

# R1RW0416D Series

R10DS0282EJ0100

Rev.1.00

## 4M High Speed SRAM (256-kword × 16-bit)

Nov.18.19

### Description

The R1RW0416D is a 4-Mbit high speed static RAM organized 256-kword × 16-bit. It has realized high speed access time by employing CMOS process (6-transistor memory cell) and high speed circuit designing technology. It is most appropriate for the application which requires high speed, high density memory and wide bit width configuration, such as cache and buffer memory in system. Especially, L-Version and S-Version are low power consumption and it is the best for the battery backup system. The package prepares 400-mil 44-pin SOJ and 400-mil 44-pin plastic TSOPII for high density surface mounting.

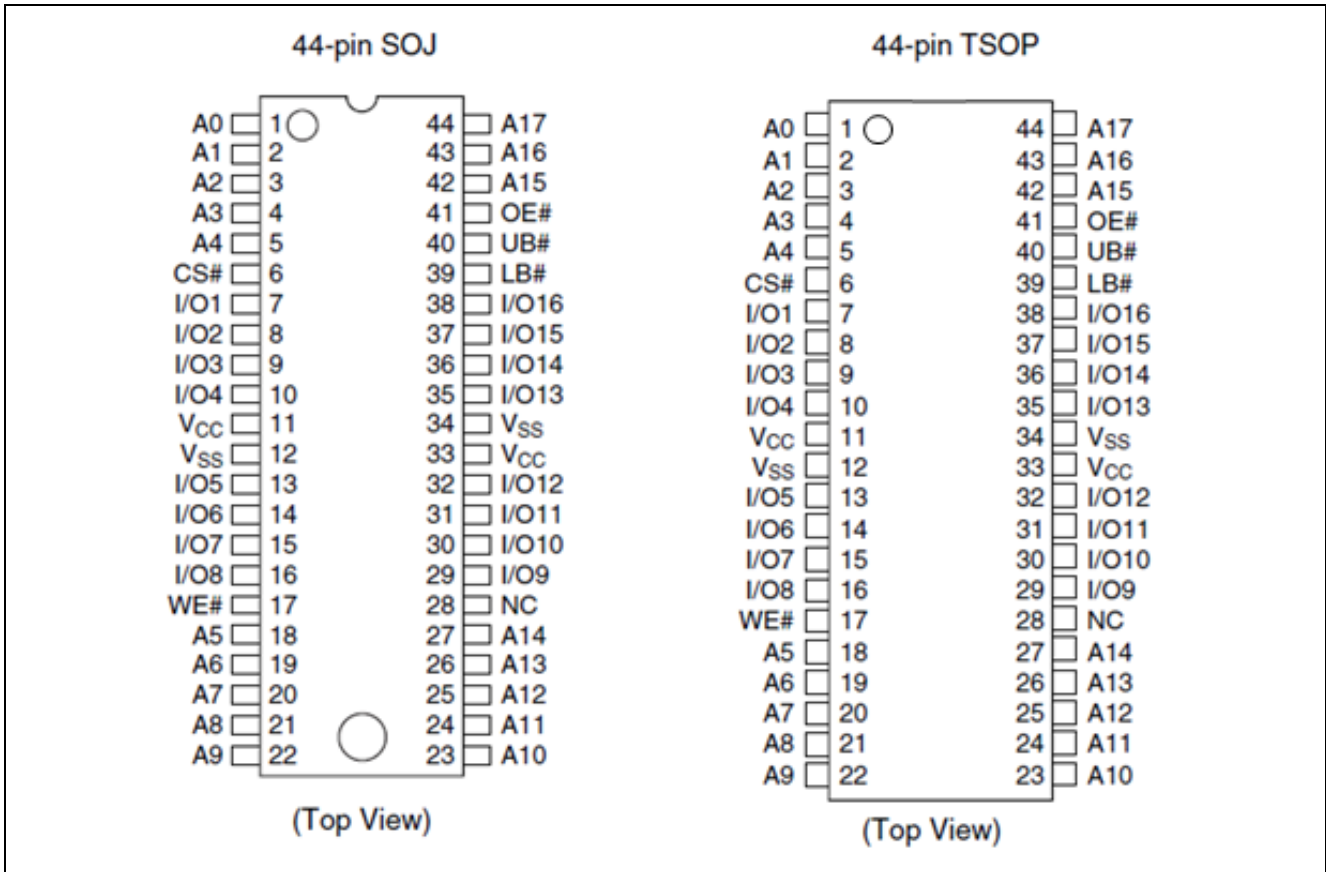
### Features

- Single 3.3V supply: 3.3V ± 0.3V
- Access time: 10ns / 12ns (max)
- Completely static memory
  - No clock or timing strobe required
- Equal access and cycle times
- Directly TTL compatible
  - All inputs and outputs
- Operating current: 145mA / 130mA (max)
- TTL standby current: 40mA (max)
- CMOS standby current : 5mA (max)
  - : 0.8mA (max) (L-version)
  - : 0.5mA (max) (S-version)
- Data retention current : 0.4mA (max) (L-version)
  - : 0.2mA (max) (S-version)
- Data retention voltage: 2.0V (min) (L-version , S-version)
- Center V<sub>CC</sub> and V<sub>SS</sub> type pin out

### Ordering Information

Type No.	Access time	Version	Package
R1RW0416DGE-2PR	12ns	Normal	400-mil 44-pin plastic SOJ
R1RW0416DGE-2LR	12ns	L-Version	
R1RW0416DSB-0PR	10ns	Normal	400-mil 44-pin plastic TSOPII
R1RW0416DSB-2PR	12ns	Normal	
R1RW0416DSB-2LR	12ns	L-Version	
R1RW0416DSB-2SR	12ns	S-Version	

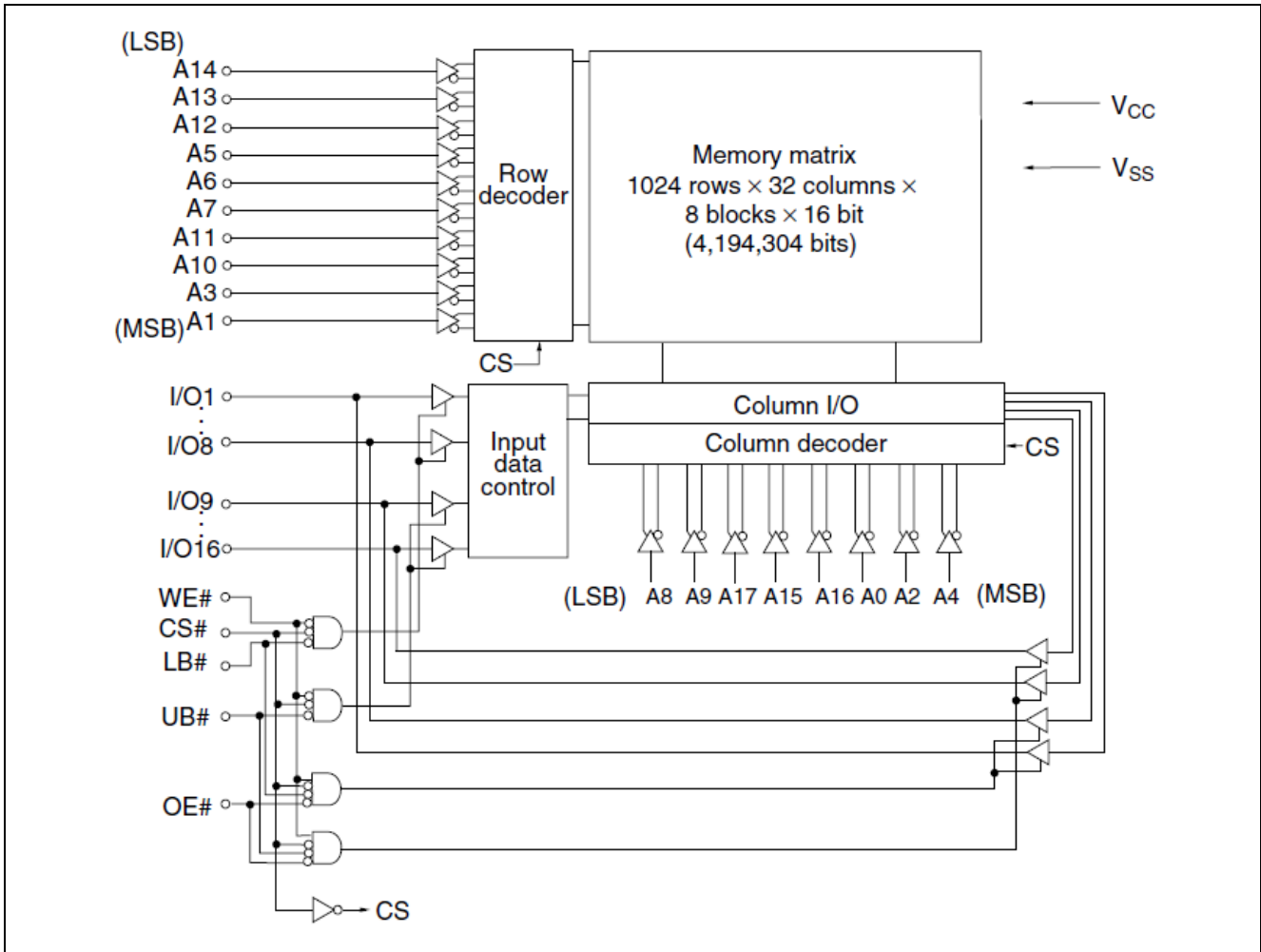
## Pin Arrangement



## Pin Description

Pin name	Function
A0 to A17	Address input
I/O1 to I/O16	Data input/output
CS#	Chip select
OE#	Output enable
WE#	Write enable
UB#	Upper byte select
LB#	Lower byte select
V <sub>CC</sub>	Power supply
V <sub>SS</sub>	Ground
NC	No connection

### Block Diagram



## Operation Table

CS#	OE#	WE#	LB#	UB#	Mode	V <sub>CC</sub> current	I/O1–I/O8	I/O9–I/O16	Ref. cycle
H	×	×	×	×	Standby	I <sub>SB</sub> , I <sub>SB1</sub>	High-Z	High-Z	—
L	H	H	×	×	Output disable	I <sub>CC</sub>	High-Z	High-Z	—
L	L	H	L	L	Read	I <sub>CC</sub>	Output	Output	Read cycle
L	L	H	L	H	Lower byte read	I <sub>CC</sub>	Output	High-Z	Read cycle
L	L	H	H	L	Upper byte read	I <sub>CC</sub>	High-Z	Output	Read cycle
L	L	H	H	H	—	I <sub>CC</sub>	High-Z	High-Z	—
L	×	L	L	L	Write	I <sub>CC</sub>	Input	Input	Write cycle
L	×	L	L	H	Lower byte write	I <sub>CC</sub>	Input	High-Z	Write cycle
L	×	L	H	L	Upper byte write	I <sub>CC</sub>	High-Z	Input	Write cycle
L	×	L	H	H	—	I <sub>CC</sub>	High-Z	High-Z	—

Note: H: V<sub>IH</sub>, L: V<sub>IL</sub>, ×: V<sub>IH</sub> or V<sub>IL</sub>

## Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Supply voltage relative to V <sub>SS</sub>	V <sub>CC</sub>	−0.5 to +4.6	V
Voltage on any pin relative to V <sub>SS</sub>	V <sub>T</sub>	−0.5* <sup>1</sup> to V <sub>CC</sub> + 0.5* <sup>2</sup>	V
Power dissipation	P <sub>T</sub>	1.0	W
Operating temperature	T <sub>opr</sub>	0 to +70	°C
Storage temperature	T <sub>stg</sub>	−55 to +125	°C
Storage temperature under bias	T <sub>bias</sub>	−10 to +85	°C

Notes: 1. V<sub>T</sub> (min) = −2.0V for pulse width (under shoot) ≤ 6ns.

2. V<sub>T</sub> (max) = V<sub>CC</sub> + 2.0V for pulse width (over shoot) ≤ 6ns.

## Recommended DC Operating Conditions

(T<sub>a</sub> = 0 to +70°C)

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	V <sub>CC</sub> * <sup>3</sup>	3.0	3.3	3.6	V
	V <sub>SS</sub> * <sup>4</sup>	0	0	0	V
Input voltage	V <sub>IH</sub>	2.0	—	V <sub>CC</sub> + 0.5* <sup>2</sup>	V
	V <sub>IL</sub>	−0.5* <sup>1</sup>	—	0.8	V

Notes: 1. V<sub>IL</sub> (min) = −2.0V for pulse width (under shoot) ≤ 6ns.

2. V<sub>IH</sub> (max) = V<sub>CC</sub> + 2.0V for pulse width (over shoot) ≤ 6ns.

3. The supply voltage with all V<sub>CC</sub> pins must be on the same level.

4. The supply voltage with all V<sub>SS</sub> pins must be on the same level.

**DC Characteristics**(Ta = 0 to +70°C, V<sub>CC</sub> = 3.3V ± 0.3V, V<sub>SS</sub> = 0V)

Parameter	Symbol	Min	Max	Unit	Test conditions	
Input leakage current	I <sub>LI</sub>	—	2	μA	V <sub>IN</sub> = V <sub>SS</sub> to V <sub>CC</sub>	
Output leakage current	I <sub>LO</sub>	—	2	μA	V <sub>IN</sub> = V <sub>SS</sub> to V <sub>CC</sub>	
Operating power supply current	10ns cycle	I <sub>CC</sub>	—	145	mA	Min cycle CS# = V <sub>IL</sub> , I <sub>OUT</sub> = 0mA Other inputs = V <sub>IH</sub> /V <sub>IL</sub>
	12ns cycle	I <sub>CC</sub>	—	130	mA	
Standby power supply current	I <sub>SB</sub>	—	40	mA	Min cycle, CS# = V <sub>IH</sub> , Other inputs = V <sub>IH</sub> /V <sub>IL</sub>	
	I <sub>SB1</sub>	—	5	mA	f = 0MHz V <sub>CC</sub> ≥ CS# ≥ V <sub>CC</sub> - 0.2V, (1) 0V ≤ V <sub>IN</sub> ≤ 0.2V or (2) V <sub>CC</sub> ≥ V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2V	
		—*1	0.8*1	mA		
		—*2	0.5*2	mA		
Output voltage	V <sub>OL</sub>	—	0.4	V	I <sub>OL</sub> = 8mA	
	V <sub>OH</sub>	2.4	—	V	I <sub>OH</sub> = -4mA	

Notes: 1. This characteristics is guaranteed only for L-version.  
2. This characteristics is guaranteed only for S-version.

**Capacitance**

(Ta = +25°C, f = 1.0MHz)

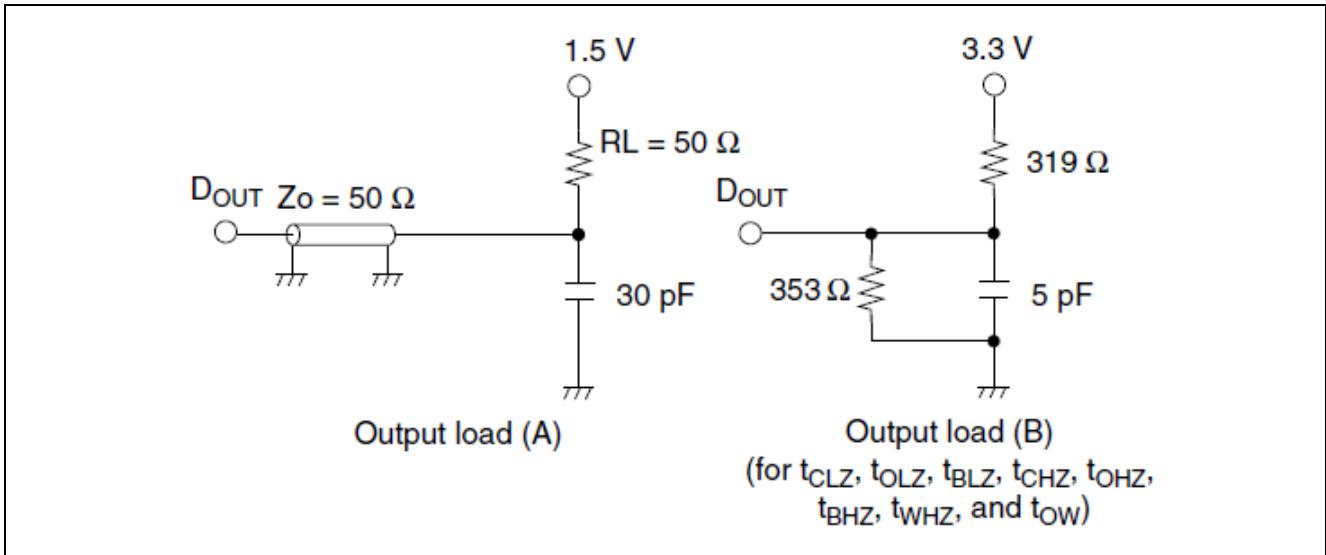
Parameter	Symbol	Min	Max	Unit	Test conditions
Input capacitance*1	C <sub>IN</sub>	—	6	pF	V <sub>IN</sub> = 0V
Input/output capacitance*1	C <sub>I/O</sub>	—	8	pF	V <sub>I/O</sub> = 0V

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

## AC Characteristics

**Test Conditions** ( $T_a = 0$  to  $+70^\circ\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 0.3\text{V}$ , unless otherwise noted.)

- Input pulse levels: 3.0V/0.0V
- Input rise and fall time: 3ns
- Input and output timing reference levels: 1.5V
- Output load: See figures (Including scope and jig)



## Read Cycle

Parameter	Symbol	R1RW0416D				Unit	Notes
		10ns Version		12ns Version			
		Min	Max	Min	Max		
Read cycle time	$t_{RC}$	10	—	12	—	ns	
Address access time	$t_{AA}$	—	10	—	12	ns	
Chip select access time	$t_{ACS}$	—	10	—	12	ns	
Output enable to output valid	$t_{OE}$	—	5	—	6	ns	
Byte select to output valid	$t_{BA}$	—	5	—	6	ns	
Output hold from address change	$t_{OH}$	3	—	3	—	ns	
Chip select to output in low-Z	$t_{CLZ}$	3	—	3	—	ns	1
Output enable to output in low-Z	$t_{OLZ}$	0	—	0	—	ns	1
Byte select to output in low-Z	$t_{BLZ}$	0	—	0	—	ns	1
Chip deselect to output in high-Z	$t_{CHZ}$	—	5	—	6	ns	1
Output disable to output in high-Z	$t_{OHZ}$	—	5	—	6	ns	1
Byte deselect to output in high-Z	$t_{BHZ}$	—	5	—	6	ns	1

**Write Cycle**

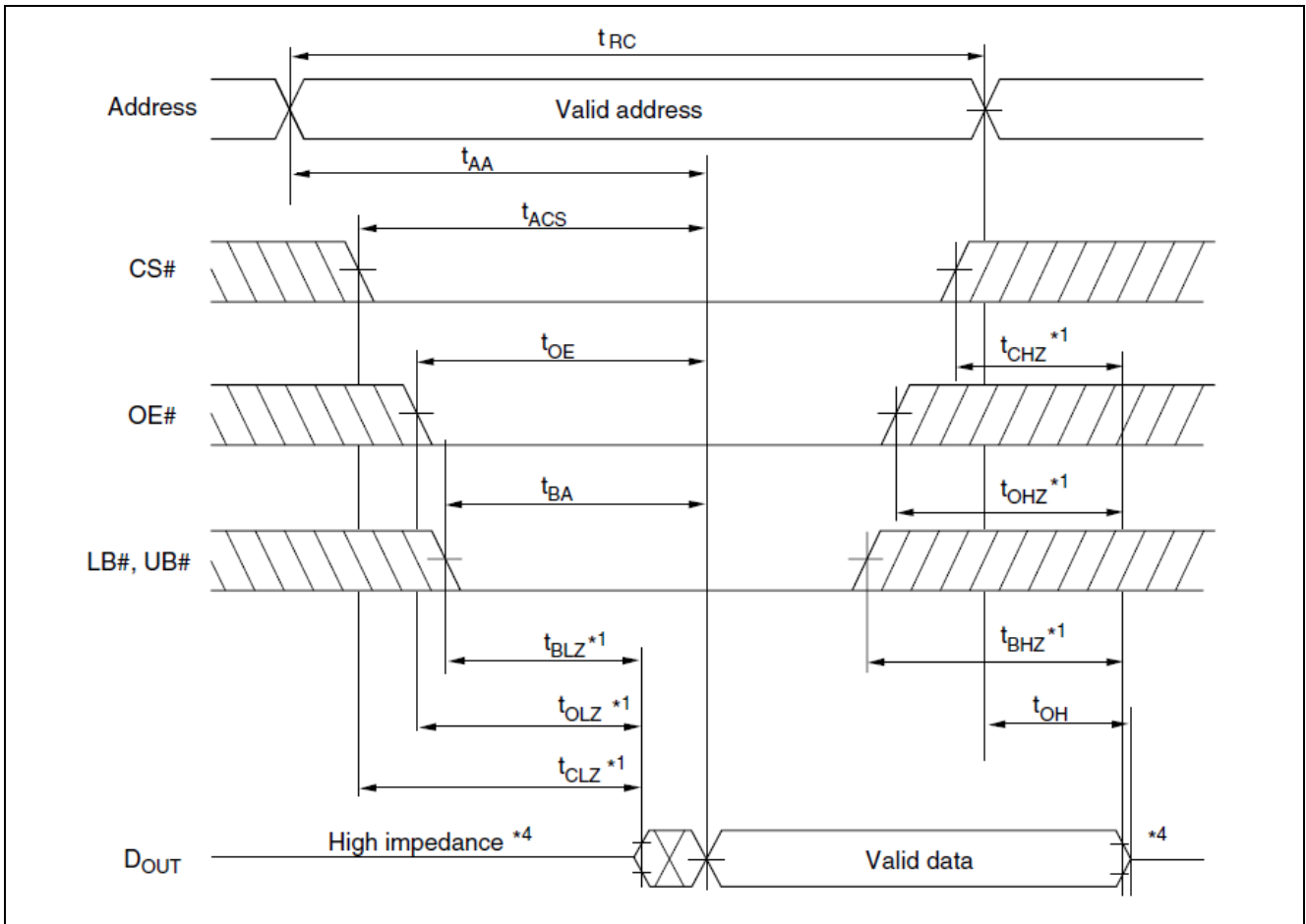
Parameter	Symbol	R1RW0416D				Unit	Notes
		10ns Version		12ns Version			
		Min	Max	Min	Max		
Write cycle time	$t_{WC}$	10	—	12	—	ns	
Address valid to end of write	$t_{AW}$	7	—	8	—	ns	
Chip select to end of write	$t_{CW}$	7	—	8	—	ns	8
Write pulse width	$t_{WP}$	7	—	8	—	ns	7
Byte select to end of write	$t_{BW}$	7	—	8	—	ns	
Address setup time	$t_{AS}$	0	—	0	—	ns	5
Write recovery time	$t_{WR}$	0	—	0	—	ns	6
Data to write time overlap	$t_{DW}$	5	—	6	—	ns	
Data hold from write time	$t_{DH}$	0	—	0	—	ns	
Write disable to output in low-Z	$t_{OW}$	3	—	3	—	ns	1
Output disable to output in high-Z	$t_{OHZ}$	—	5	—	6	ns	1
Write enable to output in high-Z	$t_{WHZ}$	—	5	—	6	ns	1

Notes: 1. Transition is measured  $\pm 200\text{mV}$  from steady voltage with output load (B). This parameter is sampled and not 100% tested.

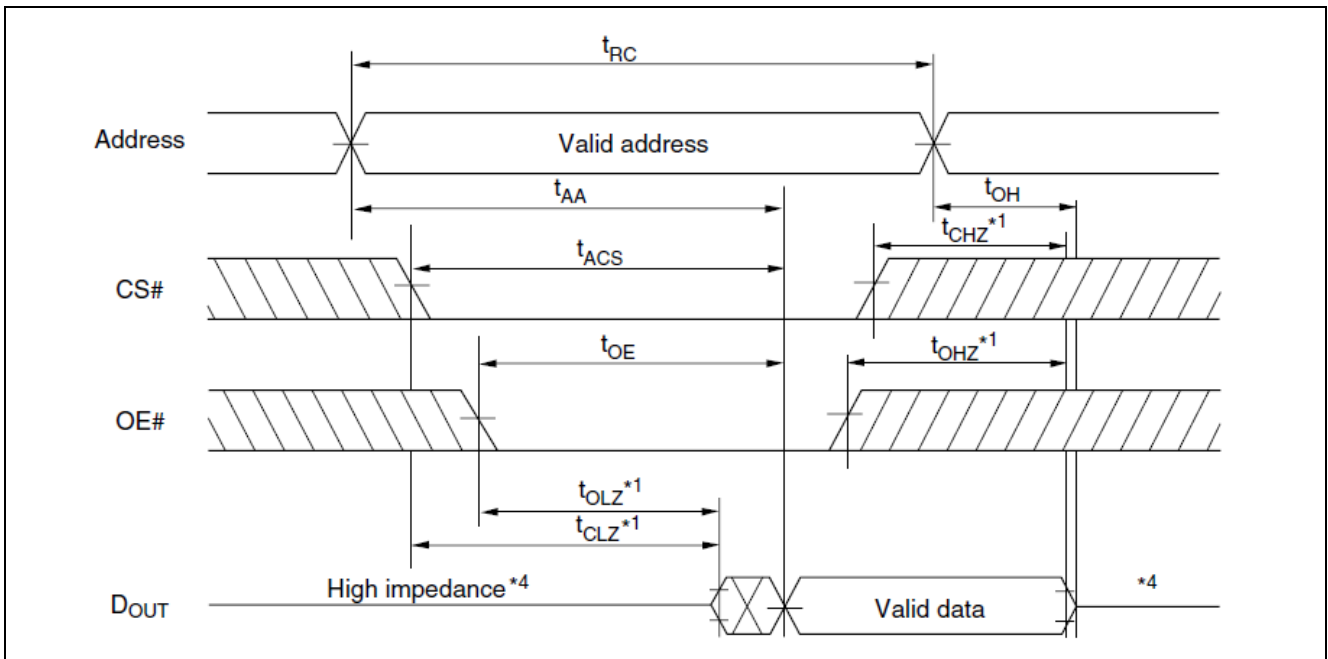
2. If the CS# or LB# or UB# low transition occurs simultaneously with the WE# low transition or after the WE# transition, output remains a high impedance state.
3. WE# and/or CS# must be high during address transition time.
4. If CS#, OE#, LB# and UB# are low during this period, I/O pins are in the output state. Then the data input signals of opposite phase to the outputs must not be applied to them.
5.  $t_{AS}$  is measured from the latest address transition to the latest of CS#, WE#, LB# or UB# going low.
6.  $t_{WR}$  is measured from the earliest of CS#, WE#, LB# or UB# going high to the first address transition.
7. A write occurs during the overlap of a low CS#, a low WE# and a low LB# or a low UB# ( $t_{WP}$ ). A write begins at the latest transition among CS# going low, WE# going low and LB# going low or UB# going low. A write ends at the earliest transition among CS# going high, WE# going high and LB# going high or UB# going high.
8.  $t_{CW}$  is measured from the later of CS# going low to the end of write.

## Timing Waveforms

Read Timing Waveform (1) (WE# = V<sub>IH</sub>)

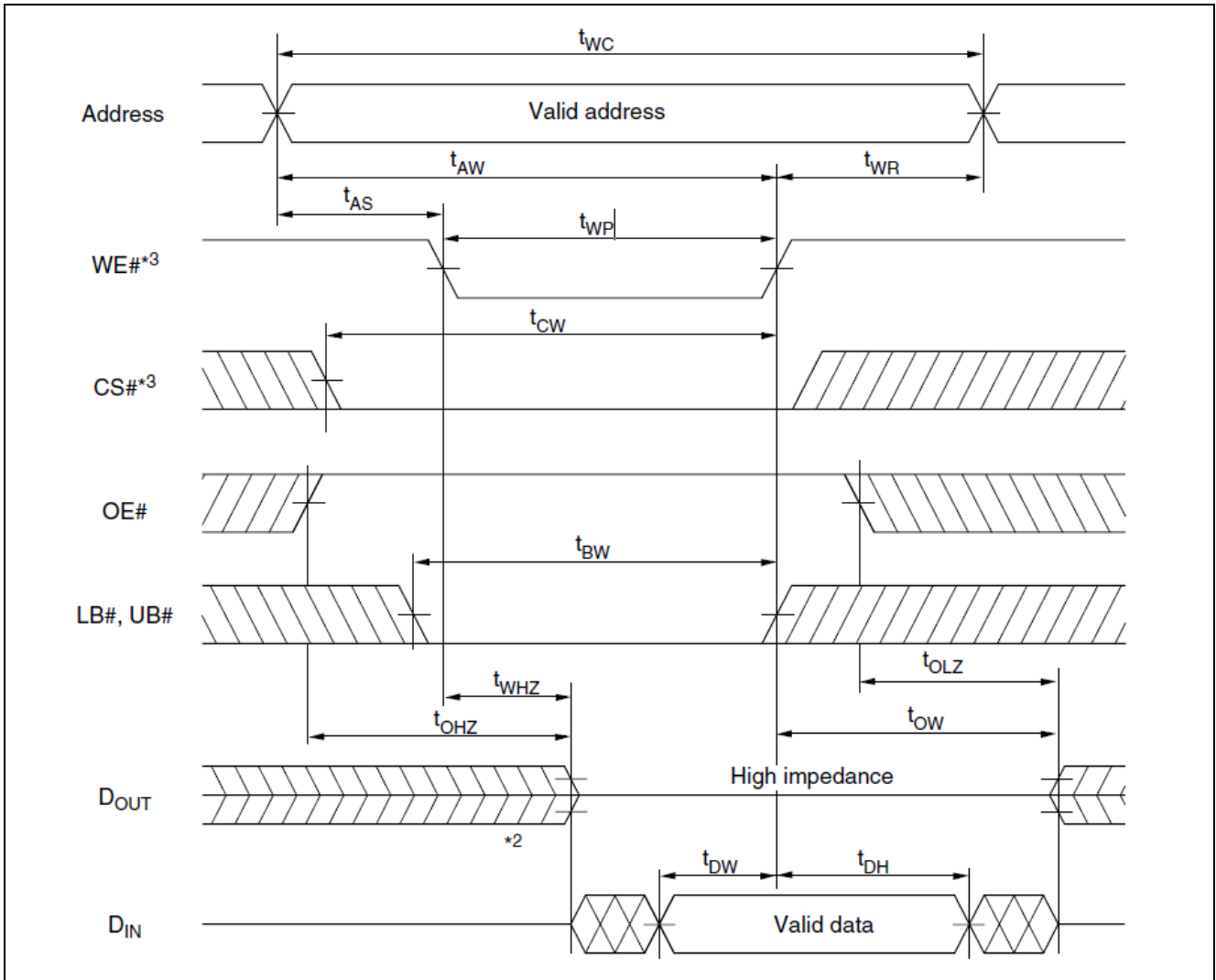


Read Timing Waveform (2) (WE# = V<sub>IH</sub>, LB# = V<sub>IL</sub>, UB# = V<sub>IL</sub>)

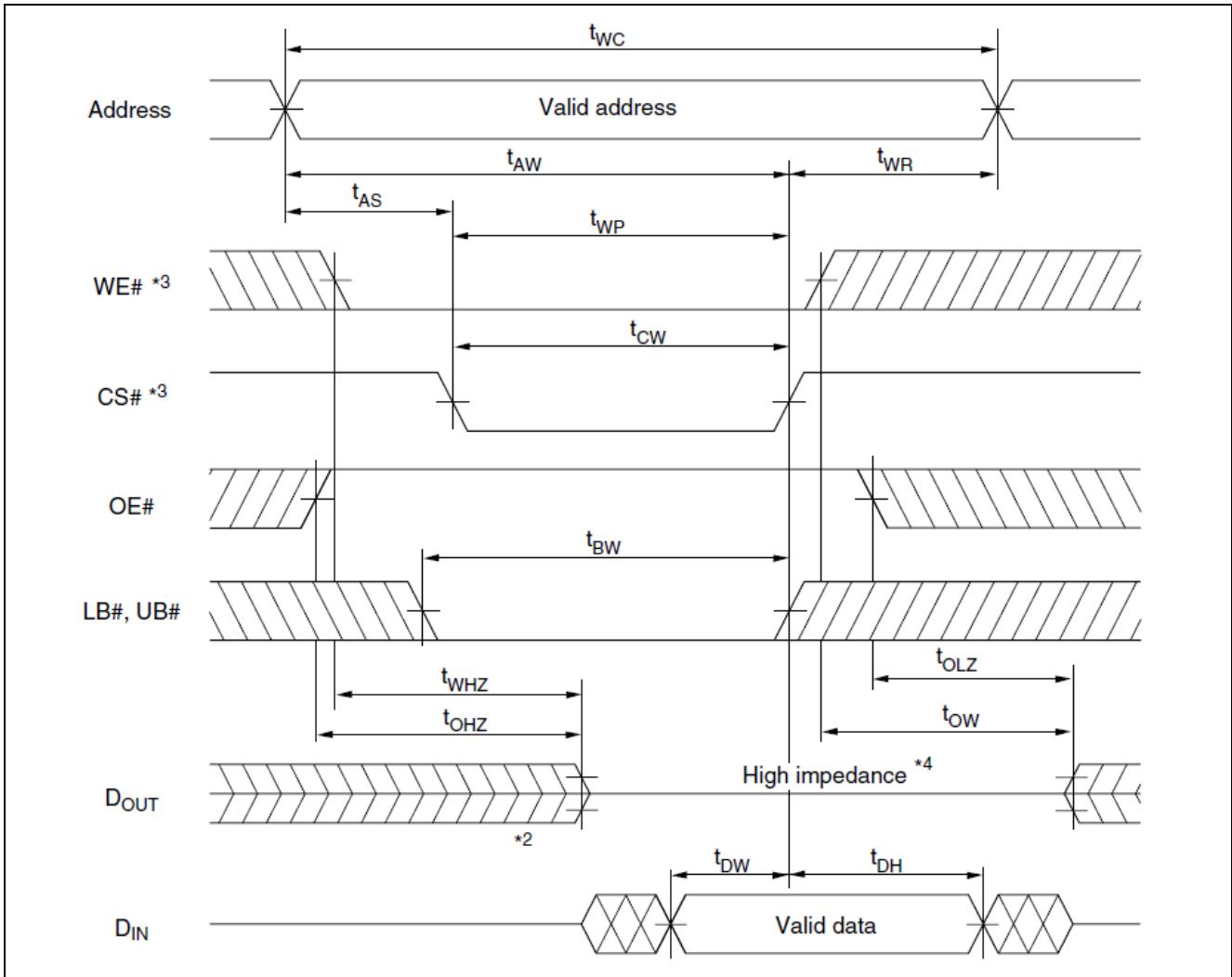




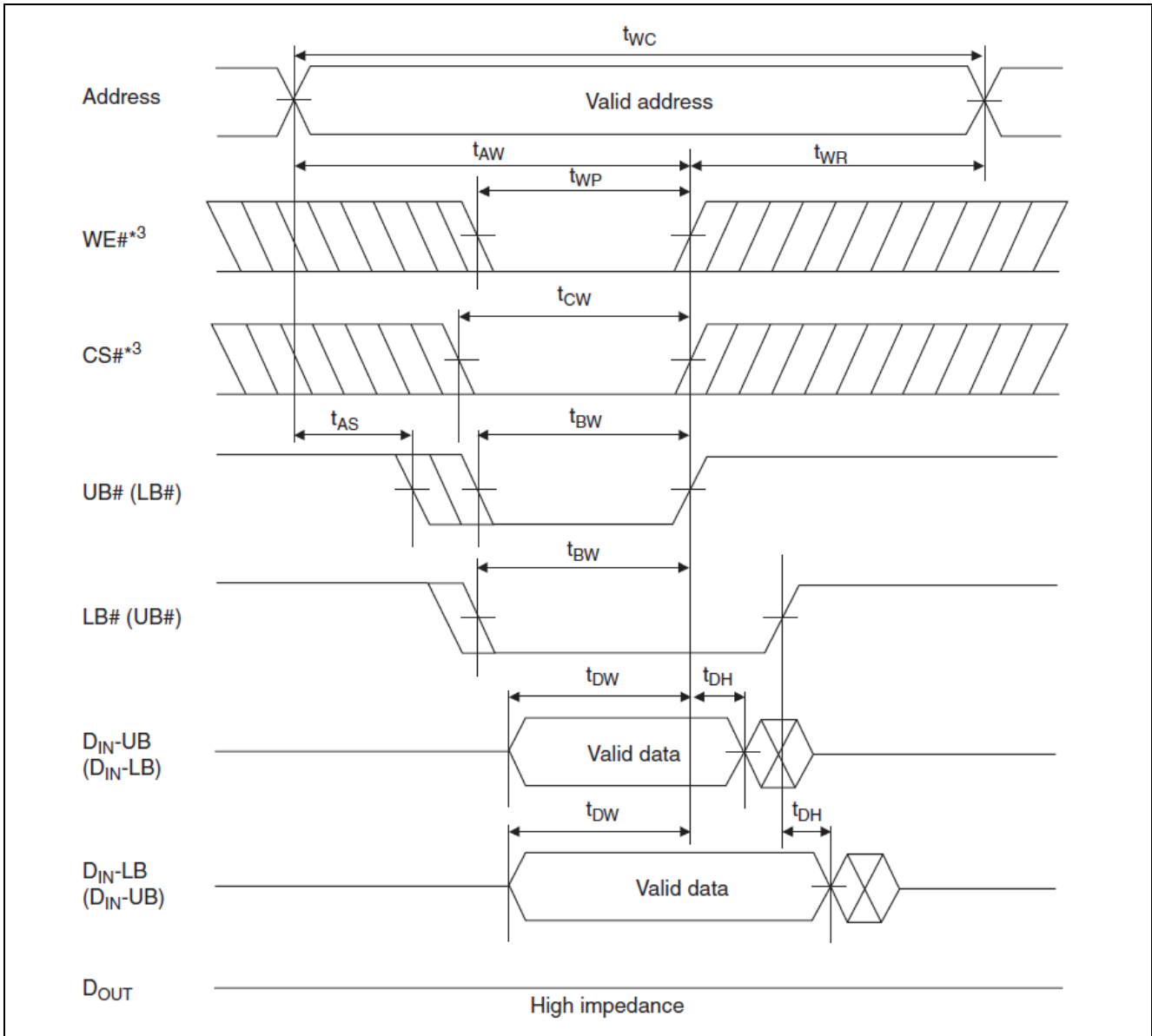
**Write Timing Waveform (1) (WE# Controlled)**



**Write Timing Waveform (2) (CS# Controlled)**



**Write Timing Waveform (3) (LB#, UB# Controlled, OE# = V<sub>IH</sub>)**



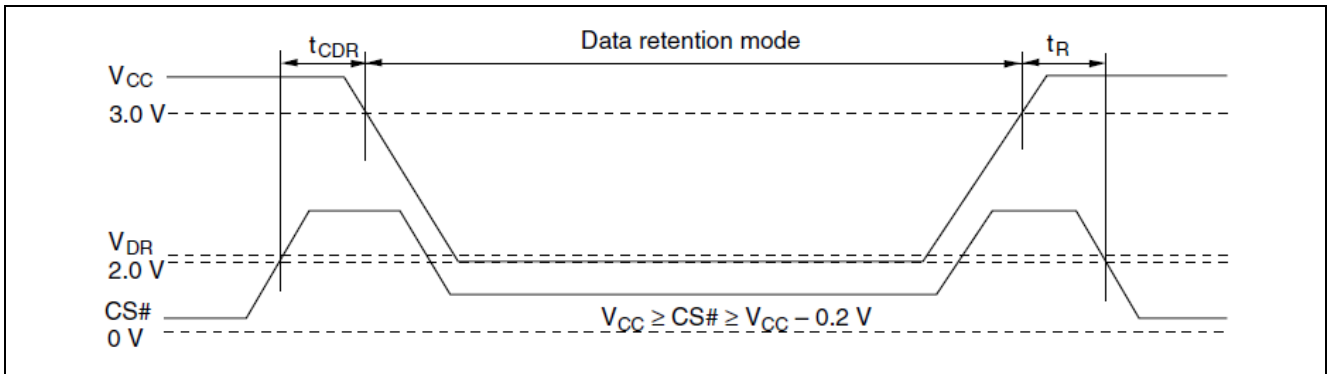
### Low V<sub>CC</sub> Data Retention Characteristics

(Ta = 0 to +70°C)

This characteristics is guaranteed only for L-version and S-version.

Parameter	Symbol	Min	Max	Unit	Test conditions
V <sub>CC</sub> for data retention	V <sub>DR</sub>	2.0	—	V	V <sub>CC</sub> ≥ CS# ≥ V <sub>CC</sub> - 0.2V, (1) 0V ≤ V <sub>IN</sub> ≤ 0.2V or (2) V <sub>CC</sub> ≥ V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2V
Data retention current	L-version	I <sub>CCDR</sub>	—	400	μA V <sub>CC</sub> = 3V V <sub>CC</sub> ≥ CS# ≥ V <sub>CC</sub> - 0.2V, (1) 0V ≤ V <sub>IN</sub> ≤ 0.2V or (2) V <sub>CC</sub> ≥ V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2V
	S-Version	I <sub>CCDR</sub>	—	200	
Chip deselect to data retention time	t <sub>CDR</sub>	0	—	ns	See retention waveform
Operation recovery time	t <sub>R</sub>	5	—	ms	

### Low V<sub>CC</sub> Data Retention Timing Waveform



**Revision History**

Rev.	Date	Description	
		Page	Summary
1.00	Nov.18.19	-	First Edition issued

All documents should contain the following section break and paragraph as the last item. The footers of this document refer to the paragraph in order to reference the last page of the document.

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