

# 24Gb DDR5 SDRAM Addendum

**MT60B6G4, MT60B3G8, MT60B1536M16**

## Die Revision C

### Features

This document describes the product specifications that are unique to Micron 24Gb DDR5 Die Revision C device. For general Micron DDR5 SDRAM specifications, see the Micron DDR5 SDRAM Core Product Data Sheet. Content in this 24Gb Die Revision C DDR5 SDRAM data sheet addendum supersedes content defined in the core data sheet.

- $V_{DD} = V_{DDQ} = 1.1V$  (NOM)
- $V_{PP} = 1.8V$  (NOM)
- On-die, internal, adjustable  $V_{REF}$  generation for DQ, CA, CS
- 1.1V pseudo open-drain I/O
- $T_C$  maximum up to 95°C
  - 32ms, 8192-cycle refresh up to 85°C
  - 16ms, 8192-cycle refresh at >85°C to 95°C
- 32 internal banks (x4, x8): 8 groups of 4 banks each
- 16 internal banks (x16): 4 groups of 4 banks each
- 16n-bit prefetch architecture
- 1 cycle/2 cycle command structure
- 2N mode
- All bank and same bank refresh
- Multi-purpose command (MPC)
- CS/CA training mode
- On-die ECC (bounded fault)
- ECC transparency and error scrub
- Decision feedback equalization (DFE)

- Loopback mode
- Command-based non-target (NT) nominal, DQ/DQS park, and dynamic WR on-die termination (ODT)
- sPPR and hPPR capability
- MBIST/mPPR capability
- Per-DRAM addressability
- JEDEC JESD-79.5 compliant

### Options<sup>1</sup>

- **Configuration**
  - 6 Gig x 4
  - 3 Gig x 8
  - 1.5 Gig x 16
- **FBGA SDP Packages** (Pb-free)
  - x4, x8 82-ball (9.5mm x 11mm)
  - x16 102-ball (9.5mm x 14mm)
- **Timing** – cycle time
  - 0.312ns @ CL = 52
  - 0.277ns @ CL = 58
  - 0.250ns @ CL = 64
- **Operating temperature**
  - Commercial (0°C <  $T_C$  < 95°C)
- Die Revision

### Marking

6G4  
3G8  
1536M16

JF  
HZ

-64B  
-72B  
-80B

None  
:C

Notes: 1. Not all options listed can be combined to define an offered product. Use the part catalog search on [micron.com](http://micron.com) for available offerings.

**Table 1: Part Numbers and Timing Parameters**

| Part Number          | Configuration | Memory Clock/<br>Data Rate | Clock Cycles<br>(CL <sub>n</sub> RCD <sub>n</sub> RP) | Designation <sup>1</sup> |
|----------------------|---------------|----------------------------|-------------------------------------------------------|--------------------------|
| MT60B6G4JF-64B:C     | 6Gb x4        | 0.312ns/6400 MT/s          | 52-52-52                                              | Production               |
| MT60B3G8JF-64B:C     | 3Gb x8        | 0.312ns/6400 MT/s          | 52-52-52                                              | Production               |
| MT60B1536M16HZ-64B:C | 1.5Gb x16     | 0.312ns/6400 MT/s          | 52-52-52                                              | Production               |
| MT60B6G4JF-72B:C     | 6Gb x4        | 0.277ns/7200 MT/s          | 58-58-58                                              | Preliminary              |
| MT60B3G8JF-72B:C     | 3Gb x8        | 0.277ns/7200 MT/s          | 58-58-58                                              | Preliminary              |
| MT60B1536M16HZ-72B:C | 1.5Gb x16     | 0.277ns/7200 MT/s          | 58-58-58                                              | Preliminary              |
| MT60B6G4JF-80B:C     | 6Gb x4        | 0.250ns/8000 MT/s          | 64-64-64                                              | Advance                  |
| MT60B3G8JF-80B:C     | 3Gb x8        | 0.250ns/8000 MT/s          | 64-64-64                                              | Advance                  |
| MT60B1536M16HZ-80B:C | 1.5Gb x16     | 0.250ns/8000 MT/s          | 64-64-64                                              | Advance                  |

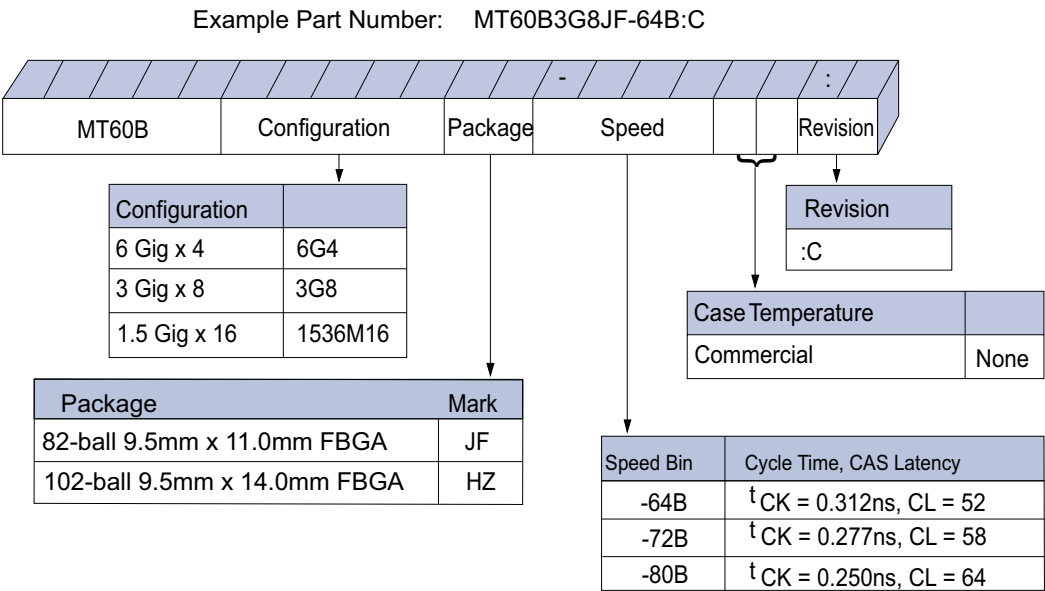
Notes: 1. **Production:** Although considered final, these specifications are subject to change as further product development and data characterization sometimes occur. **Preliminary:** For evaluation and reference purposes only and are subject to change by Micron without notice. Products are only warranted by Micron to meet Micron's production data sheet specifications.

**Table 2: 24Gb Addressing**

| Configuration                 |                                                                      | 6Gb x4              | 3Gb x8              | 1.5Gb x16           |
|-------------------------------|----------------------------------------------------------------------|---------------------|---------------------|---------------------|
| Bank address                  | Number of bank groups/number of banks per bank group/number of banks | 8 / 4 / 32          | 8 / 4 / 32          | 4 / 4 / 16          |
|                               | Bank group address                                                   | BG0-BG2             | BG0-BG2             | BG0-BG1             |
|                               | Bank address in a bank group                                         | BA0-BA1             | BA0-BA1             | BA0-BA1             |
| Row address                   |                                                                      | R0-R16 <sup>1</sup> | R0-R16 <sup>1</sup> | R0-R15 <sup>1</sup> |
| Column address                |                                                                      | C0-C10              | C0-C9               | C0-C9               |
| Page size                     |                                                                      | 1KB                 | 1KB                 | 2KB                 |
| Chip IDs/maximum stack height |                                                                      | CID0-3 / 16H        | CID0-3 / 16H        | CID0-3 / 16H        |

Notes: 1. For non-binary densities, a quarter of the row address space is invalid. When the MSB address bit is HIGH, the MSB-1 address must be LOW.

Figure 1: Order Part Number Example



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## General Notes and Functional Block Diagrams

### General Notes

- The functionality and the timing specifications discussed in this data sheet are for the DLL enable mode of operation (normal operation), unless specifically stated otherwise.
- Throughout the data sheet, the various figures and text refer to DQs as "DQ." The DQ term is to be interpreted as any and all DQ collectively, unless specifically stated otherwise.
- The terms "\_t" and "\_c" are used to represent the true and complement of a differential signal pair. These terms replace the previously used notation of "#" and/or over-bar characters. For example, differential data strobe pair DQS, DQS# is now referred to as DQS\_t, DQS\_c.
- The term "\_n" is used to represent a signal that is active LOW and replaces the previously used "#" and/or overbar characters. For example: CS# is now referred to as CS\_n.
- The terms "DQS" and "CK" found throughout the data sheet are to be interpreted as DQS\_t, DQS\_c and CK\_t, CK\_c respectively, unless specifically stated otherwise.
- Complete functionality may be described throughout the entire document; any page or diagram may have been simplified to convey a topic and may not be inclusive of all requirements.
- Any specific requirement takes precedence over a general statement.
- Any functionality not specifically stated here within is considered undefined, illegal, and not supported, and can result in unknown operation.
- Addressing is denoted as BG[n] for bank group, BA[n] for bank address, and A[n] for row/col address.
- A NOP is considered a valid command for very specific states such as power-down exit, self-refresh exit, and reset. The NOP must satisfy any associated command timings with respect to the preceding valid command.
- Not all features described within this document may be available on the Rev. A (first) version.
- Not all specifications listed are finalized industry standards; best conservative estimates have been provided when an industry standard has not been finalized.
- Although it is implied throughout the specification, the DRAM must be used after reaching a stable power-on level, which is achieved by following the proper voltage ramp and power-up initialization sequence procedures as outline in this specification.
- Not all features designated in the data sheet may be supported by earlier die revisions due to late definition by JEDEC.

### Definitions of the Device-Pin Signal Level

- HIGH: A device pin is driving the logic 1 state.
- LOW: A device pin is driving the logic 0 state.
- High-Z or (HI-Z/Hi-Z): A device pin is tri-state
- ODT: A device pin terminates with the ODT settings, which could be terminating or tri-state depending on the mode register settings.

### Definitions of the Bus Signal Level

- HIGH: One device on the bus is HIGH, and all other devices on the bus are either ODT or High-Z. The voltage level on the bus is nominally  $V_{DDQ}$ .
- LOW: One device on the bus is LOW, and all other devices on the bus are either ODT or High-Z. The voltage level on the bus is nominally  $V_{OL(DC)}$  if ODT was enabled, or  $V_{SSQ}$  if High-Z.
- High-Z or (HI-Z/Hi-Z): All devices on the bus are High-Z. The voltage level on the bus is undefined as the bus is floating.

- ODT: At least one device on the bus is ODT, and all others are High-Z. The voltage level on the bus is nominally  $V_{DDQ}$ .
- The specification requires 8,192 refresh commands within 32ms between 0°C and 85°C. This allows for a  $t_{REFI}$  of 3.9μs in normal refresh mode. The specification also requires 8,192 refresh commands within 16ms between 85°C and 95°C. This allows for a  $t_{REFI}$  of 1.95μs in normal refresh mode.

## **Industrial Temperature**

An industrial temperature (IT) device option requires that the case temperature not exceed below -40°C or above 95°C. JEDEC specifications require the refresh rate to double when  $T_C$  exceeds 85°C; this also requires use of the high-temperature self-refresh option. Additionally, ODT resistance and the input/output impedance must be derated when operating outside of the commercial temperature range, when  $T_C$  is between -40°C and 0°C.

## **Automotive Temperature**

The automotive temperature (AT) device option requires that the case temperature not exceed below -40°C or above 105°C. The specifications require the refresh rate to 2X when  $T_C$  exceeds 85°C; 4X when  $T_C$  exceeds 95°C. Additionally, ODT resistance and the input/output impedance must be derated when operating temperature  $T_C < 0^\circ\text{C}$ .

Figure 2: 6 Gig x4 Functional Block Diagram

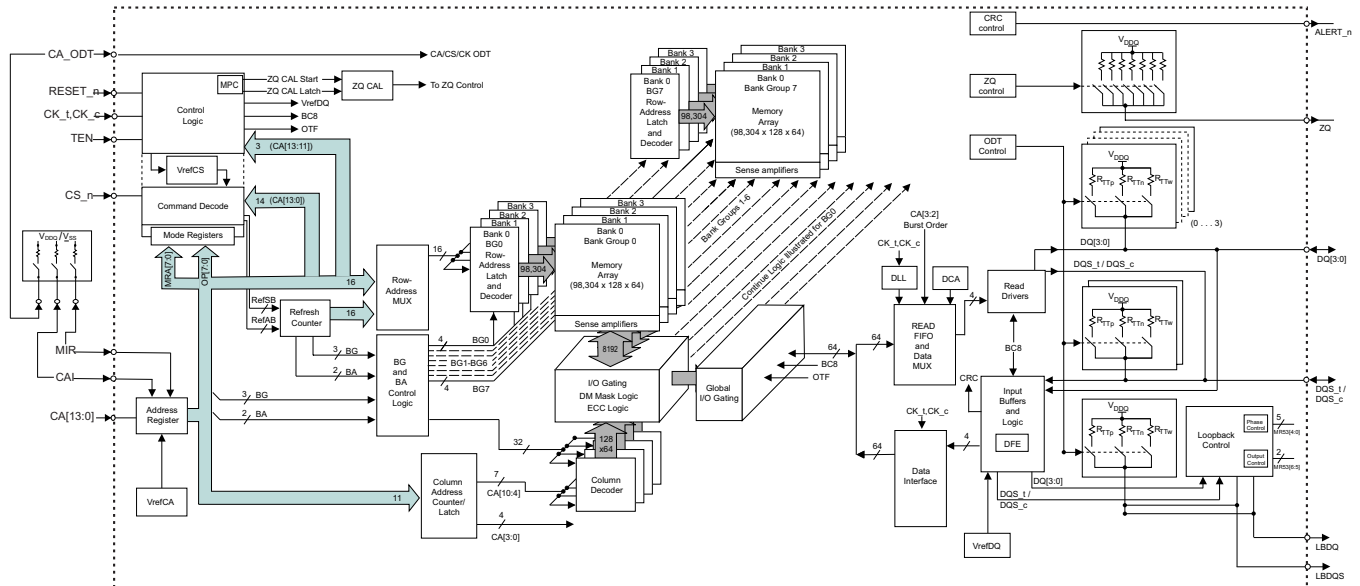
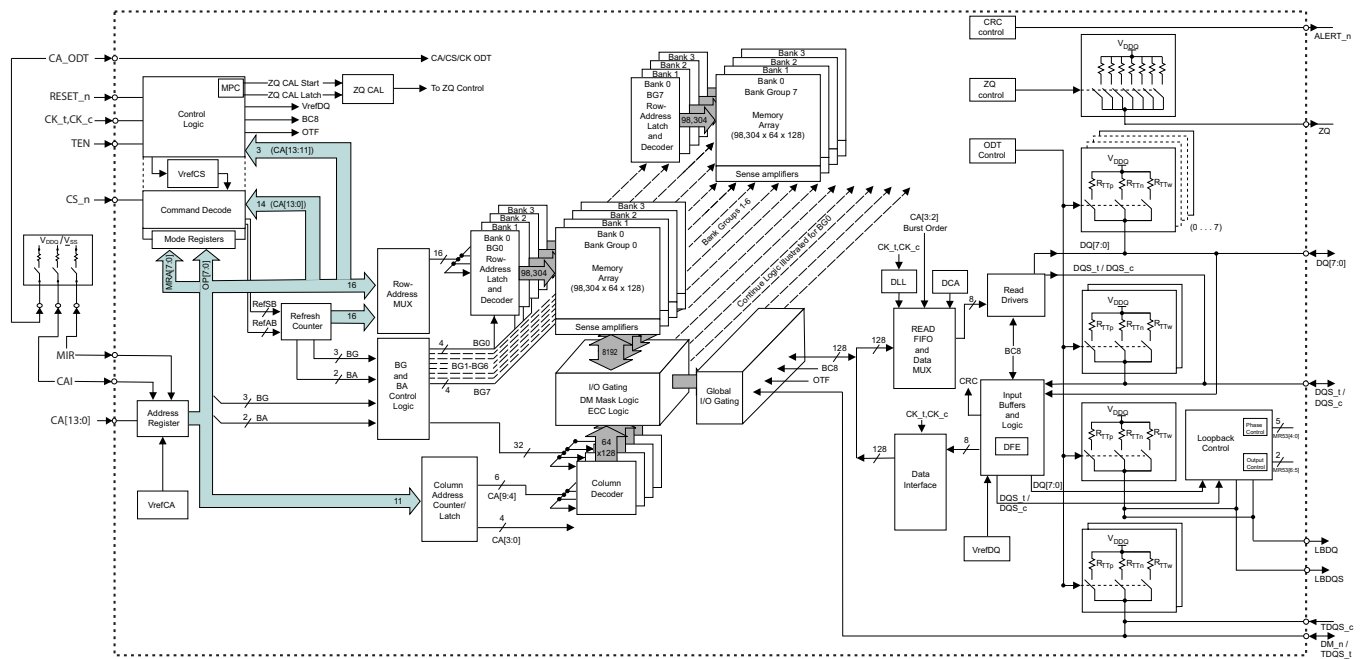


Figure 3: 3 Gig x8 Functional Block Diagram







## DDR5 Function Matrix

DDR5 SDRAM has several features supported by configuration width, by density, by speed and by device die Rev. The following table is the summary of the features supported by 24Gb Die Revision B by configuration width. The functional matrix will be defined in each device-specific data sheet; therefore, device, speed and density options will vary by device data sheet.

**Table 3: DDR5 Function Matrix - 24Gb Die Rev. C. V: Supported, Blank: Not Supported**

| Function                             | x4 | x8 | x16 | MR Default State     | Notes |
|--------------------------------------|----|----|-----|----------------------|-------|
| <b>JEDEC Mandatory</b>               |    |    |     |                      |       |
| BC8 OTF                              | V  | V  | V   |                      |       |
| TDQS                                 |    | V  |     |                      |       |
| Data Mask (DM)                       |    | V  | V   |                      |       |
| Data Output Disable                  | V  | V  | V   |                      |       |
| Connectivity Test Mode (CT)          | V  | V  | V   |                      |       |
| CA/CS/CK ODT                         | V  | V  | V   |                      |       |
| 2N Mode                              | V  | V  | V   |                      |       |
| Per DRAM Addressability (Enum)       | V  | V  | V   |                      |       |
| Mode Register Read (MRR)             | V  | V  | V   |                      |       |
| Mode Register Write (MRW)            | V  | V  | V   |                      |       |
| Multi-Purpose Command (MPC)          | V  | V  | V   |                      |       |
| ZQ calibration                       | V  | V  | V   |                      |       |
| CA Vref Training                     | V  | V  | V   |                      |       |
| CS Vref Training                     | V  | V  | V   |                      |       |
| DQ Vref Training                     | V  | V  | V   |                      |       |
| CS Training Mode (CSTM)              | V  | V  | V   |                      |       |
| CA Training Mode (CATM)              | V  | V  | V   |                      |       |
| Write Leveling Training              | V  | V  | V   |                      |       |
| DQS Interval Oscillator              | V  | V  | V   |                      |       |
| Read Training Pattern Mode (LFSR)    | V  | V  | V   |                      |       |
| Write Pattern Command                | V  | V  | V   |                      |       |
| Duty Cycle Adjuster (DCA) I          | V  | V  | V   | MR42:OP[1:0] = 10(R) | 1     |
| Loopback Mode                        | V  | V  | V   |                      |       |
| Decision Feedback Equalization (DFE) | V  | V  | V   |                      |       |
| WRITE CRC                            | V  | V  | V   |                      |       |
| READ CRC                             | V  | V  | V   |                      |       |
| Programmable Preamble                | V  | V  | V   |                      |       |
| Programmable Postamble               | V  | V  | V   |                      |       |
| sPPR                                 | V  | V  | V   |                      |       |
| hPPR                                 | V  | V  | V   |                      |       |
| PPR using DQ[3:0] only               | V  | V  | V   |                      |       |

**Table 3: DDR5 Function Matrix - 24Gb Die Rev. C. V: Supported, Blank: Not Supported (Continued)**

| Function                                                         | x4 | x8 | x16 | MR Default State        | Notes |
|------------------------------------------------------------------|----|----|-----|-------------------------|-------|
| On-Die-ECC                                                       | V  | V  | V   |                         |       |
| ECC Transparency and Error Scrub                                 | V  | V  | V   |                         |       |
| Refresh Management (RFM)                                         | V  | V  | V   | MR58:OP[0] = 0 (R)      | 2     |
|                                                                  |    |    |     | MR58:OP[7:5] = 110 (R)  | 3     |
|                                                                  |    |    |     | MR58:OP[4:1] = 1010 (R) |       |
|                                                                  |    |    |     | MR59:OP[7:6] = 00 (R)   |       |
| Fine Granularity Refresh (FGR)                                   | V  | V  | V   |                         |       |
| Same Bank Refresh                                                | V  | V  | V   |                         |       |
| Same Bank Precharge                                              | V  | V  | V   |                         |       |
| Maximum power saving mode (MPSM)                                 | V  | V  | V   |                         |       |
| CS Geardown(>= 7200 MT/s)                                        | V  | V  | V   |                         |       |
| <b>JEDEC Optional</b>                                            |    |    |     |                         |       |
| MR65-MR69 Serial Number                                          |    |    |     | MR65 - MR69 = 0x00 (R)  |       |
| BL32                                                             |    |    |     |                         |       |
| BL32 OTF                                                         |    |    |     |                         |       |
| WICA 1/2 step                                                    | V  | V  | V   |                         |       |
| Duty Cycle Adjuster (DCA) II                                     | V  | V  | V   | MR42:OP[7] = 1(SR)      |       |
| MBIST/mPPR                                                       | V  | V  | V   | MR23:OP[4] = 1 (SR)     |       |
| sPPR undo/lock                                                   | V  | V  | V   | MR23:OP[2] = 1 (SR)     |       |
| Adaptive RFM                                                     | V  | V  | V   |                         |       |
| Directed RFM                                                     | V  | V  | V   | MR59:OP[0] = 1 (SR)     | 5     |
|                                                                  |    |    |     | MR59:OP[3] = 0 (R)      |       |
| Package output driver test mode (PODTM)                          |    |    |     | MR5:OP[3] = 0 (R)       |       |
| Partial array self refresh (PASR)                                | V  | V  | V   | MR19:OP[7] = 1 (R)      |       |
| Refresh interval rate (RIR)                                      | V  | V  | V   | MR4:OP[3] = 1 (SR)      |       |
| Rx CTLE (CS_n, CA, DQS)                                          | V  | V  | V   | M22:OP[3] = 1 (R)       |       |
| MR4 wide range refresh rate support                              | V  | V  | V   | MR4:OP[5] = 1 (R)       |       |
| Test Mode MR (MR9)                                               |    |    |     |                         | 6     |
| ECS Writeback Suppression                                        | V  | V  | V   |                         |       |
| x4 RMW Suppression                                               | V  |    |     |                         |       |
| Clk Sync on SR Exit by first NOP (>=6800 MT/s, with fuse option) | V  | V  | V   | MR13:OP[5] = 1 (SR)     |       |

- Notes: 1. Device supports DCA for four-phase internal clock(s).  
2. RFM not required.  
3. RAAMMT, RAAIMT, and RAA counter decrement are only applicable if the RFM requirement bit is set to 1 (MR58:OP[0]=1) or ARFM is set to level A, B, or C.  
4. Data rates of >=7200 MT/s are not supported on this die revision.  
5. BRC support level (MR59:OP[3]) is only applicable if DRFM Enable status read bit is set to 1 (MR59:OP[0]=1)  
6. Test Mode (TM) is a vendor-specific mode register; not used by Micron.

## **DDR5 Package Pinout and Assignments**

### **Rows**

The x4/x8 device has 13 electrical rows of balls. The x16 device has 17 electrical rows of balls. Electrical is defined as rows that contain signal ball or power/ground balls. Additional rows of inactive balls may be available for mechanical support.

### **Ball Pitch**

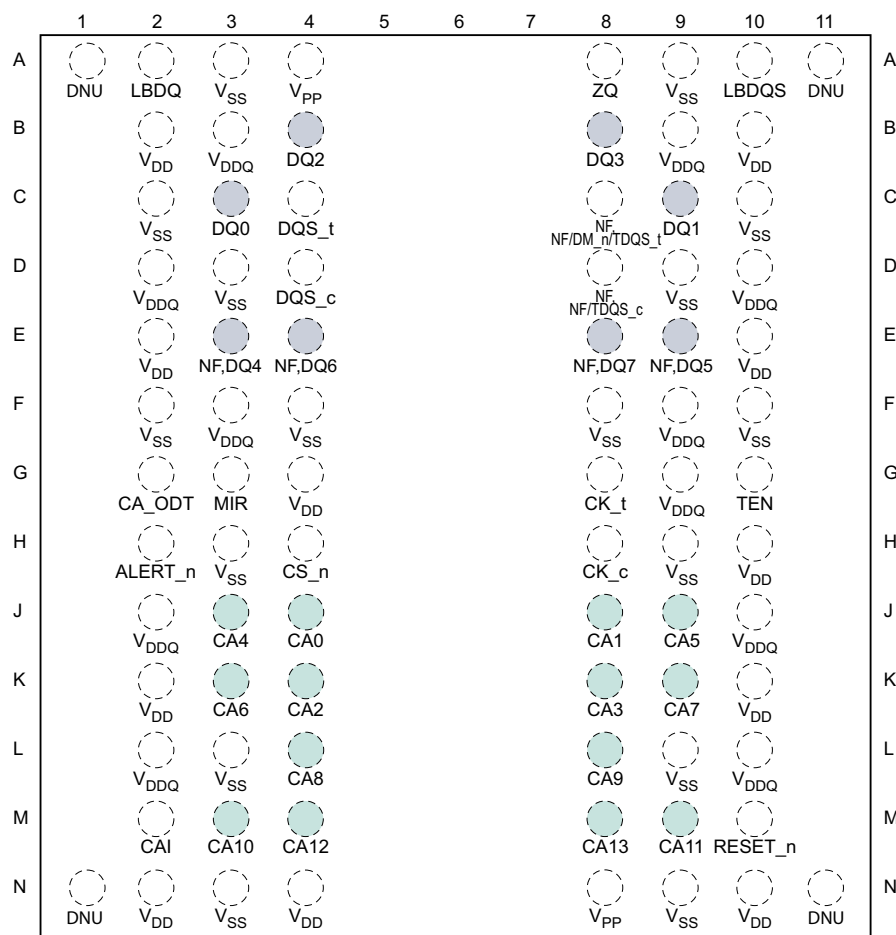
The device uses a ball pitch of 0.8mm x 0.8mm.

### **Columns**

The number of depopulated columns is 3.

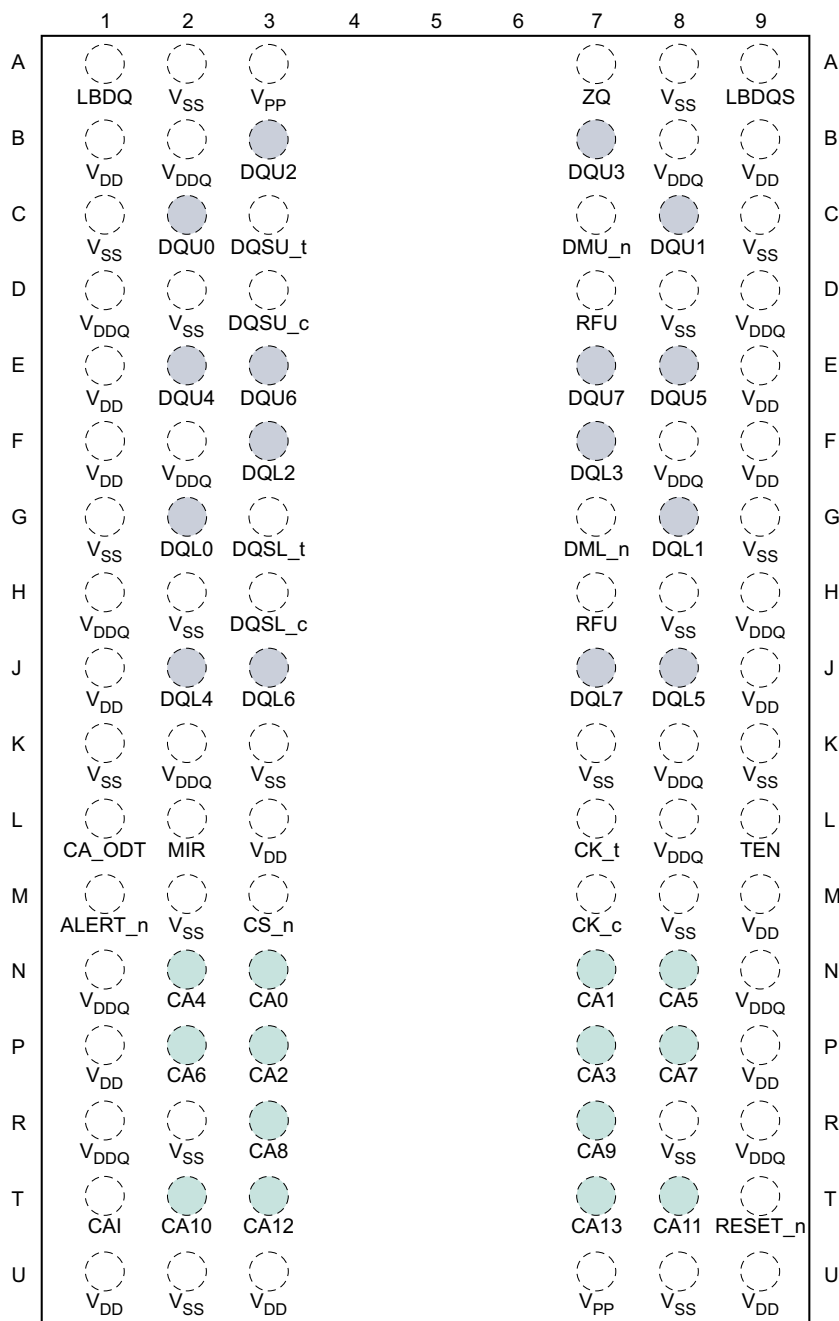
The device has six electrical columns of balls in two sets of three columns. Between the electrical columns are three columns where no balls are populated. Electrical is defined as columns that contain signal ball or power/ground balls. Additional columns of inactive balls may be available for mechanical support.

Figure 5: x4/x8 Ballout Using MO-210-AN – 82-Ball



- Notes:
1. DQ4-DQ7 higher-order DQ pins are connected but not used in the x4 configuration.
  2. DM, TDQS<sub>t</sub> and TDQS<sub>c</sub> are not valid for the x4 configuration.
  3. A comma "," separates the configuration. A slash "/" defines a mode register-selectable function, command/address function, density or package dependence.

Figure 6: x16 Ballout Using MO-210-AT –102 Ball



**Table 4: Pinout Description**

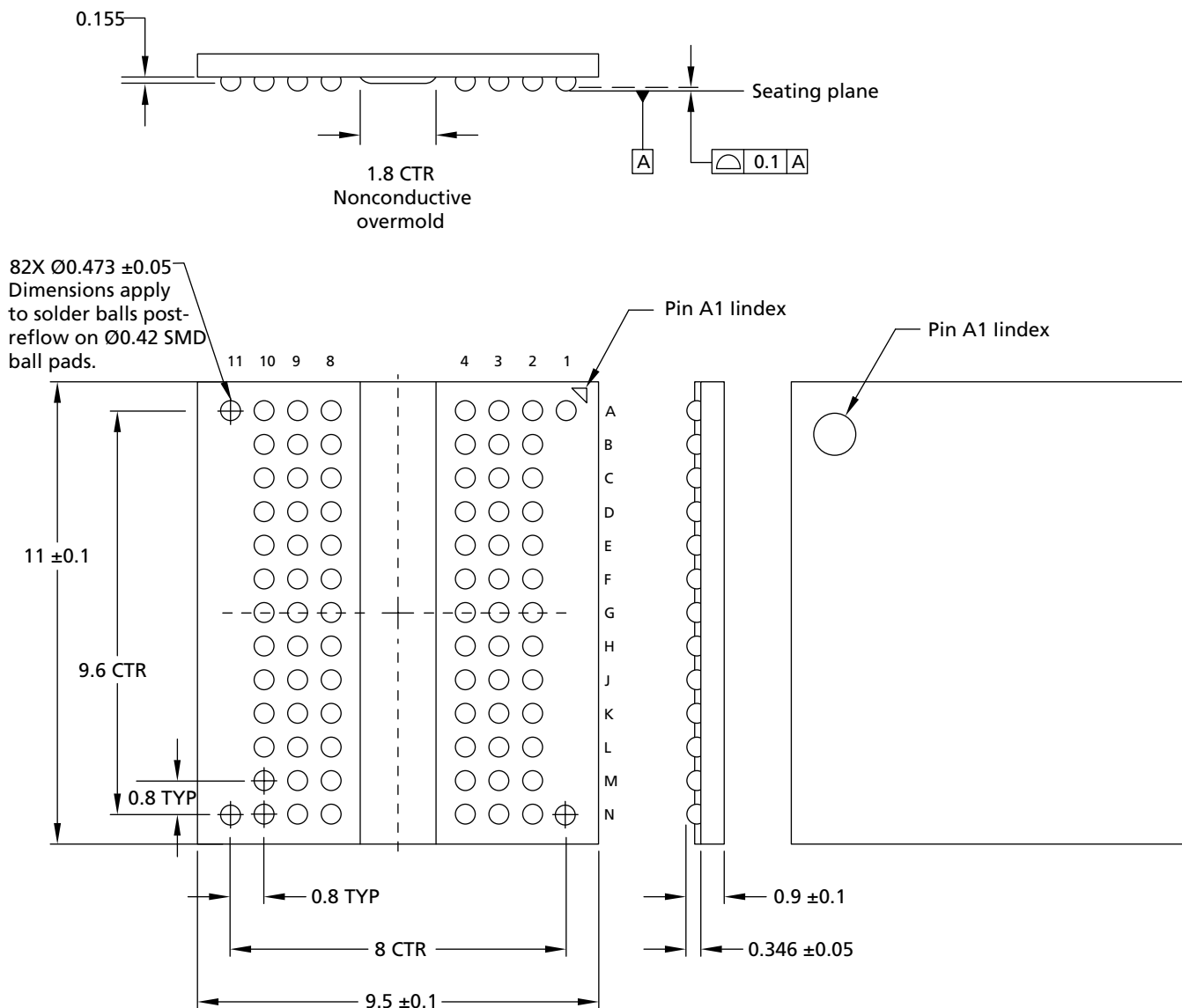
| Symbol                                       | Type         | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CK_t, CK_c                                   | Input        | <b>Clock:</b> CK_t and CK_c are differential clock inputs. All command/address and control input signals are sampled on the crossing of the positive edge of CK_t and negative edge of CK_c.                                                                                                                                                                                                                                                                                                                                                                                                 |
| CS_n                                         | Input        | <b>Chip Select:</b> 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 and is used to enter and exit the parts from power down mode and self refresh mode. While not in self refresh mode, the CS_n input buffer operates with the same ODT and V <sub>REF</sub> parameters as configured by the CA_ODT strap setting or mode register. When in self refresh mode, the CS_n is a CMOS rail-to-rail signal with DC HIGH and LOW at 80% and 20% of V <sub>DDQ</sub> . |
| DM_n, DMU_n, DML_n                           | Input        | <b>Input Data Mask:</b> 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_n is not supported on x4 devices. For x8 devices, the function of DM_n is enabled by the mode register. For x16 devices, the function of DMU_n/DML_n is enabled by the mode register.                                                                                                                                                                                     |
| CA[13:0]                                     | Input        | <b>Command/Address Inputs:</b> Command/Address (CA) signals provide the command and address inputs according to the Command Truth Table. Because some commands are multicyle, the pins may not be interchanged between devices on the same bus.                                                                                                                                                                                                                                                                                                                                              |
| RESET_n                                      | Input        | <b>Active Low Asynchronous Reset:</b> Reset is active when RESET_n is LOW, and inactive when RESET_n is HIGH. RESET_n must be HIGH during normal operation. RESET_n is a CMOS rail-to-rail signal with DC HIGH and LOW at 80% and 20% of V <sub>DDQ</sub> .                                                                                                                                                                                                                                                                                                                                  |
| DQ                                           | Input/Output | <b>Data Input/Output:</b> Bidirectional data bus. If CRC is enabled via the mode register, CRC code is added at the end of a data burst.                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| DQS_t, DQS_c, DQSU_t, DQSU_c, DQSL_t, DQSL_c | Input/Output | <b>Data Strobe:</b> Output with read data, input with write data, edge-aligned with read data, centered in write data. For x16 devices, DQSL corresponds to the data on DQL0-DQL7; DQSU corresponds to the data on DQU0-DQU7. The data strobes DQS_t, DQSL_t and DQSU_t are paired with differential signals DQS_c, DQSL_c, and DQSU_c, respectively, to provide differential pair signaling to the system during reads and writes. The device supports differential data strobe only, not single-ended.                                                                                     |
| TDQS_t, TDQS_c                               | Output       | <b>Termination Data Strobe:</b> Applicable to x8 devices only. When enabled via the mode register, the device enables the same termination resistance function on TDQS_t/TDQS_c that is applied to DQS_t/DQS_c. When disabled via the mode register, DM/TDQS provides the data mask function depending on the MR setting; TDQS_c is not used. x4/x16 devices must disable the TDQS function via the mode register.                                                                                                                                                                           |
| ALERT_n                                      | Input/Output | <b>Alert:</b> If there is an error in CRC, ALERT_n drives LOW for the period time interval and returns HIGH. During the connectivity test mode, this pin functions as an input. Usage of this signal is system-dependent. In cases where this pin is not connected, ALERT_n must be bonded to V <sub>DDQ</sub> on the system board.                                                                                                                                                                                                                                                          |
| TEN                                          | Input        | <b>Connectivity Test Mode Enable:</b> A HIGH on this pin enables CONNECTIVITY TEST MODE operation along with other pins. It is a CMOS rail-to-rail signal with AC HIGH and LOW at 80% and 20% of V <sub>DDQ</sub> . Usage of this signal is system-dependent. This pin is pulled LOW internally with a weak pulldown resistor to V <sub>SS</sub> .                                                                                                                                                                                                                                           |

**Table 4: Pinout Description (Continued)**

| Symbol    | Type         | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MIR       | Input        | <b>Mirror:</b> Used to inform the system that this device is being run in mirrored mode instead of standard mode. With the MIR pin connected (strapped) to $V_{DDQ}$ , the device internally swaps even-numbered CA with the next higher odd-number CA. The MIR pin must be tied to $V_{SS}$ if no CA mirror is required. Mirror pair examples: CA2 with CA3 (not CA1) CA4 with CA5 (not CA3). Note: the CA[13] function is only relevant for certain densities (including stacking). In the case that CA[13] is not used, its ball location, considering whether MIR is used or not, should be connected (strapped) to $V_{DDQ}$ . No active signaling requirements required. |
| CAI       | Input        | <b>Command and Address Inversion:</b> With this pin connected (strapped) to $V_{DDQ}$ , the device internally inverts the logic level present on all CA signals. The CAI pin must be connected to $V_{SS}$ if no CA inversion is required. No active signaling requirements required.                                                                                                                                                                                                                                                                                                                                                                                          |
| CA_ODT    | Input        | <b>ODT for Command and Address:</b> Apply Group A settings if the pin is connected (strapped) to $V_{SS}$ ; apply Group B settings if the pin is connected (strapped) to $V_{DDQ}$ . See the mode register defaults table for details. No active signaling requirements required.                                                                                                                                                                                                                                                                                                                                                                                              |
| LBDQ      | Output       | <b>Loopback Data Output:</b> The output of this device on the Loopback Output Select defined in MR53:OP[4:0]. When loopback is enabled, it is in driver mode using the default RON described in the Loopback Function section. When loopback is disabled, the pin is either terminated or High-Z based on MR36:OP[2:0].                                                                                                                                                                                                                                                                                                                                                        |
| LBDQS     | Output       | <b>Loopback Data Strobe Output:</b> A single-ended strobe with the rising edged aligned with loopback data edge, falling edge aligned with data center. When loopback is enabled, it is in driver mode using the default RON described in the Loopback function section. When loopback is disabled, the pin is either terminated or High-Z based on MR36:OP[2:0].                                                                                                                                                                                                                                                                                                              |
| RFU       | Input/Output | Reserved for future use.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| DNU       |              | Do not use.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| NF        |              | <b>No function:</b> Internal connection is present but has no function.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| $V_{DDQ}$ | Supply       | DQ power supply; 1.1V nominal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| $V_{DD}$  | Supply       | Power supply; 1.1V nominal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| $V_{SS}$  | Supply       | Ground                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| $V_{PP}$  | Supply       | Activating power supply; 1.8V nominal.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| ZQ        | Reference    | Reference pin for ZQ calibration. This ball is tied to an external 240 ohm resistor (RZQ), which is tied to $V_{SS}$ .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

## Package Dimensions

Figure 7: 82-Ball VFBGA – MO-210-AN (x4/x8)

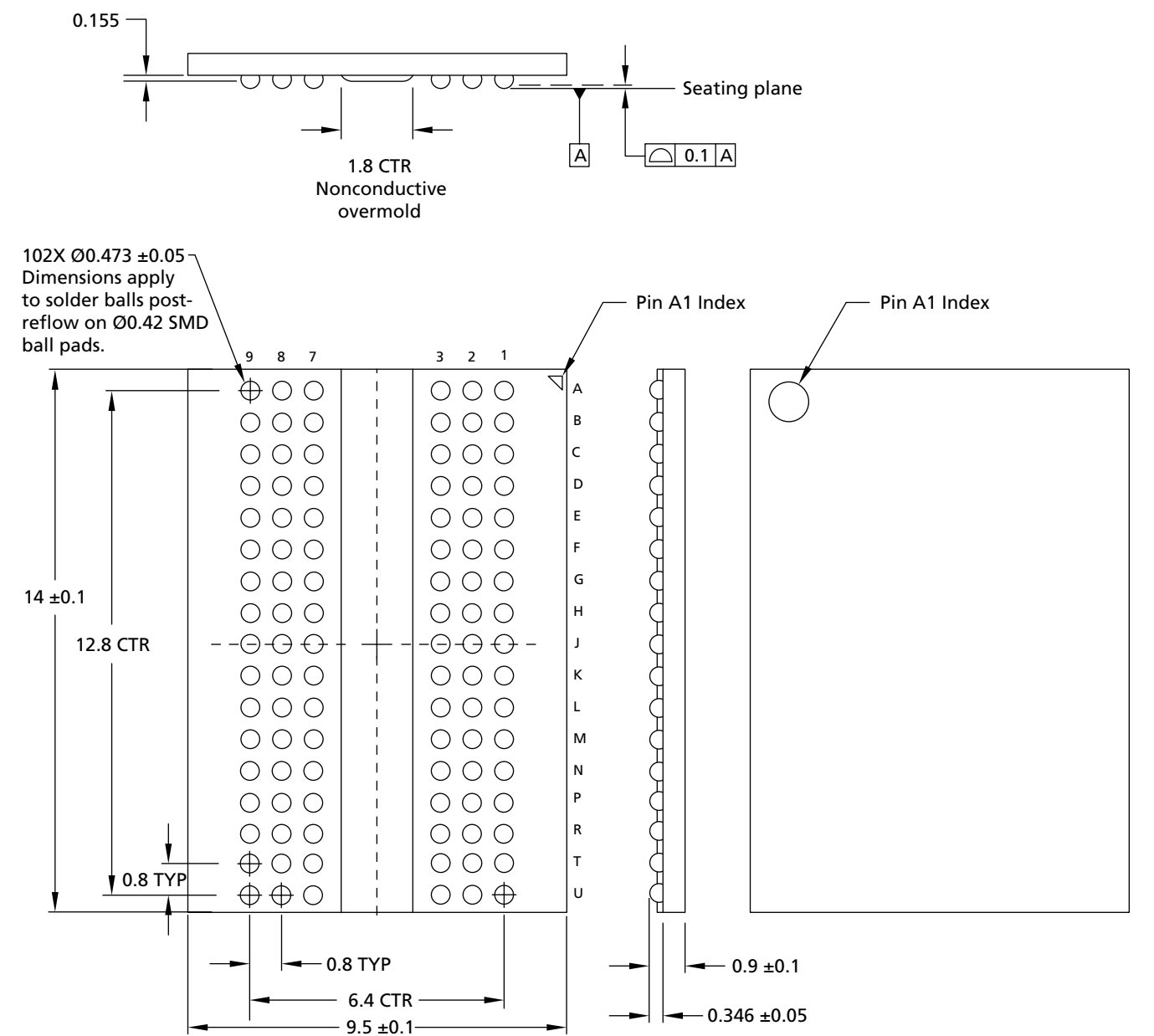


Notes: 1. All dimensions are in millimeters.

2. Solder ball material: SACQ (92.45% Sn, 4% Ag, 3% Bi, 0.5% Cu, 0.05% Ni).



Figure 8: 102-Ball VFBGA – MO-210-AT (x16)



- Notes: 1. All dimensions are in millimeters.  
2. Solder ball material: SACQ (92.45% Sn, 4% Ag, 3% Bi, 0.5% Cu, 0.05% Ni).

Table 5: Package Thermal Resistance Characteristics

| Die Revision | Package       | Parameter              | Value | Unit | Symbol |
|--------------|---------------|------------------------|-------|------|--------|
| Rev C        | 82-ball "JF"  | Junction-to-case (TOP) | 3.6   | °C/W | θJC    |
|              |               | Junction-to-board      | 15.7  | °C/W | θJB    |
|              | 102-ball "HZ" | Junction-to-case (TOP) | 3.6   | °C/W | θJC    |
|              |               | Junction-to-board      | 15.5  | °C/W | θJB    |

## DDR5 IDD,IPP,IDDQ Current Limits

DDR5 SDRAM current limits are measured and categorized based on the definitions found in the DDR5 Product Core data sheet. Refer to the IDD and IDDQ specification parameters and test conditions for details related to each current limit. Maximum values for  $I_{DD}$  currents considering worst-case conditions of process, temperature, and voltage.

**Table 6: DDR5 IDD, IPP, IDDQ Current Limits – 24Gb Die Revision C**

| Parameter | Width | DDR5-6400 | DDR5-7200 | DDR5-8000 | Unit | Notes |
|-----------|-------|-----------|-----------|-----------|------|-------|
| IDD0      | x4    | 54        | TBD       | TBD       | mA   |       |
|           | x8    | 54        | TBD       | TBD       |      |       |
|           | x16   | 66        | TBD       | TBD       |      |       |
| IPP0      | x4    | 9         | TBD       | TBD       | mA   |       |
|           | x8    | 9         | TBD       | TBD       |      |       |
|           | x16   | 10        | TBD       | TBD       |      |       |
| IDDQ0     | x4    | 89        | TBD       | TBD       | mA   |       |
|           | x8    | 91        | TBD       | TBD       |      |       |
|           | x16   | 96        | TBD       | TBD       |      |       |
| IDD0F     | x4    | 85        | TBD       | TBD       | mA   |       |
|           | x8    | 85        | TBD       | TBD       |      |       |
|           | x16   | 123       | TBD       | TBD       |      |       |
| IPP0F     | x4    | 11        | TBD       | TBD       | mA   |       |
|           | x8    | 11        | TBD       | TBD       |      |       |
|           | x16   | 14        | TBD       | TBD       |      |       |
| IDDQ0F    | x4    | 91        | TBD       | TBD       | mA   |       |
|           | x8    | 91        | TBD       | TBD       |      |       |
|           | x16   | 96        | TBD       | TBD       |      |       |
| IDD2N     | x4    | 47        | TBD       | TBD       | mA   |       |
|           | x8    | 47        | TBD       | TBD       |      |       |
|           | x16   | 47        | TBD       | TBD       |      |       |
| IPP2N     | x4    | 8         | TBD       | TBD       | mA   |       |
|           | x8    | 8         | TBD       | TBD       |      |       |
|           | x16   | 8         | TBD       | TBD       |      |       |
| IDDQ2N    | x4    | 94        | TBD       | TBD       | mA   |       |
|           | x8    | 94        | TBD       | TBD       |      |       |
|           | x16   | 94        | TBD       | TBD       |      |       |
| IDD2NT    | x4    | 79        | TBD       | TBD       | mA   |       |
|           | x8    | 79        | TBD       | TBD       |      |       |
|           | x16   | 79        | TBD       | TBD       |      |       |

**Table 6: DDR5 IDD, IPP, IDDQ Current Limits – 24Gb Die Revision C**

| Parameter | Width | DDR5-6400 | DDR5-7200 | DDR5-8000 | Unit | Notes |
|-----------|-------|-----------|-----------|-----------|------|-------|
| IPP2NT    | x4    | 8         | TBD       | TBD       | mA   |       |
|           | x8    | 8         | TBD       | TBD       |      |       |
|           | x16   | 8         | TBD       | TBD       |      |       |
| IDDQ2NT   | x4    | 96        | TBD       | TBD       | mA   |       |
|           | x8    | 96        | TBD       | TBD       |      |       |
|           | x16   | 96        | TBD       | TBD       |      |       |
| IDD2P     | x4    | 43        | TBD       | TBD       | mA   |       |
|           | x8    | 43        | TBD       | TBD       |      |       |
|           | x16   | 43        | TBD       | TBD       |      |       |
| IPP2P     | x4    | 8         | TBD       | TBD       | mA   |       |
|           | x8    | 8         | TBD       | TBD       |      |       |
|           | x16   | 8         | TBD       | TBD       |      |       |
| IDDQ2P    | x4    | 73        | TBD       | TBD       | mA   |       |
|           | x8    | 73        | TBD       | TBD       |      |       |
|           | x16   | 73        | TBD       | TBD       |      |       |
| IDD3N     | x4    | 90        | TBD       | TBD       | mA   |       |
|           | x8    | 90        | TBD       | TBD       |      |       |
|           | x16   | 95        | TBD       | TBD       |      |       |
| IPP3N     | x4    | 8         | TBD       | TBD       | mA   |       |
|           | x8    | 8         | TBD       | TBD       |      |       |
|           | x16   | 8         | TBD       | TBD       |      |       |
| IDDQ3N    | x4    | 91        | TBD       | TBD       | mA   |       |
|           | x8    | 91        | TBD       | TBD       |      |       |
|           | x16   | 96        | TBD       | TBD       |      |       |
| IDD3P     | x4    | 89        | TBD       | TBD       | mA   |       |
|           | x8    | 89        | TBD       | TBD       |      |       |
|           | x16   | 92        | TBD       | TBD       |      |       |
| IPP3P     | x4    | 8         | TBD       | TBD       | mA   |       |
|           | x8    | 8         | TBD       | TBD       |      |       |
|           | x16   | 8         | TBD       | TBD       |      |       |
| IDDQ3P    | x4    | 69        | TBD       | TBD       | mA   |       |
|           | x8    | 69        | TBD       | TBD       |      |       |
|           | x16   | 71        | TBD       | TBD       |      |       |
| IDD4R     | x4    | 248       | TBD       | TBD       | mA   |       |
|           | x8    | 290       | TBD       | TBD       |      |       |
|           | x16   | 447       | TBD       | TBD       |      |       |

**Table 6: DDR5 IDD, IPP, IDDQ Current Limits – 24Gb Die Revision C**

| Parameter | Width | DDR5-6400 | DDR5-7200 | DDR5-8000 | Unit | Notes |
|-----------|-------|-----------|-----------|-----------|------|-------|
| IPP4R     | x4    | 10        | TBD       | TBD       | mA   |       |
|           | x8    | 10        | TBD       | TBD       |      |       |
|           | x16   | 13        | TBD       | TBD       |      |       |
| IDDQ4R    | x4    | 228       | TBD       | TBD       | mA   |       |
|           | x8    | 318       | TBD       | TBD       |      |       |
|           | x16   | 609       | TBD       | TBD       |      |       |
| IDD4RC    | x4    | 248       | TBD       | TBD       | mA   |       |
|           | x8    | 287       | TBD       | TBD       |      |       |
|           | x16   | 437       | TBD       | TBD       |      |       |
| IPP4RC    | x4    | 10        | TBD       | TBD       | mA   |       |
|           | x8    | 10        | TBD       | TBD       |      |       |
|           | x16   | 13        | TBD       | TBD       |      |       |
| IDDQ4RC   | x4    | 228       | TBD       | TBD       | mA   |       |
|           | x8    | 316       | TBD       | TBD       |      |       |
|           | x16   | 607       | TBD       | TBD       |      |       |
| IDD4W     | x4    | 241       | TBD       | TBD       | mA   |       |
|           | x8    | 292       | TBD       | TBD       |      |       |
|           | x16   | 456       | TBD       | TBD       |      |       |
| IPP4W     | x4    | 22        | TBD       | TBD       | mA   |       |
|           | x8    | 22        | TBD       | TBD       |      |       |
|           | x16   | 39        | TBD       | TBD       |      |       |
| IDDQ4W    | x4    | 242       | TBD       | TBD       | mA   |       |
|           | x8    | 400       | TBD       | TBD       |      |       |
|           | x16   | 719       | TBD       | TBD       |      |       |
| IDD4WC    | x4    | 235       | TBD       | TBD       | mA   |       |
|           | x8    | 273       | TBD       | TBD       |      |       |
|           | x16   | 446       | TBD       | TBD       |      |       |
| IPP4WC    | x4    | 22        | TBD       | TBD       | mA   |       |
|           | x8    | 22        | TBD       | TBD       |      |       |
|           | x16   | 38        | TBD       | TBD       |      |       |
| IDDQ4WC   | x4    | 241       | TBD       | TBD       | mA   |       |
|           | x8    | 400       | TBD       | TBD       |      |       |
|           | x16   | 758       | TBD       | TBD       |      |       |
| IDD5B     | x4    | 353       | TBD       | TBD       | mA   |       |
|           | x8    | 353       | TBD       | TBD       |      |       |
|           | x16   | 353       | TBD       | TBD       |      |       |

**Table 6: DDR5 IDD, IPP, IDDQ Current Limits – 24Gb Die Revision C**

| Parameter      | Width | DDR5-6400 | DDR5-7200 | DDR5-8000 | Unit | Notes |
|----------------|-------|-----------|-----------|-----------|------|-------|
| IPP5B          | x4    | 35        | TBD       | TBD       | mA   |       |
|                | x8    | 35        | TBD       | TBD       |      |       |
|                | x16   | 35        | TBD       | TBD       |      |       |
| IDDQ5B         | x4    | 94        | TBD       | TBD       | mA   |       |
|                | x8    | 94        | TBD       | TBD       |      |       |
|                | x16   | 94        | TBD       | TBD       |      |       |
| IDD5C          | x4    | 125       | TBD       | TBD       | mA   |       |
|                | x8    | 125       | TBD       | TBD       |      |       |
|                | x16   | 125       | TBD       | TBD       |      |       |
| IPP5C          | x4    | 15        | TBD       | TBD       | mA   |       |
|                | x8    | 15        | TBD       | TBD       |      |       |
|                | x16   | 15        | TBD       | TBD       |      |       |
| IDDQ5C         | x4    | 94        | TBD       | TBD       | mA   |       |
|                | x8    | 94        | TBD       | TBD       |      |       |
|                | x16   | 94        | TBD       | TBD       |      |       |
| IDD5F          | x4    | 332       | TBD       | 396       | mA   |       |
|                | x8    | 332       | TBD       | 396       |      |       |
|                | x16   | 332       | TBD       | TBD       |      |       |
| IPP5F          | x4    | 33        | TBD       | TBD       | mA   |       |
|                | x8    | 33        | TBD       | TBD       |      |       |
|                | x16   | 33        | TBD       | TBD       |      |       |
| IDDQ5F         | x4    | 94        | TBD       | TBD       | mA   |       |
|                | x8    | 94        | TBD       | TBD       |      |       |
|                | x16   | 94        | TBD       | TBD       |      |       |
| IDD6N(0-85C)   | x4    | 172       | TBD       | TBD       | mA   | 1     |
|                | x8    | 172       | TBD       | TBD       |      |       |
|                | x16   | 172       | TBD       | TBD       |      |       |
| IPP6N (0-85C)  | x4    | 20        | TBD       | TBD       | mA   | 1     |
|                | x8    | 20        | TBD       | TBD       |      |       |
|                | x16   | 20        | TBD       | TBD       |      |       |
| IDDQ6N (0-85C) | x4    | 67        | TBD       | TBD       | mA   | 1     |
|                | x8    | 67        | TBD       | TBD       |      |       |
|                | x16   | 67        | TBD       | TBD       |      |       |
| IDD6E (85-95C) | x4    | 258       | TBD       | TBD       | mA   | 2     |
|                | x8    | 258       | TBD       | TBD       |      |       |
|                | x16   | 258       | TBD       | TBD       |      |       |

**Table 6: DDR5 IDD, IPP, IDDQ Current Limits – 24Gb Die Revision C**

| Parameter       | Width | DDR5-6400 | DDR5-7200 | DDR5-8000 | Unit | Notes |
|-----------------|-------|-----------|-----------|-----------|------|-------|
| IPP6E (85-95C)  | x4    | 29        | TBD       | TBD       | mA   | 2     |
|                 | x8    | 29        | TBD       | TBD       |      |       |
|                 | x16   | 29        | TBD       | TBD       |      |       |
| IDDQ6E (85-95C) | x4    | 67        | TBD       | TBD       | mA   | 2     |
|                 | x8    | 67        | TBD       | TBD       |      |       |
|                 | x16   | 67        | TBD       | TBD       |      |       |
| IDD7            | x4    | 396       | TBD       | TBD       | mA   |       |
|                 | x8    | 447       | TBD       | TBD       |      |       |
|                 | x16   | 514       | TBD       | TBD       |      |       |
| IPP7            | x4    | 24        | TBD       | TBD       | mA   |       |
|                 | x8    | 24        | TBD       | TBD       |      |       |
|                 | x16   | 28        | TBD       | TBD       |      |       |
| IDDQ7           | x4    | 221       | TBD       | TBD       | mA   |       |
|                 | x8    | 301       | TBD       | TBD       |      |       |
|                 | x16   | 449       | TBD       | TBD       |      |       |
| IDD8            | x4    | 38        | TBD       | TBD       | mA   |       |
|                 | x8    | 38        | TBD       | TBD       |      |       |
|                 | x16   | 38        | TBD       | TBD       |      |       |
| IPP8            | x4    | 7         | TBD       | TBD       | mA   |       |
|                 | x8    | 7         | TBD       | TBD       |      |       |
|                 | x16   | 7         | TBD       | TBD       |      |       |
| IDDQ8           | x4    | 67        | TBD       | TBD       | mA   |       |
|                 | x8    | 67        | TBD       | TBD       |      |       |
|                 | x16   | 67        | TBD       | TBD       |      |       |
| IDD9            | x4    | 173       | TBD       | TBD       | mA   |       |
|                 | x8    | 173       | TBD       | TBD       |      |       |
|                 | x16   | 173       | TBD       | TBD       |      |       |
| IPP9            | x4    | 22        | TBD       | TBD       | mA   |       |
|                 | x8    | 22        | TBD       | TBD       |      |       |
|                 | x16   | 22        | TBD       | TBD       |      |       |
| IDDQ9           | x4    | 204       | TBD       | TBD       | mA   |       |
|                 | x8    | 204       | TBD       | TBD       |      |       |
|                 | x16   | 204       | TBD       | TBD       |      |       |

Notes: 1. Applicable for MR4:OP[2:0]=001b, 010b.  
2. Applicable for MR4:OP[2:0]=011b, 100b, 101b.

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## Revision History

### Rev. B – 04/2025

- Corrected ball count for x4/x8, 82-ball VFPGA package

### Rev. A – 01/2025

- Initial Release

8000 S. Federal Way, P.O. Box 6, Boise, ID 83707-0006  
208-368-4000, [micron.com/support](https://micron.com/support)

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Although considered final, these specifications are subject to change, as further product development and data characterization sometimes occur.