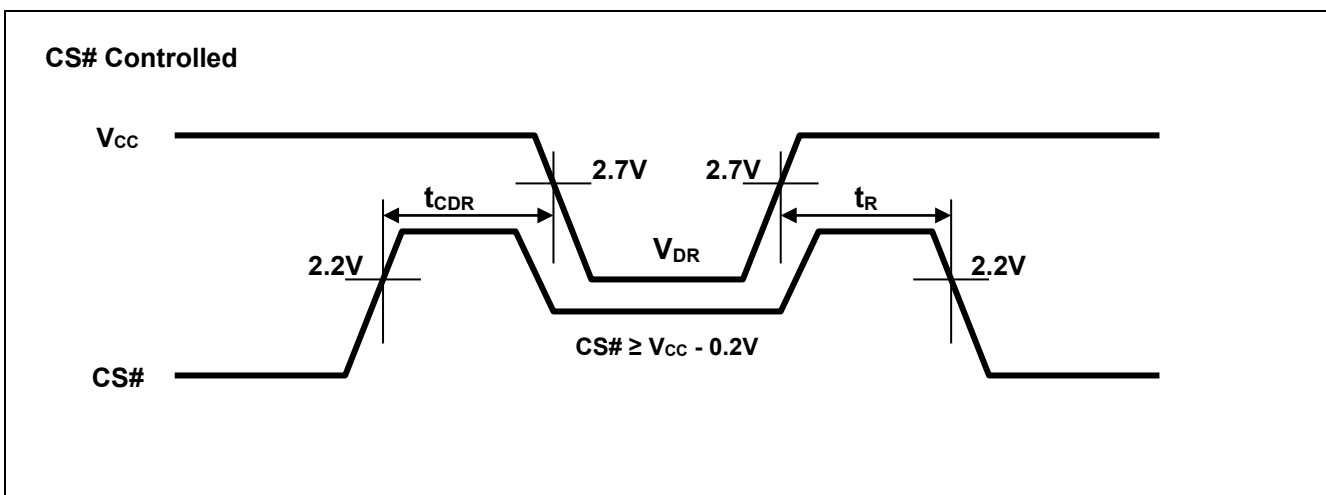
Low V_{CC} Data Retention Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions ^{*28}
V _{CC} for data retention	V _{DR}	1.5	—	—	V	V _{in} ≥ 0V, (1) CS# ≥ V _{CC} -0.2V or (2) LB# = UB# ≥ V _{CC} -0.2V, CS# ≤ 0.2V
Data retention current	I _{CCDR}	—	0.3 ^{*27}	2	μA	~+25°C
		—	—	3	μA	~+40°C
		—	—	5	μA	~+70°C
		—	—	7	μA	~+85°C
Chip deselect time to data retention	t _{CDR}	0	—	—	ns	See retention waveform.
Operation recovery time	t _R	5	—	—	ms	

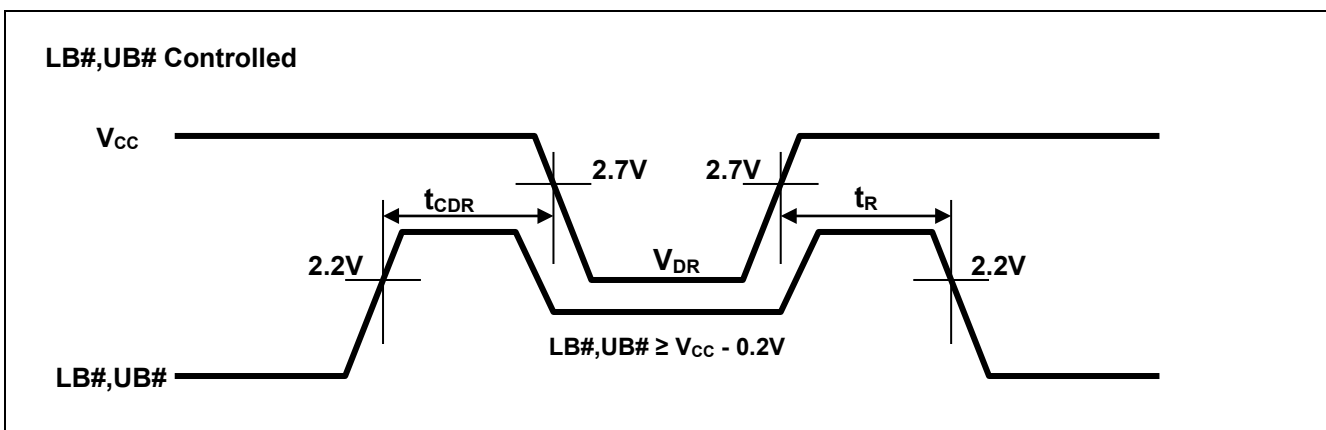
Note 27. Typical parameter indicates the value for the center of distribution at 3.0V (T_a=25°C), and not 100% tested.

28. CS# controls address buffer, WE# buffer, OE# buffer, LB# buffer, UB# buffer and I/O buffer. If CS# controls data retention mode, V_{in} levels (address, WE#, OE#, LB#,UB#, I/O) can be in the high-impedance state.

Low V_{CC} Data Retention Timing Waveforms (CS# controlled)



Low V_{CC} Data Retention Timing Waveforms (LB#,UB# controlled)



Revision History	RMLV0414E 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”
2.01	2020.2.20	Last page	Updated the Notice to the latest version
3.00	2021.8.18	1,4,12	Changed the typical value of I_{SB1} and I_{CCDR} from $0.4\mu A$ to $0.3\mu A$. Revised orderable part number information

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