



## 240pin Registered DDR2 SDRAM DIMMs based on 2Gb version A

This Hynix Registered Dual In-Line Memory Module (DIMM) series consists of 2Gb version A DDR2 SDRAMs in Fine Ball Grid Array (FBGA) packages on a 240pin glass-epoxy substrate. This Hynix 2Gb version A based Registered DDR2 DIMM series provide a high performance 8 byte interface in 5.25" width form factor of industry standard. It is suitable for easy interchange and addition.

### FEATURES

- JEDEC standard Double Data Rate2 Synchronous DRAMs (DDR2 SDRAMs) with 1.8V +/- 0.1V Power Supply
- All inputs and outputs are compatible with SSTL\_1.8 interface
- 8 Bank architecture
- Posted CAS
- Programmable CAS Latency 3, 4, 5, 6
- OCD (Off-Chip Driver Impedance Adjustment)
- ODT (On-Die Termination)
- Fully differential clock operations (CK & CK)
- Programmable Burst Length 4 / 8 with both sequential and interleave mode
- Auto refresh and self refresh supported
- 8192 refresh cycles / 64ms
- Serial presence detect with EEPROM
- DDR2 SDRAM Package: 60 ball(x4/x8)
- 133.35 x 30.00 mm form factor
- RoHS compliant

### ORDERING INFORMATION

| Part Name                | Density | Organization | # of DRAMs | # of ranks | Parity Support |
|--------------------------|---------|--------------|------------|------------|----------------|
| HMP31GP7AFR4C - Y5/S5/S6 | 8GB     | 1G X 72      | 36         | 2          | O              |

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**SPEED GRADE & KEY PARAMETERS**

|             | <b>Y5<br/>(DDR2-667)</b> | <b>S6<br/>(DDR2-800)</b> | <b>S5<br/>(DDR2-800)</b> | <b>Unit</b> |
|-------------|--------------------------|--------------------------|--------------------------|-------------|
| Speed@CL3   | 400                      | -                        | 400                      | Mbps        |
| Speed@CL4   | 533                      | 533                      | 533                      | Mbps        |
| Speed@CL5   | 667                      | 667                      | 800                      | Mbps        |
| Speed@CL6   | -                        | 800                      | -                        | Mbps        |
| CL-tRCD-tRP | 5-5-5                    | 6-6-6                    | 5-5-5                    | tCK         |

**ADDRESS TABLE**

| <b>Density</b> | <b>Organization</b> | <b>Ranks</b> | <b>SDRAMs</b> | <b># of<br/>DRAMs</b> | <b># of row/bank/column Address</b> | <b>Refresh<br/>Method</b> |
|----------------|---------------------|--------------|---------------|-----------------------|-------------------------------------|---------------------------|
| <b>8GB</b>     | 1G x 72             | 2            | 512Mb x 4     | 36                    | 15(A0~A14)/3(BA0~BA2)/11(A0~A9,A11) | 8K / 64ms                 |

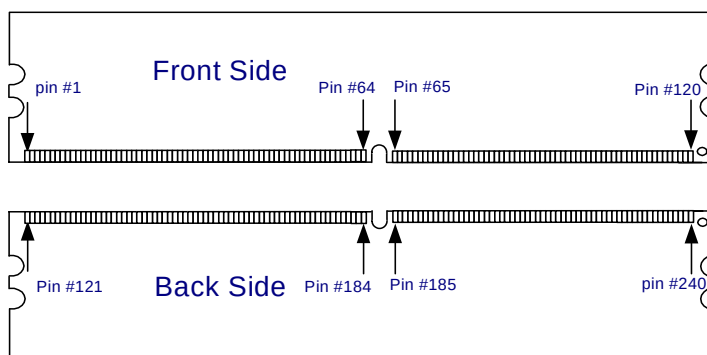
## Input/Output Functional Description

| Symbol                                                                     | Type   | Polarity      | Pin Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------------------------|--------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CK0                                                                        | IN     | Positive Edge | Positive line of the differential pair of system clock inputs that drives input to the on-DIMM PLL.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| $\overline{\text{CK0}}$                                                    | IN     | Negative Edge | Negative line of the differential pair of system clock inputs that drives input to the on-DIMM PLL.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| CKE[1:0]                                                                   | IN     | Active High   | Activates the DDR2 SDRAM CK signal when high and deactivates the CK signal when low. By deactivating the clocks, CKE low initiates the Power Down mode or the Self Refresh mode.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| $\overline{\text{S}}[1:0]$                                                 | IN     | Active Low    | Enables the associated DDR2 SDRAM command decoder when low and disables the command decoder when high. When the command decoder is disabled, new commands are ignored but previous operations continue. Rank 0 is selected by S0; Rank 1 is selected by S1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| ODT[1:0]                                                                   | IN     | Active High   | On-Die Termination signals.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| $\overline{\text{RAS}}$ , $\overline{\text{CAS}}$ , $\overline{\text{WE}}$ | IN     | Active Low    | When sampled at the positive rising edge of the clock. $\overline{\text{RAS}}$ , $\overline{\text{CAS}}$ and $\overline{\text{WE}}$ (ALONG WITH S) define the command being entered.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Vref                                                                       | Supply |               | Reference voltage for SSTL18 inputs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| V <sub>DDQ</sub>                                                           | Supply |               | Power supplies for the DDR2 SDRAM output buffers to provide improved noise immunity. For all current DDR2 unbuffered DIMM designs, V <sub>DDQ</sub> shares the same power plane as V <sub>DD</sub> pins.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| BA[2:0]                                                                    | IN     | -             | Selects which DDR2 SDRAM internal bank of Eight is activated.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| A[9:0], A10/AP<br>A[13:11]                                                 | IN     | -             | During a Bank Activate command cycle, Address input defines the row address(RA0–RA13)<br><br>During a Read or Write command cycle, Address input defines the column address when sampled at the cross point of the rising edge of CK and falling edge of CK. In addition to the column address, AP is used to invoke auto precharge operation at the end of the burst read or write cycle. If AP is high., auto precharge is selected and BA0-BAn defines the bank to be precharged. If AP is low, autoprecharge is disabled. During a Precharge command cycle., AP is used in conjunction with BA0-BAn to control which bank(s) to precharge. If AP is high, all banks will be precharged regardless of the state of BA0-BAn inputs. If AP is low, then BA0-BAn are used to define which bank to precharge. |
| DQ[63:0],<br>CB[7:0]                                                       | IN     | -             | Data and Check Bit Input/Output pins.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| DM[8:0]                                                                    | IN     | Active High   | DM is an input mask signal for write data. Input data is masked when DM is sampled High coincident with that input data during a write access. DM is sampled on both edges of DQS. Although DM pins are input only, the DM loading matches the DQ and DQS loading.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| V <sub>DD</sub> , V <sub>SS</sub>                                          | Supply |               | Power and ground for the DDR2 SDRAM input buffers, and core logic. V <sub>DD</sub> and V <sub>DDQ</sub> pins are tied to V <sub>DD</sub> /V <sub>DDQ</sub> planes on these modules.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| DQS[17:0]                                                                  | I/O    | Positive Edge | Positive line of the differential data strobe for input and output data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| $\overline{\text{DQS}}[17:0]$                                              | I/O    | Negative Edge | Negative line of the differential data strobe for input and output data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| SA[2:0]                                                                    | IN     | -             | These signals are tied at the system planar to either V <sub>SS</sub> or V <sub>DDSPD</sub> to configure the serial SPD EEPROM address range.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| SDA                                                                        | I/O    | -             | This is a bidirectional pin used to transfer data into or out of the SPD EEPROM. A resistor may be connected from the SDA bus line to V <sub>DDSPD</sub> on the system planar to act as a pull up.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| SCL                                                                        | IN     | -             | This signal is used to clock data into and out of the SPD EEPROM. A resistor may be connected from SCL to V <sub>DDSPD</sub> to act as a pull up on the system board.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| VDDSPD                                                                     | Supply |               | Power supply for SPD EEPROM. This supply is separate from the VDD/VDDQ power plane. EEPROM supply is operable from 1.7V to 3.6V.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| RESET                                                                      | IN     |               | The RESET pin is connected to the RST pin on the register and to the OE pin on the PLL. When low, all register outputs will be driven low and the PLL clocks to the DRAMs and register(s) will be set to low level (the PLL will remain synchronized with the input clock)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Par_In                                                                     | IN     |               | Parity bit for the Address and Control bus("1". Odd, "0".Even)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Err_Out                                                                    | OUT    |               | Parity error found in the Address and Control bus                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| TEST                                                                       |        |               | Used by memory bus analysis tools(unused on memory DIMMs)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

## PIN DESCRIPTION

| Pin                                          | Pin Description                            | Pin                           | Pin Description                                              |
|----------------------------------------------|--------------------------------------------|-------------------------------|--------------------------------------------------------------|
| CK0                                          | Clock Input, positive line                 | ODT[1:0]                      | On Die Termination Inputs                                    |
| $\overline{\text{CK0}}$                      | Clock input, negative line                 | VDDQ                          | DQs Power Supply                                             |
| CKE0~CKE1                                    | Clock Enable Input                         | DQ0~DQ63                      | Data Input/Output                                            |
| $\overline{\text{RAS}}$                      | Row Address Strobe                         | CB0~CB7                       | Data check bits Input/Output                                 |
| $\overline{\text{CAS}}$                      | Column Address Strobe                      | DQS(0~8)                      | Data strobes                                                 |
| $\overline{\text{WE}}$                       | Write Enable                               | $\overline{\text{DQS}}$ (0~8) | Data strobes, negative line                                  |
| $\overline{\text{S0}}, \overline{\text{S1}}$ | Chip Select Input                          | DM(0~8), DQS(9~17)            | Data Makes/Data strobes                                      |
| A0~A9, A11~A13                               | Address input                              | DQS(9~17)                     | Data strobes, negative line                                  |
| A10/AP                                       | Address input/Autoprecharge                | RFU                           | Reserved for Future Use                                      |
| BA0, BA1, BA2                                | SDRAM Bank Address                         | NC                            | No Connect                                                   |
| SCL                                          | Serial Presence Detect (SPD) Clock Input   | TEST                          | Memory bus test tool (Not Connected and Not Usable on DIMMs) |
| SDA                                          | SPD Data Input/Output                      | VDD                           | Core Power                                                   |
| SA0~SA2                                      | E <sup>2</sup> PROM Address Inputs         | VDDQ                          | I/O Power Supply                                             |
| Par_In                                       | Parity bit for the Address and Control bus | VSS                           | Ground                                                       |
| $\overline{\text{Err\_Out}}$                 | Parity error found on the Address          | VREF                          | Reference Power Supply                                       |
| $\overline{\text{RESET}}$                    | Reset Enable                               | VDDSPD                        | Power Supply for SPD                                         |
| CB0~CB7                                      | Data Strobe Inputs/Outputs                 |                               |                                                              |

## PIN LOCATION



**PIN ASSIGNMENT**

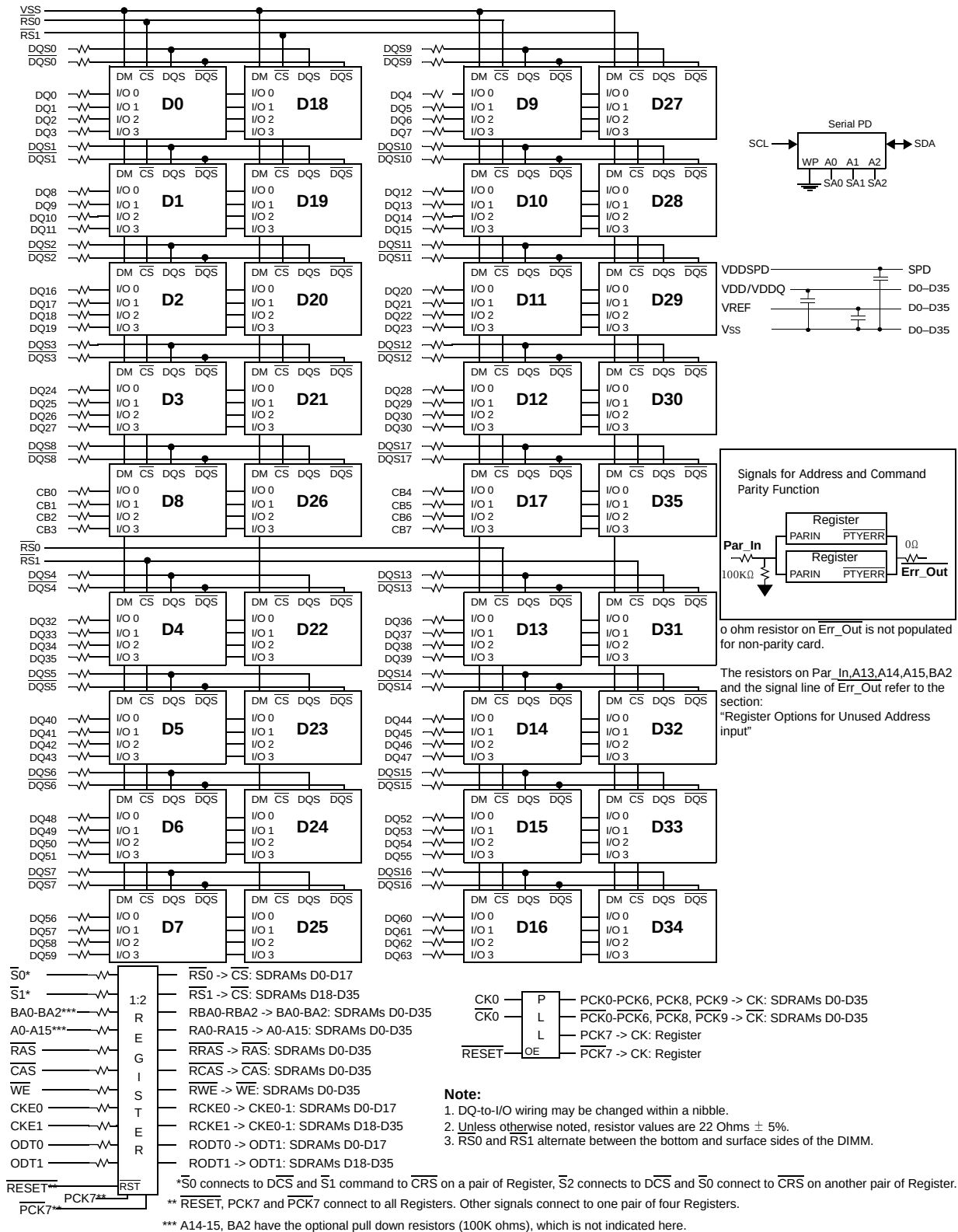
| Pin | Name                     | Pin | Name                       | Pin | Name                     | Pin | Name                      | Pin | Name                      | Pin | Name                          |
|-----|--------------------------|-----|----------------------------|-----|--------------------------|-----|---------------------------|-----|---------------------------|-----|-------------------------------|
| 1   | VREF                     | 41  | VSS                        | 81  | DQ33                     | 121 | VSS                       | 161 | CB4                       | 201 | VSS                           |
| 2   | VSS                      | 42  | CB0                        | 82  | VSS                      | 122 | DQ4                       | 162 | CB5                       | 202 | DM4/DQS13                     |
| 3   | DQ0                      | 43  | CB1                        | 83  | $\overline{\text{DQS}}4$ | 123 | DQ5                       | 163 | VSS                       | 203 | $\overline{\text{DQS}}13$     |
| 4   | DQ1                      | 44  | VSS                        | 84  | DQS4                     | 124 | VSS                       | 164 | DM8,DQS17                 | 204 | VSS                           |
| 5   | VSS                      | 45  | $\overline{\text{DQS}}8$   | 85  | VSS                      | 125 | DM0/DQS9                  | 165 | $\overline{\text{DQS}}17$ | 205 | DQ38                          |
| 6   | $\overline{\text{DQS}}0$ | 46  | DQS8                       | 86  | DQ34                     | 126 | $\overline{\text{DQS}}9$  | 166 | VSS                       | 206 | DQ39                          |
| 7   | DQS0                     | 47  | VSS                        | 87  | DQ35                     | 127 | VSS                       | 167 | CB6                       | 207 | VSS                           |
| 8   | VSS                      | 48  | CB2                        | 88  | VSS                      | 128 | DQ6                       | 168 | CB7                       | 208 | DQ44                          |
| 9   | DQ2                      | 49  | CB3                        | 89  | DQ40                     | 129 | DQ7                       | 169 | VSS                       | 209 | DQ45                          |
| 10  | DQ3                      | 50  | VSS                        | 90  | DQ41                     | 130 | VSS                       | 170 | VDDQ                      | 210 | VSS                           |
| 11  | VSS                      | 51  | VDDQ                       | 91  | VSS                      | 131 | DQ12                      | 171 | NC,CKE1                   | 211 | DM5/DQS14                     |
| 12  | DQ8                      | 52  | CKE0                       | 92  | $\overline{\text{DQS}}5$ | 132 | DQ13                      | 172 | VDD                       | 212 | $\overline{\text{DQS}}14$     |
| 13  | DQ9                      | 53  | VDD                        | 93  | DQS5                     | 133 | VSS                       | 173 | A15,NC                    | 213 | VSS                           |
| 14  | VSS                      | 54  | BA2,NC                     | 94  | VSS                      | 134 | DM1/DQS10                 | 174 | A14,NC                    | 214 | DQ46                          |
| 15  | $\overline{\text{DQS}}1$ | 55  | NC,Err_Out                 | 95  | DQ42                     | 135 | $\overline{\text{DQS}}10$ | 175 | VDDQ                      | 215 | DQ47                          |
| 16  | DQS1                     | 56  | VDDQ                       | 96  | DQ43                     | 136 | VSS                       | 176 | A12                       | 216 | VSS                           |
| 17  | VSS                      | 57  | A11                        | 97  | VSS                      | 137 | RFU                       | 177 | A9                        | 217 | DQ52                          |
| 18  | RESET                    | 58  | A7                         | 98  | DQ48                     | 138 | RFU                       | 178 | VDD                       | 218 | DQ53                          |
| 19  | NC                       | 59  | VDD                        | 99  | DQ49                     | 139 | $\overline{\text{VSS}}$   | 179 | A8                        | 219 | VSS                           |
| 20  | VSS                      | 60  | A5                         | 100 | VSS                      | 140 | DQ14                      | 180 | A6                        | 220 | RFU                           |
| 21  | DQ10                     | 61  | A4                         | 101 | SA2                      | 141 | DQ15                      | 181 | VDDQ                      | 221 | RFU                           |
| 22  | DQ11                     | 62  | VDDQ                       | 102 | NC(TEST)                 | 142 | VSS                       | 182 | A3                        | 222 | VSS                           |
| 23  | VSS                      | 63  | A2                         | 103 | VSS                      | 143 | DQ20                      | 183 | A1                        | 223 | DM6/DQS15                     |
| 24  | DQ16                     | 64  | VDD                        | 104 | $\overline{\text{DQS}}6$ | 144 | DQ21                      | 184 | VDD                       | 224 | NC, $\overline{\text{DQS}}15$ |
| 25  | DQ17                     | Key |                            | 105 | DQS6                     | 145 | VSS                       | Key |                           | 225 | VSS                           |
| 26  | VSS                      | 65  | VSS                        | 106 | VSS                      | 146 | DM2/DQS11                 | 185 | CK0                       | 226 | DQ54                          |
| 27  | $\overline{\text{DQS}}2$ | 66  | VSS                        | 107 | DQ50                     | 147 | $\overline{\text{DQS}}11$ | 186 | $\overline{\text{CK}}0$   | 227 | DQ55                          |
| 28  | DQS2                     | 67  | VDD                        | 108 | DQ51                     | 148 | VSS                       | 187 | VDD                       | 228 | VSS                           |
| 29  | VSS                      | 68  | NC,Err_Out                 | 109 | VSS                      | 149 | DQ22                      | 188 | A0                        | 229 | DQ60                          |
| 30  | DQ18                     | 69  | VDD                        | 110 | DQ56                     | 150 | DQ23                      | 189 | VDD                       | 230 | DQ61                          |
| 31  | DQ19                     | 70  | A10/AP                     | 111 | DQ57                     | 151 | VSS                       | 190 | BA1                       | 231 | VSS                           |
| 32  | VSS                      | 71  | BA0                        | 112 | VSS                      | 152 | DQ28                      | 191 | VDDQ                      | 232 | DM7/DQS16                     |
| 33  | DQ24                     | 72  | VDDQ                       | 113 | $\overline{\text{DQS}}7$ | 153 | DQ29                      | 192 | $\overline{\text{RAS}}$   | 233 | NC, $\overline{\text{DQS}}16$ |
| 34  | DQ25                     | 73  | $\overline{\text{WE}}$     | 114 | DQS7                     | 154 | VSS                       | 193 | $\overline{\text{S}}0$    | 234 | VSS                           |
| 35  | VSS                      | 74  | $\overline{\text{CAS}}$    | 115 | VSS                      | 155 | DM3/DQS12                 | 194 | VDDQ                      | 235 | DQ62                          |
| 36  | $\overline{\text{DQS}}3$ | 75  | VDDQ                       | 116 | DQ58                     | 156 | $\overline{\text{DQS}}12$ | 195 | ODT0                      | 236 | DQ63                          |
| 37  | DQS3                     | 76  | NC, $\overline{\text{S}}1$ | 117 | DQ59                     | 157 | VSS                       | 196 | A13,NC                    | 237 | VSS                           |
| 38  | VSS                      | 77  | NC, ODT1                   | 118 | VSS                      | 158 | DQ30                      | 197 | VDD                       | 238 | VDDSPD                        |
| 39  | DQ26                     | 78  | VDDQ                       | 119 | SDA                      | 159 | DQ31                      | 198 | VSS                       | 239 | SA0                           |
| 40  | DQ27                     | 79  | VSS                        | 120 | SCL                      | 160 | VSS                       | 199 | DQ36                      | 240 | SA1                           |
|     |                          | 80  | DQ32                       |     |                          |     |                           | 200 | DQ37                      |     |                               |

NC= No Connect, RFU= Reserved for Future Use.

**Note:**

1. RESET(Pin 18) is connected to both OE of PLL and Reset of register.
2. NC/Err\_out (Pin 55) and NC/Par\_in(Pin68) are for optional function to check address and command parity.
3. The Test pin(Pin 102) is reserved for bus analysis probes and is not connected on normal memory modules(DIMMs)

## FUNCTIONAL BLOCK DIAGRAM



**ABSOLUTE MAXIMUM DC RATINGS**

| Parameter                                                   | Symbol                             | Value       | Unit | Note |
|-------------------------------------------------------------|------------------------------------|-------------|------|------|
| Voltage on V <sub>DD</sub> pin relative to V <sub>SS</sub>  | V <sub>DD</sub>                    | - 1.0 ~ 2.3 | V    | 1    |
| Voltage on V <sub>DDQ</sub> pin relative to V <sub>SS</sub> | V <sub>DDQ</sub>                   | - 0.5 ~ 2.3 | V    | 1    |
| Voltage on V <sub>DDL</sub> pin relative to V <sub>SS</sub> | V <sub>DDL</sub>                   | - 0.5 ~ 2.3 | V    | 1    |
| Voltage on any pin relative to V <sub>SS</sub>              | V <sub>IN</sub> , V <sub>OUT</sub> | - 0.5 ~ 2.3 | V    | 1    |

**Operating Conditions and Environmental Parameters**

| Parameter                                     | Symbol            | Rating     | Units    | Notes |
|-----------------------------------------------|-------------------|------------|----------|-------|
| DIMM Operating temperature(ambient)           | T <sub>OPR</sub>  | 0 ~ +55    | °C       |       |
| Storage Temperature                           | T <sub>STG</sub>  | -50 ~ +100 | °C       | 1     |
| Storage Humidity(without condensation)        | H <sub>STG</sub>  | 5 to 95    | %        | 1     |
| DIMM Barometric Pressure(operating & storage) | p <sub>BAR</sub>  | 105 to 69  | K Pascal | 2     |
| DRAM Component Case Temperature Range         | T <sub>CASE</sub> | 0 ~+95     | °C       | 3     |

**Note:**

1. Stress greater than those listed may cause permanent damage to the device. This is a stress rating only, and device functional operation at or above the conditions indicated is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
2. Up to 9850 ft.
3. If the DRAM case temperature is Above 85°C, the Auto-Refresh command interval has to be reduced to tREFI=3.9us. For Measurement conditions of T<sub>CASE</sub>, please refer to the JEDEC document JESD51-2.

**DC OPERATING CONDITIONS (SSTL\_1.8)**

| Symbol | Parameter                 | Rating    |           |           | Units | Notes |
|--------|---------------------------|-----------|-----------|-----------|-------|-------|
|        |                           | Min.      | Typ.      | Max.      |       |       |
| VDD    | Supply Voltage            | 1.7       | 1.8       | 1.9       | V     | 1     |
| VDDL   | Supply Voltage for DLL    | 1.7       | 1.8       | 1.9       | V     | 1,2   |
| VDDQ   | Supply Voltage for Output | 1.7       | 1.8       | 1.9       | V     | 1,2   |
| VREF   | Input Reference Voltage   | 0.49*VDDQ | 0.50*VDDQ | 0.51*VDDQ | mV    | 3,4   |
| VTT    | Termination Voltage       | VREF-0.04 | VREF      | VREF+0.04 | V     | 5     |
| VDDSPD | EEPROM Supply Voltage     | 1.7       | -         | 3.6       | V     |       |

**Note:**

1. Min. Type. and Max. values increase by 100mV for C3(DDR2-533 3-3-3) speed option.
2. VDDQ tracks with VDD,VDDL tracks with VDD. AC parameters are measured with VDD,VDDQ and VDD.
3. The value of VREF may be selected by the user to provide optimum noise margin in the system. Typically the value of VREF is expected to be about 0.5 x VDDQ of the transmitting device and VREF is expected to track variations in VDDQ.
4. Peak to peak ac noise on VREF may not exceed +/-2% VREF (dc).
5. VTT of transmitting device must track VREF of receiving device.

**INPUT DC LOGIC LEVEL**

| Parameter           | Symbol       | Min               | Max               | Unit | Note |
|---------------------|--------------|-------------------|-------------------|------|------|
| dc Input logic HIGH | $V_{IH(DC)}$ | $V_{REF} + 0.125$ | $V_{DDQ} + 0.3$   | V    |      |
| dc Input logic LOW  | $V_{IL(DC)}$ | -0.30             | $V_{REF} - 0.125$ | V    |      |

**INPUT AC LOGIC LEVEL**

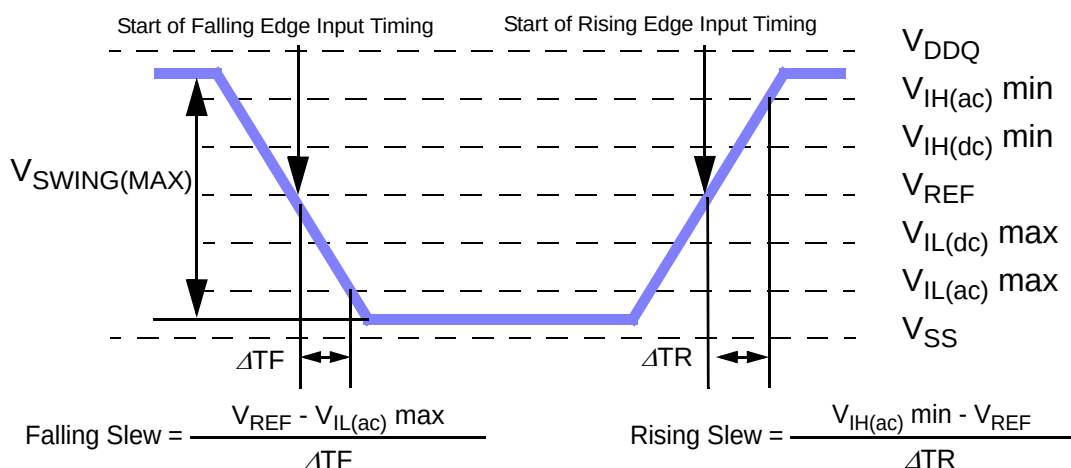
| Parameter           | Symbol       | DDR2 667/800      |                   | Unit | Notes |
|---------------------|--------------|-------------------|-------------------|------|-------|
|                     |              | Min               | Max               |      |       |
| ac Input logic HIGH | $V_{IH(AC)}$ | $V_{REF} + 0.200$ | -                 | V    |       |
| ac Input logic LOW  | $V_{IL(AC)}$ | -                 | $V_{REF} - 0.200$ | V    |       |

**AC INPUT TEST CONDITIONS**

| Symbol           | Condition                               | Value           | Units | Notes |
|------------------|-----------------------------------------|-----------------|-------|-------|
| $V_{REF}$        | Input reference voltage                 | $0.5 * V_{DDQ}$ | V     | 1     |
| $V_{SWING(MAX)}$ | Input signal maximum peak to peak swing | 1.0             | V     | 1     |
| SLEW             | Input signal minimum slew rate          | 1.0             | V/ns  | 2, 3  |

**Note:**

1. Input waveform timing is referenced to the input signal crossing through the  $V_{REF}$  level applied to the device under test.
2. The input signal minimum slew rate is to be maintained over the range from  $V_{REF}$  max to  $V_{IH(ac)}$  min for rising edges and the range from  $V_{REF}$  min to  $V_{IL(ac)}$  max for falling edges as shown in the below figure.
3. AC timings are referenced with input waveforms switching from  $V_{IL(ac)}$  to  $V_{IH(ac)}$  on the positive transitions and  $V_{IH(ac)}$  to  $V_{IL(ac)}$  on the negative transitions.



< Figure: AC Input Test Signal Waveform >

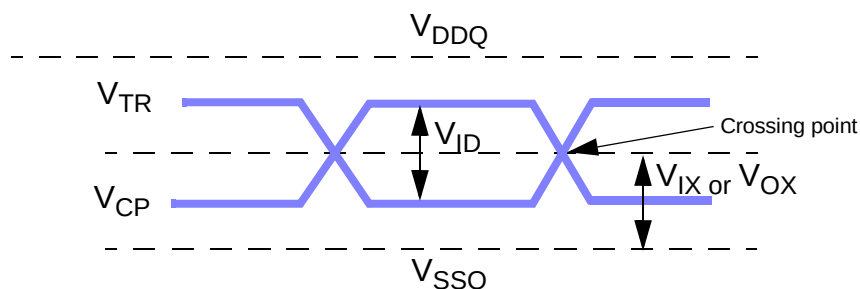


### Differential Input AC logic Level

| Symbol        | Parameter                           | Min.                    | Max.                    | Units | Note |
|---------------|-------------------------------------|-------------------------|-------------------------|-------|------|
| $V_{ID} (ac)$ | ac differential input voltage       | 0.5                     | $V_{DDQ} + 0.6$         | V     | 1    |
| $V_{IX} (ac)$ | ac differential cross point voltage | $0.5 * V_{DDQ} - 0.175$ | $0.5 * V_{DDQ} + 0.175$ | V     | 2    |

**Note:**

- $V_{IN}(DC)$  specifies the allowable DC execution of each input of differential pair such as  $\overline{CK}$ ,  $\overline{DQS}$ ,  $\overline{LDQS}$ ,  $\overline{UDQS}$  and  $\overline{UDQS}$ .
- $V_{ID}(DC)$  specifies the input differential voltage  $|V_{TR} - V_{CP}|$  required for switching, where  $V_{TR}$  is the true input (such as  $\overline{CK}$ ,  $\overline{DQS}$ ,  $\overline{LDQS}$  or  $\overline{UDQS}$ ) level and  $V_{CP}$  is the complementary input (such as  $\overline{CK}$ ,  $\overline{DQS}$ ,  $\overline{LDQS}$  or  $\overline{UDQS}$ ) level. The minimum value is equal to  $V_{IH}(DC) - V_{IL}(DC)$ .



< Differential signal levels >

**Note:**

- $V_{ID}(AC)$  specifies the input differential voltage  $|V_{TR} - V_{CP}|$  required for switching, where  $V_{TR}$  is the true input signal (such as  $\overline{CK}$ ,  $\overline{DQS}$ ,  $\overline{LDQS}$  or  $\overline{UDQS}$ ) and  $V_{CP}$  is the complementary input signal (such as  $\overline{CK}$ ,  $\overline{DQS}$ ,  $\overline{LDQS}$  or  $\overline{UDQS}$ ). The minimum value is equal to  $V_{IH}(AC) - V_{IL}(AC)$ .
- The typical value of  $V_{IX}(AC)$  is expected to be about  $0.5 * V_{DDQ}$  of the transmitting device and  $V_{IX}(AC)$  is expected to track variations in  $V_{DDQ}$ .  $V_{IX}(AC)$  indicates the voltage at which differential input signals must cross.

### DIFFERENTIAL AC OUTPUT PARAMETERS

| Symbol        | Parameter                          | Min.                    | Max.                    | Units | Note |
|---------------|------------------------------------|-------------------------|-------------------------|-------|------|
| $V_{OX} (ac)$ | ac differential crosspoint voltage | $0.5 * V_{DDQ} - 0.125$ | $0.5 * V_{DDQ} + 0.125$ | V     | 1    |

**Note:**

- The typical value of  $V_{OX}(AC)$  is expected to be about  $0.5 * V_{DDQ}$  of the transmitting device and  $V_{OX}(AC)$  is expected to track variations in  $V_{DDQ}$ .  $V_{OX}(AC)$  indicates the voltage at which differential output signals must cross.

## OUTPUT BUFFER LEVELS

### OUTPUT AC TEST CONDITIONS

| Symbol    | Parameter                                 | SSTL_18         | Units | Notes |
|-----------|-------------------------------------------|-----------------|-------|-------|
| $V_{OTR}$ | Output Timing Measurement Reference Level | $0.5 * V_{DDQ}$ | V     | 1     |

**Note:**

1. The  $V_{DDQ}$  of the device under test is referenced.

### OUTPUT DC CURRENT DRIVE

| Symbol       | Parameter                        | SSTL_18 | Units | Notes   |
|--------------|----------------------------------|---------|-------|---------|
| $I_{OH(dc)}$ | Output Minimum Source DC Current | - 13.4  | mA    | 1, 3, 4 |
| $I_{OL(dc)}$ | Output Minimum Sink DC Current   | 13.4    | mA    | 2, 3, 4 |

**Note:**

1.  $V_{DDQ} = 1.7\text{ V}$ ;  $V_{OUT} = 1420\text{ mV}$ .  $(V_{OUT} - V_{DDQ})/I_{OH}$  must be less than 21 ohm for values of  $V_{OUT}$  between  $V_{DDQ}$  and  $V_{DDQ} - 280\text{ mV}$ .
2.  $V_{DDQ} = 1.7\text{ V}$ ;  $V_{OUT} = 280\text{ mV}$ .  $V_{OUT}/I_{OL}$  must be less than 21 ohm for values of  $V_{OUT}$  between 0 V and 280 mV.
3. The dc value of  $V_{REF}$  applied to the receiving device is set to  $V_{TT}$
4. The values of  $I_{OH(dc)}$  and  $I_{OL(dc)}$  are based on the conditions given in Notes 1 and 2. They are used to test device drive current capability to ensure  $V_{IH}$  min plus a noise margin and  $V_{IL}$  max minus a noise margin are delivered to an SSTL\_18 receiver. The actual current values are derived by shifting the desired driver operating point along a 21 ohm load line to define a convenient driver current for measurement.

**PIN Capacitance** (VDD=1.8V, VDDQ=1.8V, TA=25°C)

**8GB: HMP31GP7AFR4C**

| Pin                      | Symbol | Min | Max | Unit |
|--------------------------|--------|-----|-----|------|
| CK0, /CK0                | CCK    | TBD | TBD | pF   |
| CKE, ODT                 | CI1    | TBD | TBD | pF   |
| /CS                      | CI2    | TBD | TBD | pF   |
| Address, /RAS, /CAS, /WE | CI3    | TBD | TBD | pF   |
| DQ, DM, DQS, /DQS        | CIO    | TBD | TBD | pF   |

**IDD SPECIFICATIONS** ( $T_{CASE}$ : 0 to 95°C)

**8GB, 1G x 72 Registered DIMM: HMP31GP7AFR4C**

| Symbol   | Y5<br>(DDR2 667@CL5) | S6<br>(DDR2 800@CL6) | Unit | Note |
|----------|----------------------|----------------------|------|------|
| IDD0     | 3170                 | 3350                 | mA   |      |
| IDD1     | 3350                 | 3530                 | mA   |      |
| IDD2P    | 1082                 | 1082                 | mA   |      |
| IDD2Q    | 2270                 | 2450                 | mA   |      |
| IDD2N    | 2450                 | 2630                 | mA   |      |
| IDD3P(F) | 1910                 | 1910                 | mA   |      |
| IDD3P(S) | 1298                 | 1298                 | mA   |      |
| IDD3N    | 3170                 | 3530                 | mA   |      |
| IDD4W    | 5150                 | 5960                 | mA   |      |
| IDD4R    | 4880                 | 5600                 | mA   |      |
| IDD5B    | 5310                 | 5580                 | mA   |      |
| IDD6     | 990                  | 990                  | mA   | 1    |
| IDD7     | 6590                 | 7130                 | mA   |      |

**Note:** 1. IDD6 current values are guaranteed up to Tcase of 85°Cmax.

## IDD Measurement Conditions

| Symbol | Conditions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Units                     |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|
| IDD0   | <b>Operating one bank active-precharge current;</b> $t_{CK} = t_{CK}(IDD)$ , $t_{RC} = t_{RC}(IDD)$ , $t_{RAS} = t_{RAS-min}(IDD)$ ; CKE is HIGH, $\overline{CS}$ is HIGH between valid commands; Address bus inputs are SWITCHING; Data bus inputs are SWITCHING                                                                                                                                                                                                                             | mA                        |
| IDD1   | <b>Operating one bank active-read-precharge current;</b> $I_{OUT} = 0mA$ ; $BL = 4$ , $CL = CL(IDE)$ , $AL = 0$ ; $t_{CK} = t_{CK}(IDD)$ , $t_{RC} = t_{RC}(IDD)$ , $t_{RAS} = t_{RASmin}(IDD)$ , $t_{RCD} = t_{RCD}(IDD)$ ; CKE is HIGH, $\overline{CS}$ is HIGH between valid commands; Address bus inputs are SWITCHING; Data pattern is same as IDD4W                                                                                                                                     | mA                        |
| IDD2P  | <b>Precharge power-down current;</b> All banks idle; $t_{CK} = t_{CK}(IDD)$ ; CKE is LOW; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING                                                                                                                                                                                                                                                                                                                       | mA                        |
| IDD2Q  | <b>Precharge quiet standby current;</b> All banks idle; $t_{CK} = t_{CK}(IDD)$ ; CKE is HIGH, $\overline{CS}$ is HIGH; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING                                                                                                                                                                                                                                                                                          | mA                        |
| IDD2N  | <b>Precharge standby current;</b> All banks idle; $t_{CK} = t_{CK}(IDD)$ ; CKE is HIGH, $\overline{CS}$ is HIGH; Other control and address bus inputs are SWITCHING; Data bus inputs are SWITCHING                                                                                                                                                                                                                                                                                            | mA                        |
| IDD3P  | <b>Active power-down current;</b> All banks open; $t_{CK} = t_{CK}(IDD)$ ; CKE is LOW; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING                                                                                                                                                                                                                                                                                                                          | Fast PDN Exit MRS(12) = 0 |
|        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Slow PDN Exit MRS(12) = 1 |
| IDD3N  | <b>Active standby current;</b> All banks open; $t_{CK} = t_{CK}(IDD)$ , $t_{RAS} = t_{RASmax}(IDD)$ , $t_{RP} = t_{RP}(IDD)$ ; CKE is HIGH, $\overline{CS}$ is HIGH between valid commands; Other control and address bus inputs are SWITCHING; Data bus inputs are SWITCHING                                                                                                                                                                                                                 | mA                        |
| IDD4W  | <b>Operating burst write current;</b> All banks open, Continuous burst writes; $BL = 4$ , $CL = CL(IDE)$ , $AL = 0$ ; $t_{CK} = t_{CK}(IDD)$ , $t_{RAS} = t_{RASmax}(IDD)$ , $t_{RP} = t_{RP}(IDD)$ ; CKE is HIGH, $\overline{CS}$ is HIGH between valid commands; Address bus inputs are SWITCHING; Data bus inputs are SWITCHING                                                                                                                                                            | mA                        |
| IDD4R  | <b>Operating burst read current;</b> All banks open, Continuous burst reads, $I_{OUT} = 0mA$ ; $BL = 4$ , $CL = CL(IDE)$ , $AL = 0$ ; $t_{CK} = t_{CK}(IDD)$ , $t_{RAS} = t_{RASmax}(IDD)$ , $t_{RP} = t_{RP}(IDD)$ ; CKE is HIGH, $\overline{CS}$ is HIGH between valid commands; Address bus inputs are SWITCHING; Data pattern is same as IDD4W                                                                                                                                            | mA                        |
| IDD5B  | <b>Burst refresh current;</b> $t_{CK} = t_{CK}(IDD)$ ; Refresh command at every $t_{RFC}(IDD)$ interval; CKE is HIGH, $\overline{CS}$ is HIGH between valid commands; Other control and address bus inputs are SWITCHING; Data bus inputs are SWITCHING                                                                                                                                                                                                                                       | mA                        |
| IDD6   | <b>Self refresh current;</b> CK and $\overline{CK}$ at 0V; CKE $\leq 0.2V$ ; Other control and address bus inputs are FLOATING; Data bus inputs are FLOATING. IDD6 current values are guaranteed up to Tcase of 85°C max.                                                                                                                                                                                                                                                                     | mA                        |
| IDD7   | <b>Operating bank interleave read current;</b> All bank interleaving reads, $I_{OUT} = 0mA$ ; $BL = 4$ , $CL = CL(IDE)$ , $AL = t_{RCD}(IDD) - 1 \cdot t_{CK}(IDD)$ ; $t_{CK} = t_{CK}(IDD)$ , $t_{RC} = t_{RC}(IDD)$ , $t_{RRD} = t_{RRD}(IDD)$ , $t_{RCD} = 1 \cdot t_{CK}(IDD)$ ; CKE is HIGH, $\overline{CS}$ is HIGH between valid commands; Address bus inputs are STABLE during DESELECTs; Data pattern is same as IDD4R; - Refer to the following page for detailed timing conditions | mA                        |

### Note:

1. IDD specifications are tested after the device is properly initialized
2. Input slew rate is specified by AC Parametric Test Condition
3. IDD parameters are specified with ODT disabled.
4. Data bus consists of DQ, DM, DQS,  $\overline{DQS}$ , RDQS,  $\overline{RDQS}$ , LDQS,  $\overline{LDQS}$ , UDQS, and  $\overline{UDQS}$ . IDD values must be met with all combinations of EMRS bits 10 and 11.
5. Definitions for IDD
  - LOW is defined as  $V_{in} \leq V_{ILAC}(\text{max})$
  - HIGH is defined as  $V_{in} \geq V_{IHAC}(\text{min})$
  - STABLE is defined as inputs stable at a HIGH or LOW level
  - FLOATING is defined as inputs at  $V_{REF} = V_{DDQ}/2$
  - SWITCHING is defined as: inputs changing between HIGH and LOW every other clock cycle (once per two clocks) for address and control signals, and inputs changing between HIGH and LOW every other data transfer (once per clock) for DQ signals not including masks or strobes

## Electrical Characteristics & AC Timings

Speed Bins and CL,tRCD,tRP,tRC and tRAS for Corresponding Bin

| Speed            | DDR2-800 (S5) | DDR2-667 (Y5) | Unit |
|------------------|---------------|---------------|------|
| Bin(CL-tRCD-tRP) | 5-5-5         | 5-5-5         |      |
| Parameter        | min           | min           |      |
| CAS Latency      | 5             | 5             | ns   |
| tRCD             | 12.5          | 15            | ns   |
| tRP              | 12.5          | 15            | ns   |
| tRC              | 57.5          | 60            | ns   |
| tRAS             | 45            | 45            | ns   |

**AC Timing Parameters by Speed Grade (DDR2-667 & DDR2-800)**

| Parameter                                                    | Symbol   | DDR2-667      |         | DDR2-800      |         | Unit | Note |
|--------------------------------------------------------------|----------|---------------|---------|---------------|---------|------|------|
|                                                              |          | min           | max     | min           | max     |      |      |
| DQ output access time from CK/ $\overline{\text{CK}}$        | tAC      | -450          | +450    | -400          | +400    | ps   |      |
| DQS output access time from CK/ $\overline{\text{CK}}$       | tDQSCK   | -400          | +400    | -350          | +350    | ps   |      |
| CK high-level width                                          | tCH      | 0.45          | 0.55    | 0.45          | 0.55    | tCK  |      |
| CK low-level width                                           | tCL      | 0.45          | 0.55    | 0.45          | 0.55    | tCK  |      |
| CK half period                                               | tHP      | min(tCL, tCH) | -       | min(tCL, tCH) | -       | ps   |      |
| Clock cycle time, CL=x                                       | tCK      | 3000          | 8000    | 2500          |         | ps   |      |
| DQ and DM input setup time (differential strobe)             | tDS      | 100           | -       | 50            | -       | ps   | 1    |
| DQ and DM input hold time (differential strobe)              | tDH      | 175           | -       | 125           | -       | ps   | 1    |
| Control & Address input pulse width for each input           | tIPW     | 0.6           | -       | 0.6           | -       | tCK  |      |
| DQ and DM input pulse width for each input                   | tDIPW    | 0.35          | -       | 0.35          | -       | tCK  |      |
| Data-out high-impedance time from CK/ $\overline{\text{CK}}$ | tHZ      | -             | tAC max | -             | tAC max | ps   |      |
| DQS low-impedance time from CK/ $\overline{\text{CK}}$       | tLZ(DQS) | tAC min       | tAC max | tAC min       | tAC max | ps   |      |
| DQ low-impedance time from CK/ $\overline{\text{CK}}$        | tLZ(DQ)  | 2*tAC min     | tAC max | 2*tAC min     | tAC max | ps   |      |
| DQS-DQ skew for DQS and associated DQ signals                | tDQSQ    | -             | 240     | -             | 200     | ps   |      |
| DQ hold skew factor                                          | tQHS     | -             | 340     | -             | 300     | ps   |      |
| DQ/DQS output hold time from DQS                             | tQH      | tHP - tQHS    | -       | tHP - tQHS    | -       | ps   |      |
| First DQS latching transition to associated clock edge       | tDQSS    | - 0.25        | + 0.25  | - 0.25        | + 0.25  | tCK  |      |
| DQS input high pulse width                                   | tDQSH    | 0.35          | -       | 0.35          | -       | tCK  |      |
| DQS input low pulse width                                    | tDQSL    | 0.35          | -       | 0.35          | -       | tCK  |      |
| DQS falling edge to CK setup time                            | tDSS     | 0.2           | -       | 0.2           | -       | tCK  |      |
| DQS falling edge hold time from CK                           | tDSH     | 0.2           | -       | 0.2           | -       | tCK  |      |
| Mode register set command cycle time                         | tMRD     | 2             | -       | 2             | -       | tCK  |      |
| Write preamble                                               | tWPRE    | 0.35          | -       | 0.35          | -       | tCK  |      |
| Write postamble                                              | tWPST    | 0.4           | 0.6     | 0.4           | 0.6     | tCK  |      |
| Auto-Refresh to Active/Auto-Refresh command period           | tRFC     | 127.5         | -       | 127.5         | -       | ns   |      |
| Row Active to Row Active Delay for 1KB page size             | tRRD     | 7.5           | -       | 7.5           | -       | ns   |      |
| Address and control input setup time                         | tIS      | 200           | -       | 175           | -       | ps   |      |
| Address and control input hold time                          | tIH      | 275           | -       | 250           | -       | ps   |      |
| Read preamble                                                | tRPRE    | 0.9           | 1.1     | 0.9           | 1.1     | tCK  |      |
| Read postamble                                               | tRPST    | 0.4           | 0.6     | 0.4           | 0.6     | tCK  |      |
| Activate to precharge command                                | tRAS     | 45            | 70000   | 45            | 70000   | ns   |      |
| Active to active command period for 1KB page size products   | tRRD     | 7.5           | -       | 7.5           | -       | ns   |      |
| Row Active to Row Active Delay for 2KB page size             | tRRD     | 10            | -       | 10            | -       | ns   |      |
| Four Active Window for 1KB page size products                | tFAW     | 37.5          | -       | 35            | -       | ns   |      |
| Four Activate Window for 2KB page size                       | tFAW     | 50            | -       | 50            | -       | ns   |      |
| CAS to $\overline{\text{CAS}}$ command delay                 | tCCD     | 2             |         | 2             |         | tCK  |      |
| Write recovery time                                          | tWR      | 15            | -       | 15            | -       | ns   |      |
| Auto precharge write recovery + precharge time               | tDAL     | WR+tRP        | -       | WR+tRP        | -       | tCK  |      |
| Internal write to read command delay                         | tWTR     | 7.5           | -       | 7.5           | -       | ns   |      |
| Internal read to precharge command delay                     | tRTP     | 7.5           |         | 7.5           |         | ns   |      |

| Parameter                                                         | Symbol | DDR2-667     |                     | DDR2-800      |                     | Unit | Note |
|-------------------------------------------------------------------|--------|--------------|---------------------|---------------|---------------------|------|------|
|                                                                   |        | min          | max                 | min           | max                 |      |      |
| Exit self refresh to a non-read command                           | tXSNR  | tRFC + 10    |                     | tRFC + 10     |                     | ns   |      |
| Exit self refresh to a read command                               | tXSRD  | 200          | -                   | 200           | -                   | tCK  |      |
| Exit precharge power down to any non-read command                 | tXP    | 2            | -                   | 2             | -                   | tCK  |      |
| Exit active power down to read command                            | tXARD  | 2            |                     | 2             |                     | tCK  |      |
| Exit active power down to read command (Slow exit, Lower power)   | tXARDS | 7 - AL       |                     | 8 - AL        |                     | tCK  |      |
| CKE minimum pulse width (high and low pulse width)                | tCKE   | 3            |                     | 3             |                     | tCK  |      |
| ODT turn-on delay                                                 | tAOND  | 2            | 2                   | 2             | 2                   | tCK  |      |
| ODT turn-on                                                       | tAON   | tAC(min)     | tAC(max) + 0.7      | tAC(min)      | tAC(max) + 0.7      | ns   |      |
| ODT turn-on(Power-Down mode)                                      | tAONPD | tAC(min)+2   | 2tCK + tAC(max)+1   | tAC(min) + 2  | 2tCK + tAC(max)+1   | ns   |      |
| ODT turn-off delay                                                | tAOFD  | 2.5          | 2.5                 | 2.5           | 2.5                 | tCK  |      |
| ODT turn-off                                                      | tAOF   | tAC(min)     | tAC(max) + 0.6      | tAC(min)      | tAC(max) + 0.6      | ns   |      |
| ODT turn-off (Power-Down mode)                                    | tAOFPD | tAC(min) + 2 | 2.5tCK + tAC(max)+1 | tAC(min) + 2  | 2.5tCK + tAC(max)+1 | ns   |      |
| ODT to power down entry latency                                   | tANPD  | 3            |                     | 3             |                     | tCK  |      |
| ODT power down exit latency                                       | tAXPD  | 8            |                     | 8             |                     | tCK  |      |
| OCD drive mode output delay                                       | tOIT   | 0            | 12                  | 0             | 12                  | ns   |      |
| Minimum time clocks remains ON after CKE asynchronously drops LOW | tDelay | tIS+tCK+tIH  |                     | tIS+tCK + tIH |                     | ns   |      |
| Average periodic Refresh Interval                                 | tREFI  | -            | 7.8                 | -             | 7.8                 | us   | 2    |
|                                                                   | tREFI  | -            | 3.9                 | -             | 3.9                 | us   | 3    |

**Note:**

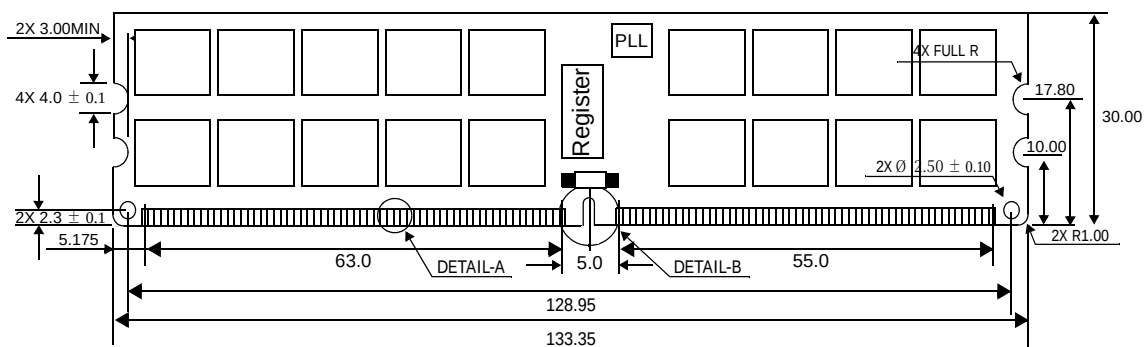
- For details and notes, please refer to the relevant HYNIX component datasheet H5PS2G[4,8]3AFR.
- $0^{\circ}\text{C} \leq T_{\text{CASE}} \leq 85^{\circ}\text{C}$
- $85^{\circ}\text{C} < T_{\text{CASE}} \leq 95^{\circ}\text{C}$



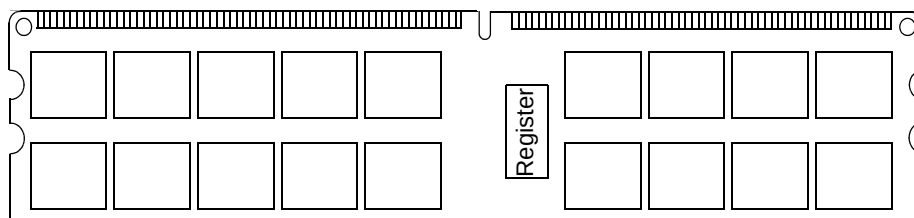
### PACKAGE OUTLINE

1Gx72 (2 ranks) - HMP31GP7AFR4C

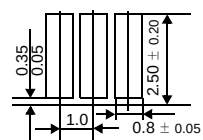
#### Front



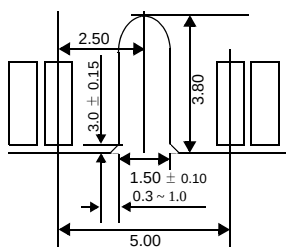
#### Back



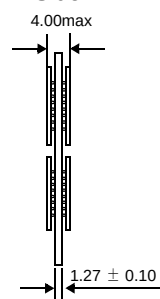
#### Detail of Contacts A



#### Detail of Contacts B



#### Side



Note) All dimensions are typical unless otherwise stated.  $\frac{\text{Millimeters}}{\text{Inches}}$

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**REVISION HISTORY**

| Revision | History                     | Date      |
|----------|-----------------------------|-----------|
| 0.1      | Initial data sheet released | Jan. 2009 |