

### MCP (MULTI-CHIP PACKAGE) FLASH MEMORY AND SRAM 32M-BIT FLASH MEMORY AND 4M-BIT SRAM

#### Description

The MC-222244A-X is a stacked type MCP (Multi-Chip Package) of 33,554,432 bits (BYTE mode : 4,194,304 words by 8 bits, WORD mode : 2,097,152 words by 16 bits) flash memory and 4,194,304 bits (BYTE mode : 524,288 words by 8 bits, WORD mode : 262,144 words by 16 bits) static RAM.

The MC-222244A-X is packaged in a 77-pin TAPE FBGA.

#### Features

##### General Features

- Fast access time :  $t_{ACC} = 85$  ns (MAX.) (Flash Memory),  $t_{AA} = 70$  ns (MAX.) (SRAM)
- Supply voltage :  $V_{CCF} / V_{CCS} = 2.7$  to  $3.6$  V
- Wide operating temperature :  $T_A = -25$  to  $+85^{\circ}\text{C}$

##### Flash Memory Features

- Two bank organization enabling simultaneous execution of erase / program and read
- Bank organization : 2 banks (16M bits + 16M bits)
- Memory organization : 4,194,304 words  $\times$  8 bits (BYTE mode)  
2,097,152 words  $\times$  16 bits (WORD mode)
- Sector organization : 71 sectors (8K bytes / 4K words  $\times$  8 sectors, 64K bytes / 32K words  $\times$  63 sectors)
- Boot sector allocated to the highest address (sector)
- 3-state output
- Automatic program
  - Program suspend / resume
- Unlock bypass program
- Automatic erase
  - Chip erase
  - Sector erase (sectors can be combined freely)
  - Erase suspend / resume
- Program / Erase completion detection
  - Detection through data polling and toggle bits
  - Detection through RY (/BY) pin
- Sector group protection
  - Any sector can be protected
  - Any protected sector can be temporary unprotected
- Sectors can be used for boot application
- Hardware reset and standby using /RESET pin
- Automatic sleep mode
- Boot block sector protect by /WP (ACC) pin
- Conforms to common flash memory interface (CFI)
- Extra One Time Protect Sector provided

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

**SRAM Features**

- Memory organization : 524,288 words × 8 bits (BYTE mode)  
262,144 words × 16 bits (WORD mode)
- Supply current : At operating : 40 mA (MAX.)  
At standby : 7  $\mu$ A (MAX.)
- Two Chip Enable inputs : /CE1s, CE2s
- Byte data control : /LB, /UB
- Byte data select : CIOs
- Low V<sub>cc</sub> data retention : 1.0 to 3.6 V

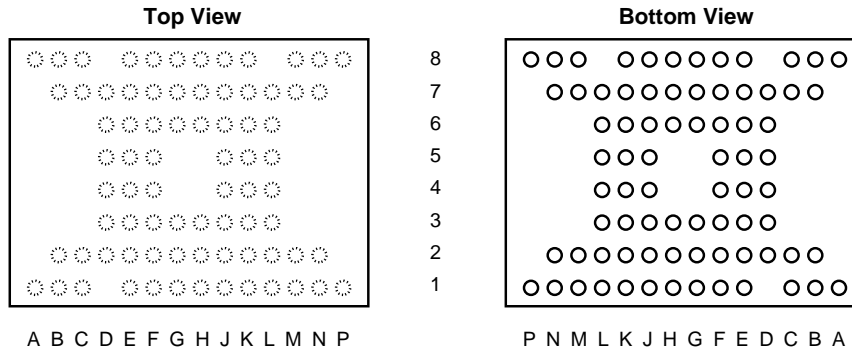
**Ordering Information**

Part number	Flash Memory Boot sector	Flash Memory Access time ns (MAX.)	SRAM Access time ns (MAX.)	Package
MC-222244AF9-B85X-BT3	Highest address (sector) (T type)	85	70	77-pin TAPE FBGA (12 × 7)

**Pin Configuration**

/xxx indicates active low signal.

**77-pin TAPE FBGA (12 × 7)**



**Top View**

	A	B	C	D	E	F	G	H	J	K	L	M	N	P
8	NC	NC	NC		A15	NC	NC	A16	CIOf	V <sub>ss</sub>		NC	NC	NC
7		NC	NC	A11	A12	A13	A14	SA	I/O15, A-1	I/O7	I/O14	NC	NC	
6				A8	A19	A9	A10	I/O6	I/O13	I/O12	I/O5			
5				/WE	CE2s	A20			I/O4	V <sub>ccs</sub>	CIOs			
4				/MP(ACC)	/RESET	RY(/BY)			I/O3	V <sub>ccf</sub>	I/O11			
3				/LB	/UB	A18	A17	I/O1	I/O9	I/O10	I/O2			
2		NC	NC	A7	A6	A5	A4	V <sub>ss</sub>	/OE	I/O0	I/O8	NC	NC	
1	NC	NC	NC		A3	A2	A1	A0	/CEf	/CE1s	NC	NC	NC	NC

**Common Pins**

- A0 - A17 : Address inputs
- I/O0 - I/O15 : Data inputs / outputs
- /OE : Output Enable
- /WE : Write Enable
- V<sub>ss</sub> : Ground
- NC <sup>Note</sup> : No Connection

**Flash Memory Pins**

- A18 - A20 : Address inputs
- I/O15, A-1 : Data inputs / outputs 15 (WORD mode)  
LSB address input (BYTE mode)
- /CEf : Chip Enable
- RY (/BY) : Ready (Busy) output
- /RESET : Hardware reset input
- V<sub>ccf</sub> : Supply Voltage
- /WP(ACC) : Hardware Write Protect (Acceleration)
- CIOf : Selects 8-bit or 16-bit mode

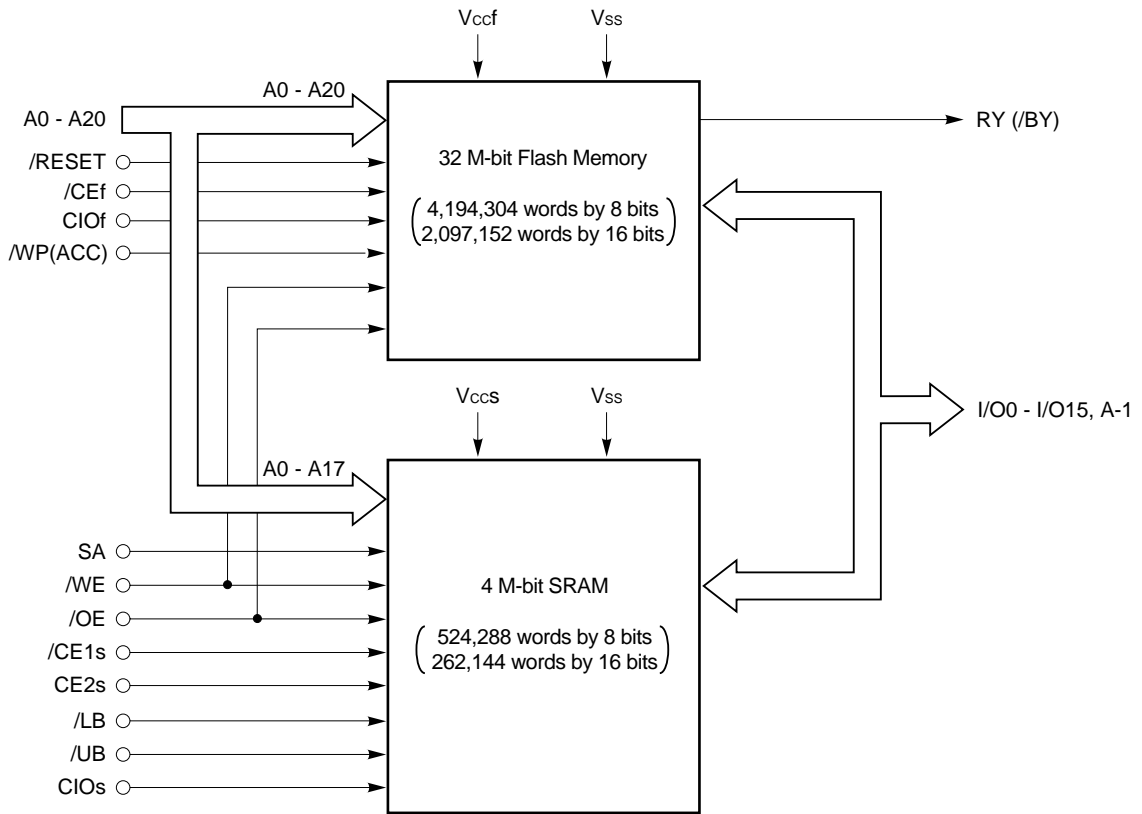
**SRAM Pins**

- SA : Address input (A18 for SRAM)
- /CE1s : Chip Enable 1
- CE2s : Chip Enable 2
- V<sub>ccs</sub> : Supply Voltage
- /LB, /UB : Byte data select
- CIOs : Selects 8-bit or 16-bit mode

**Note** Some signals can be applied because this pin is not internally connected.

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

Block Diagram



Bus Operations Table

Operation		Flash Memory				SRAM					Common				
		/RESET	/CEf	CIOf	/WP(ACC)	/CE1s	CE2s	/LB	/UB	CIOs	/OE	/WE	I/O0 - I/O7	I/O8-I/O15	
Full standby		H	H	x	x	H	x	x	x	x	x	x	x	Hi-Z	Hi-Z
						x	L								
						x	x	H	H						
Output disable		H	L	x	x	L	H	x	x	x	H	H	Hi-Z	Hi-Z	
Read (Flash Memory <sup>Note 1</sup> )	BYTE mode	H	L	L	x	Note 2					L	H	Data Out	Hi-Z	
	WORD mode			H									Data Out	Data Out	
Write (Flash Memory)	BYTE mode	H	L	L	x	Note 2					H	L	Data In	Hi-Z	
	WORD mode			H									Data In	Data In	
Temporary sector group unprotect		V <sub>ID</sub>	x	x	x	Note 2					x	x	Hi-Z or Data In/Out	Hi-Z or Data In/Out	
Boot block sector protect		x	x	x	L	x	x	x	x	x	x	x	Hi-Z or Data In/Out	Hi-Z or Data In/Out	
Flash Memory hardware reset		L	x	x	x	x	x	x	x	x	x	x	Hi-Z	Hi-Z	
Read (SRAM)	BYTE mode	Note 3				L	H	x	x	L	L	H	Data Out	Hi-Z	
	WORD mode	Note 3				L	H	L	L	H	L	H	Data Out	Data Out	
								H	H				Hi-Z	Hi-Z	
								H	L				Hi-Z	Data Out	
Write (SRAM)	BYTE mode	Note 3				L	H	x	x	L	x	L	Data In	Hi-Z	
	WORD mode	Note 3				L	H	L	L	H	x	L	Data In	Data In	
								H	H				Hi-Z	Hi-Z	
								H	L				Hi-Z	Data In	

**Caution** Other operations except for indicated in this table are inhibited.

**Notes** 1. When /OE = V<sub>IL</sub>, V<sub>IL</sub> can be applied to /WE. When /OE = V<sub>IH</sub>, a write operation is started.

- 2. SRAM should be Standby.
- 3. Flash Memory should be Standby or Hardware reset.

**Remarks** 1. H : V<sub>IH</sub>, L : V<sub>IL</sub>, x : V<sub>IH</sub> or V<sub>IL</sub>

2. Sector group protection and read the product ID are using a command.

★ 3. Refer to **DUAL OPERATION FLASH MEMORY 32M BITS A SERIES Information (M14914E)** for the flash memory bus operations.

Sector Organization / Sector Address Table (Flash Memory)

Flash Memory top boot

(1/2)

Bank	Sector Organization K bytes / K words	Address		Sectors Address	Sector Address Table								
		BYTE mode	WORD mode		Bank Address Table								
					A20	A19	A18	A17	A16	A15	A14	A13	A12
Bank 1	8/4	3FFFFFH 3FE000H	1FFFFFH 1FF000H	FSA70	1	1	1	1	1	1	1	1	1
	8/4	3FDFFFH 3FC000H	1FEFFFH 1FE000H	FSA69	1	1	1	1	1	1	1	1	0
	8/4	3FBFFFH 3FA000H	1FDFFFH 1FD000H	FSA68	1	1	1	1	1	1	1	0	1
	8/4	3F9FFFH 3F8000H	1FCFFFH 1FC000H	FSA67	1	1	1	1	1	1	1	0	0
	8/4	3F7FFFH 3F6000H	1FBFFFH 1FB000H	FSA66	1	1	1	1	1	1	0	1	1
	8/4	3F5FFFH 3F4000H	1FAFFFH 1FA000H	FSA65	1	1	1	1	1	1	0	1	0
	8/4	3F3FFFH 3F2000H	1F9FFFH 1F9000H	FSA64	1	1	1	1	1	1	0	0	1
	8/4	3F1FFFH 3F0000H	1F8FFFH 1F8000H	FSA63	1	1	1	1	1	1	0	0	0
	64/32	3EFFFFH 3E0000H	1F7FFFH 1F0000H	FSA62	1	1	1	1	1	0	x	x	x
	64/32	3DFFFH 3D0000H	1EFFFH 1E8000H	FSA61	1	1	1	1	0	1	x	x	x
	64/32	3CFFFH 3C0000H	1E7FFFH 1E0000H	FSA60	1	1	1	1	0	0	x	x	x
	64/32	3BFFFH 3B0000H	1DFFFH 1D8000H	FSA59	1	1	1	0	1	1	x	x	x
	64/32	3AFFFH 3A0000H	1D7FFFH 1D0000H	FSA58	1	1	1	0	1	0	x	x	x
	64/32	39FFFH 390000H	1CFFFH 1C8000H	FSA57	1	1	1	0	0	1	x	x	x
	64/32	38FFFH 380000H	1C7FFFH 1C0000H	FSA56	1	1	1	0	0	0	x	x	x
	64/32	37FFFH 370000H	1BFFFH 1B8000H	FSA55	1	1	0	1	1	1	x	x	x
	64/32	36FFFH 360000H	1B7FFFH 1B0000H	FSA54	1	1	0	1	1	0	x	x	x
	64/32	35FFFH 350000H	1AFFFH 1A8000H	FSA53	1	1	0	1	0	1	x	x	x
	64/32	34FFFH 340000H	1A7FFFH 1A0000H	FSA52	1	1	0	1	0	0	x	x	x
	64/32	33FFFH 330000H	19FFFH 198000H	FSA51	1	1	0	0	1	1	x	x	x
	64/32	32FFFH 320000H	197FFFH 190000H	FSA50	1	1	0	0	1	0	x	x	x
	64/32	31FFFH 310000H	18FFFH 188000H	FSA49	1	1	0	0	0	1	x	x	x
	64/32	30FFFH 300000H	187FFFH 180000H	FSA48	1	1	0	0	0	0	x	x	x
	64/32	2FFFFH 2F0000H	17FFFH 178000H	FSA47	1	0	1	1	1	1	x	x	x
	64/32	2EFFFH 2E0000H	177FFFH 170000H	FSA46	1	0	1	1	1	0	x	x	x
	64/32	2DFFFH 2D0000H	16FFFH 168000H	FSA45	1	0	1	1	0	1	x	x	x
	64/32	2CFFFH 2C0000H	167FFFH 160000H	FSA44	1	0	1	1	0	0	x	x	x
	64/32	2BFFFH 2B0000H	15FFFH 158000H	FSA43	1	0	1	0	1	1	x	x	x
	64/32	2AFFFH 2A0000H	157FFFH 150000H	FSA42	1	0	1	0	1	0	x	x	x
	64/32	29FFFH 290000H	14FFFH 148000H	FSA41	1	0	1	0	0	1	x	x	x
	64/32	28FFFH 280000H	147FFFH 140000H	FSA40	1	0	1	0	0	0	x	x	x
	64/32	27FFFH 270000H	13FFFH 138000H	FSA39	1	0	0	1	1	1	x	x	x
64/32	26FFFH 260000H	137FFFH 130000H	FSA38	1	0	0	1	1	0	x	x	x	
64/32	25FFFH 250000H	12FFFH 128000H	FSA37	1	0	0	1	0	1	x	x	x	
64/32	24FFFH 240000H	127FFFH 120000H	FSA36	1	0	0	1	0	0	x	x	x	
64/32	23FFFH 230000H	11FFFH 118000H	FSA35	1	0	0	0	1	1	x	x	x	

(2/2)

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

★ Sector Group Address Table (Flash Memory)

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

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



Command Sequence (Flash Memory)

Command sequence		Bus Cycle	1st bus Cycle		2nd bus Cycle		3rd bus Cycle		4th bus Cycle		5th bus Cycle		6th bus Cycle	
			Address	Data	Address	Data	Address	Data	Address	Data	Address	Data	Address	Data
Read / Reset <sup>Note1</sup>		1	xxxH	F0H	RA	RD	-	-	-	-	-	-	-	-
Read / Reset <sup>Note1</sup>	BYTE mode	3	AAAH	AAH	555H	55H	AAAH	F0H	RA	RD	-	-	-	-
	WORD mode		555H		2AAH		555H							
Program	BYTE mode	4	AAAH	AAH	555H	55H	AAAH	A0H	PA	PD	-	-	-	-
	WORD mode		555H		2AAH		555H							
Program Suspend <sup>Note 2</sup>		1	BA	B0H	-	-	-	-	-	-	-	-	-	-
Program Resume <sup>Note 3</sup>		1	BA	30H	-	-	-	-	-	-	-	-	-	-
Chip Erase	BYTE mode	6	AAAH	AAH	555H	55H	AAAH	80H	AAAH	AAH	555H	55H	AAAH	10H
	WORD mode		555H		2AAH		555H		555H		2AAH		555H	
Sector Erase	BYTE mode	6	AAAH	AAH	555H	55H	AAAH	80H	AAAH	AAH	555H	55H	FSA	30H
	WORD mode		555H		2AAH		555H		555H		2AAH			
Sector Erase Suspend <sup>Note 4</sup>		1	BA	B0H	-	-	-	-	-	-	-	-	-	-
Sector Erase Resume <sup>Note 5</sup>		1	BA	30H	-	-	-	-	-	-	-	-	-	-
Unlock Bypass Set	BYTE mode	3	AAAH	AAH	555H	55H	AAAH	20H	-	-	-	-	-	-
	WORD mode		555H		2AAH		555H							
Unlock Bypass Program <sup>Note 6</sup>		2	xxxH	A0H	PA	PD	-	-	-	-	-	-	-	-
Unlock Bypass Reset <sup>Note 6</sup>		2	BA	90H	xxxH	00H <sup>Note11</sup>	-	-	-	-	-	-	-	-
Product ID	BYTE mode	3	AAAH	AAH	555H	55H	(BA) AAAH	90H	IA	ID	-	-	-	-
	WORD mode		555H		2AAH		(BA) 555H							
Sector Group Protection <sup>Note 7</sup>		4	xxxH	60H	SPA	60H	SPA	40H	SPA	SD	-	-	-	-
Sector Group Unprotect <sup>Note 8</sup>		4	xxxH	60H	SUA	60H	SUA	40H	SUA	SD	-	-	-	-
Query <sup>Note 9</sup>	BYTE mode	1	AAH	98H	-	-	-	-	-	-	-	-	-	-
	WORD mode		55H											
Extra One Time Protect	BYTE mode	3	AAAH	AAH	555H	55H	AAAH	88H	-	-	-	-	-	-
Sector Entry	WORD mode		555H		2AAH		555H							
Extra One Time Protect	BYTE mode	4	AAAH	AAH	555H	55H	AAAH	A0H	PA	PD	-	-	-	-
Sector Program <sup>Note 10</sup>	WORD mode		555H		2AAH		555H							
Extra One Time Protect	BYTE mode	6	AAAH	AAH	555H	55H	AAAH	80H	AAAH	AAH	555H	55H	EOTPSA	30H
Sector Erase <sup>Note 10</sup>	WORD mode		555H		2AAH		555H		555H		2AAH			
Extra One Time Protect	BYTE mode	4	AAAH	AAH	555H	55H	AAAH	90H	xxxH	00H	-	-	-	-
Sector Reset <sup>Note 10</sup>	WORD mode		555H		2AAH		555H							
Extra One Time Protect Sector Protection <sup>Note 10</sup>		4	xxxH	60H	EOTPSA	60H	EOTPSA	40H	EOTPSA	SD	-	-	-	-

- Notes**
1. Both these read / reset commands reset the device to the read mode.
  2. Programming is suspended if B0H is input to the bank address being programmed to in a program operation.
  3. Programming is resumed if 30H is input to the bank address being suspended to in a program-suspend operation.
  4. Erasure is suspended if B0H is input to the bank address being erased in a sector erase operation.
  5. Erasure is resumed if 30H is input to the bank address being suspended in a sector-erase-suspend operation.
  6. Valid only in the unlock bypass mode.
  7. Valid only when /RESET = V<sub>DD</sub> (except in the Extra One Time Protect Sector mode).
  8. The command sequence that protects a sector group is excluded.
  9. Only A0 to A6 are valid as an address.
  10. Valid only in the Extra One Time Protect Sector mode.
  11. This command can be used even if this data is F0H.

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

★

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

Product ID Code	Address inputs			Output
	A6	A1	A0	Hex
Manufacturer Code	L	L	L	10H
Device code	L	L	H	5CH (BYTE mode), 225CH (WORD mode)

Product ID Code	Code outputs																Hex
	I/O 15	I/O 14	I/O 13	I/O 12	I/O 11	I/O 10	I/O 9	I/O 8	I/O 7	I/O 6	I/O 5	I/O 4	I/O 3	I/O 2	I/O 1	I/O 0	
Manufacturer Code	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	10H
Device code	BYTE mode	A-1	x	x	x	x	x	x	0	1	0	1	1	1	0	0	5CH
	WORD mode	0	0	1	0	0	0	1	0	0	1	0	1	1	1	0	0

**Remark** H : V<sub>IH</sub>, L : V<sub>IL</sub>, x : Hi-Z

★ **Hardware Sequence Flags, Hardware Data Protection (Flash Memory)**

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

**Electrical Specifications**

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

**Absolute Maximum Ratings**

Parameter	Symbol	Condition	Rating	Unit
Supply voltage	$V_{ccf}, V_{ccs}$	with respect to $V_{ss}$	-0.5 to +4.0	V
Input / Output voltage	$V_{\tau}$	with respect to $V_{ss}$	-0.5 <sup>Note 1</sup> to +13.0	V
		except /WP(ACC), /RESET	-0.5 <sup>Note 1</sup> to $V_{ccf}, V_{ccs} + 0.4$ (4.0 V MAX.) <sup>Note 2</sup>	
Ambient operation temperature	$T_A$		-25 to +85	°C
Storage temperature	$T_{stg}$		-55 to +125	°C

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

2.  $V_{ccf}, V_{ccs} + 0.5$  V (MAX.) (pulse width  $\leq 20$  ns)

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

**Recommended Operating Conditions**

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Supply voltage	$V_{ccf}, V_{ccs}$		2.7		3.6	V
Ambient operation temperature	$T_A$		-25		+85	°C

DC Characteristics (Recommended Operating Conditions Unless Otherwise Noted)

Common

Parameter	Symbol	Test condition	MIN.	TYP.	MAX.	Unit
High level input voltage	V <sub>IH</sub>		2.4		V <sub>ccf</sub> , V <sub>ccs</sub> + 0.3	V
Low level input voltage	V <sub>IL</sub>		-0.3		+0.5	V
High level output voltage	V <sub>OH</sub>	I <sub>OH</sub> = -500 μA, V <sub>ccf</sub> = V <sub>ccf</sub> (MIN.), V <sub>ccs</sub> = V <sub>ccs</sub> (MIN.)	2.4			V
Low level output voltage	V <sub>OL</sub>	I <sub>OL</sub> = +1.0 mA, V <sub>ccf</sub> = V <sub>ccf</sub> (MIN.), V <sub>ccs</sub> = V <sub>ccs</sub> (MIN.)			0.4	V
Input leakage current	I <sub>LI</sub>		-1.0		+1.0	μA
Output leakage current	I <sub>LO</sub>		-1.0		+1.0	μA

Flash Memory

Parameter		Symbol	Test condition	MIN.	TYP.	MAX.	Unit	
Power supply current	Read	BYTE mode	V <sub>ccf</sub> = V <sub>ccf</sub> (MAX.), /CEf = V <sub>IL</sub> , /OE = V <sub>IH</sub>	t <sub>CYCLE</sub> = 5 MHz		10	16	mA
				t <sub>CYCLE</sub> = 1 MHz		2	4	
		WORD mode		t <sub>CYCLE</sub> = 5 MHz		10	16	
				t <sub>CYCLE</sub> = 1 MHz		2	4	
	Program, Erase		I <sub>cczf</sub>	V <sub>ccf</sub> = V <sub>ccf</sub> (MAX.), /CEf = V <sub>IL</sub> , /OE = V <sub>IH</sub>		15	30	mA
	Standby		I <sub>cc3f</sub>	V <sub>ccf</sub> = V <sub>ccf</sub> (MAX.), /CEf = /RESET = /WP(ACC) = V <sub>ccf</sub> ± 0.3 V, /OE = V <sub>IL</sub>		0.2	5	μA
	Standby / Reset		I <sub>cc4f</sub>	V <sub>ccf</sub> = V <sub>ccf</sub> (MAX.), /RESET = V <sub>SS</sub> ± 0.2 V		0.2	5	μA
	Automatic sleep mode		I <sub>cc5f</sub>	V <sub>IH</sub> = V <sub>ccf</sub> ± 0.2 V, V <sub>IL</sub> = V <sub>SS</sub> ± 0.2 V		0.2	5	μA
	Read during programming		I <sub>cc6f</sub>	V <sub>IH</sub> = V <sub>ccf</sub> ± 0.2 V, V <sub>IL</sub> = V <sub>SS</sub> ± 0.2 V		21	45	mA
	Read during erasing		I <sub>cc7f</sub>	V <sub>IH</sub> = V <sub>ccf</sub> ± 0.2 V, V <sub>IL</sub> = V <sub>SS</sub> ± 0.2 V		21	45	mA
Programming during suspend		I <sub>cc8f</sub>	/CEf = V <sub>IL</sub> , /OE = V <sub>IH</sub> , Automatic programming during suspend		17	35	mA	
Accelerated programming		I <sub>ACC</sub>	/WP (ACC) pin		5	10	mA	
			V <sub>ccf</sub>		15	30		
/RESET high level input voltage		V <sub>ID</sub>	High Voltage is applied	11.5		12.5	V	
Accelerated programming voltage		V <sub>ACC</sub>	High Voltage is applied	8.5		9.5	V	
Low V <sub>ccf</sub> lock-out voltage <sup>Note</sup>		V <sub>LKO</sub>				1.7	V	

★ **Note** When V<sub>ccf</sub> is equal to or lower than V<sub>LKO</sub>, the device ignores all write cycles. Refer to Refer to **DUAL OPERATION FLASH MEMORY 32M BITS A SERIES Information (M14914E)**.

SRAM

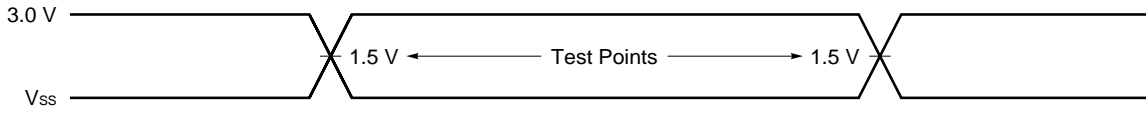
Parameter	Symbol	Test condition	MIN.	TYP.	MAX.	Unit
Power supply current	I <sub>cc1s</sub>	/CE1s = V <sub>IL</sub> , CE2s = V <sub>IH</sub> , Minimum cycle time, I <sub>I/O</sub> = 0 mA		-	40	mA
		/CE1s = V <sub>IL</sub> , CE2s = V <sub>IH</sub> , I <sub>I/O</sub> = 0 mA, Cycle time = ∞		-	10	
	I <sub>cc2s</sub>	/CE1s ≤ 0.2 V, CE2s ≥ V <sub>ccs</sub> - 0.2 V, Cycle time = 1 μs, I <sub>I/O</sub> = 0 mA, V <sub>IL</sub> ≤ 0.2 V, V <sub>IH</sub> ≥ V <sub>ccs</sub> - 0.2 V		-	8	
Standby supply current	I <sub>SB1s</sub>	/CE1s = V <sub>IH</sub> or CE2s = V <sub>IL</sub> or /LB = /UB = V <sub>IH</sub>		-	0.6	mA
		/CE1s ≥ V <sub>ccs</sub> - 0.2 V, CE2s ≥ V <sub>ccs</sub> - 0.2 V		0.5	7	
	I <sub>SB2s</sub>	CE2s ≤ 0.2 V		0.5	7	
		/LB = /UB ≥ V <sub>ccs</sub> - 0.2 V, /CE1s ≤ 0.2 V, CE2s ≥ V <sub>ccs</sub> - 0.2 V		0.5	7	

AC Characteristics (Recommended Operating Conditions Unless Otherwise Noted)

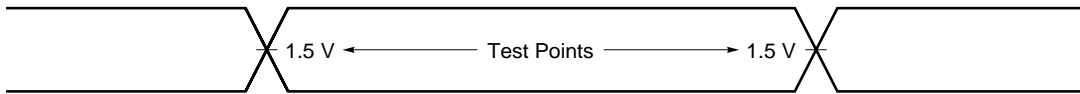
★ AC Test Conditions

Flash Memory

Input Waveform (Rise and Fall Time  $\leq 5$  ns)



Output Waveform

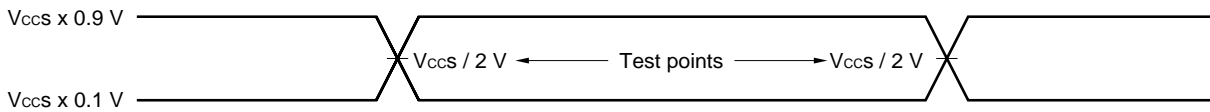


Output Load

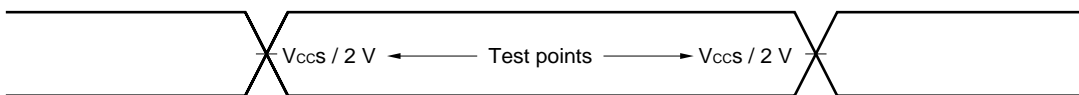
1 TTL + 30 pF

SRAM

Input Waveform (Rise and Fall Time  $\leq 5$  ns)



Output Waveform



Output Load

1 TTL + 30 pF

/CEf, /CE1s, CE2s Timing

Parameter	Symbol	Test Condition	MIN.	TYP.	MAX.	Unit	Notes
/CEf, /CE1s, CE2s recover time	t <sub>CCR</sub>		0			ns	

Read Cycle (Flash Memory)

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

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

**Write Cycle (Erase / Program) (Flash Memory)**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Notes
Write cycle time	t <sub>WC</sub>	85			ns	
Address setup time (/WE to address)	t <sub>AS</sub>	0			ns	
Address setup time (/CEf to address)	t <sub>AS</sub>	0			ns	
Address hold time (/WE to address)	t <sub>AH</sub>	45			ns	
Address hold time (/CEf to address)	t <sub>AH</sub>	45			ns	
Input data setup time	t <sub>DS</sub>	35			ns	
Input data hold time	t <sub>DH</sub>	0			ns	
/OE hold time	Read	0			ns	
	Toggle bit, Data polling	10				
Read recovery time before write (/OE to /CEf)	t <sub>GHEL</sub>	0			ns	
Read recovery time before write (/OE to /WE)	t <sub>GHWL</sub>	0			ns	
/WE setup time (/CEf to /WE)	t <sub>WS</sub>	0			ns	
/CEf setup time (/WE to /CEf)	t <sub>CS</sub>	0			ns	
/WE hold time (/CEf to /WE)	t <sub>WH</sub>	0			ns	
/CEf hold time (/WE to /CEf)	t <sub>CH</sub>	0			ns	
Write pulse width	t <sub>WP</sub>	35			ns	
/CEf pulse width	t <sub>CP</sub>	35			ns	
Write pulse width high	t <sub>WPH</sub>	30			ns	
/CEf pulse width high	t <sub>CPH</sub>	30			ns	
Byte programming operation time	t <sub>BPG</sub>		9	200	μs	
Word programming operation time	t <sub>WPG</sub>		11	200	μs	
Sector erase operation time	t <sub>SER</sub>		0.7	5	s	1
V <sub>ccf</sub> setup time	t <sub>VCS</sub>	50			μs	
RY (/BY) recovery time	t <sub>RB</sub>	0			ns	
/RESET pulse width	t <sub>RP</sub>	500			ns	
/RESET high-voltage (V <sub>ID</sub> ) hold time from high of RY(/BY) when sector group is temporarily unprotect	t <sub>RRB</sub>	20			μs	
/RESET hold time	t <sub>RH</sub>	50			ns	
From completion of automatic program / erase to data output time	t <sub>EOE</sub>			85	ns	
RY (/BY) delay time from valid program or erase operation	t <sub>BUSY</sub>			90	ns	
Address setup time to /OE low in toggle bit	t <sub>ASO</sub>	15			ns	
Address hold time to /CEf or /OE high in toggle bit	t <sub>AHT</sub>	0			ns	
/CEf pulse width high for toggle bit	t <sub>CEPH</sub>	20			ns	
/OE pulse width high for toggle bit	t <sub>OEPH</sub>	20			ns	
Voltage transition time	t <sub>VLHT</sub>	4			μs	2
Rise time to V <sub>ID</sub> (/RESET)	t <sub>VIDR</sub>	500			ns	3
Rise time to V <sub>ACC</sub> (WP(ACC))	t <sub>VACCR</sub>	500			ns	2
Erase timeout time	t <sub>TOW</sub>	50			μs	4
Erase suspend transition time	t <sub>SPD</sub>			20	μs	4

- Notes**
1. The preprogramming time prior to the erase operation is not included.
  2. Sector group protection and accelerated mode only
  3. Sector group protection only.
  4. Table only.



**Write operation (Erase / Program) Performance (Flash Memory)**

Parameter	Description	MIN.	TYP.	MAX.	Unit
Sector erase time	Excludes programming time prior to erasure		0.7	5	s
Chip erase time	Excludes programming time prior to erasure		50		s
Byte programming time	Excludes system-level overhead		9	200	$\mu$ s
Word programming time	Excludes system-level overhead		11	200	$\mu$ s
Chip programming time	Excludes system-level overhead	BYTE mode	40		s
		WORD mode	25		
Accelerated programming time	Excludes system-level overhead		7	150	$\mu$ s
Erase / Program cycle		100,000			cycles

**Read Cycle (SRAM)**

Parameter	Symbol	MIN.	MAX.	Unit	Notes
Read cycle time	t <sub>RC</sub>	70		ns	
Address access time	t <sub>AA</sub>		70	ns	
/CE1s access time	t <sub>CO1</sub>		70	ns	
CE2s access time	t <sub>CO2</sub>		70	ns	
/OE to output valid	t <sub>OE</sub>		35	ns	
/LB, /UB to output valid	t <sub>BA</sub>		70	ns	
Output hold from address change	t <sub>OH</sub>	10		ns	
/CE1s to output in Low-Z	t <sub>LZ1</sub>	10		ns	
CE2s to output in Low-Z	t <sub>LZ2</sub>	10		ns	
/OE to output in Low-Z	t <sub>OLZ</sub>	0		ns	
/LB, /UB to output in Low-Z	t <sub>BLZ</sub>	10		ns	
/CE1s to output in Hi-Z	t <sub>HZ1</sub>		25	ns	
CE2s to output in Hi-Z	t <sub>HZ2</sub>		25	ns	
/OE to output in Hi-Z	t <sub>OHZ</sub>		25	ns	
/LB, /UB to output in Hi-Z	t <sub>BHZ</sub>		25	ns	

**Write Cycle (SRAM)**

Parameter	Symbol	MIN.	MAX.	Unit	Notes
Write cycle time	t <sub>WC</sub>	70		ns	
/CE1s to end of write	t <sub>CW1</sub>	55		ns	
CE2s to end of write	t <sub>CW2</sub>	55		ns	
/LB, /UB to end of write	t <sub>BW</sub>	55		ns	
Address valid to end of write	t <sub>AW</sub>	55		ns	
Address setup time	t <sub>AS</sub>	0		ns	
★ Write pulse width	t <sub>WP</sub>	45		ns	
Write recovery time	t <sub>WR</sub>	0		ns	
Data valid to end of write	t <sub>DW</sub>	30		ns	
Data hold time	t <sub>DH</sub>	0		ns	
/WE to output in Hi-Z	t <sub>WHZ</sub>		25	ns	
Output active from end of write	t <sub>OW</sub>	5		ns	

**Low Vcc Data Retention Characteristics (SRAM)**

Parameter	Symbol	Test Condition	MIN.	TYP.	MAX.	Unit
Data retention supply voltage	V <sub>CCDR1</sub>	/CE1s ≥ V <sub>CCS</sub> – 0.2 V, CE2s ≥ V <sub>CCS</sub> – 0.2 V	1.0		3.6	V
	V <sub>CCDR2</sub>	CE2s ≤ 0.2 V	1.0		3.6	
	V <sub>CCDR3</sub>	/LB = /UB ≥ V <sub>CCS</sub> – 0.2 V, /CE1s ≤ 0.2 V, CE2s ≥ V <sub>CCS</sub> – 0.2 V	1.0		3.6	
Data retention supply current	I <sub>CCDR1</sub>	V <sub>CCS</sub> = 1.5 V, /CE1s ≥ V <sub>CCS</sub> – 0.2 V, CE2s ≥ V <sub>CCS</sub> – 0.2 V		0.3	3	μA
	I <sub>CCDR2</sub>	V <sub>CCS</sub> = 1.5 V, CE2s ≤ 0.2 V		0.3	3	
	I <sub>CCDR3</sub>	V <sub>CCS</sub> = 1.5 V, /LB = /UB ≥ V <sub>CCS</sub> – 0.2 V, /CE1s ≤ 0.2 V, CE2s ≥ V <sub>CCS</sub> – 0.2 V		0.3	3	
Chip deselection to data retention mode	t <sub>CDR</sub>		0			ns
Operation recovery time	t <sub>R</sub>		t <sub>RC</sub> <sup>Note</sup>			ns

**Note** t<sub>RC</sub> : Read cycle time

Figure 1. Alternating SRAM to Flash Memory Timing Chart

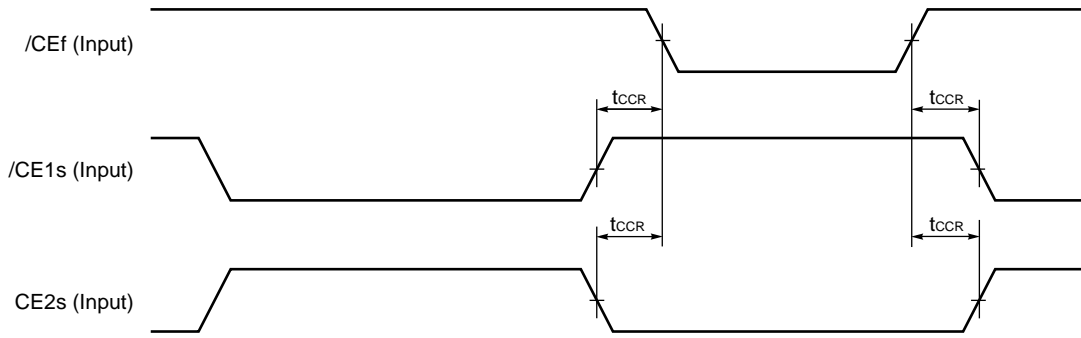


Figure 2. Read Cycle Timing Chart 1 (Flash Memory)

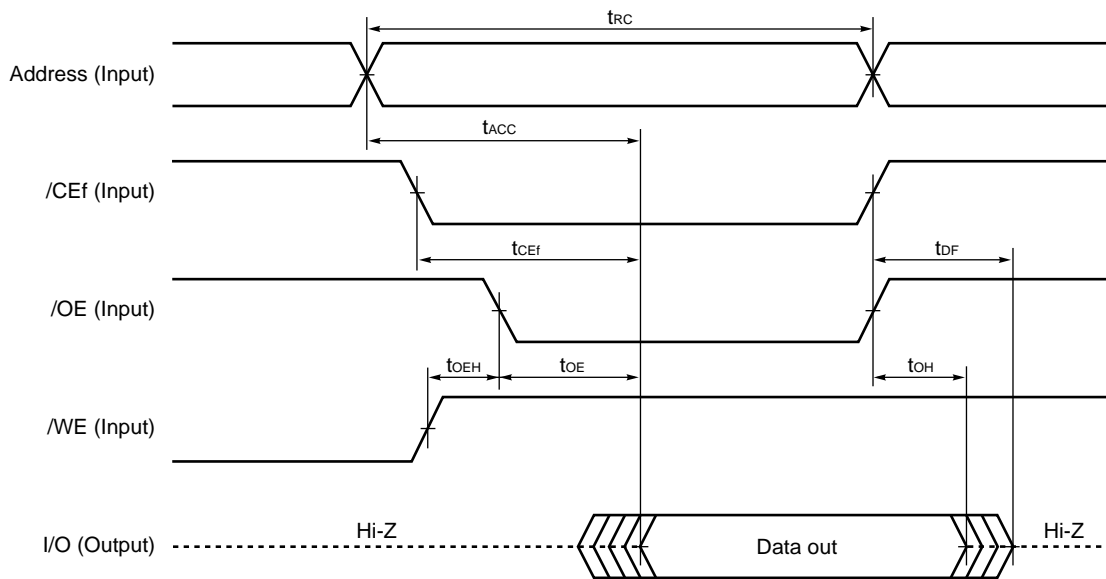


Figure 3. Read Cycle Timing Chart 2 (Flash Memory)

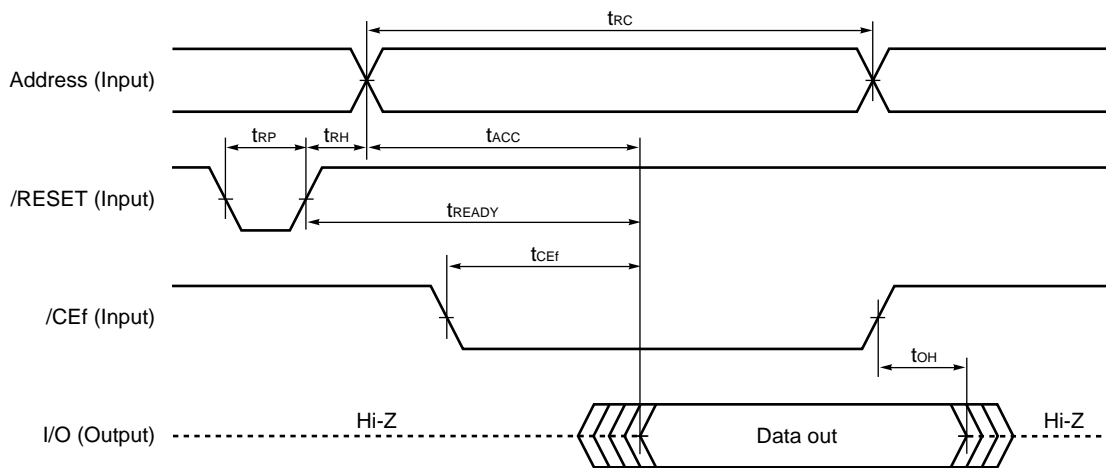
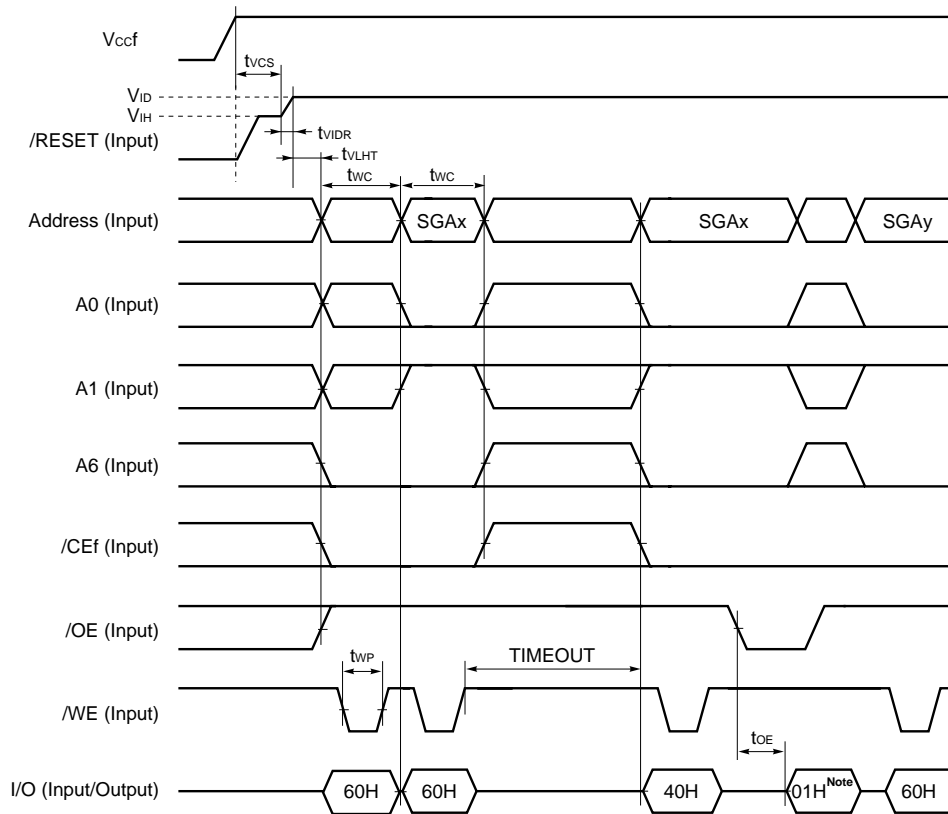


Figure 4. Sector Group Protection Timing Chart (Flash Memory)



**Note** The sector group protection verification result is output.

01H : The sector group is protected.

00H : The sector group is not protected.

Figure 5. Temporary Sector Group Unprotect Timing Chart (Flash Memory)

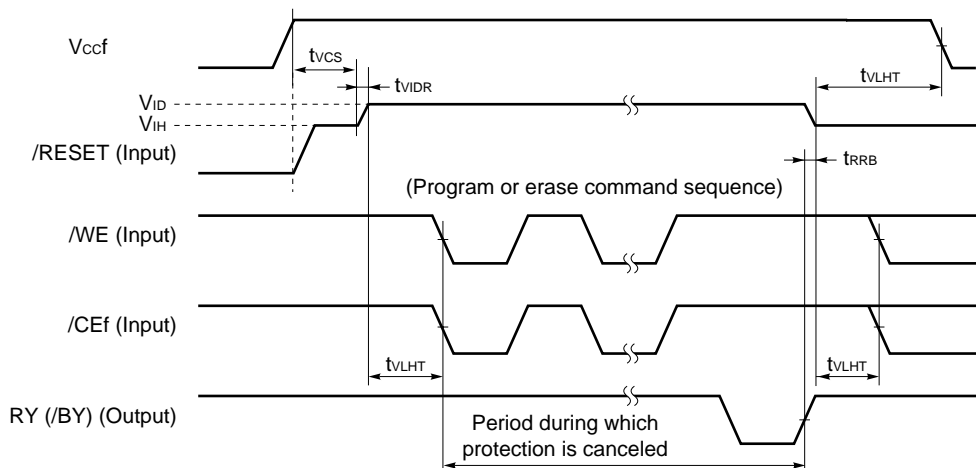


Figure 6. Accelerated Mode Timing Chart (Flash Memory)

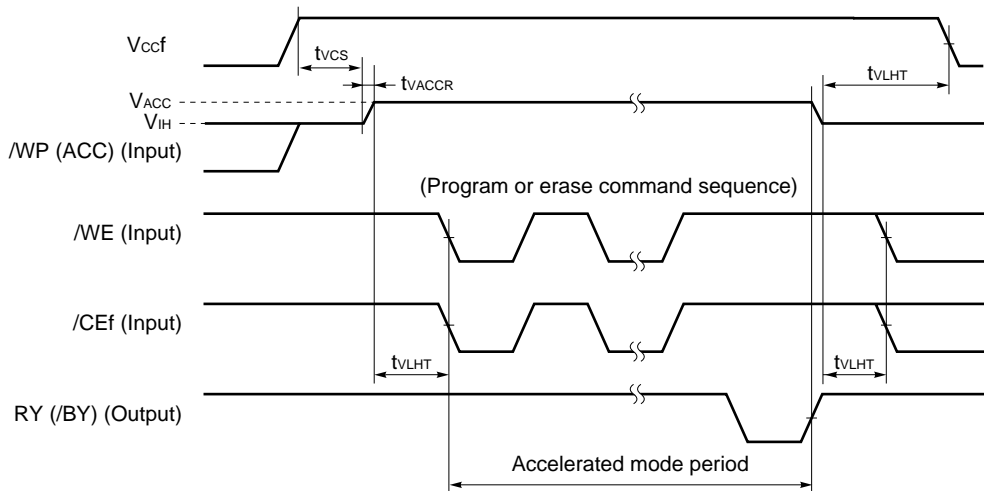
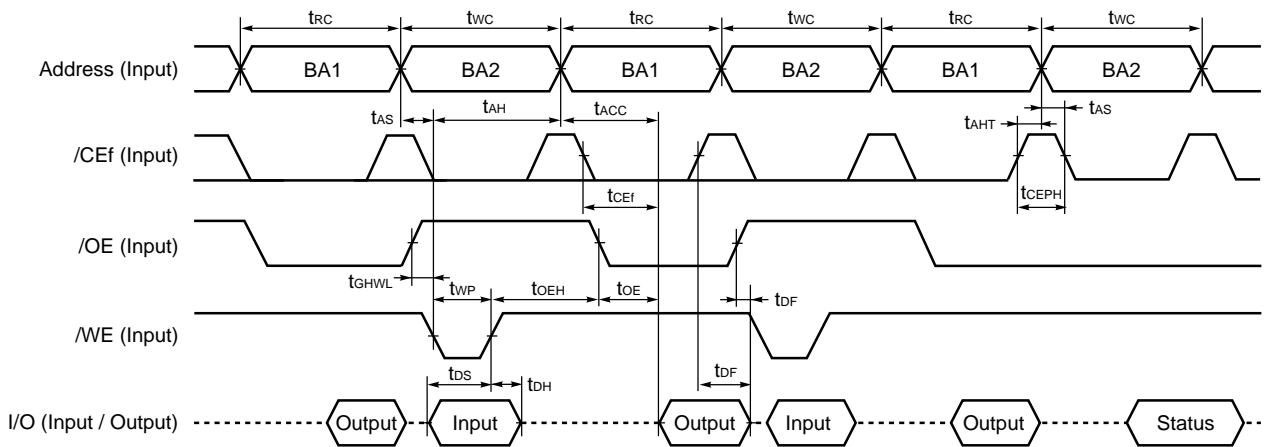
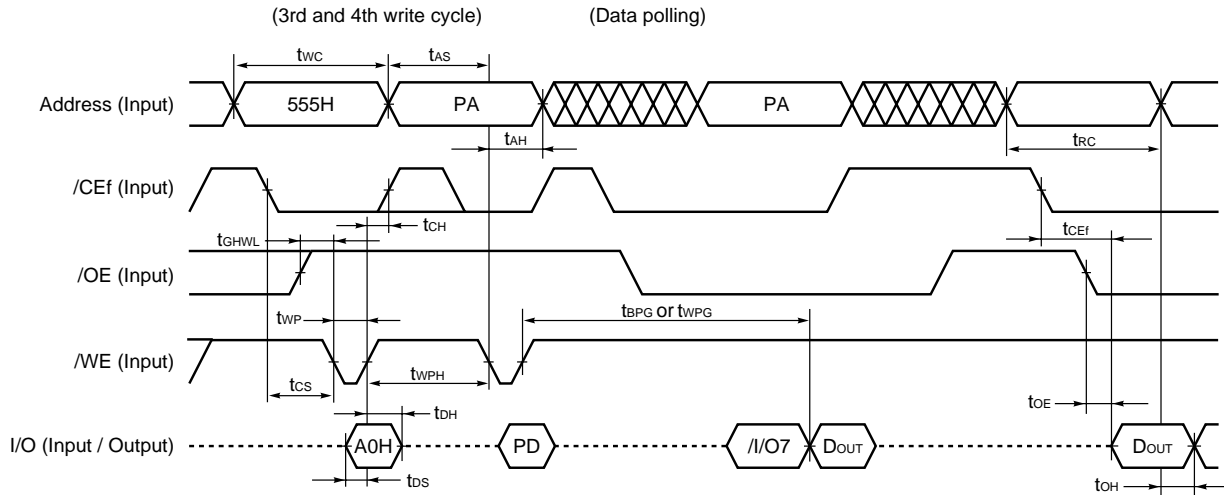


Figure 7. Dual Operation Timing Chart (Flash Memory)

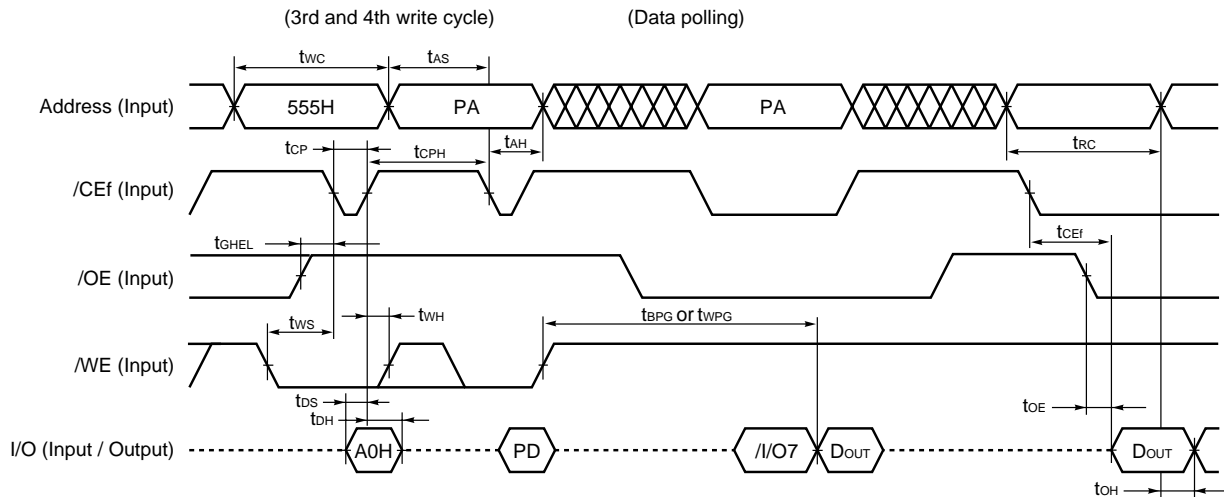


**Figure 8. Write Cycle Timing Chart (/WE Controlled) (Flash Memory)**



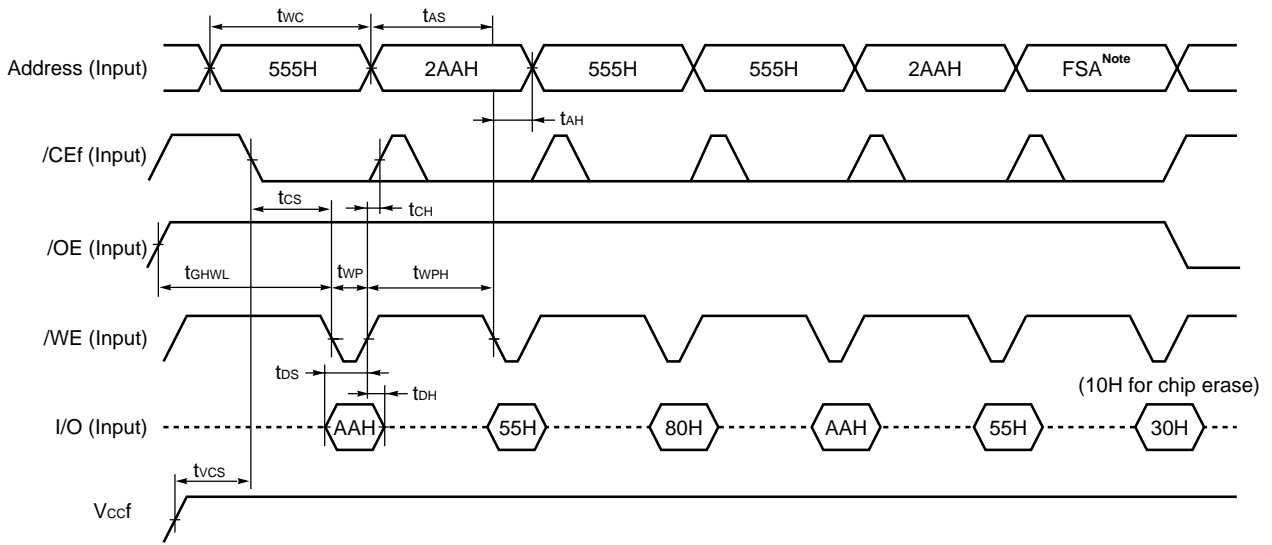
- Remarks 1.** This timing chart shows the last two write cycles among the program command sequence's four write cycles, and data polling.
- 2.** This timing chart shows the WORD mode's case. In the BYTE mode, address to be input are different from the WORD mode. See **Command Sequence (Flash Memory)**.
- 3.** PA : Program address  
 PD : Program data  
 /I/O7 : The output of the complement of the data written to the device.  
 DOUT : The output of the data written to the device.

**Figure 9. Write Cycle Timing Chart (/CEf Controlled) (Flash Memory)**



- Remarks 1.** This timing chart shows the last two write cycles among the program command sequence's four write cycles, and data polling.
- 2.** This timing chart shows the WORD mode's case. In the BYTE mode, address to be input are different from the WORD mode. See **Command Sequence (Flash Memory)**.
- 3.** PA : Program address  
 PD : Program data  
 /I/O7 : The output of the complement of the data written to the device.  
 DOUT : The output of the data written to the device.

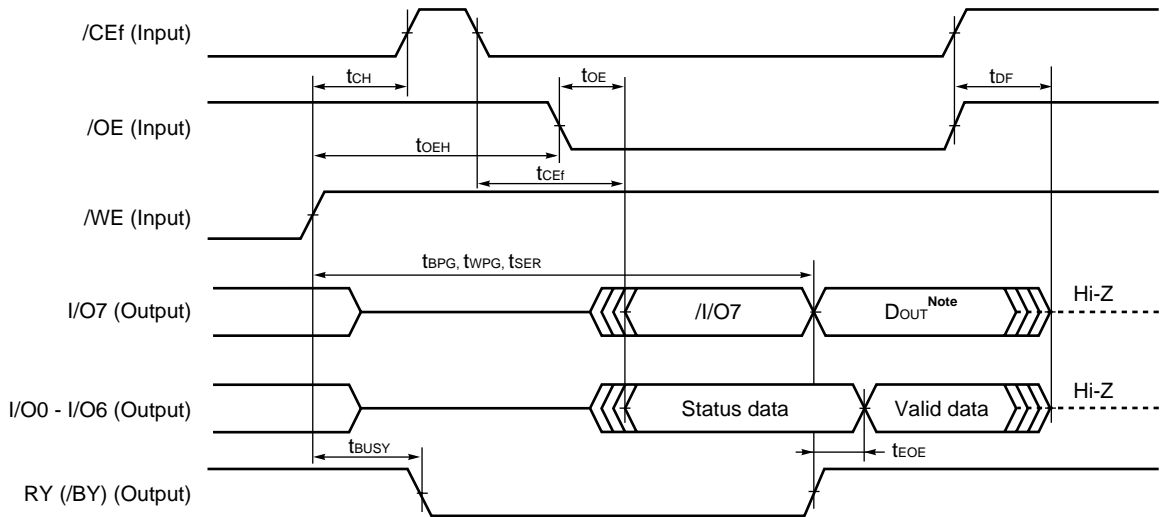
Figure 10. Sector / Chip Erase Timing Chart (Flash Memory)



**Note** FSA is the sector address to be erased. In the case of chip erase, input 555H (WORD mode), AAH (BYTE mode).

**Remark** This timing chart shows the WORD mode's case. In the BYTE mode, address to be input are different from the WORD mode. See **Command Sequence (Flash Memory)**.

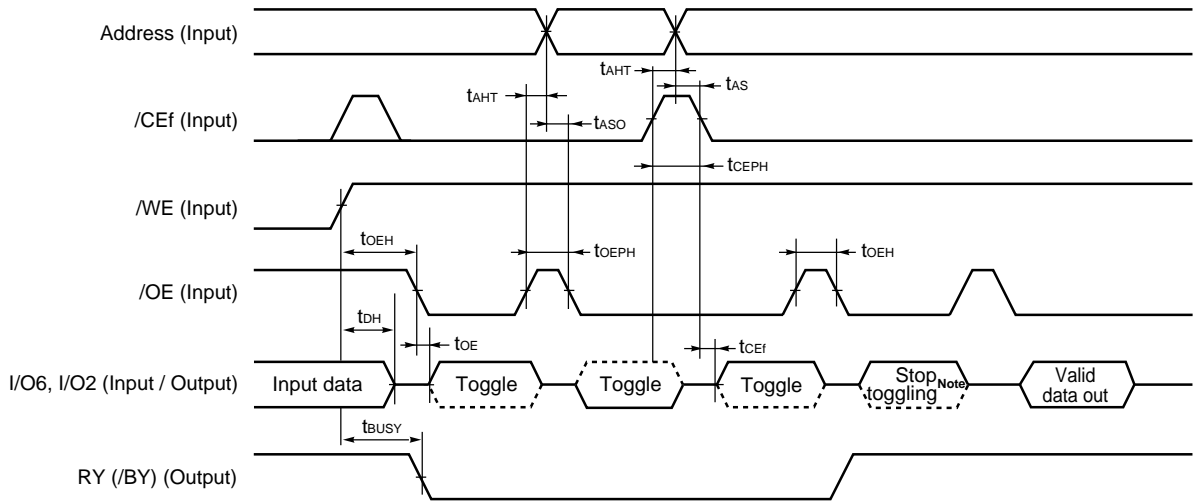
Figure 11. Data Polling Timing Chart (Flash Memory)



**Note** I/O7 = DOUT : True value of program data (indicates completion of automatic program / erase)



Figure 12. Toggle Bit Timing Chart (Flash Memory)



**Note** I/O6 stops the toggle (indicates automatic program / erase completion).

Figure 13. I/O2 vs. I/O6 Timing Chart (Flash Memory)

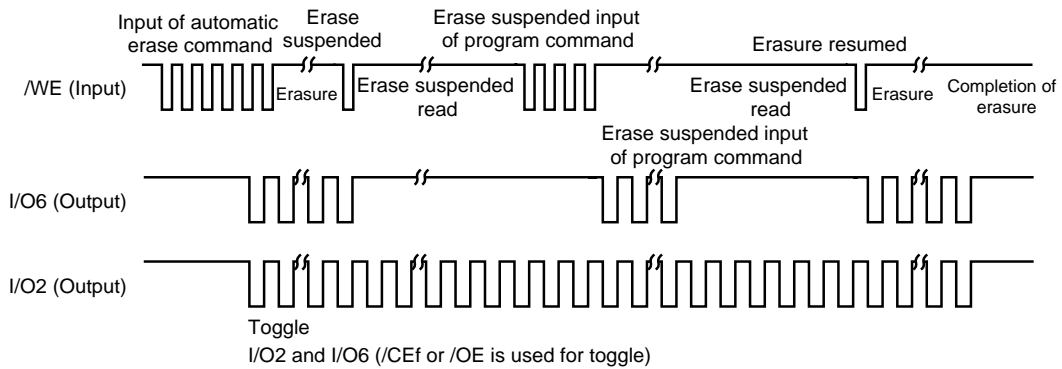


Figure 14. RY (/BY) (Ready / Busy) Timing Chart (Flash Memory)

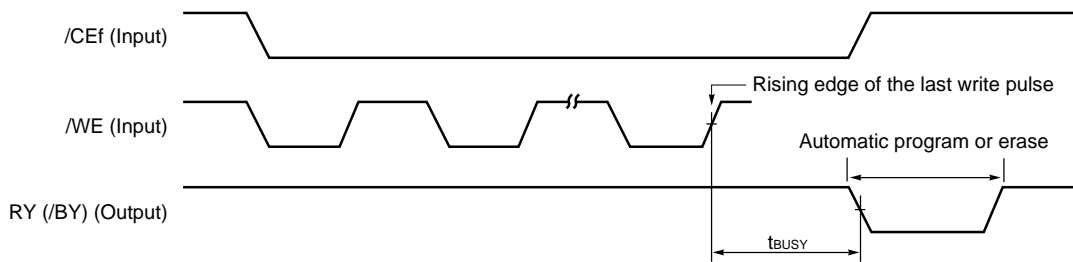


Figure 15. /RESET and RY (/BY) Timing Chart (Flash Memory)

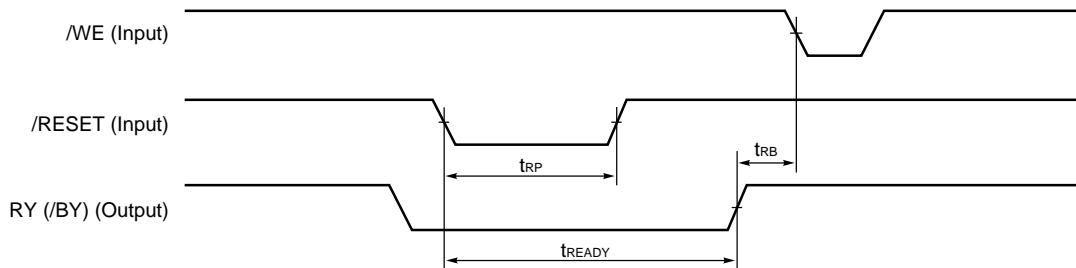
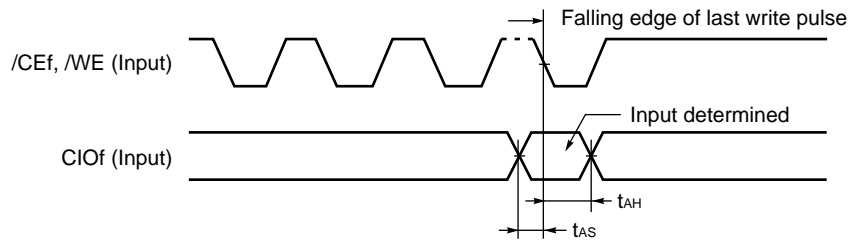
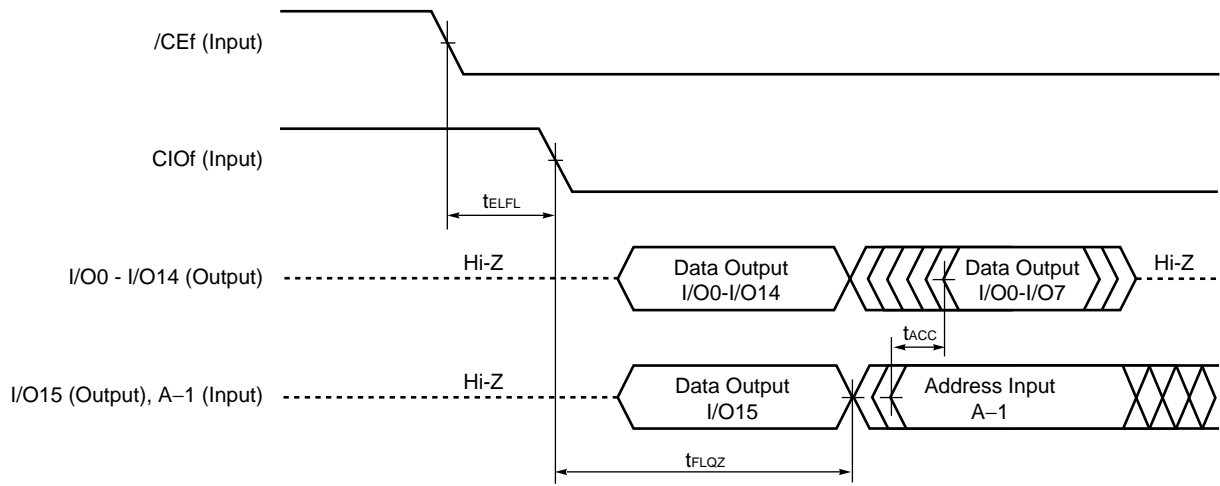


Figure 16. Write CIOf Timing Chart (Flash Memory)



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Figure 17. BYTE mode Switching Timing Chart (Flash Memory)



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Figure 18. WORD mode Switching Timing Chart (Flash Memory)

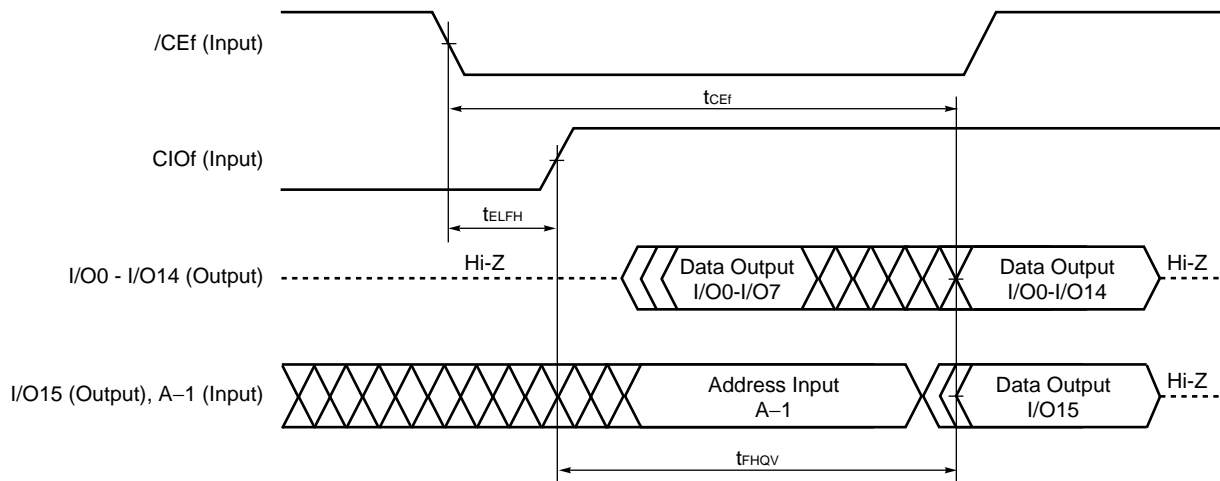
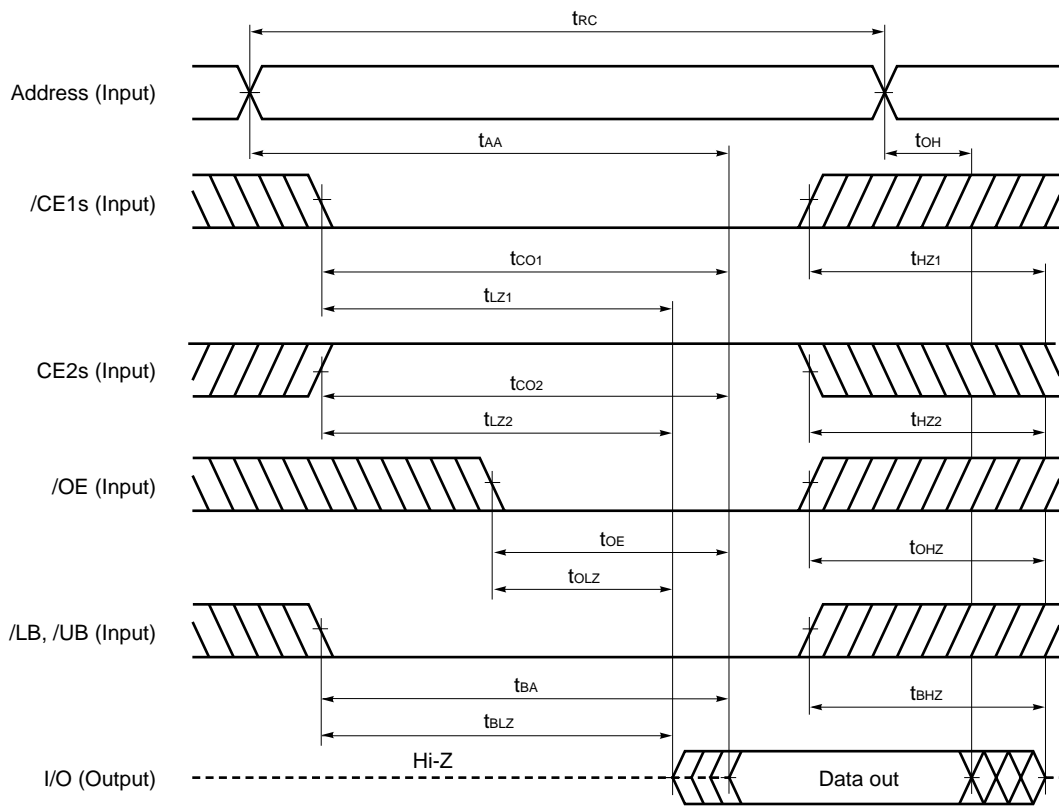
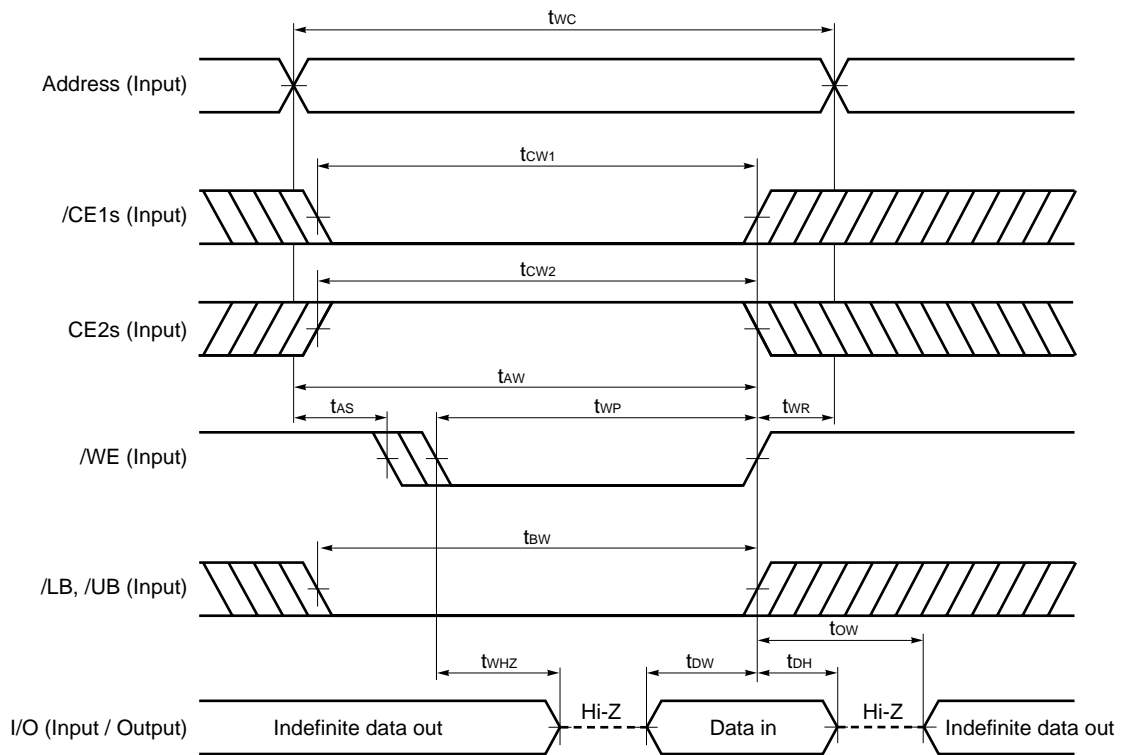


Figure 19. Read Cycle Timing Chart (SRAM)



**Remark** In read cycle, /WE should be fixed to high level.

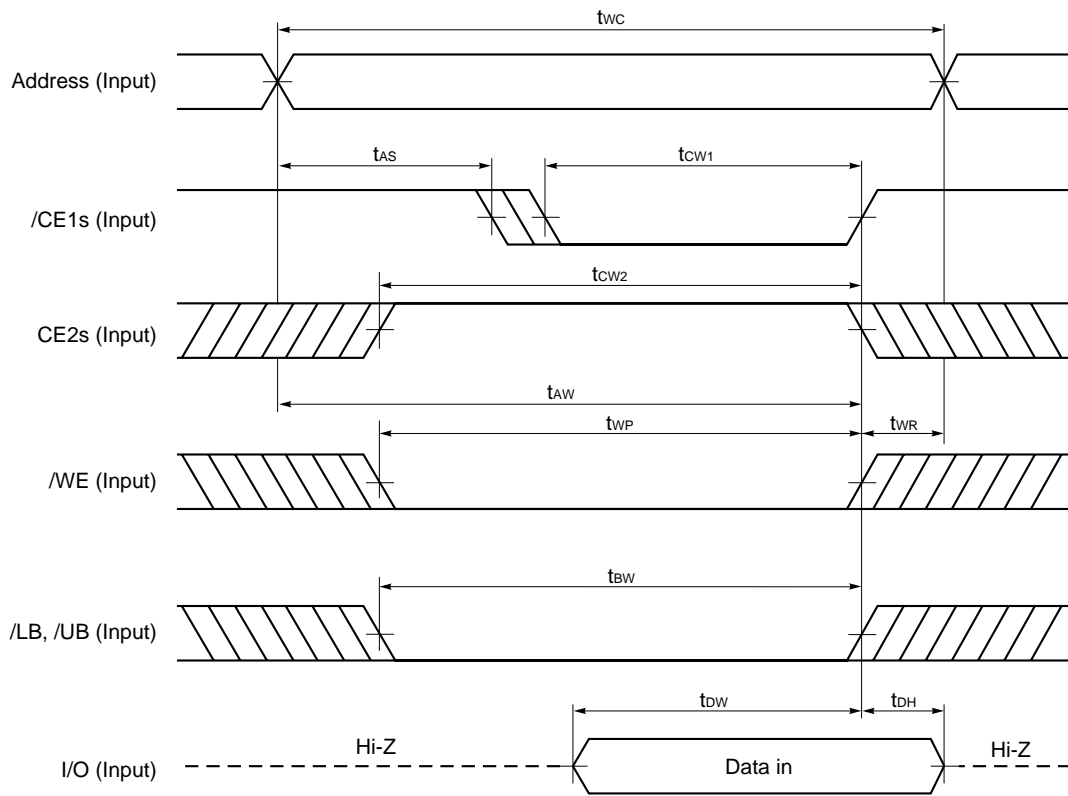
Figure 20. Write Cycle Timing Chart 1 (/WE Controlled) (SRAM)



- Cautions**
1. During address transition, at least one of pins /CE1s, CE2s, /WE should be inactivated.
  2. Do not input data to the I/O pins while they are in the output state.

- Remarks**
1. Write operation is done during the overlap time of a low level /CE1s, /WE, /LB and/or /UB, and a high level CE2s.
  2. If /CE1s changes to low level at the same time or after the change of /WE to low level, or if CE2s changes to high level at the same time or after the change of /WE to low level, the I/O pins will remain Hi-Z state.
  3. When /WE is at low level, the I/O pins are always Hi-Z. When /WE is at high level, read operation is executed. Therefore /OE should be at high level to make the I/O pins Hi-Z.

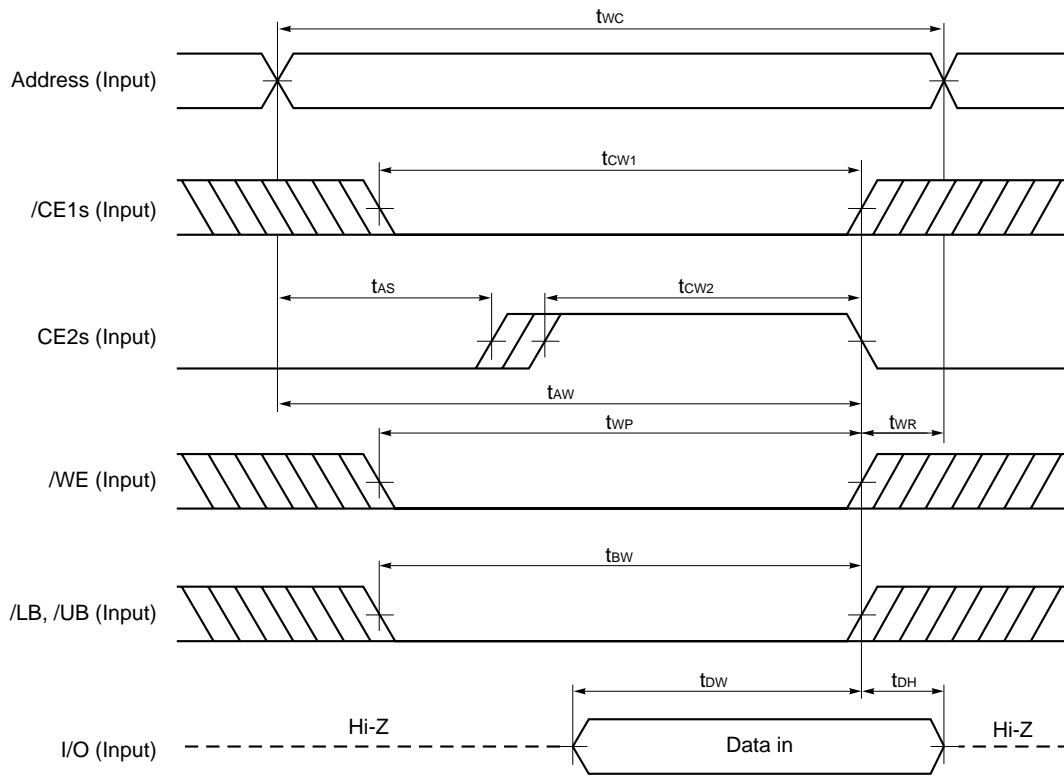
Figure 21. Write Cycle Timing Chart 2 (/CE1s Controlled) (SRAM)



- Cautions**
1. During address transition, at least one of pins /CE1s, CE2s, /WE should be inactivated.
  2. Do not input data to the I/O pins while they are in the output state.

**Remark** Write operation is done during the overlap time of a low level /CE1s, /WE, /LB and/or /UB, and a high level CE2s.

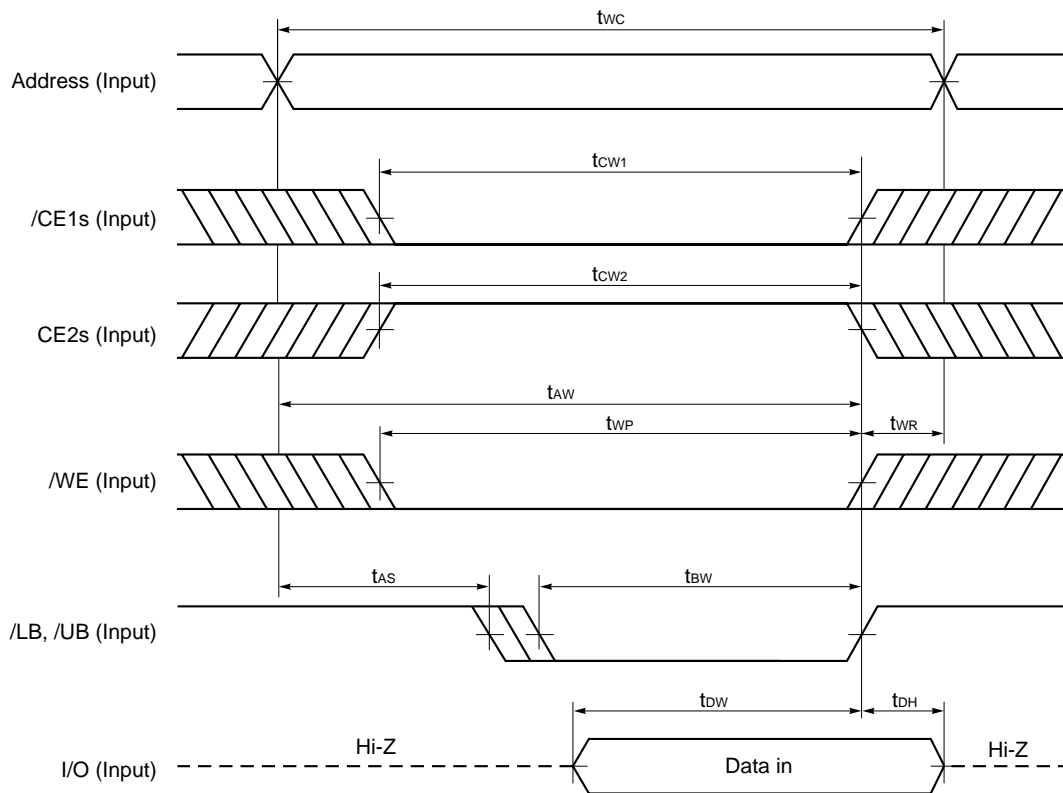
Figure 22. Write Cycle Timing Chart 3 (CE2s Controlled) (SRAM)



- Cautions**
1. During address transition, at least one of pins /CE1s, CE2s, /WE should be inactivated.
  2. Do not input data to the I/O pins while they are in the output state.

**Remark** Write operation is done during the overlap time of a low level /CE1s, /WE, /LB and/or /UB, and a high level CE2s.

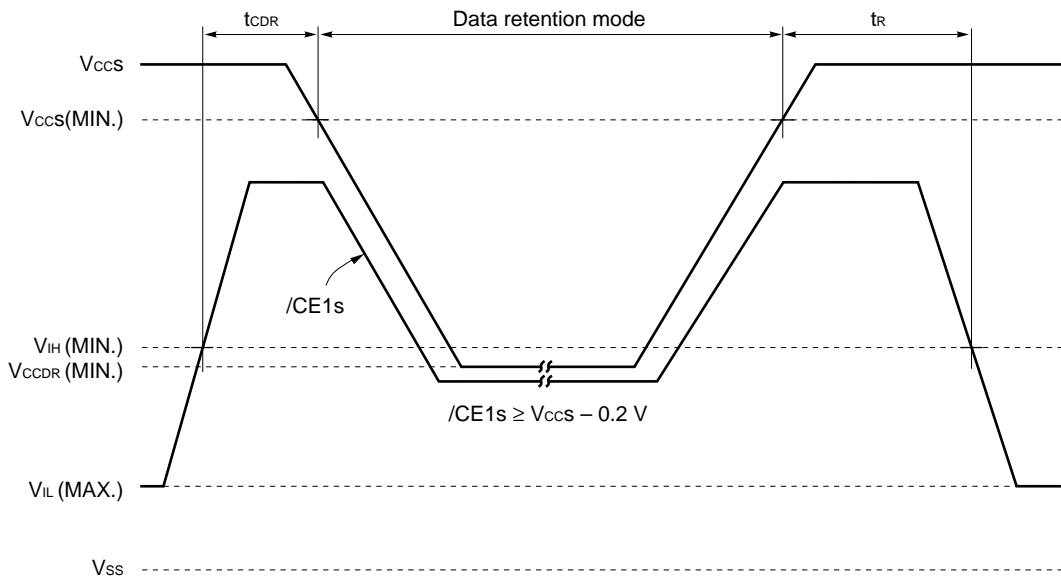
Figure 23. Write Cycle Timing Chart 4 (/LB, /UB Controlled) (SRAM)



- Cautions**
1. During address transition, at least one of pins  $\overline{CE1s}$ ,  $CE2s$ ,  $\overline{WE}$  should be inactivated.
  2. Do not input data to the I/O pins while they are in the output state.

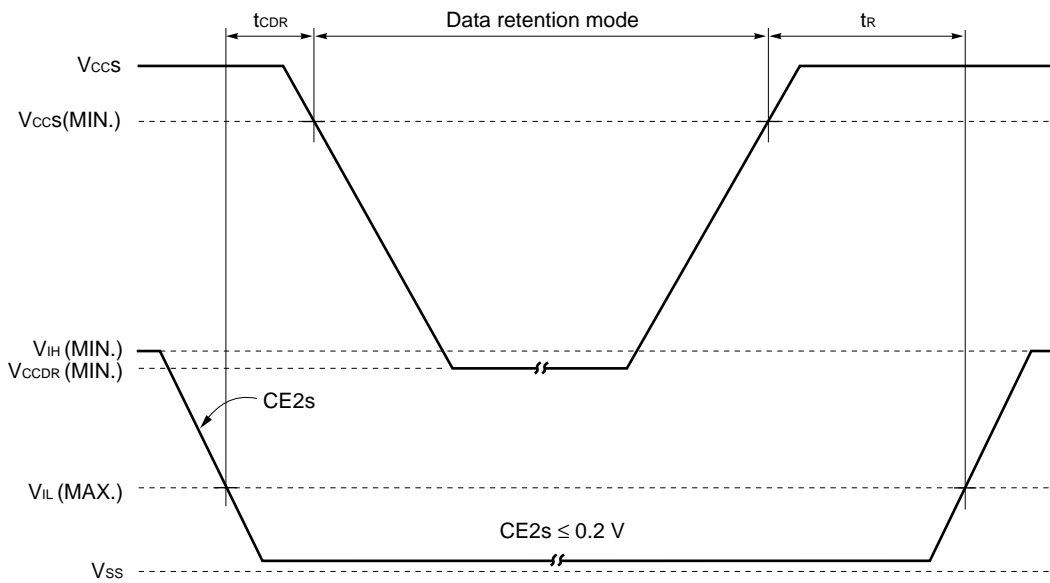
**Remark** Write operation is done during the overlap time of a low level  $\overline{CE1s}$ ,  $\overline{WE}$ ,  $\overline{LB}$  and/or  $\overline{UB}$ , and a high level  $CE2s$ .

Figure 24. Data Retention Timing Chart 1 (/CE1s Controlled) (SRAM)



**Remark** On the data retention mode by controlling  $\overline{CE1s}$ , the input level of  $CE2s$  must be  $\geq V_{CCS} - 0.2 V$  or  $\leq 0.2 V$ . The other pins (Address, I/O,  $\overline{WE}$ ,  $\overline{OE}$ ,  $\overline{LB}$ ,  $\overline{UB}$ ) can be in Hi-Z state.

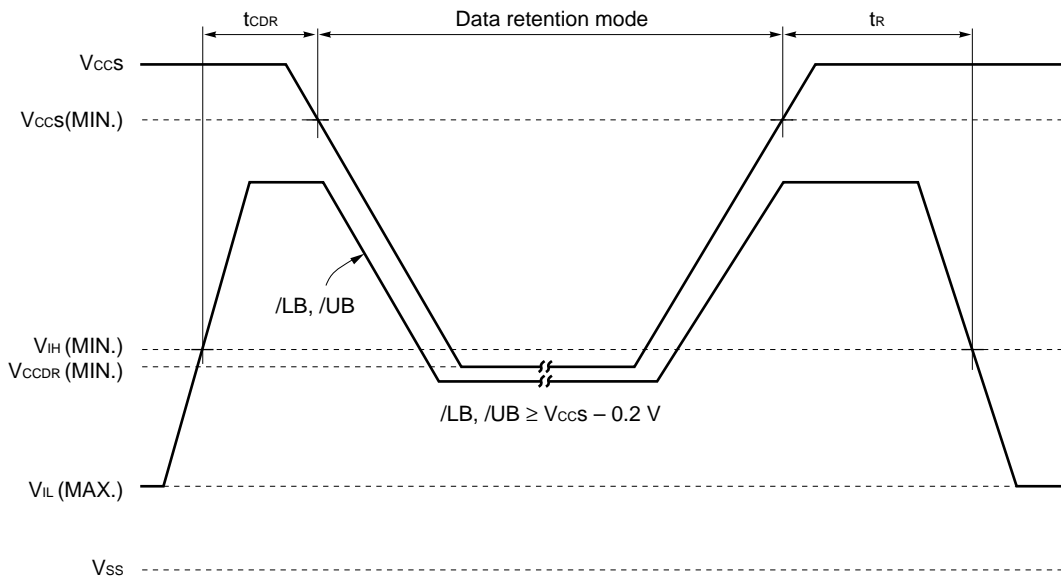
Figure 25. Data Retention Timing Chart 2 (CE2s Controlled) (SRAM)



**Remark** On the data retention mode controlling  $CE2s$ , the other pins ( $\overline{CE1s}$ , Address, I/O,  $\overline{WE}$ ,  $\overline{OE}$ ,  $\overline{LB}$ ,  $\overline{UB}$ ) can be in Hi-Z state.



Figure 26. Data Retention Timing Chart 3 (/LB, /UB Controlled) (SRAM)



**Remark** On the data retention mode by controlling  $/LB$  and  $/UB$ , the input level of  $/CE1s$  and  $CE2s$  must be  $\geq V_{CCS} - 0.2 V$  or  $\leq 0.2 V$ . The other pins (Address, I/O,  $/WE$ ,  $/OE$ ) can be in Hi-Z state.

★ **Flow Charts (Flash Memory)**

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

CFI Code List

(1/2)

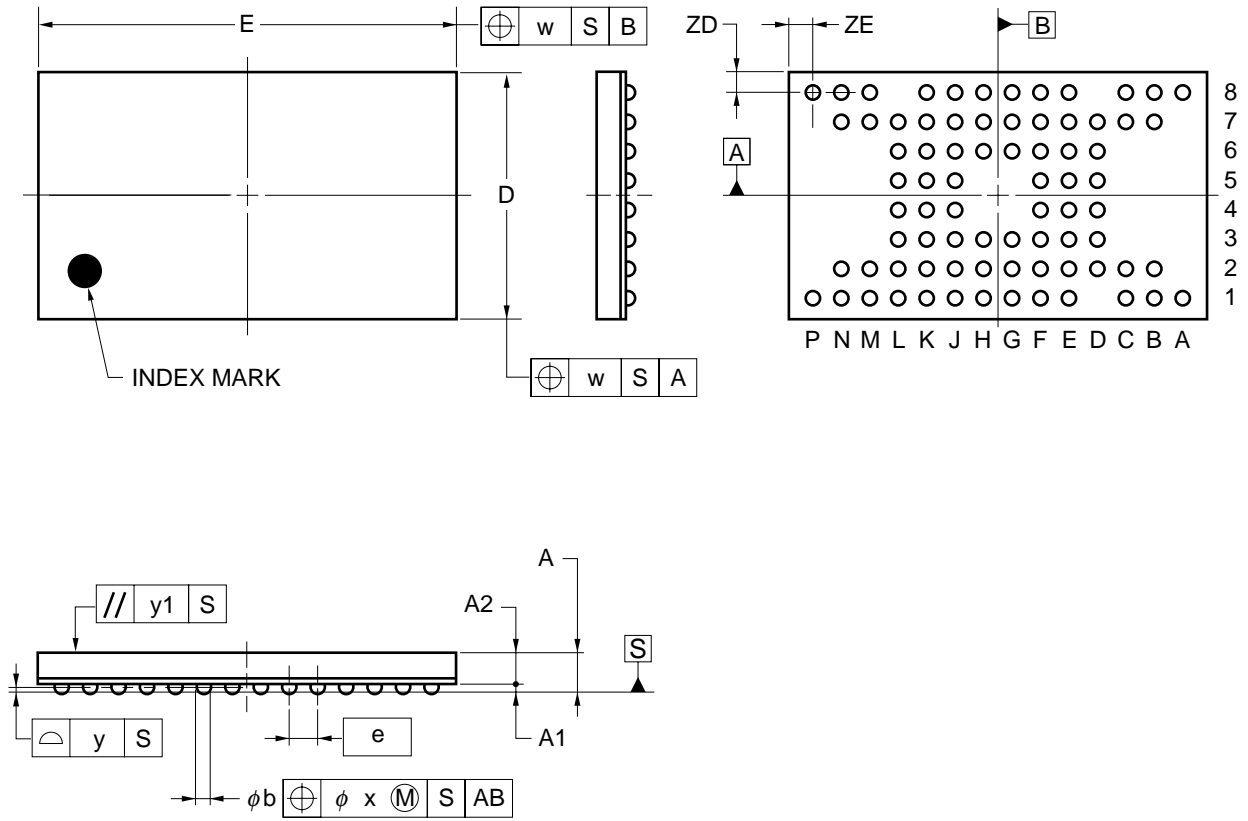
Address A6 to A0	Data I/O15 to I/O0	Description
10H	0051H	"QRY" (ASCII code)
11H	0052H	
12H	0059H	
13H	0002H	Main command set
14H	0000H	2 : AMD/FJ standard type
15H	0040H	Start address of PRIMARY table
16H	0000H	
17H	0000H	Auxiliary command set
18H	0000H	00H : Not supported
19H	0000H	Start address of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

(2/2)

Address A6 to A0	Data I/O15 to I/O0	Description
31H	003EH	Information about erase block 2
32H	0000H	bit0 to 15 : y = number of sectors
33H	0000H	bit16 to 31 : z = size
34H	0001H	(z × 256 Bytes)
40H	0050H	"PRI" (ASCII code)
41H	0052H	
42H	0049H	
43H	0031H	Main version (ASCII code)
44H	0032H	Minor version (ASCII code)
45H	0000H	Address during command input 00H : Necessary 01H : Unnecessary
46H	0002H	Temporary erase suspend function 00H : Not supported 01H : Read only 02H : Read / Program
47H	0001H	Sector group protection 00H : Not supported 01H : Supported
48H	0001H	Temporary sector group protection 00H : Not supported 01H : Supported
49H	0004H	Sector group protection algorithm
4AH	00xxH	Number of sectors of bank 2 00H : Not supported 20H : MC-22244A-X
4BH	0000H	Burst mode 00H : Not supported
4CH	0000H	Page mode 00H : Not supported
4DH	0085H	Minimum V <sub>ACC</sub> voltage I/O7 to I/O4 : 1 V/bit I/O3 to I/O0 : 100 mV/bit
4EH	0095H	Maximum V <sub>ACC</sub> voltage I/O7 to I/O4 : 1 V/bit I/O3 to I/O0 : 100 mV/bit
4FH	00xxH	Boot organization 03H : Top boot
50H	0001H	Temporary program suspend function 00H : Not supported 01H : Supported

Package Drawing

77-PIN TAPE FBGA (12x7)



ITEM	MILLIMETERS
D	7.0±0.1
E	12.0±0.1
w	0.2
A	1.1±0.1
A1	0.26±0.05
A2	0.84
$e$	0.8
b	0.45±0.05
x	0.08
y	0.1
y1	0.1
ZD	0.7
ZE	0.8

P77F9-80-BT3

**Recommended Soldering Conditions**

Please consult with our sales offices for soldering conditions of the MC-222244A-X.

**Type of Surface Mount Device**

MC-222244AF9-B85X-BT3 : 77-pin TAPE FBGA (12 × 7)

[ MEMO ]

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

Note:

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

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

Note:

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

**③ STATUS BEFORE INITIALIZATION OF MOS DEVICES**

Note:

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

Related Documents

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

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