

## Description

The R1WV3216R Series is a family of low voltage 32-Mbit static RAMs organized as 2097152-words by 16-bit, fabricated by Renesas's high-performance 0.15um CMOS and TFT technologies.

The R1WV3216R Series is suitable for memory applications where a simple interfacing , battery operating and battery backup are the important design objectives.

The R1WV3216R Series is made by stacked-micro-package technology and two chips of 16Mbit Advanced LPSRAMs are assembled in one package.

The R1WV3216R Series is packaged in a 52pin micro thin small outline mount device[μTSOP / 10.79mm x 10.49mm with the pin-pitch of 0.4mm] or a 48balls fine pitch ball grid array [f-BGA / 7.5mmx8.5mm with the ball-pitch of 0.75mm and 6x8 array] . It gives the best solution for a 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:4μA (3.0V, typ.)
- Data retention supply voltage =2.0V
- 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
- Process technology: 0.15um CMOS

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**Ordering Information**

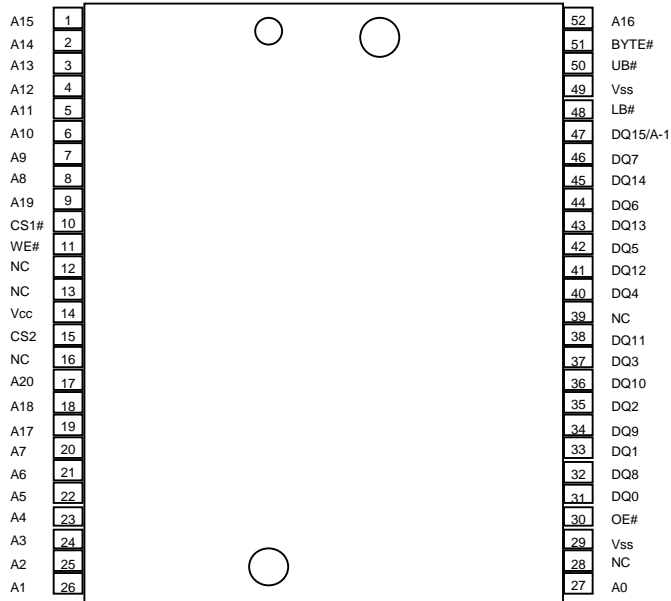
Type No.	Access time	Package
R1WV3216RSD-7S%	70 ns	350-mil 52-pin plastic $\mu$ - TSOP(II) (normal-bend type) (52PTG)
R1WV3216RSD-8S%	85 ns	
R1WV3216RBG-7S%	70 ns	7.5mmx8.5mm f-BGA 0.75mm pitch 48ball
R1WV3216RBG-8S%	85 ns	

% - Temperature version; see table below

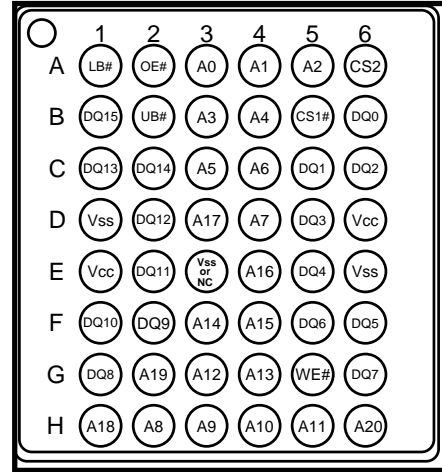
%	Temperature Range
R	0 ~ +70 °C
I	-40 ~ +85 °C

## Pin Arrangement

52-pin  $\mu$ TSSOP



48-pin fBGA



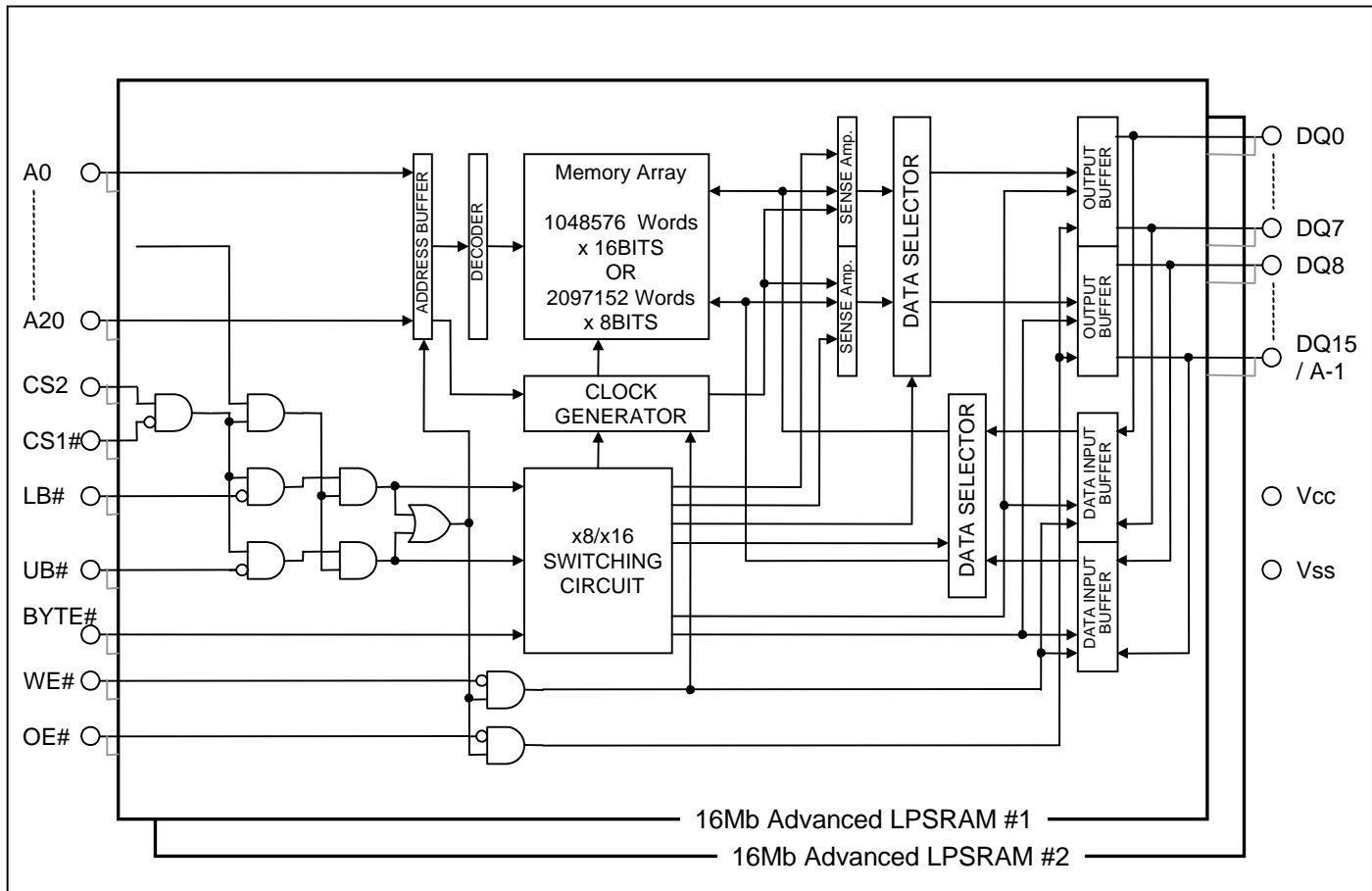
(Top view)

## Pin Description

Pin name	Function
A0 to A20	Address input (Word mode)
A-1 to A20	Address input (Byte mode)
DQ 0 to DQ15	Data input/output
CS1# & CS2	Chip select
WE#	Write enable
OE#	Output enable
LB#	Lower byte select
UB#	Upper byte select
Vcc	Power supply
Vss	Ground
BYTE#	Byte (x8 mode) enable input
NC	Non connection

Note: Byte Mode is supported by only 52-pin  $\mu$ TSSOP type.

**Block Diagram**



Note: BYTE# pin is supported by only 52-pin  $\mu$ TSOP type.

<b>Operating Table</b>
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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 from lower byte
L	H	X	X	X	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 from upper byte
L	H	H	L	L	L	X	Din	Din	Din	Write
L	H	H	L	L	H	L	Dout	Dout	Dout	Read
L	H	L	L	L	L	X	Din	High-Z	A-1	Write
L	H	L	L	L	H	L	Dout	High-Z	A-1	Read

Note 1. H:VIH L:VIL X: VIH or VIL

2. BYTE# pin is supported by only 52-pin  $\mu$ TSOP type. When apply BYTE# = "L", please assign LB#=UB#="L".

<b>Absolute Maximum Ratings</b>
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Parameter	Symbol	Value	Unit
Power supply voltage relative to Vss	Vcc	-0.5 to +4.6	V
Terminal voltage on any pin relation toVss	V <sub>T</sub>	-0.5* <sup>1</sup> to Vcc+0.3* <sup>2</sup>	V
Power dissipation	P <sub>T</sub>	0.7	W
Operation temperature	T <sub>opr</sub>	R ver. * <sup>3</sup>	0 to +70 °C
		I ver. * <sup>3</sup>	-40 to +85 °C
Storage temperature	T <sub>stg</sub>	-65 to +150	°C
Storage temperature range under bias	T <sub>bias</sub>	R ver. * <sup>3</sup>	0 to +70 °C
		I ver. * <sup>3</sup>	-40 to +85 °C

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

2: Maximum voltage is +4.6V

3: Temperature range depends on R/I-version. Please see table on page 2.

### 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 2.

### DC Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions*3
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> , V <sub>I/O</sub> =V <sub>SS</sub> to V <sub>CC</sub>
Average operating current	I <sub>CC1</sub>	-	30 *1	55	mA	BYTE# ≥ V <sub>CC</sub> -0.2V or BYTE# ≤ 0.2V, Min. cycle, duty =100% I I/O = 0 mA, CS1# = V <sub>IL</sub> , CS2 = V <sub>IH</sub> Others = V <sub>IH</sub> / V <sub>IL</sub>
	I <sub>CC2</sub>	-	3 *1	8	mA	BYTE# ≥ V <sub>CC</sub> -0.2V or BYTE# ≤ 0.2V, Cycle time = 1 μs, I I/O = 0 mA, 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, duty=100%
Standby current	I <sub>SB</sub>	-	0.1 *1	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>	-	4 *1	12	μA	~+25°C V <sub>in</sub> ≥ 0V, BYTE# ≥ V <sub>CC</sub> -0.2V or BYTE# ≤ 0.2V,
		-	7 *2	24	μA	~+40°C (1) 0V ≤ CS2 ≤ 0.2V or (2) CS2 ≥ V <sub>CC</sub> -0.2V, CS1# ≥ V <sub>CC</sub> -0.2V or
		-	-	50	μA	~+70°C (3) LB# = UB# ≥ V <sub>CC</sub> -0.2V, CS2 ≥ V <sub>CC</sub> -0.2V, CS1# ≤ 0.2V
		-	-	80	μA	~+85°C Average value
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> = -1mA
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 V<sub>CC</sub>=3.0V (T<sub>a</sub>= 25°C), and not 100% tested.

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

3. BYTE# pin is supported by only 52-pin μTSSOP type.

## Capacitance

(Ta = +25°C, f = 1MHz)

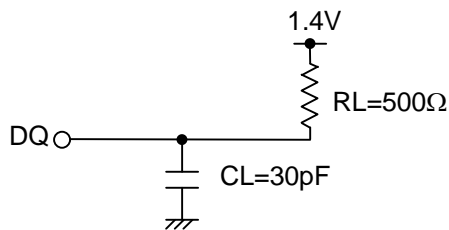
Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions	Note
Input capacitance	C in	-	-	20	pF	V in = 0V	1
Input / output capacitance	C I/O	-	-	20	pF	V I/O = 0V	1

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

## AC Characteristics

Test Conditions (Vcc=2.7~3.6V, Ta = 0~+70°C / -40~+85°C \*)

- Input pulse levels: VIL= 0.4V, VIH=2.4V
- Input rise and fall time : 5ns
- Input and output timing reference levels : 1.4V
- Output load : See figures (Including scope and jig)



Note: Temperature range depends on R/I-version. Please see table on page 2.

## Read Cycle

Parameter	Symbol	R1WV3216R**-7S		R1WV3216R**-8S		Unit	Notes
		Min.	Max.	Min.	Max.		
Read cycle time	$t_{RC}$	70	-	85	-	ns	
Address access time	$t_{AA}$	-	70	-	85	ns	
Chip select access time	$t_{ACS1}$	-	70	-	85	ns	
	$t_{ACS2}$	-	70	-	85	ns	
Output enable to output valid	$t_{OE}$	-	35	-	45	ns	
Output hold from address change	$t_{OH}$	10	-	10	-	ns	
LB#,UB# access time	$t_{BA}$	-	70	-	85	ns	
Chip select to output in low-Z	$t_{CLZ}$	10	-	10	-	ns	2,3
LB#,UB# enable to low-Z	$t_{BLZ}$	5	-	5	-	ns	2,3
Output enable to output in low-Z	$t_{OLZ}$	5	-	5	-	ns	2,3
Chip deselect to output in high-Z	$t_{CHZ1}$	0	25	0	30	ns	1,2,3
	$t_{CHZ2}$	0	25	0	30	ns	1,2,3
LB#,UB# disable to high-Z	$t_{BHZ}$	0	25	0	30	ns	1,2,3
Output disable to output in high-Z	$t_{OHZ}$	0	25	0	30	ns	1,2,3



## Write Cycle

Parameter	Symbol	R1WV3216R**-7S		R1WV3216R**-8S		Unit	Notes
		Min.	Max.	Min.	Max.		
Write cycle time	$t_{WC}$	70	-	85	-	ns	
Address valid to end of write	$t_{AW}$	65	-	70	-	ns	
Chip selection to end of write	$t_{CW}$	65	-	70	-	ns	5
Write pulse width	$t_{WP}$	55	-	60	-	ns	4
LB#,UB# valid to end of write	$t_{BW}$	65	-	70	-	ns	
Address setup time	$t_{AS}$	0	-	0	-	ns	6
Write recovery time	$t_{WR}$	0	-	0	-	ns	7
Data to write time overlap	$t_{DW}$	35	-	40	-	ns	
Data hold from write time	$t_{DH}$	0	-	0	-	ns	
Output active from end of write	$t_{OW}$	5	-	5	-	ns	2
Output disable to output in high-Z	$t_{OHZ}$	0	25	0	30	ns	1,2
Write to output in high-Z	$t_{WHZ}$	0	25	0	30	ns	1,2

## Byte Enable (supported by only 52-pin $\mu$ TSOP )

Parameter	Symbol	R1WV3216R**-7S		R1WV3216R**-8S		Unit	Notes
		Min.	Max.	Min.	Max.		
Byte setup time	$t_{BS}$	5	-	5	-	ms	
Byte recovery time	$t_{BR}$	5	-	5	-	ms	

Note 1.  $t_{CHZ}$ ,  $t_{OHZ}$ ,  $t_{WHZ}$  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 form 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.

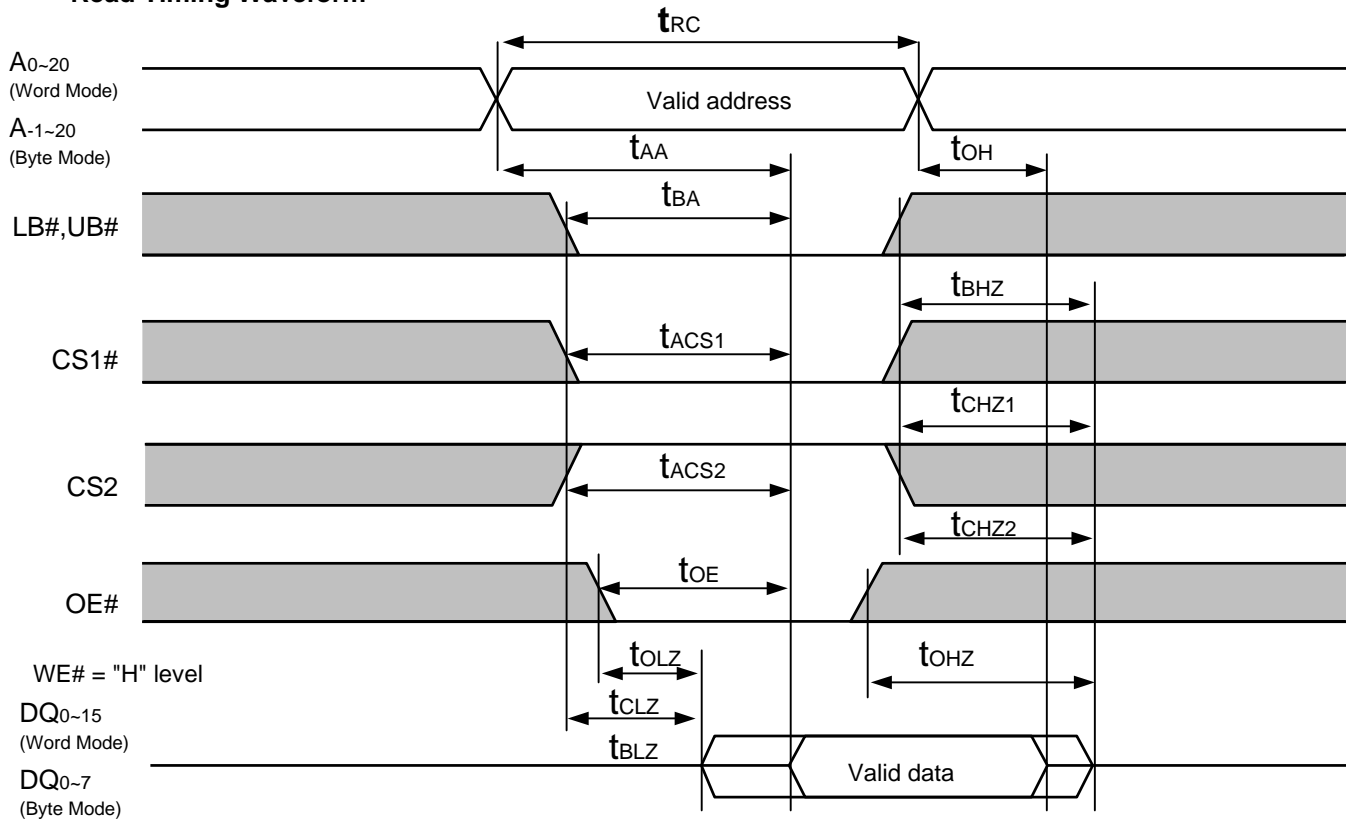
5.  $t_{CW}$  is measured from the later of CS1# going low or CS2 going high to end of write.

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.

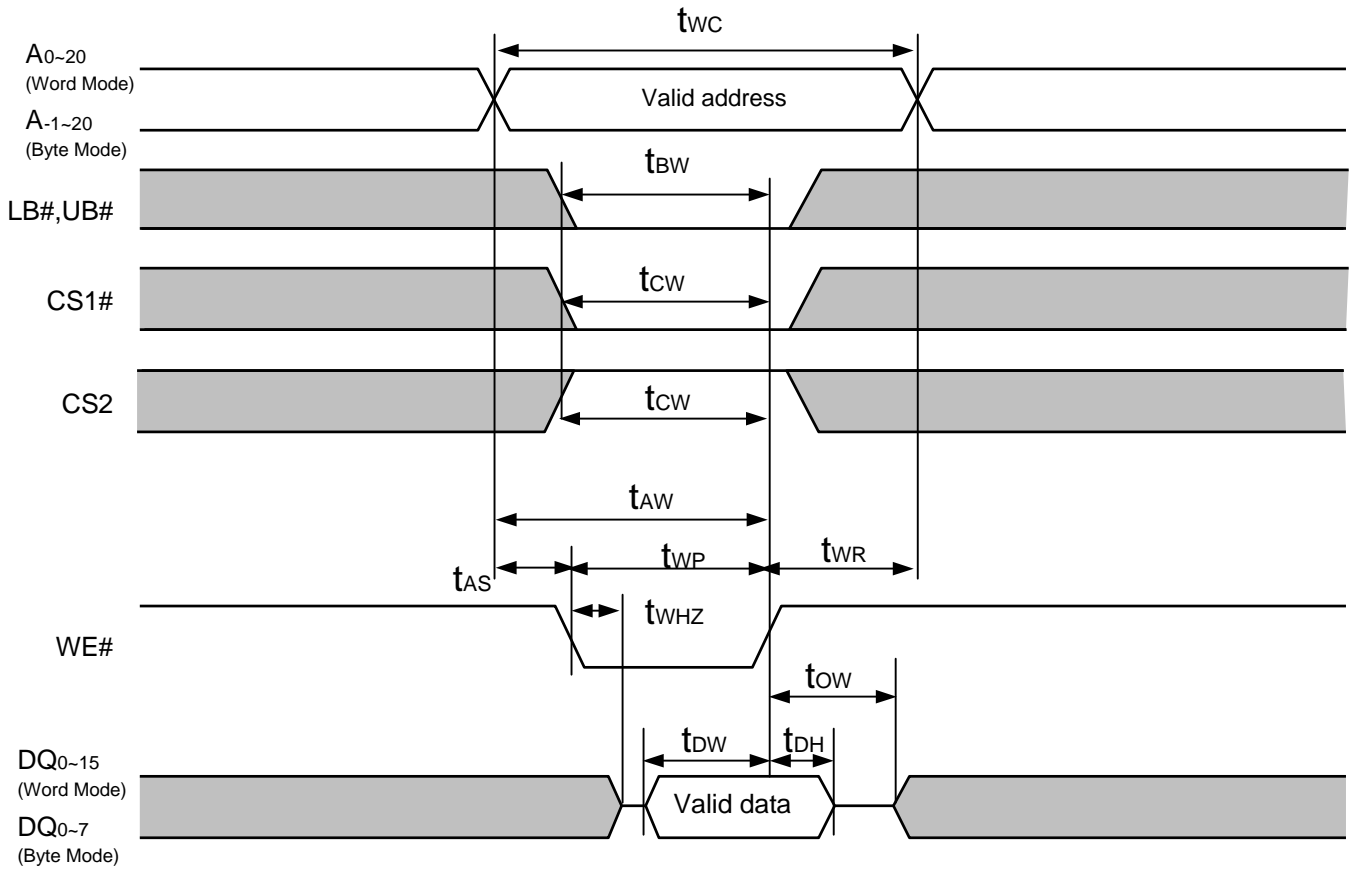
Timing Waveform

**Read Timing Waveform**



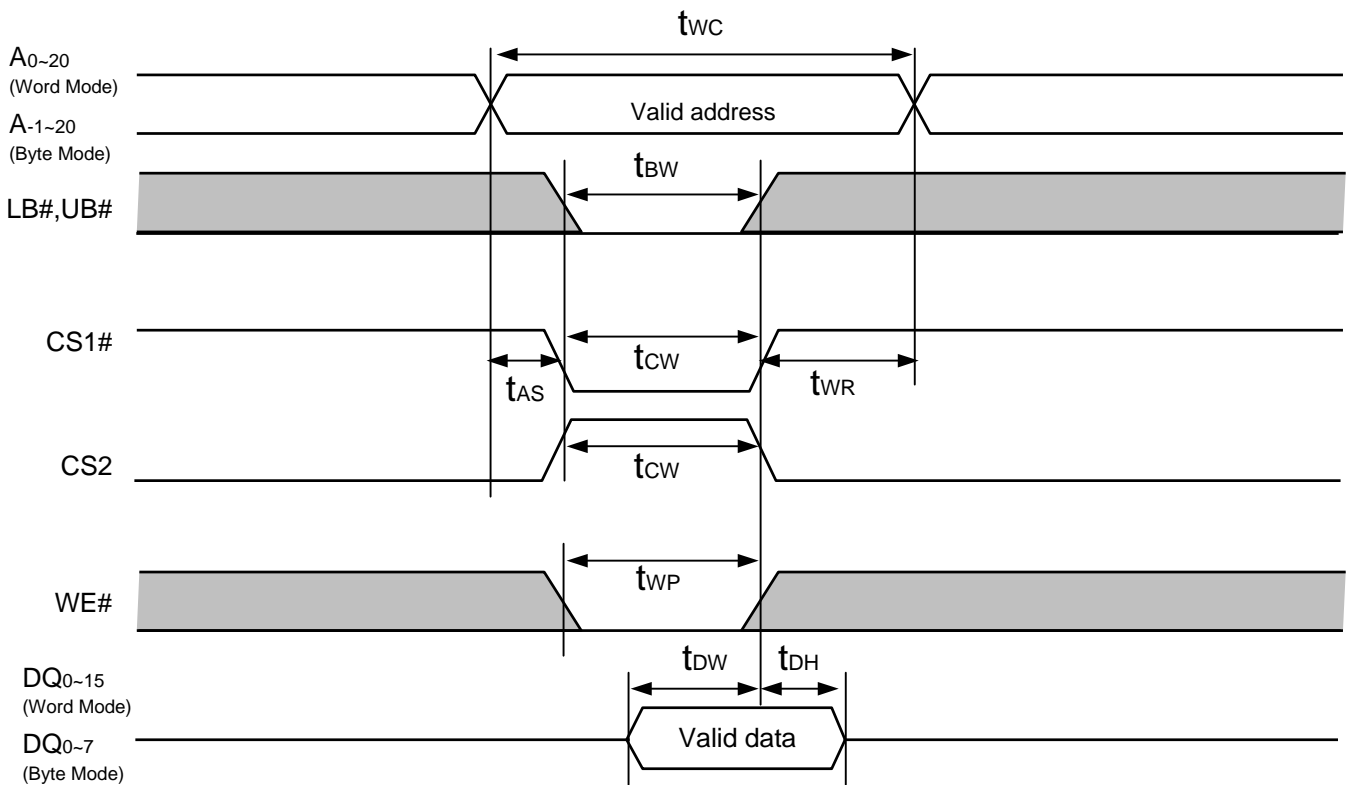
Note: Byte Mode is supported by only 52-pin  $\mu$ SOP type.  $BYTE\# \geq V_{CC}-0.2V$  or  $BYTE\# \leq 0.2V$

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



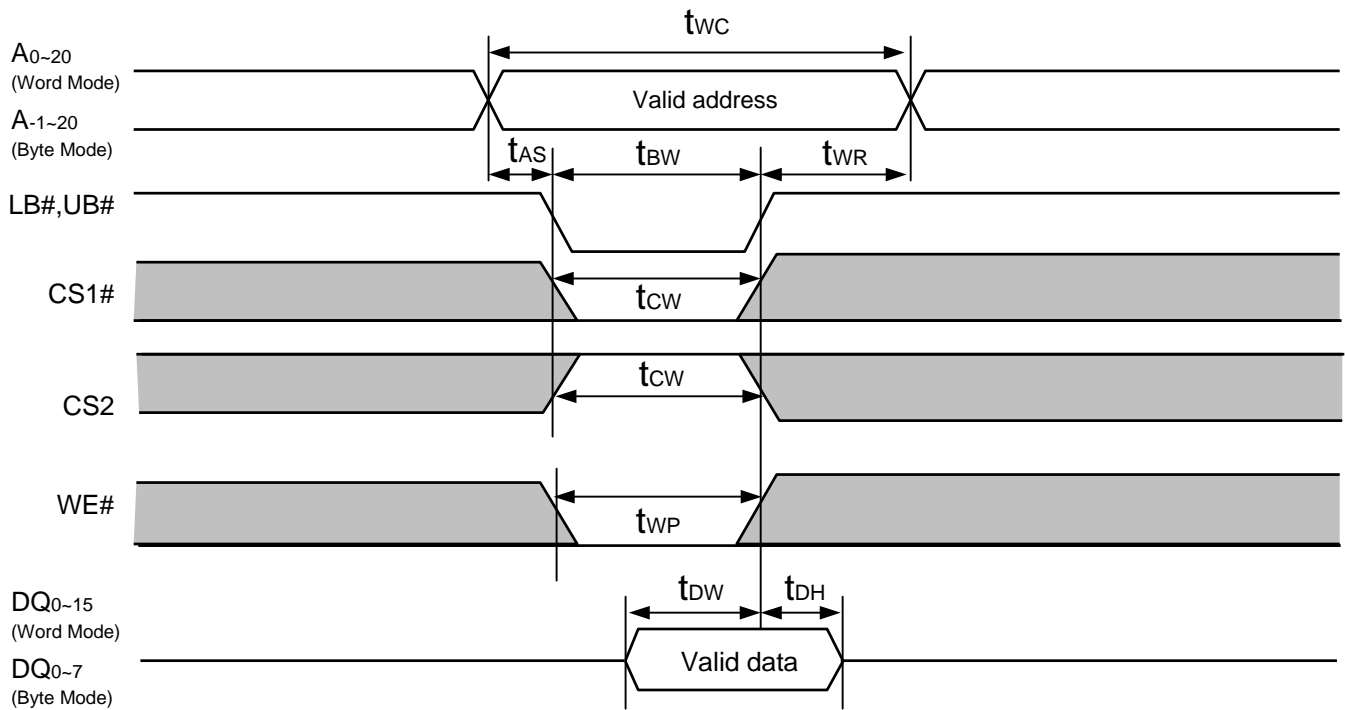
Note: Byte Mode is supported by only 52-pin  $\mu$ TSOP type.  $BYTE\# \geq V_{CC}-0.2V$  or  $BYTE\# \leq 0.2V$

**Write Timing Waveform (2)** (CS1#, CS2 CLOCK, OE#=VIH)



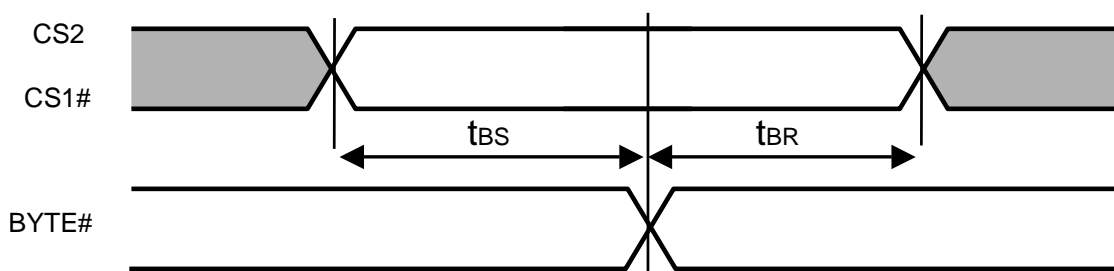
Note: Byte Mode is supported by only 52-pin  $\mu$ TSSOP type.  $BYTE\# \geq V_{CC}-0.2V$  or  $BYTE\# \leq 0.2V$

**Write Timing Waveform (3)** (LB#,UB# CLOCK, OE#=VIH)



Note: Byte Mode is supported by only 52-pin  $\mu$ SOP type.  $BYTE\# \geq V_{CC}-0.2V$  or  $BYTE\# \leq 0.2V$

**BYTE# Timing Waveform**

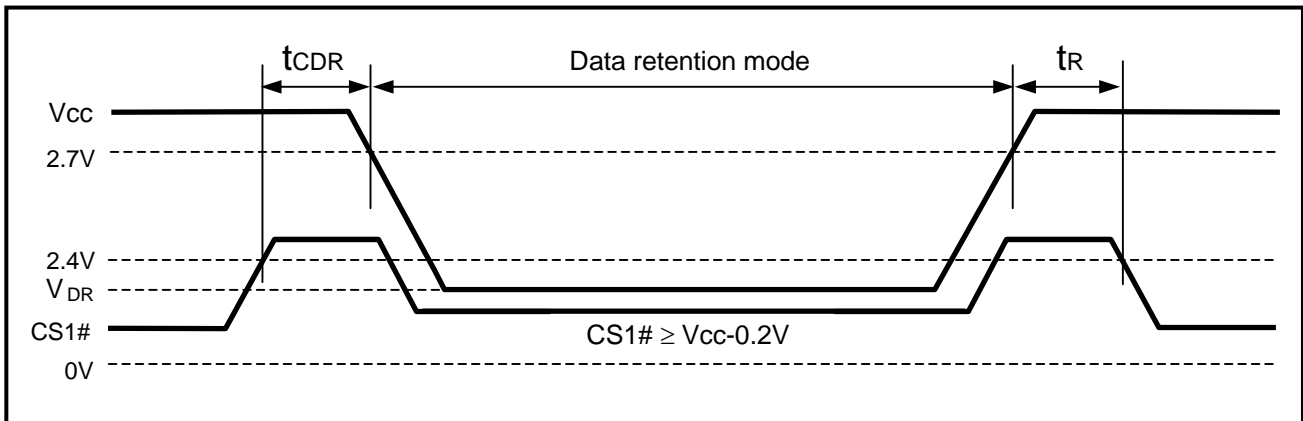


<b>Data Retention Characteristics</b>
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Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions*3,4	
Vcc for data retention	V <sub>DR</sub>	2.0	-	3.6	V	V <sub>in</sub> ≥ 0V, BYTE# ≥ Vcc-0.2V or BYTE# ≤ 0.2V (1) 0V ≤ CS2 ≤ 0.2V or (2) CS2 ≥ Vcc-0.2V, CS1# ≥ Vcc-0.2V or (3) LB# = UB# ≥ Vcc-0.2V, CS2 ≥ Vcc-0.2V, CS1# ≤ 0.2V	
Data retention current	I <sub>CCDR</sub>	-	4 *1	12	μA	~+25°C	Vcc=3.0V, Vin≥0V, BYTE# ≥ Vcc-0.2V or BYTE# ≤ 0.2V (1) 0V ≤ CS2 ≤ 0.2V or (2) CS2 ≥ Vcc-0.2V, CS1# ≥ Vcc-0.2V or (3) LB# =UB# ≥Vcc-0.2V, CS2 ≥ Vcc-0.2V, CS1# ≤ 0.2V Average value
		-	7 *2	24	μA	~+40°C	
		-	-	50	μA	~+70°C	
		-	-	80	μA	~+85°C	
Chip deselect to data retention time	t <sub>CDR</sub>	0	-	-	ns	See retention waveform	
Operation recovery time	t <sub>R</sub>	5	-	-	ms		

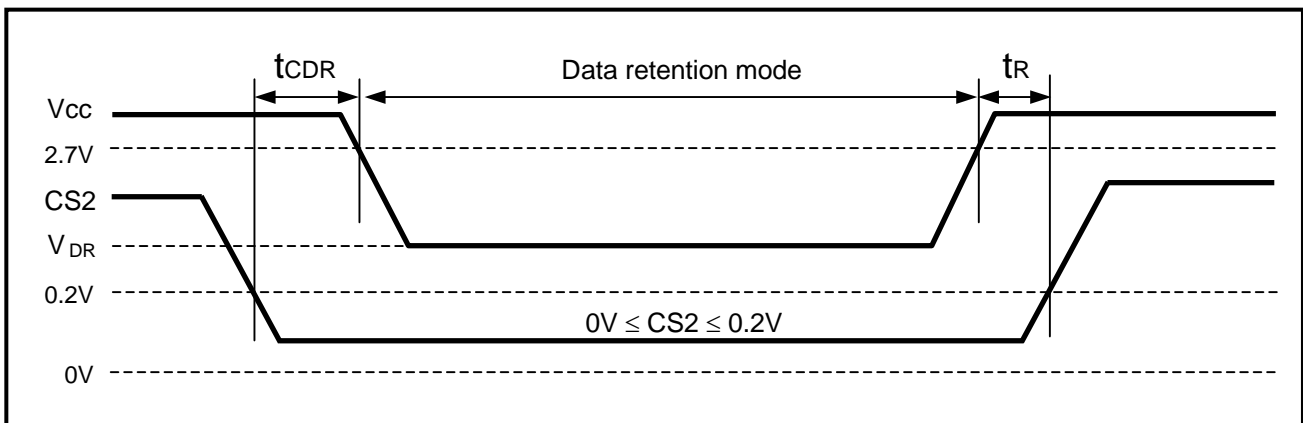
- Note 1. Typical parameter indicates the value for the center of distribution at Vcc=3.0V (Ta= 25°C) and not 100% tested.  
 2. Typical parameter indicates the value for the center of distribution at Vcc=3.0V (Ta= 40°C) and not 100% tested.  
 3. BYTE# pin is supported by only 52-pin μTSOP type.  
 4. Also CS2 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 ≥ Vcc-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 Waveform (1) (CS1# Controlled)**



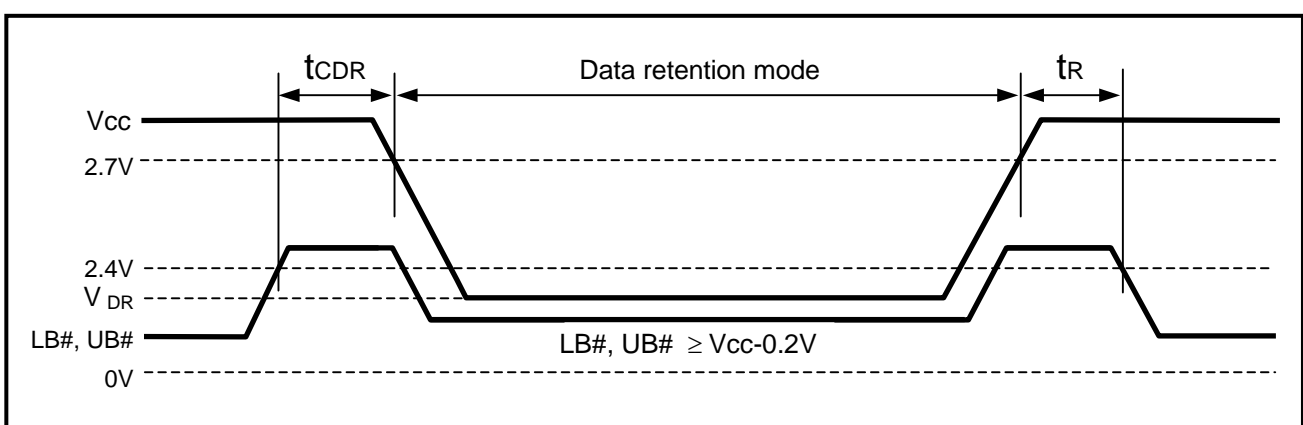
Note: BYTE# pin is supported by only 52-pin  $\mu$ TSOP type.  $BYTE\# \geq V_{cc}-0.2V$  or  $BYTE\# \leq 0.2V$

**Low Vcc Data Retention Timing Waveform (2) (CS2 Controlled)**



Note: BYTE# pin is supported by only 52-pin  $\mu$ TSOP type.  $BYTE\# \geq V_{cc}-0.2V$  or  $BYTE\# \leq 0.2V$

**Low Vcc Data Retention Timing Waveform (3) (LB#, UB# Controlled)**



Note: BYTE# pin is supported by only 52-pin  $\mu$ TSOP type.  $BYTE\# \geq V_{cc}-0.2V$  or  $BYTE\# \leq 0.2V$

Notes:

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