**64Mbyte (16Mx36) FP Mode 4K Ref. 72pin-SIMM Design**
**Part No. HMD16M32M8GH**

## GENERAL DESCRIPTION

The HMD16M32M8GH is a 16M x 32bit dynamic RAM high-density memory module. The module consists of eight CMOS 16M x 4bit DRAMs in 32-pin SOJ or TSOP packages mounted on a 72-pin glass-epoxy substrate. A 0.1 or 0.22uF decoupling capacitor is mounted on the printed circuit board for each DRAM components. The module is a Single In-line Memory Module with edge connections and is intended for mounting in to 72-pin edge connector sockets. All module components may be powered from a single 5V DC power supply and all inputs and outputs are TTL-compatible.

## FEATURES

- Part Identification
  HMD16M32M8GH
  ---4K Cycles/64ms Ref, Gold
- Access times : 50, 60ns
- High-density 64MByte design
- Single + 5V ±0.5V power supply
- JEDEC standard Pdpin & pinout
- TTL compatible inputs and outputs
- /CAS-before-/RAS & Hidden Refresh capability
- /RAS-only refresh capability
- Fast Page Mode Operation

## OPTIONS MARKING

- Timing
  - 50ns access -5
  - 60ns access -6
- Packages
  - 72-pin SIMM M

## PERFORMANCE RANGE

| Speed | $t_{RAC}$ | $t_{CAC}$ | $t_{RC}$ |
|---|---|---|---|
| 5 | 50ns | 13ns | 90ns |
| 6 | 60ns | 15ns | 110ns |

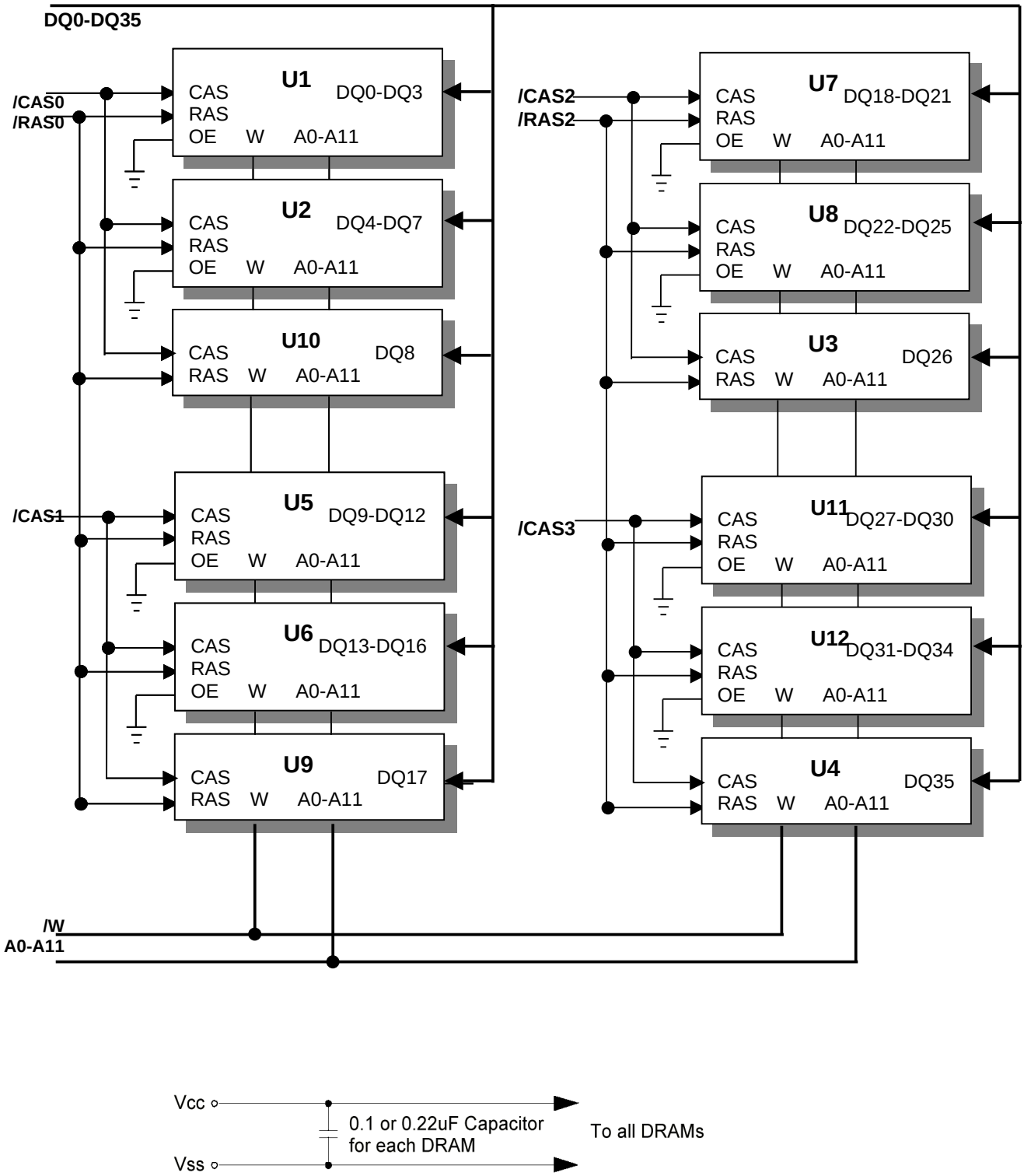
## PRESENCE DETECT PINS

| Pin | 50ns | 60ns |
|---|---|---|
| PD1 | Vss | Vss |
| PD2 | NC | NC |
| PD3 | Vss | NC |
| PD4 | Vss | NC |

## PIN ASSIGNMENT

| PIN | SYMBOL | PIN | SYMBOL | PIN | SYMBOL | PIN | SYMBOL |
|---|---|---|---|---|---|---|---|
| 1 | Vss | 19 | A10 | 37 | NC | 55 | DQ12 |
| 2 | DQ0 | 20 | DQ4 | 38 | NC | 56 | DQ30 |
| 3 | DQ18 | 21 | DQ22 | 39 | Vss | 57 | DQ13 |
| 4 | DQ1 | 22 | DQ5 | 40 | /CAS0 | 58 | DQ31 |
| 5 | DQ19 | 23 | DQ23 | 41 | /CAS2 | 59 | Vcc |
| 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 | NC | 63 | DQ15 |
| 10 | Vcc | 28 | A7 | 46 | NC | 64 | DQ34 |
| 11 | NC | 29 | A11 | 47 | /W | 65 | DQ16 |
| 12 | A0 | 30 | Vcc | 48 | NC | 66 | NC |
| 13 | A1 | 31 | A8 | 49 | DQ9 | 67 | PD1 |
| 14 | A2 | 32 | A9 | 50 | DQ27 | 68 | PD2 |
| 15 | A3 | 33 | NC | 51 | DQ10 | 69 | PD3 |
| 16 | A4 | 34 | /RAS2 | 52 | DQ28 | 70 | PD4 |
| 17 | A5 | 35 | NC | 53 | DQ11 | 71 | NC |
| 18 | A6 | 36 | NC | 54 | DQ29 | 72 | Vss |

## FUNCTIONAL BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | RATING |
|---|---|---|
| Voltage on Any Pin Relative to Vss | $V_{IN,OUT}$ | -1V to 7.0V |
| Voltage on Vcc Supply Relative to Vss | Vcc | -1V to 7.0V |
| Power Dissipation | $P_D$ | 12W |
| Storage Temperature | $T_{STG}$ | -55°C to 125°C |
| Short Circuit Output Current | $I_{OS}$ | 50mA |

w Permanent device damage may occur if " Absolute Maximum Ratings" are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## RECOMMENDED DC OPERATING CONDITIONS

( Voltage reference to $V_{SS}$, $T_A$=0 to 70 °C )

| PARAMETER | SYMBOL | MIN | TYP. | MAX | UNIT |
|---|---|---|---|---|---|
| Supply Voltage | Vcc | 4.5 | 5.0 | 5.5 | V |
| Ground | Vss | 0 | 0 | 0 | V |
| Input High Voltage | $V_{IH}$ | 2.4 | - | Vcc | V |
| Input Low Voltage | $V_{IL}$ | -1.0 | - | 0.8 | V |

## DC AND OPERATING CHARACTERISTICS

| SYMBOL | SPEED | MIN | MAX | UNITS |
|---|---|---|---|---|
| $I_{CC1}$ | -5 | - | 1080 | mA |
| | -6 | - | 960 | mA |
| $I_{CC2}$ | Don't care | - | 24 | mA |
| $I_{CC3}$ | -5 | - | 1080 | mA |
| | -6 | - | 960 | mA |
| $I_{CC4}$ | -5 | - | 840 | mA |
| | -6 | - | 600 | mA |
| $I_{CC5}$ | Don't care | - | 12 | mA |
| $I_{CC6}$ | -5 | - | 1080 | mA |
| | -6 | - | 960 | mA |
| $I_{I(L)}$ | Don't care | -10 | 10 | µA |
| $I_{O(L)}$ | | -5 | 5 | µA |
| $V_{OH}$ | | 2.4 | - | V |
| $V_{OL}$ | | - | 0.4 | V |

$I_{CC1}$ : Operating Current * (/RAS , /CAS , Address cycling @$t_{RC}$=min.)

$I_{CC2}$ : Standby Current ( /RAS=/CAS=$V_{IH}$ )

$I_{CC3}$ : /RAS Only Refresh Current * ( /CAS=$V_{IH}$, /RAS, Address cycling @$t_{RC}$=min )

$I_{CC4}$ : Fast Page Mode Current * (/RAS=$V_{IL}$, /CAS, Address cycling @$t_{PC}$=min )

$I_{CC5}$ : Standby Current (/RAS=/CAS=Vcc-0.2V )

$I_{CC6}$ : /CAS-Before-/RAS Refresh Current * (/RAS and /CAS cycling @$t_{RC}$=min )

$I_{IL}$ : Input Leakage Current (Any input 0V ≤ $V_{IN}$ ≤ 6.5V, all other pins not under test = 0V)

$I_{OL}$ : Output Leakage Current (Data out is disabled, 0V ≤ $V_{OUT}$ ≤ 5.5V

$V_{OH}$ : Output High Voltage Level ($I_{OH}$= -5mA )

$V_{OL}$ : Output Low Voltage Level ($I_{OL}$ = 4.2mA )

* **NOTE**: $I_{CC1}$, $I_{CC3}$, $I_{CC4}$ and $I_{CC6}$ are dependent on output loading and cycle rates. Specified values are obtained with the output open. $I_{CC}$ is specified as an average current. In $I_{CC1}$ and $I_{CC3}$, address cad be changed maximum once while /RAS=$V_{IL}$. In $I_{CC4}$, address can be changed maximum once within one page mode cycle.

## CAPACITANCE ( $T_A$=25°C, Vcc = 5V, f = 1Mz )

| DESCRIPTION | SYMBOL | MIN | MAX | UNITS |
|---|---|---|---|---|
| Input Capacitance (A0-A11) | $C_{IN1}$ | - | 50 | pF |
| Input Capacitance (/W) | $C_{IN2}$ | - | 66 | pF |
| Input Capacitance (/RAS0) | $C_{IN3}$ | - | 38 | pF |
| Input Capacitance (/CAS0-/CAS3) | $C_{IN4}$ | - | 24 | pF |
| Input/Output Capacitance (DQ0-31) | $C_{DQ1}$ | - | 17 | pF |

## AC CHARACTERISTICS ( 0°C ≤ $T_A$ ≤ 70°C , Vcc = 5V±10%, See notes 1,2.)

| PARAMETER | SYMBOL | -5 | | -6 | | UNIT |
|---|---|---|---|---|---|---|
| | | MIN | MAX | MIN | MAX | |
| Random read or write cycle time | $t_{RC}$ | 84 | | 104 | | ns |
| Access time from /RAS | $t_{RAC}$ | | 50 | | 60 | ns |
| Access time from /CAS | $t_{CAC}$ | | 13 | | 15 | ns |
| Access time from column address | $t_{AA}$ | | 25 | | 30 | ns |
| /CAS to output in Low-Z | $t_{CLZ}$ | 3 | | 3 | | ns |
| Output buffer turn-off delay | $t_{OFF}$ | 3 | 13 | 3 | 15 | ns |
| Transition time (rise and fall) | $t_T$ | 1 | 50 | 1 | 50 | ns |
| /RAS precharge time | $t_{RP}$ | 30 | | 40 | | ns |
| /RAS pulse width | $t_{RAS}$ | 50 | 10K | 60 | 10K | ns |
| /RAS hold time | $t_{RSH}$ | 13 | | 15 | | ns |
| /CAS hold time | $t_{CSH}$ | 38 | | 45 | | ns |
| /CAS pulse width | $t_{CAS}$ | 8 | 10K | 10 | 10K | ns |
| /RAS to /CAS delay time | $t_{RCD}$ | 20 | 37 | 20 | 45 | ns |

| | | | | | | |
|---|---|---|---|---|---|---|
| /RAS to column address delay time | $t_{RAD}$ | 15 | 25 | 15 | 30 | ns |
| /CAS to /RAS precharge time | $t_{CRP}$ | 5 | | 5 | | ns |
| Row address set-up time | $t_{ASR}$ | 0 | | 0 | | ns |
| Row address hold time | $t_{RAH}$ | 10 | | 10 | | ns |
| Column address set-up time | $t_{ASC}$ | 0 | | 0 | | ns |
| Column address hold time | $t_{CAH}$ | 8 | | 10 | | ns |
| Column address hold referenced to /RAS | $t_{AR}$ | 50 | | 55 | | ns |
| Column Address to /RAS lead time | $t_{RAL}$ | 25 | | 30 | | ns |
| Read command set-up time | $t_{RCS}$ | 0 | | 0 | | ns |
| Read command hold referenced to /CAS | $t_{RCH}$ | 0 | | 0 | | ns |
| Read command hold referenced to /RAS | $t_{RRH}$ | 0 | | 0 | | ns |
| Write command hold time | $t_{WCH}$ | 10 | | 10 | | ns |
| Write command hold referenced to /RAS | $t_{WCR}$ | 50 | | 55 | | ns |
| Write command pulse width | $t_{WP}$ | 10 | | 10 | | ns |
| Write command to /RAS lead time | $t_{RWL}$ | 13 | | 10 | | ns |
| Write command to /CAS lead time | $t_{CWL}$ | 8 | | 10 | | ns |
| Data-in set-up time | $t_{DS}$ | 0 | | 0 | | ns |
| Data-in hold time | $t_{DH}$ | 8 | | 10 | | ns |
| Data-in hold referenced to /RAS | $t_{DHR}$ | 50 | | 55 | | ns |
| Refresh period | $t_{REF}$ | | 64 | | 64 | ns |
| Write command set-up time | $t_{WCS}$ | 0 | | 0 | | ns |
| /CAS setup time (C-B-R refresh) | $t_{CSR}$ | 5 | | 5 | | ns |
| /CAS hold time (C-B-R refresh) | $t_{CHR}$ | 10 | | 10 | | ns |
| /RAS precharge to /CAS hold time | $t_{RPC}$ | 5 | | 5 | | ns |
| Access time from /CAS precharge | $t_{CPA}$ | | 28 | | 35 | ns |
| Fast page mode cycle time | $t_{PC}$ | 40 | | 45 | | ns |
| /CAS precharge time (Fast page) | $t_{CP}$ | 8 | | 10 | | ns |
| /RAS pulse width (Fast page ) | $t_{RASP}$ | 50 | 200K | 60 | 200K | ns |
| /W to /RAS precharge time(C-B-R refresh) | $t_{WRP}$ | 10 | | 10 | | ns |
| /W to /RAS hold time (C-B-R refresh) | $t_{WRH}$ | 10 | | 10 | | ns |
| /CAS precharge(C-B-R counter test) | $t_{CPT}$ | 20 | | 30 | | ns |

**NOTES**

1. An initial pause of 200μs is required after power-up followed by any 8 /RAS-only or /CAS-before-/RAS refresh cycles before proper device operation is achieved.
2. $V_{IH\ (min)}$ and $V_{IL\ (max)}$ are reference levels for measuring timing of input signals. Transition times are measured between $V_{IH(min)}$ and $V_{IL(max)}$ and are assumed to be 5ns for all inputs.
3. Measured with a load equivalent to 2TTL loads and 100pF
4. Operation within the $t_{RCD(max)}$ limit insures that $t_{RAC(max)}$ can be met. $t_{RCD(max)}$ is specified as a reference point only. If $t_{RCD}$ is greater than the specified $t_{RCD(max)}$ limit, then access time is controlled exclusively by $t_{CAC}$.

5.Assumes that $t_{RCD} \geq t_{RCD(max)}$

6. $t_{AR}$, $t_{WCR}$, $t_{DHR}$ are referenced to $t_{RAD(max)}$

7.This parameter defines the time at which the output achieves the open circuit condition and is not referenced to $V_{OH}$ or $V_{OL}$.

8. $t_{WCS}$, $t_{RWD}$, $t_{CWD}$ anf $t_{AWD}$ are non restrictive operating parameter.
They are included in the data sheet as electrical characteristic only. If $t_{WCS} \geq t_{WCS(min)}$ the cycle is an early write cycle and the data out pin will remain high impedance for the duration of the cycle.

9. Either $t_{RCH}$ or $t_{RRH}$ must be satisfied for a read cycle.

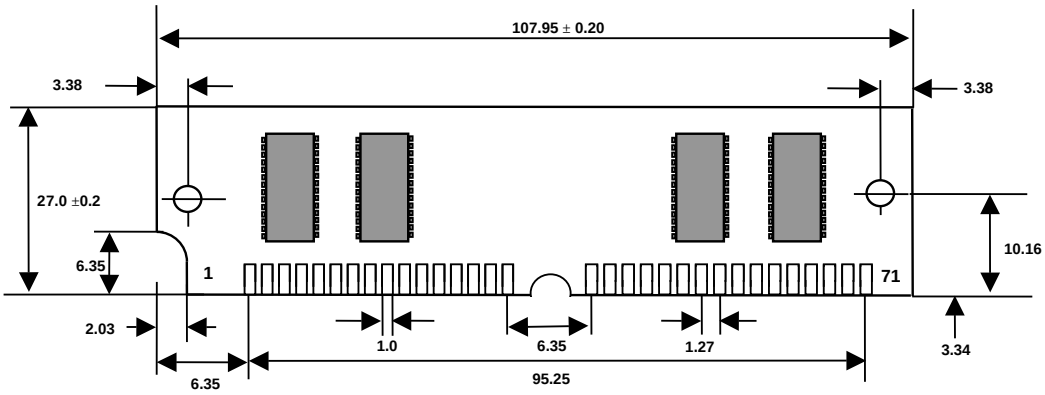
10. These parameters are referenced to the /CAS leading edge in early write cycles and to the /W leading edge in read-write cycles.

11. Operation within the $t_{RAD(max)}$ limit insures that $t_{RAC(max)}$ can be met. $t_{RAD(max)}$ is specified as a reference point only. If $t_{RAD}$ is greater than the specified $t_{RAD(max)}$ limit. then access time is controlled by $t_{AA}$.

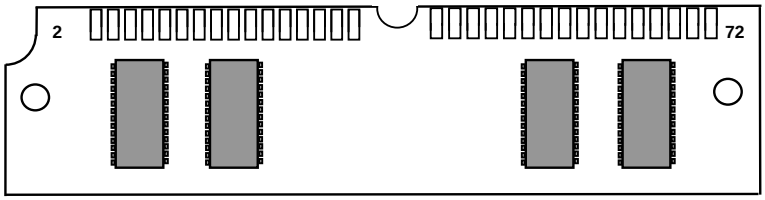
## PACKAGING INFORMATION

**SIMM Design**

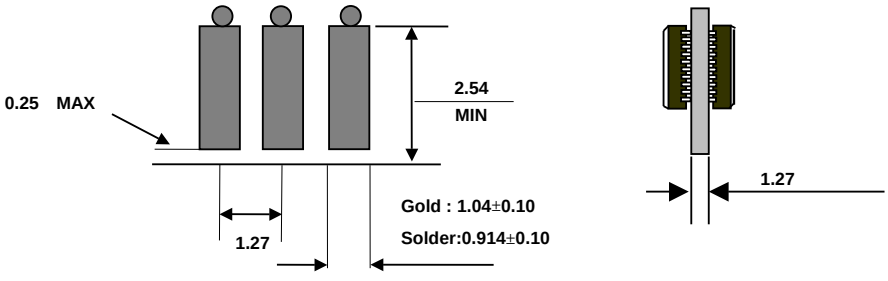
**Unit :** mm




**Front View**




**Back View**




## ORDERING INFORMATION

| Part Number | Density | Org. | Package | Ref. | Vcc | MODE | SPEED |
|---|---|---|---|---|---|---|---|
| **HMD16M32M8GH-5** | 64Byte | x 32 | 72 Pin-SIMM-Gold | 4K | 5V | FPM | 50ns |
| **HMD16M32M8GH-6** | 64Byte | x 32 | 72 Pin-SIMM-Gold | 4K | 5V | FPM | 60ns |