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# HM621400H Series

4M High Speed SRAM (4-Mword  $\times$  1-bit)

# HITACHI

ADE-203-787D (Z)

Rev. 1.0

Sept. 15, 1998

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## Description

The HM621400H is a 4-Mbit high speed static RAM organized 4-Mword  $\times$  1-bit. It has realized high speed access time by employing CMOS process (4-transistor + 2-poly resistor memory cell) and high speed circuit designing technology. It is most appropriate for the application which requires high speed and high density memory, such as cache and buffer memory in system. The HM621400H is packaged in 400-mil 32-pin SOJ for high density surface mounting.

## Features

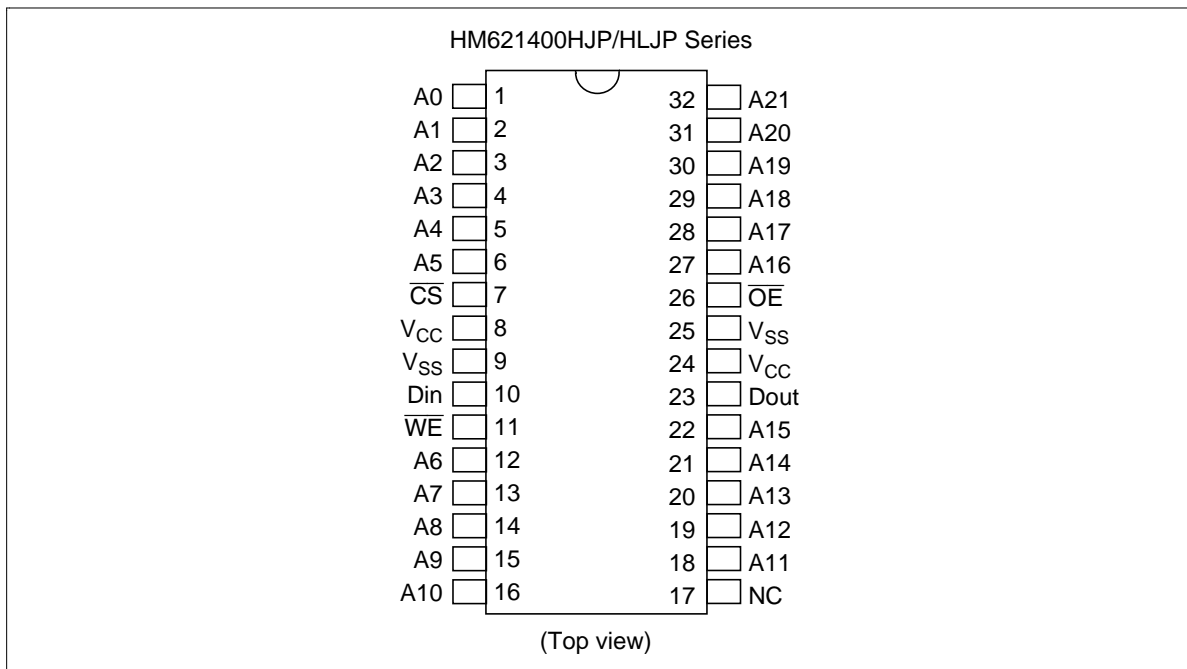
- Single 5.0 V supply : 5.0 V  $\pm$  10 %
- Access time 10/12/15 ns (max)
- Completely static memory
  - No clock or timing strobe required
- Equal access and cycle times
- Directly TTL compatible
  - All inputs and outputs
- Operating current: 200/180/160 mA (max)
- TTL standby current: 70/60/50 mA (max)
- CMOS standby current: 5 mA (max)
  - : 1.2 mA (max) (L-version)
- Data retention current: 0.8 mA (max) (L-version)
- Data retention voltage: 2 V (min) (L-version)
- Center  $V_{CC}$  and  $V_{SS}$  type pinout

## HM621400H Series

### Ordering Information

Type No.	Access time	Package
HM621400HJP-10	10 ns	400-mil 32-pin plastic SOJ (CP-32DB)
HM621400HJP-12	12 ns	
HM621400HJP-15	15 ns	
HM621400HLJP-10	10 ns	
HM621400HLJP-12	12 ns	
HM621400HLJP-15	15 ns	

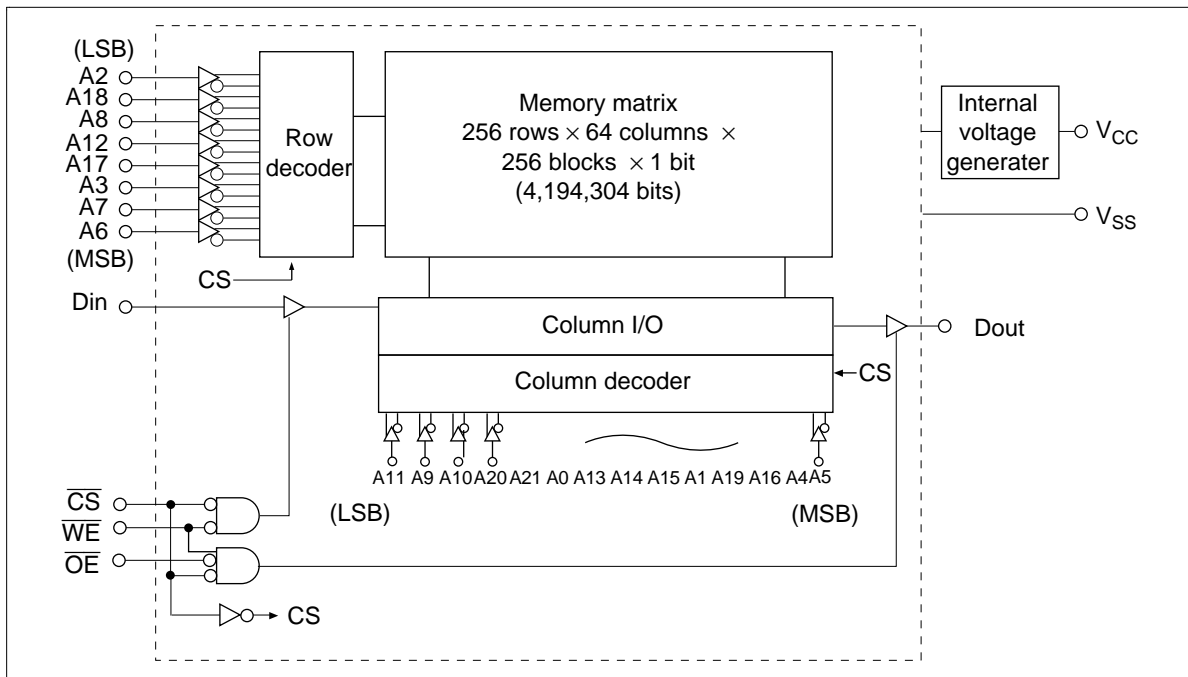
### Pin Arrangement



**Pin Description**

Pin name	Function
A0 to A21	Address input
Din	Data input
Dout	Data output
$\overline{CS}$	Chip select
$\overline{OE}$	Output enable
$\overline{WE}$	Write enable
$V_{CC}$	Power supply
$V_{SS}$	Ground
NC	No connection

**Block Diagram**



## HM621400H Series

### Operation Table

$\overline{CS}$	$\overline{OE}$	$\overline{WE}$	Mode	$V_{CC}$ current	Dout	Ref. cycle
H	×	×	Standby	$I_{SB}, I_{SB1}$	High-Z	—
L	H	H	Output disable	$I_{CC}$	High-Z	—
L	L	H	Read	$I_{CC}$	Dout	Read cycle (1) to (3)
L	H	L	Write	$I_{CC}$	High-Z	Write cycle (1)
L	L	L	Write	$I_{CC}$	High-Z	Write cycle (2)

Note: ×: H or L

### Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Supply voltage relative to $V_{SS}$	$V_{CC}$	-0.5 to +7.0	V
Voltage on any pin relative to $V_{SS}$	$V_T$	-0.5 <sup>*1</sup> to $V_{CC}+0.5$ <sup>*2</sup>	V
Power dissipation	$P_T$	1.0	W
Operating temperature	$T_{opr}$	0 to +70	°C
Storage temperature	$T_{stg}$	-55 to +125	°C
Storage temperature under bias	$T_{bias}$	-10 to +85	°C

Notes: 1.  $V_T$  (min) = -2.0 V for pulse width (under shoot) ≤ 8 ns  
 2.  $V_T$  (max) =  $V_{CC} + 2.0$  V for pulse width (over shoot) ≤ 8 ns

### Recommended DC Operating Conditions ( $T_a = 0$ to +70°C)

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	$V_{CC}$ <sup>*3</sup>	4.5	5.0	5.5	V
	$V_{SS}$ <sup>*4</sup>	0	0	0	V
Input voltage	$V_{IH}$	2.2	—	$V_{CC} + 0.5$ <sup>*2</sup>	V
	$V_{IL}$	-0.5 <sup>*1</sup>	—	0.8	V

Notes: 1.  $V_{IL}$  (min) = -2.0 V for pulse width (under shoot) ≤ 8 ns  
 2.  $V_{IH}$  (max) =  $V_{CC} + 2.0$  V for pulse width (over shoot) ≤ 8 ns  
 3. The supply voltage with all  $V_{CC}$  pins must be on the same level.  
 4. The supply voltage with all  $V_{SS}$  pins must be on the same level.

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### DC Characteristics (Ta = 0 to +70°C, V<sub>CC</sub> = 5.0 V ± 10 %, V<sub>SS</sub> = 0V)

Parameter	Symbol	Min	Typ* <sup>1</sup>	Max	Unit	Test conditions
Input leakage current	I <sub>LI</sub>	—	—	2	μA	V <sub>in</sub> = V <sub>SS</sub> to V <sub>CC</sub>
Output leakage current	I <sub>LO</sub>	—	—	2	μA	V <sub>in</sub> = V <sub>SS</sub> to V <sub>CC</sub>
Operation power supply current	10 ns cycle I <sub>CC</sub>	—	—	200	mA	Min cycle CS = V <sub>IL</sub> , I <sub>out</sub> = 0 mA Other inputs = V <sub>IH</sub> /V <sub>IL</sub>
	12 ns cycle I <sub>CC</sub>	—	—	180		
	15 ns cycle I <sub>CC</sub>	—	—	160		
Standby power supply current	10 ns cycle I <sub>SB</sub>	—	—	70	mA	Min cycle, CS = V <sub>IH</sub> , Other inputs = V <sub>IH</sub> /V <sub>IL</sub>
	12 ns cycle I <sub>SB</sub>	—	—	60		
	15 ns cycle I <sub>SB</sub>	—	—	50		
	I <sub>SB1</sub>	—	0.1	5		
		—* <sup>2</sup>	0.1* <sup>2</sup>	1.2* <sup>2</sup>		
Output voltage	V <sub>OL</sub>	—	—	0.4	V	I <sub>OL</sub> = 8 mA
	V <sub>OH</sub>	2.4	—	—	V	I <sub>OH</sub> = -4 mA

- Notes: 1. Typical values are at V<sub>CC</sub> = 5.0 V, Ta = +25°C and not guaranteed.  
2. This characteristics is guaranteed only for L-version.

### Capacitance (Ta = +25°C, f = 1.0 MHz)

Parameter	Symbol	Min	Typ	Max	Unit	Test conditions
Input capacitance* <sup>1</sup>	C <sub>in</sub>	—	—	6	pF	V <sub>in</sub> = 0 V
	C <sub>DIN</sub>	—	—	8	pF	V <sub>DIN</sub> = 0 V
Input/output capacitance* <sup>1</sup>	C <sub>DOUT</sub>	—	—	8	pF	V <sub>DOUT</sub> = 0 V

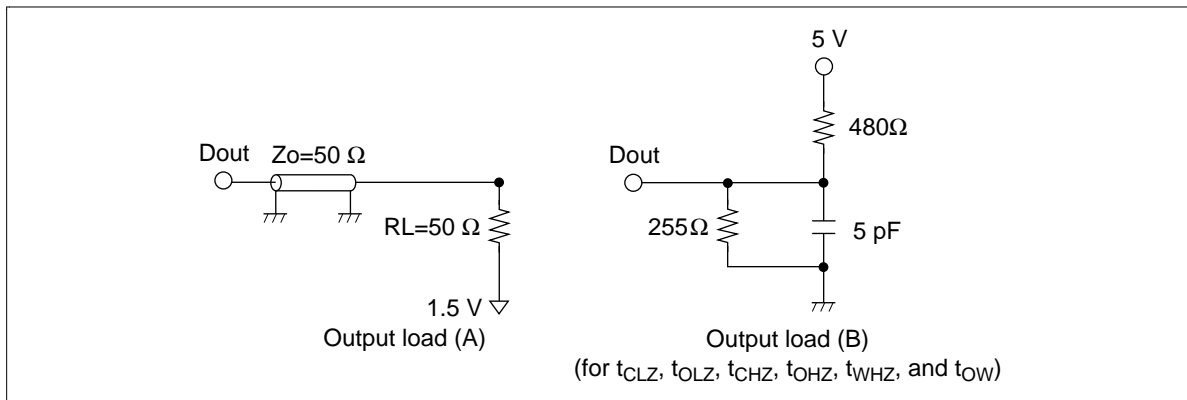
- Note: 1. This parameter is sampled and not 100% tested.

## HM621400H Series

**AC Characteristics** ( $T_a = 0$  to  $+70^\circ\text{C}$ ,  $V_{CC} = 5.0\text{ V} \pm 10\%$ , unless otherwise noted.)

### Test Conditions

- Input pulse levels: 3.0 V/0.0 V
- Input rise and fall time: 3 ns
- Input and output timing reference levels: 1.5 V
- Output load: See figures (Including scope and jig)



### Read Cycle

Parameter	Symbol	HM621400H						Unit	Notes
		-10		-12		-15			
		Min	Max	Min	Max	Min	Max		
Read cycle time	$t_{RC}$	10	—	12	—	15	—	ns	
Address access time	$t_{AA}$	—	10	—	12	—	15	ns	
Chip select access time	$t_{ACS}$	—	10	—	12	—	15	ns	
Output enable to output valid	$t_{OE}$	—	5	—	6	—	7	ns	
Output hold from address change	$t_{OH}$	3	—	3	—	3	—	ns	
Chip select to output in low-Z	$t_{CLZ}$	3	—	3	—	3	—	ns	1
Output enable to output in low-Z	$t_{OLZ}$	0	—	0	—	0	—	ns	1
Chip deselect to output in high-Z	$t_{CHZ}$	—	5	—	6	—	7	ns	1
Output disable to output in high-Z	$t_{OHZ}$	—	5	—	6	—	7	ns	1

## HM621400H Series

### Write Cycle

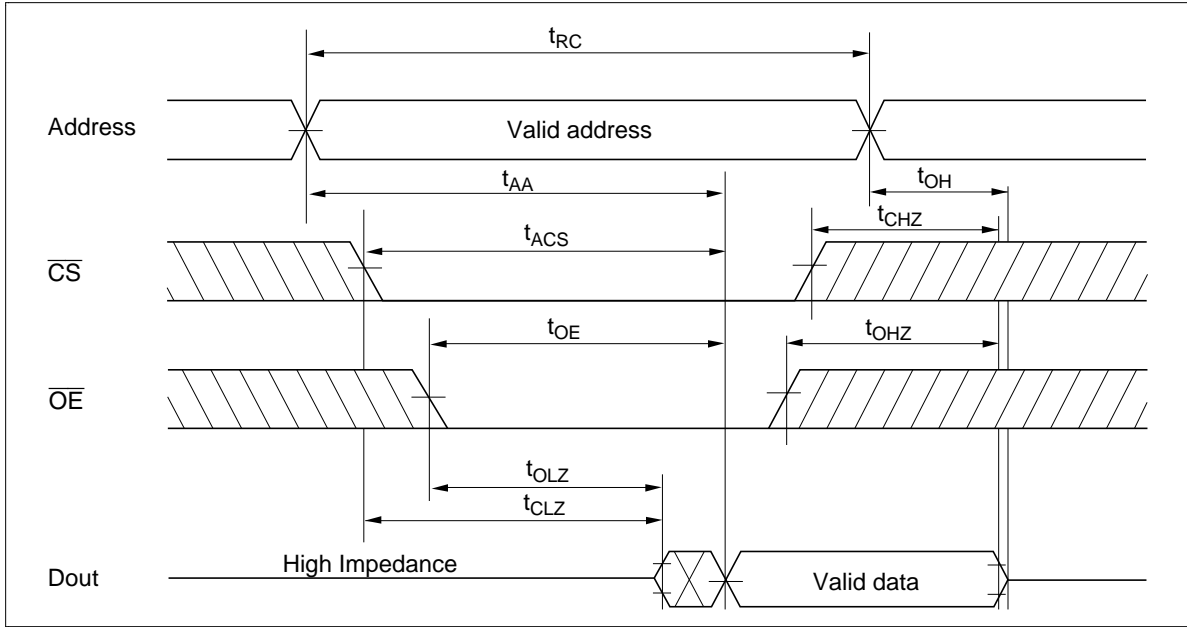
Parameter	Symbol	HM621400H						Unit	Notes
		-10		-12		-15			
		Min	Max	Min	Max	Min	Max		
Write cycle time	$t_{WC}$	10	—	12	—	15	—	ns	
Address valid to end of write	$t_{AW}$	7	—	8	—	10	—	ns	
Chip select to end of write	$t_{CW}$	7	—	8	—	10	—	ns	9
Write pulse width	$t_{WP}$	7	—	8	—	10	—	ns	8
Address setup time	$t_{AS}$	0	—	0	—	0	—	ns	6
Write recovery time	$t_{WR}$	0	—	0	—	0	—	ns	7
Data to write time overlap	$t_{DW}$	5	—	6	—	7	—	ns	
Data hold from write time	$t_{DH}$	0	—	0	—	0	—	ns	
Write disable to output in low-Z	$t_{OW}$	3	—	3	—	3	—	ns	1
Output disable to output in high-Z	$t_{OHZ}$	—	5	—	6	—	7	ns	1
Write enable to output in high-Z	$t_{WHZ}$	—	5	—	6	—	7	ns	1

- Note:
1. Transition is measured  $\pm 200$  mV from steady voltage with Load (B). This parameter is sampled and not 100% tested.
  2. Address should be valid prior to or coincident with  $\overline{CS}$  transition low.
  3.  $\overline{WE}$  and/or  $\overline{CS}$  must be high during address transition time.
  4. If  $\overline{CS}$  and  $\overline{OE}$  are low during this period, Dout pins are in the output state. Then, the data input signals of opposite phase to the outputs must not be applied to them.
  5. If the  $\overline{CS}$  low transition occurs simultaneously with the  $\overline{WE}$  low transition or after the  $\overline{WE}$  transition, output remains a high impedance state.
  6.  $t_{AS}$  is measured from the latest address transition to the later of  $\overline{CS}$  or  $\overline{WE}$  going low.
  7.  $t_{WR}$  is measured from the earlier of  $\overline{CS}$  or  $\overline{WE}$  going high to the first address transition.
  8. A write occurs during the overlap of a low  $\overline{CS}$  and a low  $\overline{WE}$ . A write begins at the latest transition among  $\overline{CS}$  going low and  $\overline{WE}$  going low. A write ends at the earliest transition among  $\overline{CS}$  going high and  $\overline{WE}$  going high.  $t_{WP}$  is measured from the beginning of write to the end of write.
  9.  $t_{CW}$  is measured from the later of  $\overline{CS}$  going low to the end of write.

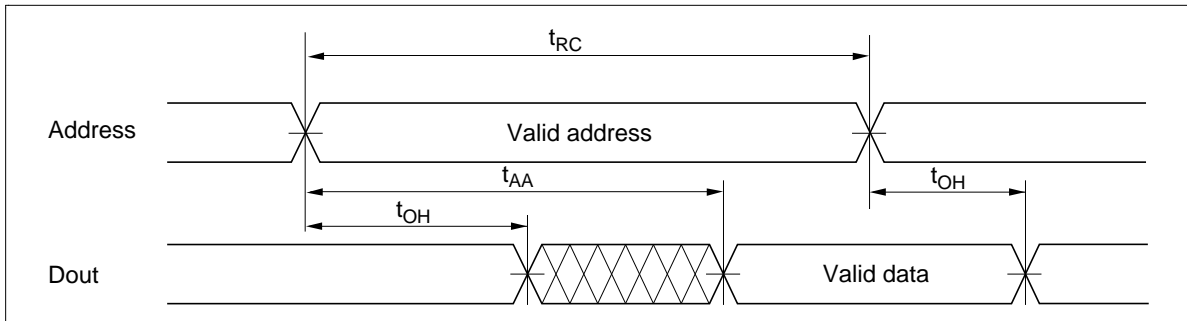
# HM621400H Series

## Timing Waveforms

Read Timing Waveform (1) ( $\overline{WE} = V_{IH}$ )



Read Timing Waveform (2) ( $\overline{WE} = V_{IH}, \overline{CS} = V_{IL}, \overline{OE} = V_{IL}$ )

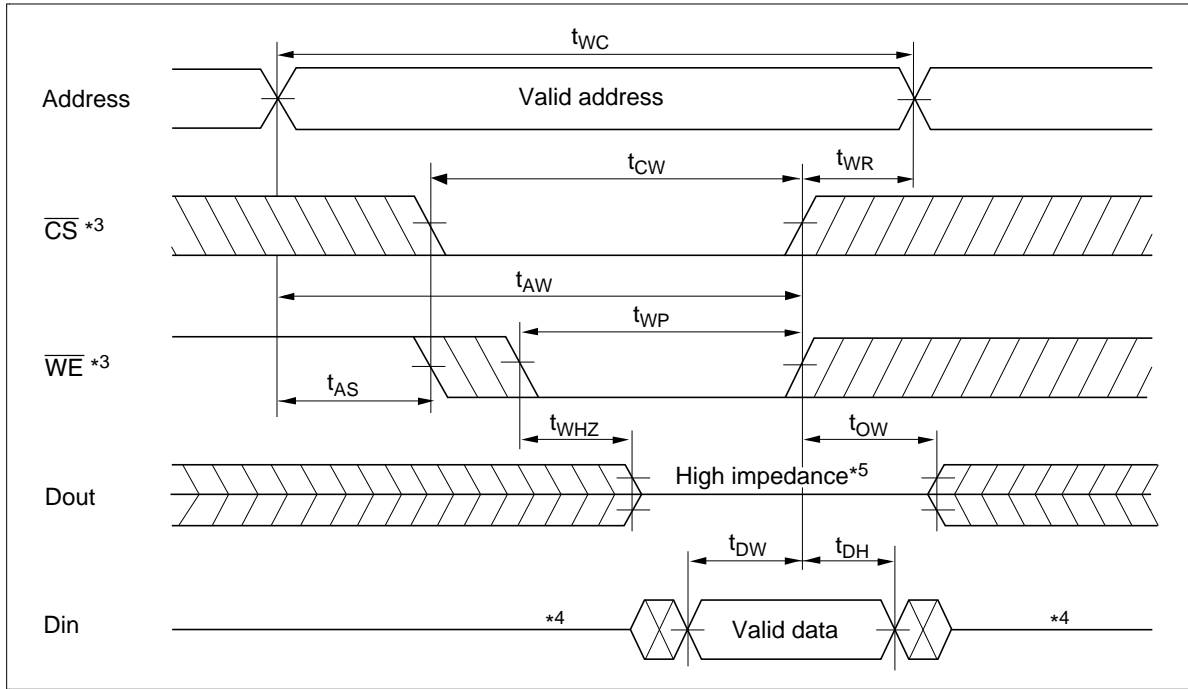






# HM621400H Series

## Write Timing Waveform (2) ( $\overline{CS}$ Controlled)



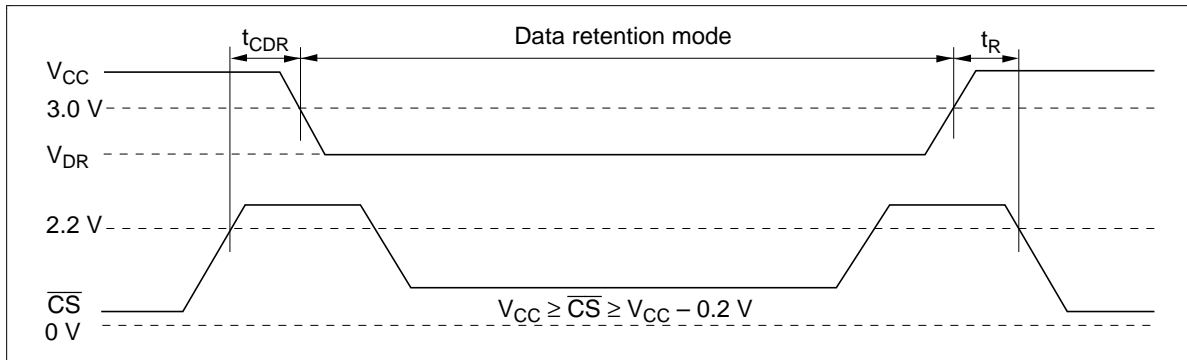
**Low  $V_{CC}$  Data Retention Characteristics** ( $T_a = 0$  to  $+70^\circ\text{C}$ )

This characteristics is guaranteed only for L-version.

Parameter	Symbol	Min	Typ* <sup>1</sup>	Max	Unit	Test conditions
$V_{CC}$ for data retention	$V_{DR}$	2.0	—	—	V	$V_{CC} \geq \overline{CS} \geq V_{CC} - 0.2$ V (1) $0 \text{ V} \leq V_{in} \leq 0.2 \text{ V}$ or (2) $V_{CC} \geq V_{in} \geq V_{CC} - 0.2 \text{ V}$
Data retention current	$I_{CCDR}$	—	50	800	$\mu\text{A}$	$V_{CC} = 3 \text{ V}$ , $V_{CC} \geq \overline{CS} \geq V_{CC} - 0.2 \text{ V}$ (1) $0 \text{ V} \leq V_{in} \leq 0.2 \text{ V}$ or (2) $V_{CC} \geq V_{in} \geq V_{CC} - 0.2 \text{ V}$
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  $V_{CC} = 3.0 \text{ V}$ ,  $T_a = +25^\circ\text{C}$ , and not guaranteed.

**Low  $V_{CC}$  Data Retention Timing Waveform**

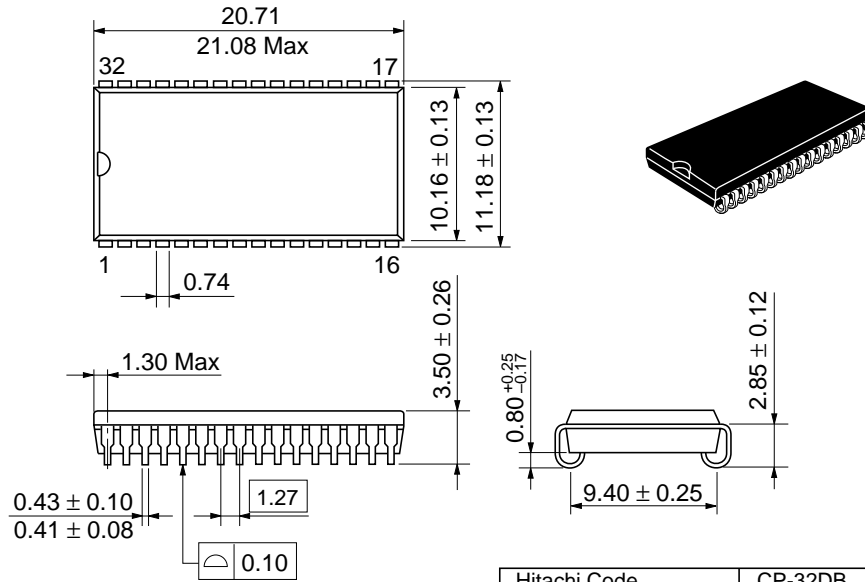


# HM621400H Series

## Package Dimensions

HM621400HJP/HLJP Series (CP-32DB)

Unit: mm



Dimension including the plating thickness  
Base material dimension

Hitachi Code	CP-32DB
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	1.2 g

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## HM621400H Series

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### Revision Record

Rev.	Date	Contents of Modification	Drawn by	Approved by
0.0	Jun. 4, 1997	Initial issue	Y. Saitoh	A. Ide
0.1	Nov. 20, 1997	Change of subtitle	K. Makuta	K. Makuta
0.2	Dec. 5, 1997	Features Addition of Operating current Addition of TTL standby current Addition of CMOS standby current Addition of Data retention current Addition of Data retention voltage Change of Block Diagram Operation table Title: I/O to Dout Dout: Din to High-Z Absolute Maximum Ratings P <sub>r</sub> : 1.0/1.5 W to 1.0 W Change of notes Recommended DC Operating Conditions Change of notes DC Characteristics I <sub>CC</sub> (max): 240/200/190 mA to 170/150/130 mA I <sub>SB</sub> (max): 100/100/100 mA to 70/60/50 mA I <sub>SB1</sub> (max): 10/1 mA to 5/1 mA Test conditions I <sub>CC</sub> and I <sub>SB</sub> : Addition of Min cycle Test conditions I <sub>SB1</sub> : Addition of f = 0 MHz Capacitance Addition of C <sub>DIN</sub> Input/output capacitance: C <sub>I/O</sub> to C <sub>DOUT</sub> AC Characteristics Change of Output load (A) t <sub>OE</sub> , t <sub>CHZ</sub> and t <sub>OHZ</sub> (max): 5/6/8 ns to 5/6/7 ns t <sub>AW</sub> , t <sub>CW</sub> and t <sub>WP</sub> (min): 6/8/10 ns to 7/8/10 ns t <sub>DW</sub> (min): 5/6/8 ns to 5/6/7 ns t <sub>OHZ</sub> and t <sub>WHZ</sub> (max): 5/6/8 ns to 5/6/7 ns Note 4.: Correct error Low V <sub>CC</sub> Data Retention Characteristics I <sub>CCDR</sub> : —/2/300 μA to —/—/300 μA	T. Fukazawa	K. Makuta
0.3	May. 15, 1998	Features Change of Operating current Change of Block Diagram DC Characteristics I <sub>CC</sub> (max): 170/150/130 mA to 200/180/160 mA	T. Fukazawa	K. Makuta

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## HM621400H Series

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Rev.	Date	Contents of Modification	Drawn by	Approved by
1.0	Sep. 15, 1998	Features Change of CMOS standby current (L-version) Change of Data retention current DC Characteristics $I_{SB1}$ (max): 5/1 mA to 5/1.2 mA $I_{SB1}$ (typ): —/— mA to 0.1/0.1 mA Low $V_{CC}$ Data Retention Characteristics $I_{CCDR}$ : —/—/300 $\mu$ A to —/50/800 $\mu$ A		

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