



AD3R1600C4G11
DDR3-1600(CL11) 240-Pin R-DIMM
4GB(512M x 72-bits)

ADATA Technology Corp.

Memory Module Data Sheet

DDR3-1600(CL11) 240-Pin R-DIMM 4GB (512M x 72-bits)

Version 1.0

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Revision History

| Version | Changes | Page | Date |
|---------|-------------------------------------|------|------------|
| 0.0 | Initial release | - | 2012/01/13 |
| 1.0 | Update Ordering Information(SU->AD) | - | 2012/07/23 |



Table of Contents

| | |
|--|--------------|
| 1. General Description | 4 |
| 2. Features | 4 |
| 3. Pin Assignment | 5~6 |
| 4. Pin Description | 7~8 |
| 5. Block Diagram | 9 |
| 6. Absolute Maximum Ratings | 10 |
| 7. DC Operating Condition | 10 |
| 8. Input DC & AC Logic Level for single-ended signals | 11 |
| 9. Input AC Logic Level for single-ended signals | 11 |
| 10. IDD Specification | 12 |
| 11. Speed Bins and CL,tRCD,tRP,tRC and tRAS for Corresponding Bin | 12 |
| 12. Timing Parameters | 13~14 |
| 13. Package Dimensions | 15 |
| 14. Ordering Information | 16 |



General Description :

The ADATA's module is a 512Mx72 bits 4GB(4096MB) DDR3-1600(CL11)-11-11-28 SDRAM memory module. The SPD is programmed to JEDEC standard latency 1600Mbps timing of 11-11-11-28 at 1.5V. The module is composed of eight-teen 256Mx8 bits CMOS DDR3 SDRAMs in FBGA package and one 2Kbit EEPROM in 8pin TDFN package on a 240pin glass-epoxy printed circuit board.

The module is a Dual In-line Memory Module and intended for mounting onto 240-pins edge connector sockets. Synchronous design allows precise cycle control with the use of system clock. Data I/O transactions are possible on both edges of DQS. Range of operating frequencies, programmable latencies and burst lengths allow the same device to be useful for a variety of high bandwidth, high performance memory system applications.

Features :

- Power supply (Normal): VDD & VDDQ = 1.5V ± 0.075V
- 1.5V (SSTL_15 compatible) I/O
- MRS Cycle with address key programs
 - CAS Latency (5,6,7,8,9,10,11)
 - Burst Length (BL):8 and 4 with Burst Chop(BC)
- Bi-directional, differential data strobe (DQS and /DQS)
- Differential clock input (CK, /CK) operation
- DLL aligns DQ and DQS transition with CK transition
- Double-data-rate architecture; two data transfers per clock cycle
- 8 independent internal bank
- Internal (self) calibration: Internal self calibration through ZQ pin (RZQ:240 ohm±1%)
- Auto refresh and self refresh
- Average Refresh Period 7.8us at lower then TCASE 85°C, 3.9us at 85°C < TCASE ≤ 95°C
- 8-bit pre-fetch.
- On Die Termination using ODT pin.
- Lead-free products are RoHS Compliant



Pin Assignment :

| Pin | Front | Pin | Front | Pin | Front | Pin | Back | Pin | Back | Pin | Back |
|-----|--------|-----|---------|-----|-------|-----|------|-----|-----------|-----|------|
| 1 | VREFDQ | 41 | VSS | 81 | DQ32 | 121 | VSS | 161 | NC,DM8 | 201 | DQ37 |
| 2 | VSS | 42 | NC | 82 | DQ33 | 122 | DQ4 | 162 | NC | 202 | VSS |
| 3 | DQ0 | 43 | NC | 83 | VSS | 123 | DQ5 | 163 | VSS | 203 | DM4 |
| 4 | DQ1 | 44 | VSS | 84 | /DQS4 | 124 | VSS | 164 | NC,CB6 | 204 | NC |
| 5 | VSS | 45 | NC,CB2 | 85 | DQS4 | 125 | DM0 | 165 | NC,CB7 | 205 | VSS |
| 6 | /DQS0 | 46 | NC,CB3 | 86 | VSS | 126 | NC | 166 | VSS | 206 | DQ38 |
| 7 | DQS0 | 47 | VSS | 87 | DQ34 | 127 | VSS | 167 | NC | 207 | DQ39 |
| 8 | VSS | 48 | NC | 88 | DQ35 | 128 | DQ6 | 168 | /RESET | 208 | VSS |
| 9 | DQ2 | 49 | NC | 89 | VSS | 129 | DQ7 | 169 | CKE1,NC | 209 | DQ44 |
| 10 | DQ3 | 50 | CKE0 | 90 | DQ40 | 130 | VSS | 170 | VDD | 210 | DQ45 |
| 11 | VSS | 51 | VDD | 91 | DQ41 | 131 | DQ12 | 171 | A15 | 211 | VSS |
| 12 | DQ8 | 52 | BA2 | 92 | VSS | 132 | DQ13 | 172 | A14 | 212 | DM5 |
| 13 | DQ9 | 53 | NC | 93 | /DQS5 | 133 | VSS | 173 | VDD | 213 | NC |
| 14 | VSS | 54 | VDD | 94 | DQS5 | 134 | DM1 | 174 | A12 | 214 | VSS |
| 15 | /DQS1 | 55 | A11 | 95 | VSS | 135 | NC | 175 | A9 | 215 | DQ46 |
| 16 | DQS1 | 56 | A7 | 96 | DQ42 | 136 | VSS | 176 | VDD | 216 | DQ47 |
| 17 | VSS | 57 | VDD | 97 | DQ43 | 137 | DQ14 | 177 | A8 | 217 | VSS |
| 18 | DQ10 | 58 | A5 | 98 | VSS | 138 | DQ15 | 178 | A6 | 218 | DQ52 |
| 19 | DQ11 | 59 | A4 | 99 | DQ48 | 139 | VSS | 179 | VDD | 219 | DQ53 |
| 20 | VSS | 60 | VDD | 100 | DQ49 | 140 | DQ20 | 180 | A3 | 220 | VSS |
| 21 | DQ16 | 61 | A2 | 101 | VSS | 141 | DQ21 | 181 | A1 | 221 | DM6 |
| 22 | DQ17 | 62 | VDD | 102 | /DQS6 | 142 | VSS | 182 | VDD | 222 | NC |
| 23 | VSS | 63 | CK1,NC | 103 | DQS6 | 143 | DM2 | 183 | VDD | 223 | VSS |
| 24 | /DQS2 | 64 | /CK1,NC | 104 | VSS | 144 | NC | 184 | CK0 | 224 | DQ54 |
| 25 | DQS2 | 65 | VDD | 105 | DQ50 | 145 | VSS | 185 | /CK0 | 225 | DQ55 |
| 26 | VSS | 66 | VDD | 106 | DQ51 | 146 | DQ22 | 186 | VDD | 226 | VSS |
| 27 | DQ18 | 67 | VREFCA | 107 | VSS | 147 | DQ23 | 187 | NC,/EVENT | 227 | DQ60 |
| 28 | DQ19 | 68 | NC | 108 | DQ56 | 148 | VSS | 188 | A0 | 228 | DQ61 |
| 29 | VSS | 69 | VDD | 109 | DQ57 | 149 | DQ28 | 189 | VDD | 229 | VSS |
| 30 | DQ24 | 70 | A10/AP | 110 | VSS | 150 | DQ29 | 190 | BA1 | 230 | DM7 |
| 31 | DQ25 | 71 | BA0 | 111 | /DQS7 | 151 | VSS | 191 | VDD | 231 | NC |
| 32 | VSS | 72 | VDD | 112 | DQS7 | 152 | DM3 | 192 | /RAS | 232 | VSS |
| 33 | /DQS3 | 73 | /WE | 113 | VSS | 153 | NC | 193 | /S0 | 233 | DQ62 |



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| | | | | | | | | | | | | |
|----|--------|----|---------|-----|------|--|-----|--------|-----|------|-----|--------|
| 34 | DQS3 | 74 | /CAS | 114 | DQ58 | | 154 | VSS | 194 | VDD | 234 | DQ63 |
| 35 | VSS | 75 | VDD | 115 | DQ59 | | 155 | DQ30 | 195 | ODT0 | 235 | VSS |
| 36 | DQ26 | 76 | /S1,NC | 116 | VSS | | 156 | DQ31 | 196 | A13 | 236 | VDDSPD |
| 37 | DQ27 | 77 | ODT1,NC | 117 | SA0 | | 157 | VSS | 197 | VDD | 237 | SA1 |
| 38 | VSS | 78 | VDD | 118 | SCL | | 158 | NC,CB4 | 198 | NC | 238 | SDA |
| 39 | NC,CB0 | 79 | NC | 119 | SA2 | | 159 | NC,CB5 | 199 | VSS | 239 | VSS |
| 40 | NC,CB1 | 80 | VSS | 120 | VTT | | 160 | VSS | 200 | DQ36 | 240 | VTT |



Pin Description :

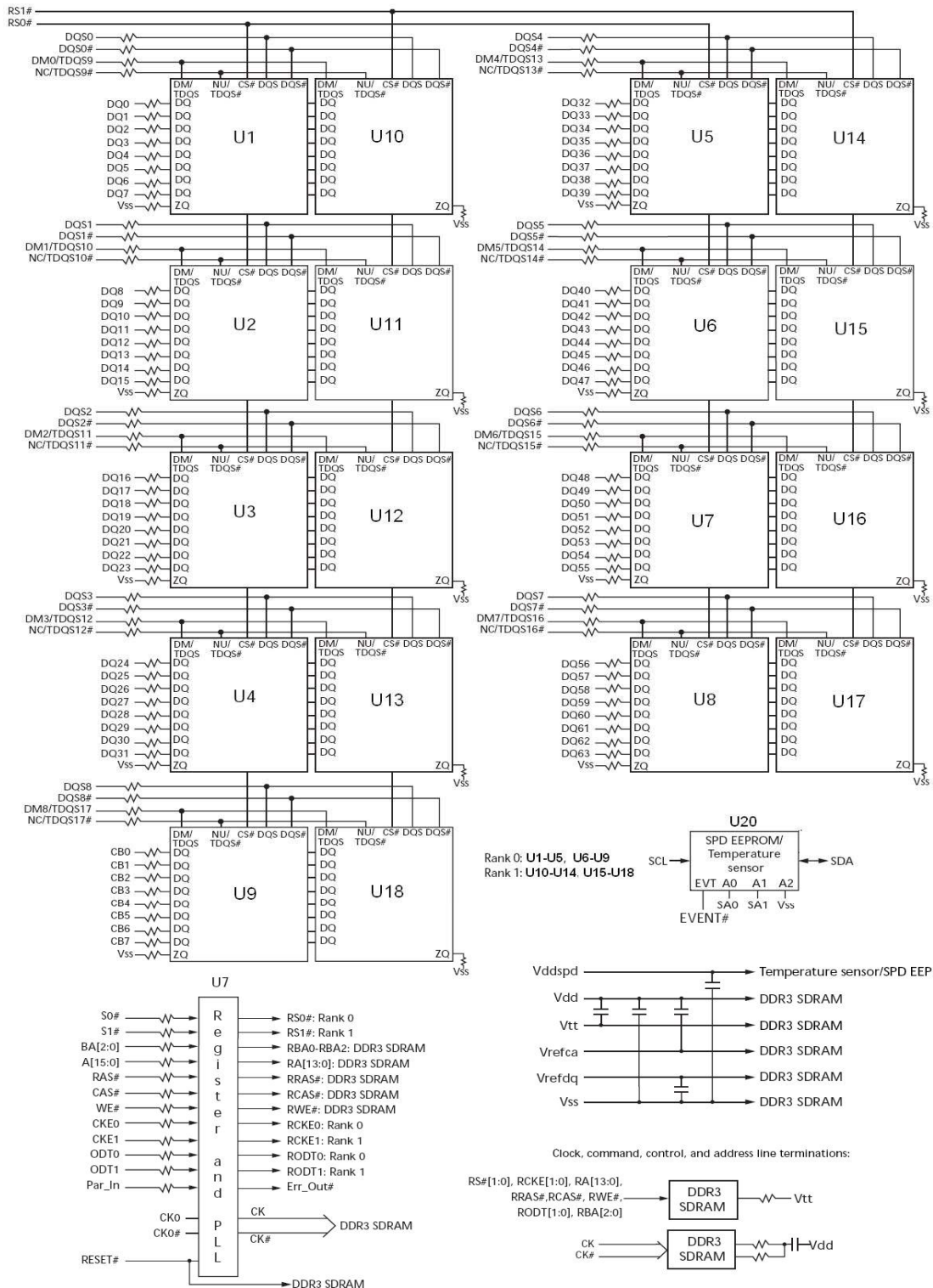
| PIN | NAME | FUNCTION |
|---------------------------|------------------------|--|
| CK0~CK1, /CK0~/CK1 | System Clock | Active on the positive and negative edge to sample all inputs. |
| CKE0~CKE1 | Clock Enable | Masks system clock to freeze operation from the next clock cycle. CKE should be enabled at least on cycle prior new command. Disable input buffers for power down in standby |
| /S0~/S1 | Chip Select | Disables or Enables device operation by masking or enabling all input except CK, CKE and L(U)DQM |
| A0~A14 | Address | Row / Column address are multiplexed on the same pins. (Row Address: A0~A14 , Column Address: A0~A9 , Auto precharge: A10/AP) |
| BA0~BA2 | Banks Select | Selects bank to be activated during row address latch time. Selects bank for read / write during column address latch time. |
| DQ0~DQ63 CB0~CB7 | Data | Data and check bit inputs / outputs are multiplexed on the same pins. |
| DQS0~DQS8, /DQS0~/DQS8 | Data Strobe | Bi-directional Data Strobe |
| DM0~DM8 | Data Mask | Mask input data when DM is high. |
| /RAS | Row Address Strobe | Latches row addresses on the positive edge of the CK with /RAS low |
| /CAS | Column Address Strobe | Latches Column addresses on the positive edge of the CK with /CAS low |
| /WE | Write Enable | Enables write operation and row recharge. |
| VDD / VSS | Power Supply/Ground | Power and Ground for the input buffers and the core logic. |
| VREFDQ | Power Supply reference | Power Supply for reference.DQ,DM.VDD/2 |
| VREFCA | Power Supply reference | Power Supply for reference. Command , address, & control.VDD/2 |
| VDDQ | Power Supply | Power supply for the DDR3 SDRAM output buffers to provide improved noise immunity |
| SDA | Serial data I/O | EEPROM serial data I/O |



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| | | |
|-----------|--------------------|---|
| SCL | Serial clock | EEPROM clock input |
| SA0~SA2 | Address in EEPROM | EEPROM address input |
| ODT0~ODT1 | On Die Termination | When high, termination resistance is enabled for all DQ, /DQ and DM pins, assuming the function is enabled in the Extended Mode Register Set. |
| NC | No Connection | This pin is recommended to be left No Connection on the device. |

Block Diagram :



Notes: 1. The ZQ ball on each DDR3 component is connected to an external 240Ω ±1% resistor that is tied to ground. It is used for the calibration of the component's ODT and output driver.

Absolute Maximum Ratings :

| Parameter | Symbol | Value | Unit |
|---------------------------------------|-----------|--------------|------|
| Voltage on VDD supply relative to Vss | VDD | -0.4 ~ 1.975 | V |
| Voltage on VDDQ pin relative to Vss | VDDQ | -0.4 ~ 1.975 | V |
| Voltage on any pin relative to Vss | VIN, Vout | -0.4 ~ 1.975 | V |
| Storage temperature | TStg | -55 ~ +100 | °C |

Note: DDR3 SDRAM component specification.

Operation Temperature Condition

| Parameter | Symbol | Value | Unit | Note |
|---------------------------------------|--------|---------|------|------|
| Normal Operating Temperature Range | TC | 0~+85 | °C | 1 |
| Extended Temperature Range (Optional) | TC | +85~+95 | °C | 1 |

Note: (1) If the DRAM case temperature is above 85 °C, the Auto-Refresh command interval has to be reduced to tREFI=3.9us.

DC Operating Condition :

Voltage referenced to Vss = 0V, VDD&VDDQ=1.5V±0.075V, Tc = 0 to 85 °C

| Parameter | Symbol | Min | Max | Unit | Note |
|--------------------------------|--------------|--------------|-------------|------|------|
| Supply Voltage | VDD | 1.425 | 1.575 | V | 1,2 |
| | VDDSPD | 3 | 3.6 | V | |
| Supply Voltage for Output | VDDQ | 1.425 | 1.575 | V | 1,2 |
| I/O Reference Voltage(CMD/ADD) | VREFCA, (DC) | 0.49 x VDDQ | 0.51 x VDDQ | V | 3,4 |
| I/O Reference Voltage(DQ) | VREFDQ, (DC) | 0.49 x VDDQ | 0.51 x VDDQ | V | 3,4 |
| Termination Voltage | VTT | VDDQ/2 - TBD | VDDQ/2 +TBD | V | |

Note: (1) Under all conditions VDDQ must be less than or equal to VDD.

(2) VDDQ tracks with VDD. AC parameters are measured with VDD and VDDQ tied together.

(3) The AC peak noise on VREF may not allow VREF to deviate from VREF(DC) by more than ±1% VDD

(for reference: approx. ±15mV)

(4) For reference: approx. VDD/2 ±15mV

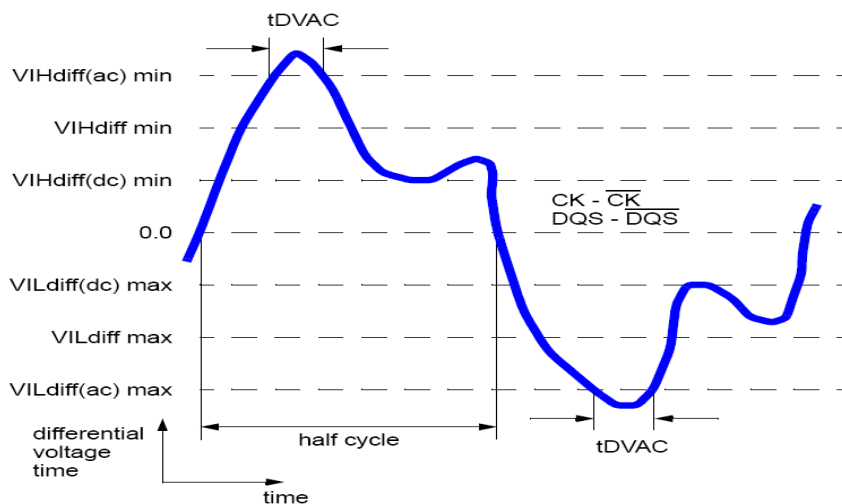
Input DC & AC Logic Level for single-ended signals :

| Parameter | Symbol | Min | Max | Unit | Note |
|-----------------------------|----------|------------|------------|------|------|
| DC Input logic high voltage | VIH (DC) | VREF+100 | VDD | mV | 1 |
| DC Input logic low voltage | VIL (DC) | VSS | VREF-100 | mV | 1 |
| AC input logic high | VIH(AC) | VREF + 175 | - | mV | 1,2 |
| AC input logic low | VIL(AC) | - | VREF – 175 | mV | 1,2 |

Note: 1. For DQ and DM, VREF = VREFDQ . For input only pins except RESET, or VREF = VREFCA.

2. See "Overshoot and Undershoot specifications" on component datasheet

Definition of differential ac-swing and "time above ac level tDVAC



Input AC Logic Level for single-ended signals :

| Parameter | Symbol | Min | Max | Unit | Note |
|----------------------------|--------------|------------------|----------------------|------|------|
| Differential input high | VIHdiff | +0.2 | Note 3 | V | 1 |
| Differential input low | VILdiff | Note 3 | -0.2 | V | 1 |
| Differential input high AC | VIHdiff(AC) | 2 (VIH(ac)-Vref) | Note 3 | V | 2 |
| Differential input low AC | VILdiff (AC) | Note 3 | 2 x (Vref - VIL(ac)) | V | 2 |

Notes: 1. Used to define a differential signal slew-rate.

2. For CK - CK use VIH/VIL(ac) of ADD/CMD and VREFCA; for DQS - DQS, DQSL - DQSL, DQSU - DQSU use VIH/VIL(ac) of DQs and VREFDQ; if a reduced ac-high or ac-low level is used for a signal group, then the reduced level applies also here.

3. These values are not defined, however they single-ended signals CK, /CK, DQS, /DQS, DQSL, /DQSL, DQSU, /DQSU need to be within the respective limits (VIH(dc) max, VIL(dc)min) for single-ended signals as well as the limitations for overshoot and undershoot on Component Datasheet.



IDD Specification :

| Symbol | Condition | Typical | Unit |
|--------|--|---------|------|
| IDD0 | Operating One Bank Active-Precharge Current | 1188 | mA |
| IDD1 | Operating One Bank Active-Read-Precharge Current | 1368 | mA |
| IDD2P0 | Precharge Power-Down Current Slow Exit | 216 | mA |
| IDD2P1 | Precharge Power-Down Current Fast Exit | 810 | mA |
| IDD2Q | Precharge Quiet Standby Current | 1206 | mA |
| IDD2N | Precharge Standby Current | 1260 | mA |
| IDD3P | Active Power-Down Current | 810 | mA |
| IDD3N | Active Standby Current | 1206 | mA |
| IDD4W | Operating Burst Write Current | 2358 | mA |
| IDD4R | Operating Burst Read Current | 2358 | mA |
| IDD5B | Burst Refresh Current | 2448 | mA |
| IDD6 | Self Refresh Current: Normal Temperature Range | 108 | mA |
| IDD7 | Operating Bank Interleave Read Current | 5508 | mA |

Note: IDD current measure method and detail patterns are described on DDR3 component datasheet. Only for reference.

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

| Speed | DDR3-1600 | Units |
|------------------|-----------|-------|
| Bin(CL-tRCD-tRP) | 11-11-11 | |
| Parameter | min | |
| CL | 11 | tCK |
| tRCD | 13.125 | ns |
| tRC | 48.125 | ns |
| tRRD | 6 | ns |
| tCK | 1.25 | ns |
| tRAS | 35 | ns |
| tRP | 13.125 | ns |
| tRFC | 160 | ns |



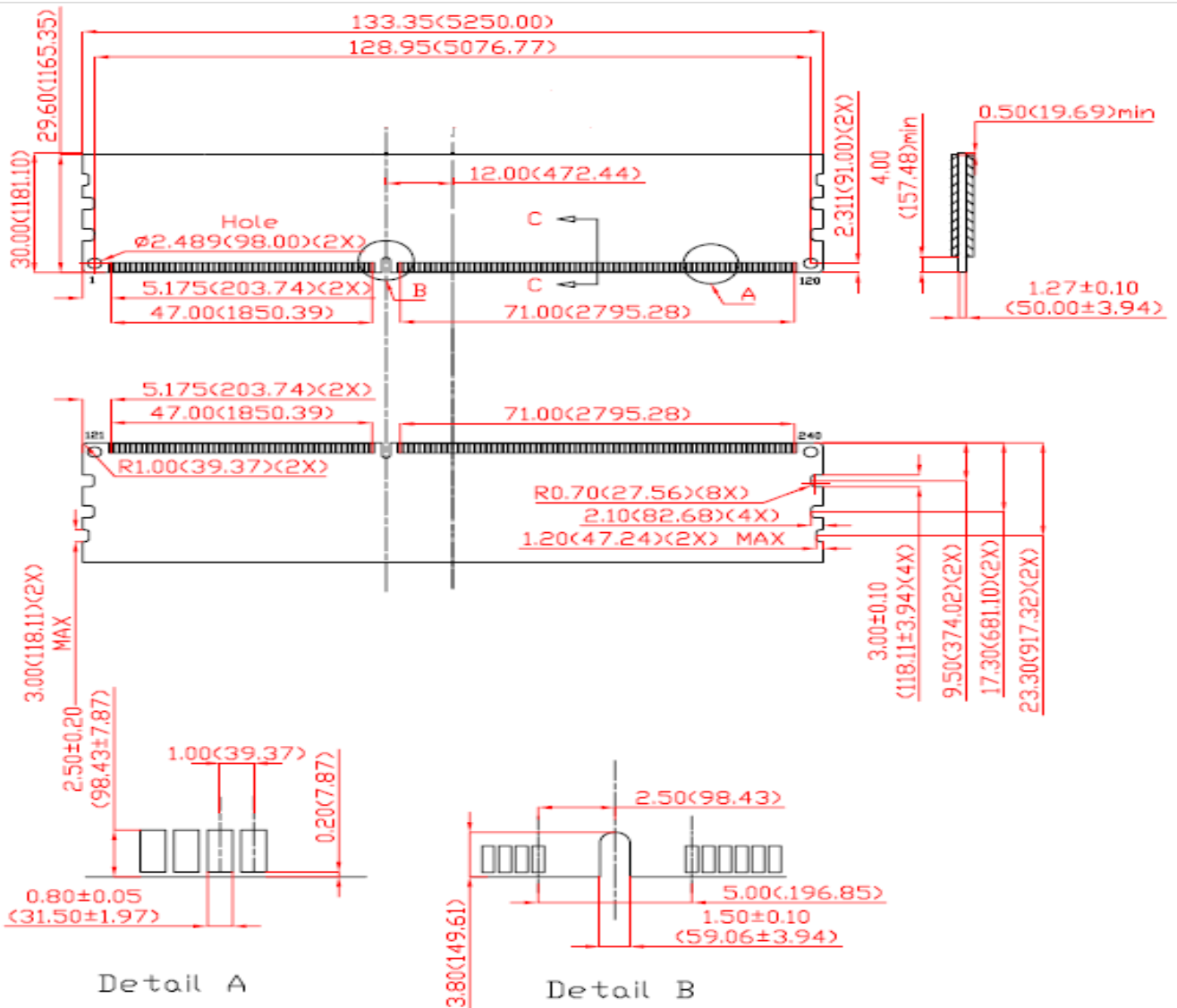
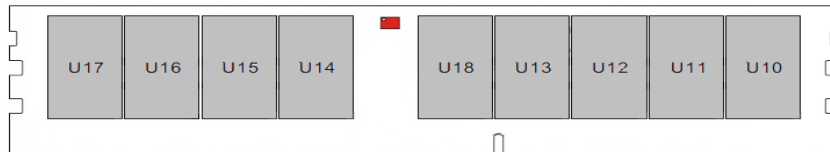
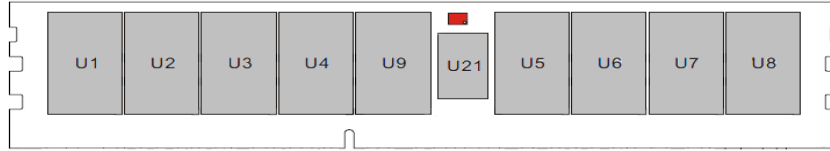
Timing Parameters:

| Symbol | AC Characteristics Parameter | Min | Max | Unit |
|--------------|---|------------------|------|----------|
| tCK(DLL_OFF) | Minimum Clock Cycle Time (DLL off mode) | 8 | - | ns |
| tCH(avg) | Average high pulse width | 0.47 | 0.53 | tCK(avg) |
| tCL(avg) | Average low pulse width | 0.47 | 0.53 | tCK(avg) |
| tDQSQ | DQS, DQS# to DQ skew, per group, per access | - | 125 | ps |
| tQH | DQ output hold time from DQS, DQS# | 0.38 | - | tCK(avg) |
| tDS(base) | Data setup time to DQS, DQS# referenced to Vih(ac) / Vil(ac) levels | 30 | - | ps |
| tDH(base) | Data hold time from DQS, DQS# referenced to Vih(dc) / Vil(dc) levels | 65 | - | ps |
| tDIPW | DQ and DM Input pulse width for each input | 400 | - | ps |
| tRPRE | DQS, DQS# differential READ Preamble | 0.9 | - | tCK(avg) |
| tRPST | DQS, DQS# differential READ Postamble | 0.3 | - | tCK(avg) |
| tQSH | DQS, DQS# differential output high time | 0.40 | - | tCK(avg) |
| tQSL | DQS, DQS# differential output low time | 0.40 | - | tCK(avg) |
| tWPRE | DQS, DQS# differential WRITE Preamble | 0.9 | - | tCK(avg) |
| tWPST | DQS, DQS# differential WRITE Postamble | 0.3 | - | tCK(avg) |
| tDQSCK | DQS, DQS# rising edge output access time from rising CK, CK# | -255 | 255 | ps |
| tLZ | DQ, DQS and DQS# low-impedance time | -500 | 250 | ps |
| tHZ | DQ, DQS and DQS# high-impedance time | - | 250 | ps |
| tDQSL | DQS, DQS# differential input low pulse width | 0.45 | 0.55 | tCK(avg) |
| tDQSH | DQS, DQS# differential input high pulse width | 0.45 | 0.55 | tCK(avg) |
| tDQSS | DQS, DQS# rising edge to CK, CK# rising edge | -0.25 | 0.25 | tCK(avg) |
| tDSS | DQS, DQS# falling edge setup time to CK, CK# rising edge | 0.2 | - | tCK(avg) |
| tDSH | DQS, DQS# falling edge hold time from CK, CK# rising edge | 0.2 | - | tCK(avg) |
| tRTP | Internal READ Command to PRECHARGE Command delay | max(4nCK, 7.5ns) | - | - |
| tWTR | Delay from start of internal write transaction to internal read command | max(4nCK, 7.5ns) | - | - |
| tWR | WRITE recovery time | 15 | - | ns |
| tMRD | Mode Register Set command cycle time | 4 | - | nCK |
| tIS(base) | Command and Address setup time to CK, CK# referenced to | 65 | - | ps |



| | | | | |
|-----------|--|-----------------------------|----------------------------|----|
| | Vih(ac) / Vil(ac) levels | | | |
| tIH(base) | Command and Address hold time from CK, CK# referenced to Vih(dc) / Vil(dc) levels | 140 | - | ps |
| tXP | Exit Power Down with DLL on to any valid command; Exit Precharge Power Down with DLL frozen to commands not requiring a locked DLL | max(3nCK,6ns) | - | - |
| tCKE | CKE minimum pulse width | max(3nCK,5.625ns) | - | - |
| tREFI | Average Periodic Refresh interval | 85°C < TCASE < 95°C /3.9 | 0°C < TCASE < 85°C /7.8 | us |

Package Dimensions :





Ordering Information :

