

# HB56D236 Series - HITACHI/ LOGIC/ARRAYS/MEM

## 2,097,152-Word × 36-Bit High Density Dynamic RAM Module

The HB56D236 is a 2M × 36 dynamic RAM module, mounted 16 pieces of 4-Mbit DRAM (HM514400AS/ALS) sealed in SOJ package and 8 pieces of 1-Mbit DRAM (HM511000AT/ALT) sealed in TSOP package. An outline of the HB56D236 is 72-pin single in-line package. Therefore, the HB56D236 makes high density mounting possible without surface mount technology. The HB56D236 provides common data inputs and outputs. Decoupling capacitors are mounted beneath each SOJ or beside each TSOP but only on the one side of its module board.

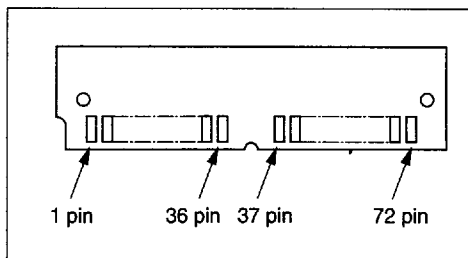
### Features

- 72-pin single in-line package
  - Lead pitch: 1.27 mm
- Single 5 V (± 5%) supply
- High speed
  - Access time: 70 ns/80 ns/100 ns (max)
- Low power dissipation
  - Active mode: 6.20 W/5.57 W/4.94 W (max)
  - Standby mode: 252 mW (max)
- Fast page mode capability
- 1,024 refresh cycle/16 ms, 128 ms (L-version)
- 2 variations of refresh
  - RAS-only refresh
  - CAS-before-RAS refresh
- TTL compatible

### Ordering Information

| Type No.             | Access time | Package                | Contact pad |
|----------------------|-------------|------------------------|-------------|
| HB56D236BS-7A/7AL    | 70 ns       | 72-pin SIP socket type | gold        |
| HB56D236BS-8A/8AL    | 80 ns       |                        |             |
| HB56D236BS-10A/10AL  | 100 ns      |                        |             |
| HB56D236SBS-7A/7AL   | 70 ns       | 72-pin SIP socket type | solder      |
| HB56D236SBS-8A/8AL   | 80 ns       |                        |             |
| HB56D236SBS-10A/10AL | 100 ns      |                        |             |

### Pin Arrangement



**HB56D236 Series**

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**Pin Arrangement (cont)**

| Pin No. | Pin name        | Pin No. | Pin name        | Pin No. | Pin name        | Pin No. | Pin name        |
|---------|-----------------|---------|-----------------|---------|-----------------|---------|-----------------|
| 1       | V <sub>SS</sub> | 19      | NC              | 37      | DQ17            | 55      | DQ12            |
| 2       | DQ0             | 20      | DQ4             | 38      | DQ35            | 56      | DQ30            |
| 3       | DQ18            | 21      | DQ22            | 39      | V <sub>SS</sub> | 57      | DQ13            |
| 4       | DQ1             | 22      | DQ5             | 40      | CAS0            | 58      | DQ31            |
| 5       | DQ19            | 23      | DQ23            | 41      | CAS2            | 59      | V <sub>CC</sub> |
| 6       | DQ2             | 24      | DQ6             | 42      | CAS3            | 60      | DQ32            |
| 7       | DQ20            | 25      | DQ24            | 43      | CAS1            | 61      | DQ14            |
| 8       | DQ3             | 26      | DQ7             | 44      | RAS0            | 62      | DQ33            |
| 9       | DQ21            | 27      | DQ25            | 45      | RAS1            | 63      | DQ15            |
| 10      | V <sub>CC</sub> | 28      | A7              | 46      | NC              | 64      | DQ34            |
| 11      | NC              | 29      | NC              | 47      | WE              | 65      | DQ16            |
| 12      | A0              | 30      | V <sub>CC</sub> | 48      | NC              | 66      | NC              |
| 13      | A1              | 31      | A8              | 49      | DQ9             | 67      | PD1             |
| 14      | A2              | 32      | A9              | 50      | DQ27            | 68      | PD2             |
| 15      | A3              | 33      | RAS3            | 51      | DQ10            | 69      | PD3             |
| 16      | A4              | 34      | RAS2            | 52      | DQ28            | 70      | PD4             |
| 17      | A5              | 35      | DQ26            | 53      | DQ11            | 71      | NC              |
| 18      | A6              | 36      | DQ8             | 54      | DQ29            | 72      | V <sub>SS</sub> |

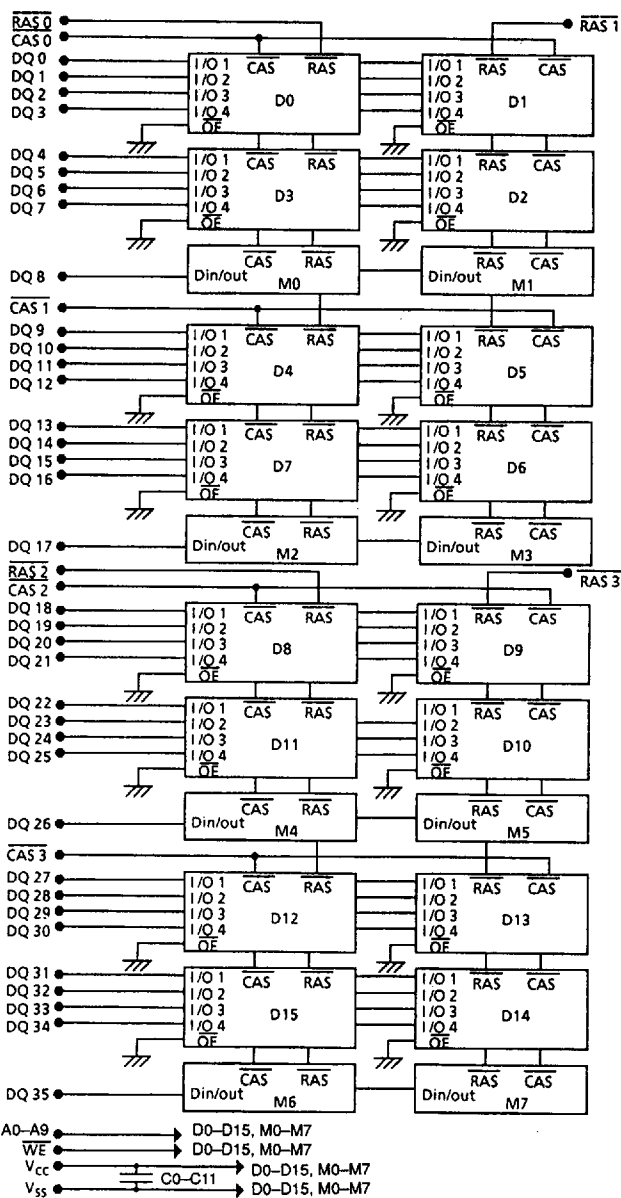
**Pin Description**

| Pin name        | Function              |
|-----------------|-----------------------|
| A0 – A9         | Address input         |
| A0 – A9         | Refresh address input |
| DQ0 – DQ35      | Data-in/data out      |
| CAS0 – CAS3     | Column address strobe |
| RAS0 – RAS3     | Row address strobe    |
| WE              | Read/write enable     |
| V <sub>CC</sub> | Power supply (+5 V)   |
| V <sub>SS</sub> | Ground                |
| PD1 – PD4       | Presence detect pin   |
| NC              | No connection         |

**Presence Detect Pin Arrangement**

| Pin No | Pin name | HB56D236BS/SBS  |                 |                 |
|--------|----------|-----------------|-----------------|-----------------|
|        |          | 70 ns           | 80 ns           | 100 ns          |
| 67     | PD1      | NC              | NC              | NC              |
| 68     | PD2      | NC              | NC              | NC              |
| 69     | PD3      | V <sub>SS</sub> | NC              | V <sub>SS</sub> |
| 70     | PD4      | NC              | V <sub>SS</sub> | V <sub>SS</sub> |

Block Diagram



**HB56D236 Series**

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**Absolute Maximum Ratings**

| Parameter                               |        | Symbol    | Value        | Unit |
|-----------------------------------------|--------|-----------|--------------|------|
| Voltage on any pin relative to $V_{SS}$ | Input  | $V_{in}$  | -1.0 to +7.0 | V    |
|                                         | Output | $V_{out}$ | -1.0 to +7.0 | V    |
| Supply voltage relative to $V_{SS}$     |        | $V_{CC}$  | -1.0 to +7.0 | V    |
| Short circuit output current            |        | $I_{out}$ | 50           | mA   |
| Power dissipation                       |        | $P_T$     | 12           | W    |
| Operating temperature                   |        | $T_{opr}$ | 0 to +70     | °C   |
| Storage temperature                     |        | $T_{stg}$ | -55 to +125  | °C   |

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

| Parameter          | Symbol   | Min  | Typ | Max  | Unit | Note |
|--------------------|----------|------|-----|------|------|------|
| Supply voltage     | $V_{SS}$ | 0    | 0   | 0    | V    |      |
|                    | $V_{CC}$ | 4.75 | 5.0 | 5.25 | V    | 1    |
| Input high voltage | $V_{IH}$ | 2.4  | —   | 5.5  | V    | 1    |
| Input low voltage  | $V_{IL}$ | -1.0 | —   | 0.8  | V    | 1    |

Note: 1. All voltage referenced to  $V_{SS}$ .

**Capacitance ( $T_a = 25^\circ\text{C}$ ,  $V_{CC} = 5\text{ V} \pm 5\%$ )**

| Parameter                                                              | Symbol     | Typ | Max | Unit | Notes |
|------------------------------------------------------------------------|------------|-----|-----|------|-------|
| Input capacitance (Address)                                            | $C_{I1}$   | —   | 161 | pF   | 1     |
| Input capacitance ( $\overline{WE}$ )                                  | $C_{I2}$   | —   | 193 | pF   | 1     |
| Input capacitance ( $\overline{RAS}$ , $\overline{CAS}$ )              | $C_{I3}$   | —   | 62  | pF   | 1     |
| Output capacitance (DQ0 – DQ7, DQ9 – DQ16<br>DQ18 – DQ25, DQ27 – DQ34) | $C_{I/O1}$ | —   | 29  | pF   | 1,2   |
| Output capacitance<br>(DQ8, DQ17, DQ26, DQ35)                          | $C_{I/O2}$ | —   | 39  | pF   | 1,2   |

Notes: 1. Capacitance measured with Boonton Meter or effective capacitance measuring method.  
2.  $\overline{CAS} = V_{IH}$  to disable Dout.

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

## HB56D236BS/SBS

| Parameter                                                            | Symbol            | -7A/7AL |                 | -8A/8AL |                 | -10A/10AL |                 | Unit | Test conditions                                                                                                                                                         | Notes |
|----------------------------------------------------------------------|-------------------|---------|-----------------|---------|-----------------|-----------|-----------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
|                                                                      |                   | Min     | Max             | Min     | Max             | Min       | Max             |      |                                                                                                                                                                         |       |
| Operating current                                                    | I <sub>CC1</sub>  | —       | 1180            | —       | 1060            | —         | 940             | mA   | t <sub>RC</sub> = min                                                                                                                                                   | 1, 2  |
| Standby current                                                      | I <sub>CC2</sub>  | —       | 48              | —       | 48              | —         | 48              | mA   | TTL interface<br>RAS, CAS = V <sub>IH</sub><br>Dout = High-Z                                                                                                            |       |
|                                                                      |                   | —       | 24              | —       | 24              | —         | 24              | mA   | CMOS interface<br>RAS, CAS ≥<br>V <sub>CC</sub> - 0.2 V<br>Dout = High-Z                                                                                                |       |
| Standby current<br>(L-version)                                       |                   | —       | 4.8             | —       | 4.8             | —         | 4.8             | mA   | CMOS interface<br>RAS, CAS = V <sub>IH</sub><br>WE, address, Din = V <sub>IH</sub><br>or V <sub>IL</sub> , Dout = High-Z                                                | 4     |
| RAS-only<br>refresh current                                          | I <sub>CC3</sub>  | —       | 1180            | —       | 1020            | —         | 900             | mA   | t <sub>RC</sub> = min                                                                                                                                                   | 2     |
| Standby current                                                      | I <sub>CC5</sub>  | —       | 120             | —       | 120             | —         | 120             | mA   | RAS = V <sub>IH</sub> , CAS = V <sub>IL</sub><br>Dout = enable                                                                                                          | 1     |
| CAS-before-RAS<br>refresh current                                    | I <sub>CC6</sub>  | —       | 1140            | —       | 1020            | —         | 900             | mA   | t <sub>RC</sub> = min                                                                                                                                                   |       |
| Page mode current                                                    | I <sub>CC7</sub>  | —       | 1140            | —       | 980             | —         | 900             | mA   | t <sub>PC</sub> = min                                                                                                                                                   | 1, 3  |
| Battery back up<br>operation current<br>(CBR refresh)<br>(L-version) | I <sub>CC10</sub> | —       | 7.2             | —       | 7.2             | —         | 7.2             | mA   | t <sub>RC</sub> = 125 μs, t <sub>RAS</sub> ≤ 1 μs<br>WE = V <sub>IH</sub> , CAS = V <sub>IL</sub><br>address, Din = V <sub>IH</sub> or V <sub>IL</sub><br>Dout = High-Z | 4     |
| Input leakage<br>current                                             | I <sub>LI</sub>   | -10     | 10              | -10     | 10              | -10       | 10              | μA   | 0 V ≤ Vin ≤ 7 V                                                                                                                                                         |       |
| Output leakage<br>current                                            | I <sub>LO</sub>   | -10     | 10              | -10     | 10              | -10       | 10              | μA   | 0 V ≤ Vout ≤ 7 V<br>Dout = disable                                                                                                                                      |       |
| Output high voltage                                                  | V <sub>OH</sub>   | 2.4     | V <sub>CC</sub> | 2.4     | V <sub>CC</sub> | 2.4       | V <sub>CC</sub> | V    | High Iout = -5 mA                                                                                                                                                       |       |
| Output low voltage                                                   | V <sub>OL</sub>   | 0       | 0.4             | 0       | 0.4             | 0         | 0.4             | V    | Low Iout = 4.2 mA                                                                                                                                                       |       |

- Notes:
1. I<sub>CC</sub> depends on output load condition when the device is selected. I<sub>CC</sub> max is specified at the output open condition.
  2. Address can be changed once or less while RAS = V<sub>IL</sub>.
  3. Address can be changed once or less while CAS = V<sub>IH</sub>.
  4. V<sub>CC</sub> - 0.2 V ≤ V<sub>IH</sub> ≤ 6.5 V, 0 V ≤ V<sub>IL</sub> ≤ 0.2 V.

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**AC Characteristics** ( $T_a = 0$  to  $+70^\circ\text{C}$ ,  $V_{CC} = 5\text{ V} \pm 5\%$ ,  $V_{SS} = 0\text{ V}$ ) \*1, \*12

**Read, Write and Refresh Cycle** (Common parameters)

|                                  |                  | HB56D236 |       |         |       |           |       |      |       |
|----------------------------------|------------------|----------|-------|---------|-------|-----------|-------|------|-------|
|                                  |                  | -7A/7AL  |       | -8A/8AL |       | -10A/10AL |       |      |       |
| Parameter                        | Symbol           | Min      | Max   | Min     | Max   | Min       | Max   | Unit | Notes |
| Random read or write cycle time  | t <sub>RC</sub>  | 130      | —     | 160     | —     | 190       | —     | ns   |       |
| RAS precharge time               | t <sub>RP</sub>  | 50       | —     | 70      | —     | 80        | —     | ns   |       |
| RAS pulse width                  | t <sub>RAS</sub> | 70       | 10000 | 80      | 10000 | 100       | 10000 | ns   |       |
| CAS pulse width                  | t <sub>CAS</sub> | 20       | 10000 | 25      | 10000 | 25        | 10000 | ns   |       |
| Row address setup time           | t <sub>ASR</sub> | 0        | —     | 0       | —     | 0         | —     | ns   |       |
| Row address hold time            | t <sub>RAH</sub> | 10       | —     | 12      | —     | 15        | —     | ns   |       |
| Column address setup time        | t <sub>ASC</sub> | 0        | —     | 0       | —     | 0         | —     | ns   |       |
| Column address hold time         | t <sub>CAH</sub> | 15       | —     | 20      | —     | 20        | —     | ns   |       |
| RAS to CAS delay time            | t <sub>RCD</sub> | 20       | 50    | 22      | 55    | 25        | 75    | ns   | 8     |
| RAS to column address delay time | t <sub>RAD</sub> | 15       | 35    | 17      | 40    | 20        | 55    | ns   | 9     |
| RAS hold time                    | t <sub>RSH</sub> | 20       | —     | 25      | —     | 25        | —     | ns   |       |
| CAS hold time                    | t <sub>CSH</sub> | 70       | —     | 80      | —     | 100       | —     | ns   |       |
| CAS to RAS precharge time        | t <sub>CRP</sub> | 10       | —     | 10      | —     | 10        | —     | ns   |       |
| Transition time (rise and fall)  | t <sub>T</sub>   | 3        | 50    | 3       | 50    | 3         | 50    | ns   | 7     |
| Refresh period                   | t <sub>REF</sub> | —        | 16    | —       | 16    | —         | 16    | ms   | 15    |

**Read Cycle**

|                          |                  | HB56D236 |     |         |     |           |     |      |       |
|--------------------------|------------------|----------|-----|---------|-----|-----------|-----|------|-------|
|                          |                  | -7A/7AL  |     | -8A/8AL |     | -10A/10AL |     |      |       |
| Parameter                | Symbol           | Min      | Max | Min     | Max | Min       | Max | Unit | Notes |
| Access time from RAS     | t <sub>RAC</sub> | —        | 70  | —       | 80  | —         | 100 | ns   | 2, 3  |
| Access time from CAS     | t <sub>CAC</sub> | —        | 20  | —       | 25  | —         | 25  | ns   | 3, 4  |
| Access time from address | t <sub>AA</sub>  | —        | 35  | —       | 40  | —         | 45  | ns   | 3, 5  |

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**HB56D236 Series**
**Read Cycle (cont)**

|                                                     |                  | HB56D236 |     |         |     |           |     |      |       |
|-----------------------------------------------------|------------------|----------|-----|---------|-----|-----------|-----|------|-------|
|                                                     |                  | -7A/7AL  |     | -8A/8AL |     | -10A/10AL |     |      |       |
| Parameter                                           | Symbol           | Min      | Max | Min     | Max | Min       | Max | Unit | Notes |
| Read command setup time                             | t <sub>RCS</sub> | 0        | —   | 0       | —   | 0         | —   | ns   |       |
| Read command hold time to $\overline{\text{CAS}}$   | t <sub>RCH</sub> | 0        | —   | 0       | —   | 0         | —   | ns   |       |
| Read command hold time to $\overline{\text{RAS}}$   | t <sub>RRH</sub> | 10       | —   | 10      | —   | 10        | —   | ns   |       |
| Column address to $\overline{\text{RAS}}$ lead time | t <sub>RAL</sub> | 35       | —   | 40      | —   | 45        | —   | ns   |       |
| Output buffer turn-off time                         | t <sub>OFF</sub> | —        | 20  | —       | 20  | —         | 25  | ns   | 6     |

**Write Cycle**

|                           |                  | HB56D236 |     |         |     |           |     |      |       |
|---------------------------|------------------|----------|-----|---------|-----|-----------|-----|------|-------|
|                           |                  | -7A/7AL  |     | -8A/8AL |     | -10A/10AL |     |      |       |
| Parameter                 | Symbol           | Min      | Max | Min     | Max | Min       | Max | Unit | Notes |
| Write command setup time  | t <sub>WCS</sub> | 0        | —   | 0       | —   | 0         | —   | ns   | 10    |
| Write command hold time   | t <sub>WCH</sub> | 15       | —   | 20      | —   | 20        | —   | ns   |       |
| Write command pulse width | t <sub>WP</sub>  | 10       | —   | 15      | —   | 20        | —   | ns   |       |
| Data-in setup time        | t <sub>DS</sub>  | 0        | —   | 0       | —   | 0         | —   | ns   | 11    |
| Data-in hold time         | t <sub>DH</sub>  | 15       | —   | 20      | —   | 20        | —   | ns   | 11    |

**Refresh Cycle**

|                                                  |                  | HB56D236 |     |         |     |           |     |      |       |
|--------------------------------------------------|------------------|----------|-----|---------|-----|-----------|-----|------|-------|
|                                                  |                  | -7A/7AL  |     | -8A/8AL |     | -10A/10AL |     |      |       |
| Parameter                                        | Symbol           | Min      | Max | Min     | Max | Min       | Max | Unit | Notes |
| CAS setup time<br>(CAS-before-RAS refresh cycle) | t <sub>CSR</sub> | 10       | —   | 10      | —   | 10        | —   | ns   |       |
| CAS hold time<br>(CAS-before-RAS refresh cycle)  | t <sub>CHR</sub> | 15       | —   | 20      | —   | 20        | —   | ns   |       |
| RAS precharge to CAS hold time                   | t <sub>RPC</sub> | 10       | —   | 10      | —   | 10        | —   | ns   |       |

**HB56D236 Series**
**HITACHI/ LOGIC/ARRAYS/MEM**
**Fast Page Mode Cycle**
**HB56D236**

| Parameter                                                  | Symbol            | -7A/7AL |        | -8A/8AL |        | -10A/10AL |        | Unit | Notes |
|------------------------------------------------------------|-------------------|---------|--------|---------|--------|-----------|--------|------|-------|
|                                                            |                   | Min     | Max    | Min     | Max    | Min       | Max    |      |       |
|                                                            |                   |         |        |         |        |           |        |      |       |
| Fast page mode cycle time                                  | t <sub>PC</sub>   | 50      | —      | 55      | —      | 55        | —      | ns   |       |
| Fast page mode $\overline{CAS}$ precharge time             | t <sub>CP</sub>   | 10      | —      | 10      | —      | 10        | —      | ns   |       |
| Fast page mode $\overline{RAS}$ pulse width                | t <sub>RASC</sub> | 70      | 100000 | 80      | 100000 | 100       | 100000 | ns   | 13    |
| Access time from $\overline{CAS}$ precharge                | t <sub>ACP</sub>  | —       | 45     | —       | 50     | —         | 50     | ns   | 14    |
| $\overline{RAS}$ hold time from $\overline{CAS}$ precharge | t <sub>RHCP</sub> | 45      | —      | 50      | —      | 50        | —      | ns   |       |

- Notes:
1. AC measurements assume  $t_T = 5$  ns.
  2. Assumes that  $t_{RCD} \leq t_{RCD}(\text{max})$  and  $t_{RAD} \leq t_{RAD}(\text{max})$ . If  $t_{RCD}$  or  $t_{RAD}$  is greater than the maximum recommended value shown in this table,  $t_{RAC}$  exceeds the value shown.
  3. Measured with a load circuit equivalent to 2TTL loads and 100 pF.
  4. Assumes that  $t_{RCD} \geq t_{RCD}(\text{max})$ ,  $t_{RAD} \leq t_{RAD}(\text{max})$ .
  5. Assumes that  $t_{RCD} \leq t_{RCD}(\text{max})$ ,  $t_{RAD} \geq t_{RAD}(\text{max})$ .
  6.  $t_{OFF}(\text{max})$  is defined as the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.
  7.  $V_{IH}(\text{min})$  and  $V_{IL}(\text{max})$  are reference levels for measuring timing of input signals. Also, transition times are measured between  $V_{IH}$  and  $V_{IL}$ .
  8. Operation with the  $t_{RCD}(\text{max})$  limit insures that  $t_{RAC}(\text{max})$  can be met,  $t_{RCD}(\text{max})$  is specified as a reference point only, if  $t_{RCD}$  is greater than the specified  $t_{RCD}(\text{max})$  limit, then access time is controlled exclusively by  $t_{CAC}$ .
  9. Operation with the  $t_{RAD}(\text{max})$  limit insures that  $t_{RAC}(\text{max})$  can be met,  $t_{RAD}(\text{max})$  is specified as a reference point only, if  $t_{RAD}$  is greater than the specified  $t_{RAD}(\text{max})$  limit, then access time is controlled exclusively by  $t_{AA}$ .
  10. Early write cycle only ( $t_{WCS} \geq t_{WCS}(\text{min})$ ).
  11. These parameters are referenced to  $\overline{CAS}$  leading edge in an early write cycle.
  12. An initial pause of 100  $\mu$ s is required after power up followed by a minimum of eight initialization cycles ( $\overline{RAS}$ -only refresh cycle or  $\overline{CAS}$ -before- $\overline{RAS}$  refresh cycle).
  13.  $t_{RASC}$  is determined by  $\overline{RAS}$  pulse width in fast page mode cycles.
  14. Access time is determined by the longer of  $t_{AA}$  or  $t_{CAC}$  or  $t_{ACP}$ .
  15.  $t_{REF}$  is determined by 1,024 refresh cycles.



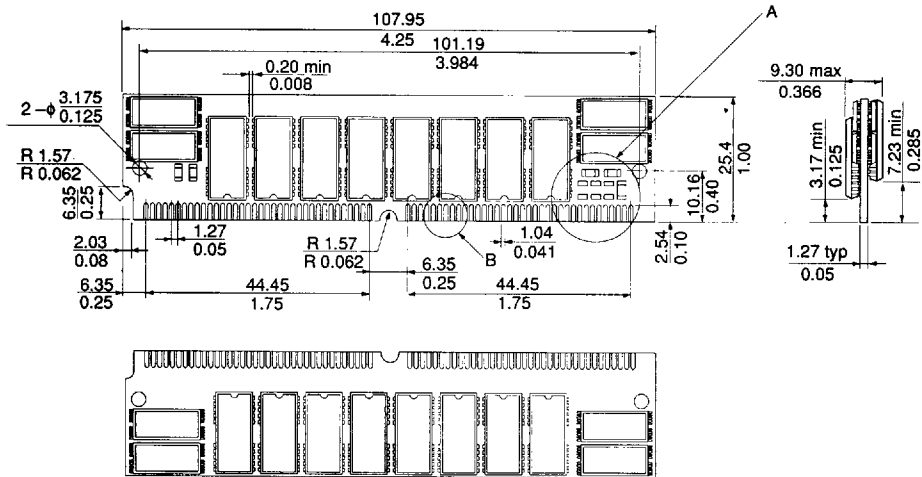
## Timing Waveforms

- Refer to the HM514400A data sheet.
- The HB56D236 writes data only in early write cycle ( $t_{WCS} \geq t_{WCS}(\min)$ )  
Delayed write cycle is not available.  $\overline{OE}$  pin is fixed to  $V_{SS}$ .

## Physical Outline

Unit: mm/inch

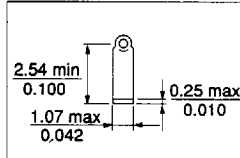
### HB56D236BS/SBS Series



Detail A

| 70 ns | 80 ns | 100 ns |
|-------|-------|--------|
|       |       |        |

Detail B



Note: Following the specification of the contact pads.

| Part No.       | Contact pad |
|----------------|-------------|
| HB56D236BS-XX  | gold        |
| HB56D236SBS-XX | solder      |