

# MOS INTEGRATED CIRCUIT

# $\mu$ PD29F032203AL-Y

## 32M-BIT CMOS LOW-VOLTAGE DUAL OPERATION FLASH MEMORY

## 4M-WORD BY 8-BIT (BYTE MODE) / 2M-WORD BY 16-BIT (WORD MODE)

### Description

The  $\mu$ PD29F032203AL-Y is a flash memory organized of 33,554,432 bits and 71 sectors. Sectors of this memory can be erased at a low voltage (2.7 to 3.3 V, 3.0 to 3.6 V) supplied from a single power source, or the contents of the entire chip can be erased. Two modes of memory organization, BYTE mode (4,194,304 words  $\times$  8 bits) and WORD mode (2,097,152 words  $\times$  16 bits), are selectable so that the memory can be programmed in byte or word units.

The  $\mu$ PD29F032203AL-Y can be read while its contents are being erased or programmed. The memory cell is divided into two banks. While sectors in one bank are being erased or programmed, data can be read from the other bank thanks to the simultaneous execution architecture. The banks are 8M bits and 24M bits.

This flash memory comes in two types. The T type has a boot sector located at the highest address (sector) and the B type has a boot sector at the lowest address (sector).

Because the  $\mu$ PD29F032203AL-Y enables the boot sector to be erased, it is ideal for storing a boot program. In addition, program code that controls the flash memory can be also stored, and the program code can be programmed or erased without the need to load it into RAM. Eight small sectors for storing parameters are provided, each of which can be erased in 8K bytes units.

Once a program or erase command sequence has been executed, an automatic program or automatic erase function internally executes program or erase and verification automatically.

Because the  $\mu$ PD29F032203AL-Y can be electrically erased or programmed by writing an instruction, data can be reprogrammed on-board after the flash memory has been installed in a system, making it suitable for a wide range of applications.

This flash memory is packed in a 48-pin PLASTIC TSOP(I) and 63-pin TAPE FBGA.

### Features

- Two bank organization enabling simultaneous execution of program / erase and read
- Bank organization: 2 banks (8M bits + 24M bits)
- Memory organization : 4,194,304 words  $\times$  8 bits (BYTE mode)  
2,097,152 words  $\times$  16 bits (WORD mode)
- Sector organization : 71 sectors (8K bytes / 4K words  $\times$  8 sectors, 64K bytes / 32K words  $\times$  63 sectors)
- 2 types of sector organization
  - T type : Boot sector allocated to the highest address (sector)
  - B type : Boot sector allocated to the lowest address (sector)
- 3-state output
- Automatic program
  - Program suspend / resume

The information in this document is subject to change without notice. Before using this document, please confirm that this is the latest version.  
Not all devices/types available in every country. Please check with local NEC representative for availability and additional information.

- Unlock bypass program
- Automatic erase
  - Chip erase
  - Sector erase (sectors can be combined freely)
- Erase suspend / resume
- Program / Erase completion detection
  - Detection through data polling and toggle bits
  - Detection through RY (/BY) pin
- Sector group protection
  - Any sector group can be protected
  - Any protected sector group can be temporary unprotected
- Sectors can be used for boot application
- Hardware reset and standby using /RESET pin
- Automatic sleep mode
- Boot block sector protect by /WP (ACC) pin
- Conforms to common flash memory interface (CFI)
- Extra One Time Protect Sector provided

| Part number          | Access time<br>ns (MAX.) | Operating supply<br>voltage<br>V | Power supply current<br>(Active mode)<br>mA (MAX.) |                 | Standby current<br>μA (MAX.) |
|----------------------|--------------------------|----------------------------------|----------------------------------------------------|-----------------|------------------------------|
|                      |                          |                                  | Read                                               | Program / Erase |                              |
| μPD29F032203AL-AxxxY | 85                       | 3.0 to 3.6                       | 16                                                 | 30              | 5                            |
| μPD29F032203AL-BxxxY |                          | 2.7 to 3.3                       |                                                    |                 |                              |

- Operating ambient temperature: -40 to +85°C
- Program / erase time
  - Program: 9.0 μs / byte (TYP.)  
11.0 μs / word (TYP.)
  - Sector erase :  
Program / erase cycle : 100,000 cycle  
0.3 s (TYP.) (4K words sector), 0.5 s (TYP.) (32K words sector)  
Program / erase cycle : 300,000 cycle  
0.5 s (TYP.) (4K words sector), 0.7 s (TYP.) (32K words sector)
- Program / erase cycle : 300,000 cycles (MIN.)

# Ordering Information

| Part number                | Access time<br>ns (MAX.) | Operating<br>supply voltage<br>V | Boot sector                         | Package                                            | Remark    |
|----------------------------|--------------------------|----------------------------------|-------------------------------------|----------------------------------------------------|-----------|
| μPD29F032203ALGZ-A85TY-MJH | 85                       | 3.0 to 3.6                       | Top address (sector)<br>(T type)    | 48-pin PLASTIC TSOP (I)<br>(12 × 20) (Normal bent) | A version |
| μPD29F032203ALGZ-A85BY-MJH |                          |                                  | Bottom address (sector)<br>(B type) |                                                    |           |
| μPD29F032203ALF9-A85TY-BS2 |                          |                                  | Top address (sector)<br>(T type)    | 63-pin TAPE FBGA<br>(11 × 7)                       |           |
| μPD29F032203ALF9-A85BY-BS2 |                          |                                  | Bottom address (sector)<br>(B type) |                                                    |           |
| μPD29F032203ALGZ-B85TY-MJH |                          | 2.7 to 3.3                       | Top address (sector)<br>(T type)    | 48-pin PLASTIC TSOP (I)<br>(12 × 20) (Normal bent) | B version |
| μPD29F032203ALGZ-B85BY-MJH |                          |                                  | Bottom address (sector)<br>(B type) |                                                    |           |
| μPD29F032203ALF9-B85TY-BS2 |                          |                                  | Top address (sector)<br>(T type)    | 63-pin TAPE FBGA<br>(11 × 7)                       |           |
| μPD29F032203ALF9-B85BY-BS2 |                          |                                  | Bottom address (sector)<br>(B type) |                                                    |           |

**Remark** For address organization of sectors, see section **Sector Organization / Sector Address Table**.

## Pin Configurations (Marking Side)

/xxx indicates active low signal.

### 48-pin PLASTIC TSOP (I) (12 × 20) (Normal bent)

[ μPD29F032203ALGZ-AxxxY-MJH ]

[ μPD29F032203ALGZ-BxxxY-MJH ]



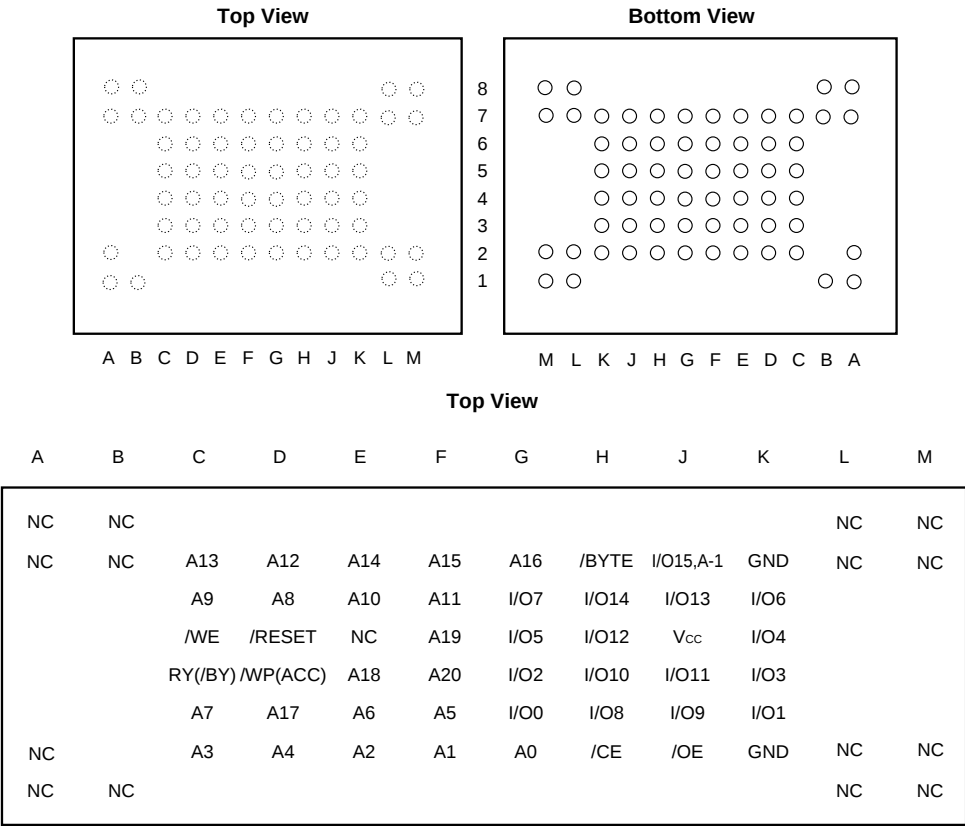
- A0 - A20 : Address inputs
- I/O0 - I/O14 : Data Inputs / Outputs
- I/O15, A-1 : Data 15 Input / output (WORD mode)  
LSB address input (BYTE mode)
- /CE : Chip Enable
- /WE : Write Enable
- /OE : Output Enable
- /BYTE : Mode select
- /RESET : Hardware reset input
- RY (/BY) : Ready (Busy) output
- /WP (ACC) : Write Protect (Accelerated) input
- Vcc : Supply Voltage
- GND : Ground
- NC <sup>Note</sup> : No Connection

**Note** Some signals can be applied because this pin is not connected to the inside of the chip.

**Remark** Refer to **Package Drawings** for the 1-pin index mark.

63-pin TAPE FBGA (11 × 7)

[ μPD29F032203ALF9-AxxxY-BS2]  
[ μPD29F032203ALF9-BxxxY-BS2]



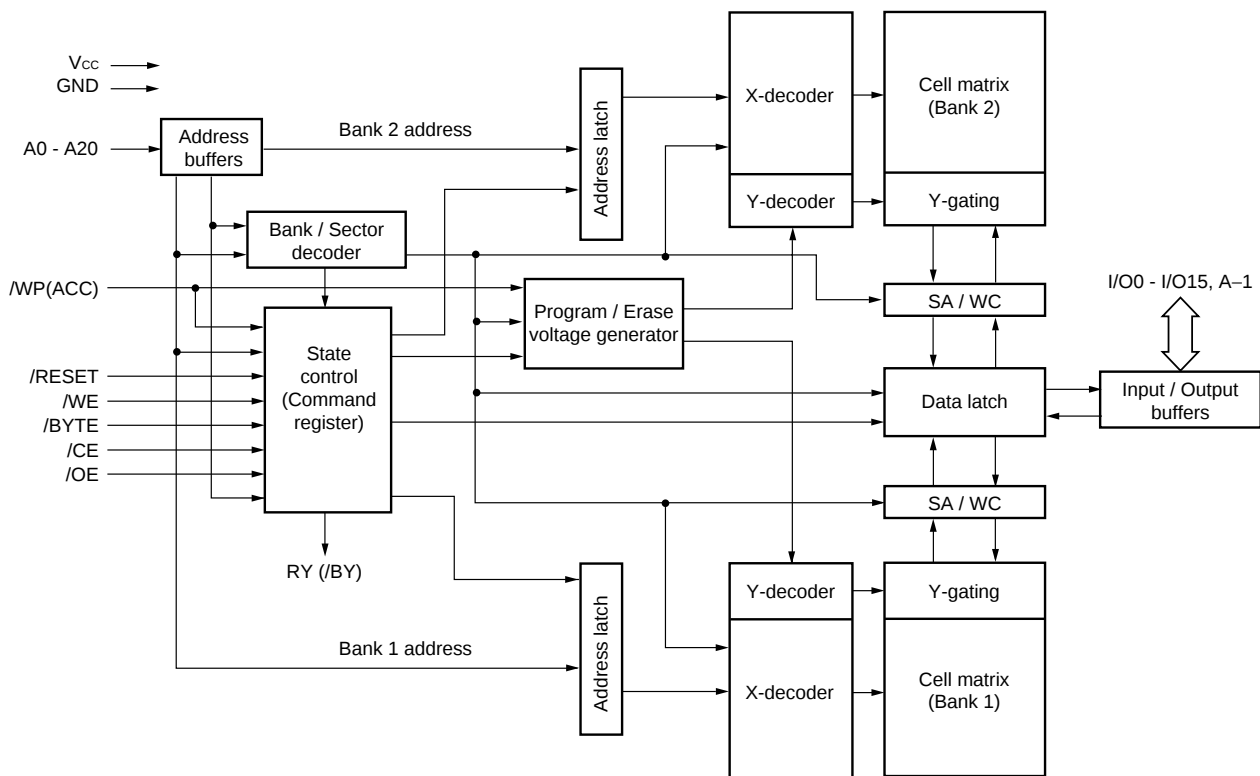
**Note** Some signals can be applied because this pin is not connected to the inside of the chip.

**Remark** Refer to **Package Drawings** for the index mark.

INPUT / OUTPUT PIN FUNCTION

Refer to **DUAL OPERATION FLASH MEMORY 32M BITS A SERIES Information (M14914E)**.

# Block Diagram



Sector Organization / Sector Address Table

[μPD29F032203AL-xxxTY]

(1/2)

| Bank   | Sector<br>Organization<br><br>K bytes / K words | Address             |                     | Sectors<br>Address | Sector Address Table |     |     |     |     |     |     |     |     |
|--------|-------------------------------------------------|---------------------|---------------------|--------------------|----------------------|-----|-----|-----|-----|-----|-----|-----|-----|
|        |                                                 | BYTE mode           | WORD mode           |                    | Bank Address Table   |     |     |     |     |     | A14 | A13 | A12 |
|        |                                                 |                     |                     |                    | A20                  | A19 | A18 | A17 | A16 | A15 |     |     |     |
| Bank 1 | 8/4                                             | 3FFFFFH<br>3FE000H  | 1FFFFFH<br>1FF000H  | FSA70              | 1                    | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   |
|        | 8/4                                             | 3DFFFFH<br>3FC000H  | 1FEFFFFH<br>1FE000H | FSA69              | 1                    | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 0   |
|        | 8/4                                             | 3BFFFFH<br>3FA000H  | 1FDFFFFH<br>1FD000H | FSA68              | 1                    | 1   | 1   | 1   | 1   | 1   | 1   | 0   | 1   |
|        | 8/4                                             | 3F9FFFFH<br>3F8000H | 1FCFFFFH<br>1FC000H | FSA67              | 1                    | 1   | 1   | 1   | 1   | 1   | 1   | 0   | 0   |
|        | 8/4                                             | 3F7FFFFH<br>3F6000H | 1FBFFFFH<br>1FB000H | FSA66              | 1                    | 1   | 1   | 1   | 1   | 1   | 0   | 1   | 1   |
|        | 8/4                                             | 3F5FFFFH<br>3F4000H | 1FAFFFFH<br>1FA000H | FSA65              | 1                    | 1   | 1   | 1   | 1   | 1   | 0   | 1   | 0   |
|        | 8/4                                             | 3F3FFFFH<br>3F2000H | 1F9FFFFH<br>1F9000H | FSA64              | 1                    | 1   | 1   | 1   | 1   | 1   | 0   | 0   | 1   |
|        | 8/4                                             | 3F1FFFFH<br>3F0000H | 1F8FFFFH<br>1F8000H | FSA63              | 1                    | 1   | 1   | 1   | 1   | 1   | 0   | 0   | 0   |
|        | 64/32                                           | 3EFFFFH<br>3E0000H  | 1F7FFFFH<br>1F0000H | FSA62              | 1                    | 1   | 1   | 1   | 1   | 0   | x   | x   | x   |
|        | 64/32                                           | 3DFFFFH<br>3D0000H  | 1EFFFFH<br>1E8000H  | FSA61              | 1                    | 1   | 1   | 1   | 0   | 1   | x   | x   | x   |
|        | 64/32                                           | 3CFFFFH<br>3C0000H  | 1E7FFFFH<br>1E0000H | FSA60              | 1                    | 1   | 1   | 1   | 0   | 0   | x   | x   | x   |
|        | 64/32                                           | 3BFFFFH<br>3B0000H  | 1DFFFFH<br>1D8000H  | FSA59              | 1                    | 1   | 1   | 0   | 1   | 1   | x   | x   | x   |
|        | 64/32                                           | 3AFFFFH<br>3A0000H  | 1D7FFFFH<br>1D0000H | FSA58              | 1                    | 1   | 1   | 0   | 1   | 0   | x   | x   | x   |
|        | 64/32                                           | 39FFFFH<br>390000H  | 1CFFFFH<br>1C8000H  | FSA57              | 1                    | 1   | 1   | 0   | 0   | 1   | x   | x   | x   |
|        | 64/32                                           | 38FFFFH<br>380000H  | 1C7FFFFH<br>1C0000H | FSA56              | 1                    | 1   | 1   | 0   | 0   | 0   | x   | x   | x   |
|        | 64/32                                           | 37FFFFH<br>370000H  | 1BFFFFH<br>1B8000H  | FSA55              | 1                    | 1   | 0   | 1   | 1   | 1   | x   | x   | x   |
|        | 64/32                                           | 36FFFFH<br>360000H  | 1B7FFFFH<br>1B0000H | FSA54              | 1                    | 1   | 0   | 1   | 1   | 0   | x   | x   | x   |
|        | 64/32                                           | 35FFFFH<br>350000H  | 1AFFFFH<br>1A8000H  | FSA53              | 1                    | 1   | 0   | 1   | 0   | 1   | x   | x   | x   |
|        | 64/32                                           | 34FFFFH<br>340000H  | 1A7FFFFH<br>1A0000H | FSA52              | 1                    | 1   | 0   | 1   | 0   | 0   | x   | x   | x   |
|        | 64/32                                           | 33FFFFH<br>330000H  | 19FFFFH<br>198000H  | FSA51              | 1                    | 1   | 0   | 0   | 1   | 1   | x   | x   | x   |
|        | 64/32                                           | 32FFFFH<br>320000H  | 197FFFFH<br>190000H | FSA50              | 1                    | 1   | 0   | 0   | 1   | 0   | x   | x   | x   |
|        | 64/32                                           | 31FFFFH<br>310000H  | 18FFFFH<br>188000H  | FSA49              | 1                    | 1   | 0   | 0   | 0   | 1   | x   | x   | x   |
|        | 64/32                                           | 30FFFFH<br>300000H  | 187FFFFH<br>180000H | FSA48              | 1                    | 1   | 0   | 0   | 0   | 0   | x   | x   | x   |
| Bank 2 | 64/32                                           | 2FFFFFH<br>2F0000H  | 17FFFFH<br>178000H  | FSA47              | 1                    | 0   | 1   | 1   | 1   | 1   | x   | x   | x   |
|        | 64/32                                           | 2EFFFFH<br>2E0000H  | 177FFFFH<br>170000H | FSA46              | 1                    | 0   | 1   | 1   | 1   | 0   | x   | x   | x   |
|        | 64/32                                           | 2DFFFFH<br>2D0000H  | 16FFFFH<br>168000H  | FSA45              | 1                    | 0   | 1   | 1   | 0   | 1   | x   | x   | x   |
|        | 64/32                                           | 2CFFFFH<br>2C0000H  | 167FFFFH<br>160000H | FSA44              | 1                    | 0   | 1   | 1   | 0   | 0   | x   | x   | x   |
|        | 64/32                                           | 2BFFFFH<br>2B0000H  | 15FFFFH<br>158000H  | FSA43              | 1                    | 0   | 1   | 0   | 1   | 1   | x   | x   | x   |
|        | 64/32                                           | 2AFFFFH<br>2A0000H  | 157FFFFH<br>150000H | FSA42              | 1                    | 0   | 1   | 0   | 1   | 0   | x   | x   | x   |
|        | 64/32                                           | 29FFFFH<br>290000H  | 14FFFFH<br>148000H  | FSA41              | 1                    | 0   | 1   | 0   | 0   | 1   | x   | x   | x   |
|        | 64/32                                           | 28FFFFH<br>280000H  | 147FFFFH<br>140000H | FSA40              | 1                    | 0   | 1   | 0   | 0   | 0   | x   | x   | x   |
|        | 64/32                                           | 27FFFFH<br>270000H  | 13FFFFH<br>138000H  | FSA39              | 1                    | 0   | 0   | 1   | 1   | 1   | x   | x   | x   |
|        | 64/32                                           | 26FFFFH<br>260000H  | 137FFFFH<br>130000H | FSA38              | 1                    | 0   | 0   | 1   | 1   | 0   | x   | x   | x   |
|        | 64/32                                           | 25FFFFH<br>250000H  | 12FFFFH<br>128000H  | FSA37              | 1                    | 0   | 0   | 1   | 0   | 1   | x   | x   | x   |
|        | 64/32                                           | 24FFFFH<br>240000H  | 127FFFFH<br>120000H | FSA36              | 1                    | 0   | 0   | 1   | 0   | 0   | x   | x   | x   |
|        | 64/32                                           | 23FFFFH<br>230000H  | 11FFFFH<br>118000H  | FSA35              | 1                    | 0   | 0   | 0   | 1   | 1   | x   | x   | x   |

[μPD29F032203AL-xxxTY]

(2/2)

| Bank   | Sector<br>Organization<br>K bytes / K words | Address             |                     | Sectors<br>Address | Sector Address Table |     |     |     |     |     |     |     |     |
|--------|---------------------------------------------|---------------------|---------------------|--------------------|----------------------|-----|-----|-----|-----|-----|-----|-----|-----|
|        |                                             | BYTE mode           | WORD mode           |                    | Bank Address Table   |     |     |     |     |     | A14 | A13 | A12 |
|        |                                             |                     |                     |                    | A20                  | A19 | A18 | A17 | A16 | A15 |     |     |     |
| Bank 2 | 64/32                                       | 22FFFFH<br>220000H  | 117FFFFH<br>110000H | FSA34              | 1                    | 0   | 0   | 0   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 21FFFFH<br>210000H  | 10FFFFFH<br>108000H | FSA33              | 1                    | 0   | 0   | 0   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 20FFFFFH<br>200000H | 107FFFFH<br>100000H | FSA32              | 1                    | 0   | 0   | 0   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 1FFFFFH<br>1F0000H  | 0FFFFFH<br>0F8000H  | FSA31              | 0                    | 1   | 1   | 1   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 1EFFFFFH<br>1E0000H | 0F7FFFFH<br>0F0000H | FSA30              | 0                    | 1   | 1   | 1   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 1DFFFFFH<br>1D0000H | 0EFFFFFH<br>0E8000H | FSA29              | 0                    | 1   | 1   | 1   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 1CFFFFFH<br>1C0000H | 0E7FFFFH<br>0E0000H | FSA28              | 0                    | 1   | 1   | 1   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 1BFFFFFH<br>1B0000H | 0DFFFFFH<br>0D8000H | FSA27              | 0                    | 1   | 1   | 0   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 1AFFFFFH<br>1A0000H | 0D7FFFFH<br>0D0000H | FSA26              | 0                    | 1   | 1   | 0   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 19FFFFFH<br>190000H | 0CFFFFFH<br>0C8000H | FSA25              | 0                    | 1   | 1   | 0   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 18FFFFFH<br>180000H | 0C7FFFFH<br>0C0000H | FSA24              | 0                    | 1   | 1   | 0   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 17FFFFFH<br>170000H | 0BFFFFFH<br>0B8000H | FSA23              | 0                    | 1   | 0   | 1   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 16FFFFFH<br>160000H | 0B7FFFFH<br>0B0000H | FSA22              | 0                    | 1   | 0   | 1   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 15FFFFFH<br>150000H | 0AFFFFFH<br>0A8000H | FSA21              | 0                    | 1   | 0   | 1   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 14FFFFFH<br>140000H | 0A7FFFFH<br>0A0000H | FSA20              | 0                    | 1   | 0   | 1   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 13FFFFFH<br>130000H | 09FFFFFH<br>098000H | FSA19              | 0                    | 1   | 0   | 0   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 12FFFFFH<br>120000H | 097FFFFH<br>090000H | FSA18              | 0                    | 1   | 0   | 0   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 11FFFFFH<br>110000H | 08FFFFFH<br>088000H | FSA17              | 0                    | 1   | 0   | 0   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 10FFFFFH<br>100000H | 087FFFFH<br>080000H | FSA16              | 0                    | 1   | 0   | 0   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 0FFFFFH<br>0F0000H  | 07FFFFFH<br>078000H | FSA15              | 0                    | 0   | 1   | 1   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 0EFFFFFH<br>0E0000H | 077FFFFH<br>070000H | FSA14              | 0                    | 0   | 1   | 1   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 0DFFFFFH<br>0D0000H | 06FFFFFH<br>068000H | FSA13              | 0                    | 0   | 1   | 1   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 0CFFFFFH<br>0C0000H | 067FFFFH<br>060000H | FSA12              | 0                    | 0   | 1   | 1   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 0BFFFFFH<br>0B0000H | 05FFFFFH<br>058000H | FSA11              | 0                    | 0   | 1   | 0   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 0AFFFFFH<br>0A0000H | 057FFFFH<br>050000H | FSA10              | 0                    | 0   | 1   | 0   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 09FFFFFH<br>090000H | 04FFFFFH<br>048000H | FSA9               | 0                    | 0   | 1   | 0   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 08FFFFFH<br>080000H | 047FFFFH<br>040000H | FSA8               | 0                    | 0   | 1   | 0   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 07FFFFFH<br>070000H | 03FFFFFH<br>038000H | FSA7               | 0                    | 0   | 0   | 1   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 06FFFFFH<br>060000H | 037FFFFH<br>030000H | FSA6               | 0                    | 0   | 0   | 1   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 05FFFFFH<br>050000H | 02FFFFFH<br>028000H | FSA5               | 0                    | 0   | 0   | 1   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 04FFFFFH<br>040000H | 027FFFFH<br>020000H | FSA4               | 0                    | 0   | 0   | 1   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 03FFFFFH<br>030000H | 01FFFFFH<br>018000H | FSA3               | 0                    | 0   | 0   | 0   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 02FFFFFH<br>020000H | 017FFFFH<br>010000H | FSA2               | 0                    | 0   | 0   | 0   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 01FFFFFH<br>010000H | 00FFFFFH<br>008000H | FSA1               | 0                    | 0   | 0   | 0   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 00FFFFFH<br>000000H | 007FFFFH<br>000000H | FSA0               | 0                    | 0   | 0   | 0   | 0   | 0   | x   | x   | x   |

[μPD29F032203AL-xxxBY]

(1/2)

| Bank   | Sector<br>Organization<br>K bytes / K words | Address             |                     | Sectors<br>Address | Sector Address Table |     |     |     |     |     |     |     |     |
|--------|---------------------------------------------|---------------------|---------------------|--------------------|----------------------|-----|-----|-----|-----|-----|-----|-----|-----|
|        |                                             | BYTE mode           | WORD mode           |                    | Bank Address Table   |     |     |     |     |     | A14 | A13 | A12 |
|        |                                             |                     |                     |                    | A20                  | A19 | A18 | A17 | A16 | A15 |     |     |     |
| Bank 2 | 64/32                                       | 3FFFFFFH<br>3F0000H | 1FFFFFFH<br>1F8000H | FSA70              | 1                    | 1   | 1   | 1   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 3EFFFFH<br>3E0000H  | 1F7FFFH<br>1F0000H  | FSA69              | 1                    | 1   | 1   | 1   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 3DFFFFH<br>3D0000H  | 1EFFFFH<br>1E8000H  | FSA68              | 1                    | 1   | 1   | 1   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 3CFFFFH<br>3C0000H  | 1E7FFFH<br>1E0000H  | FSA67              | 1                    | 1   | 1   | 1   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 3BFFFFH<br>3B0000H  | 1DFFFFH<br>1D8000H  | FSA66              | 1                    | 1   | 1   | 0   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 3AFFFFH<br>3A0000H  | 1D7FFFH<br>1D0000H  | FSA65              | 1                    | 1   | 1   | 0   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 39FFFFH<br>390000H  | 1CFFFFH<br>1C8000H  | FSA64              | 1                    | 1   | 1   | 0   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 38FFFFH<br>380000H  | 1C7FFFH<br>1C0000H  | FSA63              | 1                    | 1   | 1   | 0   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 37FFFFH<br>370000H  | 1BFFFFH<br>1B8000H  | FSA62              | 1                    | 1   | 0   | 1   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 36FFFFH<br>360000H  | 1B7FFFH<br>1B0000H  | FSA61              | 1                    | 1   | 0   | 1   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 35FFFFH<br>350000H  | 1AFFFFH<br>1A8000H  | FSA60              | 1                    | 1   | 0   | 1   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 34FFFFH<br>340000H  | 1A7FFFH<br>1A0000H  | FSA59              | 1                    | 1   | 0   | 1   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 33FFFFH<br>330000H  | 19FFFFH<br>198000H  | FSA58              | 1                    | 1   | 0   | 0   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 32FFFFH<br>320000H  | 197FFFH<br>190000H  | FSA57              | 1                    | 1   | 0   | 0   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 31FFFFH<br>310000H  | 18FFFFH<br>188000H  | FSA56              | 1                    | 1   | 0   | 0   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 30FFFFH<br>300000H  | 187FFFH<br>180000H  | FSA55              | 1                    | 1   | 0   | 0   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 2FFFFFH<br>2F0000H  | 17FFFFH<br>178000H  | FSA54              | 1                    | 0   | 1   | 1   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 2EFFFFH<br>2E0000H  | 177FFFH<br>170000H  | FSA53              | 1                    | 0   | 1   | 1   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 2DFFFFH<br>2D0000H  | 16FFFFH<br>168000H  | FSA52              | 1                    | 0   | 1   | 1   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 2CFFFFH<br>2C0000H  | 167FFFH<br>160000H  | FSA51              | 1                    | 0   | 1   | 1   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 2BFFFFH<br>2B0000H  | 15FFFFH<br>158000H  | FSA50              | 1                    | 0   | 1   | 0   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 2AFFFFH<br>2A0000H  | 157FFFH<br>150000H  | FSA49              | 1                    | 0   | 1   | 0   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 29FFFFH<br>290000H  | 14FFFFH<br>148000H  | FSA48              | 1                    | 0   | 1   | 0   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 28FFFFH<br>280000H  | 147FFFH<br>140000H  | FSA47              | 1                    | 0   | 1   | 0   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 27FFFFH<br>270000H  | 13FFFFH<br>138000H  | FSA46              | 1                    | 0   | 0   | 1   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 26FFFFH<br>260000H  | 137FFFH<br>130000H  | FSA45              | 1                    | 0   | 0   | 1   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 25FFFFH<br>250000H  | 12FFFFH<br>128000H  | FSA44              | 1                    | 0   | 0   | 1   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 24FFFFH<br>240000H  | 127FFFH<br>120000H  | FSA43              | 1                    | 0   | 0   | 1   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 23FFFFH<br>230000H  | 11FFFFH<br>118000H  | FSA42              | 1                    | 0   | 0   | 0   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 22FFFFH<br>220000H  | 117FFFH<br>110000H  | FSA41              | 1                    | 0   | 0   | 0   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 21FFFFH<br>210000H  | 10FFFFH<br>108000H  | FSA40              | 1                    | 0   | 0   | 0   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 20FFFFH<br>200000H  | 107FFFH<br>100000H  | FSA39              | 1                    | 0   | 0   | 0   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 1FFFFFH<br>1F0000H  | 0FFFFFH<br>0F8000H  | FSA38              | 0                    | 1   | 1   | 1   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 1EFFFFH<br>1E0000H  | 0F7FFFH<br>0F0000H  | FSA37              | 0                    | 1   | 1   | 1   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 1DFFFFH<br>1D0000H  | 0EFFFFH<br>0E8000H  | FSA36              | 0                    | 1   | 1   | 1   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 1CFFFFH<br>1C0000H  | 0E7FFFH<br>0E0000H  | FSA35              | 0                    | 1   | 1   | 1   | 0   | 0   | x   | x   | x   |

[μPD29F032203AL-xxxBY]

(2/2)

| Bank   | Sector<br>Organization<br>K bytes / K words | Address            |                    | Sectors<br>Address | Sector Address Table |     |     |     |     |     |     |     |     |
|--------|---------------------------------------------|--------------------|--------------------|--------------------|----------------------|-----|-----|-----|-----|-----|-----|-----|-----|
|        |                                             | BYTE mode          | WORD mode          |                    | Bank Address Table   |     |     |     |     |     | A14 | A13 | A12 |
|        |                                             |                    |                    |                    | A20                  | A19 | A18 | A17 | A16 | A15 |     |     |     |
| Bank 2 | 64/32                                       | 1BFFFFH<br>1B0000H | 0DFFFFH<br>0D8000H | FSA34              | 0                    | 1   | 1   | 0   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 1AFFFFH<br>1A0000H | 0D7FFFH<br>0D0000H | FSA33              | 0                    | 1   | 1   | 0   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 19FFFFH<br>190000H | 0CFFFFH<br>0C8000H | FSA32              | 0                    | 1   | 1   | 0   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 18FFFFH<br>180000H | 0C7FFFH<br>0C0000H | FSA31              | 0                    | 1   | 1   | 0   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 17FFFFH<br>170000H | 0BFFFFH<br>0B8000H | FSA30              | 0                    | 1   | 0   | 1   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 16FFFFH<br>160000H | 0B7FFFH<br>0B0000H | FSA29              | 0                    | 1   | 0   | 1   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 15FFFFH<br>150000H | 0AFFFFH<br>0A8000H | FSA28              | 0                    | 1   | 0   | 1   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 14FFFFH<br>140000H | 0A7FFFH<br>0A0000H | FSA27              | 0                    | 1   | 0   | 1   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 13FFFFH<br>130000H | 09FFFFH<br>098000H | FSA26              | 0                    | 1   | 0   | 0   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 12FFFFH<br>120000H | 097FFFH<br>090000H | FSA25              | 0                    | 1   | 0   | 0   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 11FFFFH<br>110000H | 08FFFFH<br>088000H | FSA24              | 0                    | 1   | 0   | 0   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 10FFFFH<br>100000H | 087FFFH<br>080000H | FSA23              | 0                    | 1   | 0   | 0   | 0   | 0   | x   | x   | x   |
| Bank 1 | 64/32                                       | 0FFFFFH<br>0F0000H | 07FFFFH<br>078000H | FSA22              | 0                    | 0   | 1   | 1   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 0EFFFFH<br>0E0000H | 077FFFH<br>070000H | FSA21              | 0                    | 0   | 1   | 1   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 0DFFFFH<br>0D0000H | 06FFFFH<br>068000H | FSA20              | 0                    | 0   | 1   | 1   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 0CFFFFH<br>0C0000H | 067FFFH<br>060000H | FSA19              | 0                    | 0   | 1   | 1   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 0BFFFFH<br>0B0000H | 05FFFFH<br>058000H | FSA18              | 0                    | 0   | 1   | 0   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 0AFFFFH<br>0A0000H | 057FFFH<br>050000H | FSA17              | 0                    | 0   | 1   | 0   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 09FFFFH<br>090000H | 04FFFFH<br>048000H | FSA16              | 0                    | 0   | 1   | 0   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 08FFFFH<br>080000H | 047FFFH<br>040000H | FSA15              | 0                    | 0   | 1   | 0   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 07FFFFH<br>070000H | 03FFFFH<br>038000H | FSA14              | 0                    | 0   | 0   | 1   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 06FFFFH<br>060000H | 037FFFH<br>030000H | FSA13              | 0                    | 0   | 0   | 1   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 05FFFFH<br>050000H | 02FFFFH<br>028000H | FSA12              | 0                    | 0   | 0   | 1   | 0   | 1   | x   | x   | x   |
|        | 64/32                                       | 04FFFFH<br>040000H | 027FFFH<br>020000H | FSA11              | 0                    | 0   | 0   | 1   | 0   | 0   | x   | x   | x   |
|        | 64/32                                       | 03FFFFH<br>030000H | 01FFFFH<br>018000H | FSA10              | 0                    | 0   | 0   | 0   | 1   | 1   | x   | x   | x   |
|        | 64/32                                       | 02FFFFH<br>020000H | 017FFFH<br>010000H | FSA9               | 0                    | 0   | 0   | 0   | 1   | 0   | x   | x   | x   |
|        | 64/32                                       | 01FFFFH<br>010000H | 00FFFFH<br>008000H | FSA8               | 0                    | 0   | 0   | 0   | 0   | 1   | x   | x   | x   |
|        | 8/4                                         | 00FFFFH<br>00E000H | 007FFFH<br>007000H | FSA7               | 0                    | 0   | 0   | 0   | 0   | 0   | 1   | 1   | 1   |
|        | 8/4                                         | 00DFFFH<br>00C000H | 006FFFH<br>006000H | FSA6               | 0                    | 0   | 0   | 0   | 0   | 0   | 1   | 1   | 0   |
|        | 8/4                                         | 00BFFFH<br>00A000H | 005FFFH<br>005000H | FSA5               | 0                    | 0   | 0   | 0   | 0   | 0   | 1   | 0   | 1   |
|        | 8/4                                         | 009FFFH<br>008000H | 004FFFH<br>004000H | FSA4               | 0                    | 0   | 0   | 0   | 0   | 0   | 1   | 0   | 0   |
|        | 8/4                                         | 007FFFH<br>006000H | 003FFFH<br>003000H | FSA3               | 0                    | 0   | 0   | 0   | 0   | 0   | 0   | 1   | 1   |
|        | 8/4                                         | 005FFFH<br>004000H | 002FFFH<br>002000H | FSA2               | 0                    | 0   | 0   | 0   | 0   | 0   | 0   | 1   | 0   |
|        | 8/4                                         | 003FFFH<br>002000H | 001FFFH<br>001000H | FSA1               | 0                    | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   |
|        | 8/4                                         | 001FFFH<br>000000H | 000FFFH<br>000000H | FSA0               | 0                    | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   |

# Sector Group Address Table

[μPD29F032203AL-xxxTY]

| Sector group | A20 | A19 | A18 | A17 | A16 | A15 | A14 | A13 | A12 | Size                   | Sector      |
|--------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------------------------|-------------|
| SGA0         | 0   | 0   | 0   | 0   | 0   | 0   | ×   | ×   | ×   | 64K Bytes (1 Sector)   | FSA0        |
| SGA1         | 0   | 0   | 0   | 0   | 0   | 1   | ×   | ×   | ×   | 192K Bytes (3 Sectors) | FSA1–FSA3   |
|              |     |     |     |     | 1   | 0   |     |     |     |                        |             |
|              |     |     |     |     | 1   | 1   |     |     |     |                        |             |
| SGA2         | 0   | 0   | 0   | 1   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA4–FSA7   |
| SGA3         | 0   | 0   | 1   | 0   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA8–FSA11  |
| SGA4         | 0   | 0   | 1   | 1   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA12–FSA15 |
| SGA5         | 0   | 1   | 0   | 0   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA16–FSA19 |
| SGA6         | 0   | 1   | 0   | 1   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA20–FSA23 |
| SGA7         | 0   | 1   | 1   | 0   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA24–FSA27 |
| SGA8         | 0   | 1   | 1   | 1   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA28–FSA31 |
| SGA9         | 1   | 0   | 0   | 0   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA32–FSA35 |
| SGA10        | 1   | 0   | 0   | 1   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA36–FSA39 |
| SGA11        | 1   | 0   | 1   | 0   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA40–FSA43 |
| SGA12        | 1   | 0   | 1   | 1   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA44–FSA47 |
| SGA13        | 1   | 1   | 0   | 0   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA48–FSA51 |
| SGA14        | 1   | 1   | 0   | 1   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA52–FSA55 |
| SGA15        | 1   | 1   | 1   | 0   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA56–FSA59 |
| SGA16        | 1   | 1   | 1   | 1   | 0   | 0   | ×   | ×   | ×   | 192K Bytes (3 Sectors) | FSA60–FSA62 |
|              |     |     |     |     | 0   | 1   |     |     |     |                        |             |
|              |     |     |     |     | 1   | 0   |     |     |     |                        |             |
| SGA17        | 1   | 1   | 1   | 1   | 1   | 1   | 0   | 0   | 0   | 8K Bytes (1 Sector)    | FSA63       |
| SGA18        | 1   | 1   | 1   | 1   | 1   | 1   | 0   | 0   | 1   | 8K Bytes (1 Sector)    | FSA64       |
| SGA19        | 1   | 1   | 1   | 1   | 1   | 1   | 0   | 1   | 0   | 8K Bytes (1 Sector)    | FSA65       |
| SGA20        | 1   | 1   | 1   | 1   | 1   | 1   | 0   | 1   | 1   | 8K Bytes (1 Sector)    | FSA66       |
| SGA21        | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 0   | 0   | 8K Bytes (1 Sector)    | FSA67       |
| SGA22        | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 0   | 1   | 8K Bytes (1 Sector)    | FSA68       |
| SGA23        | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 0   | 8K Bytes (1 Sector)    | FSA69       |
| SGA24        | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 8K Bytes (1 Sector)    | FSA70       |

**Remark** × : V<sub>IH</sub> or V<sub>IL</sub>

[μPD29F032203AL-xxxBY]

| Sector group | A20 | A19 | A18 | A17 | A16 | A15 | A14 | A13 | A12 | Size                   | Sector      |
|--------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------------------------|-------------|
| SGA0         | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 8K Bytes (1 Sector)    | FSA0        |
| SGA1         | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | 8K Bytes (1 Sector)    | FSA1        |
| SGA2         | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | 0   | 8K Bytes (1 Sector)    | FSA2        |
| SGA3         | 0   | 0   | 0   | 0   | 0   | 0   | 0   | 1   | 1   | 8K Bytes (1 Sector)    | FSA3        |
| SGA4         | 0   | 0   | 0   | 0   | 0   | 0   | 1   | 0   | 0   | 8K Bytes (1 Sector)    | FSA4        |
| SGA5         | 0   | 0   | 0   | 0   | 0   | 0   | 1   | 0   | 1   | 8K Bytes (1 Sector)    | FSA5        |
| SGA6         | 0   | 0   | 0   | 0   | 0   | 0   | 1   | 1   | 0   | 8K Bytes (1 Sector)    | FSA6        |
| SGA7         | 0   | 0   | 0   | 0   | 0   | 0   | 1   | 1   | 1   | 8K Bytes (1 Sector)    | FSA7        |
| SGA8         | 0   | 0   | 0   | 0   | 0   | 1   | ×   | ×   | ×   | 192K Bytes (3 Sectors) | FSA8–FSA10  |
|              |     |     |     |     | 1   | 0   |     |     |     |                        |             |
|              |     |     |     |     | 1   | 1   |     |     |     |                        |             |
| SGA9         | 0   | 0   | 0   | 1   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA11–FSA14 |
| SGA10        | 0   | 0   | 1   | 0   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA15–FSA18 |
| SGA11        | 0   | 0   | 1   | 1   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA19–FSA22 |
| SGA12        | 0   | 1   | 0   | 0   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA23–FSA26 |
| SGA13        | 0   | 1   | 0   | 1   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA27–FSA30 |
| SGA14        | 0   | 1   | 1   | 0   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA31–FSA34 |
| SGA15        | 0   | 1   | 1   | 1   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA35–FSA38 |
| SGA16        | 1   | 0   | 0   | 0   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA39–FSA42 |
| SGA17        | 1   | 0   | 0   | 1   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA43–FSA46 |
| SGA18        | 1   | 0   | 1   | 0   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA47–FSA50 |
| SGA19        | 1   | 0   | 1   | 1   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA51–FSA54 |
| SGA20        | 1   | 1   | 0   | 0   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA55–FSA58 |
| SGA21        | 1   | 1   | 0   | 1   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA59–FSA62 |
| SGA22        | 1   | 1   | 1   | 0   | ×   | ×   | ×   | ×   | ×   | 256K Bytes (4 Sectors) | FSA63–FSA66 |
| SGA23        | 1   | 1   | 1   | 1   | 0   | 0   | ×   | ×   | ×   | 192K Bytes (3 Sectors) | FSA67–FSA69 |
|              |     |     |     |     | 0   | 1   |     |     |     |                        |             |
|              |     |     |     |     | 1   | 0   |     |     |     |                        |             |
| SGA24        | 1   | 1   | 1   | 1   | 1   | 1   | ×   | ×   | ×   | 64K Bytes (1 Sector)   | FSA70       |

**Remark** × : V<sub>IH</sub> or V<sub>IL</sub>

**Product ID Code (Manufacturer Code / Device Code)**

| Product ID Code         |           |        | Input                |                 |                 |                 |                      | Output |       |       |       |       |       |      |      |      |      |      |      |      |      |      |       |                        |
|-------------------------|-----------|--------|----------------------|-----------------|-----------------|-----------------|----------------------|--------|-------|-------|-------|-------|-------|------|------|------|------|------|------|------|------|------|-------|------------------------|
|                         |           |        | A20 to A12           | A6              | A1              | A0              | A-1 <sup>Note1</sup> | I/O15  | I/O14 | I/O13 | I/O12 | I/O11 | I/O10 | I/O9 | I/O8 | I/O7 | I/O6 | I/O5 | I/O4 | I/O3 | I/O2 | I/O1 | I/O0  | HEX                    |
| Manufacturer Code       |           |        | ×                    | V <sub>IL</sub> | V <sub>IL</sub> | V <sub>IL</sub> | V <sub>IL</sub>      | 0      | 0     | 0     | 0     | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 1    | 0    | 0    | 0    | 0     | 0010H                  |
| Device code             | BYTE mode | -xxxTY | ×                    | V <sub>IL</sub> | V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IL</sub>      | Hi-Z   | Hi-Z  | Hi-Z  | Hi-Z  | Hi-Z  | Hi-Z  | Hi-Z | Hi-Z | 0    | 1    | 0    | 1    | 0    | 0    | 0    | 0     | 50H                    |
|                         |           | -xxxBY |                      |                 |                 |                 |                      | Hi-Z   | Hi-Z  | Hi-Z  | Hi-Z  | Hi-Z  | Hi-Z  | Hi-Z | 0    | 1    | 0    | 1    | 0    | 0    | 1    | 1    | 53H   |                        |
|                         | WORD mode | -xxxTY | ×                    | V <sub>IL</sub> | V <sub>IL</sub> | V <sub>IH</sub> | ×                    | 0      | 0     | 1     | 0     | 0     | 0     | 1    | 0    | 0    | 1    | 0    | 1    | 0    | 0    | 0    | 2250H |                        |
|                         |           | -xxxBY |                      |                 |                 |                 |                      | 0      | 0     | 1     | 0     | 0     | 0     | 1    | 0    | 0    | 1    | 0    | 1    | 0    | 0    | 1    | 1     | 2253H                  |
| Sector group protection |           |        | Sector group address | V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IL</sub> | V <sub>IL</sub>      | 0      | 0     | 0     | 0     | 0     | 0     | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 1     | 0001H <sup>Note2</sup> |

**Notes 1.** A-1 is valid only in the BYTE mode. I/O8 to I/O14 go into a high-impedance state in the BYTE mode, and I/O15 is A-1 of the lowest address.

2. If 0001H is output, the sector group is protected. If 0000H is output, the sector group is unprotected.

**Remark**  $x : V_{IH}$  or  $V_{IL}$

# Command Sequence

| Command sequence                                            |           | Bus Cycle | 1st bus Cycle |      | 2nd bus Cycle |                        | 3rd bus Cycle |      | 4th bus Cycle |      | 5th bus Cycle |      | 6th bus Cycle |      |
|-------------------------------------------------------------|-----------|-----------|---------------|------|---------------|------------------------|---------------|------|---------------|------|---------------|------|---------------|------|
|                                                             |           |           | Address       | Data | Address       | Data                   | Address       | Data | Address       | Data | Address       | Data | Address       | Data |
| Read / Reset <sup>Note 1</sup>                              |           | 1         | xxxH          | F0H  | RA            | RD                     | —             | —    | —             | —    | —             | —    | —             | —    |
| Read / Reset <sup>Note 1</sup>                              | BYTE mode | 3         | AAAH          | AAH  | 555H          | 55H                    | AAAH          | F0H  | RA            | RD   | —             | —    | —             | —    |
|                                                             | WORD mode |           | 555H          | —    | 2AAH          | —                      | 555H          | —    | —             | —    | —             | —    | —             | —    |
| Program                                                     | BYTE mode | 4         | AAAH          | AAH  | 555H          | 55H                    | AAAH          | A0H  | PA            | PD   | —             | —    | —             | —    |
|                                                             | WORD mode |           | 555H          | —    | 2AAH          | —                      | 555H          | —    | —             | —    | —             | —    | —             | —    |
| Program Suspend <sup>Note 2</sup>                           |           | 1         | BA            | B0H  | —             | —                      | —             | —    | —             | —    | —             | —    | —             | —    |
| Program Resume <sup>Note 3</sup>                            |           | 1         | BA            | 30H  | —             | —                      | —             | —    | —             | —    | —             | —    | —             | —    |
| Chip Erase                                                  | BYTE mode | 6         | AAAH          | AAH  | 555H          | 55H                    | AAAH          | 80H  | AAAH          | AAH  | 555H          | 55H  | AAAH          | 10H  |
|                                                             | WORD mode |           | 555H          | —    | 2AAH          | —                      | 555H          | —    | 555H          | —    | 2AAH          | —    | 555H          | —    |
| Sector Erase                                                | BYTE mode | 6         | AAAH          | AAH  | 555H          | 55H                    | AAAH          | 80H  | AAAH          | AAH  | 555H          | 55H  | FSA           | 30H  |
|                                                             | WORD mode |           | 555H          | —    | 2AAH          | —                      | 555H          | —    | 555H          | —    | 2AAH          | —    | —             | —    |
| Sector Erase Suspend <sup>Note 4</sup>                      |           | 1         | BA            | B0H  | —             | —                      | —             | —    | —             | —    | —             | —    | —             | —    |
| Sector Erase Resume <sup>Note 5</sup>                       |           | 1         | BA            | 30H  | —             | —                      | —             | —    | —             | —    | —             | —    | —             | —    |
| Unlock Bypass Set                                           | BYTE mode | 3         | AAAH          | AAH  | 555H          | 55H                    | AAAH          | 20H  | —             | —    | —             | —    | —             | —    |
|                                                             | WORD mode |           | 555H          | —    | 2AAH          | —                      | 555H          | —    | —             | —    | —             | —    | —             | —    |
| Unlock Bypass Program <sup>Note 6</sup>                     |           | 2         | xxxH          | A0H  | PA            | PD                     | —             | —    | —             | —    | —             | —    | —             | —    |
| Unlock Bypass Reset <sup>Note 6</sup>                       |           | 2         | BA            | 90H  | xxxH          | 00H <sup>Note 11</sup> | —             | —    | —             | —    | —             | —    | —             | —    |
| Product ID                                                  | BYTE mode | 3         | AAAH          | AAH  | 555H          | 55H                    | (BA)<br>AAAH  | 90H  | IA            | ID   | —             | —    | —             | —    |
|                                                             | WORD mode |           | 555H          | —    | 2AAH          | —                      | (BA)<br>555H  | —    | —             | —    | —             | —    | —             | —    |
| Sector Group Protection <sup>Note 7</sup>                   |           | 4         | xxxH          | 60H  | SPA           | 60H                    | SPA           | 40H  | SPA           | SD   | —             | —    | —             | —    |
| Sector Group Unprotect <sup>Note 8</sup>                    |           | 4         | xxxH          | 60H  | SUA           | 60H                    | SUA           | 40H  | SUA           | SD   | —             | —    | —             | —    |
| Query <sup>Note 9</sup>                                     | BYTE mode | 1         | AAH           | 98H  | —             | —                      | —             | —    | —             | —    | —             | —    | —             | —    |
|                                                             | WORD mode |           | 55H           | —    | —             | —                      | —             | —    | —             | —    | —             | —    | —             | —    |
| Extra One Time Protect                                      | BYTE mode | 3         | AAAH          | AAH  | 555H          | 55H                    | AAAH          | 88H  | —             | —    | —             | —    | —             | —    |
| Sector Entry                                                | WORD mode |           | 555H          | —    | 2AAH          | —                      | 555H          | —    | —             | —    | —             | —    | —             | —    |
| Extra One Time Protect                                      | BYTE mode | 4         | AAAH          | AAH  | 555H          | 55H                    | AAAH          | A0H  | PA            | PD   | —             | —    | —             | —    |
| Sector Program <sup>Note 10</sup>                           | WORD mode |           | 555H          | —    | 2AAH          | —                      | 555H          | —    | —             | —    | —             | —    | —             | —    |
| Extra One Time Protect                                      | BYTE mode | 6         | AAAH          | AAH  | 555H          | 55H                    | AAAH          | 80H  | AAAH          | AAH  | 555H          | 55H  | EOTPSA        | 30H  |
| Sector Erase <sup>Note 10</sup>                             | WORD mode |           | 555H          | —    | 2AAH          | —                      | 555H          | —    | 555H          | —    | 2AAH          | —    | —             | —    |
| Extra One Time Protect                                      | BYTE mode | 4         | AAAH          | AAH  | 555H          | 55H                    | AAAH          | 90H  | xxxH          | 00H  | —             | —    | —             | —    |
| Sector Reset <sup>Note 10</sup>                             | WORD mode |           | 555H          | —    | 2AAH          | —                      | 555H          | —    | —             | —    | —             | —    | —             | —    |
| Extra One Time Protect Sector Protection <sup>Note 10</sup> |           | 4         | xxxH          | 60H  | EOTPSA        | 60H                    | EOTPSA        | 40H  | EOTPSA        | SD   | —             | —    | —             | —    |

- Notes**
- Both these read / reset commands reset the device to the read mode.
  - Programming is suspended if B0H is input to the bank address being programmed to in a program operation.
  - Programming is resumed if 30H is input to the bank address being suspended to in a program-suspend operation.
  - Erase is suspended if B0H is input to the bank address being erased in a sector erase operation.
  - Erase is resumed if 30H is input to the bank address being suspended in a sector-erase-suspend operation.
  - Valid only in the unlock bypass mode.
  - Valid only when /RESET = V<sub>DD</sub> (except in the Extra One Time Protect Sector mode).
  - The command sequence that protects a sector group is excluded.

9. Only A6 to A0 are valid as an address.
10. Valid only in the Extra One Time Protect Sector mode.
11. This command can be used even if this data is F0H.

- Remarks**
1. Specify address 555H or 2AAH (A10 to A0) in the WORD mode, and AAAH or 555H (A10 to A0, A-1) in the BYTE mode.
  2. RA : Read address  
RD : Read data  
IA : Address input  
    xx00H (to read the manufacturer code)  
    xx02H (to read the device code in the BYTE mode)  
    xx01H (to read the device code in the WORD mode)  
ID : Code output. Refer to the **Product ID code (Manufacturer code / Device code)**.  
PA : Program address  
PD : Program data  
FSA: Erase sector address. The sector to be erased is selected by the combination of A20 to A12.  
    Refer to the **Sector Organization / Sector Address Table**.  
BA : Bank address. Refer to the **Sector Organization / Sector Address Table**.  
SPA : Sector group address to be protected. Set one of the sector group address (SGA) which consists of A20 to A12 and (A6, A1, A0) = (V<sub>IL</sub>, V<sub>IH</sub>, V<sub>IL</sub>). Refer to the **Sector Group Address Table**.  
SUA : Unprotect sector group address. Set one of the sector group address (SGA) which consists of A20 to A12 and (A6, A1, A0) = (V<sub>IH</sub>, V<sub>IH</sub>, V<sub>IL</sub>). Refer to the **Sector Group Address Table**.  
EOTPSA : Extra One Time Protect Sector area addresses. These addresses are 3F0000H to 3FFFFFFH (BYTE mode) / 1F8000H to 1FFFFFFH (WORD mode) for top boot, and 000000H to 00FFFFFFH (BYTE mode) / 000000H to 007FFFFH (WORD mode) for bottom boot.  
SD : Data for verifying whether sector groups read from the address specified by SPA, SUA, and EOTPSA are protected or unprotected
  3. The sector group address is don't care except when a program / erase address or read address are selected.
  4. For the operation of the bus, refer to **DUAL OPERATION FLASH MEMORY 32M BITS A SERIES Information (M14914E)**.
  5. × of address bit indicates V<sub>IH</sub> or V<sub>IL</sub>.

#### BUS OPERATIONS, COMMANDS, HARDWARE SEQUENCE FLAGS, HARDWARE DATA PROTECTION

Refer to **DUAL OPERATION FLASH MEMORY 32M BITS A SERIES Information (M14914E)**.

## Electrical Characteristics

Before turning on power, input GND  $\pm$  0.2 V to the /RESET pin until  $V_{CC} \geq V_{CC}(\text{MIN.})$ .

### Absolute Maximum Ratings

| Parameter                     | Symbol    | Condition               | Rating                                                                  | Unit |
|-------------------------------|-----------|-------------------------|-------------------------------------------------------------------------|------|
| Supply voltage                | $V_{CC}$  | with respect to GND     | -0.5 to +4.0                                                            | V    |
| Input / Output voltage        | $V_I$     | with respect to GND     | -0.5 <sup>Note 1</sup> to +13.0                                         | V    |
|                               |           | except /WP(ACC), /RESET | -0.5 <sup>Note 1</sup> to $V_{CC} + 0.4$ (4.0 V MAX.) <sup>Note 2</sup> |      |
| Operating ambient temperature | $T_A$     |                         | -40 to +85                                                              | °C   |
| Storage temperature           | $T_{stg}$ |                         | -55 to +125                                                             | °C   |

**Notes** 1. -2.0 V (MIN.) (pulse width  $\leq$  20 ns)

2.  $V_{CC} + 2.0$  V (MAX.) (pulse width  $\leq$  20 ns)

★

**Caution** Exposing the device to stress above those listed in Absolute Maximum Rating 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.

### Recommended Operating Conditions

| Parameter                     | Symbol   | Test condition | $\mu$ PD29F032203AL-AxxY |      |      | $\mu$ PD29F032203AL-BxxY |      |      | Unit |
|-------------------------------|----------|----------------|--------------------------|------|------|--------------------------|------|------|------|
|                               |          |                | MIN.                     | TYP. | MAX. | MIN.                     | TYP. | MAX. |      |
| Supply voltage                | $V_{CC}$ |                | 3.0                      |      | 3.6  | 2.7                      |      | 3.3  | V    |
| Operating ambient temperature | $T_A$    |                | -40                      |      | +85  | -40                      |      | +85  | °C   |

### Capacitance ( $T_A = 25^\circ\text{C}$ , $f = 1$ MHz)

| Parameter                  | Symbol    | Test condition  | MIN. | TYP. | MAX. | Unit |
|----------------------------|-----------|-----------------|------|------|------|------|
| Input capacitance          | $C_{IN}$  | $V_{IN} = 0$ V  |      |      | TBD  | pF   |
| Input / Output capacitance | $C_{I/O}$ | $V_{I/O} = 0$ V |      |      | TBD  | pF   |

**Remarks** 1.  $V_{IN}$  : Input voltage,  $V_{I/O}$  : Input / Output voltage

2. These parameters are not 100% tested.

## DC Characteristics (Recommended Operating Conditions Unless Otherwise Noted)

| Parameter                                            |                         |                            | Symbol                                                                                  | Test condition                                                                                                        |                            | MIN.  | TYP. | MAX.                 | Unit |
|------------------------------------------------------|-------------------------|----------------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|----------------------------|-------|------|----------------------|------|
| High level input voltage                             |                         |                            | V <sub>IH</sub>                                                                         |                                                                                                                       |                            | 2.4   |      | V <sub>CC</sub> +0.3 | V    |
| Low level input voltage                              |                         |                            | V <sub>IL</sub>                                                                         |                                                                                                                       |                            | − 0.3 |      | +0.5                 | V    |
| High level output voltage                            |                         |                            | V <sub>OH</sub>                                                                         | I <sub>OH</sub> = −500 μA, V <sub>CC</sub> = V <sub>CC</sub> (MIN.)                                                   |                            | 2.4   |      |                      | V    |
| Low level output voltage                             |                         |                            | V <sub>OL</sub>                                                                         | I <sub>OL</sub> = +1.0 mA, V <sub>CC</sub> = V <sub>CC</sub> (MIN.)                                                   |                            |       |      | 0.4                  | V    |
| Input leakage current                                |                         |                            | I <sub>LI</sub>                                                                         |                                                                                                                       |                            | −1.0  |      | +1.0                 | μA   |
| I/O leakage current                                  |                         |                            | I <sub>LO</sub>                                                                         |                                                                                                                       |                            | −1.0  |      | +1.0                 | μA   |
| Power supply current                                 | Read                    | BYTE mode                  | I <sub>CC1</sub>                                                                        | V <sub>CC</sub> = V <sub>CC</sub> (MAX.),<br>/CE = V <sub>IL</sub> , /OE = V <sub>IH</sub>                            | t <sub>CYCLE</sub> = 5 MHz |       | 10   | 16                   | mA   |
|                                                      |                         | t <sub>CYCLE</sub> = 1 MHz |                                                                                         |                                                                                                                       |                            | 2     | 4    |                      |      |
|                                                      |                         | WORD mode                  |                                                                                         |                                                                                                                       | t <sub>CYCLE</sub> = 5 MHz |       | 10   | 16                   |      |
|                                                      |                         | t <sub>CYCLE</sub> = 1 MHz |                                                                                         |                                                                                                                       |                            | 2     | 4    |                      |      |
|                                                      | Program, Erase          |                            | I <sub>CC2</sub>                                                                        | V <sub>CC</sub> = V <sub>CC</sub> (MAX.), /CE = V <sub>IL</sub> , /OE = V <sub>IH</sub>                               |                            |       | 15   | 30                   | mA   |
|                                                      | Standby                 |                            | I <sub>CC3</sub>                                                                        | V <sub>CC</sub> = V <sub>CC</sub> (MAX.), /CE = /RESET =<br>/WP(ACC) = V <sub>CC</sub> ± 0.3 V, /OE = V <sub>IL</sub> |                            |       | 0.2  | 5                    | μA   |
|                                                      | Standby / Reset         |                            | I <sub>CC4</sub>                                                                        | V <sub>CC</sub> = V <sub>CC</sub> (MAX.), /RESET = GND ± 0.2 V                                                        |                            |       | 0.2  | 5                    | μA   |
|                                                      | Automatic sleep mode    |                            | I <sub>CC5</sub>                                                                        | V <sub>IH</sub> = V <sub>CC</sub> ± 0.2 V, V <sub>IL</sub> = GND ± 0.2 V                                              |                            |       | 0.2  | 5                    | μA   |
|                                                      | Read during programming |                            | I <sub>CC6</sub>                                                                        | V <sub>IH</sub> = V <sub>CC</sub> ± 0.2 V, V <sub>IL</sub> = GND ± 0.2 V                                              |                            |       | 21   | 45                   | mA   |
|                                                      | Read during erasing     |                            | I <sub>CC7</sub>                                                                        | V <sub>IH</sub> = V <sub>CC</sub> ± 0.2 V, V <sub>IL</sub> = GND ± 0.2 V                                              |                            |       | 21   | 45                   | mA   |
| Programming during suspend                           |                         | I <sub>CC8</sub>           | /CE = V <sub>IL</sub> , /OE = V <sub>IH</sub> ,<br>Automatic programming during suspend |                                                                                                                       |                            | 17    | 35   | mA                   |      |
| Accelerated programming                              |                         |                            | /WP (ACC) pin                                                                           |                                                                                                                       |                            | 5     | 10   | mA                   |      |
|                                                      |                         | V <sub>CC</sub>            |                                                                                         |                                                                                                                       | 15                         | 30    |      |                      |      |
| /RESET high level input voltage                      |                         |                            | V <sub>ID</sub>                                                                         | High Voltage is applied                                                                                               |                            | 11.5  |      | 12.5                 | V    |
| Accelerated programming voltage                      |                         |                            | V <sub>ACC</sub>                                                                        | High Voltage is applied                                                                                               |                            | 8.5   |      | 9.5                  | V    |
| Low V <sub>CC</sub> lock-out voltage <sup>Note</sup> |                         |                            | V <sub>LKO</sub>                                                                        |                                                                                                                       |                            |       |      | 1.7                  | V    |

**Note** When  $V_{CC}$  is equal to or lower than  $V_{LKO}$ , the device ignores all write cycles. Refer to **DUAL OPERATION FLASH MEMORY 32M BITS A SERIES Information (M14914E)**.

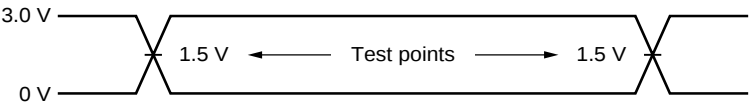
**Remark** These DC characteristics are in common regardless of product classification.

AC Characteristics (Recommended Operating Conditions Unless Otherwise Noted)

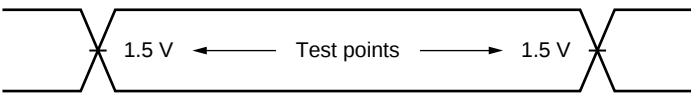
AC Test Conditions

[ μPD29F032203AL-AxxxY ]

Input Waveform (Rise and Fall Time ≤ 5 ns)



Output Waveform

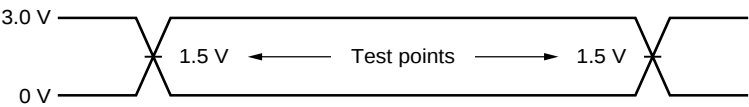


Output Load

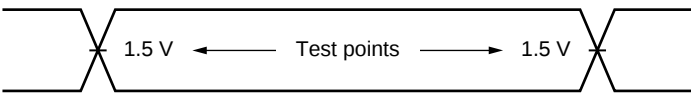
1 TTL + 30 pF

[ μPD29F032203AL-BxxxY ]

Input Waveform (Rise and Fall Time ≤ 5 ns)



Output Waveform



Output Load

1 TTL + 30 pF

# Read Cycle

| Parameter                     | Symbol                               | Test Condition                                 | MIN. | TYP. | MAX. | Unit | Note |
|-------------------------------|--------------------------------------|------------------------------------------------|------|------|------|------|------|
| Read cycle time               | t <sub>RC</sub>                      |                                                | 85   |      |      | ns   |      |
| Address access time           | t <sub>ACC</sub>                     | /CE = /OE = V <sub>IL</sub>                    |      |      | 85   | ns   |      |
| /CE access time               | t <sub>CE</sub>                      | /OE = V <sub>IL</sub>                          |      |      | 85   | ns   |      |
| /OE access time               | t <sub>OE</sub>                      | /CE = V <sub>IL</sub>                          |      |      | 40   | ns   |      |
| Output disable time           | t <sub>DF</sub>                      | /OE = V <sub>IL</sub> or /CE = V <sub>IL</sub> |      |      | 30   | ns   |      |
| Output hold time              | t <sub>OH</sub>                      |                                                | 0    |      |      | ns   |      |
| /RESET pulse width            | t <sub>RP</sub>                      |                                                | 500  |      |      | ns   |      |
| /RESET hold time before read  | t <sub>RH</sub>                      |                                                | 50   |      |      | ns   |      |
| /RESET low to read mode       | t <sub>READY</sub>                   |                                                |      |      | 20   | μs   |      |
| /CE low to /BYTE low, high    | t <sub>ELFL</sub> /t <sub>ELFH</sub> |                                                |      |      | 5    | ns   |      |
| /BYTE low output disable time | t <sub>FLQZ</sub>                    |                                                |      |      | 30   | ns   |      |
| /BYTE high access time        | t <sub>FHQV</sub>                    |                                                | 85   |      |      | ns   |      |

**Remark** t<sub>DF</sub> is the time from inactivation of /CE or /OE to Hi-Z state output.

Write Cycle (Program / Erase)

(1/2)

| Parameter                                                                                                         |                          | Symbol             | MIN.    | TYP. | MAX.  | Unit  | Note |
|-------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------|---------|------|-------|-------|------|
| Write cycle time                                                                                                  |                          | t <sub>WC</sub>    | 85      |      |       | ns    |      |
| Address setup time (/WE to address)                                                                               |                          | t <sub>AS</sub>    | 0       |      |       | ns    |      |
| Address setup time (/CE to address)                                                                               |                          | t <sub>AS</sub>    | 0       |      |       | ns    |      |
| Address hold time (/WE to address)                                                                                |                          | t <sub>AH</sub>    | 45      |      |       | ns    |      |
| Address hold time (/CE to address)                                                                                |                          | t <sub>AH</sub>    | 45      |      |       | ns    |      |
| Input data setup time                                                                                             |                          | t <sub>DS</sub>    | 35      |      |       | ns    |      |
| Input data hold time                                                                                              |                          | t <sub>DH</sub>    | 0       |      |       | ns    |      |
| /OE hold time                                                                                                     | Read                     | t <sub>OE</sub>    | 0       |      |       | ns    |      |
|                                                                                                                   | Toggle bit, Data polling |                    | 10      |      |       |       |      |
| Read recovery time before write (/OE to /CE)                                                                      |                          | t <sub>GHEL</sub>  | 0       |      |       | ns    |      |
| Read recovery time before write (/OE to /WE)                                                                      |                          | t <sub>GHWL</sub>  | 0       |      |       | ns    |      |
| /WE setup time (/CE to /WE)                                                                                       |                          | t <sub>WS</sub>    | 0       |      |       | ns    |      |
| /CE setup time (/WE to /CE)                                                                                       |                          | t <sub>CS</sub>    | 0       |      |       | ns    |      |
| /WE hold time (/CE to /WE)                                                                                        |                          | t <sub>WH</sub>    | 0       |      |       | ns    |      |
| /CE hold time (/WE to /CE)                                                                                        |                          | t <sub>CH</sub>    | 0       |      |       | ns    |      |
| Write pulse width                                                                                                 |                          | t <sub>WP</sub>    | 35      |      |       | ns    |      |
| /CE pulse width                                                                                                   |                          | t <sub>CP</sub>    | 35      |      |       | ns    |      |
| Write pulse width high                                                                                            |                          | t <sub>WPH</sub>   | 30      |      |       | ns    |      |
| /CE pulse width high                                                                                              |                          | t <sub>CPH</sub>   | 30      |      |       | ns    |      |
| Byte programming operation time                                                                                   |                          | t <sub>BPG</sub>   |         | 9    | 200   | μs    |      |
| Word programming operation time                                                                                   |                          | t <sub>WPG</sub>   |         | 11   | 200   | μs    |      |
| Sector erase operation time                                                                                       | 4K words sector          | t <sub>SER</sub>   |         | 0.3  | 1.0   | s     | 1,2  |
|                                                                                                                   | 32K words sector         |                    |         | 0.5  | 1.5   |       |      |
|                                                                                                                   | 4K words sector          |                    |         | 0.5  | 3.0   |       | 1,3  |
|                                                                                                                   | 32K words sector         |                    |         | 0.7  | 5.0   |       |      |
| Chip erase operation time                                                                                         |                          | t <sub>CER</sub>   |         | 33.9 | 102.5 | s     | 1,2  |
|                                                                                                                   |                          |                    |         | 48.1 | 339   |       | 1,3  |
| Accelerated programming time                                                                                      |                          | t <sub>ACCPG</sub> |         | 7    | 150   | μs    |      |
| Program / erase cycle                                                                                             |                          |                    | 300,000 |      |       | cycle |      |
| V <sub>CC</sub> setup time                                                                                        |                          | t <sub>VCS</sub>   | 50      |      |       | μs    |      |
| RY (/BY) recovery time                                                                                            |                          | t <sub>RB</sub>    | 0       |      |       | ns    |      |
| /RESET pulse width                                                                                                |                          | t <sub>RP</sub>    | 500     |      |       | ns    |      |
| /RESET high-voltage (V <sub>ID</sub> ) hold time from high of RY (/BY) when sector group is temporarily unprotect |                          | t <sub>RRB</sub>   | 20      |      |       | μs    |      |
| /RESET hold time                                                                                                  |                          | t <sub>RH</sub>    | 50      |      |       | ns    |      |

**Notes** 1. The preprogramming time prior to the erase operation is not included.

2. Program / erase cycle : 100,000 cycles

3. Program / erase cycle : 300,000 cycles

Write Cycle (Program / Erase)

(2/2)

| Parameter                                                        | Symbol             | MIN. | TYP. | MAX. | Unit | Note |
|------------------------------------------------------------------|--------------------|------|------|------|------|------|
| From completion of automatic program / erase to data output time | t <sub>EOE</sub>   |      |      | 85   | ns   |      |
| RY (/BY) delay time from valid program or erase operation        | t <sub>BUSY</sub>  |      |      | 90   | ns   |      |
| Address setup time to /OE low in toggle bit                      | t <sub>ASO</sub>   | 15   |      |      | ns   |      |
| Address hold time to /CE or /OE high in toggle bit               | t <sub>AHT</sub>   | 0    |      |      | ns   |      |
| /CE pulse width high for toggle bit                              | t <sub>CEPH</sub>  | 20   |      |      | ns   |      |
| /OE pulse width high for toggle bit                              | t <sub>OEPH</sub>  | 20   |      |      | ns   |      |
| Voltage transition time                                          | t <sub>VLHT</sub>  | 4    |      |      | μs   | 1    |
| Rise time to V <sub>ID</sub> (/RESET)                            | t <sub>VIDR</sub>  | 500  |      |      | ns   | 2    |
| Rise time to V <sub>ACC</sub> (/WP(ACC))                         | t <sub>VACCR</sub> | 500  |      |      | ns   | 1    |
| Erase timeout time                                               | t <sub>TOW</sub>   | 50   |      |      | μs   | 3    |
| Erase suspend transition time                                    | t <sub>SPD</sub>   |      |      | 20   | μs   | 3    |

**Notes** 1. Sector group protection and accelerated mode only.

2. Sector group protection only.

3. Table only.

Write operation (Erase / Program) Performance

| Parameter                    | Description                                |                  | MIN.    | TYP. | MAX.  | Unit  | Note |
|------------------------------|--------------------------------------------|------------------|---------|------|-------|-------|------|
| Sector erase time            | Excludes programming time prior to erasure | 4K words sector  |         | 0.3  | 1.0   | s     | 1    |
|                              |                                            | 32K words sector |         | 0.5  | 1.5   |       |      |
|                              |                                            | 4K words sector  |         | 0.5  | 3.0   | s     | 2    |
|                              |                                            | 32K words sector |         | 0.7  | 5.0   |       |      |
| Chip erase time              | Excludes programming time prior to erasure |                  |         | 33.9 | 102.5 | s     | 1    |
|                              |                                            |                  |         | 48.1 | 339   |       | 2    |
| Byte programming time        | Excludes system-level overhead             |                  |         | 9    | 200   | μs    |      |
| Word programming time        | Excludes system-level overhead             |                  |         | 11   | 200   | μs    |      |
| Chip programming time        | Excludes system-level overhead             | BYTE mode        |         | 40   |       | s     |      |
|                              |                                            | WORD mode        |         | 25   |       |       |      |
| Accelerated programming time | Excludes system-level overhead             |                  |         | 7    | 150   | μs    |      |
| Program / erase cycle        |                                            |                  | 300,000 |      |       | cycle |      |

**Notes** 1. Program / erase cycle : 100,000 cycles

2. Program / erase cycle : 300,000 cycles

TIMING CHARTS, FLOW CHARTS

Refer to **DUAL OPERATION FLASH MEMORY 32M BITS A SERIES Information (M14914E)**.

CFI Code List

(1/2)

| Address A6 to A0         | Data I/O15 to I/O0               | Description                                                                                                        |
|--------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------|
| 10H<br>11H<br>12H        | 0051H<br>0052H<br>0059H          | "QRY" (ASCII code)                                                                                                 |
| 13H<br>14H               | 0002H<br>0000H                   | Main command set<br>2 : AMD/FJ standard type                                                                       |
| 15H<br>16H               | 0040H<br>0000H                   | Start address of PRIMARY table                                                                                     |
| 17H<br>18H               | 0000H<br>0000H                   | Auxiliary command set<br>00H : Not supported                                                                       |
| 19H<br>1AH               | 0000H<br>0000H                   | Start address of auxiliary algorithm table                                                                         |
| 1BH                      | 0027H                            | Minimum V <sub>CC</sub> voltage (program / erase)<br>I/O7 to I/O4 : 1 V/bit<br>I/O3 to I/O0 : 100 mV/bit           |
| 1CH                      | 0036H                            | Maximum V <sub>CC</sub> voltage (program / erase)<br>I/O7 to I/O4 : 1 V/bit<br>I/O3 to I/O0 : 100 mV/bit           |
| 1DH                      | 0000H                            | Minimum V <sub>PP</sub> voltage                                                                                    |
| 1EH                      | 0000H                            | Maximum V <sub>PP</sub> voltage                                                                                    |
| 1FH                      | 0004H                            | Typical word program time ( $2^N \mu s$ )                                                                          |
| 20H                      | 0000H                            | Typical buffer program time ( $2^N \mu s$ )                                                                        |
| 21H                      | 000AH                            | Typical sector erase time ( $2^N ms$ )                                                                             |
| 22H                      | 0000H                            | Typical chip erase time ( $2^N ms$ )                                                                               |
| 23H                      | 0005H                            | Maximum word program time (typical time $\times 2^N$ )                                                             |
| 24H                      | 0000H                            | Maximum buffer program time (typical time $\times 2^N$ )                                                           |
| 25H                      | 0004H                            | Maximum sector erasing time (typical time $\times 2^N$ )                                                           |
| 26H                      | 0000H                            | Maximum chip erasing time (typical time $\times 2^N$ )                                                             |
| 27H                      | 0016H                            | Capacity ( $2^N$ Bytes)                                                                                            |
| 28H<br>29H               | 0002H<br>0000H                   | I/O information<br>2 : ×8/×16-bit organization                                                                     |
| 2AH<br>2BH               | 0000H<br>0000H                   | Maximum number of bytes when two banks are programmed ( $2^N$ )                                                    |
| 2CH                      | 0002H                            | Type of erase block                                                                                                |
| 2DH<br>2EH<br>2FH<br>30H | 0007H<br>0000H<br>0020H<br>0000H | Information about erase block 1<br>Bit0 to 15 : y = number of sectors<br>Bit16 to 31 : z = size<br>(Z × 256 Bytes) |

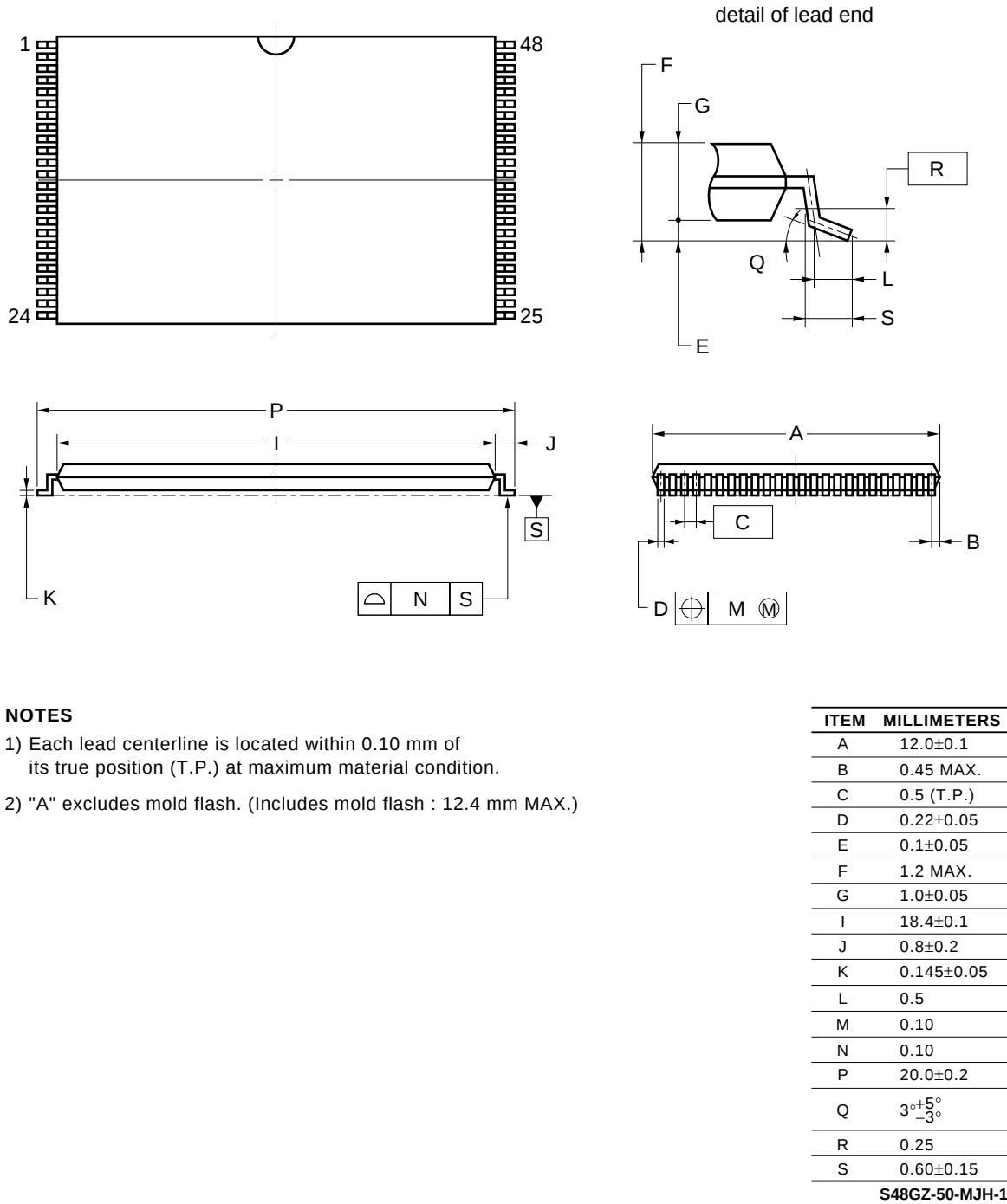
CFI Code List

(2/2)

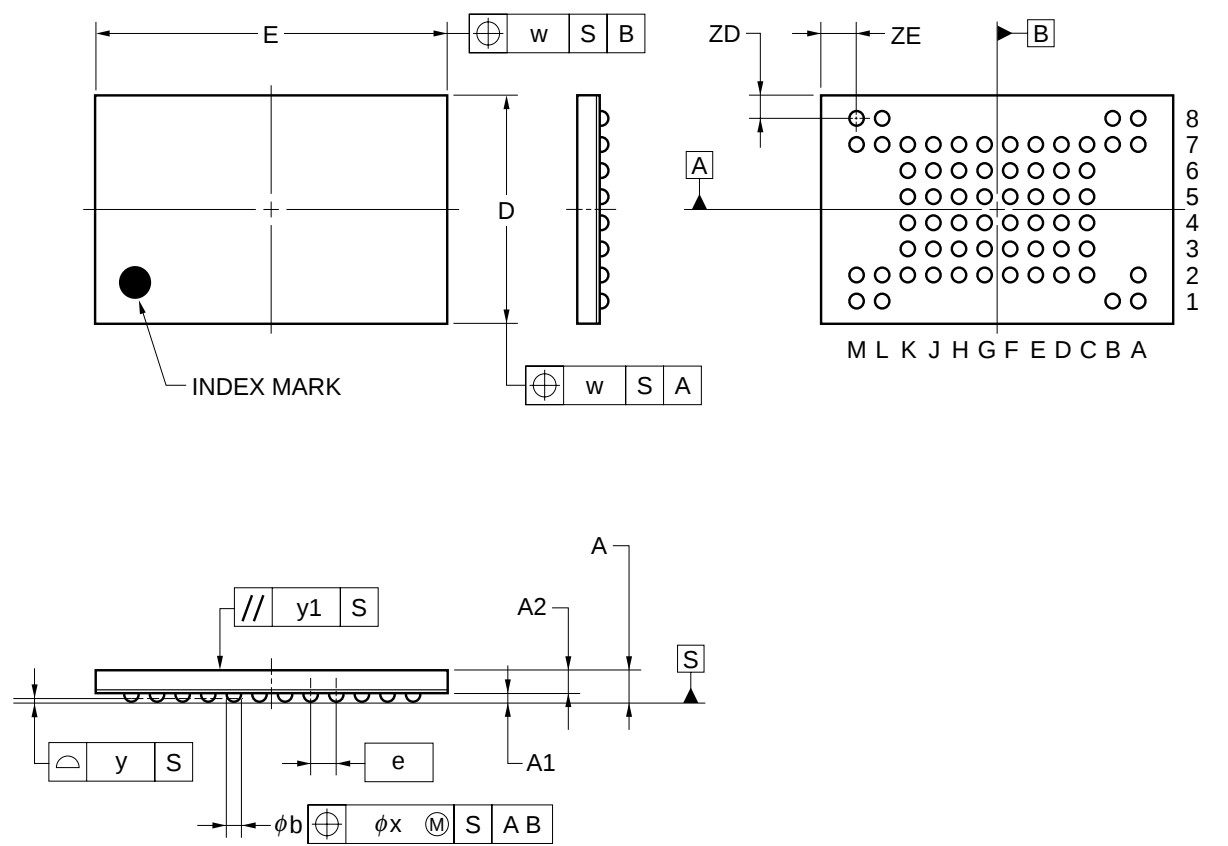
| Address A6 to A0 | Data I/O15 to I/O0 | Description                                                                                            |
|------------------|--------------------|--------------------------------------------------------------------------------------------------------|
| 31H              | 003EH              | Information about erase block 2                                                                        |
| 32H              | 0000H              | bit0 to 15 : y = number of sectors                                                                     |
| 33H              | 0000H              | bit16 to 31 : z = size                                                                                 |
| 34H              | 0001H              | (z × 256 Bytes)                                                                                        |
| 40H              | 0050H              | "PRI" (ASCII code)                                                                                     |
| 41H              | 0052H              |                                                                                                        |
| 42H              | 0049H              |                                                                                                        |
| 43H              | 0031H              | Main version (ASCII code)                                                                              |
| 44H              | 0032H              | Minor version (ASCII code)                                                                             |
| 45H              | 0000H              | Address during command input<br>00H : Necessary<br>01H : Unnecessary                                   |
| 46H              | 0002H              | Temporary erase suspend function<br>00H : Not supported<br>01H : Read only<br>02H : Read / Program     |
| 47H              | 0001H              | Sector group protection<br>00H : Not supported<br>01H : Supported                                      |
| 48H              | 0001H              | Temporary sector group protection<br>00H : Not supported<br>01H : Supported                            |
| 49H              | 0004H              | Sector group protection algorithm                                                                      |
| 4AH              | 00xxH              | Number of sectors of bank 2<br>00H : Not supported<br>30H : μPD29F032203AL-Y                           |
| 4BH              | 0000H              | Burst mode<br>00H : Not supported                                                                      |
| 4CH              | 0000H              | Page mode<br>00H : Not supported                                                                       |
| 4DH              | 0085H              | Minimum V <sub>acc</sub> voltage<br>I/O7 to I/O4 : 1 V/bit<br>I/O3 to I/O0 : 100 mV/bit                |
| 4EH              | 0095H              | Maximum V <sub>acc</sub> voltage<br>I/O7 to I/O4 : 1 V/bit<br>I/O3 to I/O0 : 100 mV/bit                |
| 4FH              | 00xxH              | Boot organization<br>02H : Bottom boot (μPD29F032203AL-xxxBY)<br>03H : Top boot (μPD29F032203AL-xxxTY) |
| 50H              | 0001H              | Temporary program suspend function<br>00H : Not supported<br>01H : Supported                           |

Package Drawings

48-PIN PLASTIC TSOP (I) (12x20)



63-PIN TAPE FBGA (11x7)



| ITEM | MILLIMETERS |
|------|-------------|
| D    | 7.00±0.10   |
| E    | 11.00±0.10  |
| w    | 0.20        |
| A    | 0.97±0.10   |
| A1   | 0.27±0.05   |
| A2   | 0.70        |
| e    | 0.80        |
| b    | 0.45±0.05   |
| x    | 0.08        |
| y    | 0.10        |
| y1   | 0.20        |
| ZD   | 0.70        |
| ZE   | 1.10        |

P63F9-80-BS2

### Recommended Soldering Conditions

Please consult with our sales offices for soldering conditions of the  $\mu$ PD29F032203AL-Y.

### Types of Surface Mount Device

$\mu$ PD29F032203ALGZ-MJH : 48-pin PLASTIC TSOP(I) (12 × 20) (Normal bent)

$\mu$ PD29F032203ALF9-BS2 : 63-pin TAPE FBGA (11 × 7)

## NOTES FOR CMOS DEVICES

### ① PRECAUTION AGAINST ESD FOR SEMICONDUCTORS

Note:

Strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when 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. Semiconductor 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. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with semiconductor devices on it.

### ② HANDLING OF UNUSED INPUT PINS FOR CMOS

Note:

No connection for CMOS device inputs can be 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. All handling related to the unused pins must be judged device by device and related specifications governing the devices.

### ③ STATUS BEFORE INITIALIZATION OF MOS DEVICES

Note:

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

## Related Documents

| Document Name                                             | Document Number |
|-----------------------------------------------------------|-----------------|
| DUAL OPERATION FLASH MEMORY 32M BITS A SERIES Information | M14914E         |

- **The information in this document is current as of January, 2002. The information is subject to change without notice. For actual design-in, refer to the latest publications of NEC's data sheets or data books, etc., for the most up-to-date specifications of NEC semiconductor products. Not all products and/or types are available in every country. Please check with an NEC sales representative for availability and additional information.**

- No part of this document may be copied or reproduced in any form or by any means without prior written consent of NEC. NEC assumes no responsibility for any errors that may appear in this document.
- NEC does not assume any liability for infringement of patents, copyrights or other intellectual property rights of third parties by or arising from the use of NEC semiconductor products listed in this document or any other liability arising from the use of such products. No license, express, implied or otherwise, is granted under any patents, copyrights or other intellectual property rights of NEC or others.

- Descriptions of circuits, software and other related information in this document are provided for illustrative purposes in semiconductor product operation and application examples. The incorporation of these circuits, software and information in the design of customer's equipment shall be done under the full responsibility of customer. NEC assumes no responsibility for any losses incurred by customers or third parties arising from the use of these circuits, software and information.

- While NEC endeavours to enhance the quality, reliability and safety of NEC semiconductor products, customers agree and acknowledge that the possibility of defects thereof cannot be eliminated entirely. To minimize risks of damage to property or injury (including death) to persons arising from defects in NEC semiconductor products, customers must incorporate sufficient safety measures in their design, such as redundancy, fire-containment, and anti-failure features.

- NEC semiconductor products are classified into the following three quality grades:  
"Standard", "Special" and "Specific". The "Specific" quality grade applies only to semiconductor products developed based on a customer-designated "quality assurance program" for a specific application. The recommended applications of a semiconductor product depend on its quality grade, as indicated below. Customers must check the quality grade of each semiconductor product before using it in a particular application.

"Standard": Computers, office equipment, communications equipment, test and measurement equipment, audio and visual equipment, home electronic appliances, machine tools, personal electronic equipment and industrial robots

"Special": Transportation equipment (automobiles, trains, ships, etc.), traffic control systems, anti-disaster systems, anti-crime systems, safety equipment and medical equipment (not specifically designed for life support)

"Specific": Aircraft, aerospace equipment, submersible repeaters, nuclear reactor control systems, life support systems and medical equipment for life support, etc.

The quality grade of NEC semiconductor products is "Standard" unless otherwise expressly specified in NEC's data sheets or data books, etc. If customers wish to use NEC semiconductor products in applications not intended by NEC, they must contact an NEC sales representative in advance to determine NEC's willingness to support a given application.

(Note)

(1) "NEC" as used in this statement means NEC Corporation and also includes its majority-owned subsidiaries.

(2) "NEC semiconductor products" means any semiconductor product developed or manufactured by or for NEC (as defined above).