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April 1, 2003

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# HM6216514I Series

Wide Temperature Range Version  
8 M SRAM (512-kword × 16-bit)



ADE-203-1303B (Z)  
Rev. 1.0  
Oct. 23, 2002

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## Description

The Hitachi HM6216514I Series is 8-Mbit static RAM organized 524,288-word × 16-bit. HM6216514I Series has realized higher density, higher performance and low power consumption by employing CMOS process technology (6-transistor memory cell). It offers low power standby power dissipation; therefore, it is suitable for battery backup systems. It is packaged in standard 44-pin plastic TSOPII.

## Features

- Single 5.0 V supply: 5.0V ± 10 %
- Fast access time: 55 ns (Max)
- Power dissipation:
  - Active: 10 mW/MHz (Typ)
  - Standby: 7.5 μW (Typ)
- Completely static memory.
  - No clock or timing strobe required
- Equal access and cycle times
- Common data input and output.
  - Three state output
- Battery backup operation.
- Temperature range: -40 to +85°C

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## HM6216514I Series

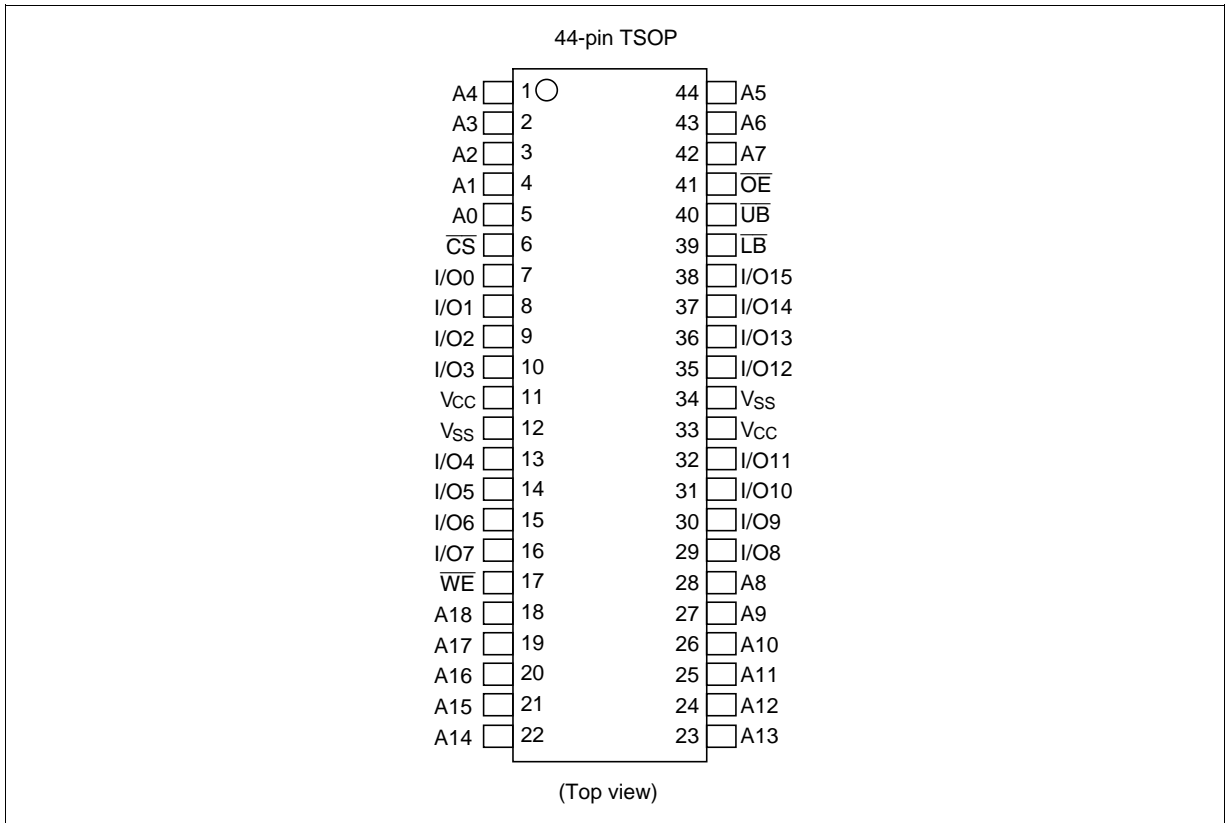
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### Ordering Information

Type No.	Access time	Package
HM6216514LTTI-5SL	55 ns	400-mil 44-pin plastic TSOPII (normal-bend type) (TTP-44DE)

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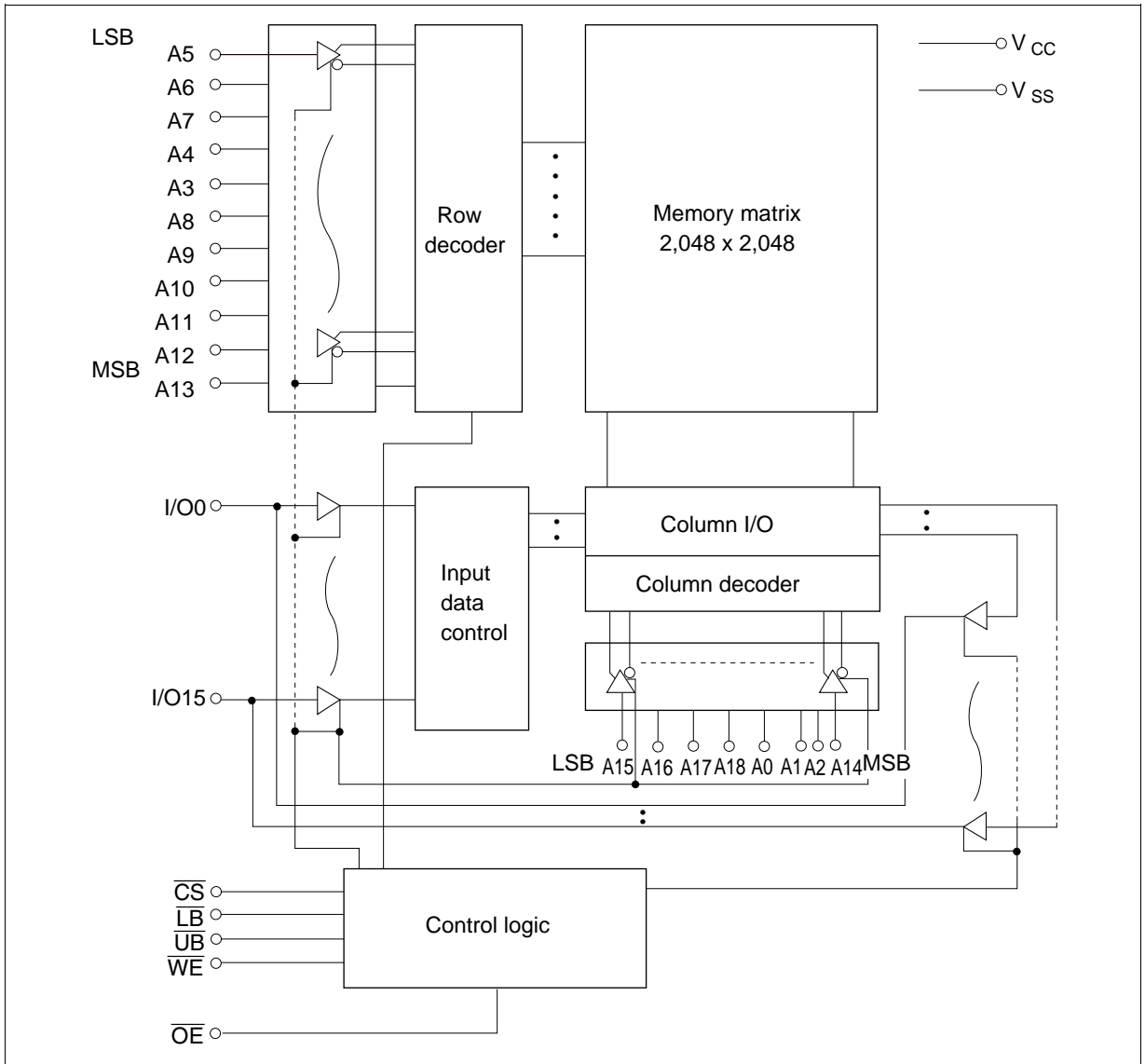
## Pin Arrangement



## Pin Description

Pin name	Function
A0 to A18	Address input
I/O0 to I/O15	Data input/output
$\overline{CS}$	Chip select
$\overline{WE}$	Write enable
$\overline{OE}$	Output enable
$\overline{LB}$	Lower byte select
$\overline{UB}$	Upper byte select
V <sub>cc</sub>	Power supply
V <sub>ss</sub>	Ground

## Block Diagram



## Operation Table

$\overline{CS}$	$\overline{WE}$	$\overline{OE}$	$\overline{UB}$	$\overline{LB}$	I/O0 to I/O7	I/O8 to I/O15	Operation
H	×	×	×	×	High-Z	High-Z	Standby
×	×	×	H	H	High-Z	High-Z	Standby
L	H	L	L	L	Dout	Dout	Read
L	H	L	H	L	Dout	High-Z	Lower byte read
L	H	L	L	H	High-Z	Dout	Upper byte read
L	L	×	L	L	Din	Din	Write
L	L	×	H	L	Din	High-Z	Lower byte write
L	L	×	L	H	High-Z	Din	Upper byte write
L	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 +7.0	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	$P_T$	1.0	W
Storage temperature range	Tstg	-55 to +125	°C
Storage temperature range under bias	Tbias	-40 to +85	°C

Notes: 1.  $V_T$  min: -3.0 V for pulse half-width ≤ 30 ns.  
 2. Maximum voltage is +7.0 V.

## DC Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit	Note
Supply voltage	$V_{CC}$	4.5	5.0	5.5	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	—	0.8	V	1
Ambient temperature range	$T_a$	-40	—	85	°C	

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

## DC Characteristics

Parameter	Symbol	Min	Typ* <sup>1</sup>	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	$\mu\text{A}$	$\overline{CS} = V_{IH}$ or $\overline{OE} = V_{IH}$ or $\overline{WE} = V_{IL}$ or, $\overline{LB} = \overline{UB} = V_{IH}$ , $V_{I/O} = V_{SS}$ to $V_{CC}$
Operating current	$I_{CC}$	—	—	20	mA	$\overline{CS} = V_{IL}$ , Others = $V_{IH}/V_{IL}$ , $I_{I/O} = 0$ mA
Average operating current	$I_{CC1}$	—	16	35	mA	Min. cycle, duty = 100%, $I_{I/O} = 0$ mA, $\overline{CS} = V_{IL}$ , Others = $V_{IH}/V_{IL}$
	$I_{CC2}$	—	2	5	mA	Cycle time = 1 $\mu\text{s}$ , duty = 100%, $I_{I/O} = 0$ mA, $\overline{CS} \leq 0.2$ V, $V_{IH} \geq V_{CC} - 0.2$ V, $V_{IL} \leq 0.2$ V
Standby current	$I_{SB}$	—	0.1	0.3	mA	$\overline{CS} = V_{IH}$
Standby current	$I_{SB1}$	—	0.8	10	$\mu\text{A}$	$0 \text{ V} \leq V_{in}$ (1) $\overline{CS} \geq V_{CC} - 0.2$ V or (2) $\overline{LB} = \overline{UB} \geq V_{CC} - 0.2$ V, $\overline{CS} \leq 0.2$ V
Output high voltage	$V_{OH}$	2.4	—	—	V	$I_{OH} = -1$ mA
Output low voltage	$V_{OL}$	—	—	0.4	V	$I_{OL} = 2.1$ mA

Notes: 1. Typical values are at  $V_{CC} = 5.0$  V,  $T_a = +25^\circ\text{C}$  and not guaranteed.

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

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

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



**AC Characteristics** ( $T_a = -40$  to  $+85^\circ\text{C}$ ,  $V_{CC} = 5.0\text{ V} \pm 10\%$ , unless otherwise noted.)

**Test Conditions**

- Input pulse levels:  $V_{IL} = 0.4\text{ V}$ ,  $V_{IH} = 2.2\text{ V}$
- Input rise and fall time:  $5\text{ ns}$
- Input and output timing reference levels:  $1.5\text{ V}$
- Output load: 1 TTL Gate +  $C_L$  ( $50\text{ pF}$ ) (Including scope and jig)

**Read Cycle**

Parameter	Symbol	HM6216514I		Unit	Notes
		-5			
		Min	Max		
Read cycle time	$t_{RC}$	55	—	ns	
Address access time	$t_{AA}$	—	55	ns	
Chip select access time	$t_{ACS}$	—	55	ns	
Output enable to output valid	$t_{OE}$	—	35	ns	
Output hold from address change	$t_{OH}$	10	—	ns	
$\overline{LB}$ , $\overline{UB}$ access time	$t_{BA}$	—	55	ns	
Chip select to output in low-Z	$t_{CLZ}$	10	—	ns	2, 3
$\overline{LB}$ , $\overline{UB}$ enable to low-z	$t_{BLZ}$	5	—	ns	2, 3
Output enable to output in low-Z	$t_{OLZ}$	5	—	ns	2, 3
Chip deselect to output in high-Z	$t_{CHZ}$	0	20	ns	1, 2, 3
$\overline{LB}$ , $\overline{UB}$ disable to high-Z	$t_{BHZ}$	0	20	ns	1, 2, 3
Output disable to output in high-Z	$t_{OHZ}$	0	20	ns	1, 2, 3

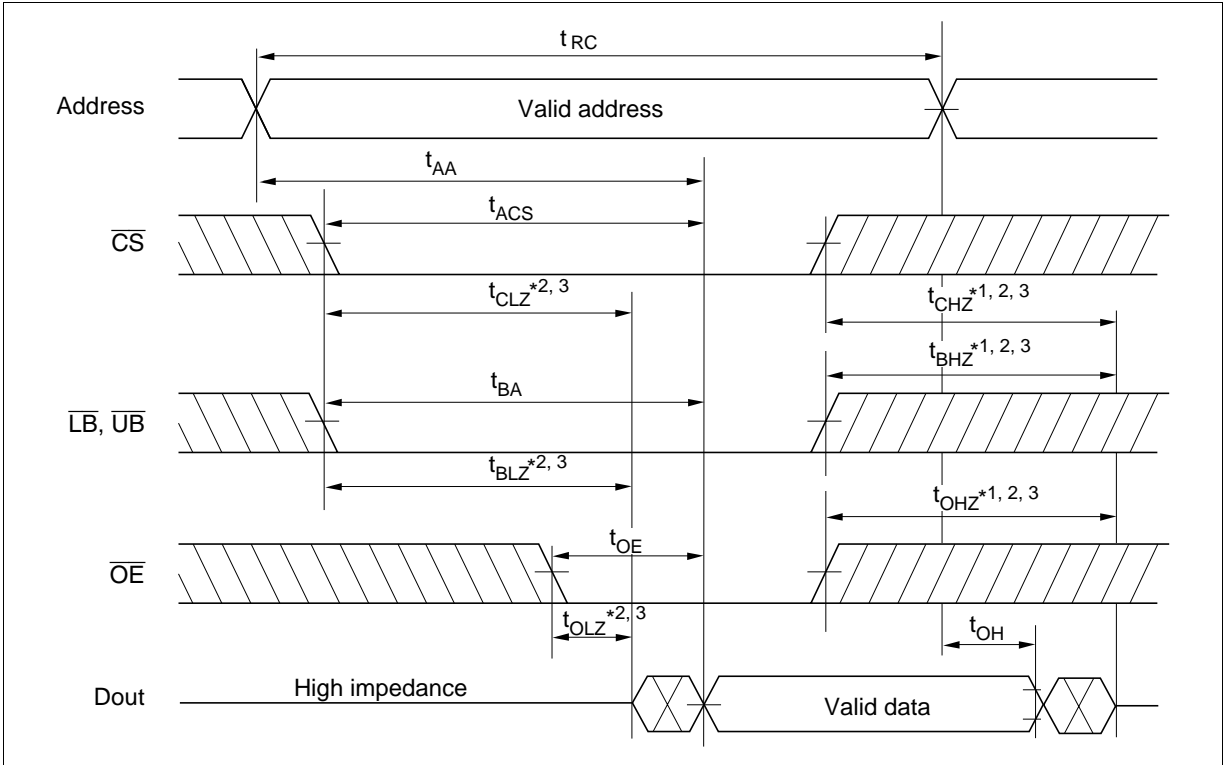
## Write Cycle

Parameter	Symbol	HM6216514I		Unit	Notes
		-5			
		Min	Max		
Write cycle time	$t_{WC}$	55	—	ns	
Address valid to end of write	$t_{AW}$	50	—	ns	
Chip selection to end of write	$t_{CW}$	50	—	ns	5
Write pulse width	$t_{WP}$	40	—	ns	4
$\overline{LB}$ , $\overline{UB}$ valid to end of write	$t_{BW}$	50	—	ns	
Address setup time	$t_{AS}$	0	—	ns	6
Write recovery time	$t_{WR}$	0	—	ns	7
Data to write time overlap	$t_{DW}$	25	—	ns	
Data hold from write time	$t_{DH}$	0	—	ns	
Output active from end of write	$t_{OW}$	5	—	ns	2
Output disable to output in high-Z	$t_{OHZ}$	0	20	ns	1, 2
Write to output in high-Z	$t_{WHZ}$	0	20	ns	1, 2

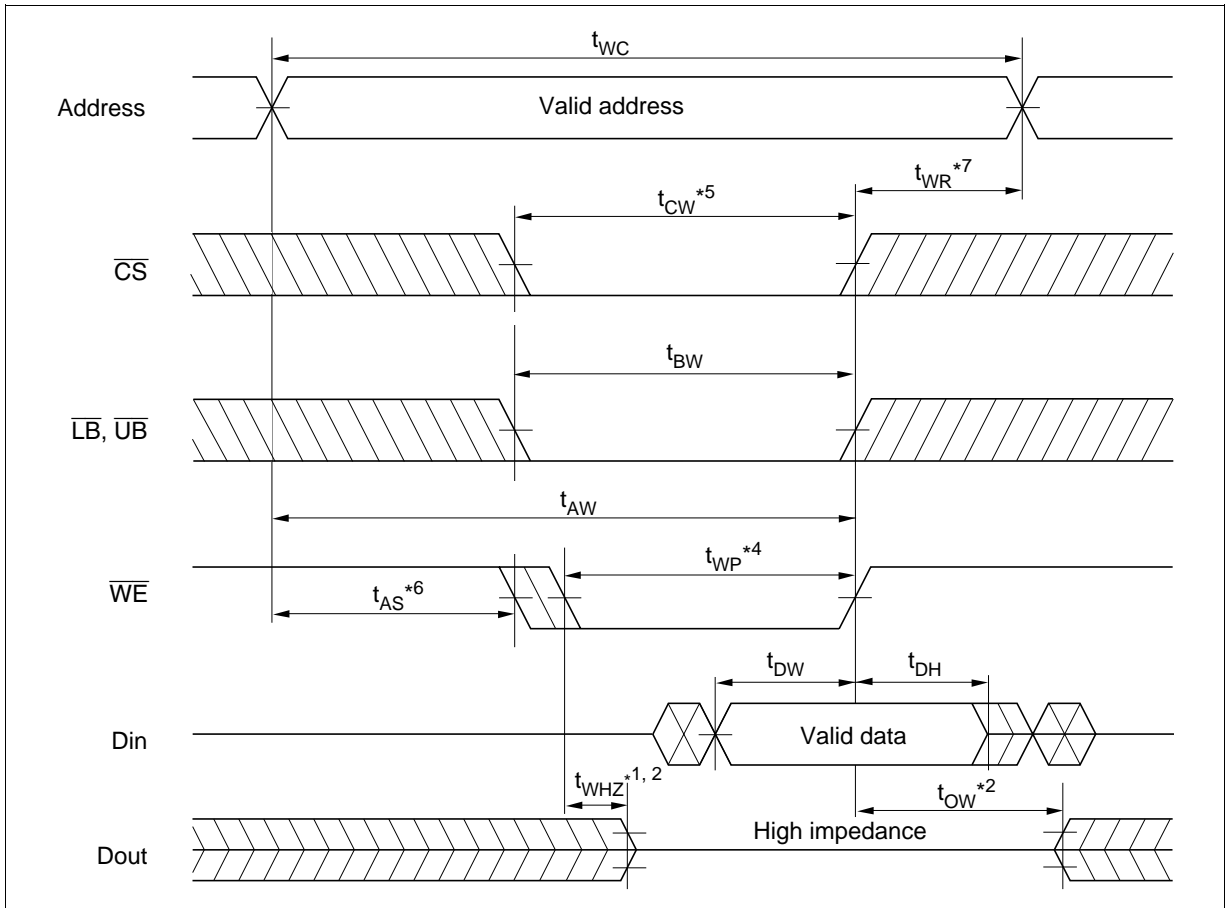
- Notes:
- $t_{CHZ}$ ,  $t_{OHZ}$ ,  $t_{WHZ}$  and  $t_{BHZ}$  are defined as the time at which the outputs achieve the open circuit conditions and are not referred to output voltage levels.
  - This parameter is sampled and not 100% tested.
  - At any given temperature and voltage condition,  $t_{HZ}$  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  $\overline{CS}$ , a low  $\overline{WE}$  and a low  $\overline{LB}$  or a low  $\overline{UB}$ . A write begins at the latest transition among  $\overline{CS}$  going low,  $\overline{WE}$  going low and  $\overline{LB}$  going low or  $\overline{UB}$  going low. A write ends at the earliest transition among  $\overline{CS}$  going high,  $\overline{WE}$  going high and  $\overline{LB}$  going high or  $\overline{UB}$  going high.  $t_{WP}$  is measured from the beginning of write to the end of write.
  - $t_{CW}$  is measured from the later of  $\overline{CS}$  going low 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  $\overline{CS}$  or  $\overline{WE}$  going high to the end of write cycle.

Timing Waveform

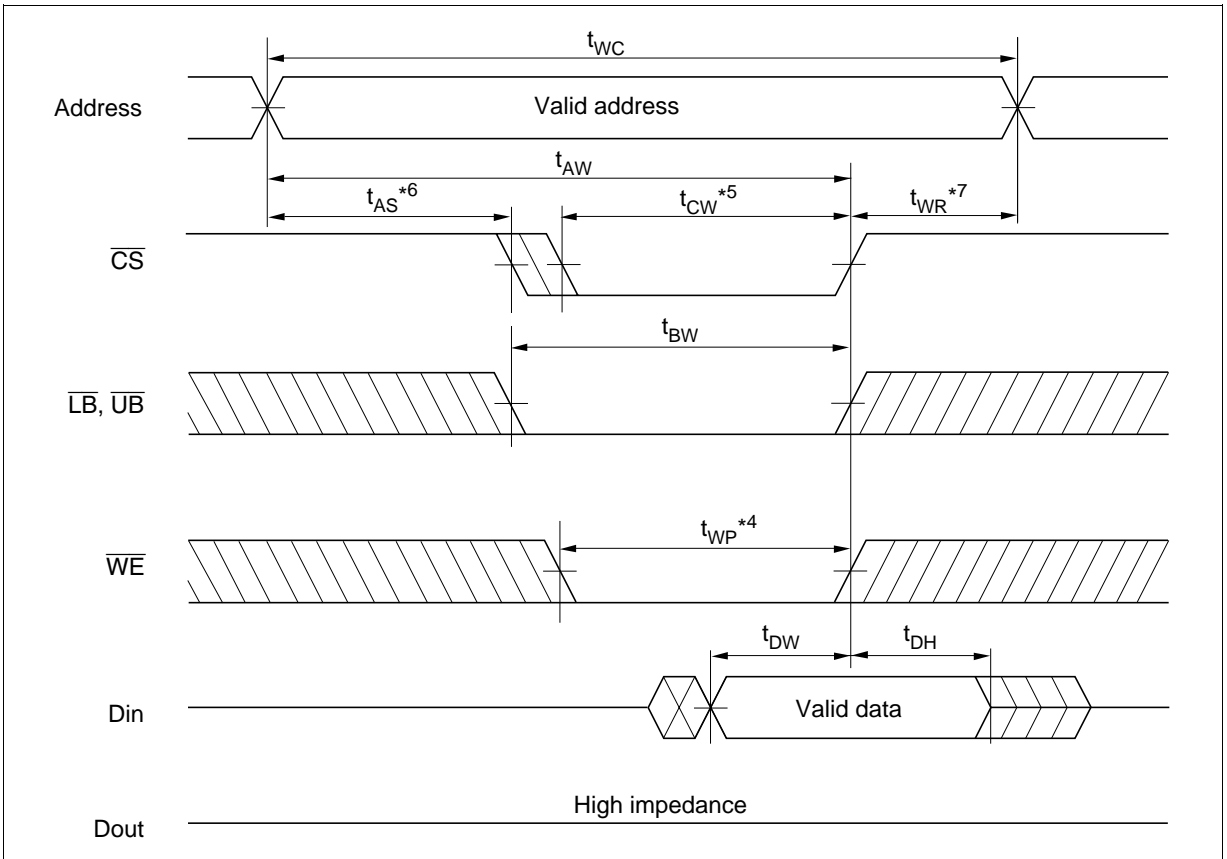
Read Cycle



## Write Cycle (1) ( $\overline{WE}$ Clock)

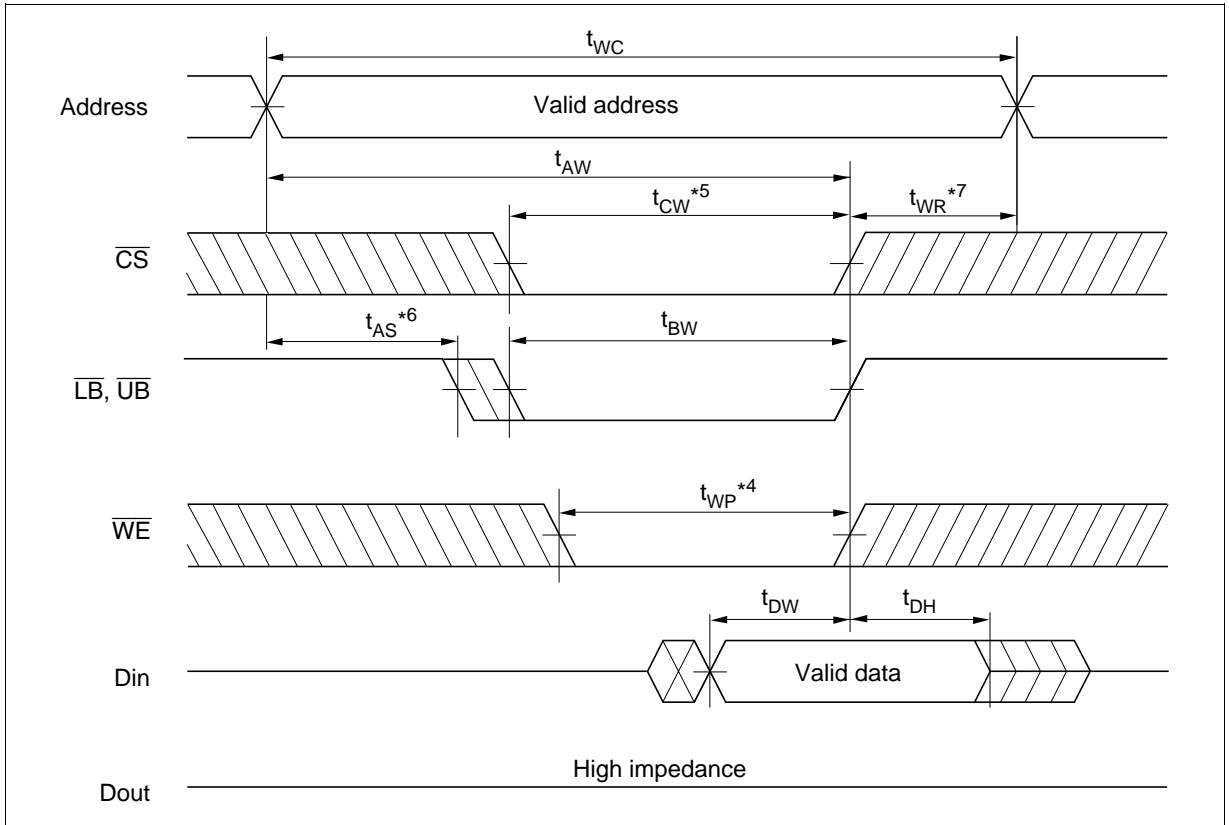


Write Cycle (2) ( $\overline{CS}$  Clock,  $\overline{OE} = V_{IH}$ )



# HM6216514I Series

Write Cycle (3) ( $\overline{\text{LB}}$ ,  $\overline{\text{UB}}$  Clock,  $\overline{\text{OE}} = \text{V}_{\text{IH}}$ )

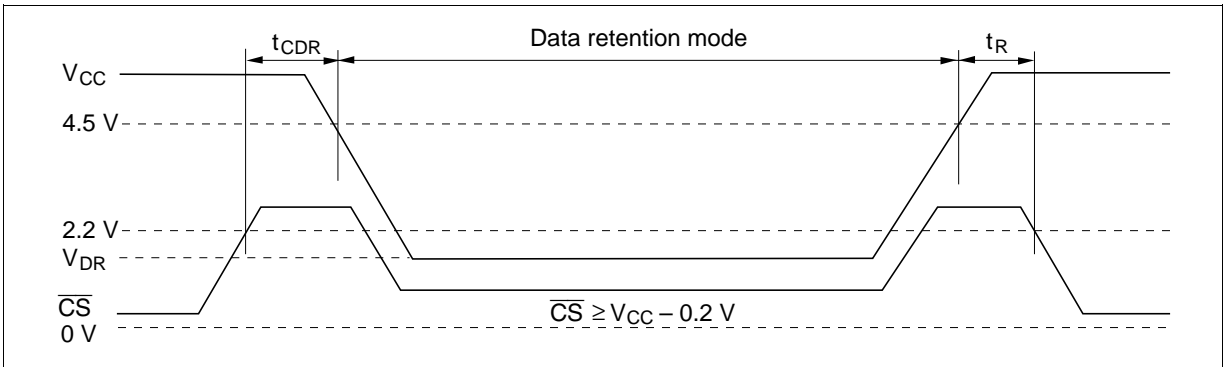


**Low  $V_{CC}$  Data Retention Characteristics** ( $T_a = -40$  to  $+85^\circ\text{C}$ )

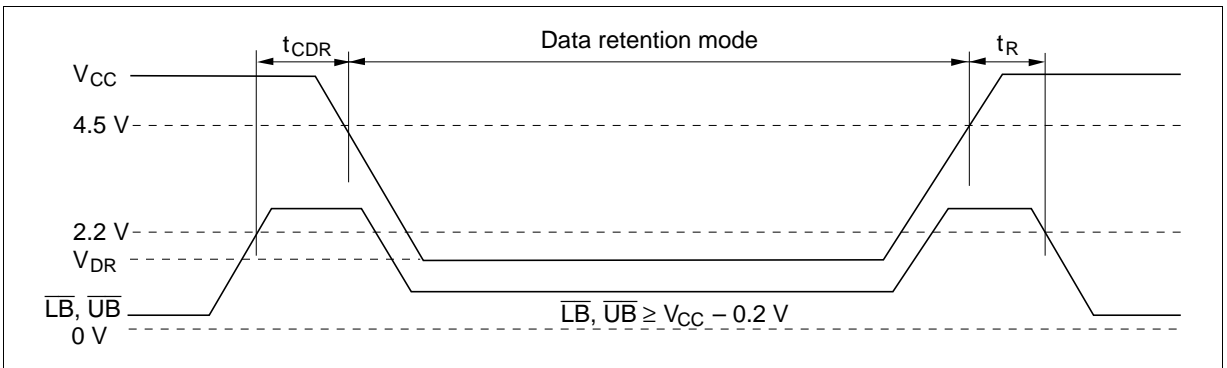
Parameter	Symbol	Min	Typ* <sup>2</sup>	Max	Unit	Test conditions* <sup>1</sup>
$V_{CC}$ for data retention	$V_{DR}$	2.0	—	—	V	$V_{in} \geq 0V$ (1) $\overline{CS} \geq V_{CC} - 0.2V$ or (2) $\overline{LB} = \overline{UB} \geq V_{CC} - 0.2V$ $\overline{CS} \leq 0.2V$
Data retention current	$I_{CCDR}$	—	0.8	10	$\mu\text{A}$	$V_{CC} = 3.0V$ , $V_{in} \geq 0V$ (1) $\overline{CS} \geq V_{CC} - 0.2V$ or (2) $\overline{LB} = \overline{UB} \geq V_{CC} - 0.2V$ $\overline{CS} \leq 0.2V$
Chip deselect to data retention time	$t_{CDR}$	0	—	—	ns	See retention waveform
Operation recovery time	$t_R$	$t_{RC}$ * <sup>3</sup>	—	—	ns	

- Notes: 1.  $\overline{CS}$  controls address buffer,  $\overline{WE}$  buffer,  $\overline{OE}$  buffer,  $\overline{LB}$ ,  $\overline{UB}$  buffer and  $D_{in}$  buffer. If  $\overline{CS}$  controls data retention mode,  $V_{in}$  levels (address,  $\overline{WE}$ ,  $\overline{OE}$ ,  $\overline{LB}$ ,  $\overline{UB}$ , I/O) can be in the high impedance state. If  $\overline{LB}$ ,  $\overline{UB}$  controls data retention mode,  $\overline{LB}$ ,  $\overline{UB}$  must be  $\overline{LB} = \overline{UB} \geq V_{CC} - 0.2V$ ,  $\overline{CS}$  must be  $\overline{CS} \leq 0.2V$ . The other input levels (address,  $\overline{WE}$ ,  $\overline{OE}$ , I/O) can be in the high impedance state.
2. Typical values are at  $V_{CC} = 3.0V$ ,  $T_a = +25^\circ\text{C}$  and not guaranteed.
3.  $t_{RC}$  = read cycle time.

## Low $V_{CC}$ Data Retention Timing Waveform (1) ( $\overline{CS}$ Controlled)



## Low $V_{CC}$ Data Retention Timing Waveform (2) ( $\overline{LB}$ , $\overline{UB}$ Controlled)







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