RMLV1616A Series

16Mb Advanced LPSRAM (1M word × 16bit / 2M word x 8bit)

R10DS0258EJ0100
Rev.1.00
2016.01.06

Description

The RMLV1616A Series is a family of 16-Mbit static RAMs organized 1,048,576-word × 16-bit, fabricated by Renesas's high-performance Advanced LPSRAM technologies. The RMLV1616A Series has realized higher density, higher performance and low power consumption. The RMLV1616A Series offers low power standby power dissipation; therefore, it is suitable for battery backup systems. It is offered in 48pin TSOP (I), 52pin µTSOP (II) or 48-ball fine pitch ball grid array.

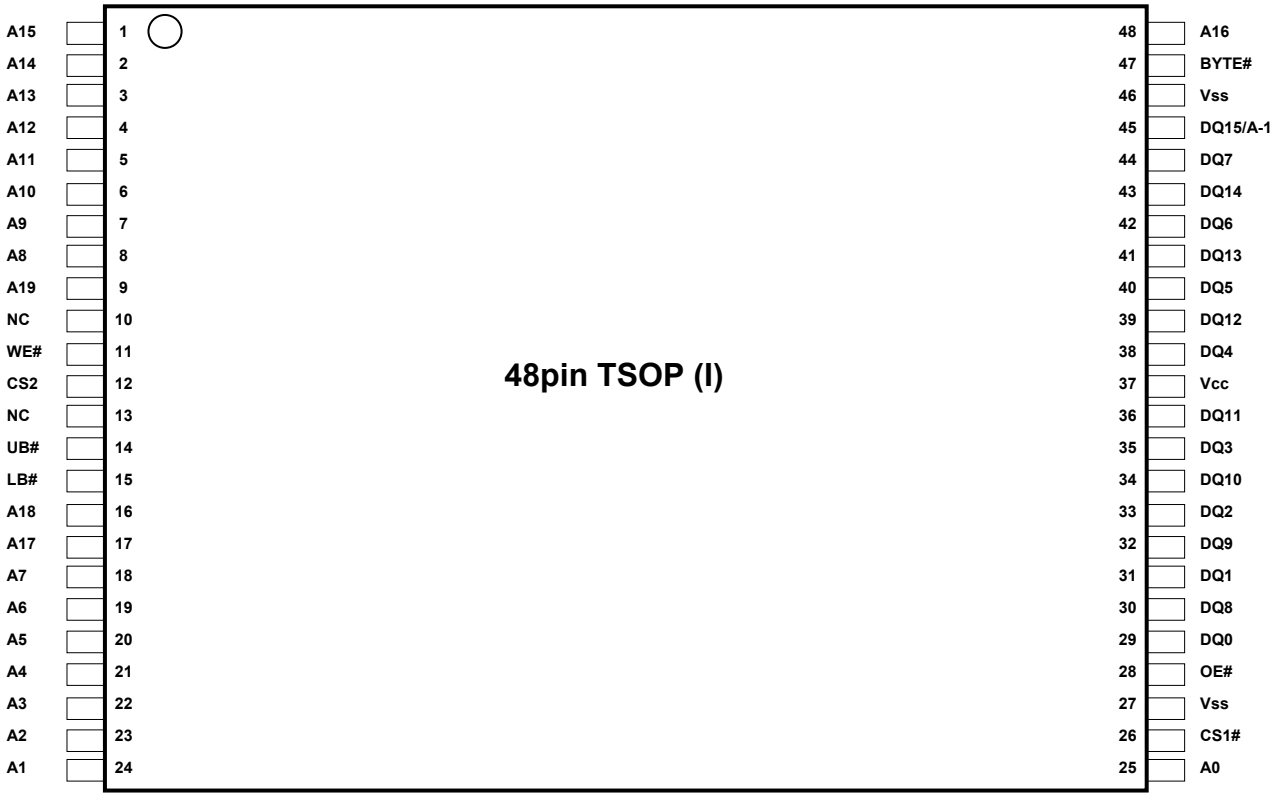
Features

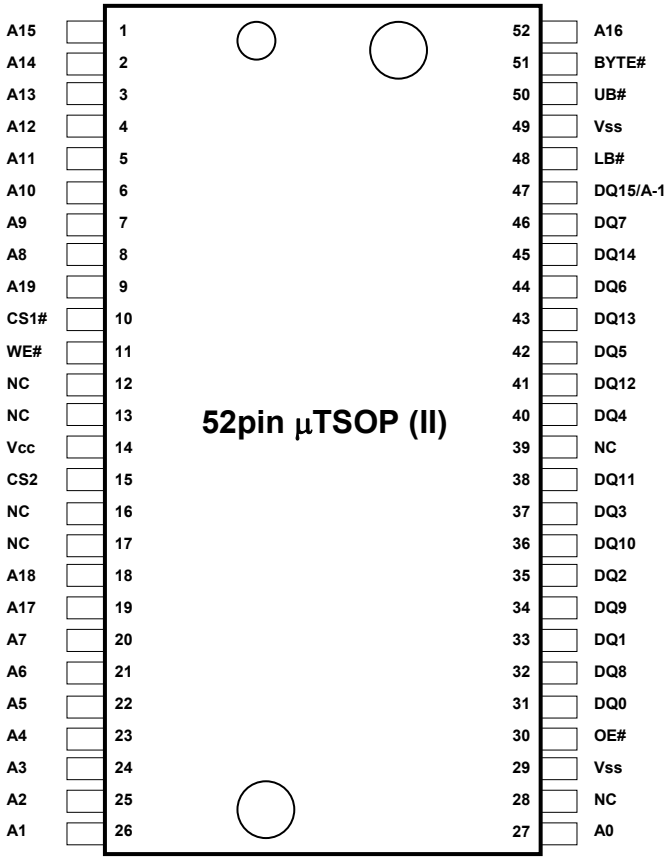
- Single 3V supply: 2.7V to 3.6V
- Access time: 55ns (max.)
- Current consumption:
  — Standby: 0.5µA (typ.)
- Common data input and output
  — Three state output
- Directly TTL compatible
  — All inputs and outputs
- Battery backup operation

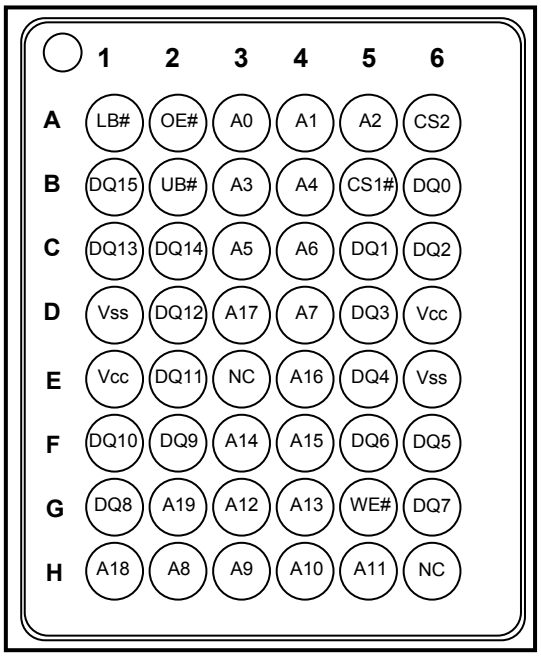
Part Name Information

Part Name	Access time	Temperature Range	Package
RMLV1616AGSA-5S2	55 ns	-40 ~ +85°C	12mm x 20mm 48pin plastic TSOP (I)
RMLV1616AGSD-5S2			10.79mm × 10.49mm 52pin plastic µTSOP (II)
RMLV1616AGBG-5S2			48-ball FBGA with 0.75mm ball pitch

Pin Arrangement



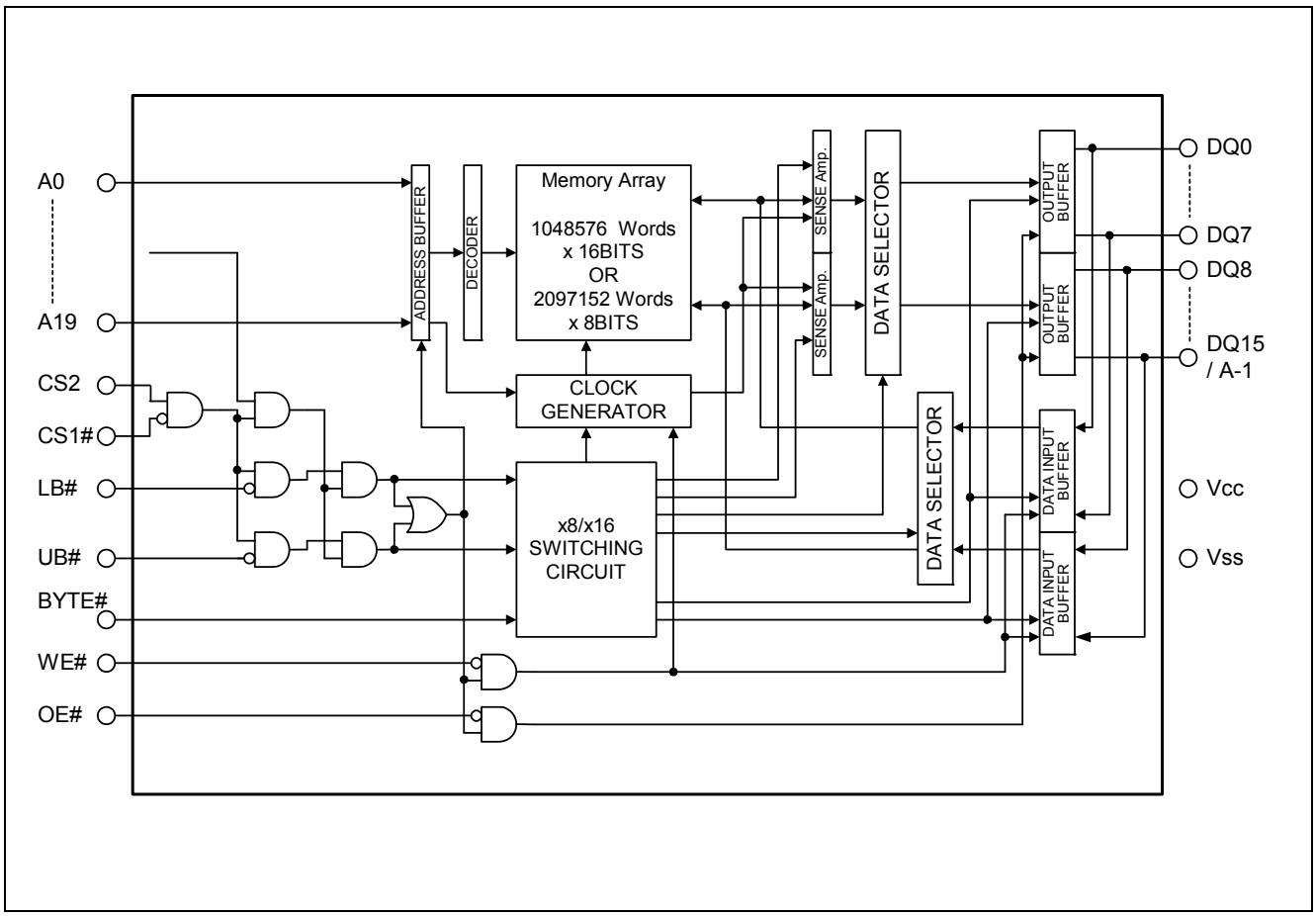




Pin Description

Pin name	Function
V_{CC}	Power supply
V_{SS}	Ground
A0 to A19	Address input (word mode)
A-1 to A19	Address input (byte mode)
DQ0 to DQ15	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
BYTE#	Byte control mode enable
NC	No connection

Block Diagram



Note 1. BYTE# pin supported by only 48pin TSOP (I) and 52pin µTSOP (II) types.

Operation Table

CS1#	CS2	BYTE#	UB#	LB#	WE#	OE#	DQ0~7	DQ8~14	DQ15	Operation
H	X	X	X	X	X	X	High-Z	High-Z	High-Z	Stand-by
X	L	X	X	X	X	X	High-Z	High-Z	High-Z	Stand-by
X	X	H	H	H	X	X	High-Z	High-Z	High-Z	Stand-by
L	H	H	H	L	L	X	Din	High-Z	High-Z	Write in lower byte
L	H	H	H	L	H	L	Dout	High-Z	High-Z	Read in lower byte
L	H	H	H	L	H	H	High-Z	High-Z	High-Z	Output disable
L	H	H	L	H	L	X	High-Z	Din	Din	Write in upper byte
L	H	H	L	H	H	L	High-Z	Dout	Dout	Read in upper byte
L	H	H	L	H	H	H	High-Z	High-Z	High-Z	Output disable
L	H	H	L	L	L	X	Din	Din	Din	Word write
L	H	H	L	L	H	L	Dout	Dout	Dout	Word read
L	H	H	L	L	H	H	High-Z	High-Z	High-Z	Output disable
L	H	L	X	X	L	X	Din	High-Z	A-1	Byte write
L	H	L	X	X	H	L	Dout	High-Z	A-1	Byte read
L	H	L	X	X	H	H	High-Z	High-Z	A-1	Output disable

Note 2. H: V_{IH} L:V_{IL} X: V_{IH} or V_{IL}

3. BYTE# pin supported by only 48pin TSOP (I) and 52pin µTSOP (II) types.
48-ball FBGA type equals BYTE#=H mode.

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[*4] to V_{CC}+0.3[*5]	V
Power dissipation	P_T	0.7	W
Operation temperature	Topr	-40 to +85	°C
Storage temperature range	Tstg	-65 to +150	°C
Storage temperature range under bias	Tbias	-40 to +85	°C

Note 4. -2.0V for pulse ≤ 30ns (full width at half maximum)

5. 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	6
Ambient temperature range	Ta	-40	—	+85	°C	

Note 6. -2.0V for pulse ≤ 30ns (full width at half maximum)

DC Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions[*7]
Input leakage current	$\lvert I_{LI} \rvert$	—	—	1	µA	Vin = V_{SS} to V_{CC}
Output leakage current	$\lvert I_{LO} \rvert$	—	—	1	µA	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}
Average operating current	I_{CC1}	—	23[*8]	30	mA	Cycle = 55ns, duty =100%, $I_{I/O}$ = 0mA, CS1# = V_{IL}, CS2 = V_{IH}, Others = V_{IH}/V_{IL}
	I_{CC2}	—	1.6[*8]	4	mA	Cycle = 1µs, duty =100%, $I_{I/O}$ = 0mA, CS1# ≤ 0.2V, CS2 ≥ V_{CC}-0.2V, V_{IH} ≥ V_{CC}-0.2V, V_{IL} ≤ 0.2V
Standby current	I_{SB}	—	—	0.3	mA	CS2 = V_{IL}, Others = V_{SS} to V_{CC}
Standby current	I_{SB1}	—	0.5[*8]	3	µA	~+25°C	Vin = V_{SS} to V_{CC}, (1) CS2 ≤ 0.2V or (2) CS1# ≥ V_{CC}-0.2V, CS2 ≥ V_{CC}-0.2V or (3) LB# = UB# ≥ V_{CC}-0.2V, CS1# ≤ 0.2V, CS2 ≥ V_{CC}-0.2V
		—	0.8[*9]	5	µA	~+40°C	
		—	2.5[*10]	12	µA	~+70°C	
		—	5[*11]	16	µA	~+85°C	
Output high voltage	V_{OH}	2.4	—	—	V	I_{OH} = -1mA
	V_{OH2}	Vcc - 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 7. BYTE# pin supported by only 48pin TSOP (I) and 52pin µTSOP (II) types.
BYTE# ≥ Vcc - 0.2V or BYTE# ≤ 0.2V

8. Typical parameter indicates the value for the center of distribution at 3.0V (Ta=25ºC), and not 100% tested.
9. Typical parameter indicates the value for the center of distribution at 3.0V (Ta=40ºC), and not 100% tested.
10. Typical parameter indicates the value for the center of distribution at 3.0V (Ta=70ºC), and not 100% tested.
11. Typical parameter indicates the value for the center of distribution at 3.0V (Ta=85ºC), and not 100% tested.

Capacitance

(Ta =25°C, f =1MHz)

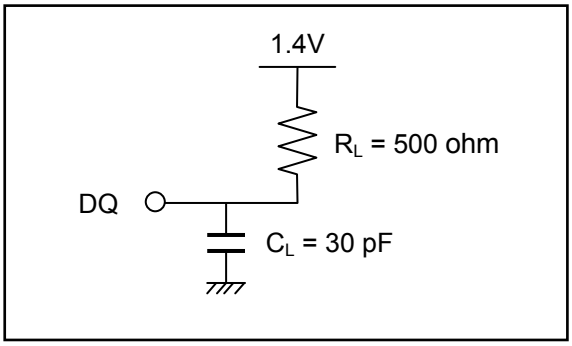
Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions	Note
Input capacitance	C in	—	—	8	pF	Vin =0V	12
Input / output capacitance	C I/O	—	—	10	pF	$V_{I/O}$ =0V	12

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

AC Characteristics

Test Conditions (Vcc = 2.7V ~ 3.6V, Ta = -40 ~ +85°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}	55		ns	
Address access time	t_{AA}	—	55	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	13,14
	t_{CLZ2}	10	—	ns	13,14
LB#, UB# enable to low-Z	t_{BLZ}	5	—	ns	13,14
Output enable to output in low-Z	t_{OLZ}	5	—	ns	13,14
Chip deselect to output in high-Z	t_{CHZ1}	0	18	ns	13,14,15
	t_{CHZ2}	0	18	ns	13,14,15
LB#, UB# disable to high-Z	t_{BHZ}	0	18	ns	13,14,15
Output disable to output in high-Z	t_{OHZ}	0	18	ns	13,14,15

Note 13. This parameter is sampled and not 100% tested.

14 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.

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

Write Cycle

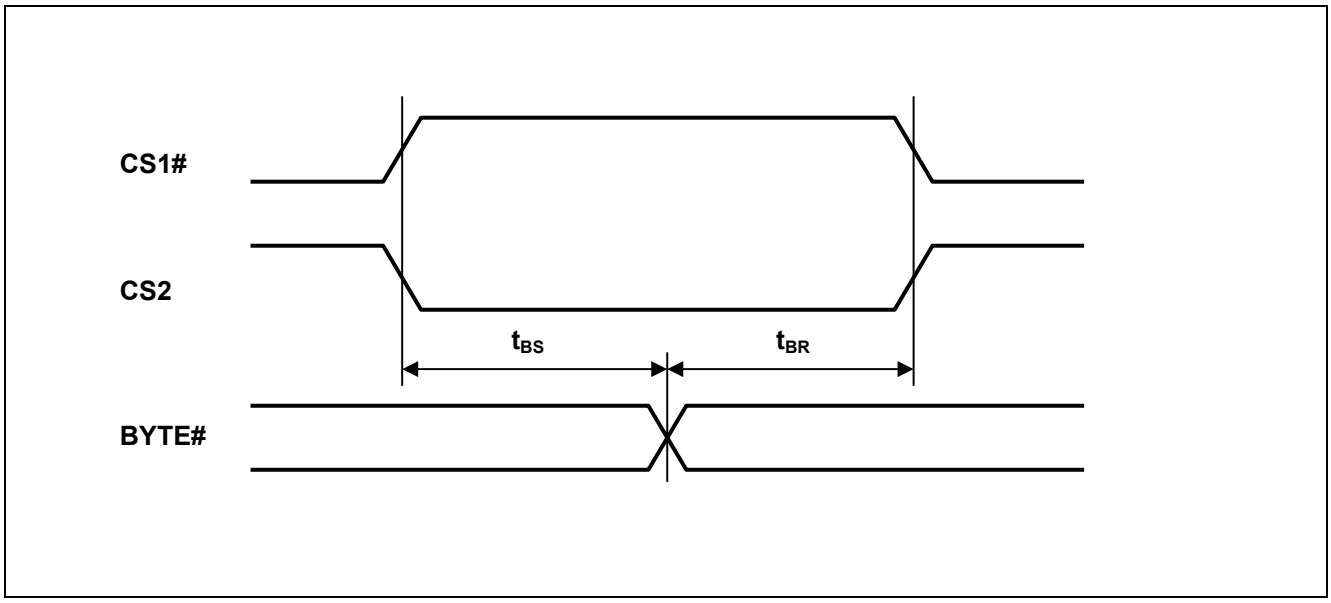
Parameter	Symbol	Min.	Max.	Unit	Note
Write cycle time	t_{WC}	55	—	ns	
Address valid to write end	t_{AW}	35	—	ns	
Chip select to write end	t_{CW}	35	—	ns	
Write pulse width	t_{WP}	35	—	ns	16
LB#,UB# valid to write end	t_{BW}	35	—	ns	
Address setup time to write start	t_{AS}	0	—	ns	
Write recovery time 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	17
Output disable to output in high-Z	t_{OHZ}	0	18	ns	17,18
Write to output in high-Z	t_{WHZ}	0	18	ns	17,18

Note 16. 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.
17. This parameter is sampled and not 100% tested.
18. t_{OHZ} and t_{WHZ} are defined as the time when the DQ pins enter a high-impedance state and are not referred to the DQ levels.

BYTE# Timing Conditions (BYTE# pin supported by only 48pin TSOP (I) and 52pin µTSOP (II) types)

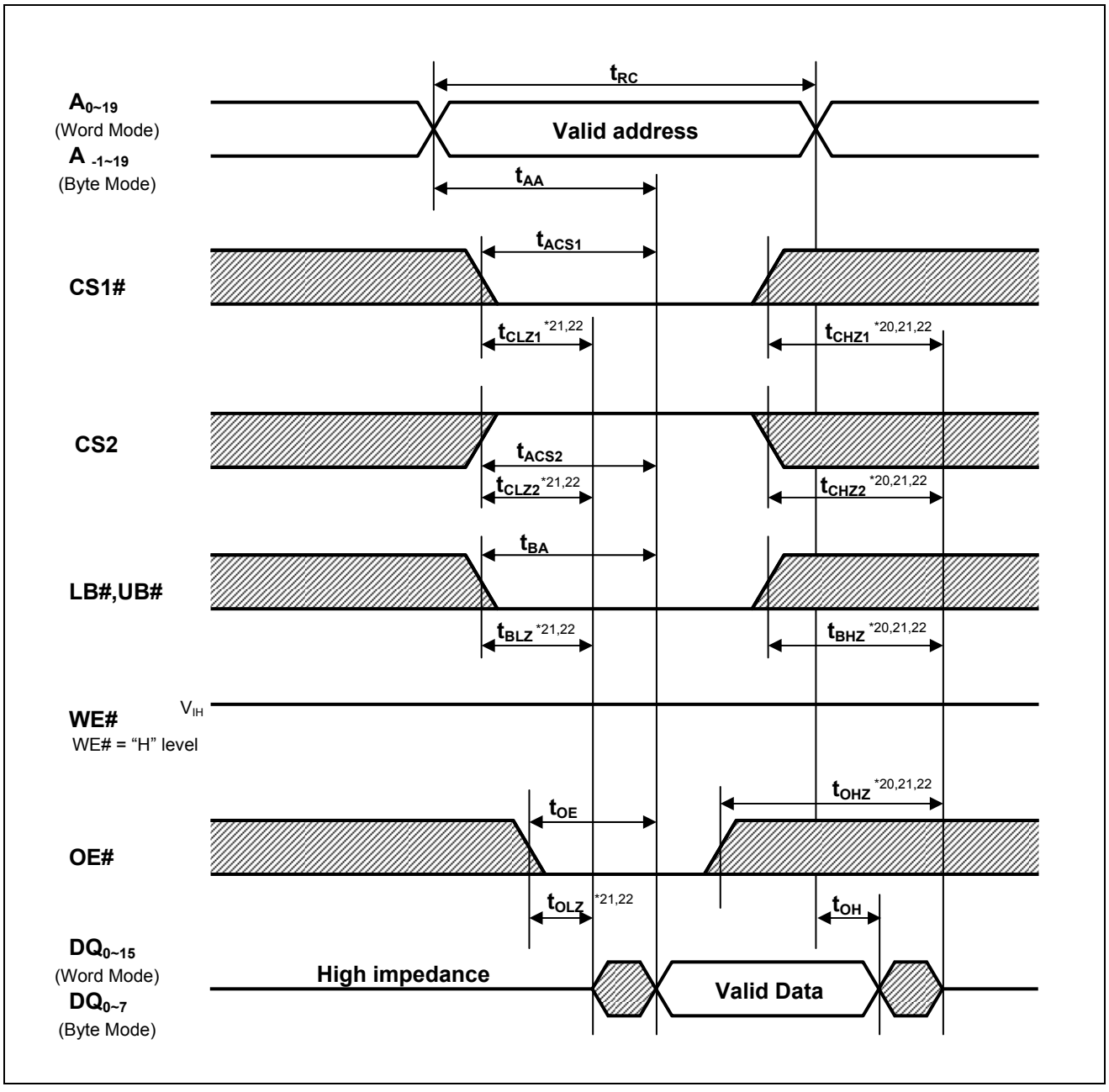
Parameter	Symbol	Min.	Max.	Unit	Note
Byte setup time	t_{BS}	5	-	ms	
Byte recovery time	t_{BR}	5	-	ms	

BYTE# Timing Waveforms



Timing Waveforms

Read Cycle[*19]



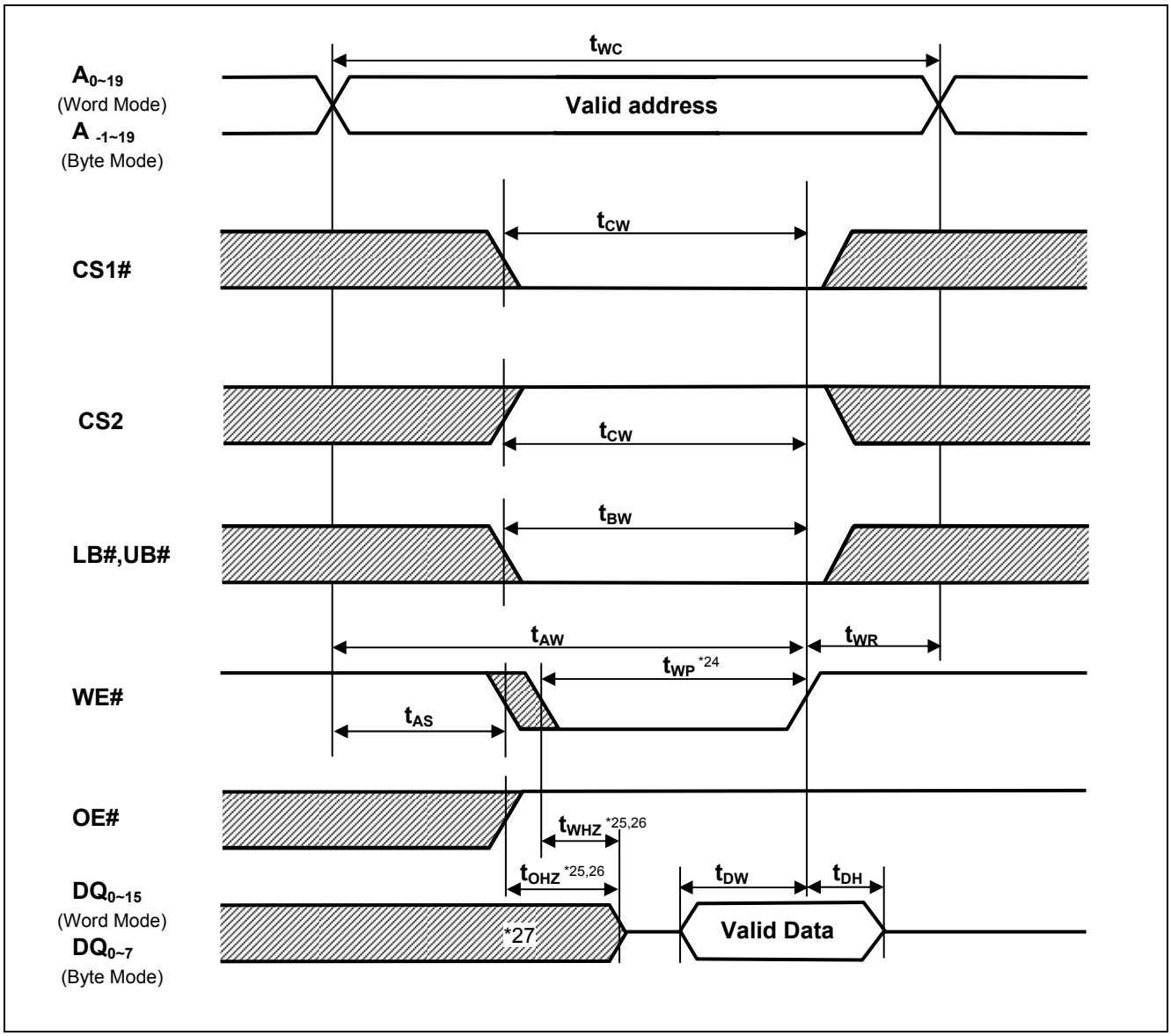
Note 19. BYTE# pin supported by only 48pin TSOP (I) and 52pin µTSOP (II) types.
BYTE# ≥ Vcc - 0.2V (Word mode) or BYTE# ≤ 0.2V (Byte mode)

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

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

22. 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)[*23] (WE# CLOCK, OE#="H" while writing)



Note 23. BYTE# pin supported by only 48pin TSOP (I) and 52pin µTSOP (II) types.
BYTE# ≥ Vcc - 0.2V (Word mode) or BYTE# ≤ 0.2V (Byte mode)

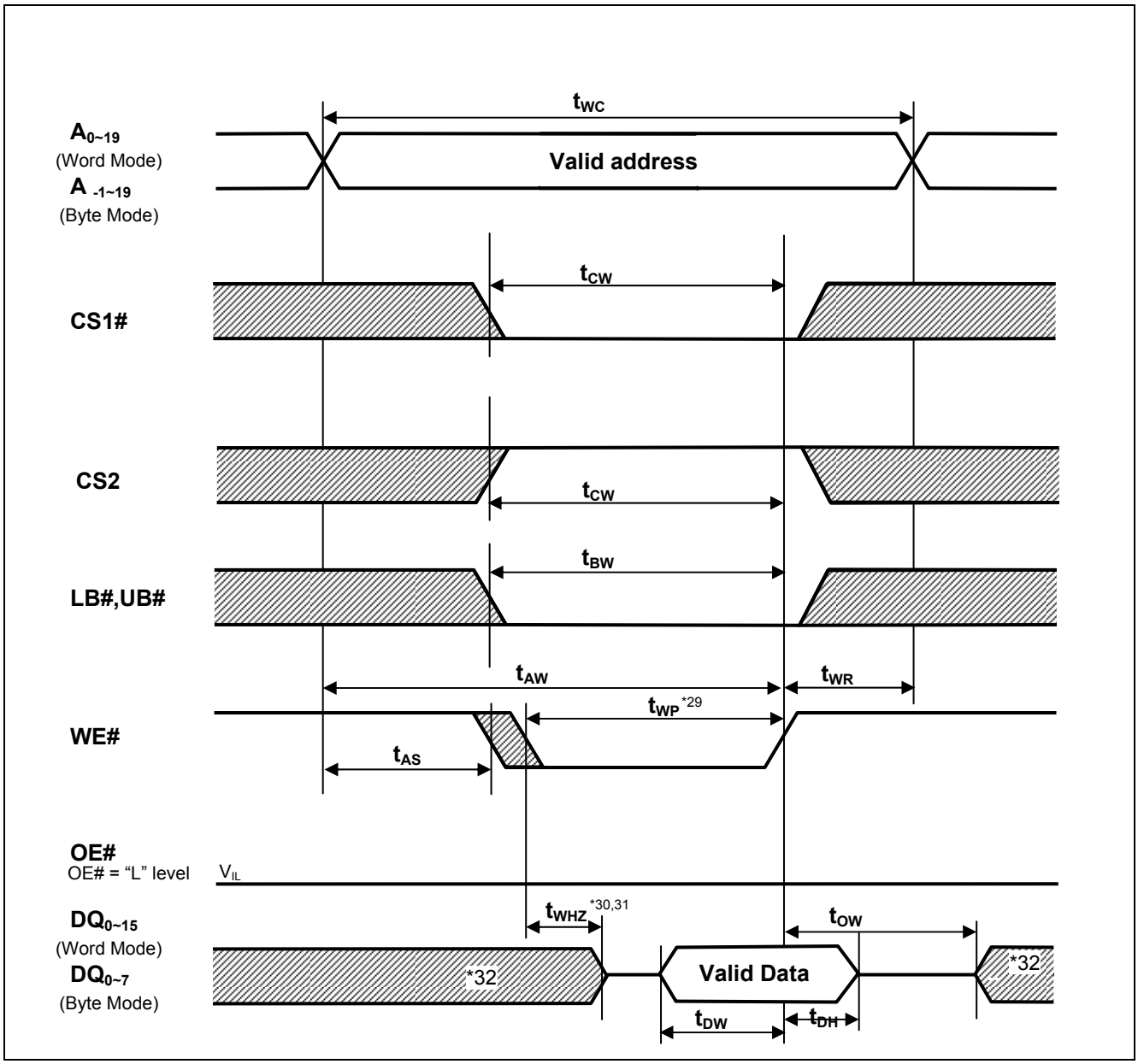
24. t_{WP} is the interval between write start and write end.
A write starts when all of (CS1#), (CS2), (WE#) and (one or both of LB# and UB#) become active.
A write is performed during the overlap of a low CS1#, a high CS2, a low WE# and a low LB# or a low UB#.
A write ends when any of (CS1#), (CS2), (WE#) or (one or both of LB# and UB#) becomes inactive.

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

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

27. During this period, DQ pins are in the output state so input signals must not be applied to the DQ pins.

Write Cycle (2)[*28] (WE# CLOCK, OE# Low Fixed)



Note 28. BYTE# pin supported by only 48pin TSOP (I) and 52pin µTSOP (II) types.
BYTE# ≥ Vcc - 0.2V (Word mode) or BYTE# ≤ 0.2V (Byte mode)

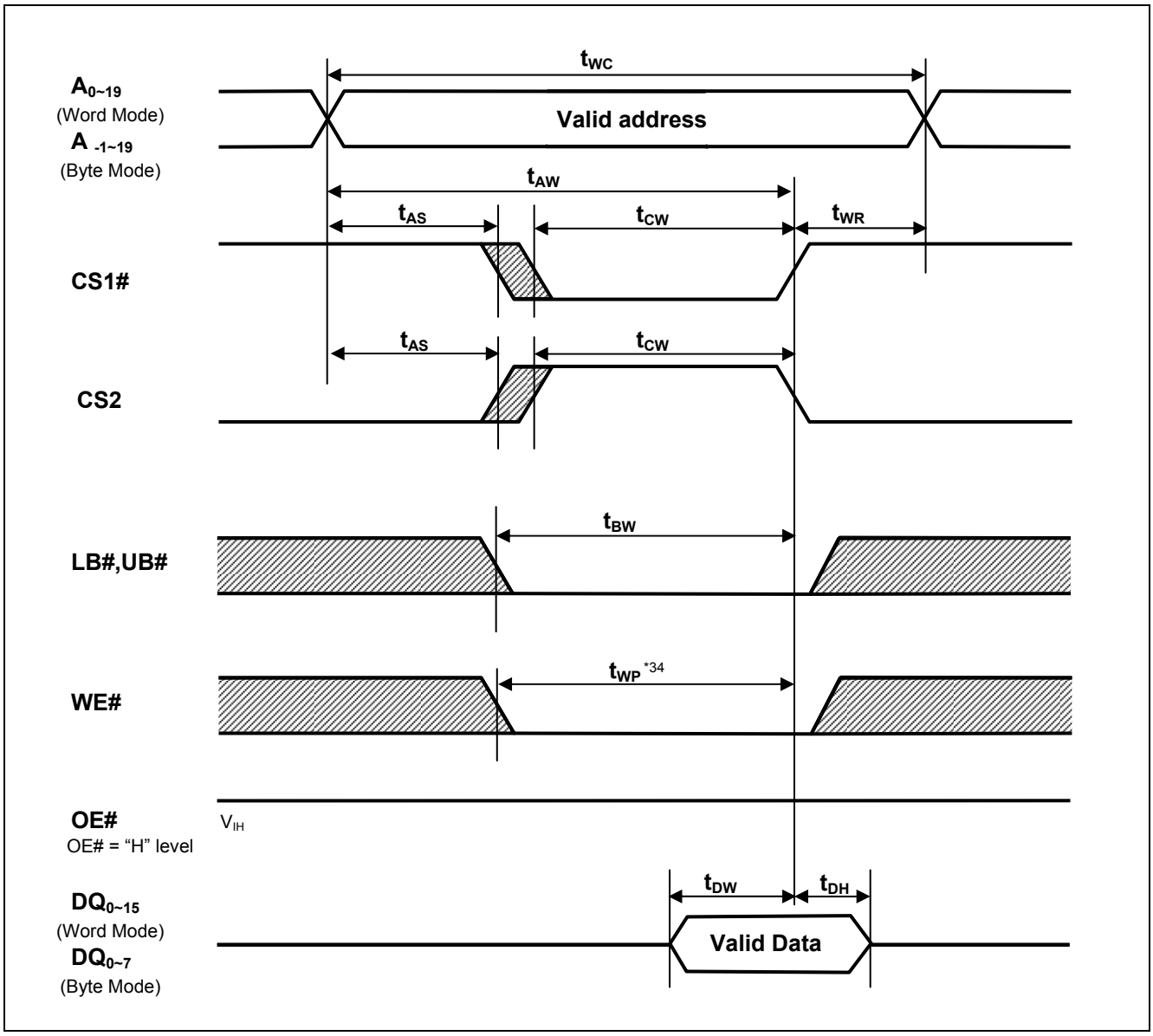
29. t_{WP} is the interval between write start and write end.
A write starts when all of (CS1#), (CS2), (WE#) and (one or both of LB# and UB#) become active.
A write is performed during the overlap of a low CS1#, a high CS2, a low WE# and a low LB# or a low UB#.
A write ends when any of (CS1#), (CS2), (WE#) or (one or both of LB# and UB#) becomes inactive.

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

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

32. During this period, DQ pins are in the output state so input signals must not be applied to the DQ pins.

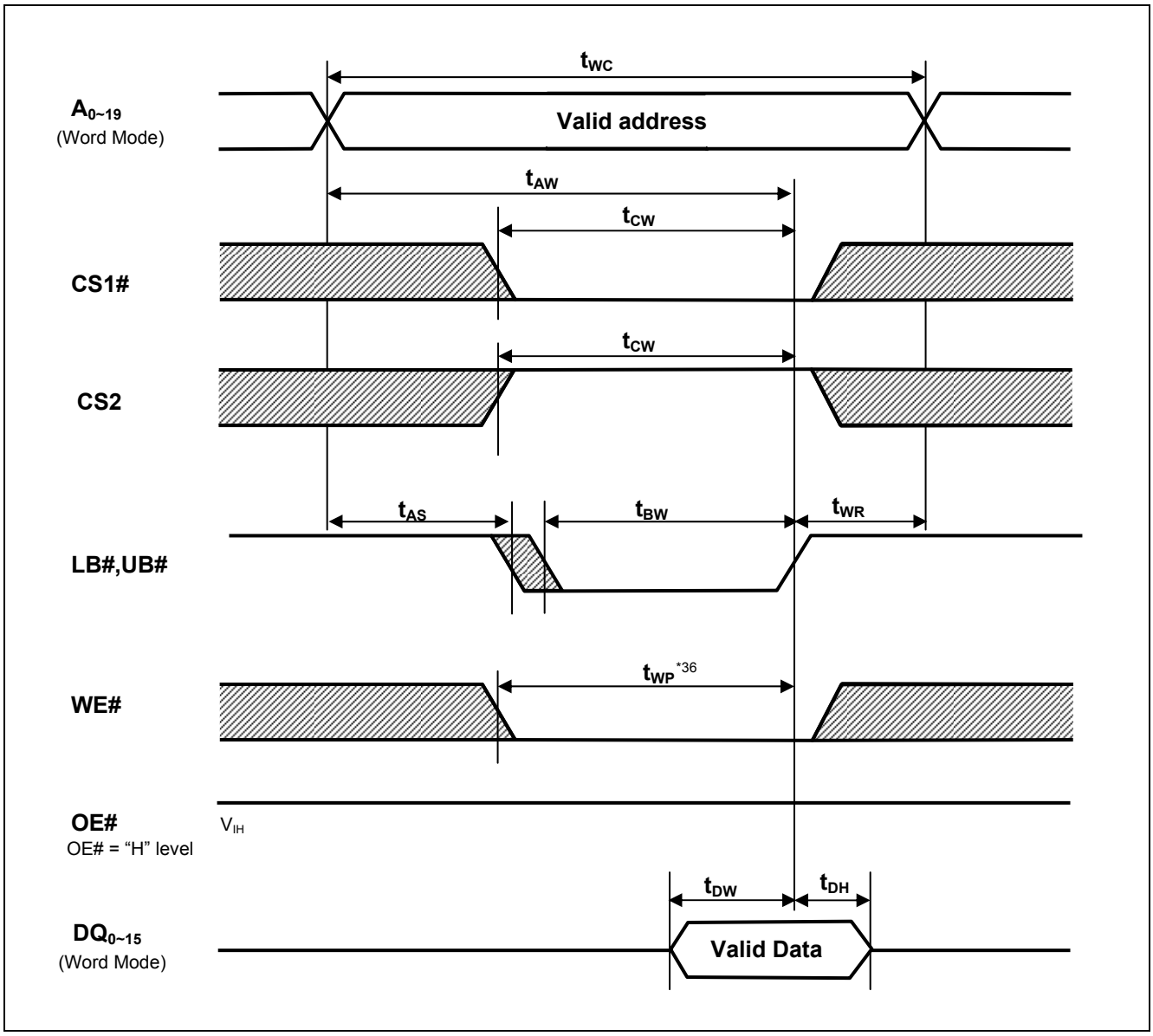
Write Cycle (3)[*33] (CS1#, CS2 CLOCK)



Note 33. BYTE# pin supported by only 48pin TSOP (I) and 52pin µTSOP (II) types.
BYTE# ≥ Vcc - 0.2V (Word mode) or BYTE# ≤ 0.2V (Byte mode)

34. 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.

Write Cycle (4)[*35] (LB#, UB# CLOCK, Word Mode)



Note 35. BYTE# pin supported by only 48pin TSOP (I) and 52pin µTSOP (II) types.
BYTE# ≥ Vcc - 0.2V (Word mode)

36. 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.

Low V_{CC} Data Retention Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions[*37,38]	
V_{CC} for data retention	V_{DR}	1.5	—	3.6	V	Vin ≥ 0V (1) CS2 ≤ 0.2V or (2) CS1# ≥ V_{CC}-0.2V, CS2 ≥ V_{CC}-0.2V or (3) LB# = UB# ≥ V_{CC}-0.2V, CS1# ≤ 0.2V, CS2 ≥ V_{CC}-0.2V	
Data retention current	I_{CCDR}	—	0.5[*39]	3	µA	~+25°C	V_{CC} = 3.0V, Vin ≥ 0V (1) CS2 ≤ 0.2V or (2) CS1# ≥ V_{CC}-0.2V, CS2 ≥ V_{CC}-0.2V or (3) LB# = UB# ≥ V_{CC}-0.2V, CS1# ≤ 0.2V, CS2 ≥ V_{CC}-0.2V
		—	0.8[*40]	5	µA	~+40°C	
		—	2.5[*41]	12	µA	~+70°C	
		—	5[*42]	16	µA	~+85°C	
Chip deselect time to data retention	t_{CDR}	0	—	—	ns	See retention waveform.	
Operation recovery time	t_R	5	—	—	ms		

Note 37. BYTE# pin supported by only 48pin TSOP (I) and 52pin µTSOP (II) types.
BYTE# ≥ Vcc - 0.2V or BYTE# ≤ 0.2V

38. CS2 controls address buffer, WE# buffer, CS1# buffer, OE# buffer, LB# buffer, UB# buffer and DQ buffer.
If CS2 controls data retention mode, Vin levels (address, WE#, CS1#, OE#, LB#, UB#, DQ) can be in the high impedance state. If CS1# controls data retention mode, CS2 must be CS2 ≥ V_{CC}-0.2V or CS2 ≤ 0.2V.
The other inputs levels (address, WE#, OE#, LB#, UB#, DQ) can be in the high-impedance state.

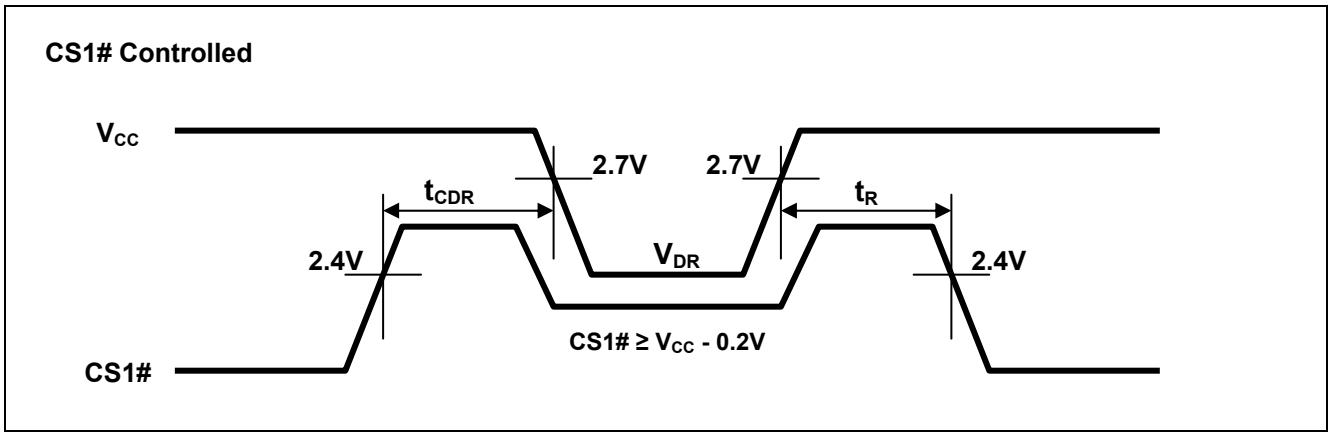
39. Typical parameter indicates the value for the center of distribution at 3.0V (Ta=25ºC), and not 100% tested.

40. Typical parameter indicates the value for the center of distribution at 3.0V (Ta=40ºC), and not 100% tested.

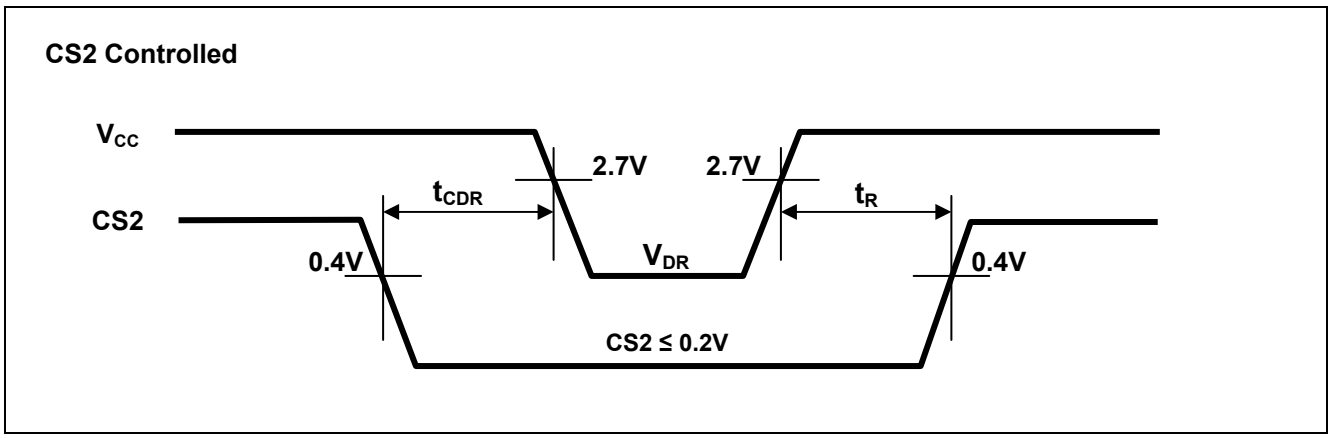
41. Typical parameter indicates the value for the center of distribution at 3.0V (Ta=70ºC), and not 100% tested.

42. Typical parameter indicates the value for the center of distribution at 3.0V (Ta=85ºC), and not 100% tested.

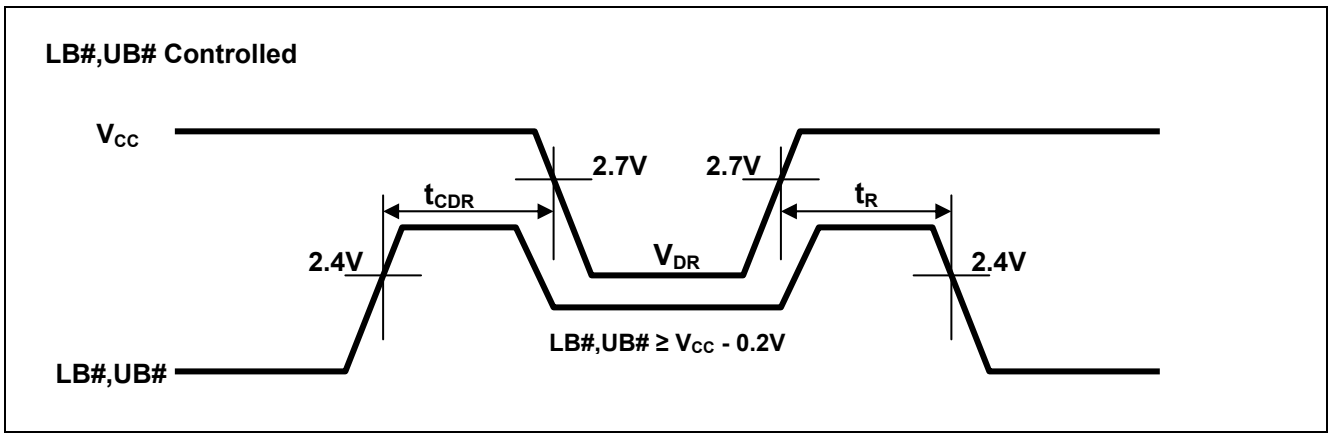
Low Vcc Data Retention Timing Waveforms (CS1# controlled)*43



Low Vcc Data Retention Timing Waveforms (CS2 controlled)*43



Low Vcc Data Retention Timing Waveforms (LB#,UB# controlled, Word Mode)*44



Note 43. BYTE# pin supported by only 48pin TSOP (I) and 52pin µTSOP (II) types.
BYTE# ≥ Vcc - 0.2V or BYTE# ≤ 0.2V

44. BYTE# pin supported by only 48pin TSOP (I) and 52pin µTSOP (II) types.
BYTE# ≥ Vcc - 0.2V (Word mode)

Revision History	RMLV1616A Series Data Sheet

Rev.	Date	Description	
		Page	Summary
1.00	2016.01.06	—	First Edition issued

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