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# R1LV0416D Series

4M SRAM (256-kword × 16-bit)

REJ03C0311-0100

Rev.1.00

May.24.2007

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## Description

The R1LV0416D is a 4-Mbit static RAM organized 256-kword × 16-bit, fabricated by Renesas's high-performance 0.15μm CMOS and TFT technologies. R1LV0416D Series has realized higher density, higher performance and low power consumption. The R1LV0416D Series offers low power standby power dissipation; therefore, it is suitable for battery backup systems. The R1LV0416D Series is packaged in a 44-pin thin small outline mount device, or a 48-ball fine pitch ball grid array.

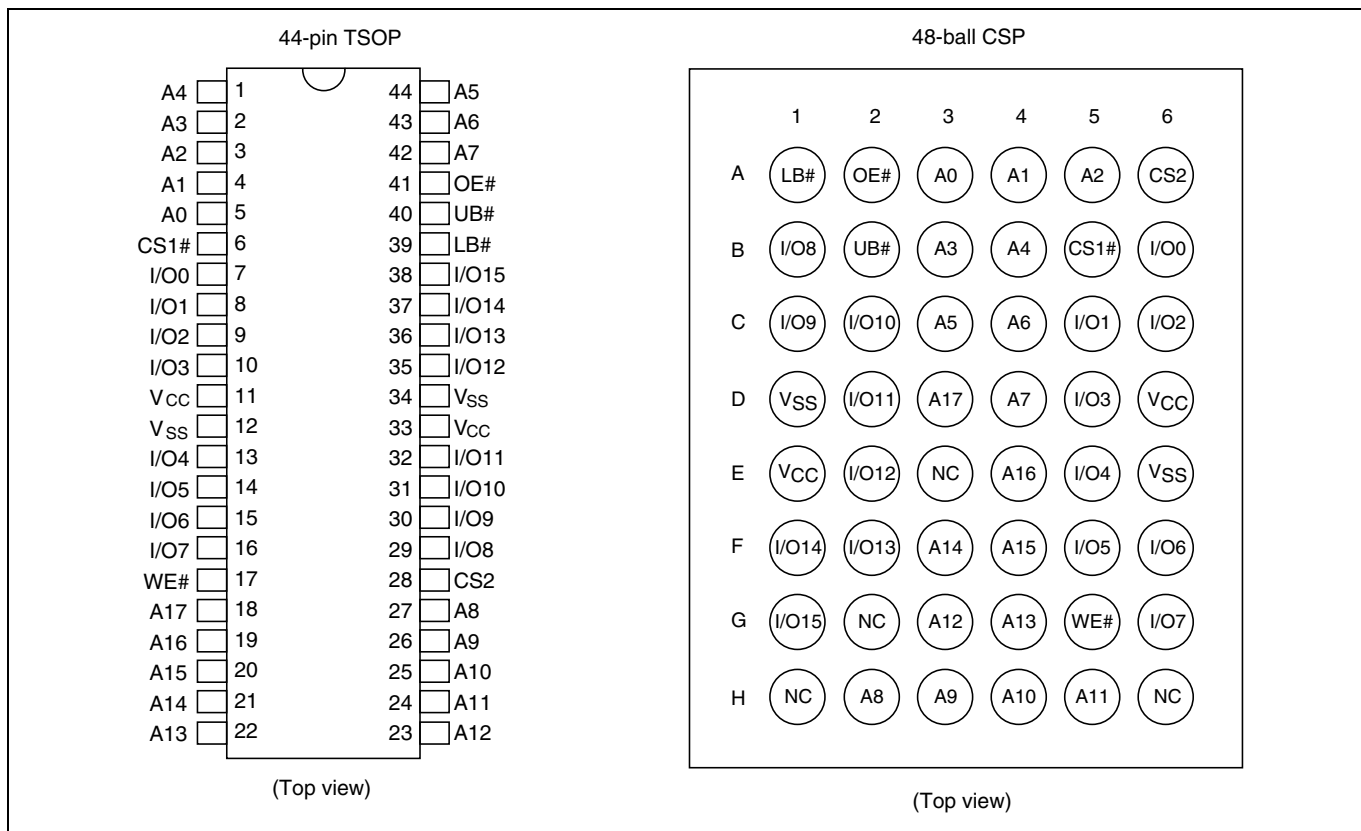
## Features

- Single 3.0 V supply: 2.7 V to 3.6 V
- Fast access time: 55/70 ns (max)
- Power dissipation:
  - Standby: 3 μW (typ) ( $V_{CC} = 3.0$  V)
- Equal access and cycle times
- Common data input and output.
  - Three state output
- Battery backup operation.
  - 2 chip selection for battery backup
- Temperature Range: -40 to +85°C

**Ordering Information**

<b>Type No.</b>	<b>Access time</b>	<b>Package</b>
R1LV0416DSB-5SI	55 ns	400-mil 44-pin plastic TSOP II PTSB0044GA-A (44P3W-H)
R1LV0416DSB-7LI	70 ns	
R1LV0416DBG-5SI	55 ns	48-ball CSP with 0.75 mm ball pitch PTBG0048HB-A (48FHH)
R1LV0416DBG-7LI	70 ns	

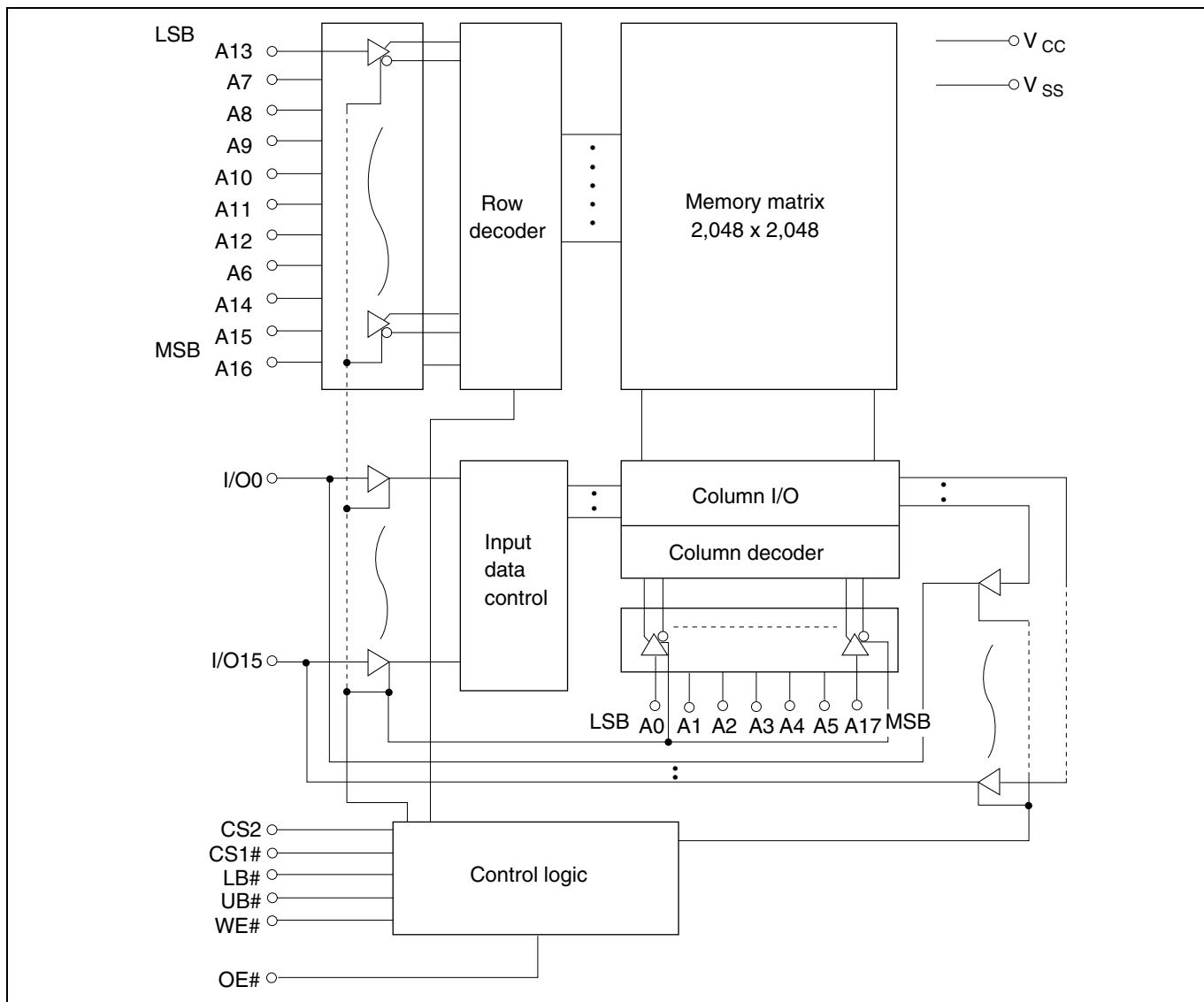
## Pin Arrangement



## Pin Description

Pin name	Function
A0 to A17	Address input
I/O0 to I/O15	Data input/output
CS1# ( $\overline{CS1}$ )	Chip select 1
CS2	Chip select 2
OE# ( $\overline{OE}$ )	Output enable
WE# ( $\overline{WE}$ )	Write enable
LB# ( $\overline{LB}$ )	Lower byte select
UB# ( $\overline{UB}$ )	Upper byte select
V <sub>cc</sub>	Power supply
V <sub>ss</sub>	Ground
NC	No connection

Block Diagram



## Operation Table

CS1#	CS2	WE#	OE#	UB#	LB#	I/O0 to I/O7	I/O8 to I/O15	Operation
H	×	×	×	×	×	High-Z	High-Z	Standby
×	L	×	×	×	×	High-Z	High-Z	Standby
×	×	×	×	H	H	High-Z	High-Z	Standby
L	H	H	L	L	L	Dout	Dout	Read
L	H	H	L	H	L	Dout	High-Z	Lower byte read
L	H	H	L	L	H	High-Z	Dout	Upper byte read
L	H	L	×	L	L	Din	Din	Write
L	H	L	×	H	L	Din	High-Z	Lower byte write
L	H	L	×	L	H	High-Z	Din	Upper byte write
L	H	H	H	×	×	High-Z	High-Z	Output disable

Note: H:  $V_{IH}$ , L:  $V_{IL}$ , ×:  $V_{IH}$  or  $V_{IL}$

## 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* <sup>1</sup> to $V_{CC} + 0.3$ * <sup>2</sup>	V
Power dissipation	$P_T$	0.7	W
Operating temperature <sup>1</sup>	Topr	-40 to +85	°C
Storage temperature range	Tstg	-65 to +150	°C
Storage temperature range under bias	Tbias	-40 to +85	°C

Notes: 1.  $V_T$  min: -3.0 V for pulse half-width  $\leq 30$  ns.

2. Maximum voltage is +4.6 V.

## 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	1
Ambient temperature range	Ta	-40	—	+85	°C	

Note: 1.  $V_{IL}$  min: -3.0 V for pulse half-width  $\leq 30$  ns.

## DC Characteristics

Parameter			Symbol	Min	Typ	Max	Unit	Test conditions
Input leakage current			$ I_{LI} $	—	—	1	$\mu\text{A}$	$V_{in} = V_{SS}$ to $V_{CC}$
Output leakage current			$ I_{LO} $	—	—	1	$\mu\text{A}$	CS1# = $V_{IH}$ or CS2 = $V_{IL}$ or OE# = $V_{IH}$ or WE# = $V_{IL}$ or LB# = UB# = $V_{IH}$ , $V_{IO} = V_{SS}$ to $V_{CC}$
Operating current			$I_{CC}$	—	—	20	$\text{mA}$	CS1# = $V_{IL}$ , CS2 = $V_{IH}$ , Others = $V_{IH}/V_{IL}$ , $I_{IO} = 0 \text{ mA}$
Average operating current			$I_{CC1}$	—	—	25	$\text{mA}$	Min. cycle, duty = 100%, $I_{IO} = 0 \text{ mA}$ , CS1# = $V_{IL}$ , CS2 = $V_{IH}$ , Others = $V_{IH}/V_{IL}$
			$I_{CC2}$	—	—	5	$\text{mA}$	Cycle time = 1 $\mu\text{s}$ , duty = 100%, $I_{IO} = 0 \text{ mA}$ , CS1# $\leq 0.2 \text{ V}$ , CS2 $\geq V_{CC} - 0.2 \text{ V}$ $V_{IH} \geq V_{CC} - 0.2 \text{ V}$ , $V_{IL} \leq 0.2 \text{ V}$
Standby current			$I_{SB}$	—	0.1* <sup>1</sup>	0.3	$\text{mA}$	CS2 = $V_{IL}$
Standby current	-5SI	to +85°C	$I_{SB1}$	—	—	10	$\mu\text{A}$	$V_{in} \geq 0 \text{ V}$
		to +70°C	$I_{SB1}$	—	—	8	$\mu\text{A}$	(1) $0 \text{ V} \leq \text{CS2} \leq 0.2 \text{ V}$ or
		to +40°C	$I_{SB1}$	—	—	3	$\mu\text{A}$	(2) CS1# $\geq V_{CC} - 0.2 \text{ V}$ ,
		to +25°C	$I_{SB1}$	—	1* <sup>1</sup>	2.5	$\mu\text{A}$	CS2 $\geq V_{CC} - 0.2 \text{ V}$ or
	-7LI	to +85°C	$I_{SB1}$	—	—	20	$\mu\text{A}$	(3) LB# = UB# $\geq V_{CC} - 0.2 \text{ V}$ ,
		to +70°C	$I_{SB1}$	—	—	16	$\mu\text{A}$	CS2 $\geq V_{CC} - 0.2 \text{ V}$ ,
		to +40°C	$I_{SB1}$	—	—	10	$\mu\text{A}$	CS1# $\leq 0.2 \text{ V}$
		to +25°C	$I_{SB1}$	—	1* <sup>1</sup>	10	$\mu\text{A}$	Average values
Output high voltage			$V_{OH}$	2.4	—	—	$\text{V}$	$I_{OH} = -1 \text{ mA}$
			$V_{OH2}$	$V_{CC} - 0.2$	—	—	—	$\text{V}$
Output low voltage			$V_{OL}$	—	—	0.4	$\text{V}$	$I_{OL} = 2 \text{ mA}$
			$V_{OL2}$	—	—	0.2	$\text{V}$	$I_{OL} = 100 \mu\text{A}$

Note: 1. Typical values are at  $V_{CC} = 3.0 \text{ V}$ ,  $T_a = +25^\circ\text{C}$  and specified loading, and not guaranteed.

## Capacitance

( $T_a = +25^\circ\text{C}$ ,  $f = 1.0 \text{ MHz}$ )

Parameter	Symbol	Min	Typ	Max	Unit	Test conditions	Note
Input capacitance	$C_{in}$	—	—	8	$\text{pF}$	$V_{in} = 0 \text{ V}$	1
Input/output capacitance	$C_{IO}$	—	—	10	$\text{pF}$	$V_{IO} = 0 \text{ V}$	1

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

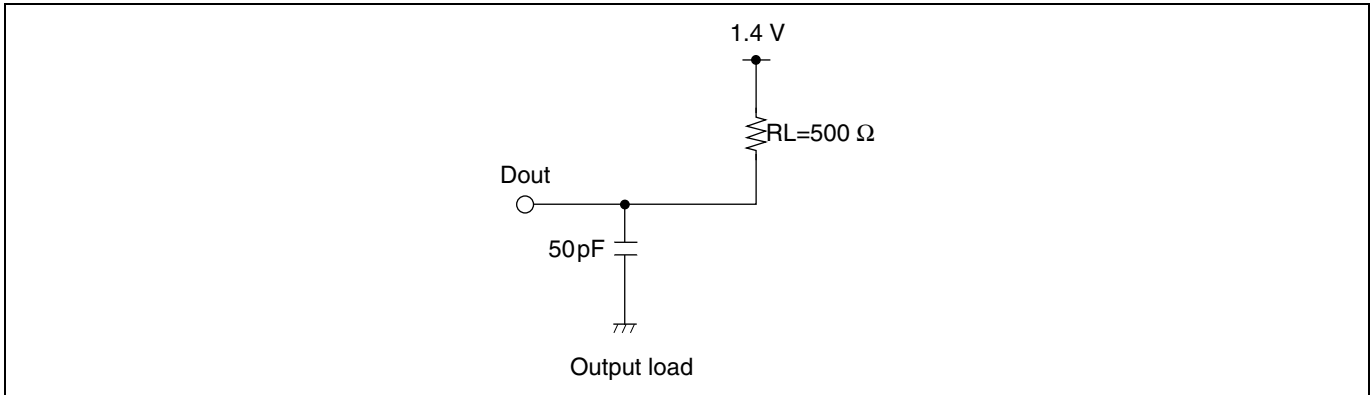
## AC Characteristics

( $T_a = -40$  to  $+85^\circ\text{C}$ ,  $V_{CC} = 2.7$  V to  $3.6$  V)

### Test Conditions

Input pulse levels:  $V_{IL} = 0.4$  V,  $V_{IH} = 2.4$  V

- Input rise and fall time: 5 ns
- Input/output timing reference levels: 1.4 V
- Output load: See figures (Including scope and jig)



## Read Cycle

Parameter	Symbol	R1LV0416D				Unit	Notes
		-5SI		-7LI			
		Min	Max	Min	Max		
Read cycle time	$t_{RC}$	55	—	70	—	ns	
Address access time	$t_{AA}$	—	55	—	70	ns	
Chip select access time	$t_{ACS1}$	—	55	—	70	ns	
	$t_{ACS2}$	—	55	—	70	ns	
Output enable to output valid	$t_{OE}$	—	35	—	40	ns	
Output hold from address change	$t_{OH}$	10	—	10	—	ns	
LB#, UB# access time	$t_{BA}$	—	55	—	70	ns	
Chip select to output in low-Z	$t_{CLZ1}$	10	—	10	—	ns	2, 3
	$t_{CLZ2}$	10	—	10	—	ns	2, 3
LB#, UB# disable 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	20	0	25	ns	1, 2, 3
	$t_{CHZ2}$	0	20	0	25	ns	1, 2, 3
LB#, UB# disable to high-Z	$t_{BHZ}$	0	20	0	25	ns	1, 2, 3
Output disable to output in high-Z	$t_{OHZ}$	0	20	0	25	ns	1, 2, 3



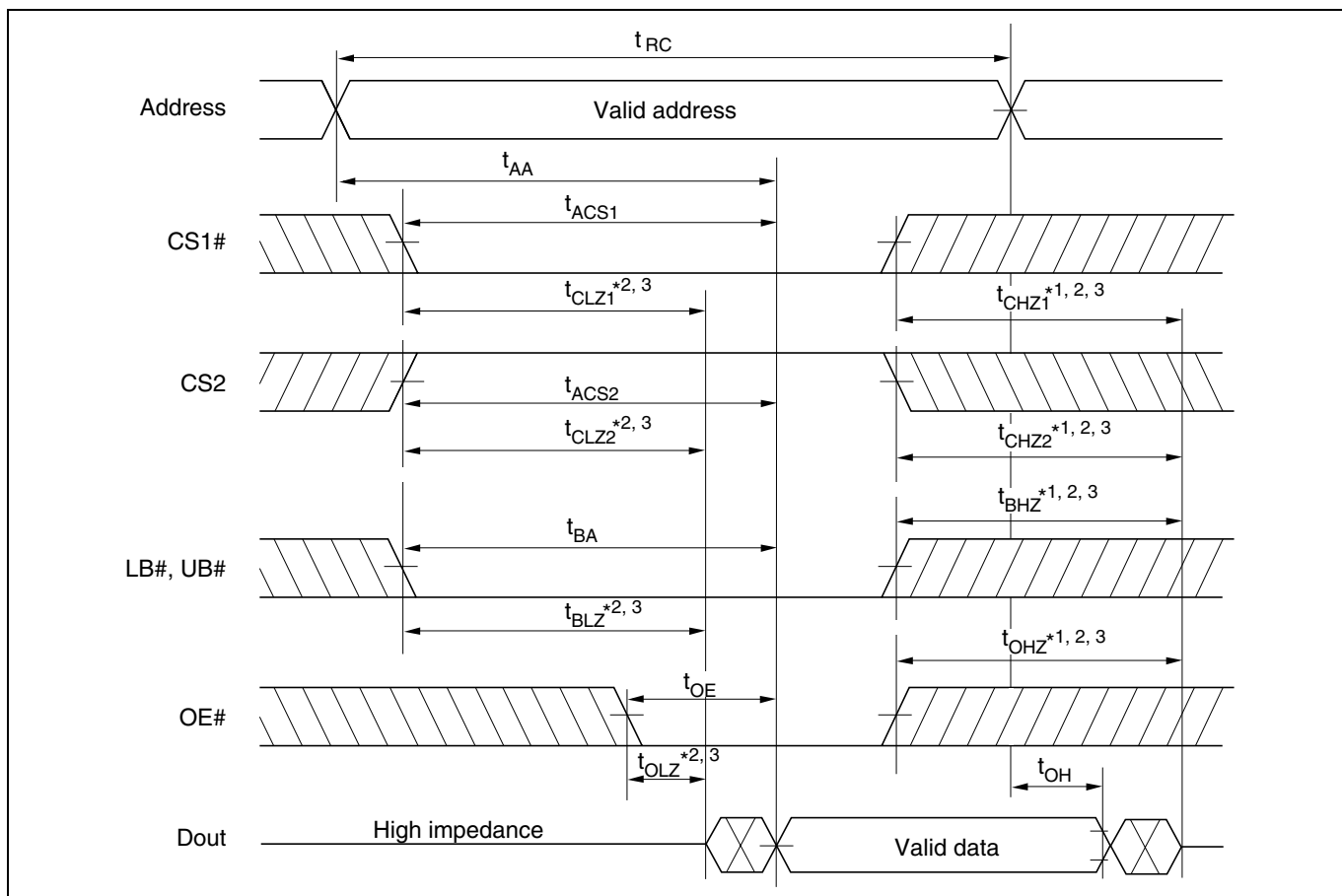
## Write Cycle

Parameter	Symbol	R1LV0416D				Unit	Notes
		-5SI		-7LI			
		Min	Max	Min	Max		
Write cycle time	$t_{WC}$	55	—	70	—	ns	
Address valid to end of write	$t_{AW}$	50	—	60	—	ns	
Chip selection to end of write	$t_{CW}$	50	—	60	—	ns	5
Write pulse width	$t_{WP}$	40	—	50	—	ns	4
LB#, UB# valid to end of write	$t_{BW}$	50	—	55	—	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	—	30	—	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	20	0	25	ns	1, 2, 3
Write to output in high-Z	$t_{WHZ}$	0	20	0	25	ns	1, 2

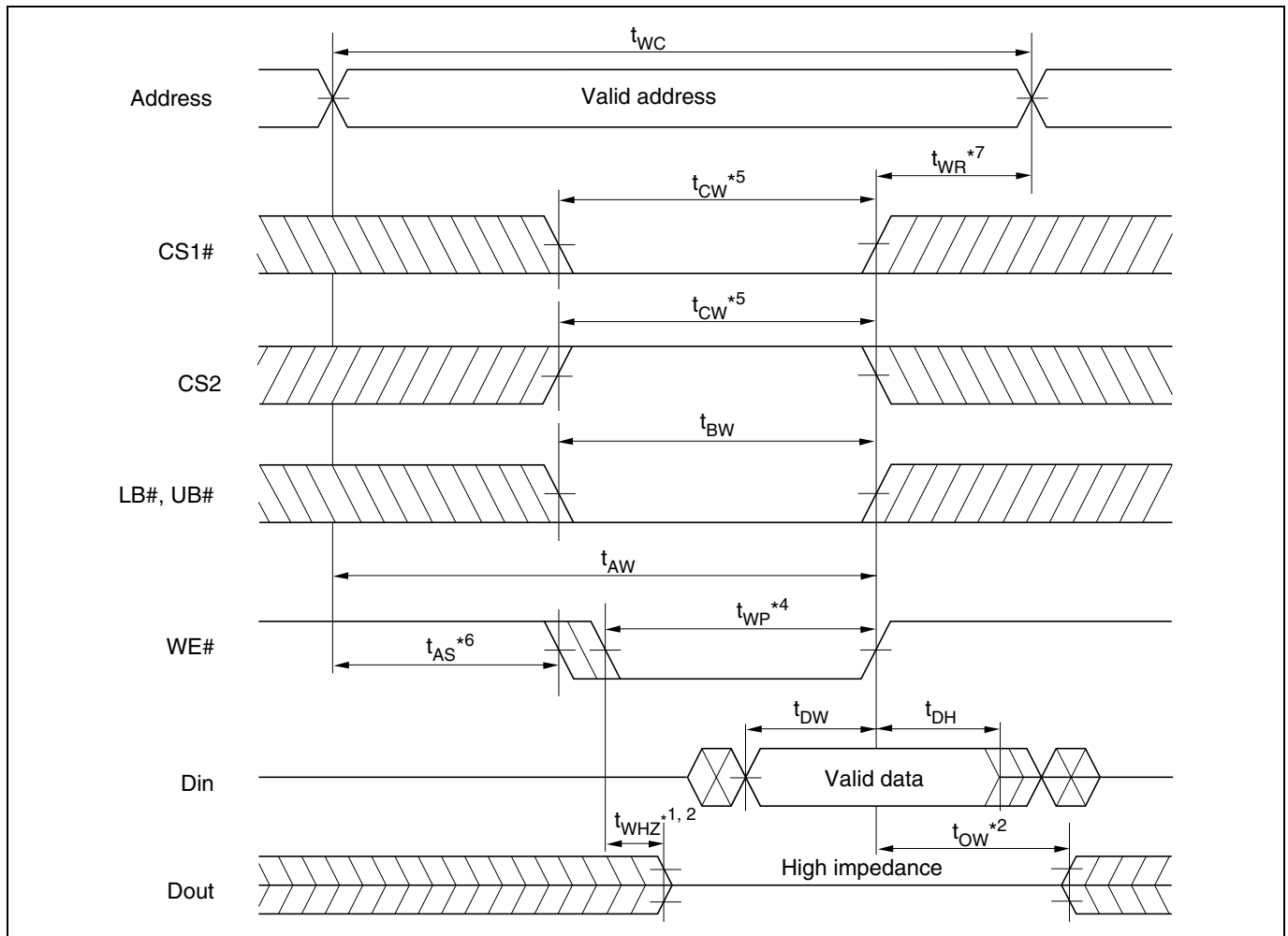
- Notes:
- $t_{CHZ}$ ,  $t_{OHZ}$ ,  $t_{WHZ}$  and  $t_{BHZ}$  are defined as the time at which the outputs achieve the open circuit conditions and are not referred to output voltage levels.
  - This parameter is sampled and not 100% tested.
  - At any given temperature and voltage condition,  $t_{HZ}$  max is less than  $t_{LZ}$  min both for a given device and from device to device.
  - 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.
  - $t_{CW}$  is measured from the later of CS1# going low or CS2 going high to the end of write.
  - $t_{AS}$  is measured from the address valid to the beginning of write.
  - $t_{WR}$  is measured from the earliest of CS1# or WE# going high or CS2 going low to the end of write cycle.

## Timing Waveform

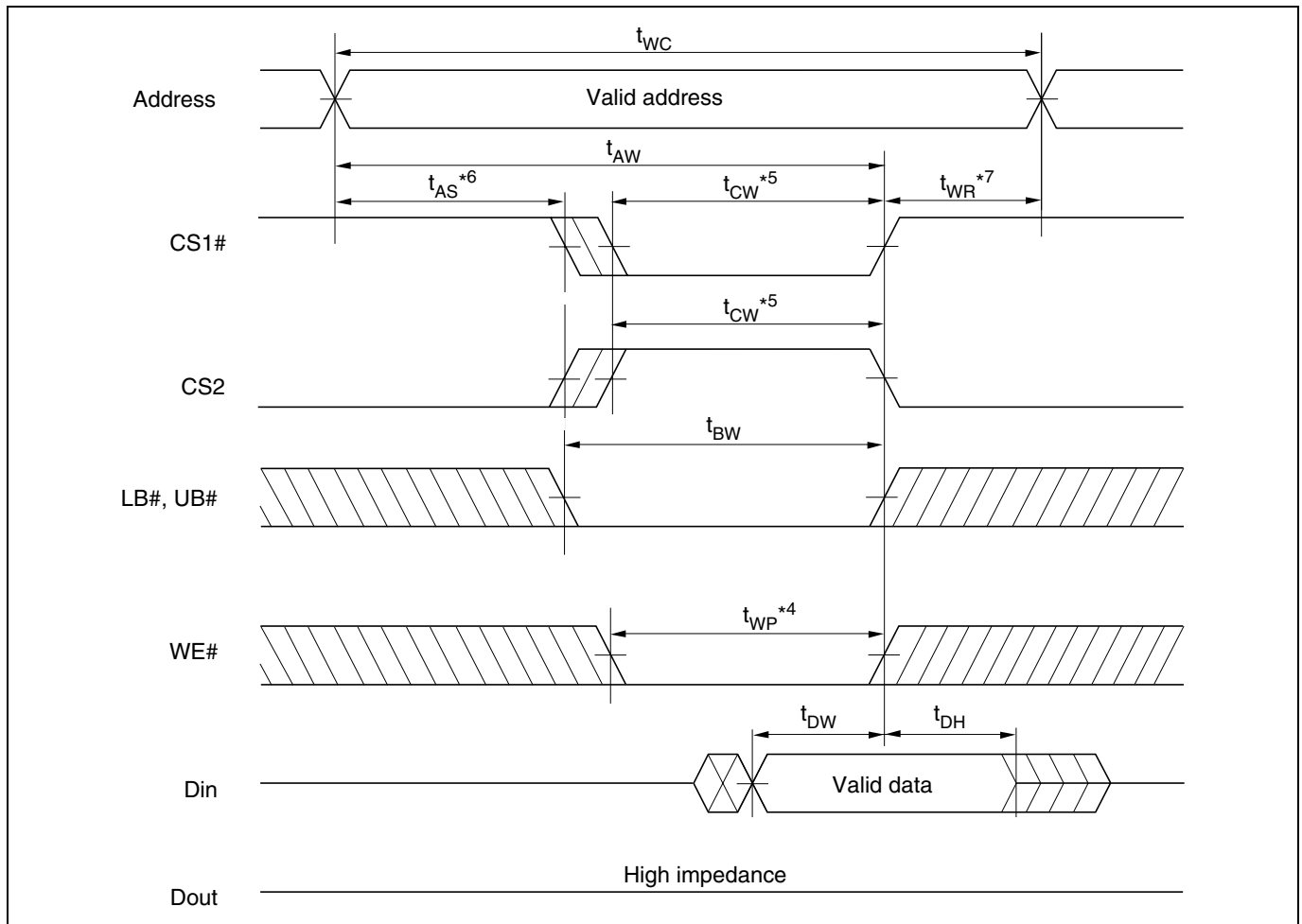
Read Timing Waveform (WE# = V<sub>ih</sub>)



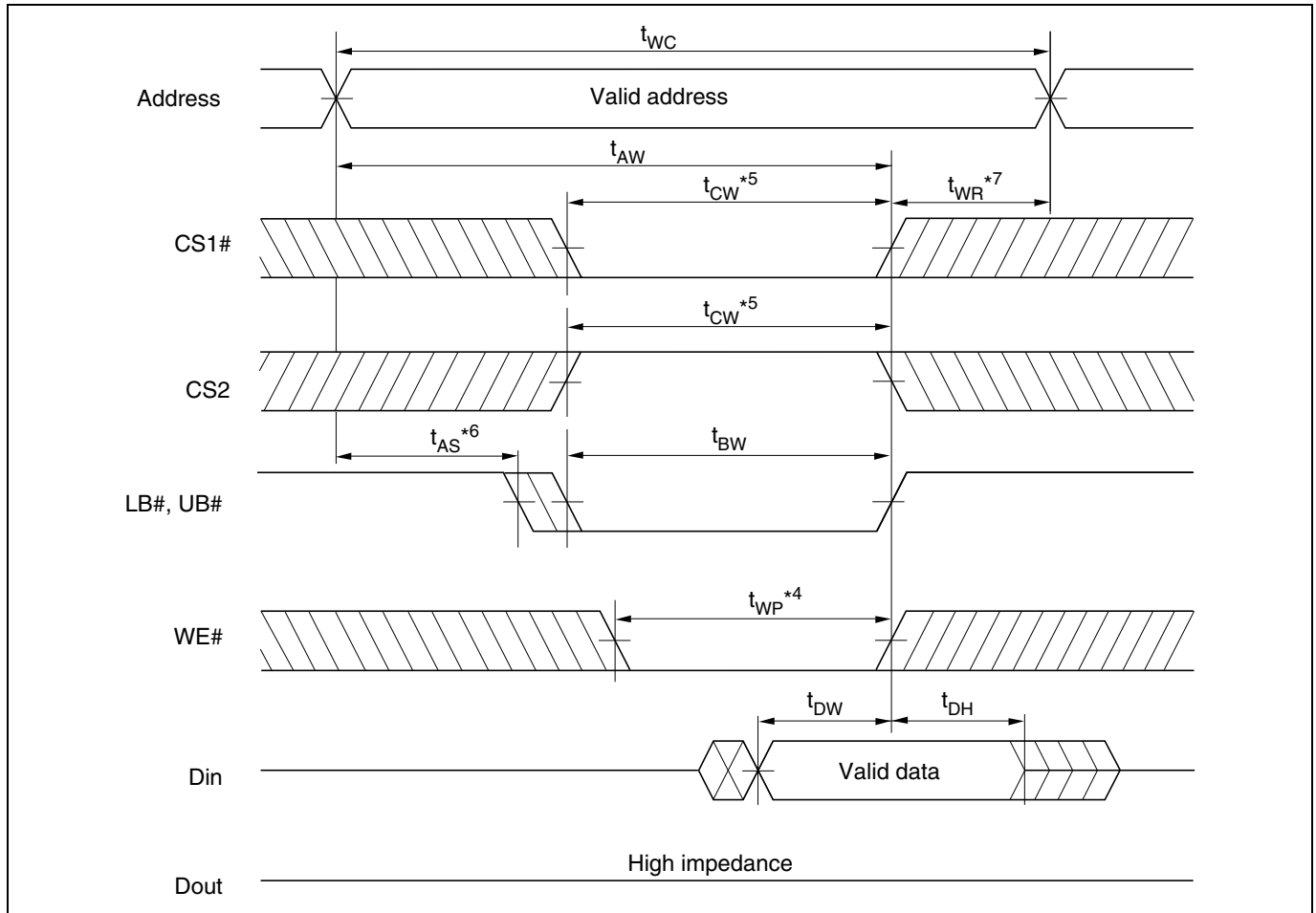
Write Timing Waveform (1) (WE# Clock)



Write Timing Waveform (2) (CS# Clock, OE# = V<sub>IH</sub>)



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



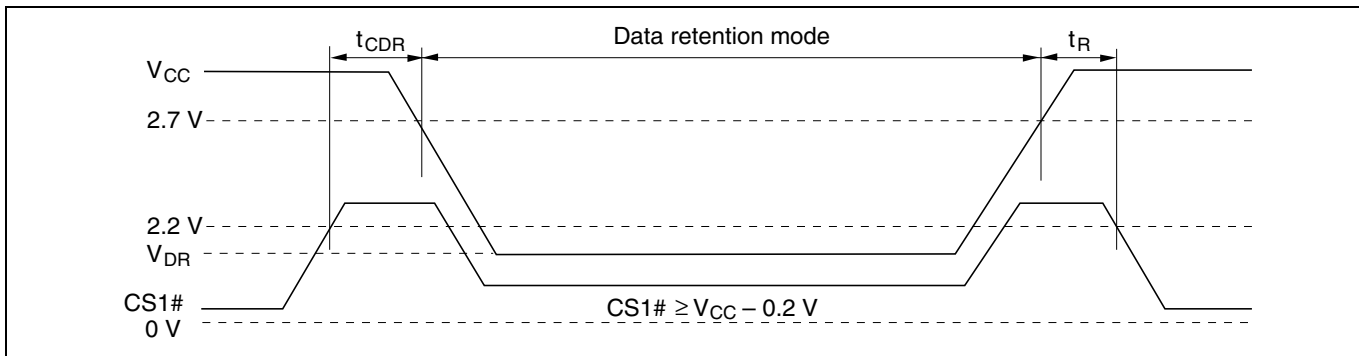
Low  $V_{CC}$  Data Retention Characteristics

(Ta = -40 to +85°C)

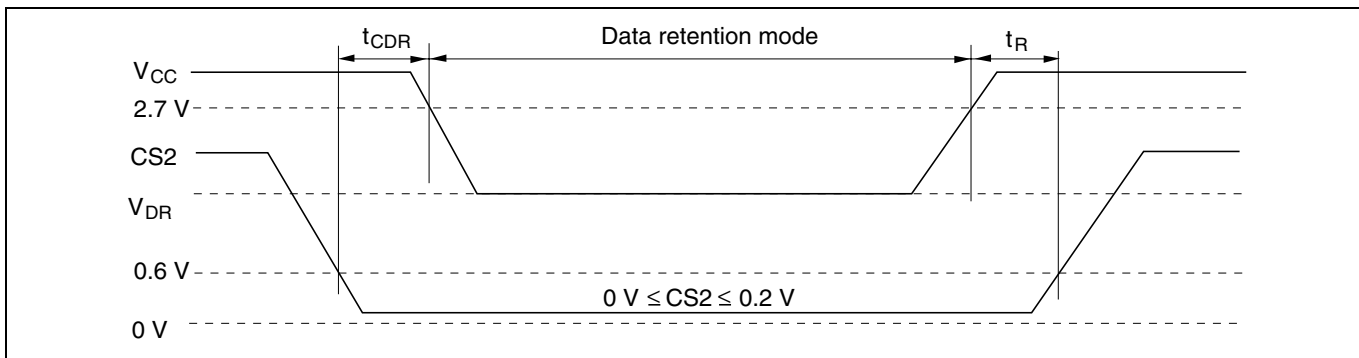
Parameter			Symbol	Min	Typ	Max	Unit	Test conditions
$V_{CC}$ for data retention			$V_{DR}$	2.0	—	—	V	$V_{in} \geq 0V$ (1) $0V \leq CS2 \leq 0.2V$ or (2) $CS2 \geq V_{CC} - 0.2V$ , $CS1\# \geq V_{CC} - 0.2V$ or (3) $LB\# = UB\# \geq V_{CC} - 0.2V$ , $CS2 \geq V_{CC} - 0.2V$ , $CS1\# \leq 0.2V$
Data retention current	-5SI	to +85°C	$I_{CCDR}$	—	—	10	$\mu A$	$V_{CC} = 3.0V$ , $V_{in} \geq 0V$ (1) $0V \leq CS2 \leq 0.2V$ or (2) $CS2 \geq V_{CC} - 0.2V$ , $CS1\# \geq V_{CC} - 0.2V$ or (3) $LB\# = UB\# \geq V_{CC} - 0.2V$ , $CS2 \geq V_{CC} - 0.2V$ , $CS1\# \leq 0.2V$ Average values
		to +70°C	$I_{CCDR}$	—	—	8	$\mu A$	
		to +40°C	$I_{CCDR}$	—	—	3	$\mu A$	
		to +25°C	$I_{CCDR}$	—	1* <sup>1</sup>	2.5	$\mu A$	
	-7LI	to +85°C	$I_{CCDR}$	—	—	20	$\mu A$	
		to +70°C	$I_{CCDR}$	—	—	16	$\mu A$	
		to +40°C	$I_{CCDR}$	—	—	10	$\mu A$	
		to +25°C	$I_{CCDR}$	—	1* <sup>1</sup>	10	$\mu A$	
Chip deselect to data retention time			$t_{CDR}$	0	—	—	ns	See retention waveform
Operation recovery time			$t_R$	5	—	—	ms	

Note: 1. Typical values are at  $V_{CC} = 3.0V$ ,  $T_a = +25^\circ C$  and specified loading, and not guaranteed.

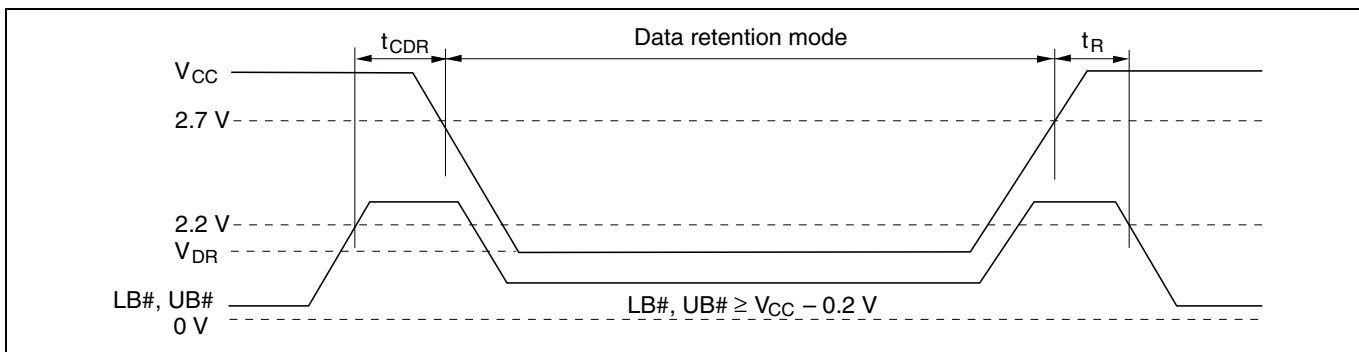
Low  $V_{CC}$  Data Retention Timing Waveform (1) (CS1# Controlled)



Low  $V_{CC}$  Data Retention Timing Waveform (2) (CS2 Controlled)



Low  $V_{CC}$  Data Retention Timing Waveform (3) (LB#, UB# Controlled)



## Revision History

## R1LV0416D Series Data Sheet

Rev.	Date	Contents of Modification	
		Page	Description
0.01	Dec. 25, 2006	—	Initial issue
1.00	May. 24, 2007	2	Ordering Information R1LV0416DSB-5S% to R1LV0416DSB-5SI R1LV0416DSB-7L% to R1LV0416DSB-7LI R1LV0416DBG-5S% to R1LV0416DBG-5SI R1LV0416DBG-7L% to R1LV0416DBG-7LI
		3	Pin Arrangement A6 to A13, A13 to A6
		4	Change of Block Diagram
		5	Absolute Maximum Ratings: Deletion of R ver. specification
		5	DC Operating Conditions: Deletion of R ver. specification
		6	DC Characteristics $I_{SB1}$ (-5SI) (to +25°C) max: 3 $\mu$ A to 2.5 $\mu$ A
		7	AC Characteristics: Change of Test Conditions
		14	Low $V_{CC}$ Data Retention Characteristics $I_{CCDR}$ (-5SI) (to +25°C) max: 3 $\mu$ A to 2.5 $\mu$ A Deletion of note 2



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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

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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  
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