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# HM628128B Series

1 M SRAM (128-kword × 8-bit)

# HITACHI

ADE-203-243E (Z)

Rev. 5.0

Nov. 1997

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## Description

The Hitachi HM628128B is a CMOS static RAM organized 131,072-word × 8-bit. It realizes higher density, higher performance and low power consumption by employing 0.8 μm Hi-CMOS shrink process technology. It offers low power standby power dissipation, therefore, it is suitable for battery backup systems. The device, packaged in a 525 mil SOP or a 8 mm × 20 mm TSOP or a 600 mil plastic DIP is available.

## Features

- Single 5 V supply: 5.0 V ± 10%
- Access time: 70/75/85 ns (max)
- Power dissipation
  - Active: 50 mW/MHz (typ)
  - Standby: 10 μW (typ) (L/L-SL version)
- Completely static memory
  - No clock or timing strobe required
- Equal access and cycle times
- Common data input and output
  - Three state output
- Directly TTL compatible all inputs and outputs
- Capability of battery backup operation (L/L-SL version)
  - 2 chip selection for battery backup

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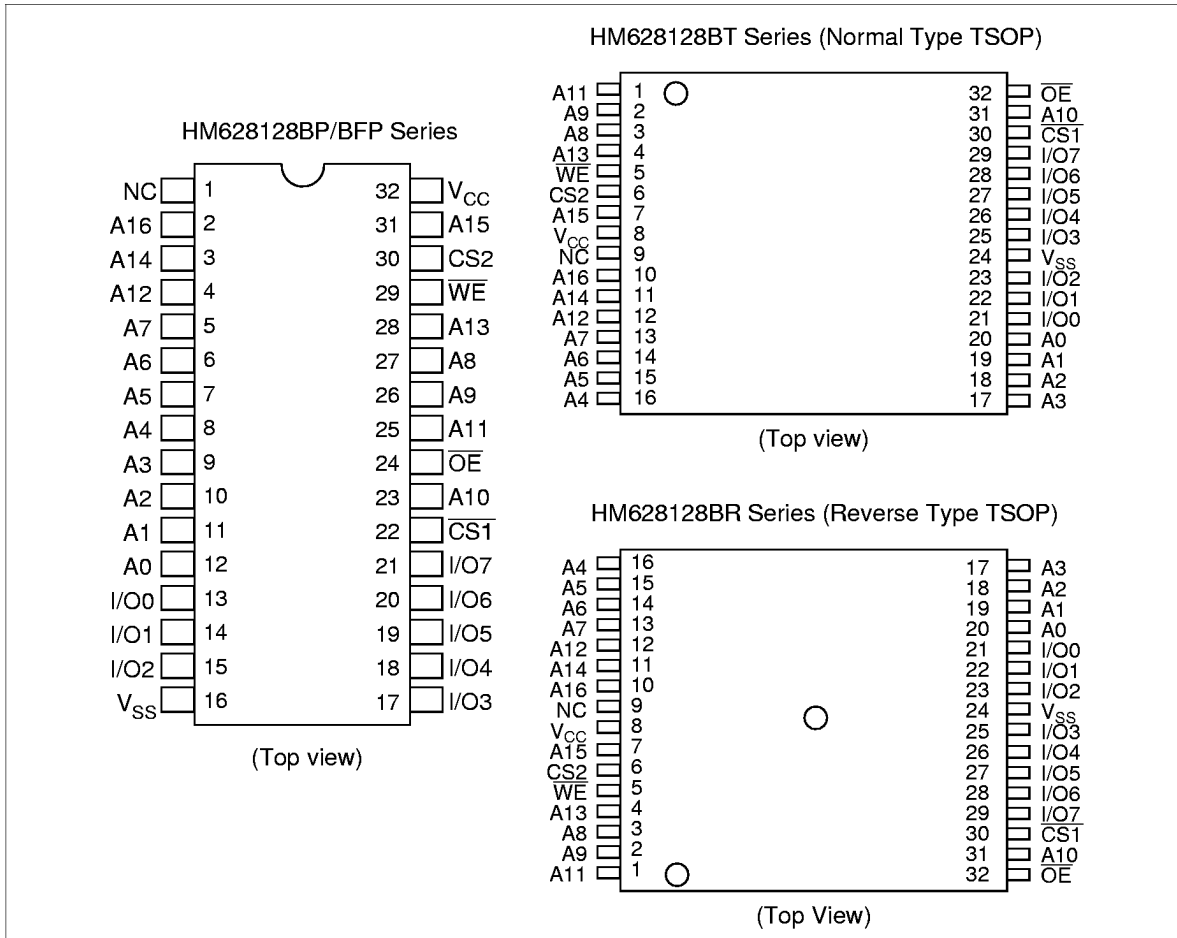
## HM628128B Series

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### Ordering Information

Type No.	Access time	Data retention current	Package
HM628128BLP-7	70 ns	50 $\mu$ A	600-mil 32-pin plastic DIP (DP-32)
HM628128BLP-8	85 ns	50 $\mu$ A	
HM628128BLP-7SL	70 ns	15 $\mu$ A	
HM628128BLP-8SL	85 ns	15 $\mu$ A	
HM628128BLFP-7	70 ns	50 $\mu$ A	525-mil 32-pin plastic SOP (FP-32D)
HM628128BLFP-75	75 ns	50 $\mu$ A	
HM628128BLFP-8	85 ns	50 $\mu$ A	
HM628128BLFP-7SL	70 ns	15 $\mu$ A	
HM628128BLFP-75SL	75 ns	15 $\mu$ A	
HM628128BLFP-8SL	85 ns	15 $\mu$ A	
HM628128BLT-7	70 ns	50 $\mu$ A	Normal-bend type 32-pin plastic 8 mm $\times$ 20 mm TSOP (TFP-32D)
HM628128BLT-75	75 ns	50 $\mu$ A	
HM628128BLT-8	85 ns	50 $\mu$ A	
HM628128BLT-7SL	70 ns	15 $\mu$ A	
HM628128BLT-75SL	75 ns	15 $\mu$ A	
HM628128BLT-8SL	85 ns	15 $\mu$ A	
HM628128BLR-7	70 ns	50 $\mu$ A	Reverse-bend type 32-pin plastic 8 mm $\times$ 20 mm TSOP (TFP-32DR)
HM628128BLR-8	85 ns	50 $\mu$ A	
HM628128BLR-7SL	70 ns	15 $\mu$ A	
HM628128BLR-8SL	85 ns	15 $\mu$ A	

## Pin Arrangement

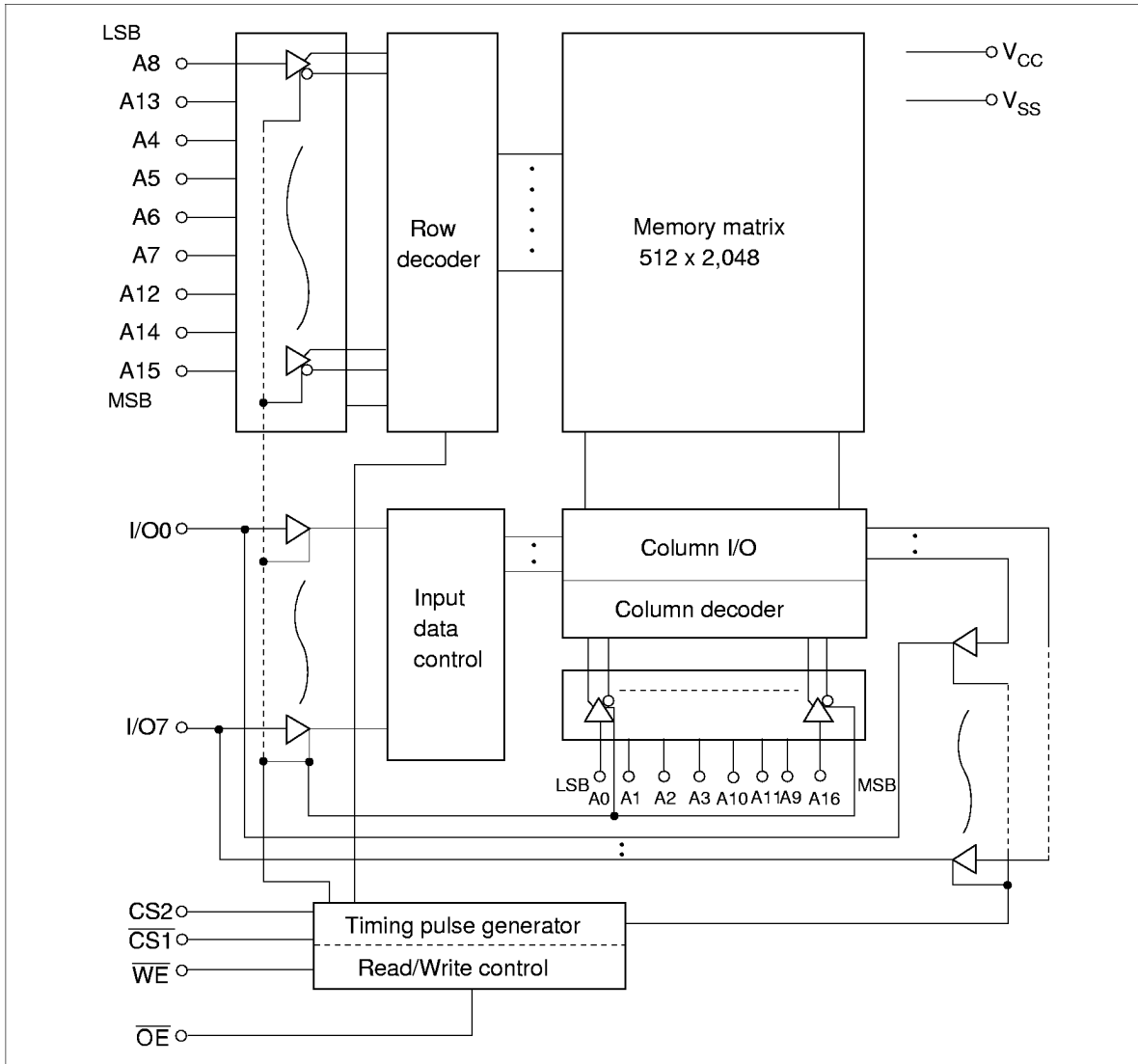


## Pin Description

Pin name	Function
A0 to A16	Address input
I/O0 to I/O7	Data input/output
CS1	Chip select 1
CS2	Chip select 2
WE	Write enable
OE	Output enable
NC	No connection
V <sub>CC</sub>	Power supply
V <sub>SS</sub>	Ground

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## Block Diagram



**Function Table**

$\overline{WE}$	$\overline{CS1}$	$\overline{CS2}$	$\overline{OE}$	Mode	$V_{CC}$ current	I/O pin	Ref. cycle
×	H	×	×	Standby	$I_{SB}, I_{SB1}$	High-Z	—
×	×	L	×	Standby	$I_{SB}, I_{SB1}$	High-Z	—
H	L	H	H	Output disable	$I_{CC}$	High-Z	—
H	L	H	L	Read	$I_{CC}$	Dout	Read cycle
L	L	H	H	Write	$I_{CC}$	Din	Write cycle (1)
L	L	H	L	Write	$I_{CC}$	Din	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 $V_{CC} + 0.3$ * <sup>2</sup>	V
Power dissipation	$P_T$	1.0	W
Operating temperature range	$T_{opr}$	0 to +70	°C
Storage temperature range	$T_{stg}$	-55 to +125	°C
Storage temperature under bias	$T_{bias}$	-10 to 85	°C

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

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

Parameter	Symbol	Min	Typ	Max	Unit
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* <sup>1</sup>	—	0.8	V

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

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DC Characteristics (Ta = 0 to +70°C, V<sub>CC</sub> = 5 V ± 10%, V<sub>SS</sub> = 0 V)

Parameter	Symbol	Min	Typ* <sup>1</sup>	Max	Unit	Test conditions
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	$\overline{CS1} = V_{IH}$ or $CS2 = V_{IL}$ or $\overline{OE} = V_{IH}$ or $\overline{WE} = V_{IL}$ , V <sub>I/O</sub> = V <sub>SS</sub> to V <sub>CC</sub>
Operating current	I <sub>CC</sub>	—	15	25	mA	$\overline{CS1} = V_{IL}$ , CS2 = V <sub>IH</sub> , Others = V <sub>IH</sub> /V <sub>IL</sub> , I <sub>I/O</sub> = 0 mA
Average operating current	I <sub>CC1</sub>	—	35	70	mA	Min cycle, duty = 100%, $\overline{CS1} = V_{IL}$ , CS2 = V <sub>IH</sub> , Others = V <sub>IH</sub> /V <sub>IL</sub> , I <sub>I/O</sub> = 0 mA
	I <sub>CC2</sub>	—	10	20	mA	Cycle time = 1 μs, duty = 100%, I <sub>I/O</sub> = 0 mA, $\overline{CS1} \leq 0.2$ V, CS2 ≥ V <sub>CC</sub> - 0.2 V, Others = V <sub>IH</sub> /V <sub>IL</sub> , V <sub>IH</sub> ≥ V <sub>CC</sub> - 0.2 V, V <sub>IL</sub> ≤ 0.2 V
Standby current	I <sub>SB</sub>	—	1	2	mA	CS2 = V <sub>IL</sub> or $\overline{CS1} = V_{IH}$ , CS2 = V <sub>IH</sub>
	I <sub>SB1</sub>	—	2* <sup>2</sup>	100* <sup>2</sup>	μA	0 V ≤ V <sub>in</sub> ≤ V <sub>CC</sub> (1) 0 V ≤ CS2 ≤ 0.2 V or (2) $\overline{CS1} \geq V_{CC} - 0.2$ V, CS2 ≥ V <sub>CC</sub> - 0.2 V
	I <sub>SB1</sub>	—	2* <sup>3</sup>	50* <sup>3</sup>	μA	
Output high voltage	V <sub>OL</sub>	—	—	0.4	V	I <sub>OL</sub> = 2.1 mA
Output low voltage	V <sub>OH</sub>	2.4	—	—	V	I <sub>OH</sub> = -1.0 mA

Notes: 1. Typical values are at V<sub>CC</sub> = 5.0 V, Ta = +25°C and not guaranteed.

2. This characteristic is guaranteed only for L version.

3. This characteristic is guaranteed only for L-SL 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>	—	—	8	pF	V <sub>in</sub> = 0 V
Input/output capacitance* <sup>1</sup>	C <sub>I/O</sub>	—	—	10	pF	V <sub>I/O</sub> = 0 V

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

## HM628128B Series

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

#### Test Conditions

- Input pulse levels: 0.8 V to 2.4 V
- Input rise and fall time: 5 ns
- Input and output timing reference levels: 1.5 V
- Output load: 1 TTL Gate and C<sub>L</sub> (100 pF) (Including scope and jig)

#### Read Cycle

Parameter	Symbol	HM628128B						Unit	Notes
		-7		-75		-8			
		Min	Max	Min	Max	Min	Max		
Read cycle time	t <sub>RC</sub>	70	—	75	—	85	—	ns	
Address access time	t <sub>AA</sub>	—	70	—	75	—	85	ns	
Chip selection to output valid	t <sub>CO1</sub>	—	70	—	75	—	85	ns	
	t <sub>CO2</sub>	—	70	—	75	—	85	ns	
Output enable to output valid	t <sub>OE</sub>	—	35	—	35	—	45	ns	
Chip selection to output in low-Z	t <sub>LZ1</sub>	10	—	10	—	10	—	ns	2, 3
	t <sub>LZ2</sub>	10	—	10	—	10	—	ns	
Output enable to output in low-Z	t <sub>OLZ</sub>	5	—	5	—	5	—	ns	2, 3
Chip deselection to output in high-Z	t <sub>HZ1</sub>	0	25	0	25	0	30	ns	1, 2, 3
	t <sub>HZ2</sub>	0	25	0	25	0	30	ns	
Output disable to output in high-Z	t <sub>OHZ</sub>	0	25	0	25	0	30	ns	1, 2, 3
Output hold from address change	t <sub>OH</sub>	10	—	10	—	10	—	ns	

## HM628128B Series

### Write Cycle

Parameter	Symbol	HM628128B						Unit	Notes
		-7		-75		-8			
		Min	Max	Min	Max	Min	Max		
Write cycle time	$t_{WC}$	70	—	75	—	85	—	ns	
Chip selection to end of write	$t_{CW}$	60	—	60	—	75	—	ns	5
Address setup time	$t_{AS}$	0	—	0	—	0	—	ns	6
Address valid to end of write	$t_{AW}$	60	—	60	—	75	—	ns	
Write pulse width	$t_{WP}$	50	—	50	—	55	—	ns	4, 13
Write recovery time	$t_{WR}$	0	—	0	—	0	—	ns	7
Write to output in high-Z	$t_{WHZ}$	0	25	0	25	0	30	ns	1, 2, 8
Data to write time overlap	$t_{DW}$	30	—	30	—	35	—	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	25	0	25	0	30	ns	1, 2, 8

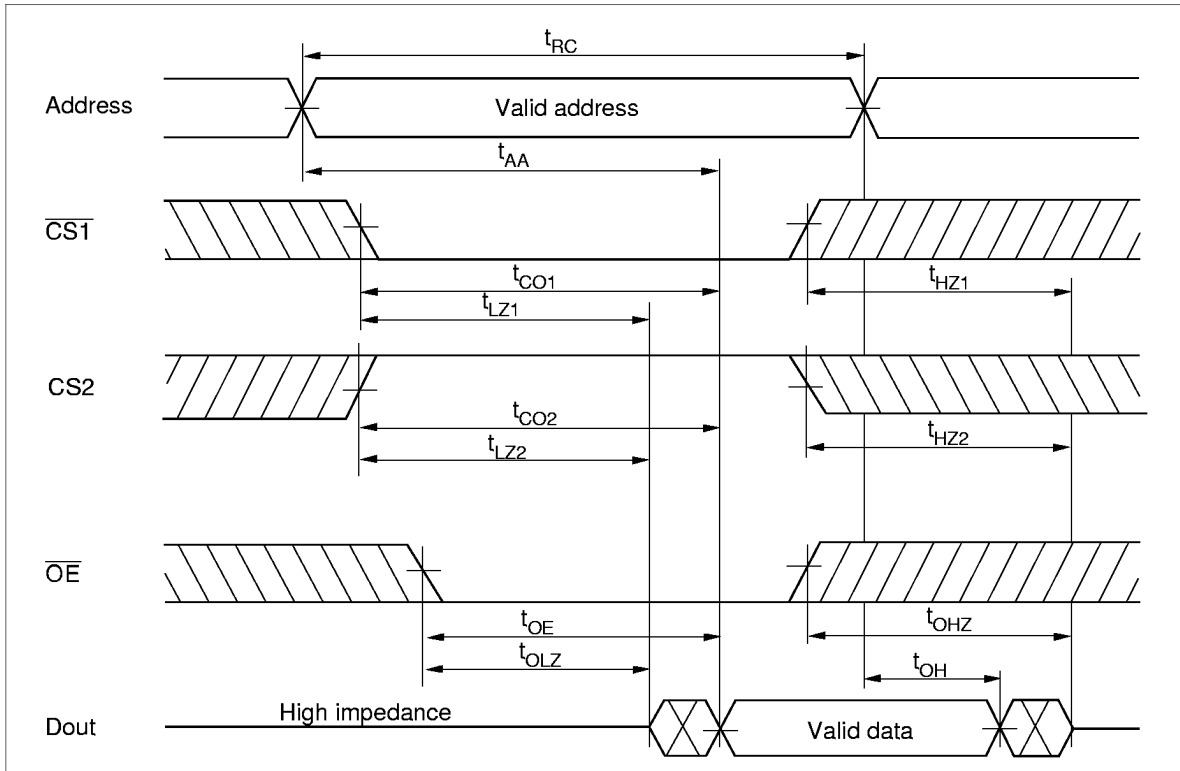
Notes: 1.  $t_{HZ}$ ,  $t_{OHZ}$  and  $t_{WHZ}$  are defined as the time at which the outputs achieve the open circuit conditions and are not referred to output voltage levels.

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 from device to device.
4. A write occurs during the overlap of a low  $\overline{CS1}$ , a high CS2, and a low  $\overline{WE}$ . A write begins at the latest transition among  $\overline{CS1}$  going low, CS2 going high, and  $\overline{WE}$  going low. A write ends at the earliest transition among  $\overline{CS1}$  going high, CS2 going low, and  $\overline{WE}$  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  $\overline{CS1}$  going low or CS2 going high to the end of write.
6.  $t_{AS}$  is measured from the address valid to the beginning of write.
7.  $t_{WR}$  is measured from the earliest of  $\overline{CS1}$  or  $\overline{WE}$  going high or CS2 going low to the end of write cycle.
8. During this period, I/O pins are in the output state; therefore, the input signals of the opposite phase to the outputs must not be applied.
9. If  $\overline{CS1}$  goes low simultaneously with  $\overline{WE}$  going low or after  $\overline{WE}$  going low, the outputs remain in a high impedance state.
10. Dout is the same phase of the latest written data in this write cycle.
11. Dout is the read data of next address.
12. If  $\overline{CS1}$  is low and CS2 high during this period, I/O pins are in the output state. Therefore, the input signals of the opposite phase to the outputs must not be applied to them.
13. In the write cycle with  $\overline{OE}$  low fixed,  $t_{WP}$  must satisfy the following equation to avoid a problem of data bus contention.
 
$$t_{WP} \geq t_{DW} \text{ min} + t_{WHZ} \text{ max}$$



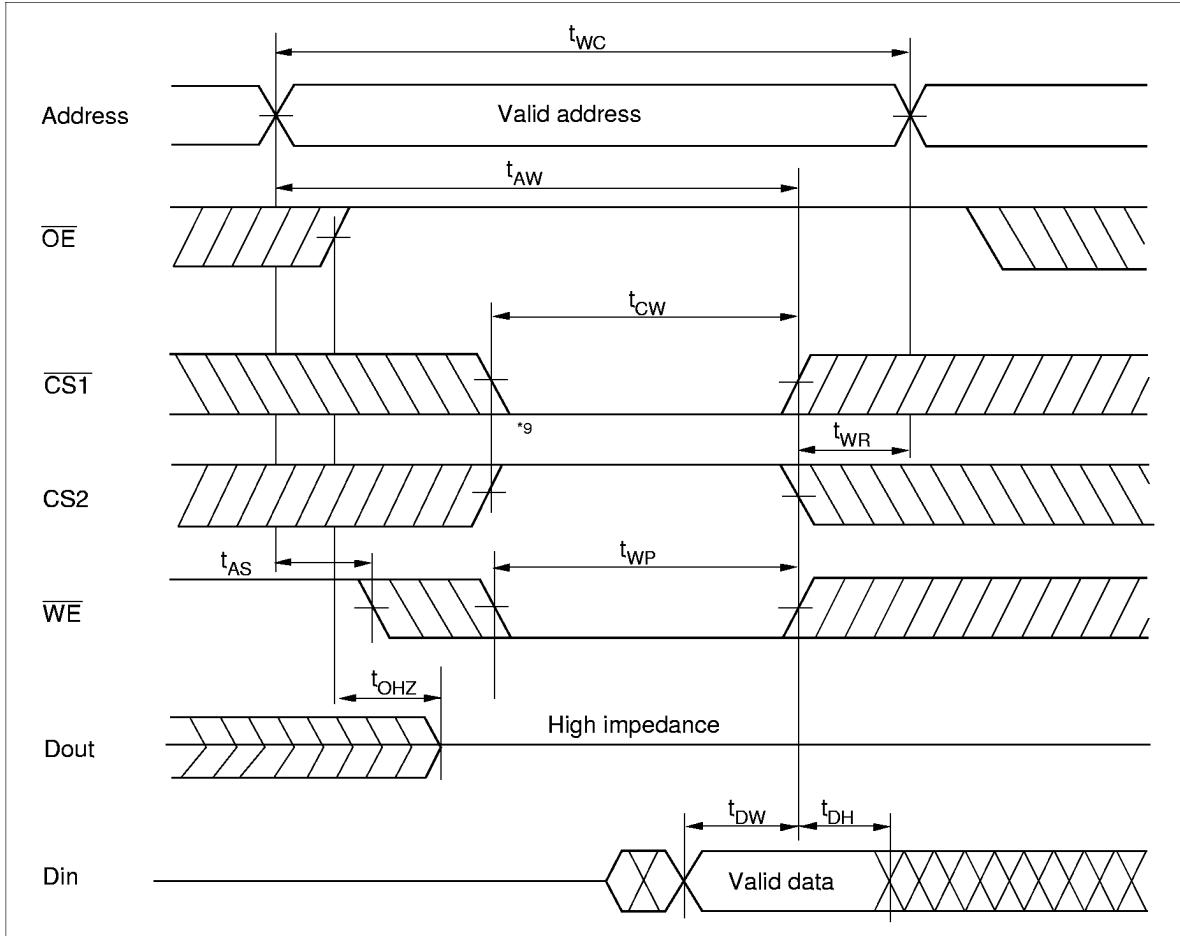
Timing Waveform

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

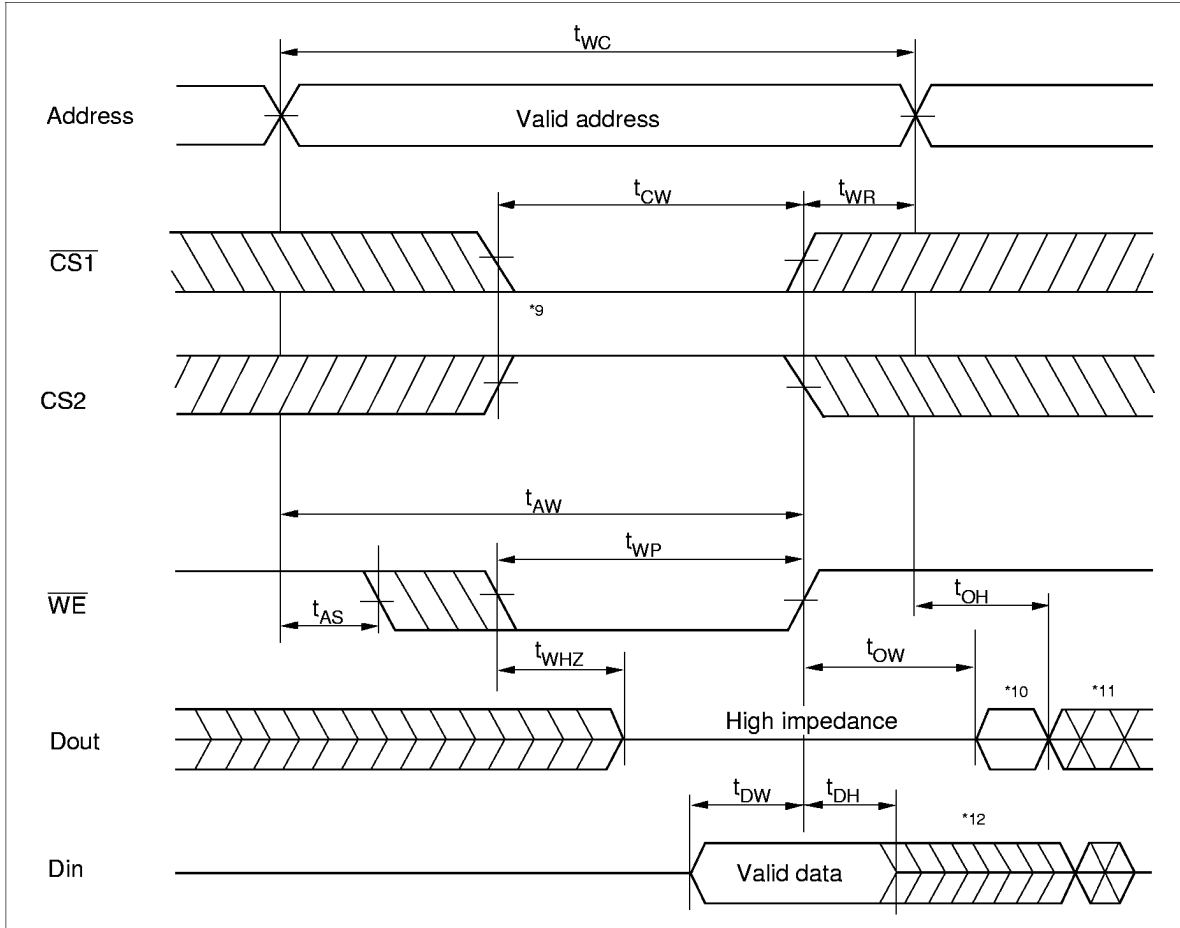


## HM628128B Series

### Write Timing Waveform (1) ( $\overline{\text{OE}}$ Clock)



Write Timing Waveform (2) ( $\overline{OE}$  Low Fixed)



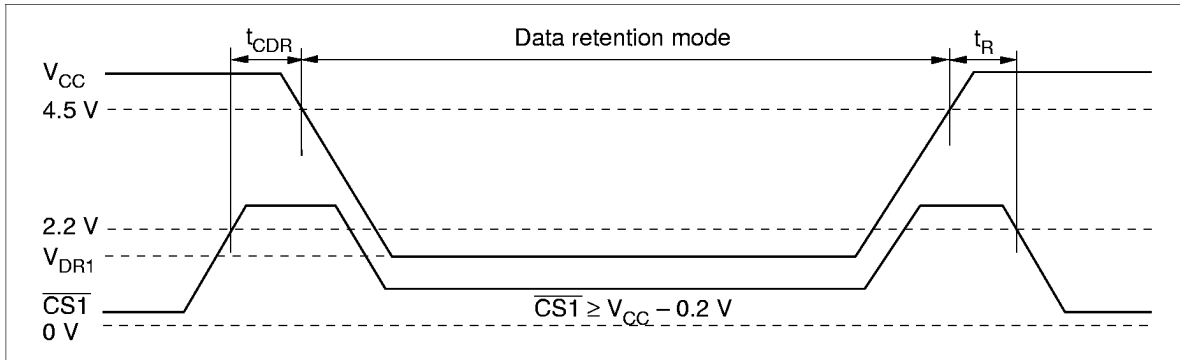
## HM628128B Series

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

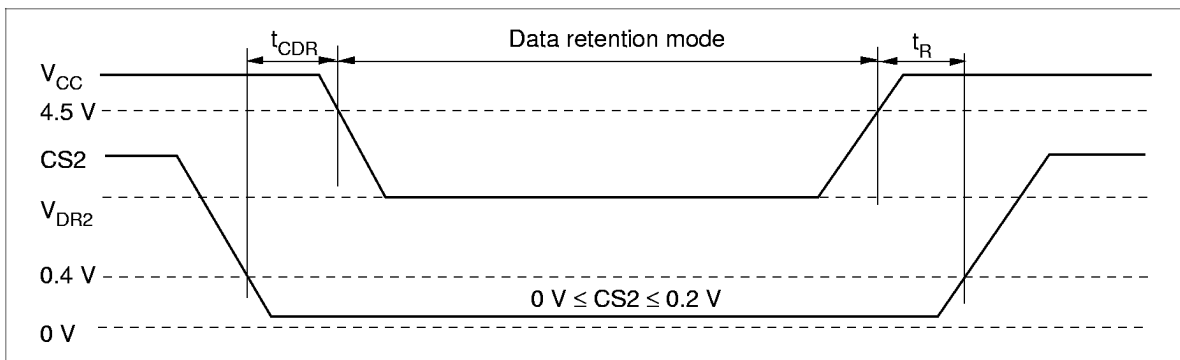
Parameter	Symbol	Min	Typ <sup>*4</sup>	Max	Unit	Test conditions <sup>3</sup>
$V_{CC}$ for data retention	$V_{DR}$	2.0	—	—	V	$0\text{V} \leq V_{in} \leq V_{CC}$ (1) $0\text{V} \leq CS2 \leq 0.2\text{V}$ or (2) $CS2 \geq V_{CC} - 0.2\text{V}$ $\overline{CS1} \geq V_{CC} - 0.2\text{V}$
Data retention current	$I_{CCDR}$	—	1	$50^{*1}$	$\mu\text{A}$	$V_{CC} = 3.0\text{V}$ , $0\text{V} \leq V_{in} \leq V_{CC}$ (1) $0\text{V} \leq CS2 \leq 0.2\text{V}$ or (2) $CS2 \geq V_{CC} - 0.2\text{V}$ , $\overline{CS1} \geq V_{CC} - 0.2\text{V}$
	$I_{CCDR}$	—	1	$15^{*2}$	$\mu\text{A}$	
Chip deselect to data retention time	$t_{CDR}$	0	—	—	ns	See retention waveform
Operation recovery time	$t_R$	5	—	—	ms	

- Notes:
1. This characteristic is guaranteed only for L version,  $20\ \mu\text{A}$  max. at  $T_a = 0$  to  $40^\circ\text{C}$ .
  2. This characteristic is guaranteed only for L-SL version,  $3\ \mu\text{A}$  max. at  $T_a = 0$  to  $40^\circ\text{C}$ .
  3. CS2 controls address buffer,  $\overline{WE}$  buffer,  $\overline{CS1}$  buffer,  $\overline{OE}$  buffer, and Din buffer. If CS2 controls data retention mode,  $V_{in}$  levels (address,  $\overline{WE}$ ,  $\overline{OE}$ ,  $\overline{CS1}$ , I/O) can be in the high impedance state. If  $\overline{CS1}$  controls data retention mode, CS2 must be  $CS2 \geq V_{CC} - 0.2\text{V}$  or  $0\text{V} \leq CS2 \leq 0.2\text{V}$ . The other input levels (address,  $\overline{WE}$ ,  $\overline{OE}$ , I/O) can be in the high impedance state.
  4. 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 (1) ( $\overline{CS1}$  Controlled)**



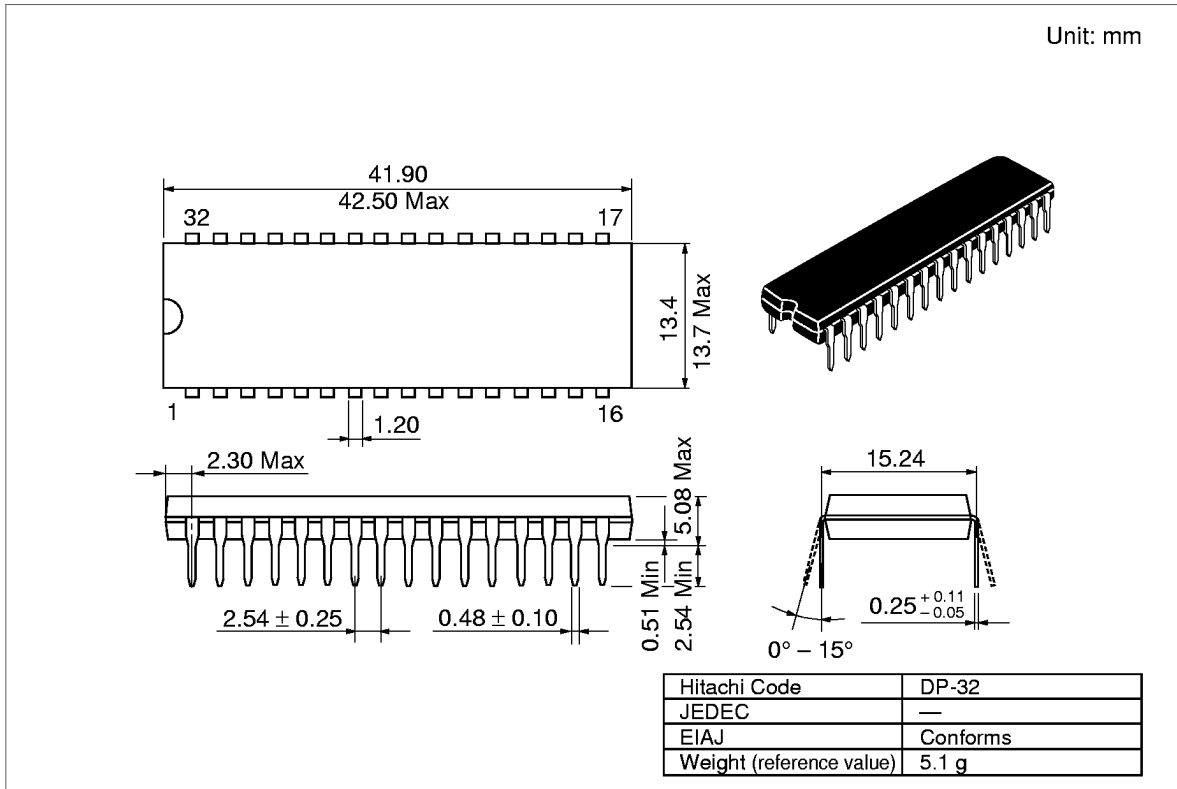
**Low  $V_{CC}$  Data Retention Timing Waveform (2) ( $CS2$  Controlled)**



# HM628128B Series

## Package Dimensions

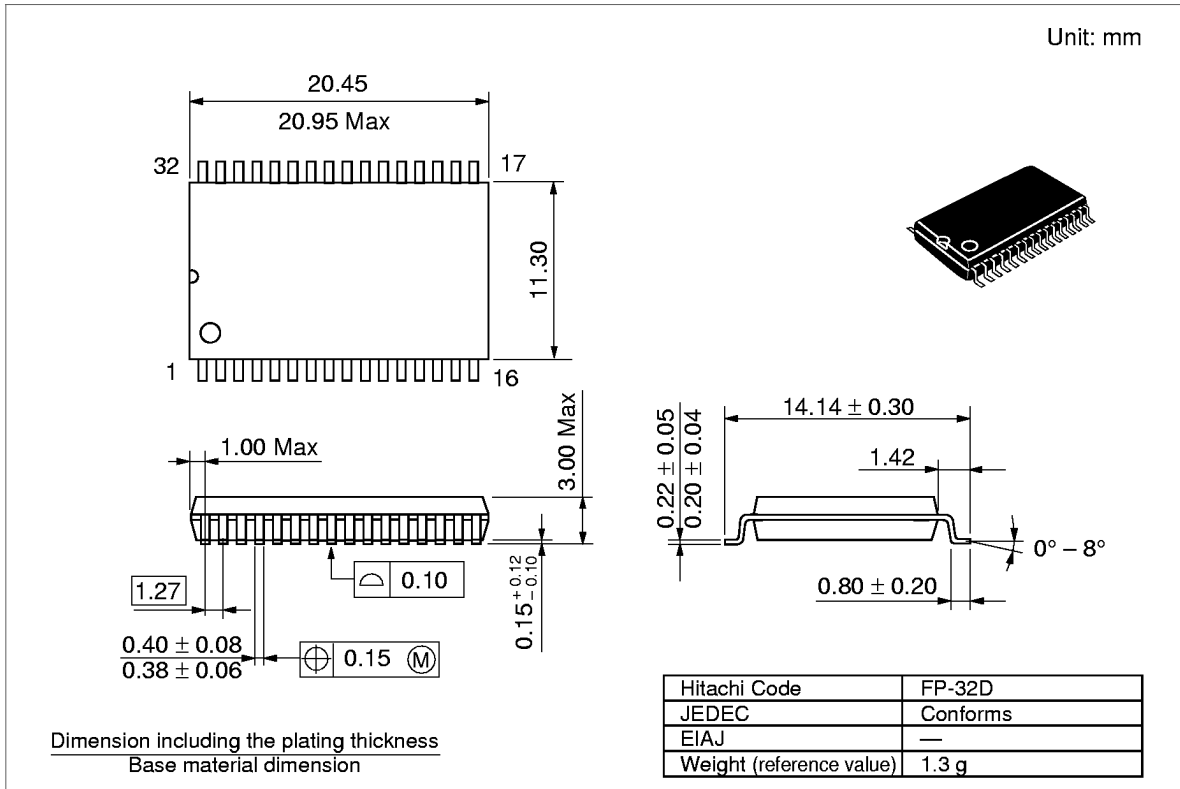
### HM628128BLP Series (DP-32)



# HM628128B Series

## Package Dimensions (cont.)

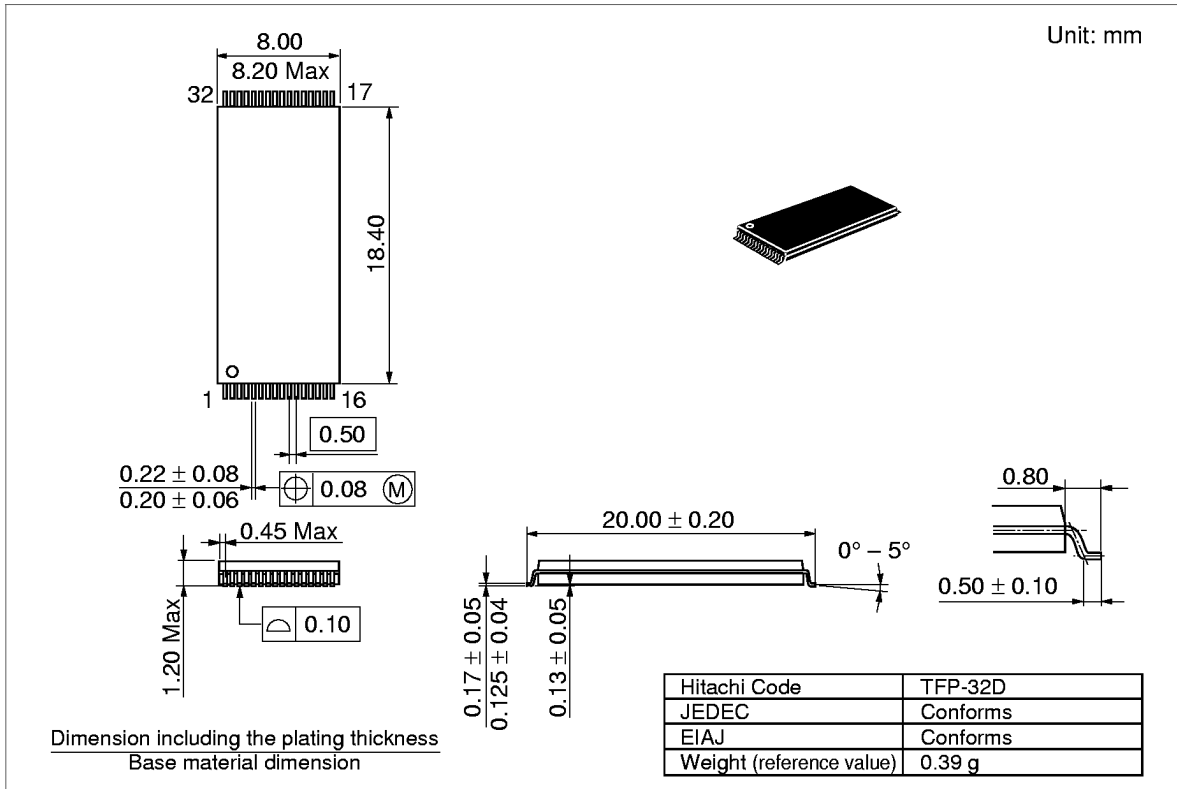
### HM628128BLFP Series (FP-32D)



# HM628128B Series

## Package Dimensions (cont.)

### HM628128BLT Series (TFP-32D)

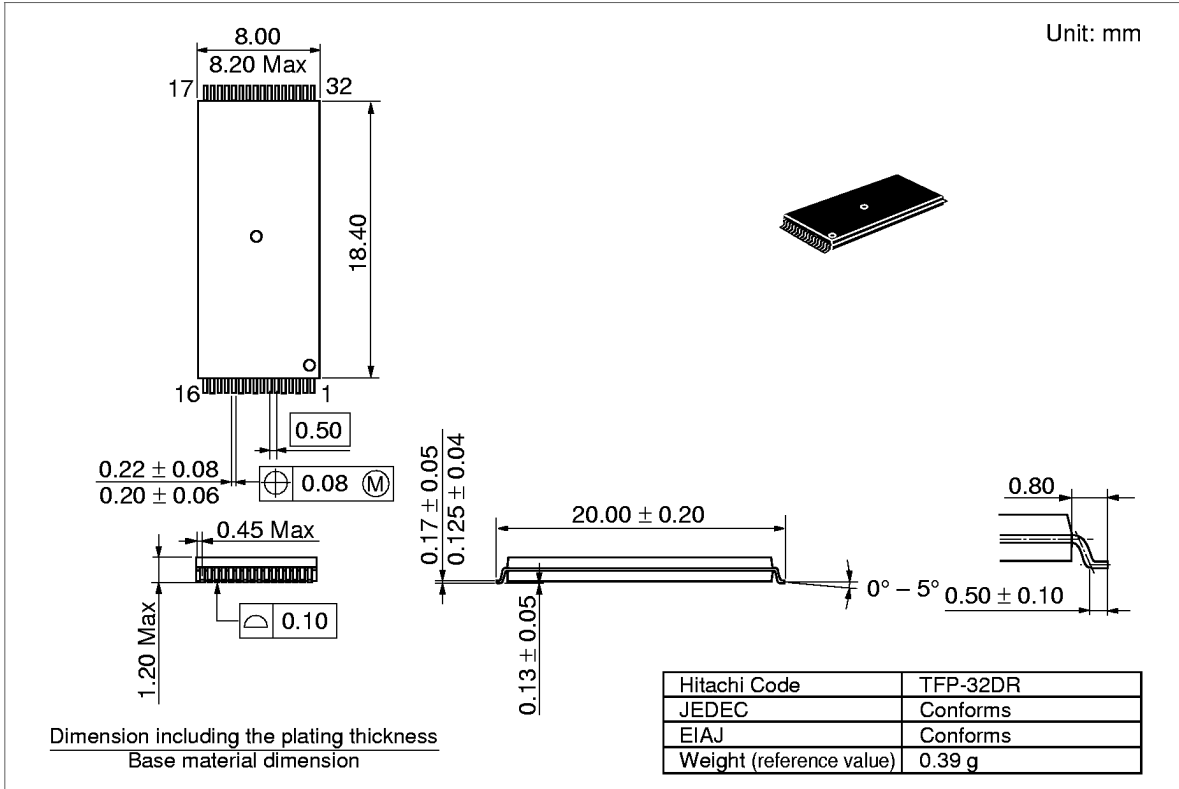




# HM628128B Series

## Package Dimensions (cont.)

### HM628128BLR Series (TFP-32DR)



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## HM628128B Series

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## HM628128B Series

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### Revision Record

Rev.	Date	Contents of Modification	Drawn by	Approved by
0.0	Oct. 5, 1994	Initial issue	M. Higuchi	K. Yoshizaki
1.0	Dec. 20, 1994	DC Characteristics $I_{CC}$ max: 15 mA to 25 mA $I_{CC2}$ typ: 5 mA to 10 mA $I_{CC2}$ max: 10 mA to 20 mA	M. Higuchi	K. Yoshizaki
2.0	Mar. 20, 1995	Low Vcc Data Retention Characteristics Addition of note 3: typical values at $V_{CC} = 3.0$ V, $T_a = +25^\circ\text{C}$ and not guaranteed	M. Higuchi	K. Yoshizaki
3.0	Aug. 10, 1996	Change of format Addition of HM628128B-10/10SL Series AC Characteristics Change order of note.	M. Higuchi	K. Yoshizaki
4.0	Jul. 1, 1997	Addition of HM628128B-75 Series DC Characteristics $V_{OH}$ Test condition: $-0.1$ mA to $-1.0$ mA	M. Higuchi	K. Imato
5.0	Nov. 1997	Change of Subtitle		

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