

## Description

The R1LV1616R Series is a family of low voltage 16-Mbit static RAMs organized as 1048576-words by 16-bit, fabricated by Renesas's high-performance 0.15um CMOS and TFT technologies.

The R1LV1616R Series is suitable for memory applications where a simple interfacing , battery operating and battery backup are the important design objectives.

The R1LV1616R 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], a 48pin thin small outline mount device[TSOP / 12mm x 20mm with the pin-pitch of 0.5mm] 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:2μA (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

<b>Ordering Information</b>
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Type No.	Access time	Package
R1LV1616RSD-5S%	55 ns (Note0)	350-mil 52-pin plastic $\mu$ - TSOP(II) (normal-bend type) (52PTG)
R1LV1616RSD-7S%	70 ns	
R1LV1616RSD-8S%	85 ns	
R1LV1616RBG-5S%	55 ns (Note0)	7.5mmx8.5mm f-BGA 0.75mm pitch 48ball
R1LV1616RBG-7S%	70 ns	
R1LV1616RBG-8S%	85 ns	
R1LV1616RSA-5S%	55 ns (Note0)	12mm x 20mm plastic TSOP(I) (normal-bend type) (48P3R)
R1LV1616RSA-7S%	70 ns	
R1LV1616RSA-8S%	85 ns	

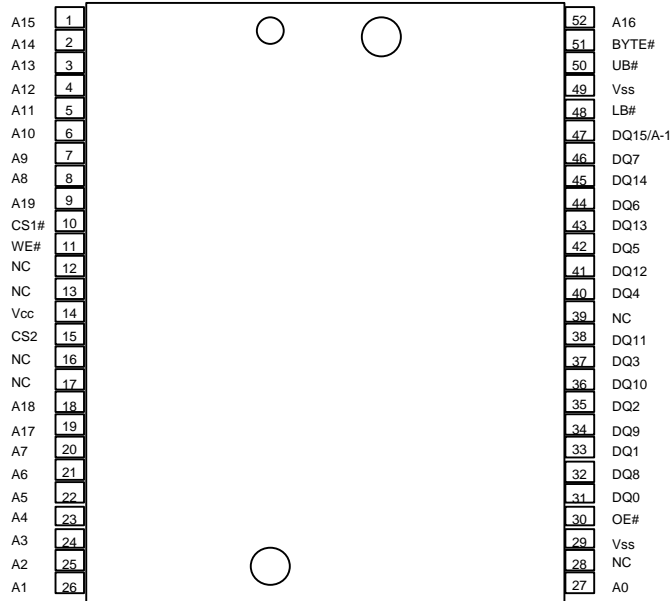
Note0. 55ns parts can be supported under the condition of the input timing limitation toward SRAM on customer's system. Please contact our sales office in your region, in case of the inquiry for 55ns parts.

% - Temperature version; see table below

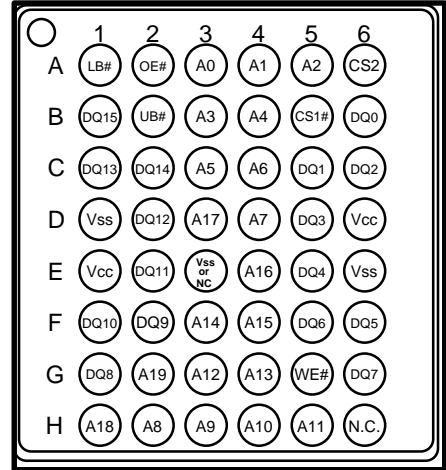
%	Temperature Range
R	0 ~ +70 °C
I	-40 ~ +85 °C

Pin Arrangement

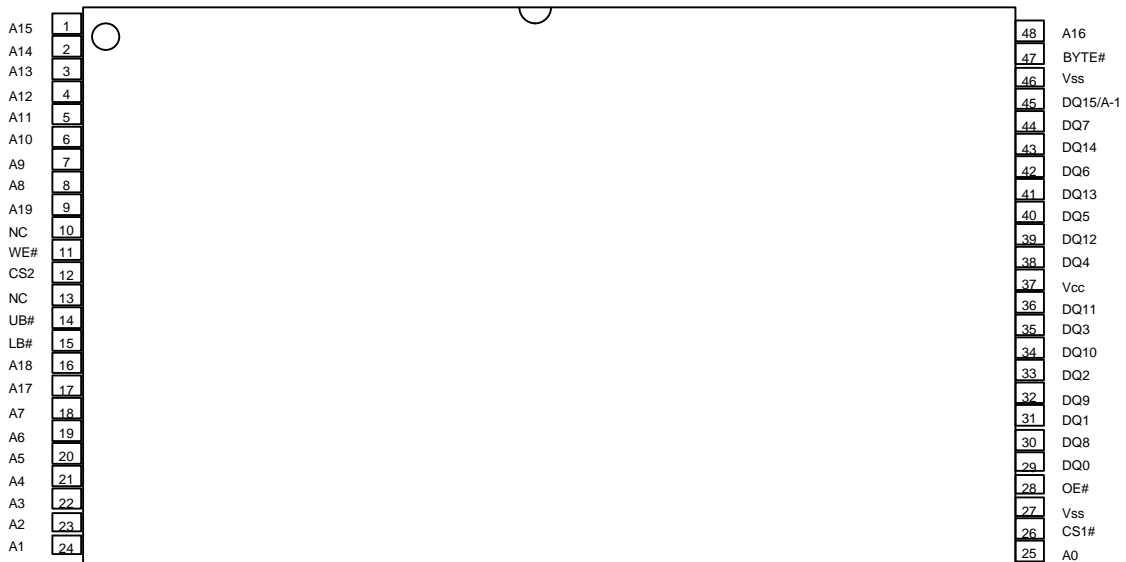
52-pin  $\mu$ TSSOP



48-pin fBGA



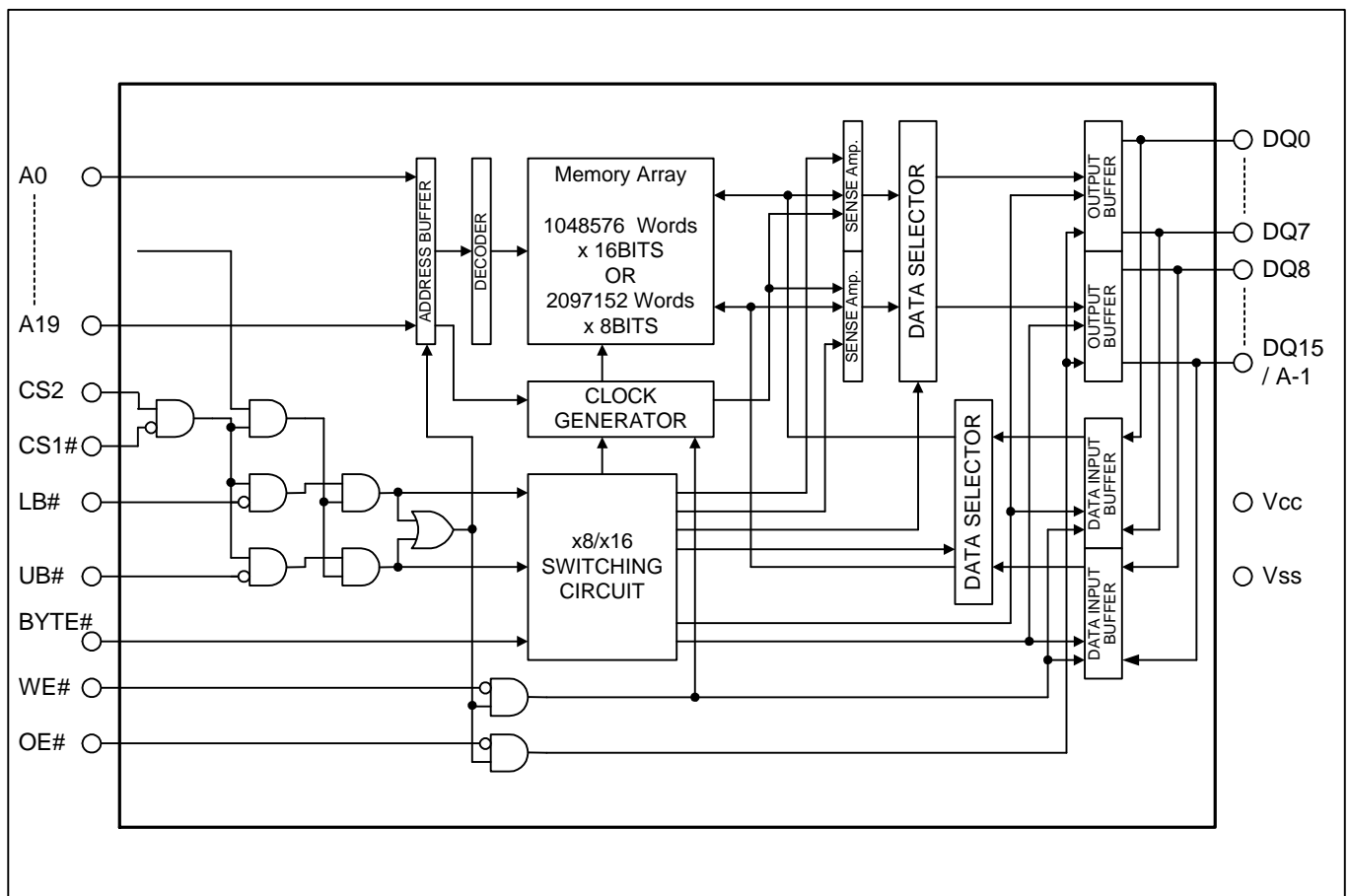
48-pin TSOP



### Pin Description

Pin name	Function
A0 to A19	Address input
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

### Block Diagram



Note. BYTE# pin supported by only TSOP and uTSOP types.

<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 supported by only TSOP and uTSOP types. 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 to Vss	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.	0 to +70	°C
		I ver.	-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.	0 to +70	°C
		I ver.	-40 to +85	°C

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

2. Maximum voltage is +4.6V

<b>Recommended Operating Conditions</b>
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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.

<b>DC Characteristics</b>
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Parameter	Symbol	Min.	Typ.*1	Max.	Unit	Test conditions*2	
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	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>	-	25	40	mA	Min. cycle, duty =100% I <sub>I/O</sub> = 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>	-	2	5	mA	Cycle time = 1 μs, I <sub>I/O</sub> = 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	0.3	mA	CS2=V <sub>IL</sub>	
Standby current	I <sub>SB1</sub>	-	2	6	μA	~+25°C	V <sub>in</sub> ≥ 0V (1) 0V ≤ CS2 ≤ 0.2V or (2) CS2 ≥ V <sub>CC</sub> -0.2V, CS1# ≥ V <sub>CC</sub> -0.2V or (3) LB# =UB# ≥ V <sub>CC</sub> -0.2V, CS2 ≥ V <sub>CC</sub> -0.2V, CS1# ≤ 0.2V Average value
		-	4	12	μA	~+40°C	
		-	-	25	μA	~+70°C	
		-	-	40	μA	~+85°C	
Output high voltage	V <sub>OH</sub>	2.4	-	-	V	I <sub>OH</sub> = -1mA	
Output Low voltage	V <sub>OL</sub>	-	-	0.4	V	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. BYTE# pin supported by only TSOP and uTSOP types.

BYTE# ≥ V<sub>CC</sub>-0.2V or BYTE# ≤ 0.2V

## Capacitance

(Ta = +25°C, f =1MHz)

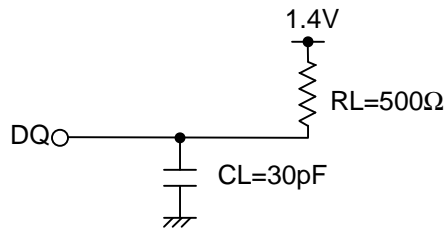
Parameter	Symbol	Min.	Typ.	Max.	Unit	Test conditions	Note
Input capacitance	C in	-	-	10	pF	V in = 0V	1
Input / output capacitance	C I/O	-	-	10	pF	V I/O = 0V	1

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	R1LV1616R**- 5S (Note0)		R1LV1616R**- 7S		R1LV1616R**- 8S		Unit	Notes
		Min.	Max.	Min.	Max.	Min.	Max.		
Read cycle time	$t_{RC}$	55	-	70	-	85	-	ns	
Address access time	$t_{AA}$	-	70	-	70	-	85	ns	
Chip select access time	$t_{ACS1}$	-	55	-	70	-	85	ns	
	$t_{ACS2}$	-	55	-	70	-	85	ns	
Output enable to output valid	$t_{OE}$	-	35	-	35	-	45	ns	
Output hold from address change	$t_{OH}$	10	-	10	-	10	-	ns	
LB#,UB# access time	$t_{BA}$	-	55	-	70	-	85	ns	
Chip select to output in low-Z	$t_{CLZ}$	10	-	10	-	10	-	ns	2,3
LB#,UB# enable to low-Z	$t_{BLZ}$	5	-	5	-	5	-	ns	2,3
Output enable to output in low-Z	$t_{OLZ}$	5	-	5	-	5	-	ns	2,3
Chip deselect to output in high-Z	$t_{CHZ1}$	0	20	0	25	0	30	ns	1,2,3
	$t_{CHZ2}$	0	20	0	25	0	30	ns	1,2,3
LB#,UB# disable to high-Z	$t_{BHZ}$	0	20	0	25	0	30	ns	1,2,3
Output disable to output in high-Z	$t_{OHZ}$	0	20	0	25	0	30	ns	1,2,3

## Write Cycle

Parameter	Symbol	R1LV1616R**-5S (Note0)		R1LV1616R**-7S		R1LV1616R**-8S		Unit	Notes
		Min.	Max.	Min.	Max.	Min.	Max.		
Write cycle time	$t_{WC}$	55	-	70	-	85	-	ns	
Address valid to end of write	$t_{AW}$	50	-	65	-	70	-	ns	
Chip selection to end of write	$t_{CW}$	55	-	65	-	70	-	ns	5
Write pulse width	$t_{WP}$	40	-	55	-	60	-	ns	4
LB#,UB# valid to end of write	$t_{BW}$	50	-	65	-	70	-	ns	
Address setup time	$t_{AS}$	0	-	0	-	0	-	ns	6
Write recovery time	$t_{WR}$	0	-	0	-	0	-	ns	7
Data to write time overlap	$t_{DW}$	25	-	35	-	40	-	ns	
Data hold from write time	$t_{DH}$	0	-	0	-	0	-	ns	
Output active from end of write	$t_{OW}$	5	-	5	-	5	-	ns	2
Output disable to output in high-Z	$t_{OHZ}$	0	20	0	25	0	30	ns	1,2
Write to output in high-Z	$t_{WHZ}$	0	20	0	25	0	30	ns	1,2

Note0. 55ns parts can be supported under the condition of the input timing limitation toward SRAM on customer's system. Please contact our sales office in your region, in case of the inquiry for 55ns parts.

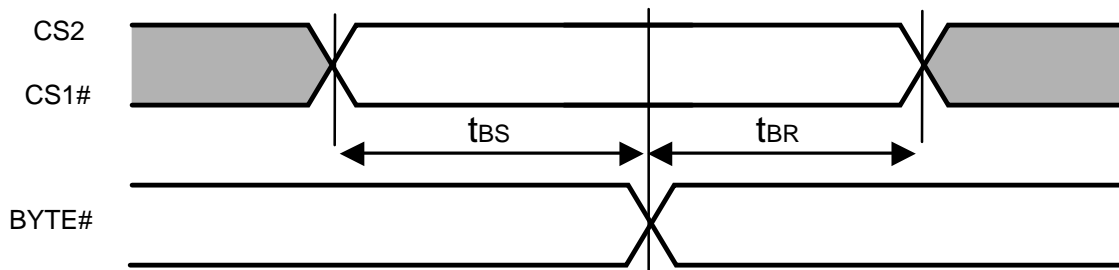
In case of  $t_{AA} = 70ns$ ,  $t_{RC} = 70ns$ .

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.

Byte enable (supported by only 48-pin TSOP and 52-pin  $\mu$ TSOP )

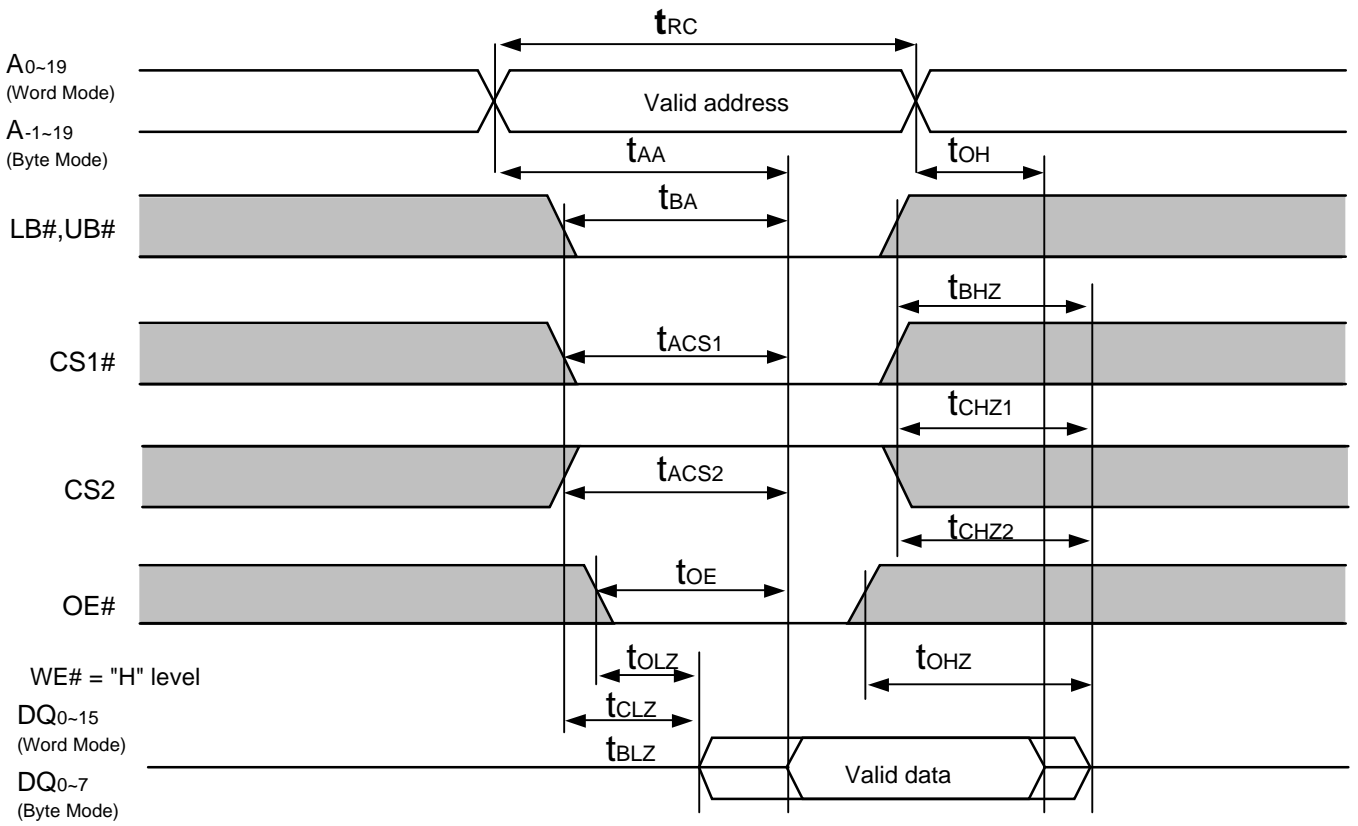
Parameter	Symbol	R1LV1616R**-5S		R1LV1616R**-7S		R1LV1616R**-8S		Unit	Notes
		Min.	Max.	Min.	Max.	Min.	Max.		
Byte setup time	$t_{BS}$	5	-	5	-	5	-	ms	
Byte recovery time	$t_{BR}$	5	-	5	-	5	-	ms	

BYTE# Timing Waveform

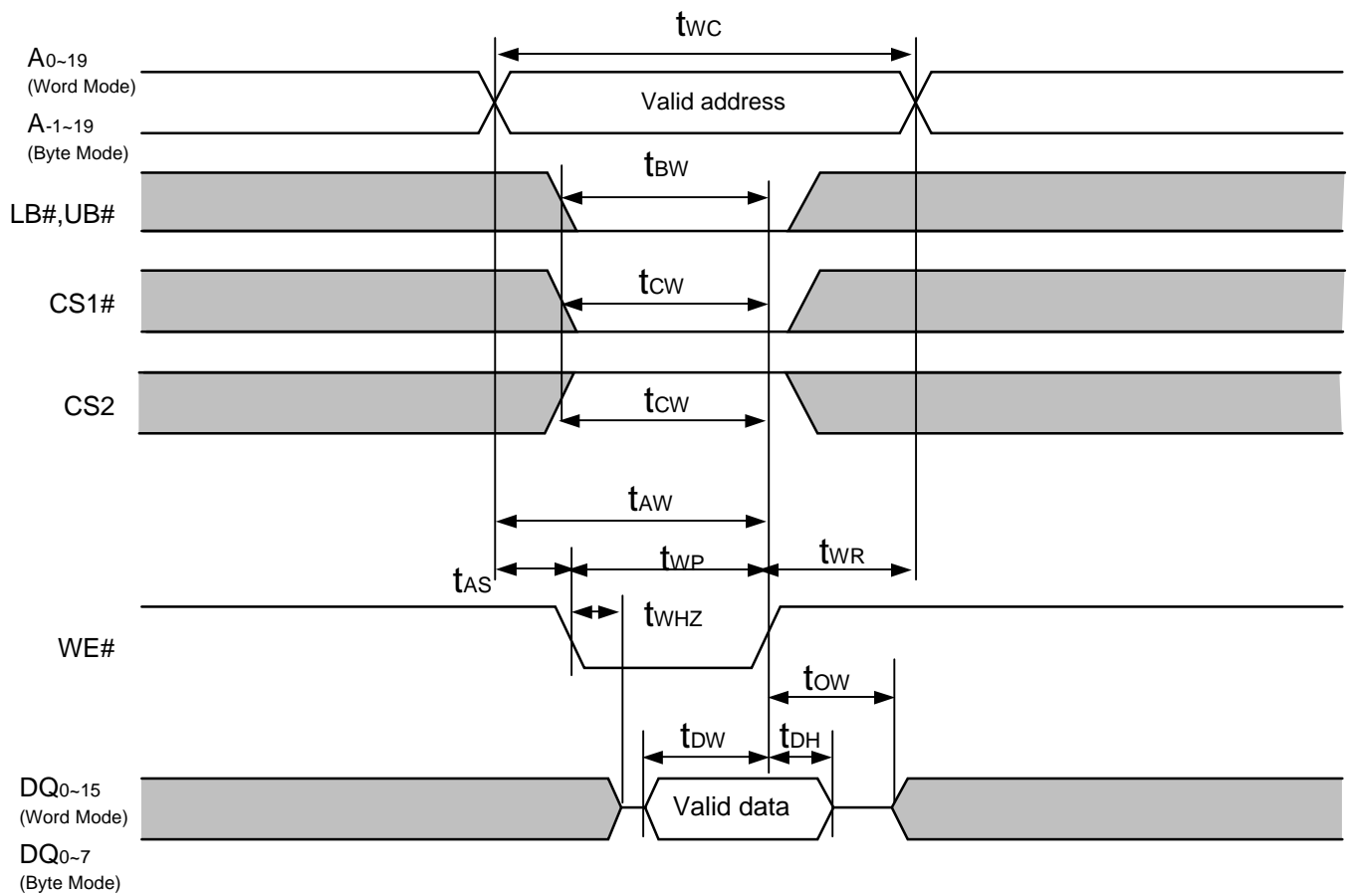


Timing Waveform

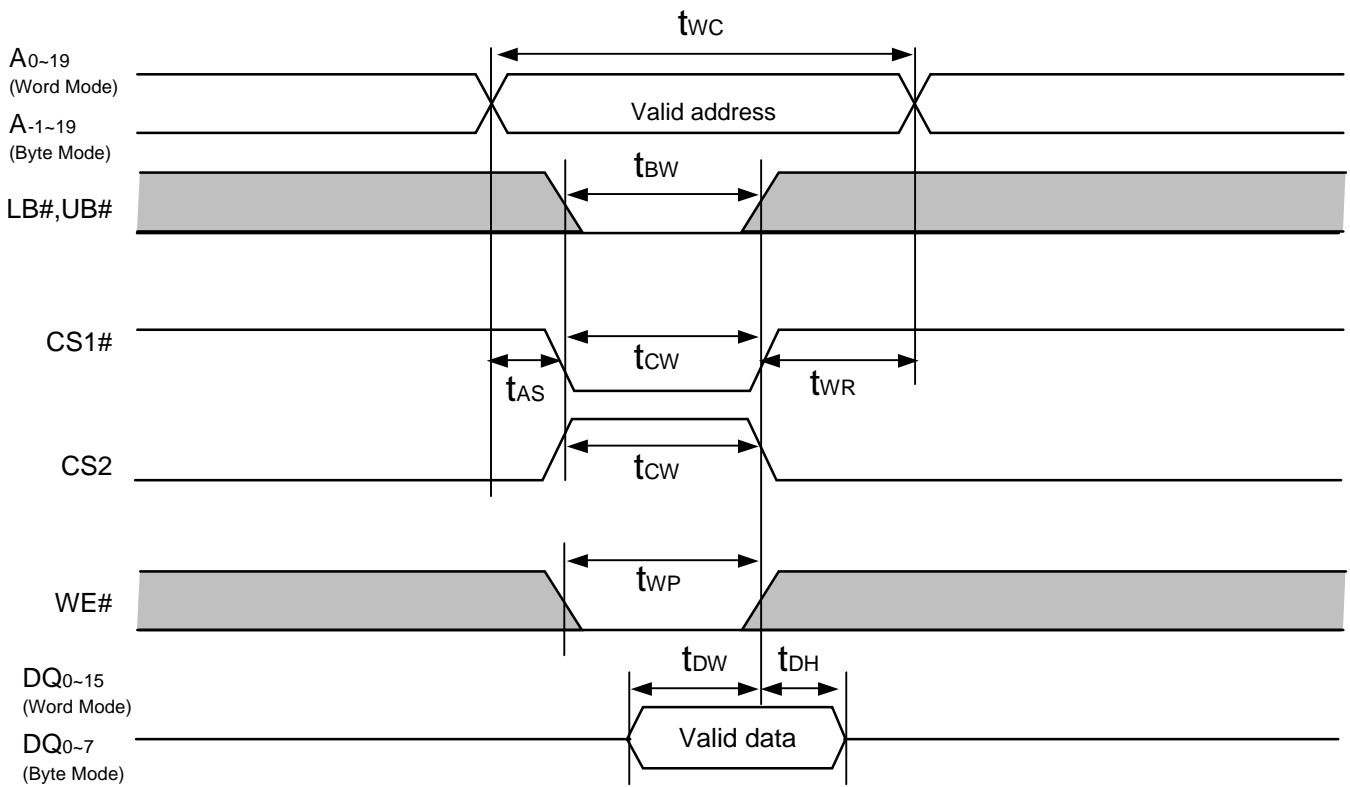
Read Cycle



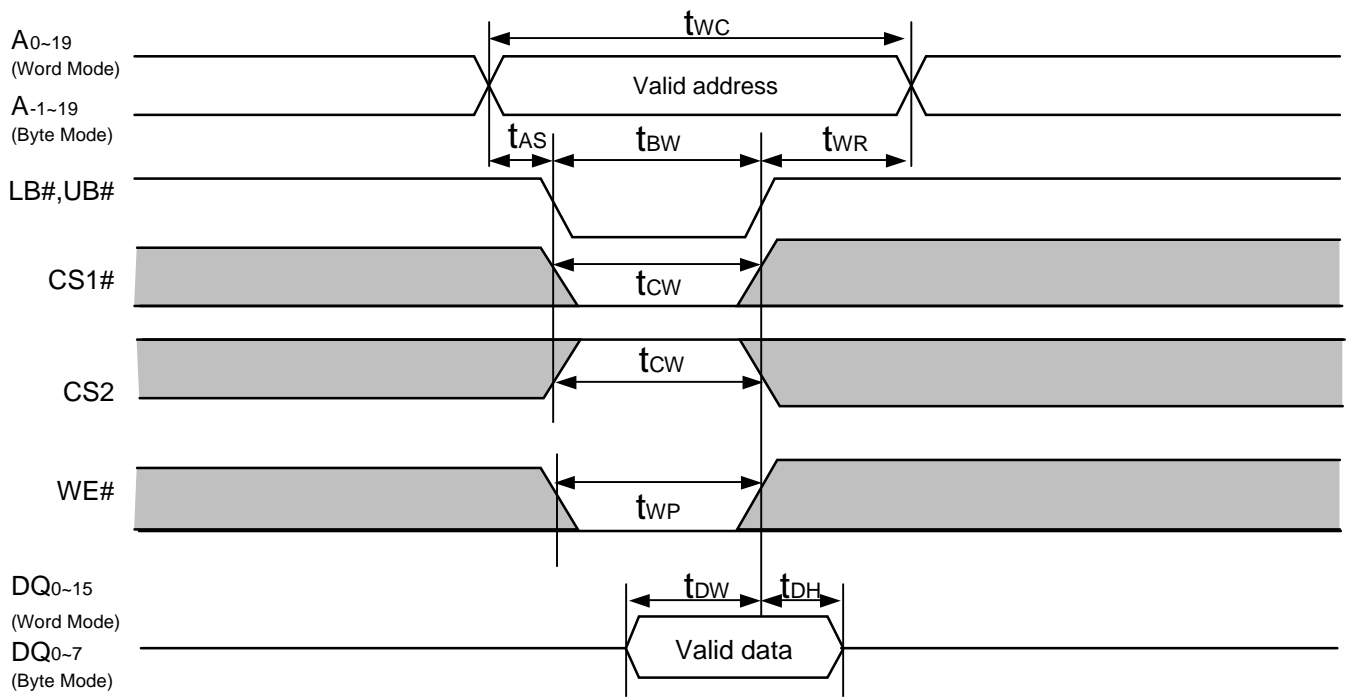
Write Cycle (1) (WE# Clock)



Write Cycle (2) (CS1# ,CS2 Clock, OE#=V<sub>IH</sub>)



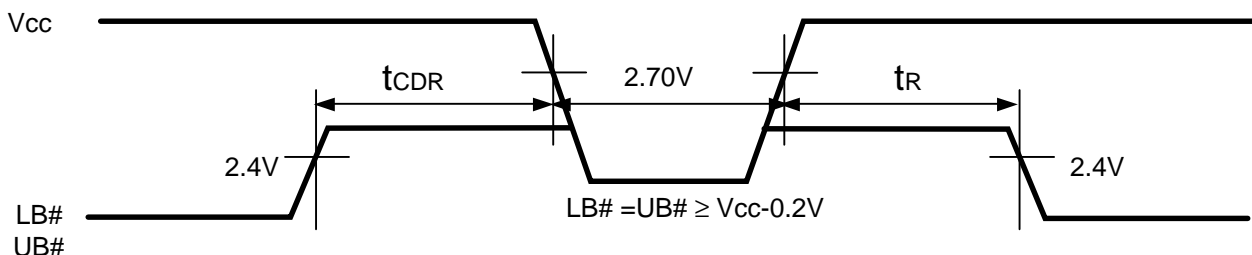
Write Cycle (3) ( LB#,UB# Clock, OE#=VIH)



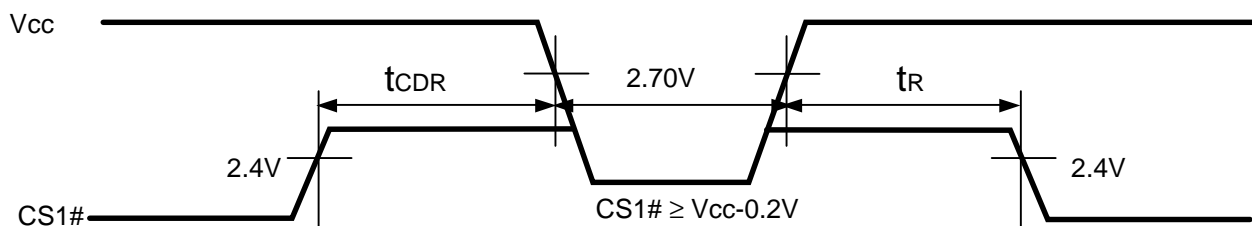
Data Retention Characteristics							
Parameter	Symbol	Min.	Typ.*1	Max.	Unit	Test conditions*2,3	
Vcc for data retention	V <sub>DR</sub>	2.0	-	3.6	V	V <sub>in</sub> ≥ 0V (1) 0V ≤ CS2 ≤ 0.2V or (2) CS2 ≥ V <sub>cc</sub> -0.2V, CS1# ≥ V <sub>cc</sub> -0.2V or (3) LB# =UB# ≥ V <sub>cc</sub> -0.2V, CS2 ≥ V <sub>cc</sub> -0.2V, CS1# ≤ 0.2V	
Data retention current	I <sub>CCDR</sub>	-	2	6	μA	~+25°C	V <sub>cc</sub> =3.0V, V <sub>in</sub> ≥0V (1) 0V ≤ CS2 ≤ 0.2V or (2) CS2 ≥ V <sub>cc</sub> -0.2V, CS1# ≥ V <sub>cc</sub> -0.2V or (3) LB# =UB# ≥ V <sub>cc</sub> -0.2V, CS2 ≥ V <sub>cc</sub> -0.2V, CS1# ≤ 0.2V Average value
		-	4	12	μA	~+40°C	
		-	-	25	μA	~+70°C	
		-	-	40	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 of I<sub>CCDR</sub> indicates the value for the center of distribution at V<sub>cc</sub>=3.0V and not 100% tested.  
 2. BYTE# pin supported only by TSOP and uTSOP types. BYTE# ≥ V<sub>cc</sub>-0.2V or BYTE# ≤ 0.2V  
 3. Also CS2 controls address buffer, WE# buffer, CS1# buffer, OE# buffer, LB#, UB# buffer and Din buffer. If CS2 controls data retention mode, V<sub>in</sub> 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.

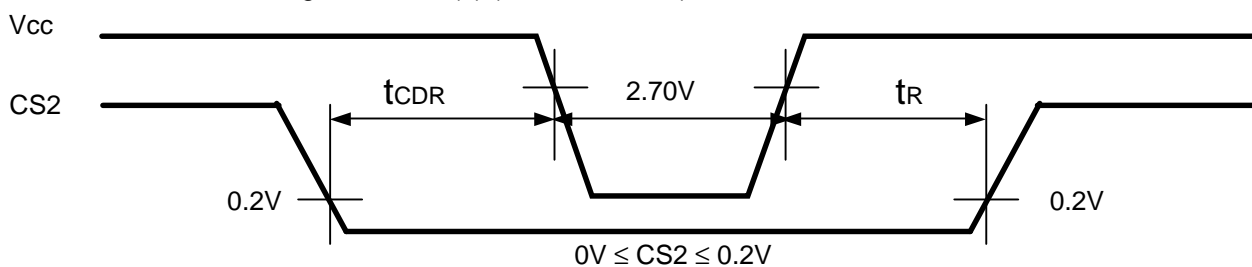
Data Retention timing Waveform (1) (LB#,UB# Controlled)



Data Retention timing Waveform (2) (CS1# Controlled)



Data Retention timing Waveform (3) (CS2 Controlled)



Notes:

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**Renesas Technology America, Inc.**  
450 Holger Way, San Jose, CA 95134-1368, U.S.A  
Tel: <1> (408) 382-7500, Fax: <1> (408) 382-7501

**Renesas Technology Europe Limited**  
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.  
Tel: <44> (1628) 585-100, Fax: <44> (1628) 585-900

**Renesas Technology (Shanghai) Co., Ltd.**  
Unit 204, 205, AZIACenter, No.1233 Lujiazui Ring Rd, Pudong District, Shanghai, China 200120  
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7898

**Renesas Technology Hong Kong Ltd.**  
7th Floor, North Tower, World Finance Centre, Harbour City, 1 Canton Road, Tsimshatsui, Kowloon, Hong Kong  
Tel: <852> 2265-6688, Fax: <852> 2730-6071

**Renesas Technology Taiwan Co., Ltd.**  
10th Floor, No.99, Fushing North Road, Taipei, Taiwan  
Tel: <886> (2) 2715-2888, Fax: <886> (2) 2713-2999

**Renesas Technology Singapore Pte. Ltd.**  
1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632  
Tel: <65> 6213-0200, Fax: <65> 6278-8001

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Kukje Center Bldg. 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea  
Tel: <82> (2) 796-3115, Fax: <82> (2) 796-2145

**Renesas Technology Malaysia Sdn. Bhd**  
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No.18, Jalan Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia  
Tel: <603> 7955-9390, Fax: <603> 7955-9510

To our customers,

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## Old Company Name in Catalogs and Other Documents

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