



# **Z6FAGH3SBAA-MC**

**16 GB, 1Rx8 288-Pin DDR4-3200 UDIMM**

## **Data Sheet**

**2023.03**  
**Rev.02**

## 16 GB DDR4 SDRAM UDIMM Specification

### Specifications

|                                                  |                 |
|--------------------------------------------------|-----------------|
| Max. Speed; CAS Latency                          | DDR4-3200@CL=22 |
| Row Cycle Time (tRCmin)                          | 45.75 ns        |
| Min. RAS-CAS-Delay (tRCD)                        | 13.75 ns        |
| Min. Row Precharge Time (tRP)                    | 13.75 ns        |
| Refresh to Active/Refresh Command Time (tRFCmin) | 350 ns          |
| Row Active Time (tRASmin)                        | 32 ns           |
| Operating Temperature                            | 0 °C to +85 °C  |
| Storage Temperature (T <sub>STG</sub> )          | -55 to 100 °C   |

### Features

- 288-pin, unbuffered dual in-line memory module (UDIMM)
- 1Rx8 memory module (1 rank of x8 DDR4 SDRAMs )
- Power supply:
  - VDD = VDDQ = 1.2 V  $\pm$  5%
  - VPP = 2.5 V  $-5\%/+10\%$
  - VDDSPD = 2.2 V to 3.6 V
- Nominal and dynamic on-die termination (ODT) for data, strobe, and mask signals
- Low-power auto self refresh (LPASR)
- Data bus inversion (DBI) for data bus
- On-die VREFDQ generation and calibration
- On-board I<sup>2</sup>C serial presence-detect (SPD) EEPROM
- 16 internal banks; 4 groups of 4 banks each
- Fixed burst chop (BC) of 4 and burst length (BL) of 8 via the mode register set (MRS)
- Selectable BC4 or BL8 on-the-fly (OTF)
- Fly-by topology
- Terminated control command and address bus
- PCB Height: 1.23" (31.25 mm)

## Ordering Information

| Part Number    | Module Density | Configuration           | Speed Bin (CL-nRCD-nRP) | Operating Temperature | Storage Temperature |
|----------------|----------------|-------------------------|-------------------------|-----------------------|---------------------|
| Z6FAGH3SBAA-MC | 16 GB          | 2G × 64<br>(2Gx8 1Rank) | DDR4-3200 (22-22-22)    | 0℃~85℃                | -55℃~100℃           |

## Address Format

| DIMM Density   | Row address  | Column address | Device bank group address | Device bank address per group | Device configuration | Module rank address | Device Quantity |
|----------------|--------------|----------------|---------------------------|-------------------------------|----------------------|---------------------|-----------------|
| 16GB(1Rx8,X64) | 128K A[16:0] | 1K A[9:0]      | 4 BG[1:0]                 | 4 BA[1:0]                     | 16Gb(2Gx8)           | 1 CS_n[0]           | 8               |

## Pin Configurations

| Pin# | Front Side        | Pin# | Back Side | Pin# | Front Side        | Pin# | Back Side |
|------|-------------------|------|-----------|------|-------------------|------|-----------|
| 1    | 12V               | 145  | 12V       | 37   | VSS               | 181  | DQ29      |
| 2    | VSS               | 146  | VREFCA    | 38   | DQ24              | 182  | VSS       |
| 3    | DQ4               | 147  | VSS       | 39   | VSS               | 183  | DQ25      |
| 4    | VSS               | 148  | DQ5       | 40   | DM3_n, DBI3_n, NC | 184  | VSS       |
| 5    | DQ0               | 149  | VSS       | 41   | NC                | 185  | DQS3_c    |
| 6    | VSS               | 150  | DQ1       | 42   | VSS               | 186  | DQS3_t    |
| 7    | DM0_n, DBI0_n, NC | 151  | VSS       | 43   | DQ30              | 187  | VSS       |
| 8    | NC                | 152  | DQS0_c    | 44   | VSS               | 188  | DQ31      |
| 9    | VSS               | 153  | DQS0_t    | 45   | DQ26              | 189  | VSS       |
| 10   | DQ6               | 154  | VSS       | 46   | VSS               | 190  | DQ27      |
| 11   | VSS               | 155  | DQ7       | 47   | NC                | 191  | VSS       |
| 12   | DQ2               | 156  | VSS       | 48   | VSS               | 192  | NC        |
| 13   | VSS               | 157  | DQ3       | 49   | NC                | 193  | VSS       |
| 14   | DQ12              | 158  | VSS       | 50   | VSS               | 194  | NC        |
| 15   | VSS               | 159  | DQ13      | 51   | DM8_n, DBI8_n, NC | 195  | VSS       |
| 16   | DQ8               | 160  | VSS       | 52   | NC                | 196  | DQS8_c    |
| 17   | VSS               | 161  | DQ9       | 53   | VSS               | 197  | DQS8_t    |
| 18   | DM1_n, DBI1_n, NC | 162  | VSS       | 54   | NC                | 198  | VSS       |
| 19   | NC                | 163  | DQS1_c    | 55   | VSS               | 199  | NC        |
| 20   | VSS               | 164  | DQS1_t    | 56   | NC                | 200  | VSS       |
| 21   | DQ14              | 165  | VSS       | 57   | VSS               | 201  | NC        |
| 22   | VSS               | 166  | DQ15      | 58   | RESET_n           | 202  | VSS       |
| 23   | DQ10              | 167  | VSS       | 59   | VDD               | 203  | CKE1      |
| 24   | VSS               | 168  | DQ11      | 60   | CKE0              | 204  | VDD       |
| 25   | DQ20              | 169  | VSS       | 61   | VDD               | 205  | RFU       |
| 26   | VSS               | 170  | DQ21      | 62   | ACT_n             | 206  | VDD       |
| 27   | DQ16              | 171  | VSS       | 63   | BG0               | 207  | BG1       |
| 28   | VSS               | 172  | DQ17      | 64   | VDD               | 208  | ALERT_n   |
| 29   | DM2_n, DBI2_n, NC | 173  | VSS       | 65   | A12               | 209  | VDD       |
| 30   | NC                | 174  | DQS2_c    | 66   | A9                | 210  | A11       |
| 31   | VSS               | 175  | DQS2_t    | 67   | VDD               | 211  | A7        |
| 32   | DQ22              | 176  | VSS       | 68   | A8                | 212  | VDD       |
| 33   | VSS               | 177  | DQ23      | 69   | A6                | 213  | A5        |
| 34   | DQ18              | 178  | VSS       | 70   | VDD               | 214  | A4        |
| 35   | VSS               | 179  | DQ19      | 71   | A3                | 215  | VDD       |
| 36   | DQ28              | 180  | VSS       | 72   | A1                | 216  | A2        |



| Pin# | Front Side        | Pin# | Back Side  | Pin# | Front Side        | Pin# | Back Side |
|------|-------------------|------|------------|------|-------------------|------|-----------|
| 73   | VDD               | 217  | VDD        | 108  | DQ40              | 252  | VSS       |
| 74   | CK0_t             | 218  | CK1_t      | 109  | VSS               | 253  | DQ41      |
| 75   | CK0_c             | 219  | CK1_c      | 110  | DM5_n, DBI5_n, NC | 254  | VSS       |
| 76   | VDD               | 220  | VDD        | 111  | NC                | 255  | DQS5_c    |
| 77   | VTT               | 221  | VTT        | 112  | VSS               | 256  | DQS5_t    |
| KEY  |                   |      |            | 113  | DQ46              | 257  | VSS       |
| 78   | EVENT_n           | 222  | PARITY     | 114  | VSS               | 258  | DQ47      |
| 79   | A0                | 223  | VDD        | 115  | DQ42              | 259  | VSS       |
| 80   | VDD               | 224  | BA1        | 116  | VSS               | 260  | DQ43      |
| 81   | BA0               | 225  | A10_AP     | 117  | DQ52              | 261  | VSS       |
| 82   | RAS_n/A16         | 226  | VDD        | 118  | VSS               | 262  | DQ53      |
| 83   | VDD               | 227  | RFU        | 119  | DQ48              | 263  | VSS       |
| 84   | S0_n              | 228  | WE_n/A14   | 120  | VSS               | 264  | DQ49      |
| 85   | VDD               | 229  | VDD        | 121  | DM6_n, DBI6_n, NC | 265  | VSS       |
| 86   | CAS_n/A15         | 230  | Save_n,NC  | 122  | NC                | 266  | DQS6_c    |
| 87   | ODT0              | 231  | VDD        | 123  | VSS               | 267  | DQS6_t    |
| 88   | VDD               | 232  | A13        | 124  | DQ54              | 268  | VSS       |
| 89   | S1_n              | 233  | VDD        | 125  | VSS               | 269  | DQ55      |
| 90   | VDD               | 234  | A17, NC    | 126  | DQ50              | 270  | VSS       |
| 91   | ODT1              | 235  | C[2], NC   | 127  | VSS               | 271  | DQ51      |
| 92   | VDD               | 236  | VDD        | 128  | DQ60              | 272  | VSS       |
| 93   | S2_n, C[0]        | 237  | S3_n, C[1] | 129  | VSS               | 273  | DQ61      |
| 94   | VSS               | 238  | SA2        | 130  | DQ56              | 274  | VSS       |
| 95   | DQ36              | 239  | VSS        | 131  | VSS               | 275  | DQ57      |
| 96   | VSS               | 240  | DQ37       | 132  | DM7_n, DBI7_n, NC | 276  | VSS       |
| 97   | DQ32              | 241  | VSS        | 133  | NC                | 277  | DQS7_c    |
| 98   | VSS               | 242  | DQ33       | 134  | VSS               | 278  | DQS7_t    |
| 99   | DM4_n, DBI4_n, NC | 243  | VSS        | 135  | DQ62              | 279  | VSS       |
| 100  | NC                | 244  | DQS4_c     | 136  | VSS               | 280  | DQ63      |
| 101  | VSS               | 245  | DQS4_t     | 137  | DQ58              | 281  | VSS       |
| 102  | DQ38              | 246  | VSS        | 138  | VSS               | 282  | DQ59      |
| 103  | VSS               | 247  | DQ39       | 139  | SA0               | 283  | VSS       |
| 104  | DQ34              | 248  | VSS        | 140  | SA1               | 284  | VDDSPD    |
| 105  | VSS               | 249  | DQ35       | 141  | SCL               | 285  | SDA       |
| 106  | DQ44              | 250  | VSS        | 142  | VPP               | 286  | VPP       |
| 107  | VSS               | 251  | DQ45       | 143  | VPP               | 287  | VPP       |
|      |                   |      |            | 144  | RFU               | 288  | VPP       |

## Pin Descriptions

| Symbol                                | Type  | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CKx_t, CKx_c,                         | Input | Clock: CK_t and CK_c are differential clock inputs. All address and control input signals are sampled on the crossing of the positive edge of CK_t and negative edge of CK_c.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| CKEx                                  | Input | Clock Enable: CKE HIGH activates, and CKE Low deactivates internal clock signals and device input buffers and output drivers. Taking CKE Low provides Precharge Power Down and Self-Refresh operation (all banks idle), or Active Power-Down (row Active in any bank). CKE is synchronous for Self-Refresh exit. After VREFCA and Internal DQ Vref have become stable during the power on and initialization sequence, they must be maintained during all operations (including Self-Refresh). CKE must be maintained high throughout read and write accesses. Input buffers, excluding CK_t, CK_c, ODT and CKE, are disabled during power-down. Input buffers, excluding CKE, are disabled during Self-Refresh. |
| CSx_n                                 | Input | Chip Select: All commands are masked when CS_n is registered HIGH. CS_n provides for external Rank selection on systems with multiple Ranks. CS_n is considered part of the command code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Cx                                    | Input | Chip ID: Chip ID is only used for 3DS for 2,4,8 high stack via TSV to select each slice of stacked component. Chip ID is considered part of the command code                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| ODT, (ODT1)                           | Input | On Die Termination: ODT (registered HIGH) enables RTT_NOM termination resistance internal to the DDR4 SDRAM. When enabled, ODT is only applied to each DQ, DQS_t, DQS_c and DM_n/DBI_n/TDQS_t, TDQS_c signal. The ODT pin will be ignored if MR1 is programmed to disable RTT_NOM                                                                                                                                                                                                                                                                                                                                                                                                                                |
| ACT_n                                 | Input | Activation Command Input: ACT_n defines the Activation command being entered along with CS_n. The input into RAS_n/A16, CAS_n/A15 and WE_n/A14 will be considered as Row Address A16, A15 and A14                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| RAS_n/A16.<br>CAS_n/A15.<br>WE_n/A14. | Input | Command Inputs: RAS_n/A16, CAS_n/A15 and WE_n/A14 (along with CS_n) define the command being entered. Those pins have multi function. For example, for activation with ACT_n Low, these are Addresses like A16, A15 and A14 but for non-activation command with ACT_n High, these are Command pins for Read, Write and other command defined in command truth table                                                                                                                                                                                                                                                                                                                                              |
| BGx                                   | Input | Bank Group Inputs: BG0 - BG1 define which bank group an Active, Read, Write or Precharge command is being applied. BG0 also determines which mode register is to be accessed during a MRS cycle                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| BAx                                   | Input | Bank Address Inputs: BA0 - BA1 define to which bank an Active, Read, Write or Precharge command is being applied. Bank address also determines which mode register is to be accessed during a MRS cycle                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Ax                                    | Input | Address Inputs: Provide the row address for ACTIVATE Commands and the column address for Read/Write commands to select one location out of the memory array in the respective bank. A10/AP, A12/BC_n, RAS_n/A16, CAS_n/A15 and WE_n/A14 have additional functions. See other rows. The address inputs also provide the op-code during Mode Register Set commands. A17 is only defined for 16 Gb x4 SDRAM configurations.                                                                                                                                                                                                                                                                                         |
| A10 / AP                              | Input | Auto-precharge: A10 is sampled during Read/Write commands to determine whether Autoprecharge should be performed to the accessed bank after the Read/Write operation. (HIGH: Autoprecharge; LOW: no Autoprecharge). A10 is sampled during a Precharge command to determine whether the Precharge applies to one bank (A10 LOW) or all banks (A10 HIGH). If only one bank is to be precharged, the bank is selected by bank addresses                                                                                                                                                                                                                                                                             |
| A12/BC_n                              | Input | Burst Chop: A12/BC_n is sampled during Read and Write commands to determine if burst chop (on-the-fly) will be performed. (HIGH, no burst chop; LOW: burst chopped). See command truth table for details.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Parity                                | Input | Command and Address Parity Input: DDR4 Supports Even Parity check in SDRAMs with MR setting. Once it's enabled via Register in MR5, then SDRAM calculates Parity with ACT_n, RAS_n/A16, CAS_n/A15, WE_n/A14, BG0-BG1, BA0-BA1, A17-A0. Input parity should be maintained at the rising edge of the clock and at the same time with command & address with CS_n Low                                                                                                                                                                                                                                                                                                                                               |
| SAX                                   | Input | Serial address inputs: Used to configure the temperature sensor/SPD EEPROM address range on the I2C bus.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| SCL                                   | Input | Serial clock for temperature sensor/SPD EEPROM: Used to synchronize communication to and from the temperature sensor/SPD EEPROM on the I2C bus                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

| Symbol                                                    | Type       | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RESET_n                                                   | CMOS Input | Active Low Asynchronous Reset: Reset is active when RESET_n is Low, and inactive when RESET_n is HIGH. RESET_n must be HIGH during normal operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| DQx, CBx                                                  | I/O        | Data Input/ Output: Bi-directional data bus. If CRC is enabled via Mode register then CRC code is added at the end of Data Burst. Any DQ from DQ0-DQ3 may indicate the internal Vref level during test via Mode Register Setting MR4 A4=High. Refer to vendor specific data sheets to determine which DQ is used                                                                                                                                                                                                                                                                                                                                                                                                                     |
| DQSx_t-DQSx_c                                             | I/O        | Data Strobe: output with read data, input with write data. Edge-aligned with read data, centered in write data. The data strobe DQS_t is paired with differential signals DQS_c, respectively, to provide differential pair signaling to the system during reads and writes. DDR4 SDRAM supports differential data strobe only and does not support single-ended.                                                                                                                                                                                                                                                                                                                                                                    |
| DM_n/DBI_n/ TDQS_t<br>(DMU_n, DBIU_n),<br>(DML_n/ DBIL_n) | I/O        | Input data mask and data bus inversion: DM_n is an input mask signal for write data. Input data is masked when DM_n is sampled LOW coincident with that input data during a write access. DM_n is sampled on both edges of DQS. DM is multiplexed with the DBI function by the mode register A10, A11, and A12 settings in MR5. For a x8 device, the function of DM or TDQS is enabled by the mode register A11 setting in MR1. DBI_n is an input/output identifying whether to store/output the true or inverted data. If DBI_n is LOW, the data will be stored/ output after inversion inside the DDR4 device and not inverted if DBI_n is HIGH. TDQS is only supported in x8 SDRAM configurations (TDQS is not valid for UDIMMs). |
| SDA                                                       | I/O        | Serial Data: Bidirectional signal used to transfer data in or out of the EEPROM or EEPROM/TS combo device.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| ALERT_n                                                   | Output     | Alert: It has multi functions such as CRC error flag, Command and Address Parity error flag as Output signal. If there is error in CRC, then ALERT_n goes LOW for the period time interval and goes back HIGH. If there is error in Command Address Parity Check, then ALERT_n goes LOW for relatively long period until ongoing SDRAM internal recovery transaction is complete. During Connectivity Test mode this pin functions as an input.                                                                                                                                                                                                                                                                                      |
| EVENT_n                                                   | Output     | Temperature event: The EVENT_n pin is asserted by the temperature sensor when critical temperature thresholds have been exceeded. This pin has no function (NF) on modules without temperature sensors.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| TDQS_t TDQS_c (x8<br>DRAM-based RDIMM<br>only)            | Output     | Termination data strobe: When enabled via the mode register, the DRAM device enables the same RTT termination resistance on TDQS_t and TDQS_c that is applied to DQS_t and DQS_c. When the TDQS function is disabled via the mode register, the DM/TDQS_t pin provides the data mask (DM) function, and the TDQS_c pin is not used. The TDQS function must be disabled in the mode register for both the x4 and x16 configurations. The DM function is supported only in x8 and x16 configurations. DM, DBI, and TDQS are a shared pin and are enabled/disabled by mode register settings. For more information about TDQS, see the DDR4 DRAM component datasheet (TDQS_t and TDQS_c are not valid for UDIMMs).                      |
| VDD                                                       | Supply     | Module power supply: 1.2V (TYP).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| VPP                                                       | Supply     | DRAM activating power supply: 2.5V -0.125V / +0.250V.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| VREFCA                                                    | Supply     | Reference voltage for control, command, and address pins.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| VSS                                                       | Supply     | Ground                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| VTT                                                       | Supply     | Power supply for termination of address, command, and control VDD/2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| VDDSPD                                                    | Supply     | Power supply used to power the I2C bus for SPD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| RFU                                                       | -          | Reserved for Future Use: No on DIMM electrical connection is present                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| NC                                                        | -          | No Connect: No on DIMM electrical connection is present                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

## General Description

High-speed DDR4 SDRAM modules use DDR4 SDRAM devices with 2 or 4 internal memory bank groups. DDR4 SDRAM modules utilizing 4- and 8-bit-wide DDR4 SDRAM have 4 internal bank groups consisting of 4 memory banks each, providing a total of 16 banks. Sixteen-bit-wide DDR4 SDRAM has 2 internal bank groups consisting of 4 memory banks each, providing a total of 8 banks. DDR4 SDRAM modules benefit from DDR4 SDRAM's use of an 8n-prefetch architecture with an interface designed to transfer two data words per clock cycle at the I/O pins. A single READ or WRITE operation for the DDR4 SDRAM effectively consists of a single 8n-bit-wide, four-clock data transfer at the internal DRAM core and eight corresponding n-bit wide, one-half-clock-cycle data transfers at the I/O pins. DDR4 modules use two sets of differential signals: DQS, DQS# to capture data and CK and CK# to capture commands, addresses, and control signals. Differential clocks and data strobes ensure exceptional noise immunity for these signals and provide precise crossing points to capture input signals.

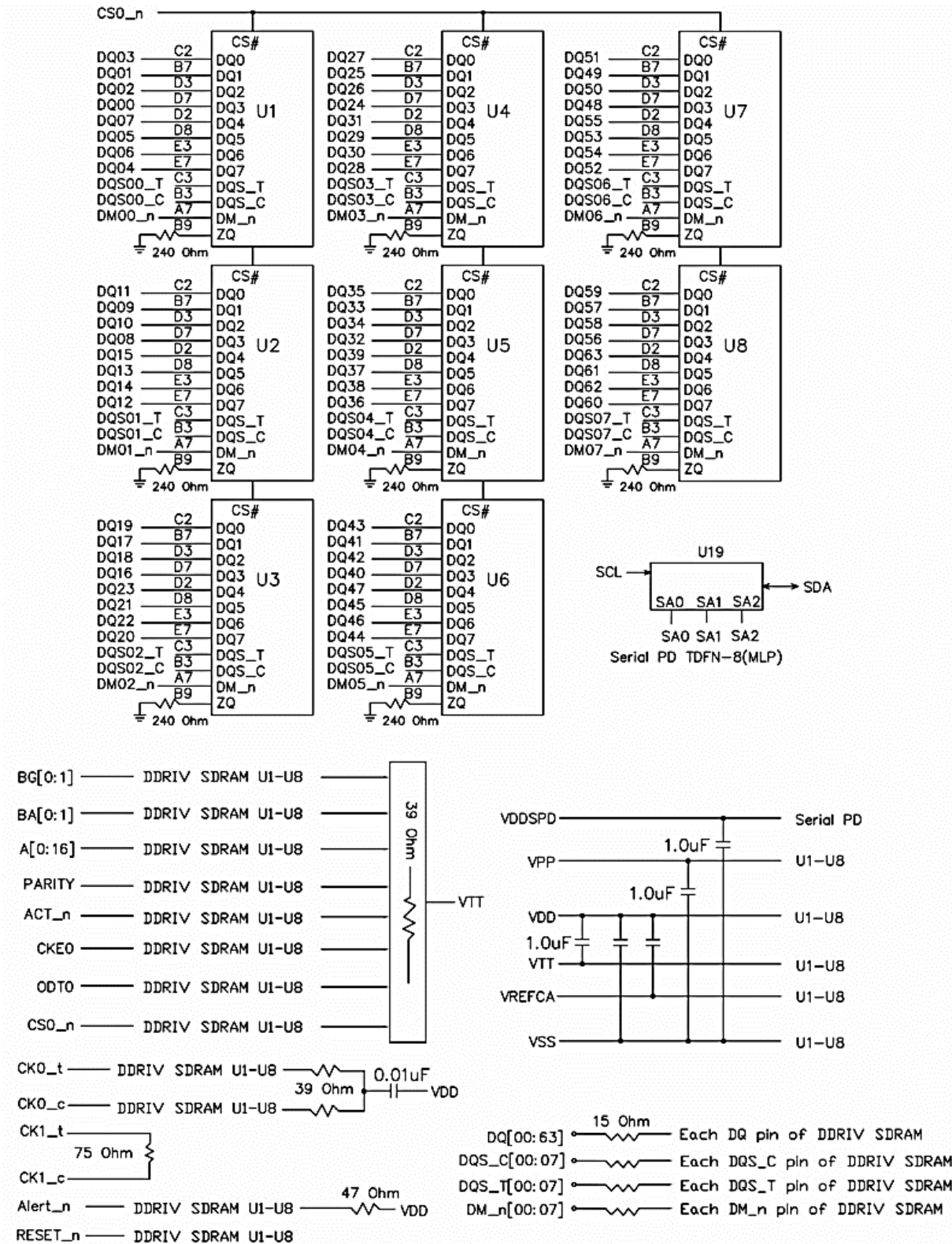
## Fly-By Topology

DDR4 modules use faster clock speeds than earlier DDR technologies, making signal quality more important than ever. For improved signal quality, the clock, control, command, and address buses have been routed in a fly-by topology, where each clock, control, command, and address pin on each DRAM is connected to a single trace and terminated (rather than a tree structure, where the termination is off the module near the connector). Inherent to fly-by topology, the timing skew between the clock and DQS signals can be easily accounted for by using the write-leveling feature of DDR4.

## Serial Presence-Detect EEPROM Operation

DDR4 SDRAM modules incorporate serial presence-detect. The SPD data is stored in a 512-byte EEPROM. System READ/WRITE operations between the master (system logic) and the slave EEPROM device occur via a standard I2C bus using the DIMM's SCL (clock) SDA (data), and SA (address) pins. Write protect (WP) is connected to VSS, permanently disabling hardware write protection.

## Function Block Diagram



**DQ Map**

| Module Pin NO. | Module DQ | Damping RES. | IC NO. | IC DQ | Module Pin NO. | Module DQ | Damping RES. | IC NO. | IC DQ |
|----------------|-----------|--------------|--------|-------|----------------|-----------|--------------|--------|-------|
| 5              | 0         | RN1(2-3)     | U1     | 3     | 16             | 8         | RN7(2-3)     | U2     | 3     |
| 150            | 1         | RN3(1-4)     |        | 1     | 161            | 9         | RN5(1-4)     |        | 1     |
| 12             | 2         | RN2(2-3)     |        | 2     | 23             | 10        | RN8(2-3)     |        | 2     |
| 157            | 3         | RN4(1-4)     |        | 0     | 168            | 11        | RN6(1-4)     |        | 0     |
| 3              | 4         | RN1(1-4)     |        | 7     | 14             | 12        | RN7(1-4)     |        | 7     |
| 148            | 5         | RN3(2-3)     |        | 5     | 159            | 13        | RN5(2-3)     |        | 5     |
| 10             | 6         | RN2(1-4)     |        | 6     | 21             | 14        | RN8(1-4)     |        | 6     |
| 155            | 7         | RN4(2-3)     |        | 4     | 166            | 15        | RN6(2-3)     |        | 4     |
| 27             | 16        | RN9(2-3)     | U3     | 3     | 38             | 24        | RN15(2-3)    | U4     | 3     |
| 172            | 17        | RN11(1-4)    |        | 1     | 183            | 25        | RN13(1-4)    |        | 1     |
| 34             | 18        | RN12(2-3)    |        | 2     | 45             | 26        | RN14(2-3)    |        | 2     |
| 179            | 19        | RN10(1-4)    |        | 0     | 190            | 27        | RN16(1-4)    |        | 0     |
| 25             | 20        | RN9(1-4)     |        | 7     | 36             | 28        | RN15(1-4)    |        | 7     |
| 170            | 21        | RN11(2-3)    |        | 5     | 181            | 29        | RN13(2-3)    |        | 5     |
| 32             | 22        | RN12(1-4)    |        | 6     | 43             | 30        | RN14(1-4)    |        | 6     |
| 177            | 23        | RN10(2-3)    |        | 4     | 188            | 31        | RN16(2-3)    |        | 4     |
| 97             | 32        | RN17(2-3)    | U5     | 3     | 108            | 40        | RN21(2-3)    | U6     | 3     |
| 242            | 33        | RN19(1-4)    |        | 1     | 253            | 41        | RN23(1-4)    |        | 1     |
| 104            | 34        | RN20(2-3)    |        | 2     | 115            | 42        | RN24(2-3)    |        | 2     |
| 249            | 35        | RN18(1-4)    |        | 0     | 260            | 43        | RN22(1-4)    |        | 0     |
| 95             | 36        | RN17(1-4)    |        | 7     | 106            | 44        | RN21(1-4)    |        | 7     |
| 240            | 37        | RN19(2-3)    |        | 5     | 251            | 45        | RN23(2-3)    |        | 5     |
| 102            | 38        | RN20(1-4)    |        | 6     | 113            | 46        | RN24(1-4)    |        | 6     |
| 247            | 39        | RN18(2-3)    |        | 4     | 258            | 47        | RN22(2-3)    |        | 4     |
| 119            | 48        | RN26(2-3)    | U7     | 3     | 130            | 56        | RN28(2-3)    | U8     | 3     |
| 264            | 49        | RN25(1-4)    |        | 1     | 275            | 57        | RN30(1-4)    |        | 1     |
| 126            | 50        | RN45(2-3)    |        | 2     | 137            | 58        | RN29(2-3)    |        | 2     |
| 271            | 51        | RN27(1-4)    |        | 0     | 282            | 59        | RN31(1-4)    |        | 0     |
| 117            | 52        | RN26(1-4)    |        | 7     | 128            | 60        | RN28(1-4)    |        | 7     |
| 262            | 53        | RN25(2-3)    |        | 5     | 273            | 61        | RN30(2-3)    |        | 5     |
| 124            | 54        | RN45(1-4)    |        | 6     | 135            | 62        | RN29(1-4)    |        | 6     |
| 269            | 55        | RN27(2-3)    |        | 4     | 280            | 63        | RN31(2-3)    |        | 4     |

## Absolute Maximum Ratings

| Symbol                             | Parameter                                        | Rating      | Units | Note |
|------------------------------------|--------------------------------------------------|-------------|-------|------|
| VDD                                | Voltage on VDD pin relative to Vss               | -0.3 ~ 1.5  | V     |      |
| VDDQ                               | Voltage on VDDQ pin relative to Vss              | -0.3 ~ 1.5  | V     |      |
| VPP                                | Voltage on VPP pin relative to Vss               | -0.3 ~ 3.0  | V     |      |
| V <sub>IN</sub> , V <sub>OUT</sub> | Voltage on any pin except VREFCA relative to Vss | -0.3 ~ 1.5  | V     |      |
| T <sub>STG</sub>                   | Storage Temperature                              | -55 to +100 | °C    |      |

Note: Stresses above the max. values listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to integrated circuit.

## Absolute Maximum Ratings

| Symbol            | Parameter             | Rating |     | Units | Note    |
|-------------------|-----------------------|--------|-----|-------|---------|
|                   |                       | Min    | Max |       |         |
| T <sub>CASE</sub> | Operating Temperature | 0      | 95  | °C    | 1,2,3,4 |

### Notes:

- Operating Temperature is the case surface temperature on the center / top side of the DRAM.
- The operating temperature ranges are the temperatures where all DRAM specification will be supported. During operation, the DRAM case temperature must be maintained between 0 - 95 °C under all other specification parameters.
- Above 85 °C the Auto-Refresh command interval has to be reduced to tREFI= 3.9 μs
- When operating this product in the 85 °C to 95 °C TCASE temperature range, the High Temperature Self Refresh has to be enabled by setting EMR(2) bit A7 to "1".

## Operating Conditions

### Recommended DC Operating Conditions

| Parameter                             | Symbol    | Min.                 | Typ.                 | Max.                 | Unit | Note  |
|---------------------------------------|-----------|----------------------|----------------------|----------------------|------|-------|
| Supply Voltage                        | $V_{DD}$  | 1.14                 | 1.2                  | 1.26                 | V    | 1,2,3 |
| Supply Voltage for Output             | $V_{DDQ}$ | 1.14                 | 1.2                  | 1.26                 | V    | 1,2,3 |
| Peak-to-Peak Voltage                  | $V_{PP}$  | 2.375                | 2.5                  | 2.75                 | V    | 3     |
| Reference Voltage for ADD, CMD inputs | $V_{REF}$ | $0.49 \times V_{DD}$ | $0.5 \times V_{DDQ}$ | $0.51 \times V_{DD}$ | V    |       |

#### Notes:

- Under all conditions  $V_{DDQ}$  must be less than or equal to  $V_{DD}$ .
- $V_{DDQ}$  tracks with  $V_{DD}$ . AC parameters are measured with VDD and VDDQ tied together.
- DC bandwidth is limited to 20MHz.

### Single-ended AC & DC input levels for Command and Address

| Parameter         | Symbol              | Min.                | Max.              | Unit |
|-------------------|---------------------|---------------------|-------------------|------|
| $V_{IH,CA}(DC65)$ | DC input logic high | $V_{REFCA} + 0.065$ | $V_{DD}$          | V    |
| $V_{IL,CA}(DC65)$ | DC input logic low  | $V_{SS}$            | $V_{REFCA}-0.065$ | V    |
| $V_{IH,CA}(AC90)$ | AC input logic high | $V_{SS}+0.09$       |                   | V    |
| $V_{IL,CA}(AC90)$ | AC input logic low  |                     | $V_{REF}-0.09$    | V    |

**IDD/IPP Specifications and Conditions**

| Symbol         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IDD0<br>IPP0   | Operating One Bank Active-Precharge Current (AL=0)<br>CKE: High; External clock: On; tCK, nRC, nRAS, CL: Refer to Component Datasheet for detail pattern; BL: 8 <sup>1</sup> ; AL: 0; CS_n: High between ACT and PRE; Command, Address, Bank Group Address, Bank Address Inputs: partially toggling; Data IO: VDDQ; DM_n: stable at 1; Bank Activity: Cycling with one bank active at a time: 0,0,1,1,2,2,...; Output Buffer and RTT: Enabled in Mode Registers <sup>2</sup> ; ODT Signal: stable at 0; Pattern Details: Refer to Component Datasheet for detail pattern                                                       |
| IDD1<br>IPP1   | Operating One Bank Active-Read-Precharge Current (AL=0)<br>CKE: High; External clock: On; tCK, nRC, nRAS, nRCD, CL: Refer to Component Datasheet for detail pattern; BL: 8 <sup>1</sup> ; AL: 0; CS_n: High between ACT, RD and PRE; Command, Address, Bank Group Address, Bank Address Inputs, Data IO: partially toggling; DM_n: stable at 1; Bank Activity: Cycling with one bank active at a time: 0,0,1,1,2,2,...; Output Buffer and RTT: Enabled in Mode Registers <sup>2</sup> ; ODT Signal: stable at 0; Pattern Details: Refer to Component Datasheet for detail pattern                                              |
| IDD2N<br>IPP2N | Precharge Standby Current (AL=0)<br>CKE: High; External clock: On; tCK, CL: Refer to Component Datasheet for detail pattern; BL: 8 <sup>1</sup> ; AL: 0; CS_n: stable at 1; Command, Address, Bank Group Address, Bank Address Inputs: partially toggling; Data IO: VDDQ; DM_n: stable at 1; Bank Activity: all banks closed; Output Buffer and RTT: Enabled in Mode Registers <sup>2</sup> ; ODT Signal: stable at 0; Pattern Details: Refer to Component Datasheet for detail pattern                                                                                                                                        |
| IDD2NT         | Precharge Standby ODT Current<br>CKE: High; External clock: On; tCK, CL: Refer to Component Datasheet for detail pattern; BL: 8 <sup>1</sup> ; AL: 0; CS_n: stable at 1; Command, Address, Bank Group Address, Bank Address Inputs: partially toggling; Data IO: VSSQ; DM_n: stable at 1; Bank Activity: all banks closed; Output Buffer and RTT: Enabled in Mode Registers <sup>2</sup> ; ODT Signal: toggling according; Pattern Details: Refer to Component Datasheet for detail pattern                                                                                                                                    |
| IDD2P<br>IPP2P | Precharge Power-Down Current<br>CKE: Low; External clock: On; tCK, CL: Refer to Component Datasheet for detail pattern; BL: 8 <sup>1</sup> ; AL: 0; CS_n: stable at 1; Command, Address, Bank Group Address, Bank Address Inputs: stable at 0; Data IO: VDDQ; DM_n: stable at 1; Bank Activity: all banks closed; Output Buffer and RTT: Enabled in Mode Registers <sup>2</sup> ; ODT Signal: stable at 0                                                                                                                                                                                                                      |
| IDD2Q          | Precharge Quiet Standby Current<br>CKE: High; External clock: On; tCK, CL: Refer to Component Datasheet for detail pattern; BL: 8 <sup>1</sup> ; AL: 0; CS_n: stable at 1; Command, Address, Bank Group Address, Bank Address Inputs: stable at 0; Data IO: VDDQ; DM_n: stable at 1; Bank Activity: all banks closed; Output Buffer and RTT: Enabled in Mode Registers <sup>2</sup> ; ODT Signal: stable at 0                                                                                                                                                                                                                  |
| IDD3N<br>IPP3N | Active Standby Current<br>CKE: High; External clock: On; tCK, CL: Refer to Component Datasheet for detail pattern; BL: 8 <sup>1</sup> ; AL: 0; CS_n: stable at 1; Command, Address, Bank Group Address, Bank Address Inputs: partially toggling; Data IO: VDDQ; DM_n: stable at 1; Bank Activity: all banks open; Output Buffer and RTT: Enabled in Mode Registers <sup>2</sup> ; ODT Signal: stable at 0; Pattern Details: Refer to Component Datasheet for detail pattern                                                                                                                                                    |
| IDD3P<br>IPP3P | Active Power-Down Current<br>CKE: Low; External clock: On; tCK, CL: Refer to Component Datasheet for detail pattern; BL: 8 <sup>1</sup> ; AL: 0; CS_n: stable at 1; Command, Address, Bank Group Address, Bank Address Inputs: stable at 0; Data IO: VDDQ; DM_n: stable at 1; Bank Activity: all banks open; Output Buffer and RTT: Enabled in Mode Registers <sup>2</sup> ; ODT Signal: stable at 0                                                                                                                                                                                                                           |
| IDD4R<br>IPP4R | Operating Burst Read Current<br>CKE: High; External clock: On; tCK, CL: Refer to Component Datasheet for detail pattern; BL: 8 <sup>2</sup> ; AL: 0; CS_n: High between RD; Command, Address, Bank Group Address, Bank Address Inputs: partially toggling; Data IO: seamless read data burst with different data between one burst and the next one according; DM_n: stable at 1; Bank Activity: all banks open, RD commands cycling through banks: 0,0,1,1,2,2,...; Output Buffer and RTT: Enabled in Mode Registers <sup>2</sup> ; ODT Signal: stable at 0; Pattern Details: Refer to Component Datasheet for detail pattern |
| IDD4W<br>IPP4W | Operating Burst Write Current<br>CKE: High; External clock: On; tCK, CL: Refer to Component Datasheet for detail pattern; BL: 8 <sup>1</sup> ; AL: 0; CS_n: High between WR; Command, Address, Bank Group Address, Bank Address Inputs: partially toggling; Data IO: seamless write data burst with different                                                                                                                                                                                                                                                                                                                  |

| Symbol           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  | data between one burst and the next one ; DM_n: stable at 1; Bank Activity: all banks open, WR commands cycling through banks: 0,0,1,1,2,2,...; Output Buffer and RTT: Enabled in Mode Registers <sup>2</sup> ; ODT Signal: stable at HIGH; Pattern Details: Refer to Component Datasheet for detail pattern                                                                                                                                                                                                                                                                                                                                                                      |
| IDD5B<br>IPP5B   | Burst Refresh Current (1X REF)<br>CKE: High; External clock: On; tCK, CL, nRFC: Refer to Component Datasheet for detail pattern; BL: 8 <sup>1</sup> ; AL: 0; CS_n: High between REF; Command, Address, Bank Group Address, Bank Address Inputs: partially toggling ; Data IO: VDDQ; DM_n: stable at 1; Bank Activity: REF command every nRFC ; Output Buffer and RTT: Enabled in Mode Registers <sup>2</sup> ; ODT Signal: stable at 0; Pattern Details: Refer to Component Datasheet for detail pattern                                                                                                                                                                          |
| IDD5F2<br>IPP5F2 | Burst Refresh Current (2X REF)<br>tRFC=tRFC_x2,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| IDD5F4<br>IPP5F4 | Burst Refresh Current (4X REF)<br>tRFC=tRFC_x4,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| IDD6N<br>IPP6N   | Self Refresh Current: Normal Temperature Range<br>Tcase: 0 - 85°C; Low Power Array Self Refresh (LP ASR) : Normal <sup>4</sup> ; CKE: Low; External clock: Off; CK_t and CK_c#: LOW; CL: Refer to Component Datasheet for detail pattern; BL: 8 <sup>1</sup> ; AL: 0; CS_n#, Command, Address, Bank Group Address, Bank Address, Data IO: High; DM_n: stable at 1; Bank Activity: Self-Refresh operation; Output Buffer and RTT: Enabled in Mode Registers <sup>2</sup> ; ODT Signal: MIDLEVEL                                                                                                                                                                                    |
| IDD6E<br>IPP6E   | Self-Refresh Current: Extended Temperature Range)<br>TCase: 0 - 95°C; Low Power Array Self Refresh (LP ASR) : Extended <sup>4</sup> ; CKE: Low; External clock: Off; CK_t and CK_c: LOW; CL: Refer to Component Datasheet for detail pattern; BL: 8 <sup>1</sup> ; AL: 0; CS_n, Command, Address, Bank Group Address, Bank Address, Data IO: High; DM_n:stable at 1; Bank Activity: Extended Temperature Self-Refresh operation; Output Buffer and RTT: Enabled in Mode Registers <sup>2</sup> ; ODT Signal: MID-LEVEL                                                                                                                                                            |
| IDD6R<br>IPP6R   | Self-Refresh Current: Reduced Temperature Range<br>TCase: 0 - 45°C; Low Power Array Self Refresh (LP ASR) : Reduced <sup>4</sup> ; CKE: Low; External clock: Off; CK_t and CK_c#: LOW; CL: Refer to Component Datasheet for detail pattern; BL: 8 <sup>1</sup> ; AL: 0; CS_n#, Command, Address, Bank Group Address, Bank Address, Data IO: High; DM_n:stable at 1; Bank Activity: Extended Temperature Self-Refresh operation; Output Buffer and RTT: Enabled in Mode Registers <sup>2</sup> ; ODT Signal: MID-LEVEL                                                                                                                                                             |
| IDD6A<br>IPP6A   | Auto Self-Refresh Current<br>TCase: 0 - 95°C; Low Power Array Self Refresh (LP ASR) : Auto <sup>4</sup> ; CKE: Low; External clock: Off; CK_t and CK_c#: LOW; CL: Refer to Component Datasheet for detail pattern; BL: 8 <sup>1</sup> ; AL: 0; CS_n#, Command, Address, Bank Group Address, Bank Address, Data IO: High; DM_n:stable at 1; Bank Activity: Auto Self-Refresh operation; Output Buffer and RTT: Enabled in Mode Registers <sup>2</sup> ; ODT Signal: MID-LEVEL                                                                                                                                                                                                      |
| IDD7<br>IPP7     | Operating Bank Interleave Read Current<br>CKE: High; External clock: On; tCK, nRC, nRAS, nRCD, nRRD, nFAW, CL: Refer to Component Datasheet for detail pattern; BL: 8 <sup>1</sup> ; AL: CL-1; CS_n: High between ACT and RDA; Command, Address, Bank Group Address, Bank Address Inputs: partially toggling ; Data IO: read data bursts with different data between one burst and the next one ; DM_n: stable at 1; Bank Activity: two times interleaved cycling through banks (0, 1, ...7) with different addressing; Output Buffer and RTT: Enabled in Mode Registers <sup>2</sup> ; ODT Signal: stable at 0; Pattern Details: Refer to Component Datasheet for detail pattern |
| IDD8<br>IPP8     | Maximum Power Down Current TBD                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

**Notes:**

- Burst Length: BL8 fixed by MRS: set MR0 [A1:0=00].
- Output Buffer Enable - set MR1 [A12 = 0] : Qoff = Output buffer enabled - set MR1 [A2:1 = 00] : Output Driver Impedance Control = RZQ/7  
RTT\_Nom enable - set MR1 [A10:8 = 011] : RTT\_NOM = RZQ/6 RTT\_WR enable - set MR2 [A10:9 = 01] : RTT\_WR = RZQ/2 RTT\_PARK disable - set MR5 [A8:6 = 000]
- CAL enabled : set MR4 [A8:6 = 001] : 1600MT/s 010] : 1866MT/s, 2133MT/s 011] : 2400MT/s Gear Down mode enabled :set MR3 [A3 = 1] : 1/4 Rate DLL disabled : set MR1 [A0 = 0] CA parity enabled :set MR5 [A2:0 = 001] : 1600MT/s,1866MT/s, 2133MT/s 010] : 2400MT/s Read DBI enabled : set MR5 [A12 = 1] Write DBI enabled : set :MR5 [A11 = 1]
- Low Power Array Self Refresh (LP ASR) : set MR2 [A7:6 = 00] : Normal 01] : Reduced Temperature range 10] : Extended Temperature range 11] : Auto Self Refresh

## IDD Specification

| Product Type | Z6FAGH3SBAA-MC | Unit | Note |
|--------------|----------------|------|------|
| Organization | 16GB           |      |      |
|              | 1 Rank (X8)    |      |      |
|              | X64            |      |      |
| Symbol       | Current        |      |      |
| IDD0         | 368            | mA   | 2    |
| IDD1         | 432            | mA   | 2    |
| IDD2N        | 288            | mA   | 3    |
| IDD2NT       | 321            | mA   | 2    |
| IDD2P        | 208            | mA   | 3    |
| IDD2Q        | 271            | mA   | 3    |
| IDD3N        | 592            | mA   | 3    |
| IDD3P        | 520            | mA   | 3    |
| IDD4R        | 1192           | mA   | 2    |
| IDD4W        | 1145           | mA   | 2    |
| IDD5B        | 4632           | mA   | 2    |
| IDD5F2       | 3192           | mA   | 2    |
| IDD5F4       | 2648           | mA   | 2    |
| IDD6N        | 376            | mA   | 3    |
| IDD6E        | 560            | mA   | 3    |
| IDD6R        | 175            | mA   | 3    |
| IDD6A        | 616            | mA   | 3    |
| IDD7         | 1280           | mA   | 2    |
| IDD8         | 120            | mA   | 3    |

### Notes:

1. Calculated values from Device data.
2. One module rank in the active IDD/IPP, the other rank in IDD2P/IPP3N.
3. All ranks in this IDD/IPP condition

## IPP Specification

| Product Type | Z6FAGH3SBAA-MC | Unit | Note |
|--------------|----------------|------|------|
| Organization | 16GB           |      |      |
|              | 1 Rank (X8)    |      |      |
|              | X64            |      |      |
| Symbol       | Current        |      |      |
| IPP0         | 25.6           | mA   | 2    |
| IPP1         | 28             | mA   | 2    |
| IPP2N        | 15.2           | mA   | 3    |
| IPP2P        | 15.2           | mA   | 3    |
| IPP3N        | 17.5           | mA   | 3    |
| IPP3P        | 17.5           | mA   | 3    |
| IPP4R        | 41.6           | mA   | 2    |
| IPP4W        | 41.6           | mA   | 2    |
| IPP5B        | 456            | mA   | 2    |
| IPP6N        | 320            | mA   | 3    |
| IPP6E        | 265            | mA   | 3    |
| IPP6R        | 38.4           | mA   | 23   |
| IPP6A        | 60.8           | mA   | 3    |
| IPP7         | 23.2           | mA   | 2    |
| IPP8         | 53.6           | mA   | 3    |

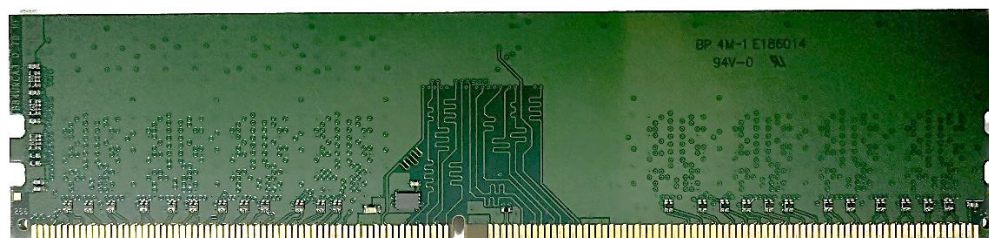
### Notes:

1. Calculated values from Device data.
2. One module rank in the active IDD/IPP, the other rank in IDD2P/IPP3N.
3. All ranks in this IDD/IPP condition

## Module Physical drawing



力存 Module Top View



力存 Module Bottom View





| Change History                        |     |            |                                                                                                                                                                                  |
|---------------------------------------|-----|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Document No.: DSZ6FAGH3SBAAZF.(Rev.#) |     |            |                                                                                                                                                                                  |
| Rev. #                                | Who | When       | What                                                                                                                                                                             |
| 01                                    | Rik | 2023-02-13 | Initial version                                                                                                                                                                  |
| 02                                    | SAE | 2023-03-07 | Add IDD&IPP Specification, IDD/IPP Specifications and Conditions, Address Format, Pin Configurations, Pin Descriptions, Operating Conditions, DQ Map and Function Block Diagrams |