ADATA Technology Corp.

Memory Module Data Sheet

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

Version 1.0

Document Number : R11-0834

ADATA Technology Co., Ltd. | www.adata-group.com
T: +886-2-8228-0886 F: +886-2-8228-0887
2F, No. 258, Lian Cheng Rd., Chung Ho Dist., New Taipei City 235, Taiwan (R.O.C.)

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

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

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

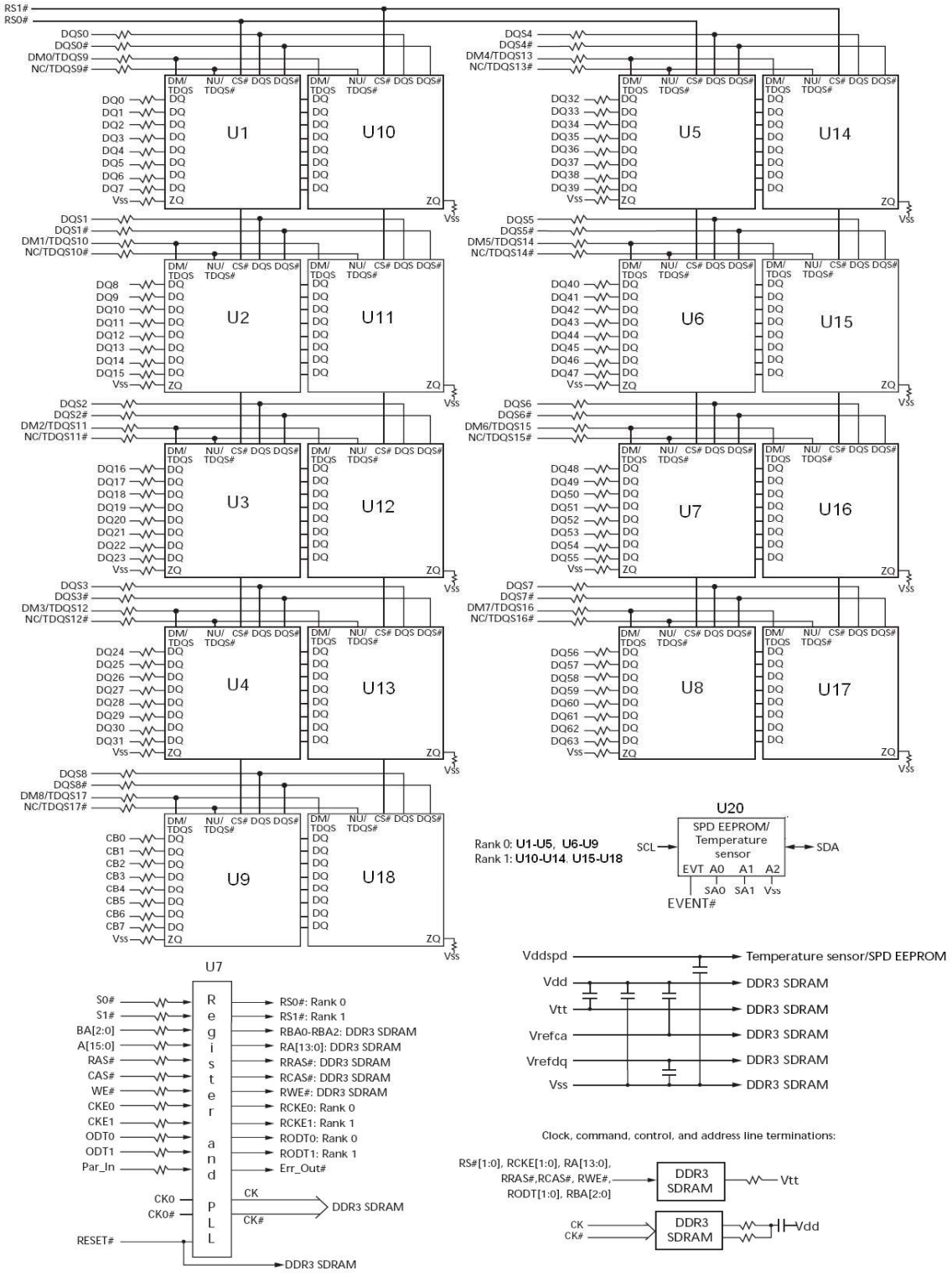
T: +886-2-8228-0886 F: +886-2-8228-0887
2F, No. 258, Lian Cheng Rd., Chung Ho Dist., New Taipei City 235, Taiwan (R.O.C.)

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

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	℃

Note: DDR3 SDRAM component specification.

Operation Temperature Condition

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

Note: (1) If the DRAM case temperature is above 85 ℃, 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 ℃

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

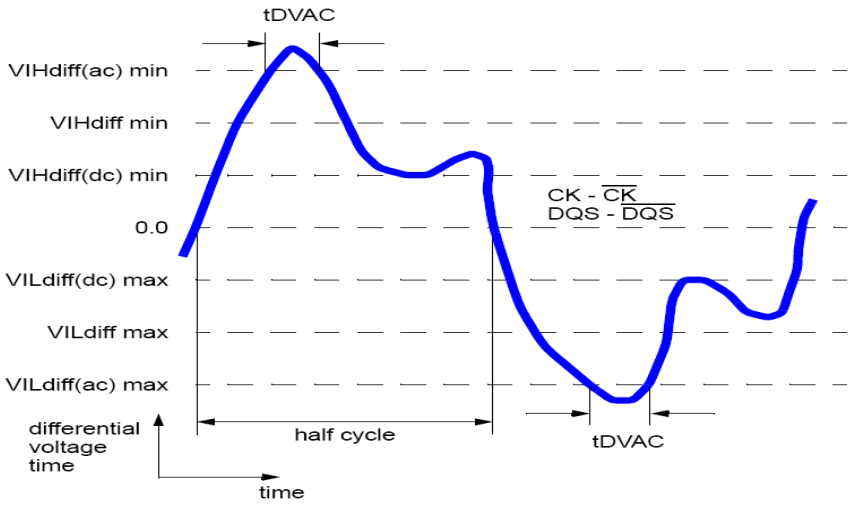
Input DC & AC Logic Level for single-ended signals：

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 differntial 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：

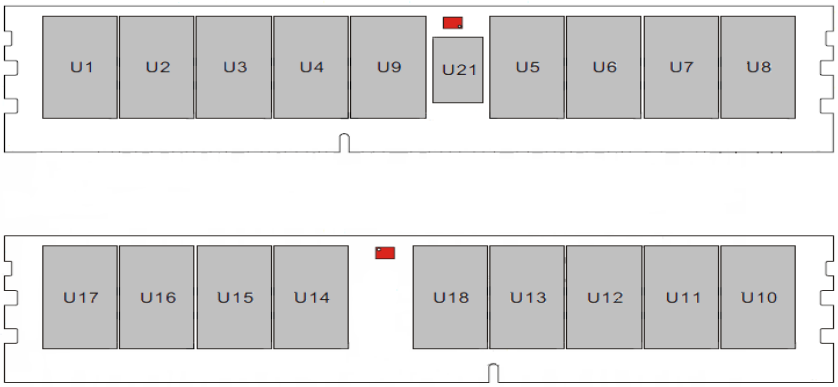
Speed	DDR3-1600	Units
Bin(CL-tRCD-tRP)	11-11-11	
Parameter	min	
CL	11	tCK
tRCD	13.125	ns
tRC	48.125	ns
tRRD	6	ns
tCK	1.25	ns
tRAS	35	ns
tRP	13.125	ns
tRFC	160	ns

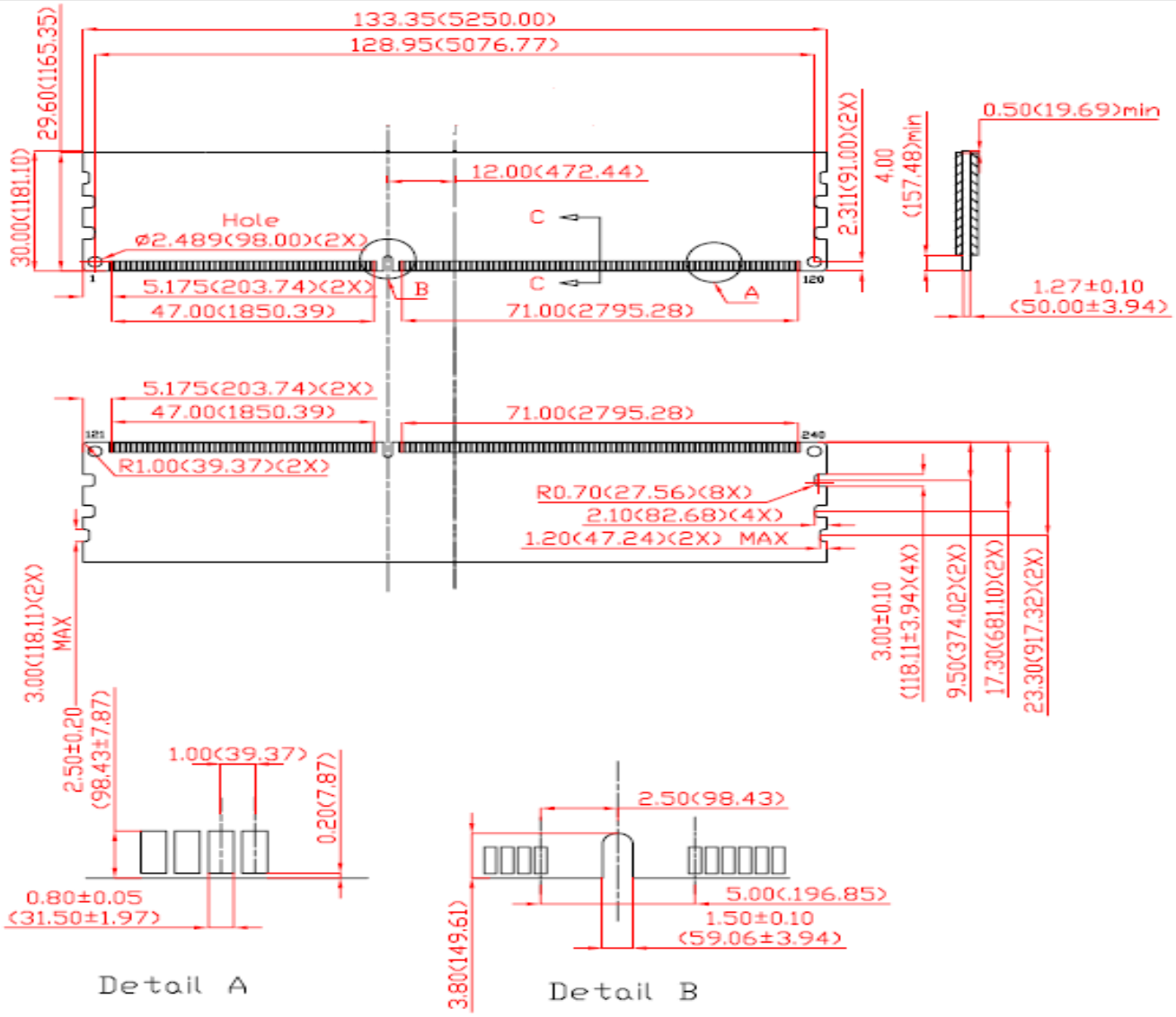
Timing Parameters:

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℃<TCASE <95℃ /3.9	0℃<TCASE <85℃ /7.8	us

Package Dimensions：





Ordering Information：