# HM628512BI Series

4 M SRAM (512-kword × 8-bit)

HITACHI

ADE-203-935C (Z)
Rev. 2.0
Aug. 24, 1999

## Description

The Hitachi HM628512BI is a 4-Mbit static RAM organized 512-kword × 8-bit. HM628512BI Series has realized higher density, higher performance and low power consumption by employing Hi-CMOS process technology. The HM628512BI Series offers low power standby power dissipation; therefore, it is suitable for battery backup systems. It has packaged in 32-pin SOP, 32-pin TSOP II and 32-pin DIP.

## Features

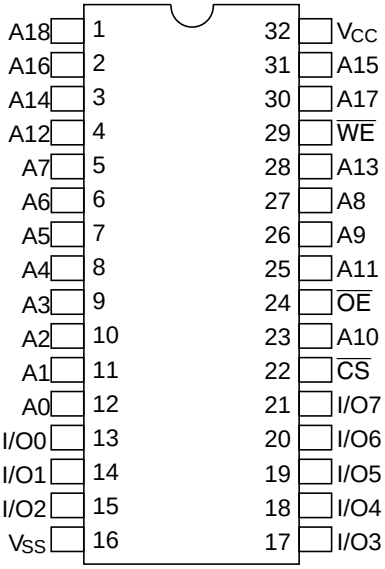
- Single 5 V supply
- Access time: 70/85 ns (max)
- Power dissipation
  - — Active: 50 mW/MHz (typ)
  - — Standby: 10 µW (typ)
- Completely static memory. No clock or timing strobe required
- Equal access and cycle times
- Common data input and output: Three state output
- Directly TTL compatible: All inputs and outputs
- Battery backup operation
- Operating temperature: –40 to +85°C

## Ordering Information

| Type No. | Access time | Package |
|---|---|---|
| HM628512BLPI-7<br>HM628512BLPI-8 | 70 ns<br>85 ns | 600-mil 32-pin plastic DIP (DP-32) |
| HM628512BLFPI-7<br>HM628512BLFPI-8 | 70 ns<br>85 ns | 525-mil 32-pin plastic SOP (FP-32D) |
| HM628512BLTTI-7<br>HM628512BLTTI-8 | 70 ns<br>85 ns | 400-mil 32-pin plastic TSOP II (TTP-32D) |
| HM628512BLRRI-7<br>HM628512BLRRI-8 | 70 ns<br>85 ns | 400-mil 32-pin plastic TSOP II reverse (TTP-32DR) |

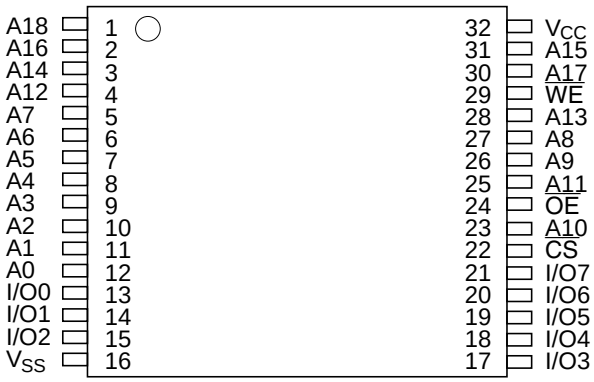
## Pin Arrangement

HM628512BLPI Series
HM628512BLFPI Series



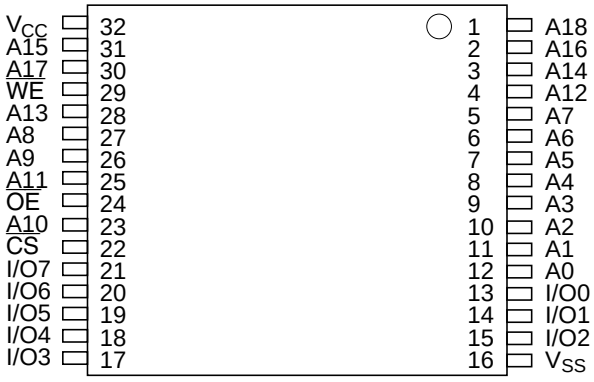

(Top view)

HM628512BLTTI Series




(Top view)

HM628512BLRRI Series

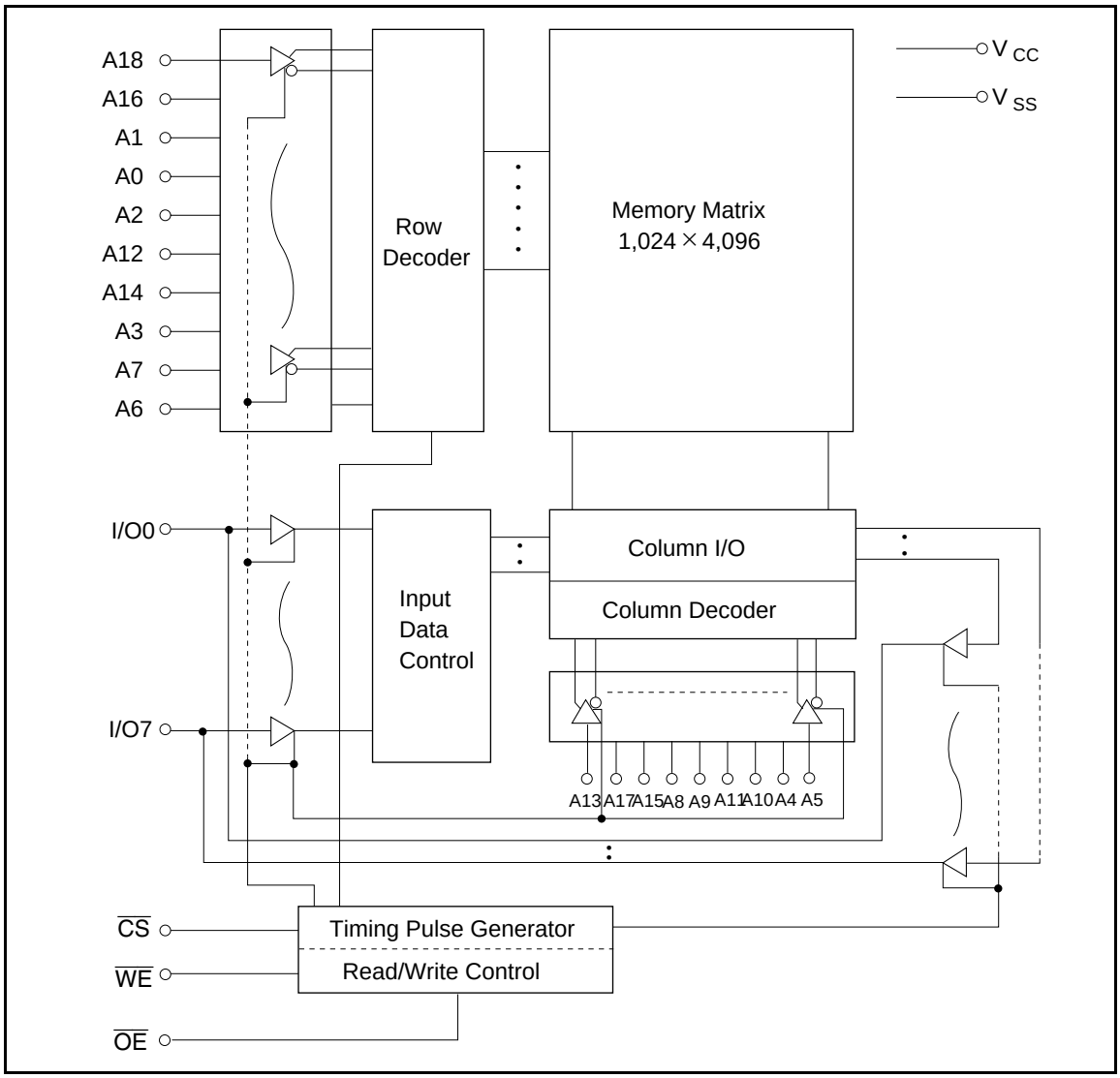



(Top view)

### Pin Description

| Pin name | Function |
|---|---|
| A0 to A18 | Address input |
| I/O0 to I/O7 | Data input/output |
| $\overline{CS}$ | Chip select |
| $\overline{OE}$ | Output enable |
| $\overline{WE}$ | Write enable |
| $V_{CC}$ | Power supply |
| $V_{SS}$ | Ground |

## Block Diagram




## Function Table

| $\overline{WE}$ | $\overline{CS}$ | $\overline{OE}$ | Mode | $V_{CC}$ current | Dout pin | Ref. cycle |
|---|---|---|---|---|---|---|
| × | H | × | Not selected | $I_{SB}$, $I_{SB1}$ | High-Z | — |
| H | L | H | Output disable | $I_{CC}$ | High-Z | — |
| H | L | L | Read | $I_{CC}$ | Dout | Read cycle |
| L | L | H | Write | $I_{CC}$ | Din | Write cycle (1) |
| L | L | L | Write | $I_{CC}$ | Din | Write cycle (2) |

Note: ×: H or L

## Absolute Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| **Power supply voltage** | **$V_{CC}$** | **–0.5 to +7.0** | **V** |
| Voltage on any pin relative to $V_{SS}$ | $V_T$ | –0.5*[1] to $V_{CC}$ + 0.3*[2] | V |
| Power dissipation | $P_T$ | 1.0 | W |
| Operating temperature | Topr | –40 to +85 | °C |
| Storage temperature | Tstg | –55 to +125 | °C |
| Storage temperature under bias | Tbias | –40 to +85 | °C |

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

### Recommended DC Operating Conditions (Ta = –40 to +85°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 | $V_{IH}$ | 2.4 | — | $V_{CC}$ + 0.3 | V |
| Input low voltage | $V_{IL}$ | –0.3*[1] | — | 0.6 | V |

Note: 1.–3.0 V for pulse half-width ≤ 30 ns

### DC Characteristics (Ta = –40 to +85°C, $V_{CC}$ = 5 V ±10% , $V_{SS}$ = 0 V)

| Parameter | Symbol | Min | Typ*[1] | Max | Unit | Test conditions |
|---|---|---|---|---|---|---|
| Input leakage current | $\|I_{LI}\|$ | — | — | 1 | µA | Vin = $V_{SS}$ to $V_{CC}$ |
| Output leakage current | $\|I_{LO}\|$ | — | — | 1 | µA | $\overline{CS}$ = $V_{IH}$ or $\overline{OE}$ = $V_{IH}$ or $\overline{WE}$ = $V_{IL}$, $V_{I/O}$ = $V_{SS}$ to $V_{CC}$ |
| Operating power supply current: DC | $I_{CC}$ | — | 8 | 15 | mA | $\overline{CS}$ = $V_{IL}$, others = $V_{IH}$/$V_{IL}$, $I_{I/O}$ = 0 mA |
| Operating power supply current | $I_{CC1}$ | — | 45 | 70 | mA | Min cycle, duty = 100% $\overline{CS}$ = $V_{IL}$, others = $V_{IH}$/$V_{IL}$ $I_{I/O}$ = 0 mA |
| Operating power supply current | $I_{CC2}$ | — | 10 | 20 | mA | Cycle time = 1 µs, duty = 100% $I_{I/O}$ = 0 mA, $\overline{CS}$ ≤ 0.2 V $V_{IH}$ ≥ $V_{CC}$ – 0.2 V, $V_{IL}$ ≤ 0.2 V |
| Standby power supply current: DC | $I_{SB}$ | — | 1 | 3 | mA | $\overline{CS}$ = $V_{IH}$ |
| Standby power supply current (1): DC | $I_{SB1}$ | — | 2 | 100 | µA | Vin ≥ 0 V, $\overline{CS}$ ≥ $V_{CC}$ – 0.2 V |
| Output low voltage | $V_{OL}$ | — | — | 0.4 | V | $I_{OL}$ = 2.1 mA |
| Output high voltage | $V_{OH}$ | 2.4 | — | — | V | $I_{OH}$ = –1.0 mA |

Note: 1.Typical values are at $V_{CC}$ = 5.0 V, Ta = +25°C and specified loading, and not guaranteed.

## Capacitance (Ta = +25°C, f = 1 MHz)

| Parameter | Symbol | Typ | Max | Unit | Test conditions |
|---|---|---|---|---|---|
| Input capacitance*[1] | Cin | — | 8 | pF | Vin = 0 V |
| Input/output capacitance*[1] | $C_{I/O}$ | — | 10 | pF | $V_{I/O}$ = 0 V |

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

## AC Characteristics (Ta = –40 to +85°C, $V_{CC}$ = 5 V ± 10%, unless otherwise noted.)

### Test Conditions

- Input pulse levels: 0.5 V to 2.5 V
- Input rise and fall time: 5 ns
- Input and output timing reference levels: 1.5 V
- Output load:1 TTL Gate + $C_L$ (100 pF) (Including scope and jig)

### Read Cycle

| | | HM628512BI | | | | | |
|---|---|---|---|---|---|---|---|
| | | -7 | | -8 | | | |
| Parameter | Symbol | Min | Max | Min | Max | Unit | Notes |
| Read cycle time | $t_{RC}$ | 70 | — | 85 | — | ns | |
| Address access time | $t_{AA}$ | — | 70 | — | 85 | ns | |
| Chip select access time | $t_{CO}$ | — | 70 | — | 85 | ns | |
| Output enable to output valid | $t_{OE}$ | — | 35 | — | 45 | ns | |
| Chip selection to output in low-Z | $t_{LZ}$ | 10 | — | 10 | — | ns | 2 |
| Output enable to output in low-Z | $t_{OLZ}$ | 5 | — | 5 | — | ns | 2 |
| Chip deselection to output in high-Z | $t_{HZ}$ | 0 | 25 | 0 | 30 | ns | 1, 2 |
| Output disable to output in high-Z | $t_{OHZ}$ | 0 | 25 | 0 | 30 | ns | 1, 2 |
| Output hold from address change | $t_{OH}$ | 10 | — | 10 | — | ns | |

## Write Cycle

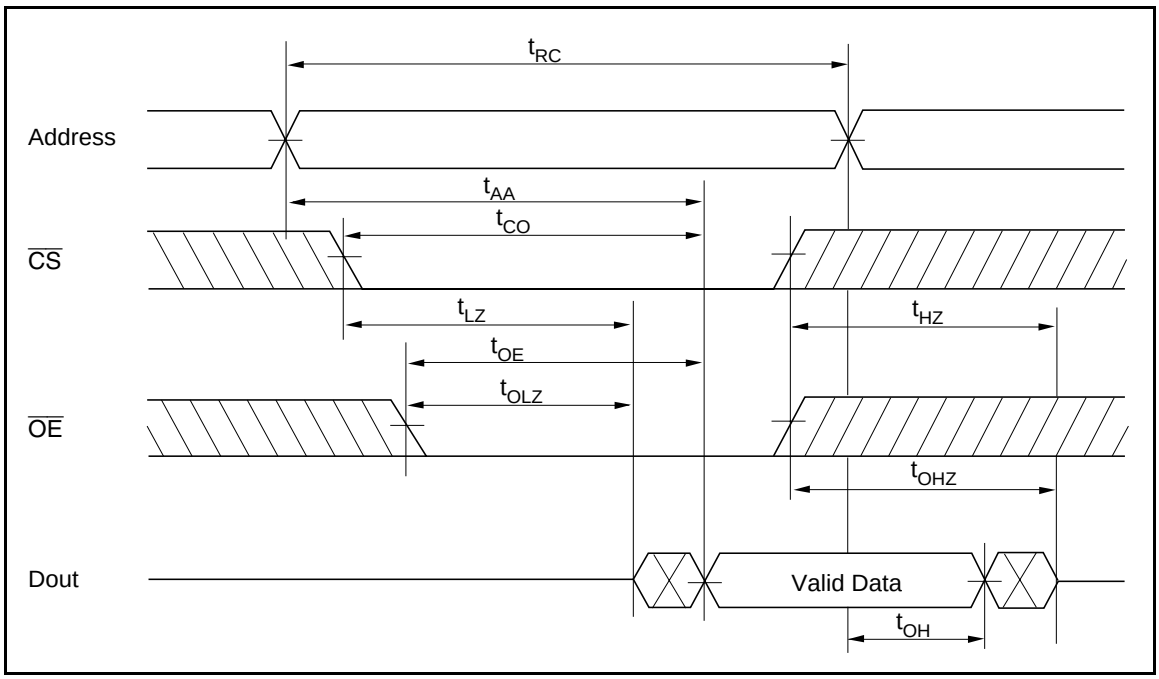
| | | HM628512BI | | | | | |
|---|---|---|---|---|---|---|---|
| | | -7 | | -8 | | | |
| **Parameter** | **Symbol** | **Min** | **Max** | **Min** | **Max** | **Unit** | **Notes** |
| Write cycle time | $t_{WC}$ | 70 | — | 85 | — | ns | |
| Chip selection to end of write | $t_{CW}$ | 60 | — | 75 | — | ns | 4 |
| Address setup time | $t_{AS}$ | 0 | — | 0 | — | ns | 5 |
| Address valid to end of write | $t_{AW}$ | 60 | — | 75 | — | ns | |
| Write pulse width | $t_{WP}$ | 50 | — | 55 | — | ns | 3, 12 |
| Write recovery time | $t_{WR}$ | 0 | — | 0 | — | ns | 6 |
| $\overline{WE}$ to output in high-Z | $t_{WHZ}$ | 0 | 25 | 0 | 30 | ns | 1, 2, 7 |
| Data to write time overlap | $t_{DW}$ | 30 | — | 35 | — | ns | |
| Data hold from write time | $t_{DH}$ | 0 | — | 0 | — | ns | |
| Output active from output in high-Z | $t_{OW}$ | 5 | — | 5 | — | ns | 2 |
| Output disable to output in high-Z | $t_{OHZ}$ | 0 | 25 | 0 | 30 | ns | 1, 2, 7 |

Notes:

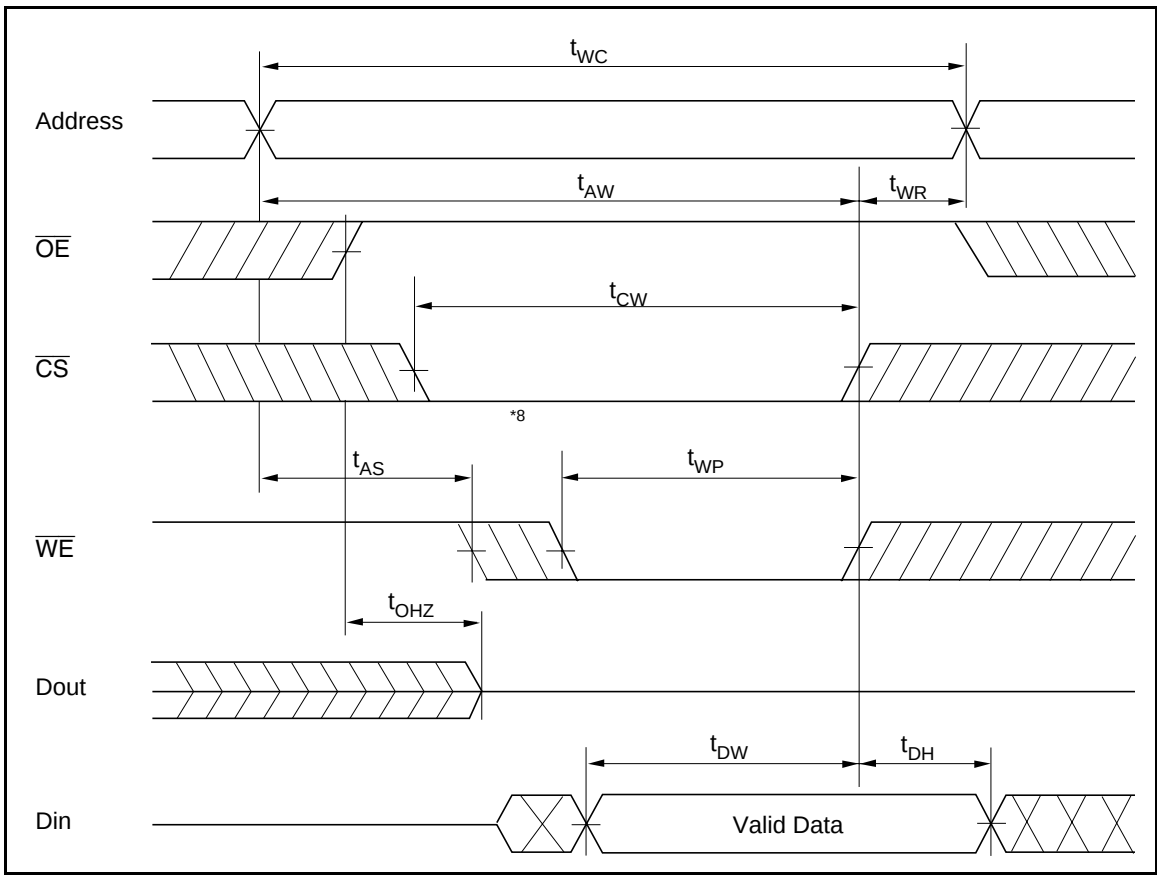
1. $t_{HZ}$, $t_{OHZ}$ and $t_{WHZ}$ are defined as the time at which the outputs achieve the open circuit\~conditions and are not referred to output voltage levels.
2. This parameter is sampled and not 100% tested.
3. A write occurs during the overlap ($t_{WP}$) of a low $\overline{CS}$ and a low $\overline{WE}$. A write begins at the later transition of $\overline{CS}$ going low or $\overline{WE}$ going low. A write ends at the earlier transition of $\overline{CS}$ going high or $\overline{WE}$ going high. $t_{WP}$ is measured from the beginning of write to the end of write.
4. $t_{CW}$ is measured from $\overline{CS}$ going low to the end of write.
5. $t_{AS}$ is measured from the address valid to the beginning of write.
6. $t_{WR}$ is measured from the earlier of $\overline{WE}$ or $\overline{CS}$ going high to the end of write cycle.
7. During this period, I/O pins are in the output state so that the input signals of the opposite phase to the outputs must not be applied.
8. If the $\overline{CS}$ low transition occurs simultaneously with the $\overline{WE}$ low transition or after the $\overline{WE}$ transition, the output remain in a high impedance state.
9. Dout is the same phase of the write data of this write cycle.
10. Dout is the read data of next address.
11. If $\overline{CS}$ is low 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.
12. In the write cycle with $\overline{OE}$ low fixed, $t_{WP}$ must satisfy the following equation to avoid a problem of data bus contention. $t_{WP} \geq t_{DW}$ min + $t_{WHZ}$ max

## Timing Waveforms

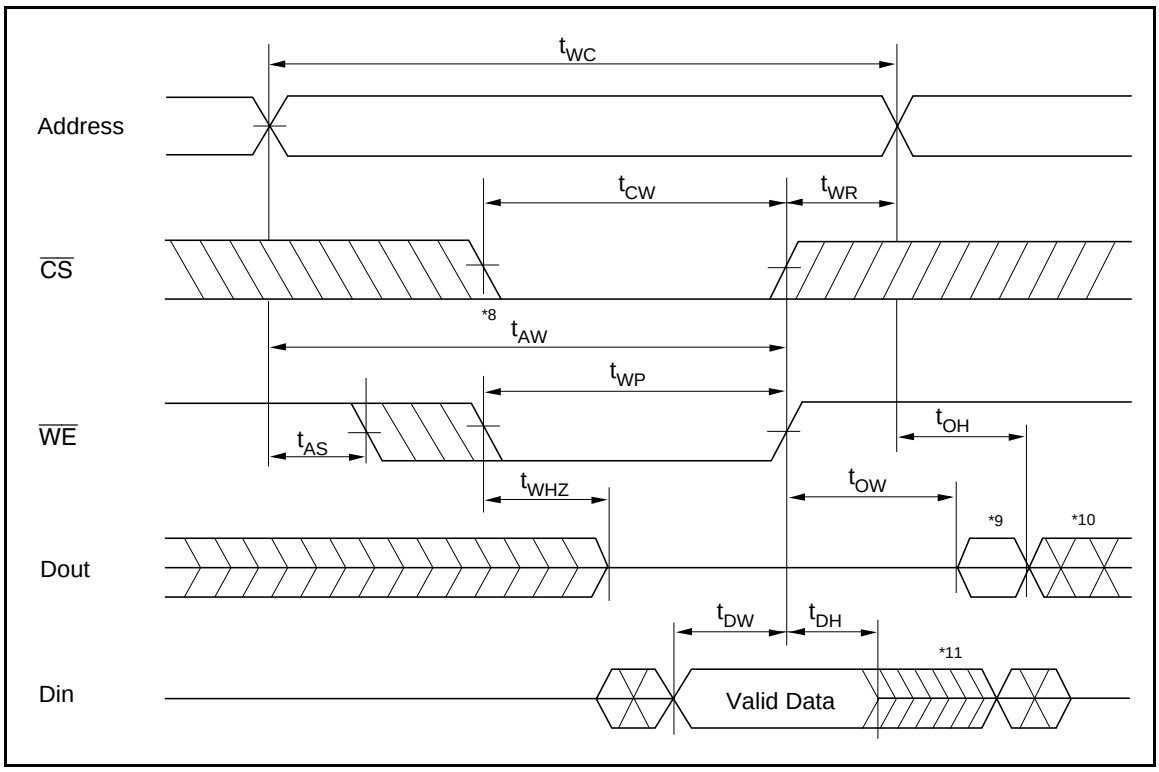
### Read Timing Waveform ($\overline{WE}$ = $V_{IH}$)



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



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




## Low $V_{CC}$ Data Retention Characteristics (Ta = –40 to +85°C)

| Parameter | Symbol | Min | Typ | Max | Unit | Test conditions*[2] |
|---|---|---|---|---|---|---|
| $V_{CC}$ for data retention | $V_{DR}$ | 2 | — | — | V | $\overline{CS} \geq V_{CC} - 0.2$ V, Vin ≥ 0 V |
| Data retention current | $I_{CCDR}$ | — | 1*[3] | 50*[1] | µA | $V_{CC}$ = 3.0 V, Vin ≥ 0 V<br>$\overline{CS} \geq V_{CC} - 0.2$ V |
| Chip deselect to data retention time | $t_{CDR}$ | 0 | — | — | ns | See retention waveform |
| Operation recovery time | $t_R$ | $t_{RC}$*[4] | — | — | ns | |

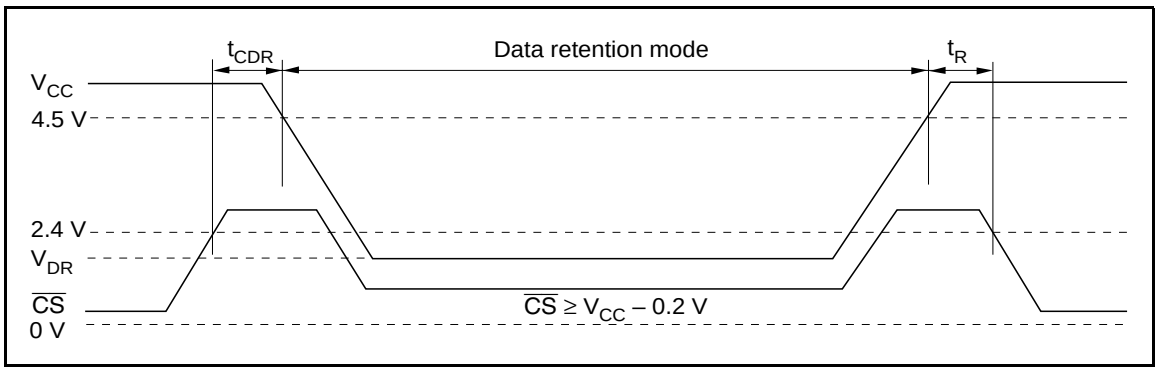
Notes: 1.For L-version and 20 µA (max.) at Ta = –40 to +40°C.

2.$\overline{CS}$ controls address buffer, $\overline{WE}$ buffer, $\overline{OE}$ buffer, and Din buffer. In data retention mode, Vin levels (address, $\overline{WE}$, $\overline{OE}$, I/O) can be in the high impedance state.

3.Typical values are at $V_{CC}$ = 3.0 V, Ta = +25°C and specified loading, and not guaranteed.

4.$t_{RC}$ = read cycle time.

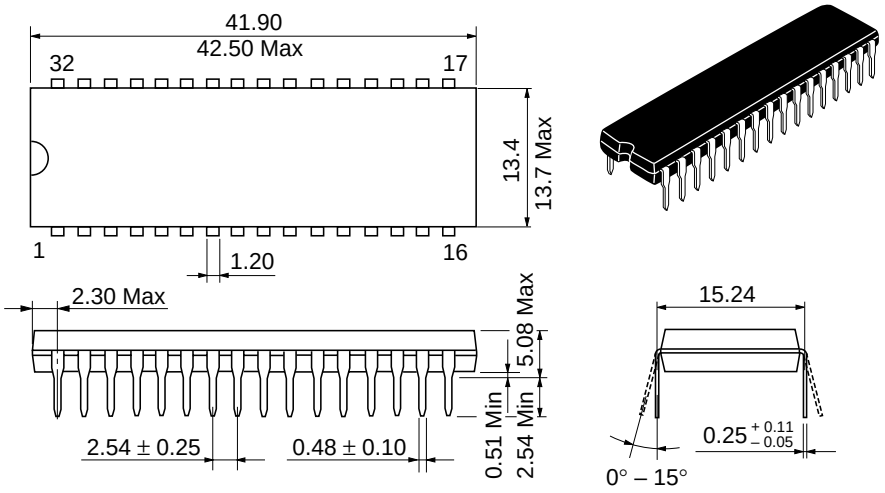
## Low $V_{CC}$ Data Retention Timing Waveform ($\overline{CS}$ Controlled)




## Package Dimensions

### HM628512BLPI Series (DP-32)

Unit: mm

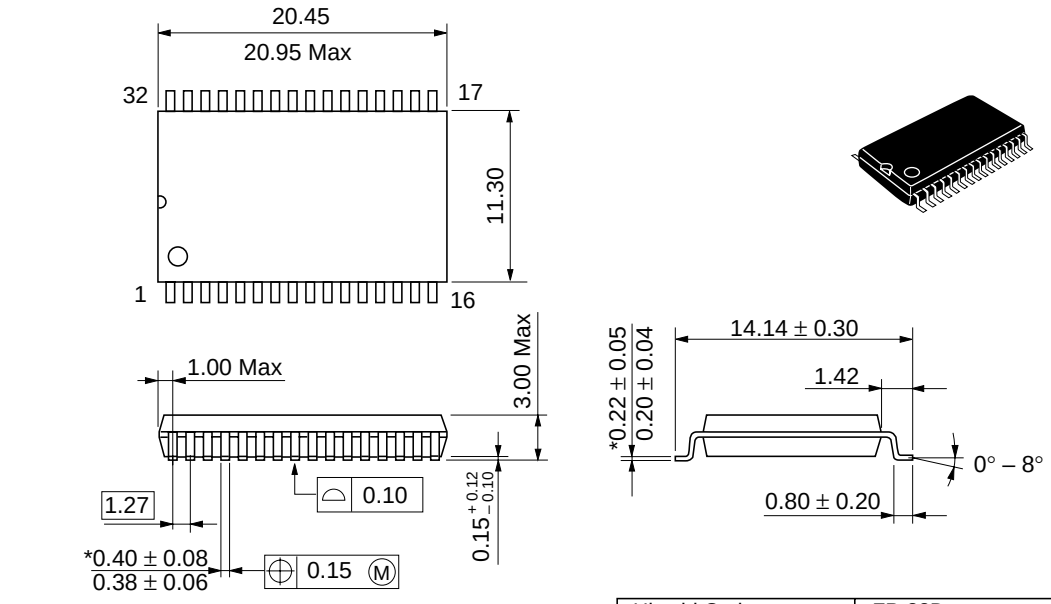



| | |
|---|---|
| Hitachi Code | DP-32 |
| JEDEC | — |
| EIAJ | Conforms |
| Weight (reference value) | 5.1 g |

## Package Dimensions (cont.)

### HM628512BLFPI Series (FP-32D)

Unit: mm



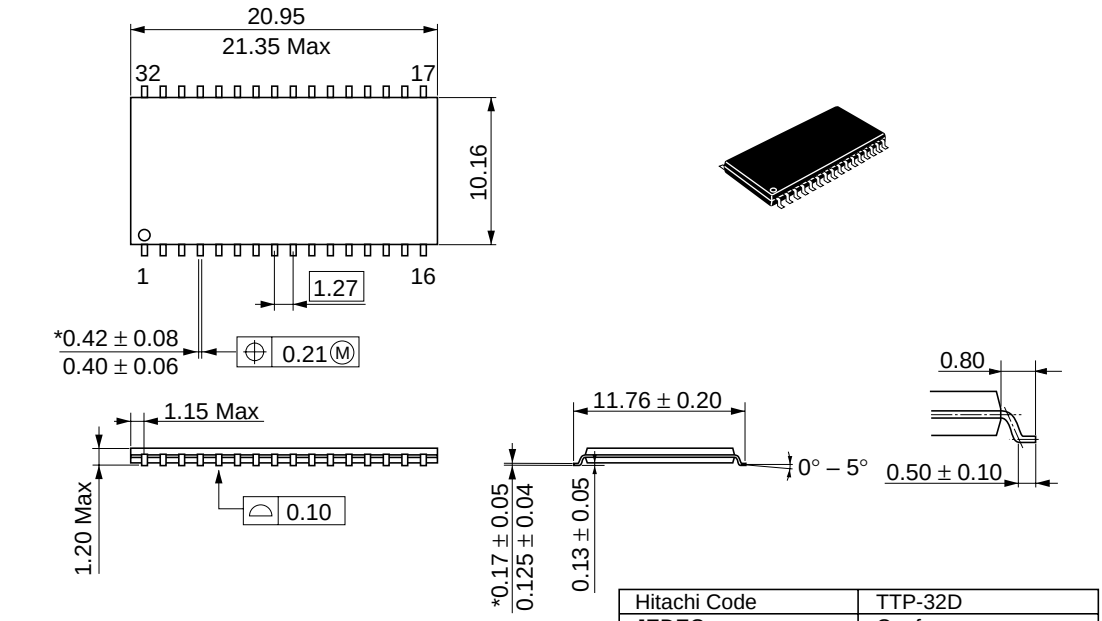

*Dimension including the plating thickness
Base material dimension

| | |
|---|---|
| Hitachi Code | FP-32D |
| JEDEC | Conforms |
| EIAJ | — |
| Weight (reference value) | 1.3 g |

## Package Dimensions (cont.)

### HM628512BLTTI Series (TTP-32D)

Unit: mm



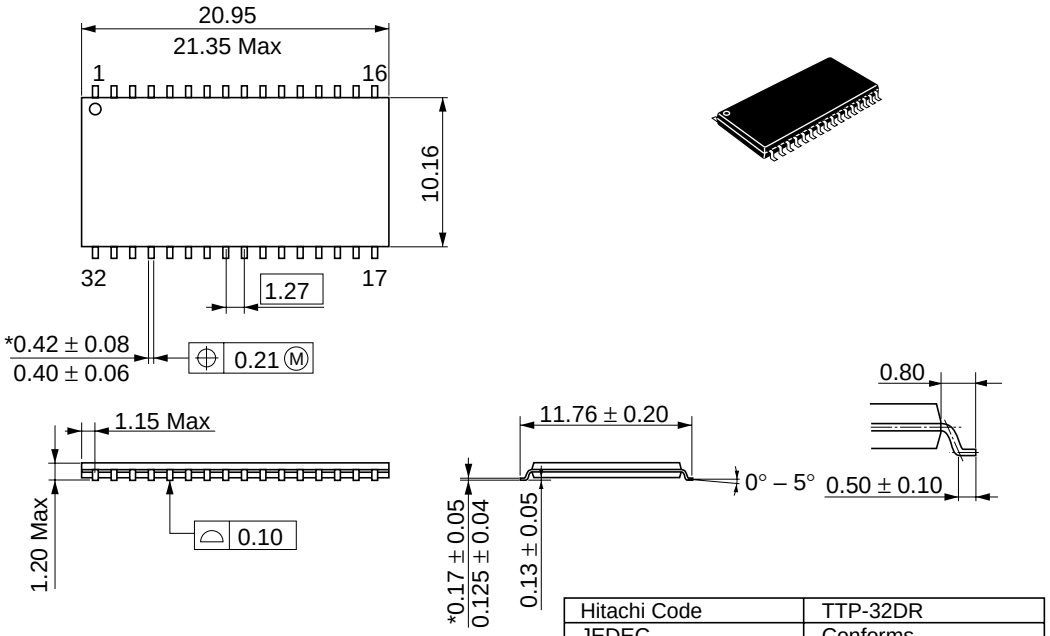

*Dimension including the plating thickness
Base material dimension

| | |
|---|---|
| Hitachi Code | TTP-32D |
| JEDEC | Conforms |
| EIAJ | — |
| Weight (reference value) | 0.51 g |

## Package Dimensions (cont.)

### HM628512BLRRI Series (TTP-32DR)

Unit: mm




*Dimension including the plating thickness
Base material dimension

| | |
|---|---|
| Hitachi Code | TTP-32DR |
| JEDEC | Conforms |
| EIAJ | — |
| Weight (reference value) | 0.51 g |

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## Revision Record

| Rev. | Date | Contents of Modification | Drawn by | Approved by |
|---|---|---|---|---|
| 0.0 | Nov. 2, 1998 | Initial issue | K. Imato | K. Imato |
| 0.1 | Dec. 14, 1998 | DC Characteristics<br>$I_{CC1}$: —/40/60 mA to —/45/70 mA<br>$I_{SB1}$ max: 40 µA to 100 µA<br>Low $V_{CC}$ Data Retention Characteristics<br>$I_{CCDR}$ max: 20 µA to 50 µA<br>$t_R$ min: 5 ms to $t_{RC}$ ms<br>Change of note1<br>Addition of note4 | S. Kunito | K. Imato |
| 1.0 | Jul. 2, 1999 | Deletion of Preliminary | S. Kunito | K. Imato |
| 2.0 | Aug. 24, 1999 | Low $V_{CC}$ Data Retention Characteristics<br>Correct error: $t_R$ unit ms to ns | | |