

3Stacked MCP (Multi-Chip Package) FLASH & FLASH & FCRAM  
CMOS

**64M (×16) FLASH MEMORY &  
32M (×16) FLASH MEMORY &  
32M (×16) Mobile FCRAM™**

## MB84VF5F4F4J2-70

### ■ FEATURES

- Power supply voltage of 2.7 to 3.1V
- High performance
  - 70 ns maximum access time (Flash\_1: 64Mb Falsh)
  - 70 ns maximum access time (Flash\_2 : 32Mb Falsh)
  - 65 ns maximum access time (FCRAM : 32Mb FCRAM)
- Operating Temperature
  - 30 °C to +85 °C
- Package 107-ball BGA

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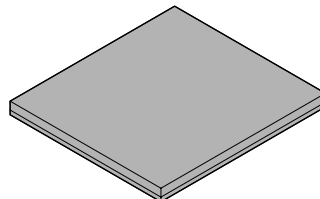
### ■ PRODUCT LINEUP

	Flash_1	Flash_2	FCRAM
Supply Voltage (V)	V <sub>ccf_1</sub> * = 2.7V to 3.1V	V <sub>ccf_2</sub> * = 2.7V to 3.1V	V <sub>ccr</sub> * = 2.7V to 3.1V
Max. Address Access Time (ns)	70	70	65
Max. $\overline{CE}$ Access Time (ns)	70	70	65
Max. $\overline{OE}$ Access Time (ns)	30	30	40

Note:\*1,All of V<sub>ccf\_1</sub>, V<sub>ccf\_2</sub>, and V<sub>ccr</sub> must be the same level when either part is being accessed.

### ■ PACKAGE

107-pin plastic FBGA



BGA-107P-M01

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## — FLASH MEMORY\_1 & \_2

- **Simultaneous Read/Write Operations (Dual Bank)**

- **Flash\_1 FlexBank™**

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)

- **Flash\_2 FlexBank™**

Bank A : 4 Mbit (8 KB × 8 and 64 KB × 7)

Bank B : 12 Mbit (64 KB × 24)

Bank C : 12 Mbit (64 KB × 24)

Bank D : 4 Mbit (64 KB × 8)

Two virtual Banks are chosen from the combination of four physical banks.

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

- **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.

- **Hidden ROM (Hi-ROM) Region**

256 byte of Hi-ROM, accessible through a new “Hi-ROM Enable” command sequence

Factory serialized and protected to provide a secure electronic serial number (ESN)

- **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™ Algorithms**

Automatically preprograms and erases the chip or any sector

- **Embedded Program™ Algorithms**

Automatically writes and verifies data at specified address

- **Data Polling and Toggle Bit Feature for Detection of Program or Erase Cycle Completion**

- **Ready/Busy Output (RY/BY\_1 or RY/BY\_2)**

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  $V_{ccf}$  write inhibit  $\leq 2.5$  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 “MBM29DL640F” Datasheet in Detailed Function for Flash\_1.**

- **Please Refer to “MBM29DL32xF” Datasheet in Detailed Function for Flash\_2.**

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## — FCRAM

- **Power Dissipation**

Operating : 25mA max.

Standby : 100  $\mu$ A max.

- **Power Down Mode**

Sleep : 10  $\mu$ A max.

NAP : 60  $\mu$ A max.

8M Partial : 70  $\mu$ A max.

- **Power Down Control by CE2r**

- **Byte Write Control:  $\overline{\text{LB}}(\text{DQ}_7\text{-DQ}_0)$ ,  $\overline{\text{UB}}(\text{DQ}_{15}\text{-DQ}_8)$**

- **8 words Address Access Capability**

\*: FlexBank™ is a trademark of Fujitsu Limited, Japan.

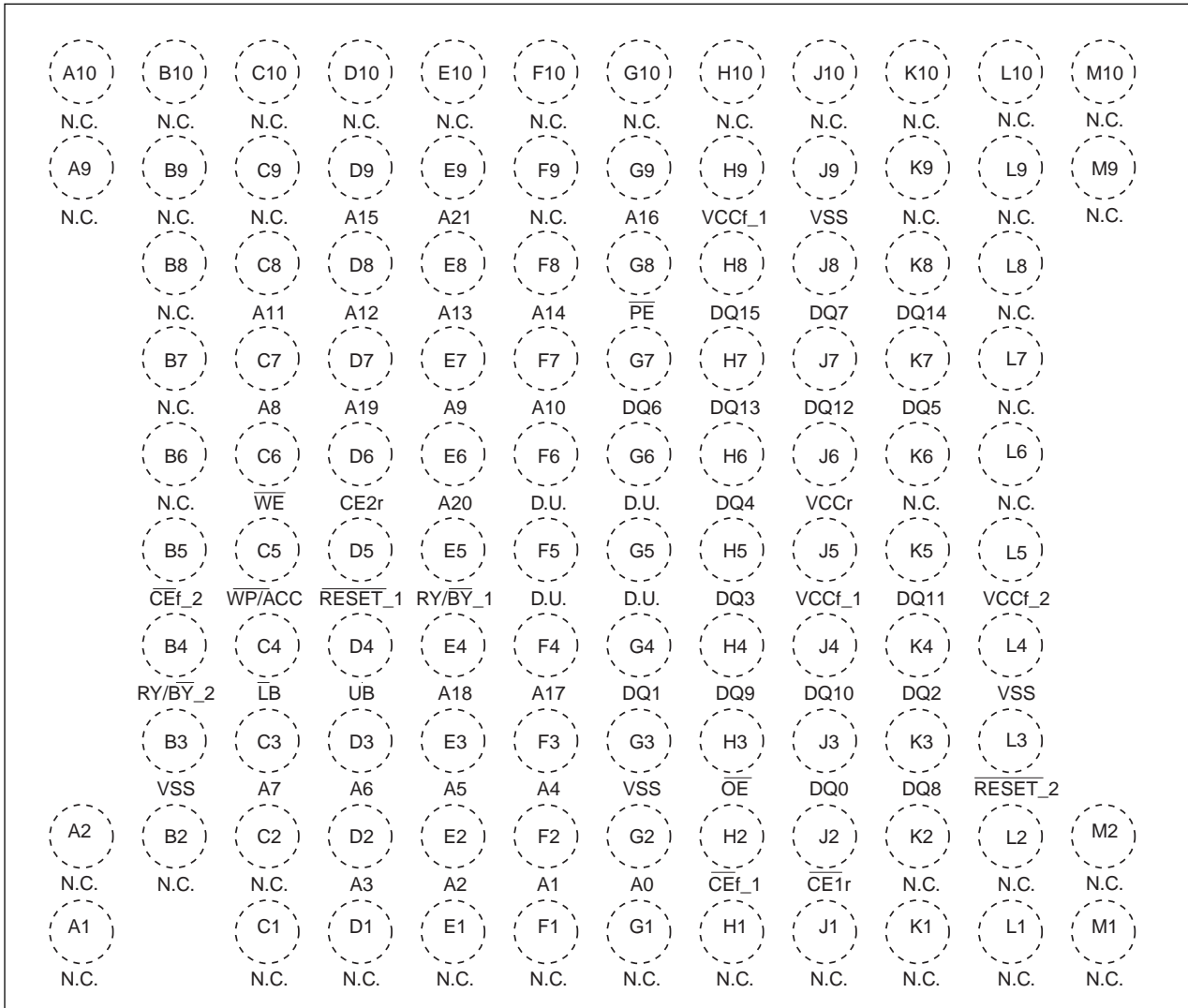
\*: Embedded Erase™ and Embedded Program™ are trademarks of Advanced Micro Devices, Inc.

\*: Mobile FCRAM™ is a trademark of Fujitsu Limited, Japan.

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## ■ PIN ASSIGNMENT

(Top View)  
Marking Side



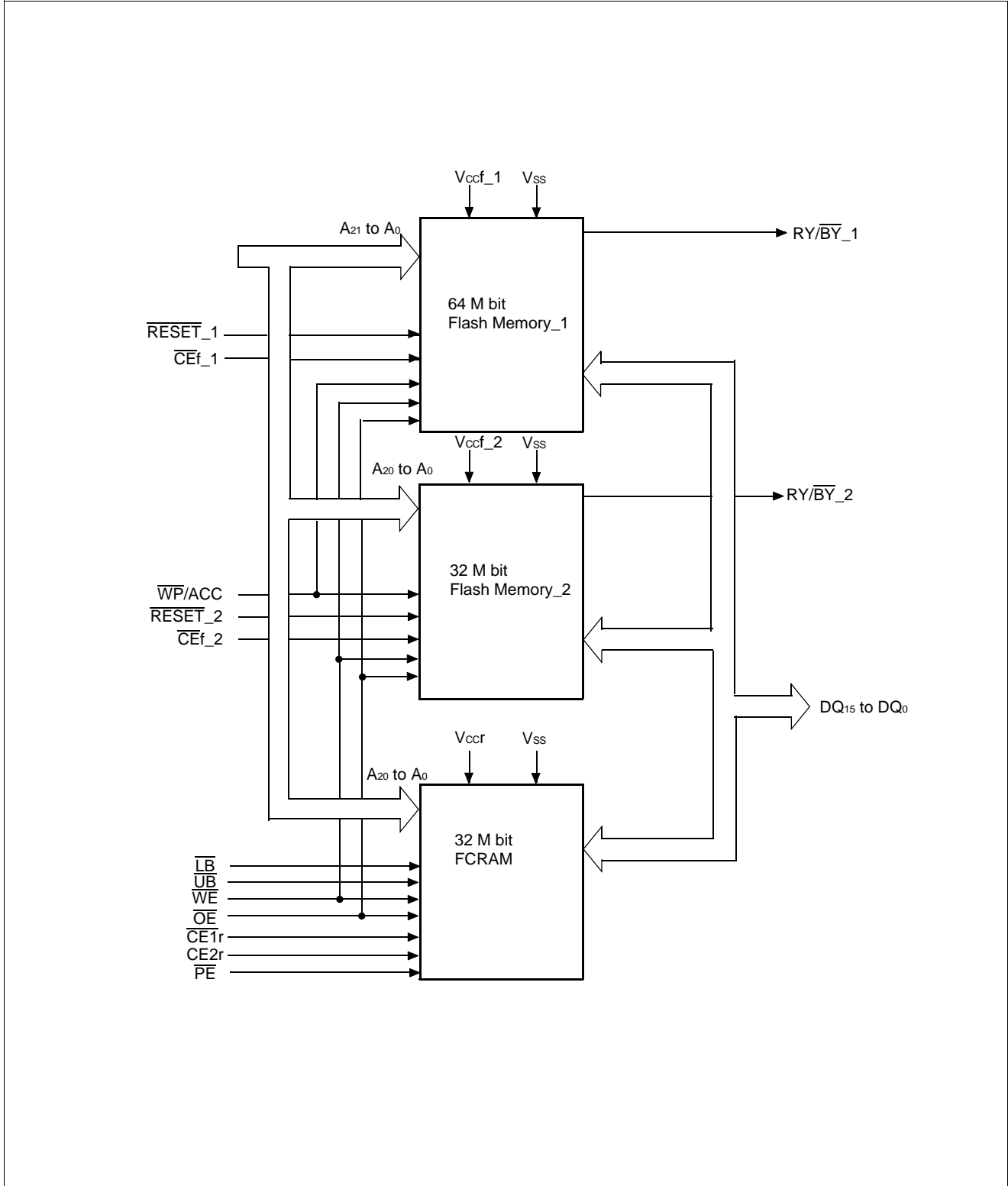
(BGA-107P-M01)

## ■ PIN DESCRIPTION

Pin name	Input/ Output	Description
A <sub>20</sub> to A <sub>0</sub>	I	Address Inputs (Common)
A <sub>21</sub>	I	Address Inputs (Flash_1)
DQ <sub>15</sub> to DQ <sub>0</sub>	I/O	Data Inputs/Outputs (Common)
$\overline{\text{CE}}_{\text{f}_1}$	I	Chip Enable (Flash_1)
$\overline{\text{CE}}_{\text{f}_2}$	I	Chip Enable (Flash_2)
$\overline{\text{CE}}_{1\text{r}}$	I	Chip Enable (FCRAM)
CE <sub>2r</sub>	I	Chip Enable (FCRAM)
$\overline{\text{OE}}$	I	Output Enable (Common)
$\overline{\text{WE}}$	I	Write Enable (Common)
RY/ $\overline{\text{BY}}$ <sub>1</sub>	O	Ready/Busy Output (Flash_1) Open Drain Output
RY/ $\overline{\text{BY}}$ <sub>2</sub>	O	Ready/Busy Output (Flash_2) Open Drain Output
$\overline{\text{UB}}$	I	Upper Byte Control (FCRAM)
$\overline{\text{LB}}$	I	Lower Byte Control (FCRAM)
$\overline{\text{RESET}}_1$	I	Hardware Reset Pin/Sector Protection Unlock (Flash_1)
$\overline{\text{RESET}}_2$	I	Hardware Reset Pin/Sector Protection Unlock (Flash_2)
$\overline{\text{WP/ACC}}$	I	Write Protect / Acceleration (Flash_1& Flash_2)
$\overline{\text{PE}}$	I	Partial Enable (FCRAM)
N.C.	—	No Internal Connection
D.U.	—	Don't Use
V <sub>ss</sub>	Power	Device Ground (Common)
V <sub>ccf_1</sub>	Power	Device Power Supply (Flash_1)
V <sub>ccf_2</sub>	Power	Device Power Supply (Flash_2)
V <sub>ccr</sub>	Power	Device Power Supply (FCRAM)

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## ■ BLOCK DIAGRAM



## ■ DEVICE BUS OPERATIONS

Operation (1), (2)	$\overline{CEf}_1$	$\overline{CEf}_2$	$\overline{CE1r}$	$\overline{CE2r}$	$\overline{OE}$	$\overline{WE}$	$\overline{LB}$	$\overline{UB}$	$\overline{PE}$	A <sub>20</sub> to A <sub>0</sub>	DQ <sub>7</sub> to DQ <sub>0</sub>	DQ <sub>15</sub> to DQ <sub>8</sub>	$\overline{RESET}_1$	$\overline{RESET}_2$	$\overline{WP/ACC}$ (12)
Full Standby	H	H	H	H	X	X	X	X	H	X	High-Z	High-Z	H	H	X
Output Disable(3)	H	H	L	H	H	H	X	X	H	X (10)	High-Z	High-Z	H	H	X
	L	H	H		H	X	X								
	H	L	H		H	X	X								
Read from Flash_1 (4)	L	H	H	H	L	H	X	X	H	Valid	DOUT	DOUT	H	H	X
Read from Flash_2 (4)	H	L	H	H	L	H	X	X	H	Valid	DOUT	DOUT	H	H	X
Write to Flash_1	L	H	H	H	H	L	X	X	H	Valid	DIN	DIN	H	H	X
Write to Flash_2	H	L	H	H	H	L	X	X	H	Valid	DIN	DIN	H	H	X
Read from FCRAM(5)	H	H	L	H	L	H	L (9)	L (9)	H	Valid	DOUT	DOUT	H	H	X
Write to FCRAM	H	H	L	H	H	L	L	L	H	Valid	DIN	DIN	H	H	X
							H	L			High-Z	DIN			
							L	H			DIN	High-Z			
							L	L		Valid	DIN	DIN			
							H	L			High-Z	DIN			
							L	H			DIN	High-Z			
Flash_1 Temporary Sector Group Unprotection(6)	X	X	X	X	X	X	X	X	X	X	X	X	V <sub>ID</sub>	X	X
Flash_2 Temporary Sector Group Unprotection(6)	X	X	X	X	X	X	X	X	X	X	X	X	X	V <sub>ID</sub>	X
Flash_1 Hardware Reset	X	X	H	H	X	X	X	X	X	X	High-Z	High-Z	L	X	X
Flash_2 Hardware Reset	X	X	H	H	X	X	X	X	X	X	High-Z	High-Z	X	L	X
Flash_1 or 2 Boot Block Sector Write Protection	X	X	X	X	X	X	X	X	X	X	X	X	X	X	L
FCRAM Power Down Program	H	H	H	H	X	X	X	X	L	Valid	High-Z	High-Z	H	H	X
FCRAM No Read (7)	H	H	L	H	L	H	H	H	H	Valid	High-Z	High-Z	H	H	X
FCRAM Power Down (8)	X	X	X	L	X	X	X	X	X	X	X	X	X	X	X

Legend: L = V<sub>IL</sub>, H = V<sub>IH</sub>, X = V<sub>IL</sub> or V<sub>IH</sub>. See DC Characteristics for voltage levels.

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- Notes:**
1. Other operations except for indicated this column are inhibited.
  2. Do not apply for a following state two or more on the same time;  
1)  $\overline{CEf\_1} = V_{IL}$ , 2)  $\overline{CEf\_2} = V_{IL}$ , 3)  $\overline{CE1r} = V_{IL}$  and  $CE2r = V_{IH}$
  3. FCRAM Output Disable condition should not be kept longer than 1 $\mu$ s.
  4.  $\overline{WE}$  can be  $V_{IL}$  if  $\overline{OE}$  is  $V_{IL}$ ,  $\overline{OE}$  at  $V_{IH}$  initiates the write operations.
  5. FCRAM  $\overline{LB}$ ,  $\overline{UB}$  control at Read operation is not supported.
  6. It is also used for the extended sector group protections.
  7. The FCRAM Power Down Program can be performed one time after compliance of Power-UP timings and it should not be re-programmed after regular Read or Write.
  8. FCRAM Power Down mode can be entered from Standby state and all DQ pins are in High-Z state.  
 $I_{PDR}$  current and data retention depends on the selection of Power Down Program.
  9. Either or both  $\overline{LB}$  and  $\overline{UB}$  must be Low for FCRAM Read Operation.
  10. Can be either  $V_{IL}$  or  $V_{IH}$  but must be valid before Read or Write.
  11. See “FCRAM Power Down Program Key Table” in next page.
  12. Protect “outer most” 2x8K bytes ( 4 words ) on both ends of the boot block sectors.



## ■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating		Unit
		Min.	Max.	
Storage Temperature	T <sub>stg</sub>	-55	+125	°C
Ambient Temperature with Power Applied	T <sub>A</sub>	-30	+85	°C
Voltage with Respect to Ground All pins except RESET_1 or RESET_2, WP/ACC *1	V <sub>IN</sub> , V <sub>OUT</sub>	-0.3	V <sub>ccf_1</sub> +0.3	V
			V <sub>ccf_2</sub> +0.3	V
			V <sub>ccr</sub> +0.3	V
V <sub>ccf_1</sub> /V <sub>ccf_2</sub> /V <sub>ccr</sub> Supply *1	V <sub>ccf_1</sub> , V <sub>ccf_2</sub> , V <sub>ccr</sub>	-0.3	+3.3	V
RESET_1 or RESET_2 *2	V <sub>IN</sub>	-0.5	+13.0	V
WP/ACC *3	V <sub>IN</sub>	-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<sub>SS</sub> to -1.0 V for periods of up to 20 ns. Maximum DC voltage on input or I/O pins is V<sub>ccf\_1</sub> + 0.3 V or V<sub>ccf\_2</sub> + 0.3 V or V<sub>ccr</sub> + 0.3 V. During voltage transitions, input or I/O pins may overshoot to V<sub>ccf\_1</sub> + 2.0 V or V<sub>ccf\_2</sub> + 2.0 V or V<sub>ccr</sub> + 1.0 V for periods of up to 20 ns.

\*2: Minimum DC input voltage on  $\overline{\text{RESET}}_1$  or  $\overline{\text{RESET}}_2$  pin is -0.5 V. During voltage transitions  $\overline{\text{RESET}}_1$  or  $\overline{\text{RESET}}_2$  pins may undershoot V<sub>SS</sub> to -2.0 V for periods of up to 20 ns. Voltage difference between input and supply voltage (V<sub>IN</sub>-V<sub>ccf\_1</sub> or V<sub>ccf\_2</sub>) does not exceed +9.0 V. Maximum DC input voltage on  $\overline{\text{RESET}}_1$  or  $\overline{\text{RESET}}_2$  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<sub>SS</sub> 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<sub>ccf\_1</sub> or V<sub>ccf\_2</sub> 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	T <sub>A</sub>	-30	+85	°C
V <sub>ccf_1</sub> /V <sub>ccf_2</sub> /V <sub>ccr</sub> Supply Voltages	V <sub>ccf_1</sub> , V <sub>ccf_2</sub> , V <sub>ccr</sub>	+2.7	+3.1	V

**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.

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

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## ■ ELECTRICAL CHARACTERISTICS

### 1. DC Characteristics

Parameter	Symbol	Conditions	Value			Unit	
			Min.	Typ.	Max.		
Input Leakage Current	$I_{LI}$	$V_{IN} = V_{SS}$ to $V_{CCf\_1}, V_{CCf}$	-1.0	—	+1.0	mA	
Output Leakage Current	$I_{LO}$	$V_{OUT} = V_{SS}$ to $V_{CCf\_1}, V_{CCf}$	-1.0	—	+1.0	mA	
$\overline{RESET}$ Inputs Leakage Current	$I_{LIT}$	$V_{CCf} = V_{CCf} \text{ Max.},$ $\overline{RESET} = 12.5 \text{ V}$	—	—	35	$\mu\text{A}$	
Flash_1 $V_{CC}$ Active Current (Read) *1	$I_{CC1f\_1}$	$\overline{CEf\_1} = V_{IL},$ $\overline{OE} = V_{IH}$	$t_{CYCLE} = 5 \text{ MHz}$	—	—	18	mA
			$t_{CYCLE} = 1 \text{ MHz}$	—	—	4	mA
Flash_1 $V_{CC}$ Active Current (Program/Erase) *2	$I_{CC2f\_1}$	$\overline{CEf\_1} = V_{IL}, \overline{OE} = V_{IH}$	—	—	35	mA	
Flash_1 $V_{CC}$ Active Current (Read-While-Program) *5	$I_{CC3f\_1}$	$\overline{CEf\_1} = V_{IL}, \overline{OE} = V_{IH}$	—	—	53	mA	
Flash_1 $V_{CC}$ Active Current (Read-While-Erase) *5	$I_{CC4f\_1}$	$\overline{CEf\_1} = V_{IL}, \overline{OE} = V_{IH}$	—	—	53	mA	
Flash_1 $V_{CC}$ Active Current (Erase-Suspend-Program)	$I_{CC5f\_1}$	$\overline{CEf\_1} = V_{IL}, \overline{OE} = V_{IH}$	—	—	40	mA	
Flash_2 $V_{CC}$ Active Current (Read) *1	$I_{CC1f\_2}$	$\overline{CEf\_2} = V_{IL},$ $\overline{OE} = V_{IH}$	$t_{CYCLE} = 5 \text{ MHz}$	—	—	18	mA
			$t_{CYCLE} = 1 \text{ MHz}$	—	—	4	
Flash_2 $V_{CC}$ Active Current (Program/Erase) *2	$I_{CC2f\_2}$	$\overline{CEf\_2} = V_{IL}, \overline{OE} = V_{IH}$	—	—	35	mA	
Flash_2 $V_{CC}$ Active Current (Read-While-Program) *5	$I_{CC3f\_2}$	$\overline{CEf\_2} = V_{IL}, \overline{OE} = V_{IH}$	—	—	53	mA	
Flash_2 $V_{CC}$ Active Current (Read-While-Erase) *5	$I_{CC4f\_2}$	$\overline{CEf\_2} = V_{IL}, \overline{OE} = V_{IH}$	—	—	53	mA	
Flash_2 $V_{CC}$ Active Current (Erase-Suspend-Program)	$I_{CC5f\_2}$	$\overline{CEf\_2} = V_{IL}, \overline{OE} = V_{IH}$	—	—	35	mA	
$\overline{WP}/\text{ACC}$ Acceleration Program Current	$I_{ACC}$	$V_{CCf} = V_{CCf} \text{ Max.},$ $\overline{WP}/\text{ACC} = V_{ACC} \text{ Max.}$	—	—	20	mA	
FCRAM $V_{CC}$ Active Current	$I_{CC1f}$	$V_{CCf} = V_{CCf} \text{ Max.},$ $\overline{CE1r} = V_{IL}, \overline{CE2r} = V_{IH},$ $V_{IN} = V_{IH} \text{ or } V_{IL}, I_{OUT} = 0 \text{ mA}$	$t_{RC} / t_{WC} = \text{min.}$	—	—	25	mA
			$t_{RC} / t_{WC} = 1 \text{ ms}$	—	—	3	
Flash $V_{CC}$ Standby Current	$I_{SB1f}$	$V_{CCf} = V_{CCf} \text{ Max.}, \overline{CEf} = V_{CCf} \pm 0.3 \text{ V}$ $\overline{RESET} = V_{CCf} \pm 0.3 \text{ V},$ $\overline{WP}/\text{ACC} = V_{CCf} \pm 0.3 \text{ V}$	—	1 *7	5 *7	$\mu\text{A}$	
Flash $V_{CC}$ Standby Current ( $\overline{RESET}$ )	$I_{SB2f}$	$V_{CCf} = V_{CCf} \text{ Max.}, \overline{RESET} = V_{SS} \pm 0.3 \text{ V},$ $\overline{WP}/\text{ACC} = V_{CCf} \pm 0.3 \text{ V}$	—	1 *7	5 *7	$\mu\text{A}$	
Flash $V_{CC}$ Current (Automatic Sleep Mode) *3	$I_{SB3f}$	$V_{CCf} = V_{CCf} \text{ Max.}, \overline{CEf} = V_{SS} \pm 0.3 \text{ V}$ $\overline{RESET} = V_{CCf} \pm 0.3 \text{ V},$ $\overline{WP}/\text{ACC} = V_{CCf} \pm 0.3 \text{ V},$ $V_{IN} = V_{CCf} \pm 0.3 \text{ V} \text{ or } V_{SS} \pm 0.3 \text{ V}$	—	1 *7	5 *7	$\mu\text{A}$	

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Parameter	Symbol	Conditions	Value			Unit	
			Min.	Typ.	Max.		
FCRAM V <sub>CC</sub> Standby Current	I <sub>SB1F</sub>	V <sub>CCr</sub> = V <sub>CCr</sub> Max., $\overline{CE1r} \geq V_{CCr} - 0.2V$ , $\overline{CE2r} \geq V_{CCr} - 0.2V$ , V <sub>IN</sub> ≤ 0.2 V or V <sub>CCr</sub> - 0.2 V	—	—	100	μA	
FCRAM V <sub>CC</sub> Power Down Current	I <sub>PDSF</sub>	V <sub>CCr</sub> = V <sub>CCr</sub> Max., $\overline{CE1r} \geq V_{CCr} - 0.2V$ , $\overline{CE2r} \leq 0.2V$ , V <sub>IN</sub> Cycle time = t <sub>RC</sub> min.	Sleep	—	—	10	μA
	I <sub>PDNF</sub>		NAP	—	—	60	μA
	I <sub>PD8F</sub>		8M Partial	—	—	70	μA
Input Low Level	V <sub>IL</sub>	—	-0.3	—	0.5	V	
Input High Level	V <sub>IH</sub>	—	2.2	—	V <sub>CC+</sub> 0.3 *6	V	
Voltage for Sector Protection, and Temporary Sector Unprotection (RESET) *4	V <sub>ID</sub>	—	11.5	—	12.5	V	
Voltage for $\overline{WP}/ACC$ Sector Protection/Unprotection and Program Acceleration *4	V <sub>ACC</sub>	—	8.5	9.0	9.5	V	
Output Low Voltage Level	V <sub>OLf</sub>	V <sub>CCf</sub> = V <sub>CCf</sub> Min., I <sub>OL</sub> =4.0 mA	Flash	—	—	0.45	V
	V <sub>OLr</sub>	V <sub>CCr</sub> = V <sub>CCr</sub> Min., I <sub>OL</sub> =1.0mA	FCRAM	—	—	0.4	V
Output High Voltage Level	V <sub>OHF</sub>	V <sub>CCf</sub> = V <sub>CCf</sub> Min., I <sub>OH</sub> =-0.1 mA	Flash	V <sub>CCf</sub> - 0.4	—	—	V
	V <sub>OHR</sub>	V <sub>CCr</sub> = V <sub>CCr</sub> Min., I <sub>OH</sub> =-0.5mA	FCRAM	2.2	—	—	V
Flash Low V <sub>CCf</sub> Lock-Out Voltage	V <sub>LKO</sub>	—	2.3	2.4	2.5	V	

Legend: Flash means Flash\_1 or Flash\_2, V<sub>CCf</sub> means V<sub>CCf\_1</sub> or V<sub>CCf\_2</sub>, V<sub>SSf</sub> means V<sub>SSf\_1</sub> or V<sub>SSf\_2</sub>,  $\overline{CEf}$  means  $\overline{CEf_1}$  or  $\overline{CEf_2}$ , RESET means RESET\_1 or RESET\_2

\*1: The I<sub>CC</sub> current listed includes both the DC operating current and the frequency dependent component.

\*2: I<sub>CC</sub> 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<sub>CCf</sub> applying.

\*5: Embedded Algorithm (program or erase) is in progress. (@5 MHz)

\*6: V<sub>CC</sub> indicates lower of V<sub>CCf\_1</sub> or V<sub>CCf\_2</sub> or V<sub>CCr</sub>.

\*7: Actual Standby Current is twice of what is indicated in the table, due to two Flash memory chips embedment with one device.

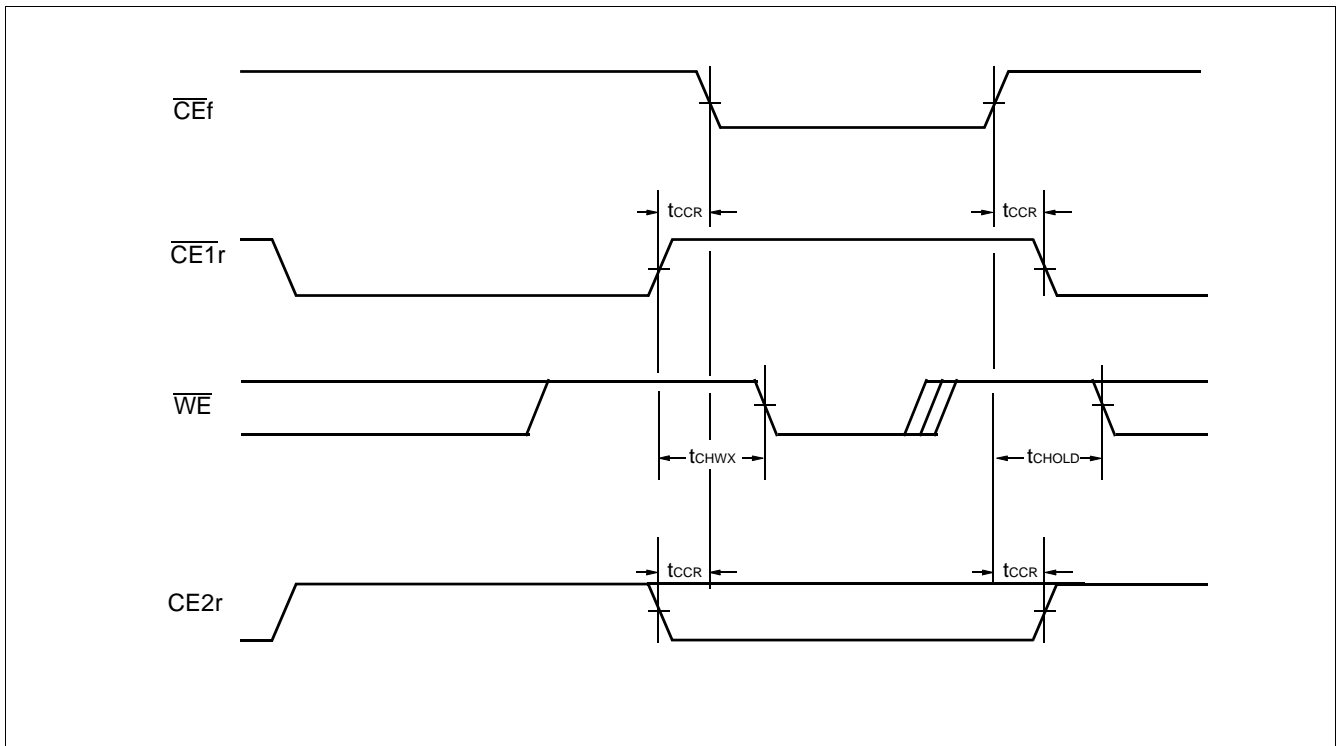
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## 2. AC Characteristics

### • $\overline{CE}$ 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
$\overline{CE1r}$ , High to $\overline{WE}$ Invalid time for Standby Entry	—	$t_{CHWX}$	—	10	—	ns

### • Timing Diagram for alternating RAM to Flash\_1 or Flash\_2



### • Flash\_1 Characteristics

Please refer to “64M Flash Memory for MCP” part. In this part, Flash means Flash\_1,  $V_{ccf}$  means  $V_{ccf\_1}$ ,  $V_{ssf}$  means  $V_{ssf\_1}$ ,  $\overline{CEf}$  means  $\overline{CEf\_1}$ ,  $\overline{RESET}$  means  $\overline{RESET\_1}$

### • Flash\_2 Characteristics

Please refer to “32M Flash Memory for MCP” part. In this part, Flash means Flash\_2,  $V_{ccf}$  means  $V_{ccf\_2}$ ,  $V_{ssf}$  means  $V_{ssf\_2}$ ,  $\overline{CEf}$  means  $\overline{CEf\_2}$ ,  $\overline{RESET}$  means  $\overline{RESET\_2}$

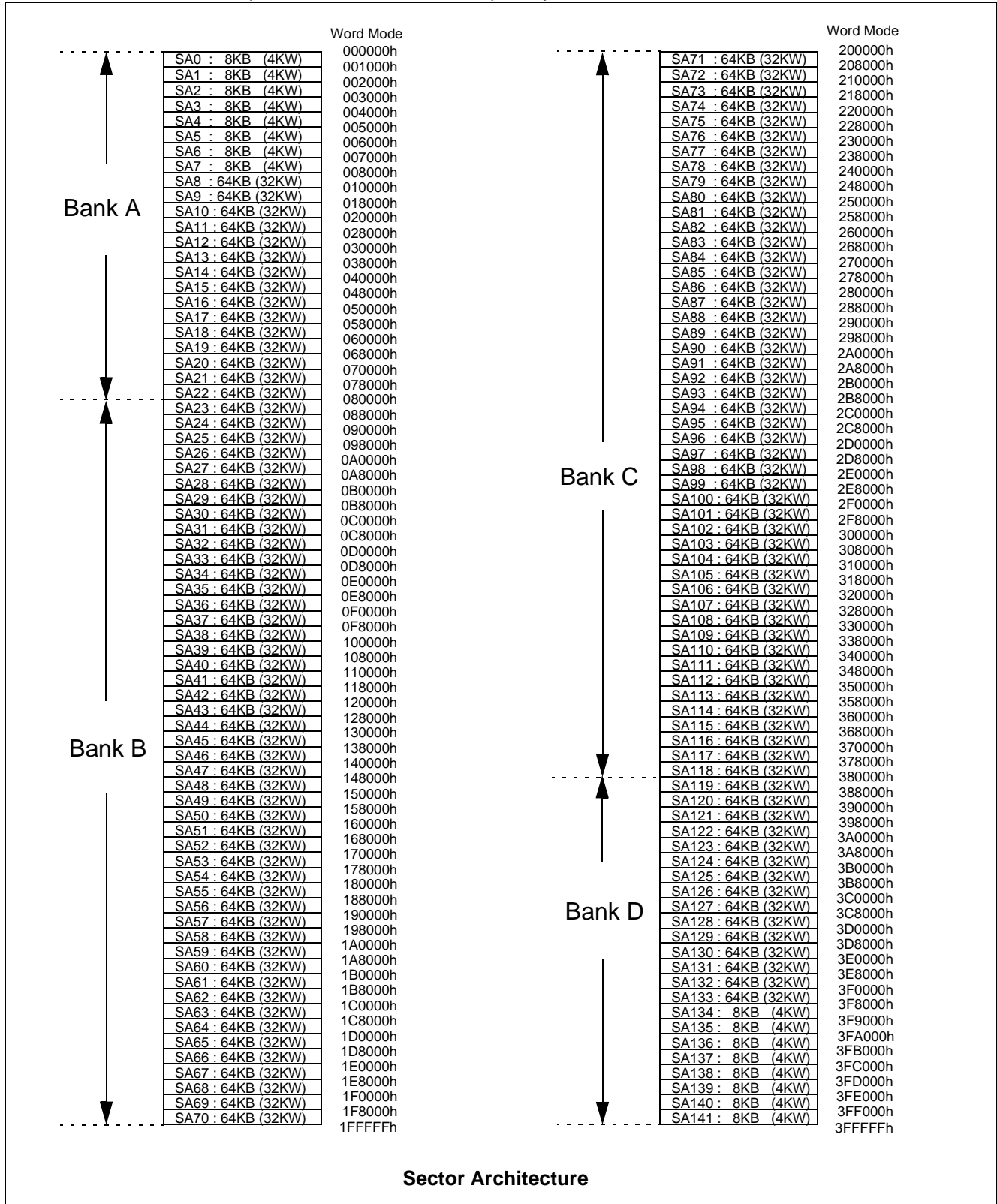
### • FCRAM Characteristics

Please refer to “32M FCRAM for MCP” part.

# 64M Flash for MCP

## ■ 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.



# 64M Flash for MCP

**Table 1 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)

**Table 2 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.

**Table 3 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.

## 64M Flash for MCP

Table 4 Sector Address Tables

Bank	Sector	Sector Address										Address Range
		Bank Address										Word Mode
		A <sub>21</sub>	A <sub>20</sub>	A <sub>19</sub>	A <sub>18</sub>	A <sub>17</sub>	A <sub>16</sub>	A <sub>15</sub>	A <sub>14</sub>	A <sub>13</sub>	A <sub>12</sub>	
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	

(Continued)

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(Continued)

Bank	Sector	Sector Address										Address Range
		Bank Address										Word Mode
		A <sub>21</sub>	A <sub>20</sub>	A <sub>19</sub>	A <sub>18</sub>	A <sub>17</sub>	A <sub>16</sub>	A <sub>15</sub>	A <sub>14</sub>	A <sub>13</sub>	A <sub>12</sub>	
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 0FFFFh
	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 1FFFFh	

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## 64M Flash for MCP

(Continued)

Bank	Sector	Sector Address										Address Range
		Bank Address										Word Mode
		A <sub>21</sub>	A <sub>20</sub>	A <sub>19</sub>	A <sub>18</sub>	A <sub>17</sub>	A <sub>16</sub>	A <sub>15</sub>	A <sub>14</sub>	A <sub>13</sub>	A <sub>12</sub>	
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 2FFFFh	
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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## 64M Flash for MCP

(Continued)

Bank	Sector	Sector Address										Address Range
		Bank Address										Word Mode
		A <sub>21</sub>	A <sub>20</sub>	A <sub>19</sub>	A <sub>18</sub>	A <sub>17</sub>	A <sub>16</sub>	A <sub>15</sub>	A <sub>14</sub>	A <sub>13</sub>	A <sub>12</sub>	
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	

## 64M Flash for MCP

Table 5 Sector Group Addresses

Sector Group	A <sub>21</sub>	A <sub>20</sub>	A <sub>19</sub>	A <sub>18</sub>	A <sub>17</sub>	A <sub>16</sub>	A <sub>15</sub>	A <sub>14</sub>	A <sub>13</sub>	A <sub>12</sub>	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

# 64M Flash for MCP

**Table 6 Flash Memory Autoselect Codes**

Type	A <sub>21</sub> to A <sub>12</sub>	A <sub>6</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>	Code (HEX)
Manufacture's Code	BA	L	L	L	L	L	04h
Device Code	BA	L	L	L	L	H	227Eh
Extended Device Code * <sup>2</sup>	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* <sup>1</sup>

Legend: L = V<sub>IL</sub>, H = V<sub>IH</sub>. 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.

## 64M Flash for MCP

Table 7 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 Resume	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	<sup>*4</sup> F0h	—	—	—	—	—	—	—	—
Query	1	(BA) 55h	98h	—	—	—	—	—	—	—	—	—	—
Hi-ROM Entry	3	555h	AAh	2AAh	55h	555h	88h	—	—	—	—	—	—
Hi-ROM Program *3	4	555h	AAh	2AAh	55h	555h	A0h	<sup>(HRA)</sup> PA	PD	—	—	—	—
Hi-ROM Exit *3	4	555h	AAh	2AAh	55h	<sup>(HRBA)</sup> <sup>5</sup> 55h	90h	XXXh	00h	—	—	—	—

(Continued)

## 64M Flash for MCP

(Continued)

\*1: This command is valid during Fast Mode.

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

\*3: This command is valid during Hi-ROM mode.

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

Notes: 1. Address bits  $A_{21}$  to  $A_{11} = X = \text{"H" or "L"}$  for all address commands except or Program Address (PA), Sector Address (SA), and Bank Address (BA), and Sector Group Address (SPA).

2. Bus operations are defined in ■ DEVICE BUS OPERATION.

3. 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 ( $A_{21}, A_{20}, A_{19}$ )

4. RD = Data read from location RA during read operation.

PD = Data to be programmed at location PA. Data is latched on the falling edge of write pulse.

5. 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.

6. HRA = Address of the Hi-ROM area: 000000h to 00007Fh

7. HRBA = Bank Address of the Hi-ROM area ( $A_{21} = A_{20} = A_{19} = V_{\text{IL}}$ )

8. The system should generate the following address patterns: 555h or 2AAh to addresses  $A_{10}$  to  $A_0$

9. Both Read/Reset commands are functionally equivalent, resetting the device to the read mode.

10. The command combinations not described in this table are illegal.

## 64M Flash for MCP

## ■ ELECTRICAL CHARACTERISTICS (AC Characteristics)

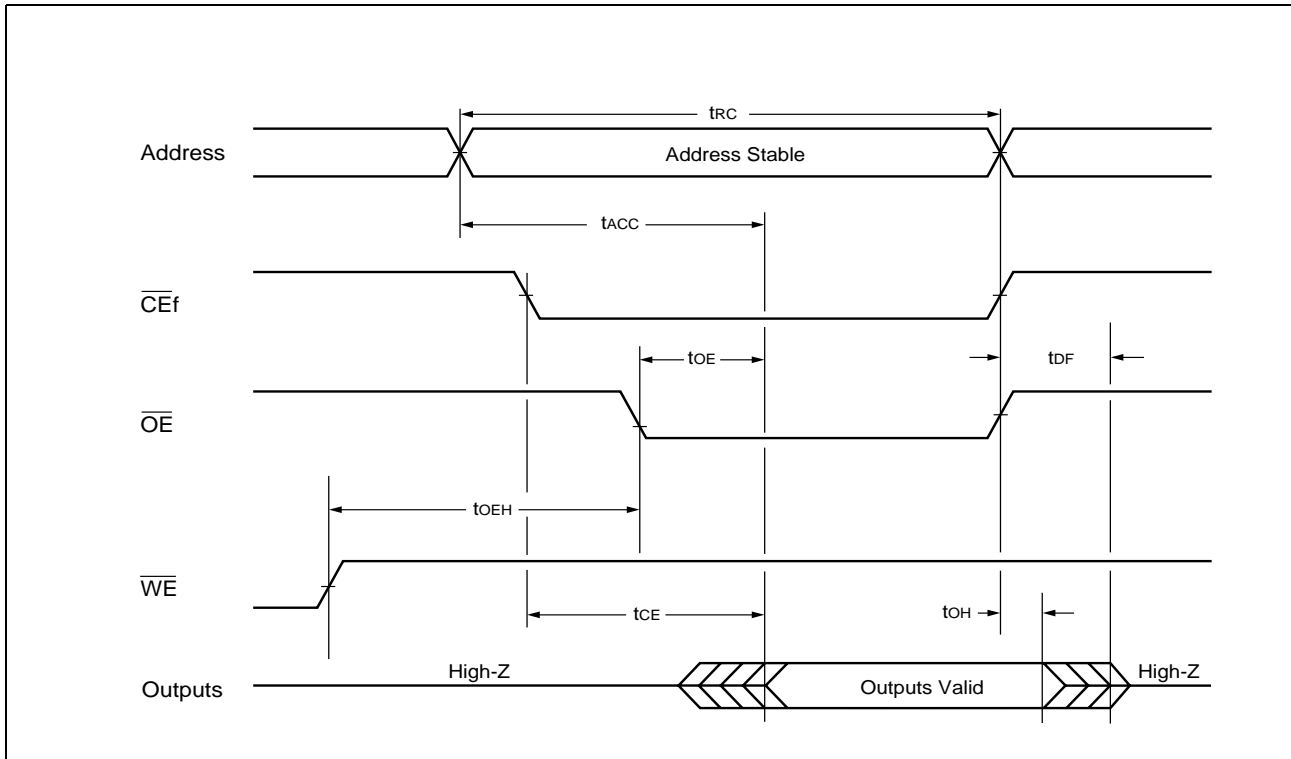
- Read Only Operations Characteristics (Flash)

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

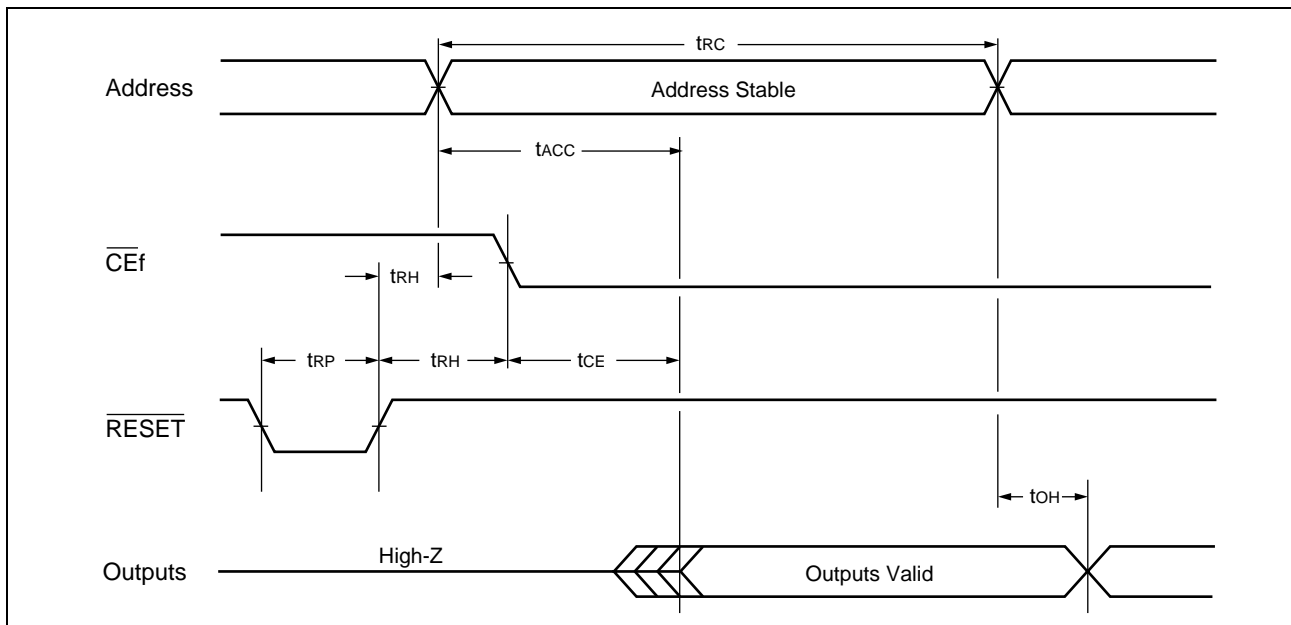
Note: Test Conditions— Output Load: 1 TTL gate and 30 pF  
 Input rise and fall times: 5 ns  
 Input pulse levels: 0.0 V to V<sub>ccf</sub>  
 Timing measurement reference level  
 Input: 0.5×V<sub>ccf</sub>  
 Output: 0.5×V<sub>ccf</sub>

# 64M Flash for MCP

## • Read Operation Timing Diagram (Flash)



## • Hardware Reset/Read Operation Timing Diagram (Flash)





## 64M Flash for MCP

## • Write/Erase/Program Operations (Flash)

Parameter		Symbol		Value			Unit
		JEDEC	Standard	Min.	Typ.	Max.	
Write Cycle Time		t <sub>AVAV</sub>	t <sub>WC</sub>	70	—	—	ns
Address Setup Time		t <sub>AVWL</sub>	t <sub>AS</sub>	0	—	—	ns
Address Setup Time to $\overline{\text{OE}}$ Low During Toggle Bit Polling		—	t <sub>ASO</sub>	12	—	—	ns
Address Hold Time		t <sub>WLAX</sub>	t <sub>AH</sub>	45	—	—	ns
Address Hold Time from $\overline{\text{CEf}}$ or $\overline{\text{OE}}$ High During Toggle Bit Polling		—	t <sub>AHT</sub>	0	—	—	ns
Data Setup Time		t <sub>DVWH</sub>	t <sub>DS</sub>	30	—	—	ns
Data Hold Time		t <sub>WHDX</sub>	t <sub>DH</sub>	0	—	—	ns
Output Enable Hold Time	Read	—	t <sub>OEH</sub>	0	—	—	ns
	Toggle and $\overline{\text{Data}}$ Polling	—		10	—	—	ns
$\overline{\text{CEf}}$ High During Toggle Bit Polling		—	t <sub>CEPH</sub>	20	—	—	ns
$\overline{\text{OE}}$ High During Toggle Bit Polling		—	t <sub>OEPH</sub>	20	—	—	ns
Read Recover Time Before Write		t <sub>GHWL</sub>	t <sub>GHWL</sub>	0	—	—	ns
Read Recover Time Before Write		t <sub>GHEL</sub>	t <sub>GHEL</sub>	0	—	—	ns
$\overline{\text{CEf}}$ Setup Time		t <sub>ELWL</sub>	t <sub>CS</sub>	0	—	—	ns
$\overline{\text{WE}}$ Setup Time		t <sub>WLEL</sub>	t <sub>WS</sub>	0	—	—	ns
$\overline{\text{CEf}}$ Hold Time		t <sub>WHEH</sub>	t <sub>CH</sub>	0	—	—	ns
$\overline{\text{WE}}$ Hold Time		t <sub>EHWH</sub>	t <sub>WH</sub>	0	—	—	ns
Write Pulse Width		t <sub>WLWH</sub>	t <sub>WP</sub>	35	—	—	ns
$\overline{\text{CEf}}$ Pulse Width		t <sub>ELEH</sub>	t <sub>CP</sub>	35	—	—	ns
Write Pulse Width High		t <sub>WHWL</sub>	t <sub>WPH</sub>	25	—	—	ns
$\overline{\text{CEf}}$ Pulse Width High		t <sub>EHEL</sub>	t <sub>CPH</sub>	25	—	—	ns
Programming Operation		t <sub>WHWH1</sub>	t <sub>WHWH1</sub>	—	6	60	μs
Sector Erase Operation *1		t <sub>WHWH2</sub>	t <sub>WHWH2</sub>	—	0.2	1	s
V <sub>ccf</sub> Setup Time		—	t <sub>VCS</sub>	50	—	—	μs
Rise Time to V <sub>ID</sub> *2		—	t <sub>VIDR</sub>	500	—	—	ns
Rise Time to V <sub>ACC</sub> *3		—	t <sub>VACCR</sub>	500	—	—	ns
Voltage Transition Time *2		—	t <sub>VLHT</sub>	4	—	—	μs
Write Pulse Width *2		—	t <sub>WPP</sub>	100	—	—	μs

(Continued)

# 64M Flash for MCP

(Continued)

Parameter	Symbol		Value			Unit
	JEDEC	Standard	Min.	Typ.	Max.	
$\overline{\text{OE}}$ Setup Time to $\overline{\text{WE}}$ Active *2	—	tOESP	4	—	—	μs
$\overline{\text{CEf}}$ Setup Time to $\overline{\text{WE}}$ Active *2	—	tCSP	4	—	—	μs
Recover Time from RY/BY	—	tRB	0	—	—	ns
$\overline{\text{RESET}}$ Pulse Width	—	tRP	500	—	—	ns
$\overline{\text{RESET}}$ High Level Period Before Read	—	tRH	200	—	—	ns
Program/Erase Valid to RY/BY Delay	—	tBUSY	—	—	90	ns
Delay Time from Embedded Output Enable	—	tEOE	—	—	70	ns
Erase Time-out Time	—	tTOW	50	—	—	μs
Erase Suspend Transition Time	—	tSPD	—	—	20	μs

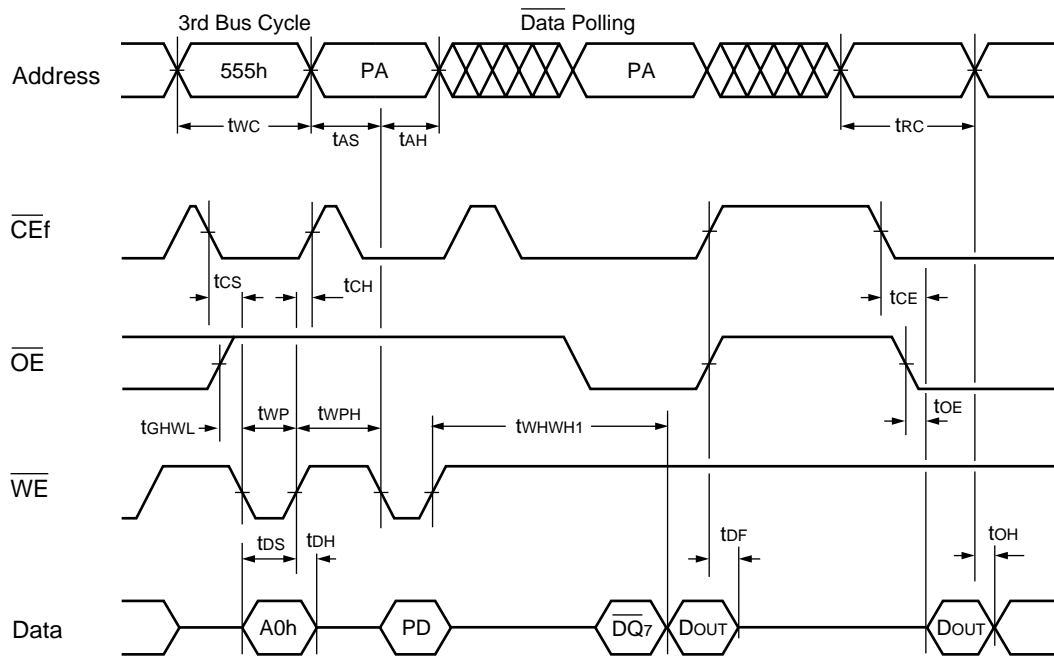
\*1: This does not include preprogramming time.

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

\*3: This timing is for Accelerated Program operation.

## 64M Flash for MCP

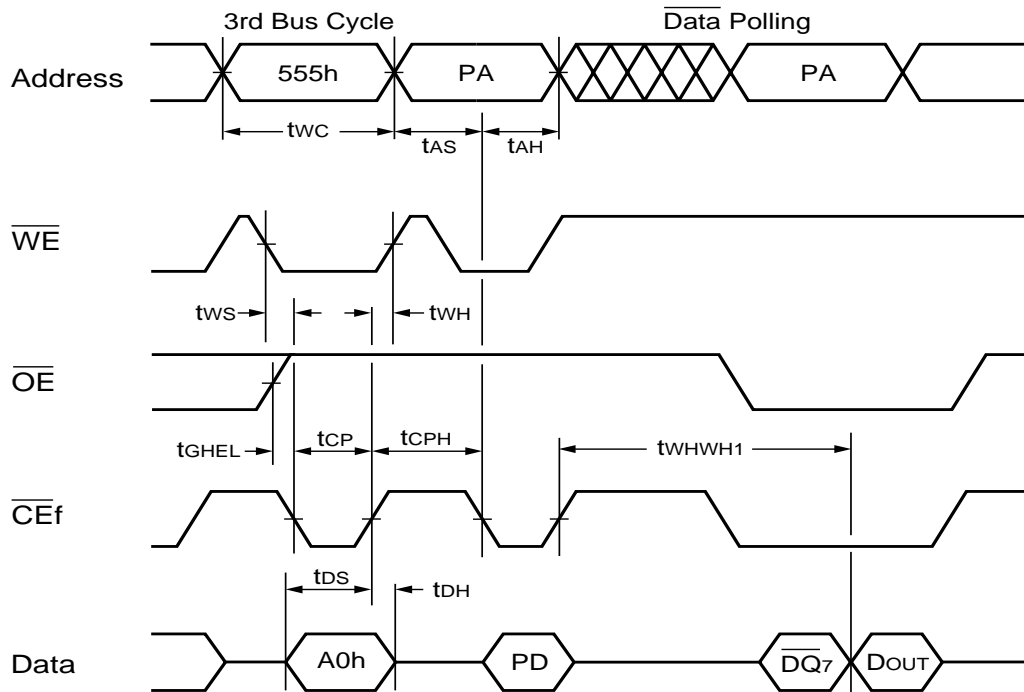
- Write Cycle ( $\overline{WE}$  control) (Flash)



- Notes:
1. PA is address of the memory location to be programmed.
  2. PD is data to be programmed at word address.
  3.  $\overline{DQ7}$  is the output of the complement of the data written to the device.
  4. DOUT is the output of the data written to the device.
  5. Figure indicates last two bus cycles out of four bus cycle sequence.

# 64M Flash for MCP

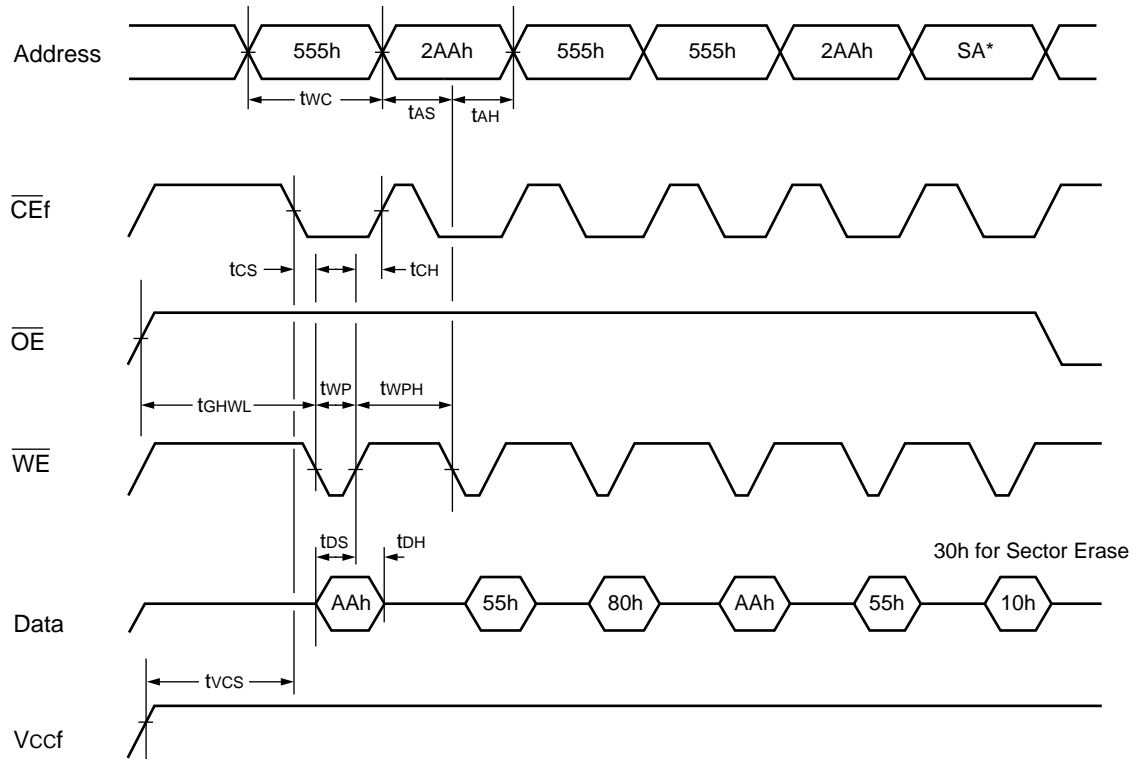
## • Write Cycle ( $\overline{\text{CEf}}$ control) (Flash)



- Notes:
1. PA is address of the memory location to be programmed.
  2. PD is data to be programmed at word address.
  3.  $\overline{\text{DQ}}_7$  is the output of the complement of the data written to the device.
  4. DOUT is the output of the data written to the device.
  5. Figure indicates last two bus cycles out of four bus cycle sequence.

# 64M Flash for MCP

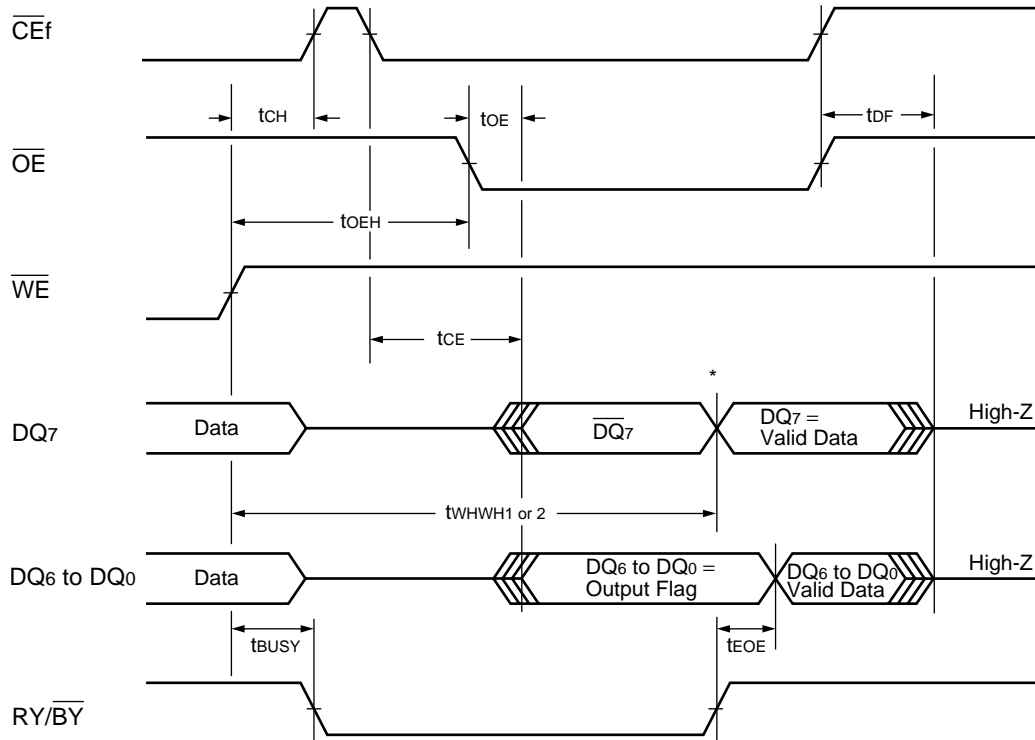
## • AC Waveforms Chip/Sector Erase Operations (Flash)



\* : SA is the sector address for Sector Erase. Addresses = 555h (Word) for Chip Erase.

# 64M Flash for MCP

- AC Waveforms for  $\overline{\text{Data}}$  Polling during Embedded Algorithm Operations (Flash)

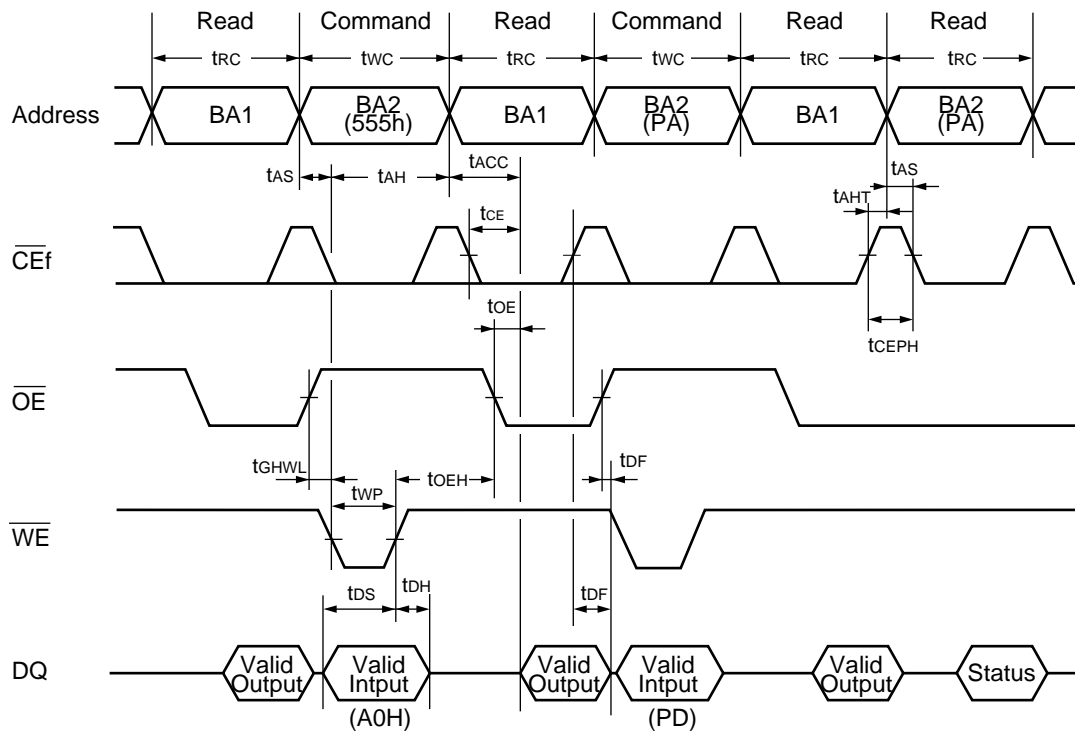


\* :  $\text{DQ7} = \text{Valid Data}$  (the device has completed the Embedded operation) .



# 64M Flash for MCP

## • Back-to-back Read/Write Timing Diagram (Flash)



Note : This is example of Read for Bank 1 and Embedded Algorithm (program) for Bank 2.

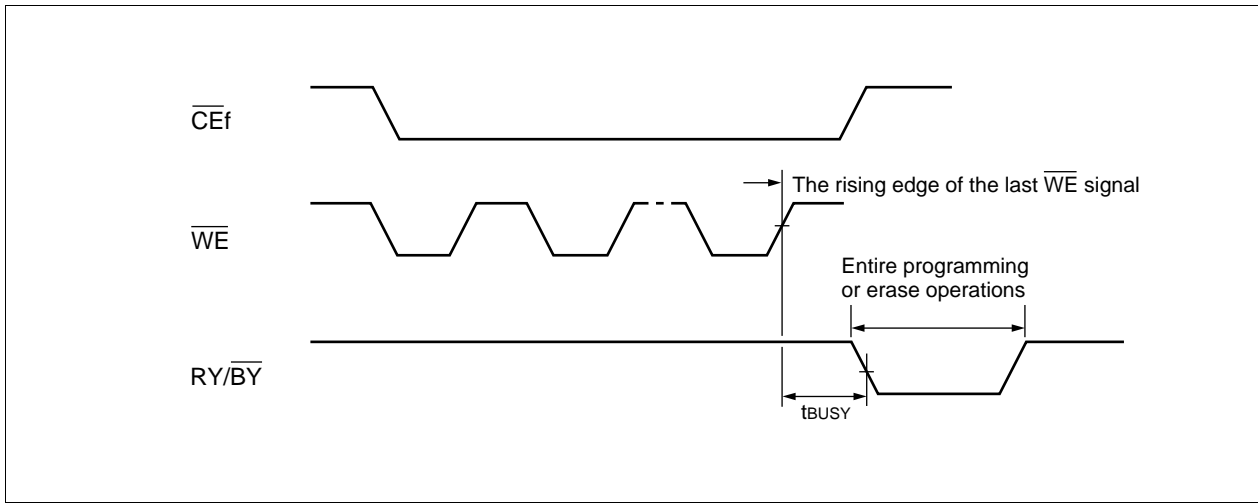
BA1 : Address corresponding to Bank 1

BA2 : Address corresponding to Bank 2

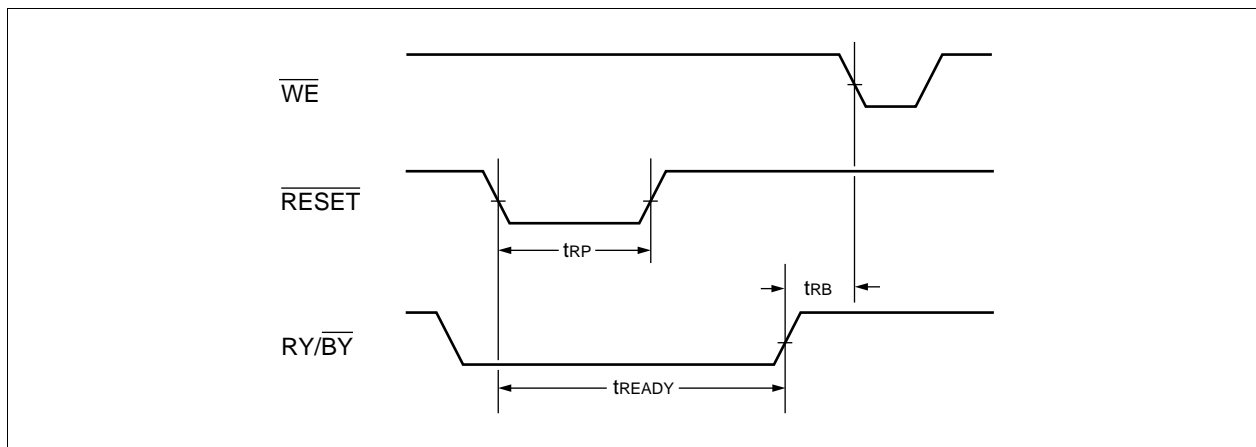


# 64M Flash for MCP

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

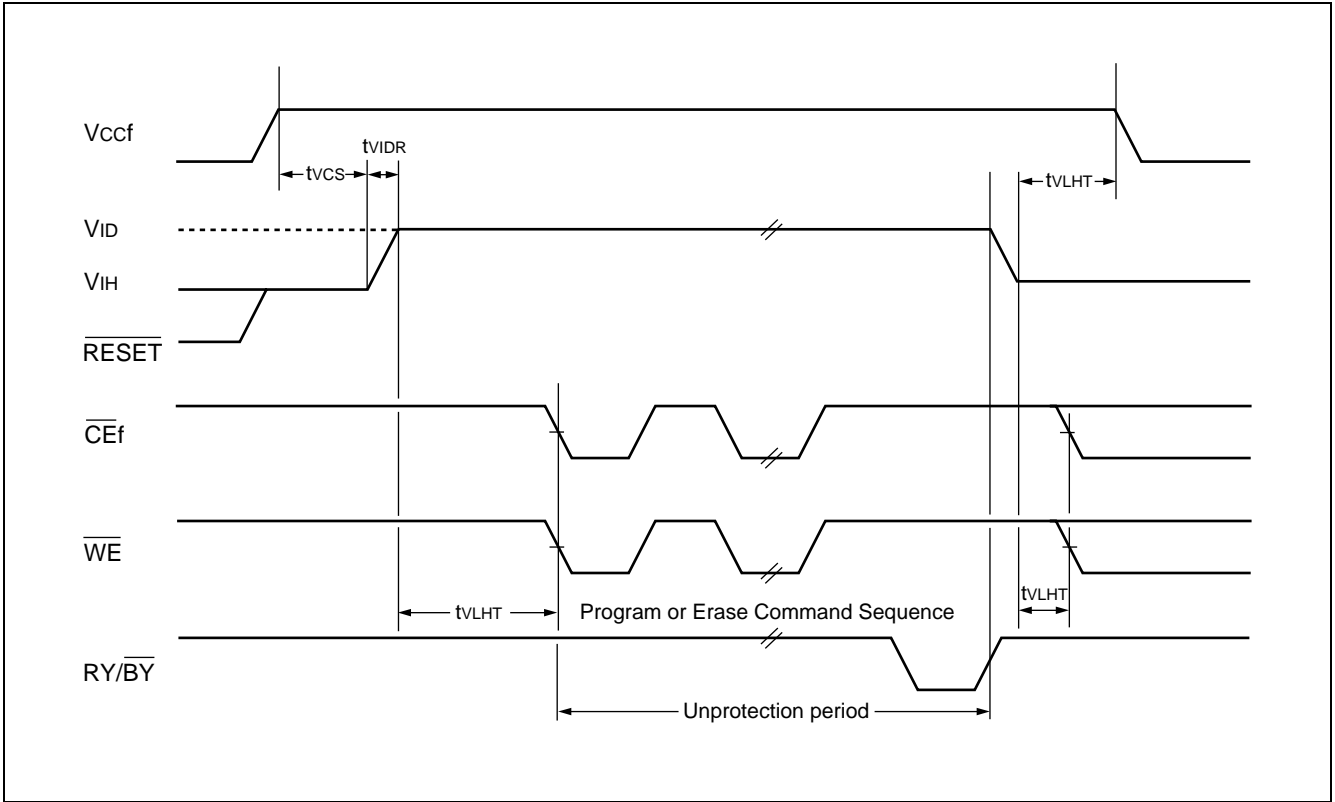


- **$\overline{\text{RESET}}$ ,  $\text{RY}/\overline{\text{BY}}$  Timing Diagram (Flash)**

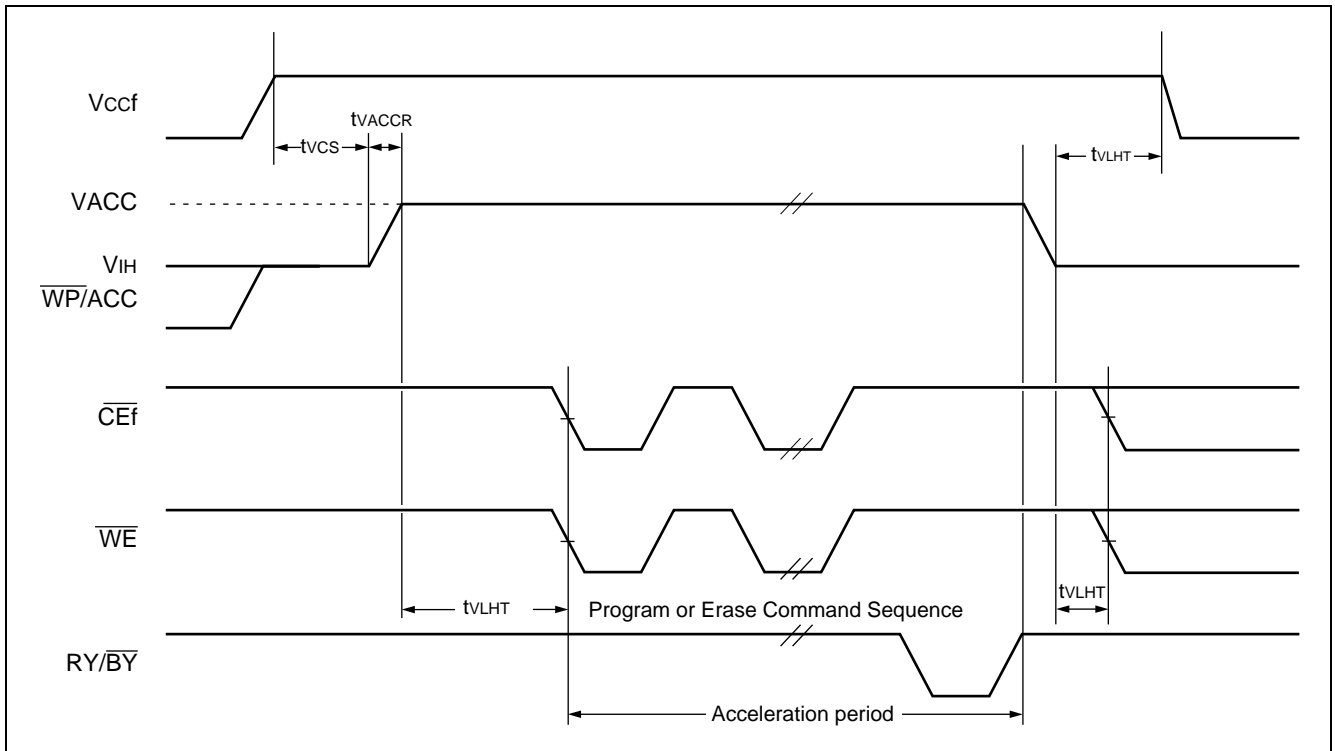


# 64M Flash for MCP

• Temporary Sector Unprotection (Flash)

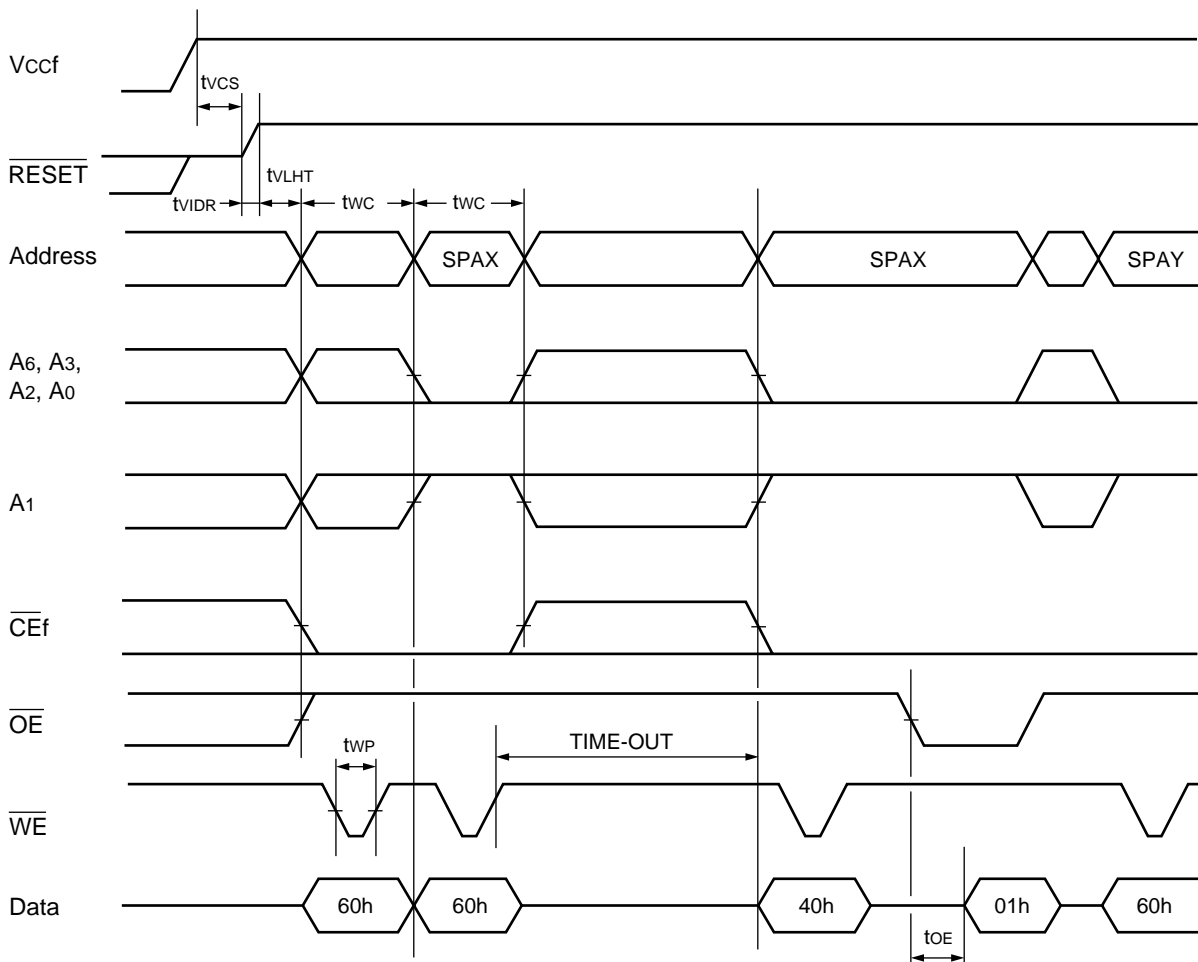


• Acceleration Mode Timing Diagram (Flash)



## 64M Flash for MCP

- 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  $\mu$ s (Min.)

# 64M Flash for MCP

## ■ ERASE AND PROGRAMMING PERFORMANCE (Flash)

Parameter	Value			Unit	Remarks
	Min.	Typ.	Max.		
Sector Erase Time	—	0.2	1	s	Excludes programming time prior to erasure
Word Programming Time	—	6	60	μs	Excludes system-level overhead
Chip Programming Time	—	25.2	95	s	Excludes system-level overhead
Erase/Program Cycle	100,000	—	—	cycle	

Typical Erase conditions  $T_A = 25^\circ\text{C}$ ,  $VCCf\_1$  &  $VCCf\_2 = 2.9\text{V}$

Typical Program conditions  $T_A = 25^\circ\text{C}$ ,  $VCCf\_1$  &  $VCCf\_2 = 2.9\text{V}$

Data= Checker

# 32M Flash for MCP (Top Boot Type)

## Command Definitions Table

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	1	XXXh	F0h	—	—	—	—	—	—	—	—	—	—
Read/Reset*1	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 Resume	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	—	—	—	—	—	—	—	—	—	—
Set to Fast Mode	3	555h	AAh	2AAh	55h	555h	20h	—	—	—	—	—	—
Fast Program *2	2	XXXh	A0h	PA	PD	—	—	—	—	—	—	—	—
Reset from Fast Mode *2	2	BA	90h	XXXh	F0h*6	—	—	—	—	—	—	—	—
Extended Sector Group Protection *3	4	XXXh	60h	SPA	60h	SPA	40h	SPA	SD	—	—	—	—
Query *4	1	(BA) 55h	98h	—	—	—	—	—	—	—	—	—	—
Hi-ROM Entry	3	555h	AAh	2AAh	55h	555h	88h	—	—	—	—	—	—
Hi-ROM Program *5	4	555h	AAh	2AAh	55h	555h	A0h	(HRA) PA	PD	—	—	—	—
Hi-ROM Exit *5	4	555h	AAh	2AAh	55h	(HRBA) 555h	90h	XXXh	00h	—	—	—	—

(Continued)

## 32M Flash for MCP (Top Boot type)

(Continued)

\*1 : Both of these reset commands are equivalent.

\*2 : This command is valid during Fast Mode.

\*3 : This command is valid while  $\overline{\text{RESET}} = V_{\text{ID}}$ .

\*4 : The valid address are  $A_6$  to  $A_0$ .

\*5 : This command is valid during Hi-ROM mode.

\*6 : The date "00h" is also acceptable.

Notes: • Address bits  $A_{20}$  to  $A_{11} = X = \text{"H"}$  or  $\text{"L"}$  for all address commands except or Program Address (PA) , Sector Address (SA) , Bank Address (BA) .

• Bus operations are defined in

"User Bus Operations Tables ( $\overline{\text{BYTE}} = V_{\text{IH}}$ )" (■ 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  $A_{20}$ ,  $A_{19}$ ,  $A_{18}$ ,  $A_{17}$ ,  $A_{16}$ ,  $A_{15}$ ,  $A_{14}$ ,  $A_{13}$ , and  $A_{12}$  will uniquely select any sector.

BA = Bank Address ( $A_{20}$  to  $A_{18}$ )

• 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 Hi-ROM area : 1FFF80h to 1FFFFFh

• HRBA = Bank Address of the Hi-ROM area :  $A_{20} = A_{19} = A_{18} = 1$

• The system should generate the following address patterns :

Word Mode : 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 "Command Definitions Table" are illegal.

# 32M Flash for MCP (Top Boot Type)

### Sector Group Protection Verify Autoselect Codes Table

Type	A <sub>20</sub> to A <sub>12</sub>	A <sub>6</sub>	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>	Code (HEX)
Manufacture's Code	BA	V <sub>IL</sub>	V <sub>IL</sub>	V <sub>IL</sub>	V <sub>IL</sub>	V <sub>IL</sub>	04h
Device Code	BA	V <sub>IL</sub>	V <sub>IL</sub>	V <sub>IL</sub>	V <sub>IL</sub>	V <sub>IH</sub>	227Eh
Extended Device Code	BA	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>IH</sub>	V <sub>IH</sub>	V <sub>IL</sub>	220Ah
	BA	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>IH</sub>	V <sub>IH</sub>	V <sub>IH</sub>	2201h
Sector Group Protection	SA	V <sub>IL</sub>	V <sub>IL</sub>	V <sub>IL</sub>	V <sub>IH</sub>	V <sub>IL</sub>	01h <sup>*1</sup>

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

### Expanded Autoselect Code Table

Type	Code	DQ <sub>15</sub>	DQ <sub>14</sub>	DQ <sub>13</sub>	DQ <sub>12</sub>	DQ <sub>11</sub>	DQ <sub>10</sub>	DQ <sub>9</sub>	DQ <sub>8</sub>	DQ <sub>7</sub>	DQ <sub>6</sub>	DQ <sub>5</sub>	DQ <sub>4</sub>	DQ <sub>3</sub>	DQ <sub>2</sub>	DQ <sub>1</sub>	DQ <sub>0</sub>
Manufacture's Code	04h	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Device Code	227Eh	0	0	1	0	0	0	1	0	0	1	1	1	1	1	1	0
Extended Device Code	220Ah	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	0
	2201h	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1
Sector Group Protection	01h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

# 32M Flash for MCP (Top Boot type)

## ■ FLEXIBLE SECTOR-ERASE ARCHITECTURE

Sector Address Table

Bank	Sector	Sector address										Sector size (Kwords)	Address range
		Bank address			A <sub>17</sub>	A <sub>16</sub>	A <sub>15</sub>	A <sub>14</sub>	A <sub>13</sub>	A <sub>12</sub>	A <sub>11</sub>		
		A <sub>20</sub>	A <sub>19</sub>	A <sub>18</sub>									
Bank D	SA0	0	0	0	0	0	0	X	X	X	X	32	000000h to 007FFFh
	SA1	0	0	0	0	0	1	X	X	X	X	32	008000h to 00FFFFh
	SA2	0	0	0	0	1	0	X	X	X	X	32	010000h to 017FFFh
	SA3	0	0	0	0	1	1	X	X	X	X	32	018000h to 01FFFFh
	SA4	0	0	0	1	0	0	X	X	X	X	32	020000h to 027FFFh
	SA5	0	0	0	1	0	1	X	X	X	X	32	028000h to 02FFFFh
	SA6	0	0	0	1	1	0	X	X	X	X	32	030000h to 037FFFh
	SA7	0	0	0	1	1	1	X	X	X	X	32	038000h to 03FFFFh
Bank C	SA8	0	0	1	0	0	0	X	X	X	X	32	040000h to 047FFFh
	SA9	0	0	1	0	0	1	X	X	X	X	32	048000h to 04FFFFh
	SA10	0	0	1	0	1	0	X	X	X	X	32	050000h to 057FFFh
	SA11	0	0	1	0	1	1	X	X	X	X	32	058000h to 05FFFFh
	SA12	0	0	1	1	0	0	X	X	X	X	32	060000h to 067FFFh
	SA13	0	0	1	1	0	1	X	X	X	X	32	068000h to 06FFFFh
	SA14	0	0	1	1	1	0	X	X	X	X	32	070000h to 077FFFh
	SA15	0	0	1	1	1	1	X	X	X	X	32	078000h to 07FFFFh
	SA16	0	1	0	0	0	0	X	X	X	X	32	080000h to 087FFFh
	SA17	0	1	0	0	0	1	X	X	X	X	32	088000h to 08FFFFh
	SA18	0	1	0	0	1	0	X	X	X	X	32	090000h to 097FFFh
	SA19	0	1	0	0	1	1	X	X	X	X	32	098000h to 09FFFFh
	SA20	0	1	0	1	0	0	X	X	X	X	32	0A0000h to 0A7FFFh
	SA21	0	1	0	1	0	1	X	X	X	X	32	0A8000h to 0AFFFFh
	SA22	0	1	0	1	1	0	X	X	X	X	32	0B0000h to 0B7FFFh
	SA23	0	1	0	1	1	1	X	X	X	X	32	0B8000h to 0BFFFFh
	SA24	0	1	1	0	0	0	X	X	X	X	32	0C0000h to 0C7FFFh
	SA25	0	1	1	0	0	1	X	X	X	X	32	0C8000h to 0CFFFFh
	SA26	0	1	1	0	1	0	X	X	X	X	32	0D0000h to 0D7FFFh
	SA27	0	1	1	0	1	1	X	X	X	X	32	0D8000h to 0DFFFFh
	SA28	0	1	1	1	0	0	X	X	X	X	32	0E0000h to 0E7FFFh
	SA29	0	1	1	1	0	1	X	X	X	X	32	0E8000h to 0EFFFFh
	SA30	0	1	1	1	1	0	X	X	X	X	32	0F0000h to 0F7FFFh
	SA31	0	1	1	1	1	1	X	X	X	X	32	0F8000h to 0FFFFFh

(Continued)



# 32M Flash for MCP (Top Boot Type)

(Continued)

Bank	Sector	Sector address										Sector size (Kwords)	Address range
		Bank address			A <sub>17</sub>	A <sub>16</sub>	A <sub>15</sub>	A <sub>14</sub>	A <sub>13</sub>	A <sub>12</sub>	A <sub>11</sub>		
		A <sub>20</sub>	A <sub>19</sub>	A <sub>18</sub>									
Bank B	SA32	1	0	0	0	0	0	X	X	X	X	32	100000h to 107FFFh
	SA33	1	0	0	0	0	1	X	X	X	X	32	108000h to 10FFFFh
	SA34	1	0	0	0	1	0	X	X	X	X	32	110000h to 117FFFh
	SA35	1	0	0	0	1	1	X	X	X	X	32	118000h to 11FFFFh
	SA36	1	0	0	1	0	0	X	X	X	X	32	120000h to 127FFFh
	SA37	1	0	0	1	0	1	X	X	X	X	32	128000h to 12FFFFh
	SA38	1	0	0	1	1	0	X	X	X	X	32	130000h to 137FFFh
	SA39	1	0	0	1	1	1	X	X	X	X	32	138000h to 13FFFFh
	SA40	1	0	1	0	0	0	X	X	X	X	32	140000h to 147FFFh
	SA41	1	0	1	0	0	1	X	X	X	X	32	148000h to 14FFFFh
	SA42	1	0	1	0	1	0	X	X	X	X	32	150000h to 157FFFh
	SA43	1	0	1	0	1	1	X	X	X	X	32	158000h to 15FFFFh
	SA44	1	0	1	1	0	0	X	X	X	X	32	160000h to 167FFFh
	SA45	1	0	1	1	0	1	X	X	X	X	32	168000h to 16FFFFh
	SA46	1	0	1	1	1	0	X	X	X	X	32	170000h to 177FFFh
	SA47	1	0	1	1	1	1	X	X	X	X	32	178000h to 17FFFFh
	SA48	1	1	0	0	0	0	X	X	X	X	32	180000h to 187FFFh
	SA49	1	1	0	0	0	1	X	X	X	X	32	188000h to 18FFFFh
	SA50	1	1	0	0	1	0	X	X	X	X	32	190000h to 197FFFh
	SA51	1	1	0	0	1	1	X	X	X	X	32	198000h to 19FFFFh
SA52	1	1	0	1	0	0	X	X	X	X	32	1A0000h to 1A7FFFh	
SA53	1	1	0	1	0	1	X	X	X	X	32	1A8000h to 1AFFFFh	
SA54	1	1	0	1	1	0	X	X	X	X	32	1B0000h to 1B7FFFh	
SA55	1	1	0	1	1	1	X	X	X	X	32	1B8000h to 1BFFFFh	

(Continued)

## 32M Flash for MCP (Top Boot type)

(Continued)

Bank	Sector	Sector address										Sector size (Kwords)	(×16) Address range
		Bank address			A <sub>17</sub>	A <sub>16</sub>	A <sub>15</sub>	A <sub>14</sub>	A <sub>13</sub>	A <sub>12</sub>	A <sub>11</sub>		
		A <sub>20</sub>	A <sub>19</sub>	A <sub>18</sub>									
Bank A	SA56	1	1	1	0	0	0	X	X	X	X	32	1C0000h to 1C7FFFh
	SA57	1	1	1	0	0	1	X	X	X	X	32	1C8000h to 1CFFFFh
	SA58	1	1	1	0	1	0	X	X	X	X	32	1D0000h to 1D7FFFh
	SA59	1	1	1	0	1	1	X	X	X	X	32	1D8000h to 1DFFFFh
	SA60	1	1	1	1	0	0	X	X	X	X	32	1E0000h to 1E7FFFh
	SA61	1	1	1	1	0	1	X	X	X	X	32	1E8000h to 1EFFFFh
	SA62	1	1	1	1	1	0	X	X	X	X	32	1F0000h to 1F7FFFh
	SA63	1	1	1	1	1	1	0	0	0	X	4	1F8000h to 1F8FFFh
	SA64	1	1	1	1	1	1	0	0	1	X	4	1F9000h to 1F9FFFh
	SA65	1	1	1	1	1	1	0	1	0	X	4	1FA000h to 1FAFFFh
	SA66	1	1	1	1	1	1	0	1	1	X	4	1FB000h to 1FBFFFh
	SA67	1	1	1	1	1	1	1	0	0	X	4	1FC000h to 1FCFFFh
	SA68	1	1	1	1	1	1	1	0	1	X	4	1FD000h to 1FDFFFh
	SA69	1	1	1	1	1	1	1	1	0	X	4	1FE000h to 1FEFFFh
SA70	1	1	1	1	1	1	1	1	1	X	4	1FF000h to 1FFFFFh	

# 32M Flash for MCP (Top Boot Type)

Sector Group Addresses Table

Sector group	A <sub>20</sub>	A <sub>19</sub>	A <sub>18</sub>	A <sub>17</sub>	A <sub>16</sub>	A <sub>15</sub>	A <sub>14</sub>	A <sub>13</sub>	A <sub>12</sub>	Sectors
SGA0	0	0	0	0	0	0	X	X	X	SA0
SGA1	0	0	0	0	0	1	X	X	X	SA1 to SA3
					1	0				
					1	1				
SGA2	0	0	0	1	X	X	X	X	X	SA4 to SA7
SGA3	0	0	1	0	X	X	X	X	X	SA8 to SA11
SGA4	0	0	1	1	X	X	X	X	X	SA12 to SA15
SGA5	0	1	0	0	X	X	X	X	X	SA16 to SA19
SGA6	0	1	0	1	X	X	X	X	X	SA20 to SA23
SGA7	0	1	1	0	X	X	X	X	X	SA24 to SA27
SGA8	0	1	1	1	X	X	X	X	X	SA28 to SA31
SGA9	1	0	0	0	X	X	X	X	X	SA32 to SA35
SGA10	1	0	0	1	X	X	X	X	X	SA36 to SA39
SGA11	1	0	1	0	X	X	X	X	X	SA40 to SA43
SGA12	1	0	1	1	X	X	X	X	X	SA44 to SA47
SGA13	1	1	0	0	X	X	X	X	X	SA48 to SA51
SGA14	1	1	0	1	X	X	X	X	X	SA52 to SA55
SGA15	1	1	1	0	X	X	X	X	X	SA56 to SA59
SGA16	1	1	1	1	0	0	X	X	X	SA60 to SA62
					0	1				
					1	0				
SGA17	1	1	1	1	1	1	0	0	0	SA63
SGA18	1	1	1	1	1	1	0	0	1	SA64
SGA19	1	1	1	1	1	1	0	1	0	SA65
SGA20	1	1	1	1	1	1	0	1	1	SA66
SGA21	1	1	1	1	1	1	1	0	0	SA67
SGA22	1	1	1	1	1	1	1	0	1	SA68
SGA23	1	1	1	1	1	1	1	1	0	SA69
SGA24	1	1	1	1	1	1	1	1	1	SA70

## 32M Flash for MCP (Top Boot type)

FlexBank™ Architecture Table

Bank Splits	Bank 1		Bank 2	
	Volume	Combination	Volume	Combination
1	4 Mbit	Bank A	28 Mbit	Bank B, C, D
2	12 Mbit	Bank B	20 Mbit	Bank A, C, D
3	12 Mbit	Bank C	20 Mbit	Bank A, B, D
4	4 Mbit	Bank D	28 Mbit	Bank A, B, C

Example of Virtual Banks Combination Table

Bank Splits	Bank 1			Bank 2		
	Volume	Combination	Sector Size	Volume	Combination	Sector Size
1	4 Mbit	Bank A	8 × 8 Kbyte/4 Kword + 7 × 64 Kbyte/32 Kword	28 Mbit	Bank B + Bank C + Bank D	56 × 64 Kbyte/32 Kword
2	8 Mbit	Bank A + Bank D	8 × 8 Kbyte/4 Kword + 15 × 64 Kbyte/32 Kword	24 Mbit	Bank B + Bank C	48 × 64 Kbyte/32 Kword
3	16 Mbit	Bank A + Bank B	8 × 8 Kbyte/4 Kword + 31 × 64 Kbyte/32 Kword	16 Mbit	Bank C + Bank D	32 × 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.

# 32M Flash for MCP (Top Boot Type)

## ■ AC Characteristics

### • Read Only Operations Characteristics

Parameter symbols		Description	Test setup		Value (Note)	Unit
JEDEC	Standard					
t <sub>AVAV</sub>	t <sub>RC</sub>	Read Cycle Time	—	Min.	70	ns
t <sub>AVQV</sub>	t <sub>ACC</sub>	Address to Output Delay	$\overline{CE}f = V_{IL}$ $\overline{OE} = V_{IL}$	Max.	70	ns
t <sub>ELQV</sub>	t <sub>CE</sub>	Chip Enable to Output Delay	$\overline{OE} = V_{IL}$	Max.	70	ns
t <sub>GLQV</sub>	t <sub>OE</sub>	Output Enable to Output Delay	—	Max.	30	ns
t <sub>EHQZ</sub>	t <sub>DF</sub>	Chip Enable to Output High-Z	—	Max.	25	ns
t <sub>GHQZ</sub>	t <sub>DF</sub>	Output Enable to Output High-Z	—	Max.	25	ns
t <sub>AXQX</sub>	t <sub>OH</sub>	Output Hold Time from Addresses, $\overline{CE}f$ or $\overline{OE}$ , Whichever Occurs First	—	Min.	0	ns
—	t <sub>READY</sub>	$\overline{RESET}$ Pin Low to Read Mode	—	Max.	20	μs

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 3.0 V  
 Timing measurement reference level  
 Input: 0.5 × V<sub>ccf</sub>  
 Output: 0.5 × V<sub>ccf</sub>

## 32M Flash for MCP (Top Boot type)

### • Write/Erase/Program Operations

Parameter symbols		Description	Value	Unit		
JEDEC	Standard					
t <sub>AVAV</sub>	t <sub>WC</sub>	Write Cycle Time	Min.	70	ns	
t <sub>AVWL</sub>	t <sub>AS</sub>	Address Setup Time	Min.	0	ns	
—	t <sub>ASO</sub>	Address Setup Time to $\overline{OE}$ Low During Toggle Bit Polling	Min.	12	ns	
t <sub>WLAX</sub>	t <sub>AH</sub>	Address Hold Time	Min.	45	ns	
—	t <sub>AHT</sub>	Address Hold Time from $\overline{CEf}$ or $\overline{OE}$ High During Toggle Bit Polling	Min.	0	ns	
t <sub>DVWH</sub>	t <sub>DS</sub>	Data Setup Time	Min.	30	ns	
t <sub>WHDX</sub>	t <sub>DH</sub>	Data Hold Time	Min.	0	ns	
—	t <sub>OEH</sub>	Output Enable Hold Time	Read	Min.	0	ns
			Toggle and $\overline{Data}$ Polling	Min.	10	ns
—	t <sub>CEPH</sub>	$\overline{CEf}$ High During Toggle Bit Polling	Min.	20	ns	
—	t <sub>OEPH</sub>	$\overline{OE}$ High During Toggle Bit Polling	Min.	20	ns	
t <sub>GHWL</sub>	t <sub>GHWL</sub>	Read Recover Time Before Write	Min.	0	ns	
t <sub>GHEL</sub>	t <sub>GHEL</sub>	Read Recover Time Before Write	Min.	0	ns	
t <sub>ELWL</sub>	t <sub>CS</sub>	$\overline{CEf}$ Setup Time	Min.	0	ns	
t <sub>WLEL</sub>	t <sub>WS</sub>	$\overline{WE}$ Setup Time	Min.	0	ns	
t <sub>WHEH</sub>	t <sub>CH</sub>	$\overline{CEf}$ Hold Time	Min.	0	ns	
t <sub>EHWH</sub>	t <sub>WH</sub>	$\overline{WE}$ Hold Time	Min.	0	ns	
t <sub>WLWH</sub>	t <sub>WP</sub>	Write Pulse Width	Min.	35	ns	
t <sub>ELEH</sub>	t <sub>CP</sub>	$\overline{CEf}$ Pulse Width	Min.	35	ns	
t <sub>WHWL</sub>	t <sub>WPH</sub>	Write Pulse Width High	Min.	25	ns	
t <sub>EHEL</sub>	t <sub>CPH</sub>	$\overline{CEf}$ Pulse Width High	Min.	25	ns	
t <sub>WHWH2</sub>	t <sub>WHWH2</sub>	Sector Erase Operation (Note 1)	Typ.	0.2	s	
—	t <sub>VCS</sub>	V <sub>ccf</sub> Setup Time	Min.	50	μs	
—	t <sub>VIDR</sub>	Rise Time to V <sub>ID</sub> (Note 2)	Min.	500	ns	
—	t <sub>VACCR</sub>	Rise Time to V <sub>ID</sub> (Note 2)	Min.	500	ns	
—	t <sub>VLHT</sub>	Voltage Transition Time (Note 2)	Min.	4	μs	
—	t <sub>WPP</sub>	Write Pulse Width (Note 2)	Min.	100	μs	
—	t <sub>OESP</sub>	$\overline{OE}$ Setup Time to $\overline{WE}$ Active (Note 2)	Min.	4	μs	

(Continued)

## 32M Flash for MCP (Top Boot Type)

(Continued)

Parameter symbols		Description	Value	Unit	
JEDEC	Standard				
—	t <sub>CSP</sub>	$\overline{CE}$ f Setup Time to $\overline{WE}$ Active (Note 2)	Min.	4	μs
—	t <sub>RB</sub>	Recover Time from RY/ $\overline{BY}$	Min.	0	ns
—	t <sub>RP</sub>	$\overline{RESET}$ Pulse Width	Min.	500	ns
—	t <sub>RH</sub>	$\overline{RESET}$ High Level Period before Read	Min.	200	ns
—	t <sub>BUSY</sub>	Program/Erase Valid to RY/ $\overline{BY}$ Delay	Max.	90	ns
—	t <sub>EOE</sub>	Delay Time from Embedded Output Enable	Max.	70	ns
—	t <sub>TOW</sub>	Erase Time-Out Time	Min.	50	μs
—	t <sub>SPD</sub>	Erase Suspend Transition Time	Max.	20	μs

- Notes: 1. This does not include the preprogramming time.  
 2. This timing is for Sector Group Protection operation.

## 32M Flash for MCP (Top Boot type)

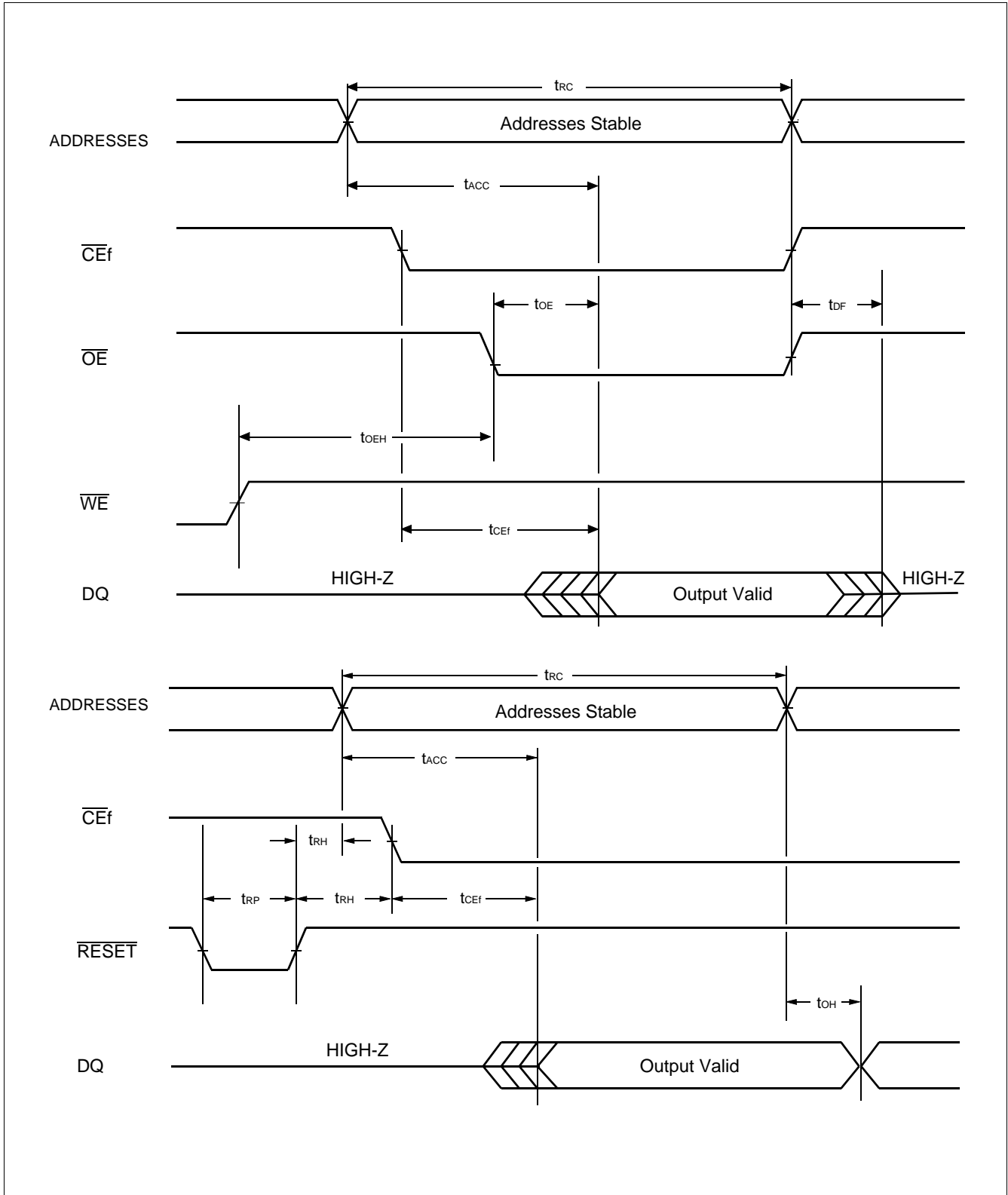
### ■ ERASE AND PROGRAMMING PERFORMANCE

Parameter	Limits			Unit	Comments
	Min	Typ	Max		
Sector Erase Time	—	0.2	1.0	s	Excludes programming time prior to erasure
Word Programming Time	—	6.0	60	μs	Excludes system-level overhead
Chip Programming Time	—	—	100	s	Excludes system-level overhead
Program/Erase Cycle	100,000	—	—	cycle	—



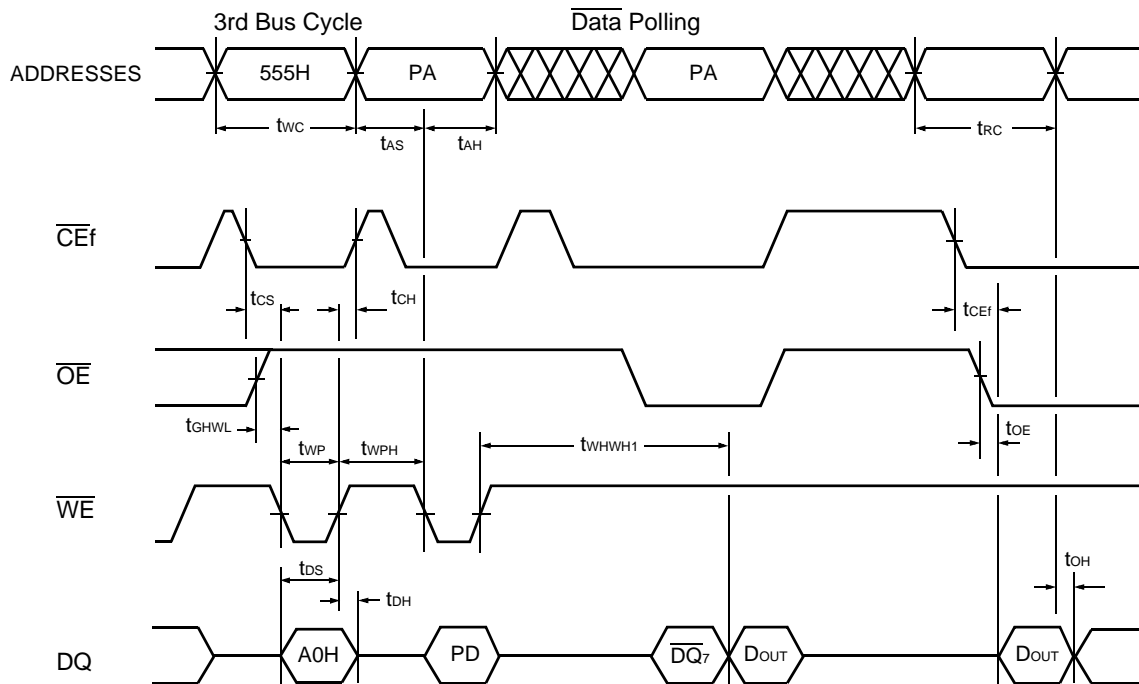
# 32M Flash for MCP (Top Boot Type)

## • Read Cycle (Flash)



## 32M Flash for MCP (Top Boot type)

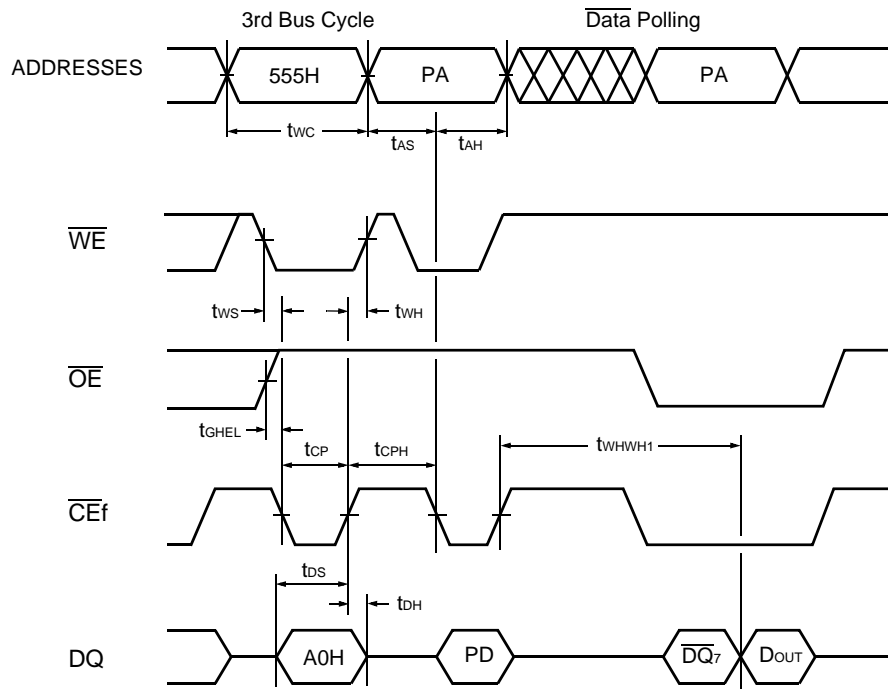
- Write Cycle ( $\overline{WE}$  control) (Flash)



- Notes:
- 1.PA is address of the memory location to be programmed.
  2. $\overline{DQ_7}$  is the output of the complement of the data written to the device.
  - 3.D<sub>OUT</sub> is the output of the data written to the device.
  - 4.Figure indicates last two bus cycles out of four bus cycle sequence.
  - 5.These waveforms are for the x16 mode.

# 32M Flash for MCP (Top Boot Type)

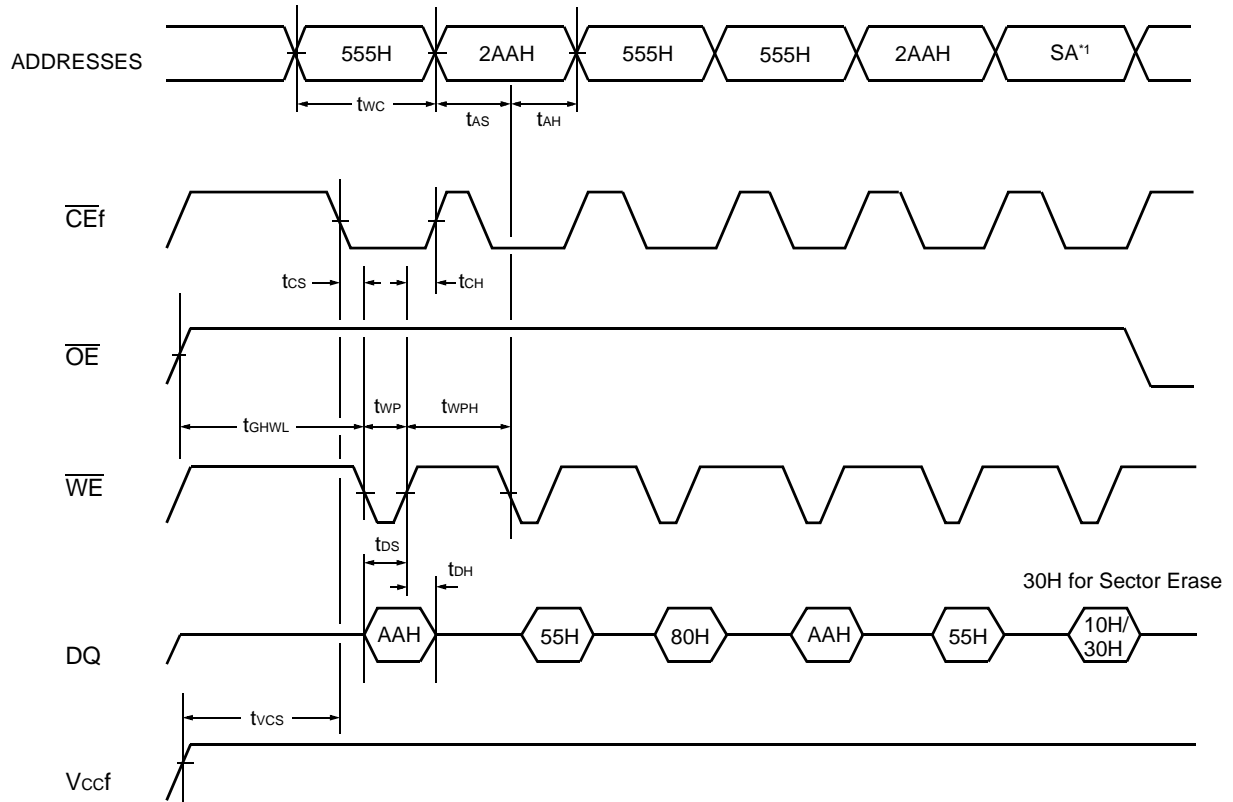
## • Write Cycle ( $\overline{\text{CEf}}$ control) (Flash)



- Notes:
1. PA is address of the memory location to be programmed.
  2.  $\overline{\text{DQ}}_7$  is the output of the complement of the data written to the device.
  3.  $\text{D}_{\text{OUT}}$  is the output of the data written to the device.
  4. Figure indicates last two bus cycles out of four bus cycle sequence.
  5. These waveforms are for the x16 mode.

# 32M Flash for MCP (Top Boot type)

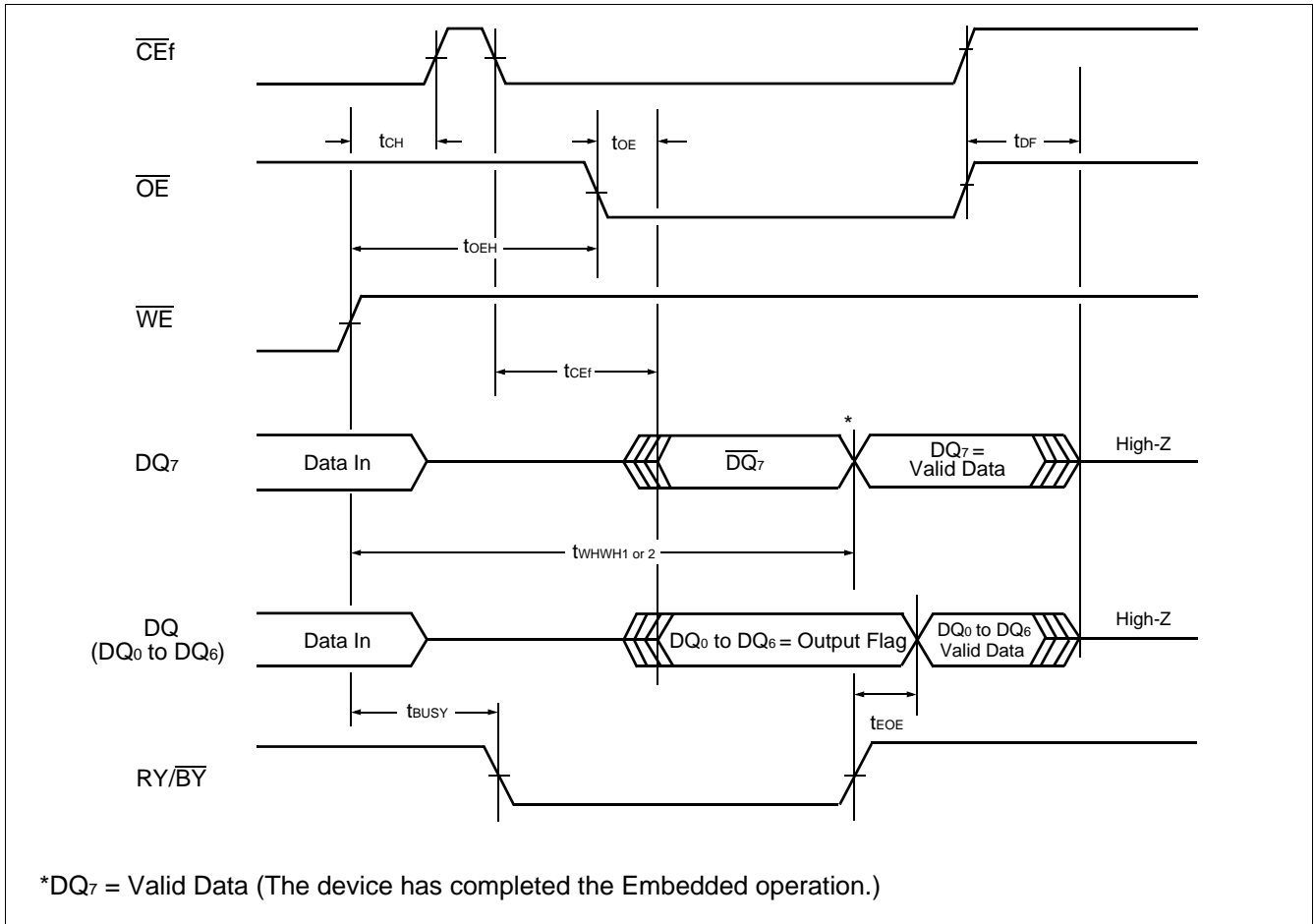
## • AC Waveforms Chip/Sector Erase Operations (Flash)



- Notes:
1. SA is the sector address for Sector Erase. Addresses = 555H for Chip Erase.
  2. These waveform are for the x16 mode.

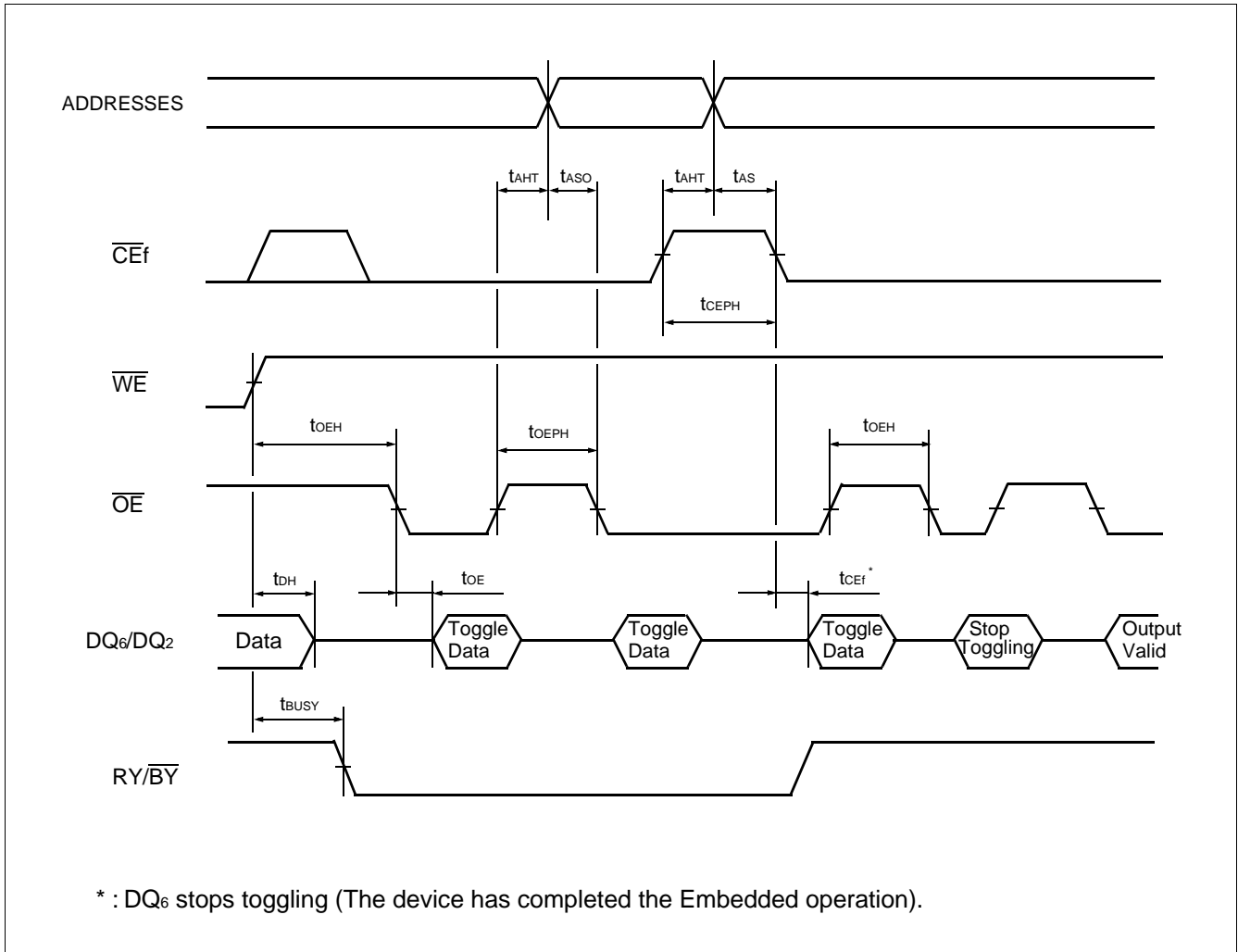
# 32M Flash for MCP (Top Boot Type)

## • AC Waveforms for Data Polling during Embedded Algorithm Operations (Flash)



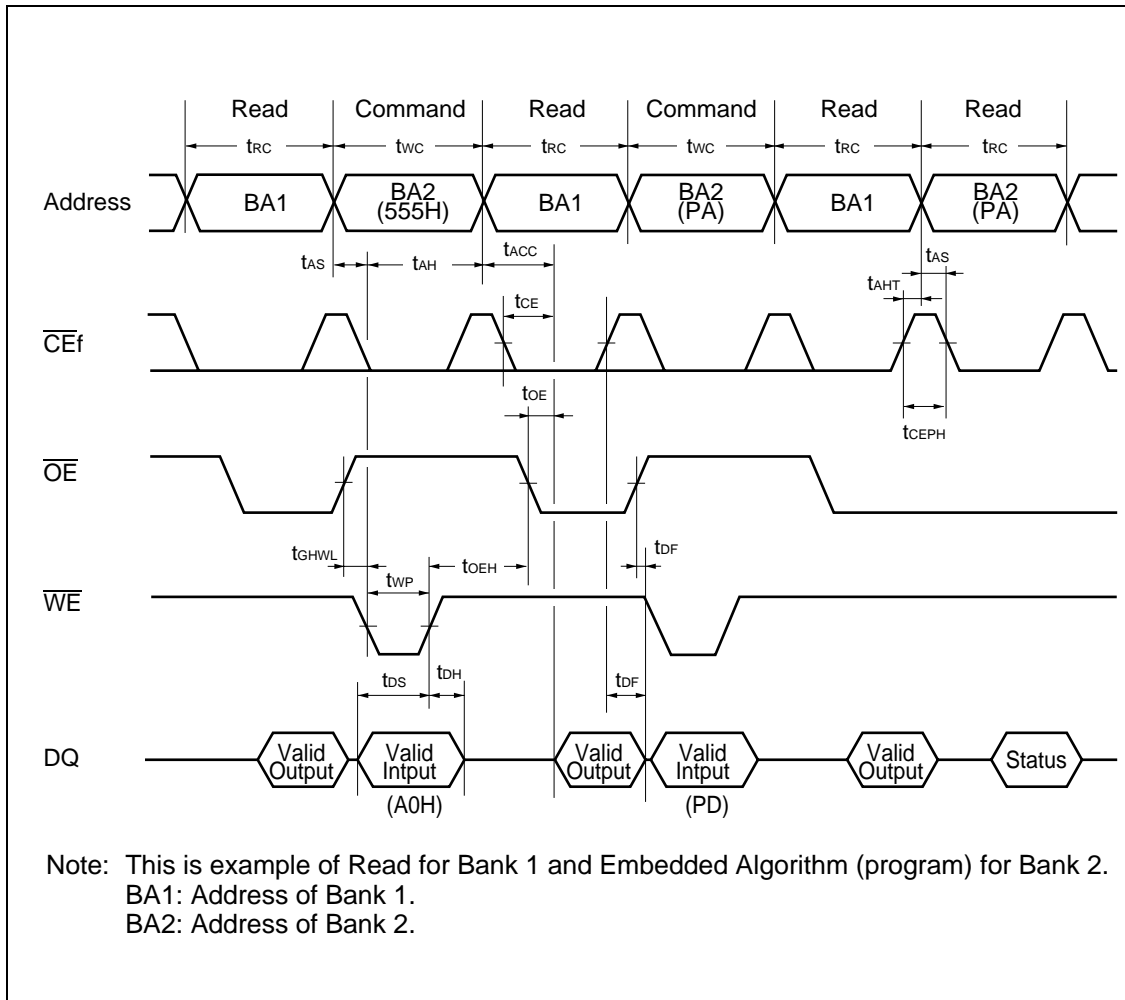
## 32M Flash for MCP (Top Boot type)

- AC Waveforms for Toggle Bit during Embedded Algorithm Operations (Flash)



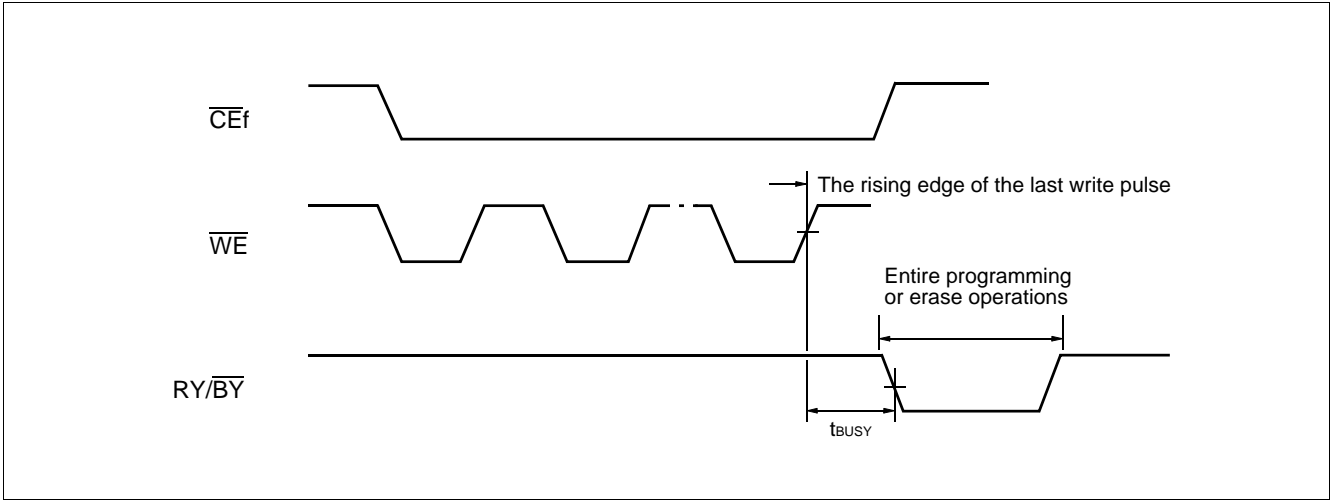
# 32M Flash for MCP (Top Boot Type)

- Back-to-back Read/Write Timing Diagram (Flash)

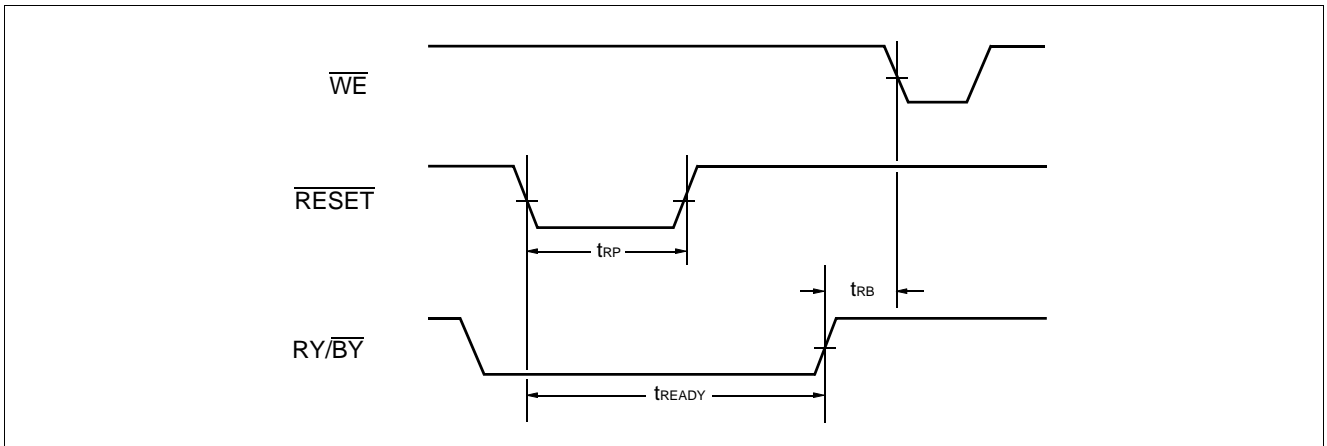


## 32M Flash for MCP (Top Boot type)

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



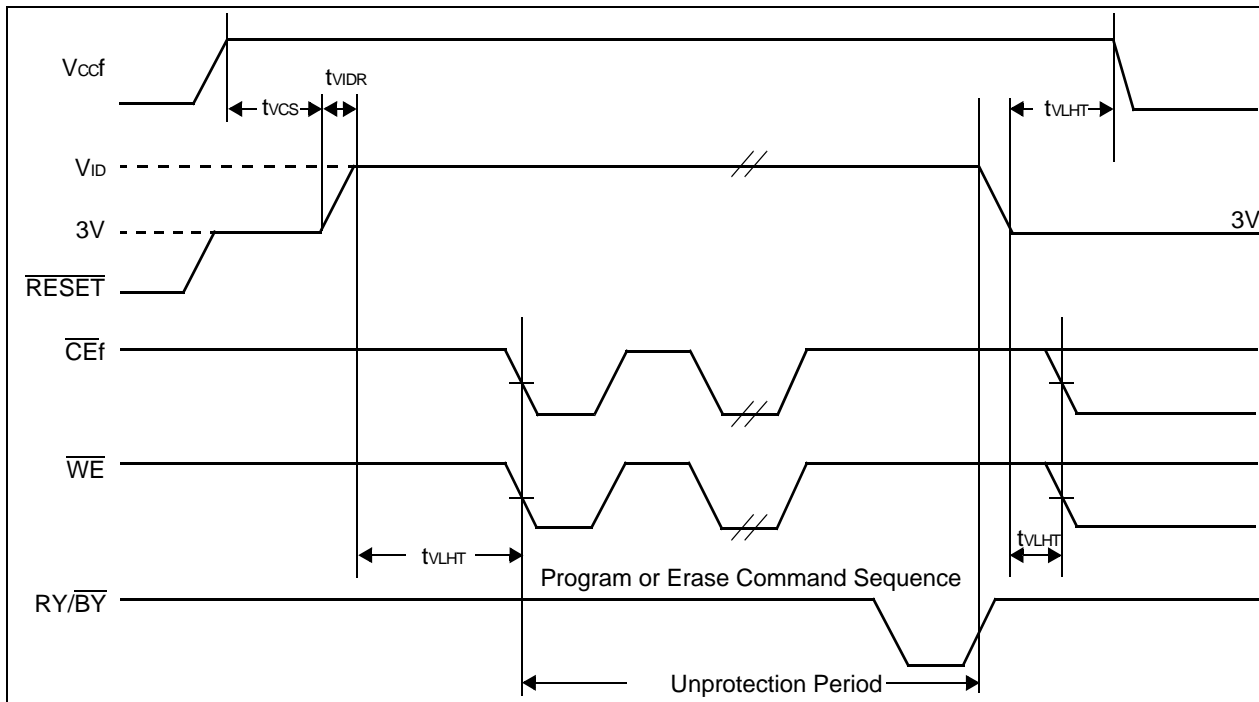
- $\overline{\text{RESET}}$ , RY/ $\overline{\text{BY}}$  Timing Diagram (Flash)





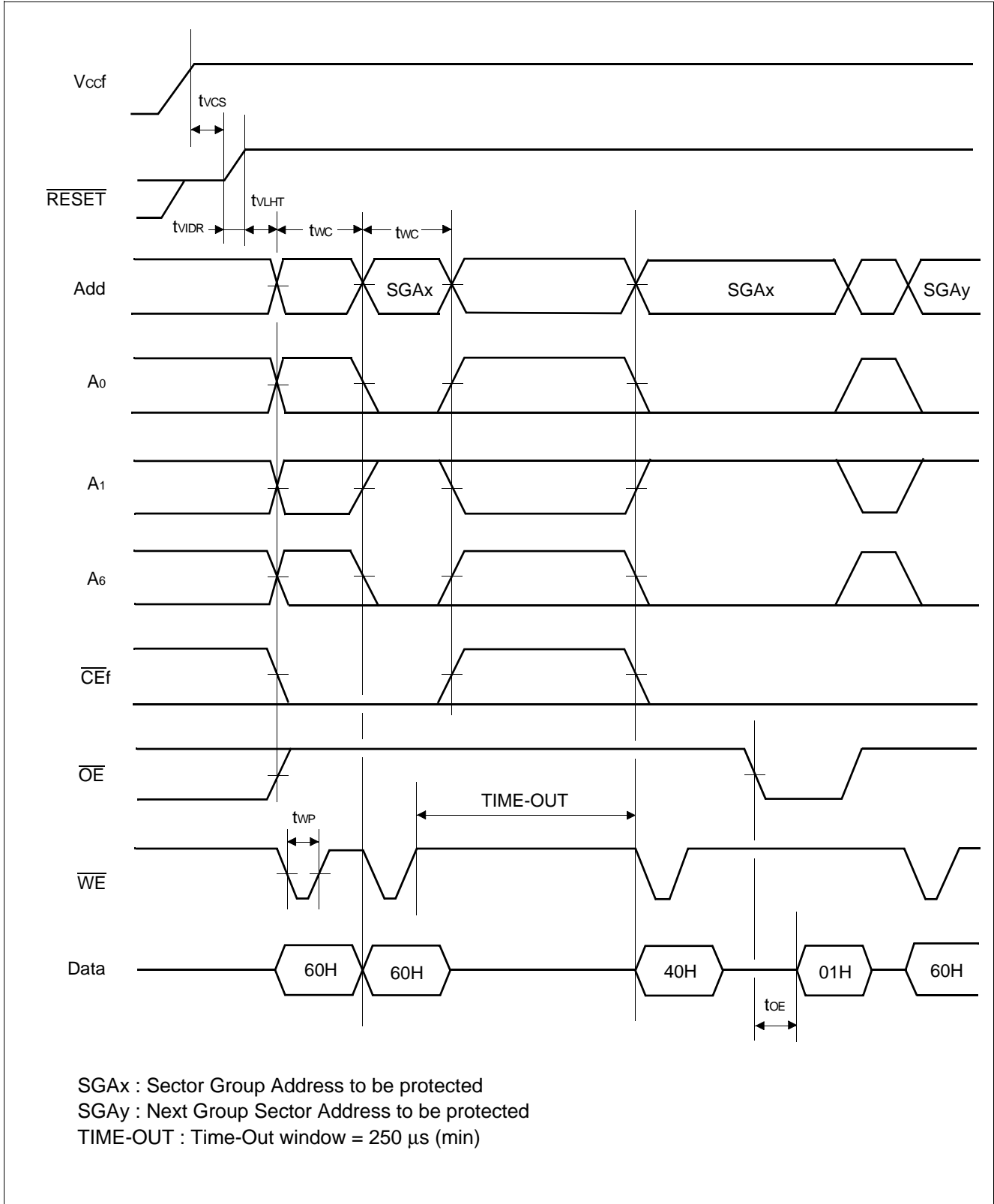
# 32M Flash for MCP (Top Boot Type)

## • Temporary Sector Unprotection (Flash)



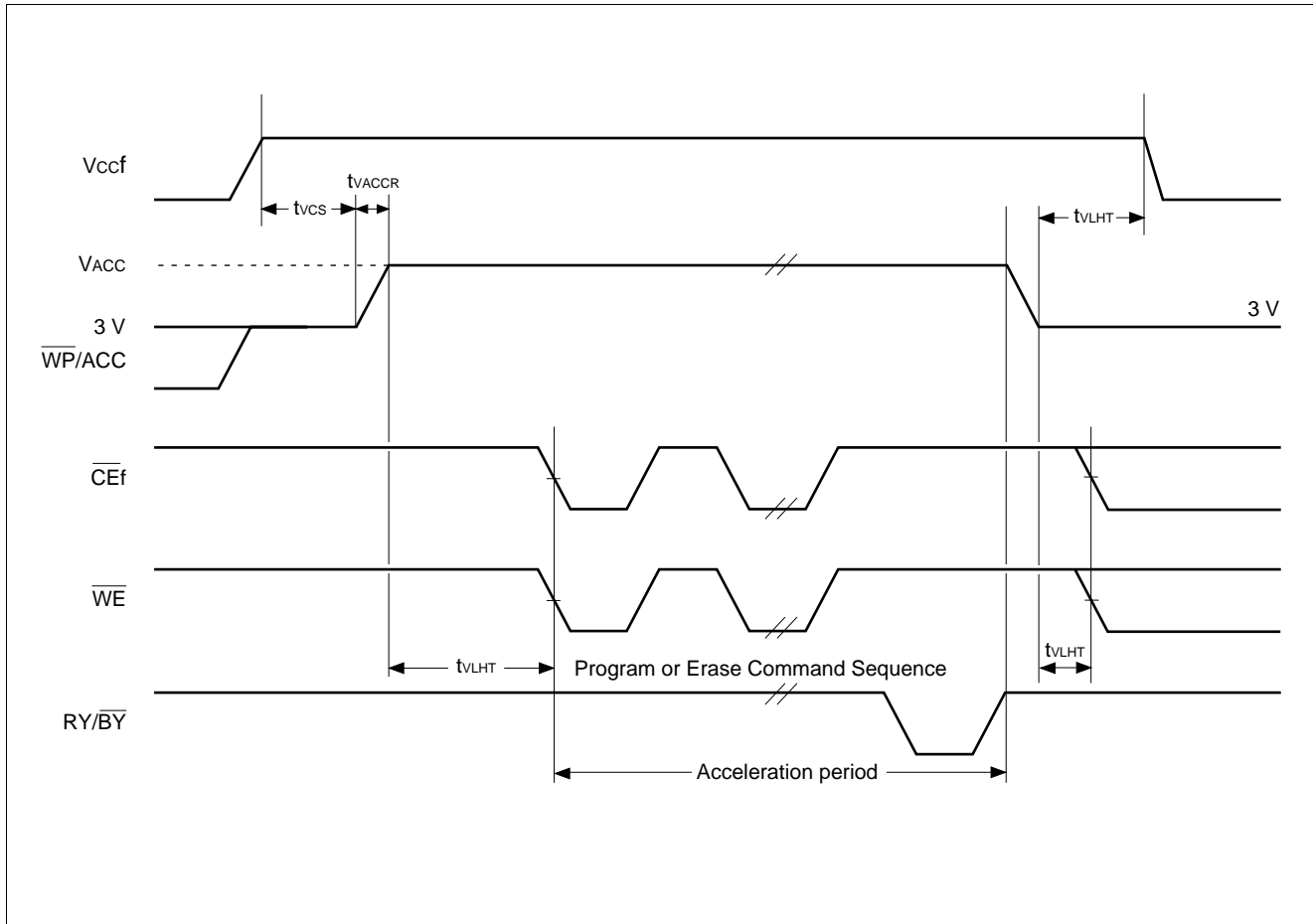
# 32M Flash for MCP (Top Boot type)

- Extended Sector Group Protection (Flash)



# 32M Flash for MCP (Top Boot Type)

- Accelerated Program (Flash)



Note:  $t_{RC}$ : Read cycle time

# 32M FCRAM for MCP

## ■ FCRAM Power Down Program Key Table

### Basic Key Table

Definition	A16	A17	A18	A19	A20
KEY	Mode Select		Area Select		

A18	A19	A20	AREA
L	L	L	BOTTOM <sup>*2</sup>
L	H	X	RESERVED
H	L	X	RESERVED
H	H	H	TOP <sup>*3</sup>

A16	A17	MODE
L	L	NAP <sup>*4</sup>
L	H	RESERVED
H	L	8M Partial
H	H	SLEEP <sup>*4, *5</sup>

### Available Key Table

MODE	A16	A17	A18	A19	A20	Data Retention Area
	Mode Select		Area Select			
NAP	L	L	X	X	X	None
8M Partial	H	L	L	L	L	Bottom 8M only
	H	L	H	H	H	Top 8M only
SLEEP	H	H	X	X	X	None

- Notes
- \*1: The Power Down Program can be performed one time after compliance of Power-up timings and it should not be re-programmed after regular Read or Write. Unspecified addresses, A0 to A15, can be either High or Low during the programming. The RESERVED key should not be used.
  - \*2: BOTTOM area is from the lowest address location. (i.e., A(20:0) = L)
  - \*3: TOP area is from the highest address location. (i.e., A(20:0) = H)
  - \*4: NAP and SLEEP do not retain the data and Area Select is ignored.
  - \*5: Default state. Power Down Program to this SLEEP mode can be omitted.

# 32M FCRAM for MCP

## ■ ELECTRICAL CHARACTERISTICS (AC Characteristics)

- READ OPERATION (FCRAM)

Parameter	Symbol	Value		Unit	Notes
		Min.	Max.		
Read Cycle Time	$t_{RC}$	70	—	ns	
Chip Enable Access Time	$t_{CE}$	—	65	ns	*1,*3
Output Enable Access Time	$t_{OE}$	—	40	ns	*1
Address Access Time	$t_{AA}$	—	65	ns	*1,*4
Output Data Hold Time	$t_{OH}$	5	—	ns	*1
$\overline{CE1r}$ Low to Output Low-Z	$t_{CLZ}$	5	—	ns	*2
$\overline{OE}$ Low to Output Low-Z	$t_{OLZ}$	0	—	ns	*2
$\overline{CE1r}$ High to Output High-Z	$t_{CHZ}$	—	20	ns	*2
$\overline{OE}$ High to Output High-Z	$t_{OHZ}$	—	20	ns	*2
Address Setup Time to $\overline{CE1r}$ Low	$t_{ASC}$	-5	—	ns	*5
Address Setup Time to $\overline{OE}$	$t_{ASO}$	25	—	ns	*3,*6
	$t_{ASO(ABS)}$	10	—	ns	*7
$\overline{LB} / \overline{UB}$ Setup Time to $\overline{CE1r}$ Low	$t_{BSC}$	-5	—		*5
$\overline{LB} / \overline{UB}$ Setup Time to $\overline{OE}$ Low	$t_{BSO}$	10	—		
Address Invalid Time	$t_{AX}$	—	5	ns	*4,*8
Address Hold Time from $\overline{CE1r}$ Low	$t_{CLAH}$	70	—	ns	*4
Address Hold Time from $\overline{OE}$ Low	$t_{OLAH}$	45	—	ns	*4,*9
Address Hold Time from $\overline{CE1r}$ High	$t_{CHAH}$	-5	—	ns	
Address Hold Time from $\overline{OE}$ High	$t_{OHAH}$	-5	—	ns	
$\overline{LB} / \overline{UB}$ Hold Time from $\overline{CE1r}$ High	$t_{CHBH}$	-5	—		
$\overline{LB} / \overline{UB}$ Hold Time from $\overline{OE}$ High	$t_{OHBH}$	-5	—		
$\overline{CE1r}$ Low to $\overline{OE}$ Low Delay Time	$t_{CLOL}$	25	1000	ns	*3,*6,*9,*10
$\overline{OE}$ Low to $\overline{CE1r}$ High Delay Time	$t_{OLCH}$	45	—	ns	*9
$\overline{CE1r}$ High Pulse Width	$t_{CP}$	12	—	ns	
$\overline{OE}$ High Pulse Width	$t_{OP}$	25	1000	ns	*6,*9,*10
	$t_{OP(ABS)}$	12	—	ns	*7

- Notes
- \*1: The output load is 30pF.
  - \*2: The output load is 5pF.
  - \*3: The  $t_{CE}$  is applicable if  $\overline{OE}$  is brought to Low before  $\overline{CE1r}$  goes Low and is also applicable if actual value of both or either  $t_{ASO}$  or  $t_{CLOL}$  is shorter than specified value.
  - \*4: Applicable only to A0 and A1 when both  $\overline{CE1r}$  and  $\overline{OE}$  are kept at Low for the address access.
  - \*5: Applicable if  $\overline{OE}$  is brought to Low before  $\overline{CE1r}$  goes Low.
  - \*6: The  $t_{ASO}$ ,  $t_{CLOL}(\min)$  and  $t_{OP}(\min)$  are reference values when the access time is determined by  $t_{OE}$ . If actual value of each parameter is shorter than specified minimum value,  $t_{OE}$  become longer by the amount of subtracting actual value from specified minimum value. For example, if actual  $t_{ASO}$ ,  $t_{ASO}(\text{actual})$ , is shorter than specified minimum value,  $t_{ASO}(\min)$ , during  $\overline{OE}$  control access (ie.,  $\overline{CE1r}$  stays Low), the  $t_{OE}$  become  $t_{OE}(\max) + t_{ASO}(\min) - t_{ASO}(\text{actual})$ .
  - \*7: The  $t_{ASO(ABS)}$  and  $t_{OP(ABS)}$  is the absolute minimum value during  $\overline{OE}$  control access.
  - \*8: The  $t_{AX}$  is applicable when both A0 and A1 are switched from previous state.
  - \*9: If actual value of either  $t_{CLOL}$  or  $t_{OP}$  is shorter than specified minimum value, both  $t_{OLAH}$  and  $t_{OLCH}$  become  $t_{RC}(\min) - t_{CLOL}(\text{actual})$  or  $t_{RC}(\min) - t_{OP}(\text{actual})$ .
  - \*10: Maximum value is applicable if  $\overline{CE1r}$  is kept at Low.

## 32M FCRAM for MCP

## • WRITE OPERATION (FCRAM)

Parameter	Symbol	Value		Unit	Notes
		Min.	Max.		
Write Cycle Time	$t_{WC}$	70	—	ns	*1
Address Setup Time	$t_{AS}$	0	—	ns	*2
Address Hold Time	$t_{AH}$	35	—	ns	*2
$\overline{CE}1r$ Write Setup Time	$t_{CS}$	0	1000	ns	
$\overline{CE}1r$ Write Hold Time	$t_{CH}$	0	1000	ns	
$\overline{WE}$ Setup Time	$t_{WS}$	0	—	ns	
$\overline{WE}$ Hold Time	$t_{WH}$	0	—	ns	
$\overline{LB}$ and $\overline{UB}$ Setup Time	$t_{BS}$	-5	—	ns	
$\overline{LB}$ and $\overline{UB}$ Hold Time	$t_{BH}$	-5	—	ns	
$\overline{OE}$ Setup Time	$t_{OES}$	0	1000	ns	*3
$\overline{OE}$ Hold Time	$t_{OEH}$	25	1000	ns	*3, *4
	$t_{OEH(ABS)}$	12	—	ns	*5
$\overline{OE}$ High to $\overline{CE}1r$ Low Setup Time	$t_{OHCL}$	-5	—	ns	*6
$\overline{OE}$ High to Address Hold Time	$t_{OHAH}$	-5	—	ns	*7
$\overline{CE}1r$ Write Pulse Width	$t_{CW}$	45	—	ns	*1, *8
$\overline{WE}$ Write Pulse Width	$t_{WP}$	45	—	ns	*1, *8
$\overline{CE}1r$ Write Recovery Time	$t_{WRC}$	10	—	ns	*1, *9
$\overline{WE}$ Write Recovery Time	$t_{WR}$	10	1000	ns	*1, *3, *9
Data Setup Time	$t_{DS}$	15	—	ns	
Data Hold Time	$t_{DH}$	0	—	ns	
$\overline{CE}1r$ High Pulse Width	$t_{CP}$	12	—	ns	*9

Notes: \*1: Minimum value must be equal or greater than the sum of actual  $t_{CW}$  (or  $t_{WP}$ ) and  $t_{WRC}$  (or  $t_{WR}$ ).

\*2: New write address is valid from either  $\overline{CE}1r$  or  $\overline{WE}$  is brought to High.

\*3: The  $t_{OEH}$  is specified from end of  $t_{WC(min)}$ . The  $t_{OEH(min)}$  is a reference value when the access time is determined by  $t_{OE}$ .

If actual value,  $t_{OEH(actual)}$  is shorter than specified minimum value,  $t_{OE}$  become longer by the amount of subtracting actual value from specified minimum value.

\*4: The  $t_{OEH(max)}$  is applicable if  $\overline{CE}1r$  is kept at Low and both  $\overline{WE}$  and  $\overline{OE}$  are kept at High.

\*5: The  $t_{OEH(ABS)}$  is the absolute minimum value if write cycle is terminated by  $\overline{WE}$  and  $\overline{CE}1r$  stays Low.

\*6:  $t_{OHCL(min)}$  must be satisfied if read operation is not performed prior to write operation.

In case  $\overline{OE}$  is disabled after  $t_{OHCL(min)}$ ,  $\overline{WE}$  Low must be asserted after  $t_{RC(min)}$  from  $\overline{CE}1r$  Low. In other words, read operation is initiated if  $t_{OHCL(min)}$  is not satisfied.

\*7: Applicable if  $\overline{CE}1r$  stays Low after read operation.

\*8:  $t_{CW}$  and  $t_{WP}$  is applicable if write operation is initiated by  $\overline{CE}1r$  and  $\overline{WE}$ , respectively.

\*9:  $t_{WRC}$  and  $t_{WR}$  is applicable if write operation is terminated by  $\overline{CE}1r$  and  $\overline{WE}$ , respectively.

The  $t_{WR(min)}$  can be ignored if  $\overline{CE}1r$  is brought to High together or after  $\overline{WE}$  is brought to High. In such case, the  $t_{CP(min)}$  must be satisfied.

# 32M FCRAM for MCP

## • POWER DOWN and POWER DOWN PROGRAM PARAMETERS (FCRAM)

Parameter	Symbol	Value		Unit	Note
		Min.	Max.		
CE2r Low Setup Time for Power Down Entry	t <sub>CSP</sub>	10	—	ns	
CE2r Low Hold Time after Power Down Entry	t <sub>C2LP</sub>	70	—	ns	
$\overline{\text{CE}}1\text{r}$ High Hold Time following CE2r High after Power Down Exit(SLEEP mode only)	t <sub>CHH</sub>	350	—	μs	
$\overline{\text{CE}}1\text{r}$ High Setup Time following CE2r High after Power Down Exit(Except for SLEEP mode)	t <sub>CHHN</sub>	1	—	μs	
$\overline{\text{CE}}1\text{r}$ High Setup Time following CE2r High after Power Down Exit	t <sub>CHS</sub>	10	—	ns	
$\overline{\text{CE}}1\text{r}$ High to $\overline{\text{PE}}$ Low Setup Time	t <sub>EPS</sub>	70	—	ns	*1
$\overline{\text{PE}}$ Power Down Program Pulse Width	t <sub>EP</sub>	70	—	ns	*1
$\overline{\text{PE}}$ High to $\overline{\text{CE}}1\text{r}$ Low Hold Time	t <sub>EPH</sub>	70	—	ns	*1
Address Setup Time to $\overline{\text{PE}}$ High	t <sub>EAS</sub>	15	—	ns	*1
Address Setup Time from $\overline{\text{PE}}$ High	t <sub>EAH</sub>	0	—	ns	*1

Notes: \*1: Applicable to Power Down Program.

## • OTHER TIMING PARAMETERS (FCRAM)

Parameter	Symbol	Value		Unit	Note
		Min.	Max.		
$\overline{\text{CE}}1\text{r}$ High to $\overline{\text{OE}}$ Invalid Time for Standby Entry	t <sub>CHOX</sub>	10	—	ns	
$\overline{\text{CE}}1\text{r}$ High to $\overline{\text{WE}}$ Invalid Time for Standby Entry	t <sub>CHWX</sub>	10	—	ns	*1
CE2r Low Hold Time after Power-up	t <sub>C2LH</sub>	50	—	μs	*2
CE2r High Hold Time after Power-up	t <sub>C2HL</sub>	50	—	μs	*3
$\overline{\text{CE}}1\text{r}$ High Hold Time following CE2r High after Power-up	t <sub>CHH</sub>	350	—	μs	*2
Input Transition Time	t <sub>T</sub>	1	25	ns	*4

Notes: \*1: It may write some data into any address location if t<sub>CHWX</sub> is not satisfied.

\*2: Must satisfy t<sub>CHH</sub>(min) after t<sub>C2LH</sub>(min).

\*3: Requires Power Down mode entry and exit after t<sub>C2HL</sub>.

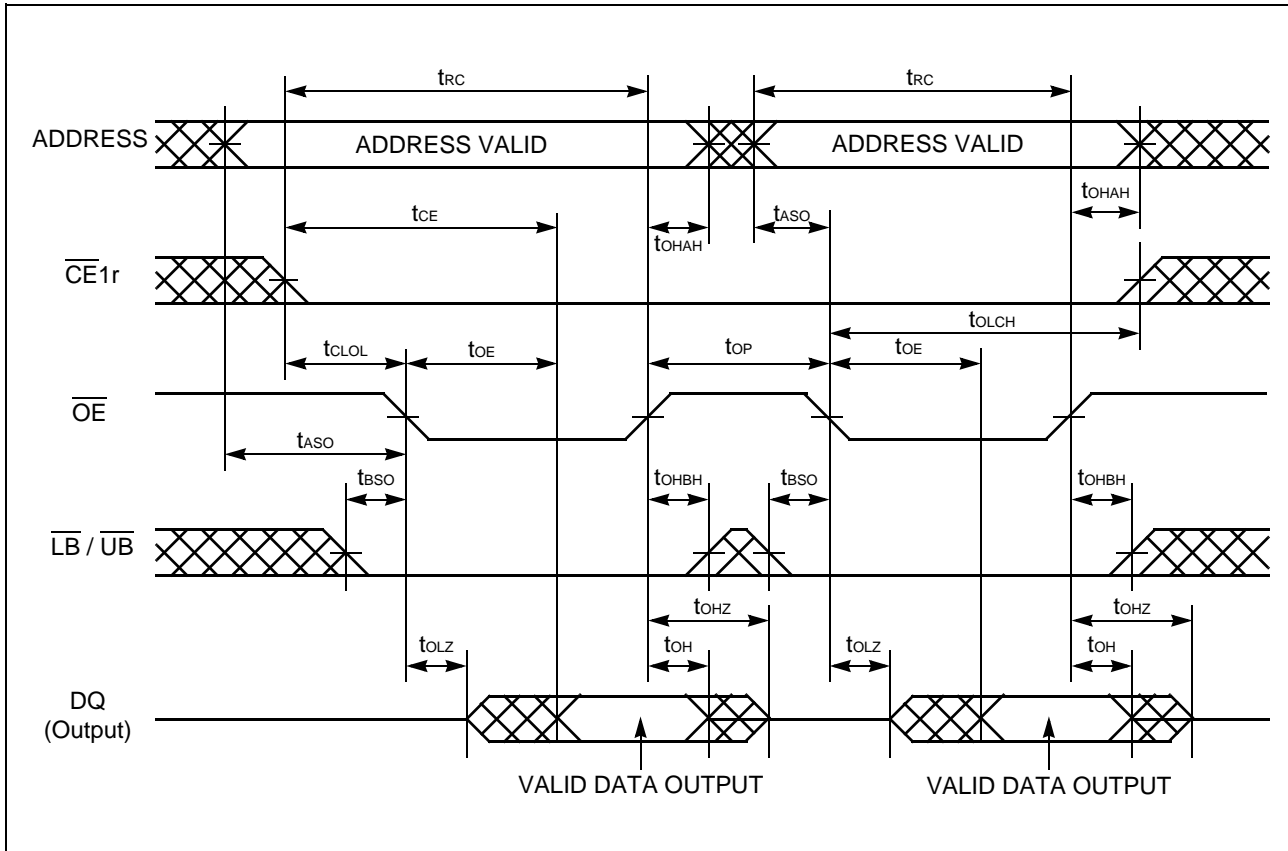
\*4: The input Transition Time(t<sub>T</sub>) at AC testing is 5ns as shown in below. If actual t<sub>T</sub> is longer than 5ns, it may violate AC specification of some timing parameters.

## • AC TEST CONDITIONS (FCRAM)

Symbol	Description	Test Setup	Value	Unit	Note
V <sub>IH</sub>	Input High Level	V <sub>CCF</sub> = 2.7V to 3.1V	2.3	V	
V <sub>IL</sub>	Input Low Level	V <sub>CCF</sub> = 2.7V to 3.1V	0.4	V	
V <sub>REF</sub>	Input Timing Measurement Level	V <sub>CCF</sub> = 2.7V to 3.1V	1.3	V	
t <sub>T</sub>	Input Transition Time	Between V <sub>IL</sub> and V <sub>IH</sub>	5	ns	

## 32M FCRAM for MCP

- READ Timing #1 ( $\overline{\text{OE}}$  Control Access) (FCRAM)

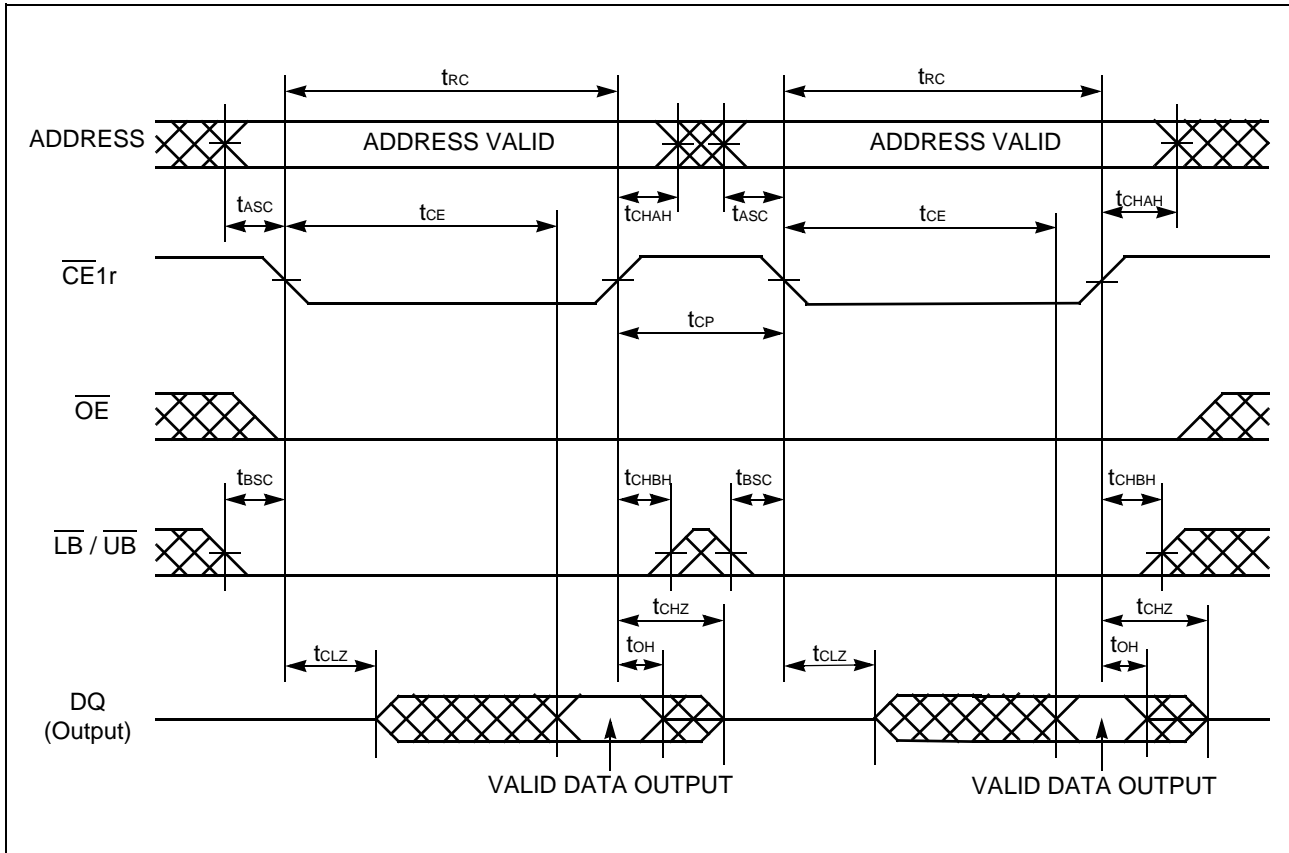


Note:  $\overline{\text{CE2r}}$ ,  $\overline{\text{PE}}$  and  $\overline{\text{WE}}$  must be High for entire read cycle.  
 Either or both  $\overline{\text{LB}}$  and  $\overline{\text{UB}}$  must be Low when both  $\overline{\text{CE1r}}$  and  $\overline{\text{OE}}$  are Low.



# 32M FCRAM for MCP

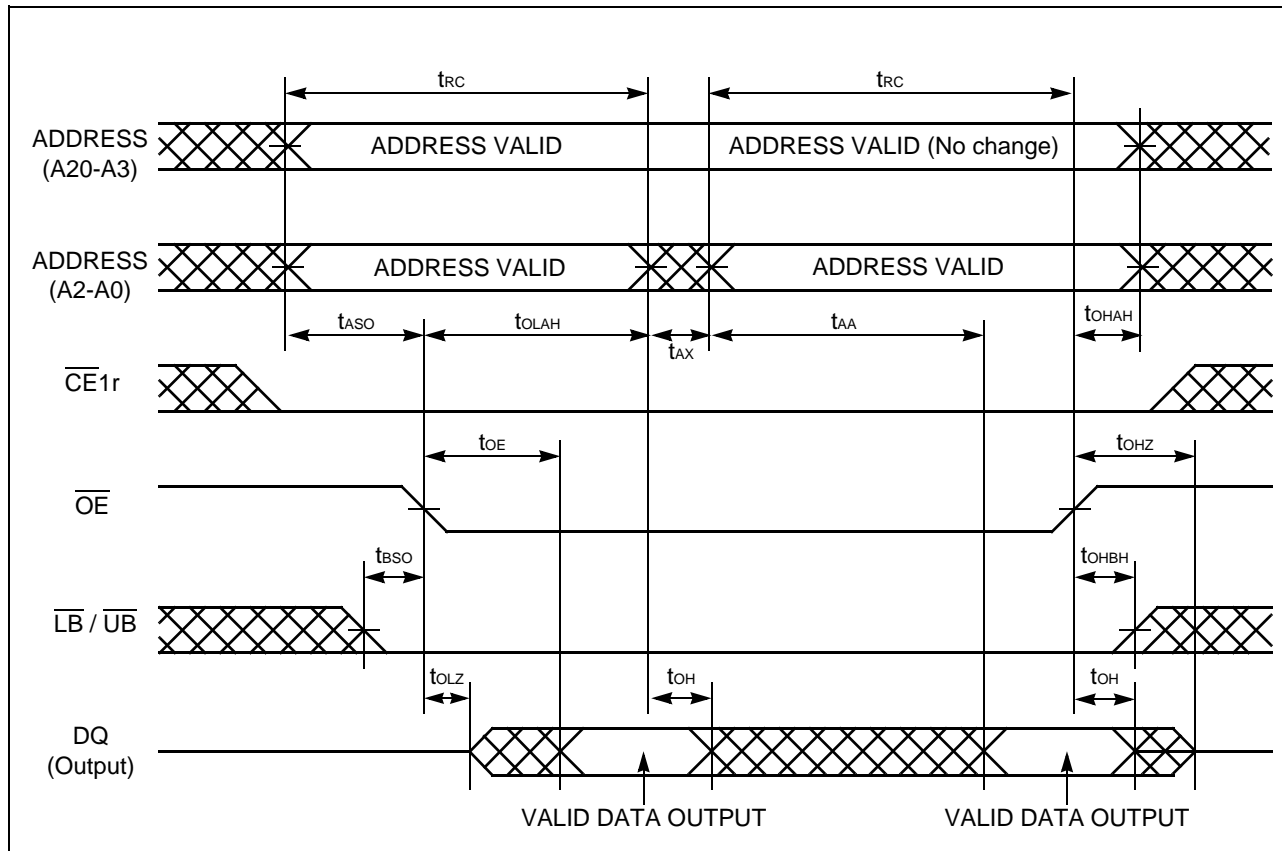
- READ Timing #2 ( $\overline{\text{CE1r}}$  Control Access) (FCRAM)



Note:  $\overline{\text{CE2r}}$ ,  $\overline{\text{PE}}$  and  $\overline{\text{WE}}$  must be High for entire read cycle.  
 Either or both  $\overline{\text{LB}}$  and  $\overline{\text{UB}}$  must be Low when both  $\overline{\text{CE1r}}$  and  $\overline{\text{OE}}$  are Low.

## 32M FCRAM for MCP

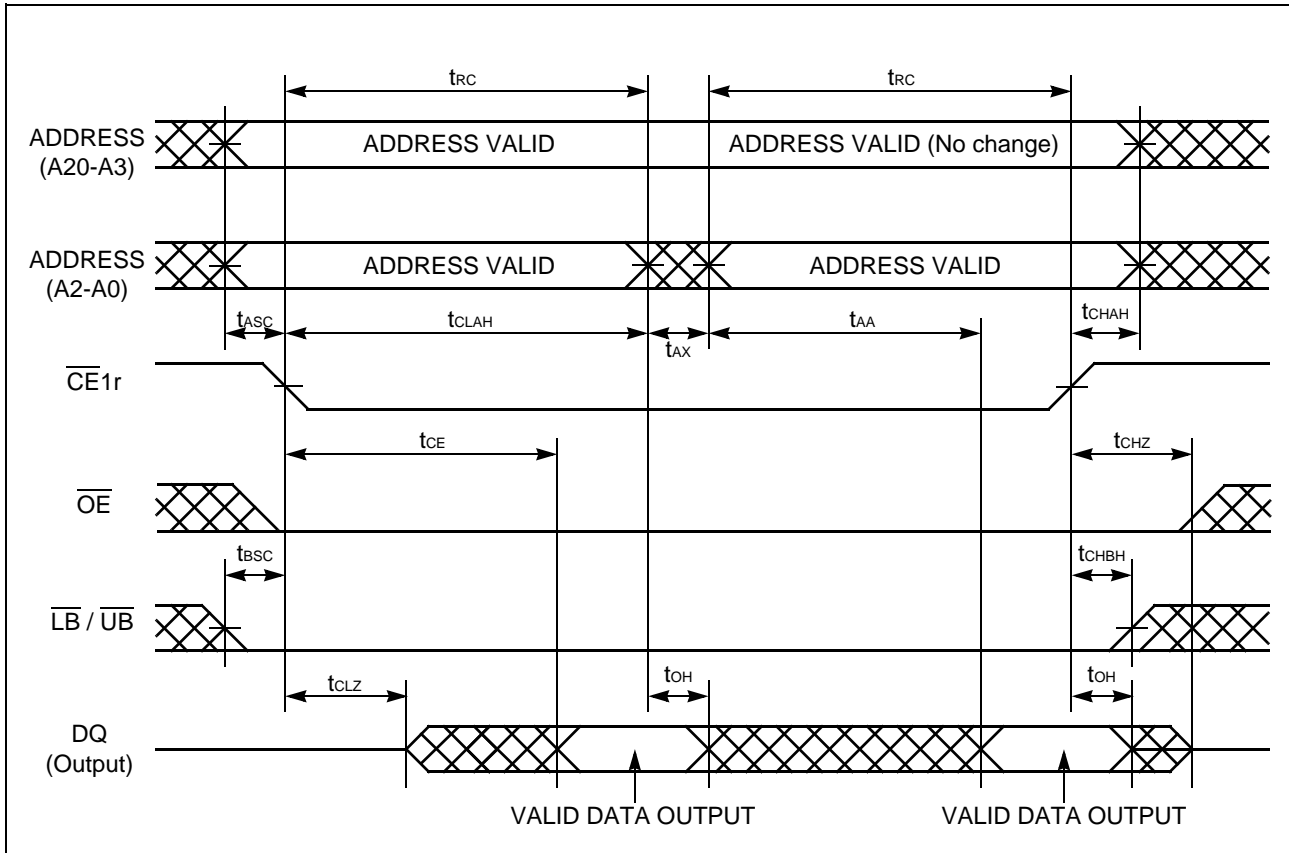
- READ Timing #3 (Address Access after  $\overline{OE}$  Control Access) (FCRAM)



Note:  $\overline{CE2r}$ ,  $\overline{PE}$  and  $\overline{WE}$  must be High for entire read cycle.  
 Either or both  $\overline{LB}$  and  $\overline{UB}$  must be Low when both  $\overline{CE1r}$  and  $\overline{OE}$  are Low.

# 32M FCRAM for MCP

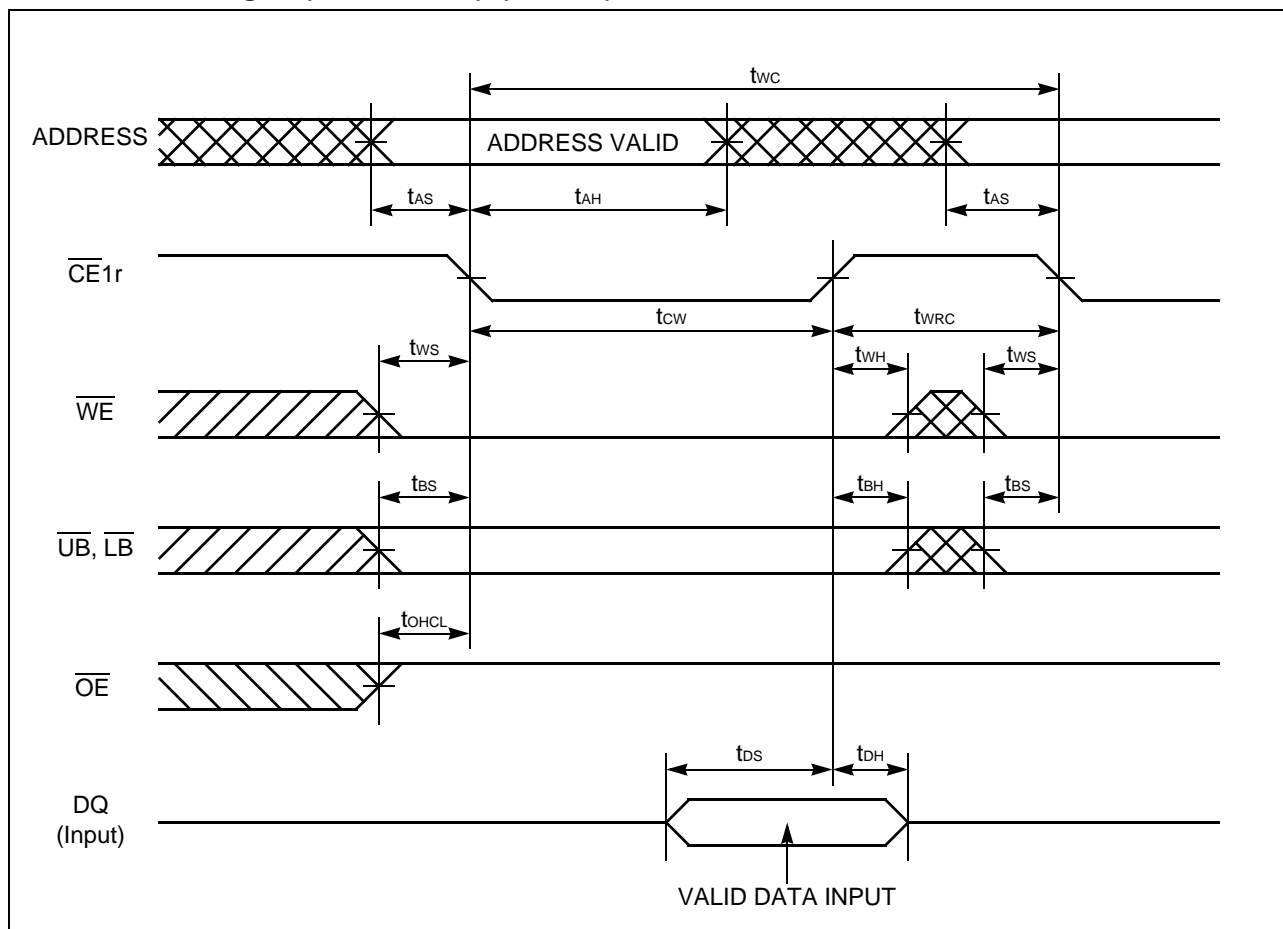
- READ Timing #4 (Address Access after  $\overline{CE1r}$  Control Access) (FCRAM)



Note:  $\overline{CE2r}$ ,  $\overline{PE}$  and  $\overline{WE}$  must be High for entire read cycle.  
 Either or both  $\overline{LB}$  and  $\overline{UB}$  must be Low when both  $\overline{CE1r}$  and  $\overline{OE}$  are Low.

## 32M FCRAM for MCP

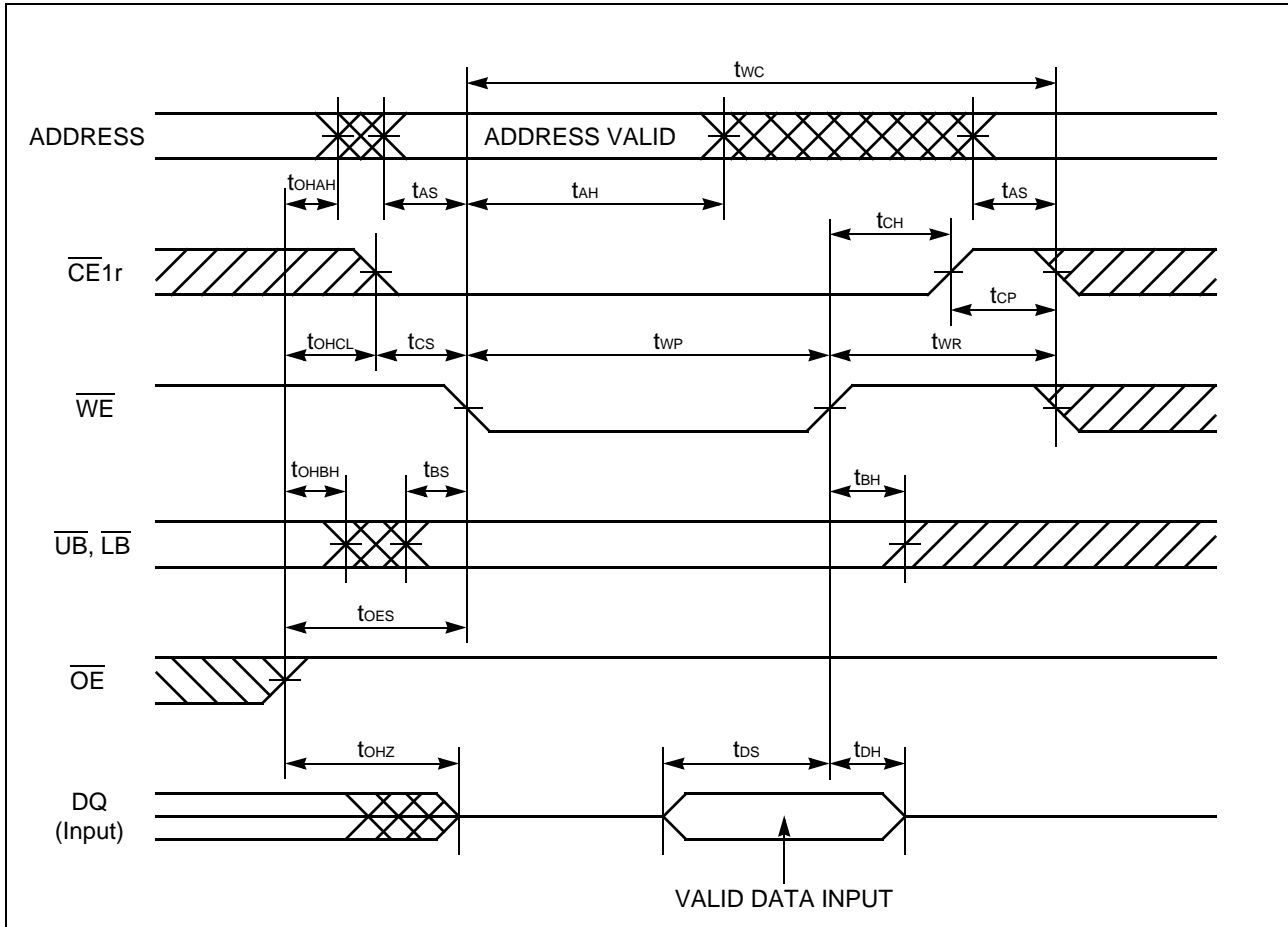
- WRITE Timing #1 ( $\overline{\text{CE}}1r$  Control) (FCRAM)



Note:  $\overline{\text{CE}}2r$  and  $\overline{\text{PE}}$  must be High for write cycle.

# 32M FCRAM for MCP

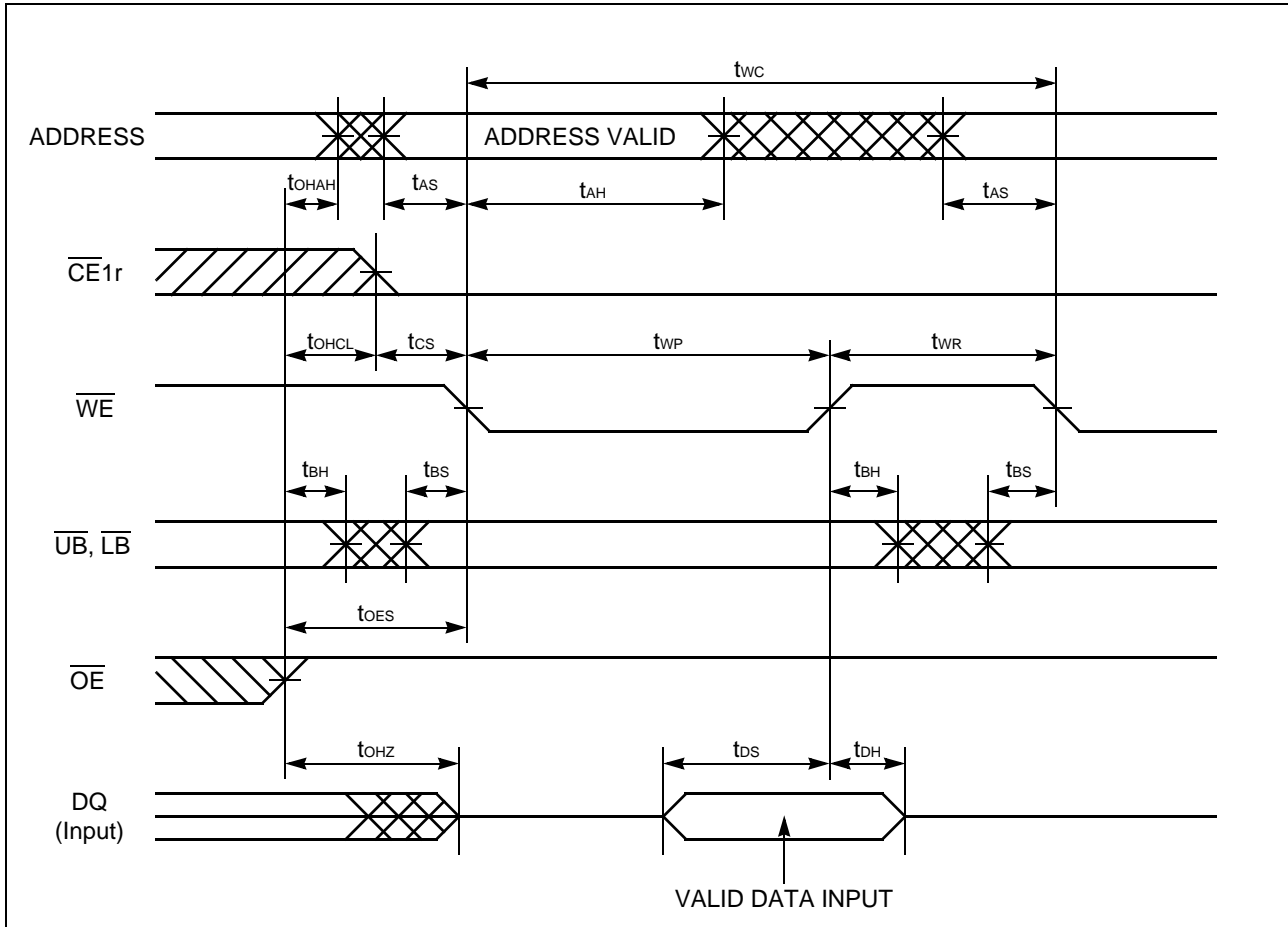
- WRITE Timing #2-1 ( $\overline{WE}$  Control, Single Write Operation) (FCRAM)



Note:  $\overline{CE2r}$  and  $\overline{PE}$  must be High for write cycle.

## 32M FCRAM for MCP

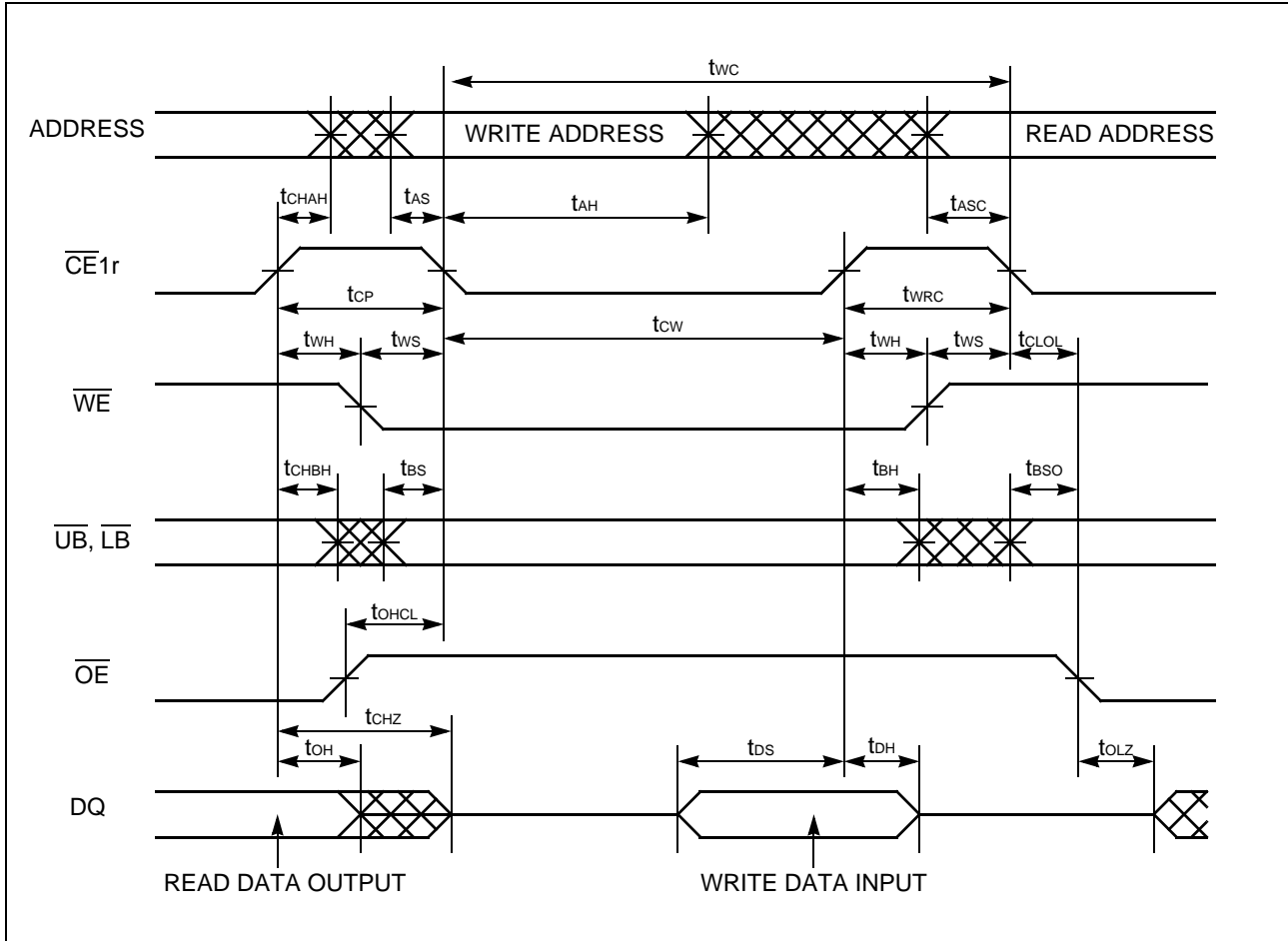
- WRITE Timing #2-2 ( $\overline{WE}$  Control, Continuous Write Operation) (FCRAM)



Note:  $\overline{CE2r}$  and  $\overline{PE}$  must be High for write cycle.

# 32M FCRAM for MCP

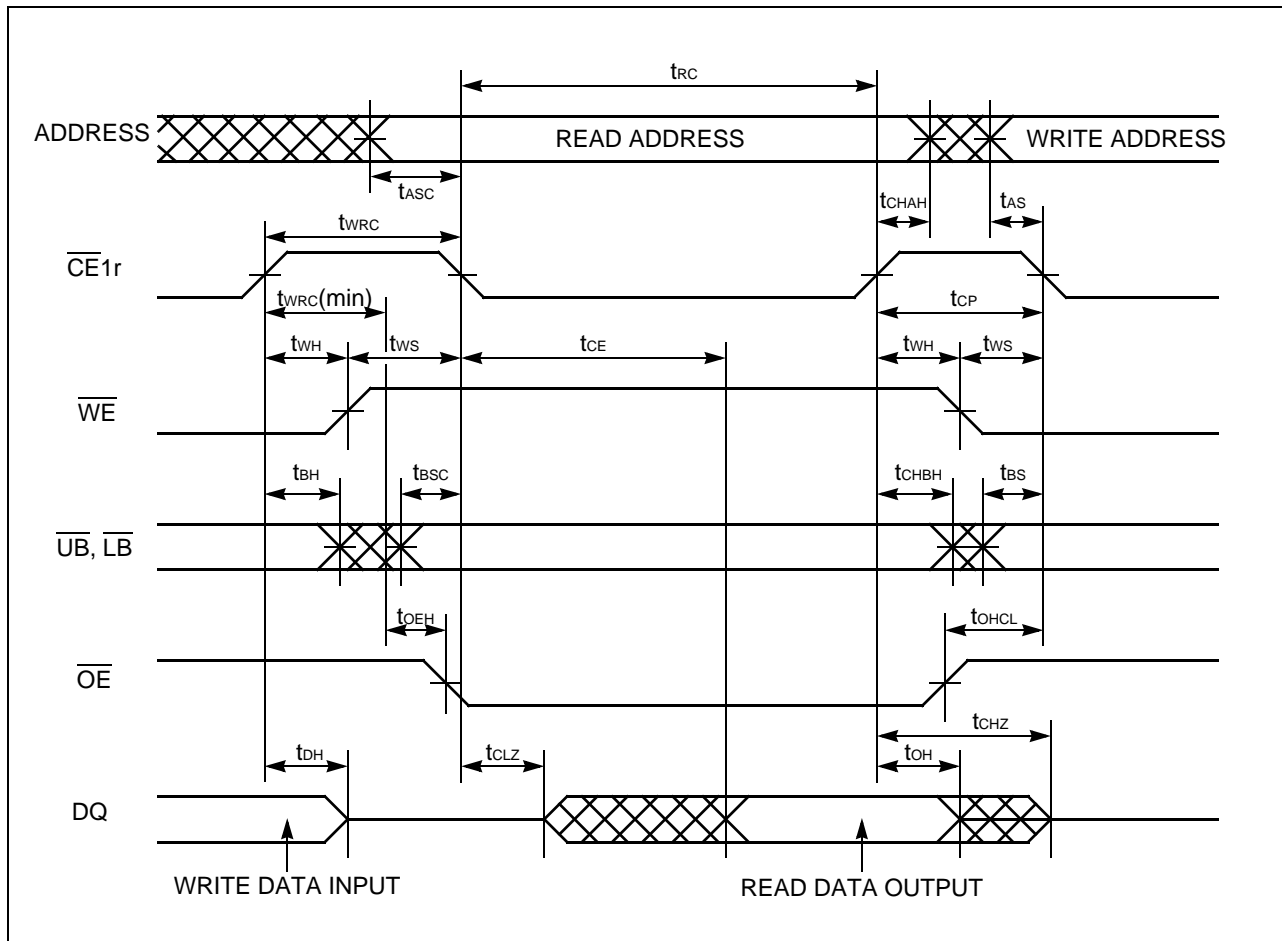
- READ / WRITE Timing #1-1 ( $\overline{\text{CE1r}}$  Control) (FCRAM)



Note: Write address is valid from either  $\overline{\text{CE1r}}$  or  $\overline{\text{WE}}$  of last falling edge.

## 32M FCRAM for MCP

- READ / WRITE Timing #1-2 ( $\overline{\text{CE1r}}$  Control) (FCRAM)

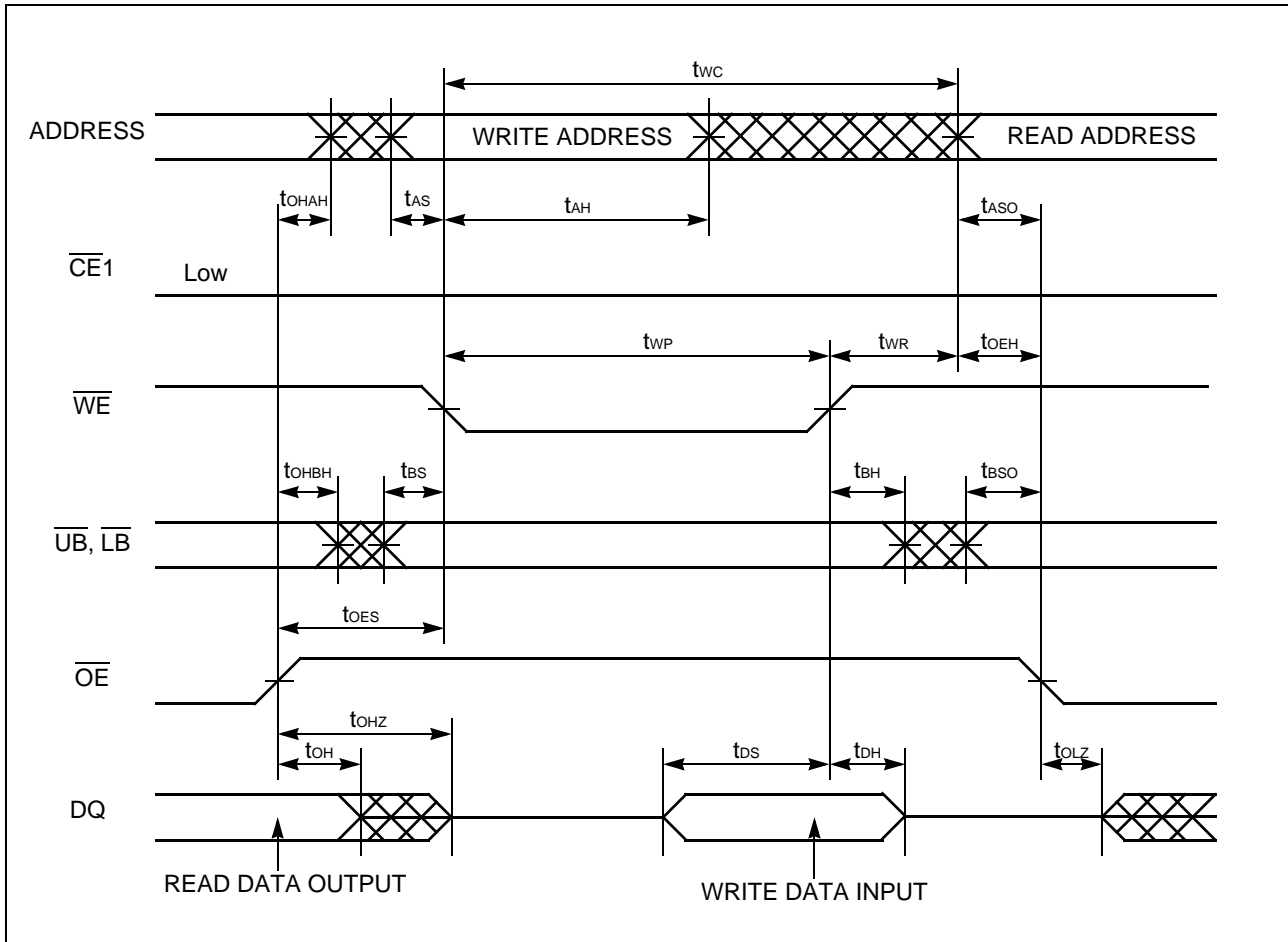


Note: The  $t_{\text{OEHL}}$  is specified from the time satisfied both  $t_{\text{WRC}}$  and  $t_{\text{WR(min)}}$ .



# 32M FCRAM for MCP

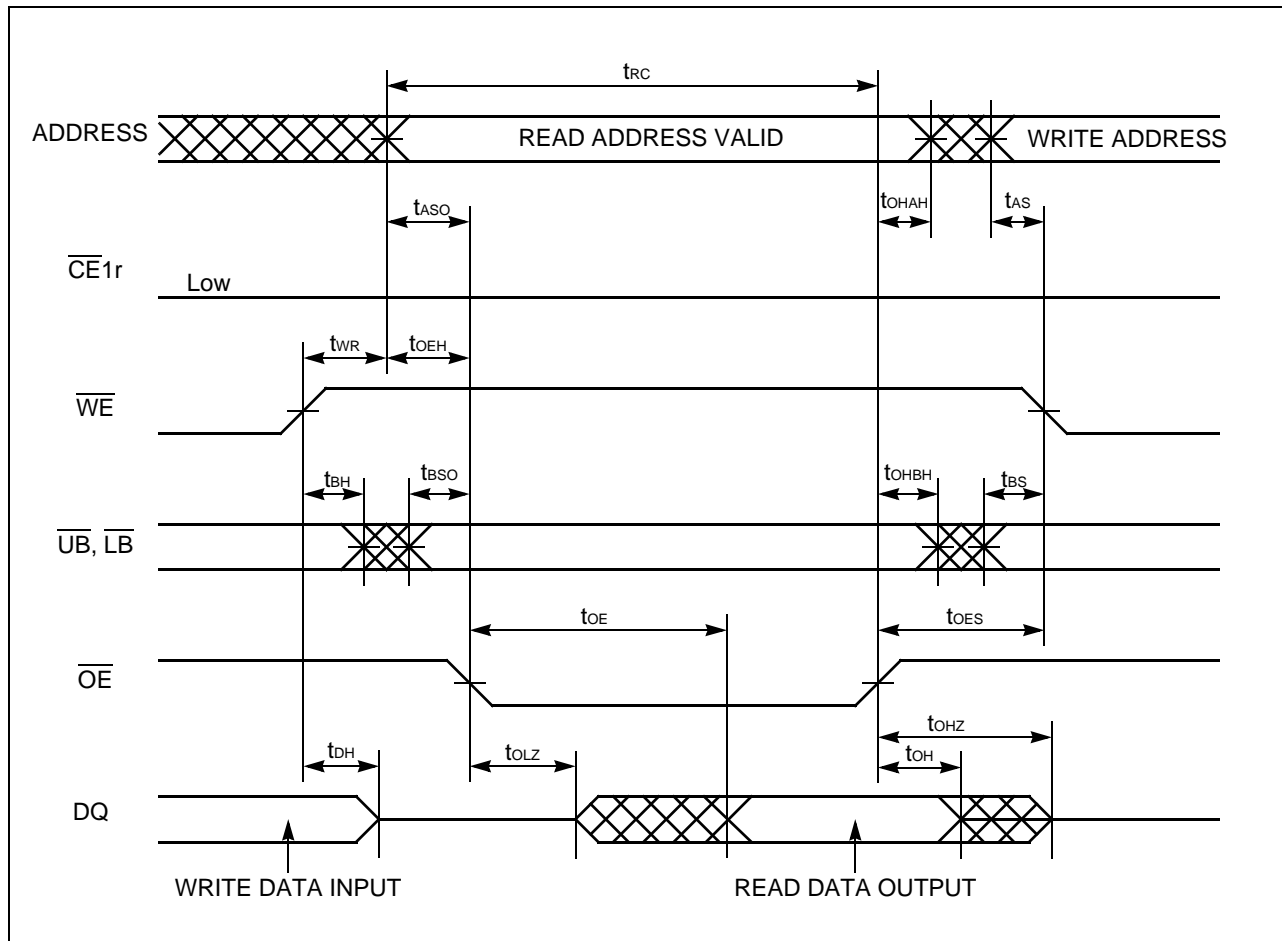
## • READ( $\overline{OE}$ Control) / WRITE( $\overline{WE}$ Control) Timing #2-1 (FCRAM)



Note:  $\overline{CE1r}$  can be tied to Low for  $\overline{WE}$  and  $\overline{OE}$  controlled operation.  
When  $\overline{CE1r}$  is tied to Low, output is exclusively controlled by  $\overline{OE}$ .

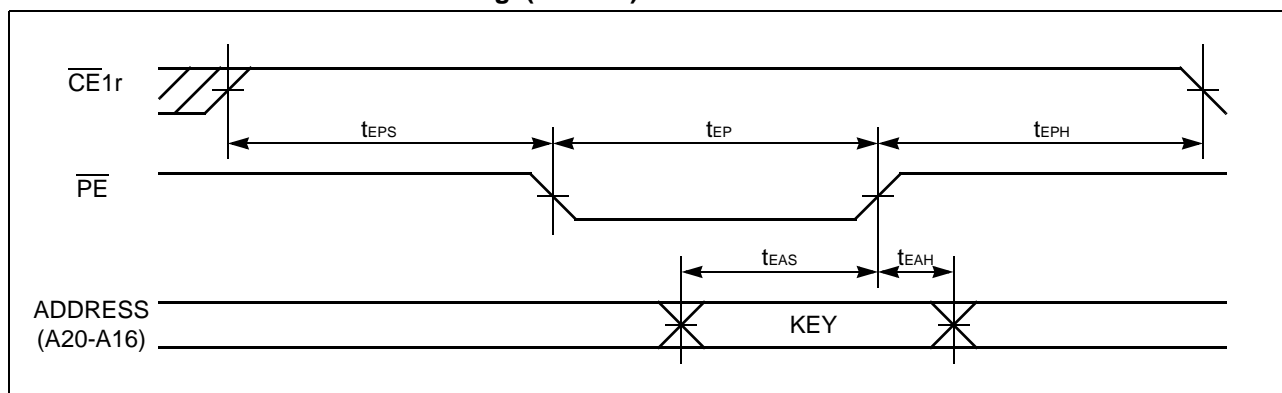
## 32M FCRAM for MCP

- READ( $\overline{OE}$  Control) / WRITE( $\overline{WE}$  Control) Timing #2-2



Note:  $\overline{CE1r}$  can be tied to Low for  $\overline{WE}$  and  $\overline{OE}$  controlled operation.  
When  $\overline{CE1r}$  is tied to Low, output is exclusively controlled by  $\overline{OE}$ .

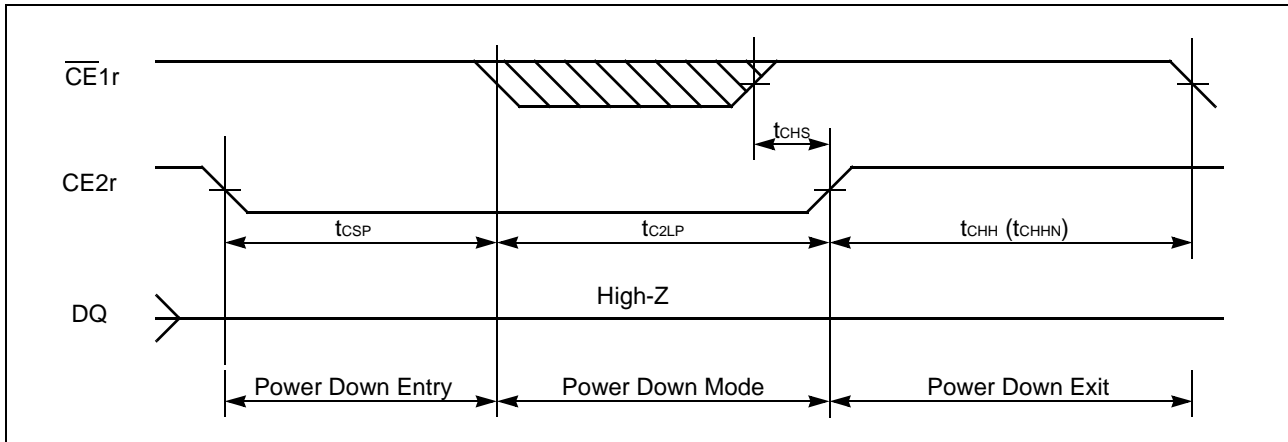
- POWER DOWN PROGRAM Timing (FCRAM)



Note:  $\overline{CE2r}$  must be High for Power Down Programming.  
Any other inputs not specified above can be either High or Low.

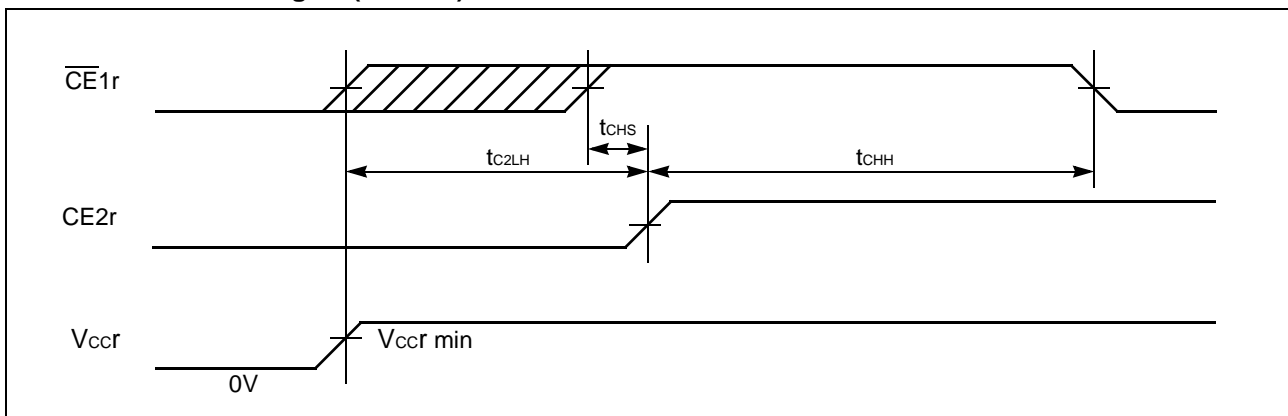
# 32M FCRAM for MCP

## • POWER DOWN Entry and Exit Timing (FCRAM)



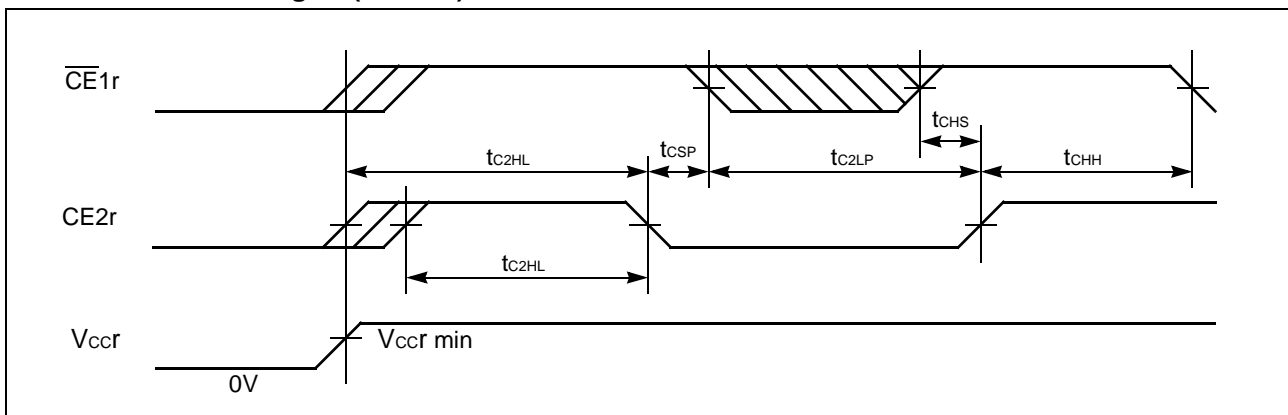
Note: This Power Down mode can be also used for Power-up #2 below except that  $t_{CHHN}$  can not be used at Power-up timing.

## • POWER-UP Timing #1 (FCRAM)



Note: The  $t_{C2LH}$  specifies after  $V_{ccr}$  reaches specified minimum level.

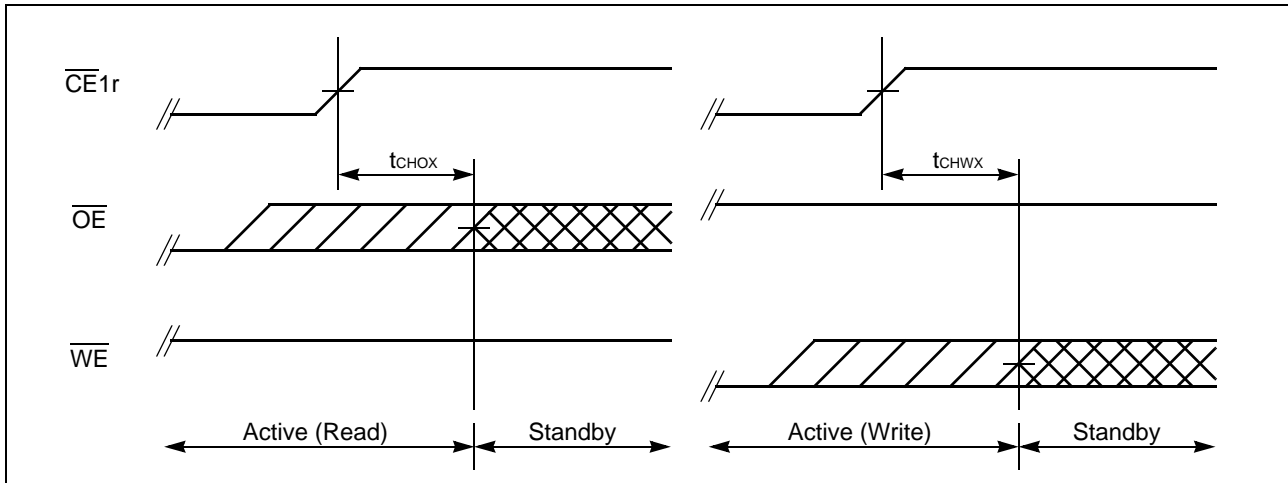
## • POWER-UP Timing #2 (FCRAM)



Note: The  $t_{C2HL}$  specifies from  $CE2r$  Low to High transition after  $V_{ccr}$  reaches specified minimum level.  $\overline{CE1r}$  must be brought to High prior to or together with  $CE2r$  Low to High transition.

# 32M FCRAM for MCP

- Standby Entry Timing after Read or Write (FCRAM)



Note: Both  $t_{CHOX}$  and  $t_{CHWX}$  define the earliest entry timing for Standby mode. If either of timing is not satisfied, it takes  $t_{RC}$  (min) period from either last address transition of A0 and A1, or  $\overline{CE1r}$  Low to High transition.

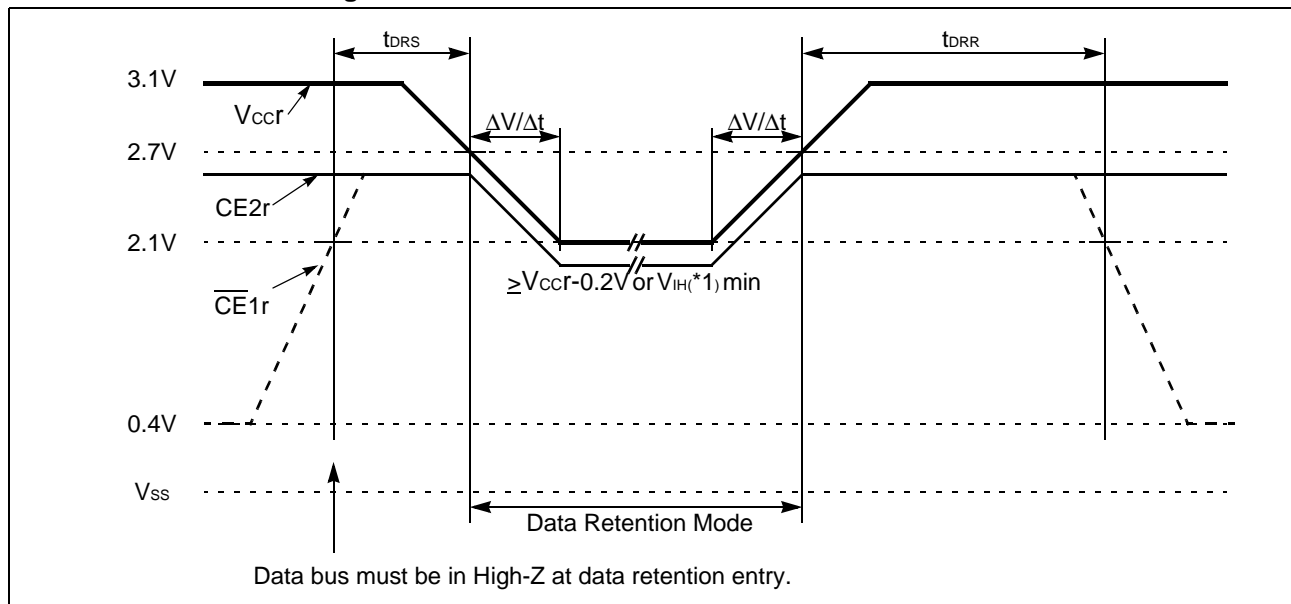
# 32M FCRAM for MCP

## ■ DATA RETENTION Low V<sub>CCr</sub> Characteristics (FCRAM)

Symbol	Parameter	Test Conditions	Value		Unit
			Min.	Max.	
V <sub>DR</sub>	V <sub>CCr</sub> Data Retention Supply Voltage	CE1r = CE2r ≥ V <sub>CCr</sub> - 0.2V or, CE1r = CE2r = V <sub>IH</sub> ,	2.1	3.1	V
I <sub>DR</sub>	V <sub>CCr</sub> Data Retention Supply Current	2.1V ≤ V <sub>CCr</sub> ≤ 2.7V, V <sub>IN</sub> = V <sub>IH</sub> (*1) or V <sub>IL</sub> CE1r = CE2r = V <sub>IH</sub> (*1), I <sub>OUT</sub> =0mA	—	1.5	mA
I <sub>DR1</sub>		2.1V ≤ V <sub>CCr</sub> ≤ 2.7V, V <sub>IN</sub> ≤ 0.2V or V <sub>IN</sub> ≥ V <sub>CCr</sub> - 0.2V, CE1r = CE2r ≥ V <sub>CCr</sub> - 0.2V, I <sub>OUT</sub> =0mA	—	100	μA
t <sub>DRS</sub>	Data Retention Setup Time	2.7V ≤ V <sub>CCr</sub> ≤ 3.1V at data retention entry	0	—	ns
t <sub>DRR</sub>	Data Retention Recovery Time	2.7V ≤ V <sub>CCr</sub> ≤ 3.1V after data retention	200	—	ns
ΔV/Δt	V <sub>CCr</sub> Voltage Transition Time	—	0.2	—	V/μs

Notes: \*1:  $2.0 \leq V_{IH} \leq V_{CCr} + 0.3V$

### • Data Retention Timing



## ■ PIN CAPACITANCE

Parameter	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Input Capacitance	$C_{IN}$	$V_{IN} = 0$	—	—	20.0	pF
Output Capacitance	$C_{OUT}$	$V_{OUT} = 0$	—	—	25.0	pF
Control Pin Capacitance	$C_{IN2}$	$V_{IN} = 0$	—	—	25.0	pF

Note: Test conditions  $T_a = 25^{\circ}\text{C}$ ,  $f = 1.0\text{ MHz}$

## ■ HANDLING OF PACKAGE

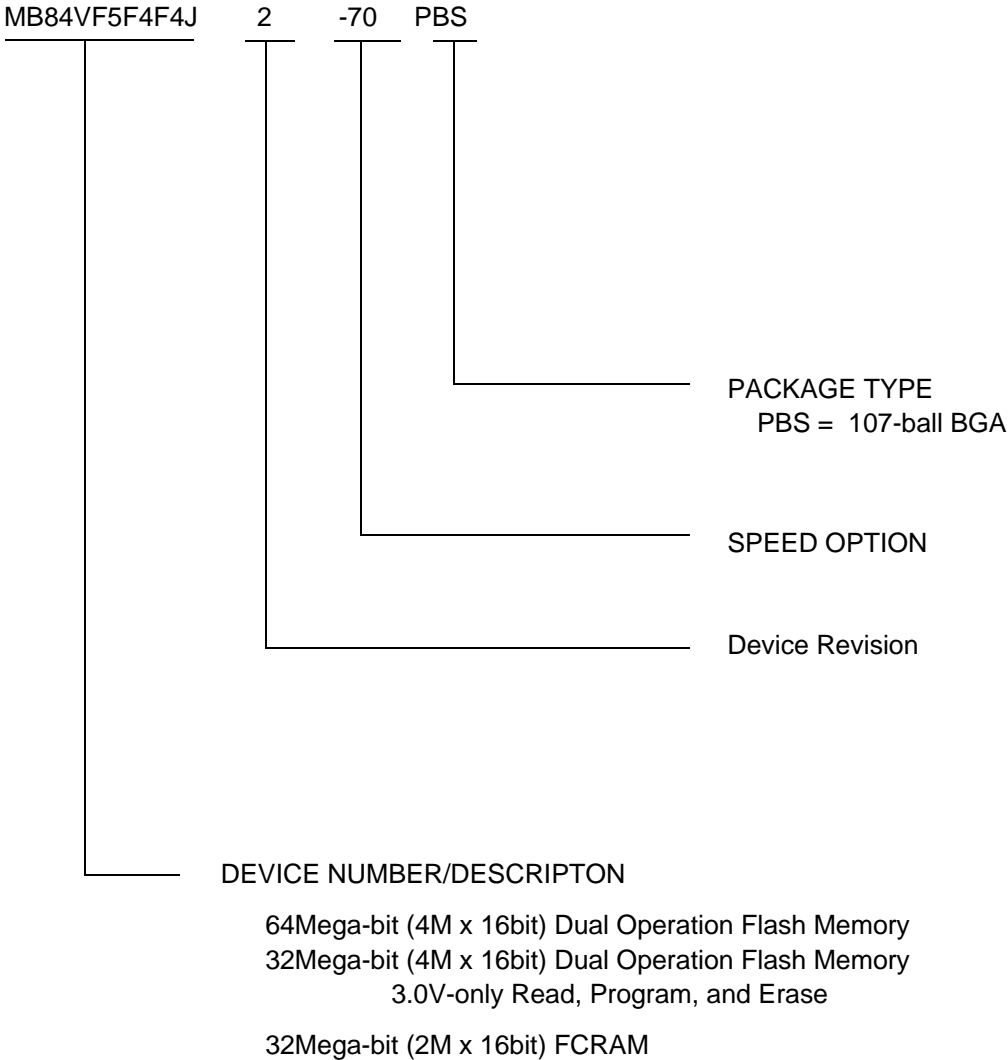
Please handle this package carefully since the sides of package create acute angles.

## ■ CAUTION

- The high voltage ( $V_{ID}$ ) cannot apply to address pins and control pins except  $\overline{\text{RESET}}$ . Exception is when autoselect and sector group protect function are used, then the high voltage ( $V_{ID}$ ) can be applied to  $\overline{\text{RESET}}$ .
- Without the high voltage ( $V_{ID}$ ), sector group protection can be achieved by using "Extended Sector Group Protection" command.

# MB84VF5F4F4J2-70

## ORDERING INFORMATION



## ■ PACKAGE DIMENSION

107-pin plastic FBGA  
(BGA-107P-M01)

**NOW PRINTING**

Dimensions in mm (inches).



## FUJITSU LIMITED

*For further information please contact:*

### **Japan**

FUJITSU LIMITED  
Corporate Global Business Support Division  
Electronic Devices  
Shinjuku Dai-Ichi Seimei Bldg. 7-1,  
Nishishinjuku 2-chome, Shinjuku-ku,  
Tokyo 163-0721, Japan  
Tel: +81-3-5322-3347  
Fax: +81-3-5322-3386

<http://edevice.fujitsu.com/>

### **North and South America**

FUJITSU MICROELECTRONICS, INC.  
3545 North First Street,  
San Jose, CA 95134-1804, U.S.A.  
Tel: +1-408-922-9000  
Fax: +1-408-922-9179

Customer Response Center  
*Mon. - Fri.: 7 am - 5 pm (PST)*  
Tel: +1-800-866-8608  
Fax: +1-408-922-9179

<http://www.fujitsumicro.com/>

### **Europe**

FUJITSU MICROELECTRONICS EUROPE GmbH  
Am Siebenstein 6-10,  
D-63303 Dreieich-Buchsschlag,  
Germany  
Tel: +49-6103-690-0  
Fax: +49-6103-690-122

<http://www.fujitsu-fme.com/>

### **Asia Pacific**

FUJITSU MICROELECTRONICS ASIA PTE. LTD.  
#05-08, 151 Lorong Chuan,  
New Tech Park,  
Singapore 556741  
Tel: +65-281-0770  
Fax: +65-281-0220

<http://www.fmap.com.sg/>

### **Korea**

FUJITSU MICROELECTRONICS KOREA LTD.  
1702 KOSMO TOWER, 1002 Daechi-Dong,  
Kangnam-Gu, Seoul 135-280  
Korea  
Tel: +82-2-3484-7100  
Fax: +82-2-3484-7111

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