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# HM67S18258 Series (Target Spec.)

262,144-words × 18-bits Synchronous Fast Static RAM

## HITACHI

ADE-203-661(Z)  
Product Preview Rev. 0  
Oct. 1, 1996

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### Features

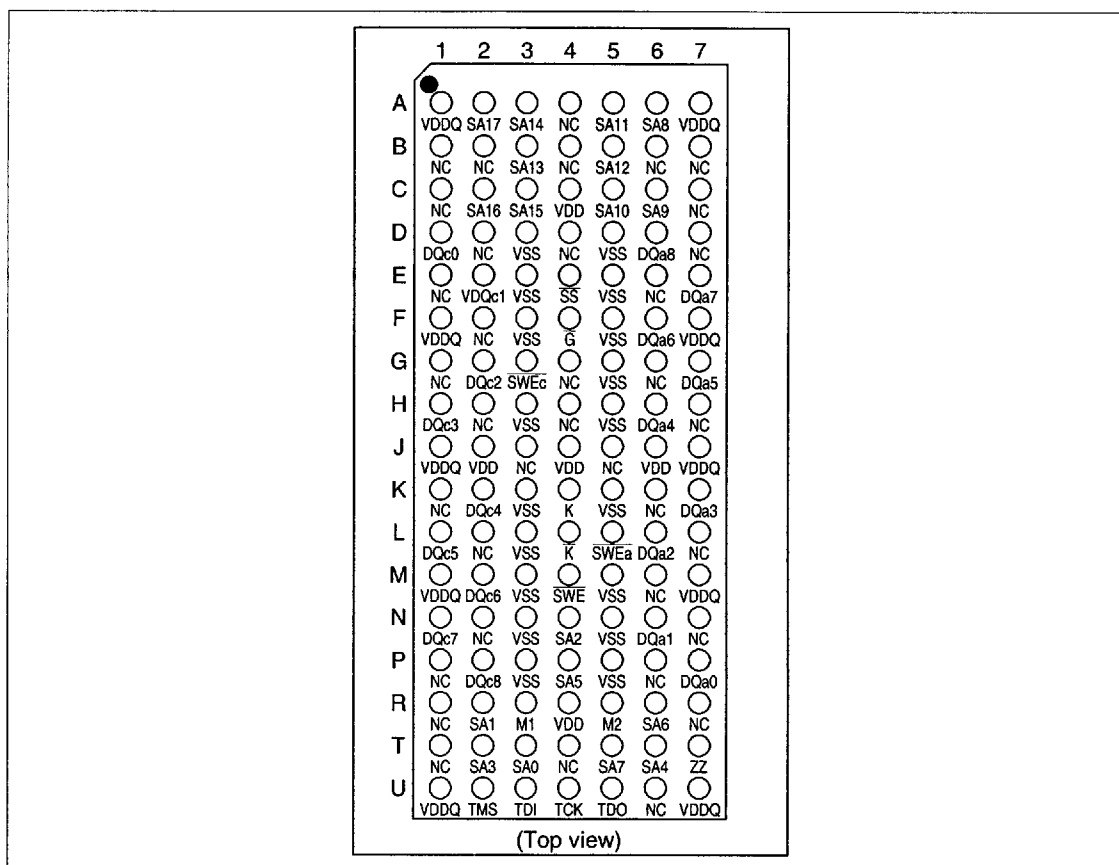
- 3.3 ± 0.1 V Operation
- LVCMOS Compatible Input and Output
- Synchronous Operation
- Internal self-timed Late Write
- Asynchronous  $\overline{G}$  Output Control
- Byte Write Control  
(2 byte write selects, one for each 9 bits)
- Power down mode is provided
- Differential PECL Clock Inputs
- Boundary Scan
- Protocol Single Clock Resister-Latch Mode

### Ordering Information

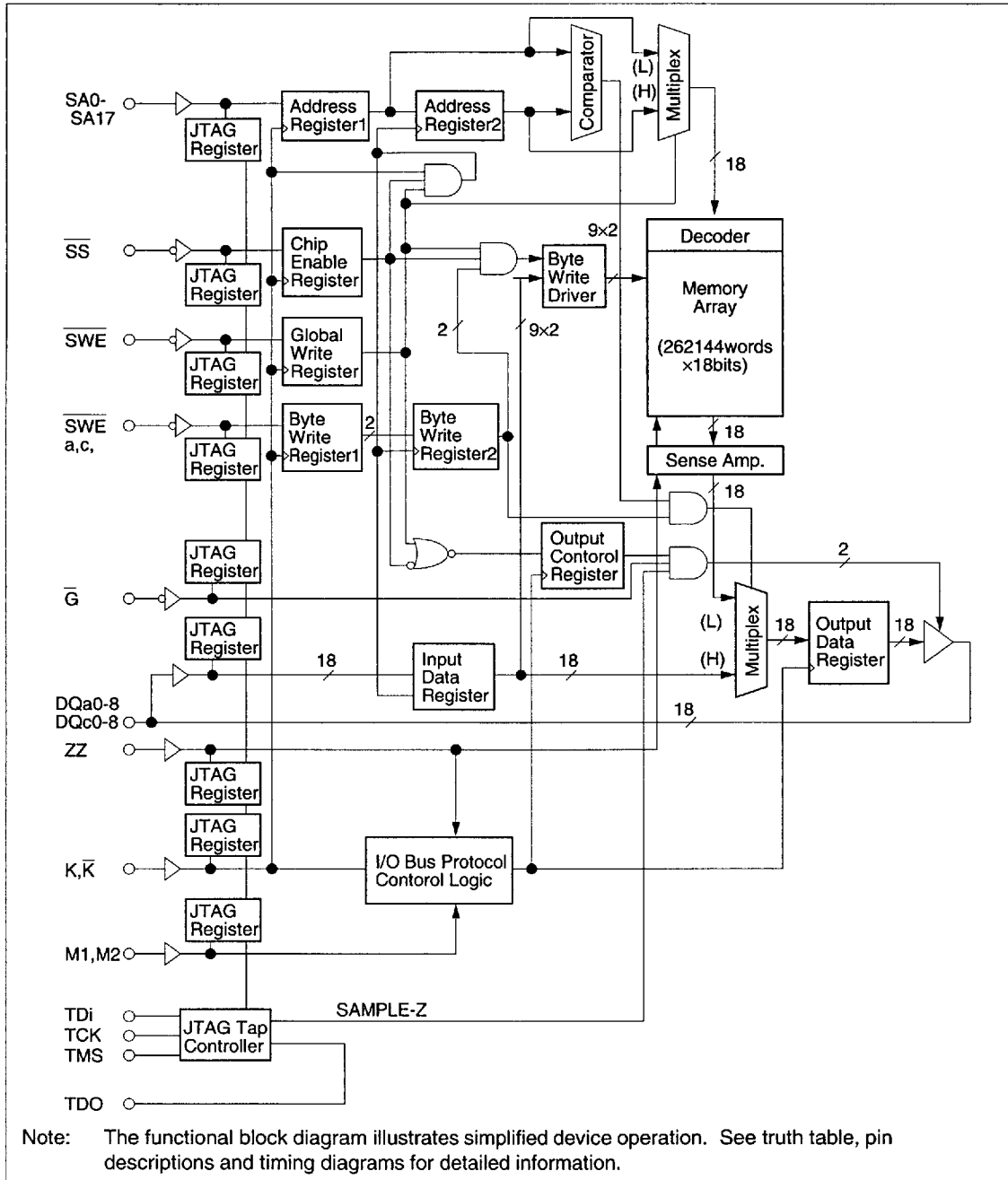
| Type Number     | Cycle Time | Package                                        |
|-----------------|------------|------------------------------------------------|
| HM67S18258BP-7H | 7.5 ns     | 119 Bump 1.27 mm<br>14 mm × 22 mm BGA (BP-119) |

## HM67S18258 Series

### Pin Arrangement



# Block Diagram



## HM67S18258 Series

### Pin Descriptions

| Name         | I/O Type | Descriptions                   | Note                        |
|--------------|----------|--------------------------------|-----------------------------|
| $V_{DD}$     |          | Power Supply                   |                             |
| $V_{SS}$     |          | Ground                         |                             |
| $V_{DDQ}$    |          | Output Power Supply            |                             |
| K            | Input    | Input Clock                    |                             |
| $\bar{K}$    | Input    | Input Clock                    |                             |
| $\bar{SS}$   | Input    | Synchronous Chip Select        |                             |
| $\bar{SWE}$  | Input    | Synchronous Write Enable       |                             |
| $\bar{SAn}$  | Input    | Synchronous Address            | n = 0, 1, 2, ... 17         |
| $\bar{SWEx}$ | Input    | Synchronous Byte Select        | x = a, c                    |
| $\bar{G}$    | Input    | Asynchronous Output Enables    |                             |
| $\bar{ZZ}$   | Input    | Power Down Mode Select         |                             |
| DQxm         | I/O      | Synchronous Data Input/Output  | x = a, c m = 0, 1, 2, ... 8 |
| M1, M2       | Input    | Output Protocol Mode Select    | 1                           |
| TMS          | Input    | Boundary Scan Test Mode Select |                             |
| TCK          | Input    | Boundary Scan Test Clock       |                             |
| TDI          | Input    | Boundary Scan Test Data In     |                             |
| TDO          | Output   | Boundary Scan Test Data Out    |                             |
| NC           |          | No Connection                  |                             |

Note: There is 1 protocol with using mode pins. Mode control pins (M1, M2) are to be tied to either  $V_{DD}$  or  $V_{SS}$ . The state of the Mode control inputs must be set before power-up and must not change during device operation. Mode control inputs are not standard inputs and may not meet  $V_{IH}$  or  $V_{IL}$  specifications.

| M1       | M2       | Protocol                    |
|----------|----------|-----------------------------|
| $V_{DD}$ | $V_{SS}$ | Single Clock Register Latch |

## HM67S18258 Series

### Truth Table

| $\overline{SS}$ | $\overline{G}$ | $\overline{SWE}$ | $\overline{SWEa}$ | $\overline{SWEc}$ | K   | $\overline{K}$ | Operation           | DQa    | DQc    |
|-----------------|----------------|------------------|-------------------|-------------------|-----|----------------|---------------------|--------|--------|
| H               | X              | X                | X                 | X                 | L-H | H-L            | Dead (not selected) | High-Z | High-Z |
| L               | H              | H                | X                 | X                 | L-H | H-L            | Dead (Dummy read)   | High-Z | High-Z |
| L               | L              | H                | X                 | X                 | L-H | H-L            | Read                | Dout   | Dout   |
| L               | X              | L                | L                 | L                 | L-H | H-L            | Write               | Din    | Din    |
| L               | X              | L                | H                 | L                 | L-H | H-L            | Write               | High-Z | Din    |
| L               | X              | L                | L                 | H                 | L-H | H-L            | Write               | Din    | High-Z |

Notes: 1. X means don't care for synchronous inputs, and H or L for asynchronous inputs.

2.  $\overline{SWE}$ ,  $\overline{SS}$ ,  $\overline{SWEa}$ ,  $\overline{SWEc}$ ,  $\overline{SA}$  are sampled at the rising edge of K clock.

### Absolute Maximum Ratings

| Parameter              | Symbol           | Value                      | Unit | Note |
|------------------------|------------------|----------------------------|------|------|
| Supply voltage         | $V_{DD}$         | -0.5 to +4.6               | V    | 1    |
| Output Supply Voltage  | $V_{DDO}$        | -0.5 to $V_{DD}+0.5$       | V    | 1, 5 |
| Voltage on any pin     | $V_{IN}$         | -0.5 to $V_{DD}+0.5$       | V    | 1, 5 |
| Operating Temperature  | $T_a$            | 0 to 70 ( $T_j$ max = 110) | °C   |      |
| Storage Temperature    | $T_{stg}$ (bias) | -55 to 125                 | °C   |      |
| Input Latchup Current  | $I_{LI}$         | ±200                       | mA   |      |
| Output Current per pin | $I_{out}$        | ±25                        | mA   |      |
| Soft Error Rate        | SER              | 100                        | FIT  |      |

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

2. Permanent device damage may occur if Absolute Maximum Ratings are exceeded. Functional operation should be restricted the Operation Conditions. Exposure to higher than recommended voltages for extended periods of time could affect device reliability.

3. These Bi-CMOS memory circuits have been designed to meet the DC and AC specifications shown in the tables after thermal equilibrium has been established.

4. Power Up Initialization

5. Not exceed 4.6 V

The following supply voltage application sequence is recommended:  $V_{SS}$ ,  $V_{DD}$  then  $V_{DDO}$ .

Remember according to the Absolute Maximum Ratings table,  $V_{DDO}$  is not to exceed  $V_{DD} + 0.5$  V, whatever the instantaneous value of  $V_{DD}$ .

## HM67S18258 Series

### Recommended DC Operating Conditions ( $T_a = 0$ to $70^\circ\text{C}$ [ $T_j$ max = $110^\circ\text{C}$ ])

| Parameter                      | Symbol                | Min   | Typ | Max            | Unit | Notes |
|--------------------------------|-----------------------|-------|-----|----------------|------|-------|
| Supply voltage                 | $V_{DD}$              | 3.2   | 3.3 | 3.4            | V    |       |
| Output Supply voltage          | $V_{DDQ}$             | 3.2   | 3.3 | 3.4            | V    | 1     |
|                                |                       | 2.4   | 2.5 | 2.6            | V    | 2     |
| Input voltage Logic High Level | $V_{IH}$              | 2.0   | —   | $V_{DD} + 0.3$ | V    |       |
| Logic Low Level                | $V_{IL}$              | -0.5  | —   | 0.8            | V    |       |
| PECL Logic High Level          | $V_{IH}(\text{PECL})$ | 2.135 | —   | 2.420          | V    |       |
| PECL Logic Low Level           | $V_{IL}(\text{PECL})$ | 1.490 | —   | 1.825          | V    |       |

Notes: 1. For  $V_{DDQ} = 3.3$  V supply.

2. For  $V_{DDQ} = 2.5$  V supply.

## HM67S18258 Series

**DC Characteristics** ( $T_a = 0$  to  $70^\circ\text{C}$  [ $T_j$  max  $110^\circ\text{C}$ ],  $V_{DD} = 3.3 \text{ V} \pm 0.1 \text{ V}$ )

| Parameter                                           | Symbol          | Min      | Typ                  | Max            | Unit                     | Note         |
|-----------------------------------------------------|-----------------|----------|----------------------|----------------|--------------------------|--------------|
| Input Leakage Current                               | $I_{LI}$        | -1       | —                    | 1              | $\mu\text{A}$            | 1            |
| Output Leakage Current                              | $I_{LO}$        | -1       | —                    | 1              | $\mu\text{A}$            | 2            |
| PECL Input Leakage Current Low                      | $I_{LI}$ (PECL) | —        | —                    | 50             | $\mu\text{A}$            |              |
| PECL Input Leakage Current High                     | $I_{LI}$ (PECL) | —        | —                    | 150            | $\mu\text{A}$            |              |
| $V_{DD}$ Operating Current excluding output drivers | $I_{DD}$        | —        | —                    | 500            | $\text{mA}$              | 3            |
| Power Dissipation including output drivers          | $P_d$           | —        | —                    | 2.7            | $\text{W}$               | 3, 8         |
| Standby Current (Power down mode)                   | $I_{SB}$        | —        | —                    | 100            | $\text{mA}$              | 5            |
| Output Voltage                                      | Logic Low       | $V_{OL}$ | 0                    | 0.4            | $\text{V}$               | 4            |
|                                                     | Logic High      | $V_{OH}$ | 2.4<br>$V_{DDQ}-0.4$ | —<br>$V_{DDQ}$ | $\text{V}$<br>$\text{V}$ | 4, 6<br>4, 7 |

- Notes: 1.  $0 \leq V_{in} \leq V_{DD}$   
2.  $0 \leq V_{I/O} \leq V_{DD}$ , Tristate I/O  
3.  $I(I/O) = 0 \text{ mA}$ , Address increment read 50% / write 50%,  $V_{DD} = V_{DD} \text{ max}$ , Frequency = 125 MHz  
4.  $I_{OH} = 2 \text{ mA}$  or  $I_{OL} = -2 \text{ mA}$   
5. All inputs (except clock) are held at either  $V_{SS}$  or  $V_{DDQ}$ , and  $\overline{ZZ}$  is held at  $V_{DDQ}$   
6. for  $V_{DDQ} = 3.3 \text{ V}$  supply  
7. for  $V_{DDQ} = 2.5 \text{ V}$  supply  
8. Output Load Capacitance = 29 pF

**Input Capacitance** ( $T_a = 25^\circ\text{C}$ ,  $f = 1 \text{ MHz}$ )

| Parameter                 | Symbol     | Min | Max | Unit | Pin Name                                                    | Note |
|---------------------------|------------|-----|-----|------|-------------------------------------------------------------|------|
| Address Input Capacitance | $C_{INA}$  | —   | 5   | pF   | SAn, $\overline{SS}$ , $\overline{SWE}$ , $\overline{SWEx}$ | 1    |
| Clock Input Capacitance   | $C_{INC}$  | —   | 8   | pF   | K, $\overline{K}$ , $\overline{G}$                          | 1    |
| I/O Capacitance           | $C_{INIO}$ | —   | 7   | pF   | DQxm                                                        | 1    |

Note: This value is measured by sampling and not 100% tested.

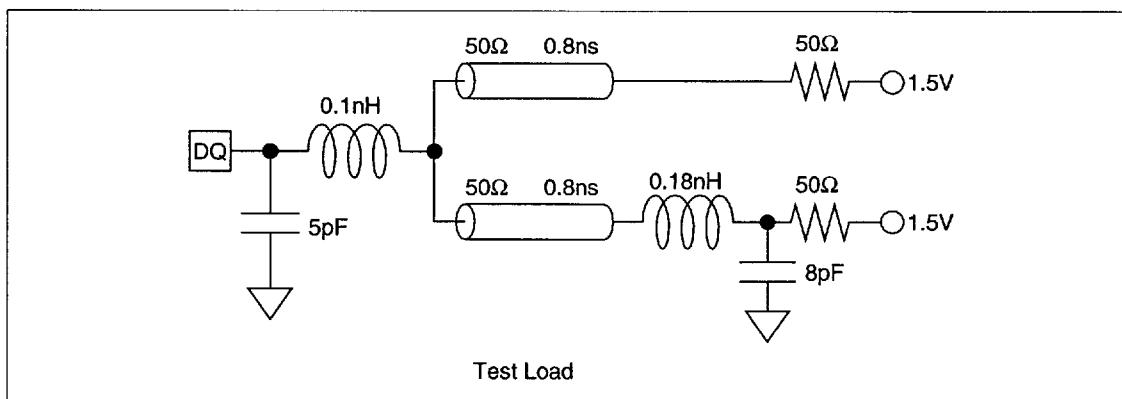
## HM67S18258 Series

### AC Test Conditions

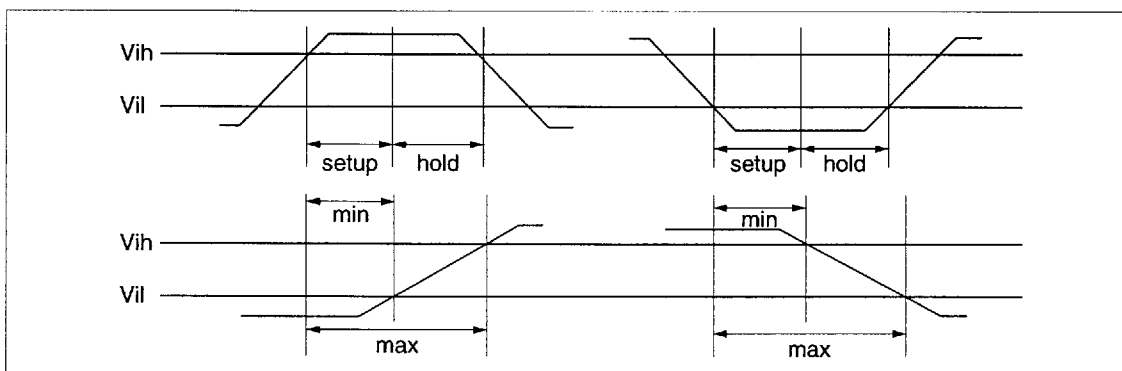
Note

- Temperature  $0^{\circ}\text{C} \leq T_a \leq 70^{\circ}\text{C}$  ( $T_j \text{ max} = 110^{\circ}\text{C}$ )
- Input Reference Point for Differential Signals Differential Cross-Over Point
- Input pulse levels 0 to 2.5 V
- Clock Input pulse levels 1.8 to 2.1 V
- Input Rise/Fall Time 0.5 to 1.5 ns (10% to 90%)
- Clock input Rise/Fall Time 0.3 to 1.0 ns (10% to 90%)
- Output timing reference
  - 2.0 V/0.8 V for  $V_{DDQ} = 3.3 \text{ V}$  1
  - 1.65 V/1.15 V for  $V_{DDQ} = 2.5 \text{ V}$  1
- Output load See figures

Note: These levels are efficient under open termination. load condition  
These vih/vil levels under termination load will be determined by correlation between open load and termination load.



### AC Timing Measurement



## HM67S18258 Series

### AC Characteristics (Ta = 0° to 70°C [Tj max = 110°C])

#### Single Differential Clock Register-Latch Mode (M1 = V<sub>DD</sub>, M2 = V<sub>SS</sub>)

| Parameter              | Symbol             | -7H |     |     |     | Unit | Notes                                    |
|------------------------|--------------------|-----|-----|-----|-----|------|------------------------------------------|
|                        |                    | Min | Max | Min | Max |      |                                          |
| Clock Control          |                    |     |     |     |     |      |                                          |
| Clock Cycle            | t <sub>KHKH</sub>  |     |     | 8.0 | —   | ns   |                                          |
| Clock High Width       | t <sub>KHKL</sub>  |     |     | 3.2 | —   | ns   |                                          |
| Clock Low Width        | t <sub>KLKH</sub>  |     |     | 3.2 | —   | ns   |                                          |
| Read Control           |                    |     |     |     |     |      |                                          |
| K Clock Access         | t <sub>KHOV</sub>  |     |     | —   | 7.5 | ns   |                                          |
| K Clock Access         | t <sub>KLOV</sub>  |     |     | —   | 3.5 | ns   |                                          |
| Output Enable Access   | t <sub>GLOV</sub>  |     |     | —   | 3.5 | ns   |                                          |
| K Low to Q Change      | t <sub>KLOX</sub>  |     |     | 1.0 | —   | ns   |                                          |
| Output Buffer Control  |                    |     |     |     |     |      |                                          |
| K Low to Low-Z         | t <sub>KLOX2</sub> |     |     | 1.0 | —   | ns   | 1                                        |
| Output Enable to Low-Z | t <sub>GLOX</sub>  |     |     | 0.5 | —   | ns   | 1                                        |
| K Clock High to Hi-Z   | t <sub>KHOZ</sub>  |     |     | —   | 3.5 | ns   | 1                                        |
| Output Enable to Hi-Z  | t <sub>GHQZ</sub>  |     |     | 0.0 | 4.0 | ns   | 1                                        |
| Setup Times            |                    |     |     |     |     |      |                                          |
| Address Setup Time     | t <sub>AVKH</sub>  |     |     | 0.5 | —   | ns   | SA, $\overline{SS}$ , $\overline{SWE}$ , |
| Data Setup Time        | t <sub>DVKH</sub>  |     |     | 0.5 | —   | ns   | $\overline{SWEa}$ , $\overline{SWEc}$    |
| Hold Times             |                    |     |     |     |     |      |                                          |
| Address Hold Time      | t <sub>KHAX</sub>  |     |     | 1.0 | —   | ns   | SA, $\overline{SS}$ , $\overline{SWE}$ , |
| Data Hold Time         | t <sub>KHDX</sub>  |     |     | 1.0 | —   | ns   | $\overline{SWEa}$ , $\overline{SWEc}$    |

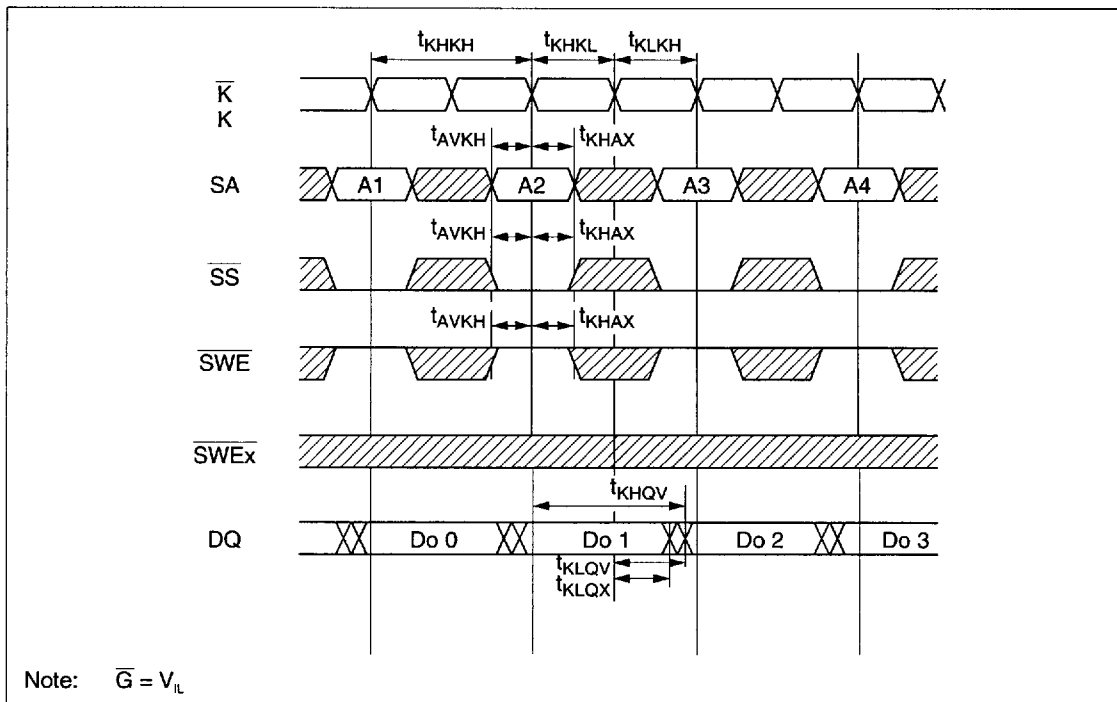
Notes: Transition is measured  $\pm 200$  mV from steady voltage with specified loading in Test Load.

## HM67S18258 Series

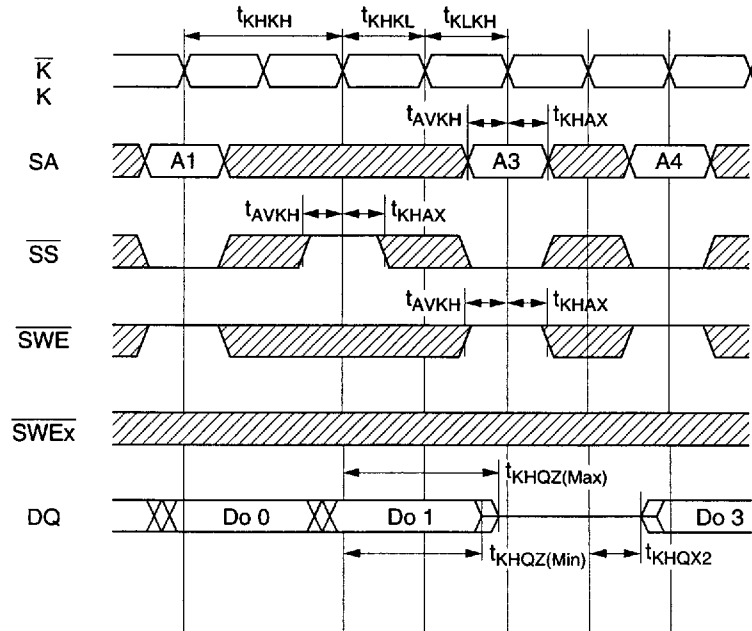
### Timing Waveforms

#### Single Clock Register Latch Mode

##### Read Cycle 1



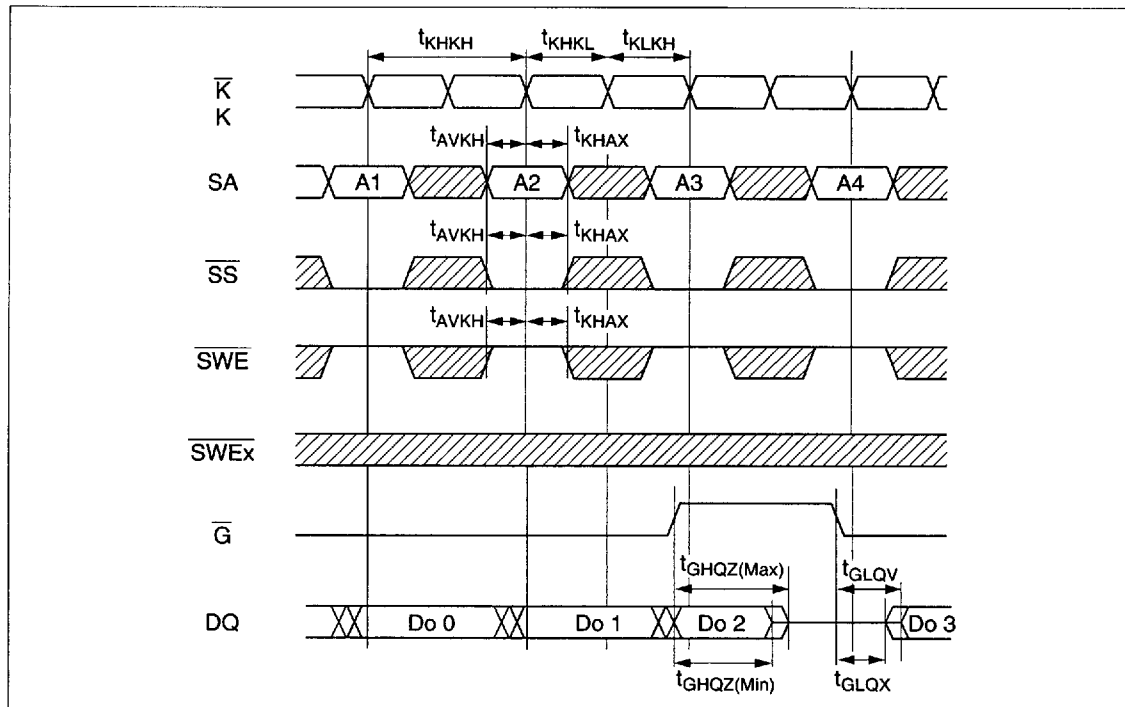
Read Cycle 2 ( $\overline{SS}$  Controlled)



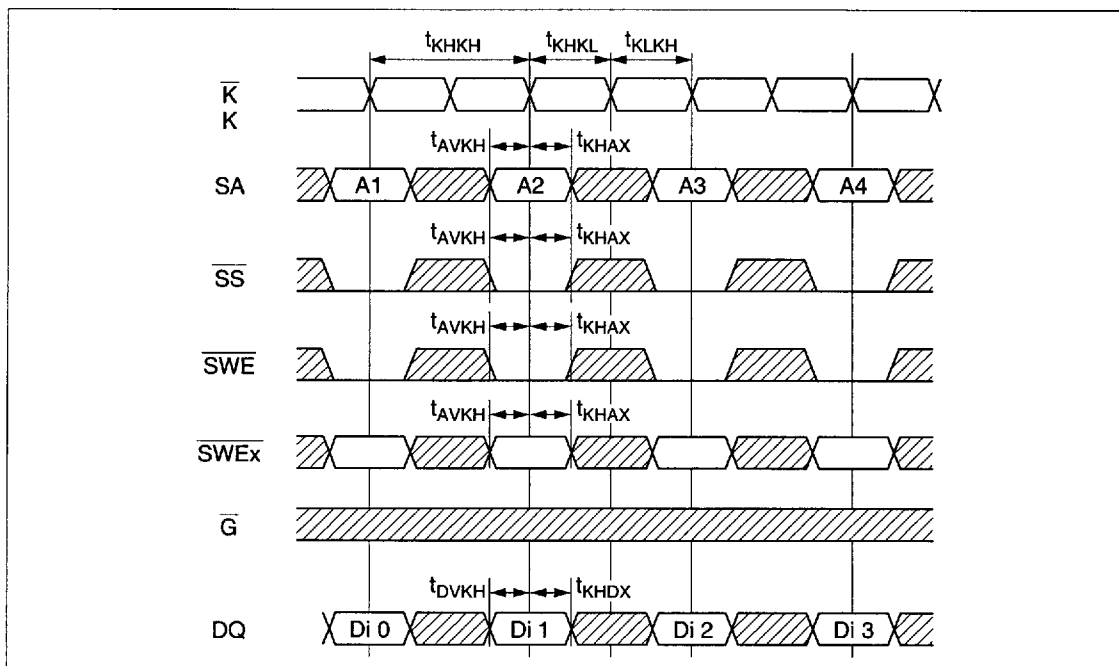
- Notes:
1. Do1 represents the output data for the input address A1.
  2.  $\overline{G} = V_{IL}$

## HM67S18258 Series

### Read Cycle 3 ( $\overline{G}$ Controlled)

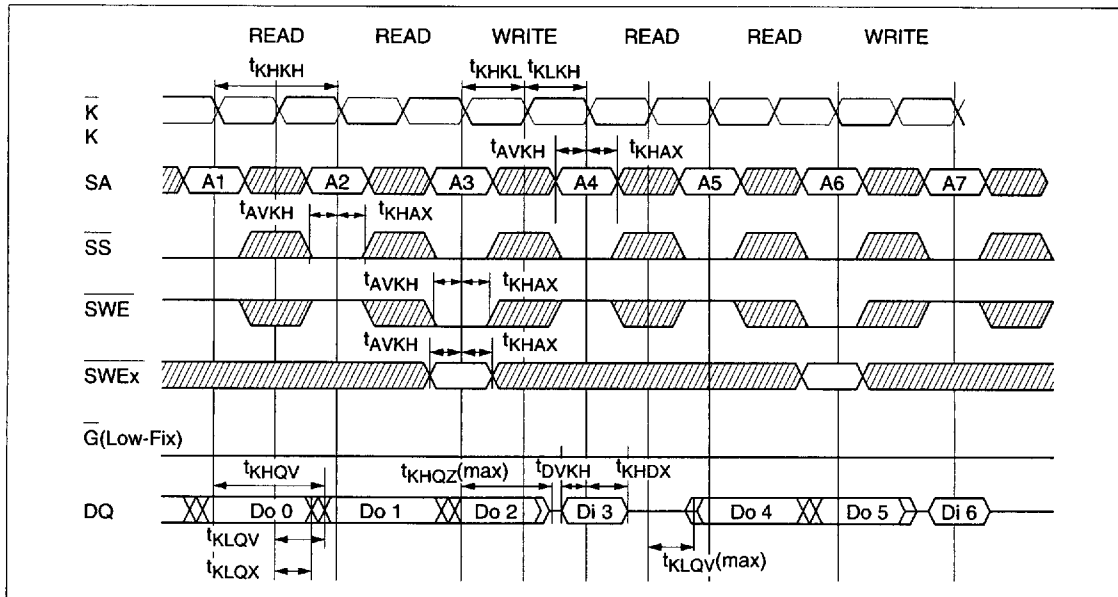


Write Cycle



## HM67S18258 Series

### Read-Write Cycle



Note: During this period  $DQ$  pins are in the output state so that the input signal of opposite phase to the outputs must not be applied.

## Boundary Scan Test Access Port Operations

### Overview

In order to perform the interconnect testing of the modules that include this SRAM, the serial boundary access port (TAP) is designed to operate in a manner consistent with IEEE Standard 1149.1 - 1990. But does not implement all of the functions required for 1149.1. the HM67S18258 contains a TAP controller. Instruction register, Boundary scan register, Bypass and ID register.

### Test Access Port Pins

| Symbol I/O | Name             |
|------------|------------------|
| TCK        | Test Clock       |
| TMS        | Test Mode Select |
| TDI        | Test Data In     |
| TDO        | Test Data Out    |

Note: This Device does not have a TRST (TAP Reset) pin. TRST is optional in IEEE 1149.1. To disable the TAP, TCK must be connected to  $V_{SS}$ . TDO should be left unconnected.

### TAP DC Operating Characteristics ( $T_a = 0^\circ\text{C}$ to $70^\circ\text{C}$ [ $T_j$ max = $110^\circ\text{C}$ ])

| Parameter                           | Symbol   | Min              | Max                      | Note |
|-------------------------------------|----------|------------------|--------------------------|------|
| Boundary scan Input High voltage    | $V_{IH}$ | 2.0 V            | $V_{DD} + 0.3 \text{ V}$ |      |
| Boundary scan Input Low voltage     | $V_{IL}$ | -0.5 V           | 0.8 V                    |      |
| Boundary scan Input Leakage Current | $I_{LI}$ | -1 $\mu\text{A}$ | +1 $\mu\text{A}$         | 1    |
| Boundary scan Output Low voltage    | $V_{OL}$ |                  | 0.4 V                    | 2    |
| Boundary scan Output High voltage   | $V_{OH}$ | 2.4 V            |                          | 3    |

Notes: 1.  $0 \leq V_{in} \leq V_{DD}$

2.  $I_{OL} = 2 \text{ mA}$

3.  $I_{OH} = -2 \text{ mA}$

## HM67S18258 Series

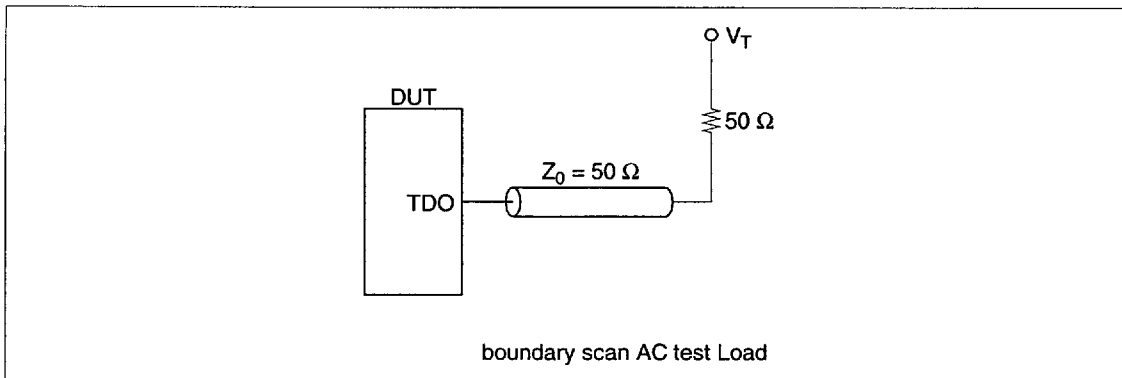
### TAP AC Operating Characteristics (Ta = 0°C to 70°C [Tj max = 110 °C])

| Parameter                   | Symbol     | Min | Max | Unit |
|-----------------------------|------------|-----|-----|------|
| Test Clock Cycle Time       | $t_{THTH}$ | 67  | —   | ns   |
| Test Clock High Pulse Width | $t_{THL}$  | 30  | —   | ns   |
| Test Clock Low Pulse Width  | $t_{LTH}$  | 30  | —   | ns   |
| Test Mode Select Setup      | $t_{MVTH}$ | 10  | —   | ns   |
| Test Mode Select Hold       | $t_{THMX}$ | 10  | —   | ns   |
| Capture Setup               | $t_{CS}$   | 10  | —   | ns   |
| Capture Hold                | $t_{CH}$   | 10  | —   | ns   |
| TDI Valid to TCK High       | $t_{DVTH}$ | 10  | —   | ns   |
| TCK High to TDI Don't Care  | $t_{THDX}$ | 10  | —   | ns   |
| TCK Low to TDO Unknown      | $t_{TLQX}$ | 0   | —   | ns   |
| TCK Low to TDO Valid        | $t_{TLOV}$ | —   | 20  | ns   |

Note:  $t_{CS} + t_{CH}$  defines the minimum pause in RAM I/O pad transitions to assure pad data capture.

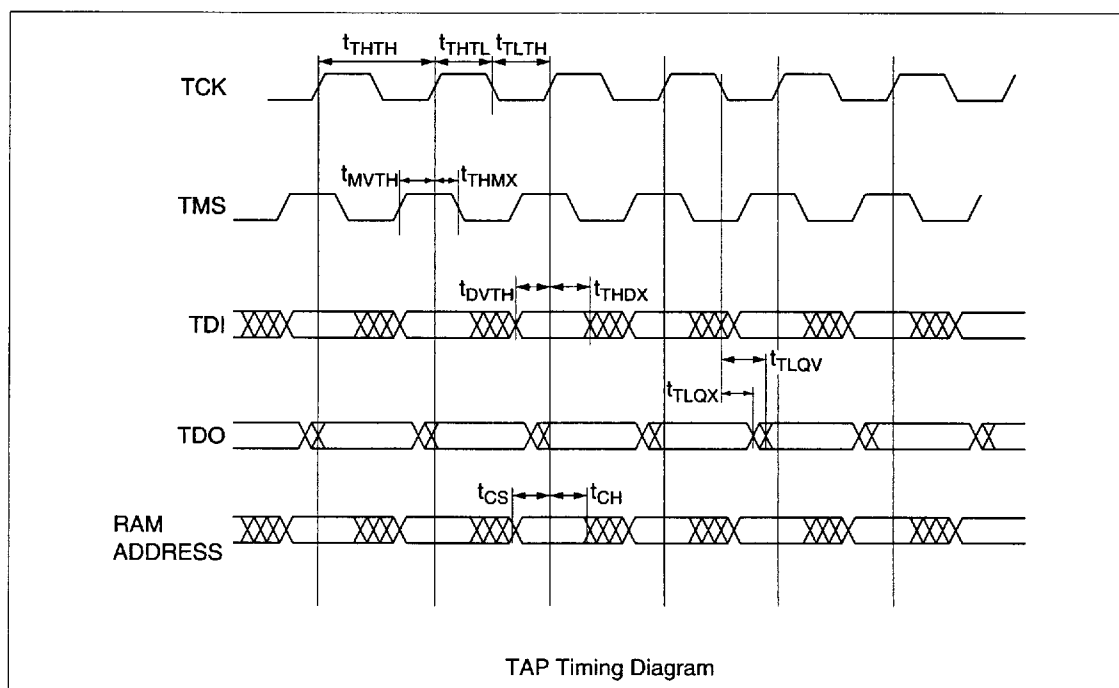
**TAP AC Test Conditions**

- |                                                  |                                                                                            |
|--------------------------------------------------|--------------------------------------------------------------------------------------------|
| • Temperature                                    | $0^{\circ}\text{C} \leq T_a \leq 70^{\circ}\text{C}$ [ $T_j$ max = $110^{\circ}\text{C}$ ] |
| • Input Reference Point for Single-Ended Signals | 1.5 V                                                                                      |
| • Input pulse levels                             | 0 to 2.5 V                                                                                 |
| • Input Rise/Fall Time                           | 2.0 ns typical (10% to 90%)                                                                |
| • Output timing reference                        | 1.5 V                                                                                      |
| • Test load termination supply voltage ( $V_T$ ) | 1.5 V                                                                                      |
| • Output Load                                    | See figures                                                                                |



## HM67S18258 Series

### TAP Timing Diagram



**Test Access Port Registers**

| Register Name          | Length  | Symbol    | Note |
|------------------------|---------|-----------|------|
| Instruction Register   | 3 bits  | IR [0;2]  |      |
| Bypass Register        | 1 bits  | BP        |      |
| ID Register            | 32 bits | ID [0;31] |      |
| Boundary Scan Register | 51 bits | BS [1;70] |      |

**TAP Controller Instruction Set**

| IR2 | IR1 | IR0 | Instruction | Operation                                           |
|-----|-----|-----|-------------|-----------------------------------------------------|
| 0   | 0   | 0   | SAMPLE-Z    | Tristate all data drivers and capture the pad value |
| 0   | 0   | 1   | IDCODE      |                                                     |
| 0   | 1   | 0   | SAMPLE-Z    | Tristate all data drivers and capture the pad value |
| 0   | 1   | 1   | BYPASS      |                                                     |
| 1   | 0   | 0   | SAMPLE      |                                                     |
| 1   | 0   | 1   | BYPASS      |                                                     |
| 1   | 1   | 0   | BYPASS      |                                                     |
| 1   | 1   | 1   | BYPASS      |                                                     |

Note: This Device does not perform EXTEST, INTEST or the preload portion of the PRELOAD command in IEEE 1149.1.

## HM67S18258 Series

### Boundary Scan Order

| Bit # | Bump ID | Signal Name              | Bit # | Bump ID | Signal Name              |
|-------|---------|--------------------------|-------|---------|--------------------------|
| 1     | 5R      | M2                       | 27    | 2B      | NC                       |
| 2     | 6T      | SA4                      | 28    | 3A      | SA14                     |
| 3     | 4P      | SA5                      | 29    | 3C      | SA15                     |
| 4     | 6R      | SA6                      | 30    | 2C      | SA16                     |
| 5     | 5T      | SA7                      | 31    | 2A      | SA17                     |
| 6     | 7T      | ZZ                       | 32    | 1D      | DQc0                     |
| 7     | 7P      | DQa0                     | 33    | 2E      | DQc1                     |
| 8     | 6N      | DQa1                     | 34    | 2G      | DQc2                     |
| 9     | 6L      | DQa2                     | 35    | 1H      | DQc3                     |
| 10    | 7K      | DQa3                     | 36    | 3G      | $\overline{\text{SWEc}}$ |
| 11    | 5L      | $\overline{\text{SWEa}}$ | 37    | 4D      | NC                       |
| 12    | 4L      | $\overline{\text{K}}$    | 38    | 4E      | $\overline{\text{SS}}$   |
| 13    | 4K      | K                        | 39    | 4G      | NC                       |
| 14    | 4F      | $\overline{\text{G}}$    | 40    | 4H      | NC                       |
| 15    | 6H      | DQa4                     | 41    | 4M      | $\overline{\text{SWE}}$  |
| 16    | 7G      | DQa5                     | 42    | 2K      | DQc4                     |
| 17    | 6F      | DQa6                     | 43    | 1L      | DQc5                     |
| 18    | 7E      | DQa7                     | 44    | 2M      | DQc6                     |
| 19    | 6D      | DQa8                     | 45    | 1N      | DQc7                     |
| 20    | 6A      | SA8                      | 46    | 2P      | DQc8                     |
| 21    | 6C      | SA9                      | 47    | 3T      | SA0                      |
| 22    | 5C      | SA10                     | 48    | 2R      | SA1                      |
| 23    | 5A      | SA11                     | 49    | 4N      | SA2                      |
| 24    | 6B      | NC                       | 50    | 2T      | SA3                      |
| 25    | 5B      | SA12                     | 51    | 3R      | M1                       |
| 26    | 3B      | SA13                     |       |         |                          |

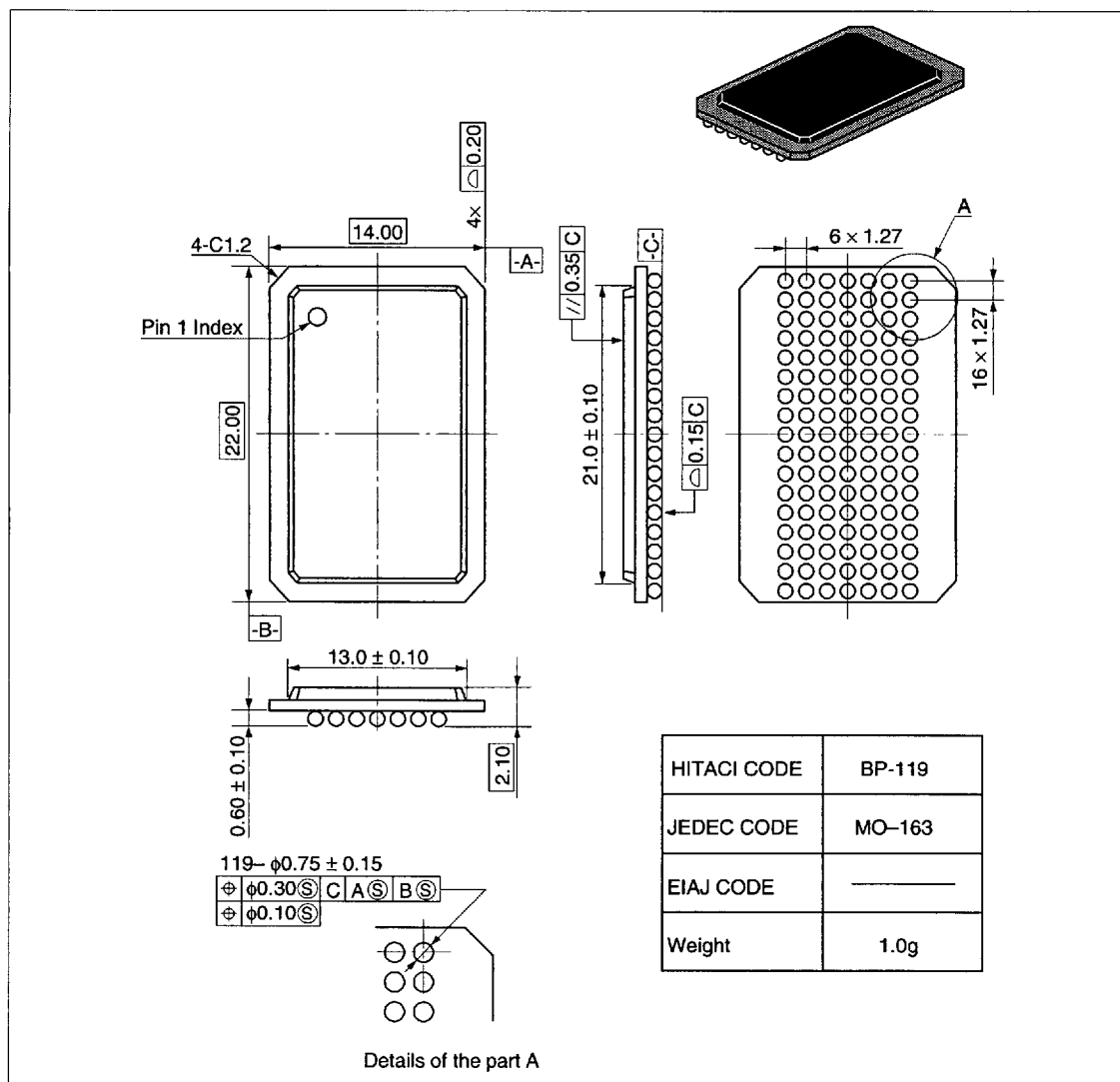
- Notes:
1. Bit#1 is the first scan bit to exit the chip.
  2. NC pads listed in the TABLE are represented in the Boundary Scan Register by a Place Holder. Place Holder registers are internally connected to  $V_{SS}$ .
  3. The clock pins (K and  $\overline{\text{K}}$ ) are needed as PECL differential levels. And, clock receiver generated single clock signal. This signal and its inverted signal are used for Boundary Scan Register input signal.



# HM67S18258 Series

## Package Outline

Unit : mm



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