

### PC-133 SDRAM Unbuffered SO-DIMM

16Mx64bits SDRAM DIMM based on 8Mx16, 4Bank, 4K Refresh, 3.3V SDRAM

#### General Description

The ADEBC2608 is 16Mx64 bits Synchronous DRAM Modules, The modules are composed of eight 8Mx16 bits CMOS Synchronous DRAMs in TSOP-II 400mil 54pin package and one 2Kbit EEPROM in 8pin TSSOP(TSOP) package on a 144pin glass-epoxy printed circuit board.

The A-Data is a Dual In-line Memory Module and is intended for mounting onto 144-pins edge connector sockets. Fully synchronous operation referenced to the positive edge of the clock. All inputs and outputs are synchronized with the rising edge of the clock.

The data paths are internally pipelined to achieve very high bandwidth.

#### Features

- PC-133 support
- Auto refresh and self refresh
- 4096 refresh cycles / 64ms
- Single 3.3±0.3V power supply
- All device pins are compatible with LVTTTL interface
- Data mask function by DQM
- Serial Presence Detect with EEPROM
- Module bank : two physical bank
- PCB : BSS960A, Height (31.75mm), double sided component, Six layers

#### Ordering Information.

Part No.	Frequency	Bank	Ref.	Package
ADEBC2608	133Mhz	4 Banks	4K	TSOP II

#### Pin Assignment

FRONT SIDE								BACK SIDE							
PIN	NAME	PIN	NAME	PIN	NAME	PIN	NAME	PIN	NAME	PIN	NAME	PIN	NAME	PIN	NAME
1	VSS	19	DQ7	37	DQ8	55	VSS	73	NC	91	VSS	109	A9	127	DQ27
2	VSS	20	DQ39	38	DQ40	56	VSS	74	CK1	92	VSS	110	BA1	128	DQ59
3	DQ0	21	VSS	39	DQ9	57	NC	75	VSS	93	DQ20	111	A10/AP	129	VDD
4	DQ32	22	VSS	40	DQ41	58	NC	76	VSS	94	DQ52	112	A11	130	VDD
5	DQ1	23	DQM0	41	DQ10	59	NC	77	NC	95	DQ21	113	VDD	131	DQ28
6	DQ33	24	DQM4	42	DQ42	60	NC	78	NC	96	DQ53	114	VDD	132	DQ60
7	DQ2	25	DQM1	43	DQ11	61	CK0	79	NC	97	DQ22	115	DQM2	133	DQ29
8	DQ34	26	DQM5	44	DQ43	62	CKE0	80	NC	98	DQ54	116	DQM6	134	DQ61
9	DQ3	27	VDD	45	VDD	63	VDD	81	VDD	99	DQ23	117	DQM3	135	DQ30
10	DQ35	28	VDD	46	VDD	64	VDD	82	VDD	100	DQ55	118	DQM7	136	DQ62
11	VDD	29	A0	47	DQ12	65	/RAS	83	DQ16	101	VDD	119	VSS	137	DQ31
12	VDD	30	A3	48	DQ44	66	/CAS	84	DQ48	102	VDD	120	VSS	138	DQ63
13	DQ4	31	A1	49	DQ13	67	/WE	85	DQ17	103	A6	121	DQ24	139	VSS
14	DQ36	32	A4	50	DQ45	68	*CKE1	83	DQ49	104	A7	122	DQ56	140	VSS
15	DQ5	33	A2	51	DQ14	69	/CS0	87	DQ18	105	A8	123	DQ25	141	**SDA
16	DQ37	34	A5	52	DQ46	70	*A12	88	DQ50	106	BA0	124	DQ57	142	**SCL
17	DQ6	35	VSS	53	DQ15	71	/CS1	89	DQ19	107	VSS	125	DQ26	143	VDD
18	DQ38	36	VSS	54	DQ47	72	*A13	90	DQ51	108	VSS	126	DQ58	144	VDD

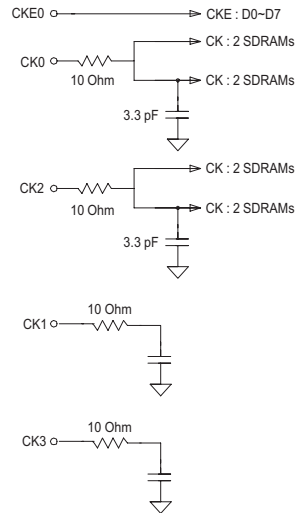
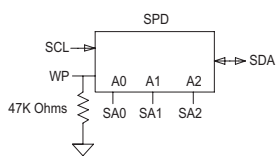
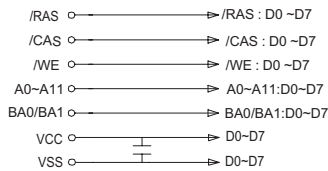
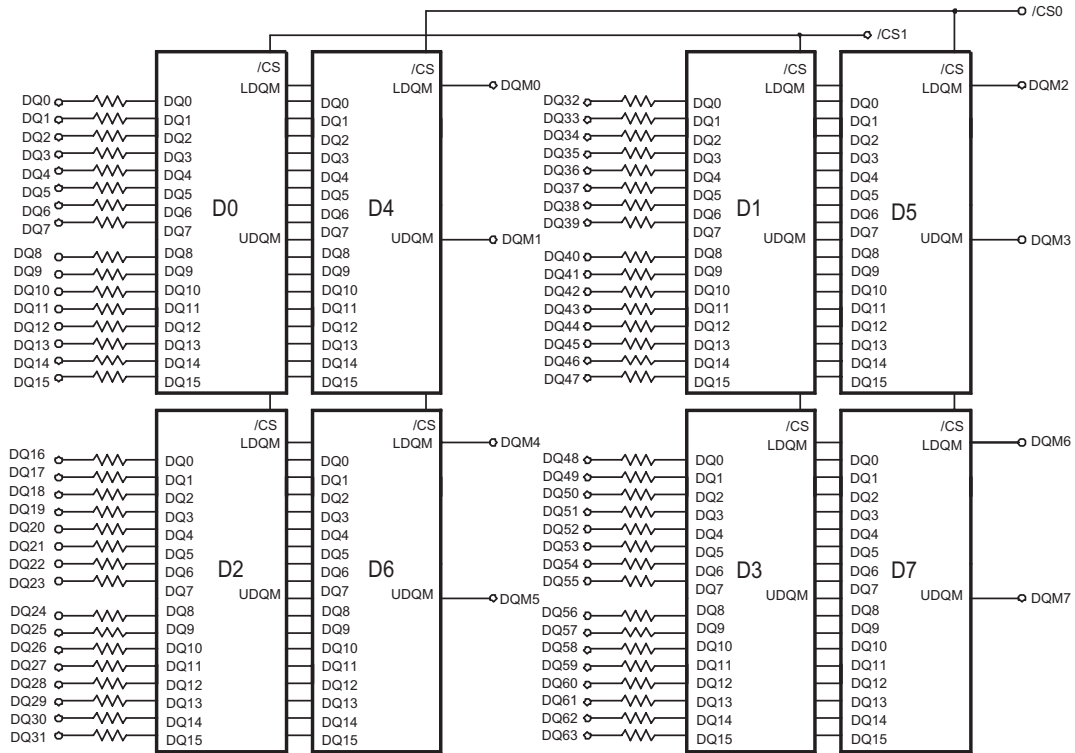
\* These pins are not used in this module.

\*\* These pins should be NC in the system which does not support SPD.

## Pin Description

PIN	NAME	FUNCTION
CK0~1	System Clock	Active on the positive edge to sample all inputs.
CKE0~1	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
/CS0~1	Chip Select	Disables or Enables device operation by masking or enabling all input except CK, CKE and L(U)DQM
A0~A11	Address	Row / Column address are multiplexed on the same pins.
BA0~BA1	Banks Select	Selects bank to be activated during row address latch time. Selects bank for read / write during column address latch time.
DQ0~DQ63	Data	Data inputs / outputs are multiplexed on the same pins.
DQM0~7	Data Mask	Makes data output Hi-Z,
/RAS	Row Address Strobe	Latches row addresses on the positive edge of the CLK with /RAS low
/CAS	Column Address Strobe	Latches Column addresses on the positive edge of the CLK 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.
SDA	Serial data I/O	EEPROM serial data I/O
SCL	Serial clock	EEPROM clock input
SA0~2	Address in EEPROM	EEPROM address input
NC	No Connection	This pin is recommended to be left No Connection on the device.

## Block Diagram



## Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Voltage on any pin relative to Vss	V <sub>IN</sub> , V <sub>out</sub>	-1.0 ~ 4.6	V
Voltage on VDD supply relative to Vss	V <sub>DD</sub> , V <sub>DDQ</sub>	-1.0 ~ 4.6	V
Storage temperature	T <sub>STG</sub>	-55 ~ +150	°C
Power dissipation	P <sub>D</sub>	8	W
Short circuit current	I <sub>os</sub>	50	mA

**Note** : Permanent device damage may occur if ABSOLUTE MAXIMUM RATING are exceeded.

Functional operation should be restricted to recommended operating condition.

Exposure to higher than recommended voltage for extended periods of time could affect device reliability.

## DC Operating Condition

Voltage referenced to Vss = 0V, T<sub>A</sub> = 0 to 70 °C

Parameter	Symbol	Min	Typ	Max	Unit	Note
Supply voltage	V <sub>DD</sub> , V <sub>DDQ</sub>	3.0	3.3	3.6	V	
Input logic high voltage	V <sub>IH</sub>	2.0	3.0	V <sub>DD</sub> +0.3	V	1
Input logic low voltage	V <sub>IL</sub>	-0.3	0	0.8	V	2
Output logic high voltage	V <sub>OH</sub>	2.4	-	-	V	I <sub>OH</sub> =-2mA
Output logic low voltage	V <sub>OL</sub>	-	-	0.4	V	I <sub>OL</sub> =2mA
Input leakage current	I <sub>IL</sub>	-5	-	5	uA	3
Output leakage current	I <sub>OL</sub>	-5	-	5	uA	4

**Note** : 1. V<sub>IH</sub> (max)=4.6V AC for pulse width ≤ 10ns acceptable.

2. V<sub>IL</sub>(min)=-1.5V AC for pulse width ≤ 10ns acceptable.

3. Any input 0V ≤ V<sub>IN</sub> ≤ V<sub>DD</sub> + 0.3V, all other pins are not under test = 0V.

4. Dout is disabled, 0V ≤ V<sub>OUT</sub> ≤ V<sub>DD</sub>.

## AC Operating Condition

Voltage referenced to Vss = 0V, T<sub>A</sub> = 0 to 70 °C

Parameter	Symbol	Value	Unit	Note
AC input high / low level voltage	V <sub>IH</sub> / V <sub>IL</sub>	2.4 / 0.4	V	
Input timing measurement reference level voltage	V <sub>trip</sub>	1.4	V	
Input rise / fall time	T <sub>R</sub> / t <sub>F</sub>	1	Ns	
Output timing measurement reference level	V <sub>outf</sub>	1.4	V	
Output load capacitance for access time measurement	C <sub>L</sub>	50	pF	2

**Note**: 1. 3.15V ≤ V<sub>DD</sub> ≤ 3.6V

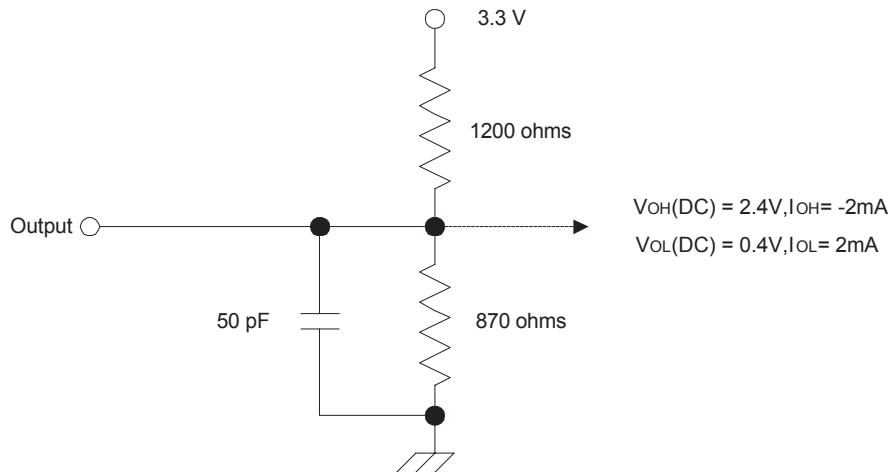
2. Output load to measure access times is equivalent to two TTL gates and one capacitor (30pF). For details, refer to AC/DC output load circuit.

## Capacitance

TA=25°C, f=1Mhz, VDD=3.3V

Parameter	Pin	Symbol	Min	Max	Unit
Input capacitance	CLK	CI1	25	40	pF
	A0~A11,BA0,BA1,CKE,/CS,/RAS, /CAS,/WE,DQM	CI2	40	55	pF
Data input / output capacitance	DQM	CI/O	5	15	pF

## Output load circuit



## DC Characteristics I

Parameter	Symbol	Min	Max	Unit	Note
Input leakage current	$I_{LI}$	-1	1	$\mu A$	1
Output leakage current	$I_{LO}$	-1	1	$\mu A$	2
Output high voltage	$V_{OH}$	2.4	-	V	$I_{OH} = -4mA$
Output low voltage	$V_{OL}$	-	0.4	V	$I_{OL} = 4mA$

**Note** : 1.  $V_{IN} = 0$  TO 3.6V, All other pins are not tested under  $V_{IN} = 0V$ .

2. DOUT is disabled,  $V_{OUT} = 0$  to 3.6.

### DC Characteristics II

Parameter	Symbol	Test condition	Speed	Unit	Note
Operating Current	IDD1	Burst length=1, One bank active $t_{RC} \geq t_{RC}(\min), I_{OL}=0\text{mA}$	700	mA	1
Precharge standby current in power down mode	IDD2P	$CKE \leq V_{IL}(\max), t_{CK}=\min$	16	mA	
	IDD2PS	$CKE \leq V_{IL}(\max), t_{CK}=\infty$	16		
Precharge standby current in Non power down mode	IDD2N	$CKE \geq V_{IH}(\min), /CS \geq V_{IH}(\min),$ $t_{CK}=\min$ input signals are changed one time during 2clks. All other pins $\geq V_{DD}-0.2V$ or $\leq$ 0.2V	160	mA	
	IDD2NS	$CKE \geq V_{IH}(\min), t_{CK}=\infty$ Input signals are stable.	800		
Active standby current in power down mode	IDD3P	$CKE \leq V_{IL}(\max), t_{CK}=\min$	60	mA	
	IDD3PS	$CKE \leq V_{IL}(\max), t_{CK}=\infty$	60		
Active standby current in Non power down mode	IDD3N	$CKE \geq V_{IH}(\min), /CS \geq V_{IH}(\min),$ $t_{CK}=\min$ input signals are changed one time during 2clks. All other pins $\geq V_{DD}-0.2V$ or $\leq$ 0.2V	320	mA	
	IDD3NS	$CKE \geq V_{IH}(\min), t_{CK}=\infty$ Input signals are stable.	320		
Burst mode operating current	IDD4	$t_{CK} \geq t_{CK}(\min), I_{OL}=0\text{ mA}$ All banks active	800	mA	1
Auto refresh current	IDD5	$t_{RRC} \geq t_{RRC}(\min),$ All banks active	1920	mA	2
Self refresh current	IDD6	$CKE \leq 0.2V$	16	mA	

**Note:** 1. IDD1 and IDD4 depend on output loading and cycle rates. Specified values are measured with the output open.

2. Min. of  $t_{RRC}$  is shown at AC characteristics.

### AC Characteristics

Parameter		Symbol	ADEBC2608		Unit	Note
			Min	Max		
System clock	/CAS Latency = 3	tCK3	7.5	1000	ns	
Cycle time	/CAS Latency = 2	tCK2	10			
Clock high pulse width		tCHW	2.5		ns	1
Clock low pulse width		tCLW	2.5		ns	1
Access time form clock	/CAS Latency = 3	tAC3		5.4	ns	2
	/CAS Latency = 2	tAC2		6		
/RAS cycle time	Operation	tRC	65		ns	
	Auto Refresh	tRRC	65			
/RAS to /CAS delay		tRCD	20		ns	
/RAS active time		tRAS	45	100K	ns	
/RAS precharge time		tRP	20		ns	
/RAS to /RAS bank active delay		tRRD	15		ns	
/CAS to /CAS delay		tCCD	1		CLK	
Write command to data – in delay		tWTL	0		CLK	
Data – in to precharge command		tDPL	2		CLK	
Data – in active command		tDAL	5		CLK	
DQM to data – out Hi-Z		tDQZ	2		CLK	
DQM to data – in mask		tDQM	0		CLK	
Data – out hold time		tOH	2.7		ns	
Data – input setup time		tDS	1.5		ns	1
Data – input hold time		tDH	0.8		ns	1
Address setup time		tAS	1.5		ns	1
Address hold time		tAH	0.8		ns	1
CKE setup time		tCKS	1.5		ns	1
CKE hold time		tCKH	0.8		ns	1
Command setup time		tCS	1.5		ns	1
Command hold time		tCH	0.8		ns	1
CLK to data output in low Z-time		tOLZ	1		ns	
MRS to new command		tMRD	2		CLK	
Power down exit time		tPDE	1		CLK	
Self refresh exit time		tSRE	1		CLK	3
Refresh time		tREF		64	ms	

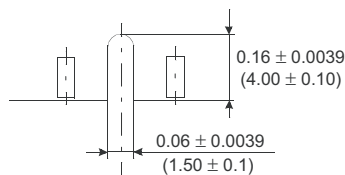
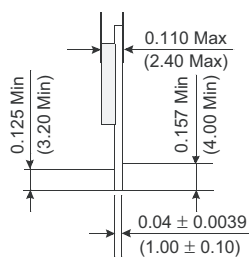
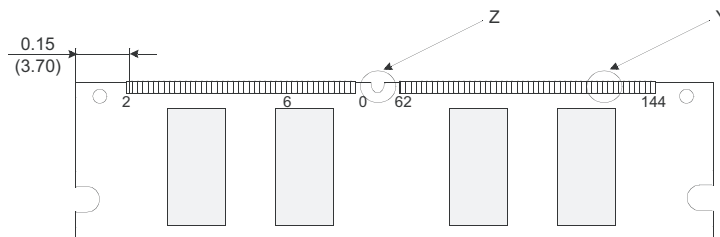
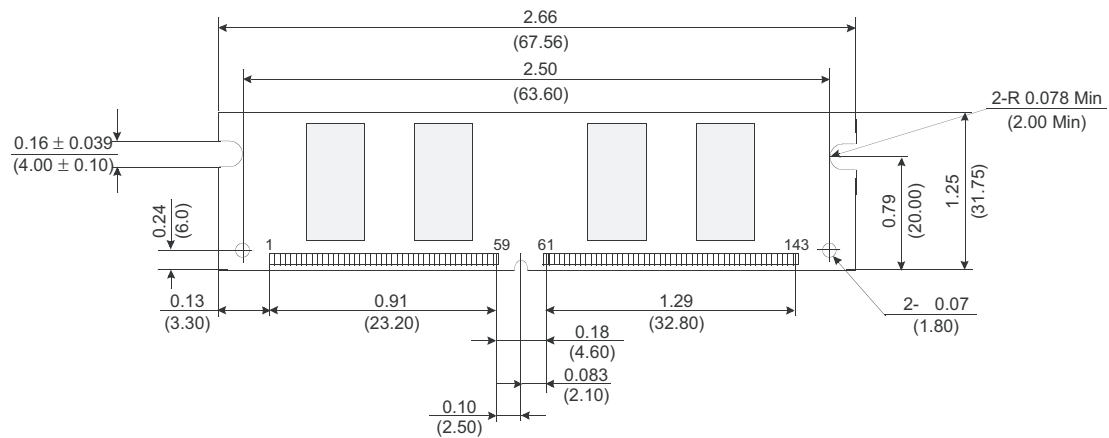
- Note** :
1. Assume tR / tF (input rise and fall time) is 1 ns.
  2. Access times to be measured with input signals of 1v / ns edge rate.
  3. A new command can be given tRRC after self refresh exit.

## Command Truth-Table

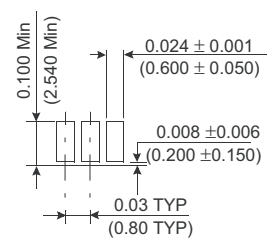
Command	CKEn-1	CKEn	/CS	/RAS	/CAS	/WE	DQM	ADDR	A10/AP	BA
Mode Register Set	H	X	L	L	L	L	X	OP code		
No Operation	H	X	H	X	X	X	X	X		
			L	H	H	H				
Bank Active	H	X	L	L	H	H	X	RA		V
Read	H	X	L	H	L	H	X	CA	L	V
Read with Auto Precharge									H	
Write	H	X	L	H	L	L	X	CA	L	V
Write with Auto Precharge									H	
Precharge All Bank	H	X	L	L	H	L	X	X	H	X
Precharge select Bank									L	V
Burst Stop	H	X	L	H	H	L	X	X		
DQM	H	X					V	X		
Auto Refresh	H	H	L	L	L	H	X	X		
Self Refresh	Entry	H	L	L	L	L	H	X	X	
	Exit	L	H	H	X	X	X	X		
L				H	H	H				
Precharge	Entry	H	L	H	X	X	X	X	X	
				L	H	H	H			
Power down	Exit	L	H	H	X	X	X	X		
				L	H	H	H			
Clock Suspend	Entry	H	L	H	X	X	X	X	X	
				L	V	V	V			
	Exit	L	H	X				X		



## Package Information



Detail Z



Detail Y