

**64Mx64bits****PC100 SDRAM Unbuffered DIMM*****based on 32Mx8 SDRAM with LVTTL, 4 banks & 8K Refresh******HYM72V64656H(L)T8 Series***

## DESCRIPTION

The HYM72V64656H(L)T8 H-series are high speed 3.3-Volt synchronous dynamic RAM Modules composed of sixteen 32Mx8 bit Synchronous DRAMs in 54-pin TSOPII and 8-pin TSSOP 2K bit EEPROM on a 168-pin glass-epoxy printed circuit board. One 0.33mF and one 0.1mF decoupling capacitors per each SDRAM are mounted on the module.

The HYM72V64656H(L)T8 H-series are gold plated socket type Dual In-line Memory Modules suitable for easy interchange and addition of 512M bytes memory. All addresses, data and control inputs are latched on the rising edge of the master clock input. The data paths are internally pipelined to achieve very high bandwidths.

## FEATURES

- 1.15(29.21mm) PCB Height
- 168-Pin Unbuffered DIMM with Double Sided
- One 0.33mF and one 0.1mF decoupling capacitors adopted
- Serial Presence Detect with Serial E<sup>2</sup>PROM
- Meets all the other JEDEC specifications
- Single 3.3V±0.3V power supply
- All device pins are LVTTL compatible
- 8192 refresh cycles / 64ms
- Fully synchronous ; all inputs referenced to positive edge of system clock
- Quad internal banks with single pulsed /RAS
- Auto precharge/precharge all banks by A<sub>10</sub> flag
- Possible to assert random column address every clock cycle
- Interleaved auto refresh mode
- Programmable burst lengths and sequences
  - 1,2,4,8,full page for Sequential type
  - 1,2,4,8 for Interleave type
- Programmable /CAS latency ; 2,3 clocks
- Support clock suspend/power down mode by CKE0, CKE1
- Data mask function by DQM
- Mode register set programming
- Burst termination command
- Self refresh provides minimum power, full internal refresh control

## ORDERING INFORMATION

| Part No.          | Clock Frequency | Internal Bank | Ref. | Power     | SDRAM Package | Plating |
|-------------------|-----------------|---------------|------|-----------|---------------|---------|
| HYM72V64656HT8-P  | 100MHz          | 4 Banks       | 8K   | Normal    | TSOP-II       | Gold    |
| HYM72V64656HT8-S  | 100MHz          |               |      |           |               |         |
| HYM72V64656HLT8-P | 100MHz          |               |      | Low Power |               |         |
| HYM72V64656HLT8-S | 100MHz          |               |      |           |               |         |

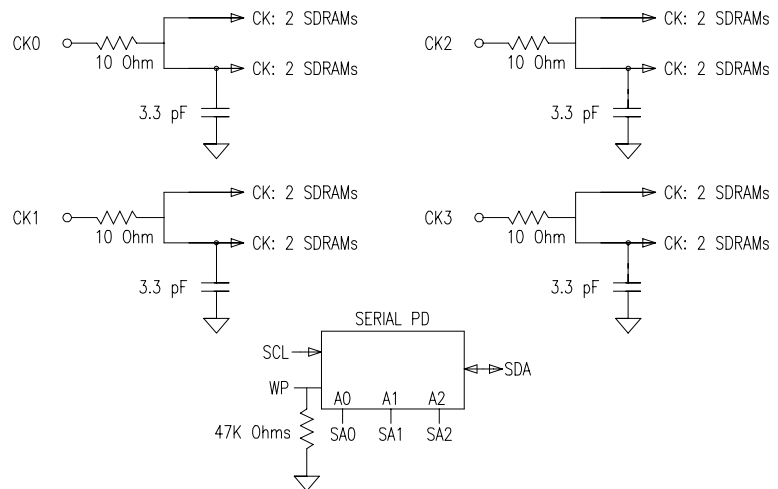
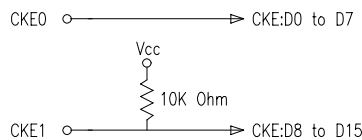
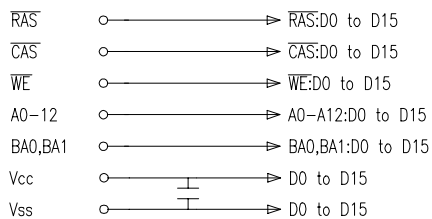
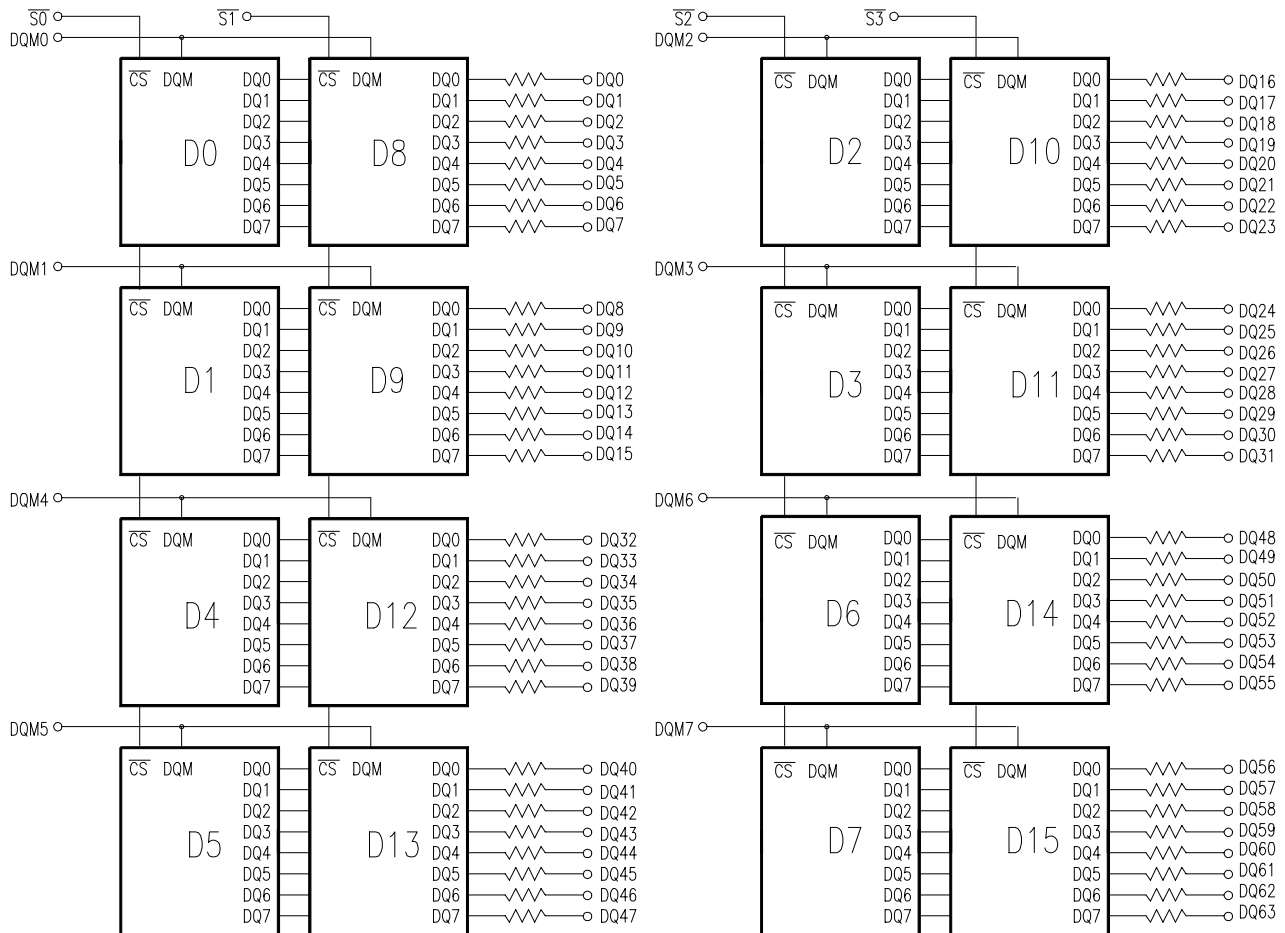
### PIN DESCRIPTION

| PIN             | PIN NAME                                                | DESCRIPTION                                                                                                                        |
|-----------------|---------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| CK0~CK3         | Clock Inputs                                            | The system clock input. All other inputs are registered to the SDRAM on the rising edge of CLK                                     |
| CKE0,CKE1       | Clock Enable                                            | Controls internal clock signal and when deactivated, the SDRAM will be one of the states among power down, suspend or self refresh |
| /S0~/S3         | Chip Select                                             | Enables or disables all inputs except CK, CKE and DQM                                                                              |
| BA0, BA1        | SDRAM Bank Address                                      | Selects bank to be activated during /RAS activity<br>Selects bank to be read/written during /CAS activity                          |
| A0 ~ A12        | Address                                                 | Row Address : RA0 ~ RA12, Column Address : CA0 ~ CA9<br>Auto-precharge flag : A10                                                  |
| /RAS, /CAS, /WE | Row Address Strobe, Column Address Strobe, Write Enable | /RAS, /CAS and /WE define the operation<br>Refer function truth table for details                                                  |
| DQM0~DQM7       | Data Input/Output Mask                                  | Controls output buffers in read mode and masks input data in write mode                                                            |
| DQ0 ~ DQ63      | Data Input/Output                                       | Multiplexed data input / output pin                                                                                                |
| VCC             | Power Supply (3.3V)                                     | Power supply for internal circuits and input buffers                                                                               |
| VSS             | Ground                                                  | Ground                                                                                                                             |
| SCL             | SPD Clock Input                                         | Serial Presence Detect Clock input                                                                                                 |
| SDA             | SPD Data Input/Output                                   | Serial Presence Detect Data input/output                                                                                           |
| SA0~2           | SPD Address Input                                       | Serial Presence Detect Address Input                                                                                               |
| WP              | Write Protect for SPD                                   | Write Protect for Serial Presence Detect on DIMM                                                                                   |
| NC              | No Connection                                           | No connection                                                                                                                      |

### PIN ASSIGNMENTS

| FRONT SIDE      |        | BACK SIDE |      | FRONT SIDE |      | BACK SIDE |      |
|-----------------|--------|-----------|------|------------|------|-----------|------|
| PIN NO.         | NAME   | PIN NO.   | NAME | PIN NO.    | NAME | PIN NO.   | NAME |
| 1               | VSS    | 85        | VSS  | 41         | VCC  | 125       | *CK1 |
| 2               | DQ0    | 86        | DQ32 | 42         | CK0  | 126       | A12  |
| 3               | DQ1    | 87        | DQ33 | 43         | VSS  | 127       | VSS  |
| 4               | DQ2    | 88        | DQ34 | 44         | NC   | 128       | CKE0 |
| 5               | DQ3    | 89        | DQ35 | 45         | /S2  | 129       | /S3  |
| 6               | VCC    | 90        | VCC  | 46         | DQM2 | 130       | DQM6 |
| 7               | DQ4    | 91        | DQ36 | 47         | DQM3 | 131       | DQM7 |
| 8               | DQ5    | 92        | DQ37 | 48         | NC   | 132       | NC   |
| 9               | DQ6    | 93        | DQ38 | 49         | VCC  | 133       | VCC  |
| 10              | DQ7    | 94        | DQ39 | 50         | NC   | 134       | NC   |
| Achitecture Key |        |           |      | 51         | NC   | 135       | NC   |
|                 |        |           |      | 52         | NC   | 136       | NC   |
| 11              | DQ8    | 95        | DQ40 | 53         | NC   | 137       | NC   |
| 12              | VSS    | 96        | VSS  | 54         | VSS  | 138       | VSS  |
| 13              | DQ9    | 97        | DQ41 | 55         | DQ16 | 139       | DQ48 |
| 14              | DQ10   | 98        | DQ42 | 56         | DQ17 | 140       | DQ49 |
| 15              | DQ11   | 99        | DQ43 | 57         | DQ18 | 141       | DQ50 |
| 16              | DQ12   | 100       | DQ44 | 58         | DQ19 | 142       | DQ51 |
| 17              | DQ13   | 101       | DQ45 | 59         | VCC  | 143       | VCC  |
| 18              | VCC    | 102       | VCC  | 60         | DQ20 | 144       | DQ52 |
| 19              | DQ14   | 103       | DQ46 | 61         | NC   | 145       | NC   |
| 20              | DQ15   | 104       | DQ47 | 62         | NC   | 146       | NC   |
| 21              | NC     | 105       | NC   | 63         | NC   | 147       | NC   |
| 22              | NC     | 106       | NC   | 64         | VSS  | 148       | VSS  |
| 23              | VSS    | 107       | VSS  | 65         | DQ21 | 149       | DQ53 |
| 24              | NC     | 108       | NC   | 66         | DQ22 | 150       | DQ54 |
| 25              | NC     | 109       | NC   | 67         | DQ23 | 151       | DQ55 |
| 26              | VCC    | 110       | VCC  | 68         | VSS  | 152       | VSS  |
| 27              | /WE    | 111       | /CAS | 69         | DQ24 | 153       | DQ56 |
| 28              | DQM0   | 112       | DQM4 | 70         | DQ25 | 154       | DQ57 |
| 29              | DQM1   | 113       | DQM5 | 71         | DQ26 | 155       | DQ58 |
| 30              | /S0    | 114       | /S1  | 72         | DQ27 | 156       | DQ59 |
| 31              | NC     | 115       | /RAS | 73         | VCC  | 157       | VCC  |
| 32              | VSS    | 116       | VSS  | 74         | DQ28 | 158       | DQ60 |
| 33              | A0     | 117       | A1   | 75         | DQ29 | 159       | DQ61 |
| 34              | A2     | 118       | A3   | 76         | DQ30 | 160       | DQ62 |
| 35              | A4     | 119       | A5   | 77         | DQ31 | 161       | DQ63 |
| 36              | A6     | 120       | A7   | 78         | VSS  | 162       | VSS  |
| 37              | A8     | 121       | A9   | 79         | CK2  | 163       | *CK3 |
| 38              | A10/AP | 122       | BA0  | 80         | NC   | 164       | NC   |
| 39              | BA1    | 123       | A11  | 81         | WP   | 165       | SA0  |
| 40              | VCC    | 124       | VCC  | 82         | SDA  | 166       | SA1  |
| Voltage Key     |        |           |      | 83         | SCL  | 167       | SA2  |
|                 |        |           |      | 84         | VCC  | 168       | VCC  |

### BLOCK DIAGRAM



Note : 1. The serial resistor values of DQs are 10ohms

### SERIAL PRESENCE DETECT

| BYTE NUMBER   | FUNCTION DESCRIPTION                                         | FUNCTION                                                                                                               |                | VALUE                                  |     | NOTE |
|---------------|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|----------------|----------------------------------------|-----|------|
|               |                                                              | -P                                                                                                                     | -S             | -P                                     | -S  |      |
| BYTE0         | # of Bytes Written into Serial Memory at Module Manufacturer | 128 Bytes                                                                                                              |                | 80h                                    |     |      |
| BYTE1         | Total # of Bytes of SPD Memory Device                        | 256 Bytes                                                                                                              |                | 08h                                    |     |      |
| BYTE2         | Fundamental Memory Type                                      | SDRAM                                                                                                                  |                | 04h                                    |     |      |
| BYTE3         | # of Row Addresses on This Assembly                          | 13                                                                                                                     |                | 0Dh                                    |     | 1    |
| BYTE4         | # of Column Addresses on This Assembly                       | 10                                                                                                                     |                | 0Ah                                    |     |      |
| BYTE5         | # of Module Banks on This Assembly                           | 2 Bank                                                                                                                 |                | 02h                                    |     |      |
| BYTE6         | Data Width of This Assembly                                  | 64 Bits                                                                                                                |                | 40h                                    |     |      |
| BYTE7         | Data Width of This Assembly (Continued)                      | -                                                                                                                      |                | 00h                                    |     |      |
| BYTE8         | Voltage Interface Standard of This Assembly                  | LVTTL                                                                                                                  |                | 01h                                    |     |      |
| BYTE9         | SDRAM Cycle Time @/CAS Latency=3                             | 10ns                                                                                                                   | 10ns           | A0h                                    | A0h |      |
| BYTE10        | Access Time from Clock @/CAS Latency=3                       | 6ns                                                                                                                    | 6ns            | 60h                                    | 60h |      |
| BYTE11        | DIMM Configuration Type                                      | None                                                                                                                   |                | 00h                                    |     |      |
| BYTE12        | Refresh Rate/Type                                            | 7.815us<br>/ Self Refresh Supported                                                                                    |                | 82h                                    |     |      |
| BYTE13        | Primary SDRAM Width                                          | x8                                                                                                                     |                | 08h                                    |     |      |
| BYTE14        | Error Checking SDRAM Width                                   | None                                                                                                                   |                | 00h                                    |     |      |
| BYTE15        | Minimum Clock Delay Back to Back Random Column Address       | tCCD = 1 CLK                                                                                                           |                | 01h                                    |     |      |
| BYTE16        | Burst Lenth Supported                                        | 1,2,4,8,Full Page                                                                                                      |                | 8Fh                                    |     | 2    |
| BYTE17        | # of Banks on Each SDRAM Device                              | 4 Banks                                                                                                                |                | 04h                                    |     |      |
| BYTE18        | SDRAM Device Attributes, /CAS Lataency                       | /CAS Latency=2,3                                                                                                       | /CAS Latency=3 | 06h                                    | 04h |      |
| BYTE19        | SDRAM Device Attributes, /CS Lataency                        | /CS Latency=0                                                                                                          |                | 01h                                    |     |      |
| BYTE20        | SDRAM Device Attributes, /WE Lataency                        | /WE Latency=0                                                                                                          |                | 01h                                    |     |      |
| BYTE21        | SDRAM Module Attributes                                      | Neither Buffered nor Registered                                                                                        |                | 00h                                    |     |      |
| BYTE22        | SDRAM Device Attributes, General                             | +/- 10% voltage tolerance, Burst Read<br>Single Bit Write, Precharge All, Auto<br>Precharge, Early RAS Precharge       |                | 0Eh                                    |     |      |
| BYTE23        | SDRAM Cycle Time @/CAS Latency=2                             | 10ns                                                                                                                   | 0ns            | A0h                                    | 00h |      |
| BYTE24        | Access Time from Clock @/CAS Latency=2                       | 6ns                                                                                                                    | 0ns            | 60h                                    | 00h |      |
| BYTE25        | SDRAM Cycle Time @/CAS Latency=1                             | -                                                                                                                      | -              | 00h                                    | 00h |      |
| BYTE26        | Access Time from Clock @/CAS Latency=1                       | -                                                                                                                      | -              | 00h                                    | 00h |      |
| BYTE27        | Minimum Row Precharge Time (tRP)                             | 20ns                                                                                                                   | 20ns           | 14h                                    | 14h |      |
| BYTE28        | Minimum Row Active to Row Active Delay (tRRD)                | 20ns                                                                                                                   | 20ns           | 14h                                    | 14h |      |
| BYTE29        | Minimum /RAS to /CAS Delay (tRCD)                            | 20ns                                                                                                                   | 20ns           | 14h                                    | 14h |      |
| BYTE30        | Minimum /RAS Pulse Width (tRAS)                              | 50ns                                                                                                                   | 50ns           | 32h                                    | 32h |      |
| BYTE31        | Module Bank Density                                          | 256MB                                                                                                                  |                | 40h                                    |     |      |
| BYTE32        | Command and Address Signal Input Setup Time                  | 2ns                                                                                                                    | 2ns            | 20h                                    | 20h |      |
| BYTE33        | Command and Address Signal Input Hold Time                   | 1ns                                                                                                                    | 1ns            | 10h                                    | 10h |      |
| BYTE34        | Data Signal Input Setup Time                                 | 2ns                                                                                                                    | 2ns            | 20h                                    | 20h |      |
| BYTE35        | Data Signal Input Hold Time                                  | 1ns                                                                                                                    | 1ns            | 10h                                    | 10h |      |
| BYTE36<br>~61 | Superset Information (may be used in future)                 | TBD-                                                                                                                   |                | 00h                                    |     |      |
| BYTE62        | SPD Revision                                                 | Intel SPD 1.2B                                                                                                         |                | 12h                                    |     | 3, 8 |
| BYTE63        | Checksum for Byte 0~62                                       | -                                                                                                                      |                | 40h                                    | 38h |      |
| BYTE64        | Manufacturer JEDEC ID Code                                   | Hynix JEDEC ID                                                                                                         |                | ADh                                    |     |      |
| BYTE65<br>~71 | ....Manufacturer JEDEC ID Code                               | Unused                                                                                                                 |                | FFh                                    |     |      |
| BYTE72        | Manufacturing Location                                       | Hynix (Korea Area)<br>HSA (United States Area)<br>HSE (Europe Area)<br>HSJ (Japan Area)<br>HSS(Singapore)<br>Asia Area |                | 0*h<br>1*h<br>2*h<br>3*h<br>4*h<br>5*h |     | 10   |

| BYTE NUMBER     | FUNCTION DESCRIPTION                                 | FUNCTION               |    | VALUE |     | NOTE |
|-----------------|------------------------------------------------------|------------------------|----|-------|-----|------|
|                 |                                                      | -8                     | -S | -8    | -S  |      |
| BYTE73          | Manufacturer's Part Number (Component)               | 7 (SDRAM)              |    | 37h   |     | 4, 5 |
| BYTE74          | Manufacturer's Part Number (256Mb based)             | 2                      |    | 32h   |     | 4, 5 |
| BYTE75          | Manufacturer's Part Number (Voltage Interface)       | V (3.3V, LVTTTL)       |    | 56h   |     | 4, 5 |
| BYTE76          | Manufacturer's Part Number (Memory Width)            | 6                      |    | 36h   |     | 4, 5 |
| BYTE77          | ....Manufacturer's Part Number (Memory Width)        | 4                      |    | 34h   |     | 4, 5 |
| BYTE78          | Manufacturer's Part Number (Data Width)              | 6                      |    | 36h   |     | 4, 5 |
| BYTE79          | ....Manufacturer's Part Number (Data Width)          | 5                      |    | 35h   |     | 4, 5 |
| BYTE80          | Manufacturer's Part Number (Refresh, SDRAM Bank)     | 6 (8K Refresh, 4Banks) |    | 36h   |     | 4, 5 |
| BYTE81          | Manufacturer's Part Number(Manufacturing Site)       | H                      |    | 48h   |     | 4, 5 |
| BYTE82          | Manufacturer's Part Number (Package Type)            | T                      |    | 54h   |     | 4, 5 |
| BYTE83          | Manufacturer's Part Number (Component Configuration) | 8 (x8 based)           |    | 38h   |     | 4, 5 |
| BYTE84          | Manufacturer's Part Number (Hyphent)                 | - (Hyphen)             |    | 2Dh   |     | 4, 5 |
| BYTE85          | Manufacturer's Part Number (Min. Cycle Time)         | P                      | S  | 50h   | 53h | 4, 5 |
| BYTE86<br>~90   | Manufacturer's Part Number                           | Blanks                 |    | 20h   |     | 4, 5 |
| BYTE91          | Revision Code (for Component)                        | Process Code           |    | -     |     | 4, 6 |
| BYTE92          | ....Revision Code (for PCB)                          | Process Code           |    | -     |     | 4, 6 |
| BYTE93          | Manufacturing Date                                   | Year                   |    | -     |     | 3, 6 |
| BYTE94          | ....Manufacturing Date                               | Work Week              |    | -     |     | 3, 6 |
| BYTE95<br>~98   | Assembly Serial Number                               | Serial Number          |    | -     |     | 6    |
| BYTE99<br>~125  | Manufacturer Specific Data (may be used in future)   | None                   |    | 00h   |     |      |
| BYTE126         | System Frequency Support                             | 100MHz                 |    | 64h   |     | 7, 8 |
| BYTE127         | Intel Specification Details for 100MHz Support       | Refer to Note7         |    | FFh   | FDh | 7, 8 |
| BYTE128<br>~256 | Unused Storage Locations                             | -                      |    | 00h   |     |      |

Note :

1. The bank address is excluded
2. 1, 2, 4, 8 for Interleave Burst Type
3. BCD adopted
4. ASCII adopted
5. Basically Hynix writes Part No. except for 'HYM' in Byte 73~90 to use the limited 18 bytes from byte 73 to byte 90
6. Not fixed but dependent
7. CK0~CK3 connected to DIMM, TBD junction temp, CL2(3) support, Intel defined Concurrent Auto Precharge suport
8. Refer to Intel SPD Specification 1.2B
9. In the case of L-Part, character 'L' will be added between byte 81 and byte 82
10. Refer to Hynix web site

### Byte 81~90 for L-Part

| BYTE NUMBER   | FUNCTION DESCRIPTION                                 | FUNCTION     |    | VALUE |     | NOTE |
|---------------|------------------------------------------------------|--------------|----|-------|-----|------|
|               |                                                      | -P           | -S | -P    | -S  |      |
| BYTE81        | Manufacturer's Part Number(Manufacturing Site)       | H            |    | 48h   |     | 4, 5 |
| BYTE82        | Manufacturer's Part Number (Power)                   | L            |    | 4Ch   |     | 4, 5 |
| BYTE83        | Manufacturer's Part Number (Package Type)            | T            |    | 54h   |     | 4, 5 |
| BYTE84        | Manufacturer's Part Number (Component Configuration) | 8 (x8 based) |    | 38h   |     | 4, 5 |
| BYTE85        | Manufacturer's Part Number (Hyphent)                 | - (Hyphen)   |    | 2Dh   |     | 4, 5 |
| BYTE86        | Manufacturer's Part Number (Min. Cycle Time)         | P            | S  | 50h   | 53h | 4, 5 |
| BYTE87<br>~90 | Manufacturer's Part Number                           | Blanks       |    | 20h   |     | 4, 5 |

### ABSOLUTE MAXIMUM RATINGS

| Parameter                          | Symbol    | Rating     | Unit     |
|------------------------------------|-----------|------------|----------|
| Ambient Temperature                | TA        | 0 ~ 70     | °C       |
| Storage Temperature                | TSTG      | -55 ~ 125  | °C       |
| Voltage on Any Pin relative to VSS | VIN, VOUT | -1.0 ~ 4.6 | V        |
| Voltage on VDD relative to VSS     | VDD, VDDQ | -1.0 ~ 4.6 | V        |
| Short Circuit Output Current       | IOS       | 50         | mA       |
| Power Dissipation                  | PD        | 1          | W        |
| Soldering Temperature · Time       | TSOLDER   | 260 · 10   | °C · Sec |

**Note :** Operation at above absolute maximum rating can adversely affect device reliability.

### DC OPERATING CONDITION (TA=0 to 70°C)

| Parameter            | Symbol    | Min  | Typ | Max        | Unit | Note |
|----------------------|-----------|------|-----|------------|------|------|
| Power Supply Voltage | VDD, VDDQ | 3.0  | 3.3 | 3.6        | V    | 1    |
| Input High voltage   | VIH       | 2.0  | 3.0 | VDDQ + 0.3 | V    | 1,2  |
| Input Low voltage    | VIL       | -0.3 | 0   | 0.8        | V    | 1,3  |

**Note :**

- 1.All voltages are referenced to VSS = 0V
- 2.VIH(max) is acceptable 5.6V AC pulse width with <=3ns of duration.
- 3.VIL(min) is acceptable -2.0V AC pulse width with <=3ns of duration.

### AC OPERATING TEST CONDITION (TA=0 to 70°C, VDD=3.3±0.3V, VSS=0V)

| Parameter                                           | Symbol    | Value   | Unit | Note |
|-----------------------------------------------------|-----------|---------|------|------|
| AC Input High / Low Level Voltage                   | VIH / VIL | 2.4/0.4 | V    |      |
| Input Timing Measurement Reference Level Voltage    | Vtrip     | 1.4     | V    |      |
| Input Rise / Fall Time                              | tR / tF   | 1       | ns   |      |
| Output Timing Measurement Reference Level Voltage   | Voutref   | 1.4     | V    |      |
| Output Load Capacitance for Access Time Measurement | CL        | 50      | pF   | 1    |

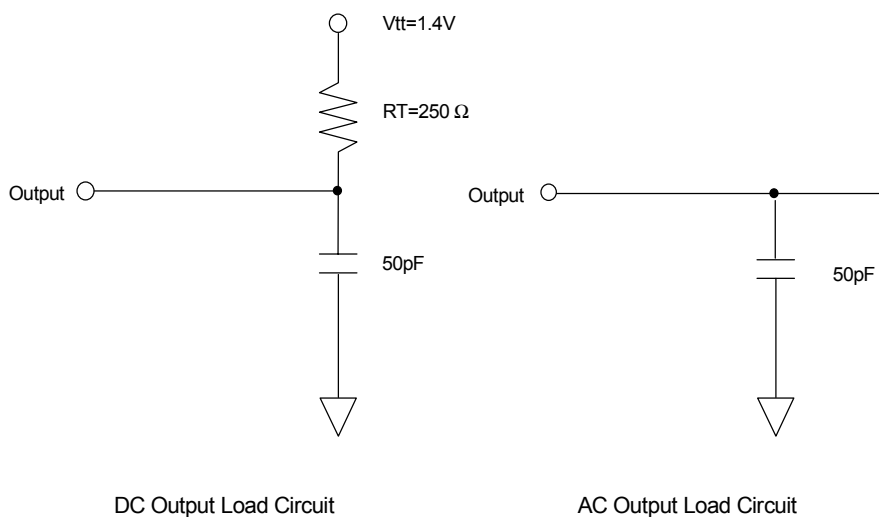
**Note :**

- 1.Output load to measure access times is equivalent to two TTL gates and one capacitor (50pF). For details, refer to AC/DC output load circuit

### CAPACITANCE (TA=25°C, f=1MHz)

| Parameter                       | Pin             | Symbol | -P/S |     | Unit |
|---------------------------------|-----------------|--------|------|-----|------|
|                                 |                 |        | Min  | Max |      |
| Input Capacitance               | CK0~CK3         | CI1    | 37   | 43  | pF   |
|                                 | CKE0,CKE1       | CI2    | 45   | 60  | pF   |
|                                 | /S0~/S3         | CI3    | 23   | 33  | pF   |
|                                 | A0~12, BA0, BA1 | CI4    | 70   | 95  | pF   |
|                                 | /RAS, /CAS, /WE | CI5    | 70   | 95  | pF   |
|                                 | DQM0~DQM7       | CI6    | 13   | 20  | pF   |
| Data Input / Output Capacitance | DQ0 ~ DQ63      | CI/O   | 12   | 17  | pF   |

### OUTPUT LOAD CIRCUIT



### DC CHARACTERISTICS I (TA=0 to 70°C, VDD=3.3±0.3V)

| Parameter              | Symbol | Min. | Max | Unit | Note       |
|------------------------|--------|------|-----|------|------------|
| Input Leakage Current  | ILI    | -16  | 16  | uA   | 1          |
| Output Leakage Current | ILO    | -2   | 2   | uA   | 2          |
| Output High Voltage    | VOH    | 2.4  | -   | V    | IOH = -4mA |
| Output Low Voltage     | VOL    | -    | 0.4 | V    | IOL = +4mA |

**Note :**

1. VIN = 0 to 3.6V, All other pins are not tested under VIN = 0V
2. DOUT is disabled, VOUT=0 to 3.6

### DC CHARACTERISTICS II

| Parameter                                           | Symbol | Test Condition                                                                                                                                   |      | Speed |      | Unit | Note |
|-----------------------------------------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------------|------|-------|------|------|------|
|                                                     |        |                                                                                                                                                  |      | -P    | -S   |      |      |
| Operating Current                                   | IDD1   | Burst length=1, One bank active<br>tRC ≥ tRC(min), IOL=0mA                                                                                       |      | 1040  | 1040 | mA   | 1    |
| Precharge Standby Current<br>in Power Down Mode     | IDD2P  | CKE ≤ VIL(max), tCK = min                                                                                                                        |      | 16    |      | mA   |      |
|                                                     | IDD2PS | CKE ≤ VIL(max), tCK = ∞                                                                                                                          |      | 16    |      |      |      |
| Precharge Standby Current<br>in Non Power Down Mode | IDD2N  | CKE ≥ VIH(min), $\overline{CS}$ ≥ VIH(min), tCK = min<br>Input signals are changed one time during<br>2clks. All other pins ≥ VDD-0.2V or ≤ 0.2V |      | 240   |      | mA   |      |
|                                                     | IDD2NS | CKE ≥ VIH(min), tCK = ∞<br>Input signals are stable.                                                                                             |      | 64    |      |      |      |
| Active Standby Current<br>in Power Down Mode        | IDD3P  | CKE ≤ VIL(max), tCK = min                                                                                                                        |      | 48    |      | mA   |      |
|                                                     | IDD3PS | CKE ≤ VIL(max), tCK = ∞                                                                                                                          |      | 48    |      |      |      |
| Active Standby Current<br>in Non Power Down Mode    | IDD3N  | CKE ≥ VIH(min), $\overline{CS}$ ≥ VIH(min), tCK = min<br>Input signals are changed one time during<br>2clks. All other pins ≥ VDD-0.2V or ≤ 0.2V |      | 400   |      | mA   |      |
|                                                     | IDD3NS | CKE ≥ VIH(min), tCK = ∞<br>Input signals are stable.                                                                                             |      | 240   |      |      |      |
| Burst Mode Operating<br>Current                     | IDD4   | tCK ≥ tCK(min), IOL=0mA<br>All banks active                                                                                                      | CL=3 | 1200  | 1040 | mA   | 1    |
| Auto Refresh Current                                | IDD5   | tRRC ≥ tRRC(min), All banks active                                                                                                               |      | 2880  |      | mA   | 2    |
| Self Refresh Current                                | IDD6   | CKE ≤ 0.2V                                                                                                                                       |      | 64    |      | mA   |      |

**Note :**

1. IDD1 and IDD4 depend on output loading and cycle rates. Specified values are measured with the output open
2. Min. of tRRC (Refresh RAS cycle time) is shown at AC CHARACTERISTICS II

### AC CHARACTERISTICS I (AC operating conditions unless otherwise noted)

| Parameter                         |                 | Symbol | -P  |      | -S  |      | Unit | Note |
|-----------------------------------|-----------------|--------|-----|------|-----|------|------|------|
|                                   |                 |        | Min | Max  | Min | Max  |      |      |
| System Clock Cycle Time           | CAS Latency = 3 | tCK3   | 10  | 1000 | 10  | 1000 | ns   |      |
|                                   | CAS Latency = 2 | tCK2   | 10  |      | 12  |      | ns   |      |
| Clock High Pulse Width            |                 | tCHW   | 3   | -    | 3   | -    | ns   | 1    |
| Clock Low Pulse Width             |                 | tCLW   | 3   | -    | 3   | -    | ns   | 1    |
| Access Time From Clock            | CAS Latency = 3 | tAC3   | -   | 6    | -   | 6    | ns   | 2    |
|                                   | CAS Latency = 2 | tAC2   | -   | 6    | -   | 6    | ns   |      |
| Data-Out Hold Time                |                 | tOH    | 3   | -    | 3   | -    | ns   |      |
| Data-Input Setup Time             |                 | tDS    | 2   | -    | 2   | -    | ns   | 1    |
| Data-Input Hold Time              |                 | tDH    | 1   | -    | 1   | -    | ns   | 1    |
| Address Setup Time                |                 | tAS    | 2   | -    | 2   | -    | ns   | 1    |
| Address Hold Time                 |                 | tAH    | 1   | -    | 1   | -    | ns   | 1    |
| CKE Setup Time                    |                 | tCKS   | 2   | -    | 2   | -    | ns   | 1    |
| CKE Hold Time                     |                 | tCKH   | 1   | -    | 1   | -    | ns   | 1    |
| Command Setup Time                |                 | tCS    | 2   | -    | 2   | -    | ns   | 1    |
| Command Hold Time                 |                 | tCH    | 1   | -    | 1   | -    | ns   | 1    |
| CLK to Data Output in Low-Z Time  |                 | tOLZ   | 1   | -    | 1   | -    | ns   |      |
| CLK to Data Output in High-Z Time | CAS Latency = 3 | tOHZ3  | 3   | 6    | 3   | 6    | ns   |      |
|                                   | CAS Latency = 2 | tOHZ2  | -   | 6    | 3   | 6    | ns   |      |

#### Note :

1. Assume  $t_R / t_F$  (input rise and fall time ) is 1ns  
If  $t_R$  &  $t_F > 1ns$ , then  $[(t_R+t_F)/2-1]ns$  should be added to the parameter
2. Access times to be measured with input signals of 1v/ns edge rate, from 0.8v to 2.0v  
If  $t_R > 1ns$ , then  $(t_R/2-0.5)ns$  should be added to the parameter

### AC CHARACTERISTICS II

| Parameter                      |                 | Symbol | -P  |      | -S  |      | Unit | Note |
|--------------------------------|-----------------|--------|-----|------|-----|------|------|------|
|                                |                 |        | Min | Max  | Min | Max  |      |      |
| RAS Cycle Time                 | Operation       | tRC    | 68  | -    | 70  | -    | ns   |      |
|                                | Auto Refresh    | tRRC   | 68  | -    | 70  | -    | ns   |      |
| RAS to CAS Delay               |                 | tRCD   | 20  | -    | 20  | -    | ns   |      |
| RAS Active Time                |                 | tRAS   | 48  | 100K | 50  | 100K | ns   |      |
| RAS Precharge Time             |                 | tRP    | 20  | -    | 20  | -    | ns   |      |
| RAS to RAS Bank Active Delay   |                 | tRRD   | 16  | -    | 20  | -    | ns   |      |
| CAS to CAS Delay               |                 | tCCD   | 1   | -    | 1   | -    | CLK  |      |
| Write Command to Data-In Delay |                 | tWTL   | 0   | -    | 0   | -    | CLK  |      |
| Data-In to Precharge Command   |                 | tDPL   | 2   | -    | 2   | -    | CLK  |      |
| Data-In to Active Command      |                 | tDAL   | 5   | -    | 5   | -    | CLK  |      |
| DQM to Data-Out Hi-Z           |                 | tDQZ   | 2   | -    | 2   | -    | CLK  |      |
| DQM to Data-In Mask            |                 | tDQM   | 0   | -    | 0   | -    | CLK  |      |
| MRS to New Command             |                 | tMRD   | 2   | -    | 2   | -    | CLK  |      |
| Precharge to Data Output Hi-Z  | CAS Latency = 3 | tPROZ3 | 3   | -    | 3   | -    | CLK  |      |
|                                | CAS Latency = 2 | tPROZ2 | -   | -    | 2   | -    | CLK  |      |
| Power Down Exit Time           |                 | tPDE   | 1   | -    | 1   | -    | CLK  |      |
| Self Refresh Exit Time         |                 | tSRE   | 1   | -    | 1   | -    | CLK  | 1    |
| Refresh Time                   |                 | tREF   | -   | 64   | -   | 64   | ms   |      |

#### Note :

1. A new command can be given tRRC after self refresh exit

### DEVICE OPERATING OPTION TABLE

#### HYM72V64656H(L)T8-P

|              | CAS Latency | tRCD  | tRAS  | tRC   | tRP   | tAC | tOH |
|--------------|-------------|-------|-------|-------|-------|-----|-----|
| 100MHz(10ns) | 2CLKs       | 2CLKs | 5CLKs | 7CLKs | 2CLKs | 6ns | 3ns |
| 83MHz(12ns)  | 2CLKs       | 2CLKs | 5CLKs | 7CLKs | 2CLKs | 6ns | 3ns |
| 66MHz(15ns)  | 2CLKs       | 2CLKs | 4CLKs | 6CLKs | 2CLKs | 6ns | 3ns |

#### HYM72V64656H(L)T8-S

|              | CAS Latency | tRCD  | tRAS  | tRC   | tRP   | tAC | tOH |
|--------------|-------------|-------|-------|-------|-------|-----|-----|
| 100MHz(10ns) | 3CLKs       | 2CLKs | 5CLKs | 7CLKs | 2CLKs | 6ns | 3ns |
| 83MHz(12ns)  | 2CLKs       | 2CLKs | 5CLKs | 7CLKs | 2CLKs | 6ns | 3ns |
| 66MHz(15ns)  | 2CLKs       | 2CLKs | 4CLKs | 6CLKs | 2CLKs | 6ns | 3ns |

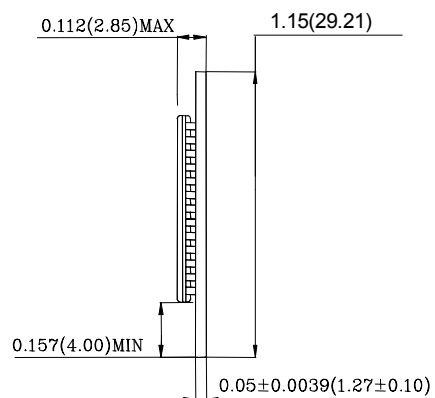
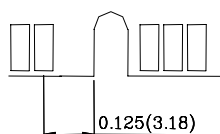
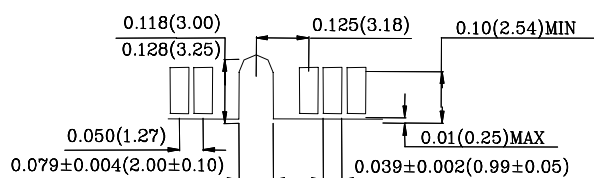
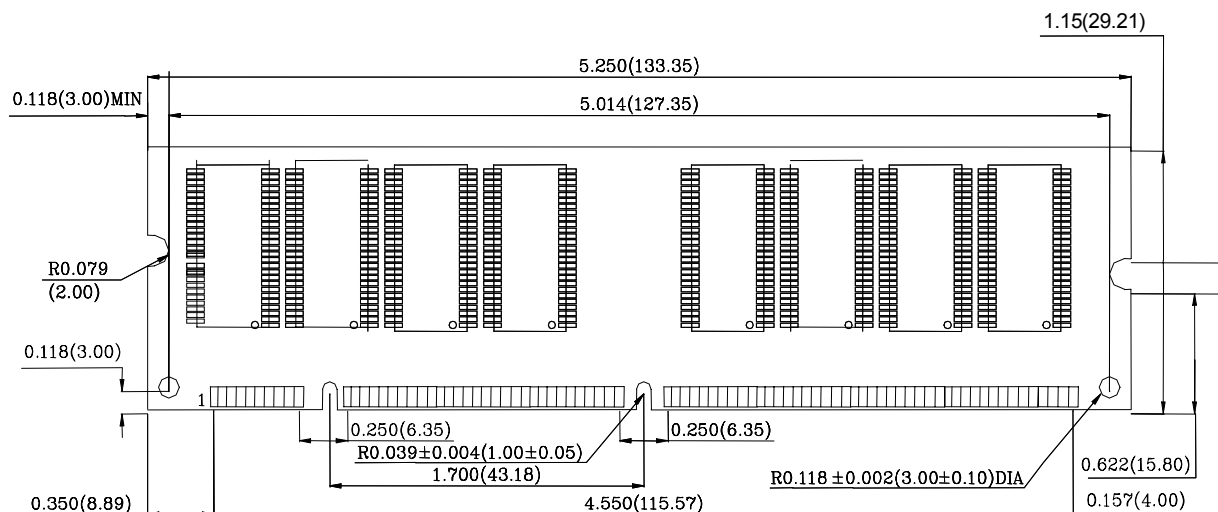
### COMMAND TRUTH TABLE

| Command                   |       | CKEn-1 | CKEn | $\overline{CS}$ | $\overline{RAS}$ | $\overline{CAS}$ | $\overline{WE}$ | DQM | ADDR                                | A10/<br>AP | BA | Note |
|---------------------------|-------|--------|------|-----------------|------------------|------------------|-----------------|-----|-------------------------------------|------------|----|------|
| Mode Register Set         |       | H      | X    | L               | L                | L                | L               | X   | OP code                             |            |    |      |
| No Operation              |       | H      | X    | H               | X                | X                | X               | X   | X                                   |            |    |      |
|                           |       |        |      | L               | H                | H                | H               |     |                                     |            |    |      |
| Bank Active               |       | H      | X    | L               | L                | H                | H               | X   | RA                                  |            | V  |      |
| Read                      |       | H      | X    | L               | H                | L                | H               | X   | CA                                  | L          | V  |      |
| Read with Autoprecharge   |       |        |      |                 |                  |                  |                 |     |                                     | H          |    |      |
| Write                     |       | H      | X    | L               | H                | L                | L               | X   | CA                                  | L          | V  |      |
| Write with Autoprecharge  |       |        |      |                 |                  |                  |                 |     |                                     | H          |    |      |
| Precharge All Banks       |       | H      | X    | L               | L                | H                | L               | X   | X                                   | H          | X  |      |
| Precharge selected Bank   |       |        |      |                 |                  |                  |                 |     |                                     | L          | V  |      |
| Burst Stop                |       | H      | X    | L               | H                | H                | L               | X   | X                                   |            |    |      |
| DQM                       |       | H      | X    |                 |                  |                  |                 | V   | X                                   |            |    |      |
| Auto Refresh              |       | H      | H    | L               | L                | L                | H               | X   | X                                   |            |    |      |
| Burst-Read-Single-WRITE   |       | H      | X    | L               | L                | L                | H               | X   | A9 Pin High<br>(Other Pins OP code) |            |    |      |
| Self Refresh <sup>1</sup> | Entry | H      | L    | L               | L                | L                | H               | X   | X                                   |            |    |      |
|                           | Exit  | L      | H    | H               | X                | X                | X               | X   |                                     |            |    |      |
| L                         |       |        |      | H               | H                | H                |                 |     |                                     |            |    |      |
| Precharge power down      | Entry | H      | L    | H               | X                | X                | X               | X   | X                                   |            |    |      |
|                           |       |        |      | L               | H                | H                | H               |     |                                     |            |    |      |
|                           | Exit  | L      | H    | H               | X                | X                | X               | X   |                                     |            |    |      |
|                           |       |        |      | L               | H                | H                | H               |     |                                     |            |    |      |
| Clock Suspend             | Entry | H      | L    | H               | X                | X                | X               | X   | X                                   |            |    |      |
|                           |       |        |      | L               | V                | V                | V               |     |                                     |            |    |      |
|                           | Exit  | L      | H    | X               |                  |                  |                 | X   |                                     |            |    |      |

**Note :**

1. Exiting Self Refresh occurs by asynchronously bringing CKE from low to high
2. X = Don't care, H = Logic High, L = Logic Low. BA = Bank Address, RA = Row Address, CA = Column Address, Opcode = Operand Code, NOP = No Operation

### PACKAGE DEMENSION



UNIT : INCH(mm)