FUJITSU SEMICONDUCTOR
DATA SHEET

DS05-50224-1E

Stacked MCP (Multi-Chip Package) FLASH MEMORY & FCRAM

CMOS

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

MB84VP23481FK-70

■ FEATURES

- **Power Supply Voltage of 2.7 V to 3.1 V**
- **High Performance**
  25 ns maximum page read access time, 65 ns maximum random access time (Flash)
  20 ns maximum page read access time, 70 ns maximum random access time (FCRAM)
- **Operating Temperature**
  –30 °C to +85 °C
- **Package 65-ball FBGA**

(Continued)

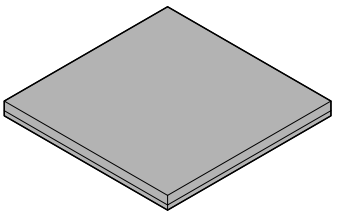
■ PRODUCT LINEUP

	Flash	FCRAM
Supply Voltage (V)	$V_{CC}f$* = 3.0 V $^{+0.1V}_{-0.3\ V}$	$V_{CC}r$* = 3.0 V $^{+0.1V}_{-0.3\ V}$
Max Random Address Access Time (ns)	65	70
Max Page Address Access Time (ns)	25	20
Max $\overline{CE}$ Access Time (ns)	65	70
Max $\overline{OE}$ Access Time (ns)	25	40

*: Both $V_{CC}f$ and $V_{CC}r$ must be the same level when either part is being accessed.

■ PACKAGE

65-ball plastic FBGA



(BGA-65P-M01)

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)
- **8 words Page**
- **Compatible with JEDEC-standard commands**
  Uses same software commands as E^2PROMs
- **Minimum 100,000 Program/Erase Cycles**
- **Sector Erase Architecture**
  Eight 8 Kbytes, a hundred twenty-six 64 Kbytes, eight 8 Kbytes sectors.
  Any combination of sectors can be concurrently erased. Also supports full chip erase
- **Dual Boot Block**
  Sixteen to 8Kbytes boot block sectors, eight at the top of the address range and eight at the bottom of the address range
- **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)
- **$\overline{\text{WP}}$/ACC Input Pin**
  At V_{IL}, allows protection of “outermost” 2×4 K words 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™ *2 Algorithms**
  Automatically writes and verifies data at specified address
- **$\overline{\text{Data}}$ Polling and Toggle Bit feature for Detection of Program or Erase Cycle Completion**
- **Ready/Busy Output (RY/$\overline{\text{BY}}$)**
  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
- **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
- **New Sector Protection**
  Persistent Sector Protection
  Password Sector Protection
- **Please refer to “MBM29QM64DF” Datasheet in Detailed Function**

(Continued)

(Continued)

— FCRAM™ *3

- **Power Dissipation**
  Operating : 30 mA Max
  Standby : 100 µA Max
- **Power Down Mode**
  Sleep : 10 µA Max
  4M Partial : 45 µA Max
  8M Partial : 55 µA Max
  16M Partial: 70 µA Max
- **Power Down Control by CE2r**
- **Byte Write Control: $\overline{LB}$(DQ_7 to DQ_0), $\overline{UB}$(DQ_{15} to DQ_8)**
- **8 words Page Access Capability**

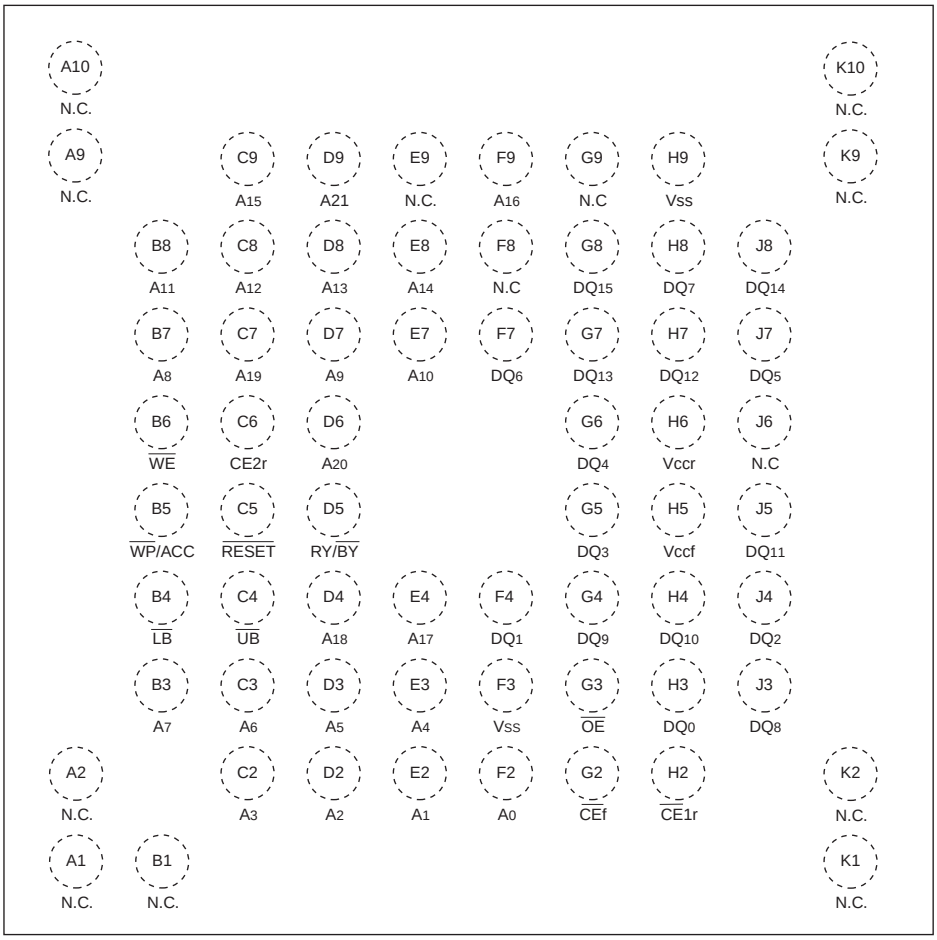
*1: FlexBank™ is a trademark of Fujitsu Limited, Japan.

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

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

■ PIN ASSIGNMENT

(Top View)
Marking Side

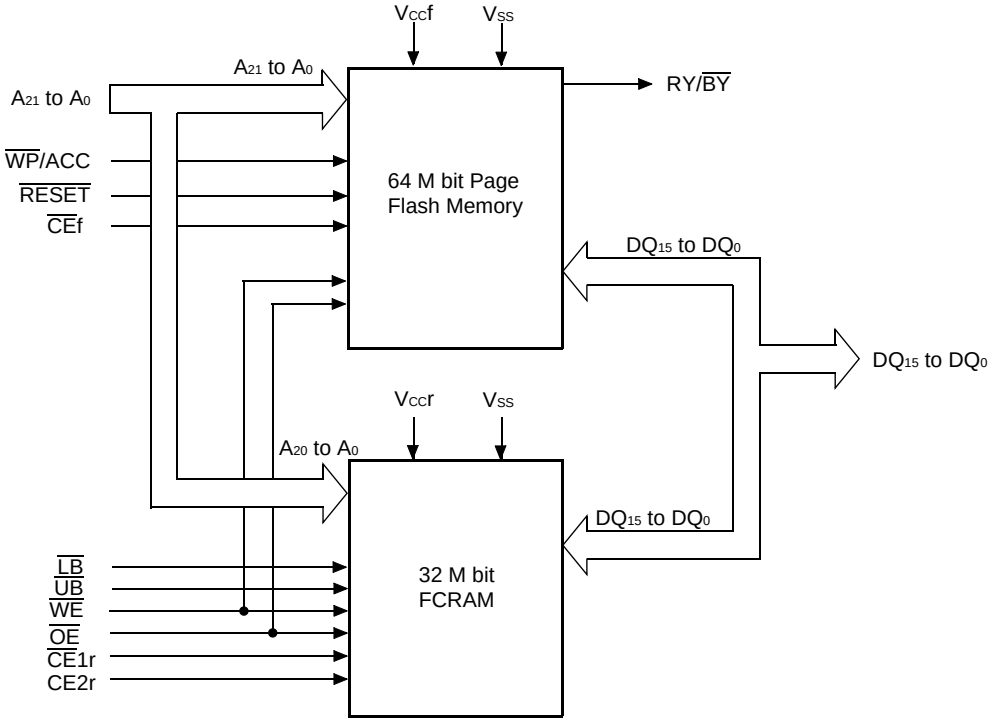


(BGA-65P-M01)

■ PIN DESCRIPTION

Pin name	Input/ Output	Description
A_{20} to A_0	I	Address Inputs (Common)
A_{21}	I	Address Input (Flash)
DQ_{15} to DQ_0	I/O	Data Inputs/Outputs (Common)
$\overline{CE}$f	I	Chip Enable (Flash)
$\overline{CE}$1r	I	Chip Enable (FCRAM)
CE2r	I	Chip Enable (FCRAM)
$\overline{OE}$	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 (FCRAM)
$\overline{LB}$	I	Lower Byte Control (FCRAM)
$\overline{RESET}$	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}r	Power	Device Power Supply (FCRAM)

■ BLOCK DIAGRAM



■ DEVICE BUS OPERATIONS

Operation*1, *2	$\overline{CEf}$	$\overline{CE1r}$	CE2r	$\overline{OE}$	$\overline{WE}$	$\overline{LB}$	$\overline{UB}$	A_{21} to A_0	DQ_7 to DQ_0	DQ_{15} to DQ_8	$\overline{RESET}$	$\overline{WP}$/ACC*9
Full Standby	H	H	H	X	X	X	X	X	High-Z	High-Z	H	X
Output Disable*3	H	L	H	H	H	X	X	X*8	High-Z	High-Z	H	X
	L	H										
Read from Flash*4	L	H	H	L	H	X	X	Valid	D_{OUT}	D_{OUT}	H	X
Write to Flash	L	H	H	H	L	X	X	Valid	D_{IN}	D_{IN}	H	X
Read from FCRAM	H	L	H	L	H	L	L	Valid	D_{IN}	D_{IN}	H	X
						H	L		High-Z	D_{IN}		
						L	H		D_{IN}	High-Z		
FCRAM No Read	H	L	H	L	H	H	H	Valid	High-Z	High-Z	H	X
Write to FCRAM	H	L	H	H*7	L	L	L	Valid	D_{IN}	D_{IN}	H	X
						H	L		High-Z	D_{IN}		
						L	H		D_{IN}	High-Z		
FCRAM No Write	H	L	H	H*7	L	H	H	Valid	High-Z	High-Z	H	X
Flash Temporary Sector Group Unprotection*5	X	X	X	X	X	X	X	X	X	X	V_{ID}	X
Flash Hardware Reset	X	H	H	X	X	X	X	X	High-Z	High-Z	L	X
Flash Boot Block Sector Write Protection	X	X	X	X	X	X	X	X	X	X	X	L
FCRAM Power Down*6	X	X	L	X	X	X	X	X	X	X	X	X

Legend: L = V_{IL}, H = V_{IH}, X can be either V_{IL} or V_{IH}, High-Z = High Impedance.
See ■DC CHARACTERISTICS for voltage levels.

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

*2 : Do not apply for two or more states of the following conditions at the same time;
- $\overline{CE}f = V_{IL}$
- $\overline{CE}1r = V_{IL}$ and $CE2r = V_{IH}$

*3 : Should not be kept FCRAM Output Disable condition longer than 1μs.

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

*5 : It is also used for the extended sector group protections.

*6 : FCRAM Power Down mode can be entered from Standby state and all DQ pins are in High-Z state. Data retention depends on the selection of Power Down Program. Please refer to “Power Down Program” in FCRAM Characteristics part.

*7 : $\overline{OE}$ can be V_{IL} during Write operation if the following conditions are satisfied;
1) Write pulse is initiated by $\overline{CE}1r$ (refer to $\overline{CE}1r$ Controlled Write timing), or cycle time of the previous operation cycle is satisfied.
2) $\overline{OE}$ stays V_{IL} during Write cycle.

*8 : Can be either V_{IL} or V_{IH} but must be valid before Read or Write.

*9 : 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	Tstg	–55	+125	°C
Ambient Temperature with Power Applied	T_A	–30	+85	°C
Voltage with Respect to Ground All pins except $\overline{RESET}$, $\overline{WP}$/ACC *1	V_{IN}, V_{OUT}	–0.3	$V_{CC}f$ + 0.3	V
			$V_{CC}r$ + 0.3	V
$V_{CC}f$/$V_{CC}r$ Supply *1	$V_{CC}f$, $V_{CC}r$	–0.3	+3.3	V
$\overline{RESET}$ *2	V_{IN}	–0.5	+ 13.0	V
$\overline{WP}$/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 –1.0 V for periods of up to 5 ns. Maximum DC voltage on input or I/O pins is $V_{CC}f$ + 0.3 V or $V_{CC}r$ + 0.3V. During voltage transitions, input or I/O pins may overshoot to $V_{CC}f$ + 2.0 V or $V_{CC}r$ + 1.0 V for periods of up to 5 ns.

*2: Minimum DC input voltage on $\overline{RESET}$ pin is –0.5 V. During voltage transitions $\overline{RESET}$ 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}-$V_{CC}f$) does not exceed +9.0 V. Maximum DC input voltage on $\overline{RESET}$ 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 $\overline{WP}$/ACC pin is –0.5 V. During voltage transitions, $\overline{WP}$/ACC pin may undershoot Vss to –2.0 V for periods of up to 20 ns. Maximum DC input voltage on $\overline{WP}$/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	T_A	–30	+85	°C
$V_{CC}f$/$V_{CC}r$ Supply Voltages	$V_{CC}f$, $V_{CC}r$	+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.

■ 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}r		–1.0	—	+1.0	µA
Output Leakage Current	I_{LO}	V_{OUT} = V_{SS} to V_{CC}f, V_{CC}r, Output Disable		–1.0	—	+1.0	µA
$\overline{RESET}$ Inputs Leakage Current (Flash)	I_{LIT}	V_{CC}f = V_{CC}f Max, $\overline{RESET}$ = 12.5 V		—	—	35	µA
$\overline{WP}$/ACC Acceleration Program Current (Flash)	I_{LIA}	V_{CC}f = V_{CC}f Max, $\overline{WP}$/ACC = V_{ACC} Max		—	—	20	mA
Flash V_{CC} Active Current *1,*6 (Initial/Random Read)	I_{CC1}f	$\overline{CE}$f = V_{IL}, $\overline{OE}$ = V_{IH}, f = 10 MHz		—	—	45	mA
		$\overline{CE}$f = V_{IL}, $\overline{OE}$ = V_{IH}, f = 5 MHz		—	—	20	mA
Flash V_{CC} Active Current *2	I_{CC2}f	$\overline{CE}$f = V_{IL}, $\overline{OE}$ = V_{IH}		—	—	25	mA
Flash V_{CC} Current (Page Mode) *9,*6	I_{CC3}f	$\overline{CE}$f = V_{IL}, $\overline{OE}$ = V_{IH}, f = 40 MHz		—	—	10	mA
Flash V_{CC} Active Current*5,*6 (Read-While-Program)	I_{CC4}f	$\overline{CE}$f = V_{IL}, $\overline{OE}$ = V_{IH}		—	—	45	mA
Flash V_{CC} Active Current*5,*6 (Read-While-Erase)	I_{CC5}f	$\overline{CE}$f = V_{IL}, $\overline{OE}$ = V_{IH}		—	—	45	mA
Flash V_{CC} Active Current*5,*6 (Erase-Suspend-Program)	I_{CC6}f	$\overline{CE}$f = V_{IL}, $\overline{OE}$ = V_{IH}		—	—	25	mA
Flash V_{CC} Current (Standby) *6	I_{SB1}f	V_{CC}f = V_{CC}f Max, $\overline{CE}$f = V_{CC}f ±0.3 V $\overline{RESET}$= V_{CC}f ±0.3 V, $\overline{WP}$/ACC =V_{CC}f ±0.3 V		—	1	5	µA
Flash V_{CC} Current (Standby, Reset) *6	I_{SB2}f	V_{CC}f = V_{CC}f Max, $\overline{RESET}$= V_{SS} ±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} ±0.3 V, $\overline{RESET}$= V_{CC}f ±0.3 V, V_{IN} = V_{CC}f ±0.3 V or V_{SS}f±0.3 V		—	1	5	µA
FCRAM V_{CC} Active Current *6, *8	I_{CC1}r	V_{CC}r = V_{CC}r Max, $\overline{CE}$1r = V_{IL}, CE2r = V_{IH}, V_{IN} = V_{IH} or V_{IL}, I_{OUT} = 0 mA*7	t_{RC} / t_{WC} =Min	—	—	30	mA
	I_{CC2}r		t_{RC} / t_{WC} =1µs	—	—	3	
FCRAM V_{CC} Page Read Current *6, *8	I_{CC3}r	V_{CC}r = V_{CC}r Max, V_{IN} = V_{IH} or V_{IL}, $\overline{CE}$1r = V_{IL}, CE2r = V_{IH}, I_{OUT} = 0 mA *7, t_{PRC}=Min		—	—	10	mA
FCRAM V_{CC} Standby Current *6, *8	I_{SB1}r	V_{CC}r = V_{CC}r Max, V_{IN} ≤ 0.2V or ≥ V_{CC}r – 0.2V $\overline{CE}$1r ≥ V_{CC}r – 0.2V, CE2r ≥ V_{CC}r– 0.2V		—	—	100	µA
FCRAM V_{CC} Power Down Current *6, *8	I_{DDPS}r	V_{CC}r = V_{CC}r Max, CE2r ≤ 0.2V, V_{IN} = V_{IH} or V_{IL}	Sleep	—	—	10	µA
	I_{DDP4}r		4M Partial	—	—	45	µA
	I_{DDP8}r		8M Partial	—	—	55	µA
	I_{DDP16}r		16M Partial	—	—	70	µA

(Continued)

(Continued)

Parameter	Sym-bol	Conditions		Value			Unit
				Min	Typ	Max	
Input Low Level	V_{IL}	—		–0.3	—	$V_{CC} \times 0.2$ *6	V
Input High Level	V_{IH}	—		$V_{CC} \times 0.8$ *6	—	$V_{CC} + 0.2$ *6	V
Voltage for Sector Protection, and Temporary Sector Unprotection ($\overline{RESET}$) *4	V_{ID}	—		11.5	12	12.5	V
Voltage for $\overline{WP}$/ACC Sector Protection/Unprotection and Program Acceleration *4	V_{ACC}	—		8.5	9.0	9.5	V
Output Low Voltage Level	$V_{OL}f$	$V_{CC}f = V_{CC}f$ Min, I_{OL}=4.0 mA	Flash	—	—	0.4	V
	$V_{OL}r$	$V_{CC}r = V_{CC}r$ Min, I_{OL} =1.0mA	FCRAM	—	—	0.4	V
Output High Voltage Level	$V_{OH}f$	$V_{CC}f = V_{CC}f$ Min, I_{OH}=–2.0 mA	Flash	2.4	—	—	V
	$V_{OH}r$	$V_{CC}r = V_{CC}r$ Min, I_{OH}=–0.5 mA	FCRAM	2.4	—	—	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 $V_{CC}r$.

*7: FCRAM Characteristics are measured after following POWER-UP timing.

*8: I_{OUT} depends on the output load conditions.

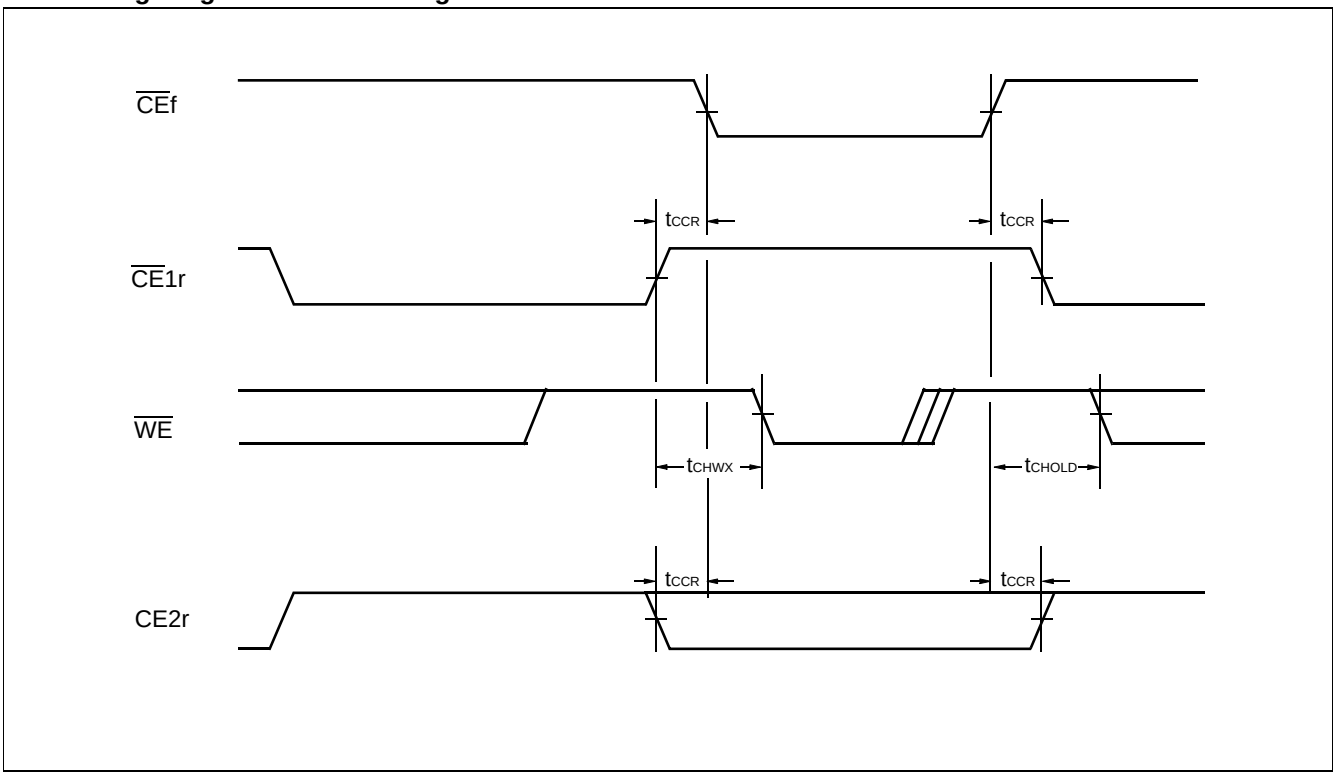
*9: Address except A_2, A_1 and A_0 are fixed.

■ 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{CE}$1r High to $\overline{WE}$ Invalid time for Standby Entry	—	t_{CHWX}	—	10	—	ns

- **Timing Diagram for alternating RAM to Flash**



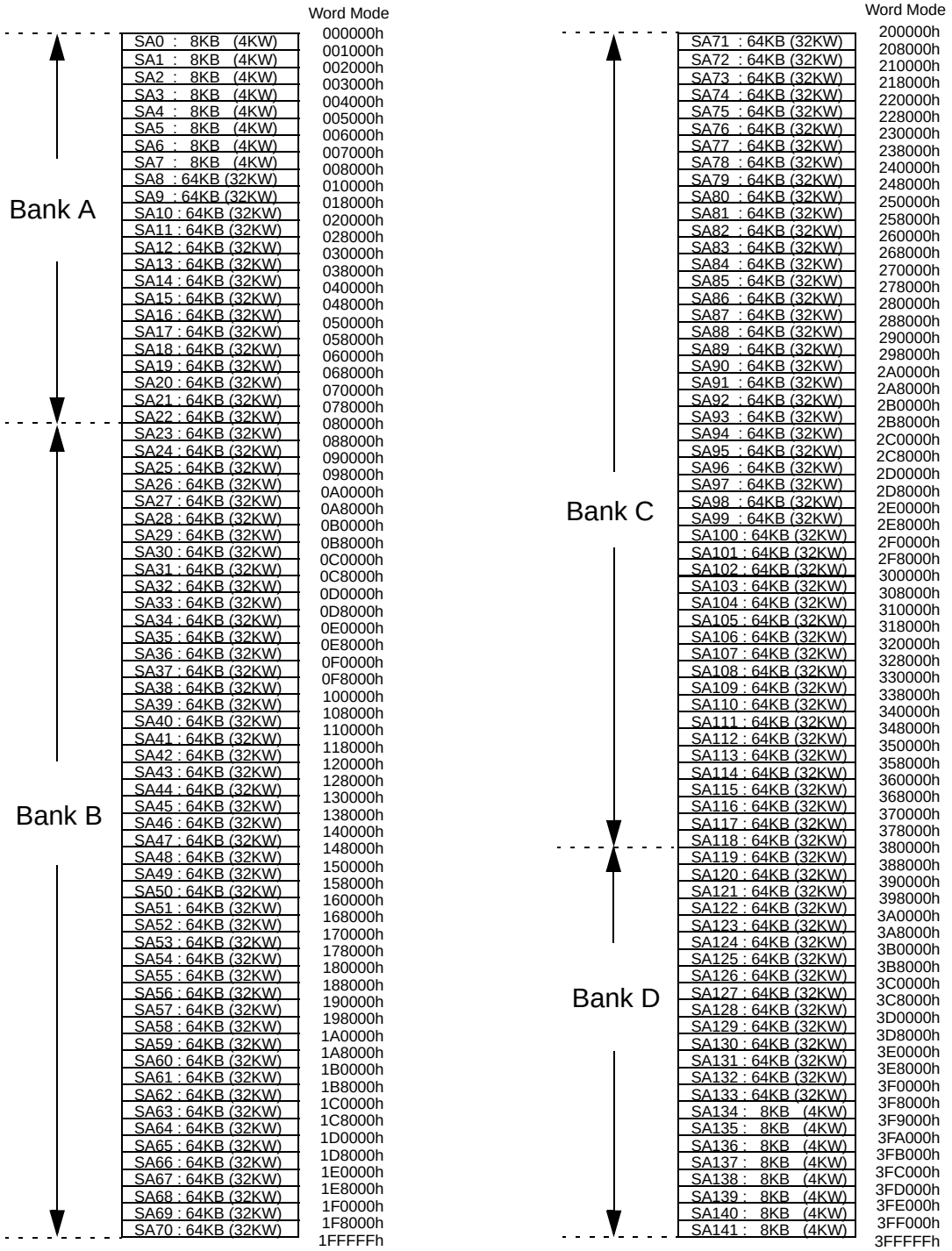
- **Flash Characteristics**
  Please refer to “■64 M PAEG FLASH MEMORY CHARACTERISTICS for MCP”.

- **FCRAM Characteristics**
  Please refer to “■32 M FCRAM CHARACTERISTICS for MCP”.

■ 64 M PAEG FLASH MEMORY CHARACTERISTICS 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.



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, Bank C 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
		A_{21}	A_{20}	A_{19}	A_{18}	A_{17}	A_{16}	A_{15}	A_{14}	A_{13}	A_{12}	
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)

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 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

(Continued)

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 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

(Continued)

(Continued)

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_5	A_4	A_3	A_2	A_1	A_0	Code (HEX)
Manufacture's Code	BA	V_{IL}	x	x	V_{IL}	V_{IL}	V_{IL}	V_{IL}	04h
Device Code	BA	V_{IL}	x	x	V_{IL}	V_{IL}	V_{IL}	V_{IH}	227Eh
Extended Device Code*2	BA	V_{IL}	x	x	V_{IH}	V_{IH}	V_{IH}	V_{IL}	2215h
	BA	V_{IL}	x	x	V_{IH}	V_{IH}	V_{IH}	V_{IH}	2201h
Sector Group Protection*1	Sector Group Addresses	V_{IL}	V_{IH}	V_{IH}	V_{IH}	V_{IL}	V_{IH}	V_{IL}	01h*1

*1:Sector Group can be protected by "Sector Group Protection", "Extended Sector Group Protection" and "New Sector Protection (PPB Protection)".
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 is output, it indicates that two additional codes, called Extended Device Codes, will be required. 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		Seventh Bus Write Cycle	
		Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data
Read/Reset *1	2	XXXh	F0h	RA	RD	—	—	—	—	—	—	—	—	—	—
Read/Reset *1	4	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	—	—	—	—	—	—
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	—	—
Program/Erase Suspend	1	BA	B0h	—	—	—	—	—	—	—	—	—	—	—	—
Program/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	SGA	60h	SGA	40h	SGA	SD	—	—	—	—	—	—
Query *4	1	(BA) 55h	98h	—	—	—	—	—	—	—	—	—	—	—	—
HiddenROM Entry	3	555h	AAh	2AAh	55h	555h	88h	—	—	—	—	—	—	—	—
HiddenROM Program *5	4	555h	AAh	2AAh	55h	555h	A0h	(HRA) PA	PD	—	—	—	—	—	—
HiddenROM Exit *5	4	555h	AAh	2AAh	55h	(HRBA) 555h	90h	XXXh	00h	—	—	—	—	—	—
HiddenROM Protect *5	6	555h	AAh	2AAh	55h	555h	60h	OPBP	68h	OPBP	48h	XXXh	RD(0)	—	—
Password Program *7	4	555h	AAh	2AAh	55h	555h	38h	XX0h	PD0	—	—	—	—	—	—
								XX1h	PD1	—	—	—	—	—	—
								XX2h	PD2	—	—	—	—	—	—
								XX3h	PD3	—	—	—	—	—	—
Password Unlock	7	555h	AAh	2AAh	55h	555h	28h	XX0h	PD0	XX1h	PD1	XX2h	PD2	XX3h	PD3
Password Verify	4	555h	AAh	2AAh	55h	555h	C8h	PWA	PWD	—	—	—	—	—	—

(Continued)

(Continued)

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		Seventh Bus Write Cycle	
		Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data	Addr.	Data
Password Mode Locking Bit Program	6	555h	AAh	2AAh	55h	555h	60h	PL	68h	PL	48h	XXh	RD(0)	—	—
Persistent Protection Mode Locking Bit Program	6	555h	AAh	2AAh	55h	555h	60h	SPML	68h	SPML	48h	XXh	RD(0)	—	—
PPB Program	6	555h	AAh	2AAh	55h	555h	60h	SA+WP	68h	SA+WP	48h	XXh	RD(0)	—	—
PPB Verify	4	555h	AAh	2AAh	55h	555h	90h	SA+x02	RD(0)	—	—	—	—	—	—
All PPB Erase *8	6	555h	AAh	2AAh	55h	555h	60h	SA+WP	60h	SA+WP	40h	XXh	RD(0)	—	—
PPB Lock Bit Set	3	555h	AAh	2AAh	55h	555h	78h	—	—	—	—	—	—	—	—
PPB Lock Bit Verify	4	555h	AAh	2AAh	55h	555h	58h	SA	RD(1)	—	—	—	—	—	—
DPB Write	4	555h	AAh	2AAh	55h	555h	48h	SA	X1h	—	—	—	—	—	—
DPB Erase	4	555h	AAh	2AAh	55h	555h	48h	SA	X0h	—	—	—	—	—	—
DPB Verify	4	555h	AAh	2AAh	55h	555h	58h	SA	RD(0)	—	—	—	—	—	—

Legend:

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

BA = Bank Address

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.

SGA = Sector group address to be protected. Set sector group address and (A_6, A_5, A_4, A_3, A_2, A_1, A_0) = (0, 1, 1, 1, 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})

RD(0) = DQ_0 data, RD(1) = DQ_1 data. PPB Lock bit is read on DQ_1 and PPB or DPB are read on DQ_0. If set, DQ_0/DQ_1=1. If cleared, DQ_0/DQ_1=0.

OPBP = (A_6, A_5, A_4, A_3, A_2, A_1, A_0) is (X, 0, 1, 1, 0, 1, 0)

SLA = Address of the sector to be locked. Set sector address (SA) and either A_6 = 1 for unlocked or A_6 = 0 for locked

PWA/PWD = Password Address/Password Data

PL = (A_6, A_5, A_4, A_3, A_2, A_1, A_0) is (X, 0, 0, 1, 0, 1, 0)

SPML = (A_6, A_5, A_4, A_3, A_2, A_1, A_0) is (X, 0, 1, 0, 0, 1, 0)

WP = (A_6, A_5, A_4, A_3, A_2, A_1, A_0) is (X, 1, 1, 1, 0, 1, 0)

*1: Both of these reset commands are equivalent.

*2: This command is valid during Fast Mode.

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

*4: The valid addresses are A_6 to A_0.

*5: This command is valid during HiddenROM mode.

*6: The data “00h” is also acceptable.

*7: Data before fourth cycle also need to be programmed repearting from first cycle to third cycle.

*8: RD(0) of the sixth cycle shows PPB erase status. When RD(0) is "1", programming must be repeated from the beginning of first cycle to the fourth cycle; both fifth and the sixth validate full completion of erase.

Notes : • Address bits A_{21} to A_{11} = X = “H” or “L” for all address commands except for PA, SA, BA, SGA, OPBP, SLA, PWA, PL, SPML, WP.
- Bus operations are defined in "■ DEVICE BUS OPERATIONS".
- 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.
- Command combinations not described in Command Definitions table are illegal.

2. AC Characteristics

- **Read Only Operations Characteristics**

Parameter	Symbol		Condition	Value*		Unit
	JEDEC	Standard		Min	Max	
Read Cycle Time	t_{AVAV}	t_{RC}	—	65	—	ns
Address to Output Delay	t_{AVQV}	t_{ACC}	$\overline{CE}f = V_{IL}$ $\overline{OE} = V_{IL}$	—	65	ns
Page Read Cycle Time	—	t_{PRC}	—	25	—	ns
Page Address to Output Delay	—	t_{PACC}	$\overline{CE}f = V_{IL}$ $\overline{OE} = V_{IL}$	—	25	ns
Chip Enable to Output Delay	t_{ELQV}	t_{CE}	$\overline{OE} = V_{IL}$	—	65	ns
Output Enable to Output Delay	t_{GLQV}	t_{OE}	—	—	25	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 Address, $\overline{CE}f$ or $\overline{OE}$, Whichever Occurs First	t_{AXQX}	t_{OH}	—	4	—	ns
$\overline{RESET}$ Pin Low to Read Mode	—	t_{READY}	—	—	20	ns

* : Test Conditions: Output Load:$V_{CC}f$ =2.7 V to 3.1 V: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 × $V_{CC}f$
Output: 0.5 × $V_{CC}f$

- **Write (Erase/Program) Operations**

Parameter		Symbol		Value			Unit
		JEDEC	Standard	Min	Typ	Max	
Write Cycle Time		t_{AVAV}	t_{WC}	65	—	—	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}	45	—	—	ns
Address Hold Time from $\overline{CE}$f or $\overline{OE}$ High During Toggle Bit Polling		—	t_{AHT}	0	—	—	ns
Data Setup Time		t_{DVWH}	t_{DS}	35	—	—	ns
Data Hold Time		t_{WHDX}	t_{DH}	0	—	—	ns
Output Enable Hold Time	Read	—	t_{OEH}	0	—	—	ns
	Toggle and $\overline{Data}$ Polling			10	—	—	ns
$\overline{CE}$ 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
$\overline{CE}$ Setup Time		t_{ELWL}	t_{CS}	0	—	—	ns
$\overline{WE}$ Setup Time		t_{WLEL}	t_{WS}	0	—	—	ns
$\overline{CE}$ 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
$\overline{CE}$ Pulse Width		t_{ELEH}	t_{CP}	35	—	—	ns
Write Pulse Width High		t_{WHWL}	t_{WPH}	30	—	—	ns
$\overline{CE}$ Pulse Width High		t_{EHEL}	t_{CPH}	30	—	—	ns
Word Programming Operation		t_{WHWH1}	t_{WHWH1}	—	6	—	µs
Sector Erase Operation*1		t_{WHWH2}	t_{WHWH2}	—	0.5	—	s
V_{CC} Setup Time		—	t_{VCS}	50	—	—	µs
Rise Time to V_{ACC}*2		—	t_{VACCR}	500	—	—	ns

(Continued)

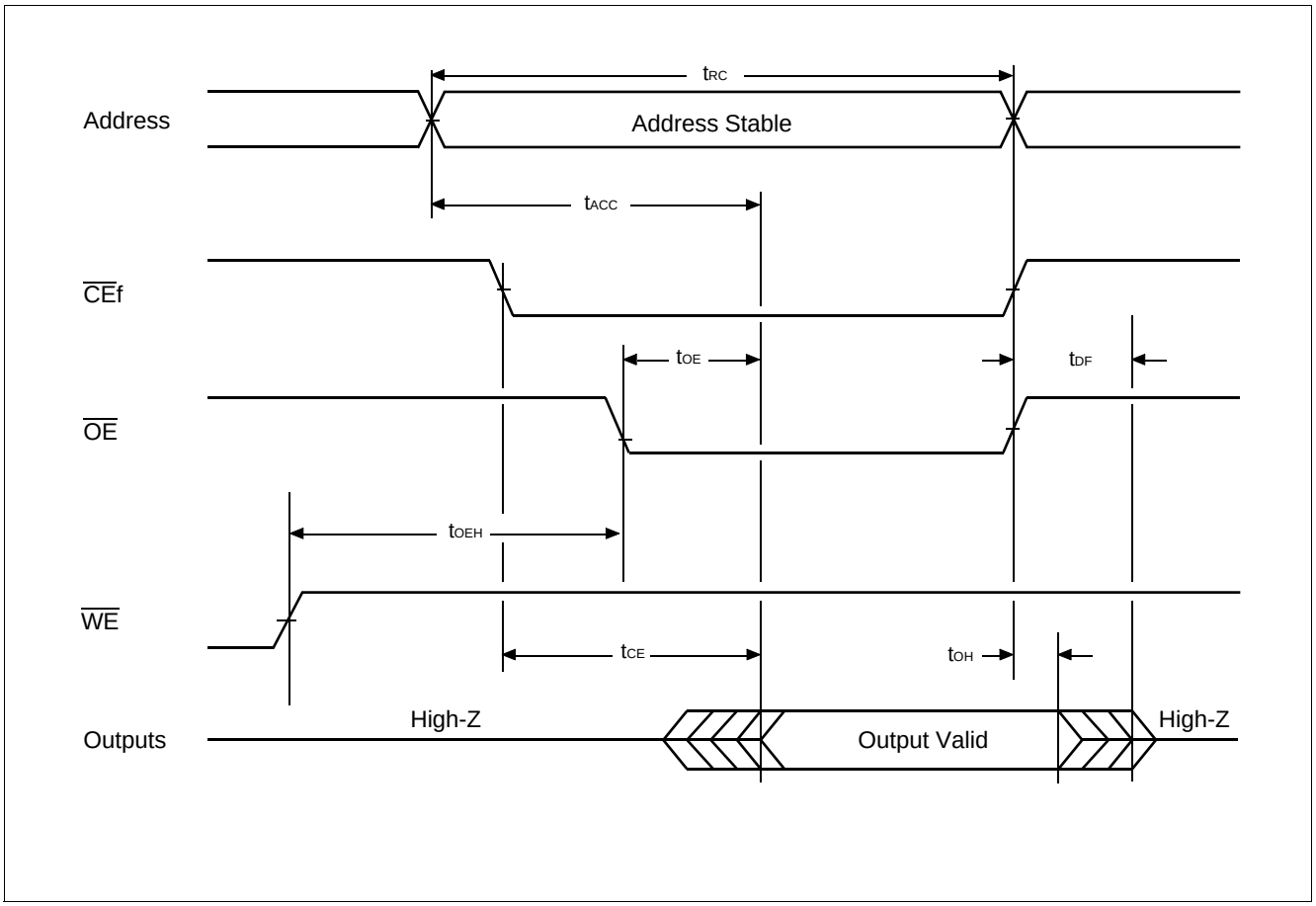
(Continued)

Parameter	Symbol		Value			Unit
	JEDEC	Standard	Min	Typ	Max	
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}	—	—	65	ns
Erase Time-out Time	—	t_{TOW}	50	—	—	ns
Erase Suspend Transition Time	—	t_{SPD}	—	—	20	ns

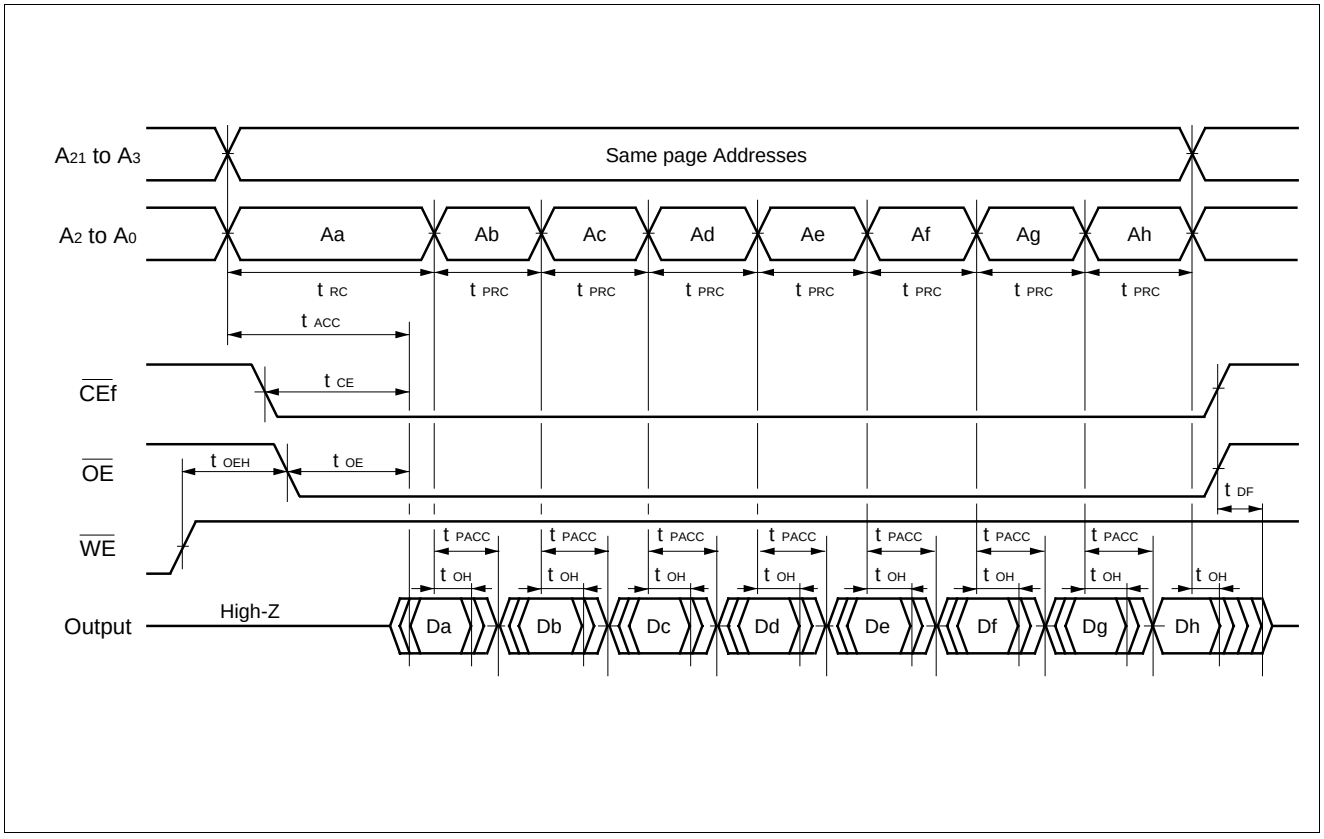
*1 : This does not include the preprogramming time.

*2 : This timing is for Accelerated Program operation.

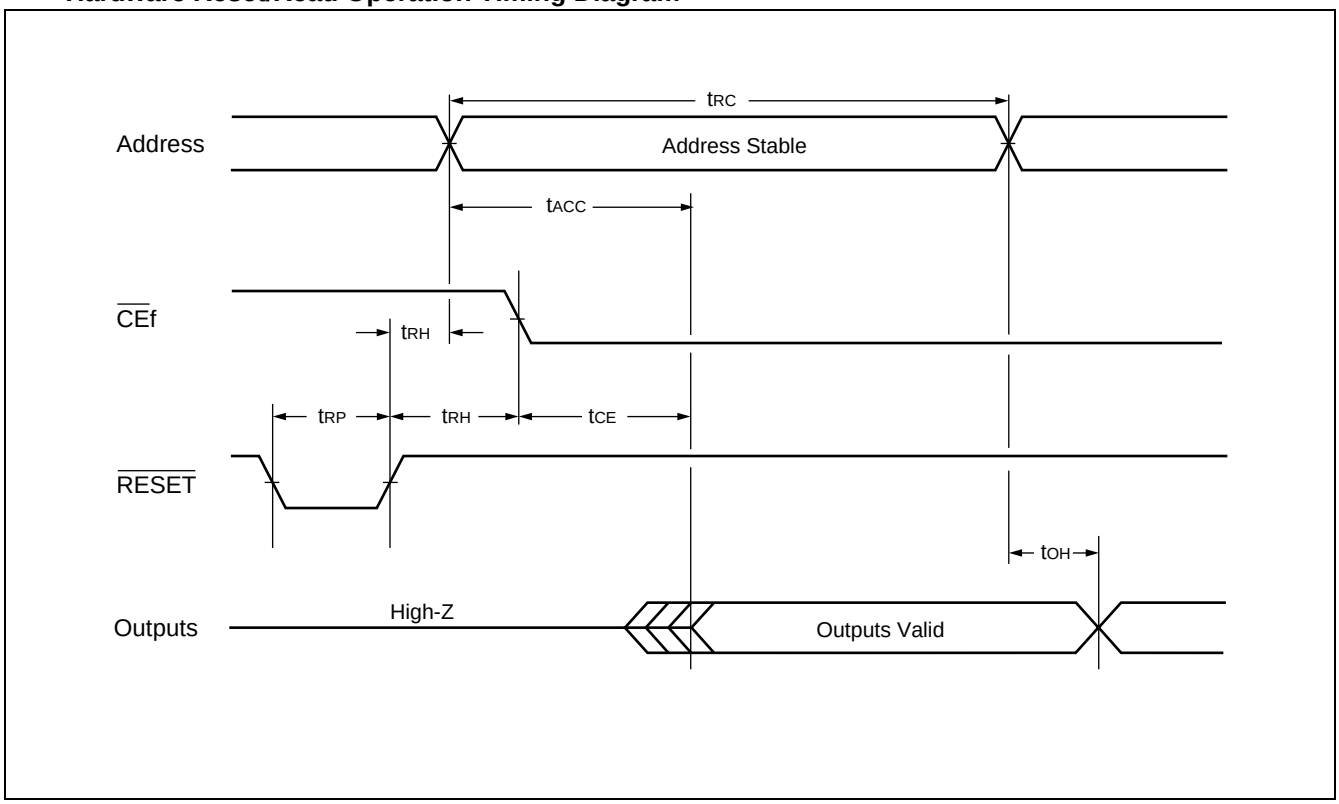
- **Read Operation Timing Diagram**



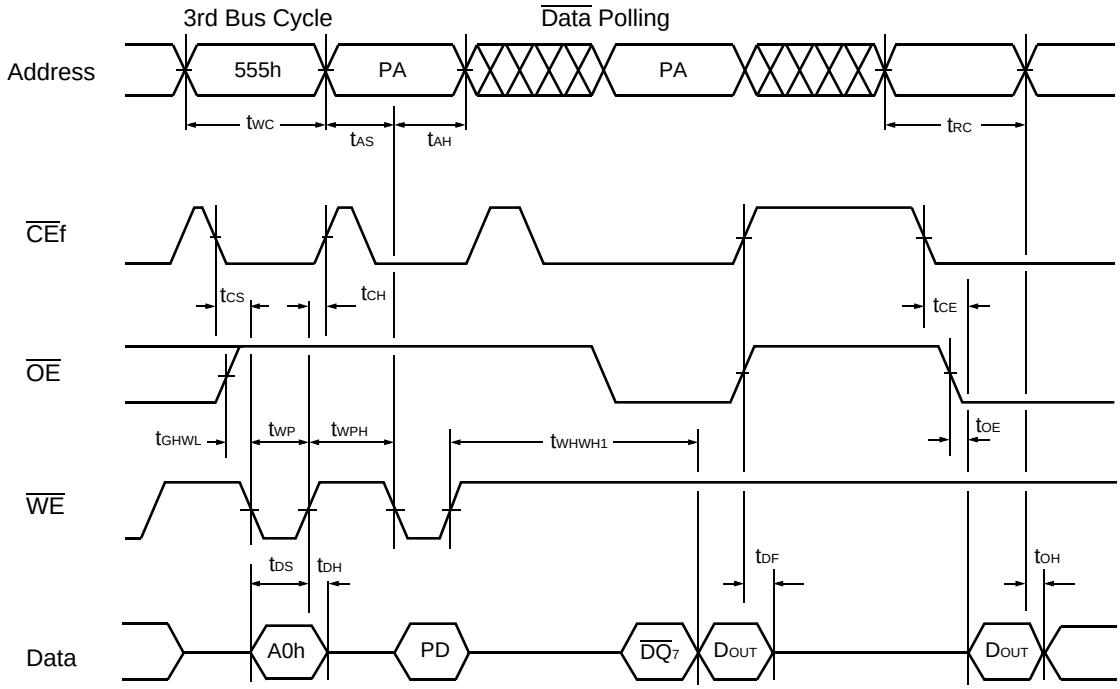
- **Page Read Operation Timing Diagram**



- **Hardware Reset/Read Operation Timing Diagram**

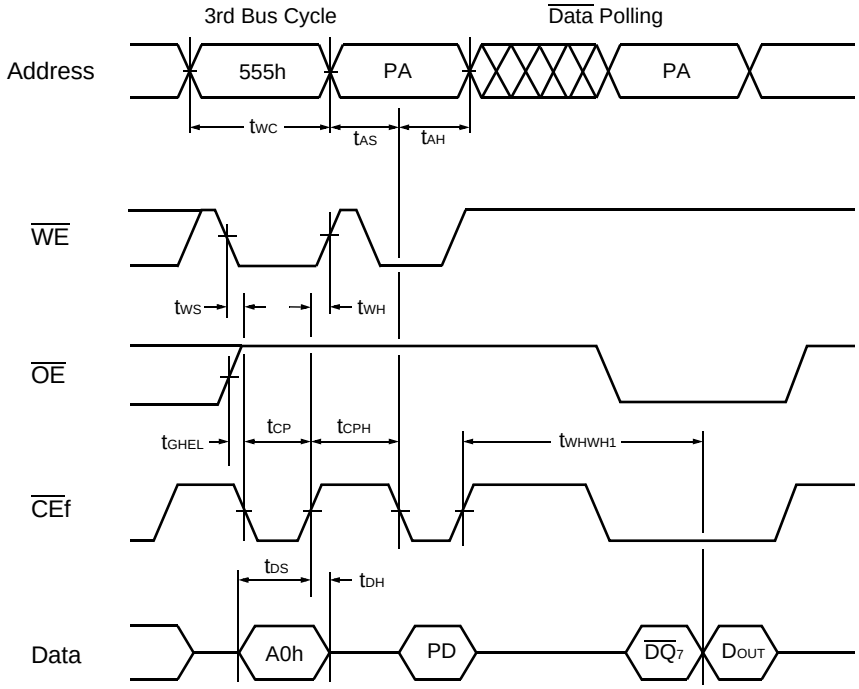


- **Alternate $\overline{WE}$ Controlled Program Operation Timing Diagram**



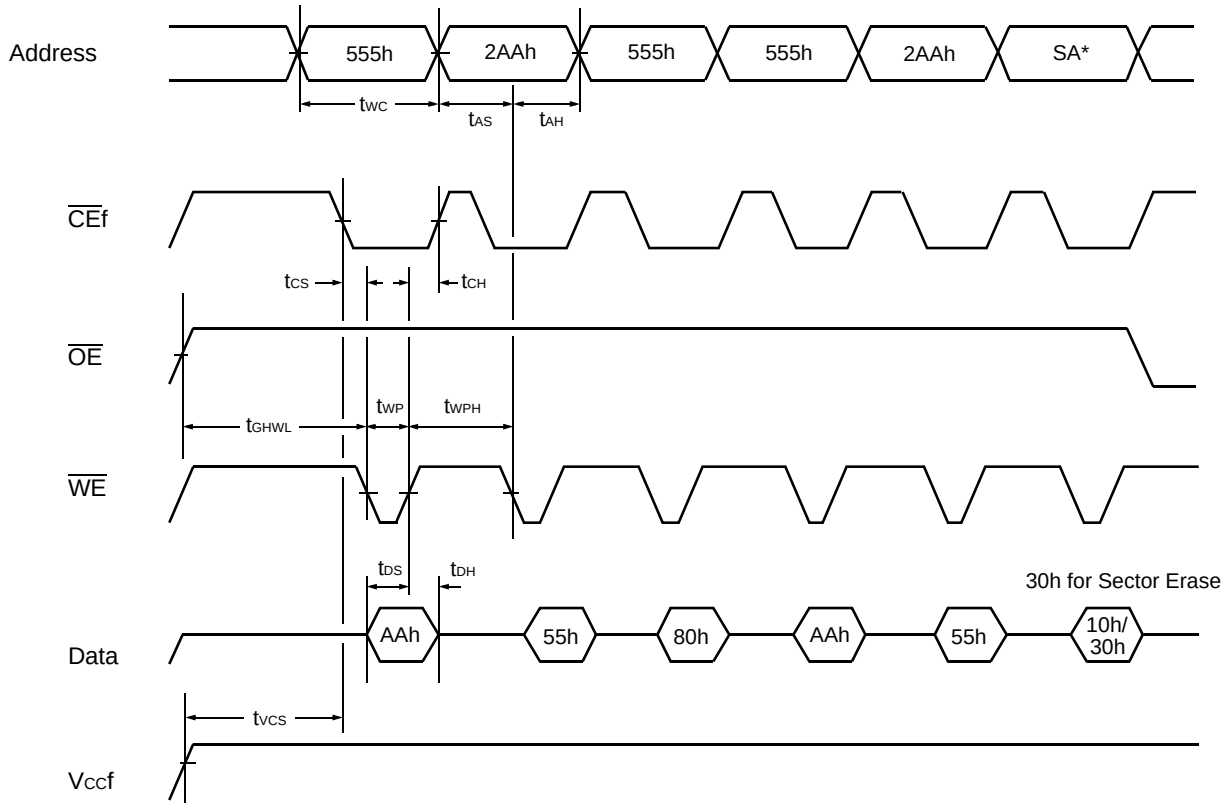
Notes :
- PA is address of the memory location to be programmed.
- PD is data to be programmed at word address.
- $\overline{DQ_7}$ is the output of the complement of the data written to the device.
- D_{OUT} is the output of the data written to the device.
- Figure indicates last two bus cycles out of four bus cycle sequence.

- **Alternate $\overline{CE}$ Controlled Program Operation Timing Diagram**



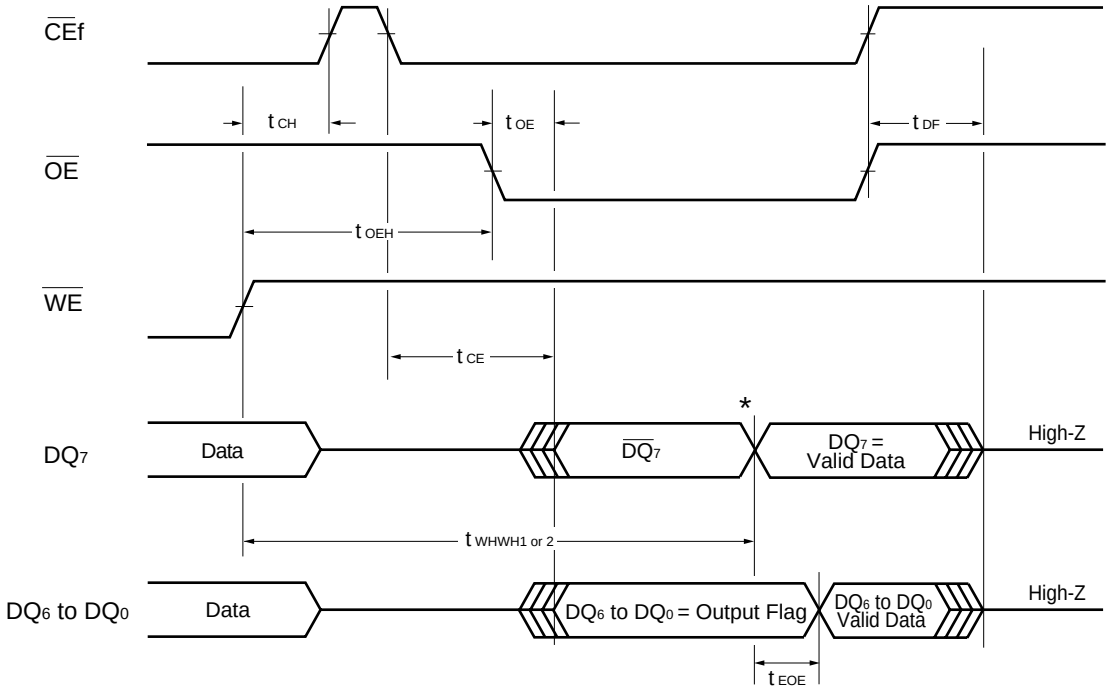
Notes :
- PA is address of the memory location to be programmed.
- PD is data to be programmed at word address.
- $\overline{DQ_7}$ is the output of the complement of the data written to the device.
- D_{OUT} is the output of the data written to the device.
- Figure indicates last two bus cycles out of four bus cycle sequence.

- **Chip/Sector Erase Operation Timing Diagram**



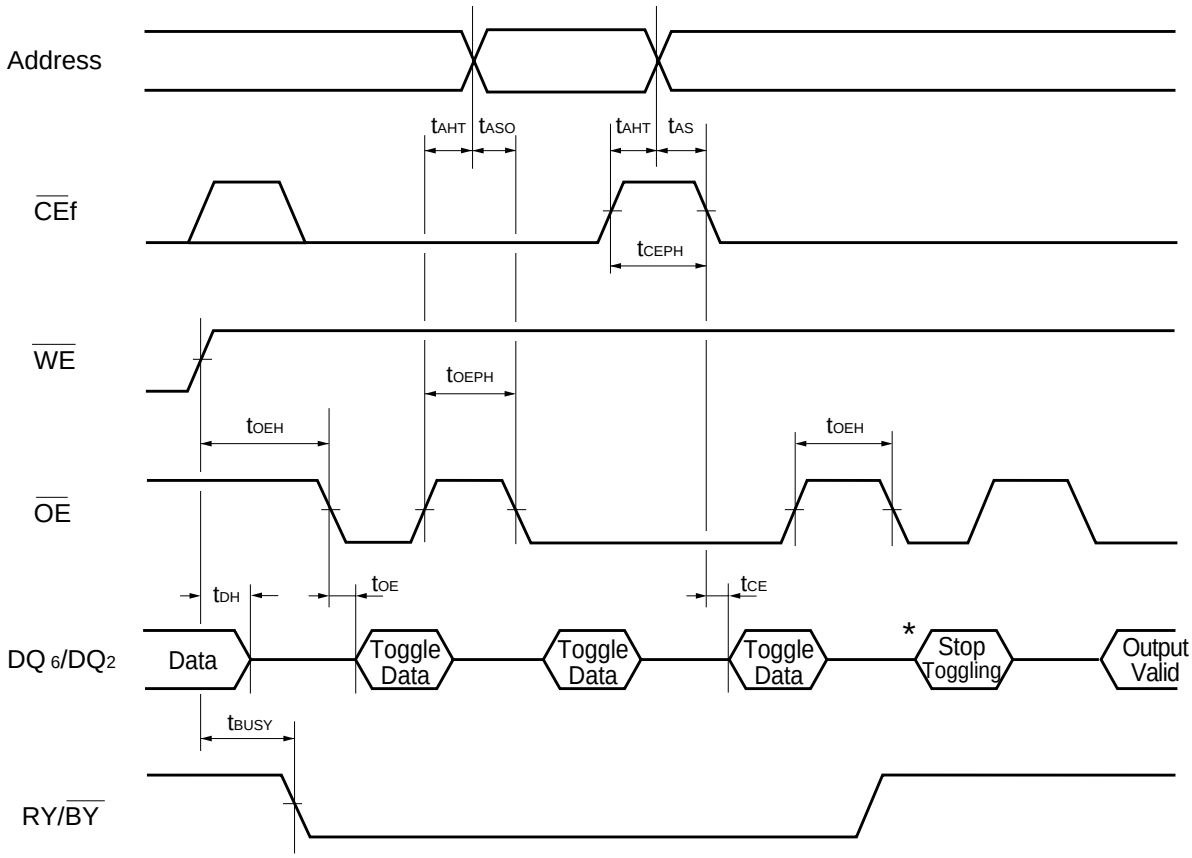
* : SA is the sector address for Sector Erase.

- **$\overline{\text{Data}}$ Polling during Embedded Algorithm Operation Timing Diagram**



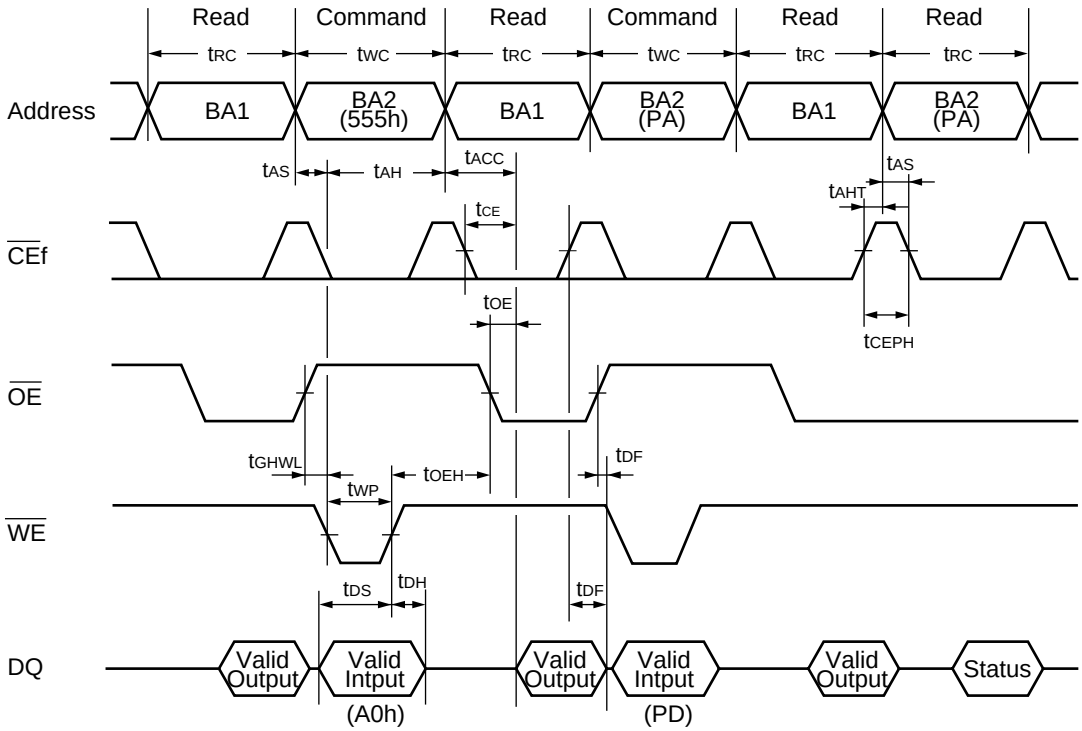
* : DQ_7 = Valid Data (The device has completed the Embedded operation).

- **AC Waveforms for Toggle Bit I during Embedded Algorithm Operations**



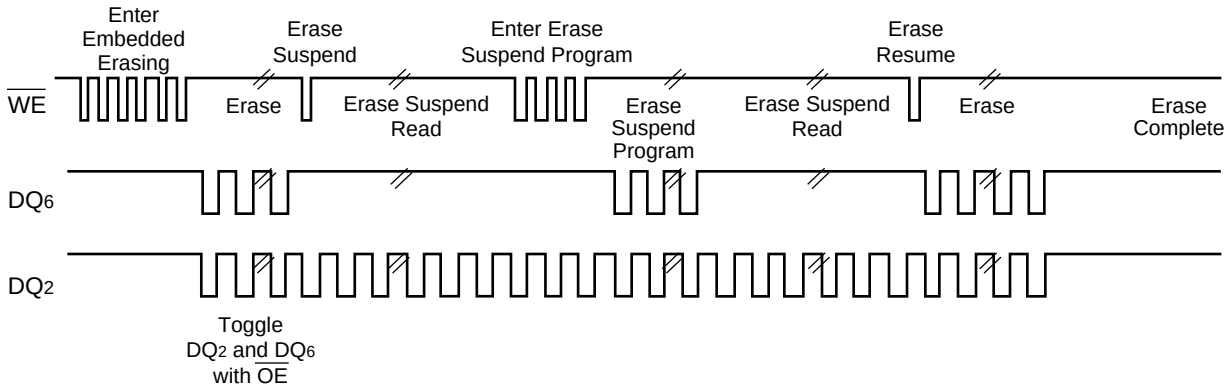
* : DQ_6 stops toggling (The device has completed the Embedded operation).

- **Bank-to-Bank Read/Write Timing Diagram**



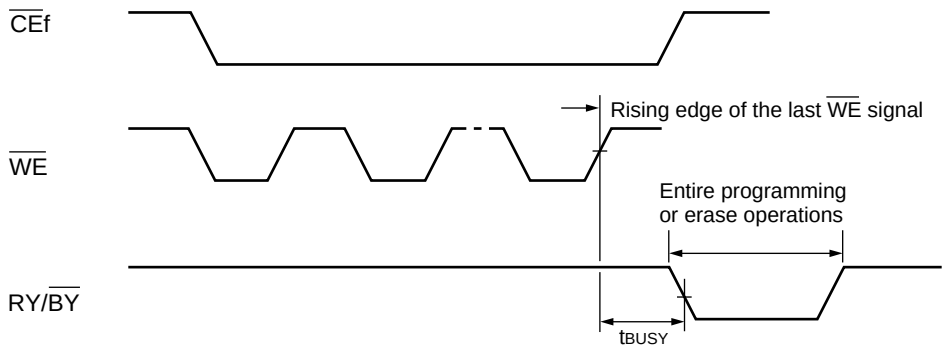
Note : This is example of Read for Bank 1 and Embedded Algorithm (program) for Bank 2.
BA1 : Address corresponding to Bank 1
BA2 : Address corresponding to Bank 2

- **DQ_2 vs. DQ_6**

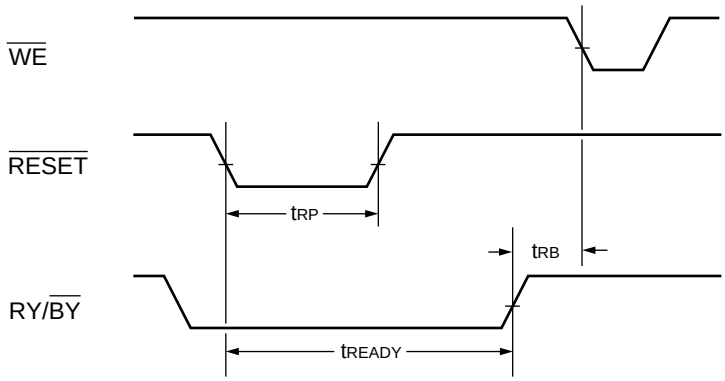


Note : DQ_2 is read from the erase-suspended sector.

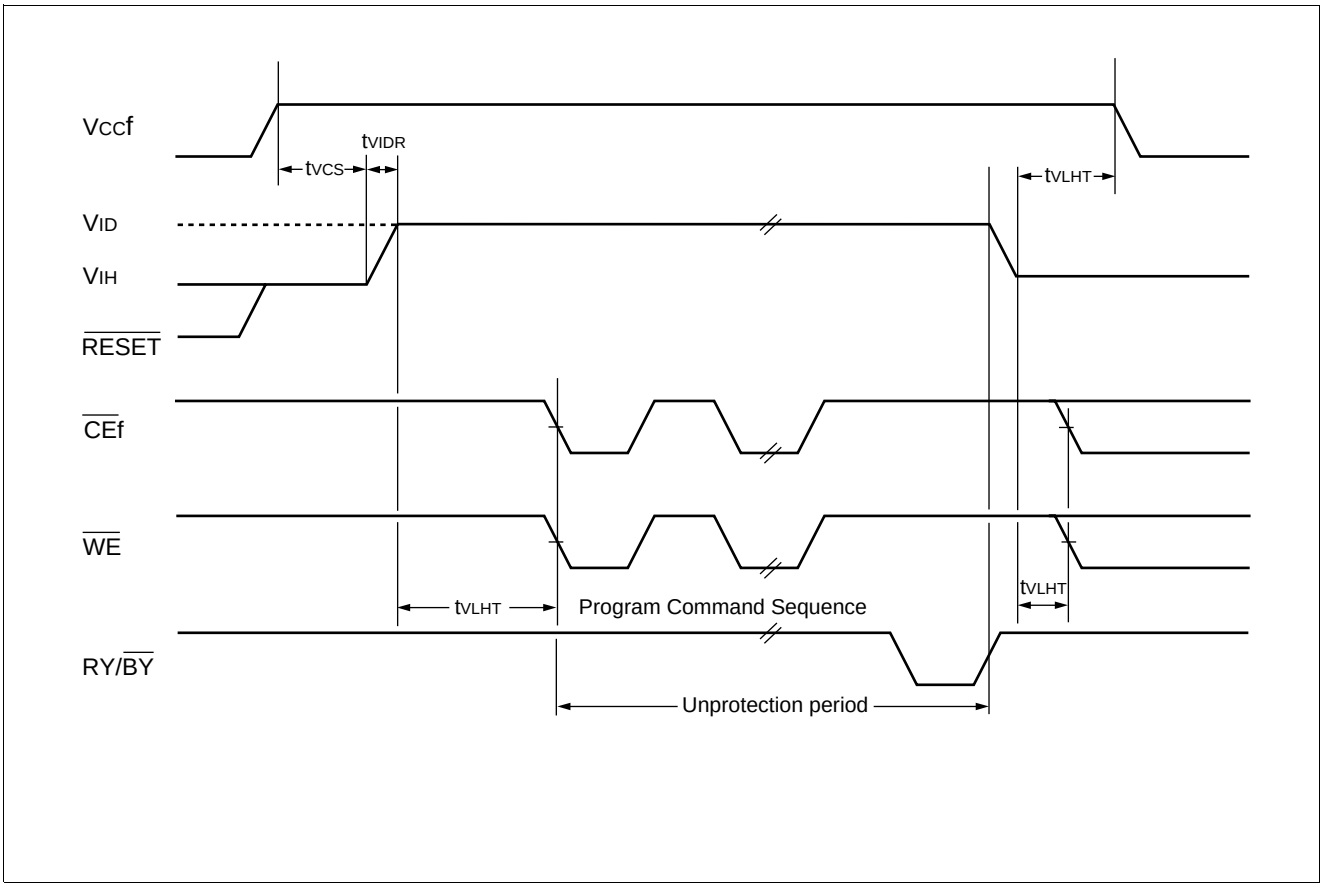
- **RY/$\overline{BY}$ Timing Diagram during Program/Erase Operation Timing Diagram**



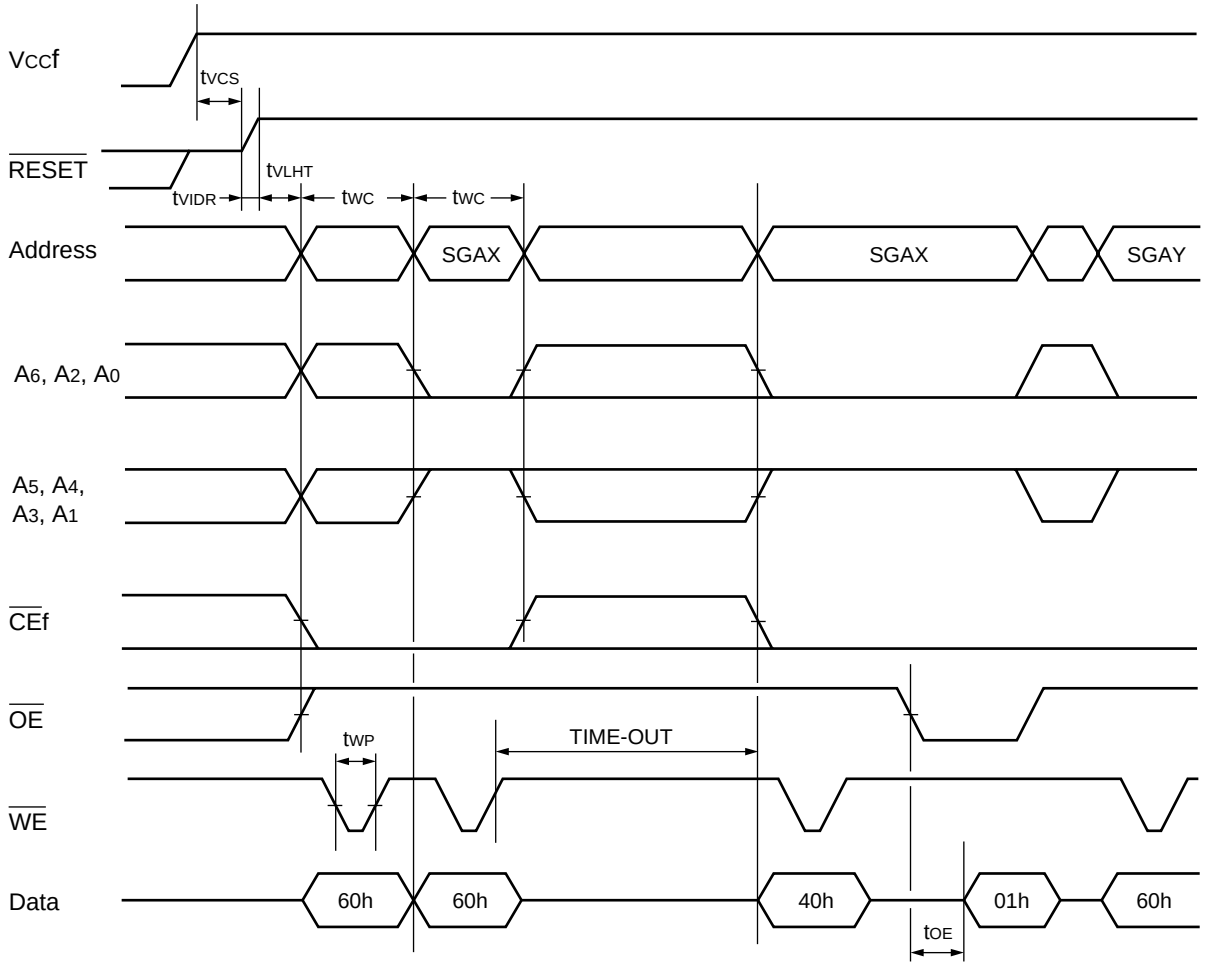
- **$\overline{\text{RESET}}$, RY/$\overline{\text{BY}}$ Timing Diagram**



- **Temporary Sector Group Unprotection Timing Diagram**

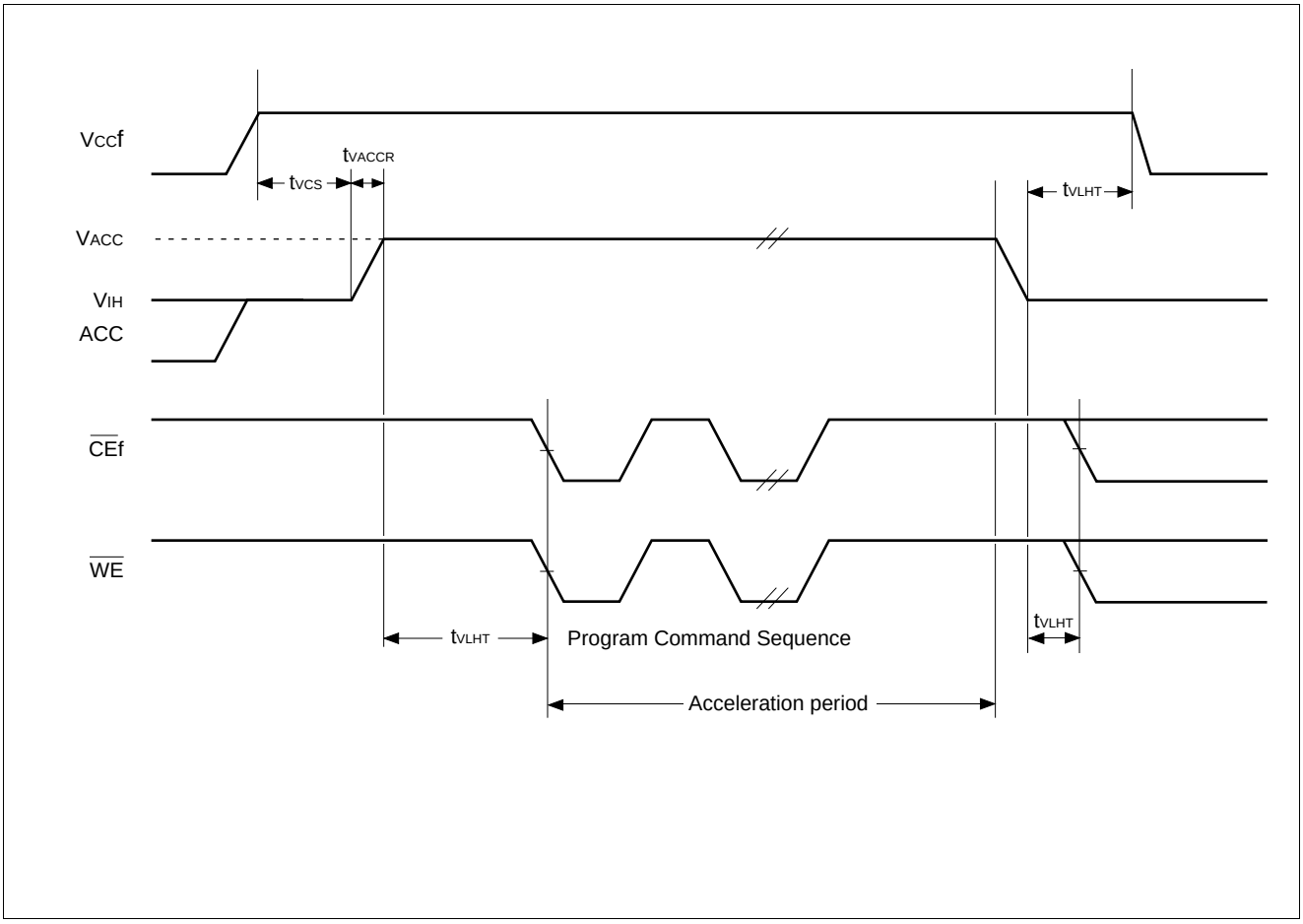


- **Extended Sector Group Protection Timing Diagram**



SGAX : Sector Group Address to be protected
SGAY : Next Sector Group Address to be protected
TIME-OUT : Time-Out window = 250 µs (Min)

- **Accelerated Program Timing Diagram**



3. Erase and Programming Performance

Parameter	Limits			Unit	Comments
	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	—	25.2	95	s	Excludes system-level overhead
Erase/Program Cycle	100,000	—	—	cycle	—

Note Typical Erase conditions T_A = + 25°C, $V_{CC}f$ = 2.9 V
Typical Program conditions T_A = + 25°C, $V_{CC}f$ = 2.9 V, Data = Checker

■ 32 M FCRAM CHARACTERISTICS for MCP

1. Power Down (32M Page Mode FCRAM)

- **Power Down (32M Page mode FCRAM)**

The Power Down is to enter low power idle state when CE2r stays Low.

The 32M page mode FCRAM has four power down mode, Sleep, 4M Partial, 8M Partial, and 16M Partial. These can be programmed by series of read/write operation. Each mode has following features.

Mode	Data Retention	Retention Address
Sleep (default)	No	N/A
4M Partial	4M bit	00000h to 3FFFFh
8M Partial	8M bit	00000h to 7FFFFh
16M Partial	16M bit	00000h to FFFFFh

The default state is Sleep and it is the lowest power consumption but all data will be lost once CE2r is brought to Low for Power Down. It is not required to program to Sleep mode after power-up.

- **Power Down Program Sequence (32M Page mode FCRAM)**

The program requires total 6 read/write operation with unique address and data. Between each read/write operation requires that device be in standby mode. Following table shows the detail sequence.

Cycle #	Operation	Address	Data
1st	Read	1FFFFFh (MSB)	Read Data (RDa)
2nd	Write	1FFFFFh	RDa
3rd	Write	1FFFFFh	RDa
4th	Write	1FFFFFh	0000h
5th	Write	1FFFFFh	Data Key
6th	Read	Address Key	Read Data (RDb)

The first cycle is to read from most significant address (MSB).
The second and third cycle are to write back the data (RDa) read by first cycle. If the third cycle is written into the different address, the program is cancelled and the data written by the second or third cycle is valid as a normal write operation.
The forth and fifth cycle is to write the data key for program. The data of forth cycle must be all 0's and data of fifth cycle is a data key for mode selection. If the forth cycle is written into different address, the program is also cancelled.
The last cycle is to read from specific address key for mode selection. The both data key written by fifth cycle and address key must be the same mode for proper programming.

Once this program sequence is performed from a Partial mode to other Partial mode, the write data may be lost. So, it should perform this program prior to regular read/write operation if Partial mode is used.

- **Address Key (32M Page mode FCRAM)**

The address key has following format.

Mode	Address			
	A_{20}	A_{19}	A_{18} to A_0	Binary
Sleep (default)	1	1	1	1FFFFFh
4M Partial	0	1	1	0FFFFFh
8M Partial	1	0	1	17FFFFh
16M Partial	0	0	1	07FFFFh

- **Data Key (32M Page mode FCRAM)**

The data key has following format.

Mode	Data			
	DQ_{15} to DQ_8	DQ_7 to DQ_2	DQ_1	DQ_0
Sleep (default)	0	0	1	1
4M Partial	0	0	1	0
8M Partial	0	0	0	1
16M Partial	0	0	0	0

The upper byte of data code may be ignored and it is just for recommendation to write 0's to upper byte for future compatibility.

2. AC Characteristics

- **READ OPERATION (32M Page mode FCRAM)**

Parameter	Symbol	Value		Unit	Remarks
		Min	Max		
Read Cycle Time	t_{RC}	70	1000	ns	*1, *2
$\overline{CE}$1r Access Time	t_{CE}	—	70	ns	*3
$\overline{OE}$ Access Time	t_{OE}	—	40	ns	*3
Address Access Time	t_{AA}	—	70	ns	*3, *5
$\overline{LB}$ / $\overline{UB}$ Access Time	t_{BA}	—	30	ns	*3
Page Address Access Time	t_{PAA}	—	18	ns	*3, *6
Page Read Cycle Time	t_{PRC}	25	1000	ns	*1, *6, *7
Output Data Hold Time	t_{OH}	5	—	ns	*3
$\overline{CE}$1r Low to Output Low-Z	t_{CLZ}	3	—	ns	*4
$\overline{OE}$ Low to Output Low-Z	t_{OLZ}	0	—	ns	*4
$\overline{LB}$ / $\overline{UB}$ Low to Output Low-Z	t_{BLZ}	0	—	ns	*4
$\overline{CE}$1r High to Output High-Z	t_{CHZ}	—	20	ns	*4
$\overline{OE}$ High to Output High-Z	t_{OHZ}	—	20	ns	*4
$\overline{LB}$ / $\overline{UB}$ High to Output High-Z	t_{BHZ}	—	20	ns	*4
Address Setup Time to $\overline{CE}$1r Low	t_{ASC}	–5	—	ns	
Address Setup Time to $\overline{OE}$ Low	t_{ASO}	10	—	ns	
Address Invalid Time	t_{AX}	—	10	ns	*5, *8
Page Address Invalid Time	t_{AXP}	—	10	ns	*6, *8
Address Hold Time from $\overline{CE}$1r High	t_{CHAH}	–5	—	ns	*9
Address Hold Time from $\overline{OE}$ High	t_{OHAH}	–5	—	ns	
$\overline{CE}$1r High Pulse Width	t_{CP}	15	—	ns	

*1 : Maximum value is applicable if $\overline{CE}$1r is kept at Low without change of address input of A_{20} to A_3.
If needed by system operation, please contact local FUJITSU representative for the relaxation of 1µs limitation.

*2 : Address should not be changed within minimum t_{RC}.

*3 : The output load 30 pF.

*4 : The output load 5 pF without any other load.

*5 : Applicable to A_{20} to A_3 when $\overline{CE}$1r is kept at Low.

*6 : Applicable only to A_2, A_1 and A_0 when $\overline{CE}$1r is kept at Low for the page address access.

*7 : In case Page Read Cycle is continued with keeping $\overline{CE}$1r stays Low, $\overline{CE}$1r must be brought to High within 4 µs.
In other words, Page Read Cycle must be closed within 4 µs.

*8 : Applicable when at least two of address inputs among applicable are switched from previous state.

*9 : t_{RC}(Min) and t_{PRC}(Min) must be satisfied.

- **WRITE OPERATION (32M Page mode FCRAM)**

Parameter	Symbol	Value		Unit	Notes
		Min	Max		
Write Cycle Time	t_{WC}	70	1000	ns	*1, *2
Address Setup Time	t_{AS}	0	—	ns	*2
$\overline{CE}$1r Write Pulse Width	t_{CW}	45	—	ns	*3
$\overline{WE}$ Write Pulse Width	t_{WP}	45	—	ns	*3
$\overline{LB}$ / $\overline{UB}$ Write Pulse Width	t_{BW}	45	—	ns	*3
$\overline{CE}$1r Write Recovery Time	t_{WRC}	15	—	ns	*4
$\overline{WE}$ Write Recovery Time	t_{WR}	15	1000	ns	*4
$\overline{LB}$ / $\overline{UB}$ Write Recovery Time	t_{BR}	15	1000	ns	*4
Data Setup Time	t_{DS}	20	—	ns	
Data Hold Time	t_{DH}	0	—	ns	
Address Invalid Time after Write	t_{AXW}	—	10	ns	*5
$\overline{OE}$ High to $\overline{CE}$1r Low Setup Time for Write	t_{OHCL}	–5	—	ns	*6
$\overline{OE}$ High to Address Setup Time for Write	t_{OES}	0	—	ns	*7
$\overline{LB}$ and $\overline{UB}$ Write Pulse Overlap	t_{BWO}	20	—	ns	
$\overline{CE}$1r High Pulse Width	t_{CP}	15	—	ns	

*1 : Maximum value is applicable if $\overline{CE}$1r is kept at Low without any address change. If the relaxation is needed by system operation, please contact local FUJITSU representative for the relaxation of 1 µs limitation.

*2 : Minimum value must be equal or greater than the sum of write pulse (t_{CW}, t_{WP} or t_{BW}) and write recovery time (t_{WRC}, t_{WR} or t_{BR}).

*3 : Write pulse is defined from High to Low transition of $\overline{CE}$1r, $\overline{WE}$, or $\overline{LB}$ / $\overline{UB}$, whichever occurs last.

*4 : Write recovery is defined from Low to High transition of $\overline{CE}$1r, $\overline{WE}$, or $\overline{LB}$ / $\overline{UB}$, whichever occurs first.

*5 : Applicable to any address change when $\overline{CE}$1r stays Low.

*6 : If $\overline{OE}$ is Low after minimum t_{OHCL}, read cycle is initiated. In other word, $\overline{OE}$ must be brought to High within 5ns after $\overline{CE}$1r is brought to Low. Once read cycle is initiated, new write pulse should be input after minimum t_{RC} is met.

*7 : If $\overline{OE}$ is Low after new address input, read cycle is initiated. In other word, $\overline{OE}$ must be brought to High at the same time or before new address valid. Once read cycle is initiated, new write pulse should be input after minimum t_{RC} is met.

- **POWER DOWN PARAMETERS (32M Page mode FCRAM)**

Parameter	Symbol	Value		Unit	Remarks
		Min	Max		
CE2r Low Setup Time for Power Down Entry	t_{CSP}	10	—	ns	
CE2r Low Hold Time after Power Down Entry	t_{C2LP}	70	—	ns	
$\overline{CE}$1r High Hold Time following CE2r High after Power Down Exit [SLEEP mode only]	t_{CHH}	300	—	µs	*1
$\overline{CE}$1r High Hold Time following CE2r High after Power Down Exit [not in SLEEP mode]	t_{CHHP}	1	—	µs	*2
$\overline{CE}$1r High Setup Time following CE2r High after Power Down Exit	t_{CHS}	0	—	ns	

*1 : Applicable also to power-up.

*2 : Applicable when 4M, 8M, and 16M Partial mode is programmed.

- **OTHER TIMING PARAMETERS (32M Page mode FCRAM)**

Parameter	Symbol	Value		Unit	Remarks
		Min	Max		
$\overline{CE}$1r High to $\overline{OE}$ Invalid Time for Standby Entry	t_{CHOX}	10	—	ns	
$\overline{CE}$1r High to $\overline{WE}$ Invalid Time for Standby Entry	t_{CHWX}	10	—	ns	*1
$\overline{CE}$1r High Hold Time following CE2r High after Power-up	t_{CHH}	300	—	µs	
Input Transition Time	t_T	1	25	ns	*2

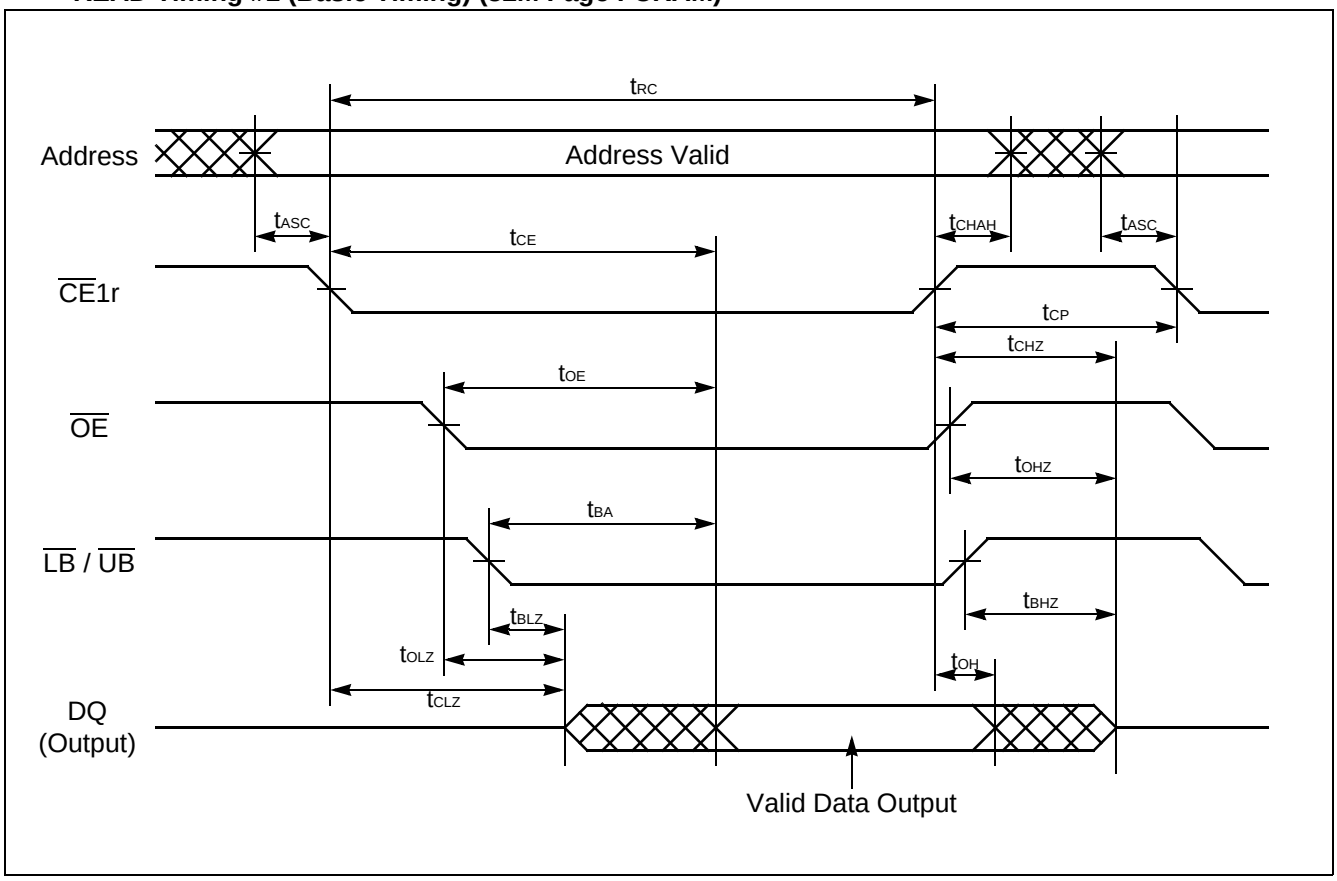
*1 : Some data might be written into any address location if t_{CHWX}(Min) is not satisfied.

*2 : The Input Transition Time (t_T) at AC testing is 5 ns as shown in below. If actual t_T is longer than 5 ns, it may violate AC specification of some timing parameters.

- **AC TEST CONDITIONS (32M Page mode FCRAM)**

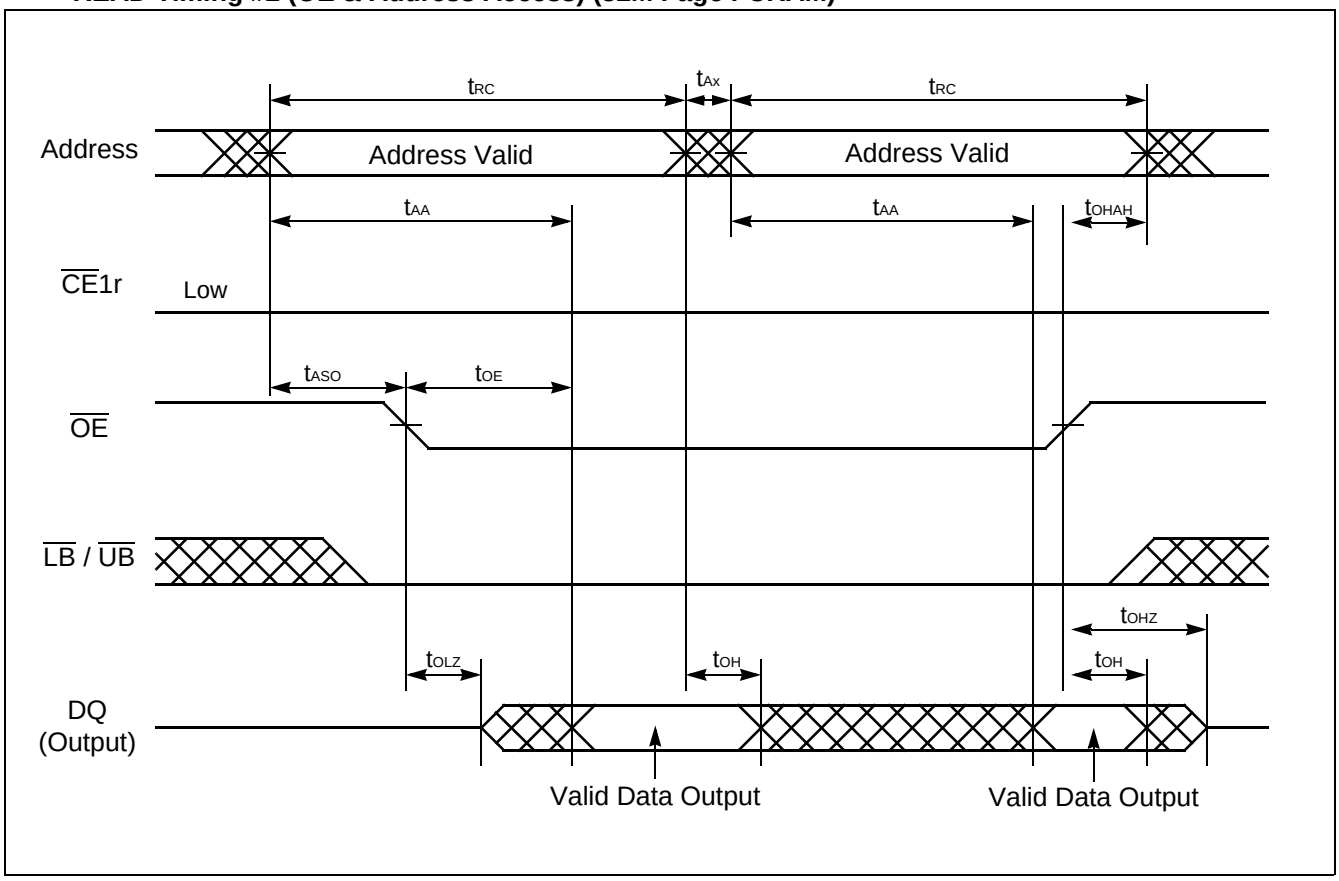
Description	Symbol	Test Setup	Value	Unit	Remarks
Input High Level	V_{IH}	—	$V_{CC}r$	V	
Input Low Level	V_{IL}	—	V_{SS}	V	
Input Timing Measurement Level	V_{REF}	—	$V_{CC}r \times 0.5$	V	
Input Transition Time	t_T	Between V_{IL} and V_{IH}	5	ns	

- **READ Timing #1 (Basic Timing) (32M Page FCRAM)**



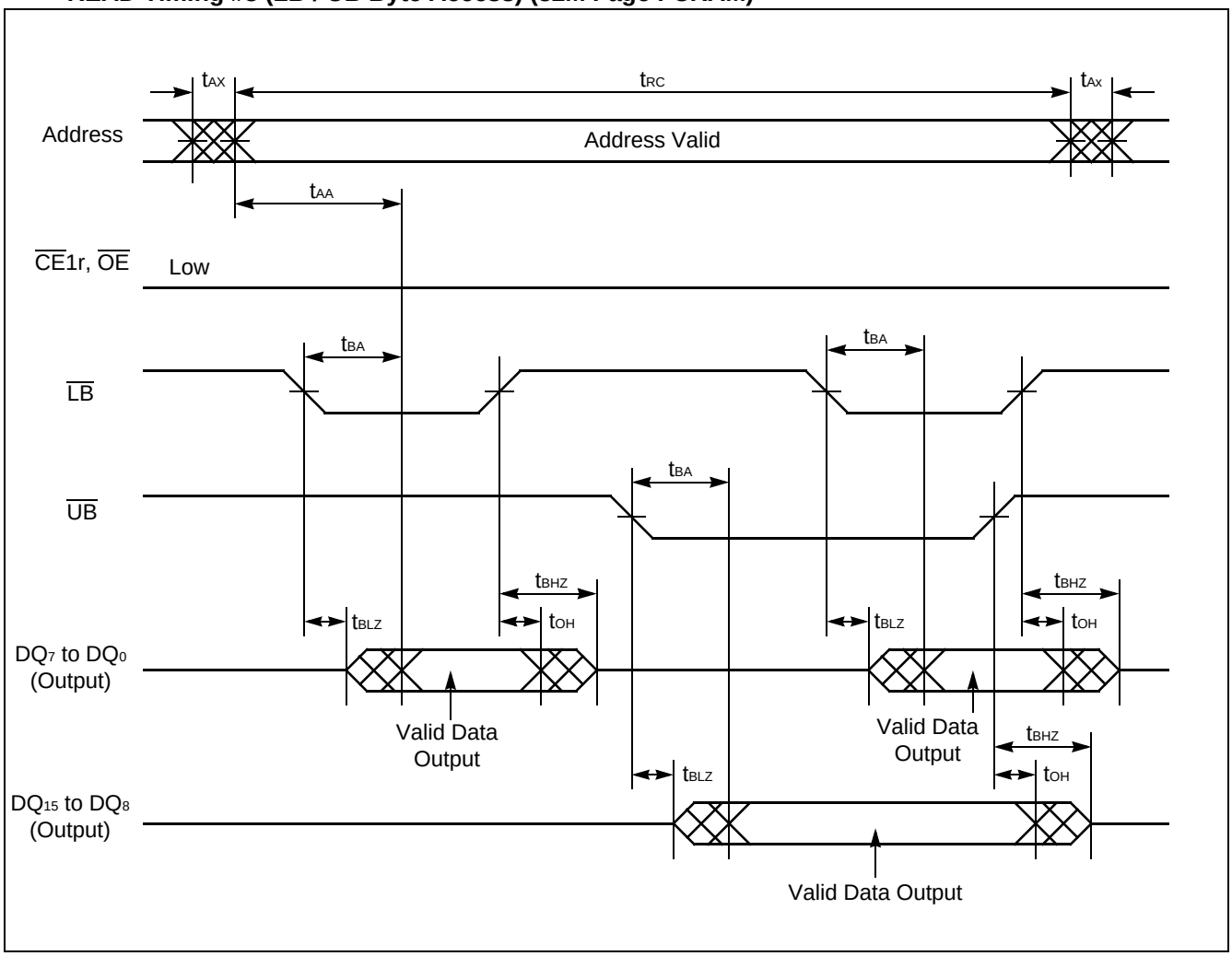
Note : CE2r and $\overline{WE}$ must be High for entire read cycle.

- **READ Timing #2 ($\overline{OE}$ & Address Access) (32M Page FCRAM)**



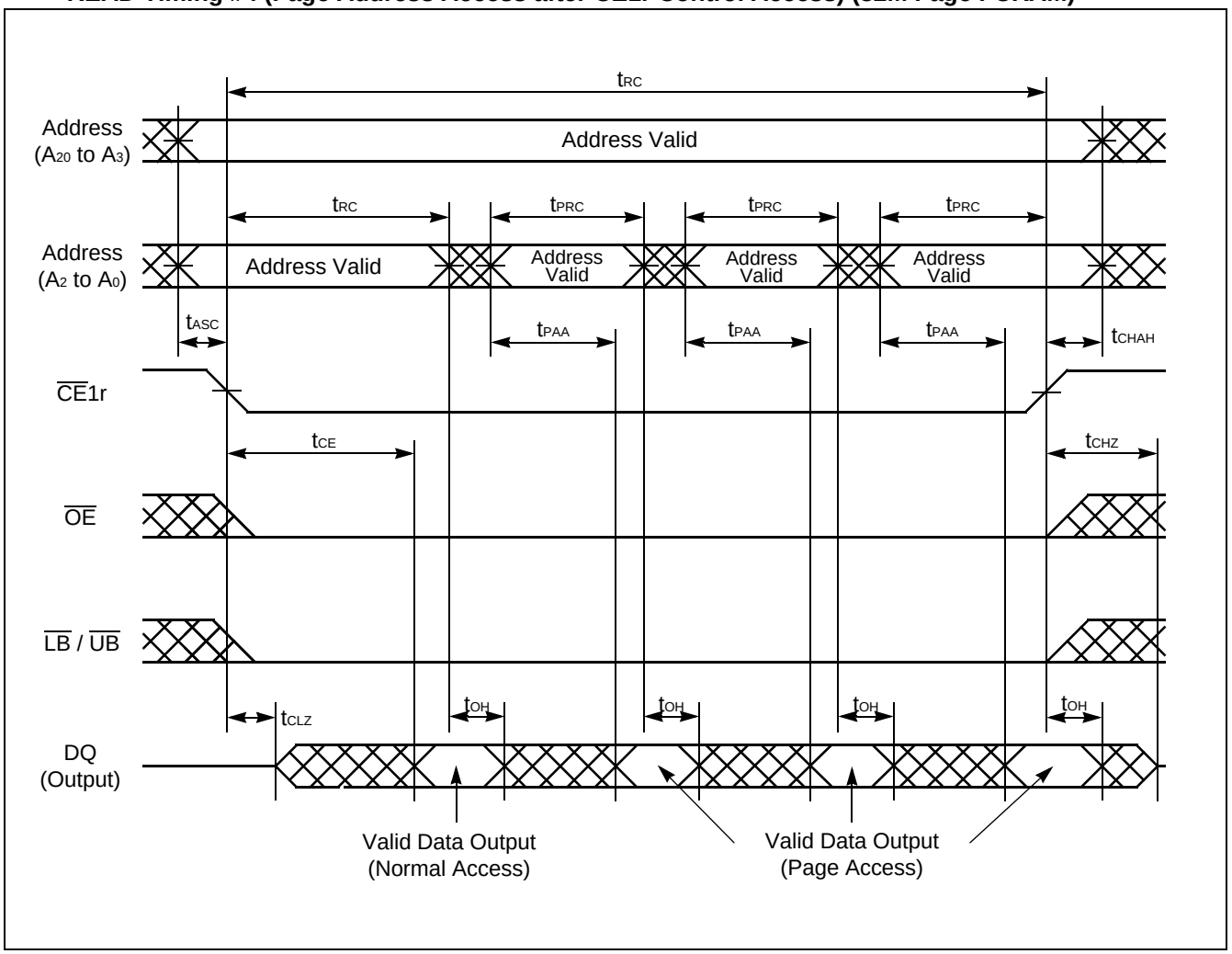
Note : CE2r and $\overline{WE}$ must be High for entire read cycle.

- **READ Timing #3 ($\overline{LB}$ / $\overline{UB}$ Byte Access) (32M Page FCRAM)**



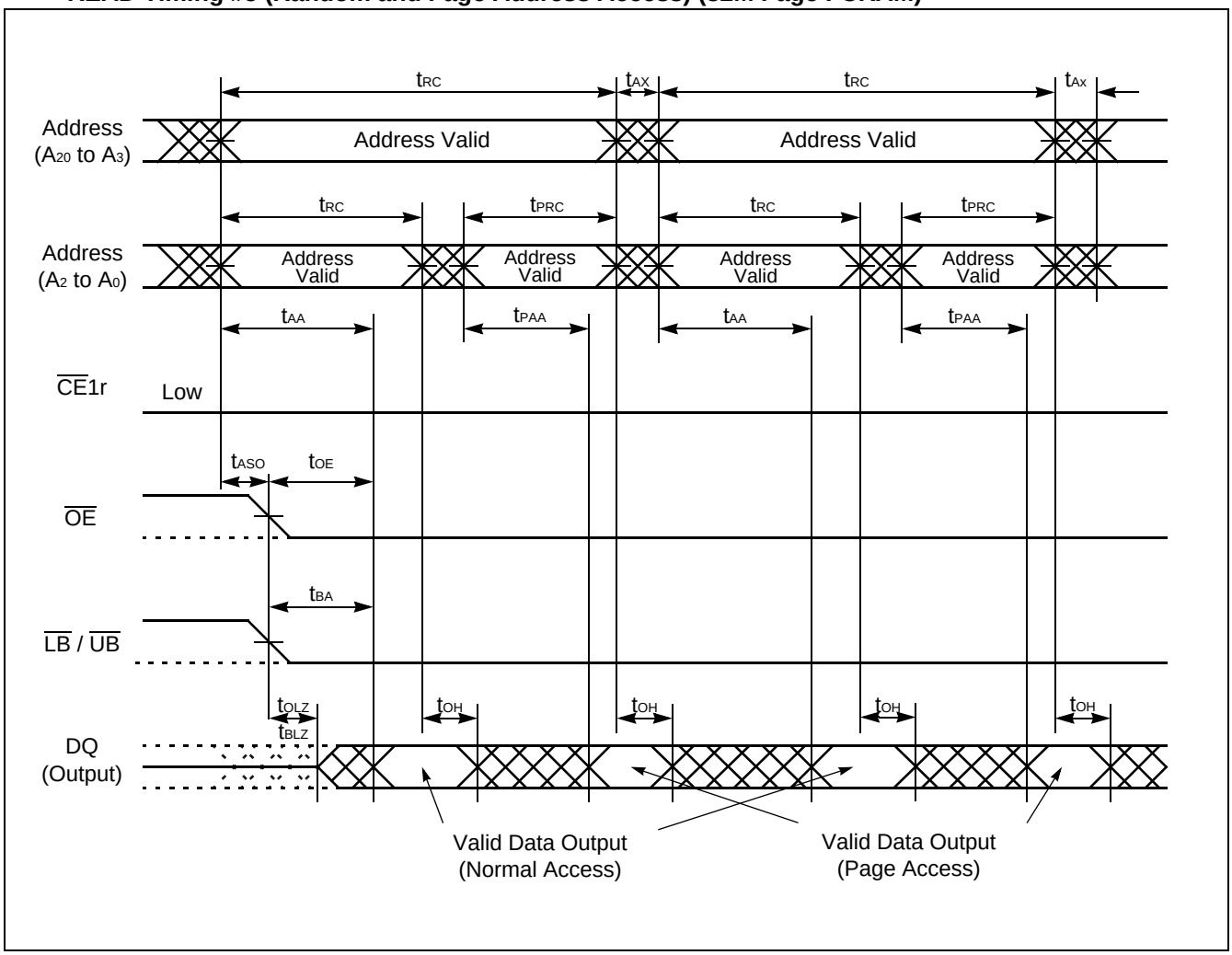
Note : CE2r and $\overline{WE}$ must be High for entire read cycle.

- **READ Timing #4 (Page Address Access after $\overline{CE}$1r Control Access) (32M Page FCRAM)**



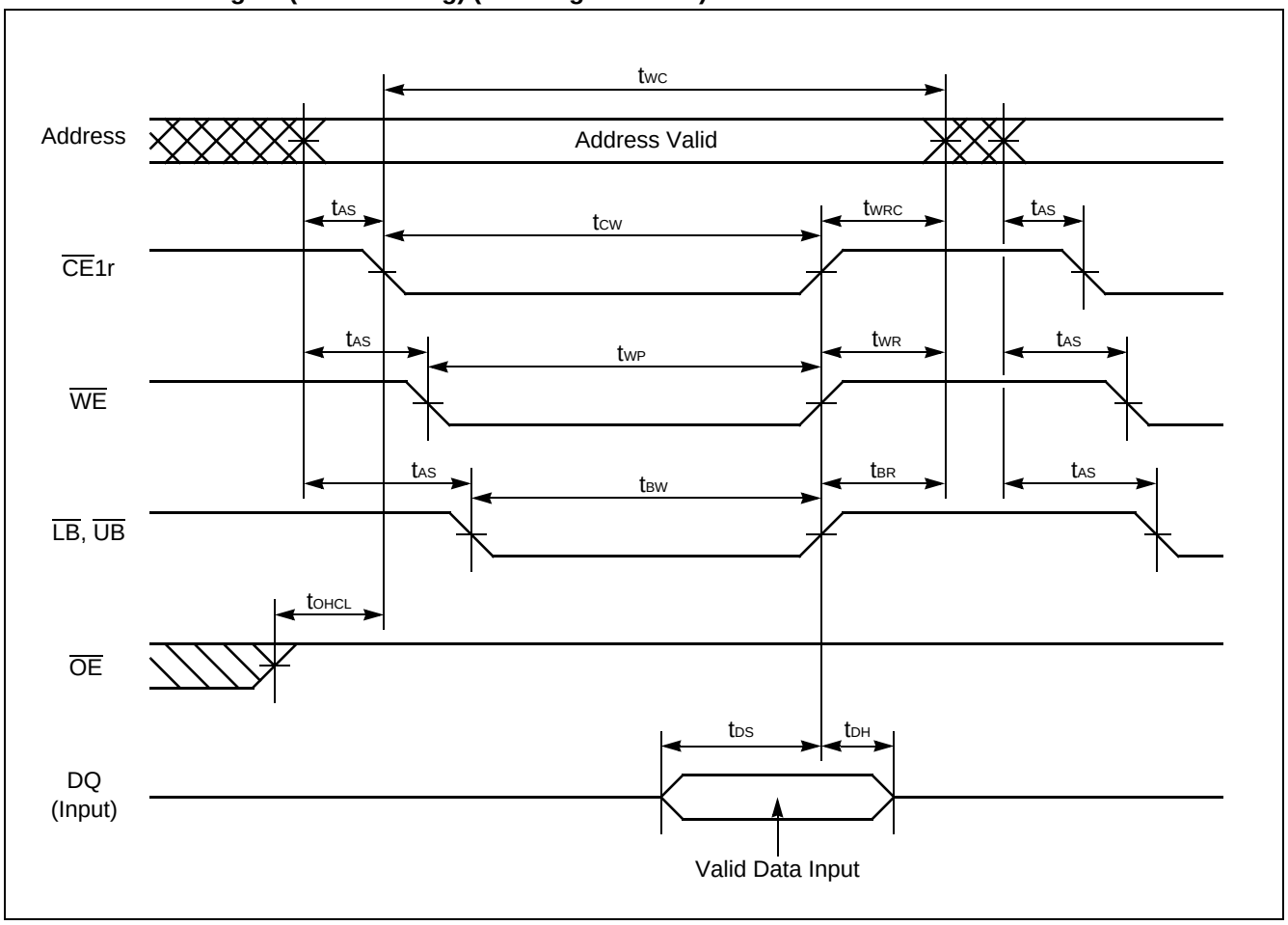
Note : CE2r, and $\overline{WE}$ must be High for entire read cycle.

- **READ Timing #5 (Random and Page Address Access) (32M Page FCRAM)**



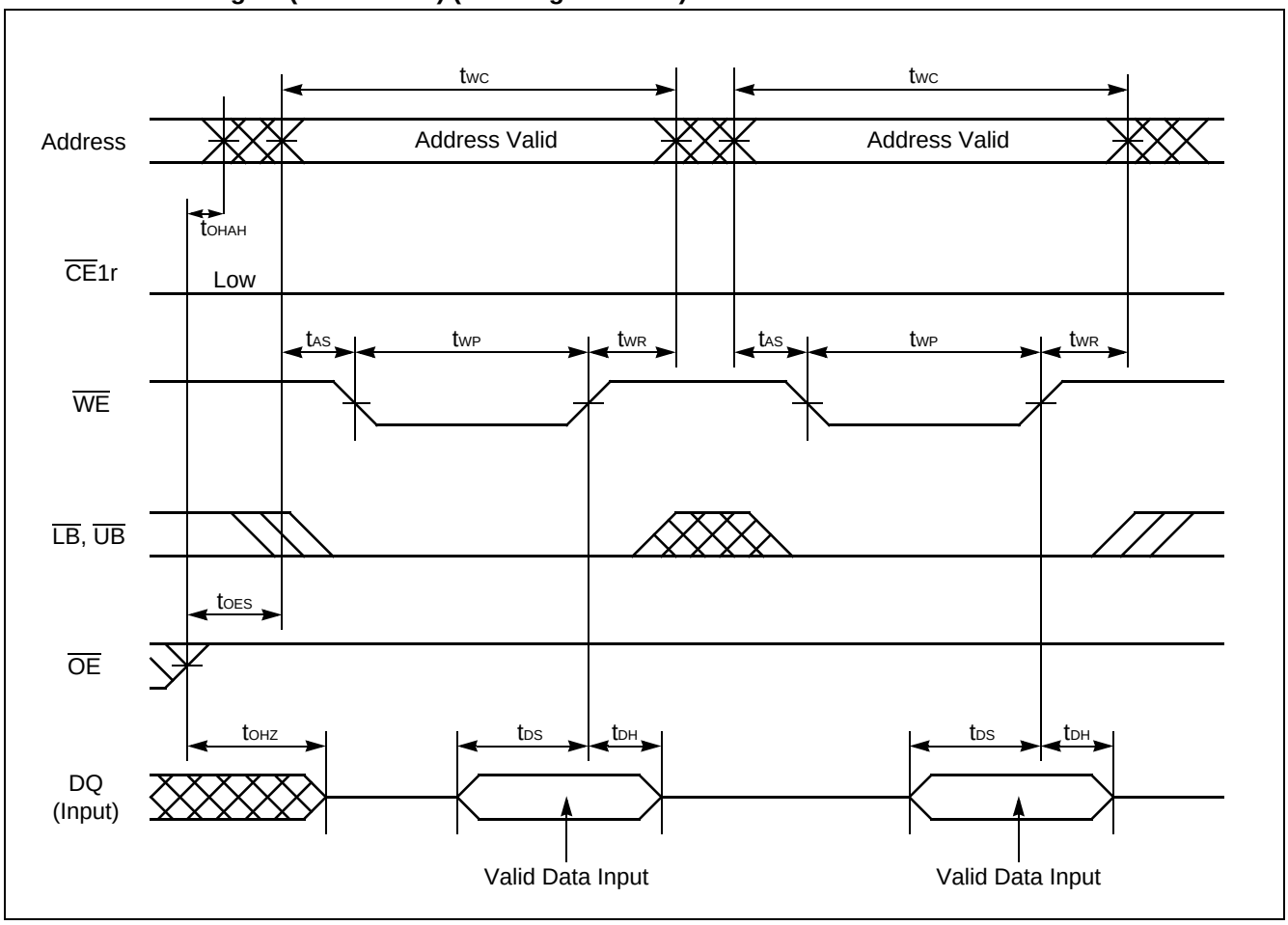
Note : CE2r, and $\overline{WE}$ must be High for entire read cycle.
Either or both $\overline{LB}$ and $\overline{UB}$ must be Low when both $\overline{CE}$1r and $\overline{OE}$ are Low.

- **WRITE Timing #1 (Basic Timing) (32M Page FCRAM)**



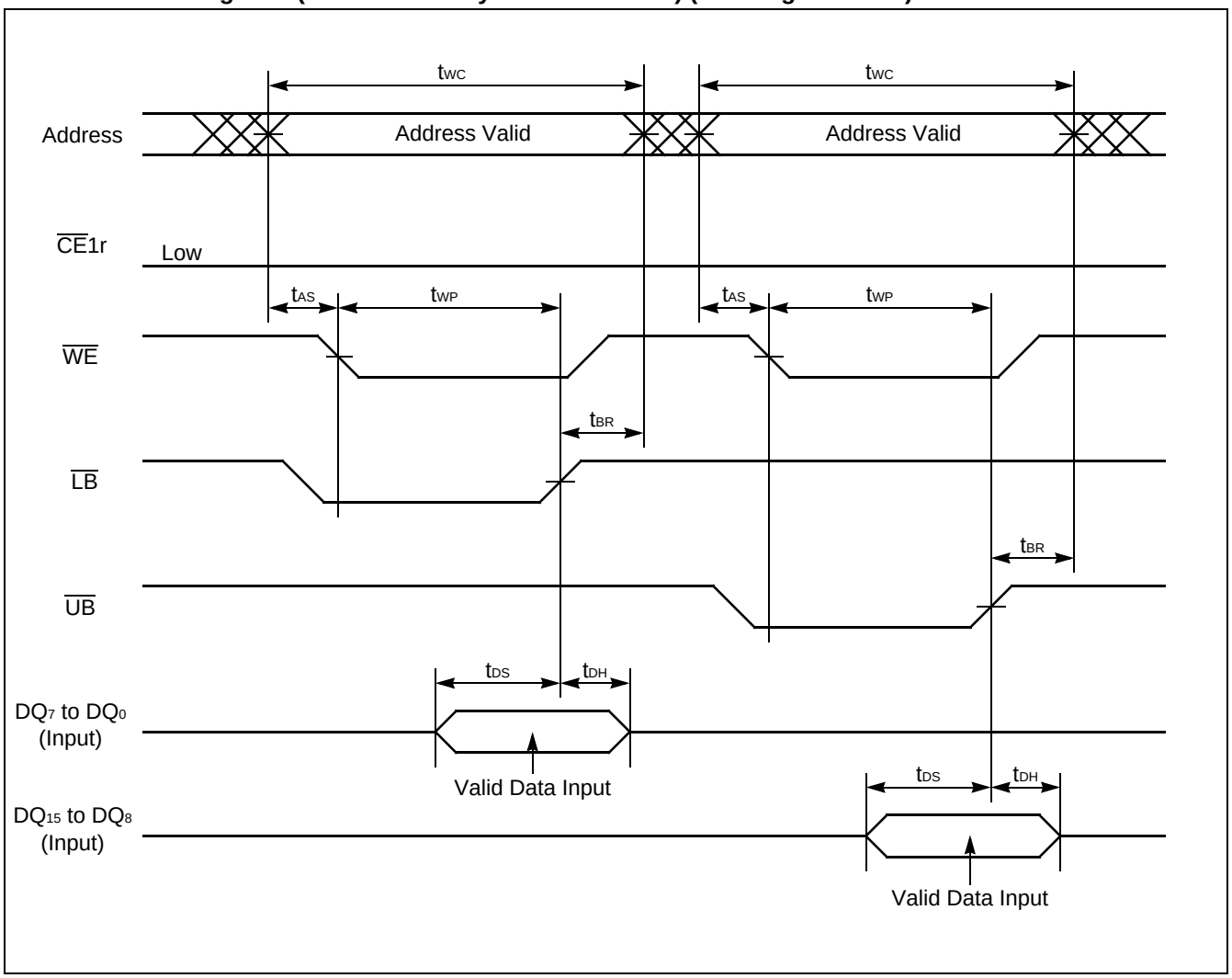
Note : CE2r must be High for write cycle.

- **WRITE Timing #2 ($\overline{WE}$ Control) (32M Page FCRAM)**



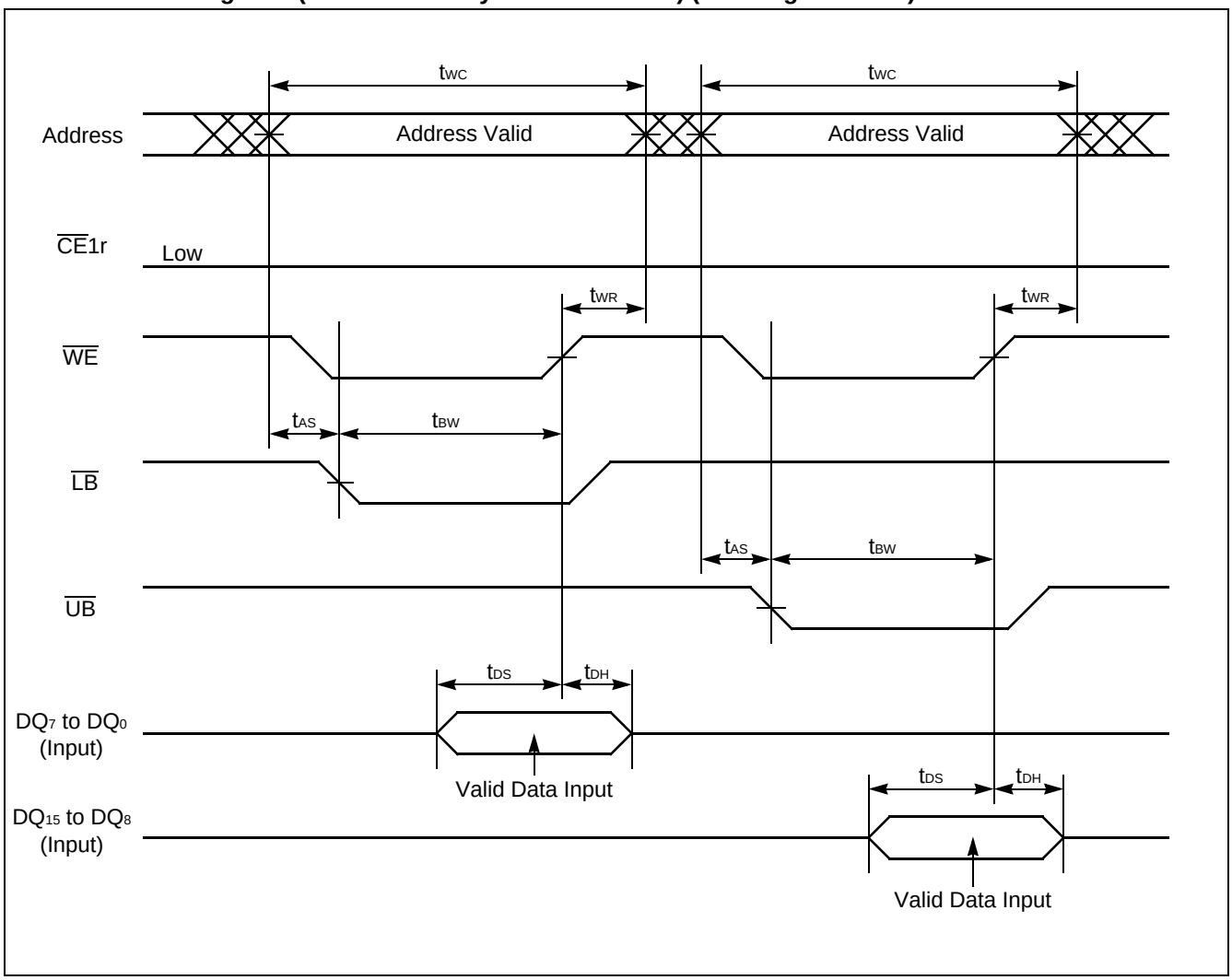
Note : CE2r must be High for write cycle.

- **WRITE Timing #3-1 ($\overline{WE}$ / $\overline{LB}$ / $\overline{UB}$ Byte Write Control) (32M Page FCRAM)**



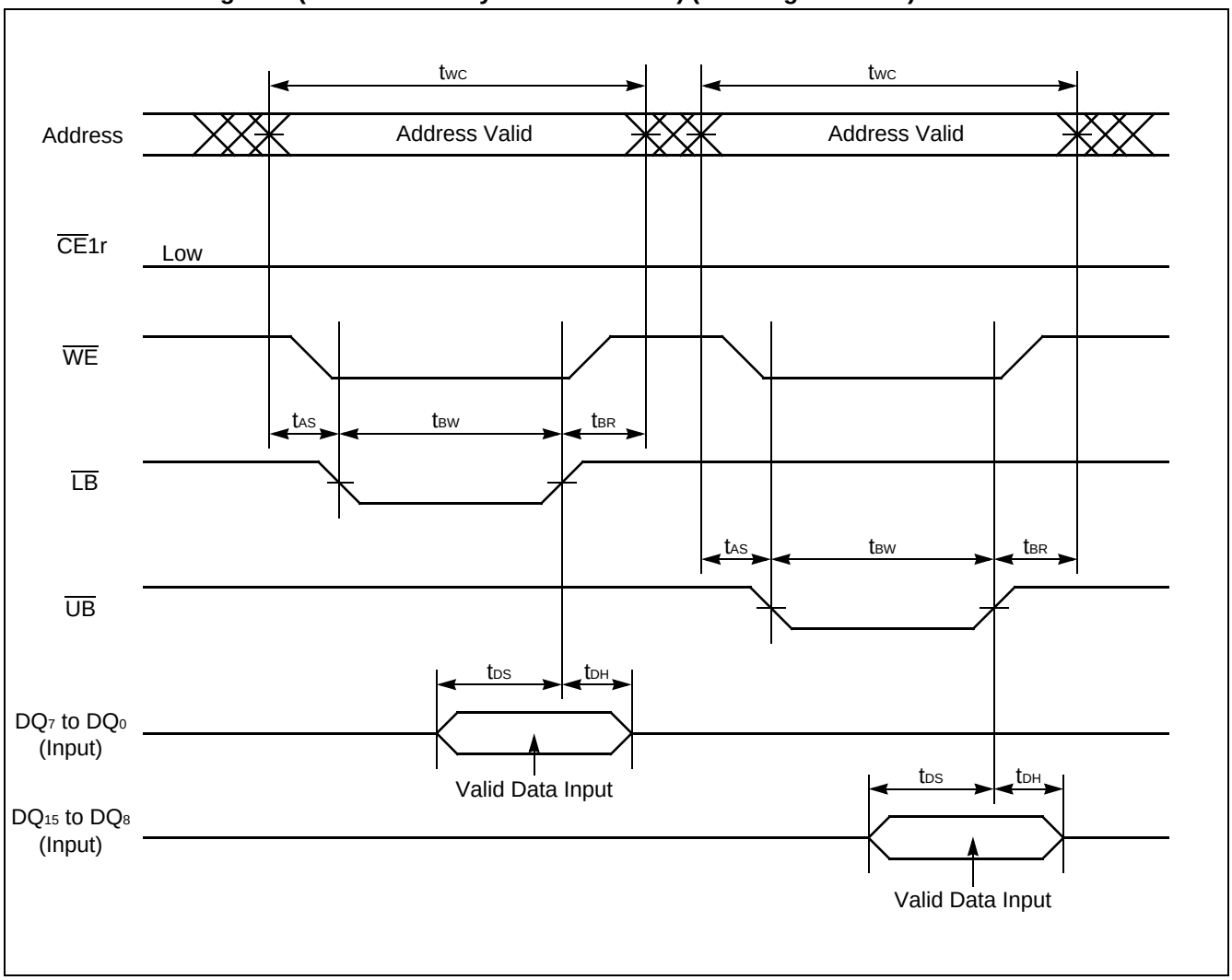
Note : CE2r must be High for write cycle.

- **WRITE Timing #3-2 ($\overline{WE}$ / $\overline{LB}$ / $\overline{UB}$ Byte Write Control) (32M Page FCRAM)**



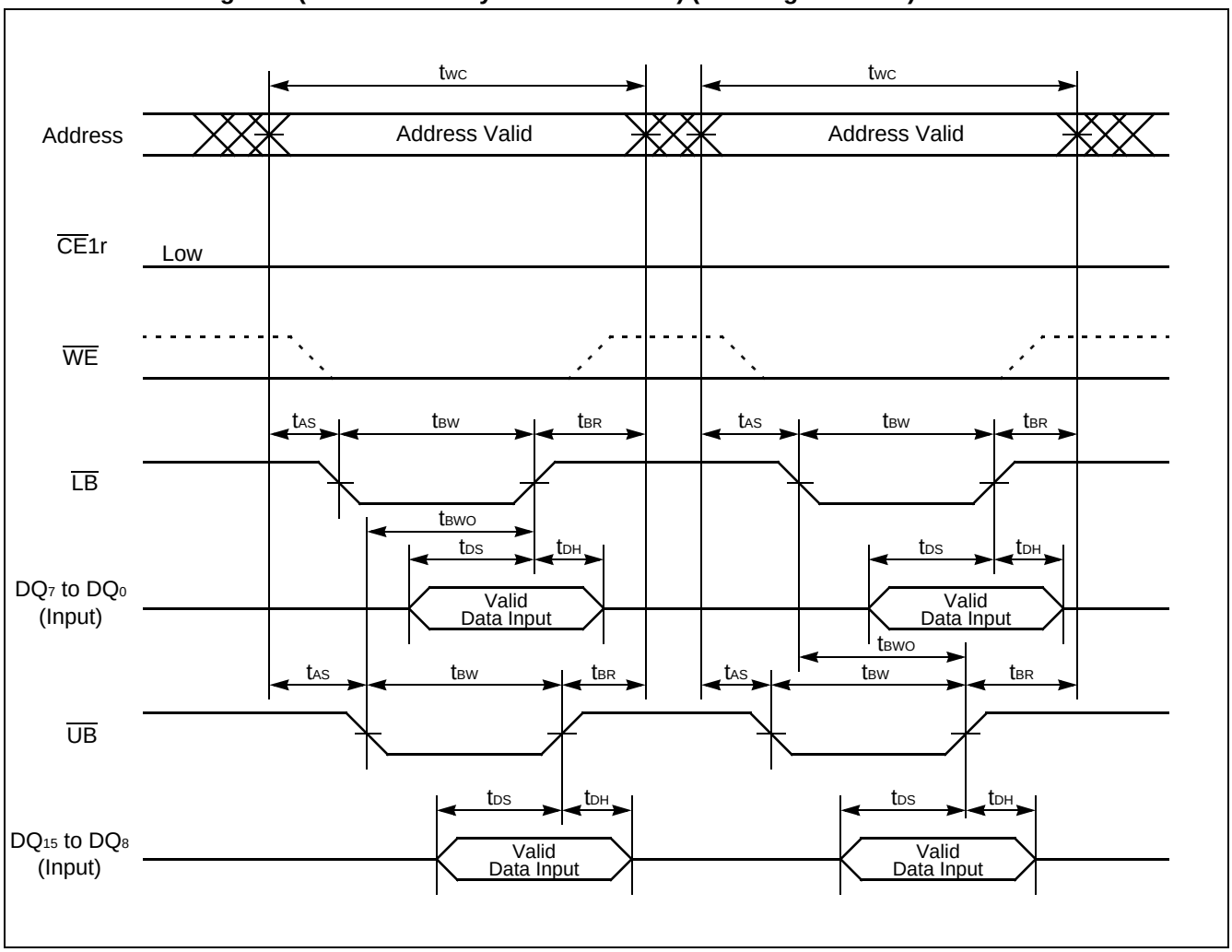
Note : CE2r must be High for write cycle.

- **WRITE Timing #3-3 ($\overline{WE}$ / $\overline{LB}$ / $\overline{UB}$ Byte Write Control) (32M Page FCRAM)**



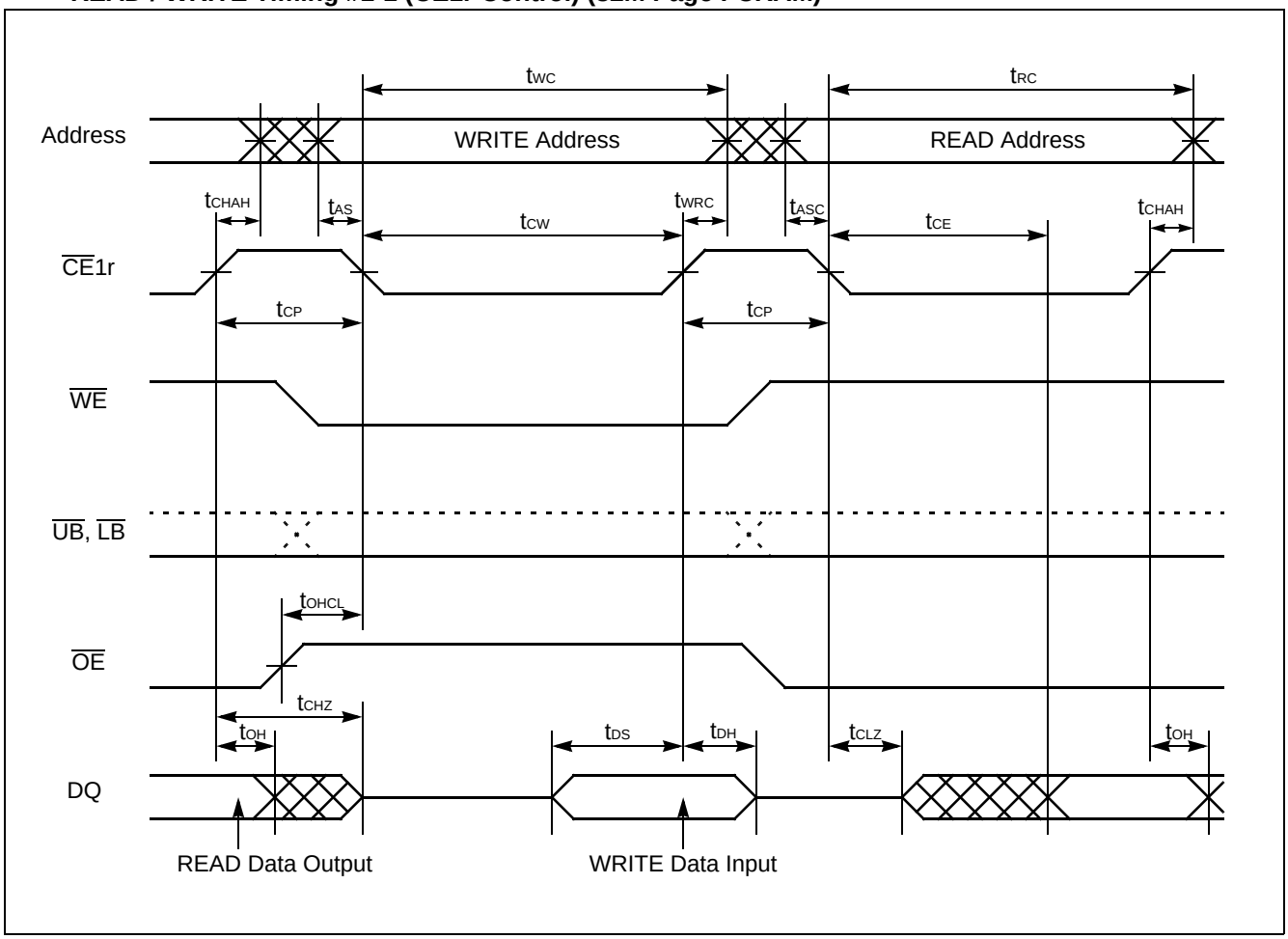
Note : CE2r must be High for write cycle.

- **WRITE Timing #3-4 ($\overline{WE}$ / $\overline{LB}$ / $\overline{UB}$ Byte Write Control) (32M Page FCRAM)**



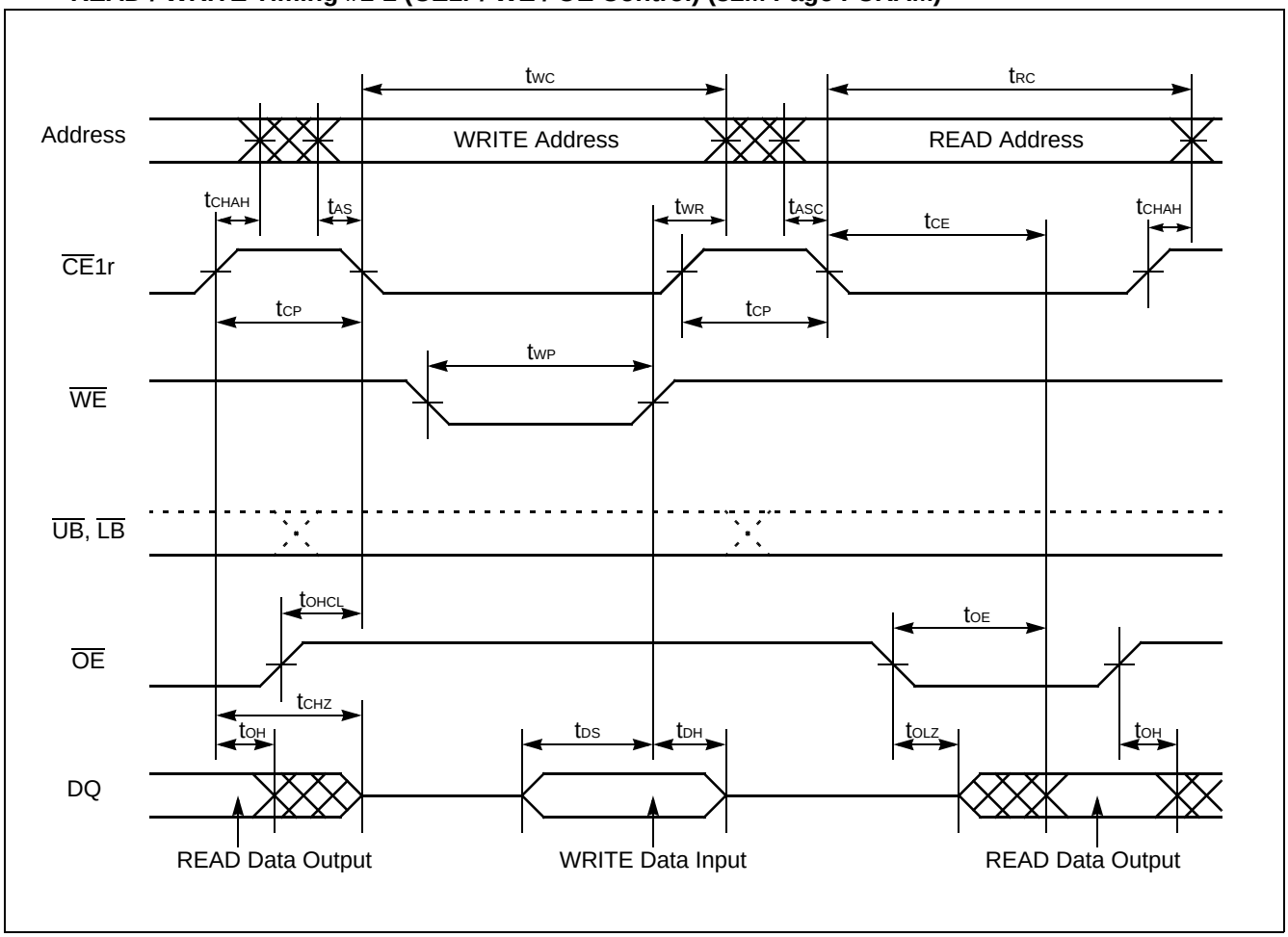
Note : CE2r must be High for write cycle.

- **READ / WRITE Timing #1-1 ($\overline{CE}$1r Control) (32M Page FCRAM)**



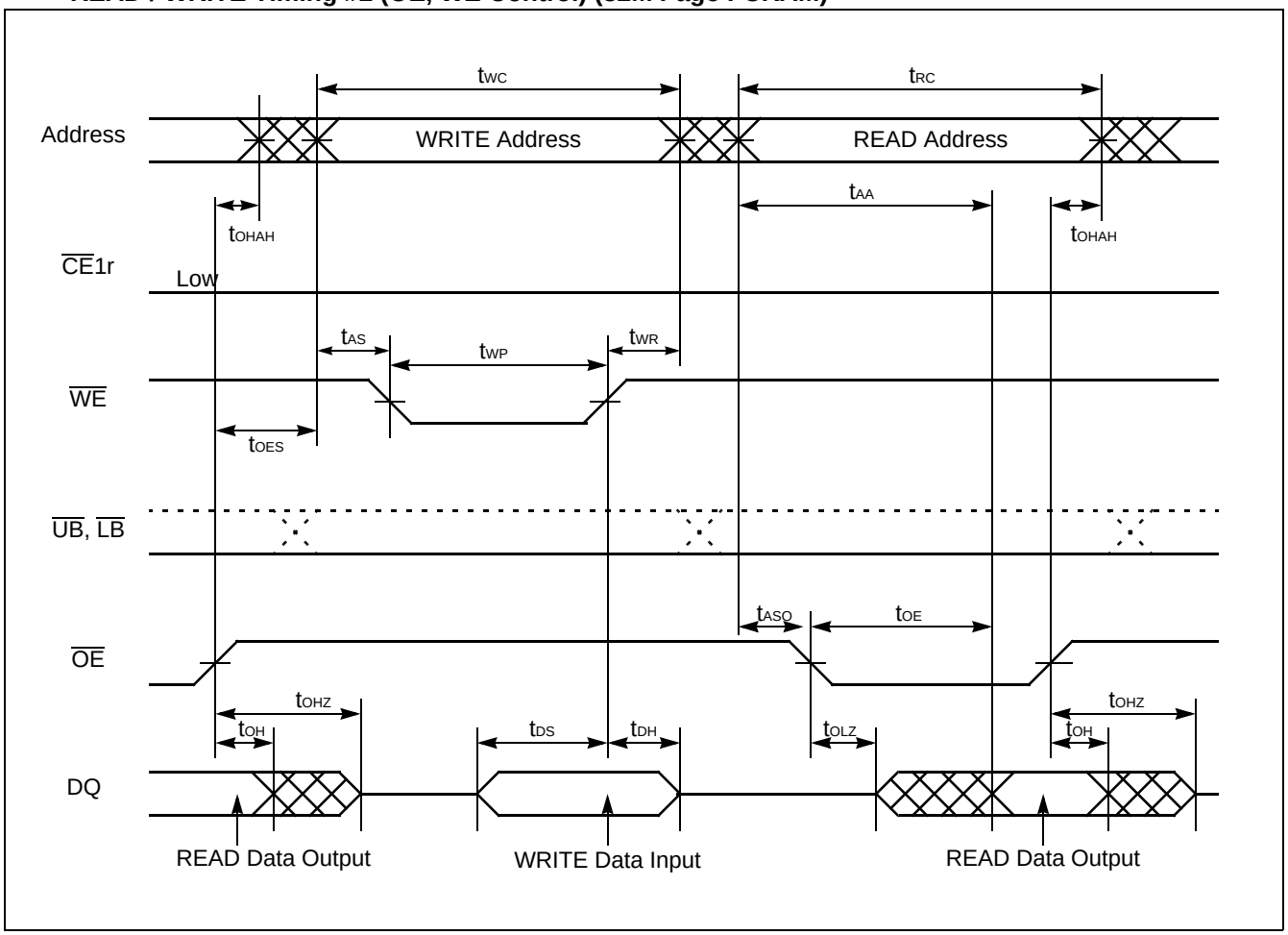
Note : Write address is valid from either $\overline{CE}$1r or $\overline{WE}$ of last falling edge.

- **READ / WRITE Timing #1-2 ($\overline{CE}$1r / $\overline{WE}$ / $\overline{OE}$ Control) (32M Page FCRAM)**



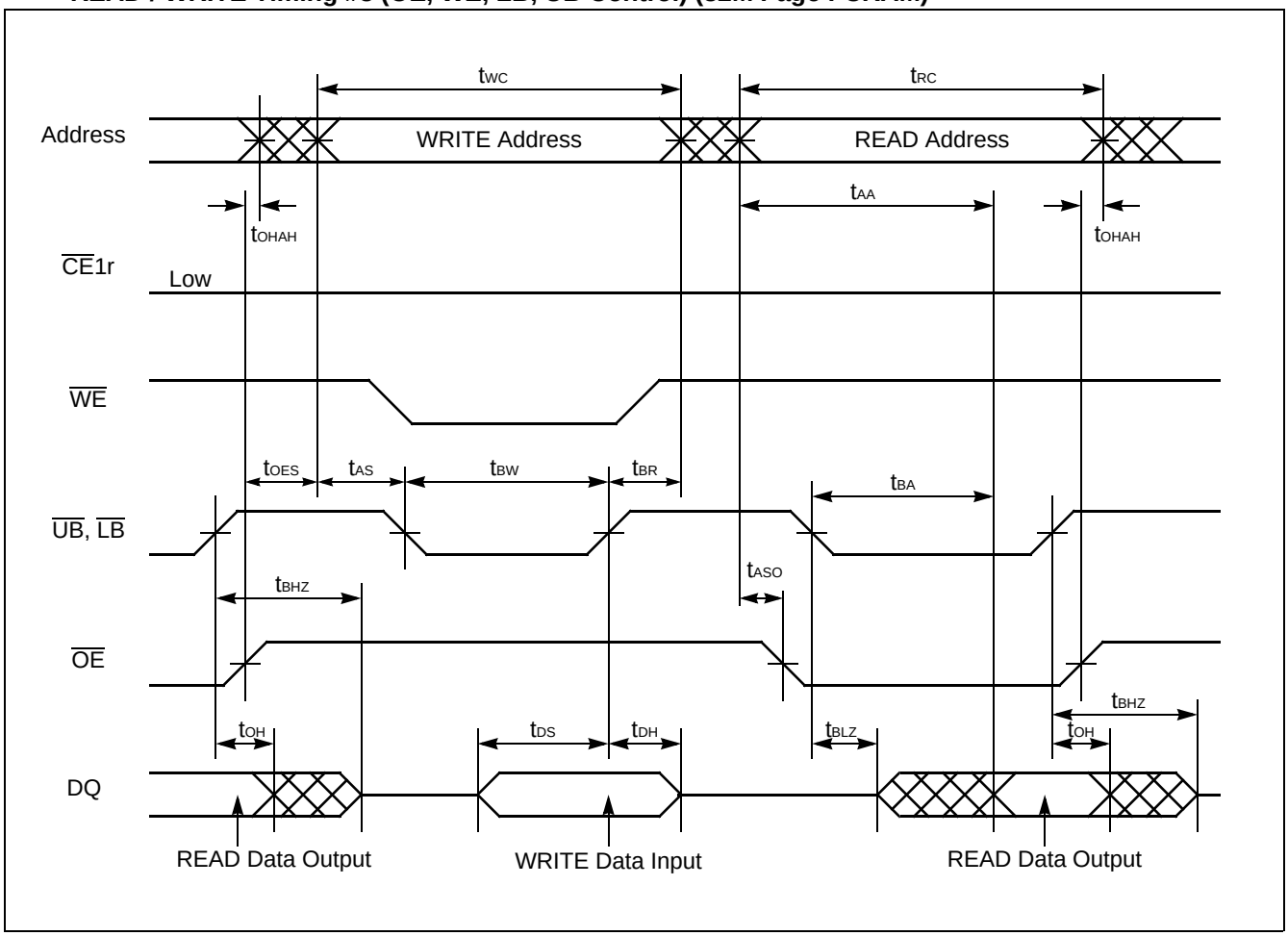
Note : $\overline{OE}$ can be Low fixed in write operation under $\overline{CE}$1r control $\overline{RD}$-$\overline{WR}$-$\overline{RD}$ operation.

- **READ / WRITE Timing #2 ($\overline{OE}$, $\overline{WE}$ Control) (32M Page FCRAM)**



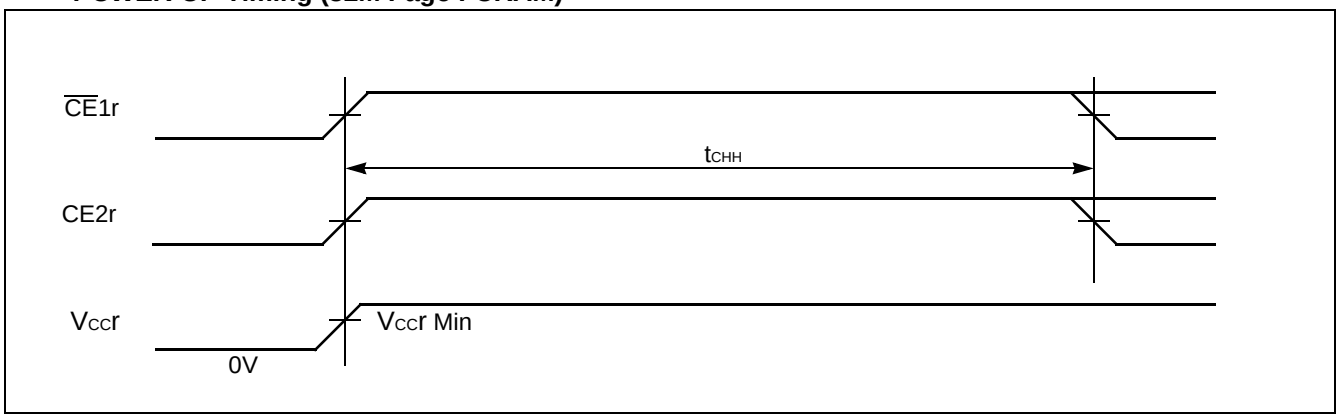
Note : $\overline{CE}$1r can be tied to Low for $\overline{WE}$ and $\overline{OE}$ controlled operation.
When $\overline{CE}$1r is tied to Low, output is exclusively controlled by $\overline{OE}$.

- **READ / WRITE Timing #3 ($\overline{OE}$, $\overline{WE}$, $\overline{LB}$, $\overline{UB}$ Control) (32M Page FCRAM)**



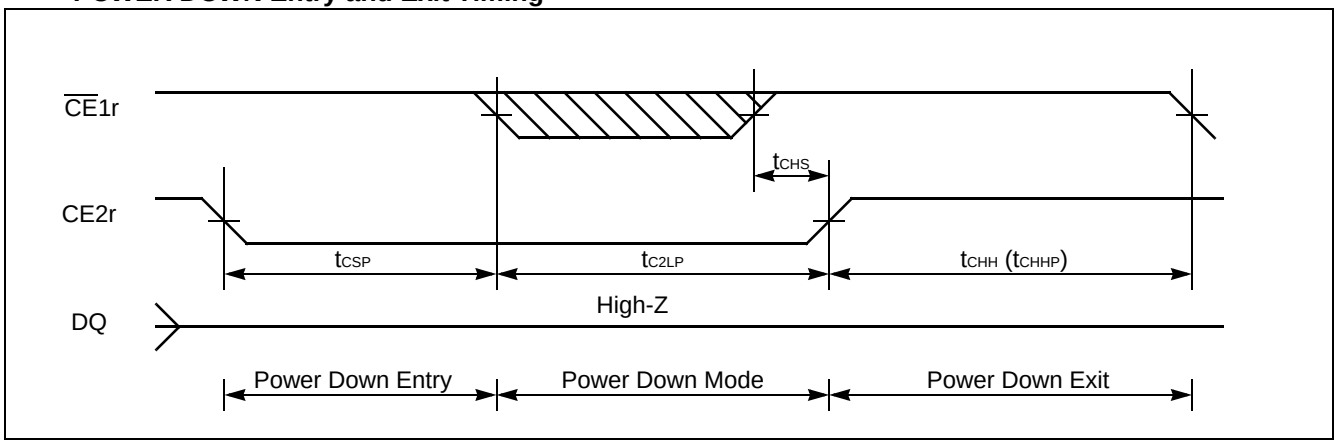
Note : $\overline{CE}$1r can be tied to Low for $\overline{WE}$ and $\overline{OE}$ controlled operation.
When $\overline{CE}$1r is tied to Low, output is exclusively controlled by $\overline{OE}$.

- **POWER-UP Timing (32M Page FCRAM)**



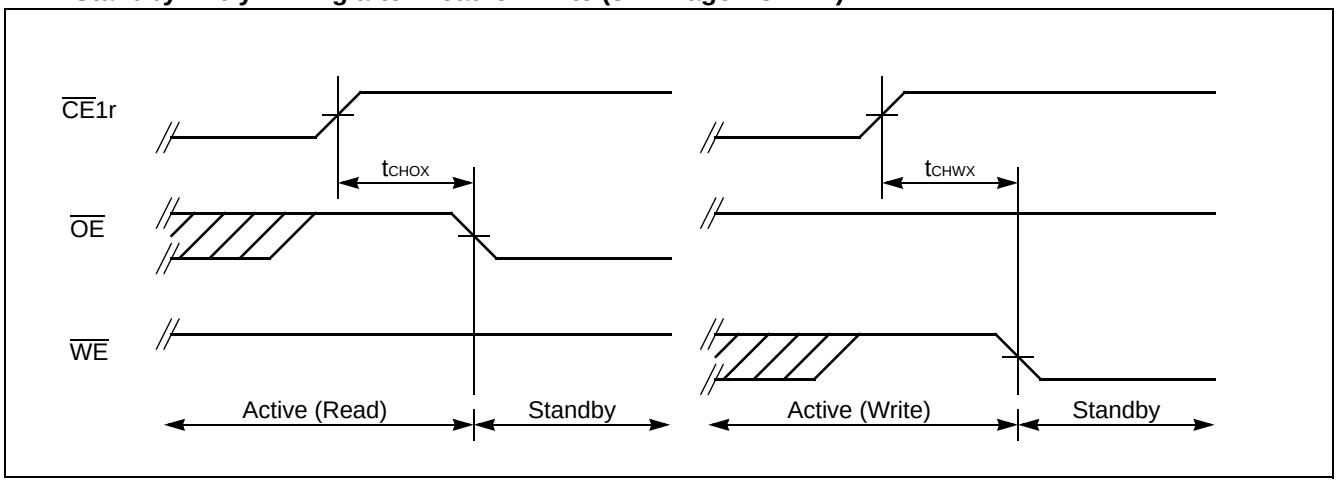
Note : The t_{CHH} specifies after $V_{CC}r$ reaches specified minimum level and applicable both $\overline{CE}1r$ and CE2r.

- **POWER DOWN Entry and Exit Timing**



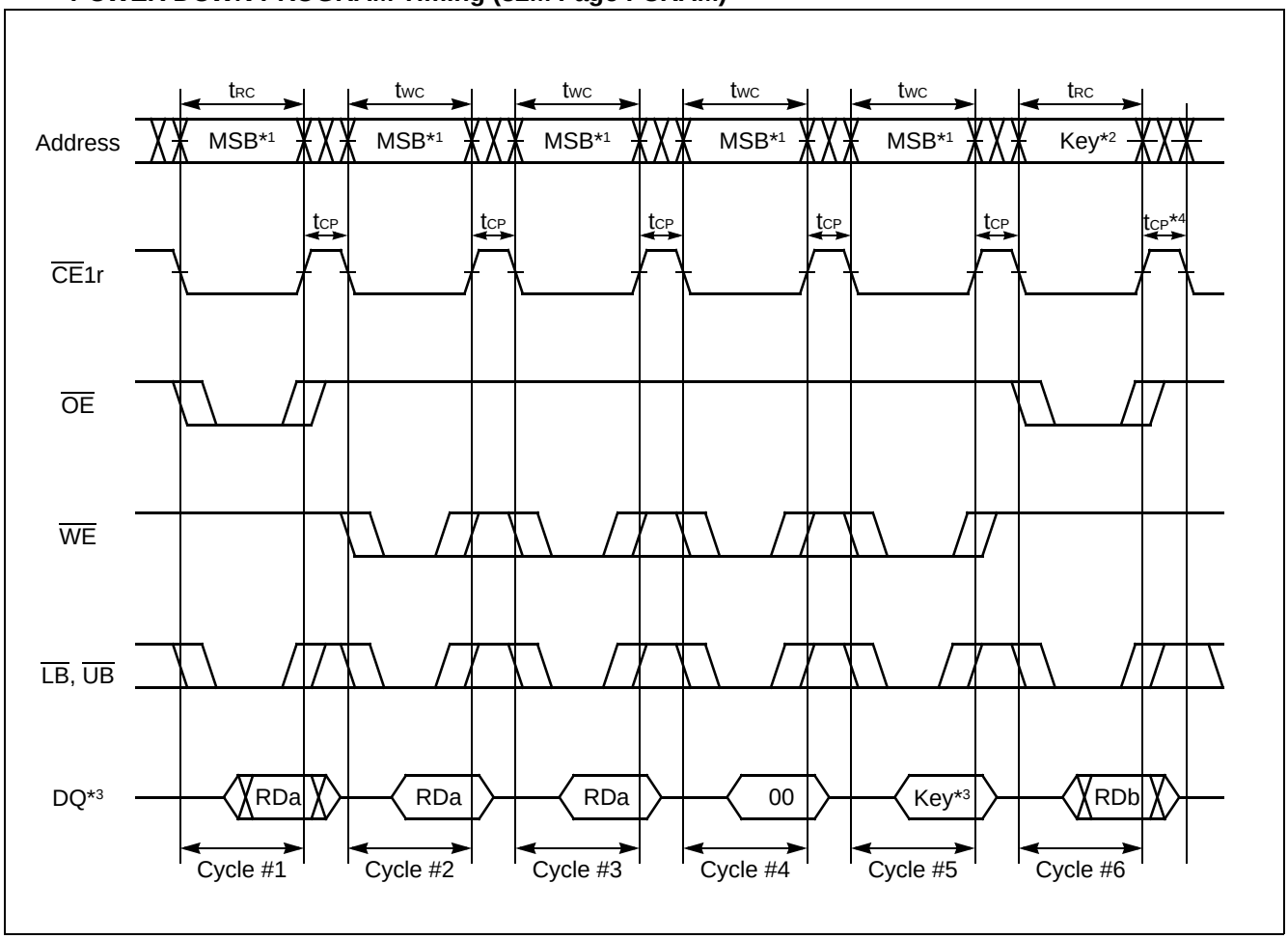
Note : This Power Down mode can be also used as a reset timing if POWER-UP timing above could not be satisfied and Power-Down program was not performed prior to this reset.

- **Standby Entry Timing after Read or Write (32M Page 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 for Standby mode from $\overline{CE}1r$ Low to High transition.

- **POWER DOWN PROGRAM Timing (32M Page FCRAM)**



*1 : The all address inputs must be High from Cycle #1 to #5.
The address key must confirm the format specified in "■ 32 M FCRAM CHARACTERISTICS for MCP 1. Power Down Program Timing (32 M Page FCRAM) ". If not, the operation and data are not guaranteed.

*2 : The data key must confirm the format specified in "■ 32 M FCRAM CHARACTERISTICS for MCP 1. Power Down Program Timing (32 M Page FCRAM) ". If not, the operation and data are not guaranteed.

*3 : After t_{CP} following Cycle #6, the Power Down Program is completed and returned to the normal operation.

■ PIN CAPACITANCE

Parameter	Symbol	Condition	Value			Unit
			Min	Typ	Max	
Input Capacitance	C_{IN}	V_{IN} = 0	—	11.0	14.0	pF
Output Capacitance	C_{OUT}	V_{OUT} = 0	—	12.0	16.0	pF
Control Pin Capacitance	C_{IN2}	V_{IN} = 0	—	14.0	16.0	pF
$\overline{WP}$/ACC Pin Capacitance	C_{IN3}	V_{IN} = 0	—	21.5	26.0	pF

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

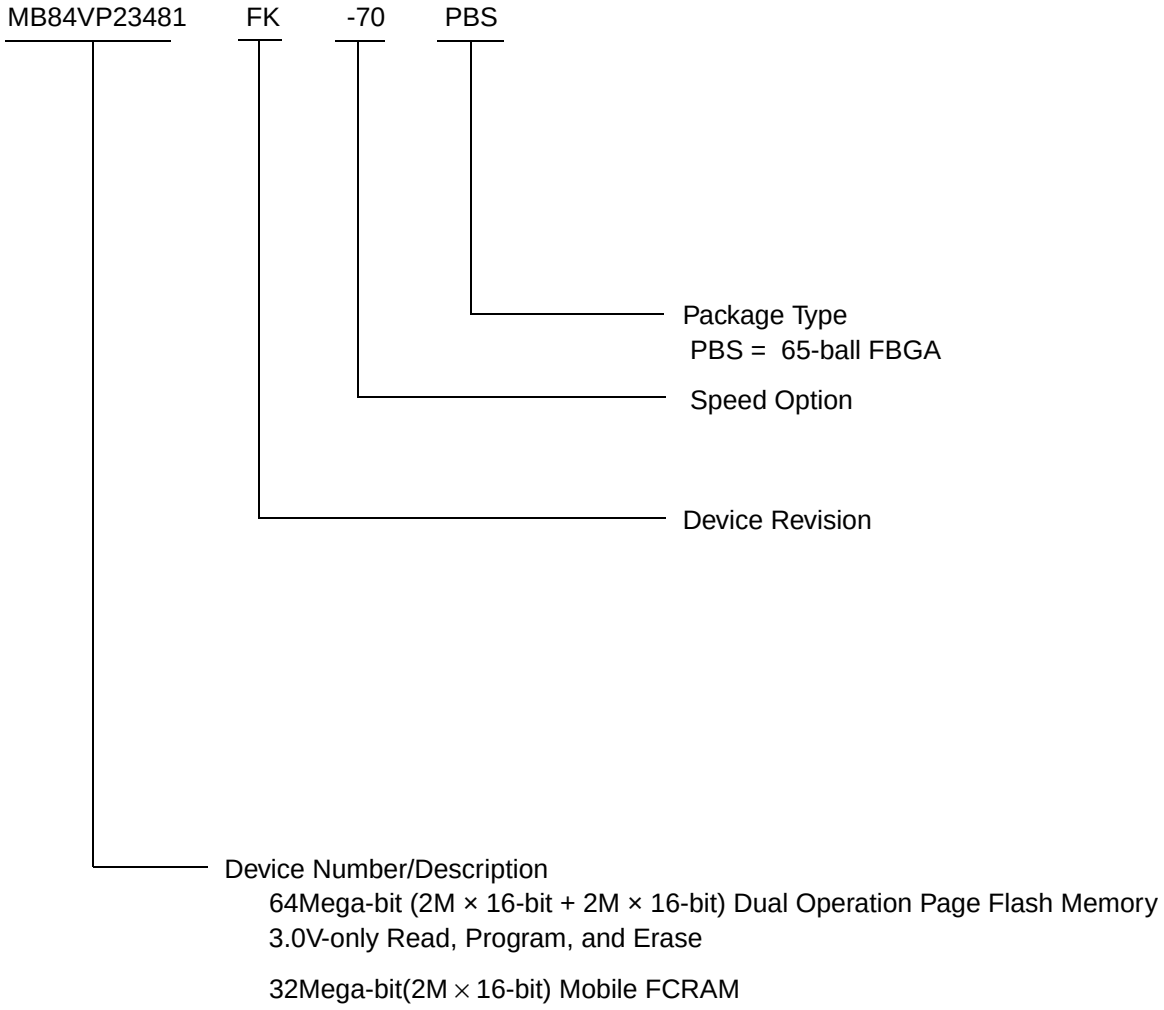
■ HANDLING OF PACKAGE

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

■ CAUTION

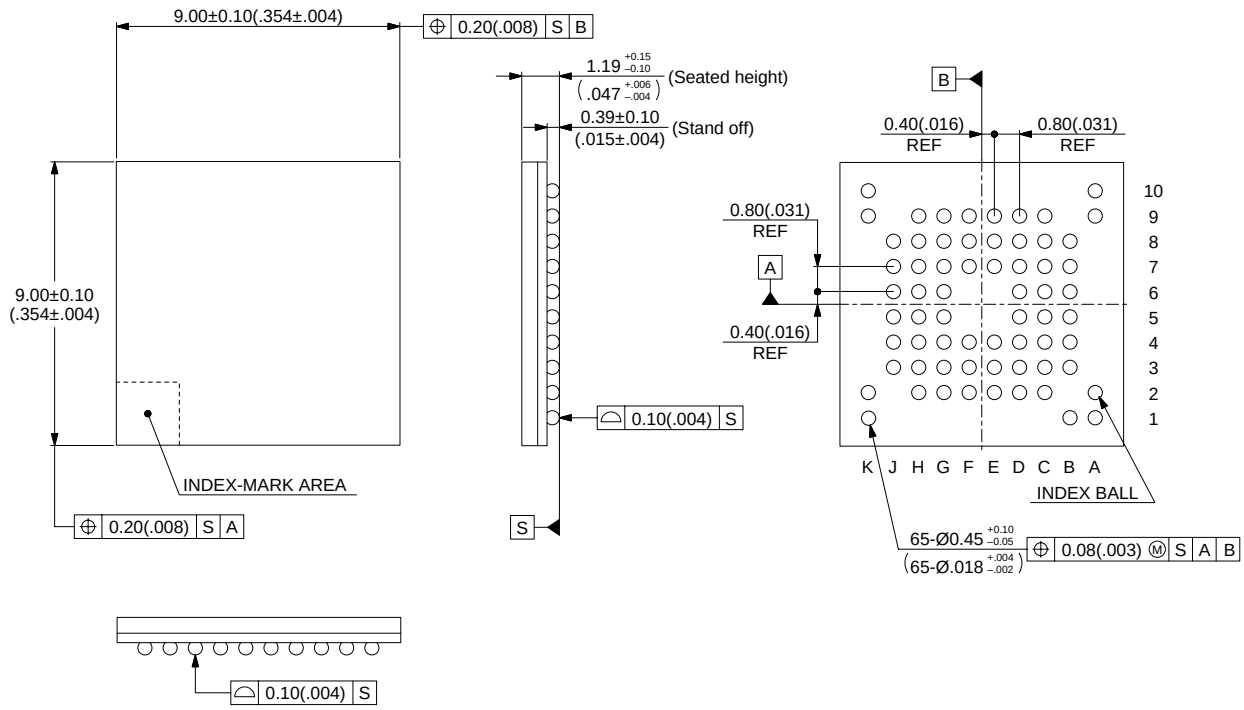
- The high voltage (V_{ID}) cannot apply to address pins and control pins except $\overline{RESET}$. Exception is when autoselect and sector group protect function are used, then the high voltage (V_{ID}) can be applied to $\overline{RESET}$.
- Without the high voltage (V_{ID}) , sector group protection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

■ ORDERING INFORMATION



■ PACKAGE DIMENSION

65-ball plastic FBGA
(BGA-65P-M01)



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

FUJITSU LIMITED

The contents of this document are subject to change without notice. Customers are advised to consult with FUJITSU sales representatives before ordering.
The information, such as descriptions of function and application circuit examples, in this document are presented solely for the purpose of reference to show examples of operations and uses of Fujitsu semiconductor device; Fujitsu does not warrant proper operation of the device with respect to use based on such information. When you develop equipment incorporating the device based on such information, you must assume any responsibility arising out of such use of the information. Fujitsu assumes no liability for any damages whatsoever arising out of the use of the information.
Any information in this document, including descriptions of function and schematic diagrams, shall not be construed as license of the use or exercise of any intellectual property right, such as patent right or copyright, or any other right of Fujitsu or any third party or does Fujitsu warrant non-infringement of any third-party's intellectual property right or other right by using such information. Fujitsu assumes no liability for any infringement of the intellectual property rights or other rights of third parties which would result from the use of information contained herein.
The products described in this document are designed, developed and manufactured as contemplated for general use, including without limitation, ordinary industrial use, general office use, personal use, and household use, but are not designed, developed and manufactured as contemplated (1) for use accompanying fatal risks or dangers that, unless extremely high safety is secured, could have a serious effect to the public, and could lead directly to death, personal injury, severe physical damage or other loss (i.e., nuclear reaction control in nuclear facility, aircraft flight control, air traffic control, mass transport control, medical life support system, missile launch control in weapon system), or (2) for use requiring extremely high reliability (i.e., submersible repeater and artificial satellite).
Please note that Fujitsu will not be liable against you and/or any third party for any claims or damages arising in connection with above-mentioned uses of the products.
Any semiconductor devices have an inherent chance of failure. You must protect against injury, damage or loss from such failures by incorporating safety design measures into your facility and equipment such as redundancy, fire protection, and prevention of over-current levels and other abnormal operating conditions.
If any products described in this document represent goods or technologies subject to certain restrictions on export under the Foreign Exchange and Foreign Trade Law of Japan, the prior authorization by Japanese government will be required for export of those products from Japan.

F0311