

***RoHS Compliant***

512MB DDR2 SDRAM SO-DIMM

***Product Specifications***

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*Version 1.1*



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## Table of Contents

|   |    |
|---|----|
| General Description .....                       | 2  |
| Ordering Information .....                      | 2  |
| Key Parameters .....                            | 2  |
| Specifications: .....                           | 3  |
| Pin Assignments .....                           | 4  |
| Pin Descriptions .....                          | 6  |
| Functional Block Diagram .....                  | 7  |
| Absolute Maximum Ratings .....                  | 8  |
| DRAM Component Operating Temperature Range..... | 9  |
| Operating Conditions .....                      | 10 |
| Mechanical Drawing .....                        | 11 |

## General Description

Apacer **78.92G85.4020C** is a 64M x 64 Double Data Rate SDRAM high density memory modules based on first generation of 512MB DDR2 SDRAM respectively.

It consists of 8 pieces 64M x 8 bit with 4banks Double Data Rate SDRAMs in 60Ball FBGA packages mounted on a 200pin glass-epoxy substrate. Decoupling capacitors are mounted on the printed circuit board in parallel for each DDR2 SDRAM.

Synchronous design allows precise cycle control with the use of system clock. Data I/O transactions are possible on both edges of DQS. Range of operating frequencies, programmable latencies and burst lengths allow the same device to be useful for a variety of high bandwidth, high performance memory system applications.

## Ordering Information

| Part Number    | Bandwidth  | Speed Grade | Max Frequency | CAS Latency |
|----------------|------------|-------------|---------------|-------------|
| 78.92G85.4020C | 6.4 GB/sec | 800 Mbps    | 400 MHz       | CL6         |

| Density | Organization | Component | Rank |
|---------|--------------|-----------|------|
| 512MB   | 64M x 64     | 64M x8*8  | 1    |

## Key Parameters

| MT/s        | DDR2-667 | DDR2-800 | DDR2-800 | Unit |
|-------------|----------|----------|----------|------|
| Grade       | -CL5     | -CL5     | -CL6     |      |
| tCK (min)   | 3        | 2.5      | 2.5      | ns   |
| CAS latency | 5        | 5        | 6        | tCK  |
| tRCD (min)  | 15       | 12.5     | 15       | ns   |
| tRP (min)   | 15       | 12.5     | 15       | ns   |
| tRAS (min)  | 45       | 45       | 45       | ns   |
| tRC (min)   | 60       | 57.5     | 60       | ns   |
| CL-tRCD-tRP | 5-5-5    | 5-5-5    | 6-6-6    | tCK  |

## Specifications:

- ◆ JEDEC standard 1.8V ± 0.1V
- ◆ Power Supply VDDQ = 1.8V± 0.1V
- ◆ Interface: SSTL\_18
- ◆ Posted CAS
- ◆ Programmable CAS Latency: 3, 4, 5, 6
- ◆ Programmable Additive Latency: 0, 1 , 2 , 3 and 4
- ◆ Write Latency(WL) = Read Latency(RL) -1
- ◆ Burst Length: 4 , 8(Interleave/nibble sequential)
- ◆ Programmable Sequential / Interleave Burst Mode
- ◆ On Die Termination
- ◆ Refresh and Self Refresh
- ◆ Average Refresh Period 7.8us
- ◆ Serial presence detect with EEPROM
- ◆ Compliance with RoHS
- ◆ Compliance with CE
- ◆ Supports auto-refresh/self-refresh
- ◆ Operating Temperature Range:  
Commercial  $0^{\circ}\text{C} \leq \text{TC} \leq 85^{\circ}\text{C}$
- ◆ Average refresh period  
7.8us at  $0^{\circ}\text{C} \leq \text{TC} \leq 85^{\circ}\text{C}$   
3.9us at  $85^{\circ}\text{C} \leq \text{TC} \leq 95^{\circ}\text{C}$

## Pin Assignments

| Pin No. | Pin name                 | Pin No. | Pin name | Pin No. | Pin name                 | Pin No. | Pin name                 |
|---------|--------------------------|---------|----------|---------|--------------------------|---------|--------------------------|
| 1       | VREF                     | 51      | DQS2     | 101     | A1                       | 151     | DQ42                     |
| 3       | VSS                      | 53      | VSS      | 103     | VDD                      | 153     | DQ43                     |
| 5       | DQ0                      | 55      | DQ18     | 105     | A10                      | 155     | VSS                      |
| 7       | DQ1                      | 57      | DQ19     | 107     | BA0                      | 157     | DQ48                     |
| 9       | VSS                      | 59      | VSS      | 109     | $\overline{\text{WE}}$   | 159     | DQ49                     |
| 11      | $\overline{\text{DQS0}}$ | 61      | DQ24     | 111     | VDD                      | 161     | VSS                      |
| 13      | DQS0                     | 63      | DQ25     | 113     | CAS#                     | 163     | NC                       |
| 15      | VSS                      | 65      | VSS      | 115     | S1#                      | 165     | VSS                      |
| 17      | DQ2                      | 67      | DM3      | 117     | VDD                      | 167     | $\overline{\text{DQS6}}$ |
| 19      | DQ3                      | 69      | NC       | 119     | ODT1                     | 169     | DQS6                     |
| 21      | VSS                      | 71      | VSS      | 121     | VSS                      | 171     | VSS                      |
| 23      | DQ8                      | 73      | DQ26     | 123     | DQ32                     | 173     | DQ50                     |
| 25      | DQ9                      | 75      | DQ27     | 125     | DQ33                     | 175     | DQ51                     |
| 27      | VSS                      | 77      | VSS      | 127     | VSS                      | 177     | VSS                      |
| 29      | $\overline{\text{DQS1}}$ | 79      | CKE0     | 129     | $\overline{\text{DQS4}}$ | 179     | DQ56                     |
| 31      | DQS1                     | 81      | VDD      | 131     | DQS4                     | 181     | DQ57                     |
| 33      | VSS                      | 83      | NC       | 133     | VSS                      | 183     | VSS                      |
| 35      | DQ10                     | 85      | NC/BA2   | 135     | DQ34                     | 185     | DM7                      |
| 37      | DQ11                     | 87      | VDD      | 137     | DQ35                     | 187     | VSS                      |
| 39      | VSS                      | 89      | A12      | 139     | VSS                      | 189     | DQ58                     |
| 41      | VSS                      | 91      | A9       | 141     | DQ40                     | 191     | DQ59                     |
| 43      | DQ16                     | 93      | A8       | 143     | DQ41                     | 193     | VSS                      |
| 45      | DQ17                     | 95      | VDD      | 145     | VSS                      | 195     | SDA                      |
| 47      | VSS                      | 97      | A5       | 147     | DM5                      | 197     | SCL                      |
| 49      | $\overline{\text{DQS2}}$ | 99      | A3       | 149     | VSS                      | 199     | VDDSPD                   |

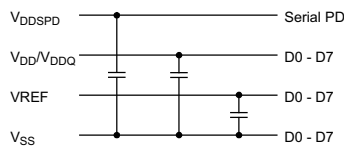
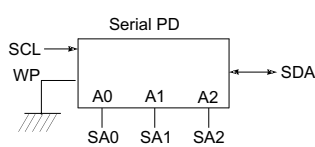
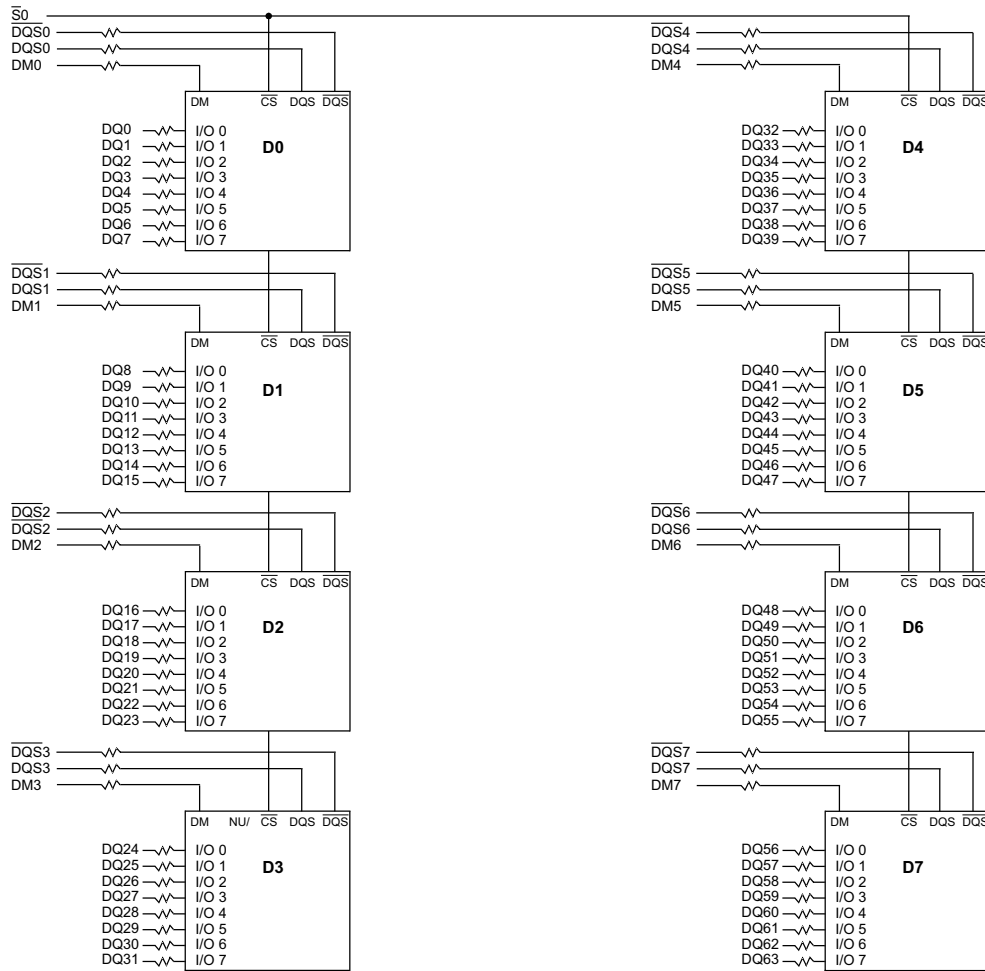
| Pin No. | Pin name                | Pin No. | Pin name                 | Pin No. | Pin name                 | Pin No. | Pin name                 |
|---------|-------------------------|---------|--------------------------|---------|--------------------------|---------|--------------------------|
| 2       | VSS                     | 52      | DM2                      | 102     | A0                       | 152     | DQ46                     |
| 4       | DQ4                     | 54      | VSS                      | 104     | VDD                      | 154     | DQ47                     |
| 6       | DQ5                     | 56      | DQ22                     | 106     | BA1                      | 156     | VSS                      |
| 8       | VSS                     | 58      | DQ23                     | 108     | $\overline{\text{RAS}}$  | 158     | DQ52                     |
| 10      | DM0                     | 60      | VSS                      | 110     | $\overline{\text{S0}}$   | 160     | DQ53                     |
| 12      | VSS                     | 62      | DQ28                     | 112     | VDD                      | 162     | VSS                      |
| 14      | DQ6                     | 64      | DQ29                     | 114     | ODT0                     | 164     | CK1                      |
| 16      | DQ7                     | 66      | VSS                      | 116     | NC                       | 166     | $\overline{\text{CK1}}$  |
| 18      | VSS                     | 68      | $\overline{\text{DQS3}}$ | 118     | VDD                      | 168     | VSS                      |
| 20      | DQ12                    | 70      | DQS3                     | 120     | NC                       | 170     | DM6                      |
| 22      | DQ13                    | 72      | VSS                      | 122     | VSS                      | 172     | VSS                      |
| 24      | VSS                     | 74      | DQ30                     | 124     | DQ36                     | 174     | DQ54                     |
| 26      | DM1                     | 76      | DQ31                     | 126     | DQ37                     | 176     | DQ55                     |
| 28      | VSS                     | 78      | VSS                      | 128     | VSS                      | 178     | VSS                      |
| 30      | CK0                     | 80      | NC/CKE1                  | 130     | DM4                      | 180     | DQ60                     |
| 32      | $\overline{\text{CK0}}$ | 82      | VDD                      | 132     | VSS                      | 182     | DQ61                     |
| 34      | VSS                     | 84      | NC                       | 134     | DQ38                     | 184     | VSS                      |
| 36      | DQ14                    | 86      | NC                       | 136     | DQ39                     | 186     | $\overline{\text{DQS7}}$ |
| 38      | DQ15                    | 88      | VDD                      | 138     | VSS                      | 188     | DQS7                     |
| 40      | VSS                     | 90      | A11                      | 140     | DQ44                     | 190     | VSS                      |
| 42      | VSS                     | 92      | A7                       | 142     | DQ45                     | 192     | DQ62                     |
| 44      | DQ20                    | 94      | A6                       | 144     | VSS                      | 194     | DQ63                     |
| 46      | DQ21                    | 96      | VDD                      | 146     | $\overline{\text{DQS5}}$ | 196     | VSS                      |
| 48      | VSS                     | 98      | A4                       | 148     | DQS5                     | 198     | SA0                      |
| 50      | NC                      | 100     | A2                       | 150     | VSS                      | 200     | SA1                      |

\*Pin 85 is NC for 512MB and BA2 for 1GB

## Pin Descriptions

| Pin Name                 | Description  |
|--------------------------|--|
| Ax                       | SDRAM address bus                                      |
| BAx                      | SDRAM bank select                                      |
| $\overline{\text{RAS}}$  | SDRAM row address strobe                               |
| $\overline{\text{CAS}}$  | SDRAM column address strobe                            |
| $\overline{\text{WE}}$   | SDRAM write enable                                     |
| $\overline{\text{Sx}}$   | DIMM Rank Select Lines                                 |
| CKEx                     | SDRAM clock enable lines                               |
| ODTx                     | On-die termination control lines                       |
| DQx                      | DIMM memory data bus                                   |
| DQSx                     | SDRAM data strobes(positive line of differential pair) |
| $\overline{\text{DQSx}}$ | SDRAM data strobes(negative line of differential pair) |
| DMx                      | SDRAM data masks high data strobes(x8-based X72 DIMMs) |
| CKx                      | SDRAM clocks(positive line of differential pair)       |
| $\overline{\text{CKx}}$  | SDRAM clocks(negative line of differential pair)       |
| SCL                      | I2C serial bus clock for EEPROM                        |
| SDA                      | I2C serial bus data line for EEPROM                    |
| SAX                      | I2C slave address select for EEPROM                    |
| VDD                      | SDRAM core power supply                                |
| VDDQ                     | SDRAM I/O Driver power supply                          |
| VREF                     | SDRAM I/O reference supply                             |
| VSS                      | Power supply return(ground)                            |
| VDDSPD                   | Serial EEPROM positive power supply                    |
| NC                       | Spare pins(no connect)                                 |

# Functional Block Diagram



- BA0 - BA2 → BA0-BA2 : DDR2 SDRAMs D0 - D7
- A0 - A13 → A0-A13 : DDR2 SDRAMs D0 - D7
- RAS → RAS : DDR2 SDRAMs D0 - D7
- CAS → CAS : DDR2 SDRAMs D0 - D7
- CKE0 → CKE : DDR2 SDRAMs D0 - D7
- WE → WE : DDR2 SDRAMs D0 - D7
- ODT0 → ODT : DDR2 SDRAMs D0 - D7

| * Clock Wiring |               |
|----------------|---------------|
| Clock Input    | DDR2 SDRAMs   |
| *CK0/CK0       | 2 DDR2 SDRAMs |
| *CK1/CK1       | 3 DDR2 SDRAMs |
| *CK2/CK2       | 3 DDR2 SDRAMs |

\*Wire per Clock Loading Table/Wiring Diagrams

**Notes :**

1. DQ,DM, DQS/DQS resistors : 22 Ohms " 5%.
2. BAX, Ax, RAS, CAS, WE resistors : 10 Ohms " 5%.



## Absolute Maximum Ratings

| Parameter                           | Symbol            | Description     | Units |
|-------------------------------------|-------------------|-----------------|-------|
| Voltage on VDD pin relative to Vss  | $V_{DD}$          | - 0.5 V ~ 2.3 V | V     |
| Voltage on VDDQ pin relative to Vss | $V_{DDQ}$         | - 0.5 V ~ 2.3 V | V     |
| Voltage on any pin relative to Vss  | $V_{IN}, V_{OUT}$ | - 0.5 V ~ 2.3 V | V     |
| Storage Temperature                 | TSTG              | -55 to +100     | °C    |

Notes:

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.

## DRAM Component Operating Temperature Range

| Symbol            | Parameter                          | Rating   | Units | Notes |
|-------------------|------------------------------------|----------|-------|-------|
| T <sub>OPER</sub> | Normal Operating Temperature Range | 0 to 85  | °C    | 1,2   |
|                   | Extended Temperature Range         | 85 to 95 | °C    | 1,3   |

Notes:

1. Operating Temperature T<sub>OPER</sub> is the case surface temperature on the center / top side of the DRAM. For measurement conditions please refer to the JEDEC document JESD51-2.
2. The Normal Temperature Range specifies the temperatures where all DRAM specifications will be supported during operation, the DRAM case temperature must be maintained between 0°C - 85°C under all operating conditions.
3. Some applications require operation of the DRAM in the Extended Temperature Range between 85°C and 95°C case temperature. Full specifications are guaranteed in this range, but the following additional conditions apply:
  - a. Refresh commands must be doubled in frequency, therefore reducing the Refresh interval tREFI to 3.9 μs.
  - b. If Self-Refresh operation is required in the Extended Temperature Range, then it is mandatory to either use the Manual Self-Refresh mode with Extended Temperature Range capability (MR2 A6 = 0b and MR2 A7 = 1b), in this case IDD6 current can be increased around 10~20% than normal Temperature range.

# Operating Conditions

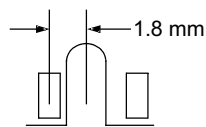
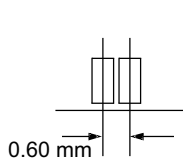
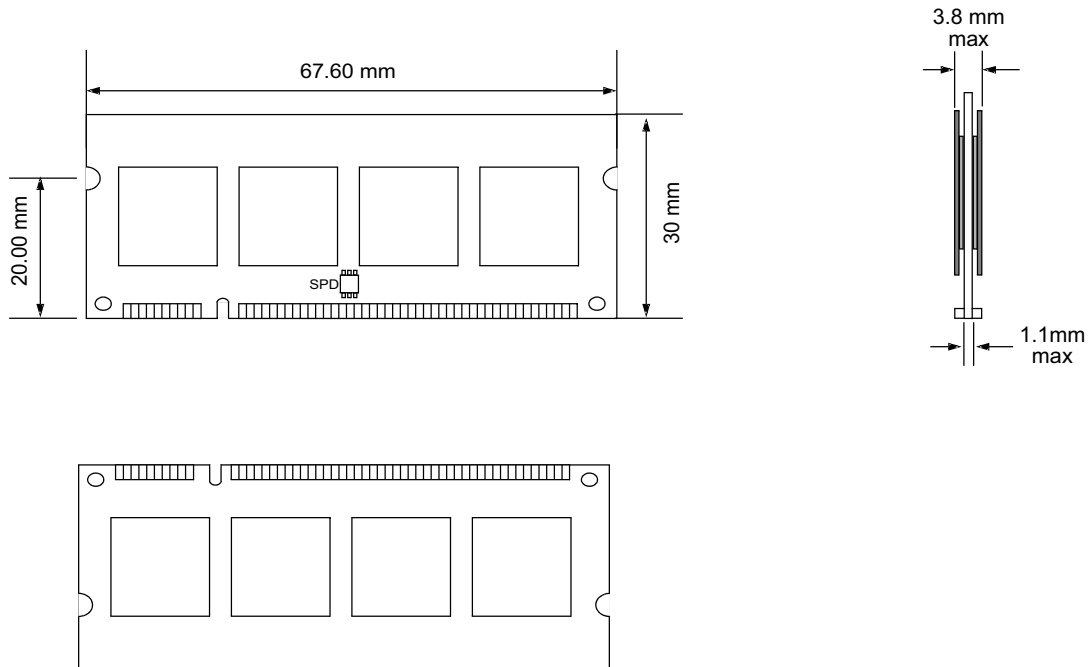
## Recommended DC Operating Conditions – DDR2 (1.8V) operation

| Symbol | Parameter                 | Rating |      |      | Units |
|--------|---------------------------|--------|------|------|-------|
|        |                           | Min.   | Typ. | Max. |       |
| VDD    | Supply Voltage            | 1.7    | 1.8  | 1.9  | V     |
| VDDQ   | Supply Voltage for Output | 1.7    | 1.8  | 1.9  | V     |

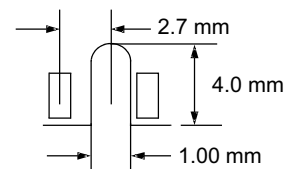
Notes:

1. Under all conditions VDDQ must be less than or equal to VDD..
2. VDDQ tracks with VDD. AC parameters are measured with VDD and VDDQ tied together.

# Mechanical Drawing



Left key position :  
Reserved



Right key position :  
 $V_{DD} = V_{DDQ} = 1.8\text{ V}$

Unit: mm

Tolerances:  $\pm 0.15\text{ mm}$  unless otherwise specified

## Revision History

| <b>Revision</b> | <b>Date</b> | <b>Description</b>           | <b>Remark</b> |
|-----------------|-------------|------------------------------|---------------|
| 0.9             | 08/28/2012  | Official release             |               |
| 1.0             | 08/29/2012  | release                      |               |
| 1.1             | 07/23/2013  | Changed headquarters address |               |

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