

# 1 GB Registered SDRAM DIMM

## EBS11RC4ACNA (128M words × 72 bits, 2 banks)

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### Description

The EBS11RC4ACNA is 128M words × 72 bits, 2 banks Synchronous Dynamic RAM Registered Module, mounted 36 pieces of 256M bits SDRAM sealed in TCP package. This module provides high density and large quantities of memory in a small space without utilizing the surface mounting technology. Decoupling capacitors are mounted on power supply line for noise reduction.

Note: Do not push the cover or drop the modules in order to protect from mechanical defects, which would be electrical defects.

### Features

- Fully compatible with 8 bytes DIMM: JEDEC standard outline
- 168-pin socket type dual in line memory module (DIMM)
  - PCB height: 30.48mm (1.20inch)
  - Lead pitch: 1.27mm
- 3.3V power supply
- Clock frequency: 133MHz (max.)
- LVTTTL interface
- Data bus width: × 72 ECC
- Single pulsed /RAS
- 4 Banks can operates simultaneously and independently
- Burst read/write operation and burst read/single write operation capability
- Programmable burst length (BL): 1, 2, 4, 8
- 2 variations of burst sequence
  - Sequential
  - Interleave
- Programmable /CAS latency (CL): 2, 3
- Registered inputs with one clock delay
- Byte control by DQMB
- Refresh cycles: 8192 refresh cycles/64ms
- 2 variations of refresh
  - Auto refresh
  - Self refresh
- 1 piece of PLL clock driver, 3 pieces of register driver and 1 piece of serial EEPROM (2k bits) for Presence Detect (SPD) on PCB.

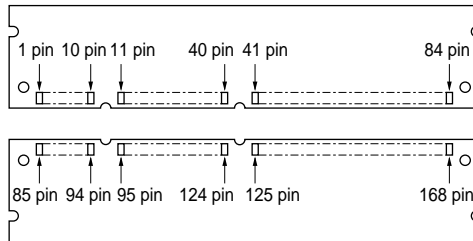
## Ordering Information

| Part number        | Clock frequency<br>MHz (max.) | /CAS latency | Package      | Contact pad | Mounted devices          |
|--------------------|-------------------------------|--------------|--------------|-------------|--------------------------|
| EBS11RC4ACNA -7A   | 133                           | 2, 3         | 168-pin DIMM | Gold        | 256M bits SDRAM<br>TCP*2 |
| EBS11RC4ACNA -75*1 | 133                           | 3            |              |             |                          |

Note: 1.100MHz operation at /CAS latency = 2.

2.Please refer to the TSOP products EDS25XXACTA datasheet (E0277E) for detail information.

## Pin Configurations



| Pin No. | Pin name | Pin No. | Pin name | Pin No. | Pin name | Pin No. | Pin name |
|---------|----------|---------|----------|---------|----------|---------|----------|
| 1       | VSS      | 43      | VSS      | 85      | VSS      | 127     | VSS      |
| 2       | DQ0      | 44      | NC       | 86      | DQ32     | 128     | CKE0     |
| 3       | DQ1      | 45      | /CS2     | 87      | DQ33     | 129     | /CS3     |
| 4       | DQ2      | 46      | DQMB2    | 88      | DQ34     | 130     | DQMB6    |
| 5       | DQ3      | 47      | DQMB3    | 89      | DQ35     | 131     | DQMB7    |
| 6       | VDD      | 48      | NC       | 90      | VDD      | 132     | NC       |
| 7       | DQ4      | 49      | VDD      | 91      | DQ36     | 133     | VDD      |
| 8       | DQ5      | 50      | NC       | 92      | DQ37     | 134     | NC       |
| 9       | DQ6      | 51      | NC       | 93      | DQ38     | 135     | NC       |
| 10      | DQ7      | 52      | CB2      | 94      | DQ39     | 136     | CB6      |
| 11      | DQ8      | 53      | CB3      | 95      | DQ40     | 137     | CB7      |
| 12      | VSS      | 54      | VSS      | 96      | VSS      | 138     | VSS      |
| 13      | DQ9      | 55      | DQ16     | 97      | DQ41     | 139     | DQ48     |
| 14      | DQ10     | 56      | DQ17     | 98      | DQ42     | 140     | DQ49     |
| 15      | DQ11     | 57      | DQ18     | 99      | DQ43     | 141     | DQ50     |
| 16      | DQ12     | 58      | DQ19     | 100     | DQ44     | 142     | DQ51     |
| 17      | DQ13     | 59      | VDD      | 101     | DQ45     | 143     | VDD      |
| 18      | VDD      | 60      | DQ20     | 102     | VDD      | 144     | DQ52     |
| 19      | DQ14     | 61      | NC       | 103     | DQ46     | 145     | NC       |
| 20      | DQ15     | 62      | NC       | 104     | DQ47     | 146     | NC       |
| 21      | CB0      | 63      | NC       | 105     | CB4      | 147     | REGE     |
| 22      | CB1      | 64      | VSS      | 106     | CB5      | 148     | VSS      |
| 23      | VSS      | 65      | DQ21     | 107     | VSS      | 149     | DQ53     |
| 24      | NC       | 66      | DQ22     | 108     | NC       | 150     | DQ54     |
| 25      | NC       | 67      | DQ23     | 109     | NC       | 151     | DQ55     |
| 26      | VDD      | 68      | VSS      | 110     | VDD      | 152     | VSS      |
| 27      | /WE      | 69      | DQ24     | 111     | /CAS     | 153     | DQ56     |
| 28      | DQMB0    | 70      | DQ25     | 112     | DQMB4    | 154     | DQ57     |
| 29      | DQMB1    | 71      | DQ26     | 113     | DQMB5    | 155     | DQ58     |

| Pin No. | Pin name | Pin No. | Pin name | Pin No. | Pin name | Pin No. | Pin name |
|---------|----------|---------|----------|---------|----------|---------|----------|
| 30      | /CS0     | 72      | DQ27     | 114     | /CS1     | 156     | DQ59     |
| 31      | NC       | 73      | VDD      | 115     | /RAS     | 157     | VDD      |
| 32      | VSS      | 74      | DQ28     | 116     | VSS      | 158     | DQ60     |
| 33      | A0       | 75      | DQ29     | 117     | A1       | 159     | DQ61     |
| 34      | A2       | 76      | DQ30     | 118     | A3       | 160     | DQ62     |
| 35      | A4       | 77      | DQ31     | 119     | A5       | 161     | DQ63     |
| 36      | A6       | 78      | VSS      | 120     | A7       | 162     | VSS      |
| 37      | A8       | 79      | CLK2     | 121     | A9       | 163     | CLK3     |
| 38      | A10 (AP) | 80      | NC       | 122     | BA0      | 164     | NC       |
| 39      | BA1      | 81      | NC       | 123     | A11      | 165     | SA0      |
| 40      | VDD      | 82      | SDA      | 124     | VDD      | 166     | SA1      |
| 41      | VDD      | 83      | SCL      | 125     | CLK1     | 167     | SA2      |
| 42      | CLK0     | 84      | VDD      | 126     | A12      | 168     | VDD      |

### Pin Description

| Pin name           | Function   |
|--------------------|--|
| A0 to A12          | Address input<br>— Row address A0 to A12<br>— Column address A0 to A9, A11 |
| BA0, BA1           | Bank select address  |
| DQ0 to DQ63        | Data input/output  |
| CB0 to CB7         | Check bit (Data input/output)  |
| /CS0 to /CS3       | Chip select input  |
| /RAS               | Row enable (/RAS) input  |
| /CAS               | Column enable (/CAS) input   |
| /WE                | Write enable input   |
| DQMB0 to DQMB7     | Byte data mask   |
| CLK0 to CLK3       | Clock input  |
| CKE0               | Clock enable input   |
| REGE* <sup>1</sup> | Register / Buffer enable   |
| SDA                | Data input/output for serial PD  |
| SCL                | Clock input for serial PD  |
| SA0 to SA2         | Serial address input   |
| VDD                | Primary positive power supply  |
| VSS                | Ground   |
| NC                 | No connection  |

Note: 1. REGE ≥ VIH: Register mode.  
REGE ≤ VIL: Buffer mode.

## Serial PD Matrix\*1

| Byte No. | Function described   | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 | Hex value | Comments                             |
|----------|--|------|------|------|------|------|------|------|------|-----------|--------------------------------------|
| 0        | Number of bytes used by module manufacturer  | 1    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 80H       | 128                                  |
| 1        | Total SPD memory size  | 0    | 0    | 0    | 0    | 1    | 0    | 0    | 0    | 08H       | 256 byte                             |
| 2        | Memory type  | 0    | 0    | 0    | 0    | 0    | 1    | 0    | 0    | 04H       | SDRAM                                |
| 3        | Number of row addresses bits   | 0    | 0    | 0    | 0    | 1    | 1    | 0    | 1    | 0DH       | 13                                   |
| 4        | Number of column addresses bits  | 0    | 0    | 0    | 0    | 1    | 0    | 1    | 1    | 0BH       | 11                                   |
| 5        | Number of banks  | 0    | 0    | 0    | 0    | 0    | 0    | 1    | 0    | 02H       | 2                                    |
| 6        | Module data width  | 0    | 1    | 0    | 0    | 1    | 0    | 0    | 0    | 48H       | 72 bit                               |
| 7        | Module data width (continued)  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 00H       | 0 (+)                                |
| 8        | Module interface signal levels   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 1    | 01H       | LVTTTL                               |
| 9        | SDRAM cycle time<br>(highest /CAS latency)<br>7.5ns  | 0    | 1    | 1    | 1    | 0    | 1    | 0    | 1    | 75H       | CL = 3*5                             |
| 10       | SDRAM access from Clock<br>(highest /CAS latency)<br>5.4ns                                   | 0    | 1    | 0    | 1    | 0    | 1    | 0    | 0    | 54H       |                                      |
| 11       | Module configuration type  | 0    | 0    | 0    | 0    | 0    | 0    | 1    | 0    | 02H       | ECC                                  |
| 12       | Refresh rate/type  | 1    | 0    | 0    | 0    | 0    | 0    | 1    | 0    | 82H       | Normal<br>(7.8125μs)<br>Self refresh |
| 13       | SDRAM width  | 0    | 0    | 0    | 0    | 0    | 1    | 0    | 0    | 04H       | 64M × 4                              |
| 14       | Error checking SDRAM width   | 0    | 0    | 0    | 0    | 0    | 1    | 0    | 0    | 04H       | × 4                                  |
| 15       | SDRAM device attributes:<br>minimum clock delay for back-to-<br>back random column addresses | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 1    | 01H       | 1 CLK                                |
| 16       | SDRAM device attributes:<br>Burst lengths supported  | 0    | 0    | 0    | 0    | 1    | 1    | 1    | 1    | 0FH       | 1, 2, 4, 8                           |
| 17       | SDRAM device attributes: number of<br>banks on SDRAM device                                  | 0    | 0    | 0    | 0    | 0    | 1    | 0    | 0    | 04H       | 4                                    |
| 18       | SDRAM device attributes:<br>/CAS latency   | 0    | 0    | 0    | 0    | 0    | 1    | 1    | 0    | 06H       | 2, 3                                 |
| 19       | SDRAM device attributes:<br>/CS latency  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 1    | 01H       | 0                                    |
| 20       | SDRAM device attributes:<br>/WE latency  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 1    | 01H       | 0                                    |
| 21       | SDRAM device attributes  | 0    | 0    | 0    | 1    | 1    | 1    | 1    | 0    | 1FH       | Registered                           |
| 22       | SDRAM device attributes: General   | 0    | 0    | 0    | 0    | 1    | 1    | 1    | 0    | 0EH       | VDD ± 10%                            |
| 23       | SDRAM cycle time<br>(2nd highest /CAS latency)<br>(-7A) 7.5ns                                | 0    | 1    | 1    | 1    | 0    | 1    | 0    | 1    | 75H       | CL = 2*5                             |
|          | (-75) 10ns   | 1    | 0    | 1    | 0    | 0    | 0    | 0    | 0    | A0H       |                                      |
| 24       | SDRAM access from Clock<br>(2nd highest /CAS latency)<br>(-7A) 5.4ns                         | 0    | 1    | 0    | 1    | 0    | 1    | 0    | 0    | 54H       |                                      |
|          | (-75) 6ns  | 0    | 1    | 1    | 0    | 0    | 0    | 0    | 0    | 60H       |                                      |
| 25       | SDRAM cycle time<br>(3rd highest /CAS latency)<br>Undefined                                  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 00H       |                                      |

| Byte No. | Function described   | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 | Hex value | Comments                         |
|----------|--|------|------|------|------|------|------|------|------|-----------|----------------------------------|
| 26       | SDRAM access from Clock<br>(3rd highest /CAS latency)<br>Undefined | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 00H       |                                  |
| 27       | Minimum row precharge time<br>(-7A)                                | 0    | 0    | 0    | 0    | 1    | 1    | 1    | 1    | 0FH       | 15ns                             |
|          | (-75)  | 0    | 0    | 0    | 1    | 0    | 1    | 0    | 0    | 14H       | 20ns                             |
| 28       | Row active to row active min                                       | 0    | 0    | 0    | 0    | 1    | 1    | 1    | 1    | 0FH       | 15ns                             |
| 29       | /RAS to /CAS delay min<br>(-7A)                                    | 0    | 0    | 0    | 0    | 1    | 1    | 1    | 1    | 0FH       | 15ns                             |
|          | (-75)  | 0    | 0    | 0    | 1    | 0    | 1    | 0    | 0    | 14H       | 20ns                             |
| 30       | Minimum /RAS pulse width   | 0    | 0    | 1    | 0    | 1    | 1    | 0    | 1    | 2DH       | 45ns                             |
| 31       | Density of each bank on module                                     | 1    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 80H       | 2 bank<br>512M byte              |
| 32       | Address and command signal input<br>setup time                     | 0    | 0    | 0    | 1    | 0    | 1    | 0    | 1    | 15H       | 1.5ns* <sup>5</sup>              |
| 33       | Address and command signal input<br>hold time                      | 0    | 0    | 0    | 0    | 1    | 0    | 0    | 0    | 08H       | 0.8ns* <sup>5</sup>              |
| 34       | Data signal input setup time                                       | 0    | 0    | 0    | 1    | 0    | 1    | 0    | 1    | 15H       | 1.5ns* <sup>5</sup>              |
| 35       | Data signal input hold time  | 0    | 0    | 0    | 0    | 1    | 0    | 0    | 0    | 08H       | 0.8ns* <sup>5</sup>              |
| 36 to 40 | Superset information   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 00H       | Future use                       |
| 41       | Minimum bank cycle time<br>(-7A)                                   | 0    | 0    | 1    | 1    | 1    | 1    | 0    | 0    | 3CH       | 60ns                             |
|          | (-75)  | 0    | 1    | 0    | 0    | 0    | 0    | 1    | 1    | 43H       | 67.5ns                           |
| 42 to 61 | Superset information   | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 00H       | Future use                       |
| 62       | SPD data revision code   | 0    | 0    | 0    | 1    | 0    | 0    | 1    | 0    | 12H       | Rev. 1.2                         |
| 63       | Checksum for bytes 0 to 62<br>(-7A)                                | 1    | 0    | 1    | 1    | 1    | 0    | 0    | 0    | B8H       | 184                              |
|          | (-75)  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 00H       | 00                               |
| 64 to 65 | Manufacturer's JEDEC ID code                                       | 0    | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 7FH       | Continuation code                |
| 66       | Manufacturer's JEDEC ID code                                       | 1    | 1    | 1    | 1    | 1    | 1    | 1    | 0    | FEH       | Elpida Memory                    |
| 67 to 71 | Manufacturer's JEDEC ID code                                       | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 00H       |                                  |
| 72       | Manufacturing location   | ×    | ×    | ×    | ×    | ×    | ×    | ×    | ×    | ×         | * <sup>2</sup> (ASCII-8bit code) |
| 73       | Manufacturer's part number   | 0    | 1    | 0    | 0    | 0    | 1    | 0    | 1    | 45H       | E                                |
| 74       | Manufacturer's part number   | 0    | 1    | 0    | 0    | 0    | 0    | 1    | 0    | 42H       | B                                |
| 75       | Manufacturer's part number   | 0    | 1    | 0    | 1    | 0    | 0    | 1    | 1    | 53H       | S                                |
| 76       | Manufacturer's part number   | 0    | 0    | 1    | 1    | 0    | 0    | 0    | 1    | 31H       | 1                                |
| 77       | Manufacturer's part number   | 0    | 0    | 1    | 1    | 0    | 0    | 0    | 1    | 31H       | 1                                |
| 78       | Manufacturer's part number   | 0    | 1    | 0    | 1    | 0    | 0    | 1    | 0    | 52H       | R                                |
| 79       | Manufacturer's part number   | 0    | 1    | 0    | 0    | 0    | 0    | 1    | 1    | 43H       | C                                |
| 80       | Manufacturer's part  | 0    | 0    | 1    | 1    | 0    | 1    | 0    | 0    | 34H       | 4                                |
| 81       | Manufacturer's part number   | 0    | 1    | 0    | 0    | 0    | 0    | 0    | 1    | 41H       | A                                |
| 82       | Manufacturer's part number   | 0    | 1    | 0    | 0    | 0    | 0    | 1    | 1    | 43H       | C                                |
| 83       | Manufacturer's part number   | 0    | 1    | 0    | 0    | 1    | 1    | 1    | 0    | 4EH       | N                                |
| 84       | Manufacturer's part number   | 0    | 1    | 0    | 0    | 0    | 0    | 0    | 1    | 41H       | A                                |
| 85       | Manufacturer's part number   | 0    | 0    | 1    | 0    | 1    | 1    | 0    | 1    | 2DH       | —                                |
| 86       | Manufacturer's part number   | 0    | 0    | 1    | 1    | 0    | 1    | 1    | 1    | 37H       | 7                                |

| Byte No.  | Function described                                   | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 | Hex value | Comments        |
|-----------|--|------|------|------|------|------|------|------|------|-----------|-----------------|
| 87        | Manufacturer's part number (-7A)                     | 0    | 1    | 0    | 0    | 0    | 0    | 0    | 1    | 41H       | A               |
|           | (-75)  | 0    | 0    | 1    | 1    | 0    | 1    | 0    | 1    | 35H       | 5               |
| 88        | Manufacturer's part number                           | 0    | 0    | 1    | 0    | 0    | 0    | 0    | 0    | 20H       | (Space)         |
| 89        | Manufacturer's part number                           | 0    | 0    | 1    | 0    | 0    | 0    | 0    | 0    | 20H       | (Space)         |
| 90        | Manufacturer's part number                           | 0    | 0    | 1    | 0    | 0    | 0    | 0    | 0    | 20H       | (Space)         |
| 91        | Revision code  | 0    | 0    | 1    | 1    | 0    | 0    | 0    | 0    | 30H       | Initial         |
| 92        | Revision code  | 0    | 0    | 1    | 0    | 0    | 0    | 0    | 0    | 20H       | (Space)         |
| 93        | Manufacturing date                                   | ×    | ×    | ×    | ×    | ×    | ×    | ×    | ×    | ×         | Year code (BCD) |
| 94        | Manufacturing date                                   | ×    | ×    | ×    | ×    | ×    | ×    | ×    | ×    | ×         | Week code (BCD) |
| 95 to 98  | Assembly serial number                               | *3   |      |      |      |      |      |      |      |           |                 |
| 99 to 125 | Manufacturer specific data                           | —    |      |      |      |      |      |      |      |           | *4              |
| 126       | Reserved (Intel specification frequency)             | 0    | 1    | 1    | 0    | 0    | 1    | 0    | 0    | 64H       |                 |
| 127       | Reserved (Intel specification /CAS# latency support) | 1    | 0    | 0    | 0    | 0    | 1    | 1    | 1    | 87H       |                 |

- Notes: 1. All serial PD data are not protected. 0: Serial data, "Low", 1: Serial data, "High".  
 2. Byte72 is manufacturing location code. (ex: In case of Japan, byte72 is 4AH. 4AH shows "J" on ASCII code.)  
 3. Bytes 95 through 98 are assembly serial number.  
 4. All bits of 99 through 125 are not defined ("1" or "0").  
 5. These specifications are defined based on component specification, not module.



## Electrical Specifications

- All voltages are referenced to VSS (GND).

### Absolute Maximum Ratings

| Parameter                          | Symbol | Value                                    | Unit | Note |
|------------------------------------|--------|--|------|------|
| Voltage on any pin relative to VSS | VT     | -0.5 to VDD + 0.5<br>( $\leq 4.6$ (Max)) | V    |      |
| Supply voltage relative to VSS     | VDD    | -0.5 to +4.6                             | V    |      |
| Short circuit output current       | IOS    | 50                                       | mA   |      |
| Power dissipation                  | PD     | 36.0                                     | W    |      |
| Operating temperature              | TA     | 0 to +70                                 | °C   | 1    |
| Storage temperature                | Tstg   | -55 to +125                              | °C   |      |

Notes: 1. SDRAM device specification

**Caution** Exposing the device to stress above those listed in Absolute Maximum Ratings could cause permanent damage. The device is not meant to be operated under conditions outside the limits described in the operational section of this specification. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

### DC Operating Conditions (TA = 0 to +70°C) (SDRAM device specification)

| Parameter           | Symbol | min. | max.      | Unit | Note |
|---------------------|--------|------|-----------|------|------|
| Supply voltage      | VDD    | 3.0  | 3.6       | V    | 1    |
|                     | VSS    | 0    | 0         | V    | 2    |
| Input high voltage  | VIH    | 2.0  | VDD + 0.3 | V    | 3    |
| Input low voltage   | VIL    | -0.3 | 0.8       | V    | 4    |
| Ambient illuminance | —      | —    | 100       | lx   |      |

Notes: 1. The supply voltage with all VDD pins must be on the same level.

2. The supply voltage with all VSS pins must be on the same level.

3. VIH (max.) = VDD + 2.0V for pulse width  $\leq 3$ ns at VDD.

4. VIL (min.) = VSS - 2.0V for pulse width  $\leq 3$ ns at VSS.

### DC Characteristics 1 (TA = 0 to 70°C, VDD = 3.3V $\pm$ 0.3V, VSS = 0V)

| Parameter                                | Symbol | Grade | min. | max. | Unit | Test condition                           | Notes   |
|--|--------|-------|------|------|------|--|---------|
| Operating current                        | ICC1   | -7A   | —    | 3575 | mA   | Burst length = 1<br>tRC = tRC (min.)     | 1, 2, 3 |
|  | ICC1   | -75   | —    | 3215 | mA   |  |         |
| Standby current in power down            | ICC2P  | —     | —    | 803  | mA   | CKE = VIL, tCK = 12ns                    | 6       |
| Standby current in non power down        | ICC2N  | —     | —    | 1415 | mA   | CKE, /CS = VIH,<br>tCK = 12ns            | 4       |
| Active standby current in power down     | ICC3P  | —     | —    | 839  | mA   | CKE = VIL, tCK = 12ns                    | 1, 2, 6 |
| Active standby current in non power down | ICC3N  | —     | —    | 1775 | mA   | CKE, /CS = VIH,<br>tCK = 12ns            | 1, 2, 4 |
| Burst operating current                  | ICC4   | —     | —    | 3575 | mA   | tCK = tCK (min.), BL = 4                 | 1, 2, 5 |
| Refresh current                          | ICC5   | -7A   | —    | 5735 | mA   | tRC = tRC (min.)                         | 3       |
|  | ICC5   | -75   | —    | 5195 | mA   |  |         |
| Self refresh current                     | ICC6   | —     | —    | 803  | mA   | VIH $\geq$ VDD - 0.2V<br>VIL $\leq$ 0.2V | 7       |



- Notes: 1. ICC depends on output load condition when the device is selected. ICC (max.) is specified at the output open condition.  
 2. One bank operation.  
 3. Input signals are changed once per one clock.  
 4. Input signals are changed once per two clocks.  
 5. Input signals are changed once per four clocks.  
 6. After power down mode, CLK operating current.  
 7. After self refresh mode set, self refresh current.

**DC Characteristics<sup>2</sup> (TA = 0 to 70°C, VDD = 3.3V ± 0.3V, VSS = 0V)**

| Parameter              | Symbol | min. | max. | Unit | Test condition                 | Notes |
|------------------------|--------|------|------|------|--------------------------------|-------|
| Input leakage current  | ILI    | -10  | 10   | μA   | 0 ≤ VIN ≤ VDD                  |       |
| Output leakage current | ILO    | -10  | 10   | μA   | 0 ≤ VOUT ≤ VDD<br>DQ = disable |       |
| Output high voltage    | VOH    | 2.4  | —    | V    | IOH = -4mA                     |       |
| Output low voltage     | VOL    | —    | 0.4  | V    | IOL = 4mA                      |       |

**Pin Capacitance (TA = 25°C, VDD = 3.3V ± 0.3V)**

| Parameter                     | Symbol | Pins            | max. | Unit | Notes      |
|-------------------------------|--------|-----------------|------|------|------------|
| Input capacitance             | CI1    | Address         | 25   | pF   | 1, 2, 4    |
|                               | CI2    | /RAS, /CAS, /WE | 25   | pF   | 1, 2, 4    |
|                               | CI3    | CKE             | 25   | pF   | 1, 2, 4    |
|                               | CI4    | /CS             | 20   | pF   | 1, 2, 4    |
|                               | CI5    | CLK             | 45   | pF   | 1, 2, 4    |
|                               | CI6    | DQMB            | 20   | pF   | 1, 2, 4    |
| Data input/output capacitance | CI/O1  | DQ, CB          | 25   | pF   | 1, 2, 3, 4 |

- Notes: 1. Capacitance measured with Boonton Meter or effective capacitance measuring method.  
 2. Measurement condition: f = 1MHz, 1.4V bias, 200mV swing.  
 3. DQMB = VIH to disable Data-out.  
 4. This parameter is sampled and not 100% tested.

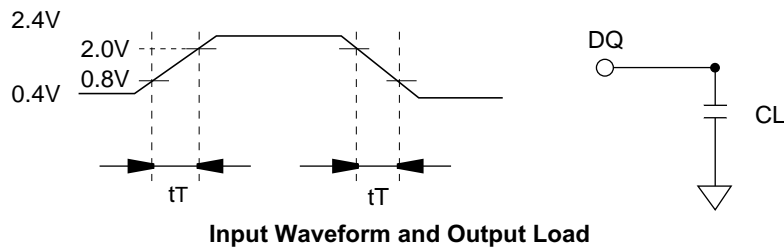
**AC Characteristics (TA = 0 to 70°C, VDD = 3.3V ± 0.3V, VSS = 0V) (SDRAM device specification)**

| Parameter  | Symbol | -7A         | -75         | max.   | Unit | Notes   |
|--|--------|-------------|-------------|--------|------|---------|
|  |        | min.        | min.        |        |      |         |
| System clock cycle time                          | tCK    | 7.5         | 7.5         | —      | ns   | 1       |
| CLK high pulse width                             | tCH    | 2.5         | 2.5         | —      | ns   | 1       |
| CLK low pulse width                              | tCL    | 2.5         | 2.5         | —      | ns   | 1       |
| Access time from CLK                             | tAC    | —           | —           | 5.4    | ns   | 1, 2    |
| Data-out hold time                               | tOH    | 2.7         | 2.7         | —      | ns   | 1, 2    |
| CLK to Data-out low impedance                    | tLZ    | 1           | 1           | —      | ns   | 1, 2, 3 |
| CLK to Data-out high impedance                   | tHZ    | —           | —           | 5.4    | ns   | 1, 4    |
| Input setup time                                 | tSI    | 1.5         | 1.5         | —      | ns   | 1       |
| Input hold time                                  | tHI    | 0.8         | 0.8         | —      | ns   | 1       |
| Ref/Active to Ref/Active command period          | tRC    | 60          | 67.5        | —      | ns   | 1       |
| Active to Precharge command period               | tRAS   | 45          | 45          | 120000 | ns   | 1       |
| Active command to column command (same bank)     | tRCD   | 15          | 20          | —      | ns   | 1       |
| Precharge to active command period               | tRP    | 15          | 20          | —      | ns   | 1       |
| Write recovery or data-in to precharge lead time | tDPL   | 15          | 15          | —      | ns   | 1       |
| Last data into active latency                    | tDAL   | 2CLK + 15ns | 2CLK + 20ns | —      |      |         |
| Active (a) to Active (b) command period          | tRRD   | 15          | 15          | —      | ns   | 1       |
| Transition time (rise and fall)                  | tT     | 0.5         | 0.5         | 5      | ns   |         |
| Refresh period (8192 refresh cycles)             | tREF   | —           | —           | 64     | ms   |         |

- Notes: 1. AC measurement assumes tT = 0.5ns. Reference level for timing of input signals is 1.4V.  
 2. Access time is measured at 1.4V. Load condition is CL = 50pF.  
 3. tLZ (min.) defines the time at which the outputs achieves the low impedance state.  
 4. tHZ (max.) defines the time at which the outputs achieves the high impedance state.

**Test Conditions**

- Input and output timing reference levels: 1.4V
- Input waveform and output load: See following figures



## Relationship Between Frequency and Minimum Latency (SDRAM device specification)

| Parameter   |        | -7A    |        | -75    |        |                |
|---|--------|--------|--------|--------|--------|----------------|
| Frequency (MHz)   |        | 133    | 133    | 133    | 100    |                |
| tCK (ns)  |        | 7.5    | 7.5    | 7.5    | 10     |                |
| /CAS latency  | Symbol | CL = 3 | CL = 2 | CL = 3 | CL = 2 | Notes          |
| Active command to column command (same bank)                | IRCD   | 2      | 2      | 3      | 2      | 1              |
| Active command to active command (same bank)                | IRC    | 8      | 8      | 9      | 7      | 1              |
| Active command to precharge command (same bank)             | IRAS   | 6      | 6      | 6      | 5      | 1              |
| Precharge command to active command (same bank)             | IRP    | 2      | 2      | 3      | 2      | 1              |
| Write recovery or data-in to precharge command (same bank)  | IDPL   | 2      | 2      | 2      | 2      | 1              |
| Active command to active command (different bank)           | IRRD   | 2      | 2      | 2      | 2      | 1              |
| Self refresh exit time                                      | ISREX  | 1      | 1      | 1      | 1      | 2              |
| Last data in to active command (Auto precharge, same bank)  | IDAL   | 4      | 4      | 5      | 4      | = [IDPL + IRP] |
| Self refresh exit to command input                          | ISEC   | 8      | 8      | 9      | 7      | = [IRC]<br>3   |
| Precharge command to high impedance                         | IHZP   | 3      | 2      | 3      | 2      |                |
| Last data out to active command (Auto precharge, same bank) | IAPR   | 1      | 1      | 1      | 1      |                |
| Last data out to precharge (early precharge)                | IEP    | -2     | -1     | -2     | -1     |                |
| Column command to column command                            | ICCD   | 1      | 1      | 1      | 1      |                |
| Write command to data in latency                            | IWCD   | 0      | 0      | 0      | 0      |                |
| DQM to data in  | IDID   | 0      | 0      | 0      | 0      |                |
| DQM to data out   | IDOD   | 2      | 2      | 2      | 2      |                |
| CKE to CLK disable  | ICLE   | 1      | 1      | 1      | 1      |                |
| Register set to active command                              | IMRD   | 1      | 1      | 1      | 1      |                |
| /CS to command disable                                      | ICDD   | 0      | 0      | 0      | 0      |                |
| Power down exit to command input                            | IPEC   | 1      | 1      | 1      | 1      |                |

Notes: 1. IRCD to IRRD are recommended value.

2. Be valid [DESL] or [NOP] at next command of self refresh exit.
3. Except [DESL] and [NOP]

## Pin Functions

**CLK0 to CLK3 (input pin):** CLK is the master clock input to this pin. The other input signals are referred at CLK rising edge.

**/CS0 to /CS3 (input pin):** When /CS is Low, the command input cycle becomes valid. When /CS is High, all inputs are ignored. However, internal operations (bank active, burst operations, etc.) are held.

**/RAS, /CAS and /WE (input pins):** Although these pin names are the same as those of conventional DRAMs, they function in a different way. These pins define operation commands (read, write, etc.) depending on the combination of their voltage levels. For details, refer to the command operation section.

**A0 to A12 (input pins):** Row address (AX0 to AX12) is determined by A0 to A12 level at the bank active command cycle CLK rising edge. Column address (AY0 to AY9, AY11) is determined by A0 to A9, A11 level at the read or write command cycle CLK rising edge. And this column address becomes burst access start address. A10 defines the precharge mode. When A10 = High at the precharge command cycle, all banks are precharged. But when A10 = Low at the precharge command cycle, only the bank that is selected by BA0, BA1 (BA) is precharged.

### BA0 and BA1 (input pin)

BA0 and BA1 are bank select signal (BA). (See Bank Select Signal Table)

#### [Bank Select Signal Table]

|        | BA0 | BA1 |
|--------|-----|-----|
| Bank 0 | L   | L   |
| Bank 1 | H   | L   |
| Bank 2 | L   | H   |
| Bank 3 | H   | H   |

Remark: H: VIH. L: VIL.

**CKE0 (input pin):** This pin determines whether or not the next CLK is valid. If CKE is High, the next CLK rising edge is valid. If CKE is Low, the next CLK rising edge is invalid. This pin is used for power-down and clock suspend modes.

**DQMB0 to DQMB7 (input pins):** Read operation: If DQMB is High, the output buffer becomes High-Z. If the DQMB is Low, the output buffer becomes Low-Z.

Write operation: If DQMB is High, the previous data is held (the new data is not written). If DQMB is Low, the data is written.

**DQ0 to DQ63, CB0 to CB7 (input/output pins):** Data is input to and output from these pins.

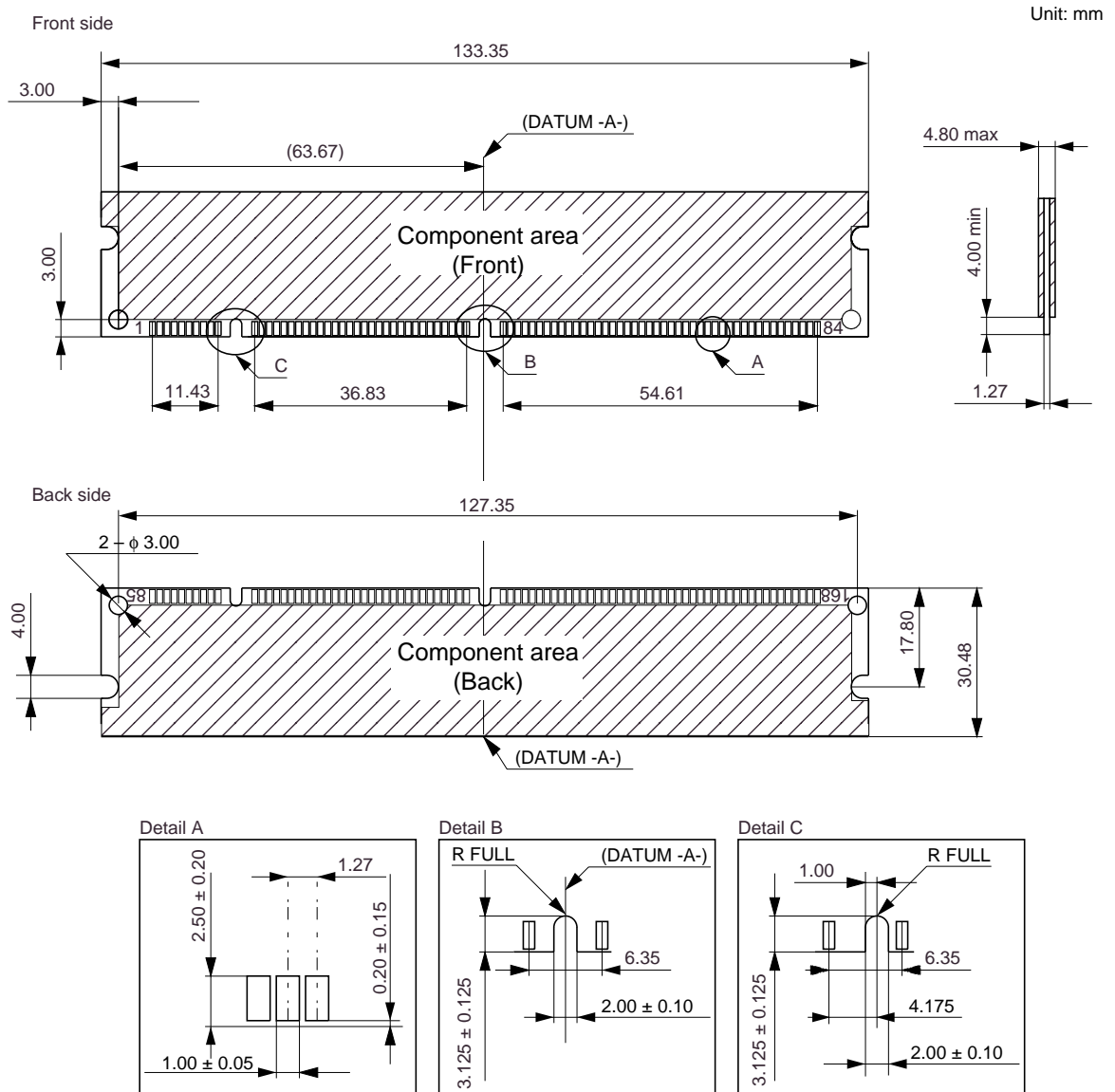
**VDD (power supply pins):** 3.3V is applied.

**VSS (power supply pins):** Ground is connected.

## Detailed Operation Part

Refer to the EDS2504ACTA/08ACTA/16ACTA datasheet (E0277E).

Physical Outline



Note: Tolerance on all dimensions ± 0.15 unless otherwise specified.

ECA-TS2-0026-01

**CAUTION FOR HANDLING MEMORY MODULES**

When handling or inserting memory modules, be sure not to touch any components on the modules, such as the memory ICs, chip capacitors and chip resistors. It is necessary to avoid undue mechanical stress on these components to prevent damaging them.

In particular, do not push module cover or drop the modules in order to protect from mechanical defects, which would be electrical defects.

When re-packing memory modules, be sure the modules are not touching each other.

Modules in contact with other modules may cause excessive mechanical stress, which may damage the modules.

MDE0202

**NOTES FOR CMOS DEVICES****① PRECAUTION AGAINST ESD FOR MOS DEVICES**

Exposing the MOS devices to a strong electric field can cause destruction of the gate oxide and ultimately degrade the MOS devices operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it, when once it has occurred. Environmental control must be adequate. When it is dry, humidifier should be used. It is recommended to avoid using insulators that easily build static electricity. MOS devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work bench and floor should be grounded. The operator should be grounded using wrist strap. MOS devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with semiconductor MOS devices on it.

**② HANDLING OF UNUSED INPUT PINS FOR CMOS DEVICES**

No connection for CMOS devices input pins can be a cause of malfunction. If no connection is provided to the input pins, it is possible that an internal input level may be generated due to noise, etc., hence causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using a pull-up or pull-down circuitry. Each unused pin should be connected to  $V_{DD}$  or GND with a resistor, if it is considered to have a possibility of being an output pin. The unused pins must be handled in accordance with the related specifications.

**③ STATUS BEFORE INITIALIZATION OF MOS DEVICES**

Power-on does not necessarily define initial status of MOS devices. Production process of MOS does not define the initial operation status of the device. Immediately after the power source is turned ON, the MOS devices with reset function have not yet been initialized. Hence, power-on does not guarantee output pin levels, I/O settings or contents of registers. MOS devices are not initialized until the reset signal is received. Reset operation must be executed immediately after power-on for MOS devices having reset function.

CME0107

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