SPANSION™ MCP

Data Sheet

September 2003

This document specifies SPANSION™ memory products that are now offered by both Advanced Micro Devices and Fujitsu. Although the document is marked with the name of the company that originally developed the specification, these products will be offered to customers of both AMD and Fujitsu.

Continuity of Specifications

There is no change to this datasheet as a result of offering the device as a SPANSION™ product. Future routine revisions will occur when appropriate, and changes will be noted in a revision summary.

Continuity of Ordering Part Numbers

AMD and Fujitsu continue to support existing part numbers beginning with "Am" and "MBM". To order these products, please use only the Ordering Part Numbers listed in this document.

For More Information

Please contact your local AMD or Fujitsu sales office for additional information about SPANSION™ memory solutions.
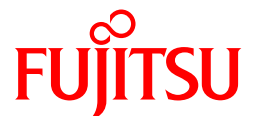
Stacked MCP (Multi-Chip Package) FLASH MEMORY & SRAM

CMOS

64M (×16) FLASH MEMORY & 4M (×16) STATIC RAM

MB84VD23180FM-70

■ FEATURES

- **Power supply voltage of 2.7 V to 3.1 V**
- **High performance**
  70 ns maximum access time (Flash)
  70 ns maximum access time (SRAM)
- **Operating Temperature**
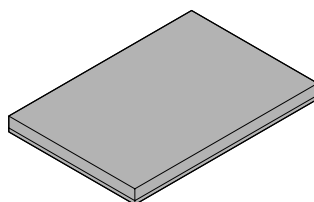 −30 ℃ to +85 ℃
- **Package 73-ball FBGA**

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■ PRODUCT LINEUP

	Flash Memory	SRAM
Supply Voltage (V)	$V_{CC}r^* = 3.0 \text{ V} \, ^{+0.1V}_{-0.3 V}$	$V_{CC}s^* = 3.0 \text{ V} \, ^{+0.1V}_{-0.3 V}$
Max Address Access Time (ns)	70	70
Max $\overline{CE}$ Access Time (ns)	70	70
Max $\overline{OE}$ Access Time (ns)	30	35

*: Both $V_{CC}f$ and $V_{CC}s$ must be in recommended operation range when either part is being accessed.

■ PACKAGE

73-ball plastic FBGA

BGA-73P-M03

FUJITSU

(Continued)

— **FLASH MEMORY**
- **Simultaneous Read/Write operations** (**Dual Bank**)
- **FlexBank™*1**
  Bank A : 8 Mbit   (8 KB × 8 and 64 KB × 15)
  Bank B : 24 Mbit (64 KB × 48)
  Bank C : 24 Mbit (64 KB × 48)
  Bank D : 8 Mbit   (8 KB × 8 and 64 KB × 15)
  Two virtual Banks are chosen from the combination of four physical banks (Refer to "Example of Virtual Banks Combination table" and "Simultaneous Operation table") .
  Host system can program or erase in one bank, and then read immediately and simultaneously from the other bank with zero latency between read and write operations.
  Read-while-erase
  Read-while-program
- **Single 3.0 V read**, **program**, **and erase**
  Minimized system level power requirements
- **Minimum 100,000 program/erase cycles**
- **Sector erase architecture**
  Sixteen 4 Kword and one hundred twenty-six 32 Kword sectors in word.
  Any combination of sectors can be concurrently erased. It also supports full chip erase.
- **HiddenROM region**
  256 byte of HiddenROM, accessible through a new "HiddenROM Enable" command sequence
  Factory serialized and protected to provide a secure electronic serial number (ESN)
- **$\overline{WP}$/ACC input pin**
  At V_{IL}, allows protection of "outermost" 2 × 8 Kbytes on both ends of boot sectors, regardless of sector protection/unprotection status
  At V_{IH}, allows removal of boot sector protection
  At V_{ACC}, increases program performance
- **Embedded Erase™*2 Algorithms**
  Automatically preprograms and erases the chip or any sector
- **Embedded Program™* Algorithms**
  Automatically writes and verifies data at specified address
- **$\overline{Data}$ Polling and Toggle Bit feature for detection of program or erase cycle completion**
- **Ready/Busy output** (**RY/$\overline{BY}$**)
  Hardware method for detection of program or erase cycle completion
- **Automatic sleep mode**
  When addresses remain stable, the device automatically switches itself to low power mode.
- **Low V_{CC}f write inhibit ≤ 2.5 V**
- **Program Suspend/Resume**
  Suspends the program operation to allow a read in another byte
- **Erase Suspend/Resume**
  Suspends the erase operation to allow a read data and/or program in another sector within the same device
- **Please refer to "MBM29DL64DF" data sheet in detailed function**

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— **SRAM**
  • **Power dissipation**
    Operating : 40 mA Max
    Standby : 10 μA Max
  • **Power down features using $\overline{CE1}$s and CE2s**
  • **Data retention supply voltage: 1.5 V to 3.1 V**
  • **$\overline{CE1}$s and CE2s Chip Select**
  • **Byte data control: $\overline{LB}$ (DQ$_7$ to DQ$_0$), $\overline{UB}$ (DQ$_{15}$ to DQ$_8$)**

*1 : FlexBank™ is a trademark of Fujitsu Limited, Japan.
*2 : Embedded Erase™ and Embedded Program™ are trademarks of Advanced Micro Devices, Inc.

■ **PIN ASSIGNMENT**

(Top View)
Marking side

| A10
N.C. | B10
N.C. | | | F10
N.C. | G10
N.C. | | | L10
N.C. | M10
N.C. |

| | | D9
A15 | E9
A21 | F9
N.C. | G9
A16 | H9
CIOf | J9
VSS | | |

| | C8
A11 | D8
A12 | E8
A13 | F8
A14 | G8
N.C. | H8
DQ15/A-1 | J8
DQ7 | K8
DQ14 | |

| | C7
A8 | D7
A19 | E7
A9 | F7
A10 | G7
DQ6 | H7
DQ13 | J7
DQ12 | K7
DQ5 | |

| B6
N.C. | C6
$\overline{WE}$ | D6
CE2s | E6
A20 | | | H6
DQ4 | J6
VCCs | K6
N.C. | L6
N.C. |

| B5
N.C. | C5
$\overline{WP/ACC}$ | D5
$\overline{RESET}$ | E5
$\overline{RY}/BY$ | | | H5
DQ3 | J5
VCCf | K5
DQ11 | L5
N.C. |

| | C4
$\overline{LB}$ | D4
$\overline{UB}$ | E4
A18 | F4
A17 | G4
DQ1 | H4
DQ9 | J4
DQ10 | K4
DQ2 | |

| | C3
A7 | D3
A6 | E3
A5 | F3
A4 | G3
VSS | H3
$\overline{OE}$ | J3
DQ0 | K3
DQ8 | |

| | | D2
A3 | E2
A2 | F2
A1 | G2
A0 | H2
$\overline{CEf}$ | J2
$\overline{CE1s}$ | | |

| A1
N.C. | B1
N.C. | C1
N.C. | | F1
N.C. | G1
N.C. | | | L1
N.C. | M1
N.C. |

(BGA-73P-M03)

■ PIN DESCRIPTION

Pin name	Input/Output	Description
A_{17} to A_0	I	Address Inputs (Common)
A_{21} to A_{18} , A_{-1}	I	Address Inputs (Flash)
DQ_{15} to DQ_0	I/O	Data Inputs/Outputs (Common)
$\overline{CE}f$	I	Chip Enable (Flash)
$\overline{CE1}s$	I	Chip Enable (SRAM)
CE2s	I	Chip Enable (SRAM)
$\overline{OE}$	I	Output Enable (Common)
$\overline{WE}$	I	Write Enable (Common)
RY/$\overline{BY}$	O	Ready/Busy Output (Flash) Open Drain Output
$\overline{UB}$	I	Upper Byte Control (SRAM)
$\overline{LB}$	I	Lower Byte Control (SRAM)
CIOf	I	I/O Configulation (Flash) CIOf = Vccf is Word mode (×16), CIOf = Vss is Byte mode (×8)
$\overline{RESET}$	I	Hardware Reset Pin/Sector Protection Unlock (Flash)
$\overline{WP}$/ACC	I	Write Protect / Acceleration (Flash)
N.C.	—	No Internal Connection
V_{SS}	Power	Device Ground (Common)
$V_{CC}f$	Power	Device Power Supply (Flash)
$V_{CC}s$	Power	Device Power Supply (SRAM)

■ **BLOCK DIAGRAM**
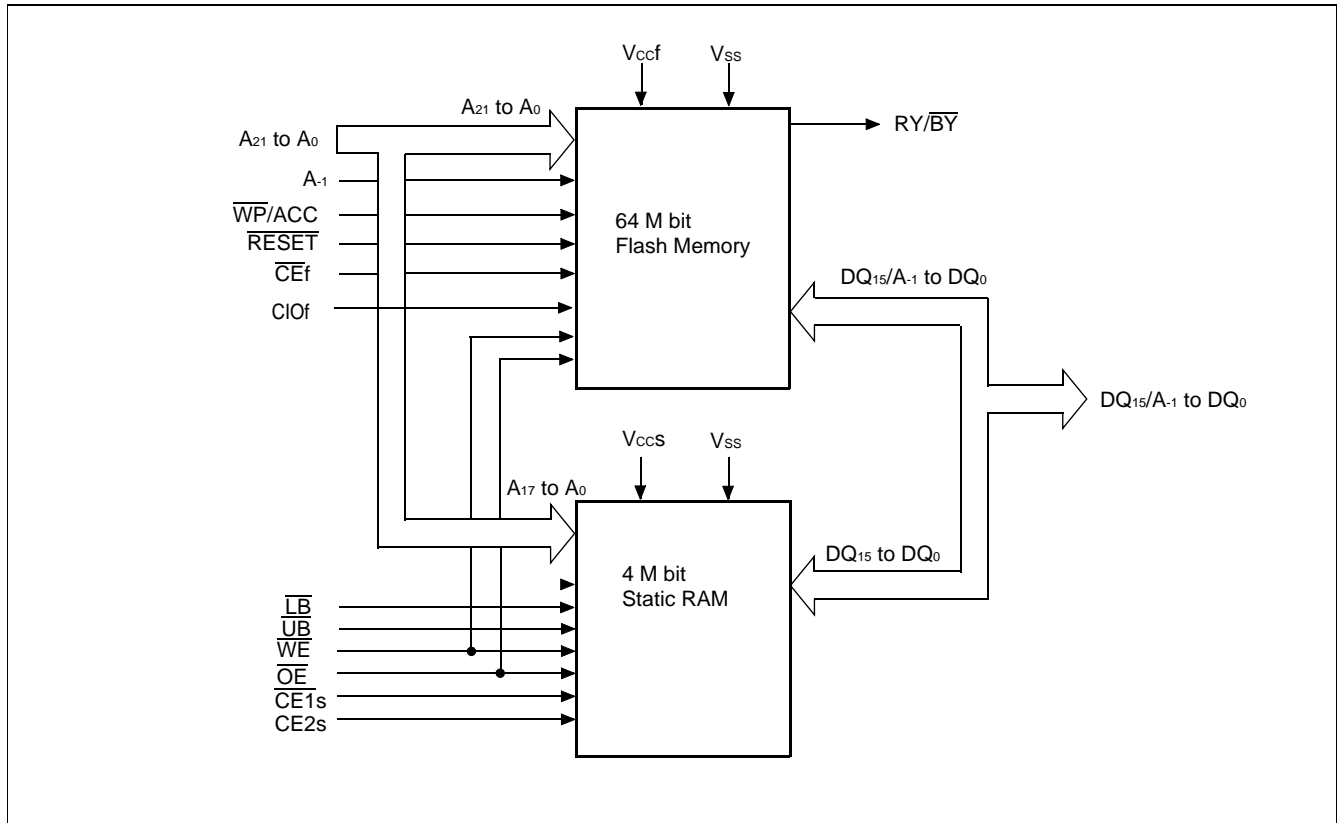
■ DEVICE BUS OPERATIONS

User Bus Operations (Flash=Word mode; CIOf=V_{ccf})

Operation [1],[3]	$\overline{CEf}$	$\overline{CE1s}$	CE2s	$\overline{OE}$	$\overline{WE}$	$\overline{LB}$	$\overline{UB}$	DQ_7 to DQ_0	DQ_{15} to DQ_8	$\overline{RESET}$	$\overline{WP}/$ACC[5]
Full Standby	H	H	X	X	X	X	X	High-Z	High-Z	H	X
		X	L								
Output Disable	H	L	H	H	H	X	X	High-Z	High-Z	H	X
				X	X	H	H	High-Z	High-Z		
	L	H	X	H	H	X	X	High-Z	High-Z		
		X	L								
Read from Flash [2]	L	H	X	L	H	X	X	D_{OUT}	D_{OUT}	H	X
		X	L								
Write to Flash	L	H	X	H	L	X	X	D_{IN}	D_{IN}	H	X
		X	L								
Read from SRAM	H	L	H	L	H	L	L	D_{OUT}	D_{OUT}	H	X
						H	L	High-Z	D_{OUT}		
						L	H	D_{OUT}	High-Z		
Write to SRAM	H	L	H	X	L	L	L	D_{IN}	D_{IN}	H	X
						H	L	High-Z	D_{IN}		
						L	H	D_{IN}	High-Z		
Temporary Sector Group Unprotection [4]	X	X	X	X	X	X	X	X	X	V_{ID}	X
Flash Hardware Reset	X	H	X	X	X	X	X	High-Z	High-Z	L	X
		X	L								
Boot Block Sector Write Protection	X	X	X	X	X	X	X	X	X	X	L

Legend: L = V_{IL}, H = V_{IH}, X = V_{IL} or V_{IH}. See DC Characteristics for voltage levels.

[1] : Other operations except for indicated this column are inhibited.

[2] : $\overline{WE}$ can be V_{IL} if $\overline{OE}$ is V_{IL}, $\overline{OE}$ at V_{IH} initiates the write operations.

[3] : Do not apply $\overline{CEf}$ = V_{IL}, $\overline{CE1s}$ = V_{IL} and CE2s = V_{IH} at a time.

[4] : It is also used for the extended sector group protections.

[5] : Protect of 2 of 8 Kbytes on both ends of each boot sector.

User Bus Operations (Flash=Byte mode; CIOf=V_{ss})

Operation [1], [3]	$\overline{CEf}$	$\overline{CE1s}$	CE2s	DQ15/A−1	$\overline{OE}$	$\overline{WE}$	$\overline{LB}$ (6)	$\overline{UB}$ (6)	DQ0 to DQ7	DQ8 to DQ14	$\overline{RESET}$	$\overline{WP}$/ACC[5]
Full Standby	H	H	X	X	X	X	X	X	High-Z	High-Z	H	X
		X	L									
Output Disable	H	L	H	X	H	H	X	X	High-Z	High-Z	H	X
				X	X	X	H	H	High-Z	High-Z		
	L	H	X	A−1	H	H	X	X	High-Z	High-Z		
		X	L									
Read from Flash[2]	L	H	X	A−1	L	H	X	X	D_{OUT}	X	H	X
		X	L									
Write to Flash	L	H	X	A−1	H	L	X	X	D_{IN}	X	H	X
		X	L									
Read from SRAM	H	L	H	X	L	H	X	X	D_{OUT}	High-Z	H	X
Write to SRAM	H	L	H	X	X	L	X	X	D_{IN}	High-Z	H	X
Temporary Sector Group Un-protection[4]	X	X	X	X	X	X	X	X	X	X	V_{ID}	X
Flash Hardware Reset	X	H	X	X	X	X	X	X	High-Z	High-Z	L	X
		X	L									
Boot Block Sector Write Protection	X	X	X	X	X	X	X	X	X	X	X	L

Legend: L = V_{IL}, H = V_{IH}, X = V_{IL} or V_{IH}. See DC Characteristics for voltage levels.

[1] : Other operations except for indicated this column are inhibited.

[2] : $\overline{WE}$ can be V_{IL} if $\overline{OE}$ is V_{IL}, $\overline{OE}$ at V_{IH} initiates the write operations.

[3] : Do not apply $\overline{CEf}$ = V_{IL}, $\overline{CE1s}$ = V_{IL} and CE2s = V_{IH} at a time.

[4] : It is also used for the extended sector group protections.

[5] : Protect of 2 of 8 Kbytes on both ends of each boot sector.

■ **ABSOLUTE MAXIMUM RATINGS**

Parameter	Symbol	Rating		Unit
		Min	**Max**	
Storage Temperature	Tstg	−55	+125	°C
Ambient Temperature with Power Applied	Ta	−30	+85	°C
Voltage with Respect to Ground All pins except $\overline{\text{RESET}}$,$\overline{\text{WP}}$/ACC *1	V_{IN}, V_{OUT}	−0.3	$V_{CC}f$ +0.3	V
			$V_{CC}s$ +0.3	V
$V_{CC}f$/$V_{CC}s$ Supply *1	$V_{CC}f$, $V_{CC}s$	−0.3	+3.3	V
$\overline{\text{RESET}}$ *2	V_{IN}	−0.5	+ 13.0	V
$\overline{\text{WP}}$/ACC *3	V_{IN}	−0.5	+10.5	V

*1: Minimum DC voltage on input or I/O pins is −0.3 V. During voltage transitions, input or I/O pins may undershoot V_{SS} to −2.0 V for periods of up to 20 ns. Maximum DC voltage on input or I/O pins is $V_{CC}f$ + 0.3 V or $V_{CC}s$ + 0.3 V. During voltage transitions, input or I/O pins may overshoot to $V_{CC}f$ + 2.0 V or $V_{CC}s$ + 2.0 V for periods of up to 20 ns.

*2: Minimum DC input voltage on $\overline{\text{RESET}}$ pin is −0.5 V. During voltage transitions, $\overline{\text{RESET}}$ pins may undershoot V_{SS} to −2.0 V for periods of up to 20 ns. Voltage difference between input and supply voltage (V_{IN}-$V_{CC}f$ or $V_{CC}s$) does not exceed +9.0 V. Maximum DC input voltage on $\overline{\text{RESET}}$ pins is +13.0 V which may overshoot to +14.0 V for periods of up to 20 ns.

*3: Minimum DC input voltage on $\overline{\text{WP}}$/ACC pin is −0.5 V. During voltage transitions, $\overline{\text{WP}}$/ACC pin may undershoot V_{SS} to −2.0 V for periods of up to 20 ns. Maximum DC input voltage on $\overline{\text{WP}}$/ACC pin is +10.5 V which may overshoot to +12.0 V for periods of up to 20 ns, when $V_{CC}f$ is applied.

WARNING: Semiconductor devices can be permanently damaged by application of stress (voltage, current, temperature, etc.) in excess of absolute maximum ratings. Do not exceed these ratings.

■ **RECOMMENDED OPERATING CONDITIONS**

Parameter	Symbol	Value		Unit
		Min	**Max**	
Ambient Temperature	Ta	−30	+85	°C
$V_{CC}f$/$V_{CC}s$ Supply Voltages	$V_{CC}f$, $V_{CC}s$	+2.7	+3.1	V

Note: Operating ranges define those limits between which the functionality of the device is guaranteed.

WARNING: The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device's electrical characteristics are warranted when the device is operated within these ranges.

Always use semiconductor devices within their recommended operating condition ranges. Operation outside these ranges may adversely affect reliability and could result in device failure.

No warranty is made with respect to uses, operating conditions, or combinations not represented on the data sheet. Users considering application outside the listed conditions are advised to contact their FUJITSU representatives beforehand.

■ ELECTRICAL CHARACTERISTICS

1. DC Characteristics

Parameter	Symbol	Conditions			Value			Unit
					Min	Typ	Max	
Input Leakage Current	I_{LI}	$V_{IN} = V_{SS}$ to $V_{CC}f$, $V_{CC}s$			−1.0	—	+1.0	μA
Output Leakage Current	I_{LO}	$V_{OUT} = V_{SS}$ to $V_{CC}f$, $V_{CC}s$			−1.0	—	+1.0	μA
$\overline{RESET}$ Inputs Leakage Current	I_{LIT}	$V_{CC}f = V_{CC}f$ Max, $V_{CC}s = V_{CC}s$ Max, $\overline{RESET} = 12.5$ V			—	—	35	μA
A_{CC} Input Leakage Current	I_{LIA}	$V_{CC}f = V_{CC}f$ Max, $V_{CC}s = V_{CC}s$ Max, $\overline{WP}/ACC = V_{ACC}$ Max			—	—	20	mA
Flash V_{CC} Active Current (Read) *1	$I_{CC1}f$	$\overline{CE}f = V_{IL}$, $\overline{OE} = V_{IH}$	$t_{CYCLE} = 5$ MHz	Word	—	—	18	mA
			$t_{CYCLE} = 1$ MHz	Word	—	—	4	
			$t_{CYCLE} = 5$ MHz	Byte	—	—	16	mA
			$t_{CYCLE} = 1$ MHz	Byte	—	—	4	mA
Flash V_{CC} Active Current (Program/Erase) *2	$I_{CC2}f$	$\overline{CE}f = V_{IL}$, $\overline{OE} = V_{IH}$			—	—	30	mA
Flash V_{CC} Active Current (Read-While-Program) *5	$I_{CC3}f$	$\overline{CE}f = V_{IL}$, $\overline{OE} = V_{IH}$	Word		—	—	48	mA
			Byte		—	—	46	mA
Flash V_{CC} Active Current (Read-While-Erase) *5	$I_{CC4}f$	$\overline{CE}f = V_{IL}$, $\overline{OE} = V_{IH}$	Word		—	—	48	mA
			Byte		—	—	46	mA
Flash V_{CC} Active Current (Erase-Suspend-Program)	$I_{CC5}f$	$\overline{CE}f = V_{IL}$, $\overline{OE} = V_{IH}$			—	—	30	mA
SRAM V_{CC} Active Current	$I_{CC1}s$	$V_{CC}s = V_{CC}s$ Max, $\overline{CE1}s = V_{IL}$, CE2s = V_{IH}	$t_{CYCLE} = 10$ MHz		—	—	40	mA
SRAM V_{CC} Active Current	$I_{CC2}s$	$\overline{CE1}s = 0.2$ V, CE2s = $V_{CC}s − 0.2$ V	$t_{CYCLE} = 10$ MHz		—	—	40	mA
			$t_{CYCLE} = 1$ MHz		—	—	8	mA
Flash V_{CC} Standby Current	$I_{SB1}f$	$V_{CC}f = V_{CC}f$ Max, $\overline{CE}f = V_{CC}f \pm 0.3$ V $\overline{RESET} = V_{CC}f \pm 0.3$ V, $\overline{WP}/ACC = V_{CC}f \pm 0.3$ V			—	1	5	μA
Flash V_{CC} Standby Current ($\overline{RESET}$)	$I_{SB2}f$	$V_{CC}f = V_{CC}f$ Max, $\overline{RESET} = V_{SS} \pm 0.3$ V, $\overline{WP}/ACC = V_{CC}f \pm 0.3$ V			—	1	5	μA
Flash V_{CC} Current (Automatic Sleep Mode) *3	$I_{SB3}f$	$V_{CC}f = V_{CC}f$ Max, $\overline{CE}f = V_{SS} \pm 0.3$ V $\overline{RESET} = V_{CC}f \pm 0.3$ V, $\overline{WP}/ACC = V_{CC}f \pm 0.3$ V, $V_{IN} = V_{CC}f \pm 0.3$ V or $V_{SS} \pm 0.3$ V			—	1	5	μA
SRAM V_{CC} Standby Current	$I_{SB1}s$	$\overline{CE1}s \geq V_{CC}s − 0.2$ V, CE2s $\geq V_{CC}s − 0.2$ V $\overline{LB} = \overline{UB} \geq V_{CC}s − 0.2$ V or ≤ 0.2V			—	—	10	μA
SRAM V_{CC} Standby Current	$I_{SB2}s$	$\overline{CE1}s \geq V_{CC}s − 0.2$ V or ≤ 0.2V, CE2s ≤ 0.2 V $\overline{LB} = \overline{UB} \geq V_{CC}s − 0.2$ V or ≤ 0.2V			—	—	10	μA

(Continued)

Parameter	Symbol	Conditions		Value			Unit
				Min	Typ	Max	
Input Low Level	V_{IL}	—		−0.3	—	0.5	V
Input High Level	V_{IH}	—		2.4	—	V_{CC}+0.3 [6]	V
Voltage for Sector Protection, and Temporary Sector Unprotection ($\overline{RESET}$) [4]	V_{ID}	—		11.5	12	12.5	V
Voltage for Program Acceleration ($\overline{WP}$/ACC) [4]	V_{ACC}	—		8.5	9.0	9.5	V
Output Low Voltage Level	V_{OL}	$V_{CC}f = V_{CC}f$ Min, I_{OL}=4.0 mA	Flash	—	—	0.45	V
		$V_{CC}s = V_{CC}s$ Min, I_{OL}=1.0 mA	SRAM	—	—	0.4	V
Output High Voltage Level	V_{OH}	$V_{CC}f = V_{CC}f$ Min, I_{OH}=−0.1 mA	Flash	0.85× $V_{CC}f$	—	—	V
		$V_{CC}s = V_{CC}s$ Min, I_{OH}=−0.5 mA	SRAM	2.2	—	—	V
Flash Low $V_{CC}f$ Lock-Out Voltage	V_{LKO}	—		2.3	2.4	2.5	V

[1]: The I_{CC} current listed includes both the DC operating current and the frequency dependent component.

[2]: I_{CC} active while Embedded Algorithm (program or erase) is in progress.

[3]: Automatic sleep mode enables the low power mode when address remains stable for 150 ns.

[4]: Applicable for only $V_{CC}f$ applying.

[5]: Embedded Algorithm (program or erase) is in progress. (@5 MHz)

[6]: V_{CC} indicates lower of $V_{CC}f$ or $V_{CC}s$.

2. AC Characteristics

• $\overline{CE}$ Timing

Parameter	Symbol		Condition	Value		Unit
	JEDEC	**Standard**		**Min**	**Max**	
$\overline{CE}$ Recover Time	—	t_{CCR}	—	0	—	ns
$\overline{CE}$ Hold Time	—	t_{CHOLD}	—	3	—	ns

• **Timing Diagram for alternating SRAM to Flash**
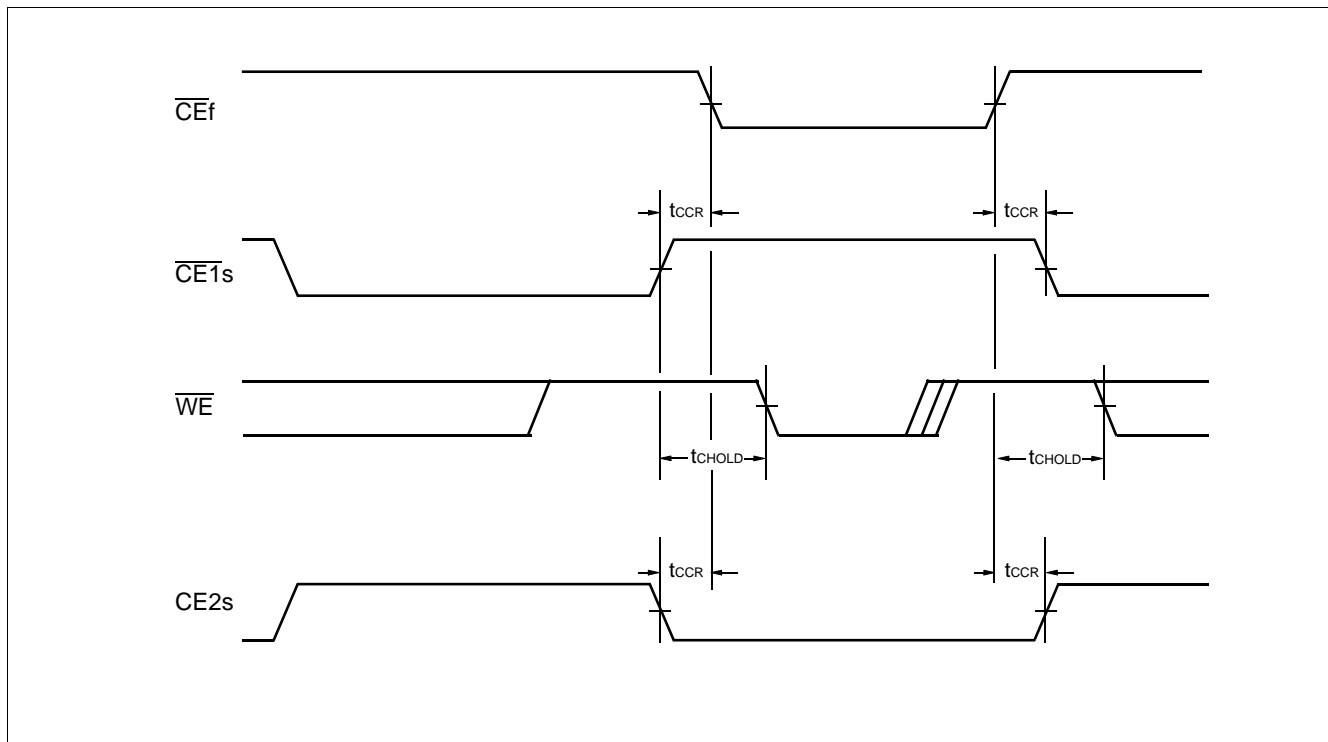
• **Flash characteristics**

Please refer to "■ 64M FLASH MEMORY CHARACTERISTICS for MCP" part.

• **SRAM characteristics**

Please refer to "■ 4M SRAM MEMORY CHARACTERISTICS for MCP" part.

■ 64M FLASH MEMORY FOR MCP

1. Flexible Sector-erase Architecture on Flash Memory
- Sixteen 4K words, and one hundred twenty-six 32 K words.
- Individual-sector, multiple-sector, or bulk-erase capability.

Word Mode (left)

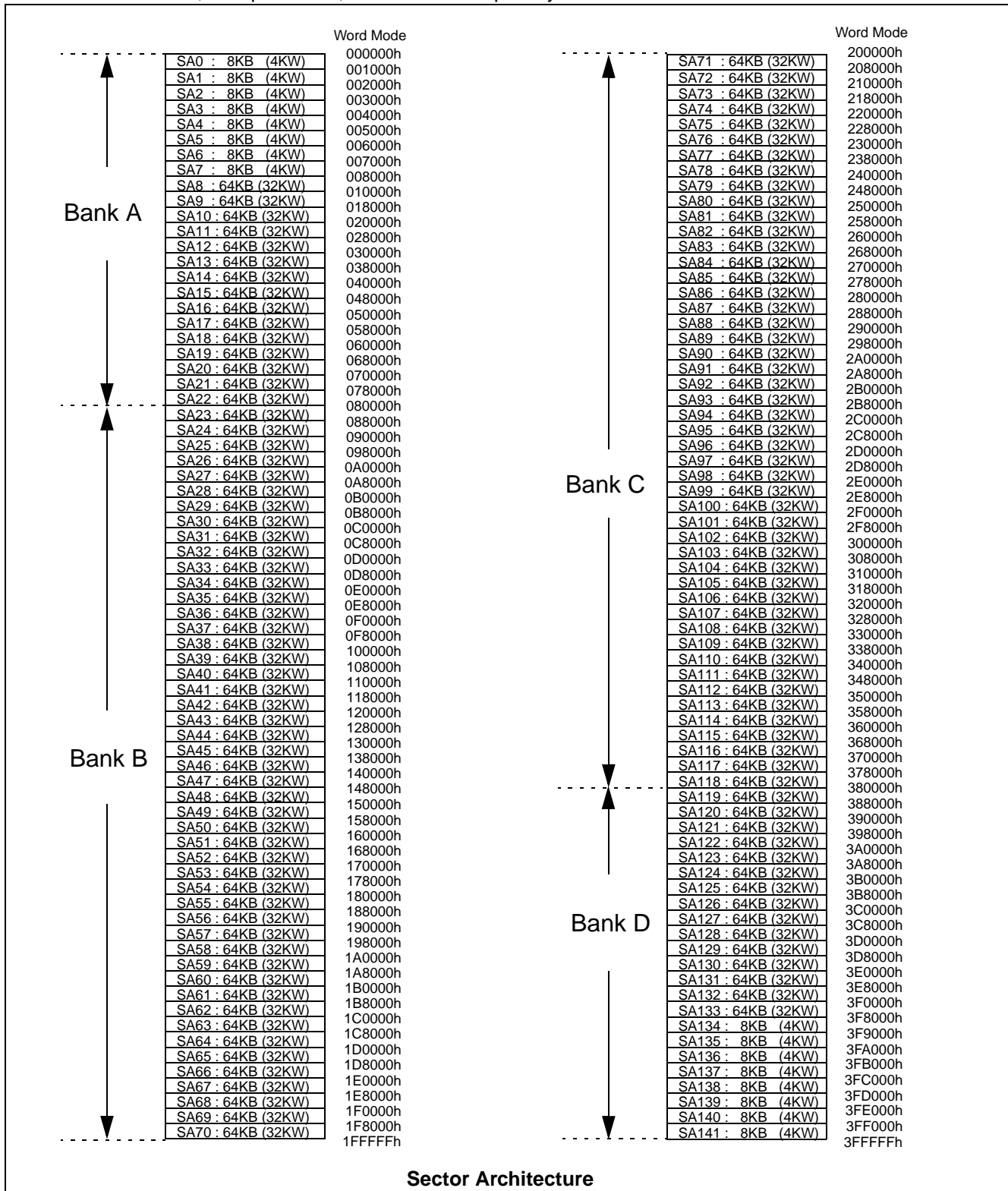| Bank	Sector	Word Mode
Bank A	SA0 : 8KB (4KW)	000000h
	SA1 : 8KB (4KW)	001000h
	SA2 : 8KB (4KW)	002000h
	SA3 : 8KB (4KW)	003000h
	SA4 : 8KB (4KW)	004000h
	SA5 : 8KB (4KW)	005000h
	SA6 : 8KB (4KW)	006000h
	SA7 : 8KB (4KW)	007000h
	SA8 : 64KB (32KW)	008000h
	SA9 : 64KB (32KW)	010000h
	SA10 : 64KB (32KW)	018000h
	SA11 : 64KB (32KW)	020000h
	SA12 : 64KB (32KW)	028000h
	SA13 : 64KB (32KW)	030000h
	SA14 : 64KB (32KW)	038000h
	SA15 : 64KB (32KW)	040000h
	SA16 : 64KB (32KW)	048000h
	SA17 : 64KB (32KW)	050000h
	SA18 : 64KB (32KW)	058000h
	SA19 : 64KB (32KW)	060000h
	SA20 : 64KB (32KW)	068000h
	SA21 : 64KB (32KW)	070000h
	SA22 : 64KB (32KW)	078000h
	SA23 : 64KB (32KW)	080000h
	SA24 : 64KB (32KW)	088000h
	SA25 : 64KB (32KW)	090000h
	SA26 : 64KB (32KW)	098000h
	SA27 : 64KB (32KW)	0A0000h
	SA28 : 64KB (32KW)	0A8000h
	SA29 : 64KB (32KW)	0B0000h
	SA30 : 64KB (32KW)	0B8000h
	SA31 : 64KB (32KW)	0C0000h
	SA32 : 64KB (32KW)	0C8000h
	SA33 : 64KB (32KW)	0D0000h
	SA34 : 64KB (32KW)	0D8000h
	SA35 : 64KB (32KW)	0E0000h
	SA36 : 64KB (32KW)	0E8000h
	SA37 : 64KB (32KW)	0F0000h
	SA38 : 64KB (32KW)	0F8000h
	SA39 : 64KB (32KW)	100000h
	SA40 : 64KB (32KW)	108000h
	SA41 : 64KB (32KW)	110000h
	SA42 : 64KB (32KW)	118000h
	SA43 : 64KB (32KW)	120000h
	SA44 : 64KB (32KW)	128000h
Bank B	SA45 : 64KB (32KW)	130000h
	SA46 : 64KB (32KW)	138000h
	SA47 : 64KB (32KW)	140000h
	SA48 : 64KB (32KW)	148000h
	SA49 : 64KB (32KW)	150000h
	SA50 : 64KB (32KW)	158000h
	SA51 : 64KB (32KW)	160000h
	SA52 : 64KB (32KW)	168000h
	SA53 : 64KB (32KW)	170000h
	SA54 : 64KB (32KW)	178000h
	SA55 : 64KB (32KW)	180000h
	SA56 : 64KB (32KW)	188000h
	SA57 : 64KB (32KW)	190000h
	SA58 : 64KB (32KW)	198000h
	SA59 : 64KB (32KW)	1A0000h
	SA60 : 64KB (32KW)	1A8000h
	SA61 : 64KB (32KW)	1B0000h
	SA62 : 64KB (32KW)	1B8000h
	SA63 : 64KB (32KW)	1C0000h
	SA64 : 64KB (32KW)	1C8000h
	SA65 : 64KB (32KW)	1D0000h
	SA66 : 64KB (32KW)	1D8000h
	SA67 : 64KB (32KW)	1E0000h
	SA68 : 64KB (32KW)	1E8000h
	SA69 : 64KB (32KW)	1F0000h
	SA70 : 64KB (32KW)	1F8000h
		1FFFFFh

Word Mode (right)

Bank	Sector	Word Mode
Bank C	SA71 : 64KB (32KW)	200000h
	SA72 : 64KB (32KW)	208000h
	SA73 : 64KB (32KW)	210000h
	SA74 : 64KB (32KW)	218000h
	SA75 : 64KB (32KW)	220000h
	SA76 : 64KB (32KW)	228000h
	SA77 : 64KB (32KW)	230000h
	SA78 : 64KB (32KW)	238000h
	SA79 : 64KB (32KW)	240000h
	SA80 : 64KB (32KW)	248000h
	SA81 : 64KB (32KW)	250000h
	SA82 : 64KB (32KW)	258000h
	SA83 : 64KB (32KW)	260000h
	SA84 : 64KB (32KW)	268000h
	SA85 : 64KB (32KW)	270000h
	SA86 : 64KB (32KW)	278000h
	SA87 : 64KB (32KW)	280000h
	SA88 : 64KB (32KW)	288000h
	SA89 : 64KB (32KW)	290000h
	SA90 : 64KB (32KW)	298000h
	SA91 : 64KB (32KW)	2A0000h
	SA92 : 64KB (32KW)	2A8000h
	SA93 : 64KB (32KW)	2B0000h
	SA94 : 64KB (32KW)	2B8000h
	SA95 : 64KB (32KW)	2C0000h
	SA96 : 64KB (32KW)	2C8000h
	SA97 : 64KB (32KW)	2D0000h
	SA98 : 64KB (32KW)	2D8000h
	SA99 : 64KB (32KW)	2E0000h
	SA100 : 64KB (32KW)	2E8000h
	SA101 : 64KB (32KW)	2F0000h
	SA102 : 64KB (32KW)	2F8000h
	SA103 : 64KB (32KW)	300000h
	SA104 : 64KB (32KW)	308000h
	SA105 : 64KB (32KW)	310000h
	SA106 : 64KB (32KW)	318000h
	SA107 : 64KB (32KW)	320000h
	SA108 : 64KB (32KW)	328000h
	SA109 : 64KB (32KW)	330000h
	SA110 : 64KB (32KW)	338000h
	SA111 : 64KB (32KW)	340000h
	SA112 : 64KB (32KW)	348000h
	SA113 : 64KB (32KW)	350000h
	SA114 : 64KB (32KW)	358000h
	SA115 : 64KB (32KW)	360000h
	SA116 : 64KB (32KW)	368000h
	SA117 : 64KB (32KW)	370000h
	SA118 : 64KB (32KW)	378000h
Bank D	SA119 : 64KB (32KW)	380000h
	SA120 : 64KB (32KW)	388000h
	SA121 : 64KB (32KW)	390000h
	SA122 : 64KB (32KW)	398000h
	SA123 : 64KB (32KW)	3A0000h
	SA124 : 64KB (32KW)	3A8000h
	SA125 : 64KB (32KW)	3B0000h
	SA126 : 64KB (32KW)	3B8000h
	SA127 : 64KB (32KW)	3C0000h
	SA128 : 64KB (32KW)	3C8000h
	SA129 : 64KB (32KW)	3D0000h
	SA130 : 64KB (32KW)	3D8000h
	SA131 : 64KB (32KW)	3E0000h
	SA132 : 64KB (32KW)	3E8000h
	SA133 : 64KB (32KW)	3F0000h
	SA134 : 8KB (4KW)	3F8000h
	SA135 : 8KB (4KW)	3F9000h
	SA136 : 8KB (4KW)	3FA000h
	SA137 : 8KB (4KW)	3FB000h
	SA138 : 8KB (4KW)	3FC000h
	SA139 : 8KB (4KW)	3FD000h
	SA140 : 8KB (4KW)	3FE000h
	SA141 : 8KB (4KW)	3FF000h
		3FFFFFh

Sector Architecture

FlexBank™ Architecture

Bank Splits	Bank 1		Bank 2	
	Volume	Combination	Volume	Combination
1	8 Mbit	Bank A	56 Mbit	Remainder (Bank B, C, D)
2	24 Mbit	Bank B	40 Mbit	Remainder (Bank A, C, D)
3	24 Mbit	Bank C	40 Mbit	Remainder (Bank A, B, D)
4	8 Mbit	Bank D	56 Mbit	Remainder (Bank A, B, C)

Example of Virtual Banks Combination

Bank Splits	Bank 1			Bank 2		
	Volume	Combination	Sector Size	Volume	Combination	Sector Size
1	8 Mbit	Bank A	8 × 8 Kbyte/4 Kword + 15 × 64 Kbyte/32 Kword	56 Mbit	Bank B + Bank C + Bank D	8 × 8 Kbyte/4 Kword + 111 × 64 Kbyte/32 Kword
2	16 Mbit	Bank A + Bank D	16 × 8 Kbyte/4 Kword + 30 × 64 Kbyte/32 Kword	48 Mbit	Bank B + Bank C	96 × 64 Kbyte/32 Kword
3	24 Mbit	Bank B	48 × 64 Kbyte/32 Kword	40 Mbit	Bank A + Bank C + Bank D	16 × 8 Kbyte/4 Kword + 78 × 64 Kbyte/32 Kword
4	32 Mbit	Bank A + Bank B	8 × 8 Kbyte/4 Kword + 63 × 64 Kbyte/32 Kword	32 Mbit	Bank C + Bank D	8 × 8 Kbyte/4 Kword + 63 × 64 Kbyte/32 Kword

Note : When multiple sector erase over several banks is operated, the system cannot read out of the bank to which a sector being erased belongs. For example, suppose that erasing is taking place at both Bank A and Bank B, neither Bank A nor Bank B is read out (they would output the sequence flag once they were selected.) Meanwhile the system would get to read from either Bank C or Bank D.

Simultaneous Operation

Case	Bank 1 Status	Bank 2 Status
1	Read mode	Read mode
2	Read mode	Autoselect mode
3	Read mode	Program mode
4	Read mode	Erase mode *
5	Autoselect mode	Read mode
6	Program mode	Read mode
7	Erase mode *	Read mode

* : By writing erase suspend command on the bank address of sector being erased, the erase operation gets suspended so that it enables reading from or programming the remaining sectors.

Note: Bank 1 and Bank 2 are divided for the sake of convenience at Simultaneous Operation. Actually, the Bank consists of 4 banks, Bank A, Bank B, BankC and Bank D. Bank Address (BA) meant to specify each of the Banks.

Sector Address Tables

Bank	Sector	Sector Address										Address Range
		Bank Address										Word Mode
		A21	A20	A19	A18	A17	A16	A15	A14	A13	A12	
Bank A	SA0	0	0	0	0	0	0	0	0	0	0	000000h to 000FFFh
	SA1	0	0	0	0	0	0	0	0	0	1	001000h to 001FFFh
	SA2	0	0	0	0	0	0	0	0	1	0	002000h to 002FFFh
	SA3	0	0	0	0	0	0	0	0	1	1	003000h to 003FFFh
	SA4	0	0	0	0	0	0	0	1	0	0	004000h to 004FFFh
	SA5	0	0	0	0	0	0	0	1	0	1	005000h to 005FFFh
	SA6	0	0	0	0	0	0	0	1	1	0	006000h to 006FFFh
	SA7	0	0	0	0	0	0	0	1	1	1	007000h to 007FFFh
	SA8	0	0	0	0	0	0	1	X	X	X	008000h to 00FFFFh
	SA9	0	0	0	0	0	1	0	X	X	X	010000h to 017FFFh
	SA10	0	0	0	0	0	1	1	X	X	X	018000h to 01FFFFh
	SA11	0	0	0	0	1	0	0	X	X	X	020000h to 027FFFh
	SA12	0	0	0	0	1	0	1	X	X	X	028000h to 02FFFFh
	SA13	0	0	0	0	1	1	0	X	X	X	030000h to 037FFFh
	SA14	0	0	0	0	1	1	1	X	X	X	038000h to 03FFFFh
	SA15	0	0	0	1	0	0	0	X	X	X	040000h to 047FFFh
	SA16	0	0	0	1	0	0	1	X	X	X	048000h to 04FFFFh
	SA17	0	0	0	1	0	1	0	X	X	X	050000h to 057FFFh
	SA18	0	0	0	1	0	1	1	X	X	X	058000h to 05FFFFh
	SA19	0	0	0	1	1	0	0	X	X	X	060000h to 067FFFh
	SA20	0	0	0	1	1	0	1	X	X	X	068000h to 06FFFFh
	SA21	0	0	0	1	1	1	0	X	X	X	070000h to 077FFFh
	SA22	0	0	0	1	1	1	1	X	X	X	078000h to 07FFFFh

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Bank	Sector	A21	A20	A19	A18	A17	A16	A15	A14	A13	A12	Word Mode
		Bank Address			**Sector Address**							**Address Range**
Bank B	SA23	0	0	1	0	0	0	0	X	X	X	080000h to 087FFFh
	SA24	0	0	1	0	0	0	1	X	X	X	088000h to 08FFFFh
	SA25	0	0	1	0	0	1	0	X	X	X	090000h to 097FFFh
	SA26	0	0	1	0	0	1	1	X	X	X	098000h to 09FFFFh
	SA27	0	0	1	0	1	0	0	X	X	X	0A0000h to 0A7FFFh
	SA28	0	0	1	0	1	0	1	X	X	X	0A8000h to 0AFFFFh
	SA29	0	0	1	0	1	1	0	X	X	X	0B0000h to 0B7FFFh
	SA30	0	0	1	0	1	1	1	X	X	X	0B8000h to 0BFFFFh
	SA31	0	0	1	1	0	0	0	X	X	X	0C0000h to 0C7FFFh
	SA32	0	0	1	1	0	0	1	X	X	X	0C8000h to 0CFFFFh
	SA33	0	0	1	1	0	1	0	X	X	X	0D0000h to 0D7FFFh
	SA34	0	0	1	1	0	1	1	X	X	X	0D8000h to 0DFFFFh
	SA35	0	0	1	1	1	0	0	X	X	X	0E0000h to 0E7FFFh
	SA36	0	0	1	1	1	0	1	X	X	X	0E8000h to 0EFFFFh
	SA37	0	0	1	1	1	1	0	X	X	X	0F0000h to 0F7FFFh
	SA38	0	0	1	1	1	1	1	X	X	X	0F8000h to 0FFFFFh
	SA39	0	1	0	0	0	0	0	X	X	X	100000h to 107FFFh
	SA40	0	1	0	0	0	0	1	X	X	X	108000h to 10FFFFh
	SA41	0	1	0	0	0	1	0	X	X	X	110000h to 117FFFh
	SA42	0	1	0	0	0	1	1	X	X	X	118000h to 11FFFFh
	SA43	0	1	0	0	1	0	0	X	X	X	120000h to 127FFFh
	SA44	0	1	0	0	1	0	1	X	X	X	128000h to 12FFFFh
	SA45	0	1	0	0	1	1	0	X	X	X	130000h to 137FFFh
	SA46	0	1	0	0	1	1	1	X	X	X	138000h to 13FFFFh
	SA47	0	1	0	1	0	0	0	X	X	X	140000h to 147FFFh
	SA48	0	1	0	1	0	0	1	X	X	X	148000h to 14FFFFh
	SA49	0	1	0	1	0	1	0	X	X	X	150000h to 157FFFh
	SA50	0	1	0	1	0	1	1	X	X	X	158000h to 15FFFFh
	SA51	0	1	0	1	1	0	0	X	X	X	160000h to 167FFFh
	SA52	0	1	0	1	1	0	1	X	X	X	168000h to 16FFFFh
	SA53	0	1	0	1	1	1	0	X	X	X	170000h to 177FFFh
	SA54	0	1	0	1	1	1	1	X	X	X	178000h to 17FFFFh
	SA55	0	1	1	0	0	0	0	X	X	X	180000h to 187FFFh
	SA56	0	1	1	0	0	0	1	X	X	X	188000h to 18FFFFh
	SA57	0	1	1	0	0	1	0	X	X	X	190000h to 197FFFh
	SA58	0	1	1	0	0	1	1	X	X	X	198000h to 19FFFFh
	SA59	0	1	1	0	1	0	0	X	X	X	1A0000h to 1A7FFFh
	SA60	0	1	1	0	1	0	1	X	X	X	1A8000h to 1AFFFFh
	SA61	0	1	1	0	1	1	0	X	X	X	1B0000h to 1B7FFFh
	SA62	0	1	1	0	1	1	1	X	X	X	1B8000h to 1BFFFFh
	SA63	0	1	1	1	0	0	0	X	X	X	1C0000h to 1C7FFFh
	SA64	0	1	1	1	0	0	1	X	X	X	1C8000h to 1CFFFFh
	SA65	0	1	1	1	0	1	0	X	X	X	1D0000h to 1D7FFFh
	SA66	0	1	1	1	0	1	1	X	X	X	1D8000h to 1DFFFFh
	SA67	0	1	1	1	1	0	0	X	X	X	1E0000h to 1E7FFFh
	SA68	0	1	1	1	1	0	1	X	X	X	1E8000h to 1EFFFFh
	SA69	0	1	1	1	1	1	0	X	X	X	1F0000h to 1F7FFFh
	SA70	0	1	1	1	1	1	1	X	X	X	1F8000h to 1FFFFFh

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Bank	Sector	Sector Address										Address Range
		Bank Address										Word Mode
		A21	A20	A19	A18	A17	A16	A15	A14	A13	A12	
Bank C	SA71	1	0	0	0	0	0	0	X	X	X	200000h to 207FFFh
	SA72	1	0	0	0	0	0	1	X	X	X	208000h to 20FFFFh
	SA73	1	0	0	0	0	1	0	X	X	X	210000h to 217FFFh
	SA74	1	0	0	0	0	1	1	X	X	X	218000h to 21FFFFh
	SA75	1	0	0	0	1	0	0	X	X	X	220000h to 227FFFh
	SA76	1	0	0	0	1	0	1	X	X	X	228000h to 22FFFFh
	SA77	1	0	0	0	1	1	0	X	X	X	230000h to 237FFFh
	SA78	1	0	0	0	1	1	1	X	X	X	238000h to 23FFFFh
	SA79	1	0	0	1	0	0	0	X	X	X	240000h to 247FFFh
	SA80	1	0	0	1	0	0	1	X	X	X	248000h to 24FFFFh
	SA81	1	0	0	1	0	1	0	X	X	X	250000h to 257FFFh
	SA82	1	0	0	1	0	1	1	X	X	X	258000h to 25FFFFh
	SA83	1	0	0	1	1	0	0	X	X	X	260000h to 267FFFh
	SA84	1	0	0	1	1	0	1	X	X	X	268000h to 26FFFFh
	SA85	1	0	0	1	1	1	0	X	X	X	270000h to 277FFFh
	SA86	1	0	0	1	1	1	1	X	X	X	278000h to 27FFFFh
	SA87	1	0	1	0	0	0	0	X	X	X	280000h to 287FFFh
	SA88	1	0	1	0	0	0	1	X	X	X	288000h to 28FFFFh
	SA89	1	0	1	0	0	1	0	X	X	X	290000h to 297FFFh
	SA90	1	0	1	0	0	1	1	X	X	X	298000h to 29FFFFh
	SA91	1	0	1	0	1	0	0	X	X	X	2A0000h to 2A7FFFh
	SA92	1	0	1	0	1	0	1	X	X	X	2A8000h to 2AFFFFh
	SA93	1	0	1	0	1	1	0	X	X	X	2B0000h to 2B7FFFh
	SA94	1	0	1	0	1	1	1	X	X	X	2B8000h to 2BFFFFh
	SA95	1	0	1	1	0	0	0	X	X	X	2C0000h to 2C7FFFh
	SA96	1	0	1	1	0	0	1	X	X	X	2C8000h to 2CFFFFh
	SA97	1	0	1	1	0	1	0	X	X	X	2D0000h to 2D7FFFh
	SA98	1	0	1	1	0	1	1	X	X	X	2D8000h to 2DFFFFh
	SA99	1	0	1	1	1	0	0	X	X	X	2E0000h to 2E7FFFh
	SA100	1	0	1	1	1	0	1	X	X	X	2E8000h to 2EFFFFh
	SA101	1	0	1	1	1	1	0	X	X	X	2F0000h to 2F7FFFh
	SA102	1	0	1	1	1	1	1	X	X	X	2F8000h to 2FFFFFh
	SA103	1	1	0	0	0	0	0	X	X	X	300000h to 307FFFh
	SA104	1	1	0	0	0	0	1	X	X	X	308000h to 30FFFFh
	SA105	1	1	0	0	0	1	0	X	X	X	310000h to 317FFFh
	SA106	1	1	0	0	0	1	1	X	X	X	318000h to 31FFFFh
	SA107	1	1	0	0	1	0	0	X	X	X	320000h to 327FFFh
	SA108	1	1	0	0	1	0	1	X	X	X	328000h to 32FFFFh
	SA109	1	1	0	0	1	1	0	X	X	X	330000h to 337FFFh
	SA110	1	1	0	0	1	1	1	X	X	X	338000h to 33FFFFh
	SA111	1	1	0	1	0	0	0	X	X	X	340000h to 347FFFh
	SA112	1	1	0	1	0	0	1	X	X	X	348000h to 34FFFFh
	SA113	1	1	0	1	0	1	0	X	X	X	350000h to 357FFFh
	SA114	1	1	0	1	0	1	1	X	X	X	358000h to 35FFFFh
	SA115	1	1	0	1	1	0	0	X	X	X	360000h to 367FFFh
	SA116	1	1	0	1	1	0	1	X	X	X	368000h to 36FFFFh
	SA117	1	1	0	1	1	1	0	X	X	X	370000h to 377FFFh
	SA118	1	1	0	1	1	1	1	X	X	X	378000h to 37FFFFh

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Bank	Sector	Sector Address										Address Range
		Bank Address										Word Mode
		A_{21}	A_{20}	A_{19}	A_{18}	A_{17}	A_{16}	A_{15}	A_{14}	A_{13}	A_{12}	
Bank D	SA119	1	1	1	0	0	0	0	X	X	X	380000h to 387FFFh
	SA120	1	1	1	0	0	0	1	X	X	X	388000h to 38FFFFh
	SA121	1	1	1	0	0	1	0	X	X	X	390000h to 397FFFh
	SA122	1	1	1	0	0	1	1	X	X	X	398000h to 39FFFFh
	SA123	1	1	1	0	1	0	0	X	X	X	3A0000h to 3A7FFFh
	SA124	1	1	1	0	1	0	1	X	X	X	3A8000h to 3AFFFFh
	SA125	1	1	1	0	1	1	0	X	X	X	3B0000h to 3B7FFFh
	SA126	1	1	1	0	1	1	1	X	X	X	3B8000h to 3BFFFFh
	SA127	1	1	1	1	0	0	0	X	X	X	3C0000h to 3C7FFFh
	SA128	1	1	1	1	0	0	1	X	X	X	3C8000h to 3CFFFFh
	SA129	1	1	1	1	0	1	0	X	X	X	3D0000h to 3D7FFFh
	SA130	1	1	1	1	0	1	1	X	X	X	3D8000h to 3DFFFFh
	SA131	1	1	1	1	1	0	0	X	X	X	3E0000h to 3E7FFFh
	SA132	1	1	1	1	1	0	1	X	X	X	3E8000h to 3EFFFFh
	SA133	1	1	1	1	1	1	0	X	X	X	3F0000h to 3F7FFFh
	SA134	1	1	1	1	1	1	1	0	0	0	3F8000h to 3F8FFFh
	SA135	1	1	1	1	1	1	1	0	0	1	3F9000h to 3F9FFFh
	SA136	1	1	1	1	1	1	1	0	1	0	3FA000h to 3FAFFFh
	SA137	1	1	1	1	1	1	1	0	1	1	3FB000h to 3FBFFFh
	SA138	1	1	1	1	1	1	1	1	0	0	3FC000h to 3FCFFFh
	SA139	1	1	1	1	1	1	1	1	0	1	3FD000h to 3FDFFFh
	SA140	1	1	1	1	1	1	1	1	1	0	3FE000h to 3FEFFFh
	SA141	1	1	1	1	1	1	1	1	1	1	3FF000h to 3FFFFFh

Sector Group Addresses

Sector Group	A$_{21}$	A$_{20}$	A$_{19}$	A$_{18}$	A$_{17}$	A$_{16}$	A$_{15}$	A$_{14}$	A$_{13}$	A$_{12}$	Sectors
SGA0	0	0	0	0	0	0	0	0	0	0	SA0
SGA1	0	0	0	0	0	0	0	0	0	1	SA1
SGA2	0	0	0	0	0	0	0	0	1	0	SA2
SGA3	0	0	0	0	0	0	0	0	1	1	SA3
SGA4	0	0	0	0	0	0	0	1	0	0	SA4
SGA5	0	0	0	0	0	0	0	1	0	1	SA5
SGA6	0	0	0	0	0	0	0	1	1	0	SA6
SGA7	0	0	0	0	0	0	0	1	1	1	SA7
SGA8	0	0	0	0	0	0	1	X	X	X	SA8 to SA10
						1	0				
						1	1				
SGA9	0	0	0	0	1	X	X	X	X	X	SA11 to SA14
SGA10	0	0	0	1	0	X	X	X	X	X	SA15 to SA18
SGA11	0	0	0	1	1	X	X	X	X	X	SA19 to SA22
SGA12	0	0	1	0	0	X	X	X	X	X	SA23 to SA26
SGA13	0	0	1	0	1	X	X	X	X	X	SA27 to SA30
SGA14	0	0	1	1	0	X	X	X	X	X	SA31 to SA34
SGA15	0	0	1	1	1	X	X	X	X	X	SA35 to SA38
SGA16	0	1	0	0	0	X	X	X	X	X	SA39 to SA42
SGA17	0	1	0	0	1	X	X	X	X	X	SA43 to SA46
SGA18	0	1	0	1	0	X	X	X	X	X	SA47 to SA50
SGA19	0	1	0	1	1	X	X	X	X	X	SA51 to SA54
SGA20	0	1	1	0	0	X	X	X	X	X	SA55 to SA58
SGA21	0	1	1	0	1	X	X	X	X	X	SA59 to SA62
SGA22	0	1	1	1	0	X	X	X	X	X	SA63 to SA66
SGA23	0	1	1	1	1	X	X	X	X	X	SA67 to SA70
SGA24	1	0	0	0	0	X	X	X	X	X	SA71 to SA74
SGA25	1	0	0	0	1	X	X	X	X	X	SA75 to SA78
SGA26	1	0	0	1	0	X	X	X	X	X	SA79 to SA82
SGA27	1	0	0	1	1	X	X	X	X	X	SA83 to SA86
SGA28	1	0	1	0	0	X	X	X	X	X	SA87 to SA90
SGA29	1	0	1	0	1	X	X	X	X	X	SA91 to SA94
SGA30	1	0	1	1	0	X	X	X	X	X	SA95 to SA98
SGA31	1	0	1	1	1	X	X	X	X	X	SA99 to SA102
SGA32	1	1	0	0	0	X	X	X	X	X	SA103 to SA106
SGA33	1	1	0	0	1	X	X	X	X	X	SA107 to SA110
SGA34	1	1	0	1	0	X	X	X	X	X	SA111 to SA114
SGA35	1	1	0	1	1	X	X	X	X	X	SA115 to SA118
SGA36	1	1	1	0	0	X	X	X	X	X	SA119 to SA122
SGA37	1	1	1	0	1	X	X	X	X	X	SA123 to SA126
SGA38	1	1	1	1	0	X	X	X	X	X	SA127 to SA130
SGA39	1	1	1	1	1	0	0	X	X	X	SA131 to SA133
						0	1				
						1	0				
SGA40	1	1	1	1	1	1	1	0	0	0	SA134
SGA41	1	1	1	1	1	1	1	0	0	1	SA135
SGA42	1	1	1	1	1	1	1	0	1	0	SA136
SGA43	1	1	1	1	1	1	1	0	1	1	SA137
SGA44	1	1	1	1	1	1	1	1	0	0	SA138
SGA45	1	1	1	1	1	1	1	1	0	1	SA139
SGA46	1	1	1	1	1	1	1	1	1	0	SA140
SGA47	1	1	1	1	1	1	1	1	1	1	SA141

Flash Memory Autoselect Codes

Type	A_{21} to A_{12}	A_6	A_3	A_2	A_1	A_0	Code (HEX)
Manufacture's Code	BA	L	L	L	L	L	04h
Device Code	BA	L	L	L	L	H	227Eh
Extended Device Code *2	BA	L	H	H	H	L	2202h
	BA	L	H	H	H	H	2201h
Sector Group Protection	Sector Group Addresses	L	L	L	H	L	01h*1

Legend: L = V_{IL}, H = V_{IH}. See DC Characteristics for voltage levels.

*1 : Outputs 01h at protected sector group addresses and outputs 00h at unprotected sector group addresses.

*2 : A read cycle at address (BA) 01h outputs device code. When 227Eh was output, this indicates that there will require two additional codes, called Extended Device Codes. Therefore the system may continue reading out these Extended Device Codes at the address of (BA) 0Eh, as well as at (BA) 0Fh.

Flash Memory Command Definitions

Command Sequence	Bus Write Cycles Req'd	First Bus Write Cycle		Second Bus Write Cycle		Third Bus Write Cycle		Fourth Bus Read/Write Cycle		Fifth Bus Write Cycle		Sixth Bus Write Cycle	
		Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data
Read/Reset	1	XXXh	F0h	—	—	—	—	—	—	—	—	—	—
Read/Reset	3	555h	AAh	2AAh	55h	555h	F0h	RA	RD	—	—	—	—
Autoselect	3	555h	AAh	2AAh	55h	(BA) 555h	90h	—	—	—	—	—	—
Program	4	555h	AAh	2AAh	55h	555h	A0h	PA	PD	—	—	—	—
Program Suspend	1	BA	B0h	—	—	—	—	—	—	—	—	—	—
Program Re-sume	1	BA	30h	—	—	—	—	—	—	—	—	—	—
Chip Erase	6	555h	AAh	2AAh	55h	555h	80h	555h	AAh	2AAh	55h	555h	10h
Sector Erase	6	555h	AAh	2AAh	55h	555h	80h	555h	AAh	2AAh	55h	SA	30h
Erase Suspend	1	BA	B0h	—	—	—	—	—	—	—	—	—	—
Erase Resume	1	BA	30h	—	—	—	—	—	—	—	—	—	—
Extended Sector Group Protection *2	4	XXXh	60h	SPA	60h	SPA	40h	SPA	SD	—	—	—	—
Set to Fast Mode	3	555h	AAh	2AAh	55h	555h	20h	—	—	—	—	—	—
Fast Program *1	2	XXXh	A0h	PA	PD	—	—	—	—	—	—	—	—
Reset from Fast Mode *1	2	BA	90h	XXXh	*4 F0h	—	—	—	—	—	—	—	—
Query	1	(BA) 55h	98h	—	—	—	—	—	—	—	—	—	—
HiddenROM Entry	3	555h	AAh	2AAh	55h	555h	88h	—	—	—	—	—	—
HiddenROM Program *3	4	555h	AAh	2AAh	55h	555h	A0h	(HRA) PA	PD	—	—	—	—
HiddenROM Exit *3	4	555h	AAh	2AAh	55h	(HRBA) 555h	90h	XXXh	00h	—	—	—	—

(Continued)

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(Continued)

*1: This command is valid during Fast Mode.

*2: This command is valid while $\overline{RESET}$ = V$_{ID}$.

*3: This command is valid during HiddenROM mode.

*4: The data "00h" is also acceptable.

Notes : • Address bits A$_{21}$ to A$_{11}$ = X = "H" or "L" for all address commands except or Program Address (PA), Sector Address (SA), and Bank Address (BA), and Sector Group Address (SPA).
- Bus operations are defined in ■ DEVICE BUS OPERATION.
- RA = Address of the memory location to be read
  PA = Address of the memory location to be programmed
  Addresses are latched on the falling edge of the write pulse.
  SA = Address of the sector to be erased. The combination of A$_{21}$, A$_{20}$, A$_{19}$, A$_{18}$, A$_{17}$, A$_{16}$, A$_{15}$, A$_{14}$, A$_{13}$, and A$_{12}$ will uniquely select any sector.
  BA = Bank Address (A$_{21}$, A$_{20}$, A$_{19}$)
- RD = Data read from location RA during read operation.
  PD = Data to be programmed at location PA. Data is latched on the rising edge of write pulse.
- SPA = Sector group address to be protected. Set sector group address and (A$_6$, A$_3$, A$_2$, A$_1$, A$_0$) = (0, 0, 0, 1, 0).
  SD = Sector group protection verify data. Output 01h at protected sector group addresses and output 00h at unprotected sector group addresses.
- HRA = Address of the HiddenROM area: 000000h to 00007Fh
- HRBA = Bank Address of the HiddenROM area (A$_{21}$ = A$_{20}$ = A$_{19}$ = V$_{IL}$)
- The system should generate the following address patterns: 555h or 2AAh to addresses A$_{10}$ to A$_0$
- Both Read/Reset commands are functionally equivalent, resetting the device to the read mode.
- The command combinations not described in this table are illegal.

2. AC Characteristics
• Read Only Operations Characteristics (Flash)

Parameter	Symbol		Condition	Value*		Unit
	JEDEC	Standard		Min	Max	
Read Cycle Time	t_{AVAV}	t_{RC}	—	70	—	ns
Address to Output Delay	t_{AVQV}	t_{ACC}	$\overline{CE}f = V_{IL}$ $\overline{OE} = V_{IL}$	—	70	ns
Chip Enable to Output Delay	t_{ELQV}	$t_{CE}f$	$\overline{OE} = V_{IL}$	—	70	ns
Output Enable to Output Delay	t_{GLQV}	t_{OE}	—	—	30	ns
Chip Enable to Output High-Z	t_{EHQZ}	t_{DF}	—	—	25	ns
Output Enable to Output High-Z	t_{GHQZ}	t_{DF}	—	—	25	ns
Output Hold Time From Addresses, $\overline{CE}f$ or $\overline{OE}$, Whichever Occurs First	t_{AXQX}	t_{OH}	—	0	—	ns
$\overline{RESET}$ Pin Low to Read Mode	—	t_{READY}	—	—	20	µs

*: Test Conditions– Output Load:1 TTL gate and 30 pF
Input rise and fall times: 5 ns
Input pulse levels: 0.0 V to $V_{CC}f$
Timing measurement reference level
    Input: $0.5 \times V_{CC}f$
    Output: $0.5 \times V_{CC}f$

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• **Read Operation Timing Diagram (Flash)**
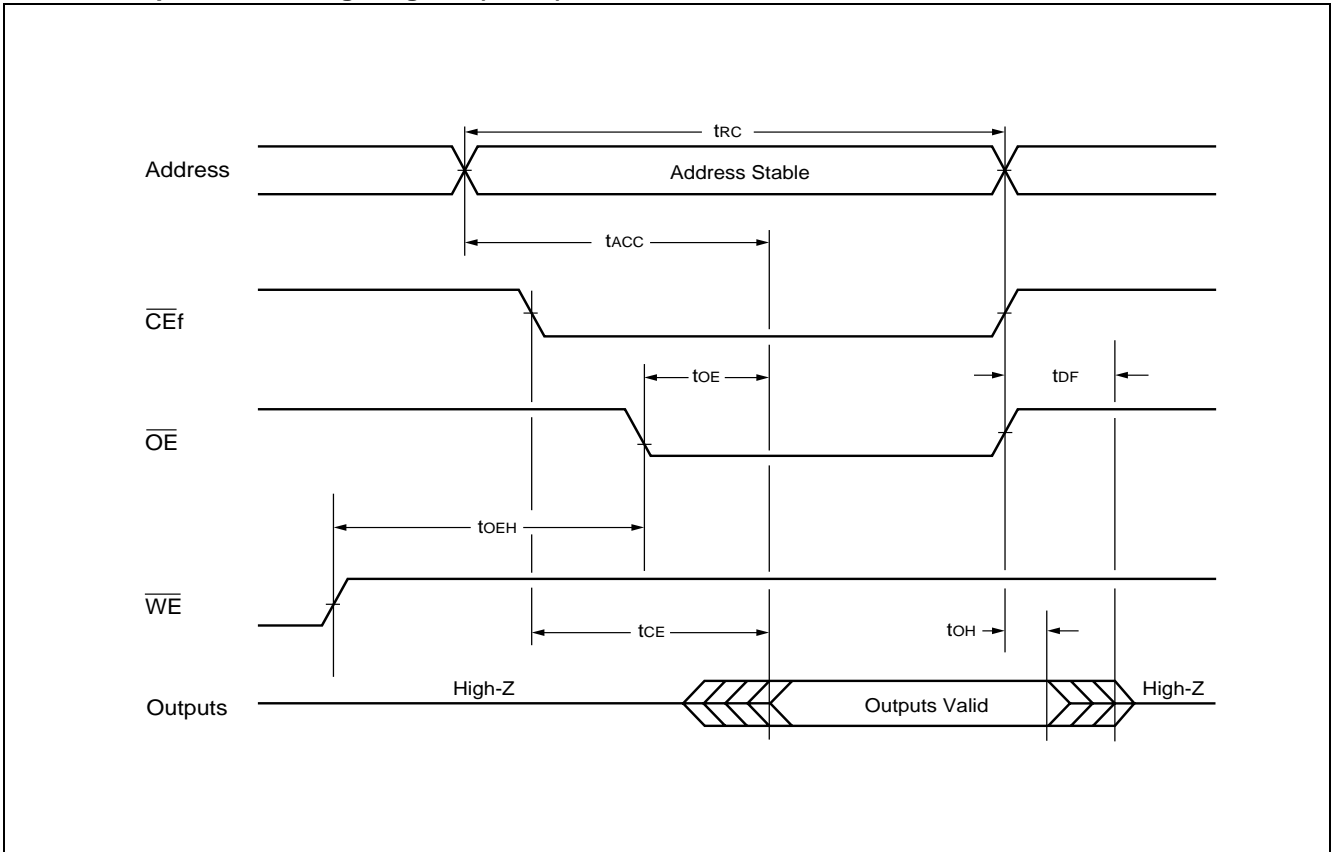
• **Hardware Reset/Read Operation Timing Diagram (Flash)**
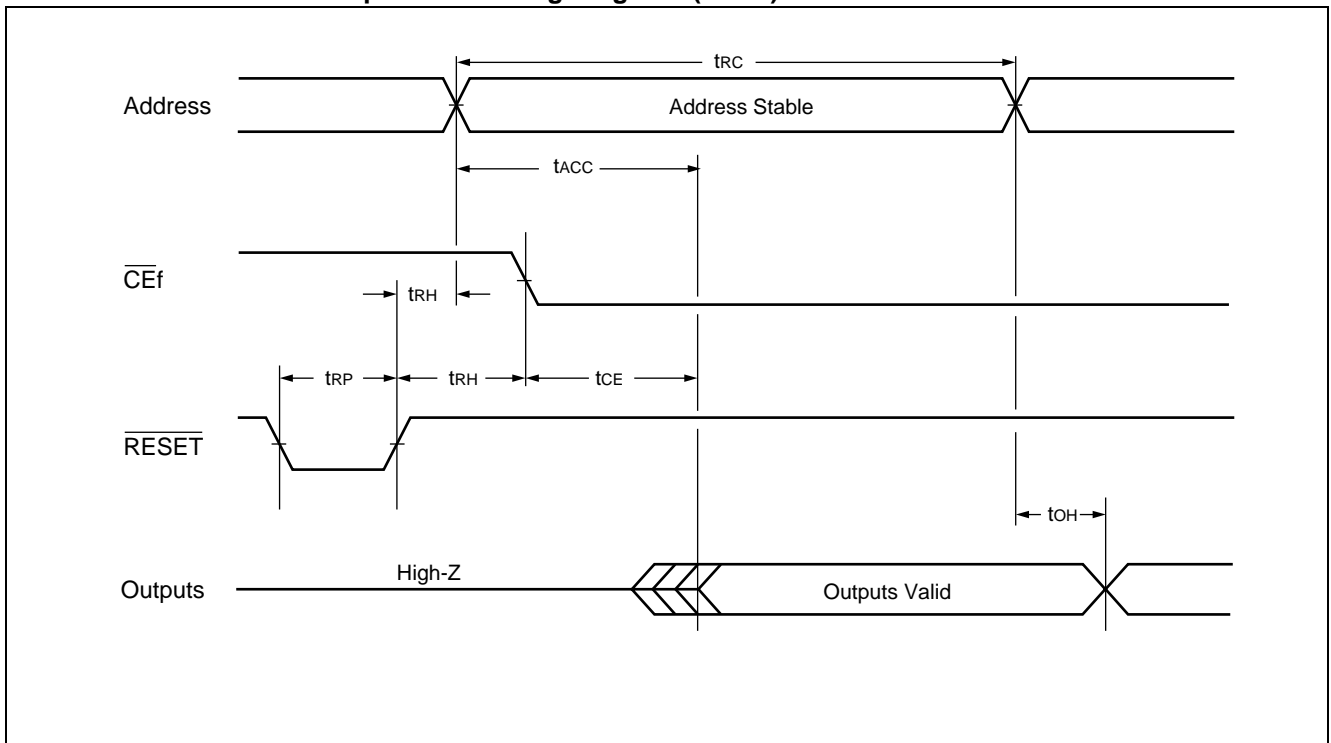
- **Write/Erase/Program Operations (Flash)**

Parameter	Symbol		Value			Unit
	JEDEC	Standard	Min	Typ	Max	
Write Cycle Time	t_{AVAV}	t_{WC}	70	—	—	ns
Address Setup Time	t_{AVWL}	t_{AS}	0	—	—	ns
Address Setup Time to $\overline{OE}$ Low During Toggle Bit Polling	—	t_{ASO}	12	—	—	ns
Address Hold Time	t_{WLAX}	t_{AH}	30	—	—	ns
Address Hold Time from $\overline{CEf}$ or $\overline{OE}$ High During Toggle Bit Polling	—	t_{AHT}	0	—	—	ns
Data Setup Time	t_{DVWH}	t_{DS}	25	—	—	ns
Data Hold Time	t_{WHDX}	t_{DH}	0	—	—	ns
Output Enable Hold Time — Read	—	t_{OEH}	0	—	—	ns
Output Enable Hold Time — Toggle and $\overline{Data}$ Polling	—	t_{OEH}	10	—	—	ns
$\overline{CEf}$ High During Toggle Bit Polling	—	t_{CEPH}	20	—	—	ns
$\overline{OE}$ High During Toggle Bit Polling	—	t_{OEPH}	20	—	—	ns
Read Recover Time Before Write	t_{GHWL}	t_{GHWL}	0	—	—	ns
Read Recover Time Before Write	t_{GHEL}	t_{GHEL}	0	—	—	ns
$\overline{CEf}$ Setup Time	t_{ELWL}	t_{CS}	0	—	—	ns
$\overline{WE}$ Setup Time	t_{WLEL}	t_{WS}	0	—	—	ns
$\overline{CEf}$ Hold Time	t_{WHEH}	t_{CH}	0	—	—	ns
$\overline{WE}$ Hold Time	t_{EHWH}	t_{WH}	0	—	—	ns
Write Pulse Width	t_{WLWH}	t_{WP}	35	—	—	ns
$\overline{CEf}$ Pulse Width	t_{ELEH}	t_{CP}	35	—	—	ns
Write Pulse Width High	t_{WHWL}	t_{WPH}	20	—	—	ns
$\overline{CEf}$ Pulse Width High	t_{EHEL}	t_{CPH}	20	—	—	ns
Programming Operation	t_{WHWH1}	t_{WHWH1}	—	6	—	µs
Sector Erase Operation *1	t_{WHWH2}	t_{WHWH2}	—	0.5	—	s
$V_{CC}f$ Setup Time	—	t_{VCS}	50	—	—	µs
Rise Time to V_{ID} *2	—	t_{VIDR}	500	—	—	ns
Rise Time to V_{ACC} *3	—	t_{VACCR}	500	—	—	ns
Voltage Transition Time *2	—	t_{VLHT}	4	—	—	µs
Write Pulse Width *2	—	t_{WPP}	100	—	—	µs

(Continued)

(Continued)

Parameter	Symbol		Value			Unit
	JEDEC	Standard	Min	Typ	Max	
$\overline{OE}$ Setup Time to $\overline{WE}$ Active *2	—	t_{OESP}	4	—	—	μs
$\overline{CE}$f Setup Time to $\overline{WE}$ Active *2	—	t_{CSP}	4	—	—	μs
Recover Time from RY/$\overline{BY}$	—	t_{RB}	0	—	—	ns
$\overline{RESET}$ Pulse Width	—	t_{RP}	500	—	—	ns
$\overline{RESET}$ High Level Period Before Read	—	t_{RH}	200	—	—	ns
Program/Erase Valid to RY/$\overline{BY}$ Delay	—	t_{BUSY}	—	—	90	ns
Delay Time from Embedded Output Enable	—	t_{EOE}	—	—	70	ns
Erase Time-out Time	—	t_{TOW}	50		—	μs
Erase Suspend Transition Time	—	t_{SPD}	—	—	20	μs

*1: This does not include preprogramming time.

*2: This timing is for Sector Group Protection operation.

*3: This timing is for Accelerated Program operation.

• **Write Cycle (WE control) (Flash)**
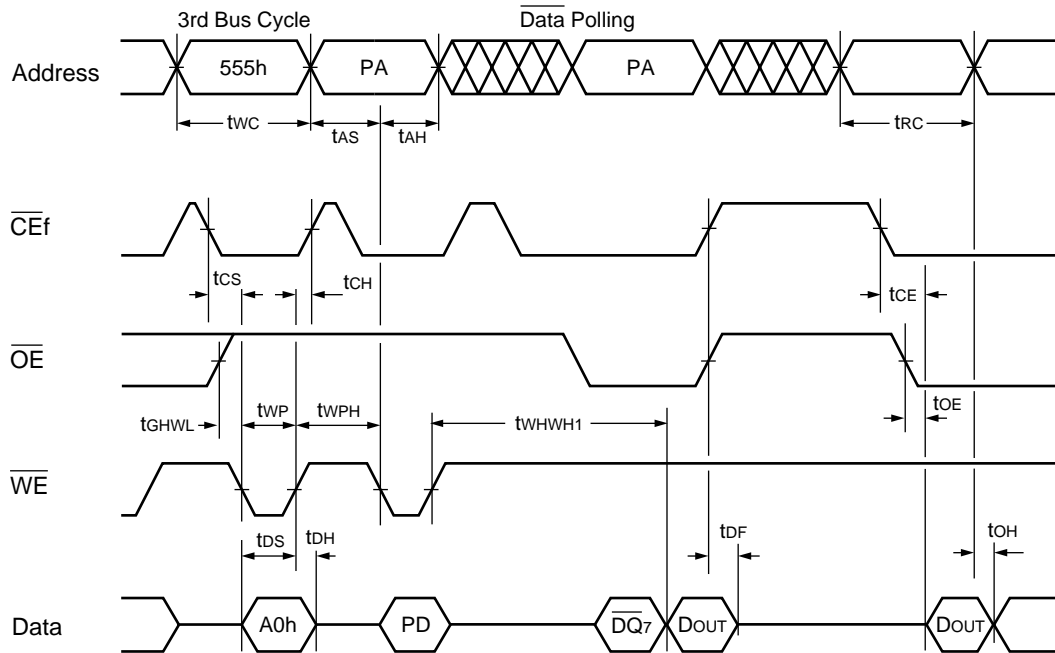
Notes : • PA is address of the memory location to be programmed.
       • PD is data to be programmed at word address.
       • DQ7 is the output of the complement of the data written to the device.
       • DOUT is the output of the data written to the device.
       • Figure indicates last two bus cycles out of four bus cycle sequence.

• **Write Cycle ($\overline{CE}$f control) (Flash)**
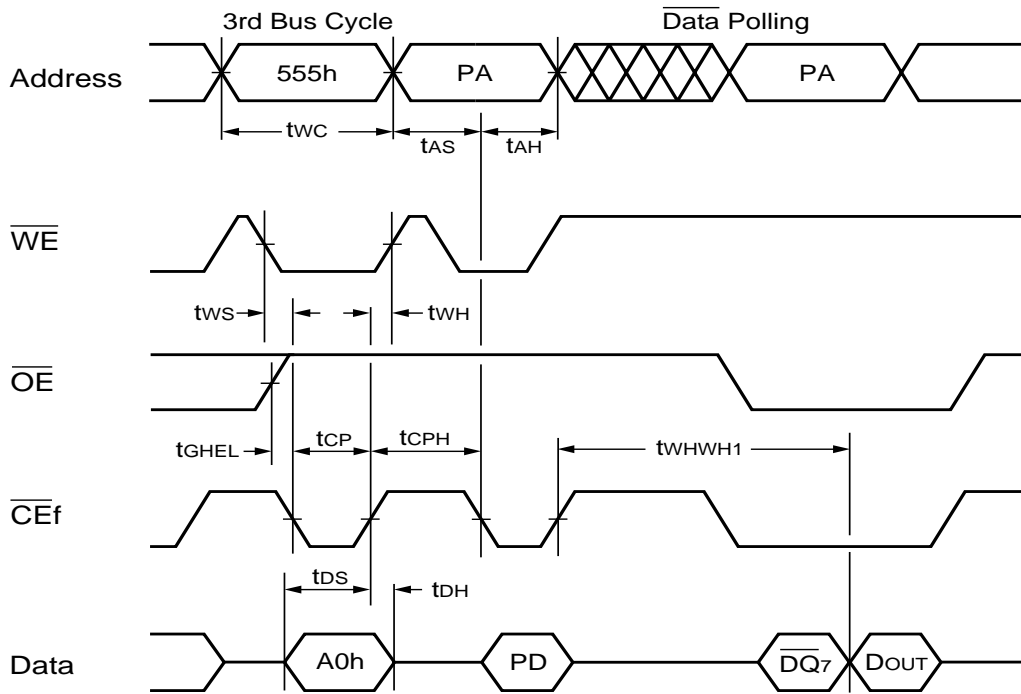
Notes : • PA is address of the memory location to be programmed.
    • PD is data to be programmed at word address.
    • $\overline{DQ_7}$ is the output of the complement of the data written to the device.
    • D$_{OUT}$ is the output of the data written to the device.
    • Figure indicates last two bus cycles out of four bus cycle sequence.

- **AC Waveforms Chip/Sector Erase Operations (Flash)**
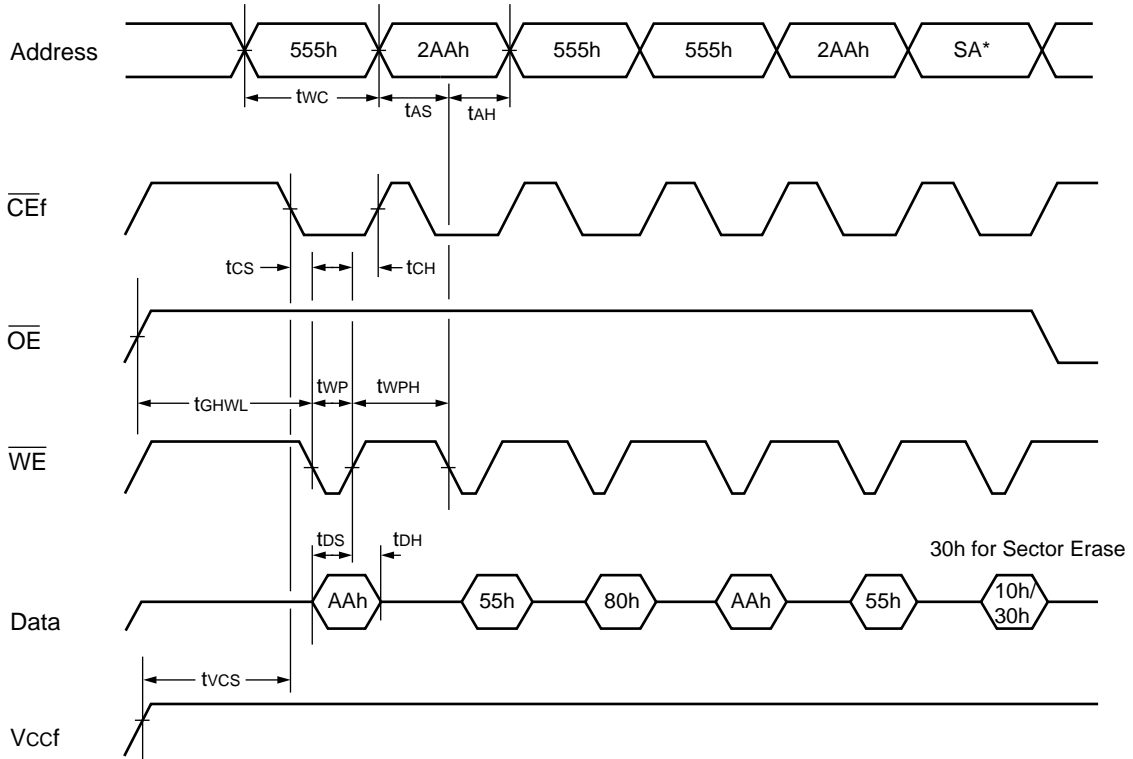
* : SA is the sector address for Sector Erase. Addresses = 555h (Word) for Chip Erase.

• **AC Waveforms for $\overline{\text{Data}}$ Polling during Embedded Algorithm Operations (Flash)**
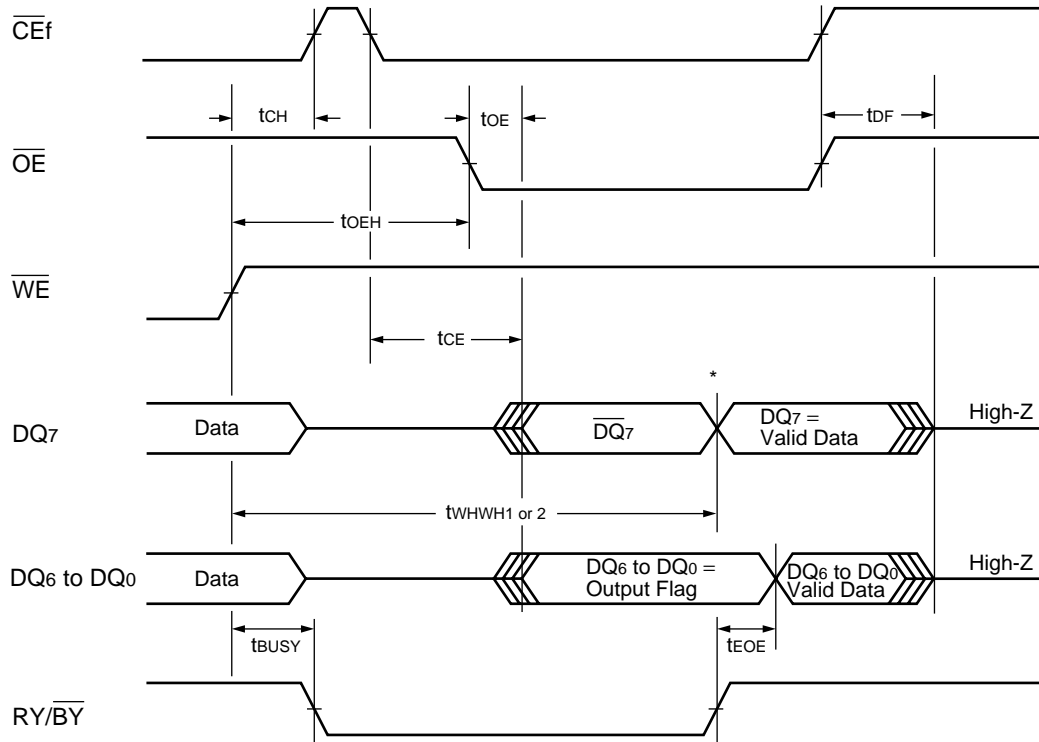
* : DQ7 = Valid Data (the device has completed the Embedded operation) .

• **AC Waveforms for Toggle Bit during Embedded Algorithm Operations (Flash)**
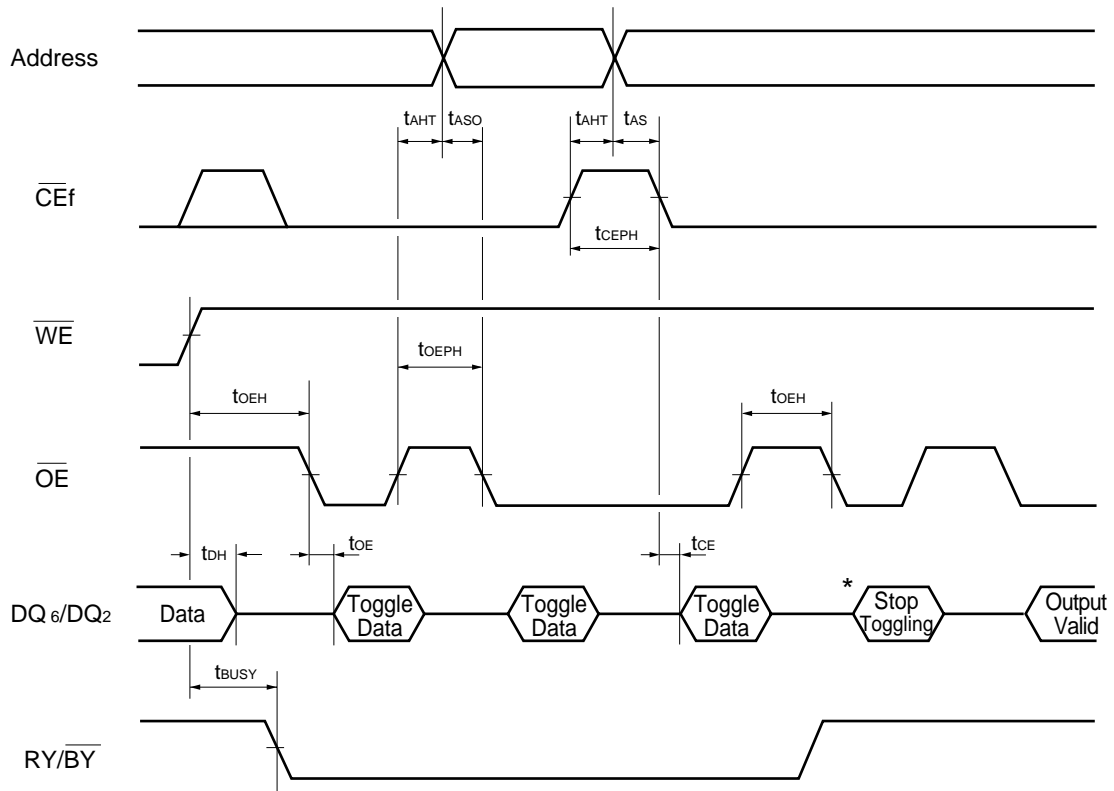
* : DQ$_6$ stops toggling (the device has completed the Embedded operation).

• **Bank-to-bank Read/Write Timing Diagram (Flash)**
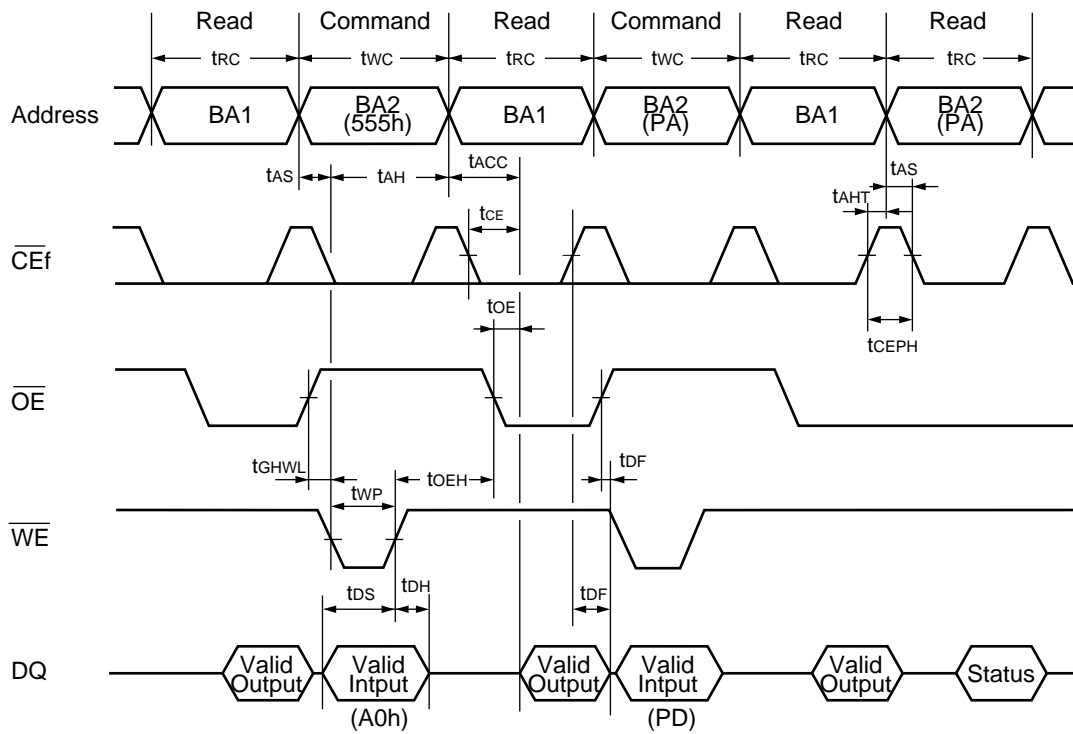
Note : This is example of Read for Bank 1 and Embedded Algorithm (program) for Bank 2.
BA1 : Address corresponding to Bank 1
BA2 : Address corresponding to Bank 2

• **RY/$\overline{BY}$ Timing Diagram during Write/Erase Operations (Flash)**

$\overline{CE}f$

$\overline{WE}$

Rising edge of the last $\overline{WE}$ signal

Entire programming
or erase operations

RY/$\overline{BY}$

t_{BUSY}
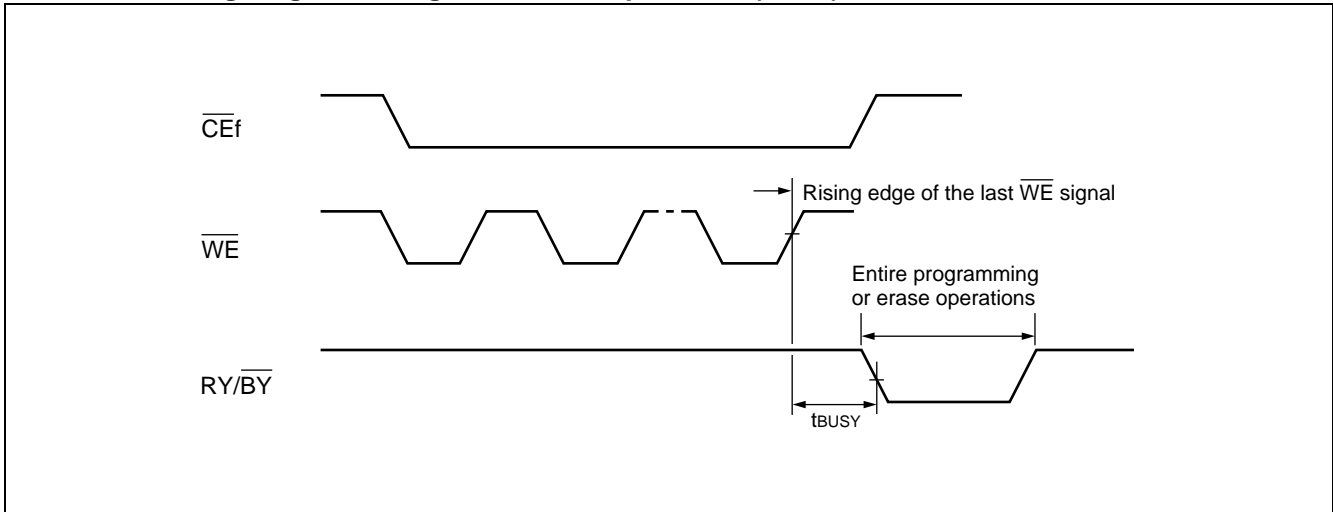
• **$\overline{RESET}$, RY/$\overline{BY}$ Timing Diagram (Flash)**

$\overline{WE}$

$\overline{RESET}$

t_{RP}

t_{RB}

RY/$\overline{BY}$

t_{READY}
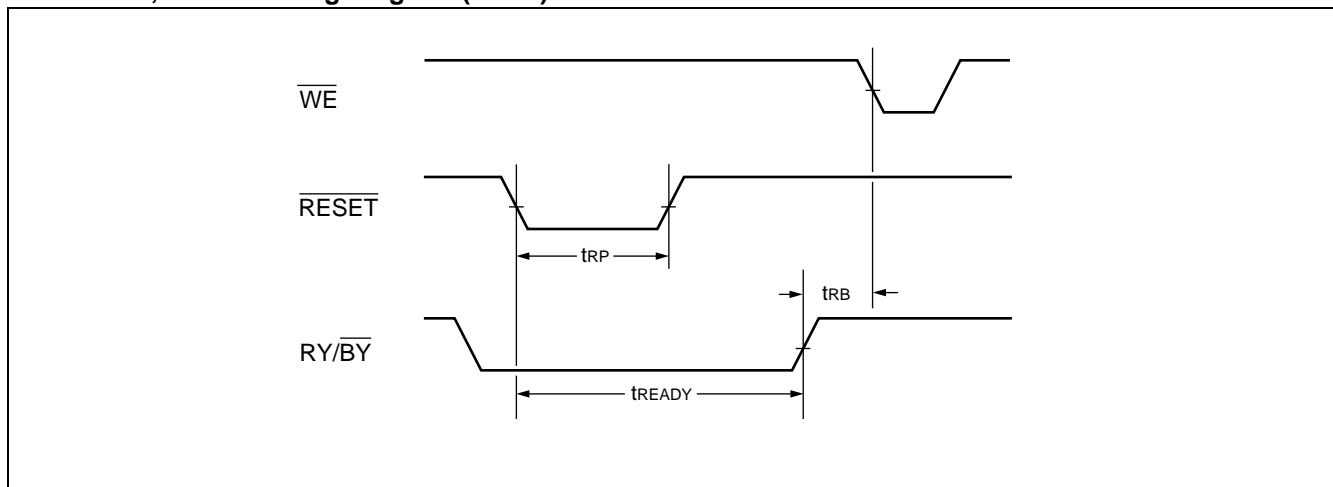
• **Temporary Sector Unprotection (Flash)**
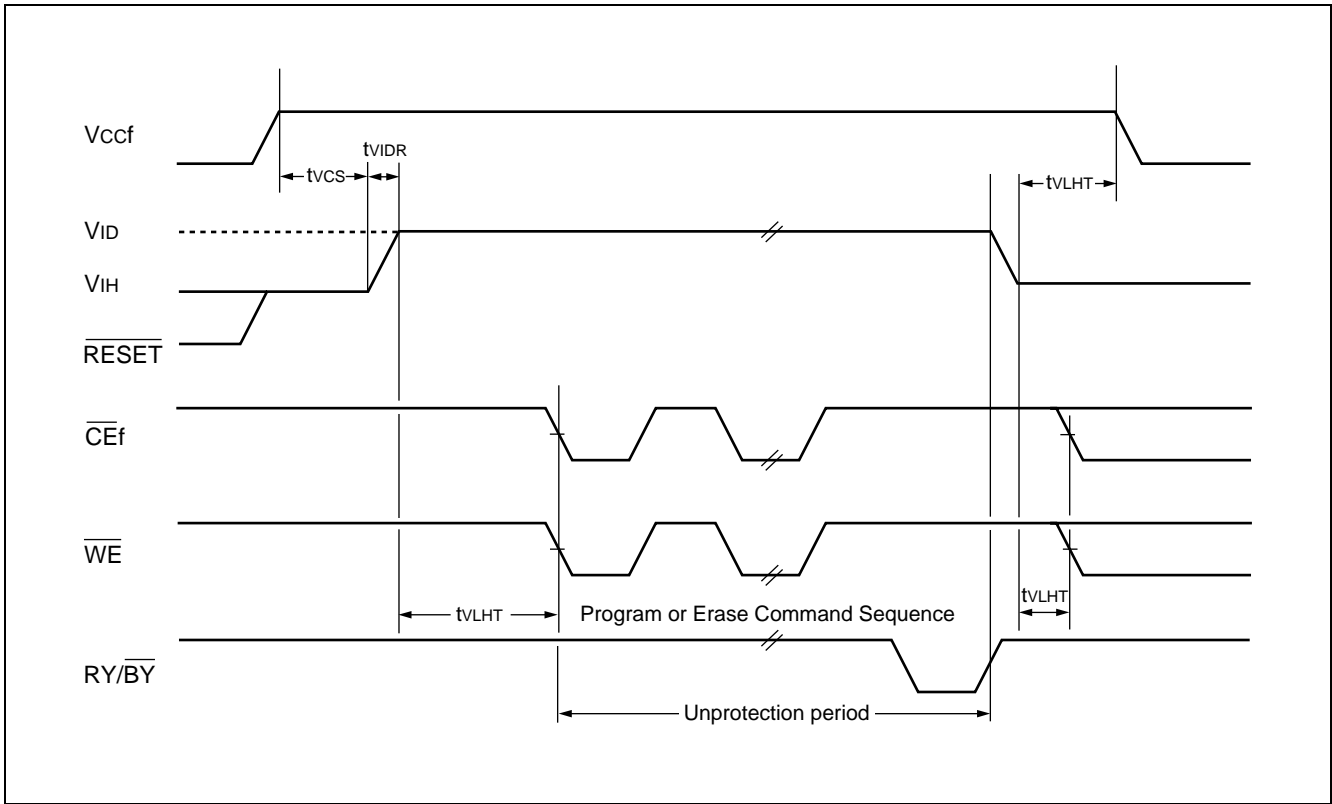
• **Acceleration Mode Timing Diagram (Flash)**
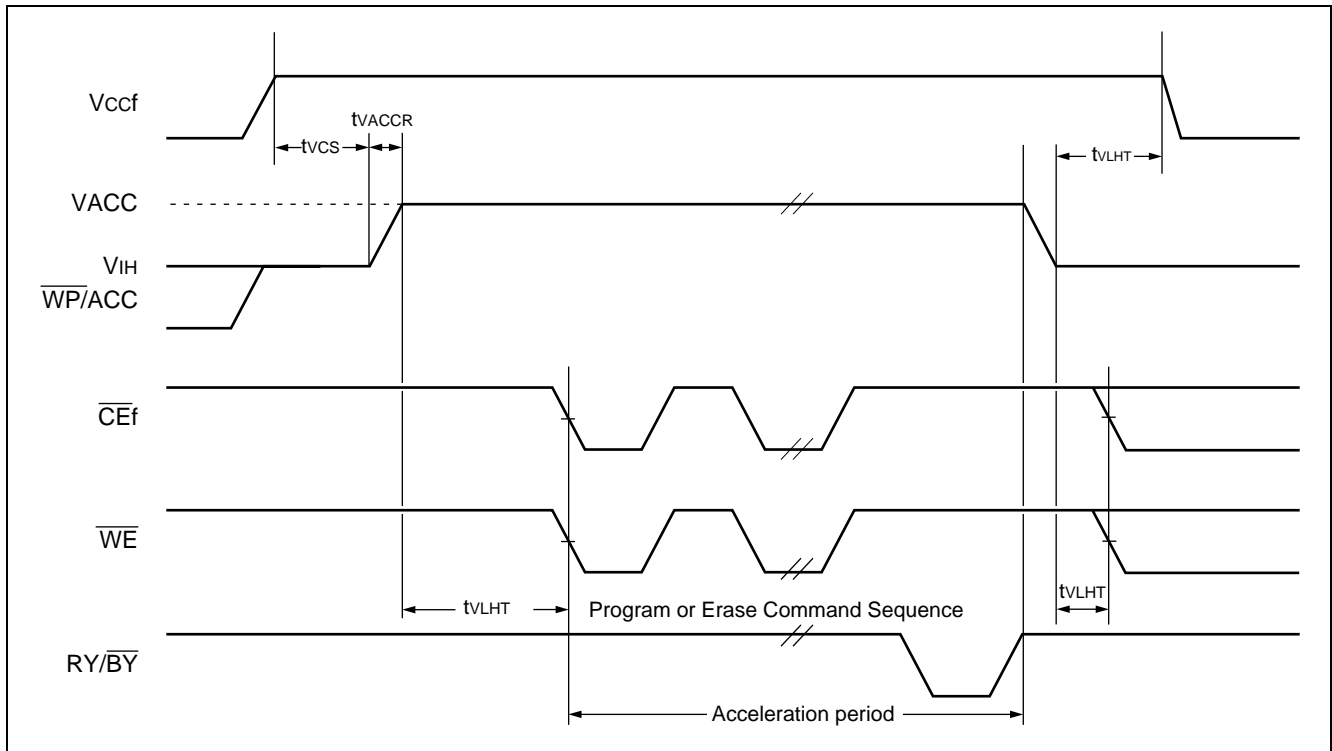
• **Extended Sector Group Protection (Flash)**
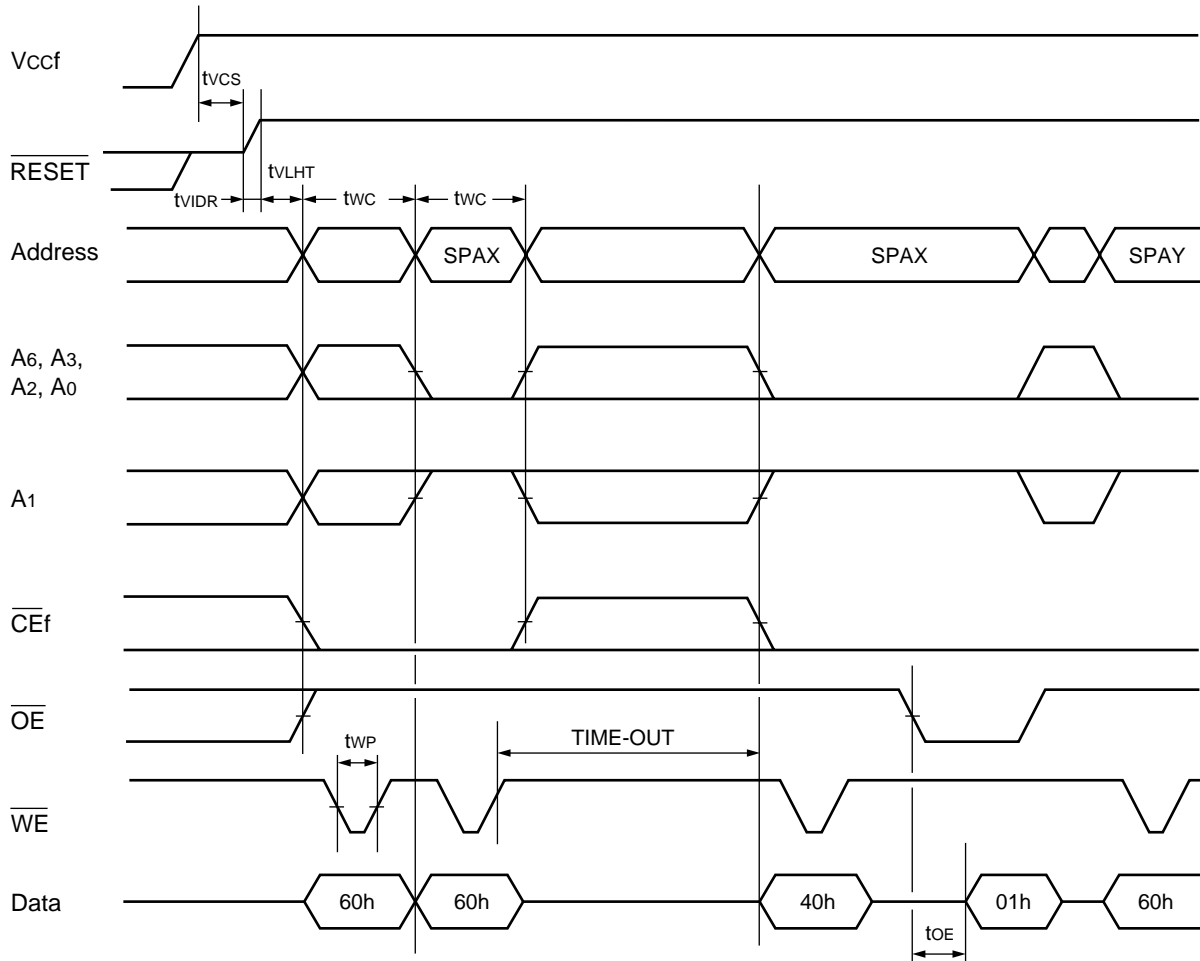
SPAX : Sector Group Address to be protected
SPAY : Next Sector Group Address to be protected
TIME-OUT : Time-Out window = 250 μs (Min)

3. Erase and Programming Performance (Flash)

Parameter	Value			Unit	Remarks
	Min	Typ	Max		
Sector Erase Time	—	0.5	2.0	s	Excludes programming time prior to erasure
Word Programming Time	—	6	100	µs	Excludes system-level overhead
Chip Programming Time	—	—	200	s	Excludes system-level overhead
Erase/Program Cycle	100,000	—	—	cycle	

Typical Erase conditions Ta = +25°C, VCCf_1 & VCCf_2 = 2.9 V
Typical Program conditions Ta = +25°C, VCCf_1 & VCCf_2 = 2.9 V　　　Data= Checker

■ **4M SRAM FOR MCP**

1. **AC Characteristics**
   • **Read Cycle (SRAM)**

Parameter	Symbol	Value		Unit
		Min	**Max**	
Read Cycle Time	t_{RC}	70	—	ns
Address Access Time	t_{AA}	—	70	ns
Chip Enable ($\overline{CE1}$s) Access Time	t_{CO1}	—	70	ns
Chip Enable (CE2s) Access Time	t_{CO2}	—	70	ns
Output Enable Access Time	t_{OE}	—	35	ns
$\overline{LB}$, $\overline{UB}$ to Output Valid	t_{BA}	—	70	ns
Chip Enable ($\overline{CE1}$s Low and CE2s High) to Output Active	t_{COE}	5	—	ns
Output Enable Low to Output Active	t_{OEE}	0	—	ns
$\overline{UB}$, $\overline{LB}$ Enable Low to Output Active	t_{BE}	0	—	ns
Chip Enable ($\overline{CE1}$s High or CE2s Low) to Output High-Z	t_{OD}	—	25	ns
Output Enable High to Output High-Z	t_{ODO}	—	25	ns
$\overline{UB}$, $\overline{LB}$ Output Enable to Output High-Z	t_{BD}	—	25	ns
Output Data Hold Time	t_{OH}	10	—	ns

Note: Test Conditions– Output Load:1 TTL gate and 30 pF
Input rise and fall times: 5 ns
Input pulse levels: 0.0 V to V_{CC}s
Timing measurement reference level
   Input: 0.5×V_{CC}s
   Output: 0.5×V_{CC}s
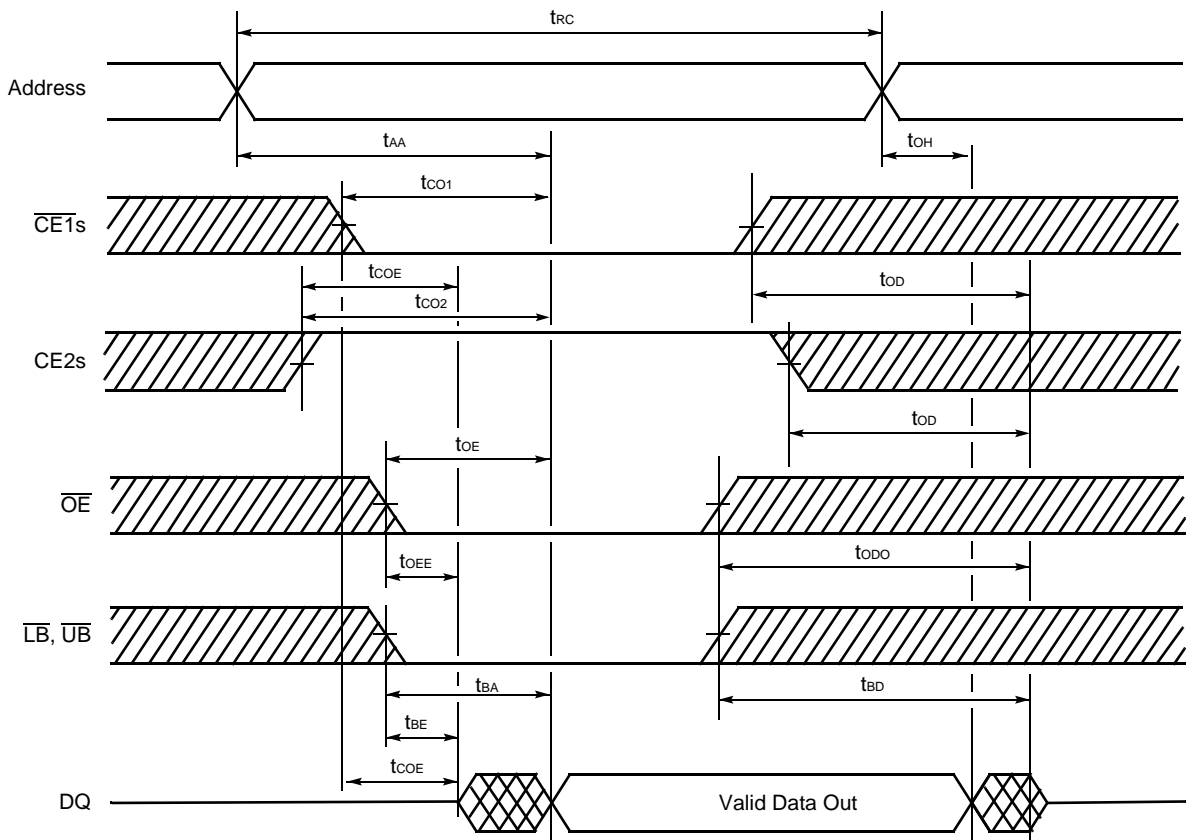
• **Read Cycle (SRAM)**

Note: $\overline{WE}$ remains HIGH for the read cycle.

• **Write Cycle (SRAM)**

Parameter	Symbol	Value		Unit
		Min	Max	
Write Cycle Time	t$_{WC}$	70	—	ns
Write Pulse Width	t$_{WP}$	50	—	ns
Chip Enable to End of Write	t$_{CW}$	55	—	ns
Address valid to End of Write	t$_{AW}$	55	—	ns
$\overline{UB}$, $\overline{LB}$ to End of Write	t$_{BW}$	55	—	ns
Address Setup Time	t$_{AS}$	0	—	ns
Write Recovery Time	t$_{WR}$	0	—	ns
$\overline{WE}$ Low to Output High-Z	t$_{ODW}$	—	25	ns
$\overline{WE}$ High to Output Active	t$_{OEW}$	0	—	ns
Data Setup Time	t$_{DS}$	30	—	ns
Data Hold Time	t$_{DH}$	0	—	ns

• **Write Cycle *1 ($\overline{\text{WE}}$ control) (SRAM)**
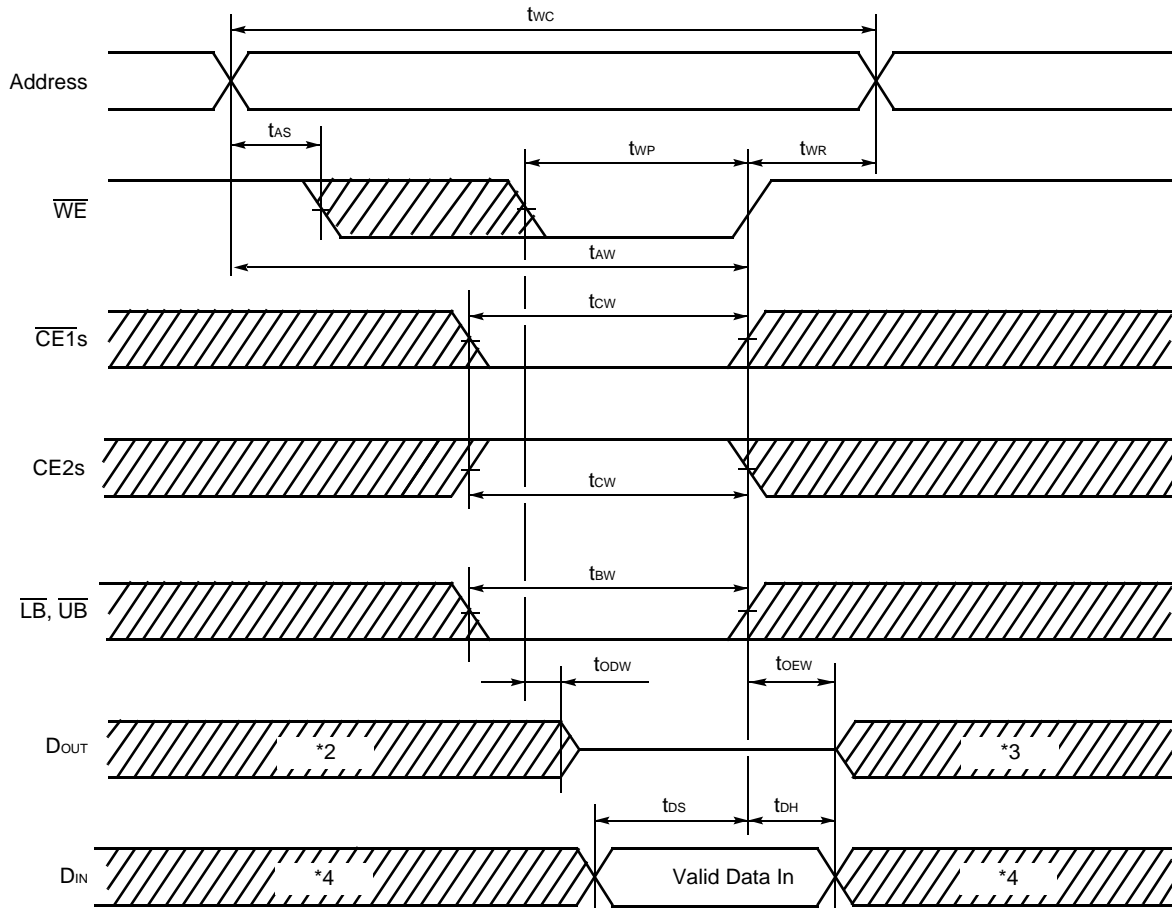
*1 : If $\overline{\text{OE}}$ is HIGH during the write cycle, the outputs will remain at high impedance.

*2 : If $\overline{\text{CE1}}$s goes LOW (or CE2s goes HIGH) coincident with or after $\overline{\text{WE}}$ goes LOW, the output will remain at high impedance.

*3 : If $\overline{\text{CE1}}$s goes HIGH (or CE2s goes LOW) coincident with or before $\overline{\text{WE}}$ goes HIGH, the output will remain at high impedance.

*4 : Because I/O signals may be in the output state at this Time, input signals of reverse polarity must not be applied.

• **Write Cycle *1 ($\overline{CE1}_S$ control) (SRAM)**
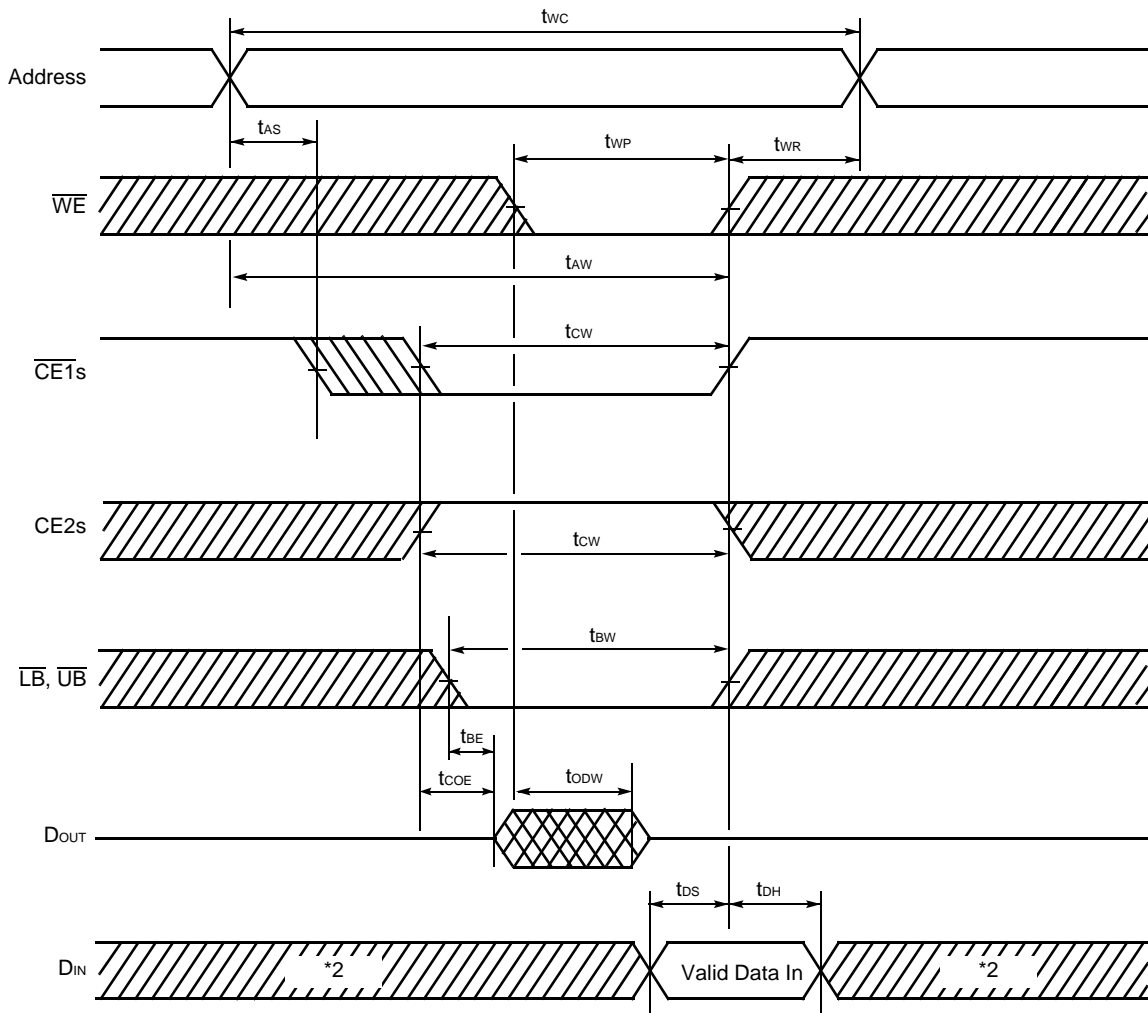
*1 : If $\overline{OE}$ is HIGH during the write cycle, the outputs will remain at high impedance.

*2 : Because I/O signals may be in the output state at this Time, input signals of reverse polarity must not be applied.

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• Write Cycle *1 (CE2s Control) (SRAM)

*1 : If $\overline{OE}$ is HIGH during the write cycle, the outputs will remain at high impedance.

*2 : Because I/O signals may be in the output state at this Time, input signals of reverse polarity must not be applied.

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• **Write Cycle *1 ($\overline{\text{LB}}$, $\overline{\text{UB}}$ Control) (SRAM)**
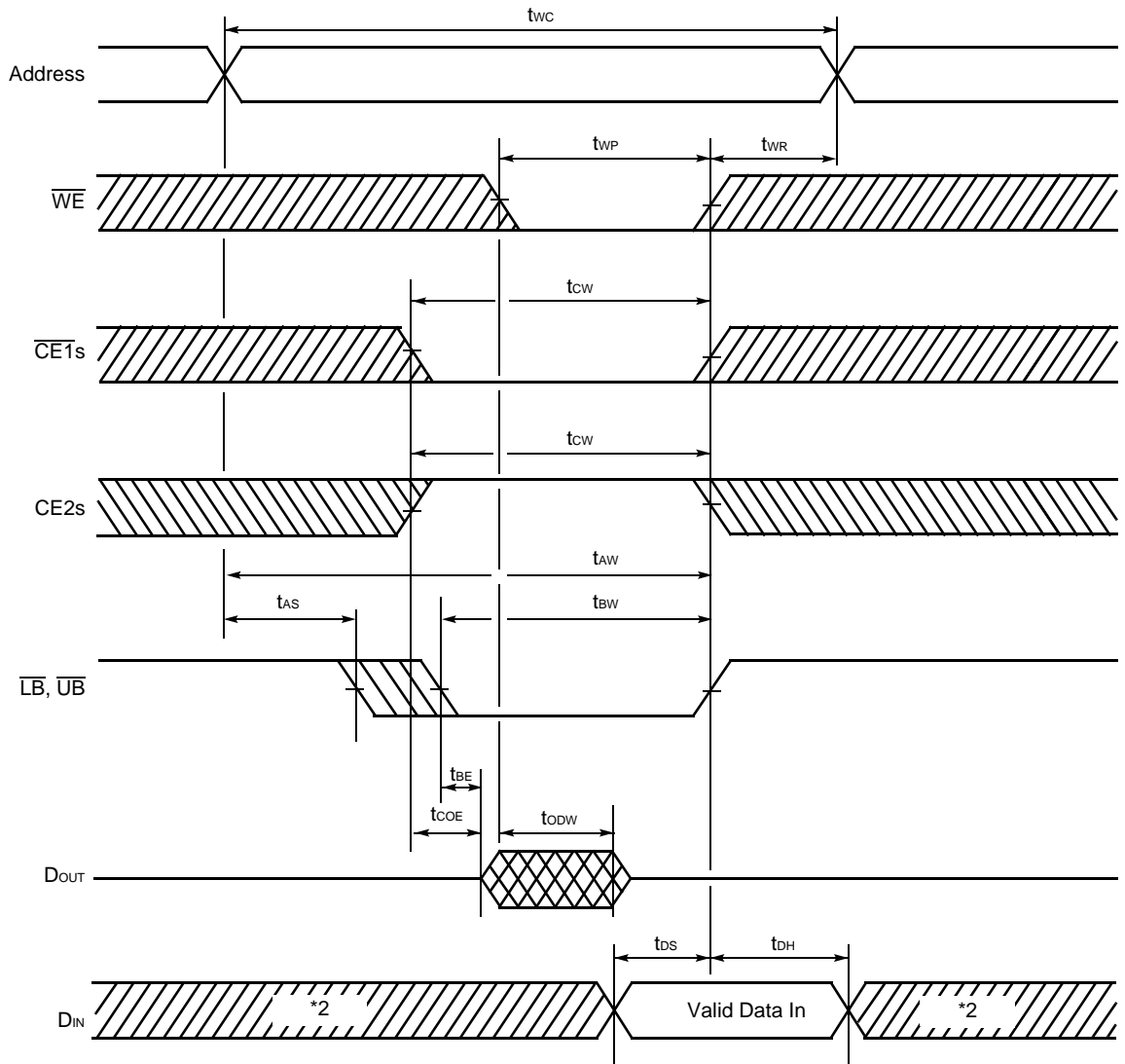
t_{WC}

Address

t_{WP} t_{WR}

$\overline{\text{WE}}$

t_{CW}

$\overline{\text{CE1}}$s

t_{CW}

CE2s

t_{AW}

t_{AS} t_{BW}

$\overline{\text{LB}}$, $\overline{\text{UB}}$

t_{BE}

t_{COE} t_{ODW}

D_{OUT}

t_{DS} t_{DH}

D_{IN} *2   Valid Data In   *2

*1 : If $\overline{\text{OE}}$ is HIGH during the write cycle, the outputs will remain at high impedance.

*2 : Because I/O signals may be in the output state at this Time, input signals of reverse polarity must not be applied.

2. Data Retention Characteristics (SRAM)

Parameter		Symbol	Value			Unit
			Min	Typ	Max	
Data Retention Supply Voltage		V_{DH}	1.5	—	3.1	V
Standby Current	V_{DH} = 3.0 V	I_{DDS2}	—	—	10	μA
Chip Deselect to Data Retention Mode Time		t_{CDR}	0	—	—	ns
Recovery Time		t_R	t_{RC}	—	—	ns

Note : t_{RC}: Read cycle time

• $\overline{CE1}$s Controlled Data Retention Mode *1
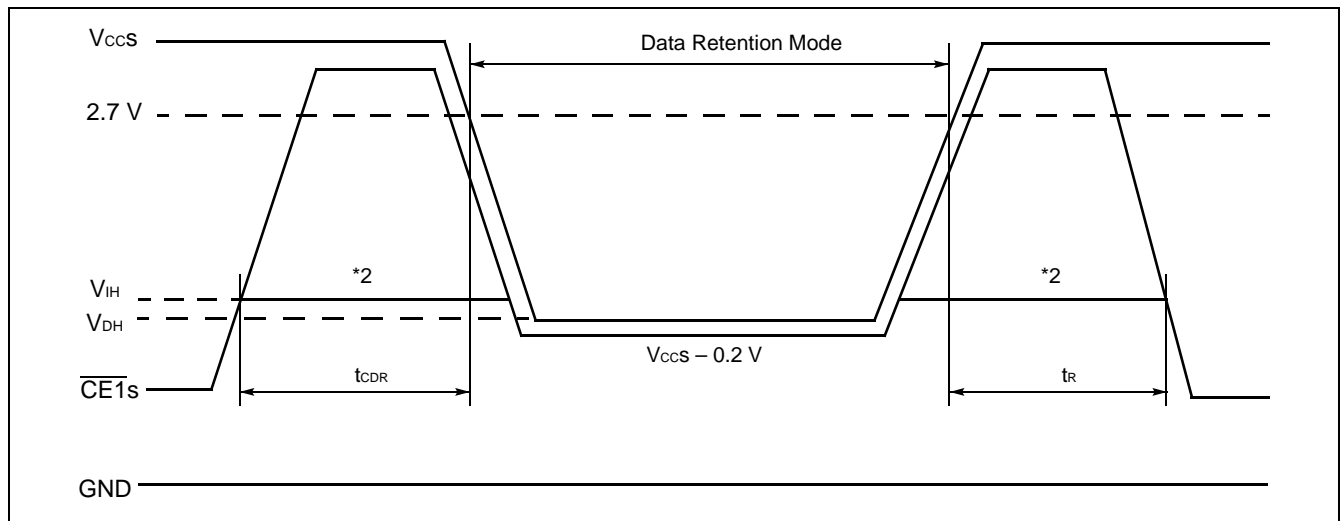
*1 : In $\overline{CE1}$s controlled data retention mode, input level of CE2s should be fixed Vccs to Vccs–0.2 V or Vss to 0.2 V during data retention mode. Other input and input/output pins can be used between –0.3 V to Vccs+0.3 V.

*2 : When $\overline{CE1}$s is operating at the V_{IH} Min level, the standby current is given by I_{SB1}s during the transition of Vccs from Vccs MAX to V_{IH} Min level.

• CE2s Controlled Data Retention Mode*
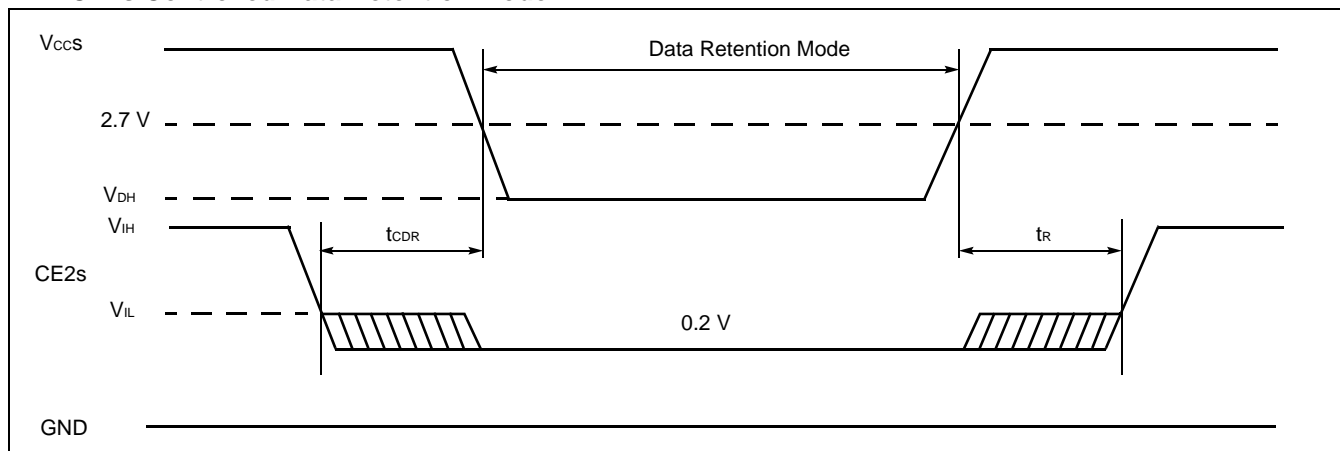
* : In CE2s controlled data retention mode, input and input/output pins can be used between –0.3 V to Vccs+0.3V.

■ **PIN CAPACITANCE**

Parameter	Symbol	Test Setup	Value		Unit
			Typ	Max	
Input Capacitance	C_{IN}	$V_{IN} = 0$	11	14	pF
Output Capacitance	C_{OUT}	$V_{OUT} = 0$	12	16	pF
Control Pin Capacitance	C_{IN2}	$V_{IN} = 0$	14	16	pF
$\overline{WP}$/ACC Pin Capacitance	C_{IN3}	$V_{IN} = 0$	21.5	26	pF

Note: Test conditions Ta = +25°C, f = 1.0 MHz

■ **HANDLING OF PACKAGE**

Please handle this package carefully since the sides of packages are acute angle.

■ **CAUTION**

(1) The high voltage (V_{ID}) can not apply to address pins and control pins except $\overline{RESET}$. Therefore, it can not use autoselect and sector protect function by applying the high voltage (V_{ID}) to specific pins.

(2) For the sector protection, since the high voltage (V_{ID}) can be applied to the $\overline{RESET}$, it can be protected the sector useing "Extended sector protect" command.

MB84VD23180FM-70

■ ORDERING INFORMATION

MB84VD23180   FM   -70   PBS

PACKAGE TYPE
  PBS = 73-ball BGA

SPEED OPTION
  See Product Selector Guide

Device Revision

DEVICE NUMBER/DESCRIPTION
  64Mega-bit (4M × 16-bit) Dual Operation Flash Memory
  3.0V-only Read, Program, and Erase

4Mega-bit(256K × 16-bit) SRAM

■ PACKAGE DIMENSION

73-ball plastic FBGA
(BGA-73P-M03)

11.60±0.10(.457±.004)

0.20(.008) S B

8.00±0.10
(.315±.004)

INDEX-MARK AREA

0.10(.004) S

$1.19^{+0.15}_{-0.10}$ $\left(.047^{+.006}_{-.004}\right)$
(Seated height)

0.80(.031)
REF

A

0.40(.016)
REF

0.10(.004) S

0.39±0.10 (Stand off)
(.015±.004)

S

0.20(.008) S A

B

0.40(.016)
REF

0.80(.031)
REF

10
9
8
7
6
5
4
3
2
1

M L K J H G F E D C B A

INDEX BALL

$73-ø0.45^{+0.10}_{-.005}$
$\left(73-ø0.18^{+.004}_{-.002}\right)$

ø0.08(.003) Ⓜ S AB

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Dimensions in mm (inches).
Note: The values in parentheses are reference values.

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