

# R1WV6416R Series

64Mb Advanced LPSRAM (4M word x 16bit / 8M word x 8bit)

REJ03C0368-0100

Rev.1.00

2009.05.07

## Description

The R1WV6416R Series is a family of low voltage 64-Mbit static RAMs organized as 4,194,304-word by 16-bit, fabricated by Renesas's high-performance 0.15um CMOS and TFT technologies.

The R1WV6416R Series is suitable for memory applications where a simple interfacing, battery operating and battery backup are the important design objectives.

The R1WV6416R Series is provided in 48-pin thin small outline package [TSOP (I): 12mm x 20mm with pin pitch of 0.5mm], 52-pin micro thin small outline package [ $\mu$ TSOP (II): 10.79mm x 10.49mm with pin pitch of 0.4mm] and 48-ball fine pitch ball grid array [f-BGA] package. It gives the best solution for compaction of mounting area as well as flexibility of wiring pattern of printed circuit boards.

## Features

- Single 2.7~3.6V power supply
- Small stand-by current: 8  $\mu$ A (3.0V, typical)
- No clocks, No refresh
- All inputs and outputs are TTL compatible.
- Easy memory expansion by CS1#, CS2, LB# and UB#
- Common Data I/O
- Three-state outputs: OR-tie Capability
- OE# prevents data contention on the I/O bus

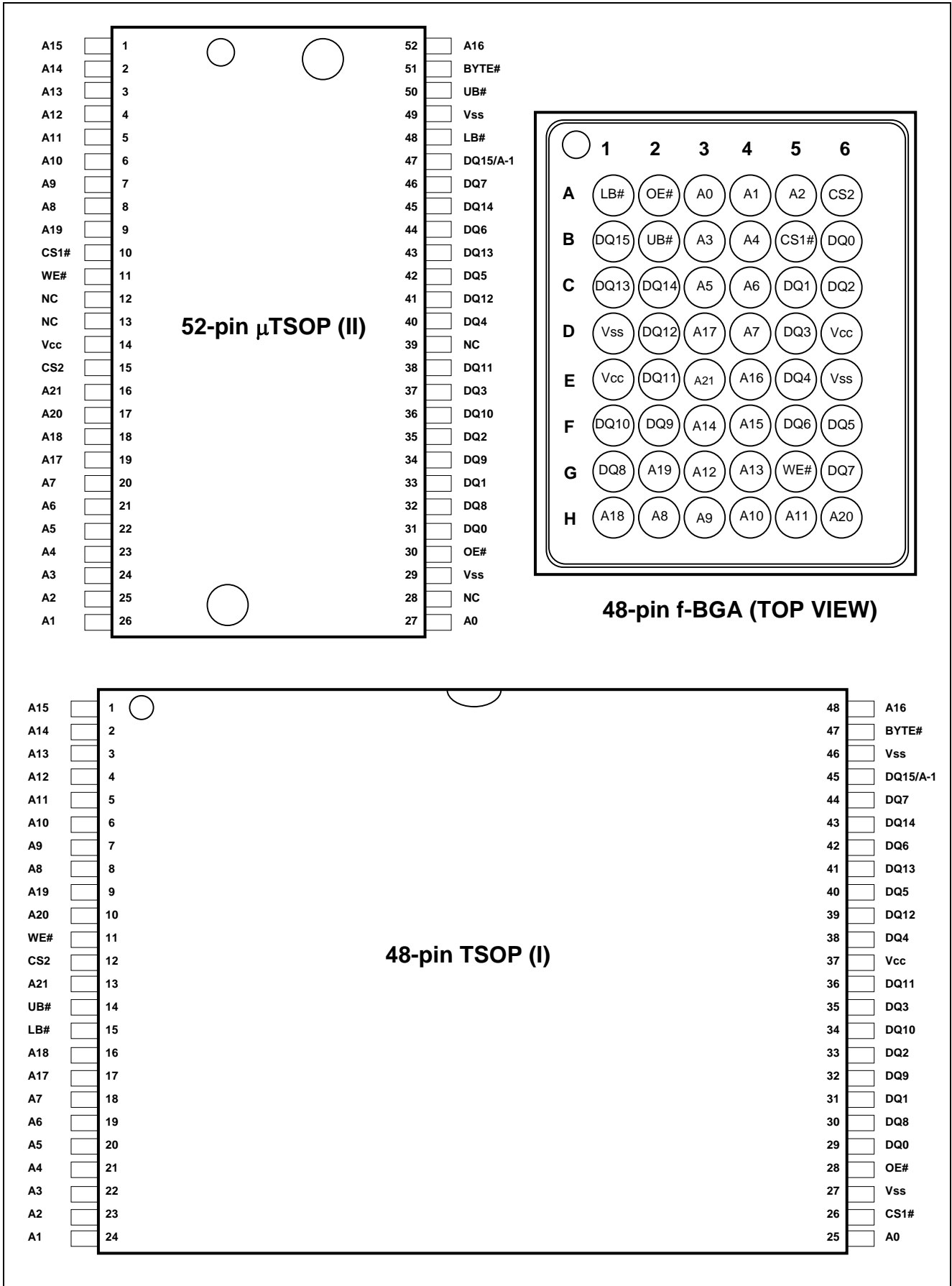
## Ordering Information

Type No.	Access time	Package
R1WV6416RSA-5S%	55 ns	12mm x 20mm 48-pin plastic TSOP (I) (normal-bend type) (48P3R)
R1WV6416RSA-7S%	70 ns	
R1WV6416RSD-5S%	55 ns	350 mil 52-pin plastic $\mu$ -TSOP (II) (normal-bend type) (52PTG)
R1WV6416RSD-7S%	70 ns	
R1WV6416RBG-5S%	55 ns	f-BGA 0.75mm pitch 48-ball
R1WV6416RBG-7S%	70 ns	

% - Temperature version; see table below

%	Temperature Range
R	0 ~ +70 °C
I	-40 ~ +85 °C

Pin Arrangement

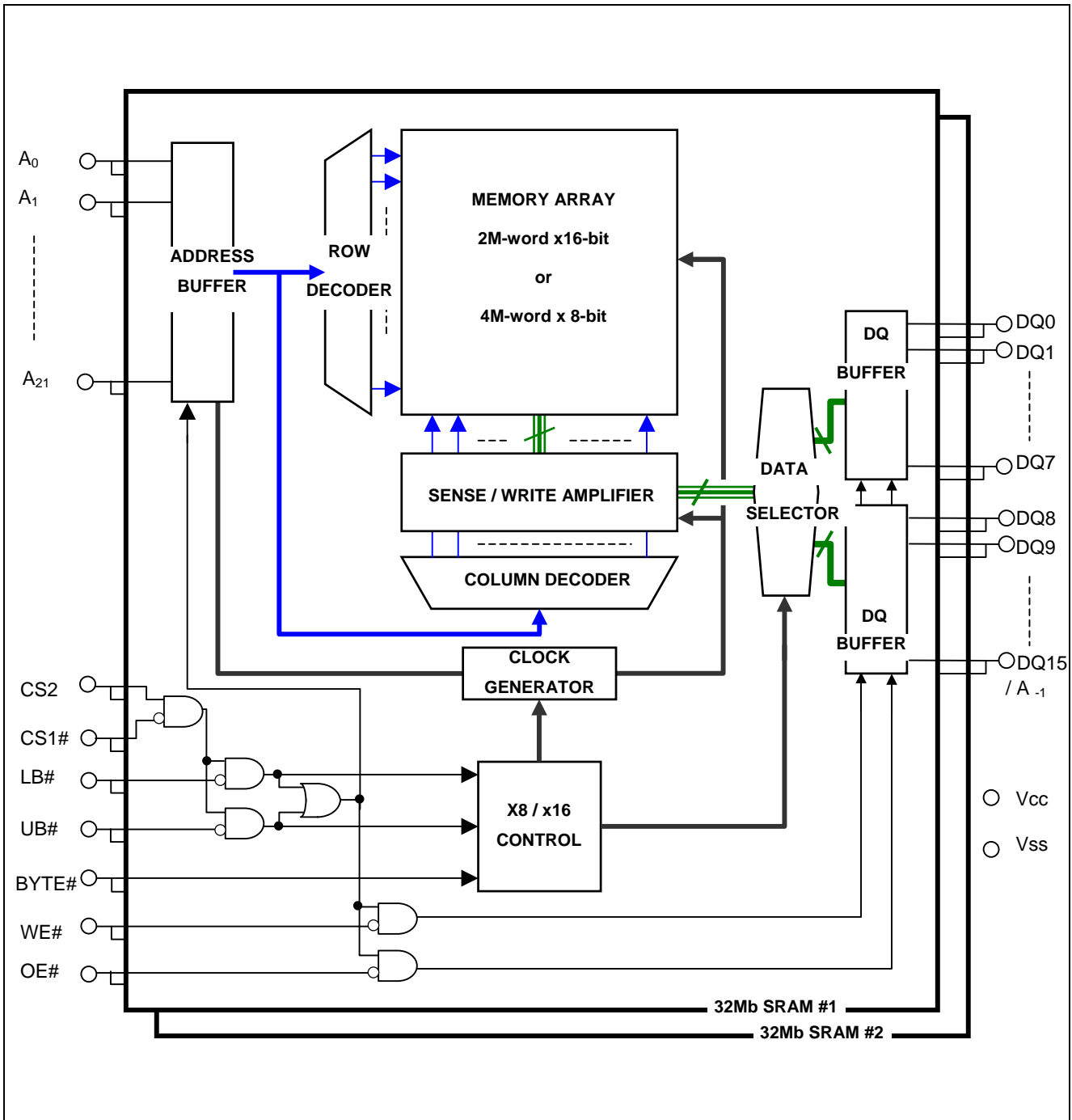


## Pin Description

Pin name	Function
Vcc	Power supply
Vss	Ground
A0 to A21	Address input (word mode)
A-1 to A21	Address input (byte mode)
DQ0 to DQ15	Data input/output
CS1#	Chip select 1
CS2	Chip select 2
WE#	Write enable
OE#	Output enable
LB#	Lower byte enable
UB#	Upper byte enable
BYTE#	Byte control mode enable
NC	Non connection

Note: BYTE# pin is supported for 48-pin TSOP (I) and 52-pin  $\mu$ TSOP (II) packages.

Block Diagram



Note: BYTE# pin is supported for 48-pin TSOP (I) and 52-pin  $\mu$ TSOP (II) packages.

## Operation Table

CS1#	CS2	BYTE#	LB#	UB#	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	L	H	L	X	Din	High-Z	High-Z	Write in lower byte
L	H	H	L	H	H	L	Dout	High-Z	High-Z	Read in lower byte
L	H	H	L	H	H	H	High-Z	High-Z	High-Z	Output disable
L	H	H	H	L	L	X	High-Z	Din	Din	Write in upper byte
L	H	H	H	L	H	L	High-Z	Dout	Dout	Read in upper byte
L	H	H	H	L	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	L	L	L	X	Din	High-Z	A-1	Byte write
L	H	L	L	L	H	L	Dout	High-Z	A-1	Byte read
L	H	L	L	L	H	H	High-Z	High-Z	A-1	Output disable

Note1. H:  $V_{IH}$  L:  $V_{IL}$  X:  $V_{IH}$  or  $V_{IL}$

2. BYTE# pin is supported for 48-pin TSOP (I) and 52-pin  $\mu$ TSOP (II) packages.

3. When apply BYTE# = "L", please assign LB#=UB#="L".

## Absolute Maximum Ratings

Parameter	Symbol	Value	unit
Power supply voltage relative to Vss	Vcc	-0.5 to +4.6	V
Terminal voltage on any pin relative to Vss	$V_T$	$-0.5^{*1}$ to $V_{cc}+0.3^{*2}$	V
Power dissipation	$P_T$	0.7	W
Operation temperature	$T_{opr}^{*3}$	R ver.	0 to +70
		I ver.	-40 to +85
Storage temperature range	$T_{stg}$	-65 to 150	$^{\circ}$ C
Storage temperature range under bias	$T_{bias}^{*3}$	R ver.	0 to +70
		I ver.	-40 to +85

Note 1. -2.0V in case of AC (Pulse width  $\leq 30$ ns)

2. Maximum voltage is +4.6V.

3. Ambient temperature range depends on R/I-version. Please see table on page 1.

## Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note	
Supply voltage	V <sub>CC</sub>	2.7	3.0	3.6	V		
	V <sub>SS</sub>	0	0	0	V		
Input high voltage	V <sub>IH</sub>	2.4	-	V <sub>CC</sub> +0.2	V		
Input low voltage	V <sub>IL</sub>	-0.2	-	0.4	V	1	
Ambient temperature range	R ver.	T <sub>a</sub>	0	-	+70	°C	2
	I ver.		-40	-	+85	°C	2

Note 1. -2.0V in case of AC (Pulse width ≤ 30ns)

2. Ambient temperature range depends on R/I-version. Please see table on page 1.

## DC Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions <sup>3</sup>
Input leakage current	I <sub>LI</sub>	-	-	1	μA	V <sub>in</sub> = V <sub>SS</sub> to V <sub>CC</sub>
Output leakage current	I <sub>LO</sub>	-	-	1	μA	BYTE# ≥ V <sub>CC</sub> -0.2V or BYTE# ≤ 0.2V CS1# =V <sub>IH</sub> or CS2 =V <sub>IL</sub> or OE# =V <sub>IH</sub> or WE# =V <sub>IL</sub> or LB# = UB# =V <sub>IH</sub> , VI/O =V <sub>SS</sub> to V <sub>CC</sub>
Average operating current	I <sub>CC1</sub>	-	45 <sup>*1</sup>	60	mA	Min. cycle, duty =100%, I/O = 0mA BYTE# ≥ V <sub>CC</sub> -0.2V or BYTE# ≤ 0.2V CS1# =V <sub>IL</sub> , CS2 =V <sub>IH</sub> , Others = V <sub>IH</sub> /V <sub>IL</sub>
	I <sub>CC2</sub>	-	5 <sup>*1</sup>	10	mA	Cycle =1μs, duty =100%, I/O = 0mA BYTE# ≥ V <sub>CC</sub> -0.2V or BYTE# ≤ 0.2V CS1# ≤ 0.2V, CS2 ≥ V <sub>CC</sub> -0.2V, V <sub>IH</sub> ≥ V <sub>CC</sub> -0.2V, V <sub>IL</sub> ≤ 0.2V
Standby current	I <sub>SB</sub>	-	0.1 <sup>*1</sup>	0.3	mA	BYTE# ≥ V <sub>CC</sub> -0.2V or BYTE# ≤ 0.2V CS2 =V <sub>IL</sub>
Standby current	I <sub>SB1</sub>	-	8 <sup>*1</sup>	24	μA	~+25°C V <sub>in</sub> ≥ 0V BYTE# ≥ V <sub>CC</sub> -0.2V or BYTE# ≤ 0.2V
		-	14 <sup>*2</sup>	48	μA	~+40°C (1) 0V ≤ CS2 ≤ 0.2V or (2) CS1# ≥ V <sub>CC</sub> -0.2V, CS2 ≥ V <sub>CC</sub> -0.2V or
		-	-	100	μA	~+70°C (3) LB# = UB# ≥ V <sub>CC</sub> -0.2V, CS1# ≤ 0.2V, CS2 ≥ V <sub>CC</sub> -0.2V
		-	-	160	μA	~+85°C
Output high voltage	V <sub>OH</sub>	2.4	-	-	V	BYTE# ≥ V <sub>CC</sub> -0.2V or BYTE# ≤ 0.2V I <sub>OH</sub> = -0.5mA
Output low voltage	V <sub>OL</sub>	-	-	0.4	V	BYTE# ≥ V <sub>CC</sub> -0.2V or BYTE# ≤ 0.2V I <sub>OL</sub> = 2mA

Note 1. Typical parameter indicates the value for the center of distribution at 3.0V (T<sub>a</sub> = 25°C), and not 100% tested.

2. Typical parameter indicates the value for the center of distribution at 3.0V (T<sub>a</sub> = 40°C), and not 100% tested.

3. BYTE# pin is supported for 48-pin TSOP (I) and 52-pin μTSOP (II) packages.

## Capacitance

(Ta =25°C, f =1MHz)

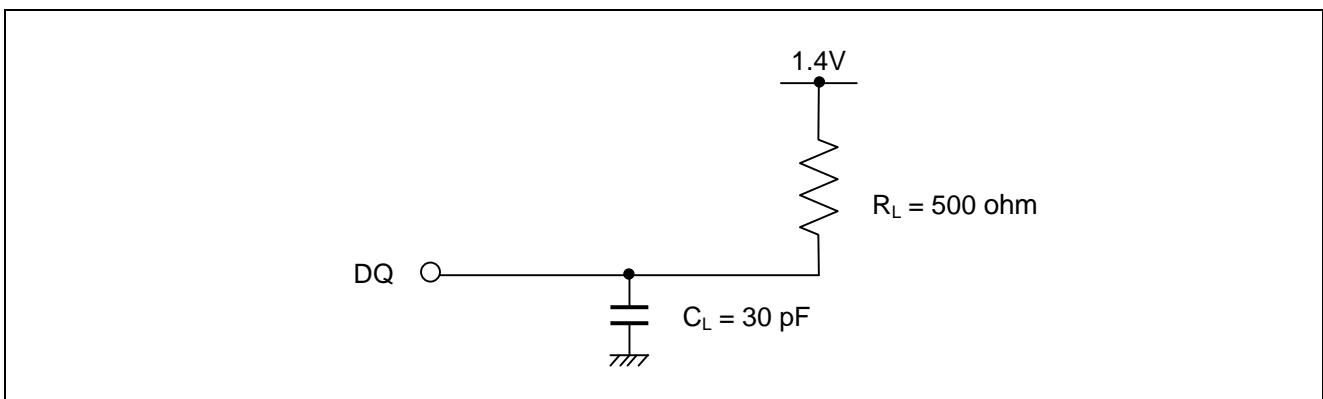
Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions	Note
Input capacitance	C <sub>in</sub>	-	-	20	pF	V <sub>in</sub> =0V	1
Input / output capacitance	C <sub>I/O</sub>	-	-	20	pF	V <sub>I/O</sub> =0V	1

Note1. This parameter is sampled and not 100% tested.

## AC Characteristics

Test Conditions (V<sub>cc</sub> = 2.7V ~ 3.6V, Ta = 0 ~ +70°C / -40 ~ +85°C\*1)

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



Note1. Ambient temperature range depends on R/I-version. Please see table on page 1.

## Read Cycle

Parameter	Symbol	R1WV6416R**-5S		R1WV6416R**-7S		Unit	Note
		Min.	Max.	Min.	Max.		
Read cycle time	t <sub>RC</sub>	55	-	70	-	ns	
Address access time	t <sub>AA</sub>	-	55	-	70	ns	
Chip select access time	t <sub>ACS1</sub>	-	55	-	70	ns	
	t <sub>ACS2</sub>	-	55	-	70	ns	
Output enable to output valid	t <sub>OE</sub>	-	25	-	35	ns	
Output hold from address change	t <sub>OH</sub>	10	-	10	-	ns	
LB#, UB# access time	t <sub>BA</sub>	-	55	-	70	ns	
Chip select to output in low-Z	t <sub>CLZ1</sub>	10	-	10	-	ns	2,3
	t <sub>CLZ2</sub>	10	-	10	-	ns	2,3
LB#, UB# enable to low-Z	t <sub>BLZ</sub>	5	-	5	-	ns	2,3
Output enable to output in low-Z	t <sub>OLZ</sub>	5	-	5	-	ns	2,3
Chip deselect to output in high-Z	t <sub>CHZ1</sub>	0	20	0	25	ns	1,2,3
	t <sub>CHZ2</sub>	0	20	0	25	ns	1,2,3
LB#, UB# disable to high-Z	t <sub>BHZ</sub>	0	20	0	25	ns	1,2,3
Output disable to output in high-Z	t <sub>OHZ</sub>	0	20	0	25	ns	1,2,3



## Write Cycle

Parameter	Symbol	R1WV6416R**-5S		R1WV6416R**-7S		Unit	Note
		Min.	Max.	Min.	Max.		
Write cycle time	$t_{WC}$	55	-	70	-	ns	
Address valid to end of write	$t_{AW}$	50	-	65	-	ns	
Chip select to end of write	$t_{CW}$	50	-	65	-	ns	5
Write pulse width	$t_{WP}$	40	-	55	-	ns	4
LB#, UB# valid to end of write	$t_{BW}$	50	-	65	-	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	-	35	-	ns	
Data hold from write time	$t_{DH}$	0	-	0	-	ns	
Output enable 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
Write to output in high-Z	$t_{WHZ}$	0	20	0	25	ns	1,2

Note1.  $t_{CHZ}$ ,  $t_{OHZ}$ ,  $t_{WHZ}$  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 end of write.

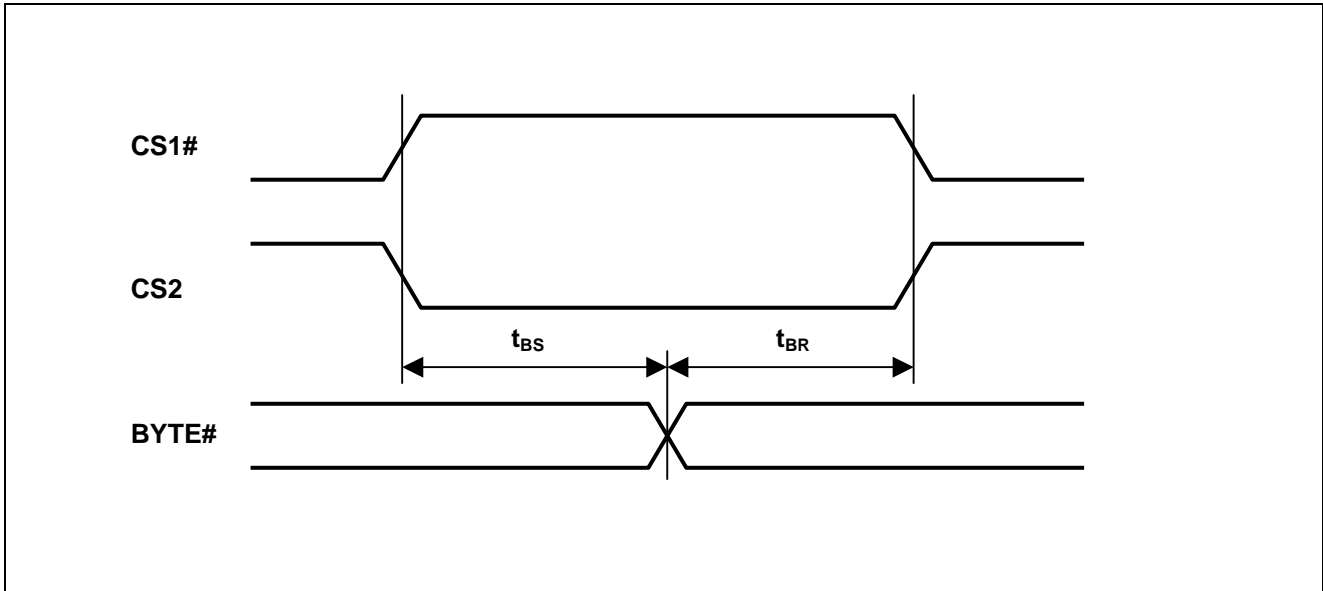
6.  $t_{AS}$  is measured the address valid to the beginning of write.

7.  $t_{WR}$  is measured from the earliest of CS1# or WE# going high or CS2 going low to the end of write cycle.

## BYTE# Timing Conditions

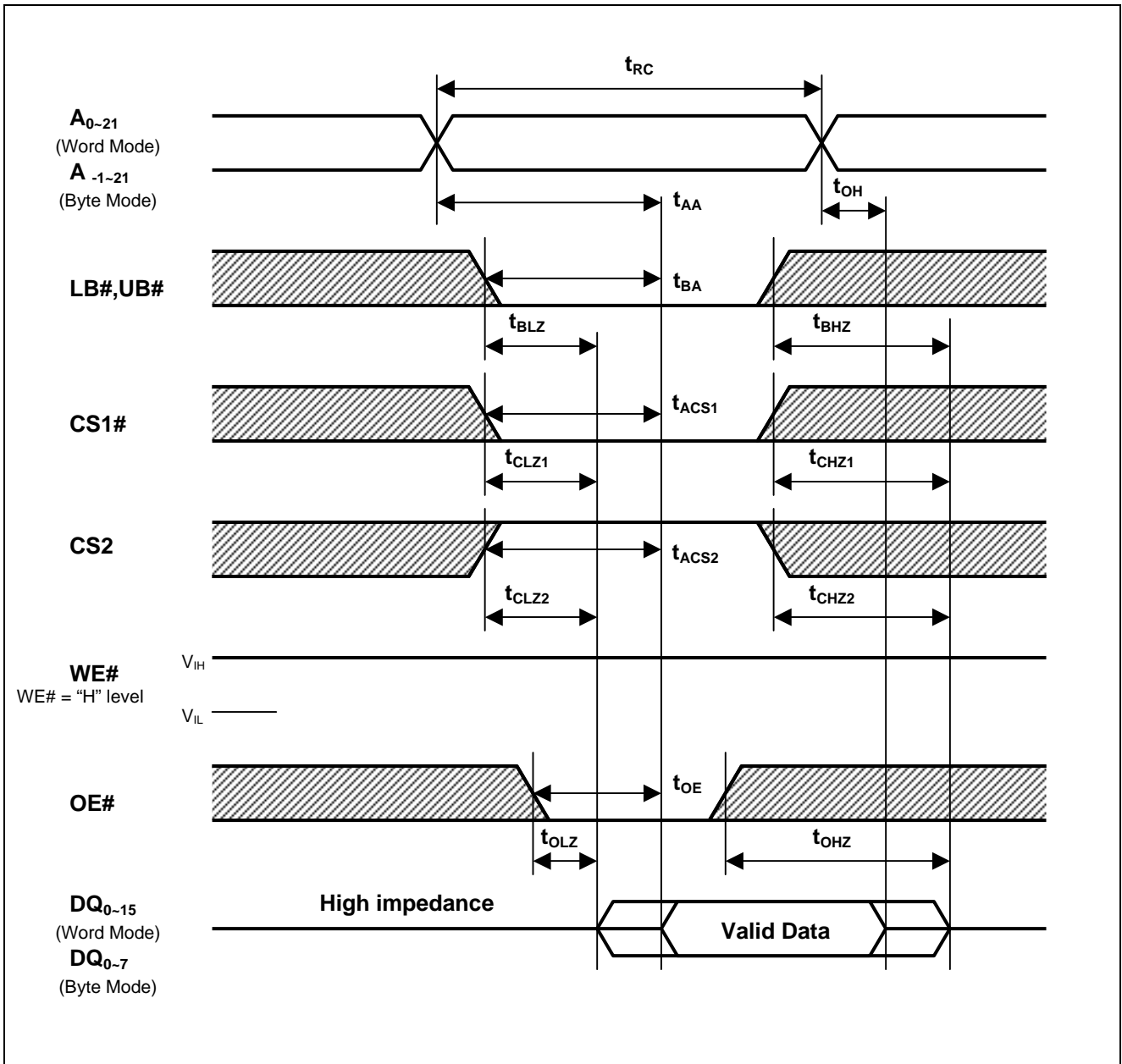
Parameter	Symbol	R1WV6416R**-5S		R1WV6416R**-7S		Unit	Note
		Min.	Max.	Min.	Max.		
Byte setup time	$t_{BS}$	5	-	5	-	ms	
Byte recovery time	$t_{BR}$	5	-	5	-	ms	

## BYTE# Timing Waveforms



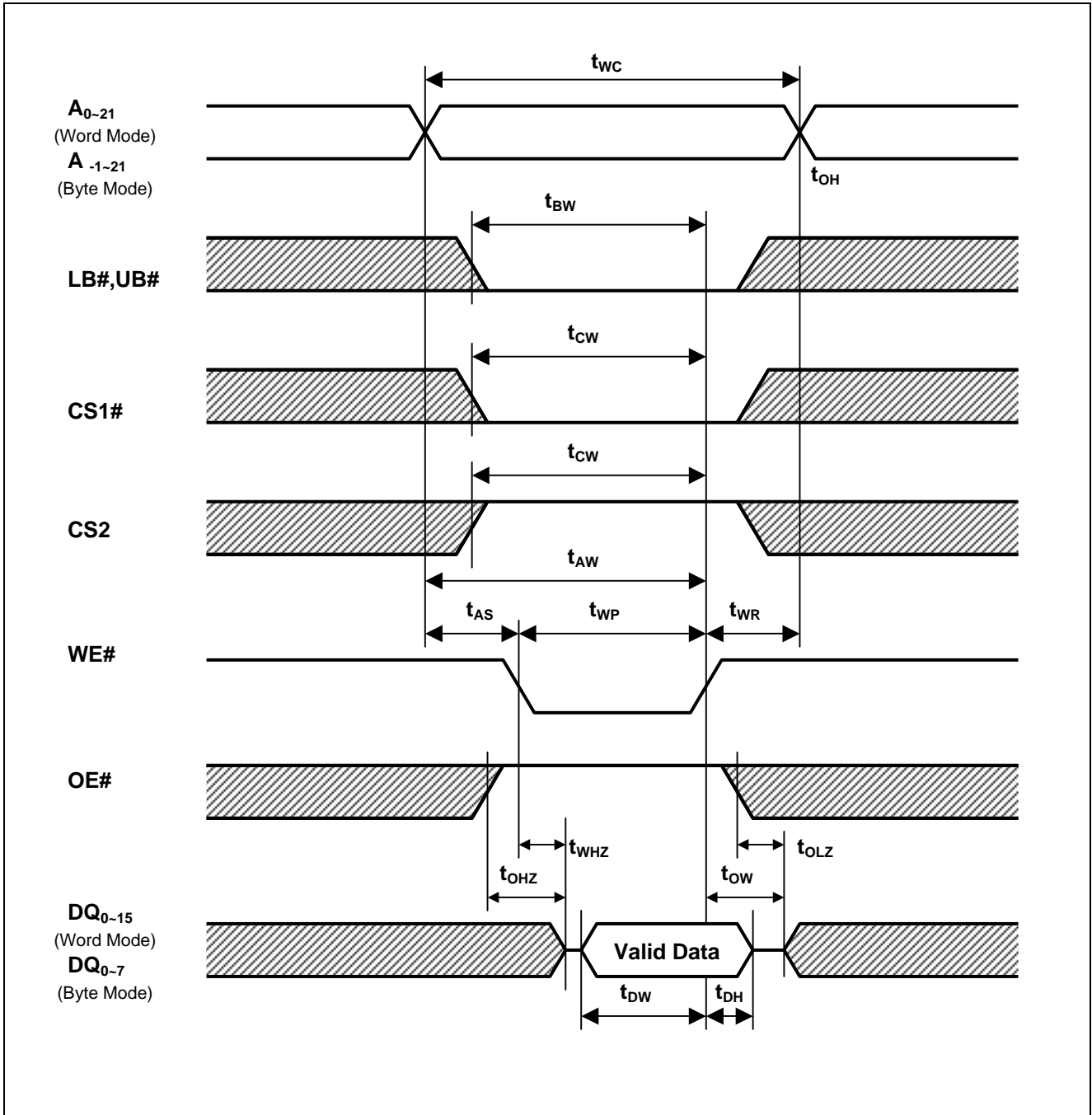
Timing Waveforms

Read Cycle<sup>\*1</sup>



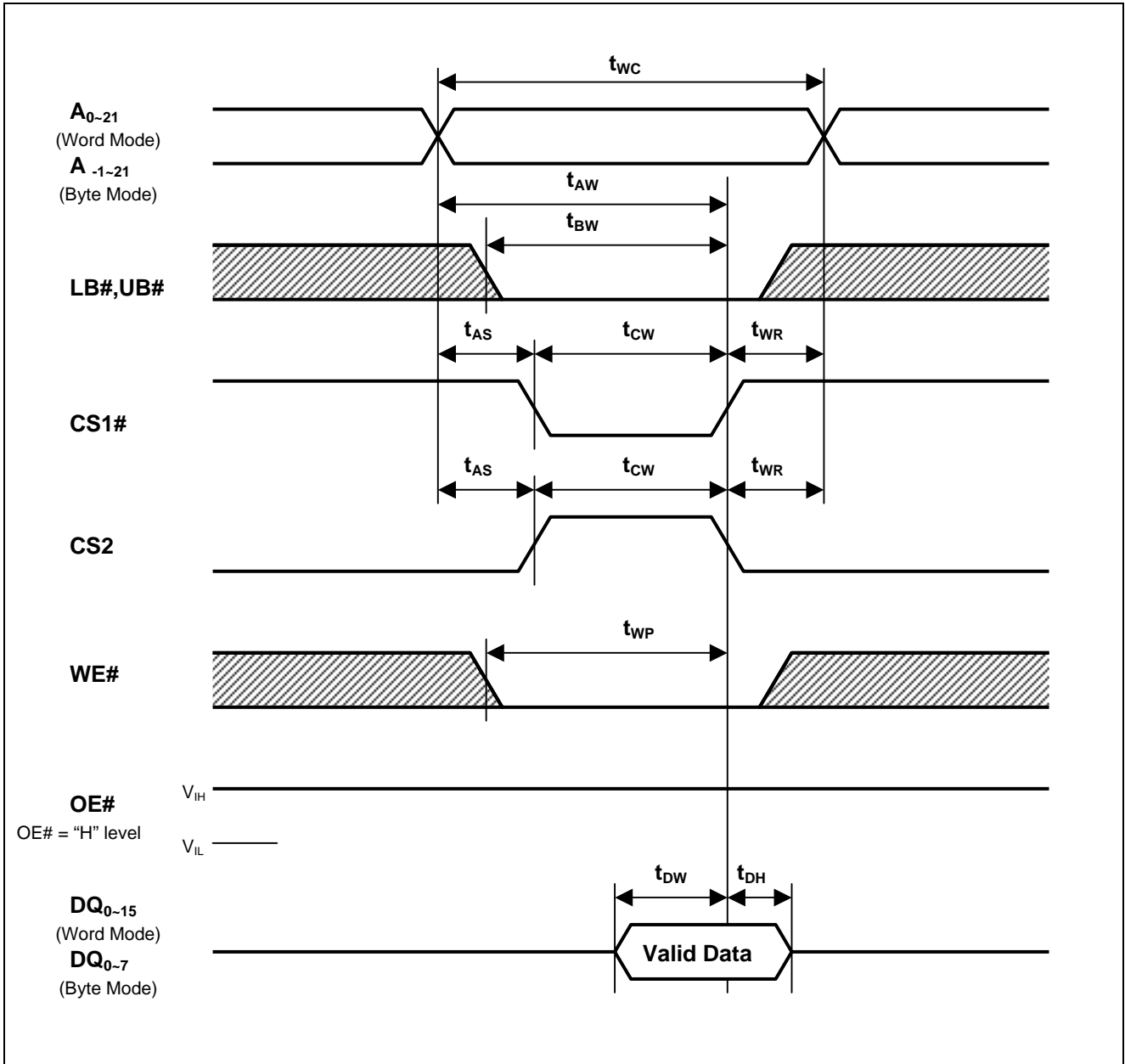
Note1. BYTE#  $\geq V_{CC} - 0.2V$  or BYTE#  $\leq 0.2V$

Write Cycle (1)<sup>\*1</sup> (WE# CLOCK)



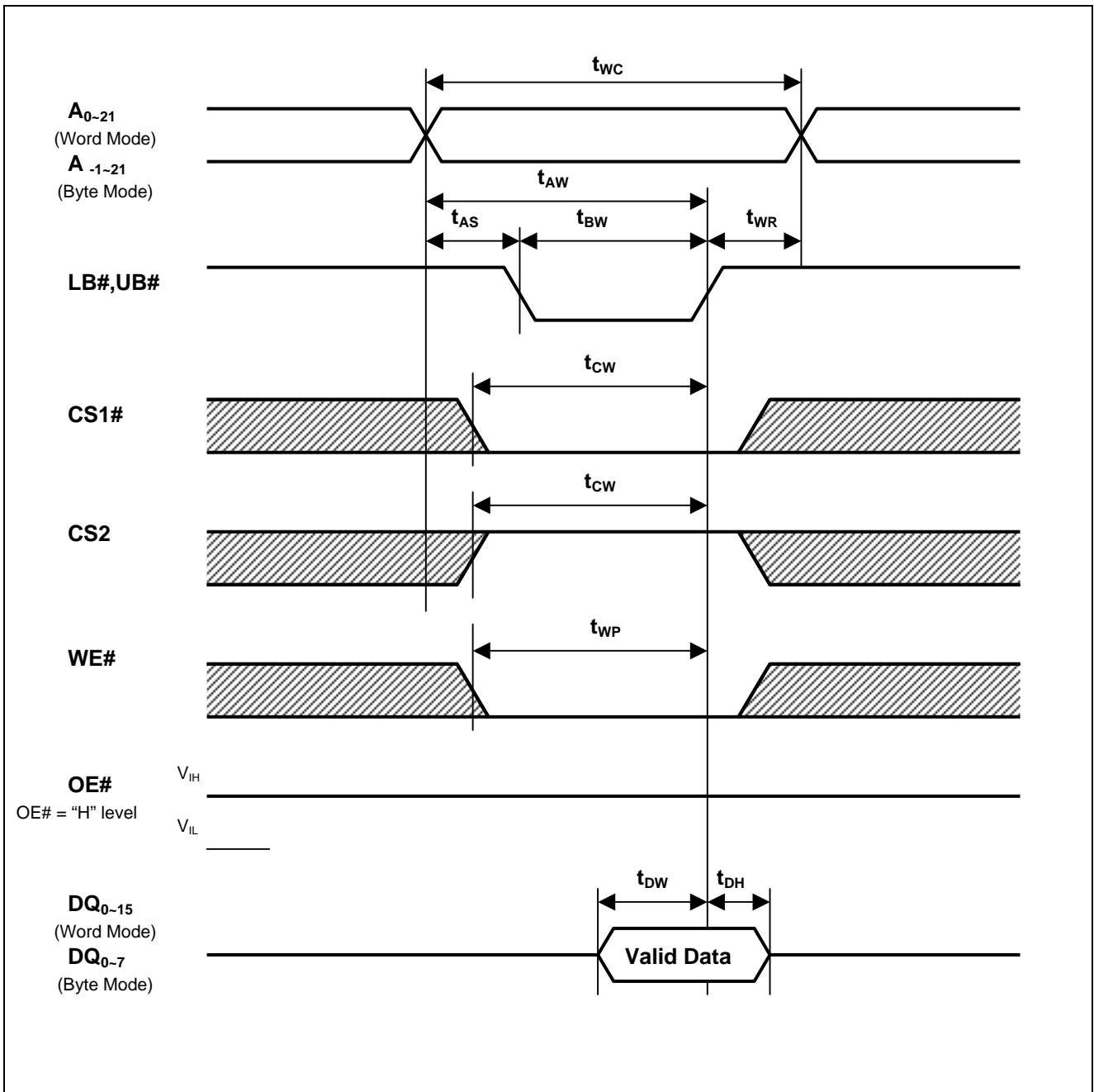
Note1. BYTE#  $\geq V_{CC} - 0.2V$  or BYTE#  $\leq 0.2V$

Write Cycle (2)<sup>\*1</sup> (CS1#, CS2 CLOCK)



Note1. BYTE#  $\geq V_{CC} - 0.2V$  or BYTE#  $\leq 0.2V$

Write Cycle (3)<sup>\*1</sup> (LB#, UB# CLOCK)



Note1. BYTE#  $\geq V_{CC} - 0.2V$  or BYTE#  $\leq 0.2V$

## Low Vcc Data Retention Characteristics

Parameter	Symbol	Min.	Typ	Max.	Unit	Test conditions <sup>*3,4</sup>	
V <sub>CC</sub> for data retention	V <sub>DR</sub>	2.0	-	3.6	V	Vin ≥ 0V BYTE# ≥ V <sub>CC</sub> -0.2V or BYTE# ≤ 0.2V (1) 0V ≤ CS2 ≤ 0.2V or (2) CS1# ≥ V <sub>CC</sub> -0.2V, CS2 ≥ V <sub>CC</sub> -0.2V or (3) LB# = UB# ≥ V <sub>CC</sub> -0.2V, CS1# ≤ 0.2V, CS2 ≥ V <sub>CC</sub> -0.2V	
Data retention current	I <sub>CCDR</sub>	-	8 <sup>*1</sup>	24	μA	~+25°C	Vin ≥ 0V BYTE# ≥ V <sub>CC</sub> -0.2V or BYTE# ≤ 0.2V
		-	14 <sup>*2</sup>	48	μA	~+40°C	(1) 0V ≤ CS2 ≤ 0.2V or (2) CS1# ≥ V <sub>CC</sub> -0.2V, CS2 ≥ V <sub>CC</sub> -0.2V or
		-	-	100	μA	~+70°C	(3) LB# = UB# ≥ V <sub>CC</sub> -0.2V, CS1# ≤ 0.2V, CS2 ≥ V <sub>CC</sub> -0.2V
		-	-	160	μA	~+85°C	CS1# ≤ 0.2V, CS2 ≥ V <sub>CC</sub> -0.2V
Chip select to data retention time	t <sub>CDR</sub>	0	-	-	ns	See retention waveform.	
Operation recovery time	t <sub>R</sub>	5	-	-	ms		

Note 1. Typical parameter indicates the value for the center of distribution at 3.0V (Ta= 25°C), and not 100% tested.

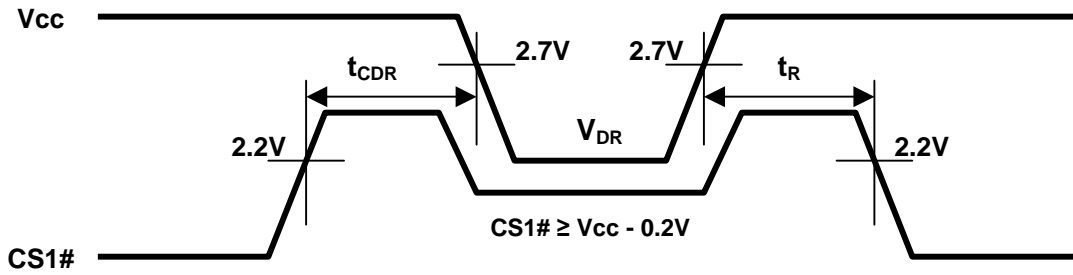
2. Typical parameter indicates the value for the center of distribution at 3.0V (Ta= 40°C), and not 100% tested.

3. BYTE# pin is supported for 48-pin TSOP (I) and 52-pin μTSOP (II) packages.

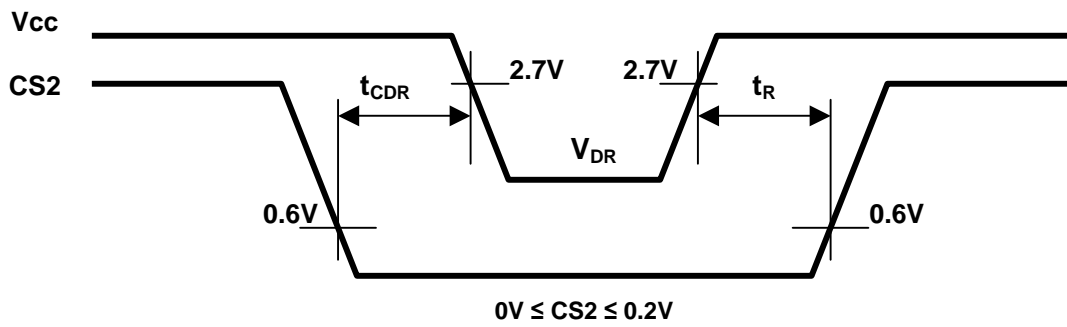
4. CS2 also controls address buffer, WE# buffer, CS1# buffer, OE# buffer, LB#, UB# buffer and Din buffer. If CS2 controls data retention mode, Vin levels (address, WE#, OE#, CS1#, LB#, UB#, I/O) can be in the high impedance state. If CS1# controls data retention mode, CS2 must be CS2 ≥ V<sub>CC</sub>-0.2V or 0V ≤ CS2 ≤ 0.2V. The other input levels (address, WE#, OE#, CS1#, LB#, UB#, I/O) can be in the high impedance state.

Low Vcc Data Retention Timing Waveforms\*1

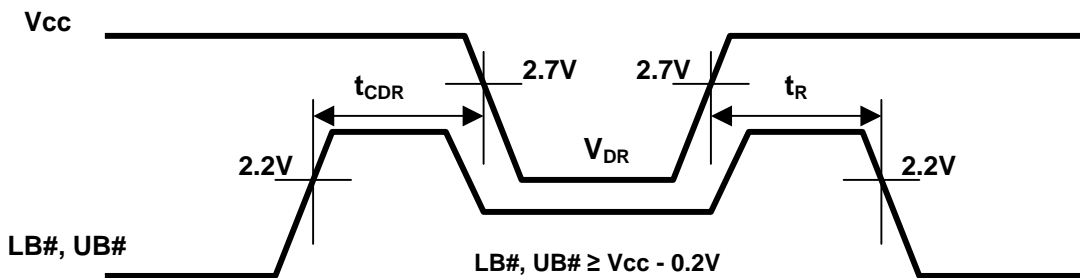
(1) CS1# Controlled



(2) CS2 Controlled



(3) LB#, UB# Controlled



Note1. BYTE#  $\geq V_{cc} - 0.2V$  or BYTE#  $\leq 0.2V$



## Revision History

## R1WV6416R Data Sheet

Rev.	Date	Contents of Revision	
		Page	Description
0.01	Mar.24, 2008	-	Initial issue: Preliminary Data Sheet
1.00	May 07, 2009	-	Finalized
		5	Operation Table corrected
		6	Error corrected: $I_{SB}$ Test condition $CS2=V_{IH} \rightarrow V_{IL}$

Notes:

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To our customers,

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April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

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